

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

- **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_{RMS} / 6.3A amplitude for PMSM motors
 - 5.5A for DC / BLDC / Step motors
 - Peak: 11.3A_{RMS} / 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 Enable, 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.
- Communication interfaces: RS232; USB; TMLCAN and CANopen (CiA 301 v4.2, CiA 305 v.2.2.13 and CiA 402 v3.0) protocols
- 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	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	...	Rsvd.	Reserved. Do not connect.
14	...	Rsvd.	Reserved. Do not connect.
15	GND	-	Ground return and shield
16	GND	-	Ground return and shield
17	...	Rsvd.	Reserved. Do not connect.
20	...	Rsvd.	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/Enable	I	5-48V digital NPN input. Drive Enable input
30	I/O0	I/O	5-48V 1.5A NPN (sink) general-purpose digital programmable input IN0 or output OUT0
31	I/O1	I/O	5-48V 0.1A NPN (sink) general-purpose digital programmable input IN1 or output OUT1
32	I/O4	I/O	5-48V 0.1A NPN (sink) general-purpose digital programmable input IN4 or output OUT4
33	GND	-	Ground return and shield
34	AnalogIn	I	Analog input (range software selectable 0-5V or ±10V)

MSB AxisID register LSB

Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
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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

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, 2	Rsvd.	-	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	Rsvd.	-	Reserved. Do not connect.

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.

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		90	%Rh
Altitude / pressure ³		Altitude (vs. sea level)		0 ± 2.5	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		100	%Rh
Ambient Pressure				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 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

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.

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Environmental Characteristics		Min.	Typ.	Max.	Units
Size (Length x Width x Height)	Global size	38.1 x 25 x 9.6			mm
Weight		~1.5 x 1 x 0.4			inch
		8			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		
	$f_{PWM} = 20KHz$		98.3		%
	$f_{PWM} = 100KHz$		91.4		
Voltage efficiency	Idle ($I_{MOT} = 0A$)		55		
	Full power ($I_{MOT} = \text{nominal}$)			100	°C
Surface temperature ¹	Full power ($I_{MOT} = \text{nominal}$)				
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		60	V _{DC}
	Absolute maximum values, continuous	-0.5		63	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		60	V _{DC}
	Absolute maximum values, continuous	-0.5		63	V _{DC}
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 ($I_{PEAK} \leq 4.0 \cdot I_{NOM}$)	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
Motor Outputs (A/A+, B/A-, C/B+, CR/B-)		Min.	Typ.	Max.	Units
Nominal current ²	PMSM motors sinusoidal amplitude			±6.3	A
	PMSM motors sinusoidal RMS			4.5	A _{RMS}
	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	V
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 ³	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	
		F _{PWM} = 100 kHz		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		1.5	1.7	
		Logic "LOW"	3	2.5	
			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/ENA)		Min.	Typ.	Max.	Units	
Mode compliance		NPN (sink)				
Default state	Input floating (wiring disconnected)	Logic HIGH				
Input voltage	Logic "LOW"		1.4	1.8	V	
	Logic "HIGH"	IN0, IN1, IN4, IN5/ENA	3.1	2.5		
	Hysteresis		0.9	1.1		
	Logic "LOW"	IN2/LSP, IN3/LSN		1.4		
	Logic "HIGH"		4	3.5		
	Hysteresis		0.6			
	Floating voltage (not connected)		4.7			
	Absolute maximum, continuous	IN2/LSP, IN3/LSN, IN5/ENA	-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	
	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		
	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	
Encoder Inputs (A1+, A1-, B1+, B1-, Z1+, Z1-, A2+, A2-, B2+, B2-) ⁴		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	

¹ 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

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

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

⁴ 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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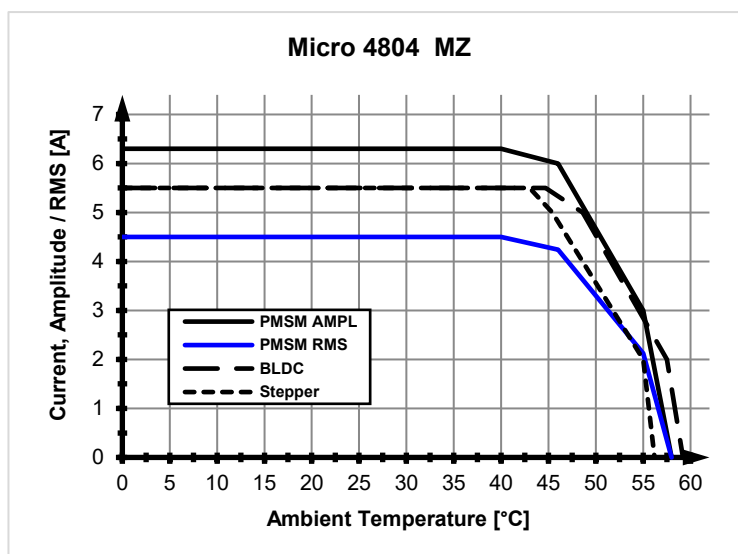
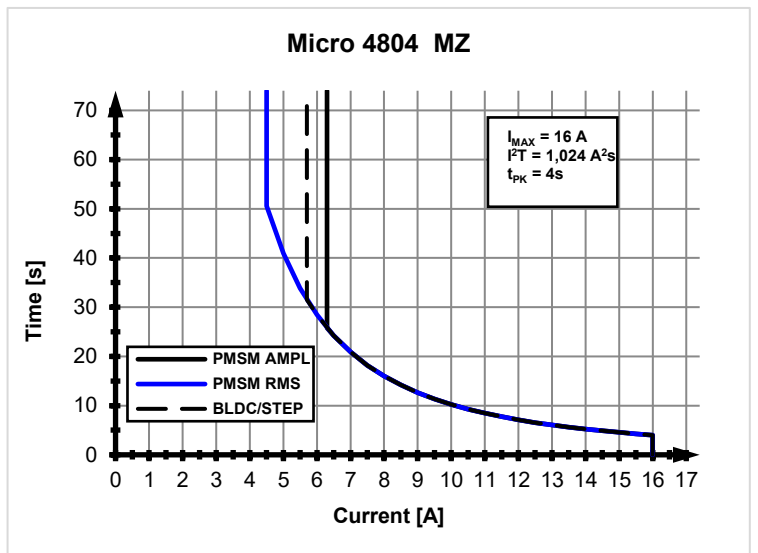
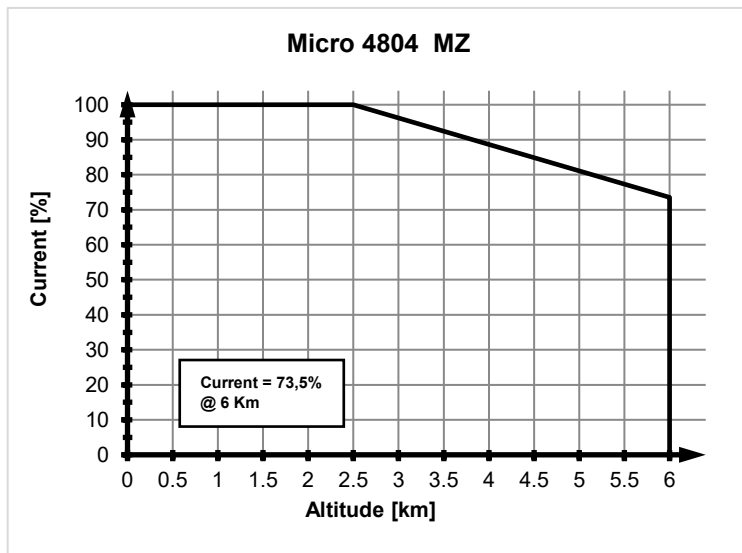
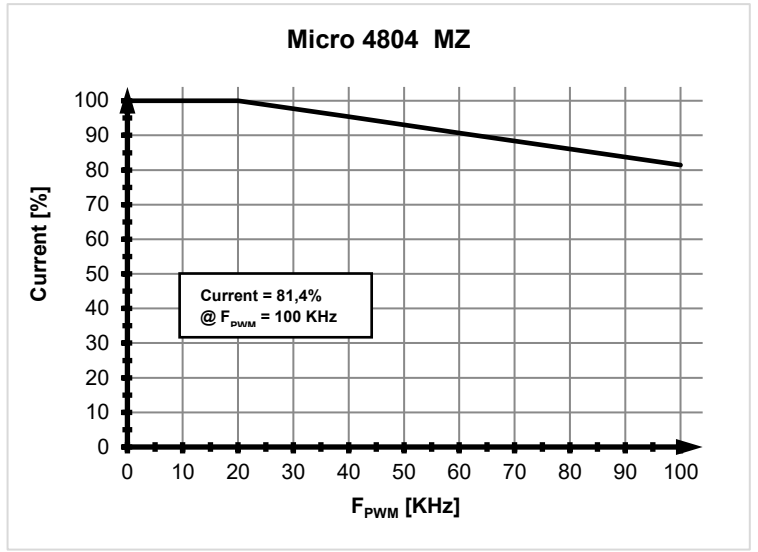
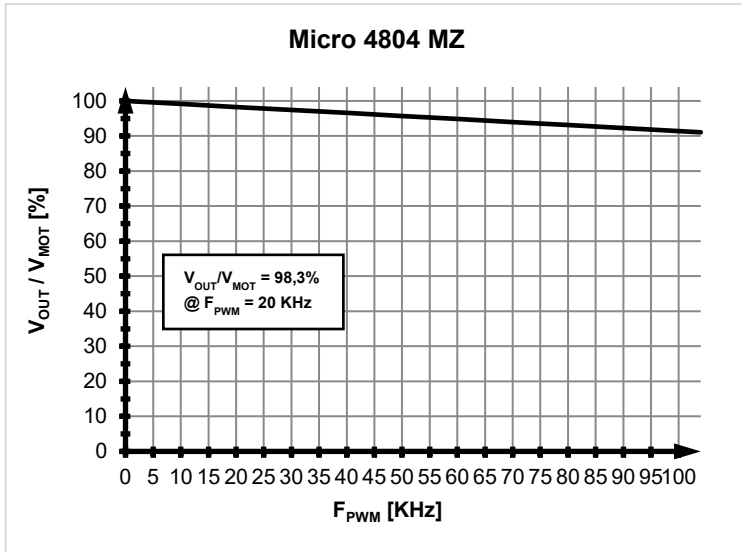
Absolute encoder interface: SSI, BISS-C, EnDAT, Tamagawa, Nikon, Sanyo Denki		Min	Typ.	Max	Units
Single-ended mode	Not recommended, reduced robustness & speed				
Differential mode compliance	For full RS422 compliance, see ¹	TIA/EIA-422-A			
Output voltage	Differential; 50Ω differential load Common-mode, referenced to GND	1.5 1	3.3 1.7	3	V
CLOCK frequency	Nikon, Sanyo Denki Panasonic, Tamagawa All others	2.5, 4 2.5		3, 4	kHz
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, ... If total resolution >31 bits, some bits must be ignored by software setting to achieve a max. 31 bits resolution			64	Bits
Analog Input (REF/ FDBK)		Min	Typ.	Max	Units
Input voltage	Operational range Absolute maximum values, continuous Absolute maximum, surge (duration ≤ 1s)	0...5 -22	-10...+10	+26 ±38	V
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 Range 0 ... +5V		±3 ±10	±10 ±30	bits
Gain error	Range -10V ... +10V Range 0 ... +5V		±0.3 ±0.5	±0.5 ±0.8	%
ESD protection	Human body model	±1.5			kV
RS-232		Min.	Typ.	Max.	Units
Compliance		TIA/EIA-232-C			
Bit rate	Software selectable	9600		115200	Baud
Output voltage		±5			V
Short-circuit	232TX to GND	Guaranteed			
Input voltage	Absolute maximum, continuous	-30		+30	V
ESD protection	Human body model	±15			kV

CAN-Bus		Min.	Typ.	Max.	Units
Compliance	CAN 2.0B, ISO 11898-2 CiA301, CiA305, CiA402, TechnoCAN, TMLcan				
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
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
BFS input		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

† 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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