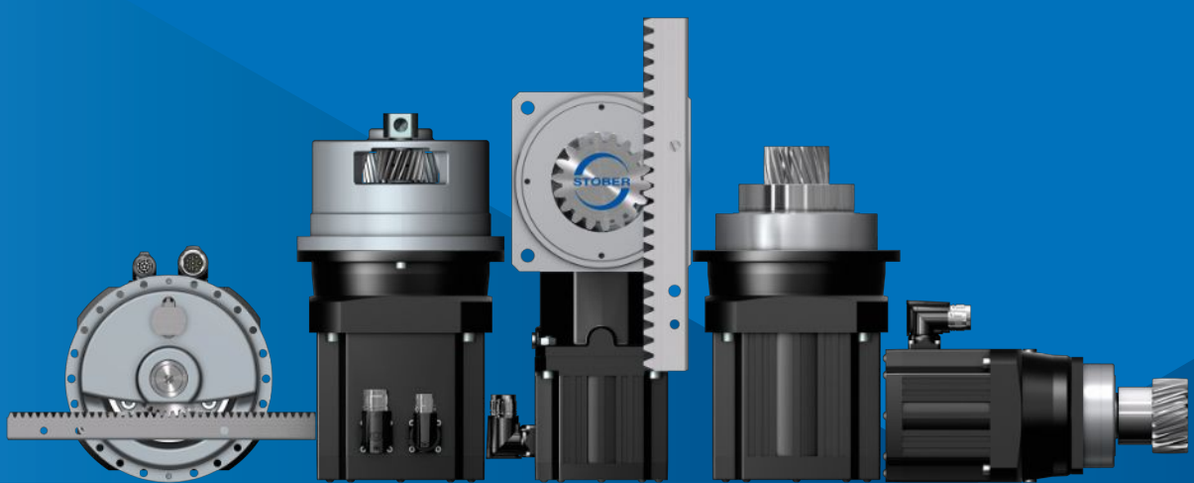


Rack and pinion drives with synchronous servo motors

In cooperation with

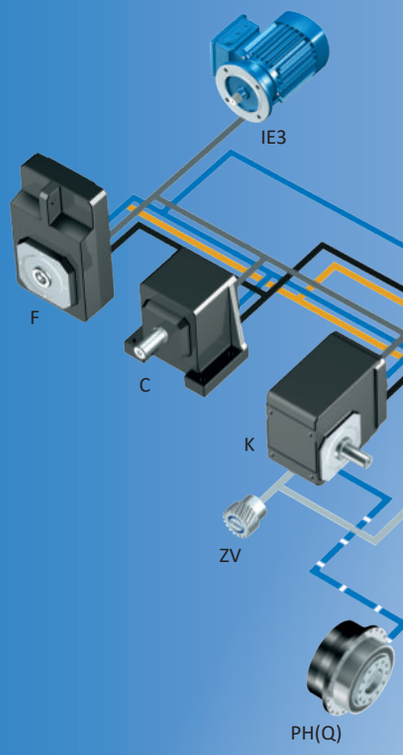
ATLANTA

STÖBER

Rack and pinion drives with synchronous servo motors

One partner. All the possibilities.

STOBER has developed and produced excellent drive technology since 1934 and is active internationally with around 800 employees at 14 locations. STOBER impresses machine manufacturers in wide-ranging industries and markets around the world with tailor-made, highly efficient drive systems for demanding movements.



"Our vision is to be the preferred partner for perfect movement."

- Andreas Thiel, CEO of STÖBER Antriebstechnik.

Rack and pinion drives with synchronous servo motors – what you can expect!

From full rotation into linear power: With the innovative system concept for rack and pinion drives, STOBER has developed a compact, easy-to-use system with process reliability that is precisely tailored to the application areas of machine tools, automation and robotics. By combining it with our planetary or helical bevel gear units and STOBER synchronous servo motors, you get the benefit of extremely compact, highly dynamic drive solutions. It's impossible to be more flexible!

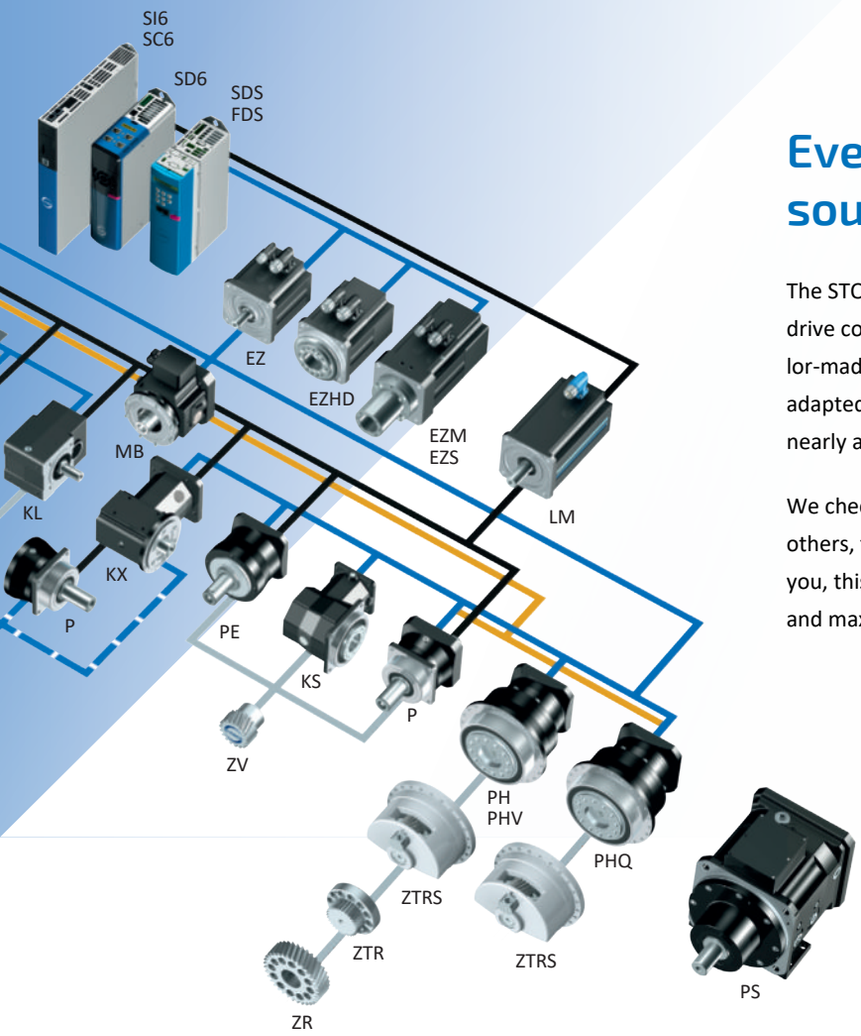
At home in the world of demanding motion

Gear units

Geared motors

Motors

Cables and drive controllers



Everything from a single source.

The STOBER drive system consisting of gear units, motors, cables and drive controllers has a modular design and is freely scalable—for tailor-made, compact and powerful machine concepts. It can be adapted to your individual requirements and combined as needed in nearly all industries and applications areas.

We check every single component and how it works together with others, taking on the responsibility for the complete drive train. For you, this means that one contact partner, certified operating safety and maximum availability are guaranteed.

Need special solutions?

Numerous one-of-a-kind product highlights and project-related adjustments make it possible. With a holistic approach to your specific task, we work together on individualized solutions that are optimally coordinated to your requirements. Dedicated and solution-oriented in the support of your visions and projects.

STOBER moves integrally and precisely.

"We put ideas in motion with passion and a great deal of dedication. In the process, we rely on our decades of experience and an exceptionally broad range of products. Our customers benefit from precise, practical system solutions with uncompromising quality and expert individual consultation."

- Patrick Stöber, CEO of STÖBER Antriebstechnik.

STOBER moves as a team and with personality.

As a family-owned company, close relationships are extremely important to us. We build relationships with our employees, customers, and partners based on trust. We put people first.

We advocate for our employees' well-being, see things from our customers' perspectives, and demonstrate personal commitment to our mutual success.

"We have installed gear units, motors and drive controllers from STOBER in nearly all our systems. STOBER supports us in new projects from the first stroke of a pencil in the design phase until commissioning. Our years of cooperation are shaped by openness and honesty and emanate a rather special spirit. The technical consulting, the support—that is real, experienced partnership"

- Jürgen Leicht, Managing Partner of Leicht Stanzautomation.

Working together. Worldwide. Successfully.

With an eye to the future, STOBER is facing the challenges of digitalization and investing in integrated solutions and a strong global production, sales and service presence. STOBER China was founded at the end of 2019. As a result, we are present in more than 40 countries around in the world with eleven subsidiaries and 80 service partners.

STOBER drives
Systems technology
Taicang, China.

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1 Selection tool

1.1 Rack and pinion drives with synchronous servo motors

Product chapter	ZTRSPH	ZTRSPHQ	ZTRSPHV	ZTRPH	ZTRPHV	ZRPH
Chapter number	[2]	[3]	[4]	[5]	[6]	[7]

Technical data

m_n	2 – 10 mm	8 – 10 mm	5 – 10 mm	2 – 8 mm	5 – 6 mm	2 – 4 mm
z	15 – 32	15 – 19	15 – 20	12 – 32	16 – 19	26 – 40
F_{f2acc}	2.8 – 94 kN	107 – 126 kN	26 – 94 kN	1.9 – 67 kN	32 – 67 kN	0.49 – 16 kN
v_{f2N}	0.12 – 4 m/s	0.12 – 0.26 m/s	0.13 – 0.49 m/s	0.1 – 4 m/s	0.12 – 0.39 m/s	0.16 – 6 m/s
Δs	7 – 70 µm	69 – 70 µm	44 – 70 µm	4 – 44 µm	42 – 44 µm	10 – 56 µm

An explanation of the formula symbols can be found in the chapter [15.1].

Features

Power density	★★★★★	★★★★★	★★★★★	★★★★☆	★★★★☆	★★★☆☆
Linear backlash	★★★★★	★★★★☆	★★★★☆	★★★★★	★★★★☆	★★★★★
Price category	€€€€€	€€€€€	€€€€€	€€€€	€€€€	€€€
Smooth operation	★★★★☆	★★★★☆	★★★★☆	★★★★☆	★★★★☆	★★★★☆
Linear rigidity	★★★★★	★★★★★	★★★★★	★★★★☆	★★★★☆	★★★☆☆
Mass moment of inertia	★★★★☆	★★★★☆	★★★★☆	★★★★☆	★★★★☆	★★★★☆
Key	★☆☆☆☆ good | ★★★★★ excellent € Economy | €€€€€ Premium					
Pinion gearing						
Helical gearing	✓	✓	✓	✓	✓	✓
Gearing quality	5	5	5	5	5	5
Bearing design						
Standard	✓	✓	✓	✓	✓	✓
Reinforced				✓ (PH3 – PH5)		✓ (PH3 – PH5)
Accessories						
Felt gear	✓	✓	✓			

ATLANTA gear racks

All gear racks suitable for our products are available from our cooperation partner, Atlanta.

http://atlantagmbh.de/

1 Selection tool

1.1 Rack and pinion drives with synchronous servo motors

Product chapter	ZVP	ZVPE
Chapter number	[8]	[9]

Technical data

m_n	2 – 4 mm	2 – 3 mm
z	16 – 25	16 – 25
F_{f2acc}	0.8 – 11 kN	0.48 – 6.1 kN
v_{f2N}	0.1 – 4.5 m/s	0.17 – 4.5 m/s
Δs	8 – 44 µm	40 – 83 µm

An explanation of the formula symbols can be found in the chapter [15.1].

Features

Power density	★★★☆☆	★★☆☆☆
Linear backlash	★★★★★	★★☆☆☆
Price category	€€	€
Smooth operation	★★★★☆	★★★☆☆
Linear rigidity	★★★☆☆	★★☆☆☆
Mass moment of inertia	★★★★☆	★★★★☆
Key	★☆☆☆☆ good | ★★★★★ excellent € Economy | €€€€€ Premium	
Pinion gearing		
Helical gearing	✓	✓
Gearing quality	6	6
Bearing design		
Standard	✓	✓
Axially reinforced	✓	

ATLANTA gear racks
All gear racks suitable for our products are available from our cooperation partner, Atlanta.
http://atlantagmbh.de/

1 Selection tool

1.1 Rack and pinion drives with synchronous servo motors

			
Product chapter	**ZVKS**	**ZVKL**	**ZVK**
Chapter number	[10]	[11]	[12]

Technical data

m_n	2 – 4 mm	2 mm	2 – 4 mm
z	18 – 25	16 – 20	18 – 25
F_{f2acc}	1.3 – 11 kN	0.64 – 2.7 kN	0.91 – 15 kN
v_{f2N}	0.08 – 3 m/s	0.21 – 1.7 m/s	0.04 – 3.4 m/s
Δs	37 – 44 µm	99 – 123 µm	12 – 111 µm

An explanation of the formula symbols can be found in the chapter [15.1].

Features

Power density	★★★☆☆	★★☆☆☆	★☆☆☆☆
Linear backlash	★★★☆☆	★☆☆☆☆	★★★☆☆
Price category	€€€	€	€
Smooth operation	★★★★☆	★★☆☆☆	★★★☆☆
Linear rigidity	★★★☆☆	★☆☆☆☆	★☆☆☆☆
Mass moment of inertia	★★★★☆	★★★★☆	★★★★☆
Key	★☆☆☆☆ good | ★★★★★ excellent € Economy | €€€€€ Premium		
Pinion gearing			
Helical gearing	✓	✓	✓
Gearing quality	6	6	6

ATLANTA gear racks
All gear racks suitable for our products are available from our cooperation partner, Atlanta.
http://atlantagmbh.de/

1 Selection tool

1.2 Synchronous servo motors

Product chapter	**EZ**
Chapter number	[▶ 13]

Technical data

M_N	0.89 – 77.2 Nm
M_0	0.95 – 94 Nm

An explanation of the formula symbols can be found in the chapter [▶ 15.1].

Shaft design	
Solid shaft without feather key	✓
Flange hollow shaft	
Encoder	
EnDat 2.2	✓
EnDat 2.1	✓
EnDat 3 One Cable Solution (OCS)	✓
Resolver	✓
Cooling	
Convection cooling	✓
Forced ventilation	✓
Brake	
Permanent magnet holding brake	✓
Marks and test symbols	
CE	✓
cURus	✓

2 ZTRSPH rack and pinion drives

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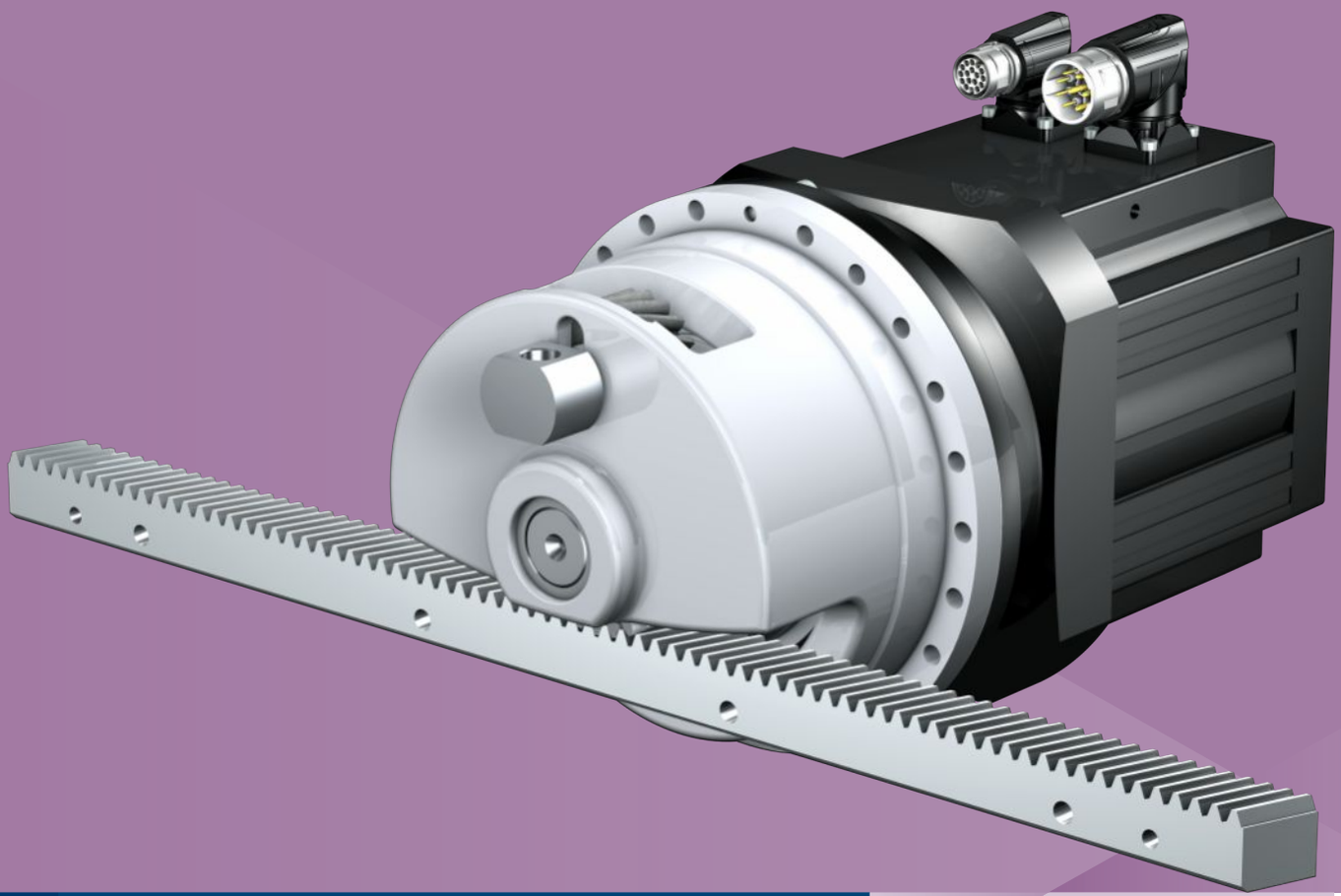


2 Rack and pinion drives

ZTRSPH

2.1 Overview

High-performance precision planetary geared motors with supporting bearing holder

Features

Power density	★★★★★
Linear clearance	★★★★★
Price category	€€€€€
Smooth operation	★★★★☆
Linear rigidity	★★★★★
Mass moment of inertia	★★★★☆
Ready-to-install drive solution	✓
Pinion gearing quality 5 (DIN 3962)	✓
Helical gearing	✓
Case-hardened and smoothed	✓
Radial runout ≤ 10 µm (optional)	✓
Compact and highly dynamic due to direct motor attachment	✓

Key ★☆☆☆☆ good | ★★★★★ excellent
€ Economy | €€€€€ Premium

Technical data

m_n	2 – 10 mm
z	15 – 32
F_{f2acc}	2.8 – 94 kN
v_{f2N}	0.12 – 4 m/s
Δs	7 – 70 µm

2.2 Selection tables

The technical data specified in the selection tables applies to:

- De-energized installation
- Permanent lubrication with the lubricants specified in the Atlanta product catalog
- Material combinations as described in the chapter [▶ 2.5.2]
- Installation altitudes up to 1000 m above sea level
- Surrounding temperatures from 0 °C to 40 °C
- Without consideration of the thermal limiting performance
- Drives with convection-cooled motors (e.g. EZ401**U**)

For the technical data on drives with forced ventilated motors (e.g. EZ401**B**), refer to http://configurator.stoeber.de.

For rack and pinion drives with reduced backlash, higher feed forces are possible. For this and all other technical data, refer to http://configurator.stoeber.de.

An explanation of the formula symbols can be found in the chapter [▶ 15.1].

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTRS3PH7 (n_{1N} = 2000 rpm, ($F_{f2acc,max}$ = 20 kN)																	
1.42	6.2	9.4	21	1.2	ZTRS317SPH731_0040 EZ805U	20	41	550	4.000	1.35	2.83	24	8	189	3	17	54.1
ZTRS3PH7 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 20 kN)																	
0.12	10	11	0.7	1.6	ZTRS317SPH732_0700 EZ501U	20	41	550	70.00	0.15	0.28	24	8	173	3	17	54.1
0.17	7.4	8.1	0.9	2.0	ZTRS317SPH732_0500 EZ501U	20	41	550	50.00	0.21	0.40	24	8	178	3	17	54.1
0.17	13	14	1.5	1.1	ZTRS317SPH732_0500 EZ502U	20	41	550	50.00	0.21	0.40	24	8	178	3	17	54.1
0.17	13	14	1.5	1.1	ZTRS317SPH732_0500 EZ701U	20	41	550	50.00	0.21	0.40	24	8	178	3	17	54.1
0.21	5.9	6.5	1.1	2.3	ZTRS317SPH732_0400 EZ501U	20	41	550	40.00	0.26	0.50	24	8	179	3	17	54.1
0.21	10	11	1.9	1.3	ZTRS317SPH732_0400 EZ502U	20	41	550	40.00	0.26	0.50	24	8	179	3	17	54.1
0.21	10	11	1.9	1.3	ZTRS317SPH732_0400 EZ701U	20	41	550	40.00	0.26	0.50	24	8	179	3	17	54.1
0.21	13	15	2.5	1.0	ZTRS317SPH732_0400 EZ503U	20	41	550	40.00	0.26	0.50	24	8	179	3	17	54.1
0.24	5.2	5.7	1.1	2.5	ZTRS317SPH732_0350 EZ501U	19	41	520	35.00	0.30	0.57	24	8	179	3	17	54.1
0.24	8.9	9.6	1.8	1.4	ZTRS317SPH732_0350 EZ502U	20	41	550	35.00	0.30	0.57	24	8	179	3	17	54.1
0.24	8.9	10	1.8	1.4	ZTRS317SPH732_0350 EZ701U	20	41	550	35.00	0.30	0.57	24	8	179	3	17	54.1
0.24	12	13	2.4	1.1	ZTRS317SPH732_0350 EZ503U	20	41	550	35.00	0.30	0.57	24	8	179	3	17	54.1
0.30	4.1	4.5	1.2	2.9	ZTRS317SPH732_0280 EZ501U	15	41	420	28.00	0.37	0.71	24	8	182	3	17	54.1
0.30	7.1	7.7	2.0	1.7	ZTRS317SPH732_0280 EZ502U	20	41	550	28.00	0.37	0.71	24	8	182	3	17	54.1
0.30	7.1	8.0	2.0	1.7	ZTRS317SPH732_0280 EZ701U	19	41	520	28.00	0.37	0.71	24	8	182	3	17	54.1
0.30	9.3	11	2.7	1.3	ZTRS317SPH732_0280 EZ503U	20	41	550	28.00	0.37	0.71	24	8	182	3	17	54.1
0.30	12	14	3.3	1.0	ZTRS317SPH732_0280 EZ702U	20	41	550	28.00	0.37	0.71	24	8	182	3	17	54.1
0.34	3.7	4.0	1.3	3.1	ZTRS317SPH732_0250 EZ501U	14	41	370	25.00	0.40	0.79	24	8	180	3	17	54.1
0.34	6.4	6.9	2.3	1.8	ZTRS317SPH732_0250 EZ502U	20	41	550	25.00	0.40	0.79	24	8	180	3	17	54.1
0.34	6.4	7.1	2.3	1.8	ZTRS317SPH732_0250 EZ701U	17	41	470	25.00	0.40	0.79	24	8	180	3	17	54.1
0.34	8.3	9.5	3.0	1.4	ZTRS317SPH732_0250 EZ503U	20	41	550	25.00	0.40	0.79	24	8	180	3	17	54.1
0.34	10	12	3.8	1.1	ZTRS317SPH732_0250 EZ702U	20	41	550	25.00	0.40	0.79	24	8	180	3	17	54.1
0.43	3.0	3.2	1.6	3.6	ZTRS317SPH732_0200 EZ501U	11	41	300	20.00	0.43	0.85	24	8	180	3	17	54.1
0.43	5.1	5.5	2.8	2.1	ZTRS317SPH732_0200 EZ502U	20	41	550	20.00	0.43	0.85	24	8	180	3	17	54.1
0.43	5.1	5.7	2.8	2.1	ZTRS317SPH732_0200 EZ701U	14	41	370	20.00	0.43	0.85	24	8	180	3	17	54.1
0.43	6.7	7.6	3.7	1.6	ZTRS317SPH732_0200 EZ503U	20	41	550	20.00	0.43	0.85	24	8	180	3	17	54.1
0.43	8.2	9.9	4.6	1.3	ZTRS317SPH732_0200 EZ702U	20	41	550	20.00	0.43	0.85	24	8	180	3	17	54.1
0.43	9.3	11	5.1	1.1	ZTRS317SPH732_0200 EZ505U	20	41	550	20.00	0.43	0.85	24	8	180	3	17	54.1
0.53	2.4	2.6	1.9	4.2	ZTRS317SPH732_0160 EZ501U	8.8	41	240	16.00	0.53	1.06	24	8	183	3	17	54.1
0.53	4.1	4.4	3.2	2.4	ZTRS317SPH732_0160 EZ502U	17	41	460	16.00	0.53	1.06	24	8	183	3	17	54.1
0.53	4.1	4.6	3.2	2.4	ZTRS317SPH732_0160 EZ701U	11	41	300	16.00	0.53	1.06	24	8	183	3	17	54.1
0.53	5.3	6.1	4.2	1.9	ZTRS317SPH732_0160 EZ503U	20	41	550	16.00	0.53	1.06	24	8	183	3	17	54.1
0.53	6.6	7.9	5.2	1.5	ZTRS317SPH732_0160 EZ702U	20	41	550	16.00	0.53	1.06	24	8	183	3	17	54.1
0.53	7.4	8.8	5.9	1.3	ZTRS317SPH732_0160 EZ505U	20	41	550	16.00	0.53	1.06	24	8	183	3	17	54.1
0.53	9.1	11	7.2	1.1	ZTRS317SPH732_0160 EZ703U	20	41	550	16.00	0.53	1.06	24	8	183	3	17	54.1
0.85	2.6	2.9	1.8	3.2	ZTRS317SPH731_0100 EZ701U	7.1	41	190	10.00	0.71	1.42	24	8	163	3	17	54.1
0.85	4.3	5.1	3.0	2.0	ZTRS317SPH731_0100 EZ702U	15	41	390	10.00	0.71	1.42	24	8	163	3	17	54.1
0.85	5.9	7.4	4.1	1.4	ZTRS317SPH731_0100 EZ703U	20	41	550	10.00	0.71	1.42	24	8	163	3	17	54.1
0.85	7.6	11	5.3	1.1	ZTRS317SPH731_0100 EZ705U	20	41	550	10.00	0.71	1.42	24	8	163	3	17	54.1
0.85	7.9	13	5.5	1.1	ZTRS317SPH731_0100 EZ802U	20	41	550	10.00	0.71	1.42	24	8	163	3	17	54.1
1.21	1.8	2.1	2.0	4.1	ZTRS317SPH731_0070 EZ701U	5.0	41	130	7.000	1.01	2.02	24	8	176	3	17	54.1
1.21	3.0	3.6	3.3	2.5	ZTRS317SPH731_0070 EZ702U	10	41	280	7.000	1.01	2.02	24	8	176	3	17	54.1
1.21	4.1	5.2	4.5	1.8	ZTRS317SPH731_0070 EZ703U	16	41	440	7.000	1.01	2.02	24	8	176	3	17	54.1

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTRS3PH7 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 20 kN)																	
1.21	5.3	7.5	5.9	1.4	ZTRS317SPH731_0070 EZ705U	20	41	550	7.000	1.01	2.02	24	8	176	3	17	54.1
1.21	5.5	9.2	6.1	1.4	ZTRS317SPH731_0070 EZ802U	20	41	550	7.000	1.01	2.02	24	8	176	3	17	54.1
1.21	6.6	12	7.3	1.1	ZTRS317SPH731_0070 EZ803U	20	41	550	7.000	1.01	2.02	24	8	176	3	17	54.1
1.70	2.1	2.6	5.0	3.2	ZTRS317SPH731_0050 EZ702U	7.3	41	200	5.000	1.25	2.83	24	8	184	3	17	54.1
1.70	2.9	3.7	6.8	2.3	ZTRS317SPH731_0050 EZ703U	12	41	310	5.000	1.25	2.83	24	8	184	3	17	54.1
1.70	3.8	5.4	8.8	1.8	ZTRS317SPH731_0050 EZ705U	18	41	500	5.000	1.25	2.83	24	8	184	3	17	54.1
1.70	4.0	6.6	9.2	1.7	ZTRS317SPH731_0050 EZ802U	18	41	480	5.000	1.25	2.83	24	8	184	3	17	54.1
1.70	4.7	8.6	11	1.4	ZTRS317SPH731_0050 EZ803U	20	41	550	5.000	1.25	2.83	24	8	184	3	17	54.1
2.13	1.7	2.0	6.5	3.7	ZTRS317SPH731_0040 EZ702U	5.8	33	160	4.000	1.35	2.83	24	8	189	3	17	54.1
2.13	2.3	3.0	8.9	2.7	ZTRS317SPH731_0040 EZ703U	9.2	33	250	4.000	1.35	2.83	24	8	189	3	17	54.1
2.13	3.0	4.3	11	2.1	ZTRS317SPH731_0040 EZ705U	15	33	400	4.000	1.35	2.83	24	8	189	3	17	54.1
2.13	3.2	5.3	12	2.0	ZTRS317SPH731_0040 EZ802U	14	41	380	4.000	1.35	2.83	24	8	189	3	17	54.1
2.13	3.8	6.8	14	1.7	ZTRS317SPH731_0040 EZ803U	20	41	550	4.000	1.35	2.83	24	8	189	3	17	54.1
ZTRS3PH7 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 20 kN)																	
0.46	9.1	15	2.9	1.1	ZTRS317SPH732_0280 EZ505U	20	41	550	28.00	0.37	0.71	24	8	182	3	17	54.1
0.51	8.2	13	3.2	1.2	ZTRS317SPH732_0250 EZ505U	20	41	550	25.00	0.40	0.79	24	8	180	3	17	54.1
0.64	6.5	11	3.7	1.4	ZTRS317SPH732_0200 EZ505U	20	41	550	20.00	0.43	0.85	24	8	180	3	17	54.1
0.64	8.3	14	4.7	1.1	ZTRS317SPH732_0200 EZ703U	20	41	550	20.00	0.43	0.85	24	8	180	3	17	54.1
0.80	5.2	8.4	4.1	1.7	ZTRS317SPH732_0160 EZ505U	20	41	550	16.00	0.53	1.06	24	8	183	3	17	54.1
0.80	6.7	11	5.3	1.3	ZTRS317SPH732_0160 EZ703U	20	41	550	16.00	0.53	1.06	24	8	183	3	17	54.1
1.28	3.7	12	3.0	2.0	ZTRS317SPH731_0100 EZ802U	20	41	550	10.00	0.71	1.42	24	8	163	3	17	54.1
1.28	4.3	7.1	3.4	1.7	ZTRS317SPH731_0100 EZ703U	20	41	550	10.00	0.71	1.42	24	8	163	3	17	54.1
1.28	5.8	11	4.7	1.3	ZTRS317SPH731_0100 EZ705U	20	41	550	10.00	0.71	1.42	24	8	163	3	17	54.1
1.82	2.6	8.6	3.3	2.5	ZTRS317SPH731_0070 EZ802U	20	41	550	7.000	1.01	2.02	24	8	176	3	17	54.1
1.82	3.0	5.0	3.8	2.2	ZTRS317SPH731_0070 EZ703U	16	41	440	7.000	1.01	2.02	24	8	176	3	17	54.1
1.82	4.1	7.5	5.2	1.6	ZTRS317SPH731_0070 EZ705U	20	41	550	7.000	1.01	2.02	24	8	176	3	17	54.1
2.55	1.9	6.1	5.0	3.1	ZTRS317SPH731_0050 EZ802U	18	41	480	5.000	1.25	2.83	24	8	184	3	17	54.1
2.55	2.1	3.5	5.7	2.7	ZTRS317SPH731_0050 EZ703U	12	41	310	5.000	1.25	2.83	24	8	184	3	17	54.1
2.55	2.9	5.3	7.7	2.0	ZTRS317SPH731_0050 EZ705U	18	41	500	5.000	1.25	2.83	24	8	184	3	17	54.1
ZTRS3PH7 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 20 kN)																	
0.24	8.2	11	0.7	1.6	ZTRS317SPH732_0700 EZ501U	20	41	550	70.00	0.15	0.28	24	8	173	3	17	54.1
0.34	5.8	7.6	0.9	2.0	ZTRS317SPH732_0500 EZ501U	20	41	550	50.00	0.21	0.40	24	8	178	3	17	54.1
0.34	8.9	13	1.3	1.3	ZTRS317SPH732_0500 EZ502U	20	41	550	50.00	0.21	0.40	24	8	178	3	17	54.1
0.34	8.9	14	1.3	1.3	ZTRS317SPH732_0500 EZ701U	20	41	550	50.00	0.21	0.40	24	8	178	3	17	54.1
0.43	4.7	6.0	1.1	2.3	ZTRS317SPH732_0400 EZ501U	20	41	550	40.00	0.26	0.50	24	8	179	3	17	54.1
0.43	7.1	11	1.7	1.5	ZTRS317SPH732_0400 EZ502U	20	41	550	40.00	0.26	0.50	24	8	179	3	17	54.1
0.43	7.1	11	1.7	1.5	ZTRS317SPH732_0400 EZ701U	20	41	550	40.00	0.26	0.50	24	8	179	3	17	54.1
0.43	8.5	15	2.0	1.2	ZTRS317SPH732_0400 EZ503U	20	41	550	40.00	0.26	0.50	24	8	179	3	17	54.1
0.49	4.1	5.3	1.0	2.5	ZTRS317SPH732_0350 EZ501U	19	41	520	35.00	0.30	0.57	24	8	179	3	17	54.1
0.49	6.3	9.4	1.6	1.6	ZTRS317SPH732_0350 EZ502U	20	41	550	35.00	0.30	0.57	24	8	179	3	17	54.1
0.49	6.3	9.5	1.6	1.6	ZTRS317SPH732_0350 EZ701U	20	41	550	35.00	0.30	0.57	24	8	179	3	17	54.1
0.49	7.5	13	1.9	1.4	ZTRS317SPH732_0350 EZ503U	20	41	550	35.00	0.30	0.57	24	8	179	3	17	54.1
0.61	3.3	4.2	1.1	2.9	ZTRS317SPH732_0280 EZ501U	15	41	420	28.00	0.37	0.71	24	8	182	3	17	54.1
0.61	5.0	7.5	1.7	1.9	ZTRS317SPH732_0280 EZ502U	20	41	550	28.00	0.37	0.71	24	8	182	3	17	54.1
0.61	5.0	7.6	1.7	1.9	ZTRS317SPH732_0280 EZ701U	19	41	520	28.00	0.37	0.71	24	8	182	3	17	54.1
0.61	6.0	10	2.1	1.6	ZTRS317SPH732_0280 EZ503U	20	41	550	28.00	0.37	0.71	24	8	182	3	17	54.1
0.61	6.9	14	2.4	1.4	ZTRS317SPH732_0280 EZ702U	20	41	550	28.00	0.37	0.71	24	8	182	3	17	54.1
0.68	2.9	3.8	1.3	3.1	ZTRS317SPH732_0250 EZ501U	14	41	370	25.00	0.40	0.79	24	8	180	3	17	54.1
0.68	4.5	6.7	2.0	2.0	ZTRS317SPH732_0250 EZ502U	20	41	550	25.00	0.40	0.79	24	8	180	3	17	54.1
0.68	4.5	6.8	2.0	2.0	ZTRS317SPH732_0250 EZ701U	17	41	470	25.00	0.40	0.79	24	8	180	3	17	54.1
0.68	5.3	9.1	2.3	1.7	ZTRS317SPH732_0250 EZ503U	20	41	550	25.00	0.40	0.79	24	8	180	3	17	54.1
0.68	6.2	12	2.7	1.5	ZTRS317SPH732_0250 EZ702U	20	41	550	25.00	0.40	0.79	24	8	180	3	17	54.1
0.85	2.3	3.0	1.5	3.6	ZTRS317SPH732_0200 EZ501U	11	41	300	20.00	0.43	0.85	24	8	180	3	17	54.1
0.85	3.6	5.4	2.2	2.4	ZTRS317SPH732_0200 EZ502U	20	41	550	20.00	0.43	0.85	24	8	180	3	17	54.1
0.85	3.6	5.4	2.2	2.4	ZTRS317SPH732_0200 EZ701U	14	41	370	20.00	0.43	0.85	24	8	180	3	17	54.1
0.85	4.3	7.3	2.6	2.0	ZTRS317SPH732_0200 EZ503U	20	41	550	20.00	0.43	0.85	24	8	180	3	17	54.1
0.85	4.9	9.8	3.1	1.7	ZTRS317SPH732_0200 EZ702U	20	41	550	20.00	0.43	0.85	24	8	180	3	17	54.1
1.06	1.9	2.4	1.6	4.2	ZTRS317SPH732_0160 EZ501U	8.8	41	240	16.00	0.53	1.06	24	8	183	3	17	54.1
1.06	2.9	4.3	2.5	2.7	ZTRS317SPH732_0160 EZ502U	17	41	460	16.00	0.53	1.06	24	8	183	3	17	54.1
1.06	2.9	4.3	2.5	2.7	ZTRS317SPH732_0160 EZ701U	11	41	300	16.00	0.53	1.06	24	8	183	3	17	54.1
1.06	3.4	5.8	3.0	2.3	ZTRS317SPH732_0160 EZ503U	20	41	550	16.00	0.53	1.06	24	8	183	3	17	54.1
1.06	4.0	7.9	3.4	2.0	ZTRS317SPH732_0160 EZ702U	20	41	550	16.00	0.53	1.06	24	8	183	3	17	54.1
ZTRS3PH8 (n_{1N} = 2000 rpm, ($F_{f2acc,max}$ = 28 kN)																	
0.67	13	19	8.4	1.7	ZTRS332SPH832_0160 EZ805U	28	55	1410	16.00	0.83	1.50	44	15	227	3	32	101.9
1.07	8.2	12	4.2	1.8	ZTRS332SPH831_0100 EZ805U	27	55	1390	10.00	1.17	2.13	44	15	197	3	32	101.9
1.52	5.8	8.7	5.0	3.4	ZTRS332SPH831_0070 EZ805U	27	55	1380	7.000	1.52	3.05	44	15	221	3	32	101.9

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTRS3PH8 (n_{1N} = 2000 rpm, ($F_{f2acc,max}$ = 28 kN)																	
2.13	4.1	6.2	7.5	4.4	ZTRS332SPH831_0050 EZ805U	19	49	980	5.000	1.71	4.27	44	15	241	3	32	101.9
2.67	3.3	5.0	12	4.8	ZTRS332SPH831_0040 EZ805U	15	39	790	4.000	1.87	4.67	44	15	243	3	32	101.9
ZTRS3PH8 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 28 kN)																	
0.16	14	15	0.7	1.3	ZTRS332SPH832_1000 EZ701U	27	54	1380	100.0	0.16	0.32	44	15	194	3	32	101.9
0.23	9.5	11	0.6	2.6	ZTRS332SPH832_0700 EZ701U	26	55	1300	70.00	0.23	0.46	44	15	214	3	32	101.9
0.23	15	18	1.0	1.6	ZTRS332SPH832_0700 EZ702U	28	55	1410	70.00	0.23	0.46	44	15	214	3	32	101.9
0.32	6.8	7.6	0.7	3.7	ZTRS332SPH832_0500 EZ701U	18	55	930	50.00	0.32	0.64	44	15	226	3	32	101.9
0.32	11	13	1.1	2.3	ZTRS332SPH832_0500 EZ702U	28	55	1410	50.00	0.32	0.64	44	15	226	3	32	101.9
0.32	15	19	1.6	1.7	ZTRS332SPH832_0500 EZ703U	28	55	1410	50.00	0.32	0.64	44	15	226	3	32	101.9
0.40	5.4	6.1	1.0	3.7	ZTRS332SPH832_0400 EZ701U	15	55	740	40.00	0.40	0.80	44	15	219	3	32	101.9
0.40	8.8	11	1.6	2.3	ZTRS332SPH832_0400 EZ702U	28	55	1410	40.00	0.40	0.80	44	15	219	3	32	101.9
0.40	12	15	2.2	1.7	ZTRS332SPH832_0400 EZ703U	28	55	1410	40.00	0.40	0.80	44	15	219	3	32	101.9
0.46	7.7	9.2	1.4	3.2	ZTRS332SPH832_0350 EZ702U	26	55	1330	35.00	0.46	0.91	44	15	229	3	32	101.9
0.46	11	13	1.9	2.3	ZTRS332SPH832_0350 EZ703U	28	55	1410	35.00	0.46	0.91	44	15	229	3	32	101.9
0.46	14	19	2.4	1.8	ZTRS332SPH832_0350 EZ705U	28	55	1410	35.00	0.46	0.91	44	15	229	3	32	101.9
0.57	6.1	7.4	1.9	3.2	ZTRS332SPH832_0280 EZ702U	21	55	1070	28.00	0.57	1.14	44	15	224	3	32	101.9
0.57	8.4	11	2.6	2.3	ZTRS332SPH832_0280 EZ703U	28	55	1410	28.00	0.57	1.14	44	15	224	3	32	101.9
0.57	11	15	3.4	1.8	ZTRS332SPH832_0280 EZ705U	28	55	1410	28.00	0.57	1.14	44	15	224	3	32	101.9
0.57	11	19	3.5	1.7	ZTRS332SPH832_0280 EZ802U	28	55	1410	28.00	0.57	1.14	44	15	224	3	32	101.9
0.64	5.5	6.6	1.6	4.5	ZTRS332SPH832_0250 EZ702U	19	55	950	25.00	0.58	1.17	44	15	230	3	32	101.9
0.64	7.5	9.5	2.2	3.3	ZTRS332SPH832_0250 EZ703U	28	55	1410	25.00	0.58	1.17	44	15	230	3	32	101.9
0.64	9.7	14	2.9	2.5	ZTRS332SPH832_0250 EZ705U	28	55	1410	25.00	0.58	1.17	44	15	230	3	32	101.9
0.64	10	17	3.0	2.4	ZTRS332SPH832_0250 EZ802U	28	55	1410	25.00	0.58	1.17	44	15	230	3	32	101.9
0.80	6.0	7.6	2.5	4.1	ZTRS332SPH832_0200 EZ703U	24	55	1210	20.00	0.67	1.20	44	15	231	3	32	101.9
0.80	7.8	11	3.2	3.2	ZTRS332SPH832_0200 EZ705U	28	55	1410	20.00	0.67	1.20	44	15	231	3	32	101.9
0.80	8.1	14	3.4	3.0	ZTRS332SPH832_0200 EZ802U	28	55	1410	20.00	0.67	1.20	44	15	231	3	32	101.9
0.80	9.7	18	4.0	2.5	ZTRS332SPH832_0200 EZ803U	28	55	1410	20.00	0.67	1.20	44	15	231	3	32	101.9
1.00	4.8	6.1	3.5	4.1	ZTRS332SPH832_0160 EZ703U	19	55	970	16.00	0.83	1.50	44	15	227	3	32	101.9
1.00	6.2	8.8	4.5	3.2	ZTRS332SPH832_0160 EZ705U	28	55	1410	16.00	0.83	1.50	44	15	227	3	32	101.9
1.00	6.5	11	4.7	3.0	ZTRS332SPH832_0160 EZ802U	28	55	1410	16.00	0.83	1.50	44	15	227	3	32	101.9
1.00	7.8	14	5.6	2.5	ZTRS332SPH832_0160 EZ803U	28	55	1410	16.00	0.83	1.50	44	15	227	3	32	101.9
1.60	4.2	7.0	2.5	3.2	ZTRS332SPH831_0100 EZ802U	19	55	960	10.00	1.17	2.13	44	15	197	3	32	101.9
1.60	5.0	9.1	2.9	2.6	ZTRS332SPH831_0100 EZ803U	27	55	1390	10.00	1.17	2.13	44	15	197	3	32	101.9
2.29	3.5	6.4	3.5	4.9	ZTRS332SPH831_0070 EZ803U	19	55	970	7.000	1.52	3.05	44	15	221	3	32	101.9
ZTRS3PH8 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 28 kN)																	
0.48	11	18	1.3	2.0	ZTRS332SPH832_0500 EZ703U	28	55	1410	50.00	0.32	0.64	44	15	226	3	32	101.9
0.60	8.8	15	1.8	2.0	ZTRS332SPH832_0400 EZ703U	28	55	1410	40.00	0.40	0.80	44	15	219	3	32	101.9
0.69	7.7	13	1.6	2.8	ZTRS332SPH832_0350 EZ703U	28	55	1410	35.00	0.46	0.91	44	15	229	3	32	101.9
0.69	10	19	2.1	2.1	ZTRS332SPH832_0350 EZ705U	28	55	1410	35.00	0.46	0.91	44	15	229	3	32	101.9
0.86	5.4	18	1.9	3.2	ZTRS332SPH832_0280 EZ802U	28	55	1410	28.00	0.57	1.14	44	15	224	3	32	101.9
0.86	6.2	10	2.2	2.8	ZTRS332SPH832_0280 EZ703U	28	55	1410	28.00	0.57	1.14	44	15	224	3	32	101.9
0.86	8.4	15	3.0	2.1	ZTRS332SPH832_0280 EZ705U	28	55	1410	28.00	0.57	1.14	44	15	224	3	32	101.9
0.96	4.8	16	1.6	4.5	ZTRS332SPH832_0250 EZ802U	28	55	1410	25.00	0.58	1.17	44	15	230	3	32	101.9
0.96	5.5	9.1	1.9	3.9	ZTRS332SPH832_0250 EZ703U	28	55	1410	25.00	0.58	1.17	44	15	230	3	32	101.9
0.96	7.5	14	2.5	2.9	ZTRS332SPH832_0250 EZ705U	28	55	1410	25.00	0.58	1.17	44	15	230	3	32	101.9
1.20	4.4	7.3	2.1	4.9	ZTRS332SPH832_0200 EZ703U	24	55	1210	20.00	0.67	1.20	44	15	231	3	32	101.9
1.20	6.0	11	2.8	3.6	ZTRS332SPH832_0200 EZ705U	28	55	1410	20.00	0.67	1.20	44	15	231	3	32	101.9
1.50	3.5	5.8	2.9	4.9	ZTRS332SPH832_0160 EZ703U	19	55	970	16.00	0.83	1.50	44	15	227	3	32	101.9
1.50	4.8	8.8	3.9	3.6	ZTRS332SPH832_0160 EZ705U	28	55	1410	16.00	0.83	1.50	44	15	227	3	32	101.9
ZTRS3PH8 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 28 kN)																	
0.32	9.5	14	0.6	1.4	ZTRS332SPH832_1000 EZ701U	27	54	1380	100.0	0.16	0.32	44	15	194	3	32	101.9
0.46	6.6	10	0.5	3.0	ZTRS332SPH832_0700 EZ701U	26	55	1300	70.00	0.23	0.46	44	15	214	3	32	101.9
0.46	9.2	18	0.7	2.1	ZTRS332SPH832_0700 EZ702U	28	55	1410	70.00	0.23	0.46	44	15	214	3	32	101.9
0.64	4.7	7.2	0.6	4.2	ZTRS332SPH832_0500 EZ701U	18	55	930	50.00	0.32	0.64	44	15	226	3	32	101.9
0.64	6.6	13	0.9	3.0	ZTRS332SPH832_0500 EZ702U	28	55	1410	50.00	0.32	0.64	44	15	226	3	32	101.9
0.80	3.8	5.8	0.9	4.2	ZTRS332SPH832_0400 EZ701U	15	55	740	40.00	0.40	0.80	44	15	219	3	32	101.9
0.80	5.3	10	1.2	3.0	ZTRS332SPH832_0400 EZ702U	28	55	1410	40.00	0.40	0.80	44	15	219	3	32	101.9
0.91	4.6	9.1	1.0	4.3	ZTRS332SPH832_0350 EZ702U	26	55	1330	35.00	0.46	0.91	44	15	229	3	32	101.9
1.14	3.7	7.3	1.4	4.3	ZTRS332SPH832_0280 EZ702U	21	55	1070	28.00	0.57	1.14	44	15	224	3	32	101.9
ZTRS4PH8 (n_{1N} = 2000 rpm, ($F_{f2acc,max}$ = 45 kN)																	
0.44	19	29	6.6	1.5	ZTRS420SPH832_0200 EZ805U	45	70	1930	20.00	0.56	1.00	37	12	284	4	20	84.9
0.56	15	23	8.4	1.7	ZTRS420SPH832_0160 EZ805U	45	70	1930	16.00	0.69	1.25	37	12	280	4	20	84.9
0.89	9.9	15	4.2	1.8	ZTRS420SPH831_0100 EZ805U	33	66	1390	10.00	0.98	1.78	37	12	247	4	20	84.9
1.27	6.9	10	5.0	2.9	ZTRS420SPH831_0070 EZ805U	32	70	1380	7.000	1.27	2.54	37	12	273	4	20	84.9
1.78	4.9	7.5	7.5	3.6	ZTRS420SPH831_0050 EZ805U	23	59	980	5.000	1.42	3.56	37	12	294	4	20	84.9
2.22	4.0	6.0	12	4.2	ZTRS420SPH831_0040 EZ805U	19	47	790	4.000	1.56	3.89	37	12	296	4	20	84.9

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTRS4PH8 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 45 kN)																	
0.13	16	18	0.7	1.3	ZTRS420SPH832_1000 EZ701U	33	65	1380	100.0	0.13	0.27	37	12	244	4	20	84.9
0.19	11	13	0.6	2.6	ZTRS420SPH832_0700 EZ701U	31	70	1300	70.00	0.19	0.38	37	12	266	4	20	84.9
0.19	18	22	1.0	1.6	ZTRS420SPH832_0700 EZ702U	44	70	1850	70.00	0.19	0.38	37	12	266	4	20	84.9
0.19	25	32	1.3	1.2	ZTRS420SPH832_0700 EZ703U	44	70	1850	70.00	0.19	0.38	37	12	266	4	20	84.9
0.27	8.1	9.1	0.7	3.7	ZTRS420SPH832_0500 EZ701U	22	70	930	50.00	0.27	0.53	37	12	278	4	20	84.9
0.27	13	16	1.1	2.3	ZTRS420SPH832_0500 EZ702U	45	70	1910	50.00	0.27	0.53	37	12	278	4	20	84.9
0.27	18	23	1.6	1.7	ZTRS420SPH832_0500 EZ703U	45	70	1930	50.00	0.27	0.53	37	12	278	4	20	84.9
0.27	23	33	2.0	1.3	ZTRS420SPH832_0500 EZ705U	45	70	1930	50.00	0.27	0.53	37	12	278	4	20	84.9
0.33	6.5	7.3	1.0	3.7	ZTRS420SPH832_0400 EZ701U	18	70	740	40.00	0.33	0.67	37	12	271	4	20	84.9
0.33	11	13	1.6	2.3	ZTRS420SPH832_0400 EZ702U	36	70	1530	40.00	0.33	0.67	37	12	271	4	20	84.9
0.33	14	18	2.2	1.7	ZTRS420SPH832_0400 EZ703U	45	70	1920	40.00	0.33	0.67	37	12	271	4	20	84.9
0.33	19	26	2.8	1.3	ZTRS420SPH832_0400 EZ705U	45	70	1920	40.00	0.33	0.67	37	12	271	4	20	84.9
0.33	20	33	2.9	1.2	ZTRS420SPH832_0400 EZ802U	45	70	1920	40.00	0.33	0.67	37	12	271	4	20	84.9
0.38	9.2	11	1.4	3.2	ZTRS420SPH832_0350 EZ702U	31	70	1330	35.00	0.38	0.76	37	12	281	4	20	84.9
0.38	13	16	1.9	2.3	ZTRS420SPH832_0350 EZ703U	45	70	1930	35.00	0.38	0.76	37	12	281	4	20	84.9
0.38	16	23	2.4	1.8	ZTRS420SPH832_0350 EZ705U	45	70	1930	35.00	0.38	0.76	37	12	281	4	20	84.9
0.38	17	28	2.5	1.7	ZTRS420SPH832_0350 EZ802U	45	70	1930	35.00	0.38	0.76	37	12	281	4	20	84.9
0.48	7.4	8.8	1.9	3.2	ZTRS420SPH832_0280 EZ702U	25	70	1070	28.00	0.48	0.95	37	12	276	4	20	84.9
0.48	10	13	2.6	2.3	ZTRS420SPH832_0280 EZ703U	40	70	1690	28.00	0.48	0.95	37	12	276	4	20	84.9
0.48	13	19	3.4	1.8	ZTRS420SPH832_0280 EZ705U	45	70	1930	28.00	0.48	0.95	37	12	276	4	20	84.9
0.48	14	23	3.5	1.7	ZTRS420SPH832_0280 EZ802U	45	70	1930	28.00	0.48	0.95	37	12	276	4	20	84.9
0.48	16	30	4.2	1.5	ZTRS420SPH832_0280 EZ803U	45	70	1930	28.00	0.48	0.95	37	12	276	4	20	84.9
0.53	6.6	7.9	1.6	4.1	ZTRS420SPH832_0250 EZ702U	22	70	950	25.00	0.48	0.98	37	12	283	4	20	84.9
0.53	9.0	11	2.2	3.0	ZTRS420SPH832_0250 EZ703U	36	70	1510	25.00	0.48	0.98	37	12	283	4	20	84.9
0.53	12	17	2.9	2.3	ZTRS420SPH832_0250 EZ705U	45	70	1930	25.00	0.48	0.98	37	12	283	4	20	84.9
0.53	12	20	3.0	2.2	ZTRS420SPH832_0250 EZ802U	45	70	1930	25.00	0.48	0.98	37	12	283	4	20	84.9
0.53	15	26	3.6	1.8	ZTRS420SPH832_0250 EZ803U	45	70	1930	25.00	0.48	0.98	37	12	283	4	20	84.9
0.67	5.3	6.3	1.8	4.7	ZTRS420SPH832_0200 EZ702U	18	70	760	20.00	0.56	1.00	37	12	284	4	20	84.9
0.67	7.2	9.1	2.5	3.4	ZTRS420SPH832_0200 EZ703U	28	70	1210	20.00	0.56	1.00	37	12	284	4	20	84.9
0.67	9.3	13	3.2	2.7	ZTRS420SPH832_0200 EZ705U	45	70	1930	20.00	0.56	1.00	37	12	284	4	20	84.9
0.67	9.8	16	3.4	2.5	ZTRS420SPH832_0200 EZ802U	44	70	1860	20.00	0.56	1.00	37	12	284	4	20	84.9
0.67	12	21	4.0	2.1	ZTRS420SPH832_0200 EZ803U	45	70	1930	20.00	0.56	1.00	37	12	284	4	20	84.9
0.83	5.8	7.3	3.5	4.0	ZTRS420SPH832_0160 EZ703U	23	70	970	16.00	0.69	1.25	37	12	280	4	20	84.9
0.83	7.5	11	4.5	3.1	ZTRS420SPH832_0160 EZ705U	36	70	1550	16.00	0.69	1.25	37	12	280	4	20	84.9
0.83	7.8	13	4.7	3.0	ZTRS420SPH832_0160 EZ802U	35	70	1490	16.00	0.69	1.25	37	12	280	4	20	84.9
0.83	9.3	17	5.6	2.5	ZTRS420SPH832_0160 EZ803U	45	70	1930	16.00	0.69	1.25	37	12	280	4	20	84.9
1.33	5.0	8.4	2.5	3.2	ZTRS420SPH831_0100 EZ802U	23	66	960	10.00	0.98	1.78	37	12	247	4	20	84.9
1.33	6.0	11	2.9	2.6	ZTRS420SPH831_0100 EZ803U	33	66	1390	10.00	0.98	1.78	37	12	247	4	20	84.9
1.91	3.5	5.9	2.9	5.0	ZTRS420SPH831_0070 EZ802U	16	70	670	7.000	1.27	2.54	37	12	273	4	20	84.9
1.91	4.2	7.6	3.5	4.2	ZTRS420SPH831_0070 EZ803U	23	70	970	7.000	1.27	2.54	37	12	273	4	20	84.9
ZTRS4PH8 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 45 kN)																	
0.29	19	31	1.1	1.4	ZTRS420SPH832_0700 EZ703U	44	70	1850	70.00	0.19	0.38	37	12	266	4	20	84.9
0.40	13	22	1.3	2.0	ZTRS420SPH832_0500 EZ703U	45	70	1930	50.00	0.27	0.53	37	12	278	4	20	84.9
0.40	18	33	1.8	1.5	ZTRS420SPH832_0500 EZ705U	45	70	1930	50.00	0.27	0.53	37	12	278	4	20	84.9
0.50	9.2	30	1.6	2.3	ZTRS420SPH832_0400 EZ802U	45	70	1920	40.00	0.33	0.67	37	12	271	4	20	84.9
0.50	11	18	1.8	2.0	ZTRS420SPH832_0400 EZ703U	45	70	1920	40.00	0.33	0.67	37	12	271	4	20	84.9
0.50	14	26	2.5	1.5	ZTRS420SPH832_0400 EZ705U	45	70	1920	40.00	0.33	0.67	37	12	271	4	20	84.9
0.57	8.1	26	1.4	3.2	ZTRS420SPH832_0350 EZ802U	45	70	1930	35.00	0.38	0.76	37	12	281	4	20	84.9
0.57	9.3	15	1.6	2.8	ZTRS420SPH832_0350 EZ703U	45	70	1930	35.00	0.38	0.76	37	12	281	4	20	84.9
0.57	13	23	2.1	2.1	ZTRS420SPH832_0350 EZ705U	45	70	1930	35.00	0.38	0.76	37	12	281	4	20	84.9
0.71	6.4	21	1.9	3.2	ZTRS420SPH832_0280 EZ802U	45	70	1930	28.00	0.48	0.95	37	12	276	4	20	84.9
0.71	7.4	12	2.2	2.8	ZTRS420SPH832_0280 EZ703U	40	70	1690	28.00	0.48	0.95	37	12	276	4	20	84.9
0.71	10	18	3.0	2.1	ZTRS420SPH832_0280 EZ705U	45	70	1930	28.00	0.48	0.95	37	12	276	4	20	84.9
0.80	5.8	19	1.6	4.1	ZTRS420SPH832_0250 EZ802U	45	70	1930	25.00	0.48	0.98	37	12	283	4	20	84.9
0.80	6.6	11	1.9	3.5	ZTRS420SPH832_0250 EZ703U	36	70	1510	25.00	0.48	0.98	37	12	283	4	20	84.9
0.80	9.0	16	2.5	2.6	ZTRS420SPH832_0250 EZ705U	45	70	1930	25.00	0.48	0.98	37	12	283	4	20	84.9
1.00	4.6	15	1.8	4.7	ZTRS420SPH832_0200 EZ802U	44	70	1860	20.00	0.56	1.00	37	12	284	4	20	84.9
1.00	5.3	8.8	2.1	4.1	ZTRS420SPH832_0200 EZ703U	28	70	1210	20.00	0.56	1.00	37	12	284	4	20	84.9
1.00	7.2	13	2.8	3.0	ZTRS420SPH832_0200 EZ705U	45	70	1930	20.00	0.56	1.00	37	12	284	4	20	84.9
1.25	4.2	7.0	2.9	4.7	ZTRS420SPH832_0160 EZ703U	23	70	970	16.00	0.69	1.25	37	12	280	4	20	84.9
1.25	5.7	11	3.9	3.5	ZTRS420SPH832_0160 EZ705U	36	70	1550	16.00	0.69	1.25	37	12	280	4	20	84.9
ZTRS4PH8 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 45 kN)																	
0.27	11	17	0.6	1.4	ZTRS420SPH832_1000 EZ701U	33	65	1380	100.0	0.13	0.27	37	12	244	4	20	84.9
0.38	8.0	12	0.5	3.0	ZTRS420SPH832_0700 EZ701U	31	70	1300	70.00	0.19	0.38	37	12	266	4	20	84.9
0.38	11	22	0.7	2.1	ZTRS420SPH832_0700 EZ702U	44	70	1850	70.00	0.19	0.38	37	12	266	4	20	84.9
0.53	5.7	8.7	0.6	4.2	ZTRS420SPH832_0500 EZ701U	22	70	930	50.00	0.27	0.53	37	12	278	4	20	84.9

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTRS4PH8 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 45 kN)																	
0.53	7.9	16	0.9	3.0	ZTRS420SPH832_0500 EZ702U	45	70	1910	50.00	0.27	0.53	37	12	278	4	20	84.9
0.67	4.6	6.9	0.9	4.2	ZTRS420SPH832_0400 EZ701U	18	70	740	40.00	0.33	0.67	37	12	271	4	20	84.9
0.67	6.3	13	1.2	3.0	ZTRS420SPH832_0400 EZ702U	36	70	1530	40.00	0.33	0.67	37	12	271	4	20	84.9
0.76	5.5	11	1.0	4.3	ZTRS420SPH832_0350 EZ702U	31	70	1330	35.00	0.38	0.76	37	12	281	4	20	84.9
0.95	4.4	8.8	1.4	4.3	ZTRS420SPH832_0280 EZ702U	25	70	1070	28.00	0.48	0.95	37	12	276	4	20	84.9
ZTRS5PH8 (n_{1N} = 2000 rpm, ($F_{f2acc,max}$ = 49 kN)																	
0.36	24	36	5.7	1.3	ZTRS516SPH832_0250 EZ805U	49	70	2100	25.00	0.48	0.98	37	12	294	5	16	84.9
0.44	19	29	6.6	1.5	ZTRS516SPH832_0200 EZ805U	49	70	2100	20.00	0.56	1.00	37	12	295	5	16	84.9
0.56	15	23	8.4	1.7	ZTRS516SPH832_0160 EZ805U	47	70	2000	16.00	0.69	1.25	37	12	290	5	16	84.9
0.89	9.9	15	4.2	1.8	ZTRS516SPH831_0100 EZ805U	33	66	1390	10.00	0.98	1.78	37	12	255	5	16	84.9
1.27	6.9	10	5.0	2.9	ZTRS516SPH831_0070 EZ805U	32	70	1380	7.000	1.27	2.54	37	12	283	5	16	84.9
1.78	4.9	7.5	7.5	3.6	ZTRS516SPH831_0050 EZ805U	23	59	980	5.000	1.42	3.56	37	12	306	5	16	84.9
2.22	4.0	6.0	12	4.1	ZTRS516SPH831_0040 EZ805U	19	47	790	4.000	1.56	3.89	37	12	308	5	16	84.9
ZTRS5PH8 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 49 kN)																	
0.13	16	18	0.7	1.3	ZTRS516SPH832_1000 EZ701U	33	65	1380	100.0	0.13	0.27	37	12	252	5	16	84.9
0.19	11	13	0.6	2.6	ZTRS516SPH832_0700 EZ701U	31	70	1300	70.00	0.19	0.38	37	12	276	5	16	84.9
0.19	18	22	1.0	1.6	ZTRS516SPH832_0700 EZ702U	44	70	1850	70.00	0.19	0.38	37	12	276	5	16	84.9
0.19	25	32	1.3	1.2	ZTRS516SPH832_0700 EZ703U	44	70	1850	70.00	0.19	0.38	37	12	276	5	16	84.9
0.27	8.1	9.1	0.7	3.7	ZTRS516SPH832_0500 EZ701U	22	70	930	50.00	0.27	0.53	37	12	289	5	16	84.9
0.27	13	16	1.1	2.3	ZTRS516SPH832_0500 EZ702U	45	70	1910	50.00	0.27	0.53	37	12	289	5	16	84.9
0.27	18	23	1.6	1.7	ZTRS516SPH832_0500 EZ703U	49	70	2100	50.00	0.27	0.53	37	12	289	5	16	84.9
0.27	23	33	2.0	1.3	ZTRS516SPH832_0500 EZ705U	49	70	2100	50.00	0.27	0.53	37	12	289	5	16	84.9
0.33	6.5	7.3	1.0	3.7	ZTRS516SPH832_0400 EZ701U	18	70	740	40.00	0.33	0.67	37	12	281	5	16	84.9
0.33	11	13	1.6	2.3	ZTRS516SPH832_0400 EZ702U	36	70	1530	40.00	0.33	0.67	37	12	281	5	16	84.9
0.33	14	18	2.2	1.7	ZTRS516SPH832_0400 EZ703U	45	70	1920	40.00	0.33	0.67	37	12	281	5	16	84.9
0.33	19	26	2.8	1.3	ZTRS516SPH832_0400 EZ705U	45	70	1920	40.00	0.33	0.67	37	12	281	5	16	84.9
0.33	20	33	2.9	1.2	ZTRS516SPH832_0400 EZ802U	45	70	1920	40.00	0.33	0.67	37	12	281	5	16	84.9
0.38	9.2	11	1.4	3.2	ZTRS516SPH832_0350 EZ702U	31	70	1330	35.00	0.38	0.76	37	12	292	5	16	84.9
0.38	13	16	1.9	2.3	ZTRS516SPH832_0350 EZ703U	49	70	2100	35.00	0.38	0.76	37	12	292	5	16	84.9
0.38	16	23	2.4	1.8	ZTRS516SPH832_0350 EZ705U	49	70	2100	35.00	0.38	0.76	37	12	292	5	16	84.9
0.38	17	28	2.5	1.7	ZTRS516SPH832_0350 EZ802U	49	70	2100	35.00	0.38	0.76	37	12	292	5	16	84.9
0.38	20	37	3.0	1.4	ZTRS516SPH832_0350 EZ803U	49	70	2100	35.00	0.38	0.76	37	12	292	5	16	84.9
0.48	7.4	8.8	1.9	3.2	ZTRS516SPH832_0280 EZ702U	25	70	1070	28.00	0.48	0.95	37	12	287	5	16	84.9
0.48	10	13	2.6	2.3	ZTRS516SPH832_0280 EZ703U	40	70	1690	28.00	0.48	0.95	37	12	287	5	16	84.9
0.48	13	19	3.4	1.8	ZTRS516SPH832_0280 EZ705U	47	70	2000	28.00	0.48	0.95	37	12	287	5	16	84.9
0.48	14	23	3.5	1.7	ZTRS516SPH832_0280 EZ802U	47	70	2000	28.00	0.48	0.95	37	12	287	5	16	84.9
0.48	16	30	4.2	1.5	ZTRS516SPH832_0280 EZ803U	47	70	2000	28.00	0.48	0.95	37	12	287	5	16	84.9
0.53	6.6	7.9	1.6	4.0	ZTRS516SPH832_0250 EZ702U	22	70	950	25.00	0.48	0.98	37	12	294	5	16	84.9
0.53	9.0	11	2.2	2.9	ZTRS516SPH832_0250 EZ703U	36	70	1510	25.00	0.48	0.98	37	12	294	5	16	84.9
0.53	12	17	2.9	2.3	ZTRS516SPH832_0250 EZ705U	49	70	2100	25.00	0.48	0.98	37	12	294	5	16	84.9
0.53	12	20	3.0	2.2	ZTRS516SPH832_0250 EZ802U	49	70	2100	25.00	0.48	0.98	37	12	294	5	16	84.9
0.53	15	26	3.6	1.8	ZTRS516SPH832_0250 EZ803U	49	70	2100	25.00	0.48	0.98	37	12	294	5	16	84.9
0.67	5.3	6.3	1.8	4.7	ZTRS516SPH832_0200 EZ702U	18	70	760	20.00	0.56	1.00	37	12	295	5	16	84.9
0.67	7.2	9.1	2.5	3.4	ZTRS516SPH832_0200 EZ703U	28	70	1210	20.00	0.56	1.00	37	12	295	5	16	84.9
0.67	9.3	13	3.2	2.6	ZTRS516SPH832_0200 EZ705U	46	70	1930	20.00	0.56	1.00	37	12	295	5	16	84.9
0.67	9.8	16	3.4	2.5	ZTRS516SPH832_0200 EZ802U	44	70	1860	20.00	0.56	1.00	37	12	295	5	16	84.9
0.67	12	21	4.0	2.1	ZTRS516SPH832_0200 EZ803U	49	70	2100	20.00	0.56	1.00	37	12	295	5	16	84.9
0.83	5.8	7.3	3.5	3.9	ZTRS516SPH832_0160 EZ703U	23	70	970	16.00	0.69	1.25	37	12	290	5	16	84.9
0.83	7.5	11	4.5	3.0	ZTRS516SPH832_0160 EZ705U	36	70	1550	16.00	0.69	1.25	37	12	290	5	16	84.9
0.83	7.8	13	4.7	2.9	ZTRS516SPH832_0160 EZ802U	35	70	1490	16.00	0.69	1.25	37	12	290	5	16	84.9
0.83	9.3	17	5.6	2.4	ZTRS516SPH832_0160 EZ803U	47	70	2000	16.00	0.69	1.25	37	12	290	5	16	84.9
1.33	5.0	8.4	2.5	3.2	ZTRS516SPH831_0100 EZ802U	23	66	960	10.00	0.98	1.78	37	12	255	5	16	84.9
1.33	6.0	11	2.9	2.6	ZTRS516SPH831_0100 EZ803U	33	66	1390	10.00	0.98	1.78	37	12	255	5	16	84.9
1.91	3.5	5.9	2.9	4.9	ZTRS516SPH831_0070 EZ802U	16	70	670	7.000	1.27	2.54	37	12	283	5	16	84.9
1.91	4.2	7.6	3.5	4.1	ZTRS516SPH831_0070 EZ803U	23	70	970	7.000	1.27	2.54	37	12	283	5	16	84.9
ZTRS5PH8 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 49 kN)																	
0.29	19	31	1.1	1.4	ZTRS516SPH832_0700 EZ703U	44	70	1850	70.00	0.19	0.38	37	12	276	5	16	84.9
0.40	12	38	1.1	2.3	ZTRS516SPH832_0500 EZ802U	49	70	2100	50.00	0.27	0.53	37	12	289	5	16	84.9
0.40	13	22	1.3	2.0	ZTRS516SPH832_0500 EZ703U	49	70	2100	50.00	0.27	0.53	37	12	289	5	16	84.9
0.40	18	33	1.8	1.5	ZTRS516SPH832_0500 EZ705U	49	70	2100	50.00	0.27	0.53	37	12	289	5	16	84.9
0.50	9.2	30	1.6	2.3	ZTRS516SPH832_0400 EZ802U	45	70	1920	40.00	0.33	0.67	37	12	281	5	16	84.9
0.50	11	18	1.8	2.0	ZTRS516SPH832_0400 EZ703U	45	70	1920	40.00	0.33	0.67	37	12	281	5	16	84.9
0.50	14	26	2.5	1.5	ZTRS516SPH832_0400 EZ705U	45	70	1920	40.00	0.33	0.67	37	12	281	5	16	84.9
0.57	8.1	26	1.4	3.2	ZTRS516SPH832_0350 EZ802U	49	70	2100	35.00	0.38	0.76	37	12	292	5	16	84.9
0.57	9.3	15	1.6	2.8	ZTRS516SPH832_0350 EZ703U	49	70	2100	35.00	0.38	0.76	37	12	292	5	16	84.9
0.57	13	23	2.1	2.1	ZTRS516SPH832_0350 EZ705U	49	70	2100	35.00	0.38	0.76	37	12	292	5	16	84.9

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTRS5PH8 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 49 kN)																	
0.71	6.4	21	1.9	3.2	ZTRS516SPH832_0280 EZ802U	47	70	2000	28.00	0.48	0.95	37	12	287	5	16	84.9
0.71	7.4	12	2.2	2.8	ZTRS516SPH832_0280 EZ703U	40	70	1690	28.00	0.48	0.95	37	12	287	5	16	84.9
0.71	10	18	3.0	2.1	ZTRS516SPH832_0280 EZ705U	47	70	2000	28.00	0.48	0.95	37	12	287	5	16	84.9
0.80	5.8	19	1.6	4.0	ZTRS516SPH832_0250 EZ802U	49	70	2100	25.00	0.48	0.98	37	12	294	5	16	84.9
0.80	6.6	11	1.9	3.5	ZTRS516SPH832_0250 EZ703U	36	70	1510	25.00	0.48	0.98	37	12	294	5	16	84.9
0.80	9.0	16	2.5	2.6	ZTRS516SPH832_0250 EZ705U	49	70	2100	25.00	0.48	0.98	37	12	294	5	16	84.9
1.00	4.6	15	1.8	4.7	ZTRS516SPH832_0200 EZ802U	44	70	1860	20.00	0.56	1.00	37	12	295	5	16	84.9
1.00	5.3	8.8	2.1	4.0	ZTRS516SPH832_0200 EZ703U	28	70	1210	20.00	0.56	1.00	37	12	295	5	16	84.9
1.00	7.2	13	2.8	3.0	ZTRS516SPH832_0200 EZ705U	46	70	1930	20.00	0.56	1.00	37	12	295	5	16	84.9
1.25	4.2	7.0	2.9	4.7	ZTRS516SPH832_0160 EZ703U	23	70	970	16.00	0.69	1.25	37	12	290	5	16	84.9
1.25	5.7	11	3.9	3.5	ZTRS516SPH832_0160 EZ705U	36	70	1550	16.00	0.69	1.25	37	12	290	5	16	84.9
ZTRS5PH8 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 45 kN)																	
0.27	11	17	0.6	1.4	ZTRS516SPH832_1000 EZ701U	33	65	1380	100.0	0.13	0.27	37	12	252	5	16	84.9
0.38	8.0	12	0.5	3.0	ZTRS516SPH832_0700 EZ701U	31	70	1300	70.00	0.19	0.38	37	12	276	5	16	84.9
0.38	11	22	0.7	2.1	ZTRS516SPH832_0700 EZ702U	44	70	1850	70.00	0.19	0.38	37	12	276	5	16	84.9
0.53	5.7	8.7	0.6	4.2	ZTRS516SPH832_0500 EZ701U	22	70	930	50.00	0.27	0.53	37	12	289	5	16	84.9
0.53	7.9	16	0.9	3.0	ZTRS516SPH832_0500 EZ702U	45	70	1910	50.00	0.27	0.53	37	12	289	5	16	84.9
0.67	4.6	6.9	0.9	4.2	ZTRS516SPH832_0400 EZ701U	18	70	740	40.00	0.33	0.67	37	12	281	5	16	84.9
0.67	6.3	13	1.2	3.0	ZTRS516SPH832_0400 EZ702U	36	70	1530	40.00	0.33	0.67	37	12	281	5	16	84.9
0.76	5.5	11	1.0	4.2	ZTRS516SPH832_0350 EZ702U	31	70	1330	35.00	0.38	0.76	37	12	292	5	16	84.9
0.95	4.4	8.8	1.4	4.3	ZTRS516SPH832_0280 EZ702U	25	70	1070	28.00	0.48	0.95	37	12	287	5	16	84.9
ZTRS5PH9 (n_{1N} = 2000 rpm, ($F_{f2acc,max}$ = 77 kN)																	
0.23	37	56	1.9	1.5	ZTRS520SPH932_0480 EZ805U	77	154	4080	48.00	0.32	0.52	46	–	385	5	20	106.1
0.27	32	49	2.0	1.7	ZTRS520SPH932_0420 EZ805U	77	154	4080	42.00	0.37	0.60	46	–	387	5	20	106.1
0.28	31	46	2.3	1.7	ZTRS520SPH932_0400 EZ805U	77	154	4080	40.00	0.39	0.63	46	–	382	5	20	106.1
0.35	25	37	2.3	2.0	ZTRS520SPH932_0320 EZ805U	77	154	4080	32.00	0.49	0.78	46	–	388	5	20	106.1
0.37	23	35	2.4	2.1	ZTRS520SPH932_0300 EZ805U	77	154	4080	30.00	0.46	0.74	46	–	388	5	20	106.1
0.40	21	32	2.5	2.2	ZTRS520SPH932_0280 EZ805U	77	154	4080	28.00	0.56	0.89	46	–	391	5	20	106.1
0.46	18	28	2.7	2.4	ZTRS520SPH932_0240 EZ805U	77	154	4080	24.00	0.51	0.81	46	–	389	5	20	106.1
0.56	15	23	3.0	2.7	ZTRS520SPH932_0200 EZ805U	72	154	3810	20.00	0.69	1.11	46	–	395	5	20	106.1
0.62	14	21	3.1	2.9	ZTRS520SPH932_0180 EZ805U	65	154	3430	18.00	0.56	0.93	46	–	390	5	20	106.1
0.69	12	19	3.3	3.2	ZTRS520SPH932_0160 EZ805U	57	154	3050	16.00	0.76	1.22	46	–	397	5	20	106.1
0.93	9.2	14	3.8	3.8	ZTRS520SPH932_0120 EZ805U	43	127	2290	12.00	0.83	1.39	46	–	400	5	20	106.1
ZTRS5PH9 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 77 kN)																	
0.28	23	39	0.9	2.2	ZTRS520SPH932_0600 EZ802U	77	154	4080	60.00	0.26	0.42	46	–	383	5	20	106.1
0.28	28	51	1.0	1.9	ZTRS520SPH932_0600 EZ803U	77	154	4080	60.00	0.26	0.42	46	–	383	5	20	106.1
0.35	19	31	1.0	2.6	ZTRS520SPH932_0480 EZ802U	77	154	4080	48.00	0.32	0.52	46	–	385	5	20	106.1
0.35	22	41	1.2	2.2	ZTRS520SPH932_0480 EZ803U	77	154	4080	48.00	0.32	0.52	46	–	385	5	20	106.1
0.40	16	27	1.0	2.9	ZTRS520SPH932_0420 EZ802U	74	154	3910	42.00	0.37	0.60	46	–	387	5	20	106.1
0.40	20	35	1.2	2.4	ZTRS520SPH932_0420 EZ803U	77	154	4080	42.00	0.37	0.60	46	–	387	5	20	106.1
0.42	16	26	1.4	2.8	ZTRS520SPH932_0400 EZ802U	70	154	3720	40.00	0.39	0.63	46	–	382	5	20	106.1
0.42	19	34	1.6	2.4	ZTRS520SPH932_0400 EZ803U	77	154	4080	40.00	0.39	0.63	46	–	382	5	20	106.1
0.52	13	21	1.3	3.4	ZTRS520SPH932_0320 EZ802U	56	154	2980	32.00	0.49	0.78	46	–	388	5	20	106.1
0.52	15	27	1.6	2.9	ZTRS520SPH932_0320 EZ803U	77	154	4080	32.00	0.49	0.78	46	–	388	5	20	106.1
0.56	12	20	1.2	3.6	ZTRS520SPH932_0300 EZ802U	53	154	2790	30.00	0.46	0.74	46	–	388	5	20	106.1
0.56	14	25	1.5	3.0	ZTRS520SPH932_0300 EZ803U	76	154	4050	30.00	0.46	0.74	46	–	388	5	20	106.1
0.60	11	18	1.3	3.7	ZTRS520SPH932_0280 EZ802U	49	154	2600	28.00	0.56	0.89	46	–	391	5	20	106.1
0.60	13	24	1.5	3.1	ZTRS520SPH932_0280 EZ803U	71	154	3780	28.00	0.56	0.89	46	–	391	5	20	106.1
0.69	9.4	16	1.4	4.1	ZTRS520SPH932_0240 EZ802U	42	154	2230	24.00	0.51	0.81	46	–	389	5	20	106.1
0.69	11	20	1.7	3.5	ZTRS520SPH932_0240 EZ803U	61	154	3240	24.00	0.51	0.81	46	–	389	5	20	106.1
0.83	7.8	13	1.5	4.7	ZTRS520SPH932_0200 EZ802U	35	145	1860	20.00	0.69	1.11	46	–	395	5	20	106.1
0.83	9.3	17	1.8	3.9	ZTRS520SPH932_0200 EZ803U	51	154	2700	20.00	0.69	1.11	46	–	395	5	20	106.1
0.93	8.4	15	1.9	4.2	ZTRS520SPH932_0180 EZ803U	46	154	2430	18.00	0.56	0.93	46	–	390	5	20	106.1
1.04	7.5	14	2.3	4.6	ZTRS520SPH932_0160 EZ803U	41	154	2160	16.00	0.76	1.22	46	–	397	5	20	106.1
ZTRS5PH9 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 77 kN)																	
0.42	11	36	0.4	4.2	ZTRS520SPH932_0600 EZ802U	77	154	4080	60.00	0.26	0.42	46	–	383	5	20	106.1
0.52	8.8	29	0.5	4.8	ZTRS520SPH932_0480 EZ802U	77	154	4080	48.00	0.32	0.52	46	–	385	5	20	106.1
ZTRS6PH9 (n_{1N} = 2000 rpm, ($F_{f2acc,max}$ = 77 kN)																	
0.28	31	46	1.9	1.5	ZTRS620SPH932_0480 EZ805U	71	141	4500	48.00	0.39	0.63	56	–	357	6	20	127.3
0.32	27	41	2.0	1.8	ZTRS620SPH932_0420 EZ805U	71	141	4500	42.00	0.44	0.71	56	–	358	6	20	127.3
0.33	26	39	2.3	1.7	ZTRS620SPH932_0400 EZ805U	72	145	4610	40.00	0.47	0.75	56	–	353	6	20	127.3
0.42	20	31	2.3	2.3	ZTRS620SPH932_0320 EZ805U	72	145	4610	32.00	0.58	0.94	56	–	360	6	20	127.3
0.44	19	29	2.4	2.5	ZTRS620SPH932_0300 EZ805U	71	141	4500	30.00	0.56	0.89	56	–	361	6	20	127.3
0.48	18	27	2.5	2.6	ZTRS620SPH932_0280 EZ805U	77	150	4920	28.00	0.67	1.07	56	–	364	6	20	127.3
0.56	15	23	2.7	2.9	ZTRS620SPH932_0240 EZ805U	71	141	4500	24.00	0.61	0.97	56	–	362	6	20	127.3

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTRS6PH9 (n_{1N} = 2000 rpm, ($F_{f2acc,max}$ = 77 kN)																	
0.67	13	19	3.0	3.3	ZTRS620SPH932_0200 EZ805U	60	150	3810	20.00	0.83	1.33	56	–	369	6	20	127.3
0.74	11	17	3.1	3.5	ZTRS620SPH932_0180 EZ805U	54	141	3430	18.00	0.67	1.11	56	–	363	6	20	127.3
0.83	10	15	3.3	3.8	ZTRS620SPH932_0160 EZ805U	48	141	3050	16.00	0.92	1.46	56	–	372	6	20	127.3
1.11	7.7	12	3.8	4.6	ZTRS620SPH932_0120 EZ805U	36	106	2290	12.00	1.00	1.67	56	–	375	6	20	127.3
ZTRS6PH9 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 72 kN)																	
0.33	20	33	0.9	2.4	ZTRS620SPH932_0600 EZ802U	71	141	4500	60.00	0.31	0.50	56	–	354	6	20	127.3
0.33	23	42	1.0	2.0	ZTRS620SPH932_0600 EZ803U	71	141	4500	60.00	0.31	0.50	56	–	354	6	20	127.3
0.42	16	26	1.0	3.0	ZTRS620SPH932_0480 EZ802U	70	141	4460	48.00	0.39	0.63	56	–	357	6	20	127.3
0.42	19	34	1.2	2.5	ZTRS620SPH932_0480 EZ803U	71	141	4500	48.00	0.39	0.63	56	–	357	6	20	127.3
0.48	14	23	1.0	3.4	ZTRS620SPH932_0420 EZ802U	61	141	3910	42.00	0.44	0.71	56	–	358	6	20	127.3
0.48	16	30	1.2	2.8	ZTRS620SPH932_0420 EZ803U	71	141	4500	42.00	0.44	0.71	56	–	358	6	20	127.3
0.50	13	22	1.4	2.8	ZTRS620SPH932_0400 EZ802U	58	145	3720	40.00	0.47	0.75	56	–	353	6	20	127.3
0.50	16	28	1.6	2.4	ZTRS620SPH932_0400 EZ803U	72	145	4610	40.00	0.47	0.75	56	–	353	6	20	127.3
0.63	10	17	1.3	4.0	ZTRS620SPH932_0320 EZ802U	47	145	2980	32.00	0.58	0.94	56	–	360	6	20	127.3
0.63	12	23	1.6	3.4	ZTRS620SPH932_0320 EZ803U	68	145	4320	32.00	0.58	0.94	56	–	360	6	20	127.3
0.67	9.8	16	1.2	4.3	ZTRS620SPH932_0300 EZ802U	44	141	2790	30.00	0.56	0.89	56	–	361	6	20	127.3
0.67	12	21	1.5	3.6	ZTRS620SPH932_0300 EZ803U	64	141	4050	30.00	0.56	0.89	56	–	361	6	20	127.3
0.71	9.1	15	1.3	4.5	ZTRS620SPH932_0280 EZ802U	41	150	2600	28.00	0.67	1.07	56	–	364	6	20	127.3
0.71	11	20	1.5	3.7	ZTRS620SPH932_0280 EZ803U	59	150	3780	28.00	0.67	1.07	56	–	364	6	20	127.3
0.83	7.8	13	1.4	4.9	ZTRS620SPH932_0240 EZ802U	35	141	2230	24.00	0.61	0.97	56	–	362	6	20	127.3
0.83	9.3	17	1.7	4.1	ZTRS620SPH932_0240 EZ803U	51	141	3240	24.00	0.61	0.97	56	–	362	6	20	127.3
1.00	7.8	14	1.8	4.7	ZTRS620SPH932_0200 EZ803U	42	150	2700	20.00	0.83	1.33	56	–	369	6	20	127.3
ZTRS6PH9 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 71 kN)																	
0.50	9.2	30	0.4	5.0	ZTRS620SPH932_0600 EZ802U	71	141	4500	60.00	0.31	0.50	56	–	354	6	20	127.3
ZTRS8PH9 (n_{1N} = 2000 rpm, ($F_{f2acc,max}$ = 79 kN)																	
0.28	31	46	1.9	1.5	ZTRS815SPH932_0480 EZ805U	71	141	4500	48.00	0.39	0.63	56	–	373	8	15	127.3
0.32	27	41	2.0	1.8	ZTRS815SPH932_0420 EZ805U	71	141	4500	42.00	0.44	0.71	56	–	375	8	15	127.3
0.33	26	39	2.3	1.7	ZTRS815SPH932_0400 EZ805U	72	145	4610	40.00	0.47	0.75	56	–	370	8	15	127.3
0.42	20	31	2.3	2.3	ZTRS815SPH932_0320 EZ805U	72	145	4610	32.00	0.58	0.94	56	–	377	8	15	127.3
0.44	19	29	2.4	2.5	ZTRS815SPH932_0300 EZ805U	71	141	4500	30.00	0.56	0.89	56	–	378	8	15	127.3
0.48	18	27	2.5	2.6	ZTRS815SPH932_0280 EZ805U	79	150	5000	28.00	0.67	1.07	56	–	382	8	15	127.3
0.56	15	23	2.7	2.9	ZTRS815SPH932_0240 EZ805U	71	141	4500	24.00	0.61	0.97	56	–	379	8	15	127.3
0.67	13	19	3.0	3.3	ZTRS815SPH932_0200 EZ805U	60	150	3810	20.00	0.83	1.33	56	–	387	8	15	127.3
0.74	11	17	3.1	3.5	ZTRS815SPH932_0180 EZ805U	54	141	3430	18.00	0.67	1.11	56	–	380	8	15	127.3
0.83	10	15	3.3	3.8	ZTRS815SPH932_0160 EZ805U	48	141	3050	16.00	0.92	1.46	56	–	390	8	15	127.3
1.11	7.7	12	3.8	4.6	ZTRS815SPH932_0120 EZ805U	36	106	2290	12.00	1.00	1.67	56	–	393	8	15	127.3
ZTRS8PH9 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 72 kN)																	
0.33	20	33	0.9	2.4	ZTRS815SPH932_0600 EZ802U	71	141	4500	60.00	0.31	0.50	56	–	370	8	15	127.3
0.33	23	42	1.0	2.0	ZTRS815SPH932_0600 EZ803U	71	141	4500	60.00	0.31	0.50	56	–	370	8	15	127.3
0.42	16	26	1.0	3.0	ZTRS815SPH932_0480 EZ802U	70	141	4460	48.00	0.39	0.63	56	–	373	8	15	127.3
0.42	19	34	1.2	2.5	ZTRS815SPH932_0480 EZ803U	71	141	4500	48.00	0.39	0.63	56	–	373	8	15	127.3
0.48	14	23	1.0	3.4	ZTRS815SPH932_0420 EZ802U	61	141	3910	42.00	0.44	0.71	56	–	375	8	15	127.3
0.48	16	30	1.2	2.8	ZTRS815SPH932_0420 EZ803U	71	141	4500	42.00	0.44	0.71	56	–	375	8	15	127.3
0.50	13	22	1.4	2.8	ZTRS815SPH932_0400 EZ802U	58	145	3720	40.00	0.47	0.75	56	–	370	8	15	127.3
0.50	16	28	1.6	2.4	ZTRS815SPH932_0400 EZ803U	72	145	4610	40.00	0.47	0.75	56	–	370	8	15	127.3
0.63	10	17	1.3	4.0	ZTRS815SPH932_0320 EZ802U	47	145	2980	32.00	0.58	0.94	56	–	377	8	15	127.3
0.63	12	23	1.6	3.4	ZTRS815SPH932_0320 EZ803U	68	145	4320	32.00	0.58	0.94	56	–	377	8	15	127.3
0.67	9.8	16	1.2	4.3	ZTRS815SPH932_0300 EZ802U	44	141	2790	30.00	0.56	0.89	56	–	378	8	15	127.3
0.67	12	21	1.5	3.6	ZTRS815SPH932_0300 EZ803U	64	141	4050	30.00	0.56	0.89	56	–	378	8	15	127.3
0.71	9.1	15	1.3	4.5	ZTRS815SPH932_0280 EZ802U	41	150	2600	28.00	0.67	1.07	56	–	382	8	15	127.3
0.71	11	20	1.5	3.7	ZTRS815SPH932_0280 EZ803U	59	150	3780	28.00	0.67	1.07	56	–	382	8	15	127.3
0.83	7.8	13	1.4	4.9	ZTRS815SPH932_0240 EZ802U	35	141	2230	24.00	0.61	0.97	56	–	379	8	15	127.3
0.83	9.3	17	1.7	4.1	ZTRS815SPH932_0240 EZ803U	51	141	3240	24.00	0.61	0.97	56	–	379	8	15	127.3
1.00	7.8	14	1.8	4.7	ZTRS815SPH932_0200 EZ803U	42	150	2700	20.00	0.83	1.33	56	–	387	8	15	127.3
ZTRS8PH9 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 71 kN)																	
0.50	9.2	30	0.4	5.0	ZTRS815SPH932_0600 EZ802U	71	141	4500	60.00	0.31	0.50	56	–	370	8	15	127.3
ZTRS8PH10 (n_{1N} = 2000 rpm, ($F_{f2acc,max}$ = 93 kN)																	
0.28	30	46	1.4	1.7	ZTRS819SPH1032_0600 EZ805U	86	171	6910	60.00	0.39	0.63	70	–	312	8	19	161.3
0.35	24	37	1.3	2.4	ZTRS819SPH1032_0480 EZ805U	86	171	6910	48.00	0.49	0.79	70	–	316	8	19	161.3
0.40	21	32	1.3	2.9	ZTRS819SPH1032_0420 EZ805U	93	186	7500	42.00	0.56	0.91	70	–	318	8	19	161.3
0.56	15	23	1.6	4.1	ZTRS819SPH1032_0300 EZ805U	71	186	5720	30.00	0.70	1.13	70	–	321	8	19	161.3
0.70	12	18	1.9	4.7	ZTRS819SPH1032_0240 EZ805U	57	167	4580	24.00	0.77	1.23	70	–	322	8	19	161.3
ZTRS8PH10 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 86 kN)																	
0.42	15	26	0.8	2.8	ZTRS819SPH1032_0600 EZ802U	69	171	5580	60.00	0.39	0.63	70	–	312	8	19	161.3
0.42	18	33	1.0	2.4	ZTRS819SPH1032_0600 EZ803U	86	171	6910	60.00	0.39	0.63	70	–	312	8	19	161.3

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTRS8PH10 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 86 kN)																	
0.53	12	21	0.8	4.0	ZTRS819SPH1032_0480 EZ802U	55	171	4460	48.00	0.49	0.79	70	–	316	8	19	161.3
0.53	15	27	0.9	3.4	ZTRS819SPH1032_0480 EZ803U	80	171	6470	48.00	0.49	0.79	70	–	316	8	19	161.3
0.60	13	23	0.8	4.6	ZTRS819SPH1032_0420 EZ803U	70	186	5660	42.00	0.56	0.91	70	–	318	8	19	161.3

2.3 Dimensional drawings

This chapter shows you the dimensions of rack and pinion drives with EZ synchronous servo motors.

Dimension az in the tables of dimensions applies to Atlanta gear racks. In general: az = ½ d0 + h0 + x*mn

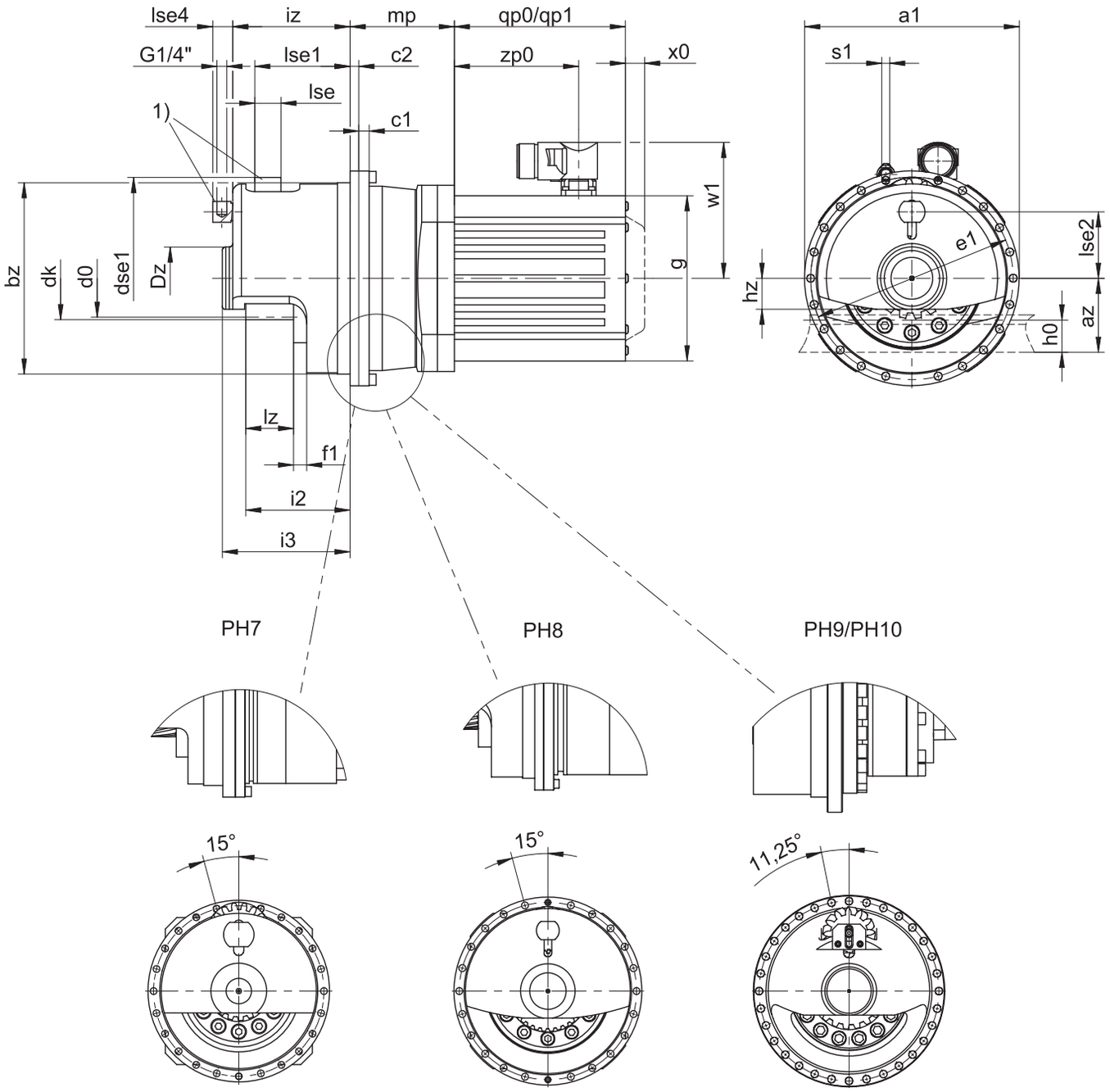
The pinion of the rack and pinion drive is helical (left-hand 19° 31 42"). The pinion gearing quality is 5.

Dimensions can exceed the specifications of ISO 2768-mK due to casting tolerances or accumulation of individual tolerances.

We reserve the right to make dimensional changes due to ongoing technical development.

You can download 3D models of our standard drives at http://configurator.stoeber.de.

Combination options and the dimensions of forced ventilated geared motors can also be found at http://configurator.stoeber.de.



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x0	Applies to encoders using an optical measuring method.	w1	Different for the One Cable Solution (OCS), see the chapter [▷ 13.4]
1)	Felt gear for lubrication (option)		

Dimensions of gear units

Type	mn	Øa1	az	Øbz	c1	c2	Ød0	Ødk	Ødse1	ØDz	Øe1	f1	i2	i3	iz	h0	hz	lz	lse	lse1	lse2	lse4	Øs1	x
ZTRS317SPH7_	3	179	53.06	156_{h7}	10	12	54.11	60.1	63.6	55	168	19.0	78.5	99.5	89.5	26	21.5	32.5	25	75.2	55.7	23.0	6.6	0.0
ZTRS332SPH8_	3	247	76.93	220_{h7}	12	10	101.86	107.9	63.6	72	233	14.0	107.0	137.0	125.0	26	35.5	42.0	30	102.6	79.5	23.0	9.0	0.0
ZTRS420SPH8_	4	247	77.44	220_{h7}	12	10	84.88	92.8	62.8	72	233	14.0	110.0	137.0	125.0	35	35.5	45.0	30	98.6	68.9	23.0	9.0	0.0
ZTRS516SPH8_	5	247	76.44	220_{h7}	12	10	84.88	94.8	78.6	72	233	14.5	120.0	147.0	135.0	34	35.5	55.0	30	109.6	76.5	23.0	9.0	0.0
ZTRS520SPH9_	5	346	87.05	300_{h7}	18	18	106.10	116.1	78.6	100	325	21.5	137.0	179.0	171.0	34	45.0	55.0	30	131.1	87.1	–	13.5	0.0
ZTRS620SPH9_	6	346	106.66	300_{h7}	18	18	127.32	139.3	94.2	100	325	21.5	147.0	189.0	181.0	43	43.5	65.0	30	131.1	104.8	–	13.5	0.0
ZTRS815SPH9_	8	346	136.66	300_{h7}	18	18	127.32	147.3	160.0	110	325	21.5	162.0	204.7	196.5	71	55.0	80.0	65	162.0	137.7	5.5	13.5	0.3
ZTRS819SPH10_	8	380	151.64	340_{h7}	20	20	161.28	177.3	160.0	110	360	21.5	212.0	260.0	251.9	71	55.0	100.0	65	211.7	152.8	–	13.5	0.0

Dimensions of motors

Type	□g	qp0	qp1	w1	x0	zp0
EZ501U	115	93	147.5	100.0	22	58.5
EZ502U	115	118	172.5	100.0	22	83.5
EZ503U	115	143	197.5	100.0	22	108.5
EZ505U	115	193	247.5	100.0	22	158.5
EZ701U	145	102	161.0	115.0	22	64.0
EZ702U	145	127	186.0	115.0	22	89.0
EZ703U	145	152	211.0	115.0	22	114.0
EZ705U	145	207	266.0	134.0	22	165.0
EZ802U	190	197	274.0	156.5	22	143.0
EZ803U	190	238	315.0	156.5	22	184.0
EZ805U	190	320	397.0	156.5	22	266.0

Dimensions of geared motors

Type	EZ5	EZ7	EZ8
	mp	mp	mp
ZTRS_PH731_	–	83.0	93.0
ZTRS_PH732_	131.0	134.0	–
ZTRS_PH831_	–	–	120.0
ZTRS_PH832_	–	171.0	181.0
ZTRS_PH932_	–	–	267.5
ZTRS_PH1032_	–	–	277.0

2.4 Type designation

2.4.1 Type designation PH7 – PH8

This chapter shows you an explanation of the type designation with the associated options.

Additional ordering information not included in the type designation can be found at the end of the chapter.

Example code

Z	TRS	3	17	S	PH	7	3	1	S	F	S	S	0050	EZ703U

Explanation

Code	Designation	Design
Z	Type	Rack and pinion drive
TRS	Design	Screwed flange pinion with supporting bearing holder
3	Module	m_n = 3 (example)
17	Number of teeth	z = 17 (example)
S SF	Toothing	Helical (left-hand 19° 31' 42") Helical (left-hand 19° 31' 42") with felt gear for lubrication
PH	Type	Planetary gear unit
7	Size	7 (example)
3	Generation	Generation 3
1 2	Stages	Single-stage Two-stage
S	Housing	Standard
F	Shaft	Flange shaft
S V	Bearing	Standard bearing Reinforced bearing (PH3 – PH5)
S R	Backlash	Standard Reduced
0050	Transmission ratio (i x 10)	i = 5 (example)
EZ703U	Motor	EZ synchronous servo motor

To complete the type designation, also specify the following in your order:

- A detailed type designation of the motor, see chapter [▶ 13]
- Position of the plug connectors, see chapter [▶ 2.5.5]
- Radial shaft seal rings at the output, made of NBR or FKM (optional), see chapter [▶ 2.6.2]
- Radial runout ≤ 10 µm (optional)
- Reverse operation of the output shaft from ±20° to ±90° for horizontal installation on request

In this catalog, you will find all information on rack and pinion drives with EZ synchronous servo motors. All input options available on request can be found in the chapter [▶ 2.5.1].

2.4.2 Type designation PH9 – PH10

This chapter shows you an explanation of the type designation with the associated options.

Additional ordering information not included in the type designation can be found at the end of the chapter.

Example code

Z	TRS	6	16	S	PH	9	3	2	F	0200	EZ802U

Explanation

Code	Designation	Design
Z	Type	Rack and pinion drive
TRS	Design	Screwed flange pinion with supporting bearing holder
6	Module	m_n = 6 (example)
16	Number of teeth	z = 16 (example)
S SF	Toothing	Helical (left-hand 19° 31' 42") Helical (left-hand 19° 31' 42") with felt gear for lubrication
PH	Type	Planetary gear unit
9	Size	9 (example)
3	Generation	Generation 3
2	Stages	Two-stage
F	Shaft	Flange shaft
0200	Transmission ratio (i x 10)	i = 20 (example)
EZ802U	Motor	EZ synchronous servo motor

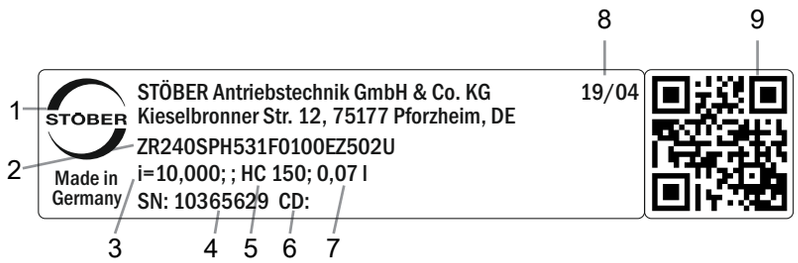
To complete the type designation, also specify the following in your order:

- A detailed type designation of the motor, see chapter [▶ 13]
- Position of the plug connectors, see chapter [▶ 2.5.5]
- Radial shaft seal rings at the output, made of NBR or FKM (optional), see chapter [▶ 2.6.2]
- Radial runout ≤ 10 µm (optional)
- Reverse operation of the output shaft from ±20° to ±90° for horizontal installation on request

In this catalog, you will find all information on rack and pinion drives with EZ synchronous servo motors. All input options available on request can be found in the chapter [▶ 2.5.1].

2.4.3 Nameplate

An example geared motor nameplate is explained in the figure below.



Code	Designation
1	Name of manufacturer
2	Type designation
3	Gear ratio of the gear unit
4	Serial number of the gear unit
5	Lubricant specification
6	Customer-specific data
7	Lubricant fill volume
8	Date of manufacture (year/calendar week)
9	QR code (link to product information)

2.4.3.1 Supporting documents

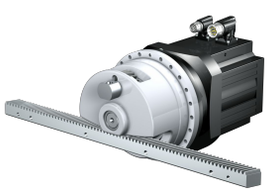
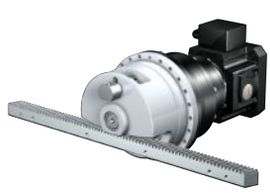
You can view or download supporting documents for the product by reading off the serial number on the nameplate of the product and entering it at the following address online:
https://id.stober.com

Alternatively, you can use a suitable mobile device to scan in the QR code on the nameplate of the product in order to be linked to the supporting documents.

2.5 Product description

2.5.1 Input options

This chapter shows you all available input options:

Synchronous servo motors	Motor adapter	KX right-angle input with MF motor adapter	K right-angle input with ME motor adapter	MB motor adapter
				
http://www.stoeber.de/en/Z_EZ	http://www.stoeber.de/en/ZTRSPHME	On request	On request	On request

2.5.2 Gear rack

The technical data specified in the Selection tables chapter applies only to gear rack combinations with the following characteristics:

The pinion of the rack and pinion drive is case-hardened and helical (left-hand 19° 31' 42"). The pinion gearing quality is 5.

The corresponding gear rack must have a right-hand design (19° 31' 42") and possess the following characteristics:

Module m_n [mm]	Minimum gear rack quality	Gear rack material
2 – 4	6	16MnCr5 inductively hardened
5	5	16MnCr5 inductively hardened
6 – 10	6	C45 inductively hardened

Also note the project configuration of the gear rack on the Atlanta pages.

2.5.3 Installation conditions

The torque and force values listed in this catalog are valid under the following conditions:

- When the gear housing is fastened on the machine side using screws of strength class 12.9
- When the gear housings are adjusted at pilot øbz. The machine-side fit must be H7.

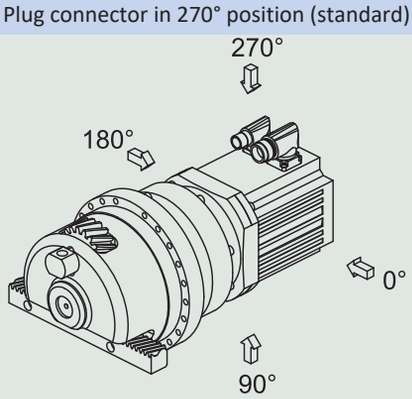
2.5.4 Lubricants

STOBER fills the gear units with the amount and type of lubricant specified on the nameplate.

You will receive lubricants for use in the food industry upon request.

2.5.5 Position of the plug connectors

Plug connector in 270° position (standard)



The plug connectors are in the 270° position as standard. Indicate variations for your rack and pinion drive in the order.

Note that the plug connectors also rotate when the gear rack is rotated to a different position.

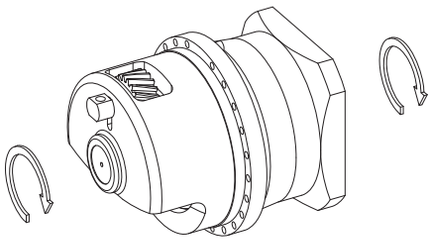
2.5.6 Other product features

Feature	Value
Max. permitted gear unit temperature (on the surface of the gear unit)	≤ 90 °C
Paint	Black RAL 9005
(ATEX) Directive 2014/34/EU (Option)	Not suitable.
Protection class: [1]	
Planetary gear units	IP65
Motor	IP56, optionally IP66
Pinion/gear rack	IPXX

[1] Observe the protection class of all the components.

2.5.7 Direction of rotation

The input and output rotate in the same direction.



2.6 Project configuration

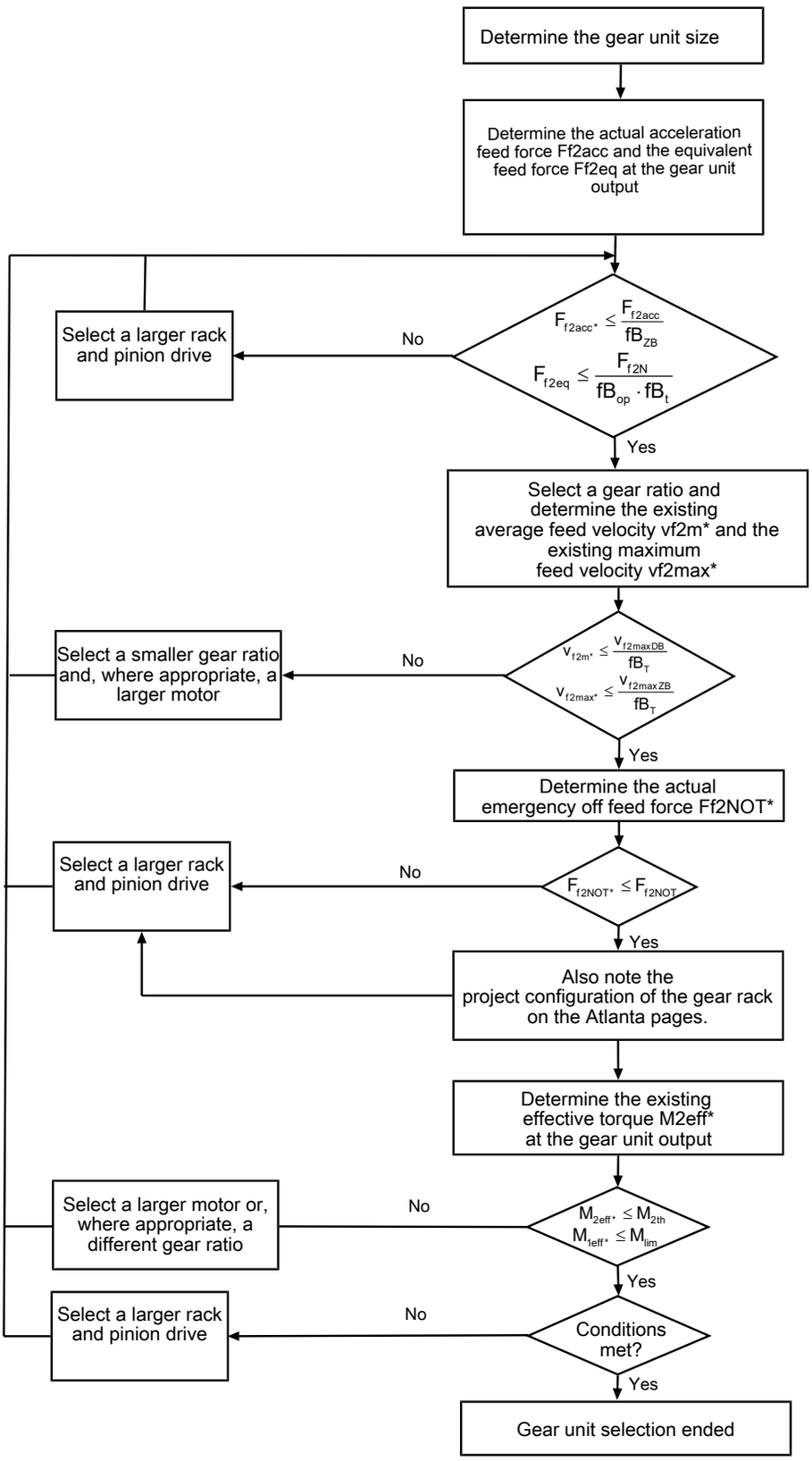
Project your drives using our SERVOsoft designing software. Download SERVOsoft for free at https://www.stoeber.de/en/ServoSoft.

Observe the limit conditions in this chapter to ensure a safe design for your drives.

The formula symbols for values actually present in the application are marked with *.

An explanation of the formula symbols can be found in the chapter [▶ 15.1].

2.6.1 Drive selection

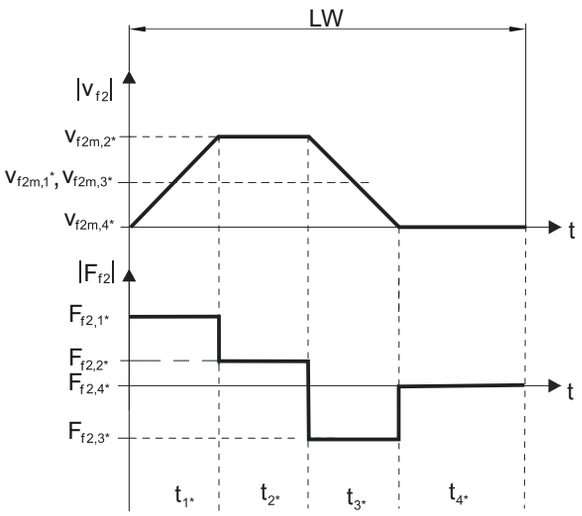


Refer to the selection tables for the values of i, $v_{f2maxDB}$, $v_{f2maxZB}$, F_{f2acc}, F_{f2N} and F_{f2NOT}.

The values for fB_T, fB_{op}, fB_t and fB_{ZB} can be found in the corresponding tables in this chapter.

Example of cyclic operation

The following calculations are based on a representation of the power taken from the output based in accordance with the following example:



Calculation of the actual maximum acceleration feed force

$$F_{f2acc*} = m* \cdot a* + F_{L*}$$

Calculation of the actual average input speed

$$n_{1m*} = \frac{v_{f2m*} \cdot i}{d_0 \cdot \pi}$$

$$v_{f2m*} = \frac{\left|v_{f2m,1*}\right| \cdot t_{1*} + \ldots + \left|v_{f2m,n*}\right| \cdot t_{n*}}{t_{1*} + \ldots + t_{n*}}$$

If $t_{1*} + \ldots + t_{3*} \geq 6$ min, determine v_{2m*} without the rest phase t_{4*}.

The values for the ratio i can be found in the selection tables.

Calculation of the actual emergency off feed force

$$F_{f2NOT*} = m* \cdot a_{NOT*} + F_{L*}$$

Calculation of the actual equivalent feed force

$$F_{f2eq*} = \sqrt[3]{\frac{\left|v_{f2m,1*}\right| \cdot t_{1*} \cdot \left|F_{f2,1*}{}^{3}\right| + \ldots + \left|v_{f2m,n*}\right| \cdot t_{n*} \cdot \left|F_{f2,n*}{}^{3}\right|}{\left|v_{f2m,1*}\right| \cdot t_{1*} + \ldots + \left|v_{f2m,n*}\right| \cdot t_{n*}}}$$

Calculation of the thermal limit torque

Calculate the thermal limit torque M_{2th} for a duty cycle $ED_{10} > 50\%$ and the actual average input speed n_{1m*}. (At $K_{mot,th} \leq 0$ you must reduce the average input speed n_{1m*} accordingly or select another geared motor size.)

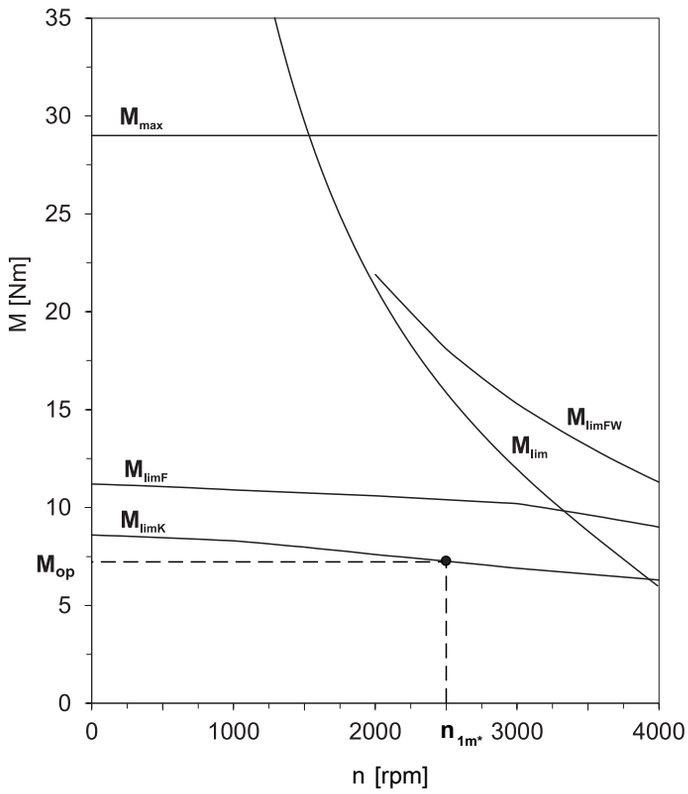
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

$$K_{mot,th} = 0{,}93 - \frac{a_{th}}{1000} \cdot fB_T \cdot \left(\frac{n_{1m*}}{1000}\right)^3$$

Refer to the selection tables for the values of i and a_{th}.

The values for fB_T can be found in the corresponding table in this chapter.

The value for the torque of the motor at operating point M_{op} with the determined average input speed n_{1m*} can be found in the motor characteristic curve of the chapter [▶ 13.3]. Note the size, nominal speed n_N and cooling type of the motor. The figure below shows an example of reading the torque M_{op} of a motor with convection cooling at the operating point.



Calculation of the actual effective torque

$$M_{2eff*} = \sqrt{\frac{t_{1*} \cdot M_{2,1*}{}^2 + \ldots + t_{n*} \cdot M_{2,n*}{}^2}{t_{1*} + \ldots + t_{n*}}}$$

$$M_{2,n*} = \frac{F_{f2,n*} \cdot d_0}{2}$$

$$M_{1eff*} = \frac{M_{2eff*}}{i \cdot \eta}$$

Operating factors

Operating mode	fB_{op}
Uniform continuous operation	1.00
Cyclic operation	1.00
Reversing load cyclic operation	1.00

Run time	fB_t
Daily runtime ≤ 8 h	1.00
Daily runtime ≤ 16 h	1.15
Daily runtime ≤ 24 h	1.20

Cyclic operation	fB_{ZB}
≤ 1000 load changes/hour (LW/h)	1.00
> 1000 load changes/hour (LW/h)	1.15

Temperature		fB_T
Motor cooling	**Surrounding temperature**	
Motor with forced ventilation	≤ 20 °C	0.9
	≤ 30 °C	1.0
	≤ 40 °C	1.15
Motor with convection cooling	≤ 20 °C	1.0
	≤ 30 °C	1.1
	≤ 40 °C	1.25

Notes

- The maximum permitted gear unit temperature (see the "Other product features" chapter) must not be exceeded, as that could result in damage.
- For braking from full speed (for example, when the power fails or when setting up the machine), note the permitted gear unit feed forces (F_{f2acc}, F_{f2NOT}) in the selection tables.

2.6.2 Recommendation for radial shaft seal rings

For a duty cycle > 60% and higher surrounding temperatures, we recommend radial shaft seal rings made of FKM at the output.

Properties:

- Excellent temperature resistance
- High chemical stability
- Very good resistance to aging
- Excellent resistance in oils and greases
- For use in the food, beverage and pharmaceutical industries

Leak-proofness

Our gear units are equipped with high-quality radial shaft seal rings and checked for leaks. However, a leak cannot be fully ruled out over the length of use of a gear unit. If you use a gear unit with goods incompatible with the lubricant, you must take measures to prevent direct contact with the gear unit lubricant in case of a leak.

2.7 Additional documentation

Additional documentation related to the product can be found at
http://www.stoeber.de/en/downloads/

Enter the ID of the documentation in the Search... field.

Documentation	ID
Operating manual for gear racks (Atlanta)	442455
Operating manual for P/PE/PH/PHQ/PHV planetary gear units and planetary geared motors	443149_en
Operating manual for EZ synchronous servo motors	443032_en

3 ZTRSPHQ rack and pinion drives

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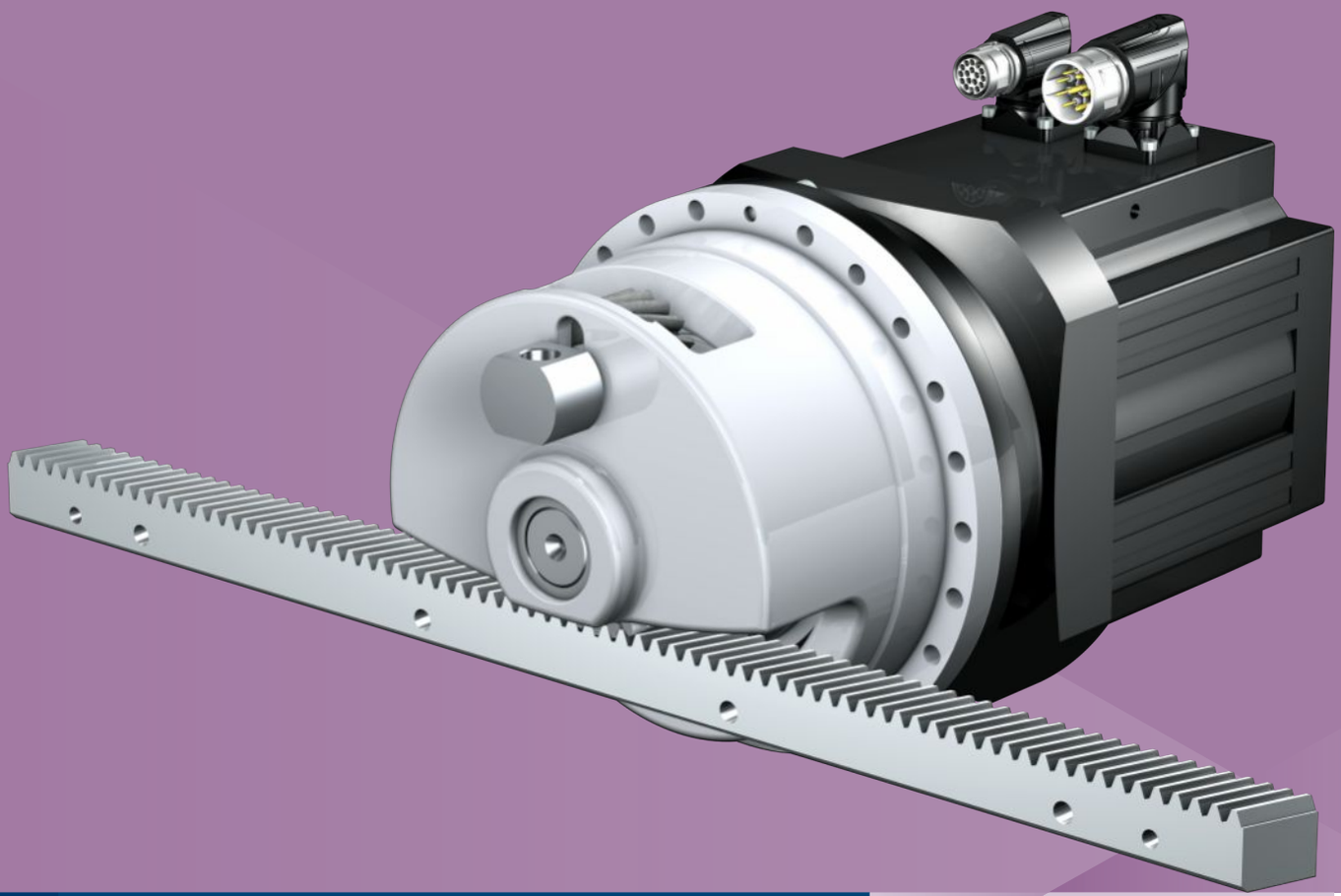


3 Rack and pinion drives

ZTRSPHQ

3.1 Overview

Quattro-Power precision planetary geared motors with supporting bearing holder

Features

Power density	★★★★★
Linear clearance	★★★★☆
Price category	€€€€€
Smooth operation	★★★★☆
Linear rigidity	★★★★★
Mass moment of inertia	★★★★☆
Ready-to-install drive solution	✓
Pinion gearing quality 5 (DIN 3962)	✓
Helical gearing	✓
Case-hardened and smoothed	✓
Radial runout ≤ 10 µm (optional)	✓
Compact and highly dynamic due to direct motor attachment	✓

Key ★☆☆☆☆ good | ★★★★★ excellent
€ Economy | €€€€€ Premium

Technical data

m_n	8 – 10 mm
z	15 – 19
F_{f2acc}	107 – 126 kN
v_{f2N}	0.12 – 0.26 m/s
Δs	69 – 70 µm

3.2 Selection tables

The technical data specified in the selection tables applies to:

- De-energized installation
- Permanent lubrication with the lubricants specified in the Atlanta product catalog
- Material combinations as described in the chapter [▶ 3.5.2]
- Installation altitudes up to 1000 m above sea level
- Surrounding temperatures from 0 °C to 40 °C
- Without consideration of the thermal limiting performance
- Drives with convection-cooled motors (e.g. EZ401**U**)

For the technical data on drives with forced ventilated motors (e.g. EZ401**B**), refer to http://configurator.stoeber.de.

For all other technical data, refer to http://configurator.stoeber.de.

An explanation of the formula symbols can be found in the chapter [▶ 15.1].

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTRS8PHQ10 (n_{1N} = 2000 rpm, ($F_{f2acc,max}$ = 124 kN)																	
0.14	59	89	0.6	1.1	ZTRS819SPHQ1033_1200 EZ805U	124	240	10000	120.0	0.16	0.25	70	–	340	8	19	161.3
0.18	47	71	0.6	1.4	ZTRS819SPHQ1033_0960 EZ805U	124	240	10000	96.00	0.19	0.31	70	–	340	8	19	161.3
ZTRS8PHQ10 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 124 kN)																	
0.12	52	87	0.2	1.3	ZTRS819SPHQ1033_2100 EZ802U	124	240	10000	210.0	0.11	0.18	70	–	340	8	19	161.3
0.15	42	70	0.3	1.6	ZTRS819SPHQ1033_1680 EZ802U	124	240	10000	168.0	0.14	0.23	70	–	340	8	19	161.3
0.15	50	90	0.3	1.3	ZTRS819SPHQ1033_1680 EZ803U	124	240	10000	168.0	0.14	0.23	70	–	340	8	19	161.3
0.17	37	62	0.3	1.8	ZTRS819SPHQ1033_1500 EZ802U	124	240	10000	150.0	0.14	0.23	70	–	340	8	19	161.3
0.17	45	81	0.3	1.5	ZTRS819SPHQ1033_1500 EZ803U	124	240	10000	150.0	0.14	0.23	70	–	340	8	19	161.3
0.21	30	50	0.3	2.0	ZTRS819SPHQ1033_1200 EZ802U	124	240	10000	120.0	0.16	0.25	70	–	340	8	19	161.3
0.21	36	65	0.4	1.7	ZTRS819SPHQ1033_1200 EZ803U	124	240	10000	120.0	0.16	0.25	70	–	340	8	19	161.3
0.26	24	40	0.3	2.4	ZTRS819SPHQ1033_0960 EZ802U	107	240	8640	96.00	0.19	0.31	70	–	340	8	19	161.3
0.26	29	52	0.4	2.0	ZTRS819SPHQ1033_0960 EZ803U	124	240	10000	96.00	0.19	0.31	70	–	340	8	19	161.3
ZTRS8PHQ10 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 124 kN)																	
0.16	28	92	0.1	2.3	ZTRS819SPHQ1033_2400 EZ802U	124	240	10000	240.0	0.10	0.16	70	–	340	8	19	161.3
0.18	25	81	0.1	2.6	ZTRS819SPHQ1033_2100 EZ802U	124	240	10000	210.0	0.11	0.18	70	–	340	8	19	161.3
0.23	20	65	0.1	3.0	ZTRS819SPHQ1033_1680 EZ802U	124	240	10000	168.0	0.14	0.23	70	–	340	8	19	161.3

3.3 Dimensional drawings

This chapter shows you the dimensions of rack and pinion drives with EZ synchronous servo motors.

Dimension az in the tables of dimensions applies to Atlanta gear racks. In general: az = ½ d0 + h0 + x*mn

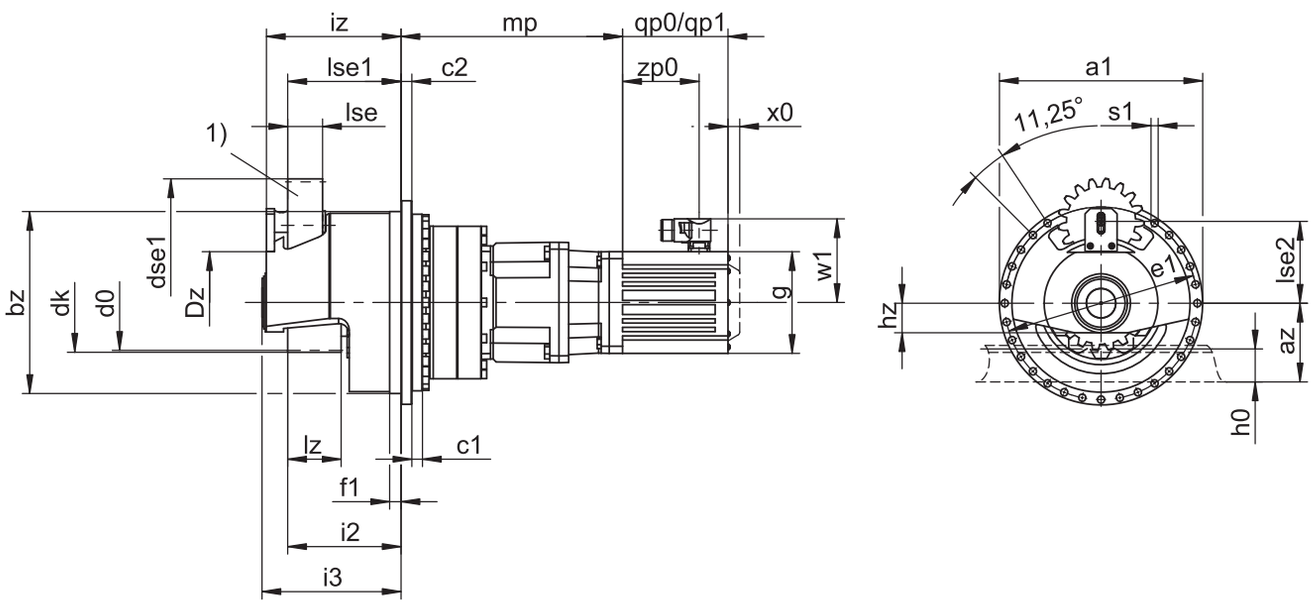
The pinion of the rack and pinion drive is helical (left-hand 19° 31 42"). The pinion gearing quality is 5.

Dimensions can exceed the specifications of ISO 2768-mK due to casting tolerances or accumulation of individual tolerances.

We reserve the right to make dimensional changes due to ongoing technical development.

You can download 3D models of our standard drives at http://configurator.stoeber.de.

Combination options and the dimensions of forced ventilated geared motors can also be found at http://configurator.stoeber.de.



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x0	Applies to encoders using an optical measuring method.	w1	Different for the One Cable Solution (OCS), see the chapter [▶ 13.4]
1)	Felt gear for lubrication (option)		

Dimensions of gear units

Type	mn	Øa1	az	Øbz	c1	c2	Ød0	Ødk	Ødse1	ØDz	Øe1	f1	i2	i3	iz	h0	hz	lz	lse	lse1	lse2	Øs1	x
ZTRS819SPHQ10_	8	380	151.64	340_{h7}	20	20	161.28	177.3	160.0	110	360	21.5	212	260	251.9	71	55	100	65	211.7	152.8	13.5	0.00

Dimensions of motors

Type	□g	qp0	qp1	w1	x0	zp0
EZ802U	190	197	274	156.5	22	143
EZ803U	190	238	315	156.5	22	184
EZ805U	190	320	397	156.5	22	266

Dimensions of geared motors

Type	EZ8
	mp
ZTRS_PHQ1033_	414

3.4 Type designation

This chapter shows you an explanation of the type designation with the associated options.

Additional ordering information not included in the type designation can be found at the end of the chapter.

Example code

Z	TRS	8	19	S	PHQ	10	3	3	F	1680	EZ802U

Explanation

Code	Designation	Design
Z	Type	Rack and pinion drive
TRS	Design	Screwed flange pinion with supporting bearing holder
8	Module	m_n = 8 (example)
19	Number of teeth	z = 19 (example)
S SF	Toothing	Helical (left-hand 19° 31' 42") Helical (left-hand 19° 31' 42") with felt gear for lubrication
PHQ	Type	Planetary gear unit
10	Size	10 (example)
3	Generation	Generation 3
2 **3**	Stages	Two-stage Three-stage
F	Shaft	Flange shaft
1680	Transmission ratio (i x 10)	i = 168 (example)
EZ802U	Motor	EZ synchronous servo motor

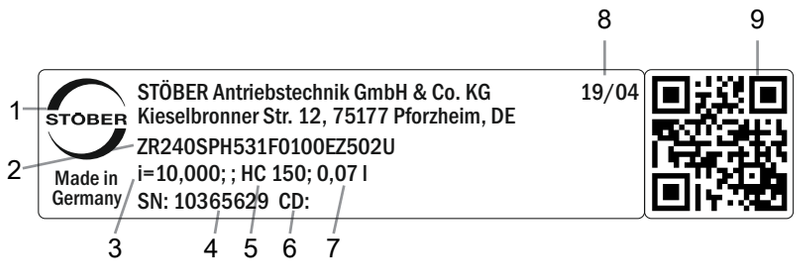
To complete the type designation, also specify the following in your order:

- A detailed type designation of the motor, see chapter [▶ 13]
- Mounting position (for three-stage gear units), see the chapter [▶ 3.5.5]
- Position of the plug connectors, see chapter [▶ 3.5.6]
- Radial shaft seal rings at the output, made of NBR or FKM (optional), see chapter [▶ 3.6.2]
- Radial runout ≤ 10 µm (optional)
- Reverse operation of the output shaft from ±20° to ±90° for horizontal installation on request

In this catalog, you will find all information on rack and pinion drives with EZ synchronous servo motors.
All input options available on request can be found in the chapter [▶ 3.5.1].

3.4.1 Nameplate

An example geared motor nameplate is explained in the figure below.



Code	Designation
1	Name of manufacturer
2	Type designation
3	Gear ratio of the gear unit
4	Serial number of the gear unit
5	Lubricant specification
6	Customer-specific data
7	Lubricant fill volume
8	Date of manufacture (year/calendar week)
9	QR code (link to product information)

3.4.1.1 Supporting documents

You can view or download supporting documents for the product by reading off the serial number on the nameplate of the product and entering it at the following address online:
https://id.stober.com

Alternatively, you can use a suitable mobile device to scan in the QR code on the nameplate of the product in order to be linked to the supporting documents.

3.5 Product description

3.5.1 Input options

This chapter shows you all available input options:

EZ synchronous servo motor	Motor adapter	K right-angle input with ME motor adapter	MB motor adapter
			
http://www.stoeber.de/en/Z_EZ	http://www.stoeber.de/en/ZTRSPHQME	On request	On request

3.5.2 Gear rack

The technical data specified in the Selection tables chapter applies only to gear rack combinations with the following characteristics:

The pinion of the rack and pinion drive is case-hardened and helical (left-hand 19° 31' 42"). The pinion gearing quality is 5.

The corresponding gear rack must have a right-hand design (19° 31' 42") and possess the following characteristics:

Module m_n [mm]	Minimum gear rack quality	Gear rack material
2 – 4	6	16MnCr5 inductively hardened
5	5	16MnCr5 inductively hardened
6 – 10	6	C45 inductively hardened

Also note the project configuration of the gear rack on the Atlanta pages.

3.5.3 Installation conditions

The torque and force values listed in this catalog are valid under the following conditions:

- When the gear housing is fastened on the machine side using screws of strength class 12.9
- When the gear housings are adjusted at pilot øbz. The machine-side fit must be H7.

3.5.4 Lubricants

STOBER fills the gear units with the amount and type of lubricant specified on the nameplate. The filling volume and the structure of the gear units depend on the mounting position.

Only install the gear units in the intended mounting position! Reposition the gear units only after consulting STOBER. Otherwise, STOBER assumes no liability for the gear units.

You will receive lubricants for use in the food industry upon request.

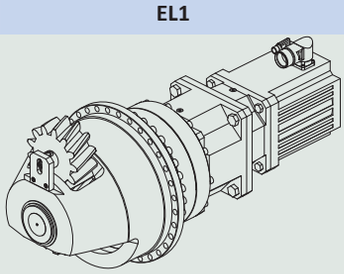
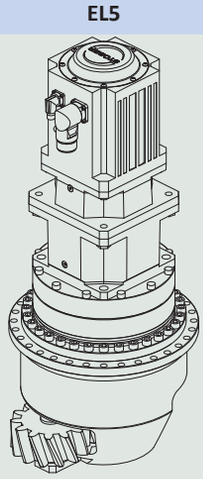
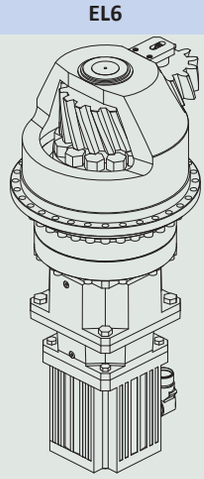
3.5.4.1 Rack and pinion drive lubrication

Make sure the rack and pinion drive has permanent lubrication with the lubricants specified in the Atlanta product catalog.

3.5.5 Mounting positions

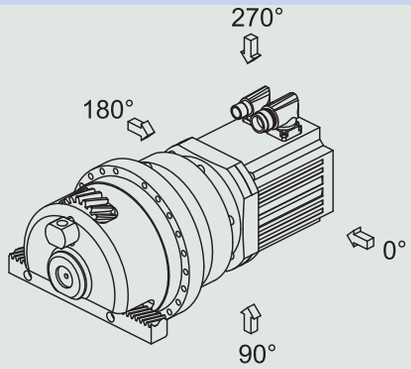
The following table shows the standard mounting positions.

Please indicate the mounting position when ordering three-stage geared motors.

EL1	EL5	EL6
		
Horizontal output	Vertical downward output	Vertical upward output

3.5.6 Position of the plug connectors

Plug connector in 270° position (standard)



The plug connectors are in the 270° position as standard. Indicate variations for your rack and pinion drive in the order.

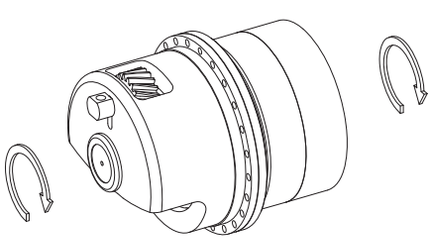
Note that the plug connectors also rotate when the gear rack is rotated to a different position.

3.5.7 Other product features

Feature	Value
Max. permitted gear unit temperature (on the surface of the gear unit)	≤ 90 °C
Paint	Black RAL 9005
(ATEX) Directive 2014/34/EU (Option)	Not suitable.
Protection class: [1]	
Planetary gear units	IP65
Motor	IP56, optionally IP66
Pinion/gear rack	IPXX

3.5.8 Direction of rotation

The input and output rotate in the same direction.



3.6 Project configuration

Project your drives using our SERVOsoft designing software. Download SERVOsoft for free at https://www.stoeber.de/en/ServoSoft.

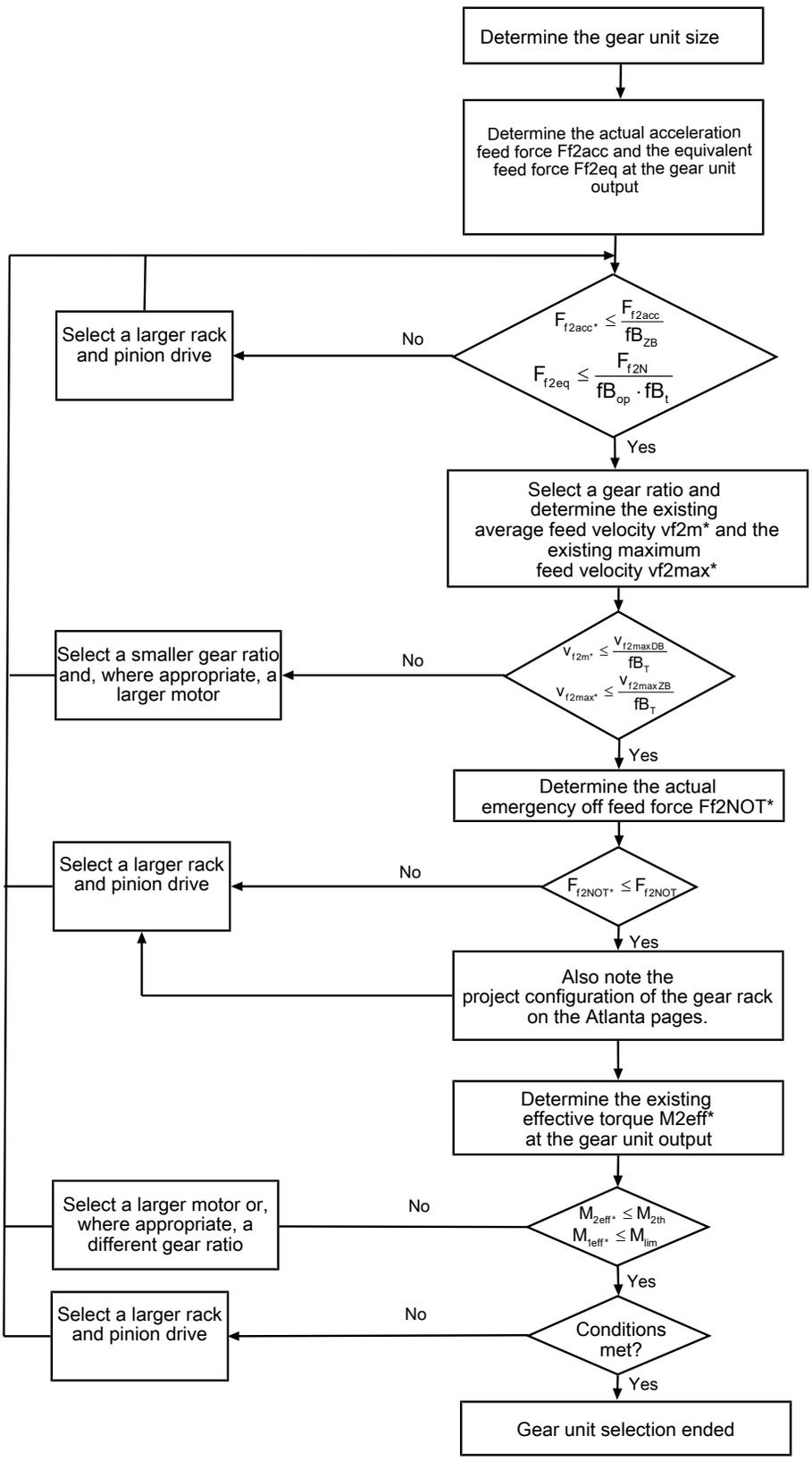
Observe the limit conditions in this chapter to ensure a safe design for your drives.

The formula symbols for values actually present in the application are marked with *.

An explanation of the formula symbols can be found in the chapter [▶ 15.1].

[1] Observe the protection class of all the components.

3.6.1 Drive selection

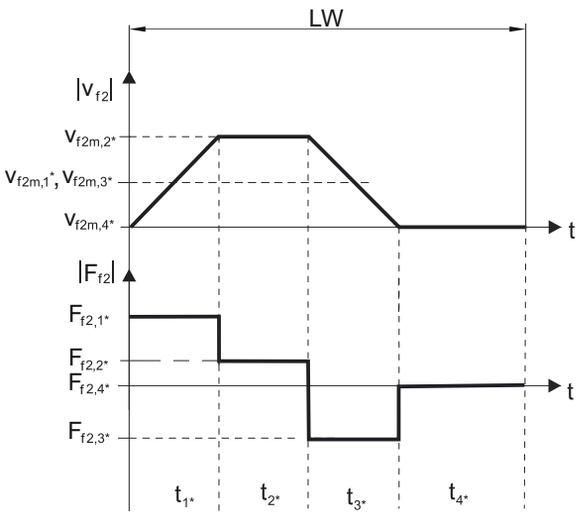


Refer to the selection tables for the values of i, $v_{f2maxDB}$, $v_{f2maxZB}$, F_{f2acc}, F_{f2N} and F_{f2NOT}.

The values for fB_T, fB_{op}, fB_t and fB_{ZB} can be found in the corresponding tables in this chapter.

Example of cyclic operation

The following calculations are based on a representation of the power taken from the output based in accordance with the following example:



Calculation of the actual maximum acceleration feed force

$$F_{f2acc*} = m* \cdot a* + F_{L*}$$

Calculation of the actual average input speed

$$n_{1m*} = \frac{v_{f2m*} \cdot i}{d_0 \cdot \pi}$$

$$v_{f2m*} = \frac{\left|v_{f2m,1*}\right| \cdot t_{1*} + \ldots + \left|v_{f2m,n*}\right| \cdot t_{n*}}{t_{1*} + \ldots + t_{n*}}$$

If $t_{1*} + \ldots + t_{3*} \geq 6$ min, determine v_{2m*} without the rest phase t_{4*}.

The values for the ratio i can be found in the selection tables.

Calculation of the actual emergency off feed force

$$F_{f2NOT*} = m* \cdot a_{NOT*} + F_{L*}$$

Calculation of the actual equivalent feed force

$$F_{f2eq*} = \sqrt[3]{\frac{\left|v_{f2m,1*}\right| \cdot t_{1*} \cdot \left|F_{f2,1*}{}^{3}\right| + \ldots + \left|v_{f2m,n*}\right| \cdot t_{n*} \cdot \left|F_{f2,n*}{}^{3}\right|}{\left|v_{f2m,1*}\right| \cdot t_{1*} + \ldots + \left|v_{f2m,n*}\right| \cdot t_{n*}}}$$

Calculation of the thermal limit torque

Calculate the thermal limit torque M_{2th} for a duty cycle $ED_{10} > 50\%$ and the actual average input speed n_{1m*}. (At $K_{mot,th} \leq 0$ you must reduce the average input speed n_{1m*} accordingly or select another geared motor size.)

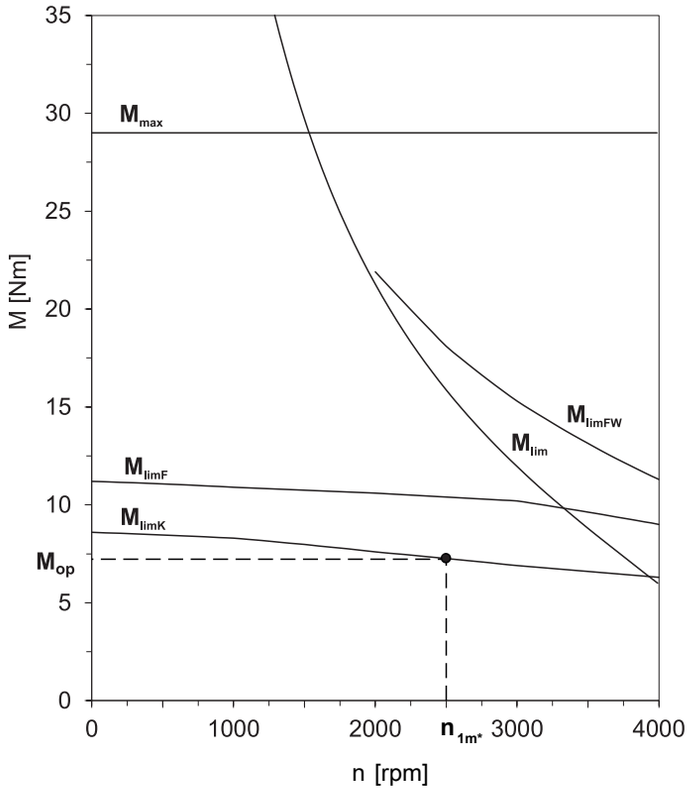
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

$$K_{mot,th} = 0{,}93 - \frac{a_{th}}{1000} \cdot fB_T \cdot \left(\frac{n_{1m*}}{1000}\right)^3$$

Refer to the selection tables for the values of i and a_{th}.

The values for fB_T can be found in the corresponding table in this chapter.

The value for the torque of the motor at operating point M_{op} with the determined average input speed n_{1m*} can be found in the motor characteristic curve of the chapter [▶ 13.3]. Note the size, nominal speed n_N and cooling type of the motor. The figure below shows an example of reading the torque M_{op} of a motor with convection cooling at the operating point.



Calculation of the actual effective torque

$$M_{2eff^*} = \sqrt{\frac{t_{1^*} \cdot M_{2,1^*}{}^2 + \ldots + t_{n^*} \cdot M_{2,n^*}{}^2}{t_{1^*} + \ldots + t_{n^*}}}$$

$$M_{2,n^*} = \frac{F_{f2,n^*} \cdot d_0}{2}$$

$$M_{1eff^*} = \frac{M_{2eff^*}}{i \cdot \eta}$$

Operating factors

Operating mode	fB_{op}
Uniform continuous operation	1.00
Cyclic operation	1.00
Reversing load cyclic operation	1.00

Run time	fB_t
Daily runtime ≤ 8 h	1.00
Daily runtime ≤ 16 h	1.15
Daily runtime ≤ 24 h	1.20

Cyclic operation	fB_{ZB}
≤ 1000 load changes/hour (LW/h)	1.00
> 1000 load changes/hour (LW/h)	1.15

Temperature		fB_T
Motor cooling	**Surrounding temperature**	
Motor with forced ventilation	≤ 20 °C	0.9
	≤ 30 °C	1.0
	≤ 40 °C	1.15
Motor with convection cooling	≤ 20 °C	1.0
	≤ 30 °C	1.1
	≤ 40 °C	1.25

Notes

- The maximum permitted gear unit temperature (see the "Other product features" chapter) must not be exceeded, as that could result in damage.
- For braking from full speed (for example, when the power fails or when setting up the machine), note the permitted gear unit feed forces (F_{f2acc}, F_{f2NOT}) in the selection tables.

3.6.2 Recommendation for radial shaft seal rings

For a duty cycle > 60% and higher surrounding temperatures, we recommend radial shaft seal rings made of FKM at the output.

Properties:

- Excellent temperature resistance
- High chemical stability
- Very good resistance to aging
- Excellent resistance in oils and greases
- For use in the food, beverage and pharmaceutical industries

Leak-proofness

Our gear units are equipped with high-quality radial shaft seal rings and checked for leaks. However, a leak cannot be fully ruled out over the length of use of a gear unit. If you use a gear unit with goods incompatible with the lubricant, you must take measures to prevent direct contact with the gear unit lubricant in case of a leak.

3.7 Additional documentation

Additional documentation related to the product can be found at
http://www.stoeber.de/en/downloads/

Enter the ID of the documentation in the Search... field.

Documentation	ID
Operating manual for gear racks (Atlanta)	442455
Operating manual for P/PA/PE/PH/PHA/PHQ/PHQA/PHV/PHVA planetary gear units and planetary geared motors	443029_en
Operating manual for EZ synchronous servo motors	443032_en

4 ZTRSPHV rack and pinion drives

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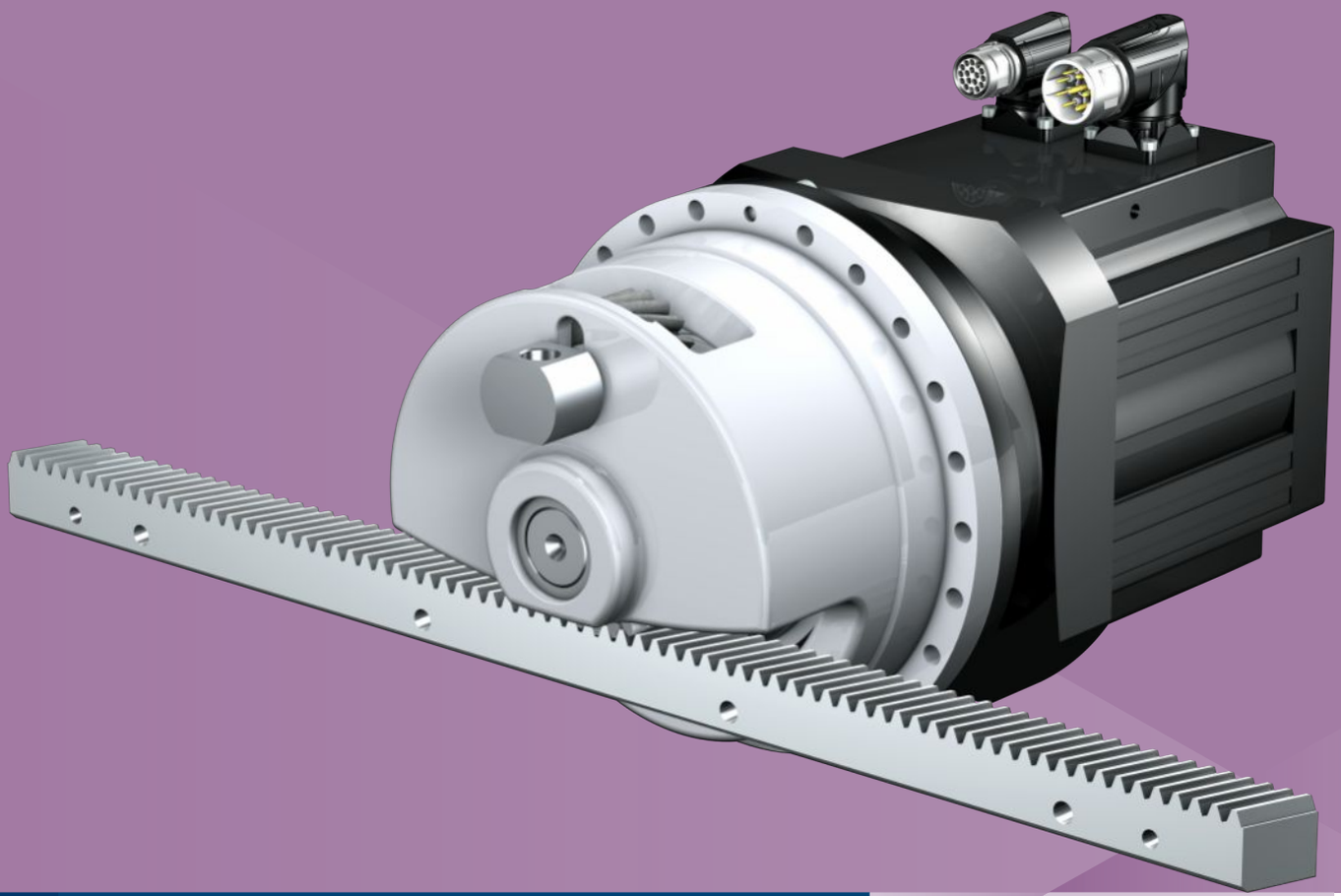


4 Rack and pinion drives

ZTRSPHV

4.1 Overview

High-performance precision planetary geared motors with supporting bearing holder

Features

Power density	★★★★★
Linear clearance	★★★★☆
Price category	€€€€€
Smooth operation	★★★★☆
Linear rigidity	★★★★★
Mass moment of inertia	★★★★☆
Ready-to-install drive solution	✓
Pinion gearing quality 5 (DIN 3962)	✓
Helical gearing	✓
Case-hardened and smoothed	✓
Radial runout ≤ 10 µm (optional)	✓
Compact and highly dynamic due to direct motor attachment	✓

Key ★☆☆☆☆ good | ★★★★★ excellent
€ Economy | €€€€€ Premium

Technical data

m_n	5 – 10 mm
z	15 – 20
F_{f2acc}	26 – 94 kN
v_{f2N}	0.13 – 0.49 m/s
Δs	44 – 70 µm

4.2 Selection tables

The technical data specified in the selection tables applies to:

- De-energized installation
- Permanent lubrication with the lubricants specified in the Atlanta product catalog
- Material combinations as described in the chapter [▶ 4.5.2]
- Installation altitudes up to 1000 m above sea level
- Surrounding temperatures from 0 °C to 40 °C
- Without consideration of the thermal limiting performance
- Drives with convection-cooled motors (e.g. EZ401**U**)

For the technical data on drives with forced ventilated motors (e.g. EZ401**B**), refer to http://configurator.stoeber.de.

For all other technical data, refer to http://configurator.stoeber.de.

An explanation of the formula symbols can be found in the chapter [▶ 15.1].

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTRS5PHV9 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 77 kN)																
0.14	15	17	0.2	3.1	ZTRS520SPHV933_1210 EZ701U	41	154	2180	121.0	0.12	0.21	46	350	5	20	106.1
0.14	25	30	0.4	1.9	ZTRS520SPHV933_1210 EZ702U	77	154	4080	121.0	0.12	0.21	46	350	5	20	106.1
0.14	34	43	0.5	1.4	ZTRS520SPHV933_1210 EZ703U	77	154	4080	121.0	0.12	0.21	46	350	5	20	106.1
0.18	11	13	0.3	4.1	ZTRS520SPHV933_0910 EZ701U	31	154	1640	91.00	0.15	0.28	46	355	5	20	106.1
0.18	19	22	0.4	2.5	ZTRS520SPHV933_0910 EZ702U	63	154	3360	91.00	0.15	0.28	46	355	5	20	106.1
0.18	25	32	0.6	1.9	ZTRS520SPHV933_0910 EZ703U	77	154	4080	91.00	0.15	0.28	46	355	5	20	106.1
0.18	33	47	0.8	1.4	ZTRS520SPHV933_0910 EZ705U	77	154	4080	91.00	0.15	0.28	46	355	5	20	106.1
0.18	34	57	0.8	1.4	ZTRS520SPHV933_0910 EZ802U	77	154	4080	91.00	0.15	0.28	46	355	5	20	106.1
0.27	23	38	1.0	2.0	ZTRS520SPHV933_0610 EZ802U	77	154	4080	61.00	0.23	0.41	46	357	5	20	106.1
0.27	28	50	1.2	1.7	ZTRS520SPHV933_0610 EZ803U	77	154	4080	61.00	0.23	0.41	46	357	5	20	106.1
ZTRS5PHV9 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 77 kN)																
0.21	25	41	0.4	1.7	ZTRS520SPHV933_1210 EZ703U	77	154	4080	121.0	0.12	0.21	46	350	5	20	106.1
0.28	16	53	0.4	2.7	ZTRS520SPHV933_0910 EZ802U	77	154	4080	91.00	0.15	0.28	46	355	5	20	106.1
0.28	19	31	0.5	2.3	ZTRS520SPHV933_0910 EZ703U	77	154	4080	91.00	0.15	0.28	46	355	5	20	106.1
0.28	25	46	0.7	1.7	ZTRS520SPHV933_0910 EZ705U	77	154	4080	91.00	0.15	0.28	46	355	5	20	106.1
0.41	11	36	0.5	4.0	ZTRS520SPHV933_0610 EZ802U	77	154	4080	61.00	0.23	0.41	46	357	5	20	106.1
ZTRS6PHV9 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 67 kN)																
0.17	13	14	0.2	3.1	ZTRS620SPHV933_1210 EZ701U	34	141	2180	121.0	0.14	0.25	56	314	6	20	127.3
0.17	21	25	0.4	1.9	ZTRS620SPHV933_1210 EZ702U	67	141	4250	121.0	0.14	0.25	56	314	6	20	127.3
0.17	28	36	0.5	1.4	ZTRS620SPHV933_1210 EZ703U	67	141	4250	121.0	0.14	0.25	56	314	6	20	127.3
0.22	9.5	11	0.3	4.1	ZTRS620SPHV933_0910 EZ701U	26	141	1640	91.00	0.18	0.33	56	320	6	20	127.3
0.22	15	19	0.4	2.5	ZTRS620SPHV933_0910 EZ702U	53	141	3360	91.00	0.18	0.33	56	320	6	20	127.3
0.22	21	27	0.6	1.9	ZTRS620SPHV933_0910 EZ703U	67	141	4250	91.00	0.18	0.33	56	320	6	20	127.3
0.22	27	39	0.8	1.4	ZTRS620SPHV933_0910 EZ705U	67	141	4250	91.00	0.18	0.33	56	320	6	20	127.3
0.22	29	48	0.8	1.4	ZTRS620SPHV933_0910 EZ802U	67	141	4250	91.00	0.18	0.33	56	320	6	20	127.3
0.33	19	32	1.0	2.0	ZTRS620SPHV933_0610 EZ802U	67	141	4250	61.00	0.27	0.49	56	322	6	20	127.3
0.33	23	42	1.2	1.7	ZTRS620SPHV933_0610 EZ803U	67	141	4250	61.00	0.27	0.49	56	322	6	20	127.3
ZTRS6PHV9 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 67 kN)																
0.25	21	34	0.4	1.7	ZTRS620SPHV933_1210 EZ703U	67	141	4250	121.0	0.14	0.25	56	314	6	20	127.3
0.25	28	51	0.6	1.3	ZTRS620SPHV933_1210 EZ705U	67	141	4250	121.0	0.14	0.25	56	314	6	20	127.3
0.33	14	44	0.4	2.7	ZTRS620SPHV933_0910 EZ802U	67	141	4250	91.00	0.18	0.33	56	320	6	20	127.3
0.33	16	26	0.5	2.3	ZTRS620SPHV933_0910 EZ703U	67	141	4250	91.00	0.18	0.33	56	320	6	20	127.3
0.33	21	39	0.7	1.7	ZTRS620SPHV933_0910 EZ705U	67	141	4250	91.00	0.18	0.33	56	320	6	20	127.3
0.49	9.1	30	0.5	4.0	ZTRS620SPHV933_0610 EZ802U	67	141	4250	61.00	0.27	0.49	56	322	6	20	127.3
ZTRS8PHV9 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 67 kN)																
0.17	13	14	0.2	3.1	ZTRS815SPHV933_1210 EZ701U	34	141	2180	121.0	0.14	0.25	56	327	8	15	127.3
0.17	21	25	0.4	1.9	ZTRS815SPHV933_1210 EZ702U	67	141	4250	121.0	0.14	0.25	56	327	8	15	127.3
0.17	28	36	0.5	1.4	ZTRS815SPHV933_1210 EZ703U	67	141	4250	121.0	0.14	0.25	56	327	8	15	127.3
0.22	9.5	11	0.3	4.1	ZTRS815SPHV933_0910 EZ701U	26	141	1640	91.00	0.18	0.33	56	334	8	15	127.3
0.22	15	19	0.4	2.5	ZTRS815SPHV933_0910 EZ702U	53	141	3360	91.00	0.18	0.33	56	334	8	15	127.3
0.22	21	27	0.6	1.9	ZTRS815SPHV933_0910 EZ703U	67	141	4250	91.00	0.18	0.33	56	334	8	15	127.3
0.22	27	39	0.8	1.4	ZTRS815SPHV933_0910 EZ705U	67	141	4250	91.00	0.18	0.33	56	334	8	15	127.3
0.22	29	48	0.8	1.4	ZTRS815SPHV933_0910 EZ802U	67	141	4250	91.00	0.18	0.33	56	334	8	15	127.3
0.33	19	32	1.0	2.0	ZTRS815SPHV933_0610 EZ802U	67	141	4250	61.00	0.27	0.49	56	336	8	15	127.3
0.33	23	42	1.2	1.7	ZTRS815SPHV933_0610 EZ803U	67	141	4250	61.00	0.27	0.49	56	336	8	15	127.3

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTRS8PHV9 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 67 kN)																
0.25	21	34	0.4	1.7	ZTRS815SPHV933_1210 EZ703U	67	141	4250	121.0	0.14	0.25	56	327	8	15	127.3
0.25	28	51	0.6	1.3	ZTRS815SPHV933_1210 EZ705U	67	141	4250	121.0	0.14	0.25	56	327	8	15	127.3
0.33	14	44	0.4	2.7	ZTRS815SPHV933_0910 EZ802U	67	141	4250	91.00	0.18	0.33	56	334	8	15	127.3
0.33	16	26	0.5	2.3	ZTRS815SPHV933_0910 EZ703U	67	141	4250	91.00	0.18	0.33	56	334	8	15	127.3
0.33	21	39	0.7	1.7	ZTRS815SPHV933_0910 EZ705U	67	141	4250	91.00	0.18	0.33	56	334	8	15	127.3
0.49	9.1	30	0.5	4.0	ZTRS815SPHV933_0610 EZ802U	67	141	4250	61.00	0.27	0.49	56	336	8	15	127.3
ZTRS8PHV10 (n_{1N} = 2000 rpm, ($F_{f2acc,max}$ = 93 kN)																
0.19	44	67	1.1	1.1	ZTRS819SPHV1033_0910 EZ805U	93	186	7500	91.00	0.23	0.42	70	291	8	19	161.3
0.28	30	45	1.3	1.7	ZTRS819SPHV1033_0610 EZ805U	93	186	7500	61.00	0.35	0.62	70	294	8	19	161.3
ZTRS8PHV10 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 93 kN)																
0.28	23	38	0.6	2.2	ZTRS819SPHV1033_0910 EZ802U	93	186	7500	91.00	0.23	0.42	70	291	8	19	161.3
0.28	27	49	0.7	1.8	ZTRS819SPHV1033_0910 EZ803U	93	186	7500	91.00	0.23	0.42	70	291	8	19	161.3
0.42	18	33	0.8	2.7	ZTRS819SPHV1033_0610 EZ803U	93	186	7500	61.00	0.35	0.62	70	294	8	19	161.3
ZTRS8PHV10 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 93 kN)																
0.42	11	35	0.3	4.4	ZTRS819SPHV1033_0910 EZ802U	93	186	7500	91.00	0.23	0.42	70	291	8	19	161.3

4.3 Dimensional drawings

This chapter shows you the dimensions of rack and pinion drives with EZ synchronous servo motors.

Dimension az in the tables of dimensions applies to Atlanta gear racks. In general: az = ½ d0 + h0 + x*mn

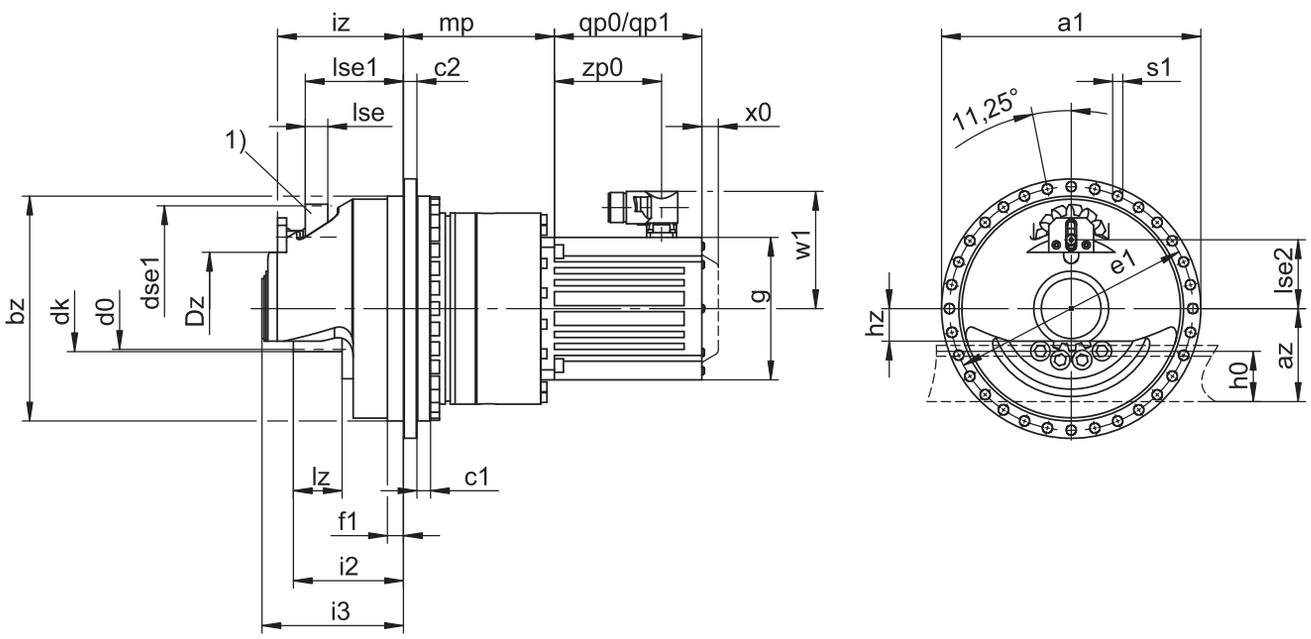
The pinion of the rack and pinion drive is helical (left-hand 19° 31 42"). The pinion gearing quality is 5.

Dimensions can exceed the specifications of ISO 2768-mK due to casting tolerances or accumulation of individual tolerances.

We reserve the right to make dimensional changes due to ongoing technical development.

You can download 3D models of our standard drives at http://configurator.stoeber.de.

Combination options and the dimensions of forced ventilated geared motors can also be found at http://configurator.stoeber.de.



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x0	Applies to encoders using an optical measuring method.	w1	Different for the One Cable Solution (OCS), see the chapter [▶ 13.4]
1)	Felt gear for lubrication (option)		

Dimensions of gear units

Type	mn	Øa1	az	Øbz	c1	c2	Ød0	Ødk	Ødse1	ØDz	Øe1	f1	i2	i3	iz	h0	hz	lz	lse	lse1	lse2	Øs1	x
ZTRS520SPHV9_	5	346	87.05	300_{h7}	18	18	106.10	116.1	78.6	100	325	21.5	137	179.0	171.0	34	45.0	55	30	131.1	87.1	13.5	0.0
ZTRS620SPHV9_	6	346	106.66	300_{h7}	18	18	127.32	139.3	94.2	100	325	21.5	147	189.0	181.0	43	43.5	65	30	131.1	104.8	13.5	0.0
ZTRS815SPHV9_	8	346	136.66	300_{h7}	18	18	127.32	147.3	160.0	110	325	21.5	162	204.7	196.5	71	55.0	80	65	162.0	137.7	13.5	0.3
ZTRS819SPHV10_	8	380	151.64	340_{h7}	20	20	161.28	177.3	160.0	110	360	21.5	212	260.0	251.9	71	55.0	100	65	211.7	152.8	13.5	0.0

Dimensions of motors

Type	□g	qp0	qp1	w1	x0	zp0
EZ701U	145	102	161	115.0	22	64
EZ702U	145	127	186	115.0	22	89
EZ703U	145	152	211	115.0	22	114
EZ705U	145	207	266	134.0	22	165
EZ802U	190	197	274	156.5	22	143
EZ803U	190	238	315	156.5	22	184
EZ805U	190	320	397	156.5	22	266

Dimensions of geared motors

Type	EZ7	EZ8
	mp	mp
ZTRS_PHV933_	189.5	201.5
ZTRS_PHV1033_	–	211.5

4.4 Type designation

This chapter shows you an explanation of the type designation with the associated options.

Additional ordering information not included in the type designation can be found at the end of the chapter.

Example code

Z	TRS	6	20	S	PHV	9	3	3	F	0910	EZ703U

Explanation

Code	Designation	Design
Z	Type	Rack and pinion drive
TRS	Design	Screwed flange pinion with supporting bearing holder
6	Module	m_n = 6 (example)
20	Number of teeth	z = 20 (example)
S SF	Toothing	Helical (left-hand 19° 31' 42") Helical (left-hand 19° 31' 42") with felt gear for lubrication
PHV	Type	Planetary gear unit
9	Size	9 (example)
3	Generation	Generation 3
3	Stages	Three-stage
F	Shaft	Flange shaft
0910	Transmission ratio (i x 10)	i = 91 (example)
EZ703U	Motor	EZ synchronous servo motor

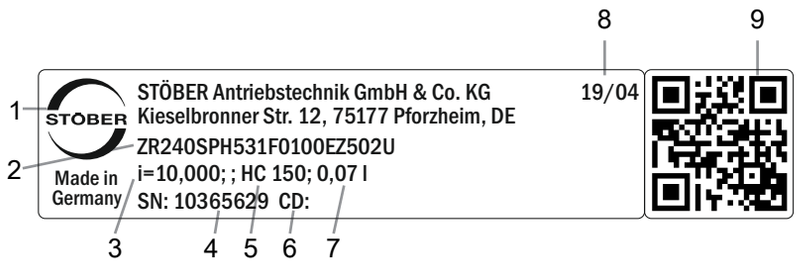
To complete the type designation, also specify the following in your order:

- A detailed type designation of the motor, see chapter [▶ 13]
- Position of the plug connectors, see chapter [▶ 4.5.5]
- Radial shaft seal rings at the output, made of NBR or FKM (optional), see chapter [▶ 4.6.2]
- Radial runout ≤ 10 µm (optional)
- Reverse operation of the output shaft from ±20° to ±90° for horizontal installation on request

In this catalog, you will find all information on rack and pinion drives with EZ synchronous servo motors. All input options available on request can be found in the chapter [▶ 4.5.1].

4.4.1 Nameplate

An example geared motor nameplate is explained in the figure below.



Code	Designation
1	Name of manufacturer
2	Type designation
3	Gear ratio of the gear unit
4	Serial number of the gear unit
5	Lubricant specification
6	Customer-specific data
7	Lubricant fill volume
8	Date of manufacture (year/calendar week)
9	QR code (link to product information)

4.4.1.1 Supporting documents

You can view or download supporting documents for the product by reading off the serial number on the nameplate of the product and entering it at the following address online:
https://id.stober.com

Alternatively, you can use a suitable mobile device to scan in the QR code on the nameplate of the product in order to be linked to the supporting documents.

4.5 Product description

4.5.1 Input options

This chapter shows you all available input options:

EZ synchronous servo motor

http://www.stoeber.de/en/Z_EZ

Motor adapter

http://www.stoeber.de/en/ZTRSPHVME

4.5.2 Gear rack

The technical data specified in the Selection tables chapter applies only to gear rack combinations with the following characteristics:

The pinion of the rack and pinion drive is case-hardened and helical (left-hand 19° 31' 42"). The pinion gearing quality is 5.

The corresponding gear rack must have a right-hand design (19° 31' 42") and possess the following characteristics:

Module m_n [mm]	Minimum gear rack quality	Gear rack material
2 – 4	6	16MnCr5 inductively hardened
5	5	16MnCr5 inductively hardened
6 – 10	6	C45 inductively hardened

Also note the project configuration of the gear rack on the Atlanta pages.

4.5.3 Installation conditions

The torque and force values listed in this catalog are valid under the following conditions:

- When the gear housing is fastened on the machine side using screws of strength class 12.9
- When the gear housings are adjusted at pilot øbz. The machine-side fit must be H7.

4.5.4 Lubricants

STOBER fills the gear units with the amount and type of lubricant specified on the nameplate.

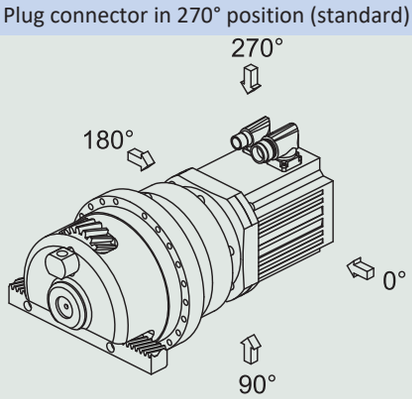
You will receive lubricants for use in the food industry upon request.

4.5.4.1 Rack and pinion drive lubrication

Make sure the rack and pinion drive has permanent lubrication with the lubricants specified in the Atlanta product catalog.

4.5.5 Position of the plug connectors

Plug connector in 270° position (standard)



The plug connectors are in the 270° position as standard. Indicate variations for your rack and pinion drive in the order.

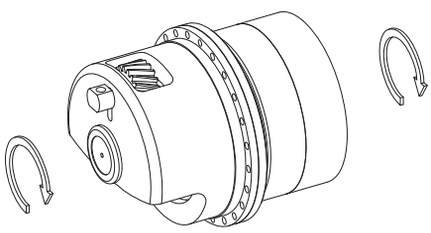
Note that the plug connectors also rotate when the gear rack is rotated to a different position.

4.5.6 Other product features

Feature	Value
Max. permitted gear unit temperature (on the surface of the gear unit)	≤ 90 °C
Paint	Black RAL 9005
(ATEX) Directive 2014/34/EU (Option)	Not suitable.
Protection class: [1]	
Planetary gear units	IP65
Motor	IP56, optionally IP66
Pinion/gear rack	IPXX

4.5.7 Direction of rotation

The input and output rotate in the same direction.



4.6 Project configuration

Project your drives using our SERVOsoft designing software. Download SERVOsoft for free at https://www.stoeber.de/en/ServoSoft.

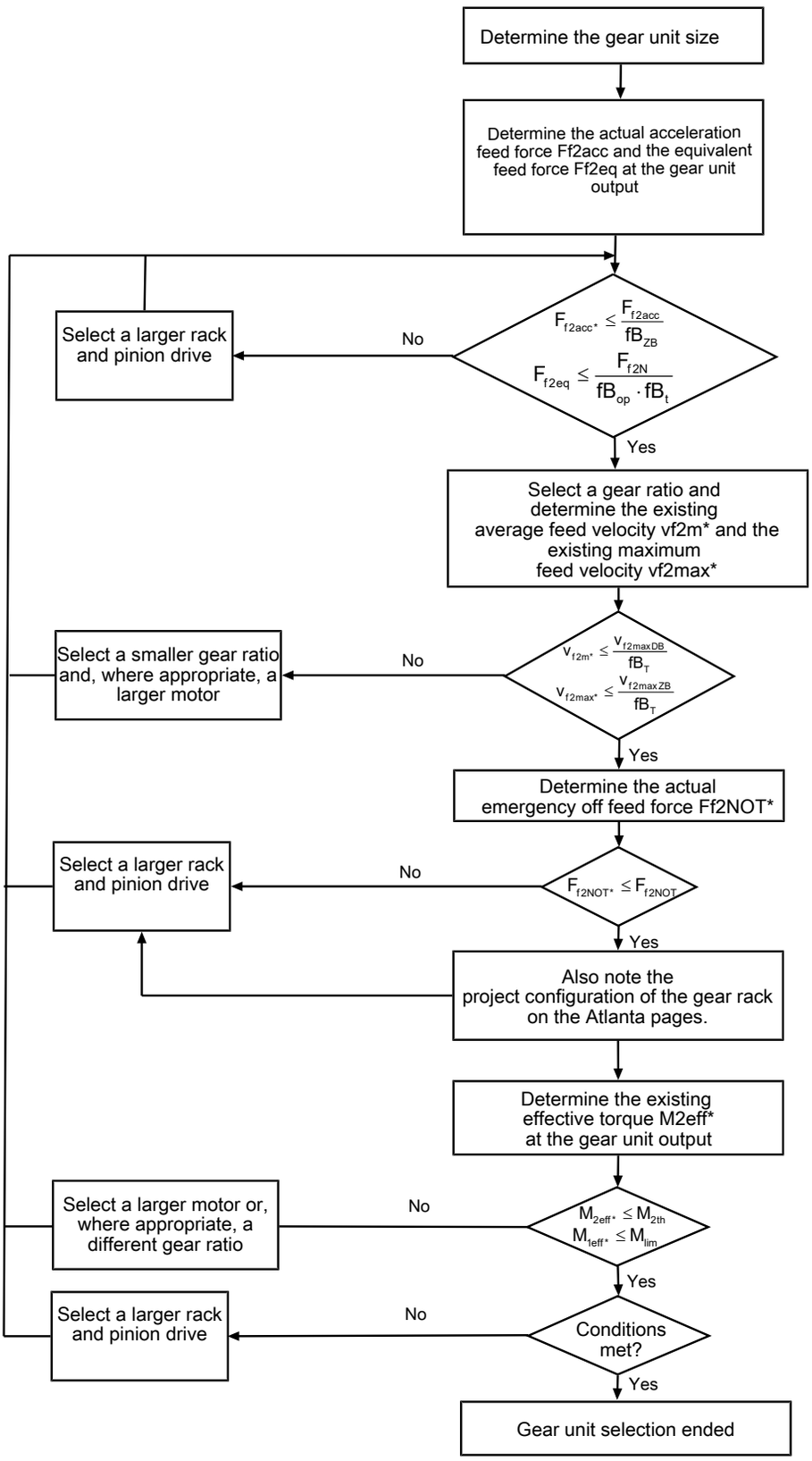
Observe the limit conditions in this chapter to ensure a safe design for your drives.

The formula symbols for values actually present in the application are marked with *.

An explanation of the formula symbols can be found in the chapter [▶ 15.1].

[1] Observe the protection class of all the components.

4.6.1 Drive selection

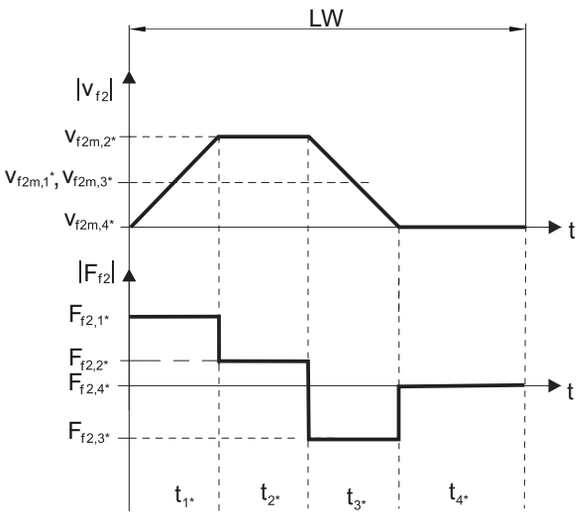


Refer to the selection tables for the values of i, $v_{f2maxDB}$, $v_{f2maxZB}$, F_{f2acc}, F_{f2N} and F_{f2NOT}.

The values for fB_T, fB_{op}, fB_t and fB_{ZB} can be found in the corresponding tables in this chapter.

Example of cyclic operation

The following calculations are based on a representation of the power taken from the output based in accordance with the following example:



Calculation of the actual maximum acceleration feed force

$$F_{f2acc*} = m* \cdot a* + F_{L*}$$

Calculation of the actual average input speed

$$n_{1m*} = \frac{v_{f2m*} \cdot i}{d_0 \cdot \pi}$$

$$v_{f2m*} = \frac{\left|v_{f2m,1*}\right| \cdot t_{1*} + \ldots + \left|v_{f2m,n*}\right| \cdot t_{n*}}{t_{1*} + \ldots + t_{n*}}$$

If $t_{1*} + \ldots + t_{3*} \geq 6$ min, determine v_{2m*} without the rest phase t_{4*}.

The values for the ratio i can be found in the selection tables.

Calculation of the actual emergency off feed force

$$F_{f2NOT*} = m* \cdot a_{NOT*} + F_{L*}$$

Calculation of the actual equivalent feed force

$$F_{f2eq*} = \sqrt[3]{\frac{\left|v_{f2m,1*}\right| \cdot t_{1*} \cdot \left|F_{f2,1*}{}^{3}\right| + \ldots + \left|v_{f2m,n*}\right| \cdot t_{n*} \cdot \left|F_{f2,n*}{}^{3}\right|}{\left|v_{f2m,1*}\right| \cdot t_{1*} + \ldots + \left|v_{f2m,n*}\right| \cdot t_{n*}}}$$

Calculation of the thermal limit torque

Calculate the thermal limit torque M_{2th} for a duty cycle $ED_{10} > 50\%$ and the actual average input speed n_{1m*}. (At $K_{mot,th} \leq 0$ you must reduce the average input speed n_{1m*} accordingly or select another geared motor size.)

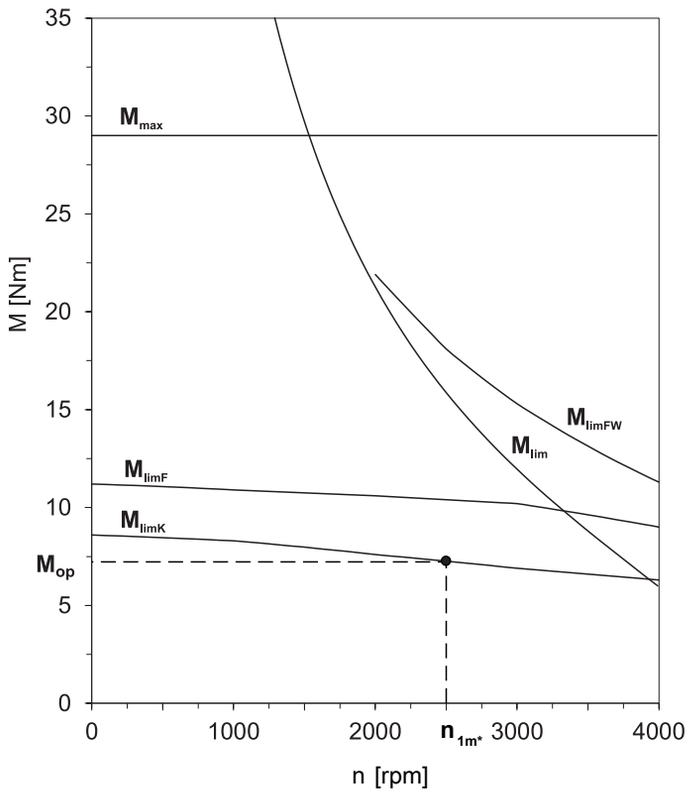
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

$$K_{mot,th} = 0{,}93 - \frac{a_{th}}{1000} \cdot fB_T \cdot \left(\frac{n_{1m*}}{1000}\right)^3$$

Refer to the selection tables for the values of i and a_{th}.

The values for fB_T can be found in the corresponding table in this chapter.

The value for the torque of the motor at operating point M_{op} with the determined average input speed n_{1m*} can be found in the motor characteristic curve of the chapter [▶ 13.3]. Note the size, nominal speed n_N and cooling type of the motor. The figure below shows an example of reading the torque M_{op} of a motor with convection cooling at the operating point.



Calculation of the actual effective torque

$$M_{2eff^*} = \sqrt{\frac{t_{1^*} \cdot M_{2,1^*}{}^2 + \ldots + t_{n^*} \cdot M_{2,n^*}{}^2}{t_{1^*} + \ldots + t_{n^*}}}$$

$$M_{2,n^*} = \frac{F_{f2,n^*} \cdot d_0}{2}$$

$$M_{1eff^*} = \frac{M_{2eff^*}}{i \cdot \eta}$$

Operating factors

Operating mode	fB_{op}
Uniform continuous operation	1.00
Cyclic operation	1.00
Reversing load cyclic operation	1.00

Run time	fB_t
Daily runtime ≤ 8 h	1.00
Daily runtime ≤ 16 h	1.15
Daily runtime ≤ 24 h	1.20

Cyclic operation	fB_{ZB}
≤ 1000 load changes/hour (LW/h)	1.00
> 1000 load changes/hour (LW/h)	1.15

Temperature		fB_T
Motor cooling	**Surrounding temperature**	
Motor with forced ventilation	≤ 20 °C	0.9
	≤ 30 °C	1.0
	≤ 40 °C	1.15
Motor with convection cooling	≤ 20 °C	1.0
	≤ 30 °C	1.1
	≤ 40 °C	1.25

Notes

- The maximum permitted gear unit temperature (see the "Other product features" chapter) must not be exceeded, as that could result in damage.
- For braking from full speed (for example, when the power fails or when setting up the machine), note the permitted gear unit feed forces (F_{f2acc}, F_{f2NOT}) in the selection tables.

4.6.2 Recommendation for radial shaft seal rings

For a duty cycle > 60% and higher surrounding temperatures, we recommend radial shaft seal rings made of FKM at the output.

Properties:

- Excellent temperature resistance
- High chemical stability
- Very good resistance to aging
- Excellent resistance in oils and greases
- For use in the food, beverage and pharmaceutical industries

Leak-proofness

Our gear units are equipped with high-quality radial shaft seal rings and checked for leaks. However, a leak cannot be fully ruled out over the length of use of a gear unit. If you use a gear unit with goods incompatible with the lubricant, you must take measures to prevent direct contact with the gear unit lubricant in case of a leak.

4.7 Additional documentation

Additional documentation related to the product can be found at
http://www.stoeber.de/en/downloads/

Enter the ID of the documentation in the Search... field.

Documentation	ID
Operating manual for gear racks (Atlanta)	442455
Operating manual for P/PA/PE/PH/PHA/PHQ/PHQA/PHV/PHVA planetary gear units and planetary geared motors	443029_en
Operating manual for EZ synchronous servo motors	443032_en

5 ZTRPH rack and pinion drives

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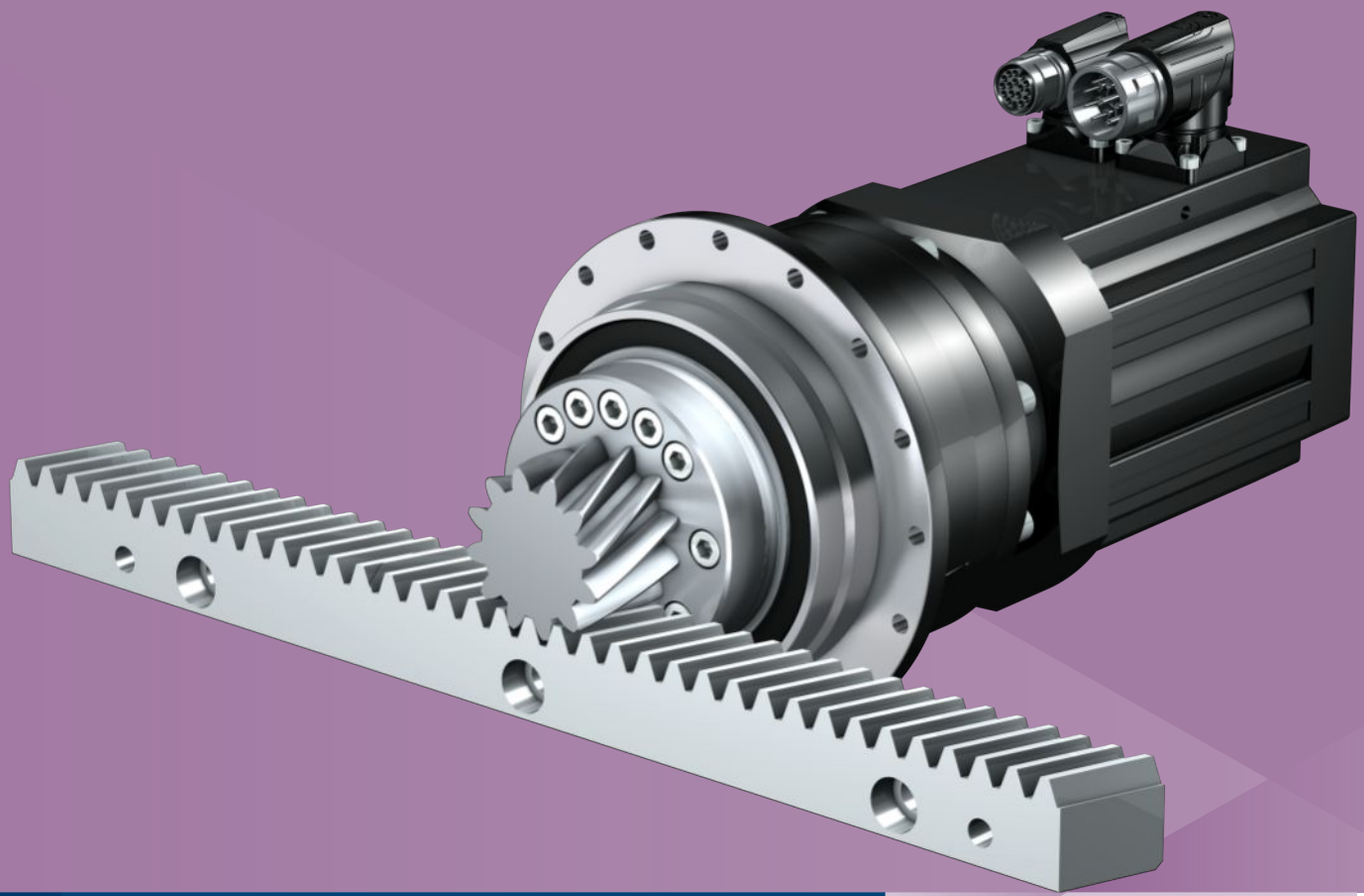


5 Rack and pinion drives

ZTRPH

5.1 Overview

High-performance precision planetary geared motors with screwed flange pinion

Features

Power density	★★★★☆
Linear clearance	★★★★★
Price category	€€€€
Smooth operation	★★★★☆
Linear rigidity	★★★★☆
Mass moment of inertia	★★★★☆
Ready-to-install drive solution	✓
Pinion gearing quality 5 (DIN 3962)	✓
Helical gearing	✓
Case-hardened and smoothed	✓
Radial runout ≤ 10 µm (optional)	✓
Reinforced output bearing (PH3 – PH5)	✓ (optional)
Compact and highly dynamic due to direct motor attachment	✓

Key ★☆☆☆☆ good | ★★★★★ excellent
€ Economy | €€€€€ Premium

Technical data

m_n	2 – 8 mm
z	12 – 32
F_{f2acc}	1.9 – 67 kN
v_{f2N}	0.1 – 4 m/s
Δs	4 – 44 µm

5.2 Selection table

The technical data specified in the selection tables applies to:

- De-energized installation
- Permanent lubrication with the lubricants specified in the Atlanta product catalog
- Material combinations as described in the chapter [▷ 5.5.2]
- Installation altitudes up to 1000 m above sea level
- Surrounding temperatures from 0 °C to 40 °C
- Without consideration of the thermal limiting performance
- Drives with convection-cooled motors (e.g. EZ401**U**)

For the technical data on drives with forced ventilated motors (e.g. EZ401**B**), refer to http://configurator.stoeber.de.

For rack and pinion drives with reduced backlash or reinforced bearings (PH3 – PH5), higher feed forces are possible. For this and all other technical data, refer to http://configurator.stoeber.de.

An explanation of the formula symbols can be found in the chapter [▷ 15.1].

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTR2PH4 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 6,7 kN)																	
0.11	2.5	2.6	0.7	1.1	ZTR216SPH432_0500 EZ301U	6.7	9.2	110	50.00	0.16	0.28	15	5	90	2	16	34.0
0.11	2.4	2.4	0.9	1.1	ZTR212SPH432_0350 EZ301U	6.7	11	85	35.00	0.17	0.31	11	4	97	2	12	25.5
0.13	2.0	2.1	0.8	1.3	ZTR216SPH432_0400 EZ301U	6.1	9.2	100	40.00	0.20	0.36	15	5	89	2	16	34.0
0.14	1.9	1.9	1.1	1.3	ZTR212SPH432_0280 EZ301U	5.7	11	73	28.00	0.21	0.38	11	4	97	2	12	25.5
0.15	1.8	1.8	0.9	1.4	ZTR216SPH432_0350 EZ301U	5.4	9.2	91	35.00	0.23	0.41	15	5	90	2	16	34.0
0.16	1.7	1.7	1.1	1.4	ZTR212SPH432_0250 EZ301U	5.1	11	65	25.00	0.24	0.43	11	4	97	2	12	25.5
0.19	1.4	1.5	1.1	1.7	ZTR216SPH432_0280 EZ301U	4.3	9.2	73	28.00	0.29	0.51	15	5	90	2	16	34.0
0.20	1.4	1.4	1.3	1.6	ZTR212SPH432_0200 EZ301U	4.1	11	52	20.00	0.27	0.53	11	4	97	2	12	25.5
0.21	1.3	1.3	1.1	1.8	ZTR216SPH432_0250 EZ301U	3.8	9.2	65	25.00	0.32	0.57	15	5	91	2	16	34.0
0.21	2.2	2.3	1.9	1.1	ZTR216SPH432_0250 EZ302U	6.7	9.2	110	25.00	0.32	0.57	15	5	91	2	16	34.0
0.25	1.1	1.1	1.5	1.8	ZTR212SPH432_0160 EZ301U	3.3	11	42	16.00	0.33	0.67	11	4	96	2	12	25.5
0.25	1.9	2.0	2.6	1.1	ZTR212SPH432_0160 EZ302U	5.8	11	74	16.00	0.33	0.67	11	4	96	2	12	25.5
0.27	1.0	1.0	1.3	2.1	ZTR216SPH432_0200 EZ301U	3.1	9.2	52	20.00	0.36	0.71	15	5	90	2	16	34.0
0.27	1.7	1.8	2.2	1.2	ZTR216SPH432_0200 EZ302U	5.5	9.2	93	20.00	0.36	0.71	15	5	90	2	16	34.0
0.33	0.8	0.8	1.5	2.4	ZTR216SPH432_0160 EZ301U	2.5	9.2	42	16.00	0.44	0.89	15	5	90	2	16	34.0
0.33	1.4	1.5	2.6	1.4	ZTR216SPH432_0160 EZ302U	4.4	9.2	74	16.00	0.44	0.89	15	5	90	2	16	34.0
0.33	1.8	1.9	3.4	1.1	ZTR216SPH432_0160 EZ303U	6.1	9.2	100	16.00	0.44	0.89	15	5	90	2	16	34.0
0.53	1.6	1.7	2.4	1.1	ZTR216SPH431_0100 EZ401U	4.8	9.2	82	10.00	0.62	1.24	15	5	81	2	16	34.0
0.57	1.5	1.6	3.0	1.0	ZTR212SPH431_0070 EZ401U	4.5	11	57	7.000	0.61	1.14	11	4	96	2	12	25.5
0.80	1.1	1.1	4.5	1.3	ZTR212SPH431_0050 EZ401U	3.2	11	41	5.000	0.80	1.60	11	4	99	2	12	25.5
1.00	0.8	0.9	5.9	1.5	ZTR212SPH431_0040 EZ401U	2.6	11	33	4.000	0.87	1.67	11	4	99	2	12	25.5
1.07	0.8	0.8	4.5	1.7	ZTR216SPH431_0050 EZ401U	2.4	9.2	41	5.000	1.07	2.13	15	5	93	2	16	34.0
1.07	1.2	1.3	6.9	1.1	ZTR216SPH431_0050 EZ501U	4.5	9.2	77	5.000	1.07	2.13	15	5	93	2	16	34.0
1.07	1.3	1.5	7.5	1.0	ZTR216SPH431_0050 EZ402U	4.5	9.2	77	5.000	1.07	2.13	15	5	93	2	16	34.0
1.33	0.6	0.7	5.9	2.0	ZTR216SPH431_0040 EZ401U	1.9	9.2	33	4.000	1.16	2.22	15	5	95	2	16	34.0
1.33	1.0	1.1	9.0	1.3	ZTR216SPH431_0040 EZ501U	3.6	9.2	61	4.000	1.16	2.22	15	5	95	2	16	34.0
1.33	1.1	1.2	9.8	1.2	ZTR216SPH431_0040 EZ402U	3.6	9.2	61	4.000	1.16	2.22	15	5	95	2	16	34.0
ZTR2PH4 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 6,1 kN)																	
0.27	2.0	2.1	1.0	1.1	ZTR216SPH432_0400 EZ301U	6.1	9.2	100	40.00	0.20	0.36	15	5	89	2	16	34.0
0.29	1.8	1.9	1.2	1.0	ZTR212SPH432_0280 EZ301U	5.7	11	73	28.00	0.21	0.38	11	4	97	2	12	25.5
0.31	1.7	1.8	1.0	1.2	ZTR216SPH432_0350 EZ301U	5.4	9.2	91	35.00	0.23	0.41	15	5	90	2	16	34.0
0.32	1.6	1.7	1.2	1.1	ZTR212SPH432_0250 EZ301U	5.1	11	65	25.00	0.24	0.43	11	4	97	2	12	25.5
0.38	1.4	1.5	1.2	1.4	ZTR216SPH432_0280 EZ301U	4.3	9.2	73	28.00	0.29	0.51	15	5	90	2	16	34.0
0.40	1.3	1.4	1.4	1.3	ZTR212SPH432_0200 EZ301U	4.1	11	52	20.00	0.27	0.53	11	4	97	2	12	25.5
0.43	1.2	1.3	1.2	1.5	ZTR216SPH432_0250 EZ301U	3.8	9.2	65	25.00	0.32	0.57	15	5	91	2	16	34.0
0.50	1.0	1.1	1.7	1.5	ZTR212SPH432_0160 EZ301U	3.3	11	42	16.00	0.33	0.67	11	4	96	2	12	25.5
0.53	1.0	1.0	1.4	1.7	ZTR216SPH432_0200 EZ301U	3.1	9.2	52	20.00	0.36	0.71	15	5	90	2	16	34.0
0.53	1.6	1.8	2.3	1.0	ZTR216SPH432_0200 EZ302U	5.5	9.2	93	20.00	0.36	0.71	15	5	90	2	16	34.0
0.67	0.8	0.8	1.7	2.0	ZTR216SPH432_0160 EZ301U	2.5	9.2	42	16.00	0.44	0.89	15	5	90	2	16	34.0
0.67	1.3	1.5	2.8	1.2	ZTR216SPH432_0160 EZ302U	4.4	9.2	74	16.00	0.44	0.89	15	5	90	2	16	34.0
1.07	1.3	1.6	2.5	1.0	ZTR216SPH431_0100 EZ401U	4.8	9.2	82	10.00	0.62	1.24	15	5	81	2	16	34.0
1.52	0.9	1.1	3.1	1.3	ZTR216SPH431_0070 EZ401U	3.4	9.2	57	7.000	0.81	1.52	15	5	89	2	16	34.0
1.60	0.9	1.1	4.6	1.2	ZTR212SPH431_0050 EZ401U	3.2	11	41	5.000	0.80	1.60	11	4	99	2	12	25.5
2.13	1.0	1.2	6.9	1.1	ZTR216SPH431_0050 EZ501U	4.5	9.2	77	5.000	1.07	2.13	15	5	93	2	16	34.0
2.13	1.0	1.4	7.1	1.1	ZTR216SPH431_0050 EZ402U	4.5	9.2	77	5.000	1.07	2.13	15	5	93	2	16	34.0

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTR2PH5 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 11 kN)																	
0.22	3.7	4.0	1.2	1.0	ZTR223SPH532_0350 EZ401U	11	14	260	35.00	0.29	0.58	21	7	89	2	23	48.8
0.25	3.2	3.5	1.4	1.0	ZTR219SPH532_0250 EZ401U	9.8	15	200	25.00	0.31	0.63	18	6	93	2	19	40.3
0.27	3.0	3.2	1.4	1.2	ZTR223SPH532_0280 EZ401U	9.1	14	220	28.00	0.37	0.73	21	7	88	2	23	48.8
0.31	2.7	2.9	1.4	1.3	ZTR223SPH532_0250 EZ401U	8.1	14	200	25.00	0.38	0.77	21	7	90	2	23	48.8
0.32	2.6	2.8	1.6	1.2	ZTR219SPH532_0200 EZ401U	7.8	15	160	20.00	0.37	0.74	18	6	93	2	19	40.3
0.40	2.1	2.2	2.0	1.4	ZTR219SPH532_0160 EZ401U	6.3	15	130	16.00	0.46	0.92	18	6	93	2	19	40.3
0.48	2.6	2.9	3.0	1.1	ZTR223SPH532_0160 EZ501U	9.8	14	240	16.00	0.56	1.12	21	7	89	2	23	48.8
0.48	2.9	3.2	3.3	1.0	ZTR223SPH532_0160 EZ402U	9.8	14	240	16.00	0.56	1.12	21	7	89	2	23	48.8
0.63	2.0	2.2	1.7	1.2	ZTR219SPH531_0100 EZ501U	7.6	15	150	10.00	0.70	1.37	18	6	87	2	19	40.3
0.91	1.4	1.6	2.1	1.5	ZTR219SPH531_0070 EZ501U	5.3	15	110	7.000	0.91	1.81	18	6	92	2	19	40.3
1.10	2.0	2.2	3.6	1.1	ZTR223SPH531_0070 EZ502U	8.5	14	210	7.000	1.10	2.19	21	7	88	2	23	48.8
1.10	2.0	2.3	3.6	1.1	ZTR223SPH531_0070 EZ701U	5.5	14	130	7.000	1.10	2.19	21	7	88	2	23	48.8
1.27	1.0	1.1	3.1	1.9	ZTR219SPH531_0050 EZ501U	3.8	15	77	5.000	1.06	2.32	18	6	95	2	19	40.3
1.27	1.8	1.9	5.3	1.1	ZTR219SPH531_0050 EZ502U	7.4	15	150	5.000	1.06	2.32	18	6	95	2	19	40.3
1.27	1.8	2.0	5.3	1.1	ZTR219SPH531_0050 EZ701U	4.8	15	96	5.000	1.06	2.32	18	6	95	2	19	40.3
1.53	0.8	0.9	3.1	2.3	ZTR223SPH531_0050 EZ501U	3.1	14	77	5.000	1.28	2.81	21	7	92	2	23	48.8
1.53	1.5	1.6	5.3	1.4	ZTR223SPH531_0050 EZ502U	6.1	14	150	5.000	1.28	2.81	21	7	92	2	23	48.8
1.53	1.5	1.6	5.3	1.4	ZTR223SPH531_0050 EZ701U	3.9	14	96	5.000	1.28	2.81	21	7	92	2	23	48.8
1.53	1.9	2.2	7.0	1.0	ZTR223SPH531_0050 EZ503U	8.5	14	210	5.000	1.28	2.81	21	7	92	2	23	48.8
1.58	0.8	0.9	4.1	2.2	ZTR219SPH531_0040 EZ501U	3.0	15	61	4.000	1.16	2.64	18	6	95	2	19	40.3
1.58	1.4	1.5	7.0	1.3	ZTR219SPH531_0040 EZ502U	5.9	15	120	4.000	1.16	2.64	18	6	95	2	19	40.3
1.58	1.4	1.6	7.0	1.3	ZTR219SPH531_0040 EZ701U	3.8	15	77	4.000	1.16	2.64	18	6	95	2	19	40.3
1.92	0.7	0.7	4.1	2.7	ZTR223SPH531_0040 EZ501U	2.5	14	61	4.000	1.41	3.19	21	7	92	2	23	48.8
1.92	1.2	1.3	7.0	1.6	ZTR223SPH531_0040 EZ502U	4.9	14	120	4.000	1.41	3.19	21	7	92	2	23	48.8
1.92	1.2	1.3	7.0	1.6	ZTR223SPH531_0040 EZ701U	3.1	14	77	4.000	1.41	3.19	21	7	92	2	23	48.8
1.92	1.5	1.7	9.1	1.2	ZTR223SPH531_0040 EZ503U	6.8	14	170	4.000	1.41	3.19	21	7	92	2	23	48.8
ZTR2PH5 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 11 kN)																	
2.88	1.5	2.4	10	1.1	ZTR223SPH531_0040 EZ505U	11	14	260	4.000	1.41	3.19	21	7	92	2	23	48.8
ZTR2PH5 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 11 kN)																	
0.51	2.7	3.2	1.4	1.0	ZTR219SPH532_0250 EZ401U	9.8	15	200	25.00	0.31	0.63	18	6	93	2	19	40.3
0.55	2.5	3.0	1.4	1.1	ZTR223SPH532_0280 EZ401U	9.1	14	220	28.00	0.37	0.73	21	7	88	2	23	48.8
0.61	2.2	2.7	1.4	1.2	ZTR223SPH532_0250 EZ401U	8.1	14	200	25.00	0.38	0.77	21	7	90	2	23	48.8
0.63	2.1	2.6	1.6	1.2	ZTR219SPH532_0200 EZ401U	7.8	15	160	20.00	0.37	0.74	18	6	93	2	19	40.3
0.79	1.7	2.1	1.9	1.4	ZTR219SPH532_0160 EZ401U	6.3	15	130	16.00	0.46	0.92	18	6	93	2	19	40.3
0.96	2.1	2.7	2.8	1.1	ZTR223SPH532_0160 EZ501U	9.8	14	240	16.00	0.56	1.12	21	7	89	2	23	48.8
0.96	2.1	3.0	2.9	1.1	ZTR223SPH532_0160 EZ402U	9.8	14	240	16.00	0.56	1.12	21	7	89	2	23	48.8
1.27	1.6	2.1	1.7	1.2	ZTR219SPH531_0100 EZ501U	7.6	15	150	10.00	0.70	1.37	18	6	87	2	19	40.3
1.81	1.1	1.5	2.1	1.5	ZTR219SPH531_0070 EZ501U	5.3	15	110	7.000	0.91	1.81	18	6	92	2	19	40.3
1.81	1.7	2.6	3.2	1.0	ZTR219SPH531_0070 EZ502U	10	15	210	7.000	0.91	1.81	18	6	92	2	19	40.3
1.81	1.7	2.6	3.2	1.0	ZTR219SPH531_0070 EZ701U	6.7	15	130	7.000	0.91	1.81	18	6	92	2	19	40.3
2.19	0.9	1.2	2.1	1.9	ZTR223SPH531_0070 EZ501U	4.4	14	110	7.000	1.10	2.19	21	7	88	2	23	48.8
2.19	1.4	2.1	3.2	1.2	ZTR223SPH531_0070 EZ502U	8.5	14	210	7.000	1.10	2.19	21	7	88	2	23	48.8
2.19	1.4	2.2	3.2	1.2	ZTR223SPH531_0070 EZ701U	5.5	14	130	7.000	1.10	2.19	21	7	88	2	23	48.8
2.19	1.7	2.9	3.8	1.0	ZTR223SPH531_0070 EZ503U	11	14	260	7.000	1.10	2.19	21	7	88	2	23	48.8
ZTR3PH5 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 9,9 kN)																	
0.25	3.3	3.5	1.4	1.0	ZTR314SPH532_0280 EZ401U	9.9	14	220	28.00	0.33	0.67	19	6	86	3	14	44.6
0.28	2.9	3.1	1.4	1.1	ZTR314SPH532_0250 EZ401U	8.9	14	200	25.00	0.35	0.70	19	6	87	3	14	44.6
0.35	2.3	2.5	1.6	1.3	ZTR314SPH532_0200 EZ401U	7.1	14	160	20.00	0.41	0.82	19	6	87	3	14	44.6
0.44	1.9	2.0	2.0	1.5	ZTR314SPH532_0160 EZ401U	5.7	14	130	16.00	0.51	1.02	19	6	87	3	14	44.6
0.70	1.9	2.0	1.7	1.3	ZTR314SPH531_0100 EZ501U	6.9	14	150	10.00	0.77	1.52	19	6	80	3	14	44.6
1.00	1.3	1.4	2.1	1.7	ZTR314SPH531_0070 EZ501U	4.8	14	110	7.000	1.00	2.00	19	6	86	3	14	44.6
1.40	0.9	1.0	3.1	2.1	ZTR314SPH531_0050 EZ501U	3.4	14	77	5.000	1.17	2.57	19	6	89	3	14	44.6
1.40	1.6	1.7	5.3	1.2	ZTR314SPH531_0050 EZ502U	6.7	14	150	5.000	1.17	2.57	19	6	89	3	14	44.6
1.40	1.6	1.8	5.3	1.2	ZTR314SPH531_0050 EZ701U	4.3	14	96	5.000	1.17	2.57	19	6	89	3	14	44.6
1.75	0.7	0.8	4.1	2.4	ZTR314SPH531_0040 EZ501U	2.8	14	61	4.000	1.28	2.92	19	6	89	3	14	44.6
1.75	1.3	1.4	7.0	1.4	ZTR314SPH531_0040 EZ502U	5.3	14	120	4.000	1.28	2.92	19	6	89	3	14	44.6
1.75	1.3	1.4	7.0	1.4	ZTR314SPH531_0040 EZ701U	3.4	14	77	4.000	1.28	2.92	19	6	89	3	14	44.6
1.75	1.7	1.9	9.1	1.1	ZTR314SPH531_0040 EZ503U	7.4	14	170	4.000	1.28	2.92	19	6	89	3	14	44.6
ZTR3PH5 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 9,9 kN)																	
0.50	2.7	3.3	1.4	1.0	ZTR314SPH532_0280 EZ401U	9.9	14	220	28.00	0.33	0.67	19	6	86	3	14	44.6
0.56	2.4	2.9	1.4	1.1	ZTR314SPH532_0250 EZ401U	8.9	14	200	25.00	0.35	0.70	19	6	87	3	14	44.6
0.70	1.9	2.3	1.6	1.3	ZTR314SPH532_0200 EZ401U	7.1	14	160	20.00	0.41	0.82	19	6	87	3	14	44.6
0.88	1.5	1.9	1.9	1.5	ZTR314SPH532_0160 EZ401U	5.7	14	130	16.00	0.51	1.02	19	6	87	3	14	44.6
1.40	1.5	1.9	1.7	1.3	ZTR314SPH531_0100 EZ501U	6.9	14	150	10.00	0.77	1.52	19	6	80	3	14	44.6
2.00	1.0	1.3	2.1	1.7	ZTR314SPH531_0070 EZ501U	4.8	14	110	7.000	1.00	2.00	19	6	86	3	14	44.6

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTR3PH5 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 9,9 kN)																	
2.00	1.6	2.4	3.2	1.1	ZTR314SPH531_0070 EZ502U	9.3	14	210	7.000	1.00	2.00	19	6	86	3	14	44.6
2.00	1.6	2.4	3.2	1.1	ZTR314SPH531_0070 EZ701U	6.0	14	130	7.000	1.00	2.00	19	6	86	3	14	44.6
ZTR2PH7 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 15 kN)																	
0.15	8.2	9.0	0.9	1.4	ZTR223SPH732_0500 EZ501U	15	29	360	50.00	0.19	0.36	21	7	117	2	23	48.8
0.19	6.6	7.2	1.1	1.6	ZTR223SPH732_0400 EZ501U	15	29	360	40.00	0.24	0.45	21	7	118	2	23	48.8
0.22	5.7	6.3	1.1	1.7	ZTR223SPH732_0350 EZ501U	15	29	360	35.00	0.27	0.51	21	7	118	2	23	48.8
0.22	9.9	11	1.8	1.0	ZTR223SPH732_0350 EZ502U	15	29	360	35.00	0.27	0.51	21	7	118	2	23	48.8
0.22	9.9	11	1.8	1.0	ZTR223SPH732_0350 EZ701U	15	29	360	35.00	0.27	0.51	21	7	118	2	23	48.8
0.27	4.6	5.0	1.2	2.0	ZTR223SPH732_0280 EZ501U	15	29	360	28.00	0.34	0.64	21	7	118	2	23	48.8
0.27	7.9	8.5	2.0	1.2	ZTR223SPH732_0280 EZ502U	15	29	360	28.00	0.34	0.64	21	7	118	2	23	48.8
0.27	7.9	8.9	2.0	1.2	ZTR223SPH732_0280 EZ701U	15	29	360	28.00	0.34	0.64	21	7	118	2	23	48.8
0.31	4.1	4.5	1.3	2.2	ZTR223SPH732_0250 EZ501U	15	29	360	25.00	0.36	0.72	21	7	118	2	23	48.8
0.31	7.1	7.6	2.3	1.3	ZTR223SPH732_0250 EZ502U	15	29	360	25.00	0.36	0.72	21	7	118	2	23	48.8
0.31	7.1	7.9	2.3	1.3	ZTR223SPH732_0250 EZ701U	15	29	360	25.00	0.36	0.72	21	7	118	2	23	48.8
0.38	3.3	3.6	1.6	2.5	ZTR223SPH732_0200 EZ501U	12	29	300	20.00	0.38	0.77	21	7	118	2	23	48.8
0.38	5.6	6.1	2.8	1.5	ZTR223SPH732_0200 EZ502U	15	29	360	20.00	0.38	0.77	21	7	118	2	23	48.8
0.38	5.6	6.3	2.8	1.5	ZTR223SPH732_0200 EZ701U	15	29	360	20.00	0.38	0.77	21	7	118	2	23	48.8
0.38	7.4	8.5	3.7	1.1	ZTR223SPH732_0200 EZ503U	15	29	360	20.00	0.38	0.77	21	7	118	2	23	48.8
0.48	2.6	2.9	1.9	2.9	ZTR223SPH732_0160 EZ501U	9.8	29	240	16.00	0.48	0.96	21	7	119	2	23	48.8
0.48	4.5	4.9	3.2	1.7	ZTR223SPH732_0160 EZ502U	15	29	360	16.00	0.48	0.96	21	7	119	2	23	48.8
0.48	4.5	5.1	3.2	1.7	ZTR223SPH732_0160 EZ701U	12	29	300	16.00	0.48	0.96	21	7	119	2	23	48.8
0.48	5.9	6.8	4.2	1.3	ZTR223SPH732_0160 EZ503U	15	29	360	16.00	0.48	0.96	21	7	119	2	23	48.8
0.48	7.3	8.8	5.2	1.0	ZTR223SPH732_0160 EZ702U	15	29	360	16.00	0.48	0.96	21	7	119	2	23	48.8
0.77	2.9	3.3	1.8	2.2	ZTR223SPH731_0100 EZ701U	7.9	29	190	10.00	0.64	1.28	21	7	112	2	23	48.8
0.77	4.7	5.7	3.0	1.4	ZTR223SPH731_0100 EZ702U	15	29	360	10.00	0.64	1.28	21	7	112	2	23	48.8
0.77	6.5	8.2	4.1	1.0	ZTR223SPH731_0100 EZ703U	15	29	360	10.00	0.64	1.28	21	7	112	2	23	48.8
1.10	2.0	2.3	2.0	2.8	ZTR223SPH731_0070 EZ701U	5.5	29	130	7.000	0.91	1.83	21	7	116	2	23	48.8
1.10	3.3	4.0	3.3	1.7	ZTR223SPH731_0070 EZ702U	11	29	280	7.000	0.91	1.83	21	7	116	2	23	48.8
1.10	4.5	5.7	4.5	1.3	ZTR223SPH731_0070 EZ703U	15	29	360	7.000	0.91	1.83	21	7	116	2	23	48.8
1.53	1.5	1.6	3.1	3.5	ZTR223SPH731_0050 EZ701U	3.9	29	96	5.000	1.12	2.56	21	7	119	2	23	48.8
1.53	2.4	2.8	5.0	2.2	ZTR223SPH731_0050 EZ702U	8.1	29	200	5.000	1.12	2.56	21	7	119	2	23	48.8
1.53	3.2	4.1	6.8	1.6	ZTR223SPH731_0050 EZ703U	13	29	310	5.000	1.12	2.56	21	7	119	2	23	48.8
1.53	4.2	5.9	8.8	1.2	ZTR223SPH731_0050 EZ705U	15	29	360	5.000	1.12	2.56	21	7	119	2	23	48.8
1.53	4.4	7.3	9.2	1.2	ZTR223SPH731_0050 EZ802U	15	29	360	5.000	1.12	2.56	21	7	119	2	23	48.8
1.92	1.2	1.3	4.0	4.1	ZTR223SPH731_0040 EZ701U	3.1	29	77	4.000	1.21	2.56	21	7	121	2	23	48.8
1.92	1.9	2.3	6.5	2.5	ZTR223SPH731_0040 EZ702U	6.5	29	160	4.000	1.21	2.56	21	7	121	2	23	48.8
1.92	2.6	3.3	8.9	1.8	ZTR223SPH731_0040 EZ703U	10	29	250	4.000	1.21	2.56	21	7	121	2	23	48.8
1.92	3.4	4.8	11	1.4	ZTR223SPH731_0040 EZ705U	15	29	360	4.000	1.21	2.56	21	7	121	2	23	48.8
1.92	3.5	5.8	12	1.4	ZTR223SPH731_0040 EZ802U	15	29	360	4.000	1.21	2.56	21	7	121	2	23	48.8
1.92	4.2	7.6	14	1.1	ZTR223SPH731_0040 EZ803U	15	29	360	4.000	1.21	2.56	21	7	121	2	23	48.8
ZTR2PH7 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 15 kN)																	
0.72	5.8	9.3	4.1	1.1	ZTR223SPH732_0160 EZ505U	15	29	360	16.00	0.48	0.96	21	7	119	2	23	48.8
1.15	4.8	7.9	3.4	1.2	ZTR223SPH731_0100 EZ703U	15	29	360	10.00	0.64	1.28	21	7	112	2	23	48.8
1.64	2.9	9.5	3.3	1.7	ZTR223SPH731_0070 EZ802U	15	29	360	7.000	0.91	1.83	21	7	116	2	23	48.8
1.64	3.3	5.5	3.8	1.5	ZTR223SPH731_0070 EZ703U	15	29	360	7.000	0.91	1.83	21	7	116	2	23	48.8
1.64	4.5	8.3	5.2	1.1	ZTR223SPH731_0070 EZ705U	15	29	360	7.000	0.91	1.83	21	7	116	2	23	48.8
2.30	2.1	6.8	5.0	2.2	ZTR223SPH731_0050 EZ802U	15	29	360	5.000	1.12	2.56	21	7	119	2	23	48.8
2.30	2.4	3.9	5.7	1.9	ZTR223SPH731_0050 EZ703U	13	29	310	5.000	1.12	2.56	21	7	119	2	23	48.8
2.30	3.2	5.9	7.7	1.4	ZTR223SPH731_0050 EZ705U	15	29	360	5.000	1.12	2.56	21	7	119	2	23	48.8
ZTR2PH7 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 15 kN)																	
0.31	6.5	8.4	0.9	1.4	ZTR223SPH732_0500 EZ501U	15	29	360	50.00	0.19	0.36	21	7	117	2	23	48.8
0.38	5.2	6.7	1.1	1.6	ZTR223SPH732_0400 EZ501U	15	29	360	40.00	0.24	0.45	21	7	118	2	23	48.8
0.44	4.5	5.9	1.0	1.7	ZTR223SPH732_0350 EZ501U	15	29	360	35.00	0.27	0.51	21	7	118	2	23	48.8
0.44	6.9	10	1.6	1.1	ZTR223SPH732_0350 EZ502U	15	29	360	35.00	0.27	0.51	21	7	118	2	23	48.8
0.44	6.9	11	1.6	1.1	ZTR223SPH732_0350 EZ701U	15	29	360	35.00	0.27	0.51	21	7	118	2	23	48.8
0.55	3.6	4.7	1.1	2.0	ZTR223SPH732_0280 EZ501U	15	29	360	28.00	0.34	0.64	21	7	118	2	23	48.8
0.55	5.5	8.3	1.7	1.3	ZTR223SPH732_0280 EZ502U	15	29	360	28.00	0.34	0.64	21	7	118	2	23	48.8
0.55	5.5	8.4	1.7	1.3	ZTR223SPH732_0280 EZ701U	15	29	360	28.00	0.34	0.64	21	7	118	2	23	48.8
0.61	3.2	4.2	1.3	2.2	ZTR223SPH732_0250 EZ501U	15	29	360	25.00	0.36	0.72	21	7	118	2	23	48.8
0.61	5.0	7.4	2.0	1.4	ZTR223SPH732_0250 EZ502U	15	29	360	25.00	0.36	0.72	21	7	118	2	23	48.8
0.61	5.0	7.5	2.0	1.4	ZTR223SPH732_0250 EZ701U	15	29	360	25.00	0.36	0.72	21	7	118	2	23	48.8
0.61	5.9	10	2.3	1.2	ZTR223SPH732_0250 EZ503U	15	29	360	25.00	0.36	0.72	21	7	118	2	23	48.8
0.77	2.6	3.4	1.5	2.5	ZTR223SPH732_0200 EZ501U	12	29	300	20.00	0.38	0.77	21	7	118	2	23	48.8
0.77	4.0	5.9	2.2	1.6	ZTR223SPH732_0200 EZ502U	15	29	360	20.00	0.38	0.77	21	7	118	2	23	48.8
0.77	4.0	6.0	2.2	1.6	ZTR223SPH732_0200 EZ701U	15	29	360	20.00	0.38	0.77	21	7	118	2	23	48.8
0.77	4.7	8.1	2.6	1.4	ZTR223SPH732_0200 EZ503U	15	29	360	20.00	0.38	0.77	21	7	118	2	23	48.8

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTR2PH7 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 15 kN)																	
0.77	5.5	11	3.1	1.2	ZTR223SPH732_0200 EZ702U	15	29	360	20.00	0.38	0.77	21	7	118	2	23	48.8
0.96	2.1	2.7	1.6	2.9	ZTR223SPH732_0160 EZ501U	9.8	29	240	16.00	0.48	0.96	21	7	119	2	23	48.8
0.96	3.2	4.8	2.5	1.9	ZTR223SPH732_0160 EZ502U	15	29	360	16.00	0.48	0.96	21	7	119	2	23	48.8
0.96	3.2	4.8	2.5	1.9	ZTR223SPH732_0160 EZ701U	12	29	300	16.00	0.48	0.96	21	7	119	2	23	48.8
0.96	3.8	6.5	3.0	1.6	ZTR223SPH732_0160 EZ503U	15	29	360	16.00	0.48	0.96	21	7	119	2	23	48.8
0.96	4.4	8.7	3.4	1.4	ZTR223SPH732_0160 EZ702U	15	29	360	16.00	0.48	0.96	21	7	119	2	23	48.8
ZTR3PH7 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 19 kN)																	
0.11	11	12	0.7	1.1	ZTR316SPH732_0700 EZ501U	17	30	450	70.00	0.14	0.27	22	7	114	3	16	50.9
0.16	7.9	8.6	0.9	1.4	ZTR316SPH732_0500 EZ501U	17	30	450	50.00	0.20	0.37	22	7	116	3	16	50.9
0.20	6.3	6.9	1.1	1.6	ZTR316SPH732_0400 EZ501U	17	30	450	40.00	0.25	0.47	22	7	117	3	16	50.9
0.23	5.5	6.0	1.1	1.8	ZTR316SPH732_0350 EZ501U	17	30	450	35.00	0.28	0.53	22	7	117	3	16	50.9
0.23	9.5	10	1.8	1.0	ZTR316SPH732_0350 EZ502U	17	30	450	35.00	0.28	0.53	22	7	117	3	16	50.9
0.23	9.5	11	1.8	1.0	ZTR316SPH732_0350 EZ701U	17	30	450	35.00	0.28	0.53	22	7	117	3	16	50.9
0.24	5.3	5.8	1.1	1.9	ZTR319SPH732_0400 EZ501U	19	26	560	40.00	0.29	0.55	26	9	113	3	19	60.5
0.24	9.1	9.8	1.9	1.1	ZTR319SPH732_0400 EZ502U	19	26	560	40.00	0.29	0.55	26	9	113	3	19	60.5
0.24	9.1	10	1.9	1.1	ZTR319SPH732_0400 EZ701U	19	26	560	40.00	0.29	0.55	26	9	113	3	19	60.5
0.27	4.6	5.1	1.1	2.1	ZTR319SPH732_0350 EZ501U	17	26	520	35.00	0.34	0.63	26	9	113	3	19	60.5
0.27	8.0	8.6	1.8	1.2	ZTR319SPH732_0350 EZ502U	19	26	560	35.00	0.34	0.63	26	9	113	3	19	60.5
0.27	8.0	8.9	1.8	1.2	ZTR319SPH732_0350 EZ701U	19	26	560	35.00	0.34	0.63	26	9	113	3	19	60.5
0.29	4.4	4.8	1.2	2.0	ZTR316SPH732_0280 EZ501U	16	30	420	28.00	0.35	0.67	22	7	117	3	16	50.9
0.29	7.6	8.2	2.0	1.2	ZTR316SPH732_0280 EZ502U	17	30	450	28.00	0.35	0.67	22	7	117	3	16	50.9
0.29	7.6	8.5	2.0	1.2	ZTR316SPH732_0280 EZ701U	17	30	450	28.00	0.35	0.67	22	7	117	3	16	50.9
0.32	3.9	4.3	1.3	2.2	ZTR316SPH732_0250 EZ501U	15	30	370	25.00	0.37	0.75	22	7	117	3	16	50.9
0.32	6.8	7.3	2.3	1.3	ZTR316SPH732_0250 EZ502U	17	30	450	25.00	0.37	0.75	22	7	117	3	16	50.9
0.32	6.8	7.6	2.3	1.3	ZTR316SPH732_0250 EZ701U	17	30	450	25.00	0.37	0.75	22	7	117	3	16	50.9
0.34	3.7	4.0	1.2	2.4	ZTR319SPH732_0280 EZ501U	14	26	420	28.00	0.42	0.79	26	9	114	3	19	60.5
0.34	6.4	6.9	2.0	1.4	ZTR319SPH732_0280 EZ502U	19	26	560	28.00	0.42	0.79	26	9	114	3	19	60.5
0.34	6.4	7.1	2.0	1.4	ZTR319SPH732_0280 EZ701U	17	26	520	28.00	0.42	0.79	26	9	114	3	19	60.5
0.34	8.4	9.6	2.7	1.1	ZTR319SPH732_0280 EZ503U	19	26	560	28.00	0.42	0.79	26	9	114	3	19	60.5
0.38	3.3	3.6	1.3	2.6	ZTR319SPH732_0250 EZ501U	12	26	370	25.00	0.44	0.89	26	9	113	3	19	60.5
0.38	5.7	6.2	2.3	1.5	ZTR319SPH732_0250 EZ502U	19	26	560	25.00	0.44	0.89	26	9	113	3	19	60.5
0.38	5.7	6.4	2.3	1.5	ZTR319SPH732_0250 EZ701U	15	26	470	25.00	0.44	0.89	26	9	113	3	19	60.5
0.38	7.5	8.5	3.0	1.2	ZTR319SPH732_0250 EZ503U	19	26	560	25.00	0.44	0.89	26	9	113	3	19	60.5
0.40	3.1	3.4	1.6	2.6	ZTR316SPH732_0200 EZ501U	12	30	300	20.00	0.40	0.80	22	7	117	3	16	50.9
0.40	5.4	5.8	2.8	1.5	ZTR316SPH732_0200 EZ502U	17	30	450	20.00	0.40	0.80	22	7	117	3	16	50.9
0.40	5.4	6.1	2.8	1.5	ZTR316SPH732_0200 EZ701U	15	30	370	20.00	0.40	0.80	22	7	117	3	16	50.9
0.40	7.1	8.1	3.7	1.1	ZTR316SPH732_0200 EZ503U	17	30	450	20.00	0.40	0.80	22	7	117	3	16	50.9
0.48	2.6	2.9	1.6	3.0	ZTR319SPH732_0200 EZ501U	9.8	26	300	20.00	0.48	0.95	26	9	113	3	19	60.5
0.48	4.6	4.9	2.8	1.8	ZTR319SPH732_0200 EZ502U	19	26	560	20.00	0.48	0.95	26	9	113	3	19	60.5
0.48	4.6	5.1	2.8	1.8	ZTR319SPH732_0200 EZ701U	12	26	370	20.00	0.48	0.95	26	9	113	3	19	60.5
0.48	6.0	6.8	3.7	1.3	ZTR319SPH732_0200 EZ503U	19	26	560	20.00	0.48	0.95	26	9	113	3	19	60.5
0.48	7.4	8.9	4.6	1.1	ZTR319SPH732_0200 EZ702U	19	26	560	20.00	0.48	0.95	26	9	113	3	19	60.5
0.50	2.5	2.7	1.9	3.0	ZTR316SPH732_0160 EZ501U	9.3	30	240	16.00	0.50	1.00	22	7	118	3	16	50.9
0.50	4.3	4.7	3.2	1.7	ZTR316SPH732_0160 EZ502U	17	30	450	16.00	0.50	1.00	22	7	118	3	16	50.9
0.50	4.3	4.8	3.2	1.7	ZTR316SPH732_0160 EZ701U	12	30	300	16.00	0.50	1.00	22	7	118	3	16	50.9
0.50	5.7	6.5	4.2	1.3	ZTR316SPH732_0160 EZ503U	17	30	450	16.00	0.50	1.00	22	7	118	3	16	50.9
0.50	7.0	8.4	5.2	1.1	ZTR316SPH732_0160 EZ702U	17	30	450	16.00	0.50	1.00	22	7	118	3	16	50.9
0.59	2.1	2.3	1.9	3.5	ZTR319SPH732_0160 EZ501U	7.9	26	240	16.00	0.59	1.19	26	9	115	3	19	60.5
0.59	3.6	3.9	3.2	2.0	ZTR319SPH732_0160 EZ502U	15	26	460	16.00	0.59	1.19	26	9	115	3	19	60.5
0.59	3.6	4.1	3.2	2.0	ZTR319SPH732_0160 EZ701U	9.8	26	300	16.00	0.59	1.19	26	9	115	3	19	60.5
0.59	4.8	5.5	4.2	1.6	ZTR319SPH732_0160 EZ503U	19	26	560	16.00	0.59	1.19	26	9	115	3	19	60.5
0.59	5.9	7.1	5.2	1.3	ZTR319SPH732_0160 EZ702U	19	26	560	16.00	0.59	1.19	26	9	115	3	19	60.5
0.59	6.6	7.9	5.9	1.1	ZTR319SPH732_0160 EZ505U	19	26	560	16.00	0.59	1.19	26	9	115	3	19	60.5
0.80	2.8	3.1	1.8	2.3	ZTR316SPH731_0100 EZ701U	7.5	30	190	10.00	0.67	1.33	22	7	110	3	16	50.9
0.80	4.5	5.4	3.0	1.4	ZTR316SPH731_0100 EZ702U	15	30	390	10.00	0.67	1.33	22	7	110	3	16	50.9
0.80	6.2	7.8	4.1	1.0	ZTR316SPH731_0100 EZ703U	17	30	450	10.00	0.67	1.33	22	7	110	3	16	50.9
0.95	2.3	2.6	1.8	2.7	ZTR319SPH731_0100 EZ701U	6.3	26	190	10.00	0.79	1.58	26	9	105	3	19	60.5
0.95	3.8	4.6	3.0	1.7	ZTR319SPH731_0100 EZ702U	13	26	390	10.00	0.79	1.58	26	9	105	3	19	60.5
0.95	5.2	6.6	4.1	1.2	ZTR319SPH731_0100 EZ703U	19	26	560	10.00	0.79	1.58	26	9	105	3	19	60.5
1.14	2.0	2.2	2.0	2.9	ZTR316SPH731_0070 EZ701U	5.3	30	130	7.000	0.95	1.91	22	7	115	3	16	50.9
1.14	3.2	3.8	3.3	1.8	ZTR316SPH731_0070 EZ702U	11	30	280	7.000	0.95	1.91	22	7	115	3	16	50.9
1.14	4.4	5.5	4.5	1.3	ZTR316SPH731_0070 EZ703U	17	30	440	7.000	0.95	1.91	22	7	115	3	16	50.9
1.14	5.6	8.0	5.9	1.0	ZTR316SPH731_0070 EZ705U	17	30	450	7.000	0.95	1.91	22	7	115	3	16	50.9
1.36	1.6	1.8	2.0	3.4	ZTR319SPH731_0070 EZ701U	4.4	26	130	7.000	1.13	2.26	26	9	111	3	19	60.5
1.36	2.7	3.2	3.3	2.1	ZTR319SPH731_0070 EZ702U	9.1	26	280	7.000	1.13	2.26	26	9	111	3	19	60.5
1.36	3.7	4.6	4.5	1.5	ZTR319SPH731_0070 EZ703U	14	26	440	7.000	1.13	2.26	26	9	111	3	19	60.5

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTR3PH7 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 19 kN)																	
1.36	4.7	6.7	5.9	1.2	ZTR319SPH731_0070 EZ705U	19	26	560	7.000	1.13	2.26	26	9	111	3	19	60.5
1.36	5.0	8.2	6.1	1.1	ZTR319SPH731_0070 EZ802U	19	26	560	7.000	1.13	2.26	26	9	111	3	19	60.5
1.60	1.4	1.6	3.1	3.6	ZTR316SPH731_0050 EZ701U	3.8	30	96	5.000	1.17	2.67	22	7	118	3	16	50.9
1.60	2.3	2.7	5.0	2.2	ZTR316SPH731_0050 EZ702U	7.7	30	200	5.000	1.17	2.67	22	7	118	3	16	50.9
1.60	3.1	3.9	6.8	1.6	ZTR316SPH731_0050 EZ703U	12	30	310	5.000	1.17	2.67	22	7	118	3	16	50.9
1.60	4.0	5.7	8.8	1.3	ZTR316SPH731_0050 EZ705U	17	30	450	5.000	1.17	2.67	22	7	118	3	16	50.9
1.60	4.2	7.0	9.2	1.2	ZTR316SPH731_0050 EZ802U	17	30	450	5.000	1.17	2.67	22	7	118	3	16	50.9
1.60	5.0	9.1	11	1.0	ZTR316SPH731_0050 EZ803U	17	30	450	5.000	1.17	2.67	22	7	118	3	16	50.9
1.90	1.2	1.3	3.1	4.3	ZTR319SPH731_0050 EZ701U	3.2	26	96	5.000	1.39	3.17	26	9	115	3	19	60.5
1.90	1.9	2.3	5.0	2.6	ZTR319SPH731_0050 EZ702U	6.5	26	200	5.000	1.39	3.17	26	9	115	3	19	60.5
1.90	2.6	3.3	6.8	1.9	ZTR319SPH731_0050 EZ703U	10	26	310	5.000	1.39	3.17	26	9	115	3	19	60.5
1.90	3.4	4.8	8.8	1.5	ZTR319SPH731_0050 EZ705U	17	26	500	5.000	1.39	3.17	26	9	115	3	19	60.5
1.90	3.5	5.9	9.2	1.4	ZTR319SPH731_0050 EZ802U	16	26	480	5.000	1.39	3.17	26	9	115	3	19	60.5
1.90	4.2	7.7	11	1.2	ZTR319SPH731_0050 EZ803U	19	26	560	5.000	1.39	3.17	26	9	115	3	19	60.5
2.00	1.1	1.3	4.0	4.2	ZTR316SPH731_0040 EZ701U	3.0	30	77	4.000	1.27	2.67	22	7	120	3	16	50.9
2.00	1.8	2.2	6.5	2.6	ZTR316SPH731_0040 EZ702U	6.2	30	160	4.000	1.27	2.67	22	7	120	3	16	50.9
2.00	2.5	3.1	8.9	1.9	ZTR316SPH731_0040 EZ703U	9.8	30	250	4.000	1.27	2.67	22	7	120	3	16	50.9
2.00	3.2	4.6	11	1.5	ZTR316SPH731_0040 EZ705U	16	30	400	4.000	1.27	2.67	22	7	120	3	16	50.9
2.00	3.4	5.6	12	1.4	ZTR316SPH731_0040 EZ802U	15	30	380	4.000	1.27	2.67	22	7	120	3	16	50.9
2.00	4.0	7.3	14	1.2	ZTR316SPH731_0040 EZ803U	17	30	450	4.000	1.27	2.67	22	7	120	3	16	50.9
2.38	0.9	1.1	4.0	5.0	ZTR319SPH731_0040 EZ701U	2.5	26	77	4.000	1.50	3.17	26	9	117	3	19	60.5
2.38	1.5	1.8	6.5	3.1	ZTR319SPH731_0040 EZ702U	5.2	26	160	4.000	1.50	3.17	26	9	117	3	19	60.5
2.38	2.1	2.6	8.9	2.2	ZTR319SPH731_0040 EZ703U	8.3	26	250	4.000	1.50	3.17	26	9	117	3	19	60.5
2.38	2.7	3.8	11	1.7	ZTR319SPH731_0040 EZ705U	13	26	400	4.000	1.50	3.17	26	9	117	3	19	60.5
2.38	2.8	4.7	12	1.7	ZTR319SPH731_0040 EZ802U	13	26	380	4.000	1.50	3.17	26	9	117	3	19	60.5
2.38	3.4	6.1	14	1.4	ZTR319SPH731_0040 EZ803U	18	26	560	4.000	1.50	3.17	26	9	117	3	19	60.5
ZTR3PH7 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 19 kN)																	
0.57	7.3	12	3.2	1.0	ZTR319SPH732_0250 EZ505U	19	26	560	25.00	0.44	0.89	26	9	113	3	19	60.5
0.60	6.9	11	3.7	1.0	ZTR316SPH732_0200 EZ505U	17	30	450	20.00	0.40	0.80	22	7	117	3	16	50.9
0.75	5.6	8.9	4.1	1.2	ZTR316SPH732_0160 EZ505U	17	30	450	16.00	0.50	1.00	22	7	118	3	16	50.9
0.89	6.0	9.8	5.3	1.1	ZTR319SPH732_0160 EZ703U	19	26	560	16.00	0.59	1.19	26	9	115	3	19	60.5
1.20	4.0	13	3.0	1.4	ZTR316SPH731_0100 EZ802U	17	30	450	10.00	0.67	1.33	22	7	110	3	16	50.9
1.20	4.6	7.5	3.4	1.2	ZTR316SPH731_0100 EZ703U	17	30	450	10.00	0.67	1.33	22	7	110	3	16	50.9
1.43	3.3	11	3.0	1.7	ZTR319SPH731_0100 EZ802U	19	26	560	10.00	0.79	1.58	26	9	105	3	19	60.5
1.43	3.8	6.3	3.4	1.4	ZTR319SPH731_0100 EZ703U	19	26	560	10.00	0.79	1.58	26	9	105	3	19	60.5
1.43	5.2	9.5	4.7	1.1	ZTR319SPH731_0100 EZ705U	19	26	560	10.00	0.79	1.58	26	9	105	3	19	60.5
1.71	2.8	9.1	3.3	1.8	ZTR316SPH731_0070 EZ802U	17	30	450	7.000	0.95	1.91	22	7	115	3	16	50.9
1.71	3.2	5.3	3.8	1.5	ZTR316SPH731_0070 EZ703U	17	30	440	7.000	0.95	1.91	22	7	115	3	16	50.9
1.71	4.3	7.9	5.2	1.1	ZTR316SPH731_0070 EZ705U	17	30	450	7.000	0.95	1.91	22	7	115	3	16	50.9
2.04	2.3	7.7	3.3	2.1	ZTR319SPH731_0070 EZ802U	19	26	560	7.000	1.13	2.26	26	9	111	3	19	60.5
2.04	2.7	4.4	3.8	1.8	ZTR319SPH731_0070 EZ703U	14	26	440	7.000	1.13	2.26	26	9	111	3	19	60.5
2.04	3.6	6.7	5.2	1.4	ZTR319SPH731_0070 EZ705U	19	26	560	7.000	1.13	2.26	26	9	111	3	19	60.5
2.40	2.0	6.5	5.0	2.2	ZTR316SPH731_0050 EZ802U	17	30	450	5.000	1.17	2.67	22	7	118	3	16	50.9
2.40	2.3	3.8	5.7	1.9	ZTR316SPH731_0050 EZ703U	12	30	310	5.000	1.17	2.67	22	7	118	3	16	50.9
2.40	3.1	5.7	7.7	1.4	ZTR316SPH731_0050 EZ705U	17	30	450	5.000	1.17	2.67	22	7	118	3	16	50.9
2.85	1.7	5.5	5.0	2.6	ZTR319SPH731_0050 EZ802U	16	26	480	5.000	1.39	3.17	26	9	115	3	19	60.5
2.85	1.9	3.2	5.7	2.3	ZTR319SPH731_0050 EZ703U	10	26	310	5.000	1.39	3.17	26	9	115	3	19	60.5
2.85	2.6	4.8	7.7	1.7	ZTR319SPH731_0050 EZ705U	17	26	500	5.000	1.39	3.17	26	9	115	3	19	60.5
ZTR3PH7 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 19 kN)																	
0.23	8.7	11	0.7	1.1	ZTR316SPH732_0700 EZ501U	17	30	450	70.00	0.14	0.27	22	7	114	3	16	50.9
0.32	6.2	8.0	0.9	1.4	ZTR316SPH732_0500 EZ501U	17	30	450	50.00	0.20	0.37	22	7	116	3	16	50.9
0.38	8.0	12	1.3	1.1	ZTR319SPH732_0500 EZ502U	19	26	560	50.00	0.23	0.44	26	9	112	3	19	60.5
0.38	8.0	12	1.3	1.1	ZTR319SPH732_0500 EZ701U	19	26	560	50.00	0.23	0.44	26	9	112	3	19	60.5
0.40	5.0	6.4	1.1	1.6	ZTR316SPH732_0400 EZ501U	17	30	450	40.00	0.25	0.47	22	7	117	3	16	50.9
0.40	7.6	11	1.7	1.1	ZTR316SPH732_0400 EZ502U	17	30	450	40.00	0.25	0.47	22	7	117	3	16	50.9
0.40	7.6	12	1.7	1.1	ZTR316SPH732_0400 EZ701U	17	30	450	40.00	0.25	0.47	22	7	117	3	16	50.9
0.46	4.3	5.6	1.0	1.8	ZTR316SPH732_0350 EZ501U	17	30	450	35.00	0.28	0.53	22	7	117	3	16	50.9
0.46	6.6	10	1.6	1.2	ZTR316SPH732_0350 EZ502U	17	30	450	35.00	0.28	0.53	22	7	117	3	16	50.9
0.46	6.6	10	1.6	1.2	ZTR316SPH732_0350 EZ701U	17	30	450	35.00	0.28	0.53	22	7	117	3	16	50.9
0.48	4.2	5.4	1.1	1.9	ZTR319SPH732_0400 EZ501U	19	26	560	40.00	0.29	0.55	26	9	113	3	19	60.5
0.48	6.4	9.6	1.7	1.2	ZTR319SPH732_0400 EZ502U	19	26	560	40.00	0.29	0.55	26	9	113	3	19	60.5
0.48	6.4	9.7	1.7	1.2	ZTR319SPH732_0400 EZ701U	19	26	560	40.00	0.29	0.55	26	9	113	3	19	60.5
0.48	7.6	13	2.0	1.0	ZTR319SPH732_0400 EZ503U	19	26	560	40.00	0.29	0.55	26	9	113	3	19	60.5
0.54	3.7	4.7	1.0	2.1	ZTR319SPH732_0350 EZ501U	17	26	520	35.00	0.34	0.63	26	9	113	3	19	60.5
0.54	5.6	8.4	1.6	1.4	ZTR319SPH732_0350 EZ502U	19	26	560	35.00	0.34	0.63	26	9	113	3	19	60.5
0.54	5.6	8.5	1.6	1.4	ZTR319SPH732_0350 EZ701U	19	26	560	35.00	0.34	0.63	26	9	113	3	19	60.5

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTR3PH7 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 19 kN)																	
0.54	6.7	11	1.9	1.1	ZTR319SPH732_0350 EZ503U	19	26	560	35.00	0.34	0.63	26	9	113	3	19	60.5
0.57	3.5	4.5	1.1	2.1	ZTR316SPH732_0280 EZ501U	16	30	420	28.00	0.35	0.67	22	7	117	3	16	50.9
0.57	5.3	8.0	1.7	1.3	ZTR316SPH732_0280 EZ502U	17	30	450	28.00	0.35	0.67	22	7	117	3	16	50.9
0.57	5.3	8.1	1.7	1.3	ZTR316SPH732_0280 EZ701U	17	30	450	28.00	0.35	0.67	22	7	117	3	16	50.9
0.57	6.3	11	2.1	1.1	ZTR316SPH732_0280 EZ503U	17	30	450	28.00	0.35	0.67	22	7	117	3	16	50.9
0.64	3.1	4.0	1.3	2.2	ZTR316SPH732_0250 EZ501U	15	30	370	25.00	0.37	0.75	22	7	117	3	16	50.9
0.64	4.7	7.1	2.0	1.4	ZTR316SPH732_0250 EZ502U	17	30	450	25.00	0.37	0.75	22	7	117	3	16	50.9
0.64	4.7	7.2	2.0	1.4	ZTR316SPH732_0250 EZ701U	17	30	450	25.00	0.37	0.75	22	7	117	3	16	50.9
0.64	5.7	9.7	2.3	1.2	ZTR316SPH732_0250 EZ503U	17	30	450	25.00	0.37	0.75	22	7	117	3	16	50.9
0.64	6.6	13	2.7	1.0	ZTR316SPH732_0250 EZ702U	17	30	450	25.00	0.37	0.75	22	7	117	3	16	50.9
0.68	2.9	3.8	1.1	2.4	ZTR319SPH732_0280 EZ501U	14	26	420	28.00	0.42	0.79	26	9	114	3	19	60.5
0.68	4.5	6.7	1.7	1.6	ZTR319SPH732_0280 EZ502U	19	26	560	28.00	0.42	0.79	26	9	114	3	19	60.5
0.68	4.5	6.8	1.7	1.6	ZTR319SPH732_0280 EZ701U	17	26	520	28.00	0.42	0.79	26	9	114	3	19	60.5
0.68	5.3	9.1	2.1	1.3	ZTR319SPH732_0280 EZ503U	19	26	560	28.00	0.42	0.79	26	9	114	3	19	60.5
0.68	6.2	12	2.4	1.1	ZTR319SPH732_0280 EZ702U	19	26	560	28.00	0.42	0.79	26	9	114	3	19	60.5
0.76	2.6	3.4	1.3	2.6	ZTR319SPH732_0250 EZ501U	12	26	370	25.00	0.44	0.89	26	9	113	3	19	60.5
0.76	4.0	6.0	2.0	1.7	ZTR319SPH732_0250 EZ502U	19	26	560	25.00	0.44	0.89	26	9	113	3	19	60.5
0.76	4.0	6.1	2.0	1.7	ZTR319SPH732_0250 EZ701U	15	26	470	25.00	0.44	0.89	26	9	113	3	19	60.5
0.76	4.8	8.1	2.3	1.4	ZTR319SPH732_0250 EZ503U	19	26	560	25.00	0.44	0.89	26	9	113	3	19	60.5
0.76	5.5	11	2.7	1.2	ZTR319SPH732_0250 EZ702U	19	26	560	25.00	0.44	0.89	26	9	113	3	19	60.5
0.80	2.5	3.2	1.5	2.6	ZTR316SPH732_0200 EZ501U	12	30	300	20.00	0.40	0.80	22	7	117	3	16	50.9
0.80	3.8	5.7	2.2	1.7	ZTR316SPH732_0200 EZ502U	17	30	450	20.00	0.40	0.80	22	7	117	3	16	50.9
0.80	3.8	5.8	2.2	1.7	ZTR316SPH732_0200 EZ701U	15	30	370	20.00	0.40	0.80	22	7	117	3	16	50.9
0.80	4.5	7.7	2.6	1.4	ZTR316SPH732_0200 EZ503U	17	30	450	20.00	0.40	0.80	22	7	117	3	16	50.9
0.80	5.3	10	3.1	1.2	ZTR316SPH732_0200 EZ702U	17	30	450	20.00	0.40	0.80	22	7	117	3	16	50.9
0.95	2.1	2.7	1.5	3.0	ZTR319SPH732_0200 EZ501U	9.8	26	300	20.00	0.48	0.95	26	9	113	3	19	60.5
0.95	3.2	4.8	2.2	2.0	ZTR319SPH732_0200 EZ502U	19	26	560	20.00	0.48	0.95	26	9	113	3	19	60.5
0.95	3.2	4.9	2.2	2.0	ZTR319SPH732_0200 EZ701U	12	26	370	20.00	0.48	0.95	26	9	113	3	19	60.5
0.95	3.8	6.5	2.6	1.7	ZTR319SPH732_0200 EZ503U	19	26	560	20.00	0.48	0.95	26	9	113	3	19	60.5
0.95	4.4	8.8	3.1	1.4	ZTR319SPH732_0200 EZ702U	19	26	560	20.00	0.48	0.95	26	9	113	3	19	60.5
1.00	2.0	2.6	1.6	3.0	ZTR316SPH732_0160 EZ501U	9.3	30	240	16.00	0.50	1.00	22	7	118	3	16	50.9
1.00	3.0	4.6	2.5	1.9	ZTR316SPH732_0160 EZ502U	17	30	450	16.00	0.50	1.00	22	7	118	3	16	50.9
1.00	3.0	4.6	2.5	1.9	ZTR316SPH732_0160 EZ701U	12	30	300	16.00	0.50	1.00	22	7	118	3	16	50.9
1.00	3.6	6.2	3.0	1.6	ZTR316SPH732_0160 EZ503U	17	30	450	16.00	0.50	1.00	22	7	118	3	16	50.9
1.00	4.2	8.4	3.4	1.4	ZTR316SPH732_0160 EZ702U	17	30	450	16.00	0.50	1.00	22	7	118	3	16	50.9
1.19	1.7	2.2	1.6	3.5	ZTR319SPH732_0160 EZ501U	7.9	26	240	16.00	0.59	1.19	26	9	115	3	19	60.5
1.19	2.6	3.8	2.5	2.3	ZTR319SPH732_0160 EZ502U	15	26	460	16.00	0.59	1.19	26	9	115	3	19	60.5
1.19	2.6	3.9	2.5	2.3	ZTR319SPH732_0160 EZ701U	9.8	26	300	16.00	0.59	1.19	26	9	115	3	19	60.5
1.19	3.1	5.2	3.0	1.9	ZTR319SPH732_0160 EZ503U	19	26	560	16.00	0.59	1.19	26	9	115	3	19	60.5
1.19	3.5	7.0	3.4	1.7	ZTR319SPH732_0160 EZ702U	19	26	560	16.00	0.59	1.19	26	9	115	3	19	60.5
ZTR4PH7 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 18 kN)																	
0.11	11	12	0.7	1.1	ZTR412SPH732_0700 EZ501U	18	28	460	70.00	0.14	0.27	22	7	110	4	12	50.9
0.16	7.9	8.6	0.9	1.3	ZTR412SPH732_0500 EZ501U	18	28	460	50.00	0.20	0.37	22	7	112	4	12	50.9
0.20	6.3	6.9	1.1	1.5	ZTR412SPH732_0400 EZ501U	18	28	460	40.00	0.25	0.47	22	7	113	4	12	50.9
0.23	5.5	6.0	1.1	1.7	ZTR412SPH732_0350 EZ501U	18	28	460	35.00	0.28	0.53	22	7	113	4	12	50.9
0.29	4.4	4.8	1.2	2.0	ZTR412SPH732_0280 EZ501U	16	28	420	28.00	0.35	0.67	22	7	114	4	12	50.9
0.29	7.6	8.2	2.0	1.1	ZTR412SPH732_0280 EZ502U	18	28	460	28.00	0.35	0.67	22	7	114	4	12	50.9
0.29	7.6	8.5	2.0	1.1	ZTR412SPH732_0280 EZ701U	18	28	460	28.00	0.35	0.67	22	7	114	4	12	50.9
0.32	3.9	4.3	1.3	2.1	ZTR412SPH732_0250 EZ501U	15	28	370	25.00	0.37	0.75	22	7	113	4	12	50.9
0.32	6.8	7.3	2.3	1.2	ZTR412SPH732_0250 EZ502U	18	28	460	25.00	0.37	0.75	22	7	113	4	12	50.9
0.32	6.8	7.6	2.3	1.2	ZTR412SPH732_0250 EZ701U	18	28	460	25.00	0.37	0.75	22	7	113	4	12	50.9
0.40	3.1	3.4	1.6	2.5	ZTR412SPH732_0200 EZ501U	12	28	300	20.00	0.40	0.80	22	7	113	4	12	50.9
0.40	5.4	5.8	2.8	1.4	ZTR412SPH732_0200 EZ502U	18	28	460	20.00	0.40	0.80	22	7	113	4	12	50.9
0.40	5.4	6.1	2.8	1.4	ZTR412SPH732_0200 EZ701U	15	28	370	20.00	0.40	0.80	22	7	113	4	12	50.9
0.40	7.1	8.1	3.7	1.1	ZTR412SPH732_0200 EZ503U	18	28	460	20.00	0.40	0.80	22	7	113	4	12	50.9
0.50	2.5	2.7	1.9	2.9	ZTR412SPH732_0160 EZ501U	9.3	28	240	16.00	0.50	1.00	22	7	114	4	12	50.9
0.50	4.3	4.7	3.2	1.7	ZTR412SPH732_0160 EZ502U	18	28	460	16.00	0.50	1.00	22	7	114	4	12	50.9
0.50	4.3	4.8	3.2	1.7	ZTR412SPH732_0160 EZ701U	12	28	300	16.00	0.50	1.00	22	7	114	4	12	50.9
0.50	5.7	6.5	4.2	1.3	ZTR412SPH732_0160 EZ503U	18	28	460	16.00	0.50	1.00	22	7	114	4	12	50.9
0.50	7.0	8.4	5.2	1.0	ZTR412SPH732_0160 EZ702U	18	28	460	16.00	0.50	1.00	22	7	114	4	12	50.9
0.80	2.8	3.1	1.8	2.2	ZTR412SPH731_0100 EZ701U	7.5	28	190	10.00	0.67	1.33	22	7	107	4	12	50.9
0.80	4.5	5.4	3.0	1.4	ZTR412SPH731_0100 EZ702U	15	28	390	10.00	0.67	1.33	22	7	107	4	12	50.9
1.14	2.0	2.2	2.0	2.8	ZTR412SPH731_0070 EZ701U	5.3	28	130	7.000	0.95	1.91	22	7	112	4	12	50.9
1.14	3.2	3.8	3.3	1.7	ZTR412SPH731_0070 EZ702U	11	28	280	7.000	0.95	1.91	22	7	112	4	12	50.9
1.14	4.4	5.5	4.5	1.3	ZTR412SPH731_0070 EZ703U	17	28	440	7.000	0.95	1.91	22	7	112	4	12	50.9
1.60	1.4	1.6	3.1	3.5	ZTR412SPH731_0050 EZ701U	3.8	28	96	5.000	1.17	2.67	22	7	115	4	12	50.9

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTR4PH7 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 18 kN)																	
1.60	2.3	2.7	5.0	2.2	ZTR412SPH731_0050 EZ702U	7.7	28	200	5.000	1.17	2.67	22	7	115	4	12	50.9
1.60	3.1	3.9	6.8	1.6	ZTR412SPH731_0050 EZ703U	12	28	310	5.000	1.17	2.67	22	7	115	4	12	50.9
1.60	4.0	5.7	8.8	1.2	ZTR412SPH731_0050 EZ705U	18	28	460	5.000	1.17	2.67	22	7	115	4	12	50.9
1.60	4.2	7.0	9.2	1.2	ZTR412SPH731_0050 EZ802U	18	28	460	5.000	1.17	2.67	22	7	115	4	12	50.9
2.00	1.1	1.3	4.0	4.0	ZTR412SPH731_0040 EZ701U	3.0	28	77	4.000	1.27	2.67	22	7	116	4	12	50.9
2.00	1.8	2.2	6.5	2.5	ZTR412SPH731_0040 EZ702U	6.2	28	160	4.000	1.27	2.67	22	7	116	4	12	50.9
2.00	2.5	3.1	8.9	1.8	ZTR412SPH731_0040 EZ703U	9.8	28	250	4.000	1.27	2.67	22	7	116	4	12	50.9
2.00	3.2	4.6	11	1.4	ZTR412SPH731_0040 EZ705U	16	28	400	4.000	1.27	2.67	22	7	116	4	12	50.9
2.00	3.4	5.6	12	1.3	ZTR412SPH731_0040 EZ802U	15	28	380	4.000	1.27	2.67	22	7	116	4	12	50.9
2.00	4.0	7.3	14	1.1	ZTR412SPH731_0040 EZ803U	18	28	460	4.000	1.27	2.67	22	7	116	4	12	50.9
ZTR4PH7 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 18 kN)																	
0.75	5.6	8.9	4.1	1.1	ZTR412SPH732_0160 EZ505U	18	28	460	16.00	0.50	1.00	22	7	114	4	12	50.9
1.20	4.0	13	3.0	1.4	ZTR412SPH731_0100 EZ802U	18	28	460	10.00	0.67	1.33	22	7	107	4	12	50.9
1.20	4.6	7.5	3.4	1.2	ZTR412SPH731_0100 EZ703U	18	28	460	10.00	0.67	1.33	22	7	107	4	12	50.9
1.71	2.8	9.1	3.3	1.7	ZTR412SPH731_0070 EZ802U	18	28	460	7.000	0.95	1.91	22	7	112	4	12	50.9
1.71	3.2	5.3	3.8	1.5	ZTR412SPH731_0070 EZ703U	17	28	440	7.000	0.95	1.91	22	7	112	4	12	50.9
1.71	4.3	7.9	5.2	1.1	ZTR412SPH731_0070 EZ705U	18	28	460	7.000	0.95	1.91	22	7	112	4	12	50.9
2.40	2.0	6.5	5.0	2.1	ZTR412SPH731_0050 EZ802U	18	28	460	5.000	1.17	2.67	22	7	115	4	12	50.9
2.40	2.3	3.8	5.7	1.9	ZTR412SPH731_0050 EZ703U	12	28	310	5.000	1.17	2.67	22	7	115	4	12	50.9
2.40	3.1	5.7	7.7	1.4	ZTR412SPH731_0050 EZ705U	18	28	460	5.000	1.17	2.67	22	7	115	4	12	50.9
ZTR4PH7 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 18 kN)																	
0.23	8.7	11	0.7	1.1	ZTR412SPH732_0700 EZ501U	18	28	460	70.00	0.14	0.27	22	7	110	4	12	50.9
0.32	6.2	8.0	0.9	1.3	ZTR412SPH732_0500 EZ501U	18	28	460	50.00	0.20	0.37	22	7	112	4	12	50.9
0.40	5.0	6.4	1.1	1.6	ZTR412SPH732_0400 EZ501U	18	28	460	40.00	0.25	0.47	22	7	113	4	12	50.9
0.40	7.6	11	1.7	1.0	ZTR412SPH732_0400 EZ502U	18	28	460	40.00	0.25	0.47	22	7	113	4	12	50.9
0.40	7.6	12	1.7	1.0	ZTR412SPH732_0400 EZ701U	18	28	460	40.00	0.25	0.47	22	7	113	4	12	50.9
0.46	4.3	5.6	1.0	1.7	ZTR412SPH732_0350 EZ501U	18	28	460	35.00	0.28	0.53	22	7	113	4	12	50.9
0.46	6.6	10	1.6	1.1	ZTR412SPH732_0350 EZ502U	18	28	460	35.00	0.28	0.53	22	7	113	4	12	50.9
0.46	6.6	10	1.6	1.1	ZTR412SPH732_0350 EZ701U	18	28	460	35.00	0.28	0.53	22	7	113	4	12	50.9
0.57	3.5	4.5	1.1	2.0	ZTR412SPH732_0280 EZ501U	16	28	420	28.00	0.35	0.67	22	7	114	4	12	50.9
0.57	5.3	8.0	1.7	1.3	ZTR412SPH732_0280 EZ502U	18	28	460	28.00	0.35	0.67	22	7	114	4	12	50.9
0.57	5.3	8.1	1.7	1.3	ZTR412SPH732_0280 EZ701U	18	28	460	28.00	0.35	0.67	22	7	114	4	12	50.9
0.57	6.3	11	2.1	1.1	ZTR412SPH732_0280 EZ503U	18	28	460	28.00	0.35	0.67	22	7	114	4	12	50.9
0.64	3.1	4.0	1.3	2.1	ZTR412SPH732_0250 EZ501U	15	28	370	25.00	0.37	0.75	22	7	113	4	12	50.9
0.64	4.7	7.1	2.0	1.4	ZTR412SPH732_0250 EZ502U	18	28	460	25.00	0.37	0.75	22	7	113	4	12	50.9
0.64	4.7	7.2	2.0	1.4	ZTR412SPH732_0250 EZ701U	18	28	460	25.00	0.37	0.75	22	7	113	4	12	50.9
0.64	5.7	9.7	2.3	1.2	ZTR412SPH732_0250 EZ503U	18	28	460	25.00	0.37	0.75	22	7	113	4	12	50.9
0.64	6.6	13	2.7	1.0	ZTR412SPH732_0250 EZ702U	18	28	460	25.00	0.37	0.75	22	7	113	4	12	50.9
0.80	2.5	3.2	1.5	2.5	ZTR412SPH732_0200 EZ501U	12	28	300	20.00	0.40	0.80	22	7	113	4	12	50.9
0.80	3.8	5.7	2.2	1.6	ZTR412SPH732_0200 EZ502U	18	28	460	20.00	0.40	0.80	22	7	113	4	12	50.9
0.80	3.8	5.8	2.2	1.6	ZTR412SPH732_0200 EZ701U	15	28	370	20.00	0.40	0.80	22	7	113	4	12	50.9
0.80	4.5	7.7	2.6	1.4	ZTR412SPH732_0200 EZ503U	18	28	460	20.00	0.40	0.80	22	7	113	4	12	50.9
0.80	5.3	10	3.1	1.2	ZTR412SPH732_0200 EZ702U	18	28	460	20.00	0.40	0.80	22	7	113	4	12	50.9
1.00	2.0	2.6	1.6	2.9	ZTR412SPH732_0160 EZ501U	9.3	28	240	16.00	0.50	1.00	22	7	114	4	12	50.9
1.00	3.0	4.6	2.5	1.9	ZTR412SPH732_0160 EZ502U	18	28	460	16.00	0.50	1.00	22	7	114	4	12	50.9
1.00	3.0	4.6	2.5	1.9	ZTR412SPH732_0160 EZ701U	12	28	300	16.00	0.50	1.00	22	7	114	4	12	50.9
1.00	3.6	6.2	3.0	1.6	ZTR412SPH732_0160 EZ503U	18	28	460	16.00	0.50	1.00	22	7	114	4	12	50.9
1.00	4.2	8.4	3.4	1.4	ZTR412SPH732_0160 EZ702U	18	28	460	16.00	0.50	1.00	22	7	114	4	12	50.9
ZTR3PH8 (n_{1N} = 2000 rpm, ($F_{f2acc,max}$ = 25 kN)																	
0.67	13	19	8.4	1.6	ZTR332SPH832_0160 EZ805U	25	44	1290	16.00	0.83	1.50	44	15	183	3	32	101.9
1.07	8.2	12	4.2	1.8	ZTR332SPH831_0100 EZ805U	25	44	1290	10.00	1.17	2.13	44	15	162	3	32	101.9
1.52	5.8	8.7	5.0	2.6	ZTR332SPH831_0070 EZ805U	25	44	1290	7.000	1.52	3.05	44	15	179	3	32	101.9
2.13	4.1	6.2	7.5	3.3	ZTR332SPH831_0050 EZ805U	19	44	980	5.000	1.71	4.27	44	15	192	3	32	101.9
2.67	3.3	5.0	12	3.8	ZTR332SPH831_0040 EZ805U	15	39	790	4.000	1.87	4.67	44	15	193	3	32	101.9
ZTR3PH8 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 25 kN)																	
0.16	14	15	0.7	1.3	ZTR332SPH832_1000 EZ701U	25	44	1290	100.0	0.16	0.32	44	15	161	3	32	101.9
0.23	9.5	11	0.6	2.6	ZTR332SPH832_0700 EZ701U	25	44	1290	70.00	0.23	0.46	44	15	174	3	32	101.9
0.23	15	18	1.0	1.6	ZTR332SPH832_0700 EZ702U	25	44	1290	70.00	0.23	0.46	44	15	174	3	32	101.9
0.32	6.8	7.6	0.7	3.7	ZTR332SPH832_0500 EZ701U	18	44	930	50.00	0.32	0.64	44	15	182	3	32	101.9
0.32	11	13	1.1	2.3	ZTR332SPH832_0500 EZ702U	25	44	1290	50.00	0.32	0.64	44	15	182	3	32	101.9
0.32	15	19	1.6	1.7	ZTR332SPH832_0500 EZ703U	25	44	1290	50.00	0.32	0.64	44	15	182	3	32	101.9
0.40	5.4	6.1	1.0	3.7	ZTR332SPH832_0400 EZ701U	15	44	740	40.00	0.40	0.80	44	15	178	3	32	101.9
0.40	8.8	11	1.6	2.3	ZTR332SPH832_0400 EZ702U	25	44	1290	40.00	0.40	0.80	44	15	178	3	32	101.9
0.40	12	15	2.2	1.7	ZTR332SPH832_0400 EZ703U	25	44	1290	40.00	0.40	0.80	44	15	178	3	32	101.9
0.46	4.7	5.3	0.8	4.8	ZTR332SPH832_0350 EZ701U	13	44	650	35.00	0.46	0.91	44	15	184	3	32	101.9
0.46	7.7	9.2	1.4	2.9	ZTR332SPH832_0350 EZ702U	25	44	1290	35.00	0.46	0.91	44	15	184	3	32	101.9

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTR3PH8 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 25 kN)																	
0.46	11	13	1.9	2.1	ZTR332SPH832_0350 EZ703U	25	44	1290	35.00	0.46	0.91	44	15	184	3	32	101.9
0.46	14	19	2.4	1.7	ZTR332SPH832_0350 EZ705U	25	44	1290	35.00	0.46	0.91	44	15	184	3	32	101.9
0.57	6.1	7.4	1.9	3.2	ZTR332SPH832_0280 EZ702U	21	44	1070	28.00	0.57	1.14	44	15	181	3	32	101.9
0.57	8.4	11	2.6	2.3	ZTR332SPH832_0280 EZ703U	25	44	1290	28.00	0.57	1.14	44	15	181	3	32	101.9
0.57	11	15	3.4	1.8	ZTR332SPH832_0280 EZ705U	25	44	1290	28.00	0.57	1.14	44	15	181	3	32	101.9
0.57	11	19	3.5	1.7	ZTR332SPH832_0280 EZ802U	25	44	1290	28.00	0.57	1.14	44	15	181	3	32	101.9
0.64	5.5	6.6	1.6	3.7	ZTR332SPH832_0250 EZ702U	19	44	950	25.00	0.58	1.17	44	15	185	3	32	101.9
0.64	7.5	9.5	2.2	2.7	ZTR332SPH832_0250 EZ703U	25	44	1290	25.00	0.58	1.17	44	15	185	3	32	101.9
0.64	9.7	14	2.9	2.1	ZTR332SPH832_0250 EZ705U	25	44	1290	25.00	0.58	1.17	44	15	185	3	32	101.9
0.64	10	17	3.0	2.0	ZTR332SPH832_0250 EZ802U	25	44	1290	25.00	0.58	1.17	44	15	185	3	32	101.9
0.80	4.4	5.3	1.8	4.3	ZTR332SPH832_0200 EZ702U	15	44	760	20.00	0.67	1.20	44	15	185	3	32	101.9
0.80	6.0	7.6	2.5	3.1	ZTR332SPH832_0200 EZ703U	24	44	1210	20.00	0.67	1.20	44	15	185	3	32	101.9
0.80	7.8	11	3.2	2.4	ZTR332SPH832_0200 EZ705U	25	44	1290	20.00	0.67	1.20	44	15	185	3	32	101.9
0.80	8.1	14	3.4	2.3	ZTR332SPH832_0200 EZ802U	25	44	1290	20.00	0.67	1.20	44	15	185	3	32	101.9
0.80	9.7	18	4.0	1.9	ZTR332SPH832_0200 EZ803U	25	44	1290	20.00	0.67	1.20	44	15	185	3	32	101.9
1.00	3.5	4.2	2.5	5.0	ZTR332SPH832_0160 EZ702U	12	44	610	16.00	0.83	1.50	44	15	183	3	32	101.9
1.00	4.8	6.1	3.5	3.6	ZTR332SPH832_0160 EZ703U	19	44	970	16.00	0.83	1.50	44	15	183	3	32	101.9
1.00	6.2	8.8	4.5	2.8	ZTR332SPH832_0160 EZ705U	25	44	1290	16.00	0.83	1.50	44	15	183	3	32	101.9
1.00	6.5	11	4.7	2.7	ZTR332SPH832_0160 EZ802U	25	44	1290	16.00	0.83	1.50	44	15	183	3	32	101.9
1.00	7.8	14	5.6	2.2	ZTR332SPH832_0160 EZ803U	25	44	1290	16.00	0.83	1.50	44	15	183	3	32	101.9
1.60	4.2	7.0	2.5	3.2	ZTR332SPH831_0100 EZ802U	19	44	960	10.00	1.17	2.13	44	15	162	3	32	101.9
1.60	5.0	9.1	2.9	2.6	ZTR332SPH831_0100 EZ803U	25	44	1290	10.00	1.17	2.13	44	15	162	3	32	101.9
2.29	2.9	4.9	2.9	4.5	ZTR332SPH831_0070 EZ802U	13	44	670	7.000	1.52	3.05	44	15	179	3	32	101.9
2.29	3.5	6.4	3.5	3.8	ZTR332SPH831_0070 EZ803U	19	44	970	7.000	1.52	3.05	44	15	179	3	32	101.9
3.20	2.5	4.5	5.2	4.7	ZTR332SPH831_0050 EZ803U	14	44	700	5.000	1.71	4.27	44	15	192	3	32	101.9
ZTR3PH8 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 25 kN)																	
0.48	11	18	1.3	2.0	ZTR332SPH832_0500 EZ703U	25	44	1290	50.00	0.32	0.64	44	15	182	3	32	101.9
0.60	8.8	15	1.8	2.0	ZTR332SPH832_0400 EZ703U	25	44	1290	40.00	0.40	0.80	44	15	178	3	32	101.9
0.69	7.7	13	1.6	2.6	ZTR332SPH832_0350 EZ703U	25	44	1290	35.00	0.46	0.91	44	15	184	3	32	101.9
0.69	10	19	2.1	1.9	ZTR332SPH832_0350 EZ705U	25	44	1290	35.00	0.46	0.91	44	15	184	3	32	101.9
0.86	5.4	18	1.9	3.2	ZTR332SPH832_0280 EZ802U	25	44	1290	28.00	0.57	1.14	44	15	181	3	32	101.9
0.86	6.2	10	2.2	2.8	ZTR332SPH832_0280 EZ703U	25	44	1290	28.00	0.57	1.14	44	15	181	3	32	101.9
0.86	8.4	15	3.0	2.1	ZTR332SPH832_0280 EZ705U	25	44	1290	28.00	0.57	1.14	44	15	181	3	32	101.9
0.96	4.8	16	1.6	3.7	ZTR332SPH832_0250 EZ802U	25	44	1290	25.00	0.58	1.17	44	15	185	3	32	101.9
0.96	5.5	9.1	1.9	3.2	ZTR332SPH832_0250 EZ703U	25	44	1290	25.00	0.58	1.17	44	15	185	3	32	101.9
0.96	7.5	14	2.5	2.4	ZTR332SPH832_0250 EZ705U	25	44	1290	25.00	0.58	1.17	44	15	185	3	32	101.9
1.20	3.8	13	1.8	4.3	ZTR332SPH832_0200 EZ802U	25	44	1290	20.00	0.67	1.20	44	15	185	3	32	101.9
1.20	4.4	7.3	2.1	3.7	ZTR332SPH832_0200 EZ703U	24	44	1210	20.00	0.67	1.20	44	15	185	3	32	101.9
1.20	6.0	11	2.8	2.7	ZTR332SPH832_0200 EZ705U	25	44	1290	20.00	0.67	1.20	44	15	185	3	32	101.9
1.50	3.1	10	2.5	5.0	ZTR332SPH832_0160 EZ802U	25	44	1290	16.00	0.83	1.50	44	15	183	3	32	101.9
1.50	3.5	5.8	2.9	4.3	ZTR332SPH832_0160 EZ703U	19	44	970	16.00	0.83	1.50	44	15	183	3	32	101.9
1.50	4.8	8.8	3.9	3.2	ZTR332SPH832_0160 EZ705U	25	44	1290	16.00	0.83	1.50	44	15	183	3	32	101.9
ZTR3PH8 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 25 kN)																	
0.32	9.5	14	0.6	1.4	ZTR332SPH832_1000 EZ701U	25	44	1290	100.0	0.16	0.32	44	15	161	3	32	101.9
0.46	6.6	10	0.5	3.0	ZTR332SPH832_0700 EZ701U	25	44	1290	70.00	0.23	0.46	44	15	174	3	32	101.9
0.46	9.2	18	0.7	2.1	ZTR332SPH832_0700 EZ702U	25	44	1290	70.00	0.23	0.46	44	15	174	3	32	101.9
0.64	4.7	7.2	0.6	4.2	ZTR332SPH832_0500 EZ701U	18	44	930	50.00	0.32	0.64	44	15	182	3	32	101.9
0.64	6.6	13	0.9	3.0	ZTR332SPH832_0500 EZ702U	25	44	1290	50.00	0.32	0.64	44	15	182	3	32	101.9
0.80	3.8	5.8	0.9	4.2	ZTR332SPH832_0400 EZ701U	15	44	740	40.00	0.40	0.80	44	15	178	3	32	101.9
0.80	5.3	10	1.2	3.0	ZTR332SPH832_0400 EZ702U	25	44	1290	40.00	0.40	0.80	44	15	178	3	32	101.9
0.91	4.6	9.1	1.0	3.9	ZTR332SPH832_0350 EZ702U	25	44	1290	35.00	0.46	0.91	44	15	184	3	32	101.9
1.14	3.7	7.3	1.4	4.3	ZTR332SPH832_0280 EZ702U	21	44	1070	28.00	0.57	1.14	44	15	181	3	32	101.9
ZTR4PH8 (n_{1N} = 2000 rpm, ($F_{f2acc,max}$ = 36 kN)																	
0.56	15	23	8.4	1.3	ZTR420SPH832_0160 EZ805U	36	50	1510	16.00	0.69	1.25	37	12	206	4	20	84.9
0.76	12	18	4.2	1.4	ZTR417SPH831_0100 EZ805U	35	55	1260	10.00	0.83	1.51	31	10	201	4	17	72.2
1.08	8.1	12	5.0	1.8	ZTR417SPH831_0070 EZ805U	35	55	1260	7.000	1.08	2.16	31	10	213	4	17	72.2
1.51	5.8	8.8	7.5	2.3	ZTR417SPH831_0050 EZ805U	27	55	980	5.000	1.21	3.02	31	10	222	4	17	72.2
1.89	4.7	7.0	12	2.7	ZTR417SPH831_0040 EZ805U	22	55	790	4.000	1.32	3.31	31	10	223	4	17	72.2
ZTR4PH8 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 36 kN)																	
0.11	19	21	0.7	1.3	ZTR417SPH832_1000 EZ701U	35	55	1260	100.0	0.11	0.23	31	10	200	4	17	72.2
0.16	13	15	0.6	2.1	ZTR417SPH832_0700 EZ701U	35	55	1260	70.00	0.16	0.32	31	10	210	4	17	72.2
0.16	22	26	1.0	1.3	ZTR417SPH832_0700 EZ702U	35	55	1260	70.00	0.16	0.32	31	10	210	4	17	72.2
0.19	11	13	0.6	2.5	ZTR420SPH832_0700 EZ701U	31	50	1300	70.00	0.19	0.38	37	12	199	4	20	84.9
0.19	18	22	1.0	1.5	ZTR420SPH832_0700 EZ702U	36	50	1510	70.00	0.19	0.38	37	12	199	4	20	84.9
0.23	9.5	11	0.7	2.6	ZTR417SPH832_0500 EZ701U	26	55	930	50.00	0.23	0.45	31	10	216	4	17	72.2
0.23	15	19	1.1	1.6	ZTR417SPH832_0500 EZ702U	35	55	1260	50.00	0.23	0.45	31	10	216	4	17	72.2

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTR4PH8 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 36 kN)																	
0.23	21	27	1.6	1.2	ZTR417SPH832_0500 EZ703U	35	55	1260	50.00	0.23	0.45	31	10	216	4	17	72.2
0.27	8.1	9.1	0.7	3.1	ZTR420SPH832_0500 EZ701U	22	50	930	50.00	0.27	0.53	37	12	205	4	20	84.9
0.27	13	16	1.1	1.9	ZTR420SPH832_0500 EZ702U	36	50	1510	50.00	0.27	0.53	37	12	205	4	20	84.9
0.27	18	23	1.6	1.4	ZTR420SPH832_0500 EZ703U	36	50	1510	50.00	0.27	0.53	37	12	205	4	20	84.9
0.28	7.6	8.6	1.0	3.1	ZTR417SPH832_0400 EZ701U	21	55	740	40.00	0.28	0.57	31	10	213	4	17	72.2
0.28	12	15	1.6	1.9	ZTR417SPH832_0400 EZ702U	35	55	1260	40.00	0.28	0.57	31	10	213	4	17	72.2
0.28	17	21	2.2	1.4	ZTR417SPH832_0400 EZ703U	35	55	1260	40.00	0.28	0.57	31	10	213	4	17	72.2
0.32	6.7	7.5	0.8	3.3	ZTR417SPH832_0350 EZ701U	18	55	650	35.00	0.32	0.65	31	10	217	4	17	72.2
0.32	11	13	1.4	2.1	ZTR417SPH832_0350 EZ702U	35	55	1260	35.00	0.32	0.65	31	10	217	4	17	72.2
0.32	15	19	1.9	1.5	ZTR417SPH832_0350 EZ703U	35	55	1260	35.00	0.32	0.65	31	10	217	4	17	72.2
0.33	6.5	7.3	1.0	3.6	ZTR420SPH832_0400 EZ701U	18	50	740	40.00	0.33	0.67	37	12	202	4	20	84.9
0.33	11	13	1.6	2.2	ZTR420SPH832_0400 EZ702U	36	50	1510	40.00	0.33	0.67	37	12	202	4	20	84.9
0.33	14	18	2.2	1.6	ZTR420SPH832_0400 EZ703U	36	50	1510	40.00	0.33	0.67	37	12	202	4	20	84.9
0.33	19	26	2.8	1.2	ZTR420SPH832_0400 EZ705U	36	50	1510	40.00	0.33	0.67	37	12	202	4	20	84.9
0.38	5.7	6.4	0.8	3.9	ZTR420SPH832_0350 EZ701U	15	50	650	35.00	0.38	0.76	37	12	207	4	20	84.9
0.38	9.2	11	1.4	2.4	ZTR420SPH832_0350 EZ702U	31	50	1330	35.00	0.38	0.76	37	12	207	4	20	84.9
0.38	13	16	1.9	1.7	ZTR420SPH832_0350 EZ703U	36	50	1510	35.00	0.38	0.76	37	12	207	4	20	84.9
0.38	16	23	2.4	1.4	ZTR420SPH832_0350 EZ705U	36	50	1510	35.00	0.38	0.76	37	12	207	4	20	84.9
0.41	5.3	6.0	1.2	3.9	ZTR417SPH832_0280 EZ701U	14	55	520	28.00	0.41	0.81	31	10	215	4	17	72.2
0.41	8.7	10	1.9	2.4	ZTR417SPH832_0280 EZ702U	30	55	1070	28.00	0.41	0.81	31	10	215	4	17	72.2
0.41	12	15	2.6	1.7	ZTR417SPH832_0280 EZ703U	35	55	1260	28.00	0.41	0.81	31	10	215	4	17	72.2
0.41	15	22	3.4	1.3	ZTR417SPH832_0280 EZ705U	35	55	1260	28.00	0.41	0.81	31	10	215	4	17	72.2
0.41	16	27	3.5	1.3	ZTR417SPH832_0280 EZ802U	35	55	1260	28.00	0.41	0.81	31	10	215	4	17	72.2
0.45	4.8	5.3	1.0	4.2	ZTR417SPH832_0250 EZ701U	13	55	470	25.00	0.41	0.83	31	10	218	4	17	72.2
0.45	7.7	9.3	1.6	2.6	ZTR417SPH832_0250 EZ702U	26	55	950	25.00	0.41	0.83	31	10	218	4	17	72.2
0.45	11	13	2.2	1.9	ZTR417SPH832_0250 EZ703U	35	55	1260	25.00	0.41	0.83	31	10	218	4	17	72.2
0.45	14	19	2.9	1.4	ZTR417SPH832_0250 EZ705U	35	55	1260	25.00	0.41	0.83	31	10	218	4	17	72.2
0.45	14	24	3.0	1.4	ZTR417SPH832_0250 EZ802U	35	55	1260	25.00	0.41	0.83	31	10	218	4	17	72.2
0.48	4.5	5.1	1.2	4.5	ZTR420SPH832_0280 EZ701U	12	50	520	28.00	0.48	0.95	37	12	204	4	20	84.9
0.48	7.4	8.8	1.9	2.8	ZTR420SPH832_0280 EZ702U	25	50	1070	28.00	0.48	0.95	37	12	204	4	20	84.9
0.48	10	13	2.6	2.0	ZTR420SPH832_0280 EZ703U	36	50	1510	28.00	0.48	0.95	37	12	204	4	20	84.9
0.48	13	19	3.4	1.6	ZTR420SPH832_0280 EZ705U	36	50	1510	28.00	0.48	0.95	37	12	204	4	20	84.9
0.48	14	23	3.5	1.5	ZTR420SPH832_0280 EZ802U	36	50	1510	28.00	0.48	0.95	37	12	204	4	20	84.9
0.53	4.1	4.5	1.0	4.9	ZTR420SPH832_0250 EZ701U	11	50	470	25.00	0.48	0.98	37	12	208	4	20	84.9
0.53	6.6	7.9	1.6	3.0	ZTR420SPH832_0250 EZ702U	22	50	950	25.00	0.48	0.98	37	12	208	4	20	84.9
0.53	9.0	11	2.2	2.2	ZTR420SPH832_0250 EZ703U	36	50	1510	25.00	0.48	0.98	37	12	208	4	20	84.9
0.53	12	17	2.9	1.7	ZTR420SPH832_0250 EZ705U	36	50	1510	25.00	0.48	0.98	37	12	208	4	20	84.9
0.53	12	20	3.0	1.6	ZTR420SPH832_0250 EZ802U	36	50	1510	25.00	0.48	0.98	37	12	208	4	20	84.9
0.53	15	26	3.6	1.4	ZTR420SPH832_0250 EZ803U	36	50	1510	25.00	0.48	0.98	37	12	208	4	20	84.9
0.57	3.8	4.3	1.1	4.8	ZTR417SPH832_0200 EZ701U	10	55	370	20.00	0.47	0.85	31	10	218	4	17	72.2
0.57	6.2	7.4	1.8	3.0	ZTR417SPH832_0200 EZ702U	21	55	760	20.00	0.47	0.85	31	10	218	4	17	72.2
0.57	8.5	11	2.5	2.2	ZTR417SPH832_0200 EZ703U	34	55	1210	20.00	0.47	0.85	31	10	218	4	17	72.2
0.57	11	16	3.2	1.7	ZTR417SPH832_0200 EZ705U	35	55	1260	20.00	0.47	0.85	31	10	218	4	17	72.2
0.57	11	19	3.4	1.6	ZTR417SPH832_0200 EZ802U	35	55	1260	20.00	0.47	0.85	31	10	218	4	17	72.2
0.57	14	25	4.0	1.3	ZTR417SPH832_0200 EZ803U	35	55	1260	20.00	0.47	0.85	31	10	218	4	17	72.2
0.67	5.3	6.3	1.8	3.5	ZTR420SPH832_0200 EZ702U	18	50	760	20.00	0.56	1.00	37	12	208	4	20	84.9
0.67	7.2	9.1	2.5	2.5	ZTR420SPH832_0200 EZ703U	28	50	1210	20.00	0.56	1.00	37	12	208	4	20	84.9
0.67	9.3	13	3.2	2.0	ZTR420SPH832_0200 EZ705U	36	50	1510	20.00	0.56	1.00	37	12	208	4	20	84.9
0.67	9.8	16	3.4	1.9	ZTR420SPH832_0200 EZ802U	36	50	1510	20.00	0.56	1.00	37	12	208	4	20	84.9
0.67	12	21	4.0	1.6	ZTR420SPH832_0200 EZ803U	36	50	1510	20.00	0.56	1.00	37	12	208	4	20	84.9
0.71	4.9	5.9	2.5	3.5	ZTR417SPH832_0160 EZ702U	17	55	610	16.00	0.59	1.06	31	10	216	4	17	72.2
0.71	6.8	8.6	3.5	2.5	ZTR417SPH832_0160 EZ703U	27	55	970	16.00	0.59	1.06	31	10	216	4	17	72.2
0.71	8.8	12	4.5	2.0	ZTR417SPH832_0160 EZ705U	35	55	1260	16.00	0.59	1.06	31	10	216	4	17	72.2
0.71	9.2	15	4.7	1.9	ZTR417SPH832_0160 EZ802U	35	55	1260	16.00	0.59	1.06	31	10	216	4	17	72.2
0.71	11	20	5.6	1.6	ZTR417SPH832_0160 EZ803U	35	55	1260	16.00	0.59	1.06	31	10	216	4	17	72.2
0.83	4.2	5.0	2.5	4.1	ZTR420SPH832_0160 EZ702U	14	50	610	16.00	0.69	1.25	37	12	206	4	20	84.9
0.83	5.8	7.3	3.5	2.9	ZTR420SPH832_0160 EZ703U	23	50	970	16.00	0.69	1.25	37	12	206	4	20	84.9
0.83	7.5	11	4.5	2.3	ZTR420SPH832_0160 EZ705U	36	50	1510	16.00	0.69	1.25	37	12	206	4	20	84.9
0.83	7.8	13	4.7	2.2	ZTR420SPH832_0160 EZ802U	35	50	1490	16.00	0.69	1.25	37	12	206	4	20	84.9
0.83	9.3	17	5.6	1.8	ZTR420SPH832_0160 EZ803U	36	50	1510	16.00	0.69	1.25	37	12	206	4	20	84.9
1.13	5.9	9.9	2.5	2.5	ZTR417SPH831_0100 EZ802U	27	55	960	10.00	0.83	1.51	31	10	201	4	17	72.2
1.13	7.1	13	2.9	2.1	ZTR417SPH831_0100 EZ803U	35	55	1260	10.00	0.83	1.51	31	10	201	4	17	72.2
1.33	5.0	8.4	2.5	2.9	ZTR420SPH831_0100 EZ802U	23	50	960	10.00	0.98	1.78	37	12	188	4	20	84.9
1.33	6.0	11	2.9	2.4	ZTR420SPH831_0100 EZ803U	33	50	1390	10.00	0.98	1.78	37	12	188	4	20	84.9
1.62	4.2	6.9	2.9	3.1	ZTR417SPH831_0070 EZ802U	19	55	670	7.000	1.08	2.16	31	10	213	4	17	72.2
1.62	5.0	9.0	3.5	2.6	ZTR417SPH831_0070 EZ803U	27	55	970	7.000	1.08	2.16	31	10	213	4	17	72.2
1.91	3.5	5.9	2.9	3.7	ZTR420SPH831_0070 EZ802U	16	50	670	7.000	1.27	2.54	37	12	203	4	20	84.9

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTR4PH8 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 36 kN)																	
1.91	4.2	7.6	3.5	3.1	ZTR420SPH831_0070 EZ803U	23	50	970	7.000	1.27	2.54	37	12	203	4	20	84.9
2.27	3.0	4.9	4.4	3.9	ZTR417SPH831_0050 EZ802U	13	55	480	5.000	1.21	3.02	31	10	222	4	17	72.2
2.27	3.5	6.4	5.2	3.3	ZTR417SPH831_0050 EZ803U	19	55	700	5.000	1.21	3.02	31	10	222	4	17	72.2
2.67	2.5	4.2	4.4	4.6	ZTR420SPH831_0050 EZ802U	11	50	480	5.000	1.42	3.56	37	12	214	4	20	84.9
2.67	3.0	5.5	5.2	3.8	ZTR420SPH831_0050 EZ803U	16	50	700	5.000	1.42	3.56	37	12	214	4	20	84.9
2.83	2.4	3.9	7.2	4.6	ZTR417SPH831_0040 EZ802U	11	55	380	4.000	1.32	3.31	31	10	223	4	17	72.2
2.83	2.8	5.1	8.6	3.8	ZTR417SPH831_0040 EZ803U	15	55	560	4.000	1.32	3.31	31	10	223	4	17	72.2
3.33	2.4	4.4	8.6	4.5	ZTR420SPH831_0040 EZ803U	13	47	560	4.000	1.56	3.89	37	12	215	4	20	84.9
ZTR4PH8 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 36 kN)																	
0.34	16	26	1.3	1.4	ZTR417SPH832_0500 EZ703U	35	55	1260	50.00	0.23	0.45	31	10	216	4	17	72.2
0.43	12	21	1.8	1.6	ZTR417SPH832_0400 EZ703U	35	55	1260	40.00	0.28	0.57	31	10	213	4	17	72.2
0.49	11	18	1.6	1.8	ZTR417SPH832_0350 EZ703U	35	55	1260	35.00	0.32	0.65	31	10	217	4	17	72.2
0.50	11	18	1.8	1.9	ZTR420SPH832_0400 EZ703U	36	50	1510	40.00	0.33	0.67	37	12	202	4	20	84.9
0.50	14	26	2.5	1.4	ZTR420SPH832_0400 EZ705U	36	50	1510	40.00	0.33	0.67	37	12	202	4	20	84.9
0.57	8.1	26	1.4	2.4	ZTR420SPH832_0350 EZ802U	36	50	1510	35.00	0.38	0.76	37	12	207	4	20	84.9
0.57	9.3	15	1.6	2.1	ZTR420SPH832_0350 EZ703U	36	50	1510	35.00	0.38	0.76	37	12	207	4	20	84.9
0.57	13	23	2.1	1.5	ZTR420SPH832_0350 EZ705U	36	50	1510	35.00	0.38	0.76	37	12	207	4	20	84.9
0.61	7.6	25	1.9	2.4	ZTR417SPH832_0280 EZ802U	35	55	1260	28.00	0.41	0.81	31	10	215	4	17	72.2
0.61	8.7	14	2.2	2.1	ZTR417SPH832_0280 EZ703U	35	55	1260	28.00	0.41	0.81	31	10	215	4	17	72.2
0.61	12	22	3.0	1.5	ZTR417SPH832_0280 EZ705U	35	55	1260	28.00	0.41	0.81	31	10	215	4	17	72.2
0.68	6.8	22	1.6	2.6	ZTR417SPH832_0250 EZ802U	35	55	1260	25.00	0.41	0.83	31	10	218	4	17	72.2
0.68	7.8	13	1.9	2.2	ZTR417SPH832_0250 EZ703U	35	55	1260	25.00	0.41	0.83	31	10	218	4	17	72.2
0.68	11	19	2.5	1.6	ZTR417SPH832_0250 EZ705U	35	55	1260	25.00	0.41	0.83	31	10	218	4	17	72.2
0.71	6.4	21	1.9	2.8	ZTR420SPH832_0280 EZ802U	36	50	1510	28.00	0.48	0.95	37	12	204	4	20	84.9
0.71	7.4	12	2.2	2.4	ZTR420SPH832_0280 EZ703U	36	50	1510	28.00	0.48	0.95	37	12	204	4	20	84.9
0.71	10	18	3.0	1.8	ZTR420SPH832_0280 EZ705U	36	50	1510	28.00	0.48	0.95	37	12	204	4	20	84.9
0.80	5.8	19	1.6	3.0	ZTR420SPH832_0250 EZ802U	36	50	1510	25.00	0.48	0.98	37	12	208	4	20	84.9
0.80	6.6	11	1.9	2.6	ZTR420SPH832_0250 EZ703U	36	50	1510	25.00	0.48	0.98	37	12	208	4	20	84.9
0.80	9.0	16	2.5	1.9	ZTR420SPH832_0250 EZ705U	36	50	1510	25.00	0.48	0.98	37	12	208	4	20	84.9
0.85	5.4	18	1.8	3.0	ZTR417SPH832_0200 EZ802U	35	55	1260	20.00	0.47	0.85	31	10	218	4	17	72.2
0.85	6.2	10	2.1	2.6	ZTR417SPH832_0200 EZ703U	34	55	1210	20.00	0.47	0.85	31	10	218	4	17	72.2
0.85	8.5	15	2.8	1.9	ZTR417SPH832_0200 EZ705U	35	55	1260	20.00	0.47	0.85	31	10	218	4	17	72.2
1.00	4.6	15	1.8	3.5	ZTR420SPH832_0200 EZ802U	36	50	1510	20.00	0.56	1.00	37	12	208	4	20	84.9
1.00	5.3	8.8	2.1	3.0	ZTR420SPH832_0200 EZ703U	28	50	1210	20.00	0.56	1.00	37	12	208	4	20	84.9
1.00	7.2	13	2.8	2.2	ZTR420SPH832_0200 EZ705U	36	50	1510	20.00	0.56	1.00	37	12	208	4	20	84.9
1.06	4.3	14	2.5	3.5	ZTR417SPH832_0160 EZ802U	35	55	1260	16.00	0.59	1.06	31	10	216	4	17	72.2
1.06	5.0	8.2	2.9	3.0	ZTR417SPH832_0160 EZ703U	27	55	970	16.00	0.59	1.06	31	10	216	4	17	72.2
1.06	6.8	12	3.9	2.2	ZTR417SPH832_0160 EZ705U	35	55	1260	16.00	0.59	1.06	31	10	216	4	17	72.2
1.25	3.7	12	2.5	4.0	ZTR420SPH832_0160 EZ802U	35	50	1490	16.00	0.69	1.25	37	12	206	4	20	84.9
1.25	4.2	7.0	2.9	3.5	ZTR420SPH832_0160 EZ703U	23	50	970	16.00	0.69	1.25	37	12	206	4	20	84.9
1.25	5.7	11	3.9	2.6	ZTR420SPH832_0160 EZ705U	36	50	1510	16.00	0.69	1.25	37	12	206	4	20	84.9
ZTR4PH8 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 36 kN)																	
0.23	13	20	0.6	1.4	ZTR417SPH832_1000 EZ701U	35	55	1260	100.0	0.11	0.23	31	10	200	4	17	72.2
0.32	9.4	14	0.5	2.4	ZTR417SPH832_0700 EZ701U	35	55	1260	70.00	0.16	0.32	31	10	210	4	17	72.2
0.32	13	26	0.7	1.7	ZTR417SPH832_0700 EZ702U	35	55	1260	70.00	0.16	0.32	31	10	210	4	17	72.2
0.38	8.0	12	0.5	2.8	ZTR420SPH832_0700 EZ701U	31	50	1300	70.00	0.19	0.38	37	12	199	4	20	84.9
0.38	11	22	0.7	2.0	ZTR420SPH832_0700 EZ702U	36	50	1510	70.00	0.19	0.38	37	12	199	4	20	84.9
0.45	6.7	10	0.6	3.0	ZTR417SPH832_0500 EZ701U	26	55	930	50.00	0.23	0.45	31	10	216	4	17	72.2
0.45	9.3	18	0.9	2.1	ZTR417SPH832_0500 EZ702U	35	55	1260	50.00	0.23	0.45	31	10	216	4	17	72.2
0.53	5.7	8.7	0.6	3.5	ZTR420SPH832_0500 EZ701U	22	50	930	50.00	0.27	0.53	37	12	205	4	20	84.9
0.53	7.9	16	0.9	2.5	ZTR420SPH832_0500 EZ702U	36	50	1510	50.00	0.27	0.53	37	12	205	4	20	84.9
0.57	5.4	8.1	0.9	3.4	ZTR417SPH832_0400 EZ701U	21	55	740	40.00	0.28	0.57	31	10	213	4	17	72.2
0.57	7.4	15	1.2	2.5	ZTR417SPH832_0400 EZ702U	35	55	1260	40.00	0.28	0.57	31	10	213	4	17	72.2
0.65	4.7	7.1	0.7	3.8	ZTR417SPH832_0350 EZ701U	18	55	650	35.00	0.32	0.65	31	10	217	4	17	72.2
0.65	6.5	13	1.0	2.7	ZTR417SPH832_0350 EZ702U	35	55	1260	35.00	0.32	0.65	31	10	217	4	17	72.2
0.67	4.6	6.9	0.9	4.0	ZTR420SPH832_0400 EZ701U	18	50	740	40.00	0.33	0.67	37	12	202	4	20	84.9
0.67	6.3	13	1.2	2.9	ZTR420SPH832_0400 EZ702U	36	50	1510	40.00	0.33	0.67	37	12	202	4	20	84.9
0.76	4.0	6.1	0.7	4.4	ZTR420SPH832_0350 EZ701U	15	50	650	35.00	0.38	0.76	37	12	207	4	20	84.9
0.76	5.5	11	1.0	3.2	ZTR420SPH832_0350 EZ702U	31	50	1330	35.00	0.38	0.76	37	12	207	4	20	84.9
0.81	3.8	5.7	1.0	4.4	ZTR417SPH832_0280 EZ701U	14	55	520	28.00	0.41	0.81	31	10	215	4	17	72.2
0.81	5.2	10	1.4	3.2	ZTR417SPH832_0280 EZ702U	30	55	1070	28.00	0.41	0.81	31	10	215	4	17	72.2
0.95	4.4	8.8	1.4	3.7	ZTR420SPH832_0280 EZ702U	25	50	1070	28.00	0.48	0.95	37	12	204	4	20	84.9
ZTR5PH8 (n_{1N} = 2000 rpm, ($F_{f2acc,max}$ = 34 kN)																	
0.50	17	26	6.6	1.2	ZTR518SPH832_0200 EZ805U	34	44	1620	20.00	0.63	1.13	42	14	204	5	18	95.5
0.63	14	21	8.4	1.4	ZTR518SPH832_0160 EZ805U	34	44	1620	16.00	0.78	1.41	42	14	201	5	18	95.5
1.00	8.8	13	4.2	1.8	ZTR518SPH831_0100 EZ805U	29	44	1390	10.00	1.10	2.00	42	14	179	5	18	95.5

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTR5PH8 (n_{1N} = 2000 rpm, ($F_{f2acc,max}$ = 34 kN)																	
1.43	6.2	9.3	5.0	2.3	ZTR518SPH831_0070 EZ805U	29	44	1380	7.000	1.43	2.86	42	14	197	5	18	95.5
2.00	4.4	6.6	7.5	2.9	ZTR518SPH831_0050 EZ805U	21	44	980	5.000	1.60	4.00	42	14	210	5	18	95.5
2.50	3.5	5.3	12	3.4	ZTR518SPH831_0040 EZ805U	16	42	790	4.000	1.75	4.38	42	14	212	5	18	95.5
ZTR5PH8 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 34 kN)																	
0.15	14	16	0.7	1.3	ZTR518SPH832_1000 EZ701U	29	44	1380	100.0	0.15	0.30	42	14	177	5	18	95.5
0.21	10	11	0.6	2.6	ZTR518SPH832_0700 EZ701U	27	44	1300	70.00	0.21	0.43	42	14	192	5	18	95.5
0.21	16	20	1.0	1.6	ZTR518SPH832_0700 EZ702U	34	44	1620	70.00	0.21	0.43	42	14	192	5	18	95.5
0.30	7.2	8.1	0.7	3.4	ZTR518SPH832_0500 EZ701U	19	44	930	50.00	0.30	0.60	42	14	200	5	18	95.5
0.30	12	14	1.1	2.1	ZTR518SPH832_0500 EZ702U	34	44	1620	50.00	0.30	0.60	42	14	200	5	18	95.5
0.30	16	20	1.6	1.5	ZTR518SPH832_0500 EZ703U	34	44	1620	50.00	0.30	0.60	42	14	200	5	18	95.5
0.38	5.8	6.5	1.0	3.7	ZTR518SPH832_0400 EZ701U	16	44	740	40.00	0.38	0.75	42	14	195	5	18	95.5
0.38	9.3	11	1.6	2.3	ZTR518SPH832_0400 EZ702U	32	44	1530	40.00	0.38	0.75	42	14	195	5	18	95.5
0.38	13	16	2.2	1.7	ZTR518SPH832_0400 EZ703U	34	44	1620	40.00	0.38	0.75	42	14	195	5	18	95.5
0.38	17	24	2.8	1.3	ZTR518SPH832_0400 EZ705U	34	44	1620	40.00	0.38	0.75	42	14	195	5	18	95.5
0.43	5.0	5.7	0.8	4.3	ZTR518SPH832_0350 EZ701U	14	44	650	35.00	0.43	0.86	42	14	202	5	18	95.5
0.43	8.2	9.8	1.4	2.6	ZTR518SPH832_0350 EZ702U	28	44	1330	35.00	0.43	0.86	42	14	202	5	18	95.5
0.43	11	14	1.9	1.9	ZTR518SPH832_0350 EZ703U	34	44	1620	35.00	0.43	0.86	42	14	202	5	18	95.5
0.43	15	21	2.4	1.5	ZTR518SPH832_0350 EZ705U	34	44	1620	35.00	0.43	0.86	42	14	202	5	18	95.5
0.43	15	25	2.5	1.4	ZTR518SPH832_0350 EZ802U	34	44	1620	35.00	0.43	0.86	42	14	202	5	18	95.5
0.54	4.0	4.5	1.2	5.0	ZTR518SPH832_0280 EZ701U	11	44	520	28.00	0.54	1.07	42	14	199	5	18	95.5
0.54	6.5	7.9	1.9	3.1	ZTR518SPH832_0280 EZ702U	22	44	1070	28.00	0.54	1.07	42	14	199	5	18	95.5
0.54	9.0	11	2.6	2.2	ZTR518SPH832_0280 EZ703U	34	44	1620	28.00	0.54	1.07	42	14	199	5	18	95.5
0.54	12	16	3.4	1.7	ZTR518SPH832_0280 EZ705U	34	44	1620	28.00	0.54	1.07	42	14	199	5	18	95.5
0.54	12	20	3.5	1.6	ZTR518SPH832_0280 EZ802U	34	44	1620	28.00	0.54	1.07	42	14	199	5	18	95.5
0.60	5.8	7.0	1.6	3.3	ZTR518SPH832_0250 EZ702U	20	44	950	25.00	0.54	1.10	42	14	203	5	18	95.5
0.60	8.0	10	2.2	2.4	ZTR518SPH832_0250 EZ703U	32	44	1510	25.00	0.54	1.10	42	14	203	5	18	95.5
0.60	10	15	2.9	1.9	ZTR518SPH832_0250 EZ705U	34	44	1620	25.00	0.54	1.10	42	14	203	5	18	95.5
0.60	11	18	3.0	1.8	ZTR518SPH832_0250 EZ802U	34	44	1620	25.00	0.54	1.10	42	14	203	5	18	95.5
0.60	13	23	3.6	1.5	ZTR518SPH832_0250 EZ803U	34	44	1620	25.00	0.54	1.10	42	14	203	5	18	95.5
0.75	4.7	5.6	1.8	3.8	ZTR518SPH832_0200 EZ702U	16	44	760	20.00	0.63	1.13	42	14	204	5	18	95.5
0.75	6.4	8.1	2.5	2.8	ZTR518SPH832_0200 EZ703U	25	44	1210	20.00	0.63	1.13	42	14	204	5	18	95.5
0.75	8.3	12	3.2	2.2	ZTR518SPH832_0200 EZ705U	34	44	1620	20.00	0.63	1.13	42	14	204	5	18	95.5
0.75	8.7	14	3.4	2.1	ZTR518SPH832_0200 EZ802U	34	44	1620	20.00	0.63	1.13	42	14	204	5	18	95.5
0.75	10	19	4.0	1.7	ZTR518SPH832_0200 EZ803U	34	44	1620	20.00	0.63	1.13	42	14	204	5	18	95.5
0.94	3.7	4.5	2.5	4.4	ZTR518SPH832_0160 EZ702U	13	44	610	16.00	0.78	1.41	42	14	201	5	18	95.5
0.94	5.1	6.5	3.5	3.2	ZTR518SPH832_0160 EZ703U	20	44	970	16.00	0.78	1.41	42	14	201	5	18	95.5
0.94	6.6	9.4	4.5	2.5	ZTR518SPH832_0160 EZ705U	32	44	1550	16.00	0.78	1.41	42	14	201	5	18	95.5
0.94	6.9	12	4.7	2.4	ZTR518SPH832_0160 EZ802U	31	44	1490	16.00	0.78	1.41	42	14	201	5	18	95.5
0.94	8.3	15	5.6	2.0	ZTR518SPH832_0160 EZ803U	34	44	1620	16.00	0.78	1.41	42	14	201	5	18	95.5
1.50	4.5	7.5	2.5	3.2	ZTR518SPH831_0100 EZ802U	20	44	960	10.00	1.10	2.00	42	14	179	5	18	95.5
1.50	5.3	9.7	2.9	2.6	ZTR518SPH831_0100 EZ803U	29	44	1390	10.00	1.10	2.00	42	14	179	5	18	95.5
2.14	3.1	5.2	2.9	4.0	ZTR518SPH831_0070 EZ802U	14	44	670	7.000	1.43	2.86	42	14	197	5	18	95.5
2.14	3.7	6.8	3.5	3.4	ZTR518SPH831_0070 EZ803U	20	44	970	7.000	1.43	2.86	42	14	197	5	18	95.5
3.00	2.7	4.8	5.2	4.2	ZTR518SPH831_0050 EZ803U	15	44	700	5.000	1.60	4.00	42	14	210	5	18	95.5
3.75	2.1	3.9	8.6	4.9	ZTR518SPH831_0040 EZ803U	12	42	560	4.000	1.75	4.38	42	14	212	5	18	95.5
ZTR5PH8 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 34 kN)																	
0.45	12	19	1.3	1.8	ZTR518SPH832_0500 EZ703U	34	44	1620	50.00	0.30	0.60	42	14	200	5	18	95.5
0.56	9.4	16	1.8	2.0	ZTR518SPH832_0400 EZ703U	34	44	1620	40.00	0.38	0.75	42	14	195	5	18	95.5
0.56	13	23	2.5	1.5	ZTR518SPH832_0400 EZ705U	34	44	1620	40.00	0.38	0.75	42	14	195	5	18	95.5
0.64	7.2	24	1.4	2.6	ZTR518SPH832_0350 EZ802U	34	44	1620	35.00	0.43	0.86	42	14	202	5	18	95.5
0.64	8.2	14	1.6	2.3	ZTR518SPH832_0350 EZ703U	34	44	1620	35.00	0.43	0.86	42	14	202	5	18	95.5
0.64	11	20	2.1	1.7	ZTR518SPH832_0350 EZ705U	34	44	1620	35.00	0.43	0.86	42	14	202	5	18	95.5
0.80	5.7	19	1.9	3.1	ZTR518SPH832_0280 EZ802U	34	44	1620	28.00	0.54	1.07	42	14	199	5	18	95.5
0.80	6.6	11	2.2	2.7	ZTR518SPH832_0280 EZ703U	34	44	1620	28.00	0.54	1.07	42	14	199	5	18	95.5
0.80	8.9	16	3.0	2.0	ZTR518SPH832_0280 EZ705U	34	44	1620	28.00	0.54	1.07	42	14	199	5	18	95.5
0.90	5.1	17	1.6	3.3	ZTR518SPH832_0250 EZ802U	34	44	1620	25.00	0.54	1.10	42	14	203	5	18	95.5
0.90	5.9	9.7	1.9	2.9	ZTR518SPH832_0250 EZ703U	32	44	1510	25.00	0.54	1.10	42	14	203	5	18	95.5
0.90	8.0	15	2.5	2.1	ZTR518SPH832_0250 EZ705U	34	44	1620	25.00	0.54	1.10	42	14	203	5	18	95.5
1.13	4.1	13	1.8	3.8	ZTR518SPH832_0200 EZ802U	34	44	1620	20.00	0.63	1.13	42	14	204	5	18	95.5
1.13	4.7	7.8	2.1	3.3	ZTR518SPH832_0200 EZ703U	25	44	1210	20.00	0.63	1.13	42	14	204	5	18	95.5
1.13	6.4	12	2.8	2.4	ZTR518SPH832_0200 EZ705U	34	44	1620	20.00	0.63	1.13	42	14	204	5	18	95.5
1.41	3.3	11	2.5	4.4	ZTR518SPH832_0160 EZ802U	31	44	1490	16.00	0.78	1.41	42	14	201	5	18	95.5
1.41	3.8	6.2	2.9	3.9	ZTR518SPH832_0160 EZ703U	20	44	970	16.00	0.78	1.41	42	14	201	5	18	95.5
1.41	5.1	9.3	3.9	2.8	ZTR518SPH832_0160 EZ705U	32	44	1550	16.00	0.78	1.41	42	14	201	5	18	95.5

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTR5PH8 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 34 kN)																	
0.30	10	15	0.6	1.4	ZTR518SPH832_1000 EZ701U	29	44	1380	100.0	0.15	0.30	42	14	177	5	18	95.5
0.43	7.1	11	0.5	3.0	ZTR518SPH832_0700 EZ701U	27	44	1300	70.00	0.21	0.43	42	14	192	5	18	95.5
0.43	9.8	19	0.7	2.1	ZTR518SPH832_0700 EZ702U	34	44	1620	70.00	0.21	0.43	42	14	192	5	18	95.5
0.60	5.1	7.7	0.6	3.8	ZTR518SPH832_0500 EZ701U	19	44	930	50.00	0.30	0.60	42	14	200	5	18	95.5
0.60	7.0	14	0.9	2.8	ZTR518SPH832_0500 EZ702U	34	44	1620	50.00	0.30	0.60	42	14	200	5	18	95.5
0.75	4.1	6.2	0.9	4.2	ZTR518SPH832_0400 EZ701U	16	44	740	40.00	0.38	0.75	42	14	195	5	18	95.5
0.75	5.6	11	1.2	3.0	ZTR518SPH832_0400 EZ702U	32	44	1530	40.00	0.38	0.75	42	14	195	5	18	95.5
0.86	3.5	5.4	0.7	4.8	ZTR518SPH832_0350 EZ701U	14	44	650	35.00	0.43	0.86	42	14	202	5	18	95.5
0.86	4.9	9.7	1.0	3.5	ZTR518SPH832_0350 EZ702U	28	44	1330	35.00	0.43	0.86	42	14	202	5	18	95.5
1.07	3.9	7.8	1.4	4.0	ZTR518SPH832_0280 EZ702U	22	44	1070	28.00	0.54	1.07	42	14	199	5	18	95.5
ZTR6PH8 (n_{1N} = 2000 rpm, ($F_{f2acc,max}$ = 33 kN)																	
0.63	14	21	8.4	1.4	ZTR615SPH832_0160 EZ805U	33	44	1580	16.00	0.78	1.41	42	14	202	6	15	95.5
1.00	8.8	13	4.2	1.8	ZTR615SPH831_0100 EZ805U	29	44	1390	10.00	1.10	2.00	42	14	180	6	15	95.5
1.43	6.2	9.3	5.0	2.3	ZTR615SPH831_0070 EZ805U	29	44	1380	7.000	1.43	2.86	42	14	198	6	15	95.5
2.00	4.4	6.6	7.5	2.9	ZTR615SPH831_0050 EZ805U	21	44	980	5.000	1.60	4.00	42	14	211	6	15	95.5
2.50	3.5	5.3	12	3.4	ZTR615SPH831_0040 EZ805U	16	42	790	4.000	1.75	4.38	42	14	213	6	15	95.5
ZTR6PH8 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 33 kN)																	
0.15	14	16	0.7	1.3	ZTR615SPH832_1000 EZ701U	29	44	1380	100.0	0.15	0.30	42	14	178	6	15	95.5
0.21	10	11	0.6	2.6	ZTR615SPH832_0700 EZ701U	27	44	1300	70.00	0.21	0.43	42	14	193	6	15	95.5
0.21	16	20	1.0	1.6	ZTR615SPH832_0700 EZ702U	33	44	1580	70.00	0.21	0.43	42	14	193	6	15	95.5
0.30	7.2	8.1	0.7	3.3	ZTR615SPH832_0500 EZ701U	19	44	930	50.00	0.30	0.60	42	14	201	6	15	95.5
0.30	12	14	1.1	2.0	ZTR615SPH832_0500 EZ702U	33	44	1580	50.00	0.30	0.60	42	14	201	6	15	95.5
0.30	16	20	1.6	1.5	ZTR615SPH832_0500 EZ703U	33	44	1580	50.00	0.30	0.60	42	14	201	6	15	95.5
0.38	5.8	6.5	1.0	3.7	ZTR615SPH832_0400 EZ701U	16	44	740	40.00	0.38	0.75	42	14	196	6	15	95.5
0.38	9.3	11	1.6	2.3	ZTR615SPH832_0400 EZ702U	32	44	1530	40.00	0.38	0.75	42	14	196	6	15	95.5
0.38	13	16	2.2	1.7	ZTR615SPH832_0400 EZ703U	33	44	1580	40.00	0.38	0.75	42	14	196	6	15	95.5
0.38	17	24	2.8	1.3	ZTR615SPH832_0400 EZ705U	33	44	1580	40.00	0.38	0.75	42	14	196	6	15	95.5
0.43	5.0	5.7	0.8	4.2	ZTR615SPH832_0350 EZ701U	14	44	650	35.00	0.43	0.86	42	14	203	6	15	95.5
0.43	8.2	9.8	1.4	2.6	ZTR615SPH832_0350 EZ702U	28	44	1330	35.00	0.43	0.86	42	14	203	6	15	95.5
0.43	11	14	1.9	1.9	ZTR615SPH832_0350 EZ703U	33	44	1580	35.00	0.43	0.86	42	14	203	6	15	95.5
0.43	15	21	2.4	1.5	ZTR615SPH832_0350 EZ705U	33	44	1580	35.00	0.43	0.86	42	14	203	6	15	95.5
0.43	15	25	2.5	1.4	ZTR615SPH832_0350 EZ802U	33	44	1580	35.00	0.43	0.86	42	14	203	6	15	95.5
0.54	4.0	4.5	1.2	4.9	ZTR615SPH832_0280 EZ701U	11	44	520	28.00	0.54	1.07	42	14	199	6	15	95.5
0.54	6.5	7.9	1.9	3.0	ZTR615SPH832_0280 EZ702U	22	44	1070	28.00	0.54	1.07	42	14	199	6	15	95.5
0.54	9.0	11	2.6	2.2	ZTR615SPH832_0280 EZ703U	33	44	1580	28.00	0.54	1.07	42	14	199	6	15	95.5
0.54	12	16	3.4	1.7	ZTR615SPH832_0280 EZ705U	33	44	1580	28.00	0.54	1.07	42	14	199	6	15	95.5
0.54	12	20	3.5	1.6	ZTR615SPH832_0280 EZ802U	33	44	1580	28.00	0.54	1.07	42	14	199	6	15	95.5
0.60	5.8	7.0	1.6	3.2	ZTR615SPH832_0250 EZ702U	20	44	950	25.00	0.54	1.10	42	14	204	6	15	95.5
0.60	8.0	10	2.2	2.4	ZTR615SPH832_0250 EZ703U	32	44	1510	25.00	0.54	1.10	42	14	204	6	15	95.5
0.60	10	15	2.9	1.8	ZTR615SPH832_0250 EZ705U	33	44	1580	25.00	0.54	1.10	42	14	204	6	15	95.5
0.60	11	18	3.0	1.7	ZTR615SPH832_0250 EZ802U	33	44	1580	25.00	0.54	1.10	42	14	204	6	15	95.5
0.60	13	23	3.6	1.5	ZTR615SPH832_0250 EZ803U	33	44	1580	25.00	0.54	1.10	42	14	204	6	15	95.5
0.75	4.7	5.6	1.8	3.8	ZTR615SPH832_0200 EZ702U	16	44	760	20.00	0.63	1.13	42	14	204	6	15	95.5
0.75	6.4	8.1	2.5	2.7	ZTR615SPH832_0200 EZ703U	25	44	1210	20.00	0.63	1.13	42	14	204	6	15	95.5
0.75	8.3	12	3.2	2.1	ZTR615SPH832_0200 EZ705U	33	44	1580	20.00	0.63	1.13	42	14	204	6	15	95.5
0.75	8.7	14	3.4	2.0	ZTR615SPH832_0200 EZ802U	33	44	1580	20.00	0.63	1.13	42	14	204	6	15	95.5
0.75	10	19	4.0	1.7	ZTR615SPH832_0200 EZ803U	33	44	1580	20.00	0.63	1.13	42	14	204	6	15	95.5
0.94	3.7	4.5	2.5	4.4	ZTR615SPH832_0160 EZ702U	13	44	610	16.00	0.78	1.41	42	14	202	6	15	95.5
0.94	5.1	6.5	3.5	3.2	ZTR615SPH832_0160 EZ703U	20	44	970	16.00	0.78	1.41	42	14	202	6	15	95.5
0.94	6.6	9.4	4.5	2.5	ZTR615SPH832_0160 EZ705U	32	44	1550	16.00	0.78	1.41	42	14	202	6	15	95.5
0.94	6.9	12	4.7	2.4	ZTR615SPH832_0160 EZ802U	31	44	1490	16.00	0.78	1.41	42	14	202	6	15	95.5
0.94	8.3	15	5.6	2.0	ZTR615SPH832_0160 EZ803U	33	44	1580	16.00	0.78	1.41	42	14	202	6	15	95.5
1.50	4.5	7.5	2.5	3.1	ZTR615SPH831_0100 EZ802U	20	44	960	10.00	1.10	2.00	42	14	180	6	15	95.5
1.50	5.3	9.7	2.9	2.6	ZTR615SPH831_0100 EZ803U	29	44	1390	10.00	1.10	2.00	42	14	180	6	15	95.5
2.14	3.1	5.2	2.9	4.0	ZTR615SPH831_0070 EZ802U	14	44	670	7.000	1.43	2.86	42	14	198	6	15	95.5
2.14	3.7	6.8	3.5	3.3	ZTR615SPH831_0070 EZ803U	20	44	970	7.000	1.43	2.86	42	14	198	6	15	95.5
3.00	2.2	3.7	4.4	4.9	ZTR615SPH831_0050 EZ802U	10	44	480	5.000	1.60	4.00	42	14	211	6	15	95.5
3.00	2.7	4.8	5.2	4.1	ZTR615SPH831_0050 EZ803U	15	44	700	5.000	1.60	4.00	42	14	211	6	15	95.5
3.75	2.1	3.9	8.6	4.8	ZTR615SPH831_0040 EZ803U	12	42	560	4.000	1.75	4.38	42	14	213	6	15	95.5
ZTR6PH8 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 33 kN)																	
0.45	12	19	1.3	1.8	ZTR615SPH832_0500 EZ703U	33	44	1580	50.00	0.30	0.60	42	14	201	6	15	95.5
0.56	9.4	16	1.8	2.0	ZTR615SPH832_0400 EZ703U	33	44	1580	40.00	0.38	0.75	42	14	196	6	15	95.5
0.56	13	23	2.5	1.5	ZTR615SPH832_0400 EZ705U	33	44	1580	40.00	0.38	0.75	42	14	196	6	15	95.5
0.64	7.2	24	1.4	2.6	ZTR615SPH832_0350 EZ802U	33	44	1580	35.00	0.43	0.86	42	14	203	6	15	95.5
0.64	8.2	14	1.6	2.2	ZTR615SPH832_0350 EZ703U	33	44	1580	35.00	0.43	0.86	42	14	203	6	15	95.5
0.64	11	20	2.1	1.7	ZTR615SPH832_0350 EZ705U	33	44	1580	35.00	0.43	0.86	42	14	203	6	15	95.5

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTR6PH8 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 33 kN)																	
0.80	5.7	19	1.9	3.0	ZTR615SPH832_0280 EZ802U	33	44	1580	28.00	0.54	1.07	42	14	199	6	15	95.5
0.80	6.6	11	2.2	2.6	ZTR615SPH832_0280 EZ703U	33	44	1580	28.00	0.54	1.07	42	14	199	6	15	95.5
0.80	8.9	16	3.0	1.9	ZTR615SPH832_0280 EZ705U	33	44	1580	28.00	0.54	1.07	42	14	199	6	15	95.5
0.90	5.1	17	1.6	3.2	ZTR615SPH832_0250 EZ802U	33	44	1580	25.00	0.54	1.10	42	14	204	6	15	95.5
0.90	5.9	9.7	1.9	2.8	ZTR615SPH832_0250 EZ703U	32	44	1510	25.00	0.54	1.10	42	14	204	6	15	95.5
0.90	8.0	15	2.5	2.1	ZTR615SPH832_0250 EZ705U	33	44	1580	25.00	0.54	1.10	42	14	204	6	15	95.5
1.13	4.1	13	1.8	3.8	ZTR615SPH832_0200 EZ802U	33	44	1580	20.00	0.63	1.13	42	14	204	6	15	95.5
1.13	4.7	7.8	2.1	3.3	ZTR615SPH832_0200 EZ703U	25	44	1210	20.00	0.63	1.13	42	14	204	6	15	95.5
1.13	6.4	12	2.8	2.4	ZTR615SPH832_0200 EZ705U	33	44	1580	20.00	0.63	1.13	42	14	204	6	15	95.5
1.41	3.3	11	2.5	4.4	ZTR615SPH832_0160 EZ802U	31	44	1490	16.00	0.78	1.41	42	14	202	6	15	95.5
1.41	3.8	6.2	2.9	3.8	ZTR615SPH832_0160 EZ703U	20	44	970	16.00	0.78	1.41	42	14	202	6	15	95.5
1.41	5.1	9.3	3.9	2.8	ZTR615SPH832_0160 EZ705U	32	44	1550	16.00	0.78	1.41	42	14	202	6	15	95.5
ZTR6PH8 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 33 kN)																	
0.30	10	15	0.6	1.4	ZTR615SPH832_1000 EZ701U	29	44	1380	100.0	0.15	0.30	42	14	178	6	15	95.5
0.43	7.1	11	0.5	3.0	ZTR615SPH832_0700 EZ701U	27	44	1300	70.00	0.21	0.43	42	14	193	6	15	95.5
0.43	9.8	19	0.7	2.1	ZTR615SPH832_0700 EZ702U	33	44	1580	70.00	0.21	0.43	42	14	193	6	15	95.5
0.60	5.1	7.7	0.6	3.7	ZTR615SPH832_0500 EZ701U	19	44	930	50.00	0.30	0.60	42	14	201	6	15	95.5
0.60	7.0	14	0.9	2.7	ZTR615SPH832_0500 EZ702U	33	44	1580	50.00	0.30	0.60	42	14	201	6	15	95.5
0.75	4.1	6.2	0.9	4.2	ZTR615SPH832_0400 EZ701U	16	44	740	40.00	0.38	0.75	42	14	196	6	15	95.5
0.75	5.6	11	1.2	3.0	ZTR615SPH832_0400 EZ702U	32	44	1530	40.00	0.38	0.75	42	14	196	6	15	95.5
0.86	3.5	5.4	0.7	4.7	ZTR615SPH832_0350 EZ701U	14	44	650	35.00	0.43	0.86	42	14	203	6	15	95.5
0.86	4.9	9.7	1.0	3.4	ZTR615SPH832_0350 EZ702U	28	44	1330	35.00	0.43	0.86	42	14	203	6	15	95.5
1.07	3.9	7.8	1.4	4.0	ZTR615SPH832_0280 EZ702U	22	44	1070	28.00	0.54	1.07	42	14	199	6	15	95.5
ZTR5PH9 (n_{1N} = 2000 rpm, ($F_{f2acc,max}$ = 67 kN)																	
0.25	34	51	2.0	1.2	ZTR519SPH932_0420 EZ805U	67	133	3360	42.00	0.35	0.57	44	–	301	5	19	100.8
0.26	32	49	2.3	1.2	ZTR519SPH932_0400 EZ805U	67	133	3360	40.00	0.37	0.59	44	–	298	5	19	100.8
0.33	26	39	2.3	1.4	ZTR519SPH932_0320 EZ805U	67	133	3360	32.00	0.46	0.74	44	–	302	5	19	100.8
0.35	24	37	2.4	1.5	ZTR519SPH932_0300 EZ805U	67	133	3360	30.00	0.44	0.70	44	–	302	5	19	100.8
0.38	23	34	2.5	1.6	ZTR519SPH932_0280 EZ805U	67	133	3360	28.00	0.53	0.85	44	–	303	5	19	100.8
0.44	19	29	2.7	1.7	ZTR519SPH932_0240 EZ805U	67	133	3360	24.00	0.48	0.77	44	–	302	5	19	100.8
0.53	16	24	3.0	2.0	ZTR519SPH932_0200 EZ805U	67	133	3360	20.00	0.66	1.06	44	–	305	5	19	100.8
0.59	15	22	3.1	2.1	ZTR519SPH932_0180 EZ805U	67	133	3360	18.00	0.53	0.88	44	–	303	5	19	100.8
0.66	13	20	3.3	2.3	ZTR519SPH932_0160 EZ805U	61	133	3050	16.00	0.73	1.15	44	–	307	5	19	100.8
0.88	9.7	15	3.8	2.8	ZTR519SPH932_0120 EZ805U	45	133	2290	12.00	0.79	1.32	44	–	308	5	19	100.8
ZTR5PH9 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 67 kN)																	
0.26	25	41	0.9	1.6	ZTR519SPH932_0600 EZ802U	67	133	3360	60.00	0.25	0.40	44	–	299	5	19	100.8
0.33	20	33	1.0	1.9	ZTR519SPH932_0480 EZ802U	67	133	3360	48.00	0.31	0.50	44	–	300	5	19	100.8
0.33	24	43	1.2	1.6	ZTR519SPH932_0480 EZ803U	67	133	3360	48.00	0.31	0.50	44	–	300	5	19	100.8
0.38	17	29	1.0	2.1	ZTR519SPH932_0420 EZ802U	67	133	3360	42.00	0.35	0.57	44	–	301	5	19	100.8
0.38	21	37	1.2	1.7	ZTR519SPH932_0420 EZ803U	67	133	3360	42.00	0.35	0.57	44	–	301	5	19	100.8
0.40	16	27	1.4	2.1	ZTR519SPH932_0400 EZ802U	67	133	3360	40.00	0.37	0.59	44	–	298	5	19	100.8
0.40	20	36	1.6	1.8	ZTR519SPH932_0400 EZ803U	67	133	3360	40.00	0.37	0.59	44	–	298	5	19	100.8
0.50	13	22	1.3	2.5	ZTR519SPH932_0320 EZ802U	59	133	2980	32.00	0.46	0.74	44	–	302	5	19	100.8
0.50	16	28	1.6	2.1	ZTR519SPH932_0320 EZ803U	67	133	3360	32.00	0.46	0.74	44	–	302	5	19	100.8
0.53	12	21	1.2	2.6	ZTR519SPH932_0300 EZ802U	55	133	2790	30.00	0.44	0.70	44	–	302	5	19	100.8
0.53	15	27	1.5	2.2	ZTR519SPH932_0300 EZ803U	67	133	3360	30.00	0.44	0.70	44	–	302	5	19	100.8
0.57	12	19	1.3	2.7	ZTR519SPH932_0280 EZ802U	52	133	2600	28.00	0.53	0.85	44	–	303	5	19	100.8
0.57	14	25	1.5	2.3	ZTR519SPH932_0280 EZ803U	67	133	3360	28.00	0.53	0.85	44	–	303	5	19	100.8
0.66	9.9	16	1.4	3.0	ZTR519SPH932_0240 EZ802U	44	133	2230	24.00	0.48	0.77	44	–	302	5	19	100.8
0.66	12	21	1.7	2.5	ZTR519SPH932_0240 EZ803U	64	133	3240	24.00	0.48	0.77	44	–	302	5	19	100.8
0.79	8.2	14	1.5	3.4	ZTR519SPH932_0200 EZ802U	37	133	1860	20.00	0.66	1.06	44	–	305	5	19	100.8
0.79	9.8	18	1.8	2.8	ZTR519SPH932_0200 EZ803U	54	133	2700	20.00	0.66	1.06	44	–	305	5	19	100.8
0.88	7.4	12	1.6	3.6	ZTR519SPH932_0180 EZ802U	33	133	1670	18.00	0.53	0.88	44	–	303	5	19	100.8
0.88	8.8	16	1.9	3.0	ZTR519SPH932_0180 EZ803U	48	133	2430	18.00	0.53	0.88	44	–	303	5	19	100.8
0.99	6.6	11	1.9	3.9	ZTR519SPH932_0160 EZ802U	30	122	1490	16.00	0.73	1.15	44	–	307	5	19	100.8
0.99	7.9	14	2.3	3.3	ZTR519SPH932_0160 EZ803U	43	133	2160	16.00	0.73	1.15	44	–	307	5	19	100.8
1.32	4.9	8.2	2.2	4.7	ZTR519SPH932_0120 EZ802U	22	92	1120	12.00	0.79	1.32	44	–	308	5	19	100.8
1.32	5.9	11	2.6	4.0	ZTR519SPH932_0120 EZ803U	32	133	1620	12.00	0.79	1.32	44	–	308	5	19	100.8
ZTR5PH9 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 67 kN)																	
0.40	12	38	0.4	3.0	ZTR519SPH932_0600 EZ802U	67	133	3360	60.00	0.25	0.40	44	–	299	5	19	100.8
0.50	9.3	31	0.5	3.5	ZTR519SPH932_0480 EZ802U	67	133	3360	48.00	0.31	0.50	44	–	300	5	19	100.8
0.57	8.1	27	0.5	3.8	ZTR519SPH932_0420 EZ802U	67	133	3360	42.00	0.35	0.57	44	–	301	5	19	100.8
0.59	7.8	25	0.7	3.9	ZTR519SPH932_0400 EZ802U	67	133	3360	40.00	0.37	0.59	44	–	298	5	19	100.8
0.74	6.2	20	0.7	4.6	ZTR519SPH932_0320 EZ802U	59	133	2980	32.00	0.46	0.74	44	–	302	5	19	100.8
0.85	5.4	18	0.6	5.0	ZTR519SPH932_0280 EZ802U	52	133	2600	28.00	0.53	0.85	44	–	303	5	19	100.8

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTR6PH9 (n_{1N} = 2000 rpm, ($F_{f2acc,max}$ = 56 kN)																	
0.33	26	39	2.3	1.4	ZTR616SPH932_0320 EZ805U	56	112	2840	32.00	0.47	0.75	44	–	308	6	16	101.9
0.36	24	36	2.4	1.5	ZTR616SPH932_0300 EZ805U	56	112	2840	30.00	0.44	0.71	44	–	308	6	16	101.9
0.38	22	34	2.5	1.6	ZTR616SPH932_0280 EZ805U	56	112	2840	28.00	0.53	0.86	44	–	309	6	16	101.9
0.44	19	29	2.7	1.7	ZTR616SPH932_0240 EZ805U	56	112	2840	24.00	0.49	0.78	44	–	308	6	16	101.9
0.53	16	24	3.0	2.0	ZTR616SPH932_0200 EZ805U	56	112	2840	20.00	0.67	1.07	44	–	312	6	16	101.9
0.59	14	22	3.1	2.1	ZTR616SPH932_0180 EZ805U	56	112	2840	18.00	0.53	0.89	44	–	309	6	16	101.9
0.67	13	19	3.3	2.3	ZTR616SPH932_0160 EZ805U	56	112	2840	16.00	0.73	1.17	44	–	313	6	16	101.9
0.89	9.6	14	3.8	2.7	ZTR616SPH932_0120 EZ805U	45	112	2290	12.00	0.80	1.33	44	–	314	6	16	101.9
ZTR6PH9 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 56 kN)																	
0.27	24	41	0.9	1.6	ZTR616SPH932_0600 EZ802U	56	112	2840	60.00	0.25	0.40	44	–	304	6	16	101.9
0.33	20	33	1.0	1.9	ZTR616SPH932_0480 EZ802U	56	112	2840	48.00	0.31	0.50	44	–	306	6	16	101.9
0.33	23	42	1.2	1.6	ZTR616SPH932_0480 EZ803U	56	112	2840	48.00	0.31	0.50	44	–	306	6	16	101.9
0.38	17	28	1.0	2.0	ZTR616SPH932_0420 EZ802U	56	112	2840	42.00	0.36	0.57	44	–	307	6	16	101.9
0.38	20	37	1.2	1.7	ZTR616SPH932_0420 EZ803U	56	112	2840	42.00	0.36	0.57	44	–	307	6	16	101.9
0.40	16	27	1.4	2.1	ZTR616SPH932_0400 EZ802U	56	112	2840	40.00	0.37	0.60	44	–	304	6	16	101.9
0.40	19	35	1.6	1.8	ZTR616SPH932_0400 EZ803U	56	112	2840	40.00	0.37	0.60	44	–	304	6	16	101.9
0.50	13	22	1.3	2.4	ZTR616SPH932_0320 EZ802U	56	112	2840	32.00	0.47	0.75	44	–	308	6	16	101.9
0.50	16	28	1.6	2.0	ZTR616SPH932_0320 EZ803U	56	112	2840	32.00	0.47	0.75	44	–	308	6	16	101.9
0.53	12	20	1.2	2.5	ZTR616SPH932_0300 EZ802U	55	112	2790	30.00	0.44	0.71	44	–	308	6	16	101.9
0.53	15	26	1.5	2.1	ZTR616SPH932_0300 EZ803U	56	112	2840	30.00	0.44	0.71	44	–	308	6	16	101.9
0.57	11	19	1.3	2.7	ZTR616SPH932_0280 EZ802U	51	112	2600	28.00	0.53	0.86	44	–	309	6	16	101.9
0.57	14	25	1.5	2.2	ZTR616SPH932_0280 EZ803U	56	112	2840	28.00	0.53	0.86	44	–	309	6	16	101.9
0.67	9.8	16	1.4	3.0	ZTR616SPH932_0240 EZ802U	44	112	2230	24.00	0.49	0.78	44	–	308	6	16	101.9
0.67	12	21	1.7	2.5	ZTR616SPH932_0240 EZ803U	56	112	2840	24.00	0.49	0.78	44	–	308	6	16	101.9
0.80	8.1	14	1.5	3.3	ZTR616SPH932_0200 EZ802U	37	112	1860	20.00	0.67	1.07	44	–	312	6	16	101.9
0.80	9.7	18	1.8	2.8	ZTR616SPH932_0200 EZ803U	53	112	2700	20.00	0.67	1.07	44	–	312	6	16	101.9
0.89	7.3	12	1.6	3.6	ZTR616SPH932_0180 EZ802U	33	112	1670	18.00	0.53	0.89	44	–	309	6	16	101.9
0.89	8.7	16	1.9	3.0	ZTR616SPH932_0180 EZ803U	48	112	2430	18.00	0.53	0.89	44	–	309	6	16	101.9
1.00	6.5	11	1.9	3.9	ZTR616SPH932_0160 EZ802U	29	112	1490	16.00	0.73	1.17	44	–	313	6	16	101.9
1.00	7.8	14	2.3	3.2	ZTR616SPH932_0160 EZ803U	42	112	2160	16.00	0.73	1.17	44	–	313	6	16	101.9
1.33	4.9	8.1	2.2	4.7	ZTR616SPH932_0120 EZ802U	22	91	1120	12.00	0.80	1.33	44	–	314	6	16	101.9
1.33	5.8	11	2.6	3.9	ZTR616SPH932_0120 EZ803U	32	112	1620	12.00	0.80	1.33	44	–	314	6	16	101.9
ZTR6PH9 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 56 kN)																	
0.40	12	38	0.4	3.0	ZTR616SPH932_0600 EZ802U	56	112	2840	60.00	0.25	0.40	44	–	304	6	16	101.9
0.50	9.2	30	0.5	3.5	ZTR616SPH932_0480 EZ802U	56	112	2840	48.00	0.31	0.50	44	–	306	6	16	101.9
0.57	8.1	26	0.5	3.8	ZTR616SPH932_0420 EZ802U	56	112	2840	42.00	0.36	0.57	44	–	307	6	16	101.9
0.60	7.7	25	0.7	3.9	ZTR616SPH932_0400 EZ802U	56	112	2840	40.00	0.37	0.60	44	–	304	6	16	101.9
0.75	6.1	20	0.7	4.5	ZTR616SPH932_0320 EZ802U	56	112	2840	32.00	0.47	0.75	44	–	308	6	16	101.9
0.86	5.4	18	0.6	5.0	ZTR616SPH932_0280 EZ802U	51	112	2600	28.00	0.53	0.86	44	–	309	6	16	101.9

5.3 Dimensional drawings

This chapter shows you the dimensions of rack and pinion drives with EZ synchronous servo motors.

Dimension az in the tables of dimensions applies to Atlanta gear racks. In general: az = ½ d0 + h0 + x*mn

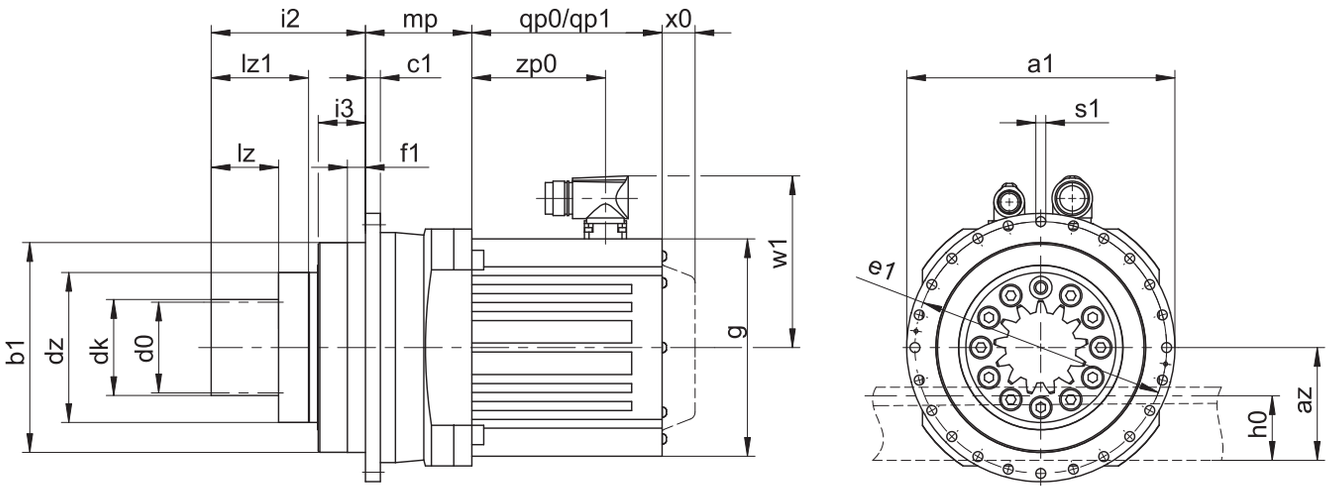
The pinion of the rack and pinion drive is helical (left-hand 19° 31 42"). The pinion gearing quality is 5.

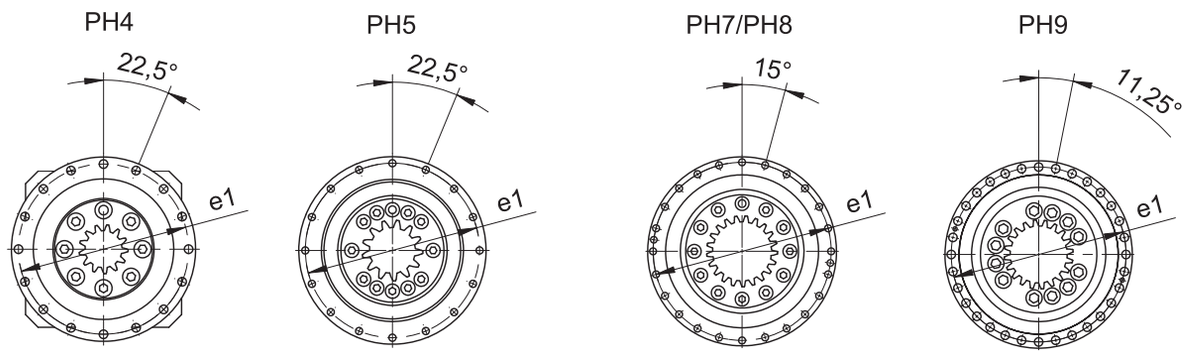
Dimensions can exceed the specifications of ISO 2768-mK due to casting tolerances or accumulation of individual tolerances.

We reserve the right to make dimensional changes due to ongoing technical development.

You can download 3D models of our standard drives at http://configurator.stoeber.de.

Combination options and the dimensions of forced ventilated geared motors can also be found at http://configurator.stoeber.de.





qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x0	Applies to encoders using an optical measuring method.	w1	Different for the One Cable Solution (OCS), see the chapter [▶ 13.4]

Dimensions of gear units

Type	mn	Øa1	az	Øb1	c1	Ød0	Ødk	dz	Øe1	f1	h0	i2	i3	lz	lz1	Øs1	x
ZTR212SPH4_	2	118_{h7}	35.73	90_{h7}	7	25.47	31.5	63	109	10	22	71.0	23.5	26.0	41.0	5.5	0.50
ZTR216SPH4_	2	118_{h7}	38.98	90_{h7}	7	33.95	38.0	63	109	10	22	71.0	23.5	26.0	41.0	5.5	0.00
ZTR219SPH5_	2	145_{h7}	42.16	110_{h7}	8	40.32	44.3	80	135	12	22	70.0	22.5	26.0	41.0	5.5	0.00
ZTR223SPH5_	2	145_{h7}	46.40	110_{h7}	8	48.81	52.8	80	135	12	22	70.0	22.5	26.0	41.0	5.5	0.00
ZTR314SPH5_	3	145_{h7}	49.18	110_{h7}	8	44.56	52.4	80	135	12	26	76.5	22.5	32.5	47.5	5.5	0.30
ZTR223SPH7_	2	179_{h7}	46.40	140_{h7}	10	48.81	52.8	100	168	12	22	84.0	31.5	26.0	46.0	6.6	0.00
ZTR316SPH7_	3	179_{h7}	51.46	140_{h7}	10	50.93	56.9	100	168	12	26	90.5	31.5	32.5	52.5	6.6	0.00
ZTR319SPH7_	3	179_{h7}	56.24	140_{h7}	10	60.48	66.5	100	168	12	26	90.5	31.5	32.5	52.5	6.6	0.00
ZTR412SPH7_	4	179_{h7}	62.46	140_{h7}	10	50.93	62.9	100	168	12	35	103.0	31.5	45.0	65.0	6.6	0.50
ZTR332SPH8_	3	247_{h7}	76.93	200_{h7}	12	101.86	107.9	148	233	15	26	107.5	41.5	32.5	57.5	9.0	0.00
ZTR417SPH8_	4	247_{h7}	71.08	200_{h7}	12	72.15	80.2	148	233	15	35	120.0	41.5	45.0	70.0	9.0	0.00
ZTR420SPH8_	4	247_{h7}	77.44	200_{h7}	12	84.88	92.9	148	233	15	35	120.0	41.5	45.0	70.0	9.0	0.00
ZTR518SPH8_	5	247_{h7}	81.75	200_{h7}	12	95.49	105.5	148	233	15	34	130.0	41.5	55.0	80.0	9.0	0.00
ZTR615SPH8_	6	247_{h7}	90.75	200_{h7}	12	95.49	107.5	148	233	15	43	140.0	41.5	65.0	90.0	9.0	0.00
ZTR519SPH9_	5	300	84.40	255_{h7}	18	100.80	110.8	187	280	20	34	155.0	54.0	55.0	101.0	13.5	0.00
ZTR616SPH9_	6	300	93.93	255_{h7}	18	101.86	113.9	187	280	20	43	165.0	54.0	65.0	111.0	13.5	0.00

Dimensions of motors

Type	□g	qp0	qp1	w1	x0	zp0
EZ301U	72	90	130.0	55.5	21	54.5
EZ302U	72	112	152.0	55.5	21	76.5
EZ303U	72	134	174.0	55.5	21	98.5
EZ401U	98	98	146.5	91.0	22	56.0
EZ402U	98	123	171.5	91.0	22	81.0
EZ501U	115	93	147.5	100.0	22	58.5
EZ502U	115	118	172.5	100.0	22	83.5
EZ503U	115	143	197.5	100.0	22	108.5
EZ505U	115	193	247.5	100.0	22	158.5
EZ701U	145	102	161.0	115.0	22	64.0
EZ702U	145	127	186.0	115.0	22	89.0
EZ703U	145	152	211.0	115.0	22	114.0
EZ705U	145	207	266.0	134.0	22	165.0
EZ802U	190	197	274.0	156.5	22	143.0
EZ803U	190	238	315.0	156.5	22	184.0
EZ805U	190	320	397.0	156.5	22	266.0

Dimensions of geared motors

Type	EZ3	EZ4	EZ5	EZ7	EZ8
	mp	mp	mp	mp	mp
ZTR_PH431_	–	54.5	54.0	–	–
ZTR_PH432_	99.0	–	–	–	–
ZTR_PH531_	–	–	61.0	64.0	–
ZTR_PH532_	–	103.0	102.5	–	–
ZTR_PH731_	–	–	–	71.0	81.0
ZTR_PH732_	–	–	119.0	122.0	–
ZTR_PH831_	–	–	–	–	110.0
ZTR_PH832_	–	–	–	161.0	171.0
ZTR_PH932_	–	–	–	–	249.5

5.4 Type designation

5.4.1 Type designation PH4 – PH8

This chapter shows you an explanation of the type designation with the associated options.

Additional ordering information not included in the type designation can be found at the end of the chapter.

Example code

Z	TR	3	19	S	PH	7	3	1	S	F	S	S	0050	EZ703U

Explanation

Code	Designation	Design
Z	Type	Rack and pinion drive
TR	Design	Screwed flange pinion
3	Module	m_n = 3 (example)
19	Number of teeth	z = 19 (example)
S	Toothing	Helical (left-hand 19° 31' 42")
PH	Type	Planetary gear unit
7	Size	7 (example)
3	Generation	Generation 3
1	Stages	Single-stage
2		Two-stage
S	Housing	Standard
F	Shaft	Flange shaft
S	Bearing	Standard bearing
V		Reinforced bearing (PH3 – PH5)
S	Backlash	Standard
R		Reduced
0050	Transmission ratio (i x 10)	i = 5 (example)
EZ703U	Motor	EZ synchronous servo motor

To complete the type designation, also specify the following in your order:

- A detailed type designation of the motor, see chapter [▶ 13]
- Radial shaft seal rings at the output, made of NBR or FKM (optional), see chapter [▶ 5.6.2]
- Radial runout ≤ 10 µm (optional)
- Reverse operation of the output shaft from ±20° to ±90° for horizontal installation on request

In this catalog, you will find all information on rack and pinion drives with EZ synchronous servo motors.
All input options available on request can be found in the chapter [▶ 5.5.1].

5.4.2 Type designation PH9

This chapter shows you an explanation of the type designation with the associated options.

Additional ordering information not included in the type designation can be found at the end of the chapter.

Example code

Z	TR	6	16	S	PH	9	3	2	F	0200	EZ802U

Explanation

Code	Designation	Design
Z	Type	Rack and pinion drive
TR	Design	Screwed flange pinion
6	Module	m_n = 6 (example)
16	Number of teeth	z = 16 (example)
S	Toothing	Helical (left-hand 19° 31' 42")
PH	Type	Planetary gear unit
9	Size	9 (example)
3	Generation	Generation 3
2	Stages	Two-stage
F	Shaft	Flange shaft
0200	Transmission ratio (i x 10)	i = 20 (example)
EZ802U	Motor	EZ synchronous servo motor

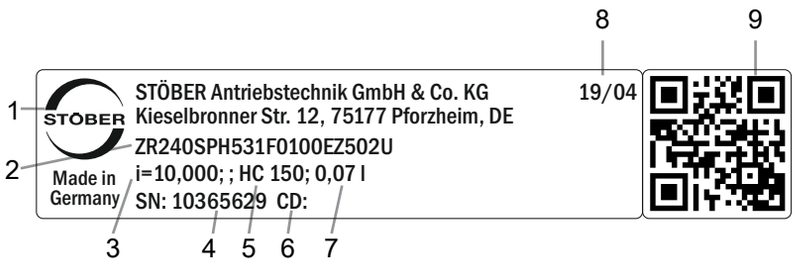
To complete the type designation, also specify the following in your order:

- A detailed type designation of the motor, see chapter [▶ 13]
- Radial shaft seal rings at the output, made of NBR or FKM (optional), see chapter [▶ 5.6.2]
- Radial runout ≤ 10 µm (optional)
- Reverse operation of the output shaft from ±20° to ±90° for horizontal installation on request

In this catalog, you will find all information on rack and pinion drives with EZ synchronous servo motors.
All input options available on request can be found in the chapter [▶ 5.5.1].

5.4.3 Nameplate

An example geared motor nameplate is explained in the figure below.



Code	Designation
1	Name of manufacturer
2	Type designation
3	Gear ratio of the gear unit
4	Serial number of the gear unit
5	Lubricant specification
6	Customer-specific data
7	Lubricant fill volume
8	Date of manufacture (year/calendar week)
9	QR code (link to product information)

5.4.3.1 Supporting documents

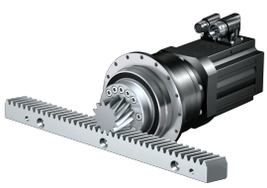
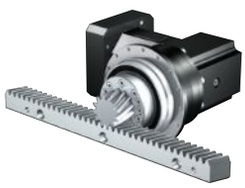
You can view or download supporting documents for the product by reading off the serial number on the nameplate of the product and entering it at the following address online:
https://id.stober.com

Alternatively, you can use a suitable mobile device to scan in the QR code on the nameplate of the product in order to be linked to the supporting documents.

5.5 Product description

5.5.1 Input options

This chapter shows you all available input options:

EZ synchronous servo motor	Motor adapter	KX right-angle input with MF motor adapter	K right-angle input with ME motor adapter	MB motor adapter
				
http://www.stoeber.de/en/Z_EZ	http://www.stoeber.de/en/ZTRPHME	On request	On request	On request

5.5.2 Gear rack

The technical data specified in the Selection tables chapter applies only to gear rack combinations with the following characteristics:

The pinion of the rack and pinion drive is case-hardened and helical (left-hand 19° 31' 42"). The pinion gearing quality is 5.

The corresponding gear rack must have a right-hand design (19° 31' 42") and possess the following characteristics:

Module m_n [mm]	Minimum gear rack quality	Gear rack material
2 – 4	6	16MnCr5 inductively hardened
5	5	16MnCr5 inductively hardened
6 – 10	6	C45 inductively hardened

Also note the project configuration of the gear rack on the Atlanta pages.

5.5.3 Installation conditions

The torque and force values listed in this catalog are valid under the following conditions:

- When the gear housing is fastened on the machine side using screws of strength class 12.9
- When the gear housings are adjusted at pilot øbz. The machine-side fit must be H7.

5.5.4 Lubricants

STOBER fills the gear units with the amount and type of lubricant specified on the nameplate.

You will receive lubricants for use in the food industry upon request.

5.5.4.1 Rack and pinion drive lubrication

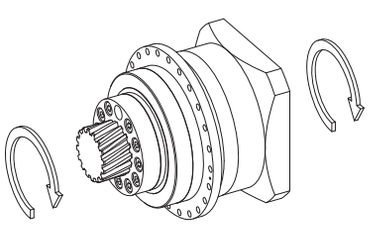
Make sure the rack and pinion drive has permanent lubrication with the lubricants specified in the Atlanta product catalog.

5.5.5 Other product features

Feature	Value
Max. permitted gear unit temperature (on the surface of the gear unit)	≤ 90 °C
Paint	Black RAL 9005
(ATEX) Directive 2014/34/EU (Option)	Not suitable.
Protection class: [1]	
Planetary gear units	IP65
Motor	IP56, optionally IP66
Pinion/gear rack	IPXX

5.5.6 Direction of rotation

The input and output rotate in the same direction.



5.6 Project configuration

Project your drives using our SERVOsoft designing software. Download SERVOsoft for free at https://www.stoeber.de/en/ServoSoft.

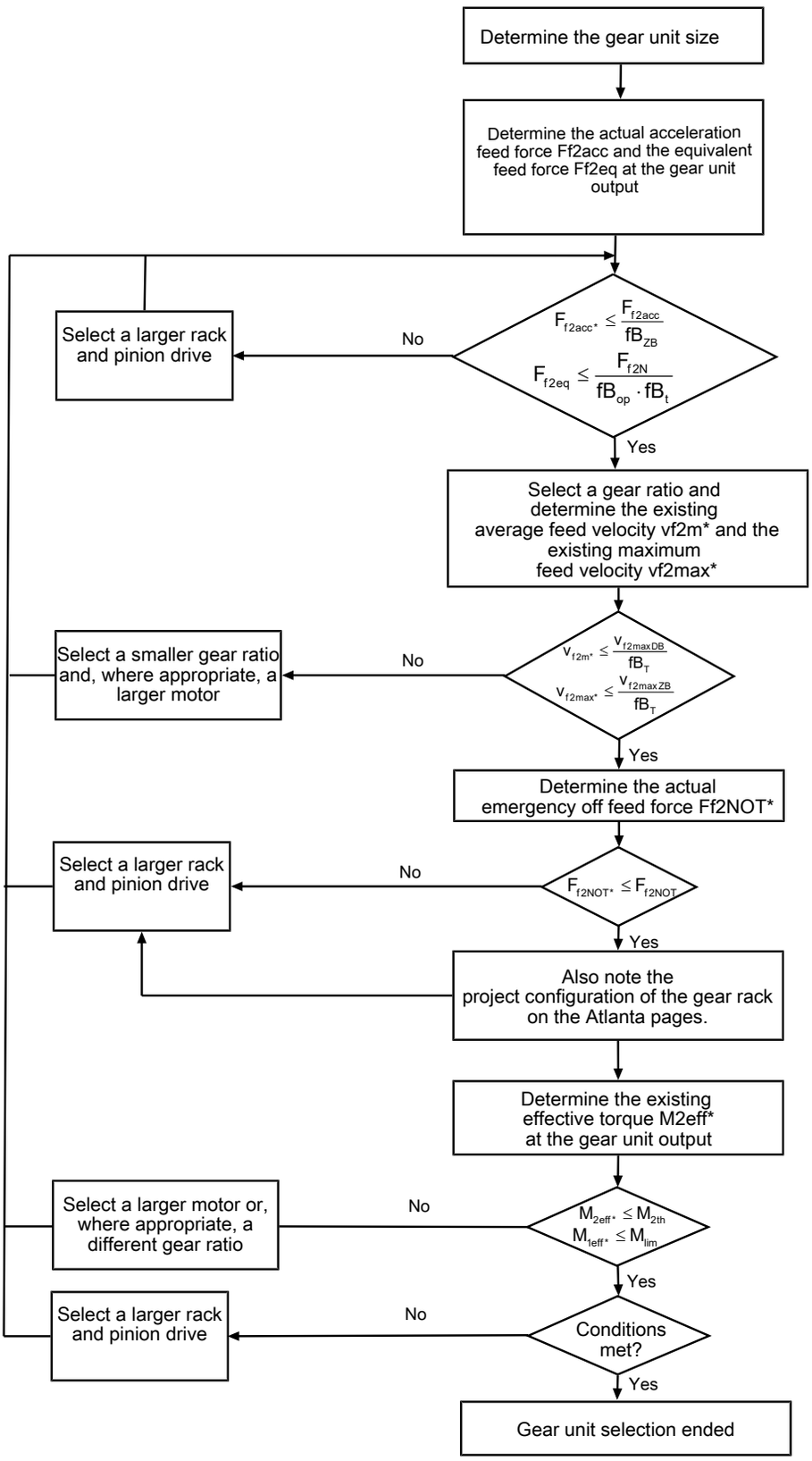
Observe the limit conditions in this chapter to ensure a safe design for your drives.

The formula symbols for values actually present in the application are marked with *.

An explanation of the formula symbols can be found in the chapter [▶ 15.1].

[1] Observe the protection class of all the components.

5.6.1 Drive selection

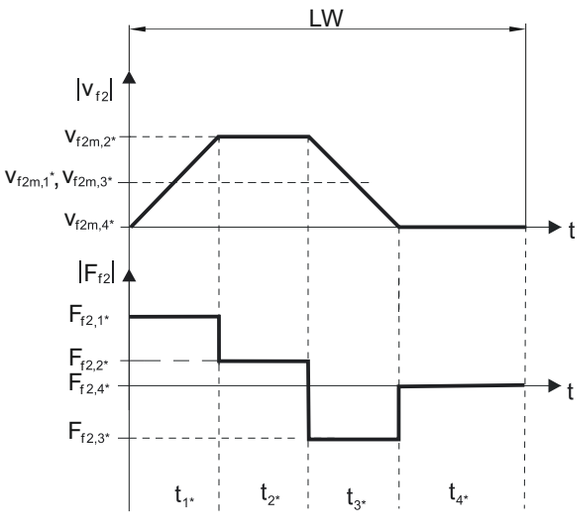


Refer to the selection tables for the values of i, $v_{f2maxDB}$, $v_{f2maxZB}$, F_{f2acc}, F_{f2N} and F_{f2NOT}.

The values for fB_T, fB_{op}, fB_t and fB_{ZB} can be found in the corresponding tables in this chapter.

Example of cyclic operation

The following calculations are based on a representation of the power taken from the output based in accordance with the following example:



Calculation of the actual maximum acceleration feed force

$$F_{f2acc*} = m* \cdot a* + F_{L*}$$

Calculation of the actual average input speed

$$n_{1m*} = \frac{v_{f2m*} \cdot i}{d_0 \cdot \pi}$$

$$v_{f2m*} = \frac{\left|v_{f2m,1*}\right| \cdot t_{1*} + \ldots + \left|v_{f2m,n*}\right| \cdot t_{n*}}{t_{1*} + \ldots + t_{n*}}$$

If $t_{1*} + \ldots + t_{3*} \geq 6$ min, determine v_{2m*} without the rest phase t_{4*}.

The values for the ratio i can be found in the selection tables.

Calculation of the actual emergency off feed force

$$F_{f2NOT*} = m* \cdot a_{NOT*} + F_{L*}$$

Calculation of the actual equivalent feed force

$$F_{f2eq*} = \sqrt[3]{\frac{\left|v_{f2m,1*}\right| \cdot t_{1*} \cdot \left|F_{f2,1*}{}^{3}\right| + \ldots + \left|v_{f2m,n*}\right| \cdot t_{n*} \cdot \left|F_{f2,n*}{}^{3}\right|}{\left|v_{f2m,1*}\right| \cdot t_{1*} + \ldots + \left|v_{f2m,n*}\right| \cdot t_{n*}}}$$

Calculation of the thermal limit torque

Calculate the thermal limit torque M_{2th} for a duty cycle $ED_{10} > 50\%$ and the actual average input speed n_{1m*}. (At $K_{mot,th} \leq 0$ you must reduce the average input speed n_{1m*} accordingly or select another geared motor size.)

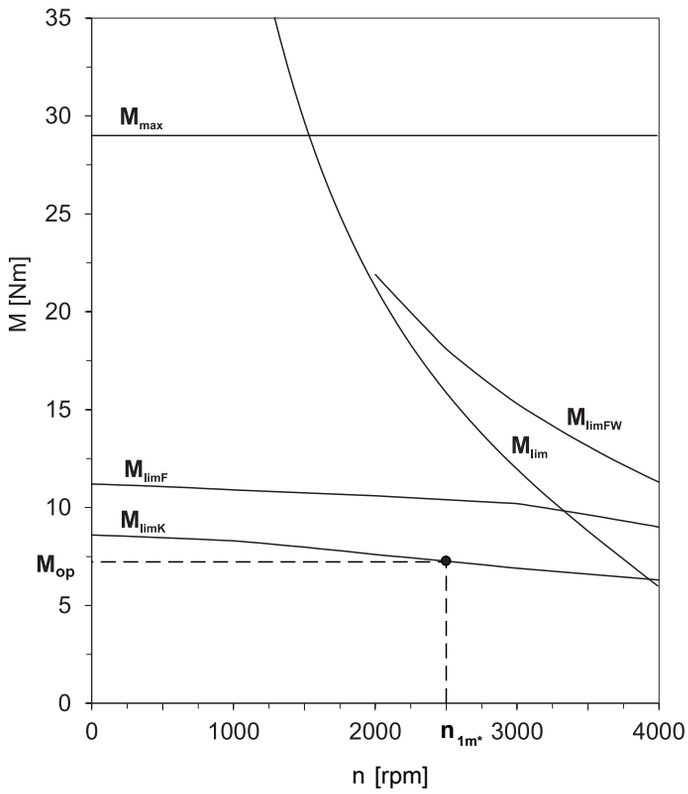
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

$$K_{mot,th} = 0{,}93 - \frac{a_{th}}{1000} \cdot fB_T \cdot \left(\frac{n_{1m*}}{1000}\right)^3$$

Refer to the selection tables for the values of i and a_{th}.

The values for fB_T can be found in the corresponding table in this chapter.

The value for the torque of the motor at operating point M_{op} with the determined average input speed n_{1m*} can be found in the motor characteristic curve of the chapter [▶ 13.3]. Note the size, nominal speed n_N and cooling type of the motor. The figure below shows an example of reading the torque M_{op} of a motor with convection cooling at the operating point.



Calculation of the actual effective torque

$$M_{2eff*} = \sqrt{\frac{t_{1*} \cdot M_{2,1*}^{\ 2} + \ldots + t_{n*} \cdot M_{2,n*}^{\ 2}}{t_{1*} + \ldots + t_{n*}}}$$

$$M_{2,n*} = \frac{F_{f2,n*} \cdot d_0}{2}$$

$$M_{1eff*} = \frac{M_{2eff*}}{i \cdot \eta}$$

Operating factors

Operating mode	fB_{op}
Uniform continuous operation	1.00
Cyclic operation	1.00
Reversing load cyclic operation	1.00

Run time	fB_t
Daily runtime ≤ 8 h	1.00
Daily runtime ≤ 16 h	1.15
Daily runtime ≤ 24 h	1.20

Cyclic operation	fB_{ZB}
≤ 1000 load changes/hour (LW/h)	1.00
> 1000 load changes/hour (LW/h)	1.15

Temperature		fB_T
Motor cooling	**Surrounding temperature**	
Motor with forced ventilation	≤ 20 °C	0.9
	≤ 30 °C	1.0
	≤ 40 °C	1.15
Motor with convection cooling	≤ 20 °C	1.0
	≤ 30 °C	1.1
	≤ 40 °C	1.25

Notes

- The maximum permitted gear unit temperature (see the "Other product features" chapter) must not be exceeded, as that could result in damage.
- For braking from full speed (for example, when the power fails or when setting up the machine), note the permitted gear unit feed forces (F_{f2acc}, F_{f2NOT}) in the selection tables.

5.6.2 Recommendation for radial shaft seal rings

For a duty cycle > 60% and higher surrounding temperatures, we recommend radial shaft seal rings made of FKM at the output.

Properties:

- Excellent temperature resistance
- High chemical stability
- Very good resistance to aging
- Excellent resistance in oils and greases
- For use in the food, beverage and pharmaceutical industries

Leak-proofness

Our gear units are equipped with high-quality radial shaft seal rings and checked for leaks. However, a leak cannot be fully ruled out over the length of use of a gear unit. If you use a gear unit with goods incompatible with the lubricant, you must take measures to prevent direct contact with the gear unit lubricant in case of a leak.

5.7 Additional documentation

Additional documentation related to the product can be found at
http://www.stoeber.de/en/downloads/

Enter the ID of the documentation in the Search... field.

Documentation	ID
Operating manual for gear racks (Atlanta)	442455
Operating manual for P/PE/PH/PHQ/PHV planetary gear units and planetary geared motors	443149_en
Operating manual for EZ synchronous servo motors	443032_en

6 ZTRPHV rack and pinion drives

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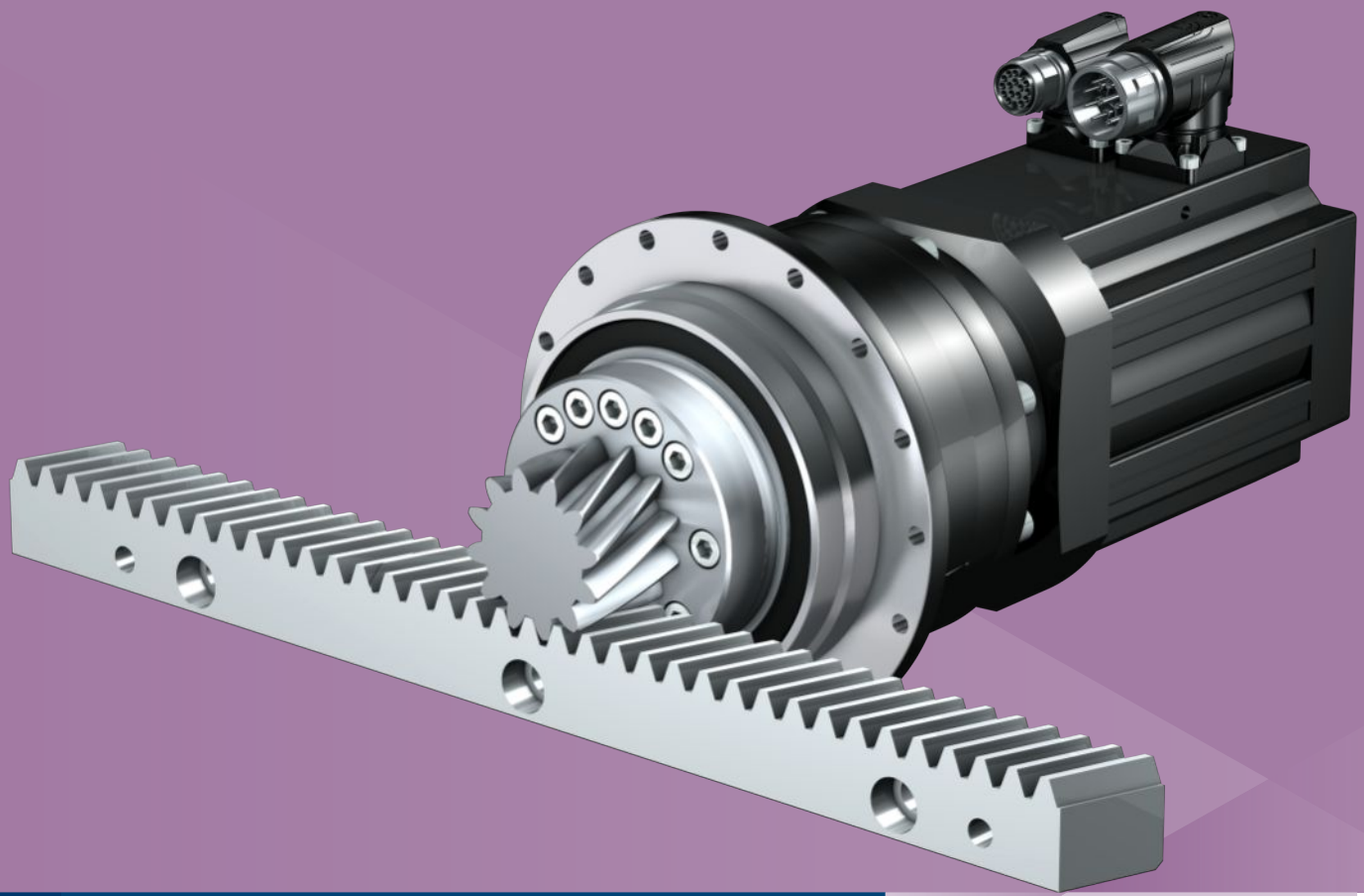


6 Rack and pinion drives

ZTRPHV

6.1 Overview

High-performance precision planetary geared motors with screwed flange pinion

Features

Power density	★★★★☆
Linear clearance	★★★★☆
Price category	€€€€
Smooth operation	★★★★☆
Linear rigidity	★★★★☆
Mass moment of inertia	★★★★☆
Ready-to-install drive solution	✓
Pinion gearing quality 5 (DIN 3962)	✓
Helical gearing	✓
Case-hardened and smoothed	✓
Radial runout ≤ 10 µm (optional)	✓
Compact and highly dynamic due to direct motor attachment	✓

Key ★☆☆☆☆ good | ★★★★★ excellent
€ Economy | €€€€€ Premium

Technical data

m_n	5 – 6 mm
z	16 – 19
F_{f2acc}	32 – 67 kN
v_{f2N}	0.12 – 0.39 m/s
Δs	42 – 44 µm

6.2 Selection tables

The technical data specified in the selection tables applies to:

- De-energized installation
- Permanent lubrication with the lubricants specified in the Atlanta product catalog
- Material combinations as described in the chapter [▶ 6.5.2]
- Installation altitudes up to 1000 m above sea level
- Surrounding temperatures from 0 °C to 40 °C
- Without consideration of the thermal limiting performance
- Drives with convection-cooled motors (e.g. EZ401**U**)

For the technical data on drives with forced ventilated motors (e.g. EZ401**B**), refer to http://configurator.stoeber.de.

For all other technical data, refer to http://configurator.stoeber.de.

An explanation of the formula symbols can be found in the chapter [▶ 15.1].

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTR5PHV9 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 67 kN)																
0.13	16	18	0.2	3.1	ZTR519SPHV933_1210 EZ701U	43	133	2180	121.0	0.11	0.20	44	280	5	19	100.8
0.13	26	31	0.4	1.9	ZTR519SPHV933_1210 EZ702U	67	133	3360	121.0	0.11	0.20	44	280	5	19	100.8
0.13	36	45	0.5	1.4	ZTR519SPHV933_1210 EZ703U	67	133	3360	121.0	0.11	0.20	44	280	5	19	100.8
0.17	12	13	0.3	3.8	ZTR519SPHV933_0910 EZ701U	33	133	1640	91.00	0.15	0.26	44	283	5	19	100.8
0.17	20	23	0.4	2.3	ZTR519SPHV933_0910 EZ702U	67	133	3360	91.00	0.15	0.26	44	283	5	19	100.8
0.17	27	34	0.6	1.7	ZTR519SPHV933_0910 EZ703U	67	133	3360	91.00	0.15	0.26	44	283	5	19	100.8
0.17	35	49	0.8	1.3	ZTR519SPHV933_0910 EZ705U	67	133	3360	91.00	0.15	0.26	44	283	5	19	100.8
0.26	24	40	1.0	1.6	ZTR519SPHV933_0610 EZ802U	67	133	3360	61.00	0.22	0.39	44	284	5	19	100.8
ZTR5PHV9 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 67 kN)																
0.20	26	43	0.4	1.7	ZTR519SPHV933_1210 EZ703U	67	133	3360	121.0	0.11	0.20	44	280	5	19	100.8
0.26	20	33	0.5	2.0	ZTR519SPHV933_0910 EZ703U	67	133	3360	91.00	0.15	0.26	44	283	5	19	100.8
0.26	27	49	0.7	1.5	ZTR519SPHV933_0910 EZ705U	67	133	3360	91.00	0.15	0.26	44	283	5	19	100.8
0.39	11	38	0.5	3.1	ZTR519SPHV933_0610 EZ802U	67	133	3360	61.00	0.22	0.39	44	284	5	19	100.8
ZTR6PHV9 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 56 kN)																
0.13	16	18	0.2	3.1	ZTR616SPHV933_1210 EZ701U	43	112	2180	121.0	0.11	0.20	44	285	6	16	101.9
0.13	26	31	0.4	1.9	ZTR616SPHV933_1210 EZ702U	56	112	2840	121.0	0.11	0.20	44	285	6	16	101.9
0.18	12	13	0.3	3.8	ZTR616SPHV933_0910 EZ701U	32	112	1640	91.00	0.15	0.26	44	288	6	16	101.9
0.18	19	23	0.4	2.3	ZTR616SPHV933_0910 EZ702U	56	112	2840	91.00	0.15	0.26	44	288	6	16	101.9
0.18	27	33	0.6	1.7	ZTR616SPHV933_0910 EZ703U	56	112	2840	91.00	0.15	0.26	44	288	6	16	101.9
0.26	24	40	1.0	1.6	ZTR616SPHV933_0610 EZ802U	56	112	2840	61.00	0.22	0.39	44	289	6	16	101.9
ZTR6PHV9 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 56 kN)																
0.20	26	43	0.4	1.7	ZTR616SPHV933_1210 EZ703U	56	112	2840	121.0	0.11	0.20	44	285	6	16	101.9
0.26	19	32	0.5	2.0	ZTR616SPHV933_0910 EZ703U	56	112	2840	91.00	0.15	0.26	44	288	6	16	101.9
0.39	11	37	0.5	3.0	ZTR616SPHV933_0610 EZ802U	56	112	2840	61.00	0.22	0.39	44	289	6	16	101.9

6.3 Dimensional drawings

This chapter shows you the dimensions of rack and pinion drives with EZ synchronous servo motors.

Dimension az in the tables of dimensions applies to Atlanta gear racks. In general: az = ½ d0 + h0 + x*mn

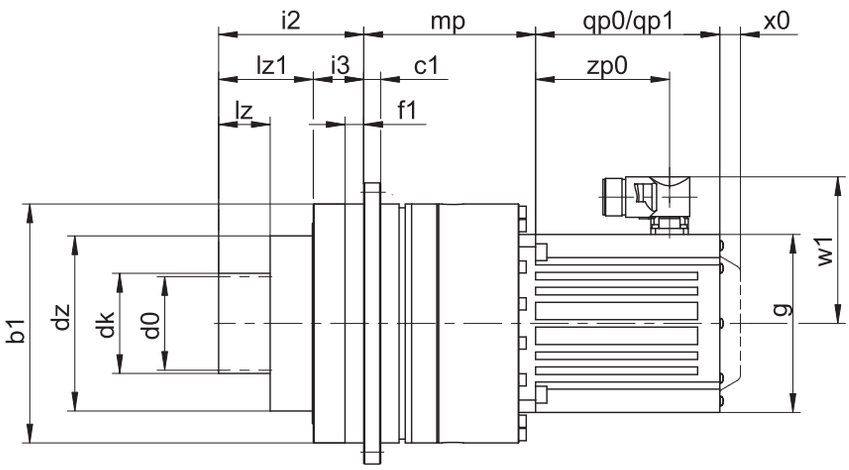
The pinion of the rack and pinion drive is helical (left-hand 19° 31 42"). The pinion gearing quality is 5.

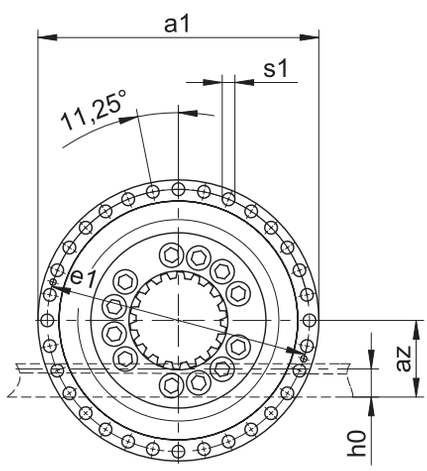
Dimensions can exceed the specifications of ISO 2768-mK due to casting tolerances or accumulation of individual tolerances.

We reserve the right to make dimensional changes due to ongoing technical development.

You can download 3D models of our standard drives at http://configurator.stoeber.de.

Combination options and the dimensions of forced ventilated geared motors can also be found at http://configurator.stoeber.de.





qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x0	Applies to encoders using an optical measuring method.	w1	Different for the One Cable Solution (OCS), see the chapter [▶ 13.4]

Dimensions of gear units

Type	mn	Øa1	az	Øb1	c1	Ød0	Ødk	Ødz	Øe1	f1	h0	i2	i3	lz	lz1	Øs1	x
ZTR519SPHV9_	5	300	84.40	255_{h7}	18	100.80	110.8	187	280	20	34	155	54	55	101	13.5	0.0
ZTR616SPHV9_	6	300	93.93	255_{h7}	18	101.86	113.9	187	280	20	43	165	54	65	111	13.5	0.0

Dimensions of motors

Type	□g	qp0	qp1	w1	x0	zp0
EZ701U	145	102	161	115.0	22	64
EZ702U	145	127	186	115.0	22	89
EZ703U	145	152	211	115.0	22	114
EZ705U	145	207	266	134.0	22	165
EZ802U	190	197	274	156.5	22	143

Dimensions of geared motors

Type	EZ7	EZ8
	mp	mp
ZTR_PHV933_	171.5	183.5

6.4 Type designation

This chapter shows you an explanation of the type designation with the associated options.

Additional ordering information not included in the type designation can be found at the end of the chapter.

Example code

Z	TR	6	16	S	PHV	9	3	3	F	0910	EZ703U

Explanation

Code	Designation	Design
Z	Type	Rack and pinion drive
TR	Design	Screwed flange pinion
6	Module	m_n = 6 (example)
16	Number of teeth	z = 16 (example)
S	Toothing	Helical (left-hand 19° 31' 42")
PHV	Type	Planetary gear unit
9	Size	9 (example)
3	Generation	Generation 3
3	Stages	Three-stage
F	Shaft	Flange shaft
0910	Transmission ratio (i x 10)	i = 91 (example)
EZ703U	Motor	EZ synchronous servo motor

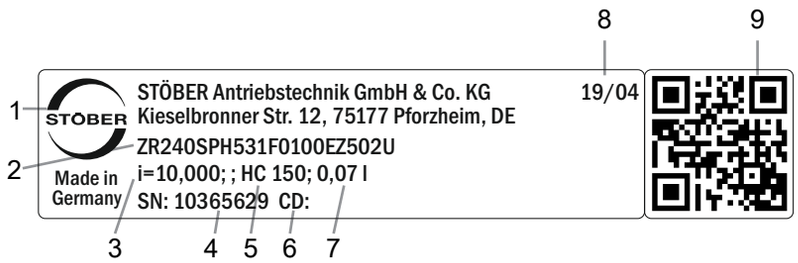
To complete the type designation, also specify the following in your order:

- A detailed type designation of the motor, see chapter [▶ 13]
- Radial shaft seal rings at the output, made of NBR or FKM (optional), see chapter [▶ 6.6.2]
- Radial runout ≤ 10 µm (optional)
- Reverse operation of the output shaft from ±20° to ±90° for horizontal installation on request

In this catalog, you will find all information on rack and pinion drives with EZ synchronous servo motors.
All input options available on request can be found in the chapter [▶ 6.5.1].

6.4.1 Nameplate

An example geared motor nameplate is explained in the figure below.



Code	Designation
1	Name of manufacturer
2	Type designation
3	Gear ratio of the gear unit
4	Serial number of the gear unit
5	Lubricant specification
6	Customer-specific data
7	Lubricant fill volume
8	Date of manufacture (year/calendar week)
9	QR code (link to product information)

6.4.1.1 Supporting documents

You can view or download supporting documents for the product by reading off the serial number on the nameplate of the product and entering it at the following address online:
https://id.stober.com

Alternatively, you can use a suitable mobile device to scan in the QR code on the nameplate of the product in order to be linked to the supporting documents.

6.5 Product description

6.5.1 Input options

This chapter shows you all available input options:

EZ synchronous servo motor

http://www.stoeber.de/en/Z_EZ

Motor adapter

http://www.stoeber.de/en/ZTRPHVME

6.5.2 Gear rack

The technical data specified in the Selection tables chapter applies only to gear rack combinations with the following characteristics:

The pinion of the rack and pinion drive is case-hardened and helical (left-hand 19° 31' 42"). The pinion gearing quality is 5.

The corresponding gear rack must have a right-hand design (19° 31' 42") and possess the following characteristics:

Module m_n [mm]	Minimum gear rack quality	Gear rack material
2 – 4	6	16MnCr5 inductively hardened
5	5	16MnCr5 inductively hardened
6 – 10	6	C45 inductively hardened

Also note the project configuration of the gear rack on the Atlanta pages.

6.5.3 Installation conditions

The torque and force values listed in this catalog are valid under the following conditions:

- When the gear housing is fastened on the machine side using screws of strength class 12.9
- When the gear housings are adjusted at pilot øbz. The machine-side fit must be H7.

6.5.4 Lubricants

STOBER fills the gear units with the amount and type of lubricant specified on the nameplate.

You will receive lubricants for use in the food industry upon request.

6.5.4.1 Rack and pinion drive lubrication

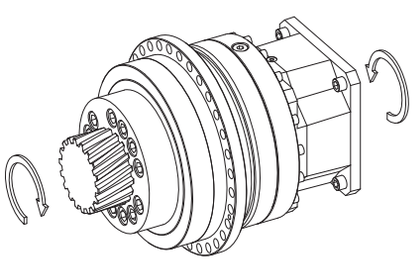
Make sure the rack and pinion drive has permanent lubrication with the lubricants specified in the Atlanta product catalog.

6.5.5 Other product features

Feature	Value
Max. permitted gear unit temperature (on the surface of the gear unit)	≤ 90 °C
Paint	Black RAL 9005
(ATEX) Directive 2014/34/EU (Option)	Not suitable.
Protection class: [1]	
Planetary gear units	IP65
Motor	IP56, optionally IP66
Pinion/gear rack	IPXX

6.5.6 Direction of rotation

The input and output rotate in the same direction.



6.6 Project configuration

Project your drives using our SERVOsoft designing software. Download SERVOsoft for free at https://www.stoeber.de/en/ServoSoft.

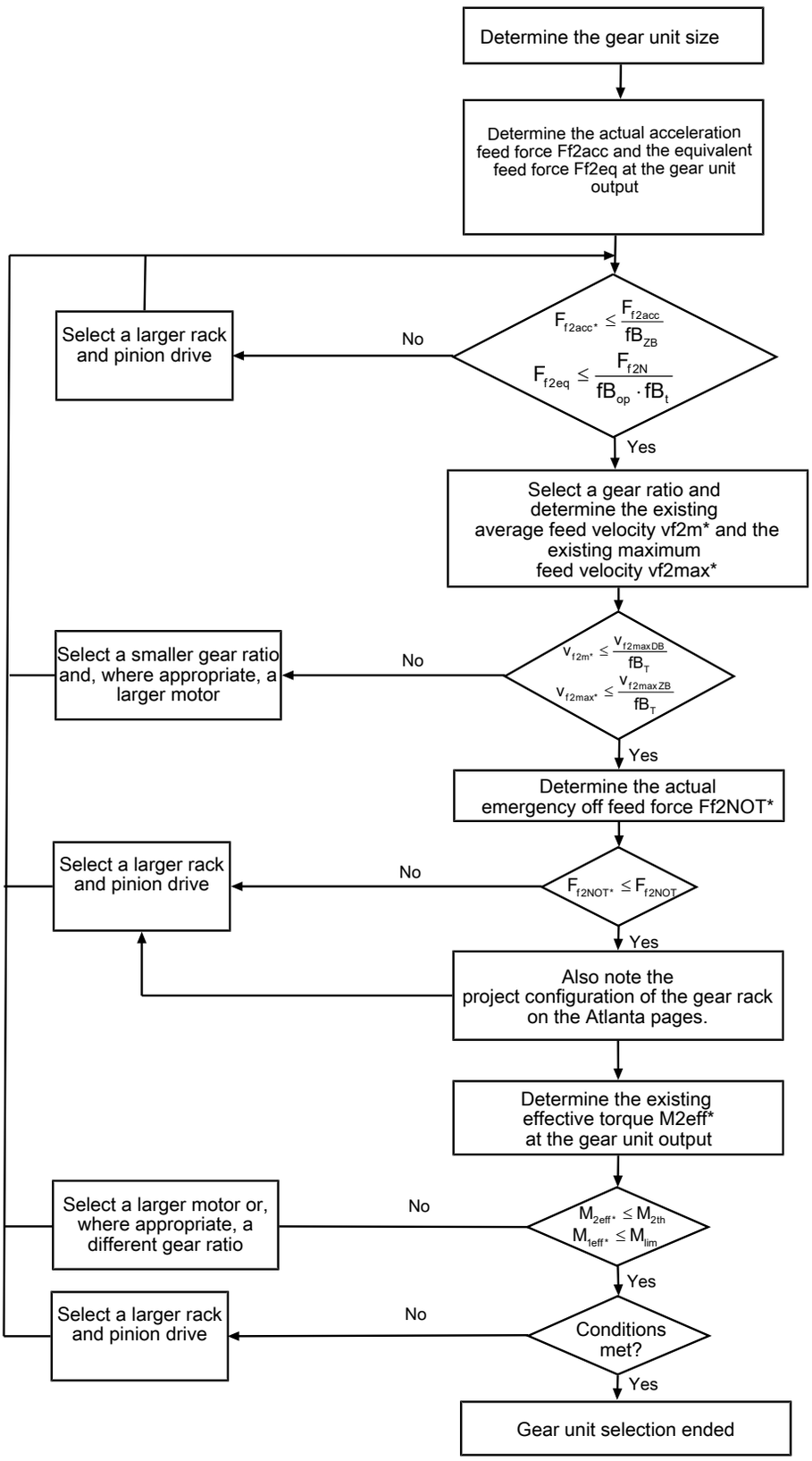
Observe the limit conditions in this chapter to ensure a safe design for your drives.

The formula symbols for values actually present in the application are marked with *.

An explanation of the formula symbols can be found in the chapter [▷ 15.1].

[1] Observe the protection class of all the components.

6.6.1 Drive selection

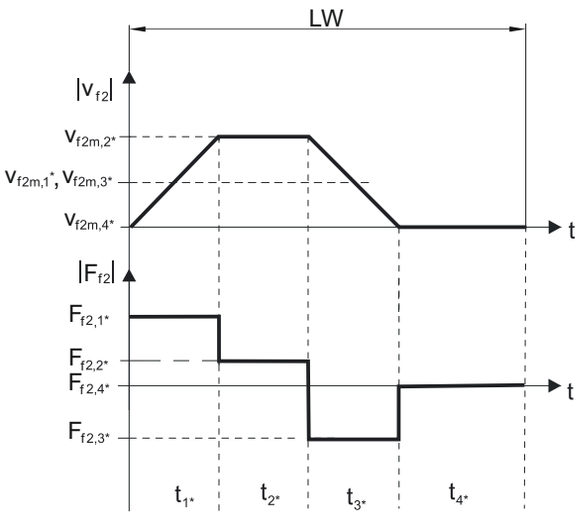


Refer to the selection tables for the values of i, $v_{f2maxDB}$, $v_{f2maxZB}$, F_{f2acc}, F_{f2N} and F_{f2NOT}.

The values for fB_T, fB_{op}, fB_t and fB_{ZB} can be found in the corresponding tables in this chapter.

Example of cyclic operation

The following calculations are based on a representation of the power taken from the output based in accordance with the following example:



Calculation of the actual maximum acceleration feed force

$$F_{f2acc*} = m* \cdot a* + F_{L*}$$

Calculation of the actual average input speed

$$n_{1m*} = \frac{v_{f2m*} \cdot i}{d_0 \cdot \pi}$$

$$v_{f2m*} = \frac{\left|v_{f2m,1*}\right| \cdot t_{1*} + \ldots + \left|v_{f2m,n*}\right| \cdot t_{n*}}{t_{1*} + \ldots + t_{n*}}$$

If $t_{1*} + \ldots + t_{3*} \geq 6$ min, determine v_{2m*} without the rest phase t_{4*}.

The values for the ratio i can be found in the selection tables.

Calculation of the actual emergency off feed force

$$F_{f2NOT*} = m* \cdot a_{NOT*} + F_{L*}$$

Calculation of the actual equivalent feed force

$$F_{f2eq*} = \sqrt[3]{\frac{\left|v_{f2m,1*}\right| \cdot t_{1*} \cdot \left|F_{f2,1*}{}^{3}\right| + \ldots + \left|v_{f2m,n*}\right| \cdot t_{n*} \cdot \left|F_{f2,n*}{}^{3}\right|}{\left|v_{f2m,1*}\right| \cdot t_{1*} + \ldots + \left|v_{f2m,n*}\right| \cdot t_{n*}}}$$

Calculation of the thermal limit torque

Calculate the thermal limit torque M_{2th} for a duty cycle $ED_{10} > 50\%$ and the actual average input speed n_{1m*}. (At $K_{mot,th} \leq 0$ you must reduce the average input speed n_{1m*} accordingly or select another geared motor size.)

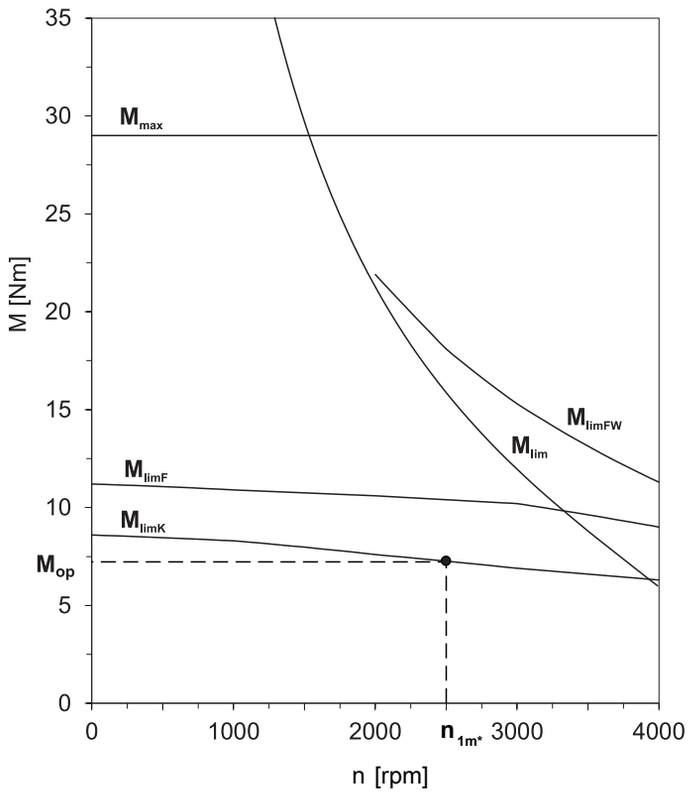
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

$$K_{mot,th} = 0{,}93 - \frac{a_{th}}{1000} \cdot fB_T \cdot \left(\frac{n_{1m*}}{1000}\right)^3$$

Refer to the selection tables for the values of i and a_{th}.

The values for fB_T can be found in the corresponding table in this chapter.

The value for the torque of the motor at operating point M_{op} with the determined average input speed n_{1m*} can be found in the motor characteristic curve of the chapter [▶ 13.3]. Note the size, nominal speed n_N and cooling type of the motor. The figure below shows an example of reading the torque M_{op} of a motor with convection cooling at the operating point.



Calculation of the actual effective torque

$$M_{2eff*} = \sqrt{\frac{t_{1*} \cdot M_{2,1*}^{\ 2} + \ldots + t_{n*} \cdot M_{2,n*}^{\ 2}}{t_{1*} + \ldots + t_{n*}}}$$

$$M_{2,n*} = \frac{F_{f2,n*} \cdot d_0}{2}$$

$$M_{1eff*} = \frac{M_{2eff*}}{i \cdot \eta}$$

Operating factors

Operating mode	fB_{op}
Uniform continuous operation	1.00
Cyclic operation	1.00
Reversing load cyclic operation	1.00

Run time	fB_t
Daily runtime ≤ 8 h	1.00
Daily runtime ≤ 16 h	1.15
Daily runtime ≤ 24 h	1.20

Cyclic operation	fB_{ZB}
≤ 1000 load changes/hour (LW/h)	1.00
> 1000 load changes/hour (LW/h)	1.15

Temperature		fB_T
Motor cooling	**Surrounding temperature**	
Motor with forced ventilation	≤ 20 °C	0.9
	≤ 30 °C	1.0
	≤ 40 °C	1.15
Motor with convection cooling	≤ 20 °C	1.0
	≤ 30 °C	1.1
	≤ 40 °C	1.25

Notes

- The maximum permitted gear unit temperature (see the "Other product features" chapter) must not be exceeded, as that could result in damage.
- For braking from full speed (for example, when the power fails or when setting up the machine), note the permitted gear unit feed forces (F_{f2acc}, F_{f2NOT}) in the selection tables.

6.6.2 Recommendation for radial shaft seal rings

For a duty cycle > 60% and higher surrounding temperatures, we recommend radial shaft seal rings made of FKM at the output.

Properties:

- Excellent temperature resistance
- High chemical stability
- Very good resistance to aging
- Excellent resistance in oils and greases
- For use in the food, beverage and pharmaceutical industries

Leak-proofness

Our gear units are equipped with high-quality radial shaft seal rings and checked for leaks. However, a leak cannot be fully ruled out over the length of use of a gear unit. If you use a gear unit with goods incompatible with the lubricant, you must take measures to prevent direct contact with the gear unit lubricant in case of a leak.

6.7 Additional documentation

Additional documentation related to the product can be found at
http://www.stoeber.de/en/downloads/

Enter the ID of the documentation in the Search... field.

Documentation	ID
Operating manual for gear racks (Atlanta)	442455
Operating manual for P/PA/PE/PH/PHA/PHQ/PHQA/PHV/PHVA planetary gear units and planetary geared motors	443029_en
Operating manual for EZ synchronous servo motors	443032_en

7 ZRPH rack and pinion drives

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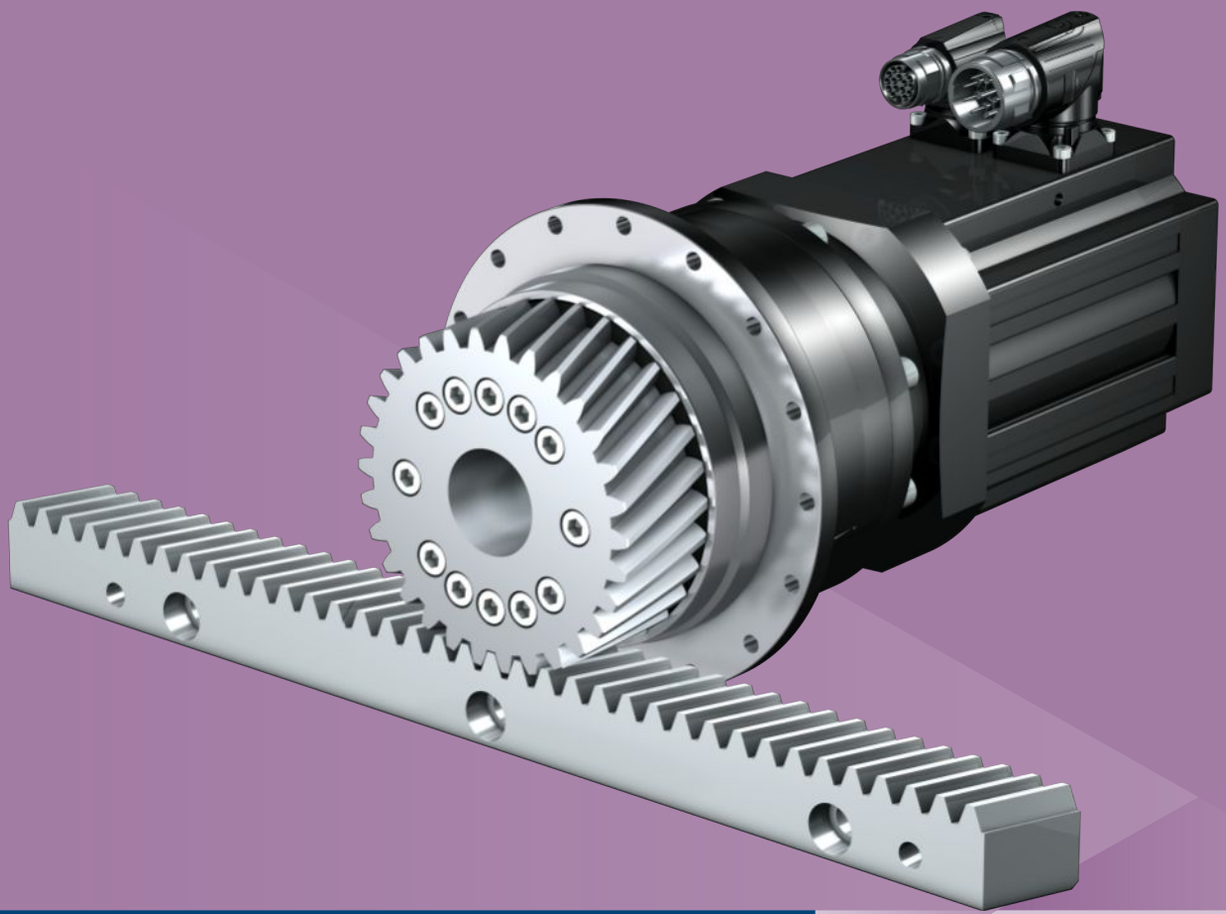


7 Rack and pinion drives

ZRPH

7.1 Overview

High-performance precision planetary geared motors with screwed pinion

Features

Power density	★★★☆☆
Linear clearance	★★★★★
Price category	€€€
Smooth operation	★★★★☆
Linear rigidity	★★★☆☆
Mass moment of inertia	★★★★☆
Ready-to-install drive solution	✓
Pinion gearing quality 5 (DIN 3962)	✓
Helical gearing	✓
Case-hardened and smoothed	✓
Reinforced output bearing (PH3 – PH5)	✓ (optional)
Compact and highly dynamic due to direct motor attachment	✓

Key ★☆☆☆☆ good | ★★★★★ excellent
€ Economy | €€€€€ Premium

Technical data

m_n	2 – 4 mm
z	26 – 40
F_{f2acc}	0.49 – 16 kN
v_{f2N}	0.16 – 6 m/s
Δs	10 – 56 µm

7.2 Selection table

The technical data specified in the selection tables applies to:

- De-energized installation
- Permanent lubrication with the lubricants specified in the Atlanta product catalog
- Material combinations as described in the chapter [▷ 7.5.2]
- Installation altitudes up to 1000 m above sea level
- Surrounding temperatures from 0 °C to 40 °C
- Without consideration of the thermal limiting performance
- Drives with convection-cooled motors (e.g. EZ401**U**)

For the technical data on drives with forced ventilated motors (e.g. EZ401**B**), refer to http://configurator.stoeber.de.

For rack and pinion drives with reduced backlash or reinforced bearings (PH3 – PH5), higher feed forces are possible. For this and all other technical data, refer to http://configurator.stoeber.de.

An explanation of the formula symbols can be found in the chapter [▷ 15.1].

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZR2PH4 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 4,9 kN)																	
0.16	1.7	1.8	0.6	1.8	ZR233SPH432_0700 EZ301U	4.5	6.4	160	70.00	0.24	0.42	31	10	42	2	33	70.0
0.16	3.0	3.1	1.0	1.0	ZR233SPH432_0700 EZ302U	4.5	6.4	160	70.00	0.24	0.42	31	10	42	2	33	70.0
0.22	1.2	1.3	0.7	2.5	ZR233SPH432_0500 EZ301U	3.7	6.4	130	50.00	0.33	0.59	31	10	44	2	33	70.0
0.22	2.1	2.2	1.2	1.4	ZR233SPH432_0500 EZ302U	4.5	6.4	160	50.00	0.33	0.59	31	10	44	2	33	70.0
0.22	2.7	2.9	1.6	1.1	ZR233SPH432_0500 EZ303U	4.5	6.4	160	50.00	0.33	0.59	31	10	44	2	33	70.0
0.28	1.0	1.0	0.8	2.9	ZR233SPH432_0400 EZ301U	3.0	6.4	100	40.00	0.41	0.73	31	10	44	2	33	70.0
0.28	1.7	1.8	1.4	1.7	ZR233SPH432_0400 EZ302U	4.4	6.4	160	40.00	0.41	0.73	31	10	44	2	33	70.0
0.28	2.2	2.3	1.9	1.3	ZR233SPH432_0400 EZ303U	4.4	6.4	160	40.00	0.41	0.73	31	10	44	2	33	70.0
0.31	0.9	0.9	0.9	3.3	ZR233SPH432_0350 EZ301U	2.6	6.4	91	35.00	0.47	0.84	31	10	45	2	33	70.0
0.31	1.5	1.6	1.5	1.9	ZR233SPH432_0350 EZ302U	4.6	6.4	160	35.00	0.47	0.84	31	10	45	2	33	70.0
0.31	1.9	2.0	1.9	1.5	ZR233SPH432_0350 EZ303U	4.6	6.4	160	35.00	0.47	0.84	31	10	45	2	33	70.0
0.31	2.6	2.8	2.6	1.1	ZR233SPH432_0350 EZ401U	4.6	6.4	160	35.00	0.47	0.84	31	10	45	2	33	70.0
0.39	0.7	0.7	1.1	3.9	ZR233SPH432_0280 EZ301U	2.1	6.4	73	28.00	0.59	1.05	31	10	45	2	33	70.0
0.39	1.2	1.2	1.9	2.3	ZR233SPH432_0280 EZ302U	3.7	6.4	130	28.00	0.59	1.05	31	10	45	2	33	70.0
0.39	1.5	1.6	2.4	1.7	ZR233SPH432_0280 EZ303U	4.6	6.4	160	28.00	0.59	1.05	31	10	45	2	33	70.0
0.39	2.1	2.2	3.3	1.3	ZR233SPH432_0280 EZ401U	4.6	6.4	160	28.00	0.59	1.05	31	10	45	2	33	70.0
0.44	0.6	0.6	1.1	4.2	ZR233SPH432_0250 EZ301U	1.9	6.4	65	25.00	0.66	1.17	31	10	46	2	33	70.0
0.44	1.1	1.1	1.9	2.4	ZR233SPH432_0250 EZ302U	3.3	6.4	120	25.00	0.66	1.17	31	10	46	2	33	70.0
0.44	1.4	1.5	2.4	1.9	ZR233SPH432_0250 EZ303U	4.6	6.4	160	25.00	0.66	1.17	31	10	46	2	33	70.0
0.44	1.9	2.0	3.3	1.4	ZR233SPH432_0250 EZ401U	4.6	6.4	160	25.00	0.66	1.17	31	10	46	2	33	70.0
0.55	0.5	0.5	1.3	4.8	ZR233SPH432_0200 EZ301U	1.5	6.4	52	20.00	0.73	1.47	31	10	45	2	33	70.0
0.55	0.8	0.9	2.2	2.8	ZR233SPH432_0200 EZ302U	2.7	6.4	93	20.00	0.73	1.47	31	10	45	2	33	70.0
0.55	1.1	1.2	2.9	2.2	ZR233SPH432_0200 EZ303U	3.7	6.4	130	20.00	0.73	1.47	31	10	45	2	33	70.0
0.55	1.5	1.6	3.9	1.6	ZR233SPH432_0200 EZ401U	4.3	6.4	150	20.00	0.73	1.47	31	10	45	2	33	70.0
0.69	0.7	0.7	2.6	3.3	ZR233SPH432_0160 EZ302U	2.1	6.4	74	16.00	0.92	1.83	31	10	44	2	33	70.0
0.69	0.9	0.9	3.4	2.5	ZR233SPH432_0160 EZ303U	3.0	6.4	100	16.00	0.92	1.83	31	10	44	2	33	70.0
0.69	1.2	1.3	4.6	1.9	ZR233SPH432_0160 EZ401U	3.6	6.4	130	16.00	0.92	1.83	31	10	44	2	33	70.0
0.69	2.0	2.2	7.6	1.1	ZR233SPH432_0160 EZ402U	4.6	6.4	160	16.00	0.92	1.83	31	10	44	2	33	70.0
1.10	0.8	0.8	2.4	2.2	ZR233SPH431_0100 EZ401U	2.3	6.4	82	10.00	1.28	2.57	31	10	36	2	33	70.0
1.10	1.2	1.3	3.7	1.4	ZR233SPH431_0100 EZ501U	3.3	6.4	120	10.00	1.28	2.57	31	10	36	2	33	70.0
1.10	1.3	1.4	4.1	1.3	ZR233SPH431_0100 EZ402U	3.3	6.4	120	10.00	1.28	2.57	31	10	36	2	33	70.0
1.57	0.5	0.6	3.0	3.1	ZR233SPH431_0070 EZ401U	1.6	6.4	57	7.000	1.68	3.14	31	10	44	2	33	70.0
1.57	0.8	0.9	4.6	2.0	ZR233SPH431_0070 EZ501U	3.1	6.4	110	7.000	1.68	3.14	31	10	44	2	33	70.0
1.57	0.9	1.0	5.0	1.9	ZR233SPH431_0070 EZ402U	3.1	6.4	110	7.000	1.68	3.14	31	10	44	2	33	70.0
1.57	1.3	1.7	7.4	1.3	ZR233SPH431_0070 EZ404U	4.6	6.4	160	7.000	1.68	3.14	31	10	44	2	33	70.0
1.57	1.4	1.5	7.9	1.2	ZR233SPH431_0070 EZ502U	4.6	6.4	160	7.000	1.68	3.14	31	10	44	2	33	70.0
2.20	0.4	0.4	4.5	3.9	ZR233SPH431_0050 EZ401U	1.2	6.4	41	5.000	2.20	4.40	31	10	48	2	33	70.0
2.20	0.6	0.6	6.9	2.6	ZR233SPH431_0050 EZ501U	2.2	6.4	77	5.000	2.20	4.40	31	10	48	2	33	70.0
2.20	0.6	0.7	7.5	2.3	ZR233SPH431_0050 EZ402U	2.2	6.4	77	5.000	2.20	4.40	31	10	48	2	33	70.0
2.20	0.9	1.2	11	1.6	ZR233SPH431_0050 EZ404U	4.0	6.4	140	5.000	2.20	4.40	31	10	48	2	33	70.0
2.20	1.0	1.1	12	1.5	ZR233SPH431_0050 EZ502U	4.2	6.4	150	5.000	2.20	4.40	31	10	48	2	33	70.0
2.20	1.3	1.5	16	1.1	ZR233SPH431_0050 EZ503U	4.9	6.4	170	5.000	2.20	4.40	31	10	48	2	33	70.0
2.75	0.3	0.3	5.9	4.5	ZR233SPH431_0040 EZ401U	0.9	6.4	33	4.000	2.38	4.58	31	10	50	2	33	70.0
2.75	0.5	0.5	9.0	3.0	ZR233SPH431_0040 EZ501U	1.8	6.4	61	4.000	2.38	4.58	31	10	50	2	33	70.0
2.75	0.5	0.6	9.8	2.7	ZR233SPH431_0040 EZ402U	1.8	6.4	61	4.000	2.38	4.58	31	10	50	2	33	70.0
2.75	0.8	0.9	14	1.8	ZR233SPH431_0040 EZ404U	3.2	6.4	110	4.000	2.38	4.58	31	10	50	2	33	70.0

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZR2PH4 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 4,9 kN)																	
2.75	0.8	0.9	15	1.7	ZR233SPH431_0040 EZ502U	3.4	6.4	120	4.000	2.38	4.58	31	10	50	2	33	70.0
2.75	1.1	1.2	20	1.3	ZR233SPH431_0040 EZ503U	3.9	6.4	140	4.000	2.38	4.58	31	10	50	2	33	70.0
ZR2PH4 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 4,9 kN)																	
3.30	1.3	2.1	17	1.0	ZR233SPH431_0050 EZ505U	4.9	6.4	170	5.000	2.20	4.40	31	10	48	2	33	70.0
4.13	1.0	1.7	23	1.2	ZR233SPH431_0040 EZ505U	3.9	6.4	140	4.000	2.38	4.58	31	10	50	2	33	70.0
ZR2PH4 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 4,9 kN)																	
0.31	1.7	1.8	0.7	1.5	ZR233SPH432_0700 EZ301U	4.5	6.4	160	70.00	0.24	0.42	31	10	42	2	33	70.0
0.44	1.2	1.3	0.9	2.1	ZR233SPH432_0500 EZ301U	3.7	6.4	130	50.00	0.33	0.59	31	10	44	2	33	70.0
0.44	2.0	2.2	1.5	1.2	ZR233SPH432_0500 EZ302U	4.5	6.4	160	50.00	0.33	0.59	31	10	44	2	33	70.0
0.55	0.9	1.0	1.0	2.4	ZR233SPH432_0400 EZ301U	3.0	6.4	100	40.00	0.41	0.73	31	10	44	2	33	70.0
0.55	1.6	1.8	1.7	1.4	ZR233SPH432_0400 EZ302U	4.4	6.4	160	40.00	0.41	0.73	31	10	44	2	33	70.0
0.55	2.1	2.4	2.2	1.1	ZR233SPH432_0400 EZ303U	4.4	6.4	160	40.00	0.41	0.73	31	10	44	2	33	70.0
0.63	0.8	0.9	1.0	2.8	ZR233SPH432_0350 EZ301U	2.6	6.4	91	35.00	0.47	0.84	31	10	45	2	33	70.0
0.63	1.4	1.6	1.7	1.6	ZR233SPH432_0350 EZ302U	4.6	6.4	160	35.00	0.47	0.84	31	10	45	2	33	70.0
0.63	1.8	2.1	2.3	1.3	ZR233SPH432_0350 EZ303U	4.6	6.4	160	35.00	0.47	0.84	31	10	45	2	33	70.0
0.63	2.1	2.6	2.7	1.1	ZR233SPH432_0350 EZ401U	4.6	6.4	160	35.00	0.47	0.84	31	10	45	2	33	70.0
0.79	0.7	0.7	1.2	3.2	ZR233SPH432_0280 EZ301U	2.1	6.4	73	28.00	0.59	1.05	31	10	45	2	33	70.0
0.79	1.1	1.2	2.0	1.9	ZR233SPH432_0280 EZ302U	3.7	6.4	130	28.00	0.59	1.05	31	10	45	2	33	70.0
0.79	1.5	1.7	2.6	1.5	ZR233SPH432_0280 EZ303U	4.6	6.4	160	28.00	0.59	1.05	31	10	45	2	33	70.0
0.79	1.7	2.1	3.0	1.2	ZR233SPH432_0280 EZ401U	4.6	6.4	160	28.00	0.59	1.05	31	10	45	2	33	70.0
0.88	0.6	0.6	1.2	3.5	ZR233SPH432_0250 EZ301U	1.9	6.4	65	25.00	0.66	1.17	31	10	46	2	33	70.0
0.88	1.0	1.1	2.1	2.0	ZR233SPH432_0250 EZ302U	3.3	6.4	120	25.00	0.66	1.17	31	10	46	2	33	70.0
0.88	1.3	1.5	2.7	1.6	ZR233SPH432_0250 EZ303U	4.6	6.4	160	25.00	0.66	1.17	31	10	46	2	33	70.0
0.88	1.5	1.9	3.2	1.3	ZR233SPH432_0250 EZ401U	4.6	6.4	160	25.00	0.66	1.17	31	10	46	2	33	70.0
1.10	0.5	0.5	1.4	4.0	ZR233SPH432_0200 EZ301U	1.5	6.4	52	20.00	0.73	1.47	31	10	45	2	33	70.0
1.10	0.8	0.9	2.3	2.4	ZR233SPH432_0200 EZ302U	2.7	6.4	93	20.00	0.73	1.47	31	10	45	2	33	70.0
1.10	1.0	1.2	3.0	1.8	ZR233SPH432_0200 EZ303U	3.7	6.4	130	20.00	0.73	1.47	31	10	45	2	33	70.0
1.10	1.2	1.5	3.5	1.6	ZR233SPH432_0200 EZ401U	4.3	6.4	150	20.00	0.73	1.47	31	10	45	2	33	70.0
1.10	1.9	2.6	5.4	1.0	ZR233SPH432_0200 EZ402U	4.3	6.4	150	20.00	0.73	1.47	31	10	45	2	33	70.0
1.38	0.4	0.4	1.7	4.6	ZR233SPH432_0160 EZ301U	1.2	6.4	42	16.00	0.92	1.83	31	10	44	2	33	70.0
1.38	0.6	0.7	2.8	2.8	ZR233SPH432_0160 EZ302U	2.1	6.4	74	16.00	0.92	1.83	31	10	44	2	33	70.0
1.38	0.8	1.0	3.6	2.1	ZR233SPH432_0160 EZ303U	3.0	6.4	100	16.00	0.92	1.83	31	10	44	2	33	70.0
1.38	1.0	1.2	4.3	1.8	ZR233SPH432_0160 EZ401U	3.6	6.4	130	16.00	0.92	1.83	31	10	44	2	33	70.0
1.38	1.5	2.1	6.5	1.2	ZR233SPH432_0160 EZ402U	4.6	6.4	160	16.00	0.92	1.83	31	10	44	2	33	70.0
2.20	0.6	0.8	2.5	2.1	ZR233SPH431_0100 EZ401U	2.3	6.4	82	10.00	1.28	2.57	31	10	36	2	33	70.0
2.20	0.9	1.2	3.7	1.4	ZR233SPH431_0100 EZ501U	3.3	6.4	120	10.00	1.28	2.57	31	10	36	2	33	70.0
2.20	1.0	1.3	3.8	1.4	ZR233SPH431_0100 EZ402U	3.3	6.4	120	10.00	1.28	2.57	31	10	36	2	33	70.0
3.14	0.4	0.5	3.1	3.0	ZR233SPH431_0070 EZ401U	1.6	6.4	57	7.000	1.68	3.14	31	10	44	2	33	70.0
3.14	0.7	0.8	4.6	2.0	ZR233SPH431_0070 EZ501U	3.1	6.4	110	7.000	1.68	3.14	31	10	44	2	33	70.0
3.14	0.7	0.9	4.7	2.0	ZR233SPH431_0070 EZ402U	3.1	6.4	110	7.000	1.68	3.14	31	10	44	2	33	70.0
3.14	1.0	1.5	7.0	1.3	ZR233SPH431_0070 EZ502U	4.6	6.4	160	7.000	1.68	3.14	31	10	44	2	33	70.0
3.14	1.1	1.6	7.8	1.2	ZR233SPH431_0070 EZ404U	4.6	6.4	160	7.000	1.68	3.14	31	10	44	2	33	70.0
3.14	1.2	2.0	8.4	1.1	ZR233SPH431_0070 EZ503U	4.6	6.4	160	7.000	1.68	3.14	31	10	44	2	33	70.0
4.40	0.3	0.4	4.6	3.8	ZR233SPH431_0050 EZ401U	1.2	6.4	41	5.000	2.20	4.40	31	10	48	2	33	70.0
4.40	0.5	0.6	6.9	2.6	ZR233SPH431_0050 EZ501U	2.2	6.4	77	5.000	2.20	4.40	31	10	48	2	33	70.0
4.40	0.5	0.7	7.1	2.5	ZR233SPH431_0050 EZ402U	2.2	6.4	77	5.000	2.20	4.40	31	10	48	2	33	70.0
4.40	0.7	1.1	10	1.7	ZR233SPH431_0050 EZ502U	4.2	6.4	150	5.000	2.20	4.40	31	10	48	2	33	70.0
4.40	0.8	1.2	12	1.5	ZR233SPH431_0050 EZ404U	4.0	6.4	140	5.000	2.20	4.40	31	10	48	2	33	70.0
4.40	0.8	1.5	13	1.4	ZR233SPH431_0050 EZ503U	4.9	6.4	170	5.000	2.20	4.40	31	10	48	2	33	70.0
ZR2PH5 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 8,1 kN)																	
0.19	4.3	4.6	0.8	1.2	ZR240SPH532_0700 EZ401U	8.1	10	340	70.00	0.25	0.51	37	12	69	2	40	84.9
0.27	3.1	3.3	1.0	1.5	ZR240SPH532_0500 EZ401U	8.1	10	340	50.00	0.36	0.71	37	12	73	2	40	84.9
0.33	2.5	2.6	1.4	1.8	ZR240SPH532_0400 EZ401U	7.5	10	320	40.00	0.44	0.89	37	12	70	2	40	84.9
0.33	3.8	4.1	2.1	1.1	ZR240SPH532_0400 EZ501U	8.1	10	340	40.00	0.44	0.89	37	12	70	2	40	84.9
0.33	4.1	4.6	2.3	1.0	ZR240SPH532_0400 EZ402U	8.1	10	340	40.00	0.44	0.89	37	12	70	2	40	84.9
0.38	2.1	2.3	1.2	1.9	ZR240SPH532_0350 EZ401U	6.5	10	280	35.00	0.51	1.02	37	12	75	2	40	84.9
0.38	3.3	3.6	1.8	1.2	ZR240SPH532_0350 EZ501U	8.1	10	340	35.00	0.51	1.02	37	12	75	2	40	84.9
0.38	3.6	4.0	2.0	1.1	ZR240SPH532_0350 EZ402U	8.1	10	340	35.00	0.51	1.02	37	12	75	2	40	84.9
0.48	1.7	1.8	1.4	2.2	ZR240SPH532_0280 EZ401U	5.2	10	220	28.00	0.64	1.27	37	12	73	2	40	84.9
0.48	2.6	2.9	2.2	1.4	ZR240SPH532_0280 EZ501U	8.1	10	340	28.00	0.64	1.27	37	12	73	2	40	84.9
0.48	2.9	3.2	2.4	1.3	ZR240SPH532_0280 EZ402U	8.1	10	340	28.00	0.64	1.27	37	12	73	2	40	84.9
0.53	1.5	1.6	1.4	2.4	ZR240SPH532_0250 EZ401U	4.7	10	200	25.00	0.66	1.33	37	12	75	2	40	84.9
0.53	2.4	2.6	2.2	1.6	ZR240SPH532_0250 EZ501U	8.1	10	340	25.00	0.66	1.33	37	12	75	2	40	84.9
0.53	2.6	2.8	2.4	1.4	ZR240SPH532_0250 EZ402U	8.1	10	340	25.00	0.66	1.33	37	12	75	2	40	84.9
0.67	1.2	1.3	1.6	2.8	ZR240SPH532_0200 EZ401U	3.7	10	160	20.00	0.78	1.56	37	12	75	2	40	84.9
0.67	1.9	2.1	2.5	1.8	ZR240SPH532_0200 EZ501U	7.0	10	300	20.00	0.78	1.56	37	12	75	2	40	84.9

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZR2PH5 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 8,1 kN)																	
0.67	2.1	2.3	2.7	1.7	ZR240SPH532_0200 EZ402U	7.0	10	300	20.00	0.78	1.56	37	12	75	2	40	84.9
0.67	3.0	3.8	4.0	1.1	ZR240SPH532_0200 EZ404U	8.1	10	340	20.00	0.78	1.56	37	12	75	2	40	84.9
0.67	3.2	3.5	4.3	1.1	ZR240SPH532_0200 EZ502U	8.1	10	340	20.00	0.78	1.56	37	12	75	2	40	84.9
0.83	1.0	1.1	2.0	3.2	ZR240SPH532_0160 EZ401U	3.0	10	130	16.00	0.97	1.94	37	12	74	2	40	84.9
0.83	1.5	1.6	3.0	2.1	ZR240SPH532_0160 EZ501U	5.6	10	240	16.00	0.97	1.94	37	12	74	2	40	84.9
0.83	1.6	1.8	3.3	1.9	ZR240SPH532_0160 EZ402U	5.6	10	240	16.00	0.97	1.94	37	12	74	2	40	84.9
0.83	2.4	3.0	4.9	1.3	ZR240SPH532_0160 EZ404U	8.1	10	340	16.00	0.97	1.94	37	12	74	2	40	84.9
0.83	2.6	2.8	5.2	1.2	ZR240SPH532_0160 EZ502U	8.1	10	340	16.00	0.97	1.94	37	12	74	2	40	84.9
1.33	1.0	1.1	1.7	2.8	ZR240SPH531_0100 EZ501U	3.6	10	150	10.00	1.47	2.89	37	12	59	2	40	84.9
1.33	1.7	1.8	3.0	1.6	ZR240SPH531_0100 EZ502U	6.8	10	290	10.00	1.47	2.89	37	12	59	2	40	84.9
1.33	1.7	1.9	3.0	1.6	ZR240SPH531_0100 EZ701U	4.5	10	190	10.00	1.47	2.89	37	12	59	2	40	84.9
1.33	2.2	2.5	3.9	1.2	ZR240SPH531_0100 EZ503U	6.8	10	290	10.00	1.47	2.89	37	12	59	2	40	84.9
1.91	0.7	0.7	2.1	3.5	ZR240SPH531_0070 EZ501U	2.5	10	110	7.000	1.91	3.81	37	12	71	2	40	84.9
1.91	1.2	1.3	3.6	2.1	ZR240SPH531_0070 EZ502U	4.9	10	210	7.000	1.91	3.81	37	12	71	2	40	84.9
1.91	1.2	1.3	3.6	2.1	ZR240SPH531_0070 EZ701U	3.2	10	130	7.000	1.91	3.81	37	12	71	2	40	84.9
1.91	1.5	1.8	4.7	1.6	ZR240SPH531_0070 EZ503U	6.8	10	290	7.000	1.91	3.81	37	12	71	2	40	84.9
1.91	1.9	2.3	5.8	1.3	ZR240SPH531_0070 EZ702U	6.5	10	280	7.000	1.91	3.81	37	12	71	2	40	84.9
1.91	2.1	2.5	6.5	1.1	ZR240SPH531_0070 EZ505U	8.1	10	340	7.000	1.91	3.81	37	12	71	2	40	84.9
2.67	0.5	0.5	3.1	4.4	ZR240SPH531_0050 EZ501U	1.8	10	77	5.000	2.22	4.89	37	12	80	2	40	84.9
2.67	0.8	0.9	5.3	2.6	ZR240SPH531_0050 EZ502U	3.5	10	150	5.000	2.22	4.89	37	12	80	2	40	84.9
2.67	0.8	0.9	5.3	2.6	ZR240SPH531_0050 EZ701U	2.3	10	96	5.000	2.22	4.89	37	12	80	2	40	84.9
2.67	1.1	1.3	7.0	2.0	ZR240SPH531_0050 EZ503U	4.9	10	210	5.000	2.22	4.89	37	12	80	2	40	84.9
2.67	1.4	1.6	8.6	1.6	ZR240SPH531_0050 EZ702U	4.6	10	200	5.000	2.22	4.89	37	12	80	2	40	84.9
2.67	1.5	1.8	9.7	1.4	ZR240SPH531_0050 EZ505U	7.6	10	320	5.000	2.22	4.89	37	12	80	2	40	84.9
2.67	1.9	2.4	12	1.2	ZR240SPH531_0050 EZ703U	7.4	10	310	5.000	2.22	4.89	37	12	80	2	40	84.9
3.33	0.7	0.7	7.0	3.0	ZR240SPH531_0040 EZ502U	2.8	10	120	4.000	2.44	5.56	37	12	81	2	40	84.9
3.33	0.7	0.8	7.0	3.0	ZR240SPH531_0040 EZ701U	1.8	10	77	4.000	2.44	5.56	37	12	81	2	40	84.9
3.33	0.9	1.0	9.1	2.3	ZR240SPH531_0040 EZ503U	3.9	10	170	4.000	2.44	5.56	37	12	81	2	40	84.9
3.33	1.1	1.3	11	1.8	ZR240SPH531_0040 EZ702U	3.7	10	160	4.000	2.44	5.56	37	12	81	2	40	84.9
3.33	1.2	1.4	13	1.6	ZR240SPH531_0040 EZ505U	6.1	10	260	4.000	2.44	5.56	37	12	81	2	40	84.9
3.33	1.5	1.9	16	1.3	ZR240SPH531_0040 EZ703U	5.9	10	250	4.000	2.44	5.56	37	12	81	2	40	84.9
3.33	1.9	2.7	20	1.0	ZR240SPH531_0040 EZ705U	8.1	10	340	4.000	2.44	5.56	37	12	81	2	40	84.9
ZR2PH5 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 8,1 kN)																	
2.00	2.1	3.5	4.4	1.1	ZR240SPH531_0100 EZ505U	6.8	10	290	10.00	1.47	2.89	37	12	59	2	40	84.9
2.86	1.5	2.4	5.2	1.4	ZR240SPH531_0070 EZ505U	8.1	10	340	7.000	1.91	3.81	37	12	71	2	40	84.9
2.86	1.9	3.2	6.7	1.1	ZR240SPH531_0070 EZ703U	8.1	10	340	7.000	1.91	3.81	37	12	71	2	40	84.9
4.00	1.1	1.7	7.8	1.8	ZR240SPH531_0050 EZ505U	7.6	10	320	5.000	2.22	4.89	37	12	80	2	40	84.9
4.00	1.4	2.3	10	1.4	ZR240SPH531_0050 EZ703U	7.4	10	310	5.000	2.22	4.89	37	12	80	2	40	84.9
4.00	1.9	3.4	14	1.0	ZR240SPH531_0050 EZ705U	8.1	10	340	5.000	2.22	4.89	37	12	80	2	40	84.9
5.00	0.9	1.4	10	2.0	ZR240SPH531_0040 EZ505U	6.1	10	260	4.000	2.44	5.56	37	12	81	2	40	84.9
5.00	1.1	1.8	13	1.6	ZR240SPH531_0040 EZ703U	5.9	10	250	4.000	2.44	5.56	37	12	81	2	40	84.9
5.00	1.5	2.7	18	1.2	ZR240SPH531_0040 EZ705U	8.1	10	340	4.000	2.44	5.56	37	12	81	2	40	84.9
ZR2PH5 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 8,1 kN)																	
0.38	3.5	4.3	0.9	1.2	ZR240SPH532_0700 EZ401U	8.1	10	340	70.00	0.25	0.51	37	12	69	2	40	84.9
0.53	2.5	3.1	1.0	1.5	ZR240SPH532_0500 EZ401U	8.1	10	340	50.00	0.36	0.71	37	12	73	2	40	84.9
0.67	2.0	2.5	1.4	1.7	ZR240SPH532_0400 EZ401U	7.5	10	320	40.00	0.44	0.89	37	12	70	2	40	84.9
0.67	3.0	3.9	2.1	1.1	ZR240SPH532_0400 EZ501U	8.1	10	340	40.00	0.44	0.89	37	12	70	2	40	84.9
0.67	3.1	4.3	2.2	1.1	ZR240SPH532_0400 EZ402U	8.1	10	340	40.00	0.44	0.89	37	12	70	2	40	84.9
0.76	1.8	2.1	1.2	1.9	ZR240SPH532_0350 EZ401U	6.5	10	280	35.00	0.51	1.02	37	12	75	2	40	84.9
0.76	2.6	3.4	1.8	1.3	ZR240SPH532_0350 EZ501U	8.1	10	340	35.00	0.51	1.02	37	12	75	2	40	84.9
0.76	2.7	3.8	1.8	1.2	ZR240SPH532_0350 EZ402U	8.1	10	340	35.00	0.51	1.02	37	12	75	2	40	84.9
0.95	1.4	1.7	1.4	2.2	ZR240SPH532_0280 EZ401U	5.2	10	220	28.00	0.64	1.27	37	12	73	2	40	84.9
0.95	2.1	2.7	2.1	1.5	ZR240SPH532_0280 EZ501U	8.1	10	340	28.00	0.64	1.27	37	12	73	2	40	84.9
0.95	2.1	3.0	2.1	1.4	ZR240SPH532_0280 EZ402U	8.1	10	340	28.00	0.64	1.27	37	12	73	2	40	84.9
1.07	1.3	1.5	1.4	2.3	ZR240SPH532_0250 EZ401U	4.7	10	200	25.00	0.66	1.33	37	12	75	2	40	84.9
1.07	1.9	2.4	2.1	1.6	ZR240SPH532_0250 EZ501U	8.1	10	340	25.00	0.66	1.33	37	12	75	2	40	84.9
1.07	1.9	2.7	2.2	1.5	ZR240SPH532_0250 EZ402U	8.1	10	340	25.00	0.66	1.33	37	12	75	2	40	84.9
1.07	2.8	4.3	3.2	1.0	ZR240SPH532_0250 EZ502U	8.1	10	340	25.00	0.66	1.33	37	12	75	2	40	84.9
1.33	1.0	1.2	1.6	2.7	ZR240SPH532_0200 EZ401U	3.7	10	160	20.00	0.78	1.56	37	12	75	2	40	84.9
1.33	1.5	1.9	2.4	1.8	ZR240SPH532_0200 EZ501U	7.0	10	300	20.00	0.78	1.56	37	12	75	2	40	84.9
1.33	1.5	2.1	2.4	1.8	ZR240SPH532_0200 EZ402U	7.0	10	300	20.00	0.78	1.56	37	12	75	2	40	84.9
1.33	2.3	3.4	3.6	1.2	ZR240SPH532_0200 EZ502U	8.1	10	340	20.00	0.78	1.56	37	12	75	2	40	84.9
1.33	2.5	3.7	4.0	1.1	ZR240SPH532_0200 EZ404U	8.1	10	340	20.00	0.78	1.56	37	12	75	2	40	84.9
1.67	0.8	1.0	1.9	3.1	ZR240SPH532_0160 EZ401U	3.0	10	130	16.00	0.97	1.94	37	12	74	2	40	84.9
1.67	1.2	1.5	2.8	2.1	ZR240SPH532_0160 EZ501U	5.6	10	240	16.00	0.97	1.94	37	12	74	2	40	84.9
1.67	1.2	1.7	2.9	2.1	ZR240SPH532_0160 EZ402U	5.6	10	240	16.00	0.97	1.94	37	12	74	2	40	84.9

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZR2PH5 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 8,1 kN)																	
1.67	1.8	2.7	4.3	1.4	ZR240SPH532_0160 EZ502U	8.1	10	340	16.00	0.97	1.94	37	12	74	2	40	84.9
1.67	2.0	2.9	4.8	1.2	ZR240SPH532_0160 EZ404U	8.1	10	340	16.00	0.97	1.94	37	12	74	2	40	84.9
1.67	2.2	3.7	5.2	1.2	ZR240SPH532_0160 EZ503U	8.1	10	340	16.00	0.97	1.94	37	12	74	2	40	84.9
2.67	0.8	1.0	1.7	2.8	ZR240SPH531_0100 EZ501U	3.6	10	150	10.00	1.47	2.89	37	12	59	2	40	84.9
2.67	1.2	1.8	2.6	1.8	ZR240SPH531_0100 EZ502U	6.8	10	290	10.00	1.47	2.89	37	12	59	2	40	84.9
2.67	1.2	1.8	2.6	1.8	ZR240SPH531_0100 EZ701U	4.5	10	190	10.00	1.47	2.89	37	12	59	2	40	84.9
2.67	1.4	2.4	3.1	1.5	ZR240SPH531_0100 EZ503U	6.8	10	290	10.00	1.47	2.89	37	12	59	2	40	84.9
2.67	1.6	3.2	3.7	1.3	ZR240SPH531_0100 EZ702U	6.8	10	290	10.00	1.47	2.89	37	12	59	2	40	84.9
3.81	0.5	0.7	2.1	3.6	ZR240SPH531_0070 EZ501U	2.5	10	110	7.000	1.91	3.81	37	12	71	2	40	84.9
3.81	0.8	1.2	3.2	2.3	ZR240SPH531_0070 EZ502U	4.9	10	210	7.000	1.91	3.81	37	12	71	2	40	84.9
3.81	0.8	1.3	3.2	2.3	ZR240SPH531_0070 EZ701U	3.2	10	130	7.000	1.91	3.81	37	12	71	2	40	84.9
3.81	1.0	1.7	3.8	1.9	ZR240SPH531_0070 EZ503U	6.8	10	290	7.000	1.91	3.81	37	12	71	2	40	84.9
3.81	1.1	2.3	4.4	1.7	ZR240SPH531_0070 EZ702U	6.5	10	280	7.000	1.91	3.81	37	12	71	2	40	84.9
ZR3PH5 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 7,7 kN)																	
0.21	3.8	4.1	0.8	1.3	ZR330SPH532_0700 EZ401U	7.7	9.6	370	70.00	0.29	0.57	42	14	55	3	30	95.5
0.30	2.7	2.9	1.0	1.7	ZR330SPH532_0500 EZ401U	7.7	9.6	370	50.00	0.40	0.80	42	14	58	3	30	95.5
0.30	4.2	4.6	1.6	1.1	ZR330SPH532_0500 EZ501U	7.7	9.6	370	50.00	0.40	0.80	42	14	58	3	30	95.5
0.38	2.2	2.3	1.4	1.9	ZR330SPH532_0400 EZ401U	6.6	9.6	320	40.00	0.50	1.00	42	14	56	3	30	95.5
0.38	3.4	3.7	2.1	1.3	ZR330SPH532_0400 EZ501U	7.4	9.6	360	40.00	0.50	1.00	42	14	56	3	30	95.5
0.38	3.7	4.1	2.3	1.2	ZR330SPH532_0400 EZ402U	7.4	9.6	360	40.00	0.50	1.00	42	14	56	3	30	95.5
0.43	1.9	2.0	1.2	2.1	ZR330SPH532_0350 EZ401U	5.8	9.6	280	35.00	0.57	1.14	42	14	60	3	30	95.5
0.43	2.9	3.2	1.8	1.4	ZR330SPH532_0350 EZ501U	7.7	9.6	370	35.00	0.57	1.14	42	14	60	3	30	95.5
0.43	3.2	3.5	2.0	1.3	ZR330SPH532_0350 EZ402U	7.7	9.6	370	35.00	0.57	1.14	42	14	60	3	30	95.5
0.54	1.5	1.6	1.4	2.5	ZR330SPH532_0280 EZ401U	4.6	9.6	220	28.00	0.71	1.43	42	14	58	3	30	95.5
0.54	2.3	2.6	2.2	1.6	ZR330SPH532_0280 EZ501U	7.4	9.6	360	28.00	0.71	1.43	42	14	58	3	30	95.5
0.54	2.6	2.8	2.4	1.5	ZR330SPH532_0280 EZ402U	7.4	9.6	360	28.00	0.71	1.43	42	14	58	3	30	95.5
0.60	1.4	1.5	1.4	2.6	ZR330SPH532_0250 EZ401U	4.1	9.6	200	25.00	0.74	1.50	42	14	60	3	30	95.5
0.60	2.1	2.3	2.2	1.7	ZR330SPH532_0250 EZ501U	7.7	9.6	370	25.00	0.74	1.50	42	14	60	3	30	95.5
0.60	2.3	2.5	2.4	1.6	ZR330SPH532_0250 EZ402U	7.7	9.6	370	25.00	0.74	1.50	42	14	60	3	30	95.5
0.60	3.4	4.2	3.5	1.1	ZR330SPH532_0250 EZ404U	7.7	9.6	370	25.00	0.74	1.50	42	14	60	3	30	95.5
0.60	3.6	3.9	3.7	1.0	ZR330SPH532_0250 EZ502U	7.7	9.6	370	25.00	0.74	1.50	42	14	60	3	30	95.5
0.75	1.1	1.2	1.6	3.1	ZR330SPH532_0200 EZ401U	3.3	9.6	160	20.00	0.88	1.75	42	14	60	3	30	95.5
0.75	1.7	1.8	2.5	2.0	ZR330SPH532_0200 EZ501U	6.2	9.6	300	20.00	0.88	1.75	42	14	60	3	30	95.5
0.75	1.8	2.0	2.7	1.8	ZR330SPH532_0200 EZ402U	6.2	9.6	300	20.00	0.88	1.75	42	14	60	3	30	95.5
0.75	2.7	3.4	4.0	1.2	ZR330SPH532_0200 EZ404U	7.7	9.6	370	20.00	0.88	1.75	42	14	60	3	30	95.5
0.75	2.9	3.1	4.3	1.2	ZR330SPH532_0200 EZ502U	7.7	9.6	370	20.00	0.88	1.75	42	14	60	3	30	95.5
0.94	0.9	0.9	2.0	3.6	ZR330SPH532_0160 EZ401U	2.6	9.6	130	16.00	1.09	2.19	42	14	59	3	30	95.5
0.94	1.3	1.5	3.0	2.3	ZR330SPH532_0160 EZ501U	5.0	9.6	240	16.00	1.09	2.19	42	14	59	3	30	95.5
0.94	1.5	1.6	3.3	2.1	ZR330SPH532_0160 EZ402U	5.0	9.6	240	16.00	1.09	2.19	42	14	59	3	30	95.5
0.94	2.2	2.7	4.9	1.4	ZR330SPH532_0160 EZ404U	7.4	9.6	360	16.00	1.09	2.19	42	14	59	3	30	95.5
0.94	2.3	2.5	5.2	1.3	ZR330SPH532_0160 EZ502U	7.4	9.6	360	16.00	1.09	2.19	42	14	59	3	30	95.5
0.94	3.0	3.5	6.9	1.0	ZR330SPH532_0160 EZ503U	7.4	9.6	360	16.00	1.09	2.19	42	14	59	3	30	95.5
1.50	0.9	0.9	1.7	3.1	ZR330SPH531_0100 EZ501U	3.2	9.6	150	10.00	1.65	3.25	42	14	47	3	30	95.5
1.50	1.5	1.6	3.0	1.8	ZR330SPH531_0100 EZ502U	6.0	9.6	290	10.00	1.65	3.25	42	14	47	3	30	95.5
1.50	1.5	1.7	3.0	1.8	ZR330SPH531_0100 EZ701U	4.0	9.6	190	10.00	1.65	3.25	42	14	47	3	30	95.5
1.50	2.0	2.2	3.9	1.4	ZR330SPH531_0100 EZ503U	6.0	9.6	290	10.00	1.65	3.25	42	14	47	3	30	95.5
1.50	2.4	2.9	4.8	1.1	ZR330SPH531_0100 EZ702U	6.0	9.6	290	10.00	1.65	3.25	42	14	47	3	30	95.5
2.14	0.6	0.7	2.1	3.9	ZR330SPH531_0070 EZ501U	2.3	9.6	110	7.000	2.14	4.29	42	14	57	3	30	95.5
2.14	1.0	1.1	3.6	2.3	ZR330SPH531_0070 EZ502U	4.4	9.6	210	7.000	2.14	4.29	42	14	57	3	30	95.5
2.14	1.0	1.2	3.6	2.3	ZR330SPH531_0070 EZ701U	2.8	9.6	130	7.000	2.14	4.29	42	14	57	3	30	95.5
2.14	1.4	1.6	4.7	1.7	ZR330SPH531_0070 EZ503U	6.1	9.6	290	7.000	2.14	4.29	42	14	57	3	30	95.5
2.14	1.7	2.0	5.8	1.4	ZR330SPH531_0070 EZ702U	5.8	9.6	280	7.000	2.14	4.29	42	14	57	3	30	95.5
2.14	1.9	2.3	6.5	1.2	ZR330SPH531_0070 EZ505U	7.7	9.6	370	7.000	2.14	4.29	42	14	57	3	30	95.5
2.14	2.3	2.9	7.9	1.0	ZR330SPH531_0070 EZ703U	7.7	9.6	370	7.000	2.14	4.29	42	14	57	3	30	95.5
3.00	0.4	0.5	3.1	4.9	ZR330SPH531_0050 EZ501U	1.6	9.6	77	5.000	2.50	5.50	42	14	64	3	30	95.5
3.00	0.7	0.8	5.3	2.8	ZR330SPH531_0050 EZ502U	3.1	9.6	150	5.000	2.50	5.50	42	14	64	3	30	95.5
3.00	0.7	0.8	5.3	2.8	ZR330SPH531_0050 EZ701U	2.0	9.6	96	5.000	2.50	5.50	42	14	64	3	30	95.5
3.00	1.0	1.1	7.0	2.2	ZR330SPH531_0050 EZ503U	4.3	9.6	210	5.000	2.50	5.50	42	14	64	3	30	95.5
3.00	1.2	1.4	8.6	1.7	ZR330SPH531_0050 EZ702U	4.1	9.6	200	5.000	2.50	5.50	42	14	64	3	30	95.5
3.00	1.4	1.6	9.7	1.6	ZR330SPH531_0050 EZ505U	6.7	9.6	320	5.000	2.50	5.50	42	14	64	3	30	95.5
3.00	1.7	2.1	12	1.3	ZR330SPH531_0050 EZ703U	6.5	9.6	310	5.000	2.50	5.50	42	14	64	3	30	95.5
3.75	0.6	0.6	7.0	3.3	ZR330SPH531_0040 EZ502U	2.5	9.5	120	4.000	2.75	6.25	42	14	65	3	30	95.5
3.75	0.6	0.7	7.0	3.3	ZR330SPH531_0040 EZ701U	1.6	9.6	77	4.000	2.75	6.25	42	14	65	3	30	95.5
3.75	0.8	0.9	9.1	2.5	ZR330SPH531_0040 EZ503U	3.5	9.5	170	4.000	2.75	6.25	42	14	65	3	30	95.5
3.75	1.0	1.2	11	2.0	ZR330SPH531_0040 EZ702U	3.3	9.6	160	4.000	2.75	6.25	42	14	65	3	30	95.5
3.75	1.1	1.3	13	1.8	ZR330SPH531_0040 EZ505U	5.4	9.5	260	4.000	2.75	6.25	42	14	65	3	30	95.5

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZR3PH5 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 7,7 kN)																	
3.75	1.3	1.7	16	1.5	ZR330SPH531_0040 EZ703U	5.2	9.6	250	4.000	2.75	6.25	42	14	65	3	30	95.5
3.75	1.7	2.4	20	1.1	ZR330SPH531_0040 EZ705U	7.4	9.6	360	4.000	2.75	6.25	42	14	65	3	30	95.5
ZR3PH5 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 7,7 kN)																	
2.25	1.9	3.1	4.4	1.2	ZR330SPH531_0100 EZ505U	6.0	9.6	290	10.00	1.65	3.25	42	14	47	3	30	95.5
3.21	1.3	2.2	5.2	1.5	ZR330SPH531_0070 EZ505U	7.7	9.6	370	7.000	2.14	4.29	42	14	57	3	30	95.5
3.21	1.7	2.8	6.7	1.2	ZR330SPH531_0070 EZ703U	7.7	9.6	370	7.000	2.14	4.29	42	14	57	3	30	95.5
4.50	1.0	1.5	7.8	1.9	ZR330SPH531_0050 EZ505U	6.7	9.6	320	5.000	2.50	5.50	42	14	64	3	30	95.5
4.50	1.2	2.0	10	1.5	ZR330SPH531_0050 EZ703U	6.5	9.6	310	5.000	2.50	5.50	42	14	64	3	30	95.5
4.50	1.6	3.0	14	1.1	ZR330SPH531_0050 EZ705U	7.7	9.6	370	5.000	2.50	5.50	42	14	64	3	30	95.5
5.63	0.8	1.2	10	2.2	ZR330SPH531_0040 EZ505U	5.4	9.5	260	4.000	2.75	6.25	42	14	65	3	30	95.5
5.63	1.0	1.6	13	1.8	ZR330SPH531_0040 EZ703U	5.2	9.6	250	4.000	2.75	6.25	42	14	65	3	30	95.5
5.63	1.3	2.4	18	1.3	ZR330SPH531_0040 EZ705U	7.4	9.6	360	4.000	2.75	6.25	42	14	65	3	30	95.5
ZR3PH5 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 7,7 kN)																	
0.43	3.1	3.8	0.9	1.3	ZR330SPH532_0700 EZ401U	7.7	9.6	370	70.00	0.29	0.57	42	14	55	3	30	95.5
0.60	2.2	2.7	1.0	1.6	ZR330SPH532_0500 EZ401U	7.7	9.6	370	50.00	0.40	0.80	42	14	58	3	30	95.5
0.60	3.3	4.3	1.6	1.1	ZR330SPH532_0500 EZ501U	7.7	9.6	370	50.00	0.40	0.80	42	14	58	3	30	95.5
0.60	3.4	4.8	1.6	1.1	ZR330SPH532_0500 EZ402U	7.7	9.6	370	50.00	0.40	0.80	42	14	58	3	30	95.5
0.75	1.8	2.2	1.4	1.9	ZR330SPH532_0400 EZ401U	6.6	9.6	320	40.00	0.50	1.00	42	14	56	3	30	95.5
0.75	2.6	3.4	2.1	1.3	ZR330SPH532_0400 EZ501U	7.4	9.6	360	40.00	0.50	1.00	42	14	56	3	30	95.5
0.75	2.7	3.8	2.2	1.2	ZR330SPH532_0400 EZ402U	7.4	9.6	360	40.00	0.50	1.00	42	14	56	3	30	95.5
0.86	1.6	1.9	1.2	2.0	ZR330SPH532_0350 EZ401U	5.8	9.6	280	35.00	0.57	1.14	42	14	60	3	30	95.5
0.86	2.3	3.0	1.8	1.4	ZR330SPH532_0350 EZ501U	7.7	9.6	370	35.00	0.57	1.14	42	14	60	3	30	95.5
0.86	2.4	3.3	1.8	1.3	ZR330SPH532_0350 EZ402U	7.7	9.6	370	35.00	0.57	1.14	42	14	60	3	30	95.5
1.07	1.3	1.5	1.4	2.4	ZR330SPH532_0280 EZ401U	4.6	9.6	220	28.00	0.71	1.43	42	14	58	3	30	95.5
1.07	1.9	2.4	2.1	1.6	ZR330SPH532_0280 EZ501U	7.4	9.6	360	28.00	0.71	1.43	42	14	58	3	30	95.5
1.07	1.9	2.7	2.1	1.6	ZR330SPH532_0280 EZ402U	7.4	9.6	360	28.00	0.71	1.43	42	14	58	3	30	95.5
1.07	2.8	4.3	3.2	1.0	ZR330SPH532_0280 EZ502U	7.4	9.6	360	28.00	0.71	1.43	42	14	58	3	30	95.5
1.20	1.1	1.4	1.4	2.6	ZR330SPH532_0250 EZ401U	4.1	9.6	200	25.00	0.74	1.50	42	14	60	3	30	95.5
1.20	1.7	2.1	2.1	1.7	ZR330SPH532_0250 EZ501U	7.7	9.6	370	25.00	0.74	1.50	42	14	60	3	30	95.5
1.20	1.7	2.4	2.2	1.7	ZR330SPH532_0250 EZ402U	7.7	9.6	370	25.00	0.74	1.50	42	14	60	3	30	95.5
1.20	2.5	3.8	3.2	1.1	ZR330SPH532_0250 EZ502U	7.7	9.6	370	25.00	0.74	1.50	42	14	60	3	30	95.5
1.20	2.8	4.1	3.6	1.0	ZR330SPH532_0250 EZ404U	7.7	9.6	370	25.00	0.74	1.50	42	14	60	3	30	95.5
1.50	0.9	1.1	1.6	3.0	ZR330SPH532_0200 EZ401U	3.3	9.6	160	20.00	0.88	1.75	42	14	60	3	30	95.5
1.50	1.3	1.7	2.4	2.0	ZR330SPH532_0200 EZ501U	6.2	9.6	300	20.00	0.88	1.75	42	14	60	3	30	95.5
1.50	1.4	1.9	2.4	1.9	ZR330SPH532_0200 EZ402U	6.2	9.6	300	20.00	0.88	1.75	42	14	60	3	30	95.5
1.50	2.0	3.0	3.6	1.3	ZR330SPH532_0200 EZ502U	7.7	9.6	370	20.00	0.88	1.75	42	14	60	3	30	95.5
1.50	2.3	3.3	4.0	1.2	ZR330SPH532_0200 EZ404U	7.7	9.6	370	20.00	0.88	1.75	42	14	60	3	30	95.5
1.50	2.4	4.1	4.3	1.1	ZR330SPH532_0200 EZ503U	7.7	9.6	370	20.00	0.88	1.75	42	14	60	3	30	95.5
1.88	0.7	0.9	1.9	3.4	ZR330SPH532_0160 EZ401U	2.6	9.6	130	16.00	1.09	2.19	42	14	59	3	30	95.5
1.88	1.1	1.4	2.8	2.3	ZR330SPH532_0160 EZ501U	5.0	9.6	240	16.00	1.09	2.19	42	14	59	3	30	95.5
1.88	1.1	1.5	2.9	2.3	ZR330SPH532_0160 EZ402U	5.0	9.6	240	16.00	1.09	2.19	42	14	59	3	30	95.5
1.88	1.6	2.4	4.3	1.5	ZR330SPH532_0160 EZ502U	7.4	9.6	360	16.00	1.09	2.19	42	14	59	3	30	95.5
1.88	1.8	2.6	4.8	1.4	ZR330SPH532_0160 EZ404U	7.4	9.6	360	16.00	1.09	2.19	42	14	59	3	30	95.5
1.88	1.9	3.3	5.2	1.3	ZR330SPH532_0160 EZ503U	7.4	9.6	360	16.00	1.09	2.19	42	14	59	3	30	95.5
3.00	0.7	0.9	1.7	3.1	ZR330SPH531_0100 EZ501U	3.2	9.6	150	10.00	1.65	3.25	42	14	47	3	30	95.5
3.00	1.0	1.6	2.6	2.0	ZR330SPH531_0100 EZ502U	6.0	9.6	290	10.00	1.65	3.25	42	14	47	3	30	95.5
3.00	1.0	1.6	2.6	2.0	ZR330SPH531_0100 EZ701U	4.0	9.6	190	10.00	1.65	3.25	42	14	47	3	30	95.5
3.00	1.2	2.1	3.1	1.7	ZR330SPH531_0100 EZ503U	6.0	9.6	290	10.00	1.65	3.25	42	14	47	3	30	95.5
3.00	1.4	2.9	3.7	1.5	ZR330SPH531_0100 EZ702U	6.0	9.6	290	10.00	1.65	3.25	42	14	47	3	30	95.5
4.29	0.5	0.6	2.1	3.9	ZR330SPH531_0070 EZ501U	2.3	9.6	110	7.000	2.14	4.29	42	14	57	3	30	95.5
4.29	0.7	1.1	3.2	2.6	ZR330SPH531_0070 EZ502U	4.4	9.6	210	7.000	2.14	4.29	42	14	57	3	30	95.5
4.29	0.7	1.1	3.2	2.6	ZR330SPH531_0070 EZ701U	2.8	9.6	130	7.000	2.14	4.29	42	14	57	3	30	95.5
4.29	0.9	1.5	3.8	2.1	ZR330SPH531_0070 EZ503U	6.1	9.6	290	7.000	2.14	4.29	42	14	57	3	30	95.5
4.29	1.0	2.0	4.4	1.8	ZR330SPH531_0070 EZ702U	5.8	9.6	280	7.000	2.14	4.29	42	14	57	3	30	95.5
ZR3PH7 (n_{1N} = 2000 rpm, ($F_{f2acc,max}$ = 16 kN)																	
1.67	5.3	8.0	11	1.4	ZR335SPH731_0070 EZ805U	16	19	870	7.000	2.08	4.17	49	16	94	3	35	111.4
2.33	3.8	5.7	16	1.7	ZR335SPH731_0050 EZ805U	16	19	870	5.000	2.57	5.83	49	16	106	3	35	111.4
2.92	3.0	4.6	21	2.0	ZR335SPH731_0040 EZ805U	14	19	790	4.000	2.77	5.83	49	16	113	3	35	111.4
ZR3PH7 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 16 kN)																	
0.25	5.0	5.5	0.7	2.0	ZR335SPH732_0700 EZ501U	15	19	810	70.00	0.31	0.58	49	16	91	3	35	111.4
0.25	8.6	9.3	1.2	1.2	ZR335SPH732_0700 EZ502U	15	19	810	70.00	0.31	0.58	49	16	91	3	35	111.4
0.25	8.6	9.7	1.2	1.2	ZR335SPH732_0700 EZ701U	15	19	810	70.00	0.31	0.58	49	16	91	3	35	111.4
0.29	4.4	4.8	0.7	2.0	ZR340SPH732_0700 EZ501U	13	17	810	70.00	0.35	0.67	56	19	78	3	40	127.3
0.29	7.6	8.2	1.2	1.2	ZR340SPH732_0700 EZ502U	13	17	810	70.00	0.35	0.67	56	19	78	3	40	127.3
0.29	7.6	8.5	1.2	1.2	ZR340SPH732_0700 EZ701U	13	17	810	70.00	0.35	0.67	56	19	78	3	40	127.3
0.35	3.6	3.9	0.9	2.8	ZR335SPH732_0500 EZ501U	13	19	740	50.00	0.43	0.82	49	16	97	3	35	111.4

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZR3PH7 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 16 kN)																	
0.35	6.2	6.7	1.5	1.6	ZR335SPH732_0500 EZ502U	15	19	830	50.00	0.43	0.82	49	16	97	3	35	111.4
0.35	6.2	6.9	1.5	1.6	ZR335SPH732_0500 EZ701U	15	19	830	50.00	0.43	0.82	49	16	97	3	35	111.4
0.35	8.1	9.3	1.9	1.2	ZR335SPH732_0500 EZ503U	15	19	830	50.00	0.43	0.82	49	16	97	3	35	111.4
0.40	3.1	3.4	0.9	2.8	ZR340SPH732_0500 EZ501U	12	17	740	50.00	0.49	0.93	56	19	85	3	40	127.3
0.40	5.4	5.8	1.5	1.6	ZR340SPH732_0500 EZ502U	13	17	830	50.00	0.49	0.93	56	19	85	3	40	127.3
0.40	5.4	6.1	1.5	1.6	ZR340SPH732_0500 EZ701U	13	17	830	50.00	0.49	0.93	56	19	85	3	40	127.3
0.40	7.1	8.1	1.9	1.2	ZR340SPH732_0500 EZ503U	13	17	830	50.00	0.49	0.93	56	19	85	3	40	127.3
0.44	2.9	3.1	1.1	3.0	ZR335SPH732_0400 EZ501U	11	19	600	40.00	0.54	1.02	49	16	99	3	35	111.4
0.44	4.9	5.3	1.9	1.7	ZR335SPH732_0400 EZ502U	14	19	770	40.00	0.54	1.02	49	16	99	3	35	111.4
0.44	4.9	5.5	1.9	1.7	ZR335SPH732_0400 EZ701U	13	19	740	40.00	0.54	1.02	49	16	99	3	35	111.4
0.44	6.5	7.4	2.5	1.3	ZR335SPH732_0400 EZ503U	14	19	770	40.00	0.54	1.02	49	16	99	3	35	111.4
0.44	8.0	9.6	3.1	1.1	ZR335SPH732_0400 EZ702U	14	19	770	40.00	0.54	1.02	49	16	99	3	35	111.4
0.50	2.5	2.7	1.1	3.9	ZR335SPH732_0350 EZ501U	9.3	19	520	35.00	0.62	1.17	49	16	99	3	35	111.4
0.50	2.5	2.7	1.1	3.0	ZR340SPH732_0400 EZ501U	9.3	17	600	40.00	0.62	1.17	56	19	86	3	40	127.3
0.50	4.3	4.7	1.8	2.2	ZR335SPH732_0350 EZ502U	16	19	870	35.00	0.62	1.17	49	16	99	3	35	111.4
0.50	4.3	4.7	1.9	1.7	ZR340SPH732_0400 EZ502U	12	17	770	40.00	0.62	1.17	56	19	86	3	40	127.3
0.50	4.3	4.8	1.8	2.2	ZR335SPH732_0350 EZ701U	12	19	650	35.00	0.62	1.17	49	16	99	3	35	111.4
0.50	4.3	4.8	1.9	1.7	ZR340SPH732_0400 EZ701U	12	17	740	40.00	0.62	1.17	56	19	86	3	40	127.3
0.50	4.3	4.8	1.8	2.2	ZR335SPH732_0350 EZ701U	12	19	650	35.00	0.62	1.17	49	16	99	3	35	111.4
0.50	5.7	6.5	2.5	1.3	ZR340SPH732_0400 EZ503U	12	17	770	40.00	0.62	1.17	56	19	86	3	40	127.3
0.50	5.7	6.5	2.4	1.7	ZR335SPH732_0350 EZ503U	16	19	870	35.00	0.62	1.17	49	16	99	3	35	111.4
0.50	7.0	8.4	2.9	1.4	ZR335SPH732_0350 EZ702U	16	19	870	35.00	0.62	1.17	49	16	99	3	35	111.4
0.50	7.0	8.4	3.1	1.1	ZR340SPH732_0400 EZ702U	12	17	770	40.00	0.62	1.17	56	19	86	3	40	127.3
0.50	7.0	8.4	2.9	1.4	ZR335SPH732_0350 EZ702U	16	19	870	35.00	0.62	1.17	49	16	99	3	35	111.4
0.50	7.9	9.3	3.3	1.2	ZR335SPH732_0350 EZ505U	16	19	870	35.00	0.62	1.17	49	16	99	3	35	111.4
0.57	2.2	2.4	1.1	3.9	ZR340SPH732_0350 EZ501U	8.2	17	520	35.00	0.71	1.33	56	19	87	3	40	127.3
0.57	3.8	4.1	1.8	2.2	ZR340SPH732_0350 EZ502U	14	17	870	35.00	0.71	1.33	56	19	87	3	40	127.3
0.57	3.8	4.2	1.8	2.2	ZR340SPH732_0350 EZ701U	10	17	650	35.00	0.71	1.33	56	19	87	3	40	127.3
0.57	5.0	5.7	2.4	1.7	ZR340SPH732_0350 EZ503U	14	17	870	35.00	0.71	1.33	56	19	87	3	40	127.3
0.57	6.1	7.4	2.9	1.4	ZR340SPH732_0350 EZ702U	14	17	870	35.00	0.71	1.33	56	19	87	3	40	127.3
0.57	6.9	8.2	3.3	1.2	ZR340SPH732_0350 EZ505U	14	17	870	35.00	0.71	1.33	56	19	87	3	40	127.3
0.63	2.0	2.2	1.2	4.8	ZR335SPH732_0280 EZ501U	7.5	19	420	28.00	0.77	1.46	49	16	102	3	35	111.4
0.63	3.5	3.7	2.0	2.8	ZR335SPH732_0280 EZ502U	14	19	770	28.00	0.77	1.46	49	16	102	3	35	111.4
0.63	3.5	3.9	2.0	2.8	ZR335SPH732_0280 EZ701U	9.3	19	520	28.00	0.77	1.46	49	16	102	3	35	111.4
0.63	4.5	5.2	2.7	2.1	ZR335SPH732_0280 EZ503U	14	19	770	28.00	0.77	1.46	49	16	102	3	35	111.4
0.63	5.6	6.7	3.3	1.7	ZR335SPH732_0280 EZ702U	14	19	770	28.00	0.77	1.46	49	16	102	3	35	111.4
0.63	6.3	7.5	3.7	1.5	ZR335SPH732_0280 EZ505U	14	19	770	28.00	0.77	1.46	49	16	102	3	35	111.4
0.63	7.7	9.7	4.5	1.3	ZR335SPH732_0280 EZ703U	14	19	770	28.00	0.77	1.46	49	16	102	3	35	111.4
0.70	3.1	3.3	2.3	2.9	ZR335SPH732_0250 EZ502U	13	19	720	25.00	0.82	1.63	49	16	100	3	35	111.4
0.70	3.1	3.5	2.3	2.9	ZR335SPH732_0250 EZ701U	8.3	19	470	25.00	0.82	1.63	49	16	100	3	35	111.4
0.70	4.0	4.6	3.0	2.2	ZR335SPH732_0250 EZ503U	16	19	870	25.00	0.82	1.63	49	16	100	3	35	111.4
0.70	5.0	6.0	3.8	1.8	ZR335SPH732_0250 EZ702U	16	19	870	25.00	0.82	1.63	49	16	100	3	35	111.4
0.70	5.6	6.7	4.2	1.6	ZR335SPH732_0250 EZ505U	16	19	870	25.00	0.82	1.63	49	16	100	3	35	111.4
0.70	6.9	8.7	5.2	1.3	ZR335SPH732_0250 EZ703U	16	19	870	25.00	0.82	1.63	49	16	100	3	35	111.4
0.71	1.8	1.9	1.2	4.8	ZR340SPH732_0280 EZ501U	6.5	17	420	28.00	0.88	1.67	56	19	90	3	40	127.3
0.71	3.0	3.3	2.0	2.8	ZR340SPH732_0280 EZ502U	12	17	770	28.00	0.88	1.67	56	19	90	3	40	127.3
0.71	3.0	3.4	2.0	2.8	ZR340SPH732_0280 EZ701U	8.2	17	520	28.00	0.88	1.67	56	19	90	3	40	127.3
0.71	4.0	4.5	2.7	2.1	ZR340SPH732_0280 EZ503U	12	17	770	28.00	0.88	1.67	56	19	90	3	40	127.3
0.71	4.9	5.9	3.3	1.7	ZR340SPH732_0280 EZ702U	12	17	770	28.00	0.88	1.67	56	19	90	3	40	127.3
0.71	5.5	6.5	3.7	1.5	ZR340SPH732_0280 EZ505U	12	17	770	28.00	0.88	1.67	56	19	90	3	40	127.3
0.71	6.7	8.5	4.5	1.3	ZR340SPH732_0280 EZ703U	12	17	770	28.00	0.88	1.67	56	19	90	3	40	127.3
0.80	2.7	2.9	2.3	2.9	ZR340SPH732_0250 EZ502U	11	17	720	25.00	0.93	1.87	56	19	87	3	40	127.3
0.80	2.7	3.0	2.3	2.9	ZR340SPH732_0250 EZ701U	7.3	17	470	25.00	0.93	1.87	56	19	87	3	40	127.3
0.80	3.5	4.1	3.0	2.2	ZR340SPH732_0250 EZ503U	14	17	870	25.00	0.93	1.87	56	19	87	3	40	127.3
0.80	4.4	5.3	3.8	1.8	ZR340SPH732_0250 EZ702U	14	17	870	25.00	0.93	1.87	56	19	87	3	40	127.3
0.80	4.9	5.8	4.2	1.6	ZR340SPH732_0250 EZ505U	14	17	870	25.00	0.93	1.87	56	19	87	3	40	127.3
0.80	6.0	7.6	5.2	1.3	ZR340SPH732_0250 EZ703U	14	17	870	25.00	0.93	1.87	56	19	87	3	40	127.3
0.88	2.5	2.7	2.8	3.3	ZR335SPH732_0200 EZ502U	10	19	580	20.00	0.88	1.75	49	16	101	3	35	111.4
0.88	2.5	2.8	2.8	3.3	ZR335SPH732_0200 EZ701U	6.7	19	370	20.00	0.88	1.75	49	16	101	3	35	111.4
0.88	3.2	3.7	3.7	2.6	ZR335SPH732_0200 EZ503U	14	19	800	20.00	0.88	1.75	49	16	101	3	35	111.4
0.88	4.0	4.8	4.6	2.1	ZR335SPH732_0200 EZ702U	14	19	760	20.00	0.88	1.75	49	16	101	3	35	111.4
0.88	4.5	5.3	5.1	1.8	ZR335SPH732_0200 EZ505U	14	19	810	20.00	0.88	1.75	49	16	101	3	35	111.4
0.88	5.5	6.9	6.3	1.5	ZR335SPH732_0200 EZ703U	14	19	810	20.00	0.88	1.75	49	16	101	3	35	111.4
0.88	7.1	10	8.1	1.2	ZR335SPH732_0200 EZ705U	14	19	810	20.00	0.88	1.75	49	16	101	3	35	111.4
1.00	2.2	2.3	2.8	3.3	ZR340SPH732_0200 EZ502U	9.1	17	580	20.00	1.00	2.00	56	19	88	3	40	127.3
1.00	2.2	2.4	2.8	3.3	ZR340SPH732_0200 EZ701U	5.8	17	370	20.00	1.00	2.00	56	19	88	3	40	127.3
1.00	2.8	3.2	3.7	2.6	ZR340SPH732_0200 EZ503U	13	17	800	20.00	1.00	2.00	56	19	88	3	40	127.3

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{iin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZR3PH7 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 16 kN)																	
1.00	3.5	4.2	4.6	2.1	ZR340SPH732_0200 EZ702U	12	17	760	20.00	1.00	2.00	56	19	88	3	40	127.3
1.00	3.9	4.7	5.1	1.8	ZR340SPH732_0200 EZ505U	13	17	810	20.00	1.00	2.00	56	19	88	3	40	127.3
1.00	4.8	6.1	6.3	1.5	ZR340SPH732_0200 EZ703U	13	17	810	20.00	1.00	2.00	56	19	88	3	40	127.3
1.00	6.2	8.8	8.1	1.2	ZR340SPH732_0200 EZ705U	13	17	810	20.00	1.00	2.00	56	19	88	3	40	127.3
1.09	2.0	2.1	3.2	4.1	ZR335SPH732_0160 EZ502U	8.3	19	460	16.00	1.09	2.19	49	16	104	3	35	111.4
1.09	2.0	2.2	3.2	4.1	ZR335SPH732_0160 EZ701U	5.3	19	300	16.00	1.09	2.19	49	16	104	3	35	111.4
1.09	2.6	3.0	4.2	3.1	ZR335SPH732_0160 EZ503U	11	19	640	16.00	1.09	2.19	49	16	104	3	35	111.4
1.09	3.2	3.8	5.2	2.5	ZR335SPH732_0160 EZ702U	11	19	610	16.00	1.09	2.19	49	16	104	3	35	111.4
1.09	3.6	4.3	5.9	2.2	ZR335SPH732_0160 EZ505U	13	19	740	16.00	1.09	2.19	49	16	104	3	35	111.4
1.09	4.4	5.6	7.2	1.8	ZR335SPH732_0160 EZ703U	13	19	740	16.00	1.09	2.19	49	16	104	3	35	111.4
1.09	5.7	8.1	9.2	1.4	ZR335SPH732_0160 EZ705U	13	19	740	16.00	1.09	2.19	49	16	104	3	35	111.4
1.25	1.7	1.9	3.2	4.1	ZR340SPH732_0160 EZ502U	7.2	17	460	16.00	1.25	2.50	56	19	92	3	40	127.3
1.25	1.7	1.9	3.2	4.1	ZR340SPH732_0160 EZ701U	4.7	17	300	16.00	1.25	2.50	56	19	92	3	40	127.3
1.25	2.3	2.6	4.2	3.1	ZR340SPH732_0160 EZ503U	10	17	640	16.00	1.25	2.50	56	19	92	3	40	127.3
1.25	2.8	3.4	5.2	2.5	ZR340SPH732_0160 EZ702U	9.6	17	610	16.00	1.25	2.50	56	19	92	3	40	127.3
1.25	3.2	3.7	5.9	2.2	ZR340SPH732_0160 EZ505U	12	17	740	16.00	1.25	2.50	56	19	92	3	40	127.3
1.25	3.9	4.9	7.2	1.8	ZR340SPH732_0160 EZ703U	12	17	740	16.00	1.25	2.50	56	19	92	3	40	127.3
1.25	5.0	7.1	9.2	1.4	ZR340SPH732_0160 EZ705U	12	17	740	16.00	1.25	2.50	56	19	92	3	40	127.3
1.75	1.3	1.4	1.8	3.9	ZR335SPH731_0100 EZ701U	3.4	19	190	10.00	1.46	2.92	49	16	81	3	35	111.4
1.75	2.1	2.5	3.0	2.4	ZR335SPH731_0100 EZ702U	7.1	19	390	10.00	1.46	2.92	49	16	81	3	35	111.4
1.75	2.8	3.6	4.1	1.8	ZR335SPH731_0100 EZ703U	10	19	580	10.00	1.46	2.92	49	16	81	3	35	111.4
1.75	3.7	5.2	5.3	1.4	ZR335SPH731_0100 EZ705U	10	19	580	10.00	1.46	2.92	49	16	81	3	35	111.4
1.75	3.8	6.4	5.5	1.3	ZR335SPH731_0100 EZ802U	10	19	580	10.00	1.46	2.92	49	16	81	3	35	111.4
2.00	1.1	1.3	1.8	3.9	ZR340SPH731_0100 EZ701U	3.0	17	190	10.00	1.67	3.33	56	19	69	3	40	127.3
2.00	1.8	2.2	3.0	2.4	ZR340SPH731_0100 EZ702U	6.2	17	390	10.00	1.67	3.33	56	19	69	3	40	127.3
2.00	2.5	3.1	4.1	1.8	ZR340SPH731_0100 EZ703U	9.0	17	580	10.00	1.67	3.33	56	19	69	3	40	127.3
2.00	3.2	4.6	5.3	1.4	ZR340SPH731_0100 EZ705U	9.0	17	580	10.00	1.67	3.33	56	19	69	3	40	127.3
2.00	3.4	5.6	5.5	1.3	ZR340SPH731_0100 EZ802U	9.0	17	580	10.00	1.67	3.33	56	19	69	3	40	127.3
2.50	1.4	1.7	3.3	4.4	ZR335SPH731_0070 EZ702U	4.9	19	280	7.000	2.08	4.17	49	16	94	3	35	111.4
2.50	2.0	2.5	4.5	3.2	ZR335SPH731_0070 EZ703U	7.8	19	440	7.000	2.08	4.17	49	16	94	3	35	111.4
2.50	2.6	3.6	5.9	2.5	ZR335SPH731_0070 EZ705U	13	19	700	7.000	2.08	4.17	49	16	94	3	35	111.4
2.50	2.7	4.5	6.1	2.4	ZR335SPH731_0070 EZ802U	12	19	670	7.000	2.08	4.17	49	16	94	3	35	111.4
2.50	3.2	5.8	7.3	2.0	ZR335SPH731_0070 EZ803U	16	19	870	7.000	2.08	4.17	49	16	94	3	35	111.4
2.86	1.3	1.5	3.3	4.8	ZR340SPH731_0070 EZ702U	4.3	17	280	7.000	2.38	4.76	56	19	82	3	40	127.3
2.86	1.7	2.2	4.5	3.5	ZR340SPH731_0070 EZ703U	6.9	17	440	7.000	2.38	4.76	56	19	82	3	40	127.3
2.86	2.2	3.2	5.9	2.7	ZR340SPH731_0070 EZ705U	11	17	700	7.000	2.38	4.76	56	19	82	3	40	127.3
2.86	2.4	3.9	6.1	2.6	ZR340SPH731_0070 EZ802U	11	17	670	7.000	2.38	4.76	56	19	82	3	40	127.3
2.86	2.8	5.1	7.3	2.2	ZR340SPH731_0070 EZ803U	14	17	870	7.000	2.38	4.76	56	19	82	3	40	127.3
3.50	1.4	1.8	6.8	4.0	ZR335SPH731_0050 EZ703U	5.6	19	310	5.000	2.57	5.83	49	16	106	3	35	111.4
3.50	1.8	2.6	8.8	3.1	ZR335SPH731_0050 EZ705U	9.0	19	500	5.000	2.57	5.83	49	16	106	3	35	111.4
3.50	1.9	3.2	9.2	3.0	ZR335SPH731_0050 EZ802U	8.6	19	480	5.000	2.57	5.83	49	16	106	3	35	111.4
3.50	2.3	4.2	11	2.5	ZR335SPH731_0050 EZ803U	12	19	700	5.000	2.57	5.83	49	16	106	3	35	111.4
4.00	1.2	1.6	6.8	4.5	ZR340SPH731_0050 EZ703U	4.9	17	310	5.000	2.93	6.67	56	19	93	3	40	127.3
4.00	1.6	2.3	8.8	3.5	ZR340SPH731_0050 EZ705U	7.8	17	500	5.000	2.93	6.67	56	19	93	3	40	127.3
4.00	1.7	2.8	9.2	3.3	ZR340SPH731_0050 EZ802U	7.5	17	480	5.000	2.93	6.67	56	19	93	3	40	127.3
4.00	2.0	3.6	11	2.8	ZR340SPH731_0050 EZ803U	11	17	700	5.000	2.93	6.67	56	19	93	3	40	127.3
4.38	1.1	1.4	8.9	4.6	ZR335SPH731_0040 EZ703U	4.5	16	250	4.000	2.77	5.83	49	16	113	3	35	111.4
4.38	1.5	2.1	11	3.6	ZR335SPH731_0040 EZ705U	7.2	16	400	4.000	2.77	5.83	49	16	113	3	35	111.4
4.38	1.5	2.6	12	3.4	ZR335SPH731_0040 EZ802U	6.9	19	380	4.000	2.77	5.83	49	16	113	3	35	111.4
4.38	1.8	3.3	14	2.9	ZR335SPH731_0040 EZ803U	10	19	560	4.000	2.77	5.83	49	16	113	3	35	111.4
5.00	1.3	1.8	11	4.1	ZR340SPH731_0040 EZ705U	6.3	14	400	4.000	3.17	6.67	56	19	100	3	40	127.3
5.00	1.3	2.2	12	3.9	ZR340SPH731_0040 EZ802U	6.0	17	380	4.000	3.17	6.67	56	19	100	3	40	127.3
5.00	1.6	2.9	14	3.2	ZR340SPH731_0040 EZ803U	8.7	17	560	4.000	3.17	6.67	56	19	100	3	40	127.3
ZR3PH7 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 16 kN)																	
0.66	6.3	10	2.8	1.2	ZR335SPH732_0400 EZ505U	14	19	770	40.00	0.54	1.02	49	16	99	3	35	111.4
0.75	5.6	8.9	2.6	1.6	ZR335SPH732_0350 EZ505U	16	19	870	35.00	0.62	1.17	49	16	99	3	35	111.4
0.75	5.6	8.9	2.8	1.2	ZR340SPH732_0400 EZ505U	12	17	770	40.00	0.62	1.17	56	19	86	3	40	127.3
0.75	7.1	12	3.3	1.2	ZR335SPH732_0350 EZ703U	16	19	870	35.00	0.62	1.17	49	16	99	3	35	111.4
0.86	4.9	7.8	2.6	1.6	ZR340SPH732_0350 EZ505U	14	17	870	35.00	0.71	1.33	56	19	87	3	40	127.3
0.86	6.2	10	3.3	1.2	ZR340SPH732_0350 EZ703U	14	17	870	35.00	0.71	1.33	56	19	87	3	40	127.3
0.94	4.4	7.2	2.9	2.0	ZR335SPH732_0280 EZ505U	14	19	770	28.00	0.77	1.46	49	16	102	3	35	111.4
0.94	5.7	9.3	3.7	1.5	ZR335SPH732_0280 EZ703U	14	19	770	28.00	0.77	1.46	49	16	102	3	35	111.4
1.05	4.0	6.4	3.2	2.1	ZR335SPH732_0250 EZ505U	16	19	870	25.00	0.82	1.63	49	16	100	3	35	111.4
1.05	5.1	8.3	4.1	1.6	ZR335SPH732_0250 EZ703U	16	19	870	25.00	0.82	1.63	49	16	100	3	35	111.4
1.07	3.9	6.3	2.9	2.0	ZR340SPH732_0280 EZ505U	12	17	770	28.00	0.88	1.67	56	19	90	3	40	127.3
1.07	4.9	8.2	3.7	1.5	ZR340SPH732_0280 EZ703U	12	17	770	28.00	0.88	1.67	56	19	90	3	40	127.3

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZR3PH7 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 16 kN)																	
1.20	3.5	5.6	3.2	2.1	ZR340SPH732_0250 EZ505U	14	17	870	25.00	0.93	1.87	56	19	87	3	40	127.3
1.20	4.4	7.3	4.1	1.6	ZR340SPH732_0250 EZ703U	14	17	870	25.00	0.93	1.87	56	19	87	3	40	127.3
1.31	3.2	5.1	3.7	2.5	ZR335SPH732_0200 EZ505U	14	19	810	20.00	0.88	1.75	49	16	101	3	35	111.4
1.31	4.0	6.7	4.7	2.0	ZR335SPH732_0200 EZ703U	14	19	810	20.00	0.88	1.75	49	16	101	3	35	111.4
1.31	5.5	10	6.4	1.4	ZR335SPH732_0200 EZ705U	14	19	810	20.00	0.88	1.75	49	16	101	3	35	111.4
1.50	2.8	4.5	3.7	2.6	ZR340SPH732_0200 EZ505U	13	17	810	20.00	1.00	2.00	56	19	88	3	40	127.3
1.50	3.5	5.8	4.7	2.0	ZR340SPH732_0200 EZ703U	13	17	810	20.00	1.00	2.00	56	19	88	3	40	127.3
1.50	4.8	8.8	6.4	1.5	ZR340SPH732_0200 EZ705U	13	17	810	20.00	1.00	2.00	56	19	88	3	40	127.3
1.64	2.5	4.1	4.1	2.9	ZR335SPH732_0160 EZ505U	13	19	740	16.00	1.09	2.19	49	16	104	3	35	111.4
1.64	3.2	5.3	5.3	2.3	ZR335SPH732_0160 EZ703U	13	19	740	16.00	1.09	2.19	49	16	104	3	35	111.4
1.64	4.4	8.0	7.1	1.7	ZR335SPH732_0160 EZ705U	13	19	740	16.00	1.09	2.19	49	16	104	3	35	111.4
1.88	2.2	3.6	4.1	3.2	ZR340SPH732_0160 EZ505U	12	17	740	16.00	1.25	2.50	56	19	92	3	40	127.3
1.88	2.8	4.7	5.3	2.5	ZR340SPH732_0160 EZ703U	12	17	740	16.00	1.25	2.50	56	19	92	3	40	127.3
1.88	3.8	7.0	7.1	1.8	ZR340SPH732_0160 EZ705U	12	17	740	16.00	1.25	2.50	56	19	92	3	40	127.3
2.63	1.8	5.9	3.0	2.4	ZR335SPH731_0100 EZ802U	10	19	580	10.00	1.46	2.92	49	16	81	3	35	111.4
2.63	2.1	3.4	3.4	2.1	ZR335SPH731_0100 EZ703U	10	19	580	10.00	1.46	2.92	49	16	81	3	35	111.4
2.63	2.8	5.2	4.7	1.5	ZR335SPH731_0100 EZ705U	10	19	580	10.00	1.46	2.92	49	16	81	3	35	111.4
3.00	1.6	5.2	3.0	2.4	ZR340SPH731_0100 EZ802U	9.0	17	580	10.00	1.67	3.33	56	19	69	3	40	127.3
3.00	1.8	3.0	3.4	2.1	ZR340SPH731_0100 EZ703U	9.0	17	580	10.00	1.67	3.33	56	19	69	3	40	127.3
3.00	2.5	4.5	4.7	1.5	ZR340SPH731_0100 EZ705U	9.0	17	580	10.00	1.67	3.33	56	19	69	3	40	127.3
3.75	1.3	4.2	3.3	4.4	ZR335SPH731_0070 EZ802U	12	19	670	7.000	2.08	4.17	49	16	94	3	35	111.4
3.75	1.5	2.4	3.8	3.8	ZR335SPH731_0070 EZ703U	7.8	19	440	7.000	2.08	4.17	49	16	94	3	35	111.4
3.75	2.0	3.6	5.2	2.8	ZR335SPH731_0070 EZ705U	13	19	700	7.000	2.08	4.17	49	16	94	3	35	111.4
4.29	1.1	3.6	3.3	4.8	ZR340SPH731_0070 EZ802U	11	17	670	7.000	2.38	4.76	56	19	82	3	40	127.3
4.29	1.3	2.1	3.8	4.1	ZR340SPH731_0070 EZ703U	6.9	17	440	7.000	2.38	4.76	56	19	82	3	40	127.3
4.29	1.7	3.2	5.2	3.0	ZR340SPH731_0070 EZ705U	11	17	700	7.000	2.38	4.76	56	19	82	3	40	127.3
5.25	1.0	1.7	5.7	4.8	ZR335SPH731_0050 EZ703U	5.6	19	310	5.000	2.57	5.83	49	16	106	3	35	111.4
5.25	1.4	2.6	7.7	3.5	ZR335SPH731_0050 EZ705U	9.0	19	500	5.000	2.57	5.83	49	16	106	3	35	111.4
6.00	1.2	2.3	7.7	4.0	ZR340SPH731_0050 EZ705U	7.8	17	500	5.000	2.93	6.67	56	19	93	3	40	127.3
ZR3PH7 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 16 kN)																	
0.50	4.0	5.1	0.7	2.0	ZR335SPH732_0700 EZ501U	15	19	810	70.00	0.31	0.58	49	16	91	3	35	111.4
0.50	6.1	9.1	1.1	1.3	ZR335SPH732_0700 EZ502U	15	19	810	70.00	0.31	0.58	49	16	91	3	35	111.4
0.50	6.1	9.2	1.1	1.3	ZR335SPH732_0700 EZ701U	15	19	810	70.00	0.31	0.58	49	16	91	3	35	111.4
0.57	3.5	4.5	0.7	2.0	ZR340SPH732_0700 EZ501U	13	17	810	70.00	0.35	0.67	56	19	78	3	40	127.3
0.57	5.3	8.0	1.1	1.3	ZR340SPH732_0700 EZ502U	13	17	810	70.00	0.35	0.67	56	19	78	3	40	127.3
0.57	5.3	8.1	1.1	1.3	ZR340SPH732_0700 EZ701U	13	17	810	70.00	0.35	0.67	56	19	78	3	40	127.3
0.70	2.8	3.7	0.9	2.8	ZR335SPH732_0500 EZ501U	13	19	740	50.00	0.43	0.82	49	16	97	3	35	111.4
0.70	4.3	6.5	1.3	1.8	ZR335SPH732_0500 EZ502U	15	19	830	50.00	0.43	0.82	49	16	97	3	35	111.4
0.70	4.3	6.6	1.3	1.8	ZR335SPH732_0500 EZ701U	15	19	830	50.00	0.43	0.82	49	16	97	3	35	111.4
0.70	5.2	8.8	1.6	1.5	ZR335SPH732_0500 EZ503U	15	19	830	50.00	0.43	0.82	49	16	97	3	35	111.4
0.80	2.5	3.2	0.9	2.8	ZR340SPH732_0500 EZ501U	12	17	740	50.00	0.49	0.93	56	19	85	3	40	127.3
0.80	3.8	5.7	1.3	1.8	ZR340SPH732_0500 EZ502U	13	17	830	50.00	0.49	0.93	56	19	85	3	40	127.3
0.80	3.8	5.8	1.3	1.8	ZR340SPH732_0500 EZ701U	13	17	830	50.00	0.49	0.93	56	19	85	3	40	127.3
0.80	4.5	7.7	1.6	1.5	ZR340SPH732_0500 EZ503U	13	17	830	50.00	0.49	0.93	56	19	85	3	40	127.3
0.88	2.3	2.9	1.1	3.0	ZR335SPH732_0400 EZ501U	11	19	600	40.00	0.54	1.02	49	16	99	3	35	111.4
0.88	3.5	5.2	1.7	1.9	ZR335SPH732_0400 EZ502U	14	19	770	40.00	0.54	1.02	49	16	99	3	35	111.4
0.88	3.5	5.3	1.7	1.9	ZR335SPH732_0400 EZ701U	13	19	740	40.00	0.54	1.02	49	16	99	3	35	111.4
0.88	4.1	7.1	2.0	1.6	ZR335SPH732_0400 EZ503U	14	19	770	40.00	0.54	1.02	49	16	99	3	35	111.4
0.88	4.8	9.5	2.4	1.4	ZR335SPH732_0400 EZ702U	14	19	770	40.00	0.54	1.02	49	16	99	3	35	111.4
1.00	2.0	2.6	1.1	3.0	ZR340SPH732_0400 EZ501U	9.3	17	600	40.00	0.62	1.17	56	19	86	3	40	127.3
1.00	2.0	2.6	1.0	4.0	ZR335SPH732_0350 EZ501U	9.3	19	520	35.00	0.62	1.17	49	16	99	3	35	111.4
1.00	3.0	4.6	1.7	1.9	ZR340SPH732_0400 EZ502U	12	17	770	40.00	0.62	1.17	56	19	86	3	40	127.3
1.00	3.0	4.6	1.6	2.6	ZR335SPH732_0350 EZ502U	16	19	870	35.00	0.62	1.17	49	16	99	3	35	111.4
1.00	3.0	4.6	1.7	1.9	ZR340SPH732_0400 EZ701U	12	17	740	40.00	0.62	1.17	56	19	86	3	40	127.3
1.00	3.0	4.6	1.6	2.6	ZR335SPH732_0350 EZ701U	12	19	650	35.00	0.62	1.17	49	16	99	3	35	111.4
1.00	3.0	4.6	1.7	1.9	ZR340SPH732_0400 EZ701U	12	17	740	40.00	0.62	1.17	56	19	86	3	40	127.3
1.00	3.6	6.2	2.0	1.6	ZR340SPH732_0400 EZ503U	12	17	770	40.00	0.62	1.17	56	19	86	3	40	127.3
1.00	3.6	6.2	1.9	2.2	ZR335SPH732_0350 EZ503U	16	19	870	35.00	0.62	1.17	49	16	99	3	35	111.4
1.00	4.2	8.4	2.2	1.9	ZR335SPH732_0350 EZ702U	16	19	870	35.00	0.62	1.17	49	16	99	3	35	111.4
1.00	4.2	8.4	2.4	1.4	ZR340SPH732_0400 EZ702U	12	17	770	40.00	0.62	1.17	56	19	86	3	40	127.3
1.00	4.2	8.4	2.2	1.9	ZR335SPH732_0350 EZ702U	16	19	870	35.00	0.62	1.17	49	16	99	3	35	111.4
1.00	4.2	8.4	2.4	1.4	ZR340SPH732_0400 EZ702U	12	17	770	40.00	0.62	1.17	56	19	86	3	40	127.3
1.14	1.7	2.2	1.0	4.0	ZR340SPH732_0350 EZ501U	8.2	17	520	35.00	0.71	1.33	56	19	87	3	40	127.3
1.14	2.7	4.0	1.6	2.6	ZR340SPH732_0350 EZ502U	14	17	870	35.00	0.71	1.33	56	19	87	3	40	127.3
1.14	2.7	4.0	1.6	2.6	ZR340SPH732_0350 EZ701U	10	17	650	35.00	0.71	1.33	56	19	87	3	40	127.3
1.14	3.2	5.4	1.9	2.2	ZR340SPH732_0350 EZ503U	14	17	870	35.00	0.71	1.33	56	19	87	3	40	127.3

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{iin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZR3PH7 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 16 kN)																	
1.14	3.7	7.3	2.2	1.9	ZR340SPH732_0350 EZ702U	14	17	870	35.00	0.71	1.33	56	19	87	3	40	127.3
1.25	1.6	2.1	1.1	5.0	ZR335SPH732_0280 EZ501U	7.5	19	420	28.00	0.77	1.46	49	16	102	3	35	111.4
1.25	2.4	3.6	1.7	3.2	ZR335SPH732_0280 EZ502U	14	19	770	28.00	0.77	1.46	49	16	102	3	35	111.4
1.25	2.4	3.7	1.7	3.2	ZR335SPH732_0280 EZ701U	9.3	19	520	28.00	0.77	1.46	49	16	102	3	35	111.4
1.25	2.9	5.0	2.1	2.7	ZR335SPH732_0280 EZ503U	14	19	770	28.00	0.77	1.46	49	16	102	3	35	111.4
1.25	3.4	6.7	2.4	2.3	ZR335SPH732_0280 EZ702U	14	19	770	28.00	0.77	1.46	49	16	102	3	35	111.4
1.40	2.2	3.3	2.0	3.4	ZR335SPH732_0250 EZ502U	13	19	720	25.00	0.82	1.63	49	16	100	3	35	111.4
1.40	2.2	3.3	2.0	3.4	ZR335SPH732_0250 EZ701U	8.3	19	470	25.00	0.82	1.63	49	16	100	3	35	111.4
1.40	2.6	4.4	2.3	2.9	ZR335SPH732_0250 EZ503U	16	19	870	25.00	0.82	1.63	49	16	100	3	35	111.4
1.40	3.0	6.0	2.7	2.5	ZR335SPH732_0250 EZ702U	16	19	870	25.00	0.82	1.63	49	16	100	3	35	111.4
1.43	1.4	1.8	1.1	5.0	ZR340SPH732_0280 EZ501U	6.5	17	420	28.00	0.88	1.67	56	19	90	3	40	127.3
1.43	2.1	3.2	1.7	3.2	ZR340SPH732_0280 EZ502U	12	17	770	28.00	0.88	1.67	56	19	90	3	40	127.3
1.43	2.1	3.2	1.7	3.2	ZR340SPH732_0280 EZ701U	8.2	17	520	28.00	0.88	1.67	56	19	90	3	40	127.3
1.43	2.5	4.3	2.1	2.7	ZR340SPH732_0280 EZ503U	12	17	770	28.00	0.88	1.67	56	19	90	3	40	127.3
1.43	2.9	5.8	2.4	2.3	ZR340SPH732_0280 EZ702U	12	17	770	28.00	0.88	1.67	56	19	90	3	40	127.3
1.60	1.9	2.8	2.0	3.4	ZR340SPH732_0250 EZ502U	11	17	720	25.00	0.93	1.87	56	19	87	3	40	127.3
1.60	1.9	2.9	2.0	3.4	ZR340SPH732_0250 EZ701U	7.3	17	470	25.00	0.93	1.87	56	19	87	3	40	127.3
1.60	2.3	3.9	2.3	2.9	ZR340SPH732_0250 EZ503U	14	17	870	25.00	0.93	1.87	56	19	87	3	40	127.3
1.60	2.6	5.2	2.7	2.5	ZR340SPH732_0250 EZ702U	14	17	870	25.00	0.93	1.87	56	19	87	3	40	127.3
1.75	1.7	2.6	2.2	4.1	ZR335SPH732_0200 EZ502U	10	19	580	20.00	0.88	1.75	49	16	101	3	35	111.4
1.75	1.7	2.6	2.2	4.1	ZR335SPH732_0200 EZ701U	6.7	19	370	20.00	0.88	1.75	49	16	101	3	35	111.4
1.75	2.1	3.5	2.6	3.5	ZR335SPH732_0200 EZ503U	14	19	800	20.00	0.88	1.75	49	16	101	3	35	111.4
1.75	2.4	4.8	3.1	3.0	ZR335SPH732_0200 EZ702U	14	19	760	20.00	0.88	1.75	49	16	101	3	35	111.4
2.00	1.5	2.3	2.2	4.2	ZR340SPH732_0200 EZ502U	9.1	17	580	20.00	1.00	2.00	56	19	88	3	40	127.3
2.00	1.5	2.3	2.2	4.2	ZR340SPH732_0200 EZ701U	5.8	17	370	20.00	1.00	2.00	56	19	88	3	40	127.3
2.00	1.8	3.1	2.6	3.6	ZR340SPH732_0200 EZ503U	13	17	800	20.00	1.00	2.00	56	19	88	3	40	127.3
2.00	2.1	4.2	3.1	3.1	ZR340SPH732_0200 EZ702U	12	17	760	20.00	1.00	2.00	56	19	88	3	40	127.3
2.19	1.4	2.1	2.5	4.8	ZR335SPH732_0160 EZ502U	8.3	19	460	16.00	1.09	2.19	49	16	104	3	35	111.4
2.19	1.4	2.1	2.5	4.8	ZR335SPH732_0160 EZ701U	5.3	19	300	16.00	1.09	2.19	49	16	104	3	35	111.4
2.19	1.7	2.8	3.0	4.0	ZR335SPH732_0160 EZ503U	11	19	640	16.00	1.09	2.19	49	16	104	3	35	111.4
2.19	1.9	3.8	3.4	3.5	ZR335SPH732_0160 EZ702U	11	19	610	16.00	1.09	2.19	49	16	104	3	35	111.4
2.50	1.4	2.5	3.0	4.4	ZR340SPH732_0160 EZ503U	10	17	640	16.00	1.25	2.50	56	19	92	3	40	127.3
2.50	1.7	3.3	3.4	3.8	ZR340SPH732_0160 EZ702U	9.6	17	610	16.00	1.25	2.50	56	19	92	3	40	127.3
ZR4PH7 (n_{1N} = 2000 rpm, ($F_{f2acc,max}$ = 14 kN)																	
1.91	4.6	7.0	11	1.5	ZR430SPH731_0070 EZ805U	14	17	870	7.000	2.38	4.76	56	19	80	4	30	127.3
2.67	3.3	5.0	16	1.9	ZR430SPH731_0050 EZ805U	14	17	880	5.000	2.93	6.67	56	19	91	4	30	127.3
3.33	2.6	4.0	21	2.2	ZR430SPH731_0040 EZ805U	12	17	790	4.000	3.17	6.67	56	19	98	4	30	127.3
ZR4PH7 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 14 kN)																	
0.29	4.4	4.8	0.7	2.0	ZR430SPH732_0700 EZ501U	13	17	810	70.00	0.35	0.67	56	19	77	4	30	127.3
0.29	7.6	8.2	1.2	1.2	ZR430SPH732_0700 EZ502U	13	17	810	70.00	0.35	0.67	56	19	77	4	30	127.3
0.29	7.6	8.5	1.2	1.2	ZR430SPH732_0700 EZ701U	13	17	810	70.00	0.35	0.67	56	19	77	4	30	127.3
0.40	3.1	3.4	0.9	2.8	ZR430SPH732_0500 EZ501U	12	17	740	50.00	0.49	0.93	56	19	83	4	30	127.3
0.40	5.4	5.8	1.5	1.6	ZR430SPH732_0500 EZ502U	13	17	830	50.00	0.49	0.93	56	19	83	4	30	127.3
0.40	5.4	6.1	1.5	1.6	ZR430SPH732_0500 EZ701U	13	17	830	50.00	0.49	0.93	56	19	83	4	30	127.3
0.40	7.1	8.1	1.9	1.2	ZR430SPH732_0500 EZ503U	13	17	830	50.00	0.49	0.93	56	19	83	4	30	127.3
0.50	2.5	2.7	1.1	3.0	ZR430SPH732_0400 EZ501U	9.3	17	600	40.00	0.62	1.17	56	19	85	4	30	127.3
0.50	4.3	4.7	1.9	1.7	ZR430SPH732_0400 EZ502U	12	17	770	40.00	0.62	1.17	56	19	85	4	30	127.3
0.50	4.3	4.8	1.9	1.7	ZR430SPH732_0400 EZ701U	12	17	740	40.00	0.62	1.17	56	19	85	4	30	127.3
0.50	5.7	6.5	2.5	1.3	ZR430SPH732_0400 EZ503U	12	17	770	40.00	0.62	1.17	56	19	85	4	30	127.3
0.50	7.0	8.4	3.1	1.1	ZR430SPH732_0400 EZ702U	12	17	770	40.00	0.62	1.17	56	19	85	4	30	127.3
0.57	2.2	2.4	1.1	3.9	ZR430SPH732_0350 EZ501U	8.2	17	520	35.00	0.71	1.33	56	19	85	4	30	127.3
0.57	3.8	4.1	1.8	2.2	ZR430SPH732_0350 EZ502U	14	17	870	35.00	0.71	1.33	56	19	85	4	30	127.3
0.57	3.8	4.2	1.8	2.2	ZR430SPH732_0350 EZ701U	10	17	650	35.00	0.71	1.33	56	19	85	4	30	127.3
0.57	5.0	5.7	2.4	1.7	ZR430SPH732_0350 EZ503U	14	17	870	35.00	0.71	1.33	56	19	85	4	30	127.3
0.57	6.1	7.4	2.9	1.4	ZR430SPH732_0350 EZ702U	14	17	870	35.00	0.71	1.33	56	19	85	4	30	127.3
0.57	6.9	8.2	3.3	1.2	ZR430SPH732_0350 EZ505U	14	17	870	35.00	0.71	1.33	56	19	85	4	30	127.3
0.71	1.8	1.9	1.2	4.8	ZR430SPH732_0280 EZ501U	6.5	17	420	28.00	0.88	1.67	56	19	88	4	30	127.3
0.71	3.0	3.3	2.0	2.8	ZR430SPH732_0280 EZ502U	12	17	770	28.00	0.88	1.67	56	19	88	4	30	127.3
0.71	3.0	3.4	2.0	2.8	ZR430SPH732_0280 EZ701U	8.2	17	520	28.00	0.88	1.67	56	19	88	4	30	127.3
0.71	4.0	4.5	2.7	2.1	ZR430SPH732_0280 EZ503U	12	17	770	28.00	0.88	1.67	56	19	88	4	30	127.3
0.71	4.9	5.9	3.3	1.7	ZR430SPH732_0280 EZ702U	12	17	770	28.00	0.88	1.67	56	19	88	4	30	127.3
0.71	5.5	6.5	3.7	1.5	ZR430SPH732_0280 EZ505U	12	17	770	28.00	0.88	1.67	56	19	88	4	30	127.3
0.71	6.7	8.5	4.5	1.3	ZR430SPH732_0280 EZ703U	12	17	770	28.00	0.88	1.67	56	19	88	4	30	127.3
0.80	2.7	2.9	2.3	2.9	ZR430SPH732_0250 EZ502U	11	17	720	25.00	0.93	1.87	56	19	86	4	30	127.3
0.80	2.7	3.0	2.3	2.9	ZR430SPH732_0250 EZ701U	7.3	17	470	25.00	0.93	1.87	56	19	86	4	30	127.3
0.80	3.5	4.1	3.0	2.2	ZR430SPH732_0250 EZ503U	14	17	870	25.00	0.93	1.87	56	19	86	4	30	127.3

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZR4PH7 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 14 kN)																	
0.80	4.4	5.3	3.8	1.8	ZR430SPH732_0250 EZ702U	14	17	870	25.00	0.93	1.87	56	19	86	4	30	127.3
0.80	4.9	5.8	4.2	1.6	ZR430SPH732_0250 EZ505U	14	17	870	25.00	0.93	1.87	56	19	86	4	30	127.3
0.80	6.0	7.6	5.2	1.3	ZR430SPH732_0250 EZ703U	14	17	870	25.00	0.93	1.87	56	19	86	4	30	127.3
1.00	2.2	2.3	2.8	3.3	ZR430SPH732_0200 EZ502U	9.1	17	580	20.00	1.00	2.00	56	19	86	4	30	127.3
1.00	2.2	2.4	2.8	3.3	ZR430SPH732_0200 EZ701U	5.8	17	370	20.00	1.00	2.00	56	19	86	4	30	127.3
1.00	2.8	3.2	3.7	2.6	ZR430SPH732_0200 EZ503U	13	17	800	20.00	1.00	2.00	56	19	86	4	30	127.3
1.00	3.5	4.2	4.6	2.1	ZR430SPH732_0200 EZ702U	12	17	760	20.00	1.00	2.00	56	19	86	4	30	127.3
1.00	3.9	4.7	5.1	1.8	ZR430SPH732_0200 EZ505U	13	17	810	20.00	1.00	2.00	56	19	86	4	30	127.3
1.00	4.8	6.1	6.3	1.5	ZR430SPH732_0200 EZ703U	13	17	810	20.00	1.00	2.00	56	19	86	4	30	127.3
1.00	6.2	8.8	8.1	1.2	ZR430SPH732_0200 EZ705U	13	17	810	20.00	1.00	2.00	56	19	86	4	30	127.3
1.25	1.7	1.9	3.2	4.1	ZR430SPH732_0160 EZ502U	7.2	17	460	16.00	1.25	2.50	56	19	90	4	30	127.3
1.25	1.7	1.9	3.2	4.1	ZR430SPH732_0160 EZ701U	4.7	17	300	16.00	1.25	2.50	56	19	90	4	30	127.3
1.25	2.3	2.6	4.2	3.1	ZR430SPH732_0160 EZ503U	10	17	640	16.00	1.25	2.50	56	19	90	4	30	127.3
1.25	2.8	3.4	5.2	2.5	ZR430SPH732_0160 EZ702U	9.6	17	610	16.00	1.25	2.50	56	19	90	4	30	127.3
1.25	3.2	3.7	5.9	2.2	ZR430SPH732_0160 EZ505U	12	17	740	16.00	1.25	2.50	56	19	90	4	30	127.3
1.25	3.9	4.9	7.2	1.8	ZR430SPH732_0160 EZ703U	12	17	740	16.00	1.25	2.50	56	19	90	4	30	127.3
1.25	5.0	7.1	9.2	1.4	ZR430SPH732_0160 EZ705U	12	17	740	16.00	1.25	2.50	56	19	90	4	30	127.3
2.00	1.1	1.3	1.8	3.9	ZR430SPH731_0100 EZ701U	3.0	17	190	10.00	1.67	3.33	56	19	68	4	30	127.3
2.00	1.8	2.2	3.0	2.4	ZR430SPH731_0100 EZ702U	6.2	17	390	10.00	1.67	3.33	56	19	68	4	30	127.3
2.00	2.5	3.1	4.1	1.8	ZR430SPH731_0100 EZ703U	9.0	17	580	10.00	1.67	3.33	56	19	68	4	30	127.3
2.00	3.2	4.6	5.3	1.4	ZR430SPH731_0100 EZ705U	9.0	17	580	10.00	1.67	3.33	56	19	68	4	30	127.3
2.00	3.4	5.6	5.5	1.3	ZR430SPH731_0100 EZ802U	9.0	17	580	10.00	1.67	3.33	56	19	68	4	30	127.3
2.86	1.3	1.5	3.3	4.8	ZR430SPH731_0070 EZ702U	4.3	17	280	7.000	2.38	4.76	56	19	80	4	30	127.3
2.86	1.7	2.2	4.5	3.5	ZR430SPH731_0070 EZ703U	6.9	17	440	7.000	2.38	4.76	56	19	80	4	30	127.3
2.86	2.2	3.2	5.9	2.7	ZR430SPH731_0070 EZ705U	11	17	700	7.000	2.38	4.76	56	19	80	4	30	127.3
2.86	2.4	3.9	6.1	2.6	ZR430SPH731_0070 EZ802U	11	17	670	7.000	2.38	4.76	56	19	80	4	30	127.3
2.86	2.8	5.1	7.3	2.2	ZR430SPH731_0070 EZ803U	14	17	870	7.000	2.38	4.76	56	19	80	4	30	127.3
4.00	1.2	1.6	6.8	4.4	ZR430SPH731_0050 EZ703U	4.9	17	310	5.000	2.93	6.67	56	19	91	4	30	127.3
4.00	1.6	2.3	8.8	3.4	ZR430SPH731_0050 EZ705U	7.8	17	500	5.000	2.93	6.67	56	19	91	4	30	127.3
4.00	1.7	2.8	9.2	3.3	ZR430SPH731_0050 EZ802U	7.5	17	480	5.000	2.93	6.67	56	19	91	4	30	127.3
4.00	2.0	3.6	11	2.7	ZR430SPH731_0050 EZ803U	11	17	700	5.000	2.93	6.67	56	19	91	4	30	127.3
5.00	1.3	1.8	11	4.0	ZR430SPH731_0040 EZ705U	6.3	14	400	4.000	3.17	6.67	56	19	98	4	30	127.3
5.00	1.3	2.2	12	3.8	ZR430SPH731_0040 EZ802U	6.0	17	380	4.000	3.17	6.67	56	19	98	4	30	127.3
5.00	1.6	2.9	14	3.2	ZR430SPH731_0040 EZ803U	8.7	17	560	4.000	3.17	6.67	56	19	98	4	30	127.3
ZR4PH7 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 14 kN)																	
0.75	5.6	8.9	2.8	1.2	ZR430SPH732_0400 EZ505U	12	17	770	40.00	0.62	1.17	56	19	85	4	30	127.3
0.86	4.9	7.8	2.6	1.6	ZR430SPH732_0350 EZ505U	14	17	870	35.00	0.71	1.33	56	19	85	4	30	127.3
0.86	6.2	10	3.3	1.2	ZR430SPH732_0350 EZ703U	14	17	870	35.00	0.71	1.33	56	19	85	4	30	127.3
1.07	3.9	6.3	2.9	2.0	ZR430SPH732_0280 EZ505U	12	17	770	28.00	0.88	1.67	56	19	88	4	30	127.3
1.07	4.9	8.2	3.7	1.5	ZR430SPH732_0280 EZ703U	12	17	770	28.00	0.88	1.67	56	19	88	4	30	127.3
1.20	3.5	5.6	3.2	2.1	ZR430SPH732_0250 EZ505U	14	17	870	25.00	0.93	1.87	56	19	86	4	30	127.3
1.20	4.4	7.3	4.1	1.6	ZR430SPH732_0250 EZ703U	14	17	870	25.00	0.93	1.87	56	19	86	4	30	127.3
1.50	2.8	4.5	3.7	2.6	ZR430SPH732_0200 EZ505U	13	17	810	20.00	1.00	2.00	56	19	86	4	30	127.3
1.50	3.5	5.8	4.7	2.0	ZR430SPH732_0200 EZ703U	13	17	810	20.00	1.00	2.00	56	19	86	4	30	127.3
1.50	4.8	8.8	6.4	1.5	ZR430SPH732_0200 EZ705U	13	17	810	20.00	1.00	2.00	56	19	86	4	30	127.3
1.88	2.2	3.6	4.1	3.2	ZR430SPH732_0160 EZ505U	12	17	740	16.00	1.25	2.50	56	19	90	4	30	127.3
1.88	2.8	4.7	5.3	2.5	ZR430SPH732_0160 EZ703U	12	17	740	16.00	1.25	2.50	56	19	90	4	30	127.3
1.88	3.8	7.0	7.1	1.8	ZR430SPH732_0160 EZ705U	12	17	740	16.00	1.25	2.50	56	19	90	4	30	127.3
3.00	1.6	5.2	3.0	2.4	ZR430SPH731_0100 EZ802U	9.0	17	580	10.00	1.67	3.33	56	19	68	4	30	127.3
3.00	1.8	3.0	3.4	2.1	ZR430SPH731_0100 EZ703U	9.0	17	580	10.00	1.67	3.33	56	19	68	4	30	127.3
3.00	2.5	4.5	4.7	1.5	ZR430SPH731_0100 EZ705U	9.0	17	580	10.00	1.67	3.33	56	19	68	4	30	127.3
4.29	1.1	3.6	3.3	4.8	ZR430SPH731_0070 EZ802U	11	17	670	7.000	2.38	4.76	56	19	80	4	30	127.3
4.29	1.3	2.1	3.8	4.1	ZR430SPH731_0070 EZ703U	6.9	17	440	7.000	2.38	4.76	56	19	80	4	30	127.3
4.29	1.7	3.2	5.2	3.0	ZR430SPH731_0070 EZ705U	11	17	700	7.000	2.38	4.76	56	19	80	4	30	127.3
6.00	1.2	2.3	7.7	3.9	ZR430SPH731_0050 EZ705U	7.8	17	500	5.000	2.93	6.67	56	19	91	4	30	127.3
ZR4PH7 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 14 kN)																	
0.57	3.5	4.5	0.7	2.0	ZR430SPH732_0700 EZ501U	13	17	810	70.00	0.35	0.67	56	19	77	4	30	127.3
0.57	5.3	8.0	1.1	1.3	ZR430SPH732_0700 EZ502U	13	17	810	70.00	0.35	0.67	56	19	77	4	30	127.3
0.57	5.3	8.1	1.1	1.3	ZR430SPH732_0700 EZ701U	13	17	810	70.00	0.35	0.67	56	19	77	4	30	127.3
0.80	2.5	3.2	0.9	2.8	ZR430SPH732_0500 EZ501U	12	17	740	50.00	0.49	0.93	56	19	83	4	30	127.3
0.80	3.8	5.7	1.3	1.8	ZR430SPH732_0500 EZ502U	13	17	830	50.00	0.49	0.93	56	19	83	4	30	127.3
0.80	3.8	5.8	1.3	1.8	ZR430SPH732_0500 EZ701U	13	17	830	50.00	0.49	0.93	56	19	83	4	30	127.3
0.80	4.5	7.7	1.6	1.5	ZR430SPH732_0500 EZ503U	13	17	830	50.00	0.49	0.93	56	19	83	4	30	127.3
1.00	2.0	2.6	1.1	3.0	ZR430SPH732_0400 EZ501U	9.3	17	600	40.00	0.62	1.17	56	19	85	4	30	127.3
1.00	3.0	4.6	1.7	1.9	ZR430SPH732_0400 EZ502U	12	17	770	40.00	0.62	1.17	56	19	85	4	30	127.3
1.00	3.0	4.6	1.7	1.9	ZR430SPH732_0400 EZ701U	12	17	740	40.00	0.62	1.17	56	19	85	4	30	127.3

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZR4PH7 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 14 kN)																	
1.00	3.6	6.2	2.0	1.6	ZR430SPH732_0400 EZ503U	12	17	770	40.00	0.62	1.17	56	19	85	4	30	127.3
1.00	4.2	8.4	2.4	1.4	ZR430SPH732_0400 EZ702U	12	17	770	40.00	0.62	1.17	56	19	85	4	30	127.3
1.14	1.7	2.2	1.0	4.0	ZR430SPH732_0350 EZ501U	8.2	17	520	35.00	0.71	1.33	56	19	85	4	30	127.3
1.14	2.7	4.0	1.6	2.6	ZR430SPH732_0350 EZ502U	14	17	870	35.00	0.71	1.33	56	19	85	4	30	127.3
1.14	2.7	4.0	1.6	2.6	ZR430SPH732_0350 EZ701U	10	17	650	35.00	0.71	1.33	56	19	85	4	30	127.3
1.14	3.2	5.4	1.9	2.2	ZR430SPH732_0350 EZ503U	14	17	870	35.00	0.71	1.33	56	19	85	4	30	127.3
1.14	3.7	7.3	2.2	1.9	ZR430SPH732_0350 EZ702U	14	17	870	35.00	0.71	1.33	56	19	85	4	30	127.3
1.43	1.4	1.8	1.1	5.0	ZR430SPH732_0280 EZ501U	6.5	17	420	28.00	0.88	1.67	56	19	88	4	30	127.3
1.43	2.1	3.2	1.7	3.2	ZR430SPH732_0280 EZ502U	12	17	770	28.00	0.88	1.67	56	19	88	4	30	127.3
1.43	2.1	3.2	1.7	3.2	ZR430SPH732_0280 EZ701U	8.2	17	520	28.00	0.88	1.67	56	19	88	4	30	127.3
1.43	2.5	4.3	2.1	2.7	ZR430SPH732_0280 EZ503U	12	17	770	28.00	0.88	1.67	56	19	88	4	30	127.3
1.43	2.9	5.8	2.4	2.3	ZR430SPH732_0280 EZ702U	12	17	770	28.00	0.88	1.67	56	19	88	4	30	127.3
1.60	1.9	2.8	2.0	3.4	ZR430SPH732_0250 EZ502U	11	17	720	25.00	0.93	1.87	56	19	86	4	30	127.3
1.60	1.9	2.9	2.0	3.4	ZR430SPH732_0250 EZ701U	7.3	17	470	25.00	0.93	1.87	56	19	86	4	30	127.3
1.60	2.3	3.9	2.3	2.9	ZR430SPH732_0250 EZ503U	14	17	870	25.00	0.93	1.87	56	19	86	4	30	127.3
1.60	2.6	5.2	2.7	2.5	ZR430SPH732_0250 EZ702U	14	17	870	25.00	0.93	1.87	56	19	86	4	30	127.3
2.00	1.5	2.3	2.2	4.2	ZR430SPH732_0200 EZ502U	9.1	17	580	20.00	1.00	2.00	56	19	86	4	30	127.3
2.00	1.5	2.3	2.2	4.2	ZR430SPH732_0200 EZ701U	5.8	17	370	20.00	1.00	2.00	56	19	86	4	30	127.3
2.00	1.8	3.1	2.6	3.6	ZR430SPH732_0200 EZ503U	13	17	800	20.00	1.00	2.00	56	19	86	4	30	127.3
2.00	2.1	4.2	3.1	3.1	ZR430SPH732_0200 EZ702U	12	17	760	20.00	1.00	2.00	56	19	86	4	30	127.3
2.50	1.4	2.5	3.0	4.4	ZR430SPH732_0160 EZ503U	10	17	640	16.00	1.25	2.50	56	19	90	4	30	127.3
2.50	1.7	3.3	3.4	3.8	ZR430SPH732_0160 EZ702U	9.6	17	610	16.00	1.25	2.50	56	19	90	4	30	127.3

7.3 Dimensional drawings

This chapter shows you the dimensions of rack and pinion drives with EZ synchronous servo motors.

Dimension az in the tables of dimensions applies to Atlanta gear racks. In general: az = ½ d0 + h0 + x*mn

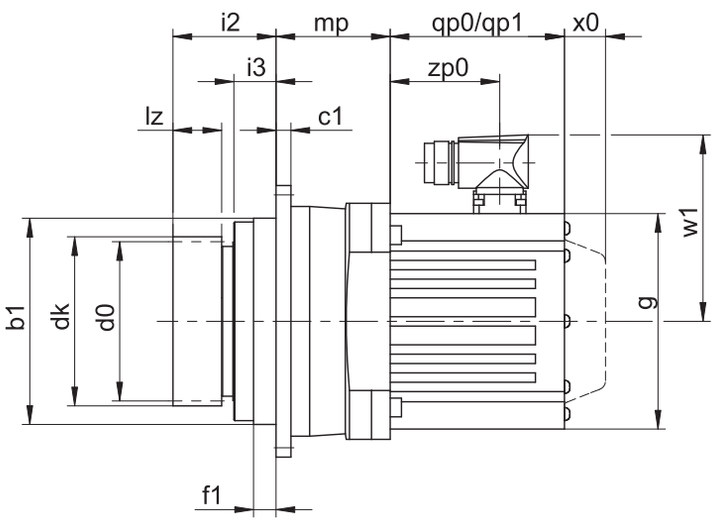
The pinion of the rack and pinion drive is helical (left-hand 19° 31 42"). The pinion gearing quality is 5.

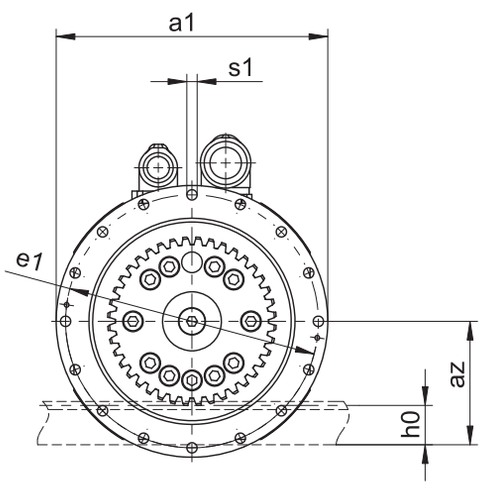
Dimensions can exceed the specifications of ISO 2768-mK due to casting tolerances or accumulation of individual tolerances.

We reserve the right to make dimensional changes due to ongoing technical development.

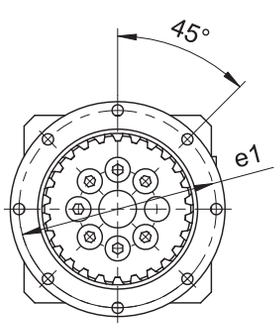
You can download 3D models of our standard drives at http://configurator.stoeber.de.

Combination options and the dimensions of forced ventilated geared motors can also be found at http://configurator.stoeber.de.

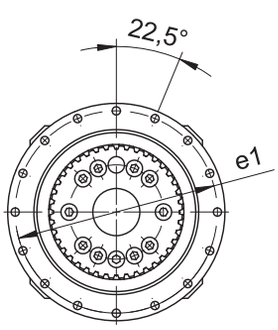




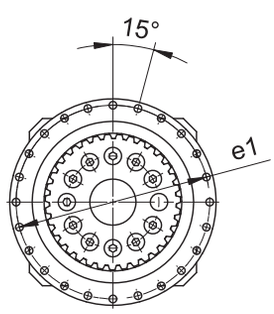
PH3/PH4



PH5



PH7



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x0	Applies to encoders using an optical measuring method.	w1	Different for the One Cable Solution (OCS), see the chapter [▶ 13.4]

Dimensions of gear units

Type	mn	Øa1	az	Øb1	c1	Ød0	Ødk	Øe1	f1	h0	i2	i3	lz	Øs1	x
ZR233SPH4_	2	118_{h7}	57.80	90_{h7}	7	70.03	75.0	109	10	22	56.0	23.5	26	5.5	0.39
ZR240SPH5_	2	145_{h7}	65.20	110_{h7}	8	84.88	90.0	135	12	22	55.0	22.5	26	5.5	0.38
ZR330SPH5_	3	145_{h7}	73.75	110_{h7}	8	95.49	101.5	135	12	26	64.0	22.5	35	5.5	0.00
ZR335SPH7_	3	179_{h7}	82.80	140_{h7}	10	111.41	119.0	168	12	26	69.0	31.5	31	6.6	0.37
ZR340SPH7_	3	179_{h7}	90.80	140_{h7}	10	127.32	135.0	168	12	26	69.0	31.5	31	6.6	0.38
ZR430SPH7_	4	179_{h7}	98.66	140_{h7}	10	127.32	135.3	168	12	35	83.0	31.5	45	6.6	0.00

Dimensions of motors

Type	□g	qp0	qp1	w1	x0	zp0
EZ301U	72	90	130.0	55.5	21	54.5
EZ302U	72	112	152.0	55.5	21	76.5
EZ303U	72	134	174.0	55.5	21	98.5
EZ401U	98	98	146.5	91.0	22	56.0
EZ402U	98	123	171.5	91.0	22	81.0
EZ501U	115	93	147.5	100.0	22	58.5
EZ502U	115	118	172.5	100.0	22	83.5
EZ503U	115	143	197.5	100.0	22	108.5
EZ505U	115	193	247.5	100.0	22	158.5
EZ701U	145	102	161.0	115.0	22	64.0
EZ702U	145	127	186.0	115.0	22	89.0
EZ703U	145	152	211.0	115.0	22	114.0
EZ705U	145	207	266.0	134.0	22	165.0
EZ802U	190	197	274.0	156.5	22	143.0
EZ803U	190	238	315.0	156.5	22	184.0
EZ805U	190	320	397.0	156.5	22	266.0

Dimensions of geared motors

Type	EZ3	EZ4	EZ5	EZ7	EZ8
	mp	mp	mp	mp	mp
ZR_PH431_	–	54.5	54.0	–	–
ZR_PH432_	99.0	95.5	–	–	–
ZR_PH531_	–	–	61.0	64.0	–
ZR_PH532_	–	103.0	102.5	–	–
ZR_PH731_	–	–	–	71.0	81.0
ZR_PH732_	–	–	119.0	122.0	–

7.4 Type designation

This chapter shows you an explanation of the type designation with the associated options.

Additional ordering information not included in the type designation can be found at the end of the chapter.

Example code

Z	R	3	30	S	PH	5	3	2	S	F	S	S	0280	EZ501U

Explanation

Code	Designation	Design
Z	Type	Rack and pinion drive
R	Design	Screwed pinion
3	Module	m_n = 3 (example)
30	Number of teeth	z = 30 (example)
S	Toothing	Helical (left-hand 19° 31' 42")
PH	Type	Planetary gear unit
5	Size	5 (example)
3	Generation	Generation 3
1	Stages	Single-stage
2		Two-stage
S	Housing	Standard
F	Shaft	Flange shaft
S	Bearing	Standard bearing
V		Reinforced bearing (PH3 – PH5)
S	Backlash	Standard
R		Reduced
0280	Transmission ratio (i x 10)	i = 28 (example)
EZ501U	Motor	EZ synchronous servo motor

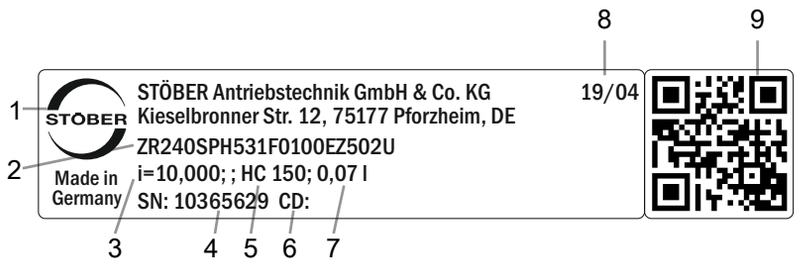
To complete the type designation, also specify the following in your order:

- A detailed type designation of the motor, see chapter [▶ 13]
- Radial shaft seal rings at the output, made of NBR or FKM (optional), see chapter [▶ 7.6.2]
- Radial runout ≤ 10 µm (optional)
- Reverse operation of the output shaft from ±20° to ±90° for horizontal installation on request

In this catalog, you will find all information on rack and pinion drives with EZ synchronous servo motors. All input options available on request can be found in the chapter [▶ 7.5.1].

7.4.1 Nameplate

An example geared motor nameplate is explained in the figure below.



Code	Designation
1	Name of manufacturer
2	Type designation
3	Gear ratio of the gear unit
4	Serial number of the gear unit
5	Lubricant specification
6	Customer-specific data
7	Lubricant fill volume
8	Date of manufacture (year/calendar week)
9	QR code (link to product information)

7.4.1.1 Supporting documents

You can view or download supporting documents for the product by reading off the serial number on the nameplate of the product and entering it at the following address online:
https://id.stober.com

Alternatively, you can use a suitable mobile device to scan in the QR code on the nameplate of the product in order to be linked to the supporting documents.

7.5 Product description

7.5.1 Input options

This chapter shows you all available input options:

EZ synchronous servo motor	Motor adapter	KX right-angle input with MF motor adapter	K right-angle input with ME motor adapter	MB motor adapter
				
http://www.stoeber.de/en/Z_EZ	http://www.stoeber.de/en/ZRPHME	On request	On request	On request

7.5.2 Gear rack

The technical data specified in the Selection tables chapter applies only to gear rack combinations with the following characteristics:

The pinion of the rack and pinion drive is case-hardened and helical (left-hand 19° 31' 42"). The pinion gearing quality is 5.

The corresponding gear rack must have a right-hand design (19° 31' 42") and possess the following characteristics:

Module m_n [mm]	Minimum gear rack quality	Gear rack material
2 – 4	6	16MnCr5 inductively hardened
5	5	16MnCr5 inductively hardened
6 – 10	6	C45 inductively hardened

Also note the project configuration of the gear rack on the Atlanta pages.

7.5.3 Installation conditions

The torque and force values listed in this catalog are valid under the following conditions:

- When the gear housing is fastened on the machine side using screws of strength class 12.9
- When the gear housings are adjusted at pilot øbz. The machine-side fit must be H7.

7.5.4 Lubricants

STOBER fills the gear units with the amount and type of lubricant specified on the nameplate.

You will receive lubricants for use in the food industry upon request.

7.5.4.1 Rack and pinion drive lubrication

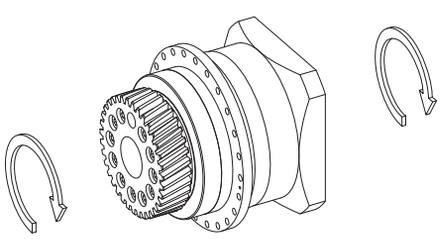
Make sure the rack and pinion drive has permanent lubrication with the lubricants specified in the Atlanta product catalog.

7.5.5 Other product features

Feature	Value
Max. permitted gear unit temperature (on the surface of the gear unit)	≤ 90 °C
Paint	Black RAL 9005
(ATEX) Directive 2014/34/EU (Option)	Not suitable.
Protection class: [1]	
Planetary gear units	IP65
Motor	IP56, optionally IP66
Pinion/gear rack	IPXX

7.5.6 Direction of rotation

The input and output rotate in the same direction.



7.6 Project configuration

Project your drives using our SERVOsoft designing software. Download SERVOsoft for free at https://www.stoeber.de/en/ServoSoft.

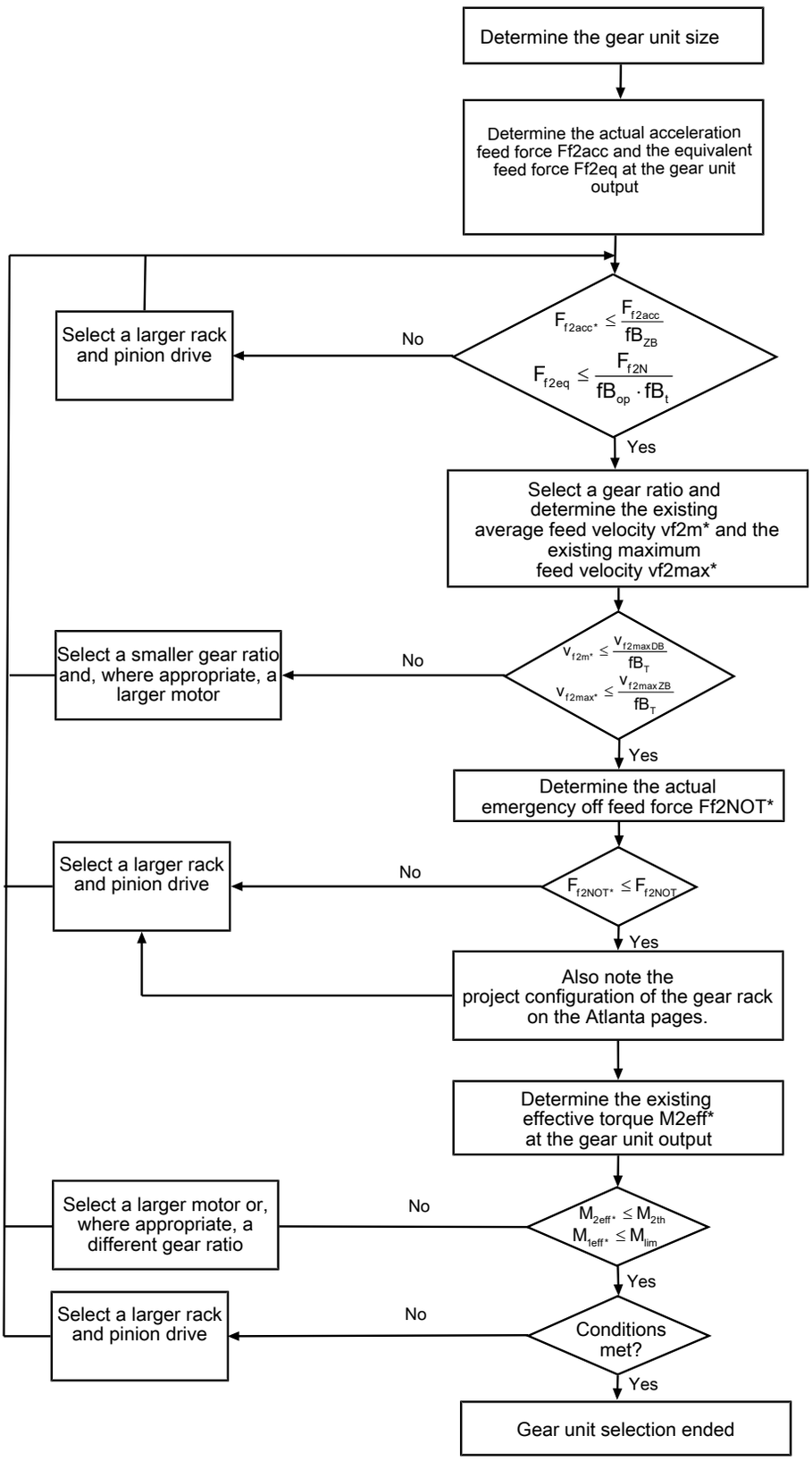
Observe the limit conditions in this chapter to ensure a safe design for your drives.

The formula symbols for values actually present in the application are marked with *.

An explanation of the formula symbols can be found in the chapter [▶ 15.1].

[1] Observe the protection class of all the components.

7.6.1 Drive selection

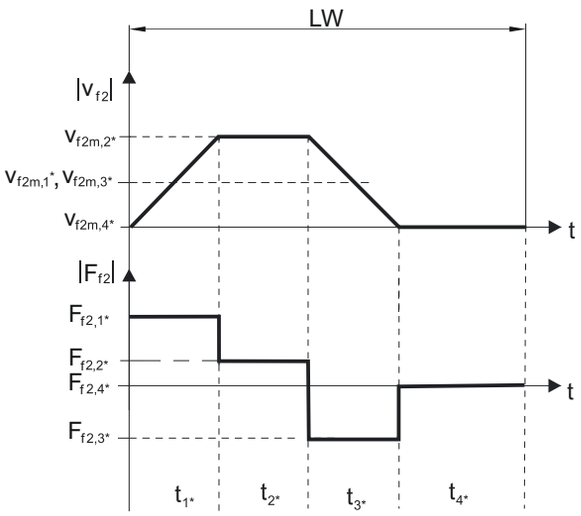


Refer to the selection tables for the values of i, $v_{f2maxDB}$, $v_{f2maxZB}$, F_{f2acc}, F_{f2N} and F_{f2NOT}.

The values for fB_T, fB_{op}, fB_t and fB_{ZB} can be found in the corresponding tables in this chapter.

Example of cyclic operation

The following calculations are based on a representation of the power taken from the output based in accordance with the following example:



Calculation of the actual maximum acceleration feed force

$$F_{f2acc*} = m* \cdot a* + F_{L*}$$

Calculation of the actual average input speed

$$n_{1m*} = \frac{v_{f2m*} \cdot i}{d_0 \cdot \pi}$$

$$v_{f2m*} = \frac{\left|v_{f2m,1*}\right| \cdot t_{1*} + \ldots + \left|v_{f2m,n*}\right| \cdot t_{n*}}{t_{1*} + \ldots + t_{n*}}$$

If $t_{1*} + \ldots + t_{3*} \geq 6$ min, determine v_{2m*} without the rest phase t_{4*}.

The values for the ratio i can be found in the selection tables.

Calculation of the actual emergency off feed force

$$F_{f2NOT*} = m* \cdot a_{NOT*} + F_{L*}$$

Calculation of the actual equivalent feed force

$$F_{f2eq*} = \sqrt[3]{\frac{\left|v_{f2m,1*}\right| \cdot t_{1*} \cdot \left|F_{f2,1*}{}^{3}\right| + \ldots + \left|v_{f2m,n*}\right| \cdot t_{n*} \cdot \left|F_{f2,n*}{}^{3}\right|}{\left|v_{f2m,1*}\right| \cdot t_{1*} + \ldots + \left|v_{f2m,n*}\right| \cdot t_{n*}}}$$

Calculation of the thermal limit torque

Calculate the thermal limit torque M_{2th} for a duty cycle $ED_{10} > 50\%$ and the actual average input speed n_{1m*}. (At $K_{mot,th} \leq 0$ you must reduce the average input speed n_{1m*} accordingly or select another geared motor size.)

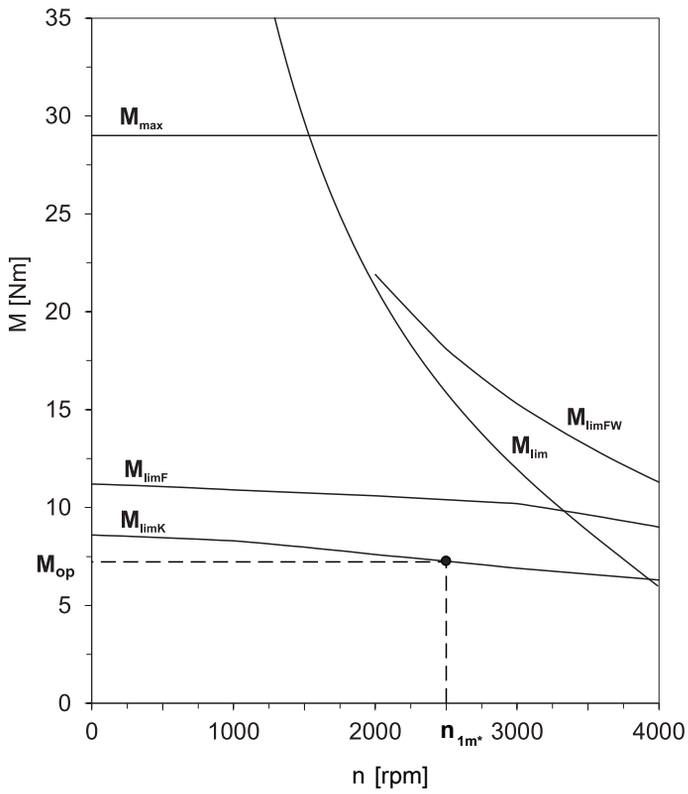
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

$$K_{mot,th} = 0{,}93 - \frac{a_{th}}{1000} \cdot fB_T \cdot \left(\frac{n_{1m*}}{1000}\right)^3$$

Refer to the selection tables for the values of i and a_{th}.

The values for fB_T can be found in the corresponding table in this chapter.

The value for the torque of the motor at operating point M_{op} with the determined average input speed n_{1m*} can be found in the motor characteristic curve of the chapter [▶ 13.3]. Note the size, nominal speed n_N and cooling type of the motor. The figure below shows an example of reading the torque M_{op} of a motor with convection cooling at the operating point.



Calculation of the actual effective torque

$$M_{2eff*} = \sqrt{\frac{t_{1*} \cdot M_{2,1*}{}^2 + \ldots + t_{n*} \cdot M_{2,n*}{}^2}{t_{1*} + \ldots + t_{n*}}}$$

$$M_{2,n*} = \frac{F_{f2,n*} \cdot d_0}{2}$$

$$M_{1eff*} = \frac{M_{2eff*}}{i \cdot \eta}$$

Operating factors

Operating mode	fB_{op}
Uniform continuous operation	1.00
Cyclic operation	1.00
Reversing load cyclic operation	1.00

Run time	fB_t
Daily runtime ≤ 8 h	1.00
Daily runtime ≤ 16 h	1.15
Daily runtime ≤ 24 h	1.20

Cyclic operation	fB_{ZB}
≤ 1000 load changes/hour (LW/h)	1.00
> 1000 load changes/hour (LW/h)	1.15

Temperature		fB_T
Motor cooling	**Surrounding temperature**	
Motor with forced ventilation	≤ 20 °C	0.9
	≤ 30 °C	1.0
	≤ 40 °C	1.15
Motor with convection cooling	≤ 20 °C	1.0
	≤ 30 °C	1.1
	≤ 40 °C	1.25

Notes

- The maximum permitted gear unit temperature (see the "Other product features" chapter) must not be exceeded, as that could result in damage.
- For braking from full speed (for example, when the power fails or when setting up the machine), note the permitted gear unit feed forces (F_{f2acc}, F_{f2NOT}) in the selection tables.

7.6.2 Recommendation for radial shaft seal rings

For a duty cycle > 60% and higher surrounding temperatures, we recommend radial shaft seal rings made of FKM at the output.

Properties:

- Excellent temperature resistance
- High chemical stability
- Very good resistance to aging
- Excellent resistance in oils and greases
- For use in the food, beverage and pharmaceutical industries

Leak-proofness

Our gear units are equipped with high-quality radial shaft seal rings and checked for leaks. However, a leak cannot be fully ruled out over the length of use of a gear unit. If you use a gear unit with goods incompatible with the lubricant, you must take measures to prevent direct contact with the gear unit lubricant in case of a leak.

7.7 Additional documentation

Additional documentation related to the product can be found at
http://www.stoeber.de/en/downloads/

Enter the ID of the documentation in the Search... field.

Documentation	ID
Operating manual for gear racks (Atlanta)	442455
Operating manual for P/PE/PH/PHQ/PHV planetary gear units and planetary geared motors	443149_en
Operating manual for EZ synchronous servo motors	443032_en

8 ZVP rack and pinion drives

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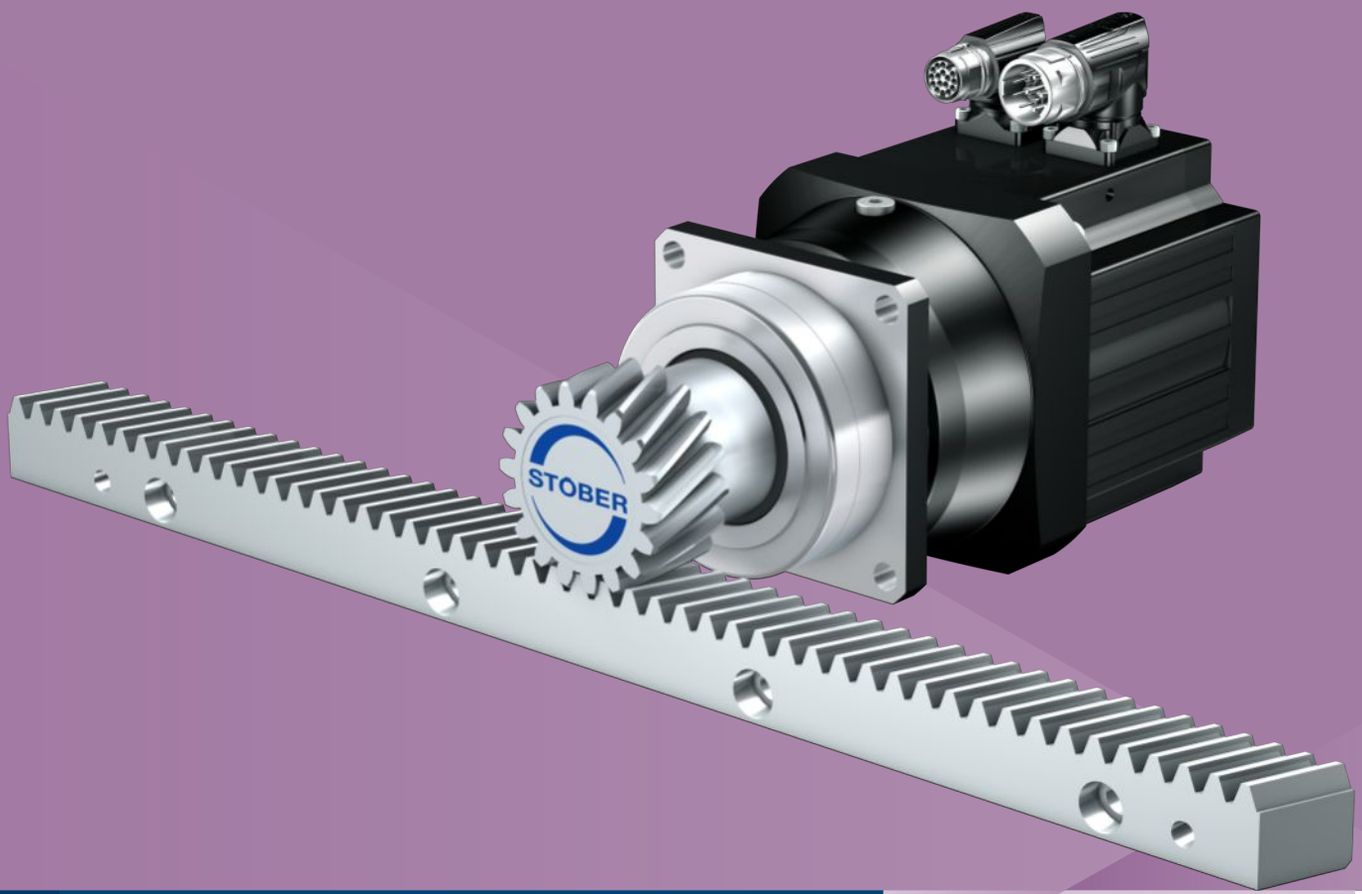


8 Rack and pinion drives

ZVP

8.1 Overview

Precision planetary geared motors with plug-on pinion

Features

Power density	★★★☆☆
Linear clearance	★★★★★
Price category	€€
Smooth operation	★★★★☆
Linear rigidity	★★★☆☆
Mass moment of inertia	★★★★☆
Ready-to-install drive solution	✓
Pinion gearing quality 6 (DIN 3962)	✓
Helical gearing	✓
Case-hardened and smoothed	✓
Compact and highly dynamic due to direct motor attachment	✓

Key ★☆☆☆☆ good | ★★★★★ excellent
€ Economy | €€€€€ Premium

Technical data

m_n	2 – 4 mm
z	16 – 25
F_{f2acc}	0.8 – 11 kN
v_{f2N}	0.1 – 4.5 m/s
Δs	8 – 44 µm

8.2 Selection table

The technical data specified in the selection tables applies to:

- Pinion position E with bearing design S (standard)
- De-energized installation
- Permanent lubrication with the lubricants specified in the Atlanta product catalog
- Material combinations as described in the chapter [▶ 8.5.2]
- Installation altitudes up to 1000 m above sea level
- Surrounding temperatures from 0 °C to 40 °C
- Without consideration of the thermal limiting performance
- Drives with convection-cooled motors (e.g. EZ401**U**)

For the technical data on drives with forced ventilated motors (e.g. EZ401**B**), refer to http://configurator.stoeber.de.

Higher feed forces are possible for rack and pinion drives with reduced backlash, reinforced bearing D (axially reinforced) or pinion position S. You can find this and all other technical data, as well as other combinations of the pinion position and bearing design, at http://configurator.stoeber.de.

An explanation of the formula symbols can be found in the chapter [▶ 15.1].

v_{f2N}	F_{f2N}	$F_{f2,0}$	a_{th}	S	Type	F_{f2accE}	$F_{f2NOT,E}$	M_{2accE}	i	$v_{f2maxDB}$	$v_{f2maxZB}$	Δs	Δs_{red}	C_{lin}	m_n	z	d_0
[m/s]	[kN]	[kN]				[kN]	[kN]	[Nm]		[m/s]	[m/s]	[µm]	[µm]	[N/µm]	[mm]		[mm]
ZV2P3 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 2,0 kN)																	
0.19	1.5	1.5	1.8	1.1	ZV216S_P332_0280 EZ301U	2.0	3.3	34	28.00	0.38	0.51	25	15	53	2	16	34.0
0.21	1.3	1.3	1.7	1.3	ZV216S_P332_0250 EZ301U	2.0	3.3	34	25.00	0.43	0.57	25	15	54	2	16	34.0
0.27	1.0	1.1	1.9	1.6	ZV216S_P332_0200 EZ301U	2.0	3.3	34	20.00	0.49	0.71	25	15	54	2	16	34.0
0.33	0.8	0.9	2.4	2.0	ZV216S_P332_0160 EZ301U	2.0	3.3	34	16.00	0.61	0.89	25	15	53	2	16	34.0
0.33	1.4	1.5	4.0	1.2	ZV216S_P332_0160 EZ302U	2.0	3.3	34	16.00	0.61	0.89	25	15	53	2	16	34.0
0.44	0.6	0.6	4.1	2.7	ZV216S_P332_0120 EZ301U	1.9	3.3	32	12.00	0.82	1.19	25	15	49	2	16	34.0
0.44	1.1	1.1	7.0	1.6	ZV216S_P332_0120 EZ302U	2.0	3.3	34	12.00	0.82	1.19	25	15	49	2	16	34.0
0.44	1.4	1.5	9.1	1.2	ZV216S_P332_0120 EZ303U	2.0	3.3	34	12.00	0.82	1.19	25	15	49	2	16	34.0
0.53	0.5	0.5	0.5	3.1	ZV216S_P331_0100 EZ301U	1.6	3.3	27	10.00	0.98	1.42	20	10	46	2	16	34.0
0.53	0.9	1.0	0.9	1.8	ZV216S_P331_0100 EZ302U	2.0	3.3	34	10.00	0.98	1.42	20	10	46	2	16	34.0
0.53	1.2	1.3	1.1	1.4	ZV216S_P331_0100 EZ303U	2.0	3.3	34	10.00	0.98	1.42	20	10	46	2	16	34.0
0.67	0.4	0.4	0.5	3.9	ZV216S_P331_0080 EZ301U	1.3	3.3	22	8.000	1.11	1.78	20	10	49	2	16	34.0
0.67	0.7	0.8	0.9	2.3	ZV216S_P331_0080 EZ302U	2.0	3.3	34	8.000	1.11	1.78	20	10	49	2	16	34.0
0.67	0.9	1.0	1.2	1.8	ZV216S_P331_0080 EZ303U	2.0	3.3	34	8.000	1.11	1.78	20	10	49	2	16	34.0
0.67	1.3	1.4	1.6	1.3	ZV216S_P331_0080 EZ401U	2.0	3.3	34	8.000	1.11	1.78	20	10	49	2	16	34.0
0.76	0.4	0.4	0.6	4.4	ZV216S_P331_0070 EZ301U	1.1	3.3	19	7.000	1.27	2.03	20	10	52	2	16	34.0
0.76	0.6	0.7	1.0	2.6	ZV216S_P331_0070 EZ302U	2.0	3.3	34	7.000	1.27	2.03	20	10	52	2	16	34.0
0.76	0.8	0.9	1.3	2.0	ZV216S_P331_0070 EZ303U	2.0	3.3	34	7.000	1.27	2.03	20	10	52	2	16	34.0
0.76	1.1	1.2	1.7	1.5	ZV216S_P331_0070 EZ401U	2.0	3.3	34	7.000	1.27	2.03	20	10	52	2	16	34.0
1.07	0.5	0.5	1.5	3.2	ZV216S_P331_0050 EZ302U	1.4	3.3	24	5.000	1.60	2.84	20	10	56	2	16	34.0
1.07	0.6	0.6	1.9	2.5	ZV216S_P331_0050 EZ303U	2.0	3.3	34	5.000	1.60	2.84	20	10	56	2	16	34.0
1.07	0.8	0.9	2.6	1.8	ZV216S_P331_0050 EZ401U	2.0	3.3	34	5.000	1.60	2.84	20	10	56	2	16	34.0
1.07	1.3	1.5	4.3	1.1	ZV216S_P331_0050 EZ402U	2.0	3.3	34	5.000	1.60	2.84	20	10	56	2	16	34.0
1.33	0.4	0.4	1.9	3.7	ZV216S_P331_0040 EZ302U	1.1	3.3	19	4.000	1.78	3.56	20	10	56	2	16	34.0
1.33	0.5	0.5	2.5	2.9	ZV216S_P331_0040 EZ303U	1.6	3.3	27	4.000	1.78	3.56	20	10	56	2	16	34.0
1.33	0.6	0.7	3.3	2.1	ZV216S_P331_0040 EZ401U	1.9	3.3	33	4.000	1.78	3.56	20	10	56	2	16	34.0
1.33	1.1	1.2	5.6	1.3	ZV216S_P331_0040 EZ402U	2.0	3.3	34	4.000	1.78	3.56	20	10	56	2	16	34.0
1.78	0.3	0.3	4.0	4.5	ZV216S_P331_0030 EZ302U	0.9	3.3	15	3.000	2.07	4.15	20	10	54	2	16	34.0
1.78	0.4	0.4	5.2	3.5	ZV216S_P331_0030 EZ303U	1.2	3.3	20	3.000	2.07	4.15	20	10	54	2	16	34.0
1.78	0.5	0.5	7.1	2.6	ZV216S_P331_0030 EZ401U	1.5	3.3	25	3.000	2.07	4.15	20	10	54	2	16	34.0
1.78	0.8	0.9	12	1.5	ZV216S_P331_0030 EZ402U	2.0	3.3	34	3.000	2.07	4.15	20	10	54	2	16	34.0
ZV2P3 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 2,0 kN)																	
0.38	1.4	1.5	2.0	1.2	ZV216S_P332_0280 EZ301U	2.0	3.3	34	28.00	0.38	0.51	25	15	53	2	16	34.0
0.43	1.2	1.3	1.8	1.3	ZV216S_P332_0250 EZ301U	2.0	3.3	34	25.00	0.43	0.57	25	15	54	2	16	34.0
0.53	1.0	1.1	2.0	1.7	ZV216S_P332_0200 EZ301U	2.0	3.3	34	20.00	0.49	0.71	25	15	54	2	16	34.0
0.67	0.8	0.9	2.6	2.1	ZV216S_P332_0160 EZ301U	2.0	3.3	34	16.00	0.61	0.89	25	15	53	2	16	34.0
0.67	1.3	1.5	4.5	1.2	ZV216S_P332_0160 EZ302U	2.0	3.3	34	16.00	0.61	0.89	25	15	53	2	16	34.0
0.89	0.6	0.6	4.3	2.6	ZV216S_P332_0120 EZ301U	1.9	3.3	32	12.00	0.82	1.19	25	15	49	2	16	34.0
0.89	1.0	1.1	7.3	1.5	ZV216S_P332_0120 EZ302U	2.0	3.3	34	12.00	0.82	1.19	25	15	49	2	16	34.0
0.89	1.3	1.5	9.5	1.2	ZV216S_P332_0120 EZ303U	2.0	3.3	34	12.00	0.82	1.19	25	15	49	2	16	34.0
1.07	0.5	0.5	0.6	2.6	ZV216S_P331_0100 EZ301U	1.6	3.3	27	10.00	0.98	1.42	20	10	46	2	16	34.0
1.07	0.9	1.0	1.0	1.6	ZV216S_P331_0100 EZ302U	2.0	3.3	34	10.00	0.98	1.42	20	10	46	2	16	34.0
1.07	1.1	1.3	1.4	1.2	ZV216S_P331_0100 EZ303U	2.0	3.3	34	10.00	0.98	1.42	20	10	46	2	16	34.0
1.33	0.4	0.4	0.7	3.3	ZV216S_P331_0080 EZ301U	1.3	3.3	22	8.000	1.11	1.78	20	10	49	2	16	34.0

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV2P3 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 2,0 kN)																	
1.33	0.7	0.8	1.1	2.0	ZV216S_P331_0080 EZ302U	2.0	3.3	34	8.000	1.11	1.78	20	10	49	2	16	34.0
1.33	0.9	1.0	1.4	1.5	ZV216S_P331_0080 EZ303U	2.0	3.3	34	8.000	1.11	1.78	20	10	49	2	16	34.0
1.33	1.1	1.3	1.7	1.3	ZV216S_P331_0080 EZ401U	2.0	3.3	34	8.000	1.11	1.78	20	10	49	2	16	34.0
1.52	0.4	0.4	0.7	3.6	ZV216S_P331_0070 EZ301U	1.1	3.3	19	7.000	1.27	2.03	20	10	52	2	16	34.0
1.52	0.6	0.7	1.2	2.2	ZV216S_P331_0070 EZ302U	2.0	3.3	34	7.000	1.27	2.03	20	10	52	2	16	34.0
1.52	0.8	0.9	1.5	1.7	ZV216S_P331_0070 EZ303U	2.0	3.3	34	7.000	1.27	2.03	20	10	52	2	16	34.0
1.52	0.9	1.1	1.8	1.4	ZV216S_P331_0070 EZ401U	2.0	3.3	34	7.000	1.27	2.03	20	10	52	2	16	34.0
2.13	0.3	0.3	1.0	4.5	ZV216S_P331_0050 EZ301U	0.8	3.3	14	5.000	1.60	2.84	20	10	56	2	16	34.0
2.13	0.4	0.5	1.7	2.7	ZV216S_P331_0050 EZ302U	1.4	3.3	24	5.000	1.60	2.84	20	10	56	2	16	34.0
2.13	0.6	0.6	2.3	2.1	ZV216S_P331_0050 EZ303U	2.0	3.3	34	5.000	1.60	2.84	20	10	56	2	16	34.0
2.13	0.7	0.8	2.6	1.8	ZV216S_P331_0050 EZ401U	2.0	3.3	34	5.000	1.60	2.84	20	10	56	2	16	34.0
2.13	1.0	1.4	4.0	1.2	ZV216S_P331_0050 EZ402U	2.0	3.3	34	5.000	1.60	2.84	20	10	56	2	16	34.0
2.67	0.3	0.4	2.3	3.1	ZV216S_P331_0040 EZ302U	1.1	3.3	19	4.000	1.78	3.56	20	10	56	2	16	34.0
2.67	0.4	0.5	3.0	2.4	ZV216S_P331_0040 EZ303U	1.6	3.3	27	4.000	1.78	3.56	20	10	56	2	16	34.0
2.67	0.5	0.6	3.5	2.0	ZV216S_P331_0040 EZ401U	1.9	3.3	33	4.000	1.78	3.56	20	10	56	2	16	34.0
2.67	0.8	1.1	5.3	1.3	ZV216S_P331_0040 EZ402U	2.0	3.3	34	4.000	1.78	3.56	20	10	56	2	16	34.0
3.56	0.3	0.3	4.8	3.8	ZV216S_P331_0030 EZ302U	0.9	3.3	15	3.000	2.07	4.15	20	10	54	2	16	34.0
3.56	0.3	0.4	6.2	2.9	ZV216S_P331_0030 EZ303U	1.2	3.3	20	3.000	2.07	4.15	20	10	54	2	16	34.0
3.56	0.4	0.5	7.3	2.5	ZV216S_P331_0030 EZ401U	1.5	3.3	25	3.000	2.07	4.15	20	10	54	2	16	34.0
3.56	0.6	0.8	11	1.6	ZV216S_P331_0030 EZ402U	2.0	3.3	34	3.000	2.07	4.15	20	10	54	2	16	34.0
ZV2P4 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 4,1 kN)																	
0.10	2.9	3.0	0.6	1.1	ZV220S_P432_0700 EZ301U	4.1	6.3	88	70.00	0.16	0.25	31	19	70	2	20	42.4
0.12	2.3	2.4	0.7	1.4	ZV220S_P432_0560 EZ301U	4.1	6.3	88	56.00	0.20	0.32	31	19	62	2	20	42.4
0.13	2.1	2.1	0.7	1.5	ZV220S_P432_0500 EZ301U	4.1	6.3	88	50.00	0.22	0.36	31	19	76	2	20	42.4
0.17	1.7	1.7	0.9	1.9	ZV220S_P432_0400 EZ301U	4.1	6.3	88	40.00	0.28	0.44	31	19	75	2	20	42.4
0.17	2.8	3.0	1.5	1.1	ZV220S_P432_0400 EZ302U	4.1	6.3	88	40.00	0.28	0.44	31	19	75	2	20	42.4
0.19	1.5	1.5	0.8	2.2	ZV220S_P432_0350 EZ301U	4.1	6.3	88	35.00	0.29	0.51	31	19	77	2	20	42.4
0.19	2.5	2.6	1.3	1.3	ZV220S_P432_0350 EZ302U	4.1	6.3	88	35.00	0.29	0.51	31	19	77	2	20	42.4
0.21	1.3	1.4	0.9	2.4	ZV220S_P432_0320 EZ301U	4.0	6.3	85	32.00	0.28	0.56	31	19	62	2	20	42.4
0.21	2.3	2.4	1.6	1.4	ZV220S_P432_0320 EZ302U	4.1	6.3	88	32.00	0.28	0.56	31	19	62	2	20	42.4
0.21	3.0	3.1	2.1	1.1	ZV220S_P432_0320 EZ303U	4.1	6.3	88	32.00	0.28	0.56	31	19	62	2	20	42.4
0.24	1.2	1.2	0.9	2.7	ZV220S_P432_0280 EZ301U	3.5	6.3	74	28.00	0.36	0.64	31	19	77	2	20	42.4
0.24	2.0	2.1	1.6	1.6	ZV220S_P432_0280 EZ302U	4.1	6.3	88	28.00	0.36	0.64	31	19	77	2	20	42.4
0.24	2.6	2.7	2.1	1.2	ZV220S_P432_0280 EZ303U	4.1	6.3	88	28.00	0.36	0.64	31	19	77	2	20	42.4
0.27	1.0	1.1	1.0	3.0	ZV220S_P432_0250 EZ301U	3.1	6.3	67	25.00	0.40	0.71	31	19	78	2	20	42.4
0.27	1.8	1.9	1.6	1.8	ZV220S_P432_0250 EZ302U	4.1	6.3	88	25.00	0.40	0.71	31	19	78	2	20	42.4
0.27	2.3	2.5	2.1	1.4	ZV220S_P432_0250 EZ303U	4.1	6.3	88	25.00	0.40	0.71	31	19	78	2	20	42.4
0.33	0.8	0.9	1.1	3.8	ZV220S_P432_0200 EZ301U	2.5	6.3	53	20.00	0.44	0.89	31	19	77	2	20	42.4
0.33	1.4	1.5	1.9	2.2	ZV220S_P432_0200 EZ302U	4.1	6.3	88	20.00	0.44	0.89	31	19	77	2	20	42.4
0.33	1.9	2.0	2.5	1.7	ZV220S_P432_0200 EZ303U	4.1	6.3	88	20.00	0.44	0.89	31	19	77	2	20	42.4
0.33	2.5	2.7	3.4	1.3	ZV220S_P432_0200 EZ401U	4.1	6.3	88	20.00	0.44	0.89	31	19	77	2	20	42.4
0.42	0.7	0.7	1.3	4.6	ZV220S_P432_0160 EZ301U	2.0	6.3	43	16.00	0.56	1.11	31	19	76	2	20	42.4
0.42	1.1	1.2	2.3	2.7	ZV220S_P432_0160 EZ302U	3.6	6.3	76	16.00	0.56	1.11	31	19	76	2	20	42.4
0.42	1.5	1.6	3.0	2.1	ZV220S_P432_0160 EZ303U	4.1	6.3	88	16.00	0.56	1.11	31	19	76	2	20	42.4
0.42	2.0	2.1	4.0	1.5	ZV220S_P432_0160 EZ401U	4.1	6.3	88	16.00	0.56	1.11	31	19	76	2	20	42.4
0.56	0.9	0.9	3.9	3.2	ZV220S_P432_0120 EZ302U	2.7	6.3	57	12.00	0.65	1.30	31	19	70	2	20	42.4
0.56	1.1	1.2	5.1	2.5	ZV220S_P432_0120 EZ303U	3.8	6.3	80	12.00	0.65	1.30	31	19	70	2	20	42.4
0.56	1.5	1.6	6.9	1.8	ZV220S_P432_0120 EZ401U	4.1	6.3	88	12.00	0.65	1.30	31	19	70	2	20	42.4
0.56	2.5	2.8	12	1.1	ZV220S_P432_0120 EZ402U	4.1	6.3	88	12.00	0.65	1.30	31	19	70	2	20	42.4
0.67	1.3	1.4	0.9	2.0	ZV220S_P431_0100 EZ401U	3.9	6.3	82	10.00	0.89	1.78	25	12	60	2	20	42.4
0.67	2.0	2.1	1.4	1.3	ZV220S_P431_0100 EZ501U	4.1	6.3	88	10.00	0.89	1.78	25	12	60	2	20	42.4
0.67	2.1	2.4	1.5	1.2	ZV220S_P431_0100 EZ402U	4.1	6.3	88	10.00	0.89	1.78	25	12	60	2	20	42.4
0.83	1.0	1.1	1.0	2.4	ZV220S_P431_0080 EZ401U	3.1	6.3	66	8.000	1.11	2.22	25	12	63	2	20	42.4
0.83	1.6	1.7	1.5	1.5	ZV220S_P431_0080 EZ501U	4.1	6.3	88	8.000	1.11	2.22	25	12	63	2	20	42.4
0.83	1.7	1.9	1.7	1.4	ZV220S_P431_0080 EZ402U	4.1	6.3	88	8.000	1.11	2.22	25	12	63	2	20	42.4
0.95	0.9	1.0	1.1	2.6	ZV220S_P431_0070 EZ401U	2.7	6.3	58	7.000	1.27	2.54	25	12	72	2	20	42.4
0.95	1.4	1.5	1.7	1.7	ZV220S_P431_0070 EZ501U	4.1	6.3	88	7.000	1.27	2.54	25	12	72	2	20	42.4
0.95	1.5	1.7	1.9	1.5	ZV220S_P431_0070 EZ402U	4.1	6.3	88	7.000	1.27	2.54	25	12	72	2	20	42.4
0.95	2.2	2.8	2.7	1.0	ZV220S_P431_0070 EZ404U	4.1	6.3	88	7.000	1.27	2.54	25	12	72	2	20	42.4
1.33	0.6	0.7	1.7	3.2	ZV220S_P431_0050 EZ401U	1.9	6.3	41	5.000	1.64	3.11	25	12	80	2	20	42.4
1.33	1.0	1.1	2.5	2.1	ZV220S_P431_0050 EZ501U	3.7	6.3	78	5.000	1.64	3.11	25	12	80	2	20	42.4
1.33	1.1	1.2	2.8	1.9	ZV220S_P431_0050 EZ402U	3.7	6.3	78	5.000	1.64	3.11	25	12	80	2	20	42.4
1.33	1.6	2.0	4.1	1.3	ZV220S_P431_0050 EZ404U	4.1	6.3	88	5.000	1.64	3.11	25	12	80	2	20	42.4
1.33	1.7	1.8	4.4	1.2	ZV220S_P431_0050 EZ502U	4.1	6.3	88	5.000	1.64	3.11	25	12	80	2	20	42.4
1.67	0.5	0.5	2.2	3.7	ZV220S_P431_0040 EZ401U	1.6	6.3	33	4.000	1.83	3.61	25	12	82	2	20	42.4
1.67	0.8	0.9	3.3	2.4	ZV220S_P431_0040 EZ501U	2.9	6.3	62	4.000	1.83	3.61	25	12	82	2	20	42.4

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV2P4 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 4,1 kN)																	
1.67	0.9	1.0	3.6	2.2	ZV220S_P431_0040 EZ402U	2.9	6.3	62	4.000	1.83	3.61	25	12	82	2	20	42.4
1.67	1.3	1.6	5.3	1.5	ZV220S_P431_0040 EZ404U	4.1	6.3	88	4.000	1.83	3.61	25	12	82	2	20	42.4
1.67	1.4	1.5	5.7	1.4	ZV220S_P431_0040 EZ502U	4.1	6.3	88	4.000	1.83	3.61	25	12	82	2	20	42.4
1.67	1.8	2.0	7.5	1.1	ZV220S_P431_0040 EZ503U	4.1	6.3	88	4.000	1.83	3.61	25	12	82	2	20	42.4
2.22	0.4	0.4	5.2	4.5	ZV220S_P431_0030 EZ401U	1.2	6.3	25	3.000	2.22	4.44	25	12	79	2	20	42.4
2.22	0.6	0.6	8.0	3.0	ZV220S_P431_0030 EZ501U	2.2	6.3	47	3.000	2.22	4.44	25	12	79	2	20	42.4
2.22	0.6	0.7	8.7	2.7	ZV220S_P431_0030 EZ402U	2.2	6.3	47	3.000	2.22	4.44	25	12	79	2	20	42.4
2.22	0.9	1.2	13	1.8	ZV220S_P431_0030 EZ404U	4.0	6.3	84	3.000	2.22	4.44	25	12	79	2	20	42.4
2.22	1.0	1.1	14	1.7	ZV220S_P431_0030 EZ502U	4.1	6.3	88	3.000	2.22	4.44	25	12	79	2	20	42.4
2.22	1.3	1.5	18	1.3	ZV220S_P431_0030 EZ503U	4.1	6.3	88	3.000	2.22	4.44	25	12	79	2	20	42.4
ZV2P4 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 4,1 kN)																	
3.33	1.3	2.1	20	1.2	ZV220S_P431_0030 EZ505U	4.1	6.3	88	3.000	2.22	4.44	25	12	79	2	20	42.4
ZV2P4 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 4,1 kN)																	
0.19	2.8	3.0	0.6	1.1	ZV220S_P432_0700 EZ301U	4.1	6.3	88	70.00	0.16	0.25	31	19	70	2	20	42.4
0.24	2.2	2.4	0.8	1.4	ZV220S_P432_0560 EZ301U	4.1	6.3	88	56.00	0.20	0.32	31	19	62	2	20	42.4
0.27	2.0	2.1	0.8	1.6	ZV220S_P432_0500 EZ301U	4.1	6.3	88	50.00	0.22	0.36	31	19	76	2	20	42.4
0.33	1.6	1.7	0.9	2.0	ZV220S_P432_0400 EZ301U	4.1	6.3	88	40.00	0.28	0.44	31	19	75	2	20	42.4
0.33	2.7	3.0	1.5	1.2	ZV220S_P432_0400 EZ302U	4.1	6.3	88	40.00	0.28	0.44	31	19	75	2	20	42.4
0.38	1.4	1.5	0.9	2.2	ZV220S_P432_0350 EZ301U	4.1	6.3	88	35.00	0.29	0.51	31	19	77	2	20	42.4
0.38	2.4	2.6	1.5	1.3	ZV220S_P432_0350 EZ302U	4.1	6.3	88	35.00	0.29	0.51	31	19	77	2	20	42.4
0.42	1.3	1.4	1.0	2.4	ZV220S_P432_0320 EZ301U	4.0	6.3	85	32.00	0.28	0.56	31	19	62	2	20	42.4
0.42	2.1	2.4	1.7	1.4	ZV220S_P432_0320 EZ302U	4.1	6.3	88	32.00	0.28	0.56	31	19	62	2	20	42.4
0.48	1.1	1.2	1.0	2.6	ZV220S_P432_0280 EZ301U	3.5	6.3	74	28.00	0.36	0.64	31	19	77	2	20	42.4
0.48	1.9	2.1	1.7	1.5	ZV220S_P432_0280 EZ302U	4.1	6.3	88	28.00	0.36	0.64	31	19	77	2	20	42.4
0.48	2.5	2.8	2.2	1.2	ZV220S_P432_0280 EZ303U	4.1	6.3	88	28.00	0.36	0.64	31	19	77	2	20	42.4
0.53	1.0	1.1	1.1	2.8	ZV220S_P432_0250 EZ301U	3.1	6.3	67	25.00	0.40	0.71	31	19	78	2	20	42.4
0.53	1.7	1.9	1.8	1.7	ZV220S_P432_0250 EZ302U	4.1	6.3	88	25.00	0.40	0.71	31	19	78	2	20	42.4
0.53	2.2	2.5	2.4	1.3	ZV220S_P432_0250 EZ303U	4.1	6.3	88	25.00	0.40	0.71	31	19	78	2	20	42.4
0.53	2.6	3.1	2.8	1.1	ZV220S_P432_0250 EZ401U	4.1	6.3	88	25.00	0.40	0.71	31	19	78	2	20	42.4
0.67	0.8	0.9	1.2	3.3	ZV220S_P432_0200 EZ301U	2.5	6.3	53	20.00	0.44	0.89	31	19	77	2	20	42.4
0.67	1.3	1.5	2.0	1.9	ZV220S_P432_0200 EZ302U	4.1	6.3	88	20.00	0.44	0.89	31	19	77	2	20	42.4
0.67	1.8	2.0	2.6	1.5	ZV220S_P432_0200 EZ303U	4.1	6.3	88	20.00	0.44	0.89	31	19	77	2	20	42.4
0.67	2.1	2.5	3.1	1.3	ZV220S_P432_0200 EZ401U	4.1	6.3	88	20.00	0.44	0.89	31	19	77	2	20	42.4
0.83	0.6	0.7	1.5	3.8	ZV220S_P432_0160 EZ301U	2.0	6.3	43	16.00	0.56	1.11	31	19	76	2	20	42.4
0.83	1.1	1.2	2.4	2.2	ZV220S_P432_0160 EZ302U	3.6	6.3	76	16.00	0.56	1.11	31	19	76	2	20	42.4
0.83	1.4	1.6	3.2	1.7	ZV220S_P432_0160 EZ303U	4.1	6.3	88	16.00	0.56	1.11	31	19	76	2	20	42.4
0.83	1.6	2.0	3.7	1.5	ZV220S_P432_0160 EZ401U	4.1	6.3	88	16.00	0.56	1.11	31	19	76	2	20	42.4
1.11	0.5	0.5	2.6	4.6	ZV220S_P432_0120 EZ301U	1.5	6.3	32	12.00	0.65	1.30	31	19	70	2	20	42.4
1.11	0.8	0.9	4.4	2.7	ZV220S_P432_0120 EZ302U	2.7	6.3	57	12.00	0.65	1.30	31	19	70	2	20	42.4
1.11	1.1	1.2	5.8	2.1	ZV220S_P432_0120 EZ303U	3.8	6.3	80	12.00	0.65	1.30	31	19	70	2	20	42.4
1.11	1.2	1.5	6.8	1.8	ZV220S_P432_0120 EZ401U	4.1	6.3	88	12.00	0.65	1.30	31	19	70	2	20	42.4
1.11	1.9	2.6	10	1.2	ZV220S_P432_0120 EZ402U	4.1	6.3	88	12.00	0.65	1.30	31	19	70	2	20	42.4
1.33	1.1	1.3	0.9	2.0	ZV220S_P431_0100 EZ401U	3.9	6.3	82	10.00	0.89	1.78	25	12	60	2	20	42.4
1.33	1.6	2.0	1.4	1.3	ZV220S_P431_0100 EZ501U	4.1	6.3	88	10.00	0.89	1.78	25	12	60	2	20	42.4
1.33	1.6	2.2	1.4	1.3	ZV220S_P431_0100 EZ402U	4.1	6.3	88	10.00	0.89	1.78	25	12	60	2	20	42.4
1.67	0.8	1.0	1.0	2.3	ZV220S_P431_0080 EZ401U	3.1	6.3	66	8.000	1.11	2.22	25	12	63	2	20	42.4
1.67	1.2	1.6	1.5	1.5	ZV220S_P431_0080 EZ501U	4.1	6.3	88	8.000	1.11	2.22	25	12	63	2	20	42.4
1.67	1.3	1.8	1.6	1.5	ZV220S_P431_0080 EZ402U	4.1	6.3	88	8.000	1.11	2.22	25	12	63	2	20	42.4
1.67	1.9	2.9	2.3	1.0	ZV220S_P431_0080 EZ502U	4.1	6.3	88	8.000	1.11	2.22	25	12	63	2	20	42.4
1.91	0.7	0.9	1.1	2.5	ZV220S_P431_0070 EZ401U	2.7	6.3	58	7.000	1.27	2.54	25	12	72	2	20	42.4
1.91	1.1	1.4	1.7	1.7	ZV220S_P431_0070 EZ501U	4.1	6.3	88	7.000	1.27	2.54	25	12	72	2	20	42.4
1.91	1.1	1.6	1.7	1.6	ZV220S_P431_0070 EZ402U	4.1	6.3	88	7.000	1.27	2.54	25	12	72	2	20	42.4
1.91	1.7	2.5	2.6	1.1	ZV220S_P431_0070 EZ502U	4.1	6.3	88	7.000	1.27	2.54	25	12	72	2	20	42.4
2.67	0.5	0.6	1.7	3.1	ZV220S_P431_0050 EZ401U	1.9	6.3	41	5.000	1.64	3.11	25	12	80	2	20	42.4
2.67	0.8	1.0	2.5	2.1	ZV220S_P431_0050 EZ501U	3.7	6.3	78	5.000	1.64	3.11	25	12	80	2	20	42.4
2.67	0.8	1.1	2.6	2.0	ZV220S_P431_0050 EZ402U	3.7	6.3	78	5.000	1.64	3.11	25	12	80	2	20	42.4
2.67	1.2	1.8	3.9	1.4	ZV220S_P431_0050 EZ502U	4.1	6.3	88	5.000	1.64	3.11	25	12	80	2	20	42.4
2.67	1.3	1.9	4.3	1.2	ZV220S_P431_0050 EZ404U	4.1	6.3	88	5.000	1.64	3.11	25	12	80	2	20	42.4
2.67	1.4	2.4	4.6	1.2	ZV220S_P431_0050 EZ503U	4.1	6.3	88	5.000	1.64	3.11	25	12	80	2	20	42.4
3.33	0.4	0.5	2.2	3.6	ZV220S_P431_0040 EZ401U	1.6	6.3	33	4.000	1.83	3.61	25	12	82	2	20	42.4
3.33	0.6	0.8	3.3	2.4	ZV220S_P431_0040 EZ501U	2.9	6.3	62	4.000	1.83	3.61	25	12	82	2	20	42.4
3.33	0.6	0.9	3.4	2.4	ZV220S_P431_0040 EZ402U	2.9	6.3	62	4.000	1.83	3.61	25	12	82	2	20	42.4
3.33	1.0	1.4	5.1	1.6	ZV220S_P431_0040 EZ502U	4.1	6.3	88	4.000	1.83	3.61	25	12	82	2	20	42.4
3.33	1.1	1.5	5.6	1.4	ZV220S_P431_0040 EZ404U	4.1	6.3	88	4.000	1.83	3.61	25	12	82	2	20	42.4
3.33	1.1	1.9	6.0	1.3	ZV220S_P431_0040 EZ503U	4.1	6.3	88	4.000	1.83	3.61	25	12	82	2	20	42.4
4.44	0.3	0.4	5.4	4.4	ZV220S_P431_0030 EZ401U	1.2	6.3	25	3.000	2.22	4.44	25	12	79	2	20	42.4

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV2P4 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 4,1 kN)																	
4.44	0.5	0.6	7.9	3.0	ZV220S_P431_0030 EZ501U	2.2	6.3	47	3.000	2.22	4.44	25	12	79	2	20	42.4
4.44	0.5	0.7	8.2	2.9	ZV220S_P431_0030 EZ402U	2.2	6.3	47	3.000	2.22	4.44	25	12	79	2	20	42.4
4.44	0.7	1.1	12	1.9	ZV220S_P431_0030 EZ502U	4.1	6.3	88	3.000	2.22	4.44	25	12	79	2	20	42.4
4.44	0.8	1.2	14	1.7	ZV220S_P431_0030 EZ404U	4.0	6.3	84	3.000	2.22	4.44	25	12	79	2	20	42.4
4.44	0.9	1.5	14	1.6	ZV220S_P431_0030 EZ503U	4.1	6.3	88	3.000	2.22	4.44	25	12	79	2	20	42.4
ZV2P5 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 6,9 kN)																	
0.21	4.0	4.3	1.2	1.3	ZV225S_P532_0400 EZ401U	6.9	10	180	40.00	0.28	0.56	31	15	111	2	25	53.1
0.24	3.5	3.8	1.0	1.4	ZV225S_P532_0350 EZ401U	6.9	10	180	35.00	0.32	0.64	31	15	116	2	25	53.1
0.26	3.2	3.4	1.2	1.6	ZV225S_P532_0320 EZ401U	6.9	10	180	32.00	0.30	0.61	31	15	96	2	25	53.1
0.30	2.8	3.0	1.3	1.8	ZV225S_P532_0280 EZ401U	6.9	10	180	28.00	0.40	0.79	31	15	114	2	25	53.1
0.30	4.3	4.7	2.0	1.2	ZV225S_P532_0280 EZ501U	6.9	10	180	28.00	0.40	0.79	31	15	114	2	25	53.1
0.30	4.7	5.2	2.2	1.1	ZV225S_P532_0280 EZ402U	6.9	10	180	28.00	0.40	0.79	31	15	114	2	25	53.1
0.33	2.5	2.7	1.2	2.0	ZV225S_P532_0250 EZ401U	6.9	10	180	25.00	0.41	0.78	31	15	116	2	25	53.1
0.33	3.8	4.2	1.9	1.3	ZV225S_P532_0250 EZ501U	6.9	10	180	25.00	0.41	0.78	31	15	116	2	25	53.1
0.33	4.2	4.7	2.1	1.2	ZV225S_P532_0250 EZ402U	6.9	10	180	25.00	0.41	0.78	31	15	116	2	25	53.1
0.42	2.0	2.1	1.4	2.3	ZV225S_P532_0200 EZ401U	6.1	10	160	20.00	0.49	0.97	31	15	116	2	25	53.1
0.42	3.1	3.4	2.2	1.5	ZV225S_P532_0200 EZ501U	6.9	10	180	20.00	0.49	0.97	31	15	116	2	25	53.1
0.42	3.4	3.7	2.4	1.4	ZV225S_P532_0200 EZ402U	6.9	10	180	20.00	0.49	0.97	31	15	116	2	25	53.1
0.52	1.6	1.7	1.8	2.7	ZV225S_P532_0160 EZ401U	4.9	10	130	16.00	0.61	1.22	31	15	115	2	25	53.1
0.52	2.5	2.7	2.8	1.7	ZV225S_P532_0160 EZ501U	6.9	10	180	16.00	0.61	1.22	31	15	115	2	25	53.1
0.52	2.7	3.0	3.0	1.6	ZV225S_P532_0160 EZ402U	6.9	10	180	16.00	0.61	1.22	31	15	115	2	25	53.1
0.52	4.0	4.9	4.5	1.1	ZV225S_P532_0160 EZ404U	6.9	10	180	16.00	0.61	1.22	31	15	115	2	25	53.1
0.52	4.2	4.6	4.8	1.0	ZV225S_P532_0160 EZ502U	6.9	10	180	16.00	0.61	1.22	31	15	115	2	25	53.1
0.69	1.2	1.3	3.8	3.2	ZV225S_P532_0120 EZ401U	3.7	10	97	12.00	0.69	1.39	31	15	110	2	25	53.1
0.69	1.8	2.0	5.9	2.1	ZV225S_P532_0120 EZ501U	6.9	10	180	12.00	0.69	1.39	31	15	110	2	25	53.1
0.69	2.0	2.2	6.4	1.9	ZV225S_P532_0120 EZ402U	6.9	10	180	12.00	0.69	1.39	31	15	110	2	25	53.1
0.69	3.0	3.7	9.5	1.3	ZV225S_P532_0120 EZ404U	6.9	10	180	12.00	0.69	1.39	31	15	110	2	25	53.1
0.69	3.2	3.4	10	1.2	ZV225S_P532_0120 EZ502U	6.9	10	180	12.00	0.69	1.39	31	15	110	2	25	53.1
0.83	1.6	1.7	1.6	2.3	ZV225S_P531_0100 EZ501U	5.9	10	160	10.00	1.03	1.94	23	8	98	2	25	53.1
0.83	2.7	2.9	2.7	1.4	ZV225S_P531_0100 EZ502U	6.9	10	180	10.00	1.03	1.94	23	8	98	2	25	53.1
0.83	2.7	3.0	2.7	1.4	ZV225S_P531_0100 EZ701U	6.9	10	180	10.00	1.03	1.94	23	8	98	2	25	53.1
0.83	3.5	4.1	3.5	1.0	ZV225S_P531_0100 EZ503U	6.9	10	180	10.00	1.03	1.94	23	8	98	2	25	53.1
1.04	1.3	1.4	1.7	2.7	ZV225S_P531_0080 EZ501U	4.7	10	120	8.000	1.29	2.43	23	8	94	2	25	53.1
1.04	2.2	2.3	2.9	1.6	ZV225S_P531_0080 EZ502U	6.9	10	180	8.000	1.29	2.43	23	8	94	2	25	53.1
1.04	2.2	2.4	2.9	1.6	ZV225S_P531_0080 EZ701U	5.9	10	160	8.000	1.29	2.43	23	8	94	2	25	53.1
1.04	2.8	3.2	3.8	1.2	ZV225S_P531_0080 EZ503U	6.9	10	180	8.000	1.29	2.43	23	8	94	2	25	53.1
1.19	1.1	1.2	1.9	2.9	ZV225S_P531_0070 EZ501U	4.1	10	110	7.000	1.47	2.78	23	8	112	2	25	53.1
1.19	1.9	2.0	3.2	1.7	ZV225S_P531_0070 EZ502U	6.9	10	180	7.000	1.47	2.78	23	8	112	2	25	53.1
1.19	1.9	2.1	3.2	1.7	ZV225S_P531_0070 EZ701U	5.1	10	140	7.000	1.47	2.78	23	8	112	2	25	53.1
1.19	2.5	2.8	4.2	1.3	ZV225S_P531_0070 EZ503U	6.9	10	180	7.000	1.47	2.78	23	8	112	2	25	53.1
1.19	3.1	3.7	5.2	1.1	ZV225S_P531_0070 EZ702U	6.9	10	180	7.000	1.47	2.78	23	8	112	2	25	53.1
1.67	0.8	0.9	2.8	3.7	ZV225S_P531_0050 EZ501U	2.9	10	78	5.000	1.94	3.89	23	8	120	2	25	53.1
1.67	1.4	1.5	4.8	2.1	ZV225S_P531_0050 EZ502U	5.7	10	150	5.000	1.94	3.89	23	8	120	2	25	53.1
1.67	1.4	1.5	4.8	2.1	ZV225S_P531_0050 EZ701U	3.7	10	97	5.000	1.94	3.89	23	8	120	2	25	53.1
1.67	1.8	2.0	6.3	1.6	ZV225S_P531_0050 EZ503U	6.9	10	180	5.000	1.94	3.89	23	8	120	2	25	53.1
1.67	2.2	2.6	7.8	1.3	ZV225S_P531_0050 EZ702U	6.9	10	180	5.000	1.94	3.89	23	8	120	2	25	53.1
1.67	2.5	2.9	8.8	1.2	ZV225S_P531_0050 EZ505U	6.9	10	180	5.000	1.94	3.89	23	8	120	2	25	53.1
2.08	0.6	0.7	3.7	4.3	ZV225S_P531_0040 EZ501U	2.3	10	62	4.000	2.08	4.17	23	8	121	2	25	53.1
2.08	1.1	1.2	6.3	2.5	ZV225S_P531_0040 EZ502U	4.5	10	120	4.000	2.08	4.17	23	8	121	2	25	53.1
2.08	1.1	1.2	6.3	2.5	ZV225S_P531_0040 EZ701U	2.9	10	78	4.000	2.08	4.17	23	8	121	2	25	53.1
2.08	1.4	1.6	8.3	1.9	ZV225S_P531_0040 EZ503U	6.3	10	170	4.000	2.08	4.17	23	8	121	2	25	53.1
2.08	1.8	2.1	10	1.5	ZV225S_P531_0040 EZ702U	6.0	10	160	4.000	2.08	4.17	23	8	121	2	25	53.1
2.08	2.0	2.3	11	1.4	ZV225S_P531_0040 EZ505U	6.9	10	180	4.000	2.08	4.17	23	8	121	2	25	53.1
2.08	2.4	3.0	14	1.1	ZV225S_P531_0040 EZ703U	6.9	10	180	4.000	2.08	4.17	23	8	121	2	25	53.1
2.78	0.8	0.9	16	3.0	ZV225S_P531_0030 EZ502U	3.4	10	90	3.000	2.32	4.63	23	8	120	2	25	53.1
2.78	0.8	0.9	16	3.0	ZV225S_P531_0030 EZ701U	2.2	10	58	3.000	2.32	4.63	23	8	120	2	25	53.1
2.78	1.1	1.2	20	2.3	ZV225S_P531_0030 EZ503U	4.7	10	130	3.000	2.32	4.63	23	8	120	2	25	53.1
2.78	1.3	1.6	25	1.9	ZV225S_P531_0030 EZ702U	4.5	10	120	3.000	2.32	4.63	23	8	120	2	25	53.1
2.78	1.5	1.8	28	1.7	ZV225S_P531_0030 EZ505U	6.9	10	180	3.000	2.32	4.63	23	8	120	2	25	53.1
2.78	1.8	2.3	35	1.4	ZV225S_P531_0030 EZ703U	6.9	10	180	3.000	2.32	4.63	23	8	120	2	25	53.1
2.78	2.3	3.3	45	1.0	ZV225S_P531_0030 EZ705U	6.9	10	180	3.000	2.32	4.63	23	8	120	2	25	53.1
ZV2P5 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 6,9 kN)																	
1.56	2.8	4.5	4.2	1.1	ZV225S_P531_0080 EZ505U	6.9	10	180	8.000	1.29	2.43	23	8	94	2	25	53.1
1.79	2.4	3.9	4.7	1.2	ZV225S_P531_0070 EZ505U	6.9	10	180	7.000	1.47	2.78	23	8	112	2	25	53.1
2.50	1.7	2.8	7.1	1.5	ZV225S_P531_0050 EZ505U	6.9	10	180	5.000	1.94	3.89	23	8	120	2	25	53.1
2.50	2.2	3.7	9.0	1.1	ZV225S_P531_0050 EZ703U	6.9	10	180	5.000	1.94	3.89	23	8	120	2	25	53.1

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV2P5 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 6,9 kN)																	
3.13	1.4	2.2	9.3	1.7	ZV225S_P531_0040 EZ505U	6.9	10	180	4.000	2.08	4.17	23	8	121	2	25	53.1
3.13	1.8	2.9	12	1.3	ZV225S_P531_0040 EZ703U	6.9	10	180	4.000	2.08	4.17	23	8	121	2	25	53.1
4.17	1.0	1.7	23	2.1	ZV225S_P531_0030 EZ505U	6.9	10	180	3.000	2.32	4.63	23	8	120	2	25	53.1
4.17	1.3	2.2	29	1.6	ZV225S_P531_0030 EZ703U	6.9	10	180	3.000	2.32	4.63	23	8	120	2	25	53.1
4.17	1.8	3.3	40	1.2	ZV225S_P531_0030 EZ705U	6.9	10	180	3.000	2.32	4.63	23	8	120	2	25	53.1
ZV2P5 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 6,9 kN)																	
0.33	4.1	5.0	0.9	1.2	ZV225S_P532_0500 EZ401U	6.9	10	180	50.00	0.22	0.44	31	15	114	2	25	53.1
0.42	3.3	4.0	1.3	1.4	ZV225S_P532_0400 EZ401U	6.9	10	180	40.00	0.28	0.56	31	15	111	2	25	53.1
0.48	2.9	3.5	1.1	1.5	ZV225S_P532_0350 EZ401U	6.9	10	180	35.00	0.32	0.64	31	15	116	2	25	53.1
0.52	2.6	3.2	1.2	1.6	ZV225S_P532_0320 EZ401U	6.9	10	180	32.00	0.30	0.61	31	15	96	2	25	53.1
0.52	3.9	5.0	1.7	1.1	ZV225S_P532_0320 EZ501U	6.9	10	180	32.00	0.30	0.61	31	15	96	2	25	53.1
0.60	2.3	2.8	1.2	1.8	ZV225S_P532_0280 EZ401U	6.9	10	180	28.00	0.40	0.79	31	15	114	2	25	53.1
0.60	3.4	4.4	1.8	1.2	ZV225S_P532_0280 EZ501U	6.9	10	180	28.00	0.40	0.79	31	15	114	2	25	53.1
0.60	3.5	4.9	1.9	1.2	ZV225S_P532_0280 EZ402U	6.9	10	180	28.00	0.40	0.79	31	15	114	2	25	53.1
0.67	2.1	2.5	1.2	1.9	ZV225S_P532_0250 EZ401U	6.9	10	180	25.00	0.41	0.78	31	15	116	2	25	53.1
0.67	3.0	3.9	1.8	1.3	ZV225S_P532_0250 EZ501U	6.9	10	180	25.00	0.41	0.78	31	15	116	2	25	53.1
0.67	3.1	4.4	1.9	1.3	ZV225S_P532_0250 EZ402U	6.9	10	180	25.00	0.41	0.78	31	15	116	2	25	53.1
0.83	1.6	2.0	1.4	2.2	ZV225S_P532_0200 EZ401U	6.1	10	160	20.00	0.49	0.97	31	15	116	2	25	53.1
0.83	2.4	3.2	2.1	1.5	ZV225S_P532_0200 EZ501U	6.9	10	180	20.00	0.49	0.97	31	15	116	2	25	53.1
0.83	2.5	3.5	2.1	1.5	ZV225S_P532_0200 EZ402U	6.9	10	180	20.00	0.49	0.97	31	15	116	2	25	53.1
1.04	1.3	1.6	1.7	2.6	ZV225S_P532_0160 EZ401U	4.9	10	130	16.00	0.61	1.22	31	15	115	2	25	53.1
1.04	1.9	2.5	2.5	1.7	ZV225S_P532_0160 EZ501U	6.9	10	180	16.00	0.61	1.22	31	15	115	2	25	53.1
1.04	2.0	2.8	2.6	1.7	ZV225S_P532_0160 EZ402U	6.9	10	180	16.00	0.61	1.22	31	15	115	2	25	53.1
1.04	3.0	4.5	3.8	1.1	ZV225S_P532_0160 EZ502U	6.9	10	180	16.00	0.61	1.22	31	15	115	2	25	53.1
1.04	3.3	4.8	4.2	1.0	ZV225S_P532_0160 EZ404U	6.9	10	180	16.00	0.61	1.22	31	15	115	2	25	53.1
1.39	1.0	1.2	3.5	3.1	ZV225S_P532_0120 EZ401U	3.7	10	97	12.00	0.69	1.39	31	15	110	2	25	53.1
1.39	1.5	1.9	5.2	2.1	ZV225S_P532_0120 EZ501U	6.9	10	180	12.00	0.69	1.39	31	15	110	2	25	53.1
1.39	1.5	2.1	5.4	2.0	ZV225S_P532_0120 EZ402U	6.9	10	180	12.00	0.69	1.39	31	15	110	2	25	53.1
1.39	2.2	3.4	8.0	1.4	ZV225S_P532_0120 EZ502U	6.9	10	180	12.00	0.69	1.39	31	15	110	2	25	53.1
1.39	2.5	3.6	8.9	1.2	ZV225S_P532_0120 EZ404U	6.9	10	180	12.00	0.69	1.39	31	15	110	2	25	53.1
1.39	2.7	4.6	9.5	1.2	ZV225S_P532_0120 EZ503U	6.9	10	180	12.00	0.69	1.39	31	15	110	2	25	53.1
1.67	1.2	1.6	1.6	2.3	ZV225S_P531_0100 EZ501U	5.9	10	160	10.00	1.03	1.94	23	8	98	2	25	53.1
1.67	1.9	2.9	2.4	1.5	ZV225S_P531_0100 EZ502U	6.9	10	180	10.00	1.03	1.94	23	8	98	2	25	53.1
1.67	1.9	2.9	2.4	1.5	ZV225S_P531_0100 EZ701U	6.9	10	180	10.00	1.03	1.94	23	8	98	2	25	53.1
1.67	2.3	3.9	2.8	1.3	ZV225S_P531_0100 EZ503U	6.9	10	180	10.00	1.03	1.94	23	8	98	2	25	53.1
1.67	2.6	5.2	3.3	1.1	ZV225S_P531_0100 EZ702U	6.9	10	180	10.00	1.03	1.94	23	8	98	2	25	53.1
2.08	1.0	1.3	1.7	2.7	ZV225S_P531_0080 EZ501U	4.7	10	120	8.000	1.29	2.43	23	8	94	2	25	53.1
2.08	1.5	2.3	2.5	1.8	ZV225S_P531_0080 EZ502U	6.9	10	180	8.000	1.29	2.43	23	8	94	2	25	53.1
2.08	1.5	2.3	2.5	1.8	ZV225S_P531_0080 EZ701U	5.9	10	160	8.000	1.29	2.43	23	8	94	2	25	53.1
2.08	1.8	3.1	3.0	1.5	ZV225S_P531_0080 EZ503U	6.9	10	180	8.000	1.29	2.43	23	8	94	2	25	53.1
2.08	2.1	4.2	3.5	1.3	ZV225S_P531_0080 EZ702U	6.9	10	180	8.000	1.29	2.43	23	8	94	2	25	53.1
2.38	0.9	1.1	1.9	3.0	ZV225S_P531_0070 EZ501U	4.1	10	110	7.000	1.47	2.78	23	8	112	2	25	53.1
2.38	1.3	2.0	2.9	1.9	ZV225S_P531_0070 EZ502U	6.9	10	180	7.000	1.47	2.78	23	8	112	2	25	53.1
2.38	1.3	2.0	2.9	1.9	ZV225S_P531_0070 EZ701U	5.1	10	140	7.000	1.47	2.78	23	8	112	2	25	53.1
2.38	1.6	2.7	3.4	1.6	ZV225S_P531_0070 EZ503U	6.9	10	180	7.000	1.47	2.78	23	8	112	2	25	53.1
2.38	1.8	3.7	3.9	1.4	ZV225S_P531_0070 EZ702U	6.9	10	180	7.000	1.47	2.78	23	8	112	2	25	53.1
3.33	0.6	0.8	2.8	3.7	ZV225S_P531_0050 EZ501U	2.9	10	78	5.000	1.94	3.89	23	8	120	2	25	53.1
3.33	1.0	1.4	4.3	2.4	ZV225S_P531_0050 EZ502U	5.7	10	150	5.000	1.94	3.89	23	8	120	2	25	53.1
3.33	1.0	1.4	4.3	2.4	ZV225S_P531_0050 EZ701U	3.7	10	97	5.000	1.94	3.89	23	8	120	2	25	53.1
3.33	1.1	1.9	5.1	2.0	ZV225S_P531_0050 EZ503U	6.9	10	180	5.000	1.94	3.89	23	8	120	2	25	53.1
3.33	1.3	2.6	5.9	1.7	ZV225S_P531_0050 EZ702U	6.9	10	180	5.000	1.94	3.89	23	8	120	2	25	53.1
4.17	0.5	0.6	3.6	4.3	ZV225S_P531_0040 EZ501U	2.3	10	62	4.000	2.08	4.17	23	8	121	2	25	53.1
4.17	0.8	1.1	5.6	2.8	ZV225S_P531_0040 EZ502U	4.5	10	120	4.000	2.08	4.17	23	8	121	2	25	53.1
4.17	0.8	1.2	5.6	2.8	ZV225S_P531_0040 EZ701U	2.9	10	78	4.000	2.08	4.17	23	8	121	2	25	53.1
4.17	0.9	1.6	6.7	2.4	ZV225S_P531_0040 EZ503U	6.3	10	170	4.000	2.08	4.17	23	8	121	2	25	53.1
4.17	1.1	2.1	7.7	2.0	ZV225S_P531_0040 EZ702U	6.0	10	160	4.000	2.08	4.17	23	8	121	2	25	53.1
ZV3P5 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 6,7 kN)																	
0.18	4.6	5.0	0.9	1.1	ZV318S_P532_0500 EZ401U	6.7	10	190	50.00	0.24	0.48	33	17	106	3	18	57.3
0.23	3.7	4.0	1.2	1.4	ZV318S_P532_0400 EZ401U	6.7	10	190	40.00	0.30	0.60	33	17	104	3	18	57.3
0.26	3.2	3.5	1.0	1.6	ZV318S_P532_0350 EZ401U	6.7	10	190	35.00	0.34	0.69	33	17	108	3	18	57.3
0.28	3.0	3.2	1.2	1.8	ZV318S_P532_0320 EZ401U	6.7	10	190	32.00	0.33	0.66	33	17	88	3	18	57.3
0.28	4.6	5.0	1.8	1.1	ZV318S_P532_0320 EZ501U	6.7	10	190	32.00	0.33	0.66	33	17	88	3	18	57.3
0.32	2.6	2.8	1.3	2.0	ZV318S_P532_0280 EZ401U	6.7	10	190	28.00	0.43	0.86	33	17	106	3	18	57.3
0.32	4.0	4.4	2.0	1.3	ZV318S_P532_0280 EZ501U	6.7	10	190	28.00	0.43	0.86	33	17	106	3	18	57.3
0.32	4.4	4.8	2.2	1.2	ZV318S_P532_0280 EZ402U	6.7	10	190	28.00	0.43	0.86	33	17	106	3	18	57.3
0.36	2.3	2.5	1.2	2.2	ZV318S_P532_0250 EZ401U	6.7	10	190	25.00	0.44	0.84	33	17	108	3	18	57.3

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV3P5 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 6,7 kN)																	
0.36	3.6	3.9	1.9	1.4	ZV318S_P532_0250 EZ501U	6.7	10	190	25.00	0.44	0.84	33	17	108	3	18	57.3
0.36	3.9	4.3	2.1	1.3	ZV318S_P532_0250 EZ402U	6.7	10	190	25.00	0.44	0.84	33	17	108	3	18	57.3
0.45	1.9	2.0	1.4	2.5	ZV318S_P532_0200 EZ401U	5.6	10	160	20.00	0.53	1.05	33	17	109	3	18	57.3
0.45	2.9	3.1	2.2	1.6	ZV318S_P532_0200 EZ501U	6.7	10	190	20.00	0.53	1.05	33	17	109	3	18	57.3
0.45	3.1	3.4	2.4	1.5	ZV318S_P532_0200 EZ402U	6.7	10	190	20.00	0.53	1.05	33	17	109	3	18	57.3
0.56	1.5	1.6	1.8	2.9	ZV318S_P532_0160 EZ401U	4.5	10	130	16.00	0.66	1.31	33	17	107	3	18	57.3
0.56	2.3	2.5	2.8	1.9	ZV318S_P532_0160 EZ501U	6.7	10	190	16.00	0.66	1.31	33	17	107	3	18	57.3
0.56	2.5	2.8	3.0	1.7	ZV318S_P532_0160 EZ402U	6.7	10	190	16.00	0.66	1.31	33	17	107	3	18	57.3
0.56	3.7	4.6	4.5	1.2	ZV318S_P532_0160 EZ404U	6.7	10	190	16.00	0.66	1.31	33	17	107	3	18	57.3
0.56	3.9	4.2	4.8	1.1	ZV318S_P532_0160 EZ502U	6.7	10	190	16.00	0.66	1.31	33	17	107	3	18	57.3
0.75	1.1	1.2	3.8	3.5	ZV318S_P532_0120 EZ401U	3.4	10	97	12.00	0.75	1.50	33	17	102	3	18	57.3
0.75	1.7	1.9	5.9	2.3	ZV318S_P532_0120 EZ501U	6.4	10	180	12.00	0.75	1.50	33	17	102	3	18	57.3
0.75	1.9	2.1	6.4	2.1	ZV318S_P532_0120 EZ402U	6.4	10	180	12.00	0.75	1.50	33	17	102	3	18	57.3
0.75	2.7	3.4	9.5	1.4	ZV318S_P532_0120 EZ404U	6.7	10	190	12.00	0.75	1.50	33	17	102	3	18	57.3
0.75	2.9	3.2	10	1.3	ZV318S_P532_0120 EZ502U	6.7	10	190	12.00	0.75	1.50	33	17	102	3	18	57.3
0.75	3.9	4.4	13	1.0	ZV318S_P532_0120 EZ503U	6.7	10	190	12.00	0.75	1.50	33	17	102	3	18	57.3
0.90	1.5	1.6	1.6	2.5	ZV318S_P531_0100 EZ501U	5.4	10	160	10.00	1.11	2.10	25	8	90	3	18	57.3
0.90	2.5	2.7	2.7	1.5	ZV318S_P531_0100 EZ502U	6.7	10	190	10.00	1.11	2.10	25	8	90	3	18	57.3
0.90	2.5	2.8	2.7	1.5	ZV318S_P531_0100 EZ701U	6.7	10	190	10.00	1.11	2.10	25	8	90	3	18	57.3
0.90	3.3	3.8	3.5	1.1	ZV318S_P531_0100 EZ503U	6.7	10	190	10.00	1.11	2.10	25	8	90	3	18	57.3
1.13	1.2	1.3	1.7	2.9	ZV318S_P531_0080 EZ501U	4.3	10	120	8.000	1.39	2.63	25	8	86	3	18	57.3
1.13	2.0	2.2	2.9	1.7	ZV318S_P531_0080 EZ502U	6.7	10	190	8.000	1.39	2.63	25	8	86	3	18	57.3
1.13	2.0	2.2	2.9	1.7	ZV318S_P531_0080 EZ701U	5.4	10	160	8.000	1.39	2.63	25	8	86	3	18	57.3
1.13	2.6	3.0	3.8	1.3	ZV318S_P531_0080 EZ503U	6.7	10	190	8.000	1.39	2.63	25	8	86	3	18	57.3
1.13	3.3	3.9	4.7	1.1	ZV318S_P531_0080 EZ702U	6.7	10	190	8.000	1.39	2.63	25	8	86	3	18	57.3
1.29	1.0	1.1	1.9	3.2	ZV318S_P531_0070 EZ501U	3.8	10	110	7.000	1.59	3.00	25	8	104	3	18	57.3
1.29	1.8	1.9	3.2	1.9	ZV318S_P531_0070 EZ502U	6.7	10	190	7.000	1.59	3.00	25	8	104	3	18	57.3
1.29	1.8	2.0	3.2	1.9	ZV318S_P531_0070 EZ701U	4.7	10	140	7.000	1.59	3.00	25	8	104	3	18	57.3
1.29	2.3	2.6	4.2	1.4	ZV318S_P531_0070 EZ503U	6.7	10	190	7.000	1.59	3.00	25	8	104	3	18	57.3
1.29	2.8	3.4	5.2	1.2	ZV318S_P531_0070 EZ702U	6.7	10	190	7.000	1.59	3.00	25	8	104	3	18	57.3
1.29	3.2	3.8	5.9	1.0	ZV318S_P531_0070 EZ505U	6.7	10	190	7.000	1.59	3.00	25	8	104	3	18	57.3
1.80	0.7	0.8	2.8	4.0	ZV318S_P531_0050 EZ501U	2.7	10	78	5.000	2.10	4.20	25	8	113	3	18	57.3
1.80	1.3	1.4	4.8	2.3	ZV318S_P531_0050 EZ502U	5.2	10	150	5.000	2.10	4.20	25	8	113	3	18	57.3
1.80	1.3	1.4	4.8	2.3	ZV318S_P531_0050 EZ701U	3.4	10	97	5.000	2.10	4.20	25	8	113	3	18	57.3
1.80	1.6	1.9	6.3	1.8	ZV318S_P531_0050 EZ503U	6.7	10	190	5.000	2.10	4.20	25	8	113	3	18	57.3
1.80	2.0	2.4	7.8	1.4	ZV318S_P531_0050 EZ702U	6.7	10	190	5.000	2.10	4.20	25	8	113	3	18	57.3
1.80	2.3	2.7	8.8	1.3	ZV318S_P531_0050 EZ505U	6.7	10	190	5.000	2.10	4.20	25	8	113	3	18	57.3
1.80	2.8	3.5	11	1.1	ZV318S_P531_0050 EZ703U	6.7	10	190	5.000	2.10	4.20	25	8	113	3	18	57.3
2.25	0.6	0.6	3.7	4.7	ZV318S_P531_0040 EZ501U	2.2	10	62	4.000	2.25	4.50	25	8	114	3	18	57.3
2.25	1.0	1.1	6.3	2.7	ZV318S_P531_0040 EZ502U	4.2	10	120	4.000	2.25	4.50	25	8	114	3	18	57.3
2.25	1.0	1.1	6.3	2.7	ZV318S_P531_0040 EZ701U	2.7	10	78	4.000	2.25	4.50	25	8	114	3	18	57.3
2.25	1.3	1.5	8.3	2.1	ZV318S_P531_0040 EZ503U	5.8	10	170	4.000	2.25	4.50	25	8	114	3	18	57.3
2.25	1.6	2.0	10	1.7	ZV318S_P531_0040 EZ702U	5.6	10	160	4.000	2.25	4.50	25	8	114	3	18	57.3
2.25	1.8	2.2	11	1.5	ZV318S_P531_0040 EZ505U	6.7	10	190	4.000	2.25	4.50	25	8	114	3	18	57.3
2.25	2.2	2.8	14	1.2	ZV318S_P531_0040 EZ703U	6.7	10	190	4.000	2.25	4.50	25	8	114	3	18	57.3
3.00	0.8	0.8	16	3.3	ZV318S_P531_0030 EZ502U	3.1	10	90	3.000	2.50	5.00	25	8	113	3	18	57.3
3.00	0.8	0.8	16	3.3	ZV318S_P531_0030 EZ701U	2.0	10	58	3.000	2.50	5.00	25	8	113	3	18	57.3
3.00	1.0	1.1	20	2.5	ZV318S_P531_0030 EZ503U	4.4	10	130	3.000	2.50	5.00	25	8	113	3	18	57.3
3.00	1.2	1.5	25	2.0	ZV318S_P531_0030 EZ702U	4.2	10	120	3.000	2.50	5.00	25	8	113	3	18	57.3
3.00	1.4	1.6	28	1.8	ZV318S_P531_0030 EZ505U	6.7	10	190	3.000	2.50	5.00	25	8	113	3	18	57.3
3.00	1.7	2.1	35	1.5	ZV318S_P531_0030 EZ703U	6.6	10	190	3.000	2.50	5.00	25	8	113	3	18	57.3
3.00	2.2	3.1	45	1.1	ZV318S_P531_0030 EZ705U	6.7	10	190	3.000	2.50	5.00	25	8	113	3	18	57.3
ZV3P5 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 6,7 kN)																	
1.69	2.6	4.1	4.2	1.2	ZV318S_P531_0080 EZ505U	6.7	10	190	8.000	1.39	2.63	25	8	86	3	18	57.3
1.93	2.3	3.6	4.7	1.3	ZV318S_P531_0070 EZ505U	6.7	10	190	7.000	1.59	3.00	25	8	104	3	18	57.3
2.70	1.6	2.6	7.1	1.6	ZV318S_P531_0050 EZ505U	6.7	10	190	5.000	2.10	4.20	25	8	113	3	18	57.3
2.70	2.0	3.4	9.0	1.3	ZV318S_P531_0050 EZ703U	6.7	10	190	5.000	2.10	4.20	25	8	113	3	18	57.3
3.38	1.3	2.1	9.3	1.8	ZV318S_P531_0040 EZ505U	6.7	10	190	4.000	2.25	4.50	25	8	114	3	18	57.3
3.38	1.6	2.7	12	1.5	ZV318S_P531_0040 EZ703U	6.7	10	190	4.000	2.25	4.50	25	8	114	3	18	57.3
3.38	2.2	4.1	16	1.1	ZV318S_P531_0040 EZ705U	6.7	10	190	4.000	2.25	4.50	25	8	114	3	18	57.3
4.50	1.0	1.6	23	2.2	ZV318S_P531_0030 EZ505U	6.7	10	190	3.000	2.50	5.00	25	8	113	3	18	57.3
4.50	1.2	2.0	29	1.8	ZV318S_P531_0030 EZ703U	6.6	10	190	3.000	2.50	5.00	25	8	113	3	18	57.3
4.50	1.7	3.0	40	1.3	ZV318S_P531_0030 EZ705U	6.7	10	190	3.000	2.50	5.00	25	8	113	3	18	57.3
ZV3P5 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 6,7 kN)																	
0.36	3.8	4.6	0.9	1.3	ZV318S_P532_0500 EZ401U	6.7	10	190	50.00	0.24	0.48	33	17	106	3	18	57.3
0.45	3.1	3.7	1.3	1.5	ZV318S_P532_0400 EZ401U	6.7	10	190	40.00	0.30	0.60	33	17	104	3	18	57.3

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV3P5 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 6,7 kN)																	
0.51	2.7	3.2	1.1	1.7	ZV318S_P532_0350 EZ401U	6.7	10	190	35.00	0.34	0.69	33	17	108	3	18	57.3
0.51	3.9	5.1	1.6	1.1	ZV318S_P532_0350 EZ501U	6.7	10	190	35.00	0.34	0.69	33	17	108	3	18	57.3
0.56	2.4	3.0	1.2	1.8	ZV318S_P532_0320 EZ401U	6.7	10	190	32.00	0.33	0.66	33	17	88	3	18	57.3
0.56	3.6	4.7	1.7	1.2	ZV318S_P532_0320 EZ501U	6.7	10	190	32.00	0.33	0.66	33	17	88	3	18	57.3
0.64	2.1	2.6	1.2	1.9	ZV318S_P532_0280 EZ401U	6.7	10	190	28.00	0.43	0.86	33	17	106	3	18	57.3
0.64	3.2	4.1	1.8	1.3	ZV318S_P532_0280 EZ501U	6.7	10	190	28.00	0.43	0.86	33	17	106	3	18	57.3
0.64	3.2	4.5	1.9	1.3	ZV318S_P532_0280 EZ402U	6.7	10	190	28.00	0.43	0.86	33	17	106	3	18	57.3
0.72	1.9	2.3	1.2	2.1	ZV318S_P532_0250 EZ401U	6.7	10	190	25.00	0.44	0.84	33	17	108	3	18	57.3
0.72	2.8	3.6	1.8	1.4	ZV318S_P532_0250 EZ501U	6.7	10	190	25.00	0.44	0.84	33	17	108	3	18	57.3
0.72	2.9	4.1	1.9	1.4	ZV318S_P532_0250 EZ402U	6.7	10	190	25.00	0.44	0.84	33	17	108	3	18	57.3
0.90	1.5	1.9	1.4	2.4	ZV318S_P532_0200 EZ401U	5.6	10	160	20.00	0.53	1.05	33	17	109	3	18	57.3
0.90	2.3	2.9	2.1	1.6	ZV318S_P532_0200 EZ501U	6.7	10	190	20.00	0.53	1.05	33	17	109	3	18	57.3
0.90	2.3	3.2	2.1	1.6	ZV318S_P532_0200 EZ402U	6.7	10	190	20.00	0.53	1.05	33	17	109	3	18	57.3
1.13	1.2	1.5	1.7	2.8	ZV318S_P532_0160 EZ401U	4.5	10	130	16.00	0.66	1.31	33	17	107	3	18	57.3
1.13	1.8	2.3	2.5	1.9	ZV318S_P532_0160 EZ501U	6.7	10	190	16.00	0.66	1.31	33	17	107	3	18	57.3
1.13	1.9	2.6	2.6	1.8	ZV318S_P532_0160 EZ402U	6.7	10	190	16.00	0.66	1.31	33	17	107	3	18	57.3
1.13	2.8	4.1	3.8	1.2	ZV318S_P532_0160 EZ502U	6.7	10	190	16.00	0.66	1.31	33	17	107	3	18	57.3
1.13	3.1	4.5	4.2	1.1	ZV318S_P532_0160 EZ404U	6.7	10	190	16.00	0.66	1.31	33	17	107	3	18	57.3
1.50	0.9	1.1	3.5	3.4	ZV318S_P532_0120 EZ401U	3.4	10	97	12.00	0.75	1.50	33	17	102	3	18	57.3
1.50	1.4	1.8	5.2	2.3	ZV318S_P532_0120 EZ501U	6.4	10	180	12.00	0.75	1.50	33	17	102	3	18	57.3
1.50	1.4	1.9	5.4	2.2	ZV318S_P532_0120 EZ402U	6.4	10	180	12.00	0.75	1.50	33	17	102	3	18	57.3
1.50	2.1	3.1	8.0	1.5	ZV318S_P532_0120 EZ502U	6.7	10	190	12.00	0.75	1.50	33	17	102	3	18	57.3
1.50	2.3	3.3	8.9	1.4	ZV318S_P532_0120 EZ404U	6.7	10	190	12.00	0.75	1.50	33	17	102	3	18	57.3
1.50	2.5	4.2	9.5	1.3	ZV318S_P532_0120 EZ503U	6.7	10	190	12.00	0.75	1.50	33	17	102	3	18	57.3
1.80	1.2	1.5	1.6	2.5	ZV318S_P531_0100 EZ501U	5.4	10	160	10.00	1.11	2.10	25	8	90	3	18	57.3
1.80	1.8	2.6	2.4	1.7	ZV318S_P531_0100 EZ502U	6.7	10	190	10.00	1.11	2.10	25	8	90	3	18	57.3
1.80	1.8	2.7	2.4	1.7	ZV318S_P531_0100 EZ701U	6.7	10	190	10.00	1.11	2.10	25	8	90	3	18	57.3
1.80	2.1	3.6	2.8	1.4	ZV318S_P531_0100 EZ503U	6.7	10	190	10.00	1.11	2.10	25	8	90	3	18	57.3
1.80	2.4	4.8	3.3	1.2	ZV318S_P531_0100 EZ702U	6.7	10	190	10.00	1.11	2.10	25	8	90	3	18	57.3
2.25	0.9	1.2	1.7	3.0	ZV318S_P531_0080 EZ501U	4.3	10	120	8.000	1.39	2.63	25	8	86	3	18	57.3
2.25	1.4	2.1	2.5	1.9	ZV318S_P531_0080 EZ502U	6.7	10	190	8.000	1.39	2.63	25	8	86	3	18	57.3
2.25	1.4	2.1	2.5	1.9	ZV318S_P531_0080 EZ701U	5.4	10	160	8.000	1.39	2.63	25	8	86	3	18	57.3
2.25	1.7	2.9	3.0	1.6	ZV318S_P531_0080 EZ503U	6.7	10	190	8.000	1.39	2.63	25	8	86	3	18	57.3
2.25	2.0	3.9	3.5	1.4	ZV318S_P531_0080 EZ702U	6.7	10	190	8.000	1.39	2.63	25	8	86	3	18	57.3
2.57	0.8	1.0	1.9	3.2	ZV318S_P531_0070 EZ501U	3.8	10	110	7.000	1.59	3.00	25	8	104	3	18	57.3
2.57	1.2	1.8	2.9	2.1	ZV318S_P531_0070 EZ502U	6.7	10	190	7.000	1.59	3.00	25	8	104	3	18	57.3
2.57	1.2	1.9	2.9	2.1	ZV318S_P531_0070 EZ701U	4.7	10	140	7.000	1.59	3.00	25	8	104	3	18	57.3
2.57	1.5	2.5	3.4	1.8	ZV318S_P531_0070 EZ503U	6.7	10	190	7.000	1.59	3.00	25	8	104	3	18	57.3
2.57	1.7	3.4	3.9	1.5	ZV318S_P531_0070 EZ702U	6.7	10	190	7.000	1.59	3.00	25	8	104	3	18	57.3
3.60	0.6	0.7	2.8	4.0	ZV318S_P531_0050 EZ501U	2.7	10	78	5.000	2.10	4.20	25	8	113	3	18	57.3
3.60	0.9	1.3	4.3	2.6	ZV318S_P531_0050 EZ502U	5.2	10	150	5.000	2.10	4.20	25	8	113	3	18	57.3
3.60	0.9	1.3	4.3	2.6	ZV318S_P531_0050 EZ701U	3.4	10	97	5.000	2.10	4.20	25	8	113	3	18	57.3
3.60	1.0	1.8	5.1	2.2	ZV318S_P531_0050 EZ503U	6.7	10	190	5.000	2.10	4.20	25	8	113	3	18	57.3
3.60	1.2	2.4	5.9	1.9	ZV318S_P531_0050 EZ702U	6.7	10	190	5.000	2.10	4.20	25	8	113	3	18	57.3
4.50	0.5	0.6	3.6	4.7	ZV318S_P531_0040 EZ501U	2.2	10	62	4.000	2.25	4.50	25	8	114	3	18	57.3
4.50	0.7	1.1	5.6	3.1	ZV318S_P531_0040 EZ502U	4.2	10	120	4.000	2.25	4.50	25	8	114	3	18	57.3
4.50	0.7	1.1	5.6	3.1	ZV318S_P531_0040 EZ701U	2.7	10	78	4.000	2.25	4.50	25	8	114	3	18	57.3
4.50	0.8	1.4	6.7	2.6	ZV318S_P531_0040 EZ503U	5.8	10	170	4.000	2.25	4.50	25	8	114	3	18	57.3
4.50	1.0	1.9	7.7	2.2	ZV318S_P531_0040 EZ702U	5.6	10	160	4.000	2.25	4.50	25	8	114	3	18	57.3
ZV3P7 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 11 kN)																	
0.20	6.5	7.1	0.8	1.1	ZV322S_P732_0560 EZ501U	11	14	380	56.00	0.24	0.46	41	20	121	3	22	70.0
0.22	5.8	6.4	0.8	1.2	ZV322S_P732_0500 EZ501U	11	14	380	50.00	0.27	0.51	41	20	130	3	22	70.0
0.28	4.7	5.1	1.0	1.3	ZV322S_P732_0400 EZ501U	11	14	380	40.00	0.34	0.64	41	20	130	3	22	70.0
0.31	4.1	4.5	0.9	1.5	ZV322S_P732_0350 EZ501U	11	14	380	35.00	0.39	0.73	41	20	132	3	22	70.0
0.34	3.7	4.1	1.1	1.6	ZV322S_P732_0320 EZ501U	11	14	380	32.00	0.34	0.69	41	20	121	3	22	70.0
0.39	3.3	3.6	1.0	1.7	ZV322S_P732_0280 EZ501U	11	14	380	28.00	0.49	0.92	41	20	132	3	22	70.0
0.44	2.9	3.2	1.2	1.8	ZV322S_P732_0250 EZ501U	11	14	380	25.00	0.51	1.03	41	20	132	3	22	70.0
0.44	5.0	5.4	2.0	1.1	ZV322S_P732_0250 EZ502U	11	14	380	25.00	0.51	1.03	41	20	132	3	22	70.0
0.44	5.0	5.6	2.0	1.1	ZV322S_P732_0250 EZ701U	11	14	380	25.00	0.51	1.03	41	20	132	3	22	70.0
0.55	2.3	2.6	1.4	2.1	ZV322S_P732_0200 EZ501U	8.7	14	300	20.00	0.55	1.10	41	20	133	3	22	70.0
0.55	4.0	4.3	2.5	1.2	ZV322S_P732_0200 EZ502U	11	14	380	20.00	0.55	1.10	41	20	133	3	22	70.0
0.55	4.0	4.5	2.5	1.2	ZV322S_P732_0200 EZ701U	11	14	380	20.00	0.55	1.10	41	20	133	3	22	70.0
0.69	1.9	2.0	1.6	2.5	ZV322S_P732_0160 EZ501U	6.9	14	240	16.00	0.69	1.38	41	20	133	3	22	70.0
0.69	3.2	3.5	2.8	1.4	ZV322S_P732_0160 EZ502U	11	14	380	16.00	0.69	1.38	41	20	133	3	22	70.0
0.69	3.2	3.6	2.8	1.4	ZV322S_P732_0160 EZ701U	8.7	14	300	16.00	0.69	1.38	41	20	133	3	22	70.0
0.69	4.2	4.8	3.7	1.1	ZV322S_P732_0160 EZ503U	11	14	380	16.00	0.69	1.38	41	20	133	3	22	70.0

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV3P7 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 11 kN)																	
0.92	1.4	1.5	2.9	3.0	ZV322S_P732_0120 EZ501U	5.2	14	180	12.00	0.76	1.53	41	20	128	3	22	70.0
0.92	2.4	2.6	5.0	1.7	ZV322S_P732_0120 EZ502U	10	14	350	12.00	0.76	1.53	41	20	128	3	22	70.0
0.92	2.4	2.7	5.0	1.7	ZV322S_P732_0120 EZ701U	6.5	14	230	12.00	0.76	1.53	41	20	128	3	22	70.0
0.92	3.2	3.6	6.5	1.3	ZV322S_P732_0120 EZ503U	11	14	380	12.00	0.76	1.53	41	20	128	3	22	70.0
0.92	3.9	4.7	8.0	1.1	ZV322S_P732_0120 EZ702U	11	14	380	12.00	0.76	1.53	41	20	128	3	22	70.0
1.10	2.1	2.3	1.7	1.9	ZV322S_P731_0100 EZ701U	5.5	14	190	10.00	1.10	2.20	31	10	117	3	22	70.0
1.10	3.3	4.0	2.7	1.2	ZV322S_P731_0100 EZ702U	11	14	380	10.00	1.10	2.20	31	10	117	3	22	70.0
1.38	1.6	1.8	1.7	2.2	ZV322S_P731_0080 EZ701U	4.4	14	160	8.000	1.38	2.75	31	10	123	3	22	70.0
1.38	2.7	3.2	2.8	1.4	ZV322S_P731_0080 EZ702U	9.1	14	320	8.000	1.38	2.75	31	10	123	3	22	70.0
1.38	3.7	4.6	3.9	1.0	ZV322S_P731_0080 EZ703U	11	14	380	8.000	1.38	2.75	31	10	123	3	22	70.0
1.57	1.4	1.6	1.8	2.4	ZV322S_P731_0070 EZ701U	3.9	14	140	7.000	1.57	3.14	31	10	128	3	22	70.0
1.57	2.3	2.8	3.0	1.5	ZV322S_P731_0070 EZ702U	8.0	14	280	7.000	1.57	3.14	31	10	128	3	22	70.0
1.57	3.2	4.0	4.1	1.1	ZV322S_P731_0070 EZ703U	11	14	380	7.000	1.57	3.14	31	10	128	3	22	70.0
2.20	1.0	1.1	2.8	3.1	ZV322S_P731_0050 EZ701U	2.8	14	97	5.000	1.98	4.03	31	10	136	3	22	70.0
2.20	1.7	2.0	4.5	1.9	ZV322S_P731_0050 EZ702U	5.7	14	200	5.000	1.98	4.03	31	10	136	3	22	70.0
2.20	2.3	2.9	6.2	1.4	ZV322S_P731_0050 EZ703U	9.0	14	320	5.000	1.98	4.03	31	10	136	3	22	70.0
2.20	3.0	4.2	7.9	1.1	ZV322S_P731_0050 EZ705U	11	14	380	5.000	1.98	4.03	31	10	136	3	22	70.0
2.20	3.1	5.1	8.3	1.0	ZV322S_P731_0050 EZ802U	11	14	380	5.000	1.98	4.03	31	10	136	3	22	70.0
2.75	0.8	0.9	3.6	3.5	ZV322S_P731_0040 EZ701U	2.2	14	78	4.000	2.29	4.58	31	10	139	3	22	70.0
2.75	1.3	1.6	5.9	2.2	ZV322S_P731_0040 EZ702U	4.5	14	160	4.000	2.29	4.58	31	10	139	3	22	70.0
2.75	1.8	2.3	8.0	1.6	ZV322S_P731_0040 EZ703U	7.2	14	250	4.000	2.29	4.58	31	10	139	3	22	70.0
2.75	2.4	3.3	10	1.2	ZV322S_P731_0040 EZ705U	11	14	380	4.000	2.29	4.58	31	10	139	3	22	70.0
2.75	2.5	4.1	11	1.2	ZV322S_P731_0040 EZ802U	11	14	380	4.000	2.29	4.58	31	10	139	3	22	70.0
3.67	0.6	0.7	8.0	4.3	ZV322S_P731_0030 EZ701U	1.7	14	58	3.000	2.69	4.89	31	10	138	3	22	70.0
3.67	1.0	1.2	13	2.6	ZV322S_P731_0030 EZ702U	3.4	14	120	3.000	2.69	4.89	31	10	138	3	22	70.0
3.67	1.4	1.7	18	1.9	ZV322S_P731_0030 EZ703U	5.4	14	190	3.000	2.69	4.89	31	10	138	3	22	70.0
3.67	1.8	2.5	23	1.5	ZV322S_P731_0030 EZ705U	8.6	14	300	3.000	2.69	4.89	31	10	138	3	22	70.0
3.67	1.9	3.1	24	1.4	ZV322S_P731_0030 EZ802U	8.3	14	290	3.000	2.69	4.89	31	10	138	3	22	70.0
3.67	2.2	4.0	29	1.2	ZV322S_P731_0030 EZ803U	11	14	380	3.000	2.69	4.89	31	10	138	3	22	70.0
ZV3P7 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 11 kN)																	
1.38	3.1	5.0	6.6	1.2	ZV322S_P732_0120 EZ505U	11	14	380	12.00	0.76	1.53	41	20	128	3	22	70.0
1.65	3.4	5.5	3.1	1.0	ZV322S_P731_0100 EZ703U	11	14	380	10.00	1.10	2.20	31	10	117	3	22	70.0
2.06	2.3	7.6	2.8	1.4	ZV322S_P731_0080 EZ802U	11	14	380	8.000	1.38	2.75	31	10	123	3	22	70.0
2.06	2.7	4.4	3.2	1.2	ZV322S_P731_0080 EZ703U	11	14	380	8.000	1.38	2.75	31	10	123	3	22	70.0
2.36	2.0	6.7	3.0	1.5	ZV322S_P731_0070 EZ802U	11	14	380	7.000	1.57	3.14	31	10	128	3	22	70.0
2.36	2.3	3.9	3.5	1.3	ZV322S_P731_0070 EZ703U	11	14	380	7.000	1.57	3.14	31	10	128	3	22	70.0
3.30	1.5	4.8	4.5	1.9	ZV322S_P731_0050 EZ802U	11	14	380	5.000	1.98	4.03	31	10	136	3	22	70.0
3.30	1.7	2.8	5.2	1.6	ZV322S_P731_0050 EZ703U	9.0	14	320	5.000	1.98	4.03	31	10	136	3	22	70.0
3.30	2.3	4.2	7.0	1.2	ZV322S_P731_0050 EZ705U	11	14	380	5.000	1.98	4.03	31	10	136	3	22	70.0
4.13	1.2	3.8	5.9	2.2	ZV322S_P731_0040 EZ802U	11	14	380	4.000	2.29	4.58	31	10	139	3	22	70.0
4.13	1.3	2.2	6.8	1.9	ZV322S_P731_0040 EZ703U	7.2	14	250	4.000	2.29	4.58	31	10	139	3	22	70.0
4.13	1.8	3.3	9.2	1.4	ZV322S_P731_0040 EZ705U	11	14	380	4.000	2.29	4.58	31	10	139	3	22	70.0
ZV3P7 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 11 kN)																	
0.39	5.2	6.7	0.8	1.1	ZV322S_P732_0560 EZ501U	11	14	380	56.00	0.24	0.46	41	20	121	3	22	70.0
0.44	4.6	6.0	0.7	1.2	ZV322S_P732_0500 EZ501U	11	14	380	50.00	0.27	0.51	41	20	130	3	22	70.0
0.55	3.7	4.8	1.0	1.3	ZV322S_P732_0400 EZ501U	11	14	380	40.00	0.34	0.64	41	20	130	3	22	70.0
0.63	3.2	4.2	0.9	1.5	ZV322S_P732_0350 EZ501U	11	14	380	35.00	0.39	0.73	41	20	132	3	22	70.0
0.69	3.0	3.8	1.1	1.6	ZV322S_P732_0320 EZ501U	11	14	380	32.00	0.34	0.69	41	20	121	3	22	70.0
0.69	4.5	6.8	1.6	1.0	ZV322S_P732_0320 EZ502U	11	14	380	32.00	0.34	0.69	41	20	121	3	22	70.0
0.69	4.5	6.9	1.6	1.0	ZV322S_P732_0320 EZ701U	11	14	380	32.00	0.34	0.69	41	20	121	3	22	70.0
0.79	2.6	3.3	1.0	1.7	ZV322S_P732_0280 EZ501U	11	14	380	28.00	0.49	0.92	41	20	132	3	22	70.0
0.79	4.0	5.9	1.5	1.1	ZV322S_P732_0280 EZ502U	11	14	380	28.00	0.49	0.92	41	20	132	3	22	70.0
0.79	4.0	6.0	1.5	1.1	ZV322S_P732_0280 EZ701U	11	14	380	28.00	0.49	0.92	41	20	132	3	22	70.0
0.88	2.3	3.0	1.1	1.8	ZV322S_P732_0250 EZ501U	11	14	380	25.00	0.51	1.03	41	20	132	3	22	70.0
0.88	3.5	5.3	1.7	1.2	ZV322S_P732_0250 EZ502U	11	14	380	25.00	0.51	1.03	41	20	132	3	22	70.0
0.88	3.5	5.4	1.7	1.2	ZV322S_P732_0250 EZ701U	11	14	380	25.00	0.51	1.03	41	20	132	3	22	70.0
0.88	4.2	7.2	2.0	1.0	ZV322S_P732_0250 EZ503U	11	14	380	25.00	0.51	1.03	41	20	132	3	22	70.0
1.10	1.8	2.4	1.3	2.1	ZV322S_P732_0200 EZ501U	8.7	14	300	20.00	0.55	1.10	41	20	133	3	22	70.0
1.10	2.8	4.2	1.9	1.4	ZV322S_P732_0200 EZ502U	11	14	380	20.00	0.55	1.10	41	20	133	3	22	70.0
1.10	2.8	4.3	1.9	1.4	ZV322S_P732_0200 EZ701U	11	14	380	20.00	0.55	1.10	41	20	133	3	22	70.0
1.10	3.4	5.8	2.3	1.2	ZV322S_P732_0200 EZ503U	11	14	380	20.00	0.55	1.10	41	20	133	3	22	70.0
1.10	3.9	7.8	2.7	1.0	ZV322S_P732_0200 EZ702U	11	14	380	20.00	0.55	1.10	41	20	133	3	22	70.0
1.38	1.5	1.9	1.4	2.5	ZV322S_P732_0160 EZ501U	6.9	14	240	16.00	0.69	1.38	41	20	133	3	22	70.0
1.38	2.3	3.4	2.2	1.6	ZV322S_P732_0160 EZ502U	11	14	380	16.00	0.69	1.38	41	20	133	3	22	70.0
1.38	2.3	3.4	2.2	1.6	ZV322S_P732_0160 EZ701U	8.7	14	300	16.00	0.69	1.38	41	20	133	3	22	70.0
1.38	2.7	4.6	2.6	1.4	ZV322S_P732_0160 EZ503U	11	14	380	16.00	0.69	1.38	41	20	133	3	22	70.0

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV3P7 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 11 kN)																	
1.38	3.1	6.2	3.0	1.2	ZV322S_P732_0160 EZ702U	11	14	380	16.00	0.69	1.38	41	20	133	3	22	70.0
2.20	1.4	2.2	1.5	2.2	ZV322S_P731_0100 EZ701U	5.5	14	190	10.00	1.10	2.20	31	10	117	3	22	70.0
2.20	2.0	4.0	2.0	1.6	ZV322S_P731_0100 EZ702U	11	14	380	10.00	1.10	2.20	31	10	117	3	22	70.0
2.75	1.2	1.8	1.5	2.5	ZV322S_P731_0080 EZ701U	4.4	14	160	8.000	1.38	2.75	31	10	123	3	22	70.0
2.75	1.6	3.2	2.1	1.8	ZV322S_P731_0080 EZ702U	9.1	14	320	8.000	1.38	2.75	31	10	123	3	22	70.0
3.14	1.0	1.5	1.6	2.8	ZV322S_P731_0070 EZ701U	3.9	14	140	7.000	1.57	3.14	31	10	128	3	22	70.0
3.14	1.4	2.8	2.3	2.0	ZV322S_P731_0070 EZ702U	8.0	14	280	7.000	1.57	3.14	31	10	128	3	22	70.0
ZV4P7 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 10 kN)																	
0.21	6.0	6.5	0.8	1.2	ZV418S_P732_0560 EZ501U	10	15	400	56.00	0.26	0.50	44	22	112	4	18	76.4
0.24	5.3	5.8	0.8	1.3	ZV418S_P732_0500 EZ501U	10	15	400	50.00	0.30	0.56	44	22	121	4	18	76.4
0.30	4.3	4.7	1.0	1.5	ZV418S_P732_0400 EZ501U	10	15	400	40.00	0.37	0.70	44	22	121	4	18	76.4
0.34	3.7	4.1	0.9	1.6	ZV418S_P732_0350 EZ501U	10	15	400	35.00	0.42	0.80	44	22	122	4	18	76.4
0.38	3.4	3.7	1.1	1.7	ZV418S_P732_0320 EZ501U	10	15	400	32.00	0.38	0.75	44	22	112	4	18	76.4
0.38	5.9	6.4	1.9	1.0	ZV418S_P732_0320 EZ502U	10	15	400	32.00	0.38	0.75	44	22	112	4	18	76.4
0.38	5.9	6.6	1.9	1.0	ZV418S_P732_0320 EZ701U	10	15	400	32.00	0.38	0.75	44	22	112	4	18	76.4
0.43	3.0	3.3	1.0	1.9	ZV418S_P732_0280 EZ501U	10	15	400	28.00	0.53	1.00	44	22	123	4	18	76.4
0.43	5.2	5.6	1.8	1.1	ZV418S_P732_0280 EZ502U	10	15	400	28.00	0.53	1.00	44	22	123	4	18	76.4
0.43	5.2	5.8	1.8	1.1	ZV418S_P732_0280 EZ701U	10	15	400	28.00	0.53	1.00	44	22	123	4	18	76.4
0.48	2.7	2.9	1.2	2.0	ZV418S_P732_0250 EZ501U	9.9	15	380	25.00	0.56	1.12	44	22	123	4	18	76.4
0.48	4.6	5.0	2.0	1.2	ZV418S_P732_0250 EZ502U	10	15	400	25.00	0.56	1.12	44	22	123	4	18	76.4
0.48	4.6	5.2	2.0	1.2	ZV418S_P732_0250 EZ701U	10	15	400	25.00	0.56	1.12	44	22	123	4	18	76.4
0.60	2.1	2.3	1.4	2.4	ZV418S_P732_0200 EZ501U	8.0	15	300	20.00	0.60	1.20	44	22	123	4	18	76.4
0.60	3.7	4.0	2.5	1.4	ZV418S_P732_0200 EZ502U	10	15	400	20.00	0.60	1.20	44	22	123	4	18	76.4
0.60	3.7	4.1	2.5	1.4	ZV418S_P732_0200 EZ701U	9.9	15	380	20.00	0.60	1.20	44	22	123	4	18	76.4
0.60	4.8	5.5	3.2	1.0	ZV418S_P732_0200 EZ503U	10	15	400	20.00	0.60	1.20	44	22	123	4	18	76.4
0.75	1.7	1.9	1.6	2.7	ZV418S_P732_0160 EZ501U	6.4	15	240	16.00	0.75	1.50	44	22	124	4	18	76.4
0.75	2.9	3.2	2.8	1.6	ZV418S_P732_0160 EZ502U	10	15	400	16.00	0.75	1.50	44	22	124	4	18	76.4
0.75	2.9	3.3	2.8	1.6	ZV418S_P732_0160 EZ701U	8.0	15	300	16.00	0.75	1.50	44	22	124	4	18	76.4
0.75	3.9	4.4	3.7	1.2	ZV418S_P732_0160 EZ503U	10	15	400	16.00	0.75	1.50	44	22	124	4	18	76.4
1.00	1.3	1.4	2.9	3.3	ZV418S_P732_0120 EZ501U	4.8	15	180	12.00	0.83	1.67	44	22	119	4	18	76.4
1.00	2.2	2.4	5.0	1.9	ZV418S_P732_0120 EZ502U	9.3	15	350	12.00	0.83	1.67	44	22	119	4	18	76.4
1.00	2.2	2.5	5.0	1.9	ZV418S_P732_0120 EZ701U	6.0	15	230	12.00	0.83	1.67	44	22	119	4	18	76.4
1.00	2.9	3.3	6.5	1.5	ZV418S_P732_0120 EZ503U	10	15	400	12.00	0.83	1.67	44	22	119	4	18	76.4
1.00	3.6	4.3	8.0	1.2	ZV418S_P732_0120 EZ702U	10	15	400	12.00	0.83	1.67	44	22	119	4	18	76.4
1.00	4.0	4.8	9.0	1.1	ZV418S_P732_0120 EZ505U	10	15	400	12.00	0.83	1.67	44	22	119	4	18	76.4
1.20	1.9	2.1	1.7	2.1	ZV418S_P731_0100 EZ701U	5.1	15	190	10.00	1.20	2.40	33	11	108	4	18	76.4
1.20	3.0	3.7	2.7	1.3	ZV418S_P731_0100 EZ702U	10	15	400	10.00	1.20	2.40	33	11	108	4	18	76.4
1.50	1.5	1.7	1.7	2.5	ZV418S_P731_0080 EZ701U	4.1	15	160	8.000	1.50	3.00	33	11	113	4	18	76.4
1.50	2.4	2.9	2.8	1.5	ZV418S_P731_0080 EZ702U	8.3	15	320	8.000	1.50	3.00	33	11	113	4	18	76.4
1.50	3.4	4.2	3.9	1.1	ZV418S_P731_0080 EZ703U	10	15	400	8.000	1.50	3.00	33	11	113	4	18	76.4
1.71	1.3	1.5	1.8	2.7	ZV418S_P731_0070 EZ701U	3.6	15	140	7.000	1.71	3.43	33	11	119	4	18	76.4
1.71	2.1	2.6	3.0	1.7	ZV418S_P731_0070 EZ702U	7.3	15	280	7.000	1.71	3.43	33	11	119	4	18	76.4
1.71	2.9	3.7	4.1	1.2	ZV418S_P731_0070 EZ703U	10	15	400	7.000	1.71	3.43	33	11	119	4	18	76.4
2.40	0.9	1.1	2.8	3.4	ZV418S_P731_0050 EZ701U	2.5	15	97	5.000	2.16	4.40	33	11	127	4	18	76.4
2.40	1.5	1.8	4.5	2.1	ZV418S_P731_0050 EZ702U	5.2	15	200	5.000	2.16	4.40	33	11	127	4	18	76.4
2.40	2.1	2.6	6.2	1.5	ZV418S_P731_0050 EZ703U	8.3	15	320	5.000	2.16	4.40	33	11	127	4	18	76.4
2.40	2.7	3.8	7.9	1.2	ZV418S_P731_0050 EZ705U	10	15	400	5.000	2.16	4.40	33	11	127	4	18	76.4
2.40	2.8	4.7	8.3	1.1	ZV418S_P731_0050 EZ802U	10	15	400	5.000	2.16	4.40	33	11	127	4	18	76.4
3.00	0.8	0.8	3.6	3.9	ZV418S_P731_0040 EZ701U	2.0	15	78	4.000	2.50	5.00	33	11	130	4	18	76.4
3.00	1.2	1.5	5.9	2.4	ZV418S_P731_0040 EZ702U	4.2	15	160	4.000	2.50	5.00	33	11	130	4	18	76.4
3.00	1.7	2.1	8.0	1.8	ZV418S_P731_0040 EZ703U	6.6	15	250	4.000	2.50	5.00	33	11	130	4	18	76.4
3.00	2.2	3.1	10	1.4	ZV418S_P731_0040 EZ705U	10	15	400	4.000	2.50	5.00	33	11	130	4	18	76.4
3.00	2.3	3.8	11	1.3	ZV418S_P731_0040 EZ802U	10	15	390	4.000	2.50	5.00	33	11	130	4	18	76.4
3.00	2.7	4.9	13	1.1	ZV418S_P731_0040 EZ803U	10	15	400	4.000	2.50	5.00	33	11	130	4	18	76.4
4.00	0.6	0.6	8.0	4.8	ZV418S_P731_0030 EZ701U	1.5	15	58	3.000	2.93	5.33	33	11	129	4	18	76.4
4.00	0.9	1.1	13	2.9	ZV418S_P731_0030 EZ702U	3.1	15	120	3.000	2.93	5.33	33	11	129	4	18	76.4
4.00	1.3	1.6	18	2.1	ZV418S_P731_0030 EZ703U	5.0	15	190	3.000	2.93	5.33	33	11	129	4	18	76.4
4.00	1.6	2.3	23	1.7	ZV418S_P731_0030 EZ705U	7.9	15	300	3.000	2.93	5.33	33	11	129	4	18	76.4
4.00	1.7	2.8	24	1.6	ZV418S_P731_0030 EZ802U	7.6	15	290	3.000	2.93	5.33	33	11	129	4	18	76.4
4.00	2.0	3.7	29	1.3	ZV418S_P731_0030 EZ803U	10	15	400	3.000	2.93	5.33	33	11	129	4	18	76.4
ZV4P7 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 10 kN)																	
1.13	3.8	6.1	3.6	1.1	ZV418S_P732_0160 EZ505U	10	15	400	16.00	0.75	1.50	44	22	124	4	18	76.4
1.50	2.8	4.6	6.6	1.3	ZV418S_P732_0120 EZ505U	10	15	400	12.00	0.83	1.67	44	22	119	4	18	76.4
1.50	3.6	6.0	8.4	1.0	ZV418S_P732_0120 EZ703U	10	15	400	12.00	0.83	1.67	44	22	119	4	18	76.4
1.80	3.1	5.1	3.1	1.1	ZV418S_P731_0100 EZ703U	10	15	400	10.00	1.20	2.40	33	11	108	4	18	76.4
2.25	2.1	7.0	2.8	1.5	ZV418S_P731_0080 EZ802U	10	15	400	8.000	1.50	3.00	33	11	113	4	18	76.4

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV4P7 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 10 kN)																	
2.25	2.5	4.1	3.2	1.3	ZV418S_P731_0080 EZ703U	10	15	400	8.000	1.50	3.00	33	11	113	4	18	76.4
2.57	1.9	6.1	3.0	1.7	ZV418S_P731_0070 EZ802U	10	15	400	7.000	1.71	3.43	33	11	119	4	18	76.4
2.57	2.2	3.6	3.5	1.4	ZV418S_P731_0070 EZ703U	10	15	400	7.000	1.71	3.43	33	11	119	4	18	76.4
2.57	2.9	5.3	4.7	1.1	ZV418S_P731_0070 EZ705U	10	15	400	7.000	1.71	3.43	33	11	119	4	18	76.4
3.60	1.3	4.4	4.5	2.1	ZV418S_P731_0050 EZ802U	10	15	400	5.000	2.16	4.40	33	11	127	4	18	76.4
3.60	1.5	2.5	5.2	1.8	ZV418S_P731_0050 EZ703U	8.3	15	320	5.000	2.16	4.40	33	11	127	4	18	76.4
3.60	2.1	3.8	7.0	1.3	ZV418S_P731_0050 EZ705U	10	15	400	5.000	2.16	4.40	33	11	127	4	18	76.4
4.50	1.1	3.5	5.9	2.4	ZV418S_P731_0040 EZ802U	10	15	390	4.000	2.50	5.00	33	11	130	4	18	76.4
4.50	1.2	2.0	6.8	2.1	ZV418S_P731_0040 EZ703U	6.6	15	250	4.000	2.50	5.00	33	11	130	4	18	76.4
4.50	1.7	3.0	9.2	1.5	ZV418S_P731_0040 EZ705U	10	15	400	4.000	2.50	5.00	33	11	130	4	18	76.4
ZV4P7 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 10 kN)																	
0.34	5.9	7.7	0.6	1.0	ZV418S_P732_0700 EZ501U	10	15	400	70.00	0.21	0.40	44	22	116	4	18	76.4
0.43	4.7	6.1	0.8	1.2	ZV418S_P732_0560 EZ501U	10	15	400	56.00	0.26	0.50	44	22	112	4	18	76.4
0.48	4.2	5.5	0.7	1.3	ZV418S_P732_0500 EZ501U	10	15	400	50.00	0.30	0.56	44	22	121	4	18	76.4
0.60	3.4	4.4	1.0	1.5	ZV418S_P732_0400 EZ501U	10	15	400	40.00	0.37	0.70	44	22	121	4	18	76.4
0.69	3.0	3.8	0.9	1.6	ZV418S_P732_0350 EZ501U	10	15	400	35.00	0.42	0.80	44	22	122	4	18	76.4
0.69	4.5	6.8	1.4	1.1	ZV418S_P732_0350 EZ502U	10	15	400	35.00	0.42	0.80	44	22	122	4	18	76.4
0.69	4.5	6.9	1.4	1.1	ZV418S_P732_0350 EZ701U	10	15	400	35.00	0.42	0.80	44	22	122	4	18	76.4
0.75	2.7	3.5	1.1	1.7	ZV418S_P732_0320 EZ501U	10	15	400	32.00	0.38	0.75	44	22	112	4	18	76.4
0.75	4.1	6.2	1.6	1.1	ZV418S_P732_0320 EZ502U	10	15	400	32.00	0.38	0.75	44	22	112	4	18	76.4
0.75	4.1	6.3	1.6	1.1	ZV418S_P732_0320 EZ701U	10	15	400	32.00	0.38	0.75	44	22	112	4	18	76.4
0.86	2.4	3.1	1.0	1.9	ZV418S_P732_0280 EZ501U	10	15	400	28.00	0.53	1.00	44	22	123	4	18	76.4
0.86	3.6	5.4	1.5	1.2	ZV418S_P732_0280 EZ502U	10	15	400	28.00	0.53	1.00	44	22	123	4	18	76.4
0.86	3.6	5.5	1.5	1.2	ZV418S_P732_0280 EZ701U	10	15	400	28.00	0.53	1.00	44	22	123	4	18	76.4
0.86	4.3	7.4	1.8	1.0	ZV418S_P732_0280 EZ503U	10	15	400	28.00	0.53	1.00	44	22	123	4	18	76.4
0.96	2.1	2.7	1.1	2.0	ZV418S_P732_0250 EZ501U	9.9	15	380	25.00	0.56	1.12	44	22	123	4	18	76.4
0.96	3.2	4.8	1.7	1.3	ZV418S_P732_0250 EZ502U	10	15	400	25.00	0.56	1.12	44	22	123	4	18	76.4
0.96	3.2	4.9	1.7	1.3	ZV418S_P732_0250 EZ701U	10	15	400	25.00	0.56	1.12	44	22	123	4	18	76.4
0.96	3.9	6.6	2.0	1.1	ZV418S_P732_0250 EZ503U	10	15	400	25.00	0.56	1.12	44	22	123	4	18	76.4
1.20	1.7	2.2	1.3	2.4	ZV418S_P732_0200 EZ501U	8.0	15	300	20.00	0.60	1.20	44	22	123	4	18	76.4
1.20	2.6	3.9	1.9	1.5	ZV418S_P732_0200 EZ502U	10	15	400	20.00	0.60	1.20	44	22	123	4	18	76.4
1.20	2.6	3.9	1.9	1.5	ZV418S_P732_0200 EZ701U	9.9	15	380	20.00	0.60	1.20	44	22	123	4	18	76.4
1.20	3.1	5.3	2.3	1.3	ZV418S_P732_0200 EZ503U	10	15	400	20.00	0.60	1.20	44	22	123	4	18	76.4
1.20	3.6	7.1	2.7	1.1	ZV418S_P732_0200 EZ702U	10	15	400	20.00	0.60	1.20	44	22	123	4	18	76.4
1.50	1.4	1.8	1.4	2.8	ZV418S_P732_0160 EZ501U	6.4	15	240	16.00	0.75	1.50	44	22	124	4	18	76.4
1.50	2.1	3.1	2.2	1.8	ZV418S_P732_0160 EZ502U	10	15	400	16.00	0.75	1.50	44	22	124	4	18	76.4
1.50	2.1	3.1	2.2	1.8	ZV418S_P732_0160 EZ701U	8.0	15	300	16.00	0.75	1.50	44	22	124	4	18	76.4
1.50	2.5	4.2	2.6	1.5	ZV418S_P732_0160 EZ503U	10	15	400	16.00	0.75	1.50	44	22	124	4	18	76.4
1.50	2.9	5.7	3.0	1.3	ZV418S_P732_0160 EZ702U	10	15	400	16.00	0.75	1.50	44	22	124	4	18	76.4
2.40	1.3	2.0	1.5	2.4	ZV418S_P731_0100 EZ701U	5.1	15	190	10.00	1.20	2.40	33	11	108	4	18	76.4
2.40	1.8	3.6	2.0	1.7	ZV418S_P731_0100 EZ702U	10	15	400	10.00	1.20	2.40	33	11	108	4	18	76.4
3.00	1.1	1.6	1.5	2.8	ZV418S_P731_0080 EZ701U	4.1	15	160	8.000	1.50	3.00	33	11	113	4	18	76.4
3.00	1.5	2.9	2.1	2.0	ZV418S_P731_0080 EZ702U	8.3	15	320	8.000	1.50	3.00	33	11	113	4	18	76.4
3.43	0.9	1.4	1.6	3.1	ZV418S_P731_0070 EZ701U	3.6	15	140	7.000	1.71	3.43	33	11	119	4	18	76.4
3.43	1.3	2.5	2.3	2.2	ZV418S_P731_0070 EZ702U	7.3	15	280	7.000	1.71	3.43	33	11	119	4	18	76.4

8.3 Dimensional drawings

This chapter shows you the dimensions of rack and pinion drives with EZ synchronous servo motors.

Dimension az in the tables of dimensions applies to Atlanta gear racks. In general: az = ½ d0 + h0 + x*mn

The pinion of the rack and pinion drive is helical (left-hand 19° 31 42"). The pinion gearing quality is 5.

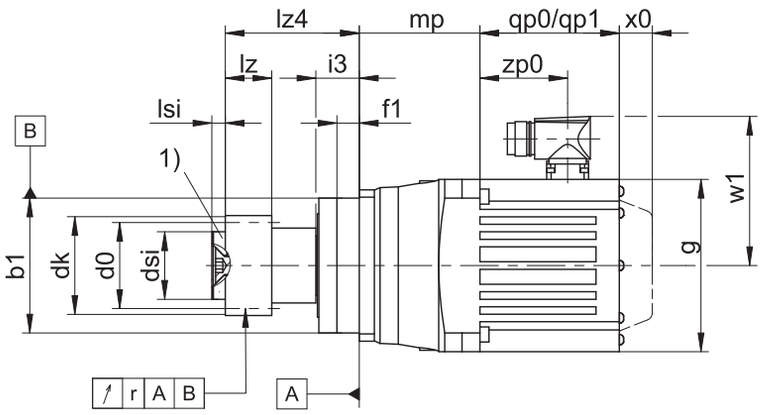
Dimensions can exceed the specifications of ISO 2768-mK due to casting tolerances or accumulation of individual tolerances.

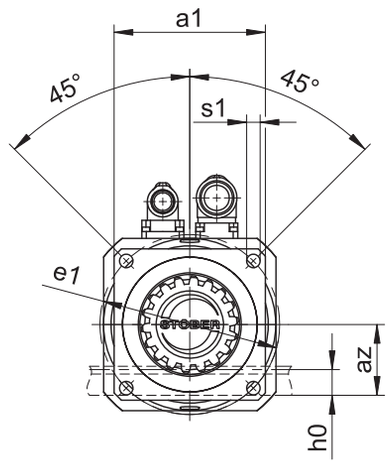
We reserve the right to make dimensional changes due to ongoing technical development.

You can download 3D models of our standard drives at http://configurator.stoeber.de.

Combination options and the dimensions of forced ventilated geared motors can also be found at http://configurator.stoeber.de.

8.3.1 Pinion position E





qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x0	Applies to encoders using an optical measuring method.	w1	Different for the One Cable Solution (OCS), see the chapter [▶ 13.4]
1)	Axial locking (optional)	–	The radial runout specification applies only to the reinforced bearing D.

Dimensions of gear units

Type	mn	□a1	az	Øb1	Ød0	Ødk	Ødsi	Øe1	f1	h0	i3	lz	lz4	lsi	r	Øs1	x
ZV216SEP3_	2	72	39.98	60_{h6}	33.95	39.81	25	75	7.5	22	18	26	49.5	4	0.025	5.5	0.5
ZV220SEP4_	2	76	44.02	70_{h6}	42.44	47.90	30	85	7.5	22	18	26	57.5	6	0.025	6.6	0.4
ZV225SEP5_	2	101	49.33	90_{h6}	53.05	58.52	45	120	15.0	22	28	26	89.5	8	0.030	9.0	0.4
ZV318SEP5_	3	101	55.55	90_{h6}	57.30	65.01	45	120	15.0	26	28	31	89.5	8	0.030	9.0	0.3
ZV322SEP7_	3	144	62.21	130_{h6}	70.03	78.35	55	165	3.5	26	28	31	113.5	10	0.035	11.0	0.4
ZV418SEP7_	4	144	74.40	130_{h6}	76.40	86.77	55	165	3.5	35	28	41	113.5	10	0.035	11.0	0.3

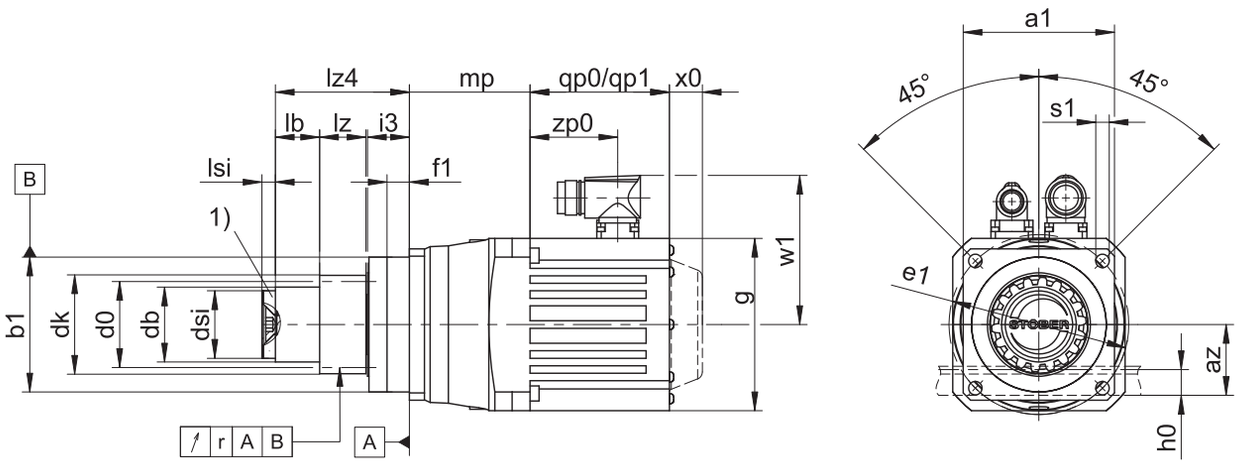
Dimensions of motors

Type	□g	qp0	qp1	w1	x0	zp0
EZ301U	72	90	130.0	55.5	21	54.5
EZ302U	72	112	152.0	55.5	21	76.5
EZ303U	72	134	174.0	55.5	21	98.5
EZ401U	98	98	146.5	91.0	22	56.0
EZ402U	98	123	171.5	91.0	22	81.0
EZ404U	98	173	221.5	91.0	22	131.0
EZ501U	115	93	147.5	100.0	22	58.5
EZ502U	115	118	172.5	100.0	22	83.5
EZ503U	115	143	197.5	100.0	22	108.5
EZ505U	115	193	247.5	100.0	22	158.5
EZ701U	145	102	161.0	115.0	22	64.0
EZ702U	145	127	186.0	115.0	22	89.0
EZ703U	145	152	211.0	115.0	22	114.0
EZ705U	145	207	266.0	134.0	22	165.0
EZ802U	190	197	274.0	156.5	22	143.0
EZ803U	190	238	315.0	156.5	22	184.0
EZ805U	190	320	397.0	156.5	22	266.0

Dimensions of geared motors

Type	EZ3	EZ4	EZ5	EZ7	EZ8
	mp	mp	mp	mp	mp
ZV_P331_	68.5	65.0	–	–	–
ZV_P332_	103.0	–	–	–	–
ZV_P431_	–	80.5	80.0	–	–
ZV_P432_	117.5	114.0	–	–	–
ZV_P531_	–	–	80.5	83.5	–
ZV_P532_	–	122.5	122.0	–	–
ZV_P731_	–	–	–	100.5	110.5
ZV_P732_	–	–	148.5	151.5	–

8.3.2 Pinion position S



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x0	Applies to encoders using an optical measuring method.	w1	Different for the One Cable Solution (OCS), see the chapter [▷ 13.4]
1)	Axial locking (optional)	–	The radial runout specification applies only to the reinforced bearing D.

Dimensions of gear units

Type	mn	□a1	az	Øb1	Ød0	Ødb	Ødk	Ødsi	Øe1	f1	h0	i3	lb	lz	lz4	lsi	r	Øs1	x
ZV216SSP3_	2	72	39.98	60_{h6}	34.0	30	39.81	25	75	7.5	22	18	4.5	26	49.5	4	0.025	5.5	0.5
ZV220SSP4_	2	76	44.02	70_{h6}	42.4	38	47.90	30	85	7.5	22	18	12.5	26	57.5	6	0.025	6.6	0.4
ZV225SSP5_	2	101	49.33	90_{h6}	53.1	50	58.52	45	120	15.0	22	28	34.5	26	89.5	8	0.030	9.0	0.4
ZV318SSP5_	3	101	55.55	90_{h6}	57.3	50	65.01	45	120	15.0	26	28	29.5	31	89.5	8	0.030	9.0	0.3
ZV322SSP7_	3	144	62.21	130_{h6}	70.0	62	78.35	55	165	3.5	26	28	53.5	31	113.5	10	0.035	11.0	0.4
ZV418SSP7_	4	144	74.40	130_{h6}	76.4	62	86.77	55	165	3.5	35	28	43.5	41	113.5	10	0.035	11.0	0.3

Dimensions of motors

Type	□g	qp0	qp1	w1	x0	zp0
EZ301U	72	90	130.0	55.5	21	54.5
EZ302U	72	112	152.0	55.5	21	76.5
EZ303U	72	134	174.0	55.5	21	98.5
EZ401U	98	98	146.5	91.0	22	56.0
EZ402U	98	123	171.5	91.0	22	81.0
EZ404U	98	173	221.5	91.0	22	131.0
EZ501U	115	93	147.5	100.0	22	58.5
EZ502U	115	118	172.5	100.0	22	83.5
EZ503U	115	143	197.5	100.0	22	108.5
EZ505U	115	193	247.5	100.0	22	158.5
EZ701U	145	102	161.0	115.0	22	64.0
EZ702U	145	127	186.0	115.0	22	89.0
EZ703U	145	152	211.0	115.0	22	114.0
EZ705U	145	207	266.0	134.0	22	165.0
EZ802U	190	197	274.0	156.5	22	143.0
EZ803U	190	238	315.0	156.5	22	184.0
EZ805U	190	320	397.0	156.5	22	266.0

Dimensions of geared motors

Type	EZ3	EZ4	EZ5	EZ7	EZ8
	mp	mp	mp	mp	mp
ZV_P331_	68.5	65.0	–	–	–
ZV_P332_	103.0	–	–	–	–
ZV_P431_	–	80.5	80.0	–	–
ZV_P432_	117.5	114.0	–	–	–
ZV_P531_	–	–	80.5	83.5	–
ZV_P532_	–	122.5	122.0	–	–
ZV_P731_	–	–	–	100.5	110.5
ZV_P732_	–	–	148.5	151.5	–

8.4 Type designation

This chapter shows you an explanation of the type designation with the associated options.

Additional ordering information not included in the type designation can be found at the end of the chapter.

Example code

Z	V	3	22	S	S	P	7	3	1	S	P	S	S	0050	EZ802U

Explanation

Code	Designation	Design
Z	Type	Rack and pinion drive
V	Design	Plug-on pinion
3	Module	m_n = 3 (example)
22	Number of teeth	z = 22 (example)
S	Toothing	Helical (left-hand 19° 31' 42")
E	Pinion position	Shaft end
S		Shaft shoulder
P	Type	Planetary gear unit
7	Size	7 (example)
3	Generation	Generation 3
1	Stages	Single-stage
2		Two-stage
S	Housing	Standard
P	Shaft	Solid shaft with feather key
S	Bearing	Standard bearing
D		Axially reinforced bearing
S	Backlash	Standard
R		Reduced
0050	Transmission ratio (i x 10)	i = 5 (example)
EZ802U	Motor	EZ synchronous servo motor

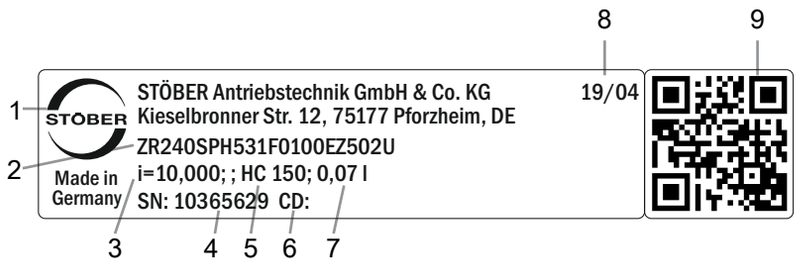
To complete the type designation, also specify the following in your order:

- A detailed type designation of the motor, see chapter [▶ 13]
- Radial shaft seal rings at the output, made of NBR or FKM (optional), see chapter [▶ 8.6.2]
- Position of the plug connectors, see chapter [▶ 8.5.5]
- For axial locking (optional), see the chapter [▶ 8.3]
- Reverse operation of the output shaft from ±20° to ±90° for horizontal installation on request

In this catalog, you will find all information on rack and pinion drives with EZ synchronous servo motors.
All input options available on request can be found in the chapter [▶ 8.5.1].

8.4.1 Nameplate

An example geared motor nameplate is explained in the figure below.



Code	Designation
1	Name of manufacturer
2	Type designation
3	Gear ratio of the gear unit
4	Serial number of the gear unit
5	Lubricant specification
6	Customer-specific data
7	Lubricant fill volume
8	Date of manufacture (year/calendar week)
9	QR code (link to product information)

8.4.1.1 Supporting documents

You can view or download supporting documents for the product by reading off the serial number on the nameplate of the product and entering it at the following address online:
https://id.stober.com

Alternatively, you can use a suitable mobile device to scan in the QR code on the nameplate of the product in order to be linked to the supporting documents.

8.5 Product description

8.5.1 Input options

This chapter shows you all available input options:

EZ synchronous servo motor	Motor adapter	KX right-angle input with MF motor adapter	K right-angle input with ME motor adapter	MB motor adapter	LM Lean motor
					
http://www.stoeber.de/en/Z_EZ	http://www.stoeber.de/en/ZVPME	On request	On request	On request	On request

8.5.2 Gear rack

The technical data specified in the Selection tables chapter applies only to gear rack combinations with the following characteristics:

The pinion of the rack and pinion drive is case-hardened and helical (left-hand 19° 31' 42"). The pinion gearing quality is 6.

The corresponding gear rack must have a right-hand design (19° 31' 42") and possess the following characteristics:

Module m_n [mm]	Minimum gear rack quality	Gear rack material
2 – 4	8	C45 inductively hardened

Also note the project configuration of the gear rack on the Atlanta pages.

8.5.2.1 Pinion position

The pinion can be fastened to the shaft in two different attachment positions:

- The toothing is flush with the shaft end (Pos. E)
- The toothing is flush with the shaft shoulder (Pos. S: For higher permitted feed forces, see the Selection tables chapter)

Please specify the desired attachment position when placing your order.

8.5.3 Installation conditions

The specified torques and forces only apply when gear units are fastened on the machine side using screws of strength class 12.9. In addition, the gear housings must be adjusted at the pilot. The machine-side fit must be H7.

8.5.4 Lubricants

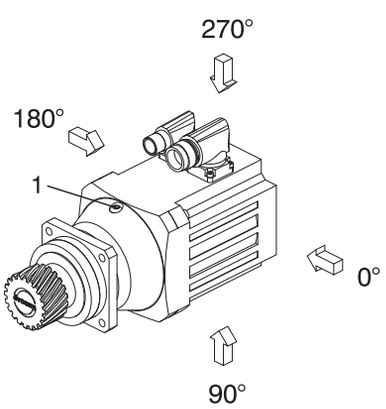
STOBER fills the gear units with the amount and type of lubricant specified on the nameplate.

You will receive lubricants for use in the food industry upon request.

8.5.4.1 Rack and pinion drive lubrication

Make sure the rack and pinion drive has permanent lubrication with the lubricants specified in the Atlanta product catalog.

8.5.5 Position of the plug connectors



In the standard version, the plug connectors are attached in the 270° position (relative to the oil drain plug (1) of the planetary gear unit). Indicate variations for your rack and pinion drive in the order.

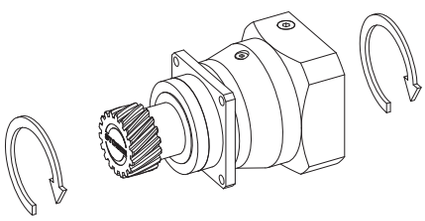
Note that the plug connectors also rotate when the gear rack is rotated to a different position.

8.5.6 Other product features

Feature	Value
Max. permitted gear unit temperature (on the surface of the gear unit)	≤ 90 °C
Paint	Black RAL 9005
(ATEX) Directive 2014/34/EU (Option)	Not suitable.
Protection class: [1]	
Planetary gear units	IP65
Motor	IP56, optionally IP66
Pinion/gear rack	IPXX

8.5.7 Direction of rotation

The input and output rotate in the same direction.



8.6 Project configuration

Project your drives using our SERVOsoft designing software. Download SERVOsoft for free at https://www.stoeber.de/en/ServoSoft.

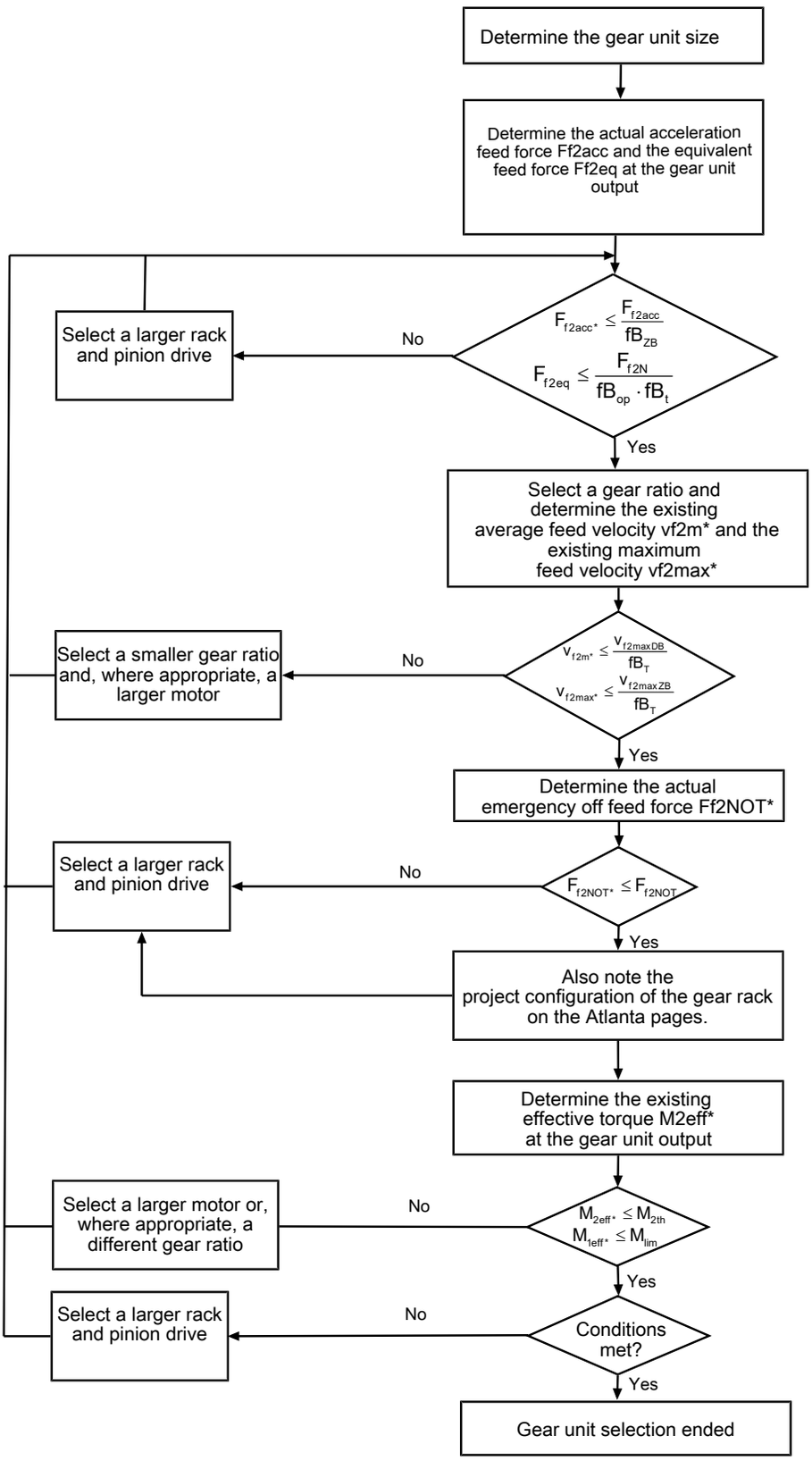
Observe the limit conditions in this chapter to ensure a safe design for your drives.

The formula symbols for values actually present in the application are marked with *.

An explanation of the formula symbols can be found in the chapter [▶ 15.1].

[1] Observe the protection class of all the components.

8.6.1 Drive selection

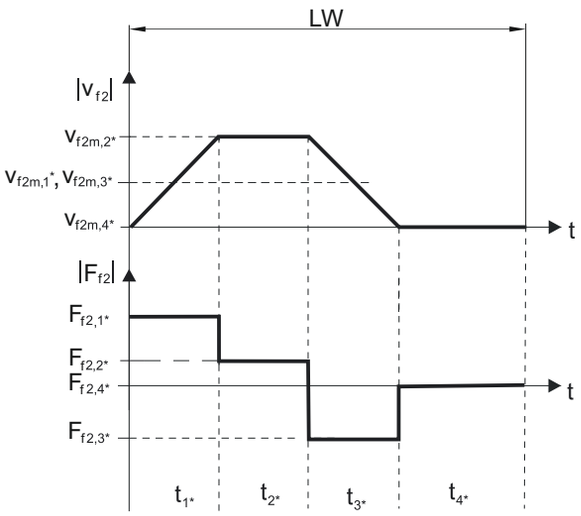


Refer to the selection tables for the values of i, $v_{f2maxDB}$, $v_{f2maxZB}$, F_{f2acc}, F_{f2N} and F_{f2NOT}.

The values for fB_T, fB_{op}, fB_t and fB_{ZB} can be found in the corresponding tables in this chapter.

Example of cyclic operation

The following calculations are based on a representation of the power taken from the output based in accordance with the following example:



Calculation of the actual maximum acceleration feed force

$$F_{f2acc*} = m* \cdot a* + F_{L*}$$

Calculation of the actual average input speed

$$n_{1m*} = \frac{v_{f2m*} \cdot i}{d_0 \cdot \pi}$$

$$v_{f2m*} = \frac{\left|v_{f2m,1*}\right| \cdot t_{1*} + \ldots + \left|v_{f2m,n*}\right| \cdot t_{n*}}{t_{1*} + \ldots + t_{n*}}$$

If $t_{1*} + \ldots + t_{3*} \geq 6$ min, determine v_{2m*} without the rest phase t_{4*}.

The values for the ratio i can be found in the selection tables.

Calculation of the actual emergency off feed force

$$F_{f2NOT*} = m* \cdot a_{NOT*} + F_{L*}$$

Calculation of the actual equivalent feed force

$$F_{f2eq*} = \sqrt[3]{\frac{\left|v_{f2m,1*}\right| \cdot t_{1*} \cdot \left|F_{f2,1*}{}^{3}\right| + \ldots + \left|v_{f2m,n*}\right| \cdot t_{n*} \cdot \left|F_{f2,n*}{}^{3}\right|}{\left|v_{f2m,1*}\right| \cdot t_{1*} + \ldots + \left|v_{f2m,n*}\right| \cdot t_{n*}}}$$

Calculation of the thermal limit torque

Calculate the thermal limit torque M_{2th} for a duty cycle $ED_{10} > 50\%$ and the actual average input speed n_{1m*}. (At $K_{mot,th} \leq 0$ you must reduce the average input speed n_{1m*} accordingly or select another geared motor size.)

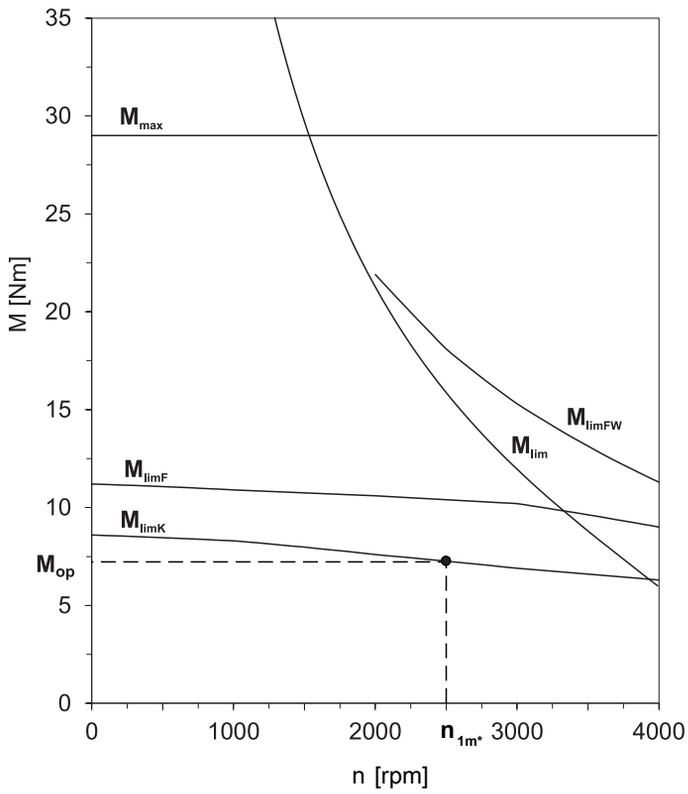
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

$$K_{mot,th} = 0{,}95 - \frac{a_{th}}{1000} \cdot fB_T \cdot \left(\frac{n_{1m*}}{1000}\right)^3$$

Refer to the selection tables for the values of i and a_{th}.

The values for fB_T can be found in the corresponding table in this chapter.

The value for the torque of the motor at operating point M_{op} with the determined average input speed n_{1m*} can be found in the motor characteristic curve of the chapter [▶ 13.3]. Note the size, nominal speed n_N and cooling type of the motor. The figure below shows an example of reading the torque M_{op} of a motor with convection cooling at the operating point.



Calculation of the actual effective torque

$$M_{2eff*} = \sqrt{\frac{t_{1*} \cdot M_{2,1*}^{\ 2} + \ldots + t_{n*} \cdot M_{2,n*}^{\ 2}}{t_{1*} + \ldots + t_{n*}}}$$

$$M_{2,n*} = \frac{F_{f2,n*} \cdot d_0}{2}$$

$$M_{1eff*} = \frac{M_{2eff*}}{i \cdot \eta}$$

Operating factors

Operating mode	fB_{op}
Uniform continuous operation	1.00
Cyclic operation	1.00
Reversing load cyclic operation	1.00

Run time	fB_t
Daily runtime ≤ 8 h	1.00
Daily runtime ≤ 16 h	1.15
Daily runtime ≤ 24 h	1.20

Cyclic operation	fB_{ZB}
≤ 1000 load changes/hour (LW/h)	1.00
> 1000 load changes/hour (LW/h)	1.15

Temperature		fB_T
Motor cooling	**Surrounding temperature**	
Motor with forced ventilation	≤ 20 °C	0.9
	≤ 30 °C	1.0
	≤ 40 °C	1.15
Motor with convection cooling	≤ 20 °C	1.0
	≤ 30 °C	1.1
	≤ 40 °C	1.25

Notes

- The maximum permitted gear unit temperature (see the "Other product features" chapter) must not be exceeded, as that could result in damage.
- For braking from full speed (for example, when the power fails or when setting up the machine), note the permitted gear unit feed forces (F_{f2acc}, F_{f2NOT}) in the selection tables.

8.6.2 Recommendation for radial shaft seal rings

For a duty cycle > 60% and higher surrounding temperatures, we recommend radial shaft seal rings made of FKM at the output.

Properties:

- Excellent temperature resistance
- High chemical stability
- Very good resistance to aging
- Excellent resistance in oils and greases
- For use in the food, beverage and pharmaceutical industries

Leak-proofness

Our gear units are equipped with high-quality radial shaft seal rings and checked for leaks. However, a leak cannot be fully ruled out over the length of use of a gear unit. If you use a gear unit with goods incompatible with the lubricant, you must take measures to prevent direct contact with the gear unit lubricant in case of a leak.

8.7 Additional documentation

Additional documentation related to the product can be found at
http://www.stoeber.de/en/downloads/

Enter the ID of the documentation in the Search... field.

Documentation	ID
Operating manual for gear racks (Atlanta)	442455
Operating manual for P/PE/PH/PHQ/PHV planetary gear units and planetary geared motors	443149_en
Operating manual for EZ synchronous servo motors	443032_en

9 ZVPE rack and pinion drives

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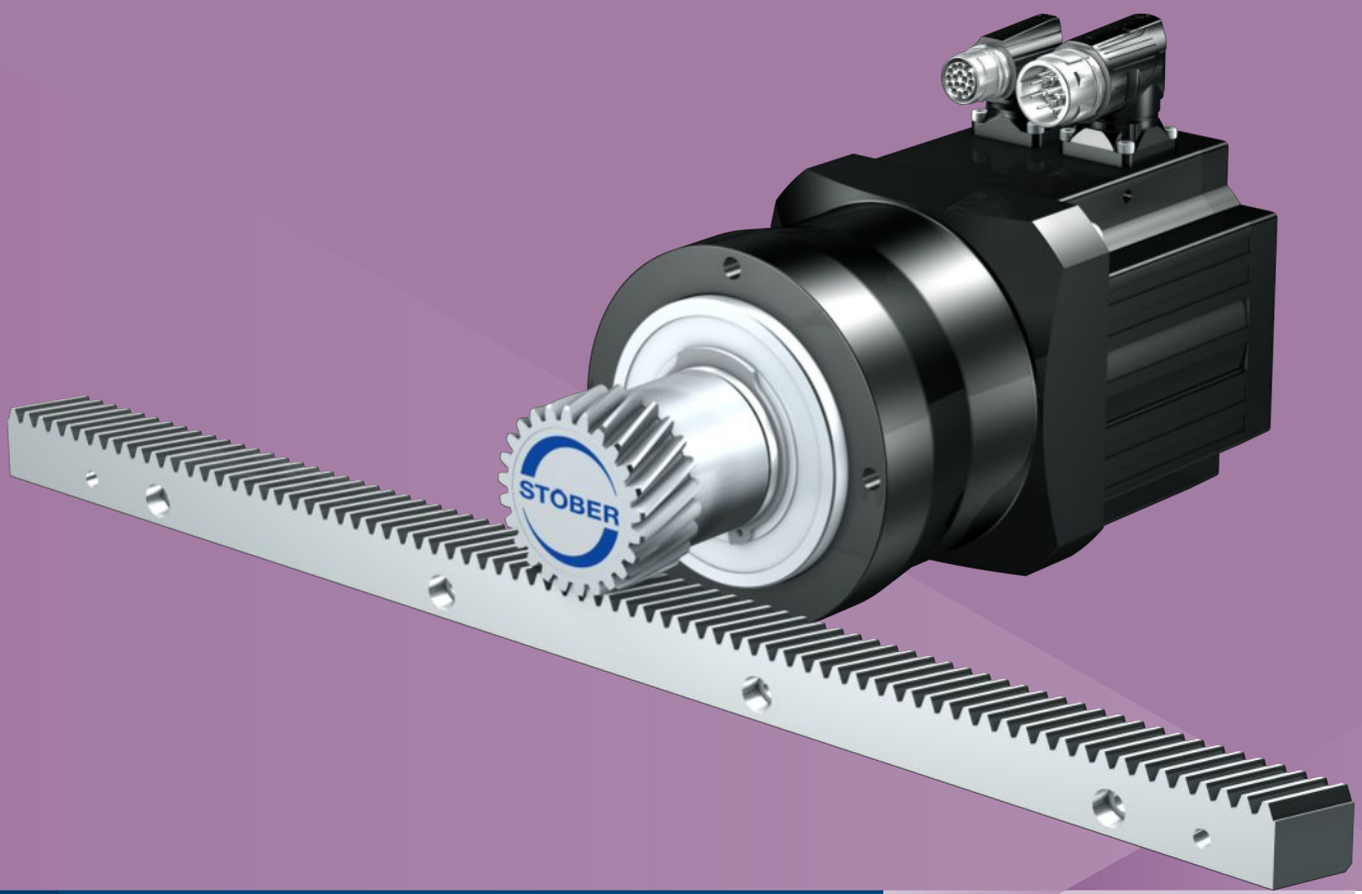


9 Rack and pinion drives

ZVPE

9.1 Overview

Cost-effective planetary geared motors with plug-on pinions

Features

Power density	★★☆☆☆
Linear clearance	★★☆☆☆
Price category	€
Smooth operation	★★★☆☆
Linear rigidity	★★☆☆☆
Mass moment of inertia	★★★★☆
Ready-to-install drive solution	✓
Pinion gearing quality 6 (DIN 3962)	✓
Helical gearing	✓
Case-hardened and smoothed	✓
Compact and highly dynamic due to direct motor attachment	✓

Key ★☆☆☆☆ good | ★★★★★ excellent
€ Economy | €€€€€ Premium

Technical data

m_n	2 – 3 mm
z	16 – 25
F_{f2acc}	0.48 – 6.1 kN
v_{f2N}	0.17 – 4.5 m/s
Δs	40 – 83 µm

9.2 Selection tables

The technical data specified in the selection tables applies to:

- De-energized installation
- Permanent lubrication with the lubricants specified in the Atlanta product catalog
- Material combinations as described in the chapter [▶ 9.5.2]
- Installation altitudes up to 1000 m above sea level
- Surrounding temperatures from 0 °C to 40 °C
- Without consideration of the thermal limiting performance
- Drives with convection-cooled motors (e.g. EZ401**U**)

For the technical data on drives with forced ventilated motors (e.g. EZ401**B**), refer to http://configurator.stoeber.de.

For all other technical data, refer to http://configurator.stoeber.de.

An explanation of the formula symbols can be found in the chapter [▶ 15.1].

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV2PE3 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 1,9 kN)																
0.21	1.3	1.3	3.6	1.1	ZV216S_PE322_0250 EZ301U	1.9	3.4	32	25.00	0.28	0.57	49	45	2	16	34.0
0.27	1.0	1.1	4.0	1.3	ZV216S_PE322_0200 EZ301U	1.9	3.4	32	20.00	0.36	0.71	49	43	2	16	34.0
0.33	0.8	0.9	4.5	1.5	ZV216S_PE322_0160 EZ301U	1.9	3.4	32	16.00	0.44	0.89	49	43	2	16	34.0
0.53	0.5	0.5	0.7	2.0	ZV216S_PE321_0100 EZ301U	1.6	3.4	27	10.00	0.71	1.24	40	40	2	16	34.0
0.53	0.9	1.0	1.2	1.2	ZV216S_PE321_0100 EZ302U	1.9	3.4	32	10.00	0.71	1.24	40	40	2	16	34.0
0.76	0.4	0.4	1.1	2.6	ZV216S_PE321_0070 EZ301U	1.1	3.4	19	7.000	1.02	1.78	40	44	2	16	34.0
0.76	0.6	0.7	1.8	1.5	ZV216S_PE321_0070 EZ302U	1.9	3.4	32	7.000	1.02	1.78	40	44	2	16	34.0
0.76	0.8	0.9	2.4	1.2	ZV216S_PE321_0070 EZ303U	1.9	3.4	32	7.000	1.02	1.78	40	44	2	16	34.0
1.07	0.3	0.3	1.7	3.2	ZV216S_PE321_0050 EZ301U	0.8	3.4	14	5.000	1.32	2.49	40	47	2	16	34.0
1.07	0.5	0.5	2.9	1.9	ZV216S_PE321_0050 EZ302U	1.4	3.4	24	5.000	1.32	2.49	40	47	2	16	34.0
1.07	0.6	0.6	3.7	1.5	ZV216S_PE321_0050 EZ303U	1.9	3.4	32	5.000	1.32	2.49	40	47	2	16	34.0
1.07	0.8	0.9	5.1	1.1	ZV216S_PE321_0050 EZ401U	1.9	3.4	32	5.000	1.32	2.49	40	47	2	16	34.0
1.33	0.2	0.2	2.3	3.8	ZV216S_PE321_0040 EZ301U	0.6	3.4	11	4.000	1.64	3.11	40	46	2	16	34.0
1.33	0.4	0.4	3.9	2.2	ZV216S_PE321_0040 EZ302U	1.1	3.4	19	4.000	1.64	3.11	40	46	2	16	34.0
1.33	0.5	0.5	5.1	1.7	ZV216S_PE321_0040 EZ303U	1.6	3.4	27	4.000	1.64	3.11	40	46	2	16	34.0
1.33	0.6	0.7	6.9	1.3	ZV216S_PE321_0040 EZ401U	1.9	3.4	32	4.000	1.64	3.11	40	46	2	16	34.0
1.78	0.2	0.2	3.7	4.6	ZV216S_PE321_0030 EZ301U	0.5	3.4	8.1	3.000	2.07	3.56	40	38	2	16	34.0
1.78	0.3	0.3	6.3	2.7	ZV216S_PE321_0030 EZ302U	0.9	3.4	15	3.000	2.07	3.56	40	38	2	16	34.0
1.78	0.4	0.4	8.2	2.1	ZV216S_PE321_0030 EZ303U	1.2	3.4	20	3.000	2.07	3.56	40	38	2	16	34.0
1.78	0.5	0.5	11	1.5	ZV216S_PE321_0030 EZ401U	1.5	3.4	25	3.000	2.07	3.56	40	38	2	16	34.0
ZV2PE3 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 1,9 kN)																
0.53	1.0	1.1	4.8	1.1	ZV216S_PE322_0200 EZ301U	1.9	3.4	32	20.00	0.36	0.71	49	43	2	16	34.0
0.67	0.8	0.9	5.4	1.3	ZV216S_PE322_0160 EZ301U	1.9	3.4	32	16.00	0.44	0.89	49	43	2	16	34.0
1.07	0.5	0.5	0.9	1.7	ZV216S_PE321_0100 EZ301U	1.6	3.4	27	10.00	0.71	1.24	40	40	2	16	34.0
1.07	0.9	1.0	1.4	1.0	ZV216S_PE321_0100 EZ302U	1.9	3.4	32	10.00	0.71	1.24	40	40	2	16	34.0
1.52	0.4	0.4	1.3	2.2	ZV216S_PE321_0070 EZ301U	1.1	3.4	19	7.000	1.02	1.78	40	44	2	16	34.0
1.52	0.6	0.7	2.2	1.3	ZV216S_PE321_0070 EZ302U	1.9	3.4	32	7.000	1.02	1.78	40	44	2	16	34.0
2.13	0.3	0.3	2.0	2.7	ZV216S_PE321_0050 EZ301U	0.8	3.4	14	5.000	1.32	2.49	40	47	2	16	34.0
2.13	0.4	0.5	3.4	1.6	ZV216S_PE321_0050 EZ302U	1.4	3.4	24	5.000	1.32	2.49	40	47	2	16	34.0
2.13	0.6	0.6	4.5	1.2	ZV216S_PE321_0050 EZ303U	1.9	3.4	32	5.000	1.32	2.49	40	47	2	16	34.0
2.13	0.7	0.8	5.2	1.0	ZV216S_PE321_0050 EZ401U	1.9	3.4	32	5.000	1.32	2.49	40	47	2	16	34.0
2.67	0.2	0.2	2.8	3.1	ZV216S_PE321_0040 EZ301U	0.6	3.4	11	4.000	1.64	3.11	40	46	2	16	34.0
2.67	0.3	0.4	4.7	1.9	ZV216S_PE321_0040 EZ302U	1.1	3.4	19	4.000	1.64	3.11	40	46	2	16	34.0
2.67	0.4	0.5	6.1	1.4	ZV216S_PE321_0040 EZ303U	1.6	3.4	27	4.000	1.64	3.11	40	46	2	16	34.0
2.67	0.5	0.6	7.1	1.2	ZV216S_PE321_0040 EZ401U	1.9	3.4	32	4.000	1.64	3.11	40	46	2	16	34.0
3.56	0.2	0.2	4.5	3.8	ZV216S_PE321_0030 EZ301U	0.5	3.4	8.1	3.000	2.07	3.56	40	38	2	16	34.0
3.56	0.3	0.3	7.5	2.2	ZV216S_PE321_0030 EZ302U	0.9	3.4	15	3.000	2.07	3.56	40	38	2	16	34.0
3.56	0.3	0.4	9.8	1.7	ZV216S_PE321_0030 EZ303U	1.2	3.4	20	3.000	2.07	3.56	40	38	2	16	34.0
3.56	0.4	0.5	12	1.5	ZV216S_PE321_0030 EZ401U	1.5	3.4	25	3.000	2.07	3.56	40	38	2	16	34.0
ZV2PE4 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 2,7 kN)																
0.17	1.7	1.7	1.5	1.1	ZV220S_PE422_0400 EZ301U	2.7	4.3	58	40.00	0.22	0.39	62	78	2	20	42.4
0.19	1.5	1.5	1.6	1.2	ZV220S_PE422_0350 EZ301U	2.7	4.3	58	35.00	0.25	0.44	62	81	2	20	42.4
0.24	1.2	1.2	1.7	1.4	ZV220S_PE422_0280 EZ301U	2.7	4.3	58	28.00	0.32	0.56	62	80	2	20	42.4
0.27	1.0	1.1	1.8	1.5	ZV220S_PE422_0250 EZ301U	2.7	4.3	58	25.00	0.33	0.62	62	81	2	20	42.4
0.33	0.8	0.9	2.1	1.8	ZV220S_PE422_0200 EZ301U	2.5	4.3	53	20.00	0.41	0.78	62	81	2	20	42.4
0.33	1.4	1.5	3.5	1.0	ZV220S_PE422_0200 EZ302U	2.7	4.3	58	20.00	0.41	0.78	62	81	2	20	42.4
0.42	0.7	0.7	2.3	2.1	ZV220S_PE422_0160 EZ301U	2.0	4.3	43	16.00	0.51	0.97	62	81	2	20	42.4

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV2PE4 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 2,7 kN)																
0.42	1.1	1.2	4.0	1.2	ZV220S_PE422_0160 EZ302U	2.7	4.3	58	16.00	0.51	0.97	62	81	2	20	42.4
0.95	0.9	1.0	1.7	1.2	ZV220S_PE421_0070 EZ401U	2.7	4.3	58	7.000	1.14	1.91	49	78	2	20	42.4
1.33	0.6	0.7	2.8	1.4	ZV220S_PE421_0050 EZ401U	1.9	4.3	41	5.000	1.51	2.67	49	84	2	20	42.4
1.67	0.5	0.5	3.7	1.7	ZV220S_PE421_0040 EZ401U	1.6	4.3	33	4.000	1.89	3.33	49	85	2	20	42.4
1.67	0.8	0.9	5.6	1.1	ZV220S_PE421_0040 EZ501U	2.7	4.3	58	4.000	1.89	3.33	49	85	2	20	42.4
1.67	0.9	1.0	6.2	1.0	ZV220S_PE421_0040 EZ402U	2.7	4.3	58	4.000	1.89	3.33	49	85	2	20	42.4
2.22	0.4	0.4	6.3	2.0	ZV220S_PE421_0030 EZ401U	1.2	4.3	25	3.000	2.22	4.07	49	77	2	20	42.4
2.22	0.6	0.6	9.7	1.3	ZV220S_PE421_0030 EZ501U	2.2	4.3	47	3.000	2.22	4.07	49	77	2	20	42.4
2.22	0.6	0.7	11	1.2	ZV220S_PE421_0030 EZ402U	2.2	4.3	47	3.000	2.22	4.07	49	77	2	20	42.4
ZV2PE4 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 2,7 kN)																
0.38	1.4	1.5	1.9	1.0	ZV220S_PE422_0350 EZ301U	2.7	4.3	58	35.00	0.25	0.44	62	81	2	20	42.4
0.48	1.1	1.2	2.1	1.2	ZV220S_PE422_0280 EZ301U	2.7	4.3	58	28.00	0.32	0.56	62	80	2	20	42.4
0.53	1.0	1.1	2.2	1.3	ZV220S_PE422_0250 EZ301U	2.7	4.3	58	25.00	0.33	0.62	62	81	2	20	42.4
0.67	0.8	0.9	2.5	1.5	ZV220S_PE422_0200 EZ301U	2.5	4.3	53	20.00	0.41	0.78	62	81	2	20	42.4
0.83	0.6	0.7	2.8	1.7	ZV220S_PE422_0160 EZ301U	2.0	4.3	43	16.00	0.51	0.97	62	81	2	20	42.4
0.83	1.1	1.2	4.7	1.0	ZV220S_PE422_0160 EZ302U	2.7	4.3	58	16.00	0.51	0.97	62	81	2	20	42.4
1.91	0.7	0.9	1.8	1.1	ZV220S_PE421_0070 EZ401U	2.7	4.3	58	7.000	1.14	1.91	49	78	2	20	42.4
2.67	0.5	0.6	2.9	1.4	ZV220S_PE421_0050 EZ401U	1.9	4.3	41	5.000	1.51	2.67	49	84	2	20	42.4
3.33	0.4	0.5	3.8	1.6	ZV220S_PE421_0040 EZ401U	1.6	4.3	33	4.000	1.89	3.33	49	85	2	20	42.4
3.33	0.6	0.8	5.6	1.1	ZV220S_PE421_0040 EZ501U	2.7	4.3	58	4.000	1.89	3.33	49	85	2	20	42.4
3.33	0.6	0.9	5.8	1.1	ZV220S_PE421_0040 EZ402U	2.7	4.3	58	4.000	1.89	3.33	49	85	2	20	42.4
ZV2PE5 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 6,1 kN)																
0.24	3.5	3.8	2.1	1.0	ZV225S_PE522_0350 EZ401U	6.1	7.6	160	35.00	0.29	0.48	77	116	2	25	53.1
0.30	2.8	3.0	2.4	1.2	ZV225S_PE522_0280 EZ401U	6.1	7.6	160	28.00	0.36	0.60	77	116	2	25	53.1
0.33	2.5	2.7	2.5	1.3	ZV225S_PE522_0250 EZ401U	6.1	7.6	160	25.00	0.38	0.67	77	116	2	25	53.1
0.42	2.0	2.1	2.8	1.5	ZV225S_PE522_0200 EZ401U	6.1	7.6	160	20.00	0.47	0.83	77	116	2	25	53.1
0.52	1.6	1.7	3.1	1.7	ZV225S_PE522_0160 EZ401U	4.9	7.6	130	16.00	0.59	1.04	77	116	2	25	53.1
0.52	2.5	2.7	4.8	1.1	ZV225S_PE522_0160 EZ501U	6.1	7.6	160	16.00	0.59	1.04	77	116	2	25	53.1
0.52	2.7	3.0	5.3	1.0	ZV225S_PE522_0160 EZ402U	6.1	7.6	160	16.00	0.59	1.04	77	116	2	25	53.1
0.83	1.6	1.7	2.2	1.5	ZV225S_PE521_0100 EZ501U	5.9	7.6	160	10.00	0.83	1.39	62	100	2	25	53.1
1.19	1.1	1.2	3.3	1.9	ZV225S_PE521_0070 EZ501U	4.1	7.6	110	7.000	1.11	1.98	62	113	2	25	53.1
1.19	1.9	2.0	5.7	1.1	ZV225S_PE521_0070 EZ502U	6.1	7.6	160	7.000	1.11	1.98	62	113	2	25	53.1
1.19	1.9	2.1	5.7	1.1	ZV225S_PE521_0070 EZ701U	5.1	7.6	140	7.000	1.11	1.98	62	113	2	25	53.1
1.67	0.8	0.9	5.0	2.3	ZV225S_PE521_0050 EZ501U	2.9	7.6	78	5.000	1.44	2.78	62	123	2	25	53.1
1.67	1.4	1.5	8.6	1.4	ZV225S_PE521_0050 EZ502U	5.7	7.6	150	5.000	1.44	2.78	62	123	2	25	53.1
1.67	1.4	1.5	8.6	1.4	ZV225S_PE521_0050 EZ701U	3.7	7.6	97	5.000	1.44	2.78	62	123	2	25	53.1
1.67	1.8	2.0	11	1.0	ZV225S_PE521_0050 EZ503U	6.1	7.6	160	5.000	1.44	2.78	62	123	2	25	53.1
2.08	0.6	0.7	6.5	2.7	ZV225S_PE521_0040 EZ501U	2.3	7.6	62	4.000	1.81	3.47	62	125	2	25	53.1
2.08	1.1	1.2	11	1.6	ZV225S_PE521_0040 EZ502U	4.5	7.6	120	4.000	1.81	3.47	62	125	2	25	53.1
2.08	1.1	1.2	11	1.6	ZV225S_PE521_0040 EZ701U	2.9	7.6	78	4.000	1.81	3.47	62	125	2	25	53.1
2.08	1.4	1.6	15	1.2	ZV225S_PE521_0040 EZ503U	6.1	7.6	160	4.000	1.81	3.47	62	125	2	25	53.1
2.78	0.5	0.5	13	3.3	ZV225S_PE521_0030 EZ501U	1.8	7.6	47	3.000	2.32	4.17	62	116	2	25	53.1
2.78	0.8	0.9	23	1.9	ZV225S_PE521_0030 EZ502U	3.4	7.6	90	3.000	2.32	4.17	62	116	2	25	53.1
2.78	0.8	0.9	23	1.9	ZV225S_PE521_0030 EZ701U	2.2	7.6	58	3.000	2.32	4.17	62	116	2	25	53.1
2.78	1.1	1.2	30	1.5	ZV225S_PE521_0030 EZ503U	4.7	7.6	130	3.000	2.32	4.17	62	116	2	25	53.1
2.78	1.3	1.6	37	1.2	ZV225S_PE521_0030 EZ702U	4.5	7.6	120	3.000	2.32	4.17	62	116	2	25	53.1
2.78	1.5	1.8	42	1.0	ZV225S_PE521_0030 EZ505U	6.1	7.6	160	3.000	2.32	4.17	62	116	2	25	53.1
ZV2PE5 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 6,1 kN)																
3.13	1.4	2.2	16	1.1	ZV225S_PE521_0040 EZ505U	6.1	7.6	160	4.000	1.81	3.47	62	125	2	25	53.1
4.17	1.0	1.7	34	1.3	ZV225S_PE521_0030 EZ505U	6.1	7.6	160	3.000	2.32	4.17	62	116	2	25	53.1
4.17	1.3	2.2	43	1.0	ZV225S_PE521_0030 EZ703U	6.1	7.6	160	3.000	2.32	4.17	62	116	2	25	53.1
ZV2PE5 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 6,1 kN)																
0.60	2.3	2.8	2.5	1.1	ZV225S_PE522_0280 EZ401U	6.1	7.6	160	28.00	0.36	0.60	77	116	2	25	53.1
0.67	2.1	2.5	2.6	1.2	ZV225S_PE522_0250 EZ401U	6.1	7.6	160	25.00	0.38	0.67	77	116	2	25	53.1
0.83	1.6	2.0	2.9	1.4	ZV225S_PE522_0200 EZ401U	6.1	7.6	160	20.00	0.47	0.83	77	116	2	25	53.1
1.04	1.3	1.6	3.3	1.6	ZV225S_PE522_0160 EZ401U	4.9	7.6	130	16.00	0.59	1.04	77	116	2	25	53.1
1.04	1.9	2.5	4.8	1.1	ZV225S_PE522_0160 EZ501U	6.1	7.6	160	16.00	0.59	1.04	77	116	2	25	53.1
1.04	2.0	2.8	4.9	1.1	ZV225S_PE522_0160 EZ402U	6.1	7.6	160	16.00	0.59	1.04	77	116	2	25	53.1
ZV3PE5 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 5,8 kN)																
0.23	3.7	4.0	2.0	1.0	ZV318S_PE522_0400 EZ401U	5.8	7.8	170	40.00	0.27	0.45	83	108	3	18	57.3
0.26	3.2	3.5	2.1	1.1	ZV318S_PE522_0350 EZ401U	5.8	7.8	170	35.00	0.31	0.51	83	108	3	18	57.3
0.32	2.6	2.8	2.4	1.3	ZV318S_PE522_0280 EZ401U	5.8	7.8	170	28.00	0.39	0.64	83	108	3	18	57.3
0.36	2.3	2.5	2.5	1.4	ZV318S_PE522_0250 EZ401U	5.8	7.8	170	25.00	0.41	0.72	83	108	3	18	57.3
0.45	1.9	2.0	2.8	1.6	ZV318S_PE522_0200 EZ401U	5.6	7.8	160	20.00	0.51	0.90	83	108	3	18	57.3
0.45	2.9	3.1	4.3	1.0	ZV318S_PE522_0200 EZ501U	5.8	7.8	170	20.00	0.51	0.90	83	108	3	18	57.3

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV3PE5 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 5,8 kN)																
0.56	1.5	1.6	3.1	1.9	ZV318S_PE522_0160 EZ401U	4.5	7.8	130	16.00	0.64	1.13	83	108	3	18	57.3
0.56	2.3	2.5	4.8	1.2	ZV318S_PE522_0160 EZ501U	5.8	7.8	170	16.00	0.64	1.13	83	108	3	18	57.3
0.56	2.5	2.8	5.3	1.1	ZV318S_PE522_0160 EZ402U	5.8	7.8	170	16.00	0.64	1.13	83	108	3	18	57.3
0.90	1.5	1.6	2.2	1.6	ZV318S_PE521_0100 EZ501U	5.4	7.8	160	10.00	0.90	1.50	67	92	3	18	57.3
1.29	1.0	1.1	3.3	2.1	ZV318S_PE521_0070 EZ501U	3.8	7.8	110	7.000	1.20	2.14	67	106	3	18	57.3
1.29	1.8	1.9	5.7	1.2	ZV318S_PE521_0070 EZ502U	5.8	7.8	170	7.000	1.20	2.14	67	106	3	18	57.3
1.29	1.8	2.0	5.7	1.2	ZV318S_PE521_0070 EZ701U	4.7	7.8	140	7.000	1.20	2.14	67	106	3	18	57.3
1.80	0.7	0.8	5.0	2.6	ZV318S_PE521_0050 EZ501U	2.7	7.8	78	5.000	1.56	3.00	67	116	3	18	57.3
1.80	1.3	1.4	8.6	1.5	ZV318S_PE521_0050 EZ502U	5.2	7.8	150	5.000	1.56	3.00	67	116	3	18	57.3
1.80	1.3	1.4	8.6	1.5	ZV318S_PE521_0050 EZ701U	3.4	7.8	97	5.000	1.56	3.00	67	116	3	18	57.3
1.80	1.6	1.9	11	1.1	ZV318S_PE521_0050 EZ503U	5.8	7.8	170	5.000	1.56	3.00	67	116	3	18	57.3
2.25	0.6	0.6	6.5	3.0	ZV318S_PE521_0040 EZ501U	2.2	7.8	62	4.000	1.95	3.75	67	117	3	18	57.3
2.25	1.0	1.1	11	1.7	ZV318S_PE521_0040 EZ502U	4.2	7.8	120	4.000	1.95	3.75	67	117	3	18	57.3
2.25	1.0	1.1	11	1.7	ZV318S_PE521_0040 EZ701U	2.7	7.8	78	4.000	1.95	3.75	67	117	3	18	57.3
2.25	1.3	1.5	15	1.3	ZV318S_PE521_0040 EZ503U	5.8	7.8	170	4.000	1.95	3.75	67	117	3	18	57.3
2.25	1.6	2.0	18	1.1	ZV318S_PE521_0040 EZ702U	5.6	7.8	160	4.000	1.95	3.75	67	117	3	18	57.3
3.00	0.4	0.5	13	3.6	ZV318S_PE521_0030 EZ501U	1.6	7.8	47	3.000	2.50	4.50	67	108	3	18	57.3
3.00	0.8	0.8	23	2.1	ZV318S_PE521_0030 EZ502U	3.1	7.8	90	3.000	2.50	4.50	67	108	3	18	57.3
3.00	0.8	0.8	23	2.1	ZV318S_PE521_0030 EZ701U	2.0	7.8	58	3.000	2.50	4.50	67	108	3	18	57.3
3.00	1.0	1.1	30	1.6	ZV318S_PE521_0030 EZ503U	4.4	7.8	130	3.000	2.50	4.50	67	108	3	18	57.3
3.00	1.2	1.5	37	1.3	ZV318S_PE521_0030 EZ702U	4.2	7.8	120	3.000	2.50	4.50	67	108	3	18	57.3
3.00	1.4	1.6	42	1.2	ZV318S_PE521_0030 EZ505U	5.8	7.8	170	3.000	2.50	4.50	67	108	3	18	57.3
ZV3PE5 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 5,8 kN)																
2.70	1.6	2.6	13	1.0	ZV318S_PE521_0050 EZ505U	5.8	7.8	170	5.000	1.56	3.00	67	116	3	18	57.3
3.38	1.3	2.1	16	1.2	ZV318S_PE521_0040 EZ505U	5.8	7.8	170	4.000	1.95	3.75	67	117	3	18	57.3
4.50	1.0	1.6	34	1.4	ZV318S_PE521_0030 EZ505U	5.8	7.8	170	3.000	2.50	4.50	67	108	3	18	57.3
4.50	1.2	2.0	43	1.1	ZV318S_PE521_0030 EZ703U	5.8	7.8	170	3.000	2.50	4.50	67	108	3	18	57.3
ZV3PE5 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 5,8 kN)																
0.51	2.7	3.2	2.2	1.1	ZV318S_PE522_0350 EZ401U	5.8	7.8	170	35.00	0.31	0.51	83	108	3	18	57.3
0.64	2.1	2.6	2.5	1.2	ZV318S_PE522_0280 EZ401U	5.8	7.8	170	28.00	0.39	0.64	83	108	3	18	57.3
0.72	1.9	2.3	2.6	1.3	ZV318S_PE522_0250 EZ401U	5.8	7.8	170	25.00	0.41	0.72	83	108	3	18	57.3
0.90	1.5	1.9	2.9	1.5	ZV318S_PE522_0200 EZ401U	5.6	7.8	160	20.00	0.51	0.90	83	108	3	18	57.3
0.90	2.3	2.9	4.3	1.0	ZV318S_PE522_0200 EZ501U	5.8	7.8	170	20.00	0.51	0.90	83	108	3	18	57.3
0.90	2.3	3.2	4.4	1.0	ZV318S_PE522_0200 EZ402U	5.8	7.8	170	20.00	0.51	0.90	83	108	3	18	57.3
1.13	1.2	1.5	3.3	1.8	ZV318S_PE522_0160 EZ401U	4.5	7.8	130	16.00	0.64	1.13	83	108	3	18	57.3
1.13	1.8	2.3	4.8	1.2	ZV318S_PE522_0160 EZ501U	5.8	7.8	170	16.00	0.64	1.13	83	108	3	18	57.3
1.13	1.9	2.6	4.9	1.2	ZV318S_PE522_0160 EZ402U	5.8	7.8	170	16.00	0.64	1.13	83	108	3	18	57.3

9.3 Dimensional drawings

This chapter shows you the dimensions of rack and pinion drives with EZ synchronous servo motors.

Dimension az in the tables of dimensions applies to Atlanta gear racks. In general: az = ½ d0 + h0 + x*mn

The pinion of the rack and pinion drive is helical (left-hand 19° 31 42"). The pinion gearing quality is 5.

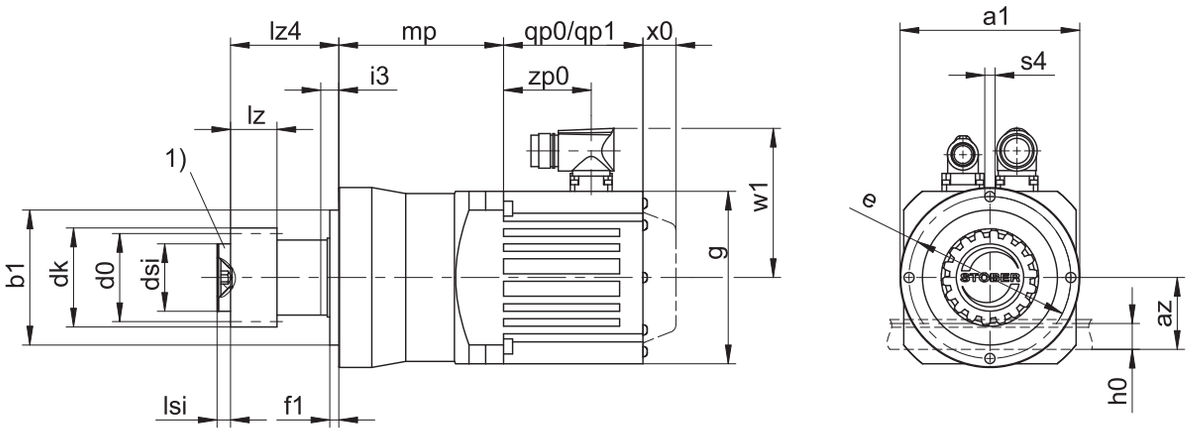
Dimensions can exceed the specifications of ISO 2768-mK due to casting tolerances or accumulation of individual tolerances.

We reserve the right to make dimensional changes due to ongoing technical development.

You can download 3D models of our standard drives at http://configurator.stoeber.de.

Combination options and the dimensions of forced ventilated geared motors can also be found at http://configurator.stoeber.de.

9.3.1 Pinion position E



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x0	Applies to encoders using an optical measuring method.	w1	Different for the One Cable Solution (OCS), see the chapter [▶ 13.4]
1)	Axial locking (optional)		

Dimensions of gear units

Type	mn	Øa1	az	Øb1	Ød0	Ødk	Ødsi	Øe	f1	h0	i3	lz	lz4	lsi	Øs4	x
ZV216SEPE3_	2	70	39.98	52_{h6}	33.95	39.81	25	62	5	22	7	26	37.5	4	M5	0.5
ZV220SEPE4_	2	90	44.02	68_{h6}	42.44	47.90	30	80	5	22	10	26	48.5	6	M6	0.4
ZV225SEPE5_	2	120	49.33	90_{h6}	53.05	58.52	45	108	6	22	12	26	72.5	8	M8	0.4
ZV318SEPE5_	3	120	55.55	90_{h6}	57.30	65.01	45	108	6	26	12	31	72.5	8	M8	0.3

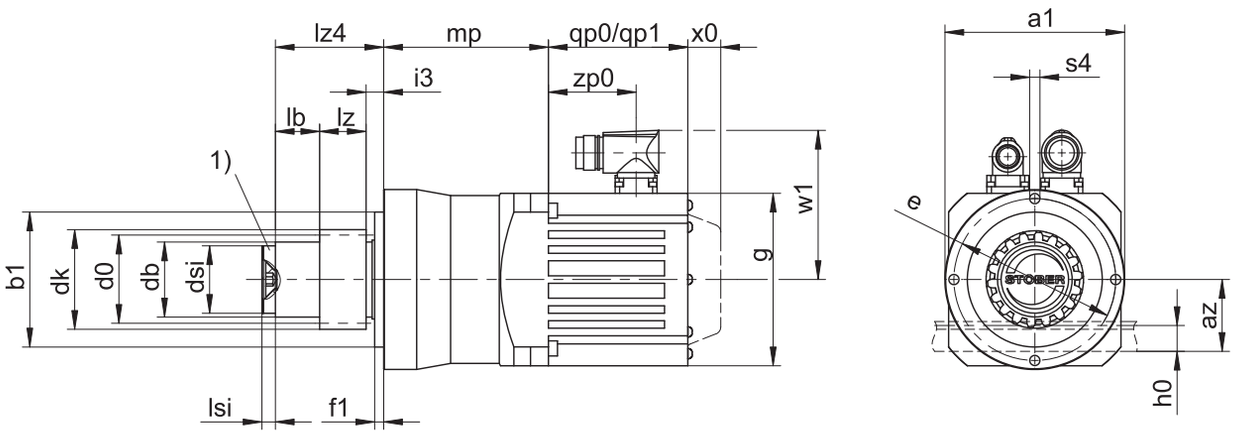
Dimensions of motors

Type	□g	qp0	qp1	w1	x0	zp0
EZ301U	72	90	130.0	55.5	21	54.5
EZ302U	72	112	152.0	55.5	21	76.5
EZ303U	72	134	174.0	55.5	21	98.5
EZ401U	98	98	146.5	91.0	22	56.0
EZ402U	98	123	171.5	91.0	22	81.0
EZ501U	115	93	147.5	100.0	22	58.5
EZ502U	115	118	172.5	100.0	22	83.5
EZ503U	115	143	197.5	100.0	22	108.5
EZ505U	115	193	247.5	100.0	22	158.5
EZ701U	145	102	161.0	115.0	22	64.0
EZ702U	145	127	186.0	115.0	22	89.0
EZ703U	145	152	211.0	115.0	22	114.0
EZ705U	145	207	266.0	134.0	22	165.0

Dimensions of geared motors

Type	EZ3	EZ4	EZ5	EZ7
	mp	mp	mp	mp
ZV_PE321_	86.5	83.0	–	–
ZV_PE322_	120.0	–	–	–
ZV_PE421_	–	89.0	91.5	–
ZV_PE422_	129.0	–	–	–
ZV_PE521_	–	–	110.0	113.0
ZV_PE522_	–	152.0	151.5	–

9.3.2 Pinion position S



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x0	Applies to encoders using an optical measuring method.	w1	Different for the One Cable Solution (OCS), see the chapter [▶ 13.4]
1)	Axial locking (optional)		

Dimensions of gear units

Type	mn	Øa1	az	Øb1	Ød0	Ødb	Ødk	Ødsi	Øe	f1	h0	i3	lb	lz	lz4	lsi	Øs4	x
ZV216SSPE3_	2	70	39.98	52_{h6}	33.95	30	39.81	25	62	5	22	7	4.5	26	37.5	4	M5	0.5
ZV220SSPE4_	2	90	44.02	68_{h6}	42.44	38	47.90	30	80	5	22	10	12.5	26	48.5	6	M6	0.4
ZV225SSPE5_	2	120	49.33	90_{h6}	53.05	50	58.52	45	108	6	22	12	34.5	26	72.5	8	M8	0.4
ZV318SSPE5_	3	120	55.55	90_{h6}	57.30	50	65.01	45	108	6	26	12	29.5	31	72.5	8	M8	0.3

Dimensions of motors

Type	□g	qp0	qp1	w1	x0	zp0
EZ301U	72	90	130.0	55.5	21	54.5
EZ302U	72	112	152.0	55.5	21	76.5
EZ303U	72	134	174.0	55.5	21	98.5
EZ401U	98	98	146.5	91.0	22	56.0
EZ402U	98	123	171.5	91.0	22	81.0
EZ501U	115	93	147.5	100.0	22	58.5
EZ502U	115	118	172.5	100.0	22	83.5
EZ503U	115	143	197.5	100.0	22	108.5
EZ505U	115	193	247.5	100.0	22	158.5
EZ701U	145	102	161.0	115.0	22	64.0
EZ702U	145	127	186.0	115.0	22	89.0
EZ703U	145	152	211.0	115.0	22	114.0
EZ705U	145	207	266.0	134.0	22	165.0

Dimensions of geared motors

Type	EZ3	EZ4	EZ5	EZ7
	mp	mp	mp	mp
ZV_PE321_	86.5	83.0	–	–
ZV_PE322_	120.0	–	–	–
ZV_PE421_	–	89.0	91.5	–
ZV_PE422_	129.0	–	–	–
ZV_PE521_	–	–	110.0	113.0
ZV_PE522_	–	152.0	151.5	–

9.4 Type designation

This chapter shows you an explanation of the type designation with the associated options.

Additional ordering information not included in the type designation can be found at the end of the chapter.

Example code

Z	V	2	20	S	S	PE	4	2	1	S	P	S	S	0050	EZ401U

Explanation

Code	Designation	Design
Z	Type	Rack and pinion drive
V	Design	Plug-on pinion
2	Module	m_n = 2 (example)
20	Number of teeth	z = 20 (example)
S	Toothing	Helical (left-hand 19° 31' 42")
E	Pinion position	Shaft end
S		Shaft shoulder
PE	Type	Planetary gear unit
4	Size	4 (example)
2	Generation	Generation 2
1	Stages	Single-stage
2		Two-stage
S	Housing	Standard
P	Shaft	Solid shaft with feather key
S	Bearing	Standard bearing
S	Backlash	Standard
0050	Transmission ratio (i x 10)	i = 5 (example)
EZ401U	Motor	EZ synchronous servo motor

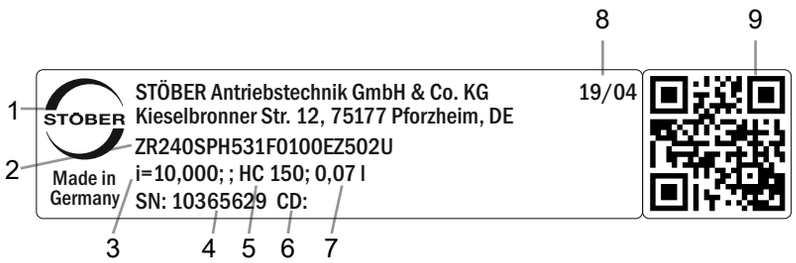
To complete the type designation, also specify the following in your order:

- For a detailed type designation of the motor, see the chapter [▶ 13]
- For axial locking (optional), see the chapter [▶ 9.3]

In this catalog, you will find all information on rack and pinion drives with EZ synchronous servo motors.
All input options available on request can be found in the chapter [▶ 9.5.1].

9.4.1 Nameplate

An example geared motor nameplate is explained in the figure below.



Code	Designation
1	Name of manufacturer
2	Type designation
3	Gear ratio of the gear unit
4	Serial number of the gear unit
5	Lubricant specification
6	Customer-specific data
7	Lubricant fill volume
8	Date of manufacture (year/calendar week)
9	QR code (link to product information)

9.4.1.1 Supporting documents

You can view or download supporting documents for the product by reading off the serial number on the nameplate of the product and entering it at the following address online:
https://id.stober.com

Alternatively, you can use a suitable mobile device to scan in the QR code on the nameplate of the product in order to be linked to the supporting documents.

9.5 Product description

9.5.1 Input options

This chapter shows you all available input options:

EZ synchronous servo motor	ME motor adapter	LM Lean motor
		
http://www.stoeber.de/en/Z_EZ	http://www.stoeber.de/en/ZVPEME	On request

9.5.2 Gear rack

The technical data specified in the Selection tables chapter applies only to gear rack combinations with the following characteristics:

The pinion of the rack and pinion drive is case-hardened and helical (left-hand 19° 31' 42"). The pinion gearing quality is 6.

The corresponding gear rack must have a right-hand design (19° 31' 42") and possess the following characteristics:

Module m_n [mm]	Minimum gear rack quality	Gear rack material
2 – 4	8	C45 inductively hardened

Also note the project configuration of the gear rack on the Atlanta pages.

9.5.2.1 Pinion position

The pinion can be fastened to the shaft in two different attachment positions:

- The toothing is flush with the shaft end (Pos. E)
- The toothing is flush with the shaft shoulder (Pos. S: For higher permitted feed forces, see the Selection tables chapter)

Please specify the desired attachment position when placing your order.

9.5.3 Installation conditions

The specified torques and forces only apply when gear units are fastened on the machine side using screws of strength class 10.9. In addition, the gear housings must be adjusted at the pilot. The machine-side fit must be H7.

9.5.4 Lubricants

STOBER fills the gear units with the amount and type of lubricant specified on the nameplate.

You will receive lubricants for use in the food industry upon request.

9.5.4.1 Rack and pinion drive lubrication

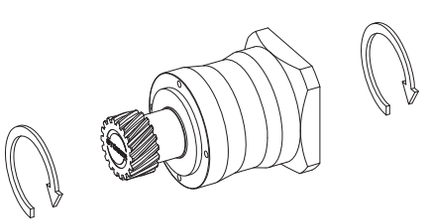
Make sure the rack and pinion drive has permanent lubrication with the lubricants specified in the Atlanta product catalog.

9.5.5 Other product features

Feature	Value
Max. permitted gear unit temperature (on the surface of the gear unit)	≤ 80 °C
Paint	Black RAL 9005
(ATEX) Directive 2014/34/EU (Option)	Not suitable
Protection class: [1]	
Planetary gear units	IP64
Motor	IP56, optionally IP66
Pinion/gear rack	IPXX

9.5.6 Direction of rotation

The input and output rotate in the same direction.



[1] Observe the protection class of all the components.

9.6 Project configuration

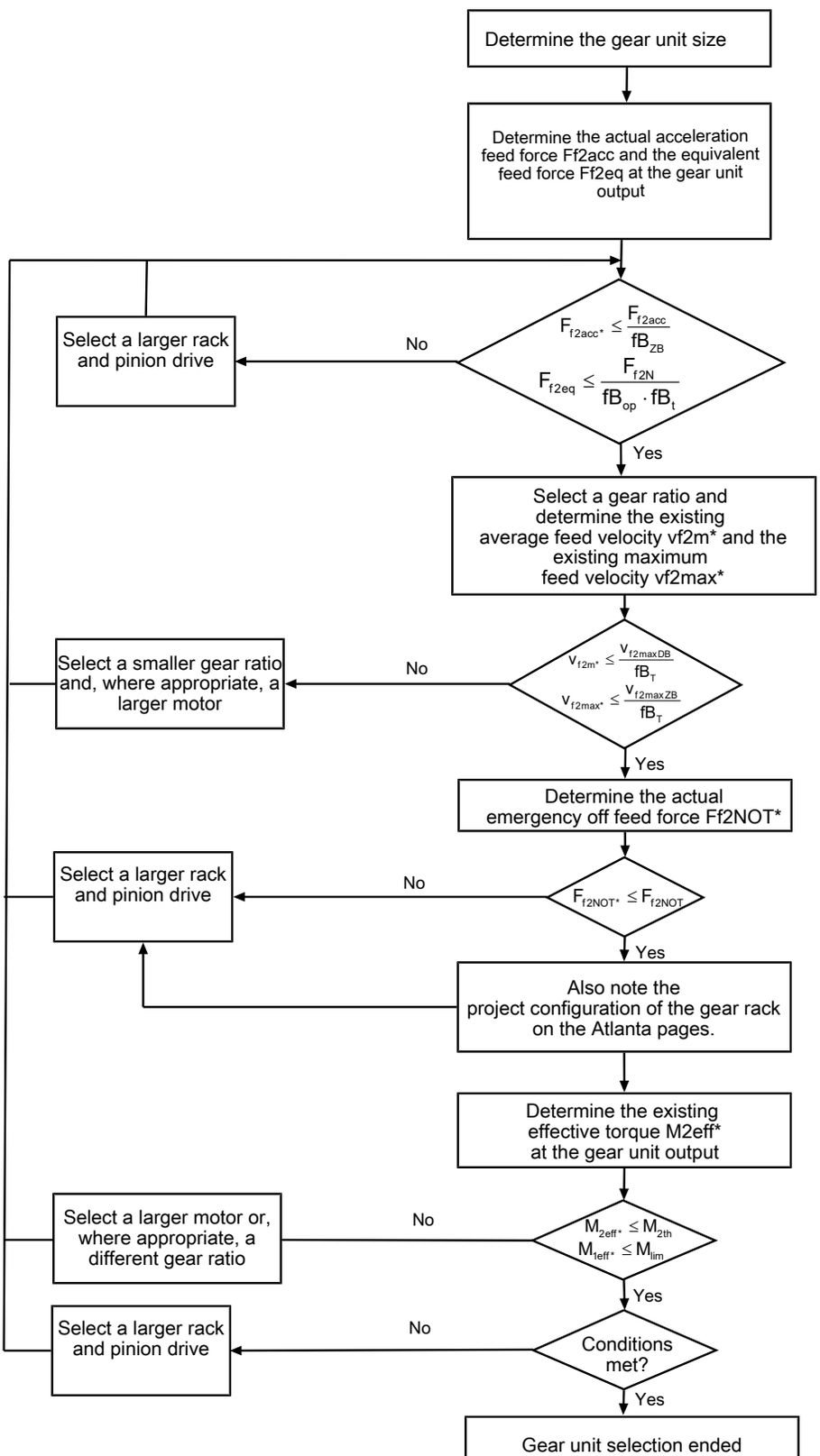
Project your drives using our SERVOsoft designing software. Download SERVOsoft for free at https://www.stoeber.de/en/ServoSoft.

Observe the limit conditions in this chapter to ensure a safe design for your drives.

The formula symbols for values actually present in the application are marked with *.

An explanation of the formula symbols can be found in the chapter [▶ 15.1].

9.6.1 Drive selection

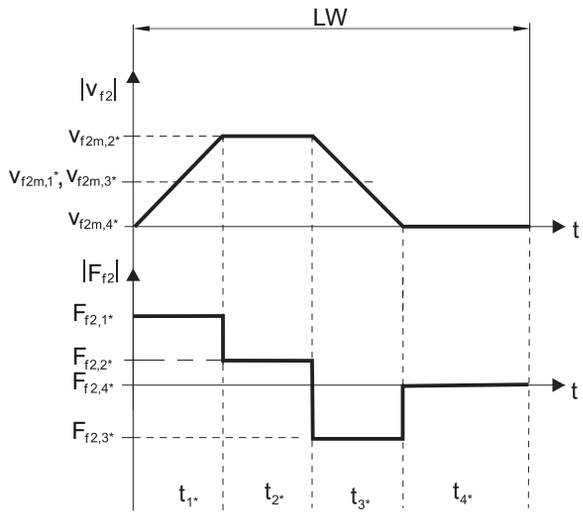


Refer to the selection tables for the values of i, $v_{f2maxDB}$, $v_{f2maxZB}$, F_{f2acc}, F_{f2N} and F_{f2NOT}.

The values for fB_T, fB_{op}, fB_t and fB_{ZB} can be found in the corresponding tables in this chapter.

Example of cyclic operation

The following calculations are based on a representation of the power taken from the output based in accordance with the following example:



Calculation of the actual maximum acceleration feed force

$$F_{f2acc*} = m* \cdot a* + F_{L*}$$

Calculation of the actual average input speed

$$n_{1m*} = \frac{v_{f2m*} \cdot i}{d_0 \cdot \pi}$$

$$v_{f2m*} = \frac{\left|v_{f2m,1*}\right| \cdot t_{1*} + \ldots + \left|v_{f2m,n*}\right| \cdot t_{n*}}{t_{1*} + \ldots + t_{n*}}$$

If $t_{1*} + \ldots + t_{3*} \geq 6$ min, determine v_{2m*} without the rest phase t_{4*}.

The values for the ratio i can be found in the selection tables.

Calculation of the actual emergency off feed force

$$F_{f2NOT*} = m* \cdot a_{NOT*} + F_{L*}$$

Calculation of the actual equivalent feed force

$$F_{f2eq*} = \sqrt[3]{\frac{\left|v_{f2m,1*}\right| \cdot t_{1*} \cdot \left|F_{f2,1*}{}^3\right| + \ldots + \left|v_{f2m,n*}\right| \cdot t_{n*} \cdot \left|F_{f2,n*}{}^3\right|}{\left|v_{f2m,1*}\right| \cdot t_{1*} + \ldots + \left|v_{f2m,n*}\right| \cdot t_{n*}}}$$

Calculation of the thermal limit torque

Calculate the thermal limit torque M_{2th} for a duty cycle $ED_{10} > 50\%$ and the actual average input speed n_{1m*}. (At $K_{mot,th} \leq 0$ you must reduce the average input speed n_{1m*} accordingly or select another geared motor size.)

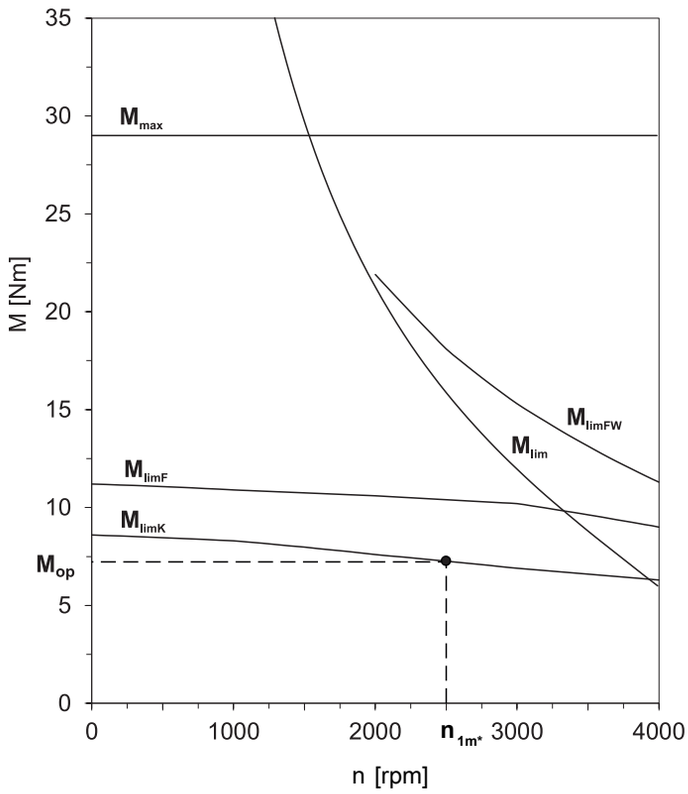
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

$$K_{mot,th} = 0{,}95 - \frac{a_{th}}{1000} \cdot fB_T \cdot \left(\frac{n_{1m*}}{1000}\right)^3$$

Refer to the selection tables for the values of i and a_{th}.

The values for fB_T can be found in the corresponding table in this chapter.

The value for the torque of the motor at operating point M_{op} with the determined average input speed n_{1m*} can be found in the motor characteristic curve of the chapter [▶ 13.3]. Note the size, nominal speed n_N and cooling type of the motor. The figure below shows an example of reading the torque M_{op} of a motor with convection cooling at the operating point.



Calculation of the actual effective torque

$$M_{2eff*} = \sqrt{\frac{t_{1*} \cdot M_{2,1*}^{\ 2} + \ldots + t_{n*} \cdot M_{2,n*}^{\ 2}}{t_{1*} + \ldots + t_{n*}}}$$

$$M_{2,n*} = \frac{F_{f2,n*} \cdot d_0}{2}$$

$$M_{1eff*} = \frac{M_{2eff*}}{i \cdot \eta}$$

Operating factors

Operating mode	fB_{op}
Uniform continuous operation	1.00
Cyclic operation	1.00
Reversing load cyclic operation	1.00

Run time	fB_t
Daily runtime ≤ 8 h	1.00
Daily runtime ≤ 16 h	1.15
Daily runtime ≤ 24 h	1.20

Cyclic operation	fB_{ZB}
≤ 1000 load changes/hour (LW/h)	1.00
> 1000 load changes/hour (LW/h)	1.15

Temperature		fB_T
Motor cooling	**Surrounding temperature**	
Motor with forced ventilation	≤ 20 °C	0.9
	≤ 30 °C	1.0
	≤ 40 °C	1.15
Motor with convection cooling	≤ 20 °C	1.0
	≤ 30 °C	1.1
	≤ 40 °C	1.25

Notes

- The maximum permitted gear unit temperature (see the "Other product features" chapter) must not be exceeded, as that could result in damage.
- For braking from full speed (for example, when the power fails or when setting up the machine), note the permitted gear unit feed forces (F_{f2acc}, F_{f2NOT}) in the selection tables.

9.6.2 Radial shaft seal rings

Leak-proofness

Our gear units are equipped with high-quality radial shaft seal rings and checked for leaks. However, a leak cannot be fully ruled out over the length of use of a gear unit. If you use a gear unit with goods incompatible with the lubricant, you must take measures to prevent direct contact with the gear unit lubricant in case of a leak.

9.7 Additional documentation

Additional documentation related to the product can be found at
http://www.stoeber.de/en/downloads/

Enter the ID of the documentation in the Search... field.

Documentation	ID
Operating manual for gear racks (Atlanta)	442455
Operating manual for PE22 – PE52 planetary gear units and planetary geared motors	443252_en
Operating manual for EZ synchronous servo motors	443032_en

10 ZVKS rack and pinion drives

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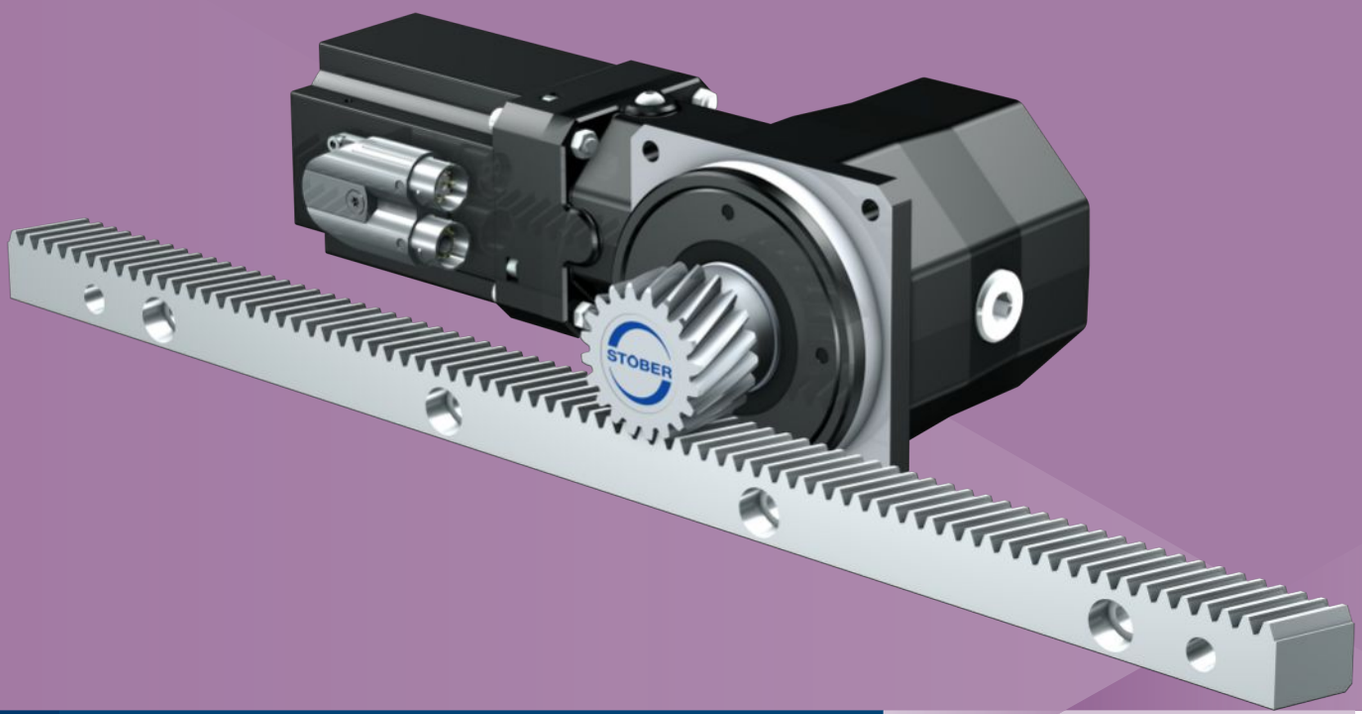


10 Rack and pinion drives

ZVKS

10.1 Overview

Right-angle servo geared motors with plug-on pinion

Features

Power density	★★★☆☆
Linear clearance	★★★☆☆
Price category	€€€
Smooth operation	★★★★☆
Linear rigidity	★★★☆☆
Mass moment of inertia	★★★★☆
Ready-to-install drive solution	✓
Pinion gearing quality 6 (DIN 3962)	✓
Helical gearing	✓
Case-hardened and smoothed	✓
Compact and highly dynamic due to direct motor attachment	✓

Key ★☆☆☆☆ good | ★★★★★ excellent
€ Economy | €€€€€ Premium

Technical data

m_n	2 – 4 mm
z	18 – 25
F_{f2acc}	1.3 – 11 kN
v_{f2N}	0.08 – 3 m/s
Δs	37 – 44 µm

10.2 Selection table

The technical data specified in the selection tables applies to:

- De-energized installation
- Permanent lubrication with the lubricants specified in the Atlanta product catalog
- Material combinations as described in the chapter [▶ 10.5.2]
- Installation altitudes up to 1000 m above sea level
- Surrounding temperatures from 0 °C to 40 °C
- Without consideration of the thermal limiting performance
- Drives with convection-cooled motors (e.g. EZ401**U**)

For the technical data on drives with forced ventilated motors (e.g. EZ401**B**), refer to http://configurator.stoeber.de.

For all other technical data, refer to http://configurator.stoeber.de.

An explanation of the formula symbols can be found in the chapter [▶ 15.1].

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV2KS4 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 4,2 kN)																
0.13	2.0	2.1	0.2	1.2	ZV220S_KS403_0500 EZ301U	4.2	6.6	90	50.00	0.18	0.27	37	56	2	20	42.4
0.17	1.6	1.7	0.3	1.5	ZV220S_KS403_0400 EZ301U	4.2	6.6	90	40.00	0.19	0.33	37	56	2	20	42.4
0.21	1.3	1.3	0.4	1.9	ZV220S_KS403_0320 EZ301U	3.9	6.6	83	32.00	0.24	0.42	37	56	2	20	42.4
0.21	2.2	2.4	0.6	1.1	ZV220S_KS403_0320 EZ302U	4.2	6.6	90	32.00	0.24	0.42	37	56	2	20	42.4
0.28	1.0	1.0	0.5	2.5	ZV220S_KS403_0240 EZ301U	2.9	6.6	62	24.00	0.32	0.56	37	56	2	20	42.4
0.28	1.7	1.8	0.9	1.5	ZV220S_KS403_0240 EZ302U	4.2	6.6	90	24.00	0.32	0.56	37	56	2	20	42.4
0.28	2.2	2.3	1.2	1.1	ZV220S_KS403_0240 EZ303U	4.2	6.6	90	24.00	0.32	0.56	37	56	2	20	42.4
0.33	0.8	0.9	0.7	2.9	ZV220S_KS402_0200 EZ301U	2.5	6.6	53	20.00	0.44	0.67	37	56	2	20	42.4
0.33	1.4	1.5	1.2	1.7	ZV220S_KS402_0200 EZ302U	4.2	6.6	90	20.00	0.44	0.67	37	56	2	20	42.4
0.33	1.9	2.0	1.5	1.3	ZV220S_KS402_0200 EZ303U	4.2	6.6	90	20.00	0.44	0.67	37	56	2	20	42.4
0.48	0.6	0.6	1.0	4.2	ZV220S_KS402_0140 EZ301U	1.8	6.6	37	14.00	0.64	0.95	37	56	2	20	42.4
0.48	1.0	1.1	1.8	2.4	ZV220S_KS402_0140 EZ302U	3.1	6.6	67	14.00	0.64	0.95	37	56	2	20	42.4
0.48	1.3	1.4	2.3	1.9	ZV220S_KS402_0140 EZ303U	4.2	6.6	90	14.00	0.64	0.95	37	56	2	20	42.4
0.48	1.8	1.9	3.1	1.4	ZV220S_KS402_0140 EZ401U	4.2	6.6	90	14.00	0.64	0.95	37	56	2	20	42.4
0.67	0.7	0.8	2.6	3.4	ZV220S_KS402_0100 EZ302U	2.2	6.6	48	10.00	0.84	1.33	37	56	2	20	42.4
0.67	0.9	1.0	3.4	2.6	ZV220S_KS402_0100 EZ303U	3.1	6.6	67	10.00	0.84	1.33	37	56	2	20	42.4
0.67	1.3	1.3	4.7	1.9	ZV220S_KS402_0100 EZ401U	3.8	6.6	81	10.00	0.84	1.33	37	56	2	20	42.4
0.67	2.1	2.3	7.8	1.2	ZV220S_KS402_0100 EZ402U	4.2	6.6	90	10.00	0.84	1.33	37	56	2	20	42.4
0.83	0.6	0.6	3.5	4.3	ZV220S_KS402_0080 EZ302U	1.8	6.6	38	8.000	0.97	1.67	37	56	2	20	42.4
0.83	0.7	0.8	4.5	3.3	ZV220S_KS402_0080 EZ303U	2.5	6.6	53	8.000	0.97	1.67	37	56	2	20	42.4
0.83	1.0	1.1	6.1	2.4	ZV220S_KS402_0080 EZ401U	3.0	6.6	65	8.000	0.97	1.67	37	56	2	20	42.4
0.83	1.7	1.9	10	1.4	ZV220S_KS402_0080 EZ402U	4.2	6.6	90	8.000	0.97	1.67	37	56	2	20	42.4
1.11	0.6	0.6	6.4	4.4	ZV220S_KS402_0060 EZ303U	1.9	6.6	40	6.000	1.11	2.22	37	56	2	20	42.4
1.11	0.8	0.8	8.6	3.2	ZV220S_KS402_0060 EZ401U	2.3	6.6	48	6.000	1.11	2.22	37	56	2	20	42.4
1.11	1.3	1.4	14	1.9	ZV220S_KS402_0060 EZ402U	4.2	6.6	90	6.000	1.11	2.22	37	56	2	20	42.4
ZV2KS4 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 4,2 kN)																
0.33	1.6	1.7	0.3	1.2	ZV220S_KS403_0400 EZ301U	4.2	6.6	90	40.00	0.19	0.33	37	56	2	20	42.4
0.42	1.2	1.3	0.5	1.5	ZV220S_KS403_0320 EZ301U	3.9	6.6	83	32.00	0.24	0.42	37	56	2	20	42.4
0.56	0.9	1.0	0.6	2.1	ZV220S_KS403_0240 EZ301U	2.9	6.6	62	24.00	0.32	0.56	37	56	2	20	42.4
0.56	1.6	1.8	1.1	1.2	ZV220S_KS403_0240 EZ302U	4.2	6.6	90	24.00	0.32	0.56	37	56	2	20	42.4
0.67	0.8	0.9	0.8	2.4	ZV220S_KS402_0200 EZ301U	2.5	6.6	53	20.00	0.44	0.67	37	56	2	20	42.4
0.67	1.3	1.5	1.4	1.4	ZV220S_KS402_0200 EZ302U	4.2	6.6	90	20.00	0.44	0.67	37	56	2	20	42.4
0.67	1.8	2.0	1.8	1.1	ZV220S_KS402_0200 EZ303U	4.2	6.6	90	20.00	0.44	0.67	37	56	2	20	42.4
0.95	0.6	0.6	1.2	3.5	ZV220S_KS402_0140 EZ301U	1.8	6.6	37	14.00	0.64	0.95	37	56	2	20	42.4
0.95	0.9	1.1	2.1	2.1	ZV220S_KS402_0140 EZ302U	3.1	6.6	67	14.00	0.64	0.95	37	56	2	20	42.4
0.95	1.2	1.4	2.7	1.6	ZV220S_KS402_0140 EZ303U	4.2	6.6	90	14.00	0.64	0.95	37	56	2	20	42.4
0.95	1.4	1.8	3.2	1.3	ZV220S_KS402_0140 EZ401U	4.2	6.6	90	14.00	0.64	0.95	37	56	2	20	42.4
1.33	0.4	0.4	1.9	4.8	ZV220S_KS402_0100 EZ301U	1.3	6.6	27	10.00	0.84	1.33	37	56	2	20	42.4
1.33	0.7	0.8	3.1	2.9	ZV220S_KS402_0100 EZ302U	2.2	6.6	48	10.00	0.84	1.33	37	56	2	20	42.4
1.33	0.9	1.0	4.1	2.2	ZV220S_KS402_0100 EZ303U	3.1	6.6	67	10.00	0.84	1.33	37	56	2	20	42.4
1.33	1.0	1.3	4.8	1.9	ZV220S_KS402_0100 EZ401U	3.8	6.6	81	10.00	0.84	1.33	37	56	2	20	42.4
1.33	1.6	2.2	7.3	1.2	ZV220S_KS402_0100 EZ402U	4.2	6.6	90	10.00	0.84	1.33	37	56	2	20	42.4
1.67	0.5	0.6	4.1	3.6	ZV220S_KS402_0080 EZ302U	1.8	6.6	38	8.000	0.97	1.67	37	56	2	20	42.4
1.67	0.7	0.8	5.4	2.7	ZV220S_KS402_0080 EZ303U	2.5	6.6	53	8.000	0.97	1.67	37	56	2	20	42.4
1.67	0.8	1.0	6.3	2.3	ZV220S_KS402_0080 EZ401U	3.0	6.6	65	8.000	0.97	1.67	37	56	2	20	42.4
1.67	1.3	1.8	9.6	1.5	ZV220S_KS402_0080 EZ402U	4.2	6.6	90	8.000	0.97	1.67	37	56	2	20	42.4
2.22	0.4	0.5	5.8	4.8	ZV220S_KS402_0060 EZ302U	1.3	6.6	29	6.000	1.11	2.22	37	56	2	20	42.4
2.22	0.5	0.6	7.6	3.7	ZV220S_KS402_0060 EZ303U	1.9	6.6	40	6.000	1.11	2.22	37	56	2	20	42.4

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV2KS4 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 4,2 kN)																
2.22	0.6	0.8	8.9	3.1	ZV220S_KS402_0060 EZ401U	2.3	6.6	48	6.000	1.11	2.22	37	56	2	20	42.4
2.22	0.9	1.3	14	2.1	ZV220S_KS402_0060 EZ402U	4.2	6.6	90	6.000	1.11	2.22	37	56	2	20	42.4
ZV2KS5 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 7,5 kN)																
0.08	3.3	3.3	0.1	1.1	ZV225S_KS503_1000 EZ301U	7.5	11	200	100.0	0.12	0.17	39	69	2	25	53.1
0.10	2.6	2.7	0.1	1.4	ZV225S_KS503_0800 EZ301U	7.5	11	200	80.00	0.15	0.21	39	69	2	25	53.1
0.12	2.3	2.3	0.1	1.6	ZV225S_KS503_0700 EZ301U	6.9	11	180	70.00	0.17	0.24	39	69	2	25	53.1
0.17	1.6	1.7	0.1	2.3	ZV225S_KS503_0500 EZ301U	4.9	11	130	50.00	0.19	0.33	39	69	2	25	53.1
0.17	2.8	2.9	0.2	1.3	ZV225S_KS503_0500 EZ302U	7.5	11	200	50.00	0.19	0.33	39	69	2	25	53.1
0.17	3.6	3.8	0.3	1.0	ZV225S_KS503_0500 EZ303U	7.5	11	200	50.00	0.19	0.33	39	69	2	25	53.1
0.21	1.3	1.3	0.2	2.9	ZV225S_KS503_0400 EZ301U	3.9	11	100	40.00	0.22	0.42	39	69	2	25	53.1
0.21	2.2	2.4	0.3	1.7	ZV225S_KS503_0400 EZ302U	7.0	11	190	40.00	0.22	0.42	39	69	2	25	53.1
0.21	2.9	3.1	0.4	1.3	ZV225S_KS503_0400 EZ303U	7.5	11	200	40.00	0.22	0.42	39	69	2	25	53.1
0.26	1.0	1.1	0.2	3.6	ZV225S_KS503_0320 EZ301U	3.1	11	83	32.00	0.27	0.52	39	69	2	25	53.1
0.26	1.8	1.9	0.4	2.1	ZV225S_KS503_0320 EZ302U	5.6	11	150	32.00	0.27	0.52	39	69	2	25	53.1
0.26	2.3	2.5	0.5	1.6	ZV225S_KS503_0320 EZ303U	7.5	11	200	32.00	0.27	0.52	39	69	2	25	53.1
0.26	3.1	3.4	0.7	1.2	ZV225S_KS503_0320 EZ401U	7.5	11	200	32.00	0.27	0.52	39	69	2	25	53.1
0.35	0.8	0.8	0.3	4.8	ZV225S_KS503_0240 EZ301U	2.4	11	62	24.00	0.36	0.69	39	69	2	25	53.1
0.35	1.3	1.4	0.6	2.8	ZV225S_KS503_0240 EZ302U	4.2	11	110	24.00	0.36	0.69	39	69	2	25	53.1
0.35	1.7	1.8	0.7	2.1	ZV225S_KS503_0240 EZ303U	5.9	11	160	24.00	0.36	0.69	39	69	2	25	53.1
0.35	2.4	2.5	1.0	1.6	ZV225S_KS503_0240 EZ401U	7.2	11	190	24.00	0.36	0.69	39	69	2	25	53.1
0.42	2.0	2.1	1.2	1.9	ZV225S_KS502_0200 EZ401U	6.1	11	160	20.00	0.49	0.83	39	69	2	25	53.1
0.42	3.1	3.4	1.9	1.2	ZV225S_KS502_0200 EZ501U	7.5	11	200	20.00	0.49	0.83	39	69	2	25	53.1
0.42	3.4	3.7	2.1	1.1	ZV225S_KS502_0200 EZ402U	7.5	11	200	20.00	0.49	0.83	39	69	2	25	53.1
0.60	1.4	1.5	1.9	2.7	ZV225S_KS502_0140 EZ401U	4.3	11	110	14.00	0.64	1.19	39	69	2	25	53.1
0.60	2.2	2.4	2.9	1.7	ZV225S_KS502_0140 EZ501U	7.5	11	200	14.00	0.64	1.19	39	69	2	25	53.1
0.60	2.4	2.6	3.2	1.6	ZV225S_KS502_0140 EZ402U	7.5	11	200	14.00	0.64	1.19	39	69	2	25	53.1
0.60	3.5	4.3	4.7	1.1	ZV225S_KS502_0140 EZ404U	7.5	11	200	14.00	0.64	1.19	39	69	2	25	53.1
0.60	3.7	4.0	5.0	1.0	ZV225S_KS502_0140 EZ502U	7.5	11	200	14.00	0.64	1.19	39	69	2	25	53.1
0.83	1.0	1.1	2.9	3.7	ZV225S_KS502_0100 EZ401U	3.0	11	81	10.00	0.83	1.67	39	69	2	25	53.1
0.83	1.5	1.7	4.4	2.4	ZV225S_KS502_0100 EZ501U	5.7	11	150	10.00	0.83	1.67	39	69	2	25	53.1
0.83	1.7	1.9	4.8	2.2	ZV225S_KS502_0100 EZ402U	5.7	11	150	10.00	0.83	1.67	39	69	2	25	53.1
0.83	2.5	3.1	7.0	1.5	ZV225S_KS502_0100 EZ404U	7.5	11	200	10.00	0.83	1.67	39	69	2	25	53.1
0.83	2.7	2.9	7.6	1.4	ZV225S_KS502_0100 EZ502U	7.5	11	200	10.00	0.83	1.67	39	69	2	25	53.1
0.83	3.5	4.0	9.9	1.1	ZV225S_KS502_0100 EZ503U	7.5	11	200	10.00	0.83	1.67	39	69	2	25	53.1
1.04	0.8	0.9	3.7	4.7	ZV225S_KS502_0080 EZ401U	2.4	11	65	8.000	0.97	2.08	39	69	2	25	53.1
1.04	1.2	1.3	5.7	3.0	ZV225S_KS502_0080 EZ501U	4.6	11	120	8.000	0.97	2.08	39	69	2	25	53.1
1.04	1.3	1.5	6.3	2.8	ZV225S_KS502_0080 EZ402U	4.6	11	120	8.000	0.97	2.08	39	69	2	25	53.1
1.04	2.0	2.5	9.2	1.9	ZV225S_KS502_0080 EZ404U	7.5	11	200	8.000	0.97	2.08	39	69	2	25	53.1
1.04	2.1	2.3	9.9	1.8	ZV225S_KS502_0080 EZ502U	7.5	11	200	8.000	0.97	2.08	39	69	2	25	53.1
1.04	2.8	3.2	13	1.3	ZV225S_KS502_0080 EZ503U	7.5	11	200	8.000	0.97	2.08	39	69	2	25	53.1
1.39	0.9	1.0	9.2	3.6	ZV225S_KS502_0060 EZ501U	3.4	11	91	6.000	1.16	2.55	39	69	2	25	53.1
1.39	1.0	1.1	10	3.3	ZV225S_KS502_0060 EZ402U	3.4	11	91	6.000	1.16	2.55	39	69	2	25	53.1
1.39	1.5	1.8	15	2.2	ZV225S_KS502_0060 EZ404U	6.2	11	170	6.000	1.16	2.55	39	69	2	25	53.1
1.39	1.6	1.7	16	2.1	ZV225S_KS502_0060 EZ502U	6.7	11	180	6.000	1.16	2.55	39	69	2	25	53.1
1.39	2.1	2.4	21	1.6	ZV225S_KS502_0060 EZ503U	7.5	11	200	6.000	1.16	2.55	39	69	2	25	53.1
ZV2KS5 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 7,5 kN)																
0.21	2.5	2.7	0.1	1.2	ZV225S_KS503_0800 EZ301U	7.5	11	200	80.00	0.15	0.21	39	69	2	25	53.1
0.24	2.2	2.3	0.1	1.4	ZV225S_KS503_0700 EZ301U	6.9	11	180	70.00	0.17	0.24	39	69	2	25	53.1
0.33	1.6	1.7	0.2	1.9	ZV225S_KS503_0500 EZ301U	4.9	11	130	50.00	0.19	0.33	39	69	2	25	53.1
0.33	2.6	2.9	0.3	1.1	ZV225S_KS503_0500 EZ302U	7.5	11	200	50.00	0.19	0.33	39	69	2	25	53.1
0.42	1.2	1.3	0.2	2.4	ZV225S_KS503_0400 EZ301U	3.9	11	100	40.00	0.22	0.42	39	69	2	25	53.1
0.42	2.1	2.4	0.4	1.4	ZV225S_KS503_0400 EZ302U	7.0	11	190	40.00	0.22	0.42	39	69	2	25	53.1
0.42	2.7	3.2	0.5	1.1	ZV225S_KS503_0400 EZ303U	7.5	11	200	40.00	0.22	0.42	39	69	2	25	53.1
0.52	1.0	1.1	0.3	3.0	ZV225S_KS503_0320 EZ301U	3.1	11	83	32.00	0.27	0.52	39	69	2	25	53.1
0.52	1.7	1.9	0.5	1.8	ZV225S_KS503_0320 EZ302U	5.6	11	150	32.00	0.27	0.52	39	69	2	25	53.1
0.52	2.2	2.5	0.6	1.4	ZV225S_KS503_0320 EZ303U	7.5	11	200	32.00	0.27	0.52	39	69	2	25	53.1
0.52	2.6	3.1	0.7	1.2	ZV225S_KS503_0320 EZ401U	7.5	11	200	32.00	0.27	0.52	39	69	2	25	53.1
0.69	0.7	0.8	0.4	4.0	ZV225S_KS503_0240 EZ301U	2.4	11	62	24.00	0.36	0.69	39	69	2	25	53.1
0.69	1.3	1.4	0.7	2.4	ZV225S_KS503_0240 EZ302U	4.2	11	110	24.00	0.36	0.69	39	69	2	25	53.1
0.69	1.6	1.9	0.9	1.8	ZV225S_KS503_0240 EZ303U	5.9	11	160	24.00	0.36	0.69	39	69	2	25	53.1
0.69	1.9	2.4	1.0	1.5	ZV225S_KS503_0240 EZ401U	7.2	11	190	24.00	0.36	0.69	39	69	2	25	53.1
0.69	2.9	4.1	1.5	1.0	ZV225S_KS503_0240 EZ402U	7.5	11	200	24.00	0.36	0.69	39	69	2	25	53.1
0.83	1.6	2.0	1.3	1.8	ZV225S_KS502_0200 EZ401U	6.1	11	160	20.00	0.49	0.83	39	69	2	25	53.1
0.83	2.4	3.2	1.9	1.2	ZV225S_KS502_0200 EZ501U	7.5	11	200	20.00	0.49	0.83	39	69	2	25	53.1
0.83	2.5	3.5	2.0	1.2	ZV225S_KS502_0200 EZ402U	7.5	11	200	20.00	0.49	0.83	39	69	2	25	53.1
1.19	1.2	1.4	2.0	2.6	ZV225S_KS502_0140 EZ401U	4.3	11	110	14.00	0.64	1.19	39	69	2	25	53.1

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV2KS5 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 7,5 kN)																
1.19	1.7	2.2	2.9	1.7	ZV225S_KS502_0140 EZ501U	7.5	11	200	14.00	0.64	1.19	39	69	2	25	53.1
1.19	1.8	2.5	3.0	1.7	ZV225S_KS502_0140 EZ402U	7.5	11	200	14.00	0.64	1.19	39	69	2	25	53.1
1.19	2.6	3.9	4.5	1.1	ZV225S_KS502_0140 EZ502U	7.5	11	200	14.00	0.64	1.19	39	69	2	25	53.1
1.19	2.9	4.2	5.0	1.0	ZV225S_KS502_0140 EZ404U	7.5	11	200	14.00	0.64	1.19	39	69	2	25	53.1
1.67	0.8	1.0	3.0	3.6	ZV225S_KS502_0100 EZ401U	3.0	11	81	10.00	0.83	1.67	39	69	2	25	53.1
1.67	1.2	1.6	4.4	2.4	ZV225S_KS502_0100 EZ501U	5.7	11	150	10.00	0.83	1.67	39	69	2	25	53.1
1.67	1.3	1.8	4.5	2.4	ZV225S_KS502_0100 EZ402U	5.7	11	150	10.00	0.83	1.67	39	69	2	25	53.1
1.67	1.9	2.8	6.7	1.6	ZV225S_KS502_0100 EZ502U	7.5	11	200	10.00	0.83	1.67	39	69	2	25	53.1
1.67	2.1	3.0	7.5	1.4	ZV225S_KS502_0100 EZ404U	7.5	11	200	10.00	0.83	1.67	39	69	2	25	53.1
1.67	2.2	3.8	8.0	1.3	ZV225S_KS502_0100 EZ503U	7.5	11	200	10.00	0.83	1.67	39	69	2	25	53.1
2.08	0.7	0.8	3.9	4.5	ZV225S_KS502_0080 EZ401U	2.4	11	65	8.000	0.97	2.08	39	69	2	25	53.1
2.08	1.0	1.3	5.7	3.0	ZV225S_KS502_0080 EZ501U	4.6	11	120	8.000	0.97	2.08	39	69	2	25	53.1
2.08	1.0	1.4	5.9	3.0	ZV225S_KS502_0080 EZ402U	4.6	11	120	8.000	0.97	2.08	39	69	2	25	53.1
2.08	1.5	2.2	8.7	2.0	ZV225S_KS502_0080 EZ502U	7.5	11	200	8.000	0.97	2.08	39	69	2	25	53.1
2.08	1.7	2.4	9.7	1.8	ZV225S_KS502_0080 EZ404U	7.5	11	200	8.000	0.97	2.08	39	69	2	25	53.1
2.08	1.8	3.0	10	1.7	ZV225S_KS502_0080 EZ503U	7.5	11	200	8.000	0.97	2.08	39	69	2	25	53.1
ZV3KS5 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 7,0 kN)																
0.09	3.0	3.1	0.1	1.1	ZV318S_KS503_1000 EZ301U	7.0	10	200	100.0	0.13	0.18	42	62	3	18	57.3
0.11	2.4	2.5	0.1	1.4	ZV318S_KS503_0800 EZ301U	7.0	10	200	80.00	0.16	0.23	42	62	3	18	57.3
0.13	2.1	2.2	0.1	1.6	ZV318S_KS503_0700 EZ301U	6.4	10	180	70.00	0.18	0.26	42	62	3	18	57.3
0.18	1.5	1.5	0.1	2.3	ZV318S_KS503_0500 EZ301U	4.5	10	130	50.00	0.21	0.36	42	62	3	18	57.3
0.18	2.6	2.7	0.2	1.3	ZV318S_KS503_0500 EZ302U	7.0	10	200	50.00	0.21	0.36	42	62	3	18	57.3
0.18	3.4	3.6	0.3	1.0	ZV318S_KS503_0500 EZ303U	7.0	10	200	50.00	0.21	0.36	42	62	3	18	57.3
0.23	1.2	1.2	0.2	2.9	ZV318S_KS503_0400 EZ301U	3.6	10	100	40.00	0.23	0.45	42	62	3	18	57.3
0.23	2.1	2.2	0.3	1.7	ZV318S_KS503_0400 EZ302U	6.5	10	190	40.00	0.23	0.45	42	62	3	18	57.3
0.23	2.7	2.8	0.4	1.3	ZV318S_KS503_0400 EZ303U	7.0	10	200	40.00	0.23	0.45	42	62	3	18	57.3
0.28	1.0	1.0	0.2	3.6	ZV318S_KS503_0320 EZ301U	2.9	10	83	32.00	0.29	0.56	42	62	3	18	57.3
0.28	1.7	1.7	0.4	2.1	ZV318S_KS503_0320 EZ302U	5.2	10	150	32.00	0.29	0.56	42	62	3	18	57.3
0.28	2.2	2.3	0.5	1.6	ZV318S_KS503_0320 EZ303U	7.0	10	200	32.00	0.29	0.56	42	62	3	18	57.3
0.28	2.9	3.1	0.7	1.2	ZV318S_KS503_0320 EZ401U	7.0	10	200	32.00	0.29	0.56	42	62	3	18	57.3
0.38	0.7	0.7	0.3	4.8	ZV318S_KS503_0240 EZ301U	2.2	10	62	24.00	0.39	0.75	42	62	3	18	57.3
0.38	1.2	1.3	0.6	2.8	ZV318S_KS503_0240 EZ302U	3.9	10	110	24.00	0.39	0.75	42	62	3	18	57.3
0.38	1.6	1.7	0.7	2.1	ZV318S_KS503_0240 EZ303U	5.5	10	160	24.00	0.39	0.75	42	62	3	18	57.3
0.38	2.2	2.3	1.0	1.6	ZV318S_KS503_0240 EZ401U	6.6	10	190	24.00	0.39	0.75	42	62	3	18	57.3
0.45	1.9	2.0	1.2	1.9	ZV318S_KS502_0200 EZ401U	5.6	10	160	20.00	0.53	0.90	42	62	3	18	57.3
0.45	2.9	3.1	1.9	1.2	ZV318S_KS502_0200 EZ501U	7.0	10	200	20.00	0.53	0.90	42	62	3	18	57.3
0.45	3.1	3.4	2.1	1.1	ZV318S_KS502_0200 EZ402U	7.0	10	200	20.00	0.53	0.90	42	62	3	18	57.3
0.64	1.3	1.4	1.9	2.7	ZV318S_KS502_0140 EZ401U	3.9	10	110	14.00	0.69	1.29	42	62	3	18	57.3
0.64	2.0	2.2	2.9	1.7	ZV318S_KS502_0140 EZ501U	7.0	10	200	14.00	0.69	1.29	42	62	3	18	57.3
0.64	2.2	2.4	3.2	1.6	ZV318S_KS502_0140 EZ402U	7.0	10	200	14.00	0.69	1.29	42	62	3	18	57.3
0.64	3.2	4.0	4.7	1.1	ZV318S_KS502_0140 EZ404U	7.0	10	200	14.00	0.69	1.29	42	62	3	18	57.3
0.64	3.4	3.7	5.0	1.0	ZV318S_KS502_0140 EZ502U	7.0	10	200	14.00	0.69	1.29	42	62	3	18	57.3
0.90	0.9	1.0	2.9	3.7	ZV318S_KS502_0100 EZ401U	2.8	10	81	10.00	0.90	1.80	42	62	3	18	57.3
0.90	1.4	1.6	4.4	2.4	ZV318S_KS502_0100 EZ501U	5.3	10	150	10.00	0.90	1.80	42	62	3	18	57.3
0.90	1.6	1.7	4.8	2.2	ZV318S_KS502_0100 EZ402U	5.3	10	150	10.00	0.90	1.80	42	62	3	18	57.3
0.90	2.3	2.9	7.0	1.5	ZV318S_KS502_0100 EZ404U	7.0	10	200	10.00	0.90	1.80	42	62	3	18	57.3
0.90	2.5	2.7	7.6	1.4	ZV318S_KS502_0100 EZ502U	7.0	10	200	10.00	0.90	1.80	42	62	3	18	57.3
0.90	3.2	3.7	9.9	1.1	ZV318S_KS502_0100 EZ503U	7.0	10	200	10.00	0.90	1.80	42	62	3	18	57.3
1.13	0.7	0.8	3.7	4.7	ZV318S_KS502_0080 EZ401U	2.3	10	65	8.000	1.05	2.25	42	62	3	18	57.3
1.13	1.1	1.2	5.7	3.0	ZV318S_KS502_0080 EZ501U	4.2	10	120	8.000	1.05	2.25	42	62	3	18	57.3
1.13	1.2	1.4	6.3	2.8	ZV318S_KS502_0080 EZ402U	4.2	10	120	8.000	1.05	2.25	42	62	3	18	57.3
1.13	1.8	2.3	9.2	1.9	ZV318S_KS502_0080 EZ404U	7.0	10	200	8.000	1.05	2.25	42	62	3	18	57.3
1.13	2.0	2.1	9.9	1.8	ZV318S_KS502_0080 EZ502U	7.0	10	200	8.000	1.05	2.25	42	62	3	18	57.3
1.13	2.6	2.9	13	1.3	ZV318S_KS502_0080 EZ503U	7.0	10	200	8.000	1.05	2.25	42	62	3	18	57.3
1.50	0.9	0.9	9.2	3.6	ZV318S_KS502_0060 EZ501U	3.2	10	91	6.000	1.25	2.75	42	62	3	18	57.3
1.50	0.9	1.0	10	3.3	ZV318S_KS502_0060 EZ402U	3.2	10	91	6.000	1.25	2.75	42	62	3	18	57.3
1.50	1.4	1.7	15	2.2	ZV318S_KS502_0060 EZ404U	5.8	10	170	6.000	1.25	2.75	42	62	3	18	57.3
1.50	1.5	1.6	16	2.1	ZV318S_KS502_0060 EZ502U	6.2	10	180	6.000	1.25	2.75	42	62	3	18	57.3
1.50	1.9	2.2	21	1.6	ZV318S_KS502_0060 EZ503U	7.0	10	200	6.000	1.25	2.75	42	62	3	18	57.3
ZV3KS5 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 7,0 kN)																
0.23	2.3	2.5	0.1	1.2	ZV318S_KS503_0800 EZ301U	7.0	10	200	80.00	0.16	0.23	42	62	3	18	57.3
0.26	2.0	2.2	0.1	1.4	ZV318S_KS503_0700 EZ301U	6.4	10	180	70.00	0.18	0.26	42	62	3	18	57.3
0.36	1.4	1.5	0.2	1.9	ZV318S_KS503_0500 EZ301U	4.5	10	130	50.00	0.21	0.36	42	62	3	18	57.3
0.36	2.4	2.7	0.3	1.1	ZV318S_KS503_0500 EZ302U	7.0	10	200	50.00	0.21	0.36	42	62	3	18	57.3
0.45	1.2	1.2	0.2	2.4	ZV318S_KS503_0400 EZ301U	3.6	10	100	40.00	0.23	0.45	42	62	3	18	57.3
0.45	1.9	2.2	0.4	1.4	ZV318S_KS503_0400 EZ302U	6.5	10	190	40.00	0.23	0.45	42	62	3	18	57.3

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV3KS5 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 7,0 kN)																
0.45	2.5	2.9	0.5	1.1	ZV318S_KS503_0400 EZ303U	7.0	10	200	40.00	0.23	0.45	42	62	3	18	57.3
0.56	0.9	1.0	0.3	3.0	ZV318S_KS503_0320 EZ301U	2.9	10	83	32.00	0.29	0.56	42	62	3	18	57.3
0.56	1.6	1.7	0.5	1.8	ZV318S_KS503_0320 EZ302U	5.2	10	150	32.00	0.29	0.56	42	62	3	18	57.3
0.56	2.0	2.3	0.6	1.4	ZV318S_KS503_0320 EZ303U	7.0	10	200	32.00	0.29	0.56	42	62	3	18	57.3
0.56	2.4	2.9	0.7	1.2	ZV318S_KS503_0320 EZ401U	7.0	10	200	32.00	0.29	0.56	42	62	3	18	57.3
0.75	0.7	0.7	0.4	4.0	ZV318S_KS503_0240 EZ301U	2.2	10	62	24.00	0.39	0.75	42	62	3	18	57.3
0.75	1.2	1.3	0.7	2.4	ZV318S_KS503_0240 EZ302U	3.9	10	110	24.00	0.39	0.75	42	62	3	18	57.3
0.75	1.5	1.8	0.9	1.8	ZV318S_KS503_0240 EZ303U	5.5	10	160	24.00	0.39	0.75	42	62	3	18	57.3
0.75	1.8	2.2	1.0	1.5	ZV318S_KS503_0240 EZ401U	6.6	10	190	24.00	0.39	0.75	42	62	3	18	57.3
0.75	2.7	3.8	1.5	1.0	ZV318S_KS503_0240 EZ402U	7.0	10	200	24.00	0.39	0.75	42	62	3	18	57.3
0.90	1.5	1.9	1.3	1.8	ZV318S_KS502_0200 EZ401U	5.6	10	160	20.00	0.53	0.90	42	62	3	18	57.3
0.90	2.3	2.9	1.9	1.2	ZV318S_KS502_0200 EZ501U	7.0	10	200	20.00	0.53	0.90	42	62	3	18	57.3
0.90	2.3	3.2	2.0	1.2	ZV318S_KS502_0200 EZ402U	7.0	10	200	20.00	0.53	0.90	42	62	3	18	57.3
1.29	1.1	1.3	2.0	2.6	ZV318S_KS502_0140 EZ401U	3.9	10	110	14.00	0.69	1.29	42	62	3	18	57.3
1.29	1.6	2.0	2.9	1.7	ZV318S_KS502_0140 EZ501U	7.0	10	200	14.00	0.69	1.29	42	62	3	18	57.3
1.29	1.6	2.3	3.0	1.7	ZV318S_KS502_0140 EZ402U	7.0	10	200	14.00	0.69	1.29	42	62	3	18	57.3
1.29	2.4	3.6	4.5	1.1	ZV318S_KS502_0140 EZ502U	7.0	10	200	14.00	0.69	1.29	42	62	3	18	57.3
1.29	2.7	3.9	5.0	1.0	ZV318S_KS502_0140 EZ404U	7.0	10	200	14.00	0.69	1.29	42	62	3	18	57.3
1.80	0.8	0.9	3.0	3.6	ZV318S_KS502_0100 EZ401U	2.8	10	81	10.00	0.90	1.80	42	62	3	18	57.3
1.80	1.1	1.5	4.4	2.4	ZV318S_KS502_0100 EZ501U	5.3	10	150	10.00	0.90	1.80	42	62	3	18	57.3
1.80	1.2	1.6	4.5	2.4	ZV318S_KS502_0100 EZ402U	5.3	10	150	10.00	0.90	1.80	42	62	3	18	57.3
1.80	1.7	2.6	6.7	1.6	ZV318S_KS502_0100 EZ502U	7.0	10	200	10.00	0.90	1.80	42	62	3	18	57.3
1.80	1.9	2.8	7.5	1.4	ZV318S_KS502_0100 EZ404U	7.0	10	200	10.00	0.90	1.80	42	62	3	18	57.3
1.80	2.1	3.5	8.0	1.3	ZV318S_KS502_0100 EZ503U	7.0	10	200	10.00	0.90	1.80	42	62	3	18	57.3
2.25	0.6	0.7	3.9	4.5	ZV318S_KS502_0080 EZ401U	2.3	10	65	8.000	1.05	2.25	42	62	3	18	57.3
2.25	0.9	1.2	5.7	3.0	ZV318S_KS502_0080 EZ501U	4.2	10	120	8.000	1.05	2.25	42	62	3	18	57.3
2.25	0.9	1.3	5.9	3.0	ZV318S_KS502_0080 EZ402U	4.2	10	120	8.000	1.05	2.25	42	62	3	18	57.3
2.25	1.4	2.1	8.7	2.0	ZV318S_KS502_0080 EZ502U	7.0	10	200	8.000	1.05	2.25	42	62	3	18	57.3
2.25	1.5	2.2	9.7	1.8	ZV318S_KS502_0080 EZ404U	7.0	10	200	8.000	1.05	2.25	42	62	3	18	57.3
2.25	1.6	2.8	10	1.7	ZV318S_KS502_0080 EZ503U	7.0	10	200	8.000	1.05	2.25	42	62	3	18	57.3
ZV3KS7 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 11 kN)																
0.16	5.2	5.6	0.2	1.1	ZV322S_KS703_0700 EZ401U	11	17	400	70.00	0.18	0.31	41	95	3	22	70.0
0.22	3.7	4.0	0.3	1.5	ZV322S_KS703_0500 EZ401U	11	17	400	50.00	0.24	0.44	41	95	3	22	70.0
0.28	3.0	3.2	0.3	1.9	ZV322S_KS703_0400 EZ401U	9.0	17	320	40.00	0.28	0.55	41	95	3	22	70.0
0.28	4.6	5.0	0.5	1.2	ZV322S_KS703_0400 EZ501U	11	17	400	40.00	0.28	0.55	41	95	3	22	70.0
0.28	5.0	5.5	0.6	1.1	ZV322S_KS703_0400 EZ402U	11	17	400	40.00	0.28	0.55	41	95	3	22	70.0
0.34	2.4	2.5	0.5	2.4	ZV322S_KS703_0320 EZ401U	7.2	17	250	32.00	0.34	0.69	41	95	3	22	70.0
0.34	3.7	4.0	0.7	1.6	ZV322S_KS703_0320 EZ501U	11	17	400	32.00	0.34	0.69	41	95	3	22	70.0
0.34	4.0	4.4	0.8	1.4	ZV322S_KS703_0320 EZ402U	11	17	400	32.00	0.34	0.69	41	95	3	22	70.0
0.46	1.8	1.9	0.6	3.2	ZV322S_KS703_0240 EZ401U	5.4	17	190	24.00	0.46	0.92	41	95	3	22	70.0
0.46	2.7	3.0	1.0	2.1	ZV322S_KS703_0240 EZ501U	10	17	360	24.00	0.46	0.92	41	95	3	22	70.0
0.46	3.0	3.3	1.1	1.9	ZV322S_KS703_0240 EZ402U	10	17	360	24.00	0.46	0.92	41	95	3	22	70.0
0.46	4.4	5.5	1.6	1.3	ZV322S_KS703_0240 EZ404U	11	17	400	24.00	0.46	0.92	41	95	3	22	70.0
0.46	4.7	5.1	1.7	1.2	ZV322S_KS703_0240 EZ502U	11	17	400	24.00	0.46	0.92	41	95	3	22	70.0
0.55	2.3	2.6	2.7	2.4	ZV322S_KS702_0200 EZ501U	8.7	17	300	20.00	0.59	1.10	41	95	3	22	70.0
0.55	4.0	4.3	4.6	1.4	ZV322S_KS702_0200 EZ502U	11	17	400	20.00	0.59	1.10	41	95	3	22	70.0
0.55	4.0	4.5	4.6	1.4	ZV322S_KS702_0200 EZ701U	11	17	380	20.00	0.59	1.10	41	95	3	22	70.0
0.55	5.3	6.0	6.0	1.1	ZV322S_KS702_0200 EZ503U	11	17	400	20.00	0.59	1.10	41	95	3	22	70.0
0.79	1.6	1.8	4.1	3.5	ZV322S_KS702_0140 EZ501U	6.1	17	210	14.00	0.79	1.57	41	95	3	22	70.0
0.79	2.8	3.0	7.0	2.0	ZV322S_KS702_0140 EZ502U	11	17	400	14.00	0.79	1.57	41	95	3	22	70.0
0.79	2.8	3.2	7.0	2.0	ZV322S_KS702_0140 EZ701U	7.6	17	270	14.00	0.79	1.57	41	95	3	22	70.0
0.79	3.7	4.2	9.2	1.5	ZV322S_KS702_0140 EZ503U	11	17	400	14.00	0.79	1.57	41	95	3	22	70.0
1.10	1.2	1.3	6.1	4.9	ZV322S_KS702_0100 EZ501U	4.3	17	150	10.00	1.03	2.20	41	95	3	22	70.0
1.10	2.0	2.2	10	2.8	ZV322S_KS702_0100 EZ502U	8.4	17	290	10.00	1.03	2.20	41	95	3	22	70.0
1.10	2.0	2.3	10	2.8	ZV322S_KS702_0100 EZ701U	5.4	17	190	10.00	1.03	2.20	41	95	3	22	70.0
1.10	2.6	3.0	14	2.2	ZV322S_KS702_0100 EZ503U	11	17	400	10.00	1.03	2.20	41	95	3	22	70.0
1.10	3.3	3.9	17	1.7	ZV322S_KS702_0100 EZ702U	11	17	390	10.00	1.03	2.20	41	95	3	22	70.0
1.10	3.7	4.3	19	1.5	ZV322S_KS702_0100 EZ505U	11	17	400	10.00	1.03	2.20	41	95	3	22	70.0
1.10	4.5	5.6	23	1.3	ZV322S_KS702_0100 EZ703U	11	17	400	10.00	1.03	2.20	41	95	3	22	70.0
1.38	1.6	1.7	14	3.5	ZV322S_KS702_0080 EZ502U	6.7	17	240	8.000	1.15	2.29	41	95	3	22	70.0
1.38	1.6	1.8	14	3.5	ZV322S_KS702_0080 EZ701U	4.3	17	150	8.000	1.15	2.29	41	95	3	22	70.0
1.38	2.1	2.4	18	2.7	ZV322S_KS702_0080 EZ503U	9.3	17	330	8.000	1.15	2.29	41	95	3	22	70.0
1.38	2.6	3.1	22	2.2	ZV322S_KS702_0080 EZ702U	8.9	17	310	8.000	1.15	2.29	41	95	3	22	70.0
1.38	2.9	3.5	25	1.9	ZV322S_KS702_0080 EZ505U	11	17	400	8.000	1.15	2.29	41	95	3	22	70.0
1.38	3.6	4.5	31	1.6	ZV322S_KS702_0080 EZ703U	11	17	400	8.000	1.15	2.29	41	95	3	22	70.0
1.83	1.2	1.3	19	4.7	ZV322S_KS702_0060 EZ502U	5.0	17	180	6.000	1.28	2.75	41	95	3	22	70.0

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV3KS7 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 11 kN)																
1.83	1.2	1.4	19	4.7	ZV322S_KS702_0060 EZ701U	3.3	17	110	6.000	1.28	2.75	41	95	3	22	70.0
1.83	1.6	1.8	25	3.6	ZV322S_KS702_0060 EZ503U	7.0	17	250	6.000	1.28	2.75	41	95	3	22	70.0
1.83	2.0	2.3	31	2.9	ZV322S_KS702_0060 EZ702U	6.7	17	230	6.000	1.28	2.75	41	95	3	22	70.0
1.83	2.2	2.6	35	2.6	ZV322S_KS702_0060 EZ505U	11	17	380	6.000	1.28	2.75	41	95	3	22	70.0
1.83	2.7	3.4	43	2.1	ZV322S_KS702_0060 EZ703U	11	17	370	6.000	1.28	2.75	41	95	3	22	70.0
ZV3KS7 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 11 kN)																
1.65	2.6	4.2	15	1.9	ZV322S_KS702_0100 EZ505U	11	17	400	10.00	1.03	2.20	41	95	3	22	70.0
1.65	3.3	5.4	20	1.5	ZV322S_KS702_0100 EZ703U	11	17	400	10.00	1.03	2.20	41	95	3	22	70.0
2.06	2.1	3.3	20	2.4	ZV322S_KS702_0080 EZ505U	11	17	400	8.000	1.15	2.29	41	95	3	22	70.0
2.06	2.6	4.3	26	1.9	ZV322S_KS702_0080 EZ703U	11	17	400	8.000	1.15	2.29	41	95	3	22	70.0
2.75	1.5	2.5	28	3.2	ZV322S_KS702_0060 EZ505U	11	17	380	6.000	1.28	2.75	41	95	3	22	70.0
2.75	2.0	3.3	36	2.5	ZV322S_KS702_0060 EZ703U	11	17	370	6.000	1.28	2.75	41	95	3	22	70.0
ZV3KS7 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 11 kN)																
0.31	4.3	5.2	0.2	1.1	ZV322S_KS703_0700 EZ401U	11	17	400	70.00	0.18	0.31	41	95	3	22	70.0
0.44	3.1	3.7	0.3	1.5	ZV322S_KS703_0500 EZ401U	11	17	400	50.00	0.24	0.44	41	95	3	22	70.0
0.55	2.4	3.0	0.4	1.8	ZV322S_KS703_0400 EZ401U	9.0	17	320	40.00	0.28	0.55	41	95	3	22	70.0
0.55	3.6	4.7	0.5	1.2	ZV322S_KS703_0400 EZ501U	11	17	400	40.00	0.28	0.55	41	95	3	22	70.0
0.55	3.7	5.2	0.5	1.2	ZV322S_KS703_0400 EZ402U	11	17	400	40.00	0.28	0.55	41	95	3	22	70.0
0.69	2.0	2.4	0.5	2.3	ZV322S_KS703_0320 EZ401U	7.2	17	250	32.00	0.34	0.69	41	95	3	22	70.0
0.69	2.9	3.7	0.7	1.6	ZV322S_KS703_0320 EZ501U	11	17	400	32.00	0.34	0.69	41	95	3	22	70.0
0.69	3.0	4.2	0.7	1.5	ZV322S_KS703_0320 EZ402U	11	17	400	32.00	0.34	0.69	41	95	3	22	70.0
0.69	4.4	6.6	1.1	1.0	ZV322S_KS703_0320 EZ502U	11	17	400	32.00	0.34	0.69	41	95	3	22	70.0
0.92	1.5	1.8	0.7	3.1	ZV322S_KS703_0240 EZ401U	5.4	17	190	24.00	0.46	0.92	41	95	3	22	70.0
0.92	2.2	2.8	1.0	2.1	ZV322S_KS703_0240 EZ501U	10	17	360	24.00	0.46	0.92	41	95	3	22	70.0
0.92	2.2	3.1	1.0	2.0	ZV322S_KS703_0240 EZ402U	10	17	360	24.00	0.46	0.92	41	95	3	22	70.0
0.92	3.3	5.0	1.5	1.4	ZV322S_KS703_0240 EZ502U	11	17	400	24.00	0.46	0.92	41	95	3	22	70.0
0.92	3.7	5.4	1.7	1.2	ZV322S_KS703_0240 EZ404U	11	17	400	24.00	0.46	0.92	41	95	3	22	70.0
0.92	4.0	6.8	1.8	1.1	ZV322S_KS703_0240 EZ503U	11	17	400	24.00	0.46	0.92	41	95	3	22	70.0
1.10	1.8	2.4	2.6	2.4	ZV322S_KS702_0200 EZ501U	8.7	17	300	20.00	0.59	1.10	41	95	3	22	70.0
1.10	2.8	4.2	4.0	1.6	ZV322S_KS702_0200 EZ502U	11	17	400	20.00	0.59	1.10	41	95	3	22	70.0
1.10	2.8	4.3	4.0	1.6	ZV322S_KS702_0200 EZ701U	11	17	380	20.00	0.59	1.10	41	95	3	22	70.0
1.10	3.4	5.8	4.8	1.3	ZV322S_KS702_0200 EZ503U	11	17	400	20.00	0.59	1.10	41	95	3	22	70.0
1.57	1.3	1.7	4.1	3.5	ZV322S_KS702_0140 EZ501U	6.1	17	210	14.00	0.79	1.57	41	95	3	22	70.0
1.57	2.0	3.0	6.2	2.3	ZV322S_KS702_0140 EZ502U	11	17	400	14.00	0.79	1.57	41	95	3	22	70.0
1.57	2.0	3.0	6.2	2.3	ZV322S_KS702_0140 EZ701U	7.6	17	270	14.00	0.79	1.57	41	95	3	22	70.0
1.57	2.4	4.0	7.4	1.9	ZV322S_KS702_0140 EZ503U	11	17	400	14.00	0.79	1.57	41	95	3	22	70.0
2.20	0.9	1.2	6.1	4.9	ZV322S_KS702_0100 EZ501U	4.3	17	150	10.00	1.03	2.20	41	95	3	22	70.0
2.20	1.4	2.1	9.3	3.2	ZV322S_KS702_0100 EZ502U	8.4	17	290	10.00	1.03	2.20	41	95	3	22	70.0
2.20	1.4	2.1	9.3	3.2	ZV322S_KS702_0100 EZ701U	5.4	17	190	10.00	1.03	2.20	41	95	3	22	70.0
2.20	1.7	2.9	11	2.7	ZV322S_KS702_0100 EZ503U	11	17	400	10.00	1.03	2.20	41	95	3	22	70.0
2.20	2.0	3.9	13	2.3	ZV322S_KS702_0100 EZ702U	11	17	390	10.00	1.03	2.20	41	95	3	22	70.0
ZV4KS7 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 10 kN)																
0.17	4.8	5.1	0.2	1.1	ZV418S_KS703_0700 EZ401U	10	16	400	70.00	0.20	0.34	44	86	4	18	76.4
0.24	3.4	3.7	0.3	1.5	ZV418S_KS703_0500 EZ401U	10	16	400	50.00	0.26	0.48	44	86	4	18	76.4
0.30	2.7	2.9	0.3	1.9	ZV418S_KS703_0400 EZ401U	8.3	16	320	40.00	0.30	0.60	44	86	4	18	76.4
0.30	4.2	4.6	0.5	1.2	ZV418S_KS703_0400 EZ501U	10	16	400	40.00	0.30	0.60	44	86	4	18	76.4
0.30	4.6	5.1	0.6	1.1	ZV418S_KS703_0400 EZ402U	10	16	400	40.00	0.30	0.60	44	86	4	18	76.4
0.38	2.2	2.3	0.5	2.4	ZV418S_KS703_0320 EZ401U	6.6	16	250	32.00	0.38	0.75	44	86	4	18	76.4
0.38	3.4	3.7	0.7	1.6	ZV418S_KS703_0320 EZ501U	10	16	400	32.00	0.38	0.75	44	86	4	18	76.4
0.38	3.7	4.1	0.8	1.4	ZV418S_KS703_0320 EZ402U	10	16	400	32.00	0.38	0.75	44	86	4	18	76.4
0.50	1.6	1.8	0.6	3.2	ZV418S_KS703_0240 EZ401U	5.0	16	190	24.00	0.50	1.00	44	86	4	18	76.4
0.50	2.5	2.7	1.0	2.1	ZV418S_KS703_0240 EZ501U	9.3	16	360	24.00	0.50	1.00	44	86	4	18	76.4
0.50	2.7	3.0	1.1	1.9	ZV418S_KS703_0240 EZ402U	9.3	16	360	24.00	0.50	1.00	44	86	4	18	76.4
0.50	4.0	5.0	1.6	1.3	ZV418S_KS703_0240 EZ404U	10	16	400	24.00	0.50	1.00	44	86	4	18	76.4
0.50	4.3	4.7	1.7	1.2	ZV418S_KS703_0240 EZ502U	10	16	400	24.00	0.50	1.00	44	86	4	18	76.4
0.60	2.1	2.3	2.7	2.4	ZV418S_KS702_0200 EZ501U	8.0	16	300	20.00	0.64	1.20	44	86	4	18	76.4
0.60	3.7	4.0	4.6	1.4	ZV418S_KS702_0200 EZ502U	10	16	400	20.00	0.64	1.20	44	86	4	18	76.4
0.60	3.7	4.1	4.6	1.4	ZV418S_KS702_0200 EZ701U	9.9	16	380	20.00	0.64	1.20	44	86	4	18	76.4
0.60	4.8	5.5	6.0	1.1	ZV418S_KS702_0200 EZ503U	10	16	400	20.00	0.64	1.20	44	86	4	18	76.4
0.86	1.5	1.6	4.1	3.5	ZV418S_KS702_0140 EZ501U	5.6	16	210	14.00	0.86	1.71	44	86	4	18	76.4
0.86	2.6	2.8	7.0	2.0	ZV418S_KS702_0140 EZ502U	10	16	400	14.00	0.86	1.71	44	86	4	18	76.4
0.86	2.6	2.9	7.0	2.0	ZV418S_KS702_0140 EZ701U	7.0	16	270	14.00	0.86	1.71	44	86	4	18	76.4
0.86	3.4	3.9	9.2	1.5	ZV418S_KS702_0140 EZ503U	10	16	400	14.00	0.86	1.71	44	86	4	18	76.4
1.20	1.1	1.2	6.1	4.9	ZV418S_KS702_0100 EZ501U	4.0	16	150	10.00	1.12	2.40	44	86	4	18	76.4
1.20	1.8	2.0	10	2.8	ZV418S_KS702_0100 EZ502U	7.7	16	290	10.00	1.12	2.40	44	86	4	18	76.4
1.20	1.8	2.1	10	2.8	ZV418S_KS702_0100 EZ701U	5.0	16	190	10.00	1.12	2.40	44	86	4	18	76.4

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV4KS7 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 10 kN)																
1.20	2.4	2.8	14	2.2	ZV418S_KS702_0100 EZ503U	10	16	400	10.00	1.12	2.40	44	86	4	18	76.4
1.20	3.0	3.6	17	1.7	ZV418S_KS702_0100 EZ702U	10	16	390	10.00	1.12	2.40	44	86	4	18	76.4
1.20	3.4	4.0	19	1.5	ZV418S_KS702_0100 EZ505U	10	16	400	10.00	1.12	2.40	44	86	4	18	76.4
1.20	4.1	5.2	23	1.3	ZV418S_KS702_0100 EZ703U	10	16	400	10.00	1.12	2.40	44	86	4	18	76.4
1.50	1.5	1.6	14	3.5	ZV418S_KS702_0080 EZ502U	6.2	16	240	8.000	1.25	2.50	44	86	4	18	76.4
1.50	1.5	1.7	14	3.5	ZV418S_KS702_0080 EZ701U	4.0	16	150	8.000	1.25	2.50	44	86	4	18	76.4
1.50	1.9	2.2	18	2.7	ZV418S_KS702_0080 EZ503U	8.6	16	330	8.000	1.25	2.50	44	86	4	18	76.4
1.50	2.4	2.9	22	2.2	ZV418S_KS702_0080 EZ702U	8.2	16	310	8.000	1.25	2.50	44	86	4	18	76.4
1.50	2.7	3.2	25	1.9	ZV418S_KS702_0080 EZ505U	10	16	400	8.000	1.25	2.50	44	86	4	18	76.4
1.50	3.3	4.1	31	1.6	ZV418S_KS702_0080 EZ703U	10	16	400	8.000	1.25	2.50	44	86	4	18	76.4
2.00	1.1	1.2	19	4.7	ZV418S_KS702_0060 EZ502U	4.6	16	180	6.000	1.40	3.00	44	86	4	18	76.4
2.00	1.1	1.2	19	4.7	ZV418S_KS702_0060 EZ701U	3.0	16	110	6.000	1.40	3.00	44	86	4	18	76.4
2.00	1.4	1.7	25	3.6	ZV418S_KS702_0060 EZ503U	6.4	16	250	6.000	1.40	3.00	44	86	4	18	76.4
2.00	1.8	2.1	31	2.9	ZV418S_KS702_0060 EZ702U	6.1	16	230	6.000	1.40	3.00	44	86	4	18	76.4
2.00	2.0	2.4	35	2.6	ZV418S_KS702_0060 EZ505U	10	16	380	6.000	1.40	3.00	44	86	4	18	76.4
2.00	2.5	3.1	43	2.1	ZV418S_KS702_0060 EZ703U	9.7	16	370	6.000	1.40	3.00	44	86	4	18	76.4
ZV4KS7 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 10 kN)																
1.80	2.4	3.8	15	1.9	ZV418S_KS702_0100 EZ505U	10	16	400	10.00	1.12	2.40	44	86	4	18	76.4
1.80	3.0	5.0	20	1.5	ZV418S_KS702_0100 EZ703U	10	16	400	10.00	1.12	2.40	44	86	4	18	76.4
2.25	1.9	3.0	20	2.4	ZV418S_KS702_0080 EZ505U	10	16	400	8.000	1.25	2.50	44	86	4	18	76.4
2.25	2.4	4.0	26	1.9	ZV418S_KS702_0080 EZ703U	10	16	400	8.000	1.25	2.50	44	86	4	18	76.4
3.00	1.4	2.3	28	3.2	ZV418S_KS702_0060 EZ505U	10	16	380	6.000	1.40	3.00	44	86	4	18	76.4
3.00	1.8	3.0	36	2.5	ZV418S_KS702_0060 EZ703U	9.7	16	370	6.000	1.40	3.00	44	86	4	18	76.4
ZV4KS7 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 10 kN)																
0.34	3.9	4.8	0.2	1.1	ZV418S_KS703_0700 EZ401U	10	16	400	70.00	0.20	0.34	44	86	4	18	76.4
0.48	2.8	3.4	0.3	1.5	ZV418S_KS703_0500 EZ401U	10	16	400	50.00	0.26	0.48	44	86	4	18	76.4
0.60	2.2	2.7	0.4	1.8	ZV418S_KS703_0400 EZ401U	8.3	16	320	40.00	0.30	0.60	44	86	4	18	76.4
0.60	3.3	4.3	0.5	1.2	ZV418S_KS703_0400 EZ501U	10	16	400	40.00	0.30	0.60	44	86	4	18	76.4
0.60	3.4	4.8	0.5	1.2	ZV418S_KS703_0400 EZ402U	10	16	400	40.00	0.30	0.60	44	86	4	18	76.4
0.75	1.8	2.2	0.5	2.3	ZV418S_KS703_0320 EZ401U	6.6	16	250	32.00	0.38	0.75	44	86	4	18	76.4
0.75	2.6	3.4	0.7	1.6	ZV418S_KS703_0320 EZ501U	10	16	400	32.00	0.38	0.75	44	86	4	18	76.4
0.75	2.7	3.8	0.7	1.5	ZV418S_KS703_0320 EZ402U	10	16	400	32.00	0.38	0.75	44	86	4	18	76.4
0.75	4.1	6.1	1.1	1.0	ZV418S_KS703_0320 EZ502U	10	16	400	32.00	0.38	0.75	44	86	4	18	76.4
1.00	1.3	1.6	0.7	3.1	ZV418S_KS703_0240 EZ401U	5.0	16	190	24.00	0.50	1.00	44	86	4	18	76.4
1.00	2.0	2.6	1.0	2.1	ZV418S_KS703_0240 EZ501U	9.3	16	360	24.00	0.50	1.00	44	86	4	18	76.4
1.00	2.0	2.9	1.0	2.0	ZV418S_KS703_0240 EZ402U	9.3	16	360	24.00	0.50	1.00	44	86	4	18	76.4
1.00	3.0	4.6	1.5	1.4	ZV418S_KS703_0240 EZ502U	10	16	400	24.00	0.50	1.00	44	86	4	18	76.4
1.00	3.4	4.9	1.7	1.2	ZV418S_KS703_0240 EZ404U	10	16	400	24.00	0.50	1.00	44	86	4	18	76.4
1.00	3.6	6.2	1.8	1.1	ZV418S_KS703_0240 EZ503U	10	16	400	24.00	0.50	1.00	44	86	4	18	76.4
1.20	1.7	2.2	2.6	2.4	ZV418S_KS702_0200 EZ501U	8.0	16	300	20.00	0.64	1.20	44	86	4	18	76.4
1.20	2.6	3.9	4.0	1.6	ZV418S_KS702_0200 EZ502U	10	16	400	20.00	0.64	1.20	44	86	4	18	76.4
1.20	2.6	3.9	4.0	1.6	ZV418S_KS702_0200 EZ701U	9.9	16	380	20.00	0.64	1.20	44	86	4	18	76.4
1.20	3.1	5.3	4.8	1.3	ZV418S_KS702_0200 EZ503U	10	16	400	20.00	0.64	1.20	44	86	4	18	76.4
1.71	1.2	1.5	4.1	3.5	ZV418S_KS702_0140 EZ501U	5.6	16	210	14.00	0.86	1.71	44	86	4	18	76.4
1.71	1.8	2.7	6.2	2.3	ZV418S_KS702_0140 EZ502U	10	16	400	14.00	0.86	1.71	44	86	4	18	76.4
1.71	1.8	2.8	6.2	2.3	ZV418S_KS702_0140 EZ701U	7.0	16	270	14.00	0.86	1.71	44	86	4	18	76.4
1.71	2.2	3.7	7.4	1.9	ZV418S_KS702_0140 EZ503U	10	16	400	14.00	0.86	1.71	44	86	4	18	76.4
2.40	0.8	1.1	6.1	4.9	ZV418S_KS702_0100 EZ501U	4.0	16	150	10.00	1.12	2.40	44	86	4	18	76.4
2.40	1.3	1.9	9.3	3.2	ZV418S_KS702_0100 EZ502U	7.7	16	290	10.00	1.12	2.40	44	86	4	18	76.4
2.40	1.3	2.0	9.3	3.2	ZV418S_KS702_0100 EZ701U	5.0	16	190	10.00	1.12	2.40	44	86	4	18	76.4
2.40	1.5	2.6	11	2.7	ZV418S_KS702_0100 EZ503U	10	16	400	10.00	1.12	2.40	44	86	4	18	76.4
2.40	1.8	3.6	13	2.3	ZV418S_KS702_0100 EZ702U	10	16	390	10.00	1.12	2.40	44	86	4	18	76.4

10.3 Dimensional drawings

This chapter shows you the dimensions of rack and pinion drives with EZ synchronous servo motors.

Dimension az in the tables of dimensions applies to Atlanta gear racks. In general: az = ½ d0 + h0 + x*mn

The pinion of the rack and pinion drive is helical (left-hand 19° 31 42"). The pinion gearing quality is 5.

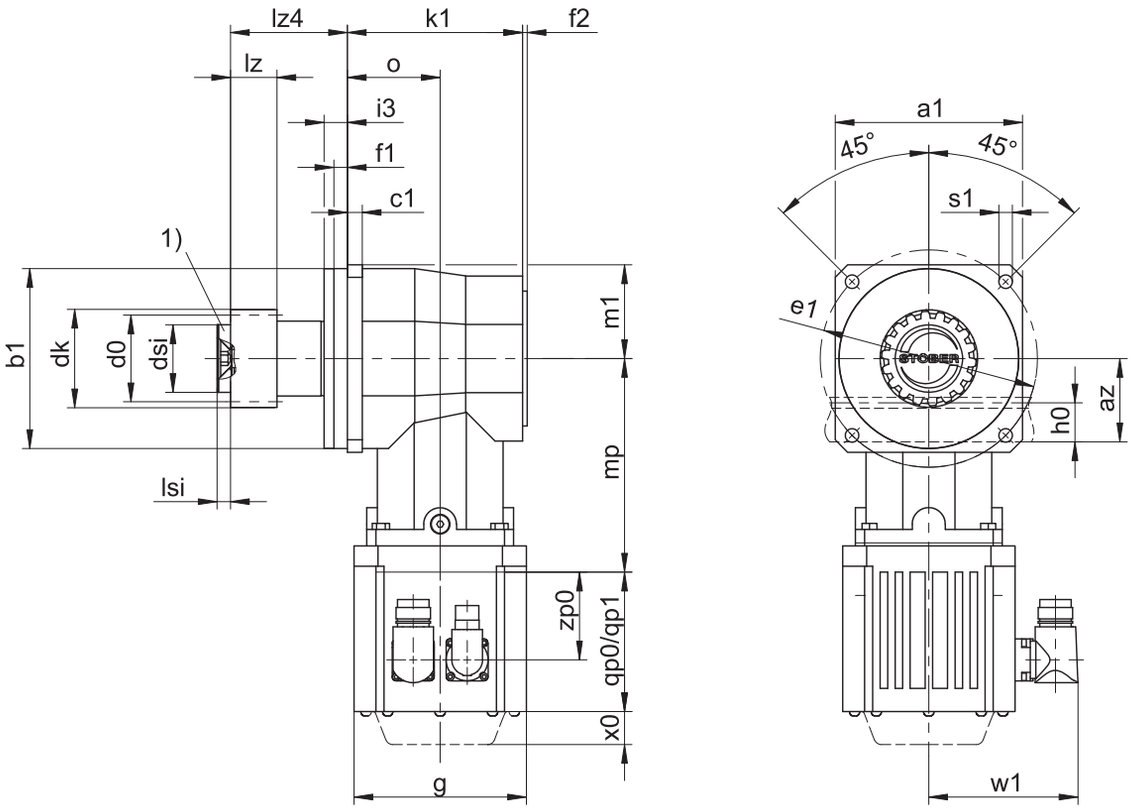
Dimensions can exceed the specifications of ISO 2768-mK due to casting tolerances or accumulation of individual tolerances.

We reserve the right to make dimensional changes due to ongoing technical development.

You can download 3D models of our standard drives at http://configurator.stoeber.de.

Combination options and the dimensions of forced ventilated geared motors can also be found at http://configurator.stoeber.de.

10.3.1 Pinion position E



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x0	Applies to encoders using an optical measuring method.	w1	Different for the One Cable Solution (OCS), see the chapter [▶ 13.4]
1)	Axial locking (optional)		

Dimensions of gear units

Type	mn	a1	az	Øb1	c1	Ød0	Ødk	Ødsi	Øe1	f1	f2	h0	i3	k1	lz	lz4	lsi	m1	o	Øs1	x
ZV220SEKS4_	2	101	44.02	95_{h6}	10	42.44	47.90	30	120	8	3	22	14.0	101	26	54.5	6	50.5	53	6.6	0.4
ZV225SEKS5_	2	125	49.33	120_{h6}	10	53.05	58.52	45	145	9	3	22	15.5	117	26	78.0	8	62.5	62	9.0	0.4
ZV318SEKS5_	3	125	55.55	120_{h6}	10	57.30	65.01	45	145	9	3	26	15.5	117	31	78.0	8	62.5	62	9.0	0.3
ZV322SEKS7_	3	155	62.21	150_{h6}	15	70.03	78.35	55	180	10	3	26	20.0	145	31	107.5	10	77.5	78	11.0	0.4
ZV418SEKS7_	4	155	74.40	150_{h6}	15	76.40	86.77	55	180	10	3	35	20.0	145	41	107.5	10	77.5	78	11.0	0.3

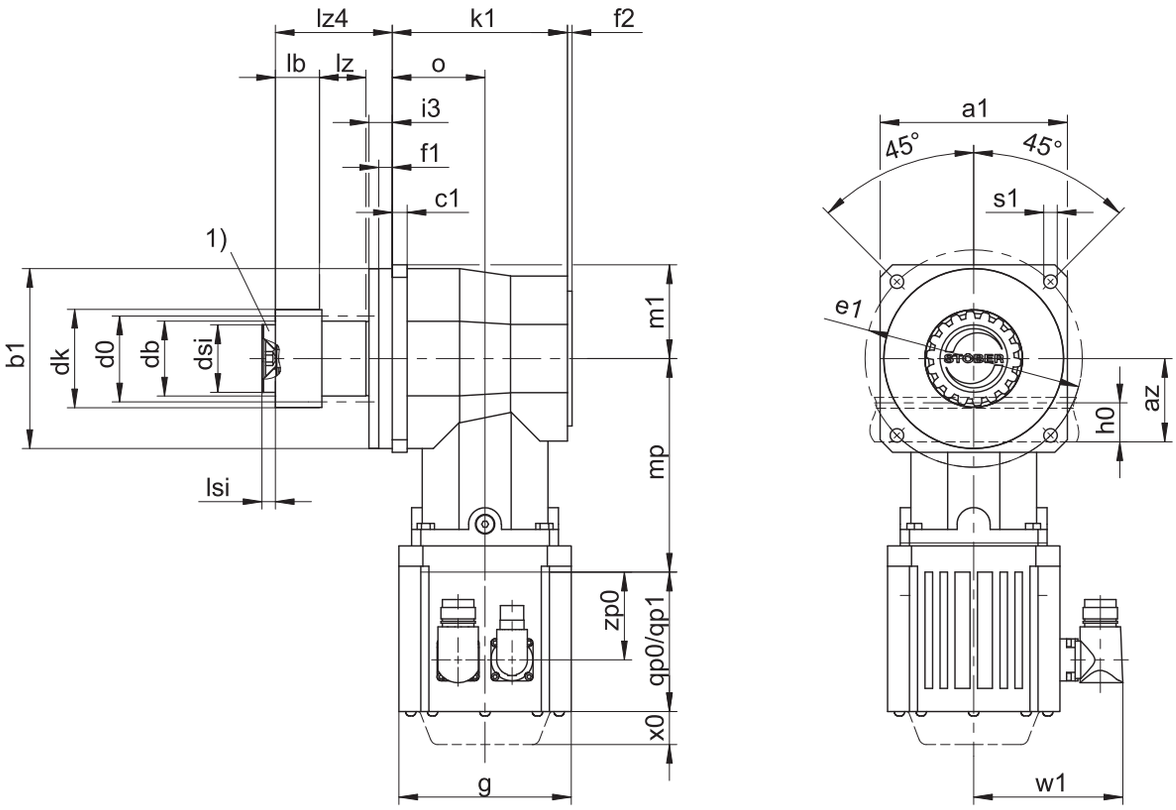
Dimensions of motors

Type	□g	qp0	qp1	w1	x0	zp0
EZ301U	72	90	130.0	55.5	21	54.5
EZ302U	72	112	152.0	55.5	21	76.5
EZ303U	72	134	174.0	55.5	21	98.5
EZ401U	98	98	146.5	91.0	22	56.0
EZ402U	98	123	171.5	91.0	22	81.0
EZ404U	98	173	221.5	91.0	22	131.0
EZ501U	115	93	147.5	100.0	22	58.5
EZ502U	115	118	172.5	100.0	22	83.5
EZ503U	115	143	197.5	100.0	22	108.5
EZ505U	115	193	247.5	100.0	22	158.5
EZ701U	145	102	161.0	115.0	22	64.0
EZ702U	145	127	186.0	115.0	22	89.0
EZ703U	145	152	211.0	115.0	22	114.0

Dimensions of geared motors

Type	EZ3	EZ4	EZ5	EZ7
	mp	mp	mp	mp
ZV_KS402_	124.0	120.5	–	–
ZV_KS403_	164.0	–	–	–
ZV_KS502_	–	140.0	142.5	–
ZV_KS503_	192.0	188.5	–	–
ZV_KS702_	–	–	167.0	173.0
ZV_KS703_	–	222.5	225.0	–

10.3.2 Pinion position S



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x0	Applies to encoders using an optical measuring method.	w1	Different for the One Cable Solution (OCS), see the chapter [▶ 13.4]
1)	Axial locking (optional)		

Dimensions of gear units

Type	mn	a1	az	Ød1	c1	Ød0	Ødb	Ødk	Ødsi	Øe1	f1	f2	h0	i3	k1	lb	lz	lz4	lsi	m1	o	Øs1	x
ZV220SSKS4_	2	101	44.02	95_{h6}	10	42.44	38	47.90	30	120	8	3	22	14.0	101	12.5	26	54.5	6	50.5	53	6.6	0.4
ZV225SSKS5_	2	125	49.33	120_{h6}	10	53.05	50	58.52	45	145	9	3	22	15.5	117	34.5	26	78.0	8	62.5	62	9.0	0.4
ZV318SSKS5_	3	125	55.55	120_{h6}	10	57.30	50	65.01	45	145	9	3	26	15.5	117	29.5	31	78.0	8	62.5	62	9.0	0.3
ZV322SSKS7_	3	155	62.21	150_{h6}	15	70.03	62	78.35	55	180	10	3	26	20.0	145	53.5	31	107.5	10	77.5	78	11.0	0.4
ZV418SSKS7_	4	155	74.40	150_{h6}	15	76.40	62	86.77	55	180	10	3	35	20.0	145	43.5	41	107.5	10	77.5	78	11.0	0.3

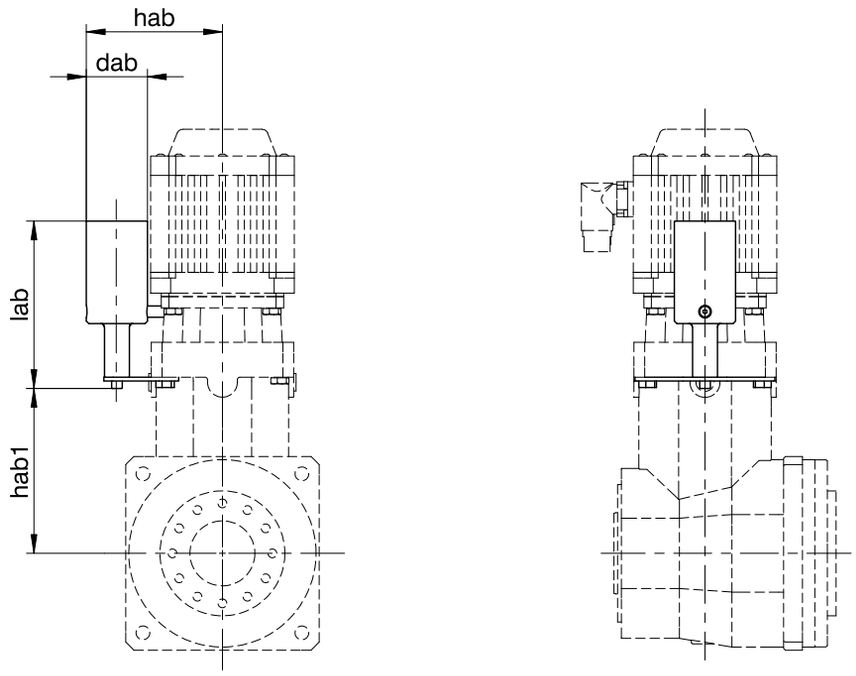
Dimensions of motors

Type	□g	qp0	qp1	w1	x0	zp0
EZ301U	72	90	130.0	55.5	21	54.5
EZ302U	72	112	152.0	55.5	21	76.5
EZ303U	72	134	174.0	55.5	21	98.5
EZ401U	98	98	146.5	91.0	22	56.0
EZ402U	98	123	171.5	91.0	22	81.0
EZ404U	98	173	221.5	91.0	22	131.0
EZ501U	115	93	147.5	100.0	22	58.5
EZ502U	115	118	172.5	100.0	22	83.5
EZ503U	115	143	197.5	100.0	22	108.5
EZ505U	115	193	247.5	100.0	22	158.5
EZ701U	145	102	161.0	115.0	22	64.0
EZ702U	145	127	186.0	115.0	22	89.0
EZ703U	145	152	211.0	115.0	22	114.0

Dimensions of geared motors

Type	EZ3	EZ4	EZ5	EZ7
	mp	mp	mp	mp
ZV_KS402_	124.0	120.5	–	–
ZV_KS403_	164.0	–	–	–
ZV_KS502_	–	140.0	142.5	–
ZV_KS503_	192.0	188.5	–	–
ZV_KS702_	–	–	167.0	173.0
ZV_KS703_	–	222.5	225.0	–

10.3.3 Oil expansion tank



Dimensions

Type	EZ3				EZ4				EZ5			
	dab	lab	hab	hab1	dab	lab	hab	hab1	dab	lab	hab	hab1
ZV_KS403_	34	100	74.5	85	–	–	–	–	–	–	–	–
ZV_KS503_	39	122	92.0	105	39	122	92.0	105	–	–	–	–
ZV_KS703_	–	–	–	–	49	134	109.5	132	49	134	109.5	132

More information can be found in the chapter [▷ 10.6.3]

10.4 Type designation

This chapter shows you an explanation of the type designation with the associated options.

Additional ordering information not included in the type designation can be found at the end of the chapter.

Example code

Z	V	2	20	S	S	KS	4	0	2	P	F	0080	EZ401U

Explanation

Code	Designation	Design
Z	Type	Rack and pinion drive
V	Design	Plug-on pinion
2	Module	m_n = 2 (example)
20	Number of teeth	z = 20 (example)
S	Toothing	Helical (left-hand 19° 31' 42")
E	Pinion position	Shaft end
S		Shaft shoulder
KS	Type	Right-angle servo gear unit
4	Size	4 (example)
0	Generation	Generation 0
2	Stages	Two-stage
3		Three-stage
P	Shaft	Solid shaft with feather key
F	Housing	Standard
0080	Transmission ratio (i x 10)	i = 8 (example)
EZ401U	Motor	EZ synchronous servo motor

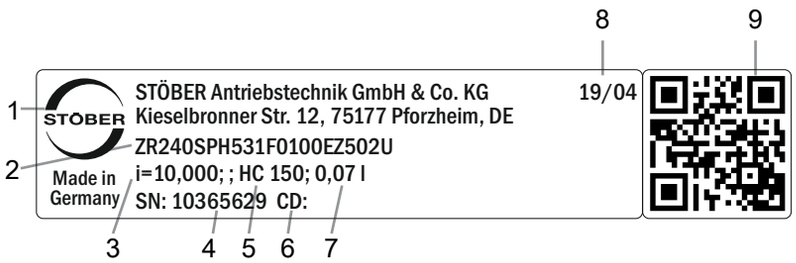
To complete the type designation, also specify the following in your order:

- A detailed type designation of the motor, see chapter [▶ 13]
- Mounting position, see chapter [▶ 10.5.4]
- Radial shaft seal rings at the output, made of NBR or FKM (optional), see chapter [▶ 10.6.2]
- Position of the plug connectors, see chapter [▶ 10.5.6]
- For the attachment of oil expansion tank on gear unit side 1 or 2 (required without exception for three-stage gear units in mounting position EL5), see the chapter [▶ 10.3.3]
- For axial locking (optional), see the chapter [▶ 10.3]

In this catalog, you will find all information on rack and pinion drives with EZ synchronous servo motors.
All input options available on request can be found in the chapter [▶ 10.5.1].

10.4.1 Nameplate

An example geared motor nameplate is explained in the figure below.



Code	Designation
1	Name of manufacturer
2	Type designation
3	Gear ratio of the gear unit
4	Serial number of the gear unit
5	Lubricant specification
6	Customer-specific data
7	Lubricant fill volume
8	Date of manufacture (year/calendar week)
9	QR code (link to product information)

10.4.1.1 Supporting documents

You can view or download supporting documents for the product by reading off the serial number on the nameplate of the product and entering it at the following address online:
https://id.stober.com

Alternatively, you can use a suitable mobile device to scan in the QR code on the nameplate of the product in order to be linked to the supporting documents.

10.5 Product description

10.5.1 Input options

This chapter shows you all available input options:

EZ synchronous servo motor

http://www.stoeber.de/en/Z_EZ

ME motor adapter

http://www.stoeber.de/en/ZVKSME

10.5.2 Gear rack

The technical data specified in the Selection tables chapter applies only to gear rack combinations with the following characteristics:

The pinion of the rack and pinion drive is case-hardened and helical (left-hand 19° 31' 42"). The pinion gearing quality is 6.

The corresponding gear rack must have a right-hand design (19° 31' 42") and possess the following characteristics:

Module m_n [mm]	Minimum gear rack quality	Gear rack material
2 – 4	8	C45 inductively hardened

Also note the project configuration of the gear rack on the Atlanta pages.

10.5.2.1 Pinion position

The pinion can be fastened to the shaft in two different attachment positions:

- The toothing is flush with the shaft end (Pos. E)
- The toothing is flush with the shaft shoulder (Pos. S: For higher permitted feed forces, see the Selection tables chapter)

Please specify the desired attachment position when placing your order.

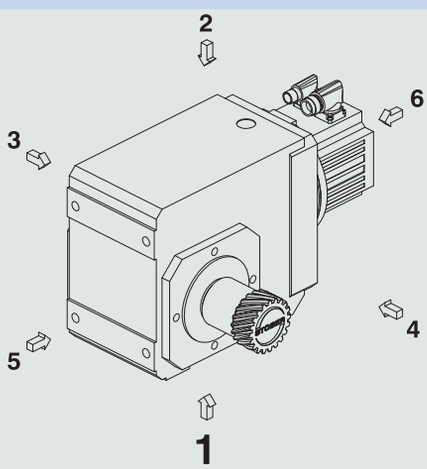
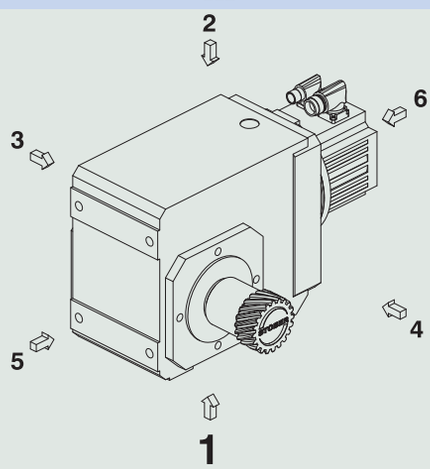
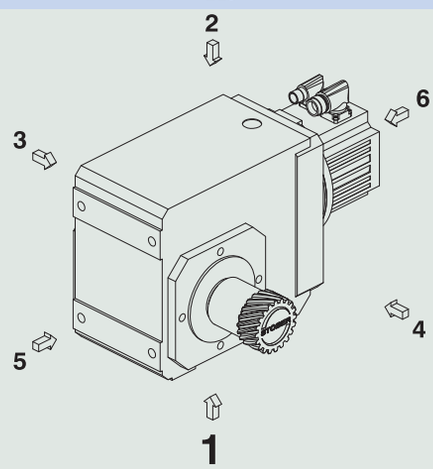
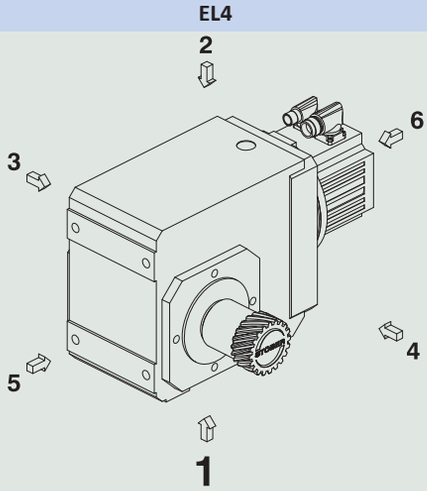
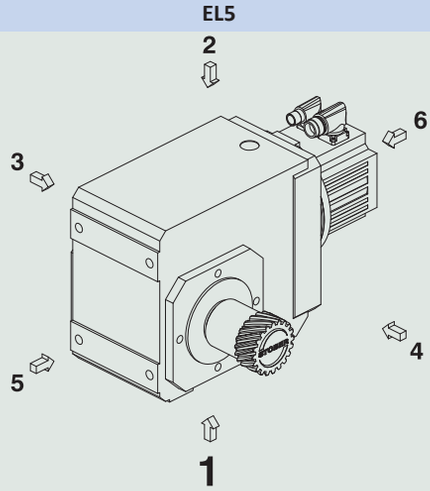
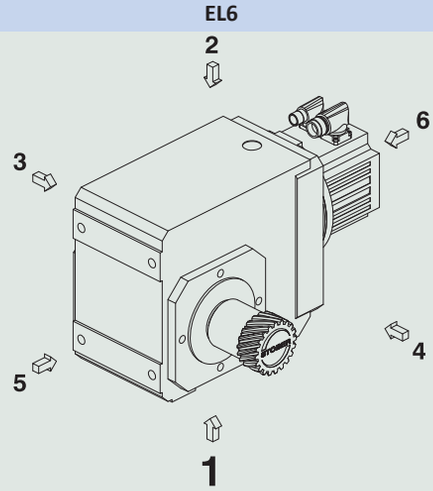
10.5.3 Installation conditions

The specified torques and forces only apply when gear units are fastened on the machine side using screws of strength class 10.9. In addition, the gear housings must be adjusted at the pilot. The machine-side fit must be H7.

10.5.4 Mounting positions

The following table shows the standard mounting positions.

The numbers identify the gear unit sides. The mounting position is defined by the gear side facing downwards.

EL1	EL2	EL3
		
EL4	**EL5**	**EL6**
		

Since the lubricant filling volume of the gear unit depends on the mounting position, the mounting position must be specified when ordering.

10.5.5 Lubricants

STOBER fills the gear units with the amount and type of lubricant specified on the nameplate. The filling volume and the structure of the gear units depend on the mounting position.

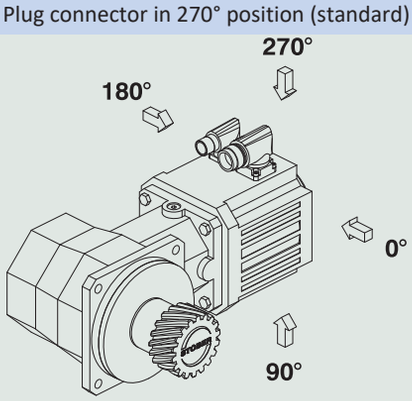
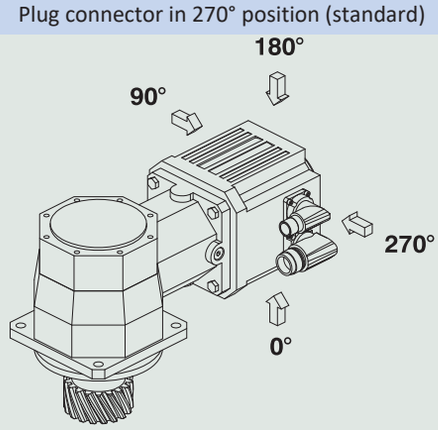
Only install the gear units in the intended mounting position! Reposition the gear units only after consulting STOBER. Otherwise, STOBER assumes no liability for the gear units.

You will receive lubricants for use in the food industry upon request.

10.5.5.1 Rack and pinion drive lubrication

Make sure the rack and pinion drive has permanent lubrication with the lubricants specified in the Atlanta product catalog.

10.5.6 Position of the plug connectors

Mounting position EL1	Mounting position EL4
Plug connector in 270° position (standard)	Plug connector in 270° position (standard)
	

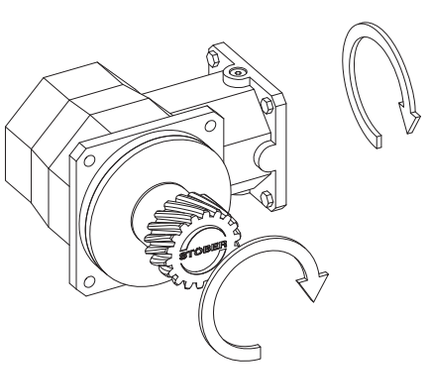
The plug connectors are in the 270° position as standard. Indicate variations for your rack and pinion drive in the order.

Note that the plug connectors also rotate when the gear rack is rotated to a different position.

10.5.7 Other product features

Feature	Value
Max. permitted gear unit temperature (on the surface of the gear unit)	≤ 90 °C
Paint	Black RAL 9005
(ATEX) Directive 2014/34/EU (Option)	Not suitable.
Protection class: [1]	
Planetary gear units	IP65
Motor	IP56, optionally IP66
Pinion/gear rack	IPXX

10.5.8 Direction of rotation



The pictures show mounting position EL1.

[1] Observe the protection class of all the components.

10.6 Project configuration

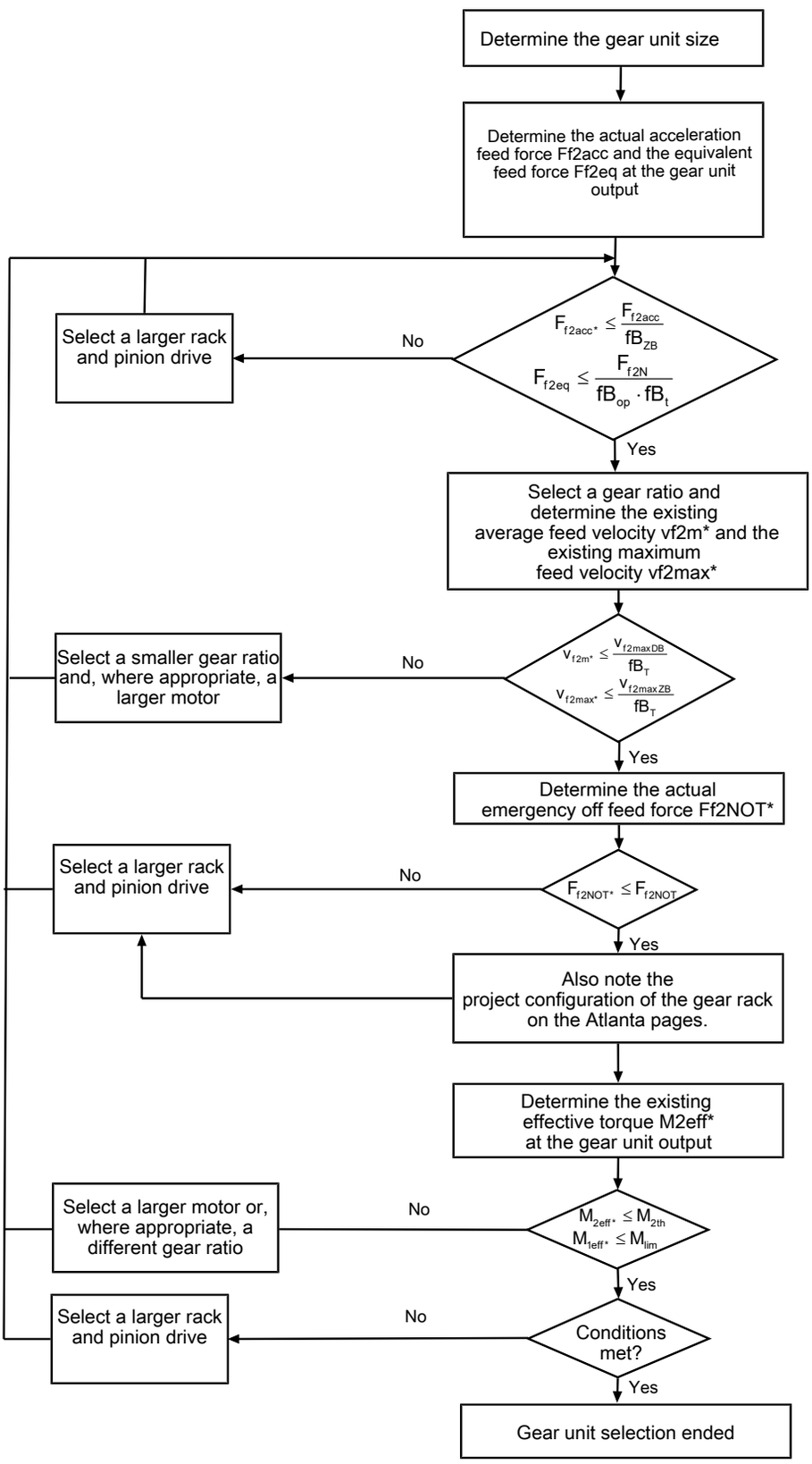
Project your drives using our SERVOsoft designing software. Download SERVOsoft for free at https://www.stoeber.de/en/ServoSoft.

Observe the limit conditions in this chapter to ensure a safe design for your drives.

The formula symbols for values actually present in the application are marked with *.

An explanation of the formula symbols can be found in the chapter [▶ 15.1].

10.6.1 Drive selection

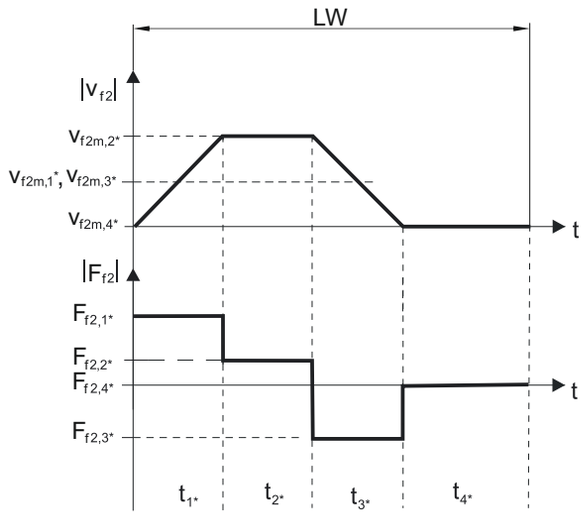


Refer to the selection tables for the values of i, $v_{f2maxDB}$, $v_{f2maxZB}$, F_{f2acc}, F_{f2N} and F_{f2NOT}.

The values for fB_T, fB_{op}, fB_t and fB_{ZB} can be found in the corresponding tables in this chapter.

Example of cyclic operation

The following calculations are based on a representation of the power taken from the output based in accordance with the following example:



Calculation of the actual maximum acceleration feed force

$$F_{f2acc^*} = m^* \cdot a^* + F_{L^*}$$

Calculation of the actual average input speed

$$n_{1m^*} = \frac{v_{f2m^*} \cdot i}{d_0 \cdot \pi}$$

$$v_{f2m^*} = \frac{\left|v_{f2m,1^*}\right| \cdot t_{1^*} + \ldots + \left|v_{f2m,n^*}\right| \cdot t_{n^*}}{t_{1^*} + \ldots + t_{n^*}}$$

If $t_{1^*} + \ldots + t_{3^*} \geq 6$ min, determine v_{2m^*} without the rest phase t_{4^*}.

The values for the ratio i can be found in the selection tables.

Calculation of the actual emergency off feed force

$$F_{f2NOT^*} = m^* \cdot a_{NOT^*} + F_{L^*}$$

Calculation of the actual equivalent feed force

$$F_{f2eq^*} = \sqrt[3]{\frac{\left|v_{f2m,1^*}\right| \cdot t_{1^*} \cdot \left|F_{f2,1^*}{}^3\right| + \ldots + \left|v_{f2m,n^*}\right| \cdot t_{n^*} \cdot \left|F_{f2,n^*}{}^3\right|}{\left|v_{f2m,1^*}\right| \cdot t_{1^*} + \ldots + \left|v_{f2m,n^*}\right| \cdot t_{n^*}}}$$

Calculation of the thermal limit torque

Calculate the thermal limit torque M_{2th} for a duty cycle $ED_{10} > 50\%$ and the actual average input speed n_{1m^*}. (At $K_{mot,th} \leq 0$ you must reduce the average input speed n_{1m^*} accordingly or select another geared motor size.)

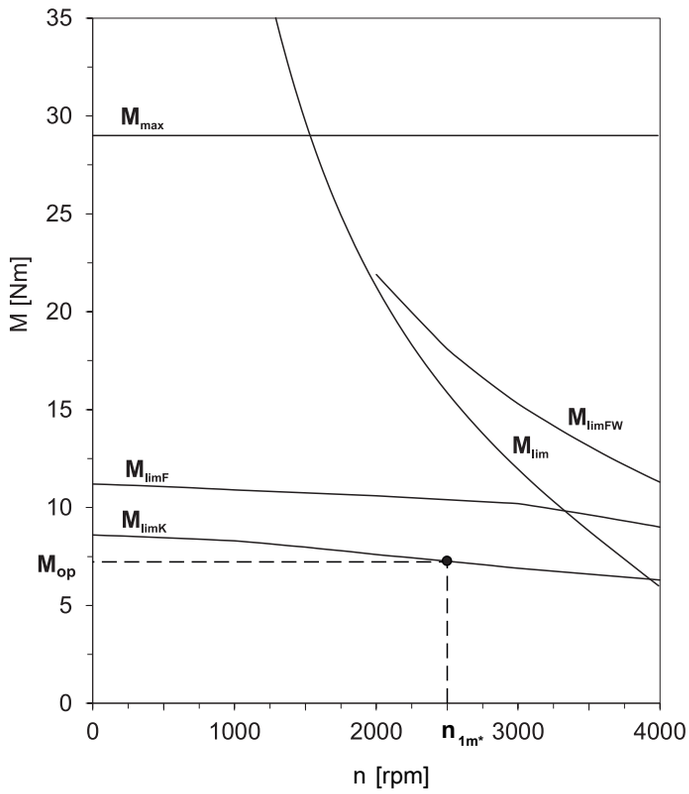
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

$$K_{mot,th} = 0{,}93 - \frac{a_{th}}{1000} \cdot fB_T \cdot \left(\frac{n_{1m^*}}{1000}\right)^3$$

Refer to the selection tables for the values of i and a_{th}.

The values for fB_T can be found in the corresponding table in this chapter.

The value for the torque of the motor at operating point M_{op} with the determined average input speed n_{1m*} can be found in the motor characteristic curve of the chapter [▶ 13.3]. Note the size, nominal speed n_N and cooling type of the motor. The figure below shows an example of reading the torque M_{op} of a motor with convection cooling at the operating point.



Calculation of the actual effective torque

$$M_{2eff*} = \sqrt{\frac{t_{1*} \cdot M_{2,1*}{}^2 + \ldots + t_{n*} \cdot M_{2,n*}{}^2}{t_{1*} + \ldots + t_{n*}}}$$

$$M_{2,n*} = \frac{F_{f2,n*} \cdot d_0}{2}$$

$$M_{1eff*} = \frac{M_{2eff*}}{i \cdot \eta}$$

Operating factors

Operating mode	fB_{op}
Uniform continuous operation	1.00
Cyclic operation	1.00
Reversing load cyclic operation	1.00

Run time	fB_t
Daily runtime ≤ 8 h	1.00
Daily runtime ≤ 16 h	1.15
Daily runtime ≤ 24 h	1.20

Cyclic operation	fB_{ZB}
≤ 1000 load changes/hour (LW/h)	1.00
> 1000 load changes/hour (LW/h)	1.15

Temperature		fB_T
Motor cooling	**Surrounding temperature**	
Motor with forced ventilation	≤ 20 °C	0.9
	≤ 30 °C	1.0
	≤ 40 °C	1.15
Motor with convection cooling	≤ 20 °C	1.0
	≤ 30 °C	1.1
	≤ 40 °C	1.25

Notes

- The maximum permitted gear unit temperature (see the "Other product features" chapter) must not be exceeded, as that could result in damage.
- For braking from full speed (for example, when the power fails or when setting up the machine), note the permitted gear unit feed forces (F_{f2acc}, F_{f2NOT}) in the selection tables.

10.6.2 Recommendation for radial shaft seal rings

For a duty cycle > 60% and higher surrounding temperatures, we recommend radial shaft seal rings made of FKM at the output.

Properties:

- Excellent temperature resistance
- High chemical stability
- Very good resistance to aging
- Excellent resistance in oils and greases
- For use in the food, beverage and pharmaceutical industries

Leak-proofness

Our gear units are equipped with high-quality radial shaft seal rings and checked for leaks. However, a leak cannot be fully ruled out over the length of use of a gear unit. If you use a gear unit with goods incompatible with the lubricant, you must take measures to prevent direct contact with the gear unit lubricant in case of a leak.

10.6.3 Oil expansion tank

The gear units have a higher fill level in mounting position EL5. The oil expansion tank prevents oil from escaping out of the gear unit.

Notes

- Three-stage KS gear units in mounting position EL5 can be used only in combination with an oil expansion tank!
- It is not possible to use an oil expansion tank if the plug connector and oil expansion tank are on the same side!
- Please specify the attachment side (gear unit side 1 or 2) in the order.
- Note that mounting an oil expansion tank is not possible with every motor adapter (collision between motor adapter and oil expansion tank).

10.7 Additional documentation

Additional documentation related to the product can be found at
http://www.stoeber.de/en/downloads/

Enter the ID of the documentation in the Search... field.

Documentation	ID
Operating manual for gear racks (Atlanta)	442455
Operating manual for KL/KS/PHK/PHKX/PHQK/PK/PKX right-angle servo gear units and right-angle servo geared motors	443150_en
Operating manual for EZ synchronous servo motors	443032_en

11 ZVKL rack and pinion drives

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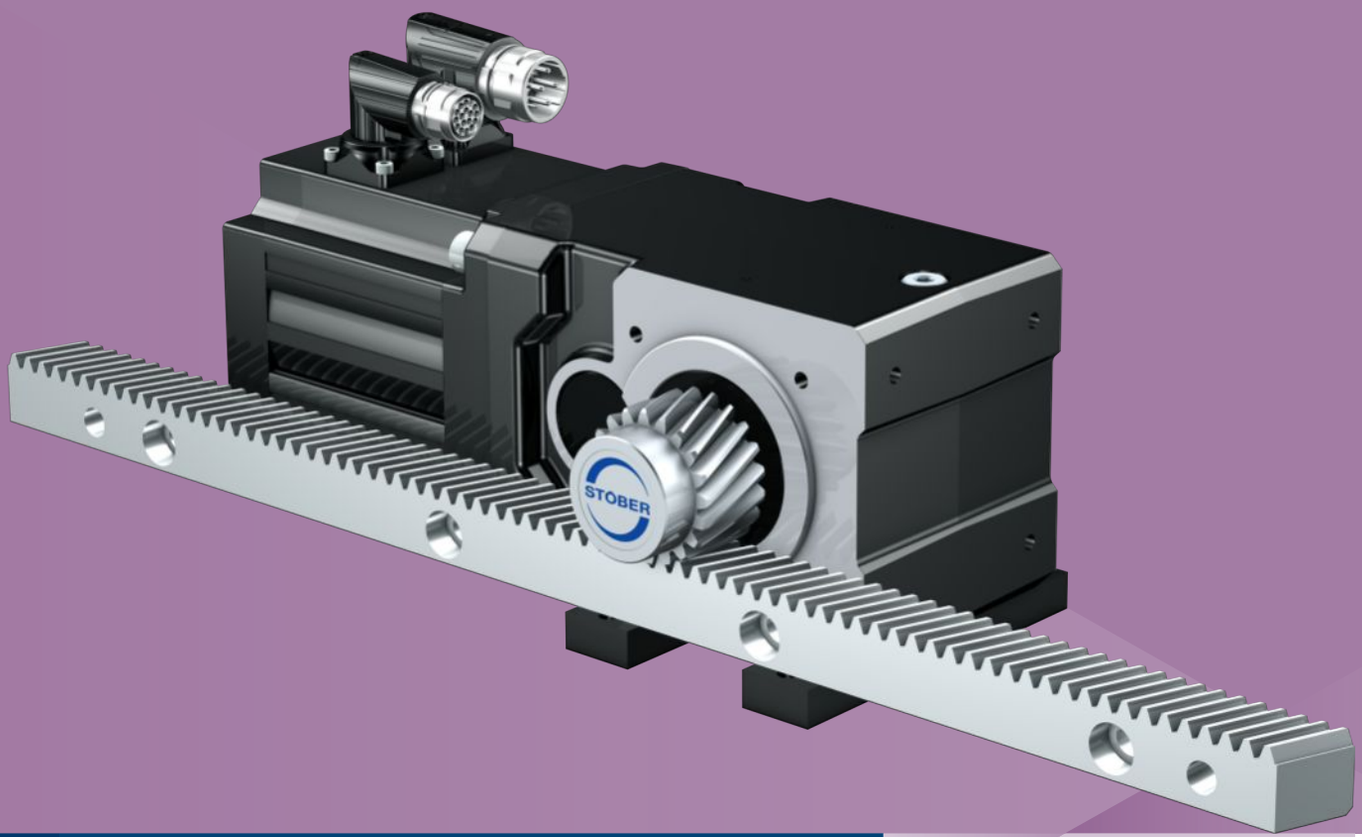


11 Rack and pinion drives

ZVKL

11.1 Overview

Compact right-angle geared motors with plug-on pinion

Features

Power density	★★☆☆☆
Linear clearance	★☆☆☆☆
Price category	€
Smooth operation	★★☆☆☆
Linear rigidity	★☆☆☆☆
Mass moment of inertia	★★★★☆
Ready-to-install drive solution	✓
Pinion gearing quality 6 (DIN 3962)	✓
Helical gearing	✓
Case-hardened and smoothed	✓
Compact and highly dynamic due to direct motor attachment	✓

Key ★☆☆☆☆ good | ★★★★★ excellent
€ Economy | €€€€€ Premium

Technical data

m_n	2 mm
z	16 – 20
F_{f2acc}	0.64 – 2.7 kN
v_{f2N}	0.21 – 1.7 m/s
Δs	99 – 123 µm

11.2 Selection table

The technical data specified in the selection tables applies to:

- De-energized installation
- Permanent lubrication with the lubricants specified in the Atlanta product catalog
- Material combinations as described in the chapter [▶ 11.5.2]
- Installation altitudes up to 1000 m above sea level
- Surrounding temperatures from 0 °C to 40 °C
- Without consideration of the thermal limiting performance
- Drives with convection-cooled motors (e.g. EZ401**U**)

For the technical data on drives with forced ventilated motors (e.g. EZ401**B**), refer to http://configurator.stoeber.de.

For all other technical data, refer to http://configurator.stoeber.de.

An explanation of the formula symbols can be found in the chapter [▶ 15.1].

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV2KL1 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 1,5 kN)																
0.33	0.9	0.9	16	1.0	ZV216S_KL102_0160 EZ301U	1.5	3.5	26	16.00	0.44	0.67	99	20	2	16	34.0
0.67	0.4	0.4	17	1.6	ZV216S_KL102_0080 EZ301U	1.3	3.4	22	8.000	0.78	1.11	99	20	2	16	34.0
1.33	0.2	0.2	22	2.6	ZV216S_KL102_0040 EZ301U	0.6	1.7	11	4.000	1.56	2.22	123	15	2	16	34.0
1.33	0.4	0.4	37	1.5	ZV216S_KL102_0040 EZ302U	1.1	1.7	19	4.000	1.56	2.22	123	15	2	16	34.0
1.33	0.5	0.5	49	1.2	ZV216S_KL102_0040 EZ303U	1.3	1.7	22	4.000	1.56	2.22	123	15	2	16	34.0
ZV2KL2 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 2,7 kN)																
0.21	1.4	1.4	11	1.1	ZV220S_KL202_0320 EZ301U	2.7	6.1	57	32.00	0.28	0.42	99	23	2	20	42.4
0.42	0.7	0.7	9.0	1.8	ZV220S_KL202_0160 EZ301U	2.0	5.5	43	16.00	0.56	0.83	99	28	2	20	42.4
0.42	1.2	1.2	15	1.1	ZV220S_KL202_0160 EZ302U	2.7	5.5	57	16.00	0.56	0.83	99	28	2	20	42.4
0.83	0.3	0.3	15	2.9	ZV220S_KL202_0080 EZ301U	1.0	2.7	22	8.000	1.11	1.67	123	18	2	20	42.4
0.83	0.6	0.6	26	1.7	ZV220S_KL202_0080 EZ302U	1.7	2.7	35	8.000	1.11	1.67	123	18	2	20	42.4
0.83	0.8	0.8	33	1.3	ZV220S_KL202_0080 EZ303U	1.7	2.7	35	8.000	1.11	1.67	123	18	2	20	42.4
1.67	0.5	0.5	34	1.5	ZV220S_KL202_0040 EZ401U	1.6	5.1	33	4.000	1.94	2.78	123	18	2	20	42.4
ZV2KL2 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 2,0 kN)																
0.83	0.7	0.7	11	1.5	ZV220S_KL202_0160 EZ301U	2.0	5.5	43	16.00	0.56	0.83	99	28	2	20	42.4
1.67	0.3	0.3	14	2.4	ZV220S_KL202_0080 EZ301U	1.0	2.7	22	8.000	1.11	1.67	123	18	2	20	42.4
1.67	0.5	0.6	24	1.4	ZV220S_KL202_0080 EZ302U	1.7	2.7	35	8.000	1.11	1.67	123	18	2	20	42.4
1.67	0.7	0.8	32	1.1	ZV220S_KL202_0080 EZ303U	1.7	2.7	35	8.000	1.11	1.67	123	18	2	20	42.4

11.3 Dimensional drawings

This chapter shows you the dimensions of rack and pinion drives with EZ synchronous servo motors.

Dimension az in the tables of dimensions applies to Atlanta gear racks. In general: az = ½ d0 + h0 + x*mn

The pinion of the rack and pinion drive is helical (left-hand 19° 31 42"). The pinion gearing quality is 5.

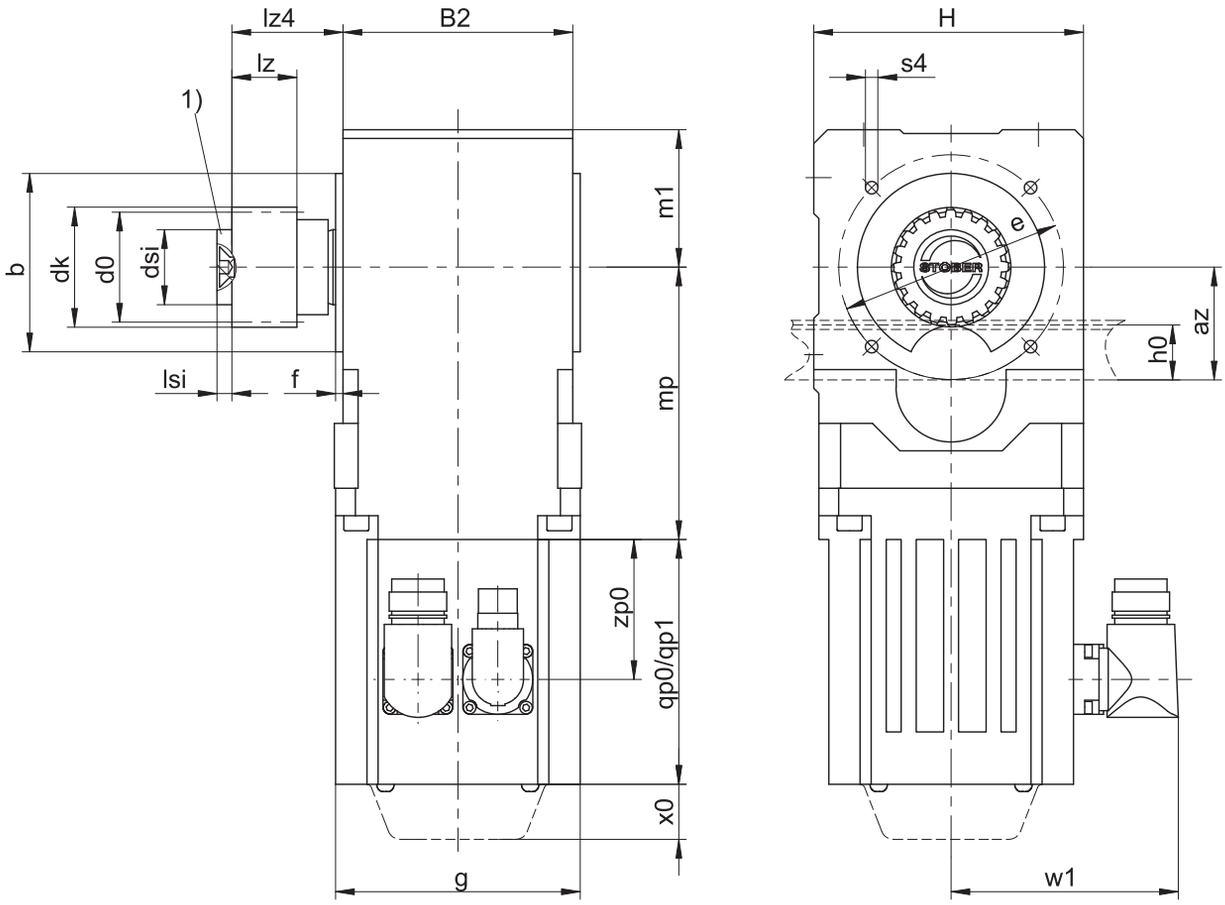
Dimensions can exceed the specifications of ISO 2768-mK due to casting tolerances or accumulation of individual tolerances.

We reserve the right to make dimensional changes due to ongoing technical development.

You can download 3D models of our standard drives at http://configurator.stoeber.de.

Combination options and the dimensions of forced ventilated geared motors can also be found at http://configurator.stoeber.de.

11.3.1 Pinion position E



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x0	Applies to encoders using an optical measuring method.	w1	Different for the One Cable Solution (OCS), see the chapter [▶ 13.4]
1)	Axial locking (optional)		

Dimensions of gear units

Type	mn	az	Øb	B2	Ød0	Ødk	Ødsi	Øe	f	h0	H	lz	lz4	lsi	m1	s4	x
ZV216SEKL1_	2	39.98	60_{j6}	75	33.95	39.81	25	75	3	22	90	26	35.5	5	46	M6	0.5
ZV220SEKL2_	2	44.02	75_{j6}	92	42.44	47.90	30	90	3	22	108	26	44.5	7	55	M6	0.4

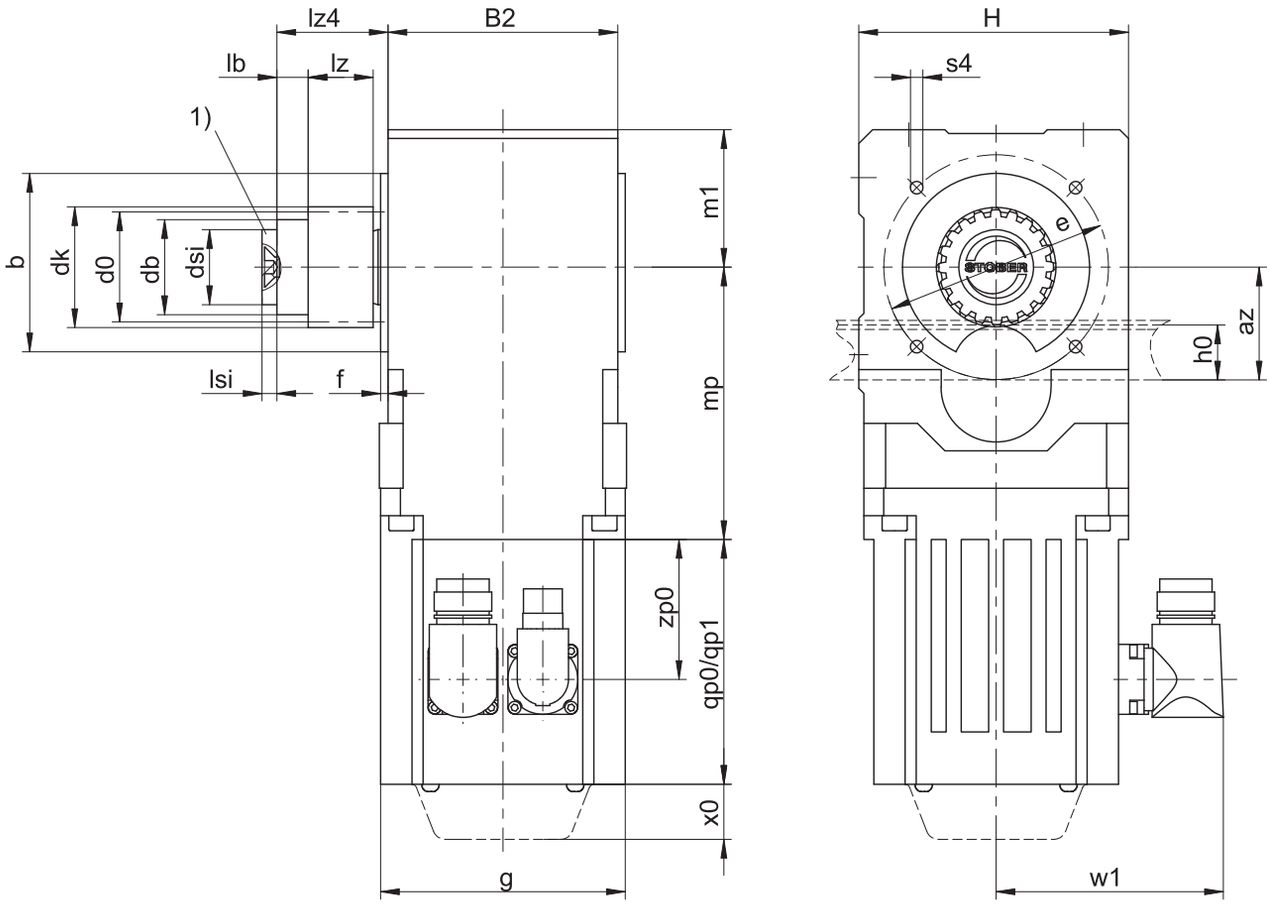
Dimensions of motors

Type	□g	qp0	qp1	w1	x0	zp0
EZ301U	72	90	130.0	55.5	21	54.5
EZ302U	72	112	152.0	55.5	21	76.5
EZ303U	72	134	174.0	55.5	21	98.5
EZ401U	98	98	146.5	91.0	22	56.0

Dimensions of geared motors

Type	EZ3	EZ4
	mp	mp
ZV_KL102_	95.5	–
ZV_KL202_	112.5	109.0

11.3.2 Pinion position S



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x0	Applies to encoders using an optical measuring method.	w1	Different for the One Cable Solution (OCS), see the chapter [▶ 13.4]
1)	Axial locking (optional)		

Dimensions of gear units

Type	mn	az	Øb	B2	Ød0	Ødb	Ødk	Ødsi	Øe	f	h0	H	lb	lz	lz4	lsi	m1	s4	x
ZV216SSKL1_	2	39.98	60_{j6}	75	33.95	30	39.81	25	75	3	22	90	4.5	26	35.5	5	46	M6	0.5
ZV220SSKL2_	2	44.02	75_{j6}	92	42.44	38	47.90	30	90	3	22	108	12.5	26	44.5	7	55	M6	0.4

Dimensions of motors

Type	□g	qp0	qp1	w1	x0	zp0
EZ301U	72	90	130.0	55.5	21	54.5
EZ302U	72	112	152.0	55.5	21	76.5
EZ303U	72	134	174.0	55.5	21	98.5
EZ401U	98	98	146.5	91.0	22	56.0

Dimensions of geared motors

Type	EZ3	EZ4
	mp	mp
ZV_KL102_	95.5	–
ZV_KL202_	112.5	109.0

11.4 Type designation

This chapter shows you an explanation of the type designation with the associated options.

Additional ordering information not included in the type designation can be found at the end of the chapter.

Example code

Z	V	2	20	S	S	KL	2	0	2	P	G	0080	EZ401U

Explanation

Code	Designation	Design
Z	Type	Rack and pinion drive
V	Design	Plug-on pinion
2	Module	m_n = 2 (example)
20	Number of teeth	z = 20 (example)
S	Toothing	Helical (left-hand 19° 31' 42")
E	Pinion position	Shaft end
S		Shaft shoulder
KL	Type	Helical bevel gear unit
2	Size	2 (example)
0	Generation	Generation 0
2	Stages	Two-stage
P	Shaft	Solid shaft with feather key
G	Housing	Pitch circle diameter
0080	Transmission ratio (i x 10)	i = 8 (example)
EZ401U	Motor	EZ synchronous servo motor

To complete the type designation, also specify the following in your order:

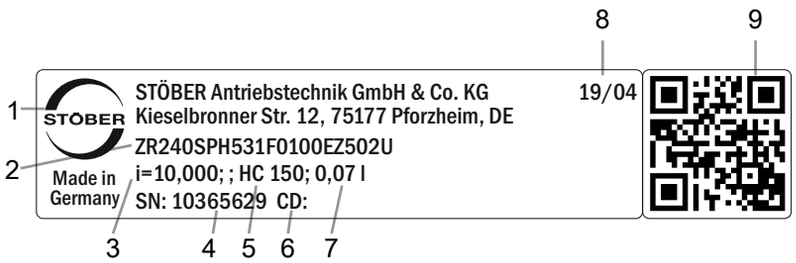
- For a detailed type designation of the motor, see the chapter [▶ 13]
- Attachment of solid shaft: gear unit side 3 or 4
- Pitch circle diameter: gear unit side 3 or 4
- For the position of the plug connectors, see the chapter [▶ 11.5.6]
- For axial locking (optional), see the chapter [▶ 11.3]

An explanation of the gear unit sides can be found in the chapter [▶ 11.5.4]

In this catalog, you will find all information on rack and pinion drives with EZ synchronous servo motors.
All input options available on request can be found in the chapter [▶ 11.5.1].

11.4.1 Nameplate

An example geared motor nameplate is explained in the figure below.



Code	Designation
1	Name of manufacturer
2	Type designation
3	Gear ratio of the gear unit
4	Serial number of the gear unit
5	Lubricant specification
6	Customer-specific data
7	Lubricant fill volume
8	Date of manufacture (year/calendar week)
9	QR code (link to product information)

11.4.1.1 Supporting documents

You can view or download supporting documents for the product by reading off the serial number on the nameplate of the product and entering it at the following address online:
https://id.stober.com

Alternatively, you can use a suitable mobile device to scan in the QR code on the nameplate of the product in order to be linked to the supporting documents.

11.5 Product description

11.5.1 Input options

This chapter shows you all available input options:

EZ synchronous servo motor	MQ motor adapter	LM Lean motor
		
http://www.stoeber.de/en/Z_EZ	http://www.stoeber.de/en/ZVKLMQ	On request

11.5.2 Gear rack

The technical data specified in the Selection tables chapter applies only to gear rack combinations with the following characteristics:

The pinion of the rack and pinion drive is case-hardened and helical (left-hand 19° 31' 42"). The pinion gearing quality is 6.

The corresponding gear rack must have a right-hand design (19° 31' 42") and possess the following characteristics:

Module m_n [mm]	Minimum gear rack quality	Gear rack material
2 – 4	8	C45 inductively hardened

Also note the project configuration of the gear rack on the Atlanta pages.

11.5.2.1 Pinion position

The pinion can be fastened to the shaft in two different attachment positions:

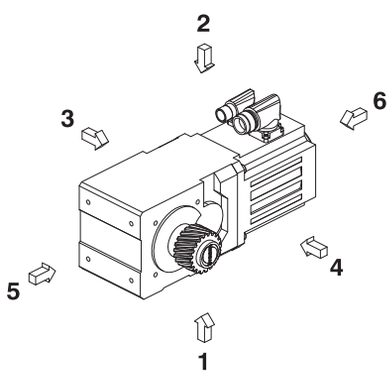
- The toothing is flush with the shaft end (Pos. E)
- The toothing is flush with the shaft shoulder (Pos. S: For higher permitted feed forces, see the Selection tables chapter)

Please specify the desired attachment position when placing your order.

11.5.3 Installation conditions

The specified torques and forces only apply when gear units are fastened on the machine side using screws of strength class 10.9. In addition, the gear housings must be adjusted at the pilot. The machine-side fit must be H7.

11.5.4 Gear unit sides



The numbers identify the gear unit sides.

11.5.5 Lubricants

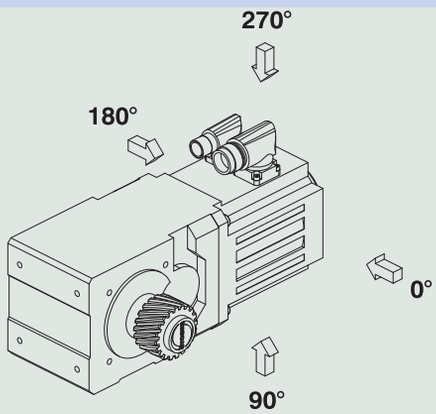
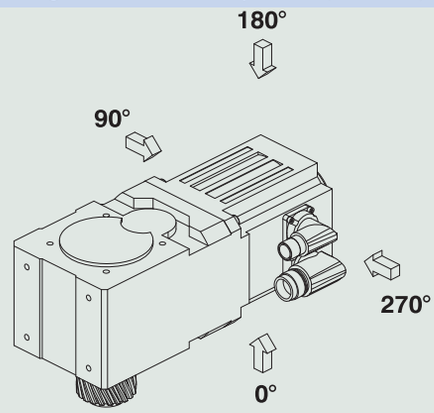
STOBER fills the gear units with the amount and type of lubricant specified on the nameplate.

You will receive lubricants for use in the food industry upon request.

11.5.5.1 Rack and pinion drive lubrication

Make sure the rack and pinion drive has permanent lubrication with the lubricants specified in the Atlanta product catalog.

11.5.6 Position of the plug connectors

Mounting position EL1	Mounting position EL4
Plug connector in 270° position (standard)	Plug connector in 270° position (standard)
	

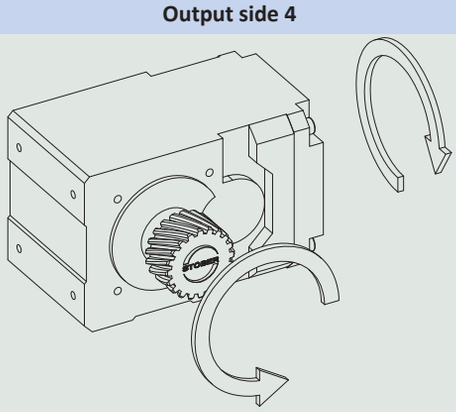
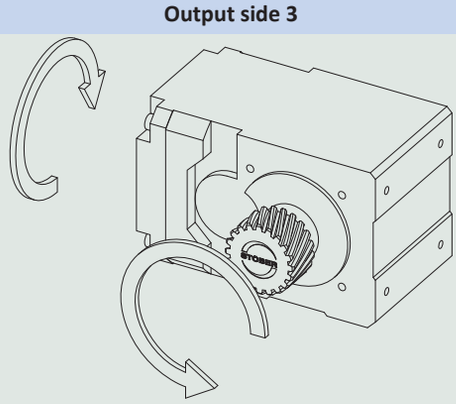
The plug connectors are in the 270° position as standard. Indicate variations for your rack and pinion drive in the order.

Note that the plug connectors also rotate when the gear rack is rotated to a different position.

11.5.7 Other product features

Feature	Value
Max. permitted gear unit temperature (on the surface of the gear unit)	≤ 80 °C
Paint	Black RAL 9005
(ATEX) Directive 2014/34/EU (Option)	Not suitable.
Protection class: [1]	
Planetary gear units	IP65
Motor	IP56, optionally IP66
Pinion/gear rack	IPXX

11.5.8 Direction of rotation

Output side 4	Output side 3
	

The pictures show mounting position EL1.

11.6 Project configuration

Project your drives using our SERVOsoft designing software. Download SERVOsoft for free at https://www.stoeber.de/en/ServoSoft.

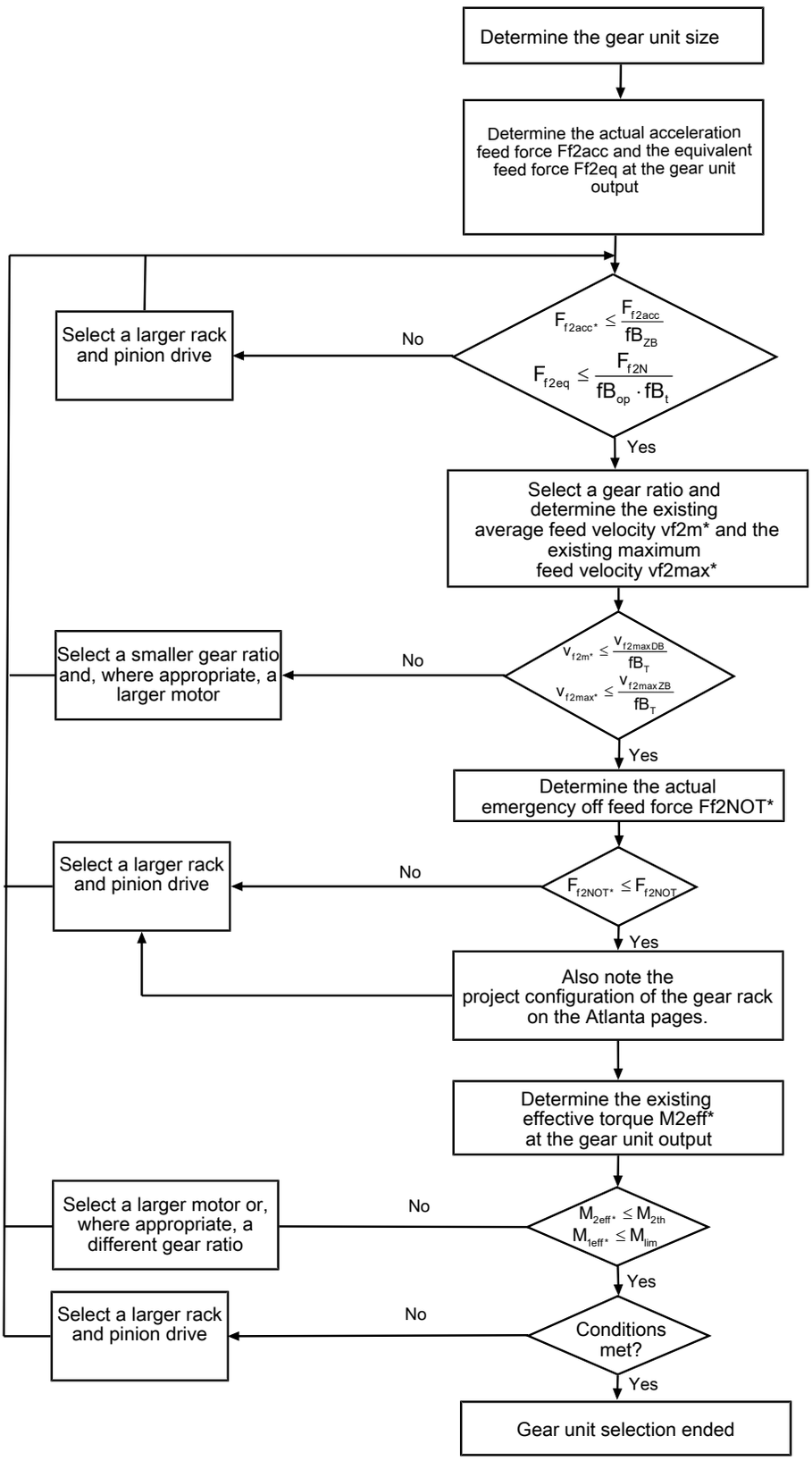
Observe the limit conditions in this chapter to ensure a safe design for your drives.

The formula symbols for values actually present in the application are marked with *.

An explanation of the formula symbols can be found in the chapter [▶ 15.1].

[1] Observe the protection class of all the components.

11.6.1 Drive selection

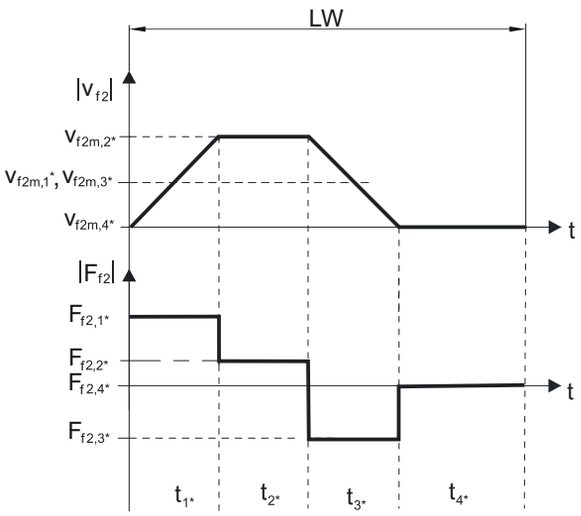


Refer to the selection tables for the values of i, $v_{f2maxDB}$, $v_{f2maxZB}$, F_{f2acc}, F_{f2N} and F_{f2NOT}.

The values for fB_T, fB_{op}, fB_t and fB_{ZB} can be found in the corresponding tables in this chapter.

Example of cyclic operation

The following calculations are based on a representation of the power taken from the output based in accordance with the following example:



Calculation of the actual maximum acceleration feed force

$$F_{f2acc*} = m* \cdot a* + F_{L*}$$

Calculation of the actual average input speed

$$n_{1m*} = \frac{v_{f2m*} \cdot i}{d_0 \cdot \pi}$$

$$v_{f2m*} = \frac{\left|v_{f2m,1*}\right| \cdot t_{1*} + \ldots + \left|v_{f2m,n*}\right| \cdot t_{n*}}{t_{1*} + \ldots + t_{n*}}$$

If $t_{1*} + \ldots + t_{3*} \geq 6$ min, determine v_{2m*} without the rest phase t_{4*}.

The values for the ratio i can be found in the selection tables.

Calculation of the actual emergency off feed force

$$F_{f2NOT*} = m* \cdot a_{NOT*} + F_{L*}$$

Calculation of the actual equivalent feed force

$$F_{f2eq*} = \sqrt[3]{\frac{\left|v_{f2m,1*}\right| \cdot t_{1*} \cdot \left|F_{f2,1*}{}^{3}\right| + \ldots + \left|v_{f2m,n*}\right| \cdot t_{n*} \cdot \left|F_{f2,n*}{}^{3}\right|}{\left|v_{f2m,1*}\right| \cdot t_{1*} + \ldots + \left|v_{f2m,n*}\right| \cdot t_{n*}}}$$

Calculation of the thermal limit torque

Calculate the thermal limit torque M_{2th} for a duty cycle $ED_{10} > 50\%$ and the actual average input speed n_{1m*}. (At $K_{mot,th} \leq 0$ you must reduce the average input speed n_{1m*} accordingly or select another geared motor size.)

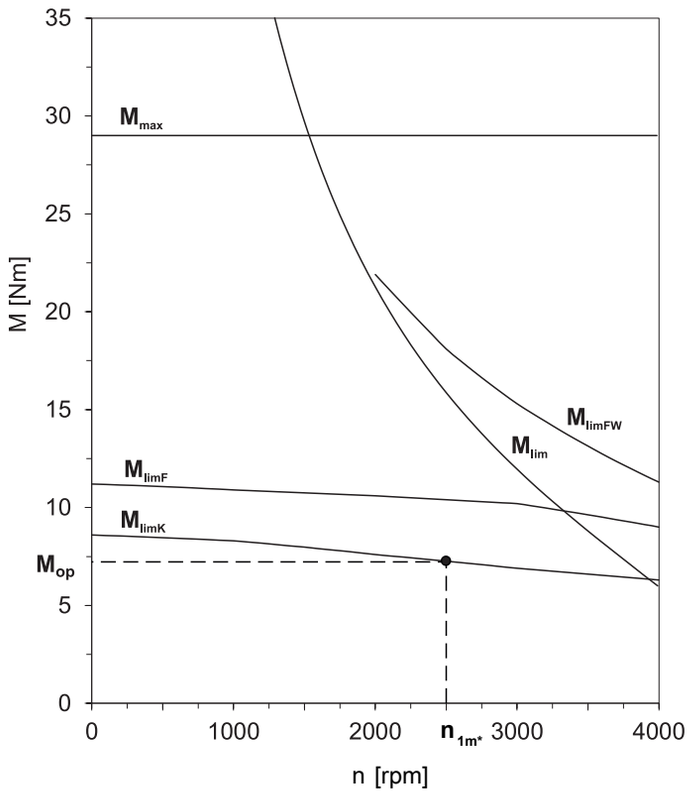
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

$$K_{mot,th} = 0{,}9 - \frac{a_{th}}{1000} \cdot fB_T \cdot \left(\frac{n_{1m*}}{1000}\right)^2$$

Refer to the selection tables for the values of i and a_{th}.

The values for fB_T can be found in the corresponding table in this chapter.

The value for the torque of the motor at operating point M_{op} with the determined average input speed n_{1m*} can be found in the motor characteristic curve of the chapter [▶ 13.3]. Note the size, nominal speed n_N and cooling type of the motor. The figure below shows an example of reading the torque M_{op} of a motor with convection cooling at the operating point.



Calculation of the actual effective torque

$$M_{2eff*} = \sqrt{\frac{t_{1*} \cdot M_{2,1*}{}^2 + \ldots + t_{n*} \cdot M_{2,n*}{}^2}{t_{1*} + \ldots + t_{n*}}}$$

$$M_{2,n*} = \frac{F_{f2,n*} \cdot d_0}{2}$$

$$M_{1eff*} = \frac{M_{2eff*}}{i \cdot \eta}$$

Operating factors

Operating mode	fB_{op}
Uniform continuous operation	1.00
Cyclic operation	1.00
Reversing load cyclic operation	1.00

Run time	fB_t
Daily runtime ≤ 8 h	1.00
Daily runtime ≤ 16 h	1.15
Daily runtime ≤ 24 h	1.20

Cyclic operation	fB_{ZB}
≤ 1000 load changes/hour (LW/h)	1.00
> 1000 load changes/hour (LW/h)	1.15

Temperature		fB_T
Motor cooling	**Surrounding temperature**	
Motor with forced ventilation	≤ 20 °C	0.9
	≤ 30 °C	1.0
	≤ 40 °C	1.15
Motor with convection cooling	≤ 20 °C	1.0
	≤ 30 °C	1.1
	≤ 40 °C	1.25

Notes

- The maximum permitted gear unit temperature (see the "Other product features" chapter) must not be exceeded, as that could result in damage.
- For braking from full speed (for example, when the power fails or when setting up the machine), note the permitted gear unit feed forces (F_{f2acc}, F_{f2NOT}) in the selection tables.

11.7 Additional documentation

Additional documentation related to the product can be found at
http://www.stoeber.de/en/downloads/

Enter the ID of the documentation in the Search... field.

Documentation	ID
Operating manual for gear racks (Atlanta)	442455
Operating manual for KL/KS/PHK/PHKX/PHQK/PK/PKX right-angle servo gear units and right-angle servo geared motors	443150_en
Operating manual for EZ synchronous servo motors	443032_en

12 ZVK rack and pinion drives

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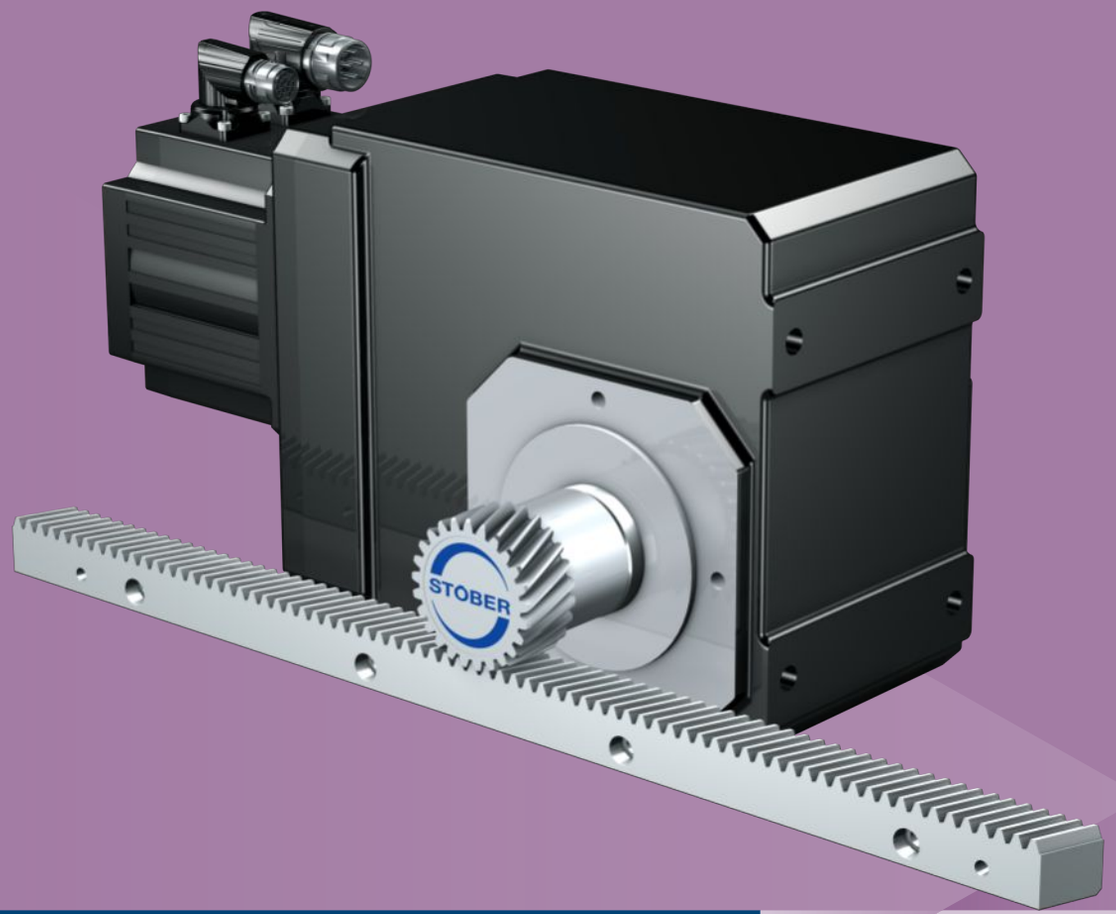


12 Rack and pinion drives

ZVK

12.1 Overview

Highly rigid right-angle geared with plug-on pinion

Features

Power density	★☆☆☆☆
Linear clearance	★★★☆☆
Price category	€
Smooth operation	★★★☆☆
Linear rigidity	★☆☆☆☆
Mass moment of inertia	★★★★☆
Ready-to-install drive solution	✓
Pinion gearing quality 6 (DIN 3962)	✓
Helical gearing	✓
Case-hardened and smoothed	✓
Compact and highly dynamic due to direct motor attachment	✓

Key ★☆☆☆☆ good | ★★★★★ excellent
€ Economy | €€€€€ Premium

Technical data

m_n	2 – 4 mm
z	18 – 25
F_{f2acc}	0.91 – 15 kN
v_{f2N}	0.04 – 3.4 m/s
Δs	12 – 111 µm

12.2 Selection table

The technical data specified in the selection tables applies to:

- De-energized installation
- Permanent lubrication with the lubricants specified in the Atlanta product catalog
- Material combinations as described in the chapter [▶ 12.5.2]
- Installation altitudes up to 1000 m above sea level
- Surrounding temperatures from 0 °C to 40 °C
- Without consideration of the thermal limiting performance
- Drives with convection-cooled motors (e.g. EZ401**U**)

For the technical data on drives with forced ventilated motors (e.g. EZ401**B**), refer to http://configurator.stoeber.de.

For all other technical data, refer to http://configurator.stoeber.de.

An explanation of the formula symbols can be found in the chapter [▶ 15.1].

v_{f2N}	F_{f2N}	$F_{f2,0}$	a_{th}	S	Type	F_{f2accE}	$F_{f2NOT,E}$	M_{2accE}	i	$v_{f2maxDB}$		$v_{f2maxZB}$	Δs	Δs_{redII}	Δs_{redI}	C_{lin}	m_n	z	d_0
										EL1,2	EL3,4,5,6								
[m/s]	[kN]	[kN]				[kN]	[kN]	[Nm]		[m/s]	[m/s]	[m/s]	[µm]	[µm]	[µm]	[N/µm]	[mm]		[mm]
ZV2K1 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 4,9 kN)																			
0.12	2.4	2.4	6.5	1.4	ZV220S_K102_0560 EZ301U	4.8	8.1	100	56.10	0.16	0.16	0.28	74	37	–	46	2	20	42.4
0.14	2.0	2.0	5.2	1.6	ZV220S_K102_0470 EZ301U	4.9	9.6	100	46.92	0.19	0.19	0.33	74	37	–	46	2	20	42.4
0.17	1.7	1.8	8.3	1.7	ZV220S_K102_0400 EZ301U	3.5	5.8	74	40.30	0.22	0.22	0.39	74	37	–	46	2	20	42.4
0.19	1.5	1.5	4.6	2.2	ZV220S_K102_0350 EZ301U	4.5	9.2	95	35.11	0.25	0.25	0.44	74	37	–	46	2	20	42.4
0.19	2.6	2.7	7.9	1.3	ZV220S_K102_0350 EZ302U	4.9	9.2	100	35.11	0.25	0.25	0.44	74	37	–	46	2	20	42.4
0.20	1.4	1.5	6.7	2.3	ZV220S_K102_0340 EZ301U	4.1	6.9	88	33.71	0.26	0.26	0.46	74	37	–	46	2	20	42.4
0.20	2.4	2.6	11	1.3	ZV220S_K102_0340 EZ302U	4.1	6.9	88	33.71	0.26	0.26	0.46	74	37	–	46	2	20	42.4
0.24	1.2	1.2	4.7	2.7	ZV220S_K102_0280 EZ301U	3.6	7.9	76	28.05	0.32	0.32	0.56	74	37	–	46	2	20	42.4
0.24	2.0	2.2	8.1	1.6	ZV220S_K102_0280 EZ302U	4.9	7.9	100	28.05	0.32	0.32	0.56	74	37	–	46	2	20	42.4
0.24	2.7	2.8	11	1.2	ZV220S_K102_0280 EZ303U	4.9	7.9	100	28.05	0.32	0.32	0.56	74	37	–	46	2	20	42.4
0.26	1.1	1.1	4.8	3.0	ZV220S_K102_0250 EZ301U	3.2	6.6	68	25.22	0.35	0.35	0.62	74	37	–	46	2	20	42.4
0.26	1.8	1.9	8.1	1.8	ZV220S_K102_0250 EZ302U	4.9	6.6	100	25.22	0.35	0.35	0.62	74	37	–	46	2	20	42.4
0.26	2.4	2.5	11	1.4	ZV220S_K102_0250 EZ303U	4.9	6.6	100	25.22	0.35	0.35	0.62	74	37	–	46	2	20	42.4
0.29	1.0	1.0	4.8	3.3	ZV220S_K102_0230 EZ301U	3.0	7.5	63	23.27	0.38	0.38	0.67	74	37	–	46	2	20	42.4
0.29	1.7	1.8	8.2	1.9	ZV220S_K102_0230 EZ302U	4.9	7.5	100	23.27	0.38	0.38	0.67	74	37	–	46	2	20	42.4
0.29	2.2	2.3	11	1.5	ZV220S_K102_0230 EZ303U	4.9	7.5	100	23.27	0.38	0.38	0.67	74	37	–	46	2	20	42.4
0.29	3.0	3.2	14	1.1	ZV220S_K102_0230 EZ401U	4.9	11	100	23.27	0.38	0.38	0.67	74	37	–	46	2	20	42.4
0.33	0.9	0.9	4.9	3.8	ZV220S_K102_0200 EZ301U	2.6	5.7	55	20.15	0.44	0.44	0.77	74	37	–	46	2	20	42.4
0.33	1.5	1.5	8.3	2.2	ZV220S_K102_0200 EZ302U	4.6	5.7	97	20.15	0.44	0.44	0.77	74	37	–	46	2	20	42.4
0.33	1.9	2.0	11	1.7	ZV220S_K102_0200 EZ303U	4.6	5.7	97	20.15	0.44	0.44	0.77	74	37	–	46	2	20	42.4
0.33	2.6	2.8	15	1.3	ZV220S_K102_0200 EZ401U	4.9	10	100	20.15	0.44	0.44	0.77	74	37	–	46	2	20	42.4
0.38	0.7	0.8	4.9	4.3	ZV220S_K102_0175 EZ301U	2.2	6.0	48	17.56	0.51	0.48	0.76	74	37	–	46	2	20	42.4
0.38	1.3	1.3	8.4	2.5	ZV220S_K102_0175 EZ302U	4.0	6.0	85	17.56	0.51	0.48	0.76	74	37	–	46	2	20	42.4
0.38	1.7	1.8	11	1.9	ZV220S_K102_0175 EZ303U	4.8	6.0	100	17.56	0.51	0.48	0.76	74	37	–	46	2	20	42.4
0.38	2.2	2.4	15	1.4	ZV220S_K102_0175 EZ401U	4.9	11	100	17.56	0.51	0.48	0.76	74	37	–	46	2	20	42.4
0.40	0.7	0.7	4.9	4.5	ZV220S_K102_0165 EZ301U	2.1	5.4	45	16.71	0.53	0.53	0.93	74	37	–	46	2	20	42.4
0.40	1.2	1.3	8.4	2.7	ZV220S_K102_0165 EZ302U	3.8	5.4	81	16.71	0.53	0.53	0.93	74	37	–	46	2	20	42.4
0.40	1.6	1.7	11	2.0	ZV220S_K102_0165 EZ303U	4.3	5.4	91	16.71	0.53	0.53	0.93	74	37	–	46	2	20	42.4
0.40	2.1	2.3	15	1.5	ZV220S_K102_0165 EZ401U	4.9	10	100	16.71	0.53	0.53	0.93	74	37	–	46	2	20	42.4
0.47	1.0	1.1	8.5	3.1	ZV220S_K102_0140 EZ302U	3.2	4.8	68	14.11	0.63	0.60	0.95	74	37	–	46	2	20	42.4
0.47	1.3	1.4	11	2.4	ZV220S_K102_0140 EZ303U	3.9	4.8	82	14.11	0.63	0.60	0.95	74	37	–	46	2	20	42.4
0.47	1.8	1.9	15	1.8	ZV220S_K102_0140 EZ401U	4.9	11	100	14.11	0.63	0.60	0.95	74	37	–	46	2	20	42.4
0.47	2.8	3.0	23	1.2	ZV220S_K102_0140 EZ501U	4.9	11	100	14.11	0.63	0.60	0.95	74	37	–	46	2	20	42.4
0.47	3.0	3.4	25	1.1	ZV220S_K102_0140 EZ402U	4.9	11	100	14.11	0.63	0.60	0.95	74	37	–	46	2	20	42.4
0.53	0.9	1.0	8.9	3.5	ZV220S_K102_0125 EZ302U	2.9	4.3	61	12.62	0.70	0.67	1.06	74	37	–	46	2	20	42.4
0.53	1.2	1.3	12	2.7	ZV220S_K102_0125 EZ303U	3.5	4.3	73	12.62	0.70	0.67	1.06	74	37	–	46	2	20	42.4
0.53	1.6	1.7	15	2.0	ZV220S_K102_0125 EZ401U	4.9	10	100	12.62	0.70	0.67	1.06	74	37	–	46	2	20	42.4
0.53	2.5	2.7	23	1.3	ZV220S_K102_0125 EZ501U	4.9	10	100	12.62	0.70	0.67	1.06	74	37	–	46	2	20	42.4
0.53	2.7	3.0	25	1.2	ZV220S_K102_0125 EZ402U	4.9	10	100	12.62	0.70	0.67	1.06	74	37	–	46	2	20	42.4
0.58	0.8	0.9	9.5	3.8	ZV220S_K102_0115 EZ302U	2.6	4.0	56	11.57	0.69	0.63	1.06	74	37	–	46	2	20	42.4
0.58	1.1	1.2	12	2.9	ZV220S_K102_0115 EZ303U	3.2	4.0	67	11.57	0.69	0.63	1.06	74	37	–	46	2	20	42.4
0.58	1.5	1.6	15	2.2	ZV220S_K102_0115 EZ401U	4.5	11	95	11.57	0.69	0.63	1.06	74	37	–	46	2	20	42.4
0.58	2.3	2.5	23	1.4	ZV220S_K102_0115 EZ501U	4.9	11	100	11.57	0.69	0.63	1.06	74	37	–	46	2	20	42.4
0.58	2.5	2.7	26	1.3	ZV220S_K102_0115 EZ402U	4.9	11	100	11.57	0.69	0.63	1.06	74	37	–	46	2	20	42.4
0.66	0.7	0.8	10	3.8	ZV220S_K102_0100 EZ302U	2.3	3.5	49	10.14	0.88	0.83	1.32	74	37	–	46	2	20	42.4
0.66	1.0	1.0	14	2.9	ZV220S_K102_0100 EZ303U	2.8	3.5	59	10.14	0.88	0.83	1.32	74	37	–	46	2	20	42.4

v_{f2N}	F_{f2N}	$F_{f2,0}$	a_{th}	S	Type	F_{f2accE}	$F_{f2NOT,E}$	M_{2accE}	i	$v_{f2maxDB}$		$v_{f2maxZB}$	Δs	Δs_{redII}	Δs_{redI}	C_{lin}	m_n	z	d_0
										EL1,2	EL3,4,5,6								
[m/s]	[kN]	[kN]				[kN]	[kN]	[Nm]		[m/s]	[m/s]	[m/s]	[µm]	[µm]	[µm]	[N/µm]	[mm]		[mm]
ZV2K1 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 4,9 kN)																			
0.66	1.3	1.4	15	2.5	ZV220S_K102_0100 EZ401U	3.9	10	84	10.14	0.88	0.83	1.32	74	37	–	46	2	20	42.4
0.66	2.0	2.2	24	1.6	ZV220S_K102_0100 EZ501U	4.9	10	100	10.14	0.88	0.83	1.32	74	37	–	46	2	20	42.4
0.66	2.2	2.4	26	1.5	ZV220S_K102_0100 EZ402U	4.9	10	100	10.14	0.88	0.83	1.32	74	37	–	46	2	20	42.4
0.72	0.7	0.7	11	3.8	ZV220S_K102_0092 EZ302U	2.1	3.2	45	9.249	0.87	0.79	1.32	74	37	–	46	2	20	42.4
0.72	0.9	0.9	15	2.9	ZV220S_K102_0092 EZ303U	2.5	3.2	54	9.249	0.87	0.79	1.32	74	37	–	46	2	20	42.4
0.72	1.2	1.3	16	2.7	ZV220S_K102_0092 EZ401U	3.6	11	76	9.249	0.87	0.79	1.32	74	37	–	46	2	20	42.4
0.72	1.8	2.0	24	1.8	ZV220S_K102_0092 EZ501U	4.9	11	100	9.249	0.87	0.79	1.32	74	37	–	46	2	20	42.4
0.72	2.0	2.2	26	1.6	ZV220S_K102_0092 EZ402U	4.9	11	100	9.249	0.87	0.79	1.32	74	37	–	46	2	20	42.4
0.72	2.9	3.6	38	1.1	ZV220S_K102_0092 EZ404U	4.9	11	100	9.249	0.87	0.79	1.32	74	37	–	46	2	20	42.4
0.72	3.1	3.4	41	1.0	ZV220S_K102_0092 EZ502U	4.9	11	100	9.249	0.87	0.79	1.32	74	37	–	46	2	20	42.4
0.72	3.1	3.5	41	1.0	ZV220S_K102_0092 EZ701U	4.9	11	100	9.249	0.87	0.79	1.32	74	37	–	46	2	20	42.4
0.80	0.6	0.6	12	3.8	ZV220S_K102_0083 EZ302U	1.9	2.8	40	8.309	0.96	0.88	1.47	74	37	–	46	2	20	42.4
0.80	0.8	0.8	16	2.9	ZV220S_K102_0083 EZ303U	2.3	2.8	48	8.309	0.96	0.88	1.47	74	37	–	46	2	20	42.4
0.80	1.1	1.1	16	2.9	ZV220S_K102_0083 EZ401U	3.2	10	69	8.309	0.96	0.88	1.47	74	37	–	46	2	20	42.4
0.80	1.6	1.8	24	1.9	ZV220S_K102_0083 EZ501U	4.9	10	100	8.309	0.96	0.88	1.47	74	37	–	46	2	20	42.4
0.80	1.8	2.0	26	1.7	ZV220S_K102_0083 EZ402U	4.9	10	100	8.309	0.96	0.88	1.47	74	37	–	46	2	20	42.4
0.80	2.6	3.3	39	1.2	ZV220S_K102_0083 EZ404U	4.9	10	100	8.309	0.96	0.88	1.47	74	37	–	46	2	20	42.4
0.80	2.8	3.0	42	1.1	ZV220S_K102_0083 EZ502U	4.9	10	100	8.309	0.96	0.88	1.47	74	37	–	46	2	20	42.4
0.80	2.8	3.2	42	1.1	ZV220S_K102_0083 EZ701U	4.9	10	100	8.309	0.96	0.88	1.47	74	37	–	46	2	20	42.4
1.00	0.5	0.5	14	3.8	ZV220S_K102_0066 EZ302U	1.5	2.3	32	6.644	1.20	1.10	1.84	74	37	–	46	2	20	42.4
1.00	0.6	0.7	19	2.9	ZV220S_K102_0066 EZ303U	1.8	2.3	39	6.644	1.20	1.10	1.84	74	37	–	46	2	20	42.4
1.00	0.9	0.9	16	3.4	ZV220S_K102_0066 EZ401U	2.6	9.1	55	6.644	1.20	1.10	1.84	74	37	–	46	2	20	42.4
1.00	1.3	1.4	25	2.2	ZV220S_K102_0066 EZ501U	4.9	9.1	100	6.644	1.20	1.10	1.84	74	37	–	46	2	20	42.4
1.00	1.4	1.6	27	2.0	ZV220S_K102_0066 EZ402U	4.9	9.1	100	6.644	1.20	1.10	1.84	74	37	–	46	2	20	42.4
1.00	2.1	2.6	39	1.4	ZV220S_K102_0066 EZ404U	4.9	9.1	100	6.644	1.20	1.10	1.84	74	37	–	46	2	20	42.4
1.00	2.2	2.4	42	1.3	ZV220S_K102_0066 EZ502U	4.9	9.1	100	6.644	1.20	1.10	1.84	74	37	–	46	2	20	42.4
1.00	2.2	2.5	42	1.3	ZV220S_K102_0066 EZ701U	4.9	9.1	100	6.644	1.20	1.10	1.84	74	37	–	46	2	20	42.4
1.11	0.8	0.8	16	3.6	ZV220S_K102_0060 EZ401U	2.3	8.2	49	6.000	1.22	1.04	1.85	74	37	–	46	2	20	42.4
1.11	1.2	1.3	25	2.4	ZV220S_K102_0060 EZ501U	4.4	8.2	93	6.000	1.22	1.04	1.85	74	37	–	46	2	20	42.4
1.11	1.3	1.4	27	2.2	ZV220S_K102_0060 EZ402U	4.4	8.2	93	6.000	1.22	1.04	1.85	74	37	–	46	2	20	42.4
1.11	1.9	2.4	40	1.5	ZV220S_K102_0060 EZ404U	4.9	8.2	100	6.000	1.22	1.04	1.85	74	37	–	46	2	20	42.4
1.11	2.0	2.2	43	1.4	ZV220S_K102_0060 EZ502U	4.9	8.2	100	6.000	1.22	1.04	1.85	74	37	–	46	2	20	42.4
1.11	2.0	2.3	43	1.4	ZV220S_K102_0060 EZ701U	4.9	8.2	100	6.000	1.22	1.04	1.85	74	37	–	46	2	20	42.4
1.11	2.7	3.0	56	1.0	ZV220S_K102_0060 EZ503U	4.9	8.2	100	6.000	1.22	1.04	1.85	74	37	–	46	2	20	42.4
1.20	0.4	0.4	16	3.8	ZV220S_K102_0056 EZ302U	1.3	1.9	27	5.568	1.32	1.12	2.00	74	37	–	46	2	20	42.4
1.20	0.5	0.6	21	2.9	ZV220S_K102_0056 EZ303U	1.5	1.9	32	5.568	1.32	1.12	2.00	74	37	–	46	2	20	42.4
1.20	0.7	0.8	16	3.8	ZV220S_K102_0056 EZ401U	2.2	7.6	46	5.568	1.32	1.12	2.00	74	37	–	46	2	20	42.4
1.20	1.1	1.2	25	2.5	ZV220S_K102_0056 EZ501U	4.1	7.6	86	5.568	1.32	1.12	2.00	74	37	–	46	2	20	42.4
1.20	1.2	1.3	27	2.3	ZV220S_K102_0056 EZ402U	4.1	7.6	86	5.568	1.32	1.12	2.00	74	37	–	46	2	20	42.4
1.20	1.8	2.2	40	1.5	ZV220S_K102_0056 EZ404U	4.9	7.6	100	5.568	1.32	1.12	2.00	74	37	–	46	2	20	42.4
1.20	1.9	2.0	43	1.4	ZV220S_K102_0056 EZ502U	4.9	7.6	100	5.568	1.32	1.12	2.00	74	37	–	46	2	20	42.4
1.20	1.9	2.1	43	1.4	ZV220S_K102_0056 EZ701U	4.9	7.6	100	5.568	1.32	1.12	2.00	74	37	–	46	2	20	42.4
1.20	2.5	2.8	56	1.1	ZV220S_K102_0056 EZ503U	4.9	7.6	100	5.568	1.32	1.12	2.00	74	37	–	46	2	20	42.4
1.67	0.3	0.3	21	3.8	ZV220S_K102_0040 EZ302U	0.9	1.4	19	4.000	1.83	1.56	2.78	74	37	–	46	2	20	42.4
1.67	0.4	0.4	27	2.9	ZV220S_K102_0040 EZ303U	1.1	1.4	23	4.000	1.83	1.56	2.78	74	37	–	46	2	20	42.4
1.67	0.5	0.5	17	4.8	ZV220S_K102_0040 EZ401U	1.6	5.5	33	4.000	1.83	1.56	2.78	74	37	–	46	2	20	42.4
1.67	0.8	0.9	26	3.1	ZV220S_K102_0040 EZ501U	2.9	5.5	62	4.000	1.83	1.56	2.78	74	37	–	46	2	20	42.4
1.67	0.9	1.0	28	2.8	ZV220S_K102_0040 EZ402U	2.9	5.5	62	4.000	1.83	1.56	2.78	74	37	–	46	2	20	42.4
1.67	1.3	1.6	41	1.9	ZV220S_K102_0040 EZ404U	4.4	5.5	93	4.000	1.83	1.56	2.78	74	37	–	46	2	20	42.4
1.67	1.4	1.5	44	1.8	ZV220S_K102_0040 EZ502U	4.4	5.5	93	4.000	1.83	1.56	2.78	74	37	–	46	2	20	42.4
1.67	1.4	1.5	44	1.8	ZV220S_K102_0040 EZ701U	3.7	5.5	78	4.000	1.83	1.56	2.78	74	37	–	46	2	20	42.4
1.67	1.8	2.0	58	1.4	ZV220S_K102_0040 EZ503U	4.4	5.5	93	4.000	1.83	1.56	2.78	74	37	–	46	2	20	42.4
ZV2K1 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 4,9 kN)																			
0.24	2.3	2.4	6.2	1.4	ZV220S_K102_0560 EZ301U	4.8	8.1	100	56.10	0.16	0.16	0.28	74	37	–	46	2	20	42.4
0.28	1.9	2.0	5.5	1.7	ZV220S_K102_0470 EZ301U	4.9	9.6	100	46.92	0.19	0.19	0.33	74	37	–	46	2	20	42.4
0.28	3.2	3.6	9.2	1.0	ZV220S_K102_0470 EZ302U	4.9	9.6	100	46.92	0.19	0.19	0.33	74	37	–	46	2	20	42.4
0.33	1.6	1.8	8.0	1.8	ZV220S_K102_0400 EZ301U	3.5	5.8	74	40.30	0.22	0.22	0.39	74	37	–	46	2	20	42.4
0.38	1.4	1.5	5.6	2.3	ZV220S_K102_0350 EZ301U	4.5	9.2	95	35.11	0.25	0.25	0.44	74	37	–	46	2	20	42.4
0.38	2.4	2.7	9.4	1.3	ZV220S_K102_0350 EZ302U	4.9	9.2	100	35.11	0.25	0.25	0.44	74	37	–	46	2	20	42.4
0.38	3.1	3.6	12	1.0	ZV220S_K102_0350 EZ303U	4.9	9.2	100	35.11	0.25	0.25	0.44	74	37	–	46	2	20	42.4
0.40	1.4	1.5	6.4	2.4	ZV220S_K102_0340 EZ301U	4.1	6.9	88	33.71	0.26	0.26	0.46	74	37	–	46	2	20	42.4
0.40	2.3	2.6	11	1.4	ZV220S_K102_0340 EZ302U	4.1	6.9	88	33.71	0.26	0.26	0.46	74	37	–	46	2	20	42.4
0.48	1.1	1.2	5.7	2.8	ZV220S_K102_0280 EZ301U	3.6	7.9	76	28.05	0.32	0.32	0.56	74	37	–	46	2	20	42.4
0.48	1.9	2.2	9.6	1.7	ZV220S_K102_0280 EZ302U	4.9	7.9	100	28.05	0.32	0.32	0.56	74	37	–	46	2	20	42.4

v_{f2N}	F_{f2N}	$F_{f2,0}$	a_{th}	S	Type	F_{f2accE}	$F_{f2NOT,E}$	M_{2accE}	i	$v_{f2maxDB}$		$v_{f2maxZB}$	Δs	Δs_{redII}	Δs_{redI}	C_{lin}	m_n	z	d_0
										EL1,2	EL3,4,5,6								
[m/s]	[kN]	[kN]				[kN]	[kN]	[Nm]		[m/s]	[m/s]	[m/s]	[µm]	[µm]	[µm]	[N/µm]	[mm]		[mm]
ZV2K1 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 4,9 kN)																			
0.48	2.5	2.9	13	1.3	ZV220S_K102_0280 EZ303U	4.9	7.9	100	28.05	0.32	0.32	0.56	74	37	–	46	2	20	42.4
0.48	2.9	3.6	15	1.1	ZV220S_K102_0280 EZ401U	4.9	11	100	28.05	0.32	0.32	0.56	74	37	–	46	2	20	42.4
0.53	1.0	1.1	5.7	3.1	ZV220S_K102_0250 EZ301U	3.2	6.6	68	25.22	0.35	0.35	0.62	74	37	–	46	2	20	42.4
0.53	1.7	1.9	9.7	1.9	ZV220S_K102_0250 EZ302U	4.9	6.6	100	25.22	0.35	0.35	0.62	74	37	–	46	2	20	42.4
0.53	2.3	2.6	13	1.4	ZV220S_K102_0250 EZ303U	4.9	6.6	100	25.22	0.35	0.35	0.62	74	37	–	46	2	20	42.4
0.53	2.7	3.2	15	1.2	ZV220S_K102_0250 EZ401U	4.9	9.1	100	25.22	0.35	0.35	0.62	74	37	–	46	2	20	42.4
0.57	0.9	1.0	5.8	3.4	ZV220S_K102_0230 EZ301U	3.0	7.5	63	23.27	0.38	0.38	0.67	74	37	–	46	2	20	42.4
0.57	1.6	1.8	9.7	2.0	ZV220S_K102_0230 EZ302U	4.9	7.5	100	23.27	0.38	0.38	0.67	74	37	–	46	2	20	42.4
0.57	2.1	2.4	13	1.5	ZV220S_K102_0230 EZ303U	4.9	7.5	100	23.27	0.38	0.38	0.67	74	37	–	46	2	20	42.4
0.57	2.4	3.0	15	1.3	ZV220S_K102_0230 EZ401U	4.9	11	100	23.27	0.38	0.38	0.67	74	37	–	46	2	20	42.4
0.66	0.8	0.9	5.9	3.9	ZV220S_K102_0200 EZ301U	2.6	5.7	55	20.15	0.44	0.44	0.77	74	37	–	46	2	20	42.4
0.66	1.4	1.5	9.9	2.3	ZV220S_K102_0200 EZ302U	4.6	5.7	97	20.15	0.44	0.44	0.77	74	37	–	46	2	20	42.4
0.66	1.8	2.1	13	1.8	ZV220S_K102_0200 EZ303U	4.6	5.7	97	20.15	0.44	0.44	0.77	74	37	–	46	2	20	42.4
0.66	2.1	2.6	15	1.5	ZV220S_K102_0200 EZ401U	4.9	10	100	20.15	0.44	0.44	0.77	74	37	–	46	2	20	42.4
0.76	0.7	0.8	5.9	4.4	ZV220S_K102_0175 EZ301U	2.2	6.0	48	17.56	0.51	0.48	0.76	74	37	–	46	2	20	42.4
0.76	1.2	1.3	10	2.6	ZV220S_K102_0175 EZ302U	4.0	6.0	85	17.56	0.51	0.48	0.76	74	37	–	46	2	20	42.4
0.76	1.6	1.8	13	2.0	ZV220S_K102_0175 EZ303U	4.8	6.0	100	17.56	0.51	0.48	0.76	74	37	–	46	2	20	42.4
0.76	1.8	2.2	15	1.7	ZV220S_K102_0175 EZ401U	4.9	11	100	17.56	0.51	0.48	0.76	74	37	–	46	2	20	42.4
0.76	2.7	3.5	23	1.2	ZV220S_K102_0175 EZ501U	4.9	11	100	17.56	0.51	0.48	0.76	74	37	–	46	2	20	42.4
0.80	0.7	0.7	5.9	4.6	ZV220S_K102_0165 EZ301U	2.1	5.4	45	16.71	0.53	0.53	0.93	74	37	–	46	2	20	42.4
0.80	1.1	1.3	10	2.7	ZV220S_K102_0165 EZ302U	3.8	5.4	81	16.71	0.53	0.53	0.93	74	37	–	46	2	20	42.4
0.80	1.5	1.7	13	2.1	ZV220S_K102_0165 EZ303U	4.3	5.4	91	16.71	0.53	0.53	0.93	74	37	–	46	2	20	42.4
0.80	1.8	2.1	15	1.8	ZV220S_K102_0165 EZ401U	4.9	10	100	16.71	0.53	0.53	0.93	74	37	–	46	2	20	42.4
0.80	2.6	3.4	23	1.2	ZV220S_K102_0165 EZ501U	4.9	10	100	16.71	0.53	0.53	0.93	74	37	–	46	2	20	42.4
0.80	2.7	3.7	23	1.2	ZV220S_K102_0165 EZ402U	4.9	10	100	16.71	0.53	0.53	0.93	74	37	–	46	2	20	42.4
0.95	1.0	1.1	10	3.0	ZV220S_K102_0140 EZ302U	3.2	4.8	68	14.11	0.63	0.60	0.95	74	37	–	46	2	20	42.4
0.95	1.3	1.5	13	2.3	ZV220S_K102_0140 EZ303U	3.9	4.8	82	14.11	0.63	0.60	0.95	74	37	–	46	2	20	42.4
0.95	1.5	1.8	16	2.0	ZV220S_K102_0140 EZ401U	4.9	11	100	14.11	0.63	0.60	0.95	74	37	–	46	2	20	42.4
0.95	2.2	2.8	23	1.3	ZV220S_K102_0140 EZ501U	4.9	11	100	14.11	0.63	0.60	0.95	74	37	–	46	2	20	42.4
0.95	2.3	3.2	24	1.3	ZV220S_K102_0140 EZ402U	4.9	11	100	14.11	0.63	0.60	0.95	74	37	–	46	2	20	42.4
1.06	0.9	1.0	10	3.3	ZV220S_K102_0125 EZ302U	2.9	4.3	61	12.62	0.70	0.67	1.06	74	37	–	46	2	20	42.4
1.06	1.1	1.3	13	2.5	ZV220S_K102_0125 EZ303U	3.5	4.3	73	12.62	0.70	0.67	1.06	74	37	–	46	2	20	42.4
1.06	1.3	1.6	16	2.1	ZV220S_K102_0125 EZ401U	4.9	10	100	12.62	0.70	0.67	1.06	74	37	–	46	2	20	42.4
1.06	2.0	2.5	23	1.4	ZV220S_K102_0125 EZ501U	4.9	10	100	12.62	0.70	0.67	1.06	74	37	–	46	2	20	42.4
1.06	2.0	2.8	24	1.4	ZV220S_K102_0125 EZ402U	4.9	10	100	12.62	0.70	0.67	1.06	74	37	–	46	2	20	42.4
1.32	0.7	0.8	10	3.8	ZV220S_K102_0100 EZ302U	2.3	3.5	49	10.14	0.88	0.83	1.32	74	37	–	46	2	20	42.4
1.32	0.9	1.0	14	2.9	ZV220S_K102_0100 EZ303U	2.8	3.5	59	10.14	0.88	0.83	1.32	74	37	–	46	2	20	42.4
1.32	1.1	1.3	16	2.5	ZV220S_K102_0100 EZ401U	3.9	10	84	10.14	0.88	0.83	1.32	74	37	–	46	2	20	42.4
1.32	1.6	2.0	24	1.7	ZV220S_K102_0100 EZ501U	4.9	10	100	10.14	0.88	0.83	1.32	74	37	–	46	2	20	42.4
1.32	1.6	2.3	24	1.6	ZV220S_K102_0100 EZ402U	4.9	10	100	10.14	0.88	0.83	1.32	74	37	–	46	2	20	42.4
1.32	2.4	3.6	36	1.1	ZV220S_K102_0100 EZ502U	4.9	10	100	10.14	0.88	0.83	1.32	74	37	–	46	2	20	42.4
1.32	2.4	3.7	36	1.1	ZV220S_K102_0100 EZ701U	4.9	10	100	10.14	0.88	0.83	1.32	74	37	–	46	2	20	42.4
ZV2K2 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 8,3 kN)																			
0.06	4.5	4.6	3.8	1.1	ZV225S_K203_1350 EZ301U	8.3	15	220	135.3	0.08	0.08	0.13	77	46	19	46	2	25	53.1
0.08	3.7	3.7	3.6	1.4	ZV225S_K203_1090 EZ301U	8.3	15	220	109.5	0.10	0.10	0.17	77	46	19	46	2	25	53.1
0.09	3.0	3.1	3.4	1.7	ZV225S_K203_0910 EZ301U	8.3	15	220	90.79	0.12	0.12	0.20	77	46	19	46	2	25	53.1
0.09	5.2	5.5	5.9	1.0	ZV225S_K203_0910 EZ302U	8.3	15	220	90.79	0.12	0.12	0.20	77	46	19	46	2	25	53.1
0.11	2.7	2.7	3.3	2.0	ZV225S_K203_0800 EZ301U	8.0	15	210	79.62	0.14	0.14	0.23	77	46	19	46	2	25	53.1
0.11	4.6	4.8	5.7	1.1	ZV225S_K203_0800 EZ302U	8.3	15	220	79.62	0.14	0.14	0.23	77	46	19	46	2	25	53.1
0.12	2.4	2.4	4.9	2.1	ZV225S_K202_0690 EZ301U	6.0	9.6	160	69.43	0.16	0.16	0.26	77	39	12	46	2	25	53.1
0.12	4.0	4.3	8.4	1.2	ZV225S_K202_0690 EZ302U	6.0	9.6	160	69.43	0.16	0.16	0.26	77	39	12	46	2	25	53.1
0.12	2.3	2.3	3.2	2.3	ZV225S_K203_0680 EZ301U	6.9	15	180	68.42	0.16	0.16	0.26	77	46	19	46	2	25	53.1
0.12	3.9	4.1	5.5	1.3	ZV225S_K203_0680 EZ302U	8.3	15	220	68.42	0.16	0.16	0.26	77	46	19	46	2	25	53.1
0.12	5.1	5.4	7.1	1.0	ZV225S_K203_0680 EZ303U	8.3	15	220	68.42	0.16	0.16	0.26	77	46	19	46	2	25	53.1
0.13	2.2	2.3	3.2	2.4	ZV225S_K203_0660 EZ301U	6.7	15	180	66.03	0.17	0.16	0.27	77	46	19	46	2	25	53.1
0.13	3.8	4.0	5.4	1.4	ZV225S_K203_0660 EZ302U	8.3	15	220	66.03	0.17	0.16	0.27	77	46	19	46	2	25	53.1
0.13	4.9	5.2	7.1	1.1	ZV225S_K203_0660 EZ303U	8.3	15	220	66.03	0.17	0.16	0.27	77	46	19	46	2	25	53.1
0.15	1.9	1.9	3.9	2.8	ZV225S_K202_0560 EZ301U	5.7	10	150	55.54	0.20	0.20	0.33	77	39	12	46	2	25	53.1
0.15	3.2	3.4	6.6	1.6	ZV225S_K202_0560 EZ302U	7.2	10	190	55.54	0.20	0.20	0.33	77	39	12	46	2	25	53.1
0.15	4.2	4.4	8.6	1.2	ZV225S_K202_0560 EZ303U	7.2	10	190	55.54	0.20	0.20	0.33	77	39	12	46	2	25	53.1
0.15	1.8	1.9	3.0	2.9	ZV225S_K203_0540 EZ301U	5.5	13	150	54.25	0.21	0.20	0.33	77	46	19	46	2	25	53.1
0.15	3.1	3.3	5.2	1.7	ZV225S_K203_0540 EZ302U	8.3	13	220	54.25	0.21	0.20	0.33	77	46	19	46	2	25	53.1
0.15	4.0	4.3	6.7	1.3	ZV225S_K203_0540 EZ303U	8.3	13	220	54.25	0.21	0.20	0.33	77	46	19	46	2	25	53.1
0.17	1.7	1.8	6.2	2.1	ZV225S_K202_0500 EZ301U	4.4	7.0	120	50.49	0.22	0.22	0.36	77	39	12	46	2	25	53.1

v_{f2N}	F_{f2N}	$F_{f2,0}$	a_{th}	S	Type	F_{f2accE}	$F_{f2NOT,E}$	M_{2accE}	i	$v_{f2maxDB}$		$v_{f2maxZB}$	Δs	Δs_{redII}	Δs_{redI}	C_{lin}	m_n	z	d_0
										EL1,2	EL3,4,5,6								
[m/s]	[kN]	[kN]				[kN]	[kN]	[Nm]		[m/s]	[m/s]	[m/s]	[µm]	[µm]	[µm]	[N/µm]	[mm]		[mm]
ZV2K2 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 8,3 kN)																			
0.17	2.9	3.1	11	1.2	ZV225S_K202_0500 EZ302U	4.4	7.0	120	50.49	0.22	0.22	0.36	77	39	12	46	2	25	53.1
0.17	1.7	1.7	3.0	3.1	ZV225S_K203_0500 EZ301U	5.0	12	130	49.76	0.22	0.22	0.36	77	46	19	46	2	25	53.1
0.17	2.9	3.0	5.0	1.8	ZV225S_K203_0500 EZ302U	8.3	12	220	49.76	0.22	0.22	0.36	77	46	19	46	2	25	53.1
0.17	3.7	3.9	6.6	1.4	ZV225S_K203_0500 EZ303U	8.3	12	220	49.76	0.22	0.22	0.36	77	46	19	46	2	25	53.1
0.17	5.0	5.4	8.9	1.0	ZV225S_K203_0500 EZ401U	8.3	12	220	49.76	0.22	0.22	0.36	77	46	19	46	2	25	53.1
0.18	1.6	1.6	2.9	3.3	ZV225S_K202_0460 EZ301U	4.7	9.7	130	46.23	0.24	0.23	0.39	77	39	12	46	2	25	53.1
0.18	2.7	2.8	5.0	1.9	ZV225S_K202_0460 EZ302U	7.8	9.7	210	46.23	0.24	0.23	0.39	77	39	12	46	2	25	53.1
0.18	3.5	3.7	6.5	1.5	ZV225S_K202_0460 EZ303U	7.8	9.7	210	46.23	0.24	0.23	0.39	77	39	12	46	2	25	53.1
0.18	4.7	5.1	8.9	1.1	ZV225S_K202_0460 EZ401U	8.3	15	220	46.23	0.24	0.23	0.39	77	39	12	46	2	25	53.1
0.18	1.5	1.5	2.9	3.4	ZV225S_K203_0450 EZ301U	4.6	11	120	45.22	0.25	0.24	0.40	77	46	19	46	2	25	53.1
0.18	2.6	2.7	4.9	2.0	ZV225S_K203_0450 EZ302U	8.1	11	220	45.22	0.25	0.24	0.40	77	46	19	46	2	25	53.1
0.18	3.4	3.6	6.4	1.5	ZV225S_K203_0450 EZ303U	8.3	11	220	45.22	0.25	0.24	0.40	77	46	19	46	2	25	53.1
0.18	4.6	4.9	8.7	1.1	ZV225S_K203_0450 EZ401U	8.3	11	220	45.22	0.25	0.24	0.40	77	46	19	46	2	25	53.1
0.21	1.4	1.4	4.9	3.2	ZV225S_K202_0400 EZ301U	4.1	7.5	110	40.39	0.28	0.27	0.45	77	39	12	46	2	25	53.1
0.21	2.3	2.5	8.4	1.9	ZV225S_K202_0400 EZ302U	5.2	7.5	140	40.39	0.28	0.27	0.45	77	39	12	46	2	25	53.1
0.21	3.1	3.2	11	1.4	ZV225S_K202_0400 EZ303U	5.2	7.5	140	40.39	0.28	0.27	0.45	77	39	12	46	2	25	53.1
0.21	1.3	1.4	2.8	3.9	ZV225S_K203_0390 EZ301U	4.0	9.5	110	39.45	0.28	0.28	0.46	77	46	19	46	2	25	53.1
0.21	2.3	2.4	4.8	2.3	ZV225S_K203_0390 EZ302U	7.1	9.5	190	39.45	0.28	0.28	0.46	77	46	19	46	2	25	53.1
0.21	2.9	3.1	6.3	1.8	ZV225S_K203_0390 EZ303U	7.6	9.5	200	39.45	0.28	0.28	0.46	77	46	19	46	2	25	53.1
0.21	4.0	4.3	8.5	1.3	ZV225S_K203_0390 EZ401U	7.6	9.5	200	39.45	0.28	0.28	0.46	77	46	19	46	2	25	53.1
0.24	1.2	1.2	3.2	4.4	ZV225S_K202_0350 EZ301U	3.5	8.1	94	34.55	0.32	0.31	0.52	77	39	12	46	2	25	53.1
0.24	2.0	2.1	5.5	2.6	ZV225S_K202_0350 EZ302U	6.3	8.1	170	34.55	0.32	0.31	0.52	77	39	12	46	2	25	53.1
0.24	2.6	2.8	7.1	2.0	ZV225S_K202_0350 EZ303U	6.5	8.1	170	34.55	0.32	0.31	0.52	77	39	12	46	2	25	53.1
0.24	3.5	3.8	8.7	1.5	ZV225S_K202_0350 EZ401U	8.3	15	220	34.55	0.32	0.31	0.52	77	39	12	46	2	25	53.1
0.25	1.1	1.2	3.6	4.6	ZV225S_K202_0340 EZ301U	3.4	7.1	91	33.62	0.33	0.32	0.54	77	39	12	46	2	25	53.1
0.25	2.0	2.1	6.2	2.7	ZV225S_K202_0340 EZ302U	5.7	7.1	150	33.62	0.33	0.32	0.54	77	39	12	46	2	25	53.1
0.25	2.5	2.7	8.1	2.0	ZV225S_K202_0340 EZ303U	5.7	7.1	150	33.62	0.33	0.32	0.54	77	39	12	46	2	25	53.1
0.25	3.4	3.7	11	1.5	ZV225S_K202_0340 EZ401U	7.0	12	180	33.62	0.33	0.32	0.54	77	39	12	46	2	25	53.1
0.30	2.9	3.1	8.8	1.8	ZV225S_K202_0280 EZ401U	8.3	15	220	27.95	0.40	0.39	0.65	77	39	12	46	2	25	53.1
0.30	4.4	4.8	14	1.2	ZV225S_K202_0280 EZ501U	8.3	15	220	27.95	0.40	0.39	0.65	77	39	12	46	2	25	53.1
0.30	4.8	5.3	15	1.1	ZV225S_K202_0280 EZ402U	8.3	15	220	27.95	0.40	0.39	0.65	77	39	12	46	2	25	53.1
0.33	1.5	1.5	6.9	3.2	ZV225S_K202_0250 EZ302U	4.6	5.9	120	25.13	0.44	0.43	0.72	77	39	12	46	2	25	53.1
0.33	1.9	2.0	9.0	2.5	ZV225S_K202_0250 EZ303U	4.7	5.9	120	25.13	0.44	0.43	0.72	77	39	12	46	2	25	53.1
0.33	2.6	2.8	8.9	2.0	ZV225S_K202_0250 EZ401U	7.8	15	210	25.13	0.44	0.43	0.72	77	39	12	46	2	25	53.1
0.33	4.0	4.3	14	1.3	ZV225S_K202_0250 EZ501U	8.3	15	220	25.13	0.44	0.43	0.72	77	39	12	46	2	25	53.1
0.33	4.3	4.8	15	1.2	ZV225S_K202_0250 EZ402U	8.3	15	220	25.13	0.44	0.43	0.72	77	39	12	46	2	25	53.1
0.36	1.3	1.4	6.3	3.8	ZV225S_K202_0230 EZ302U	4.2	6.4	110	23.18	0.48	0.47	0.78	77	39	12	46	2	25	53.1
0.36	1.8	1.9	8.2	2.9	ZV225S_K202_0230 EZ303U	5.1	6.4	130	23.18	0.48	0.47	0.78	77	39	12	46	2	25	53.1
0.36	2.4	2.5	9.0	2.2	ZV225S_K202_0230 EZ401U	7.2	15	190	23.18	0.48	0.47	0.78	77	39	12	46	2	25	53.1
0.36	3.6	4.0	14	1.4	ZV225S_K202_0230 EZ501U	8.3	15	220	23.18	0.48	0.47	0.78	77	39	12	46	2	25	53.1
0.36	4.0	4.4	15	1.3	ZV225S_K202_0230 EZ402U	8.3	15	220	23.18	0.48	0.47	0.78	77	39	12	46	2	25	53.1
0.41	2.1	2.2	9.1	2.5	ZV225S_K202_0200 EZ401U	6.3	15	170	20.33	0.55	0.53	0.89	77	39	12	46	2	25	53.1
0.41	3.2	3.5	14	1.6	ZV225S_K202_0200 EZ501U	8.3	15	220	20.33	0.55	0.53	0.89	77	39	12	46	2	25	53.1
0.41	3.5	3.9	15	1.5	ZV225S_K202_0200 EZ402U	8.3	15	220	20.33	0.55	0.53	0.89	77	39	12	46	2	25	53.1
0.41	5.1	6.4	22	1.0	ZV225S_K202_0200 EZ404U	8.3	15	220	20.33	0.55	0.53	0.89	77	39	12	46	2	25	53.1
0.48	1.0	1.1	7.8	3.8	ZV225S_K202_0175 EZ302U	3.2	4.8	85	17.47	0.62	0.56	0.88	77	39	12	46	2	25	53.1
0.48	1.3	1.4	10	2.9	ZV225S_K202_0175 EZ303U	3.8	4.8	100	17.47	0.62	0.56	0.88	77	39	12	46	2	25	53.1
0.48	1.8	1.9	9.2	2.9	ZV225S_K202_0175 EZ401U	5.4	15	140	17.47	0.62	0.56	0.88	77	39	12	46	2	25	53.1
0.48	2.7	3.0	14	1.9	ZV225S_K202_0175 EZ501U	8.3	15	220	17.47	0.62	0.56	0.88	77	39	12	46	2	25	53.1
0.48	3.0	3.3	15	1.7	ZV225S_K202_0175 EZ402U	8.3	15	220	17.47	0.62	0.56	0.88	77	39	12	46	2	25	53.1
0.48	4.4	5.5	23	1.2	ZV225S_K202_0175 EZ404U	8.3	15	220	17.47	0.62	0.56	0.88	77	39	12	46	2	25	53.1
0.48	4.7	5.1	24	1.1	ZV225S_K202_0175 EZ502U	8.3	15	220	17.47	0.62	0.56	0.88	77	39	12	46	2	25	53.1
0.48	4.7	5.3	24	1.1	ZV225S_K202_0175 EZ701U	8.3	15	220	17.47	0.62	0.56	0.88	77	39	12	46	2	25	53.1
0.49	1.0	1.0	8.0	3.8	ZV225S_K202_0170 EZ302U	3.1	4.6	82	16.86	0.66	0.64	1.07	77	39	12	46	2	25	53.1
0.49	1.3	1.4	10	2.9	ZV225S_K202_0170 EZ303U	3.7	4.6	98	16.86	0.66	0.64	1.07	77	39	12	46	2	25	53.1
0.49	1.7	1.8	9.2	3.0	ZV225S_K202_0170 EZ401U	5.2	15	140	16.86	0.66	0.64	1.07	77	39	12	46	2	25	53.1
0.49	2.7	2.9	14	2.0	ZV225S_K202_0170 EZ501U	8.3	15	220	16.86	0.66	0.64	1.07	77	39	12	46	2	25	53.1
0.49	2.9	3.2	15	1.8	ZV225S_K202_0170 EZ402U	8.3	15	220	16.86	0.66	0.64	1.07	77	39	12	46	2	25	53.1
0.49	4.3	5.3	23	1.2	ZV225S_K202_0170 EZ404U	8.3	15	220	16.86	0.66	0.64	1.07	77	39	12	46	2	25	53.1
0.49	4.6	4.9	24	1.1	ZV225S_K202_0170 EZ502U	8.3	15	220	16.86	0.66	0.64	1.07	77	39	12	46	2	25	53.1
0.49	4.6	5.1	24	1.1	ZV225S_K202_0170 EZ701U	8.3	15	220	16.86	0.66	0.64	1.07	77	39	12	46	2	25	53.1
0.60	1.4	1.5	9.4	3.5	ZV225S_K202_0140 EZ401U	4.3	15	110	13.85	0.78	0.70	1.10	77	39	12	46	2	25	53.1
0.60	2.2	2.4	14	2.3	ZV225S_K202_0140 EZ501U	8.1	15	210	13.85	0.78	0.70	1.10	77	39	12	46	2	25	53.1
0.60	2.4	2.6	16	2.1	ZV225S_K202_0140 EZ402U	8.1	15	210	13.85	0.78	0.70	1.10	77	39	12	46	2	25	53.1

v_{f2N}	F_{f2N}	$F_{f2,0}$	a_{th}	S	Type	F_{f2accE}	$F_{f2NOT,E}$	M_{2accE}	i	$v_{f2maxDB}$		$v_{f2maxZB}$	Δs	Δs_{redII}	Δs_{redI}	C_{lin}	m_n	z	d_0
										EL1,2	EL3,4,5,6								
[m/s]	[kN]	[kN]				[kN]	[kN]	[Nm]		[m/s]	[m/s]	[m/s]	[µm]	[µm]	[µm]	[N/µm]	[mm]		[mm]
ZV2K2 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 8,3 kN)																			
0.60	3.5	4.4	23	1.4	ZV225S_K202_0140 EZ404U	8.3	15	220	13.85	0.78	0.70	1.10	77	39	12	46	2	25	53.1
0.60	3.7	4.1	25	1.3	ZV225S_K202_0140 EZ502U	8.3	15	220	13.85	0.78	0.70	1.10	77	39	12	46	2	25	53.1
0.60	3.7	4.2	25	1.3	ZV225S_K202_0140 EZ701U	8.3	15	220	13.85	0.78	0.70	1.10	77	39	12	46	2	25	53.1
0.60	4.9	5.6	32	1.0	ZV225S_K202_0140 EZ503U	8.3	15	220	13.85	0.78	0.70	1.10	77	39	12	46	2	25	53.1
0.66	0.7	0.8	9.8	3.8	ZV225S_K202_0125 EZ302U	2.3	3.5	62	12.71	0.85	0.77	1.20	77	39	12	46	2	25	53.1
0.66	1.0	1.0	13	2.9	ZV225S_K202_0125 EZ303U	2.8	3.5	74	12.71	0.85	0.77	1.20	77	39	12	46	2	25	53.1
0.66	1.3	1.4	9.4	3.7	ZV225S_K202_0125 EZ401U	3.9	14	100	12.71	0.85	0.77	1.20	77	39	12	46	2	25	53.1
0.66	2.0	2.2	15	2.4	ZV225S_K202_0125 EZ501U	7.4	14	200	12.71	0.85	0.77	1.20	77	39	12	46	2	25	53.1
0.66	2.2	2.4	16	2.2	ZV225S_K202_0125 EZ402U	7.4	14	200	12.71	0.85	0.77	1.20	77	39	12	46	2	25	53.1
0.66	3.2	4.0	23	1.5	ZV225S_K202_0125 EZ404U	8.3	14	220	12.71	0.85	0.77	1.20	77	39	12	46	2	25	53.1
0.66	3.4	3.7	25	1.4	ZV225S_K202_0125 EZ502U	8.3	14	220	12.71	0.85	0.77	1.20	77	39	12	46	2	25	53.1
0.66	3.4	3.9	25	1.4	ZV225S_K202_0125 EZ701U	8.3	15	220	12.71	0.85	0.77	1.20	77	39	12	46	2	25	53.1
0.66	4.5	5.2	33	1.1	ZV225S_K202_0125 EZ503U	8.3	14	220	12.71	0.85	0.77	1.20	77	39	12	46	2	25	53.1
0.72	0.7	0.7	11	3.8	ZV225S_K202_0115 EZ302U	2.1	3.2	56	11.55	0.84	0.75	1.20	77	39	12	46	2	25	53.1
0.72	0.9	0.9	14	2.9	ZV225S_K202_0115 EZ303U	2.5	3.2	67	11.55	0.84	0.75	1.20	77	39	12	46	2	25	53.1
0.72	1.2	1.3	9.5	3.9	ZV225S_K202_0115 EZ401U	3.6	13	95	11.55	0.84	0.75	1.20	77	39	12	46	2	25	53.1
0.72	1.8	2.0	15	2.6	ZV225S_K202_0115 EZ501U	6.8	13	180	11.55	0.84	0.75	1.20	77	39	12	46	2	25	53.1
0.72	2.0	2.2	16	2.4	ZV225S_K202_0115 EZ402U	6.8	13	180	11.55	0.84	0.75	1.20	77	39	12	46	2	25	53.1
0.72	2.9	3.6	23	1.6	ZV225S_K202_0115 EZ404U	8.3	13	220	11.55	0.84	0.75	1.20	77	39	12	46	2	25	53.1
0.72	3.1	3.4	25	1.5	ZV225S_K202_0115 EZ502U	8.3	13	220	11.55	0.84	0.75	1.20	77	39	12	46	2	25	53.1
0.72	3.1	3.5	25	1.5	ZV225S_K202_0115 EZ701U	8.3	15	220	11.55	0.84	0.75	1.20	77	39	12	46	2	25	53.1
0.72	4.1	4.7	33	1.1	ZV225S_K202_0115 EZ503U	8.3	13	220	11.55	0.84	0.75	1.20	77	39	12	46	2	25	53.1
0.83	1.0	1.1	9.6	4.3	ZV225S_K202_0100 EZ401U	3.1	11	83	10.07	1.08	0.97	1.52	77	39	12	46	2	25	53.1
0.83	1.6	1.7	15	2.8	ZV225S_K202_0100 EZ501U	5.9	11	160	10.07	1.08	0.97	1.52	77	39	12	46	2	25	53.1
0.83	1.7	1.9	16	2.6	ZV225S_K202_0100 EZ402U	5.9	11	160	10.07	1.08	0.97	1.52	77	39	12	46	2	25	53.1
0.83	2.5	3.2	24	1.8	ZV225S_K202_0100 EZ404U	8.3	11	220	10.07	1.08	0.97	1.52	77	39	12	46	2	25	53.1
0.83	2.7	2.9	25	1.6	ZV225S_K202_0100 EZ502U	8.3	11	220	10.07	1.08	0.97	1.52	77	39	12	46	2	25	53.1
0.83	2.7	3.1	25	1.6	ZV225S_K202_0100 EZ701U	7.4	15	200	10.07	1.08	0.97	1.52	77	39	12	46	2	25	53.1
0.83	3.6	4.1	33	1.2	ZV225S_K202_0100 EZ503U	8.3	11	220	10.07	1.08	0.97	1.52	77	39	12	46	2	25	53.1
0.83	4.4	5.3	41	1.0	ZV225S_K202_0100 EZ702U	8.3	15	220	10.07	1.08	0.97	1.52	77	39	12	46	2	25	53.1
0.91	0.9	1.0	9.7	4.6	ZV225S_K202_0092 EZ401U	2.9	10	76	9.190	1.06	0.94	1.51	77	39	12	46	2	25	53.1
0.91	1.4	1.6	15	3.0	ZV225S_K202_0092 EZ501U	5.4	10	140	9.190	1.06	0.94	1.51	77	39	12	46	2	25	53.1
0.91	1.6	1.7	16	2.7	ZV225S_K202_0092 EZ402U	5.4	10	140	9.190	1.06	0.94	1.51	77	39	12	46	2	25	53.1
0.91	2.3	2.9	24	1.9	ZV225S_K202_0092 EZ404U	8.1	10	210	9.190	1.06	0.94	1.51	77	39	12	46	2	25	53.1
0.91	2.5	2.7	26	1.7	ZV225S_K202_0092 EZ502U	8.1	10	210	9.190	1.06	0.94	1.51	77	39	12	46	2	25	53.1
0.91	2.5	2.8	26	1.7	ZV225S_K202_0092 EZ701U	6.7	15	180	9.190	1.06	0.94	1.51	77	39	12	46	2	25	53.1
0.91	3.3	3.7	34	1.3	ZV225S_K202_0092 EZ503U	8.1	10	210	9.190	1.06	0.94	1.51	77	39	12	46	2	25	53.1
0.91	4.0	4.8	42	1.1	ZV225S_K202_0092 EZ702U	8.3	15	220	9.190	1.06	0.94	1.51	77	39	12	46	2	25	53.1
0.99	0.5	0.5	13	3.8	ZV225S_K202_0084 EZ302U	1.5	2.3	41	8.397	1.16	1.03	1.65	77	39	12	46	2	25	53.1
0.99	0.6	0.7	17	2.9	ZV225S_K202_0084 EZ303U	1.8	2.3	49	8.397	1.16	1.03	1.65	77	39	12	46	2	25	53.1
0.99	0.9	0.9	9.8	4.9	ZV225S_K202_0084 EZ401U	2.6	9.2	69	8.397	1.16	1.03	1.65	77	39	12	46	2	25	53.1
0.99	1.3	1.4	15	3.2	ZV225S_K202_0084 EZ501U	4.9	9.2	130	8.397	1.16	1.03	1.65	77	39	12	46	2	25	53.1
0.99	1.4	1.6	16	2.9	ZV225S_K202_0084 EZ402U	4.9	9.2	130	8.397	1.16	1.03	1.65	77	39	12	46	2	25	53.1
0.99	2.1	2.6	24	2.0	ZV225S_K202_0084 EZ404U	7.4	9.2	200	8.397	1.16	1.03	1.65	77	39	12	46	2	25	53.1
0.99	2.3	2.5	26	1.8	ZV225S_K202_0084 EZ502U	7.4	9.2	200	8.397	1.16	1.03	1.65	77	39	12	46	2	25	53.1
0.99	2.3	2.5	26	1.8	ZV225S_K202_0084 EZ701U	6.1	15	160	8.397	1.16	1.03	1.65	77	39	12	46	2	25	53.1
0.99	3.0	3.4	34	1.4	ZV225S_K202_0084 EZ503U	7.4	9.2	200	8.397	1.16	1.03	1.65	77	39	12	46	2	25	53.1
0.99	3.7	4.4	42	1.1	ZV225S_K202_0084 EZ702U	8.3	15	220	8.397	1.16	1.03	1.65	77	39	12	46	2	25	53.1
0.99	4.1	4.9	47	1.0	ZV225S_K202_0084 EZ505U	8.3	15	220	8.397	1.16	1.03	1.65	77	39	12	46	2	25	53.1
1.17	1.9	2.2	26	2.1	ZV225S_K202_0071 EZ701U	5.2	15	140	7.118	1.17	1.02	1.76	77	39	12	46	2	25	53.1
1.17	3.1	3.7	42	1.3	ZV225S_K202_0071 EZ702U	8.0	15	210	7.118	1.17	1.02	1.76	77	39	12	46	2	25	53.1
1.17	3.5	4.2	48	1.1	ZV225S_K202_0071 EZ505U	8.0	15	210	7.118	1.17	1.02	1.76	77	39	12	46	2	25	53.1
1.25	1.1	1.1	15	3.7	ZV225S_K202_0067 EZ501U	3.9	7.3	100	6.683	1.46	1.29	2.08	77	39	12	46	2	25	53.1
1.25	1.1	1.3	17	3.4	ZV225S_K202_0067 EZ402U	3.9	7.3	100	6.683	1.46	1.29	2.08	77	39	12	46	2	25	53.1
1.25	1.7	2.1	25	2.3	ZV225S_K202_0067 EZ404U	5.9	7.3	160	6.683	1.46	1.29	2.08	77	39	12	46	2	25	53.1
1.25	1.8	2.0	26	2.1	ZV225S_K202_0067 EZ502U	5.9	7.3	160	6.683	1.46	1.29	2.08	77	39	12	46	2	25	53.1
1.25	1.8	2.0	26	2.1	ZV225S_K202_0067 EZ701U	4.9	15	130	6.683	1.46	1.29	2.08	77	39	12	46	2	25	53.1
1.25	2.4	2.7	35	1.6	ZV225S_K202_0067 EZ503U	5.9	7.3	160	6.683	1.46	1.29	2.08	77	39	12	46	2	25	53.1
1.25	2.9	3.5	43	1.3	ZV225S_K202_0067 EZ702U	7.8	15	210	6.683	1.46	1.29	2.08	77	39	12	46	2	25	53.1
1.25	3.3	3.9	48	1.2	ZV225S_K202_0067 EZ505U	7.8	15	210	6.683	1.46	1.29	2.08	77	39	12	46	2	25	53.1
1.39	0.9	1.0	15	4.0	ZV225S_K202_0060 EZ501U	3.5	6.6	93	6.000	1.39	1.20	2.08	77	39	12	46	2	25	53.1
1.39	1.0	1.1	17	3.6	ZV225S_K202_0060 EZ402U	3.5	6.6	93	6.000	1.39	1.20	2.08	77	39	12	46	2	25	53.1
1.39	1.5	1.9	25	2.5	ZV225S_K202_0060 EZ404U	5.3	6.6	140	6.000	1.39	1.20	2.08	77	39	12	46	2	25	53.1
1.39	1.6	1.8	27	2.3	ZV225S_K202_0060 EZ502U	5.3	6.6	140	6.000	1.39	1.20	2.08	77	39	12	46	2	25	53.1

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ EL1,2 [m/s]	$v_{f2maxDB}$ EL3,4,5,6 [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{redII} [µm]	Δs_{redI} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV2K2 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 8,3 kN)																			
1.39	1.6	1.8	27	2.3	ZV225S_K202_0060 EZ701U	4.4	15	120	6.000	1.39	1.20	2.08	77	39	12	46	2	25	53.1
1.39	2.1	2.4	35	1.8	ZV225S_K202_0060 EZ503U	5.3	6.6	140	6.000	1.39	1.20	2.08	77	39	12	46	2	25	53.1
1.39	2.6	3.2	43	1.4	ZV225S_K202_0060 EZ702U	7.5	15	200	6.000	1.39	1.20	2.08	77	39	12	46	2	25	53.1
1.39	3.0	3.5	48	1.3	ZV225S_K202_0060 EZ505U	7.5	15	200	6.000	1.39	1.20	2.08	77	39	12	46	2	25	53.1
1.39	3.6	4.6	59	1.0	ZV225S_K202_0060 EZ703U	7.5	15	200	6.000	1.39	1.20	2.08	77	39	12	46	2	25	53.1
1.61	1.4	1.6	27	2.5	ZV225S_K202_0052 EZ701U	3.8	14	100	5.177	1.61	1.40	2.41	77	39	12	46	2	25	53.1
1.61	2.3	2.7	44	1.6	ZV225S_K202_0052 EZ702U	7.2	14	190	5.177	1.61	1.40	2.41	77	39	12	46	2	25	53.1
1.61	2.6	3.0	49	1.4	ZV225S_K202_0052 EZ505U	7.2	14	190	5.177	1.61	1.40	2.41	77	39	12	46	2	25	53.1
1.61	3.1	3.9	60	1.1	ZV225S_K202_0052 EZ703U	7.2	14	190	5.177	1.61	1.40	2.41	77	39	12	46	2	25	53.1
1.91	0.7	0.8	16	4.9	ZV225S_K202_0044 EZ501U	2.6	4.8	68	4.364	1.91	1.66	2.86	77	39	12	46	2	25	53.1
1.91	0.8	0.8	17	4.5	ZV225S_K202_0044 EZ402U	2.6	4.8	68	4.364	1.91	1.66	2.86	77	39	12	46	2	25	53.1
1.91	1.1	1.4	25	3.1	ZV225S_K202_0044 EZ404U	3.8	4.8	100	4.364	1.91	1.66	2.86	77	39	12	46	2	25	53.1
1.91	1.2	1.3	27	2.9	ZV225S_K202_0044 EZ502U	3.8	4.8	100	4.364	1.91	1.66	2.86	77	39	12	46	2	25	53.1
1.91	1.2	1.3	27	2.9	ZV225S_K202_0044 EZ701U	3.2	12	85	4.364	1.91	1.66	2.86	77	39	12	46	2	25	53.1
1.91	1.5	1.8	36	2.2	ZV225S_K202_0044 EZ503U	3.8	4.8	100	4.364	1.91	1.66	2.86	77	39	12	46	2	25	53.1
1.91	1.9	2.3	44	1.8	ZV225S_K202_0044 EZ702U	6.5	12	170	4.364	1.91	1.66	2.86	77	39	12	46	2	25	53.1
1.91	2.2	2.6	50	1.6	ZV225S_K202_0044 EZ505U	6.8	12	180	4.364	1.91	1.66	2.86	77	39	12	46	2	25	53.1
1.91	2.6	3.3	61	1.3	ZV225S_K202_0044 EZ703U	6.8	12	180	4.364	1.91	1.66	2.86	77	39	12	46	2	25	53.1
2.08	1.1	1.2	27	3.0	ZV225S_K202_0040 EZ701U	2.9	11	78	4.000	2.08	1.81	3.13	77	39	12	46	2	25	53.1
2.08	1.8	2.1	45	1.9	ZV225S_K202_0040 EZ702U	6.0	11	160	4.000	2.08	1.81	3.13	77	39	12	46	2	25	53.1
2.08	2.0	2.3	50	1.7	ZV225S_K202_0040 EZ505U	6.6	11	170	4.000	2.08	1.81	3.13	77	39	12	46	2	25	53.1
2.08	2.4	3.0	61	1.4	ZV225S_K202_0040 EZ703U	6.6	11	170	4.000	2.08	1.81	3.13	77	39	12	46	2	25	53.1
ZV2K2 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 8,3 kN)																			
1.24	3.5	5.6	37	1.1	ZV225S_K202_0100 EZ505U	8.3	15	220	10.07	1.08	0.97	1.52	77	39	12	46	2	25	53.1
1.36	3.2	5.1	38	1.2	ZV225S_K202_0092 EZ505U	8.3	15	220	9.190	1.06	0.94	1.51	77	39	12	46	2	25	53.1
1.49	2.9	4.7	38	1.3	ZV225S_K202_0084 EZ505U	8.3	15	220	8.397	1.16	1.03	1.65	77	39	12	46	2	25	53.1
1.76	2.5	4.0	39	1.4	ZV225S_K202_0071 EZ505U	8.0	15	210	7.118	1.17	1.02	1.76	77	39	12	46	2	25	53.1
1.76	3.1	5.2	49	1.1	ZV225S_K202_0071 EZ703U	8.0	15	210	7.118	1.17	1.02	1.76	77	39	12	46	2	25	53.1
1.87	2.3	3.7	39	1.5	ZV225S_K202_0067 EZ505U	7.8	15	210	6.683	1.46	1.29	2.08	77	39	12	46	2	25	53.1
1.87	3.0	4.9	49	1.1	ZV225S_K202_0067 EZ703U	7.8	15	210	6.683	1.46	1.29	2.08	77	39	12	46	2	25	53.1
2.08	2.1	3.4	39	1.6	ZV225S_K202_0060 EZ505U	7.5	15	200	6.000	1.39	1.20	2.08	77	39	12	46	2	25	53.1
2.08	2.7	4.4	50	1.2	ZV225S_K202_0060 EZ703U	7.5	15	200	6.000	1.39	1.20	2.08	77	39	12	46	2	25	53.1
2.41	1.8	2.9	40	1.7	ZV225S_K202_0052 EZ505U	7.2	14	190	5.177	1.61	1.40	2.41	77	39	12	46	2	25	53.1
2.41	2.3	3.8	50	1.4	ZV225S_K202_0052 EZ703U	7.2	14	190	5.177	1.61	1.40	2.41	77	39	12	46	2	25	53.1
2.86	1.5	2.4	40	1.9	ZV225S_K202_0044 EZ505U	6.8	12	180	4.364	1.91	1.66	2.86	77	39	12	46	2	25	53.1
2.86	1.9	3.2	51	1.5	ZV225S_K202_0044 EZ703U	6.8	12	180	4.364	1.91	1.66	2.86	77	39	12	46	2	25	53.1
3.13	1.4	2.2	40	2.1	ZV225S_K202_0040 EZ505U	6.6	11	170	4.000	2.08	1.81	3.13	77	39	12	46	2	25	53.1
3.13	1.8	2.9	51	1.6	ZV225S_K202_0040 EZ703U	6.6	11	170	4.000	2.08	1.81	3.13	77	39	12	46	2	25	53.1
ZV2K2 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 8,3 kN)																			
0.12	4.3	4.6	3.6	1.2	ZV225S_K203_1350 EZ301U	8.3	15	220	135.3	0.08	0.08	0.13	77	46	19	46	2	25	53.1
0.15	3.5	3.7	3.4	1.5	ZV225S_K203_1090 EZ301U	8.3	15	220	109.5	0.10	0.10	0.17	77	46	19	46	2	25	53.1
0.18	2.9	3.1	3.3	1.8	ZV225S_K203_0910 EZ301U	8.3	15	220	90.79	0.12	0.12	0.20	77	46	19	46	2	25	53.1
0.18	4.9	5.5	5.5	1.1	ZV225S_K203_0910 EZ302U	8.3	15	220	90.79	0.12	0.12	0.20	77	46	19	46	2	25	53.1
0.21	2.6	2.7	3.2	2.0	ZV225S_K203_0800 EZ301U	8.0	15	210	79.62	0.14	0.14	0.23	77	46	19	46	2	25	53.1
0.21	4.3	4.8	5.4	1.2	ZV225S_K203_0800 EZ302U	8.3	15	220	79.62	0.14	0.14	0.23	77	46	19	46	2	25	53.1
0.24	2.3	2.4	4.7	2.2	ZV225S_K202_0690 EZ301U	6.0	9.6	160	69.43	0.16	0.16	0.26	77	39	12	46	2	25	53.1
0.24	3.8	4.3	7.9	1.3	ZV225S_K202_0690 EZ302U	6.0	9.6	160	69.43	0.16	0.16	0.26	77	39	12	46	2	25	53.1
0.24	2.2	2.3	3.2	2.4	ZV225S_K203_0680 EZ301U	6.9	15	180	68.42	0.16	0.16	0.26	77	46	19	46	2	25	53.1
0.24	3.7	4.1	5.5	1.4	ZV225S_K203_0680 EZ302U	8.3	15	220	68.42	0.16	0.16	0.26	77	46	19	46	2	25	53.1
0.24	4.8	5.5	7.1	1.1	ZV225S_K203_0680 EZ303U	8.3	15	220	68.42	0.16	0.16	0.26	77	46	19	46	2	25	53.1
0.25	2.1	2.3	3.3	2.5	ZV225S_K203_0660 EZ301U	6.7	15	180	66.03	0.17	0.16	0.27	77	46	19	46	2	25	53.1
0.25	3.6	4.0	5.5	1.5	ZV225S_K203_0660 EZ302U	8.3	15	220	66.03	0.17	0.16	0.27	77	46	19	46	2	25	53.1
0.25	4.7	5.4	7.2	1.1	ZV225S_K203_0660 EZ303U	8.3	15	220	66.03	0.17	0.16	0.27	77	46	19	46	2	25	53.1
0.30	1.8	1.9	3.7	2.9	ZV225S_K202_0560 EZ301U	5.7	10	150	55.54	0.20	0.20	0.33	77	39	12	46	2	25	53.1
0.30	3.0	3.4	6.3	1.7	ZV225S_K202_0560 EZ302U	7.2	10	190	55.54	0.20	0.20	0.33	77	39	12	46	2	25	53.1
0.30	4.0	4.6	8.2	1.3	ZV225S_K202_0560 EZ303U	7.2	10	190	55.54	0.20	0.20	0.33	77	39	12	46	2	25	53.1
0.31	1.7	1.9	3.3	3.0	ZV225S_K203_0540 EZ301U	5.5	13	150	54.25	0.21	0.20	0.33	77	46	19	46	2	25	53.1
0.31	2.9	3.3	5.6	1.8	ZV225S_K203_0540 EZ302U	8.3	13	220	54.25	0.21	0.20	0.33	77	46	19	46	2	25	53.1
0.31	3.8	4.4	7.3	1.4	ZV225S_K203_0540 EZ303U	8.3	13	220	54.25	0.21	0.20	0.33	77	46	19	46	2	25	53.1
0.31	4.5	5.5	8.5	1.2	ZV225S_K203_0540 EZ401U	8.3	13	220	54.25	0.21	0.20	0.33	77	46	19	46	2	25	53.1
0.33	1.6	1.8	6.0	2.2	ZV225S_K202_0500 EZ301U	4.4	7.0	120	50.49	0.22	0.22	0.36	77	39	12	46	2	25	53.1
0.33	2.8	3.1	10	1.3	ZV225S_K202_0500 EZ302U	4.4	7.0	120	50.49	0.22	0.22	0.36	77	39	12	46	2	25	53.1
0.34	1.6	1.7	3.3	3.3	ZV225S_K203_0500 EZ301U	5.0	12	130	49.76	0.22	0.22	0.36	77	46	19	46	2	25	53.1
0.34	2.7	3.0	5.6	1.9	ZV225S_K203_0500 EZ302U	8.3	12	220	49.76	0.22	0.22	0.36	77	46	19	46	2	25	53.1

v_{f2N}	F_{f2N}	$F_{f2,0}$	a_{th}	S	Type	F_{f2accE}	$F_{f2NOT,E}$	M_{2accE}	i	$v_{f2maxDB}$		$v_{f2maxZB}$	Δs	Δs_{redII}	Δs_{redI}	C_{lin}	m_n	z	d_0
										EL1,2	EL3,4,5,6								
[m/s]	[kN]	[kN]				[kN]	[kN]	[Nm]		[m/s]	[m/s]	[m/s]	[µm]	[µm]	[µm]	[N/µm]	[mm]		[mm]
ZV2K2 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 8,3 kN)																			
0.34	3.5	4.0	7.3	1.5	ZV225S_K203_0500 EZ303U	8.3	12	220	49.76	0.22	0.22	0.36	77	46	19	46	2	25	53.1
0.34	4.1	5.0	8.6	1.3	ZV225S_K203_0500 EZ401U	8.3	12	220	49.76	0.22	0.22	0.36	77	46	19	46	2	25	53.1
0.36	1.5	1.6	3.4	3.5	ZV225S_K202_0460 EZ301U	4.7	9.7	130	46.23	0.24	0.23	0.39	77	39	12	46	2	25	53.1
0.36	2.5	2.8	5.7	2.1	ZV225S_K202_0460 EZ302U	7.8	9.7	210	46.23	0.24	0.23	0.39	77	39	12	46	2	25	53.1
0.36	3.3	3.8	7.5	1.6	ZV225S_K202_0460 EZ303U	7.8	9.7	210	46.23	0.24	0.23	0.39	77	39	12	46	2	25	53.1
0.36	3.9	4.7	8.8	1.3	ZV225S_K202_0460 EZ401U	8.3	15	220	46.23	0.24	0.23	0.39	77	39	12	46	2	25	53.1
0.37	1.5	1.5	3.4	3.6	ZV225S_K203_0450 EZ301U	4.6	11	120	45.22	0.25	0.24	0.40	77	46	19	46	2	25	53.1
0.37	2.4	2.7	5.7	2.1	ZV225S_K203_0450 EZ302U	8.1	11	220	45.22	0.25	0.24	0.40	77	46	19	46	2	25	53.1
0.37	3.2	3.7	7.4	1.6	ZV225S_K203_0450 EZ303U	8.3	11	220	45.22	0.25	0.24	0.40	77	46	19	46	2	25	53.1
0.37	3.7	4.6	8.7	1.4	ZV225S_K203_0450 EZ401U	8.3	11	220	45.22	0.25	0.24	0.40	77	46	19	46	2	25	53.1
0.41	1.3	1.4	4.7	3.3	ZV225S_K202_0400 EZ301U	4.1	7.5	110	40.39	0.28	0.27	0.45	77	39	12	46	2	25	53.1
0.41	2.2	2.5	7.9	2.0	ZV225S_K202_0400 EZ302U	5.2	7.5	140	40.39	0.28	0.27	0.45	77	39	12	46	2	25	53.1
0.41	2.9	3.3	10	1.5	ZV225S_K202_0400 EZ303U	5.2	7.5	140	40.39	0.28	0.27	0.45	77	39	12	46	2	25	53.1
0.42	1.3	1.4	3.4	4.1	ZV225S_K203_0390 EZ301U	4.0	9.5	110	39.45	0.28	0.28	0.46	77	46	19	46	2	25	53.1
0.42	2.1	2.4	5.7	2.4	ZV225S_K203_0390 EZ302U	7.1	9.5	190	39.45	0.28	0.28	0.46	77	46	19	46	2	25	53.1
0.42	2.8	3.2	7.5	1.9	ZV225S_K203_0390 EZ303U	7.6	9.5	200	39.45	0.28	0.28	0.46	77	46	19	46	2	25	53.1
0.42	3.3	4.0	8.8	1.6	ZV225S_K203_0390 EZ401U	7.6	9.5	200	39.45	0.28	0.28	0.46	77	46	19	46	2	25	53.1
0.48	1.1	1.2	3.5	4.6	ZV225S_K202_0350 EZ301U	3.5	8.1	94	34.55	0.32	0.31	0.52	77	39	12	46	2	25	53.1
0.48	1.9	2.1	5.9	2.8	ZV225S_K202_0350 EZ302U	6.3	8.1	170	34.55	0.32	0.31	0.52	77	39	12	46	2	25	53.1
0.48	2.5	2.8	7.7	2.1	ZV225S_K202_0350 EZ303U	6.5	8.1	170	34.55	0.32	0.31	0.52	77	39	12	46	2	25	53.1
0.48	2.9	3.5	9.0	1.8	ZV225S_K202_0350 EZ401U	8.3	15	220	34.55	0.32	0.31	0.52	77	39	12	46	2	25	53.1
0.48	4.3	5.6	13	1.2	ZV225S_K202_0350 EZ501U	8.3	15	220	34.55	0.32	0.31	0.52	77	39	12	46	2	25	53.1
0.48	4.4	6.2	14	1.2	ZV225S_K202_0350 EZ402U	8.3	15	220	34.55	0.32	0.31	0.52	77	39	12	46	2	25	53.1
0.50	1.1	1.2	3.5	4.8	ZV225S_K202_0340 EZ301U	3.4	7.1	91	33.62	0.33	0.32	0.54	77	39	12	46	2	25	53.1
0.50	1.8	2.1	5.9	2.8	ZV225S_K202_0340 EZ302U	5.7	7.1	150	33.62	0.33	0.32	0.54	77	39	12	46	2	25	53.1
0.50	2.4	2.8	7.7	2.2	ZV225S_K202_0340 EZ303U	5.7	7.1	150	33.62	0.33	0.32	0.54	77	39	12	46	2	25	53.1
0.50	2.8	3.4	9.0	1.8	ZV225S_K202_0340 EZ401U	7.0	12	180	33.62	0.33	0.32	0.54	77	39	12	46	2	25	53.1
0.60	2.4	2.9	9.2	2.1	ZV225S_K202_0280 EZ401U	8.3	15	220	27.95	0.40	0.39	0.65	77	39	12	46	2	25	53.1
0.60	3.5	4.5	14	1.4	ZV225S_K202_0280 EZ501U	8.3	15	220	27.95	0.40	0.39	0.65	77	39	12	46	2	25	53.1
0.60	3.6	5.0	14	1.4	ZV225S_K202_0280 EZ402U	8.3	15	220	27.95	0.40	0.39	0.65	77	39	12	46	2	25	53.1
0.66	1.4	1.5	6.5	3.4	ZV225S_K202_0250 EZ302U	4.6	5.9	120	25.13	0.44	0.43	0.72	77	39	12	46	2	25	53.1
0.66	1.8	2.1	8.5	2.6	ZV225S_K202_0250 EZ303U	4.7	5.9	120	25.13	0.44	0.43	0.72	77	39	12	46	2	25	53.1
0.66	2.1	2.6	9.2	2.3	ZV225S_K202_0250 EZ401U	7.8	15	210	25.13	0.44	0.43	0.72	77	39	12	46	2	25	53.1
0.66	3.1	4.0	14	1.5	ZV225S_K202_0250 EZ501U	8.3	15	220	25.13	0.44	0.43	0.72	77	39	12	46	2	25	53.1
0.66	3.2	4.5	14	1.5	ZV225S_K202_0250 EZ402U	8.3	15	220	25.13	0.44	0.43	0.72	77	39	12	46	2	25	53.1
0.72	1.3	1.4	6.1	3.7	ZV225S_K202_0230 EZ302U	4.2	6.4	110	23.18	0.48	0.47	0.78	77	39	12	46	2	25	53.1
0.72	1.7	1.9	7.9	2.8	ZV225S_K202_0230 EZ303U	5.1	6.4	130	23.18	0.48	0.47	0.78	77	39	12	46	2	25	53.1
0.72	1.9	2.4	9.3	2.4	ZV225S_K202_0230 EZ401U	7.2	15	190	23.18	0.48	0.47	0.78	77	39	12	46	2	25	53.1
0.72	2.9	3.7	14	1.6	ZV225S_K202_0230 EZ501U	8.3	15	220	23.18	0.48	0.47	0.78	77	39	12	46	2	25	53.1
0.72	3.0	4.2	14	1.6	ZV225S_K202_0230 EZ402U	8.3	15	220	23.18	0.48	0.47	0.78	77	39	12	46	2	25	53.1
0.82	1.7	2.1	9.4	2.6	ZV225S_K202_0200 EZ401U	6.3	15	170	20.33	0.55	0.53	0.89	77	39	12	46	2	25	53.1
0.82	2.5	3.3	14	1.8	ZV225S_K202_0200 EZ501U	8.3	15	220	20.33	0.55	0.53	0.89	77	39	12	46	2	25	53.1
0.82	2.6	3.6	14	1.7	ZV225S_K202_0200 EZ402U	8.3	15	220	20.33	0.55	0.53	0.89	77	39	12	46	2	25	53.1
0.82	3.9	5.8	21	1.2	ZV225S_K202_0200 EZ502U	8.3	15	220	20.33	0.55	0.53	0.89	77	39	12	46	2	25	53.1
0.82	3.9	5.9	21	1.2	ZV225S_K202_0200 EZ701U	8.3	15	220	20.33	0.55	0.53	0.89	77	39	12	46	2	25	53.1
0.82	4.3	6.2	24	1.0	ZV225S_K202_0200 EZ404U	8.3	15	220	20.33	0.55	0.53	0.89	77	39	12	46	2	25	53.1
0.99	0.9	1.0	7.5	4.0	ZV225S_K202_0170 EZ302U	3.1	4.6	82	16.86	0.66	0.64	1.07	77	39	12	46	2	25	53.1
0.99	1.2	1.4	9.8	3.1	ZV225S_K202_0170 EZ303U	3.7	4.6	98	16.86	0.66	0.64	1.07	77	39	12	46	2	25	53.1
0.99	1.4	1.7	9.5	3.0	ZV225S_K202_0170 EZ401U	5.2	15	140	16.86	0.66	0.64	1.07	77	39	12	46	2	25	53.1
0.99	2.1	2.7	14	2.0	ZV225S_K202_0170 EZ501U	8.3	15	220	16.86	0.66	0.64	1.07	77	39	12	46	2	25	53.1
0.99	2.2	3.0	15	1.9	ZV225S_K202_0170 EZ402U	8.3	15	220	16.86	0.66	0.64	1.07	77	39	12	46	2	25	53.1
0.99	3.2	4.8	22	1.3	ZV225S_K202_0170 EZ502U	8.3	15	220	16.86	0.66	0.64	1.07	77	39	12	46	2	25	53.1
0.99	3.2	4.9	22	1.3	ZV225S_K202_0170 EZ701U	8.3	15	220	16.86	0.66	0.64	1.07	77	39	12	46	2	25	53.1
0.99	3.6	5.2	24	1.2	ZV225S_K202_0170 EZ404U	8.3	15	220	16.86	0.66	0.64	1.07	77	39	12	46	2	25	53.1
ZV3K2 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 7,7 kN)																			
0.07	4.2	4.3	3.8	1.3	ZV318S_K203_1350 EZ301U	7.7	14	220	135.3	0.09	0.09	0.14	83	50	21	41	3	18	57.3
0.08	3.4	3.5	3.6	1.6	ZV318S_K203_1090 EZ301U	7.7	14	220	109.5	0.11	0.11	0.18	83	50	21	41	3	18	57.3
0.10	2.8	2.9	3.4	1.9	ZV318S_K203_0910 EZ301U	7.7	14	220	90.79	0.13	0.13	0.22	83	50	21	41	3	18	57.3
0.10	4.8	5.1	5.9	1.1	ZV318S_K203_0910 EZ302U	7.7	14	220	90.79	0.13	0.13	0.22	83	50	21	41	3	18	57.3
0.11	2.5	2.5	3.3	2.2	ZV318S_K203_0800 EZ301U	7.4	14	210	79.62	0.15	0.15	0.25	83	50	21	41	3	18	57.3
0.11	4.2	4.5	5.7	1.3	ZV318S_K203_0800 EZ302U	7.7	14	220	79.62	0.15	0.15	0.25	83	50	21	41	3	18	57.3
0.13	2.2	2.2	4.9	2.1	ZV318S_K202_0690 EZ301U	5.5	8.9	160	69.43	0.17	0.17	0.28	83	42	12	41	3	18	57.3
0.13	3.7	3.9	8.4	1.2	ZV318S_K202_0690 EZ302U	5.5	8.9	160	69.43	0.17	0.17	0.28	83	42	12	41	3	18	57.3
0.13	2.1	2.2	3.2	2.5	ZV318S_K203_0680 EZ301U	6.4	14	180	68.42	0.18	0.17	0.29	83	50	21	41	3	18	57.3

v_{f2N}	F_{f2N}	$F_{f2,0}$	a_{th}	S	Type	F_{f2accE}	$F_{f2NOT,E}$	M_{2accE}	i	$v_{f2maxDB}$		$v_{f2maxZB}$	Δs	Δs_{redII}	Δs_{redI}	C_{lin}	m_n	z	d_0
										EL1,2	EL3,4,5,6								
[m/s]	[kN]	[kN]				[kN]	[kN]	[Nm]		[m/s]	[m/s]	[m/s]	[µm]	[µm]	[µm]	[N/µm]	[mm]		[mm]
ZV3K2 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 7,7 kN)																			
0.13	3.6	3.8	5.5	1.5	ZV318S_K203_0680 EZ302U	7.7	14	220	68.42	0.18	0.17	0.29	83	50	21	41	3	18	57.3
0.13	4.7	5.0	7.1	1.1	ZV318S_K203_0680 EZ303U	7.7	14	220	68.42	0.18	0.17	0.29	83	50	21	41	3	18	57.3
0.14	2.0	2.1	3.2	2.6	ZV318S_K203_0660 EZ301U	6.2	14	180	66.03	0.18	0.18	0.30	83	50	21	41	3	18	57.3
0.14	3.5	3.7	5.4	1.5	ZV318S_K203_0660 EZ302U	7.7	14	220	66.03	0.18	0.18	0.30	83	50	21	41	3	18	57.3
0.14	4.6	4.8	7.1	1.2	ZV318S_K203_0660 EZ303U	7.7	14	220	66.03	0.18	0.18	0.30	83	50	21	41	3	18	57.3
0.16	1.7	1.8	3.9	3.1	ZV318S_K202_0560 EZ301U	5.3	9.5	150	55.54	0.22	0.21	0.35	83	42	12	41	3	18	57.3
0.16	3.0	3.2	6.6	1.8	ZV318S_K202_0560 EZ302U	6.7	9.5	190	55.54	0.22	0.21	0.35	83	42	12	41	3	18	57.3
0.16	3.9	4.1	8.6	1.4	ZV318S_K202_0560 EZ303U	6.7	9.5	190	55.54	0.22	0.21	0.35	83	42	12	41	3	18	57.3
0.17	1.7	1.7	3.0	3.2	ZV318S_K203_0540 EZ301U	5.1	12	150	54.25	0.22	0.22	0.36	83	50	21	41	3	18	57.3
0.17	2.9	3.0	5.2	1.9	ZV318S_K203_0540 EZ302U	7.7	12	220	54.25	0.22	0.22	0.36	83	50	21	41	3	18	57.3
0.17	3.7	4.0	6.7	1.4	ZV318S_K203_0540 EZ303U	7.7	12	220	54.25	0.22	0.22	0.36	83	50	21	41	3	18	57.3
0.17	5.1	5.4	9.1	1.1	ZV318S_K203_0540 EZ401U	7.7	12	220	54.25	0.22	0.22	0.36	83	50	21	41	3	18	57.3
0.18	1.6	1.6	6.2	2.1	ZV318S_K202_0500 EZ301U	4.0	6.5	120	50.49	0.24	0.23	0.39	83	42	12	41	3	18	57.3
0.18	2.7	2.9	11	1.2	ZV318S_K202_0500 EZ302U	4.0	6.5	120	50.49	0.24	0.23	0.39	83	42	12	41	3	18	57.3
0.18	1.5	1.6	3.0	3.5	ZV318S_K203_0500 EZ301U	4.6	11	130	49.76	0.24	0.24	0.39	83	50	21	41	3	18	57.3
0.18	2.6	2.8	5.0	2.0	ZV318S_K203_0500 EZ302U	7.7	11	220	49.76	0.24	0.24	0.39	83	50	21	41	3	18	57.3
0.18	3.4	3.6	6.6	1.6	ZV318S_K203_0500 EZ303U	7.7	11	220	49.76	0.24	0.24	0.39	83	50	21	41	3	18	57.3
0.18	4.6	5.0	8.9	1.2	ZV318S_K203_0500 EZ401U	7.7	11	220	49.76	0.24	0.24	0.39	83	50	21	41	3	18	57.3
0.20	1.5	1.5	2.9	3.7	ZV318S_K202_0460 EZ301U	4.4	9.0	130	46.23	0.26	0.25	0.42	83	42	12	41	3	18	57.3
0.20	2.5	2.6	5.0	2.2	ZV318S_K202_0460 EZ302U	7.2	9.0	210	46.23	0.26	0.25	0.42	83	42	12	41	3	18	57.3
0.20	3.2	3.4	6.5	1.7	ZV318S_K202_0460 EZ303U	7.2	9.0	210	46.23	0.26	0.25	0.42	83	42	12	41	3	18	57.3
0.20	4.4	4.7	8.9	1.2	ZV318S_K202_0460 EZ401U	7.7	14	220	46.23	0.26	0.25	0.42	83	42	12	41	3	18	57.3
0.20	1.4	1.4	2.9	3.8	ZV318S_K203_0450 EZ301U	4.2	10	120	45.22	0.27	0.26	0.43	83	50	21	41	3	18	57.3
0.20	2.4	2.5	4.9	2.2	ZV318S_K203_0450 EZ302U	7.5	10	220	45.22	0.27	0.26	0.43	83	50	21	41	3	18	57.3
0.20	3.1	3.3	6.4	1.7	ZV318S_K203_0450 EZ303U	7.7	10	220	45.22	0.27	0.26	0.43	83	50	21	41	3	18	57.3
0.20	4.2	4.5	8.7	1.3	ZV318S_K203_0450 EZ401U	7.7	10	220	45.22	0.27	0.26	0.43	83	50	21	41	3	18	57.3
0.22	1.3	1.3	4.9	3.2	ZV318S_K202_0400 EZ301U	3.8	6.9	110	40.39	0.30	0.29	0.48	83	42	12	41	3	18	57.3
0.22	2.2	2.3	8.4	1.9	ZV318S_K202_0400 EZ302U	4.8	6.9	140	40.39	0.30	0.29	0.48	83	42	12	41	3	18	57.3
0.22	2.8	3.0	11	1.4	ZV318S_K202_0400 EZ303U	4.8	6.9	140	40.39	0.30	0.29	0.48	83	42	12	41	3	18	57.3
0.23	1.2	1.3	2.8	4.4	ZV318S_K203_0390 EZ301U	3.7	8.8	110	39.45	0.30	0.30	0.49	83	50	21	41	3	18	57.3
0.23	2.1	2.2	4.8	2.6	ZV318S_K203_0390 EZ302U	6.6	8.8	190	39.45	0.30	0.30	0.49	83	50	21	41	3	18	57.3
0.23	2.7	2.9	6.3	2.0	ZV318S_K203_0390 EZ303U	7.1	8.8	200	39.45	0.30	0.30	0.49	83	50	21	41	3	18	57.3
0.23	3.7	3.9	8.5	1.5	ZV318S_K203_0390 EZ401U	7.1	8.8	200	39.45	0.30	0.30	0.49	83	50	21	41	3	18	57.3
0.26	1.1	1.1	3.2	4.9	ZV318S_K202_0350 EZ301U	3.3	7.5	94	34.55	0.35	0.34	0.56	83	42	12	41	3	18	57.3
0.26	1.9	2.0	5.5	2.9	ZV318S_K202_0350 EZ302U	5.8	7.5	170	34.55	0.35	0.34	0.56	83	42	12	41	3	18	57.3
0.26	2.4	2.6	7.1	2.2	ZV318S_K202_0350 EZ303U	6.0	7.5	170	34.55	0.35	0.34	0.56	83	42	12	41	3	18	57.3
0.26	3.3	3.5	8.7	1.6	ZV318S_K202_0350 EZ401U	7.7	14	220	34.55	0.35	0.34	0.56	83	42	12	41	3	18	57.3
0.26	5.0	5.5	13	1.1	ZV318S_K202_0350 EZ501U	7.7	14	220	34.55	0.35	0.34	0.56	83	42	12	41	3	18	57.3
0.27	1.1	1.1	3.6	4.9	ZV318S_K202_0340 EZ301U	3.2	6.5	91	33.62	0.36	0.35	0.58	83	42	12	41	3	18	57.3
0.27	1.8	1.9	6.2	2.9	ZV318S_K202_0340 EZ302U	5.2	6.5	150	33.62	0.36	0.35	0.58	83	42	12	41	3	18	57.3
0.27	2.4	2.5	8.1	2.2	ZV318S_K202_0340 EZ303U	5.2	6.5	150	33.62	0.36	0.35	0.58	83	42	12	41	3	18	57.3
0.27	3.2	3.4	11	1.7	ZV318S_K202_0340 EZ401U	6.5	11	180	33.62	0.36	0.35	0.58	83	42	12	41	3	18	57.3
0.32	2.6	2.8	8.8	2.0	ZV318S_K202_0280 EZ401U	7.7	14	220	27.95	0.43	0.42	0.70	83	42	12	41	3	18	57.3
0.32	4.1	4.4	14	1.3	ZV318S_K202_0280 EZ501U	7.7	14	220	27.95	0.43	0.42	0.70	83	42	12	41	3	18	57.3
0.32	4.4	4.9	15	1.2	ZV318S_K202_0280 EZ402U	7.7	14	220	27.95	0.43	0.42	0.70	83	42	12	41	3	18	57.3
0.36	1.4	1.4	6.9	3.2	ZV318S_K202_0250 EZ302U	4.3	5.4	120	25.13	0.48	0.47	0.78	83	42	12	41	3	18	57.3
0.36	1.8	1.9	9.0	2.5	ZV318S_K202_0250 EZ303U	4.4	5.4	120	25.13	0.48	0.47	0.78	83	42	12	41	3	18	57.3
0.36	2.4	2.6	8.9	2.3	ZV318S_K202_0250 EZ401U	7.2	14	210	25.13	0.48	0.47	0.78	83	42	12	41	3	18	57.3
0.36	3.7	4.0	14	1.5	ZV318S_K202_0250 EZ501U	7.7	14	220	25.13	0.48	0.47	0.78	83	42	12	41	3	18	57.3
0.36	4.0	4.4	15	1.3	ZV318S_K202_0250 EZ402U	7.7	14	220	25.13	0.48	0.47	0.78	83	42	12	41	3	18	57.3
0.39	1.2	1.3	6.3	3.8	ZV318S_K202_0230 EZ302U	3.9	5.9	110	23.18	0.52	0.51	0.84	83	42	12	41	3	18	57.3
0.39	1.6	1.7	8.2	2.9	ZV318S_K202_0230 EZ303U	4.7	5.9	130	23.18	0.52	0.51	0.84	83	42	12	41	3	18	57.3
0.39	2.2	2.4	9.0	2.4	ZV318S_K202_0230 EZ401U	6.7	14	190	23.18	0.52	0.51	0.84	83	42	12	41	3	18	57.3
0.39	3.4	3.7	14	1.6	ZV318S_K202_0230 EZ501U	7.7	14	220	23.18	0.52	0.51	0.84	83	42	12	41	3	18	57.3
0.39	3.7	4.1	15	1.5	ZV318S_K202_0230 EZ402U	7.7	14	220	23.18	0.52	0.51	0.84	83	42	12	41	3	18	57.3
0.44	1.9	2.1	9.1	2.8	ZV318S_K202_0200 EZ401U	5.9	14	170	20.33	0.59	0.58	0.96	83	42	12	41	3	18	57.3
0.44	3.0	3.2	14	1.8	ZV318S_K202_0200 EZ501U	7.7	14	220	20.33	0.59	0.58	0.96	83	42	12	41	3	18	57.3
0.44	3.2	3.6	15	1.7	ZV318S_K202_0200 EZ402U	7.7	14	220	20.33	0.59	0.58	0.96	83	42	12	41	3	18	57.3
0.44	4.7	5.9	22	1.1	ZV318S_K202_0200 EZ404U	7.7	14	220	20.33	0.59	0.58	0.96	83	42	12	41	3	18	57.3
0.44	5.1	5.5	24	1.1	ZV318S_K202_0200 EZ502U	7.7	14	220	20.33	0.59	0.58	0.96	83	42	12	41	3	18	57.3
0.44	5.1	5.7	24	1.1	ZV318S_K202_0200 EZ701U	7.7	14	220	20.33	0.59	0.58	0.96	83	42	12	41	3	18	57.3
0.52	0.9	1.0	7.8	3.8	ZV318S_K202_0175 EZ302U	3.0	4.4	85	17.47	0.67	0.60	0.95	83	42	12	41	3	18	57.3
0.52	1.2	1.3	10	2.9	ZV318S_K202_0175 EZ303U	3.5	4.4	100	17.47	0.67	0.60	0.95	83	42	12	41	3	18	57.3
0.52	1.7	1.8	9.2	3.2	ZV318S_K202_0175 EZ401U	5.0	14	140	17.47	0.67	0.60	0.95	83	42	12	41	3	18	57.3

v_{f2N}	F_{f2N}	$F_{f2,0}$	a_{th}	S	Type	F_{f2accE}	$F_{f2NOT,E}$	M_{2accE}	i	$v_{f2maxDB}$		$v_{f2maxZB}$	Δs	Δs_{redII}	Δs_{redI}	C_{lin}	m_n	z	d_0
										EL1,2	EL3,4,5,6								
[m/s]	[kN]	[kN]				[kN]	[kN]	[Nm]		[m/s]	[m/s]	[m/s]	[µm]	[µm]	[µm]	[N/µm]	[mm]		[mm]
ZV3K2 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 7,7 kN)																			
0.52	2.5	2.8	14	2.1	ZV318S_K202_0175 EZ501U	7.7	14	220	17.47	0.67	0.60	0.95	83	42	12	41	3	18	57.3
0.52	2.8	3.1	15	1.9	ZV318S_K202_0175 EZ402U	7.7	14	220	17.47	0.67	0.60	0.95	83	42	12	41	3	18	57.3
0.52	4.1	5.1	23	1.3	ZV318S_K202_0175 EZ404U	7.7	14	220	17.47	0.67	0.60	0.95	83	42	12	41	3	18	57.3
0.52	4.4	4.7	24	1.2	ZV318S_K202_0175 EZ502U	7.7	14	220	17.47	0.67	0.60	0.95	83	42	12	41	3	18	57.3
0.52	4.4	4.9	24	1.2	ZV318S_K202_0175 EZ701U	7.7	14	220	17.47	0.67	0.60	0.95	83	42	12	41	3	18	57.3
0.53	0.9	1.0	8.0	3.8	ZV318S_K202_0170 EZ302U	2.9	4.3	82	16.86	0.71	0.69	1.16	83	42	12	41	3	18	57.3
0.53	1.2	1.3	10	2.9	ZV318S_K202_0170 EZ303U	3.4	4.3	98	16.86	0.71	0.69	1.16	83	42	12	41	3	18	57.3
0.53	1.6	1.7	9.2	3.3	ZV318S_K202_0170 EZ401U	4.9	14	140	16.86	0.71	0.69	1.16	83	42	12	41	3	18	57.3
0.53	2.5	2.7	14	2.1	ZV318S_K202_0170 EZ501U	7.7	14	220	16.86	0.71	0.69	1.16	83	42	12	41	3	18	57.3
0.53	2.7	3.0	15	1.9	ZV318S_K202_0170 EZ402U	7.7	14	220	16.86	0.71	0.69	1.16	83	42	12	41	3	18	57.3
0.53	3.9	4.9	23	1.3	ZV318S_K202_0170 EZ404U	7.7	14	220	16.86	0.71	0.69	1.16	83	42	12	41	3	18	57.3
0.53	4.2	4.6	24	1.2	ZV318S_K202_0170 EZ502U	7.7	14	220	16.86	0.71	0.69	1.16	83	42	12	41	3	18	57.3
0.53	4.2	4.7	24	1.2	ZV318S_K202_0170 EZ701U	7.7	14	220	16.86	0.71	0.69	1.16	83	42	12	41	3	18	57.3
0.65	1.3	1.4	9.4	3.7	ZV318S_K202_0140 EZ401U	4.0	14	110	13.85	0.85	0.76	1.19	83	42	12	41	3	18	57.3
0.65	2.0	2.2	14	2.4	ZV318S_K202_0140 EZ501U	7.5	14	210	13.85	0.85	0.76	1.19	83	42	12	41	3	18	57.3
0.65	2.2	2.4	16	2.2	ZV318S_K202_0140 EZ402U	7.5	14	210	13.85	0.85	0.76	1.19	83	42	12	41	3	18	57.3
0.65	3.2	4.0	23	1.5	ZV318S_K202_0140 EZ404U	7.7	14	220	13.85	0.85	0.76	1.19	83	42	12	41	3	18	57.3
0.65	3.5	3.8	25	1.4	ZV318S_K202_0140 EZ502U	7.7	14	220	13.85	0.85	0.76	1.19	83	42	12	41	3	18	57.3
0.65	3.5	3.9	25	1.4	ZV318S_K202_0140 EZ701U	7.7	14	220	13.85	0.85	0.76	1.19	83	42	12	41	3	18	57.3
0.65	4.5	5.2	32	1.1	ZV318S_K202_0140 EZ503U	7.7	14	220	13.85	0.85	0.76	1.19	83	42	12	41	3	18	57.3
0.71	0.7	0.7	9.8	3.8	ZV318S_K202_0125 EZ302U	2.2	3.2	62	12.71	0.92	0.83	1.30	83	42	12	41	3	18	57.3
0.71	0.9	0.9	13	2.9	ZV318S_K202_0125 EZ303U	2.6	3.2	74	12.71	0.92	0.83	1.30	83	42	12	41	3	18	57.3
0.71	1.2	1.3	9.4	3.9	ZV318S_K202_0125 EZ401U	3.7	13	100	12.71	0.92	0.83	1.30	83	42	12	41	3	18	57.3
0.71	1.8	2.0	15	2.6	ZV318S_K202_0125 EZ501U	6.9	13	200	12.71	0.92	0.83	1.30	83	42	12	41	3	18	57.3
0.71	2.0	2.2	16	2.3	ZV318S_K202_0125 EZ402U	6.9	13	200	12.71	0.92	0.83	1.30	83	42	12	41	3	18	57.3
0.71	3.0	3.7	23	1.6	ZV318S_K202_0125 EZ404U	7.7	13	220	12.71	0.92	0.83	1.30	83	42	12	41	3	18	57.3
0.71	3.2	3.4	25	1.5	ZV318S_K202_0125 EZ502U	7.7	13	220	12.71	0.92	0.83	1.30	83	42	12	41	3	18	57.3
0.71	3.2	3.6	25	1.5	ZV318S_K202_0125 EZ701U	7.7	14	220	12.71	0.92	0.83	1.30	83	42	12	41	3	18	57.3
0.71	4.2	4.8	33	1.1	ZV318S_K202_0125 EZ503U	7.7	13	220	12.71	0.92	0.83	1.30	83	42	12	41	3	18	57.3
0.78	0.6	0.7	11	3.8	ZV318S_K202_0115 EZ302U	2.0	2.9	56	11.55	0.91	0.81	1.30	83	42	12	41	3	18	57.3
0.78	0.8	0.9	14	2.9	ZV318S_K202_0115 EZ303U	2.3	2.9	67	11.55	0.91	0.81	1.30	83	42	12	41	3	18	57.3
0.78	1.1	1.2	9.5	4.2	ZV318S_K202_0115 EZ401U	3.3	12	95	11.55	0.91	0.81	1.30	83	42	12	41	3	18	57.3
0.78	1.7	1.8	15	2.7	ZV318S_K202_0115 EZ501U	6.3	12	180	11.55	0.91	0.81	1.30	83	42	12	41	3	18	57.3
0.78	1.8	2.0	16	2.5	ZV318S_K202_0115 EZ402U	6.3	12	180	11.55	0.91	0.81	1.30	83	42	12	41	3	18	57.3
0.78	2.7	3.4	23	1.7	ZV318S_K202_0115 EZ404U	7.7	12	220	11.55	0.91	0.81	1.30	83	42	12	41	3	18	57.3
0.78	2.9	3.1	25	1.6	ZV318S_K202_0115 EZ502U	7.7	12	220	11.55	0.91	0.81	1.30	83	42	12	41	3	18	57.3
0.78	2.9	3.2	25	1.6	ZV318S_K202_0115 EZ701U	7.7	14	220	11.55	0.91	0.81	1.30	83	42	12	41	3	18	57.3
0.78	3.8	4.3	33	1.2	ZV318S_K202_0115 EZ503U	7.7	12	220	11.55	0.91	0.81	1.30	83	42	12	41	3	18	57.3
0.89	1.0	1.0	9.6	4.6	ZV318S_K202_0100 EZ401U	2.9	10	83	10.07	1.16	1.04	1.64	83	42	12	41	3	18	57.3
0.89	1.5	1.6	15	3.0	ZV318S_K202_0100 EZ501U	5.5	10	160	10.07	1.16	1.04	1.64	83	42	12	41	3	18	57.3
0.89	1.6	1.8	16	2.7	ZV318S_K202_0100 EZ402U	5.5	10	160	10.07	1.16	1.04	1.64	83	42	12	41	3	18	57.3
0.89	2.4	2.9	24	1.9	ZV318S_K202_0100 EZ404U	7.7	10	220	10.07	1.16	1.04	1.64	83	42	12	41	3	18	57.3
0.89	2.5	2.7	25	1.7	ZV318S_K202_0100 EZ502U	7.7	10	220	10.07	1.16	1.04	1.64	83	42	12	41	3	18	57.3
0.89	2.5	2.8	25	1.7	ZV318S_K202_0100 EZ701U	6.8	14	200	10.07	1.16	1.04	1.64	83	42	12	41	3	18	57.3
0.89	3.3	3.8	33	1.3	ZV318S_K202_0100 EZ503U	7.7	10	220	10.07	1.16	1.04	1.64	83	42	12	41	3	18	57.3
0.89	4.1	4.9	41	1.1	ZV318S_K202_0100 EZ702U	7.7	14	220	10.07	1.16	1.04	1.64	83	42	12	41	3	18	57.3
0.98	0.9	0.9	9.7	4.9	ZV318S_K202_0092 EZ401U	2.6	9.3	76	9.190	1.14	1.01	1.63	83	42	12	41	3	18	57.3
0.98	1.3	1.5	15	3.2	ZV318S_K202_0092 EZ501U	5.0	9.3	140	9.190	1.14	1.01	1.63	83	42	12	41	3	18	57.3
0.98	1.5	1.6	16	2.9	ZV318S_K202_0092 EZ402U	5.0	9.3	140	9.190	1.14	1.01	1.63	83	42	12	41	3	18	57.3
0.98	2.1	2.7	24	2.0	ZV318S_K202_0092 EZ404U	7.5	9.3	210	9.190	1.14	1.01	1.63	83	42	12	41	3	18	57.3
0.98	2.3	2.5	26	1.8	ZV318S_K202_0092 EZ502U	7.5	9.3	210	9.190	1.14	1.01	1.63	83	42	12	41	3	18	57.3
0.98	2.3	2.6	26	1.8	ZV318S_K202_0092 EZ701U	6.2	14	180	9.190	1.14	1.01	1.63	83	42	12	41	3	18	57.3
0.98	3.0	3.5	34	1.4	ZV318S_K202_0092 EZ503U	7.5	9.3	210	9.190	1.14	1.01	1.63	83	42	12	41	3	18	57.3
0.98	3.7	4.5	42	1.1	ZV318S_K202_0092 EZ702U	7.7	14	220	9.190	1.14	1.01	1.63	83	42	12	41	3	18	57.3
0.98	4.2	5.0	47	1.0	ZV318S_K202_0092 EZ505U	7.7	14	220	9.190	1.14	1.01	1.63	83	42	12	41	3	18	57.3
1.07	0.5	0.5	13	3.8	ZV318S_K202_0084 EZ302U	1.4	2.1	41	8.397	1.25	1.11	1.79	83	42	12	41	3	18	57.3
1.07	0.6	0.6	17	2.9	ZV318S_K202_0084 EZ303U	1.7	2.1	49	8.397	1.25	1.11	1.79	83	42	12	41	3	18	57.3
1.07	1.2	1.3	15	3.4	ZV318S_K202_0084 EZ501U	4.5	8.5	130	8.397	1.25	1.11	1.79	83	42	12	41	3	18	57.3
1.07	1.3	1.5	16	3.1	ZV318S_K202_0084 EZ402U	4.5	8.5	130	8.397	1.25	1.11	1.79	83	42	12	41	3	18	57.3
1.07	2.0	2.4	24	2.1	ZV318S_K202_0084 EZ404U	6.8	8.5	200	8.397	1.25	1.11	1.79	83	42	12	41	3	18	57.3
1.07	2.1	2.3	26	2.0	ZV318S_K202_0084 EZ502U	6.8	8.5	200	8.397	1.25	1.11	1.79	83	42	12	41	3	18	57.3
1.07	2.1	2.4	26	2.0	ZV318S_K202_0084 EZ701U	5.7	14	160	8.397	1.25	1.11	1.79	83	42	12	41	3	18	57.3
1.07	2.8	3.2	34	1.5	ZV318S_K202_0084 EZ503U	6.8	8.5	200	8.397	1.25	1.11	1.79	83	42	12	41	3	18	57.3
1.07	3.4	4.1	42	1.2	ZV318S_K202_0084 EZ702U	7.7	14	220	8.397	1.25	1.11	1.79	83	42	12	41	3	18	57.3

v_{f2N}	F_{f2N}	$F_{f2,0}$	a_{th}	S	Type	F_{f2accE}	$F_{f2NOT,E}$	M_{2accE}	i	$v_{f2maxDB}$		$v_{f2maxZB}$	Δs	Δs_{redII}	Δs_{redI}	C_{lin}	m_n	z	d_0
										EL1,2	EL3,4,5,6								
[m/s]	[kN]	[kN]				[kN]	[kN]	[Nm]		[m/s]	[m/s]	[m/s]	[µm]	[µm]	[µm]	[N/µm]	[mm]		[mm]
ZV3K2 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 7,7 kN)																			
1.07	3.8	4.5	47	1.1	ZV318S_K202_0084 EZ505U	7.7	14	220	8.397	1.25	1.11	1.79	83	42	12	41	3	18	57.3
1.26	1.8	2.0	26	2.2	ZV318S_K202_0071 EZ701U	4.8	14	140	7.118	1.26	1.10	1.90	83	42	12	41	3	18	57.3
1.26	2.9	3.5	42	1.4	ZV318S_K202_0071 EZ702U	7.4	14	210	7.118	1.26	1.10	1.90	83	42	12	41	3	18	57.3
1.26	3.3	3.9	48	1.2	ZV318S_K202_0071 EZ505U	7.4	14	210	7.118	1.26	1.10	1.90	83	42	12	41	3	18	57.3
1.35	1.0	1.1	15	3.9	ZV318S_K202_0067 EZ501U	3.6	6.8	100	6.683	1.57	1.39	2.24	83	42	12	41	3	18	57.3
1.35	1.1	1.2	17	3.6	ZV318S_K202_0067 EZ402U	3.6	6.8	100	6.683	1.57	1.39	2.24	83	42	12	41	3	18	57.3
1.35	1.6	1.9	25	2.4	ZV318S_K202_0067 EZ404U	5.4	6.8	160	6.683	1.57	1.39	2.24	83	42	12	41	3	18	57.3
1.35	1.7	1.8	26	2.3	ZV318S_K202_0067 EZ502U	5.4	6.8	160	6.683	1.57	1.39	2.24	83	42	12	41	3	18	57.3
1.35	1.7	1.9	26	2.3	ZV318S_K202_0067 EZ701U	4.5	14	130	6.683	1.57	1.39	2.24	83	42	12	41	3	18	57.3
1.35	2.2	2.5	35	1.7	ZV318S_K202_0067 EZ503U	5.4	6.8	160	6.683	1.57	1.39	2.24	83	42	12	41	3	18	57.3
1.35	2.7	3.3	43	1.4	ZV318S_K202_0067 EZ702U	7.2	14	210	6.683	1.57	1.39	2.24	83	42	12	41	3	18	57.3
1.35	3.1	3.6	48	1.3	ZV318S_K202_0067 EZ505U	7.2	14	210	6.683	1.57	1.39	2.24	83	42	12	41	3	18	57.3
1.35	3.7	4.7	59	1.0	ZV318S_K202_0067 EZ703U	7.2	14	210	6.683	1.57	1.39	2.24	83	42	12	41	3	18	57.3
1.50	0.9	1.0	15	4.2	ZV318S_K202_0060 EZ501U	3.3	6.1	93	6.000	1.50	1.30	2.25	83	42	12	41	3	18	57.3
1.50	1.0	1.1	17	3.9	ZV318S_K202_0060 EZ402U	3.3	6.1	93	6.000	1.50	1.30	2.25	83	42	12	41	3	18	57.3
1.50	1.4	1.7	25	2.6	ZV318S_K202_0060 EZ404U	4.9	6.1	140	6.000	1.50	1.30	2.25	83	42	12	41	3	18	57.3
1.50	1.5	1.6	27	2.5	ZV318S_K202_0060 EZ502U	4.9	6.1	140	6.000	1.50	1.30	2.25	83	42	12	41	3	18	57.3
1.50	1.5	1.7	27	2.5	ZV318S_K202_0060 EZ701U	4.1	14	120	6.000	1.50	1.30	2.25	83	42	12	41	3	18	57.3
1.50	2.0	2.3	35	1.9	ZV318S_K202_0060 EZ503U	4.9	6.1	140	6.000	1.50	1.30	2.25	83	42	12	41	3	18	57.3
1.50	2.4	2.9	43	1.5	ZV318S_K202_0060 EZ702U	7.0	14	200	6.000	1.50	1.30	2.25	83	42	12	41	3	18	57.3
1.50	2.7	3.3	48	1.3	ZV318S_K202_0060 EZ505U	7.0	14	200	6.000	1.50	1.30	2.25	83	42	12	41	3	18	57.3
1.50	3.4	4.2	59	1.1	ZV318S_K202_0060 EZ703U	7.0	14	200	6.000	1.50	1.30	2.25	83	42	12	41	3	18	57.3
1.74	1.3	1.5	27	2.7	ZV318S_K202_0052 EZ701U	3.5	13	100	5.177	1.74	1.51	2.61	83	42	12	41	3	18	57.3
1.74	2.1	2.5	44	1.7	ZV318S_K202_0052 EZ702U	6.6	13	190	5.177	1.74	1.51	2.61	83	42	12	41	3	18	57.3
1.74	2.4	2.8	49	1.5	ZV318S_K202_0052 EZ505U	6.6	13	190	5.177	1.74	1.51	2.61	83	42	12	41	3	18	57.3
1.74	2.9	3.6	60	1.2	ZV318S_K202_0052 EZ703U	6.6	13	190	5.177	1.74	1.51	2.61	83	42	12	41	3	18	57.3
2.06	0.7	0.8	17	4.8	ZV318S_K202_0044 EZ402U	2.4	4.4	68	4.364	2.06	1.79	3.09	83	42	12	41	3	18	57.3
2.06	1.0	1.3	25	3.3	ZV318S_K202_0044 EZ404U	3.5	4.4	100	4.364	2.06	1.79	3.09	83	42	12	41	3	18	57.3
2.06	1.1	1.2	27	3.0	ZV318S_K202_0044 EZ502U	3.5	4.4	100	4.364	2.06	1.79	3.09	83	42	12	41	3	18	57.3
2.06	1.1	1.2	27	3.0	ZV318S_K202_0044 EZ701U	3.0	11	85	4.364	2.06	1.79	3.09	83	42	12	41	3	18	57.3
2.06	1.4	1.6	36	2.3	ZV318S_K202_0044 EZ503U	3.5	4.4	100	4.364	2.06	1.79	3.09	83	42	12	41	3	18	57.3
2.06	1.8	2.1	44	1.9	ZV318S_K202_0044 EZ702U	6.1	11	170	4.364	2.06	1.79	3.09	83	42	12	41	3	18	57.3
2.06	2.0	2.4	50	1.7	ZV318S_K202_0044 EZ505U	6.3	11	180	4.364	2.06	1.79	3.09	83	42	12	41	3	18	57.3
2.06	2.4	3.1	61	1.4	ZV318S_K202_0044 EZ703U	6.3	11	180	4.364	2.06	1.79	3.09	83	42	12	41	3	18	57.3
2.25	1.0	1.1	27	3.2	ZV318S_K202_0040 EZ701U	2.7	10	78	4.000	2.25	1.95	3.38	83	42	12	41	3	18	57.3
2.25	1.6	2.0	45	2.0	ZV318S_K202_0040 EZ702U	5.6	10	160	4.000	2.25	1.95	3.38	83	42	12	41	3	18	57.3
2.25	1.8	2.2	50	1.8	ZV318S_K202_0040 EZ505U	6.1	10	170	4.000	2.25	1.95	3.38	83	42	12	41	3	18	57.3
2.25	2.2	2.8	61	1.4	ZV318S_K202_0040 EZ703U	6.1	10	170	4.000	2.25	1.95	3.38	83	42	12	41	3	18	57.3
ZV3K2 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 7,7 kN)																			
1.34	3.2	5.2	37	1.2	ZV318S_K202_0100 EZ505U	7.7	14	220	10.07	1.16	1.04	1.64	83	42	12	41	3	18	57.3
1.47	3.0	4.8	38	1.3	ZV318S_K202_0092 EZ505U	7.7	14	220	9.190	1.14	1.01	1.63	83	42	12	41	3	18	57.3
1.61	2.7	4.4	38	1.3	ZV318S_K202_0084 EZ505U	7.7	14	220	8.397	1.25	1.11	1.79	83	42	12	41	3	18	57.3
1.61	3.4	5.7	48	1.0	ZV318S_K202_0084 EZ703U	7.7	14	220	8.397	1.25	1.11	1.79	83	42	12	41	3	18	57.3
1.90	2.3	3.7	39	1.5	ZV318S_K202_0071 EZ505U	7.4	14	210	7.118	1.26	1.10	1.90	83	42	12	41	3	18	57.3
1.90	2.9	4.8	49	1.2	ZV318S_K202_0071 EZ703U	7.4	14	210	7.118	1.26	1.10	1.90	83	42	12	41	3	18	57.3
2.02	2.1	3.5	39	1.6	ZV318S_K202_0067 EZ505U	7.2	14	210	6.683	1.57	1.39	2.24	83	42	12	41	3	18	57.3
2.02	2.7	4.5	49	1.2	ZV318S_K202_0067 EZ703U	7.2	14	210	6.683	1.57	1.39	2.24	83	42	12	41	3	18	57.3
2.25	1.9	3.1	39	1.7	ZV318S_K202_0060 EZ505U	7.0	14	200	6.000	1.50	1.30	2.25	83	42	12	41	3	18	57.3
2.25	2.5	4.1	50	1.3	ZV318S_K202_0060 EZ703U	7.0	14	200	6.000	1.50	1.30	2.25	83	42	12	41	3	18	57.3
2.61	1.7	2.7	40	1.8	ZV318S_K202_0052 EZ505U	6.6	13	190	5.177	1.74	1.51	2.61	83	42	12	41	3	18	57.3
2.61	2.1	3.5	50	1.4	ZV318S_K202_0052 EZ703U	6.6	13	190	5.177	1.74	1.51	2.61	83	42	12	41	3	18	57.3
3.09	1.4	2.3	40	2.1	ZV318S_K202_0044 EZ505U	6.3	11	180	4.364	2.06	1.79	3.09	83	42	12	41	3	18	57.3
3.09	1.8	3.0	51	1.6	ZV318S_K202_0044 EZ703U	6.3	11	180	4.364	2.06	1.79	3.09	83	42	12	41	3	18	57.3
3.38	1.3	2.1	40	2.2	ZV318S_K202_0040 EZ505U	6.1	10	170	4.000	2.25	1.95	3.38	83	42	12	41	3	18	57.3
3.38	1.6	2.7	51	1.7	ZV318S_K202_0040 EZ703U	6.1	10	170	4.000	2.25	1.95	3.38	83	42	12	41	3	18	57.3
ZV3K2 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 7,7 kN)																			
0.13	4.0	4.3	3.6	1.3	ZV318S_K203_1350 EZ301U	7.7	14	220	135.3	0.09	0.09	0.14	83	50	21	41	3	18	57.3
0.16	3.3	3.5	3.4	1.7	ZV318S_K203_1090 EZ301U	7.7	14	220	109.5	0.11	0.11	0.18	83	50	21	41	3	18	57.3
0.20	2.7	2.9	3.3	2.0	ZV318S_K203_0910 EZ301U	7.7	14	220	90.79	0.13	0.13	0.22	83	50	21	41	3	18	57.3
0.20	4.5	5.1	5.5	1.2	ZV318S_K203_0910 EZ302U	7.7	14	220	90.79	0.13	0.13	0.22	83	50	21	41	3	18	57.3
0.23	2.4	2.5	3.2	2.3	ZV318S_K203_0800 EZ301U	7.4	14	210	79.62	0.15	0.15	0.25	83	50	21	41	3	18	57.3
0.23	4.0	4.5	5.4	1.3	ZV318S_K203_0800 EZ302U	7.7	14	220	79.62	0.15	0.15	0.25	83	50	21	41	3	18	57.3
0.26	2.1	2.2	4.7	2.2	ZV318S_K202_0690 EZ301U	5.5	8.9	160	69.43	0.17	0.17	0.28	83	42	12	41	3	18	57.3
0.26	3.5	3.9	7.9	1.3	ZV318S_K202_0690 EZ302U	5.5	8.9	160	69.43	0.17	0.17	0.28	83	42	12	41	3	18	57.3

v_{f2N}	F_{f2N}	$F_{f2,0}$	a_{th}	S	Type	F_{f2accE}	$F_{f2NOT,E}$	M_{2accE}	i	$v_{f2maxDB}$		$v_{f2maxZB}$	Δs	Δs_{redII}	Δs_{redI}	C_{lin}	m_n	z	d_0
										EL1,2	EL3,4,5,6								
[m/s]	[kN]	[kN]				[kN]	[kN]	[Nm]		[m/s]	[m/s]	[m/s]	[µm]	[µm]	[µm]	[N/µm]	[mm]		[mm]
ZV3K2 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 7,7 kN)																			
0.26	2.0	2.2	3.2	2.6	ZV318S_K203_0680 EZ301U	6.4	14	180	68.42	0.18	0.17	0.29	83	50	21	41	3	18	57.3
0.26	3.4	3.8	5.5	1.6	ZV318S_K203_0680 EZ302U	7.7	14	220	68.42	0.18	0.17	0.29	83	50	21	41	3	18	57.3
0.26	4.5	5.1	7.1	1.2	ZV318S_K203_0680 EZ303U	7.7	14	220	68.42	0.18	0.17	0.29	83	50	21	41	3	18	57.3
0.27	2.0	2.1	3.3	2.7	ZV318S_K203_0660 EZ301U	6.2	14	180	66.03	0.18	0.18	0.30	83	50	21	41	3	18	57.3
0.27	3.3	3.7	5.5	1.6	ZV318S_K203_0660 EZ302U	7.7	14	220	66.03	0.18	0.18	0.30	83	50	21	41	3	18	57.3
0.27	4.3	5.0	7.2	1.2	ZV318S_K203_0660 EZ303U	7.7	14	220	66.03	0.18	0.18	0.30	83	50	21	41	3	18	57.3
0.32	1.7	1.8	3.7	3.2	ZV318S_K202_0560 EZ301U	5.3	9.5	150	55.54	0.22	0.21	0.35	83	42	12	41	3	18	57.3
0.32	2.8	3.2	6.3	1.9	ZV318S_K202_0560 EZ302U	6.7	9.5	190	55.54	0.22	0.21	0.35	83	42	12	41	3	18	57.3
0.32	3.7	4.2	8.2	1.5	ZV318S_K202_0560 EZ303U	6.7	9.5	190	55.54	0.22	0.21	0.35	83	42	12	41	3	18	57.3
0.33	1.6	1.7	3.3	3.3	ZV318S_K203_0540 EZ301U	5.1	12	150	54.25	0.22	0.22	0.36	83	50	21	41	3	18	57.3
0.33	2.7	3.0	5.6	2.0	ZV318S_K203_0540 EZ302U	7.7	12	220	54.25	0.22	0.22	0.36	83	50	21	41	3	18	57.3
0.33	3.5	4.1	7.3	1.5	ZV318S_K203_0540 EZ303U	7.7	12	220	54.25	0.22	0.22	0.36	83	50	21	41	3	18	57.3
0.33	4.2	5.1	8.5	1.3	ZV318S_K203_0540 EZ401U	7.7	12	220	54.25	0.22	0.22	0.36	83	50	21	41	3	18	57.3
0.36	1.5	1.6	6.0	2.2	ZV318S_K202_0500 EZ301U	4.0	6.5	120	50.49	0.24	0.23	0.39	83	42	12	41	3	18	57.3
0.36	2.6	2.9	10	1.3	ZV318S_K202_0500 EZ302U	4.0	6.5	120	50.49	0.24	0.23	0.39	83	42	12	41	3	18	57.3
0.36	1.5	1.6	3.3	3.6	ZV318S_K203_0500 EZ301U	4.6	11	130	49.76	0.24	0.24	0.39	83	50	21	41	3	18	57.3
0.36	2.5	2.8	5.6	2.2	ZV318S_K203_0500 EZ302U	7.7	11	220	49.76	0.24	0.24	0.39	83	50	21	41	3	18	57.3
0.36	3.3	3.7	7.3	1.7	ZV318S_K203_0500 EZ303U	7.7	11	220	49.76	0.24	0.24	0.39	83	50	21	41	3	18	57.3
0.36	3.8	4.6	8.6	1.4	ZV318S_K203_0500 EZ401U	7.7	11	220	49.76	0.24	0.24	0.39	83	50	21	41	3	18	57.3
0.39	1.4	1.5	3.4	3.9	ZV318S_K202_0460 EZ301U	4.4	9.0	130	46.23	0.26	0.25	0.42	83	42	12	41	3	18	57.3
0.39	2.3	2.6	5.7	2.3	ZV318S_K202_0460 EZ302U	7.2	9.0	210	46.23	0.26	0.25	0.42	83	42	12	41	3	18	57.3
0.39	3.1	3.5	7.5	1.8	ZV318S_K202_0460 EZ303U	7.2	9.0	210	46.23	0.26	0.25	0.42	83	42	12	41	3	18	57.3
0.39	3.6	4.4	8.8	1.5	ZV318S_K202_0460 EZ401U	7.7	14	220	46.23	0.26	0.25	0.42	83	42	12	41	3	18	57.3
0.40	1.3	1.4	3.4	4.0	ZV318S_K203_0450 EZ301U	4.2	10	120	45.22	0.27	0.26	0.43	83	50	21	41	3	18	57.3
0.40	2.3	2.5	5.7	2.4	ZV318S_K203_0450 EZ302U	7.5	10	220	45.22	0.27	0.26	0.43	83	50	21	41	3	18	57.3
0.40	3.0	3.4	7.4	1.8	ZV318S_K203_0450 EZ303U	7.7	10	220	45.22	0.27	0.26	0.43	83	50	21	41	3	18	57.3
0.40	3.5	4.2	8.7	1.5	ZV318S_K203_0450 EZ401U	7.7	10	220	45.22	0.27	0.26	0.43	83	50	21	41	3	18	57.3
0.45	1.2	1.3	4.7	3.3	ZV318S_K202_0400 EZ301U	3.8	6.9	110	40.39	0.30	0.29	0.48	83	42	12	41	3	18	57.3
0.45	2.1	2.3	7.9	2.0	ZV318S_K202_0400 EZ302U	4.8	6.9	140	40.39	0.30	0.29	0.48	83	42	12	41	3	18	57.3
0.45	2.7	3.1	10	1.5	ZV318S_K202_0400 EZ303U	4.8	6.9	140	40.39	0.30	0.29	0.48	83	42	12	41	3	18	57.3
0.46	1.2	1.3	3.4	4.6	ZV318S_K203_0390 EZ301U	3.7	8.8	110	39.45	0.30	0.30	0.49	83	50	21	41	3	18	57.3
0.46	2.0	2.2	5.7	2.7	ZV318S_K203_0390 EZ302U	6.6	8.8	190	39.45	0.30	0.30	0.49	83	50	21	41	3	18	57.3
0.46	2.6	3.0	7.5	2.1	ZV318S_K203_0390 EZ303U	7.1	8.8	200	39.45	0.30	0.30	0.49	83	50	21	41	3	18	57.3
0.46	3.0	3.7	8.8	1.8	ZV318S_K203_0390 EZ401U	7.1	8.8	200	39.45	0.30	0.30	0.49	83	50	21	41	3	18	57.3
0.52	1.8	2.0	5.9	3.0	ZV318S_K202_0350 EZ302U	5.8	7.5	170	34.55	0.35	0.34	0.56	83	42	12	41	3	18	57.3
0.52	2.3	2.6	7.7	2.3	ZV318S_K202_0350 EZ303U	6.0	7.5	170	34.55	0.35	0.34	0.56	83	42	12	41	3	18	57.3
0.52	2.7	3.3	9.0	2.0	ZV318S_K202_0350 EZ401U	7.7	14	220	34.55	0.35	0.34	0.56	83	42	12	41	3	18	57.3
0.52	4.0	5.1	13	1.3	ZV318S_K202_0350 EZ501U	7.7	14	220	34.55	0.35	0.34	0.56	83	42	12	41	3	18	57.3
0.52	4.1	5.7	14	1.3	ZV318S_K202_0350 EZ402U	7.7	14	220	34.55	0.35	0.34	0.56	83	42	12	41	3	18	57.3
0.54	1.7	1.9	5.9	3.0	ZV318S_K202_0340 EZ302U	5.2	6.5	150	33.62	0.36	0.35	0.58	83	42	12	41	3	18	57.3
0.54	2.2	2.6	7.7	2.3	ZV318S_K202_0340 EZ303U	5.2	6.5	150	33.62	0.36	0.35	0.58	83	42	12	41	3	18	57.3
0.54	2.6	3.2	9.0	2.0	ZV318S_K202_0340 EZ401U	6.5	11	180	33.62	0.36	0.35	0.58	83	42	12	41	3	18	57.3
0.64	2.2	2.6	9.2	2.2	ZV318S_K202_0280 EZ401U	7.7	14	220	27.95	0.43	0.42	0.70	83	42	12	41	3	18	57.3
0.64	3.2	4.2	14	1.5	ZV318S_K202_0280 EZ501U	7.7	14	220	27.95	0.43	0.42	0.70	83	42	12	41	3	18	57.3
0.64	3.3	4.6	14	1.5	ZV318S_K202_0280 EZ402U	7.7	14	220	27.95	0.43	0.42	0.70	83	42	12	41	3	18	57.3
0.72	1.3	1.4	6.5	3.4	ZV318S_K202_0250 EZ302U	4.3	5.4	120	25.13	0.48	0.47	0.78	83	42	12	41	3	18	57.3
0.72	1.7	1.9	8.5	2.6	ZV318S_K202_0250 EZ303U	4.4	5.4	120	25.13	0.48	0.47	0.78	83	42	12	41	3	18	57.3
0.72	2.0	2.4	9.2	2.4	ZV318S_K202_0250 EZ401U	7.2	14	210	25.13	0.48	0.47	0.78	83	42	12	41	3	18	57.3
0.72	2.9	3.7	14	1.6	ZV318S_K202_0250 EZ501U	7.7	14	220	25.13	0.48	0.47	0.78	83	42	12	41	3	18	57.3
0.72	3.0	4.2	14	1.6	ZV318S_K202_0250 EZ402U	7.7	14	220	25.13	0.48	0.47	0.78	83	42	12	41	3	18	57.3
0.78	1.2	1.3	6.1	3.9	ZV318S_K202_0230 EZ302U	3.9	5.9	110	23.18	0.52	0.51	0.84	83	42	12	41	3	18	57.3
0.78	1.5	1.8	7.9	3.0	ZV318S_K202_0230 EZ303U	4.7	5.9	130	23.18	0.52	0.51	0.84	83	42	12	41	3	18	57.3
0.78	1.8	2.2	9.3	2.5	ZV318S_K202_0230 EZ401U	6.7	14	190	23.18	0.52	0.51	0.84	83	42	12	41	3	18	57.3
0.78	2.7	3.5	14	1.7	ZV318S_K202_0230 EZ501U	7.7	14	220	23.18	0.52	0.51	0.84	83	42	12	41	3	18	57.3
0.78	2.7	3.8	14	1.7	ZV318S_K202_0230 EZ402U	7.7	14	220	23.18	0.52	0.51	0.84	83	42	12	41	3	18	57.3
0.89	1.6	1.9	9.4	2.8	ZV318S_K202_0200 EZ401U	5.9	14	170	20.33	0.59	0.58	0.96	83	42	12	41	3	18	57.3
0.89	2.3	3.0	14	1.9	ZV318S_K202_0200 EZ501U	7.7	14	220	20.33	0.59	0.58	0.96	83	42	12	41	3	18	57.3
0.89	2.4	3.4	14	1.8	ZV318S_K202_0200 EZ402U	7.7	14	220	20.33	0.59	0.58	0.96	83	42	12	41	3	18	57.3
0.89	3.6	5.4	21	1.2	ZV318S_K202_0200 EZ502U	7.7	14	220	20.33	0.59	0.58	0.96	83	42	12	41	3	18	57.3
0.89	3.6	5.4	21	1.2	ZV318S_K202_0200 EZ701U	7.7	14	220	20.33	0.59	0.58	0.96	83	42	12	41	3	18	57.3
0.89	4.0	5.8	24	1.1	ZV318S_K202_0200 EZ404U	7.7	14	220	20.33	0.59	0.58	0.96	83	42	12	41	3	18	57.3
1.07	0.9	1.0	7.5	4.0	ZV318S_K202_0170 EZ302U	2.9	4.3	82	16.86	0.71	0.69	1.16	83	42	12	41	3	18	57.3
1.07	1.1	1.3	9.8	3.1	ZV318S_K202_0170 EZ303U	3.4	4.3	98	16.86	0.71	0.69	1.16	83	42	12	41	3	18	57.3
1.07	1.3	1.6	9.5	3.1	ZV318S_K202_0170 EZ401U	4.9	14	140	16.86	0.71	0.69	1.16	83	42	12	41	3	18	57.3

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ EL1,2 [m/s]	$v_{f2maxDB}$ EL3,4,5,6 [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{redII} [µm]	Δs_{redI} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV3K2 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 7,7 kN)																			
1.07	1.9	2.5	14	2.1	ZV318S_K202_0170 EZ501U	7.7	14	220	16.86	0.71	0.69	1.16	83	42	12	41	3	18	57.3
1.07	2.0	2.8	15	2.1	ZV318S_K202_0170 EZ402U	7.7	14	220	16.86	0.71	0.69	1.16	83	42	12	41	3	18	57.3
1.07	3.0	4.5	22	1.4	ZV318S_K202_0170 EZ502U	7.7	14	220	16.86	0.71	0.69	1.16	83	42	12	41	3	18	57.3
1.07	3.0	4.5	22	1.4	ZV318S_K202_0170 EZ701U	7.7	14	220	16.86	0.71	0.69	1.16	83	42	12	41	3	18	57.3
1.07	3.3	4.8	24	1.2	ZV318S_K202_0170 EZ404U	7.7	14	220	16.86	0.71	0.69	1.16	83	42	12	41	3	18	57.3
ZV2K3 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 10 kN)																			
0.06	4.6	4.7	2.4	1.1	ZV225S_K303_1360 EZ301U	10	26	280	136.0	0.08	0.07	0.12	77	39	19	67	2	25	53.1
0.08	3.7	3.7	2.3	1.4	ZV225S_K303_1090 EZ301U	10	26	280	109.2	0.10	0.09	0.15	77	39	19	67	2	25	53.1
0.09	3.1	3.1	2.2	1.7	ZV225S_K303_0910 EZ301U	9.2	22	240	91.23	0.12	0.11	0.18	77	39	19	67	2	25	53.1
0.11	2.7	2.7	2.6	1.9	ZV225S_K303_0790 EZ301U	8.0	19	210	79.42	0.13	0.12	0.21	77	39	19	67	2	25	53.1
0.11	4.6	4.8	4.4	1.1	ZV225S_K303_0790 EZ302U	10	19	280	79.42	0.13	0.12	0.21	77	39	19	67	2	25	53.1
0.12	2.4	2.4	3.4	2.2	ZV225S_K302_0690 EZ301U	7.1	11	190	69.43	0.15	0.14	0.24	77	31	12	67	2	25	53.1
0.12	4.0	4.3	5.8	1.3	ZV225S_K302_0690 EZ302U	8.9	11	240	69.43	0.15	0.14	0.24	77	31	12	67	2	25	53.1
0.12	2.3	2.3	2.1	2.3	ZV225S_K303_0680 EZ301U	6.8	16	180	67.73	0.16	0.14	0.25	77	39	19	67	2	25	53.1
0.12	3.9	4.1	3.5	1.3	ZV225S_K303_0680 EZ302U	10	16	280	67.73	0.16	0.14	0.25	77	39	19	67	2	25	53.1
0.12	5.1	5.3	4.6	1.0	ZV225S_K303_0680 EZ303U	10	16	280	67.73	0.16	0.14	0.25	77	39	19	67	2	25	53.1
0.13	2.2	2.3	2.6	2.3	ZV225S_K303_0660 EZ301U	6.7	16	180	66.35	0.16	0.15	0.25	77	39	19	67	2	25	53.1
0.13	3.8	4.0	4.4	1.4	ZV225S_K303_0660 EZ302U	10	16	280	66.35	0.16	0.15	0.25	77	39	19	67	2	25	53.1
0.13	4.9	5.2	5.8	1.0	ZV225S_K303_0660 EZ303U	10	16	280	66.35	0.16	0.15	0.25	77	39	19	67	2	25	53.1
0.15	1.8	1.9	2.4	2.8	ZV225S_K303_0550 EZ301U	5.5	13	150	54.58	0.19	0.18	0.31	77	39	19	67	2	25	53.1
0.15	3.1	3.3	4.1	1.7	ZV225S_K303_0550 EZ302U	9.8	13	260	54.58	0.19	0.18	0.31	77	39	19	67	2	25	53.1
0.15	4.1	4.3	5.3	1.3	ZV225S_K303_0550 EZ303U	10	13	280	54.58	0.19	0.18	0.31	77	39	19	67	2	25	53.1
0.17	1.7	1.8	4.3	3.0	ZV225S_K302_0500 EZ301U	5.2	8.1	140	50.49	0.21	0.19	0.33	77	31	12	67	2	25	53.1
0.17	2.9	3.1	7.3	1.8	ZV225S_K302_0500 EZ302U	6.5	8.1	170	50.49	0.21	0.19	0.33	77	31	12	67	2	25	53.1
0.17	3.8	4.0	9.6	1.4	ZV225S_K302_0500 EZ303U	6.5	8.1	170	50.49	0.21	0.19	0.33	77	31	12	67	2	25	53.1
0.17	1.7	1.7	2.6	3.1	ZV225S_K303_0490 EZ301U	5.0	12	130	49.26	0.21	0.20	0.34	77	39	19	67	2	25	53.1
0.17	2.8	3.0	4.5	1.8	ZV225S_K303_0490 EZ302U	8.9	12	240	49.26	0.21	0.20	0.34	77	39	19	67	2	25	53.1
0.17	3.7	3.9	5.8	1.4	ZV225S_K303_0490 EZ303U	9.5	12	250	49.26	0.21	0.20	0.34	77	39	19	67	2	25	53.1
0.17	5.0	5.3	7.8	1.0	ZV225S_K303_0490 EZ401U	9.5	12	250	49.26	0.21	0.20	0.34	77	39	19	67	2	25	53.1
0.18	4.7	5.1	5.7	1.1	ZV225S_K302_0460 EZ401U	10	26	280	46.23	0.23	0.21	0.36	77	31	12	67	2	25	53.1
0.21	4.1	4.4	9.8	1.2	ZV225S_K302_0410 EZ401U	8.7	15	230	40.51	0.26	0.24	0.41	77	31	12	67	2	25	53.1
0.24	3.6	3.8	5.5	1.5	ZV225S_K302_0350 EZ401U	10	26	280	34.73	0.30	0.28	0.48	77	31	12	67	2	25	53.1
0.25	3.4	3.7	7.2	1.5	ZV225S_K302_0340 EZ401U	10	19	280	33.62	0.31	0.29	0.50	77	31	12	67	2	25	53.1
0.26	5.1	5.5	8.3	1.0	ZV225S_K303_0330 EZ501U	10	22	280	32.65	0.32	0.30	0.51	77	39	19	67	2	25	53.1
0.30	2.9	3.1	5.6	1.8	ZV225S_K302_0280 EZ401U	8.7	26	230	27.88	0.38	0.35	0.60	77	31	12	67	2	25	53.1
0.30	4.4	4.8	8.5	1.2	ZV225S_K302_0280 EZ501U	10	26	280	27.88	0.38	0.35	0.60	77	31	12	67	2	25	53.1
0.30	4.8	5.3	9.3	1.1	ZV225S_K302_0280 EZ402U	10	26	280	27.88	0.38	0.35	0.60	77	31	12	67	2	25	53.1
0.33	2.6	2.8	5.6	2.0	ZV225S_K302_0250 EZ401U	7.9	23	210	25.26	0.42	0.39	0.66	77	31	12	67	2	25	53.1
0.33	4.0	4.3	8.6	1.3	ZV225S_K302_0250 EZ501U	10	23	280	25.26	0.42	0.39	0.66	77	31	12	67	2	25	53.1
0.33	4.3	4.8	9.4	1.2	ZV225S_K302_0250 EZ402U	10	23	280	25.26	0.42	0.39	0.66	77	31	12	67	2	25	53.1
0.36	2.4	2.6	5.6	2.2	ZV225S_K302_0230 EZ401U	7.2	24	190	23.29	0.45	0.42	0.72	77	31	12	67	2	25	53.1
0.36	3.7	4.0	8.7	1.4	ZV225S_K302_0230 EZ501U	10	24	280	23.29	0.45	0.42	0.72	77	31	12	67	2	25	53.1
0.36	4.0	4.4	9.5	1.3	ZV225S_K302_0230 EZ402U	10	24	280	23.29	0.45	0.42	0.72	77	31	12	67	2	25	53.1
0.41	2.1	2.2	5.7	2.5	ZV225S_K302_0200 EZ401U	6.3	19	170	20.28	0.52	0.48	0.82	77	31	12	67	2	25	53.1
0.41	3.2	3.5	8.8	1.6	ZV225S_K302_0200 EZ501U	10	19	280	20.28	0.52	0.48	0.82	77	31	12	67	2	25	53.1
0.41	3.5	3.9	9.6	1.5	ZV225S_K302_0200 EZ402U	10	19	280	20.28	0.52	0.48	0.82	77	31	12	67	2	25	53.1
0.41	5.1	6.4	14	1.0	ZV225S_K302_0200 EZ404U	10	19	280	20.28	0.52	0.48	0.82	77	31	12	67	2	25	53.1
0.48	1.8	1.9	5.8	2.9	ZV225S_K302_0175 EZ401U	5.4	19	140	17.29	0.56	0.50	0.80	77	31	12	67	2	25	53.1
0.48	2.7	3.0	8.9	1.9	ZV225S_K302_0175 EZ501U	10	19	270	17.29	0.56	0.50	0.80	77	31	12	67	2	25	53.1
0.48	3.0	3.3	9.7	1.7	ZV225S_K302_0175 EZ402U	10	19	270	17.29	0.56	0.50	0.80	77	31	12	67	2	25	53.1
0.48	4.4	5.4	14	1.2	ZV225S_K302_0175 EZ404U	10	19	280	17.29	0.56	0.50	0.80	77	31	12	67	2	25	53.1
0.48	4.7	5.1	15	1.1	ZV225S_K302_0175 EZ502U	10	19	280	17.29	0.56	0.50	0.80	77	31	12	67	2	25	53.1
0.48	4.7	5.2	15	1.1	ZV225S_K302_0175 EZ701U	10	26	280	17.29	0.56	0.50	0.80	77	31	12	67	2	25	53.1
0.49	1.7	1.9	5.8	3.0	ZV225S_K302_0170 EZ401U	5.3	18	140	16.94	0.62	0.57	0.98	77	31	12	67	2	25	53.1
0.49	2.7	2.9	8.9	1.9	ZV225S_K302_0170 EZ501U	9.9	18	260	16.94	0.62	0.57	0.98	77	31	12	67	2	25	53.1
0.49	2.9	3.2	9.7	1.8	ZV225S_K302_0170 EZ402U	9.9	18	260	16.94	0.62	0.57	0.98	77	31	12	67	2	25	53.1
0.49	4.3	5.3	14	1.2	ZV225S_K302_0170 EZ404U	10	18	280	16.94	0.62	0.57	0.98	77	31	12	67	2	25	53.1
0.49	4.6	5.0	15	1.1	ZV225S_K302_0170 EZ502U	10	18	280	16.94	0.62	0.57	0.98	77	31	12	67	2	25	53.1
0.49	4.6	5.1	15	1.1	ZV225S_K302_0170 EZ701U	10	26	280	16.94	0.62	0.57	0.98	77	31	12	67	2	25	53.1
0.60	1.4	1.5	5.9	3.6	ZV225S_K302_0140 EZ401U	4.3	15	110	13.94	0.70	0.62	1.00	77	31	12	67	2	25	53.1
0.60	2.2	2.4	9.0	2.4	ZV225S_K302_0140 EZ501U	8.2	15	220	13.94	0.70	0.62	1.00	77	31	12	67	2	25	53.1
0.60	2.4	2.6	9.9	2.2	ZV225S_K302_0140 EZ402U	8.2	15	220	13.94	0.70	0.62	1.00	77	31	12	67	2	25	53.1
0.60	3.5	4.4	15	1.5	ZV225S_K302_0140 EZ404U	10	15	280	13.94	0.70	0.62	1.00	77	31	12	67	2	25	53.1
0.60	3.8	4.1	16	1.4	ZV225S_K302_0140 EZ502U	10	15	280	13.94	0.70	0.62	1.00	77	31	12	67	2	25	53.1

v_{f2N}	F_{f2N}	$F_{f2,0}$	a_{th}	S	Type	F_{f2accE}	$F_{f2NOT,E}$	M_{2accE}	i	$v_{f2maxDB}$		$v_{f2maxZB}$	Δs	Δs_{redII}	Δs_{redI}	C_{lin}	m_n	z	d_0
										EL1,2	EL3,4,5,6								
[m/s]	[kN]	[kN]				[kN]	[kN]	[Nm]		[m/s]	[m/s]	[m/s]	[µm]	[µm]	[µm]	[N/µm]	[mm]		[mm]
ZV2K3 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 10 kN)																			
0.60	3.8	4.2	16	1.4	ZV225S_K302_0140 EZ701U	10	26	270	13.94	0.70	0.62	1.00	77	31	12	67	2	25	53.1
0.60	4.9	5.7	20	1.0	ZV225S_K302_0140 EZ503U	10	15	280	13.94	0.70	0.62	1.00	77	31	12	67	2	25	53.1
0.66	1.3	1.4	5.9	4.0	ZV225S_K302_0125 EZ401U	3.9	14	100	12.58	0.77	0.69	1.10	77	31	12	67	2	25	53.1
0.66	2.0	2.2	9.1	2.6	ZV225S_K302_0125 EZ501U	7.4	14	200	12.58	0.77	0.69	1.10	77	31	12	67	2	25	53.1
0.66	2.2	2.4	10	2.4	ZV225S_K302_0125 EZ402U	7.4	14	200	12.58	0.77	0.69	1.10	77	31	12	67	2	25	53.1
0.66	3.2	4.0	15	1.6	ZV225S_K302_0125 EZ404U	10	14	280	12.58	0.77	0.69	1.10	77	31	12	67	2	25	53.1
0.66	3.4	3.7	16	1.5	ZV225S_K302_0125 EZ502U	10	14	280	12.58	0.77	0.69	1.10	77	31	12	67	2	25	53.1
0.66	3.4	3.8	16	1.5	ZV225S_K302_0125 EZ701U	9.2	26	240	12.58	0.77	0.69	1.10	77	31	12	67	2	25	53.1
0.66	4.5	5.1	21	1.2	ZV225S_K302_0125 EZ503U	10	14	280	12.58	0.77	0.69	1.10	77	31	12	67	2	25	53.1
0.72	1.2	1.3	6.0	4.3	ZV225S_K302_0115 EZ401U	3.6	13	96	11.61	0.77	0.67	1.08	77	31	12	67	2	25	53.1
0.72	1.8	2.0	9.2	2.8	ZV225S_K302_0115 EZ501U	6.8	13	180	11.61	0.77	0.67	1.08	77	31	12	67	2	25	53.1
0.72	2.0	2.2	10	2.6	ZV225S_K302_0115 EZ402U	6.8	13	180	11.61	0.77	0.67	1.08	77	31	12	67	2	25	53.1
0.72	2.9	3.7	15	1.8	ZV225S_K302_0115 EZ404U	10	13	270	11.61	0.77	0.67	1.08	77	31	12	67	2	25	53.1
0.72	3.1	3.4	16	1.6	ZV225S_K302_0115 EZ502U	10	13	270	11.61	0.77	0.67	1.08	77	31	12	67	2	25	53.1
0.72	3.1	3.5	16	1.6	ZV225S_K302_0115 EZ701U	8.5	26	230	11.61	0.77	0.67	1.08	77	31	12	67	2	25	53.1
0.72	4.1	4.7	21	1.3	ZV225S_K302_0115 EZ503U	10	13	270	11.61	0.77	0.67	1.08	77	31	12	67	2	25	53.1
0.72	5.1	6.1	26	1.0	ZV225S_K302_0115 EZ702U	10	26	280	11.61	0.77	0.67	1.08	77	31	12	67	2	25	53.1
0.82	1.0	1.1	6.0	5.0	ZV225S_K302_0100 EZ401U	3.2	11	84	10.14	0.96	0.85	1.37	77	31	12	67	2	25	53.1
0.82	1.6	1.7	9.3	3.2	ZV225S_K302_0100 EZ501U	5.9	11	160	10.14	0.96	0.85	1.37	77	31	12	67	2	25	53.1
0.82	1.7	1.9	10	3.0	ZV225S_K302_0100 EZ402U	5.9	11	160	10.14	0.96	0.85	1.37	77	31	12	67	2	25	53.1
0.82	2.6	3.2	15	2.0	ZV225S_K302_0100 EZ404U	8.9	11	240	10.14	0.96	0.85	1.37	77	31	12	67	2	25	53.1
0.82	2.7	3.0	16	1.9	ZV225S_K302_0100 EZ502U	8.9	11	240	10.14	0.96	0.85	1.37	77	31	12	67	2	25	53.1
0.82	2.7	3.1	16	1.9	ZV225S_K302_0100 EZ701U	7.4	26	200	10.14	0.96	0.85	1.37	77	31	12	67	2	25	53.1
0.82	3.6	4.1	21	1.4	ZV225S_K302_0100 EZ503U	8.9	11	240	10.14	0.96	0.85	1.37	77	31	12	67	2	25	53.1
0.82	4.4	5.3	26	1.2	ZV225S_K302_0100 EZ702U	10	26	280	10.14	0.96	0.85	1.37	77	31	12	67	2	25	53.1
0.82	5.0	5.9	29	1.0	ZV225S_K302_0100 EZ505U	10	26	280	10.14	0.96	0.85	1.37	77	31	12	67	2	25	53.1
0.90	2.5	2.8	16	2.0	ZV225S_K302_0093 EZ701U	6.8	25	180	9.267	0.96	0.84	1.35	77	31	12	67	2	25	53.1
0.90	4.1	4.9	26	1.2	ZV225S_K302_0093 EZ702U	10	25	280	9.267	0.96	0.84	1.35	77	31	12	67	2	25	53.1
0.90	4.6	5.4	29	1.1	ZV225S_K302_0093 EZ505U	10	25	280	9.267	0.96	0.84	1.35	77	31	12	67	2	25	53.1
0.99	1.3	1.5	9.9	3.7	ZV225S_K302_0084 EZ501U	4.9	9.3	130	8.444	1.05	0.92	1.48	77	31	12	67	2	25	53.1
0.99	1.5	1.6	11	3.4	ZV225S_K302_0084 EZ402U	4.9	9.3	130	8.444	1.05	0.92	1.48	77	31	12	67	2	25	53.1
0.99	2.1	2.7	16	2.3	ZV225S_K302_0084 EZ404U	7.4	9.3	200	8.444	1.05	0.92	1.48	77	31	12	67	2	25	53.1
0.99	2.3	2.5	17	2.1	ZV225S_K302_0084 EZ502U	7.4	9.3	200	8.444	1.05	0.92	1.48	77	31	12	67	2	25	53.1
0.99	2.3	2.6	16	2.1	ZV225S_K302_0084 EZ701U	6.2	23	160	8.444	1.05	0.92	1.48	77	31	12	67	2	25	53.1
0.99	3.0	3.4	22	1.6	ZV225S_K302_0084 EZ503U	7.4	9.3	200	8.444	1.05	0.92	1.48	77	31	12	67	2	25	53.1
0.99	3.7	4.4	26	1.3	ZV225S_K302_0084 EZ702U	10	23	280	8.444	1.05	0.92	1.48	77	31	12	67	2	25	53.1
0.99	4.2	4.9	30	1.2	ZV225S_K302_0084 EZ505U	10	23	280	8.444	1.05	0.92	1.48	77	31	12	67	2	25	53.1
1.13	2.0	2.2	16	2.3	ZV225S_K302_0074 EZ701U	5.4	20	140	7.391	1.02	0.86	1.50	77	31	12	67	2	25	53.1
1.13	3.2	3.9	27	1.4	ZV225S_K302_0074 EZ702U	10	20	280	7.391	1.02	0.86	1.50	77	31	12	67	2	25	53.1
1.13	3.6	4.3	30	1.3	ZV225S_K302_0074 EZ505U	10	20	280	7.391	1.02	0.86	1.50	77	31	12	67	2	25	53.1
1.13	4.5	5.6	37	1.0	ZV225S_K302_0074 EZ703U	10	20	280	7.391	1.02	0.86	1.50	77	31	12	67	2	25	53.1
1.24	1.8	2.0	17	2.5	ZV225S_K302_0067 EZ701U	4.9	18	130	6.740	1.32	1.15	1.86	77	31	12	67	2	25	53.1
1.24	3.0	3.5	27	1.5	ZV225S_K302_0067 EZ702U	10	18	270	6.740	1.32	1.15	1.86	77	31	12	67	2	25	53.1
1.24	3.3	3.9	30	1.4	ZV225S_K302_0067 EZ505U	10	18	280	6.740	1.32	1.15	1.86	77	31	12	67	2	25	53.1
1.24	4.1	5.1	37	1.1	ZV225S_K302_0067 EZ703U	10	18	280	6.740	1.32	1.15	1.86	77	31	12	67	2	25	53.1
1.39	1.6	1.8	17	2.7	ZV225S_K302_0060 EZ701U	4.4	16	120	6.000	1.25	1.07	1.85	77	31	12	67	2	25	53.1
1.39	2.6	3.2	27	1.7	ZV225S_K302_0060 EZ702U	9.0	16	240	6.000	1.25	1.07	1.85	77	31	12	67	2	25	53.1
1.39	3.0	3.5	30	1.5	ZV225S_K302_0060 EZ505U	10	16	280	6.000	1.25	1.07	1.85	77	31	12	67	2	25	53.1
1.39	3.6	4.6	37	1.2	ZV225S_K302_0060 EZ703U	10	16	280	6.000	1.25	1.07	1.85	77	31	12	67	2	25	53.1
1.55	1.5	1.6	17	2.9	ZV225S_K302_0054 EZ701U	3.9	15	100	5.375	1.40	1.19	2.07	77	31	12	67	2	25	53.1
1.55	2.4	2.8	27	1.8	ZV225S_K302_0054 EZ702U	8.1	15	210	5.375	1.40	1.19	2.07	77	31	12	67	2	25	53.1
1.55	2.7	3.1	31	1.6	ZV225S_K302_0054 EZ505U	10	15	280	5.375	1.40	1.19	2.07	77	31	12	67	2	25	53.1
1.55	3.2	4.1	38	1.3	ZV225S_K302_0054 EZ703U	10	15	280	5.375	1.40	1.19	2.07	77	31	12	67	2	25	53.1
1.91	1.2	1.3	17	3.3	ZV225S_K302_0044 EZ701U	3.2	12	85	4.364	1.72	1.46	2.55	77	31	12	67	2	25	53.1
1.91	1.9	2.3	28	2.0	ZV225S_K302_0044 EZ702U	6.5	12	170	4.364	1.72	1.46	2.55	77	31	12	67	2	25	53.1
1.91	2.2	2.6	31	1.8	ZV225S_K302_0044 EZ505U	9.6	12	250	4.364	1.72	1.46	2.55	77	31	12	67	2	25	53.1
1.91	2.6	3.3	38	1.5	ZV225S_K302_0044 EZ703U	9.6	12	250	4.364	1.72	1.46	2.55	77	31	12	67	2	25	53.1
1.91	3.4	4.8	49	1.2	ZV225S_K302_0044 EZ705U	10	26	280	4.364	1.72	1.46	2.55	77	31	12	67	2	25	53.1
2.08	1.1	1.2	17	3.5	ZV225S_K302_0040 EZ701U	2.9	11	78	4.000	1.88	1.60	2.78	77	31	12	67	2	25	53.1
2.08	1.8	2.1	28	2.2	ZV225S_K302_0040 EZ702U	6.0	11	160	4.000	1.88	1.60	2.78	77	31	12	67	2	25	53.1
2.08	2.0	2.3	31	1.9	ZV225S_K302_0040 EZ505U	8.8	11	230	4.000	1.88	1.60	2.78	77	31	12	67	2	25	53.1
2.08	2.4	3.0	38	1.6	ZV225S_K302_0040 EZ703U	8.8	11	230	4.000	1.88	1.60	2.78	77	31	12	67	2	25	53.1
2.08	3.1	4.4	50	1.2	ZV225S_K302_0040 EZ705U	10	26	280	4.000	1.88	1.60	2.78	77	31	12	67	2	25	53.1

v_{f2N}	F_{f2N}	$F_{f2,0}$	a_{th}	S	Type	F_{f2accE}	$F_{f2NOT,E}$	M_{2accE}	i	$v_{f2maxDB}$		$v_{f2maxZB}$	Δs	Δs_{redII}	Δs_{redI}	C_{lin}	m_n	z	d_0
										EL1,2	EL3,4,5,6								
[m/s]	[kN]	[kN]				[kN]	[kN]	[Nm]		[m/s]	[m/s]	[m/s]	[µm]	[µm]	[µm]	[N/µm]	[mm]		[mm]
ZV2K3 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 10 kN)																			
0.90	4.8	7.8	23	1.0	ZV225S_K302_0140 EZ505U	10	26	280	13.94	0.70	0.62	1.00	77	31	12	67	2	25	53.1
0.99	4.4	7.0	23	1.1	ZV225S_K302_0125 EZ505U	10	26	280	12.58	0.77	0.69	1.10	77	31	12	67	2	25	53.1
1.08	4.0	6.5	23	1.2	ZV225S_K302_0115 EZ505U	10	26	280	11.61	0.77	0.67	1.08	77	31	12	67	2	25	53.1
1.23	3.5	5.7	23	1.3	ZV225S_K302_0100 EZ505U	10	26	280	10.14	0.96	0.85	1.37	77	31	12	67	2	25	53.1
1.23	4.5	7.4	30	1.0	ZV225S_K302_0100 EZ703U	10	26	280	10.14	0.96	0.85	1.37	77	31	12	67	2	25	53.1
1.35	3.2	5.2	24	1.4	ZV225S_K302_0093 EZ505U	10	25	280	9.267	0.96	0.84	1.35	77	31	12	67	2	25	53.1
1.35	4.1	6.8	30	1.1	ZV225S_K302_0093 EZ703U	10	25	280	9.267	0.96	0.84	1.35	77	31	12	67	2	25	53.1
1.48	2.9	4.7	24	1.5	ZV225S_K302_0084 EZ505U	10	23	280	8.444	1.05	0.92	1.48	77	31	12	67	2	25	53.1
1.48	3.7	6.2	30	1.1	ZV225S_K302_0084 EZ703U	10	23	280	8.444	1.05	0.92	1.48	77	31	12	67	2	25	53.1
1.86	2.3	3.8	24	1.7	ZV225S_K302_0067 EZ505U	10	18	280	6.740	1.32	1.15	1.86	77	31	12	67	2	25	53.1
1.86	3.0	4.9	31	1.3	ZV225S_K302_0067 EZ703U	10	18	280	6.740	1.32	1.15	1.86	77	31	12	67	2	25	53.1
ZV2K3 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 10 kN)																			
0.12	4.4	4.7	2.5	1.2	ZV225S_K303_1360 EZ301U	10	26	280	136.0	0.08	0.07	0.12	77	39	19	67	2	25	53.1
0.15	3.5	3.7	2.4	1.5	ZV225S_K303_1090 EZ301U	10	26	280	109.2	0.10	0.09	0.15	77	39	19	67	2	25	53.1
0.18	2.9	3.1	2.5	1.8	ZV225S_K303_0910 EZ301U	9.2	22	240	91.23	0.12	0.11	0.18	77	39	19	67	2	25	53.1
0.18	4.9	5.5	4.2	1.0	ZV225S_K303_0910 EZ302U	10	22	280	91.23	0.12	0.11	0.18	77	39	19	67	2	25	53.1
0.21	2.5	2.7	3.1	2.0	ZV225S_K303_0790 EZ301U	8.0	19	210	79.42	0.13	0.12	0.21	77	39	19	67	2	25	53.1
0.21	4.3	4.8	5.2	1.2	ZV225S_K303_0790 EZ302U	10	19	280	79.42	0.13	0.12	0.21	77	39	19	67	2	25	53.1
0.24	2.3	2.4	3.2	2.3	ZV225S_K302_0690 EZ301U	7.1	11	190	69.43	0.15	0.14	0.24	77	31	12	67	2	25	53.1
0.24	3.8	4.3	5.5	1.4	ZV225S_K302_0690 EZ302U	8.9	11	240	69.43	0.15	0.14	0.24	77	31	12	67	2	25	53.1
0.24	5.0	5.7	7.1	1.0	ZV225S_K302_0690 EZ303U	8.9	11	240	69.43	0.15	0.14	0.24	77	31	12	67	2	25	53.1
0.25	2.2	2.3	2.5	2.4	ZV225S_K303_0680 EZ301U	6.8	16	180	67.73	0.16	0.14	0.25	77	39	19	67	2	25	53.1
0.25	3.7	4.1	4.2	1.4	ZV225S_K303_0680 EZ302U	10	16	280	67.73	0.16	0.14	0.25	77	39	19	67	2	25	53.1
0.25	4.8	5.5	5.4	1.1	ZV225S_K303_0680 EZ303U	10	16	280	67.73	0.16	0.14	0.25	77	39	19	67	2	25	53.1
0.25	2.1	2.3	3.1	2.4	ZV225S_K303_0660 EZ301U	6.7	16	180	66.35	0.16	0.15	0.25	77	39	19	67	2	25	53.1
0.25	3.6	4.0	5.3	1.4	ZV225S_K303_0660 EZ302U	10	16	280	66.35	0.16	0.15	0.25	77	39	19	67	2	25	53.1
0.25	4.7	5.4	6.9	1.1	ZV225S_K303_0660 EZ303U	10	16	280	66.35	0.16	0.15	0.25	77	39	19	67	2	25	53.1
0.30	4.7	5.7	6.3	1.1	ZV225S_K302_0560 EZ401U	10	20	280	55.71	0.19	0.18	0.30	77	31	12	67	2	25	53.1
0.31	1.8	1.9	2.5	3.0	ZV225S_K303_0550 EZ301U	5.5	13	150	54.58	0.19	0.18	0.31	77	39	19	67	2	25	53.1
0.31	3.0	3.3	4.2	1.8	ZV225S_K303_0550 EZ302U	9.8	13	260	54.58	0.19	0.18	0.31	77	39	19	67	2	25	53.1
0.31	3.9	4.4	5.5	1.3	ZV225S_K303_0550 EZ303U	10	13	280	54.58	0.19	0.18	0.31	77	39	19	67	2	25	53.1
0.31	4.5	5.5	6.5	1.1	ZV225S_K303_0550 EZ401U	10	13	280	54.58	0.19	0.18	0.31	77	39	19	67	2	25	53.1
0.33	1.6	1.8	4.1	3.1	ZV225S_K302_0500 EZ301U	5.2	8.1	140	50.49	0.21	0.19	0.33	77	31	12	67	2	25	53.1
0.33	2.8	3.1	6.9	1.9	ZV225S_K302_0500 EZ302U	6.5	8.1	170	50.49	0.21	0.19	0.33	77	31	12	67	2	25	53.1
0.33	3.6	4.2	9.1	1.4	ZV225S_K302_0500 EZ303U	6.5	8.1	170	50.49	0.21	0.19	0.33	77	31	12	67	2	25	53.1
0.34	1.6	1.7	3.1	3.3	ZV225S_K303_0490 EZ301U	5.0	12	130	49.26	0.21	0.20	0.34	77	39	19	67	2	25	53.1
0.34	2.7	3.0	5.3	1.9	ZV225S_K303_0490 EZ302U	8.9	12	240	49.26	0.21	0.20	0.34	77	39	19	67	2	25	53.1
0.34	3.5	4.0	6.9	1.5	ZV225S_K303_0490 EZ303U	9.5	12	250	49.26	0.21	0.20	0.34	77	39	19	67	2	25	53.1
0.34	4.1	5.0	8.1	1.3	ZV225S_K303_0490 EZ401U	9.5	12	250	49.26	0.21	0.20	0.34	77	39	19	67	2	25	53.1
0.36	3.9	4.7	5.5	1.3	ZV225S_K302_0460 EZ401U	10	26	280	46.23	0.23	0.21	0.36	77	31	12	67	2	25	53.1
0.41	3.4	4.1	8.0	1.5	ZV225S_K302_0410 EZ401U	8.7	15	230	40.51	0.26	0.24	0.41	77	31	12	67	2	25	53.1
0.41	5.0	6.5	12	1.0	ZV225S_K302_0410 EZ501U	8.7	15	230	40.51	0.26	0.24	0.41	77	31	12	67	2	25	53.1
0.43	4.8	6.2	8.1	1.1	ZV225S_K303_0390 EZ501U	10	26	280	39.19	0.27	0.25	0.43	77	39	19	67	2	25	53.1
0.47	4.4	5.7	8.2	1.2	ZV225S_K303_0360 EZ501U	10	24	280	35.83	0.30	0.27	0.47	77	39	19	67	2	25	53.1
0.48	2.9	3.6	5.6	1.8	ZV225S_K302_0350 EZ401U	10	26	280	34.73	0.30	0.28	0.48	77	31	12	67	2	25	53.1
0.48	4.3	5.6	8.3	1.2	ZV225S_K302_0350 EZ501U	10	26	280	34.73	0.30	0.28	0.48	77	31	12	67	2	25	53.1
0.48	4.4	6.2	8.6	1.2	ZV225S_K302_0350 EZ402U	10	26	280	34.73	0.30	0.28	0.48	77	31	12	67	2	25	53.1
0.50	2.8	3.4	5.9	1.8	ZV225S_K302_0340 EZ401U	10	19	280	33.62	0.31	0.29	0.50	77	31	12	67	2	25	53.1
0.50	4.2	5.4	8.7	1.2	ZV225S_K302_0340 EZ501U	10	19	280	33.62	0.31	0.29	0.50	77	31	12	67	2	25	53.1
0.50	4.3	6.0	9.0	1.2	ZV225S_K302_0340 EZ402U	10	19	280	33.62	0.31	0.29	0.50	77	31	12	67	2	25	53.1
0.51	4.0	5.2	8.3	1.3	ZV225S_K303_0330 EZ501U	10	22	280	32.65	0.32	0.30	0.51	77	39	19	67	2	25	53.1
0.60	2.3	2.9	5.8	2.2	ZV225S_K302_0280 EZ401U	8.7	26	230	27.88	0.38	0.35	0.60	77	31	12	67	2	25	53.1
0.60	3.5	4.5	8.5	1.5	ZV225S_K302_0280 EZ501U	10	26	280	27.88	0.38	0.35	0.60	77	31	12	67	2	25	53.1
0.60	3.6	5.0	8.8	1.4	ZV225S_K302_0280 EZ402U	10	26	280	27.88	0.38	0.35	0.60	77	31	12	67	2	25	53.1
0.66	2.1	2.6	5.8	2.4	ZV225S_K302_0250 EZ401U	7.9	23	210	25.26	0.42	0.39	0.66	77	31	12	67	2	25	53.1
0.66	3.1	4.1	8.6	1.6	ZV225S_K302_0250 EZ501U	10	23	280	25.26	0.42	0.39	0.66	77	31	12	67	2	25	53.1
0.66	3.2	4.5	8.8	1.6	ZV225S_K302_0250 EZ402U	10	23	280	25.26	0.42	0.39	0.66	77	31	12	67	2	25	53.1
0.66	4.8	7.2	13	1.1	ZV225S_K302_0250 EZ502U	10	23	280	25.26	0.42	0.39	0.66	77	31	12	67	2	25	53.1
0.66	4.8	7.3	13	1.1	ZV225S_K302_0250 EZ701U	10	23	280	25.26	0.42	0.39	0.66	77	31	12	67	2	25	53.1
0.72	2.0	2.4	5.8	2.6	ZV225S_K302_0230 EZ401U	7.2	24	190	23.29	0.45	0.42	0.72	77	31	12	67	2	25	53.1
0.72	2.9	3.7	8.6	1.8	ZV225S_K302_0230 EZ501U	10	24	280	23.29	0.45	0.42	0.72	77	31	12	67	2	25	53.1
0.72	3.0	4.2	8.9	1.7	ZV225S_K302_0230 EZ402U	10	24	280	23.29	0.45	0.42	0.72	77	31	12	67	2	25	53.1
0.72	4.4	6.6	13	1.2	ZV225S_K302_0230 EZ502U	10	24	280	23.29	0.45	0.42	0.72	77	31	12	67	2	25	53.1
0.72	4.4	6.7	13	1.2	ZV225S_K302_0230 EZ701U	10	26	280	23.29	0.45	0.42	0.72	77	31	12	67	2	25	53.1

v_{f2N}	F_{f2N}	$F_{f2,0}$	a_{th}	S	Type	F_{f2accE}	$F_{f2NOT,E}$	M_{2accE}	i	$v_{f2maxDB}$		$v_{f2maxZB}$	Δs	Δs_{redII}	Δs_{redI}	C_{lin}	m_n	z	d_0
										EL1,2	EL3,4,5,6								
[m/s]	[kN]	[kN]				[kN]	[kN]	[Nm]		[m/s]	[m/s]	[m/s]	[µm]	[µm]	[µm]	[N/µm]	[mm]		[mm]
ZV2K3 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 10 kN)																			
0.72	4.9	7.2	15	1.0	ZV225S_K302_0230 EZ404U	10	24	280	23.29	0.45	0.42	0.72	77	31	12	67	2	25	53.1
0.82	1.7	2.1	5.9	3.0	ZV225S_K302_0200 EZ401U	6.3	19	170	20.28	0.52	0.48	0.82	77	31	12	67	2	25	53.1
0.82	2.5	3.3	8.7	2.1	ZV225S_K302_0200 EZ501U	10	19	280	20.28	0.52	0.48	0.82	77	31	12	67	2	25	53.1
0.82	2.6	3.6	9.0	2.0	ZV225S_K302_0200 EZ402U	10	19	280	20.28	0.52	0.48	0.82	77	31	12	67	2	25	53.1
0.82	3.9	5.8	13	1.3	ZV225S_K302_0200 EZ502U	10	19	280	20.28	0.52	0.48	0.82	77	31	12	67	2	25	53.1
0.82	3.9	5.9	13	1.3	ZV225S_K302_0200 EZ701U	10	26	280	20.28	0.52	0.48	0.82	77	31	12	67	2	25	53.1
0.82	4.3	6.2	15	1.2	ZV225S_K302_0200 EZ404U	10	19	280	20.28	0.52	0.48	0.82	77	31	12	67	2	25	53.1
0.82	4.6	7.9	16	1.1	ZV225S_K302_0200 EZ503U	10	19	280	20.28	0.52	0.48	0.82	77	31	12	67	2	25	53.1
0.98	1.4	1.7	6.0	3.4	ZV225S_K302_0170 EZ401U	5.3	18	140	16.94	0.62	0.57	0.98	77	31	12	67	2	25	53.1
0.98	2.1	2.7	8.9	2.3	ZV225S_K302_0170 EZ501U	9.9	18	260	16.94	0.62	0.57	0.98	77	31	12	67	2	25	53.1
0.98	2.2	3.0	9.1	2.3	ZV225S_K302_0170 EZ402U	9.9	18	260	16.94	0.62	0.57	0.98	77	31	12	67	2	25	53.1
0.98	3.2	4.8	14	1.5	ZV225S_K302_0170 EZ502U	10	18	280	16.94	0.62	0.57	0.98	77	31	12	67	2	25	53.1
0.98	3.2	4.9	14	1.5	ZV225S_K302_0170 EZ701U	10	26	280	16.94	0.62	0.57	0.98	77	31	12	67	2	25	53.1
0.98	3.6	5.2	15	1.4	ZV225S_K302_0170 EZ404U	10	18	280	16.94	0.62	0.57	0.98	77	31	12	67	2	25	53.1
0.98	3.8	6.6	16	1.3	ZV225S_K302_0170 EZ503U	10	18	280	16.94	0.62	0.57	0.98	77	31	12	67	2	25	53.1
ZV3K3 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 11 kN)																			
0.07	4.2	4.3	2.4	1.3	ZV318S_K303_1360 EZ301U	11	24	310	136.0	0.08	0.08	0.13	83	42	21	61	3	18	57.3
0.08	3.4	3.5	2.3	1.6	ZV318S_K303_1090 EZ301U	10	24	290	109.2	0.10	0.10	0.17	83	42	21	61	3	18	57.3
0.10	2.8	2.9	2.2	1.9	ZV318S_K303_0910 EZ301U	8.5	20	240	91.23	0.13	0.12	0.20	83	42	21	61	3	18	57.3
0.10	4.8	5.1	3.7	1.1	ZV318S_K303_0910 EZ302U	11	20	310	91.23	0.13	0.12	0.20	83	42	21	61	3	18	57.3
0.11	2.5	2.5	2.6	2.2	ZV318S_K303_0790 EZ301U	7.4	18	210	79.42	0.14	0.13	0.23	83	42	21	61	3	18	57.3
0.11	4.2	4.5	4.4	1.3	ZV318S_K303_0790 EZ302U	11	18	310	79.42	0.14	0.13	0.23	83	42	21	61	3	18	57.3
0.13	2.2	2.2	3.4	2.4	ZV318S_K302_0690 EZ301U	6.6	10	190	69.43	0.16	0.15	0.26	83	33	12	61	3	18	57.3
0.13	3.7	3.9	5.8	1.4	ZV318S_K302_0690 EZ302U	8.3	10	240	69.43	0.16	0.15	0.26	83	33	12	61	3	18	57.3
0.13	4.9	5.1	7.5	1.1	ZV318S_K302_0690 EZ303U	8.3	10	240	69.43	0.16	0.15	0.26	83	33	12	61	3	18	57.3
0.13	2.1	2.1	2.1	2.5	ZV318S_K303_0680 EZ301U	6.3	15	180	67.73	0.17	0.16	0.27	83	42	21	61	3	18	57.3
0.13	3.6	3.8	3.5	1.5	ZV318S_K303_0680 EZ302U	11	15	310	67.73	0.17	0.16	0.27	83	42	21	61	3	18	57.3
0.13	4.7	5.0	4.6	1.1	ZV318S_K303_0680 EZ303U	11	15	310	67.73	0.17	0.16	0.27	83	42	21	61	3	18	57.3
0.14	2.1	2.1	2.6	2.6	ZV318S_K303_0660 EZ301U	6.2	15	180	66.35	0.17	0.16	0.27	83	42	21	61	3	18	57.3
0.14	3.5	3.7	4.4	1.5	ZV318S_K303_0660 EZ302U	11	15	310	66.35	0.17	0.16	0.27	83	42	21	61	3	18	57.3
0.14	4.6	4.8	5.8	1.2	ZV318S_K303_0660 EZ303U	11	15	310	66.35	0.17	0.16	0.27	83	42	21	61	3	18	57.3
0.16	5.3	5.7	7.7	1.0	ZV318S_K302_0560 EZ401U	11	18	310	55.71	0.21	0.19	0.32	83	33	12	61	3	18	57.3
0.17	1.7	1.7	2.4	3.1	ZV318S_K303_0550 EZ301U	5.1	12	150	54.58	0.21	0.19	0.33	83	42	21	61	3	18	57.3
0.17	2.9	3.1	4.1	1.8	ZV318S_K303_0550 EZ302U	9.1	12	260	54.58	0.21	0.19	0.33	83	42	21	61	3	18	57.3
0.17	3.8	4.0	5.3	1.4	ZV318S_K303_0550 EZ303U	9.8	12	280	54.58	0.21	0.19	0.33	83	42	21	61	3	18	57.3
0.17	5.1	5.5	7.1	1.0	ZV318S_K303_0550 EZ401U	9.8	12	280	54.58	0.21	0.19	0.33	83	42	21	61	3	18	57.3
0.18	1.6	1.6	4.3	3.4	ZV318S_K302_0500 EZ301U	4.8	7.5	140	50.49	0.23	0.21	0.36	83	33	12	61	3	18	57.3
0.18	2.7	2.9	7.3	2.0	ZV318S_K302_0500 EZ302U	6.0	7.5	170	50.49	0.23	0.21	0.36	83	33	12	61	3	18	57.3
0.18	3.5	3.7	9.6	1.5	ZV318S_K302_0500 EZ303U	6.0	7.5	170	50.49	0.23	0.21	0.36	83	33	12	61	3	18	57.3
0.18	1.5	1.6	2.6	3.5	ZV318S_K303_0490 EZ301U	4.6	11	130	49.26	0.23	0.21	0.37	83	42	21	61	3	18	57.3
0.18	2.6	2.8	4.5	2.0	ZV318S_K303_0490 EZ302U	8.2	11	240	49.26	0.23	0.21	0.37	83	42	21	61	3	18	57.3
0.18	3.4	3.6	5.8	1.6	ZV318S_K303_0490 EZ303U	8.8	11	250	49.26	0.23	0.21	0.37	83	42	21	61	3	18	57.3
0.18	4.6	4.9	7.8	1.2	ZV318S_K303_0490 EZ401U	8.8	11	250	49.26	0.23	0.21	0.37	83	42	21	61	3	18	57.3
0.20	4.4	4.7	5.7	1.2	ZV318S_K302_0460 EZ401U	11	24	310	46.23	0.25	0.23	0.39	83	33	12	61	3	18	57.3
0.22	3.8	4.1	9.8	1.4	ZV318S_K302_0410 EZ401U	8.1	13	230	40.51	0.28	0.26	0.44	83	33	12	61	3	18	57.3
0.25	5.1	5.6	8.2	1.0	ZV318S_K303_0360 EZ501U	11	22	310	35.83	0.32	0.29	0.50	83	42	21	61	3	18	57.3
0.26	3.3	3.5	5.5	1.6	ZV318S_K302_0350 EZ401U	10	24	290	34.73	0.33	0.30	0.52	83	33	12	61	3	18	57.3
0.26	5.1	5.5	8.4	1.1	ZV318S_K302_0350 EZ501U	11	24	310	34.73	0.33	0.30	0.52	83	33	12	61	3	18	57.3
0.27	3.2	3.4	7.2	1.7	ZV318S_K302_0340 EZ401U	9.7	17	280	33.62	0.34	0.31	0.54	83	33	12	61	3	18	57.3
0.27	4.9	5.3	11	1.1	ZV318S_K302_0340 EZ501U	10	17	300	33.62	0.34	0.31	0.54	83	33	12	61	3	18	57.3
0.28	4.7	5.1	8.3	1.1	ZV318S_K303_0330 EZ501U	11	20	310	32.65	0.35	0.32	0.55	83	42	21	61	3	18	57.3
0.32	2.6	2.8	5.6	2.0	ZV318S_K302_0280 EZ401U	8.0	24	230	27.88	0.41	0.38	0.65	83	33	12	61	3	18	57.3
0.32	4.1	4.4	8.5	1.3	ZV318S_K302_0280 EZ501U	11	24	310	27.88	0.41	0.38	0.65	83	33	12	61	3	18	57.3
0.32	4.4	4.9	9.3	1.2	ZV318S_K302_0280 EZ402U	11	24	310	27.88	0.41	0.38	0.65	83	33	12	61	3	18	57.3
0.36	2.4	2.6	5.6	2.2	ZV318S_K302_0250 EZ401U	7.3	21	210	25.26	0.45	0.42	0.71	83	33	12	61	3	18	57.3
0.36	3.7	4.0	8.6	1.4	ZV318S_K302_0250 EZ501U	11	21	310	25.26	0.45	0.42	0.71	83	33	12	61	3	18	57.3
0.36	4.0	4.4	9.4	1.3	ZV318S_K302_0250 EZ402U	11	21	310	25.26	0.45	0.42	0.71	83	33	12	61	3	18	57.3
0.39	2.2	2.4	5.6	2.4	ZV318S_K302_0230 EZ401U	6.7	23	190	23.29	0.49	0.45	0.77	83	33	12	61	3	18	57.3
0.39	3.4	3.7	8.7	1.6	ZV318S_K302_0230 EZ501U	11	23	310	23.29	0.49	0.45	0.77	83	33	12	61	3	18	57.3
0.39	3.7	4.1	9.5	1.4	ZV318S_K302_0230 EZ402U	11	23	310	23.29	0.49	0.45	0.77	83	33	12	61	3	18	57.3
0.44	1.9	2.1	5.7	2.8	ZV318S_K302_0200 EZ401U	5.8	18	170	20.28	0.56	0.52	0.89	83	33	12	61	3	18	57.3
0.44	3.0	3.2	8.8	1.8	ZV318S_K302_0200 EZ501U	11	18	310	20.28	0.56	0.52	0.89	83	33	12	61	3	18	57.3
0.44	3.2	3.6	9.6	1.7	ZV318S_K302_0200 EZ402U	11	18	310	20.28	0.56	0.52	0.89	83	33	12	61	3	18	57.3
0.44	4.7	5.9	14	1.1	ZV318S_K302_0200 EZ404U	11	18	310	20.28	0.56	0.52	0.89	83	33	12	61	3	18	57.3

v_{f2N}	F_{f2N}	$F_{f2,0}$	a_{th}	S	Type	F_{f2accE}	$F_{f2NOT,E}$	M_{2accE}	i	$v_{f2maxDB}$		$v_{f2maxZB}$	Δs	Δs_{redII}	Δs_{redI}	C_{lin}	m_n	z	d_0
										EL1,2	EL3,4,5,6								
[m/s]	[kN]	[kN]				[kN]	[kN]	[Nm]		[m/s]	[m/s]	[m/s]	[µm]	[µm]	[µm]	[N/µm]	[mm]		[mm]
ZV3K3 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 11 kN)																			
0.44	5.1	5.5	15	1.0	ZV318S_K302_0200 EZ502U	11	18	310	20.28	0.56	0.52	0.89	83	33	12	61	3	18	57.3
0.44	5.1	5.7	15	1.0	ZV318S_K302_0200 EZ701U	11	24	310	20.28	0.56	0.52	0.89	83	33	12	61	3	18	57.3
0.52	1.6	1.8	5.8	3.2	ZV318S_K302_0175 EZ401U	5.0	18	140	17.29	0.61	0.54	0.87	83	33	12	61	3	18	57.3
0.52	2.5	2.8	8.9	2.1	ZV318S_K302_0175 EZ501U	9.4	18	270	17.29	0.61	0.54	0.87	83	33	12	61	3	18	57.3
0.52	2.8	3.0	9.7	1.9	ZV318S_K302_0175 EZ402U	9.4	18	270	17.29	0.61	0.54	0.87	83	33	12	61	3	18	57.3
0.52	4.0	5.0	14	1.3	ZV318S_K302_0175 EZ404U	11	18	310	17.29	0.61	0.54	0.87	83	33	12	61	3	18	57.3
0.52	4.3	4.7	15	1.2	ZV318S_K302_0175 EZ502U	11	18	310	17.29	0.61	0.54	0.87	83	33	12	61	3	18	57.3
0.52	4.3	4.9	15	1.2	ZV318S_K302_0175 EZ701U	11	24	310	17.29	0.61	0.54	0.87	83	33	12	61	3	18	57.3
0.53	1.6	1.7	5.8	3.3	ZV318S_K302_0170 EZ401U	4.9	16	140	16.94	0.67	0.62	1.06	83	33	12	61	3	18	57.3
0.53	2.5	2.7	8.9	2.2	ZV318S_K302_0170 EZ501U	9.2	16	260	16.94	0.67	0.62	1.06	83	33	12	61	3	18	57.3
0.53	2.7	3.0	9.7	2.0	ZV318S_K302_0170 EZ402U	9.2	16	260	16.94	0.67	0.62	1.06	83	33	12	61	3	18	57.3
0.53	4.0	4.9	14	1.3	ZV318S_K302_0170 EZ404U	11	16	310	16.94	0.67	0.62	1.06	83	33	12	61	3	18	57.3
0.53	4.2	4.6	15	1.3	ZV318S_K302_0170 EZ502U	11	16	310	16.94	0.67	0.62	1.06	83	33	12	61	3	18	57.3
0.53	4.2	4.8	15	1.3	ZV318S_K302_0170 EZ701U	11	24	310	16.94	0.67	0.62	1.06	83	33	12	61	3	18	57.3
0.65	1.3	1.4	5.9	4.0	ZV318S_K302_0140 EZ401U	4.0	14	110	13.94	0.75	0.67	1.08	83	33	12	61	3	18	57.3
0.65	2.0	2.2	9.0	2.6	ZV318S_K302_0140 EZ501U	7.5	14	220	13.94	0.75	0.67	1.08	83	33	12	61	3	18	57.3
0.65	2.2	2.5	9.9	2.4	ZV318S_K302_0140 EZ402U	7.5	14	220	13.94	0.75	0.67	1.08	83	33	12	61	3	18	57.3
0.65	3.3	4.1	15	1.6	ZV318S_K302_0140 EZ404U	11	14	310	13.94	0.75	0.67	1.08	83	33	12	61	3	18	57.3
0.65	3.5	3.8	16	1.5	ZV318S_K302_0140 EZ502U	11	14	310	13.94	0.75	0.67	1.08	83	33	12	61	3	18	57.3
0.65	3.5	3.9	16	1.5	ZV318S_K302_0140 EZ701U	9.4	24	270	13.94	0.75	0.67	1.08	83	33	12	61	3	18	57.3
0.65	4.6	5.2	20	1.2	ZV318S_K302_0140 EZ503U	11	14	310	13.94	0.75	0.67	1.08	83	33	12	61	3	18	57.3
0.72	1.2	1.3	5.9	4.5	ZV318S_K302_0125 EZ401U	3.6	13	100	12.58	0.84	0.74	1.19	83	33	12	61	3	18	57.3
0.72	1.8	2.0	9.1	2.9	ZV318S_K302_0125 EZ501U	6.8	13	200	12.58	0.84	0.74	1.19	83	33	12	61	3	18	57.3
0.72	2.0	2.2	10	2.7	ZV318S_K302_0125 EZ402U	6.8	13	200	12.58	0.84	0.74	1.19	83	33	12	61	3	18	57.3
0.72	2.9	3.7	15	1.8	ZV318S_K302_0125 EZ404U	10	13	290	12.58	0.84	0.74	1.19	83	33	12	61	3	18	57.3
0.72	3.2	3.4	16	1.7	ZV318S_K302_0125 EZ502U	10	13	290	12.58	0.84	0.74	1.19	83	33	12	61	3	18	57.3
0.72	3.2	3.5	16	1.7	ZV318S_K302_0125 EZ701U	8.5	24	240	12.58	0.84	0.74	1.19	83	33	12	61	3	18	57.3
0.72	4.1	4.7	21	1.3	ZV318S_K302_0125 EZ503U	10	13	290	12.58	0.84	0.74	1.19	83	33	12	61	3	18	57.3
0.72	5.1	6.1	25	1.0	ZV318S_K302_0125 EZ702U	11	24	310	12.58	0.84	0.74	1.19	83	33	12	61	3	18	57.3
0.78	1.1	1.2	6.0	4.8	ZV318S_K302_0115 EZ401U	3.3	12	96	11.61	0.83	0.72	1.16	83	33	12	61	3	18	57.3
0.78	1.7	1.8	9.2	3.2	ZV318S_K302_0115 EZ501U	6.3	12	180	11.61	0.83	0.72	1.16	83	33	12	61	3	18	57.3
0.78	1.8	2.0	10	2.9	ZV318S_K302_0115 EZ402U	6.3	12	180	11.61	0.83	0.72	1.16	83	33	12	61	3	18	57.3
0.78	2.7	3.4	15	2.0	ZV318S_K302_0115 EZ404U	9.4	12	270	11.61	0.83	0.72	1.16	83	33	12	61	3	18	57.3
0.78	2.9	3.1	16	1.8	ZV318S_K302_0115 EZ502U	9.4	12	270	11.61	0.83	0.72	1.16	83	33	12	61	3	18	57.3
0.78	2.9	3.3	16	1.8	ZV318S_K302_0115 EZ701U	7.9	24	230	11.61	0.83	0.72	1.16	83	33	12	61	3	18	57.3
0.78	3.8	4.4	21	1.4	ZV318S_K302_0115 EZ503U	9.4	12	270	11.61	0.83	0.72	1.16	83	33	12	61	3	18	57.3
0.78	4.7	5.7	26	1.1	ZV318S_K302_0115 EZ702U	11	24	310	11.61	0.83	0.72	1.16	83	33	12	61	3	18	57.3
0.78	5.3	6.3	29	1.0	ZV318S_K302_0115 EZ505U	11	24	310	11.61	0.83	0.72	1.16	83	33	12	61	3	18	57.3
0.89	1.5	1.6	9.3	3.6	ZV318S_K302_0100 EZ501U	5.5	10	160	10.14	1.04	0.92	1.48	83	33	12	61	3	18	57.3
0.89	1.6	1.8	10	3.3	ZV318S_K302_0100 EZ402U	5.5	10	160	10.14	1.04	0.92	1.48	83	33	12	61	3	18	57.3
0.89	2.4	3.0	15	2.2	ZV318S_K302_0100 EZ404U	8.2	10	240	10.14	1.04	0.92	1.48	83	33	12	61	3	18	57.3
0.89	2.5	2.7	16	2.1	ZV318S_K302_0100 EZ502U	8.2	10	240	10.14	1.04	0.92	1.48	83	33	12	61	3	18	57.3
0.89	2.5	2.8	16	2.1	ZV318S_K302_0100 EZ701U	6.9	24	200	10.14	1.04	0.92	1.48	83	33	12	61	3	18	57.3
0.89	3.3	3.8	21	1.6	ZV318S_K302_0100 EZ503U	8.2	10	240	10.14	1.04	0.92	1.48	83	33	12	61	3	18	57.3
0.89	4.1	4.9	26	1.3	ZV318S_K302_0100 EZ702U	11	24	310	10.14	1.04	0.92	1.48	83	33	12	61	3	18	57.3
0.89	4.6	5.5	29	1.1	ZV318S_K302_0100 EZ505U	11	24	310	10.14	1.04	0.92	1.48	83	33	12	61	3	18	57.3
0.97	2.3	2.6	16	2.2	ZV318S_K302_0093 EZ701U	6.3	24	180	9.267	1.04	0.91	1.46	83	33	12	61	3	18	57.3
0.97	3.8	4.5	26	1.4	ZV318S_K302_0093 EZ702U	11	24	310	9.267	1.04	0.91	1.46	83	33	12	61	3	18	57.3
0.97	4.2	5.0	29	1.2	ZV318S_K302_0093 EZ505U	11	24	310	9.267	1.04	0.91	1.46	83	33	12	61	3	18	57.3
1.07	1.2	1.3	9.9	4.0	ZV318S_K302_0084 EZ501U	4.6	8.6	130	8.444	1.14	1.00	1.60	83	33	12	61	3	18	57.3
1.07	1.3	1.5	11	3.7	ZV318S_K302_0084 EZ402U	4.6	8.6	130	8.444	1.14	1.00	1.60	83	33	12	61	3	18	57.3
1.07	2.0	2.5	16	2.5	ZV318S_K302_0084 EZ404U	6.9	8.6	200	8.444	1.14	1.00	1.60	83	33	12	61	3	18	57.3
1.07	2.1	2.3	17	2.3	ZV318S_K302_0084 EZ502U	6.9	8.6	200	8.444	1.14	1.00	1.60	83	33	12	61	3	18	57.3
1.07	2.1	2.4	16	2.3	ZV318S_K302_0084 EZ701U	5.7	21	160	8.444	1.14	1.00	1.60	83	33	12	61	3	18	57.3
1.07	2.8	3.2	22	1.8	ZV318S_K302_0084 EZ503U	6.9	8.6	200	8.444	1.14	1.00	1.60	83	33	12	61	3	18	57.3
1.07	3.4	4.1	26	1.4	ZV318S_K302_0084 EZ702U	11	21	310	8.444	1.14	1.00	1.60	83	33	12	61	3	18	57.3
1.07	3.9	4.6	30	1.3	ZV318S_K302_0084 EZ505U	11	21	310	8.444	1.14	1.00	1.60	83	33	12	61	3	18	57.3
1.07	4.7	5.9	36	1.1	ZV318S_K302_0084 EZ703U	11	21	310	8.444	1.14	1.00	1.60	83	33	12	61	3	18	57.3
1.22	1.9	2.1	16	2.6	ZV318S_K302_0074 EZ701U	5.0	19	140	7.391	1.10	0.93	1.62	83	33	12	61	3	18	57.3
1.22	3.0	3.6	27	1.6	ZV318S_K302_0074 EZ702U	10	19	290	7.391	1.10	0.93	1.62	83	33	12	61	3	18	57.3
1.22	3.4	4.0	30	1.4	ZV318S_K302_0074 EZ505U	11	19	310	7.391	1.10	0.93	1.62	83	33	12	61	3	18	57.3
1.22	4.1	5.2	37	1.1	ZV318S_K302_0074 EZ703U	11	19	310	7.391	1.10	0.93	1.62	83	33	12	61	3	18	57.3
1.34	1.7	1.9	17	2.7	ZV318S_K302_0067 EZ701U	4.6	17	130	6.740	1.42	1.25	2.00	83	33	12	61	3	18	57.3
1.34	2.7	3.3	27	1.7	ZV318S_K302_0067 EZ702U	9.4	17	270	6.740	1.42	1.25	2.00	83	33	12	61	3	18	57.3

v_{f2N}	F_{f2N}	$F_{f2,0}$	a_{th}	S	Type	F_{f2accE}	$F_{f2NOT,E}$	M_{2accE}	i	$v_{f2maxDB}$		$v_{f2maxZB}$	Δs	Δs_{redII}	Δs_{redI}	C_{lin}	m_n	z	d_0
										EL1,2	EL3,4,5,6								
[m/s]	[kN]	[kN]				[kN]	[kN]	[Nm]		[m/s]	[m/s]	[m/s]	[µm]	[µm]	[µm]	[N/µm]	[mm]		[mm]
ZV3K3 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 11 kN)																			
1.34	3.1	3.7	30	1.5	ZV318S_K302_0067 EZ505U	11	17	310	6.740	1.42	1.25	2.00	83	33	12	61	3	18	57.3
1.34	3.8	4.7	37	1.2	ZV318S_K302_0067 EZ703U	11	17	310	6.740	1.42	1.25	2.00	83	33	12	61	3	18	57.3
1.50	1.5	1.7	17	2.9	ZV318S_K302_0060 EZ701U	4.1	15	120	6.000	1.35	1.15	2.00	83	33	12	61	3	18	57.3
1.50	2.4	2.9	27	1.8	ZV318S_K302_0060 EZ702U	8.3	15	240	6.000	1.35	1.15	2.00	83	33	12	61	3	18	57.3
1.50	2.7	3.3	30	1.6	ZV318S_K302_0060 EZ505U	11	15	310	6.000	1.35	1.15	2.00	83	33	12	61	3	18	57.3
1.50	3.4	4.2	37	1.3	ZV318S_K302_0060 EZ703U	11	15	310	6.000	1.35	1.15	2.00	83	33	12	61	3	18	57.3
1.50	4.3	6.1	48	1.0	ZV318S_K302_0060 EZ705U	11	24	310	6.000	1.35	1.15	2.00	83	33	12	61	3	18	57.3
1.67	1.3	1.5	17	3.2	ZV318S_K302_0054 EZ701U	3.6	14	100	5.375	1.51	1.28	2.23	83	33	12	61	3	18	57.3
1.67	2.2	2.6	27	2.0	ZV318S_K302_0054 EZ702U	7.5	14	210	5.375	1.51	1.28	2.23	83	33	12	61	3	18	57.3
1.67	2.5	2.9	31	1.7	ZV318S_K302_0054 EZ505U	11	14	310	5.375	1.51	1.28	2.23	83	33	12	61	3	18	57.3
1.67	3.0	3.8	38	1.4	ZV318S_K302_0054 EZ703U	11	14	310	5.375	1.51	1.28	2.23	83	33	12	61	3	18	57.3
2.06	1.1	1.2	17	3.6	ZV318S_K302_0044 EZ701U	3.0	11	85	4.364	1.86	1.58	2.75	83	33	12	61	3	18	57.3
2.06	1.8	2.1	28	2.2	ZV318S_K302_0044 EZ702U	6.1	11	170	4.364	1.86	1.58	2.75	83	33	12	61	3	18	57.3
2.06	2.0	2.4	31	2.0	ZV318S_K302_0044 EZ505U	8.9	11	250	4.364	1.86	1.58	2.75	83	33	12	61	3	18	57.3
2.06	2.4	3.1	38	1.6	ZV318S_K302_0044 EZ703U	8.9	11	250	4.364	1.86	1.58	2.75	83	33	12	61	3	18	57.3
2.06	3.1	4.5	49	1.3	ZV318S_K302_0044 EZ705U	11	24	310	4.364	1.86	1.58	2.75	83	33	12	61	3	18	57.3
2.25	1.0	1.1	17	3.9	ZV318S_K302_0040 EZ701U	2.7	10	78	4.000	2.03	1.73	3.00	83	33	12	61	3	18	57.3
2.25	1.6	2.0	28	2.4	ZV318S_K302_0040 EZ702U	5.6	10	160	4.000	2.03	1.73	3.00	83	33	12	61	3	18	57.3
2.25	1.8	2.2	31	2.1	ZV318S_K302_0040 EZ505U	8.1	10	230	4.000	2.03	1.73	3.00	83	33	12	61	3	18	57.3
2.25	2.2	2.8	38	1.7	ZV318S_K302_0040 EZ703U	8.1	10	230	4.000	2.03	1.73	3.00	83	33	12	61	3	18	57.3
2.25	2.9	4.1	50	1.3	ZV318S_K302_0040 EZ705U	11	24	310	4.000	2.03	1.73	3.00	83	33	12	61	3	18	57.3
ZV3K3 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 11 kN)																			
0.97	4.5	7.2	23	1.1	ZV318S_K302_0140 EZ505U	11	24	310	13.94	0.75	0.67	1.08	83	33	12	61	3	18	57.3
1.07	4.0	6.5	23	1.2	ZV318S_K302_0125 EZ505U	11	24	310	12.58	0.84	0.74	1.19	83	33	12	61	3	18	57.3
1.16	3.7	6.0	23	1.3	ZV318S_K302_0115 EZ505U	11	24	310	11.61	0.83	0.72	1.16	83	33	12	61	3	18	57.3
1.16	4.8	7.9	30	1.0	ZV318S_K302_0115 EZ703U	11	24	310	11.61	0.83	0.72	1.16	83	33	12	61	3	18	57.3
1.33	3.3	5.3	23	1.4	ZV318S_K302_0100 EZ505U	11	24	310	10.14	1.04	0.92	1.48	83	33	12	61	3	18	57.3
1.33	4.2	6.9	30	1.1	ZV318S_K302_0100 EZ703U	11	24	310	10.14	1.04	0.92	1.48	83	33	12	61	3	18	57.3
1.46	3.0	4.8	24	1.5	ZV318S_K302_0093 EZ505U	11	24	310	9.267	1.04	0.91	1.46	83	33	12	61	3	18	57.3
1.46	3.8	6.3	30	1.2	ZV318S_K302_0093 EZ703U	11	24	310	9.267	1.04	0.91	1.46	83	33	12	61	3	18	57.3
1.60	2.7	4.4	24	1.6	ZV318S_K302_0084 EZ505U	11	21	310	8.444	1.14	1.00	1.60	83	33	12	61	3	18	57.3
1.60	3.5	5.7	30	1.3	ZV318S_K302_0084 EZ703U	11	21	310	8.444	1.14	1.00	1.60	83	33	12	61	3	18	57.3
2.00	2.2	3.5	24	1.9	ZV318S_K302_0067 EZ505U	11	17	310	6.740	1.42	1.25	2.00	83	33	12	61	3	18	57.3
2.00	2.8	4.6	31	1.5	ZV318S_K302_0067 EZ703U	11	17	310	6.740	1.42	1.25	2.00	83	33	12	61	3	18	57.3
ZV3K3 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 11 kN)																			
0.13	4.0	4.3	2.5	1.3	ZV318S_K303_1360 EZ301U	11	24	310	136.0	0.08	0.08	0.13	83	42	21	61	3	18	57.3
0.17	3.2	3.5	2.4	1.6	ZV318S_K303_1090 EZ301U	10	24	290	109.2	0.10	0.10	0.17	83	42	21	61	3	18	57.3
0.20	2.7	2.9	2.5	2.0	ZV318S_K303_0910 EZ301U	8.5	20	240	91.23	0.13	0.12	0.20	83	42	21	61	3	18	57.3
0.20	4.6	5.1	4.2	1.2	ZV318S_K303_0910 EZ302U	11	20	310	91.23	0.13	0.12	0.20	83	42	21	61	3	18	57.3
0.23	2.4	2.5	3.1	2.3	ZV318S_K303_0790 EZ301U	7.4	18	210	79.42	0.14	0.13	0.23	83	42	21	61	3	18	57.3
0.23	4.0	4.5	5.2	1.3	ZV318S_K303_0790 EZ302U	11	18	310	79.42	0.14	0.13	0.23	83	42	21	61	3	18	57.3
0.23	5.2	6.0	6.8	1.0	ZV318S_K303_0790 EZ303U	11	18	310	79.42	0.14	0.13	0.23	83	42	21	61	3	18	57.3
0.26	2.1	2.2	3.2	2.5	ZV318S_K302_0690 EZ301U	6.6	10	190	69.43	0.16	0.15	0.26	83	33	12	61	3	18	57.3
0.26	3.5	3.9	5.5	1.5	ZV318S_K302_0690 EZ302U	8.3	10	240	69.43	0.16	0.15	0.26	83	33	12	61	3	18	57.3
0.26	4.6	5.3	7.1	1.2	ZV318S_K302_0690 EZ303U	8.3	10	240	69.43	0.16	0.15	0.26	83	33	12	61	3	18	57.3
0.27	2.0	2.1	2.5	2.6	ZV318S_K303_0680 EZ301U	6.3	15	180	67.73	0.17	0.16	0.27	83	42	21	61	3	18	57.3
0.27	3.4	3.8	4.2	1.6	ZV318S_K303_0680 EZ302U	11	15	310	67.73	0.17	0.16	0.27	83	42	21	61	3	18	57.3
0.27	4.4	5.1	5.4	1.2	ZV318S_K303_0680 EZ303U	11	15	310	67.73	0.17	0.16	0.27	83	42	21	61	3	18	57.3
0.27	5.2	6.3	6.4	1.0	ZV318S_K303_0680 EZ401U	11	15	310	67.73	0.17	0.16	0.27	83	42	21	61	3	18	57.3
0.27	2.0	2.1	3.1	2.7	ZV318S_K303_0660 EZ301U	6.2	15	180	66.35	0.17	0.16	0.27	83	42	21	61	3	18	57.3
0.27	3.3	3.7	5.3	1.6	ZV318S_K303_0660 EZ302U	11	15	310	66.35	0.17	0.16	0.27	83	42	21	61	3	18	57.3
0.27	4.3	5.0	6.9	1.2	ZV318S_K303_0660 EZ303U	11	15	310	66.35	0.17	0.16	0.27	83	42	21	61	3	18	57.3
0.27	5.1	6.2	8.1	1.0	ZV318S_K303_0660 EZ401U	11	15	310	66.35	0.17	0.16	0.27	83	42	21	61	3	18	57.3
0.32	4.3	5.3	6.3	1.2	ZV318S_K302_0560 EZ401U	11	18	310	55.71	0.21	0.19	0.32	83	33	12	61	3	18	57.3
0.33	1.6	1.7	2.5	3.3	ZV318S_K303_0550 EZ301U	5.1	12	150	54.58	0.21	0.19	0.33	83	42	21	61	3	18	57.3
0.33	2.7	3.1	4.2	1.9	ZV318S_K303_0550 EZ302U	9.1	12	260	54.58	0.21	0.19	0.33	83	42	21	61	3	18	57.3
0.33	3.6	4.1	5.5	1.5	ZV318S_K303_0550 EZ303U	9.8	12	280	54.58	0.21	0.19	0.33	83	42	21	61	3	18	57.3
0.33	4.2	5.1	6.5	1.3	ZV318S_K303_0550 EZ401U	9.8	12	280	54.58	0.21	0.19	0.33	83	42	21	61	3	18	57.3
0.36	1.5	1.6	4.1	3.5	ZV318S_K302_0500 EZ301U	4.8	7.5	140	50.49	0.23	0.21	0.36	83	33	12	61	3	18	57.3
0.36	2.6	2.9	6.9	2.1	ZV318S_K302_0500 EZ302U	6.0	7.5	170	50.49	0.23	0.21	0.36	83	33	12	61	3	18	57.3
0.36	3.4	3.8	9.1	1.6	ZV318S_K302_0500 EZ303U	6.0	7.5	170	50.49	0.23	0.21	0.36	83	33	12	61	3	18	57.3
0.37	1.5	1.6	3.1	3.6	ZV318S_K303_0490 EZ301U	4.6	11	130	49.26	0.23	0.21	0.37	83	42	21	61	3	18	57.3
0.37	2.5	2.8	5.3	2.2	ZV318S_K303_0490 EZ302U	8.2	11	240	49.26	0.23	0.21	0.37	83	42	21	61	3	18	57.3
0.37	3.2	3.7	6.9	1.7	ZV318S_K303_0490 EZ303U	8.8	11	250	49.26	0.23	0.21	0.37	83	42	21	61	3	18	57.3

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ EL1,2 [m/s]	$v_{f2maxDB}$ EL3,4,5,6 [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{redII} [µm]	Δs_{redI} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV3K3 (n_{1N} = 6000 rpm, ($F_{f2acc,max}$ = 11 kN)																			
0.37	3.8	4.6	8.1	1.4	ZV318S_K303_0490 EZ401U	8.8	11	250	49.26	0.23	0.21	0.37	83	42	21	61	3	18	57.3
0.39	3.6	4.4	5.5	1.5	ZV318S_K302_0460 EZ401U	11	24	310	46.23	0.25	0.23	0.39	83	33	12	61	3	18	57.3
0.39	5.3	6.9	8.2	1.0	ZV318S_K302_0460 EZ501U	11	24	310	46.23	0.25	0.23	0.39	83	33	12	61	3	18	57.3
0.40	5.1	6.6	8.1	1.0	ZV318S_K303_0450 EZ501U	11	24	310	44.89	0.25	0.23	0.40	83	42	21	61	3	18	57.3
0.44	3.2	3.8	8.0	1.7	ZV318S_K302_0410 EZ401U	8.1	13	230	40.51	0.28	0.26	0.44	83	33	12	61	3	18	57.3
0.44	4.7	6.0	12	1.1	ZV318S_K302_0410 EZ501U	8.1	13	230	40.51	0.28	0.26	0.44	83	33	12	61	3	18	57.3
0.46	4.4	5.8	8.1	1.2	ZV318S_K303_0390 EZ501U	11	24	310	39.19	0.29	0.27	0.46	83	42	21	61	3	18	57.3
0.50	4.1	5.3	8.2	1.3	ZV318S_K303_0360 EZ501U	11	22	310	35.83	0.32	0.29	0.50	83	42	21	61	3	18	57.3
0.52	2.7	3.3	5.6	2.0	ZV318S_K302_0350 EZ401U	10	24	290	34.73	0.33	0.30	0.52	83	33	12	61	3	18	57.3
0.52	4.0	5.2	8.3	1.3	ZV318S_K302_0350 EZ501U	11	24	310	34.73	0.33	0.30	0.52	83	33	12	61	3	18	57.3
0.52	4.1	5.8	8.6	1.3	ZV318S_K302_0350 EZ402U	11	24	310	34.73	0.33	0.30	0.52	83	33	12	61	3	18	57.3
0.54	2.6	3.2	5.9	2.0	ZV318S_K302_0340 EZ401U	9.7	17	280	33.62	0.34	0.31	0.54	83	33	12	61	3	18	57.3
0.54	3.9	5.0	8.7	1.4	ZV318S_K302_0340 EZ501U	10	17	300	33.62	0.34	0.31	0.54	83	33	12	61	3	18	57.3
0.54	4.0	5.6	9.0	1.3	ZV318S_K302_0340 EZ402U	10	17	300	33.62	0.34	0.31	0.54	83	33	12	61	3	18	57.3
0.55	3.7	4.8	8.3	1.4	ZV318S_K303_0330 EZ501U	11	20	310	32.65	0.35	0.32	0.55	83	42	21	61	3	18	57.3
0.65	2.2	2.6	5.8	2.5	ZV318S_K302_0280 EZ401U	8.0	24	230	27.88	0.41	0.38	0.65	83	33	12	61	3	18	57.3
0.65	3.2	4.2	8.5	1.7	ZV318S_K302_0280 EZ501U	11	24	310	27.88	0.41	0.38	0.65	83	33	12	61	3	18	57.3
0.65	3.3	4.6	8.8	1.6	ZV318S_K302_0280 EZ402U	11	24	310	27.88	0.41	0.38	0.65	83	33	12	61	3	18	57.3
0.65	4.9	7.4	13	1.1	ZV318S_K302_0280 EZ502U	11	24	310	27.88	0.41	0.38	0.65	83	33	12	61	3	18	57.3
0.65	4.9	7.5	13	1.1	ZV318S_K302_0280 EZ701U	11	24	310	27.88	0.41	0.38	0.65	83	33	12	61	3	18	57.3
0.71	2.0	2.4	5.8	2.7	ZV318S_K302_0250 EZ401U	7.3	21	210	25.26	0.45	0.42	0.71	83	33	12	61	3	18	57.3
0.71	2.9	3.8	8.6	1.8	ZV318S_K302_0250 EZ501U	11	21	310	25.26	0.45	0.42	0.71	83	33	12	61	3	18	57.3
0.71	3.0	4.2	8.8	1.8	ZV318S_K302_0250 EZ402U	11	21	310	25.26	0.45	0.42	0.71	83	33	12	61	3	18	57.3
0.71	4.4	6.7	13	1.2	ZV318S_K302_0250 EZ502U	11	21	310	25.26	0.45	0.42	0.71	83	33	12	61	3	18	57.3
0.71	4.4	6.8	13	1.2	ZV318S_K302_0250 EZ701U	11	21	310	25.26	0.45	0.42	0.71	83	33	12	61	3	18	57.3
0.71	5.0	7.2	15	1.1	ZV318S_K302_0250 EZ404U	11	21	310	25.26	0.45	0.42	0.71	83	33	12	61	3	18	57.3
0.77	1.8	2.2	5.8	2.9	ZV318S_K302_0230 EZ401U	6.7	23	190	23.29	0.49	0.45	0.77	83	33	12	61	3	18	57.3
0.77	2.7	3.5	8.6	2.0	ZV318S_K302_0230 EZ501U	11	23	310	23.29	0.49	0.45	0.77	83	33	12	61	3	18	57.3
0.77	2.8	3.9	8.9	1.9	ZV318S_K302_0230 EZ402U	11	23	310	23.29	0.49	0.45	0.77	83	33	12	61	3	18	57.3
0.77	4.1	6.2	13	1.3	ZV318S_K302_0230 EZ502U	11	23	310	23.29	0.49	0.45	0.77	83	33	12	61	3	18	57.3
0.77	4.1	6.2	13	1.3	ZV318S_K302_0230 EZ701U	11	24	310	23.29	0.49	0.45	0.77	83	33	12	61	3	18	57.3
0.77	4.6	6.6	15	1.2	ZV318S_K302_0230 EZ404U	11	23	310	23.29	0.49	0.45	0.77	83	33	12	61	3	18	57.3
0.89	1.6	1.9	5.9	3.3	ZV318S_K302_0200 EZ401U	5.8	18	170	20.28	0.56	0.52	0.89	83	33	12	61	3	18	57.3
0.89	2.3	3.0	8.7	2.3	ZV318S_K302_0200 EZ501U	11	18	310	20.28	0.56	0.52	0.89	83	33	12	61	3	18	57.3
0.89	2.4	3.4	9.0	2.2	ZV318S_K302_0200 EZ402U	11	18	310	20.28	0.56	0.52	0.89	83	33	12	61	3	18	57.3
0.89	3.6	5.4	13	1.5	ZV318S_K302_0200 EZ502U	11	18	310	20.28	0.56	0.52	0.89	83	33	12	61	3	18	57.3
0.89	3.6	5.4	13	1.5	ZV318S_K302_0200 EZ701U	11	24	310	20.28	0.56	0.52	0.89	83	33	12	61	3	18	57.3
0.89	4.0	5.8	15	1.3	ZV318S_K302_0200 EZ404U	11	18	310	20.28	0.56	0.52	0.89	83	33	12	61	3	18	57.3
0.89	4.3	7.3	16	1.2	ZV318S_K302_0200 EZ503U	11	18	310	20.28	0.56	0.52	0.89	83	33	12	61	3	18	57.3
1.06	1.3	1.6	6.0	3.8	ZV318S_K302_0170 EZ401U	4.9	16	140	16.94	0.67	0.62	1.06	83	33	12	61	3	18	57.3
1.06	2.0	2.5	8.9	2.5	ZV318S_K302_0170 EZ501U	9.2	16	260	16.94	0.67	0.62	1.06	83	33	12	61	3	18	57.3
1.06	2.0	2.8	9.1	2.5	ZV318S_K302_0170 EZ402U	9.2	16	260	16.94	0.67	0.62	1.06	83	33	12	61	3	18	57.3
1.06	3.0	4.5	14	1.7	ZV318S_K302_0170 EZ502U	11	16	310	16.94	0.67	0.62	1.06	83	33	12	61	3	18	57.3
1.06	3.0	4.5	14	1.7	ZV318S_K302_0170 EZ701U	11	24	310	16.94	0.67	0.62	1.06	83	33	12	61	3	18	57.3
1.06	3.3	4.8	15	1.5	ZV318S_K302_0170 EZ404U	11	16	310	16.94	0.67	0.62	1.06	83	33	12	61	3	18	57.3
1.06	3.6	6.1	16	1.4	ZV318S_K302_0170 EZ503U	11	16	310	16.94	0.67	0.62	1.06	83	33	12	61	3	18	57.3
1.06	4.1	8.2	19	1.2	ZV318S_K302_0170 EZ702U	11	24	310	16.94	0.67	0.62	1.06	83	33	12	61	3	18	57.3
ZV3K4 (n_{1N} = 2000 rpm, ($F_{f2acc,max}$ = 13 kN)																			
1.68	5.3	8.0	64	1.0	ZV322S_K402_0044 EZ805U	13	24	470	4.364	2.18	1.85	3.19	102	41	15	74	3	22	70.0
1.83	4.8	7.3	65	1.1	ZV322S_K402_0040 EZ805U	13	22	460	4.000	2.38	2.02	3.48	102	41	15	74	3	22	70.0
ZV3K4 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 15 kN)																			
0.05	5.5	5.7	2.4	1.2	ZV322S_K403_2180 EZ301U	15	24	510	218.2	0.06	0.06	0.09	102	51	25	74	3	22	70.0
0.06	4.6	4.7	2.0	1.4	ZV322S_K403_1810 EZ301U	14	28	490	181.4	0.07	0.07	0.11	102	51	25	74	3	22	70.0
0.08	3.5	3.5	2.0	1.9	ZV322S_K403_1360 EZ301U	10	23	360	136.1	0.10	0.09	0.15	102	51	25	74	3	22	70.0
0.08	5.9	6.2	3.4	1.1	ZV322S_K403_1360 EZ302U	15	23	540	136.1	0.10	0.09	0.15	102	51	25	74	3	22	70.0
0.10	2.8	2.8	2.0	2.4	ZV322S_K403_1090 EZ301U	8.3	20	290	108.8	0.12	0.11	0.19	102	51	25	74	3	22	70.0
0.10	4.7	5.0	3.3	1.4	ZV322S_K403_1090 EZ302U	15	20	520	108.8	0.12	0.11	0.19	102	51	25	74	3	22	70.0
0.10	6.1	6.5	4.4	1.1	ZV322S_K403_1090 EZ303U	15	20	540	108.8	0.12	0.11	0.19	102	51	25	74	3	22	70.0
0.12	2.3	2.4	2.0	2.9	ZV322S_K403_0910 EZ301U	7.0	17	240	91.23	0.15	0.13	0.22	102	51	25	74	3	22	70.0
0.12	4.0	4.2	3.4	1.7	ZV322S_K403_0910 EZ302U	12	17	440	91.23	0.15	0.13	0.22	102	51	25	74	3	22	70.0
0.12	5.2	5.5	4.4	1.3	ZV322S_K403_0910 EZ303U	13	17	470	91.23	0.15	0.13	0.22	102	51	25	74	3	22	70.0
0.14	2.0	2.1	2.5	3.3	ZV322S_K403_0790 EZ301U	6.0	14	210	79.11	0.17	0.15	0.26	102	51	25	74	3	22	70.0
0.14	3.4	3.6	4.2	1.9	ZV322S_K403_0790 EZ302U	11	14	380	79.11	0.17	0.15	0.26	102	51	25	74	3	22	70.0
0.14	4.5	4.7	5.5	1.5	ZV322S_K403_0790 EZ303U	12	14	410	79.11	0.17	0.15	0.26	102	51	25	74	3	22	70.0

v_{f2N}	F_{f2N}	$F_{f2,0}$	a_{th}	S	Type	F_{f2accE}	$F_{f2NOT,E}$	M_{2accE}	i	$v_{f2maxDB}$		$v_{f2maxZB}$	Δs	Δs_{redII}	Δs_{redI}	C_{lin}	m_n	z	d_0
										EL1,2	EL3,4,5,6								
[m/s]	[kN]	[kN]				[kN]	[kN]	[Nm]		[m/s]	[m/s]	[m/s]	[µm]	[µm]	[µm]	[N/µm]	[mm]		[mm]
ZV3K4 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 15 kN)																			
0.14	6.0	6.5	7.5	1.1	ZV322S_K403_0790 EZ401U	12	14	410	79.11	0.17	0.15	0.26	102	51	25	74	3	22	70.0
0.17	1.7	1.7	2.5	3.9	ZV322S_K403_0660 EZ301U	5.1	12	180	66.35	0.20	0.18	0.30	102	51	25	74	3	22	70.0
0.17	2.9	3.0	4.3	2.3	ZV322S_K403_0660 EZ302U	9.1	12	320	66.35	0.20	0.18	0.30	102	51	25	74	3	22	70.0
0.17	3.7	4.0	5.6	1.8	ZV322S_K403_0660 EZ303U	9.7	12	340	66.35	0.20	0.18	0.30	102	51	25	74	3	22	70.0
0.17	5.1	5.4	7.5	1.3	ZV322S_K403_0660 EZ401U	9.7	12	340	66.35	0.20	0.18	0.30	102	51	25	74	3	22	70.0
0.21	6.3	6.9	6.1	1.0	ZV322S_K403_0540 EZ501U	15	27	540	53.69	0.25	0.23	0.38	102	51	25	74	3	22	70.0
0.22	6.0	6.6	12	1.1	ZV322S_K402_0500 EZ501U	9.2	15	320	50.43	0.26	0.24	0.40	102	41	15	74	3	22	70.0
0.23	5.7	6.3	5.9	1.2	ZV322S_K403_0490 EZ501U	15	25	540	48.94	0.27	0.25	0.41	102	51	25	74	3	22	70.0
0.24	5.5	6.0	6.1	1.2	ZV322S_K402_0460 EZ501U	15	28	540	46.31	0.29	0.26	0.44	102	41	15	74	3	22	70.0
0.25	5.2	5.7	5.9	1.3	ZV322S_K403_0450 EZ501U	15	22	540	44.54	0.30	0.27	0.45	102	51	25	74	3	22	70.0
0.27	4.8	5.3	10	1.4	ZV322S_K402_0410 EZ501U	11	18	370	40.51	0.33	0.30	0.50	102	41	15	74	3	22	70.0
0.28	4.6	5.0	6.1	1.4	ZV322S_K403_0390 EZ501U	15	20	540	39.05	0.34	0.31	0.52	102	51	25	74	3	22	70.0
0.31	4.2	4.6	6.0	1.6	ZV322S_K403_0360 EZ501U	14	18	500	35.72	0.37	0.34	0.57	102	51	25	74	3	22	70.0
0.32	4.1	4.5	6.1	1.6	ZV322S_K402_0350 EZ501U	15	23	540	34.76	0.38	0.35	0.58	102	41	15	74	3	22	70.0
0.33	4.0	4.4	7.8	1.6	ZV322S_K402_0340 EZ501U	13	20	470	33.68	0.39	0.36	0.60	102	41	15	74	3	22	70.0
0.34	3.8	4.2	6.4	1.7	ZV322S_K403_0320 EZ501U	13	16	460	32.39	0.41	0.37	0.62	102	51	25	74	3	22	70.0
0.34	6.5	7.1	11	1.0	ZV322S_K403_0320 EZ502U	13	16	460	32.39	0.41	0.37	0.62	102	51	25	74	3	22	70.0
0.40	3.3	3.6	6.2	2.0	ZV322S_K402_0280 EZ501U	12	21	430	27.77	0.48	0.44	0.73	102	41	15	74	3	22	70.0
0.40	5.7	6.2	11	1.2	ZV322S_K402_0280 EZ502U	15	21	540	27.77	0.48	0.44	0.73	102	41	15	74	3	22	70.0
0.40	5.7	6.4	11	1.2	ZV322S_K402_0280 EZ701U	15	31	540	27.77	0.48	0.44	0.73	102	41	15	74	3	22	70.0
0.44	3.0	3.3	6.3	2.2	ZV322S_K402_0250 EZ501U	11	17	390	25.28	0.52	0.48	0.80	102	41	15	74	3	22	70.0
0.44	5.2	5.6	11	1.3	ZV322S_K402_0250 EZ502U	13	17	470	25.28	0.52	0.48	0.80	102	41	15	74	3	22	70.0
0.44	5.2	5.8	11	1.3	ZV322S_K402_0250 EZ701U	14	29	490	25.28	0.52	0.48	0.80	102	41	15	74	3	22	70.0
0.47	2.8	3.0	6.3	2.4	ZV322S_K402_0230 EZ501U	10	19	360	23.29	0.57	0.52	0.87	102	41	15	74	3	22	70.0
0.47	4.8	5.2	11	1.4	ZV322S_K402_0230 EZ502U	15	19	540	23.29	0.57	0.52	0.87	102	41	15	74	3	22	70.0
0.47	4.8	5.4	11	1.4	ZV322S_K402_0230 EZ701U	13	31	450	23.29	0.57	0.52	0.87	102	41	15	74	3	22	70.0
0.47	6.3	7.2	14	1.1	ZV322S_K402_0230 EZ503U	15	19	540	23.29	0.57	0.52	0.87	102	41	15	74	3	22	70.0
0.55	2.4	2.6	6.4	2.7	ZV322S_K402_0200 EZ501U	9.0	15	310	20.20	0.65	0.60	1.00	102	41	15	74	3	22	70.0
0.55	4.1	4.5	11	1.6	ZV322S_K402_0200 EZ502U	12	15	430	20.20	0.65	0.60	1.00	102	41	15	74	3	22	70.0
0.55	4.1	4.6	11	1.6	ZV322S_K402_0200 EZ701U	11	31	390	20.20	0.65	0.60	1.00	102	41	15	74	3	22	70.0
0.55	5.4	6.2	14	1.2	ZV322S_K402_0200 EZ503U	12	15	430	20.20	0.65	0.60	1.00	102	41	15	74	3	22	70.0
0.63	3.6	4.0	11	1.9	ZV322S_K402_0175 EZ701U	9.6	31	340	17.41	0.72	0.63	1.05	102	41	15	74	3	22	70.0
0.63	5.8	6.9	18	1.1	ZV322S_K402_0175 EZ702U	15	31	540	17.41	0.72	0.63	1.05	102	41	15	74	3	22	70.0
0.63	6.5	7.7	20	1.0	ZV322S_K402_0175 EZ505U	15	31	540	17.41	0.72	0.63	1.05	102	41	15	74	3	22	70.0
0.65	2.0	2.2	6.5	3.3	ZV322S_K402_0170 EZ501U	7.5	14	260	16.94	0.78	0.71	1.19	102	41	15	74	3	22	70.0
0.65	3.5	3.8	11	1.9	ZV322S_K402_0170 EZ502U	11	14	390	16.94	0.78	0.71	1.19	102	41	15	74	3	22	70.0
0.65	3.5	3.9	11	1.9	ZV322S_K402_0170 EZ701U	9.4	29	330	16.94	0.78	0.71	1.19	102	41	15	74	3	22	70.0
0.65	4.6	5.2	15	1.5	ZV322S_K402_0170 EZ503U	11	14	390	16.94	0.78	0.71	1.19	102	41	15	74	3	22	70.0
0.65	5.6	6.8	18	1.2	ZV322S_K402_0170 EZ702U	15	29	540	16.94	0.78	0.71	1.19	102	41	15	74	3	22	70.0
0.65	6.3	7.5	20	1.0	ZV322S_K402_0170 EZ505U	15	29	540	16.94	0.78	0.71	1.19	102	41	15	74	3	22	70.0
0.79	2.8	3.2	11	2.3	ZV322S_K402_0140 EZ701U	7.7	29	270	13.89	0.90	0.79	1.32	102	41	15	74	3	22	70.0
0.79	4.6	5.5	18	1.4	ZV322S_K402_0140 EZ702U	15	29	540	13.89	0.90	0.79	1.32	102	41	15	74	3	22	70.0
0.79	5.2	6.2	21	1.3	ZV322S_K402_0140 EZ505U	15	29	540	13.89	0.90	0.79	1.32	102	41	15	74	3	22	70.0
0.79	6.3	8.0	25	1.0	ZV322S_K402_0140 EZ703U	15	29	540	13.89	0.90	0.79	1.32	102	41	15	74	3	22	70.0
0.87	2.6	2.9	11	2.5	ZV322S_K402_0125 EZ701U	7.0	25	250	12.66	0.99	0.87	1.45	102	41	15	74	3	22	70.0
0.87	4.2	5.0	18	1.6	ZV322S_K402_0125 EZ702U	14	25	500	12.66	0.99	0.87	1.45	102	41	15	74	3	22	70.0
0.87	4.7	5.6	21	1.4	ZV322S_K402_0125 EZ505U	15	25	540	12.66	0.99	0.87	1.45	102	41	15	74	3	22	70.0
0.87	5.8	7.3	25	1.1	ZV322S_K402_0125 EZ703U	15	25	540	12.66	0.99	0.87	1.45	102	41	15	74	3	22	70.0
0.96	2.4	2.6	11	2.8	ZV322S_K402_0115 EZ701U	6.4	24	220	11.52	0.96	0.83	1.43	102	41	15	74	3	22	70.0
0.96	3.8	4.6	19	1.7	ZV322S_K402_0115 EZ702U	13	24	460	11.52	0.96	0.83	1.43	102	41	15	74	3	22	70.0
0.96	4.3	5.1	21	1.5	ZV322S_K402_0115 EZ505U	15	24	540	11.52	0.96	0.83	1.43	102	41	15	74	3	22	70.0
0.96	5.3	6.6	26	1.3	ZV322S_K402_0115 EZ703U	15	24	540	11.52	0.96	0.83	1.43	102	41	15	74	3	22	70.0
1.09	2.1	2.3	12	3.1	ZV322S_K402_0100 EZ701U	5.6	21	200	10.10	1.24	1.09	1.82	102	41	15	74	3	22	70.0
1.09	3.4	4.0	19	1.9	ZV322S_K402_0100 EZ702U	11	21	400	10.10	1.24	1.09	1.82	102	41	15	74	3	22	70.0
1.09	3.8	4.5	21	1.7	ZV322S_K402_0100 EZ505U	15	21	540	10.10	1.24	1.09	1.82	102	41	15	74	3	22	70.0
1.09	4.6	5.8	26	1.4	ZV322S_K402_0100 EZ703U	15	21	540	10.10	1.24	1.09	1.82	102	41	15	74	3	22	70.0
1.09	6.0	8.4	33	1.1	ZV322S_K402_0100 EZ705U	15	31	540	10.10	1.24	1.09	1.82	102	41	15	74	3	22	70.0
1.09	6.2	10	35	1.0	ZV322S_K402_0100 EZ802U	15	31	540	10.10	1.24	1.09	1.82	102	41	15	74	3	22	70.0
1.19	1.9	2.1	12	3.3	ZV322S_K402_0092 EZ701U	5.1	19	180	9.238	1.19	1.03	1.79	102	41	15	74	3	22	70.0
1.19	3.1	3.7	19	2.0	ZV322S_K402_0092 EZ702U	10	19	370	9.238	1.19	1.03	1.79	102	41	15	74	3	22	70.0
1.19	3.5	4.1	21	1.8	ZV322S_K402_0092 EZ505U	15	19	540	9.238	1.19	1.03	1.79	102	41	15	74	3	22	70.0
1.19	4.2	5.3	26	1.5	ZV322S_K402_0092 EZ703U	15	19	540	9.238	1.19	1.03	1.79	102	41	15	74	3	22	70.0
1.19	5.5	7.7	34	1.1	ZV322S_K402_0092 EZ705U	15	31	540	9.238	1.19	1.03	1.79	102	41	15	74	3	22	70.0
1.19	5.7	9.5	35	1.1	ZV322S_K402_0092 EZ802U	15	31	540	9.238	1.19	1.03	1.79	102	41	15	74	3	22	70.0

v_{f2N} [m/s]	F_{f2N} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ EL1,2 [m/s]	$v_{f2maxDB}$ EL3,4,5,6 [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{redII} [µm]	Δs_{redI} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV3K4 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 15 kN)																			
1.31	1.7	1.9	12	3.5	ZV322S_K402_0084 EZ701U	4.6	17	160	8.377	1.31	1.14	1.97	102	41	15	74	3	22	70.0
1.31	2.8	3.3	19	2.2	ZV322S_K402_0084 EZ702U	9.5	17	330	8.377	1.31	1.14	1.97	102	41	15	74	3	22	70.0
1.31	3.1	3.7	22	1.9	ZV322S_K402_0084 EZ505U	14	17	490	8.377	1.31	1.14	1.97	102	41	15	74	3	22	70.0
1.31	3.8	4.8	26	1.6	ZV322S_K402_0084 EZ703U	14	17	490	8.377	1.31	1.14	1.97	102	41	15	74	3	22	70.0
1.31	4.9	7.0	34	1.2	ZV322S_K402_0084 EZ705U	15	31	540	8.377	1.31	1.14	1.97	102	41	15	74	3	22	70.0
1.31	5.2	8.6	36	1.2	ZV322S_K402_0084 EZ802U	15	31	540	8.377	1.31	1.14	1.97	102	41	15	74	3	22	70.0
1.48	4.4	6.2	34	1.3	ZV322S_K402_0075 EZ705U	15	31	540	7.456	1.28	1.08	1.87	102	41	15	74	3	22	70.0
1.48	4.6	7.7	36	1.3	ZV322S_K402_0075 EZ802U	15	31	540	7.456	1.28	1.08	1.87	102	41	15	74	3	22	70.0
1.48	5.5	10	43	1.0	ZV322S_K402_0075 EZ803U	15	31	540	7.456	1.28	1.08	1.87	102	41	15	74	3	22	70.0
1.64	1.4	1.5	12	4.0	ZV322S_K402_0067 EZ701U	3.7	14	130	6.719	1.64	1.42	2.46	102	41	15	74	3	22	70.0
1.64	2.2	2.7	19	2.5	ZV322S_K402_0067 EZ702U	7.6	14	270	6.719	1.64	1.42	2.46	102	41	15	74	3	22	70.0
1.64	2.5	3.0	22	2.2	ZV322S_K402_0067 EZ505U	11	14	390	6.719	1.64	1.42	2.46	102	41	15	74	3	22	70.0
1.64	3.1	3.9	27	1.8	ZV322S_K402_0067 EZ703U	11	14	390	6.719	1.64	1.42	2.46	102	41	15	74	3	22	70.0
1.64	4.0	5.6	35	1.4	ZV322S_K402_0067 EZ705U	15	31	540	6.719	1.64	1.42	2.46	102	41	15	74	3	22	70.0
1.64	4.2	6.9	36	1.3	ZV322S_K402_0067 EZ802U	15	31	540	6.719	1.64	1.42	2.46	102	41	15	74	3	22	70.0
1.64	5.0	9.0	43	1.1	ZV322S_K402_0067 EZ803U	15	31	540	6.719	1.64	1.42	2.46	102	41	15	74	3	22	70.0
1.83	3.5	5.0	35	1.5	ZV322S_K402_0060 EZ705U	15	31	520	6.000	1.59	1.34	2.32	102	41	15	74	3	22	70.0
1.83	3.7	6.2	37	1.4	ZV322S_K402_0060 EZ802U	15	31	520	6.000	1.59	1.34	2.32	102	41	15	74	3	22	70.0
1.83	4.4	8.0	44	1.2	ZV322S_K402_0060 EZ803U	15	31	520	6.000	1.59	1.34	2.32	102	41	15	74	3	22	70.0
2.03	3.2	4.5	35	1.6	ZV322S_K402_0054 EZ705U	14	30	510	5.422	1.76	1.49	2.57	102	41	15	74	3	22	70.0
2.03	3.3	5.6	37	1.5	ZV322S_K402_0054 EZ802U	14	30	510	5.422	1.76	1.49	2.57	102	41	15	74	3	22	70.0
2.03	4.0	7.2	44	1.3	ZV322S_K402_0054 EZ803U	14	30	510	5.422	1.76	1.49	2.57	102	41	15	74	3	22	70.0
2.52	2.6	3.7	36	1.9	ZV322S_K402_0044 EZ705U	13	24	440	4.364	2.18	1.85	3.19	102	41	15	74	3	22	70.0
2.52	2.7	4.5	38	1.8	ZV322S_K402_0044 EZ802U	12	24	420	4.364	2.18	1.85	3.19	102	41	15	74	3	22	70.0
2.52	3.2	5.8	45	1.5	ZV322S_K402_0044 EZ803U	13	24	470	4.364	2.18	1.85	3.19	102	41	15	74	3	22	70.0
2.75	2.4	3.3	36	2.0	ZV322S_K402_0040 EZ705U	12	22	400	4.000	2.38	2.02	3.48	102	41	15	74	3	22	70.0
2.75	2.5	4.1	38	1.9	ZV322S_K402_0040 EZ802U	11	22	390	4.000	2.38	2.02	3.48	102	41	15	74	3	22	70.0
2.75	2.9	5.3	45	1.6	ZV322S_K402_0040 EZ803U	13	22	460	4.000	2.38	2.02	3.48	102	41	15	74	3	22	70.0
ZV3K4 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 15 kN)																			
0.71	6.1	9.9	16	1.1	ZV322S_K402_0230 EZ505U	15	31	540	23.29	0.57	0.52	0.87	102	41	15	74	3	22	70.0
0.82	5.3	8.6	16	1.2	ZV322S_K402_0200 EZ505U	15	31	540	20.20	0.65	0.60	1.00	102	41	15	74	3	22	70.0
0.95	4.6	7.4	16	1.4	ZV322S_K402_0175 EZ505U	15	31	540	17.41	0.72	0.63	1.05	102	41	15	74	3	22	70.0
0.95	5.8	9.6	21	1.1	ZV322S_K402_0175 EZ703U	15	31	540	17.41	0.72	0.63	1.05	102	41	15	74	3	22	70.0
0.97	4.5	7.2	16	1.5	ZV322S_K402_0170 EZ505U	15	29	540	16.94	0.78	0.71	1.19	102	41	15	74	3	22	70.0
0.97	5.7	9.4	21	1.2	ZV322S_K402_0170 EZ703U	15	29	540	16.94	0.78	0.71	1.19	102	41	15	74	3	22	70.0
1.19	3.7	5.9	17	1.7	ZV322S_K402_0140 EZ505U	15	29	540	13.89	0.90	0.79	1.32	102	41	15	74	3	22	70.0
1.19	4.7	7.7	21	1.3	ZV322S_K402_0140 EZ703U	15	29	540	13.89	0.90	0.79	1.32	102	41	15	74	3	22	70.0
1.30	3.3	5.4	17	1.8	ZV322S_K402_0125 EZ505U	15	25	540	12.66	0.99	0.87	1.45	102	41	15	74	3	22	70.0
1.30	4.2	7.0	21	1.4	ZV322S_K402_0125 EZ703U	15	25	540	12.66	0.99	0.87	1.45	102	41	15	74	3	22	70.0
1.30	5.8	11	29	1.0	ZV322S_K402_0125 EZ705U	15	31	540	12.66	0.99	0.87	1.45	102	41	15	74	3	22	70.0
1.43	3.0	4.9	17	1.9	ZV322S_K402_0115 EZ505U	15	24	540	11.52	0.96	0.83	1.43	102	41	15	74	3	22	70.0
1.43	3.4	11	19	1.7	ZV322S_K402_0115 EZ802U	15	31	540	11.52	0.96	0.83	1.43	102	41	15	74	3	22	70.0
1.43	3.9	6.4	22	1.5	ZV322S_K402_0115 EZ703U	15	24	540	11.52	0.96	0.83	1.43	102	41	15	74	3	22	70.0
1.43	5.2	9.6	29	1.1	ZV322S_K402_0115 EZ705U	15	31	540	11.52	0.96	0.83	1.43	102	41	15	74	3	22	70.0
1.63	2.7	4.3	17	2.1	ZV322S_K402_0100 EZ505U	15	21	540	10.10	1.24	1.09	1.82	102	41	15	74	3	22	70.0
1.63	2.9	9.7	19	1.9	ZV322S_K402_0100 EZ802U	15	31	540	10.10	1.24	1.09	1.82	102	41	15	74	3	22	70.0
1.63	3.4	5.6	22	1.6	ZV322S_K402_0100 EZ703U	15	21	540	10.10	1.24	1.09	1.82	102	41	15	74	3	22	70.0
1.63	4.6	8.4	29	1.2	ZV322S_K402_0100 EZ705U	15	31	540	10.10	1.24	1.09	1.82	102	41	15	74	3	22	70.0
1.79	2.4	3.9	17	2.2	ZV322S_K402_0092 EZ505U	15	19	540	9.238	1.19	1.03	1.79	102	41	15	74	3	22	70.0
1.79	2.7	8.8	19	2.0	ZV322S_K402_0092 EZ802U	15	31	540	9.238	1.19	1.03	1.79	102	41	15	74	3	22	70.0
1.79	3.1	5.1	22	1.7	ZV322S_K402_0092 EZ703U	15	19	540	9.238	1.19	1.03	1.79	102	41	15	74	3	22	70.0
1.79	4.2	7.7	30	1.3	ZV322S_K402_0092 EZ705U	15	31	540	9.238	1.19	1.03	1.79	102	41	15	74	3	22	70.0
1.97	2.2	3.6	17	2.4	ZV322S_K402_0084 EZ505U	14	17	490	8.377	1.31	1.14	1.97	102	41	15	74	3	22	70.0
1.97	2.4	8.0	19	2.1	ZV322S_K402_0084 EZ802U	15	31	540	8.377	1.31	1.14	1.97	102	41	15	74	3	22	70.0
1.97	2.8	4.6	22	1.9	ZV322S_K402_0084 EZ703U	14	17	490	8.377	1.31	1.14	1.97	102	41	15	74	3	22	70.0
1.97	3.8	7.0	30	1.4	ZV322S_K402_0084 EZ705U	15	31	540	8.377	1.31	1.14	1.97	102	41	15	74	3	22	70.0
2.46	1.8	2.8	18	2.7	ZV322S_K402_0067 EZ505U	11	14	390	6.719	1.64	1.42	2.46	102	41	15	74	3	22	70.0
2.46	2.0	6.4	20	2.5	ZV322S_K402_0067 EZ802U	15	31	540	6.719	1.64	1.42	2.46	102	41	15	74	3	22	70.0
2.46	2.3	3.7	23	2.2	ZV322S_K402_0067 EZ703U	11	14	390	6.719	1.64	1.42	2.46	102	41	15	74	3	22	70.0
2.46	3.1	5.6	30	1.6	ZV322S_K402_0067 EZ705U	15	31	540	6.719	1.64	1.42	2.46	102	41	15	74	3	22	70.0
ZV4K4 (n_{1N} = 2000 rpm, ($F_{f2acc,max}$ = 12 kN)																			
1.83	4.8	7.3	64	1.1	ZV418S_K402_0044 EZ805U	12	22	470	4.364	2.38	2.02	3.48	111	44	17	65	4	18	76.4
2.00	4.4	6.7	65	1.2	ZV418S_K402_0040 EZ805U	12	20	460	4.000	2.60	2.20	3.80	111	44	17	65	4	18	76.4

v_{f2N}	F_{f2N}	$F_{f2,0}$	a_{th}	S	Type	F_{f2accE}	$F_{f2NOT,E}$	M_{2accE}	i	$v_{f2maxDB}$		$v_{f2maxZB}$	Δs	Δs_{redII}	Δs_{redI}	C_{lin}	m_n	z	d_0
										EL1,2	EL3,4,5,6								
[m/s]	[kN]	[kN]				[kN]	[kN]	[Nm]		[m/s]	[m/s]	[m/s]	[µm]	[µm]	[µm]	[N/µm]	[mm]		[mm]
ZV4K4 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 15 kN)																			
0.04	6.3	6.5	2.9	1.1	ZV418S_K403_2720 EZ301U	12	19	440	271.6	0.05	0.05	0.08	111	56	28	65	4	18	76.4
0.06	5.1	5.2	2.4	1.4	ZV418S_K403_2180 EZ301U	13	22	510	218.2	0.07	0.06	0.10	111	56	28	65	4	18	76.4
0.07	4.2	4.3	2.0	1.6	ZV418S_K403_1810 EZ301U	13	26	490	181.4	0.08	0.07	0.12	111	56	28	65	4	18	76.4
0.09	3.2	3.2	2.0	2.2	ZV418S_K403_1360 EZ301U	9.5	21	360	136.1	0.11	0.10	0.16	111	56	28	65	4	18	76.4
0.09	5.4	5.7	3.4	1.3	ZV418S_K403_1360 EZ302U	15	21	570	136.1	0.11	0.10	0.16	111	56	28	65	4	18	76.4
0.11	2.5	2.6	2.0	2.7	ZV418S_K403_1090 EZ301U	7.6	18	290	108.8	0.13	0.12	0.20	111	56	28	65	4	18	76.4
0.11	4.3	4.6	3.3	1.6	ZV418S_K403_1090 EZ302U	14	18	520	108.8	0.13	0.12	0.20	111	56	28	65	4	18	76.4
0.11	5.6	6.0	4.4	1.2	ZV418S_K403_1090 EZ303U	15	18	560	108.8	0.13	0.12	0.20	111	56	28	65	4	18	76.4
0.13	2.1	2.2	2.0	3.3	ZV418S_K403_0910 EZ301U	6.4	15	240	91.23	0.16	0.15	0.24	111	56	28	65	4	18	76.4
0.13	3.6	3.8	3.4	1.9	ZV418S_K403_0910 EZ302U	11	15	440	91.23	0.16	0.15	0.24	111	56	28	65	4	18	76.4
0.13	4.7	5.0	4.4	1.5	ZV418S_K403_0910 EZ303U	12	15	470	91.23	0.16	0.15	0.24	111	56	28	65	4	18	76.4
0.13	6.4	6.8	5.9	1.1	ZV418S_K403_0910 EZ401U	12	15	470	91.23	0.16	0.15	0.24	111	56	28	65	4	18	76.4
0.15	1.8	1.9	2.5	3.8	ZV418S_K403_0790 EZ301U	5.5	13	210	79.11	0.18	0.17	0.28	111	56	28	65	4	18	76.4
0.15	3.1	3.3	4.2	2.2	ZV418S_K403_0790 EZ302U	9.9	13	380	79.11	0.18	0.17	0.28	111	56	28	65	4	18	76.4
0.15	4.1	4.3	5.5	1.7	ZV418S_K403_0790 EZ303U	11	13	410	79.11	0.18	0.17	0.28	111	56	28	65	4	18	76.4
0.15	5.5	5.9	7.5	1.3	ZV418S_K403_0790 EZ401U	11	13	410	79.11	0.18	0.17	0.28	111	56	28	65	4	18	76.4
0.18	1.5	1.6	2.5	4.5	ZV418S_K403_0660 EZ301U	4.6	11	180	66.35	0.22	0.20	0.33	111	56	28	65	4	18	76.4
0.18	2.6	2.8	4.3	2.6	ZV418S_K403_0660 EZ302U	8.3	11	320	66.35	0.22	0.20	0.33	111	56	28	65	4	18	76.4
0.18	3.4	3.6	5.6	2.0	ZV418S_K403_0660 EZ303U	8.9	11	340	66.35	0.22	0.20	0.33	111	56	28	65	4	18	76.4
0.18	4.6	5.0	7.5	1.5	ZV418S_K403_0660 EZ401U	8.9	11	340	66.35	0.22	0.20	0.33	111	56	28	65	4	18	76.4
0.22	6.1	6.6	8.1	1.1	ZV418S_K402_0560 EZ501U	13	22	510	55.71	0.26	0.24	0.40	111	44	17	65	4	18	76.4
0.22	5.8	6.3	6.1	1.2	ZV418S_K403_0540 EZ501U	15	25	570	53.69	0.27	0.25	0.41	111	56	28	65	4	18	76.4
0.24	5.5	6.0	12	1.3	ZV418S_K402_0500 EZ501U	8.5	14	320	50.43	0.29	0.26	0.44	111	44	17	65	4	18	76.4
0.25	5.3	5.8	5.9	1.3	ZV418S_K403_0490 EZ501U	15	23	570	48.94	0.29	0.27	0.45	111	56	28	65	4	18	76.4
0.26	5.1	5.5	6.1	1.4	ZV418S_K402_0460 EZ501U	15	26	570	46.31	0.31	0.29	0.48	111	44	17	65	4	18	76.4
0.27	4.8	5.2	5.9	1.4	ZV418S_K403_0450 EZ501U	15	21	570	44.54	0.32	0.30	0.49	111	56	28	65	4	18	76.4
0.30	4.4	4.8	10	1.6	ZV418S_K402_0410 EZ501U	9.7	16	370	40.51	0.36	0.33	0.54	111	44	17	65	4	18	76.4
0.31	4.2	4.6	6.1	1.7	ZV418S_K403_0390 EZ501U	14	18	550	39.05	0.37	0.34	0.56	111	56	28	65	4	18	76.4
0.34	3.8	4.2	6.0	1.8	ZV418S_K403_0360 EZ501U	13	17	500	35.72	0.40	0.37	0.62	111	56	28	65	4	18	76.4
0.34	6.6	7.2	10	1.1	ZV418S_K403_0360 EZ502U	13	17	500	35.72	0.40	0.37	0.62	111	56	28	65	4	18	76.4
0.35	3.8	4.1	6.1	1.8	ZV418S_K402_0350 EZ501U	14	21	540	34.76	0.41	0.38	0.63	111	44	17	65	4	18	76.4
0.35	6.5	7.1	10	1.1	ZV418S_K402_0350 EZ502U	15	21	570	34.76	0.41	0.38	0.63	111	44	17	65	4	18	76.4
0.35	6.5	7.3	10	1.1	ZV418S_K402_0350 EZ701U	15	29	570	34.76	0.41	0.38	0.63	111	44	17	65	4	18	76.4
0.36	3.7	4.0	7.8	1.9	ZV418S_K402_0340 EZ501U	12	19	470	33.68	0.43	0.39	0.65	111	44	17	65	4	18	76.4
0.36	6.3	6.8	13	1.1	ZV418S_K402_0340 EZ502U	12	19	470	33.68	0.43	0.39	0.65	111	44	17	65	4	18	76.4
0.36	6.3	7.1	13	1.1	ZV418S_K402_0340 EZ701U	12	19	470	33.68	0.43	0.39	0.65	111	44	17	65	4	18	76.4
0.37	3.5	3.8	6.4	2.0	ZV418S_K403_0320 EZ501U	12	15	460	32.39	0.45	0.41	0.68	111	56	28	65	4	18	76.4
0.37	6.0	6.5	11	1.2	ZV418S_K403_0320 EZ502U	12	15	460	32.39	0.45	0.41	0.68	111	56	28	65	4	18	76.4
0.43	3.0	3.3	6.2	2.3	ZV418S_K402_0280 EZ501U	11	20	430	27.77	0.52	0.48	0.79	111	44	17	65	4	18	76.4
0.43	5.2	5.6	11	1.3	ZV418S_K402_0280 EZ502U	15	20	570	27.77	0.52	0.48	0.79	111	44	17	65	4	18	76.4
0.43	5.2	5.9	11	1.3	ZV418S_K402_0280 EZ701U	14	29	540	27.77	0.52	0.48	0.79	111	44	17	65	4	18	76.4
0.43	6.8	7.8	14	1.0	ZV418S_K402_0280 EZ503U	15	20	570	27.77	0.52	0.48	0.79	111	44	17	65	4	18	76.4
0.48	2.8	3.0	6.3	2.5	ZV418S_K402_0250 EZ501U	10	15	390	25.28	0.57	0.52	0.87	111	44	17	65	4	18	76.4
0.48	4.8	5.1	11	1.5	ZV418S_K402_0250 EZ502U	12	15	470	25.28	0.57	0.52	0.87	111	44	17	65	4	18	76.4
0.48	4.8	5.3	11	1.5	ZV418S_K402_0250 EZ701U	13	26	490	25.28	0.57	0.52	0.87	111	44	17	65	4	18	76.4
0.48	6.2	7.1	14	1.1	ZV418S_K402_0250 EZ503U	12	15	470	25.28	0.57	0.52	0.87	111	44	17	65	4	18	76.4
0.52	2.5	2.8	6.3	2.7	ZV418S_K402_0230 EZ501U	9.5	18	360	23.29	0.62	0.57	0.95	111	44	17	65	4	18	76.4
0.52	4.4	4.7	11	1.6	ZV418S_K402_0230 EZ502U	14	18	540	23.29	0.62	0.57	0.95	111	44	17	65	4	18	76.4
0.52	4.4	4.9	11	1.6	ZV418S_K402_0230 EZ701U	12	29	450	23.29	0.62	0.57	0.95	111	44	17	65	4	18	76.4
0.52	5.7	6.6	14	1.2	ZV418S_K402_0230 EZ503U	14	18	540	23.29	0.62	0.57	0.95	111	44	17	65	4	18	76.4
0.59	2.2	2.4	6.4	3.1	ZV418S_K402_0200 EZ501U	8.2	14	310	20.20	0.71	0.65	1.09	111	44	17	65	4	18	76.4
0.59	3.8	4.1	11	1.8	ZV418S_K402_0200 EZ502U	11	14	430	20.20	0.71	0.65	1.09	111	44	17	65	4	18	76.4
0.59	3.8	4.3	11	1.8	ZV418S_K402_0200 EZ701U	10	29	390	20.20	0.71	0.65	1.09	111	44	17	65	4	18	76.4
0.59	5.0	5.7	14	1.4	ZV418S_K402_0200 EZ503U	11	14	430	20.20	0.71	0.65	1.09	111	44	17	65	4	18	76.4
0.59	6.2	7.4	18	1.1	ZV418S_K402_0200 EZ702U	15	29	570	20.20	0.71	0.65	1.09	111	44	17	65	4	18	76.4
0.59	6.9	8.2	20	1.0	ZV418S_K402_0200 EZ505U	15	29	570	20.20	0.71	0.65	1.09	111	44	17	65	4	18	76.4
0.69	3.3	3.7	11	2.1	ZV418S_K402_0175 EZ701U	8.8	29	340	17.41	0.78	0.69	1.15	111	44	17	65	4	18	76.4
0.69	5.3	6.4	18	1.3	ZV418S_K402_0175 EZ702U	15	29	570	17.41	0.78	0.69	1.15	111	44	17	65	4	18	76.4
0.69	6.0	7.1	20	1.2	ZV418S_K402_0175 EZ505U	15	29	570	17.41	0.78	0.69	1.15	111	44	17	65	4	18	76.4
0.71	1.8	2.0	6.5	3.8	ZV418S_K402_0170 EZ501U	6.9	13	260	16.94	0.85	0.78	1.30	111	44	17	65	4	18	76.4
0.71	3.2	3.4	11	2.2	ZV418S_K402_0170 EZ502U	10	13	390	16.94	0.85	0.78	1.30	111	44	17	65	4	18	76.4
0.71	3.2	3.6	11	2.2	ZV418S_K402_0170 EZ701U	8.6	27	330	16.94	0.85	0.78	1.30	111	44	17	65	4	18	76.4
0.71	4.2	4.8	15	1.7	ZV418S_K402_0170 EZ503U	10	13	390	16.94	0.85	0.78	1.30	111	44	17	65	4	18	76.4
0.71	5.2	6.2	18	1.3	ZV418S_K402_0170 EZ702U	15	27	570	16.94	0.85	0.78	1.30	111	44	17	65	4	18	76.4

v_{f2N}	F_{f2N}	$F_{f2,0}$	a_{th}	S	Type	F_{f2accE}	$F_{f2NOT,E}$	M_{2accE}	i	$v_{f2maxDB}$		$v_{f2maxZB}$	Δs	Δs_{redII}	Δs_{redI}	C_{lin}	m_n	z	d_0
										EL1,2	EL3,4,5,6								
[m/s]	[kN]	[kN]				[kN]	[kN]	[Nm]		[m/s]	[m/s]	[m/s]	[µm]	[µm]	[µm]	[N/µm]	[mm]		[mm]
ZV4K4 (n_{1N} = 3000 rpm, ($F_{f2acc,max}$ = 15 kN)																			
0.71	5.8	6.9	20	1.2	ZV418S_K402_0170 EZ505U	15	27	570	16.94	0.85	0.78	1.30	111	44	17	65	4	18	76.4
0.86	2.6	2.9	11	2.7	ZV418S_K402_0140 EZ701U	7.1	26	270	13.89	0.98	0.86	1.44	111	44	17	65	4	18	76.4
0.86	4.2	5.1	18	1.6	ZV418S_K402_0140 EZ702U	14	26	550	13.89	0.98	0.86	1.44	111	44	17	65	4	18	76.4
0.86	4.8	5.6	21	1.5	ZV418S_K402_0140 EZ505U	15	26	570	13.89	0.98	0.86	1.44	111	44	17	65	4	18	76.4
0.86	5.8	7.3	25	1.2	ZV418S_K402_0140 EZ703U	15	26	570	13.89	0.98	0.86	1.44	111	44	17	65	4	18	76.4
0.95	2.4	2.7	11	2.9	ZV418S_K402_0125 EZ701U	6.4	23	250	12.66	1.07	0.95	1.58	111	44	17	65	4	18	76.4
0.95	3.9	4.6	18	1.8	ZV418S_K402_0125 EZ702U	13	23	500	12.66	1.07	0.95	1.58	111	44	17	65	4	18	76.4
0.95	4.3	5.1	21	1.6	ZV418S_K402_0125 EZ505U	15	23	570	12.66	1.07	0.95	1.58	111	44	17	65	4	18	76.4
0.95	5.3	6.7	25	1.3	ZV418S_K402_0125 EZ703U	15	23	570	12.66	1.07	0.95	1.58	111	44	17	65	4	18	76.4
0.95	6.8	9.7	33	1.0	ZV418S_K402_0125 EZ705U	15	29	570	12.66	1.07	0.95	1.58	111	44	17	65	4	18	76.4
1.04	2.2	2.4	11	3.1	ZV418S_K402_0115 EZ701U	5.8	22	220	11.52	1.04	0.90	1.56	111	44	17	65	4	18	76.4
1.04	3.5	4.2	19	1.9	ZV418S_K402_0115 EZ702U	12	22	460	11.52	1.04	0.90	1.56	111	44	17	65	4	18	76.4
1.04	3.9	4.7	21	1.7	ZV418S_K402_0115 EZ505U	15	22	570	11.52	1.04	0.90	1.56	111	44	17	65	4	18	76.4
1.04	4.8	6.1	26	1.4	ZV418S_K402_0115 EZ703U	15	22	570	11.52	1.04	0.90	1.56	111	44	17	65	4	18	76.4
1.04	6.2	8.8	33	1.1	ZV418S_K402_0115 EZ705U	15	29	570	11.52	1.04	0.90	1.56	111	44	17	65	4	18	76.4
1.04	6.5	11	35	1.0	ZV418S_K402_0115 EZ802U	15	29	570	11.52	1.04	0.90	1.56	111	44	17	65	4	18	76.4
1.19	1.9	2.1	12	3.4	ZV418S_K402_0100 EZ701U	5.1	19	200	10.10	1.35	1.19	1.98	111	44	17	65	4	18	76.4
1.19	3.1	3.7	19	2.1	ZV418S_K402_0100 EZ702U	11	19	400	10.10	1.35	1.19	1.98	111	44	17	65	4	18	76.4
1.19	3.5	4.1	21	1.9	ZV418S_K402_0100 EZ505U	15	19	570	10.10	1.35	1.19	1.98	111	44	17	65	4	18	76.4
1.19	4.2	5.3	26	1.5	ZV418S_K402_0100 EZ703U	15	19	570	10.10	1.35	1.19	1.98	111	44	17	65	4	18	76.4
1.19	5.5	7.7	33	1.2	ZV418S_K402_0100 EZ705U	15	29	570	10.10	1.35	1.19	1.98	111	44	17	65	4	18	76.4
1.19	5.7	9.5	35	1.1	ZV418S_K402_0100 EZ802U	15	29	570	10.10	1.35	1.19	1.98	111	44	17	65	4	18	76.4
1.30	1.7	1.9	12	3.6	ZV418S_K402_0092 EZ701U	4.7	18	180	9.238	1.30	1.13	1.95	111	44	17	65	4	18	76.4
1.30	2.8	3.4	19	2.2	ZV418S_K402_0092 EZ702U	9.6	18	370	9.238	1.30	1.13	1.95	111	44	17	65	4	18	76.4
1.30	3.2	3.8	21	2.0	ZV418S_K402_0092 EZ505U	14	18	540	9.238	1.30	1.13	1.95	111	44	17	65	4	18	76.4
1.30	3.9	4.9	26	1.6	ZV418S_K402_0092 EZ703U	14	18	540	9.238	1.30	1.13	1.95	111	44	17	65	4	18	76.4
1.30	5.0	7.1	34	1.2	ZV418S_K402_0092 EZ705U	15	29	570	9.238	1.30	1.13	1.95	111	44	17	65	4	18	76.4
1.30	5.2	8.7	35	1.2	ZV418S_K402_0092 EZ802U	15	29	570	9.238	1.30	1.13	1.95	111	44	17	65	4	18	76.4
1.43	1.6	1.8	12	3.8	ZV418S_K402_0084 EZ701U	4.3	16	160	8.377	1.43	1.24	2.15	111	44	17	65	4	18	76.4
1.43	2.6	3.1	19	2.4	ZV418S_K402_0084 EZ702U	8.7	16	330	8.377	1.43	1.24	2.15	111	44	17	65	4	18	76.4
1.43	2.9	3.4	22	2.1	ZV418S_K402_0084 EZ505U	13	16	490	8.377	1.43	1.24	2.15	111	44	17	65	4	18	76.4
1.43	3.5	4.4	26	1.7	ZV418S_K402_0084 EZ703U	13	16	490	8.377	1.43	1.24	2.15	111	44	17	65	4	18	76.4
1.43	4.5	6.4	34	1.3	ZV418S_K402_0084 EZ705U	15	29	570	8.377	1.43	1.24	2.15	111	44	17	65	4	18	76.4
1.43	4.7	7.9	36	1.3	ZV418S_K402_0084 EZ802U	15	29	570	8.377	1.43	1.24	2.15	111	44	17	65	4	18	76.4
1.43	5.7	10	42	1.1	ZV418S_K402_0084 EZ803U	15	29	570	8.377	1.43	1.24	2.15	111	44	17	65	4	18	76.4
1.61	4.0	5.7	34	1.4	ZV418S_K402_0075 EZ705U	15	29	560	7.456	1.40	1.18	2.04	111	44	17	65	4	18	76.4
1.61	4.2	7.0	36	1.4	ZV418S_K402_0075 EZ802U	15	29	560	7.456	1.40	1.18	2.04	111	44	17	65	4	18	76.4
1.61	5.0	9.1	43	1.2	ZV418S_K402_0075 EZ803U	15	29	560	7.456	1.40	1.18	2.04	111	44	17	65	4	18	76.4
1.79	1.3	1.4	12	4.4	ZV418S_K402_0067 EZ701U	3.4	13	130	6.719	1.79	1.55	2.68	111	44	17	65	4	18	76.4
1.79	2.0	2.5	19	2.7	ZV418S_K402_0067 EZ702U	7.0	13	270	6.719	1.79	1.55	2.68	111	44	17	65	4	18	76.4
1.79	2.3	2.7	22	2.4	ZV418S_K402_0067 EZ505U	10	13	390	6.719	1.79	1.55	2.68	111	44	17	65	4	18	76.4
1.79	2.8	3.5	27	2.0	ZV418S_K402_0067 EZ703U	10	13	390	6.719	1.79	1.55	2.68	111	44	17	65	4	18	76.4
1.79	3.6	5.2	35	1.5	ZV418S_K402_0067 EZ705U	14	29	550	6.719	1.79	1.55	2.68	111	44	17	65	4	18	76.4
1.79	3.8	6.3	36	1.5	ZV418S_K402_0067 EZ802U	14	29	550	6.719	1.79	1.55	2.68	111	44	17	65	4	18	76.4
1.79	4.5	8.2	43	1.2	ZV418S_K402_0067 EZ803U	14	29	550	6.719	1.79	1.55	2.68	111	44	17	65	4	18	76.4
2.00	3.2	4.6	35	1.7	ZV418S_K402_0060 EZ705U	14	29	520	6.000	1.73	1.47	2.53	111	44	17	65	4	18	76.4
2.00	3.4	5.7	37	1.6	ZV418S_K402_0060 EZ802U	14	29	520	6.000	1.73	1.47	2.53	111	44	17	65	4	18	76.4
2.00	4.1	7.3	44	1.3	ZV418S_K402_0060 EZ803U	14	29	520	6.000	1.73	1.47	2.53	111	44	17	65	4	18	76.4
2.21	2.9	4.2	35	1.8	ZV418S_K402_0054 EZ705U	13	28	510	5.422	1.92	1.62	2.80	111	44	17	65	4	18	76.4
2.21	3.1	5.1	37	1.7	ZV418S_K402_0054 EZ802U	13	28	510	5.422	1.92	1.62	2.80	111	44	17	65	4	18	76.4
2.21	3.7	6.6	44	1.4	ZV418S_K402_0054 EZ803U	13	28	510	5.422	1.92	1.62	2.80	111	44	17	65	4	18	76.4
2.75	2.4	3.3	36	2.1	ZV418S_K402_0044 EZ705U	12	22	440	4.364	2.38	2.02	3.48	111	44	17	65	4	18	76.4
2.75	2.5	4.1	38	2.0	ZV418S_K402_0044 EZ802U	11	22	420	4.364	2.38	2.02	3.48	111	44	17	65	4	18	76.4
2.75	2.9	5.3	45	1.6	ZV418S_K402_0044 EZ803U	12	22	470	4.364	2.38	2.02	3.48	111	44	17	65	4	18	76.4
3.00	2.2	3.1	36	2.2	ZV418S_K402_0040 EZ705U	11	20	400	4.000	2.60	2.20	3.80	111	44	17	65	4	18	76.4
3.00	2.3	3.8	38	2.1	ZV418S_K402_0040 EZ802U	10	20	390	4.000	2.60	2.20	3.80	111	44	17	65	4	18	76.4
3.00	2.7	4.9	45	1.7	ZV418S_K402_0040 EZ803U	12	20	460	4.000	2.60	2.20	3.80	111	44	17	65	4	18	76.4
ZV4K4 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 15 kN)																			
0.65	6.7	11	16	1.0	ZV418S_K402_0280 EZ505U	15	29	570	27.77	0.52	0.48	0.79	111	44	17	65	4	18	76.4
0.71	6.1	9.8	16	1.1	ZV418S_K402_0250 EZ505U	15	26	570	25.28	0.57	0.52	0.87	111	44	17	65	4	18	76.4
0.77	5.6	9.0	16	1.2	ZV418S_K402_0230 EZ505U	15	29	570	23.29	0.62	0.57	0.95	111	44	17	65	4	18	76.4
0.89	4.9	7.8	16	1.4	ZV418S_K402_0200 EZ505U	15	29	570	20.20	0.71	0.65	1.09	111	44	17	65	4	18	76.4
0.89	6.2	10	21	1.1	ZV418S_K402_0200 EZ703U	15	29	570	20.20	0.71	0.65	1.09	111	44	17	65	4	18	76.4
1.03	4.2	6.8	16	1.6	ZV418S_K402_0175 EZ505U	15	29	570	17.41	0.78	0.69	1.15	111	44	17	65	4	18	76.4

v_{f2N}	F_{f2N}	$F_{f2,0}$	a_{th}	S	Type	F_{f2accE}	$F_{f2NOT,E}$	M_{2accE}	i	$v_{f2maxDB}$		$v_{f2maxZB}$	Δs	Δs_{redII}	Δs_{redI}	C_{lin}	m_n	z	d_0
										EL1,2	EL3,4,5,6								
[m/s]	[kN]	[kN]				[kN]	[kN]	[Nm]		[m/s]	[m/s]	[m/s]	[µm]	[µm]	[µm]	[N/µm]	[mm]		[mm]
ZV4K4 (n_{1N} = 4500 rpm, ($F_{f2acc,max}$ = 15 kN)																			
1.03	5.3	8.8	21	1.3	ZV418S_K402_0175 EZ703U	15	29	570	17.41	0.78	0.69	1.15	111	44	17	65	4	18	76.4
1.06	4.1	6.6	16	1.6	ZV418S_K402_0170 EZ505U	15	27	570	16.94	0.85	0.78	1.30	111	44	17	65	4	18	76.4
1.06	5.2	8.6	21	1.3	ZV418S_K402_0170 EZ703U	15	27	570	16.94	0.85	0.78	1.30	111	44	17	65	4	18	76.4
1.30	3.3	5.4	17	1.9	ZV418S_K402_0140 EZ505U	15	26	570	13.89	0.98	0.86	1.44	111	44	17	65	4	18	76.4
1.30	4.3	7.1	21	1.5	ZV418S_K402_0140 EZ703U	15	26	570	13.89	0.98	0.86	1.44	111	44	17	65	4	18	76.4
1.30	5.8	11	29	1.1	ZV418S_K402_0140 EZ705U	15	29	570	13.89	0.98	0.86	1.44	111	44	17	65	4	18	76.4
1.42	3.1	4.9	17	2.0	ZV418S_K402_0125 EZ505U	15	23	570	12.66	1.07	0.95	1.58	111	44	17	65	4	18	76.4
1.42	3.4	11	19	1.8	ZV418S_K402_0125 EZ802U	15	29	570	12.66	1.07	0.95	1.58	111	44	17	65	4	18	76.4
1.42	3.9	6.4	21	1.6	ZV418S_K402_0125 EZ703U	15	23	570	12.66	1.07	0.95	1.58	111	44	17	65	4	18	76.4
1.42	5.3	9.6	29	1.1	ZV418S_K402_0125 EZ705U	15	29	570	12.66	1.07	0.95	1.58	111	44	17	65	4	18	76.4
1.56	2.8	4.5	17	2.1	ZV418S_K402_0115 EZ505U	15	22	570	11.52	1.04	0.90	1.56	111	44	17	65	4	18	76.4
1.56	3.1	10	19	1.9	ZV418S_K402_0115 EZ802U	15	29	570	11.52	1.04	0.90	1.56	111	44	17	65	4	18	76.4
1.56	3.5	5.8	22	1.7	ZV418S_K402_0115 EZ703U	15	22	570	11.52	1.04	0.90	1.56	111	44	17	65	4	18	76.4
1.56	4.8	8.8	29	1.2	ZV418S_K402_0115 EZ705U	15	29	570	11.52	1.04	0.90	1.56	111	44	17	65	4	18	76.4
1.78	2.4	3.9	17	2.3	ZV418S_K402_0100 EZ505U	15	19	570	10.10	1.35	1.19	1.98	111	44	17	65	4	18	76.4
1.78	2.7	8.8	19	2.1	ZV418S_K402_0100 EZ802U	15	29	570	10.10	1.35	1.19	1.98	111	44	17	65	4	18	76.4
1.78	3.1	5.1	22	1.8	ZV418S_K402_0100 EZ703U	15	19	570	10.10	1.35	1.19	1.98	111	44	17	65	4	18	76.4
1.78	4.2	7.7	29	1.3	ZV418S_K402_0100 EZ705U	15	29	570	10.10	1.35	1.19	1.98	111	44	17	65	4	18	76.4
1.95	2.2	3.6	17	2.4	ZV418S_K402_0092 EZ505U	14	18	540	9.238	1.30	1.13	1.95	111	44	17	65	4	18	76.4
1.95	2.5	8.1	19	2.2	ZV418S_K402_0092 EZ802U	15	29	570	9.238	1.30	1.13	1.95	111	44	17	65	4	18	76.4
1.95	2.8	4.7	22	1.9	ZV418S_K402_0092 EZ703U	14	18	540	9.238	1.30	1.13	1.95	111	44	17	65	4	18	76.4
1.95	3.8	7.0	30	1.4	ZV418S_K402_0092 EZ705U	15	29	570	9.238	1.30	1.13	1.95	111	44	17	65	4	18	76.4
2.15	2.0	3.3	17	2.6	ZV418S_K402_0084 EZ505U	13	16	490	8.377	1.43	1.24	2.15	111	44	17	65	4	18	76.4
2.15	2.2	7.3	19	2.4	ZV418S_K402_0084 EZ802U	15	29	570	8.377	1.43	1.24	2.15	111	44	17	65	4	18	76.4
2.15	2.6	4.3	22	2.0	ZV418S_K402_0084 EZ703U	13	16	490	8.377	1.43	1.24	2.15	111	44	17	65	4	18	76.4
2.15	3.5	6.4	30	1.5	ZV418S_K402_0084 EZ705U	15	29	570	8.377	1.43	1.24	2.15	111	44	17	65	4	18	76.4
2.68	1.6	2.6	18	3.0	ZV418S_K402_0067 EZ505U	10	13	390	6.719	1.79	1.55	2.68	111	44	17	65	4	18	76.4
2.68	1.8	5.9	20	2.7	ZV418S_K402_0067 EZ802U	14	29	550	6.719	1.79	1.55	2.68	111	44	17	65	4	18	76.4
2.68	2.1	3.4	23	2.4	ZV418S_K402_0067 EZ703U	10	13	390	6.719	1.79	1.55	2.68	111	44	17	65	4	18	76.4
2.68	2.8	5.1	30	1.8	ZV418S_K402_0067 EZ705U	14	29	550	6.719	1.79	1.55	2.68	111	44	17	65	4	18	76.4

12.3 Dimensional drawings

This chapter shows you the dimensions of rack and pinion drives with EZ synchronous servo motors.

Dimension az in the tables of dimensions applies to Atlanta gear racks. In general: az = ½ d0 + h0 + x*mn

The pinion of the rack and pinion drive is helical (left-hand 19° 31 42"). The pinion gearing quality is 5.

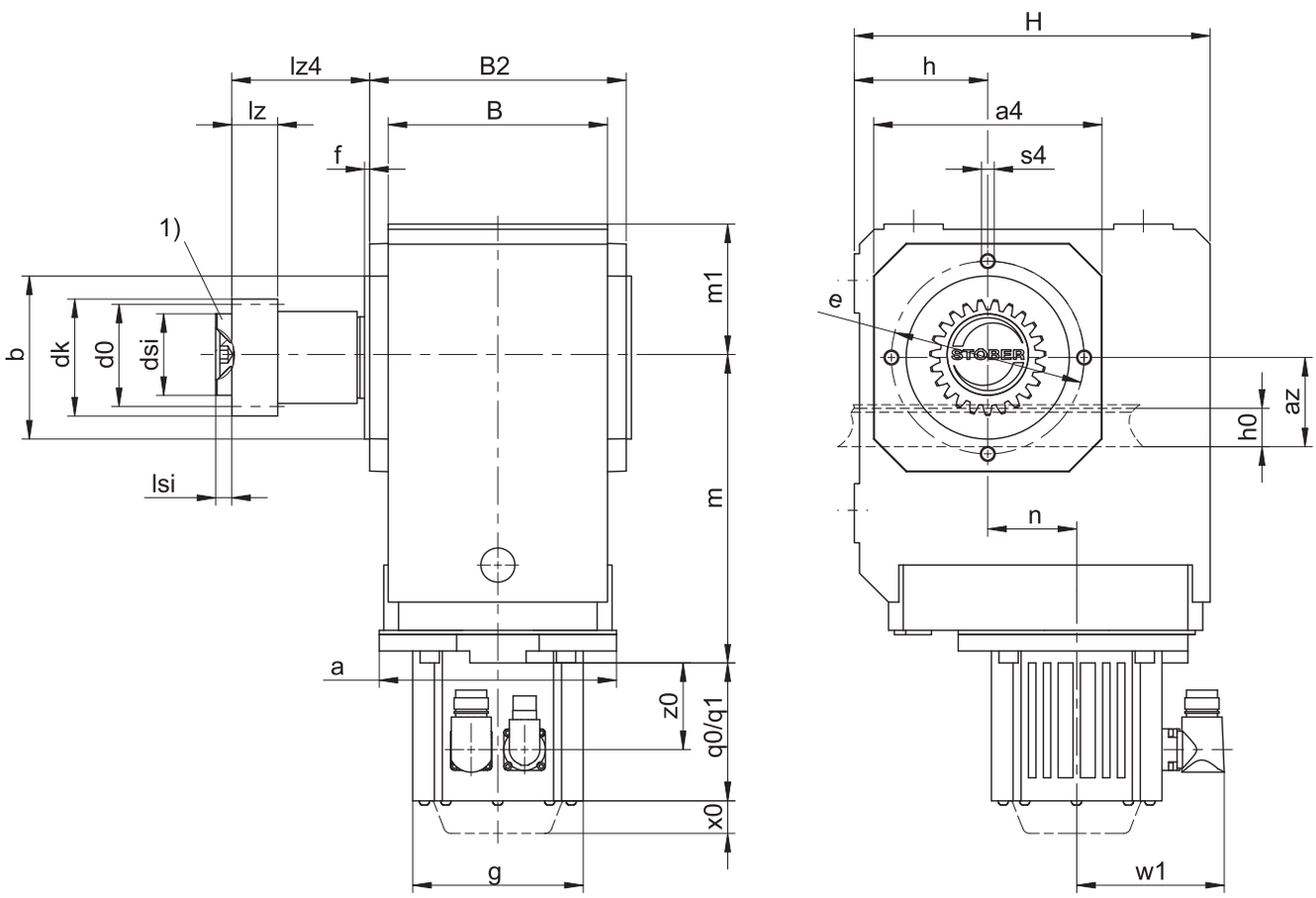
Dimensions can exceed the specifications of ISO 2768-mK due to casting tolerances or accumulation of individual tolerances.

We reserve the right to make dimensional changes due to ongoing technical development.

You can download 3D models of our standard drives at http://configurator.stoeber.de.

Combination options and the dimensions of forced ventilated geared motors can also be found at http://configurator.stoeber.de.

12.3.1 Pinion position E



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x0	Applies to encoders using an optical measuring method.	w1	Different for the One Cable Solution (OCS), see the chapter [▶ 13.4]
1)	Axial locking (optional)		

Dimensions of gear units

Type	mn	az	□a4	Øb	B	B2	Ød0	Ødk	Ødsi	Øe	f	h	h0	H	lz	lz4	lsi	m1	s4	x
ZV220SEK1_	2	44.02	105	75_{j6}	90	106	42.44	47.90	30	90	3.0	60	22	160	26	50.5	6	60	M8	0.4
ZV225SEK2_	2	49.33	116	82_{j6}	115	134	53.05	58.52	45	100	3.0	65	22	190	26	67.5	8	65	M8	0.4
ZV318SEK2_	3	55.55	116	82_{j6}	115	134	57.30	65.01	45	100	3.0	65	26	190	31	67.5	8	65	M8	0.3
ZV225SEK3_	2	49.33	132	95_{j6}	130	146	53.05	58.52	45	115	3.0	75	22	213	26	68.5	8	75	M8	0.4
ZV318SEK3_	3	55.55	132	95_{j6}	130	146	57.30	65.01	45	115	3.0	75	26	213	31	68.5	8	75	M8	0.3
ZV322SEK4_	3	62.21	152	110_{j6}	148	173	70.03	78.35	55	130	3.5	90	26	240	31	93.0	10	90	M10	0.4
ZV418SEK4_	4	74.40	152	110_{j6}	148	173	76.40	86.77	55	130	3.5	90	35	240	41	93.0	10	90	M10	0.3

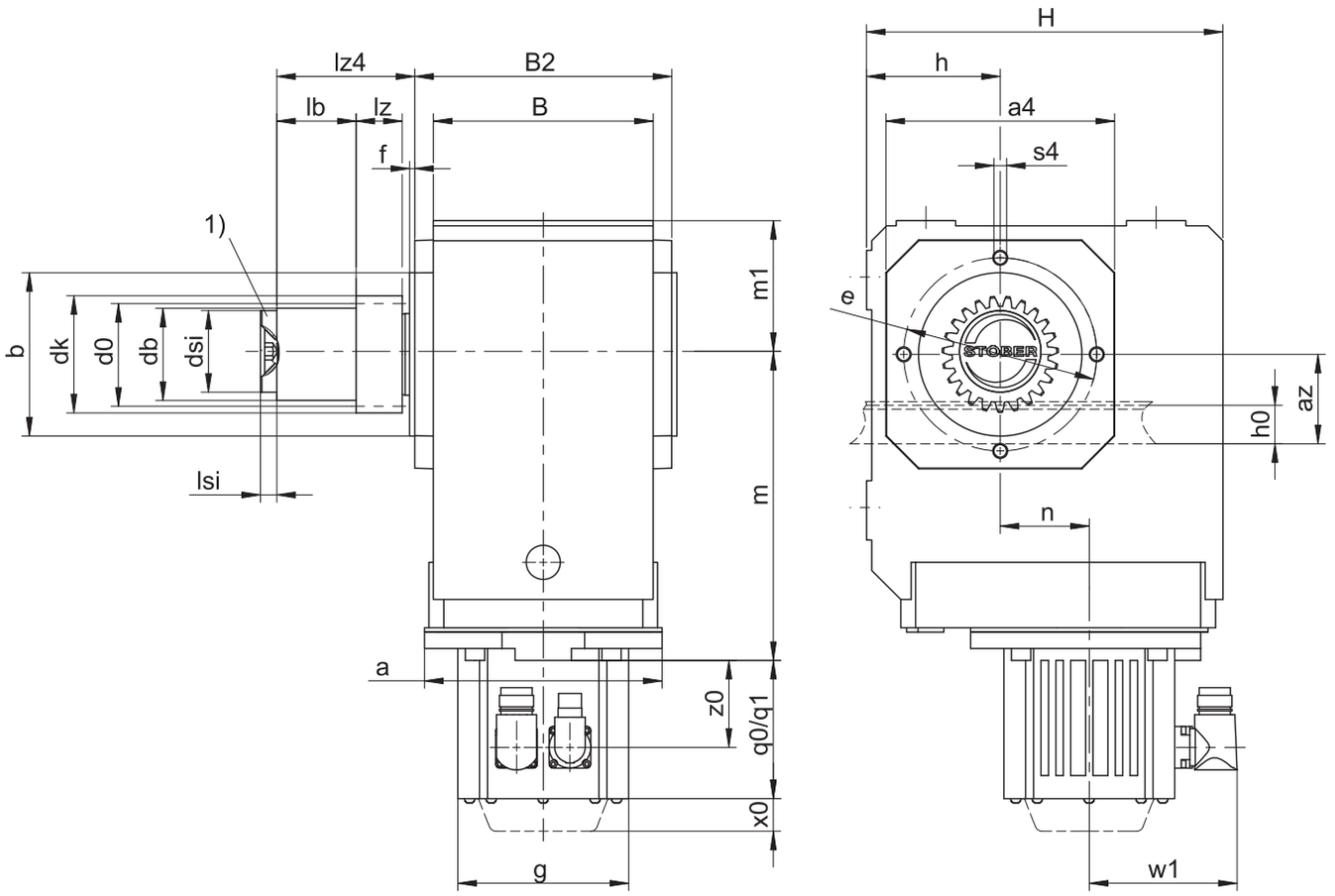
Dimensions of motors

Type	□g	q0	q1	w1	x0	z0
EZ301U	72	114.0	154.0	55.5	21	78.5
EZ302U	72	136.0	176.0	55.5	21	100.5
EZ303U	72	158.0	198.0	55.5	21	122.5
EZ401U	98	118.5	167.0	91.0	22	76.5
EZ402U	98	143.5	192.0	91.0	22	101.5
EZ404U	98	193.5	242.0	91.0	22	151.5
EZ501U	115	112.0	166.5	100.0	22	77.5
EZ502U	115	137.0	191.5	100.0	22	102.5
EZ503U	115	162.0	216.5	100.0	22	127.5
EZ505U	115	212.0	266.5	100.0	22	177.5
EZ701U	145	125.0	184.0	115.0	22	87.0
EZ702U	145	150.0	209.0	115.0	22	112.0
EZ703U	145	175.0	234.0	115.0	22	137.0
EZ705U	145	230.0	289.0	134.0	22	188.0
EZ802U	190	232.5	309.5	156.5	22	178.5
EZ803U	190	273.5	350.5	156.5	22	219.5
EZ805U	190	355.5	432.5	156.5	22	301.5

Dimensions of geared motors

Type	EZ3			EZ4			EZ5			EZ7			EZ8		
	a	m	n	a	m	n	a	m	n	a	m	n	a	m	n
ZV_K102_	□72	124	36.0	□98	124	36.0	□115	128	36.0	□145	130	36.0	–	–	–
ZV_K202_	□72	143	46.0	□98	143	46.0	□115	147	46.0	□145	149	46.0	–	–	–
ZV_K203_	∅140	180	46.0	∅140	180	46.0	–	–	–	–	–	–	–	–	–
ZV_K302_	∅140	163	52.5	∅140	163	52.5	□115	167	52.5	□145	169	52.5	–	–	–
ZV_K303_	∅140	200	52.5	∅140	200	52.5	∅160	210	16.0	–	–	–	–	–	–
ZV_K402_	–	–	–	–	–	–	∅160	187	60.0	□145	189	60.0	□190	192	60.0
ZV_K403_	∅140	220	60.0	∅140	220	60.0	∅160	230	23.0	–	–	–	–	–	–

12.3.2 Pinion position S



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x0	Applies to encoders using an optical measuring method.	w1	Different for the One Cable Solution (OCS), see the chapter [▶ 13.4]
1)	Axial locking (optional)		

Dimensions of gear units

Type	mn	az	□a4	Øb	B	B2	Ød0	Ødb	Ødk	Ødsi	Øe	f	h	h0	H	lb	lz	lz4	lsi	m1	Øs4	x
ZV220SSK1_	2	44.02	105	75_{j6}	90	106	42.44	38	47.90	30	90	3.0	60	22	160	12.5	26	50.5	6	60	M8	0.4
ZV225SSK2_	2	49.33	116	82_{j6}	115	134	53.05	50	58.52	45	100	3.0	65	22	190	34.5	26	67.5	8	65	M8	0.4
ZV318SSK2_	3	55.55	116	82_{j6}	115	134	57.30	50	65.01	45	100	3.0	65	26	190	29.5	31	67.5	8	65	M8	0.3
ZV225SSK3_	2	49.33	132	95_{j6}	130	146	53.05	50	58.52	45	115	3.0	75	22	213	34.5	26	68.5	8	75	M8	0.4
ZV318SSK3_	3	55.55	132	95_{j6}	130	146	57.30	50	65.01	45	115	3.0	75	26	213	29.5	31	68.5	8	75	M8	0.3
ZV322SSK4_	3	62.21	152	110_{j6}	148	173	70.03	62	78.35	55	130	3.5	90	26	240	53.5	31	93.0	10	90	M10	0.4
ZV418SSK4_	4	74.40	152	110_{j6}	148	173	76.40	62	86.77	55	130	3.5	90	35	240	43.5	41	93.0	10	90	M10	0.3

Dimensions of motors

Type	□g	q0	q1	w1	x0	z0
EZ301U	72	114.0	154.0	55.5	21	78.5
EZ302U	72	136.0	176.0	55.5	21	100.5
EZ303U	72	158.0	198.0	55.5	21	122.5
EZ401U	98	118.5	167.0	91.0	22	76.5
EZ402U	98	143.5	192.0	91.0	22	101.5
EZ404U	98	193.5	242.0	91.0	22	151.5
EZ501U	115	112.0	166.5	100.0	22	77.5
EZ502U	115	137.0	191.5	100.0	22	102.5
EZ503U	115	162.0	216.5	100.0	22	127.5
EZ505U	115	212.0	266.5	100.0	22	177.5
EZ701U	145	125.0	184.0	115.0	22	87.0
EZ702U	145	150.0	209.0	115.0	22	112.0
EZ703U	145	175.0	234.0	115.0	22	137.0
EZ705U	145	230.0	289.0	134.0	22	188.0
EZ802U	190	232.5	309.5	156.5	22	178.5
EZ803U	190	273.5	350.5	156.5	22	219.5
EZ805U	190	355.5	432.5	156.5	22	301.5

Dimensions of geared motors

Type	EZ3			EZ4			EZ5			EZ7			EZ8		
	a	m	n	a	m	n	a	m	n	a	m	n	a	m	n
ZV_K102_	□72	124	36.0	□98	124	36.0	□115	128	36.0	□145	130	36.0	–	–	–
ZV_K202_	□72	143	46.0	□98	143	46.0	□115	147	46.0	□145	149	46.0	–	–	–
ZV_K203_	∅140	180	46.0	∅140	180	46.0	–	–	–	–	–	–	–	–	–
ZV_K302_	∅140	163	52.5	∅140	163	52.5	□115	167	52.5	□145	169	52.5	–	–	–
ZV_K303_	∅140	200	52.5	∅140	200	52.5	∅160	210	16.0	–	–	–	–	–	–
ZV_K402_	–	–	–	–	–	–	∅160	187	60.0	□145	189	60.0	□190	192	60.0
ZV_K403_	∅140	220	60.0	∅140	220	60.0	∅160	230	23.0	–	–	–	–	–	–

12.4 Type designation

This chapter shows you an explanation of the type designation with the associated options.

Additional ordering information not included in the type designation can be found at the end of the chapter.

Example code

Z	V	3	22	S	S	K	4	0	2	V	G	0084	EZ802U

Explanation

Code	Designation	Design
Z	Type	Rack and pinion drive
V	Design	Plug-on pinion
3	Module	m_n = 3 (example)
22	Number of teeth	z = 22 (example)
S	Toothing	Helical (left-hand 19° 31' 42")
E **S**	Pinion position	Shaft end Shaft shoulder
K	Type	Helical bevel gear unit
4	Size	4 (example)
0 1	Generation	Generation 0 Generation 1
2 3	Stages	Two-stage Three-stage
V	Shaft	Solid shaft
G	Housing	Pitch circle diameter
0080	Transmission ratio (i x 10 rounded)	i = 8.377 (example)
EZ802U	Motor	EZ synchronous servo motor

To complete the type designation, also specify the following in your order:

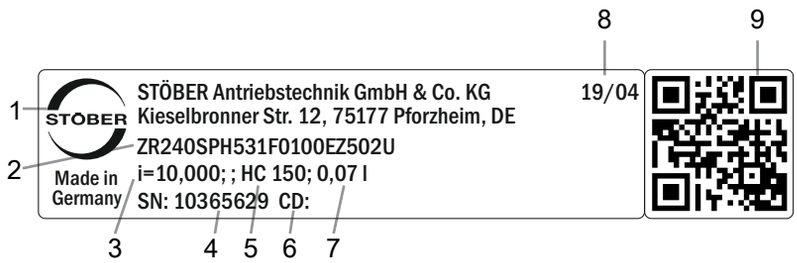
- For a detailed type designation of the motor, see the chapter [▶ 13]
- For the mounting position, see the chapter [▶ 12.5.4]
- Attachment of solid shaft: gear unit side 3 or 4
- Pitch circle diameter: gear unit side 3 or 4
- Backlash: Standard/class II/class I. Backlash class II and class I for an additional charge.
- For axial locking (optional), see the chapter [▶ 12.3]
- For the position of the plug connectors, see the chapter [▶ 12.5.6]

An explanation of the gear unit sides can be found in the chapter [▶ 12.5.4]

In this catalog, you will find all information on rack and pinion drives with EZ synchronous servo motors.
All input options available on request can be found in the chapter [▶ 12.5.1].

12.4.1 Nameplate

An example geared motor nameplate is explained in the figure below.



Code	Designation
1	Name of manufacturer
2	Type designation
3	Gear ratio of the gear unit
4	Serial number of the gear unit
5	Lubricant specification
6	Customer-specific data
7	Lubricant fill volume
8	Date of manufacture (year/calendar week)
9	QR code (link to product information)

12.4.1.1 Supporting documents

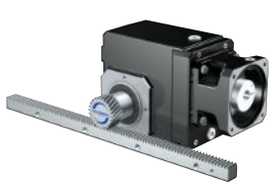
You can view or download supporting documents for the product by reading off the serial number on the nameplate of the product and entering it at the following address online:
https://id.stober.com

Alternatively, you can use a suitable mobile device to scan in the QR code on the nameplate of the product in order to be linked to the supporting documents.

12.5 Product description

12.5.1 Input options

This chapter shows you all available input options:

EZ synchronous servo motor	ME motor adapter	MB motor adapter	LM Lean motor
			
http://www.stoeber.de/en/Z_EZ	http://www.stoeber.de/en/ZVKME	On request	On request

You can also acquire rack and pinion drives with low-backlash K gear units on request. To do so, send us an e-mail at sales@stoeber.de.

12.5.2 Gear rack

The technical data specified in the Selection tables chapter applies only to gear rack combinations with the following characteristics:

The pinion of the rack and pinion drive is case-hardened and helical (left-hand 19° 31' 42"). The pinion gearing quality is 6.

The corresponding gear rack must have a right-hand design (19° 31' 42") and possess the following characteristics:

Module m_n [mm]	Minimum gear rack quality	Gear rack material
2 – 4	8	C45 inductively hardened

Also note the project configuration of the gear rack on the Atlanta pages.

12.5.2.1 Pinion position

The pinion can be fastened to the shaft in two different attachment positions:

- The toothing is flush with the shaft end (Pos. E)
- The toothing is flush with the shaft shoulder (Pos. S: For higher permitted feed forces, see the Selection tables chapter)

Please specify the desired attachment position when placing your order.

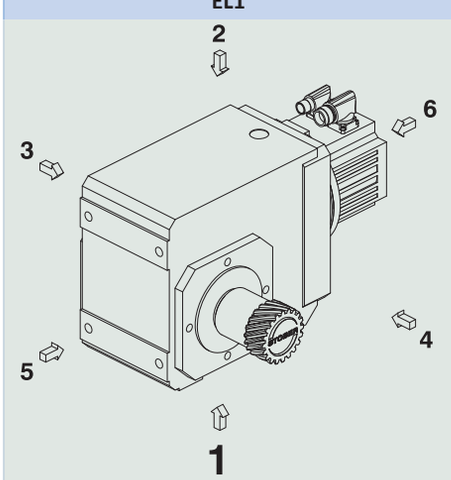
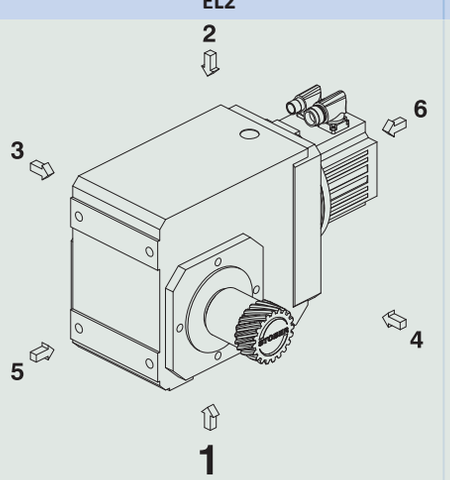
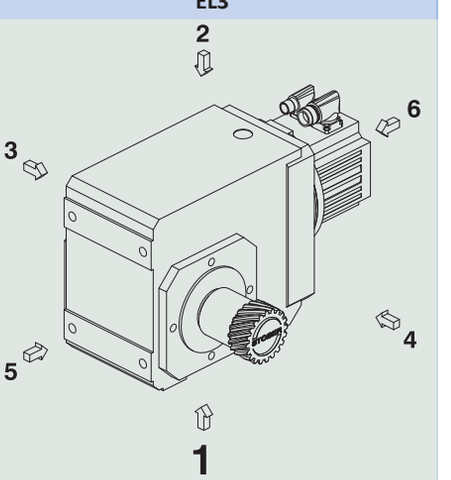
12.5.3 Installation conditions

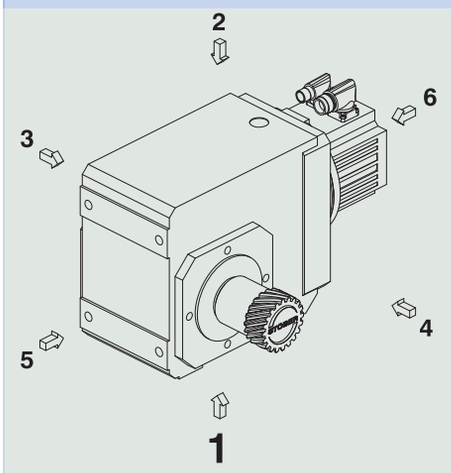
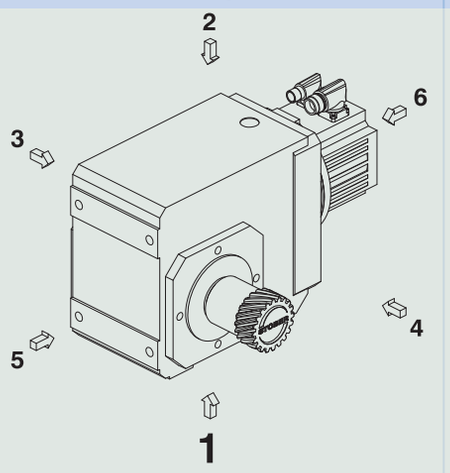
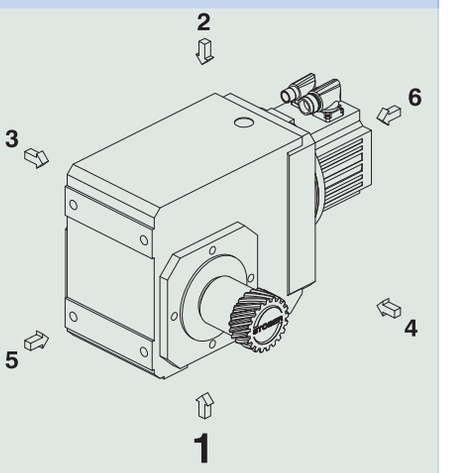
The specified torques and forces only apply when gear units are fastened on the machine side using screws of strength class 10.9. In addition, the gear housings must be adjusted at the pilot. The machine-side fit must be H7.

12.5.4 Mounting positions

The following table shows the standard mounting positions.

The numbers identify the gear unit sides. The mounting position is defined by the gear side facing downwards.

EL1	EL2	EL3
		

EL4	EL5	EL6
		

Since the lubricant filling volume of the gear unit depends on the mounting position, the mounting position must be specified when ordering.

12.5.5 Lubricants

STOBER fills the gear units with the amount and type of lubricant specified on the nameplate. The filling volume and the structure of the gear units depend on the mounting position.

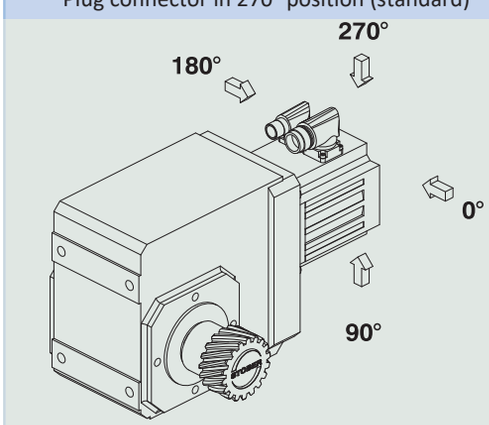
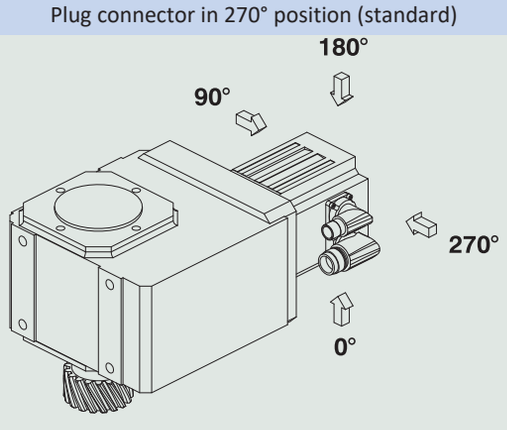
Only install the gear units in the intended mounting position! Reposition the gear units only after consulting STOBER. Otherwise, STOBER assumes no liability for the gear units.

You will receive lubricants for use in the food industry upon request.

12.5.5.1 Rack and pinion drive lubrication

Make sure the rack and pinion drive has permanent lubrication with the lubricants specified in the Atlanta product catalog.

12.5.6 Position of the plug connectors

Mounting position EL1 Plug connector in 270° position (standard)	Mounting position EL4 Plug connector in 270° position (standard)
	

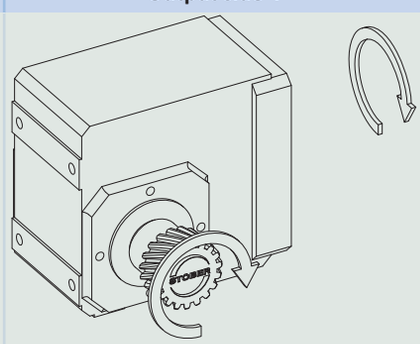
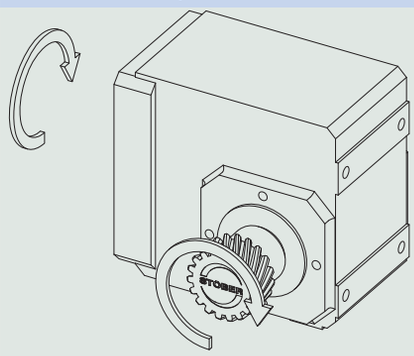
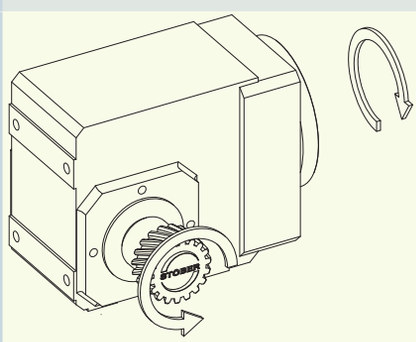
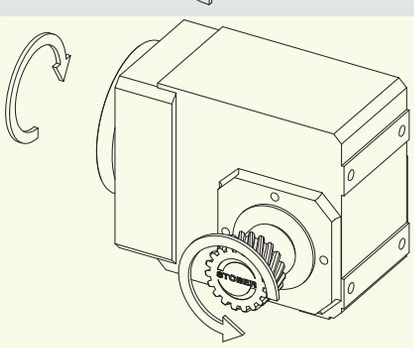
The plug connectors are in the 270° position as standard. Indicate variations for your rack and pinion drive in the order.

Note that the plug connectors also rotate when the gear rack is rotated to a different position.

12.5.7 Other product features

Feature	Value
Max. permitted gear unit temperature (on the surface of the gear unit)	≤ 80 °C
Paint	Black RAL 9005
(ATEX) Directive 2014/34/EU (Option)	Not suitable.
Protection class: [1]	
Planetary gear units	IP65
Motor	IP56, optionally IP66
Pinion/gear rack	IPXX

12.5.8 Direction of rotation

Type	Output side 4	Output side 3
K102 – K402		
K203 – K403		

The pictures show mounting position EL1.

12.6 Project configuration

Project your drives using our SERVOsoft designing software. Download SERVOsoft for free at https://www.stoeber.de/en/ServoSoft.

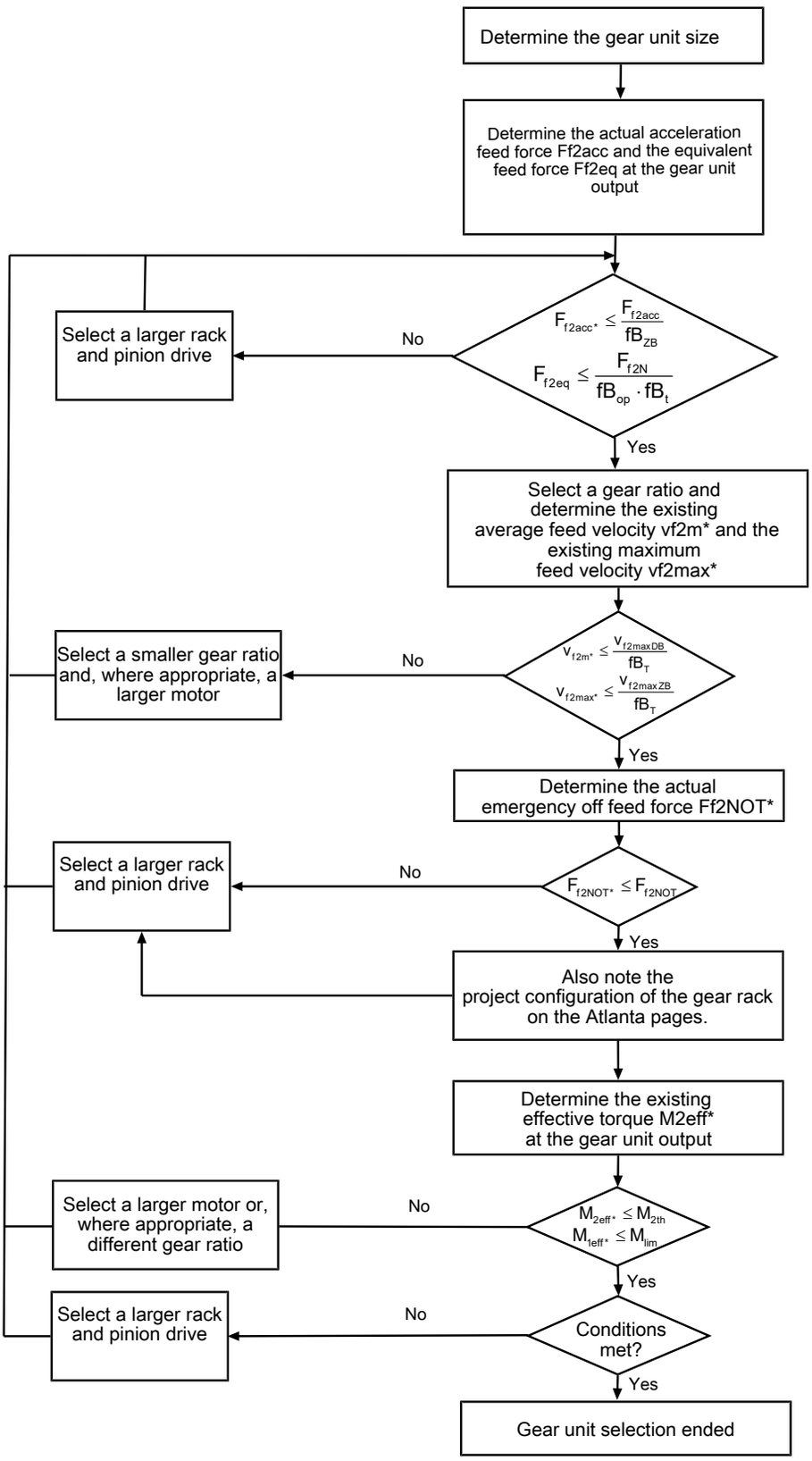
Observe the limit conditions in this chapter to ensure a safe design for your drives.

The formula symbols for values actually present in the application are marked with *.

An explanation of the formula symbols can be found in the chapter [▶ 15.1].

[1] Observe the protection class of all the components.

12.6.1 Drive selection

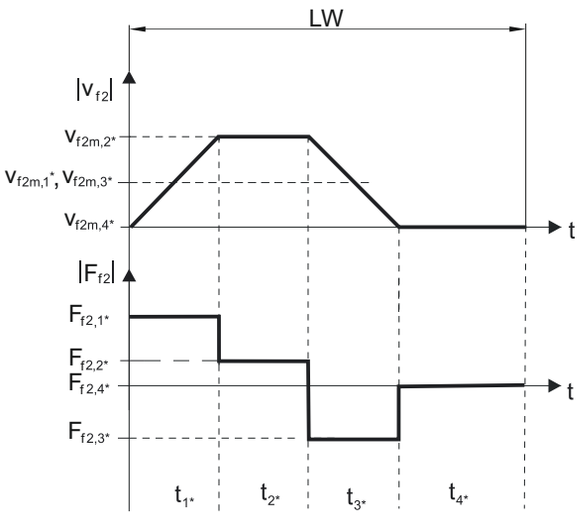


Refer to the selection tables for the values of i, $v_{f2maxDB}$, $v_{f2maxZB}$, F_{f2acc}, F_{f2N} and F_{f2NOT}.

The values for fB_T, fB_{op}, fB_t and fB_{ZB} can be found in the corresponding tables in this chapter.

Example of cyclic operation

The following calculations are based on a representation of the power taken from the output based in accordance with the following example:



Calculation of the actual maximum acceleration feed force

$$F_{f2acc*} = m* \cdot a* + F_{L*}$$

Calculation of the actual average input speed

$$n_{1m*} = \frac{v_{f2m*} \cdot i}{d_0 \cdot \pi}$$

$$v_{f2m*} = \frac{\left|v_{f2m,1*}\right| \cdot t_{1*} + \ldots + \left|v_{f2m,n*}\right| \cdot t_{n*}}{t_{1*} + \ldots + t_{n*}}$$

If $t_{1*} + \ldots + t_{3*} \geq 6$ min, determine v_{2m*} without the rest phase t_{4*}.

The values for the ratio i can be found in the selection tables.

Calculation of the actual emergency off feed force

$$F_{f2NOT*} = m* \cdot a_{NOT*} + F_{L*}$$

Calculation of the actual equivalent feed force

$$F_{f2eq*} = \sqrt[3]{\frac{\left|v_{f2m,1*}\right| \cdot t_{1*} \cdot \left|F_{f2,1*}{}^{3}\right| + \ldots + \left|v_{f2m,n*}\right| \cdot t_{n*} \cdot \left|F_{f2,n*}{}^{3}\right|}{\left|v_{f2m,1*}\right| \cdot t_{1*} + \ldots + \left|v_{f2m,n*}\right| \cdot t_{n*}}}$$

Calculation of the thermal limit torque

Calculate the thermal limit torque M_{2th} for a duty cycle $ED_{10} > 50\%$ and the actual average input speed n_{1m*}. (At $K_{mot,th} \leq 0$ you must reduce the average input speed n_{1m*} accordingly or select another geared motor size.)

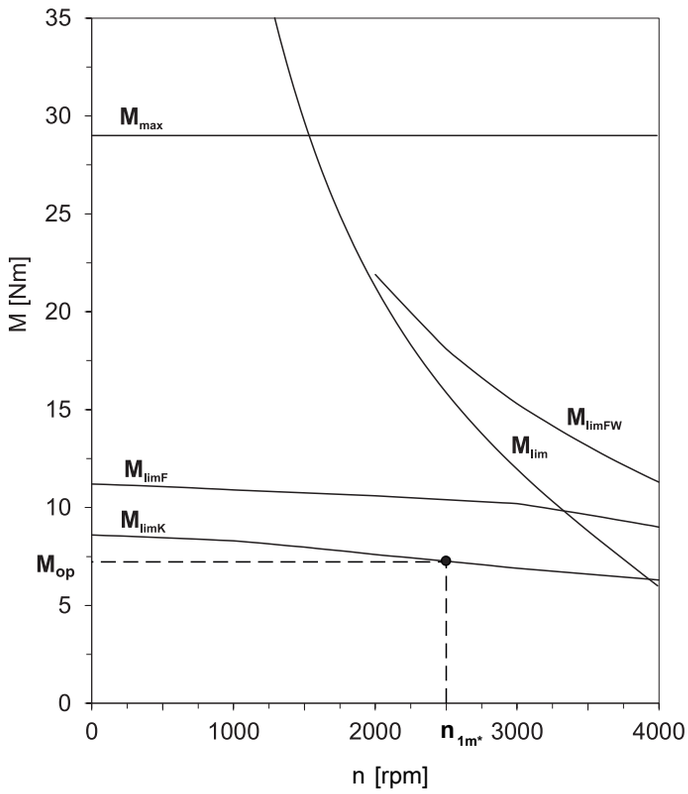
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

$$K_{mot,th} = 0{,}95 - \frac{a_{th}}{1000} \cdot athEL \cdot fB_T \cdot \left(\frac{n_{1m*}}{1000}\right)^2$$

Refer to the selection tables for the values of i and a_{th}.

The values for a_{thEL} and fB_T can be found in the corresponding tables in this chapter.

The value for the torque of the motor at operating point M_{op} with the determined average input speed n_{1m*} can be found in the motor characteristic curve of the chapter [▶ 13.3]. Note the size, nominal speed n_N and cooling type of the motor. The figure below shows an example of reading the torque M_{op} of a motor with convection cooling at the operating point.



Calculation of the actual effective torque

$$M_{2eff*} = \sqrt{\frac{t_{1*} \cdot M_{2,1*}{}^2 + \ldots + t_{n*} \cdot M_{2,n*}{}^2}{t_{1*} + \ldots + t_{n*}}}$$

$$M_{2,n*} = \frac{F_{f2,n*} \cdot d_0}{2}$$

$$M_{1eff*} = \frac{M_{2eff*}}{i \cdot \eta}$$

Operating factors

Parameter a_{thEL}

Mounting position	a_{thEL}
EL1, 2	1.0
EL3, 4, 5, 6	1.1

Operating mode	fB_{op}
Uniform continuous operation	1.00
Cyclic operation	1.00
Reversing load cyclic operation	1.00

Run time	fB_t
Daily runtime ≤ 8 h	1.00
Daily runtime ≤ 16 h	1.15
Daily runtime ≤ 24 h	1.20

Cyclic operation	fB_{ZB}
≤ 1000 load changes/hour (LW/h)	1.00
> 1000 load changes/hour (LW/h)	1.15

Temperature		fB_T
Motor cooling	**Surrounding temperature**	
Motor with forced ventilation	≤ 20 °C	0.9
	≤ 30 °C	1.0
	≤ 40 °C	1.15
Motor with convection cooling	≤ 20 °C	1.0
	≤ 30 °C	1.1
	≤ 40 °C	1.25

Notes

- The maximum permitted gear unit temperature (see the "Other product features" chapter) must not be exceeded, as that could result in damage.
- For braking from full speed (for example, when the power fails or when setting up the machine), note the permitted gear unit feed forces (F_{f2acc}, F_{f2NOT}) in the selection tables.

12.7 Additional documentation

Additional documentation related to the product can be found at
http://www.stoeber.de/en/downloads/

Enter the ID of the documentation in the Search... field.

Documentation	ID
Operating manual for gear racks (Atlanta)	442455
Operating manual for C/F/K/S gear units and gear motors	443027_en
Operating manual for EZ synchronous servo motors	443032_en

13 EZ synchronous servo motors

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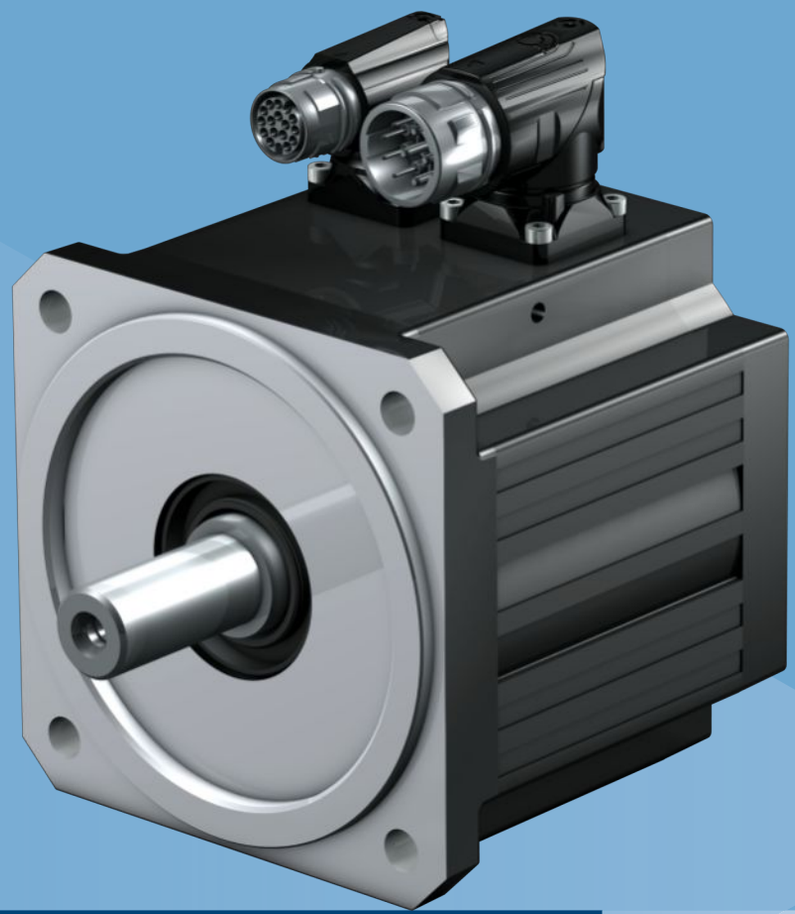


13 Synchronous servo motors EZ

13.1 Overview

Synchronous servo motors with single tooth winding

Features

High dynamics	✓
Short length	✓
Super compact due to tooth-coil winding method with the highest possible copper fill factor	✓
Backlash-free holding brake (optional)	✓
Electronic nameplate for fast and reliable commissioning	✓
Convection cooling or forced ventilation (optional)	✓
Optical, inductive EnDat absolute encoders or resolvers	✓
Elimination of referencing with multi-turn absolute encoders (optional)	✓
One Cable Solution (OCS) with EnDat 3 encoder (optional)	✓
Rotatable plug connectors with quick lock	✓

Torques

M_N	0.89 – 77.2 Nm
M_0	0.95 – 94 Nm

13.2 Selection tables

The technical data specified in the selection tables applies to:

- Installation altitudes up to 1000 m above sea level
- Surrounding temperatures from −15 °C to +40 °C
- Operation on a STOBER drive controller
- DC link voltage U_{ZK} = DC 540 V
- Coating: RAL 9005 Jet black, matte

In addition, the technical data applies to an uninsulated design with the following thermal mounting conditions:

Type	Dimensions of steel mounting flange (thickness x width x height)	Convection surface area Steel mounting flange
EZ3 – EZ5	23 x 210 x 275 mm	0.16 m^2
EZ7 – EZ8	28 x 300 x 400 mm	0.3 m^2

Note the differing ambient conditions in Chapter Derating

Formula symbols

An explanation of the formula symbols can be found in Chapter Symbols in formulas.

Observe the additional information on the following formula symbols:

- I_0 = RMS value of the line-to-line current when stall torque M_0 is generated (tolerance ±5%).
- I_{max} = RMS value of the short-term maximum permitted line-to-line current when maximum torque M_{max} is generated (tolerance ±5%). Exceeding I_{max} may lead to irreversible damage (demagnetization) of the rotor.
- I_N = RMS value of the line-to-line current when nominal torque M_N is generated at the nominal point (tolerance ±5%).
- M_0 = Torque that a motor is continuously able to deliver at a speed of 10 rpm (tolerance ±5%). At a speed of 0 rpm, a minor continuous torque has to be taken into account. Contact your STOBER customer advisor for such an application.

13.2.1 EZ motors with convection cooling

Type	K_{EM} [V/1000 rpm]	n_N [rpm]	M_N [Nm]	I_N [A]	$K_{M,N}$ [Nm/A]	P_N [kW]	M_0 [Nm]	I_0 [A]	K_{M0} [Nm/A]	M_R [Nm]	M_{max} [Nm]	I_{max} [A]	R_{U-V} [Ω]	L_{U-V} [mH]	T_{el} [ms]	J_{dyn} [kgcm²]	m_{dyn} [kg]
EZ301U	40	6000	0.89	1.93	0.46	0.56	0.95	2.02	0.49	0.04	2.80	12.7	11.70	39.80	3.40	0.19	1.50
EZ301U	40	3000	0.93	1.99	0.47	0.29	0.95	2.02	0.49	0.04	2.80	12.7	11.70	39.80	3.40	0.19	1.50
EZ302U	42	6000	1.50	3.18	0.47	0.94	1.68	3.48	0.49	0.04	5.00	17.8	4.50	18.70	4.16	0.29	2.10
EZ302U	86	3000	1.59	1.60	0.99	0.50	1.68	1.67	1.03	0.04	5.00	8.55	17.80	75.00	4.21	0.29	2.10
EZ303U	55	6000	1.96	3.17	0.62	1.2	2.25	3.55	0.65	0.04	7.00	16.9	4.90	21.10	4.31	0.40	2.60
EZ303U	109	3000	2.07	1.63	1.27	0.65	2.19	1.71	1.30	0.04	7.00	8.25	20.30	68.70	5.24	0.40	2.60
EZ401U	47	6000	2.30	4.56	0.50	1.4	2.80	5.36	0.53	0.04	8.50	33.0	1.94	11.52	5.94	0.93	4.00
EZ401U	96	3000	2.80	2.74	1.02	0.88	3.00	2.88	1.06	0.04	8.50	16.5	6.70	37.70	5.63	0.93	4.00
EZ402U	60	6000	3.50	5.65	0.62	2.2	4.90	7.43	0.66	0.04	16.0	43.5	1.20	8.88	7.40	1.63	5.10
EZ402U	94	3000	4.70	4.40	1.07	1.5	5.20	4.80	1.09	0.04	16.0	26.5	3.00	21.80	7.26	1.63	5.10
EZ404U	78	6000	5.80	7.18	0.81	3.6	8.40	9.78	0.86	0.04	29.0	51.0	0.89	7.07	7.94	2.98	7.20
EZ404U	116	3000	6.90	5.80	1.19	2.2	8.60	6.60	1.31	0.04	29.0	35.0	1.85	15.00	8.11	2.98	7.20
EZ501U	68	6000	3.40	4.77	0.71	2.1	4.40	5.80	0.77	0.06	16.0	31.0	2.10	12.10	5.76	2.90	5.00
EZ501U	97	3000	4.30	3.74	1.15	1.4	4.70	4.00	1.19	0.06	16.0	22.0	3.80	23.50	6.18	2.90	5.00
EZ502U	72	6000	5.20	7.35	0.71	3.3	7.80	9.80	0.80	0.06	31.0	59.0	0.76	5.60	7.37	5.20	6.50
EZ502U	121	3000	7.40	5.46	1.36	2.3	8.00	5.76	1.40	0.06	31.0	33.0	2.32	16.80	7.24	5.20	6.50
EZ503U	84	6000	6.20	7.64	0.81	3.9	10.6	11.6	0.92	0.06	43.0	63.5	0.62	5.00	8.06	7.58	8.00
EZ503U	119	3000	9.70	6.90	1.41	3.1	11.1	7.67	1.46	0.06	43.0	41.0	1.25	10.00	8.00	7.58	8.00
EZ505U	103	4500	9.50	8.94	1.06	4.5	15.3	13.4	1.15	0.06	67.0	73.0	0.50	4.47	8.94	12.2	10.9
EZ505U	141	3000	13.5	8.80	1.53	4.2	16.0	10.0	1.61	0.06	67.0	52.0	0.93	8.33	8.96	12.2	10.9
EZ701U	76	6000	5.20	6.68	0.78	3.3	7.90	9.38	0.87	0.24	20.0	31.0	0.87	8.13	9.34	8.50	8.30
EZ701U	95	3000	7.40	7.20	1.03	2.3	8.30	8.00	1.07	0.24	20.0	25.0	1.30	12.83	9.87	8.50	8.30
EZ702U	82	6000	7.20	8.96	0.80	4.5	14.3	16.5	0.88	0.24	41.0	60.5	0.34	3.90	11.47	13.7	10.8
EZ702U	133	3000	12.0	8.20	1.46	3.8	14.4	9.60	1.53	0.24	41.0	36.0	1.00	11.73	11.73	13.7	10.8
EZ703U	99	4500	12.1	11.5	1.05	5.7	20.0	17.8	1.14	0.24	65.0	78.0	0.36	4.42	12.28	21.6	12.8
EZ703U	122	3000	16.5	11.4	1.45	5.2	20.8	14.0	1.50	0.24	65.0	62.0	0.52	6.80	13.08	21.6	12.8
EZ705U	106	4500	16.4	14.8	1.11	7.7	30.0	25.2	1.20	0.24	104	114	0.22	2.76	12.55	34.0	18.3
EZ705U	140	3000	21.3	14.2	1.50	6.7	30.2	19.5	1.56	0.24	104	87.0	0.33	4.80	14.55	34.0	18.3
EZ802U	90	4500	10.5	11.2	0.94	5.0	34.5	33.3	1.05	0.30	100	135	0.13	1.90	14.60	58.0	26.6
EZ802U	136	3000	22.3	13.9	1.60	7.0	37.1	22.3	1.68	0.30	100	84.0	0.30	5.00	16.66	58.0	26.6
EZ803U	131	3000	26.6	17.7	1.50	8.4	48.2	31.1	1.56	0.30	145	124	0.18	2.79	15.50	83.5	32.7
EZ805U	142	2000	43.7	25.9	1.69	9.2	66.1	37.9	1.75	0.30	205	155	0.13	2.22	17.08	133	45.8

13.2.2 EZ motors with forced ventilation

Type	K_{EM} [V/1000 rpm]	n_N [rpm]	M_N [Nm]	I_N [A]	$K_{M,N}$ [Nm/A]	P_N [kW]	M_0 [Nm]	I_0 [A]	K_{M0} [Nm/A]	M_R [Nm]	M_{max} [Nm]	I_{max} [A]	R_{U-V} [Ω]	L_{U-V} [mH]	T_{el} [ms]	J_{dyn} [kgcm²]	m_{dyn} [kg]
EZ401B	47	6000	2.90	5.62	0.52	1.8	3.50	6.83	0.52	0.04	8.50	33.0	1.94	11.52	5.94	0.93	5.40
EZ401B	96	3000	3.40	3.40	1.00	1.1	3.70	3.60	1.04	0.04	8.50	16.5	6.70	37.70	5.63	0.93	5.40
EZ402B	60	6000	5.10	7.88	0.65	3.2	6.40	9.34	0.69	0.04	16.0	43.5	1.20	8.88	7.40	1.63	6.50
EZ402B	94	3000	5.90	5.50	1.07	1.9	6.30	5.80	1.09	0.04	16.0	26.5	3.00	21.80	7.26	1.63	6.50
EZ404B	78	6000	8.00	9.98	0.80	5.0	10.5	12.0	0.88	0.04	29.0	51.0	0.89	7.07	7.94	2.98	8.60
EZ404B	116	3000	10.2	8.20	1.24	3.2	11.2	8.70	1.29	0.04	29.0	35.0	1.85	15.00	8.11	2.98	8.60
EZ501B	68	6000	4.50	6.70	0.67	2.8	5.70	7.50	0.77	0.06	16.0	31.0	2.10	12.10	5.76	2.90	7.00
EZ501B	97	3000	5.40	4.70	1.15	1.7	5.80	5.00	1.17	0.06	16.0	22.0	3.80	23.50	6.18	2.90	7.00
EZ502B	72	6000	8.20	11.4	0.72	5.2	10.5	13.4	0.79	0.06	31.0	59.0	0.76	5.60	7.37	5.20	8.50
EZ502B	121	3000	10.3	7.80	1.32	3.2	11.2	8.16	1.38	0.06	31.0	33.0	2.32	16.80	7.24	5.20	8.50
EZ503B	84	6000	10.4	13.5	0.77	6.5	14.8	15.9	1.07	0.06	43.0	63.5	0.62	5.00	8.06	7.58	10.0
EZ503B	119	3000	14.4	10.9	1.32	4.5	15.9	11.8	1.35	0.06	43.0	41.0	1.25	10.00	8.00	7.58	10.0
EZ505B	103	4500	16.4	16.4	1.00	7.7	22.0	19.4	1.14	0.06	67.0	73.0	0.50	4.47	8.94	12.2	12.9
EZ505B	141	3000	20.2	13.7	1.47	6.4	23.4	14.7	1.60	0.06	67.0	52.0	0.93	8.33	8.96	12.2	12.9
EZ701B	76	6000	7.50	10.6	0.71	4.7	10.2	12.4	0.84	0.24	20.0	31.0	0.87	8.13	9.34	8.50	11.2
EZ701B	95	3000	9.70	9.50	1.02	3.1	10.5	10.0	1.07	0.24	20.0	25.0	1.30	12.83	9.87	8.50	11.2
EZ702B	82	6000	12.5	16.7	0.75	7.9	19.3	22.1	0.89	0.24	41.0	60.5	0.34	3.90	11.47	13.7	13.7
EZ702B	133	3000	16.6	11.8	1.41	5.2	19.3	12.9	1.51	0.24	41.0	36.0	1.00	11.73	11.73	13.7	13.7
EZ703B	99	4500	19.8	20.3	0.98	9.3	27.2	24.2	1.13	0.24	65.0	78.0	0.36	4.42	12.28	21.6	15.7
EZ703B	122	3000	24.0	18.2	1.32	7.5	28.0	20.0	1.41	0.24	65.0	62.0	0.52	6.80	13.08	21.6	15.7
EZ705B	106	4500	27.7	25.4	1.09	13	39.4	32.8	1.21	0.24	104	114	0.22	2.76	12.55	34.0	21.2
EZ705B	140	3000	33.8	22.9	1.48	11	41.8	26.5	1.59	0.24	104	87.0	0.33	4.80	14.55	34.0	21.2
EZ802B	90	4500	30.6	30.5	1.00	14	47.4	45.1	1.06	0.30	100	135	0.13	1.90	14.60	58.0	31.6
EZ802B	136	3000	34.3	26.5	1.29	11	47.9	28.9	1.67	0.30	100	84.0	0.30	5.00	16.66	58.0	31.6
EZ803B	131	3000	49.0	35.9	1.37	15	66.7	42.3	1.58	0.30	145	124	0.18	2.79	15.50	83.5	37.7
EZ805B	142	2000	77.2	45.2	1.71	16	94.0	53.9	1.75	0.30	205	155	0.13	2.22	17.08	133	51.8

13.3 Torque/speed curves

Torque/speed curves depend on the nominal speed and/or winding design of the motor and the DC link voltage of the drive controller that is used. The following torque/speed curves apply to the DC link voltage DC 540 V.

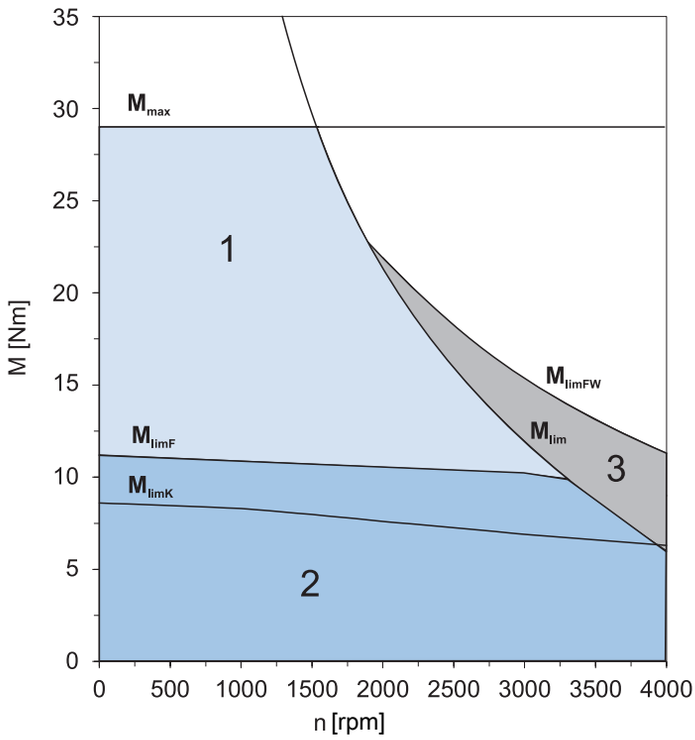
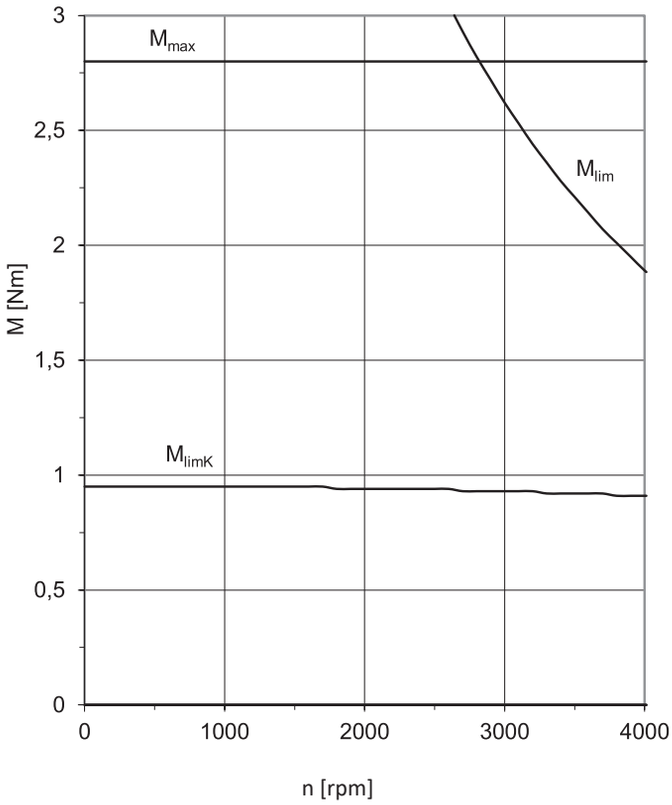


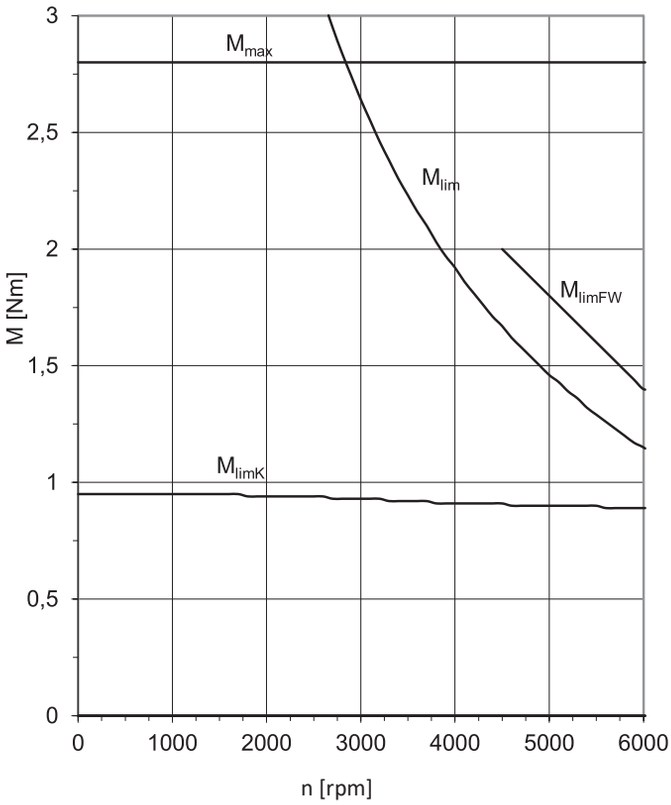
Fig. 1: Explanation of a torque/speed curve

1	Torque range for brief operation (ED_{10} < 100%) with $\Delta\vartheta$ = 100 K	2	Torque range for continuous operation with constant load (S1 mode, ED_{10} = 100%) with $\Delta\vartheta$ = 100 K
3	Field weakening range (can be used only with operation on STOBER drive controllers)		

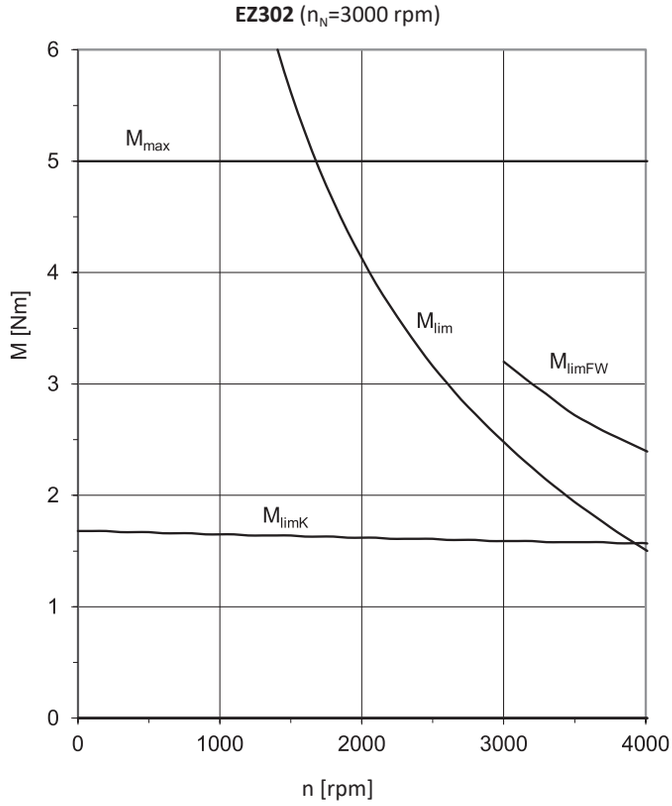
EZ301 (n_N=3000 rpm)



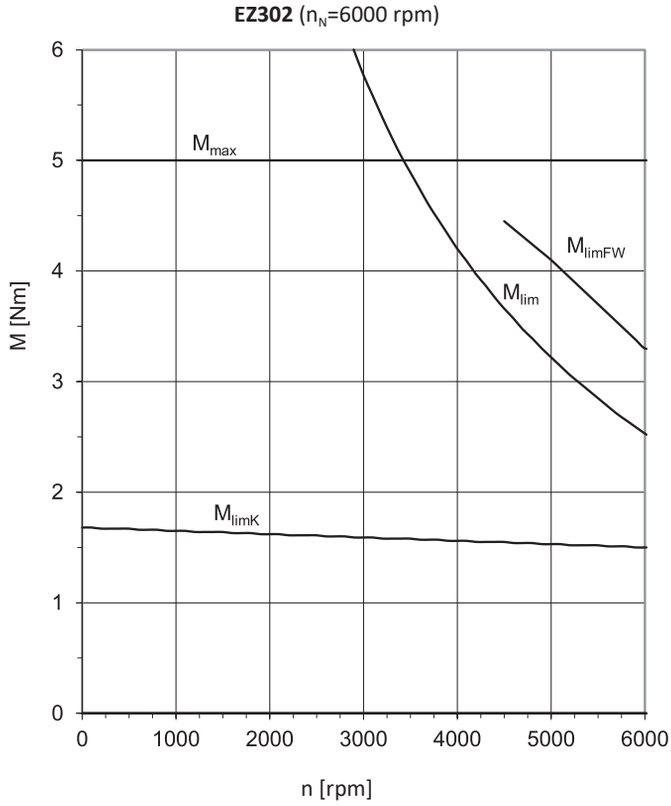
EZ301 (n_N=6000 rpm)



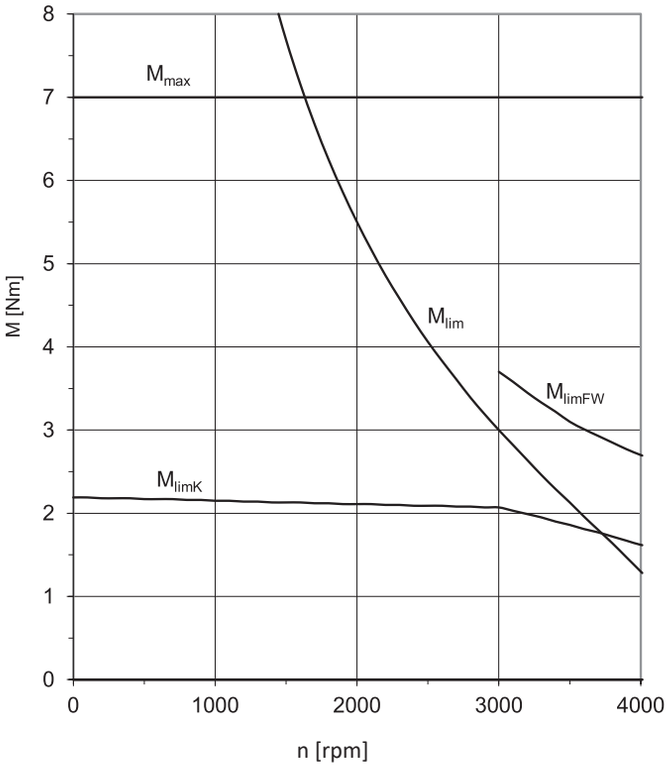
EZ302 (n_N=3000 rpm)



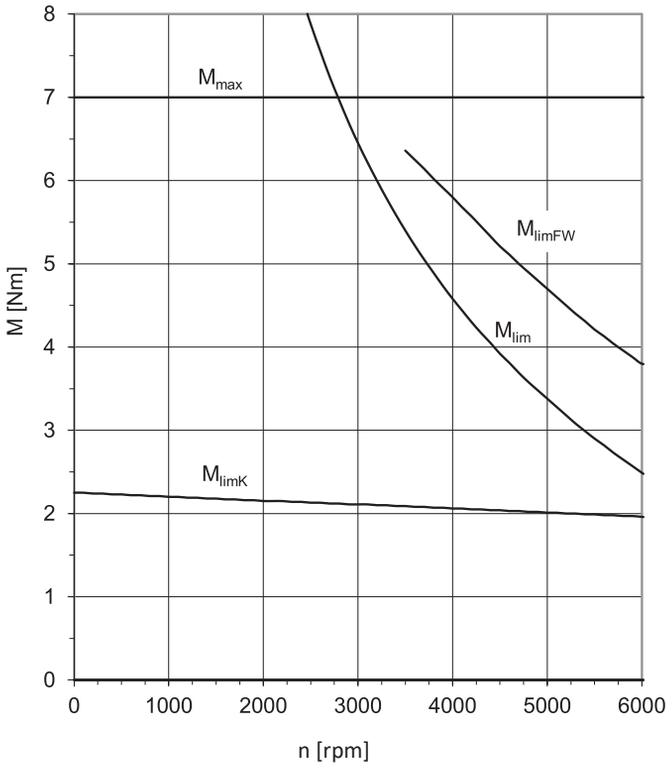
EZ302 (n_N=6000 rpm)



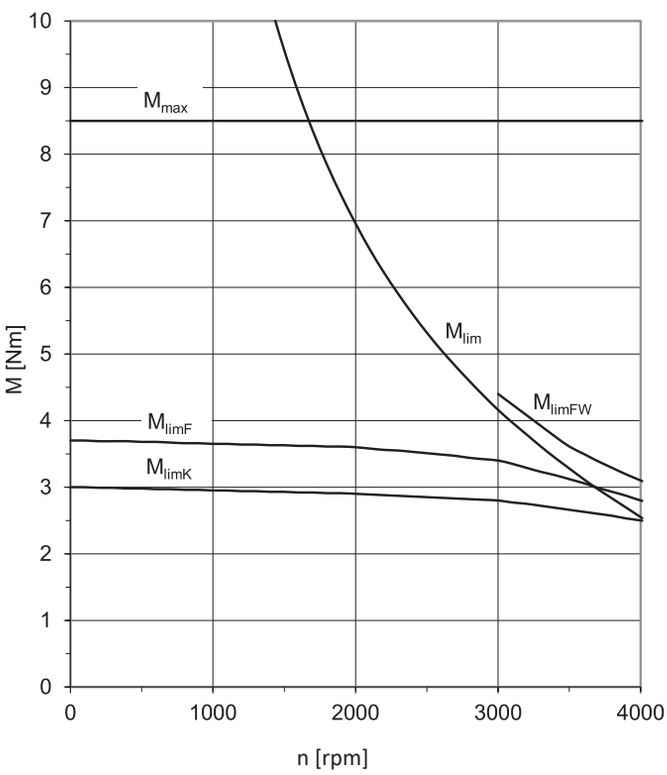
EZ303 (n_N=3000 rpm)



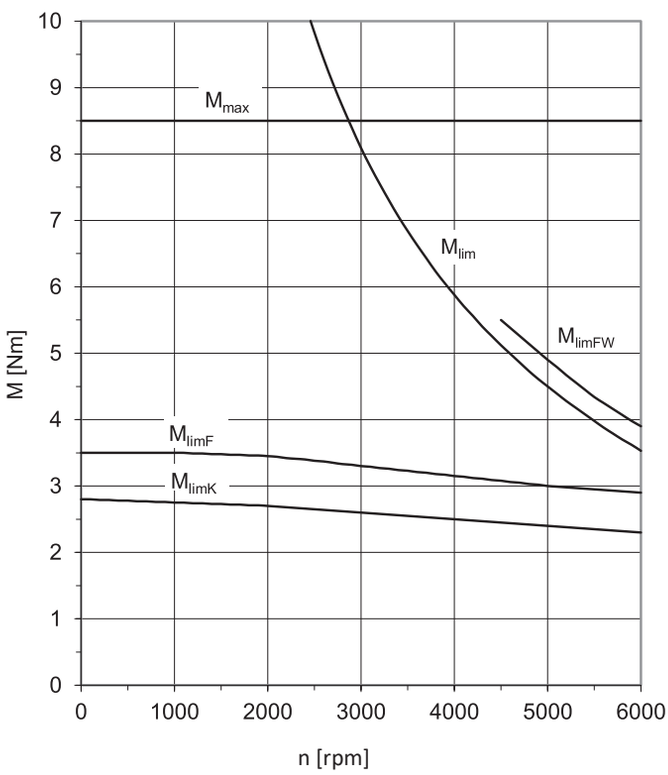
EZ303 (n_N=6000 rpm)



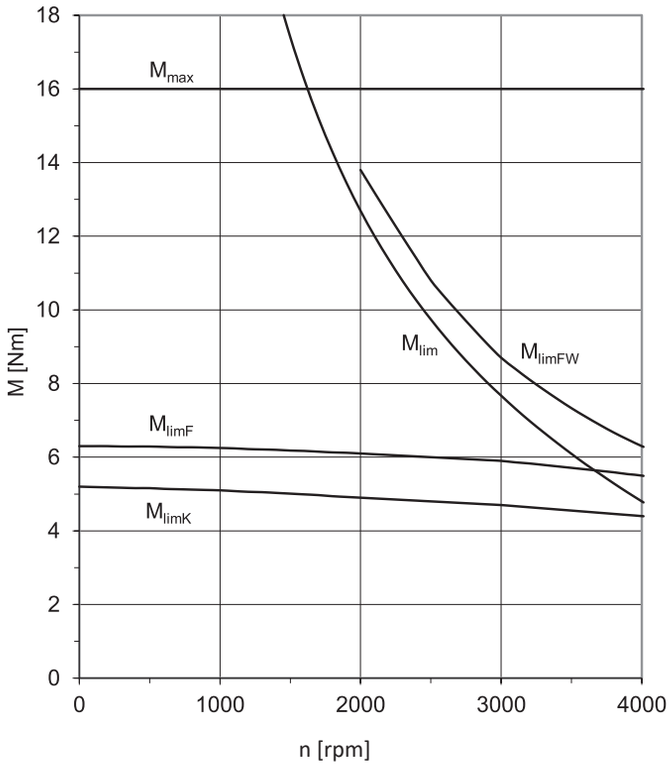
EZ401 (n_N=3000 rpm)



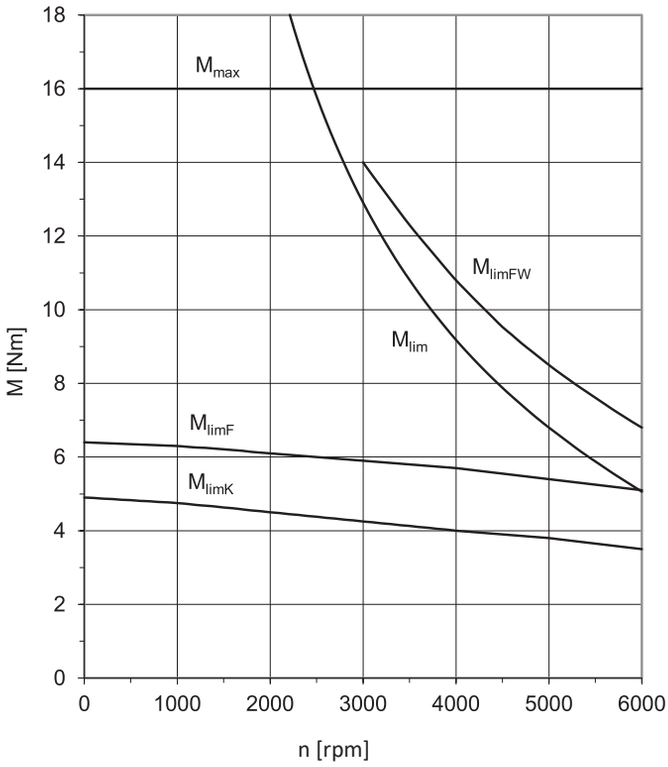
EZ401 (n_N=6000 rpm)



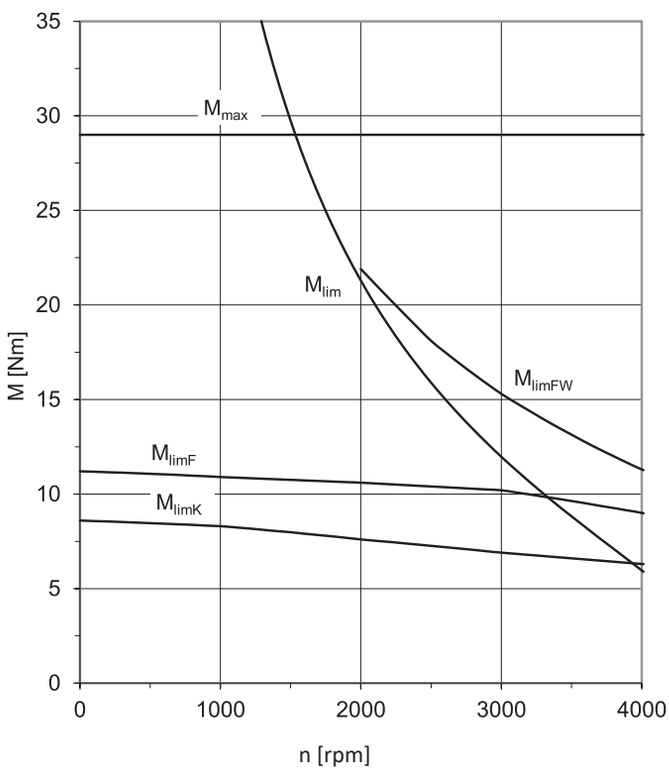
EZ402 (n_N=3000 rpm)



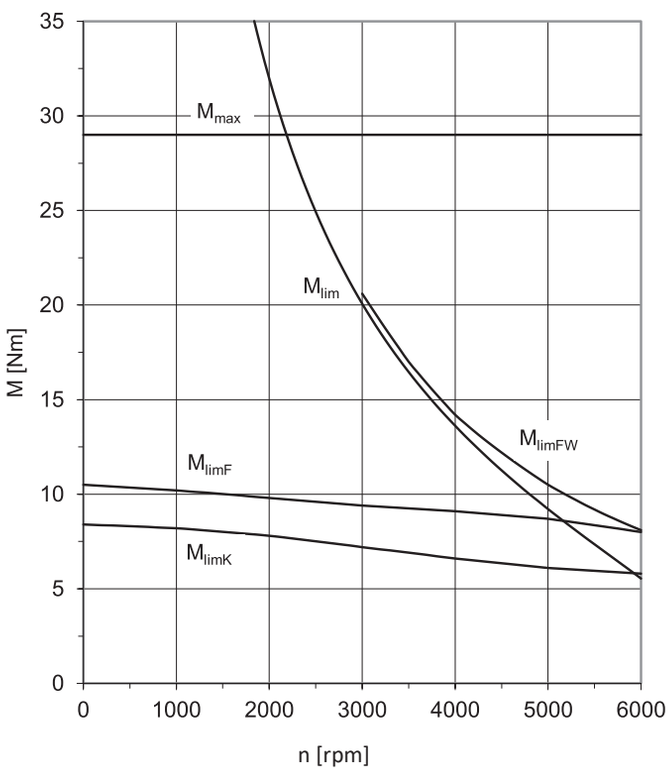
EZ402 (n_N=6000 rpm)



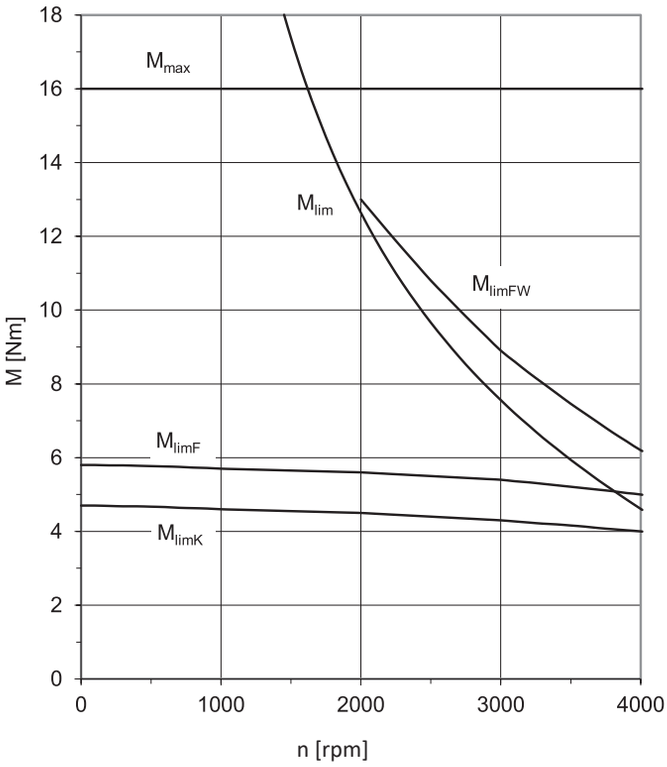
EZ404 (n_N=3000 rpm)



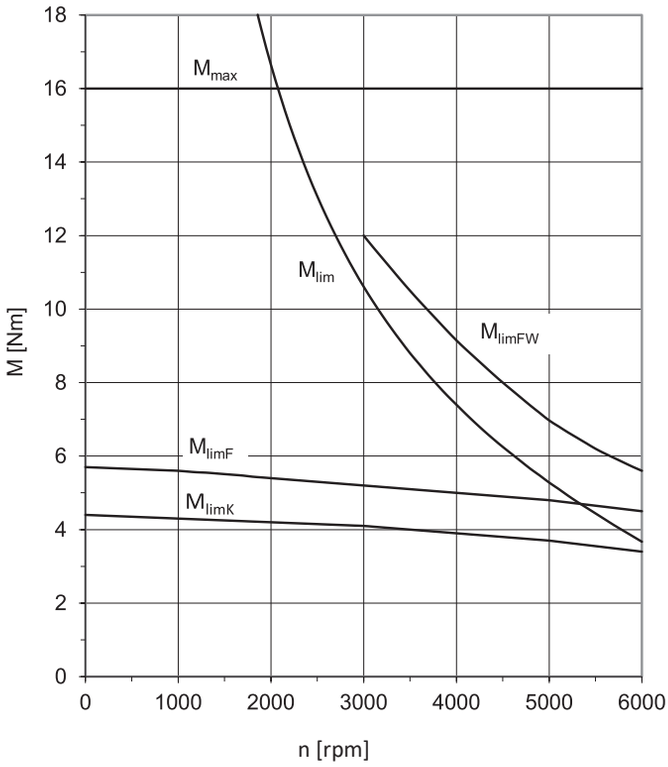
EZ404 (n_N=6000 rpm)



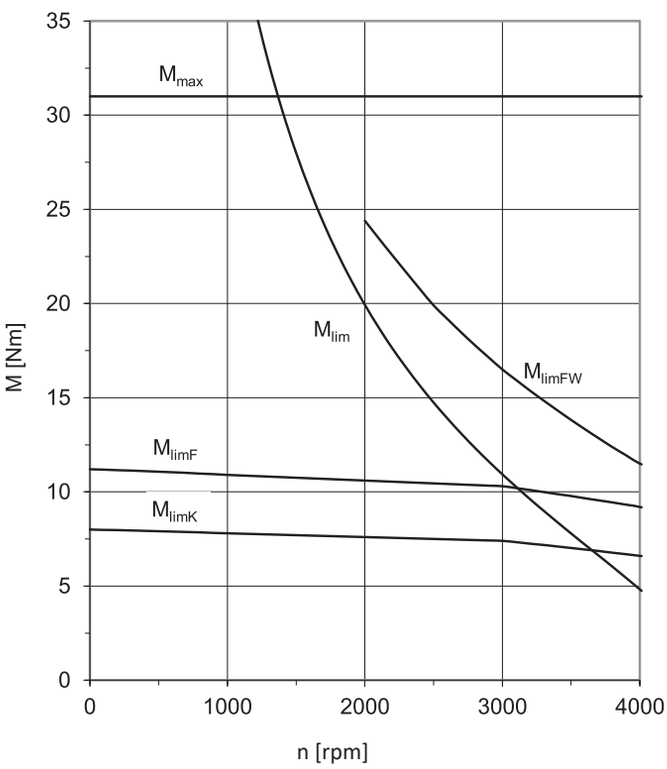
EZ501 (n_N=3000 rpm)



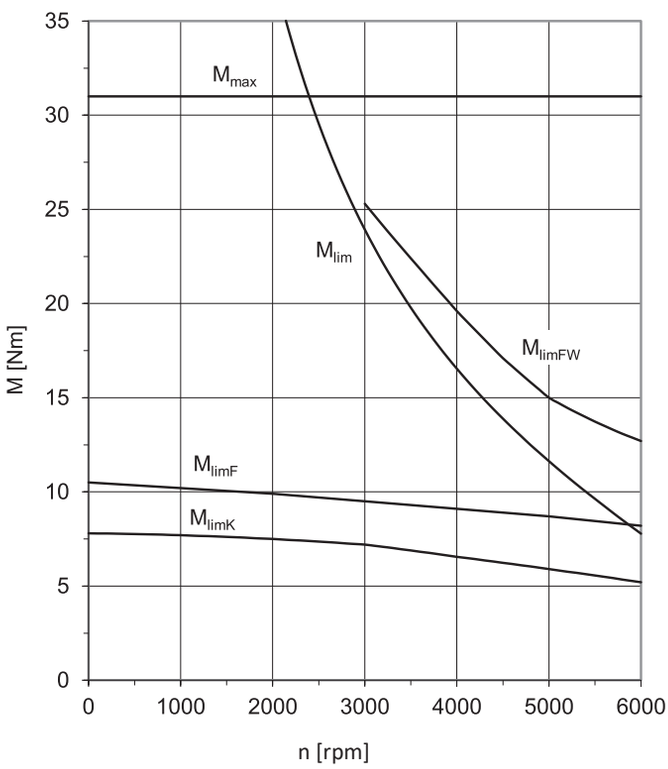
EZ501 (n_N=6000 rpm)



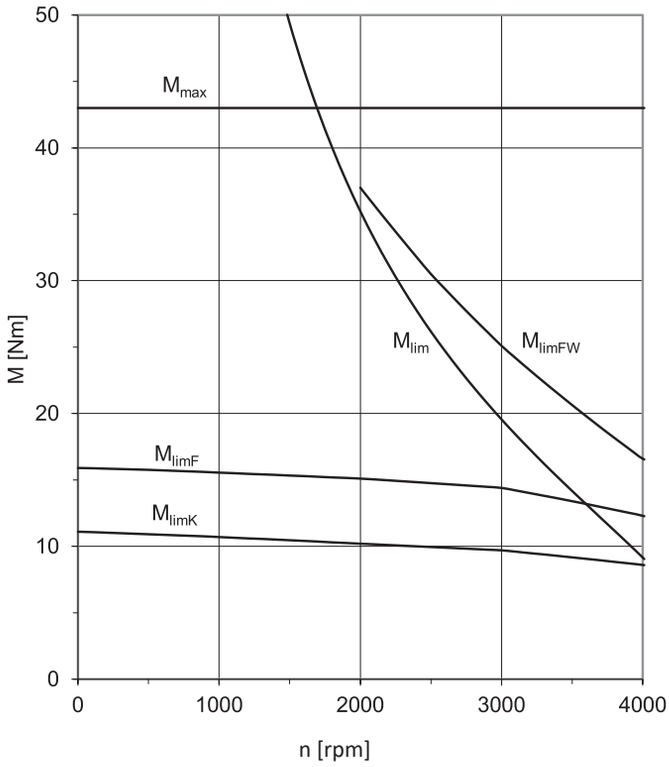
EZ502 (n_N=3000 rpm)



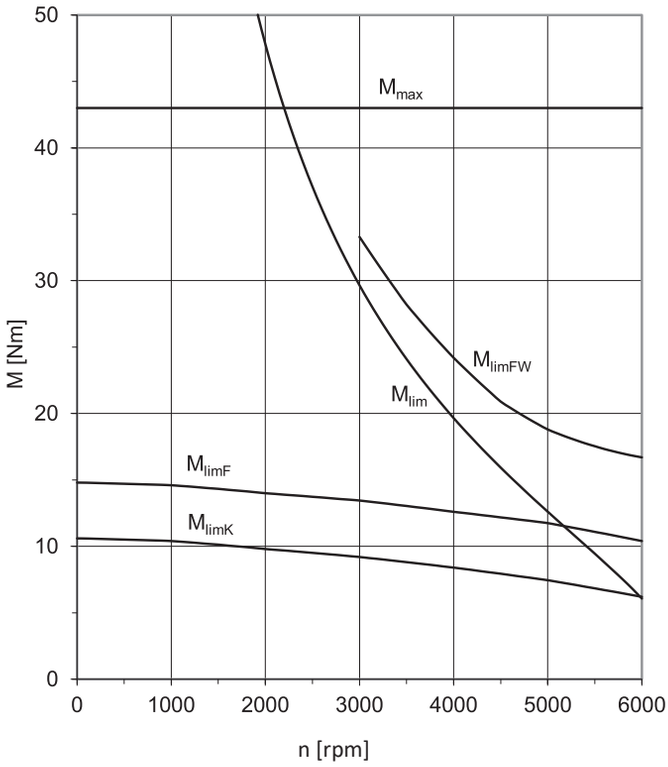
EZ502 (n_N=6000 rpm)



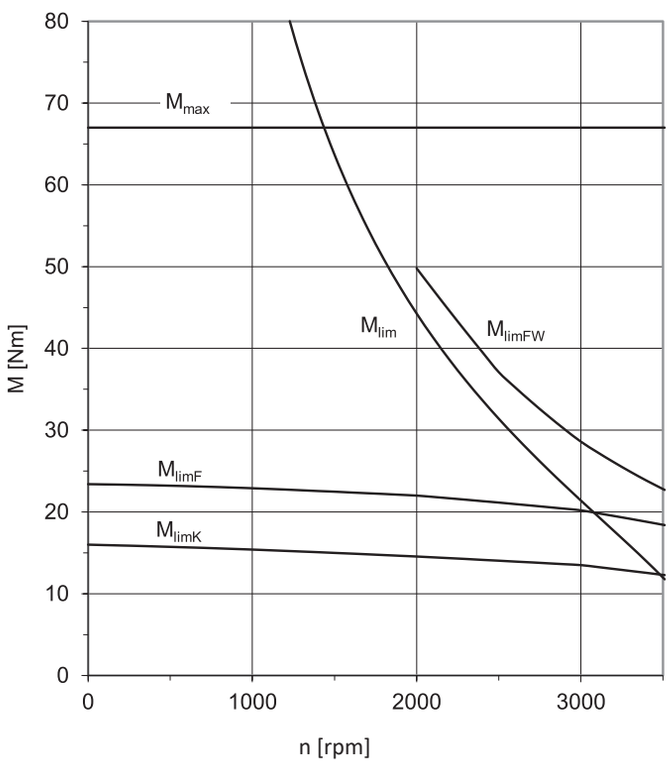
EZ503 (n_N=3000 rpm)



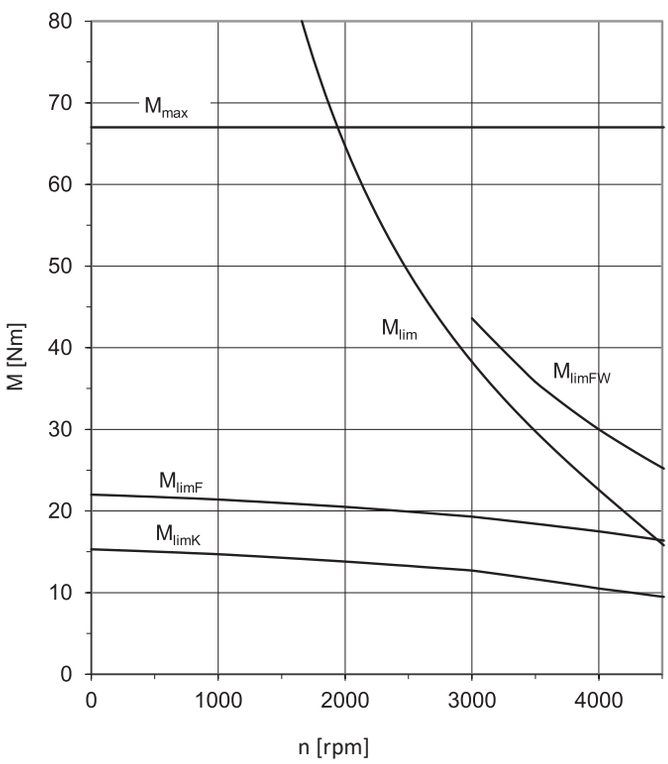
EZ503 (n_N=6000 rpm)



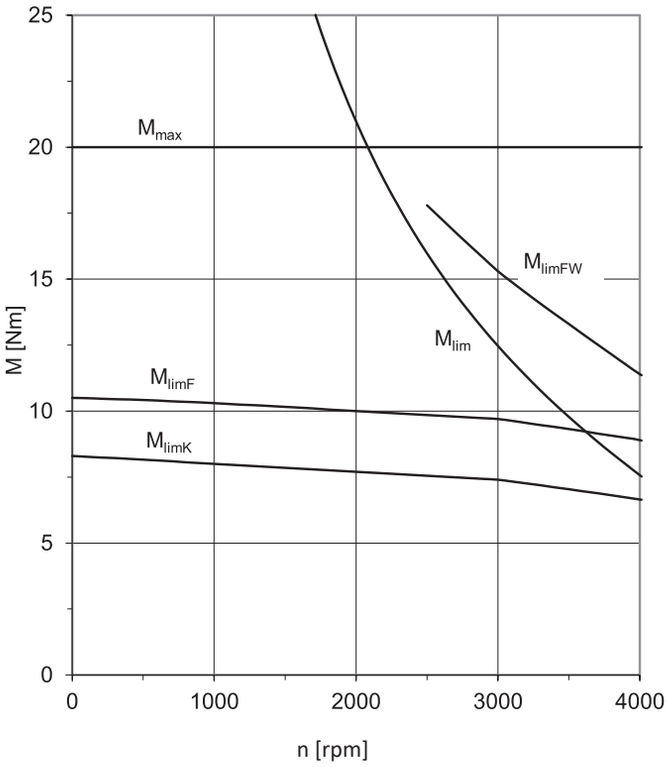
EZ505 (n_N=3000 rpm)



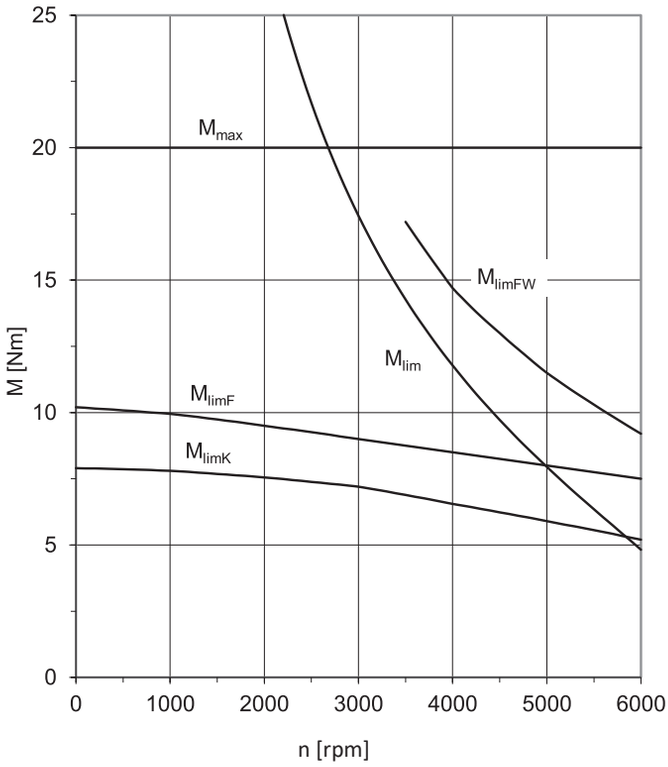
EZ505 (n_N=4500 rpm)



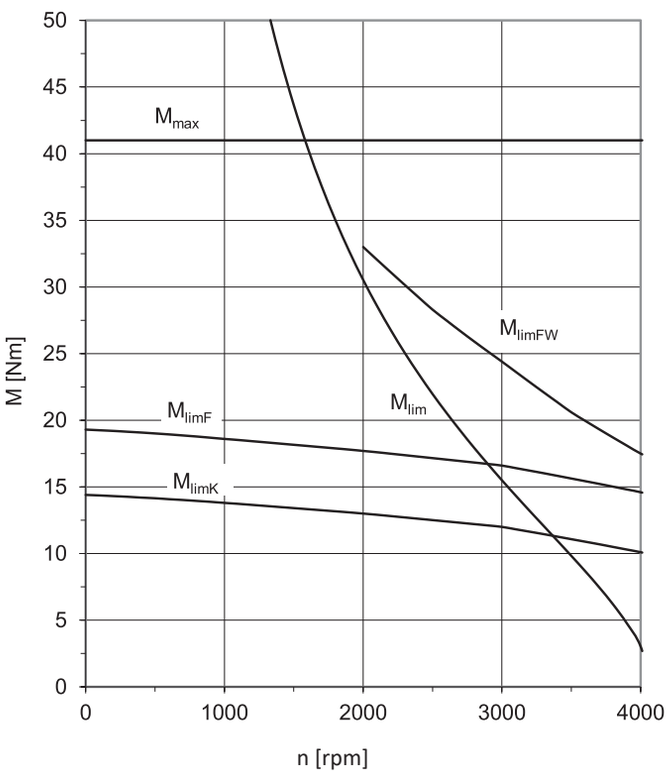
EZ701 (n_N=3000 rpm)



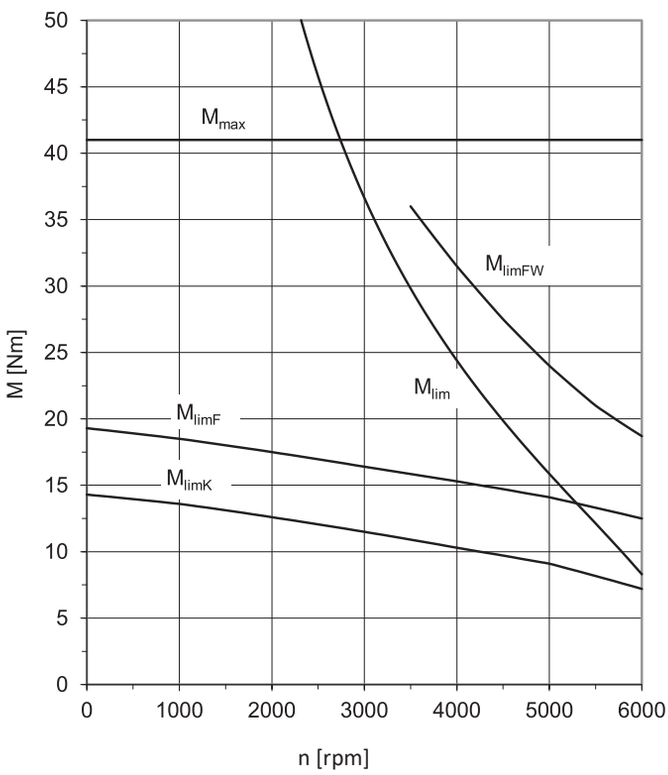
EZ701 (n_N=6000 rpm)



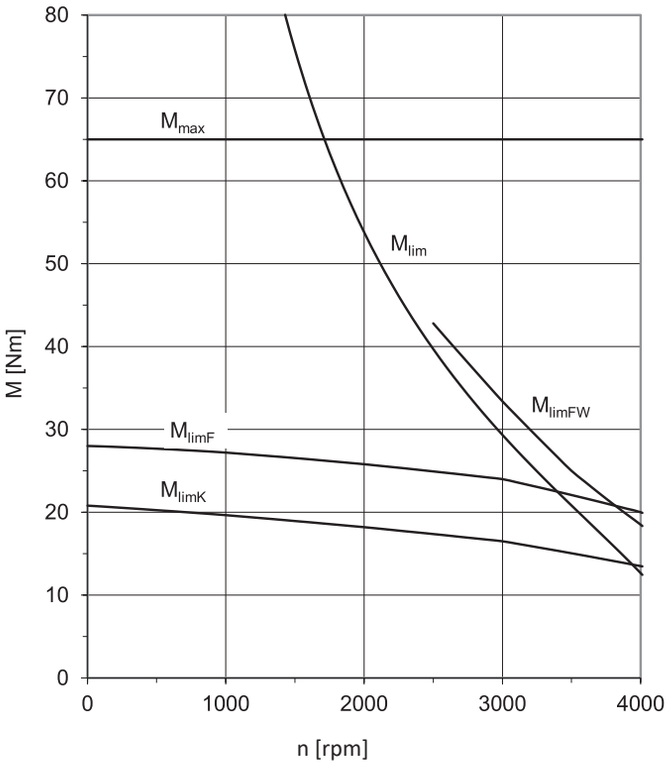
EZ702 (n_N=3000 rpm)



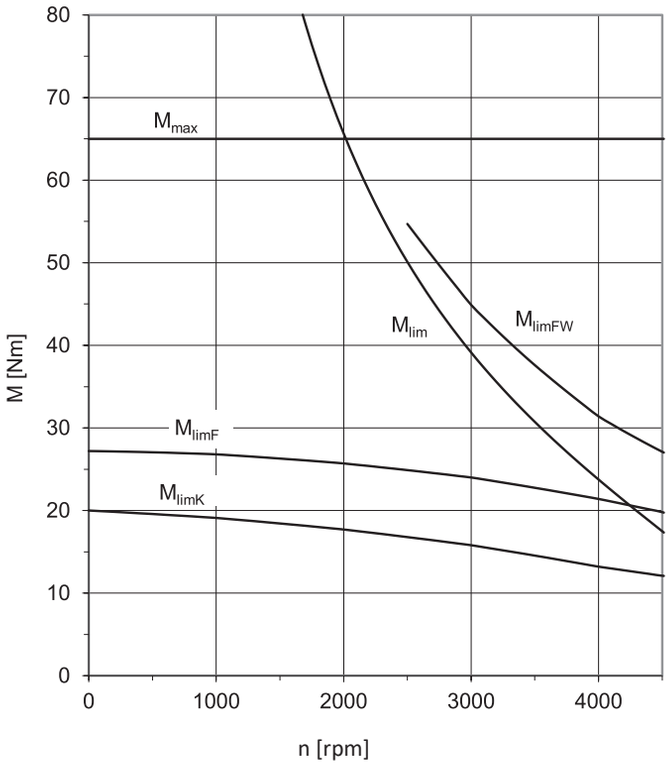
EZ702 (n_N=6000 rpm)



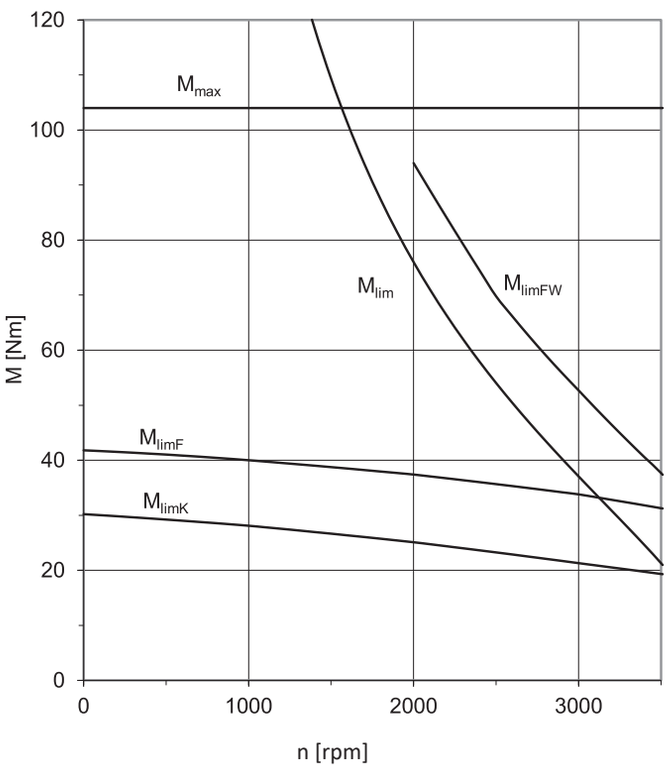
EZ703 (n_N=3000 rpm)



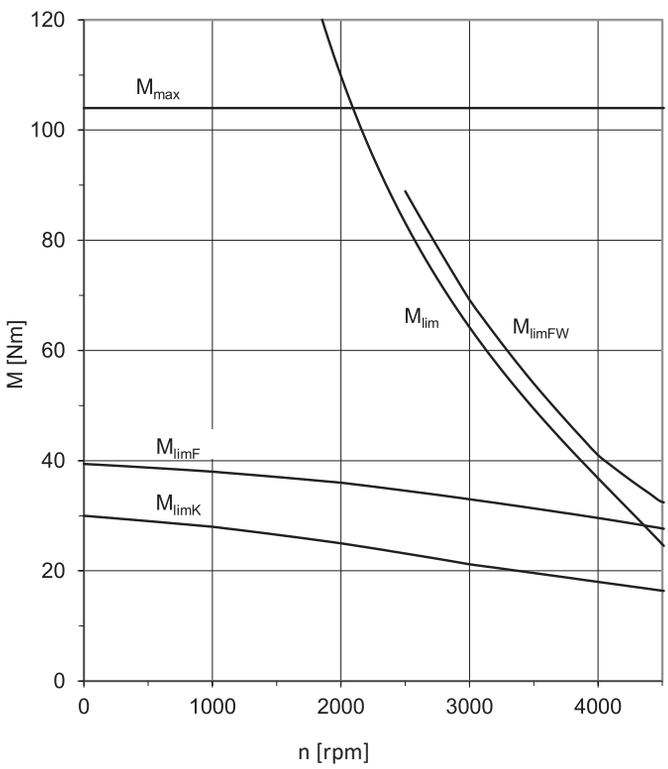
EZ703 (n_N=4500 rpm)



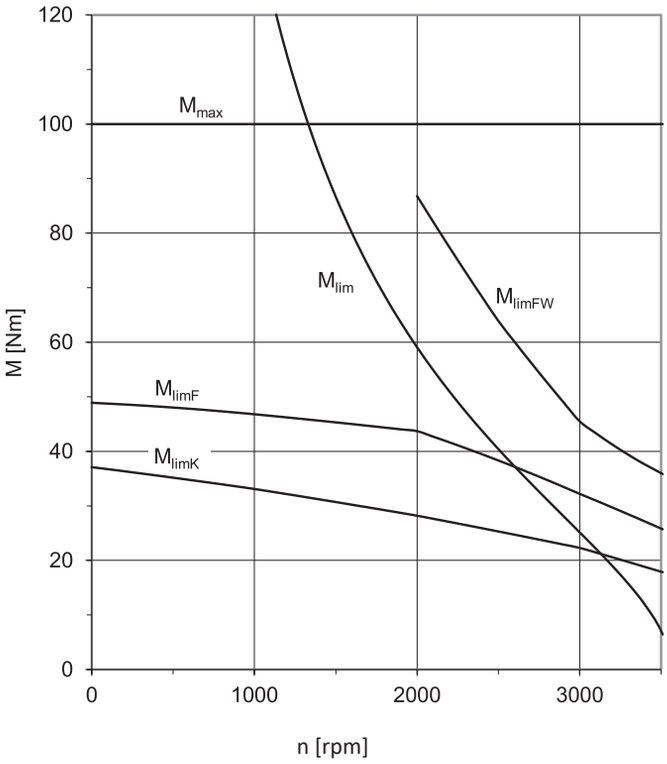
EZ705 (n_N=3000 rpm)



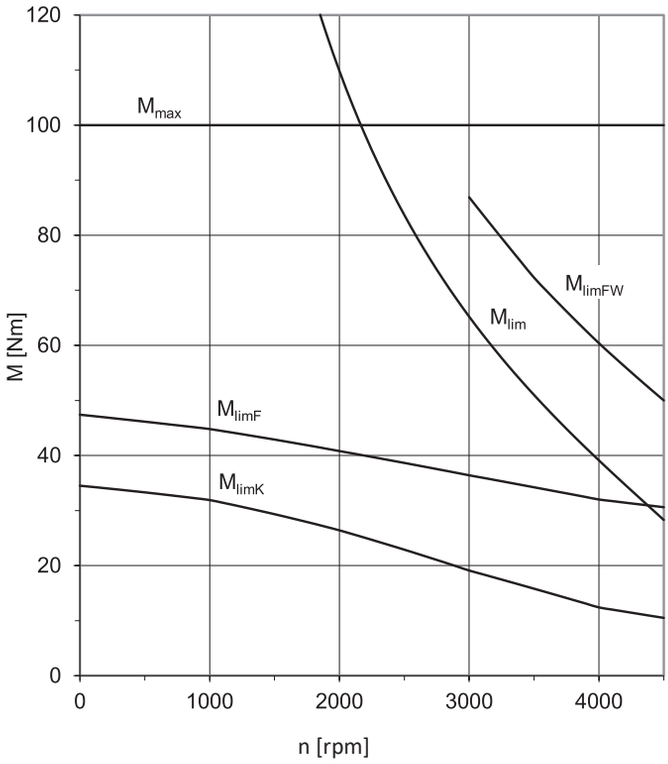
EZ705 (n_N=4500 rpm)



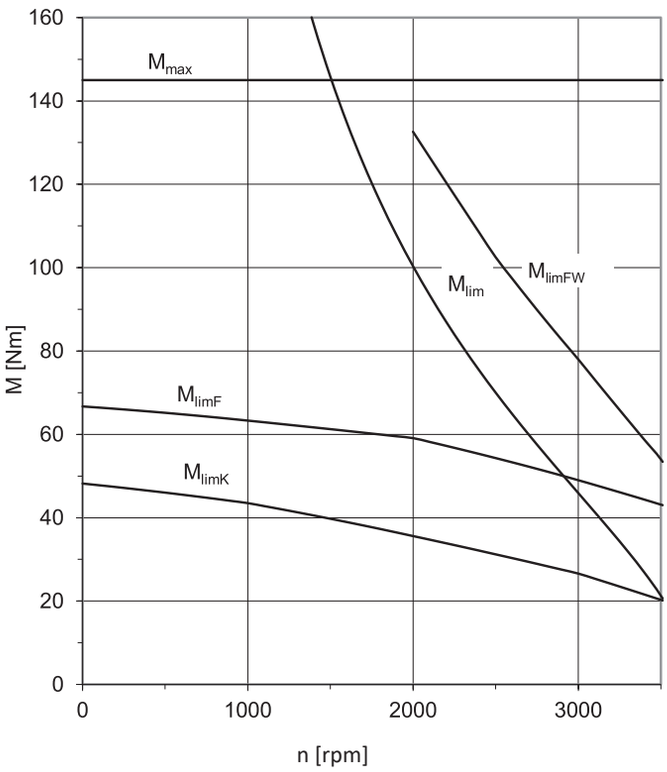
EZ802 (n_N=3000 rpm)



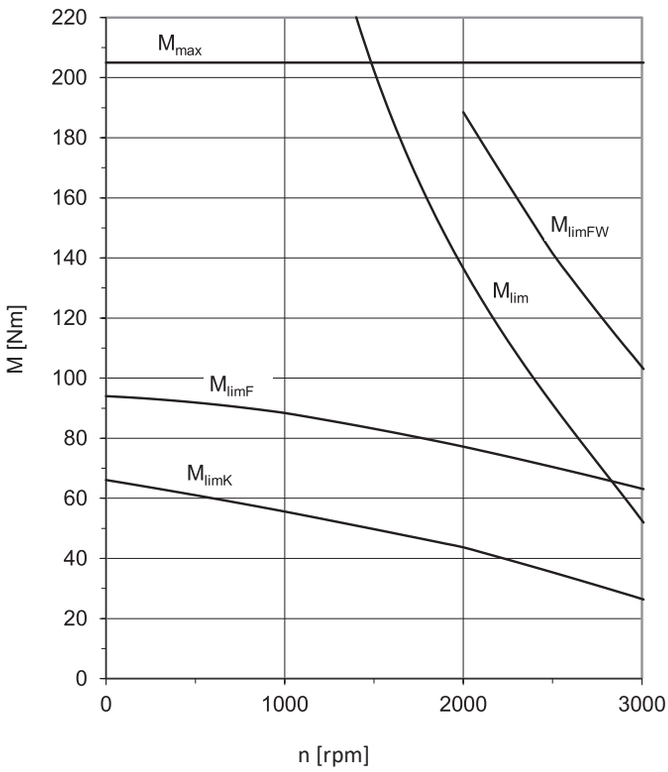
EZ802 (n_N=4500 rpm)



EZ803 (n_N=3000 rpm)



EZ805 (n_N=2000 rpm)



13.4 Dimensional drawings

In this chapter, you can find the dimensions of the motors.

Dimensions can exceed the specifications of ISO 2768-mK due to casting tolerances or accumulation of individual tolerances.

We reserve the right to make dimensional changes due to ongoing technical development.

You can download 3D models of our standard drives at http://configurator.stoeber.de.

In this chapter, the dimensions p1 and w1 for standard motor designs are presented. In designs for connection to drive controllers of third-party manufacturers, dimensions p1 and w1 may differ. You can find more details at http://configurator.stoeber.de.

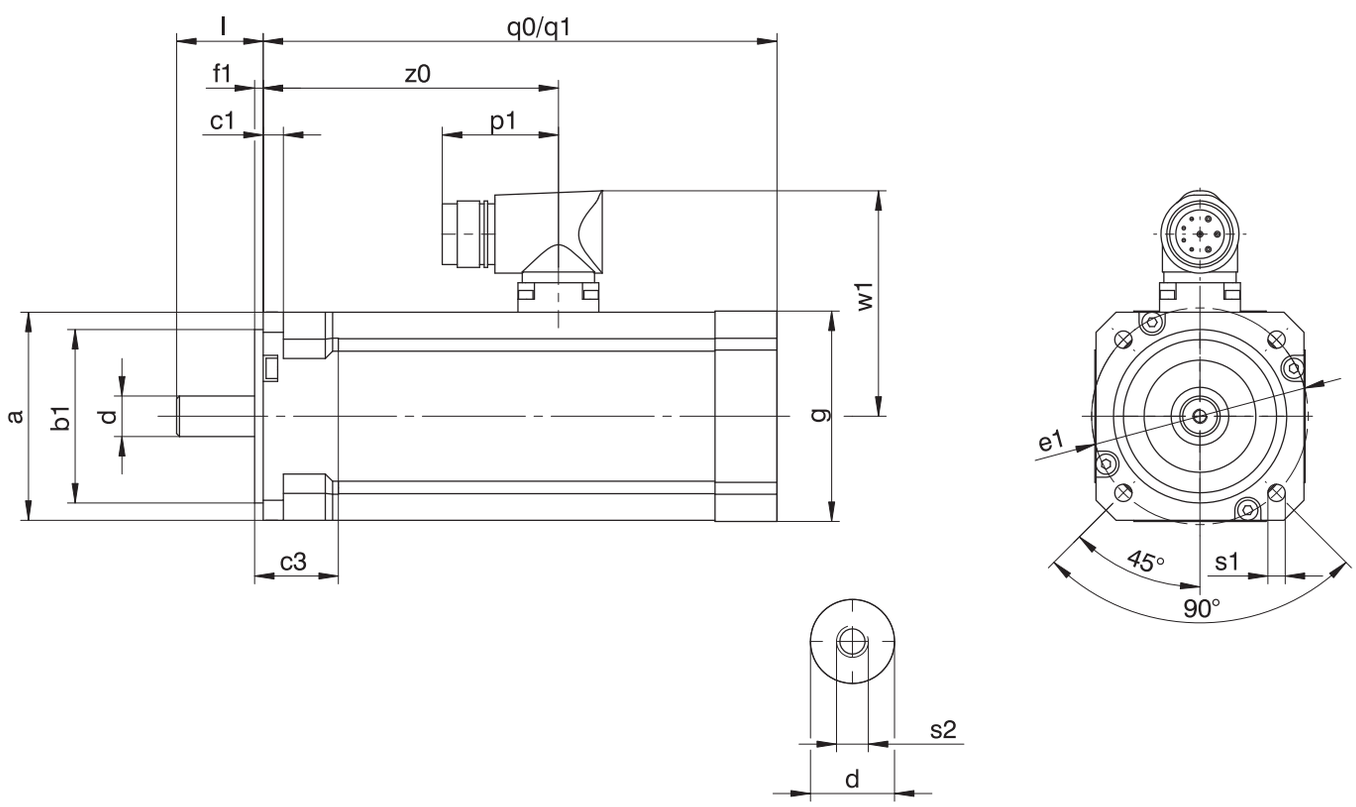
Tolerances

Solid shaft	Tolerance
Shaft ∅ fit ≤ 50 mm	DIN 748-1, ISO k6
Shaft ∅ fit > 50 mm	DIN 748-1, ISO m6

Centering holes in solid shafts in accordance with DIN 332-2, DR shape

Thread size	M4	M5	M6	M8	M10	M12	M16	M20	M24
Thread depth [mm]	10	12.5	16	19	22	28	36	42	50

13.4.1 EZ3 motors (One Cable Solution)

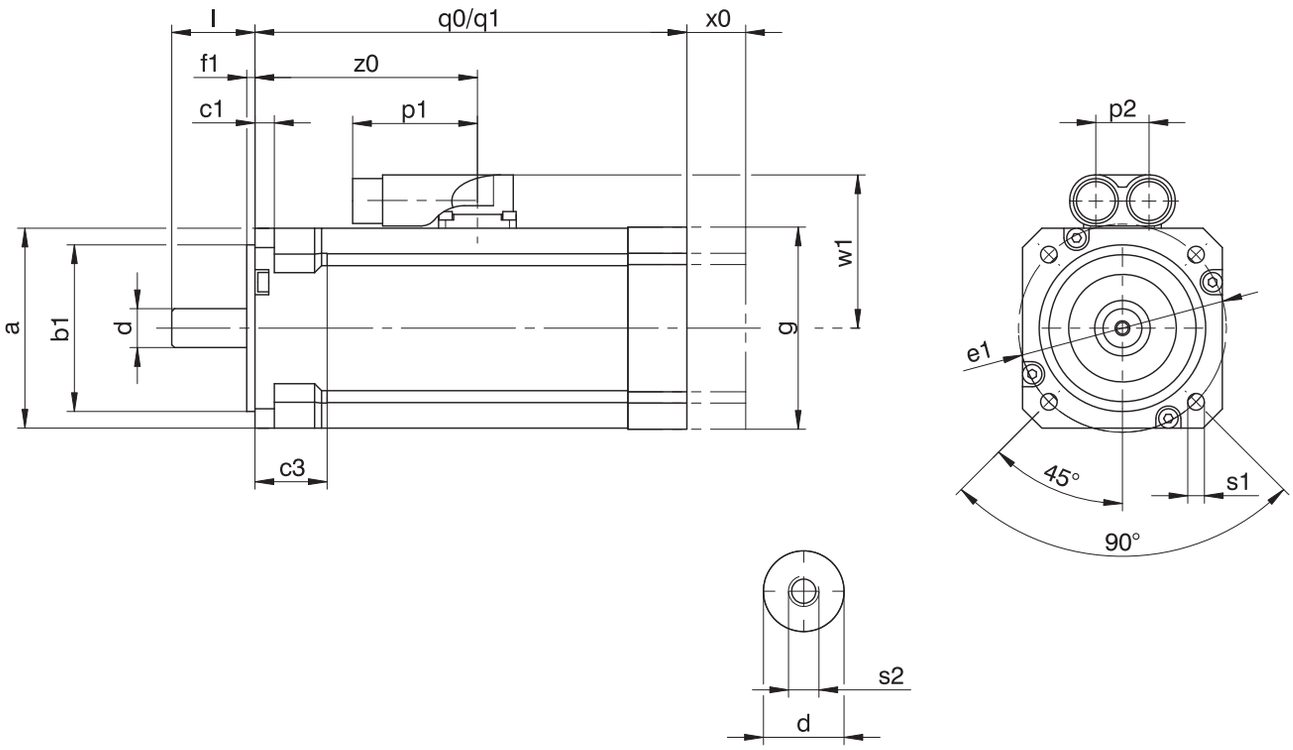


q0 Applies to motors without holding brake

q1 Applies to motors with holding brake

Type	□a	Øb1	c1	c3	Ød	Øe1	f1	□g	l	p1	q0	q1	Øs1	s2	w1	z0
EZ301U	72	60_{j6}	7	26	14_{k6}	75	3	72	30	40	116	156	6	M5	78	80.5
EZ302U	72	60_{j6}	7	26	14_{k6}	75	3	72	30	40	138	178	6	M5	78	102.5
EZ303U	72	60_{j6}	7	26	14_{k6}	75	3	72	30	40	160	200	6	M5	78	124.5

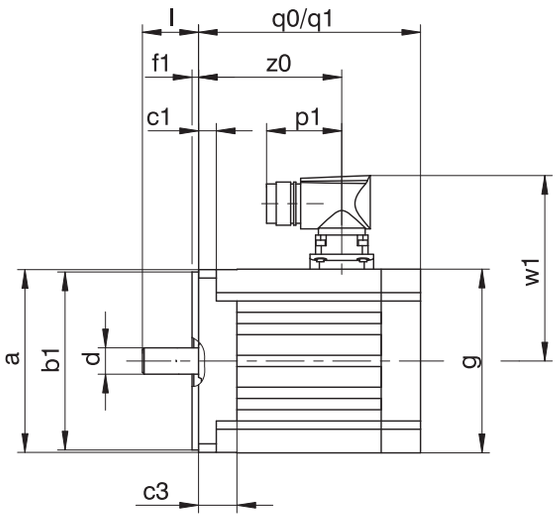
13.4.2 EZ3 motors

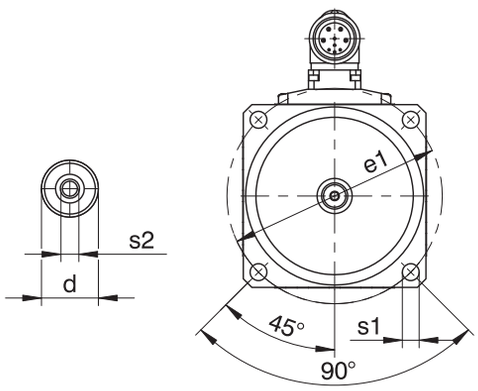


q0	Applies to motors without holding brake	q1	Applies to motors with holding brake
x0	Applies to encoders based on an optical measuring method		

Type	□a	Øb1	c1	c3	Ød	Øe1	f1	□g	l	p1	p2	q0	q1	Øs1	s2	w1	x0	z0
EZ301U	72	60_{j6}	7	26	14_{k6}	75	3	72	30	45	19	116	156	6	M5	55.5	21	80.5
EZ302U	72	60_{j6}	7	26	14_{k6}	75	3	72	30	45	19	138	178	6	M5	55.5	21	102.5
EZ303U	72	60_{j6}	7	26	14_{k6}	75	3	72	30	45	19	160	200	6	M5	55.5	21	124.5

13.4.3 EZ4 – EZ7 motors with convection cooling (One Cable Solution)



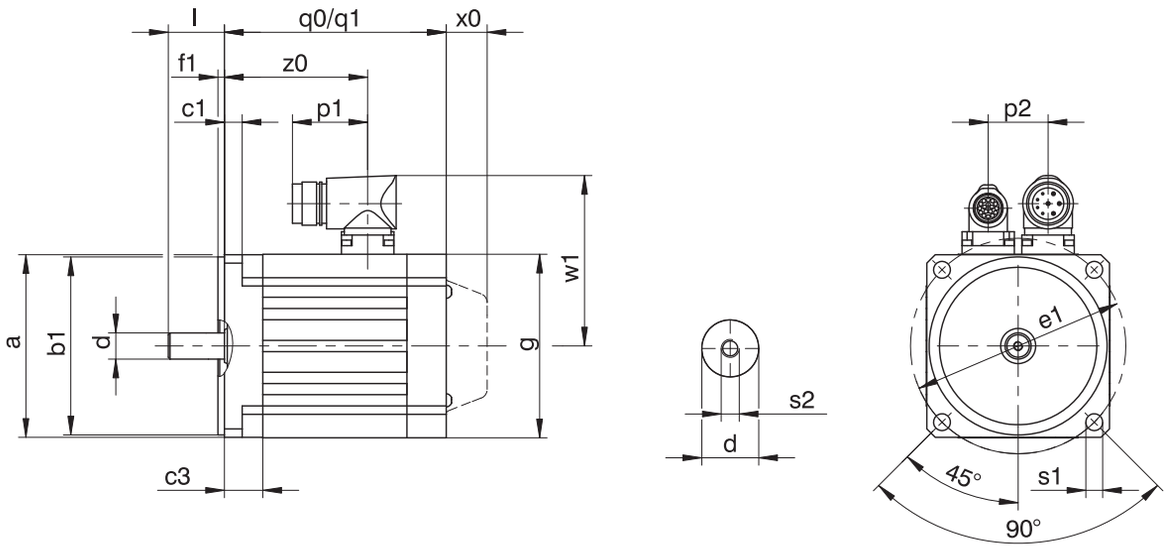


q0 Applies to motors without holding brake

q1 Applies to motors with holding brake

Type	□a	Øb1	c1	c3	Ød	Øe1	f1	□g	l	p1	q0	q1	Øs1	s2	w1	z0
EZ401U	98	95_{j6}	9.5	20.5	14_{k6}	115	3.5	98	30	40	118.5	167.0	9	M5	99	76.5
EZ402U	98	95_{j6}	9.5	20.5	19_{k6}	115	3.5	98	40	40	143.5	192.0	9	M6	99	101.5
EZ404U	98	95_{j6}	9.5	20.5	19_{k6}	115	3.5	98	40	40	193.5	242.0	9	M6	99	151.5
EZ501U	115	110_{j6}	10.0	16.0	19_{k6}	130	3.5	115	40	40	109.0	163.5	9	M6	110	74.5
EZ502U	115	110_{j6}	10.0	16.0	19_{k6}	130	3.5	115	40	40	134.0	188.5	9	M6	110	99.5
EZ503U	115	110_{j6}	10.0	16.0	24_{k6}	130	3.5	115	50	40	159.0	213.5	9	M8	110	124.5
EZ505U	115	110_{j6}	10.0	16.0	24_{k6}	130	3.5	115	50	40	209.0	263.5	9	M8	110	174.5
EZ701U	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	145	50	40	121.0	180.0	11	M8	125	83.0
EZ702U	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	145	50	40	146.0	205.0	11	M8	125	108.0
EZ703U	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	145	50	40	171.0	230.0	11	M8	125	133.0
EZ705U	145	130_{j6}	10.0	19.0	32_{k6}	165	3.5	145	58	40	226.0	285.0	11	M12	125	184.0

13.4.4 EZ4 – EZ8 motors with convection cooling



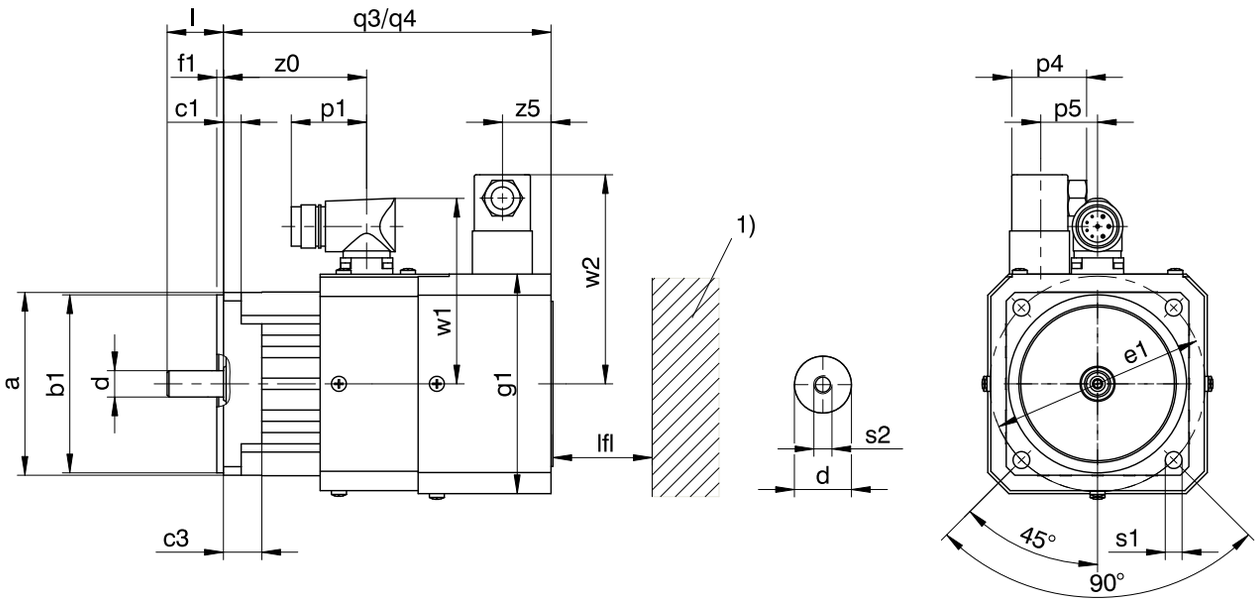
q0 Applies to motors without holding brake

q1 Applies to motors with holding brake

x0 Applies to encoders based on an optical measuring method

Type	□a	Ø$b1_{j6}$	c1	c3	Ød_{k6}	Øe1	f1	□g	l	p1	p2	q0	q1	Øs1	s2	w1	x0	z0
EZ401U	98	95_{j6}	9.5	20.5	14_{k6}	115	3.5	98	30	40	32	118.5	167.0	9	M5	91.0	22	76.5
EZ402U	98	95_{j6}	9.5	20.5	19_{k6}	115	3.5	98	40	40	32	143.5	192.0	9	M6	91.0	22	101.5
EZ404U	98	95_{j6}	9.5	20.5	19_{k6}	115	3.5	98	40	40	32	193.5	242.0	9	M6	91.0	22	151.5
EZ501U	115	110_{j6}	10.0	16.0	19_{k6}	130	3.5	115	40	40	36	109.0	163.5	9	M6	100.0	22	74.5
EZ502U	115	110_{j6}	10.0	16.0	19_{k6}	130	3.5	115	40	40	36	134.0	188.5	9	M6	100.0	22	99.5
EZ503U	115	110_{j6}	10.0	16.0	24_{k6}	130	3.5	115	50	40	36	159.0	213.5	9	M8	100.0	22	124.5
EZ505U	115	110_{j6}	10.0	16.0	24_{k6}	130	3.5	115	50	40	36	209.0	263.5	9	M8	100.0	22	174.5
EZ701U	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	145	50	40	42	121.0	180.0	11	M8	115.0	22	83.0
EZ702U	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	145	50	40	42	146.0	205.0	11	M8	115.0	22	108.0
EZ703U	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	145	50	40	42	171.0	230.0	11	M8	115.0	22	133.0
EZ705U	145	130_{j6}	10.0	19.0	32_{k6}	165	3.5	145	58	71	42	226.0	285.0	11	M12	134.0	22	184.0
EZ802U	190	180_{j6}	15.0	25.0	32_{k6}	215	3.5	190	58	71	60	222.0	299.0	13.5	M12	156.5	22	168.0
EZ803U	190	180_{j6}	15.0	25.0	38_{k6}	215	3.5	190	80	71	60	263.0	340.0	13.5	M12	156.5	22	209.0
EZ805U	190	180_{j6}	15.0	25.0	38_{k6}	215	3.5	190	80	71	60	345.0	422.0	13.5	M12	156.5	22	277.0

13.4.5 EZ4 – EZ7 motors with forced ventilation (One Cable Solution)



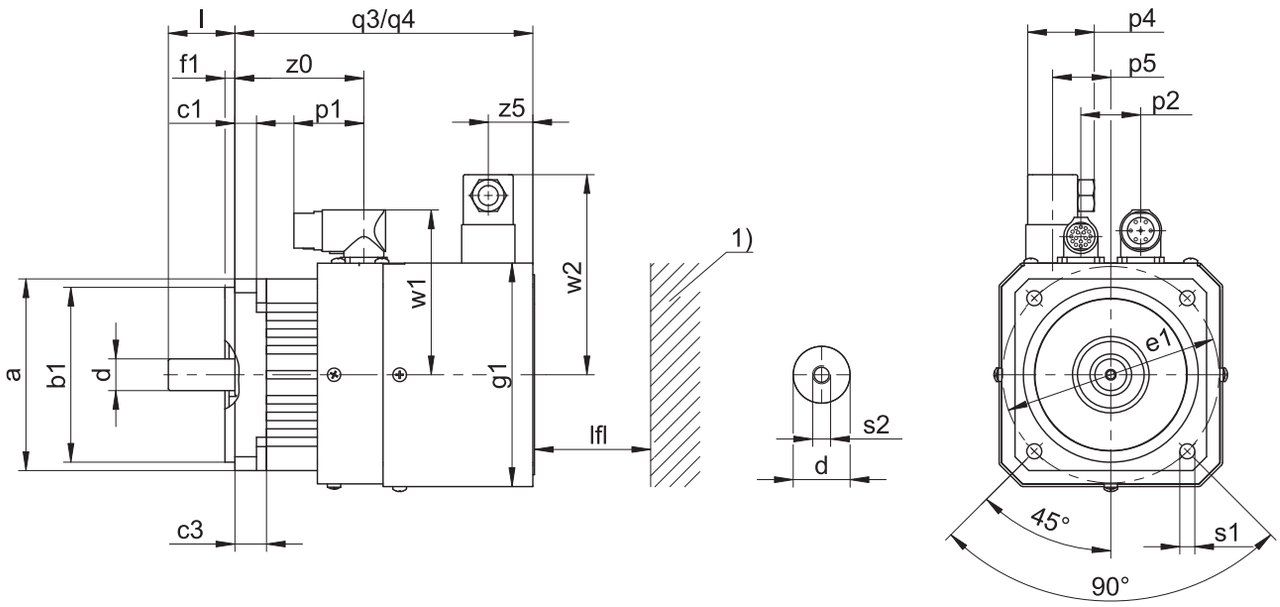
q3 Applies to motors without holding brake

q4 Applies to motors with holding brake

1) Machine wall

Type	□a	Øb1	c1	c3	Ød	Øe1	f1	□g1	l	lfl_{min}	p1	p4	p5	q3	q4	Øs1	s2	w1	w2	z0	z5
EZ401B	98	95_{j6}	9.5	20.5	14_{k6}	115	3.5	118	30	20	40	37.5	0	175	224	9.0	M5	99	111	76.5	25
EZ402B	98	95_{j6}	9.5	20.5	19_{k6}	115	3.5	118	40	20	40	37.5	0	200	249	9.0	M6	99	111	101.5	25
EZ404B	98	95_{j6}	9.5	20.5	19_{k6}	115	3.5	118	40	20	40	37.5	0	250	299	9.0	M6	99	111	151.5	25
EZ501B	115	110_{j6}	10.0	16.0	19_{k6}	130	3.5	135	40	20	40	37.5	0	179	234	9.0	M6	110	120	74.5	25
EZ502B	115	110_{j6}	10.0	16.0	19_{k6}	130	3.5	135	40	20	40	37.5	0	204	259	9.0	M6	110	120	99.5	25
EZ503B	115	110_{j6}	10.0	16.0	24_{k6}	130	3.5	135	50	20	40	37.5	0	229	284	9.0	M8	110	120	124.5	25
EZ505B	115	110_{j6}	10.0	16.0	24_{k6}	130	3.5	135	50	20	40	37.5	0	279	334	9.0	M8	110	120	174.5	25
EZ701B	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	165	50	30	40	37.5	0	213	272	11.0	M8	125	134	83.0	40
EZ702B	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	165	50	30	40	37.5	0	238	297	11.0	M8	125	134	108.0	40
EZ703B	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	165	50	30	40	37.5	0	263	322	11.0	M8	125	134	133.0	40

13.4.6 EZ4 – EZ8 motors with forced ventilation



q3 Applies to motors without holding brake

q4 Applies to motors with holding brake

1) Machine wall

Type	□a	Øb1	c1	c3	Ød	Øe1	f1	□g1	l	lfl_{min}	p1	p2	p4	p5	q3	q4	Øs1	s2	w1	w2	z0	z5
EZ401B	98	95_{j6}	9.5	20.5	14_{k6}	115	3.5	118	30	20	40	32	37.5	0	175	224	9.0	M5	91.0	111	76.5	25
EZ402B	98	95_{j6}	9.5	20.5	19_{k6}	115	3.5	118	40	20	40	32	37.5	0	200	249	9.0	M6	91.0	111	101.5	25
EZ404B	98	95_{j6}	9.5	20.5	19_{k6}	115	3.5	118	40	20	40	32	37.5	0	250	299	9.0	M6	91.0	111	151.5	25
EZ501B	115	110_{j6}	10.0	16.0	19_{k6}	130	3.5	135	40	20	40	36	37.5	0	179	234	9.0	M6	100.0	120	74.5	25
EZ502B	115	110_{j6}	10.0	16.0	19_{k6}	130	3.5	135	40	20	40	36	37.5	0	204	259	9.0	M6	100.0	120	99.5	25
EZ503B	115	110_{j6}	10.0	16.0	24_{k6}	130	3.5	135	50	20	40	36	37.5	0	229	284	9.0	M8	100.0	120	124.5	25
EZ505B	115	110_{j6}	10.0	16.0	24_{k6}	130	3.5	135	50	20	40	36	37.5	0	279	334	9.0	M8	100.0	120	174.5	25
EZ701B	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	165	50	30	40	42	37.5	0	213	272	11.0	M8	115.0	134	83.0	40
EZ702B	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	165	50	30	40	42	37.5	0	238	297	11.0	M8	115.0	134	108.0	40
EZ703B	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	165	50	30	40	42	37.5	0	263	322	11.0	M8	115.0	134	133.0	40
EZ705B	145	130_{j6}	10.0	19.0	32_{k6}	165	3.5	165	58	30	71	42	37.5	0	318	377	11.0	M12	134.0	134	184.0	40
EZ802B	190	180_{j6}	15.0	25.0	32_{k6}	215	3.5	215	58	30	71	60	37.5	62	322	399	13.5	M12	156.5	160	168.0	40
EZ803B	190	180_{j6}	15.0	25.0	38_{k6}	215	3.5	215	80	30	71	60	37.5	62	363	440	13.5	M12	156.5	160	209.0	40
EZ805B	190	180_{j6}	15.0	25.0	38_{k6}	215	3.5	215	80	30	71	60	37.5	62	445	522	13.5	M12	178.0	160	277.0	40

13.5 Type designation

Example code

EZ	4	0	1	U	D	BB	Q7	O	096

Explanation

Code	Designation	Design
EZ	Type	Synchronous servo motor
4	Size	4 (example)
0	Generation	0
1	Length	1 (example)
U	Cooling[1]	Convection cooling
B		Forced ventilation
D	Design	Dynamic
BB	Drive controller	SI6 (example)
Q7	Encoder	EnDat 3 EQI 1131 (example)
O	Brake	Without holding brake
P		Permanent magnet holding brake
096	Voltage constant K_{EM}	96 V/1000 rpm (example)

Notes

- In Chapter Encoders, you can find information about available encoders.
- In Chapter Possible combinations with drive controllers, you can find information about connecting synchronous servo motors to other drive controllers from STOBER.
- In Chapter [▷ 14], you can find information about options for connecting STOBER synchronous servo motors to drive controllers from other manufacturers.

13.6 Product description

13.6.1 General features

Feature	Description
Design	IM B5, IM V1, IM V3 in accordance with EN 60034-7
Protection class	IP56 / IP66 (option)
Thermal class	155 (F) in accordance with EN 60034-1 (155 °C, heating $\Delta\vartheta$ = 100 K)
Surface	Matte black as per RAL 9005
Cooling	IC 410 convection cooling (IC 416 convection cooling with forced ventilation units, optional)
Bearing	Rolling bearing with lifetime lubrication and non-contact sealing
Sealing	Radial shaft seal rings made of FKM (A side)
Shaft	Shaft without feather key, diameter quality k6
Radial runout	Normal tolerance class in accordance with IEC 60072-1
Concentricity	Normal tolerance class in accordance with IEC 60072-1
Axial runout	Normal tolerance class in accordance with IEC 60072-1
Vibration intensity	A in accordance with EN 60034-14
Noise level	Limit values in accordance with EN 60034-9

[1] EZ3 motors only available with convection cooling

13.6.2 Electrical features

General electrical features of the motor are described in this chapter. Details can be found in the "Selection tables" chapter.

Feature	Description
DC link voltage	DC 540 V (max. 620 V) on STOBER drive controllers
Winding	Three-phase, single-tooth coil design
Circuit	Star, center not led through
Protection class	I (protective grounding) in accordance with EN 61140
Impulse voltage insulation class (IVIC)	C in accordance with DIN EN 60034-18-41 (inverter connection voltage 0 – 480 V ± 10%)
Number of pole pairs	5 (EZ3) 7 (EZ4/EZ5/EZ7) 8 (EZ8)

13.6.3 Ambient conditions

Standard ambient conditions for transport, storage and operation of the motor are described in this chapter. Information about differing ambient conditions can be found in the chapter Derating.

Feature	Description
Surrounding temperature for transport/storage	−30 °C to +85 °C
Surrounding temperature for operation	−15 °C to +40 °C
Relative humidity	5% to 95%, no condensation
Installation altitude	≤ 1000 m above sea level
Shock load	≤ 50 m/s^2 (5 g), 6 ms in accordance with EN 60068-2-27

Notes

- STOBER synchronous servo motors are not suitable for potentially explosive atmospheres.
- Secure the power cables close to the motor so that vibrations of the cable do not place impermissible loads on the motor plug connector.
- Note that the braking torques of the holding brake (optional) may be reduced by shock loading.
- At operating temperatures below 0 °C, note that the discs of the holding brake (optional) may ice up.
- Also take into consideration the shock load of the motor due to output units (such as gear units and pumps) which are coupled with the motor.

13.6.4 Encoders

STOBER synchronous servo motors can be designed with different encoder models. The following chapters include information for choosing the optimal encoder for your application.

13.6.4.1 Encoder measuring method selection tool

The following table offers a selection tool for an encoder measuring method that is optimally suited for your application.

Feature	Absolute encoder		Resolver
Measuring method	Optical	Inductive	Electromagnetic
Temperature resistance	★★☆	★★★	★★★
Vibration strength and shock resistance	★★☆	★★★	★★★
System accuracy	★★★	★★☆	★☆☆
FMA version with fault exclusion for mechanical coupling (option with EnDat interface)	✓	✓	–
Elimination of referencing with multi-turn design (optional)	✓	✓	–
Simple commissioning with electronic nameplate	✓	✓	–
Key: ★☆☆ = satisfactory, ★★☆ = good, ★★★ = very good			

13.6.4.2 Selection tool for EnDat interface

The following table offers a selection tool for the EnDat interface of absolute encoders.

Feature	EnDat 2.1	EnDat 2.2	EnDat 3
Short cycle times	★★☆	★★★	★★★
Transfer of additional information along with the position value	–	✓	✓
Expanded power supply range	★★☆	★★★	★★★
One Cable Solution (OCS)	–	–	✓
Key: ★★☆ = good, ★★★ = very good			

13.6.4.3 EnDat 3 encoders

EnDat 3 is a robust, purely digital protocol that functions with minimal connection lines. EnDat 3 facilitates the One Cable Solution, which allows the connection lines between the encoder and drive controller to be routed along in the motor's power cable.

The One Cable Solution offers the following advantages:

- Significantly reduced wiring effort by eliminating the encoder cable
- For cable lengths up to 50 m, a choke between the drive controller and motor is not necessary
- Advanced safety functions possible (up to SIL2 / category 3, PLd)
- Significantly reduced space requirements by eliminating the encoder plug connector
- Transmission of measured values from the temperature sensor using the EnDat 3 protocol

A motor with the EnDat 3 encoder can be operated only on a SI6 or SC6 drive controller from STOBER.

The EnDat 3 encoder has the following features:

Encoder model	Code	Measuring method	Recordable revolutions	Resolution	Position values per revolution
EnDat 3 EQI 1131	Q7	Inductive	4096	19 bit	524288

13.6.4.4 EnDat 2 encoders

In this chapter, you can find detailed technical data for encoder models that can be selected with EnDat interface.

Encoders with EnDat 2.2 interface

Encoder model	Code	Measuring method	Recordable revolutions	Resolution	Position values per revolution
EnDat 2.2 EQI 1131	Q6	Inductive	4096	19 bit	524288
EnDat 2.2 EBI 1135	B0	Inductive	65536	18 bit	262144
EnDat 2.2 EQN 1135 FMA	M3	Optical	4096	23 bit	8388608
EnDat 2.2 EQN 1135	Q5	Optical	4096	23 bit	8388608
EnDat 2.2 ECN 1123 FMA	M1	Optical	–	23 bit	8388608
EnDat 2.2 ECN 1123	C7	Optical	–	23 bit	8388608
EnDat 2.2 ECI 1118-G2	C5	Inductive	–	18 bit	262144

Encoders with EnDat 2.1 interface

Encoder model	Code	Measuring method	Recordable revolutions	Resolution	Position values per revolution	Periods per revolution
EnDat 2.1 EQN 1125 FMA	M2	Optical	4096	13 bit	8192	Sin/Cos 512
EnDat 2.1 EQN 1125	Q4	Optical	4096	13 bit	8192	Sin/Cos 512
EnDat 2.1 ECN 1113 FMA	M0	Optical	–	13 bit	8192	Sin/Cos 512
EnDat 2.1 ECN 1113	C6	Optical	–	13 bit	8192	Sin/Cos 512

Notes

- The encoder code is a part of the type designation of the motor.
- FMA = Version with fault exclusion for mechanical coupling.
- The EnDat 2.2 EBI 1135 encoder requires an external buffer battery so that absolute position information is retained after the power supply is turned off (AES option for STOBER drive controllers).
- Multiple revolutions of the motor shaft can be recorded only using multi-turn encoders.

13.6.4.5 Resolver

In this chapter, you can find detailed technical data for the resolver that can be installed as an encoder in a STOBER synchronous servo motor.

Feature	Description
Number of poles	2
Input voltage U_{1eff}	7 V ± 5%
Input frequency f_1	10 kHz
Output voltage $U_{2,S1–S3}$	$K_{tr} \cdot U_{R1–R2} \cdot \cos \theta$
Output voltage $U_{2,S2–S4}$	$K_{tr} \cdot U_{R1–R2} \cdot \sin \theta$
Transformation ratio K_{tr}	0.5 ± 5%
Electrical fault	±10 arcmin

13.6.4.6 Possible combinations with drive controllers

The following table shows the options for combining STOBER drive controllers with selectable encoder models.

Drive controller		SDS 5000		SD6		SI6			SC6		
Drive controller code		AA	AC	AD	AE	AP	AQ	**BB**	AU	AV	**BA**
Connection plan ID		442305	442307	442450	442451	442771	442772	**443175**	443052	443053	**443174**
Encoder	Encoder code										
EnDat 3 EQI 1131	Q7	–	–	–	–	–	–	✓	–	–	✓
EnDat 2.2 EQI 1131	Q6	✓	–	✓	–	✓	–	–	✓	–	–
EnDat 2.2 EQN 1135 FMA	M3	✓	–	✓	–	–	–	–	–	–	–
EnDat 2.2 EQN 1135	Q5	✓	–	✓	–	✓	–	–	✓	–	–
EnDat 2.2 ECN 1123 FMA	M1	✓	–	✓	–	–	–	–	–	–	–
EnDat 2.2 ECN 1123	C7	✓	–	✓	–	✓	–	–	✓	–	–
EnDat 2.2 ECI 1118-G2	C5	✓	–	✓	–	✓	–	–	✓	–	–
EnDat 2.1 EQN 1125 FMA	M2	✓	✓	✓	✓	–	–	–	–	–	–
EnDat 2.1 EQN 1125	Q4	✓	✓	✓	✓	–	–	–	–	–	–
EnDat 2.1 ECN 1113 FMA	M0	✓	✓	✓	✓	–	–	–	–	–	–
EnDat 2.1 ECN 1113	C6	✓	✓	✓	✓	–	–	–	–	–	–
Resolver	R0	✓	–	–	✓	–	✓	–	–	✓	–

Notes

- The drive controller and encoder codes are a part of the type designation of the motor (see the "Type designation" chapter).
- In Chapter [▷ 14], you can find information about options for connecting STOBER synchronous servo motors to drive controllers from other manufacturers.

13.6.5 Temperature sensor

In this chapter, you can find technical data for the temperature sensors that are installed in STOBER synchronous servo motors for implementing thermal winding protection. To prevent damage to the motor, always monitor the temperature sensor with appropriate devices that will turn off the motor if the maximum permitted winding temperature is exceeded.

Some encoders feature integrated temperature monitoring, the warning and switch-off thresholds of which may overlap with the corresponding values set for the temperature sensor in the drive controller. In some cases, this may result in an instance where an encoder with internal temperature monitoring forces the motor to shut down, even before the motor has reached its nominal data.

You can find information about the electrical connection of the temperature sensor in the "Connection method" chapter.

13.6.5.1 PTC thermistor

The PTC thermistor is installed as a standard temperature sensor in STOBER synchronous servo motors.

The PTC thermistor is a triple thermistor in accordance with DIN 44082 that can be used for monitoring the temperature of each winding phase. The resistance values in the following table and curve refer to a single thermistor in accordance with DIN 44081. These values must be multiplied by 3 for a triple thermistor in accordance with DIN 44082.

Feature	Description
Nominal response temperature ϑ_{NAT}	145 °C ± 5 K
Resistance R −20 °C up to ϑ_{NAT} − 20 K	≤ 250 Ω
Resistance R with ϑ_{NAT} − 5 K	≤ 550 Ω
Resistance R with ϑ_{NAT} + 5 K	≥ 1330 Ω
Resistance R with ϑ_{NAT} + 15 K	≥ 4000 Ω
Operating voltage	≤ DC 7.5 V
Thermal response time	< 5 s
Thermal class	155 (F) in accordance with EN 60034-1 (155 °C, heating Δϑ = 100 K)

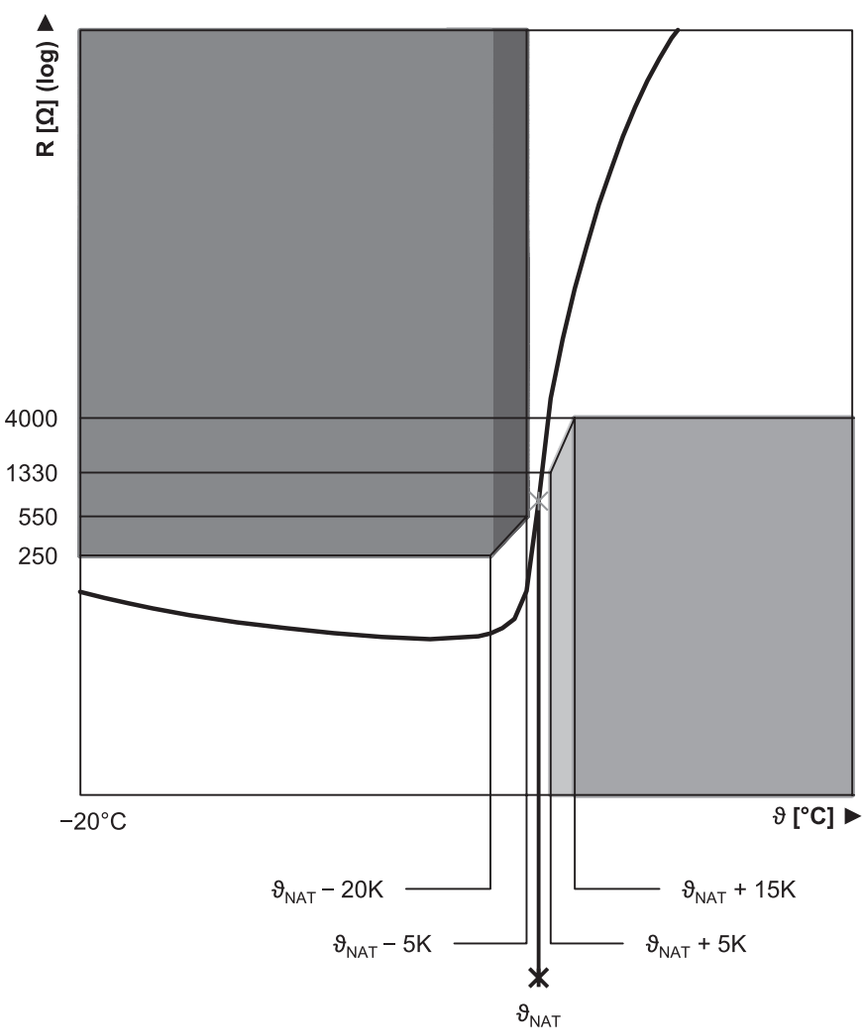


Fig. 2: PTC thermistor curve (single thermistor)

13.6.5.2 Pt1000 temperature sensor

STOBER synchronous servo motors are available in versions with a Pt1000 temperature sensor. The Pt1000 is a temperature-dependent resistor that has a resistance curve with a linear relationship with temperature. As a result, the Pt1000 allows for measurements of the winding temperature. These measurements are limited to one phase of the motor winding, however. In order to adequately protect the motor from exceeding the maximum permitted winding temperature, use a i^2t model in the drive controller to monitor the winding temperature.

Pt1000 temperature sensors can also be used with the One Cable Solution.

Avoid exceeding the specified measurement current so that the measured values are not falsified due to self-heating of the temperature sensor.

Feature	Description
Measurement current (constant)	2 mA
Resistance R for ϑ = 0 °C	1000 Ω
Resistance R for ϑ = 80 °C	1300 Ω
Resistance R for ϑ = 150 °C	1570 Ω

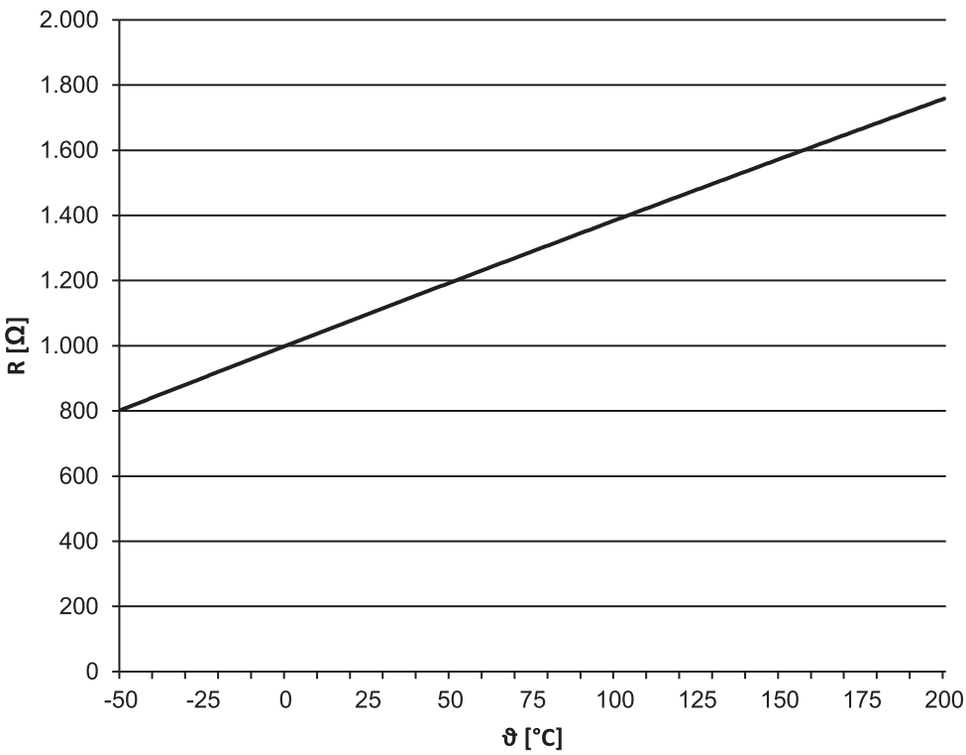


Fig. 3: Pt1000 temperature sensor characteristic curve

13.6.6 Cooling

A synchronous servo motor in the standard version is cooled by convection cooling (IC 410 in accordance with EN 60034-6). Optionally, forced ventilation can be used to cool the motor.

13.6.6.1 Forced ventilation

STOBER synchronous servo motors offer the option of being cooled with forced ventilation in order to increase performance data while maintaining the same size. Retrofitting with a forced ventilation unit is also possible in order to optimize the drive at a later date. When retrofitting, check whether the conductor cross-section of the power cable of the motor must be increased. Also take into account the dimensions of the forced ventilation unit.

The performance data for motors with forced ventilation can be found in the chapter Selection tables and the dimensions in the chapter Dimensional drawings.

Technical data

Motor	Forced ventilation unit	$U_{N,F}$ [V]	$I_{N,F}$ [A]	$P_{N,F}$ [W]	q_{vF} [m³/h]	$L_{p(A)}$ [dBA]	m_F [kg]	Protection class
EZ4_B	FL4	230 V ± 5%, 50/60 Hz	0.07	10	59	41	1.4	IP44
EZ5_B	FL5		0.10	14	160	45	1.9	IP54
EZ7_B	FL7		0.10	14	160	45	2.9	IP54
EZ8_B	FL8		0.20	26	420	54	5.0	IP55

Terminal assignment for forced ventilation unit plug connectors

Connection diagram	Pin	Connection
	1	
	2	
	3	
	⏚	

13.6.7 Holding brake

STOBER synchronous servo motors can be equipped with a backlash-free holding brake using permanent magnets in order to secure the motor shaft when at a standstill. The holding brake engages automatically if the voltage drops.

The holding brake is designed for a high number of operations (B_{10} = 10 million operations, B_{10d} = 20 million operations).

Nominal voltage of permanent magnet holding brake: DC 24 V ± 5%, smoothed.

Observe the following during project configuration:

- The holding brake is designed to keep the motor shaft from moving. Activate braking processes during operation using the corresponding electrical functions of the drive controller. In exceptional circumstances, the holding brake can be used for braking from full speed (following a power failure or when setting up the machine). The maximum permitted work done by friction $W_{B,Rmax/h}$ may not be exceeded.
- Note that the braking torque M_{Bdyn} may initially be up to 50% less when braking from full speed. As a result, the braking effect has a delayed action and braking distances become longer.
- Regularly perform a brake test to ensure the functional safety of the brakes. Details can be found in the documentation of the motor and the drive controller.
- Connect a varistor of type S14 K35 (or comparable) in parallel to the brake coil to protect your machine from switching surges. (Not necessary for connecting the holding brake to STOBER drive controllers of the 5th and 6th generation with a BRS/BRM brake module).
- The holding brake of the motor does not offer adequate safety for persons in the hazardous area of gravity-loaded vertical axes. Therefore take additional measures to minimize risk, e.g. by providing a mechanical substructure for maintenance work.
- Take into consideration voltage losses in the connection cables that connect the voltage source to the holding brake connections.
- The holding torque of the brake can be reduced by shock loading. Information about shock loading can be found in the "Ambient conditions" chapter.
- At operating temperatures from −15 °C to 0 °C, a cold holding brake in the released state may cause operating noises. As the temperature of the holding brake increases, these noises decrease such that operating noises are not heard when using holding brake at operating temperature in the released state.

Calculation of work done by friction per braking process

$$W_{B,R/B} = \frac{J_{tot} \cdot n^2}{182.4} \cdot \frac{M_{Bdyn}}{M_{Bdyn} \pm M_L}, \; M_{Bdyn} > M_L$$

The sign of M_L is positive if the movement runs vertically upwards or horizontally and it is negative if the movement runs vertically down.

Calculation of the stop time

$$t_{dec} = 2.66 \cdot t_{1B} + \frac{n \cdot J_{tot}}{9.55 \cdot M_{Bdyn}}$$

Switching behavior

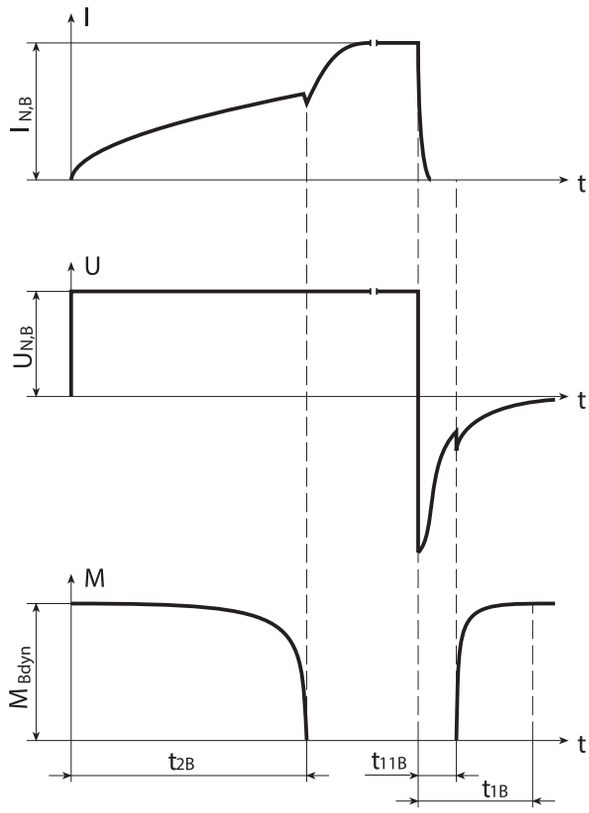


Fig. 4: Holding brake – Switching behavior

Technical data

Type	M_{Bstat} [Nm]	M_{Bdyn} [Nm]	$I_{N,B}$ [A]	$W_{B,Rmax/h}$ [kJ/h]	N_{Bstop}	J_{Bstop} [kgcm²]	$W_{B,Rlim}$ [kJ]	t_{2B} [ms]	t_{11B} [ms]	t_{1B} [ms]	$x_{B,N}$ [mm]	ΔJ_B [kgcm²]	Δm_B [kg]
EZ301	2.5	2.3	0.51	6.0	48000	0.752	180	25	3.0	20	0.2	0.186	0.55
EZ302	4.0	3.8	0.50	8.5	38000	0.952	180	44	4.0	26	0.3	0.186	0.55
EZ303	4.0	3.8	0.50	8.5	30000	1.17	180	44	4.0	26	0.3	0.186	0.55
EZ401	4.0	3.8	0.50	8.5	16000	2.24	180	44	4.0	26	0.3	0.192	0.76
EZ402	8.0	7.0	0.75	8.5	13500	4.39	300	40	2.0	20	0.3	0.566	0.97
EZ404	8.0	7.0	0.75	8.5	8500	7.09	300	40	2.0	20	0.3	0.566	0.97
EZ501	8.0	7.0	0.75	8.5	8700	6.94	300	40	2.0	20	0.3	0.571	1.19
EZ502	8.0	7.0	0.80	8.5	5200	11.5	300	40	2.0	20	0.3	0.571	1.19
EZ503	15	12	1.0	11.0	5900	18.6	550	60	5.0	30	0.3	1.721	1.62
EZ505	15	12	1.0	11.0	4000	27.8	550	60	5.0	30	0.3	1.721	1.62
EZ701	15	12	1.0	11.0	5400	20.5	550	60	5.0	30	0.3	1.743	1.94
EZ702	15	12	1.0	11.0	3600	30.9	550	60	5.0	30	0.3	1.743	1.94
EZ703	32	28	1.1	25.0	5200	54.6	1400	100	5.0	25	0.4	5.680	2.81
EZ705	32	28	1.1	25.0	3500	79.4	1400	100	5.0	25	0.4	5.680	2.81
EZ802	65	35	1.7	45.0	6000	149	2250	200	10	50	0.4	16.460	5.40
EZ803	65	35	1.7	45.0	4500	200	2250	200	10	50	0.4	16.460	5.40
EZ805	115	70	2.1	65.0	7000	376	6500	190	12	65	0.5	55.460	8.40

13.6.8 Connection method

The following chapters describe the connection technology of STOBER synchronous servo motors in the standard version on STOBER drive controllers. You can find further information relating to the drive controller type that was specified in your order in the connection plan that is delivered with every synchronous servo motor.

In Chapter [▶ 14], you can find information about options for connecting STOBER synchronous servo motors to drive controllers from other manufacturers.

13.6.8.1 Connection of the motor housing to the grounding conductor system

Connect the motor housing to the grounding conductor system of the machine in order to prevent personal injury and faulty triggering of residual current protective devices.

All attachment parts required for the connection of the grounding conductor to the motor housing are delivered with the motor. The grounding screw of the motor is identified with the symbol ⏚ in accordance with IEC 60417-DB. The cross-section of the grounding conductor has to be at least as large as the cross-section of the lines in the power connection.

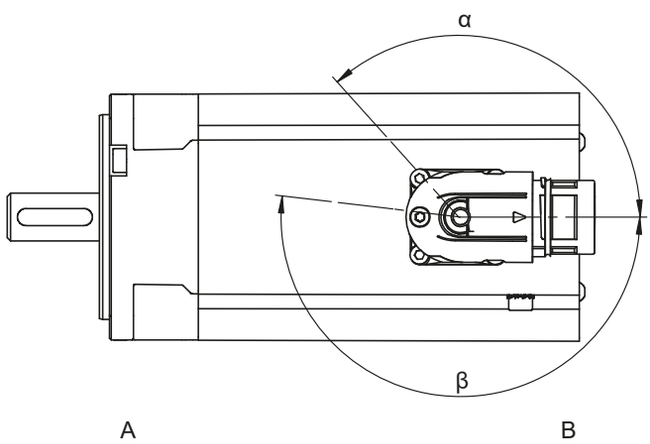
13.6.8.2 Plug connectors (One Cable Solution)

In the One Cable Solution design, the power and encoder lines are connected using a shared plug connector.

For motors with forced ventilation, avoid collisions between the motor connection cables and the plug connector of the forced ventilation unit. In the event of a collision, turn the motor plug connectors accordingly. Details regarding the position of the plug connector for the forced ventilation unit can be found in the "Dimensional drawings" chapter.

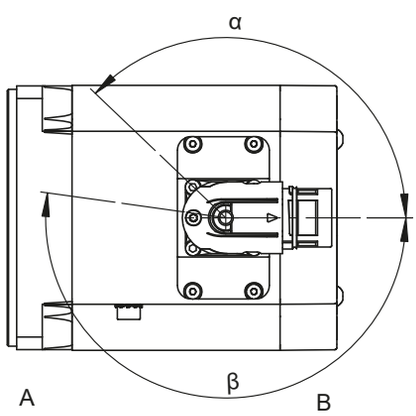
The figures represent the position of the plug connectors upon delivery.

Turning ranges of plug connectors (EZ3 motors)



A	Attachment or output side of the motor	B	Rear side of the motor

Turning ranges of plug connectors (EZ4 – EZ7 motors)



A	Attachment or output side of the motor	B	Rear side of the motor

Plug connector features

Motor type	Size	Connection	Turning range	
			α	β
EZ3 – EZ5, EZ701 – EZ703, EZ705U	con.23	Quick lock	130°	190°

Notes

- The number after "con." indicates the approximate external thread diameter of the plug connector in mm (for example, con.23 designates a plug connector with an external thread diameter of about 23 mm).

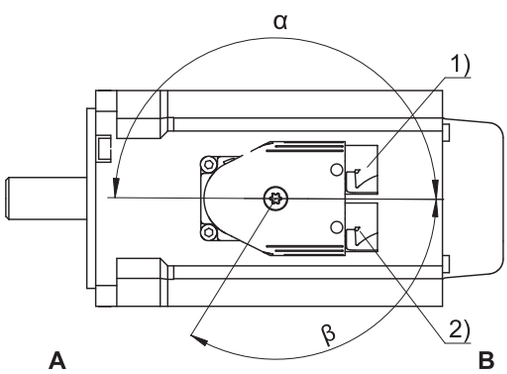
13.6.8.3 Plug connectors

STOBER synchronous servo motors are equipped with rotatable quick-lock plug connectors in the standard version (except for plug connector size con.58). Details can be found in this chapter.

For motors with forced ventilation, avoid collisions between the motor connection cables and the plug connector of the forced ventilation unit. In the event of a collision, turn the motor plug connectors accordingly. Details regarding the position of the plug connector for the forced ventilation unit can be found in the "Dimensional drawings" chapter.

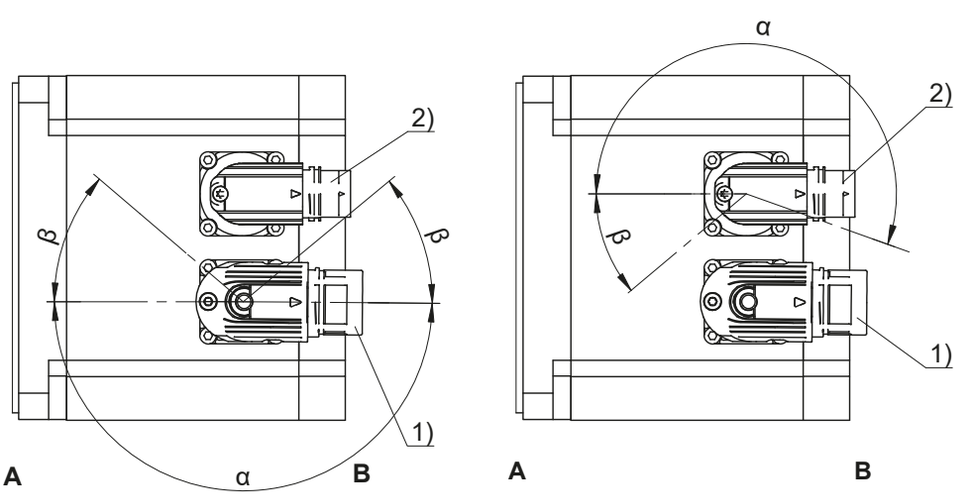
The figures represent the position of the plug connectors upon delivery.

Turning ranges of plug connectors (EZ3 motors)



1	Power plug connector	2	Encoder plug connector
A	Attachment or output side of the motor	B	Rear side of the motor

Turning ranges of plug connectors (EZ4 – EZ8 motors)



1	Power plug connector	2	Encoder plug connector
A	Attachment or output side of the motor	B	Rear side of the motor

Power plug connector features

Motor type	Size	Connection	Turning range	
			α	β
EZ3	con.15	Quick lock	180°	140°
EZ4, EZ5, EZ701, EZ702, EZ703	con.23	Quick lock	180°	40°
EZ705, EZ802, EZ803, EZ805U	con.40	Quick lock	180°	40°
EZ805B	con.58	Screw thread[2]	0°	0°

Encoder plug connector features

Motor type	Size	Connection	Turning range	
			α	β
EZ3	con.15	Quick lock	180°	140°
EZ4, EZ5, EZ7, EZ802, EZ803, EZ805U	con.17	Quick lock	195°	35°
EZ805B	con.17	Quick lock	180°	0°

Notes

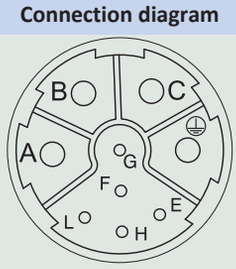
- The number after "con." indicates the approximate external thread diameter of the plug connector in mm (for example, con.23 designates a plug connector with an external thread diameter of about 23 mm).
- In turning range β, the power or encoder plug connectors can be turned only if doing so does not cause them to collide.
- For the EZ3 motor, the power and encoder plug connectors are mechanically connected and can only be turned together.

13.6.8.4 Terminal assignment for plug connectors (One Cable Solution)

In the One Cable Solution design, the power and encoder lines are connected using a shared plug connector.

The temperature sensor of the motor is connected to the encoder internally. The measured values from the temperature sensor are transmitted via the EnDat 3 protocol of the encoder.

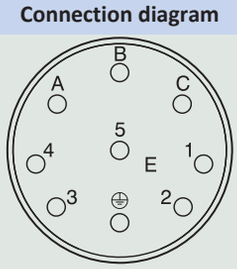
Plug connector size con.23

Connection diagram	Pin	Connection	Color
	A		BK
	B		BU
	C		RD
	E		YE
	F		
	G		
	H		VT
	L		
	⏚		GNYE

13.6.8.5 Connection assignment of the power plug connector

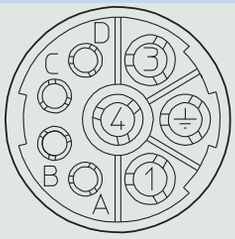
The size and connection plan of the power plug connector depend on the size of the motor. The colors of the connecting wires inside the motor are specified in accordance with IEC 60757.

Plug connector size con.15

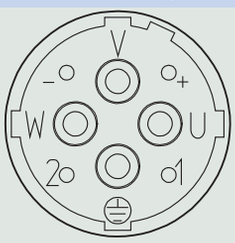
Connection diagram	Pin	Connection	Color
	A		BK
	B		BU
	C		RD
	1		
	2		
	3		RD
	4		BK
	⏚		GNYE

[2] Specify alignment on side A or B in the order.

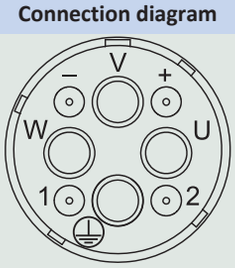
Plug connector size con.23

Connection diagram	Pin	Connection	Color
	1		BK
	3		BU
	4		RD
	A		RD
	B		BK
	C		
	D		
	⏚		GNYE

Plug connector size con.40 (1.5)

Connection diagram	Pin	Connection	Color
	U		BK
	V		BU
	W		RD
	+		RD
	–		BK
	1		
	2		
	⏚		GNYE

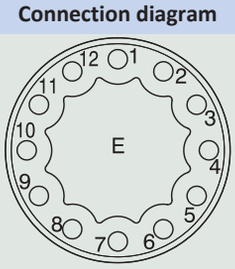
Plug connector size con.58 (3)

Connection diagram	Pin	Connection	Color
	U		BK
	V		BU
	W		RD
	+		RD
	–		BK
	1		
	2		
	⏚		GNYE

13.6.8.6 Connection assignment of the encoder plug connector

The size and connection assignment of the encoder plug connectors depend on the model of encoder installed and the size of the motor.

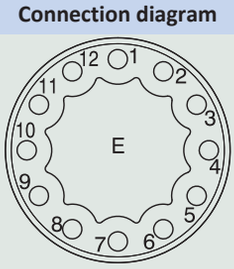
EnDat 2.1/2.2 digital encoders, plug connector size con.15

Connection diagram	Pin	Connection	Color
	1		VT
	2		BNGN
	3		
	4		
	5		PK
	6		GY
	7		
	8		YE
	9		
	10		WHGN
	11		
	12		BNGN

EnDat 2.1/2.2 digital encoders, plug connector size con.17

Connection diagram	Pin	Connection	Color
	1		VT
	2		BNGN
	3		
	4		
	5		PK
	6		GY
	7		
	8		YE
	9		
	10		WHGN
	11		
	12		BNGN

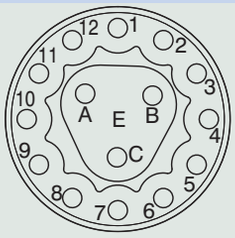
EnDat 2.2 digital encoder with battery buffering, plug connector size con.15

Connection diagram	Pin	Connection	Color
	1		VT
	2		BU
	3		WH
	4		
	5		PK
	6		GY
	7		
	8		YE
	9		
	10		WHGN
	11		
	12		BNGN
	UBatt+ = DC 3.6 V for encoder model EBI in combination with the AES option of STOBER drive controllers		

EnDat 2.2 digital encoder with battery buffering, plug connector size con.17

Connection diagram	Pin	Connection	Color
	1		VT
	2		BU
	3		WH
	4		
	5		PK
	6		GY
	7		
	8		YE
	9		
	10		WHGN
	11		
	12		BNGN
	UBatt+ = DC 3.6 V for encoder model EBI in combination with the AES option of STOBER drive controllers		

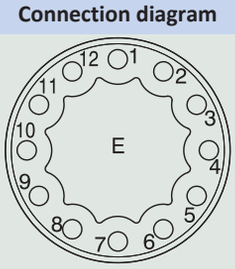
EnDat 2.1 encoder with sin/cos incremental signals, plug connector size con.15

Connection diagram	Pin	Connection	Color
	1		BU
	2		WH
	3		BNGN
	4		VT
	5		YE
	6		WHGN
	7		BUBK
	8		RDBK
	9		GY
	10		GNBK
	11		YEBK
	12		PK
	A		
	B		
	C		

EnDat 2.1 encoder with sin/cos incremental signals, plug connector size con.17

Connection diagram	Pin	Connection	Color
	1		BU
	2		
	3		
	4		WH
	5		
	6		
	7		BNGN
	8		VT
	9		YE
	10		WHGN
	11		
	12		BUBK
	13		RDBK
	14		GY
	15		GNBK
	16		YEBK
	17		PK

Resolver, plug connector size con.15

Connection diagram	Pin	Connection	Color
	1		BK
	2		RD
	3		BU
	4		YE
	5		
	6		
	7		YEWH/BKWH[3]
	8		RDWH
	9		
	10		
	11		
	12		

[3] (depending on the brand of the resolver)

Resolver, plug connector size con.17

Connection diagram	Pin	Connection	Color
	1		BK
	2		RD
	3		BU
	4		YE
	5		
	6		
	7		YEWH/BKWH[4]
	8		RDWH
	9		
	10		
	11		
	12		

13.7 Project configuration

Project your drives using our SERVOsoft designing software. Download SERVOsoft for free at https://www.stoeber.de/en/ServoSoft.

Observe the limit conditions in this chapter to ensure a safe design for your drives.

An explanation of the formula symbols can be found in Chapter Symbols in formulas.

The formula symbols for values actually present in the application are marked with *.

13.7.1 Calculation of the operating point

In this chapter, you can find information needed to calculate the operating point.

Check the following conditions for operating points other than the nominal point M_N specified in the selection tables:

$n_{m*} \leq n_N$

$M_{eff*} \leq M_{limK}$ and $M_{eff*} \leq M_{limF}$

$M_{max*} < M_{max}$

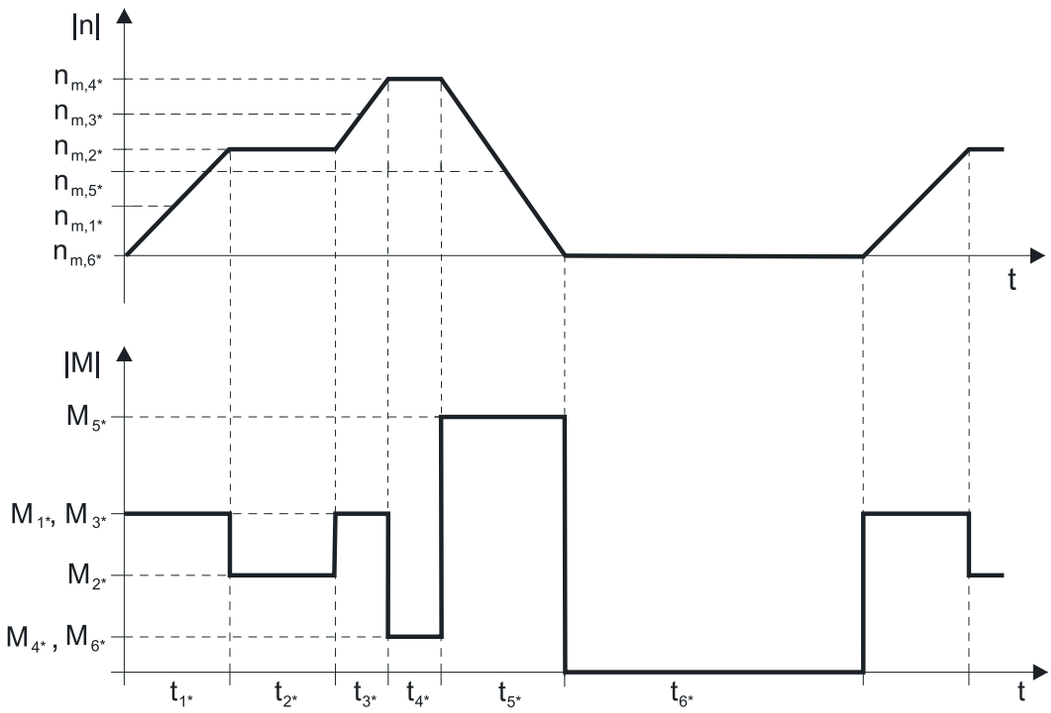
The values for M_N, n_N, M_{max} can be found in the selection tables.

The values for M_{limK} and M_{limF} can be found in the torque/speed curves.

[4] (depending on the brand of the resolver)

Example of cyclic operation

The following calculations refer to a representation of the power delivered at the motor shaft based on the following example:



Calculation of the actual average input speed

$$n_{m^*} = \frac{\left|n_{m,1^*}\right| \cdot t_{1^*} + \ldots + \left|n_{m,n^*}\right| \cdot t_{n^*}}{t_{1^*} + \ldots + t_{n^*}}$$

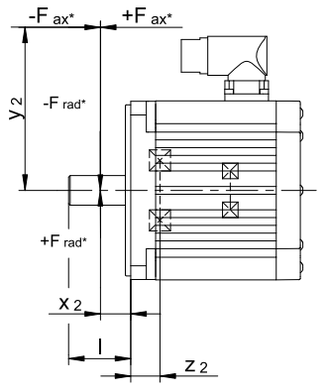
If $t_{1^*} + \ldots + t_{5^*} \geq 6$ min, determine n_{m^*} without the rest phase t_{6^*}.

Calculation of the actual effective torque

$$M_{eff^*} = \sqrt{\frac{t_{1^*} \cdot M_{1^*}{}^2 + \ldots + t_{n^*} \cdot M_{n^*}{}^2}{t_{1^*} + \ldots + t_{n^*}}}$$

13.7.2 Permitted shaft loads

This chapter contains information about the maximum permitted shaft loads of the output shaft of the motor.



Type	z_2 [mm]	F_{ax100} [N]	F_{rad100} [N]	M_{k100} [Nm]
EZ301	24.0	350	1000	39
EZ302	24.0	350	1000	39
EZ303	24.0	350	1000	39
EZ401	19.5	550	1800	62
EZ402	19.5	550	1800	71
EZ404	19.5	550	1800	71
EZ501	19.5	750	2000	79
EZ502	19.5	750	2400	95
EZ503	19.5	750	2400	107
EZ505	19.5	750	2400	107
EZ701	24.5	1300	3500	173
EZ702	24.5	1300	4200	208
EZ703	24.5	1300	4200	208
EZ705	24.5	1300	4200	225
EZ802	28.5	1750	5600	384
EZ803	28.5	1750	5600	384
EZ805	28.5	1750	5600	384

The values for permitted shaft loads specified in the table apply:

- For shaft dimensions in accordance with the catalog
- A force applied at the center of the output shaft: $x_2 = l / 2$ (shaft dimensions can be found in the chapter Dimensional drawings)
- Output speeds $n_{m*} \leq 100$ rpm ($F_{ax} = F_{ax100}$; $F_{rad} = F_{rad100}$; $M_k = M_{k100}$)

The following applies to output speeds $n_{m*} > 100$ rpm:

$$F_{ax} = \frac{F_{ax100}}{\sqrt[3]{\frac{n_{m*}}{100\ \text{rpm}}}} \qquad F_{rad} = \frac{F_{rad100}}{\sqrt[3]{\frac{n_{m*}}{100\ \text{rpm}}}} \qquad M_k = \frac{M_{k100}}{\sqrt[3]{\frac{n_{m*}}{100\ \text{rpm}}}}$$

The following applies to other force application points:

$$M_{k*} = \frac{2 \cdot F_{ax*} \cdot y_2 + F_{rad*} \cdot (x_2 + z_2)}{1000} \leq M_{k100}$$

$$F_{rad*} \leq F_{rad100}$$

$$F_{ax*} \leq F_{ax100}$$

For applications with multiple axial and/or radial forces, you must add the forces as vectors.

13.7.3 Derating

If you use the motor under ambient conditions that differ from the standard ambient conditions, the nominal torque M_N of the motor is reduced. In this chapter, you can find information for calculating the reduced nominal torque.

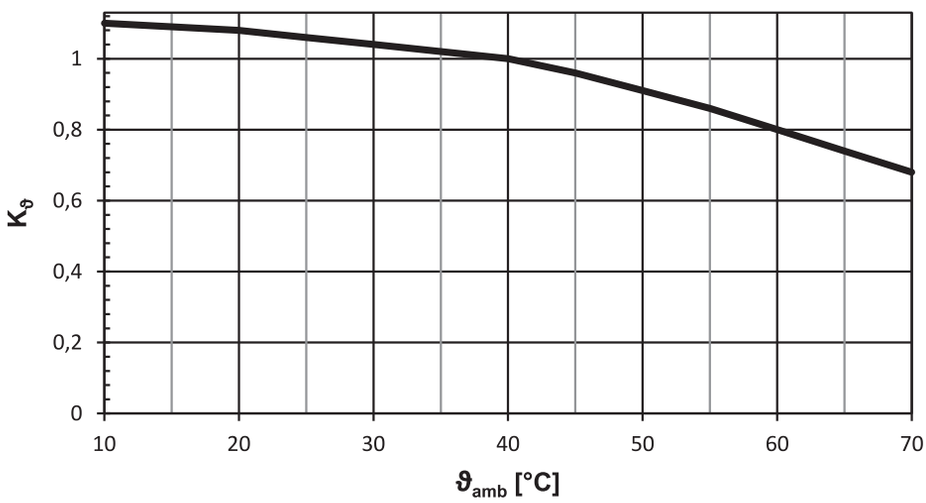


Fig. 5: Derating depending on the surrounding temperature

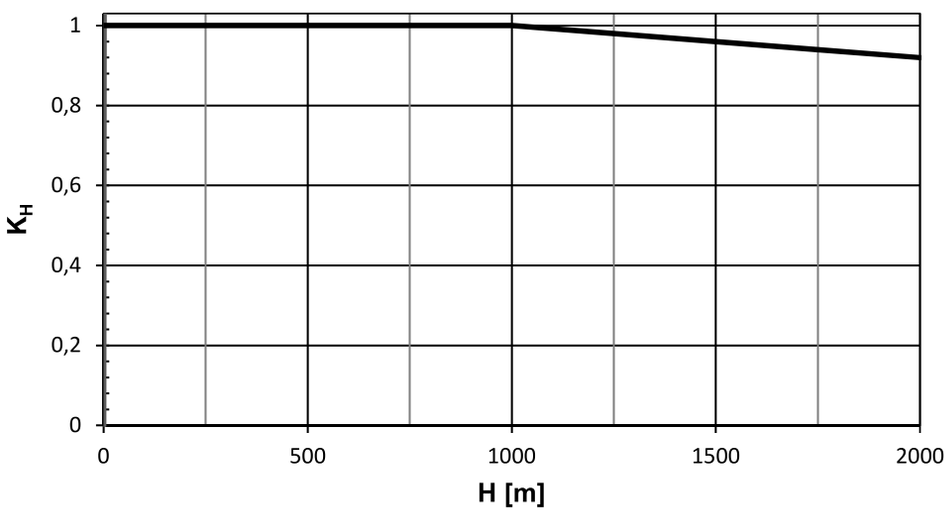


Fig. 6: Derating depending on the installation height

Calculation

If surrounding temperature ϑ_{amb} > 40 °C:

$M_{Nred} = M_N \cdot K_\vartheta$

If installation altitude H > 1000 m above sea level:

$M_{Nred} = M_N \cdot K_H$

If the surrounding temperature ϑ_{amb} > 40 °C and installation altitude H > 1000 m above sea level:

$M_{Nred} = M_N \cdot K_H \cdot K_\vartheta$

13.8 Further information

13.8.1 Directives and standards

STOBER synchronous servo motors meet the requirements of the following directives and standards:

- (Low Voltage) Directive 2014/35/EU
- EN 60034-1:2010 + Cor.:2010
- EN 60034-5:2001 + A1:2007
- EN 60034-6:1993

13.8.2 Identifiers and test symbols

STOBER synchronous servo motors have the following identifiers and test symbols:

CE mark: The product meets the requirements of EU directives.

cURus test symbol "Servo and Stepper Motors – Component"; registered under UL number E488992 with Underwriters Laboratories USA (optional).

13.8.3 Additional documentation

Additional documentation related to the product can be found at
http://www.stoeber.de/en/downloads/

Enter the ID of the documentation in the Search... field.

Documentation	ID
Operating manual for EZ synchronous servo motors	443032_en

14 Connecting to drive controllers of third-party manufacturers

Table of contents

14.1 General notes

STOBER synchronous servo motors are designed for connection to STOBER drive controllers in the standard version. STOBER offers an extensive assortment of high-quality, trusted power and encoder connection cables for this purpose. However, STOBER synchronous servo motors can also be operated on drive controllers from third-party manufacturers. Notes and information for this purpose can be found in the following chapters. You can find all other information about STOBER synchronous servo motors in the corresponding chapters of this catalog.

14.1.1 Nominal data

Nominal data for synchronous servo motors specified in the selection tables of this catalog were calculated for connecting to STOBER drive controllers. Note that this nominal data may change when STOBER synchronous servo motors are connected to drive controllers of third-party manufacturers. The following drive controller plug connectors are determining factors here:

- f_{2PU}
- $f_{PWM,PU}$
- U_{ZK}
- Compensation of the field weakening range.

The maximum achievable speed of a synchronous servo motor depends on the number of pole pairs (p) of the synchronous servo motor and, if applicable, on the restriction of f_{2PU} by Regulation (EC) No. 428/2009 (EC Dual Use Regulation). Details are shown in the figure below.

Some encoders feature integrated temperature monitoring, the warning and switch-off thresholds of which may overlap with the corresponding values set for the thermal winding protection in the drive controller. In some cases, this may result in an instance where an encoder with internal temperature monitoring forces the motor to shut down, even before the motor has reached its nominal data.

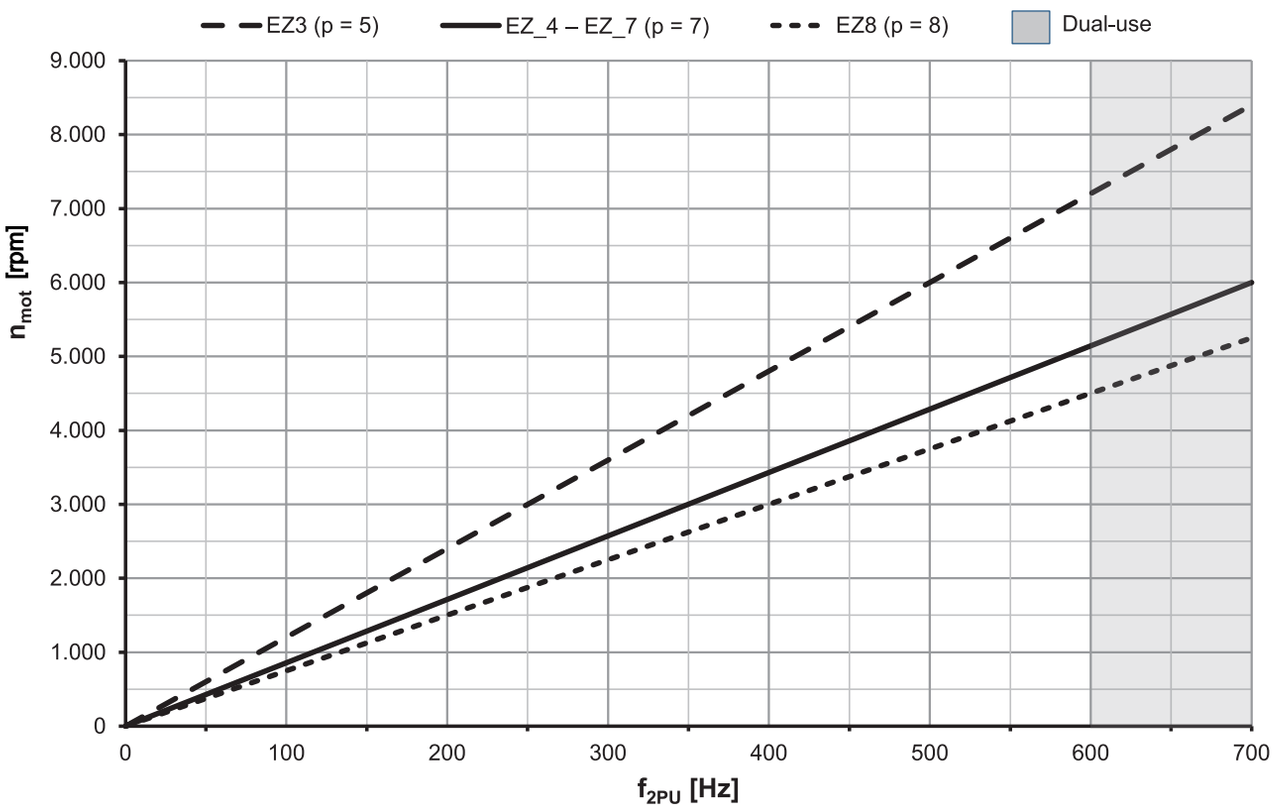


Fig. 1: Speed/frequency graph for EZ motors

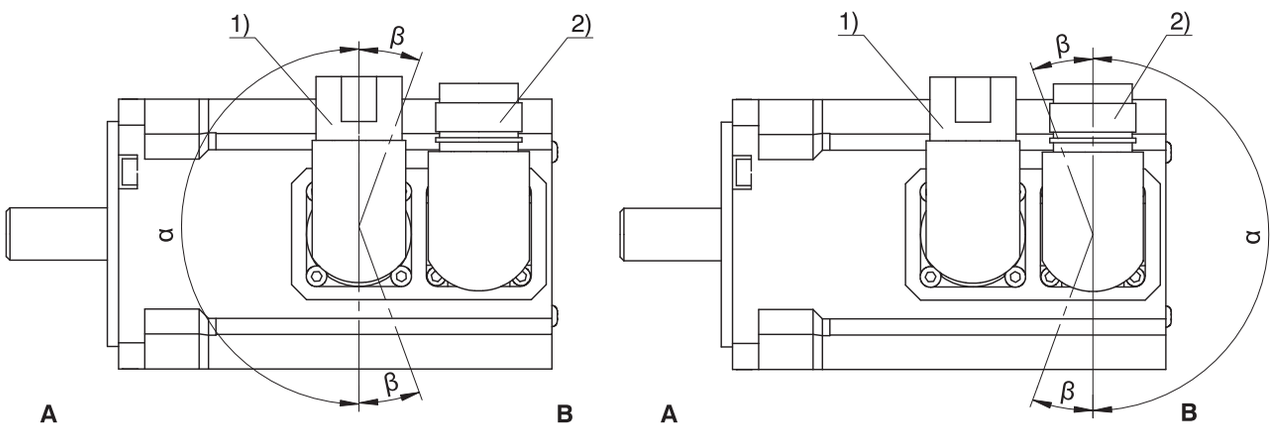
14.1.2 Plug connectors

STOBER synchronous servo motors are equipped with angled, round plug connectors (INTERCONTEC brand) for power and encoder connection in the standard version. You can find detailed technical information about the plug connectors at http://www.intercontec.biz.

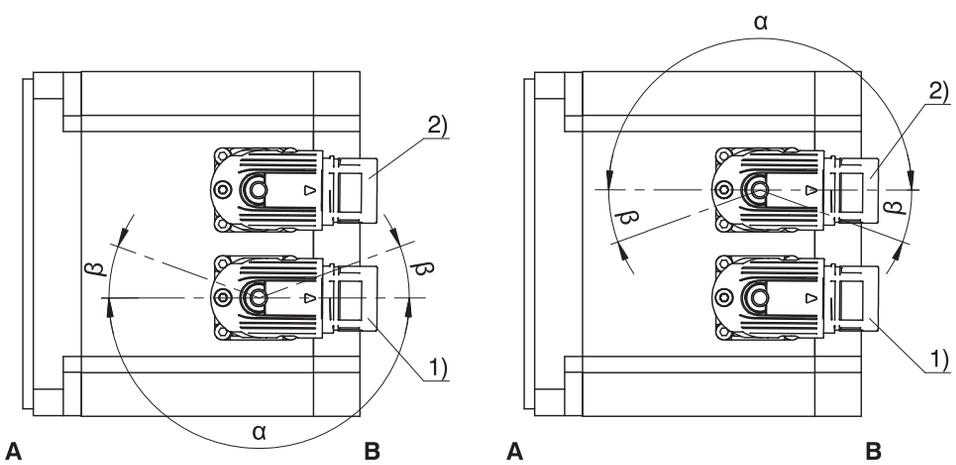
For motors with forced ventilation, avoid collisions between the motor connection cables and the plug connector of the forced ventilation unit. In the event of a collision, turn the motor plug connectors accordingly. Details regarding the position of the plug connector for the forced ventilation unit can be found in the "Dimensional drawings" chapter.

The figures represent the position of the plug connectors upon delivery.

Turning ranges of plug connectors (EZ3 motors)



Turning ranges of plug connectors (motors EZ4 – EZ8, EZHD, EZM, EZS)



1	Power plug connector	2	Encoder plug connector
A	Attachment or output side of the motor	B	Rear side of the motor

Power plug connector features

Motor type	Size	Connection	Turning range	
			α	β
EZ3 – EZ5, EZ701, EZ703 EZHD_4, EZHD_5, EZHD_711 – EZHD_713 EZM, EZS	con.23	Quick lock	180°	20°
EZ705, EZ802, EZ803, EZ805U EZHD_715	con.40	Quick lock	180°	20°
EZ805B	con.58	Screw thread[1]	0°	0°

[1] Specify the alignment on side A or B in the order.

Encoder plug connector features

Motor type	Size	Connection	Turning range	
			α	β
EZ3 – EZ7, EZ802, EZ803, EZ805U, EZHD, EZM, EZS	con.23[2]	Quick lock	180°	20°
EZ805B	con.23[3]	Quick lock	180°	0°

Notes

- In turning range β, the power or encoder plug connectors can be turned only if doing so does not cause them to collide.
- The number after "con." indicates the approximate external thread diameter of the plug connector in mm (for example, con.23 designates a plug connector with an external thread diameter of about 23 mm).

14.1.3 Connection cables

The plug connectors and connection assignment of STOBER synchronous servo motors are designed for connecting to drive controllers from third-party manufacturers in such a way that allows you to connect the original cable of the respective manufacturer. Keep the following information regarding cable quality and design in mind.

- Because the original cable from Bosch Rexroth cannot be used, STOBER offers suitable cables for this purpose. More detailed information is available from your STOBER customer consultant.
- Ensure that the cable quality and cable design is suitable for the ambient conditions at the installation location.

Electromagnetic compatibility (EMC)

Ensure compliance with statutory EMC requirements for the drive system at the installation location.

Connect the cable shields on both ends of the connection cable. Connect the grounding screw of the synchronous servo motor with the grounding at the installation location.

Power cables

Operation with unsuitable power cables may lead to inadmissibly high voltage peaks, which could damage the motor. For this reason, the capacitances and inductances must match the motor. Recommended values can be found in the table below.

The conductor cross-section of the power cable must be designed appropriately for the stall current of the motor. Details on this can be found in the table below.

Conductor cross-section [mm²]	1.0	1.5	2.5	4.0	6.0	10.0	16.0	25.0
Nominal current [A]	12.5	15.0	20.0	28.3	35.8	49.2	66.7	90.0
Maximum capacitance in accordance with test type A (core/core) [nF/km]	45	55	65	60	70	75	75	Values on request
Maximum capacitance in accordance with test type B (core/residual) [nF/km]	250	300	325	260	300	350	360	Values on request
Maximum inductance (core/core) [µH/km]	800	700	700	600	650	600	570	Values on request

Notes

- The maximum capacitance is specified in accordance with DIN VDE 0472-504. Specifications in accordance with EN 50289-1-5 in preparation.
- The maximum inductance is specified in accordance with EN 50289-1-12.

[2] con.15 for connection to B&R ACOPOSmulti with EnDat 2.2 Interface (drive controller type code GG).

[3] con.15 for connection to B&R ACOPOSmulti with EnDat 2.2 Interface (drive controller type code GG).

Encoder cables

When operating with unsuitable encoder cables, encoder signals can no longer be transferred free of interference. Note the recommended values in the following table.

Signal shape	Digital		Sin-Cos			Resolver	
Conductor cross-section [mm²]	0.14	0.25	0.14	0.25	0.37	0.14	0.25
Maximum capacitance in accordance with test type A (core/core) [nF/km]	30	35	60	110	130	40	50
Maximum capacitance in accordance with test type B (core/remainder) [nF/km]	110	130	300	300	325	300	300
Maximum inductance (core/core) [µH/km]	800	800	650	700	700	800	800
Shielding type of cable	Tin-plated copper braiding						
Shielding type of core pairs	–		Tin-plated copper braiding			Film + braiding	
Cover	≥ 90 %		≥ 80 %			≥ 80 %	

Notes

- The maximum capacitance is specified in accordance with DIN VDE 0472-504. Specifications in accordance with EN 50289-1-5 in preparation.
- The maximum inductance is specified in accordance with EN 50289-1-12.

14.2 Connection to B&R drive controllers

This chapter contains the information for connecting STOBER synchronous servo motors to drive controllers of the above-named manufacturer which differs from connecting to STOBER drive controllers. You can find all other information about STOBER synchronous servo motors in the respective chapter of this catalog.

STOBER has taken the following measures to minimize the effort of commissioning STOBER motors connected to B&R drive controllers and avoid errors during parameterization:

- The commutation offset of the motor was set so that calibration by the customer is not necessary.
- The electronic nameplate of the motor was designed to be compatible with the B&R controllers.

14.2.1 Encoders

Encoders with EnDat 2.2 interface

Encoder model	Code	Measuring method	Recordable revolutions	Resolution	Position values per revolution
EnDat 2.2 EQI 1131 FMA	M4	Inductive	4096	19 bit	524288
EnDat 2.2 EQI 1131	Q6	Inductive	4096	19 bit	524288
EnDat 2.2 EQN 1135 FMA	M3	Optical	4096	23 bit	8388608
EnDat 2.2 EQN 1135	Q5	Optical	4096	23 bit	8388608
EnDat 2.2 ECN 1123 FMA	M1	Optical	–	23 bit	8388608
EnDat 2.2 ECN 1123	C7	Optical	–	23 bit	8388608
EnDat 2.2 ECI 1118-G2	C5	Inductive	–	18 bit	262144
EnDat 2.2 ECI 119-G2	C9	Inductive	–	19 bit	524288

Encoders with EnDat 2.1 interface

Encoder model	Code	Measuring method	Recordable revolutions	Resolution	Position values per revolution	Periods per revolution
EnDat 2.1 ECI 119	C4	Inductive	–	19 bit	524288	Sin/Cos 32
EnDat 2.1 EQN 1125 FMA	M2	Optical	4096	13 bit	8192	Sin/Cos 512
EnDat 2.1 EQN 1125	Q4	Optical	4096	13 bit	8192	Sin/Cos 512
EnDat 2.1 ECN 1113 FMA	M0	Optical	–	13 bit	8192	Sin/Cos 512
EnDat 2.1 ECN 1113	C6	Optical	–	13 bit	8192	Sin/Cos 512

Notes

- The encoder code is a part of the type designation of the motor.
- FMA = Version with fault exclusion for mechanical coupling.
- Encoders with EnDat 2.2 interface and in the FMA design are ready for operation as a one-encoder solution on a safety-related position measuring system with an EnDat 2.2 interface
- Multiple revolutions of the motor shaft can be recorded only using multi-turn encoders.

14.2.2 Possible combinations with drive controllers

The following table shows the possible combinations of STOBER synchronous servo motors with drive controllers from B&R depending on the encoder model.

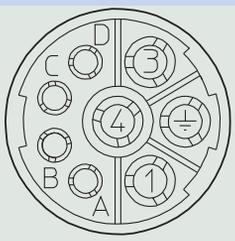
Drive controller		ACOPOS	ACOPOSmulti (EnDat 2.1)	ACOPOSmulti (EnDat 2.2)	ACOPOS P3 (EnDat 2.2)	ACOPOS P3 OCS (EnDat 2.2)	ACOPOSmulti OCS (EnDat 2.2)
Drive controller code		FG	FV	GG	GY	GP	GV
Connection plan ID		442313	442444	442677	443095	443022	443092
Encoder	**Encoder code**						
EnDat 2.2 EQI 1131 FMA	M4	–	–	EZ, EZS	EZ, EZS	EZ, EZS	EZ, EZS
EnDat 2.2 EQI 1131	Q6	–	–	EZ, EZS	EZ, EZS	EZ, EZS	EZ, EZS
EnDat 2.2 EQN 1135 FMA	M3	–	–	EZ, EZS	EZ, EZS	EZ, EZS	EZ, EZS
EnDat 2.2 EQN 1135	Q5	–	–	EZ, EZS	EZ, EZS	EZ, EZS	EZ, EZS
EnDat 2.2 ECN 1123 FMA	M1	–	–	EZ, EZS	EZ, EZS	EZ, EZS	EZ, EZS
EnDat 2.2 ECN 1123	C7	–	–	EZ, EZS	EZ, EZS	EZ, EZS	EZ, EZS
EnDat 2.2 ECI 1118-G2	C5	–	–	EZ, EZS	EZ, EZS	–	–
EnDat 2.1 ECI 119	C4	–	EZHD, EZM	–	–	–	–
EnDat 2.2 ECI 119-G2	C9	–	–	EZHD, EZM	EZHD, EZM	EZHD, EZM	EZHD, EZM
EnDat 2.1 EQN 1125 FMA	M2	EZ, EZS	EZ, EZS	–	–	–	–
EnDat 2.1 EQN 1125	Q4	EZ, EZS	EZ, EZS	–	–	–	–
EnDat 2.1 ECN 1113 FMA	M0	–	EZ, EZS	–	–	–	–
EnDat 2.1 ECN 1113	C6	–	EZ, EZS	–	–	–	–
Resolver	R0	EZ, EZS	EZ, EZS	–	–	–	–

The encoder and drive controller codes are a part of the type designation of the motor.

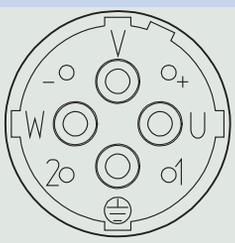
14.2.3 Connection assignment of the power plug connector

The size and connection plan of the power plug connector depend on the size of the motor. The colors of the connecting wires inside the motor are specified in accordance with IEC 60757.

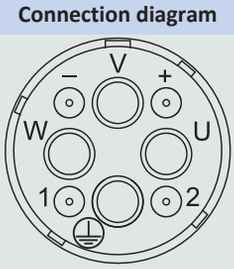
Plug connector size con.23

Connection diagram	Pin	Connection	Color
	1		BK
	3		RD
	4		BU
	A		
	B		
	C		RD
	D		BK
	⏚		GNYE

Plug connector size con.40 (1.5)

Connection diagram	Pin	Connection	Color
	U		BK
	V		BU
	W		RD
	+		RD
	–		BK
	1		
	2		
	⏚		GNYE

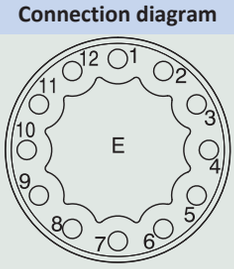
Plug connector size con.58 (3)

Connection diagram	Pin	Connection	Color
	U		BK
	V		BU
	W		RD
	+		RD
	–		BK
	1		
	2		
	⏚		GNYE

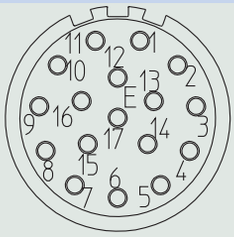
14.2.4 Connection assignment of the encoder plug connector

The size and connection assignment of the encoder plug connectors depend on the model of encoder installed and the size of the motor. The colors of the connecting wires inside the motor are specified in accordance with IEC 60757.

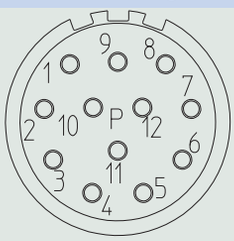
EnDat 2.2 digital encoder, plug connector size con.15

Connection diagram	Pin	Connection	Color
	1		BNGN
	2		GY
	3		PK
	4		VT
	5		YE
	6		
	7		WHGN
	8		
	9		
	10		
	11		
	12		

EnDat 2.1 encoder with sin/cos incremental signals, plug connector size con.23

Connection diagram	Pin	Connection	Color
	1		BU
	2		
	3		
	4		WH
	5		
	6		
	7		BNGN
	8		VT
	9		YE
	10		WHGN
	11		
	12		BUBK
	13		RDBK
	14		GY
	15		GNBK
	16		YEBK
	17		PK

Resolver, plug connector size con.23

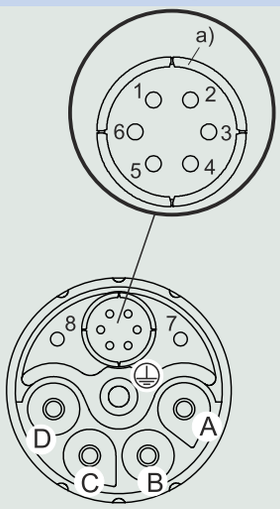
Connection diagram	Pin	Connection	Color
	1		
	2		
	3		BU
	4		RD
	5		YEWH
	6		
	7		YE
	8		BK
	9		RDWH
	10		
	11		
	12		

14.2.5 Terminal assignment for plug connectors (One Cable Solution)

In the One Cable Solution design, the power and encoder lines are connected using a shared plug connector.

The temperature sensor of the motor is connected to the encoder internally. The measured values from the temperature sensor are transmitted via the log of the encoder.

Plug connector size con.23

Connection diagram	Pin	Connection	Color
	A		
	B		
	C		
	D		
	1		
	2		
	3		
	4		
	5		
	6		
	7		
	8		
	⏚		

a) Coaxial shield to which the shield of the encoder cores is connected

14.3 Connection to Siemens drive controllers

This chapter contains the information for connecting STOBER synchronous servo motors to drive controllers of the above-named manufacturer which differs from connecting to STOBER drive controllers. You can find all other information about STOBER synchronous servo motors in the respective chapter of this catalog.

STOBER has taken the following measures to minimize the effort of commissioning STOBER motors connected to SINAMICS S120 drive controllers and avoid errors during parameterization:

- The commutation offset of the motor was set so that calibration by the customer is not necessary.
- Parameter lists are provided on request.

14.3.1 EIB 3392S interface

The EIB 3392S interface made by Heidenhain enables the connection of EnDat 2.2 encoders to Siemens SINAMICS S120 drive controllers using the powerful DRIVE-CLiQ system interface. STOBER offers the EIB 3392S interface with the ID 1250663-01. In this design, the connector and the terminal assignment on the EnDat 2.2 side are adapted to STOBER synchronous servo motors so that the interface can be connected and commissioned without additional work.

Advantages

- Support for all DRIVE-CLiQ interface options
- Compact and robust industrial design
- Easy, fast commissioning
- No space or wiring necessary in the control cabinet
- Because the DRIVE-CLiQ electronics are located outside of the motor, it is not necessary to reduce the performance data of the motor based on the temperature.

Features

Feature	Description
Surrounding temperature for operation	0 °C to 60 °C
Protection class	IP 65
Bending radius of the interface connection cable	75 mm, freely movable 20 mm, permanently installed

The EIB 3392S interface is connected to the plug connector of the motor on the EnDat 2.2 side. On the DRIVE-CLiQ side, an original Siemens encoder cable with a length of up to 30 m can be connected.

The EIB 3392S interface may only be connected to motors with a Pt1000 temperature sensor. The temperature sensor is connected to the EnDat 2.2 encoder inside the motor. The EIB 3392S interface transmits the values from the temperature sensor over the DRIVE-CLiQ interface unchanged.

The housing of the EIB 3392S must be attached at the installation location. A cable clip can be used for this purpose (see dimensional drawing).

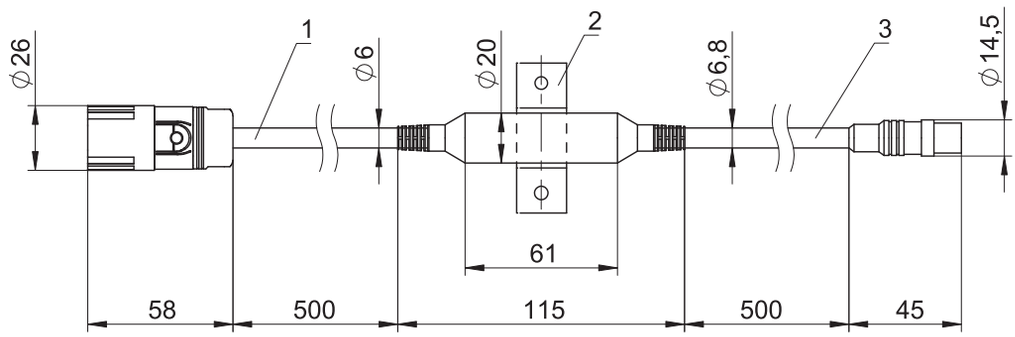
Functional safety

Depending on the connected encoder and the downstream electronics, the EIB 3392S can be used in safety-oriented applications up to Safety Integrity Level (SIL) 2 in accordance with EN 61508-1 / EN 61800-5-2 or up to Category 3, PL d in accordance with EN ISO 13849-1.

The probability of a failure per hour (PFH) is 26×10^{-9} for an installation altitude ≤ 1000 m above sea level.

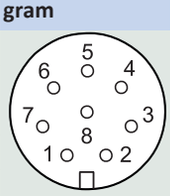
The EIB 3392S interface does not have any effect on the safe position that can be implemented by the motor encoder and the downstream electronics.

14.3.1.1 Dimensional drawing



1	Black cable color (EnDat 2.2 side)	2	Cable clip (not included in the scope of delivery)
3	Green cable color (DRIVE-CLiQ side)		

14.3.1.2 Terminal assignment

EnDat 2.2 side, con.23 plug connector			DRIVE-CLiQ side, M12 plug connector		
Connection diagram	Pin	Connection	Connection	Pin	Connection diagram
	1	Clock +	Up +	1	
	2			2	
	3		RXP	3	
	4		RXN	4	
	5	Data –	0 V GND	5	
	6	Data +	TXN	6	
	7		TXP	7	
	8	Clock –		8	
	9				
	10	0 V GND			
	11				
	12	Up +			

14.3.2 Encoders

Encoders with EnDat 2.2 interface

Encoders with an EnDat 2.2 interface can be connected to Siemens S120 drive controllers and operated using the EIB 3392S interface.

Encoder model	Code	Measuring method	Recordable revolutions	Resolution	Position values per revolution
EnDat 2.2 EQI 1131 FMA	M4	Inductive	4096	19 bit	524288
EnDat 2.2 EQI 1131	Q6	Inductive	4096	19 bit	524288
EnDat 2.2 EQN 1135 FMA	M3	Optical	4096	23 bit	8388608
EnDat 2.2 EQN 1135	Q5	Optical	4096	23 bit	8388608
EnDat 2.2 ECN 1123 FMA	M1	Optical	–	23 bit	8388608
EnDat 2.2 ECN 1123	C7	Optical	–	23 bit	8388608
EnDat 2.2 ECI 119-G2	C9	Inductive	–	19 bit	524288

Encoders with EnDat 2.1 interface

Encoder model	Code	Measuring method	Recordable revolutions	Resolution	Position values per revolution	Periods per revolution
EnDat 2.1 ECI 119	C4	Inductive	–	19 bit	524288	Sin/Cos 32
EnDat 2.1 EQN 1125 FMA	M2	Optical	4096	13 bit	8192	Sin/Cos 512
EnDat 2.1 EQN 1125	Q4	Optical	4096	13 bit	8192	Sin/Cos 512
EnDat 2.1 ECN 1113 FMA	M0	Optical	–	13 bit	8192	Sin/Cos 512
EnDat 2.1 ECN 1113	C6	Optical	–	13 bit	8192	Sin/Cos 512

Notes

- The encoder code is a part of the type designation of the motor.
- FMA = Version with fault exclusion for mechanical coupling.
- Multiple revolutions of the motor shaft can be recorded only using multi-turn encoders.

14.3.3 Possible combinations with drive controllers

The following table shows the possible combinations of STOBER synchronous servo motors with drive controllers from Siemens depending on the encoder model.

Encoders with an EnDat 2.2 interface can be connected to Siemens S120 drive controllers and operated using the EIB 3392S interface.

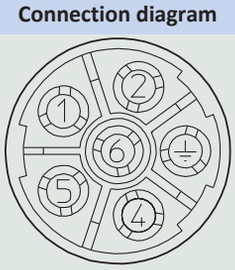
Drive controller		**SINAMICS S120** (with EnDat 2.1 and resolver interface)	**SINAMICS S120** (with DRIVE-CLiQ interface)
Drive controller code		FJ	GQ
Connection plan ID		442315	443049
Encoder	**Encoder code**		
EnDat 2.2 EQI 1131 FMA	M4	–	EZ, EZS
EnDat 2.2 EQI 1131	Q6	–	EZ, EZS
EnDat 2.2 EQN 1135 FMA	M3	–	EZ, EZS
EnDat 2.2 EQN 1135	Q5	–	EZ, EZS
EnDat 2.2 ECN 1123 FMA	M1	–	EZ, EZS
EnDat 2.2 ECN 1123	C7	–	EZ, EZS
EnDat 2.2 ECI 119-G2	C9	–	EZHD, EZM
EnDat 2.1 ECI 119	C4	EZHD, EZM	–
EnDat 2.1 EQN 1125 FMA	M2	EZ, EZS	–
EnDat 2.1 EQN 1125	Q4	EZ, EZS	–
EnDat 2.1 ECN 1113 FMA	M0	EZ, EZS	–
EnDat 2.1 ECN 1113	C6	EZ, EZS	–
Resolver	R0	EZ, EZS	–

The encoder and drive controller codes are a part of the type designation of the motor.

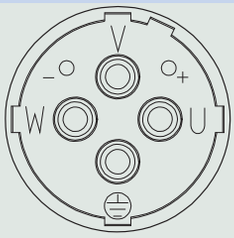
14.3.4 Connection assignment of the power plug connector

The size and connection plan of the power plug connector depend on the size of the motor. The colors of the connecting wires inside the motor are specified in accordance with IEC 60757.

Plug connector size con.23

Connection diagram	Pin	Connection	Color
	1		BK
	2		BU
	4		RD
	5		BK
	6		RD
	⏚		GNYE

Plug connector size con.40 (1.5)

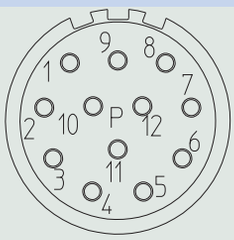
Connection diagram	Pin	Connection	Color
	U		BK
	V		BU
	W		RD
	+		RD
	–		BK
	⏚		GNYE

14.3.5 Connection assignment of the encoder plug connector

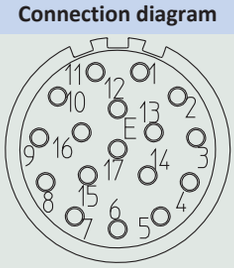
The size and terminal assignment of the encoder plug connectors depend on the model of encoder installed and the size of the motor.

EnDat 2.2 digital encoder, plug connector size con.23

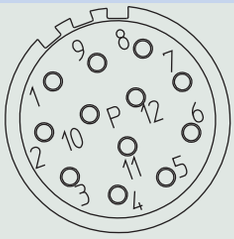
Encoders with an EnDat 2.2 interface can be connected to Siemens S120 drive controllers and operated using the EIB 3392S interface.

Connection diagram	Pin	Connection	Color
	1		VT
	2		
	3		
	4		
	5		PK
	6		GY
	7		
	8		YE
	9		
	10		WHGN
	11		
	12		BN GN

EnDat 2.1 encoder with sin/cos incremental signals, plug connector size con.23

Connection diagram	Pin	Connection	Color
	1		GNBK
	2		YEBK
	3		GY
	4		
	5		VT
	6		
	7		WHGN
	8		BK/BN
	9		WH/WH
	10		BNGN
	11		BUBK
	12		RDBK
	13		PK
	14		YE
	15		WH
	16		BU
	17		

Resolver, plug connector size con.23

Connection diagram	Pin	Connection	Color
	1		BU
	2		YE
	3		
	4		
	5		
	6		
	7		RDWH
	8		BK/BN
	9		WH/WH
	10		YEWH
	11		BK
	12		RD

14.4 Connection to Kollmorgen drive controllers

This chapter contains the information for connecting STOBER synchronous servo motors to drive controllers of the above-named manufacturer which differs from connecting to STOBER drive controllers. You can find all other information about STOBER synchronous servo motors in the respective chapter of this catalog.

STOBER has taken the following measures to minimize the effort of commissioning STOBER motors connected to Kollmorgen drive controllers and avoid errors during parameterization:

- The commutation offset of the motor was set so that calibration by the customer is not necessary.
- Parameter lists are provided on request.

14.4.1 Encoders

Encoders with EnDat 2.1 interface

Encoder model	Code	Measuring method	Recordable revolutions	Resolution	Position values per revolution	Periods per revolution
EnDat 2.1 ECI 119	C4	Inductive	–	19 bit	524288	Sin/Cos 32
EnDat 2.1 EQN 1125 FMA	M2	Optical	4096	13 bit	8192	Sin/Cos 512
EnDat 2.1 EQN 1125	Q4	Optical	4096	13 bit	8192	Sin/Cos 512

Notes

- The encoder code is a part of the type designation of the motor.
- FMA = Version with fault exclusion for mechanical coupling.
- Multiple revolutions of the motor shaft can be recorded only using multi-turn encoders.

14.4.2 Possible combinations with drive controllers

The following table shows the possible combinations of STOBER synchronous servo motors with drive controllers from Kollmorgen depending on the encoder model.

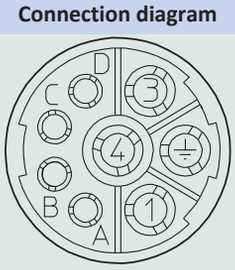
Drive controller		**Servostar S300/S400/S600/S700**
Drive controller code		FE
Connection plan ID		442311
Encoder	**Encoder code**	
EnDat 2.1 ECI 119	C4	EZHD, EZM
EnDat 2.1 EQN 1125 FMA	M2	EZ, EZS
EnDat 2.1 EQN 1125	Q4	EZ, EZS
Resolver	R0	EZ, EZS

The encoder and drive controller codes are a part of the type designation of the motor.

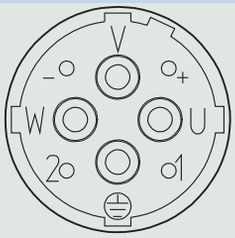
14.4.3 Connection assignment of the power plug connector

The size and connection plan of the power plug connector depend on the size of the motor. The colors of the connecting wires inside the motor are specified in accordance with IEC 60757.

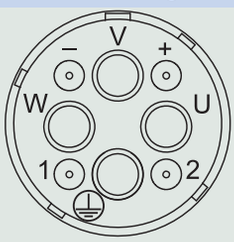
Plug connector size con.23

Connection diagram	Pin	Connection	Color
	1		BK
	3		RD
	4		BU
	A		RD
	B		BK
	C		
	D		
	⏚		GNYE

Plug connector size con.40 (1.5)

Connection diagram	Pin	Connection	Color
	U		BK
	V		BU
	W		RD
	+		RD
	–		BK
	1		
	2		
	⏚		GNYE

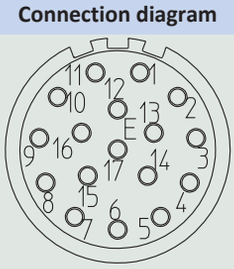
Plug connector size con.58 (3)

Connection diagram	Pin	Connection	Color
	U		BK
	V		BU
	W		RD
	+		RD
	–		BK
	1		
	2		
	⏚		GNYE

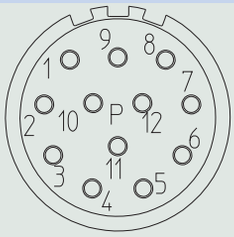
14.4.4 Connection assignment of the encoder plug connector

The size and connection assignment of the encoder plug connectors depend on the model of encoder installed and the size of the motor.

EnDat 2.1 encoder with sin/cos incremental signals, plug connector size con.23

Connection diagram	Pin	Connection	Color
	1		RDBK
	2		WHGN
	3		YEBK
	4		BNGN
	5		GY
	6		
	7		BK/RD
	8		VT
	9		BUBK
	10		WH
	11		GNBK
	12		BU
	13		PK
	14		WH/WH
	15		YE
	16		
	17		

Resolver, plug connector size con.23

Connection diagram	Pin	Connection	Color
	1		
	2		BK/RD
	3		BU
	4		BK
	5		YEWH
	6		WH/WH
	7		YE
	8		RD
	9		RDWH
	10		
	11		
	12		

14.5 Connection to Bosch Rexroth drive controllers

This chapter contains the information for connecting STOBER synchronous servo motors to drive controllers of the above-named manufacturer which differs from connecting to STOBER drive controllers. You can find all other information about STOBER synchronous servo motors in the respective chapter of this catalog.

STOBER has taken the following measures to minimize the effort of commissioning STOBER motors connected to IndraDrive C/Cs drive controllers and avoid errors during parameterization:

- The commutation offset of the motor was set so that calibration by the customer is not necessary.
- Parameter lists are provided on request.

14.5.1 Encoders

Encoders with EnDat 2.1 interface

Encoder model	Code	Measuring method	Recordable revolutions	Resolution	Position values per revolution	Periods per revolution
EnDat 2.1 ECI 119	C4	Inductive	–	19 bit	524288	Sin/Cos 32
EnDat 2.1 EQN 1125 FMA	M2	Optical	4096	13 bit	8192	Sin/Cos 512
EnDat 2.1 EQN 1125	Q4	Optical	4096	13 bit	8192	Sin/Cos 512
EnDat 2.1 ECN 1113 FMA	M0	Optical	–	13 bit	8192	Sin/Cos 512
EnDat 2.1 ECN 1113	C6	Optical	–	13 bit	8192	Sin/Cos 512

Encoders with HIPERFACE interface

Encoder model	Code	Measuring method	Recordable revolutions	Resolution	Position values per revolution	Periods per revolution
SKM36	H1	Optical	4096	12 bit	4096	Sin/Cos 128
SEK90	H4	Capacitive	–	11 bit	2048	Sin/Cos 64

Notes

- The encoder code is a part of the type designation of the motor.
- FMA = Version with fault exclusion for mechanical coupling.
- Multiple revolutions of the motor shaft can be recorded only using multi-turn encoders.

14.5.2 Possible combinations with drive controllers

The following table shows the possible combinations of STOBER synchronous servo motors with drive controllers from Bosch Rexroth depending on the encoder model.

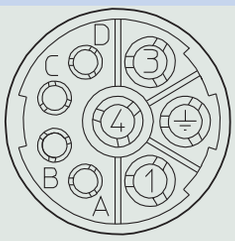
Drive controller		IndraDrive C/Cs
Drive controller code		FW
DC link voltage U_{ZK}		540 V
Connection plan ID		442445
Encoder	**Encoder code**	
EnDat 2.1 ECI 119	C4	EZHD, EZM
EnDat 2.1 EQN 1125 FMA	M2	EZ, EZS
EnDat 2.1 EQN 1125	Q4	EZ, EZS
EnDat 2.1 ECN 1113 FMA	M0	EZ, EZS
EnDat 2.1 ECN 1113	C6	EZ, EZS
SKM36	H1	EZ, EZS
SEK90	H4	EZHD, EZM

The encoder and drive controller codes are a part of the type designation of the motor.

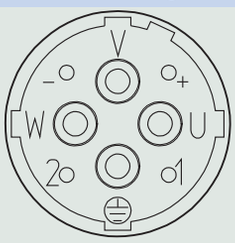
14.5.3 Connection assignment of the power plug connector

The size and connection plan of the power plug connector depend on the size of the motor. The colors of the connecting wires inside the motor are specified in accordance with IEC 60757.

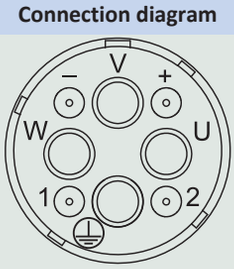
Plug connector size con.23

Connection diagram	Pin	Connection	Color
	1		BK
	3		BU
	4		RD
	A		RD
	B		BK
	C		
	D		
	⏚		GNYE

Plug connector size con.40 (1.5)

Connection diagram	Pin	Connection	Color
	U		BK
	V		BU
	W		RD
	+		RD
	–		BK
	1		
	2		
	⏚		GNYE

Plug connector size con.58 (3)

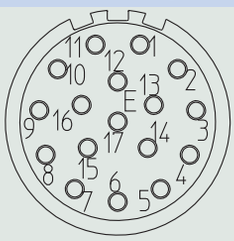
Connection diagram	Pin	Connection	Color
	U		BK
	V		BU
	W		RD
	+		RD
	–		BK
	1		
	2		
	⏚		GNYE

14.5.4 Connection assignment of the encoder plug connector

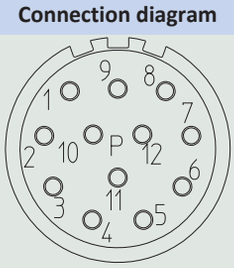
The size and connection assignment of the encoder plug connectors depend on the model of encoder installed and the size of the motor. The colors of the connecting wires inside the motor are specified in accordance with IEC 60757.

EnDat 2.1 encoder with sin/cos incremental signals, plug connector size con.23

This connection assignment only applies to the IndraDrive C/Cs drive controller.

Connection diagram	Pin	Connection	Color
	1		BU
	2		
	3		
	4		WH
	5		
	6		
	7		BNGN
	8		VT
	9		YE
	10		WHGN
	11		
	12		BUBK
	13		RDBK
	14		GY
	15		GNBK
	16		YEBK
	17		PK

Hiperface encoder, plug connector size con.23

Connection diagram	Pin	Connection	Color
	1		RD
	2		BU
	3		BN
	4		BK
	5		GY
	6		GN
	7		WH
	8		PK
	9		
	10		
	11		
	12		

14.6 Connection to Beckhoff drive controllers

This chapter contains the information for connecting STOBER synchronous servo motors to drive controllers of the above-named manufacturer which differs from connecting to STOBER drive controllers. You can find all other information about STOBER synchronous servo motors in the respective chapter of this catalog.

STOBER has taken the following measures to minimize the effort of commissioning STOBER motors connected to AX5000 drive controllers and avoiding errors during parameterization:

- The commutation offset of the motor was set so that calibration by the customer is not necessary.
- The electronic nameplate of the motor was designed to be compatible with the AX5000.
- Parameter files for all supported motor versions are available for download.

More information on commissioning EZ motors connected to Beckhoff AX5000 drive controllers can be found in the 443185_en document in the download area on the STOBER website.

14.6.1 Encoders

Encoders with EnDat 2.1 interface

Encoder model	Code	Measuring method	Recordable revolutions	Resolution	Position values per revolution	Periods per revolution
EnDat 2.1 ECI 119	C4	Inductive	–	19 bit	524288	Sin/Cos 32
EnDat 2.1 EQN 1125 FMA	M2	Optical	4096	13 bit	8192	Sin/Cos 512
EnDat 2.1 EQN 1125	Q4	Optical	4096	13 bit	8192	Sin/Cos 512
EnDat 2.1 ECN 1113 FMA	M0	Optical	–	13 bit	8192	Sin/Cos 512
EnDat 2.1 ECN 1113	C6	Optical	–	13 bit	8192	Sin/Cos 512

Notes

- The encoder code is a part of the type designation of the motor.
- FMA = Version with fault exclusion for mechanical coupling.
- Multiple revolutions of the motor shaft can be recorded only using multi-turn encoders.

14.6.2 Possible combinations with drive controllers

The following table shows the possible combinations of STOBER synchronous servo motors with drive controllers from Beckhoff depending on the encoder model.

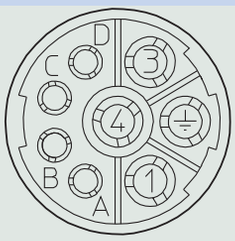
Drive controller		**AX5000**
Drive controller code		FM
Connection plan ID		442318
Encoder	**Encoder code**	
EnDat 2.1 ECI 119	C4	EZHD, EZM
EnDat 2.1 EQN 1125 FMA	M2	EZ, EZS
EnDat 2.1 EQN 1125	Q4	EZ, EZS
EnDat 2.1 ECN 1113 FMA	M0	EZ, EZS
EnDat 2.1 ECN 1113	C6	EZ, EZS

The encoder and drive controller codes are a part of the type designation of the motor.

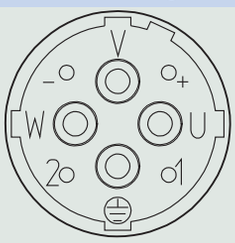
14.6.3 Connection assignment of the power plug connector

The size and connection plan of the power plug connector depend on the size of the motor. The colors of the connecting wires inside the motor are specified in accordance with IEC 60757.

Plug connector size con.23

Connection diagram	Pin	Connection	Color
	1		BK
	3		RD
	4		BU
	A		RD
	B		BK
	C		
	D		
	⏚		GNYE

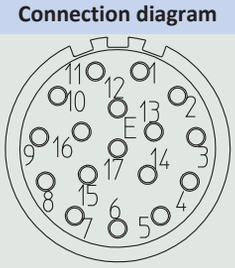
Plug connector size con.40 (1.5)

Connection diagram	Pin	Connection	Color
	U		BK
	V		BU
	W		RD
	+		RD
	–		BK
	1		
	2		
	⏚		GNYE

14.6.4 Connection assignment of the encoder plug connector

The size and connection assignment of the encoder plug connectors depend on the model of encoder installed and the size of the motor.

EnDat 2.1 encoder with sin/cos incremental signals, plug connector size con.23

Connection diagram	Pin	Connection	Color
	1		RDBK
	2		WHGN
	3		YEBK
	4		BNGN
	5		GY
	6		
	7		
	8		VT
	9		BUBK
	10		WH
	11		GNBK
	12		BN
	13		PK
	14		
	15		YE
	16		
	17		

14.7 Connection to Allen-Bradley drive controllers

This chapter contains the information for connecting STOBER synchronous servo motors to drive controllers of the above-named manufacturer which differs from connecting to STOBER drive controllers. You can find all other information about STOBER synchronous servo motors in the respective chapter of this catalog.

The following STOBER series can be configured to Kinetix 5500/5700/6500 drive controllers fully automatically: EZ geared motors; EZHD, EZM, EZS motors. This does not include EZ motors without an attached gear unit and other STOBER series.

STOBER has taken the following measures to minimize the effort of commissioning STOBER motors connected to Allen-Bradley drive controllers and avoid errors during parameterization:

- The commutation offset of the motor was set so that calibration by the customer is not necessary.
- The electronic nameplate of the motor was designed to be compatible with the Kinetix 5500/5700/6500.
- STOBER tests the motor connected to Allen-Bradley drive controllers before delivery to the customer.
- Configuration files for supported motor versions are available for download.

14.7.1 Encoders

Encoders with EnDat 2.2 interface

Encoder model	Code	Measuring method	Recordable revolutions	Resolution	Position values per revolution
EnDat 2.2 EQN 1135	Q5	Optical	4096	23 bit	8388608
EnDat 2.2 ECI 119-G2	C9	Inductive	–	19 bit	524288

Encoders with HIPERFACE interface

Encoder model	Code	Measuring method	Recordable revolutions	Resolution	Position values per revolution
EDM35	H6	Optical	4096	20 bit	1048576

Notes

- The encoder code is a part of the type designation of the motor.
- Multiple revolutions of the motor shaft can be recorded only using multi-turn encoders.

14.7.2 Possible combinations with drive controllers

The following table shows the possible combinations of STOBER motors and geared motors with drive controllers from Allen-Bradley depending on the encoder model.

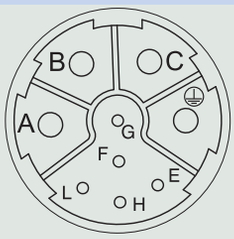
Drive controller		KINETIX 5500 (with HIPERFACE DSL)	KINETIX 5700 (with HIPERFACE DSL)	KINETIX 5700 (with EnDat 2.2)	KINETIX 6500 (with EnDat 2.2)
Drive controller code		HB	GD	HA	GC
Connection plan ID		443169	442449	443096	442448
Encoder	**Encoder code**				
EnDat 2.2 EQN 1135	Q5	–	–	EZ, EZS	EZ, EZS
EnDat 2.2 ECI 119-G2	C9	–	–	EZHD, EZM	EZHD, EZM
EDM35	H6	EZ, EZS	EZ, EZS	–	–

The encoder and drive controller codes are a part of the type designation of the motor.

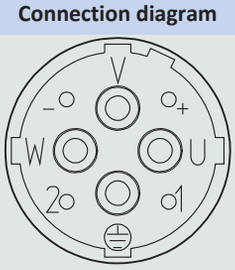
14.7.3 Terminal assignment of the power plug connector

The size and connection plan of the power plug connector depend on the size of the motor. The colors of the connecting wires inside the motor are specified in accordance with IEC 60757.

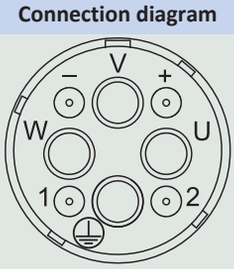
Plug connector size con.23

Connection diagram	Pin	Connection	Color
	A	1U1 (U phase)	BK
	B	1V1 (V phase)	RD
	C	1W1 (W phase)	BU
	F	MBRK + (1BD1)	RD
	G	MBRK – (1BD2)	BK
	E		
	H		
	L		
	⏚	PE (grounding conductor)	GNYE

Plug connector size con.40 (1.5)

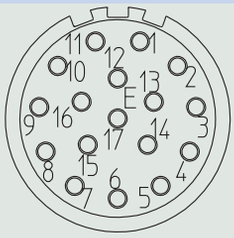
Connection diagram	Pin	Connection	Color
	U	1U1 (U phase)	BK
	V	1V1 (V phase)	BU
	W	1W1 (W phase)	RD
	+	MBRK + (1BD1)	RD
	–	MBRK – (1BD2)	BK
	1		
	2		
	⏚	PE (grounding conductor)	GNYE

Plug connector size con.58 (3)

Connection diagram	Pin	Connection	Color
	U	1U1 (U phase)	BK
	V	1V1 (V phase)	BU
	W	1W1 (W phase)	RD
	+	MBRK + (1BD1)	RD
	–	MBRK – (1BD2)	BK
	1		
	2		
	⏚	PE (grounding conductor)	GNYE

14.7.4 Terminal assignment of the encoder plug connector

EnDat 2.2 digital encoder, plug connector size con.23

Connection diagram	Pin	Connection	Color
	1		
	2		
	3		
	4		
	5	DATA +	GY
	6	DATA –	PK
	7	CLK + (Clock +)	VT
	8	CLK – (Clock –)	YE
	9	EPWR_5V (Up +)	BNGN
	10	ECOM (0 V)	WHGN
	11		
	12		
	13	TS + (1TP1)	BK
	14	TS – (1TP2)	WH
	15		
	16		
	17		

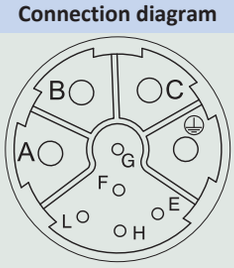
14.7.5 Terminal assignment for plug connectors (One Cable Solution)

In the One Cable Solution design, the power and encoder lines are connected using a shared plug connector.

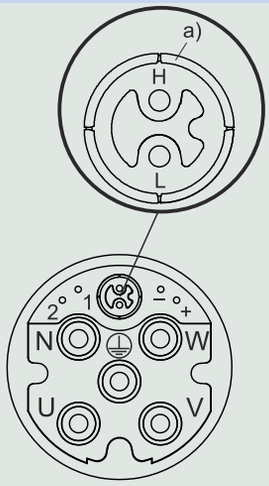
The size of the plug connector depends on the size of the motor.

The temperature sensor of the motor is connected to the encoder internally. The measured values from the temperature sensor are transmitted via the log of the encoder.

Plug connector size con.23

Connection diagram	Pin	Connection	Color
	A	1U1 (U phase)	BK
	B	1V1 (V phase)	BU
	C	1W1 (W phase)	RD
	E	DATA + (DSL +)	GY
	F	MBRK + (1BD1)	RD
	G	MBRK – (1BD2)	BK
	H	DATA – (DSL –)	GN
	L		
	⏚	PE (grounding conductor)	GNYE

Plug connector size con.40 (1.5)

Connection diagram	Pin	Connection	Color
	U	1U1 (U phase)	BK
	V	1V1 (V phase)	BU
	W	1W1 (W phase)	RD
	N		
	+		
	–		
	1	MBRK + (1BD1)	RD
	2	MBRK – (1BD2)	BK
	H	DATA – (DSL –)	GY
	L	DATA + (DSL +)	GN
	⏚	PE (grounding conductor)	GNYE

a) Coaxial shield to which the DSL shield is connected

15 Appendix

Table of contents

15.1 Formula symbols

The formula symbols for values actually present in the application are marked with *.

Symbol	Unit	Explanation
a^*	m/s^2	Acceleration
a_{NOT*}	m/s^2	Emergency off acceleration
a_{th}	–	Parameter for calculating $K_{mot,th}$
a_{thEL}	–	Parameters for calculating $K_{mot,th}$ (dependent on the mounting position)
B_{10}	–	Number of cycles after which 10% of components have failed
B_{10D}	–	Number of cycles until 10% of components have failed dangerously
C_{lin}	N/µm	Total linear spring rigidity
d_0	mm	Pitch circle diameter
ΔJ_B	$kgcm^2$	Additive mass moment of inertia of a motor with brake
Δm_B	kg	Additive weight of a motor with brake
Δs	mm	Linear backlash resulting from the backlash of the gear unit
ED_{10}	%	Duty cycle based on 10 minutes
F_{ax}	N	Permitted axial force on the output
F_{ax*}	N	Actual axial force on the output
F_{ax100}	N	Permitted axial force on the output for $n_{m*} \leq 100$ rpm
fB_{op}	–	Operating mode operating factor
fB_t	–	Runtime operating factor
fB_T	–	Temperature operating factor
fB_{ZB}	–	Operating factor for cyclic operation
$\lvert F_{f2} \rvert$	kN	Amount of feed force at output
$F_{f2,0}$	kN	Standstill feed force at gear unit output at n_1 = 500 rpm
$F_{f2,1*} – F_{f2,4*}$	kN	Existing feed force in the respective time segment (1 to 4)
$F_{f2,n*}$	kN	Existing feed force in the nth time segment
F_{f2acc}	kN	Permitted acceleration feed force at the gear unit output
F_{f2acc*}	N	Actual acceleration feed force at the gear unit output
F_{f2accE}	kN	Permitted acceleration feed force at the gear unit output, pinion position E
F_{f2eq}	kN	Equivalent feed force at the gear unit output
F_{f2eq*}	kN	Actual equivalent feed force at the gear unit output
F_{f2N}	kN	Nominal feed force at the gear unit output for n_1 = 500 rpm
F_{f2NOT}	kN	Emergency off feed force of the gear unit at the gear unit output for a maximum of 1000 load changes
		Without consideration of the maximum torque of the motor
F_{f2NOT*}	kN	Actual emergency off feed force at the gear unit output
$F_{f2NOT,E}$	kN	Emergency off feed force of the gear unit at the gear unit output for a maximum of 1000 load changes, pinion position E
F_{L*}	N	Existing load force
F_{rad}	N	Permitted radial force on the output
F_{rad*}	N	Actual radial force on the output
F_{rad100}	N	Permitted radial force on the output for $n_{m*} \leq 100$ rpm
H	m	Installation altitude above sea level
i	–	Gear ratio
I_0	A	Stall current
I_{max}	A	Maximum current
I_N	A	Nominal current
$I_{N,B}$	A	Nominal current of the brake at 20 °C
$I_{N,F}$	A	Nominal current of the forced ventilation unit
J_{Bstop}	$kgcm^2$	Reference mass moment of inertia when braking from full speed: $J_{Bstop} = J_{dyn} \times 2$
J_{dyn}	$kgcm^2$	Mass moment of inertia of a motor in dynamic operation
J_{tot}	$kgcm^2$	Total mass moment of inertia (based on the motor shaft)
K_{EM}	V/1000 rpm	Voltage constant: peak value of the induced voltage between the phases U, V, W of the motor at operating temperature at a speed of 1000 rpm
K_H	–	Derating factor for installation altitude

Symbol	Unit	Explanation
K_{M0}	Nm/A	Torque constant: ratio of the stall torque and frictional torque to the stall current; $K_{M0} = (M_0 + M_R) / I_0$ (tolerance ±10%)
$K_{M,N}$	Nm/A	Torque constant: ratio of the nominal torque M_N to the nominal current I_N; $K_{M,N} = M_N / I_N$ (tolerance ±10%)
$K_{mot,th}$	–	Factor for determining the thermal limit torque
K_ϑ	–	Derating factor for surrounding temperature
l	mm	Length of the output shaft
L_{pA}	dBA	Sound pressure level of the gear unit at n_{1N} = 2000 rpm
L_{U-V}	mH	Winding inductance of a motor between two phases (determined in a resonant circuit)
LW	-	Load change: A load change (LW) corresponds to an acceleration and a deceleration.
m*	kg	Mass to be accelerated
M	Nm	Torque
M_0	Nm	Stall torque: The continuous torque the motor is able to deliver at a speed of 10 rpm (tolerance ±5%)
$M_{1*} – M_{6*}$	Nm	Actual torque of the motor in the respective time segment (1 to 6)
$M_{2.1*} – M_{2.4*}$	Nm	Actual torque in the respective time segment (1 to 4)
$M_{2,n*}$	Nm	Actual torque in the n-th time segment
M_{2acc}	Nm	Maximum permitted acceleration torque on the gear unit output
M_{2accE}	Nm	Maximum permitted acceleration torque at the gear unit output, pinion position E
M_{2eff*}	Nm	Actual effective torque on the gear unit output
M_{2th}	Nm	Thermal limit torque on the gear unit output
M_{Bdyn}	Nm	Dynamic braking torque at 100 °C (Tolerance +40%, −20%)
M_{Bstat}	Nm	Static braking torque of the motor brake at 100 °C (tolerance +40%, −20%)
m_{dyn}	kg	Weight of a motor in dynamic operation
M_{eff*}	Nm	Actual effective torque of the motor
m_F	kg	Weight of the forced ventilation unit
M_k	Nm	Permitted tilting torque on the output
M_{k*}	Nm	Actual tilting torque on the output
M_{k100}	Nm	Permitted tilting torque on the output for $n_{m*} \leq 100$ rpm
M_L	Nm	Load torque
M_{lim}	Nm	Torque limit without compensating for field weakening
M_{limF}	Nm	Torque limit of the motor with forced ventilation
M_{limFW}	Nm	Torque limit with compensation for field weakening (applies to operation on STOBER drive controllers only)
M_{limK}	Nm	Torque limit of the motor with convection cooling
M_{max}	Nm	Maximum torque: the maximum permitted torque the motor is able to deliver over a short period (when accelerating or decelerating) (tolerance ±10%)
M_{max*}	Nm	Actual maximum torque
m_n	mm	Module
M_{n*}	Nm	Actual torque of the motor in the n-th time segment
M_N	Nm	Nominal torque: the maximum torque of a motor in S1 mode at nominal speed n_N (tolerance ±5%)
M_{Nred}	Nm	Reduced nominal torque of the motor
M_{op}	Nm	Torque of motor at the operating point from the motor characteristic curve at n_{1m*}
M_R	Nm	Frictional torque (of the bearings and seals) of a motor at winding temperature $\Delta\vartheta$ = 100 K
n	rpm	Speed
n_{1m*}	rpm	Actual average input speed
n_{1max*}	rpm	Actual maximum input speed
n_{1maxDB}	min^{-1}	Maximum permitted input speed of the gear unit in continuous operation
n_{1maxZB}	min^{-1}	Maximum permitted input speed of the gear unit in cyclic operation
N_{Bstop}	–	Permitted number of braking processes from full speed (n = 3000 rpm) with J_{Bstop} (M_L = 0). The following applies if the values of n and J_{Bstop} differ: $N_{Bstop} = W_{B,Rlim} / W_{B,R/B}$.

Symbol	Unit	Explanation
n_{m*}	rpm	Actual average motor speed
$n_{m,1*} – n_{m,6*}$	rpm	Actual average speed of the motor in the respective time segment (1 to 6)
$n_{m,n*}$	rpm	Actual average speed of the motor in the n-th time segment
n_N	rpm	Nominal speed: The speed for which the nominal torque M_N is specified
P_N	kW	Nominal power: the power the motor is able to deliver long term in S1 mode at the nominal point (tolerance ±5 %)
$P_{N,F}$	W	Nominal output of the forced ventilation unit
q_{vF}	m^3/h	Delivery capacity of the forced ventilation unit in open air
R_{U-V}	Ω	Winding resistance of a motor between two phases at a winding temperature of 20 °C
S	–	Service factor: Quotient of the nominal torque from the gear unit and the motor without consideration for thermal limiting performance. Represents a value for the reserve of the geared motor.
t	s	Time
$t_{1*} – t_{4*}$	s	Duration of the respective time segment (1 to 4)
$t_{1*} – t_{n*}$	s	Duration of the respective time segment
t_{11B}	ms	Response delay: time from when the current is turned off until the torque increases
t_{1B}	ms	Linking time: time from when the current is turned off until the nominal braking torque is reached
t_{2B}	ms	Disengagement time: time from when the current is turned on until the torque begins to drop
t_{dec}	ms	Stop time
T_{el}	ms	Electrical time constant: ratio of the winding inductance to the winding resistance of a motor: $T_{el} = L_{U-V} / R_{U-V}$
ϑ_{amb}	°C	Surrounding temperature
t_{n*}	s	Duration of the n-th time segment
U	V	Voltage
$U_{N,B}$	V	Nominal voltage of brake
$U_{N,F}$	V	Nominal voltage of the forced ventilation unit
$\lvert v_{f2} \rvert$	m/s	Amount of feed velocity
v_{f2m*}	m/s	Actual average feed velocity
$v_{f2m,1*} – v_{f2m,4*}$	m/s	Actual average feed velocity in the respective time segment (1 to 4)
$v_{f2m,n*}$	m/s	Actual average feed velocity in the nth time segment
v_{f2N}	m/s	Nominal feed rate at gear unit output
$v_{f2maxDB}$	m/s	Maximum feed velocity at the gear unit output at n_{1maxDB}
$v_{f2maxZB}$	m/s	Maximum feed velocity at the gear unit output at n_{1maxZB}
$W_{B,R/B}$	J	Work done by friction for braking
$W_{B,Rlim}$	J	Work done by friction until wear limit is reached
$W_{B,Rmax/h}$	J/h	Maximum permitted work done by friction per hour with individual braking
x	mm	Profile offset factor
x_2	mm	Distance of the shaft shoulder to the force application point
$x_{B,N}$	mm	Nominal air gap of brake
y_2	mm	Distance of the shaft axis to the axial force application point
z	–	Number of teeth
z_2	mm	Distance of the shaft shoulder to the middle of the output bearing

15.2 Trademarks

The following names used in connection with the device, its optional equipment and its accessories are trademarks or registered trademarks of other companies:

ACOPOS®	ACOPOS is a registered trademark of ABB Asea Brown Boveri Ltd., Zurich, Switzerland.
DRIVE-CLiQ®,	DRIVE-CLiQ® is a registered trademark of Siemens AG, Munich, Germany.
EnDat®	EnDat® and the EnDat® logo are registered trademarks of Dr. Johannes Heidenhain GmbH, Traunreut, Germany.
HIPERFACE®	HIPERFACE® and the HIPERFACE DSL® logo are registered trademarks of SICK STEGMANN GmbH, Donaueschingen, Germany.
IndraDrive®	IndraDrive® is a registered trademark of Bosch Rexroth AG, Lohr, Germany.
INTERCONTEC®	INTERCONTEC® is a registered trademark of TE Connectivity Industrial GmbH, Niederwinkling, Germany.
RINGFEDER®	RINGFEDER® is a registered trademark of VBG GROUP TRUCK EQUIPMENT GmbH, Krefeld, Germany.
SERVOSTAR®	SERVOSTAR® is a registered trademark of Kollmorgen Corporation, Waltham, USA.
SINAMICS®	SINAMICS® is a registered trademark of Siemens AG, Munich, Germany.

All other trademarks not listed here are the property of their respective owners.

Products that are registered as trademarks are not specially indicated in this documentation. Existing property rights (patents, trademarks, protection of utility models) are to be observed.

15.3 Sales terms and delivery conditions

You can find our current sales terms and delivery conditions at http://www.stoeber.de/en/gtc.

15.4 Legal notice

Catalog Rack and pinion drives with synchronous servo motors ID 443286_de.

You can find current versions of PDF files online at http://www.stoeber.de/en/downloads/.

ATLANTA gear racks
All gear racks suitable for our products are available from our cooperation partner, Atlanta.
http://atlantagmbh.de/

15.5 ATLANTA product catalog pages

The following pages include an excerpt from the product catalog of ATLANTA Antriebssysteme.

ATLANTA Antriebssysteme
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Carl-Benz-Str. 16
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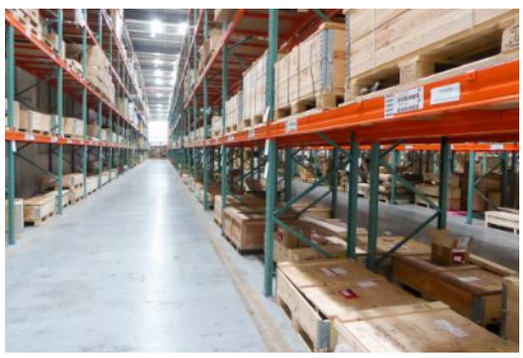
Germany
Phone: +49 7142 7001-0
info@atlantagmbh.de
www.atlantagmbh.de

The values given in the load table are based upon uniform, smooth operation, $K_{H\beta}$=1,0 and reliable grease lubrication. Since, in practice, the applications are very diverse, it is important to consider the given conditions by using appropriate factors S_B, K_A, $L_{KH\beta}$ and f_n (see below).

Formulas for determining the tangential force

$$a = \frac{v}{t_b} \quad [m/s^2]$$

$$F_u = \frac{m \cdot g + m \cdot a}{1000} \text{ (for lifting axle)} \quad [kN]$$

$$F_u = \frac{m \cdot g \cdot \mu + m \cdot a}{1000} \text{ (for driving axle)} \quad [kN]$$

$$F_{u\,perm.} = \frac{F_{u\,tab}}{K_A \cdot S_B \cdot f_n \cdot L_{KH\beta}} \quad [kN]$$

Formula dimensions see page ZD-3

The condition $F_u < F_{u\,perm.}$ must be fulfilled.

Load factor K_A

Drive	Type of load from the machines to be driven		
	uniform	medium shocks	heavy shocks
uniform	1,00	1,25	1,75
light shocks	1,25	1,50	2,00
medium shocks	1,50	1,75	2,25

Safety coefficient S_B

The safety coefficient should be allowed for according to experience (S_B = 1.25 ÷ 1.50). This is valid for rack drives with one drive / rack line. For multiple drives on one rack line, as well as for preloaded drives, this safety coefficient have to be increased. In case of doubts please contact our technical service.

Life-time factor f_n

considering of the peripheral speed of the pinion and lubrication.

Lubrication		contin.	daily	monthly
Peripheral speed of gearing				
m/sec	m/min			
0,5	30	0,85	0,95	
1,0	60	0,95	1,10	from
1,5	90	1,00	1,20	3
2,0	120	1,05	1,30	to
3,0	180	1,10	1,50	10
5,0	300	1,25	1,90	

Linear load distribution factor $L_{KH\beta}$

The linear load distribution factor considers the contact stress, while it describes unintegrated load distribution over the tooth width ($L_{KH\beta} = \sqrt{K_{H\beta}}$).

$L_{KH\beta}$ = 1,1 for counter bearing, e.g. Torque Supporter
= 1,2 for preloaded bearings on the output shaft e.g. Atlanta Ht-, HP- and E-servo worm gear unit, BG-bevel gear unit
= 1,5 for unpreloaded bearings on the output shaft e.g. Atlanta B-servo worm gear unit

Calculation example

Values given

⊗ travelling operation

mass to be moved	m	=	820 kg
speed	v	=	2 m/s
acceleration time	t_b	=	1 s
acceleration due to gravity	g	=	9,81 m/s²
coefficient of friction	μ	=	0,1
load factor	K_A	=	1,5
life-time factor	f_n	=	1,05 (cont. lubrication)
safety coefficient	S_B	=	1,4
linear load distribution factor	$L_{KHß}$	=	1,5

Calculation process — Results

$$a = \frac{v}{t_b} \qquad a = \frac{2}{1} = 2\ m/s^2$$

$$F_u = \frac{m \cdot g \cdot \mu + m \cdot a}{1000}$$

$$F_u = \frac{820 \cdot 9{,}81 \cdot 0{,}1 + 820 \cdot 2}{1000} = 2{,}44\ kN$$

permissible feed force $F_{u\ Tab}$:
rack C45, ind. hardened, Q10, straight tooth, module 3,
pinion 16MnCr5, case hardened, 20 teeth
page ZB-40 with $F_{u\ Tab}$ = 11,5 kN

$$F_{u\ per.} = \frac{F_{uTab}}{K_A \cdot S_B \cdot f_n \cdot L_{KHß}} ;$$

$$F_{u\ per.} = \frac{11{,}5\ kN}{1{,}5 \cdot 1{,}4 \cdot 1{,}05 \cdot 1{,}5} = 3{,}47\ kN$$

Condition

$F_{u\ per.} > F_u$; 3,47 kN > 2,44 kN = > fulfilled

Result:	Rack	27 30 101	Page ZB-13
	Pinion	24 35 220	Page ZB-23 case hardened

Your calculation

Values given

⊗ travelling operation

mass to be moved	m	=	_____ kg
speed	v	=	_____ m/s
acceleration time	t_b	=	_____ s
acceleration due to gravity	g	=	9,81 m/s²
coefficient of friction	μ	=	_____
load factor	K_A	=	_____
life-time factor	f_n	=	_____
safety coefficient	S_B	=	_____
linear load distribution factor	$L_{KHß}$	=	_____

Calculation process — Results

$$a = \frac{v}{t_b} \qquad a = \_\_\_\_\_ = \_\_\_\_ m/s^2$$

$$F_u = \frac{m \cdot g \cdot \mu + m \cdot a}{1000} ; \quad F_u = \frac{\_\_\_\_\_}{1000} = \_\_\_\_ kN$$

permissible feed force $F_{u\ Tab}$

$$F_{u\ per.} = \frac{F_{u\ Tab}}{K_A \cdot S_B \cdot f_n \cdot L_{KHß}} ;$$

$F_{u\ per.}$ = _____ = _____ kN

Condition

$F_{u\ per.} > F_u$; _____ kN > _____ kN = > fulfilled

Calculation example

Values given

⊗ travelling operation

mass to be moved	m	=	300 kg
speed	v	=	1,08 m/s
acceleration time	t_b	=	0,27 s
acceleration due to gravity	g	=	9,81 m/s²
load factor	K_A	=	1,2
life-time factor	f_n	=	1,1 (cont. lubrication)
safety coefficient	S_B	=	1,4
linear load distribution factor	$L_{KHß}$	=	1,2

Calculation process

$$a = \frac{v}{t_b} \qquad a = \frac{1,08}{0,27} = 4 \text{ m/s}^2$$

$$F_u = \frac{m \cdot g + m \cdot a}{1000} \qquad F_u = \frac{300 \cdot 9,81 + 300 \cdot 4}{1000} = 4,1 \text{ kN}$$

permissible feed force $F_{u\,Tab}$:
rack C45, ind. hardened, Q6, helical tooth, module 2,
pinion 16MnCr5, case hardened, 20 teeth
page ZA-31 with $F_{u\,Tab}$ = 11,5 kN

$$F_{u\,per.} = \frac{F_{u\,Tab}}{K_A \cdot S_B \cdot f_n \cdot L_{KHß}} \; ; \; F_{u\,per.} = \frac{11,5 \text{ kN}}{1,2 \cdot 1,4 \cdot 1,1 \cdot 1,2} = 5,18 \text{ kN}$$

Condition

$F_{u\,per.} > F_u$; 5,18 kN > 4,1 kN => fulfilled

Result: Rack 29 20 105 Page ZA-7
Pinion 24 29 520 Page ZA-24

Your calculation

Values given

⊗ travelling operation

mass to be moved	m	=	kg
speed	v	=	m/s
acceleration time	t_b	=	s
acceleration due to gravity	g	=	9,81 m/s²
load factor	K_A	=	
life-time factor	f_n	=	
safety coefficient	S_B	=	
linear load distribution factor	$L_{KHß}$	=	

Calculation process

$$a = \frac{v}{t_b} \qquad a = \_\_\_\_ = \_\_\_\_ \text{ m/s}^2$$

$$F_u = \frac{m \cdot g + m \cdot a}{1000} \qquad F_{u\,req.} = \frac{\_\_\_\_}{1000} = \_\_\_\_ \text{ kN}$$

permissible feed force $F_{u\,Tab}$

$$F_{u\,per.} = \frac{F_{u\,Tab}}{K_A \cdot S_B \cdot f_n \cdot L_{KHß}} \; ; \; F_{u\,per.} = \_\_\_\_ = \_\_\_\_ \text{ kN}$$

Condition

$F_{u\,per.} > F_u$; ____ kN > ____ kN => fulfilled

Module 1,0

Module 1,25

Module 1,5

Module 2,0

Module 2,5

Module 3,0

Module 4,0

Module 5,0

Module 6,0

Module 8,0

Module 10,0

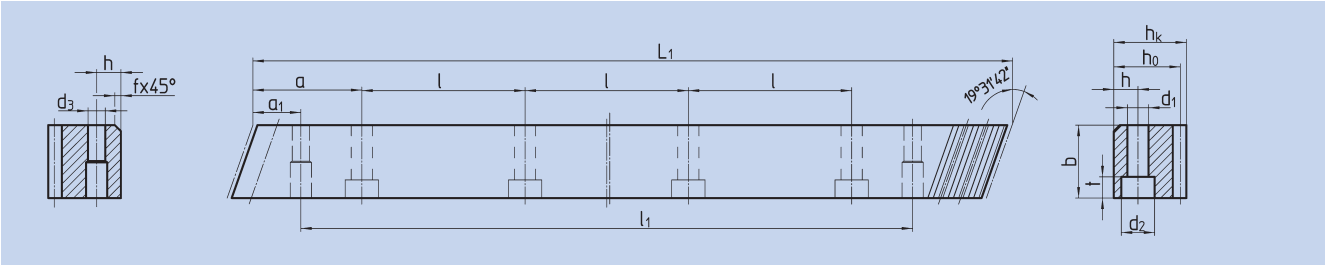
Module 12,0

Class	ATLANTA Quality	Module	Total pitch error [1] (±µm/m)	Tooth thickness tolerance (µm)	max. length (mm)	Max. feed force per pinion contact [2] kN	Applications (examples)
HPR High Precision Rack	6	2	34	-20	2000	19,5	**Wood, plastic, composite, aluminium working machines**
		3	34	-20	2000	31,0	
		4	34	-20	2000	60,0	
	6	1,5	34	-20	1000	9,0	**Machine tools, integratable racks, water cutting machines, tube bending systems, plasma cutting machines**
		2	34	-20	2000	15,5	
		3	34	-20	2000	28,5	
		4	34	-20	2000	51,5	
		5	34	-20	2000	76,0	
		6	34	-20	2000	109,0	
		8	34	-20	1920	191,0	
		10	34	-20	1500	287,0	
		12	34	-20	1000	409,0	
	7	2	52	-36	2000	15,5	**Wood working machines, linear axes with high requirement for a smooth running**
		3	52	-36	2000	28,5	
		4	52	-36	2000	51,5	
		5	52	-36	2000	76,0	
		6	52	-36	2000	109,0	
		8	52	-36	1920	191,0	
		10	52	-36	1500	287,0	
PR Precision Rack	8	2	60	-59	2000	13,5	**Portals, handling linear axes**
		3	60	-59	2000	24,5	
		4	60	-59	2000	44,0	
		5	60	-59	2000	64,5	
		6	60	-59	2000	90,5	
	8	2	100	-110	2000	8,0	**Linear axes**
		3	100	-110	2000	14,0	
		4	100	-110	2000	27,0	

1) Values available for 1000 mm. Other total pitch errors for other length, see detailed description (ATLANTA Servo Drive catalogue).
2) Values are only valid for special steel according ATLANTA-Standard.

When using the maximum capacity of the teeth, or multiple pinions in contact, the mounting screw loads must be checked separately! Please ask ATLANTA for advice!

ATLANTA-Quality 6



Order code	Module	L_1	N° of teeth	b	h_k	h_0	f	a	l	N° of holes	h	d_1	d_2	t	a_1	l_1	d_3	kg
29 20 100	2	1000,00	150	24	24	22	2	62,5	125	8	8	7	11	7	31,7	936,6	5,7	4,10
29 20 150	2	1500,00	225	24	24	22	2	62,5	125	12	8	7	11	7	31,7	1436,6	5,7	6,15
29 20 200	2	2000,00	300	24	24	22	2	62,5	125	16	8	7	11	7	31,7	1936,6	5,7	8,20
29 30 100	3	1000,00	100	29	29	26	2	62,5	125	8	9	10	15	9	35,0	930,0	7,7	5,90
29 30 150	3	1500,00	150	29	29	26	2	62,5	125	12	9	10	15	9	35,0	1430,0	7,7	8,85
29 30 200	3	2000,00	200	29	29	26	2	62,5	125	16	9	10	15	9	35,0	1930,0	7,7	11,80
29 40 100 [2]	4	1000,00	75	39	39	35	2	62,5	125	8	12	10	15	9	33,3	933,4	7,7	10,70
29 42 100	4	1000,00	75	39	39	35	2	62,5	125	8	12	14	20	13	33,3	933,4	11,7	10,70
29 42 150 [1]	4	1506,67	113	39	39	35	2	62,5	125	12	12	14	20	13	33,3	1433,4	11,7	16,00
29 42 200	4	2000,00	150	39	39	35	2	62,5	125	16	12	14	20	13	33,3	1933,4	11,7	21,40

1) This racks could be used for continous linking only with the left side (see sketch).
2) The screw joint limits the feed force.

500 mm and other length on request.

Total pitch error **GT_f/1000 ≤ 0,034 mm,**
GT_f/1500 ≤ 0,041 mm (≙ 0,027 mm/1000),
GT_f/2000 ≤ 0,044 mm (≙ 0,022 mm/1000).

- Teeth hardened with the ATLANTA high performance hardening process and ground
- case hardening steel acc. ATLANTA-Standard
- ground on all sides after hardening

Mounting racks, see Atlanta Servo Drive catalogue.

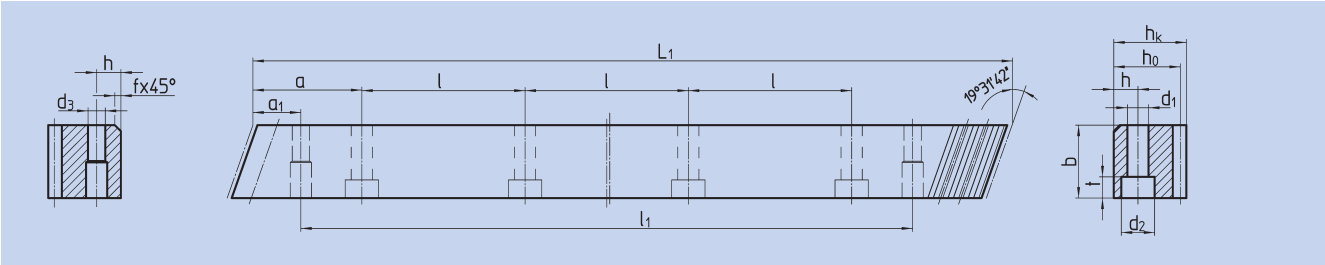
To achieve precision rack joints, we recommend our patented assembly kit, see Atlanta Servo Drive catalogue.

For lubrication of racks & pinions we recommend our automatic lubrication system, see Atlanta Servo Drive catalogue.

For the calculation and selection of the rack & pinion drive, see calculation sample in the Atlanta Servo Drive catalogue.

Srews for rack mounting, see Atlanta Servo Drive catalogue.

ATLANTA-Quality 6



Order code	Module	L_1	N° of teeth	b	h_k	h_0	f	a	l	N° of holes	h	d_1	d_2	t	a_1	l_1	d_3	kg
29 15 105	1,5	1000,00	200	19	19	17,5	2,0	62,5	125	8	8	7	11	7	31,7	936,6	5,7	2,60
29 20 105	2	1000,00	150	24	24	22	2,0	62,5	125	8	8	7	11	7	31,7	936,6	5,7	4,10
29 20 155	2	1500,00	225	24	24	22	2,0	62,5	125	12	8	7	11	7	31,7	1436,6	5,7	6,15
29 20 205	2	2000,00	300	24	24	22	2,0	62,5	125	16	8	7	11	7	31,7	1936,6	5,7	8,20
29 30 105	3	1000,00	100	29	29	26	2,0	62,5	125	8	9	10	15	9	35,0	930,0	7,7	5,90
29 30 155	3	1500,00	150	29	29	26	2,0	62,5	125	12	9	10	15	9	35,0	1430,0	7,7	8,85
29 30 205	3	2000,00	200	29	29	26	2,0	62,5	125	16	9	10	15	9	35,0	1930,0	7,7	11,80
29 40 105 [2]	4	1000,00	75	39	39	35	2,0	62,5	125	8	12	10	15	9	33,3	933,4	7,7	10,70
29 42 105	4	1000,00	75	39	39	35	2,0	62,5	125	8	12	14	20	13	33,3	933,4	11,7	10,70
29 42 155 [1]	4	1506,67	113	39	39	35	2,0	62,5	125	12	12	14	20	13	33,3	1433,4	11,7	16,05
29 40 205	4	2000,00	150	39	39	35	2,0	62,5	125	16	12	10	15	9	33,3	1933,4	7,7	21,40
29 42 205	4	2000,00	150	39	39	35	2,0	62,5	125	16	12	14	20	13	33,3	1933,4	11,7	21,40
29 50 105	5	1000,00	60	49	39	34	2,5	62,5	125	8	12	14	20	13	37,5	925,0	11,7	13,00
29 50 155	5	1500,00	90	49	39	34	2,5	62,5	125	12	12	14	20	13	37,5	1425,0	11,7	19,50
29 50 205	5	2000,00	120	49	39	34	2,5	62,5	125	16	12	14	20	13	37,5	1925,0	11,7	26,00
29 60 105	6	1000,00	50	59	49	43	2,5	62,5	125	8	16	18	26	17	37,5	925,0	15,7	18,10
29 60 155	6	1500,00	75	59	49	43	2,5	62,5	125	12	16	18	26	17	37,5	1425,0	15,7	27,10
29 60 205	6	2000,00	100	59	49	43	2,5	62,5	125	16	16	18	26	17	37,5	1925,0	15,7	36,20
29 80 105	8	960,00	36	79	79	71	2,5	60,0	120	8	25	22	33	21	120,0	720,0	19,7	42,50
29 80 155	8	1440,00	54	79	79	71	2,5	60,0	120	12	25	22	33	21	120,0	1200,0	19,7	63,80
29 80 205	8	1920,00	72	79	79	71	2,5	60,0	120	16	25	22	33	21	120,0	1680,0	19,7	85,00
29 10 105	10	1000,00	30	99	99	89	2,5	62,5	125	8	32	33	48	32	125,0	750,0	19,7	68,72
29 10 155	10	1500,00	45	99	99	89	2,5	62,5	125	12	32	33	48	32	125	1250,0	19,7	103,00
29 12 105	12	1000,00	25	120	120	108	2,5	40,0	125	8	40	39	58	38	125,0	750,0	19,7	111,00

1) This racks could be used for continous linking only with the left side (see sketch).
2) The screw joint limits the feed force.

500 mm and other length on request.

Total pitch error **$GT_f/1000 \leq 0{,}034$ mm,**
$GT_f/1500 \leq 0{,}041$ mm ($\triangleq 0{,}027$ mm/1000),
$GT_f/2000 \leq 0{,}044$ mm ($\triangleq 0{,}022$ mm/1000).

- Teeth hardened with the ATLANTA high performance hardening process and ground
- heat-treatable steel acc. ATLANTA-Standard, carburized
- ground on all sides after hardening

Mounting racks, see Atlanta Servo Drive catalogue.

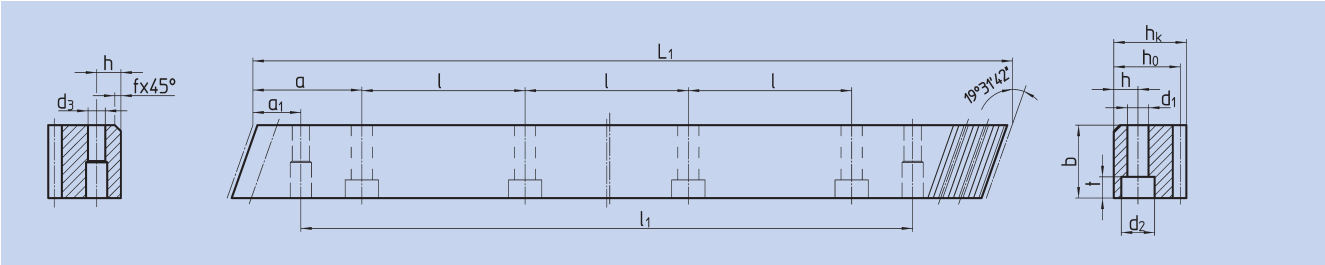
To achieve precision rack joints, we recommend our patented assembly kit, see Atlanta Servo Drive catalogue.

For lubrication of racks & pinions we recommend our automatic lubrication system, see Atlanta Servo Drive catalogue.

For the calculation and selection of the rack & pinion drive, see calculation sample in the Atlanta Servo Drive catalogue.

Srews for rack mounting, see Atlanta Servo Drive catalogue.

ATLANTA-Quality 7



Order code	Module	L_1	N° of teeth	$b^{+0,4}$	h_k	h_0	f	a	l	N° of holes	h	d_1	d_2	t	a_1	l_1	d_3	kg
29 20 107	2	1000,00	150	24	24	22	2	62,5	125	8	8	7	11	7	31,7	936,6	5,7	4,10
29 20 157	2	1500,00	225	24	24	22	2	62,5	125	12	8	7	11	7	31,7	1436,6	5,7	6,15
29 20 207	2	2000,00	300	24	24	22	2	62,5	125	16	8	7	11	7	31,7	1936,6	5,7	8,20
29 30 107	3	1000,00	100	29	29	26	2	62,5	125	8	9	10	15	9	35,0	930,0	7,7	5,90
29 30 157	3	1500,00	150	29	29	26	2	62,5	125	12	9	10	15	9	35,0	1430,0	7,7	8,85
29 30 207	3	2000,00	200	29	29	26	2	62,5	125	16	9	10	15	9	35,0	1930,0	7,7	11,80
29 40 107	4	1000,00	75	39	39	35	2	62,5	125	8	12	14	20	13	33,3	933,4	11,7	10,70
29 40 157 [1]	4	1506,67	113	39	39	35	2	62,5	125	12	12	14	20	13	33,3	1433,0	11,7	16,00
29 40 207	4	2000,00	150	39	39	35	2	62,5	125	16	12	14	20	13	33,3	1933,4	11,7	21,40
29 50 107	5	1000,00	60	49	39	34	2,5	62,5	125	8	12	14	20	13	37,5	925,0	11,7	13,00
29 50 157	5	1500,00	90	49	39	34	2,5	62,5	125	12	12	14	20	13	37,5	1425,0	11,7	19,50
29 50 207	5	2000,00	120	49	39	34	2,5	62,5	125	16	12	14	20	13	37,5	1925,0	11,7	26,00
29 60 107	6	1000,00	50	59	49	43	2,5	62,5	125	8	16	18	26	17	37,5	925,0	15,7	18,10
29 60 157	6	1500,00	75	59	49	43	2,5	62,5	125	12	16	18	26	17	37,5	1425,0	15,7	27,10
29 60 207	6	2000,00	100	59	49	43	2,5	62,5	125	16	16	18	26	17	37,5	1925,0	15,7	36,20
29 80 107	8	960,00	36	79	79	71	2,5	60,0	120	8	25	22	33	21	120,0	720,0	19,7	42,50
29 80 157	8	1440,00	54	79	79	71	2,5	60,0	120	12	25	22	33	21	120,0	1200,0	19,7	65,00
29 80 207	8	1920,00	72	79	79	71	2,5	60,0	120	16	25	22	33	21	120,0	1680,0	19,7	85,00
29 10 107	10	1000,00	30	99	99	89	2,5	62,5	125	8	32	33	48	32	125,0	750,0	19,7	68,72
29 10 157	10	1500,00	45	99	99	89	2,5	62,5	125	12	32	33	48	32	125,0	1250,0	19,7	104,00

1) This racks could be used for continous linking only with the left side (see sketch).

500 mm and other length on request.

Total pitch error **GT_f/1000 ≤ 0,052 mm,**
GT_f/1500 ≤ 0,062 mm (≙ 0,042 mm/1000),
GT_f/2000 ≤ 0,068 mm (≙ 0,034 mm/1000).

- Teeth hardened with the ATLANTA high performance hardening process and ground
- heat-treatable steel acc. ATLANTA-Standard
- ground on all sides after hardening

Mounting racks, see Atlanta Servo Drive catalogue.

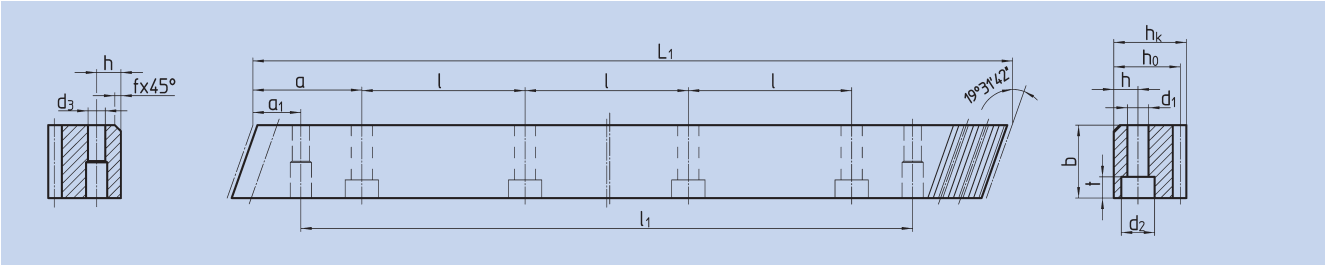
To achieve precision rack joints, we recommend our patented rack assembly kit, see Atlanta Servo Drive catalogue.

For lubrication of racks & pinions, we recommend our automatic lubrication systems, Atlanta Servo Drive catalogue.

For the calculation and selection of the rack & pinion drive, see Atlanta Servo Drive catalogue.

Screws for rack mounting, see Atlanta Servo Drive catalogue.

ATLANTA-Quality 8



Order code	Module	L_1	N° of teeth	$b^{+0,4}$	h_k	h_0	f	a	l	N° of holes	h	d_1	d_2	t	a_1	l_1	d_3	kg
29 20 108	2	1000,00	150	24	24	22	2	62,5	125	8	8	7	11	7	31,7	936,6	5,7	4,12
29 20 158	2	1500,00	225	24	24	22	2	62,5	125	12	8	7	11	7	31,7	1486,6	5,7	6,15
29 20 208	2	2000,00	300	24	24	22	2	62,5	125	16	8	7	11	7	31,7	1936,6	5,7	8,00
29 30 108	3	1000,00	100	29	29	26	2	62,5	125	8	9	10	15	9	35,0	930,0	7,7	5,70
29 30 158	3	1500,00	150	29	29	26	2	62,5	125	12	9	10	15	9	35,0	1430,0	7,7	8,90
29 30 208	3	2000,00	200	29	29	26	2	62,5	125	16	9	10	15	9	35,0	1930,0	7,7	11,20
29 40 108	4	1000,00	75	39	39	35	2	62,5	125	8	12	14	20	13	33,3	933,4	11,7	10,10
29 40 158[1)]	4	1506,67	113	39	39	35	2	62,5	125	12	12	14	20	13	33,3	1433,4	11,7	16,00
29 40 208	4	2000,00	150	39	39	35	2	62,5	125	16	12	14	20	13	33,3	1933,4	11,7	20,16
29 50 108	5	1000,00	60	49	39	34	2,5	62,5	125	8	12	14	20	13	37,5	925,0	11,7	13,00
29 50 208	5	2000,00	120	49	39	34	2,5	62,5	125	16	12	14	20	13	37,5	1925,0	11,7	24,52
29 60 108	6	1000,00	50	59	49	43	2,5	62,5	125	8	16	18	26	17	37,5	925,0	15,7	18,25
29 60 208	6	2000,00	100	59	49	43	2,5	62,5	125	16	16	18	26	17	37,5	1925,0	15,7	36,20

1) This racks could be used for continous linking only with the left side (see sketch).

500 mm and other length on request.
Without bores on request.

Total pitch error **$GT_f/1000 \leq 0{,}060$ mm,**
$GT_f/1500 \leq 0{,}072$ mm ($\triangleq 0{,}048$ mm/1000)
$GT_f/2000 \leq 0{,}078$ mm ($\triangleq 0{,}039$ mm/1000).

- Teeth hardened with the ATLANTA high performance hardening process and ground
- heat-treatable steel acc, ATLANTA-Standard
- ground on all sides after hardening

Mounting racks, see Atlanta Servo Drive catalogue.

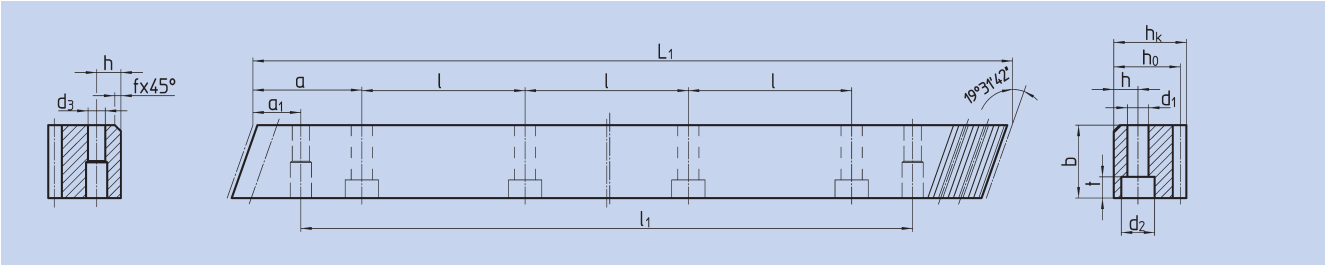
To achieve precision rack joints, we recommend our patented rack assembly kit, see Atlanta Servo Drive catalogue.

For lubrication of racks & pinions, we recommend our automatic lubrication systems, see Atlanta Servo Drive catalogue.

For the calculation and selection of the rack & pinion drive, see Atlanta Servo Drive catalogue.

Screws for rack mounting, see Atlanta Servo Drive catalogue.

ATLANTA-Quality 8



Order code	Module	L_1	N° of teeth	$b_{-0,5}$	h_k	h_0	f	a	l	N° of holes	h	d_1	d_2	t	a_1	l_1	d_3	kg
38 21 100	2	1000,00	150	25	24	22	2	62,5	125	8	8	7	11	7	31,7	936,6	5,7	4,30
38 20 100	2	1000,00	150	25	24	22	2	without mounting holes										4,30
38 21 200	2	2000,00	300	25	24	22	2	62,5	125	16	8	7	11	7	31,7	1936,6	5,7	8,60
38 20 200	2	2000,00	300	25	24	22	2	without mounting holes										8,60
38 31 100	3	1000,00	100	30	29	26	2	62,5	125	8	9	10	15	9	35,0	930,0	7,7	6,10
38 30 100	3	1000,00	100	30	29	26	2	without mounting holes										6,10
38 31 200	3	2000,00	200	30	29	26	2	62,5	125	16	9	10	15	9	35,0	1930,0	7,7	12,20
38 30 200	3	2000,00	200	30	29	26	2	without mounting holes										12,20
38 41 100	4	1000,00	75	40	39	35	2	62,5	125	8	12	10	15	9	33,3	933,4	7,7	10,90
38 40 100	4	1000,00	75	40	39	35	2	without mounting holes										10,90
38 41 200	4	2000,00	150	40	39	35	2	62,5	125	16	12	10	15	9	33,3	1933,4	7,7	21,80
38 40 200	4	2000,00	150	40	39	35	2	without mounting holes										21,80

500 mm and other length on request.

Total pitch error **GT_f/1000 ≤ 0,100 mm,**
GT_f/2000 ≤ 0,200 mm.

- Milled teeth, quenched and tempered
- heat-treatable steel according ATLANTA-Standard
- bright steel, backside machined

Mounting racks, see Atlanta Servo Drive catalogue.

To achieve precision rack joints, we recommend our patented rack assembly kit, Atlanta Servo Drive catalogue.

For lubrication of racks & pinions, we recommend our automatic lubrication systems, see Atlanta Servo Drive catalogue.

For the calculation and selection of the rack & pinion drive, see Atlanta Servo Drive catalogue.

Screws for rack mounting, see Atlanta Servo Drive catalogue.

Rack and pinion drive – calculation and selection – module 2 – helical tooth system

Rack		HPR			PR			BR			
ATLANTA-Quality		6		7	8			9		10	
Rack	material	case hardening steel [2]	heat-treatable steel according ATLANTA-standard								
	heat treatment	high performance hardening process				quenched + tempered		soft		high performance hardening process	
Pinion	material	16MnCr5	16MnCr5	16MnCr5	16MnCr5	16MnCr5	C45	16MnCr5	C45	16MnCr5	C45
	heattreatment	case hardened	case hardened	case hardened	case hardened	case hardened	ind. gardened	case hardened	soft	case hardened	ind. hardened
No. of pinion teeth [1]	pitch circle dia.	**maximum feed force** (values are only valid for material according ATLANTA-standard)									
12	25,46 mm	8,0 kN	6,0 kN	6,0 kN	5,0 kN	2,0 kN	1,0 kN	1,0 kN	0,6 kN	3,5 kN	2,5 kN
13	27,59 mm	8,5 kN	6,0 kN	6,0 kN	5,5 kN	2,0 kN	1,0 kN	1,0 kN	0,6 kN	4,0 kN	2,5 kN
14	29,71 mm	10,0 kN	7,5 kN	7,5 kN	6,5 kN	2,5 kN	1,5 kN	1,0 kN	0,7 kN	4,5 kN	3,0 kN
15	31,83 mm	11,0 kN	8,0 kN	8,0 kN	7,0 kN	2,5 kN	1,5 kN	1,5 kN	0,8 kN	5,0 kN	3,5 kN
16	33,95 mm	12,0 kN	9,0 kN	9,0 kN	7,5 kN	3,0 kN	2,0 kN	1,5 kN	0,9 kN	5,5 kN	3,5 kN
17	36,08 mm	13,0 kN	9,5 kN	9,5 kN	8,0 kN	3,0 kN	2,0 kN	1,5 kN	1,0 kN	6,0 kN	4,0 kN
18	38,20 mm	13,5 kN	10,0 kN	10,0 kN	8,5 kN	3,5 kN	2,0 kN	1,5 kN	1,0 kN	6,5 kN	4,0 kN
19	40,32 mm	14,5 kN	10,5 kN	10,5 kN	9,0 kN	3,5 kN	2,0 kN	2,0 kN	1,0 kN	7,0 kN	4,5 kN
20	42,44 mm	15,5 kN	11,5 kN	11,5 kN	9,5 kN	4,0 kN	2,5 kN	2,0 kN	1,0 kN	7,0 kN	4,5 kN
21	44,56 mm	16,0 kN	12,0 kN	12,0 kN	10,5 kN	4,0 kN	2,5 kN	2,0 kN	1,0 kN	7,5 kN	5,0 kN
22	46,69 mm	17,0 kN	12,5 kN	12,5 kN	11,0 kN	4,0 kN	2,5 kN	2,0 kN	1,0 kN	8,0 kN	5,5 kN
23	48,81 mm	17,5 kN	13,0 kN	13,0 kN	11,5 kN	4,5 kN	3,0 kN	2,5 kN	1,0 kN	8,5 kN	5,5 kN
24	50,93 mm	18,0 kN	13,5 kN	13,5 kN	12,0 kN	4,5 kN	3,0 kN	2,5 kN	1,0 kN	8,5 kN	5,5 kN
25	53,05 mm	18,5 kN	14,5 kN	14,5 kN	12,5 kN	5,0 kN	3,0 kN	2,5 kN	1,5 kN	9,0 kN	5,5 kN
26	55,17 mm	18,5 kN	15,0 kN	15,0 kN	13,0 kN	5,0 kN	3,0 kN	2,5 kN	1,5 kN	9,0 kN	5,5 kN
27	57,30 mm	18,5 kN	15,0 kN	15,0 kN	13,0 kN	5,5 kN	3,5 kN	2,5 kN	1,5 kN	9,0 kN	5,5 kN
28	59,42 mm	18,5 kN	15,0 kN	15,0 kN	13,0 kN	5,5 kN	3,5 kN	3,0 kN	1,5 kN	9,5 kN	5,5 kN
29	61,54 mm	18,5 kN	15,0 kN	15,0 kN	13,0 kN	6,0 kN	3,5 kN	3,0 kN	1,5 kN	9,5 kN	5,5 kN
30	63,66 mm	18,5 kN	15,0 kN	15,0 kN	13,0 kN	6,0 kN	4,0 kN	3,0 kN	1,5 kN	9,5 kN	6,0 kN
31	65,78 mm	19,0 kN	15,5 kN	15,5 kN	13,0 kN	6,0 kN	4,0 kN	3,0 kN	1,5 kN	9,5 kN	6,0 kN
32	67,91 mm	19,0 kN	15,5 kN	15,5 kN	13,0 kN	6,5 kN	4,0 kN	3,5 kN	1,5 kN	9,5 kN	6,0 kN
33	70,03 mm	19,0 kN	15,5 kN	15,5 kN	13,5 kN	6,5 kN	4,0 kN	3,5 kN	2,0 kN	9,5 kN	6,0 kN
34	72,15 mm	19,0 kN	15,5 kN	15,5 kN	13,5 kN	7,0 kN	4,5 kN	3,5 kN	2,0 kN	9,5 kN	6,0 kN
35	74,27 mm	19,0 kN	15,5 kN	15,5 kN	13,5 kN	7,0 kN	4,5 kN	3,5 kN	2,0 kN	9,5 kN	6,0 kN
36	76,39 mm	19,0 kN	15,5 kN	15,5 kN	13,5 kN	7,5 kN	4,5 kN	4,0 kN	2,0 kN	9,5 kN	6,0 kN
37	78,52 mm	19,0 kN	15,5 kN	15,5 kN	13,5 kN	7,5 kN	5,0 kN	4,0 kN	2,0 kN	9,5 kN	6,0 kN
38	80,64 mm	19,0 kN	15,5 kN	15,5 kN	13,5 kN	7,5 kN	5,0 kN	4,0 kN	2,0 kN	9,5 kN	6,0 kN
39	82,76 mm	19,0 kN	15,5 kN	15,5 kN	13,5 kN	8,0 kN	5,0 kN	4,0 kN	2,0 kN	9,5 kN	6,0 kN
40	84,88 mm	19,5 kN	15,5 kN	15,5 kN	13,5 kN	8,0 kN	5,0 kN	4,0 kN	2,0 kN	9,5 kN	6,0 kN

1) check availability (chapter ZA)
2) according ATLANTA-standard

Maximum permissible feed forces – description see page ZA-23 ATLANTA Servo catalogue

Rack and pinion drive – calculation and selection – module 3 – helical tooth system

Rack		HPR			PR			BR			
ATLANTA-Quality		6		7	8			9		10	
Rack	material	case hardening steel [2]	heat-treatable steel according ATLANTA-standard								
	heat treatment	high performance hardening process				quenched + tempered		soft		high performance hardening process	
Pinion	material	16MnCr5	16MnCr5	16MnCr5	16MnCr5	16MnCr5	C45	16MnCr5	C45	16MnCr5	C45
	heattreatment	case hardened	case hardened	case hardened	case hardened	case hardened	ind. gardened	case hardened	soft	case hardened	ind. hardened
No. of pinion teeth [1]	pitch circle dia.	**maximum feed force** (values are only valid for material according ATLANTA-standard)									
12	38,20 mm	13,0 kN	9,5 kN	9,5 kN	8,0 kN	3,0 kN	2,5 kN	1,5 kN	1,0 kN	5,5 kN	5,0 kN
13	41,38 mm	15,0 kN	11,0 kN	11,0 kN	9,0 kN	3,5 kN	3,0 kN	1,5 kN	1,5 kN	6,5 kN	6,0 kN
14	44,56 mm	18,0 kN	13,0 kN	13,0 kN	11,0 kN	4,5 kN	3,5 kN	2,0 kN	1,5 kN	8,0 kN	7,5 kN
15	47,75 mm	19,5 kN	14,5 kN	14,5 kN	12,0 kN	5,0 kN	4,0 kN	2,5 kN	2,0 kN	9,0 kN	8,0 kN
16	50,93 mm	21,0 kN	15,5 kN	15,5 kN	13,0 kN	5,0 kN	4,5 kN	2,5 kN	2,0 kN	9,5 kN	8,5 kN
17	54,11 mm	22,5 kN	16,5 kN	16,5 kN	14,0 kN	5,5 kN	4,5 kN	2,5 kN	2,0 kN	10,0 kN	9,0 kN
18	57,30 mm	24,0 kN	17,5 kN	17,5 kN	14,5 kN	6,0 kN	5,0 kN	3,0 kN	2,0 kN	11,0 kN	10,0 kN
19	60,48 mm	25,5 kN	19,0 kN	19,0 kN	15,5 kN	6,0 kN	5,5 kN	3,0 kN	2,5 kN	11,5 kN	10,5 kN
20	63,66 mm	27,0 kN	20,0 kN	20,0 kN	16,5 kN	6,5 kN	5,5 kN	3,0 kN	2,5 kN	12,0 kN	11,0 kN
21	66,85 mm	28,5 kN	21,0 kN	21,0 kN	17,5 kN	7,0 kN	6,0 kN	3,5 kN	2,5 kN	13,0 kN	11,5 kN
22	70,03 mm	29,5 kN	22,0 kN	22,0 kN	18,5 kN	7,5 kN	6,5 kN	3,5 kN	2,5 kN	13,5 kN	12,0 kN
23	73,21 mm	29,5 kN	23,0 kN	23,0 kN	19,0 kN	7,5 kN	6,5 kN	4,0 kN	3,0 kN	14,0 kN	13,0 kN
24	76,39 mm	29,5 kN	24,0 kN	24,0 kN	20,0 kN	8,0 kN	7,0 kN	4,0 kN	3,0 kN	15,0 kN	13,0 kN
25	79,58 mm	30,0 kN	25,5 kN	25,0 kN	21,0 kN	8,5 kN	7,5 kN	4,0 kN	3,0 kN	15,5 kN	13,0 kN
26	82,76 mm	30,0 kN	26,5 kN	26,5 kN	22,0 kN	8,5 kN	7,5 kN	4,5 kN	3,5 kN	16,0 kN	13,0 kN
27	85,94 mm	30,0 kN	27,5 kN	27,5 kN	22,5 kN	9,0 kN	8,0 kN	4,5 kN	3,5 kN	17,0 kN	13,5 kN
28	89,13 mm	30,5 kN	27,5 kN	27,5 kN	23,5 kN	9,5 kN	8,0 kN	4,5 kN	3,5 kN	17,0 kN	13,5 kN
29	92,31 mm	30,5 kN	27,5 kN	27,5 kN	23,5 kN	10,0 kN	8,5 kN	5,0 kN	4,0 kN	17,0 kN	13,5 kN
30	95,49 mm	30,5 kN	27,5 kN	27,5 kN	24,0 kN	10,0 kN	9,0 kN	5,0 kN	4,0 kN	17,5 kN	13,5 kN
31	98,68 mm	30,5 kN	28,0 kN	28,0 kN	24,0 kN	10,5 kN	9,0 kN	5,5 kN	4,0 kN	17,5 kN	13,5 kN
32	101,86 mm	30,5 kN	28,0 kN	28,0 kN	24,0 kN	11,0 kN	9,5 kN	5,5 kN	4,0 kN	17,5 kN	13,5 kN
33	105,04 mm	31,0 kN	28,0 kN	28,0 kN	24,0 kN	11,5 kN	10,0 kN	5,5 kN	4,5 kN	17,5 kN	13,5 kN
34	108,23 mm	31,0 kN	28,0 kN	28,0 kN	24,0 kN	11,5 kN	10,0 kN	6,0 kN	4,5 kN	17,5 kN	13,5 kN
35	111,41 mm	31,0 kN	28,0 kN	28,0 kN	24,0 kN	12,0 kN	10,5 kN	6,0 kN	4,5 kN	17,5 kN	13,5 kN
36	114,59 mm	31,0 kN	28,5 kN	28,5 kN	24,5 kN	12,5 kN	11,0 kN	6,0 kN	5,0 kN	17,5 kN	13,5 kN
37	117,77 mm	31,0 kN	28,5 kN	28,5 kN	24,5 kN	13,0 kN	11,0 kN	6,5 kN	5,0 kN	17,5 kN	13,5 kN
38	120,96 mm	31,0 kN	28,5 kN	28,5 kN	24,5 kN	13,0 kN	11,5 kN	6,5 kN	5,0 kN	17,5 kN	13,5 kN
39	124,14 mm	31,0 kN	28,5 kN	28,5 kN	24,5 kN	13,5 kN	11,5 kN	7,0 kN	5,0 kN	17,5 kN	13,5 kN
40	127,32 mm	31,0 kN	28,5 kN	28,5 kN	24,5 kN	14,0 kN	12,0 kN	7,0 kN	5,5 kN	17,5 kN	13,5 kN

1) check availability (chapter ZA)
2) according ATLANTA-standard

Maximum permissible feed forces – description see page ZA-23 ATLANTA Servo catalogue

Rack and pinion drive – calculation and selection – module 4 – helical tooth system

Rack		HPR			PR			BR			
ATLANTA-Quality		6		7	8			9		10	
Rack	material	case hardening steel [2]	heat-treatable steel according ATLANTA-standard								
	heat treatment	high performance hardening process				quenched + tempered		soft		high performance hardening process	
Pinion	material	16MnCr5	16MnCr5	16MnCr5	16MnCr5	16MnCr5	C45	16MnCr5	C45	16MnCr5	C45
	heattreatment	case hardened	case hardened	case hardened	case hardened	case hardened	ind. gardened	case hardened	soft	case hardened	ind. hardened
No. of pinion teeth [1]	pitch circle dia.	**maximum feed force** (values are only valid for material according ATLANTA-standard)									
12	50,93 mm	24,0 kN	18,0 kN	17,5 kN	15,0 kN	6,0 kN	5,0 kN	3,0 kN	2,0 kN	11,0 kN	9,5 kN
13	55,17 mm	28,0 kN	20,5 kN	20,5 kN	17,5 kN	7,0 kN	5,5 kN	3,5 kN	2,5 kN	13,0 kN	11,0 kN
14	59,42 mm	32,5 kN	24,0 kN	24,0 kN	20,5 kN	8,0 kN	6,5 kN	4,0 kN	3,0 kN	15,0 kN	12,5 kN
15	63,66 mm	37,0 kN	27,5 kN	27,5 kN	23,5 kN	9,5 kN	7,5 kN	4,5 kN	3,5 kN	17,0 kN	14,5 kN
16	67,91 mm	39,5 kN	29,5 kN	29,5 kN	25,0 kN	10,0 kN	8,0 kN	5,0 kN	3,5 kN	18,5 kN	15,5 kN
17	72,15 mm	42,0 kN	31,5 kN	31,0 kN	26,5 kN	10,5 kN	8,5 kN	5,5 kN	4,0 kN	19,5 kN	16,5 kN
18	76,39 mm	45,0 kN	33,5 kN	33,0 kN	28,5 kN	11,5 kN	9,0 kN	5,5 kN	4,0 kN	21,0 kN	17,5 kN
19	80,64 mm	47,5 kN	35,5 kN	35,0 kN	30,0 kN	12,0 kN	10,0 kN	6,0 kN	4,5 kN	22,5 kN	19,0 kN
20	84,88 mm	50,0 kN	37,0 kN	37,0 kN	31,5 kN	13,0 kN	10,5 kN	6,5 kN	4,5 kN	23,5 kN	20,0 kN
21	89,13 mm	53,0 kN	39,0 kN	39,0 kN	33,5 kN	13,5 kN	11,0 kN	7,0 kN	5,0 kN	25,0 kN	21,0 kN
22	93,37 mm	55,5 kN	41,0 kN	41,0 kN	35,0 kN	14,0 kN	11,5 kN	7,0 kN	5,0 kN	26,0 kN	22,0 kN
23	97,62 mm	56,5 kN	43,0 kN	43,0 kN	37,0 kN	15,0 kN	12,0 kN	7,5 kN	5,5 kN	27,5 kN	23,0 kN
24	101,86 mm	57,0 kN	45,0 kN	45,0 kN	38,5 kN	15,5 kN	12,5 kN	8,0 kN	5,5 kN	28,5 kN	23,5 kN
25	106,10 mm	57,5 kN	47,0 kN	47,0 kN	40,0 kN	16,0 kN	13,0 kN	8,0 kN	6,0 kN	30,0 kN	23,5 kN
26	110,35 mm	57,5 kN	49,0 kN	49,0 kN	42,0 kN	17,0 kN	13,5 kN	8,5 kN	6,0 kN	30,5 kN	24,0 kN
27	114,59 mm	58,0 kN	49,5 kN	49,5 kN	42,0 kN	17,5 kN	14,5 kN	9,0 kN	6,5 kN	31,0 kN	24,0 kN
28	118,84 mm	58,5 kN	49,5 kN	49,5 kN	42,0 kN	18,5 kN	15,0 kN	9,5 kN	6,5 kN	31,0 kN	24,0 kN
29	123,08 mm	58,5 kN	50,0 kN	50,0 kN	42,5 kN	19,0 kN	15,5 kN	9,5 kN	7,0 kN	31,0 kN	24,0 kN
30	127,32 mm	58,5 kN	50,0 kN	50,0 kN	42,5 kN	19,5 kN	16,0 kN	10,0 kN	7,0 kN	31,0 kN	24,0 kN
31	131,57 mm	59,0 kN	50,0 kN	50,0 kN	42,5 kN	20,5 kN	16,5 kN	10,5 kN	7,5 kN	31,0 kN	24,5 kN
32	135,81 mm	59,0 kN	50,5 kN	50,5 kN	43,0 kN	21,0 kN	17,0 kN	11,0 kN	7,5 kN	31,5 kN	24,5 kN
33	140,06 mm	59,0 kN	50,5 kN	50,5 kN	43,0 kN	22,0 kN	17,5 kN	11,0 kN	8,0 kN	31,5 kN	24,5 kN
34	144,30 mm	59,5 kN	50,5 kN	50,5 kN	43,0 kN	22,5 kN	18,0 kN	11,5 kN	8,0 kN	31,5 kN	24,5 kN
35	148,54 mm	59,5 kN	51,0 kN	51,0 kN	43,5 kN	23,0 kN	19,0 kN	12,0 kN	8,5 kN	31,5 kN	24,5 kN
36	152,79 mm	59,5 kN	51,0 kN	51,0 kN	43,5 kN	24,0 kN	19,5 kN	12,0 kN	8,5 kN	31,5 kN	24,5 kN
37	157,03 mm	59,5 kN	51,0 kN	51,0 kN	43,5 kN	24,5 kN	20,0 kN	12,5 kN	9,0 kN	31,5 kN	24,5 kN
38	161,28 mm	59,5 kN	51,5 kN	51,5 kN	43,5 kN	25,5 kN	20,5 kN	13,0 kN	9,0 kN	32,0 kN	24,5 kN
39	165,52 mm	59,5 kN	51,5 kN	51,5 kN	43,5 kN	26,0 kN	21,0 kN	13,5 kN	9,5 kN	32,0 kN	24,5 kN
40	169,77 mm	60,0 kN	51,5 kN	51,5 kN	44,0 kN	27,0 kN	21,5 kN	13,5 kN	10,0 kN	32,0 kN	24,5 kN

1) check availability (chapter ZA)
2) according ATLANTA-standard

Maximum permissible feed forces – description see page ZA-23 ATLANTA Servo catalogue

Rack and pinion drive – calculation and selection – module 5 – helical tooth system

Rack		HPR		PR	BR			
ATLANTA-Quality		6	7	8	9		10	
Rack	material	heat-treatable steel according ATLANTA-standard						
	heat treatment	high performance hardening process			soft		high performance hardening process	
Pinion	material	16MnCr5	16MnCr5	16MnCr5	16MnCr5	C45	16MnCr5	C45
	heat treatment	case hardened	case hardened	case hardened	case hardened	soft	case hardened	ind. hardened
No. of pinion teeth[1)]	pitch circle dia.	**maximum feed force** (values are only valid for material according ATLANTA-standard)						
12	63,66 mm	28,0 kN	28,0 kN	23,5 kN	5,0 kN	3,5 kN	17,5 kN	15,0 kN
13	68,97 mm	32,5 kN	32,5 kN	27,5 kN	5,5 kN	4,0 kN	20,5 kN	17,5 kN
14	74,27 mm	37,5 kN	37,5 kN	32,0 kN	6,5 kN	4,5 kN	23,5 kN	20,0 kN
15	79,58 mm	43,0 kN	43,0 kN	36,5 kN	7,5 kN	5,5 kN	27,0 kN	23,0 kN
16	84,88 mm	46,0 kN	46,0 kN	39,0 kN	8,0 kN	5,5 kN	29,0 kN	24,5 kN
17	90,19 mm	49,5 kN	49,5 kN	42,0 kN	8,5 kN	6,0 kN	31,0 kN	26,0 kN
18	95,49 mm	52,5 kN	52,5 kN	44,5 kN	9,0 kN	6,5 kN	33,0 kN	28,0 kN
19	100,80 mm	55,5 kN	55,5 kN	47,0 kN	9,5 kN	7,0 kN	35,0 kN	29,5 kN
20	106,10 mm	58,5 kN	58,5 kN	49,5 kN	10,5 kN	7,5 kN	37,0 kN	31,0 kN
21	111,41 mm	61,5 kN	61,5 kN	52,5 kN	11,0 kN	7,5 kN	39,0 kN	33,0 kN
22	116,71 mm	65,0 kN	65,0 kN	55,0 kN	11,5 kN	8,0 kN	41,0 kN	34,5 kN
23	122,02 mm	68,0 kN	68,0 kN	57,5 kN	12,0 kN	8,5 kN	43,0 kN	36,5 kN
24	127,32 mm	71,0 kN	71,0 kN	60,5 kN	12,5 kN	9,0 kN	45,0 kN	37,0 kN
25	132,63 mm	74,5 kN	74,5 kN	63,0 kN	13,0 kN	9,5 kN	47,0 kN	37,0 kN
26	137,93 mm	75,0 kN	75,0 kN	63,5 kN	13,5 kN	10,0 kN	48,0 kN	37,5 kN
27	143,24 mm	75,5 kN	75,5 kN	64,0 kN	14,0 kN	10,0 kN	48,0 kN	37,5 kN
28	148,54 mm	75,5 kN	75,5 kN	64,0 kN	15,0 kN	10,5 kN	48,5 kN	38,0 kN
29	153,85 mm	76,0 kN	76,0 kN	64,5 kN	15,5 kN	11,0 kN	48,5 kN	38,0 kN
30	159,16 mm	76,0 kN	76,0 kN	64,5 kN	16,0 kN	11,5 kN	49,0 kN	38,0 kN

1) check availability (chapter ZA)

Maximum permissible feed forces – description see page ZA-23 ATLANTA Servo catalogue

Rack and pinion drive – calculation and selection – module 6 – helical tooth system

Rack		HPR		PR	BR			
ATLANTA-Quality		6	7	8	9		10	
Rack	material	heat-treatable steel according ATLANTA-standard						
	heat treatment	high performance hardening process			soft		high performance hardening process	
Pinion	material	16MnCr5	16MnCr5	16MnCr5	16MnCr5	C45	16MnCr5	C45
	heat treatment	case hardened	case hardened	case hardened	case hardened	soft	case hardened	ind. hardened
No. of pinion teeth [1]	pitch circle dia.	**maximum feed force** (values are only valid for material according ATLANTA-standard)						
12	76,39 mm	40,5 kN	40,5 kN	33,5 kN	7,0 kN	5,0 kN	25,5 kN	21,5 kN
13	82,76 mm	47,0 kN	47,0 kN	39,0 kN	8,0 kN	6,0 kN	29,5 kN	25,0 kN
14	89,13 mm	54,5 kN	54,5 kN	45,5 kN	9,5 kN	7,0 kN	34,5 kN	29,0 kN
15	95,49 mm	62,5 kN	62,5 kN	52,0 kN	11,0 kN	8,0 kN	39,0 kN	33,0 kN
16	101,86 mm	67,0 kN	67,0 kN	55,5 kN	11,5 kN	8,5 kN	42,0 kN	35,5 kN
17	108,23 mm	71,5 kN	71,5 kN	59,5 kN	12,5 kN	9,0 kN	45,0 kN	38,0 kN
18	114,59 mm	76,0 kN	76,0 kN	63,0 kN	13,5 kN	9,5 kN	47,5 kN	40,5 kN
19	120,96 mm	80,5 kN	80,5 kN	67,0 kN	14,0 kN	10,0 kN	50,5 kN	43,0 kN
20	127,32 mm	85,0 kN	85,0 kN	70,5 kN	15,0 kN	10,5 kN	53,5 kN	45,0 kN
21	133,69 mm	89,5 kN	89,5 kN	74,5 kN	15,5 kN	11,5 kN	56,5 kN	47,5 kN
22	140,06 mm	94,0 kN	94,0 kN	78,0 kN	16,5 kN	12,0 kN	59,0 kN	50,0 kN
23	146,42 mm	98,5 kN	98,5 kN	82,0 kN	17,5 kN	12,5 kN	62,0 kN	52,5 kN
24	152,79 mm	103,0 kN	103,0 kN	85,5 kN	18,0 kN	13,0 kN	65,0 kN	53,0 kN
25	159,16 mm	107,0 kN	107,0 kN	89,0 kN	19,0 kN	13,5 kN	66,5 kN	53,5 kN
26	165,52 mm	107,5 kN	107,5 kN	89,5 kN	20,0 kN	14,0 kN	66,5 kN	53,5 kN
27	171,89 mm	108,0 kN	108,0 kN	89,5 kN	20,5 kN	15,0 kN	67,0 kN	54,0 kN
28	178,25 mm	108,0 kN	108,0 kN	90,0 kN	21,5 kN	15,5 kN	67,0 kN	54,0 kN
29	184,62 mm	108,5 kN	108,5 kN	90,5 kN	22,0 kN	16,0 kN	67,5 kN	54,5 kN
30	190,99 mm	109,0 kN	109,0 kN	90,5 kN	23,0 kN	16,5 kN	67,5 kN	54,5 kN

1) check availability (chapter ZA)

Maximum permissible feed forces – description see page ZA-23 ATLANTA Servo catalogue

Rack and pinion drive – calculation and selection – module 8 – helical tooth system

Rack		HPR		BR			
ATLANTA-Quality		6	7	9		10	
Rack	material	heat-treatable steel according ATLANTA-standard					
	heat treatment	high performance hardening process		soft		high performance hardening process	
Pinion	material	16MnCr5	16MnCr5	16MnCr5	C45	16MnCr5	C45
	heat treatment	case hardened	case hardened	case hardened	soft	case hardened	ind. hardened
No. of pinion teeth[1)]	pitch circle dia.	**maximum feed force** (values are only valid for material according ATLANTA-standard)					
12	101,86 mm	72,5 kN	72,5 kN	12,5 kN	9,0 kN	45,5 kN	38,5 kN
13	110,35 mm	84,5 kN	84,5 kN	15,0 kN	10,5 kN	53,0 kN	44,5 kN
14	118,84 mm	97,5 kN	97,5 kN	17,0 kN	12,5 kN	61,5 kN	52,0 kN
15	127,32 mm	111,5 kN	111,5 kN	19,5 kN	14,0 kN	70,0 kN	59,5 kN
16	135,81 mm	119,5 kN	119,5 kN	21,0 kN	15,0 kN	75,0 kN	63,5 kN
17	144,30 mm	127,5 kN	127,5 kN	22,5 kN	16,0 kN	80,0 kN	67,5 kN
18	152,79 mm	135,5 kN	135,5 kN	24,0 kN	17,0 kN	85,0 kN	72,0 kN
19	161,28 mm	143,5 kN	143,5 kN	25,5 kN	18,0 kN	90,0 kN	76,5 kN
20	169,77 mm	151,5 kN	151,5 kN	27,0 kN	19,5 kN	95,5 kN	80,5 kN
21	178,25 mm	160,0 kN	159,5 kN	28,5 kN	20,5 kN	100,5 kN	85,0 kN
22	186,74 mm	168,0 kN	167,5 kN	29,5 kN	21,5 kN	105,5 kN	89,0 kN
23	195,23 mm	176,0 kN	176,0 kN	31,0 kN	22,5 kN	110,5 kN	92,5 kN
24	203,72 mm	184,0 kN	184,0 kN	32,5 kN	23,5 kN	115,5 kN	93,0 kN
25	212,21 mm	187,0 kN	187,0 kN	34,0 kN	24,5 kN	116,5 kN	93,5 kN
26	220,70 mm	188,0 kN	188,0 kN	35,5 kN	25,5 kN	117,0 kN	94,0 kN
27	229,18 mm	189,0 kN	188,5 kN	37,0 kN	26,5 kN	117,5 kN	94,5 kN
28	237,67 mm	189,5 kN	189,5 kN	38,5 kN	27,5 kN	117,5 kN	95,0 kN
29	246,16 mm	190,5 kN	190,5 kN	40,0 kN	28,5 kN	118,0 kN	95,0 kN
30	254,65 mm	191,0 kN	191,0 kN	41,5 kN	29,5 kN	118,5 kN	95,5 kN

1) check availability (chapter ZA)

Maximum permissible feed forces – description see page ZA-23 ATLANTA Servo catalogue

Rack and pinion drive – calculation and selection – module 10 – helical tooth system

Rack		HPR		BR			
ATLANTA-Quality		6	7	9		10	
Rack	material	heat-treatable steel according ATLANTA-standard					
	heat treatment	high performance hardening process		soft		high performance hardening process	
Pinion	material	16MnCr5	16MnCr5	16MnCr5	C45	16MnCr5	C45
	heat treatment	case hardened	case hardened	case hardened	soft	case hardened	ind. hardened
No. of pinion teeth[1)]	pitch circle dia.	**maximum feed force** (values are only valid for material according ATLANTA-standard)					
12	127,32 mm	114,0 kN	114,0 kN	20,0 kN	14,5 kN	71,5 kN	60,5 kN
13	137,93 mm	132,5 kN	132,5 kN	23,5 kN	16,5 kN	83,0 kN	70,0 kN
14	148,54 mm	153,5 kN	153,5 kN	27,0 kN	19,5 kN	96,0 kN	81,5 kN
15	159,16 mm	175,0 kN	175,0 kN	31,0 kN	22,0 kN	109,5 kN	93,0 kN
16	169,77 mm	187,5 kN	187,5 kN	33,0 kN	24,0 kN	117,5 kN	99,5 kN
17	180,38 mm	200,0 kN	200,0 kN	35,5 kN	25,5 kN	125,5 kN	106,0 kN
18	190,99 mm	212,5 kN	212,5 kN	37,5 kN	27,0 kN	133,5 kN	113,0 kN
19	201,60 mm	225,5 kN	225,0 kN	40,0 kN	28,5 kN	141,5 kN	119,5 kN
20	212,21 mm	238,0 kN	237,5 kN	42,0 kN	30,5 kN	149,5 kN	126,0 kN
21	222,82 mm	250,5 kN	250,5 kN	44,5 kN	32,0 kN	157,0 kN	133,0 kN
22	233,43 mm	263,0 kN	263,0 kN	46,5 kN	33,5 kN	165,0 kN	140,0 kN
23	244,04 mm	276,0 kN	276,0 kN	49,0 kN	35,0 kN	173,0 kN	142,0 kN
24	254,65 mm	285,5 kN	285,5 kN	51,0 kN	37,0 kN	178,0 kN	143,0 kN
25	265,26 mm	287,0 kN	287,0 kN	53,5 kN	38,5 kN	178,5 kN	143,5 kN

1) check availability (chapter ZA)

Maximum permissible feed forces – description see page ZA-23 ATLANTA Servo catalogue

Rack and pinion drive – calculation and selection – module 12 – helical tooth system

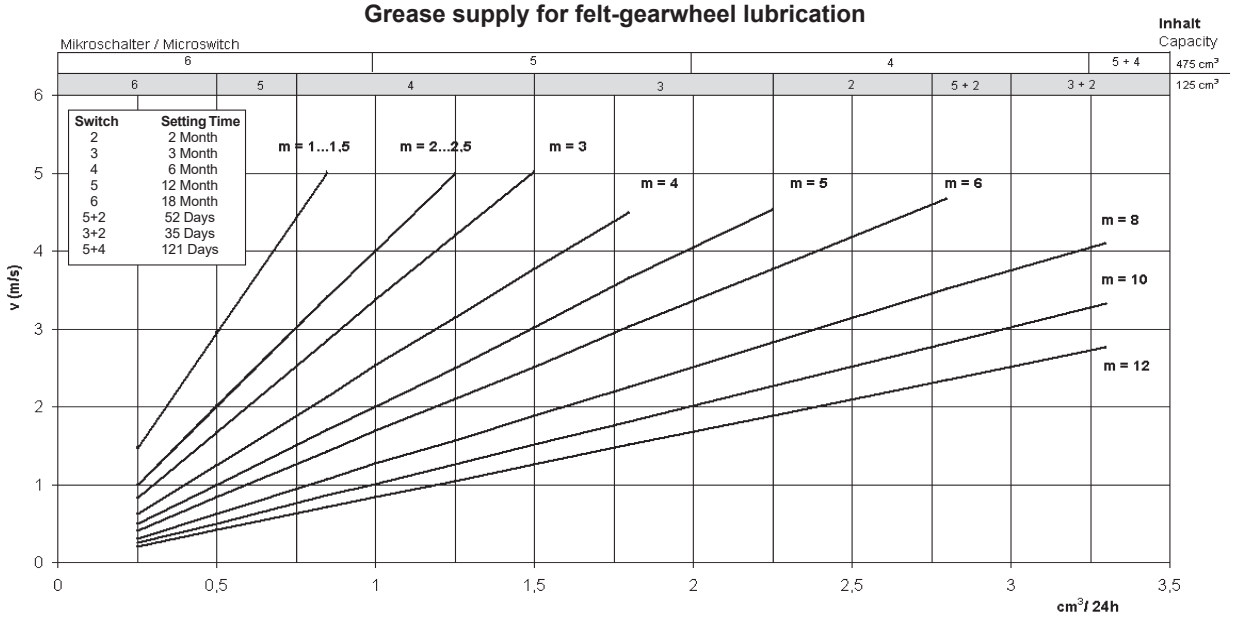
Rack		HPR	BR	
ATLANTA-Quality		6	10	
Rack	material	heat-treatable steel according ATLANTA-standard		
	heat treatment	high performance hardening process		
Pinion	material	16MnCr5	16MnCr5	C45
	heat treatment	case hardened	case hardened	ind. hardened
No. of pinion teeth[1)]	pitch circle dia.	maximum feed force (values are only valid for material according ATLANTA-standard)		
12	152,79 mm	163,0 kN	101,0 kN	85,5 kN
13	165,52 mm	189,5 kN	117,5 kN	99,0 kN
14	178,25 mm	219,0 kN	136,0 kN	115,0 kN
15	190,99 mm	249,5 kN	155,0 kN	131,0 kN
16	203,72 mm	267,0 kN	166,0 kN	140,5 kN
17	216,45 mm	285,5 kN	177,0 kN	150,0 kN
18	229,18 mm	303,0 kN	188,5 kN	159,5 kN
19	241,92 mm	321,0 kN	199,5 kN	169,0 kN
20	254,65 mm	339,0 kN	210,5 kN	178,5 kN
21	267,38 mm	357,0 kN	222,0 kN	187,5 kN
22	280,11 mm	375,0 kN	233,0 kN	197,5 kN
23	292,85 mm	393,5 kN	244,5 kN	200,0 kN
24	305,58 mm	407,5 kN	251,0 kN	201,5 kN
25	318,31 mm	409,0 kN	252,5 kN	202,5 kN

1) check availability (chapter ZA)

Maximum permissible feed forces – description see page ZA-23 ATLANTA Servo catalogue

Lubrication of rack and pinion drives
When lubricating rack and pinion drives by means of a felt gearwheel and electronically controlled lubricator the optimal grease supply can be seen from the diagram below. For lubrication with sliding brush use the next higher switch position. If, for example, micro-switch position 4 is chosen for felt-gearwheel lubrication, choose 3 for sliding-brush lubrication at the same speed and with the same module.

Grease supply for felt-gearwheel lubrication



Pressure build-up
Set all micro-switches to „ON“. Pressure build-up time 6 – 8 hours. Then set the desired time. The micro-switch 7 must be always on. Before starting up the lubricator the connecting hose between felt wheel and lubricator should be filled and the felt wheel soaked with grease.

Battery exchange
The guaranteed service life of the battery is 1 year. Then the battery should be replaced. Although the control lamp may still flash it is possible that the battery capacity has already decreased. The lubricator can also be operated by means of external power supply via an intermediate relay.

Recommended lubricants for rack drives:

Felt-gear lubrication: Klüber Microlube GB 0
Order code 65 90 002 (1 kg)
Klüber Structovis AHD
Order code 65 90 003 (1 kg)

Sliding brush lubrication: Klüber Microlube GB 0
Order code 65 90 002 (1 kg)

Furthermore the following lubricants have been tested with good results.

Oest Langzeitfett LT 200
BP Energrease LS EP 00
DEA Glissando 6833 EP 00
Fuchs Lubritech Gearmaster ZSA
Molykote G-Rapid plus 3694

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