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NETWORK ANALYZER

M4M 2X
User manual

Table of Contents

1. General information

1.1.Use and storage of manuals

Carefully read this manual and adhere to the indications described prior to using the device.

This manual contains all of the safety information, the technical aspects and the operations necessary to ensure the correct use of the device and maintain it in safe conditions.

1.2.Copyright

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1.3.Liability disclaimer

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1.4.General safety warnings

Non-adherence to the following points can lead to serious injury or death.

Use the suitable personal protection devices and adhere to the current regulations governing electrical safety.

- This device must be installed exclusively by qualified personnel who have read all of the information relative to the installation.
- Check that the voltage supply and measurement are compatible with the range permitted by the device.
- Ensure that all current and voltage supplies are disconnected prior to carrying out any controls, visual inspections and tests on the device.
- Always assume that all circuits are under voltage until they are completely disconnected, subjected to tests and labelled.
- Disconnect all of the power supply prior to working on the device.
- Always use a suitable voltage detection device to check that the supply is interrupted.
- Pay attention to any dangers and carefully check the work area ensuring that no instruments or foreign objects have been left inside the compartment in which the device is housed.
- The correct use of this device depends on a correct manipulation, installation and use.hdfh.
- Failure to adhere to the basic installation information can lead to injuries as well as damage to the electric instruments or to any other product.
- **NEVER** connect an external fuse in by-pass.
- Disconnect all of the input and output wires before carrying out a dielectric rigidity test or an insulation test on an instrument in which the device is installed.
- The tests carried out at a high voltage can damage the device's electronic components.
- The device has to be installed inside a switchboard.
- Installation of M4M shall include a switch or circuit breaker for the connection of auxiliary supply and voltage measurement. The switch or circuit breaker must be suitably located and easily reachable and must be marked as the disconnecting device for M4M.
- Switch off circuit breaker or switch before disconnecting from the auxiliary supply and voltage measurement or connecting to the auxiliary supply or voltage measurement.

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1.5.Cyber Security Disclaimer

M4M 2X network analyzer is designed to be connected and to communicate information and data via a network interface, which should be connected to a secure network. It is your sole responsibility to provide and continuously ensure a secure connection between the product and your network or any other network (as the case may be) and to establish and maintain appropriate measures (such as but not limited to the installation of firewalls, application of authentication measures, encryption of data, installation of antivirus programs, etc.) to protect the M4M 2X network analyzer product, the network, its system and interfaces against any kind of security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information. ABB S.p.A. and its affiliates are not liable for damages and/or losses related to such security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information.

Although ABB S.p.A. provides functionality testing on the products and updates that we release, you should institute your own testing program for any product updates or other major system updates (to include but not limited to code changes, configuration file changes, third party software updates or patches, hardware change out, etc.) to ensure that the security measures that you have implemented have not been compromised and system functionality in your environment is as expected.

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2. Packaging contents
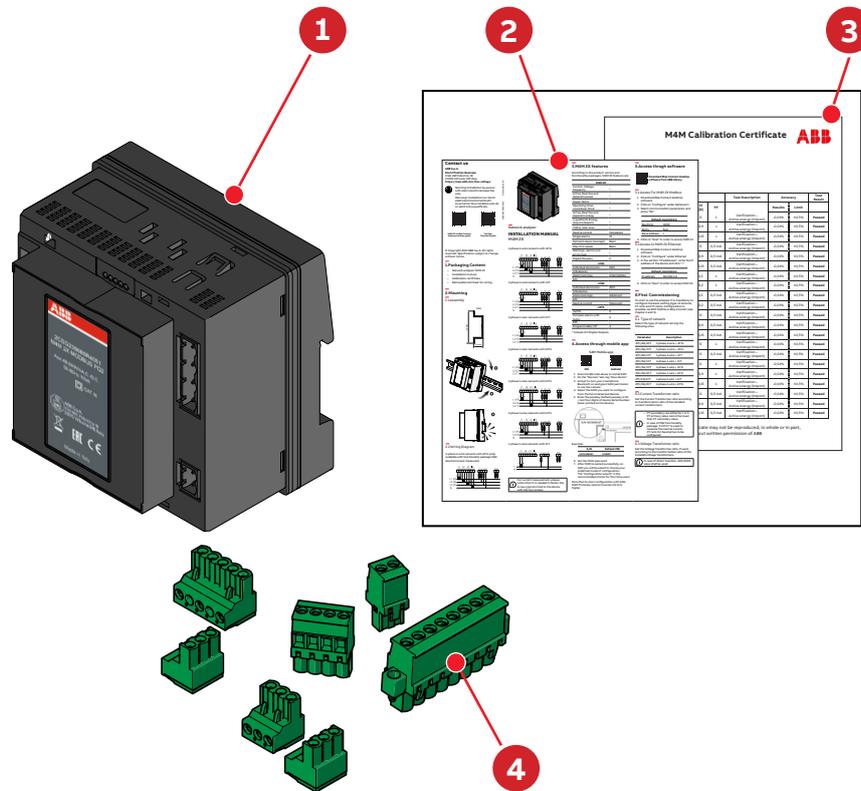
Packaging contents	
1	Network analyzer M4M 2X
2	Installation manual
3	Calibration certificate
4	Removable terminals for wiring

The number and type of removable terminals in the package varies according to the different versions. Please refer to below table to check the removable terminals included in each package.

Product Name	Current input terminal (8 poles)	Voltage input terminal (4 poles)	Auxiliary supply terminal (2 poles)	Programmable I/O terminal (5 poles)	Digital output terminal (3 poles)	Analogue outputs terminal (3 poles)	RS485 terminal (3 poles)
M4M 2X MODBUS	□	□	□				□
M4M 2X ETHERNET	□	□	□				
M4M 2X Ethernet PQ1	□	□	□				
M4M 2X Ethernet PQ1+RTS	□	□	□	□	□		
M4M 2X Ethernet PQ2	□	□	□				
M4M 2X Ethernet PQ2+RTS	□	□	□	□	□		
M4M 2X Ethernet RTS	□	□	□	□	□		
M4M 2X Modbus PQ1	□	□	□				□
M4M 2X Modbus PQ1+RTS	□	□	□	□	□		□
M4M 2X Modbus PQ2	□	□	□				□
M4M 2X Modbus PQ2+RTS	□	□	□	□	□		□
M4M 2X Modbus RTS	□	□	□	□	□		□

3. Technical characteristics

3.1.Description of the device

M4M 2X is ABB's network analyzer range that ensures higher flexibility to project specifications compared to standard network analyzers.

M4M 2X is available without display, only communicating via protocols and Bluetooth module for smart remote commissioning.

3.2.Main functionalities

The set of functionalities of M4M 2X can vary according to the different versions. Please refer to the table of p. 9 of "3.3 Versions" chapter table for further information.

Real-time	
TRMS current	•
TRMS Voltage	•
Frequency	•
Active, Reactive and Apparent Power	•
Power Factor	•
Operating timer, countdown timer	•
Energy	
Active, Reactive and Apparent Energy	•
4 quadrant Energy (Import/Export)	•
Tariffs	•
Power quality	
THD (I, VLN, VLL)	•
Individual Harmonics	40th
Unbalances (I, VLN, VLL)	•
Neutral current	Measured
Data recording and logs	
Flash memory	32 MB
Single alarms	25
Warnings, alarms and errors logs	•
Complex alarms with logics	4
Demand values (average)	Basic or advanced
Min/Max Demand values	Basic or advanced
Energy Trending logs	•
RTC	•
Connectivity	
Automatic integration in ABB Ability™ EAM	•
Automatic integration in System pro M compact® InSite	•
Bluetooth Low Energy	•
Compatibility with EPiC mobile app	•
Compatibility with S4M mobile app	•
Communication Protocols	Modbus RTU, Modbus TCP/IP
RJ45 Daisy Chain (Ethernet version)	•

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3.3.Versions

The set of functionalities of M4M 2X can vary according to the different versions. Please refer to the table below for further information.

M4M 2X (same as M4M 20)	
TRMS current	•
TRMS voltage	•
Frequency	•
Active, Reactive and Apparent power	•
Power factor	•
Operating timer, countdown timer	•
Active, Reactive and Apparent energy	•
4 quadrants Energy (Import/Export)	•
THD (I, VLN, VLL)	•
Neutral current	Calculated
Single alarms	25
Demand values (average)	Basic
Historicals logs	Basic
Warnings, alarms and errors logs	•
Digital Outputs	2
+PQ1	
Individual Harmonics	25th
Unbalances	•
Historicals logs	Intermediate
RTC	•
+PQ2	
Individual Harmonics	40th
Unbalances	•
Historicals logs	Advanced
RTC	•
Neutral current	Measured
+RTS	
Tariffs	6
Complex alarms with logics	4
RTC	•
Programmable I/O	4*

*replacing 2 Digital Outputs features

3.4.Overall dimensions

96 mm

96 mm

57 mm*

74 mm

78 mm*
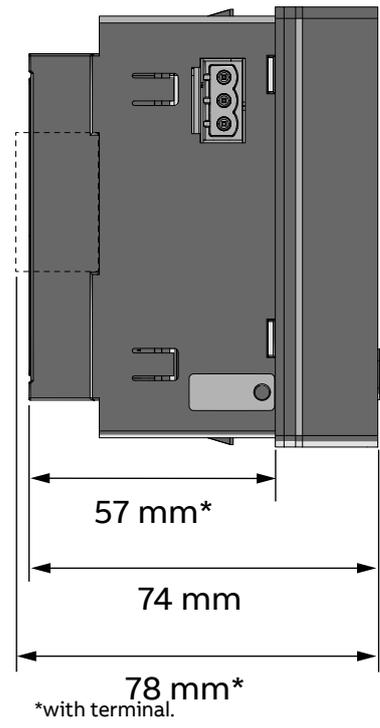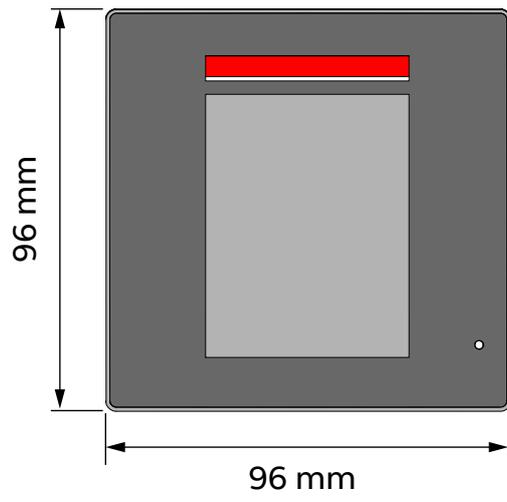
*with terminal.

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3.5. Technical data

Auxiliary power supply		
Voltage range	[V]	48 to 240 VAC/VDC ±15%
Frequency	[Hz]	50/60 Hz ±5%
Power Consumption	[VA]	10 VA max
Installation category		CAT III 300V class per IEC 61010-1 edition 3
Protection fuse		T1 A - 277 VAC

Measurement accuracy	
Measurement type	True RMS up to the 40th harmonic
	128 samples per cycle, zero blind
IEC 61557-12	IEC 61557-12 PMD/S/K70/0,5
Active energy	Class 0,5 acc. to IEC 61557-12
	Class 0,5S acc. to IEC 62053-22
Reactive energy	Class 2 acc. to IEC 61557-12
	Class 2 acc. to IEC 62053-23
Active power	Class 0,5 acc. to IEC 61557-12
Reactive power	Class 1 acc. to IEC 61557-12
Apparent power	Class 0,5 acc. to IEC 61557-12
Voltage	Class 0,2 acc. to IEC 61557-12
Current	Class 0,2 acc. to IEC 61557-12
Neutral current	Class 0,2 acc. to IEC 61557-12
Frequency	Class 0,1 acc. to IEC 61557-12
Unbalances	Class 0,2 acc. to IEC 61557-12
Harmonics, THD (Current, voltage)	Class 1 acc. to IEC 61557-12

Voltage measurement inputs		
Measurement range	[V]	46(80)...480(830) V
Measurement category		400V~ (CAT III)
Rated frequency	[Hz]	50-60 Hz
Max. VT secondary (indirect connection)	[V]	400 VAC (L-N)
Max over voltage	[V]	800 VAC (L-L)
Protection fuse		T1 A - 277 VAC

The M4M voltage inputs have a high impedance which decreases power consumption and increases security due low current flow in the voltage input circuit. However, if the voltage input wirings are floating, i.e. not connected to a voltage source, the wires may work as an antenna to the surroundings electric fields which can create a perceived floating voltage. The M4M will not show this floating voltage in case it is below 40V (below the Voltage measurement range) and in case of a three phase system with measuring current below starting current (below current measurement range). In all other cases of floating voltage the M4M display may show a voltage bigger than zero, which depends on installation conditions. This behavior does not affect the reliability of the M4M in normal conditions with a connected load.

Current measurement inputs		
Number of current inputs		4 (L1, L2, L3, N)

Indirect insertion with CT		
CT secondary		5 A (Class 0.5S)
		1 A (Class 0,5S)
Measurement range without accuracy derating		50 mA - 6 A
Starting current		1 mA
Burden		0.024 VA at 6 A

I/O		
Digital Output		
Voltage (min - max)		5 - 240 VAC/DC
Current (min - max)		2 - 100 mA
Max ON state drop voltage		1,5 V
Max R value at Min voltage conditions (5 V)		1750 Ohm
Min R value at Max voltage conditions (240 V)		2400 Ohm
Pulse duration	[ms]	20 ms ON, 20 ms OFF
Pulse frequency		25 Hz
Alarm activation delay	[s]	0 - 900 s (programmable)
Alarm return hysteresis		0 - 40% (programmable)

Mechanical characteristics		
Overall dimensions		96 mm x 96 mm x 77,5 mm (Depth inside the switchboard: 57mm)
IP degree of protection (IEC 60529)		Front: IP54
		Terminals: IP20
Weight	[g]	400

Terminal characteristics		
Tightening torque		0,4 Nm
Voltage inputs		Nominal cross section: 2,5 mm^2 Solid/stranded wire: 0,2 - 2,5 mm^2 (AWG 24 - 12) Pitch: 7,62 mm Poles: 4
Current inputs		Nominal cross section: 2,5 mm^2 Solid/stranded wire: 0,2 - 2,5 mm^2 (AWG 24 - 12) Pitch: 5,08 mm Poles: 8 Screw flanges for fixing
RS-485 Serial port		Nominal cross section: 2,5 mm^2 Solid/stranded wire: 0,2 - 2,5 mm^2 (AWG 24 - 12) Pitch: 5,08 mm Poles: 3
I/O		Nominal cross section: 2,5 mm^2 Solid/stranded wire: 0,2 - 2,5 mm^2 (AWG 24 - 12) Pitch: 5,08 mm Poles: 5 (Programmable I/O)

Climatic conditions

Operating temperature	-25 to 70 °C (K70 acc. to IEC 61557-12)
Storage temperature	-40 to 85 °C (K70 acc. to IEC 61557-12)
Relative humidity	Max 93% (non-condensing) at 40°C
Pollution degree	2
Altitude	< 2000 m*
Mounting requirement	Only for internal usage

Communication protocol

Modbus RTU

Communication interface	RS485 with optical isolation
Baud rate	9.6, 19.2, 38.4, 57.6, 115.2 kbps
Parity number	Odd, Even, None
Stop bit	1, 2
Address	1-247
Connector	3 pole terminal

Modbus TCP/IP

Protocol	Modbus TCP/IP
Communication interface	RJ45 (2 ports for daisy-chain)*
Number of simultaneous connections	Up to 3 different clients

Bluetooth

Type	BLE (Bluetooth Low Energy)

Real-time clock

Clock drift	~ 0.4 seconds per day
Battery backup time	~ 3 days without control power

Standards

Power metering and monitoring devices (PMD)	IEC 61557-12 (IEC 62053-22, IEC 62053-23)
Electrical safety	IEC 61010-1
EMC	IEC 61326-1 (IEC 61000-3-2, IEC 61000-3-3,IEC 61000-4-2, IEC 61000-4-3, IEC 61000-4-4, IEC 61000-4-5, IEC 61000-4-6, IEC 61000-4-8, IEC 61000-4-11)

M4M has been designed and tested up to 2000m. Higher altitude can impact electrical safety, not performances.

Acc. to IEC 61010-1, clearances distances should be higher if you are at >2000m. M4M has been designed with a "Multiplication factor = 1".

Consequently, it is not possible to highlight a performance derating when at an altitude >2000m, because all tests related to IEC 61010-1 and product design have been carried out up to 2000m.

4. Measurement method

Import energy registers increments when the power is positive and export energy registers increments when power is negative.

All import and export registers are positive (or zero) and will either increment or stand still. Net energy registers contains the import minus the export register for corresponding registers and can be positive or negative.

The ABB M4Ms use the vector registration method for computation of energy.

4.1.Vector registration method

In the vector registration method the instantaneous energy consumption of the measuring elements (the three phases in 3-phase 4-wire metering) is summed up to the total register. If the sum is positive the import register is incremented and if the sum is negative the export register is incremented.

Say for example that the power in the three phases are L1: **+1** kW, L2: **-1** kW and L3: **+1** kW. The total power will then be **1 – 1 + 1= 1 kW** and **the total import register will increase** at a rate of 1 kWh each hour and **the total export register will stand still**.

If the power in the three phases instead are L1: **+1** kW, L2: **-1** kW and L3: **-1** kW the total power will be **1 – 1 -1= -1 kW** and **the total export register will increase** with the rate of 1 kWh each hour and **the total import register will stand still**.

Note that if a 3-phase load with neutral have connections between the phases that have a power factor smaller than 0.5, that is constitute a mainly reactive load, the power in single phases can be negative even if the 3-phase load is consuming energy. The total power and energy will however always be positive for a 3-phase load that is consuming energy.

Note also that the sum of the per phase registers will be bigger than the total register if the power in the phases contains a mix of both positive and negative power. In applications where the load is a 3-phase load the total register should always be used for billing.

5. Installation

5.1.Assembly M4M 2X

TS35

35 mm

7,5 mm

1

2

3
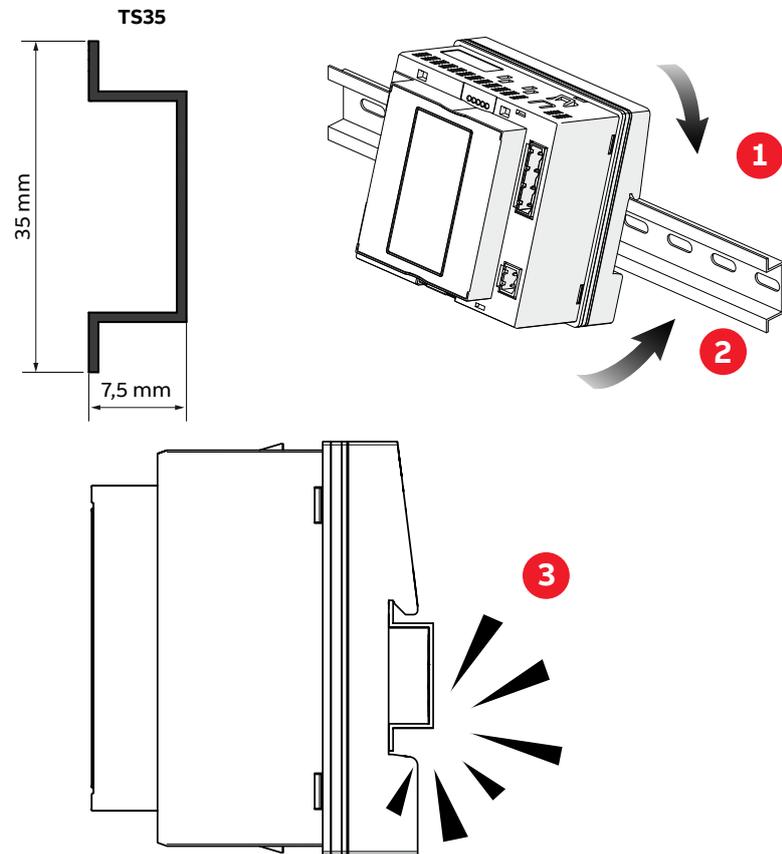
— 5.2.Wiring diagrams

The operations to carry out for the correct connection of the device, based on the type of electric line available, are described in this section.

The installation and the cabling of the device must be carried out by qualified personnel.
Please find below our recommended wiring.

Danger of electrocution, burning and electric arc.
Use the personal protection devices suitable to adhere to the current regulations governing electrical safety.
Prior to carrying out any connections check the sectioning of the electric supply with the voltage detection device.

- M4M 2X MODBUS connection
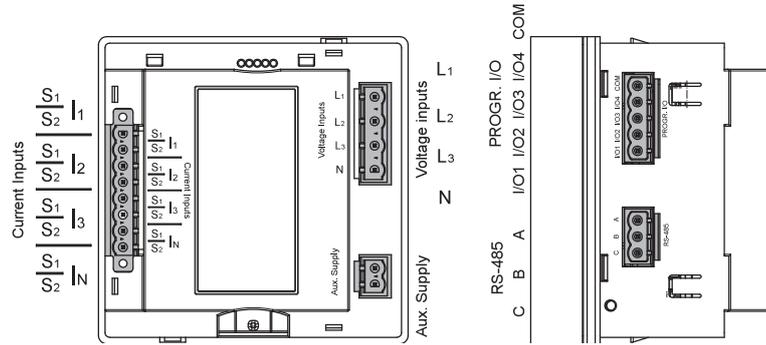
- M4M 2X ETHERNET connection
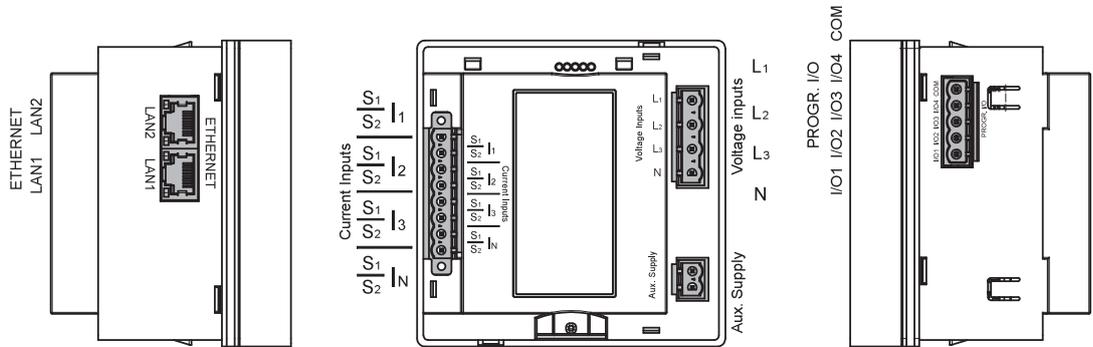
The M4M 2X can be used on different type of network (please refer to chapter "7. First commissioning" for the configuration on the device).

According to the type of network that has been chosen, the measurable parameters change. Below the recommended wiring diagrams for M4M 2X working with CT …/5A or …/1A:

- 3-phase 4-wire network with 4CTs
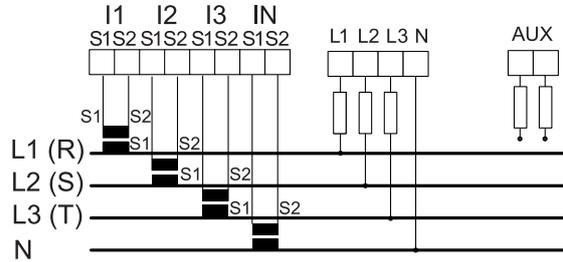
- 3-phase 4-wire network with 3CTs
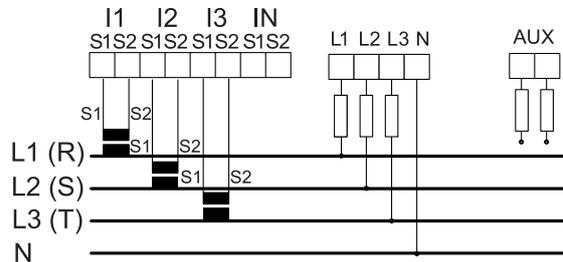
- 3-phase 4-wire network with 1CT
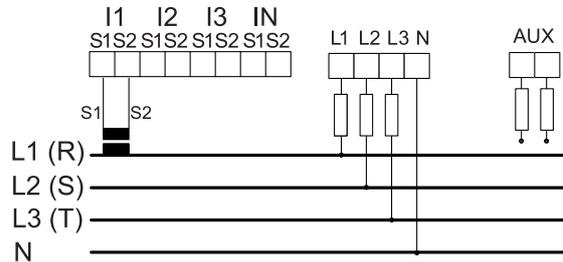
- 3-phase 3-wire network with 1CT
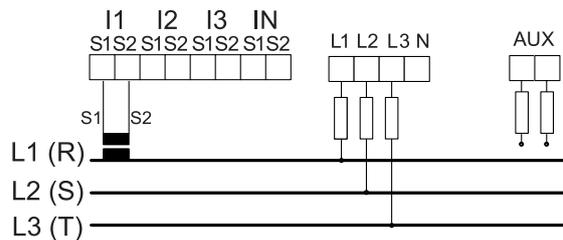
- 3-phase 3-wire network with 3CTs
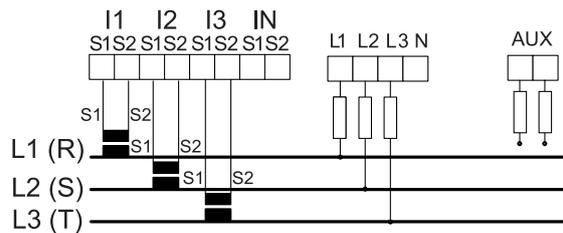
- 3-phase 3-wire network with 2CTs
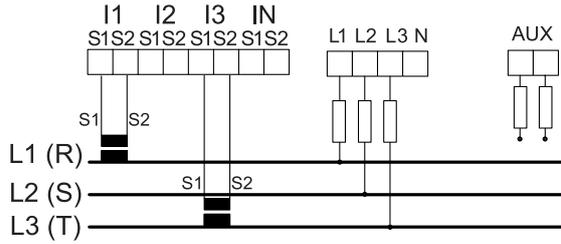
- 2-phase 3-wire network with 2CTs
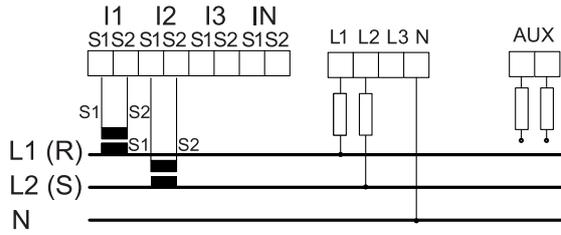
- 1-phase 2-wire network with 1CT
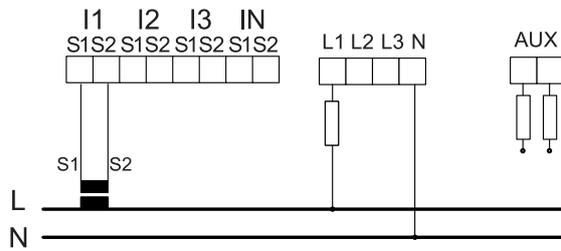
- 3-phase 4-wire network with 3CT + 3VT
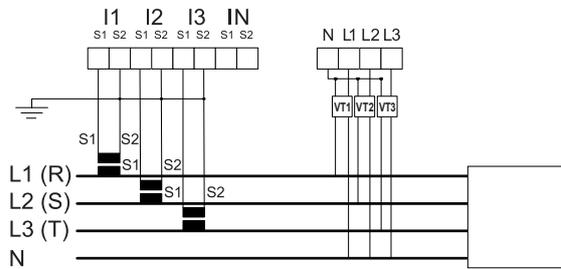
- 3-phase 3-wire 3-CTs + 3VTs
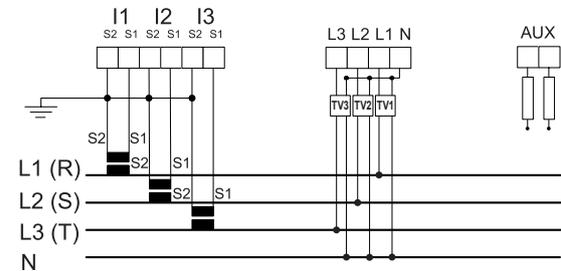
- 2-phase 3-wire network with 2CT + 2VT
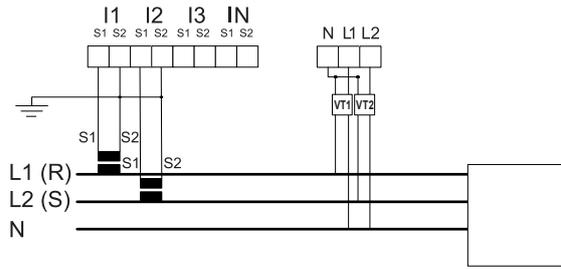
- 1-phase 2-wire network with 1CT + 1VT
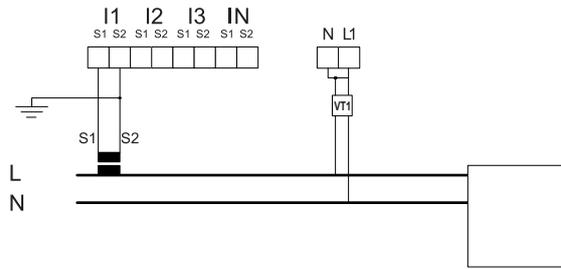
Inputs and outputs connections

- Programmable I/O: Alarm output with external relays for load command. Example of wiring for I/O1 as alarm output, COM is common for all I/O:

I/01 I/02 I/03 I/04 COM
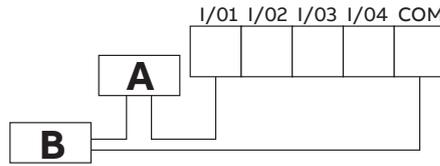
A: V aux 48 V a.c./d.c. 100mA
B: External relay

- Programmable I/O: Pulse output. Example of wiring for I/O1 as pulse output, COM is common for all I/O:

I/01 I/02 I/03 I/04 COM
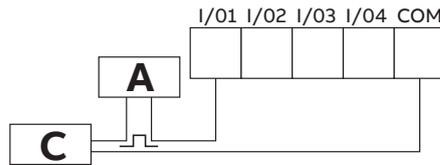
A: V aux 48 V a.c./d.c. 100mA
**C**: Pulse acquisition

- Programmable I/O: Tariff input. Please note that only I/O1, I/O2, I/O3 can be used as tariff inputs. Example of wiring for I/O1 as tariff input, COM is common for all I/O:

I/01 I/02 I/03 I/04 COM
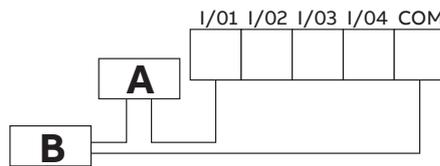
A: 24-240VDC / 57-240VAC
B: Tariff acquisition

- Programmable I/O: Pulse input for external pulse acquisition. Example of wiring for I/O1 as pulse input, COM is common for all I/O:

I/01 I/02 I/03 I/04 COM
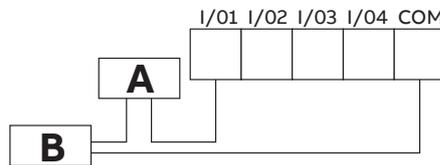
A: 24-240VDC / 57-240VAC
B: Pulse acquisition (Impulse length at least 30 mS)

6. Access to device

Connection to M4M 2X is necessary to perform configuration setup, energy monitoring, notification readings and firmware updates.

Automatic integration can be established choosing one among the four M4M dedicated tools powered by ABB. It is also possible to setup connection via a third-party software that support the device communication protocols, but we suggest using ABB tools for enhanced user experience.

Each tool is compatible with different platforms to ensure the highest availability.

Tool	Configuration	Energy monitoring	FW update	Platform
Ekip connect Software	Complete	Complete	Yes	Desktop
ABB Ability™	None	Complete	None	Desktop
Setup4Meter	Complete	Complete	None	Smartphone, tablet
EPiC	Partial*	Complete	None	Smartphone, tablet

The recommended choice for a complete configuration and reading of M4M are Ekip connect desktop Software and Setup4Meter mobile app.

*EPiC configuration includes CT ratio, VT ratio and type of network only.

Further details on ABB tools are illustrated below.

6.1.Ekip connect Software

Ekip connect is a desktop software for complete configuration, monitoring activity and firmware up-date of the M4M series.

You can download Ekip Connect 3 software, updated to the latest version, at this link.
Please note that you can rely on a M4M and Ekip Connect dedicated guide, which can be found in ABB Library or downloaded at this link.

6.2.ABB Ability™

M4M exploits the scalability of the ABB solution: from stand-alone visualization via HMI or via other ABB tools, to monitoring, optimization and control of the complete electrical system via ABB Ability™.

ABB Ability™ EDCS also provides access on a multi-site level, simultaneously monitoring and comparing the performance of different facilities, as well as collecting and exporting data for historical trend analysis with on-demand queries or scheduled automatic reports.

6.3.EPiC

Electrification Products intuitive Configurator (EPiC) is the unique ABB tool for supporting the user in the management of M4M network analyzers and many other ABB devices. It allows you to perform basic configuration and readings of KPIs right from your smartphone.

EPiC encompasses a wide range of products, allowing you to manage not only M4M but also Circuit Breakers, Smart Monitoring Relays and Ekip UP+ Digital Unit.

You can search for the app in your app store of choice.

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6.4.Setup4Meter

S4M is an alternative solution to interaction via the product display that makes professional activities smarter and faster.

With S4M app, you manage all M4Ms in one place, including: configuration, monitoring, and data sharing. The user experience is further enhanced by template-centered function which allow professionals to apply the same configuration throughout different sites, reducing the amount of repetitive work down to zero.

The result will be a quicker, simpler, and more reliable method of commissioning and monitoring for intermediate and high-level metering devices.

You can search for the app in your app store of choice, or you can scan the QR codes below.

For further information, you can download the S4M dedicated guide at this link.

S4M Mobile app	
iOS	**Android**

7. Configurable parameters

7.1.General parameters

Type of Network

In order to configure the type of network it is needed to choose one of the available options according to the installation conditions. According to the type of network that has been chosen, the parameters read by the meter will vary, please refer to "9. Overview Installation" to see the details.

CT Ratio

M4M 2X is capable to measure current only via indirect connection by means of current transformers CTs.../5A or .../1A.

If CTs are used, then on the network analyzer it is needed to set the transformation ratio of the installed current transformers.

VT Ratio

M4M is capable to measure voltage via direct connection up to 400 VL-N (690V L-L), or via indirect connection by means of voltage transformers.

In case of direct insertion without voltage transformers (possible up to 400V L-N), please set VT ratio as 400/400 (default).

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7.2.Historicals

Historicals functionalities allow to store measurements (instantaneous snapshots, demand values) inside the device flash memory. There are three sorts of historicals, as illustrated in the table below:

Menu	Description
Load profile	Configuration for the Load profile feature in Historicals.
Max/Min Demand	Configuration for the Max/Min demand feature in Historicals.
Energy historicals	Common configuration for Energy - Snapshots and Energy - Trends features in Historicals.

Load profile

Load profile functionality allows to calculate the demand value of main real time measured quantities like voltage, current, power and THD, calculated over a specific time interval. These demand values are then visualized in a load profile curve in order to check the trend of the real time quantities.

At the end of each time interval, the average value of defined quantities is stored into the memory with timestamp. Up to 25 parameters, thus up to 25 channels of flash memory can be configured. Configuration is set up according to the time interval and channel parameter.

Menu	Description
Time interval	Time interval used for calculation of demand values that will be stored into the memory with timestamp.
Channels	Available channels in load profile. Each channel can be configured to a defined parameter.

- Time interval
The time interval is in common for all the load profile channels. For this reason, this configuration has to be done only once. The demand calculation will take place over the time interval defined. The interval will start in the moment of selection and the following one will start after the time interval is over. Select the time interval among one of the following options: 1, 2, 5, 10, 15 (default value), 30, 60 minutes.

- Channels
It is possible to configure each channel to one of the following parameters, allowing to store one parameter in each channel. Up to 25 parameters can be selected and stored. Default parameters are already configured and defined in the M4M for each channel, see details below.

Channels parameters	Channels parameters
Active Power Imp. Tot. (CH1 default value)	Voltage L1 (CH13 default value)
Active Power Imp. L1 (CH2 default value)	Voltage L2 (CH14 default value)
Active Power Imp. L2 (CH3 default value)	Voltage L3 (CH15 default value)
Active Power Imp. L3 (CH4 default value)	Voltage L1-L2 (CH16 default value)
Reactive Power Imp. Tot. (CH5 default value)	Voltage L2-L3 (CH17 default value)
Reactive Power Imp. L1 (CH6 default value)	Voltage L1-L3 (CH18 default value)
Reactive Power Imp. L2 (CH7 default value)	Current L1 (CH19 default value)
Reactive Power Imp. L3 (CH8 default value)	Current L2 (CH20 default value)
Apparent Power Imp. Tot. (CH9 default value)	Current L3 (CH21 default value)
Apparent Power Imp. L1 (CH10 default value)	Current N. (CH22 default value)
Apparent Power Imp. L2 (CH11 default value)	THD Voltage L1
Apparent Power Imp. L3 (CH12 default value)	THD Voltage L2
Active Power Exp. Tot.	THD Voltage L3
Active Power Exp. L1	THD Voltage L1-L2
Active Power Exp. L2	THD Voltage L2-L3
Active Power Exp. L3	THD Voltage L3-L1
Reactive Power Exp. Tot.	THD Current L1 (CH23 default value)
Reactive Power Exp. L1	THD Current L2 (CH24 default value)
Reactive Power Exp. L2	THD Current L3 (CH25 default value)
Reactive Power Exp. L3	THD Current N
Apparent Power Exp. Tot.	Power Factor Tot.
Apparent Power Exp. L1	Power Factor L1
Apparent Power Exp. L2	Power Factor L2
Apparent Power Exp. L3	Power Factor L3

Max/Min Demand

Max/min demand functionality is used to measure and store in the product flash memory the maxi-mum and minimum demand values referred to a specific time period (day, week, month) of main real time measured. Demand values are calculated over a specific time interval (from 1 to 60 minutes). When the last interval of an ongoing period has finished, the maximum and/or minimum values are stored together with the timestamps, and a new period starts. Therefore, within the defined time pe-riod M4M will provide the max/min demand values calculated over the time interval.

It is possible to store also the 2nd and the 3rd max/min. Max/min demand functionality allows to store up to the 3 highest and/or lowest demand values per each parameter. Up to 25 parameters, thus up to 25 channels of flash memory can be configured.

Menu	Description
Time interval	Time interval used for calculation of demand values that will be stored into the memory with timestamp.
Time period	Time period over which max and/or min values are evaluated and then stored.
Channels	Available channels in max/min demand. Each channel can be configured to a defined parameter.

Please note that M4M allows to store 1 year of 3 highest and 3 lowest demand values with time interval of 30 min. and time period of day for 25 parameters (25 channels of memory).

- Time interval

The time interval is in common for all the max/min demand channels. For this reason, this configuration has to be done only once. Average values can either be calculated with sliding demand or no sliding.

The demand calculation will take place over the time interval defined. The interval will start in the moment of selection and the following one will start after the time interval is over.

Select the time interval among one of the following options: 1, 2, 5, 10, 15 (default value), 30, 60 minutes. After the configuration of time interval, it is needed to select the time sub-interval.

Menu	Description
No sliding	After the configuration of time interval, in case **no sliding demand** is needed, please configure the time sub-interval as no sliding. If no sliding is selected the average will be calculated over the intervals **01:00 - 01:15 - 01:15 - 01:30 - 01:30 - 01:45** etc...
1 min	After the configuration of time interval, in case no sliding demand it is needed to setup a sub-interval, with measured interval that will slide forward one sub interval at a time. The sub-interval must always be smaller than the time interval the time interval must be evenly divisible with the sub-interval. If for example an interval of 15 minutes and a sub-interval of 1 minute is selected the average will be measured over the intervals 01:00 - 01:15 - 01:01 - 01:16 - 01:02 - 01:17 etc...
2 min	
5 min	
10 min	
15 min (default value)	
30 min	
60 min	

- Time period

The time period is in common for all the max/min demand channels. For this reason, this can configuration has to be done only once.

The time period represents the timeframe over which the max/min demand values are evaluated and then stored. When the last interval of an ongoing period has finished, the max and/or min values are stored, and a new period starts.

Time period can be set among one of the following options: day (default value), week, month.

Menu	Description
Day (default value)	If day is chosen the starting point for evaluation of max and min will be now and the ending point will be 00:00 (time period ends and restarts at 00:00).
Week	If week is chosen, a start day of the period has to be chosen. Options are: Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, and Sunday.
Month	If month is chosen the starting point will be now and the ending point will be the first of next month at 00:00 (time period ends and restarts on the 1st).

The time period and time interval are common for all the max/min demand channels. For this reason, the configuration of time period and time interval are applied to all the channels.

- Channel

It is possible to link each channel to one of the following parameters, allowing to store one parameter in each channel. Up to 25 parameters can be selected and stored. Default parameters are already setup in the M4M for each channel, see details below.

Channels parameters	Channels parameters
Active Power Imp. Tot. (CH1 default value)	Voltage L1 (CH13 default value)
Active Power Imp. L1 (CH2 default value)	Voltage L2 (CH14 default value)
Active Power Imp. L2 (CH3 default value)	Voltage L3 (CH15 default value)
Active Power Imp. L3 (CH4 default value)	Voltage L1-L2 (CH16 default value)
Reactive Power Imp. Tot. (CH5 default value)	Voltage L2-L3 (CH17 default value)
Reactive Power Imp. L1 (CH6 default value)	Voltage L1-L3 (CH18 default value)
Reactive Power Imp. L2 (CH7 default value)	Current L1 (CH19 default value)
Reactive Power Imp. L3 (CH8 default value)	Current L2 (CH20 default value)
Apparent Power Imp. Tot. (CH9 default value)	Current L3 (CH21 default value)
Apparent Power Imp. L1 (CH10 default value)	Current N. (CH22 default value)
Apparent Power Imp. L2 (CH11 default value)	THD Voltage L1
Apparent Power Imp. L3 (CH12 default value)	THD Voltage L2
Active Power Exp. Tot.	THD Voltage L3
Active Power Exp. L1	THD Voltage L1-L2
Active Power Exp. L2	THD Voltage L2-L3
Active Power Exp. L3	THD Voltage L3-L1
Reactive Power Exp. Tot.	THD Current L1 (CH23 default value)
Reactive Power Exp. L1	THD Current L2 (CH24 default value)
Reactive Power Exp. L2	THD Current L3 (CH25 default value)
Reactive Power Exp. L3	THD Current N
Apparent Power Exp. Tot.	Power Factor Tot.
Apparent Power Exp. L1	Power Factor L1
Apparent Power Exp. L2	Power Factor L2
Apparent Power Exp. L3	Power Factor L3

Energy historical

Configuration of energy historicals is linked to two different functionalities: Energy Snapshots allows to obtain instantaneous energy snapshots taken in each time interval, and Energy Trend allows to obtain the difference between the energy values at the end and at the beginning of each time interval. At the end of a defined time interval, up to 20 energy parameters are stored together with the timestamp.

Menu	Description
Time interval	Time interval selected for storage of energy values.
Channel	Channels of memory of the device, allowing to store a defined parameter in each channel.

• Time interval
The time interval is in common for all the channels of memory. For this reason, this can configuration has to be done only once.

Menu	Description
1 hour	The snapshot will take place now and the following one will be after 1 hour.
6 hour	The snapshot will take place now and the following one will be after 6 hour.
12 hour	The snapshot will take place now and the following one will be after 12 hour.
Day (default value)	The snapshot will take place now and the following one will be at 00:00.
Week	It is needed to indicate when the demand period ends between these following options: Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, and Sunday.
Month	The snapshot will take place now and the following one will be at the first of next month at 00:00.

- Channels

It is possible to link each channel to one of the following parameters, allowing to store one parameter in each channel. Up to 20 parameters can be selected and stored. Default parameters are already setup in the M4M for each channel, as illustrated in the table below.

Channels parameters	Channels parameters
Active Energy Import Total (CH1 default value)	Active Energy Export Tariff 3
Active Energy Export Total (CH2 default value)	Active Energy Export Tariff 4
Active Energy Import L1 (CH4 default value)	Active Energy Export Tariff 5
Active Energy Import L2 (CH5 default value)	Active Energy Export Tariff 6
Active Energy Import L3 (CH6 default value)	Reactive Energy Import Tariff 1
Active Energy Export L1 (CH7 default value)	Reactive Energy Import Tariff 2
Active Energy Import L2 (CH8 default value)	Reactive Energy Import Tariff 3
Active Energy Export L3 (CH9 default value)	Reactive Energy Import Tariff 4
Reactive Energy Import Total (CH10 default value)	Reactive Energy Import Tariff 5
Reactive Energy Export Total (CH11 default value)	Reactive Energy Import Tariff 6
Reactive Energy Import L1 (CH13 default value)	Reactive Energy Export Tariff 1
Reactive Energy Import L2 (CH14 default value)	Reactive Energy Export Tariff 2
Reactive Energy Import L3 (CH15 default value)	Reactive Energy Export Tariff 3
Reactive Energy Export L1 (CH16 default value)	Reactive Energy Export Tariff 4
Reactive Energy Export L2 (CH17 default value)	Reactive Energy Export Tariff 5
Reactive Energy Export L3 (CH18 default value)	Reactive Energy Export Tariff 6
Apparent Energy Import Total (CH19 default value)	Active Energy Net Total (CH3 default value)
Apparent Energy Export Total (CH20 default value)	Active Energy Net L1
Apparent Energy Import L1	Active Energy Net L2
Apparent Energy Import L2	Active Energy Net L3
Apparent Energy Import L3	Reactive Energy Net Total (CH12 default value)
Apparent Energy Export L1	Reactive Energy Net L1
Apparent Energy Export L2	Reactive Energy Net L2
Apparent Energy Export L3	Reactive Energy Net L3
Resettable Active Energy Import Total	Apparent Energy Net Total
Resettable Active Energy Export Total	Apparent Energy Net L1
Resettable Reactive Energy Import Total	Apparent Energy Net L2
Resettable Reactive Energy Export Total	Apparent Energy Net L3
Active Energy Import Tariff 1	Active Energy CO_2
Active Energy Import Tariff 2	Active Energy Currency
Active Energy Import Tariff 3	Energy Counter Input 1
Active Energy Import Tariff 4	Energy Counter Input 2
Active Energy Import Tariff 5	Energy Counter Input 3
Active Energy Import Tariff 6	Energy Counter Input 4
Active Energy Export Tariff 1	Energy Counter Input 5
Active Energy Export Tariff 2	Energy Counter Input 6

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7.3.Input/Output

The number and type of I/O on the M4M network analyzer varies according to the different product versions. Please refer to the "Version" chapter at page X for details.

Input

Each programmable I/O can be configured as Pulse Input or Tariff Input.

Selecting Pulse Input, the device counts detected pulses connected to input port, that should last at least 30ms. It is needed to consecutively set a pulse ratio associated to the pulse counter, and then a unit of measurement to be associated to the pulses.

Setting page	Description
1. Time interval	Manual value between 1 and 999999.
2. Unit	No unit, Wh, kWh, MWh, Varh, kVarh, MVARh, VAh, kVAh, MVAh, gal, BTU, L, m^3, MCF, Ibs, kg, klbs, Therm.

Selecting Tariff Input allows to manage the tariffs via inputs. Only I/O1, I/O2 and I/O3 can be used for Tariff inputs. To use the function is also necessary to set up a corresponding number of Inputs as "Tariff" source. For more details, please check the Tariffs dedicated chapter at page 32.

Setting page	Slots to be configured as Tariff input
Up to 2	I/01
Up to 4	I/01, I/02
Up to 6	I/01, I/02, I/03

Digital Output

Each programmable I/O can be configured as Alarm output, Communication output, Pulse output, Output ON or Output OFF.

Selecting **Alarm output**, the output can be associated to a simple alarm or to a complex alarm. Please note that it is mandatory to set up a single alarm or a complex alarm prior to setting an output as Alarm output. In case no alarms have been set up, an information pop-up will appear to inform that no alarm is set, with an hyperlink to the Alarm settings. For alarm settings, please refer to chapter "7.4. Alarms" and "7.5. Complex alarms".

Selecting **Comm. output**, the output status is controlled directly via bus.

Selecting **Pulse output**, the output is set as a pulse generator associated with a measured parameter. It is needed to consecutively set a measured parameter associated to the pulse output, the pulse ratio and the pulse length.

| Setting page	Description
Parameter	Total Active Import Energy, Total Active Export Energy, Net Active Energy, Total Reactive Import Energy, Total Reactive Export Energy, Net Reactive Energy, Total Apparent Import Energy, Total Apparent Export Energy, Net Apparent Energy.
Pulse ratio	Default values: 10/100/1000/5000 pulses for each kWh/kvarh/kVAh or 10/50/100 pulses for each Wh/varh/VAh. Manual between 1 and 999999 pulses for each kWh/kvarh/kVAh or pulses for each MWh/Mvarh/MVAh.
Length	Manual value between 10 and 990ms.

Selecting **Output ON**, the output status is always set High.

Selecting **Output OFF**, the output status is always set Low.

7.4.Alarms

M4M 2X are equipped to support configurable alarms. When specific conditions are met, alarms are turned on or off. Triggering of alarms will be visualized as notifications or linked to I/O. There are two types of alarms available on M4M: simple alarms and complex alarms, for complex alarms please go to next chapter.

Up to 25 simple alarms can be configured in the device. The following graph explains how the alarm features work in relationship to threshold, delay, hysteresis.
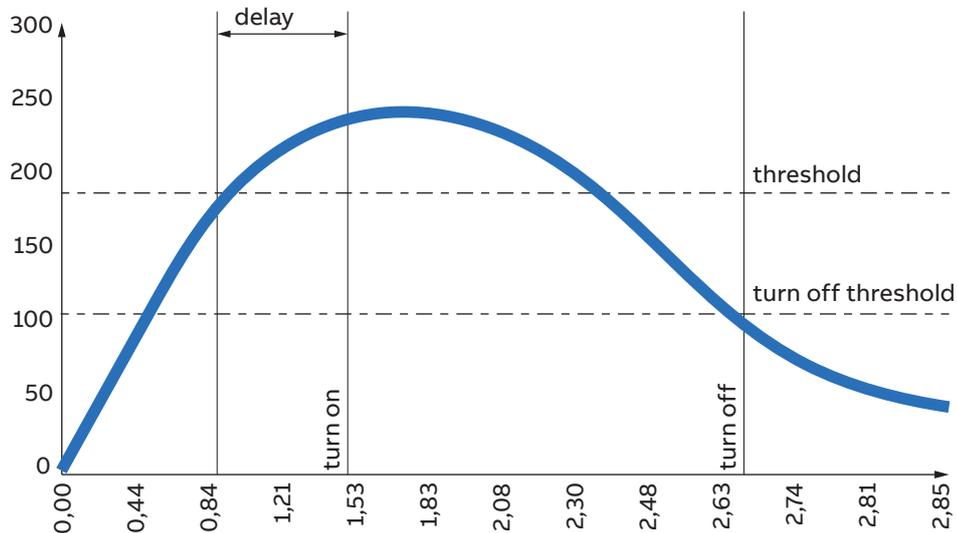
In order to set an alarm, it is needed to define the parameter associated to the alarm, the alarm type (cross up over threshold, or cross down under threshold), the threshold value for the parameter, the activation delay and the hysteresis for the turn off threshold.

How the alarm is turned on: Whenever measured value crosses threshold for a time that is higher than the defined delay, timer is set and starts counting down delay. If count down is finished and the value have not crossed back the threshold, alarm is turned on. At this point, according to configuration, alarms trip is registered in the notifications log (alarm section) and/or alarm output is set High.

How the alarm is turned off: The alarm state is held until the value crosses turn off threshold, which is the difference between the threshold and the threshold hysteresis. Crossing turn off threshold results in turning off the alarm, thus digital output is turned off or/and it is registered in the notifications log.

7.5.Complex Alarms

According to the M4M 2X version (M4M 2X RTU/TCP RTS, PQ1+R, PQ2+R), it is possible to configure up to 4 complex alarms, allowing to combine simple alarm into one single entity through specific logics.

It is possible to create an alarm logic that will allow the alarm activation only in case specific conditions take place. Each complex alarm can be linked to up to 4 simple alarms, selected along with OR / AND logical operator. When OR is selected alarm will be tripped every time one of the conditions of the equation will turn positive; when AND is selected alarm will be tripped every time all the conditions of the equation will turn positive.

Complex alarm trip can be registered in the notifications and/or alarm output is set High. Once logical equation will turn negative again, complex alarm is turned off, thus digital output is turned off or/and it is registered in the notifications log.

7.6.Tariffs

It is possible to configure up to six tariffs to monitor consumption in different time frames. Tariffs can be activated via clock, or setting up to three input channels or via bus. This feature is available on all M4M 2X with RTS package (M4M 2X RTU/TCP RTS, PQ1+R, PQ2+R).

Menu	Description
Clock	Up to 6 tariffs can be defined according to specific timebands, driven by the device Real Time Clock.
Input	Based on the number of I/O that are set as Tariff Inputs (from 1 to 3) that are set up from the Input menu (please refer to chapter "7.3.Input / output"), 2, 4 or 6 tariffs can be activated.
Communication	It is possible control directly the activation of the individual tariffs. Multiple configuration settings cannot be used.

Clock

Selecting Clock, it is possible to define when the different tariffs are active, according to specific day and hour, driven by Real Time Clock.

Select the day type among one of the following options: None, Weekday, Weekend. In order to disable a tariff, please select None. If weekday or weekend is chosen, then the tariff will be enabled during the weekdays or during the weekend, and it is needed to select the start hour of the tariff.

Each tariff is kept active until the next tariff is activated, this to define the end hour of each tariff set it as the start hour of the following tariff in the same day type.

Input

Selecting Input, the activation of the tariffs will follow the following table:

Input 1	Input 2	Input 3	Tariff
OFF	OFF	OFF	= T1
ON	OFF	OFF	= T2
OFF	ON	OFF	= T3
ON	ON	OFF	= T4
OFF	OFF	ON	= T5
ON	OFF	ON	= T6

Please see chapter "7.3 Inputs / Outputs" for further details on how to setup an I/O slot as Tariff input.

Communication

Selecting Communication, the activation of the tariffs is controlled by bus. It is possible control directly the activation of the individual tariffs. Multiple configuration settings cannot be used.

See Modbus communication manual for details on how to read Tariff via communication.

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7.7.Communication

It is possible to set all the parameters related to the communication protocol available for a specific product version. The embedded communication protocol varies according to the different product versions, Modbus ethernet or RTU. Please refer to "X Versions" for the details on the embedded communication protocols.

Bluetooth

Bluetooth communication protocol is available on all product version and allow to read data via mobile app.

To perform first commissioning of an M4M 2X with S4M, open S4M and perform the following activities:

1. On the "Devices" tab, tap "New device"
2. Accept to turn your smartphone Bluetooth on and grant S4M permission to use the camera
3. Select the M4M you want to configure from the list of detected devices
4. Enter the passkey. Default passkey is 00 + last four digits of device Serial Number (laser printed on the device). See example below:
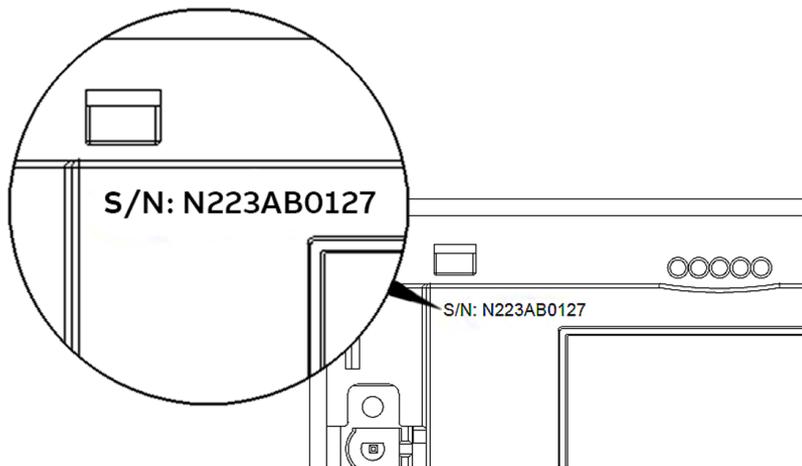
Example:

S/N	Default PIN
N223AB**0127**	000**0127**

5. Set the M4M password
6. After M4M is paired successfully, on S4M you will be asked to choose your preferred mode of configuration. The "Configuration wizard" is the recommended choice for first time users.

ⓘ Bluetooth is always active for all M4M 2X.

MODBUS RTU

Modbus RTU settings are available on all the M4M 2X product versions with Modbus RTU embedded communication.

Menu	Description
Address	From 1 to 247
Baud rate	9600, 19200, 38400, 57600, 115200
Parity	Even, Odd, None

ⓘ See Modbus communication manual for details on Modbus communication protocol and communication map.

MODBUS TCP/IP

Modbus TCP/IP settings are available on all the M4M 2X product versions with Modbus TCP/IP embed-ded communication.

Menu	Description
DHCP	Enable / Disable (disabled by default)
IP address	192.168.1.12 (by default)
Subnet mask	255.255.255.0 (by default)
Gateway	192.168.1.1 (by default)
TCP port	502 (by default)

If DHCP is disabled, the values of above configurations (IP address, subnet mask, gateway, TCP port) are the default ones. In this case, it is possible to modify each of above configurations.

If DHCP is enabled, it is not needed to enter the above configurations as they are automatically set. See Modbus communication manual for details on Modbus communication protocol and communication map.

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7.8.Reset

It is possible to carry out total or partial resets in M4M device.

Type of reset	Description
Factory reset	Restore the device to the factory state except for the audit log. Up to 20 factory resets can be carried out over the product lifetime.
Global reset	Complete reset of the device except for the settings and the audit log.
Historicals reset	Erase all historical data (Load Profile, Demands, Energy Snapshots and Energy Trend).
Avg/Min/Max reset	Reset the average, min and max data.
Energy reset	Erase all energy measurement accumulators. Up to 240 energy resets can be carried out over the product lifetime.
Notification reset	Erase all notifications (Alarms, Warnings, Errors).
Countdown timer	Reset of the count-down timer.

8. Frequently Asked Questions

Can I directly install this product without the use of any Current Transformer?

No, M4M is not suitable for direct insertion for current measurement. All M4M, except the M4M Rogowski versions, work with either …/1A or …/5A CTs. M4M Rogowski versions only work with R4M Rogowski coils.

Do I need external Voltage Transformers to measure 690V L-L?

No, all M4M versions measure voltage up to 400V L-N, thus 690V L-L, without any need for VTs (voltage transformers). For higher voltage levels it is possible to use Voltage Transformers.

Do I need to use different order codes if I have to install M4M with …/1A or …/5A CTs?

No, all M4M versions working with standard CTs (except M4M Rogowski versions) can be installed with either …/1A or …/5A CTs. CT secondary will have to be set as 1A or 5A during M4M's configuration.

Is M4M integrated in any connectivity solution?

Yes, M4M is natively integrated into ABB scalable digital solutions for energy management, such as the sub-distribution management System pro M compact InSite and ABB Ability™ Energy and Asset Manager cloud-solution with automatic recognition and no need for external integration of the meter in the system.

More information here.

Do I have to choose a specific product version in order to have a Bluetooth-equipped M4M?

No. All M4M 20 and M4M 30 versions are equipped with Bluetooth for smart commissioning and visualization via EPiC mobile APP, available for both iOS and Android devices.

When the customer does not have any supervisory system or cloud-based platform, does the M4M have some memory inside?

M4M 20 has a memory storing the energy value data, configurations of the meter, various logs (notifications, audit, etc). M4M 30 also has a 32MB flash memory allowing to store historical measurements (load profiles, energy trends, etc).

Is it needed to have an external gasket to reach IP54?

No, all M4M are tested as IP54 on the front with no need for external gaskets or covers.

Can I check when and how the configuration of the meter was changed?

Yes, all M4M have an audit log that stores the configuration data of the meter and timestamp every time FW is updated and/or CT ratio, VT ratio or Type of network is modified.

Is there any certificate available with the M4M?

Every package of M4M contains its calibration certificate related to the specific device. Moreover, Certificates of Compliance (CoC) released by external certification body are available on the Library.

Can I use M4M inside Medium Voltage (MV) systems?

Yes, M4M can measure up to 500kV through Voltage Transformers (VT primary).

What are the maximum current that M4M can measure?

Maximum current that can be measured via CT is 50kA (CT primary).

Is there a maximum value of accumulated energy in M4M?
What happens to the energy value after such maximum value is reached?

Max value for energy accumulators (active, reactive, apparent) is 999.999.999 kWh/kVArh/kVAh. After exceeding it, the accumulated value will restart from 0.

What is M4M sampling time?

Measurement via M4M for TRMS values is done with 128 samples per line cycle at 50Hz. Refresh time for measurements is 25 line cycles, therefore at 50Hz it is 500ms, while at 60Hz it is 416ms.

Can I use M4M Ethernet version with multiple TCP clients?

Yes, M4M Ethernet versions work with up to 3 simultaneous TCP clients.

Is there a desktop software available to remotely configure M4M?

Yes, Ekip Connect desktop software allows the stand-alone visualization and configuration of an M4M through PC. Connection between M4M and PC should be Modbus RTU or Modbus TCP/IP.

Download the manual "M4M desktop software - Getting started with Ekip Connect".

Can I configure M4M through my smartphone or tablet?

Yes, thanks to EPiC and S4M Mobile app that allow quick visualization and first commissioning of M4M via Bluetooth. The apps are available for Android and for iOS.

Can I replicate the configuration of one M4M on several others in my switchboard?

Yes, both via PC (Ekip Connect desktop software) and via smartphone or tablet (S4M mobile app) thanks to the "Import/Export" function and "Template" function that allow to save configuration time in case of similar configuration setup of different M4Ms with same product code.

When I set date and time on M4M, will it be stored even in case of power outage?

Date and time will be stored only for M4M 30 thanks to the integrated Real Time Clock (RTC) for approximately 3 days without power. For M4M 20, it will be needed to configure again date and time after a power outage.

9. Overview Installation

According to the type of network that has been chosen, the parameters read by the meter will vary, please refer to table below to see the details.

Instrumentation	3Ph/ 4W/ 4CT	3Ph/ 4W/ 3CT	3Ph/ 4W/ 1CT	3Ph/ 3W/ 3CT	3Ph/ 3W/ 2CT	3Ph/ 3W/ 1CT	2Ph/ 3W/ 2CT	1Ph/ 2W/ 1CT
Three phase system voltage	□	□	□	□	□	□		
Voltage L1 - N	□	□	□				□	□
Voltage L2 - N	□	□	□				□	
Voltage L3 - N	□	□	□					
Voltage L1 - L2	□	□	□	□	□	□	□	
Voltage L3 - L2	□	□	□	□	□	□		
Voltage L1 - L3	□	□	□	□	□	□		
Three phase system current	□	□	□	□	□	□	□	□
Current L1	□	□	□	□	□	□	□	□
Current L2	□	□	□	□		□	□	
Current L3	□	□	□	□	□	□		
Current N	□	□					□	□
Active power, total	□	□	□	□	□	□	□	□
Active power, L1	□	□	□		□		□	□
Active power, L2	□	□	□				□	
Active power, L3	□	□	□	□				
Reactive power, Total	□	□	□	□	□	□	□	□
Reactive power, L1	□	□	□		□		□	□
Reactive power, L2	□	□	□				□	
Reactive power, L3	□	□	□	□				
Apparent power, Total	□	□	□	□	□	□	□	□
Apparent power, L1	□	□	□		□		□	□
Apparent power, L2	□	□	□				□	
Apparent power, L3	□	□	□	□				
Frequency	□	□	□	□	□	□	□	□
Phase angle power, Total	□	□	□	□	□	□	□	□
Phase angle power, L1	□	□	□		□		□	□
Phase angle power, L2	□	□	□				□	
Phase angle power, L3	□	□	□	□				
Phase angle voltage, L1	□	□	□	□	□	□	□	□
Phase angle voltage, L2	□	□	□	□		□	□	
Phase angle voltage, L3	□	□	□	□	□	□		
Phase angle current, L1	□	□	□	□	□	□	□	□
Phase angle current, L2	□	□	□	□		□	□	
Phase angle current, L3	□	□	□	□	□	□		
Power factor, Total	□	□	□	□	□	□	□	□
Power factor, L1	□	□	□		□		□	□
Power factor, L2	□	□	□				□	
Power factor, L3	□	□	□	□				
Current quadrant, Total	□	□	□	□	□	□	□	□
Current quadrant, L1	□	□	□		□		□	□
Current quadrant, L2	□	□	□				□	
Current quadrant, L3	□	□	□	□				
Cosphi (displacement factor) Total	□	□	□	□	□	□	□	□
Cosphi (displacement factor) L1	□	□	□		□		□	□
Cosphi (displacement factor) L2	□	□	□				□	
Cosphi (displacement factor) L3	□	□	□	□				
THD for voltages	□	□	□	□	□	□	□	□
Harmonics voltage L1	□	□	□				□	□

Instrumentation	3Ph/ 4W/ 4CT	3Ph/ 4W/ 3CT	3Ph/ 4W/ 1CT	3Ph/ 3W/ 3CT	3Ph/ 3W/ 2CT	3Ph/ 3W/ 1CT	2Ph/ 3W/ 2CT	1Ph/ 2W/ 1CT
Harmonics voltage L2	□	□	□				□	
Harmonics voltage L3	□	□	□					
Harmonics voltage L1-L2	□	□	□	□	□	□	□	
Harmonics voltage L2-L3	□	□	□	□	□	□		
Harmonics voltage L1-L3	□	□	□	□	□	□		
THD for currents	□	□	□	□	□	□	□	□
Harmonics current L1	□	□	□	□	□	□	□	□
Harmonics current L2	□	□	□	□		□	□	
Harmonics current L3	□	□	□	□	□	□		
Harmonics current N	□	□					□	□
Unbalances - Phase voltage	□	□	□	□	□	□		
Unbalances - Line voltage	□	□	□					
Unbalances - Current	□	□		□				