

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		Ⓣ				
Tacho				Ⓣ		
Open-loop (no sensor)					Ⓣ	Ⓣ

Mating Connector				
Producer	Part No.	Connector	Description	Wire Gauge
MOLEX	43025-0200	J1	MICROFIT RECEPTACLE HOUSING, 2x1 WAY	AWG 20..24
MOLEX	43025-0400	J5,J6,J7	MICROFIT RECEPTACLE HOUSING, 2x2 WAY	AWG 20..24
MOLEX	43025-1000	J2	MICROFIT RECEPTACLE HOUSING, 2x5 WAY	AWG 20..24
MOLEX	43025-1400	J4	MICROFIT RECEPTACLE HOUSING, 2x7 WAY	AWG 20..24
MOLEX	43030-0007	J1,J2,J4,J5,J6,J7	CRIMP PIN, MICROFIT, 5A	AWG 20..24
MOLEX	51110-1056	J3	MILLIGRID RECEPTACLE HOUSING, 2x5 WAY	AWG 24..30
MOLEX	50394-8400	J3	CRIMP PIN, MILLIGRID	AWG 24..30

Features

- Motor supply: 9-36V. Optional logic supply: 9-36V
- 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)
- Analogue sin/cos encoder interface (differential 1V_{pp})
- 5 digital inputs, 5-36V, PNP or NPN software selectable: Enable, 2 for limit switches, 2 general-purpose
- 4 digital outputs, 5-36V, 0.5A, NPN open-collector: Ready, Error, 2 general-purpose
- 1 analogue input: 12-bit, 0-5V: Reference or feedback or general purpose
- RS-232 serial & CAN-bus 2.0B interfaces with H/W selectable addresses
- TMLCAN and CANopen (CiA 301 v4.2 and CiA 402 v3.0) protocols selectable by jumper
- 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
1	GND	-	Negative return (ground) of the power supply
2	+V _{MOT}	I	Positive terminal of the motor supply: 9 to 36V _{DC} / Positive terminal of the internal logic supply if J4 pin 7 not connected (I/Os work only when J4 pin 7 is connected)

Pin	Name	Type	Description
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	CR/B-	O	Chopping resistor / Phase B- for step motors
8	+5V _{OUT}	O	5V output supply - internally generated
9	GND	-	Negative return (ground) of the motor supply
10	GND	-	Negative return (ground) of the motor supply

Pin	Name	Type	Description
1	GND	-	Return ground for sensors supply
2	+5V _{OUT}	O	5V output supply for I/O usage
3	GND	-	Return ground for sensors supply
4	+5V _{OUT}	O	5V output supply for I/O usage
5	A-/Sin-	I	Incr. encoder A- diff. input, or analogue encoder Sin- diff. input
6	A+/Sin+	I	Incr. encoder A+ diff. input, or analogue encoder Sin+ diff. input
7	B-/Cos-	I	Incr. encoder B- diff. input, or analogue encoder Cos- diff. input
8	B+/Cos+	I	Incr. encoder B+ diff. input, or analogue encoder Cos+ diff. input
9	Z-	I	Incr. encoder Z- diff. input,
10	Z+	I	Incr. encoder Z+ (index) diff. input

Pin	Name	Type	Description
1	+5V _{OUT}	O	5V output supply for I/O usage
2	ANLG	I	Analogue input, 12-bit, 0-5V. Used to read an analog position, speed or torque reference, or an analogue position or speed feedback or as general purpose analogue input
3	IN0	I	5-36V general-purpose digital PNP/NPN input
4	IN4/Enable	I	5-36V digital PNP input. Drive enable input
5	IN3/LSN	I	5-36V digital PNP input. Negative limit switch input
6	OUT2/Error	O	5-36V 0.5A, drive Error output, active low, NPN open-collector/TTL pull-up. Also drives the red LED
7	+V _{LOG} ¹	I	Positive terminal of the logic supply for inputs and outputs operation: 9 to 36V _{DC}
8	GND	-	Return ground for I/O pins
9	ANLG	I	Analogue input, 12-bit, 0-5V. Used to read an analog position, speed or torque reference, or an analogue position or speed feedback or as general purpose analogue input
10	IN1	I	5-36V general-purpose digital PNP/NPN input
11	IN2/LSP	I	5-36V digital PNP/NPN input. Positive limit switch input
12	OUT0	O	5-36V 0.5A, general-purpose digital output, NPN open-collector/TTL pull-up
13	OUT3/Ready	O	5-36V 0.5A, drive Ready output, active low, NPN open-collector/TTL pull-up. Also drives the green LED.
14	OUT1	O	5-36V 0.5A, general-purpose digital output, NPN open-collector/TTL pull-up

Pin	Name	Type	Description
1	+V _{LOG}	O	Positive terminal of the logic supply: 9 to 36V _{DC}
2	GND	-	Return ground for CAN-Bus
3	Can-Hi	I/O	CAN-Bus positive line (dominant high)
4	Can-Lo	I/O	CAN-Bus negative line (dominant low)

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

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) = 4A

Operating Conditions		Min.	Typ.	Max.	Units
Ambient temperature ²		0		+40	°C
Ambient humidity	Non-condensing	0		90	%Rh
Altitude / pressure ³	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		+85	°C
Ambient humidity	Non-condensing	0		100	%Rh
Ambient Pressure		0		10.0	atm
Mechanical Mounting		Min.	Typ.	Max.	Units
Airflow				natural convection ⁴ , closed box	

Environmental Characteristics		Min.	Typ.	Max.	Units
Size (Length x Width x Height)	Without mating connectors	72.4 x 44.6 x 15.6			mm
		~2.85 x 1.76 x 0.61			inch
Weight	Without mating connectors	48			g
Power dissipation	Idle (no load)	1			W
	Operating	3			
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			V _{DC}
	Absolute maximum values, drive operating but outside guaranteed parameters	5.9			V _{DC}
	Absolute maximum values, continuous	0			V _{DC}
	Absolute maximum values, surge (duration ≤ 10ms) [†]	0			+45
Supply current	No Load on Digital Outputs	+V _{LOG} = 9V	125	300	mA
		+V _{LOG} = 12V	80	200	
		+V _{LOG} = 24V	50	125	
		+V _{LOG} = 39V	40	100	
Motor Supply Input (+V _{MOT})		Min.	Typ.	Max.	Units
Supply voltage	Nominal values	9			V _{DC}
	Absolute maximum values, drive operating but outside guaranteed parameters	8.5			V _{DC}
	Absolute maximum values, continuous	0			V _{DC}
	Absolute maximum values, surge (duration ≤ 10ms) [†]	0			+45
Supply current	Idle	1			mA
	Operating	-10	±4	+10	A
	Absolute maximum value, short-circuit condition (duration ≤ 10ms) [†]				15
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
	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
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	100 kHz	45		µH
		20 kHz	75		
		40 kHz	25		
		60 kHz	20		
		80 kHz	10		
100 kHz	5				

¹ If +V_{LOG} (J4 pin7) is not connected, the digital outputs and inputs will not be operational.

² Operating temperature can be extended up to +65°C with reduced current and power ratings.

³ 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.

⁴ It is recommended to mount the iPOS3604 HX-CAN on a metallic support using the provided mounting holes, for better reliability and reduced de-rating due to heat dissipation

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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		PNP				
Default state	Input floating (wiring disconnected)	Logic LOW				
Input voltage	Logic "LOW"		0	1.6	V	
	Logic "HIGH"	1.8	24	39		
	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	0	mA	
	Logic "HIGH"		2.9	3.4		

Mode compliance		NPN/ TTL / CMOS / LVTTTL (3.3V) / Open-collector			
Default state	Input floating (wiring disconnected)	Logic HIGH			
Input voltage	Logic "LOW"	2	5±24		V
	Logic "HIGH"		3		
	Floating voltage (not connected)	-10		+30	
	Absolute maximum, continuous	-20		+40	
	Absolute maximum, surge (duration ≤ 1s) [†]	2	5±24		
Input current	Logic "LOW"; Pulled 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				
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	±15			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"; Pulled 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	
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	
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		
Input impedance	Absolute maximum, surge (duration ≤ 1s) [†]	-11		+14	kΩ	
	Differential, Sin+ to Sin-, Cos+ to Cos- ²	4.2	4.7			
Resolution with interpolation	Common-mode, to GND		2.2		kΩ	
	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	

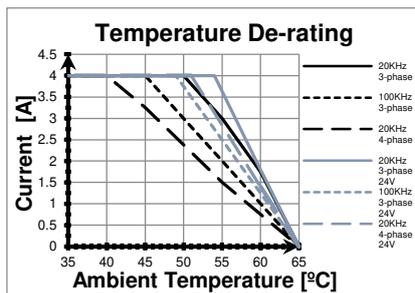
¹ For full RS-422 compliance, 120Ω termination resistors must be connected across the differential pairs, as close as possible to the drive input pins.

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

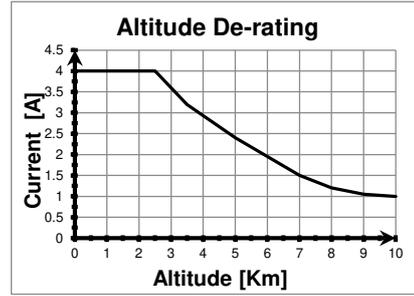
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Analog 0...5V Input (ANLG)		Min.	Typ.	Max.	Units
Input voltage	Operational range	0		4.95	V
	Absolute maximum values, continuous	-12		+18	
	Absolute maximum, surge (duration ≤ 1s) [†]			±36	
Input impedance	To GND		30		kΩ
Resolution			12		bits
Integral linearity				±2	bits
Offset error			±2	±10	bits
Gain error			±1%	±3%	% FS ¹
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
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
	500Kbps			100	
	≤ 250Kbps			250	
Resistor	Between CAN-Hi, CAN-Lo	none on-board			
Node addressing	Hardware: by Hex switch	1-15 & 255			
	Software	1 ÷ 127; 255 (CANopen); 1- 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)			

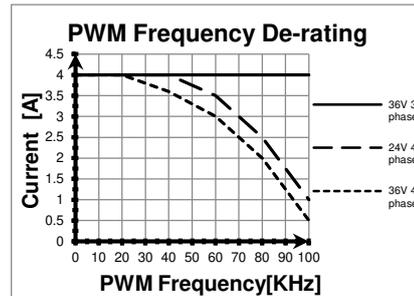
[†] Stresses beyond values listed under "absolute maximum ratings" may cause permanent damage to the device. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.



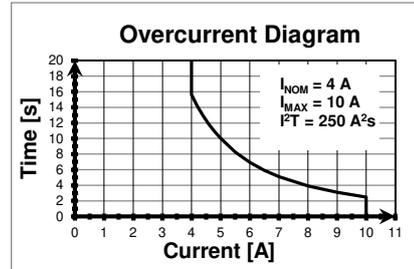
De-rating with ambient temperature



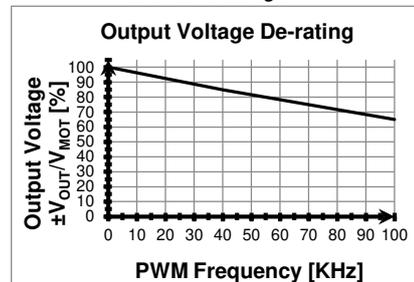
De-rating with altitude



Current De-rating with PWM frequency



Over-current diagram



Output Voltage De-rating with PWM frequency²

¹ "FS" stands for "Full Scale"

² V_{OUT} – the output voltage, V_{MOT} – the motor supply voltage

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