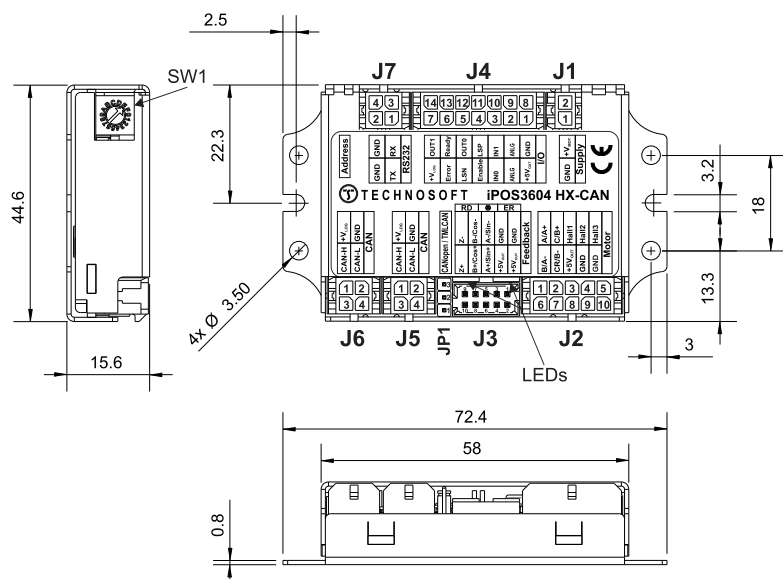




All dimensions are in mm.

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

| Mating Connector |            |                       |                                             |            |
|------------------|------------|-----------------------|---------------------------------------------|------------|
| Producer         | Part No.   | Connector             | Description                                 | Wire Gauge |
| MOLEX            | 43025-0200 | J1                    | MICROFIT<br>RECEPTACLE<br>HOUSING, 2x1 WAY  | AWG 20..24 |
| MOLEX            | 43025-0400 | J5,J6,J7              | MICROFIT<br>RECEPTACLE<br>HOUSING, 2x2 WAY  | AWG 20..24 |
| MOLEX            | 43025-1000 | J2                    | MICROFIT<br>RECEPTACLE<br>HOUSING, 2x5 WAY  | AWG 20..24 |
| MOLEX            | 43025-1400 | J4                    | MICROFIT<br>RECEPTACLE<br>HOUSING, 2x7 WAY  | AWG 20..24 |
| MOLEX            | 43030-0007 | J1,J2,J4,J5,J<br>6,J7 | CRIMP PIN,<br>MICROFIT, 5A                  | AWG 20..24 |
| MOLEX            | 51110-1056 | J3                    | MILLIGRID<br>RECEPTACLE<br>HOUSING, 2x5 WAY | AWG 24..30 |
| MOLEX            | 50394-8400 | J3                    | CRIMP PIN,<br>MILLIGRID                     | AWG 24..30 |

## Features

- Motor supply: 9-36V. Optional logic supply: 9-36V
- Output current: 4A cont. (BLDC mode); 10A<sub>PEAK</sub> , 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<sub>pp</sub>)
- 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 E<sup>2</sup>ROM 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<sup>2</sup>t
- Firmware: F508M+ or F523E+

### Connector Description

|   | Pin | Name              | Type | Description                                                                                                                                                                          |
|---|-----|-------------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5 | 1   | GND               | -    | Negative return (ground) of the power supply                                                                                                                                         |
|   | 2   | +V <sub>MOT</sub> | I    | Positive terminal of the motor supply: 9 to 36V <sub>DC</sub> / 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    | <b>Phase A</b> for 3-ph motors, A+ for 2-ph steppers, Motor+ for DC brush motors |
| 2   | C/B+               | O    | <b>Phase C</b> 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    | <b>Phase B</b> for 3-ph motors, A- for 2-ph steppers, Motor- for DC brush motors |
| 7   | CR/B-              | O    | <b>Chopping resistor / Phase B-</b> for step motors                              |
| 8   | +5V <sub>OUT</sub> | 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 <sub>OUT</sub> | O        | 5V output supply for I/O usage                                       |
| 3   | GND                | -        | Return ground for sensors supply                                     |
| 4   | +5V <sub>OUT</sub> | O        | 5V output supply for I/O usage                                       |
| 3   | 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 <sub>OUT</sub>             | O    | 5V output supply for I/O usage                                                                                                                                             |
| 2   | ANLG                           | I    | Analogue input, 12-bit, 0-5V. Used to read an analogue 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 <sub>LOG</sub> <sup>1</sup> | I    | Positive terminal of the logic supply for inputs and outputs operation: 9 to 36V <sub>DC</sub>                                                                             |
| 8   | GND                            | -    | Return ground for I/O pins                                                                                                                                                 |
| 9   | ANLG                           | I    | Analogue input, 12-bit, 0-5V. Used to read an analogue 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 <sub>LOG</sub> | O    | Positive terminal of the logic supply: 9 to 36V <sub>DC</sub> |
| 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):

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

| Operating Conditions             |                          | Min.           | Typ.     | Max.                                         | Units |
|----------------------------------|--------------------------|----------------|----------|----------------------------------------------|-------|
| Ambient temperature <sup>2</sup> |                          | 0              |          | +40                                          | °C    |
| Ambient humidity                 | Non-condensing           | 0              |          | 90                                           | %Rh   |
| Altitude / pressure <sup>3</sup> | Altitude (vs. sea level) | -0.1           | 0 ÷ 2.5  | <sup>2</sup>                                 | Km    |
|                                  | Ambient Pressure         | 0 <sup>2</sup> | 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 <sup>4</sup> , 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    | 5    | 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 <sub>LOG</sub> ) |                                                                                        |                         | Min.                          | Typ. | Max. | Units           |
| Supply voltage                          | Nominal values                                                                         |                         | 9                             |      | 36   | V <sub>DC</sub> |
|                                         | Absolute maximum values, drive operating but outside guaranteed parameters             |                         | 5.9                           |      | 39   | V <sub>DC</sub> |
|                                         | Absolute maximum values, continuous                                                    |                         | 0                             |      | 39   | V <sub>DC</sub> |
|                                         | Absolute maximum values, surge (duration ≤ 10ms) <sup>†</sup>                          |                         | 0                             |      | +45  | V               |
| Supply current                          | No Load on Digital Outputs                                                             | +V <sub>LOG</sub> = 9V  |                               | 125  | 300  | mA              |
|                                         |                                                                                        | +V <sub>LOG</sub> = 12V |                               | 80   | 200  |                 |
|                                         |                                                                                        | +V <sub>LOG</sub> = 24V |                               | 50   | 125  |                 |
|                                         |                                                                                        | +V <sub>LOG</sub> = 39V |                               | 40   | 100  |                 |
| Motor Supply Input (+V <sub>MOT</sub> ) |                                                                                        |                         | Min.                          | Typ. | Max. | Units           |
| Supply voltage                          | Nominal values                                                                         |                         | 9                             |      | 36   | V <sub>DC</sub> |
|                                         | Absolute maximum values, drive operating but outside guaranteed parameters             |                         | 8.5                           |      | 40   | V <sub>DC</sub> |
|                                         | Absolute maximum values, continuous                                                    |                         | 0                             |      | 42   | V <sub>DC</sub> |
|                                         | Absolute maximum values, surge (duration ≤ 10ms) <sup>†</sup>                          |                         | 0                             |      | +45  | V               |
| Supply current                          | Idle                                                                                   |                         |                               | 1    | 5    | mA              |
|                                         | Operating                                                                              |                         | -10                           | ±4   | +10  | A               |
|                                         | Absolute maximum value, short-circuit condition (duration ≤ 10ms) <sup>†</sup>         |                         |                               |      | 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 <sub>MOT</sub> = 36 V | F <sub>PWM</sub>        |                               |      |      | µH              |
|                                         |                                                                                        | 20 kHz                  | 250                           |      |      |                 |
|                                         |                                                                                        | 40 kHz                  | 120                           |      |      |                 |
|                                         |                                                                                        | 60 kHz                  | 100                           |      |      |                 |
|                                         |                                                                                        | 80 kHz                  | 60                            |      |      |                 |
|                                         |                                                                                        | 100 kHz                 | 45                            |      |      |                 |
|                                         | Minimum value, limited by short-circuit protection; +V <sub>MOT</sub> = 36 V           | 20 kHz                  | 75                            |      |      | µH              |
|                                         |                                                                                        | 40 kHz                  | 25                            |      |      |                 |
|                                         |                                                                                        | 60 kHz                  | 20                            |      |      |                 |
|                                         |                                                                                        | 80 kHz                  | 10                            |      |      |                 |
|                                         |                                                                                        | 100 kHz                 | 5                             |      |      |                 |
|                                         |                                                                                        |                         |                               |      |      |                 |

<sup>1</sup> If +V<sub>LOG</sub> (J4 pin7) is not connected, the digital outputs and inputs will not be operational.

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

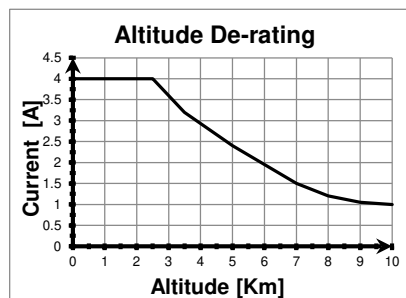
<sup>3</sup> iPOS360x can be operated in vacuum (no altitude restriction), but at altitudes over 2,500m, current and power rating are reduced due to thermal dissipation efficiency.

<sup>4</sup> 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

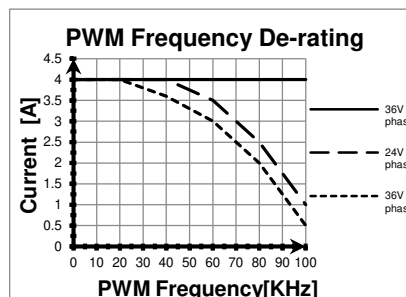
|                                                                                                      |                                   |                                                                                  |                                                                     |        |
|------------------------------------------------------------------------------------------------------|-----------------------------------|----------------------------------------------------------------------------------|---------------------------------------------------------------------|--------|
| Name<br>E. P.                                                                                        | First edition<br>October 05, 2015 | Document template: P099.TQT.564.0001                                             | Last edition<br>October 8, 2018                                     | Visa : |
|  <b>TECHNOSOFT</b> |                                   | Title of document<br><br><b>iPOS3604 HX-CAN</b><br><br><b>PRODUCT DATA SHEET</b> | N° document<br><br><b>P028.002.E501.DSH.10D</b><br><br>Page: 2 of 4 |        |



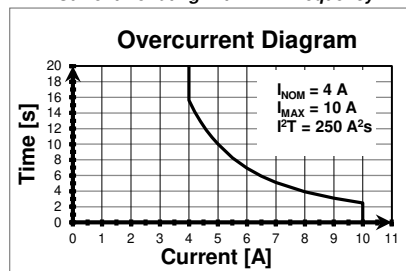
| Analog 0...5V Input (ANLG) |                                                      | Min.                                                                                                                                                                              | Typ. | Max.   | Units             |
|----------------------------|------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------|-------------------|
| Input voltage              | Operational range                                    | 0                                                                                                                                                                                 |      | 4.95   | V                 |
|                            | Absolute maximum values, continuous                  | -12                                                                                                                                                                               |      | +18    |                   |
|                            | Absolute maximum, surge (duration ≤ 1s) <sup>†</sup> |                                                                                                                                                                                   |      | ±36    |                   |
| Input impedance            | To GND                                               |                                                                                                                                                                                   | 30   |        | kΩ                |
| Resolution                 |                                                      | 12                                                                                                                                                                                |      |        | bits              |
| Integral linearity         |                                                      |                                                                                                                                                                                   |      | ±2     | bits              |
| Offset error               |                                                      |                                                                                                                                                                                   | ±2   | ±10    | bits              |
| Gain error                 |                                                      |                                                                                                                                                                                   | ±1%  | ±3%    | % FS <sup>1</sup> |
| 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 (TLMCAN)                                                                                                                                           |      |        |                   |
| 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) |      |        |                   |



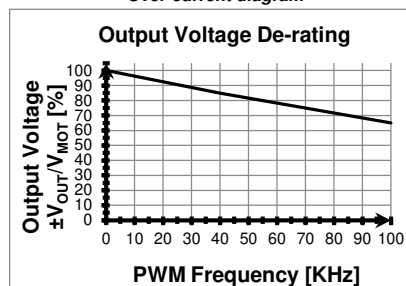
De-rating with altitude



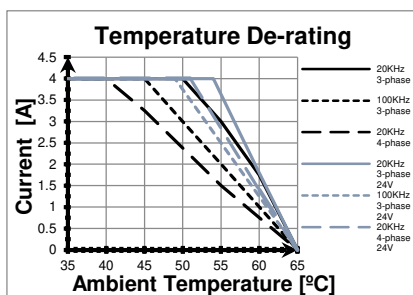
Current De-rating with PWM frequency



Over-current diagram



Output Voltage De-rating with PWM frequency<sup>2</sup>



De-rating with ambient temperature

<sup>†</sup> 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.

<sup>1</sup> "FS" stands for "Full Scale"

<sup>2</sup>  $V_{OUT}$  – the output voltage,  $V_{MOT}$  – the motor supply voltage

|                                                                                                      |                                   |                                                                        |                                                 |        |
|------------------------------------------------------------------------------------------------------|-----------------------------------|------------------------------------------------------------------------|-------------------------------------------------|--------|
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|  <b>TECHNOSOFT</b> |                                   | Title of document<br><br><b>iPOS3604 HX-CAN<br/>PRODUCT DATA SHEET</b> | N° document<br><br><b>P028.002.E501.DSH.10D</b> |        |
| Page: 4 of 4                                                                                         |                                   |                                                                        |                                                 |        |