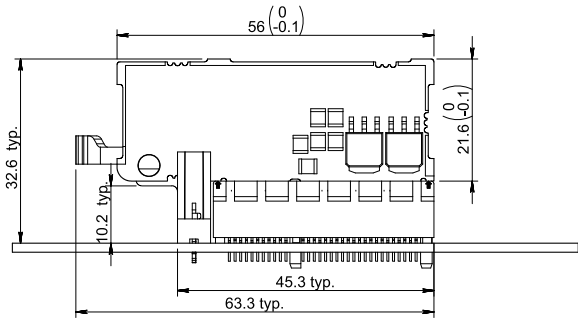
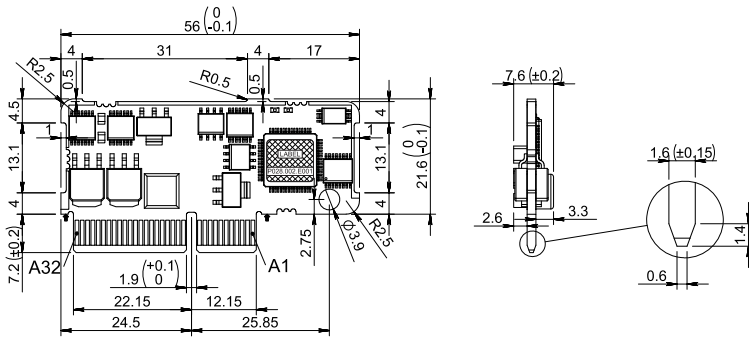


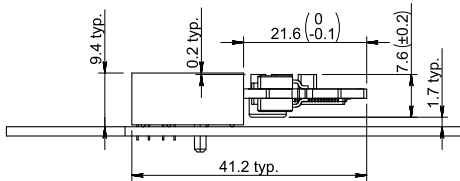


iPOS3604 VX-CAT DATASHEET

P/N: P028.002.E021



Overall dimensions for vertical mounting using recommended mating connector and retainer



Overall dimensions for horizontal mounting

Features

- Motor supply: 9-36V. Optional logic supply: 7-36V
- Output current: 4A cont. (BLDC mode); 10 A_{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
- 2 analogue inputs: 12-bit, 0-5V: Reference, Feedback or general-purpose
- RS-232 serial & EtherCAT compatible with h/w selectable addresses
- TMLCAN and EtherCAT (through the E-CAT VX interface board) protocols
- 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: F511J+

Motor – sensor configurations						
Sensor	Motor	PMSM	BLDC	DC BRUSH	STEP (2-ph)	STEP (3-ph)
Incr. Encoder		Ⓜ		Ⓜ	Ⓜ	
Incr. Encoder + Hall		Ⓜ	Ⓜ			
Analog Sin/Cos encoder		Ⓜ				
Linear Halls		Ⓜ				
Digital Halls		Ⓜ				
Tacho				Ⓜ		
Open-loop (no sensor)					Ⓜ	Ⓜ

Mating Connectors		
Producer	Part No.	Description
FCI	10018783-11111TLF	PCIe 4x vertical card edge connector, 1.0mm pitch, 2x32 contacts
Tyco	1761465-2	PCIe 4x horizontal card edge connector, 1.0mm pitch, 2x32 contacts
Samtec	PCIE-064-02-F-D-RA	PCIe 4x horizontal card edge connector, 1.0mm pitch, 2x32 contacts
FCI	10035591-001LF	Retainer for vertical PCIe card
FCI	10042618-002LF	

Pin	Name	Type	Description
A1	GND	-	Return ground for extension bus
A2	Clock	O	3.3V digital output; for ECAT interface board
A3	reserved	I/O	Reserved, do not connect
A4	Data In	O	3.3V digital output; for ECAT interface board
A5	Chip Select	O	3.3V digital output; for ECAT interface board
A6	OUT1†	O	5-36V 0.5A digital output, NPN O.C. / TTL pull-up
A7	Data Out	I	3.3V digital input; for ECAT interface board
A8	Hall 1	I	Digital input Hall 1 sensor
A9	Hall 2	I	Digital input Hall 2 sensor
A10	Hall 3	I	Digital input Hall 3 sensor
A11	+5VOUT	O	5V supply for sensors - internally generated
A12	GND	-	Return ground for sensors supply
A13	A-/Sin-/LH1	I	Incr. encoder A- diff. input, or analogue encoder Sin- diff. input, or linear Hall 1 input
A14	A/A+/Sin+	I	Incr. encoder A single-ended, or A+ diff. input, or analogue encoder Sin+ diff. input
A15	B-/Cos-/LH2	I	Incr. encoder B- diff. input, or analogue encoder Cos- diff. input, or linear Hall 2 input
A16	B/B+/Cos+	I	Incr. encoder B single-ended, or B+ diff. input, or analogue encoder Cos+ diff. input
A17	Z-/LH3	I	Incr. encoder Z- diff. input, or linear Hall 3 input
A18	Z/Z+	I	Incr. encoder Z (index) single-ended, or Z+ diff. input
A19	reserved	I/O	Reserved, do not connect
A20	GND	-	Negative return (ground) of the logic supply
A21-A22	+V _{MOT}	I	Positive terminal of the motor supply: 9 to 36V _{DC}
A23-A24	GND	-	Negative return (ground) of the motor supply
A25-A28	CR/B-	O	Chopping resistor / Phase B- for step motors
A29-A32	B/A-	O	Phase B for 3-ph motors, A- for 2-ph steppers, Motor- for DC brush motors

Name ALN	First edition June 23, 2021	Document template: P099.TQT.564.0001	Last edition April 25, 2024	Visa:
TECHNOSOFT		Title of document iPOS3604 VX-CAT PRODUCT DATA SHEET	N° document P028.002.E021.DSH.10C	Page: 1 of 5



iPOS3604 VX-CAT DATASHEET

P/N: P028.002.E021



Pin	Name	Type	Description
B1	GND	-	Return ground for CAN-Bus and RS-232 pins
B2	232TX	O	RS-232 Data Transmission
B3	232RX	I	RS-232 Data Reception
B4	OUT0	O	5-36V 0.5A general-purpose digital output, NPN open-collector / TTL pull-up
B5	GND	-	Return ground for I/O pins
B6	Interrupt	I	3.3V digital input; for ECAT interface board
B7	ECAT Ready	I	3.3V digital input; for ECAT interface board
B8	Sync	I	3.3V digital input; for ECAT interface board
B9	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
B10	FDBK	I	Analogue input, 12-bit, 0-5V. Used to read an analogue position or speed feedback (as tacho), or used as general-purpose analogue input
B11	+5VOUT	O	5V output supply for I/O usage
B12	OUT2/ Error	O	5-36V 0.5A drive error output, active low, NPN open-collector/TTL pull-up. Also drives the red LED
B13	OUT3/ Ready	O	5-36V 0.5A drive ready output, active low, NPN open-collector/TTL pull-up. Also drives the green LED.
B14	IN0	I	5-36V digital input, General-purpose
B15	IN1	I	5-36V digital input
B16	IN2/LSP	I	5-36V digital input Positive limit switch input
B17	IN3/LSN	I	5-36V digital input. Negative limit switch input
B18	IN4/ Enable	I	5-36V digital input. Drive enable input
B19	Rsvd.	I/O	Reserved, do not connect
B20	+VLOG	I	Positive terminal of the logic supply: 7 to 36VDC
B21-B22	+VMOT	I	Positive terminal of the motor supply: 9 to 36VDC
B23-B24	GND	-	Negative return (ground) of the motor supply
B25-B28	C/B+	O	Phase C for 3-ph motors, B+ for 2-ph steppers
B29-B32	A/A+	O	Phase A for 3-ph motors, A+ for 2-ph steppers, Motor+ for DC brush motors

† not available when additional feedback extension module is used

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	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		+85	°C
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; without retainer		20	36	N
Extraction force		5	10		N
Environmental Characteristics		Min.	Typ.	Max.	Units
Size (Length x Width x Height)	Without mating connector / retainer	56 x 28.8 x 7.6			mm
		~2.2 x 1.1 x 0.3			inch
	With recommended mating vertical connector and retainer. Height above PCB surface.	63.3 x 32.6 x 16.3			mm
		~2.5 x 1.3 x 0.64			inch
	With recommended mating horizontal connector. Height above PCB surface.	56 x 41.2 x 7.6			mm
		~2.2 x 1.6 x 0.3			inch
Weight		10			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 (+VLOG)		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	

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

Name ALN	First edition June 23, 2021	Document template: P099.TQT.564.0001	Last edition April 25, 2024	Visa:
TECHNOSOFT		Title of document iPOS3604 VX-CAT PRODUCT DATA SHEET	N° document P028.002.E021.DSH.10C Page: 2 of 5	



iPOS3604 VX-CAT DATASHEET

P/N: P028.002.E021



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+, CR/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	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		
	Minimum value, limited by short-circuit protection; +V _{MOT} = 36 V	20 kHz	75		
		40 kHz	25		
		60 kHz	20		
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		
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	
Input current	Absolute maximum, surge (duration ≤ 1s) †	-20		+40	mA
	Logic "LOW"; pulled to GND		0.6	1	
	Logic "HIGH"; Internal 4.7KΩ pull-up to +3.3	0	0	0	
Input current	Logic "HIGH"; Pulled to +5V		0.15	0.2	mA
	Logic "HIGH"; Pulled to +24V		2	2.5	
	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

Mode compliance	All outputs (OUT0, OUT1, OUT2/Error, OUT3/Ready)	TTL / CMOS / Open-collector / NPN 24V				
	Ready, Error	Same as above + LVTTTL (3.3V)				
Default state	Not supplied (+V _{LOG} floating or to GND)	High-Z (floating)				
	Immediately after power-up	OUT0, OUT1 OUT2/Error, OUT3/ Ready	Logic "HIGH"			
	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
Output current	Absolute maximum, surge (duration ≤ 1s) †				V _{LOG} +1	
	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	±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				
Input voltage, single-ended mode Z/Z+	Floating voltage (not connected)		4.5		V	
	Logic "LOW"			1.2		
Input current, single-ended mode A/A+, B/B+, Z/Z+	Logic "HIGH"; Internal 2.2KΩ pull-up to +5	0	0	0	mA	
	Logic "LOW"; Pulled to GND		2.5	3		
Differential mode compliance	For full RS422 compliance, see	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

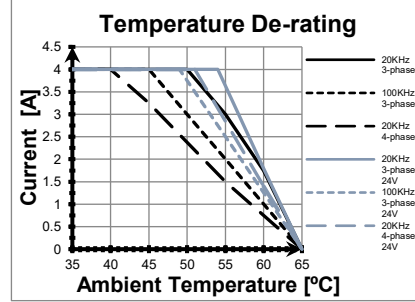
Digital Outputs (OUT0, OUT1, OUT2/Error, OUT3/ Ready)	Min.	Typ.	Max.	Units
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Minimum pulse width	Single-ended mode, Open-collector / NPN	1			µs
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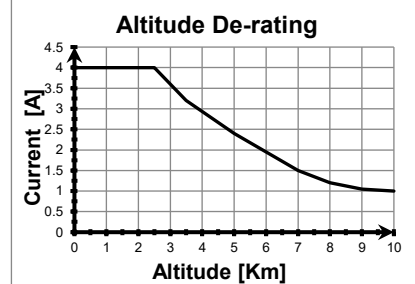
Name ALN	First edition June 23, 2021	Document template: P099.TQT.564.0001	Last edition April 25, 2024	Visa:
		Title of document iPOS3604 VX-CAT PRODUCT DATA SHEET	N° document P028.002.E021.DSH.10C	
				Page: 3 of 5



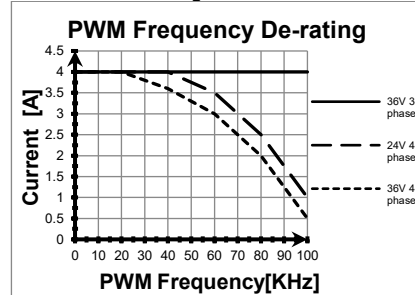
	Differential mode, or Single-ended driven by push-pull (TTL / CMOS)	50			ns	
Input voltage, any pin to GND	Absolute maximum values, continuous	-7		+7	V	
	Absolute maximum, surge (duration ≤ 1s) [†]	-11		+14		
ESD protection	Human body model	±1			kV	
Linear Hall Inputs (LH1, LH2, LH3)						
Input voltage	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	-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-)						
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	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)						
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 ⁵
Bandwidth (-3dB)	Software selectable	0		1	kHz	
ESD protection	Human body model	±5			kV	
Axis ID Inputs (AxisID 0, AxisID 1, AxisID 2)						
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	
RS-232						
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)						
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						
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)				



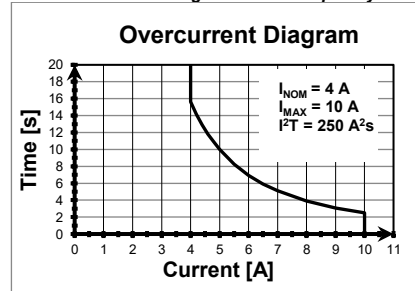
De-rating with ambient temperature



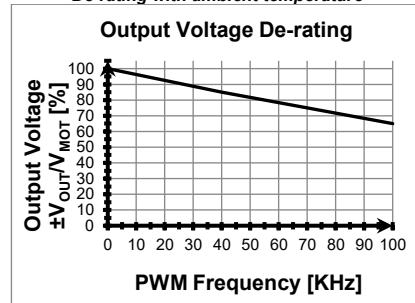
De-rating with altitude



Current De-rating with PWM frequency



De-rating with ambient temperature



Output Voltage De-rating with PWM frequency⁶

⁴ 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.

⁵ "FS" stands for "Full Scale"

⁶ V_{OUT} – the output voltage, V_{MOT} – the motor supply voltage

Name ALN	First edition June 23, 2021	Document template: P099.TQT.564.0001	Last edition April 25, 2024	Visa:
		Title of document iPOS3604 VX-CAT PRODUCT DATA SHEET	N° document P028.002.E021.DSH.10C	
			Page: 4 of 5	