EM640

Energy meter for three phase, two phase and single phase systems

Description

EM640 is a direct connection energy analyser, for single- and three-phase systems up to 480 V L-L and current up to 65 A.
Modbus TCP/IP and HTTPS rest API communication is available via Ethernet port and/or Wi- Fi. According to the model, a digital input combined with digital output, a Modbus RTU or an M-Bus port are available thanks to additional patented sliding module.W versions also feature Wi-Fi connection and RTC synchronization.

Benefits

- **Quick configuration.** The configuration wizard which runs when the system is started up for the first time allows you to commission the unit without errors in a matter of seconds. The UCS configuration software is available for download free of charge. The embedded webserver makes the configuration even easier and faster (W versions only).
- **User-friendly interface.** The 128x96 matrix LCD with backlit display ensures perfect visibility and readability of the information. Page configuration and browsing are very intuitive, thanks to the user interface with 3 mechanical keys. Finally, the page filter allows you to hide the unnecessary information.
- **Flexible installation.** It can be installed in Single-phase, two-phase and three-phase (with or without neutral). It also permits the monitoring of 3 loads in single-phase systems.
- **Robust design.** Able to work in an extremely wide temperature range, up to 70 °C / 158 °F., thanks to the temperature drift compensation and up to 3000 m / 9842.5 ft altitude.
- **Multi-interface communication.** EM640 is able to transmit and receive data through Modbus TCP/IP or HTTPS rest API via Ethernet or Wi-Fi. In addition, Modbus RTU or M-Bus are optionally available.
- **Fiscal and revenue grade metrology.** EM640 is the perfect solution for fiscal metrology; in fact, the product conforms with the most important European and American standards for fiscal metrology: ANSI and MID regulation.
- **Real-time synchronization.** Clock and datalogging. Thanks to the real time clock and the internal memory, EM640 guarantees log of energy consumption/production up to two years.

Applications

EM640 can be installed in any low-voltage switchboard with rated current up to 65 A, to monitor the energy consumption, the main electrical variables and the harmonic distortion.

If used to monitor a single machine, it provides all the main electrical variables to identify any possible malfunction in its early stage and can correlate the energy consumption with the hours of operation, to plan maintenance and prevent failures. The partial meter reset function, easily implementable by means of a digital input, allows you to monitor each individual machine cycle.

Thanks to the measurement refresh time (100 ms) and to the high resolution of the variables available through Modbus communication modules, it can also be used as data source for control actions, such as avoiding feeding energy into the electricity grid in a photovoltaic installation with energy storage.

EM640 B is the perfect solution when Ethernet connection is needed in combination with inverter and energy storage systems or installed in machines and industrial environments to monitor single loads or total consumption.

EM640 W, adding Wi-Fi connectivity, is the right choice in retrofit installations where wired communication is not possible. Specific options, able to combine Wi-Fi and Ethernet with Modbus RTU or M-Bus, permit data retrieving in parallel from different systems at the same time (for instance SCADA and BMS)

Finally, the embedded Webserver makes the configuration of the unit easy and fast, while the datalogger permits precise billing and consumption trend analysis.

Main functions

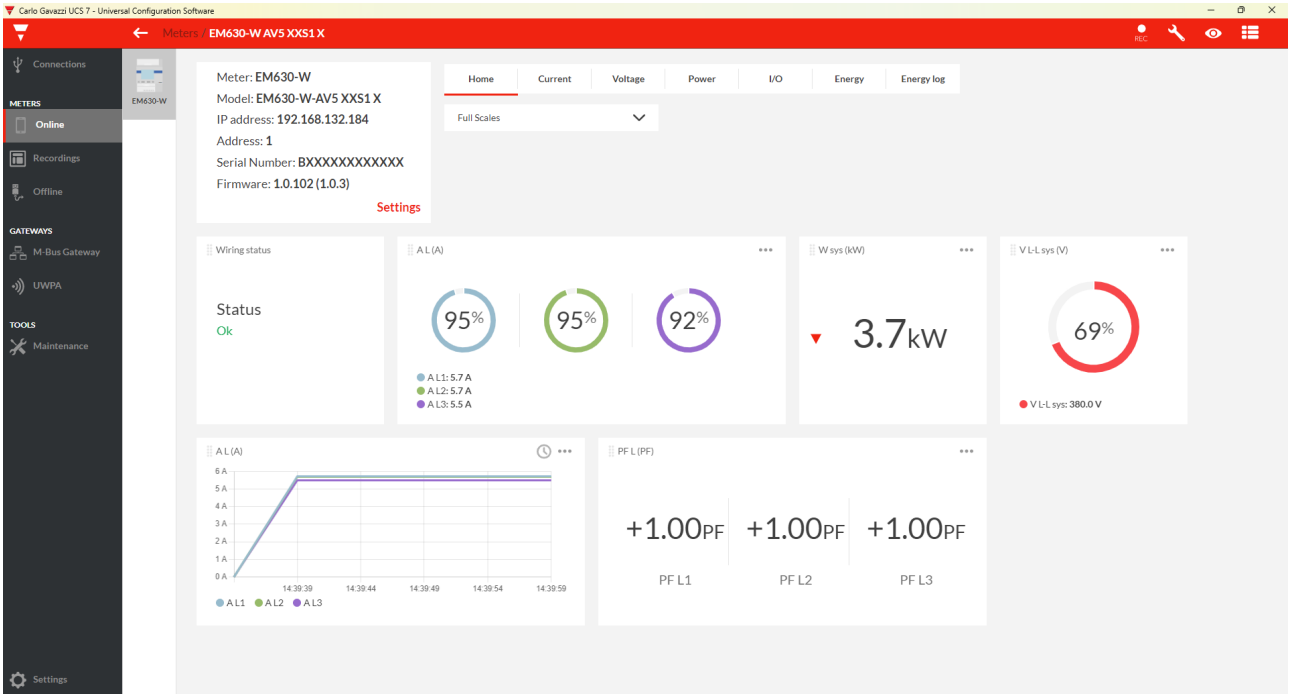
- Active, reactive and apparent energy measurement
- Main electrical variables measurement
- Load run hours and total ON time
- Total harmonic distortion (THD) of current and voltages measurement
- Data transmission to other systems through Modbus TCP/IP and HTTP rest API
- Alarm management for monitoring of up to 4 variables among active/reactive/apparent powers, currents, voltages, frequency and power factor
- Digital output for pulses or alarm transmission management (O1 option, W versions only)
- Measured variables visualisation on the display
- Modbus RTU or M-Bus communication (W versions only)
- Wi-Fi communication , in alternative or in combination with Ethernet (W versions only)

Main features

- System and phase variables (V L-L, V L-N, A, W/var, VA, PF, Hz)
- Displaying of the active energy with a resolution of 0.001 kWh
- 0.001 Hz frequency resolution
- Average value calculation (dmd) for current and power (kW / kVA)
- Streamlined user interface featuring 3 mechanical buttons
- Modbus TCP/IP (100 ms refresh time) and HTTPS rest API
- Dual ethernet port (internal switch) for easy daisy chain connection without an external switch (E2 versions)
- Continuous sampling of each voltage and current
- Direct connection to mobile or PC via Wi-Fi 1-to-1 for configuration and diagnostics and LAN connection for fixed installations
- Backlit display
- Bidirectional MID certified versions (W version only)
- MID-certified meter resolution 0.001 kWh
- cULus approved (UL 61010)
- SunSpec compliance
- Operating temperature up to 70 °C / 158 °F temperature
- Operating altitude up to 3000 m / 9842.5 ft
- Real time clock, NTP synchronization (W version only)
- Active energy data logger (current/previous year, current/previous month, current/previous day) (W versions only)

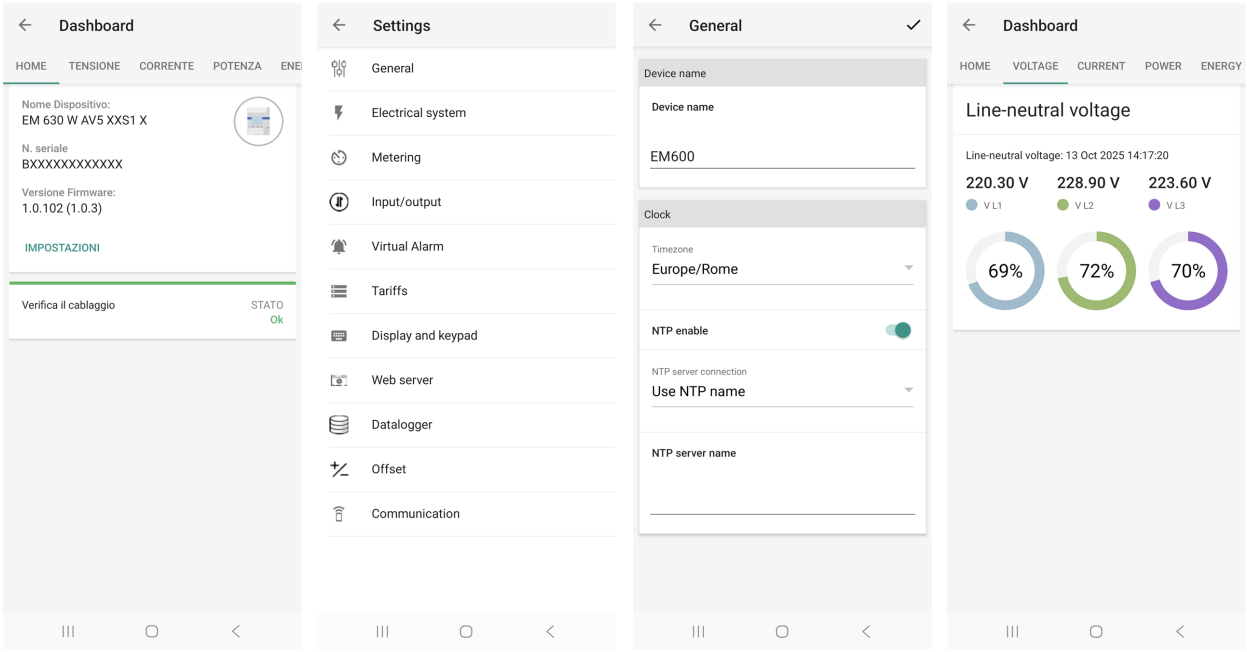
UCS software

- Free download from Carlo Gavazzi website
- Configuration through RS485 from PC or trough UWP3.0 via LAN or the web (UWP Secure Bridge function)
- Setups can be saved offline for serial programming with a single command
- Real time data view for testing and diagnostics
- Notification of possible wiring errors and display of the corrective steps, reassignment of the correct association of the phases or the direction of the currents via software control



UCS mobile APP

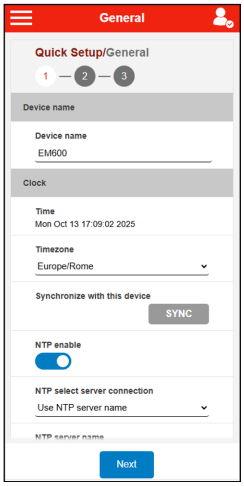
- Free download from Google Play Store
- Configuration through Wi-Fi from Android® mobile phone or tablet
- Setups can be saved offline for recurrent programming with a single command
- Real time data view for testing and diagnostics



Webserver (W versions only)

It is available on W models, since it requires Wi-Fi to connect. It is accessible from Carlo Gavazzi website and allows:

- Quicksetup and parameter configuration
- Real time data viewing for testing and diagnostics
- Energy logs reading
- Two users: admin user password protected for complete access and configuration, free access user for data visualization



Structure

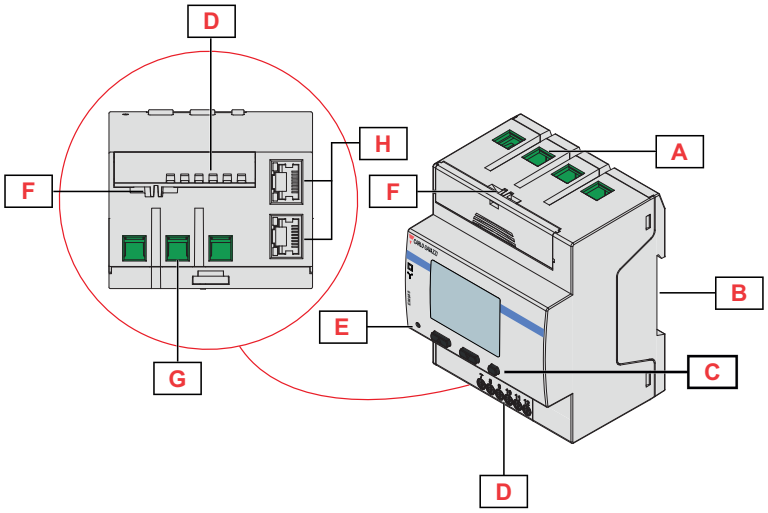


Fig. 1 *EM640 front*

Area	Description
A	Voltage/Current inputs
B	DIN rail mounting bracket
C	Browsing and configuration buttons
D	Sliding module (optional digital input and output or RS485 or M-Bus connection)
E	LED
F	Seal housings
GF	Voltage/Current Outputs
HG	Ethernet RJ45 ports (if present)

Features

General

Material	Housing: PBT Transparent cover: polycarbonate
Protection degree	Front: IP51 Terminals: IP20
Protective class	Class II
Terminals	Measurement inputs (Phase 1, 2, 3, N): 2.5 mm^2 to 16 mm^2 / 5 to 13 AWG, 2.5 Nm / 22.12 lbin max. Auxiliary input: 0.2 mm^2 to 1.5 mm^2 / 16 to 24 AWG, 0.4 Nm / 3,54 lbin max.
Overvoltage category	Cat. III
Rated impulse voltage	4kV
Pollution degree	2
Utilization category	UC2
Mounting	DIN rail
Weight	370 g / 0.82 lb (packaging included)
Dimensions	4 DIN modules

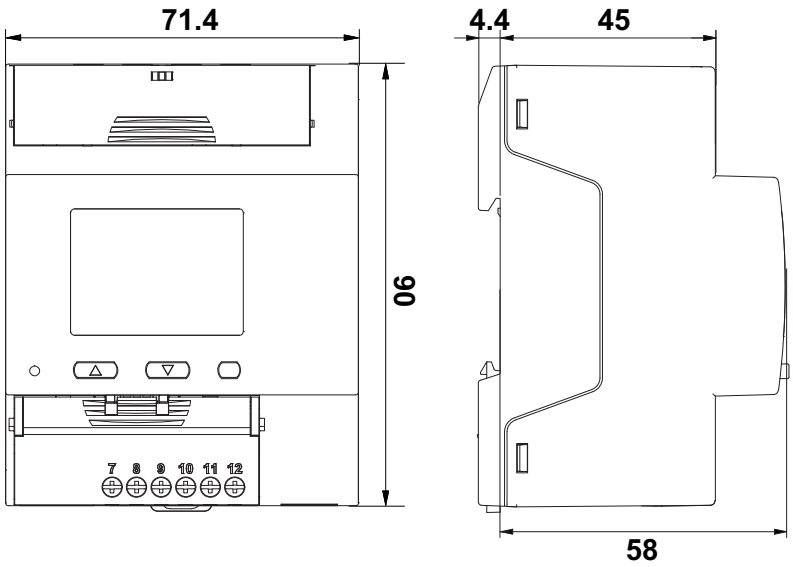


Fig. 2

Environmental specifications

Operating temperature	From -25 to +70 °C (-13 to +158 °F) at Imax = 45 A From-25 to +55 °C (-13 to +131 °F) at Imax = 65 A
Storage temperature	From -30 to +70 °C / from -22 to +158 °F
Max Altitude	3000 m / 9842.5 ft
Electromechanical environmental condition	E2
Mechanical environmental condition	M2

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

Input and output insulation

Type	Measurement inputs	Ethernet Modbus TCP	Serial communication	Digital input	Digital output
Measurement inputs	-	Double/Reinforced	Double/Reinforced	Double/Reinforced	Double/Reinforced
Ethernet Modbus TCP	Double/Reinforced	-	-	-	
Serial communication	Double/Reinforced	-	-	-	
Digital input	Double/Reinforced	-	-	-	
Digital output	Double/Reinforced				

According to: EN IEC 61010-1, EN IEC 62052-31 (MID). Overvoltage category III. Pollution degree 2.

Compatibility and conformity

Directives	2014/53/EU 2014/32/EU (MID) 2014/35/EU (LVD - Low Voltage) 2014/30/EU (EMC - Electro Magnetic Compatibility) 2011/65/EU, 2015/863/EU (Electric-electronic equipment hazardous substances)
Standards	**Radio (W versions only)**: EN 300 328 V2.2.2 **Electromagnetic compatibility (EMC) - emissions and immunity**: EN 301 489-1 V2.2.3, EN 301 489-17 V3.2.4, EN 62052-11.2021, EN IEC 61000-6-3, EN IEC 61000-6-2 **Safety**: EN IEC 61010-1, EN IEC 62052-31 **Health (W versions only)**: EN 62311:2020 **Metrology**: EN IEC 62053-21, EN IEC 62053-23, 50470-3 (MID), ANSI C12.1 **FCC (USA) Radio Emission (W versions only)**: FCC CFR title 47 Part 15C, FCC CFR title 47 Part 2.1091 **IC (canadian) Radio Emission (W versions only)**: ISED RSS-247 Issue 3; ISED RSS-102 Issue 5
Approvals	CE Wi Fi **(W versions only)** c UL us LISTED

***Note**: the equipment must be installed and operated with minimum distance of 20 cm of the human body.*

Electrical specifications

Electrical system	
Managed electrical system	Single-phase Three single-phase Two-phase (3-wire) Three-phase with neutral (4-wire) Three-phase without neutral (3-wire) Wild leg system (three-phase, four-wire delta)
MID managed electrical system	Three-phase with neutral (4-wire) Three-phase without neutral (3-wire) Single phase system

Non MID models	
Voltage connection	Direct
Rated voltage L-N (U_n minimum to U_n maximum)	120 to 277 V
Rated voltage L-L (U_n minimum to U_n maximum)	208 to 480 V
Voltage tolerance	From 0.8 to 1.15 U_n
Overload	Continuous: 1.15 U_n max.
Input impedance	Refer to “Power supply”
Frequency	50/60 Hz

Note: EM640 can also be installed in a wild leg system (three phases, four delta wires), where one of the phase-neutral voltages is higher than the other two.

MID models voltage inputs	
Voltage connection	Direct
Rated voltage L-N (U_n minimum to U_n maximum)	120 to 230 V
Rated voltage L-L (U_n minimum to U_n maximum)	208 to 400 V
Voltage tolerance	From 0.8 to 1.15 U_n
Overload	Continuous: 1.15 U_n max.
Input impedance	Refer to “Power supply”
Frequency	50 Hz

Current inputs	
Current connection	Direct
Rated current (I_n)	5 A
Minimum current (I_{min})	0.25 A (0.05 I_n)
Maximum current (I_{max})	65 A (13 I_n)
Start-up current (I_{st})	20 mA (0.004 I_n)
Overload	For 10 ms: 1950 A (30 I_{max})
Input impedance	< 3.4 VA
Crest factor	3 (I_{max} peak 98A)

Power supply

Type	Self power supply
Consumption	4W / 6 VA
Frequency	50/60 Hz

Measurements

Method	TRMS measurements of distorted waveforms

Energy metering

Energy metering depends on the measurement type you chose.

A measurement (Easy connection)

Models: MID PFA or non-MID with selection A

Irrespective of the current direction, the power always has a plus sign and contributes to increase the positive energy meter. The negative energy meter is not available.

B measurement (Bidirectional)

Models: PFB or non-MID with selection B

For each measuring time interval, the individual phase energies with a plus sign are summed to increase the positive energy meter (kWh+), while the others increase the negative one (kWh-).

Example:
P L1= +2 kW, P L2= +2 kW, P L3= -3 kW
Integration time = 1 hour
kWh+ = (2+2) x1h = 4 kWh
kWh- = 3 x 1h= 3kWh

C measurement (Net Bidirectional)

Models: PFC or non-MID with selection C

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

Available measurements

Active energy	Unit	System	Phase
Imported (+) Total	kWh+	●	●
Imported (+) partial	kWh+	●	-
Exported (-) Total	kWh-	●	●
Exported (-) partial	kWh-	●	-
Imported (+) Total by tariff (t1, t2)	kWh+	●	-
Quadrant I, II, III, IV	kWh	●	-

Reactive energy	Unit	System	Phase
Imported (+) Total	kvarh+	●	●
Imported (+) partial	kvarh+	●	-
Exported (-) Total	kvarh-	●	●
Exported (-) partial	kvarh-	●	-
Quadrant I, II, III, IV	kvarh	●	-

Apparent energy	Unit	System	Phase
Total	kVAh	●	-
Partial	kVAh	●	-
Quadrant I, II, III, IV	kVah	●	-

Run hour meter	Unit	System	Phase
Total (kWh+)	hh:mm	●	-
Partial (kWh+)	hh:mm	●	-
Total (kWh-)	hh:mm -	●	-
Partial (kWh-)	hh:mm -	●	-
Total ON time	hh:mm	●	-

Electrical variable	Unit	System	Phase
Voltage L-N	V	●	●
Voltage L-L	V	●	●
Current	A	●	●
DMD	A	-	●
DMD MAX	A	-	●
Neutral current	A	●	-
Active power	W	●	●
DMD	W	●	-
DMD MAX	W	●	-

Electrical variable	Unit	System	Phase
Apparent power	VA	●	●
DMD	VA	●	-
DMD MAX	VA	●	-
Reactive power	Var	●	●
Power factor	PF	●	●
Frequency	Hz	●	-
THD Current*	THD A %	-	●
THD Voltage L-N*	THD L-N %	-	●
THD Voltage L-L*	THD L-L %	-	●

* Up to 31st harmonic

***Note**: the available variables depend on the type of system set.*

PFA models: total imported active energy (kWh TOT) is the only MID certified meter. Apparent energy, reactive energy and exported active energy are not MID certified. Partial meters are not MID certified.

PFB and PFC models: total imported active energy (kWh+ TOT) and total exported active energy (kWh- TOT) are the only MID certified meters. Apparent energy, reactive energy are not MID certified. Partial meters are not MID certified.

Measurement accuracy

Current	
From I_{min} to I_{tr}	+/- 1.0% rdg
From I_{tr} to I_{max}	+/- 0.5% rdg

Phase-phase and Phase-neutral voltage	
U_n minimum -20% to U_n maximum +15%	+/- 0.5% rdg

Active and apparent power	
From I_{min} to I_{tr} (PF=1)	+/- 1.5 % rdg
From I_{tr} to I_{max} (PF= 1 - 0.5 L - 0.8 C)	+/- 1.0 % rdg
Active energy	Class 1 EN IEC 62053-21, class B EN 50470-3 (MID)

Reactive power	
From 0.05 I_n to 0.1 I_n Sin(ø) = 1	2.5%
From 0.1 I_n to I_{max} Sin(ø) = 1	2.0%
From 0.1 I_n to 0.2 I_n Sin(ø) = 0.5 L - 0.5 C	2.5%
From 0.2 I_n to I_{max} Sin(ø) = 0.5 L - 0.5 C	2.0%
From 0.2 I_n to I_{max} Sin(ø) = 0.25 L - 0.25 C	2.5%
Reactive energy	Class 2 EN IEC 62053-23

Frequency	
From 45 to 65 Hz	+/- 0.1% rdg

Measurement resolution

Variable	Display resolution	Resolution by serial communication
Energy	0.001 kWh/kvarh/kVAh	0.0001 kWh/kvarh/kVAh
Single phase energy	0.001 kWh	0.001 kWh
Power	0.001 kW/kvarkVA	0.1 W/var/VA
Current	0.001 A	
Voltage	0.1 V	
Frequency	0.001 Hz	
THD	0.01 %	
Power factor	0.01	0.001

Display

Type	Matrix LCD 128 x 96 pixels
Refresh time	500 ms
Description	Backlit LCD
Variable readout	Instantaneous: 5+1 dgt or 5+3 dgt Power factor: 1+2 dgt Energy: 8+3 dgt

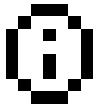
Clock (W version only)

Type	RTC
Accuracy	25 ppm
Synchronization	NTP (recommended) Modbus Webserver
Backup	Lithium battery

***Note**: It is highly recommended to synchronize the clock using NTP server.*

Display icons description

The table reports the icons that can appear on the display.

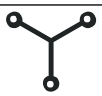
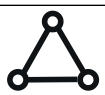
Icon	Description
	Off: Ethernet link inactive (cable disconnected or no link) ON: Ethernet link active (cable connected and link detected) Note: The icon shows only the physical link status. Correct network settings required for communication.
	Off: Wi-Fi LAN disabled Blinking: Wi-Fi LAN active but not connected Fixed: Wi-Fi LAN connected
	Wiring information: virtual correction via UCS
	Current range exceeded: the measured value is still displayed
	Voltage range exceeded: the measured value is still displayed
	Undervoltage: the measured value is displayed anyway
	Frequency in an out-of-range condition
	Fixed: internal failure Blinking: alarm signal
	Wiring error
	Reading or writing command is addressed to EM640

LED

Front	Red. Pulse weight proportional to positive energy (display page 1) or negative energy (display page 2)
LED Constant	1000 pulse/kWh

Symbols

The table describes all the symbols that you can find in the documents and on the product.

Symbol	Description
	Dangerous voltage
	Danger, live parts
	Caution
	Provides essential information on completing the task that should not be neglected
	Manual symbol
	Safety sign notice
	The product is not to be discarded with normal household waste
	Double insulation
	Single phase
	Three phase (four-wire)
	Three phase (three-wire)

Communication ports

Ethernet port (E2 versions)

Protocol	Modbus TCP/IP HTTPS REST API DHCP mDNS
Devices on the same bus	Maximum 5 connections simultaneously
Connection type	RJ45 connector (10 Base-T, 100 Base-TX), maximum distance 100 m, Integrated switch function to connect another ethernet device
Configuration parameters	DHCP client mDNS Modbus TCP enabling HTTPS REST API
Cable type	Minimum Cat 5, Standard EIA/TIA T568B Ethernet Patch Cable or Ethernet Crossover Cable (autodetection)
Refresh time	Modbus TCP/IP: ≤ 100 ms HTTPS Rest API: ≤ 200 ms HTTPS Webserver: ≤ 3 s
Configuration mode	Via keypad, UCS software/APP or Webserver

Modbus RTU (S1 versions)

Protocol	Modbus RTU
Devices on the same bus	Max247 (1/8 unit load)
Communication type	Multidrop, bidirectional
Connection type	2 wires
Configuration parameters	Modbus address (from 1 to 247) Baud rate (9.6/19.2/38.4/57.6/115.2 kbps) Parity (None/Even) Stop bit (1 or 2)
Refresh time	≤ 100 ms
Configuration mode	Via keypad, UCS software/APP and Webserver

M-Bus (M1 versions)

Protocol	M-Bus according to EN IEC 13757-3:2013
Devices on the same bus	Max 250 (1 unit load)
Connection type	2 wires
Configuration parameters	Primary address (1 to 250) Baudrate (0.3/2.4/9.6 kbps)
Refresh time	≤ 100 ms
Configuration mode	Via keypad, UCS software/APP and Webserver

Wi-Fi

General	
Technology	Wi-Fi IEEE 802.11 b/g/n 20/40 MHz
Centre frequency range of operating channel	2412 – 2472 MHz
Maximum EIRP output power	18.34 dBm
Number of channels	13
Channel bandwidth	20 MHz, 40 MHz
Modulations	DSSS, OFDM
Number of Tx Antennas	1
Type of antenna	PCB antenna
Antenna gain	2.87 dBi
Installation category	Mobile
Connectivity	2.4 GHz Spectrum Capabilities
Modes	SoftAP (Wi-Fi 1-to-1) Station (Wi-Fi LAN)

Wi-Fi 1-to-1	
Protocol	HTTPS (webserver)
Mode	SoftAP
Bit rate	Up to 150 Mbps
Configuration parameters	Enable SSID Password
Refresh time	≤ 3 s
Configuration mode	UCS software/APP and Webserver

Wi-Fi LAN	
Protocol	Modbus TCP/IP, HTTPS REST API, HTTPS (webserver)
Mode	Station
Bit rate	Up to 150 Mbps
Configuration parameters	Enable SSID Password DHCP IP address Netmask Gateway
Refresh time	Modbus TCP/IP: ≤ 100 ms REST API: ≤ 200 ms HTTPS Webserver: ≤ 3 s
Configuration mode	UCS software/APP and Webserver

Digital inputs/outputs

Digital inputs (S1, M1 or O1 versions)

Connection type	Screw terminals
Number of inputs	1
Type	Free contact
Function	Remote status Tariff management Partial meter start/pause Partial meter reset
Features	Open contact voltage: 5 Vdc +/- 5% Closed contact voltage: 5 mA max Input impedance: 11.6 k Ω Open contact resistance: ≥ 25 kΩ Closed contact resistance: ≤ 840 Ω Maximum voltage applicable with no damages: 30 V ac
Configuration parameters	Input function
Configuration mode	Via keypad or software/app and Webserver

***Note**: type S0, class B in accordance with EN62053-31*

Digital ouput (O1 versions)

Connection type	Screw terminals
Maximum number of outputs	1
Type	Opto-mosfet
Function	Pulse output or alarm output
Features	V_{ON} 2.5 V ac/dc, max 100 mA V_{OFF} 42 V ac/dc
Configuration parameters	Output function (pulse/alarm) Pulse weight (from 0.001 to 10 kWh per pulse) Pulse duration (30 or 100 ms) Output normal status (NO or NC)
Configuration mode	Via keypad, UCS software/APP and Webserver

Connection Diagrams

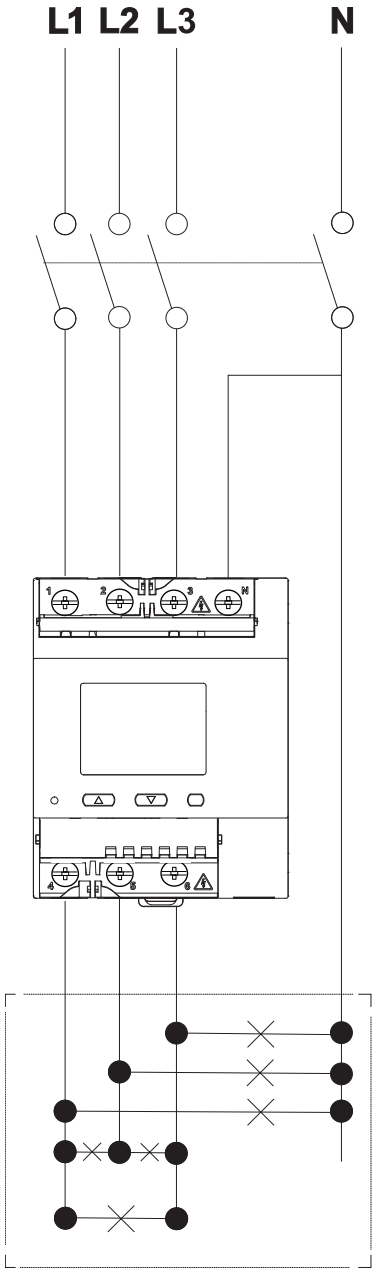


Fig. 3 Three-phase with neutral (4-wire)

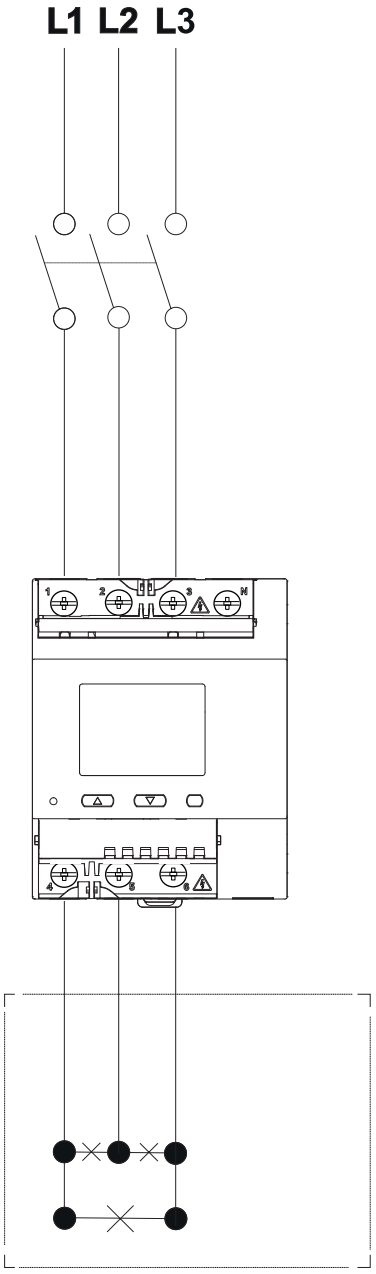


Fig. 4 Three-phase without neutral (3-wire)

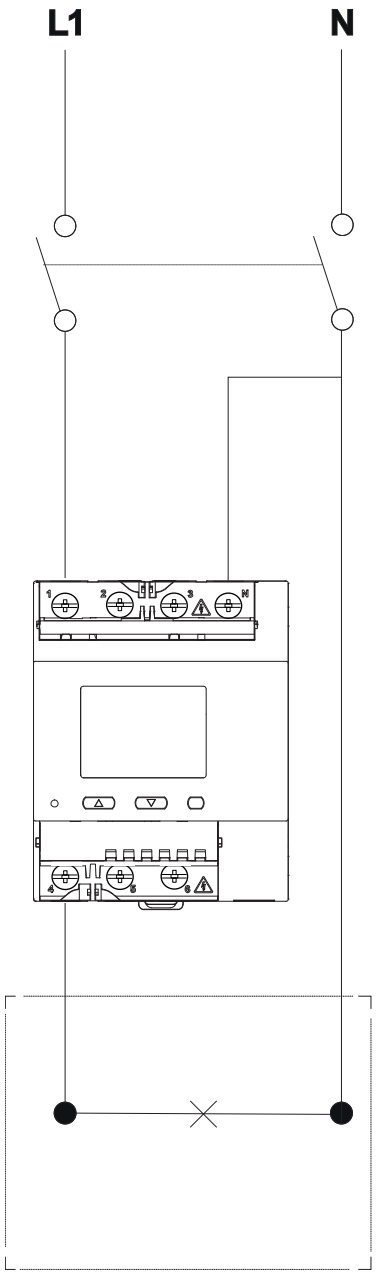


Fig. 5 *Single-phase system*

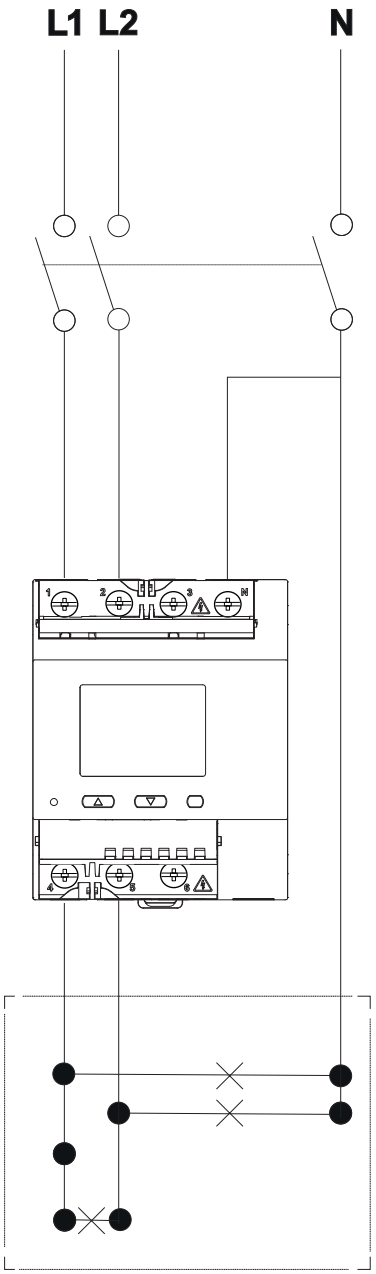


Fig. 6 *Two-phase (3-wire)*

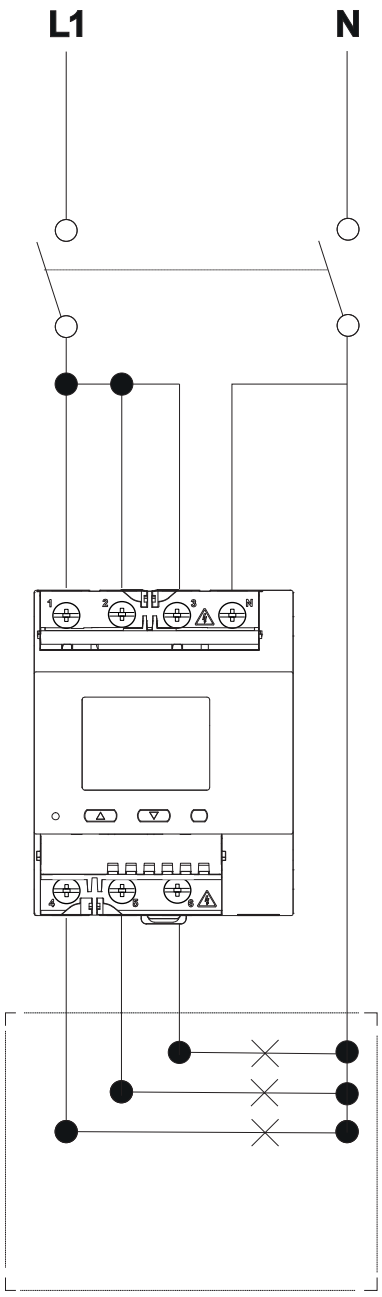


Fig. 7 *Single-phase system, 3 loads*

Digital input/output

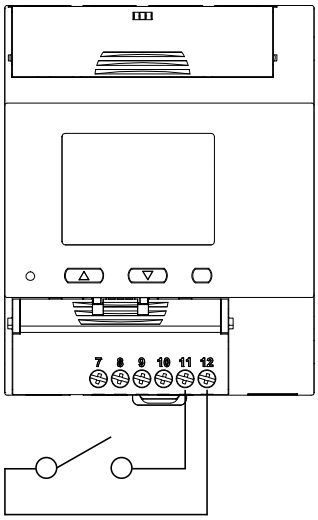


Fig. 8 *Digital Input (S1, O1 or M1)*

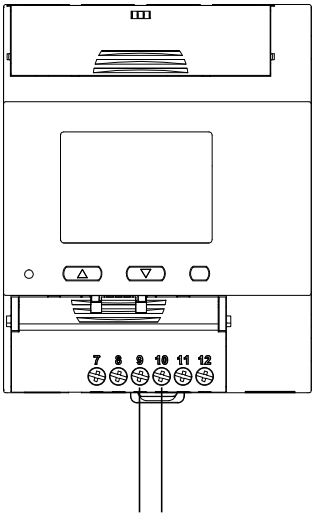


Fig. 9 *Digital Output (option O1)*

Communication

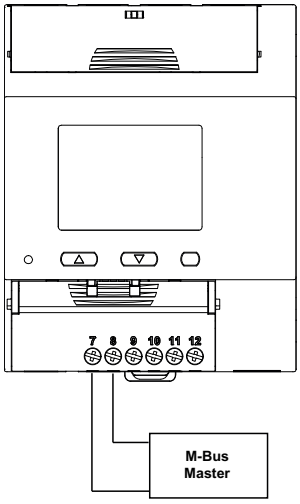


Fig. 10 *M-Bus (option M1)*

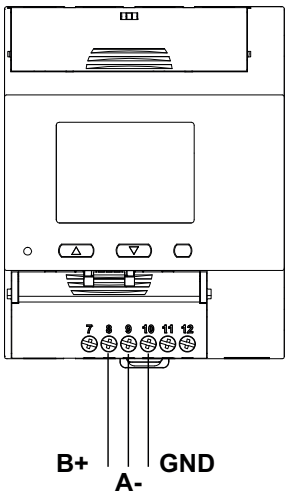


Fig. 11 *Modbus RS485 (option S1)*

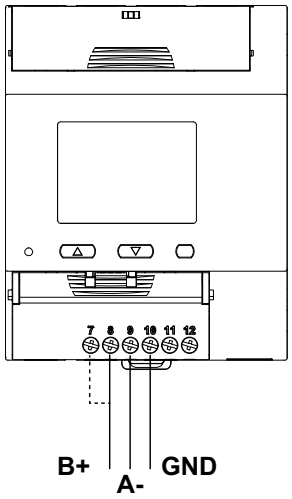


Fig. 12 *Last device on Modbus RS485 (option S1)*

References

Order code

EM640 B AV2 3X E2 XX X

Enter the code option instead of ☐

Code	Options	Description
EM640 B	-	-
AV2	-	65 A direct connection
3X	-	Three phase, self power supply
E2	-	Ethernet Modbus TCP
XX	-	-
X	-	CE, cULus

EM640 W AV2 3X ☐ ☐ ☐

Enter the code option instead of ☐

Code	Options	Description
EM640 W	-	Wi-Fi and RTC
AV2	-	65 A direct connection
3X	-	Three phase, self power supply
☐	XX	Wi-Fi LAN and Wi-Fi 1-to-1
	E2	Wi-Fi LAN and Wi-Fi 1-to-1 and Ethernet
☐	S1	RS485 Modbus RTU and digital input
	O1	Digital output and digital input
	M1	M-Bus and Digital input
☐	X	CE, cULus
	PFA	CE, MID easy connection
	PFB	CE, MID Bidirectional
	PFC	CE, MID Net Bidirectional

- PFA: Easy connection, the total energy totalizer (kWh+) is certified according to MID.

- PFB: Bidirectional, total imported active energy (kWh+ TOT) and Total exported active energy (kWh- TOT) are MID certified meters; manufactured in Italy.

  Note: for each measuring time interval, the individual phase energies with a plus sign are summed up to increase the positive energy meter (kWh+), while the others increase the negative one (kWh-).

- PFC: Bidirectional, total imported active energy (kWh+ TOT) and Total exported active energy (kWh- TOT) are MID certified meters; manufactured in Italy.

  Note: for each measuring time interval, the energies of the individual phases are summed up; according to the sign of the result, the system increases the positive totalizer (kWh+) or the negative one (kWh-).

CARLO GAVAZZI compatible components

Purpose	Component name/code key	Notes
Configure analyzer via desktop application	UCS software	Available for free download at www.gavazziautomation.com
Aggregate, store and transmit data to other systems	UWP	For further information please refer to www.gavazziautomation.com

COPYRIGHT ©2026
Content subject to change. Download the PDF: www.gavazziautomation.com