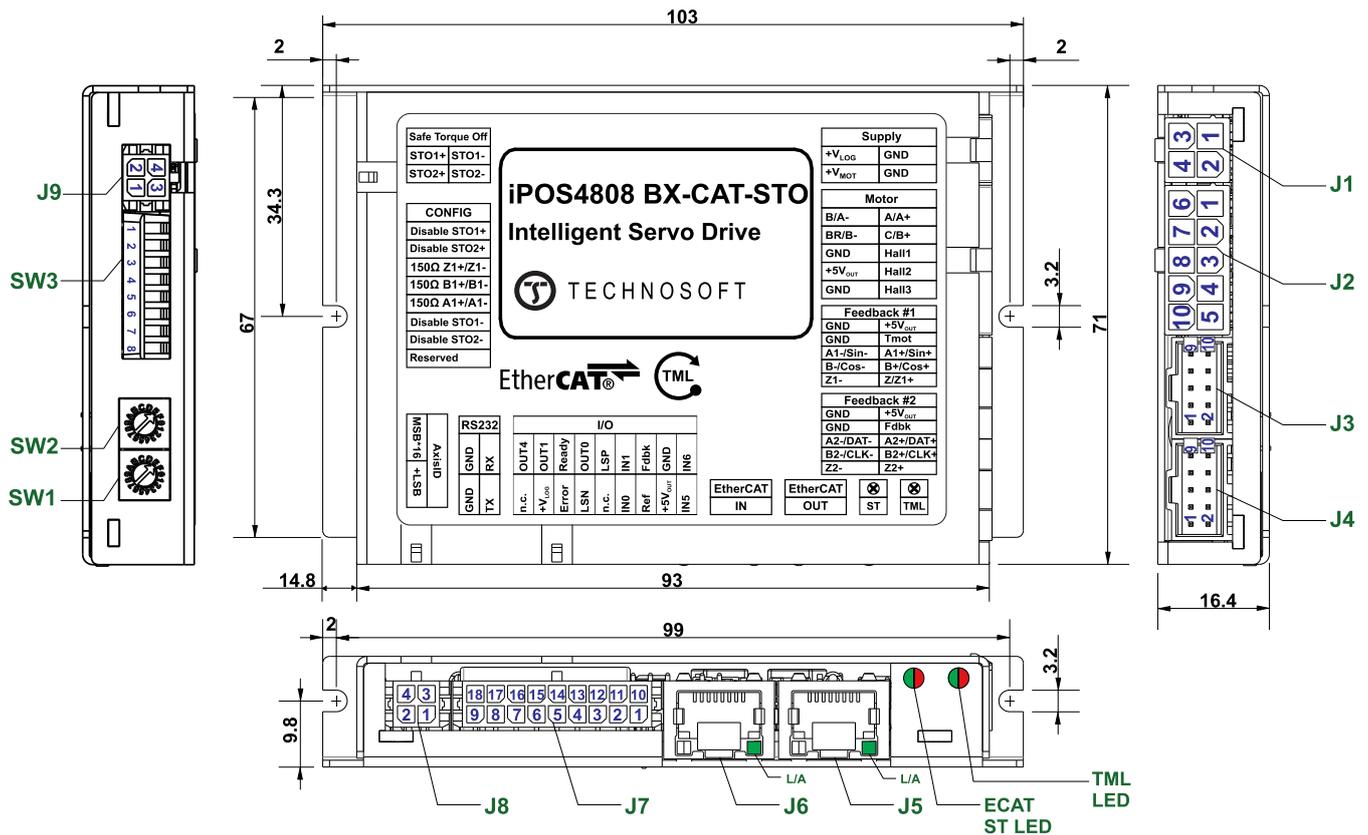


iPOS4808 BX-CAT-STO DATASHEET

P/N: P027.314.E221



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 + Hall	Ⓢ	Ⓢ			
Analog Sin/Cos encoder	Ⓢ		Ⓢ		
SSI	Ⓢ		Ⓢ		
BiSS-C*	Ⓢ				
Linear Halls**	Ⓢ				
Tacho			Ⓢ		
Open-loop (no sensor)				Ⓢ	Ⓢ

*currently in development

**optional, check the iPOS4808 BX-CAT-STO user manual for details

- Features**
 - Motor supply: 11-50V. Logic supply: 9-36V
 - Output current: 8A cont. (BLDC mode); 20A_{PEAK}, up to 100KHz PWM
 - Feedback Devices (dual-loop support)
 - 1st feedback devices supported:
 - Incremental encoder interface (single ended or differential)
 - pulse & direction interface (single ended) for external (master) digital reference
 - Analogue sin/cos encoder interface (differential 1V_{pp})
 - Digital Hall sensor interface (single-ended and open collector)
 - 2nd feedback devices supported:
 - Incremental encoder interface (differential)
 - pulse & direction interface (differential) for external (master) digital reference
 - BiSS¹ / SSI encoder interface
 - 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.
 - 6 digital inputs, 12-36V, PNP/NPN programmable: 2 for limit switches, 4 general-purpose
 - 5 digital outputs, 5-36V, 0.5A, NPN open-collector: Ready, Error, 3 general-purpose
 - 2 analogue inputs: 12-bit, 0-5V: Reference, Feedback or general purpose
 - RS-232 serial & dual 100Mbps RJ45 EtherCAT® interfaces
 - EtherCAT® with CAN application protocol over EtherCAT (CoE)
 - 127 h/w addresses selectable by h/w rotary hex switches
 - 16k x 16 SRAM memory for data acquisition
 - 16k x16 E²ROM to store setup data, TML motion programs, cam tables and other user data
 - Operating ambient temperature: 0-40°C (over 40°C with derating)
 - NTC/PTC analogue Motor Temperature sensor input

¹Currently in development

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Mating Connectors				
Producer	Part No.	Connector	Description	Wire Gauge
MOLEX	39-03-9042	J1	MINIFIT JR. receptacle housing, 2x2 way	AWG 18-20
MOLEX	39-03-9102	J2	MINIFIT JR. receptacle housing, 2x5 way	AWG 18-20
MOLEX	45750-1111	J1, J2	CRIMP PIN, MINIFIT JR., 13A	AWG 18-20
MOLEX	90142-0010	J3, J4	C-Grid III™ Crimp Housing Dual Row, 10 Circuits, with retention	AWG 22..24
	90143-0010		C-Grid III™ Crimp Housing Dual Row, 10 Circuits, without retention	
MOLEX	90119-0109	J3, J4	C-Grid III™ Crimp Terminal	AWG 22..24
MOLEX	43025-1800	J7	MICROFIT RECEPTACLE HOUSING, 2x9 WAY	AWG 20..24
MOLEX	43025-0400	J8, J9	MICROFIT RECEPTACLE HOUSING, 2x2 WAY	AWG 20..24
MOLEX	43030-0007	J7, J8, J9	CRIMP PIN, MICROFIT, 5A	AWG 20..24
-	-	J5, J6	Standard 8P8C modular jack (RJ-45) male	-

Connectors Description

Pin	Name	Type	Description
J1	1	GND	- Negative return (ground) of the power supply
	2	GND	- Negative return (ground) of the power supply
	3	+V _{LOG}	I Positive terminal of the logic supply input: 9 to 36V _{DC}
	4	+V _{MOT}	I Positive terminal of the motor supply: 11 to 50V _{DC} .

Pin	Name	Type	Description
J2	1	A/A+	O Phase A for 3-ph motors, A+ for 2-ph steppers, Motor+ for DC brush motors
	2	C/B+	O Phase C for 3-ph motors, B+ for 2-ph steppers
	3	Hall 1	I Digital input Hall 1 sensor
	4	Hall 2	I Digital input Hall 2 sensor
	5	Hall 3	I Digital input Hall 3 sensor
	6	B/A-	O Phase B for 3-ph motors, A- for 2-ph steppers, Motor- for DC brush motors
	7	BR/B-	O Brake resistor / Phase B- for step motors
	8	GND	- Negative return (ground) of the motor supply
	9	+5V _{OUT}	O 5V output supply - internally generated
	10	GND	- Negative return (ground) of the motor supply

Pin	Name	Type	Description
J3	1	Z1-	I Incr. encoder1 Z- diff. input
	2	Z1+	I Incr. encoder1 Z single-ended, or Z+ diff. input
	3	B1-/Cos-	I Incr. encoder1 B- diff. input, or analogue encoder Cos- diff. input
	4	B1+/Cos+/Dir	I Incr. encoder1 B single-ended, or B+ diff. input, or Dir, or analogue encoder Cos+ diff. input
	5	A1-/Sin-	I Incr. encoder1 A- diff. input, or analogue encoder Sin- diff. input
	6	A1+/Sin+/Pulse	I Incr. encoder1 A single-ended, or A+ diff. input, or Pulse, or analogue encoder Sin+ diff. input
	7	GND	- Return ground for sensors supply
	8	Temp Mot	I NTC/PTC input. Used to read an analog temperature value
	9	GND	- Return ground for sensors supply
	10	+5V _{OUT}	O 5V output supply for I/O usage

Pin	Name	Type	Description
J4	1	Z2-	I Incr. encoder2 Z- diff. input; has 150Ω resistor between pins 1 and 2
	2	Z2+	I Incr. encoder2 Z+ diff. input ; has 150Ω resistor between pins 1 and 2
	3	B2-/Dir-/CLK-/MA-	I/O Incr. encoder2 B- diff. input, or Dir-, or Clock- for SSI, or Master- for BiSS; has 150Ω resistor between pins 3 and 4
	4	B2+/Dir+/CLK+/MA+	I/O Incr. encoder2 B+ diff. input, or Dir+, or Clock+ for SSI, or Master+ for BiSS; has 150Ω resistor between pins 3 and 4
	5	A2-/Pulse-/Data-/SL-	I Incr. encoder2 A- diff. input, or Pulse-, or Data- for SSI, or Slave- for BiSS; has 150Ω resistor between pins 5 and 6
	6	A2+/Pulse+/Data+/SL+	I Incr. encoder2 A+ diff. input, or Pulse+, or Data+ for SSI, or Slave+ for BiSS; has 150Ω resistor between pins 5 and 6
	7	GND	- Return ground for sensors supply
	8	FDBK	I Analogue input, 12-bit, 0-5V. Used to read an analogue position or speed feedback (as tacho), or used as general purpose analogue input; Also connected to J7 pin12.
	9	GND	- Return ground for sensors supply
	10	+5V _{OUT}	O 5V output supply for sensors usage

Port	Name	Type	Description
J5	ECAT OUT	O	EtherCAT standard RJ45 Ethernet OUT port
J6	ECAT IN	I	EtherCAT standard RJ45 Ethernet IN port

Pin	Name	Type	Description
J7	1	IN5	I 12-36V general-purpose digital PNP/NPN input
	2	+5V _{OUT}	O 5V output supply for I/O usage
	3	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
	4	IN0	I 12-36V general-purpose digital PNP/NPN input
	5	n.c.	- not connected
	6	IN3/LSN	I 12-36V digital PNP/NPN input. Negative limit switch input
	7	OUT2/Error	O 5-36V 0.5A, drive Error output, active low, NPN open-collector/TTL pull-up. Also drives the red Error LED.
	8	+V _{LOG}	I Positive terminal of the logic supply: 9 to 36V _{DC}
	9	n.c.	- not connected
	10	IN6	I 12-36V general-purpose digital PNP/NPN input
	11	GND	- Return ground for I/O pins
	12	FDBK	I Analogue input, 12-bit, 0-5V. Used to read an analogue position or speed feedback (as tacho), or used as general purpose analogue input; Connected also to J4 pin 8.
	13	IN1	I 12-36V general-purpose digital PNP/NPN input
	14	IN2/LSP	I 12-36V digital PNP/NPN input. Positive limit switch input
	15	OUT0	O 5-36V 0.5A, general-purpose digital output, NPN open-collector/TTL pull-up
	16	OUT3/Ready	O 5-36V 0.5A, drive Ready output, active low, NPN open-collector/TTL pull-up. Also drives the green Ready LED.
	17	OUT1	O 5-36V 0.5A, general-purpose digital output, NPN open-collector/TTL pull-up
	18	OUT4	O 5-36V 0.5A, general-purpose digital output, NPN open-collector/TTL pull-up

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Pin	Name	Type	Description
1	232TX	O	RS-232 Data Transmission
2	GND	-	Return ground for RS-232 pins
3	232RX	I	RS-232 Data Reception
4	GND	-	Return ground for RS-232 pins

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

Switch	Position	Description
SW1	0..F	H/W Axis ID = SW2(MSB)*16 + SW1(LSB) Exception: SW2=0 and SW1 = 0 -->Axis ID = 255.
SW2	0..7	Remark:SW2 should be set only between 0 and 7.

Pin	Position	Description
1	down(ON)	Disable STO1+ function. Connects internally +V _{LOG} to STO1+
2	down(ON)	Disable STO2+ function. Connects internally +V _{LOG} to STO2+
3	down(ON)	Connect an 150Ω resistor between Z1+ and Z1- feedback pins
4	down(ON)	Connect an 150Ω resistor between B1+ and B1- feedback pins
5	down(ON)	Connect an 150Ω resistor between A1+ and A1- feedback pins
6	down(ON)	Disable STO1- function. Connects internally GND to STO1-
7	down(ON)	Disable STO2- function. Connects internally GND to STO2-
8	down(ON)	Reserved

Electrical characteristics

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

- V_{LOG} = 24 VDC; V_{MOT} = 48VDC
- Supplies start-up / shutdown sequence: -any-
- Load current (sinusoidal amplitude / continuous BLDC, DC, stepper) = 8A

Operating Conditions		Min.	Typ.	Max.	Units
Ambient temperature		0		40 ^{1,3}	°C
Ambient humidity	Non-condensing	0		90	%Rh
Altitude / pressure ²	Altitude (vs. sea level)	-0.1	0 ± 2.5	2	Km
	Ambient Pressure	0 ²	0.75 ± 1	10.0	atm
Storage Conditions		Min.	Typ.	Max.	Units
Ambient temperature		-40		105	°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			
Environmental Characteristics		Min.	Typ.	Max.	Units
Size (Length x Width x Height)	Without mating connectors	103 x 71 x 16.4			mm
	With recommended mating connectors.	~4.06 x 2.8 x 0.65			inch
Weight	Without mating connectors	125			g
	With recommended mating connectors.	~4.3 x 3.1 x 0.77			inch
Power dissipation	Idle (no load)	3.4			W
	Operating	8.5			
Efficiency		98			%
Cleaning agents	Dry cleaning is recommended Only Water- or Alcohol- based				
Protection degree	According to IEC60529, UL508	IP20			-

Logic Supply Input (+V _{LOG})		Min.	Typ.	Max.	Units
Supply voltage	Nominal values	9		36	V _{DC}
	Absolute maximum values, drive operating but outside guaranteed parameters	8		40	V _{DC}
	Absolute maximum values, surge (duration ≤ 10ms) [†]	-1		+45	V
Supply current	No Load on Digital Outputs	+V _{LOG} = 9V		400	mA
		+V _{LOG} = 12V		300	
		+V _{LOG} = 24V		150	
		+V _{LOG} = 39V		90	
Motor Supply Input (+V _{MOT})		Min.	Typ.	Max.	Units
Supply voltage	Nominal values	11		50	V _{DC}
	Absolute maximum values, drive operating but outside guaranteed parameters	9		52	V _{DC}
	Absolute maximum values, continuous	-0.6		54	V _{DC}
Supply current	Absolute maximum values, surge (duration ≤ 10ms) [†]	-1		+57	V
	Idle		1	5	mA
	Operating	-20	±8	+20	
Supply current	Absolute maximum value, short-circuit condition (duration ≤ 10ms) [†]			26	A
Motor Outputs (A/A+, B/A-, C/B+, BR/B-)		Min.	Typ.	Max.	Units
Nominal output current, continuous ⁴	for DC brushed, steppers and BLDC motors with Hall-based trapezoidal control			8	A
	for PMSM motors with FOC sinusoidal control (sinusoidal amplitude value)			8	
	for PMSM motors with FOC sinusoidal control (sinusoidal effective value)			5.66	
Motor output current, peak	maximum 2.5s	-20		+20	A
Short-circuit protection threshold		±22	±26	±30	A
Short-circuit protection delay		5	10		µs
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}	20 kHz	330	µH
			40 kHz	150	
			60 kHz	120	
			80 kHz	80	
			100 kHz	60	
			Minimum value, limited by short-circuit protection; +V _{MOT} = 36 V	20 kHz	
60 kHz	40				
40 kHz	30				
80 kHz	15				
100 kHz	8				
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

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

² iPOS4808 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 maximum ambient temperature can be increased substantially.

⁴ @20KHz F_{PWM}

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Digital Inputs (IN0, IN1, IN2/LSP, IN3/LSN, IN5, IN6) ¹		Min.	Typ.	Max.	Units
Mode compliance		PNP			
Default state	Input floating (wiring disconnected)	Logic LOW			
Input voltage	Logic "LOW"	-36	0	2.4	V
	Logic "HIGH"	7.5	24	36	
	Hysteresis	1.2	2.4	2.8	
	Floating voltage (not connected)		0		
	Absolute maximum, continuous	-36		+39	
Input current	Absolute maximum, surge (duration ≤ 1s) [†]	-50		+50	mA
	Logic "LOW"; pulled to GND		0		
	Logic "HIGH"; pulled to +24V		3.6	4	
Input frequency		0		10	kHz
Minimum pulse width		6			μs
ESD protection	Human body model	±5			kV

Mode compliance		NPN			
Default state	Input floating (wiring disconnected)	Logic HIGH			
Input voltage	Logic "LOW"		0	1.6	V
	Logic "HIGH"	1.8	24	39	
	Hysteresis	1.2	2.4	2.8	
	Floating voltage (not connected)		15		
	Absolute maximum, continuous	-10		+39	
Input current	Absolute maximum, surge (duration ≤ 1s) [†]	-40		+40	mA
	Logic "LOW"; Pulled to GND		2	2.2	
	Logic "HIGH"; Internal 12KΩ pull-up to +V _{LOG}	0	0	0	
Input frequency		0		10	kHz
Minimum pulse width		6			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			5	mA
	Logic "HIGH"; Internal 1KΩ pull-up to +5	0	0	0	
Minimum pulse width		2			μs
ESD protection	Human body model	±5			kV
Encoder2 Inputs (A2+/Data+, A2-/Data-, B2+/Clk+, B2-/Clk-, Z2+, Z2-)		Min.	Typ.	Max.	Units
Differential mode compliance		TIA/EIA-422-A			
Input voltage	Hysteresis	±0.06	±0.1	±0.2	V
	Differential mode	-14		+14	
	Common-mode range (A+ to GND, etc.)	-11		+14	
Input impedance, differential	A2+, B2+, Z2+ A2-, B2-, Z2-		150		Ω
Input frequency	Differential mode	0		10	MHz
Minimum pulse width	Differential mode	50			ns

Digital Outputs (OUT0, OUT1, OUT2/Error, OUT3/ Ready, OUT4)		Min.	Typ.	Max.	Units
Mode compliance	All outputs (OUT0, OUT1, OUT2/Error, OUT3/Ready)	TTL / open-collector / NPN 24V			
Default state	Not supplied (+V _{LOG} floating or to GND)	High-Z (floating)			
	Immediately after power-up	OUT0, OUT1, OUT4	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			0.8	V
	Logic "HIGH"; output current = 0, no load	2.9	3	3.3	
	Logic "HIGH"; external load to +V _{LOG}	4	4.5	5	
	Absolute maximum, continuous	-0.5		V _{LOG} +0.5	
	Absolute maximum, surge (duration ≤ 1s) [†]	-1		V _{LOG} +1	
Output current	Logic "LOW"; sink current			0.5	A
	Logic "LOW"; sink current, pulse ≤ 5 sec.			1	A
	Logic "HIGH"; source current; external load to GND; V _{OUT} ≥ 2.0V			2	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	±15			kV
Encoder1 Inputs (A1/A1+, A1-, B1/B1+, B1-, Z1/Z1+, Z1-)		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)		3.3		
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		5.5	6	mA
	Logic "HIGH"; Internal 2.2KΩ pull-up to +5	0	0	0	
Differential mode compliance	For full RS422 compliance, see ²	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	A1+ to A1-, B1+ to B1-, Z1+ to Z1-		1		kΩ
Input frequency	Single-ended mode, Open-collector / NPN	0		5	MHz
	Differential mode, or Single-ended driven by push-pull (TTL / CMOS)	0		10	
Minimum pulse width	Single-ended mode, Open-collector / NPN	1			μs
	Differential mode, or Single-ended driven by push-pull (TTL / CMOS)	50			
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

¹ The digital inputs are software selectable as PNP or NPN

² For full RS-422 compliance, 150Ω termination resistors must be connected across the differential pairs, set SW3 pins 3,4 and 5 to ON.

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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		5	V
	Absolute maximum values, continuous	-12		+18	
	Absolute maximum, surge (duration ≤ 1s) [†]			±36	
Input impedance	To GND		28		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
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

Safe Torque OFF (STO1+; STO1-; STO2+; STO2-)		Min.	Typ.	Max.	Units
Safety function	According to EN61800-5-2	STO (Safe Torque OFF)			
EN 61800-5-1/-2 and EN 61508-5-3/-4 Classification	Safety Integrity Level	safety integrity level 3 (SIL3)			
	PFHd (Probability of Failures per Hour - dangerous)	8*10 ⁻¹⁰		hour ⁻¹ (0.8 FIT)	
EN13849-1 Classification	Performance Level	Cat3/PLe			
	MTTFd (mean time to dangerous failure)	377		years	
Mode compliance		PNP			
Default state	Input floating (wiring disconnected)	Logic LOW			
Input voltage	Logic "LOW" (PWM operation disabled)	-20		5.6	V
	Logic "HIGH" (PWM operation enabled)	18		36	
	Absolute maximum, continuous	-20		+40	
Input current	Logic "LOW"; pulled to GND		0		mA
	Logic "HIGH"; pulled to +Vlog		5	13	
Pulse duration	Ignored high-low-high			5	ms
	Accepted pulse			20	Hz
PWM operation delay	From Enabled low-high transition to PWM operation enabled			30	ms
ESD protection	Human body model	±2			kV
Supply Output (+5V)		Min.	Typ.	Max.	Units
Output voltage	Current sourced = 250mA	4.8	5	5.2	V
Output current		200	250		mA
Short-circuit		Yes			
Over-voltage		NOT protected			
ESD protection	Human body model	±1			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 For many applications, a 150Ω termination resistor should be connected across SIN+ to SIN-, and across COS+ to COS- (set SW3 switches 3 and 4 to ON). Please consult the feedback device datasheet for confirmation. ² "FS" stands for "Full Scale"

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