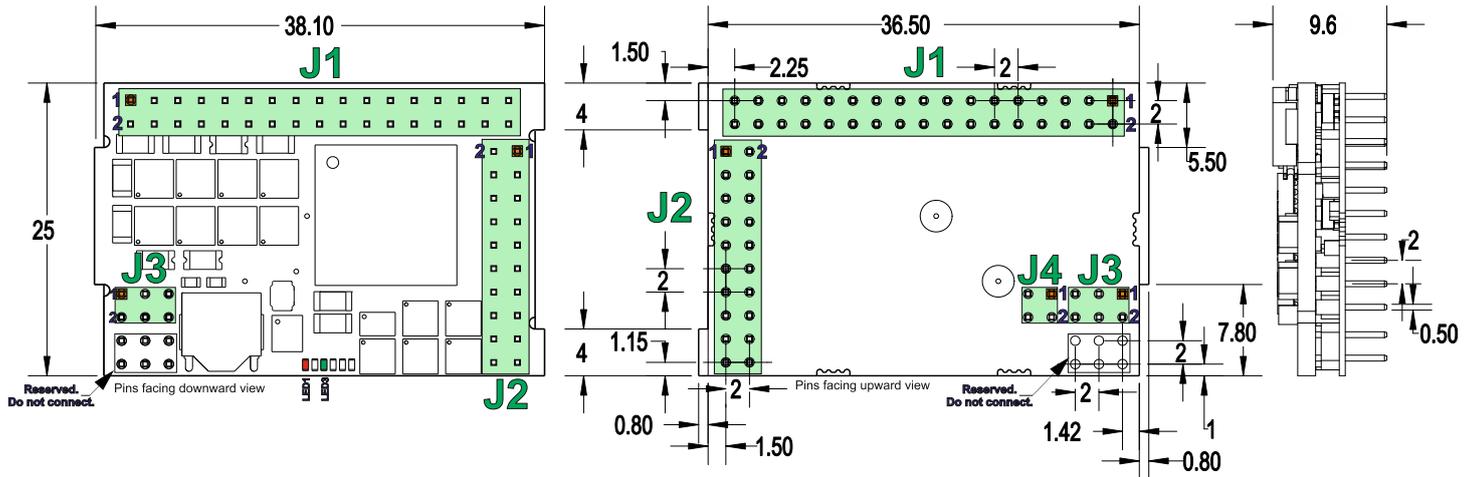


# Micro 4804 MZ-CAN-STO DATASHEET P/N: P020.003.E102



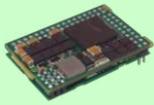
All dimensions are in mm. Drawing not to scale.

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
Samtec	SQW-117-01-F-D(-VS)	J1	2x17, 2.0mm THT (SMD) socket
	CLT-117-02-F-D		2x17, 2.0mm SMD pass-through socket
	SQW-110-01-F-D(-VS)	J2	2x10, 2.0mm THT (SMD) socket
	CLT-110-02-F-D		2x10, 2.0mm SMD pass-through socket
	SQW-103-01-F-D(-VS)	J3	2x3, 2.0mm THT (SMD) socket
	CLT-103-02-F-D		2x3, 2.0mm SMD pass-through socket
	SQW-102-01-F-D(-VS)	J4	2x2, 2.0mm THT (SMD) socket
	CLT-102-02-F-D		2x2, 2.0mm SMD pass-through socket

- **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: 4.5A<sub>RMS</sub> / 6.3A amplitude for PMSM motors
  - 5.5A for DC / BLDC / Step motors
  - Peak: 11.3A<sub>RMS</sub> / 16A amplitude
- Logic supply: 24V nominal, 48V max
- Feedback#1 and Feedback#2 can be:
  - 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 50mA.
- Communication interfaces: RS232; USB; TMLCAN and CANopen (CiA 301 v4.2, CiA 305 v.2.2.13 and CiA 402 v3.0) protocols
- 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 E<sup>2</sup>ROM 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, I<sup>2</sup>t drive & motor, control error
- 3 AxisID inputs, for hardware-based address setting
- >98% voltage efficiency, >98% power efficiency

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# Micro 4804 MZ-CAN-STO DATASHEET P/N: P020.003.E102

Pin	Name	Type	Description
1	+Vlog	I	Positive terminal of the logic supply input: 6 to 48 V <sub>DC</sub>
2	A/A+	O	Phase A for 3-ph motors, A+ for 2-ph steppers, Motor+ for DC brush motors
3	GND	-	Ground return for logic supply
4	B/A-	O	Phase B for 3-ph motors, A- for 2-ph steppers, Motor- for DC brush motors
5	GND	-	Ground return for motor supply & shield for motor windings cable
6	C/B+	O	Phase C for 3-ph motors, B+ for 2-ph steppers
7	+Vm <sub>ot</sub>	I	Positive terminal of the motor supply: 7 to 48 VDC
8	Cr/B-	O	Chopping resistor / Phase B- for 2-ph steppers
9	BFS	I	Boot Fail-Safe: Connect to GND to reprogram firmware in the improbable case when a power loss occurs during a firmware update and the normal firmware recovery fails
10	ID2	I	AxisID2 selection pin. See AxisID register settings table.
11	...	-	Reserved. Do not connect.
14	...	-	Reserved. Do not connect.
15	GND	-	Ground return and shield
16	GND	-	Ground return and shield
17	...	-	Reserved. Do not connect.
20	...	-	Reserved. Do not connect.
21	ID0	I	AxisID0 selection pin. See AxisID register settings table.
22	ID1	I	AxisID1 selection pin. See AxisID register settings table.
23	232TX	O	RS-232 Data Transmission.
24	232RX	I	RS-232 Data Reception.
25	CAN Hi	O	CAN-Bus positive line (dominant high)
26	CAN Lo	I	CAN-Bus negative line (dominant low)
27	IN2/LSP	I	5-48V digital NPN input. Positive limit switch input
28	IN3/LSN	I	5-48V digital NPN input. Negative limit switch input
29	IN5	I	5-48V digital general-purpose NPN input
30	I/O0	I/O	5-48V 1.5A NPN (sink) general-purpose digital programmable output OUT0 or input IN0
31	I/O1	I/O	5-48V 50mA NPN (sink) general-purpose digital programmable output OUT1 or input IN1
32	I/O4	I/O	5-48V 50mA NPN (sink) general-purpose digital programmable output OUT4 or input IN4
33	GND	-	Ground return and shield
34	AnalogIn	I	Analog input (range software selectable 0-5V or ±10V)

Pin	Name	Type	Description
1, 2	Reserved.	-	Reserved. Do not connect.
3	TML RDY	O	Lit after power-on when the drive initialization ends. Turned off when an error occurs. Active high, LV-TTL.
4	TML ERR	O	Turned on when the drive detects an error condition. Active high, LV-TTL.
5, 6	Reserved.	-	Reserved. Do not connect.

Pin	Name	Type	Description
1	STO1+	I	Safe Torque Off input 1, positive input (opto-isolated, 18+40V) Apply between both STO1+, STO2+ and return (opto-isolated, 0V)
2	STO2-	I	Safe Torque Off input 2, negative return (opto-isolated, 0V)
3	STO1-	I	Safe Torque Off input 1, negative from SELV/ PELV power supply for motor
4	STO2+	I	Safe Torque Off input 2, positive PWM output operation input (opto-isolated, 18+40V)

No.	Name	Color	Description
LED1	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.

Pin	Name	Type	Description
1	+V USB	I	USB 5V detect input
2	GND	-	Ground return for USB
3	Hall1	I	Digital Hall, or Linear Hall sensor 1
4	Hall2	I	Digital Hall, or Linear Hall sensor 2
5	Hall3	I	Digital Hall, or Linear Hall sensor 3
6	GND	-	Ground return and shield
7	+5V	O	Supply for all feedback sensors
8	GND	-	Ground return and shield
9	EncA1+/EncA1/Dt1+/Dt1	I	Encoder 1 A+/Data+ diff. input or single-ended input
10	EncA1-/Dt1-	I	Encoder 1 A-/Data- diff. input. Leave open for single-ended; Add externally 120Ω to pin 9 for differential
11	EncB1+/EncB1/Clk1+/Clk1	I	Encoder 1 B+/Clock+ diff. input or single-ended input
12	EncB1-/Clk1-	I	Encoder 1 B-/Clock- diff. input. Leave open for single-ended; Add externally 120Ω to pin 11 for differential
13	EncA2+/EncA2/Dt2+/Dt2	I	Encoder 2 A+/Data+ diff. input or single-ended input
14	EncA2-/Dt2-	I	Encoder 2 A-/Data- diff. input. Leave open for single-ended; Add externally 120Ω to pin 13 for differential
15	EncB2+/EncB2/Clk2+/Clk2	I/O	Encoder 2 B+/Clock+ diff. input or single-ended input
16	EncB2-/Clk2-	I	Encoder 2 B-/Clock- diff. input. Leave open for single-ended; Add externally 120Ω to pin 15 for differential
17	Z1+	I	Encoder 1 Z+ diff. input or single-ended input
18	Z1-	I	Encoder 1 Z- diff. input. Leave open for single-ended; Add externally 120Ω to pin 17 for differential
19	USB DM	I/O	USB data-
20	USB DP	I/O	USB data+

## MSB AxisID register LSB

ID2		ID1		ID0
Nominal[V]	Minimum[V]	Maximum[V]	IDx* Bits	IDx* Value
0.000	0.00	0.53	000	0
1.06	0.53	1.41	001	1
1.76	1.41	2.01	010	2
2.25	2.01	2.43	011	3
2.60	2.43	2.75	100	4
2.89	2.75	3.01	101	5
3.13	3.01	3.22	110	6
3.32	3.22	3.30	111	7

### Remarks:

- If Bit 7 (ID2) = 1 -> TMLCAN mode is selected
- If Bit 7 (ID2) = 0 -> CANopen mode is selected
- Bit 8 (MSB of ID2) is ignored, and always considered as "0"
- The maximum AxisID value is 127 (Bit 0 ... Bit 6)
- TMLCAN mode:  $AxisID = (64 * ID2\_Value - 128) + (8 * ID1\_Value) + ID0\_Value$
- CANopen mode:  $AxisID = (64 * ID2\_Value) + (8 * ID1\_Value) + ID0\_Value$
- If all "IDx" pins are left not connected or connected to GND, the AxisID value is 255 and CANopen mode is selected. In this case, the drive will be in "LSS inactive" state and the Green LED will flash at 1 second intervals

\* where "x" can be 0, 1 or 2

### Electrical characteristics

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

- V<sub>LOG</sub> = 24 VDC; V<sub>MOT</sub> = 48 VDC; F<sub>PWM</sub> = 20 kHz
- Ambient temperature = 25°C (typical values) / 0°C...40°C (min/max values)
- Supplies start-up / shutdown sequence: -any-
- Load current = nominal

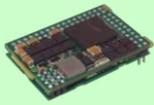
Operating Conditions		Min.	Typ.	Max.	Units
Ambient temperature		0		40 <sup>1,2</sup>	°C
Ambient humidity		0		90	%Rh
Altitude / pressure <sup>3</sup>		-0.1	0 ± 2.5	3	Km
		0 <sup>2</sup>	0.75 ± 1	10.0	atm

<sup>1</sup> Operating temperature at higher temperatures is possible with reduced current and power ratings  
<sup>2</sup> In case of forced cooling (conduction or ventilation): a) the ambient temperature requirements may be extended substantially as long as the drive (PCB) temperature is kept below 85 °C; b) the

spacing requirements can be dropped down to zero; c) the surface temperature will decrease accordingly

<sup>3</sup> 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.

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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			±0.5	kV
	Original packaging			±15	kV
Mechanical Mounting		Min	Typ	Max	Units
Airflow		natural convection <sup>1</sup> , closed box			
Spacing required for horizontal mounting <sup>1</sup>	Between adjacent drives		10		mm
	Between drives and nearby walls		10		mm
	Space needed for drive removal		20		mm
Between drives and roof-top			30		mm
Insertion force	Using recommended mating connectors			40	N
Extraction force		8			N
Environmental Characteristics		Min.	Typ.	Max.	Units
Size (Length x Width x Height)	Global size	38.1 x 25 x 9.6			mm
		~1.5 x 1 x 0.4			inch
Weight		12			g
Cleaning agents	Dry cleaning is recommended	Only Water- or Alcohol-based			
Protection degree	According to IEC60529	IP20			
Power dissipation	Idle (I <sub>MOT</sub> = 0A)		1	1.2	W
	Full power (I <sub>MOT</sub> = nominal)		2.0	2.4	W
Power efficiency	Full power (I <sub>MOT</sub> = nominal)		98.7		%
	f <sub>PWM</sub> = 20KHz		98.3		%
Voltage efficiency	f <sub>PWM</sub> = 100KHz		91.4		%
	Idle (I <sub>MOT</sub> = 0A)		55		%
Surface temperature <sup>1</sup>	Full power (I <sub>MOT</sub> = nominal)			100	°C
					°C
Logic Supply Input (+V <sub>LOG</sub> )		Min	Typ.	Max.	Units
Supply voltage	Nominal values	6	24	48	V <sub>DC</sub>
	Absolute maximum values, drive operating but outside guaranteed parameters	4.9		57	V <sub>DC</sub>
	Absolute maximum values, continuous	-0.5		58	V <sub>DC</sub>
Supply current	+V <sub>LOG</sub> = 12V		90	150	mA
	+V <sub>LOG</sub> = 24V		60	90	mA
	+V <sub>LOG</sub> = 48V		45	60	mA
Utilization category	Acc. to 60947-4-1 (I <sub>PEAK</sub> ≤ 1.05 * I <sub>NOM</sub> )	DC-1			
Motor Supply Input (+V <sub>MOT</sub> )		Min	Typ.	Max.	Units
Supply voltage	Nominal values	7		48	V <sub>DC</sub>
	Absolute maximum values, drive operating but outside guaranteed parameters	6		57	V <sub>DC</sub>
	Absolute maximum values, continuous	-0.5		58	V <sub>DC</sub>
Supply current	Idle		0.3		mA
	Operating	-16	±7	+16	A
Voltage measurement error			±0.15	±0.25	V
Utilization category	Acc. to 60947-4-1 (I <sub>PEAK</sub> ≤ 4.0 * I <sub>NOM</sub> )	DC-3			
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
	Digital				V
Input voltage	Logic "LOW"		1.5	1.7	
	Logic "HIGH"	3	2.5		
	Hysteresis		0.5		
Input current	Analog	0	0.5...4.5	4.95	mA
	Logic "LOW"; Pull to GND		2.4		mA
Minimum pulse width	Logic "HIGH"; Internal 2.2KΩ pull-up to +5		0		μs
			66		μs
ESD protection - Human body model		±15			kV
RS-232		Min.	Typ.	Max.	Units
Compliance		TIA/EIA-232-C			
Bit rate	Default	9600			Baud
	Software selectable	9600		115200	Baud
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

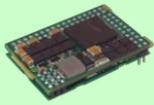
Motor Outputs (A/A+, B/A-, C/B+, CR/B-)		Min.	Typ.	Max.	Units
Nominal current <sup>2</sup>	PMSM motors sinusoidal amplitude			±6.3	A
	PMSM motors sinusoidal RMS			4.5	A <sub>RMS</sub>
	DC/BLDC/STEP motors continuous			5.5	A
Peak current	maximum 4 seconds	-16		+16	A
Short-circuit protection threshold			±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	mA
	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 <sup>3</sup> V <sub>MOT</sub>			μH
		50μs 48V	133		
		100μs 48V	266		
		50μs 24V	66		
Motor electrical time-constant (L/R)	Recommended value for ±5% current measurement error	F <sub>PWM</sub> = 20 kHz		330	μs
		F <sub>PWM</sub> = 40 kHz		170	
		F <sub>PWM</sub> = 60 kHz		140	
		F <sub>PWM</sub> = 80 kHz		80	
	F <sub>PWM</sub> = 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)			
Input voltage	Logic "LOW"		1.4	1.8	V
	Logic "HIGH"	IN0, IN1, IN4, IN5	3.1	2.5	
	Hysteresis		0.9	1.1	
	Logic "LOW"			1.4	
	Logic "HIGH"	IN2/LSP, IN3/LSN	4	3.5	
	Hysteresis			0.6	
	Floating voltage (not connected)			4.7	
Input current	Absolute maximum, continuous	IN2/LSP, IN3/LSN, IN5	-2	+80	
	Logic "LOW"; Pulled to GND	IN0, IN1, IN4	-0.5	V <sub>LOG</sub> +0.5	
Input frequency	Logic "HIGH"; Pulled to +24V		6.5	8	
			0.2	0.4	
Minimum pulse			0	500	kHz
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 <sub>LOG</sub> 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
	Logic "HIGH"; output current = 0, no load	4	4.7	5.2	
	Logic "HIGH", external load to +V <sub>LOG</sub>		V <sub>LOG</sub>		
	Absolute maximum, continuous (free-wheeling diodes to +V <sub>LOG</sub> to GND)	-0.5		V <sub>LOG</sub> +0.5	
	Absolute maximum, surge (duration ≤ 1s) <sup>†</sup>	-1		V <sub>LOG</sub> +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 <sub>OUT</sub> ≤ 0.4V	OUT1, OUT4	0.05		
		OUT0	1.5		
Logic "HIGH", source current; external load to GND; V <sub>OUT</sub> ≥ 2.0V			5	mA	
Logic "HIGH", leakage current; external load to +V <sub>LOG</sub> ; V <sub>OUT</sub> = V <sub>LOG</sub> max = 40V	V <sub>LOG</sub> =24V	0.18	0.2	mA	
	V <sub>LOG</sub> =48V	0.42	0.45		
Minimum pulse width			0.5		μs
ESD protection - Human body model			±25		kV

<sup>1</sup> In case of forced cooling (conduction or ventilation): a) the ambient temperature requirements may be extended substantially as long as the drive (PCB) temperature is kept below 85 °C; b) the spacing requirements can be dropped down to zero; c) the surface temperature will decrease accordingly

<sup>2</sup> For current values >4A<sub>RMS</sub>, pins J1/2...8 may need to be soldered instead of socketed, for long-term reliability – check socket manufacturer specifications.

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

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# Micro 4804 MZ-CAN-STO DATASHEET P/N: P020.003.E102

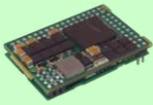
Encoder Inputs (A1+, A1-, B1+, B1-, Z1+, Z1-, A2+, A2-, B2+, B2-) <sup>1</sup>		Min.	Typ.	Max	Units
Single-ended mode compliance	Leave A1-, B1-, Z1-, A2-, B2- floating	TTL / CMOS / Open-collector (NPN sink)			
Single-ended threshold	A1+, B1+, Z1+, A2+, B2+	1.3	1.4	1.5	V
Single-ended input current	Input pulled to GND against on-board 2.2 KΩ pull-up to +5V		2.4	2.7	mA
Differential mode compliance	For full RS422 compliance, see <sup>1</sup>	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		kΩ
	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
<b>Absolute encoder interface: SSI, BiSS-C, EnDAT, Tamagawa, Nikon, Sanyo Denki</b>					
Single-ended mode		Not recommended, reduced robustness & speed			
Differential mode compliance	For full RS422 compliance, see <sup>1</sup>	TIA/EIA-422-A			
Output voltage	Differential; 50Ω 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 ±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				
<b>Analog Input (REF/ FDBK)</b>		Min	Typ.	Max	Units
Input voltage	Operational range	0...5, -10...+10			
	Absolute maximum values, continuous	-22		+26	V
	Absolute maximum, surge (duration ≤ 1s)			±38	
Input impedance	To 1.44V		20	kΩ	
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	
	Range -10V ... +10V		±30	±50	
Gain error	Range -10V ... +10V		±25	±40	kV
	Range 0 ... +5V		±1.5		
ESD protection	Human body model	±10			kV
<b>CAN-Bus</b>		Min.	Typ.	Max.	Units
Compliance	CAN 2.0B, ISO 11898-2				
Software protocols compatibility	CiA301, CiA305, CiA402, TechnoCAN, TMLcan				
Bit rate	Software selectable	125, 250, 500, 1000			KBaud
Node addressing	TMLcan	1 ÷ 255			
	CANopen	not configured, 1 ÷ 127			
Voltage	Common-mode, operating	-12		+12	V
	Common-mode, max. continuous	-58		+58	V
	Differential, max. continuous	-45		+45	V
Input impedance	Differential	40		90	kΩ
	Common-mode	20		45	kΩ
Termination resistor (120Ω)	NOT included				
ESD protection	Human body model	±10			kV

AxisID inputs		Min.	Typ.	Max.	Units
Default state	ID1, ID1, ID2 floating	Configured Station Alias = 0, AxisID=255			
Internal pull-down to GND		95	100	105	kΩ
ESD protection	Human body model		±250		V
<b>LED outputs</b>		Min.	Typ.	Max.	Units
Polarity	Active high (high=LED lit)				
	Common cathode to GND				
Voltage	$I_{OH} \leq 0.9mA$	2.9	3.3		V
	$I_{OH} \leq 1.5mA$	2.4			V
	$I_{OL} \leq 2.0mA$		0	0.4	V
	Abs. max., continuous	-0.5		3.8	V
Current	Sink ( $I_{OL}$ ) current larger than source ( $I_{OH}$ ) current	-2.0		+1.5	mA
Short-circuit protection		NOT protected			
ESD protection	Human body model		±250		V
<b>BFS input</b>		Min.	Typ.	Max.	Units
Polarity	Active Low (0=fail-safe boot, 1=normal)				
Default state	BFS floating	High			
Voltage	Logic low (active)		0	1.1	V
	Logic high (inactive)	2.0	3.3		V
	Abs. max., continuous	-0.5		3.8	V
Current	Logic low (2.2KΩ pull to +3.3V)		1.5	1.6	mA
	Logic high		0		mA
ESD protection	Human body model	±250			V
<b>Safe Torque Off (STO) Inputs</b>		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 <sub>LOG</sub>	External power supply	SELV or PELV			
Pollution Degree	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, STO+ to STO-	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

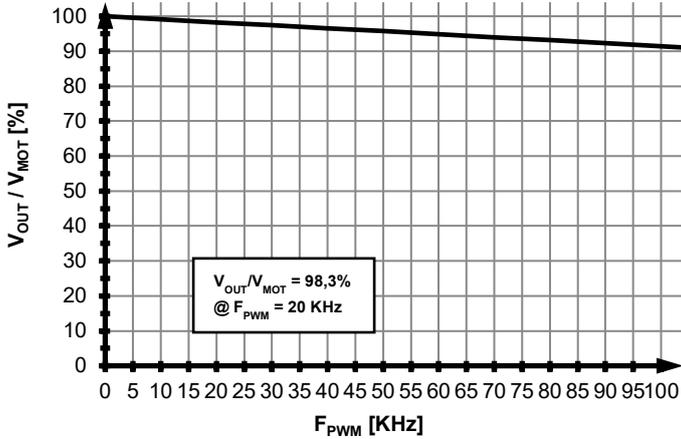
† Stresses beyond values listed under "absolute maximum ratings" may cause permanent damage to the device. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

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

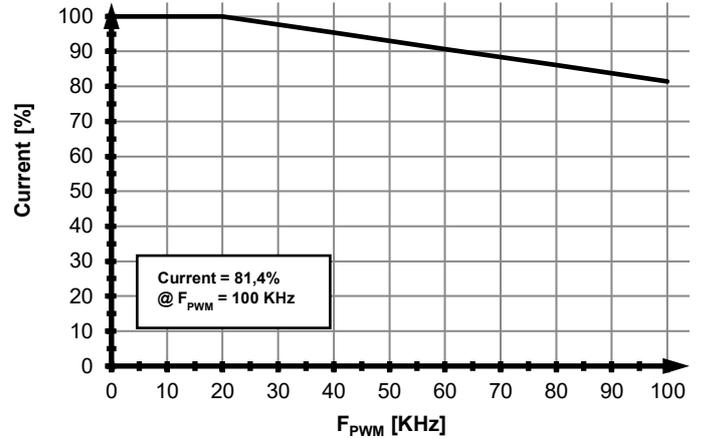
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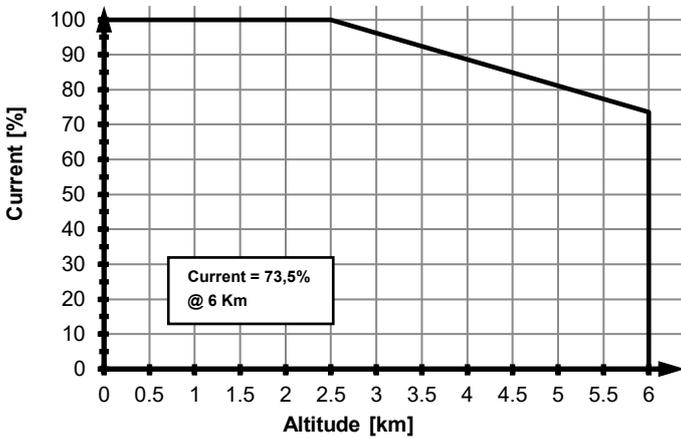
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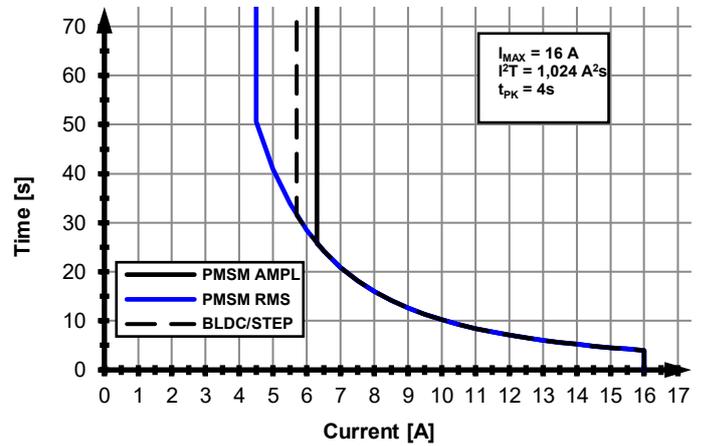
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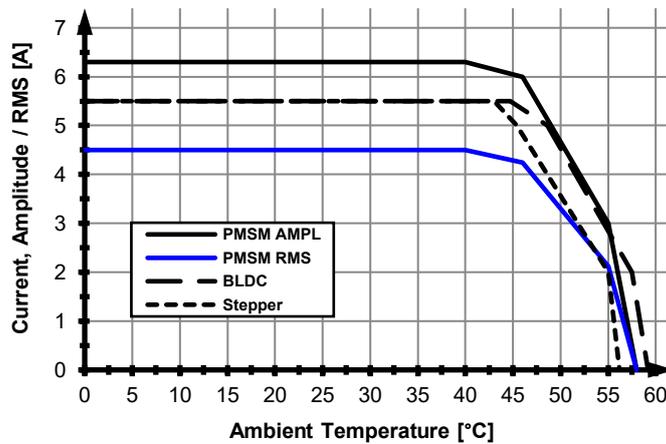
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