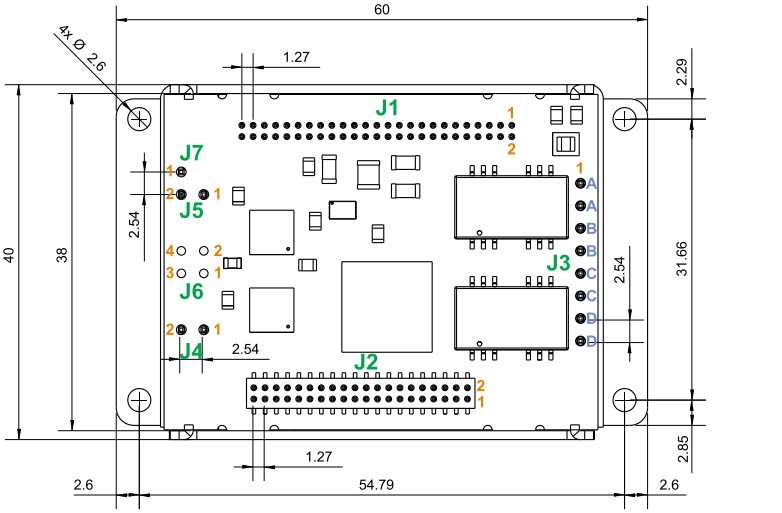

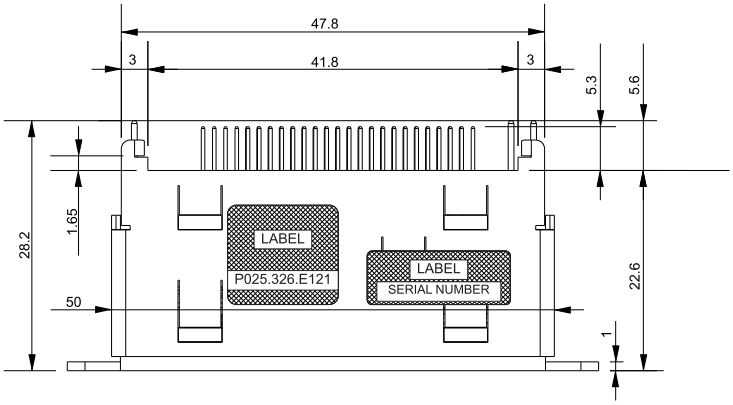

All dimensions are in mm.

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)				✓	✓

*available only with additional circuit

Mating connectors				
Connector	Description			
J1	Socket 2x25 pins, 1.27x1.27mm pitch, square 0.4 mm pins			
	If J3&J4 are soldered on motherboard		If J3&J4 are used with mating SSQ connectors	
	Harwin	M50-3152542	Harwin	M50-3002545
J2	Socket 2x20 pins, 1.27x1.27mm pitch, square 0.4 mm pins			
	If J3&J4 are soldered on motherboard		If J3&J4 are used with mating SSQ connectors	
	Harwin	M50-3152042	Harwin	M50-3002045
J3	To use full current capabilities of the drive, solder these pins directly to the motherboard without using socket connectors			
	High-current socket 2 pins, 2.54 mm pitch, square 0.635 mm pins -use only if nominal current is < 8A-			SSQ-108-01-G-S
J4	To use full current capabilities of the drive, solder these pins directly to the motherboard without using socket connectors			
	High-current socket 2 pins, 2.54 mm pitch, square 0.635 mm pins -use only if nominal current is < 8A-			SSQ-102-01-G-S
J5+J7	To use full current capabilities of the drive, solder these pins directly to the motherboard without using socket connectors			
	High-current socket 2x2 pins, 2.54 mm pitch, square 0.635 mm pins -use only if nominal current is < 8A-			SSQ-102-01-G-D
J6	Connector Header Through Hole 4 position 0.100" (2.54mm)			TSW-102-14-F-D

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 capabilities (CSP, PVT,S-curve, electronic gearing and cam)
- Motor supply: 12-80V; Logic SELV/ PELV supply: 9-36V; STO SELV/ PELV supply: 18-40V
- Output current: 20A cont. (BLDC mode)*; 40A_{PEAK} , up to 120kHz PWM
- Feedback Devices (dual-loop support)
  - 1st feedback devices supported (TTL 5V):
    - Incremental encoder interface (single ended or differential)
    - Analogue sin/cos encoder interface (differential 1V_{pp}) – needs external 120Ω resistors
    - Digital Hall sensor interface (single-ended and open collector)
    - Linear Hall sensors interface
    - pulse & direction interface (single ended) for external (master) digital reference
  - 2nd feedback devices supported (LVTTL 3.3V):
    - Incremental encoder interface (single ended)
    - pulse & direction interface (single ended) for external digital reference (from master)
    - BISS / SSI encoder interface capability available only using external circuit
- 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.
- 4 digital inputs, 5-36V, PNP/NPN programmable: 2 for limit switches, 2 general-purpose
- 4 digital outputs, 5-36V, 0.5A, NPN open-collector: Ready, Error, 2 general-purpose
- 2 analogue inputs: 12-bit, 0-5V: Reference, Feedback or general purpose
- RS-232 serial & dual 100Mbps EtherCAT® interfaces
- 127 h/w addresses selectable by h/w pins configuration
- 16k x 16 SRAM memory for data acquisition
- 16k x16 E^2ROM to store setup data, TML motion programs, cam tables and other user data
- NTC/PTC analogue Motor Temperature sensor input
- Operating ambient temperature: 0-40°C (over 40°C with derating)
- Programmable protections: short-circuit between motor phases or motor phases to GND, over/under-voltage, over-current, I^2t, control error

* with external heat sink

Connector description

J1

Pin	Name	Type	Description
1	232RX	I	RS232 data reception
2	Enc1 A+/Sin1+	I	Incr. encoder # A+ diff. input, analogue encoder #1 Sin+ diff. input.
3	232TX	O	RS232 data transmission
4	Enc1 A-/Sin1-	I	Incr. encoder #1 A- diff. input, analogue encoder #1 Sin1- diff. input
5	AxisID 0	I	Axis ID / Address input #0. Analogue input, 0-5V
6	Enc1 B+/Cos1+	I	Incr. encoder # B+ diff. input, analogue encoder #1 Cos+ diff. input.
7	AxisID 1	I	Axis ID / Address input #1. Analogue input, 0-5V
8	ENC1B-/ Cos1-	I	Incr. encoder #1 B- diff. input, analogue encoder Cos1- diff. input
9	AxisID 2	I	Axis ID / Address input #2. Analogue input, 0-5V
10	Enc1 Z+	I	Incr. encoder #1 Z+ diff. input.
11	CAN-Hi	-	CAN-Bus positive line (dominant high)
12	Enc1 Z-	I	Incr. encoder Z- diff. input
13	CAN-Lo	-	CAN-Bus negative line (dominant low)
14	Hall1	I/O	Hall 1 sensor 5V digital input
15	Reserved	-	Reserved
16	Hall2	I/O	Hall 2 sensor 5V digital input
17	Reserved	-	Reserved
18	Hall3	I	Hall 3 sensor 5V digital input
19	Ref	I	Analogue input, 12-bit, 0-5V. Used to read an analog position, speed or torque reference, or as general purpose analogue input
20	Fdbk	I	Analogue input, 12-bit, 0-5V. Used to read an analogue position or speed feedback, or as general purpose analogue input
21	+Vlog	I	Positive terminal for logic supply 9-36V_{DC}
22	+5V_{OUT}	O	5V output supply. Max 300mA for feedback sensors and I/Os
23	IN0	I	24V digital input #0, programmable NPN or PNP, general-purpose
24	OUT0	O	24 digital output #0, NPN, general-purpose
25	IN1	I	24V digital input #1, programmable NPN or PNP, general-purpose
26	OUT1	O	24V digital output #1, NPN, general-purpose
27	IN2/LSP	I	24V digital input #2, programmable NPN or PNP, positive limit switch
28	Out2/ Error	O	24V digital output #2, NPN, drive error
29	In3/LSN	I	24V digital input #3, programmable NPN or PNP type, negative limit switch
30	Out3/ Ready	O	24V digital output 3, NPN type, drive ready
31	TMOT	I	Motor temperature sensor input. Analogue input, 0-3.3V
32..34	Reserved	-	Reserved
35	GND	-	Ground
36	GND	-	Ground
37	SIMO	O	Slave In Master Out (for SPI communication)
38	SPI_CLK	O	Serial Clock (for SPI communication)
39	SOMI	I	Slave Out Master In (for SPI communication)
40	Reserved	-	Reserved
41	Enc2 A	I	Incr. encoder #2 A digital input, 0-3.3V
42	SIN2	I	Analogue encoder #2 SIN input, 0-3.3V
43	Enc2 B	I	Incr. encoder #2 B digital input, 0-3.3V
44	COS2	I	Analogue encoder #2 COS input, 0-3.3V
45	Enc2 Z	I	Incr. encoder #2 Z digital input, 0-3.3V
46	+5Vout	O	5V output supply. Max 300mA for feedback sensors and I/Os
47	SPICS	O	SPI Chip Select
48..50	Reserved	-	Reserved

Connector Description

J2

Pin	Name	Type	Description
1	Rx0+	I/O	Receive/Transmit positive, ECAT IN port. Connect directly to RJ45 pin3.
2	Tx0+	I/O	Transmit/Receive positive, ECAT IN port. Connect directly to RJ45 pin1.
3	Rx0-	I/O	Receive/Transmit negative, ECAT IN port. Connect directly to RJ45 pin6.
4	Tx0-	I/O	Transmit/Receive negative, ECAT IN port. Connect directly to RJ45 pin2.
5	450	-	GND connection for ECAT IN port. Connect directly to RJ45 pins 4 and 5.
6	Shield0	-	Shield connection for ECAT IN port. Connect directly to RJ45 shield.
7	780	-	GND connection for ECAT IN port. Connect directly to RJ45 pins 7 and 8.
8..11	Reserved	-	Reserved
12	781	-	GND connection for ECAT OUT port. Connect directly to RJ45 pins 7 and 8.
13	Shield1	-	Shield connection for ECAT OUT port. Connect directly to RJ45 shield.
14	451	-	GND connection for ECAT OUT port. Connect directly to RJ45 pins 4 and 5.
15	Tx1-	I/O	Transmit/Receive negative, ECAT OUT port. Connect directly to RJ45 pin2.
16	Rx1+	I/O	Receive/Transmit positive, ECAT OUT port. Connect directly to RJ45 pin3.
17	Tx1+	I/O	Transmit/Receive positive, ECAT OUT port. Connect directly to RJ45 pin1.
18	Rx1-	I/O	Receive/Transmit negative, ECAT OUT port. Connect directly to RJ45 pin6.
19..22	Reserved	-	Reserved
23	ACT0	O	Anode of Link/Activity LED for port IN.
24	ERR	O	Anode of Error LED (EtherCAT status machine).
25	ACT1	O	Anode of Link/Activity LED for port OUT.
26	RUN	O	Anode of Run LED (EtherCAT status machine).
27	+3.3V	O	+3.3V output power supply
28	Sync0	O	Sync0 ECAT signal
29..31	Reserved	-	Reserved
32	SPI_IRQ	O	EtherCAT communication interrupt signal
33	+5V	O	+5V output power supply
34	GND	-	Ground
35..39	Reserved	-	Reserved
40	GND	-	Ground

J6

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

J3

Pin	Name	Type	Description
1,2	A/A+	O	Phase A for 3-ph motors, A+ for 2-ph steppers, Motor+ for DC brush motors
3,4	B / A-	O	Phase B for 3-ph motors, A- for 2-ph steppers, Motor- for DC brush motors
5,6	C / B+	O	Phase C for 3-ph motors, B+ for 2-ph steppers
7,8	CR / B-	O	Chopping resistor / Phase B- for step motors

	Pin	Name	Type	Description
J4	1,2	+V_{MOT}	I	Positive terminal of the motor supply

	Pin	Name	Type	Description
J5	1,2	GND	-	Negative return (ground) of the motor supply

	Pin	Name	Type	Description
J7	1	Earth	-	Earth connection

Electrical characteristics

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

- Tamb = 0…40ºC, VLOG = 24 VDC; VMOT = 80VDC
- Supplies start-up / shutdown sequence: -any-
- Load current (sinusoidal amplitude / continuous BLDC, DC, stepper) = 20A

Operating Conditions		**Min**	**Typ**	**Max**	**Units**
Ambient temperature[1]		0		+40	ºC
Ambient humidity	Non-condensing	0		90	%Rh
Altitude / pressure[2]	Altitude (vs. sea level)	-0.1	0 ÷ 2	2	Km
	Ambient Pressure	0 [2]	0.75 ÷ 1	10.0	atm
Storage Conditions		**Min**	**Typ**	**Max**	**Units**
Ambient temperature		-40		+85	ºC
Ambient humidity	Non-condensing	0		100	%Rh
Ambient Pressure		0		10.0	atm
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	60 x 40 x 28.2			mm
		~2.36 x 1.58 x 1.11			inch
Weight	Without mating connectors	45			g
Power dissipation	Idle (no load)		3.6		W
	Operating		11		
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		300		mA
		+V_{LOG} = 12V		250		
		+V_{LOG} = 24V		150		
		+V_{LOG} = 36V		100		

Motor Supply Input (+V_{MOT})		**Min**	**Typ**	**Max**	**Units**
Supply voltage	Nominal values	12	80	90	V_{DC}
	Absolute maximum values, drive operating but outside guaranteed parameters	11		94	V_{DC}
	Absolute maximum values, surge (duration ≤ 10ms) †	-1		95	V
Supply current	Idle		1	5	mA
	Operating	-40	±20	+40	A
	Absolute maximum value, short-circuit condition (duration ≤ 10ms) †			45	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			20	A
	for PMSM motors with FOC sinusoidal control (sinusoidal amplitude value)			20	
	for PMSM motors with FOC sinusoidal control (sinusoidal effective value)			14.2	
Motor output current, peak	maximum 10s	-40		+40	A

Short-circuit protection threshold	measurement range			±45	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} = 80 V	F_{PWM}			µH
		20 kHz	330		
		40 kHz	150		
		60 kHz	120		
		80 kHz	80		
		100 kHz	60		
	Minimum value, limited by short-circuit protection; +V_{MOT} = 80 V	20 kHz	120		µH
		40 kHz	40		
		60 kHz	30		
		80 kHz	15		
		100 kHz	8		
Motor electrical time-constant (L/R)	Recommended value for ±5% current measure-ment error	20 kHz	250		µs
		40 kHz	125		
		60 kHz	100		
		80 kHz	63		
		100 kHz	50		
Current measurement	FS = Full Scale accuracy		±5	±8	%FS

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"	1.8			
	Floating voltage (not connected)		4.5		
	Absolute maximum, surge (duration ≤ 1s) †	-10		+15	
Input current	Logic "LOW"; Pull to GND		5	3	mA
	Logic "HIGH"; Internal 1KΩ pull-up to +5	0	0	0	
Minimum pulse width		2			µs
ESD protection	Human body model	±5			kV

Linear Hall Inputs (LH1, LH2, LH3)		**Min**	**Typ**	**Max**	**Units**
Input voltage	Operational range	0	0.5÷4.5	4.9	V
	Absolute maximum values, continuous	-7		+7	
	Absolute maximum, surge (duration ≤ 1s) †	-11		+14	
Input current	Input voltage 0…+5V	-1	±0.9	+1	mA
Interpolation Resolution	Depending on software settings			10	bits
Frequency		0		1	kHz
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		8		kΩ
Resolution			12		bits
Integral linearity				±2	bits
Offset error			±2	±10	bits
Gain error			±1%	±3%	% FS[4]
Bandwidth (-3dB)	Software selectable	0		1	kHz
ESD protection	Human body model	±2			kV

[1] Operating temperature can be extended up to **+65ºC** with reduced current and power ratings.
[2] iMOTIONCUBE 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] It is recommended to mount the iMOTIONCUBE on a metallic support using the provided mounting holes, for better reliability and reduced de-rating due to heat dissipation
[4] "FS" stands for "Full Scale"

Encoder #1 Inputs (A2+, A2-, B2+, B2-, Z2+, Z2-)[1]		**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)		4.7		
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 [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	A1+, B1+, Z1+ to GND		2.2		kΩ
	A1-, B1-, Z1- to GND		3.6		
Input frequency	Single-ended mode	0		500	kHz
	Differential mode	0		10	MHz
Input voltage, any pin to GND	Absolute maximum, surge duration ≤1s†	-11		+14	V
ESD protection	human body model	±1			kV
Encoder #2 Inputs (A2, B2, Z2)		**Min**	**Typ**	**Max**	**Units**
Single ended mode compliance		TTL / CMOS / Open collector			
Input voltage, single-ended mode	Logic "LOW"			0.8	V
	Logic "HIGH"	2			
Input current, single-ended mode	Logic "LOW"			0.1	mA
	Logic "HIGH"			0.1	
Sin-Cos Encoder Inputs (Sin+, Sin-, Cos+, Cos-)[1]		**Min**	**Typ**	**Max**	**Units**
Input voltage, differential	Sin+ to Sin-, Cos+ to Cos-	0.8	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-		120		Ω
	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	±2			kV
Digital Inputs (IN0, IN1, IN2/LSP, IN3/LSN)[3]		**Min**	**Typ**	**Max**	**Units**
Mode compliance		PNP			
Default state	Input floating (wiring disconnected)	Logic LOW			
Input voltage	Logic "LOW"	-10	0	2.2	V
	Logic "HIGH"	6.3		36	
	Floating voltage (not connected)		0		
	Absolute maximum, continuous	-10		+39	
	Absolute maximum, surge (duration ≤ 1s)†	-20		+40	
Input current	Logic "LOW"; pulled to GND		0		mA
	Logic "HIGH"		6	8	

Mode compliance		NPN			
Default state	Input floating (wiring disconnected)	Logic HIGH			
Input voltage	Logic "LOW"	-10		2.2	V
	Logic "HIGH"	6.3		36	
	Floating voltage (not connected)		Vlog-1		
	Absolute maximum, continuous	-10		+36	
	Absolute maximum, surge (duration ≤ 1s)†	-20		+40	
Input current	Logic "LOW"; Pulled to GND		6	8	mA
	Logic "HIGH"; Pulled to +24V		0		

Input frequency		0		150	kHz
Minimum pulse		3.3			µs
ESD protection	Human body model	±2			kV
Digital Outputs (OUT0, OUT1, OUT2/Error, OUT3/ Ready)		**Min**	**Typ**	**Max**	**Units**
Mode compliance	All outputs (OUT0, OUT1, OUT2/Error, OUT3/Ready)	NPN 24V			
Default state	Not supplied (+V_{LOG} floating or to GND)	High-Z (floating)			
	Immediately after power-up: OUT0, OUT1	Logic "HIGH"			
	Immediately after power-up: OUT2/Error, OUT3/Ready	Logic "LOW"			
	Normal operation: OUT0, OUT1, OUT2/Error	Logic "HIGH"			
	Normal operation: OUT3/Ready	Logic "LOW"			
Output voltage	Logic "LOW"; output current = 0.5A			0.8	V
	Logic "HIGH", external load to +V_{LOG}		V_{LOG}		
	Absolute maximum, continuous	-0.5		36V	
Output current	Logic "LOW", sink current, continuous			0.5	A
	Logic "HIGH", leakage current; external load to +V_{LOG}; V_{OUT} = V_{LOG} max = 39V			0.2	mA
Minimum pulse width		2			µs
ESD protection	Human body model	±2			kV
Encoder#1 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 [4]	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		5	MHz
	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

[1] Encoder #1 differential input pins do not have internal 120Ω termination resistors connected across. Contact Technosoft in case they are needed.

[2] For full RS-422 compliance, 120Ω termination resistors must be connected across the differential pairs

[3] The digital inputs are software selectable as PNP or NPN

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

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	±2			kV
Encoder#2 Inputs (A2, B2, Z2)		**Min**	**Typ**	**Max**	**Units**
Single-ended mode compliance		TTL / CMOS / Open-collector			
Input voltage, single-ended mode A2, B2, Z2	Logic "LOW"			0.8	V
	Logic "HIGH"	2			
Input current, single-ended mode A2, B2, Z2	Logic "LOW"			0.1	mA
	Logic "HIGH"			0.1	
Sin-Cos Encoder Inputs (Sin+, Sin-, Cos+, Cos-)[2]		**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-	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	±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 (meantime 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

Ethernet Ports		**Min.**	**Typ.**	**Max.**	**Units**
Standard Compliance		EtherCAT (IEC61158-3/4/5/6-12)			
		Fast Ethernet 100BASE-TX (IEEE802.3u)			
		Auto-negotiation for 100Mbps/s full-duplex			
		Auto-detect MDI/MDI-X			
Power over Ethernet	NOT used by ECAT MX, separate 5V supply	compliant to IEEE802.3af mode A "Mixed DC & Data"			
		NOT compliant to IEEE802.3af mode B "DC on Spares"			
Isolation GND0,GND1	Requirement for motherboard PCB routing	500			V_{rms}
		1.5			kV_{peak}
Maximum cable length	2-pair UTP Cat5	100	150		m
ESD protection	Human body model	±4			kV
ECAT LED signals		**Min.**	**Typ.**	**Max.**	**Units**
LED connection		Common anode to 3.3V output			
		Direct, no series resistor			
LED current			8	10	mA
3.3 output voltage		3.15	3.3	3.45	V
3.3 output current				60	mA
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
Supply Output (+5V)		**Min**	**Typ**	**Max**	**Units**
Output voltage	Current sourced = 500mA	4.8	5	5.2	V
Output current		200	250		mA
Short-circuit		NOT protected			
Over-voltage		NOT protected			
ESD protection	Human body model	±2			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.