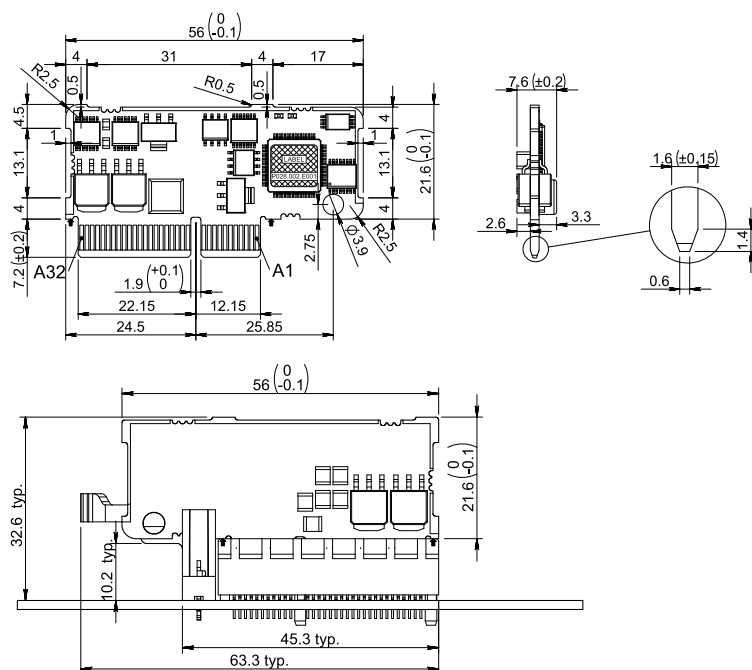
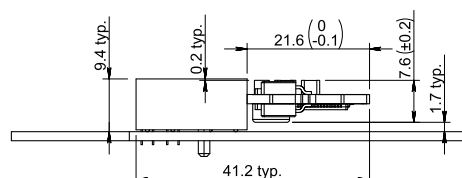




Overall dimensions for vertical mounting using recommended mating connector and retainer



Overall dimensions for horizontal mounting

Motor – sensor configurations					
Sensor \ Motor	PMSM	BLDC	DC BRUSH	STEP (2-ph)	STEP (3-ph)
Incr. Encoder	Y		Y	Y	
Incr. Encoder + Hall	Y	Y			
Analog Sin/Cos encoder	Y				
Linear Halls	Y				
Digital Halls	Y				
Tacho			Y		
Open-loop (no sensor)				Y	Y

Mating Connectors		
Producer	Part No.	Description
Tyco	2-1775801-4	PCIe 4x vertical card edge connector, 1.0mm pitch, 2x32 contacts
FCI	10018784-11101TLF	
Tyco	1761465-2	PCIe 4x horizontal card edge connector, 1.0mm pitch, 2x32 contacts
Samtec	PCIE-064-02-F-D-RA	
FCI	10035591-001LF	Retainer for vertical PCIe card
FCI	10042618-002LF	

Features

- Motor supply: 9-36V. Optional logic supply: 7-36V
- Output current: 4A cont. (BLDC mode); 10A_{PEAK}, up to 100KHz PWM
- Digital Hall sensor interface (single-ended and open collector)
- Incremental encoder interface (single-ended, open collector and differential)
- Linear Hall sensors interface
- Analogue sin/cos encoder interface (differential 1V_{pp})
- 5 digital inputs, 5-36V, NPN: Enable, 2 for limit switches, general-purpose 2
- 4 digital outputs, 5-36V, 0.5A, NPN O.C.: Ready, Error, 2 general-purpose
- 2 analogue inputs: 12-bit, 0-5V: Reference, Feedback or general purpose
- RS-232 serial & CAN-bus 2.0B interfaces with h/w selectable addresses
- TMLCAN and CANopen (CiA 301v4.2 and 402v3.0) protocols
- 2K × 16 SRAM for data acquisition
- 4K × 16 E²ROM to store TML motion programs and data
- Operating ambient temperature: 0-40°C (over 40°C with derating)
- Hardware Protections: short-circuit between motor phases and from motor phases to GND, over-voltage, under-voltage and I²t
- Firmware: F508M+ or F523E+

Connector description

Pin	Name	Type	Description
A1	GND	-	Return ground for extension bus
A2-A5	reserved	I/O	Reserved, do not connect
A6	OUT1†	O	5-36V 0.5A digital output, NPN O.C. / TTL pull-up
A7	reserved	I/O	Reserved, do not connect
A8	Hall 1	I	Digital input Hall 1 sensor
A9	Hall 2	I	Digital input Hall 2 sensor
A10	Hall 3	I	Digital input Hall 3 sensor
A11	+5V _{OUT}	O	5V supply for sensors - internally generated
A12	GND	-	Return ground for sensors supply
A13	A-/Sin-/LH1	I	Incr. encoder A- diff. input, or analogue encoder Sin- diff. input, or linear Hall 1 input
A14	A+/A+/Sin+	I	Incr. encoder A single-ended, or A+ diff. input, or analogue encoder Sin+ diff. input
A15	B-/Cos-/LH2	I	Incr. encoder B- diff. input, or analogue encoder Cos- diff. input, or linear Hall 2 input
A16	B+/B+/Cos+	I	Incr. encoder B single-ended, or B+ diff. input, or analogue encoder Cos+ diff. input
A17	Z-/LH3	I	Incr. encoder Z- diff. input, or linear Hall 3 input
A18	Z/Z+	I	Incr. encoder Z (index) single-ended, or Z+ diff. input
A19	Can-Hi	I/O	CAN-Bus positive line(dominant high)
A20	GND	-	Negative return (ground) of the logic supply
A21-A22	+V _{MOT}	I	Positive terminal of the motor supply: 9 to 36V _{DC}
A23-A24	GND	-	Negative return (ground) of the motor supply
A25-A28	CR/B-	O	Chopping resistor / Phase B- for step motors
A29-A32	B/A-	O	Phase B for 3-ph motors, A- for 2-ph steppers, Motor- for DC brush motors

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Pin	Name	Type	Description
B1	GND	-	Return ground for CAN-Bus and RS-232 pins
B2	232TX	O	RS-232 Data Transmission
B3	232RX	I	RS-232 Data Reception
B4	OUT0	O	5-36V 0.5A general-purpose digital output, NPN open-collector / TTL pull-up
B5	GND	-	Return ground for I/O pins
B6	AxisID 0	I	Axis ID/Address input. 7 states: floating, strap to GND or +5V, resistor 4K7 or 22K to GND or +5V
B7	AxisID 1	I	Axis ID/Address input. 7 states: floating, strap to GND or +5V, resistor 4K7 or 22K to GND or +5V
B8	AxisID 2	I	Axis ID/Address input. 7 states: floating, strap to GND or +5V, resistor 4K7 or 22K to GND or +5V
B9	REF	I	Analogue input, 12-bit, 0-5V. Used to read an analog position, speed or torque reference, or used as general purpose analogue input
B10	FDBK	I	Analogue input, 12-bit, 0-5V. Used to read an analogue position or speed feedback (as tach), or used as general purpose analogue input
B11	+5V _{OUT}	O	5V output supply for I/O usage
B12	OUT2/ Error	O	5-36V 0.5A drive error output, active low, NPN open-collector/TTL pull-up. Also drives the red LED
B13	OUT3/ Ready	O	5-36V 0.5A drive ready output, active low, NPN open-collector/TTL pull-up. Also drives the green LED
B14	IN0	I	5-36V digital input General-purpose
B15	IN1	I	5-36V digital input
B16	IN2/LSP	I	5-36V digital input Positive limit switch input
B17	IN3/LSN	I	5-36V digital input. Negative limit switch input
B18	IN4/ Enable	I	5-36V digital input. Drive enable input
B19	Can-Lo	I/O	CAN-Bus negative line (dominant low)
B20	+V _{LOG}	I	Positive terminal of the logic supply: 7 to 36V _{DC}
B21- B22	+V _{MOT}	I	Positive terminal of the motor supply: 9 to 36V _{DC}
B23- B24	GND	-	Negative return (ground) of the motor supply
B25- B28	C/B+	O	Phase C for 3-ph motors, B+ for 2-ph steppers
B29- B32	A/A+	O	Phase A for 3-ph motors, A+ for 2-ph steppers, Motor+ for DC brush motors

† not available when additional feedback extension module is used

Electrical characteristics

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

- T_{amb} = 0...40°C, V_{LOG} = 24 VDC; V_{MOT} = 36VDC
- Supplies start-up / shutdown sequence: -any-
- Load current (sinusoidal amplitude / continuous BLDC, DC, stepper) = 2A

Operating Conditions		Min.	Typ.	Max.	Units
Ambient temperature ¹		0		+40	°C
Ambient humidity	Non-condensing	0		90	%Rh
Altitude / pressure ²	Altitude (vs. sea level)	-0.1	0 ÷ 2.5		Km
	Ambient Pressure	0 ²	0.75 ÷ 1	10.0	atm
Storage Conditions		Min.	Typ.	Max.	Units
Ambient temperature		-40		+85	°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 ³ , closed box			
Spacing required for vertical mounting	Between adjacent drives	30			mm
	Between drives and nearby walls	30			mm
	Between drives and roof-top	20			mm
Spacing required for horizontal mounting	Between adjacent drives	4			mm
	Between drives and nearby walls	5			mm
	Space needed for drive removal	10			mm
	Between drives and roof-top	15			mm
Insertion force	Using recommended mating connectors; without retainer		20	36	N
Extraction force		5	10		N
Environmental Characteristics		Min.	Typ.	Max.	Units
Size (Length x Width x Height)	Without mating connector / retainer	56 x 28.8 x 7.6			mm
		~2.2 x 1.1 x 0.3			inch
	With recommended mating vertical connector and retainer. Height above PCB surface.	63.3 x 32.6 x 16.3			mm
		~2.5 x 1.3 x 0.64			inch
	With recommended mating horizontal connector. Height above PCB surface.	56 x 41.2 x 7.6			mm
Weight		10			g
Power dissipation	Idle (no load)		1		W
	Operating		3		W
Efficiency			98		%
Cleaning agents	Dry cleaning is recommended	Only Water- or Alcohol- based			
Protection degree	According to IEC60529, UL508	IP00			-
Logic Supply Input (+V _{LOG})		Min.	Typ.	Max.	Units
Supply voltage	Nominal values	7		36	V _{DC}
	Absolute maximum values, drive operating but outside guaranteed parameters	4.9		40	V _{DC}
	Absolute maximum values, continuous	-0.7		42	V _{DC}
	Absolute maximum values, surge (duration ≤ 10ms) [†]	-1		+45	V
Supply current	+V _{LOG} = 7V		125	300	mA
	+V _{LOG} = 12V		80	200	
	+V _{LOG} = 24V		50	125	
	+V _{LOG} = 40V		40	100	
Motor Supply Input (+V _{MOT})		Min.	Typ.	Max.	Units
Supply voltage	Nominal values	9		36	V _{DC}
	Absolute maximum values, drive operating but outside guaranteed parameters	8.5		40	V _{DC}
	Absolute maximum values, continuous	-0.7		42	V _{DC}
	Absolute maximum values, surge (duration ≤ 10ms) [†]	-1		+45	V
Supply current	Idle		1	5	mA
	Operating	-10	±4	+10	
Supply current	Absolute maximum value, short-circuit condition (duration ≤ 10ms) [†]			15	A
Motor Outputs (A/A+, B/A-, C/B+, CR/B-)		Min.	Typ.	Max.	Units
Nominal output current, continuous	for DC brushed, steppers and BLDC motors with Hall-based trapezoidal control			4	A
	for PMSM motors with FOC sinusoidal control (sinusoidal amplitude value)			4	
	for PMSM motors with FOC sinusoidal control (sinusoidal effective value)			2.82	
Motor output current, peak	maximum 2.5s	-10		+10	A
Short-circuit protection threshold	measurement range		±13	±15	A
Short-circuit protection delay		5	10		μS

¹ Operating temperature can be extended up to +65°C with reduced current and power ratings.

² iPOS360x 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 In case of forced cooling (conduction or ventilation) the spacing requirements may drop substantially down to zero as long as the ambient temperature is kept below the maximum operating limit

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On-state voltage drop	Nominal output current; including typical mating connector contact resistance			±0.3	±0.5	V
Off-state leakage current				±0.5	±1	mA
Motor inductance (phase-to-phase)	Recommended value, for current ripple max. ±5% of full range; +V _{MOT} = 36 V	F _{PWM}				μH
		20 kHz	250			
		40 kHz	120			
		60 kHz	100			
		80 kHz	60			
		100 kHz	45			
	Minimum value, limited by short-circuit protection; +V _{MOT} = 36 V	20 kHz	75			μH
		40 kHz	25			
		60 kHz	20			
		80 kHz	10			
100 kHz		5				
Motor electrical time-constant (L/R)	Recommended value for ±5% current measurement error	20 kHz	250			μs
		40 kHz	125			
		60 kHz	100			
		80 kHz	63			
		100 kHz	50			
Current measurement	FS = Full Scale accuracy			±4	±8	%FS
Digital Inputs (IN0, IN1, IN2/LSP, IN3/LSN, IN4/Enable)			Min.	Typ.	Max.	Units
Mode compliance			TTL / CMOS / LVTTTL (3.3V) / Open-collector / NPN / 24V outputs			
Default state	Input floating (wiring disconnected)		Logic HIGH			
Input voltage	Logic "LOW"			0	0.8	V
	Logic "HIGH"		2	5÷24		
	Floating voltage (not connected)			3		
	Absolute maximum, continuous		-10		+30	
	Absolute maximum, surge (duration ≤ 1s) [†]		-20		+40	
Input current	Logic "LOW"; ulled to GND			0.6	1	mA
	Logic "HIGH"; Internal 4.7KΩ pull-up to +3.3		0	0	0	
	Logic "HIGH"; Pulled to +5V			0.15	0.2	
	Logic "HIGH"; Pulled to +24V			2	2.5	
Input frequency			0		150	kHz
Minimum pulse			3.3			μs
ESD protection	Human body model		±5			kV
Digital Outputs (OUT0, OUT1, OUT2/Error, OUT3/ Ready)			Min.	Typ.	Max.	Units
Mode compliance	All outputs (OUT0, OUT1, OUT2/Error, OUT3/Ready)		TTL / CMOS / Open-collector / NPN 24V			
	Ready, Error		Same as above + LVTTTL (3.3V)			
Default state	Not supplied (+V _{LOG} floating or to GND)		High-Z (floating)			
	Immediately after power-up	OUT0, OUT1	Logic "HIGH"			
		OUT2/Error, OUT3/ Ready	Logic "LOW"			
	Normal operation	OUT0, OUT1, OUT2/Error	Logic "HIGH"			
OUT3/Ready		Logic "LOW"				
Output voltage	Logic "LOW"; output current = 0.5A			0.2	0.8	V
	Logic "HIGH"; output current = 0, no load	OUT2/Error, OUT3/ Ready	2.9	3	3.3	
		OUT0, OUT1	4	4.5	5	
	Logic "HIGH", external load to +V _{LOG}			V _{LOG}		
	Absolute maximum, continuous		-0.5		V _{LOG} +0.5	
	Absolute maximum, surge (duration ≤ 1s) [†]		-1		V _{LOG} +1	
Output current	Logic "LOW", sink current, continuous				0.5	A
	Logic "LOW", sink current, pulse ≤ 5 sec.				1	A
	Logic "HIGH", source current; external load to GND; V _{OUT} ≥ 2.0V	OUT2/Error , OUT3/ Ready			2	mA
		OUT0, OUT1			4	mA

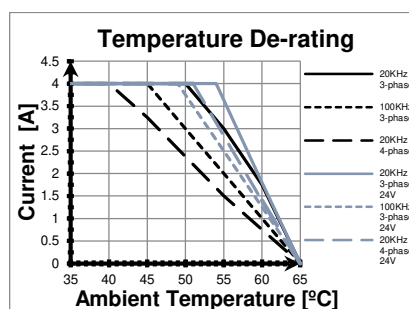
	Logic "HIGH", leakage current; external load to +V _{LOG} ; V _{OUT} = V _{LOG} max = 40V		0.1	0.2	mA
Minimum pulse width		2			μs
ESD protection	Human body model	±5			kV
Digital Hall Inputs (Hall1, Hall2, Hall3)		Min.	Typ.	Max.	Units
Mode compliance		TTL / CMOS / Open-collector			
Default state	Input floating (wiring disconnected)	Logic HIGH			
Input voltage	Logic "LOW"		0	0.8	V
	Logic "HIGH"	2	5		
	Floating voltage (not connected)		4.4		
	Absolute maximum, surge (duration ≤ 1s) [†]	-10		+15	
Input current	Logic "LOW"; Pull to GND			1.2	mA
	Logic "HIGH"; Internal 4.7KΩ pull-up to +5	0	0	0	
Minimum pulse width		2			μs
ESD protection	Human body model	±5			kV
Encoder Inputs (A/A+, A-, B/B+, B-, Z/Z+, Z)		Min.	Typ.	Max.	Units
Single-ended mode compliance	Leave negative inputs disconnected	TTL / CMOS / Open-collector			
Input voltage, single-ended mode A/A+, B/B+	Logic "LOW"			1.6	V
	Logic "HIGH"	1.8			
	Floating voltage (not connected)		4.5		
Input voltage, single-ended mode Z/Z+	Logic "LOW"			1.2	V
	Logic "HIGH"	1.4			
	Floating voltage (not connected)		4.7		
Input current, single-ended mode A/A+, B/B+, Z/Z+	Logic "LOW"; Pull to GND		2.5	3	mA
	Logic "HIGH"; Internal 2.2KΩ pull-up to +5	0	0	0	
Differential mode compliance	For full RS422 compliance, see [†]	TIA/EIA-422-A			
Input voltage, differential mode	Hysteresis	±0.06	±0.1	±0.2	V
	Common-mode range (A+ to GND, etc.)	-7		+7	
Input impedance, differential	A+ to A-, B+ to B-	4.2	4.7		KΩ
	Z+ to Z-	6.1	7.2		
Input frequency	Single-ended mode, Open-collector / NPN	0		500	kHz
	Differential mode, or Single-ended driven by push-pull (TTL / CMOS)	0		10	MHz
Minimum pulse width	Single-ended mode, Open-collector / NPN	1			μs
	Differential mode, or Single-ended driven by push-pull (TTL / CMOS)	50			ns
Input voltage, any pin to GND	Absolute maximum values, continuous	-7		+7	V
	Absolute maximum, surge (duration ≤ 1s) [†]	-11		+14	
ESD protection	Human body model	±1			kV
Linear Hall Inputs (LH1, LH2, LH3)		Min.	Typ.	Max.	Units
Input voltage	Operational range	0	0.5÷4.5	4.9	V
Input voltage	Absolute maximum values, continuous	-7		+7	V
	Absolute maximum, surge (duration ≤ 1s) [†]	-11		+14	
Input current	Input voltage 0...+5V	-1	±0.9	+1	mA
Interpolation Resolution	Depending on software settings			11	bits
Frequency		0		1	kHz
ESD protection	Human body model	±1			kV

[†] For full RS-422 compliance, 120Ω termination resistors must be connected across the differential pairs, as close as possible to the drive input pins.

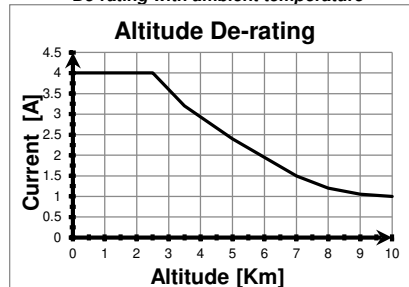
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Sin-Cos Encoder Inputs (Sin+, Sin-, Cos+, Cos-)		Min.	Typ.	Max.	Units
Input voltage, differential	Sin+ to Sin-, Cos+ to Cos-		1	1.25	V _{PP}
Input voltage, any pin to GND	Operational range	-1	2.5	4	V
	Absolute maximum values, continuous	-7		+7	
	Absolute maximum, surge (duration ≤ 1s) [†]	-11		+14	
Input impedance	Differential, Sin+ to Sin-, Cos+ to Cos- ¹	4.2	4.7		KΩ
	Common-mode, to GND		2.2		KΩ
Resolution with interpolation	Software selectable, for one sine/cosine period	2		10	bits
Frequency	Sin-Cos interpolation	0		450	kHz
	Quadrature, no interpolation	0		10	MHz
ESD protection	Human body model	±1			kV
Analog 0...5V Inputs (REF, FDBK)		Min.	Typ.	Max.	Units
Input voltage	Operational range	0		4.95	V
	Absolute maximum values, continuous	-12		+18	
	Absolute maximum, surge (duration ≤ 1s) [†]			±36	
Input impedance	To GND		30		KΩ
Resolution		12			bits
Integral linearity				±2	bits
Offset error			±2	±10	bits
Gain error			±1%	±3%	% FS ²
Bandwidth (-3dB)	Software selectable	0		1	kHz
ESD protection	Human body model	±5			kV
Axis ID Inputs (AxisID 0, AxisID 1, AxisID 2)		Min.	Typ.	Max.	Units
External connections	7 levels	Not connected; Strap to GND; Strap to +5V; 4.7KΩ to GND; 4.7KΩ to +5V; 22KΩ to GND; 22KΩ to +5V;			
Pin current	Use to size PCB tracks			±0.5	mA
4.7KΩ/22KΩ resistor	Power rating	3			mW
	Tolerance			±5	%
ESD protection	Human body model	±5			kV
RS-232		Min.	Typ.	Max.	Units
Compliance		TIA/EIA-232-C			
Bit rate	Software selectable	9600		115200	Baud
Short-circuit	232TX short to GND	Guaranteed			
ESD protection	Human body model	±2			kV
CAN-Bus		Min.	Typ.	Max.	Units
Compliance		ISO11898, CiA-301v4.2 & 402v3.0			
Bit rate	Software selectable	125		1000	Kbps
Bus length	1Mbps			25	m
	800Kbps			50	
	500Kbps			100	
	≤ 250Kbps			250	
Resistor	Between CAN-Hi, CAN-Lo	none on-board			
Node addressing	Strapping option (AxisID0,1,2)	1 ÷ 127 (CANopen); 1-195 & 255 (TMLCAN)			-
ESD protection	Human body model	±15			kV
Supply Output (+5V)		Min.	Typ.	Max.	Units
Output voltage	Current sourced = 250mA	4.8	5	5.2	V
Output current		250	350		mA
Short-circuit		NOT protected			
Over-voltage		NOT protected			
ESD protection	Human body model	±1			kV
Conformity		Min.	Typ.	Max.	Units
EU Declaration		2014/30/EU (EMC), 2014/35/EU (LVD), 2011/65/EU (RoHS), 1907/2006/EC (REACH), 93/68/EEC (CE Marking Directive), EC 428/2009 (non dual-use item, output frequency limited to 590Hz)			

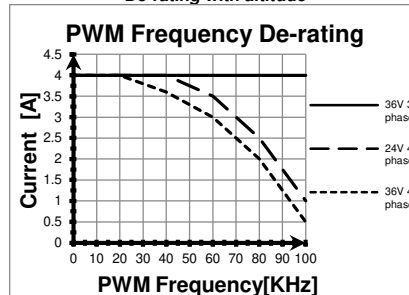
[†] Stresses beyond values listed under "absolute maximum ratings" may cause permanent damage to the device. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.



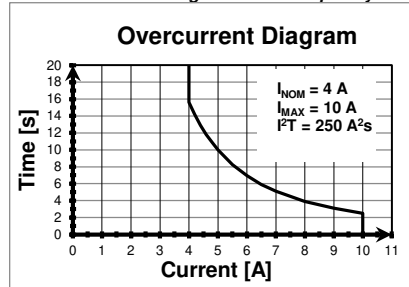
De-rating with ambient temperature



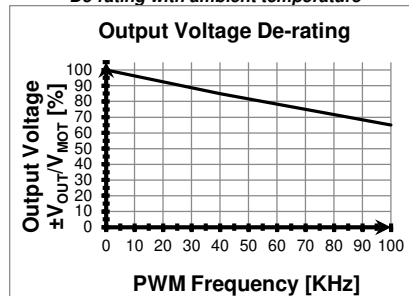
De-rating with altitude



Current De-rating with PWM frequency



De-rating with ambient temperature



Output Voltage De-rating with PWM frequency³

¹ For many applications, an 120Ω termination resistor should be connected across SIN+ to SIN-, and ³ V_{OUT} – the output voltage, V_{MOT} – the motor supply voltage across COS+ to COS-. Please consult the feedback device datasheet for confirmation.

² "FS" stands for "Full Scale"

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