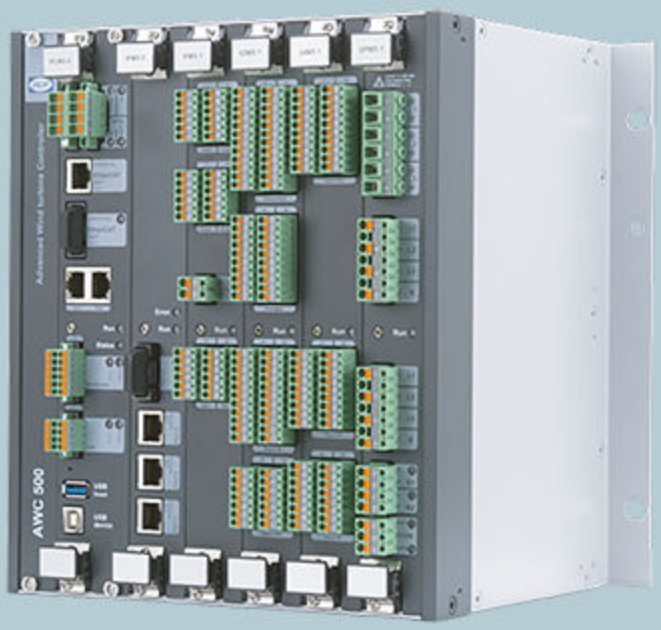
# DATA SHEET

## Advanced Controller, AWC 500

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# 1. AWC 500 system

## 1.1 System specifications

### System specifications

The AWC 500 is designed as a highly flexible, modular process controller covering the special demands of for example wind power plants in terms of reliability, robustness and flexibility.

**Technical specifications**

| | | |
|---|---|---|
| Default rack sizes | Rack5·0, Rack5·1, Rack5·2, Rack5·3, Rack5·5 and Rack5·8<br>All racks have one slot reserved for a PCM5·x or PDM5·1 and a variable number of I/O modules.<br>The maximum number of I/O modules is indicated in the name of the rack. For example; the rack named Rack5·2 has two available slots for I/O modules. | |
| Temperature | Operating: -40 to 70 °C<br>Storage: -40 to 85 °C<br>Reference: 15 to 30 °C | IEC 60068-2-1<br>IEC 60068-2-2 |
| Climate | All modules are conformal coated, hence protected against moisture, mold, dust, corrosion and other environmental stresses.<br>55 °C / 97 % relative humidity, condensing | IEC 60068-2-30, test Db |
| Altitude | Up-to 4,000 m without de-rating<br>For deployment above 4,000 m contact Product Management | |
| Vibration | 3 to 13.2 Hz: 6 $mm_{peak-peak}$<br>13.2 to 50 Hz: 2.1 g<br>3 to 13.2 Hz: 2.85 $mm_{peak-peak}$<br>13.2 to 100 Hz: 1.0 g | IEC 60068-2-6, DNV C<br><br>IEC 60068-2-6, DNV A<br>IACS E10 |
| Shock | 50 g, 11 ms, half sine<br>Tested with 3 impacts in each direction in all 3 axes<br>A total of 18 impacts per test | IEC 60068-2-27, test Ea |
| Bump | 25 g, 6 ms, half sine<br>1,000 bumps in each direction. 2 directions in each axis<br>A total of 6,000 bumps | IEC 60068-2-27, test Ea |

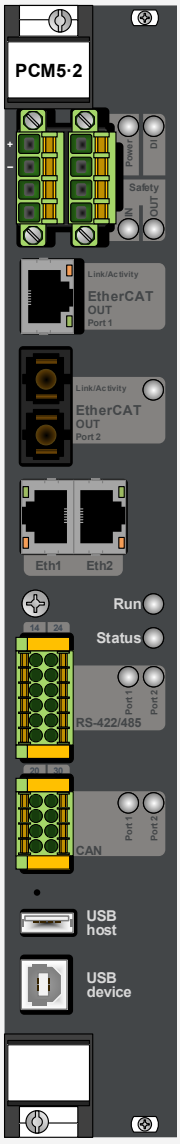
| Technical specifications | | |
|---|---|---|
| EMC/CE | **Electromagnetic compatibility (EMC)** | EN 61000-6-1/2/3/4 |
| | **Electrostatic discharge (ESD):**<br>Contact: 7.2 kV<br>Air: 9.6 kV | EN 61000-4-2 |
| | **Radiated E-field emission:**<br>30 to 230 MHz: 40 dB (µV/m)<br>230 to 1,000 MHz: 47 dB (µV/m)<br>1 to 3 GHz: 70 dB (µV/m) peak<br>1 to 3 GHz: 50 dB (µV/m) average<br>3 to 6 GHz: 74 dB (µV/m) peak<br>3 to 6 GHz: 54 dB (µV/m) average | IEC 61000-6-3 (not PCM5·2), IEC 61000-6-4, IEC 60255-26 |
| | **Conducted emission:** | IEC 60255-26 |
| | **Fast transients (burst):**<br>Power: 2.4 $kV_p$<br>Signal: 1.2 $kV_p$ | IEC 60255-22-4, GL, LR, DNV, EN 61000-4-4 |
| | **Slow transients (surge):**<br>AC power: DM 2 $kV_p$, CM 4 $kV_p$<br>DC power: DM 1 $kV_p$, CM 2 $kV_p$<br>Signal and I/O: DM 1 $kV_p$, CM 2 $kV_p$<br>Frequency input: DM 1 $kV_p$, CM 1.2 $kV_p$ | IACS E10, IEC60533, EN 60945, IEC 60255-26, EN 61000-4-5 |
| | **RF E-field (electric) immunity:**<br>80 to 2,000 MHz: 12 V/m<br>2 to 3 GHz: 10 V/m | IEC 60255-26, EN60945, GL, LR, BV, DNV, EN 61000-4-3 |
| | **RF conducted immunity**<br>0.15 to 80 MHz: 12 $V_{RMS}$ | IEC 60255-26, EN 60945, GL, LR, BV, DNV, EN 61000-4-6 |
| | **Power frequency H-field (magnetic) immunity:**<br>Field: 400 A/m | IEC 60051, EN 61000-4-8 |
| Safety | Installation (over-voltage) category III, 600 V, pollution degree 2. | EN 61010-1 |
| Protection class | IP30 | IEC/EN 60529 |
| Material | Aluminium case and cover plates. All plastic parts are self-extinguishing. | UL94 (V1) |
| UL/cUL Listing | UL applications:<br>Maximum surrounding temperature 60 °C.<br>Use min. 75/90 °C copper conductors only.<br>Terminal tightening torque 5-7 lb-in or equivalent.<br>Use AWG 30-12 or equivalent wire size.<br>To be installed in accordance with the NEC (United States) or the CEC (Canada). | UL/cUL Listed to UL508 & CSA C22.2 No. 142-M1987 |

# 2. Power and Control Modules

## 2.1 PCM5·2 module specifications

### PCM5·2 module specifications

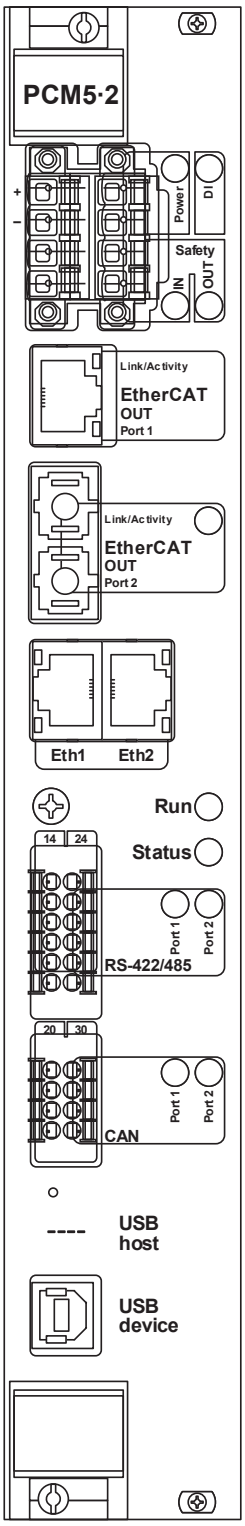
The PCM5·2 module offers a powerful dual core 1 GHz application CPU. It is well suited for extremely demanding C/C++ and CODESYS applications, ultra fast data logging as well as redundant hot-standby solution for land applications.

| Power and control module | | |
|---|---|---|
|  | Power supply* | 50 W internal power supply with 1 s internal UPS.<br>Input level: 24 V, 18 to 32 V |
| | Input | Digital input (DI):<br>High: 9 to 36 V or -9 to -36 V with reference to common<br>Low: 5 to -5 V with reference to common<br>Impedance: Approximately 4 kΩ<br>Isolation: Optically isolated from other potentials, 550 V 50 Hz |
| | Safety | Digital input (IN):<br>High: 9 to 36 V or -9 to -36 V with reference to common<br>Low: 5 to -5 V with reference to common<br>Impedance: Approximately 4 kΩ<br>Isolation: Optically isolated from other potentials, 550 V 50 Hz<br>Digital relay output (OUT): 24 V, maximum 1 A resistive |
| | Interfaces | 1 x EtherCAT® OUT (Port 2), electrical:<br>100BASE-TX, 8P8C (“RJ45”), shielded Cat 5, >0.76 µm gold plating<br>1 x EtherCAT® OUT (Port 1), optical:<br>100BASE-FX, SC connectors, multimode fibre 62.5 µm, OM1<br>2 x Ethernet (Eth1 and Eth2):<br>1000BASE-T, 8P8C (“RJ45”), shielded Cat 5e, >0.76 µm gold plating<br>2 x CAN (CAN 1, CAN 2):<br>ISO 11898, shielded twisted copper cable, 50 to 1,000 kbit/s<br>2 x RS-422/485 (COM1, COM2), Profibus DP slave (COM1) :<br>ANSI/TIA/EIA-422-B and TIA/EIA-485, shielded twisted copper cable<br>4.8 to 921.6 kbit/s (full duplex) |
| | USB host | USB 3.0, Mass Storage Class |
| | USB device | USB 2.0, console on virtual COM port, 115.2 kbit/s (D:8,S:1,P:N,F:N) |
| | Processor | 1 GHz dual-core industrial grade CPU with ECC protected cache |
| | Operating system | DEIF OS based on real-time embedded Linux. Fail-safe remote SW update. |
| | Programming | ANSI C/C++ and IEC 61131-3 via CODESYS version 3 (optional) |
| | Memory | Industrial grade 64 bit ECC protected DDR3 RAM: 1 GB |
| | Storage | Non-volatile data storage: 2 GB industrial grade flash |
| | Storage** | SSD, industrial grade: up-to 32 GB (optional) |
| | Size | 8 TE (40.64 mm) |
| | Power consumption | 12 W |

*Note: External branch protection of maximum 10 A shall be provided. Any JDYX 10 A @ minimum 50 V DC may be used. If operated in ambient temperatures above 60 °C it must be installed in an area with forced air ventilation.

**Note: Non-industrial grade (0 to 70 °C): for example 120, 250, 500 or 1000 GB.

## 2.1.1 PCM5·2 wiring




| | | | |
|---|---|---|---|
| Power | 6 + Supply<br>7 - Supply | DI | 10 +<br>11 - |
| Safety IN | 8 +<br>9 - | Safety OUT | 12 + Supply<br>13 - Supply |
| EtherCAT OUT | 8P8C (RJ45) connector, shielded Cat5, >0.76 µm gold plating | | |
| EtherCAT OUT | SC duplex connector, multi mode f bre 62.5 µm, OM 1 | | |
| Ethernet | 2 x 1000BASE-T 8P8C ( RJ45 ) connector, shielded Cat5e, >0.76 µm gold plating | | |
| RS-422 Port 1* | 14 RxD +<br>15 RxD -<br>16 GND<br>17 TxD +<br>18 TxD -<br>19 SHIELD | RS-422 Port 2* | 24 RxD +<br>25 RxD -<br>26 GND<br>27 TxD +<br>28 TxD -<br>29 SHIELD |
| RS-485 Port 1* | 14 DATA +<br>15 DATA -<br>16 GND<br>17 SHIELD | RS-485 Port 2* | 24 DATA +<br>25 DATA -<br>26 GND<br>27 SHIELD |
| CAN Port 1** | 20 High<br>21 GND<br>22 Low<br>23 SHIELD | CAN Port 2 | 30 High<br>31 GND<br>32 Low<br>33 SHIELD |
| USB host | USB Standard-A plug, MSC | | |
| USB device | USB Standard-B plug, serial service console | | |

*Note: SW configurable (on/off) termination resistor (120 Ω).
SW configurable (on/off) bias (pull up/pull down, 500 Ω).
GND decoupled to shield through 1.5 MΩ || 1.5 nF.

**Note: SW configurable (on/off) termination resistor (120 Ω).
GND decoupled to shield through 1.5 MΩ || 1.5 nF.

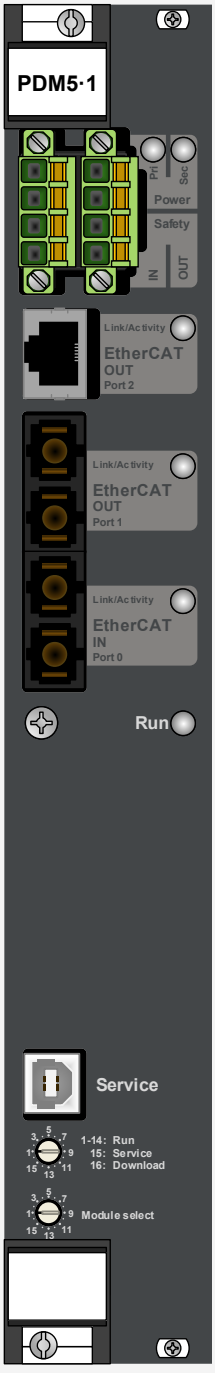
## 2.1.2 PCM5·2 terminal specifications

| | Terminal | Description |
|---|---|---|
| 1 | ECAT OUT P1 | EtherCAT OUT Port 1 |
| 2 | ECAT OUT P2 | EtherCAT OUT Port 2 |
| 3 | Eth1, Eth2 | Ethernet 1 and 2 |
| 4 | USB host | USB, Mass Storage Class |
| 5 | USB device | USB, Media Transfer Protocol, serial service console |
| 6 | Power supply + | Power supply input, 24 V |
| 7 | Power supply - | Power supply input, GND |
| 8 | Safety IN + | Safety chain digital input |
| 9 | Safety IN - | Safety chain digital input |
| 10 | Digital IN + | Digital input |
| 11 | Digital IN - | Digital input |
| 12 | Safety OUT + | Safety chain relay output |
| 13 | Safety OUT - | Safety chain relay output |
| 14 | RS-422 1: RxD +<br>RS-485 1: Data + | Differential receive signal, '+', non-inverting pin<br>Differential data signal, '+', non-inverting pin |
| 15 | RS-422 1: RxD -<br>RS-485 1: Data - | Differential receive signal, '-', inverting pin<br>Differential data signal, '-', inverting pin |
| 16 | RS-422 1: GND<br>RS-485 1: GND | Ground<br>Ground |
| 17 | RS-422 1: TxD + | Differential transmit signal, '+', non-inverting pin |
| 18 | RS-422 1: TxD - | Differential transmit signal, '-', inverting pin |
| 19 | RS-422 1: SHIELD<br>RS-485 1: SHIELD | Shield<br>Shield |
| 20 | CAN 1 - High | Differential data signal, '+', non-inverting pin |
| 21 | CAN 1 - GND | Ground |
| 22 | CAN 1 - Low | Differential data signal, '-', inverting pin |
| 23 | CAN 1 - SHIELD | Shield |
| 24 | RS-422 2: RxD +<br>RS-485 2: Data + | Differential receive signal, '+', non-inverting pin<br>Differential data signal, '+', non-inverting pin |
| 25 | RS-422 2: RxD -<br>RS-485 2: Data - | Differential receive signal, '-', inverting pin<br>Differential data signal, '-', inverting pin |
| 26 | RS-422 2: GND<br>RS-485 2: GND | Ground<br>Ground |
| 27 | RS-422 2: TxD + | Differential transmit signal, '+', non-inverting pin |
| 28 | RS-422 2: TxD - | Differential transmit signal, '-', inverting pin |
| 29 | RS-422 2: SHIELD<br>RS-485 2: SHIELD | Shield<br>Shield |
| 30 | CAN 2 - High | Differential data signal, '+', non-inverting pin |
| 31 | CAN 2 - GND | Ground |
| 32 | CAN 2 - Low | Differential data signal, '-', inverting pin |
| 33 | CAN 2 - SHIELD | Shield |

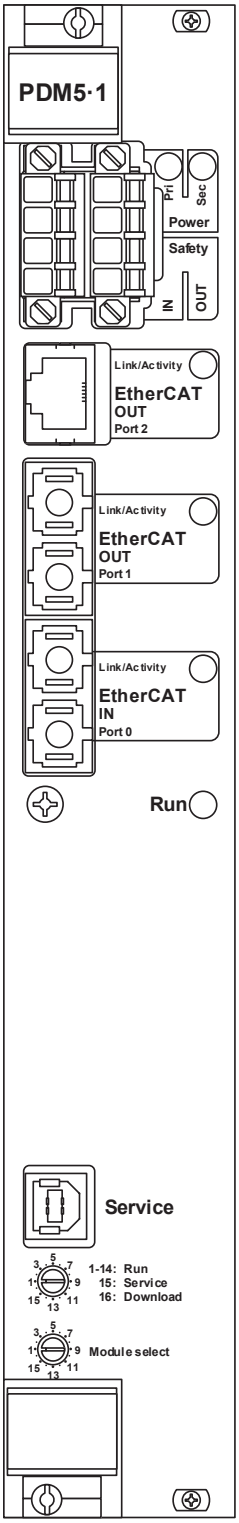
# 3. Power and Distributed communication Modules

## 3.1 PDM5·1 module specifications

The PDM5·1 module is used as an EtherCAT interface for distributed I/O nodes via fibre optical Ethernet.

| Power module and EtherCAT interface | | |
|---|---|---|
|  | Power | 50 W internal power supply with redundant inputs and 50 ms full power fail protection.<br>Supporting direct battery and/or UPS supply.<br>Input level: 24 V, +50 %, -25 % (18 to 36 V) |
| | Safety | Input (IN):<br>High: 9 to 36 V or -9 to -36 V with reference to common<br>Low: 5 to -5 V with reference to common<br>Impedance: Approximately 4 kΩ<br>Isolation: Optically isolated from other potentials, 550 V 50 Hz<br>Digital relay output (OUT): 24 V, maximum 1 A resistive |
| | Interfaces | 1 x EtherCAT® OUT (Port 2), electrical:<br>100Base-TX, 8P8C (“RJ45”), shielded Cat 5, >0.76 µm gold plating<br><br>1 x EtherCAT® OUT (Port 1), optical:<br>100Base-FX, SC connectors, multimode fibre 62.5 µm, OM1<br><br>1 x EtherCAT® IN (Port 0), optical:<br>100Base-FX, SC connectors, multimode fibre 62.5 µm, OM1 |
| | Service | USB service interface:<br>USB 2.0, console on virtual COM port, 115.2 kbit/s (8/N/1), no flow control |
| | Size | 8 TE (40.64 mm) |
| | Power consumption | Maximum 6 W |

## 3.1.1 PDM5·1 wiring




| | | | |
|---|---|---|---|
| Primary power input | 6 + Supply<br>7 - Supply | Secondary power input | 10 + Supply<br>11 - Supply |
| Safety digital input | 8 +<br>9 - | Safety relay output | 12 + Supply<br>13 - Supply |

| | |
|---|---|
| EtherCAT OUT | 8P8C (RJ45) connector, shielded Cat5, >0.76 µm gold plating |
| EtherCAT OUT | SC duplex connector, multi mode f bre 62.5 µm, OM 1 |
| EtherCAT IN | SC duplex connector, multi mode f bre 62.5 µm, OM 1 |
| Service interface | USB Standard-B plug |

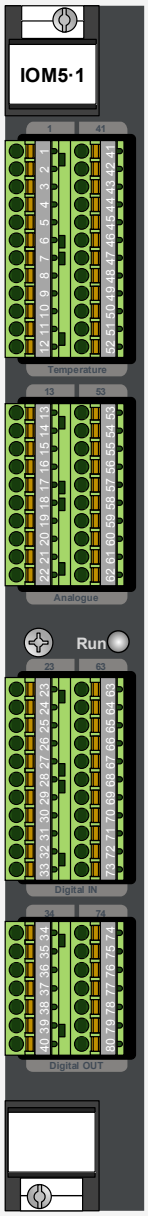
### 3.1.2 PDM5·1 terminal specifications

| | Terminal | Description |
|---|---|---|
| 1 | ECAT OUT P1 | EtherCAT OUT Port 1 |
| 2 | ECAT OUT P2 | EtherCAT OUT Port 2 |
| 3 | ECAT OUT P0 | EtherCAT OUT Port 0 |
| 4 | | |
| 5 | Service | USB Service interface |
| 6 | Power supply + (Pri) | Primary power supply input, 24 V |
| 7 | Power supply - (Pri) | Primary power supply input, GND |
| 8 | Safety IN | Safety chain digital input |
| 9 | Safety IN | Safety chain digital input |
| 10 | Power supply + (Sec) | Secondary power supply input, 24 V |
| 11 | Power supply - (Sec) | Secondary power supply input, GND |
| 12 | Safety OUT | Safety chain relay output |
| 13 | Safety OUT | Safety chain relay output |

# 4. Input and Output Modules

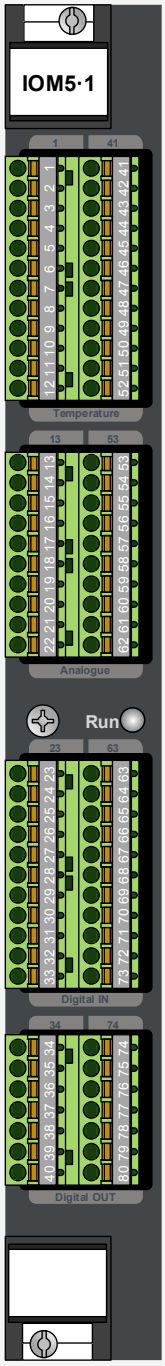
## 4.1 IOM5·1 module specifications

IOM5•1 is a highly flexible I/O module which holds the most commonly used I/O signals in a wind power plant. IOM5•1 is designed for the rough electrical environments, and all inputs and outputs are protected by optical isolation from other potentials.

| 40 channel multi-function I/O module with analogue inputs, temperature inputs, digital inputs, frequency counter inputs, analogue outputs and digital outputs | | | |
|---|---|---|---|
|  | 12 digital inputs | Input | High*: 9 to 36 V or -9 to -36 V with reference to common<br>Low: 5 to -5 V with reference to common |
| | | Impedance | Approximately 2.4 kΩ |
| | | Isolation | Optically isolated from other potentials, 550 V 50 Hz |
| | 4 frequency/digital inputs | Input | High*[1]: 9 to 36 V<br>Low: 0 to 5 V |
| | | Impedance | Approximately 2.4 kΩ |
| | | Isolation | Optically isolated from other potentials, 550 V 50 Hz |
| | | Frequency | 0 to 125 kHz.<br>(Internal frequency divider for frequency >1 kHz) |
| | | Duty cycle | 48 to 52 % at 20 to 125 kHz<br>40 to 60 % at 1 to 20 kHz<br>20 to 80 % at 0 to 1 kHz |
| | | Resolution | 0.8 µs |
| | 10 digital outputs | Supply | External supply 9 to 36 V |
| | | Voltage | Voltage drop <1 V according to external supply |
| | | Current | For each output: 0 to 2 A source or sink<br>Maximum total for all outputs: 2 A |
| | | Isolation | Optically isolated from other potentials, 550 V 50 Hz |
| | | Protection | Current limited for short-circuit protection or thermal overload |

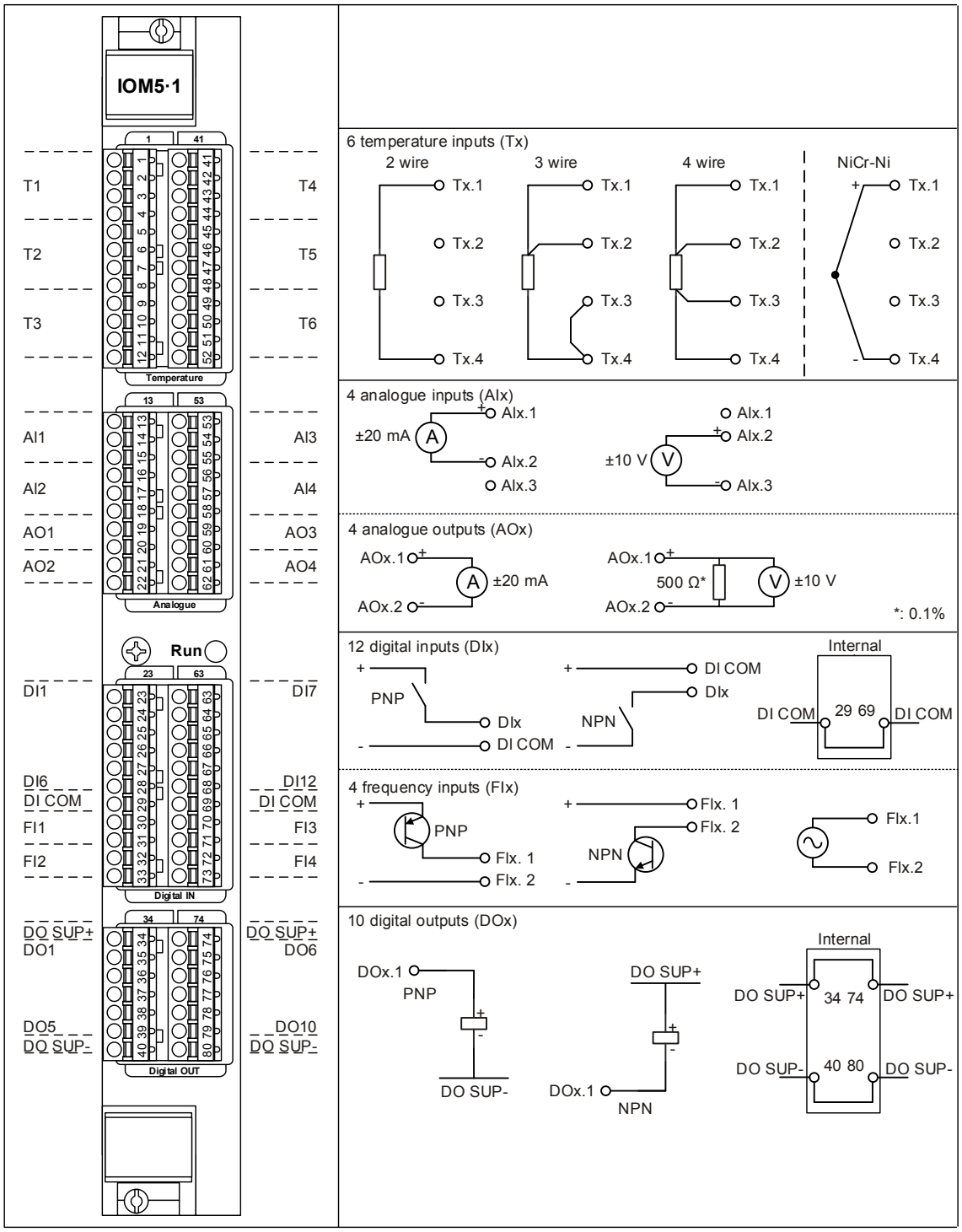
*Note: Above 30 V, some de-rating based on temperature is specified. See the Installation Instruction documentation for details.

**40 channel multi-function I/O module with analogue inputs, temperature inputs, digital inputs, frequency counter inputs, analogue outputs and digital outputs**




| | | |
|---|---|---|
| 6 temperature inputs | Sensor type | Pt100, Pt1000 or NiCr-Ni sensors |
| | Range | -50 to 200 °C for Pt sensors<br>-50 to 1000 °C for NiCr-Ni sensors |
| | Wire | 2-, 3- or 4-wire connection for Pt sensors |
| | Cable error | Open input and short-circuit are detected<br>(only open for NiCr-Ni) |
| | Resolution | 0.1 °C |
| | Accuracy (Pt100, Pt1000 4-wire) | 0.5 °C at reference temperature<br>2.0 °C at operational temperature |
| | Accuracy (Pt100, Pt1000 2 or 3-wire) | 1.0 °C at reference temperature<br>2.5 °C at operational temperature<br>(2-wire cables must be shorter than 1 m) |
| | Accuracy<br>(NiCr-Ni sensor) | 5.0 °C at reference temperature<br>20.0 °C at operational temperature |
| | Isolation | Same potential as analogue inputs and outputs. Optically isolated from other potentials, 550 V 50 Hz. |
| 4 analogue inputs | Input type | -20 to 20 mA or -10 to 10 V |
| | Impedance | Approximately 50 Ω (mA-input)/10 kΩ (V-input) |
| | Resolution | 16 bit |
| | Accuracy | 0.5 % of full range input (40 mA/20 V) at reference temperature<br>1.0 % of full range input (40 mA/20 V) at operational temperature |
| | Isolation | Same potential as analogue outputs and temperature inputs. Optically isolated from other potentials, 550 V 50 Hz. |
| 4 analogue outputs | Output | Configurable ramp time: 5 to 1000 ms Range: -20 to 20 mA |
| | Load | 0 to 500 Ω |
| | Resolution | 12 bit |
| | Accuracy | 0.5 % of full range output (40 mA) at reference temperature<br>1.0 % of full range output (40 mA) at operational temperature |
| | Isolation | Same potential as analogue inputs and temperature inputs. Optically isolated from other potentials, 550 V 50 Hz. |
| Size | 6 TE (30.48 mm) | |
| Power consumption | Maximum 5 W (all 4 analogue outputs at full load) | |

## 4.1.1 IOM5·1 wiring




## 4.1.2 IOM5·1 terminal specifications

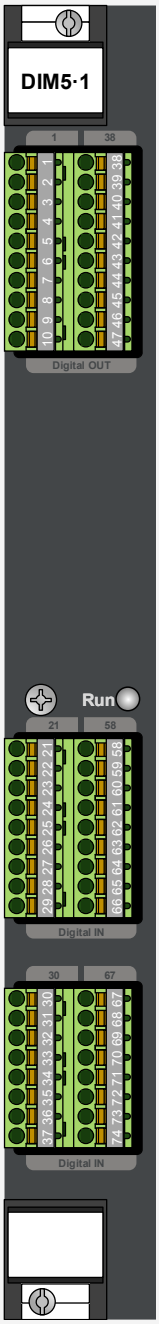
| Terminals | | Description |
|---|---|---|
| 1-4 | T1 | Temperature 1 |
| 5-8 | T2 | Temperature 2 |
| 9-12 | T3 | Temperature 3 |
| 41-44 | T4 | Temperature 4 |
| 45-48 | T5 | Temperature 5 |

| Terminals | | Description |
|---|---|---|
| 49-52 | T6 | Temperature 6 |
| 13-15 | AI1 | Analogue input 1. 13-14 using -20 to 20 mA input, 14-15 using -10 to 10 V input |
| 16-18 | AI2 | Analogue input 2. 16-17 using -20 to 20 mA input, 17-18 using -10 to 10 V input |
| 53-55 | AI3 | Analogue input 3. 53-54 using -20 to 20 mA input, 54-55 using -10 to 10 V input |
| 56-58 | AI4 | Analogue input 4. 56-57 using -20 to 20 mA input, 57-58 using -10 to 10 V input |
| 19-20 | AO1 | Analogue output -20 to 20 mA |
| 21-22 | AO2 | Analogue output -20 to 20 mA |
| 59-60 | AO3 | Analogue output -20 to 20 mA |
| 61-62 | AO4 | Analogue output -20 to 20 mA |
| 23 | DI1 | Digital input 1 |
| 24 | DI2 | Digital input 2 |
| 25 | DI3 | Digital input 3 |
| 26 | DI4 | Digital input 4 |
| 27 | DI5 | Digital input 5 |
| 28 | DI6 | Digital input 6 |
| 29 | DI COM | Digital common input reference supply (DI1-DI12). 24 V for NPN input signal, GND for PNP input signal. Note: Terminal 29 and 69 are internally connected. |
| 63 | DI7 | Digital input 7 |
| 64 | DI8 | Digital input 8 |
| 65 | DI9 | Digital input 9 |
| 66 | DI10 | Digital input 10 |
| 67 | DI11 | Digital input 11 |
| 68 | DI12 | Digital input 12 |
| 69 | DI COM | Digital common input reference supply (DI1-DI12). 24 V for NPN input signal, GND for PNP input signal. Note: Terminal 29 and 69 are internally connected. |
| 30-31 | FI1 | Frequency input 1, NPN or PNP coupling<br>Digital input 13, 30+, 31- |
| 32-33 | FI2 | Frequency input 2 NPN or PNP coupling<br>Digital input 14, 32+, 33- |
| 70-71 | FI3 | Frequency input 3 NPN or PNP coupling<br>Digital input 15, 70+, 71- |
| 72-73 | FI4 | Frequency input 4 NPN or PNP coupling<br>Digital input 16, 72+, 73- |
| 34 | DO SUP+ | 24 V digital output supply. Note: terminals 34 and 74 are internally connected |
| 35 | DO1 | Digital output 1 |
| 36 | DO2 | Digital output 2 |
| 37 | DO3 | Digital output 3 |
| 38 | DO4 | Digital output 4 |
| 39 | DO5 | Digital output 5 |
| 40 | DO SUP- | GND digital output supply. Note: terminals 40 and 80 are internally connected |
| 74 | DO SUP+ | 24 V digital output supply. Note: terminals 34 and 74 are internally connected |

| Terminals | | Description |
|---|---|---|
| 75 | DO6 | Digital output 6 |
| 76 | DO7 | Digital output 7 |
| 77 | DO8 | Digital output 8 |
| 78 | DO9 | Digital output 9 |
| 79 | DO10 | Digital output 10 |
| 80 | DO SUP- | GND digital output supply. Note: terminals 40 and 80 are internally connected |

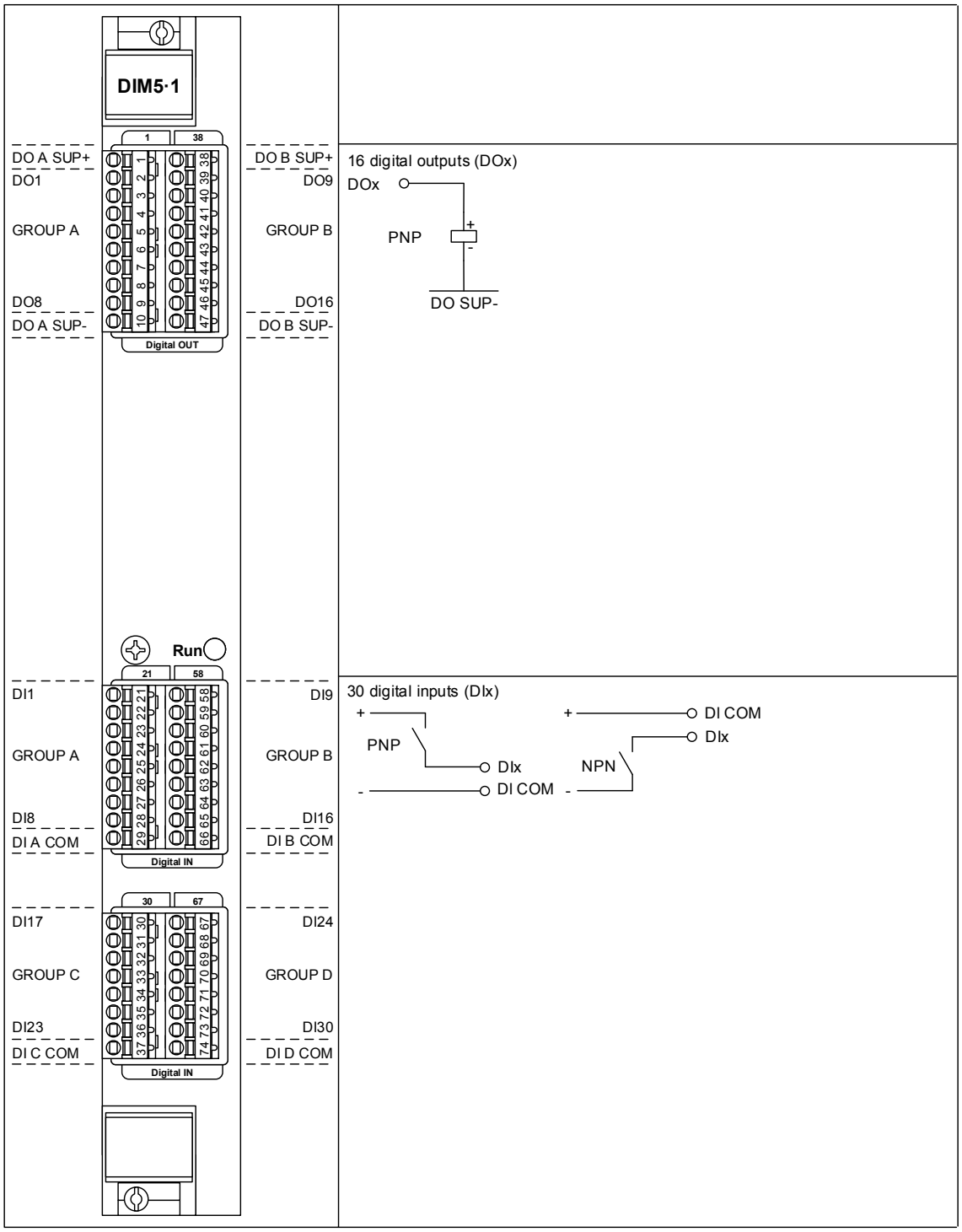
# 4.2 DIM5·1 module specifications

The Digital I/O Module, DIM5·1, is a dedicated digital I/O module offering 30 digital inputs as well as 16 digital outputs. The 30 digital inputs are divided into four individually galvanically separated groups, and the 16 digital outputs are divided into two individually galvanically separated groups.

| 46 channel digital I/O module | | | |
|---|---|---|---|
|  | 16 digital outputs<br>(split in two groups with 8 DO in each; A and B) | Supply | External supply 12 to 36 V<br><br>The status of the external supply can be monitored. |
| | | Voltage | Voltage drop <1 V according to external supply |
| | | Current | For each output: 0 to 500 mA source<br><br>Maximum total for all outputs in same group: 2 A |
| | | Isolation | Optically isolated from other potentials, 550 V 50 Hz |
| | | Protection | Current limited for short-circuit protection or thermal overload.<br><br>The status of the protection can be monitored. |
| | 30 digital inputs<br>(split in four groups with 8 DI in groups A and B; and 7 DI in groups C and D) | Input | High*: 9 to 36 V or -9 to -36 V with reference to common<br>Low: 5 to -5 V with reference to common |
| | | Impedance | Approximately 2.4 kΩ |
| | | Isolation | Optically isolated from other potentials, 550 V 50 Hz |
| | Size | 6 TE (30.48 mm) | |
| | Power consumption | Maximum 2 W | |

*Note: Above 30 V, some de-rating based on temperature is specified. See the Installation Instruction documentation for details.

## 4.2.1 DIM5·1 wiring




## 4.2.2 DIM5·1 terminal specifications

| Terminals | | Description |
|---|---|---|
| 1 | DO A SUP+ | 24 V digital output supply for DO1-DO8; Group A |
| 2 | DO1 | Digital output 1 |
| 3 | DO2 | Digital output 2 |
| 4 | DO3 | Digital output 3 |
| 5 | DO4 | Digital output 4 |

| Terminals | | Description |
|---|---|---|
| 6 | DO5 | Digital output 5 |
| 7 | DO6 | Digital output 6 |
| 8 | DO7 | Digital output 7 |
| 9 | DO8 | Digital output 8 |
| 10 | DO A SUP- | GND digital output supply for DO1-DO8; Group A |
| 38 | DO B SUP+ | 24 V digital output supply for DO9-DO16; Group B |
| 39 | DO9 | Digital output 9 |
| 40 | DO10 | Digital output 10 |
| 41 | DO11 | Digital output 11 |
| 42 | DO12 | Digital output 12 |
| 43 | DO13 | Digital output 13 |
| 44 | DO14 | Digital output 14 |
| 45 | DO15 | Digital output 15 |
| 46 | DO16 | Digital output 16 |
| 47 | DO B SUP- | GND digital output supply for DO9-DO16; Group B |
| 21 | DI1 | Digital input 1 |
| 22 | DI2 | Digital input 2 |
| 23 | DI3 | Digital input 3 |
| 24 | DI4 | Digital input 4 |
| 25 | DI5 | Digital input 5 |
| 26 | DI6 | Digital input 6 |
| 27 | DI7 | Digital input 7 |
| 28 | DI8 | Digital input 8 |
| 29 | DI A COM | Digital common input reference supply (DI1-DI8). 24 V for NPN input signal, GND for PNP input signal. |
| 58 | DI9 | Digital input 9 |
| 59 | DI10 | Digital input 10 |
| 60 | DI11 | Digital input 11 |
| 61 | DI12 | Digital input 12 |
| 62 | DI13 | Digital input 13 |
| 63 | DI14 | Digital input 14 |
| 64 | DI15 | Digital input 15 |
| 65 | DI16 | Digital input 16 |
| 66 | DI B COM | Digital common input reference supply (DI9-DI16). 24 V for NPN input signal, GND for PNP input signal. |
| 30 | DI17 | Digital input 17 |
| 31 | DI18 | Digital input 18 |
| 32 | DI19 | Digital input 19 |
| 33 | DI20 | Digital input 20 |
| 34 | DI21 | Digital input 21 |
| 35 | DI22 | Digital input 22 |

| Terminals | | Description |
|---|---|---|
| 36 | DI23 | Digital input 23 |
| 37 | DI C COM | Digital common input reference supply (DI17-DI23). 24 V for NPN input signal, GND for PNP input signal. |
| 67 | DI24 | Digital input 24 |
| 68 | DI25 | Digital input 25 |
| 69 | DI26 | Digital input 26 |
| 70 | DI27 | Digital input 27 |
| 71 | DI28 | Digital input 28 |
| 72 | DI29 | Digital input 29 |
| 73 | DI30 | Digital input 30 |
| 74 | DI D COM | Digital common input reference supply (DI24-DI30). 24 V for NPN input signal, GND for PNP input signal. |

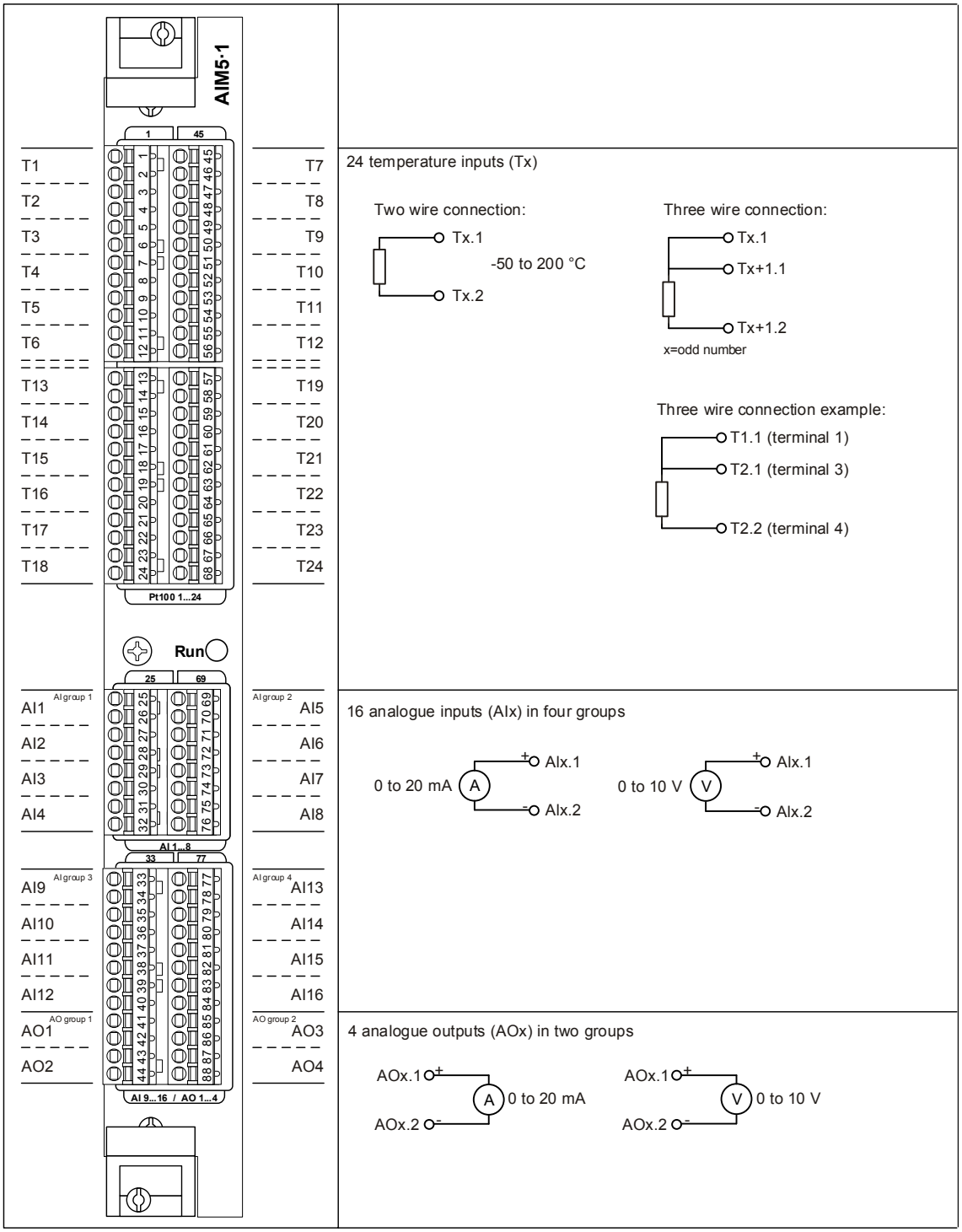
# 4.3 AIM5·1 module specifications

## AIM5·1 module specifications

AIM5·1 is a high density I/O module which offers 24 2-wire Pt100 temperature inputs, 16 analogue inputs and 4 analogue outputs. Both the analogue inputs and outputs support both current and voltage, which can be configured in software.

| 44 channel multi-function I/O module with 24 temperature inputs, 16 analogue inputs and 4 analogue outputs | | | |
|---|---|---|---|
|  | 24 2-wire temperature inputs<br>Two 2-wire inputs can be converted into one 3-wire input | Sensor type | Pt100 |
| | | Range | -50 to 200 °C |
| | | Wire | 2-wire and 3-wire |
| | | Cable error | Open input and short-circuit are detected |
| | | Resolution | 0.1 °C |
| | | Accuracy | 1.0 °C at reference temperature<br>2.0 °C at operational temperature |
| | | Isolation | One group. Galvanic isolated from other potentials, 550 V 50 Hz. |
| | 16 analogue inputs | Input type | 0 to 20 mA or 0 to 10 V |
| | | Impedance | ≤50 Ω (mA-input) / ≥10 kΩ (V-input) |
| | | Resolution | 16 bit |
| | | Accuracy | 0.2 % of full range input (20 mA/10 V) at reference temperature<br>0.4 % of full range input (20 mA/10 V) at operational temperature |
| | | Isolation | Four groups. Galvanic isolated from other potentials, 550 V 50 Hz. |
| | 4 analogue outputs | Output | Range: 0 to 20 mA or 0 to 10 V |
| | | Load | ≤500 Ω (mA-output) / ≥1 kΩ (V-output) |
| | | Resolution | 16 bit |
| | | Accuracy | 0.2 % of full range output (20 mA/10 V) at reference temperature<br>0.4 % of full range output (20 mA / 10 V) at operational temperature |
| | | Isolation | Two groups. Galvanic isolated from other potentials, 550 V 50 Hz. |
| | Size | 6 TE (30.48 mm) | |
| | Power consumption | Maximum 5 W (all 4 analogue outputs at full load) | |

## 4.3.1 AIM5·1 wiring




## 4.3.2 AIM5·1 terminal specifications

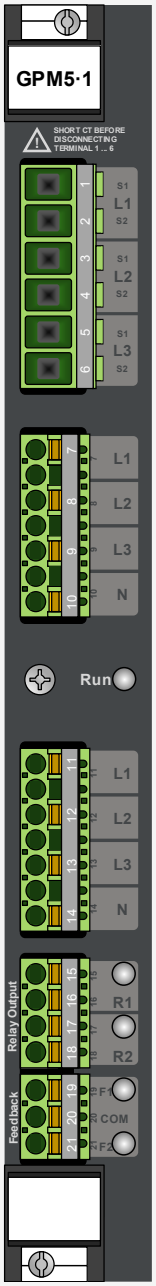
| Terminals | | Description |
|---|---|---|
| 1-2 | T1 | Temperature 1 |
| 3-4 | T2 | Temperature 2 (supports 3-wire together with T1) |
| 5-6 | T3 | Temperature 3 |
| 7-8 | T4 | Temperature 4 (supports 3-wire together with T3) |
| 9-10 | T5 | Temperature 5 |

| Terminals | | Description |
|---|---|---|
| 11-12 | T6 | Temperature 6 (supports 3-wire together with T5) |
| 45-46 | T7 | Temperature 7 |
| 47-48 | T8 | Temperature 8 (supports 3-wire together with T7) |
| 49-50 | T9 | Temperature 9 |
| 51-52 | T10 | Temperature 10 (supports 3-wire together with T9) |
| 53-54 | T11 | Temperature 11 |
| 55-56 | T12 | Temperature 12 (supports 3-wire together with T11) |
| 13-14 | T13 | Temperature 13 |
| 15-16 | T14 | Temperature 14 (supports 3-wire together with T13) |
| 17-18 | T15 | Temperature 15 |
| 19-20 | T16 | Temperature 16 (supports 3-wire together with T15) |
| 21-22 | T17 | Temperature 17 |
| 23-24 | T18 | Temperature 18 (supports 3-wire together with T17) |
| 57-58 | T19 | Temperature 19 |
| 59-60 | T20 | Temperature 20 (supports 3-wire together with T19) |
| 61-62 | T21 | Temperature 21 |
| 63-64 | T22 | Temperature 22 (supports 3-wire together with T21) |
| 65-66 | T23 | Temperature 23 |
| 67-68 | T24 | Temperature 24 (supports 3-wire together with T23) |
| 25-26 | AI1 | Analogue input 1 |
| 27-28 | AI2 | Analogue input 2 |
| 29-30 | AI3 | Analogue input 3 |
| 31-32 | AI4 | Analogue input 4 |
| 59-70 | AI5 | Analogue input 5 |
| 71-72 | AI6 | Analogue input 6 |
| 73-74 | AI7 | Analogue input 7 |
| 75-76 | AI8 | Analogue input 8 |
| 33-34 | AI9 | Analogue input 9 |
| 35-36 | AI10 | Analogue input 10 |
| 37-38 | AI11 | Analogue input 11 |
| 39-40 | AI12 | Analogue input 12 |
| 77-78 | AI13 | Analogue input 13 |
| 79-80 | AI14 | Analogue input 14 |
| 81-82 | AI15 | Analogue input 15 |
| 83-84 | AI16 | Analogue input 16 |
| 41-42 | AO1 | Analogue output 1 |
| 43-44 | AO2 | Analogue output 2 |
| 85-86 | AO3 | Analogue output 3 |
| 87-88 | AO4 | Analogue output 4 |

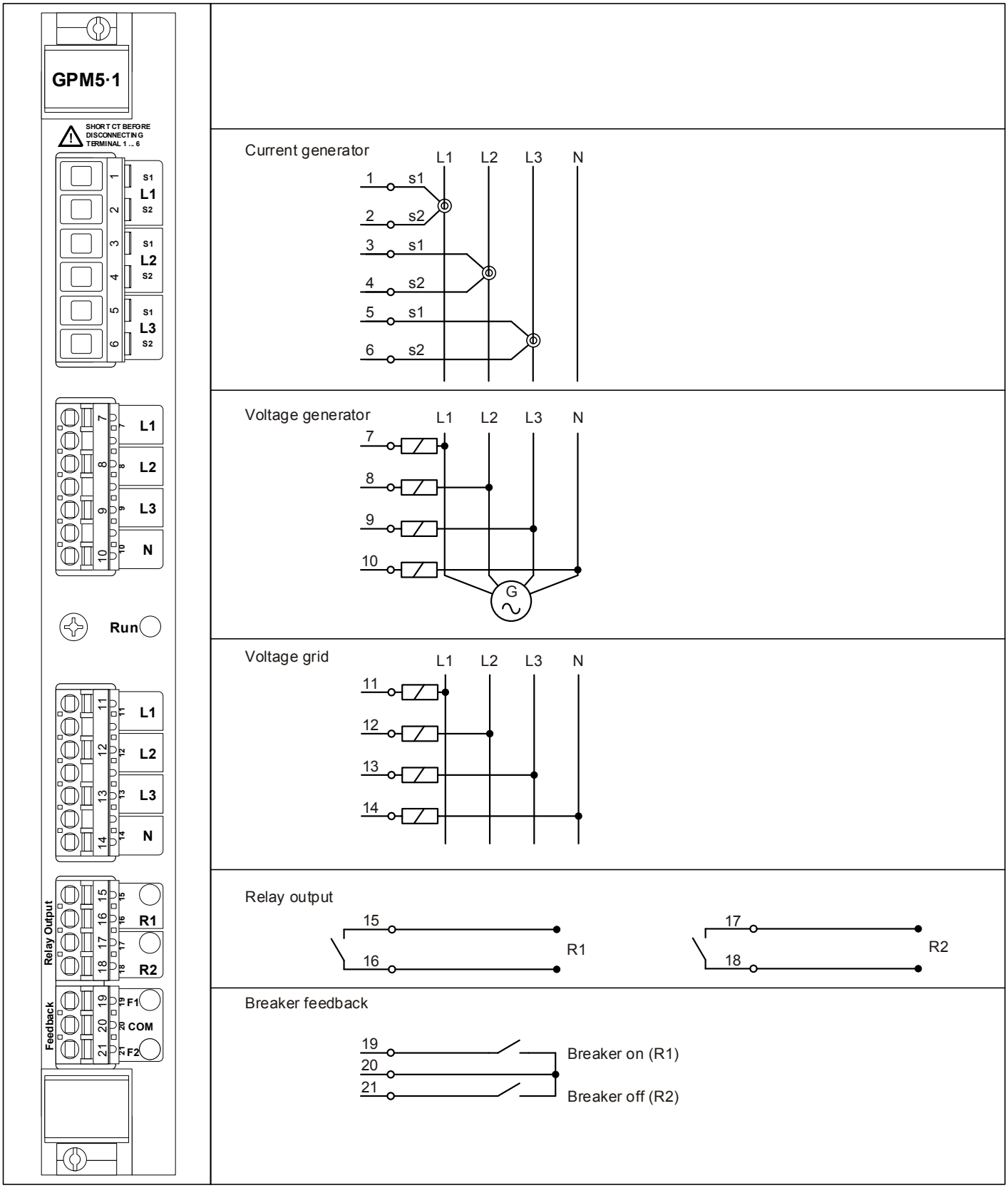
# 5. Grid Protection Module

## 5.1 GPM5·1 module specifications

The GPM5·1 module is a class 0.5 grid measurement and protection module which can be fully configured from the main application. For each period of the connected grid, all measurements are available for the main application.

| Direct class 0.5 3-phase grid, generator voltage and current measurement | | |
|---|---|---|
|  | Inputs | 2 x direct three phase voltage inputs (L1, L2, L3, N)<br>Input range: 0 to 690 V<br>Measure range: 40 to 690 V<br>Frequency: 40 to 70 Hz<br>Load max.: 0.5 mA or 0.3 VA per phase<br>Overload: 130 % continuously, 200 % for 10 s<br>External fuse, maximum 2 A slow-blow<br>UL/cUL: Maximum 600 V L-L, above 2000 m altitude maximum 520 V<br><br>1 x direct three phase current input (L1, L2, L3)<br>Input range: 0 to 1 or 0 to 5 A<br>Frequency: 40 to 70 Hz<br>Load max.: 0.4 VA per phase<br>Overload: 20 A for 60 s, < 75 A for 10 s, < 300 A for 1 s<br>UL/cUL: From listed or R/C (XODW2.8) current transformers |
| | Outputs | 2 x digital relay outputs (normally open) with feedback supervision<br>24 V, maximum 1 A resistive |
| | Certification class | 0.5 measurement of voltage, frequency, current, power, reactive power, phase angle. |
| | Galvanic separation | 3.25 kV 50 Hz isolation between voltage measurement inputs individually and between voltage measurement inputs and all other potentials.<br>550 V 50 Hz isolation between relay outputs, digital inputs (feedback supervision) and all other potentials. |
| | Safety | Installation (over-voltage) category III, 600 V, pollution degree 2.<br><br>EN 61010-1 tested at 50 Hz, 60 s.<br>Each galvanic group tested to other galvanic groups and to Protective Earth, PE. |
| | Accuracy | 0.5 % at reference temperatures<br>1.0 % at operational temperatures<br>IEC 60688 |
| | Size | 6 TE (30.48 mm) |
| | Power consumption | Maximum 4 W |

## 5.1.1 GPM5·1 wiring



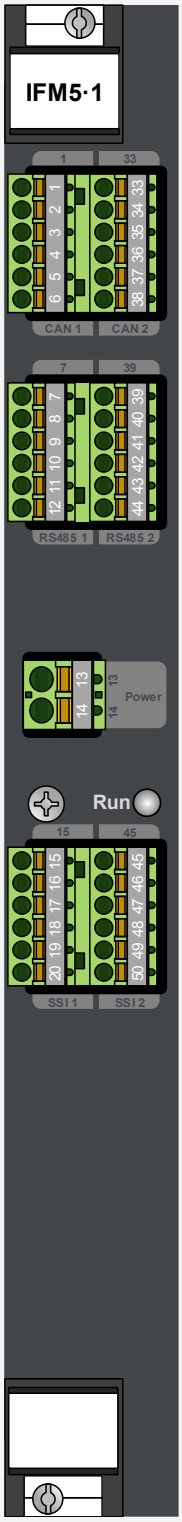
### 5.1.2 GPM5·1 terminal specifications

| Terminal | | Description |
|---|---|---|
| 1 | L1-S1 | Generator Line 1 S1 connection of current transformer |
| 2 | L1-S2 | Generator Line 1 S2 connection of current transformer |
| 3 | L2-S1 | Generator Line 2 S1 connection of current transformer |
| 4 | L2-S2 | Generator Line 2 S2 connection of current transformer |
| 5 | L3-S1 | Generator Line 3 S1 connection of current transformer |
| 6 | L3-S2 | Generator Line 3 S2 connection of current transformer |
| 7 | L1 | Generator Line 1 voltage input |
| 8 | L2 | Generator Line 2 voltage input |
| 9 | L3 | Generator Line 3 voltage input |
| 10 | N | Generator Neutral input |
| 11 | L1 | Grid Line 1 voltage input |
| 12 | L2 | Grid Line 2 voltage input |
| 13 | L3 | Grid Line 3 voltage input |
| 14 | N | Grid Neutral input |
| 15-16 | R1 | Relay output 1 |
| 17-18 | R2 | Relay output 2 |
| 19 | 1 | R1 feedback input |
| 20 | COM | Common |
| 21 | 2 | R2 feedback input |

# 6. Interface and Fieldbus Modules

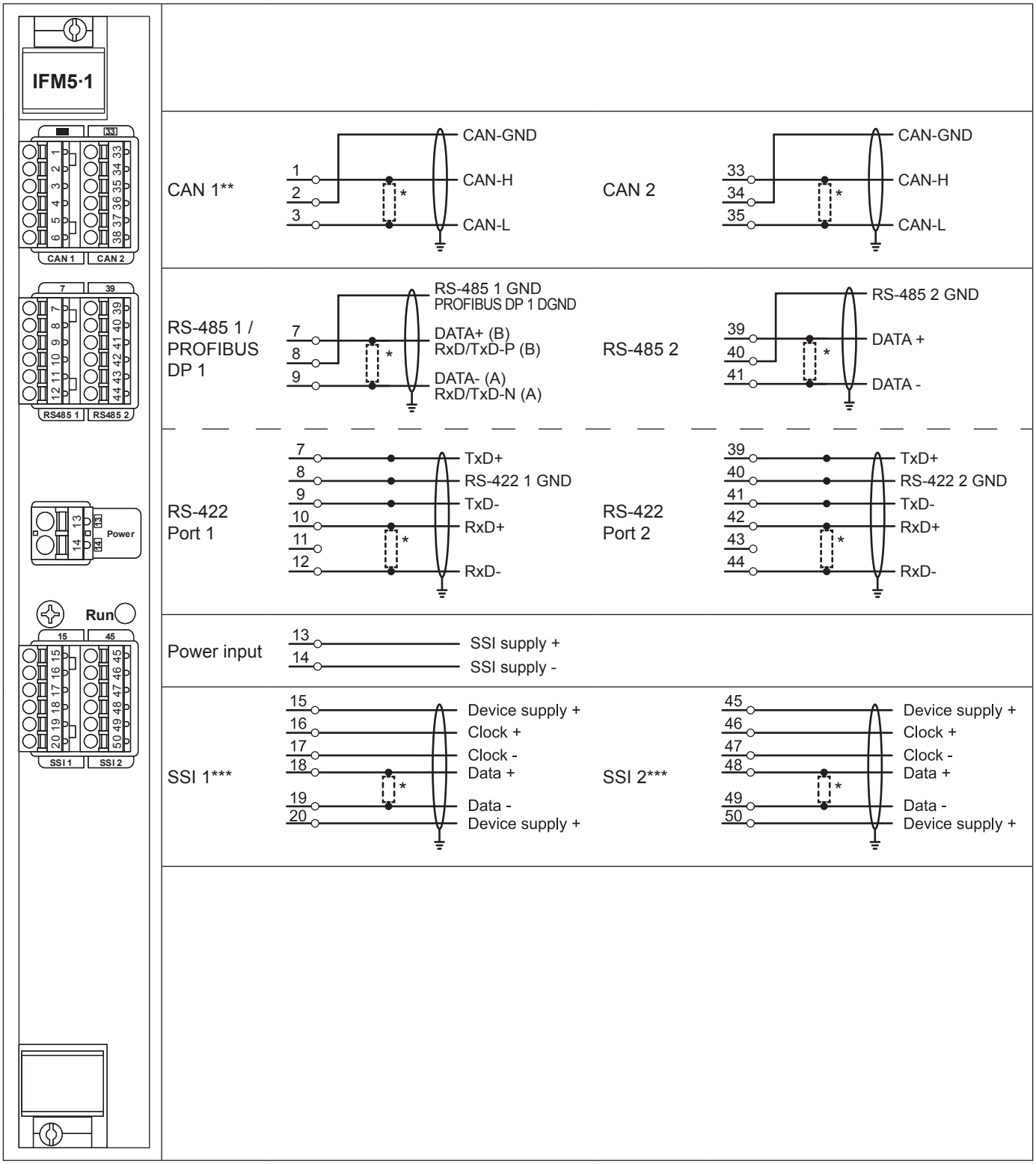
## 6.1 IFM5·1 module specifications

The IFM5·1 interface and fieldbus module with two firmware variants offers RS-485/422, SSI and CAN interfaces or alternatively PROFIBUS DP Master and SSI interface (as variant IFM5·1 Profi).

| RS-485/422, SSI and CAN interfaces | | | |
|---|---|---|---|
|  | 2 RS-485/422<br>or<br>1 DP Master interface | RS-485/422 | |
| | | Standards | TIA/EIA-485<br>ANSI/TIA/EIA-422-B |
| | | Baud rate | 4.8 to 921.6 kbit/s |
| | | Word length | 5, 6, 7 or 8 bits |
| | | Parity | None, even, odd, mark or space |
| | | Stop bits | 1 or 2 |
| | | Flow control | None |
| | | Biasing | On or off |
| | | Communication lines | 4 wire full duplex or 2 wire half duplex |
| | | DP Master | |
| | | Standards | PROFIBUS DP-V0 (Cyclic data and diagnostics) |
| | | Baud rate | 9.6 kbaud to 3 Mbaud |
| | | Max. slaves | 4 |
| | | Isolation | Optically isolated from other potentials, 550 V 50 Hz. |
| | 2 CAN interfaces* | Standards | ISO 11898 |
| | | Baud rate | 20, 50, 125, 250, 500, 800 or 1000 kbit/s<br>sample point at 80 to 87.5 % |
| | | Isolation | Optically isolated from other potentials, 550 V 50 Hz. |
| | 2 SSI interfaces | Standards | Synchronous Serial Interface, SSI<br>Stegmann Interface<br>ANSI/TIA/EIA-422-B |
| | | Baud rate | 125, 250, 500, 1000, 1250 or 1500 kbit/s |
| | | Word length | 8 to 32 bits |
| | | Data delay | Configurable: 0.04 to 50 ms |
| | | Coding | Binary or Gray code |
| | | Frame error suppression | Yes or no |
| | | Isolation | As a group, SSI is optically isolated from other potentials, 550 V 50 Hz. |
| | | SSI device supply | 24 V, maximum 100 mA per channel/device. |
| | | SSI power supply input | 18 to 36 V, maximum 1 A |
| | Size | 6 TE (30.48 mm) | |
| | Power consumption | Maximum 4 W | |

*Note: CAN and UART via RS-485/422 are not functional in firmware variant IFM5·1 Profi.

## 6.1.1 IFM5·1 wiring




| | |
|---|---|
| *Note | Termination resistor (typically, 120 Ω for twisted pairs). |
| **Note: | SW configurable (on/off) bias (pull up/pull down, 470 Ω).<br>GND decoupled to shield through 1.5 MΩ \|\| 1.5 nF. |
| ***Note: | GND decoupled to shield through 1.5 nF. |

## 6.1.2 IFM5·1 terminal specifications

| | Terminal | Description |
|---|---|---|
| 1 | CAN-H | CAN 1: differential data signal, '+', non-inverting pin |
| 2 | CAN-GND | CAN 1: reference potential |
| 3 | CAN-L | CAN 1: differential data signal, '-', inverting pin |
| 4 to 6 | - | Not used |
| 7 | DATA + | RS-485 1: differential data signal, '+', non-inverting pin |
| | RxD/TxD-P | PROFIBUS DP 1: Dataline plus (B conductor) (Red) |
| | TxD + | RS-422 1: differential receive signal, '+', non-inverting pin |
| 8 | GND | RS-485/422 1: reference potential |
| | DGND | PROFIBUS DP 1 : Data ground |
| 9 | DATA - | RS-485 1: differential data signal, '−', inverting pin |
| | RxD/TxD-N | PROFIBUS DP 1: Dataline minus (A conductor) (Green) |
| | TxD - | RS-422 1: differential receive signal, '-', inverting pin |
| 10 | RxD + | RS-422 1: differential transmit signal, '+', non-inverting pin |
| 11 | - | Not connected |
| 12 | RxD - | RS-422 1: differential transmit signal, '-', inverting pin |
| 13 | +SSI supply | Power input for device supplies, 24 V |
| 14 | -SSI supply | Power input for device supplies, GND |
| 15 | Device supply + | SSI 1: 24 V |
| 16 | Clock + | SSI 1: differential clock signal, '+', non-inverting pin |
| 17 | Clock - | SSI 1: differential clock signal, '-', inverting pin |
| 18 | Data + | SSI 1: differential data signal, '+', non-inverting pin |
| 19 | Data - | SSI 1: differential data signal, '-', inverting pin |
| 20 | Device supply - | SSI 1: GND |
| 21 to 32 | - | Not used |
| 33 | CAN-H | CAN 2: differential data signal, '+', non-inverting pin |
| 34 | Shield | CAN 2: reference potential |
| 35 | CAN-L | CAN 2: differential data signal, '-', inverting pin |
| 36 to 38 | - | Not used |
| 39 | DATA + | RS-485 2: differential data signal, '+', non-inverting pin |
| | TxD + | RS-422 2: differential receive signal, '+', non-inverting pin |
| 40 | GND | RS-485/422 2: reference potential |
| 41 | DATA - | RS-485 2: differential data signal, '−', inverting pin |
| | TxD - | RS-422 2: differential receive signal, '-', inverting pin |
| 42 | RxD + | RS-422 2: differential transmit signal, '+', non-inverting pin |
| 43 | - | Not connected |
| 44 | RxD - | RS-422 2: differential transmit signal, '-', inverting pin |
| 45 | Encoder supply + | SSI 2: 24 V |
| 46 | Clock + | SSI 2: differential clock signal, '+', non-inverting pin |

| | Terminal | Description |
|---|---|---|
| 47 | Clock - | SSI 2: differential clock signal, '-', inverting pin |
| 48 | Data + | SSI 2: differential data signal, '+', non-inverting pin |
| 49 | Data - | SSI 2: differential data signal, '-', inverting pin |
| 50 | Encoder supply - | SSI 2: GND |

## 6.2 IFM5·2 module specifications

The IFM5·2 is an industrial grade Ethernet switch with extreme robustness and operation temperature range.

The IFM5·2 can serve as a media converter module, securing galvanic isolation of networks in the wind turbine and to external networks.

IFM5·2 offers an advanced, yet simple to use, ring-protection feature which is much faster and more reliable than normally used network equipment in wind turbines and other industrial systems.

The technology behind this feature is the ERPS standard, which is normally used in high-end back-bone switches at professional network operators/providers.

This means that in case of for example cable breaks, the recovery time is much faster than "‘standard ring-switches".

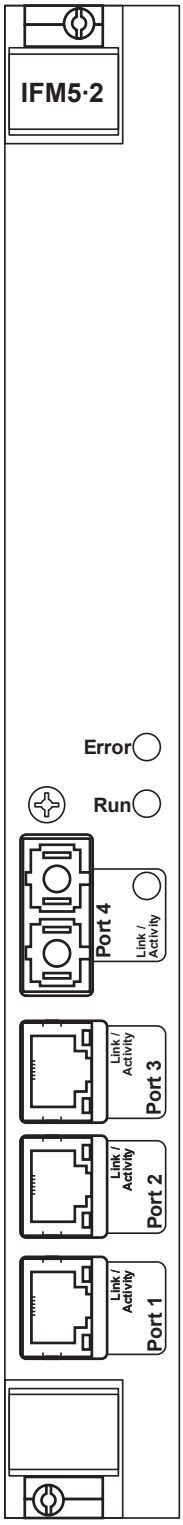
The IFM5·2 has full support for Virtual LAN configuration (VLAN) in accordance with IEEE 802.1Q and is fully configurable from the application running on the processor module (PCM5·x).

It furthermore supports Ethernet over EtherCAT (EoE), ensuring full distributed integration of the modules, allowing Ethernet to be available at any position in the wind turbine without additional fibre connections.

## Four-port Ethernet twisted-pair and fibre module


| | |
|---|---|
| LAN ports | 1 x Ethernet (Port 4) optical:<br>100Base-FX, SC connectors, multimode fibre 62,5 µm, OM1<br><br>1 x Ethernet (Port 3) electrical:<br>100Base-TX, 8P8C (“RJ45”), shielded Cat5, >0.76 µm gold plating<br><br>1 x Ethernet (Port 2) electrical:<br>100Base-TX, 8P8C (“RJ45”), shielded Cat5, >0.76 µm gold plating<br><br>1 x Ethernet (Port 1) electrical:<br>100Base-TX, 8P8C (“RJ45”), shielded Cat5, >0.76 µm gold plating |
| Size | 6 TE (30.48 mm) |
| Power consumption | Maximum 4 W |

## 6.2.1 IFM5·2 wiring




| | |
|---|---|
| Port 4 | SC duplex connector, multi mode f bre 62.5 µm, OM 1 |
| Port 3 | 8P8C (RJ45) connector, shielded Cat5, >0.76 µm gold plating |
| Port 2 | 8P8C (RJ45) connector, shielded Cat5, >0.76 µm gold plating |
| Port 1 | 8P8C (RJ45) connector, shielded Cat5, >0.76 µm gold plating |

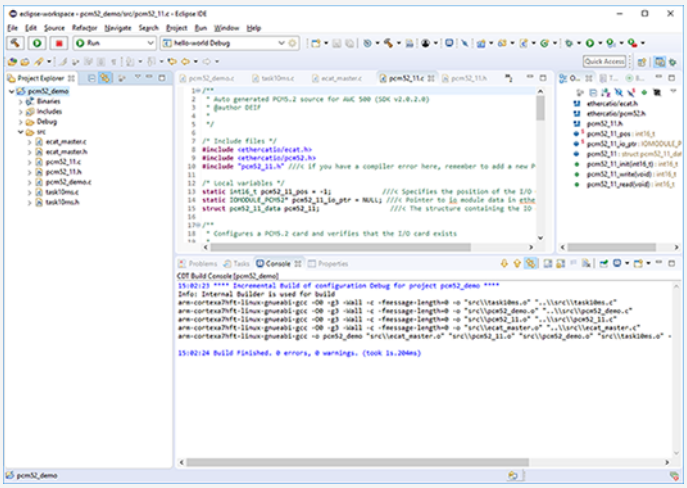
### 6.2.2 IFM5·2 terminal specifications

| | Terminal | Description |
|---|---|---|
| 1 | Port 1 | 1 x Ethernet port (electrical): 100Base-TX, 8P8C (“RJ45”), shielded Cat5, >0.76 µm gold plating |
| 2 | Port 2 | 1 x Ethernet port (electrical): 100Base-TX, 8P8C (“RJ45”), shielded Cat5, >0.76 µm gold plating |
| 3 | Port 3 | 1 x Ethernet port (electrical): 100Base-TX, 8P8C (“RJ45”), shielded Cat5, >0.76 µm gold plating |
| 4 | Port 4 | 1 x Ethernet port (optical): 100Base-FX, SC connectors, multimode fibre 62.5µm, OM1 |

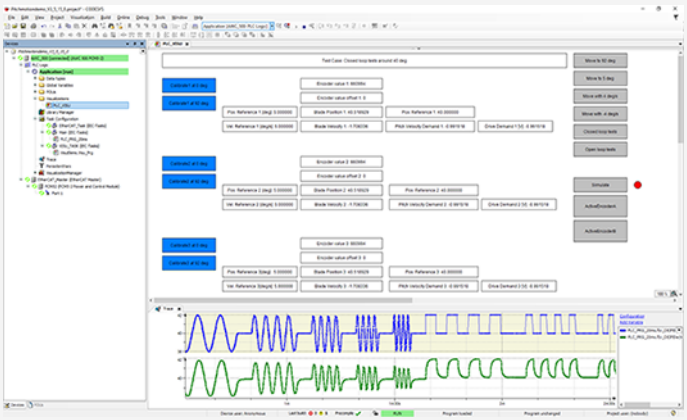
# 7. Application development

## 7.1 Software packages

### 7.1.1 C/C++ programming

| Application development | |
|---|---|
|  | Windows and Linux SDK (Software Development Kit) available for use with for example Eclipse IDE, Visual Studio IDE or CODESYS IDE. |
| AWC 500 C/C++ development package | • AWC 500 Windows and Linux SDK.<br>• Eclipse IDE with C/C++ Development Toolkit (CDT).<br>• Optional : Cygwin64 for External Builder (make) or GNU gcc/gdb toolchain for windows. |

### 7.1.2 IEC61131-3 programming

| Application Development | |
|---|---|
|  | IEC61131-3 PLC-programmed based on CODESYS<br>Programming languages:<br>• Sequential Function Chart (SFC)<br>• Function Block Diagram (FBD)<br>• Structured Text (ST)<br>• Ladder Diagram (LD)<br>• ANSI C/C++ (via AWC 500 C/C++ development package)<br><br>• Multi-language help in Chinese, German and English<br>• Programmed via Ethernet connection (TCP/IP)<br>• Download of boot projects and source code<br>• Integrated PLC and task configuration<br>• Web visualisation on PanelPC or remote via Secure communication (HTTPS)<br>• Online debugging and sampling<br>• Trace-integrated simulation |
| AWC 500 CODESYS package | • CODESYS V3.5 IDE<br>• DEIF AWC 500 TSP (Target Support Package) with device descriptions |

### 7.1.3 Supported software features

| Software | AWC 500 C programming | AWC 500 CODESYS and web visualisation |
|---|---|---|
| **PLC runtime** | - | CODESYS V3.5 SP15+ |
| | | |
| **Programming** | | |
| IEC61131-3 | - | LD, SFC, FBD, ST |
| | - | CODESYS V3.5 SP15+ IDE |
| C/C++ | ANSI C/C++ | Yes as FB components |
| | Eclipse-based IDE | |
| | | |
| **Communication drivers** | Modbus (TCP/IP) | |
| | CAN layer 2 | |
| | CANopen master/slave | |
| | Serial communication | |
| | Socket communication (UDP, TCP/IP) | |
| | SSI - Serial Synchronous Interface | |
| | Profibus DP-V0 Master (CODESYS only) | |
| | | |
| **Network protocols** | File Transfer Protocol (FTP), server and client | |
| | Secure/SSH File Transfer Protocol (SFTP), server | |
| | Trivial File Transfer Protocol (TFTP), client | |
| | Secure Copy (SCP), server and client | |
| | Secure Shell (SSH), version 2, server and client | |
| | Network Time Protocol (NTP), client | |
| | Dynamic Host Configuration Protocol (DHCP), client | |
| | | |
| **MATLAB/Simulink interface** | DEIF PLC Link | |
| C code generation | Yes | |
| IEC 61131-3 structured text generation | Yes | |
| FLEX/GH bladed interface | Yes | |
| | | |
| **Visualisation** | | DEIF HMI solution (TCP/IP) or<br>CODESYS web visualisation |
| | | |
| **System Configuration** | Configuration via file access or shell commands.<br>IP address (static/dynamic), hostname, change root and default password, view module serial numbers. | |
| Device handling | Software (DEIF I/O Handler) | CODESYS Device handling (EtherCAT Master, CANOpen Manager, Profibus Master) |
| Configuration | Device handling | |
| | | |

| Software | AWC 500 C programming | AWC 500 CODESYS and web visualisation |
|---|---|---|
| **Visualisation designer** | Via software (DEIF HMI) | CODESYS V3.5 visualisation |
| Scope/trace | | Yes (trace in CODESYS) |

| HMI visualisation tool | |
|---|---|
| CODESYS web visualisation | Panel PC and remote HMI client (communication via HTTPS)<br>Requires: Browser with HTML5/JavaScript support, such as Chrome, Firefox, Safari, Edge, and more (Kiosk mode possible) |

| External communication | |
|---|---|
| OPC DA | Via CODESYS Gateway and CODESYS OPC Server |
| OPC-UA | Via Open62541 |
| Modbus<br>• TCP/IP<br>• RTU | Yes |

# 8. General information

## 8.1 Legal information and disclaimer

### 8.1.1 Open source software

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