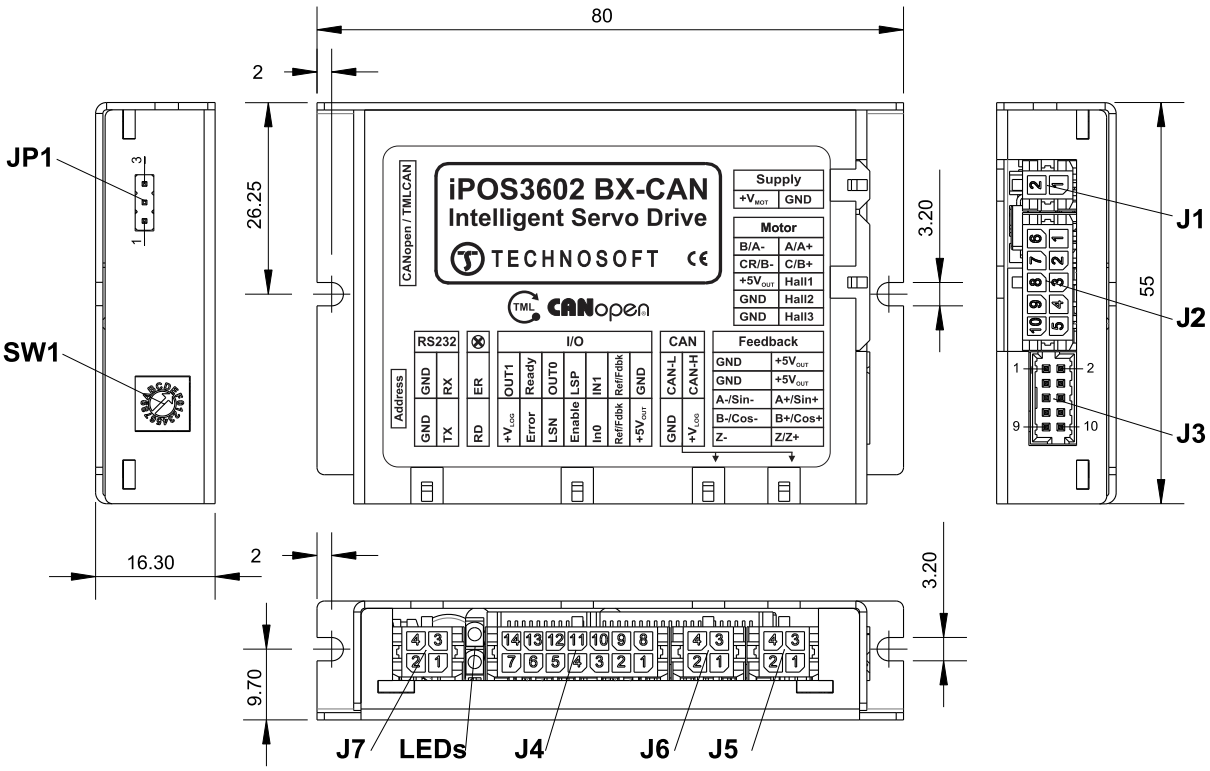


All dimensions are in mm.

Motor – sensor configurations					
Motor / Sensor	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: 2A cont. (BLDC mode); $3.2A_{PEAK}$, up to 100KHz PWM
- Digital Hall sensor interface (single-ended and open collector)
- Incremental encoder interface (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/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 E^2ROM 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 I^2t
- Firmware: F509M+ or F524E+

iPOS3602 BX-CAN DATASHEET
P/N: P028.001.E201

Connector Description

	Pin	Name	Type	Description
J1	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 logic supply if J4 pin 7 not connected

	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	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
J3	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/ Z+	I	Incr. encoder Z+ (index) diff. input

	Pin	Name	Type	Description
J4	1	+5V_{OUT}	O	5V output supply for I/O usage
	2	Reserved	-	Reserved. Do not connect.
	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}	I	Positive terminal of the logic supply: 9 to 36V_{DC} / If not connected, the logic supply is automatically routed from J1 pin 2[1]
	8	GND	-	Return ground for I/O pins
	9	REF/FDBK	I	Analogue input, 12-bit, 0-5V. Used to read an analogue position/speed reference or feedback , or used 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
J5, J6	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
J7	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):

- Tamb = 0…40ºC, 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[2]		0		+40	ºC
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	ºC
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	80 x 55 x 16.3			mm
		~3.15 x 2.17 x 0.64			inch
	With recommended mating connectors.	84 x 63 x 16.3			mm
		~3.3 x 2.5 x 0.64			inch
Weight	Without mating connectors	70			g
Power dissipation	Idle (no load)		1		W
	Operating		3	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	5.9		39	V_{DC}
	Absolute maximum values, continuous	0		39	V_{DC}
	Absolute maximum values, surge (duration ≤ 10ms)[†]	0		+45	V
Supply current	No Load on Digital Outputs, +V_{LOG} = 9V		125	300	mA
	No Load on Digital Outputs, +V_{LOG} = 12V		80	200	
	No Load on Digital Outputs, +V_{LOG} = 24V		50	125	
	No Load on Digital Outputs, +V_{LOG} = 39V		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	-3.2	±2	+3.2	A
	Absolute maximum value, short-circuit condition (duration ≤ 10ms)[†]			5	A

[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 **+65ºC** 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 BX-CAN on a metallic support using the provided mounting holes, for better reliability and reduced de-rating due to heat dissipation

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				2	A
	for PMSM motors with FOC sinusoidal control (sinusoidal amplitude value)				2	
	for PMSM motors with FOC sinusoidal control (sinusoidal effective value)				1.41	
Motor output current, peak	maximum 24s		-3.2		+3.2	A
Short-circuit protection threshold	measurement range			±4.3	±5	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			
		100 kHz	45			
	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 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			±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 / LVTTL (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	9	mA
	Logic “HIGH”; Internal 2.7KΩ 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

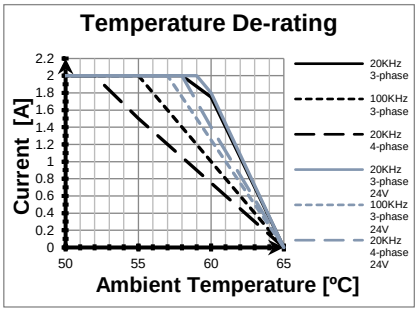
Digital Hall Inputs (Hall1, Hall2, Hall3)		Min.	Typ.	Max.	Units
Mode compliance		TTL / CMOS / Open-collector			
Default state	Input floating (wiring disconnected)	Logic HIGH			
Input voltage	Logic “LOW”		0	0.8	V
	Logic “HIGH”	2	5		
	Floating voltage (not connected)		4.4		
	Absolute maximum, surge (duration ≤ 1s)†	-10		+15	
Input current	Logic “LOW”; 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-, B+, B-, 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	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
Input voltage, any pin to GND	Absolute maximum, surge (duration ≤ 1s)†	-11		+14	
ESD protection	Human body model	±1			kV

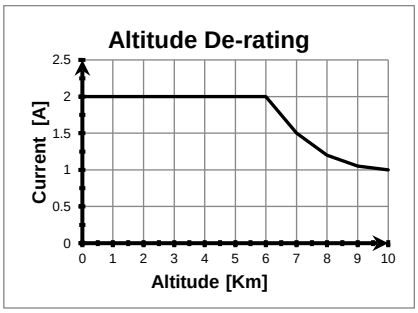
[1] For full RS-422 compliance, 120Ω termination resistors must be connected across the differential pairs, as close as possible to the drive input pins.

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 Input (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		30		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
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		Yes / Drive resets at event			
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)				

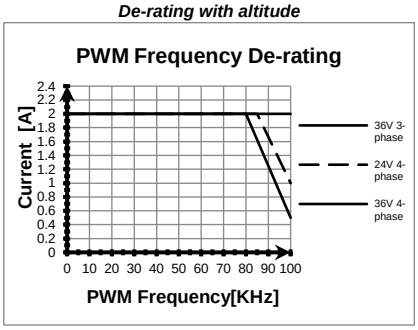
† Stresses beyond values listed under "absolute maximum ratings" may cause permanent damage to the device. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.



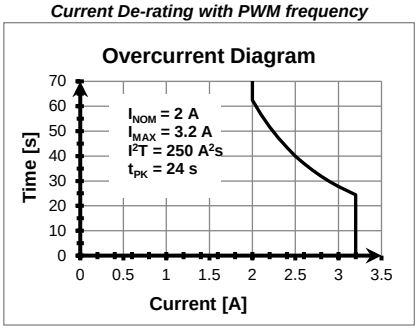
De-rating with ambient temperature



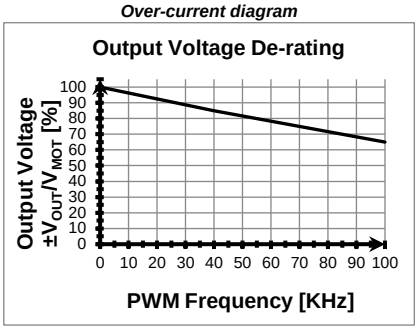
De-rating with altitude



Current De-rating with PWM frequency



Over-current diagram



Output Voltage De-rating with PWM frequency[3]

[1] 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.

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

[3] V_{OUT} – the output voltage, V_{MOT} – the motor supply voltage