Electrical installation solutions for buildings – Technical details

Energy efficiency

Index

Multimeters and network analyser  8/2
DMTME multimeters  8/5
M4M Network analyser  8/8
EQ meters pulse outputs and digital inputs  8/9
Digital instruments  8/10
TMD temperature control units  8/12
Measurement current transformers with through primary  8/13
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.
Energy efficiency technical details

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 lifetime 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, due to overloads and undervoltages, to manage maintenance 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 excites 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.
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 technician 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
M4M Network analyzer

Operating principle
M4M is a network analyzer that can perform a variety of functions. Available in two versions M4M 30 and M4M 20. Some of M4M 30 functionalities are:
- **Complete electrical parameters measurement** (including avg/max/min, bi-directional metering)
- **Power quality** (THD, individual harmonics, unbalances, measured neutral current, power quality events, waveforms and phasors visualization)
- **Energy management** (max. demand, I/O, tariffs)
- **Log functionalities** (1-year flash memory for load profiles, max/min demand, energy trends)

While M4M 20 functionalities are:
- **Complete electrical parameters** measurement (including avg/max/min, bi-directional metering)
- **Basic power quality** (THD, calculated neutral current)
- **Basic energy management** (max. demand, I/O)

Application environments
M4M is suitable for industrial and commercial buildings, facilities, data centers that requires accurate energy efficiency monitoring of all the energy assets.

Installation
As it is shown in the picture all terminals on M4M are removable, including the current transformers (CTs) inputs for current measurement, allowing to carry out the wiring directly on the terminals and speeding up the process. Moreover, the vertical disposition of the terminals makes the cabling inside the switchboard more comfortable. They are easily installed. Secure fix on the panel is ensured by the easy-to-use clips, with different thickness setup for compatibility with any panel. One-hand mounting of the device thanks to the hooks on the housing. The reduced depth of only 57 mm inside the panel makes M4M suitable even in small-size switchboards.

---

**Easy to Install**
Fast one-hand mounting and comfortable installation with clips in only 57 mm depth inside the panel.

**Fast wiring**
All-removable terminals and one tool process to speed up the wiring activities.

Full communication
ABB Ability™ native network analyzers with complete communication protocols and I/O options for integration in any system.
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 1) 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

---

1) 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**

<table>
<thead>
<tr>
<th>Device status</th>
<th>NO polarity (default)</th>
<th>NC polarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instrument not supplied</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instrument supplied - no alarm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instrument supplied - alarm condition</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Digital measurement instruments with relays**

Control of a load with the following characteristics:
- In = 5 A (rated normal operating current)
- Vn = 230 V a.c. (rated normal operating voltage)
- Vmin = 200 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 (Vmin = 200 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

Pt 100
- white
- red
- red

Auxiliary supply
*U aux
25 - 27: 24, 230 V a.c./d.c.

PT 100 temperature sensor inputs

Relay outputs
ALARM  TRIP  FAN  FAULT

Serial Output RS485

B  A  gnd

25 26 27 28

TMD-T4
Energy efficiency technical details
Measurement current transformers with through primary

Power consumption of copper cables between the device and the transformer

<table>
<thead>
<tr>
<th>Cable section (mm²)</th>
<th>Power (two-pole cable) VA (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 m</td>
<td>2 m</td>
</tr>
<tr>
<td>1.5</td>
<td>0.58</td>
</tr>
<tr>
<td>2.5</td>
<td>0.36</td>
</tr>
<tr>
<td>4</td>
<td>0.22</td>
</tr>
<tr>
<td>6</td>
<td>0.15</td>
</tr>
<tr>
<td>10</td>
<td>0.09</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Bar dimensions (mm)</th>
<th>Rated current (In) A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 bar</td>
<td>2 bars</td>
</tr>
<tr>
<td>20x5</td>
<td>325</td>
</tr>
<tr>
<td>20x10</td>
<td>427</td>
</tr>
<tr>
<td>30x5</td>
<td>379</td>
</tr>
<tr>
<td>30x10</td>
<td>573</td>
</tr>
<tr>
<td>40x5</td>
<td>482</td>
</tr>
<tr>
<td>40x10</td>
<td>715</td>
</tr>
<tr>
<td>50x10</td>
<td>852</td>
</tr>
<tr>
<td>60x10</td>
<td>985</td>
</tr>
<tr>
<td>80x10</td>
<td>1240</td>
</tr>
<tr>
<td>100x10</td>
<td>1490</td>
</tr>
</tbody>
</table>

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

- Curve at 1/4 of nominal impedance
- Curve at nominal impedance

Error Curves

- Curvature at 1/4 of nominal impedance

Magnetic saturation

- 0.05 In
- 0.2 In
- 0.5 In
- 1.2 In
- F %
- Overcurrent in measuring transformer up to Fs 5