Top view; Pins facing upward; All dimensions are in mm; Header pitch of J1 & J2 is 1.27mm and for J3 is 2.54 mm. Drawing not to scale.

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	Ⓣ				
Analog Sin/Cos encoder	Ⓣ	Ⓣ	Ⓣ	Ⓣ	
SSI / BiSS-C/ EnDAT/ TAMAGAWA/ Panasonic	Ⓣ	Ⓣ	Ⓣ	Ⓣ	
Tacho			Ⓣ		
Open-loop (no sensor)				Ⓣ	Ⓣ

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 (PVT, S-curve, electronic cam)
- Motor supply: 11-50V; Logic SELV/ PELV supply: 9-36V; STO SELV/ PELV supply: 18-40V
- Output current: 15A [1] RMS cont. (BLDC mode); 28 A_{PEAK} RMS, up to 100kHz PWM
- Operating ambient temperature: 0-40°C (over 40°C with derating)
- NTC/PTC analogue Motor Temperature sensor input
- Communication interfaces:
  - USB
  - RS232
  - dual 100Mbps EtherCAT® ports

- Feedback Devices (dual-loop support)
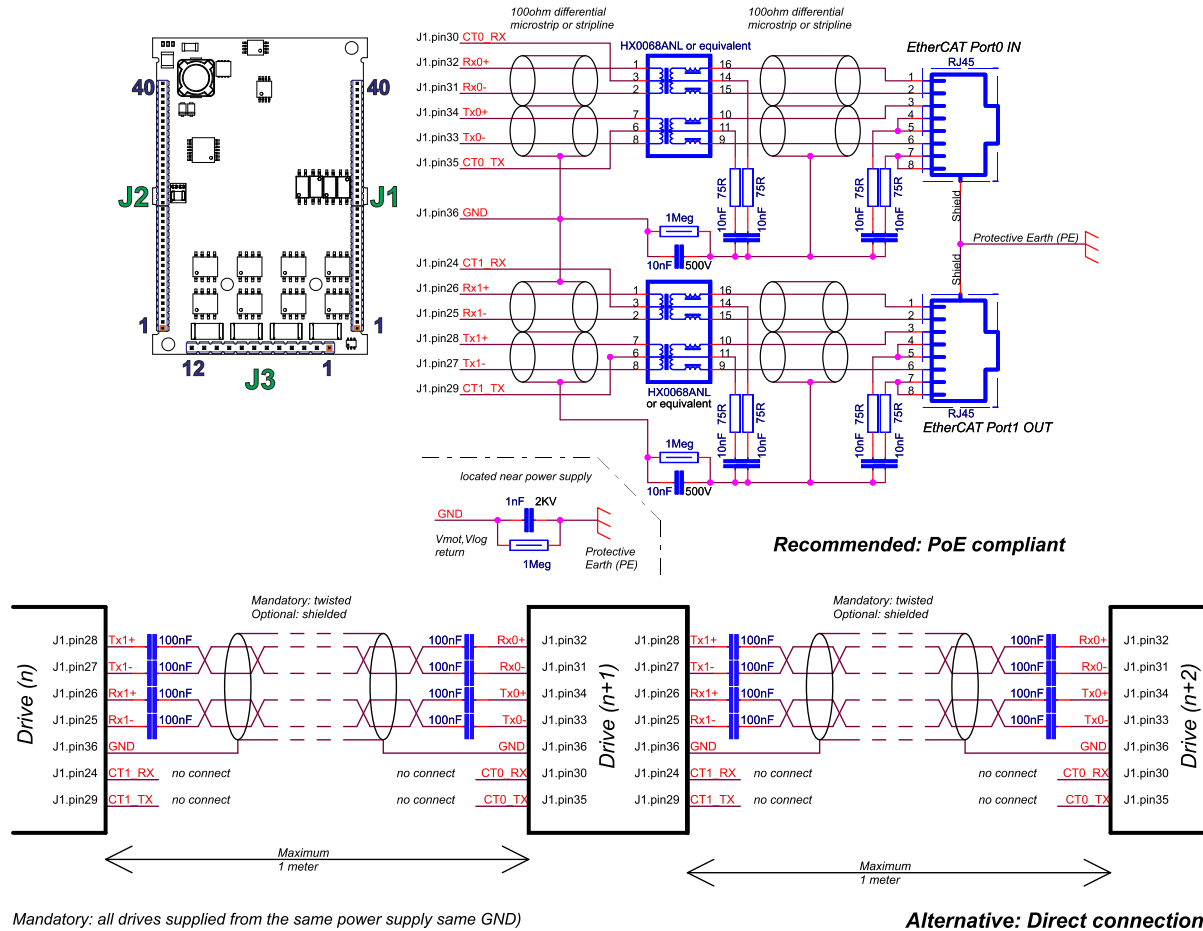
1st feedback devices supported:
  - Incremental encoder interface (single ended or differential)
  - Analogue sin/cos encoder interface (differential 1V_{pp})
  - Digital Hall sensor interface (single-ended and open collector)
  - Linear Hall sensors interface
  - pulse & direction interface (single ended or differential) for external (master) digital reference

2nd feedback devices supported:
  - Incremental encoder interface (differential)
  - pulse & direction interface (differential) for external (master) digital reference
  - BISS / SSI / EnDAT / TAMAGAWA / Panasonic 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
- 6 digital outputs: 5-36V, programmable polarity: 0.3A sourcing/NPN or 0.2 A sinking/PNP: (Ready, Error and 4 general-purpose)
- 2 analogue inputs: 12-bit, 0-5V: Reference, Feedback or general purpose
- Commissioning (set-up) possible through RS232, FoE (file-over-EtherCAT®), EoE (Ethernet-over-EtherCAT®)
- EtherCAT® connection between multiple MZ drives: direct 1:1 without any series components
- EtherCAT® connection to standard RJ45: requires external magnetics (may be integrated into RJ45)
- 255 h/w addresses selectable by h/w pins configuration
- 16k x 16 SRAM memory for data acquisition
- 24k x16 E^2ROM to store setup data, TML motion programs, cam tables and other user data

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[1]Nominal current can be increased if external cooling is ensured over cooling area

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EtherCAT connection schematic (HX0068ANL or equivalent, EtherCAT Port0 IN / Port1 OUT, RJ45)

Recommended: PoE compliant

J1.pin30 CT0_RX, J1.pin32 Rx0+, J1.pin31 Rx0-, J1.pin34 Tx0+, J1.pin33 Tx0-, J1.pin35 CT0_TX, J1.pin36 GND
J1.pin24 CT1_RX, J1.pin26 Rx1+, J1.pin25 Rx1-, J1.pin28 Tx1+, J1.pin27 Tx1-, J1.pin29 CT1_TX

100ohm differential microstrip or stripline

located near power supply — GND, Vmot,Vlog return, 1nF 2KV, 1Meg, Protective Earth (PE)

Drive interconnection schematic:

Mandatory: twisted / Optional: shielded

Maximum 1 meter

Drive (n): J1.pin28 Tx1+ 100nF, J1.pin27 Tx1- 100nF, J1.pin26 Rx1+ 100nF, J1.pin25 Rx1- 100nF, J1.pin36 GND, J1.pin24 CT1_RX no connect, J1.pin29 CT1_TX no connect

Drive (n+1): J1.pin32, J1.pin31, J1.pin34, J1.pin33, J1.pin36, J1.pin30, J1.pin35 / J1.pin28 Tx1+ 100nF, J1.pin27 Tx1- 100nF, J1.pin26 Rx1+ 100nF, J1.pin25 Rx1- 100nF, J1.pin36 GND, J1.pin24 CT1_RX, J1.pin29 CT1_TX

Drive (n+2): J1.pin32, J1.pin31, J1.pin34, J1.pin33, J1.pin36, J1.pin30, J1.pin35

Mandatory: all drives supplied from the same power supply same GND)

Mating Connectors			
When J3 is plugged into a connector and maximum current should not exceed 12.7A Sine amplitude			
Ref	**Producer**	**Part No.**	**Description**
J1, J2	Harwin	M52-5012045	1x20 contacts, socket 1.27mm-pitch; 4 pcs needed for one drive
	Samtec	SMS-140-01-L-S	1x40 contacts, socket 1.27mm-pitch; 2 pcs needed for one drive
		SMS-140-01-G-S	
J3	Mill-Max	801-47-012-10-001000	1x12 contacts, High-current socket 2.54mm-pitch accepting 0.635mm square pin; 1 pcs is needed for one drive; the current should not exceed 12.7A
When J3 is soldered directly onto a motherboard and the maximum current can exceed 13A Sine amplitude			
Ref	**Producer**	**Part No.**	**Description**
J1, J2	Harwin	M52-5012045	1x20 contacts, socket 1.27mm-pitch; 4 pcs needed for one drive
J3			The pins are directly soldered onto a motherboard for increased current capability

Alternative: Direct connection

	Pin	Name	Type	Description
J3	1,2	GND	-	Return ground for motor. Internally connected to all GND signals except STO GND.
	3,4	Cr/B-	O	Chopping resistor / Phase B- for 2-ph steppers
	5,6	C/B+	O	Phase C for 3-ph motors, B+ for 2-ph steppers
	7,8	B/A-	O	Phase B for 3-ph motors, A- for 2-ph steppers, Motor- for DC brush motors
	9,10	A/A+	O	Phase A for 3-ph motors, A+ for 2-ph steppers, Motor+ for DC brush motors
	11,12	+V$_{MOT}$	I	Positive terminal of the motor supply: 11 to 48V$_{DC}$.

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J1

Pin	Name	Type	Description
1	Temp Mot	I	NTC/PTC 3.3V input. Used to read an analog temperature value
2	232TX	O	RS-232 Data Transmission
3	232RX	I	RS-232 Data Reception
4	USB Data-	I/O	USB Data negative
5	USB Data+	I/O	USB Data positive
6	USB V+	I	USB +5V input
7	P1 LED	O	ECAT OUT port LED
8	P0 LED	O	ECAT IN port LED
9	Axis ID Bit7	I	8 bit H/W Axis ID register. Connect pin to GND to set bit to 1. Sets hardware Axis ID that is found in the ECAT register *configured station alias* Pin 16 is Bit 0... Pin 9 is Bit 8 of the Axis value. Possible values: from 1 to 255 (all pins OFF); When Axis ID is 255, the EtherCAT register called "*configured station alias*" will be 0.
10	Axis ID Bit6	I	
11	Axis ID Bit5	I	
12	Axis ID Bit4	I	
13	Axis ID Bit3	I	
14	Axis ID Bit2	I	
15	Axis ID Bit1	I	
16	Axis ID Bit0	I	
17	RUN	O	Anode of Run LED (EtherCAT status machine).
18	ERR	O	Anode of Error LED (EtherCAT status machine).
19	Spi2 Clk	O	Reserved. Do not use
20	Spi2 Out	O	Reserved. Do not use
21	Spi2 In	I	Reserved. Do not use
22	Spi2 CS	O	Reserved. Do not use
23	Spi2 Irq	I	Reserved. Do not use
24	CT1_Rx	-	Connect to center tap of OUT port magnetics PHY Rx.
25	RX1-	I/O	Receive/Transmit negative, OUT port. Connect to magnetics PHY RX1.
26	RX1+	I/O	Receive/Transmit positive, OUT port. Connect to magnetics PHY RX1.
27	TX1-	I/O	Transmit/Receive negative, OUT port. Connect to magnetics PHY TX1.
28	TX1+	I/O	Transmit/Receive positive, OUT port. Connect to magnetics PHY TX1.
29	CT1_Tx	-	Connect to center tap of OUT port magnetics PHY Tx.
30	CT0_Rx	-	Connect to center tap of IN port magnetics PHY Rx.
31	RX0-	I/O	Receive/Transmit negative, IN port. Connect to magnetics PHY RX0.
32	RX0+	I/O	Receive/Transmit positive, IN port. Connect to magnetics PHY RX0.
33	TX0-	I/O	Transmit/Receive negative, IN port. Connect to magnetics PHY TX0.
34	TX0+	I/O	Transmit/Receive positive, IN port. Connect to magnetics PHY TX0.
35	CT0_Tx	-	Connect to center tap of IN port magnetics PHY Tx.
36	GND	-	Return ground. Internally connected to all GND signals except STO GND.
37	STO2-	I	Safe Torque Off input 2, negative return (opto-isolated, 0V)
38	STO2+	I	Safe Torque Off input 2, positive input (opto-isolated, 18÷40V)
39	STO1-	I	Safe Torque Off input 1, negative return (opto-isolated, 0V)
40	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

J2

Pin	Name	Type	Description
1	LH1	I	Linear Hall 1 input
2	LH2	I	Linear Hall 2 input
3	LH3	I	Linear Hall 3 input
4	FDBK	I	Analogue input, 12-bit, 0-5V. Reads an analogue feedback (tacho), or general purpose
5	REF	I	Analogue input, 12-bit, 0-5V. Reads analog reference, or general-purpose analogue input
6	Hall 3	I	Digital input Hall 3 sensor
7	Hall 2	I	Digital input Hall 2 sensor
8	Hall 1	I	Digital input Hall 1 sensor
9	GND	-	Return ground. Internally connected to all GND signals except STO GND.
10	IN5	I	12-36V general-purpose digital PNP/NPN input
11	IN4	I	12-36V general-purpose digital PNP/NPN input
12	IN1	I	12-36V general-purpose digital PNP/NPN input
13	IN0	I	12-36V general-purpose digital PNP/NPN input
14	IN2/LSP	I	12-36V digital PNP/NPN input. Positive limit switch input
15	IN3/LSN	I	12-36V digital PNP/NPN input. Negative limit switch input
16	OUT3	O	5-36V general-purpose digital output, 0.2A PNP/ 0.3A NPN, software selectable
17	OUT2	O	5-36V general-purpose digital output, 0.2A PNP/ 0.3A NPN, software selectable
18	OUT5	O	5-36V general-purpose digital output, 0.2A PNP/ 0.3A NPN, software selectable
19	OUT4	O	5-36V general-purpose digital output, 0.2A PNP/ 0.3A NPN, software selectable
20	OUT1	O	5-36V general-purpose digital output, 0.2A PNP/ 0.3A NPN, software selectable
21	OUT0	O	5-36V general-purpose digital output, 0.2A PNP/ 0.3A NPN, software selectable
22	Z1+	I	Incr. encoder1 Z single-ended, or Z+ diff. input,
23	Z1-	I	Incr. encoder1 Z- diff. input
24	B1+/Cos+	I	Incr. encoder1 B single-ended, or B+ diff. input, or analogue encoder Cos+ diff. input
25	B1-/Cos-	I	Incr. encoder1 B- diff. input, or analogue encoder Cos- diff. input
26	A1+/Sin+	I	Incr. encoder1 A single-ended, or A+ diff. input, or analogue encoder Sin+ diff. input
27	A1- /Sin-	I	Incr. encoder1 A- diff. input, or analogue encoder Sin- diff. input
28	Z2+	I	Incr. encoder2 Z+ diff. input; has 150Ω resistor between pins 28 and 29
29	Z2-	I	Incr. encoder2 Z- diff. input; has 150Ω resistor between pins 28 and 29
30	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 30 and 31
31	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 30 and 31
32	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 32 and 33
33	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 32 and 33
34	Reserved	-	Reserved. Do not use
35	Reserved	-	Reserved. Do not use
36	Reserved	-	Reserved. Do not use
37	Reserved	-	Reserved. Do not use
38	+5V_OUT	O	5V output supply for I/O usage
39	-V_LOG	I	Negative terminal of the logic supply input: 9 to $36V_{DC}$ from SELV/ PELV type power supply.
40	+V_LOG	I	Positive terminal of the logic supply input: 9 to $36V_{DC}$ from SELV/ PELV type power supply.

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Electrical characteristics

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

- VLOG = 24 VDC; VMOT = 48VDC
- Supplies start-up / shutdown sequence: -any-
- Load current (sinusoidal amplitude / cont. BLDC, DC, stepper) = 15A RMS

Operating Conditions		Min.	Typ.	Max.	Units
Ambient temperature		0		40 [1]	ºC
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		100	ºC
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		TBD	TBD	N
Extraction force		TBD	TBD		N

Environmental Characteristics		Min.	Typ.	Max.	Units
Size (Length x Width x Height)	Global size		64 x 43.8 x 15.7		mm
			~2.52 x 1.72 x 0.62		inch
Weight			36.3		g
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, continuous	-0.6		42	V_{DC}
	Absolute maximum values, surge (duration ≤ 10ms) [†]	-1		+45	V
Supply current	+V_LOG = 12V		TBD		mA
	+V_LOG = 24V		TBD		
	+V_LOG = 40V		TBD		

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}
	Absolute maximum values, surge (duration ≤ 10ms) [†]	-1		57	V
Supply current	Idle		1	5	mA
	Operating	-40	±10	+40	A
	Absolute maximum value, short-circuit condition (duration ≤ 10ms) [†]			43	A

Supply Output (+5V)		Min.	Typ.	Max.	Units
Output voltage	Current sourced = 250mA	4.8	5	5.2	V
Output current			TBD		mA
Short-circuit		NOT protected			
Over-voltage		NOT protected			
ESD protection	Human body model	±1			kV

Motor Outputs (A/A+, B/A-, C/B+, CR/B-)			Min.	Typ.	Max.	Units
Nominal output current, continuous [4]	for DC brushed, steppers and BLDC motors with Hall-based trapezoidal control				21.21	A
	for PMSM motors with FOC sinusoidal control (sinusoidal amplitude value)				21.21	
	for PMSM motors with FOC sinusoidal control (sinusoidal effective value)				15	
Motor output current, peak	maximum TBD s		-40		+40	A
Short-circuit protection threshold			±43		±43	A
Short-circuit protection delay				TBD		µs
On-state voltage drop	Nominal output current; including typical mating connector contact resistance			TBD		V
Voltage efficiency				100		%
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				µH
		40 kHz				
		60 kHz				
		80 kHz				
		100 kHz				
	Minimum value, limited by short-circuit protection; +V_MOT = 36 V	20 kHz				µH
		60 kHz				
		40 kHz				
		80 kHz				
		100 kHz				
Motor electrical time-constant (L/R)	Recommended value for ±5% current measurement error	20 kHz				µs
		40 kHz				
		60 kHz				
		80 kHz				
		100 kHz				
Current measurement	FS = Full Scale accuracy			TBD		%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"	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

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	0		0.2	mA
Interpolation Resolution	Depending on software settings			11	bits
Frequency		0		1	kHz
ESD protection	Human body model	±1			kV

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[1] Operating temperature at higher temperatures is possible with reduced current and power ratings
[2] iPOS4815 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
[4] @20kHz F_{PWM}

Digital Inputs (IN0, IN1, IN2/LSP, IN3/LSN, IN4, IN5, IN6)[1]

Parameter		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	24	36	
	Hysteresis	1.2	2.4	2.8	
	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"		8	10	
Mode compliance			NPN		
Default state	Input floating (wiring disconnected)		Logic HIGH		
Input voltage	Logic "LOW"		0	2.2	V
	Logic "HIGH"	6.3	24	36	
	Hysteresis	1.2	2.4	2.8	
	Floating voltage (not connected)		15		
	Absolute maximum, continuous	-10		+39	
	Absolute maximum, surge (duration ≤ 1s)[†]	-20		+40	
Input current	Logic "LOW"; Pulled to GND		8	10	mA
	Logic "HIGH"; Pulled to +24V	0	0	0	
Input frequency		0		10	kHz
Minimum pulse		6			µs
ESD protection	Human body model	±5			kV

Encoder1 Inputs (A1/A1+, A1-, B1/B1+, B1-, Z1/Z1+, Z1-)

Parameter		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-		1		kΩ
	Z1+ to Z1-		1		
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
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

Digital Outputs (OUT0, OUT1, OUT2/Error, OUT3/Ready, OUT4, OUT5)[1]

Parameter		Min.	Typ.	Max.	Units
Mode compliance			PNP 24V		
Default state	Not supplied (+VLOG floating or to GND)		High-Z (floating)		
	Normal operation		Logic "High"		
Output voltage	Logic "HIGH"; output current = 0.2A		V_{LOG}-0.2	V_{LOG}-0.8	V
	Logic "LOW"; output current = 0, no load		open-collector		
	Logic "HIGH", external load to GND		0		
	Absolute maximum, continuous	-0.3		V_{LOG}+0.3	
	Absolute maximum, surge (duration ≤ 1s)[†]	-0.5		V_{LOG}+0.5	
Output current	Logic "HIGH", source current, continuous			0.2	A
	Logic "HIGH", source current, pulse ≤ 5 s			0.4	A
	Logic "LOW", means High-Z				mA
Minimum pulse width			2		µs
ESD protection	Human body model	±15			kV
Mode compliance			NPN 24V		
Default state	Not supplied (+VLOG floating or to GND)		High-Z (floating)		
	Normal operation		High-Z		
Output voltage	Logic "LOW"; output current = 0.3A		0.2	0.8	V
	Logic "HIGH"; output current = 0, no load		open-collector		
	Logic "HIGH", external load to +V_{LOG}		V_{LOG}		
	Absolute maximum, continuous	-0.3		V_{LOG}+0.3	
	Absolute maximum, surge (duration ≤ 1s)[†]	-0.5		V_{LOG}+0.5	
Output current	Logic "LOW", sink current, continuous			0.3	A
	Logic "LOW", sink current, pulse ≤ 5 s			0.5	A
	Logic "HIGH", means High-Z				mA
Minimum pulse width			2		µs
ESD protection	Human body model	±15			kV

Encoder2 Inputs (A2+/Data+, A2-/Data-, B2+/Clk+, B2-/Clk-, Z2+, Z2-)[3]

Parameter		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

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[1] The digital inputs and outputs are software selectable as PNP or NPN

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

[3] Encoder2 differential input pins have internal 150Ω termination resistors connected across

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 dangerous failures per hour)	8*10[-10]	hour[-1] (0.8 FIT)		
EN13849-1 Classification	Performance Level		Cat3/PLe		
	MTTFM (meantime to dangerous failure)		377		years
Mode compliance			PNP		
Default state	Input floating (wiring disconnected)		Logic LOW		
Input voltage	Logic "LOW"	-20		5.6	V
	Logic "HIGH"	18		36	
	Absolute maximum, continuous	-20		+40	
Input current	Logic "LOW"; pulled to GND		0		mA
	Logic "HIGH", pulled to +Vlog		5	13	
Repetitive test pulses (high-low-high)	Ignored high-low-high			5	ms
				20	Hz
Fault reaction time	From internal fault detection to register DER bit 14 =1 and OUT2/Error high-to-low			30	ms
PWM operation delay	From external STO 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 the iPOS4810, requires separate +Vlog SELV/ PELV 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

When the connections between drives are done directly, without magnetics (nonstandard, not conform to Ethernet IEEE802.3 100BASE-TX), it is imperative that the ground voltage difference between drives is kept to a minimum. The installation must provide a supplementary GND link between the drives. This link must have low inductance. Low inductance is best achieved by using large metal parts, such as a metallic chassis / baseplate, or using copper conductive tape.

LED signals		Min.	Typ.	Max.	Units
LED connection			Common cathode to GND		
			Direct, no series resistor		
LED current			0.7	1	mA

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.

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[1] For many applications, a 120Ω termination resistor should be connected across SIN+ to SIN-, and across COS+ to COS-. Please consult the feedback device datasheet for confirmation.

[2] "FS" stands for "Full Scale"

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