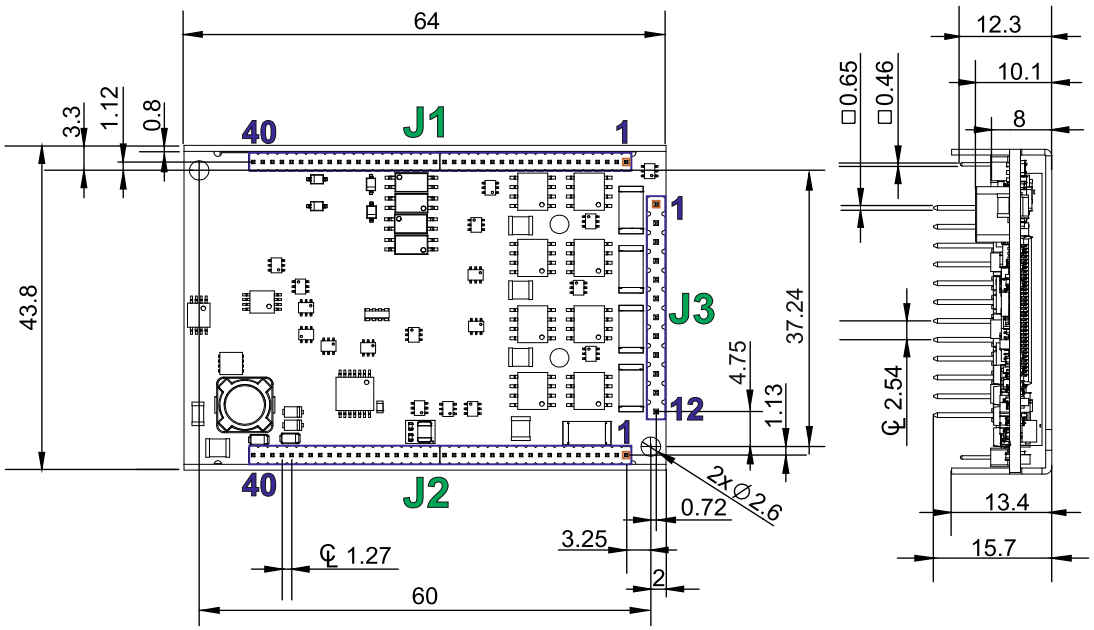
# iPOS8015 MZ-CAT DATASHEET

**P/N: P022.036.E122**

***-Preliminary-***



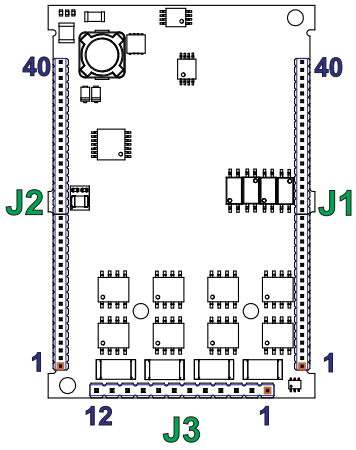

Top view; Pins facing upward; All dimensions are in mm; Header pitch of J1 & J2 is 1.27mm and for J3 is 2.54 mm. Drawing not to scale.
The free area around the mounting holes (free of components or other copper features) has a 5.5mm diameter.

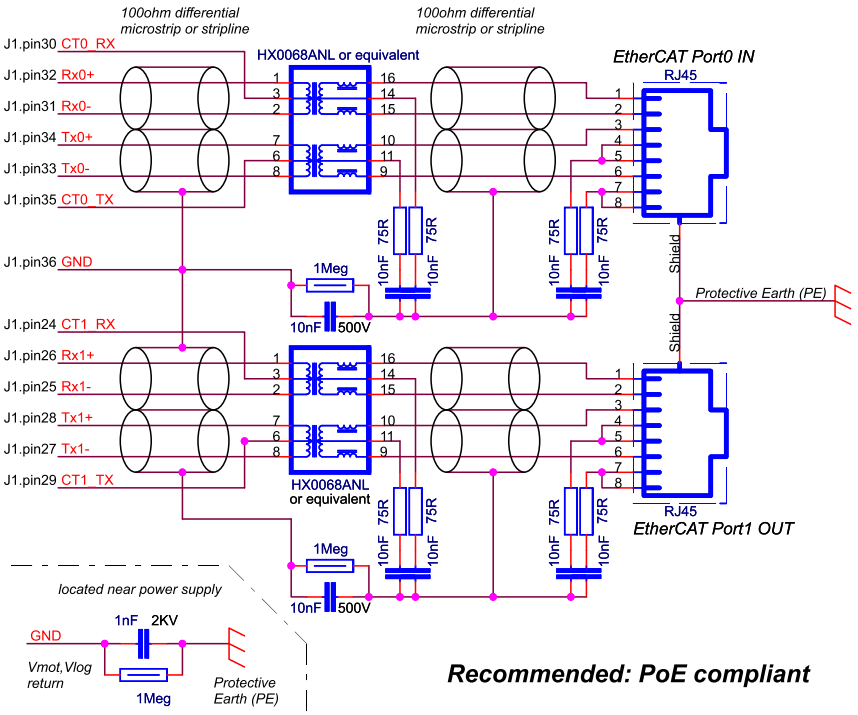
**Motor – sensor configurations**

| Sensor \ Motor | PMSM | BLDC | DC BRUSH | STEP (2-ph) | STEP (3-ph) |
|---|---|---|---|---|---|
| **Incr. Encoder** | ✓ | | ✓ | ✓ | |
| **Incr. Encoder + Dig. Hall** | ✓ | ✓ | | | |
| **Linear Halls** | ✓ | | | | |
| **Digital Hall control only** | ✓ | | | | |
| **Analog Sin/Cos encoder** | ✓ | ✓ | ✓ | ✓ | |
| **SSI / BiSS-C/ EnDAT/ TAMAGAWA/ Panasonic/ Nikon / Sanyo Denki** | ✓ | ✓ | ✓ | ✓ | |
| **Tacho** | | | ✓ | | |
| **Open-loop (no sensor)** | | | | ✓ | ✓ |

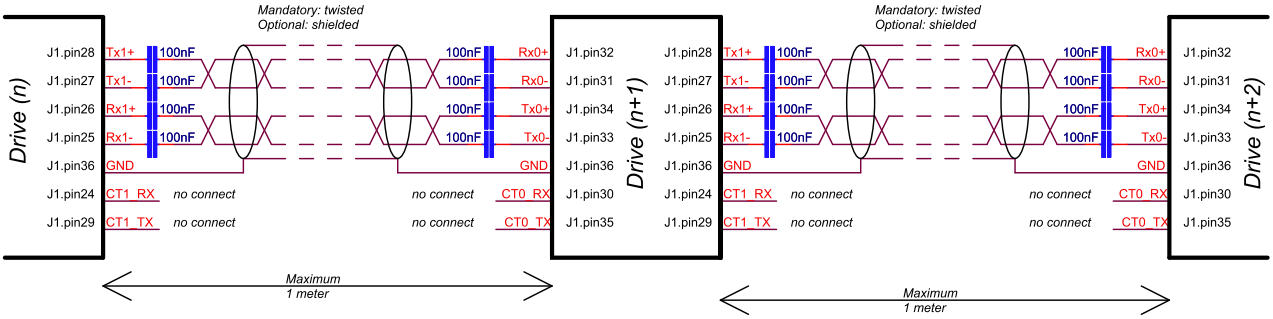
- **Features**
- Motion controller and drive in a single compact unit based on MotionChip™ technology
- Universal solution for control of rotary and linear brushless, brushed and 2 or 3-phase step motors
- Advanced motion control capabilities (PVT, S-curve, electronic cam)
- Motor supply: 12-80V; Logic SELV/ PELV supply: 9-36V; STO SELV/ PELV supply: 18-40V
- Motor output current:
  - Nominal*: 15$A_{RMS}$ / 21.2A amplitude;
  - Peak: 28.3$A_{RMS}$ / 40A amplitude.
- Operating ambient temperature: 0-40°C (over 40°C with derating)
- NTC/PTC analogue Motor Temperature sensor input
- Communication interfaces:
  - USB
  - LV-TTL UART (RS-232 with external transceiver)
  - dual 100Mbps EtherCAT® ports
- Feedback Devices (dual-loop support)
  - 1st feedback devices supported:
    - Incremental encoder interface (single ended or differential)
    - Analogue sin/cos encoder interface (differential 1$V_{pp}$)
    - Digital Hall sensor interface (single-ended and open collector)
    - Linear Hall sensors interface
  - 2nd feedback devices supported:
    - Incremental encoder interface (differential)
    - SSI / BiSS-C/ EnDAT/ TAMAGAWA/ Panasonic/ Nikon/ Sanyo Denki encoder interface
- Pulse & direction reference (single-ended or differential) capability
- STO: 2 safe torque-off inputs, safety integrity level (SIL3/Cat3/PLe) acc. to EN61800-5-1; -2/ EN61508-3; -4/ EN ISO 13849-1.
- 6 x digital inputs, 12-36V, PNP/NPN software selectable: 2 x for limit switches or general-purpose, 4 x general-purpose
- 5 x digital outputs, 5-36V: 0.4A NPN / 0.3A PNP, polarity software selectable: Ready, Error or general-purpose
- 1 x dedicated motor brake or general-purpose output (OUT0): 2A NPN / 1.5A PNP, polarity software selectable
- 2 x analogue inputs software selectable: 12-bit 0-5V: Reference, Feedback or general-purpose
- Commissioning (set-up) possible through RS232, FoE (file-over-EtherCAT®), EoE (Ethernet-over-EtherCAT®)
- EtherCAT® connection between multiple MZ drives: direct 1:1 without any series components
- EtherCAT® connection to standard RJ45: requires external magnetics (may be integrated into RJ45)
- 255 h/w addresses selectable by h/w pins configuration
- 16k x 16 SRAM memory for data acquisition
- 24k x16 E²ROM to store setup data, TML motion programs, cam tables and other user data

** It is mandatory to mount the iPOS8015 MZ on a metallic support using the provided mounting holes. To achieve the rated current capability, the heat sink temperature must not exceed **75°C**.*




***Recommended: PoE compliant***




*Mandatory: all drives supplied from the same power supply same GND)*

***Alternative: Direct connection***

| Mating Connectors | | | |
|---|---|---|---|
| **When J3 is plugged into a connector and maximum current should not exceed 12.7A Sine amplitude** | | | |
| **Ref** | **Producer** | **Part No.** | **Description** |
| J1, J2 | Harwin | M52-5012045 | 1x20 contacts, socket 1.27mm-pitch; 4 pcs needed for one drive |
| | Samtec | SMS-140-01-L-S | 1x40 contacts, socket 1.27mm-pitch; 2 pcs needed for one drive |
| | | SMS-140-01-G-S | |
| J3 | Mill-Max | 801-47-012-10-001000 | 1x12 contacts, High-current socket 2.54mm-pitch accepting 0.635mm square pin; 1 pcs is needed for one drive; the current should not exceed 12.7A |
| **When J3 is soldered directly onto a motherboard and the maximum current can exceed 13A Sine amplitude** | | | |
| **Ref** | **Producer** | **Part No.** | **Description** |
| J1, J2 | Harwin | M52-5012045 | 1x20 contacts, socket 1.27mm-pitch; 4 pcs needed for one drive |
| J3 | The pins are directly soldered onto a motherboard for increased current capability | | |

| | Pin | Name | Type | Description |
|---|---|---|---|---|
| J3 | 1,2 | GND | - | Return ground for motor. Internally connected to all GND signals except STO GND. |
| | 3,4 | Cr/B- | O | Chopping resistor / Phase B- for 2-ph steppers |
| | 5,6 | C/B+ | O | Phase C for 3-ph motors, B+ for 2-ph steppers |
| | 7,8 | B/A- | O | Phase B for 3-ph motors, A- for 2-ph steppers, Motor- for DC brush motors |
| | 9,10 | A/A+ | O | Phase A for 3-ph motors, A+ for 2-ph steppers, Motor+ for DC brush motors |
| | 11,12 | $+V_{MOT}$ | I | Positive terminal of the motor supply: 12 to $80V_{DC}$. |

| | Pin | Name | Type | Description |
|---|---|---|---|---|
| J1 | 1 | Temp Mot | I | NTC/PTC 3.3V input. Used to read an analog temperature value |
| | 2 | TTL TX | O | Low voltage TTL UART data transmission |
| | 3 | TTL RX | I | Low voltage TTL UART data reception |
| | 4 | USB Data- | I/O | USB Data negative |
| | 5 | USB Data+ | I/O | USB Data positive |
| | 6 | USB V+ | I | USB +5V input |
| | 7 | P1 LED | O | ECAT OUT port LED |
| | 8 | P0 LED | O | ECAT IN port LED |
| | 9 | Axis ID Bit7 | I | 8-bit H/W Axis ID register.<br>Pin 16 is Bit 0... Pin 9 is Bit 7 of the Axis value.<br>• Bit = 0, if pin is left unconnected.<br>• Bit = 1, if pin is connected to GND.<br>AxisID values: from 1 to 255. AxisID = 255 also when all pins are left unconnected.<br>In EtherCAT, when Axis ID is 255, the register called "*configured station alias"* will be 0. |
| | 10 | Axis ID Bit6 | I | |
| | 11 | Axis ID Bit5 | I | |
| | 12 | Axis ID Bit4 | I | |
| | 13 | Axis ID Bit3 | I | |
| | 14 | Axis ID Bit2 | I | |
| | 15 | Axis ID Bit1 | I | |
| | 16 | Axis ID Bit0 | I | |
| | 17 | RUN | O | Anode of Run LED (EtherCAT status machine). |
| | 18 | ERR | O | Anode of Error LED (EtherCAT status machine). |
| | 19 | Spi2 Clk | O | Reserved. Do not use |
| | 20 | Spi2 Out | O | Reserved. Do not use |
| | 21 | Spi2 In | I | Reserved. Do not use |
| | 22 | Spi2 CS | O | Reserved. Do not use |
| | 23 | Spi2 Irq | I | Reserved. Do not use |
| | 24 | CT1_Rx | - | Connect to center tap of OUT port magnetics PHY Rx. |
| | 25 | RX1- | I/O | Receive/Transmit negative, OUT port. Connect to magnetics PHY RX1. |
| | 26 | RX1+ | I/O | Receive/Transmit positive, OUT port. Connect to magnetics PHY RX1. |
| | 27 | TX1- | I/O | Transmit/Receive negative, OUT port. Connect to magnetics PHY TX1. |
| | 28 | TX1+ | I/O | Transmit/Receive positive, OUT port. Connect to magnetics PHY TX1. |
| | 29 | CT1_Tx | - | Connect to center tap of OUT port magnetics PHY Tx. |
| | 30 | CT0_Rx | - | Connect to center tap of IN port magnetics PHY Rx. |
| | 31 | RX0- | I/O | Receive/Transmit negative, IN port. Connect to magnetics PHY RX0. |
| | 32 | RX0+ | I/O | Receive/Transmit positive, IN port. Connect to magnetics PHY RX0. |
| | 33 | TX0- | I/O | Transmit/Receive negative, IN port. Connect to magnetics PHY TX0. |
| | 34 | TX0+ | I/O | Transmit/Receive positive, IN port. Connect to magnetics PHY TX0. |
| | 35 | CT0_Tx | - | Connect to center tap of IN port magnetics PHY Tx. |
| | 36 | GND | - | Return ground. Internally connected to all GND signals except STO GND. |
| | 37 | STO2- | I | Safe Torque Off input 2, negative return (opto-isolated, 0V) — Apply between both STO1+, STO2+ and STO1-, STO2- 24V DC from SELV/ PELV power supply for motor PWM output operation |
| | 38 | STO2+ | I | Safe Torque Off input 2, positive input (opto-isolated, 18÷40V) |
| | 39 | STO1- | I | Safe Torque Off input 1, negative return (opto-isolated, 0V) |
| | 40 | STO1+ | I | Safe Torque Off input 1, positive input (opto-isolated, 18÷40V) |

| | Pin | Name | Type | Description |
|---|---|---|---|---|
| J2 | 1 | LH1 | I | Linear Hall 1 input |
| | 2 | LH2 | I | Linear Hall 2 input |
| | 3 | LH3 | I | Linear Hall 3 input |
| | 4 | FDBK | I | Analogue input, 12-bit, 0-5V. Reads analogue feedback (tacho), or general purpose |
| | 5 | REF | I | Analogue input, 12-bit, 0-5V. Reads analog reference, or general-purpose analogue input |
| | 6 | Hall 3 | I | Digital input Hall 3 sensor |
| | 7 | Hall 2 | I | Digital input Hall 2 sensor |
| | 8 | Hall 1 | I | Digital input Hall 1 sensor |
| | 9 | GND | - | Return ground. Internally connected to all GND signals except STO GND. |
| | 10 | IN5 | I | 12-36V general-purpose digital PNP/NPN input |
| | 11 | IN4 | I | 12-36V general-purpose digital PNP/NPN input |
| | 12 | IN1 | I | 12-36V general-purpose digital PNP/NPN input |
| | 13 | IN0 | I | 12-36V general-purpose digital PNP/NPN input |
| | 14 | IN2/LSP | I | 12-36V digital PNP/NPN input. Positive limit switch input |
| | 15 | IN3/LSN | I | 12-36V digital PNP/NPN input. Negative limit switch input |
| | 16 | OUT3 | O | 5-36V general-purpose digital output, 0.3A PNP/ 0.4A NPN, software selectable |
| | 17 | OUT2 | O | 5-36V general-purpose digital output, 0.3A PNP/ 0.4A NPN, software selectable |
| | 18 | OUT5 | O | 5-36V general-purpose digital output, 0.3A PNP/ 0.4A NPN, software selectable |
| | 19 | OUT4 | O | 5-36V general-purpose digital output, 0.3A PNP/ 0.4A NPN, software selectable |
| | 20 | OUT1 | O | 5-36V general-purpose digital output, 0.3A PNP/ 0.4A NPN, software selectable |
| | 21 | OUT0 | O | 5-36V general-purpose digital output, 1.5A PNP/ 2A NPN, software selectable |
| | 22 | Z1+ | I | Incr. encoder1 Z single-ended, or Z+ diff. input, |
| | 23 | Z1- | I | Incr. encoder1 Z- diff. input |
| | 24 | B1+/Cos+ | I | Incr. encoder1 B single-ended, or B+ diff. input, or analogue encoder Cos+ diff. input |
| | 25 | B1-/Cos- | I | Incr. encoder1 B- diff. input, or analogue encoder Cos- diff. input |
| | 26 | A1+/Sin+ | I | Incr. encoder1 A single-ended, or A+ diff. input, or analogue encoder Sin+ diff. input |
| | 27 | A1- /Sin- | I | Incr. encoder1 A- diff. input, or analogue encoder Sin- diff. input |
| | 28 | Z2+ | I | Incr. encoder2 Z+ diff. input; has 120Ω resistor between pins 28 and 29 |
| | 29 | Z2- | I | Incr. encoder2 Z- diff. input; has 120Ω resistor between pins 28 and 29 |
| | 30 | B2-/Dir-/CLK-/MA- | I/O | Incr. encoder2 B- diff. input, or Dir--, or Clock- for SSI, or Master- for BiSS; has 120Ω resistor between pins 30 and 31 |
| | 31 | B2+/Dir+/CLK+/MA+ | I/O | Incr. encoder2 B+ diff. input, or Dir+-, or Clock+ for SSI, or Master+ for BiSS; has 120Ω resistor between pins 30 and 31 |
| | 32 | A2+/Pulse+ / Data+/SL+ | I | Incr. encoder2 A+ diff. input, or Pulse+, or Data+ for SSI, or Slave+ for BiSS; has 120Ω resistor between pins 32 and 33 |
| | 33 | A2- /Pulse-/ Data-/SL- | I | Incr. encoder2 A- diff. input, or Pulse-, or Data- for SSI, or Slave- for BiSS; has 120Ω resistor between pins 32 and 33 |
| | 34 | Reserved | - | Reserved. Do not use |
| | 35 | Reserved | - | Reserved. Do not use |
| | 36 | Reserved | - | Reserved. Do not use |
| | 37 | Reserved | - | Reserved. Do not use |
| | 38 | $+5V_{OUT}$ | O | 5V output supply for I/O usage |
| | 39 | $-V_{LOG}$ | I | Negative terminal of the logic supply input: 9 to $36V_{DC}$ from SELV/ PELV type power supply. |
| | 40 | $+V_{LOG}$ | I | Positive terminal of the logic supply input: 9 to $36V_{DC}$ from SELV/ PELV type power supply. |

## Electrical characteristics

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

- $V_{LOG}$ = 24 VDC; $V_{MOT}$ = 80VDC; $F_{PWM}$ = 20kHZ
- Supplies start-up / shutdown sequence: -any-
- Load current (sinusoidal amplitude) = 21.2 A

| **Operating Conditions** | | **Min.** | **Typ.** | **Max.** | **Units** |
|---|---|---|---|---|---|
| Ambient temperature | | 0 | | 40[1] | ºC |
| 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 | | 100 | ºC |
| 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 | | 12 | 8 | N |
| Extraction force | | 8 | 10 | | N |
| Heat sink | mounted | Full current capability | | | |
| | not mounted | max 12A output current | | | |
| **Environmental Characteristics** | | **Min.** | **Typ.** | **Max.** | **Units** |
| Size (Length x Width x Height) | Global size | 64 x 43.8 x 15.7 | | | mm |
| | | ~2.52 x 1.72 x 0.62 | | | inch |
| Weight | | ~34 | | | g |
| 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 | 8 | | 40 | $V_{DC}$ |
| | Absolute maximum values, continuous | -0.6 | | 42 | $V_{DC}$ |
| | Absolute maximum values, surge (duration ≤ 10ms) † | -1 | | +45 | V |
| Supply current | +$V_{LOG}$ = 12V | | 150 | | mA |
| | +$V_{LOG}$ = 24V | | 100 | | |
| | +$V_{LOG}$ = 40V | | 80 | | |
| Utilization Category | Acc. to 60947-4-1 (IPEAK<=1.05*INOM) | DC-1 | | | |
| **Motor Supply Input (+$V_{MOT}$)** | | **Min.** | **Typ.** | **Max.** | **Units** |
| Supply voltage | Nominal values | 12 | 80 | 82 | $V_{DC}$ |
| | Absolute maximum values, drive operating but outside guaranteed parameters | 11 | | 94 | $V_{DC}$ |
| | Absolute maximum values, surge (duration ≤ 10ms) † | -1 | | 95 | V |
| Supply current | Idle | | 1 | 5 | mA |
| | Operating | -40 | ±20 | +40 | A |
| | Absolute maximum value, short circuit condition (duration ≤ 10ms) † | | | 45 | A |
| Utilization Category | Acc. to 60947-4-1 (IPEAK<=4.0*INOM) | DC-3 | | | |
| **Supply Output (+5V)** | | **Min.** | **Typ.** | **Max.** | **Units** |
| Output voltage | Current sourced = 250mA | 4.95 | 5.11 | 5.25 | V |
| Output current | | 360 | 450 | | mA |
| Short-circuit | | NOT protected | | | |
| Over-voltage | | NOT protected | | | |
| ESD protection | Human body model | ±1 | | | kV |
| Isolation PE (earth) – GND | | | | ±250 | V |

| **Motor Outputs (A/A+, B/A-, C/B+, CR/B-)** | | | **Min.** | **Typ.** | **Max.** | **Units** |
|---|---|---|---|---|---|---|
| Nominal current with heat sink[4] | PMSM motors sinusoidal amplitude | | | | 21.2 | A |
| | PMSM motors sinusoidal RMS | | | | 15 | |
| | DC/BLDC motors continuous | | | | 18.3 | |
| Nominal current without heat sink | PMSM motors sinusoidal amplitude | | | | 12 | |
| | PMSM motors sinusoidal RMS | | | | 8.5 | |
| | DC/BLDC motors continuous | | | | 10.4 | |
| Peak current | maximum 12.5 s | | -40 | | +40 | A |
| Short-circuit protection threshold | | | | 70 | | A |
| Short-circuit protection delay | | | 1.5 | | 3.3 | µs |
| On-state voltage drop | Nominal output current; including typical mating connector contact resistance | | | 0.15 | | V |
| Voltage efficiency | | | | 100 | | % |
| Off-state leakage current | | | | ±0.5 | ±1 | mA |
| Motor inductance (phase-to-phase) | Recommended value, for current ripple max. ±5% of full range; +$V_{MOT}$ = 80 V | $F_{PWM}$ | | | | µH |
| | | 20 kHz | 400 | | | |
| | | 40 kHz | 200 | | | |
| | | 60 kHz | 150 | | | |
| | | 80 kHz | 100 | | | |
| | | 100 kHz | 80 | | | |
| | Minimum value, limited by short-circuit protection; +$V_{MOT}$ = 80 V | 20 kHz | 150 | | | µH |
| | | 60 kHz | 50 | | | |
| | | 40 kHz | 40 | | | |
| | | 80 kHz | 20 | | | |
| | | 100 kHz | 10 | | | |
| Motor electrical time-constant (L/R) | Recommended value for ±5% current measurement error | 20 kHz | 330 | | | µs |
| | | 40 kHz | 170 | | | |
| | | 60 kHz | 140 | | | |
| | | 80 kHz | 80 | | | |
| | | 100 kHz | 66 | | | |
| Current measurement | FS = Full Scale accuracy | | -9.3 | +/- 3.4 | +9.3 | %FS |
| **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 |
| **Linear Hall Inputs (LH1, LH2, LH3)** | | | **Min.** | **Typ.** | **Max.** | **Units** |
| 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 | | 0 | | 0.2 | mA |
| Interpolation Resolution | Depending on software settings | | | | 11 | bits |
| Frequency | | | 0 | | 1 | kHz |
| ESD protection | Human body model | | ±1 | | | kV |
| **Digital Inputs (IN0, IN1, IN2/LSP, IN3/LSN, IN4, IN5, IN6)[5]** | | | **Min.** | **Typ.** | **Max.** | **Units** |
| Mode compliance | | | PNP | | | |
| Default state | Input floating (wiring disconnected) | | Logic LOW | | | |
| Input voltage | Logic "LOW" | | -10 | 0 | 2.2 | V |
| | Logic "HIGH" | | 6.3 | 24 | 36 | |
| | Hysteresis | | 1.2 | 2.4 | 2.8 | |
| | 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 | | mA |
| | Logic "HIGH" | | | 8 | 10 | |

[1] Operating temperature at higher temperatures is possible with reduced current and power ratings

[2] iPOS8015 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

[4] It is mandatory to mount the iPOS8015 MZ on a metallic support using the provided mounting holes. To achieve the rated current capability, the heat sink temperature must not exceed **75°C**.

[5] The digital inputs and outputs are software selectable as PNP or NPN

| Mode compliance | | NPN | | | |
|---|---|---|---|---|---|
| Default state | Input floating (wiring disconnected) | Logic HIGH | | | |
| Input voltage | Logic “LOW” | | 0 | 2.2 | V |
| | Logic “HIGH” | 6.3 | 24 | 36 | |
| | Hysteresis | 1.2 | 2.4 | 2.8 | |
| | Floating voltage (not connected) | | 15 | | |
| | Absolute maximum, continuous | -10 | | +39 | |
| | Absolute maximum, surge (duration ≤ 1s) † | -20 | | +40 | |
| Input current | Logic “LOW”; Pulled to GND | | 8 | 10 | mA |
| | Logic “HIGH”; Pulled to +24V | 0 | 0 | 0 | |
| Input frequency | | 0 | | 10 | kHz |
| Minimum pulse | | 6 | | | µs |
| ESD protection | Human body model | ±5 | | | kV |

| **Encoder1 Inputs (A1/A1+, A1-, B1/B1+, B1-, Z1/Z1+, Z1-)** | | **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) | | 3.3 | | |
| 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 | | 5.5 | 6 | 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 | A1+ to A1-, B1+ to B1- | | 1 | | kΩ |
| | Z1+ to Z1- | | 1 | | |
| Input frequency | Single-ended mode, Open-collector / NPN | 0 | | 5 | MHz |
| | 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 |
| | Absolute maximum, surge (duration ≤ 1s) † | -11 | | +14 | |
| ESD protection | Human body model | ±1 | | | kV |

| **Digital Outputs (OUT1, OUT2/Error, OUT3/Ready, OUT4, OUT5)[2]** | | **Min** | **Typ.** | **Max.** | **Units** |
|---|---|---|---|---|---|
| Mode compliance | | PNP 24V | | | |
| Default state | Not supplied (+$V_{LOG}$ floating or to GND) | High-Z (floating) | | | |
| | Normal operation | Logic “High” | | | |
| Output voltage | Logic “HIGH”; output current = 0.3A | | $V_{LOG}$-1.0 | $V_{LOG}$-2.0 | V |
| | Logic “LOW”; output current = 0, no load | open-collector | | | |
| | Logic “HIGH”, external load to GND | | 0 | | |
| | Absolute maximum, continuous | -0.3 | | $V_{LOG}$+0.3 | |
| | Absolute maximum, surge (duration ≤ 1s) † | -0.5 | | $V_{LOG}$+0.5 | |
| Output current | Logic “HIGH”, source current, continuous | | | 0.3 | A |
| | Logic “HIGH”, source current, pulse ≤ 5 s | | | 0.4 | A |
| | Logic “LOW”, means High-Z | | | 20 | µA |
| Minimum pulse width | | 3 | 1.5 | | µs |
| ESD protection | Human body model | ±15 | | | kV |

| Mode compliance | | NPN 24V | | | |
|---|---|---|---|---|---|
| Default state | Not supplied (+$V_{LOG}$ floating or to GND) | High-Z (floating) | | | |
| | Normal operation | High-Z | | | |
| Output voltage | Logic “LOW”; output current = 0.4A | | 0.6 | 1.3 | V |
| | Logic “HIGH”; output current = 0, no load | open-collector | | | |
| | Logic “HIGH”, external load to +$V_{LOG}$ | | $V_{LOG}$ | | |
| | Absolute maximum, continuous | -0.3 | | $V_{LOG}$+0.3 | |
| | Absolute maximum, surge (duration ≤ 1s) † | -0.5 | | $V_{LOG}$+0.5 | |
| Output current | Logic “LOW”, sink current, continuous | | | 0.4 | A |
| | Logic “LOW”, sink current, pulse ≤ 5 s | | | 0.5 | A |
| | Logic “HIGH”, means High-Z | | | 20 | µA |
| Minimum pulse width | | 5 | 1.8 | | µs |
| ESD protection | Human body model | ±15 | | | kV |

| **OUT0 – Brake or general-purpose digital output[2]** | **Min.** | **Typ.** | **Max.** | **Units** |
|---|---|---|---|---|

| Mode compliance | | PNP 24V | | | |
|---|---|---|---|---|---|
| Default state | Not supplied (+VLOG floating or to GND) | High-Z (floating) | | | |
| | Normal operation | Logic “High” | | | |
| Output voltage | Logic “HIGH”; output current = 1.5A | | $V_{LOG}$-0.4 | $V_{LOG}$-0.7 | V |
| | Logic “LOW”; output current = 0, no load | open-collector | | | |
| | Logic “HIGH”, external load to GND | | 0 | | |
| | Absolute maximum, continuous | -0.3 | | $V_{LOG}$+0.3 | |
| | Absolute maximum, surge (duration ≤ 1s) † | -0.5 | | $V_{LOG}$+0.5 | |
| Output current | Logic “HIGH”, source current, continuous | | | 1.5 | A |
| | Logic “HIGH”, source current, pulse ≤ 5 s | | | 2.0 | A |
| | Logic “LOW”, means High-Z | | | 50 | µA |
| Minimum pulse width | | 30 | 15 | | µs |
| ESD protection | Human body model | ±15 | | | kV |

| Mode compliance | | NPN 24V | | | |
|---|---|---|---|---|---|
| Default state | Not supplied (+$V_{LOG}$ floating or to GND) | High-Z (floating) | | | |
| | Normal operation | High-Z | | | |
| Output voltage | Logic “LOW”; output current = 2.0A | | 0.2 | 0.3 | V |
| | Logic “HIGH”; output current = 0, no load | open-collector | | | |
| | Logic “HIGH”, external load to +$V_{LOG}$ | | $V_{LOG}$ | | |
| | Absolute maximum, continuous | -0.3 | | $V_{LOG}$+0.3 | |
| | Absolute maximum, surge (duration ≤ 1s) † | -0.5 | | $V_{LOG}$+0.5 | |
| Output current | Logic “LOW”, sink current, continuous | | | 2.0 | A |
| | Logic “LOW”, sink current, pulse ≤ 5 s | | | 2.5 | A |
| | Logic “HIGH”, means High-Z | | | 50 | µA |
| Minimum pulse width | | 30 | 10 | | µs |
| ESD protection | Human body model | ±15 | | | 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] The digital inputs and outputs are software selectable as PNP or NPN

| **Encoder2 Inputs (A2+/Data+, A2-/Data-, B2+/Clk+, B2-/Clk-, Z2+, Z2-)**[1] | | **Min.** | **Typ.** | **Max.** | **Units** |
|---|---|---|---|---|---|
| Differential mode compliance | | | TIA/EIA-422-A | | |
| Input voltage | Hysteresis | ±0.06 | ±0.1 | ±0.2 | V |
| | Differential mode | -14 | | +14 | |
| | Common-mode range (A+ to GND, etc.) | -11 | | +14 | |
| Input impedance, differential | A2+, B2+, Z2+ A2-, B2-, Z2- | | 120 | | Ω |
| Input frequency | Differential mode | 0 | | 10 | MHz |
| Minimum pulse width | Differential mode | 50 | | | ns |

| **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- [2] | 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)** | | **Min.** | **Typ.** | **Max.** | **Units** |
|---|---|---|---|---|---|
| Input voltage | Operational range | 0 | | 5 | V |
| | Absolute maximum values, continuous | -12 | | +18 | |
| | Absolute maximum, surge (duration ≤ 1s) † | | | ±36 | |
| Input impedance | To GND | | 28 | | kΩ |
| Resolution | | | 12 | | bits |
| Integral linearity | | | | ±2 | bits |
| Offset error | | | ±2 | ±10 | bits |
| Gain error | | | ±1% | ±3% | % FS[3] |
| Bandwidth (-3db) | Software selectable | 0 | | 1 | kHz |
| ESD protection | Human body model | ±5 | | | kV |

| **LV-TTL UART (RS-232 with external transceiver)** | | | **Min.** | **Typ.** | **Max.** | **Units** |
|---|---|---|---|---|---|---|
| TTL TX | Voltage level | Absolute maximum, surge (duration ≤ 1s) † | -0.3 | | +3.6 | V |
| | | Logic 0 | | 0 | 0.4 | |
| | | Logic 1 | 2.4 | 3.3 | | |
| | Output current | Absolute maximum, surge (duration ≤ 1s) † | -5 | | +5 | mA |
| | | - | -2 | | +2 | |
| TTL RX | Voltage level | Absolute maximum, surge (duration ≤ 1s) † | -0.3 | | +3.6 | V |
| | | Logic 0 | | 0 | 0.4 | |
| | | Logic 1 | 2.4 | 3.3 | | |
| | Input current | | -0.15 | | +0.15 | mA |
| Bit rate | Software selectable | | 9600 | | 115200 | Baud |
| Short-circuit | TTL TX short to GND | | -No- | | | |

⚠ Do not connect directly to standard RS-232 serial connector!
Always power-off the drive supplies before inserting/removing the adapter

| **Safe torque OFF (STO1+, STO1-, STO2+, STO2+)** | | **Min.** | **Typ.** | **Max.** | **Units** |
|---|---|---|---|---|---|
| Safety function | According to EN61800-5-2 | STO (Safe Torque OFF) | | | |
| EN 61800-5-1/ -2 and EN 61508-5-3/ -4 Classification | Safety Integrity Level | safety integrity level 3 (SIL3) | | | |
| | PFHD (probability of dangerous failures per hour) | $8*10^{-10}$ | hour$^{-1}$ (0.8 FIT) | | |
| EN13849-1 Classification | Performance Level | Cat3/PLe | | | |
| | MTTFM (meantime to dangerous failure) | 377 | | | years |
| Mode compliance | | PNP | | | |
| Default state | Input floating (wiring disconnected) | Logic LOW | | | |
| Input voltage | Logic "LOW" | -20 | | 5.6 | V |
| | Logic "HIGH" | 18 | | 36 | |
| | Absolute maximum, continuous | -20 | | +40 | |
| Input current | Logic "LOW"; pulled to GND | | 0 | | mA |
| | Logic "HIGH", pulled to +Vlog | | 5 | 13 | |
| Repetitive test pulses | Ignored high-low-high | | | 5 | ms |
| | - | | | 20 | Hz |
| Fault reaction time | From internal fault detection to register DER bit 14 =1 and OUT2/Error high-to-low | | | 30 | ms |
| PWM operation delay | From external STO low-high transition to PWM operation enabled | | | 30 | ms |
| ESD protection | Human body model | ±2 | | | kV |

| **Ethernet Ports** | | **Min.** | **Typ.** | **Max.** | **Units** |
|---|---|---|---|---|---|
| Standard Compliance | EtherCAT (IEC61158-3/4/5/6-12) | | | | |
| | Fast Ethernet 100BASE-TX (IEEE802.3u) | | | | |
| | Auto-negotiation for 100Mbps/s full-duplex | | | | |
| | Auto-detect MDI/MDI-X | | | | |
| Power over Ethernet | NOT used by the iPOS8015, requires separate +Vlog SELV/ PELV supply | compliant to IEEE802.3af mode A "Mixed DC & Data" | | | |
| | | NOT compliant to IEEE802.3af mode B "DC on Spares" | | | |
| Isolation GND0, GND1 | Requirement for motherboard PCB routing | 500 | | | $V_{rms}$ |
| | | 1.5 | | | $kV_{peak}$ |
| Maximum cable length | 2-pair UTP Cat5 | 100 | 150 | | m |
| ESD protection | Human body model | ±4 | | | kV |

When the connections between drives is done directly, without magnetics (nonstandard, not conform to Ethernet IEEE802.3 100BASE-TX), it is imperative that the ground voltage difference between drives is kept to a minimum. The installation must provide a supplementary GND link between the drives. This link must have low inductance. Low inductance is best achieved by using large metal parts, such as a metallic chassis / baseplate, or using copper conductive tape.

| **LED signals** | **Min.** | **Typ.** | **Max.** | **Units** |
|---|---|---|---|---|
| LED connection | Common cathode to GND | | | |
| | Direct, no series resistor | | | |
| LED current | | 0.7 | 1 | mA |

| **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] Feedback#2 differential input pins have internal 120Ω termination resistors connected across
[2] An 120Ω termination resistor should be connected across SIN+ to SIN-, and across COS+ to COS- signals.
[3] "FS" stands for "Full Scale"