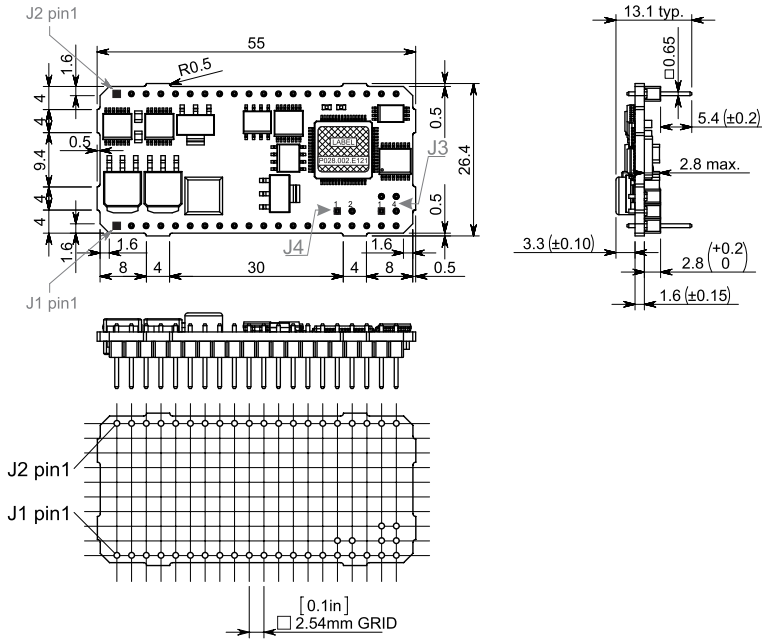




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Motor – sensor configurations					
Sensor \ Motor	PMSM	BLDC	DC BRUSH	STEP (2-ph)	STEP (3-ph)
Incr. Encoder	Ⓢ		Ⓢ	Ⓢ	
Incr. Encoder + Digital Hall	Ⓢ	Ⓢ			
Analog Sin/Cos encoder	Ⓢ				
Linear Halls	Ⓢ				
Digital Halls only	Ⓢ				
Tacho			Ⓢ		
Open-loop (no sensor)				Ⓢ	Ⓢ
Open-loop (with step loss detection using incr. enc.)				Ⓢ	Ⓢ
Open-loop (with incr. enc on load.)				Ⓢ	Ⓢ

Connectors type			
Ref.	Producer	On-board connector	Mating connector
J1, J2	Fischer Elektronik	SL 11 112 020 G	BL 5 20
J1, J2, J3, J4	-	Standard header square pin 0.635 x 0.635 mm; 2.54 mm pitch	Standard socket for square pin 0.635 x 0.635 mm; 2.54 mm pitch

- ### 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, 2 general-purpose
 - 4 digital outputs, 5-36V, 0.5A, NPN O.C.: Ready, Error, 2 general-purpose
 - 1 analogue input: 12-bit, 0-5V: Reference/Feedback or general purpose
 - RS-232 serial & dual 100Mbps EtherCAT® interfaces
 - 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

Connector description

Pin	Name	Type	Description
1-2	B / A-	O	Phase B for 3-ph motors, A- for 2-ph steppers, Motor- for DC brush motors
3-4	CR / B-	O	Chopping resistor / Phase B- for step motors
5-6	+V _{MOT}	I	Positive terminal of the motor supply: 9 to 36V _{DC}
7	+V _{LOG}	I	Positive terminal of the logic supply: 7 to 36V _{DC}
8	OUT3 / Ready	O	5-36V 0.5A drive ready output, active low, NPN open-collector/TTL pull-up. Also drives the green LED.
9	OUT2 / Error	O	5-36V 0.5A drive error output, active low, NPN open-collector/TTL pull-up. Also drives the red LED
10	Hall 1	I	Digital input Hall 1 sensor
11	Hall 2	I	Digital input Hall 2 sensor
12	Hall 3	I	Digital input Hall 3 sensor
13	OUT0	O	5-36V 0.5A general-purpose digital output, NPN open-collector / TTL pull-up
14	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

- | | | | |
|----|-----------------|---|---|
| 15 | Z / Z+ | I | Incr. encoder Z (index) single-ended, or Z+ diff. input |
| 16 | Z- / LH3 | I | Incr. encoder Z- differential input, or linear Hall 3 input |
| 17 | A / A+ / Sin+ | I | Incr. encoder A single-ended, or A+ diff. input, or analogue encoder Sin+ diff. input |
| 18 | A- / Sin- / LH1 | I | Incr. encoder A- diff. input, or analogue encoder Sin-diff. input, or linear Hall 1 input |
| 19 | B / B+ / Cos+ | I | Incr. encoder B single-ended, or B+ diff. input, or analogue encoder Cos+ diff. input |
| 20 | B- / Cos- / LH2 | I | Incr. encoder B- diff. input, or analogue encoder Cos-diff. input, or linear Hall 2 input |

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	C / B+	O	Phase C for 3-ph motors, B+ for 2-ph steppers
5-6	GND	-	Negative return (ground) of the motor supply
7	IN0	I	5-36V digital input General-purpose
8	IN1	I	5-36V digital input
9	IN2 / LSP	I	5-36V digital input Positive limit switch input
10	IN3 / LSN	I	5-36V digital input Negative limit switch input
11	IN4 / Enable	I	5-36V digital input Drive enable input
12	GND	-	Return ground
13	+5V _{OUT}	O	5V output supply
14	Sync	I	3.3V digital input; for ECAT interface board
15	ECAT Ready	I	3.3V digital input; for ECAT interface board
16	Interrupt	I	3.3V digital input; for ECAT interface board
17	Reserved	I/O	Reserved. Do not connect.
18	Reserved	I/O	Reserved. Do not connect.
19	232TX	O	RS-232 Data Transmission
20	232RX	I	RS-232 Data Reception

Pin	Name	Type	Description
1	Data In	O	3.3V digital output; for ECAT interface board
2	Chip Select	O	3.3V digital output; for ECAT interface board
3	Data Out	I	3.3V digital input; for ECAT interface board
4	Clock	O	3.3V digital output; for ECAT interface board

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Pin	Name	Type	Description
J4	1	OUT1	O 5-36V 0.5A general-purpose digital output, NPN open-collector / TTL pull-up
	2	Reserved	I Reserved. Do not connect.

Electrical characteristics

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

- Tamb = 0...40°C, VLOG = 24 VDC; VMOT = 36VDC
- Supplies start-up / shutdown sequence: -any-
- Load current (sinusoidal amplitude / continuous BLDC, DC, stepper) = 4A

Operating Conditions	Min.	Typ.	Max.	Units
Ambient temperature ¹	0		+40	°C
Ambient humidity	Non-condensing		90	%Rh
Altitude / pressure ²	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		+85	°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 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	N
Extraction force			5 10	N

Environmental Characteristics	Min.	Typ.	Max.	Units
Size (Length x Width x Height)	Global size		55 x 26.4 x 13.1	mm
			~2.2 x 1 x 0.5	inch
Weight			8	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	A
	Absolute maximum value, short-circuit condition (duration ≤ 10ms) [†]			15	A	

Motor Outputs (A/A+, B/A-, C/B+, BR/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			±13	±15	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}			µH
		20 kHz	250		
		40 kHz	120		
		60 kHz	100		
		80 kHz	60		
	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"; pulled to GND		0.6	1	mA
	Logic "HIGH"; Internal 4.7KΩ pull-up to +3.3		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

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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Digital Outputs (OUT0, OUT2/Error, OUT3/ Ready)		Min.	Typ.	Max.	Units	
Mode compliance	All outputs (OUT0, OUT2/Error, OUT3/Ready) Ready, Error	TTL / CMOS / Open-collector / NPN 24V				
		Same as above + LVTTTL (3.3V)				
Default state	Not supplied (+V _{LOG} floating or to GND)	High-Z (floating)				
	Immediately after power-up	OUT0	Logic "HIGH"			
		OUT2/Error, OUT3/ Ready	Logic "LOW"			
Normal operation	OUT0, 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	4	4.5	5	
	Logic "HIGH", external load to +V _{LOG}		V _{LOG}		V	
	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			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 ¹	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	
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

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	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

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}
	Operational range	-1	2.5	4	
	Absolute maximum values, continuous	-7		+7	
Input voltage, any pin to GND	Absolute maximum, surge (duration ≤ 1S) †	-11		+14	V
Input impedance	Differential, Sin+ to Sin-, Cos+ to Cos- ²	4.2	4.7		kΩ
	Common-mode, to GND		2.2		
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	
ESD protection	Human body model	±1			kV

Analog 0...5V Inputs (REF)		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	bits	
Gain error				±1%	±3%	% FS ³
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

¹ For full RS-422 compliance, 120Ω termination resistors must be connected across the differential pairs, as close as possible to the drive input pins.

² For many applications, an 120Ω termination resistor should be connected across SIN+ to SIN-, and across COS+ to COS-. Please consult the feedback device datasheet for confirmation.

³ "FS" stands for "Full Scale"

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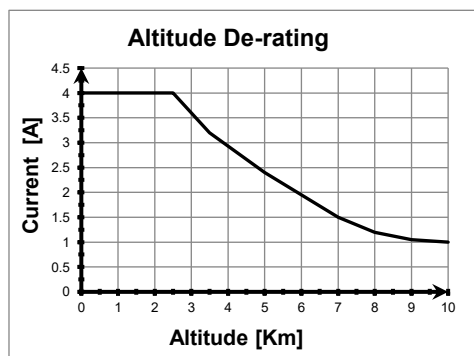
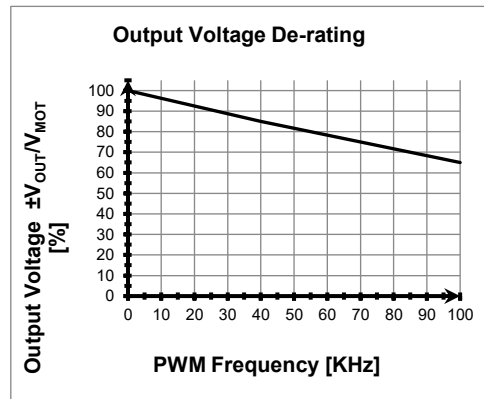
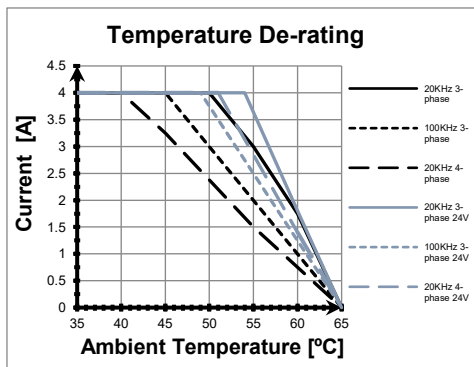
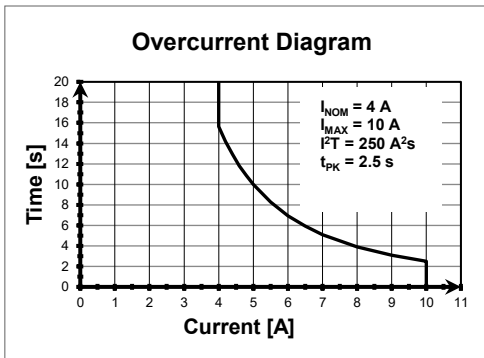
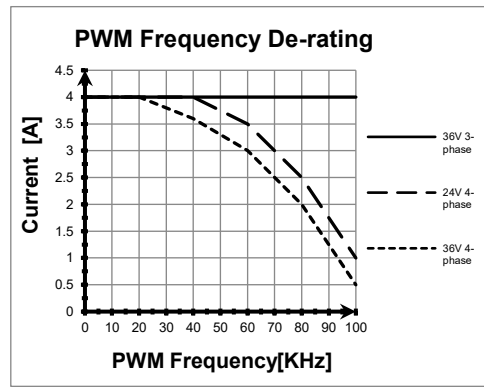
RS-232		Min.	Typ.	Max.	Units
Compliance		TIA/EIA-232-C			
Bit rate	Software selectable	9600		115200	Baud
Short-circuit	232TX short to GND	Guaranteed			
ESD protection	Human body model	±2			kV

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.



¹ V_{OUT} – the output voltage, V_{MOT} – the motor supply voltage

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