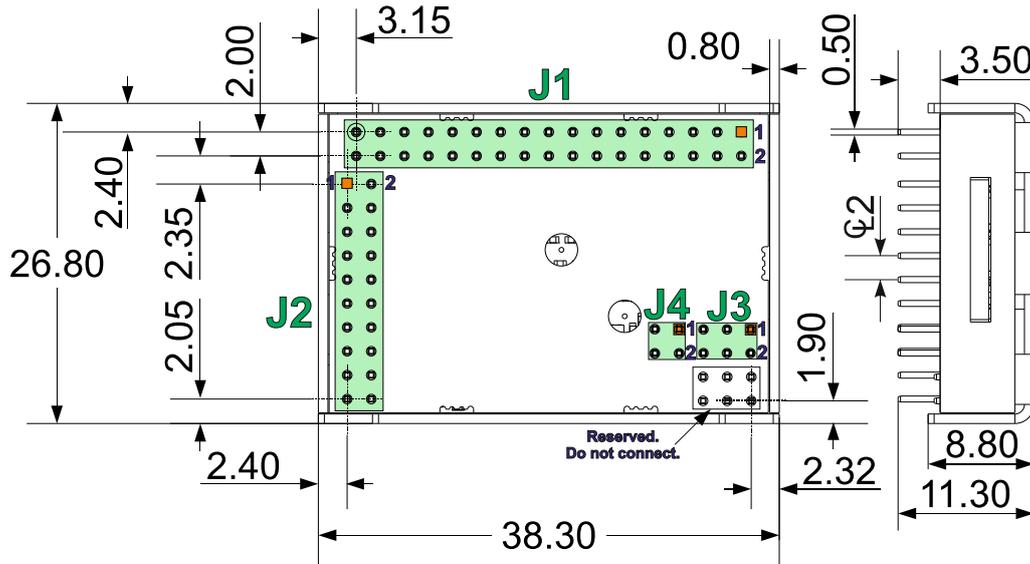




Micro 4804 PZ-CAT-STO DATASHEET P/N: P020.003.E322



All dimensions are in mm. Drawing not to scale. Pins facing upward view.

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: 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 50mA.
- Commissioning (set-up) possible through RS232, USB, FoE (file-over-EtherCAT) or EoE (Ethernet-over-EtherCAT)
- EtherCAT connection to standard RJ45: requires external magnetics (may be integrated into RJ45)
- 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
- 3 AxisID inputs, for hardware-based address setting
- >98% voltage efficiency, >98% power efficiency

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Pin	Name	Type	Description
1	+Vlog	I	Positive terminal of the logic supply input: 6 to 48 V _{DC}
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	+Vmot	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	-	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	TX1-	I/O	Transmit/Receive negative, OUT port. Connect to magnetics PHY TX1 or directly to nearby RX0-
12	RX1-	I/O	Receive/Transmit negative, OUT port. Connect to magnetics PHY RX1 or directly to nearby TX0-
13	TX1+	I/O	Transmit/Receive positive, OUT port. Connect to magnetics PHY TX1 or directly to nearby RX0+
14	RX1+	I/O	Receive/Transmit positive, OUT port. Connect to magnetics PHY RX1 or directly to nearby TX0+
15	GND1*	-	Ground shield & center-tap for ECAT magnetics port 1
16	GND0*	-	Ground shield & center-tap for ECAT magnetics port 0
17	TX0-	I/O	Transmit/Receive negative, IN port. Connect to magnetics PHY TX0 or directly to nearby RX1-
18	RX0-	I/O	Receive/Transmit negative, IN port. Connect to magnetics PHY RX0 or directly to nearby TX1-
19	TX0+	I/O	Transmit/Receive positive, IN port. Connect to magnetics PHY TX0 or directly to nearby RX1+
20	RX0+	I/O	Receive/Transmit positive, IN port. Connect to magnetics PHY RX0 or directly to nearby TX1+
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	...	Rsvd.	Reserved. Do not connect.
26			
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)

* GND0, GND1, and all other GND pins are internally connected within the drive. However, it is strongly recommended to reserve GND0 and GND1 exclusively for EtherCAT-related functions, and avoid using them for any other purposes.

Pin	Name	Type	Description
1	ECAT ACT0	O	Shows the state of the physical link and activity for ECAT IN port. Active high, LV-TTL.
2	ECAT ACT1	O	Shows the state of the physical link and activity for ECAT OUT port. Active high, LV-TTL.
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	ECAT RUN	O	EtherCAT® RUN indicator. Active high, LV-TTL.
6	ECAT ERR	O	EtherCAT® ERROR indicator. Active high, LV-TTL.

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+

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

Apply between both STO1+, STO2+ and STO1-, STO2- 24V DC from SELV/PELV power supply for motor PWM output operation

AxisID register									
MSB	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	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				

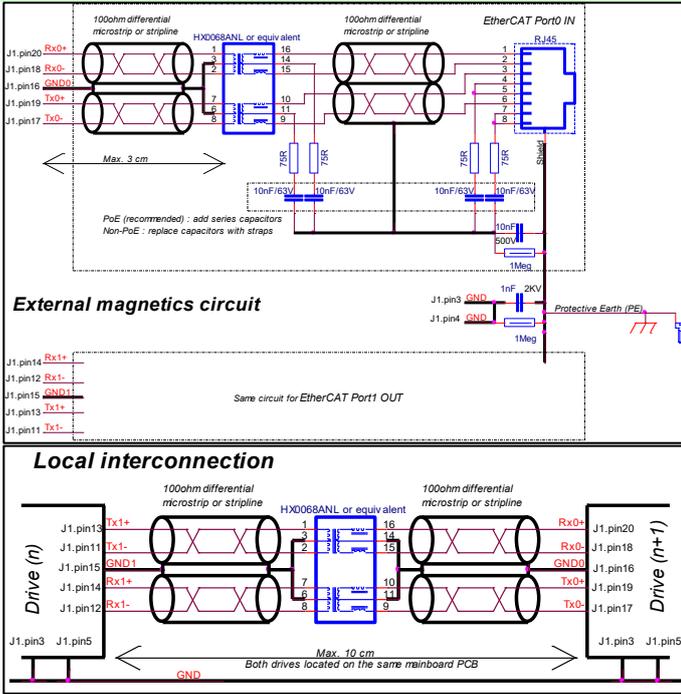
Remarks:
 1. $AxisID = (64 * ID2_Value) + (8 * ID1_Value) + ID0_Value$
 2. If all "IDx" pins are left not connected or connected to GND, the AxisID value is 255 and the EtherCAT register called "configured station alias" will be 0.
 3. Bit 8 (MSB of ID2) is ignored, and always considered as "0"
 * where "x" can be 0, 1 or 2

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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, 2}	°C
Ambient humidity	Non-condensing	0		90	%Rh
Altitude / pressure ³	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	38.3 x 26.8 x 11.3			mm
		~1.5 x 1.1 x 0.45			inch
Weight		26			g
Cleaning agents	Dry cleaning is recommended	Only Water- or Alcohol- based			
Protection degree	According to IEC60529	IP20			-
Power dissipation	Idle ($I_{MOT} = 0A$)		1	1.2	W
	Full power ($I_{MOT} = \text{nominal}$)		2.0	2.4	
Power efficiency	Full power ($I_{MOT} = \text{nominal}$)		98.7		%
Voltage efficiency	$f_{PWM} = 20KHz$		98.3		
	$f_{PWM} = 100KHz$		91.4		
Surface temperature ²	Idle ($I_{MOT} = 0A$)		55		°C
	Full power ($I_{MOT} = \text{nominal}$)			100	
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		57	V _{DC}
	Absolute maximum values, continuous	-0.5		58	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 ($I_{PEAK} \leq 1.05 \cdot I_{NOM}$)				DC-1

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		57	V _{DC}	
	Absolute maximum values, continuous	-0.5		58	V _{DC}	
Supply current	Idle		0.3		mA	
	Operating	-16	±7	+16	A	
Voltage measurement error		±0.15			V	
Utilization category	Acc. to 60947-4-1 ($I_{PEAK} \leq 4.0 \cdot I_{NOM}$)				DC-3	
Mechanical Mounting		Min.	Typ.	Max.	Units	
Airflow		natural convection ² , closed box				
Spacing required for horizontal mounting ²	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	
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	
Motor Outputs (A/A+, B/A-, C/B+, CR/B-)		Min.	Typ.	Max.	Units	
Nominal current ⁴	PMSM motors sinusoidal amplitude			±8	A	
	PMSM motors sinusoidal RMS			5.7	ARMS	
	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	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 ⁵ V _{MOT}			µH	
		50µs 48V		133		
		100µs 48V		266		
		50µs 24V		66		
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		
				66		
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	Logic "LOW"	1.5		1.7	
		Logic "HIGH"	3		2.5	
		Hysteresis	0.5			
	Analog	0	0.5...4.5	4.95		
Input current	Logic "LOW"; Pull to GND	2.4			mA	
	Logic "HIGH"; Internal 2.2KΩ pull-up to +5	0				
Minimum pulse width		66			µs	
ESD protection - Human body model		±15			kV	
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	
			3.1		2.5	
			0.9		1.1	
	Logic "HIGH"	IN2/LSP, IN3/LSN	1.4		1.6	
			4		3.5	
			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			mA
	Logic "HIGH"; Pulled to +24V	0.2				
Input frequency		0			500	kHz
Minimum pulse		1			µs	
ESD protection - Human body model		±2			kV	

¹ Operating temperature at higher temperatures is possible with reduced current and power ratings

² 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

³ 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.

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

⁵ Fast loop period of 50µs is not possible with all feedback device types.

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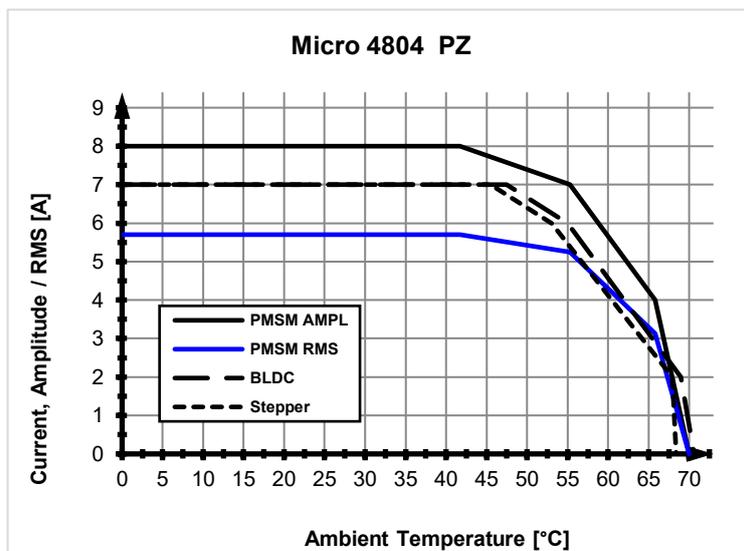
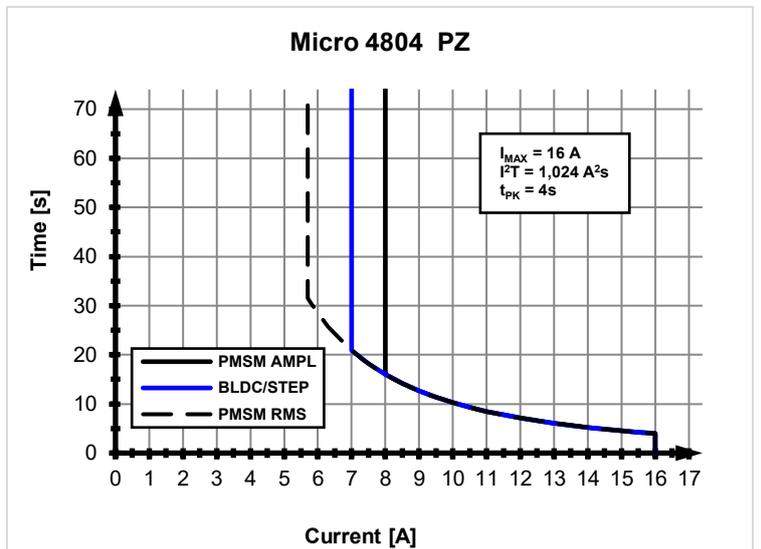
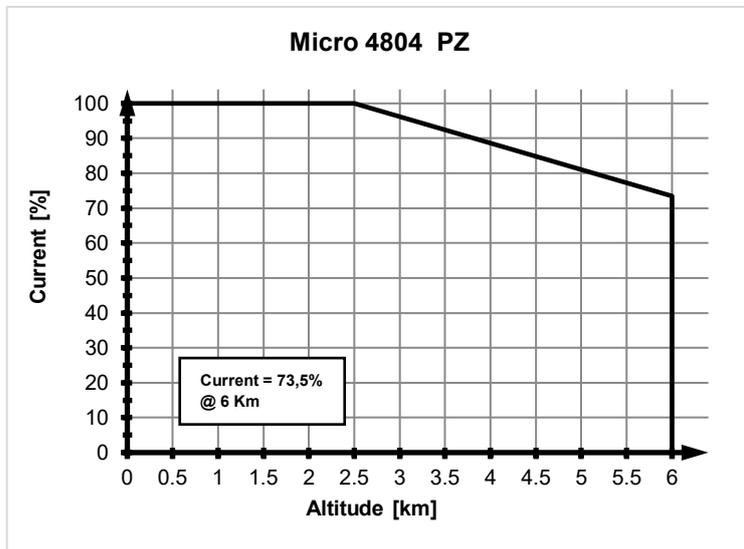
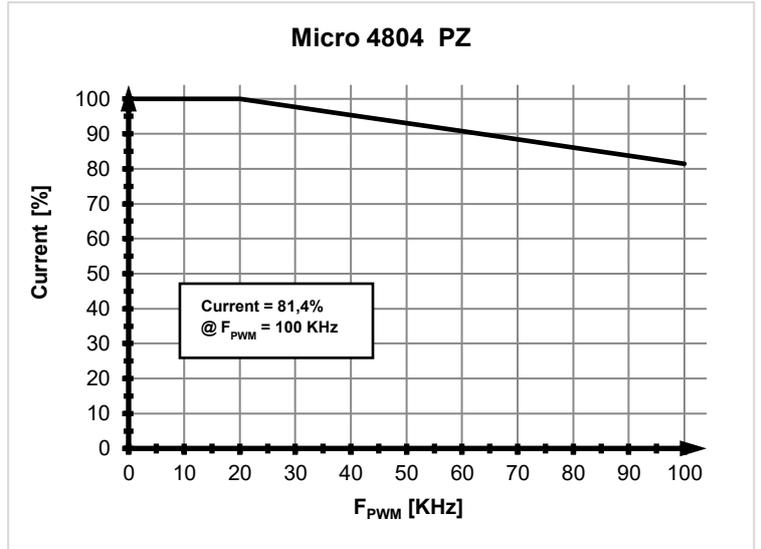
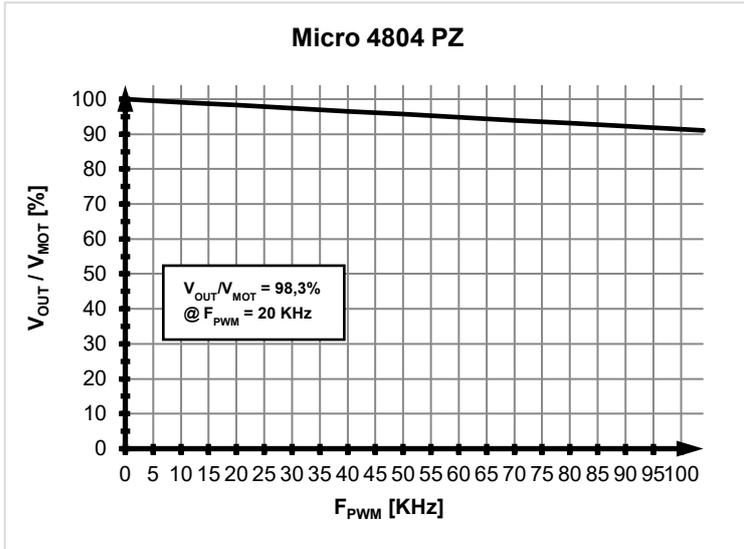
Digital Outputs (OUT0, OUT1, OUT4)		Min.	Typ.	Max.	Units
Mode compliance		NPN (sink) 24V			
Load type		Resistive, Inductive			
Default state		High-Z (floating)			
Immediately after power-up		Logic "HIGH"			
Output voltage	Logic "LOW"; output current = 1.5A for OUT0/ 0.05A for OUT1, OUT4			0.4	V
	Logic "HIGH"; output current = 0, no load	4	4.7	5.2	
	Logic "HIGH", external load to +V _{LOG}		V _{LOG}		
	Absolute maximum, continuous (free-wheeling diodes to +V _{LOG} to GND)	-0.5		V _{LOG} +0.5	
Output current	Absolute maximum, surge (duration ≤ 1s) †	-1		V _{LOG} +1	A
	Logic "LOW", sink current, short duration, duty cycle ≤ 1%			0.1	
	5s max			2	
	0.5s max			0.15	
	Logic "LOW", sink current, continuous; V _{OUT} ≤ 0.4V			2.5	
	Logic "HIGH", source current; external load to GND; V _{OUT} ≥ 2.0V			0.05	
Output current	Logic "HIGH", leakage current; external load to +V _{LOG} ; V _{OUT} = V _{LOG} max = 40V			5	mA
	V _{LOG} =24V	0.18		0.2	
	V _{LOG} =48V	0.42		0.45	mA
Minimum pulse width		0.5			
ESD protection - Human body model		±25			kV
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 KΩ 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		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
RS-232		Min.	Typ.	Max.	Units
Compliance		TIA/EIA-232-C			
Bit rate	Default	9600			
	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
EtherCAT®		Min.	Typ.	Max.	Units
Compliance		IEEE802.3, IEC61158			
Software protocols compatibility		CoE, FoE, EoE, IEC61800-7-301			
Magnetics	Turns ratio	Required, external			
	Inductance	350			µH
	Common mode rejection	-30			dB
	Center tap	to J1 pins 15, 16			
Transmission line	According to TIA/EIA-568-5-A	5	5e	6	Category
		UTP	FTP	STP	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 ÷ 255			
ESD protection Human body model		±5			kV
BFS input		Min.	Typ.	Max.	Units
Polarity		Active Low (0=fail-safe boot, 1=normal)			
Default state		High			
Voltage	BFS floating				V
	Logic low (active)		0	1.1	
	Logic high (inactive)	2.0	3.3		
	Abs. max., continuous	-0.5		3.8	
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

Absolute encoder interface:		Min	Typ.	Max	Units
SSI, BISS-C, EnDAT, Tamagawa, Nikon, Sanyo Denki					
Single-ended mode		Not recommended, reduced robustness & speed			
Differential mode compliance	For full RS422 compliance, see ¹	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				
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 ≤ 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 0 ... +5V		±25	±40	mV
	ESD protection Human body model	±1.5			
AxisID inputs		Min.	Typ.	Max.	Units
Default state		ID1, ID1, ID2 floating			
Internal pull-down to GND		95	100	105	kΩ
ESD protection Human body model		±250			V
LED outputs		Min.	Typ.	Max.	Units
Polarity	Active high (high=LED lit)				
	Common cathode to GND				
Voltage	I _{OH} ≤ 0.9mA	2.9	3.3		V
	I _{OH} ≤ 1.5mA	2.4			V
	I _{OL} ≤ 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
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}	External power supply	SELV or PELV			
Pollution Degree	Cabinet / Housing	IP54			
	Bundling / Grouping	Separate wiring for STO1, STO2			
STO wiring	Shielding	Separate shield for STO1, STO2			
	Compatibility	Each STO channel has separate + and - terminals			
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			
	Isolation, STOx to GND	±2			
Current	STOx+ - STOx- = 24V	3			
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 120Ω resistor connected across each signal pair (A1+/A1-, B1+/B1-, Z1+/Z1-, A2+/A2-, B2+/B2-)

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