ITRON EM620

User manual

revision 1.1.5

Identification
EM620 - user manual
November 30, 2021

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Contents

CHAPTER 1
Introduction

1.1 About this guide

This guide describes all functions and features of EM620 meter.

This guide provides all information required to:

- understand the principles of meter operation
- assess the suitability of the meter for any application
- install the meter safely and correctly
- test meter functionality and configuration
- use and interpret the meter displays

This manual is intended for use primarily by meter installers, utility testers and specifying engineers.

1.2 Abbreviations

AC	Alternating current	M	Mega (10^6)
ANSI	American national standards institute	Max	Maximum
CE	European conformity (logo)	MDI	Maximum demand indicator
COSEM	Companion Specification for Energy Metering	MID	Measurement Instruments Directive (European Union)
CT	Current transformer	Min	Minimum
DC	Direct current	mm	Millimeters
DLMS	Device language message specification	Nom	Nominal
DST	Daylight savings time	NVM	Non-volatile memory
EOB	End of billing	OBIS	Object identification system
EOI	End of integration	PF	Power factor
EMC	Electro-magnetic compatibility	PSTN	Packet switching telephone network
G	Giga (10^9)	PSU	Power supply unit
GSM	Global system for mobile communications	RF	Radio frequency
GPRS	General packet radio service	RH	Relative humidity
HHT	Hand-held terminal	RMS	Root mean square
HF	High frequency	RTC	Real-time clock
Hz	Hertz	RWP	Read without power
I	Current	SAP	Service access point (Cosem)
i.a.w	In accordance with	SCADA	Supervisory control and data acquisition
Ib	Base current	secs	Seconds
I/O	Inputs and outputs	T	Tera (10^12)
IR	Infrared	TER	Total energy register
IEC	International electrotechnical commission	THD	Total harmonic distortion
k	Kilo (10^3)	TOU	Time of use
LAN	Local area network	V	Volt
LCD	Liquid crystal display	VT	Voltage transformer
LED	Light emitting diode	W	Watt
LP	Load profile	PT	Potential Transformer

CHAPTER 2
Certification

2.1 Applicable standards

The EM500/600 meter complies, where applicable, with the following standards and regulations.

- **IEC 62052-11 Electricity metering equipment (AC)** - General requirements, tests and test conditions, part 11: Metering equipment (equivalent to EN 62052-11)
- **IEC 62052-31 Electricity metering equipment (AC) -** General requirements, tests and test conditions - Part 31: Product safety requirements and tests
- **IEC 62053-21 Electricity metering equipment (AC)** - Particular requirements, part 21: Static meters for active energy (classes 1 and 2), (equivalent to EN 62053-21)
- **IEC 62053-22 Electricity metering equipment (AC)** - Particular requirements, part 22: Static meters for active energy (classes 0,2 S and 0,5 S)
- **IEC 62053-23 Electricity metering equipment (AC)** - Particular requirements, part 23: Static meters for reactive energy (classes 2 and 3)
- **IEC 62053-24 Electricity metering equipment (AC)** - Particular requirements, part 24: Static meters for reactive energy (classes 0,5 and 1)
- **IEC 62053-31 Electricity metering equipment (AC)** - Particular requirements, part 31: Pulse output devices for electro-mechanical and electronic meters (equivalent to EN 62053-31)
- **IEC 62053-52 Electricity metering equipment (AC)** - Particular requirements, part 52: Symbols
- **IEC 62053-61 Electricity metering equipment (AC)** - Particular requirements, part 61: Power Consumption and Voltage Requirements
- **IEC 62054-21 Electricity metering equipment (AC)** - Tariff Load control, part 21: Particular requirements for time switches
- **IEC 62056-21 Electricity Metering** – Data exchange for meter reading, tariff and load control - Direct local data exchange (supersedes IEC1107)
- **IEC 62056-42 Electricity Metering** – Data exchange for meter reading, tariff and load control, part 42: Physical layer services and procedures for connection-oriented asynchronous data exchange
- **IEC 62056-46 Electricity Metering** – Data exchange for meter reading, tariff and load control, part 46: Data link layer using HDLC protocol
- **IEC 62056-5-3 ED3 Electricity Metering** – Data exchange for meter reading, tariff and load control, part 53: COSEM Application layer
- **IEC 62056-6-1 ED3 Electricity Metering** – Data exchange for meter reading, tariff and load **control, part 61: Object identification system (OBIS)**
- **IEC 62056-6-2 ED3 Electricity Metering** – Data exchange for meter reading, tariff and load control, part 62: Interface classes
- **IEC 62059-31-1 Electricity metering equipment** – Dependability – Part 31-1: Accelerated reliability testing – Elevated temperature and humidity
- **Directive 2011/65/EU (RoHS2)** – Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment
- **European Directive 2014/32/EU for Measurement Instrument Directive (MID)**
- **EMC Directive 2014/30/EC**
- **EN 50470-1 Electricity metering equipment (AC)** : Part 1 General requirements

- **EN 50470-3 Electricity metering equipment (AC) :** Part 3 Particular requirements

2.1.1 Reference to instructions

- Chapter 3 : Safety information
- Chapter 10 : Installation

2.2 End-of-life disposal

At the end of their service life, meters should be uninstalled and then passed to a licensed/certified contractor for disposal in accordance with these regulations and with all applicable local regulations.

Before passing the meters to the contractor the legal certification stamps or marks must be removed or defaced.

CHAPTER 3
Safety information

Meters must be installed and maintained only by suitably-qualified personnel. Observe the following safety advice when performing installation or service work on meters.

3.1 Meter handling

Before installing or removing a meter, or removing the terminal cover for any reason, isolate the meter from the mains supply by removing the supply-side fuses or using alternative local arrangements. Take appropriate measures to ensure that the isolation cannot be overridden by another person. For example, keep physical possession of the supply fuses.

- Adhere strictly to all relevant national regulations for the avoidance of electrical accidents.
- Always disconnect all measurement and auxiliary circuit connections from the meter before attempting to open the meter housing.
- Use only tools that have been approved for electrical installations.
- Clean meters only with a damp cloth or sponge. Do not use excessive or running water.

3.2 Installation

Install meters in accordance with the voltage and current specifications printed on the front panel and the wire and environmental specifications given in the installation information.

- The meter measuring, and auxiliary circuits must be galvanically isolated.
- All voltage paths (measurement and auxiliary) must be fused.
- The meter voltage connections must be physically separated from the communication lines in accordance with local laws and regulations.
- Do not install meters that are obviously damaged.
- Do not install meters that have been dropped or otherwise subjected to significant impact even if no damage can be seen.
- Do not HIPOT/Dielectric test the auxiliary or communication circuit connections.
- Do not use any meter functions or features for primary protection purposes.
- Do not install meters where failure of the device could cause death, injury or release sufficient energy to start a fire.
- Following installation, ensure that the meter terminal covers are correctly fitted and sealed to prevent user access.

3.3 Transformer connections

Observe all industry guidelines and safety precautions when performing any installation or service work on meters connected to Voltage (VT) and/or Current Transformers (CT).

- Contact with transformer connections while current is flowing in the primary will result in severe personal injury or death.
- Transformers that do not have a ground connection on the secondary may reach dangerously high output voltages.
- Always isolate voltage transformers by removing their fuses.
- Always short-out current transformer secondary circuits.
- Always ensure the transformer secondary circuit is connected to ground unless a special wiring arrangement is required.
- Always exercise extreme caution when handling transformer connections, especially if the transformer secondary does not have a ground connection.

CHAPTER 4
General information

4.1 Meter overview

Itron EM620 is a static, polyphase, four-quadrant, multi-rate, smart meter. It is intended for commercial / industrial applications and suitable for Low Voltage / High Voltage Current Transformer connected operated networks (LVCT, HVCT), as well as low voltage Direct Connected operated network (LVDC).

The following table highlights the overall specifications of the EM620

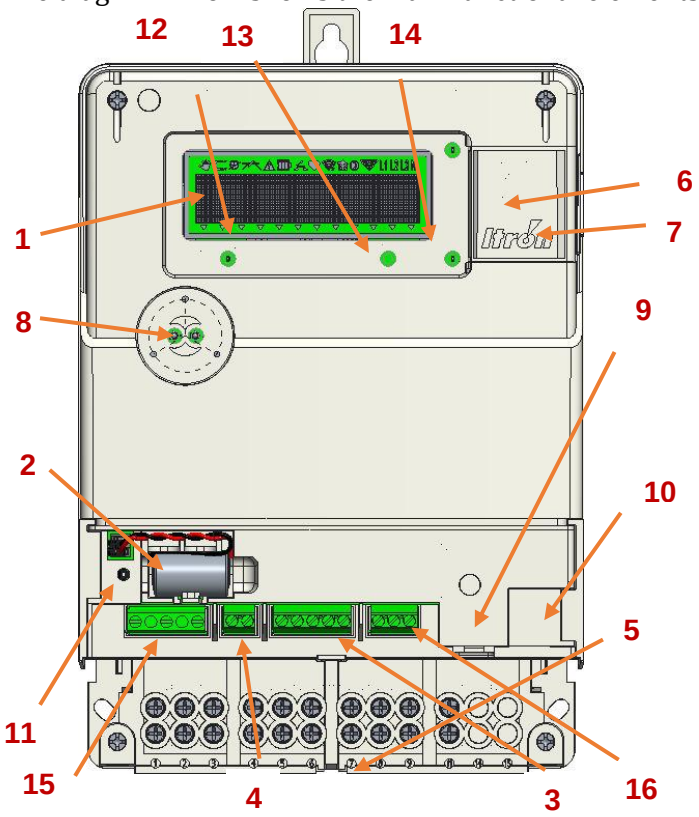
Frequency	50 or 60 Hz (manufacturing option)
Connection configuration	Direct Current Transformer Current & Voltage Transformer
Connection wiring	4 wires (EM500) 3 or 4 wires (EM600)
Terminal wiring	VDE (asymmetrical) or USE (symmetrical)
External load switch	1 relay 250V 8A (option)
Real Time Clock (RTC) energy backup	Field-replaceable battery and Internal super-capacitor (option)
Reading Without Power (RWP) energy backup	Manufacturing option
Enclosure type	Panel mounting DIN compliant
Environmental protection	IP 54
Isolation protection	Class II
Temperature range	Limit range of operation: -40°C to +75°C Storage and transport: -40°C to +85°C
Relative Humidity	95% i.a.w. IEC62052-11 standard
Net weight	1,7 kg
Dimensions (W x H x D)	165 x 232 x 84 mm (meter body) 165 x 232 x 84 mm (with short terminal cover) 165 x 300 x 93.5 mm (with long terminal cover) 165 x 250 x 110,5 mm (with short terminal cover including modem fixing)

Voltage	3x57.7/100 Vac up to 3x277/480 Vac (autoranging)
Current rating Ib(Imax)	5(100)A for DC variant 1(10)A for CT variant
Accuracy (active energy)	Class 0.5 or Class 1 for DC variant Class 0.2, Class 0.5 or Class 1 for CT variant
Accuracy (reactive energy)	Class 1 or Class 2

The meter can provide the following **minimum** features and functions:

Multi-quantities registers	Active, Reactive and Apparent energy (per phase, per quadrant) ▪ 42 energy registers ▪ 18 demand registers per phase + 10 total rates = total 28 registers ▪ 10 excess demand registers + 18 excess demand per phase = 28 registers ▪ 18 Max demand per phase + 10 total max demand ▪ 6 last average demands
Time Of Use (TOU)	Separate registers per rate: ▪ 88 energy registers (8 rates x 11 channels) ▪ 80 demand rate registers (8 rates x 10 channels) ▪ 80 Max demand rate registers (8 rates x 10 channels) Switching rates performed by internal clock and calendar: ▪ Up to 6 seasons ▪ Up to 6 week profiles ▪ Up to 8 day profiles ▪ Up to 12 switching times per day profiles ▪ Up to 45 special days
Load profiling	3 independent sets to save energy, power, RMS and power quality data: LP1: Up to 20 channels LP2: Up to 20 channels Power Quality profile : Up to 20 channels
Billing	1 set of 96 channels (energy total and rated, max demand), monthly execution (13 last entries) 1 set of 20 channels (total energy), daily execution (40 last entries) 1 set of 20 channels (total energy) for instantaneous read
Communication	1 Optical port 1 RS485 port for: - external modem (2xRJ45 outputs for daisy chaining, 8W power supply available, 12V) DLMS/COSEM compliant - or readout to end-customer, e.g. In-Home Display (1xRJ45 output) 1 RS232 port for remote communication : - with external modem (DLMS/COSEM Compliant) - with Gen5 NIC (Manufacturing option) PSTN, LAN (TCP/IP), cellular media supported Remote Firmware upgrade possibility
Network quality monitoring	Total Harmonics Distortion (THD), up to H15. Voltage cuts, sags and swells (i.a.w EN50160)

The diagram below shows the main functional elements of the meter:



1	Liquid crystal display (LCD)
2	RTC/RWP battery holder
3	Pulse/control output connectors
4	Relay terminal connectors
5	Main wiring terminal block
6	Display pushbuttons (scrolling up, scrolling down)
7	Reset pushbutton (sealable)
8	Infrared communication port, with metallic ring
9	RS485 serial communication ports (external modem/read out)
10	RS232 serial communication port (External modem / gateway)
11	Terminal cover switch
12	LED1: Active power LED (kWh)
13	LED2: Reactive power LED (kvarh)
14	LED3: apparent power LED (kVAh) or tamper indicator (manufacturing option)
15	control input connectors
16	pulse input connectors

4.2 Support tools

The configuration of the EM620 meter may be changed at any time using dedicated Windows™ based support tools that typically communicate via the optical port on the front of the meter.

Support tool applications provide the following main features:

- metering point management
- configuration creation and editing
- configuration programming and reading
- meter data reading
- meter firmware upgrading

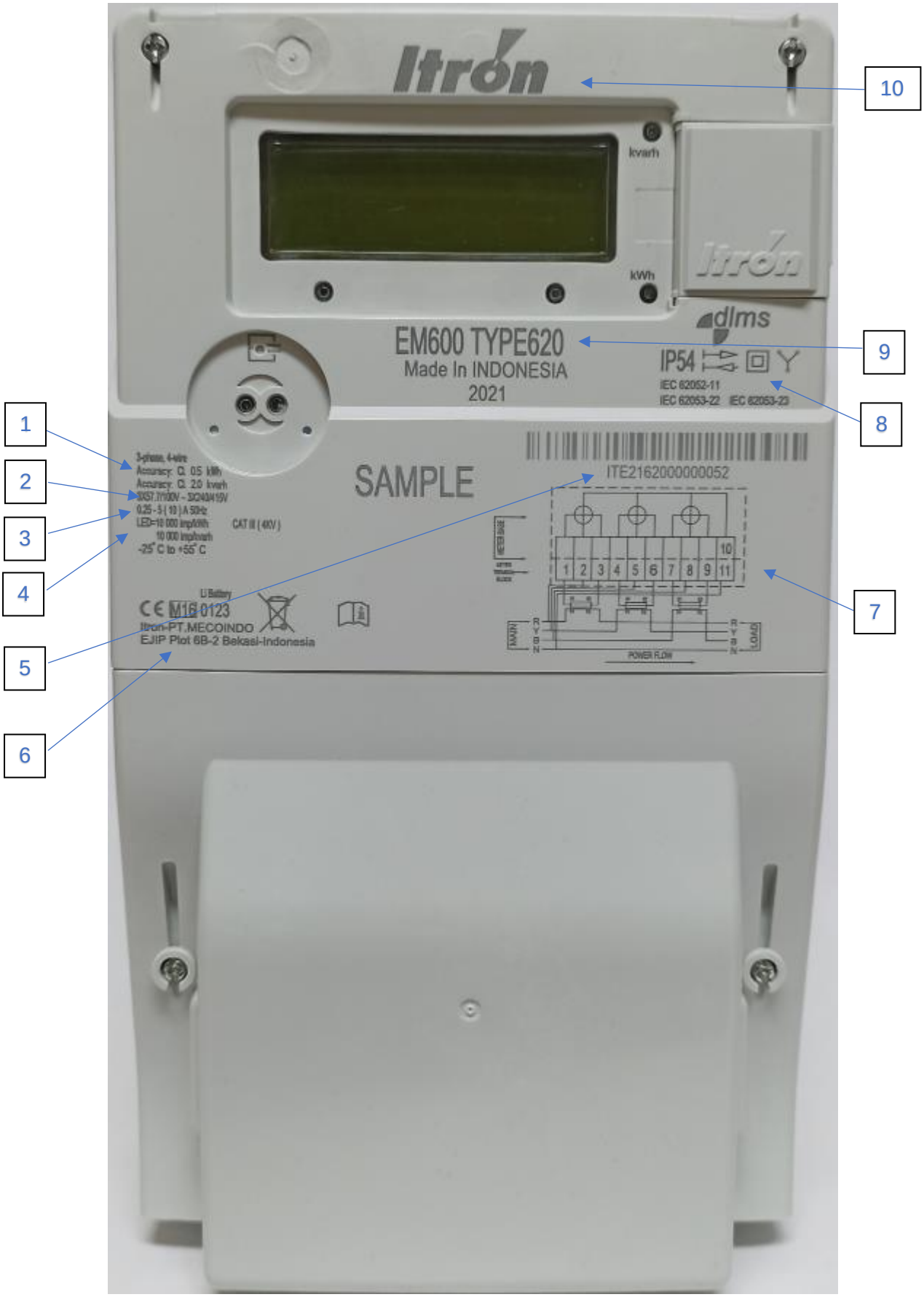
The following support tools are currently available: **ACE Pilot 7.5.0 and later versions.**

ACE Pilot is compliant with the following Microsoft Windows™ operating systems: Window 7, Windows 10.

4.3 Markings

The meter cover is laser-marked with at least the information illustrated below, in accordance with IEC 62053-52. Additional markings may be present, and the layout of the markings will vary, according to the meter configuration and specific customer requirements.

An example of laser-marked nameplate is shown below:


Itron
kvarh
kWh
itron
dlms
EM600 TYPE620
Made In INDONESIA
2021
IP54
IEC 62052-11
IEC 62053-22 IEC 62053-23
SAMPLE
ITE2162000000052
3-phase, 4-wire
Accuracy: Cl. 0.5 kWh
Accuracy: Cl. 2.0 kvarh
3X57.7/100V ~ 3X240/415V
0.25 - 5 (10) A 50Hz
LED=10 000 imp/kWh
10 000 imp/kvarh
-25° C to +55° C
CAT III (4KV)
M16 0123
Itron-PT.MECOINDO
EJIP Plot 6B-2 Bekasi-Indonesia
1 2 3 4 5 6 7 8 9 10 11
MAIN
LOAD
POWER FLOW
1
2
3
4
5
6
7
8
9
10

1	Appropriate certifications identifying accuracy class
2	Nominal voltage
3	Nominal and maximum current, nominal frequency
4	Metrology constant
5	Meter serial number: 1-D barcode (code 128) and numerical format
6	Place of manufacture
7	Connection diagram showing typical main supply connections for the meter configuration
8	Appropriate symbols (IEC 62053-52) identifying insulation class, measuring elements, and other relevant characteristics
9	Meter type
10	Manufacturer name

Warning triangle and hazardous icon is marked under the terminal cover

Main terminal numbering corresponding to the connection diagram is laser-printed on the terminal cover. Any terminal numbering will be in accordance with the relevant DIN standard unless alternative custom numbering is requested.

Other terminals numbering (such as pulse output, relay…) is laser printed on the meter cover.

4.4 Supported use cases

Meter is developed according to Itron Companion Specification (ICS), based on IDIS. The following use cases are supported by the meter:

UC #	Use Case Name	Sub use cases	Purpose	IDIS Use Case
01	Data Collection	On Demand reading, End of Billing Data reading Load profile reading Instantaneous data reading	This collection can happen on demand or per a schedule either remotely or locally. Process of reading regularly the meter for any purpose. Process of collecting load profile, billing data.	UC3, UC4

02	Disconnection and Reconnection	On demand disconnection / reconnection Scheduled disconnection / reconnection	Process of disconnecting or reconnecting the load of a meter. This includes local and remote operations. Load limitation, Connection/ Disconnection, Load shedding, Unpaid situations	UC5
03	Clock management	Clock setting involvement DST management	Process of adjusting the internal clock of the electricity meter	UC6
04	Meter Configuration	TOU tariff programming Local customer interface configuration Display List configuration and message Disconnection mode configuration (reconnection with or without user intervention, local / manual disconnection enablement	Process of programming the functional parameters of the Electricity meter.	UC2, UC11
05	Firmware Update	Image transfer Scheduled Image activation On demand image activation Firmware versions management	Process of downloading, verifying and activating new firmware on the electricity meter.	UC9
06	Alarms and Events	Alarm notification, Logbooks collection Error management	Process of reading the meter for monitoring purposes (Meter supervision) Process of collecting and receiving event / error and alarm in real time from a meter. Process of acknowledging and clearing the alarms	UC7, UC10, UC12
07	Load Management by relay	Excess demand management, Load management	Process of connecting or disconnecting the load controlled by an auxiliary relay.	UC8
08	Local consumer Interface Activation and Deactivation	Local customer interface enablement and disablement	Process of enabling or disabling consumer interface on the Electricity meter.	UC13
09	Local communication Interface protection	Local Communication port Enablement and disablement	Process of protecting the local port of the Electricity meter.	UC13
10	Meter Registration	Meter serial number reading Meter identification parameters	Process of retrieving the meter identity and capabilities during registration and commissioning.	UC1

11	Security	Changing the security policy Key changes	Process of enabling the security suite, increasing the security policy and changing the security credentials of the Electricity meter.	N/A
12	Power Quality	Power Quality Data	Process of monitoring the quality of supply	UC7
13	Function control	Opt in/out on consumption profile Enable/Disable Comms for optical interface	Process of enabling/disabling functionalities in the meter based on user request.	UC13

CHAPTER 5
Technical specification

5.1 General

	Description
Manufaturer	ITRON
Meter type	EM620
Connection wiring	4 wires for DC variant 3 or 4 wires for CT variant
Connection configuration	Direct Transformer
Terminal wiring	VDE (asymmetrical) or USE (symmetrical)
Metering	Four quadrants
Metrology sensors	Current transformers
Metrology accuracy (active)	Class 1 or 0.5 (DC variant) i.a.w. IEC62053-21, -22 Class 0.2, 0.5 or 1 (CT variant) i.a.w. IEC62053-22 Class B and C i.a.w. EN50470-1 and EN50470-3
Reactive Energy Accuracy	Class 1 / Class 2 i.a.w. IEC62053-23, -24

5.2 Voltage

	Description
Reference voltage (Un)	57,7/100Vac to 277/480Vac
Operating voltage	-20% to +15% Un
Voltage Interruptions	0,5 second
High voltage withstands	3 x 500/865Vac during 10 s for ruggedized Power supply unit (manufacturing option)
Nominal frequency	50 or 60 Hz (-2% to +2%)

5.3 Direct current connection

	Description
Current rating Ib(Imax)	5(100)A
Starting current (class 1)	Ib /250

5.4 Transformer current connection

	Description
Current rating Ib(Imax)	1(10)A
Starting current (class 0.5 & 0.2)	Ib / 1000
Starting current (Class 1)	Ib / 500

5.5 Voltage circuit power consumption

	Description
Voltage circuit per phase	< 2 W (1.1W)
Burden per phase at Un	< 10 VA (2.1VA)
Burden per phase with communication device	< 3 W as per IEC62053-61

5.6 Current circuit power consumption

	Description
Burden per phase at In	< 0.5 VA (0.001VA)

5.7 Display

	Description	Details
Type	Liquid Crystal Display (LCD)	Dot matrix display
Value field	Digit height	12 mm
	Digit width	5 mm
	Space between digits	1.4 mm
	Number of digit	9
Identification (obis) field	Digit height	8 mm
	Digit width	4.5 mm
	Space between digits	1.4mm
	Number of digit	14

5.8 Communications

	Description	Details
Metrology LEDs	Direct	1000 pulses per kWh / kvarh
	Current transformer	10000 pulses per kWh / kvarh
Optical port	i.a.w IEC62056-21 mode E	Up to 19 200 bps
Serial ports	RS485 interface for modem connection or readout (e.g. IHD)	2 x RJ45 connectors for daisy-chaining topology. Up to 115 200 bps.

	RS232 interface for modem connection or Gen5 NIC (option)	1 x RJ45 connector. Up to 115 200 bps.
Protocols	DLMS/COSEM over HDLC	i.a.w IEC62056-42,46,53,61 & 62
Physical link	Supported by external modem	Ethernet, cellular (CSD, GPRS, 3G, LTE), Gen5 NIC
Modem supply	12V (-/+5%), 8W max.	Available on RJ45 connectors

5.9 Pulse outputs

	Description	**Details**
Number of outputs	4	
Number of common connection	1	
Standard	IEC62053-31	
Pulse duration (Toff / Ton)	30 ms	
Pulse logic	Negative or positive	0 (closed), 1 (open)

5.10 Pulse inputs

	Description	**Details**
Number of inputs	2	
Number of common connection	1	
Standard	IEC62053-31	
Pulse duration (Toff / Ton)	30 ms	
Max switching current	30mA	
Impedance	1kΩ	
Maximum switching voltage	27VDC	

5.11 Auxiliary relay

	Description	**Details**
Number of relay	1	
Type	Latching, normally open	
Admissible intensity	8A at 250 Vac	Switching power: 1,25 kVA
Rated operating voltage (Ue)	250Vac	
Rated operating current (Ie)	1A	
Maximum total current (Itot)	8A	
Bounce free	Yes	

Isolation	5kV

5.12 Control output

	Description	**Details**
Number of outputs	4	
Number of common connection	1	
Maximum switching voltage	400VAC/VDC	
Maximum switching current	100mA	
Maximum power rating	23VA	
Energy pulse output	Configurable from 10ms to 1s	

5.13 Control input

	Description	**Details**
Number of inputs	2	
Number of common connection	1	
Maximum input voltage	288VDC 300VAC	
Maximum input current	3mA	

5.14 Environmental

	Description	**Details**
Temperature range	Limit range of operation	-40°C to +75°C
	Limit range of storage and transport	-40°C to +85°C
Humidity range	Relative humidity	95% (i.a.w IEC62052-11)
Environmental protection	IP54	
Isolation protection	Class II	
Impulse voltage immunity	6 kV based on IEC62052-11, 12kV acc. SPM1618.	
Surge immunity (main circuit)	6 kV	
Surge immunity (auxiliary circuit)	4 kV	
Electromagnetic immunity	Magnetic field up to 1.2T, all faces (with optional shield)	
	Magnetic field immunity: 200mT without shield	

5.15 Weight and dimensions

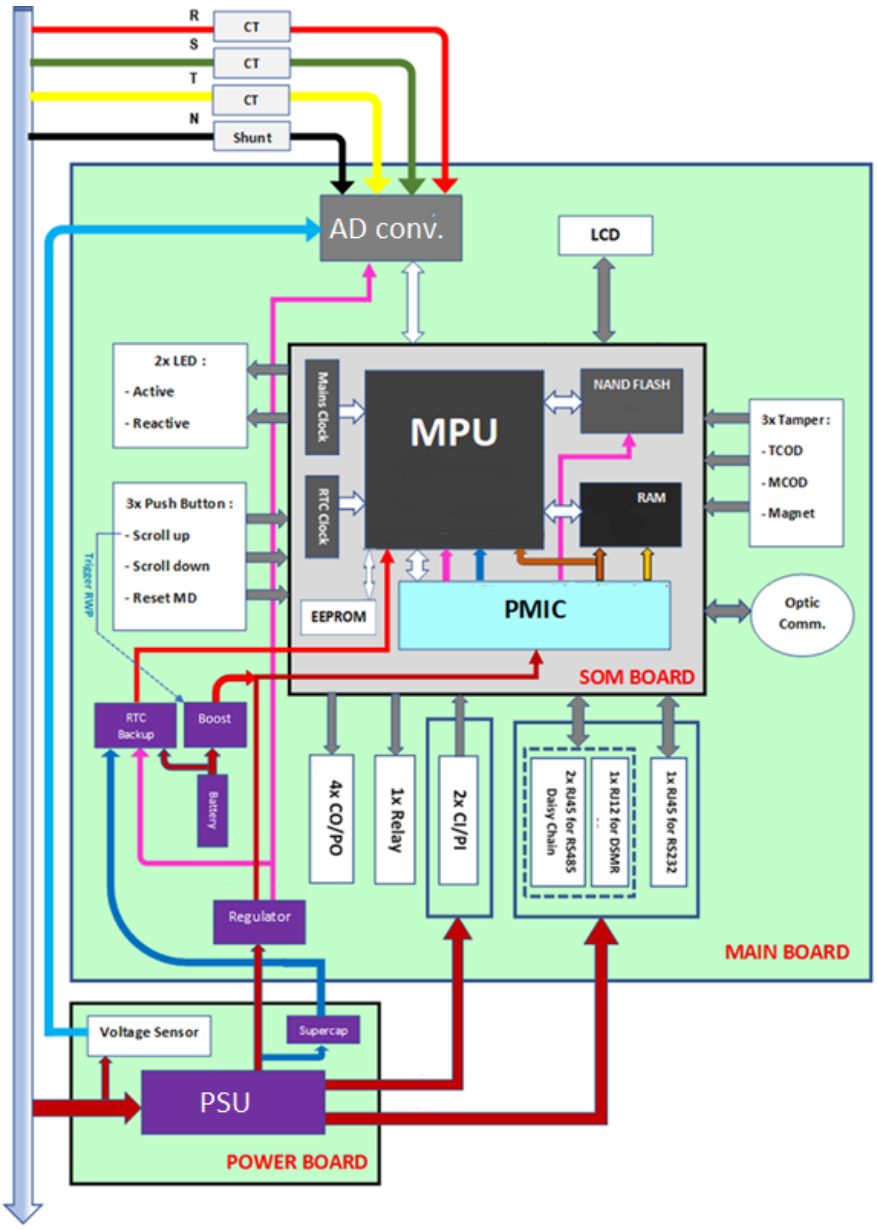
	Description	Details
Weight	1,7 kg	
Dimensions (width x height x depth)	165 x 232 x 84 mm	meter body
	165 x 232 x 84 mm	With short TC
	165 x 300 x 93.5 mm	With long TC
	165 x 250 x 110,5 mm	With short TC including modem fixing

CHAPTER 6
Functional description

The design of the EM620 meter is decomposed into 3 main components:

- the PSU (Power Supply Unit), managing the energy supply of the internal circuitry and energy back-up storage.
- the CPU (Central Processing Unit – SOM board), containing all circuitry including metrology front-end, microcontroller, memory devices
- the communication unit (main board) including all the circuitry to manage the difference communication interfaces, and various I/O (e.g. LCD…).

The block diagram below shows the main functional elements of the meter:



This chapter provides technical details on the different functions and features of the EM620 meter.

6.1 Meter identification

The meter includes many information fields available for reading to identify clearly the product.

6.1.1 Type

The meter type identifies the product and is used for certification and approval purposes. It is also used as a prefix in the Itron logical device name

It is a 6-characters (visible) string using manufacturer flag identifier ('ITE' for Itron Electricity) as a prefix:

- I T E 6 2 0 EM600 meter type 620

6.1.2 Model

The meter model gives information on the main hardware parameters that have been configured during the factory process:

It is an 18-characters (visible) string providing the following information:

	Details
Nominal mains frequency	50 Hz or 60 Hz
Connection topology	3 wires or 4 wires
Connection type	CT or DC
Metrology class (active energy)	Class 0.2, class 0.5 or class 1
Terminal block	Asymmetric (VDE) or Symmetric (USE)
Communication ports	None or RS485 for modem connection port None or RS485 for readout port or RS232
Tampering shield (option)	Additional protection for magnet immunity
Inputs / Outputs	None or up to 4 pulse outputs None or up to 2 pulse inputs None or up to 4 control outputs None or up to 2 control inputs Load switch: none or 1 auxiliary relay
Read Without Power (RWP)	Yes / No
Power supply	Ruggedized / not ruggedized Coated/ non coated
IPlink (DC variant only)	Internal / external
Neutral sensor (DC variant only)	Yes / No

6.1.3 Firmware version

The firmware version identifies the metrological and applicative softwares which are currently active in the meter:

It is a string including field separators (space, dot…):

Vxxvv

xx: major firmware version (from 1 to 9), increasing when a significant change is implemented

vv: minor firmware version (from 00 to 99), increasing when a fix / small evolution is implemented

6.1.4 Serial number (COSEM logical device name)

The serial number is programmed in the meter during the factory process and appears on the meter nameplate (typically marked along with the bar code). The range of numbers may be specified by the utility along with a manufacturing order.

It is a 16-characters (visible) string and this number also used to identify the name of the unique COSEM logical device implemented in the meter. Below is a typical structure of serial number programming.

ITEYYMMMxxxxxxxx

ITE manufacturer flag identifier (3 characters)

YY year of manufacturing (2 characters)

MMM meter model (3 characters)

xxxxxxxx meter number (8 characters)

The 8-characters identifying the meter number can also be read separately.

6.2 Firmware upgrade

The EM620 meter supports a secure process to upgrade the embedded software (firmware) while the meter is still operating. The upgrade mechanism can be performed locally through the optical port or remotely through the external modem.

The firmware update is performed by the customer himself, but on the agreement of the manufacturer (i.e. the new firmware has been validated by the manufacturer and is ready to be deployed). A parameter can be configured by the customer to enable or disable this function.

The mechanism used to update a firmware follows the process described in the *DLMS/COSEM Bluebook*. It is separated in 4 consecutive stages (initiate, transfer, verify and activate) requested by the utility.

6.2.1 Stage 1: initiate image transfer

The first step consists in initializing the transfer process in order to define the image target that must be updated. The target identification transmitted to the meter is defined with an “image size” and an “image identifier”, that follows a specific format defined by ITRON.

6.2.2 Stage 2: transfer image

The second step consists in transferring the new image code into the meter. The image is split and sent in many blocks of identical size (except the block containing the last part of the image that could be smaller). Each block is either saved by the meter. The blocks can be received in any order because each block is identified with a number.

The image transfer is completed when all the blocks have been received by the application (which can be checked by reading a blocks status). The meter automatically triggers the next stage (verify image) when it has received the last missing block of the image.

Note: The new image consists in a secure binary file (ciphered and authenticated).

6.2.3 Stage 3: verify image

The third step consists in verifying the integrity and authenticity of the new image code received by the meter, preventing the unintentional or malicious introduction of corrupted firmware. This is done by checking a cryptographic signature located at the end of the image. The algorithm used for signature calculation is chosen by ITRON.

When the signature is not correct, it is not possible to complete the firmware update process.

When the signature is correct, the fourth and final stage can be executed.

6.2.4 Stage 4: activate image

At this stage, the new executable code has been downloaded, verified and is now waiting to be installed. The activation can be scheduled by the customer on a specific date and time or executed immediately by command.

The activation process requires the meter to stop operating in order to update the code of the microcontroller. Then, the firmware is restarted.

6.3 Metrology

The meter current sensors are Current Transformers, providing a non-derivative effect on the waveforms.

The three current sensors generate a signal per phase that is proportional to the instantaneous current, while voltage signals are derived by dividing the distribution-network line voltages through a resistive divider.

The current and voltage input signals are sampled and digitized at 8 kHz frequency (i.e. every 125 µs) by an analogue to digital (A-to-D) converter, then processed by a microcontroller to compute various energy values. The microcontroller records these values in a suite of registers that are independent of any meter configuration and are always available.

These registers accumulate their respective energy values in an incremental way, until they reach the register limit of 2^32 Wh/varh/VAh. At that point they are automatically reset to zero and an event is recorded.

The contents of these registers can be displayed at any time as instantaneous values on the meter LCD.

Visible metrology pulses proportional to active and reactive energy consumption are provided via two LED indicators. These indicators flash in accordance with the metrological constant marked on the front of the meter (imp/kWh or imp/kvarh or imp/kVAh).

The metrology LED outputs comply with IEC 62053-21 and are used for metrological verification and meter accuracy testing.

A low-pass filter with cutoff frequency at 2kHz is introduced on the I and V measurement channels. These filters make the metrology resistant against High Frequency (HF) currents superimposed on nominal currents and added harmonic currents, and also resistant against HF voltage superimposed on nominal voltages and added harmonic voltages. This HF resistance is relative to the frequency domain from 2kHz to 150kHz.

6.4 Power supply

6.4.1 Main supply

Power for the meter's internal electronics is provided by a three-phase switched-mode PSU, supplied from the measured distribution-network voltages. To maintain meter accuracy in both 3 and 4 wire configurations, the power supply can tolerate any of the following network failure conditions:

4 wire systems

- missing one or two phases
- missing neutral or neutral and one phase
- inversion of one phase and neutral

3 wire systems

- missing one phase

The power supply has enough reserve energy to withstand three-phase power outages up to 0.5 seconds.

On power failure occurrence, the unit unconditionally maintains sufficient energy for all critical data to be saved to non-volatile memory.

6.4.2 Reading without power (RWP)

The meter can be factory-fitted with an option that allows meter reading even when main network power is missing. The Read Without Power (RWP) mode provides the ability to display all the meter data and events/alarms logging even if the meter is not powered by the main power supply.

The energy storage for this function is provided by a the 1/2AA battery (replaceable cylinder battery type 1/2AA, 3.6 V, 1200mAh). The expected battery life is 20 years based on a typical usage cycle of 12 x 5 minutes readings a year.

An RWP session is initialized with a long push on the scroll-up pushbutton. Wake up process is achieved in less than 2s. During an RWP session, only the following functions are enabled to reduce power consumption to the minimum and save energy storage:

- Real time clock
- Display (except the backlight which is disabled) and push buttons management

The RWP session is automatically closed after 5-minutes.

6.4.3 Data retention

In the event of a continuous absence of power, the meter data is saved in a non-volatile memory, with a retention time of at least 10 years without supply from any backup power.

The contents of the non-volatile memory are regularly checked with checksum markers and an error flag is raised if data corruption is detected. Moreover, for security purpose, sensitive data are ciphered in non-volatile memory.

6.5 Real-time clock

6.5.1 Principle

The meter incorporates a Real-Time Clock (RTC) to facilitate date and time-based energy rate switching, interval measurement and time stamping of events.

The frequency source for RTC calculation is provided by a crystal. The quartz crystal is temperature-compensated to ensure accuracy over the operating range of the meter.

The internal time of the meter provides the following local time information according to the Gregorian calendar: year, month, day of month (leap year is covered), day of week, hour, minute, second.

The local time of the meter can be adjusted / programmed at any time through the optical port or remotely by the HES.

The RTC meets the requirements for IEC 62052-21 and IEC 62054-21 time-switches for metering.

(5PPM RTC accuracy at reference temperature of 22 °C)

6.5.2 Daylight Saving Time (DST)

The meter can be programmed to enable seasonally-based changes in local time, generally referred to as Daylight Saving Time (DST) or Summer Time.

When this option is enabled, the meter clock will be adjusted twice each year by an offset, configurable in minutes (up to 120 min). The DST transitions date-time (from normal to summer time, and from summer to normal time) can be programmed to allow for use in both the Northern and Southern hemispheres and accommodate the different rules that apply in different countries

6.5.3 Energy back-up

To ensure the real-time clock (and the cover opening detectors) are maintained during periods of power failure, the meter is equipped with a backup power supply comprising:

- Super-capacitor (optional)
  An internal device specified to provide a minimum capacity of 7-days power outage carry-over period. (power outage carry-over period at 23°c)

- Lithium battery (1/2AA, 3,6V)

A field-replaceable device, specified to provide a minimum capacity of 10 years continuous operation at 25°C and a minimum shelf-life of 20 years, with less than 10% loss of capacity due to self-discharge at 25°C.

The battery can be replaced without any interruption to meter operation.

An icon on the LCD is reserved to indicate the battery voltage level. Moreover, when the battery falls below a pre-set threshold value, an error flag is raised to notify that the battery must be replaced.

Note: During a power failure, the super-capacitor is the first backup device to be drained.

If the real-time clock is detected as "lost" when the meter is power-up (potentially due to energy back-up discharged or disconnected), an error flag is raised, and the meter clock is automatically reset to the 01/01/2000 00h00.

6.6 Calendar (Time Of Use)

6.6.1 Principle

The calendar provides a flexible and configurable switching scheme that handles up to rate switches per day. The calendar can also apply different energy rate regimes during different seasons of the year and on designated individual days.

The application supports a single calendar (called *activity calendar*), for the utility to define period of time during which some registers are activated:

- the energies measured are recorded in separate registers, called *energy rates registers*,
- the demands calculated are recorded in separate registers, called *demand rates registers*,
- the maximum demands calculated are recorded in separate registers, called *maximum demand rates registers*,

As the activity calendar is composed of many parameters, its configuration is managed using a switch between a passive calendar and an active calendar. This is to ensure that all the parameters are applied at the same time.

First, all the parameters of the passive calendar must be programmed, and then an activation process is triggered either on command request or on scheduled date-time. During the activation process, the passive calendar becomes effective (all the parameters are copied from the passive to the active calendar). Consequently, the parameters of the active calendar are read-only.

This feature accommodates any contractually agreed energy rate changes and automatically applies them when they are due to come into force.

6.6.2 Energy rate switching

The contract between the customer and the utility will usually specify how many energy rates are available and at what times of the day these rates can be applied. These energy rate regimes are known as tariffs. The meter can support up to 8 different tariffs.

Number of tariffs are defined and downloaded to the meter using the meter support tool or the remote Head-End System (HES).

A tariff specifies a set of energy and demand rates for one energy quantity and only energy registers associated with those rates are updated; all other energy registers are not modified. For billing purposes, each tariff can be associated to an energy cost.

The real-time clock and calendar enable the meter to perform Time-Of-Use (TOU) energy rate switching under control of these programmable tariff regimes.

6.6.3 Seasons

The meter supports up to 6 seasons per year, for which different tariff schemes can be programmed. These seasons are defined by start dates, which can be set individually.

The start date of the first tariff season is always defined as 1st of January.

The following example illustrates four individually configured seasons:

Season	Starting date
1	01/01
2	01/04
3	01/07
4	01/09
5	01/11

6.6.4 Week profiles

A week profile is always associated with a season and contains a collection of seven individually-defined day profiles (Monday through to Sunday). Consequently, up to 6 week profiles can be configured.

The following example illustrates individual weekly profiles for five seasons

Season	Mon	Tue	Wed	Thu	Fri	Sat	Sun
1	DP1	DP1	DP1	DP1	DP1	DP1	DP4
2	DP2	DP2	DP2	DP2	DP2	DP2	DP4
3	DP3	DP3	DP3	DP3	DP3	DP3	DP5
4	DP2	DP2	DP2	DP2	DP2	DP2	DP4
5	DP1	DP1	DP1	DP1	DP1	DP1	DP4

6.6.5 Day profiles

Each Day Profile (DP) enables the tariff rate to be changed (switched) up to 12 times over a 24-hour period. Each tariff rate switch has a pre-configured ***script selector*** associated with it and a switching-time resolution of 1 minute.

Up to 8 individual day profiles can be defined with a total usage limit of 12 switching-time operations.

The meter will apply the same day profile every day unless the tariff specifies different profiles for weekends, special days and different seasons. The start time of a day profile is always defined as 00:00.

The following example illustrates 5 daily profiles with 7 switching-times:

Profile	TS1	TS2	TS3	TS4	TS5	TS6	TS7
1	00:00 [3]	06:00 [2]	09:00 [1]	11:00 [2]	18:00 [1]	20:00 [2]	20:00 [3]
2	00:00 [3]	06:00 [2]	22:00 [3]				
3	00:00 [5]	06:00 [4]	22:00 [5]				
4	00:00 [3]						
5	00:00 [5]						

Note: The numbers in enclosed brackets, e.g. [3], show the associated script selector.

6.6.6 Script selectors

The specified tariffs define the energy and demand rates being used by the meter. A script selector identifies a *mask*, which is a combination of energy and demand registers that are activated during a period defined in the calendar.

8 masks are available to activate the 8 available rates for all the registers which depend on the tariff (energy, demand). Only one register activation is available for all quantity types. Refer to section "TOU registers".

Note: At any one time, only one mask (so, tariff rate) is active. The active rate number is visible on the display.

6.6.7 Special days

The special days facility is intended to allow energy consumption charges on any locally-significant days, such as religious or public holidays, to be different from the rest of the week in which they occur.

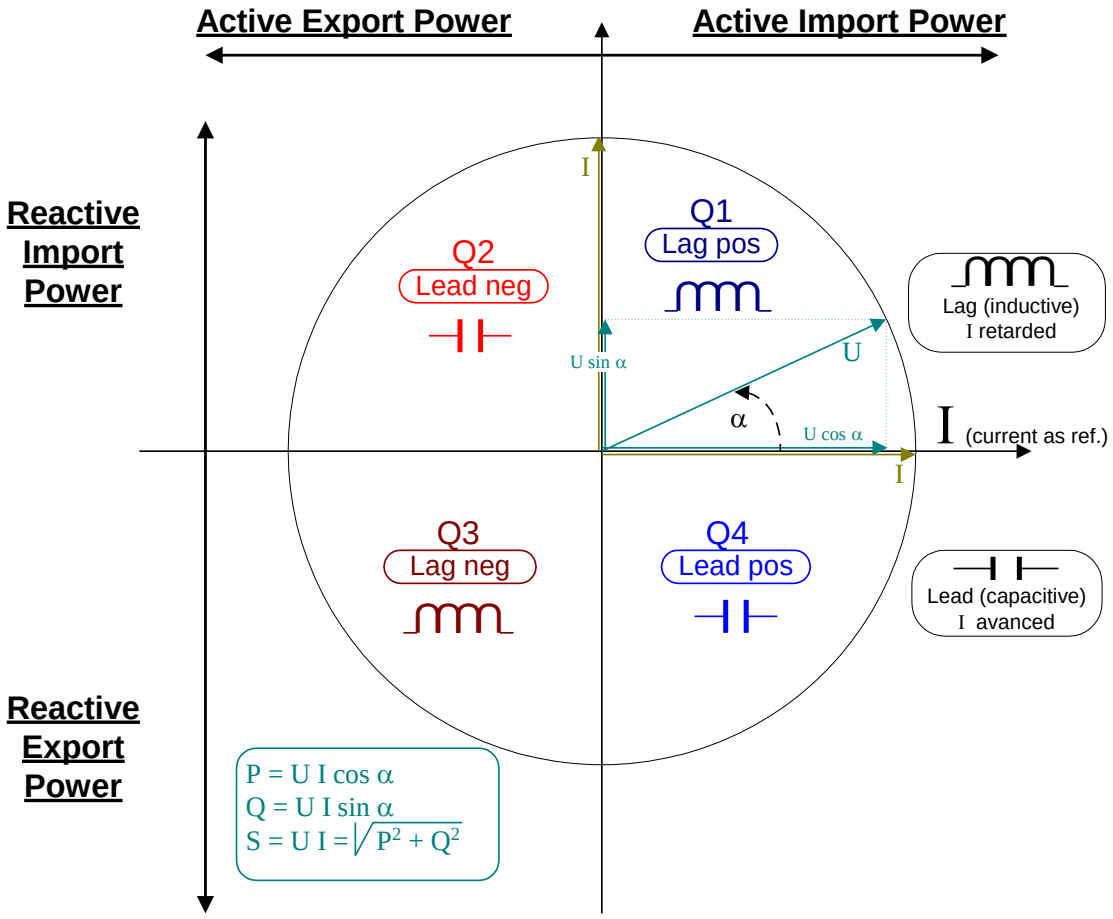
The meter can accommodate up to 45 entries (regular and irregular holidays) in an internal special days list. Each entry can have a different day profile (DP) applied.

- **Regular (generic date)**: these allow different day profiles to be applied on fixed dates during the year. The same dates will be used for all subsequent years.
- **Non-regular (fixed date)**: these allow a different day profile to be applied on a specific day. Each non-repetitive entry is completely independent and when the last entry is reached it will be necessary to reprogram the meter with new values.

6.7 Metering quantities

6.7.1 Four quadrant measurements

The meter measures various energy values or quantities, in all four quadrants of the AC waveform.



6.7.2 Total energies registers (TER)

The following energy quantities are updated every 1 second and recorded in a series of total energy registers (TER), dedicated to store the total accumulation of an energy quantity since the origin the meter (manufacturing). These energy registers (TER) are:

- independent of any tariff switching or calendar definition
- not reset at the end of a billing period
- not programmable

	Phase	Quadrant	Direction	Resolution
Active energy (8 registers)	Aggregate	-	Import	Wh
	Aggregate	-	Export	Wh
	L1	-	Import	Wh
	L1	-	Export	Wh
	L2	-	Import	Wh

	L2	-	Export	Wh
	L3	-	Import	Wh
	L3	-	Export	Wh
Reactive energy (24 registers)	Aggregate	-	Import	varh
	Aggregate	-	Export	varh
	L1	-	Import	varh
	L1	-	Export	varh
	L2	-	Import	varh
	L2	-	Export	varh
	L3	-	Import	varh
	L3	-	Export	varh
	Aggregate	Q1	-	varh
	Aggregate	Q2	-	varh
	Aggregate	Q3	-	varh
	Aggregate	Q4	-	varh
	L1	Q1	-	varh
	L1	Q2	-	varh
	L1	Q3	-	varh
	L1	Q4	-	varh
	L2	Q1	-	varh
	L2	Q2	-	varh
	L2	Q3	-	varh
	L2	Q4	-	varh
	L3	Q1	-	varh
	L3	Q2	-	varh
	L3	Q3	-	varh
	L3	Q4	-	varh
Apparent energy (8 registers)	Aggregate	-	Import	VAh
	Aggregate	-	Export	VAh
	L1	-	Import	VAh
	L1	-	Export	VAh
	L2	-	Import	VAh
	L2	-	Export	VAh
	L3	-	Import	VAh
	L3	-	Export	VAh

Note: Apparent energy is calculated by one of the following methods (configurable in the meter)

Arithmetical: multiplication of the RMS voltage and current values => S = Urms x Irms

Vectoral: quadratic sum of active and reactive powers => $S = P^2 + Q^2$

6.7.3 Total demand registers

The contract between the customer and the utility company may specify certain energy demand limitations. Meter-based demand registering is a convenient way for both the customer and the utility to monitor energy consumption.

6.7.3.1 Demand channels

The meter can register with up to 24 independent demand channels:

	Phase	Quadrant	Direction	Resolution
Active demand	Aggregate	-	Import	W
	Aggregate	-	Export	W
	L1		Import	W
	L1		Export	W
	L2		Import	W
	L2		Export	W
	L3		Import	W
	L3		Export	W
Reactive demand	Aggregate	-	Import	var
	Aggregate	-	Export	var
	L1		Import	var
	L1		Export	var
	L2		Import	var
	L2		Export	var
	L3		Import	var
	L3		Export	var
Apparent demand	Aggregate	-	Import	VA
	Aggregate	-	Export	VA
	L1		Import	VA
	L1		Export	VA
	L2		Import	VA
	L2		Export	VA
	L3		Import	VA
	L3		Export	VA

Note: tariffs can be applied to these channel and demand rates registers are managed for this purpose. Refer to section "TOU registers".

The demand registers are dedicated to record the average energy demand over a configurable duration, known as the *integration period*.

6.7.3.2 Demand calculation (integration period)

Calculating demand over a period of time helps avoid any short peak values (typically, transients caused by starting heavy inductive loads) from affecting the calculation.

The integration period is defined by:

- a programmable duration: 5, 10, 15, 30 or 60 minutes
- a programmable operation mode: fixed (or block) mode or sliding mode

Note: the meter applies the selected mode and duration value across all demand channels.

During the integration period, the *current average value* (or rising value) of each demand channel is updated every second by integrating the energy consumed since the beginning of the period over the total duration of the period.

At the end of each completed integration period (EOI), also equivalent to the start of new integration period:

- the *last average value* is updated with the *current average value*, and the meter time is snapshot in the *capture time*.
- if the *current average value* is greater than the previous maximum demand value recorded, the new value is time stamped and replaces the previous maximum value.
- the *current average value* is reset to 0 (for the new integration period being started), and the *start time* is set accordingly to indicate the beginning time of the integration period.

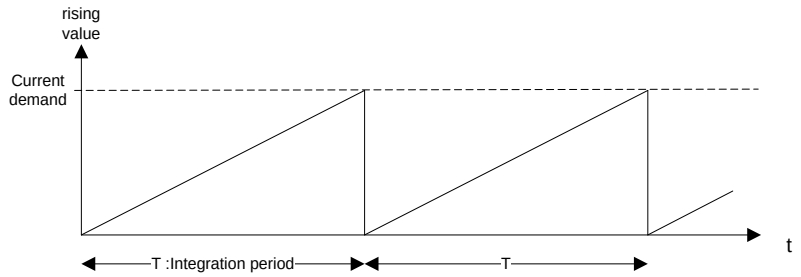
The following table gives an example of *capture time* and *start time* update, considering a sliding integration period of 30 minutes (6 sub-intervals of 5 minutes):

Meter time	Capture time	Start time
09:30	09:30	09:05
09:35	09:35	09.10
09:40	09:40	09.15
09:45	09:45	09.20

6.7.3.2.1 Fixed (block) mode

In the fixed (or block) mode, the demand is calculated over a fixed window period, composed of a single predefined duration value. When a new integration period is triggered, the energy cumulated is reset, so the calculation of rising value starts from zero.

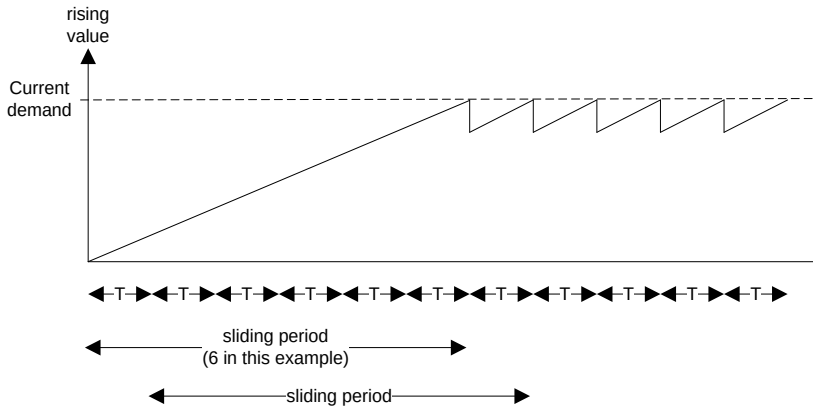
The illustration below shows two successive fixed (or block) integration periods with, considering a constant demand value over the time:



6.7.3.2.2 Sliding mode

In the sliding mode, the demand is calculated over an integration period, divided into 3, 6 or 12 sub-intervals of predefined duration value, known as sliding window. When a new integration period is triggered, the energy cumulated over the integration period is reset, so the calculation of rising value starts from the average of the (n-1) integration period demands over the total duration of the sliding period.

The illustration below shows an example of sliding mode demand period comprising 6 sub-intervals, considering a constant demand value over the time:



6.7.3.2.3 Incomplete period

In typical situation, the end of integration is processed on a complete period, synchronized according to the meter real-time clock. There are some situations where the meter must deal with some use cases resulting in performing a EOI on an incomplete period:

- power outage:
  - if the power outage and recovery occur within the same integration period, the demand calculation is performed at the end of the integration period over the total duration of the period (i.e. including the outage duration).
  - if the power outage and recovery do not occur within the same integration period, the current period is closed with the theoretical time of EOI.
- time setting:
  - if the old and new time are within the same integration period, the demand calculation is performed at the end of the integration period over the total duration of the period (i.e. including the outage duration).
  - if the old and new time are not within the same integration period, the current period is closed with the theoretical time of EOI. Contrary to the power outage occurrence, the intermediate values for the sliding window calculation are not completed because no operating time has been lost.

- demand parameters setting:
    - the current period is closed, and the demand calculation is performed with the with the theoretical time of EOI. The intermediate values for the sliding window calculation are cleared.

6.7.3.3 Maximum demand calculation

For all demand channels and rates, the meter maintains separate registers to store maximum demand value, associated with the timestamp, reached during a billing period. The maximum demand registers are cleared at the end of the billing period (EOB occurrence).

6.7.4 TOU registers (rates registers)

The meter can be programmed to record the consumption of tariff-based quantities in up to 248 individual rates registers: 88 energy rate registers, 108 max demand registers (80 max demand rate registers, 10 MD aggregate, 18 Max demand/phase), 80 Demand rate registers, 28 excess demand registers.

Channels	Rate	Resolution
Active import energy (8 registers)	1 to 8	Wh
Active export energy (8 registers)	1 to 8	Wh
Reactive import energy (8 registers)	1 to 8	varh
Reactive export energy (8 registers)	1 to 8	varh
Reactive Q1 energy (8 registers)	1 to 8	varh
Reactive Q2 energy (8 registers)	1 to 8	varh
Reactive Q3 energy (8 registers)	1 to 8	varh
Reactive Q4 energy (8 registers)	1 to 8	varh
Apparent import energy (8 registers)	1 to 8	VAh
Apparent export energy (8 registers)	1 to 8	VAh
Total active absolute aggregate energy	1 to 8	Wh
Active import demand (8 registers)	1 to 8	W
Active export demand (8 registers)	1 to 8	W
Reactive import demand (8 registers)	1 to 8	var
Reactive export demand (8 registers)	1 to 8	var
Apparent import demand (8 registers)	1 to 8	VA
Apparent export demand (8 registers)	1 to 8	VA

The above rate registers are programmed in a *mask* to manage tariff rate switching during the day in accordance with the configured calendar scheme. Refer to section "Script selectors".

Consequently, the configuration of these registers assignment shall be done accordingly with the calendar configuration.

NOTE: along with the assignment of demand rate registers, maximum demand rate registers are also recorded.

6.7.5 Instantaneous power quality data

To help monitoring the quality of the network, the meter provides various instantaneous quantities, measured and updated every 1 second (except for THD calculation):

	Phase	**Quadrant**	**Direction**	**Resolution**
RMS voltages (3 quantities)	L1	-	-	Unit to 10^{-3} V
	L2	-	-	Unit to 10^{-3} V
	L3	-	-	Unit to 10^{-3} V
RMS currents (3 quantities)	L1	-	-	Unit to 10^{-3} A
	L2	-	-	Unit to 10^{-3} A
	L3	-	-	Unit to 10^{-3} A
THD voltages (3 quantities)	L1	-	-	%
	L2	-	-	%
	L3	-	-	%
THD currents (3 quantities)	L1	-	-	%
	L2	-	-	%
	L3	-	-	%
Phases angles (12 quantities)	L1 (U – I)	-	-	1°
	L2 (U – I)	-	-	1 °
	L3 (U – I)	-	-	1 °
	U1-N			1°
	U2-N			1°
	U3-N			1°
	I1-I2			1°
	I2-I3			1°
	I3-I1			1°
	U1-U2	-	-	1 °
	U2-U3	-	-	1 °
	U3-U1	-	-	1 °
Mains frequency (1 quantities)	-	-	-	10^{-2} Hz

6.7.6 Power quality profile

The power quality profile records instantaneous RMS voltage(s) and current(s) per phase, upon the occurrence of a sag or a swell or a neutral fault as defined by sag, swell and neutral fault thresholds after filtering time.

	Phase	Quadrant	Direction	Resolution
Power factors (3 quantities)	Aggregate	-	Import	10^{-3}
	L1	-	Import	10^{-3}
	L2	-	Import	10^{-3}
	L3	-	Import	10^{-3}
RMS voltages (3 quantities)	L1	-	-	10^{-2} V
	L2	-	-	10^{-2} V
	L3	-	-	10^{-2} V
RMS currents (3 quantities)	L1	-	-	10^{-2} A
	L2	-	-	10^{-2} A
	L3	-	-	10^{-2} A
Phases angles (3 quantities)	L1 (U – I)	-	-	1 °
	L2 (U – I)	-	-	1 °
	L3 (U – I)	-	-	1 °

6.7.7 Registering modes

EM620 meter contains registers to allow the registering according with the following metrological algorithms:

Algo 1 (Net result)
Algo 2 (Positive aggregate)
Algo 3 (Both sum)
Algo 4 (Anti-fraud)

algo 1(net result)

L1	L2	L3	import	export
1	1	1	3	0
1	1	-1	1	0

Active difference energy register can be used (1.0.16.8.0.255)

algo 2 (positive aggregate)

L1	L2	L3	import	export
1	1	1	3	0
1	1	-1	2	0

Import active energy register can be used (1.0.1.8.0.255)

algo 3 (both sum)

L1	L2	L3	Import	export
1	1	1	3	0
1	1	-1	2	1

Import active energy register (1.0.1.8.0.255) and export active energy register (1.0.2.8.0255) can be used

algo 4 (anti fraud)

L1	L2	L3	import	export
1	1	1	3	0
1	1	-1	3	1

Total absolute energy register (1.0.15.8.0.255) can be used.

6.8 Historical data recording

The meter can be configured to record multiple set of historical data, available at any time for reading locally via optical port or remotely by the HES. The data can be collected in a whole, or in a selected range of time (selective access by range).

All sets of historical data are recorded in circular buffering in a first-in first-out (FIFO) mechanism: in other words, when a set historical data is full, the oldest data recorded is lost and overwritten by the most recent one.

Note: It is important that the utility manages data reading carefully and periodically, before any "old" data are lost.

6.8.1 Daily read data profile

The meter can record energy values snapshot on daily basis. Every day a new snapshot is captured: automatically every day at a configurable time, after a power outage or when a command script is invoked.

The meter can record 40 entries maximum in the energy data daily profile, with 20 channels configurable among following data:

- meter time
- any of total energy registers
- any of TOU apparent, import and export energy registers
- any of TOU apparent, import and export max demand registers

The energy data profile is automatically cleared when its configuration is changed or when selected as part of the 'Global meter reset' command.

6.8.2 Billing data profile (EOB reset)

The meter can record data values necessary for billing purpose at regular intervals, also called *billing period*. The recording process is also called 'EOB reset' and a new snapshot is captured on different action triggers, depending on the option selected for the *reset mode*:

- **automatic reset**: automatically every month on configurable day of month (1st day of each month), at a configurable time (default: 00:00), or when a command script is invoked.
- **manual reset**: manually when the user presses the sealable button.

The EOB reset process automatically invokes a daily auto reset and demand reset.

The meter can record 18 entries maximum in the billing data profile.

Up to 96 channels selected among the following data can be configured in the billing data profile:

- meter time
- Total energy registers (configurable among 42 channels)
- Energy rate registers (configurable among 88 channels)
- Max demand registers (configurable among 108 channels)
- Excess demand registers (configurable among 26 channels)

The billing data profile is automatically cleared when its configuration is changed or when selected as part of the 'Global meter reset' command.

Note: when one or more automatic EOB occurrences is missed due to a power outage or by a time change, an EOB reset is processed when the power is restored or when the new time is set.

A configurable lock-out duration (default: 10 minutes) is triggered after each EOB reset: this is to prevent multiple a repeated data records in short period of time. During the lock-out period, manual and script command to trigger an EOB process are rejected.

6.8.3 Load data profile (interval snapshot)

Load data profile are of interest to both the utility and the end customer as they can help determine which electricity contract and tariff rates may be the most appropriate, based on the consumption profile within the day.

A load data profile is a continuous record of a quantity (a channel) taken over a predefined period (the recording interval). The end of the last record in a day matches with 00:00.

The recording interval value is programmable with following intervals :1, 5, 10, 15, 30, 60, or 1440 minutes and is applied as a common value across all profile channels in the array. In typical situation, this interval value programmed has the same value with the value programmed for the demand integration period: this is to ensure that the capture of demand registers in the load profile is synchronized with demand calculation.

Note: in case of incomplete interval period (due to power outage or time setting), the same rules than for demand calculation apply.

The meter can record 11520 entries maximum in the load profile 1, and 11520 entries maximum in load profile 2: this is equivalent to 120 last days of data registration when the interval value is configured to 15 minutes.

Up to 20 channels in LP1 and 20 channels in LP2 among the following data can be configured in the load data profile:

- meter time
- status information
- any of total energy registers

- any of total demand registers
- RMS voltages
- RMS currents

The load data profile is automatically cleared when its configuration is changed or when selected as part of the 'Global meter reset' command.

6.8.4 Average voltage and current profile

The meter can record average voltage and currents data profile so that the utility can get information about quality of the electrical power.

The recording interval value is programmable with following intervals: 1, 5, 10, 15, 30 or 60 minutes and is applied as a common value across all profile channels in the array.

Note: in case of incomplete interval period (due to power outage or time setting), the same rules than for demand calculation apply.

The meter can record 1152 entries maximum in the average voltages and currents profile: this is equivalent to 8 last days of data registration when the interval value is configured to 10 minutes.

Up to 17 channels selected among the following data can be configured in this profile:

- meter time
- Average voltage per phase
- Average current per phase
- Average THD current per phase
- Average voltage THD per phase
- Average Power Factor per phase
- Instantaneous power factor (import) per phase
- Phase angle Ux-N per phase

The average voltages and current profile is automatically cleared when its configuration is changed or when selected as part of the 'Global meter reset' command.

6.9 Load switch (Auxiliary relay)

6.9.1 Definition

A load switch is an equipment that offers the possibility for the utility to optimize (by controlling or restricting) the electricity power demand at the consumption point, using disconnect and reconnect operations.

EM620 is equipped (optionally) by 1 auxiliary relay, intended to (dis)connect an external circuit breaker or other electrical appliances (e.g. as hot water cylinders, air-conditioners, ventilation systems...)

Warning: The auxiliary relay operates on voltage above 33 V, it has risk to be hazardous live category.

At any time, the current state of the load switch (open / closed) is available with an annunciator icon on the meter display.

Note: this relay supports a latching mechanism so that the position of the load switch is maintained during a power outage.

6.9.2 Operation mode

The load switch can be operated (disconnect / reconnect) in the following situations:

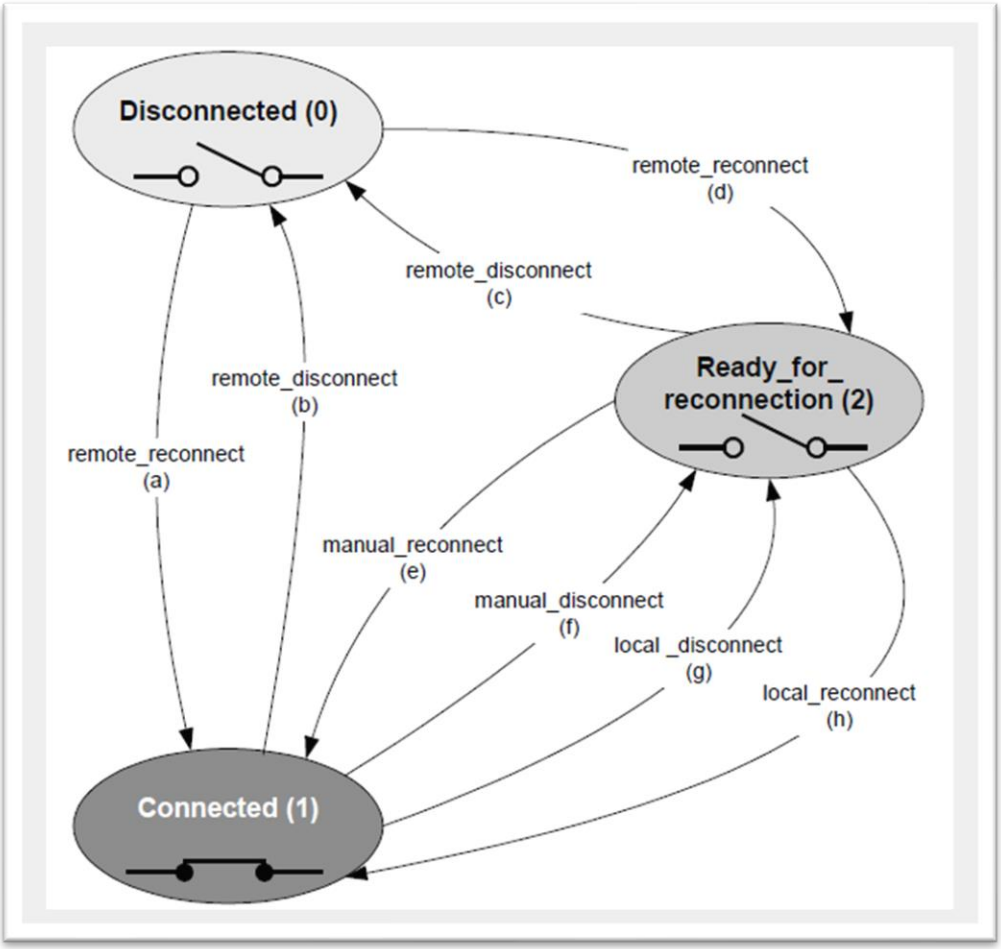
- *remotely*: by the software tool or HES using a command on a communication channel (optical or modem port)
- *locally* (automatically): by a function of the meter using over current limiter.
- *By calendar (automatically):* by a calendar configuration through ACE Pilot (TOU calendar or load management calendar).

Note: for safety reason, if the load switch has been disconnected via command invoke over the optical port, the meter reject any reconnection command received remotely over the modem port.

The triggering source for the load switch operation can be enabled / disabled according to a configuration parameter:

- No trigger sources
- Current over limit only
- Remote control only
- Current over limit and Remote control
- Load Management Calendar control

The meter handles a control state of the load switch which is updated on each operation according to the following state chart and control mode definition (extracted from the *DLMS/COSEM Bluebook*)



control _mode	Disconnection				Reconnection			
	Remote		Manual	Local	Remote		Manual	Local
enum:	(b)	(c)	(f)	(g)	(a)	(d)	(e)	(h)
(0)	–	–	–	–	–	–	–	–
(1)	x	x	x	x	–	x	x	–
(2)	x	x	x	x	x	–	x	–
(3)	x	x	–	x	–	x	x	–
(4)	x	x	–	x	x	–	x	–
(5)	x	x	x	x	–	x	x	x
(6)	x	x	–	x	–	x	x	x

The control mode is used to enable/disable some of the operations and can be configured from mode 0 to 6. The utility must select the appropriate mode according to the use cases.

6.9.3 Limiter operation

When enabled by configuration, the meter can manage automatic disconnection and reconnection of the load switch depending on the instantaneous demand value summed over the 3 phases.

When the instantaneous demand monitored value (can be demand active import but also demand active export, demand reactive import, demand reactive export, demand apparent import or demand apparent export) exceeds a predefined threshold during a configurable duration in minutes, a *local disconnect* operation is triggered by the meter.

When the instantaneous demand value drops below the same threshold during the same duration, a *local reconnect* operation is triggered by the meter (if allowed by the control mode).

6.10 Anti-tamper measures

EM620 integrates some features designed to prevent tampering and assist in the detection of attempted fraud.

6.10.1 Protection

The meter is "secure-by-design", undergoes Security Development Lifecycle (SDL) review, and is subject to penetration testing by a third-party laboratory to confirm its immunity to attack.

The enclosure of the meter, which is mechanically protected against unauthorized access, ensures protection against physical attacks. The terminal cover and the main cover are sealed separately. The main meter (metrology) cover cannot be removed before first removing the terminal cover. The main cover is protected by 2 sealed screws to prevent intruding into the meter and tampering it without removing the seals or damaging the meter casing. Moreover, the internal metrology sensors are protected with shields, so that the metrology function is not disturbed by magnetic fields.

To reduce the fraud attempt and enhance protection against software attacks, a locking mechanism is implemented. In case of 3 consecutive COSEM association failures (due to wrong password usage on any communication port), the meter locks any subsequent communication attempts (by the same COSEM client). The utility can then unlock the mechanism in a secure way.

6.10.2 Tamper attempts detection

In addition to the sealing mechanism, the meter integrates sensors enabling events detection and logging related to the following tamper attempts:

- Opening of metrology (main) cover
- Opening of terminal cover
- Presence of DC magnetic field above 200mT

Note: the sensors for cover opening and terminal cover opening are also active during mains outage.

To prevent from any damage of the internal electronics, the power supply of the external modem is temporary stopped during the detection of magnetic field presence.

6.11 Meter supervision

EM620 integrates some mechanisms able to detects events related to potential abnormal situations, internally to the meter enclosure.

6.11.1 Memory error

The meter integrates a self-diagnostic mechanism to check periodically the integrity of the memories (Read-Only Memory for code execution, Non-Volatile Memory for data storage, Random Access Memory for data calculation…) and detect the following occurrence:

- Program memory error

- RAM error
- NV memory error
- Measurement system error
- Watchdog error

6.12 Network quality monitoring

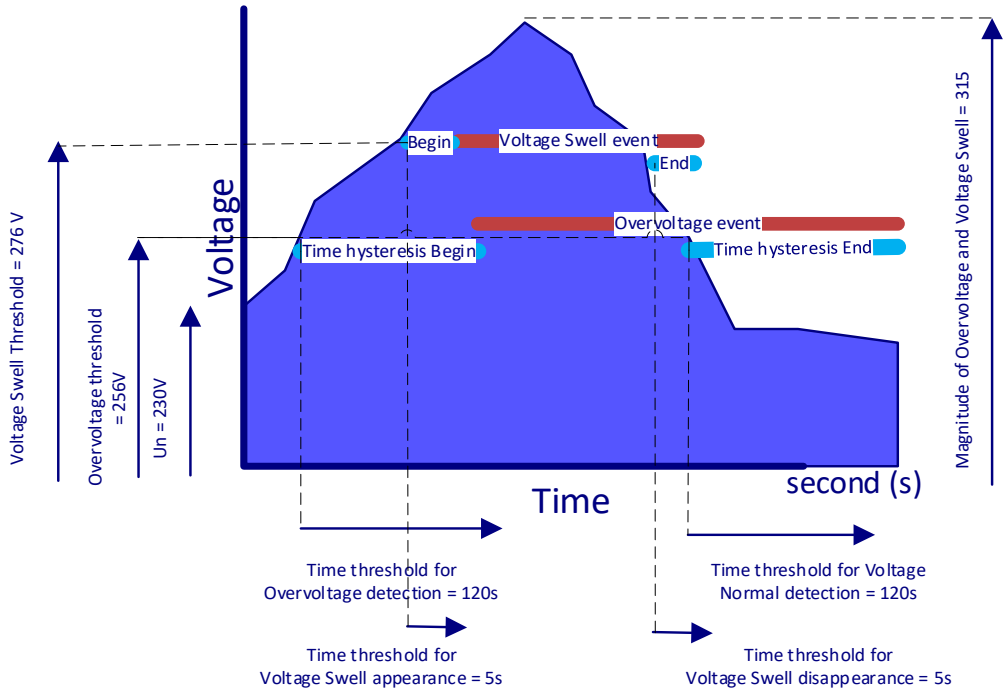
EM620 integrates some mechanisms able to detects events related to the quality of the electrical network. The process is based with a continuous sampling and analysis of the per-phase metrological values (RMS voltage, RMS currents, THDs…).

6.12.1 Voltage phase limit

On each phase individually, the RMS voltage value (U_{rms}) is compared periodically to a set of pre-defined thresholds (configurable in percentage of the nominal voltage) to detect the following occurrences (default values mentioned):

- Voltage cuts
- Voltage sags: Short term voltage variations, threshold detection -20% below nominal voltage (230V), Time threshold 5s
- Voltage swells: Short term voltage variations, threshold detection +20% above nominal voltage (230V), Time threshold 5s
- Under-voltages: Long term voltage variation, threshold detection -10% below nominal voltage (230V), Time threshold 120s
- Over-voltages: Long term voltage variation, threshold detection +10% above nominal voltage (230V), Time threshold 120s

The event is notified if the value is greater/lower than the threshold during a filtering time, configurable in seconds. There are 2 thresholds for both under and over limit voltage anomalies to allow the customer to track shortterm and longterm variations. The customers can configure the 2 threshold and time threshold values as they prefere, however the Voltage Swell threshold need to always be higher than the Overvoltage, similarly the Voltage Sag threshold should be lower than the Undervoltage.



In this example the default threshold and time threshold value are used for both Overvoltage and Voltage Sag events (see above). In this situation the Overvoltage is detected after the Voltage Swell event, as its time hysteris is larger, however the overall duration of overevoltage is still longer. The Votlage Swell is quickly detected, but it is also ended just few seconds after the voltage goes below the Voltage Swell threshold value. The calculation of time hysteresis for Voltage Normal event only starts when the voltage drops below lower extremity threshold value (in this case Overvotlage threshold) as it can be seen in the diagram. The magnitude of both Overvoltage and Voltage Swell will always record the highest voltage extremity value (in this case both objects will have same value). The content of power quality event log would be the following for the situation illustrated in the diagram above (assuming 00:00:00 is the starting point for time):

00:01:45 – Voltage Swell L1

00:02:30 – Overvoltage L1 (took 30 seconds from 00:00:00 until voltage grew above o.v. limit)

00:02:55 - Voltage Swell L1 end

00:06:52 – Voltage normal L1 □ at this point duration and magnitude are calculated:

Duration of last voltage swell: 00:01:10, Duration of last overvoltage: 00:02:05, Magnitude of last overvoltage: 315 V

6.12.2 Current phase limit

On each phase individually, the RMS current value (I_{rms}) is compared periodically to a pre-defined threshold (configurable in percentage of the maximum current voltage) to detect the following occurrences:

- Over current (L1, L2, L3)

The event is notified if the value is greater than the threshold during a filtering time, configurable in seconds.

Note: depending on the configuration, this event can also generate a disconnection of the auxiliary relay. Refer to Limiter operation.

6.12.3 THD phase limit

On each phase individually, the THD voltage value and THD current value are compared periodically to a pre-defined threshold (configurable in percentage of the nominal voltage or percentage of maximum current) to detect the following occurrences:

- Voltage Harmonic distorsion over limit L1, L2, L3
- Current Harmonic distorsion over limit L1, L2, L3

The event is notified if the value is greater than the threshold during a filtering time, configurable in seconds.

6.12.4 Power factor limit

The Metering Unit manages the power factor per phase and aggregate. For power factor per phase when the value of the average power factor of the related phase crosses the power factor under limit threshold, a power factor deviation event is recorded:

- Power factor deviation on L1, L2, L3

The event is notified if the value on one of the phases is lower than the threshold.

6.12.5 Phases sequence

The 3 angles between voltage phases (L1 and L2, L2 and L3, L3 and L1) are computed and monitored periodically to detect the following occurrences:

- Phase sequence reversal

6.12.6 Missing neutral

Conditioning that the 3 phases voltages are present (i.e. when there is no voltage phase cut), the Zero Sequence Voltage (RMS value of the vectoral sum of the 3-phases voltages) is computed and compared periodically to a fixed threshold to detect the following occurrence:

- Missing neutral

6.12.7 Current Reversal

On each phase individually, the direction of current flow is checked. If the current flow changes from import to export, the following occurrence is detected:

- Current reversal L1, L2, L3

6.12.8 Neutral Fault

The Neutral fault event is deemed active, when the neutral current exceeds the limiter threshold. Neutral fault are detected by the means of neutral current sensor.

This raises the following alarm:

- Neutral fault

6.12.9 Phase Asymmetry

This event indicates phase asymmetry due to large unbalance of loads connected.

This raises the following alarm:

- Phase Asymmetry

Phase asymmetry alarm threshold setting is under Zero Sequence Current Limiter. Setting are available in both Current (in Amperes) and duration.

6.12.10 Under and Over Frequency

Under and over frequency events indicate that the network frequency has exceeded the configured limit (typically +/-2% from nominal) during more than 10s.

This raises one of the following events:

- Underfrequency
- Overfrequency

6.13 Events management

6.13.1 Event logging

The meter is designed to support multiple logs, dedicated to record some events occurrences. All event logs are recorded in circular buffering in a first-in first-out (FIFO) mechanism: in other words, when a set historical data is full, the oldest data recorded is lost and overwritten by the most recent one.

Note: It is important that the utility manages data reading carefully and periodically, before any "old" data are lost.

Each event log can be read in a whole, or in a selected range of time (selective access by range).

The following table gives the list of all event logs implemented in the meter:

Event logs	OBIS Code, Attribute	Size
Standard Event Log	1,0-0:96.11.0.255,2	1000
Fraud Detection Log	1,0-0:96.11.1.255,2	1000
Configuration Modification Log	1,0-0:96.11.10.255,2	128
Power Quality Log	1,0-0:96.11.4.255,2	1000
Power Failure Log	3,0-0:96.7.19.255,2	1000
Communication Log	1,0-0:96.11.5.255,2	1000

Each event log has an associated “event filter object”. The event filter is used to enable and disable the logging of event codes in the event log profile. Each event logger will have its own event filter, which can only enable/disable events that are related to its own profile.

6.13.1.1 Standard events

N°	Event Name	Description
1	Power Down	Indicates a complete power down of the device. Please note that this is related to the device and not necessarily to the network.
2	Power Up	Indicates that the device is powered again after a complete power down.
3	Daylight saving time enabled or disabled	Indicates the regular change from and to daylight saving time. The time stamp shows the time before the change. This event is not set in case of manual clock changes and in case of power failures.
4	Clock adjusted (old date/time)	Indicates that the clock has been adjusted. The date/time that is stored in the event log is the old date/time before adjusting the clock.
5	Clock adjusted (new date/time)	Indicates that the clock has been adjusted. The date/time that is stored in the event log is the new date/time after adjusting the clock.
6	Clock invalid	Indicates that clock may be invalid, i.e. if the power reserve of the clock has exhausted. It is set at power up.
7	Replace Battery	Indicates that the battery must be exchanged due to the expected end of life time.
8	Battery voltage low	Indicates that the current battery voltage is low.
9	TOU activated	Indicates that the passive TOU has been activated.
10	Error register cleared	Indicates that the error register was cleared.
11	Alarm register cleared	Indicates that the alarm register was cleared.
12	Program memory error	Indicates a physical or a logical error in the program memory.
13	RAM error	Indicates a physical or a logical error in the RAM.
14	NV memory error	Indicates a physical or a logical error in the non volatile memory
15	Watchdog error	Indicates a watch dog reset or a hardware reset of the microcontroller.
16	Measurement system error	Indicates a logical or physical error in the measurement system
17	Firmware ready for activation	Indicates that the new firmware has been successfully downloaded and verified, i.e. it is ready for activation
18	Firmware activated	Indicates that a new firmware has been activated
19	Passive TOU programmed	The passive structures of TOU or a new activation date/time were programed

20	External alert detected	Indicates a signal detected on the meter's input terminal
47	One or more parameters changed	Indicates the change of at least one parameter
48	Global key(s) changed	One or more global keys changed
51	FW verification failed	Indicates the transferred firmware verification failed i.e. cannot be activated.
52	Unexpected consumption	Indicates consumption is detected at least on one phase when the disconnector has been disconnected
254	Load profile cleared	Any of the profiles cleared. NOTE: If it appears in Standard Event Log then any of the E-load profiles was cleared. If the event appears in the M-Bus Event log then one of the M-Bus load profiles was cleared
255	Event log cleared	Indicates that the event log was cleared. This is always the first entry in an event log. It is only stored in the affected event log.

6.13.1.2 Configuration modification events

N°	Event Name	Description
1		Billing data configuration capture objects or capture period
2		Load profiles capture objects or capture period
3		Energy and Demand register activation modification
4		Activity calendar modification
5		Special days modification
6		Disconnect control parameters modification
7		Demand register configuration modification
8		Load management modification
9		Power quality configuration modification
10		Transformer ratio modification
11		Reserved
12		Reserved
13		Display configuration modification
14		Customer information management
15		Reserved
16		Reserved

6.13.1.3 Fraud events

N°	Event Name	Description

40	Terminal cover removed	Indicates that the terminal cover has been removed. (Detection even during power off)
41	Terminal cover closed	Indicates that the terminal cover has been closed.
42	Strong DC field detected	Indicates that a strong magnetic DC field has been detected.
43	No strong DC field anymore	Indicates that the strong magnetic DC field has disappeared.
44	Meter cover removed	Indicates that the meter cover has been removed. . (Detection even during power off)
45	Meter cover closed	Indicates that the meter cover has been closed.
46	Association authentication failure (n time failed authentication)	Indicates that a user tried to gain LLS access with wrong password (intrusion detection) or HLS access challenge processing failed n-times
49	Decryption or authentication failure (n time failure)	Decryption with currently valid key (global or dedicated) failed to generate a valid APDU or authentication tag
50	Replay attack	Receive frame counter value less or equal to the last successfully received frame counter in the received APDU Event signalizes as well, the situation when the DC has lost the frame counter synchronization.
91	Current Reversal	Indicates unexpected energy export (for devices which are configured for energy import measurement only)
254	Load profile cleared	Any of the profiles cleared. NOTE: If it appears in Standard Event Log then any of the E-load profiles was cleared. If the event appears in the M-Bus Event log then one of the M-Bus load profiles was cleared
255	Event log cleared	Indicates that the event log was cleared. This is always the first entry in an event log. It is only stored in the affected event log.

6.13.1.4 Power Quality events

N°	Event Name	Description
56	Neutral fault	Indicates the end of the occurrence of Neutral Fault
57	End neutral fault	Indicates the end of the occurrence of Neutral Fault
58	Over current L1	Indicates an occurrence of Over current on Phase L1
59	Over current L2	Indicates an occurrence of Over current on Phase L2
60	Over current L3	Indicates an occurrence of Over current on Phase L3
61	End Over current L1	Indicates the end of the occurrence of Over current on Phase L1

62	End Over current L2	Indicates the end of the occurrence of Over current on Phase L2
63	End Over current L3	Indicates the end of the occurrence of Over current on Phase L3
64	Power Factor deviation on L1	Indicates an occurrence of Power Factor deviation on Phase L1
65	Power Factor deviation on L2	Indicates an occurrence of Power Factor deviation on Phase L2
66	Power Factor deviation on L3	Indicates an occurrence of Power Factor deviation on Phase L3
67	End Power Factor deviation on L1	Indicates the end of the occurrence of Power Factor deviation on Phase L1
68	End Power Factor deviation on L2	Indicates the end of the occurrence of Power Factor deviation on Phase L2
69	End Power Factor deviation on L3	Indicates the end of the occurrence of Power Factor deviation on Phase L3
76	Undervoltage L1	Indicates undervoltage on at least L1 phase was detected - long voltage variation anyomaly
77	Undervoltage L2	Indicates undervoltage on at least L2 phase was detected - long voltage variation anyomaly
78	Undervoltage L3	Indicates undervoltage on at least L3 phase was detected - long voltage variation anyomaly
79	Overvoltage L1	Indicates overvoltage on at least L1 phase was detected - long voltage variation anyomaly
80	Overvoltage L2	Indicates overvoltage on at least L2 phase was detected - long voltage variation anyomaly
81	Overvoltage L3	Indicates overvoltage on at least L3 phase was detected - long voltage variation anyomaly
82	Missing voltage L1	Indicates that the voltage on at least L1 phase has fallen below the Umin threshold for longer than the time delay.
83	Missing voltage L2	Indicates that the voltage on at least L2 phase has fallen below the Umin threshold for longer than the time delay.
84	Missing voltage L3	Indicates that the voltage on at least L3 phase has fallen below the Umin threshold for longer than the time delay.
85	Voltage L1 normal	Indicates that the mains voltage is in normal limits again, e.g. after overvoltage.
86	Voltage L2 normal	Indicates that the mains voltage is in normal limits again, e.g. after overvoltage.
87	Voltage L3 normal	Indicates that the mains voltage is in normal limits again, e.g. after overvoltage.
88	Phase sequence reversal	Indicates wrong mains connection. Usually indicates fraud or wrong installation. For poly phase connection only!

89	Missing neutral	Indicates that the neutral connection from the supplier to the meter is interrupted (but the neutral connection to the load prevails). The phase voltages measured by the meter may differ from their nominal values. For DC meter.
90	Phase Asymmetry	Indicates phase asymmetry due to large unbalance of loads connected
91	Current Reversal	Indicates unexpected energy export (for devices which are configured for energy import measurement only)
92	Current Reversal L1	Indicates an occurrence of Current Reversal on Phase L1 was detected.
93	Current Reversal L2	Indicates an occurrence of Current Reversal on Phase L2 was detected.
94	Current Reversal L3	Indicates an occurrence of Current Reversal on Phase L2 was detected.
95	Current Reversal L1 End	Indicates the end of the occurrence of Current Reversal on Phase L1 was detected.
96	Current Reversal L2 End	Indicates the end of the occurrence of Current Reversal on Phase L2 was detected.
97	Current Reversal L3 End	Indicates the end of the occurrence of Current Reversal on Phase L3 was detected.
98	Voltage Sag L1	Indicates an occurrence of short duration undervoltage or also called voltage sag on Phase L1 was detected.
99	Voltage Sag L2	Indicates an occurrence of short duration undervoltage or also called voltage sag on Phase L2 was detected.
100	Voltage Sag L3	Indicates an occurrence of short duration undervoltage or also called voltage sag on Phase L3 was detected.
101	Voltage Sag L1 end	Indicates the end of short duration undervoltage event or also called Voltage Sag end on phase 1.
102	Voltage Sag L2 end	Indicates the end of short duration undervoltage event or also called Voltage Sag end on phase 2.
103	Voltage Sag L3 end	Indicates the end of short duration undervoltage event or also called Voltage Sag end on phase 3.
104	Voltage Swell L1	Indicates an occurrence of short duration overvoltage or also called voltage swell on Phase L1 was detected.
105	Voltage Swell L2	Indicates an occurrence of short duration overvoltage or also called voltage swell on Phase L2 was detected.
106	Voltage Swell L3	Indicates an occurrence of short duration overvoltage or also called voltage swell on Phase L3 was detected.
107	Voltage Swell L1 end	Indicates the end of short duration overvoltage event or also called Voltage Swell end on phase 1.
108	Voltage Swell L2 end	Indicates the end of short duration overvoltage event or also called Voltage Swell end on phase 2.
109	Voltage Swell L3 end	Indicates the end of short duration overvoltage event or also called Voltage Swell end on phase 3.

110	Underfrequency	Indicates that the network frequency has dropped below the configured limit (typically -2% from nominal).
111	Overfrequency	Indicates that the network frequency has exceeded the configured limit (typically +2% from nominal).
112	Frequency Normal	Indicates that the network frequency is in normal limits again (eg. After over or under frequency event)
113	Voltage harmonic distortion over limit L1	The Voltage THD on phase 1 has exeeded the configured limit (typically 5%)
114	Voltage harmonic distortion over limit L2	The Voltage THD on phase 2 has exeeded the configured limit (typically 5%)
115	Voltage harmonic distortion over limit L3	The Voltage THD on phase 3 has exeeded the configured limit (typically 5%)
116	Voltage harmonic distortion normal L1	The Voltage THD on Phase 1 is again within configured limit, indicating the end of voltage harmonic distortion event on Phase L1.
117	Voltage harmonic distortion normal L2	The Voltage THD on Phase 2 is again within configured limit, indicating the end of voltage harmonic distortion event on Phase L2.
118	Voltage harmonic distortion normal L3	The Voltage THD on Phase 3 is again within configured limit, indicating the end of voltage harmonic distortion event on Phase L3.
119	Current harmonic distortion over limit L1	The Current THD on phase 1 has exeeded the configured limit
120	Current harmonic distortion over limit L2	The Current THD on phase 2 has exeeded the configured limit
121	Current harmonic distortion over limit L3	The Current THD on phase 3 has exeeded the configured limit
122	Current harmonic distortion normal L1	The Current THD on Phase 1 is again within configured limit, indicating the end of current harmonic distortion event on Phase L1.
123	Current harmonic distortion normal L2	The Current THD on Phase 2 is again within configured limit, indicating the end of current harmonic distortion event on Phase L1.
124	Current harmonic distortion normal L3	The Current THD on Phase 3 is again within configured limit, indicating the end of current harmonic distortion event on Phase L1.
254	Load profile cleared	Any of the profiles cleared. NOTE: If it appears in Standard Event Log then any of the E-load profiles was cleared. If the event appears in the M-Bus Event log then one of the M-Bus load profiles was cleared

255	Event log cleared	Indicates that the event log was cleared. This is always the first entry in an event log. It is only stored in the affected event log.

6.13.1.5 Communication events

N°	Event Name	Description
1	NAN access disabled	
2	NAN initialized	
3	NAN found	
4	NAN connected	
51	HAN access disabled	-
52	HAN initialized	
53	HAN found	-
54	HAN connected	-
101	WAN access disabled	
102	WAN initialized	
103	WAN found	
104	WAN connected	
158	Local communication established	Indicates that the communication on the local optical port was successful.
254	Load profile cleared	Any of the profiles cleared. NOTE: If it appears in Standard Event Log then any of the E-load profiles was cleared. If the event appears in the M-Bus Event log then one of the M-Bus load profiles was cleared
255	Event log cleared	Indicates that the event log was cleared. This is always the first entry in an event log. It is only stored in the affected event log.

6.13.1.6 SMS notification for events

This is possible with ACE Pilot to configure up to 3 phone numbers for SMS notification on event occurrence. Once the phone numbers are configured, this is possible to select the events in event list, for which a real time notification per SMS will be sent, when event occurs.

Note: This function depends on the modem connected to the meter, and could not be available for modems not compatible with this feature. Please contact your local Itron representative for more information on this function.

6.13.2 Alarm registers

Some events listed above can trigger alarms. If one of these events occurs, then the corresponding flag in the alarm register is set high and the alarm is sent via the configured push channel. Not all possible alarms will be wanted therefore the alarm filters can be programmed to mask out unwanted alarms. The trigger of a given alarm bit may be originated from diverse events therefore the alarm event only provides to the HES, an insight of the device situation. A deeper knowledge of the device diagnostic (what kind of event? When? And why?) needs the reading of the related event logs involved.

Below is the detail regarding the 3 alarm registers.

6.13.2.1 Alarm register 1

Bit	Alarm Name	Triggering Event
0	Clock invalid	6
1	Battery replace	7
8	Program memory error	12
9	RAM error	13
10	NV memory error	14
11	Measurement system error	16
12	Watchdog error	15
13	Fraud attempt	40, 42, 44, 46, 49, 50

6.13.2.2 Alarm register 2

Bit	Alarm Name	Triggering Event
0	Total Power Failure	Std 01
1	Power Resume	Std 02
2	Voltage Missing Phase L1	PQ 82
3	Voltage Missing Phase L2	PQ 83
4	Voltage Missing Phase L3	PQ 84
5	Voltage Normal Phase L1	PQ 85
6	Voltage Normal Phase L2	PQ 86
7	Voltage Normal Phase L3	PQ 87
8	Other alarm	See note
9	Phase Asymmetry	PQ 90
10	Current Reversal	Fraud 91
11	Wrong Phase Sequence	Std 88

12	Unexpected Consumption	Std 52
13	Key Exchanged	Fraud 48
14	Reserved – Bad Voltage Quality L1	
15	Reserved – Bad Voltage Quality L2	
16	Reserved – Bad Voltage Quality L3	
17	External Alert	Std 20
18	Local communication established	Comm 158
19	Supply opened	Disc 62, Disc 64
20	Supply closed	Disc 63, 61, 69
21	Limiter Threshold Exceeded	Disc 65
22	Missing neutral	PQ 89
23	Current neutral fault	PQ 56
24	Power factor deviation on L1	PQ 64
25	Power factor deviation on L2	PQ 65
26	Power factor deviation on L3	PQ 66
27	Unauthorized export of energy	Std 97
31	Disconnect/Reconnect Failure	Disc 68

6.13.2.3 Alarm register 3

Bit	Alarm Name	Triggering Event
0	Overvoltage L1	PQ 79
1	Overvoltage L2	PQ 80
2	Overvoltage L3	PQ 81
3	Undervoltage L1	PQ 76
4	Undervoltage L1	PQ 77
5	Undervoltage L3	PQ 78
6	Voltage Sag L1	PQ 98
7	Voltage Sag L2	PQ 99
8	Voltage Sag L3	PQ 100
9	Voltage Swell L1	PQ 105
10	Voltage Swell L2	PQ 106
11	Voltage Swell L3	PQ 107
12	OverCurrent L1	PQ 58
13	OverCurrent L2	PQ 59

14	OverCurrent L3	PQ 60
15	Network frequency over limit	PQ 110
16	Network frequency under limit	PQ 111
17	Voltage THD over limit L1	PQ 113
18	Voltage THD over limit L2	PQ 114
19	Voltage THD over limit L3	PQ 115
20	Current THD over limit L1	PQ 119
21	Current THD over limit L1	PQ 120
22	Current THD over limit L1	PQ 121
31	Disconnect/Reconnect Failure	Disc 68

6.13.2.4 Push notification

Push operation is triggered by an alarm monitor and allows the EM620 meter to send an unsolicited notification to a specified SMS address, configurable with ACE Pilot.

Using Gen5 NIC (Mesh RF network), meter sets Message service pin at high level if event(s) as set in alarm filter is detected. Once this pin is set to high, Gen5 NIC will read alarm descriptor and will do the rest of the push mechanism to the HES.

6.13.3 Errors registers

The error register can be read and displayed at any time to see if there is a malfunction in the device. Error register holds the status of the current events captured also in Alarm register 1 (has the same structure as the Alarm register 1), however error register is not used to push data asynchronously to head end system. Depending on the type of error, some errors clear themselves if the reason for the error has disappeared. Other must be cleared via HES.

CHAPTER 7
Communications

The EM620 meter provide 3 types of communication channel:

- **Optical port** (infrared interface): for local reading of meter data and configuration (by HHU or software tool)
- **RS Port 1** (RS232 interface): for remote reading of meter data and configuration (via an external modem) or gateway connection for connectivity with the HES (Gen5 NIC, MicroAP NIC).
- **RS port 2 and 3** (RS485 interface): for remote reading of meter data and configuration (via an external modem), or can be used to support consumer readout (by an IHD).

Note: the meter can support communications over the 3 channels simultaneously (except when the same COSEM client is used).

7.1 Optical port (infrared)

The meter is equipped with infrared (IR) optical interface that complies with the requirements defined in IEC62056-21 mode E protocol.

This interface is intended to be used by the utility company for transmission of metering values from the meter to a Hand-Held Unit (HHU) or personal computer running suitable software (e.g. ACE Pilot) to enable communication. It is also possible to program and re-configure the meter using this channel.

Bi-directional (2-ways) communication in half-duplex mode is supported over this interface in accordance with IEC62056-42/46/53/61/62 standards (DLMS/COSEM protocol over HDLC data link layer).

The following table identifies the different parameters related to the optical port.

	Details
Default mode	0 (protocol i.a.w. IEC62056-21)
Response time	configurable 20 or 200 ms (default: 200 ms)
Default baudrate (IEC62056-21)	300 bauds
HDLC communication speed	default: 9600 bauds
HDLC address	configurable (default: 16)
HDLC inter octet timeout	configurable in ms (default: 25 ms)
HDLC inactivity timeout	configurable in sec (default: 120 sec)
HDLC window size Tx / Rx	1 frame / 1 frame
HDLC maximum info length Tx / Rx	configurable in bytes (default: 128 bytes / 128 bytes)

7.2 External modem/gateway port (serial port 1 -Gateway)

The meter is equipped with an electrical and isolated serial RS232 interface, available on 1 x RJ45 output connectors, compatible with DLMS protocol.

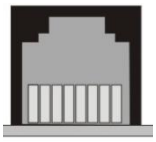
This interface is intended to be used by the utility company for transmission of metering values from the meter to an external modem or gateway, capable of communicating to the remote HES. It is also possible to program and re-configure the meter using this channel.

Remote connections can be established using a variety of media types via the external modem connection.

- LAN - Local Area Network using TCP/IP (or an Internet connection)
- GSM / GPRS - Global System for Mobile communication / General Packet Radio Service
- 3G, LTE …

Bi-directional (2-ways) communication in half-duplex mode is supported over this interface in accordance with IEC62056-42/46/53/61/62 standards (DLMS/COSEM protocol over HDLC data link layer).

The diagram below gives the pinout definition of the RJ45 connectors.



Pin	Details (RS232)	NIC interface
1	VMDM (12V +/- 5%) 8W	VMDM (12V +/- 5%) 8W
2	Not connected	MDM_BUSY_IN
3	Not connected	PF_OUT
4	Rx	RX (*HW option for TTL or RS232 level)
5	Tx	TX (*HW option for TTL or RS232 level)
6	GNDMDM (0V)	GNDMDM (0V)
7	DTR (HW option for RS232 level)	MTR_SRVC_OUT (TTL Level)
8	Not connected	Zero_Crossing

The following table identifies the different parameters related to the external modem port 1.

HDLC Configuration	Details
HDLC communication speed	configurable from 1200 to 115200 bauds (default: 9600 bauds)
HDLC address	configurable (default: 16)
HDLC inter octet timeout	configurable in ms (default: 30 ms)
HDLC inactivity timeout	configurable in sec (default: 3 sec)
HDLC window size Transmit	Configurable (default: 7 frames)
HDLC maximum info length Tx / Rx	configurable in bytes (default: 256 bytes / 256 bytes)

7.3 External modem/Readout port (serial 2 and 3 - Consumer)

The meter is equipped with 2nd electrical and isolated serial RS485 interface, available on 2 x RJ45 output connector.

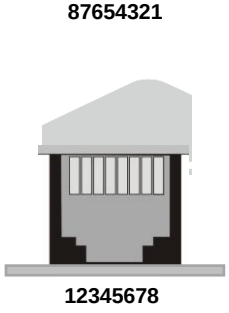
This interface is intended to be used by end-customer to read metering values in real time from the meter on an external device, capable of displaying these data, such as an In-Home Display (IHD). Uni-directional (1-way) communication in transmission mode is supported over this interface and follows the protocol defined in the Dutch Smart Meter Requirements (DSMR) P1 companion specification (v5.0.2, section 6). This protocol is based on the IEC62056-21 mode D standard (data readout).

Data telegram is updated and transmitted according to a time configured inside the meter (5, 15, 30 or 60s).

This port can also be used as a RS485 communication port, to connect an external modem on it. The 2 x RJ45 connectors enable to connect several meters to a single external modem or gateway, with a daisy-chaining mechanism. They provide an isolated DC supply voltage (V_{MDM}) suitable for powering the external modem. The consumption must not exceed 8W under 12V (8W shared between Consumer and Gateway ports) . GND_{MDM} is its reference potential.

The protocol used on those port is configurable as DSMR or DLMS.

The diagram below gives the pinout definition of the 2 x RJ45 connector.



Pin	Details (RS485 DLMS)	ReadOut (DSMR)
1	VMDM (12V +/- 5%)	5V
2	Rx-	Rx-
3	Not connected	Data Request (RX MCU TTL)
4	Rx+	Rx+
5	Tx+	Tx+
6	GNDMDM (0V)	GNDMDM (0V)
7	Tx-	Tx-
8	Not connected	Data (TX MCU)

When this port is configured in HDLC, following parameters can be configured:

HDLC Configuration	Details
HDLC communication speed	configurable from 1200 to 115200 bauds (default: 9600 bauds)
HDLC address	configurable (default: 16)
HDLC inter octet timeout	configurable in ms (default: 25 ms)

HDLC inactivity timeout	configurable in sec (default: 120 sec)
HDLC window size Transmit	Configurable (default: 1 frame)
HDLC maximum info length Tx / Rx	configurable in bytes (default: 256 bytes / 256 bytes)

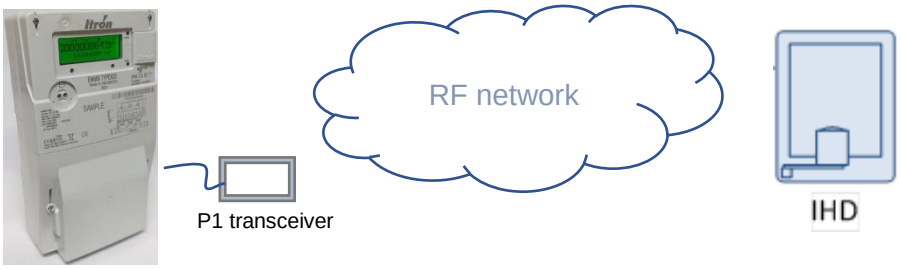
The following table identifies the different parameters related to the readout port.

	Details
Transfer speed	configurable from 300 to 115200 bauds (default: 115200 bauds)
Data list	Configurable among the following items ▪ Device ID 2, Customer meter equipment identifier /Faceplate & barcode ▪ Clock ▪ Active energy import (+A) ▪ Active energy export (-A) ▪ Reactive energy import (+R)_(QI+QII) ▪ Reactive energy export (-R)_(QIII+QIV) ▪ Instantaneous Active Power L1 ▪ Instantaneous Active Power L2 ▪ Instantaneous Active Power L3 ▪ Instantaneous reactive import power (+R) L1 ▪ Instantaneous reactive import power (+R) L2 ▪ Instantaneous reactive import power (+R) L3 ▪ Instantaneous reactive export power (-R) L1 ▪ Instantaneous reactive export power (-R) L2 ▪ Instantaneous reactive export power (-R) L3 ▪ Instantaneous voltage L1 ▪ Instantaneous voltage L2 ▪ Instantaneous voltage L3 ▪ Instantaneous current L1 ▪ Instantaneous current L2 ▪ Instantaneous current L3 ▪ Consumer Message Text

The following screenshot illustrates an example of data telegram transmitted by the meter over the readout port.

```
/ITE9\ITE620MA00123456....
0-0:96.1.1(ITRONEM620)
0-0:1.0.0(210507162418W)
1-0:1.8.0(0000.000*kWh)
1-0:2.8.0(0000.000*kWh)
1-0:3.8.0(0000.000*kVarh)
1-0:4.8.0(0000.000*kVarh)
1-0:15.7.0(00.000*kW)
1-0:3.7.0(00.000*kVar)
1-0:4.7.0(00.000*kVar)
1-0:32.7.0(000.0*V)
1-0:31.7.0(000*A)
0-0:0.0.0(0)
!4126..
```

An example of readout port is illustrated below, also called Home-Area Network (HAN) application. It shows an external device connected on the RJ45 port, capable of interpret the data telegram push by the meter and transmit the meter information to an IHD.



Note: There are 2 communication ports available on the meter (Consumer port and Gateway port). Readings on both communication ports can be done simultaneously. For simultaneous configuration, meter will only serve the first client which is logged.

7.4 Application protocol (DLMS/COSEM)

7.4.1 Data access

In accordance with IEC 62056-53, security access levels of the DLMS/COSEM protocol are applied over the meter communication.

Data access are controlled by the *COSEM logical device* implemented in the meter (acting as a server) supporting different COSEM client identifications (connection profiles). Each connection profile is protected by dedicated security credentials (password and/or keys), and all connection attempts by COSEM clients are checked by the meter before establishing a connection.

The meter implements a single “management” logical device, identified by its SAP (Service Access Point) in the HDLC frames.

Logical device	SAP	Name
Management	0x01	ITE[yy]620[Serial number 8 digits] Refer to section Serial number (COSEM logical device name)

Associations with the management logical device can be established by the following predetermined clients, each having different authorizations to access data. Each client is identified by a SAP which has different value depending on the association security mechanism.

Clients	SAP ID	Typical use
Reader	112	Read-only access to meter data locally on site
Administrator	1	Full access is provided for most attributes.
Pre-established	102	Used for broadcast
Supervisor	111	Installation/local configuration Association

Public	16 (without LLS / HLS mechanism)	Read-only access to meter's basic information Mandatory for DLMS certification (CTT)

Note: a same client cannot be associated with the management logical device on the optical port and on the modem port at the same time.

The access rights definition on each COSEM objects according to the clients is provided in a separate document (object model definition).

7.4.2 Security model

This section describes the mechanisms supported by the server to ensure security during data exchange with the client. Security mechanism applies during data exchange to ensure the following protections:

- *Authentication*: the client should be sure to access the suitable server and the server should be sure to be requested by the suitable client.
- *Confidentiality:* data exchanged should not be interpreted by unknown persons because parameters and data are confidential.
- *Integrity:* it should be possible to detect an altered message.
- *Anti-replay:* it should not be possible to send again a valid message already sent in the past.
- *Service denial:* it should not be possible to process some operations that could result in locking the server temporary or definitively.

7.4.2.1 Security suite

2 solutions are implemented in the EM620:

- a symmetric encryption mechanism with secret keys. The algorithm used is AES128 with GCM mode (security suite id = 0 as prescribed by the DLMS GreenBook v10).

- An asymmetric encryption mechanism : AES-GCM authenticated encryption, ECDSA P-256 digital signature, ECDH P-256 key agreement, SHA-256 hash and AES-128 key wrap (security suite id = 1 as prescribed by the DLMS GreenBook v10).

7.4.2.2 Security keys and password

The DLMS/COSEM standard specifies 2 kinds of security keys:

- dedicated (valid for only one COSEM association)
- global (valid for all COSEM associations).

Only global key usage is supported by the meter.

The server (i.e. the meter) stores different private keys of 128 bits (string of 16 bytes) and passwords of 64 bits (string of 8 bytes):

Name	Type	Usage
Key encryption key (1 key for all clients)	Master	For global keys change using RFC 3394 AES Key Wrap algorithm
Unicast encryption key (1 key per client)	Global	For DLMS message authentication & encryption For COSEM association establishment using HLS-5 (GMAC)

Authentication key (1 key per client)	Global	For DLMS message authentication For COSEM association establishment using HLS-5 (GMAC)
LLS password (1 password per client)	Password	For COSEM association establishment using LLS

The Master key is only programmed during the manufacturing process and can never be changed after the meter has been delivered to the customer. It is unique per meter.

The Global keys can be changed by the utility: the new keys must be wrapped with the Master key.

The LLS passwords can be changed by the utility.

Note: both Global keys and LLS passwords have default value loaded in the meter using a HSM (Hardware Security Module) in factory. These pre-defined keys and password are then exported from this module and provided to the utility in a secure manner

7.4.2.3 Security on association mechanism

When a client requests for a COSEM association establishment with the server (AARQ), an association mechanism is used.

Lowest Security (LS, mechanism identifier = 0): no control takes place.

Low Level Security (LLS, mechanism identifier = 1): the LLS password of the client is verified by the server (1-pass mechanism).

High Level Security mode 5 (HLS-5, mechanism identifier = 5): an encrypted message is verified by the client and by the server (4-pass mechanism). The message is a random byte string (from 8 to 64 bytes). The encrypted result is a string of 17 bytes generated by the AES-GMAC algorithm using the global keys.

High Level Security mode 7 (HLS-7, mechanism identifier = 7)

7.4.2.4 Security on message exchange

When COSEM messages are exchanged between the client and the server, a security policy is applied according to 4 different levels:

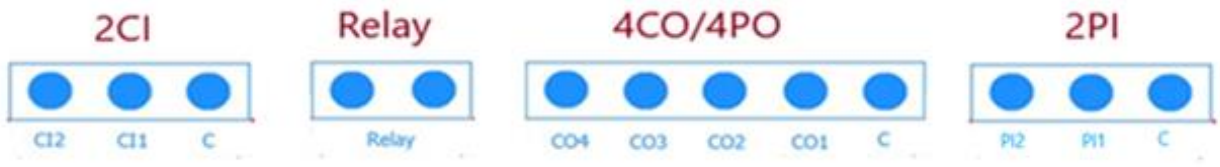
Level	Policy
0	COSEM messages are not secured (plain text without authentication tag)
1	COSEM messages are authenticated only (plain text with authentication tag)
2	COSEM messages are encrypted only (ciphered text without authentication tag)
3	COSEM messages are authenticated and encrypted (ciphered text with authentication tag)

When a COSEM message needs to be encrypted, the message is ciphered with the AES-GMAC algorithm.

When a COSEM message needs to be authenticated, an authentication tag is calculated with the AES-GMAC algorithm and added to the message.

CHAPTER 8
External connections

The meter can be optionally fitted with pulse outputs, pulses inputs, control outputs and control inputs or relay, as detailed in this section. Below is a display of the terminals that can be accessible :



8.1 Pulse output

EM620 meter can be optionally factory-configured with 4 pulse outputs terminals on which external devices can be connected (e.g. load controller). The pulse outputs are programmed to transmit or indicate meter energy. List of configurable data is below:

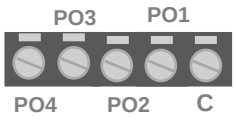
Active energy import (+A)	1-0:1.8.0.255
Active energy export (-A)	1-0:2.8.0.255
Active energy (|+A|+|-A|) Combined total	1-0:15.8.0.255
Active energy (|+A|-|-A|) Combined total	1-0:16.8.0.255
Reactive energy QI (+Ri)	1-0:5.8.0.255
Reactive energy QII (+Rc)	1-0:6.8.0.255
Reactive energy QIII (-Ri)	1-0:7.8.0.255
Reactive energy QIV (-Rc)	1-0:8.8.0.255
Reactive energy import (+R) (QI+QII)	1-0:3.8.0.255
Reactive energy export (-R) (QIII+QIV)	1-0:4.8.0.255
Apparent energy import (+VA) (QI+QIV)	1-0:9.8.0.255
Apparent energy export (-VA) (QII+QIII)	1-0:10.8.0.255
Active energy import (+A) L1	1-0:21.8.0.255
Active energy export (-A) L1	1-0:22.8.0.255
Active energy (|+A|+|-A|) L1 Combined total	1-0:35.8.0.255
Active energy (|+A|-|-A|) L1 Combined total	1-0:36.8.0.255
Reactive energy QI (+Ri) L1	1-0:25.8.0.255
Reactive energy QI (+Ri) (Delta Values) L1	1-0:25.29.0.255
Reactive energy QII (+Rc) L1	1-0:26.8.0.255
Reactive energy QII (+Rc) (Delta Values) L1	1-0:26.29.0.255
Reactive energy QIII (-Ri) L1	1-0:27.8.0.255

Reactive energy QIII (-Ri) (Delta Values) L1	1-0:27.29.0.255
Reactive energy QIV (-Rc) L1	1-0:28.8.0.255
Reactive energy QIV (-Rc) (Delta Values) L1	1-0:28.29.0.255
Reactive energy import (+R) L1 (QI+QII)	1-0:23.8.0.255
Reactive energy export (-R) L1 (QIII+QIV)	1-0:24.8.0.255
Reactive energy Lag Inductive (QI+QIII)	1-0:100.8.0.255
Reactive energy Lag Inductive (QI+QIII) Phase L1	1-0:101.8.0.255
Reactive energy Lag Inductive (QI+QIII) Phase L2	1-0:102.8.0.255
Reactive energy Lag Inductive (QI+QIII) Phase L3	1-0:103.8.0.255
Reactive energy Lead Capacitive (QII+QIV)	1-0:104.8.0.255
Reactive energy Lead Capacitive (QII+QIV) Phase L1	1-0:105.8.0.255
Reactive energy Lead Capacitive (QII+QIV) Phase L2	1-0:106.8.0.255
Reactive energy Lead Capacitive (QII+QIV) Phase L3	1-0:107.8.0.255
Apparent energy import (+VA) L1 (QI+QIV)	1-0:29.8.0.255
Apparent energy export (-VA) L1 (QII+QIII)	1-0:30.8.0.255
Active energy import (+A) L2	1-0:41.8.0.255
Active energy export (-A) L2	1-0:42.8.0.255
Active energy (|+A|+|-A|) L2 Combined total	1-0:55.8.0.255
Active energy (|+A|-|-A|) L2 Combined total	1-0:56.8.0.255
Reactive energy QI (+Ri) L2	1-0:45.8.0.255
Reactive energy QII (+Rc) L2	1-0:46.8.0.255
Reactive energy QIII (-Ri) L2	1-0:47.8.0.255
Reactive energy QIV (-Rc) L2	1-0:48.8.0.255
Reactive energy import (+R) L2 (QI+QII)	1-0:43.8.0.255
Reactive energy export (-R) L2 (QIII+QIV)	1-0:44.8.0.255
Apparent energy import (+VA) L2 (QI+QIV)	1-0:49.8.0.255
Apparent energy export (-VA) L2 (QII+QIII)	1-0:50.8.0.255
Active energy import (+A) L3	1-0:61.8.0.255
Active energy export (-A) L3	1-0:62.8.0.255
Active energy (|+A|+|-A|) L3 Combined total	1-0:75.8.0.255
Active energy (|+A|-|-A|) L3 Combined total	1-0:76.8.0.255
Reactive energy QI (+Ri) L3	1-0:65.8.0.255
Reactive energy QII (+Rc) L3	1-0:66.8.0.255
Reactive energy QIII (-Ri) L3	1-0:67.8.0.255
Reactive energy QIV (-Rc) L3	1-0:68.8.0.255
Reactive energy import (+R) L3 (QI+QII)	1-0:63.8.0.255

Reactive energy export (-R) L3 (QIII+QIV)	1-0:64.8.0.255
Apparent energy import (+VA) L3 (QI+QIV)	1-0:69.8.0.255
Apparent energy export (-VA) L3 (QII+QIII)	1-0:70.8.0.255

Note: If the Hardware configuration is set as Pulse Outputs, the Pulse outputs cannot be configured as Control Output.

The pulse output terminal block provides 1 common connection points and accepts cables up to 1.5mm².

Schematics	Name	Purpose
	PO1	Pulse output 1
	PO2	Pulse output 2
	PO3	Pulse output 3
	PO4	Pulse output 4
	C	Common point

8.2 Control Output

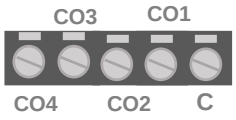
EM620 Meter can be equipped with 4CO.

Each of output can be set with different functionality as below

- Pulse Output
- Alarm 1
- Alarm 2
- Alarm 3
- EOI Demand
- Excess Demand
- EOB 1
- EOI LP1
- EOI LP2
- Phase Cut R
- Phase Cut S
- Phase Cut T
- Clock Synchronization (1kHz 50% duty cycle)

Below the schematics of Control outputs terminals:

Schematics	Name	Purpose
	CO1	Control output 1



CO2	Control output 2
CO3	Control output 3
CO4	Control output 4
C	Common point

The different configurations are explained below.

8.2.1 Pulse Output

When a CO is configured as Pulse output, the behavior is exactly the same with Pulse Output, for example CO1 configured as Pulse Output then CO1 will behave exactly the same with PO1, including the functionality and setting.

8.2.2 Alarm

Each of CO can be set as Alarm 1 or Alarm 2, representing the information of alarm register 1 or 2. Alarm pin will be set when the value of alarm descriptor > 0. The pin stays active until alarm descriptor has been cleared by command.

8.2.3 Excess Demand

This function is dedicated to inform the end customer when the internal calculation of the meter demand is over the subscribed limit.

CO behaves the same with excess demand relay operation. CO is set when the demand register monitor exceeds the threshold.

8.2.4 EOB

CO pin is set when a Monthly EOB and EOB By Button is performed.

8.2.5 EOI

When the CO is configured as an End of Interval, pulse is generated when an end of demand interval occurs.

8.2.6 Phase Cut R/S/T

CO is set when the related phase is below the threshold during a certain period (time delay).

Information	**Details**

Missing Voltage L1	Indicates that the voltage on at least L1 phase has fallen below the Umin threshold for longer than the time delay
Missing Voltage L2	Indicates that the voltage on at least L2 phase has fallen below the Umin threshold for longer than the time delay
Missing Voltage L3	Indicates that the voltage on at least L3 phase has fallen below the Umin threshold for longer than the time delay

8.2.7 Clock Synchronization

When the CO is used as clock synchronization, 1 Hz pulse at 50% duty cycle is generated on this pin.

8.3 Pulse Input

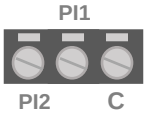
EM620 meter can be factory-configured with a number of optically-isolated pulse inputs for connection to further DIN S0 meters or other pulse output devices that are compliant with IEC 62053-31.

Pulse input is connected with a pulse output from external devices, it can be the same EM620 meter or another meter. Pulse Output from another devices can be active 'low' or 'high', therefore the first alignment should be the type of pulse: active low or high. After this configuration, the user should identify what is the type of energy intended to be stored on EM620 meter. There are a list of energy type that can be chosen for electricity meter or another type of energy if this comes from water or gas meter. Below are the quantities configurable in the meter:

1	ExtActive energy import (+A)
2	ExtActive energy export (-A)
3	ExtActive energy (|+A|+|-A|) Combined total
4	ExtActive energy (|+A|-|-A|) Combined total
5	ExtReactive energy QI (+Ri)
6	ExtReactive energy QII (+Rc)
7	ExtReactive energy QIII (-Ri)
8	ExtReactive energy QIV (-Rc)
9	ExtReactive energy import (+R) (QI+QII)
10	ExtReactive energy export (-R) (QIII+QIV)
11	ExtApparent energy import (+VA) (QI+QIV)
12	ExtApparent energy export (-VA) (QII+QIII)
13	ExtActive energy import (+A) L1
14	ExtActive energy export (-A) L1
15	ExtActive energy (|+A|+|-A|) L1 Combined total
16	ExtActive energy (|+A|-|-A|) L1 Combined total
17	ExtReactive energy QI (+Ri) L1
18	ExtReactive energy QI (+Ri) (Delta Values) L1
19	ExtReactive energy QII (+Rc) L1
20	ExtReactive energy QII (+Rc) (Delta Values) L1
21	ExtReactive energy QIII (-Ri) L1
22	ExtReactive energy QIII (-Ri) (Delta Values) L1
23	ExtReactive energy QIV (-Rc) L1
24	ExtReactive energy QIV (-Rc) (Delta Values) L1
25	ExtReactive energy import (+R) L1 (QI+QII)
26	ExtReactive energy export (-R) L1 (QIII+QIV)
27	ExtReactive energy Lag Inductive (QI+QIII)
28	ExtReactive energy Lag Inductive (QI+QIII) Phase L1
29	ExtReactive energy Lag Inductive (QI+QIII) Phase L2
30	ExtReactive energy Lag Inductive (QI+QIII) Phase L3
31	ExtReactive energy Lead Capacitive (QII+QIV)
32	ExtReactive energy Lead Capacitive (QII+QIV) Phase L1
33	ExtReactive energy Lead Capacitive (QII+QIV) Phase L2
34	ExtReactive energy Lead Capacitive (QII+QIV) Phase L3
35	ExtApparent energy import (+VA) L1 (QI+QIV)
36	ExtApparent energy export (-VA) L1 (QII+QIII)
37	ExtActive energy import (+A) L2
38	ExtActive energy export (-A) L2
39	ExtActive energy (|+A|+|-A|) L2 Combined total
40	ExtActive energy (|+A|-|-A|) L2 Combined total
41	ExtReactive energy QI (+Ri) L2
42	ExtReactive energy QII (+Rc) L2
43	ExtReactive energy QIII (-Ri) L2
44	ExtReactive energy QIV (-Rc) L2
45	ExtReactive energy import (+R) L2 (QI+QII)
46	ExtReactive energy export (-R) L2 (QIII+QIV)
47	ExtApparent energy import (+VA) L2 (QI+QIV)
48	ExtApparent energy export (-VA) L2 (QII+QIII)
49	ExtActive energy import (+A) L3
50	ExtActive energy export (-A) L3
51	ExtActive energy (|+A|+|-A|) L3 Combined total
52	ExtActive energy (|+A|-|-A|) L3 Combined total
53	ExtReactive energy QI (+Ri) L3
54	ExtReactive energy QII (+Rc) L3
55	ExtReactive energy QIII (-Ri) L3
56	ExtReactive energy QIV (-Rc) L3
57	ExtReactive energy import (+R) L3 (QI+QII)
58	ExtReactive energy export (-R) L3 (QIII+QIV)

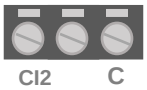
59	ExtApparent energy import (+VA) L3 (QI+QIV)
60	ExtApparent energy export (-VA) L3 (QII+QIII)
61	Gas Meter
62	Water Meter
63	Another type of energy 1
64	Another type of energy 2
65	Another type of energy 3
255	No Energy / Not Used

The last step, user shall configure in EM620 meter, the constant of the external devices. For example if the type of energy is '1' Ext active energy import, 10000 pulse/kwh then the External Energy Configuration should set as Value : 10000, scalar 30 (/kwh). If the scalar does not align with the type of energy specified, meter will reject it.

Schematics	Name	Purpose
	PI1	Pulse input 1
	PI2	Pulse input 2
	C	Common point

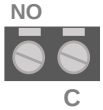
8.4 Control Input

EM620 meter can be factory-configured with up to 2 control inputs. Those physical inputs are assigned to indicate external alarms

Schematics	Name	Purpose
	CI1	Control input 1
	CI2	Control input 2
	C	Common point

8.5 Relay output

EM620 meter is factory-configured with 1 latching relay output on which external device can be connected (typically, an external breaker).

Schematics	Name	Purpose
	NO	Normally-open point
	C	Common point

Warning: The auxiliary relay operates on voltage above 33 V, it has risk to be hazardous live category.

CHAPTER 9
User interface

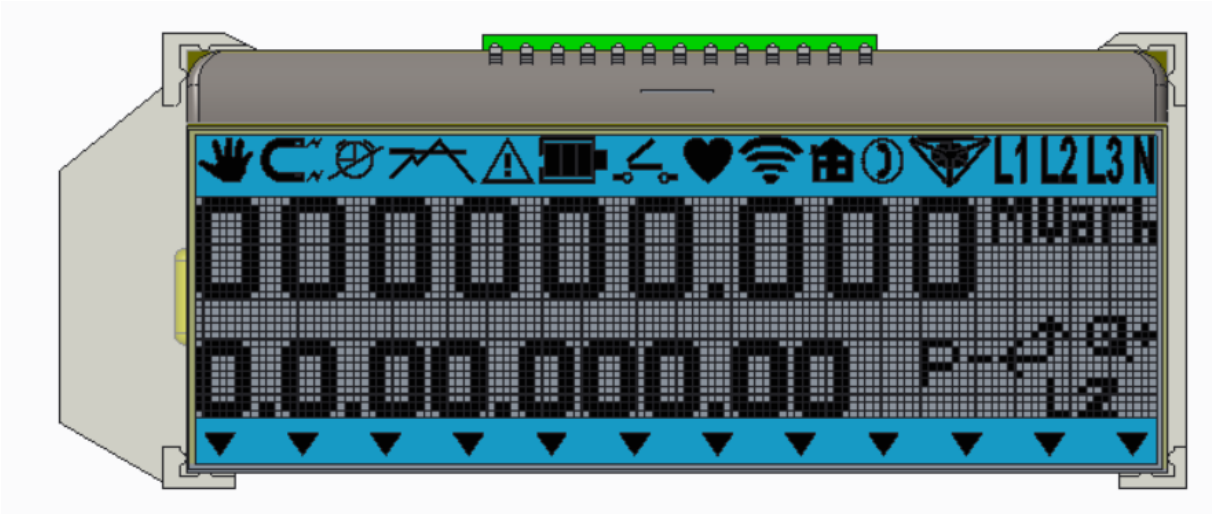
The meter is equipped with a front-panel mounted, high-visibility, liquid crystal display (LCD) capable of showing the values held in all billing and other registers, as well as configuration and other information displays.

The meter display has backlight function, which can be activated by pushing a button and then automatically switched off after 60 seconds of inactivity. If the meter is not powered, it is still possible to read out the tariff registers of the meter via the display, thanks to the RWP optional capability.

The meter configuration defines which displays are available to the user, the resolution of those displays and the order in which parameters appear. The configuration for any individual meter will initially be defined during manufacture according to the utility requirements. However, it may subsequently be changed using the meter support tool ACE Pilot.

9.1 LCD display

The drawing of the LCD is indicated in the following picture:



It comprises 3 main alphanumeric character displays:

- **Value field (9 digits max.)**: to show the register value with or without decimals depending on the energy registers resolution and demand registers resolution which can be configured separately.

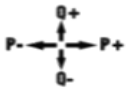
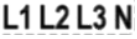
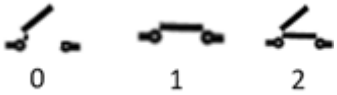
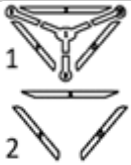
- **Unit field**: to show the unit and scaler of the value displayed. The following range of units can be displayed:

W	Wh	var	varh	VA	VAh	V	Ah
kW	kWh	kvar	kvarh	kVA	kVAh	A	Vh
MW	MWh	Mvar	Mvarh	MVA	MVAh	Hz	

- **OBIS code field (14 characters max.)**: to show the identification of the value displayed with the reduced OBIS code rules.

- A set of annunciator icons is also available to identify the current meter display mode and provide indication of various conditions, helpful for on-site maintenance.

The following items can be shown:

Icon	Name	Purpose
	Quadrant	Displays the direction and type of energy currently measured by the meter. The arrows indicate: ▪ Active and Reactive ▪ Import and Export
	Phase	Each of the three icons represent a connected phase. If a phase is missing, the associated icon is not lit. If the incoming supply phase-sequence is incorrect (e.g. 1,3,2) these three icons flash.
	Invalid clock	The icon is switched-on when the clock is invalid (e.g. lost).
	Alarm	The icon is switched-on when an alarm is detected.
	Load switch	Displays the current position of auxiliary relay: open (0), closed (1), or ready for reconnection (2).  0 1 2
	Battery	Displays indication about RTC battery level, with different blinking speed according to the voltage range.
	Local port	this icon appear when the serial port is set as DSMR
	MCOD/TCOD	This icon appears during Main or Terminal cover opening detection, auto disappears when the MCOD/TCOD is not active
	Topology	1: 3 phase 4 wire topology 2 : 3 phase 3 wire topology
	Signal	X: Signal value is 0
		Reserved for future use
	Custom Icon	1 triangle: Manual mode display 2 triangles: Test Mode display 3 triangles: stop mode measurements 4 triangles: Manufacture mode
	Limiter	Indicates that the load has exceeded the pre-defined threshold.
	Magnet	Indicates the presence of external magnetic field.
	Communication	Indicates that there is active communication in progress between the meter and an external device.

Note: All the items above are permanently shown independently of the meter display mode.

9.2 Push buttons

The meter is equipped with three front-panel mounted pushbutton controls, located adjacent to the LCD. The actions generated by these controls depend on the current operating mode and configuration of the meter, and the duration of the push on the button:

- Short push - (less than 2 seconds)
- Long push - (greater or equal to 2 seconds but less than 5 seconds)
- Very long push - (greater or equal to 5 seconds)

9.2.1 Display Up button (Button D_{up})

It is used to scroll up the data in the display sequence. It is accessible by all users.

9.2.1 Display Down button (Button D_{down})

It is used to scroll down the data in the display sequence. It is accessible by all users.

9.2.2 Sealable button (Button S)

It is used to perform some actions (e.g. perform a manual reset for End-Of-Billing). The button is protected with a seal, so that to ensure only authorized user can access (e.g. utilities agent).

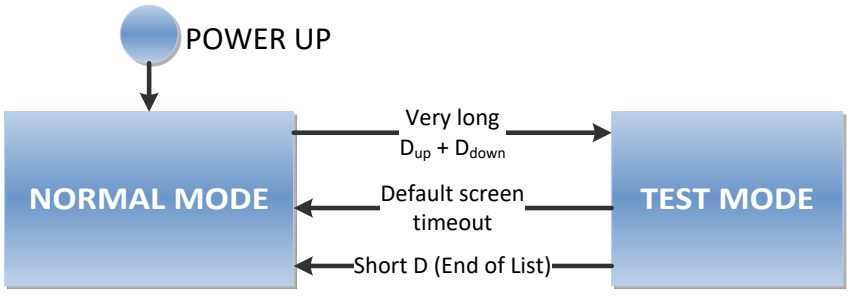
9.3 Display modes

The meter is designed to operate in the following display modes:

- Manual Mode
- Auto Scroll Mode (Normal mode)
- EOB reset mode
- RWP Mode
- Test Mode / MID Display

At power up, the meter displays the auto-scroll mode by default.

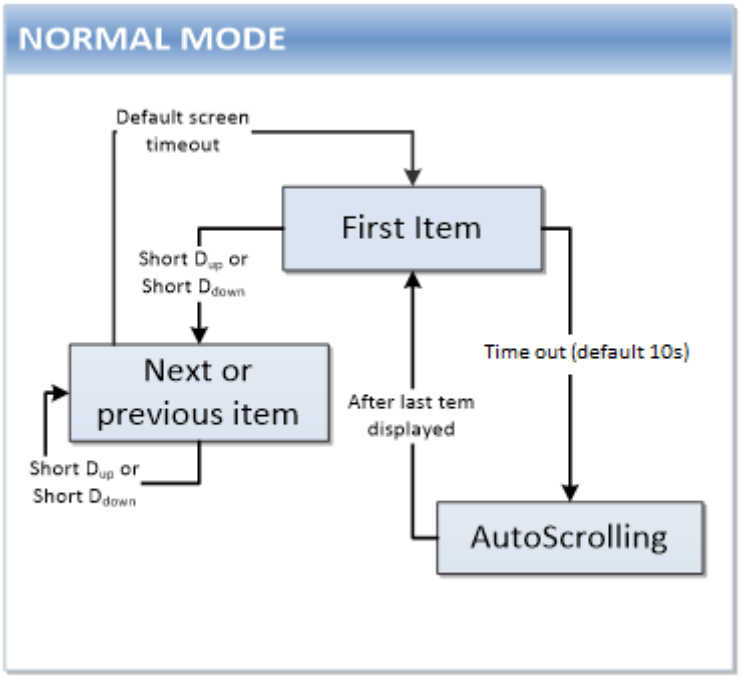
- When a long push is done on the UP button, meter enters inside the Manual mode.
- When a very long push is performed simultaneously on both scroll buttons, the meter switches to the test mode and provides legal information for MID.



The default screen timeout of inactivity is configurable in seconds (10 seconds, by default).

9.3.1 Normal mode

This is the default display mode where pre-selected energy parameter values and other meter data can manually or automatically scroll on to the LCD. The sequence of normal mode on LCD is described below:



When entering in this mode, the first item of the normal display list is displayed by default. The user can then manually scroll data up or down among this list using the D_{up} and D_{down} buttons. An auto scrolling mechanism can also be activated as shown in the diagram above. In this state, each item of the list is displayed consecutively with a configurable auto scroll time (2 seconds, by default).

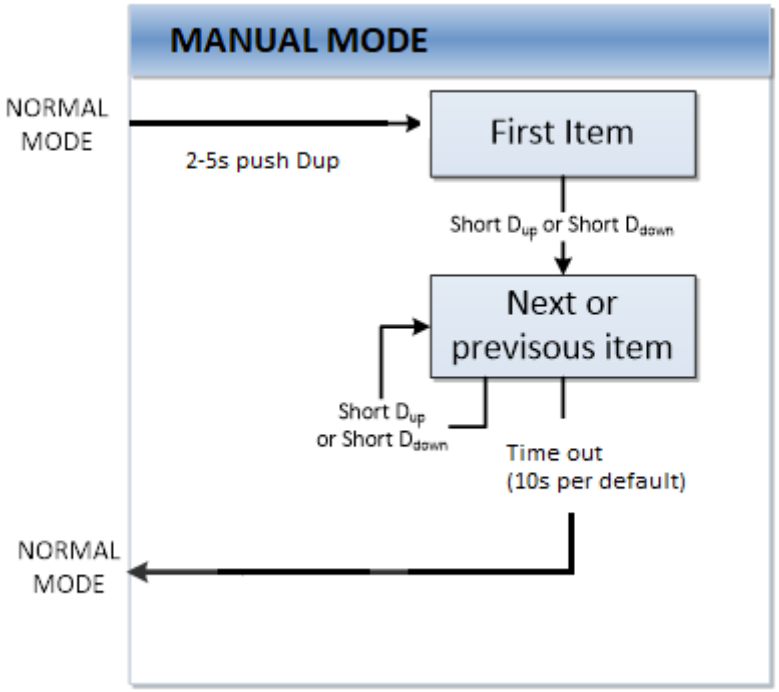
The display list in normal mode can contain up to 100 elements, configurable with ACE Pilot.

9.3.2 Manual Mode

This mode is entered from the Auto Scrolling mode, when a long push is performed on the button UP. Once entered in this mode, one triangle icon is visible on the bottom right side of the LCD.

A specific Display list is configurable inside the meter with ACE Pilot, for manual mode.

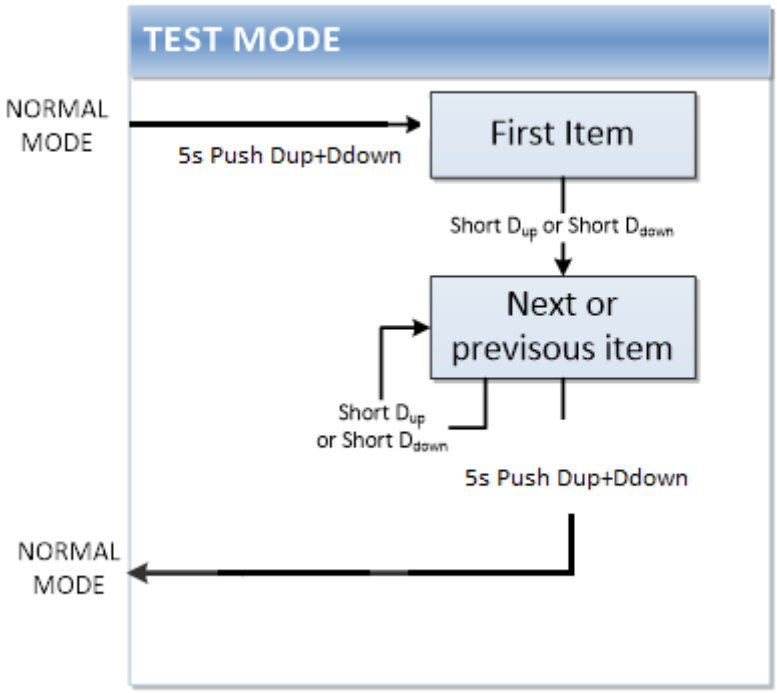
Return into auto scroll mode is done by reaching the time out (10s per default, without push on any button)



9.3.3 Test mode / MID Display

This is the mode where a specific pre-selected list of data can be manually scrolled by the user on the LCD. Pressing button UP/DOWN simultaneously during 5 seconds will force meter to enter into High Resolution mode (test mode/MID Display).

The sequence of test mode on LCD is described below:



When entering in this mode, the first item of the test display list is displayed by default. The user can then manually scroll data up or down among this list using the D_{up} and D_{down} buttons.

Display for test mode can be configured to display energies in Wh or kWh with 6+3 digit

The display list in test mode contains the following information:

total active import energy	**1-0:1.8.0.255**
total active export energy	**1-0:2.8.0.255**
total reactive import energy	**1-0:3.8.0.255**
total reactive export energy	**1-0:4.8.0.255**
total active absolute	**1-0:15.8.0.255**
metrology FW version	**·1:0.2.0.255**
Metrology firmware signature	**1-1:0.2.8.255**

Note: associated OBIS code might be different if a specific companion specification different than ICS is implemented

Exit test mode: Pressing UP/DOWN Button simultaneously during 5 seconds will disable high resolution test mode.

9.3.4 EOB reset mode

EOB reset mode is entered by a push on button reset.

The meter will trigger an EOB reset when a short push is performed on reset button. The confirmation message will be displayed:

- The meter will display *"DONE"* if the EOB reset has been successfully performed.
- The meter will display *"REFUSED"* if the EOB reset has not been performed (due to manual EOB not allowed or lock-out period in progress).

9.4 Display lists

The table below indicates the data which can be selected in the manual and autoscroll display sequences. The configuration also enables the user to define the order of each item within the list.

This is possible to configure up to 100 entries in manual display list, and 100 entries in autoscroll display list.

Data available on the display lists are part of the data listed below:

- Date and Time
- TER (aggregate in import, export, apparent, active, reactive, Q1/Q2/Q3/Q4 for reactive)
- Energy registers (per phase in import, export, apparent, active, reactive, Q1/Q2/Q3/Q4 for reactive)
- Energy rate registers
- Max demand registers
- Instantaneous aggregate powers import/export/Q1/Q2/Q3/Q4 (Q for reactive only) active/reactive/apparent
- Instantaneous power per phase import/export active/reactive/apparent
- Instantaneous values per phase : V (primary and secondary), I (primary and secondary), PF (and aggregate), Hz, voltage angles, U-I angles, load and voltage unbalance
- THD information (current, voltage)
- Other : FW numbers, checksums, CTVT ratio, active alarms, meter serial numbers, active rate

Below is the exhaustive list of data available on display:

Data	Obis Code
LocalTime	1;0;0;9;1;255
LocalDate	1;0;0;9;2;255
LoadManagementRelayControl	0;1;96;3;10;255
BatteryVoltage	0;0;96;6;3;255
TotalEnergyActiveImportAggregate	1;0;1;8;0;255
TotalEnergyActiveExportAggregate	1;0;2;8;0;255
TotalEnergyReactiveImportAggregate	1;0;3;8;0;255
TotalEnergyReactiveExportAggregate	1;0;4;8;0;255
TotalEnergyReactiveQ1Aggregate	1;0;5;8;0;255
TotalEnergyReactiveQ2Aggregate	1;0;6;8;0;255
TotalEnergyReactiveQ3Aggregate	1;0;7;8;0;255
TotalEnergyReactiveQ4Aggregate	1;0;8;8;0;255
TotalEnergyApparentImportAggregate	1;0;9;8;0;255
TotalEnergyApparentExportAggregate	1;0;10;8;0;255
TotalEnergyActiveAbsoluteAggregate	1;0;15;8;0;255
TotalEnergyActiveImportPhase1	1;0;21;8;0;255
TotalEnergyActiveExportPhase1	1;0;22;8;0;255
TotalEnergyReactiveImportPhase1	1;0;23;8;0;255
TotalEnergyReactiveExportPhase1	1;0;24;8;0;255
TotalEnergyReactiveQ1Phase1	1;0;25;8;0;255
TotalEnergyReactiveQ2Phase1	1;0;26;8;0;255

TotalEnergyReactiveQ3Phase1	1;0;27;8;0;255
TotalEnergyReactiveQ4Phase1	1;0;28;8;0;255
TotalEnergyApparentImportPhase1	1;0;29;8;0;255
TotalEnergyApparentExportPhase1	1;0;30;8;0;255
TotalEnergyActiveImportPhase2	1;0;41;8;0;255
TotalEnergyActiveExportPhase2	1;0;42;8;0;255
TotalEnergyReactiveImportPhase2	1;0;43;8;0;255
TotalEnergyReactiveExportPhase2	1;0;44;8;0;255
TotalEnergyReactiveQ1Phase2	1;0;45;8;0;255
TotalEnergyReactiveQ2Phase2	1;0;46;8;0;255
TotalEnergyReactiveQ3Phase2	1;0;47;8;0;255
TotalEnergyReactiveQ4Phase2	1;0;48;8;0;255
TotalEnergyApparentImportPhase2	1;0;49;8;0;255
TotalEnergyApparentExportPhase2	1;0;50;8;0;255
TotalEnergyActiveImportPhase3	1;0;61;8;0;255
TotalEnergyActiveExportPhase3	1;0;62;8;0;255
TotalEnergyReactiveImportPhase3	1;0;63;8;0;255
TotalEnergyReactiveExportPhase3	1;0;64;8;0;255
TotalEnergyReactiveQ1Phase3	1;0;65;8;0;255
TotalEnergyReactiveQ2Phase3	1;0;66;8;0;255
TotalEnergyReactiveQ3Phase3	1;0;67;8;0;255
TotalEnergyReactiveQ4Phase3	1;0;68;8;0;255
TotalEnergyApparentImportPhase3	1;0;69;8;0;255
TotalEnergyApparentExportPhase3	1;0;70;8;0;255
TotalEnergyActiveAbsolutePhase1	1;0;35;8;0;255
TotalEnergyActiveAbsolutePhase2	1;0;55;8;0;255
TotalEnergyActiveAbsolutePhase3	1;0;75;8;0;255
TotalEnergyActiveDifferenceAggregate	1;0;16;8;0;255
TotalEnergyActiveDifferencePhase1	1;0;36;8;0;255
TotalEnergyActiveDifferencePhase2	1;0;56;8;0;255
TotalEnergyActiveDifferencePhase3	1;0;76;8;0;255
TotalEnergyReactiveLagQ1Q3Aggregate	1;0;100;8;0;255
TotalEnergyReactiveLagQ1Q3Phase1	1;0;101;8;0;255
TotalEnergyReactiveLagQ1Q3Phase2	1;0;102;8;0;255
TotalEnergyReactiveLagQ1Q3Phase3	1;0;103;8;0;255
TotalEnergyReactiveLeadQ2Q4Aggregate	1;0;104;8;0;255
TotalEnergyReactiveLeadQ2Q4Phase1	1;0;105;8;0;255
TotalEnergyReactiveLeadQ2Q4Phase2	1;0;106;8;0;255
TotalEnergyReactiveLeadQ2Q4Phase3	1;0;107;8;0;255
EnergyActiveImportRate01	1;0;1;8;1;255
EnergyActiveImportRate02	1;0;1;8;2;255
EnergyActiveImportRate03	1;0;1;8;3;255
EnergyActiveImportRate04	1;0;1;8;4;255
EnergyActiveImportRate05	1;0;1;8;5;255
EnergyActiveImportRate06	1;0;1;8;6;255

EnergyActiveImportRate07	1;0;1;8;7;255
EnergyActiveImportRate08	1;0;1;8;8;255
EnergyActiveExportRate01	1;0;2;8;1;255
EnergyActiveExportRate02	1;0;2;8;2;255
EnergyActiveExportRate03	1;0;2;8;3;255
EnergyActiveExportRate04	1;0;2;8;4;255
EnergyActiveExportRate05	1;0;2;8;5;255
EnergyActiveExportRate06	1;0;2;8;6;255
EnergyActiveExportRate07	1;0;2;8;7;255
EnergyActiveExportRate08	1;0;2;8;8;255
EnergyReactiveImportRate01	1;0;3;8;1;255
EnergyReactiveImportRate02	1;0;3;8;2;255
EnergyReactiveImportRate03	1;0;3;8;3;255
EnergyReactiveImportRate04	1;0;3;8;4;255
EnergyReactiveImportRate05	1;0;3;8;5;255
EnergyReactiveImportRate06	1;0;3;8;6;255
EnergyReactiveImportRate07	1;0;3;8;7;255
EnergyReactiveImportRate08	1;0;3;8;8;255
EnergyReactiveExportRate01	1;0;4;8;1;255
EnergyReactiveExportRate02	1;0;4;8;2;255
EnergyReactiveExportRate03	1;0;4;8;3;255
EnergyReactiveExportRate04	1;0;4;8;4;255
EnergyReactiveExportRate05	1;0;4;8;5;255
EnergyReactiveExportRate06	1;0;4;8;6;255
EnergyReactiveExportRate07	1;0;4;8;7;255
EnergyReactiveExportRate08	1;0;4;8;8;255
EnergyReactiveQ1Rate01	1;0;5;8;1;255
EnergyReactiveQ1Rate02	1;0;5;8;2;255
EnergyReactiveQ1Rate03	1;0;5;8;3;255
EnergyReactiveQ1Rate04	1;0;5;8;4;255
EnergyReactiveQ1Rate05	1;0;5;8;5;255
EnergyReactiveQ1Rate06	1;0;5;8;6;255
EnergyReactiveQ1Rate07	1;0;5;8;7;255
EnergyReactiveQ1Rate08	1;0;5;8;8;255
EnergyReactiveQ4Rate01	1;0;8;8;1;255
EnergyReactiveQ4Rate02	1;0;8;8;2;255
EnergyReactiveQ4Rate03	1;0;8;8;3;255
EnergyReactiveQ4Rate04	1;0;8;8;4;255
EnergyReactiveQ4Rate05	1;0;8;8;5;255
EnergyReactiveQ4Rate06	1;0;8;8;6;255
EnergyReactiveQ4Rate07	1;0;8;8;7;255
EnergyReactiveQ4Rate08	1;0;8;8;8;255
EnergyApparentImportRate01	1;0;9;8;1;255
EnergyApparentImportRate02	1;0;9;8;2;255
EnergyApparentImportRate03	1;0;9;8;3;255

EnergyApparentImportRate04	1;0;9;8;4;255
EnergyApparentImportRate05	1;0;9;8;5;255
EnergyApparentImportRate06	1;0;9;8;6;255
EnergyApparentImportRate07	1;0;9;8;7;255
EnergyApparentImportRate08	1;0;9;8;8;255
EnergyApparentExportRate01	1;0;10;8;1;255
EnergyApparentExportRate02	1;0;10;8;2;255
EnergyApparentExportRate03	1;0;10;8;3;255
EnergyApparentExportRate04	1;0;10;8;4;255
EnergyApparentExportRate05	1;0;10;8;5;255
EnergyApparentExportRate06	1;0;10;8;6;255
EnergyApparentExportRate07	1;0;10;8;7;255
EnergyApparentExportRate08	1;0;10;8;8;255
EnergyReactiveQ2Rate01	1;0;6;8;1;255
EnergyReactiveQ2Rate02	1;0;6;8;2;255
EnergyReactiveQ2Rate03	1;0;6;8;3;255
EnergyReactiveQ2Rate04	1;0;6;8;4;255
EnergyReactiveQ2Rate05	1;0;6;8;5;255
EnergyReactiveQ2Rate06	1;0;6;8;6;255
EnergyReactiveQ2Rate07	1;0;6;8;7;255
EnergyReactiveQ2Rate08	1;0;6;8;8;255
EnergyReactiveQ3Rate01	1;0;7;8;1;255
EnergyReactiveQ3Rate02	1;0;7;8;2;255
EnergyReactiveQ3Rate03	1;0;7;8;3;255
EnergyReactiveQ3Rate04	1;0;7;8;4;255
EnergyReactiveQ3Rate05	1;0;7;8;5;255
EnergyReactiveQ3Rate06	1;0;7;8;6;255
EnergyReactiveQ3Rate07	1;0;7;8;7;255
EnergyReactiveQ3Rate08	1;0;7;8;8;255
TotalEnergyActiveAbsoluteAggregateRate01	1;0;15;8;1;255
TotalEnergyActiveAbsoluteAggregateRate02	1;0;15;8;2;255
TotalEnergyActiveAbsoluteAggregateRate03	1;0;15;8;3;255
TotalEnergyActiveAbsoluteAggregateRate04	1;0;15;8;4;255
TotalEnergyActiveAbsoluteAggregateRate05	1;0;15;8;5;255
TotalEnergyActiveAbsoluteAggregateRate06	1;0;15;8;6;255
TotalEnergyActiveAbsoluteAggregateRate07	1;0;15;8;7;255
TotalEnergyActiveAbsoluteAggregateRate08	1;0;15;8;8;255
InstantaneousPowerActiveImportAggregate	1;0;1;7;0;255
InstantaneousPowerActiveExportAggregate	1;0;2;7;0;255
InstantaneousPowerReactiveImportAggregate	1;0;3;7;0;255
InstantaneousPowerReactiveExportAggregate	1;0;4;7;0;255
InstantaneousPowerApparentImportAggregate	1;0;9;7;0;255
InstantaneousPowerApparentExportAggregate	1;0;10;7;0;255
InstantaneousPwrFactorImportAggregate	1;0;13;7;0;255
InstantaneousSupplyFrequency	1;0;14;7;0;255

InstantaneousRMSVoltagePhase1	1;0;32;7;0;255
InstantaneousRMSCurrentPhase1	1;0;31;7;0;255
InstantaneousPwrFactorImportPhase1	1;0;33;7;0;255
InstantaneousRMSVoltagePhase2	1;0;52;7;0;255
InstantaneousRMSCurrentPhase2	1;0;51;7;0;255
InstantaneousPwrFactorImportPhase2	1;0;53;7;0;255
InstantaneousRMSVoltagePhase3	1;0;72;7;0;255
InstantaneousRMSCurrentPhase3	1;0;71;7;0;255
InstantaneousPwrFactorImportPhase3	1;0;73;7;0;255
InstantaneousPowerActivePhase1	1;0;35;7;0;255
InstantaneousPowerActivePhase2	1;0;55;7;0;255
InstantaneousPowerActivePhase3	1;0;75;7;0;255
InstantaneousVoltageU1U2	1;0;124;7;0;255
InstantaneousVoltageU2U3	1;0;125;7;0;255
InstantaneousVoltageU3U1	1;0;126;7;0;255
InstantaneousCurrentAggregate	1;0;90;7;0;255
InstantaneousRMSCurrentNeutral	1;0;91;7;0;255
InstantaneousRMSVoltageNeutral	1;0;92;7;0;255
InstantaneousPowerActiveAbsolute	1;0;15;7;0;255
InstantaneousPowerActiveDifference	1;0;16;7;0;255
InstantaneousPowerReactiveImportPhase1	1;0;23;7;0;255
InstantaneousPowerReactiveImportPhase2	1;0;43;7;0;255
InstantaneousPowerReactiveImportPhase3	1;0;63;7;0;255
InstantaneousPowerReactiveExportPhase1	1;0;24;7;0;255
InstantaneousPowerReactiveExportPhase2	1;0;44;7;0;255
InstantaneousPowerReactiveExportPhase3	1;0;64;7;0;255
InstantaneousPowerApparentImportPhase1	1;0;29;7;0;255
InstantaneousPowerApparentImportPhase2	1;0;49;7;0;255
InstantaneousPowerApparentImportPhase3	1;0;69;7;0;255
InstantaneousPowerApparentExportPhase1	1;0;30;7;0;255
InstantaneousPowerApparentExportPhase2	1;0;50;7;0;255
InstantaneousPowerApparentExportPhase3	1;0;70;7;0;255
InstantaneousPowerActiveImportPhase1	1;0;21;7;0;255
InstantaneousPowerActiveImportPhase2	1;0;41;7;0;255
InstantaneousPowerActiveImportPhase3	1;0;61;7;0;255
InstantaneousPowerActiveExportPhase1	1;0;22;7;0;255
InstantaneousPowerActiveExportPhase2	1;0;42;7;0;255
InstantaneousPowerActiveExportPhase3	1;0;62;7;0;255
InstantaneousAngleU3I3Phase3	1;0;81;7;62;255
InstantaneousTHDCurrentPhase1	1;0;31;7;124;255
InstantaneousTHDCurrentPhase2	1;0;51;7;124;255
InstantaneousTHDCurrentPhase3	1;0;71;7;124;255
InstantaneousTHDVoltagePhase1	1;0;32;7;124;255
InstantaneousTHDVoltagePhase2	1;0;52;7;124;255
InstantaneousTHDVoltagePhase3	1;0;72;7;124;255

InstantaneousAngleU1I1Phase1	1;0;81;7;40;255
InstantaneousAngleU2I2Phase2	1;0;81;7;51;255
InstantaneousAngleU3I3Phase3	1;0;81;7;62;255
PhaseAngleU1-Neutral	1;0;81;7;70;255
PhaseAngleU2-Neutral	1;0;81;7;71;255
PhaseAngleU3-Neutral	1;0;81;7;72;255
PhaseAngleU1U2	1;0;81;7;10;255
PhaseAngleU2U3	1;0;81;7;21;255
PhaseAngleU3U1	1;0;81;7;2;255
PhaseAngleI1I2	1;0;81;7;54;255
PhaseAngleI2I3	1;0;81;7;65;255
PhaseAngleI3I1	1;0;81;7;46;255
InstantaneousRMSVoltageFundamentalPhase1	1;0;32;7;1;255
InstantaneousRMSCurrentFundamentalPhase1	1;0;31;7;1;255
InstantaneousRMSVoltageFundamentalPhase2	1;0;52;7;1;255
InstantaneousRMSCurrentFundamentalPhase2	1;0;51;7;1;255
InstantaneousRMSVoltageFundamentalPhase3	1;0;72;7;1;255
InstantaneousRMSCurrentFundamentalPhase3	1;0;71;7;1;255
DemandActiveImportRate00	1;0;1;4;0;255
DemandActiveExportRate00	1;0;2;4;0;255
DemandReactiveImportRate00	1;0;3;4;0;255
DemandReactiveExportRate00	1;0;4;4;0;255
DemandApparentImportRate00	1;0;9;4;0;255
DemandApparentExportRate00	1;0;10;4;0;255
DemandReactiveQ1Rate00	1;0;5;4;0;255
DemandReactiveQ2Rate00	1;0;6;4;0;255
DemandReactiveQ3Rate00	1;0;7;4;0;255
DemandReactiveQ4Rate00	1;0;8;4;0;255
DemandActiveImportRate01	1;0;1;4;1;255
DemandActiveImportRate02	1;0;1;4;2;255
DemandActiveImportRate03	1;0;1;4;3;255
DemandActiveImportRate04	1;0;1;4;4;255
DemandActiveImportRate05	1;0;1;4;5;255
DemandActiveImportRate06	1;0;1;4;6;255
DemandActiveImportRate07	1;0;1;4;7;255
DemandActiveImportRate08	1;0;1;4;8;255
DemandActiveExportRate01	1;0;2;4;1;255
DemandActiveExportRate02	1;0;2;4;2;255
DemandActiveExportRate03	1;0;2;4;3;255
DemandActiveExportRate04	1;0;2;4;4;255
DemandActiveExportRate05	1;0;2;4;5;255
DemandActiveExportRate06	1;0;2;4;6;255
DemandActiveExportRate07	1;0;2;4;7;255
DemandActiveExportRate08	1;0;2;4;8;255
DemandReactiveImportRate01	1;0;3;4;1;255

DemandReactiveImportRate02	1;0;3;4;2;255
DemandReactiveImportRate03	1;0;3;4;3;255
DemandReactiveImportRate04	1;0;3;4;4;255
DemandReactiveImportRate05	1;0;3;4;5;255
DemandReactiveImportRate06	1;0;3;4;6;255
DemandReactiveImportRate07	1;0;3;4;7;255
DemandReactiveImportRate08	1;0;3;4;8;255
DemandReactiveExportRate01	1;0;4;4;1;255
DemandReactiveExportRate02	1;0;4;4;2;255
DemandReactiveExportRate03	1;0;4;4;3;255
DemandReactiveExportRate04	1;0;4;4;4;255
DemandReactiveExportRate05	1;0;4;4;5;255
DemandReactiveExportRate06	1;0;4;4;6;255
DemandReactiveExportRate07	1;0;4;4;7;255
DemandReactiveExportRate08	1;0;4;4;8;255
DemandApparentImportRate01	1;0;9;4;1;255
DemandApparentImportRate02	1;0;9;4;2;255
DemandApparentImportRate03	1;0;9;4;3;255
DemandApparentImportRate04	1;0;9;4;4;255
DemandApparentImportRate05	1;0;9;4;5;255
DemandApparentImportRate06	1;0;9;4;6;255
DemandApparentImportRate07	1;0;9;4;7;255
DemandApparentImportRate08	1;0;9;4;8;255
DemandApparentExportRate01	1;0;10;4;1;255
DemandApparentExportRate02	1;0;10;4;2;255
DemandApparentExportRate03	1;0;10;4;3;255
DemandApparentExportRate04	1;0;10;4;4;255
DemandApparentExportRate05	1;0;10;4;5;255
DemandApparentExportRate06	1;0;10;4;6;255
DemandApparentExportRate07	1;0;10;4;7;255
DemandApparentExportRate08	1;0;10;4;8;255
DemandReactiveQ1Rate01	1;0;5;4;1;255
DemandReactiveQ1Rate02	1;0;5;4;2;255
DemandReactiveQ1Rate03	1;0;5;4;3;255
DemandReactiveQ1Rate04	1;0;5;4;4;255
DemandReactiveQ1Rate05	1;0;5;4;5;255
DemandReactiveQ1Rate06	1;0;5;4;6;255
DemandReactiveQ1Rate07	1;0;5;4;7;255
DemandReactiveQ1Rate08	1;0;5;4;8;255
DemandReactiveQ2Rate01	1;0;6;4;1;255
DemandReactiveQ2Rate02	1;0;6;4;2;255
DemandReactiveQ2Rate03	1;0;6;4;3;255
DemandReactiveQ2Rate04	1;0;6;4;4;255
DemandReactiveQ2Rate05	1;0;6;4;5;255
DemandReactiveQ2Rate06	1;0;6;4;6;255

DemandReactiveQ2Rate07	1;0;6;4;7;255
DemandReactiveQ2Rate08	1;0;6;4;8;255
DemandReactiveQ3Rate01	1;0;7;4;1;255
DemandReactiveQ3Rate02	1;0;7;4;2;255
DemandReactiveQ3Rate03	1;0;7;4;3;255
DemandReactiveQ3Rate04	1;0;7;4;4;255
DemandReactiveQ3Rate05	1;0;7;4;5;255
DemandReactiveQ3Rate06	1;0;7;4;6;255
DemandReactiveQ3Rate07	1;0;7;4;7;255
DemandReactiveQ3Rate08	1;0;7;4;8;255
DemandReactiveQ4Rate01	1;0;8;4;1;255
DemandReactiveQ4Rate02	1;0;8;4;2;255
DemandReactiveQ4Rate03	1;0;8;4;3;255
DemandReactiveQ4Rate04	1;0;8;4;4;255
DemandReactiveQ4Rate05	1;0;8;4;5;255
DemandReactiveQ4Rate06	1;0;8;4;6;255
DemandReactiveQ4Rate07	1;0;8;4;7;255
DemandReactiveQ4Rate08	1;0;8;4;8;255
DemandActiveImportPhase1	1;0;21;4;0;255
DemandActiveImportPhase2	1;0;41;4;0;255
DemandActiveImportPhase3	1;0;61;4;0;255
DemandActiveExportPhase1	1;0;22;4;0;255
DemandActiveExportPhase2	1;0;42;4;0;255
DemandActiveExportPhase3	1;0;62;4;0;255
DemandReactiveImportPhase1	1;0;23;4;0;255
DemandReactiveImportPhase2	1;0;43;4;0;255
DemandReactiveImportPhase3	1;0;63;4;0;255
DemandReactiveExportPhase1	1;0;24;4;0;255
DemandReactiveExportPhase2	1;0;44;4;0;255
DemandReactiveExportPhase3	1;0;64;4;0;255
DemandApparentImportPhase1	1;0;29;4;0;255
DemandApparentImportPhase2	1;0;49;4;0;255
DemandApparentImportPhase3	1;0;69;4;0;255
DemandApparentExportPhase1	1;0;30;4;0;255
DemandApparentExportPhase2	1;0;50;4;0;255
DemandApparentExportPhase3	1;0;70;4;0;255
MaximumDemandActiveImportRate00	1;0;1;6;0;255
MaximumDemandActiveExportRate00	1;0;2;6;0;255
MaximumDemandReactiveImportRate00	1;0;3;6;0;255
MaximumDemandReactiveExportRate00	1;0;4;6;0;255
MaximumDemandApparentImportRate00	1;0;9;6;0;255
MaximumDemandApparentExportRate00	1;0;10;6;0;255
MaximumDemandReactiveQ1Rate00	1;0;5;6;0;255
MaximumDemandReactiveQ2Rate00	1;0;6;6;0;255
MaximumDemandReactiveQ3Rate00	1;0;7;6;0;255

MaximumDemandReactiveQ4Rate00	1;0;8;6;0;255
MaximumDemandActiveImportRate01	1;0;1;6;1;255
MaximumDemandActiveImportRate02	1;0;1;6;2;255
MaximumDemandActiveImportRate03	1;0;1;6;3;255
MaximumDemandActiveImportRate04	1;0;1;6;4;255
MaximumDemandActiveImportRate05	1;0;1;6;5;255
MaximumDemandActiveImportRate06	1;0;1;6;6;255
MaximumDemandActiveImportRate07	1;0;1;6;7;255
MaximumDemandActiveImportRate08	1;0;1;6;8;255
MaximumDemandActiveExportRate01	1;0;2;6;1;255
MaximumDemandActiveExportRate02	1;0;2;6;2;255
MaximumDemandActiveExportRate03	1;0;2;6;3;255
MaximumDemandActiveExportRate04	1;0;2;6;4;255
MaximumDemandActiveExportRate05	1;0;2;6;5;255
MaximumDemandActiveExportRate06	1;0;2;6;6;255
MaximumDemandActiveExportRate07	1;0;2;6;7;255
MaximumDemandActiveExportRate08	1;0;2;6;8;255
MaximumDemandReactiveImportRate01	1;0;3;6;1;255
MaximumDemandReactiveImportRate02	1;0;3;6;2;255
MaximumDemandReactiveImportRate03	1;0;3;6;3;255
MaximumDemandReactiveImportRate04	1;0;3;6;4;255
MaximumDemandReactiveImportRate05	1;0;3;6;5;255
MaximumDemandReactiveImportRate06	1;0;3;6;6;255
MaximumDemandReactiveImportRate07	1;0;3;6;7;255
MaximumDemandReactiveImportRate08	1;0;3;6;8;255
MaximumDemandReactiveExportRate01	1;0;4;6;1;255
MaximumDemandReactiveExportRate02	1;0;4;6;2;255
MaximumDemandReactiveExportRate03	1;0;4;6;3;255
MaximumDemandReactiveExportRate04	1;0;4;6;4;255
MaximumDemandReactiveExportRate05	1;0;4;6;5;255
MaximumDemandReactiveExportRate06	1;0;4;6;6;255
MaximumDemandReactiveExportRate07	1;0;4;6;7;255
MaximumDemandReactiveExportRate08	1;0;4;6;8;255
MaximumDemandApparentImportRate01	1;0;9;6;1;255
MaximumDemandApparentImportRate02	1;0;9;6;2;255
MaximumDemandApparentImportRate03	1;0;9;6;3;255
MaximumDemandApparentImportRate04	1;0;9;6;4;255
MaximumDemandApparentImportRate05	1;0;9;6;5;255
MaximumDemandApparentImportRate06	1;0;9;6;6;255
MaximumDemandApparentImportRate07	1;0;9;6;7;255
MaximumDemandApparentImportRate08	1;0;9;6;8;255
MaximumDemandApparentExportRate01	1;0;10;6;1;255
MaximumDemandApparentExportRate02	1;0;10;6;2;255
MaximumDemandApparentExportRate03	1;0;10;6;3;255
MaximumDemandApparentExportRate04	1;0;10;6;4;255

MaximumDemandApparentExportRate05	1;0;10;6;5;255
MaximumDemandApparentExportRate06	1;0;10;6;6;255
MaximumDemandApparentExportRate07	1;0;10;6;7;255
MaximumDemandApparentExportRate08	1;0;10;6;8;255
MaximumDemandReactiveQ1Rate01	1;0;5;6;1;255
MaximumDemandReactiveQ1Rate02	1;0;5;6;2;255
MaximumDemandReactiveQ1Rate03	1;0;5;6;3;255
MaximumDemandReactiveQ1Rate04	1;0;5;6;4;255
MaximumDemandReactiveQ1Rate05	1;0;5;6;5;255
MaximumDemandReactiveQ1Rate06	1;0;5;6;6;255
MaximumDemandReactiveQ1Rate07	1;0;5;6;7;255
MaximumDemandReactiveQ1Rate08	1;0;5;6;8;255
MaximumDemandReactiveQ2Rate01	1;0;6;6;1;255
MaximumDemandReactiveQ2Rate02	1;0;6;6;2;255
MaximumDemandReactiveQ2Rate03	1;0;6;6;3;255
MaximumDemandReactiveQ2Rate04	1;0;6;6;4;255
MaximumDemandReactiveQ2Rate05	1;0;6;6;5;255
MaximumDemandReactiveQ2Rate06	1;0;6;6;6;255
MaximumDemandReactiveQ2Rate07	1;0;6;6;7;255
MaximumDemandReactiveQ2Rate08	1;0;6;6;8;255
MaximumDemandReactiveQ3Rate01	1;0;7;6;1;255
MaximumDemandReactiveQ3Rate02	1;0;7;6;2;255
MaximumDemandReactiveQ3Rate03	1;0;7;6;3;255
MaximumDemandReactiveQ3Rate04	1;0;7;6;4;255
MaximumDemandReactiveQ3Rate05	1;0;7;6;5;255
MaximumDemandReactiveQ3Rate06	1;0;7;6;6;255
MaximumDemandReactiveQ3Rate07	1;0;7;6;7;255
MaximumDemandReactiveQ3Rate08	1;0;7;6;8;255
MaximumDemandReactiveQ4Rate01	1;0;8;6;1;255
MaximumDemandReactiveQ4Rate02	1;0;8;6;2;255
MaximumDemandReactiveQ4Rate03	1;0;8;6;3;255
MaximumDemandReactiveQ4Rate04	1;0;8;6;4;255
MaximumDemandReactiveQ4Rate05	1;0;8;6;5;255
MaximumDemandReactiveQ4Rate06	1;0;8;6;6;255
MaximumDemandReactiveQ4Rate07	1;0;8;6;7;255
MaximumDemandReactiveQ4Rate08	1;0;8;6;8;255
MaximumDemandActiveImportPhase1	1;0;21;6;0;255
MaximumDemandActiveImportPhase2	1;0;41;6;0;255
MaximumDemandActiveImportPhase3	1;0;61;6;0;255
MaximumDemandActiveExportPhase1	1;0;22;6;0;255
MaximumDemandActiveExportPhase2	1;0;42;6;0;255
MaximumDemandActiveExportPhase3	1;0;62;6;0;255
MaximumDemandReactiveImportPhase1	1;0;23;6;0;255
MaximumDemandReactiveImportPhase2	1;0;43;6;0;255
MaximumDemandReactiveImportPhase3	1;0;63;6;0;255

MaximumDemandReactiveExportPhase1	1;0;24;6;0;255
MaximumDemandReactiveExportPhase2	1;0;44;6;0;255
MaximumDemandReactiveExportPhase3	1;0;64;6;0;255
MaximumDemandApparentImportPhase1	1;0;29;6;0;255
MaximumDemandApparentImportPhase2	1;0;49;6;0;255
MaximumDemandApparentImportPhase3	1;0;69;6;0;255
MaximumDemandApparentExportPhase1	1;0;30;6;0;255
MaximumDemandApparentExportPhase2	1;0;50;6;0;255
MaximumDemandApparentExportPhase3	1;0;70;6;0;255
DemandLastAverageActiveExport	1;0;2;5;0;255
DemandLastAverageActiveImport	1;0;1;5;0;255
DemandLastAverageApparentExport	1;0;10;5;0;255
DemandLastAverageApparentImport	1;0;9;5;0;255
DemandLastAverageReactiveExport	1;0;4;5;0;255
DemandLastAverageReactiveImport	1;0;3;5;0;255
BillingPeriodCounter	0;0;0;1;0;255
NumberOfAvailableBillingPeriods	0;0;0;1;1;255
MostRecentBillingPeriodTimeStamp	0;0;0;1;2;255
EOBLockoutPeriod	1;0;0;9;16;255
AppliFirmwareVersion	1;0;0;2;0;255
AppliFirmwareSignature	1;0;0;2;8;255
MetrolFirmwareVersion	1;1;0;2;0;255
MetrolFirmwareSignature	1;1;0;2;8;255
CTNumerator	1;0;0;4;2;255
VTNumerator	1;0;0;4;3;255
CTDenominator	1;0;0;4;5;255
VTDenominator	1;0;0;4;6;255
CommunicationEventCode	0;0;96;11;5;255
ErrorRegister	0;0;97;97;0;255
AlarmFilter1	0;0;97;98;10;255
AlarmDescriptor1	0;0;97;98;20;255
StandardEventCode	0;0;96;11;0;255
FraudEventCode	0;0;96;11;1;255
AlarmRegister1	0;0;97;98;0;255
AlarmRegister2	0;0;97;98;1;255
AlarmFilter2	0;0;97;98;11;255
AlarmDescriptor2	0;0;97;98;21;255
AlarmFilter3	0;0;97;98;12;255
AlarmRegister3	0;0;97;98;2;255
AlarmDescriptor3	0;0;97;98;22;255
ErrorRegister2	0;0;97;97;1;255
ErrorRegister3	0;0;97;97;2;255
MeterSerialNumber	0;0;96;1;0;255
DeviceID2CustomerMeterIdentifier	0;0;96;1;1;255
DeviceID3MeterPaymentType	0;0;96;1;2;255

COSEMLogicalDeviceName	0;0;42;0;0;255
CurrentActiveTariff	0;0;96;14;0;255
DeviceID4LocationInformation	0;0;96;1;3;255
DeviceId5HardwareId	0;0;96;1;4;255
DeviceID6	0;0;96;1;5;255
DeviceID7ICSIdentificationNumber	0;0;96;1;6;255
MaximumDemandActiveImportRate00	1;0;1;6;0;255
MaximumDemandActiveExportRate00	1;0;2;6;0;255
MaximumDemandReactiveImportRate00	1;0;3;6;0;255
MaximumDemandReactiveExportRate00	1;0;4;6;0;255
MaximumDemandApparentImportRate00	1;0;9;6;0;255
MaximumDemandApparentExportRate00	1;0;10;6;0;255
MaximumDemandReactiveQ1Rate00	1;0;5;6;0;255
MaximumDemandReactiveQ2Rate00	1;0;6;6;0;255
MaximumDemandReactiveQ3Rate00	1;0;7;6;0;255
MaximumDemandReactiveQ4Rate00	1;0;8;6;0;255
DemandActiveImportRate00	1;0;1;4;0;255
DemandActiveExportRate00	1;0;2;4;0;255
DemandReactiveImportRate00	1;0;3;4;0;255
DemandReactiveExportRate00	1;0;4;4;0;255
DemandApparentImportRate00	1;0;9;4;0;255
DemandApparentExportRate00	1;0;10;4;0;255
DemandReactiveQ1Rate00	1;0;5;4;0;255
DemandReactiveQ2Rate00	1;0;6;4;0;255
DemandReactiveQ3Rate00	1;0;7;4;0;255
DemandReactiveQ4Rate00	1;0;8;4;0;255
DemandActiveImportRate00	1;0;1;4;0;255
DemandActiveExportRate00	1;0;2;4;0;255
DemandReactiveImportRate00	1;0;3;4;0;255
DemandReactiveExportRate00	1;0;4;4;0;255
DemandApparentImportRate00	1;0;9;4;0;255
DemandApparentExportRate00	1;0;10;4;0;255
DemandReactiveQ1Rate00	1;0;5;4;0;255
DemandReactiveQ2Rate00	1;0;6;4;0;255
DemandReactiveQ3Rate00	1;0;7;4;0;255
DemandReactiveQ4Rate00	1;0;8;4;0;255
DemandActiveImportRate00	1;0;1;4;0;255
DemandActiveExportRate00	1;0;2;4;0;255
DemandReactiveImportRate00	1;0;3;4;0;255
DemandReactiveExportRate00	1;0;4;4;0;255
DemandApparentImportRate00	1;0;9;4;0;255
DemandApparentExportRate00	1;0;10;4;0;255
DemandReactiveQ1Rate00	1;0;5;4;0;255
DemandReactiveQ2Rate00	1;0;6;4;0;255
DemandReactiveQ3Rate00	1;0;7;4;0;255

DemandReactiveQ4Rate00	1;0;8;4;0;255

Note for Event codes, Alarm registers and Alarm descriptors:

- Event code: will display only the latest event detected by the meter.
- Alarm Register: will display event that are ongoing. Bit detection is not latch.
- Alarm Descriptor: similar to register, but the bit detection are latched until meter receive command to clear the list.

Bit used for Alarm registers/alarm descriptors are given in §6.13.2.

Example:

- Display of alarm descriptor 2 shows value of 512, it means “phase asymmetry” was or is occurring. Binary conversion 0000 0000 0100
- Display of alarm descriptor 2 shows value of 16777219, it means “total power failure”, “power resume” and “power factor deviation on L1” were or are occurring. Binary conversion 1100 0000 0000 0000 0000 0000 1000

CHAPTER 10
Installation

10.1 Warnings

DANGER OF ELECTRIC SHOCK
Before and during installation of a meter, observe all requirements given in the Safety information. In particular:

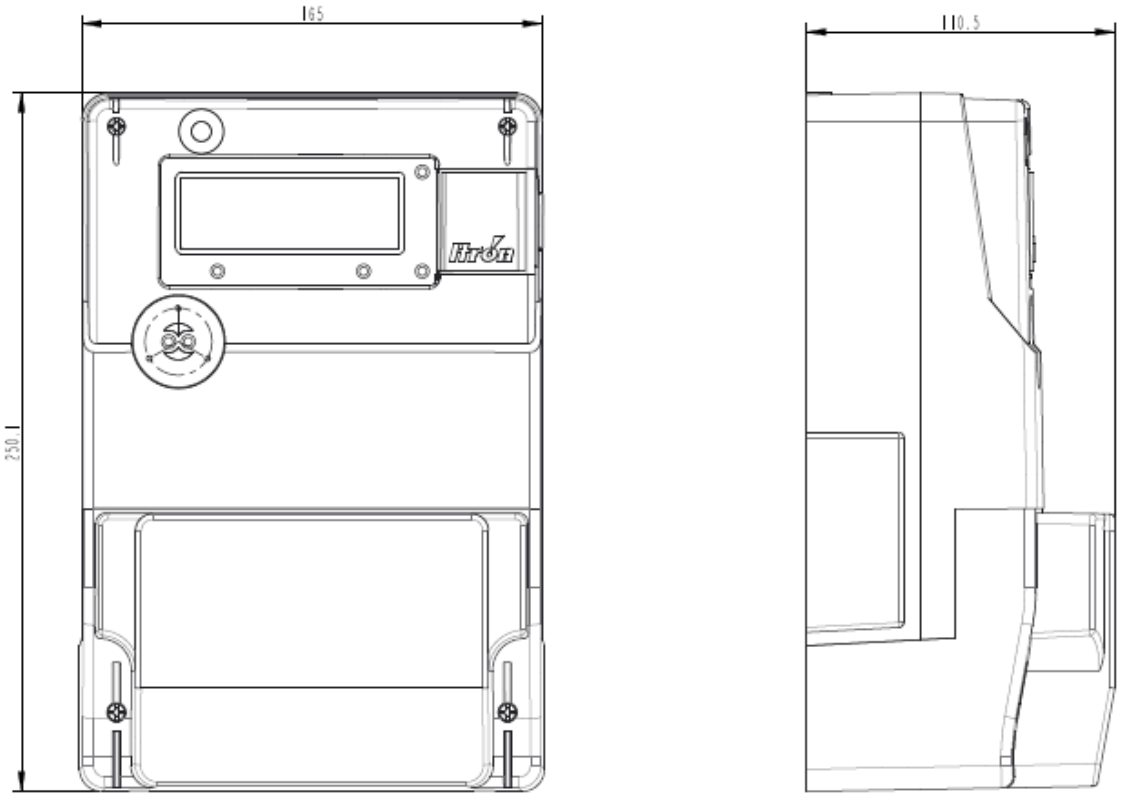
- Meters must be installed only by suitably-qualified personnel.
- Ensure that the meter supply cabling is isolated from the mains supply, and that the isolation cannot be overridden by another person.
- Following installation, ensure that the meter covers are correctly fitted and sealed to prevent user access.

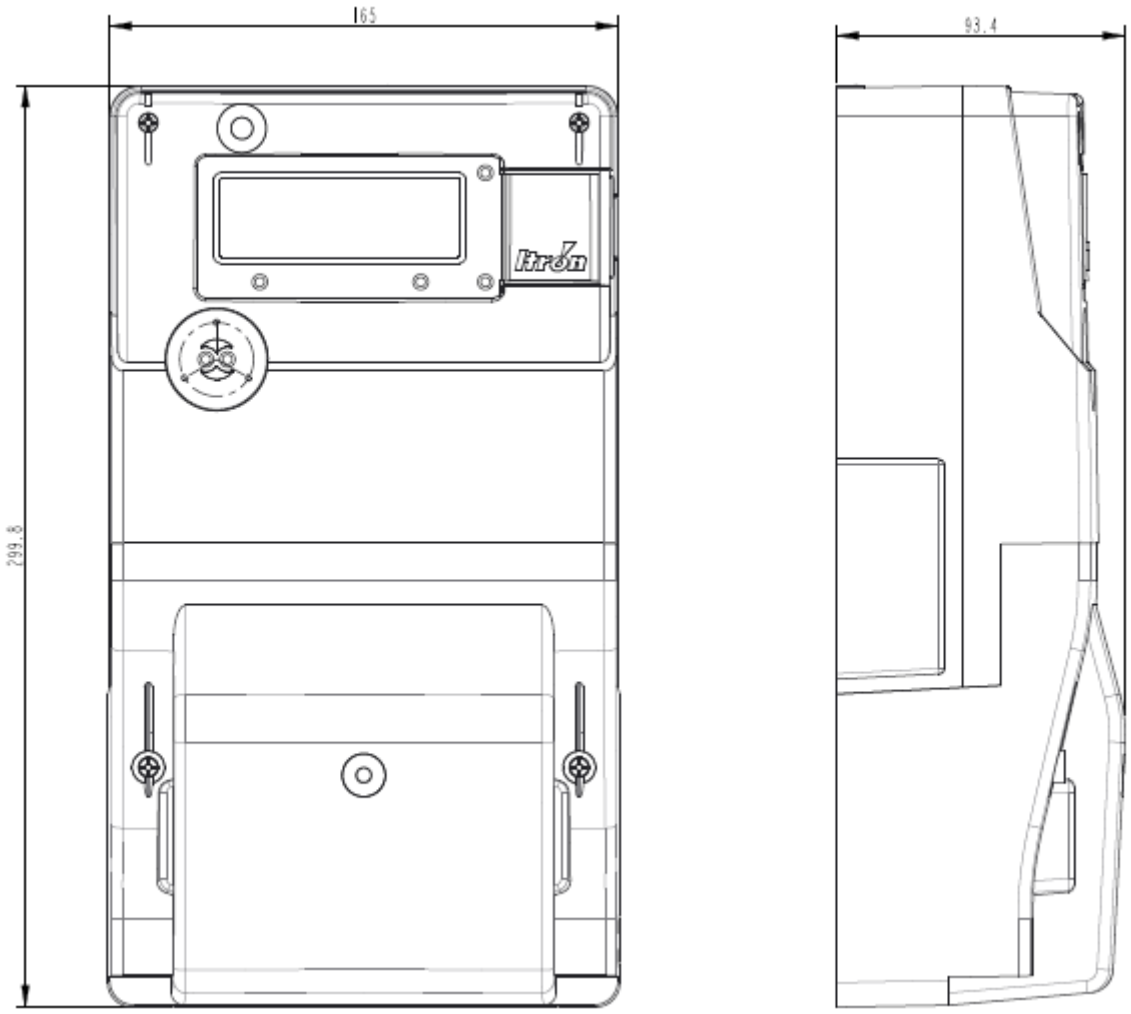
10.2 Conditions

EM620 meters are designed for indoor use, or outdoor in case they are housed in an enclosure which can maintain the indoor environmental conditions.

10.3 Fixing

The main dimensions of the EM620 are shown in the following pictures:

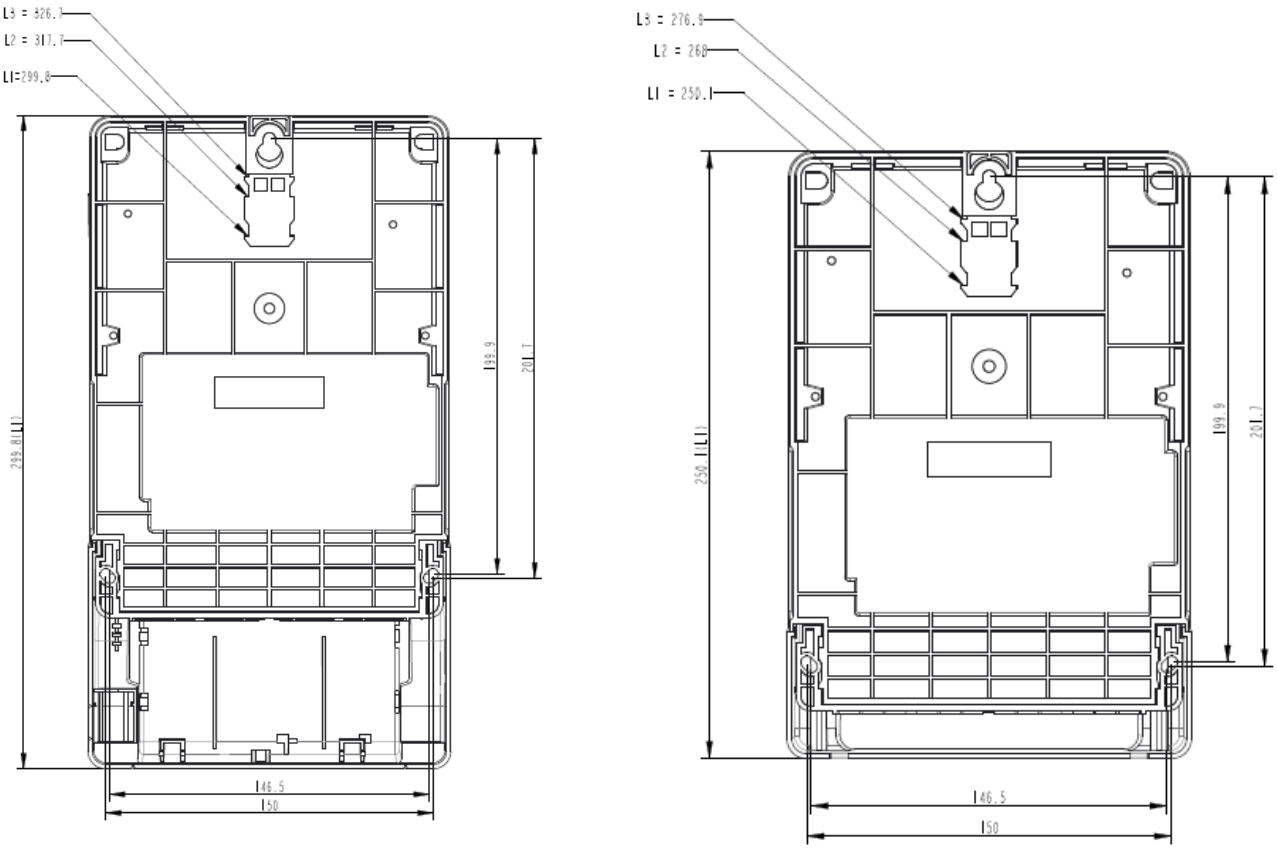




Note: all dimensions are in millimeters.

"Cut-out" plastic parts are provided on each side of the terminal cover to easily pass through cables for external devices connection (communication module, In-Home Display).

The meter is fitted with a 2-step adjustable hanging bracket that provides an upper fixing point. 2 further lower fixing points are located within the terminal area; these can be accessed only by removing the terminal cover. Below are the dimensions for short and long terminal covers:



Note: all dimensions are in millimeters.

10.4 Cabling (power connection)

EM620 can be delivered with different main terminal blocks configuration:

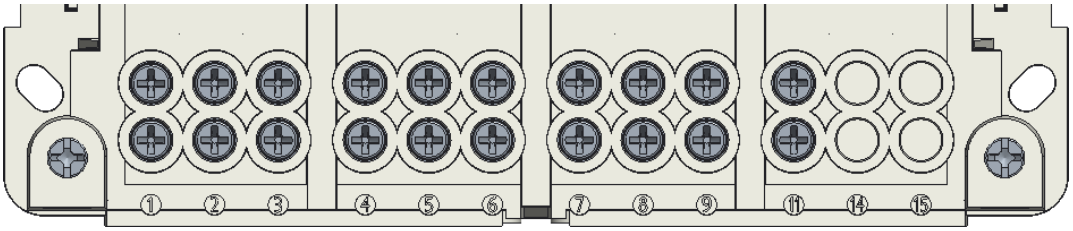
- bottom asymmetrical (VDE) power connection.
- Bottom symmetrical (USE) power connection.

It is made of solid brass with the following features:

	Cable diameter (max)	**Clamping screws (per cable)**
DC connection	9.1 mm	2 x M8 (slotted)
CT-CTVT connection	5 mm	2 x M4 (slotted)

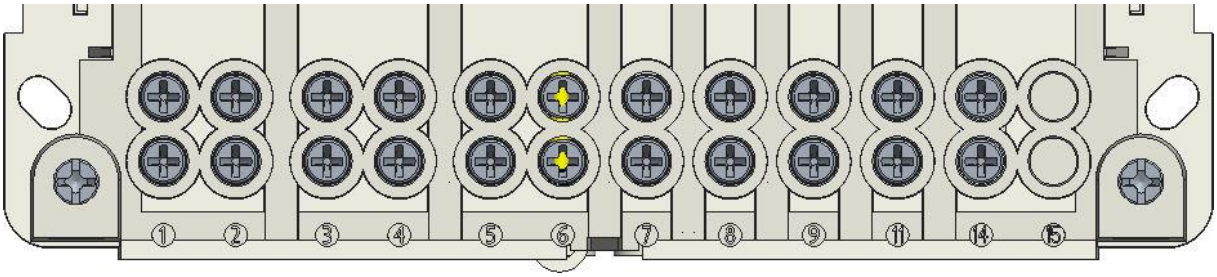
Main terminal wiring - transformer connection

VDE Wiring



Terminal	Function	Terminal	Function	Terminal	Function	Terminal	Function
1	I1 in	4	I2 in	7	I3 in	11	Neutral
2	U1 in	5	U2 in	8	U3 in		
3	I1 out	6	I2 out	9	I3 out		

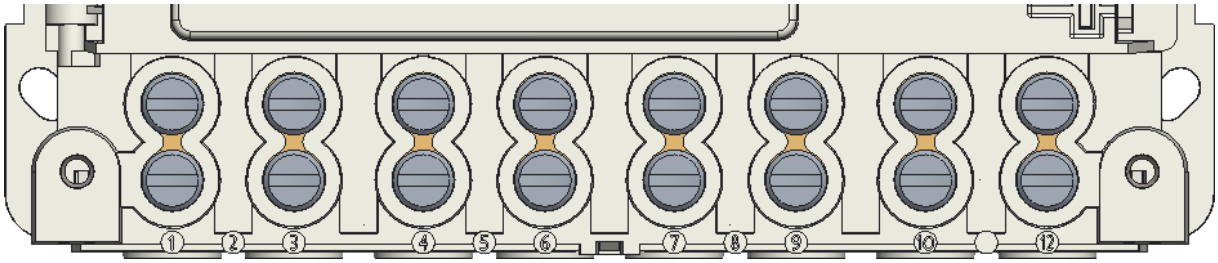
USE wiring



Terminal	Function	Terminal	Function	Terminal	Function	Terminal	Function
1	I1 in	4	U2 in	7	Neutral	11	I2 out
2	U1 in	5	I3 in	8	Not used	14	I1 out
3	I2 in	6	U3 in	9	I3 out		

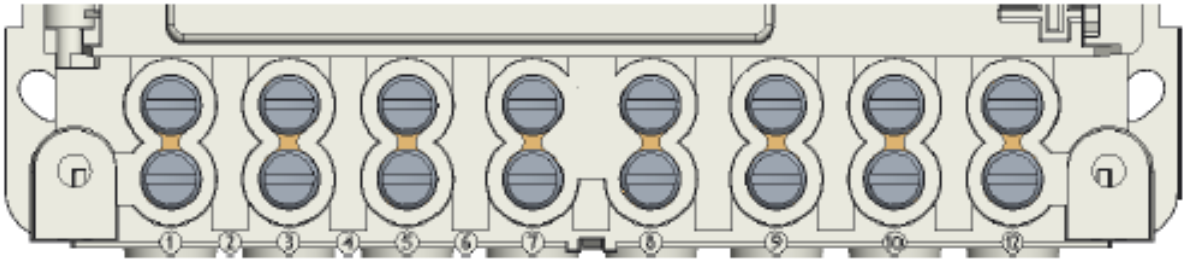
Main terminal wiring - direct connection

VDE Wiring



Terminal	Function	Terminal	Function	Terminal	Function	Terminal	Function
1	I1 in	4	I2 in	7	I3 in	10	Neutral In
2	U1 in	5	U2 in	8	U3 in	12	Neutral Out
3	I1 out	6	I2 out	9	I3 out		

USE Wiring



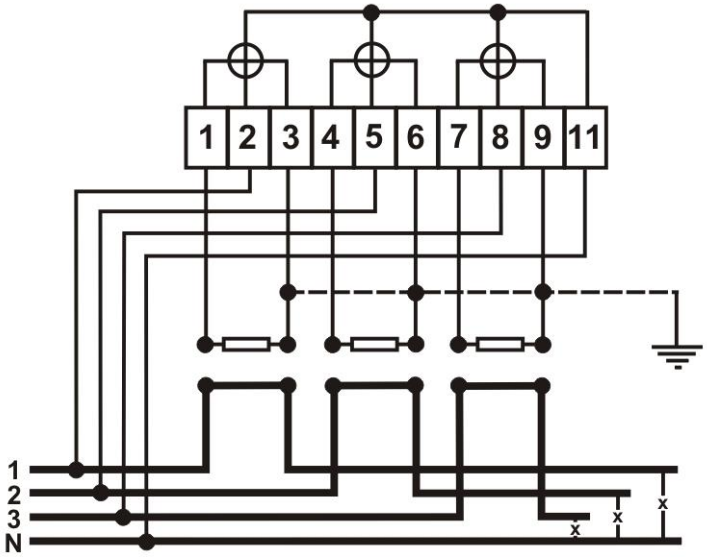
Terminal	Function	Terminal	Function	Terminal	Function	Terminal	Function
1	I1 in	4	U2 in	7	Neutral In	10	I2 out
2	U1 in	5	I3 in	8	Neutral Out	12	I1 out
3	I2 in	6	V3 in	9	I3 out		

The meter can be configured for both 3 wire and 4 wire cabling, as shown in the following chapters.
Screw heads can be slotted or pozi-slotted (factory option when ordering)

10.4.1 Three-Phase LV CT connections

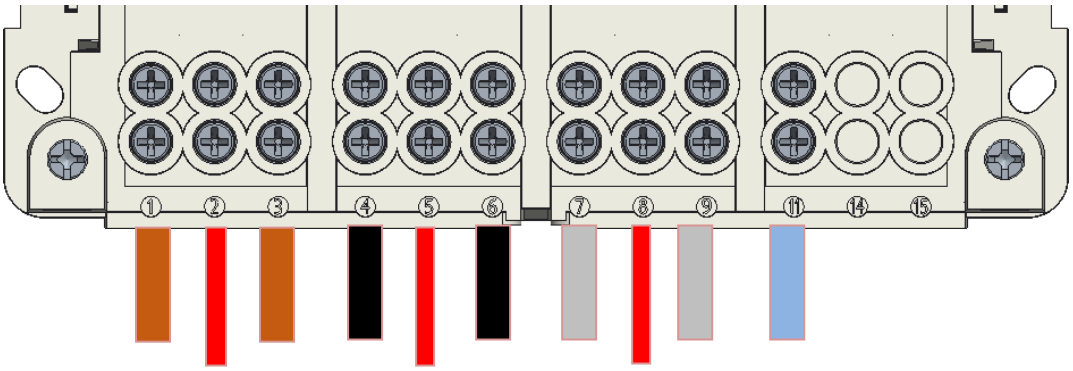
In a low Voltage network, depending on the number of current transformers (CT) available, three-phase meter connections can be configured as follows:

10.4.1.1 4 wire asymmetrical (VDE) current transformer configuration

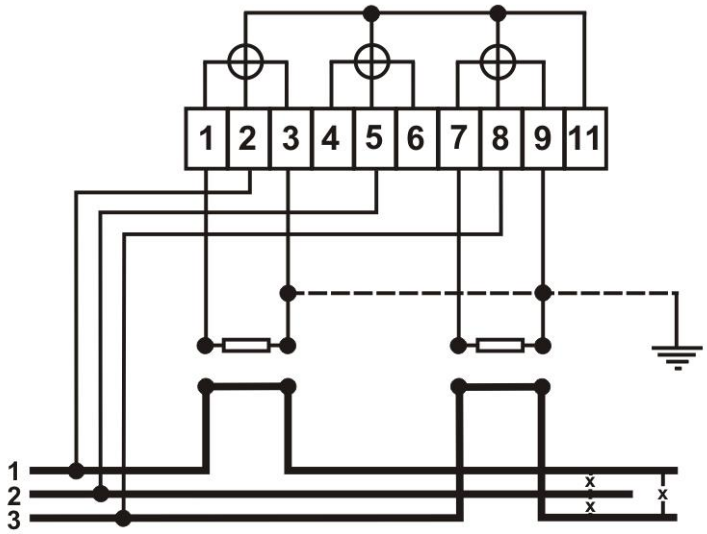


Terminal	Phase	Function	Terminal	Phase	Function
1	1	I1 - CT1 in	7	3	I3- CT3 in
2	1	U1 - Voltage	8	3	U3 - Voltage
3	1	I1 - CT1 out	9	3	I3 - CT3 out
4	2	I2 - CT2 in	11	N	Un - Neutral
5	2	U2 - Voltage			
6	2	I2 - CT2 out			

Typical wiring illustrated below:

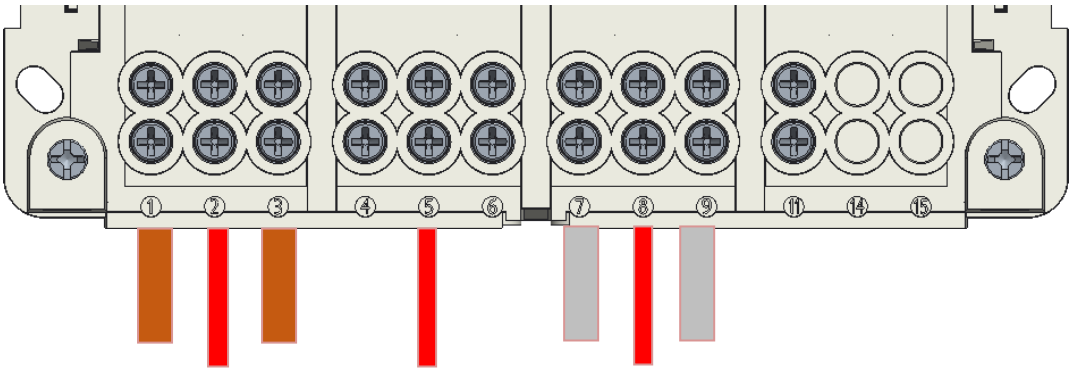


10.4.1.2 3 wire asymmetrical (VDE) current transformer configuration

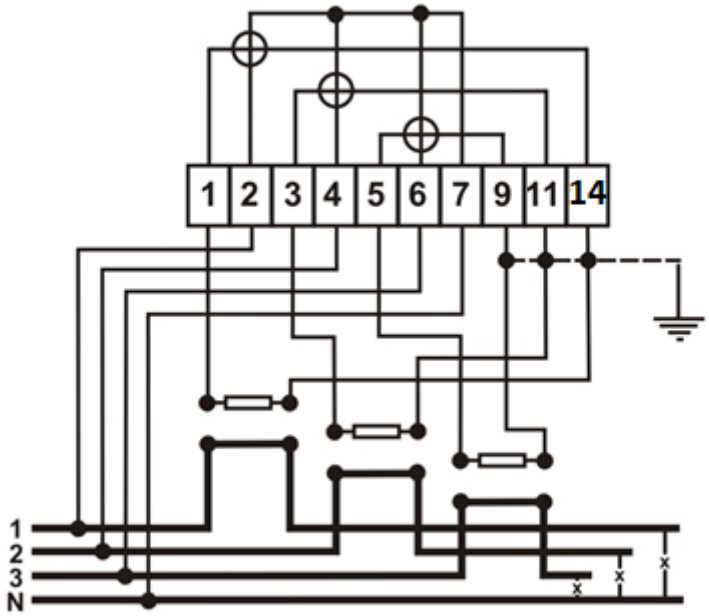


Terminal	Phase	Function	Terminal	Phase	Function
1	1	I1 - CT1 in	7	3	I3- CT2 in
2	1	U1 - Voltage	8	3	U3 - Voltage
3	1	I1 - CT1 out	9	3	I3 - CT2 out
4		No connection	11		No connection
5	2	U2 - Voltage			
6		No connection			

Typical wiring illustrated below:

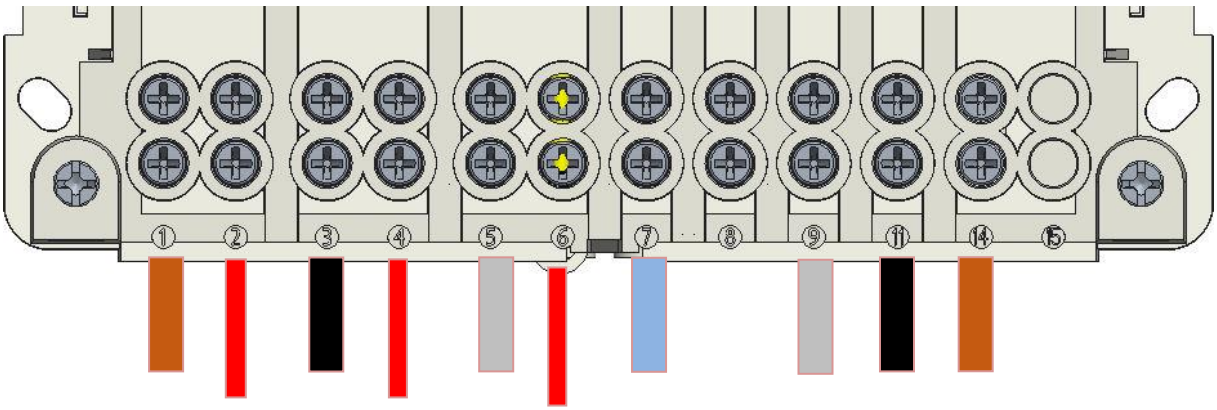


10.4.1.3 4 wire symmetrical (USE) current transformer configuration

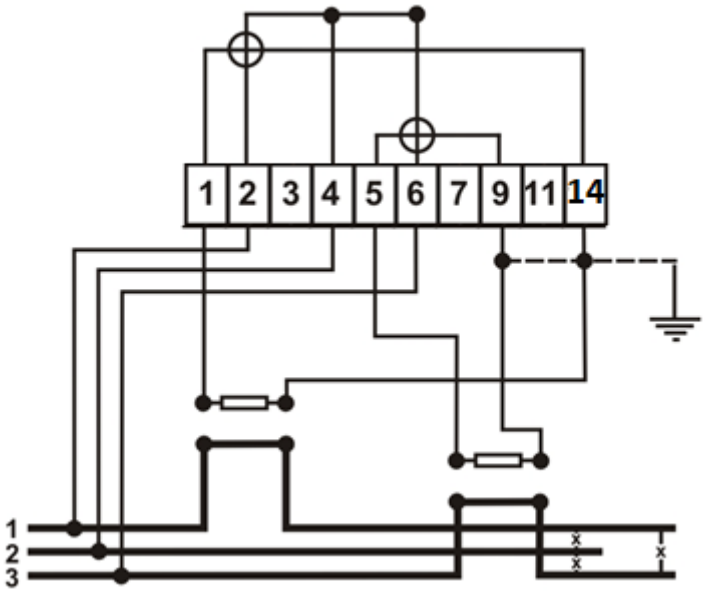


Terminal	Phase	Function	Terminal	Phase	Function
1	1	I1 - CT1 in	7	N	Un - Neutral
2	1	U1 - Voltage	8		No connection
3	2	I2 - CT2 in	9	3	I3 - CT3 out
4	2	U2 - Voltage	11	2	I2 - CT2 out
5	3	I3- CT3 in	14	1	I1 - CT1 out
6	3	U3 - Voltage			

Typical wiring illustrated below:

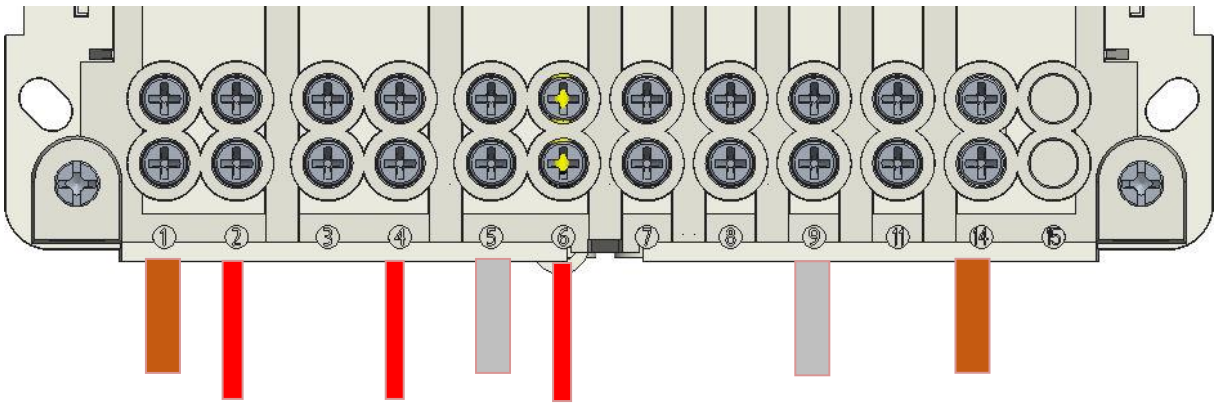


10.4.1.4 3 wire symmetrical (USE) current transformer configuration



Terminal	Phase	Function	Terminal	Phase	Function
1	1	I1 - CT1 in	7		No connection
2	1	U1 - Voltage	8		No connection
3		No connection	9	3	I3 - CT2 out
4	2	U2 - Voltage	11		No connection
5	3	I3- CT2 in	14	1	I1 - CT1 out
6	3	U3 - Voltage			

Typical wiring illustrated below:

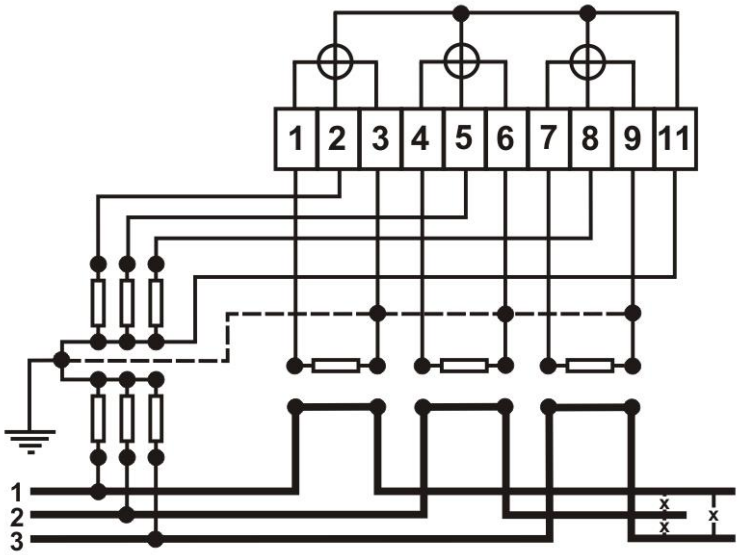


10.4.2 Three-Phase MV CT connections

10.4.2.1 4-wire 3 x VT and 3 x CT

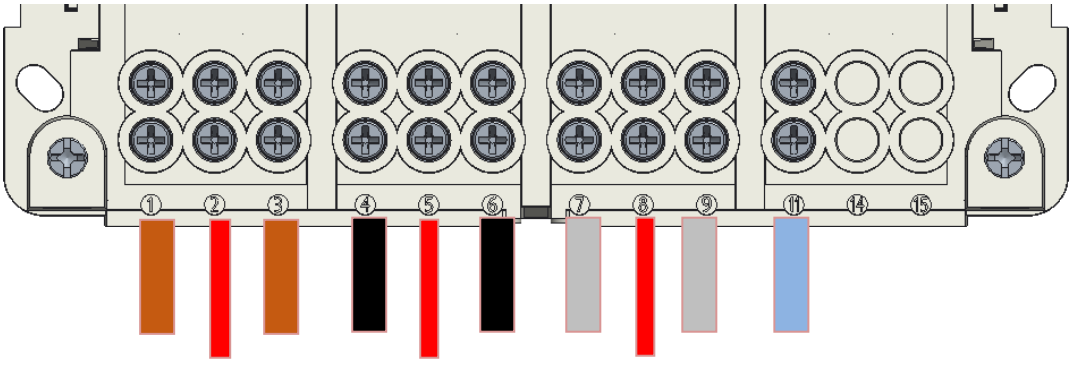
4 wire asymmetrical (VDE) 3 x VT and 3 x CT configuration

Meter configured for 4 wire, 3 element metrology



Terminal	Phase	Function	Terminal	Phase	Function
1	1	I1 - CT1 in	7	3	I3- CT3 in
2	1	U1 - VT1 in	8	3	U3 - VT3 in
3	1	I1 - CT1 out	9	3	I3 - CT3 out
4	2	I2 - CT2 in	11	Un	VT common + ground
5	2	U2 - VT2 in			
6	2	I2 - CT2 out			

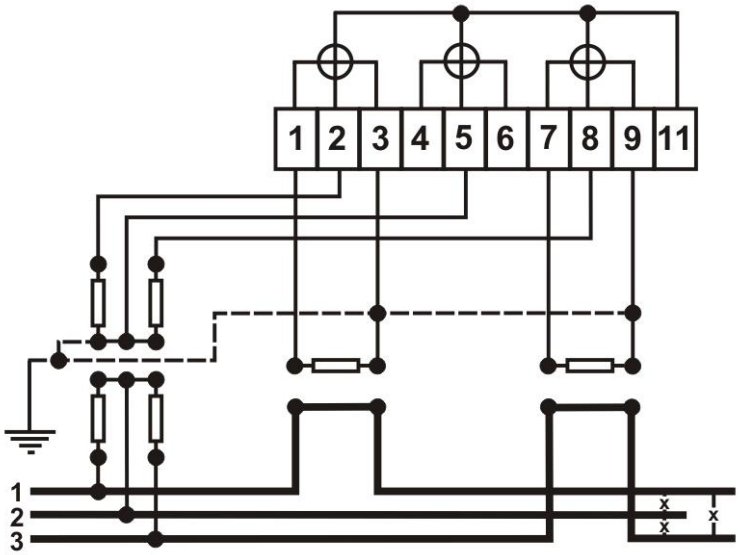
Typical wiring illustrated below:



10.4.2.2 3-wire 2 x VT and 2 x CT

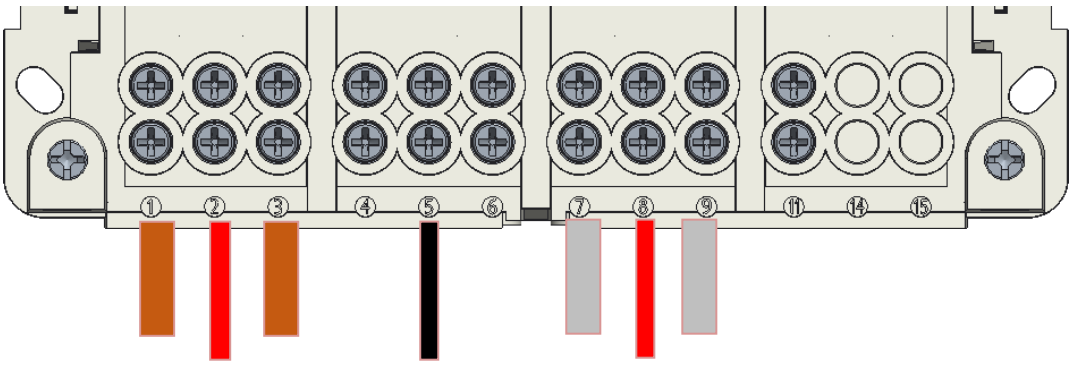
3 wire asymmetrical (VDE) 2 x VT and 2 x CT configuration

Meter configured for 3 wire, 2 element metrology



Terminal	Phase	Function	Terminal	Phase	Function
1	1	I1 - CT1 in	7	3	I3- CT2 in
2	1	U1 - VT1 in	8	3	U3 - VT2 in
3	1	I1 - CT1 out	9	3	I3 - CT2 out
4		No connection	11		No connection
5	U	U2 - VT common			
6		No connection			

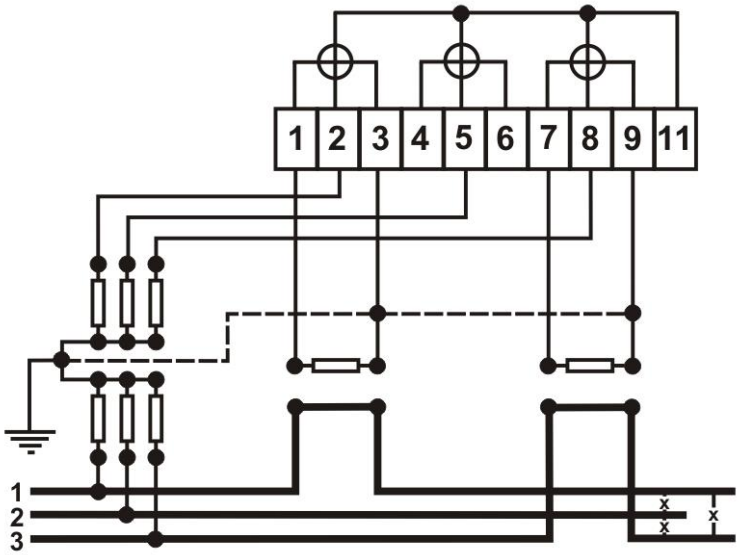
The Un connection (terminal 11) remains unconnected. Do NOT connect it to ground.
Typical wiring illustrated below:



10.4.2.3 3-wire 3 x VT and 2 x CT

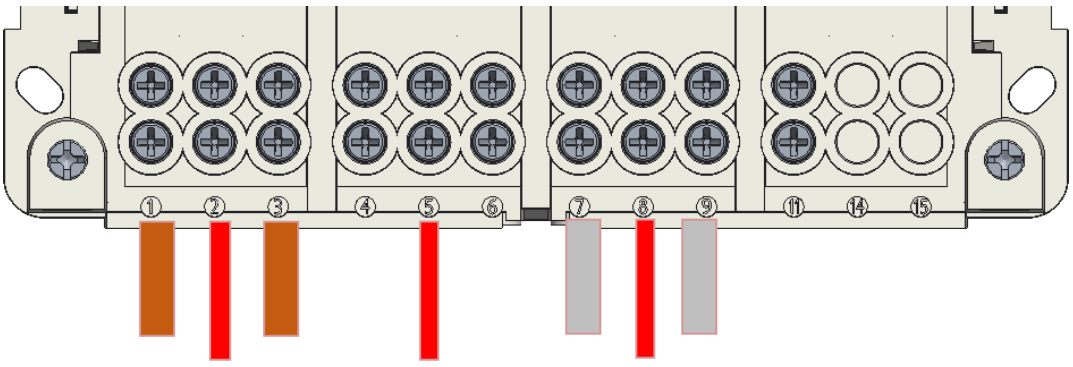
3 wire asymmetrical (VDE) 3 x VT and 2 x CT configuration

Meter configured for 3 wire, 2 element metrology



Terminal	Phase	Function	Terminal	Phase	Function
1	1	I1 - CT1 in	7	3	I3- CT2 in
2	1	U1 - VT1 in	8	3	U3 - VT3 in
3	1	I1 - CT1 out	9	3	I3 - CT2 out
4		No connection	11	Un	No connection (see note below)
5	2	U2 - VT2 in			
6		No connection			

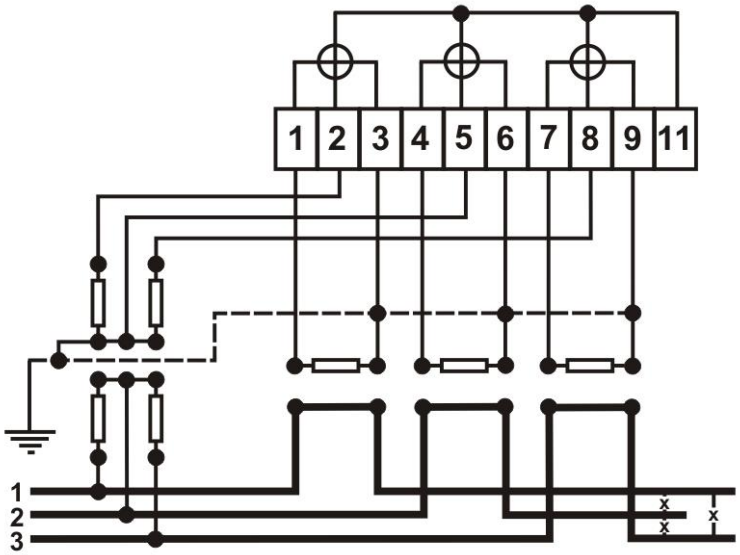
The Un connection (terminal 11) may remain unconnected or be connected to ground. Typical wiring illustrated below:



10.4.2.4 3-wire 2 x VT and 3 x CT

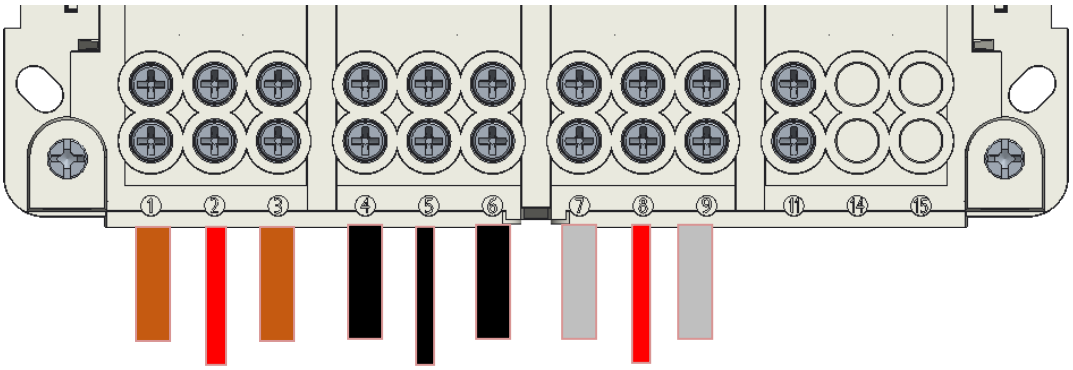
3 wire asymmetrical (VDE) 2 x VT and 3 x CT configuration

Meter configured for 4 wire, 3 element metrology



Terminal	Phase	Function	Terminal	Phase	Function
1	1	I1 - CT1 in	7	3	I3- CT3 in
2	1	U1 - VT1 in	8	3	U3 - VT2 in
3	1	I1 - CT1 out	9	3	I3 - CT3 out
4	2	I2 - CT2 in	11	Un	No connection
5		U2 - VT common			
6	2	I2 - CT2 out			

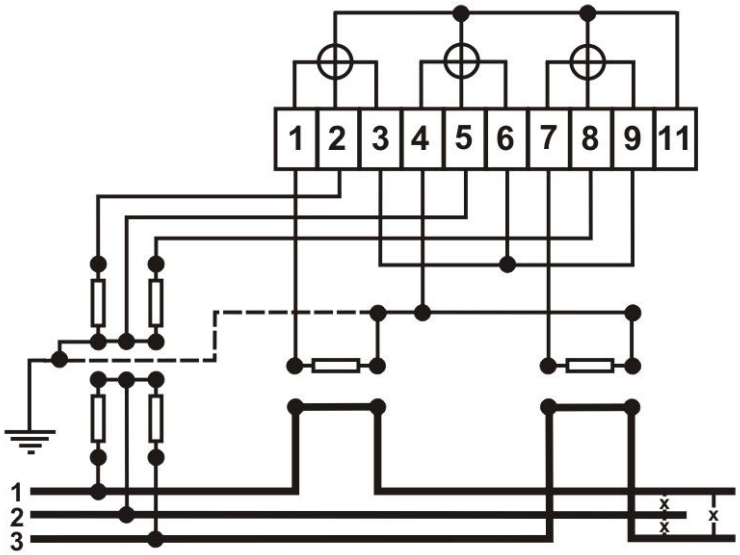
The Un connection (terminal 11) remains unconnected. Do NOT connect it to ground.
Typical wiring illustrated below:



10.4.2.5 3-wire ARON connection

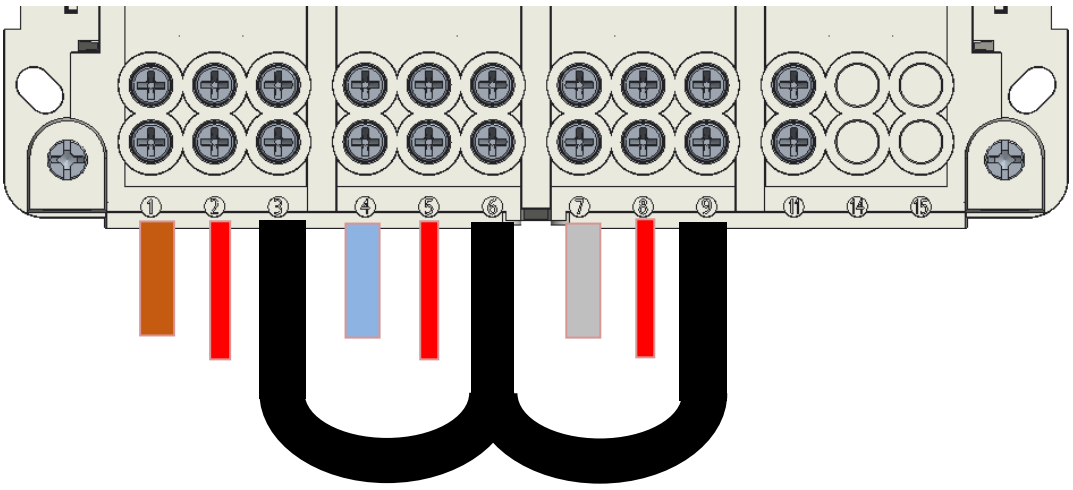
3 wire asymmetrical (VDE) 2 x VT and 2 x CT ARON configuration

Meter configured for 4 wire, 3 element metrology



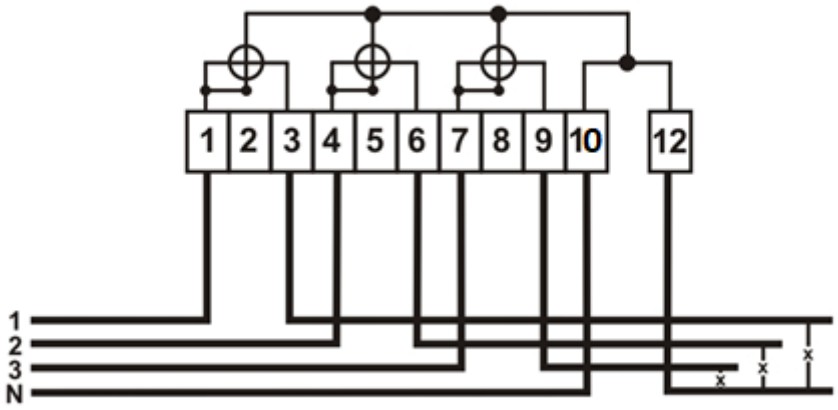
Terminal	Phase	Function	Link to	Terminal	Phase	Function	Link to
1	1	I1 - CT1 in		7	3	I3- CT2 in	
2	1	U1 - VT1 in		8	3	U3 - VT2 in	
3		I1 - common	I2 and I3	9		I3 - common	I1 and I2
4		I2 - CT1 / CT2 out common		11	Un	No connection	
5		U2 - VT common					
6		I2 - common	I1 and I3				

The Un connection (terminal 11) remains unconnected. Do NOT connect it to ground.
The two current circuit neutral returns are connected in the reverse direction via the missing current circuit.
The wiring diagram is correct if there is no homopolar current (I1+I2+I3=0) in the three-phase network.
Typical wiring illustrated below:



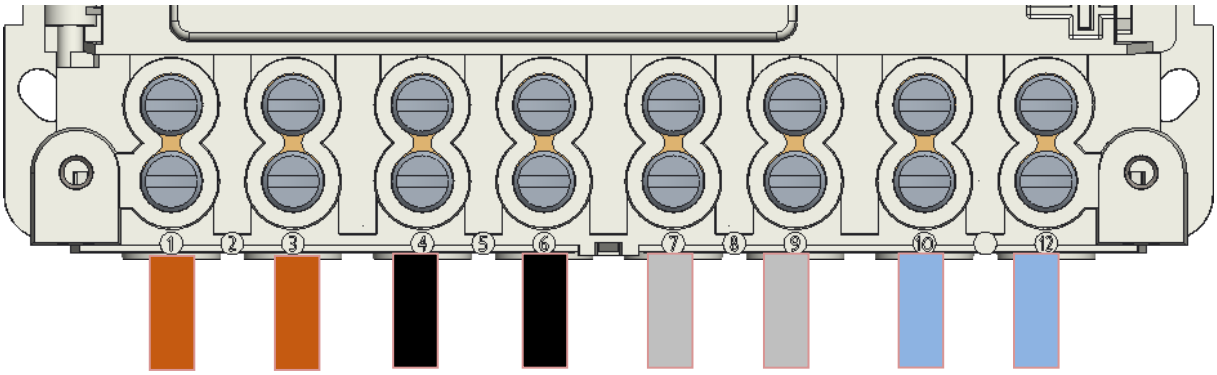
10.4.3 Direct connection configuration

10.4.3.1 Direct Connected: 4-wire asymmetrical (VDE) configuration



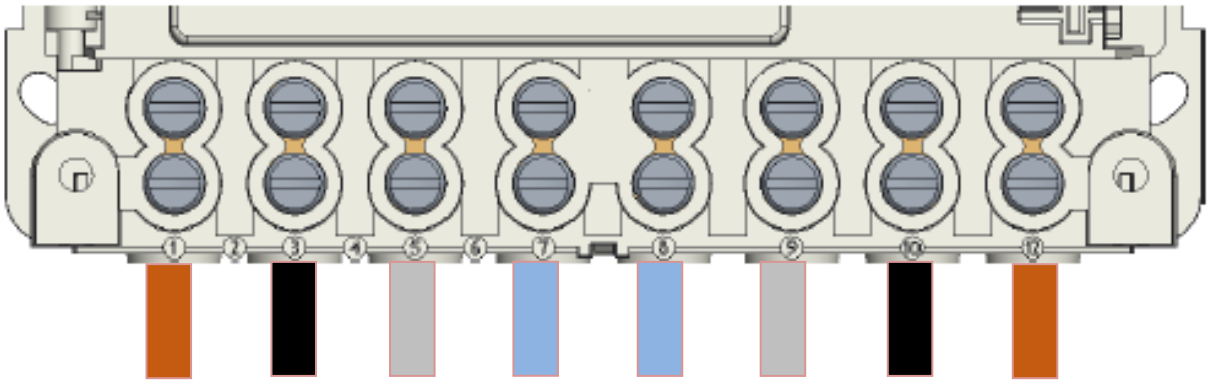
Terminal	Phase	Function	Terminal	Phase	Function
1	1	I1 - Phase 1 in	7	3	I3- Phase 3 in
2		No connection	8		No connection
3	1	I1 - Phase 1 out	9	3	I3 - Phase 3 out
4	2	I2 - Phase 2 in	10	N	Un - Neutral in
5		No connection	12	N	Un - Neutral out
6	2	I2 - Phase 2 out			

Typical wiring illustrated below:



10.4.3.2 Direct Connected: 4-wire asymmetrical (USE) configuration

Terminal	Phase	Function	Terminal	Phase	Function
1	1	I1 - Phase 1 in	7	N	Un - Neutral In
2		No connection	8	N	Un - Neutral out
3	2	I2- Phase 2 in	9	3	I3 - Phase 3 out
4		No connection	10	2	I2 – Phase 2 out
5	3	I3 - Phase 3 in	12	1	I1 – Phase 1 out
6		No connection			



10.4.4 Using aluminum cables

The certification of meters in respect of current rating is valid only when used with copper supply and load cables of the correct diameter. If aluminum cables are to be used, the meter current rating will be downgraded, and the meters should be ordered with plated terminals instead of standard brass terminals.

Meters with standard brass terminals should not be connected directly to aluminum mains cables, as this may cause corrosion due to electrolytic action. If a meter with brass terminals must be used in premises with aluminum cables, it is highly advisable to:

- Terminate the aluminum cables in a suitable junction box close to the meter.
- Complete the connections to the meter with copper cables > 0.5m in length.

Alternatively, use suitable copper cable-sheaths on the terminating ends of the aluminum cables.

This will prevent terminal corrosion and allow the meter to be used at its certified current rating.

10.5 Battery

The meter is designed so the lithium battery can be safely installed or replaced while the meter is operating.

Process to change the battery is as follows:

1. Open the terminal cover.
2. Take the battery out by pushing the ping socket
3. Insert the new battery in the holder
4. Connect the battery wire on the meter.
5. Close the terminal cover and seal it as necessary.

Note: due to the design of the battery holder it is not possible to connect the wire in the wrong way around.

10.6 Installation checks

Before applying the mains supply to the installed meter, carefully check that:

- all mains supply and auxiliary cables are connected to the correct terminals.
- all cable clamp screws are securely tightened.
- the battery has been correctly installed.

10.7 Start-up and functional checks

EM620 LCD display provides the field operator with indicators to verify installation progress and status. In brief, after having applied the mains supply to the meter, the operator should:

1) Check that the LCD display turns on and shows coherent displays.

Note: depending on the meter configuration, the LCD may move automatically through a sequence of displays, or it may be necessary to use the meter display pushbutton to move through the sequence.

2) Check the phase sequence is correct; the phase indicators icons in the LCD should not be flashing.

3) Should a load be connected to the meter, check that the metrology LED starts to flash.

Note: the flash rate is proportional to the load.

Note 2: When there is no load, LED is not lit

4) Check that no alarm is raised on the LCD display (message or icon)

10.8 Sealing the meter

Before leaving the installation site, fit the terminal cover, and seal the meter against unauthorized access or tampering by fitting wire or plastic seals in the following locations:

1 Main cover

2 Terminal cover

3 Reset button seal

Note1: In order to seal the reset button, the button shall be turned from 90° with a screwdriver or a coin:

Not sealable position:

Sealable position:

Note2:

The button cover can be removed to ease the installation of the seal on the reset button. You can open it from 45° then remove the button cover from the down, as per picture below:

Note 3:
Button cover is optional and the meter keeps its IP54 rating even without the button cover fitted