

Data sheet

DF *plus*



Technical data

Type	-	DF1 plus	DF2 plus	DF3 plus	DF4 plus	DF5 plus
Accuracy class	%	≤±0.04				
Rated torque (Md _n)	Nm	100 200 500	500 1,000	1,000 2,000 3,000	4,000 5,000	5,000 10,000

Torque measuring system						
Technology	-	Rotating				
Rated torque (Md _n) #1	Nm	100 200 500	500 1,000	1,000 2,000 3,000	4,000 5,000	5,000 10,000
Rated torque short measurement range (optional, minimum) (Md _{ns}) #2	Nm	N/A				
Accuracy class extended (for Md _n)	%	N/A				
Outputs	-	Frequency (RS422), Voltage, CAN bus, Alert				
Test signal	-	see test report				

Mechanical dimensions #3						
Outer diameter of rotor #4	mm	107	128	158	187	230
Lengths (Rotor, without centering)	mm	45	48	49	50	60
Pitch circle diameter #5	mm	84.0	101.5	130.0	155.5	196.0

Speeds and speed measuring systems						
Speed detection (integrated)	-	without				
Speed detection (optional)	-	magn.				
Maximum Speed without speed detection system	rpm	21,000	20,000	16,000	15,000	12,000
Optional increased speed	rpm	25,000	23,000	18,000	17,000	14,000
Maximum speed with magnetic speed encoder	rpm	14,000	11,000	9,000	8,000	6,500
Maximum speed with optical speed encoder	rpm	N/A				
Maximum speed with inductive speed encoder	rpm	N/A				

Torque accuracy class per output type (related to Md _n)						
Frequency output	%	≤±0.04				
CAN output	%	≤±0.04				
Voltage output	%	≤±0.05				
Current output	%	N/A				
Frequency output (option higher accuracy)	%	N/A				
CAN (option higher accuracy)	%	N/A				

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Accuracy class	%	≤±0.04				
Rated torque (Md _n)	Nm	100 200 500	500 1,000	1,000 2,000 3,000	4,000 5,000	5,000 10,000
Linearity deviation including hysteresis related to Md _n #6						
Frequency, 0%...30%	%	≤±0.010				
Frequency, 30%...60%	%	≤±0.020				
Frequency, 60%...100%	%	≤±0.030				
CAN, 0%...30%	%	≤±0.010				
CAN, 30%...60%	%	≤±0.020				
CAN, 60%...100%	%	≤±0.030				
Voltage output	%	≤±0.05				
Current output	%	N/A				
Rel. standard deviation of the reproducibility according to DIN 1319, by reference to variation of the output signal (rel. to Md _n)						
Frequency output	%	≤±0.03				
CAN output	%	≤±0.03				
Voltage output	%	≤±0.05				
Current output	%	N/A				
Temperature influence per 10K in the nominal temperature range on the output signal related to the actual value of signal span (rel. to Md _n)						
Frequency output	%	≤±0.04				
CAN output	%	≤±0.04				
Voltage output	%	≤±0.05				
Current output	%	N/A				
Temperature influence per 10K in the nominal temperature range on the zero signal (rel. to Md _n)						
Frequency output	%	≤±0.04				
CAN output	%	≤±0.04				
Voltage output	%	≤±0.05				
Current output	%	N/A				
Long-term drift over 48h at reference temperature						
Voltage output	mV	<1.5 / <3.0 / <0.8 / <1.5				
Current output	μA	N/A				

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Accuracy class	%	≤±0.04				
Rated torque (Md _n)	Nm	100 200 500	500 1,000	1,000 2,000 3,000	4,000 5,000	5,000 10,000
Nominal sensitivity (range between zero torque and rated torque)						
Frequency output	kHz	5 / 20 / 30 / 120				
Voltage output	V	5.0 / 10.0 / 2.5 / 5.0				
Current output	mA	N/A				
Output signal at zero torque						
Frequency output	kHz	10 / 60 / 60 / 240				
Voltage output	V	0.0 / 0.0 / 2.5 / 5.0				
Current output	mA	N/A				
Nominal output signal						
Frequency output at positive nominal value	kHz	15 / 80 / 90 / 360				
Frequency output at negative nominal value	kHz	5 / 40 / 30 / 120				
Voltage output at positive nominal value	V	5 / 10 / 5 / 10				
Voltage output at negative nominal value	V	-5 / -10 / 0 / 0				
Current output at positive nominal value	mA	N/A				
Current output at negative nominal value	mA	N/A				
Max. modulation range						
Frequency output	kHz	0...420				
Voltage output	V	-12.0...12.0				
Current output	mA	N/A				
Group delay time (main TCU)						
Frequency output	μs	300				
Voltage output	μs	300				
CAN bus	μs	800				

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Rated torque (M _{dN})	Nm	100 200 500	500 1,000	1,000 2,000 3,000	4,000 5,000	5,000 10,000

Speed measuring system		Inductive (track at rotor)				
Pulse per rev (PPR)	ppr.	N/A				
Maximum speeds (related to PPR)	rpm	N/A				
Max. output frequency (RS422)	kHz	N/A				
Minimum speed for sufficient pulse stability	rpm	N/A				
Speed measuring system		Magneto resistive (2 tracks approx. 90 degree phase shifted)				
Pulses per rev (PPR)	ppr.	680	808	1,000	1,176	1,448
Maximum speeds (related to PPR)	rpm	14,000	11,000	9,000	8,000	6,500
Max. output frequency (RS422)	kHz	159	149	150	157	157
Minimum speed for sufficient pulse stability	rpm	>0.1				
Nominal clearance (sensor - pole ring)	mm	0.7				
Working airgap (sensor - pole ring)	mm	0.1...1.0				
Nominal axial displacement (rotor - stator) #7	mm	7.0				
Tolerance to nominal axial displacement (rotor - stator)	mm	±0.5				
Speed measuring system		Optical				
Pulses per rev (PPR)	ppr.	N/A				
Maximum speeds (related to PPR)	rpm	N/A				
Max. output frequency (RS422)	kHz	N/A				
Minimum speed for sufficient pulse stability	rpm	N/A				
Nominal radial displacement (rotor - stator)	mm	N/A				
Tolerated radial displacement (rotor - stator) #7	mm	N/A				
Nominal axial displacement (rotor - stator) #7	mm	N/A				
Tolerance to nominal axial displacement (rotor - stator)	mm	N/A				

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Accuracy class	%	≤±0.04				
Rated torque (M _{dN})	Nm	100 200 500	500 1,000	1,000 2,000 3,000	4,000 5,000	5,000 10,000
Angular measuring system						
Pulses per rev	ppr.	680	808	1,000	1,176	1,448
Resolution	°	0.132	0.111	0.090	0.077	0.062
Output signals	-	CAN bus, Voltage				
Measurement ranges	°	0.00...360.00 / -180.00...180.00 / -360.00...360.00 / -720.00...720.00 / -1,080.00...1,080.00 / -1,440.00...1,440.00 / -1,800.00...1,800.00				

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Accuracy class	%	≤±0.04				
Rated torque (Md _n)	Nm	100 200 500	500 1,000	1,000 2,000 3,000	4,000 5,000	5,000 10,000
Temperature ranges						
Nominal temperature range <i>(Rotor)</i>	°C	0...80				
Operating temperature range <i>(Rotor)</i> #8	°C	-20...85				
Storage temperature range <i>(Rotor)</i>	°C	-30...85				
Nominal temperature range <i>(Stator)</i>	°C	0...80				
Operating temperature range <i>(Stator)</i> #9	°C	-20...85				
Storage temperature range <i>(Stator)</i>	°C	-30...85				
Nominal temperature range <i>(TCU)</i>	°C	0...70				
Operating temperature range <i>(TCU)</i>	°C	-20...70				
Storage temperature range <i>(TCU)</i>	°C	-30...85				
Mechanical shock (EN 60068-2-27)						
Quantity	-	1,000				
Duration	ms	3				
Acceleration	m/s²	650				
Vibration load (EN 60068-2-6)						
Frequency	Hz	10...2,000				
Duration	min.	150				
Acceleration	m/s²	200				
Load limits #10						
Limit torque, related to Md _n	%	500 275 175	300	300	300	300
Breaking torque approx., related to Md _n	%	1,000 550 350	600	600	600	600
Axial limit force	kN	2.90 5.40 7.40	19.00 26.00	35.00 46.00 57.00	83.00 89.00	82.00 104.00
Lateral limit force	N	1,000.00 1,890.00 2,880.00	4,000.00 7,000.00	7,000.00 11,000.0 0 15,000.0 0	20,000.0 0 23,000.0 0	20,000.0 0 32,000.0 0
Bending limit torque	Nm	22.50 42.00 65.00	152.00 245.00	221.00 348.00 487.00	841.00 986.00	1,057.00 1,689.00

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Rated torque (M _{dN})	Nm	100 200 500	500 1,000	1,000 2,000 3,000	4,000 5,000	5,000 10,000

Mechanical values						
Torsional stiffness	kNm/rad	83 156 269	376 647	865 1,461 1,988	3,317 3,894	5,047 8,296
Angle of twist at M _{dN}	°	0.068 0.073 0.106	0.076 0.089	0.066 0.078 0.086	0.069 0.074	0.057 0.069
Axial stiffness	kN/mm	145 272 374	952 1,338	1,170 1,539 1,912	2,074 2,237	2,072 2,603
Radial stiffness	kN/mm	68 126 192	281 467	466 775 1,061	1,366 1,578	1,370 2,148
Bending stiffness	kNm/°	0.55 1.05 1.60	3.80 6.00	7.40 11.60 16.20	24.00 28.00	35.20 56.30
Deflection at axial limit force	mm	<0.03	<0.03	<0.03 <0.04 <0.04	<0.05	<0.05
Additional radial deviation at lateral limit force	mm	<0.02				
Parallel deviation at bending limit torque	mm	<0.08	<0.10	<0.10	<0.12	<0.14
Inherent frequency	Hz	1,400 1,400 1,800	N/A	N/A	N/A	N/A
Balance quality-level (DIN ISO 1949)	-	G2.5				
Inertia of rotor	kgm²	0.0010 0.0017 0.0017	0.0033 0.0034	0.0084 0.0085 0.0085	0.0188 0.0189	0.0486 0.0492
Max. limits for relative shaft vibration (peak to peak) #11	µm	$S_{(p-p)} = \frac{9000}{\sqrt{n}}$				

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Accuracy class	%	≤±0.04				
Rated torque (Md _n)	Nm	100 200 500	500 1,000	1,000 2,000 3,000	4,000 5,000	5,000 10,000
Weight approx.						
Rotor #12	kg	0.7 1.2 1.2	1.6 1.7	2.8 2.9 2.9	4.4 4.5	7.5 7.8
Stator (without speed encoder) #12	kg	0.60				
Mounting distances (without optional speed detection system)						
Nominal radial displacement (rotor - stator)	mm	3				
Tolerance to nominal radial displacement (rotor - stator)	mm	+1/-2				
Nominal axial displacement (rotor - stator) #7	mm	7				
Tolerance to nominal axial displacement (rotor - stator)	mm	≤±1				
Flatness and concentricity tolerances rotor						
Circular run-out-axial tolerance #13	mm	0.01	0.01	0.01	0.03	0.04
Circular run-out-radial tolerance #13	mm	0.01	0.01	0.01	0.03	0.04
Power supply						
Nominal supply	V	(DC) 24				
Supply range #14	V	(DC) 23...25				
Max. current consumption in measuring mode	A	<1				
Max. current consumption in start-up mode	A	<2				
Nominal power consumption	W	<24				
Load resistance						
Frequency output	-	RS422				
Voltage output	kOhm	≥50				
Dynamic						
Frequency output	kHz	≤6				
Voltage output	kHz	≤6				
Current output	kHz	N/A				
CAN output conversation rate	1/s	≤2,000				

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Rated torque (Md _n)	Nm	100 200 500	500 1,000	1,000 2,000 3,000	4,000 5,000	5,000 10,000
Miscellaneous						
Protection class (<i>Rotor</i>)	-	IP54				
Protection class (<i>Stator</i>)	-	IP54				
Protection class (rotor, extended)	-	N/A				
Protection class (stator, extended)	-	N/A				
Pitch circle screw information	-	6 * M8 (10.9) 6 * M8 (12.9) 6 * M8 (12.9)	8 * M10 (12.9)	8 * M12 (12.9)	8 * M14 (12.9)	8 * M16 (12.9)
CAN bus type	-	2B				
Configuration interface	-	Ethernet				
Central hole	mm	N/A				
Material	-	Titanium Steel Steel	Steel	Steel	Steel	Steel
Measuring range (related to Md _n)	%	110				
Compatible evaluation units (TCU)	-	TCU5				
Stator type	-	DF plus				
Sales information						
Article number	-	1000445 0 1000375 1 1000375 1	1000375 3	1000375 5	1000375 7	1000375 9
U.S. FCC certificate	-	Yes	Yes	Yes	Yes	No

Remarks and information

Link no.	Topic	Remark
#1	Nominal torque	Based on customer requests, the measurement systems can optionally be optimized for not listed nominal torque values (intermediate ranges possible).
#2	Second torque range	The written second nominal torque value ($M_{d_{ns}}$) is the smallest possible. Greater second torque ranges can be chosen on demand. Mechanical values and load limits vary between single and dual range torque meters. A data sheet for dual range torque meters with specific values can be requested.
#3	Dimensions	Mechanical dimensions are without engagement. Use the drawings and step files as master for your constructions.
#4	Details in the drawings	Value can vary by optional components. Please find details to this attribute in the integrated drawings.
#5	Pitch circle diameter	The pitch circle diameter is identically at input and output side for most systems. More information is given in the drawings of a product.
#6	Linearity	Values of Linearity deviation incl. Hysteresis can only be reached if positive and negative sensitivity values are used.
#7	Reference planes	Please check the drawings for information about the reference planes of this attribute.
#8	Temperature range (rotor)	No condensation allowed.
#9	Temperature range (stator)	No condensation allowed. Temperature related to housing ground point.
#10	Load limits	The given values are only valid if no other load occurs at the same time. If the loads in sum are 100%, the max. error will be 0.3% of the nominal torque. Limit and break torque are lower if other loads are applied (such as lateral forces).

Remarks and information

Link no.	Topic	Remark
#11	Vibration limits	Vibration limits are not an influence to the machine. They reflect the allowed effect onto the rotor (ISO 7919-3). Parameter "n" is given in "r/min".
#12	Weights	Weights are related to components without options like speed detection system. Please contact us for exact weight information of options.
#13	Flatness and concentricity tolerances	The parameters of "Flatness and concentricity tolerances rotor" are manufacturing tolerances.
#14	Supply voltage	The supply voltage range must be given at measurement system side. Long wires can reduce the voltage level from power supply to measurement system.

Drawing

