



INSTALLATION AND USER MANUAL

EMT130 · EMT132

Three-phase power analyzer

English · Revision 1



MODEL

EMT130

Self-powered from the measuring inputs



MODEL

EMT132

SELV power supply 10–36 VDC / 19–26 VAC from the T-BUS connector



CONTENTS

1 INTRODUCTION.....	5
1.1 Product description.....	5
1.2 Models and main differences.....	5
1.3 Product features	5
1.4 Symbols	6
2 MEASUREMENTS AND RECORDINGS	7
3 TECHNICAL SPECIFICATIONS	9
3.1 Power supply.....	9
3.2 Measuring inputs	9
3.3 Accuracy.....	10
3.4 General specifications.....	10
3.5 Standards	11
3.6 RS485 port.....	11
3.7 Wifi port	11
3.8 Software functions.....	12
3.9 Digital output	12
4 ADDITIONAL INFORMATION	13
4.1 Accuracy (according to EN50470-3 and EN62053-24)	13
4.2 Digital output	13
4.3 Power Quality.....	15
4.4 Unbalance	16
4.5 Real-time waveforms	16
4.6 Insulation between inputs and outputs	16
4.7 Advanced programming.....	16
4.8 Calculation formulas	17
5 WIRING DIAGRAMS.....	18
5.1 Measuring inputs	18
5.2 RS485 communication and digital output.....	19
5.3 Power supply.....	19
5.4 Installation, safety and maintenance warnings	19
6 FIRST CONNECTION	21
7 ORDER CODES	22

1 INTRODUCTION

1.1 Product description

EMT130 and EMT132 are three-phase power analyzers in a 1 DIN module format, with a 160x80 pixel colour graphic display and touch button, RS485 port, Wifi, NFC and pulse/alarm output. Current inputs from 5 A (1 A) CTs or from CTs with 333 mV voltage output / Rogowski coils. The two models share measurements, communication and software functions; they differ in the type of power supply and in the insulation, as shown in the following table.

- **EMT130 – self-powered from the measuring inputs: 85 - 265 VL-N, 150 - 450 VL-L.**
- **EMT132 – SELV power supply 10 - 36 VDC or 19 - 26 VAC from the T-BUS connector.**

1.2 Models and main differences

Model comparison		
Parameter	EMT130	EMT132
Power supply	Self-powered (from the voltage inputs)	SELV, from the T-BUS connector
Supply voltage	85 - 265 VAC L-N 150 - 450 VAC L-L	10 - 36 VDC 19 - 26 VAC
Consumption	< 1,5 W	< 1 W
Active energy class	class C (EN50470-1/3) class 0.5 S (EN62053-22)	
Reactive energy class	class 0.5 S (EN62053-24)	
Insulation power supply / measuring inputs	not insulated	4 kVRMS
Dimensions	93x69x17 mm (1 DIN module)	
Display	160x80 pixel colour, with touch button	
T-BUS connector	RS485 communication only (optional accessory)	Power supply and RS485 communication

1.3 Product features

- Accuracy $\pm 0.5\%$ RDG
- Bidirectional energy meter
- TRMS measurement of distorted waveforms (voltage/current)
- Neutral current measurement
- One output (MOSFET) for alarms or pulses
- Wifi Station and Access Point (Modbus TCP)
- RS485 serial output (Modbus RTU)
- NFC for reading the configuration parameters
- Logging in flash memory up to 1 MB
- MQTT available (FULL version)
- 16-bit 160x80 pixel colour display with touch button
- Sampling rate: 6400 samples/s @ 50 Hz
- Size: 1 DIN module
- Chronos CTs can be paired directly via the App to correct signal phase shift and amplitude

- Full harmonic analysis (amplitudes and phases)
- Two versions: for current-output CTs 5 A (or 1 A) or voltage-output CTs (333 mV/Rogowski)
- Built-in integrator for Rogowski coils
- Available in two variants: BASE, FULL

1.4 Symbols

	DANGER: Failure to follow the instructions may cause damage to property, people or animals.		WARNING, DANGEROUS VOLTAGE: Live electrical voltage. Disconnect the power supply before working on the device.
	DOUBLE INSULATION: Class II equipment. No earth connection is required.		WEEE: Do not dispose of with household waste. Take to an authorised collection centre.

2 MEASUREMENTS AND RECORDINGS

Measurements and recordings are the same for EMT130 and EMT132 and depend only on the version (BASE or FULL).

Real-time measurements	BASE	FULL
VRMS LL and VRMS LN [V]	•	•
IRMS [A]	•	•
Active power P [W]	•	•
Reactive power Q [VAR]	•	•
Apparent power S [VA]	•	•
Cos ϕ	•	•
Tan ϕ	•	•
Crest factor	•	•
Frequency [Hz]	•	•
Internal temperature [°C]	•	•
Phase sequence	•	•
RSSI Wifi	•	•

Counters	BASE	FULL
Active energy [Wh] (pos, neg, total)	•	•
Reactive energy [VARh] (pos, neg, total)	•	•
Apparent energy [VAh] (pos, neg, total)	•	•
Installation time [h]	•	•

Average, maximum and minimum values	BASE	FULL
VRMS LL average, maximum and minimum	•	•
VRMS LN average, maximum and minimum	•	•
IRMS average, maximum and minimum	•	•
Active power P average, maximum and minimum	•	•
Reactive power Q average, maximum and minimum	•	•
Apparent power S average, maximum and minimum	•	•
Cos ϕ average, maximum and minimum	•	•
Crest factor average, maximum and minimum	•	•
Frequency average, maximum and minimum	•	•
Peaks on voltage VLL	•	•
Peaks on voltage VLN	•	•
Peaks on currents I	•	•
MAX demand	•	•
Configurable moving average on P, P_plus, P_neg, Q_plus_ind, Q_plus_cap, Q_neg_ind, Q_neg_cap	•	•

Logging and connectivity	BASE	FULL
Logging of real-time measurements, exportable via webserver		•
Oscilloscope function accessible via RS485		•
Oscilloscope function accessible via webserver		•

Logging and connectivity	BASE	FULL
Direct connection via MQTT		•

Power quality	BASE	FULL
Voltage harmonics up to the 63rd order		•
Current interharmonics up to the 63rd order		•
Power quality:		•
- Undervoltages		•
- Overvoltages		•
- Voltage dips		•
Oscilloscope function via webserver and RS485		•
Distortion power factor		•
Voltage THD, TDD		•
Current THD, TDD		•
Efficiency between phase 1 and phase 2		•
K-factor		•

3 TECHNICAL SPECIFICATIONS

3.1 Power supply

Power supply specifications		
	EMT130	EMT132
Type	Self-powered	SELV power supply
Power supply type	From the voltage measuring inputs (single-phase or three-phase)	Single-phase from the T-BUS connector
Voltage	85 - 265 VAC (L-N) 150 - 450 VAC (L-L)	10 - 36 VDC 19 - 26 VAC
Consumption	< 1,5 W	< 1,5 W

3.2 Measuring inputs

Input specifications (common to all models)	
Voltage	
Rated voltage range L-N	85 - 265 VAC
Rated voltage range L-L	150 - 450 VAC
Operating frequency	DC / 1 - 65 Hz
Current	
Connection	With 5 A (1 A) current-output CTs or voltage-output CTs (333 mV / Rogowski)
CTs with current output	
Starting current (I _{st})	5 mA
Minimum current (I _{min})	50 mA
Rated current (I _n)	5 AAC
Maximum current (I _{MAX})	6 AAC
Crest factor	< 4 (20 APK MAX)
Impedance	< 1 VA per phase
Overload for 500 ms	40 AAC
CTs with voltage output	
Starting voltage (V _{st})	0.33 mVAC
Minimum voltage (V _{min})	3.33 mVAC
Rated voltage (V _n)	333 mVAC
Maximum voltage (V _{MAX})	500 mVAC
Crest factor	< 3 (1 VPK MAX)
Impedance	220 kΩ
Overload for 500 ms	6 VPK

3.3 Accuracy

Accuracy (@25 ± 5 °C; frequency = 50 Hz)		Update times
Frequency	± 0.008 Hz (45..65 Hz)	100 ms
Voltage	± 0.2% rdg	Configurable from 1 to 65535 periods (from 20 ms to 21.8 minutes at 50 Hz)
Current	± 0.3% rdg	
Active and apparent power (PF = 0.5L .. 0.5C)	± 0.3% rdg (In or Vn from 5% to 100%) ± 0.4% rdg (In or Vn from 1% to 5%)	
Reactive power (sinφ = 0.5L .. 0.5C)	± 0.3% rdg (In or Vn from 5% to 100%) ± 0.4% rdg (In or Vn from 1% to 5%)	
Active energy	class C according to EN50470-1/3; class 0.5 S according to EN62053-22	
Reactive energy (when measured, see below)	class 0.5 S according to EN62053-24	
Power factor	± (0.001 + 1%(1.00 - PF))	
Bandwidth (-3 dB)	> 2 kHz	Not applicable
Thermal drift	< 100 ppm/°C	
THD	± 0,3%	100 ms
Harmonics	± 3% amplitude up to the 16th harmonic ± 5% amplitude from the 17th to the 63rd harmonic ± 5° phase shift up to the 16th harmonic ± 10° phase shift from the 17th to the 63rd harmonic	

3.4 General specifications

General specifications	
Operating temperature	-25 °C ... +65 °C
Storage temperature	-40 °C ... +85 °C
Humidity	10 ... 90% non-condensing
Altitude	Up to 2000 m a.s.l.
Measurement category	III 300 V
Overvoltage category (installation)	III
Insulation	EMT130: 0 kVRMS between power supply and measuring inputs (self-powered); 4 kVRMS between RS485 and measuring inputs; 4 kVRMS between power supply and RS485 EMT132: 4 kVRMS between power supply and measuring inputs; 4 kVRMS between RS485 and measuring inputs; 1.5 kVRMS between power supply and RS485
Enclosure	
Connections	1 × plug-in terminal, 3.5 mm pitch, 4 poles 1 × plug-in terminal, 5 mm pitch, 4 poles 1 × plug-in terminal, 5 mm pitch, 6 poles 1 × T-BUS connector (EMT132)
Dimensions	93x69x17 mm (1 DIN module)
Material	PBT, grey
IP protection rating	IP20
Environmental pollution degree	Pollution degree 2
Mounting	On DIN rail, ready for bus mounting (connector not included)

General specifications	
Configuration	Via built-in webserver (accessible from AP 192.168.4.1 or from the IP assigned in the local network) Via Cloud (FULL version only)
Overcurrent protection devices	External fuses, essential for safety (for example Littelfuse 477 series, 1 A)

3.5 Standards

Standards	
Electrostatic discharge (EN 61000-4-2)	8 kV contact 15 kV air
Radiated immunity (EN 61000-4-3)	10 V/m
Electrical fast transient (EFT) immunity (EN 61000-4-4)	2 kV
Surge immunity (EN 61000-4-5)	2 kV on the power supply 1 kV on the current measuring inputs, RS485 and digital output
Conducted disturbance immunity (EN 61000-4-6)	10 V
Conducted and radiated emissions (EN 55032)	Class B
Safety	EN61010-1; EN61010-2-030
Certifications	 

3.6 RS485 port

RS485 port	
Protocol	Modbus RTU
Number of addresses	Up to 247 (default 1)
Baudrate	From 1200 to 115200 baud (default 9600)
Configuration parameters	Address Baudrate Parity Stop bit
Connection	Via 4-pole plug-in terminal, 3.5 mm pitch Or via the T-BUS connector
Cable cross-section	0.2 mm ² or less recommended. Belden 9841 cables or equivalent recommended

3.7 Wifi port

Wifi port	
Protocol	Modbus TCP HTTP MQTT SNTP
Number of clients	Up to 10

Wifi port	
Frequency	2.4 GHz 802.11 b/g/n
Related functions	Webserver Firmware update Communication Logging MQTT (FULL version only)
Configuration parameters	IP address Subnet mask Gateway address TCP port DHCP MQTT

3.8 Software functions

Software functions	
Measurement type	TRMS
Sampling rate	6400 samples/s @ 50 Hz 7680 samples/s @ 60 Hz
Measurement update	Programmable via software Default: every 50 cycles (AC) MAX: 65535 cycles
Transformation ratios	CT and VT default 1.0; configurable via software or the APP
Transformation delays	0.0° @ 50 Hz default; configurable via software or the APP
Minimum display threshold	Configurable for voltage, current and power
Internal calendar	Via NTP (Wifi) or internal RTC with battery; minimum battery life 4 years with the instrument unpowered

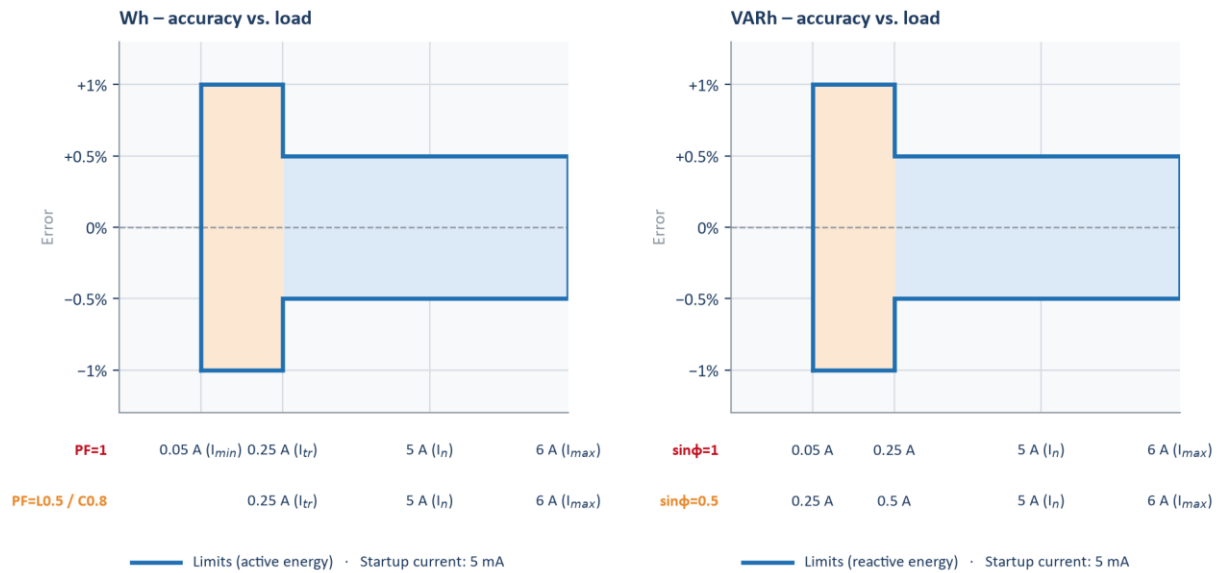
3.9 Digital output

Digital output	
Use	Alarm or pulses/kWh
Number	1
Type	Solid state (MOSFET)
Rating	< 40 V, < 100 mA
Connection	Via 4-pole plug-in terminal, 3.5 mm pitch
Cable cross-section	0.2 mm ² or less recommended. Belden 9841 cables or equivalent recommended

4 ADDITIONAL INFORMATION

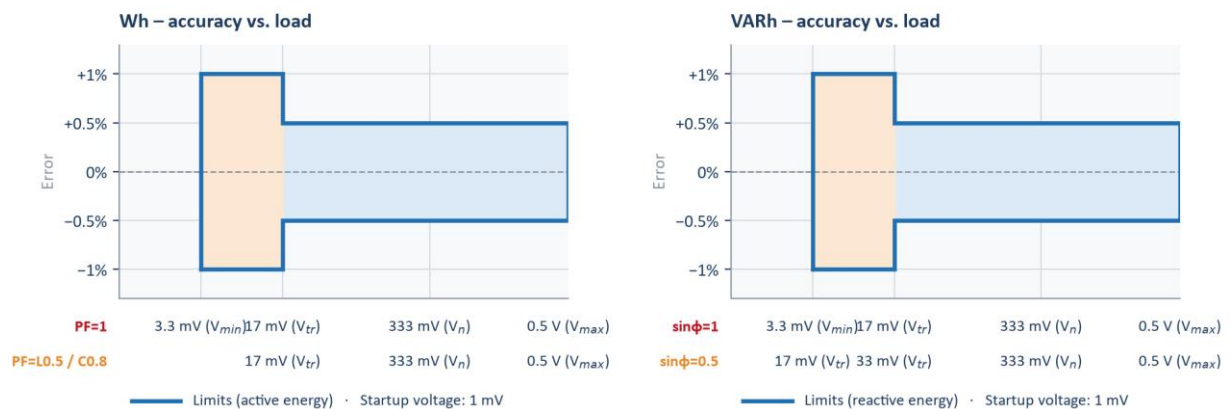
4.1 Accuracy (according to EN50470-3 and EN62053-24)

CTs with current output



Wh and VARh accuracy as a function of load – CTs with current output (startup current: 5 mA)

CTs with voltage output



Wh and VARh accuracy as a function of load – CTs with voltage output (startup voltage: 1 mV)

Note: reactive power accuracy is guaranteed when the instrument is set to calculate Q using the Budeanu formula.

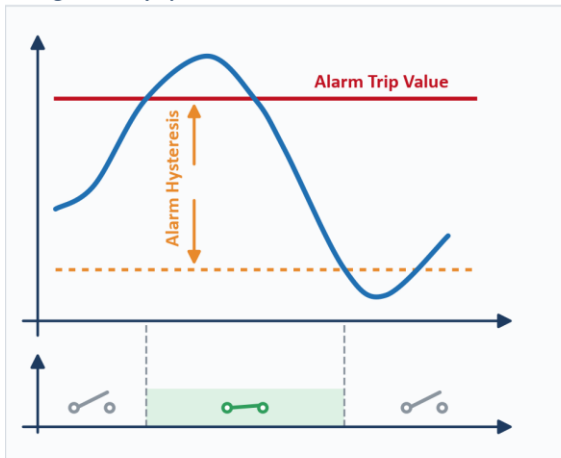
4.2 Digital output

The digital output can be set to work as an alarm or as a pulse output.

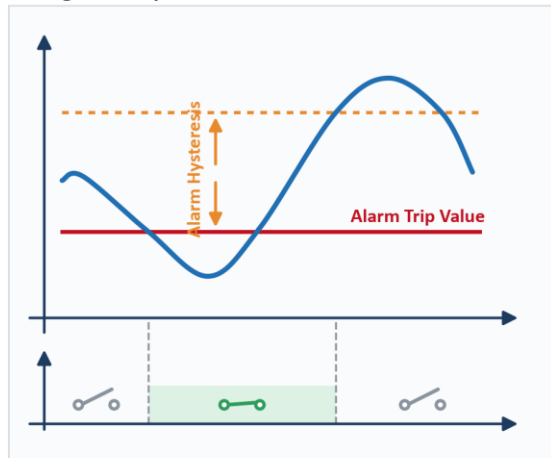
Alarms

Rising: normally open contact. Falling: normally closed contact. Window: contact closed between the thresholds, or contact closed outside the thresholds.

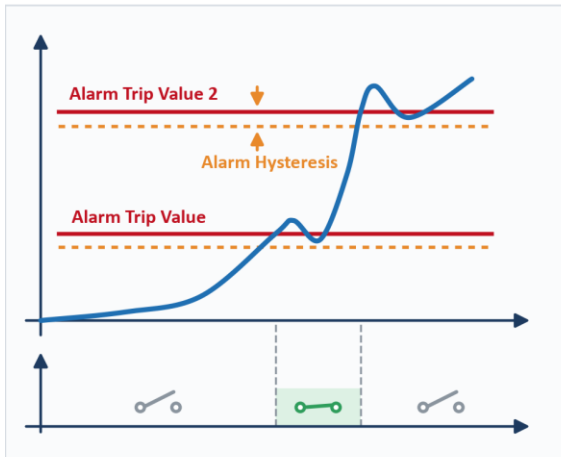
Rising: normally open contact



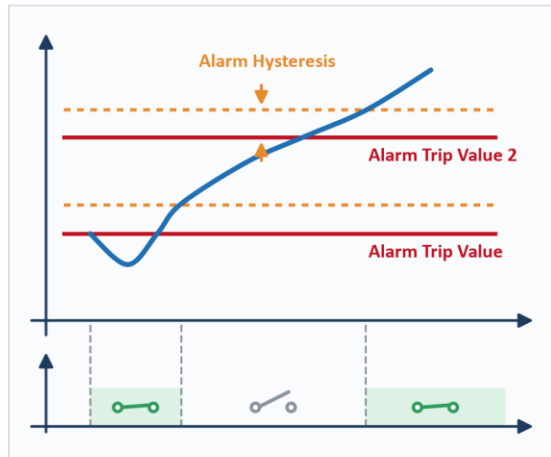
Falling: normally closed contact



Window: contact closed between the thresholds



Window: contact closed outside the thresholds

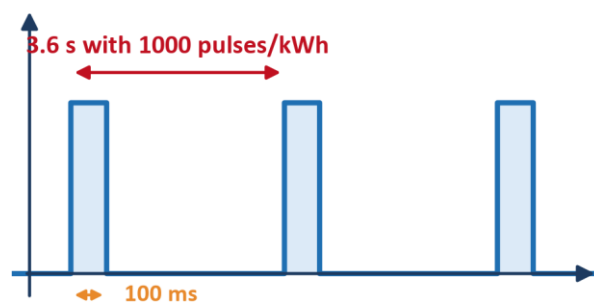


Alarm operation (Alarm Trip Value / Alarm Hysteresis)

Note: the buzzer can be associated with the alarms to obtain an audible alarm.

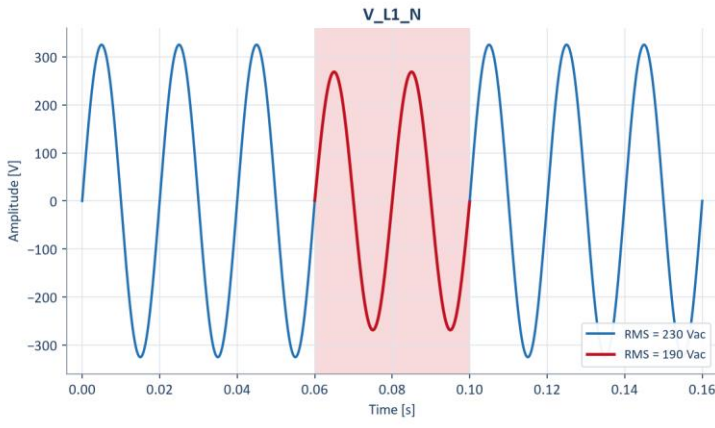
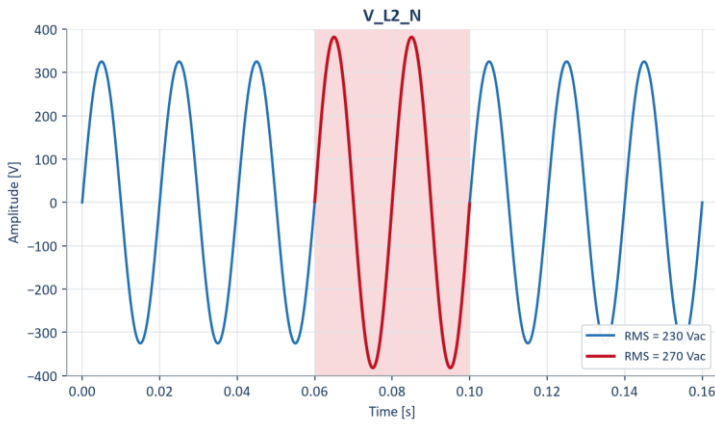
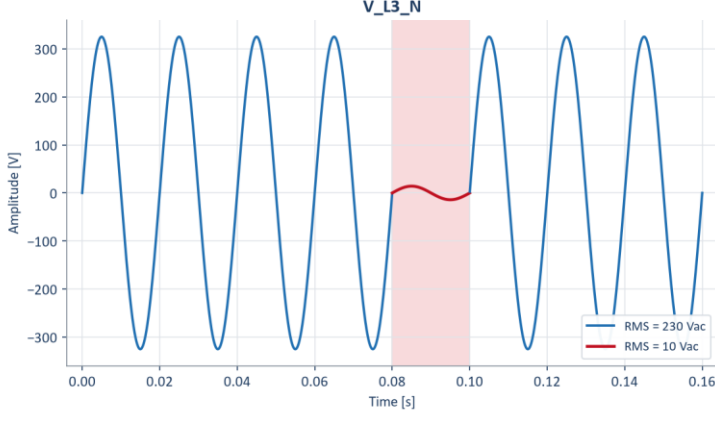
Pulse output

Pulse output as an alternative to the alarm digital output. Example: with 1000 pulses/kWh, 100 ms pulses.

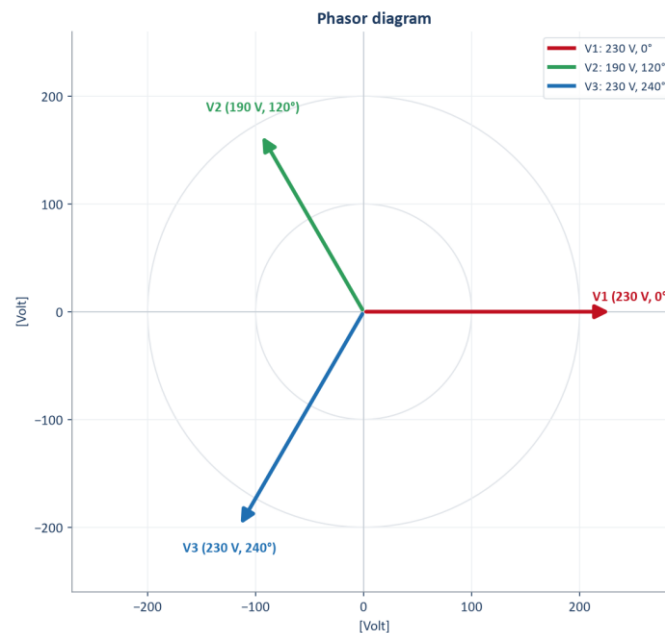


4.3 Power Quality

Examples of events recorded by the instrument:

Event	Recorded values (example)
SAG 	Type: Sag Value: 190 V Query: 1 (V_L2_N) Duration: 40 ms
SWELL 	Type: Swell Value: 270 V Query: 2 (V_L2_N) Duration: 40 ms
INTERRUPTION 	Type: Interruption Value: 10 V Query: 3 (V_L3_N) Duration: 20 ms

4.4 Unbalance



Phasor diagram – example with Unbalance: 6.15%

4.5 Real-time waveforms

The analyzer can record up to 10 waveforms (3 phase-to-neutral voltage channels, 3 phase-to-phase, 4 line currents). 128 samples are acquired for each period; sampling is at 6400 sps @ 50 Hz. The waveforms can be displayed directly via the webserver. The values can also be accessed via Modbus registers, either through RS485 (Modbus RTU) or through Wifi (Modbus TCP, recommended for its higher speed).

4.6 Insulation between inputs and outputs

Insulation between inputs and outputs		
Between	EMT130	EMT132
Power supply and measuring inputs	0 kV (self-powered)	4 kV
Power supply and RS485	4 kV	1.5 kV
Power supply and digital output	4 kV	1.5 kV
Measuring inputs and RS485	4 kV	
Measuring inputs and digital output	4 kV	
RS485 and digital output	0 kV (not insulated)	

4.7 Advanced programming

In addition to Modbus RTU and TCP and the built-in webserver, the instrument exposes a list of APIs (Application Programming Interface), formatted in JSON, for easy management of measurements and settings. To use them, enter

in a browser the IP of the device followed by the function to be used, for example

http://192.168.178.30/get_measurements_status. The updated list of functions is given in the documents on the website:

Function	Description
api_http_gets	GET APIs exposed by the device
api_http_posts	POST APIs exposed by the device
api_mqtt_getposts	GET APIs exposed by the device, available via MQTT

4.8 Calculation formulas

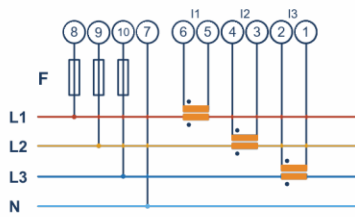
Phase variables	System variables	Energy metering
<i>RMS voltage</i>	<i>Average voltage</i>	<i>Active energy</i>
$V_i = \sqrt{\frac{1}{N} \sum_{l=1}^N (v_L)_i^2}$	$V_{AVG} = \frac{V_1 + V_2 + V_3}{3}$	$Wh_i = \int_{t_1}^{t_2} P_i(t) dt \approx \Delta t \sum_{n_1}^{n_2} P(n)_i$
<i>RMS current</i>	<i>Average current</i>	<i>Reactive energy</i>
$I_i = \sqrt{\frac{1}{N} \sum_{l=1}^N (i_L)_i^2}$	$I_{AVG} = \frac{I_1 + I_2 + I_3}{3}$	$VARh_i = \int_{t_1}^{t_2} Q_i(t) dt \approx \Delta t \sum_{n_1}^{n_2} Q(n)_i$
<i>Active power</i>	<i>Three-phase active power</i>	<i>Apparent energy</i>
$P_i = \frac{1}{N} \sum_{l=1}^N v_{Li} \cdot i_{Li}$	$P_{3PH} = P_1 + P_2 + P_3$	$VAh_i = \int_{t_1}^{t_2} S_i(t) dt \approx \Delta t \sum_{n_1}^{n_2} S(n)_i$
<i>Apparent power</i>	<i>Three-phase apparent power</i>	<i>Voltage unbalance</i>
$S_i = V_i \cdot I_i$	$S_{3PH} = S_1 + S_2 + S_3$	$V_{UNB} = \frac{MAX(V_i - V_{AVG})}{V_{AVG}}$
<i>Reactive power</i>	<i>Three-phase reactive power</i>	Where: i = phase considered (L1, L2 or L3); P = active power; Q = reactive power; t1, t2 = start and end of the metering period; n = time unit; t = time unit width; n1, n2 = first and last time unit in the metering period.
$Q_i = \frac{1}{N} \sum_{l=1}^N v_{Li} \cdot \widehat{i_{Li}} \quad \text{Budeanu}$ $Q_i = \sqrt{S_i^2 - P_i^2} \quad \text{triangle}$	$Q_{3PH} = Q_1 + Q_2 + Q_3$	
<i>Power factor</i>	<i>Three-phase power factor</i>	
$\cos \phi_i = \frac{P_i}{S_i}$	$\cos \phi_{3PH} = \frac{P_{3PH}}{S_{3PH}}$	

5 WIRING DIAGRAMS

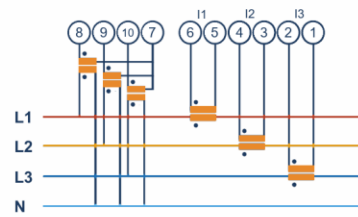
5.1 Measuring inputs

The wiring diagrams of the measuring inputs are common to both models.

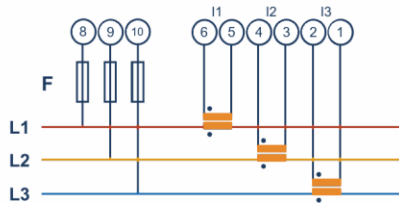
Three-phase, 4 wires, connection with 3 CTs



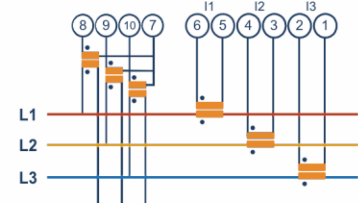
Three-phase, 4 wires, with 3 CTs and 3 VTs



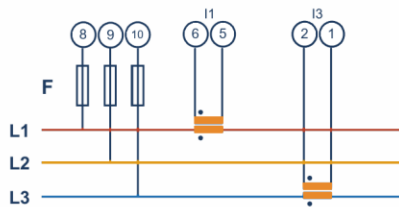
Three-phase, 3 wires, connection with 3 CTs



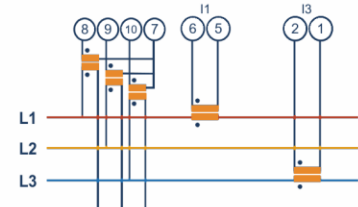
Three-phase, 3 wires, with 3 CTs and 3 VTs



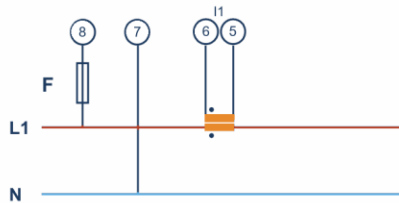
Three-phase, 3 wires, with 2 CTs (Aron)



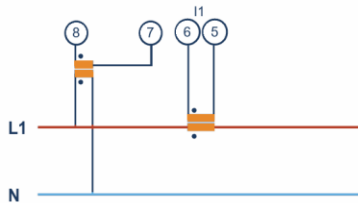
Three-phase, 3 wires, 2 CTs and 3 VTs (Aron)



Single-phase, 2 wires, connection with 1 CT

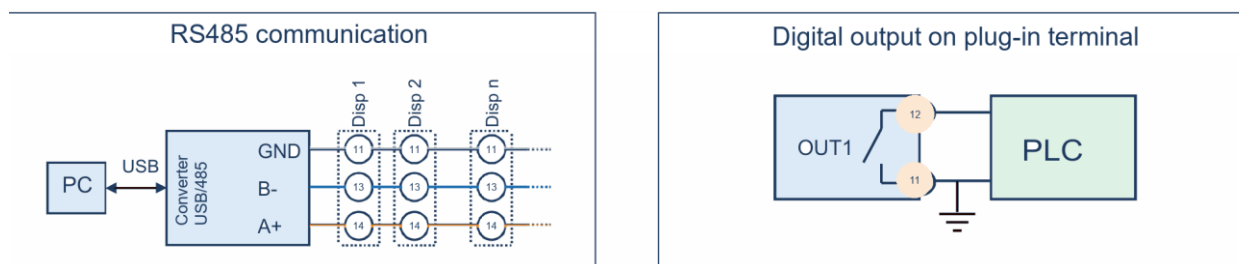


Single-phase, 2 wires, with 1 CT and 1 VT

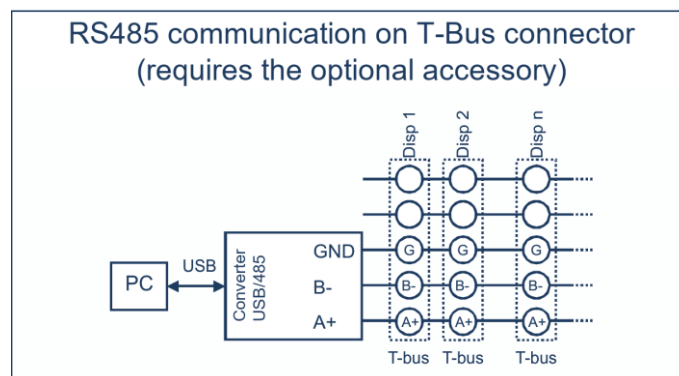


Three-phase 4-wire, three-phase 3-wire, Aron and single-phase connections, with and without VTs (F = protection fuse)

5.2 RS485 communication and digital output



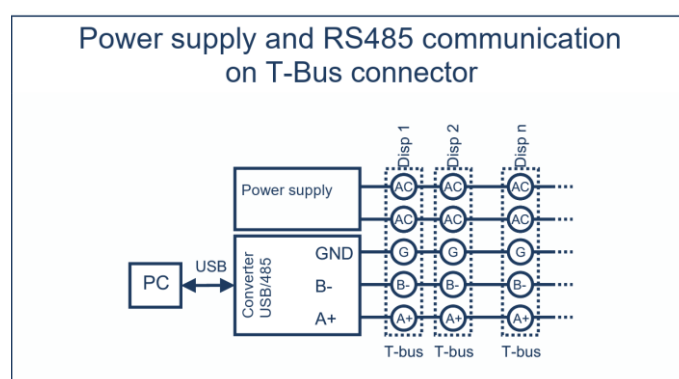
RS485 communication (PC – USB/485 converter – devices) and digital output on plug-in terminal



EMT130: RS485 communication on T-Bus connector (requires the optional accessory)

5.3 Power supply

Power supply connection		
	EMT130	EMT132
Connection	No dedicated power terminal: the instrument is powered from the voltage inputs (terminals 7 - 10).	T-BUS connector (terminals AC - AC): from SELV power supply 10..36 VDC / 19..26 VAC



EMT132: power supply and RS485 communication on T-Bus connector

5.4 Installation, safety and maintenance warnings

N.B.: since the instrument is class II, according to standard EN 61140:2004-05 "Protection against electric shock - Common aspects for installation and equipment - Equipotential bonding", earthing the instrument is not recommended, so as not to reduce the safety of the installation. Any earthing must ensure that no current flows between terminal 7 (N) and PE earth.

- Device intended exclusively for indoor installation in an electrical panel (degree of protection provided by the panel).
- The device must be connected downstream of a circuit breaker or disconnecter that is easily accessible and marked as the disconnecting device of the equipment.
- For safety reasons it is essential to fit fuses as shown in the wiring diagrams (for example Littelfuse 477 series, 1 A).
- The unit does not require any cleaning or decontamination by the user.
- All maintenance, inspection or service activities must be carried out exclusively by personnel authorised by Chronos.

6 FIRST CONNECTION

To connect to the instrument via Wifi, follow these steps:

1. Using a smartphone, connect to the Access Point exposed by the instrument (by default EMT130-WifiAP-SerialNumber or EMT132-WifiAP-SerialNumber). Password: the one shown on the label as PW AP.
2. Disable mobile data.
3. Open a browser (e.g. Chrome) and enter the address **https://192.168.4.1**.
4. Enter user name **"admin"** and the password shown on the label as **PW WEB**.
5. In the built-in webserver, on the Wifi connections page, enter the SSID and password of the Wifi network to be used.
6. Restart the instrument, which will then be visible directly from the local network. If the connection was successful, the Wifi icon on the front of the instrument will be white. To check correct operation, access the internal webserver, where the main electrical quantities can be monitored; they should match the expected values.

7 ORDER CODES

EMT13x – Input type – Version

Series	Input type	Version
EMT130 = self-powered EMT132 = SELV power supply 10-36 VDC / 19-26 VAC (T-BUS)	I = 5 A (1 A) CT V = 333 mV CT / Rogowski	BASE = base model FULL = model with advanced electrical analysis, logging and MQTT

Examples

Code	Description
EMT130.I.FULL	EMT130 with 5 A CT input, model with advanced analysis, logging and MQTT
EMT132.I.BASE	EMT132 with 5 A CT input, base model
EMT132.V.FULL	EMT132 with 333 mV CT / Rogowski input, model with advanced analysis, logging and MQTT

CHRONOS SRL

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