# EM24

## Energy analyzer for three-phase systems


## Description

Three- phase energy analyzer for DIN- rail mounting with configuration joystick, frontal selector and LCD display. Direct connection up to 65A or via current and voltage transformers. It can be equipped with 2 digital outputs (pulse transmission or alarm function). In alternative the Modbus RTU or Dupline communication port and 3 digital inputs, the M-Bus communication, or the Modbus TCP/IP Ethernet ports are available.
The wireless M-Bus version is the perfect solution when cabling is not possible.

## Benefits

- **Time saving set-up**, by frontal joystick and selector.
- **Error- proof installation,** by self- power supply and phase sequence detection.
- **Easy variable scrolling,** by means of the front joystick.
- **Wide interfacing capability,** choosing among 2 pulse outputs, the RS485, the M-Bus, Dupline or the Ethernet communication port.
- **Extended energy measurements,** using total/partial or total/multi-tariff metering.
- **Flexible installation,** by means of the direct connection up to 65 A or the connection of 5 A current transformers.
- **Extended alarm control** on any available variable by means of up to two digital outputs.
- **Accurate measurement.** It is compliant with the international accuracy standard EN IEC 62053-21, and the EN IEC 61557- 12 performance requirements (active power and active energy).
- **Legal metrology,** guaranteed by the MID approval
- **Wireless communication,** wireless M-Bus version allows remote data collection when cabling is not possible

due to cost or installation requirements.

- **Easy commissioning** of wireless communication thanks to the test function of the joystick and to transmission counter for diagnostics

## Applications

EM24 is the perfect solution in any application, specially in building and industrial automation where energy and main electrical variables monitoring is required.

EM24 is particularly suited for:

- energy efficiency monitoring
- cost allocation
- fiscal/legal sub-billing, where the wireless M-Bus version is the best choice for quick and easy installation without cables. Encryption ensures data security and safeguards confidentiality.

## Main functions

- Measurement of energy consumption and main electrical variables of single-phase, two-phase or three-phase loads.
- Display of single phase measurements and total measurements.
- Transmission of data via serial communication (Modbus RTU, M-Bus or Dupline) or Ethernet (Modbus TCP/IP).
- Transmission of energy consumption via pulse output (optional).
- Easy connection function.
- Transmission of data via wireless M-Bus (868 MHz for the European market).
- Two wireless M-Bus versions: a compact model with internal antenna and a SMA connector model with external antenna (in case of metallic switchboard).

## Main features

- Energy measurements: total and partial kWh and kvarh or based on 4 different tariffs; single phase measurements
- Gas, cold water, hot water, kWh remote heating measurements via digital inputs
- TRMS measurements of distorted sine waves (voltages/currents)
- Data encryption (a unique key will be provided for any device in a sealed envelope included in the instrument box)
- Compliant with EN IEC 61557-12 performance requirements (active power and active energy)

## Structure

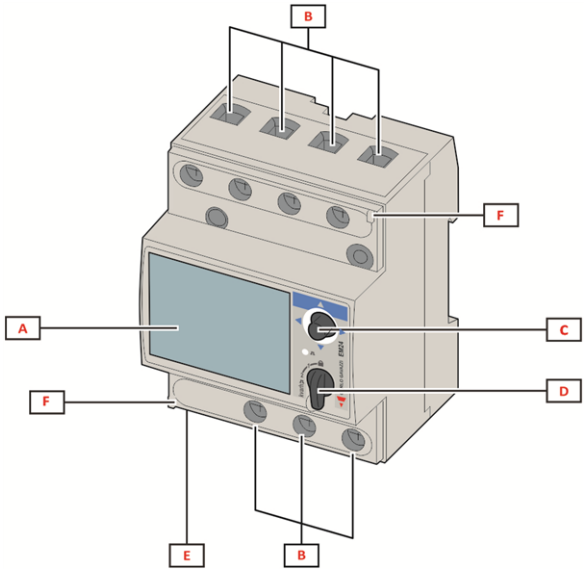



***Fig. 1*** *Direct connection*

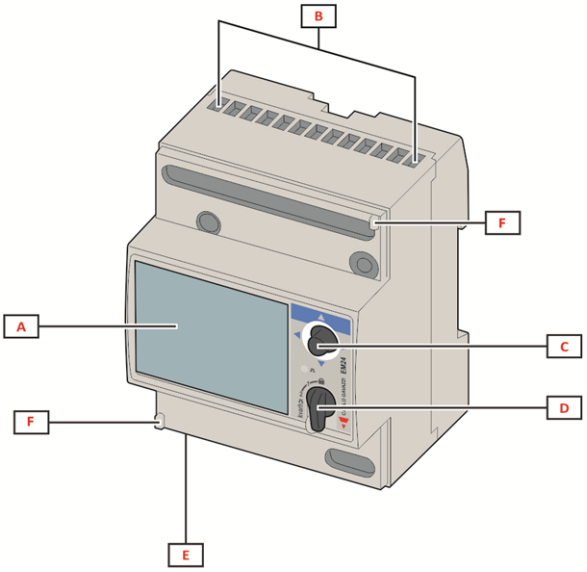



***Fig. 2*** *CT connection*

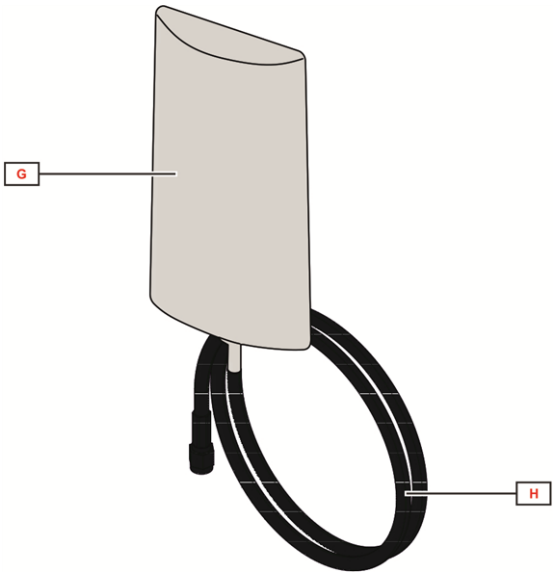


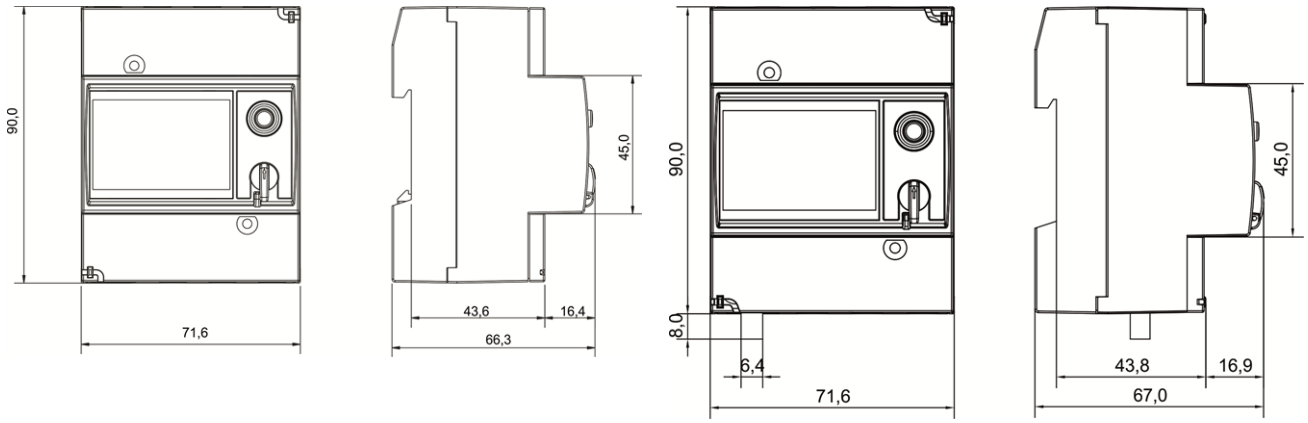

***Fig. 3*** *External antenna (only for EM24DINAV...W1E...)*

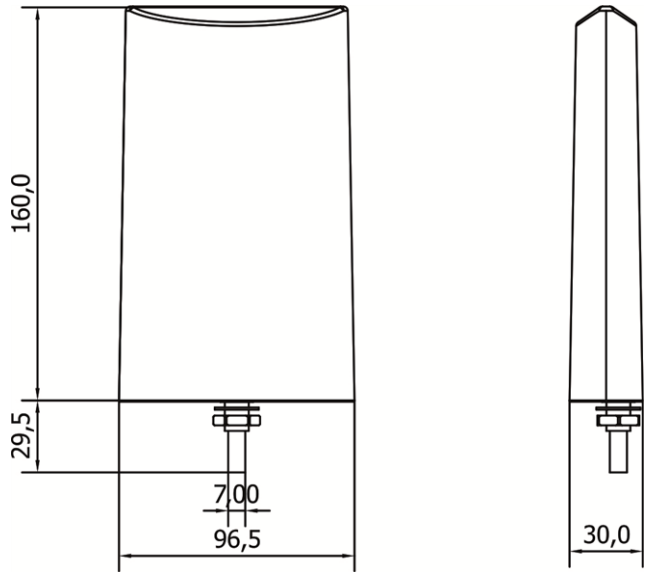
| Area | Description |
|---|---|
| **A** | LCD display |
| **B** | Voltage/current connections |
| **C** | Joystick |
| **D** | Selector with pin for MID seal (programming block) |
| **E** | Inputs/outputs or communication port |
| **F** | Pins for MID seal (protection covers included) |
| **G** | External antenna for wireless M-Bus communication |
| **H** | SMA connector cable (2 m) |

# Features

## General

| | |
|---|---|
| **Protection degree** | Front: IP50. Terminals: IP20 |
| **Terminals** | AV2/AV9 models:<br>Measurement inputs: 2.5 to 16 $mm^2$ / 1.7 to 3 Nm;<br>Other inputs: 1.5$mm^2$ / 0.4 to 0.8 Nm<br>AV5/AV6 models:<br>Measurement inputs and other inputs: 1.5 $mm^2$ max. / 0.4 to 0.8 Nm |
| **Overvoltage category** | Cat. III |
| **Utilisation category** | UC2 |
| **Pollution degree** | 2 |
| **Noise rejection (CMRR)** | 100 dB, from 42 to 62 Hz |
| **Mounting** | DIN rail |
| **Weight** | 400 g (packaging included)<br>800 g with external antenna (packaging included) |






## Environmental specifications

| | |
|---|---|
| **Operating temperature** | From -25 to +55 °C / from -13 to +131 °F |
| **Storage temperature** | From -30 to +70 °C / from -22 to +158 °F |

*NOTE: R.H. < 90 % non-condensing @ 40 °C / 104 °F.*

## Input and output insulation

| Type | Measuring inputs | Relay outputs | Open collector outputs | Communication port and digital inputs | Dupline | Ethernet port | Self power supply | Auxiliary power supply |
|---|---|---|---|---|---|---|---|---|
| **Measuring inputs** | - | 4 kV | 4 kV | 4 kV | 4 kV | 4 kV | 0 kV | 4 kV |
| **Relay outputs** | 4 kV | - | - | - | - | - | 4 kV | 4 kV |
| **Open collector outputs** | 4 kV | - | - | - | - | - | 4 kV | 4 kV |
| **Communication port and digital inputs** | 4 kV | - | - | - | - | - | 4 kV | 4 kV |
| **Dupline** | 4 kV | - | - | - | - | - | 4 kV | 4 kV |
| **Ethernet port** | 4 kV | - | - | - | - | - | 4 kV | - |
| **Self power supply** | 0 kV | 4 kV | 4 kV | 4 kV | 4 kV | 4 kV | - | - |
| **Auxiliary power supply** | 4 kV | 4 kV | 4 kV | 4 kV | 4 kV | - | - | - |

## Compatibility and conformity

| | |
|---|---|
| **Directives** | 2011/65/EU (RoHs)<br>2014/53/EU (RED) |
| **Standards** | **Electromagnetic compatibility (EMC) - emissions and immunity**: EN IEC 62052-11<br>**Electrical safety**: EN IEC 61010-1, EN 50470-1 (MID), UL 61010-1<br>**Accuracy**: EN IEC 62053-21, EN IEC 62053-23, EN 50470-3 (MID), EN IEC 61557-12 (active power and active energy, MID models only)<br>**Pulse outputs**: EN IEC 62053-31, DIN 43864 |
| **Approvals** | CE UKCA c UL us LISTED (UL508: AV5 and AV6 except M2 and W1; UL61010-1: E1) **MID** (PF only) |

## Electrical specifications

| **Voltage - MID models** | | | |
|---|---|---|---|
| **Voltage inputs** | AV2 | AV9 | AV5 |
| **Voltage connection** | Direct | | |
| **Rated voltage L-N (from $U_n$ min. to $U_n$ max.)** | 133 to 230 V | 230 V | 230 V |
| **Rated voltage L-L (from $U_n$ min. to $U_n$ max.)** | 230 to 400 V | 400 V | 400 V |
| **Voltage tolerance** | -20%, +15% | | |
| **Input impedance** | Refer to “Power supply” | | |
| **Frequency** | 50 Hz | | |

| **Voltage - Non MID models (according to EN IEC 62052-11)** | | | | | |
|---|---|---|---|---|---|
| **Voltage inputs** | | AV2 | AV9 | AV5 | AV6 |
| **Voltage connection** | | Direct | | | Direct or via VT |
| **Rated voltage L-N (from $U_n$ min. to $U_n$ max.)** | **All models except E1:** | 133 to 230 V | 230 V | 230 V | 57.7 to 120 V |
| | **Models: E1, W1** | 120 to 277 V | / | 120 to 277 V | / |
| **Rated voltage L-L (from $U_n$ min. to $U_n$ max.)** | **All models except E1:** | 230 to 400 V | 400 V | 400 V | 100 to 240 V |
| | **Models: E1, W1** | 208 to 480 V | / | 208 to 480 V | / |
| **Voltage tolerance** | | -20%, +15% | | | |
| **Input impedance** | | Refer to “Power supply” | | >1600 kΩ | |
| **Frequency** | | 50/60 Hz | | | |

| Voltage - Non MID models (according to UL) | | | | | |
|---|---|---|---|---|---|
| **Voltage inputs** | | AV2 | AV9 | AV5 | AV6 |
| **Voltage connection** | | Direct | | | Direct or via VT |
| **Rated voltage L-N (from $U_n$ min. to $U_n$ max.)** | **All models except E1, M2, W1:** | / | / | 230 to 347 V | 57.7 to 144 V |
| | **E1 model:** | 120 to 277 V | / | 120 to 277 V | / |
| **Rated voltage L-L (from $U_n$ min. to $U_n$ max.)** | **All models except E1, M2, W1:** | / | / | 400 to 600 V | 100 to 250 V |
| | **E1 model:** | 208 to 480 V | / | 208 to 480 V | / |
| **Voltage tolerance** | | -20%, +15% | | | |
| **Input impedance** | | Refer to “Power supply” | | >1600 kΩ | |
| **Frequency** | | 50/60 Hz | | | |

| Current | | | | |
|---|---|---|---|---|
| **Current inputs** | AV2 | AV9 | AV5 | AV6 |
| **Current connection** | Direct | | Via CT | |
| **Rated current ($I_n$)** | - | | 5 A | |
| **Base current ($I_b$)** | 10 A | | - | |
| **Minimum current ($I_{min}$)** | 0.5 A | | 0.05 A | |
| **Maximum current ($I_{max}$)** | 65 A | | 10 A | |
| **Start-up current ($I_{st}$)** | 0.04 A | | 0.01 A | |
| **Overload** | Continuous: 65 A @50 Hz<br>For 10 ms: 1950 A @50 Hz | | Continuous: 10 A @50 Hz<br>For 500 ms: 200 A @ 50 Hz | |
| **Short circuit withstand** | For 10 ms: 4500 A according to EN IEC 62052-31:2015 | | - | |
| **Input impedance** | < 1.1 VA | | < 0.6 VA | |
| **Crest factor** | 4<br>(92 A max. peak) | | 3<br>(15 A max. peak) | |

| Maximum CTxVT ratio | | | | |
|---|---|---|---|---|
| **Current inputs** | AV2 | AV9 | AV5 | AV6 |
| **Non-MID models except E1** | - | - | 4629 | 14529 |
| **Non-MID models: E1, W1** | - | - | 6975 | - |
| **MID models except E1** | - | - | 3150 | - |
| **MID models: E1, W1** | - | - | 2615 | - |

## Power supply

| Non MID models | | | | |
|---|---|---|---|---|
| | AV2 | AV9 | AV5 | AV6 |
| **Type** | Self power supply | | D: 115/230 V ac, +/-15%, 50/60Hz<br>L: 24 to 48 V ac/dc; ac: +/-15%, 50/60Hz, dc: +/-20%<br>X (E1 only): Self power supply | |
| **Consumption** | IS and DP: < 12 VA / 2 W<br>E1: 4.7 VA / < 2.9 W<br>Others: < 20 VA / 1 W | | D: < 2.5 VA / 1.5 W<br>L: < 2.5 VA / 1 W<br>E1: <4.7 VA / 2.9 W | |
| | W1: 2.7 VA / 1.8 W | | | |

| MID models | | | |
|---|---|---|---|
| | AV2 | AV9 | AV5 |
| **Type** | Self power supply | | |
| **Consumption** | IS and DP: < 12 VA / 2 W<br>E1: < 4.7 VA / 2.9 W<br>Others: < 20 VA / 1 W | | <4.5 VA / 2.9 W<br>E1: < 4.7 VA / 2.9 W |
| | W1: 2.7 VA / 1.8 W | | |

## Measurements

| | |
|---|---|
| **Method** | TRMS measurements of distorted waveforms |
| **Sampling** | 1600 samples/s @50 Hz<br>1900 samples/s @60 Hz |

## Available measurements

| Active energy | Unit | System | Phase | Note |
|---|---|---|---|---|
| Imported (+) Total | kWh+ | ● | ● | |
| Imported (+) partial | kWh+ | ● | - | |
| Exported (-) Total | kWh- | ● | - | |
| Imported (+) by tariff (IS, DP) | kWh+ | ● | - | T1, T2, T3, T4 |

| Reactive energy | Unit | System | Phase |
|---|---|---|---|
| Imported (+) Total | kvarh+ | ● | - |
| Imported (+) partial | kvarh+ | ● | - |
| Exported (-) Total | kvarh- | ● | - |
| Imported (+) by tariff | kvarh+ | ● | - |

| Electrical variable | Unit | System | Phase |
|---|---|---|---|
| Voltage L-N | V | ● | ● |
| Voltage L-L | V | ● | ● |
| Current | A | - | ● |
| #DMD MAX | A | ● | - |
| Active power | kW | ● | ● |
| #DMD | kW | ● | - |
| #DMD MAX | kW | ● | - |
| Apparent power | kVA | ● | ● |
| #DMD | kVA | ● | - |
| #DMD MAX | kVA | ● | - |
| Reactive power | kvar | ● | ● |
| Power factor | PF | ● | ● |
| Frequency | Hz | ● | - |
| Run hour meter | h | ● | - |

## Measurement mode

Depending on the APPLICATION setting, a different selection of variables is available on the display (see manual) and the energy calculation is worked out as follows:

- Standard: both kWh+ and kWh- are available;
- EC: easy connection function, the power is always integrated (both in case of positive and negative power).

In MID analyzers the calculation depends on the model:

- PFA: Easy connection, the total energy totalizer (kWh+) is certified according to MID;
- PFB: only the total positive totalizer (kWh+) is certified according to MID. The negative energy totalizer is available but not certified according to MID.

## Energy metering

For every measuring interval time, the energies of the single phases are summed; according to the sign of the result, the positive (kWh+) or negative totalizer (kWh-) is increased.

Example:

P L1= +2 kW, P L2= +2 kW, P L3= -3 kW

Integration time = 1 hour

+kWh=(+2+2-3)x1h=(+1)x1h=1 kWh

-kWh=0 kWh

## Measurement accuracy

| Current | AV2 | AV9 | AV5 | AV6 |
|---|---|---|---|---|
| From 0.5 A to 2 A | 2 ±(0.5% rdg + 3dgt) | | - | - |
| From 2 A to 65 A | ±(0.5% rdg + 1dgt) | | - | - |
| From 0.05 A to 1 A | - | - | ±(0.5% rdg + 3dgt) | |
| From 1 A to 10 A | - | - | ±(0.5% rdg + 1dgt) | |

| Phase-phase voltage | AV2 | AV9 | AV5 | AV6 |
|---|---|---|---|---|
| In the range $U_n$ | ±(1% rdg +1dgt) | | | |

| Phase-neutral voltage | AV2 | AV9 | AV5 | AV6 |
|---|---|---|---|---|
| In the range $U_n$ | ±(0.5% rdg +1dgt) | | | |

| Active and apparent power | AV2 | AV9 | AV5 | AV6 |
|---|---|---|---|---|
| From 1.0 A to 65.0 A (PF=0.5 L, 1, 0.8 C) | ±(1% rdg +1dgt) | | - | |
| From 0.5 A to 1.0 A (PF=1) | ±(1.5% rdg +1dgt) | | - | |
| From 0.25 A to 10 A (PF=0.5 L, 1, 0.8 C) | - | | ±(1% rdg +1dgt) | |
| From 0.05 A to 0.25 A (PF=1) | - | | ±(1.5% rdg +1dgt) | |

| Reactive power | AV2 | AV9 | AV5 | AV6 |
|---|---|---|---|---|
| From 1.0 A to 2.0 A (sinϕ=0.5 L, 0.5 C)<br>From 0.5 A to 1.0 A (sinϕ=1) | ±(2.5% rdg + 1 dgt) | | - | |
| From 2.0 A to 65.0 A (sinϕ=0.5 L, 0.5 C)<br>From 1.0 A to 65.0 A (sinϕ=1) | ±(2% rdg + 1 dgt) | | - | |
| From 0.25 A to 0.5 A (sinϕ=0.5 L, 0.5 C)<br>From 0.1 A to 0.25 A (sinϕ=1) | - | | ±(2.5% rdg + 1 dgt) | |
| From 0.5 A to 10 A (sinϕ-ϕ=0.5 L, 0.5 C)<br>From 0.25 A to 10 A (sinϕ=1) | - | | ±(2% rdg + 1 dgt) | |
| Active energy | Class 1 (EN IEC 62053-21)<br>Class B (EN 50470-3) (MID) | | | |
| Reactive energy | Class 2 (EN IEC 62053-23) | | | |

| Frequency | |
|---|---|
| **From 45 to 65 Hz** | ±0.1 Hz |

| Measurement accuracy according to EN IEC 61557-12 (MID models) | |
|---|---|
| **Active power** | Performance class 1 |
| **Active energy** | Performance class 2 |

## Display

| | |
|---|---|
| **Type** | LCD |
| **Refresh time** | < 750 ms |
| **Description** | 3 rows:<br>1st: 8 digits (7 mm)<br>2nd: 4 digits (7 mm)<br>3rd: 4 digits (7 mm) |
| **Variable readout** | Instantaneous: 4 digits, min.: 0.000, max.: 9999<br>Energy: 8 digits (imported), 7 digits (exported), min.: 0.00, max.: 99 999 999 |

## LED

| Model | CT*VT | Weight (kWh per pulse) |
|---|---|---|
| **AV5/AV6** | ≤ 7 | 0.001 |
| | > 7 ≤ 70.0 | 0.01 |
| | > 70 ≤ 700.0 | 0.1 |
| | > 700 | 1 |
| **AV2/AV9** | N/A | 0.001 |

# Digital outputs/inputs

## Digital outputs: static output (O2)

| | |
|---|---|
| **Connection type** | Screw terminals |
| **Maximum number of outputs** | 2 |
| **Type** | Open collector |
| **Function** | Pulse output or alarm output |
| **Features** | $V_{ON}$ 1.2 V dc, max. 100 mA<br>$V_{OFF}$ 30 V dc max |
| **Configuration parameters** | Output function (pulse/alarm)<br>Output normal status<br>Pulse weight (0.001 to 10 kWh/pulse or kvarh/pulse)<br>Pulse duration (30 or 100 ms)<br>Linked variable<br>Alarm delay |
| **Configuration mode** | Via joystick |

## Digital outputs: relay output (R2)

| | |
|---|---|
| **Configuration parameters** | Screw terminals |
| **Maximum number of outputs** | 2 |
| **Type** | relay (SPST) |
| **Function** | Pulse output or alarm output |
| **Features** | AC-1: 5 A@250 V ac<br>DC-12: 5 A@24 V dc<br>AC-15: 1.5 A @ 250 V ac<br>DC-13: 1.5 A @ 24 V dc |
| **Configuration parameters** | Output function (pulse/alarm)<br>Output normal status<br>Pulse weight (0.001 to 10 kWh/pulse or kvarh/pulse)<br>Pulse duration (30 or 100 ms)<br>Linked variable<br>Alarm delay |
| **Configuration mode** | Via joystick |

## Digital inputs (IS, DP)

| | |
|---|---|
| **Number of inputs** | 3 |
| **Functions** | Remote status (IS)<br>DMD synchronization (IS)<br>Pulse counting<br>Tariff management (IS) |
| **Frequency** | 20Hz max., duty cycle 50% |
| **Pulse weight** | From 0.001 to 999.9 m3 or kWh per pulse |
| **Contact measuring voltage** | 5 V dc +/- 5% |
| **Contact measuring current** | 10 mA max. |
| **Input impedance** | 680 Ω |
| **Open contact resistance** | ≥500 kΩ |
| **Closed contact resistance** | ≤100 Ω |
| **Configuration parameters** | Input function<br>Pulse weight |
| **Configuration mode** | Via joystick or UCS software (IS) |

# Communication ports

## RS485 port (IS)

| | |
|---|---|
| **Protocols** | Modbus RTU |
| **Devices on the same bus** | Max 160 (1/5 unit load) |
| **Communication type** | Multidrop, bidirectional |
| **Connection type** | 2 wires |
| **Configuration parameters** | Modbus address (from 1 to 247)<br>Baud rate (4.6/9.6 kbps)<br>1 stop bit, no parity |
| **Refresh time** | < 750 ms |
| **Configuration mode** | Via joystick or UCS software |

## M-Bus (M1, M2)

| | |
|---|---|
| **Protocols** | M1: M-Bus according to EN13757-3:2005<br>M2: M-Bus according to EN13757-3:2013 |
| **Driver input capability** | 1 unit load |
| **Communication type** | One-drop, directional |
| **Connection type** | 2 wires |
| **Configuration parameters** | Primary address (1 to 247)<br>Baud rate (0.3/ 2.4 / 9.6 kbps) |
| **Configuration mode** | Via joystick |

## Ethernet port (E1)

| | |
|---|---|
| **Protocols** | Modbus TCP/IP |
| **Client connections** | Maximum 5 simultaneously |
| **Connection type** | RJ45 connector (10 Base-T, 100 Base-TX), maximum distance 100 m |
| **Configuration parameters** | IP address<br>Subnet mask<br>Gateway<br>TCP/IP port<br>DHCP enabling |
| **Configuration mode** | Via joystick or UCS software |

## Wireless M-Bus (W1)

| | |
|---|---|
| **Protocols** | Wireless M-Bus according to EN13757-3, EN13757-4 |
| **Frame format** | A |
| **Frequency** | 868 MHz |
| **Frame type** | Selectable among the followin options:<br>-1: kWh+<br>-2: kWh+, kvarh+, kvarh-, kW+<br>-3: kWh+, kvarh+, kvarh-, kW+, kvar+, kvar-, current by phase, voltage by phase, frequency<br>-4: kWh+, kWh-, kvarh+, kvarh-, kW+, kW-, kvar+, kvar- |
| **Mode** | T1 or C1 |
| **Encryption** | No encryption, ENC-Mode 5 or ENC-Mode 7 |
| **Transmission interval** | Selectable from 10 s to 60 min. |
| **Configuration parameters** | Frame format<br>Transmission mode<br>Communication interval<br>Encryption enabling |
| **Configuration mode** | Via joystick |

## Dupline port (DP)

| | |
|---|---|
| **Protocols** | Dupline |
| **Connection type** | 2 wires |
| **Dupline data format** | 3 1/2 dgt BCD |
| **Full scale value** | selectable from 1.999 to 1999 M |
| **Used channels** | depending on the number of variables |
| **Multiplexer** | A1 to A4<br>G1 to H8 (1st group of 16 variables)<br>I1 to J8 (2nd group of 16 variables)<br>K1 to L8 (3th group of 16 variables)<br>M1 to N8 (4th group of 16 variables)<br>O1 to P8 (5th group of 16 variables) |
| **Available variables** | all, except for the “max” variables |
| **Configuration parameters** | Dupline inputs<br>Dupline counters<br>Dupline analogue variables<br>Dupline output |
| **Configuration mode** | Via joystick |

| Counters | |
|---|---|
| **Function** | Multiplexer for counter values |
| **Number of counters** | 6 per instrument, 128 per network |
| **Counter range** | 0... 99 999 999 |
| **Used channels** | B to F |
| **Multiplexer** | B2 to B8 |
| **Reset** | B1 |
| **Value** | C1 to F8 |
| **Counter reset** | enable/disable function for all the counters |
| **Available counters** | kWh tot, -kWh tot,<br>kvarh tot, -kvarh tot,<br>kWh t1, kWh t2,<br>kWh L1, kWh L2, kWh L3,<br>counter dig. in. 1,<br>counter dig. in. 2,<br>counter dig. in. 3,<br>Counter |

| Input (synchro/tariff) | |
|---|---|
| **Function** | Monostable (push-button), realtime |
| **Used channels** | A5 |
| **Working mode** | selectable:<br>none<br>Wdmd synchronization<br>total and partial energy meter (kWh, kvarh) managed by time periods (t1-t2). |

| Outputs (alarms) | |
|---|---|
| **Function** | monostable |
| **Used channells** | selectable (A1 to P8). No control that the selected channels are not used for counters or analog variables |
| **Number of alarms** | 2 per instrument |
| **Alarm modes** | up alarm, down alarm |
| **Set-point adjustment** | from 0 to 100% of the display scale |
| **Hysteresis** | from 0 to full scale |
| **On-time delay** | 0 to 255 s |
| **Output status** | normally energised |
| **Available variables** | all, except for the “max” variables |

| Analogue variables | |
|---|---|
| **Function** | Multiplexer for analogue values |
| **Number of variables** | 8 per instrument, 80 per network |

# Connection Diagrams

### Three-phase with neutral (4-wire)

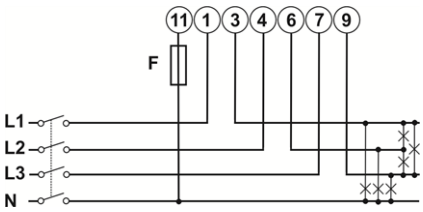



***Fig. 4*** *AV2, AV9*

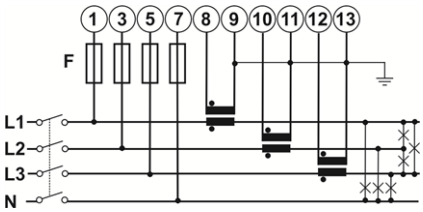



***Fig. 5*** *AV5, AV6*

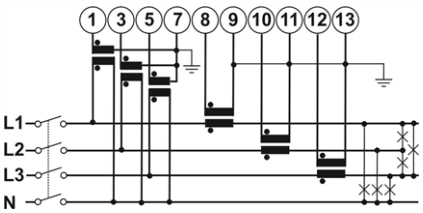



***Fig. 6*** *AV6*

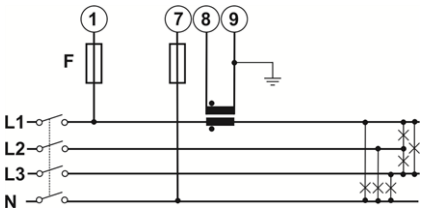



***Fig. 7*** *AV5, AV6 balanced load*

### Three-phase without neutral (3-wire)

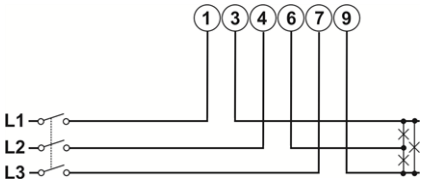



***Fig. 8*** *AV2, AV9 (except IS, R2)*

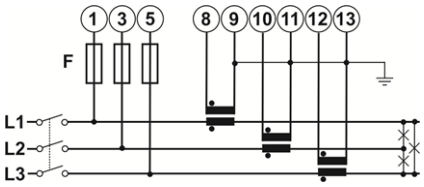



***Fig. 9*** *AV5, AV6*

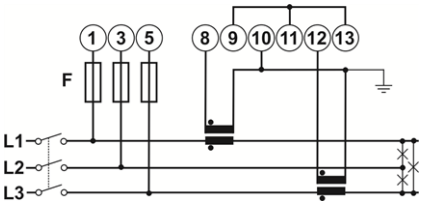



***Fig. 10*** *AV5, AV6*

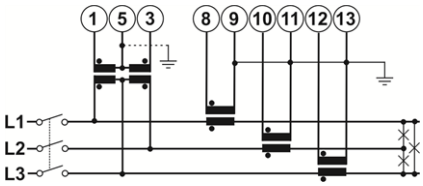



***Fig. 11*** *AV6*

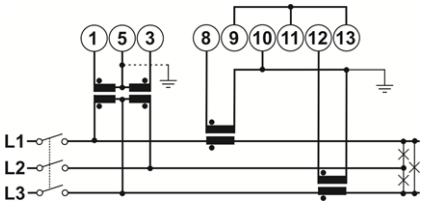



***Fig. 12*** *AV6*

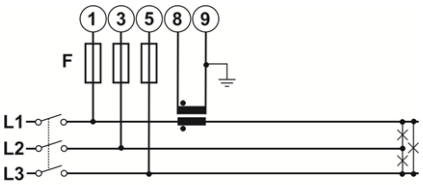



***Fig. 13*** *AV5, AV6 balanced load*

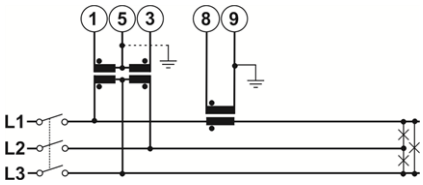



***Fig. 14*** *AV6 balanced load*

### Two-phase system with neutral (3-wire)

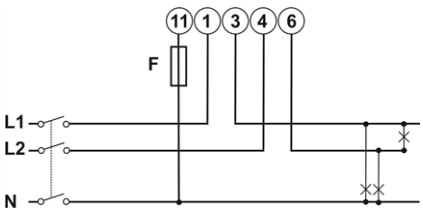



***Fig. 15*** *AV2, AV9*

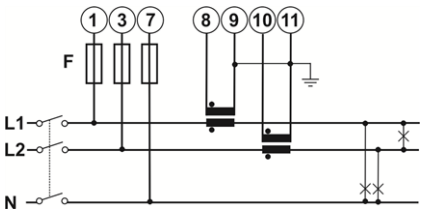



***Fig. 16*** *AV5, AV6*

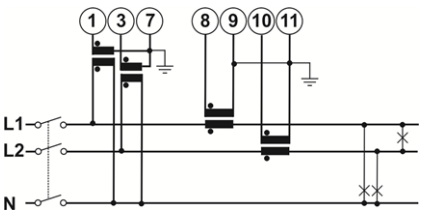



***Fig. 17*** *AV6*

### Single-phase (2-wire)

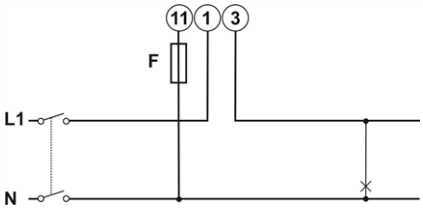



***Fig. 18*** *AV2, AV9 (except IS, R2, M1)*

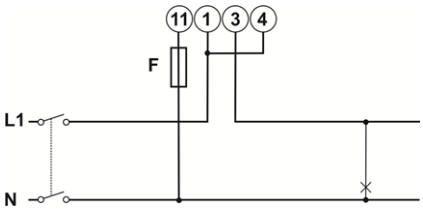



***Fig. 19*** *AV2, AV9 (IS, R2, M1)*

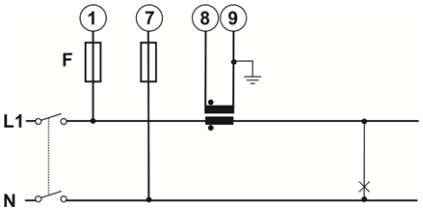



***Fig. 20*** *AV5, AV6*

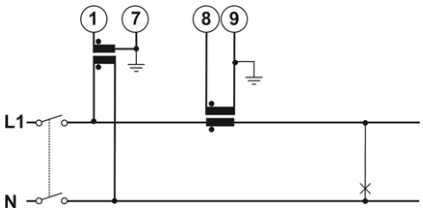



***Fig. 21*** *AV6*

NOTE: F=315 mA/250 mA time-delay

### Power supply

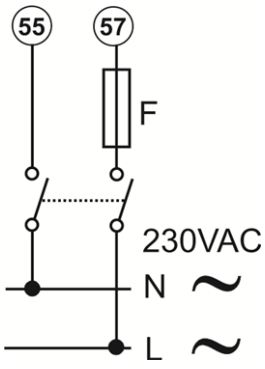



***Fig. 22*** *D option. F = 250 V, 50 mA*

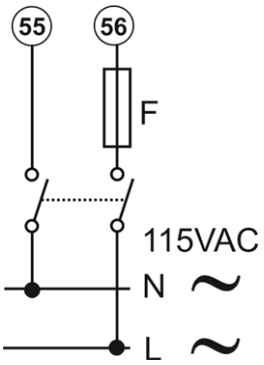



***Fig. 23*** *D option. F = 250 V, 100 mA*

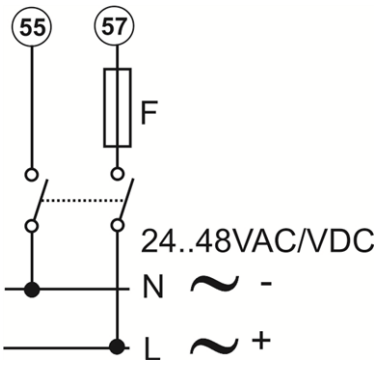



***Fig. 24*** *L option. F = 250 V, 200 mA*

## Static outputs and relay outputs

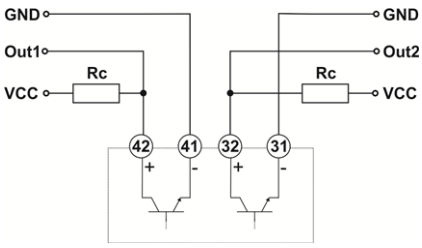



***Fig. 25*** *Static outputs, GND reference*

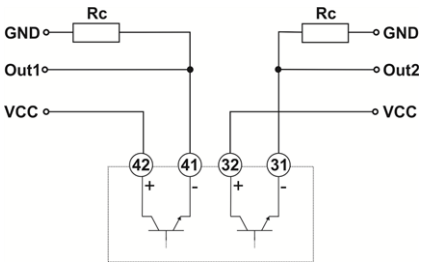



***Fig. 26*** *Static outputs, VDC reference*

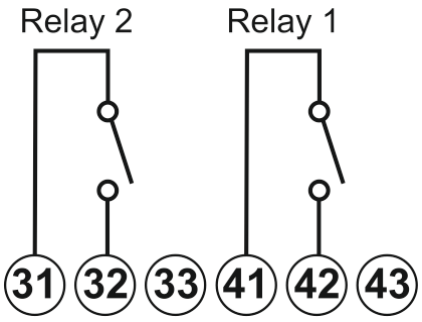



***Fig. 27*** *Relay outputs*

## Digital inputs, RS485 and Dupline ports

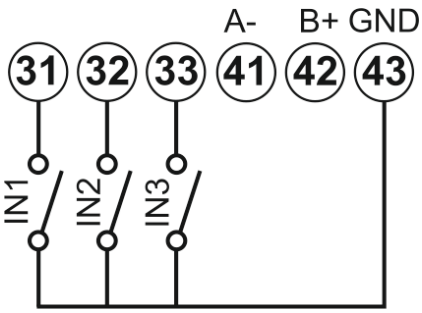



***Fig. 28*** *Digital inputs*

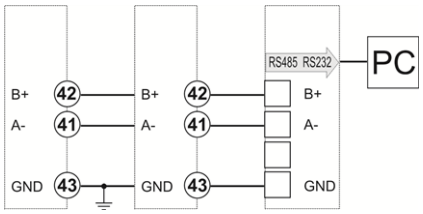



***Fig. 29*** *RS485 port*

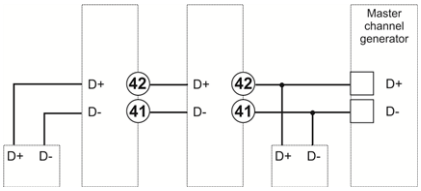



***Fig. 30*** *Dupline port*

## M-Bus

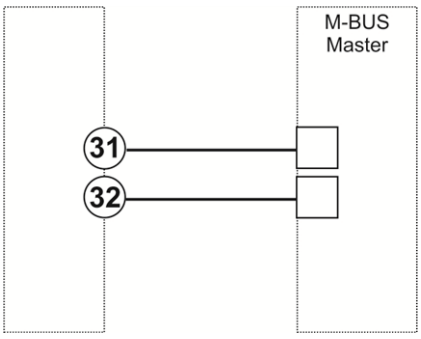



***Fig. 31*** *M-Bus port*

# MID connection diagrams

### Three-phase with neutral (4-wire)

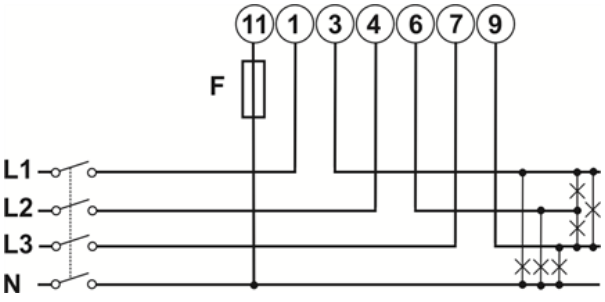



*Fig. 32 AV2, AV9*

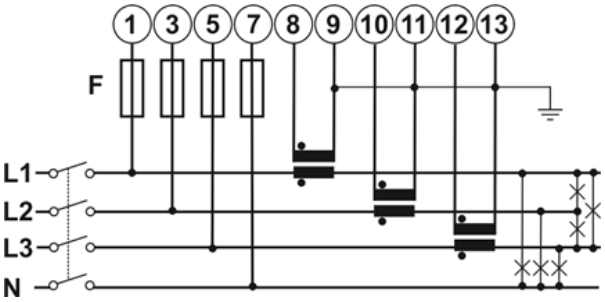



*Fig. 33 Type*

### Three-phase without neutral (3-wire) (W1 only)

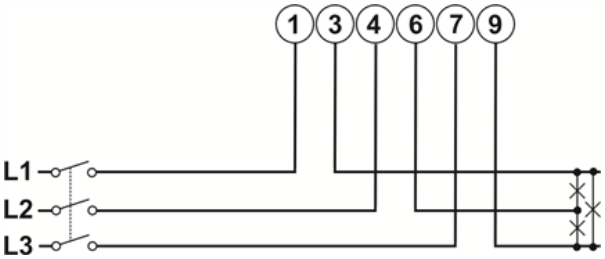



*Fig. 34 AV2*

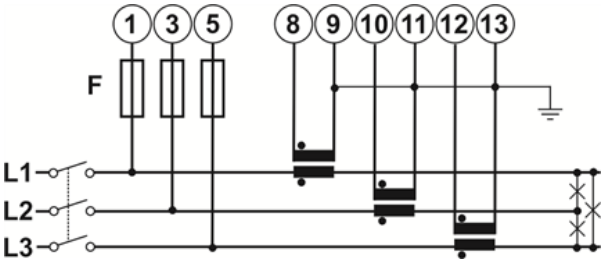



*Fig. 35 Type*

### Single-phase (2-wire) (W1 only)

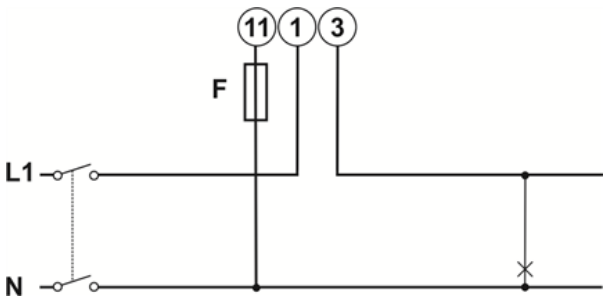



*Fig. 36 AV2 1X*

*Note: F=315 mA*

# References

## Order code

### Non MID models

| Component name/part number | I/O communication | Voltage inputs | Current inputs | Power supply |
|---|---|---|---|---|
| **EM24DIN AV9 3X XX X** | none | 230V L-N<br>400V L-L | 10 (65) A | Self power supply |

| Component name/part number | I/O communication | Voltage inputs | Current inputs | Power supply |
|---|---|---|---|---|
| **EM24DIN AV9 3X R2 X** | 2 relay outputs | 230 V L-N<br>400 V L-L | 10 (65) A | Self power supply |

| Component name/part number | I/O communication | Voltage inputs | Current inputs | Power supply |
|---|---|---|---|---|
| **EM24DIN AV5 3D O2 X** | 2 static outputs | 23 0V L-N<br>400 V L-L | 5 (10) A via CT | 115/230 V ac |
| **EM24DIN AV5 3L O2 X** | 2 static outputs | 230 V L-N<br>400 V L-L | 10 (65) A | From 24 to 48 V ac/dc |
| **EM24DIN AV9 3X O2 X** | 2 static outputs | 230 V L-N<br>400 V L-L | 10 (65) A | Self power supply |

| Component name/part number | I/O communication | Voltage inputs | Current inputs | Power supply |
|---|---|---|---|---|
| **EM24DIN AV6 3D DP X** | 3 digital inputs + Dupline | From 57.7 to 120 V L-N<br>From 100 to 208 V L-L | 5 (10) A via CT | 115/230 V ac |
| **EM24DIN AV6 3L DP X** | 3 digital inputs + Dupline | From 57.7 to 120 V L-N<br>From 100 to 208 V L-L | 5 (10) A via CT | From 24 to 48 V ac/dc |
| **EM24DIN AV9 3X DP X** | 3 digital inputs + Dupline | 230 V L-N<br>400 V L-L | 10 (65) A | Self power supply |

| Component name/part number | I/O communication | Voltage inputs | Current inputs | Power supply |
|---|---|---|---|---|
| **EM24DIN AV6 3D IS X** | 3 digital inputs + RS485 Modbus RTU | From 57.7 to 120 V L-N<br>From 100 to 208 V L-L | 5 (10) A via CT | 115/230 V ac |
| **EM24DIN AV6 3L IS X** | 3 digital inputs + RS485 Modbus RTU | From 57.7 to 120 V L-N<br>From 100 to 208 V L-L | 5 (10) A via CT | From 24 to 48 V ac/dc |
| **EM24DIN AV9 3X IS X** | 3 digital inputs + RS485 Modbus RTU | 230 V L-N<br>400 V L-L | 10 (65) A | Self power supply |

| Component name/part number | I/O communication | Voltage inputs | Current inputs | Power supply |
|---|---|---|---|---|
| **EM24DIN AV5 3X E1 X** | Ethernet Modbus TCP/IP | From 120 to 277 V L-N<br>From 208 to 480 V L-L | 5 (10) A via CT | Self power supply |
| **EM24DIN AV2 3X E1 X** | Ethernet Modbus TCP/IP | From 120 to 277 V L-N<br>From 208 to 480 V L-L | 10 (65) A | Self power supply |

| Component name/part number | I/O communication | Voltage inputs | Current inputs | Power supply |
|---|---|---|---|---|
| **EM24DIN AV9 3X M1 X** | M-Bus according to EN 13757-3 (2005) | 230 V L-N<br>400 V L-L | 10 (65) A | Self power supply |

| Component name/part number | I/O communication | Voltage inputs | Current inputs | Power supply |
|---|---|---|---|---|
| **EM24DIN AV9 3X M2 X** | M-Bus according to EN 13757-3 (2013) | 230 V L-N<br>400 V L-L | 10 (65) A | Self power supply |

| Component name/part number | I/O communication | Voltage inputs | Current inputs | Power supply |
|---|---|---|---|---|
| **EM24DIN AV5 3X W1 I X** | Wireless M-Bus, internal antenna | From 120 to 277 V L-N<br>From 208 to 480 V L-L | 5 (10) A via CT | Self power supply |
| **EM24DIN AV5 3X W1 E X** | Wireless M-Bus, external antenna | From 120 to 277 V L-N<br>From 208 to 480 V L-L | 5 (10) A via CT | Self power supply |

| Component name/part number | I/O communication | Voltage inputs | Current inputs | Power supply |
|---|---|---|---|---|
| **EM24DIN AV2 3X W1 I X** | Wireless M-Bus, internal antenna | From 120 to 277 V L-N<br>From 208 to 480 V L-L | 10 (65) A | Self power supply |
| **EM24DIN AV2 3X W1 E X** | Wireless M-Bus, external antenna | From 120 to 277 V L-N<br>From 208 to 480 V L-L | 10 (65) A | Self power supply |
| **EM24DIN AV2 1X W1 I X** | Wireless M-Bus, internal antenna, 1-phase | From 120 to 277 V L-N | 10 (65) A | Self power supply |
| **EM24DIN AV2 1X W1 E X** | Wireless M-Bus, external antenna, 1-phase | From 120 to 277 V L-N | 10 (65) A | Self power supply |

### MID models

| Component name/part number | I/O communication | Voltage inputs | Current inputs | Power supply |
|---|---|---|---|---|
| **EM24DIN AV2 3X XX PFA**<br>**EM24DIN AV2 3X XX PFB** | none | 230 V L-N<br>400 V L-L | 10 (65) A | Self power supply |
| **EM24DIN AV9 3X XX PFA**<br>**EM24DIN AV9 3X XX PFB** | none | 230 V L-N<br>400 V L-L | 10 (65) A | Self power supply |

| Component name/part number | I/O communication | Voltage inputs | Current inputs | Power supply |
|---|---|---|---|---|
| **EM24DIN AV9 3X O2 PFA**<br>**EM24DIN AV9 3X O2 PFB** | 2 static outputs | 230V L-N<br>400V L-L | 10 (65) A | Self power supply |

| Component name/part number | I/O communication | Voltage inputs | Current inputs | Power supply |
|---|---|---|---|---|
| **EM24DIN AV9 3X IS PFA**<br>**EM24DIN AV9 3X IS PFB** | 3 digital inputs + RS485 Modbus RTU | 230 V L-N<br>400 V L-L | 10 (65) A | Self power supply |

| Component name/part number | I/O communication | Voltage inputs | Current inputs | Power supply |
|---|---|---|---|---|
| **EM24DIN AV5 3X E1 PFA**<br>**EM24DIN AV5 3X E1 PFB** | Ethernet Modbus TCP/IP | 230 V L-N<br>400 V L-L | 5 (10) A via CT | Self power supply |
| **EM24DIN AV2 3X E1 PFA**<br>**EM24DIN AV2 3X E1 PFB** | Ethernet Modbus TCP/IP | 230 V L-N<br>400 V L-L | 10(65) A | Self power supply |

| Component name/part number | I/O communication | Voltage inputs | Current inputs | Power supply |
|---|---|---|---|---|
| **EM24DIN AV5 3X W1 I PFA**<br>**EM24DIN AV5 3X W1 I PFB** | Wireless M-Bus, internal antenna | 230 V L-N<br>400 V L-L | 5 (10) A via CT | Self power supply |
| **EM24DIN AV5 3X W1 E PFA**<br>**EM24DIN AV5 3X W1 E PFB** | Wireless M-Bus, external antenna | 230 V L-N<br>400 V L-L | 5 (10) A via CT | Self power supply |
| **EM24DIN AV2 3X W1 I PFA**<br>**EM24DIN AV2 3X W1 I PFB** | Wireless M-Bus, internal antenna | 230 V L-N<br>400 V L-L | 10(65) A | Self power supply |
| **EM24DIN AV2 3X W1 E PFA**<br>**EM24DIN AV2 3X W1 E PFB** | Wireless M-Bus, external antenna | 230 V L-N<br>400 V L-L | 10(65) A | Self power supply |
| **EM24DIN AV2 1X W1 I PFA**<br>**EM24DIN AV2 1X W1 I PFB** | Wireless M-Bus, internal antenna, 1-phase | 230 V L-N | 10(65) A | Self power supply |
| **EM24DIN AV2 1X W1 E PFA**<br>**EM24DIN AV2 1X W1 E PFB** | Wireless M-Bus, external antenna, 1-phase | 230 V L-N | 10(65) A | Self power supply |

- PFA: Easy connection, the total energy totalizer (kWh+) is certified according to MID;
- PFB: only the total positive totalizer (kWh+) is certified according to MID. The negative energy totalizer is available but not certified according to MID.

## Further reading

| Information | Where to find it |
|---|---|
| **User manual - E1** | https://www.gavazziautomation.com/fileadmin/images/PIM/MANUALS/ENG/EM24_E1_IM_USE.pdf |
| **Installation instruction - E1** | https://www.gavazziautomation.com/fileadmin/images/PIM/MANUALS/ENG/EM24_E1_IM_INST.pdf |
| **User manual - IS** | https://www.gavazziautomation.com/fileadmin/images/PIM/MANUALS/ENG/EM24_IS_IM_USE.pdf |
| **Installation instruction - IS** | https://www.gavazziautomation.com/fileadmin/images/PIM/MANUALS/ENG/EM24_IS_IM_INST.pdf |
| **User manual - M1/M2** | https://www.gavazziautomation.com/fileadmin/images/PIM/MANUALS/ENG/EM24_M1_M2_USE.pdf |
| **Installation instruction - M1/M2** | https://www.gavazziautomation.com/fileadmin/images/PIM/MANUALS/ENG/EM24_M1_M2_IM_INST.pdf |
| **User manual - W1** | https://www.gavazziautomation.com/fileadmin/images/PIM/MANUALS/ENG/EM24_W1_IM_USE.pdf |
| **Installation instruction - W1** | https://www.gavazziautomation.com/fileadmin/images/PIM/MANUALS/ENG/EM24_W1_IM_INST.pdf |
| **Instruction manual - other versions** | https://www.gavazziautomation.com/fileadmin/images/PIM/MANUALS/ENG/EM24_IM.PDF |

## CARLO GAVAZZI compatible components

| Purpose | Component name/part number | NOTES |
|---|---|---|
| Monitor data from several analyzers | VMU-C | See relevant datasheet |
| Collect data from wireless M-Bus devices and transmit data via Modbus TCP/IP | SIU-MBM-02 | See relevant datasheet |