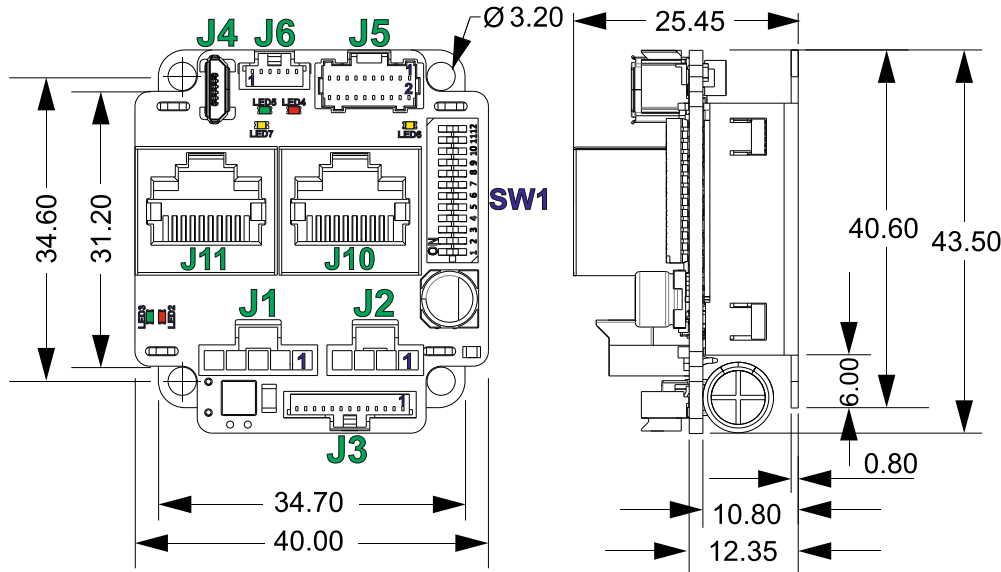




Micro 4804 CZ-CAT-STO DATASHEET P/N: P020.803.E222



All dimensions are in mm. Drawing not to scale.

Motor – sensor configurations

Sensor \ Motor	PMSM	BLDC	DC BRUSH	STEP (2-ph)	STEP (3-ph)
Incr. Encoder	Ⓢ		Ⓢ	Ⓢ	
Incr. Encoder + Dig. Hall	Ⓢ	Ⓢ			
Linear Halls	Ⓢ				
Digital Hall control only	Ⓢ				
BISS / SSI / EnDAT / TAMAGAWA / Nikon / Sanyo Denki / Panasonic	Ⓢ	Ⓢ	Ⓢ	Ⓢ	
Tacho			Ⓢ		
Open-loop (no sensor)				Ⓢ	Ⓢ

Mating Connectors

Producer	Part No.	Connector	Description
Molex	1053071205	J1	1x5 Nano-Fit, 2.50mm Pitch Nano-Fit Wire-to-Board Housing, 5 circuits
Molex	1053071204	J2	1x4 Nano-Fit, 2.50mm Pitch Nano-Fit Wire-to-Board Housing, 4 circuits
Molex	5013301300	J3	1x13 Pico-Clasp, 1.00mm Pitch Pico-Clasp Wire-to-Board Housing, 13 Circuits
Molex	5011892010	J5	2x10 Pico-Clasp, 1.00mm Pitch Pico-Clasp Wire-to-Board Housing, 20 Circuits
Molex	5013300600	J6	1x6 Pico-Clasp, 1.00mm Pitch Pico-Clasp Wire-to-Board Housing, 6 Circuits
Tensility International Corp	1002333	J4	USB cable, Cable USB A Male - Micro B Male, 1m, shielded, black, 9.6mm plastic width
Molex	0797582140	J1, J2	Pre-Crimped wires for Nano-Fit Cable Assembly, Nano-Fit Crimp Terminal Socket to Nano-Fit Crimp Terminal Socket, 300mm
Molex	0797581019	J3, J5, J6	Pre-Crimped wires for Pico-Clasp Cable Assembly, Pico-Clasp Crimp Terminal Socket to Pico-Clasp Crimp Terminal Socket, 300mm
Molex	1053001400	J1, J2	Pins for Nano-Fit Nano-Fit Crimp Terminal, Female, 0.76µm Gold (Au) Plating, Lubricated, 24-26 AWG
Molex	5011937000	J3, J5, J6	Pins for Pico-Clasp 1.00mm Pitch, Pico-Clasp Female Crimp Terminal, Gold Plating 0.10µm, 28-32 AWG, Reel
Molex	638276000	J1, J2	Crimp tool Nano Fit Crimp Tool, Ratchet, Molex Nano-Fit 105300 Series 26-24AWG Socket Contacts, 207129 Series
Molex	638191500	J3, J5, J6	Crimp tool Pico-Clasp Crimp Tool, Ratchet, Molex Pico-Clasp 501193 & 501334 Series 32-28AWG Contacts

Features

- Motion controller and drive in a single compact unit based on MotionChip™ technology
- Universal solution for control of rotary and linear brushless, brushed and 2 or 3-phase step motors
- Advanced motion control features, including CSP, CSV, CST, PVT, S-curve, electronic gearing, camming, and more.
- Motor supply: 48V nominal
 - Motor output current:
 - Nominal: 5.7A_{RMS} / 8A amplitude for PMSM motors
 - 7A for DC / BLDC / Step motors
 - Peak: 11.3A_{RMS} / 16A amplitude
- Logic supply: 24V nominal, 48V max
- Feedback Options:
 - 1 x Hall sensor interface (digital or linear)
 - Feedback#1 and Feedback#2 can be:
 - Incremental encoder A / B (index Z only for Feedback 1): differential or single-ended;
 - Absolute encoder: differential or single-ended. Supported protocols: SSI, BiSS, EnDAT, Tamagawa, Panasonic, Nikon, Sanyo Denki.
 - 1 x analogue input, 12-bit, software selectable: 0-5V or ±10V; Reference, Feedback or General purpose
 - 3 x digital inputs: 2 for limit switches + one general-purpose, NPN, pull-up on-board to +5V. Pull to GND to activate.
 - 3 x configurable I/Os, each software selectable as:
 - Digital input, NPN, with pull-up on-board to +5V. Pull to GND to activate;
 - Digital output, NPN (open-collector), with pull-up on-board to +5V. Sink current: 1 x 1.5A to drive inductive loads (such as mechanical brake), 2 x 0.1A.
 - Commissioning (set-up) possible through RS232, USB, FoE (file-over-EtherCAT) or EoE (Ethernet-over-EtherCAT)
 - EtherCAT connection: standard RJ45 ports
 - STO: 2 safe torque-off inputs, safety integrity level (SIL3/Cat3/PLe) acc. to EN61800-5-1; -2/ EN61508-3; -4/ EN ISO 13849-1.
 - 24Kwords E²ROM to store setup data, TML motion programs, cam tables and other user data
 - 16Kwords SRAM memory for data acquisition
 - Operating ambient temperature: 0-40°C (over 40°C with de-rating)
 - Programmable protections: any short-circuit between motor phases, GND and/or supply, over/under-voltage, over-current, I²t drive & motor, control error
 - >98% voltage efficiency, >98% power efficiency

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Pin	Name	Type	Description
1	A/A+	O	Phase A for 3-ph motors, A+ for 2-ph steppers, Motor+ for DC brush motors
2	B/A-	O	Phase B for 3-ph motors, A- for 2-ph steppers, Motor- for DC brush motors
3	C/B+	O	Phase C for 3-ph motors, B+ for 2-ph steppers
4	Cr/B-	O	Chopping resistor / Phase B- for 2-ph steppers
5	PE	-	Earth connection

Pin	Name	Type	Description
1	+Vmot	I	Positive terminal of the motor supply: 7 to 48 V _{DC} .
2	GND	-	Ground return.
3	+Vlog	I	Positive terminal of the logic supply input: 6 to 48 V _{DC} .
4	PE	-	Earth connection

Pin	Name	Type	Description
1	232TX	O	RS-232 Data Transmission.
2	232RX	I	RS-232 Data Reception.
3	GND	-	Ground return.
4	+Vlog	I	Positive terminal of the logic supply input: 6 to 48 V _{DC} .
5	IN2/LSP	I	5-48V digital NPN input. Positive limit switch input.
6	IN3/LSN	I	5-48V digital NPN input. Negative limit switch input.
7	I/O0	I/O	5-48V 1.5A NPN (sink) general-purpose digital programmable input IN0 or output OUT0
8	I/O1	I/O	5-48V 0.1A NPN (sink) general-purpose digital programmable input IN1 or output OUT1
9	I/O4	I/O	5-48V 0.1A NPN (sink) general-purpose digital programmable input IN4 or output OUT4
10	IN5	I	5-48V digital general-purpose NPN input
11	GND	-	Ground return.
12	AnalogIn	I	Analog input (range software selectable 0-5V or ±10V)
13	+5V	O	Supply for all feedback sensors.

Pin	Name	Type	Description
1	GND	-	Ground return.
2	Hall1 / LH1	I	Digital Hall, or Linear Hall sensor 1.
3	+5V	O	5V supply for all feedback sensors.
4	Hall2 / LH2	I	Digital Hall, or Linear Hall sensor 2.
5	+5V	O	5V supply for all feedback sensors.
6	Hall3 / LH3	I	Digital Hall, or Linear Hall sensor 3.
7	EncA1+/EncA1-Dt1+/Dt1-	I	Encoder 1 A / Data+ diff. input or single-ended input; set SW1 position 7 for differential.
8	GND	-	Ground return.
9	EncA1-/Dt1-	I	Encoder 1 A-/Data- diff. input.; set SW1 position 7 for differential.
10	+5V	O	5V supply for all feedback sensors.
11	EncB1+/EncB1-Clk1+/Clk1-	I	Encoder 1 B+ / Clock+ diff. input or single-ended input; set SW1 position 8 for differential.
12	EncA2+/EncA2-Dt2+/Dt2-	I	Incr. encoder 2 A / Data+ diff. input or single-ended input; set SW1 position 9 for differential.
13	EncB1-/Clk1-	I	Encoder 1 B- / Clock- diff. input.; set SW1 position 8 for differential.
14	EncA2-/Dt2-	I	Incr. encoder 2 A- diff. input; set SW1 position 9 for differential.
15	Z1+	I	Incr. encoder 1 Z / Z+ diff. input or single-ended input; set SW1 position 11 for differential.
16	EncB2+/EncB2-Clk2+/Clk2-	I/O	Incr. encoder 2 B+ / Clock+ diff. input or single-ended input; set SW1 position 10 for differential.
17	Z1-	I	Incr. encoder 1 Z- diff. input; set SW1 position 11 for differential.
18	EncB2-/Clk2-	I	Encoder 2 B- / Clock- diff. input; set SW1 position 10 for differential.
19	GND	-	Ground return.
20	+Vlog	I	Positive terminal of the logic supply: 6 to 48 V _{DC} .

Pin	Name	Type	Description
1	+V USB	I	USB supply.
2	USB DM	I/O	USB data-.
3	USB DP	I/O	USB data+.
4	Rsvd	-	Reserved. Do not connect.
5	GND	-	Ground return.

Pin	Name	Type	Description
1	STO2-	I	Safe Torque Off input 2, negative return (opto-isolated, 0V)
2	STO2+	I	Safe Torque Off input 2, positive input (opto-isolated, 18+40V)
3	PE	-	Earth connection
4	PE	-	Earth connection
5	STO1+	I	Safe Torque Off input 1, positive input (opto-isolated, 18+40V)
6	STO1-	I	Safe Torque Off input 1, negative return (opto-isolated, 0V)

Port	Name	Type	Description
J10	ECAT IN	I	EtherCAT standard RJ45 Ethernet IN port.
J11	ECAT OUT	O	EtherCAT standard RJ45 Ethernet OUT port.

SW1



Position	Description
1	AxisID register Bit 0.
2	AxisID register Bit 1.
3	AxisID register Bit 2.
4	AxisID register Bit 3.
5	AxisID register Bit 4.
6	AxisID register Bit 7.
7	ON = Connect an 120Ω resistor between EncA1-/Dt1- and EncA1+/EncA1/Dt1+/Dt1 feedback pins.
8	ON = Connect an 120Ω resistor between EncB1-/Clk1- and EncB1+/EncB1/Clk1+/Clk1 feedback pins.
9	ON = Connect an 120Ω resistor between EncA2-/Dt2- and EncA2+/EncA2/Dt2+/Dt2 feedback pins.
10	ON = Connect an 120Ω resistor between EncB2-/Clk2- and EncB2+/EncB2/Clk2+/Clk2 feedback pins.
11	ON = Connect an 120Ω resistor between Z1- and Z1+ feedback pins.
12	Reserved.

No.	Name	Color	Description
LED2	TML ERR	RED	Turned on when the drive detects an error condition.
LED3	TML RDY	GREEN	Lit after power-on when the drive initialization ends. Turned off when an error occurs.
LED4	ECAT ERR	RED	EtherCAT® ERROR indicator.
LED5	ECAT RUN	GREEN	EtherCAT® RUN indicator.
LED6	ECAT ACT0	YELLOW	Shows the state of the physical link and activity for ECAT IN and OUT ports.
LED7	ECAT ACT1	YELLOW	



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Electrical characteristics

All parameters measured under the following conditions (unless otherwise specified):

- $V_{LOG} = 24$ VDC; $V_{MOT} = 48$ VDC; $F_{PWM} = 20$ kHz
- Ambient temperature = 25°C (typical values) / 0°C...40°C (min/max values)
- Supplies start-up / shutdown sequence: -any-
- Load current = nominal

Operating Conditions		Min.	Typ.	Max.	Units
Ambient temperature		0		40 ¹	°C
Ambient humidity	Non-condensing	0		90	%Rh
Altitude / pressure ²	Altitude (vs. sea level)	-0.1	0 ÷ 2.5	3	Km
	Ambient Pressure	0 ²	0.75 ÷ 1	10.0	atm
Storage Conditions		Min	Typ	Max	Units
Ambient temperature		-40		100	°C
Ambient humidity	Non-condensing	0		100	%Rh
Ambient Pressure		0		10.0	atm
ESD capability (Human body model)	Not powered; applies to any accessible part			±5	kV
	Original packaging			±15	kV
Environmental Characteristics		Min.	Typ.	Max.	Units
Size (Length x Width x Height)	Global size	43.5 x 40 x 25.4			mm
		~ 1.7 x 1.6 x 1			inch
Weight		42.3			g
Cleaning agents		Dry cleaning is recommended			
Protection degree		According to IEC60529			IP20
Power dissipation	Idle (I _{MOT} = 0A)		1	1.2	W
	Full power (I _{MOT} = nominal)		2.0	2.4	
Power efficiency	Full power (I _{MOT} = nominal)		98.7		%
Voltage efficiency	f _{PWM} = 20KHz		98.3		
	f _{PWM} = 100KHz		91.4		
Surface temperature of metallic baseplate				40	°C
Mechanical Mounting		Min	Typ	Max	Units
Airflow	natural convection, closed box				
Spacing required between adjacent drives		10			mm
Spacing required above drive	For counter-connectors & cable bending	30	80		
Logic Supply Input (+V _{LOG})		Min	Typ.	Max.	Units
Supply voltage	Nominal values	6	24	48	V _{DC}
	Absolute maximum values, drive operating but outside guaranteed parameters	4.9		50	V _{DC}
	Absolute maximum values, continuous	-0.5		53	V _{DC}
Supply current	+V _{LOG} = 12V		90	150	mA
	+V _{LOG} = 24V		60	90	
	+V _{LOG} = 48V		45	60	
Utilization category		Acc. to 60947-4-1 (I _{PEAK} ≤ 1.05 * I _{NOM})			
Motor Supply Input (+V _{MOT})		Min	Typ.	Max.	Units
Supply voltage	Nominal values	7		48	V _{DC}
	Absolute maximum values, drive operating but outside guaranteed parameters	6		50	V _{DC}
	Absolute maximum values, continuous	-0.5		53	V _{DC}
Supply current	Idle		0.3		mA
	Operating	-16	±7	+16	
Voltage measurement error			±0.15	±0.25	V
Utilization category		Acc. to 60947-4-1 (I _{PEAK} ≤ 4.0 * I _{NOM})			
Supply Output (+5V)		Min.	Typ.	Max.	Units
Output voltage	Current sourced = 400mA	5.05	5.2	5.25	V
Output current	Output voltage ≥ 4.85V			1,200	mA
Short-circuit to GND protection		Yes / Drive resets at event			
Over-voltage protection		NOT protected			
ESD protection	Human body model	±1			KV
Hall Inputs (Hall1, Hall2, Hall3)		Min.	Typ.	Max.	Units
Mode compliance		TTL / CMOS / Open-collector (NPN sink), or analog (linear) 0...5V			
Default state	Input floating (Wiring disconnected)	4.5	4.8	5.2	V
Input voltage	Digital		1.5	1.7	
		3	2.5		
			0.5		
Input current	Analog	0	0.5...4.5	4.95	mA
	Logic "LOW"; Pull to GND		2.4		
	Logic "HIGH"; Internal 2.2KΩ pull-up to +5		0		
Minimum pulse width			66		µs
ESD protection - Human body model			±15		kV

Motor Outputs (A/A+, B/A-, C/B+, CR/B-)				Min.	Typ.	Max.	Units	
Nominal current	PMSM motors sinusoidal amplitude					±8	A	
	PMSM motors sinusoidal RMS					5.7	A _{RMS}	
	DC/BLDC/STEP motors continuous					7	A	
Peak current		maximum 4 seconds		-16		+16	A	
Short-circuit protection threshold					±25	±28	A	
Short-circuit protection delay				2.6		3.5	µs	
On-state voltage drop		Nominal output current; including typical mating connector contact resistance			50	70	mV	
Off-state leakage current					0.3	1	mA	
Current measurement	Accuracy (FS = Full Scale)				±1	±1.5	%FS	
	Noise (current ≤ 2A)				±4	±6	mA	
	Noise (current ≥ 2A)				±30	±50		
	Offset drift (compensated @ AxisOn)					±0.16	mA/°C	
Motor inductance (phase-to-phase)	Recommended value to avoid spurious short-circuit protection, triggered by ripple	Fast loop ³	V _{MOT}				µH	
			50µs	48V		133		
			100µs	48V		266		
			50µs	24V		66		
			100µs	24V		133		
Motor electrical time-constant (L/R)	Recommended value for ±5% current measurement error		F _{PWM} = 20 kHz		330		µs	
			F _{PWM} = 40 kHz		170			
			F _{PWM} = 60 kHz		140			
			F _{PWM} = 80 kHz		80			
			F _{PWM} = 100 kHz		66			
Digital Inputs (IN0, IN1, IN2/LSP, IN3/LSN, IN4, IN5)				Min.	Typ.	Max.	Units	
Mode compliance				NPN (sink)				
Default state		Input floating (wiring disconnected)		Logic HIGH				
Input voltage	Logic "LOW"	IN0, IN1, IN4, IN5		1.4	1.8	V		
			Logic "HIGH"	3.1	2.5			
	Hysteresis		0.9	1.1	1.4			
	Logic "LOW"			1.4	1.6			
	Logic "HIGH"		4	3.5				
	Hysteresis			0.6				
	Floating voltage (not connected)			4.7				
	Absolute maximum, continuous	IN2/LSP, IN3/LSN, IN5		-2			+80	
IN0, IN1, IN4			-0.5		V _{LOG} +0.5			
Input current	Logic "LOW"; Pulled to GND			6.5	8	mA		
	Logic "HIGH"; Pulled to +24V			0.2	0.4			
Input frequency				0		500	kHz	
Minimum pulse				1			µs	
ESD protection - Human body model				±2			kV	
Digital Outputs (OUT0, OUT1, OUT4)				Min.	Typ.	Max.	Units	
Mode compliance				NPN (sink) 24V				
Load type				Resistive, Inductive				
Default state	Not supplied (+V _{LOG} floating)			High-Z (floating)				
	Immediately after power-up			Logic "HIGH"				
Output voltage	Logic "LOW"; output current = 1.5A for OUT0/ 0.05A for OUT1, OUT4					0.4	V	
				4	4.7	5.2		
				V _{LOG}				
				-0.5		V _{LOG} +0.5		
				Absolute maximum, continuous (free-wheeling diodes to +V _{LOG} to GND)				
	Absolute maximum, surge (duration ≤ 1s) [†]	-1		V _{LOG} +1				
Output current	Logic "LOW", sink current, short duration, duty cycle ≤1%	5s max	OUT1, OUT4			0.1	A	
			OUT0			2		
		0.5s max	OUT1, OUT4			0.15		
			OUT0			2.5		
	Logic "LOW", sink current, continuous; V _{OUT} ≤ 0.4V		OUT1, OUT4			0.05		
			OUT0			1.5		
	Logic "HIGH", source current; external load to GND; V _{OUT} ≥ 2.0V					5	mA	
	Logic "HIGH", leakage current; external load to +V _{LOG} ; V _{OUT} = V _{LOG} max = 40V		V _{LOG} =24V		0.18	0.2	mA	
			V _{LOG} =48V		0.42	0.45		
Minimum pulse width				0.5			µs	
ESD protection - Human body model				±25			kV	

¹ Operating temperature at higher temperatures is possible with reduced current and power ratings
² Micro 4804 can be operated in vacuum (no altitude restriction), but at altitudes over 2,500m, current and power rating are reduced due to thermal dissipation efficiency.

³ Fast loop period of 50µs is not possible with all feedback device types.

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Encoder Inputs (A1+, A1-, B1+, B1-, Z1+, Z1-, A2+, A2-, B2+, B2-) ¹		Min.	Typ.	Max	Units
Single-ended mode compliance	Leave A1-, B1-, Z1-, A2-, B2- floating	TTL / CMOS / Open-collector (NPN sink)			
Single-ended threshold	A1+, B1+, Z1+, A2+, B2+	1.3	1.4	1.5	V
Single-ended input current	Input pulled to GND against on-board 2.2 K Ω pull-up to +5V		2.4	2.7	mA
Differential mode compliance	For full RS422 compliance, see ¹	TIA/EIA-422-A			
Input voltage	Hysteresis	± 0.03	± 0.05	± 0.2	V
	Differential mode	-15		+15	
	Common-mode range (A+ to GND, etc.)	-7		+12	
Input impedance, differential	Common-mode (A1+ to GND, etc.)		2.2		k Ω
	Differential (A1+ to A1-, etc.)		4.4		
Input frequency	Differential mode	0		15	MHz
Minimum pulse width	Differential mode	33			ns
ESD protection	Human body model	± 30			kV
RS-232		Min.	Typ.	Max.	Units
Compliance		TIA/EIA-232-C			
Bit rate	Default	9600			Baud
	Software selectable	9600		115200	
Output voltage		± 5	± 5.7		V
Short-circuit	232TX to GND	Guaranteed			
Input voltage	Absolute maximum, continuous	-30		+30	V
ESD protection	Human body model	± 15			kV
EtherCAT®		Min.	Typ.	Max.	Units
Compliance		IEEE802.3, IEC61158			
Software protocols compatibility		CoE, FoE, EoE, IEC61800-7-301			
Transmission line	According to TIA/EIA-568-5-A	5 UTP	5e FTP	6 STP	Category Shield
Auto	swap + / - inside a pair	Yes (MLT3 encoding)			
	swap Rx / Tx pairs	Yes (auto-MDI/MDIX)			
	Swap port0(IN) / port1(OUT)	NO (EtherCAT requirement)			
Configured Station Alias (using AxisID)		0+31 and 128+159			-
ESD protection	Human body model	± 5			kV
Absolute encoder interface: SSI, BiSS-C, EnDAT, Tamagawa, Nikon, Sanyo Denki		Min	Typ.	Max	Units
Single-ended mode	Not recommended, reduced robustness & speed				
Differential mode compliance	For full RS422 compliance, see ¹	TIA/EIA-422-A			
Output voltage	Differential; 50 Ω differential load	1.5	3.3		V
	Common-mode, referenced to GND	1	1.7	3	
CLOCK frequency	Nikon, Sanyo Denki	2.5, 4			MHz
	Panasonic, Tamagawa	2.5			
	All others	1, 2, 3, 4			
Output Short- circuit protection	Common-mode voltage $\pm 15V$	Yes, protected			
DATA format	Software selectable	Binary / Gray			
		Single-turn / Multi-turn			
		Counting direction			
		CRC type			
DATA resolution	Including CRC, flags, ...			64	Bits
	If total resolution >31 bits, some bits must be ignored by software setting to achieve a max. 31 bits resolution				

Analog Input (REF/ FDBK)		Min	Typ.	Max	Units
Input voltage	Operational range	0...5, -10...+10			
	Absolute maximum values, continuous	-22		+26	V
	Absolute maximum, surge (duration $\leq 1s$)			± 38	
Input impedance	To 1.44V		20		k Ω
Bandwidth (-3dB)	Software selectable	0		5.3	kHz
Resolution			12		bits
Integral linearity				± 1	bits
Offset error	Range -10V ... +10V		± 10	± 30	mV
	Range 0 ... +5V		± 15	± 40	
Gain error	Range -10V ... +10V		± 30	± 50	
	Range 0 ... +5V		± 25	± 40	
ESD protection	Human body model	± 1.5			kV
Safe Torque Off (STO) Inputs		Min.	Typ.	Max.	Units
Safety Integrity Level		SIL 3			
Performance Level		PL e			
Safety Category		Cat 3			
Reaction time				30	ms
Ignored diagnostic pulses	Duration			5	ms
	Repetition rate			20	Hz
MTTFd			377		years
DC			90		%
PFH			8E-10		hours
Lifetime			20		years
V _{Log}		SELV or PELV			
Pollution Degree	External power supply			2	-
	Cabinet / Housing	IP54			-
STO wiring	Bundling / Grouping	Separate wiring for STO1, STO2			
	Shielding	Separate shield for STO1, STO2			
Compatibility	Each STO channels has separate + and - terminals	PNP (source) or NPN (sink), depending on user connection			
Isolation		Each STO channel is opto-isolated			
Voltage, STOx+ to STOx-	Inactive (torque off)		0	5.6	V
	Active (motor driven)	18	24		V
	Abs. maximum, continuous	-70		+70	V
Voltage	Isolation, STO1 to STO2	± 2			KV
	Isolation, STOx to GND	± 2			KV
Current	STOx+ - STOx- = 24V		3	5	mA
ESD protection	Human body model	± 30			kV

[†] Stresses beyond values listed under "absolute maximum ratings" may cause permanent damage to the device. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

¹ Full RS-422 compatibility, as well as noise rejection improvement requires an external 120 Ω resistor connected across each signal pair (A1+/A1-, B1+/B1-, Z1+/Z1-, A2+/A2-, B2+/B2-)

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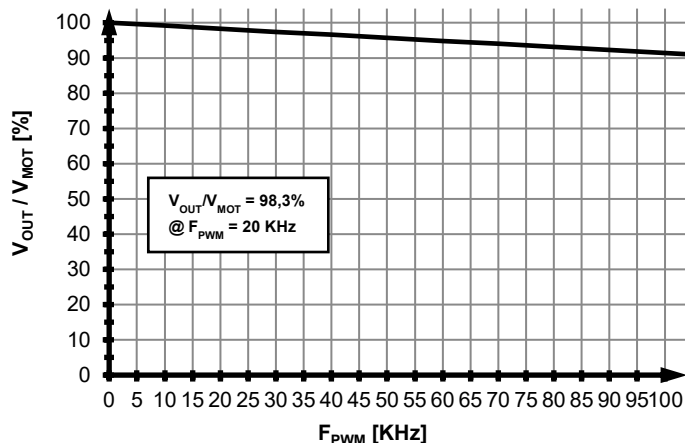


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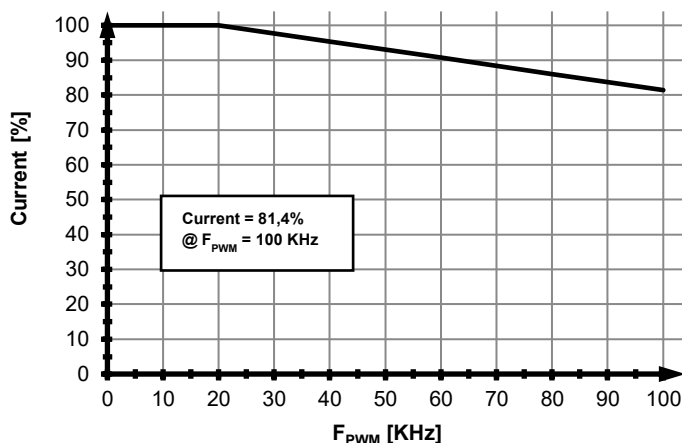
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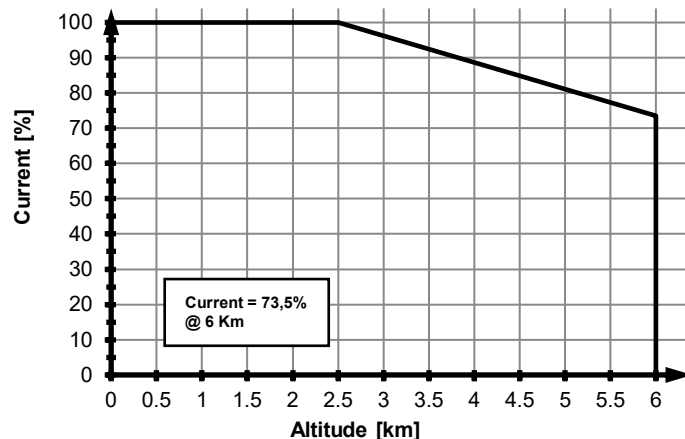
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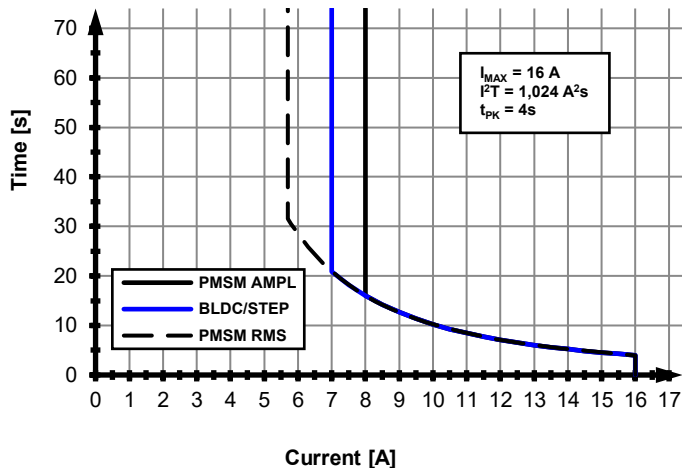
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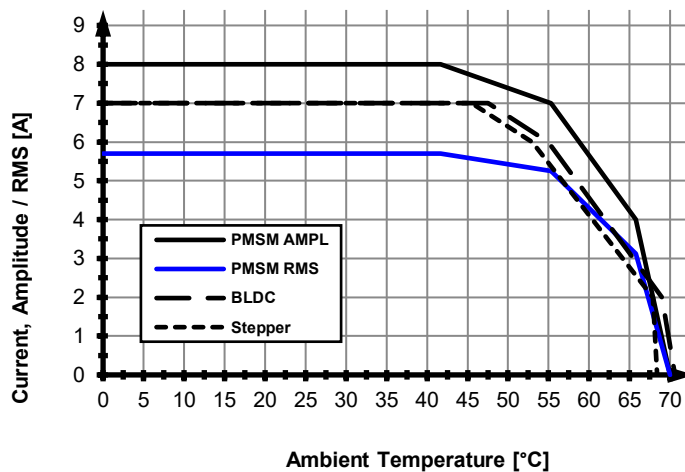
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