

# Electrical installation solutions for buildings – Technical details

## Energy efficiency

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## Energy efficiency technical details

### Multimeters and network analyser

**Communication networks with Modbus RTU protocol** Modbus is a serial communication protocol created for use with programmable logic controllers (PLC). It has become an industry standard and is the most widely used protocol for connecting of industrial electronic devices.

Its principal benefits are:

- Ease of use
- Low resource requirements
- Openly published and royalty-free
- Allows communication between many devices connected to the same network

The Modbus support was created for controlling transfer on the line and pipeline monitoring. The system's flexibility and reliability make it suitable for a wide variety of processes and operations in nearly every industry.

Modbus determines how many MASTERS and SLAVES to recognise and connect together, how many senders and receivers are identified, how many messages are exchanged in an orderly manner and how many errors occur.

Every peripheral that needs to communicate via Modbus is assigned a unique address.

Any one of them can then send a Modbus command, although generally (necessarily, in the case of serial) only one peripheral acts as a master.

A Modbus command contains the Modbus address of the peripheral it is intended for, and only that peripheral will act on the command, even though all the others receive it as well.

All Modbus commands incorporate control information to ensure that the received command is correct.

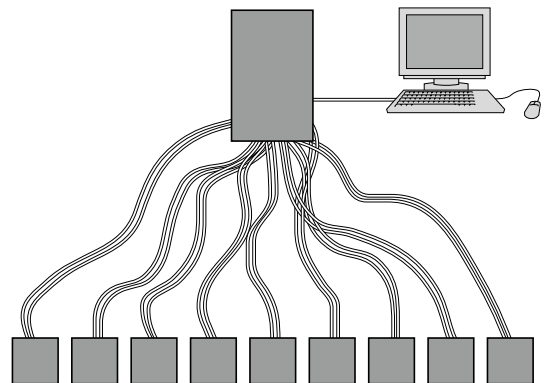
#### Conventional I/O system

##### Plus

Field devices unaffected from wiring error caused by other devices  
thanks to independent wiring  
Devices are cheaper  
Well known technology

##### Minus

Higher installation complexity caused by:  
point to point wiring  
many terminal blocks, need additional rack space or more cabinets  
troubleshooting on complex wiring  
increased number of point of failure  
longer initial check and start up  
Expensive installation



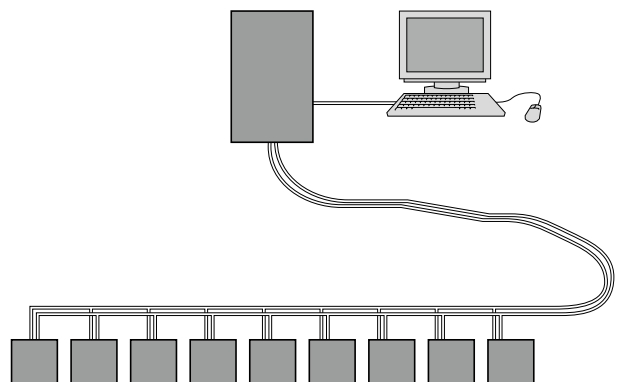
#### Modbus Network

##### Plus

Well known protocol, fully documented  
Many PLC, DCS and process systems are supporting this protocol  
Many facilities already use it  
Optimum choice when:  
Modbus network or devices are being used  
Modbus protocol is already used as a facility standard

##### Minus

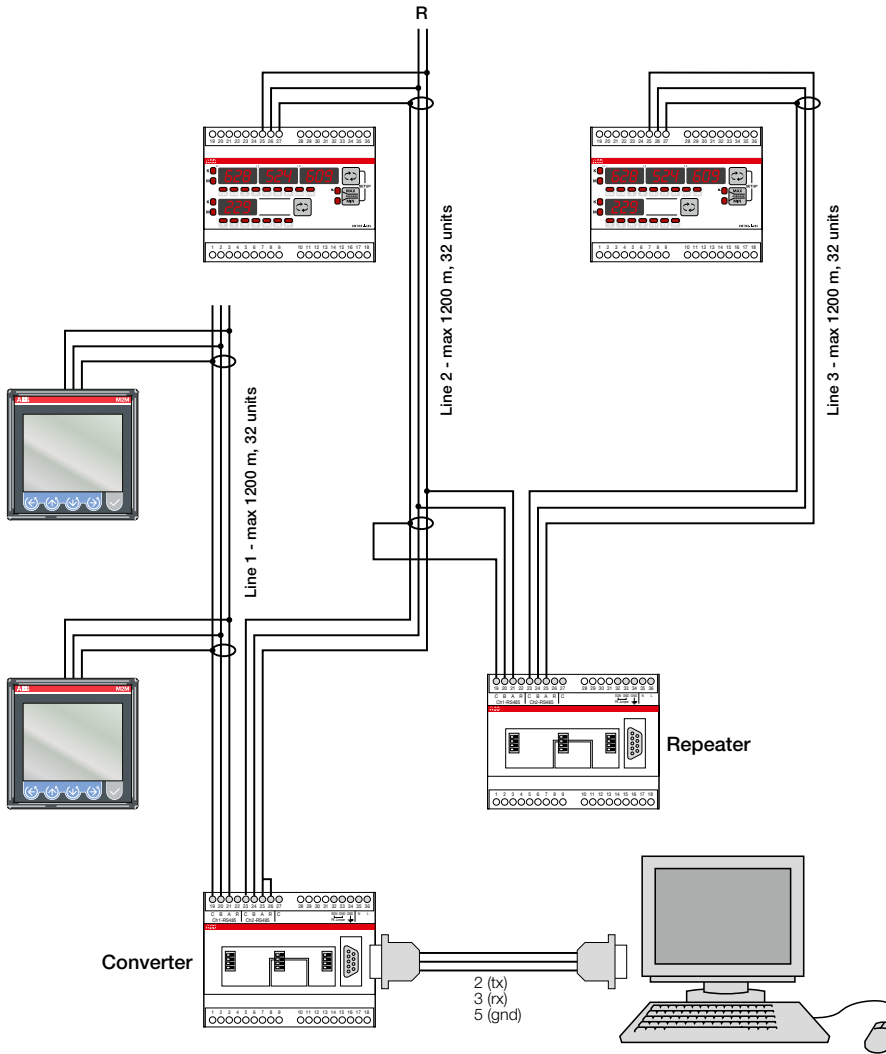
Device operations require separate power  
Limited diagnostic capabilities (device applications)  
Limited use as a device bus



# Energy efficiency technical details

Multimeters and network analyser

## Application example



## Energy efficiency technical details

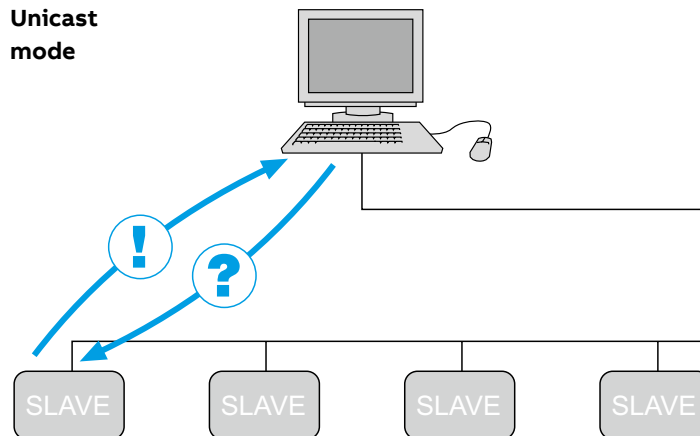
### Multimeters and network analyser

#### Connection among the devices

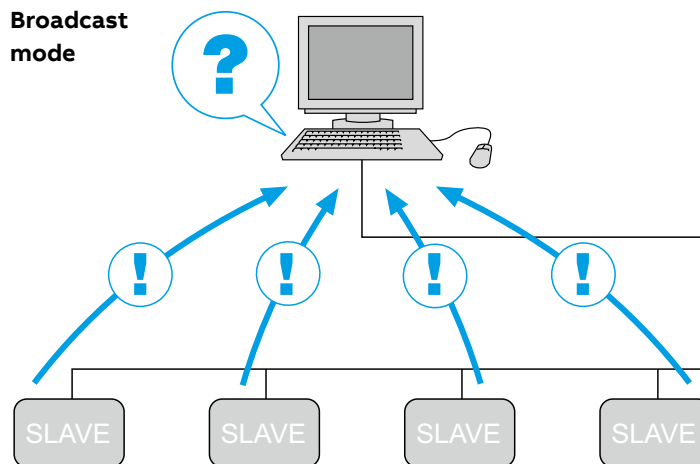
The protocol has one Master and up to 247 Slaves on a common line covering a maximum distance of 1200 metres. Only the Master initiates transactions. The transactions are of the request/reply type (addressed to a single Slave) or of the broadcast/reply type (addressed to all Slaves).

Modbus is often used for connecting a supervisory computer with a remote terminal unit (RTU) in supervisory control and data acquisition systems (SCADA). There are two versions of the protocol: one for serial ports (RS232 by default, but also RS485) and one for Ethernet. Modbus uses a compact hexadecimal data representation. The RTU format appends to commands/ data a cyclic redundancy checksum (CRC) field, while the ASCII format uses an LRU type (longitudinal redundancy check) checksum.

#### Unicast mode



#### Broadcast mode



## Energy efficiency technical details

### DMTME multimeters

#### DMTME multimeters

The DMTME series instruments are digital multimeters that measure the true rms value of the principal electrical quantities in 230/400 V a.c. networks, with the ability to store in memory the maximum/minimum/average measured values, and meter active and reactive energy. Four red LED displays provide a clear local readout of multiple measurements simultaneously. The DMTME multimeters perform the functions of a voltmeter, ammeter, power factor meter, wattmeter, varmeter, frequency meter, active and reactive energy meter in a single instrument, thus substantially reducing installation space requirements and wiring time.

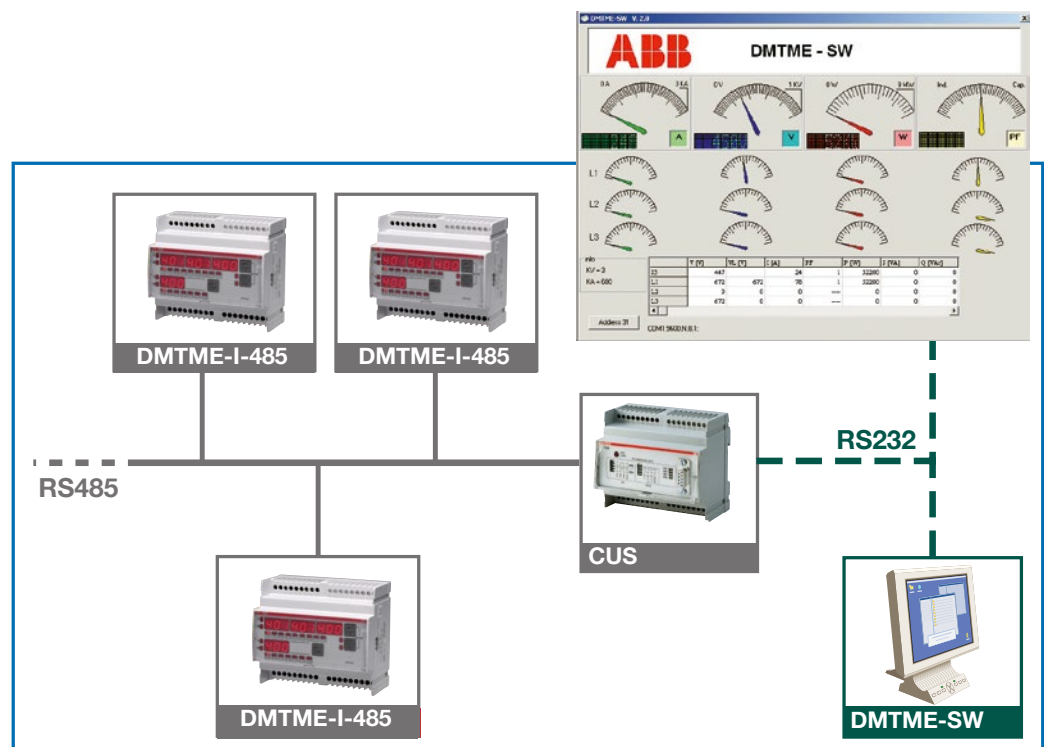
The DMTME-I-485 version is additionally equipped with a pulse output and RS485 port for communicating the measured parameters via a Modbus network.

All versions come with a mini CD containing the instruction manuals, technical documentation, communication protocol and the DMTME-SW software.

The main innovations of the range are:

- Automatic recognition of the C.T. connection polarity, which simplifies installation of the instrument, making it error-proof.
- An hour counter for scheduled maintenance and an instrument life time display, to assist the installer with routine activities.
- Separate auxiliary 115/230 V a.c. power supply on all models, with extractable terminal blocks.

The DMTME-SW software can perform real-time acquisition of all the readings of a multimeter or network of DMTME multimeters, with the values displayed in a single on-screen window. The measurements are shown in both numeric and “analog instrument” format. DMTME-SW also functions as a simple Modbus communication test instrument, allowing the installer to check the correct operation of the network prior to testing by the system integrator. Configuration example of networked DMTME multimeters



## Energy efficiency technical details

### DMTME multimeters

#### Operating principle

Beyond the custom functions of electric measure, the DMTME-I-485 multimeter is equipped with two programmable relays used as output alarms. The setting of the alarm thresholds of all the network electrical parameters allows the customer to hold always under control its own system.

#### Application environments

The installation of DMTME-I-485 multimeter is adapt in all those cases in which the customer must hold under remote control its own system.

The use of the multimeter allows to set up system automation, to prevent malfunctions, dued to overloads and undervoltages, to manage maintainance and to prevent overcoming of the contractual power, avoiding penal from the energy supplier.

The multimeter can carry out the same functions of the LSS1/2 load shedding switch, with the advantage of allowing installation in three-phase systems, instead of only single phase systems.

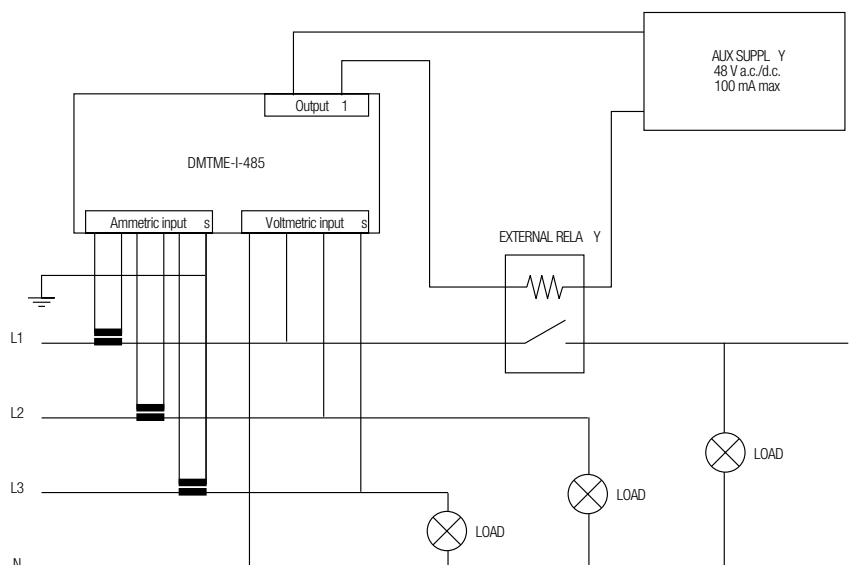
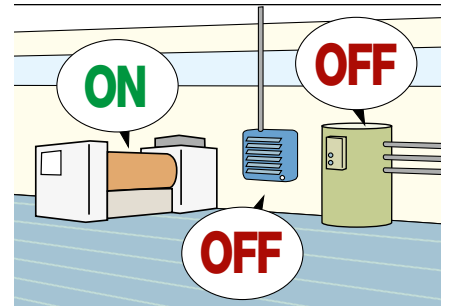
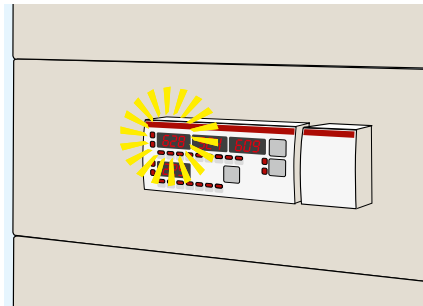
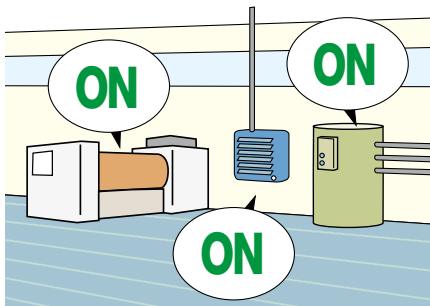
#### Example of installation

A possible application is the installation of DMTME-I-485 inside an electrical distribution switchboard of an industrial system.

It's possible to set up an alarm based on the total absorbed power from the system. When the power exceeds the set up threshold, the switching of the multimeter inner contact excitates the coil of an auxiliary external relay.

The switching of the external relay, a ESB contactor or a E234 electronic timer, detaches a non primary load to lower the absorption levels of the entire system.

This application can be performed also by using M2M and ANR network analyser.



## Energy efficiency technical details

### DMTME multimeters

#### Operating principle

In addition to measuring the main electrical quantities, the DMTME-I-485-96 digital front panel multimeter has a serial port for implementing a communication network, and two digital outputs which can be configured as alarm outputs. Programmable alarm thresholds on all the electrical parameters of the network allow the user to continually monitor the entire installation.

#### Application environments

The DMTME-I-485-96 multimeter is ideal for those situations where users must remotely monitor their installation. The multimeter makes it possible to implement system automation, prevent malfunctions due to overloads and undervoltages, manage maintenance, and monitor the functioning of the installation.

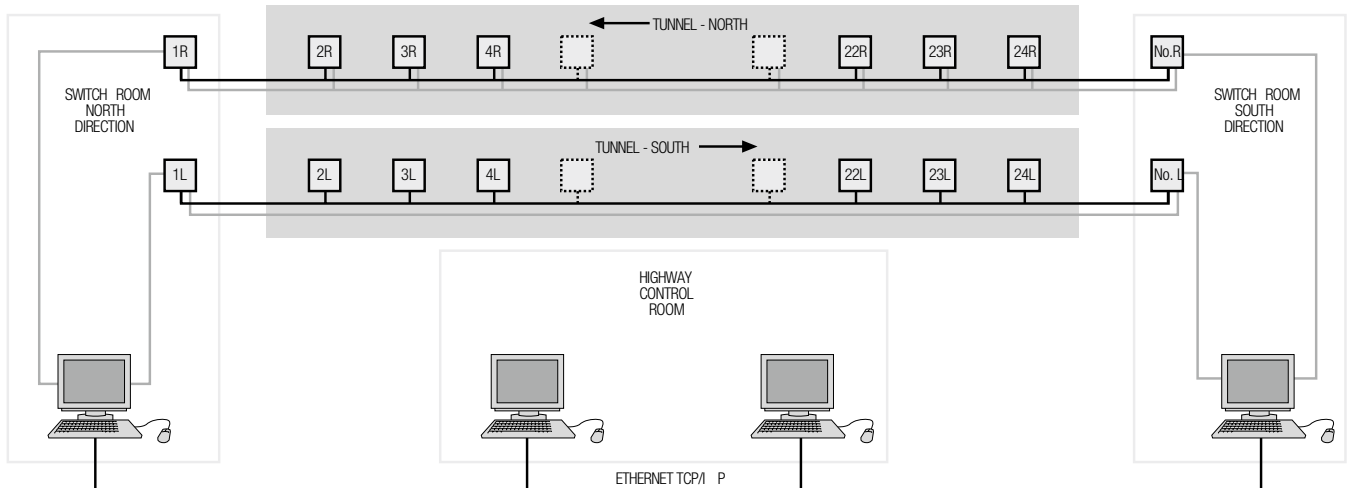
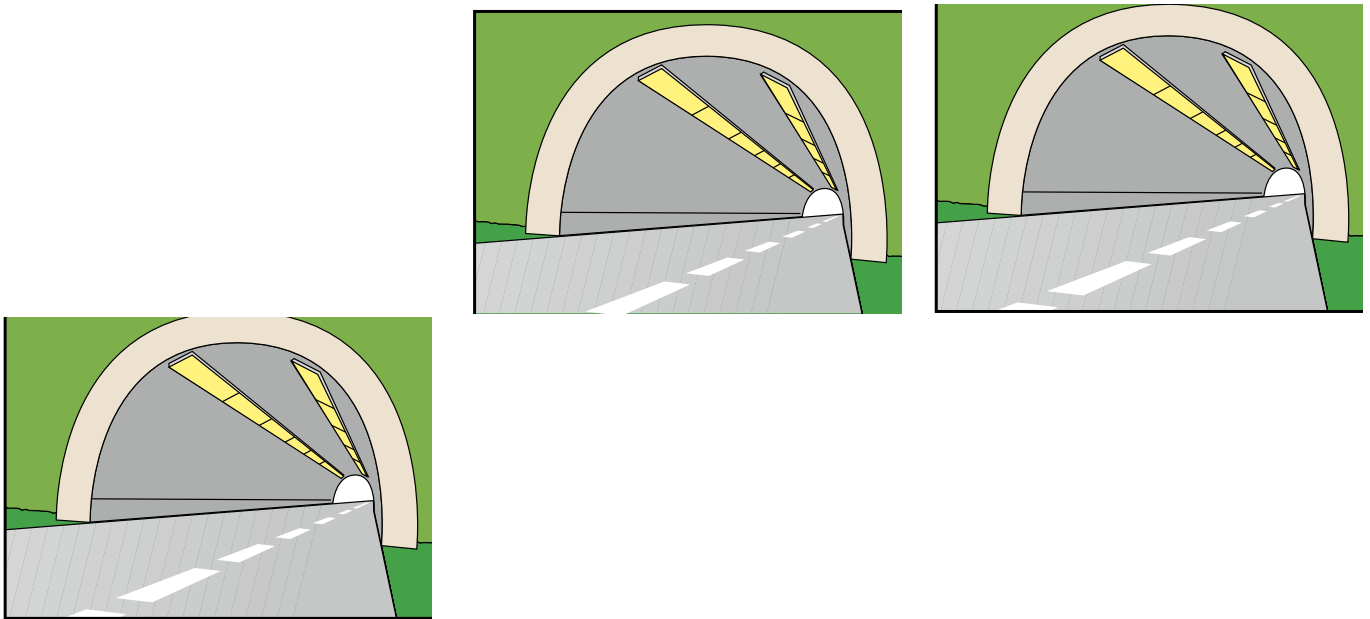
#### Example of installation

The figures show an application example in which the DMTME-I-485-96 is installed in a motorway tunnel panel, with an alarm threshold programmed on the total power consumption of the row of lights.

If one or more lamps burn out, the total power consumption drops and triggers an alarm.

Remote acquisition of this data thus allows a maintenance technicians to be sent out only when effectively needed.

This application can be performed also by using M2M and ANR network analyser.



## Energy efficiency technical details

### ANR Network analyser

#### Operating principle

The ANR network analyser can perform a variety of functions. In this example the ANR is used as a data concentrator, acquiring incoming data from other measuring devices and energy meters, and as a load manager.

The digital outputs in fact allow alarm thresholds to be programmed which, if breached, will trigger audible and visible alarm signals, or command the energising of a relay coil or switch to disconnect a particular load, thereby implementing effective automated management of energy consumption to comply with the maximum power draw permitted under the contract with the energy supplier.

#### Application environments

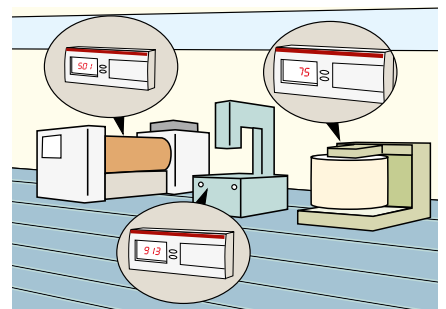
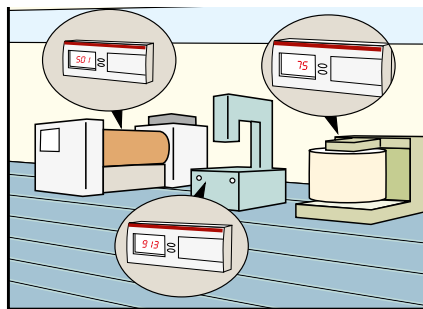
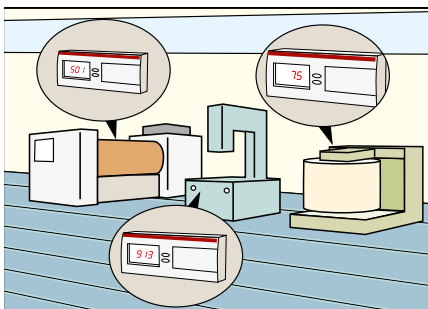
ANR is suitable for industrial and services sector applications which require implementing control of energy consumption, optimising service continuity and managing the quality of the network.

#### Example of installation

As illustrated in the figures, the ANR can be used to allocate power consumption among production cycles and track the share of energy costs in the total product cost.

Through its digital inputs, the ANR is able to acquire the pulse signals output by various energy meters and thus keep track of their totals.

This application can be performed also by using M2M and DMTME network analyser.





## Energy efficiency technical details

### M2M Network analyser

#### Operating principle

Among its several functionalities, M2M performs bidirectional metering of energy and power on the 4 quadrants, allowing both production and consumption of energy to be monitored with a single device.

With the M2M analyser it is possible to keep the electrical consumption of all types of system under control, measuring them in real time both in economic and environmental impact terms, thanks to the immediate conversion of the energy balance into Euros and CO<sub>2</sub> kg.

#### Application environment

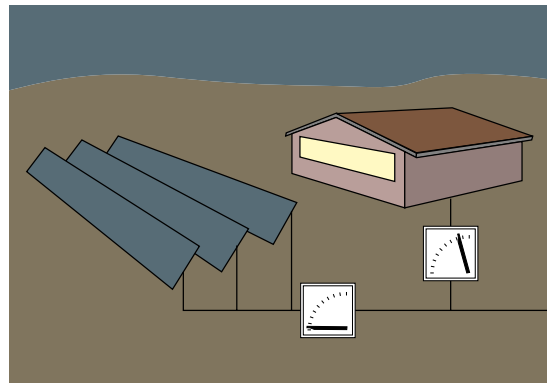
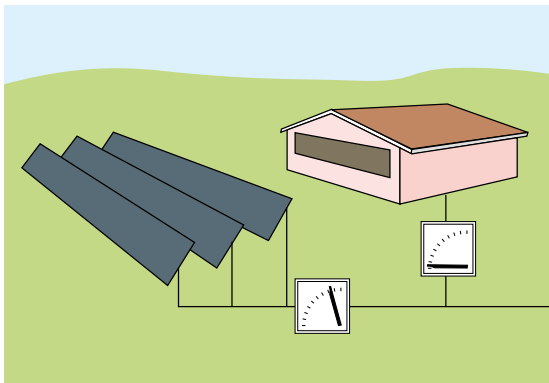
M2M bidirectional reading allows the amount of produced and consumed energy, saved money and avoided pollution to be displayed, optimal in systems generating energy from renewable sources. At the same time the possibility of keeping the quality of electrical parameters under control helps in achieving positive results on safety and operating costs.

#### Example of installation

A typical application where to use these M2M functionalities is a photovoltaic plant. By activating the GENERATION option, the energy counts will be carried out on 4 quadrants separating energy and absorbed power. Through the monitoring of network THD and Power factor, M2M can control harmonic distortion introduced in the system by non-linear loads such as inverter, computers, etc.

The integration of electrical consumption measurement in a supervision system can be done via the most advanced communication protocols (Modbus RTU, Modbus TCP/IP and Profibus DP ) allowing 360° analysis of system performances.

This application can be performed also by using ANR network analyser.

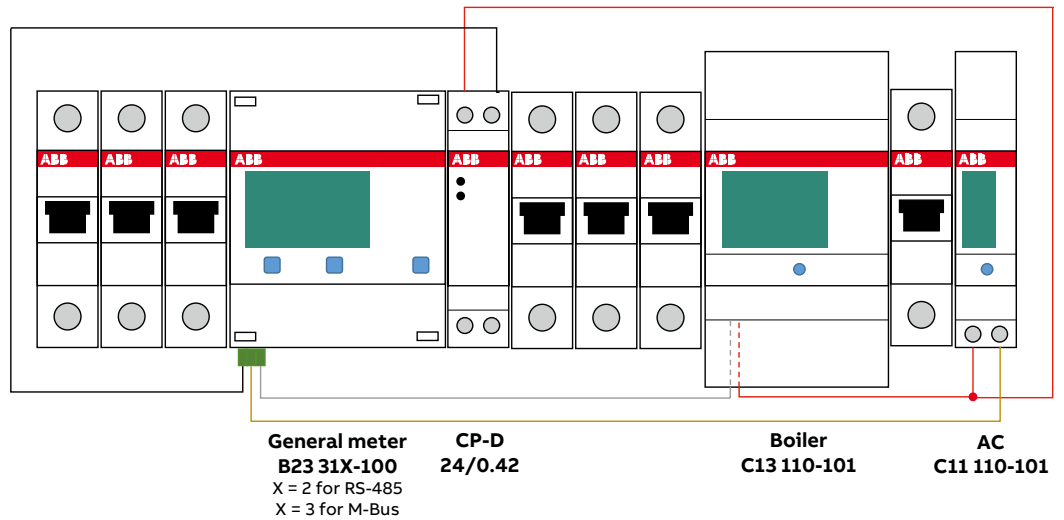


## Energy efficiency technical details

### EQ meters pulse outputs and digital inputs

#### Using the input counters on an A or B series meter for read out of C series meters values

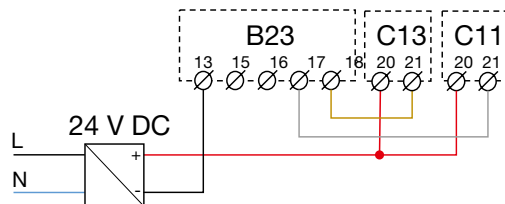
Now and then it can be useful to measure special loads like for example a boiler and an AC. These loads can be measured with C series meters which has their pulse outputs connected <sup>3)</sup> to one A or B series meter in Silver level or higher for functionality. In this way the measured values of the C series meters can be read over Modbus or M-Bus networks by read out of input counters on the general A or B series meter.



#### Water, Gas, heat and other meters

Similar connections can be used for reading water, gas or heat meters for example as long as they can generate pulses according to the specification of the inputs of the EQ meters. The most common pulse output is called S0 and it is common on all sorts of meters. Please note that the EQ meters do not provide the power for the pulses.

#### Wiring diagram for the 24 V DC installation



<sup>3)</sup> Please be aware that the same inputs cannot be used for tariff shift if they are used for pulse counting. To shift four tariffs via input a minimum of two inputs is needed. Tariffs can be shifted via communication for meters above Silver level if it has RS-485 or M-Bus interface or internal clock if the meter is in Gold or platinum level.

## Energy efficiency technical details

### Digital instruments

#### Alarm activation logic

Device status	NO polarity (default)	NC polarity
Instrument not supplied		
Instrument supplied - no alarm		
Instrument supplied - alarm condition		

#### Digital measurement instruments with relays

Control of a load with the following characteristics:

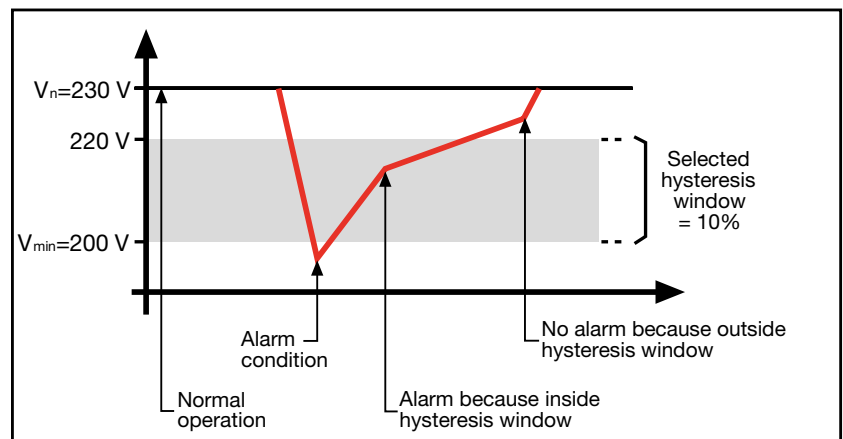
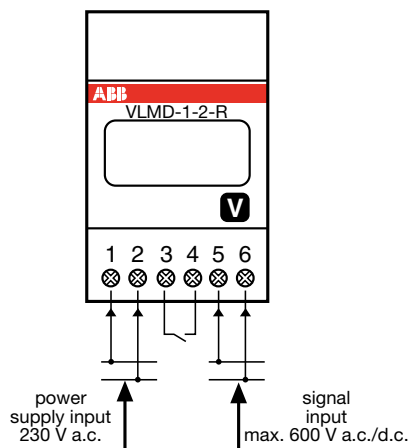
$I_n = 5 \text{ A}$  (rated normal operating current)

$V_n = 230 \text{ V a.c.}$  (rated normal operating voltage)

$V_{min} = 200 \text{ V a.c.}$  (RLV relay trip)

To scroll through the menu items press briefly (<3sec); to confirm press and hold (>3sec).

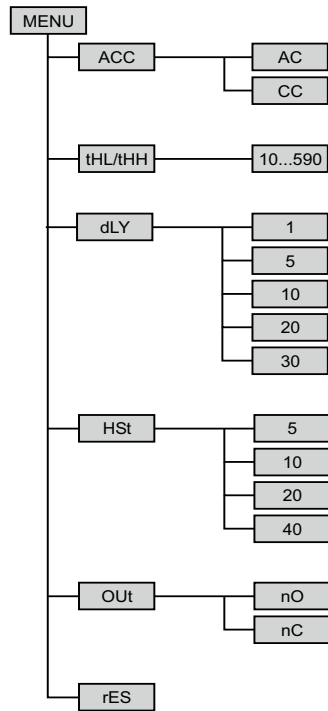
- 1 Connect as shown in the diagram ( $V_{min} = 200 \text{ V}$ ).
- 2 Press and hold the key to enter the programming menu.
- 3 Scroll to the ACC menu item and confirm, then choose CC to select direct current operation, and confirm.
- 4 Set the full scale value to 300 V
- 5 Set the alarm threshold at 70 and confirm.
- 6 Adjust the Delay trimmer: scroll to the dLY menu item and confirm, then select the relay tripping delay (1...30 sec).
- 7 Program the alarm reset hysteresis (HySTeresis) at 10% of the threshold: scroll to the HST menu item, confirm, and select the value 10. This results in a trip window between 200 and 220 V. The relay will be tripped at 200 V and return to normal operation at 220 V.
- 8 Set the alarm output polarity: scroll to the OUT menu item and confirm, then choose whether the contact opens or closes when an alarm is triggered (N.O. by default).



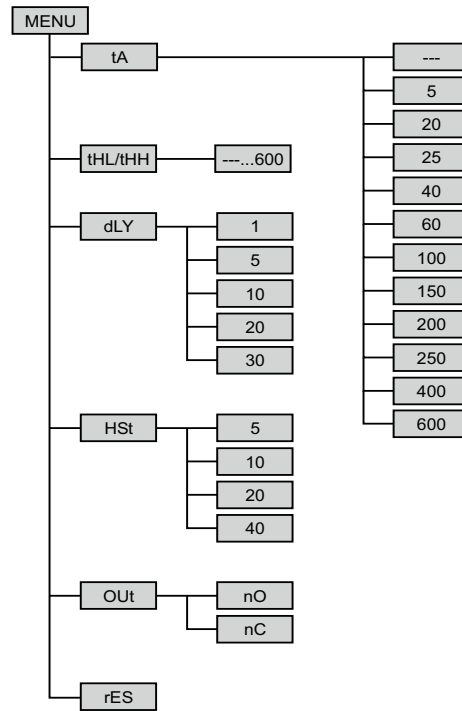
## Energy efficiency technical details

### Digital instruments

#### Voltmeters menu layout

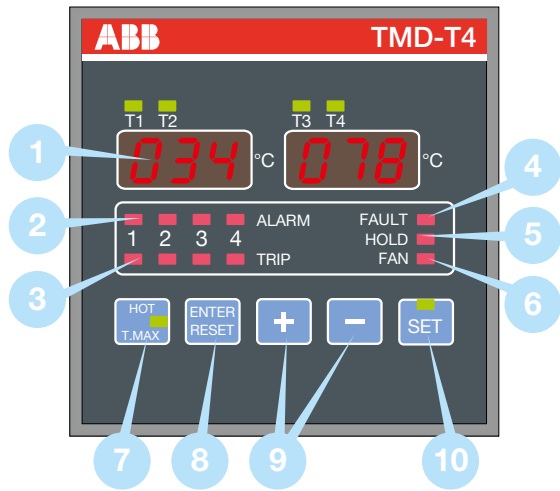


#### Ammeters menu layout

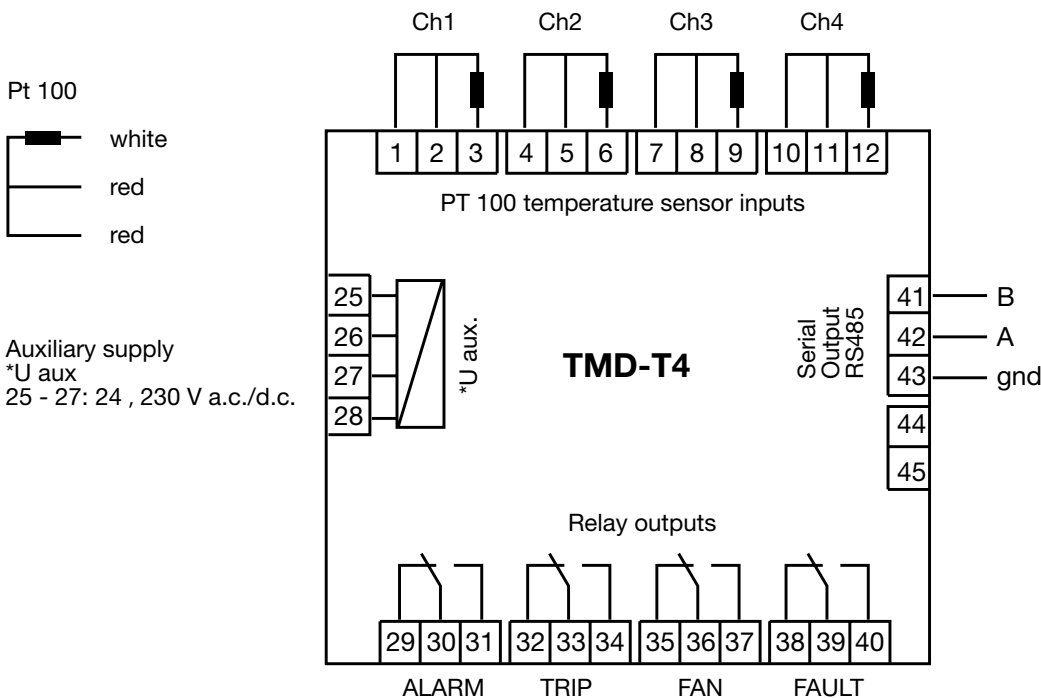


## Energy efficiency technical details

### TMD temperature control units



- 1 Display for viewing temperature values and settings
- 2 ALARM LED for viewing alarm status of measuring channels
- 3 TRIP LED for viewing trip status (second-level alarm) of measuring channels
- 4 FAULT LED for indicating temperature control unit and sensor faults
- 5 HOLD LED for indicating whether manual reset function is enabled
- 6 FAN LED for indicating whether fan output is enabled
- 7 MAX T. pushbutton for selecting to view the max temperature level
- 8 ENTER/RESET pushbutton for confirming the programmed settings and for manually resetting any alarms that have been tripped
- 9 +/- pushbuttons for selecting the measuring channels and for adjusting the programming parameters
- 10 SET pushbutton with status LED for accessing and programming the device's settings



## Energy efficiency technical details

### Measurement current transformers with through primary

#### Power consumption of copper cables between the device and the transformer

For 5 A secondary

Cable section mm <sup>2</sup>	Power (two-pole cable) VA					
	Distance					
	1 m	2 m	4 m	6 m	8 m	10 m
1.5	0.58	1.15	2.31	3.46	4.62	5.77
2.5	0.36	0.71	1.43	2.14	2.86	3.57
4	0.22	0.45	0.89	1.34	1.79	2.24
6	0.15	0.30	0.60	0.89	1.19	1.49
10	0.09	0.18	0.36	0.54	0.71	0.89

#### Maximum load (A) on copper bars according to DIN 43670 and 43671

Bar dimensions mm	Rated current (In) A		
	1 bar	2 bars	3 bars
20x5	325	560	
20x10	427	925	1180
30x5	379	672	896
30x10	573	1060	1480
40x5	482	836	1090
40x10	715	1290	1770
50x10	852	1510	2040
60x10	985	1720	2300
80x10	1240	2110	2790
100x10	1490	2480	3260

Rating	Ratio fault limit in %			
	0.05 In	0.2 In	In	1.2 In
0.5	±1	±0.75	±0.5	±0.5
1	±2	±1.5	±1	±1
3	From 0.5 In to 1.2 In = ±3			

Rating	Angle fault limit in %			
	0.05 In	0.2 In	In	1.2 In
0.5	±1.8	±1.35	±0.9	±0.9
1	±3.6	±2.7	±1.8	±1.8
3	No prescriptions			

#### Accuracy rating

- 0.5 rating is required for power meters.
- 1 rating is required for unofficial power measures and power meters (measurements within the firm).
- 3 rating is required for relays and protection devices.

#### Error Curves

