GE
Grid Solutions

iSTAT M2x3
Enhanced Measurement Centre
M203, M213, M233, M243, M253

Manual

Publication reference: iSTAT M2x3/EN/M/F

1. SAFETY SECTION

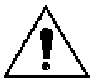
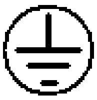
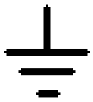
This Safety Section should be read before commencing any work on the equipment.

1.1 Health and Safety

The information in the Safety Section of the product documentation is intended to ensure that products are properly installed and handled in order to maintain them in a safe condition. It is assumed that everyone who will be associated with the equipment will be familiar with the contents of the Safety Section.

1.2 Explanation of symbols and labels

The meaning of symbols and labels may be used on the equipment or in the product documentation, is given below.

 Caution: refer to product documentation	 Caution: risk of electric shock
 Protective/safety *earth terminal	 Functional *earth terminal Note: This symbol may also be used for a protective/safety earth terminal if that terminal is part of a terminal block or sub-assembly e.g. power supply.

*NOTE: The term earth used throughout the product documentation is the direct equivalent of the North American term ground.

2. INSTALLING, COMMISSIONING AND SERVICING

Equipment connections

Personnel undertaking installation, commissioning or servicing work on this equipment should be aware of the correct working procedures to ensure safety. The product documentation should be consulted before installing, commissioning or servicing the equipment.

Terminals exposed during installation, commissioning and maintenance may present a hazardous voltage unless the equipment is electrically isolated.

If there is unlocked access to the rear of the equipment, care should be taken by all personnel to avoid electrical shock or energy hazards.

Voltage and current connections should be made using insulated crimp terminations to ensure that terminal block insulation requirements are maintained for safety. To ensure that wires are correctly terminated the correct crimp terminal and tool for the wire size should be used.

Before energising the equipment it must be earthed using the protective earth terminal, or the appropriate termination of the supply plug in the case of plug connected equipment. Omitting or disconnecting the equipment earth may cause a safety hazard.

The recommended minimum earth wire size is 2.5mm^2, unless otherwise stated in the technical data section of the product documentation.

Before energising the equipment, the following should be checked:

- Voltage rating, frequency and polarity
- VT ratio and phase sequence
- CT circuit rating and integrity of connections;
- Protective fuse rating;
- Integrity of earth connection (where applicable)
- Supply voltage

3. EQUIPMENT OPERATING CONDITIONS

The equipment should be operated within the specified electrical and environmental limits.

3.1 Current transformer circuits

Do not open the secondary circuit of a live CT since the high level voltage produced may be lethal to personnel and could damage insulation.

3.2 Battery Replacement

Where internal batteries are fitted they should be replaced with the recommended type and be installed with the correct polarity, to avoid possible damage to the equipment. The M233, M243 and M253 may have a Varta CR2032 SLF or equivalent fitted with an estimated life of 6 years.

3.3 Insulation and dielectric strength testing

Insulation testing may leave capacitors charged up to a hazardous voltage. At the end of each part of the test, the voltage should be gradually reduced to zero, to discharge capacitors, before the test leads are disconnected.

3.4 Opening enclosure

There are no customer replaceable PCB cards or components within the enclosure, so the enclosure should not be opened.

4. DECOMMISSIONING AND DISPOSAL

Decommissioning: The auxiliary supply circuit in the relay may include capacitors across the supply or to earth. To avoid electric shock or energy hazards, after completely isolating the supplies to the relay (both poles of any dc supply), the capacitors should be safely discharged via the external terminals prior to decommissioning.

Disposal: It is recommended that incineration and disposal to water courses is avoided. The product should be disposed of in a safe manner. Any products containing batteries should have them removed before disposal, taking precautions to avoid short circuits. Particular regulations within the country of operation, may apply to the disposal of lithium batteries.

5. TECHNICAL SPECIFICATIONS

5.1 Protective fuse rating

The recommended maximum rating of the external protective fuse for this equipment is 6A, Red Spot type or equivalent, unless otherwise stated in the technical data section of the product documentation.

Insulation class:	IEC 61010-1 : 2002 Class II EN 61010-1 : 2002 Class II	
Insulation Category (Over voltage):	IEC 61010-1 : 2002 Category II (600V), III (300V) EN 61010-1 : 2002 Category II (600V), III (300V)	
Environment:	IEC 61010-1 : 2002 Pollution degree 2 (600V), 3 (300V) EN 61010-1 : 2002 Pollution degree 2 (600V), 3 (300V)	Compliance is demonstrated by reference to generic safety standards.
Product Safety: CE	2006/95/EC EN 61010-1 : 2002	Compliance with the European Commission Low Voltage Directive. Compliance is demonstrated by reference to generic safety standards.

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6. INTRODUCTION

6.1 General

The **M2x3** is a comprehensive measurement centre family aimed particularly at the medium voltage and industrial market segments throughout the world. It allows the user to select the most appropriate model from the family and customise the features to suit the particular on site conditions.

The **M2x3** measurement centre family integrates a number of measurements, monitoring, recording and metering functions in the same unit for comprehensive power system management. The use of numerical technology achieves high accuracy over a wide dynamic measuring family for instantaneous and integrated power system parameters. The **M2x3** offers:

- A cost-effective solution for Medium Voltage and Industrial markets
- Power Quality analysis and reporting to EN50160
- Modbus protocol for integrating into energy management and control systems.
- Setup and wrong connection wizards, demonstration screens and user customised display making the **M2x3** family user friendly.
- Tariff and cost management functions for use in secondary metering applications.
- High accuracy measurements
- Multi-lingual menu (English, German, French, Italian, Spanish, Russian etc)
- CE certification

The **M2x3** also provides a host of other measurement, monitoring, recording and metering facilities as detailed below:

- Digital and analogue inputs and outputs
- High Measurement accuracy
- Power Quality Metering
- Tariff metering and cost management structure

The **M2x3** uses a software package called QDSP. It is suggested that the QDSP software is used when possible for programming the **M2x3** as it provides a simple interface for communicating with the product. A separate QDSP manual is available.

- QDSP is used for setting and monitoring all of the iSTAT devices with communications, i400, i4Mx, and i500, M2x1, M2x2 and **M2x3**. It can also be used off line with the **M2x3** when used with a memory card. QDSP is also used to provide the interface to the data logging and Power Quality functionality required for **M243** and **M253**.
- QDSP also offers additional features such as upgrading from a secure web site for both the QDSP software and device firmware.

KEY MESSAGES

- The iSTAT **M2x3** family is **easy to set and test**. In the substation world, more settings increase the chance of misapplication, and the potential for incorrect settings and inaccurate measurements. The ISTAT **M2x3** minimises the chance of an incorrect setting by using a setup wizard to help the operator configure the device.
- The iSTAT **M2x3** is an **economical** choice for measurements, with a family that allows the user to tailor the measurement centre and functions to the application.
- The iSTAT **M2x3** offers **easy fitting**, by using embedded current transformers and a wrong connection warning for the current circuits. It uses a standard 96mm DIN case.
- The **comprehensive** Energy Cost Management Library of functions enables the **M2x3** to energy readings from 4 registers, programme tariff structures and costs. This data can be recorded, communicated (MODBUS) or read via pulse outputs
- **M2x3** allows connection to MODBUS based systems that are widely used by industrial and utility customers worldwide.
- All models in the **M2x3** family can use a memory card for configuring the meters and extracting data. This means that the “non–communicating” models can be configured off line prior to receipt by the user.

ISTAT – **THE standard** measurement platform

- Multiple advanced configuration features fitted as standard.
- Comprehensive choice of features for measurement applications – to satisfy all metering, measurement and data recording and power quality applications
- Flexible programmable software (QDSP) allows the off line and on line settings and data interpretation
- Complete and informative documentation, QDSP also includes help information.
- A choice of different input and output options.

Simple to fit, **simple** to set, **simple** to connect

- Standard 96mm DIN
- Set up Wizard to aid configuration
- Wrong connection warning
- Demonstration displays
- User defined customised displays

Advanced technology

- High sampling rate of 128 samples per cycle
- A frequency family of 16 2/3Hz, 45/65Hz or 400Hz
- A memory card for data transfer
- Non-volatile Flash memory

Economical

- 5 models in the family tailored with a family of functions
- Universal Power for all site situations
- Common case size permits retrofitting without major re-engineering of the panel.
- 140 measurements available for all applications.

6.2 Family

The **ISTAT M2x3** family provides:

- **M203** class 0.5 non-communicating Power meter. The **M203** is used to monitor and measure electrical parameters in a power system. It can be used in both single and three phase applications and provides voltage, current, frequency, phase angle and power information.
- **M213** class 0.5 non-communicating Power and class 1 Energy Meter. The **M213** adds energy measurement in all four quadrants and also includes hardware options of tariff inputs and pulsed energy contact outputs.
- **M233** class 0.5 or 0.2 communicating Measurement Centre. The **M233** adds a tariff structure, alarm indication, class 1 or 0.5S energy measurement function and a range of communications options. This can be used for secondary metering applications.
- **M243** class 0.5 or 0.2 communicating Network Recorder with class 1 or 0.5S energy measurement. The **M243** adds up to 5 Data recorders so that up to 64 different electrical parameters can be monitored and 32 alarms recorded. This is used to monitor the status of plant or an electrical power system, and log the required data.
- **M253** class 0.5 or 0.2 communicating Network Analyser with class 1 or 0.5S energy measurement. The **M253** adds Power Quality Compliance monitoring to EN50160.

Software:

- QDSP programming and analysis software

6.3 Measurements

The **M2x3** family is therefore ideally suited to applications where continuous monitoring of a single or three-phase system is required:

- **M203**: local indication for ac switchboard power measurements
- **M213**: local indication for ac switchboard power measurements, energy metering into a remote energy management system using pulsed outputs.
- **M233**: local and remote indication for ac switchboard power measurements, energy metering into a remote energy management system via communications.
- **M243**: System monitoring and alarm recording, local and remote indication for ac switchboard power measurements, energy metering into a remote energy management system,
- **M253**: Quality of supply compliance monitoring, system monitoring and alarm recording, local and remote indication for ac switchboard power measurements, energy metering into a remote energy management system.

TABLE 7-1 summarises the measurements available. The **M2x3** can be user configured for either single or three phase connection.

TABLE 7-1 : MEASUREMENTS	M203	M213	M233	M243	M253
V, I, P, Q, S, PF, PA, F, φ	●	●	●	●	●
Energy kWh class 1 or 0.5S		●	●	●	●
Maximum demand		●TF	●	●	●
Minimum values: V, I, P, Q, S, PF, PA, F, φ			●	●	●
Maximum values: V, I, P, Q, S, PF, PA, F, φ			●	●	●
THD (actual, min, max)			●	●	●
Harmonics (up to)			31st or 63rd	31st or 63rd	63rd

NOTE: (TF) The **M213** has a thermal function only for maximum demand

6.4 Hardware features

The **M2x3** family has a number of hardware features that are designed to make the installation, commissioning and use of the meters as simple as possible, see TABLE 7-2.

It has a large 128 x 64 pixel Liquid Crystal Display (LCD) that can display information in a number of different font sizes and is backlit for use in conditions with a low light level. The menu is driven locally by a 5 key function pad on the front of the meter and the **M2x3** family has the ability to customise the display and key functions to enable to user to retrieve information as quickly as possible.

The **M2x3** has a LED alarm indicator that indicates the status for a number of functions depending on the model in the family; Steady RED for Memory Card activity; blinking GREEN for communications activity and blinking RED for an alarm condition.

The **M2x3** has an AC or Universal auxiliary supply and an auto ranging current and voltage measurement input so that it can be used in most site conditions without the need to specify this information at the order stage.

The **M2x3** (excluding **M203, M213**) has 4 energy counters and a real time clock so that it supports the comprehensive energy management applications.

The **M243** has 8MB of internal memory to support the data logging functions and the **M253** has 8MB of internal memory to support the data logging and Power Quality Recorder functions.

All the **M2x3** family supports a memory card with capacity up to 1GB which can be used to carry settings and extract records from the **M2x3** family. This means that all the **M2x3** family, including the non-communicating models, can have their settings made off line and downloaded via a memory card using the front card access port. The slot is protected by a cover to prevent humidity and dust ingress.

TABLE 7-2 : HARDWARE	M203	M213	M233	M243	M253
Large backlit LCD 128 x 64	●	●	●	●	●
LED alarm indication	●	●	●	●	●
5 key menu	●	●	●	●	●
Autorange V&I input	●	●	●	●	●
Power supply AC (A) or universal AC/DC (U)	A or U	A or U	A or U	A or U	A or U
Watchdog (optional)			●	●	●
4 Energy counters		●	●	●	●
Real time clock			●	●	●
Internal Flash Memory				8MB	8MB
Memory card	●	●	●	●	●

6.5 Communication and inputs/outputs

The **M2x3** family has a wide range of communications options that allow it to integrate with a number of different management systems, see TABLE 7-3.

The communicating meters (**M233**, **M243** and **M253**) have the option of an RS232/RS485 wired port, USB port or an RJ45 Ethernet port that supports MODBUS.

All the **M2x3** family has a front port supporting a memory card so that settings and records (**M243**, **M253** only) can be extracted locally from the meter. It can also be used to upgrade the firmware of the **M2x3**.

The **M2x3** (with the exception of the **M203**) has two rear hardware modules, each of which can support 1 or 2 inputs or outputs as shown in table 7-3. Each module configuration is specified at the order stage and they are independent from each other.

TABLE 7-3 : COMMUNICATIONS	M203	M213	M233	M243	M253
Memory card port	●	●	●	●	●
RS232/RS485, USB or Ethernet			●	●	●
Modbus RTU & TCP			●	●	●
Rear Hardware modules: 2 modules maximum, each having the option of:					
2x energy contacts		●	●	●	●
2x tariff inputs		●	●	●	●
2x alarm contacts			●	●	●
2x analogue outputs			●	●	●
1x Watchdog & 1x alarm contact			●	●	●
1x bistable alarm contact			●	●	●
2x digital inputs			●	●	●
2x analogue input			●	●	●
2x pulse input			●	●	●
1x RS485 port (COM2)			●	●	●
1x RS232 port (COM2)			●	●	●

6.6 User features

The **M2x3** family has a wide range of user features that are designed to make the installation and commissioning simple. These features are summarised in TABLE 7-4 below.

The Setup Wizard takes the user through the basic settings required to commission the **M2x3**. The benefit of the wizard is that it leads the commissioning engineer through all the basic settings required to install the **M2x3** ensuring that the **M2x3** is correctly setup. This is fully detailed in section 12.1

The **M2x3** will monitor the voltage and current polarity and when it detects that an input has been incorrectly connected it will display a warning symbol on the display. This is useful when direction is important, such as in energy applications, to ensure that the values calculated are correct.

The **M2x3** provides over 140 different measurements that the operator can scroll through and read on the display. If the operator only wants to see a small number of measurements, they can configure the display to show up to 3 customised screens. The refresh time is programmable to enable the operator time to interpret the information on the display.

To demonstrate the different display options that are available, the **M2x3** has a demo option which will display each of the different screens available. The refresh time is programmable so that the operator is given time to interpret the information shown.

TABLE 7-4 : USER FEATURES	M203	M213	M233	M243	M253
Set up Wizard	●	●	●	●	●
Wrong connection warning	●	●	●	●	●
3 Custom screens	●	●	●	●	●
Reset default settings	●	●	●	●	●
Demonstration screens	●	●	●	●	●
Settable refresh times	●	●	●	●	●

6.7 Applications

The **M2x3** family can be used in a wide range of different applications depending on the model, the applications are summarised in TABLE 7-5 below.

TABLE 7-5 : APPLICATION	M203	M213	M233	M243	M253
Power measurements	●	●	●	●	●
Energy Metering		●	●	●	●
Cost Management			●	●	●
Programmable alarms			●	●	●
Measurement recorder				●	●
Quality of supply					●
QDSP setting software	●(Memory card only)	●(Memory card only)	●	●	●

Power Measurements: All the **M2x3** family provide a wide range of instantaneous analogue values; Voltage, current, Power, phase angle, power factor and frequency. These are available locally on all the **M2x3** family and remotely on selected models. The **M2x3** therefore replaces a number of separate instruments and is ideally suited to ac switchboard applications.

Energy and sub Metering: With addition of 4 quadrant energy measurement, the **M2x3** can be used in sub metering applications were information is passed to an energy management system to monitor the performance of the ac power system. Depending on the **M2x3** model and options selected, the **M2x3** can use a combination of pulsed energy contacts, analogue tariff inputs and communications to integrate with and provide this data to the control system.

In addition, measurements such as maximum and minimum values and maximum demand information provide valuable information on the operation of plant and system monitoring to ensure that it performing correctly.

Cost Management: The addition of a real time clock and a tariff structure means that the **M2x3** can be used in stand-alone tariff or revenue sub metering applications. This allows the energy consumed to be given a financial cost that can vary depending on the time of day and season of the year. This provides information on the cost of plant operation and can be used to ensure that equipment and processes are used in the most financially efficient manner.

Measurement Recorder: The **M243** and **M253** have up to 4 independent data recorders that provide trending information on up to 64 different analogue values. The type of value can be defined for each parameter, i.e. minimum, maximum, or average. Maximum demand and maximum and minimum instantaneous (every cycle) values can also be recorded. The status of all of the 32 software alarms can also be recorded within a separate alarm recorder. This provides a comprehensive record of the status of the monitoring system and a timed record of events.

Quality of supply: The **M253** provides a quality of supply monitor that complies with the European standard EN50160. This power quality standard is used to monitor electrical systems and ensure that it falls within a number of different limits ensuring that the user has a consistent and correct supply of electricity. The EN50160 standard monitors the following electrical characteristics:

- Frequency and voltage variations
- Voltage unbalances, interruptions and dips
- Flicker
- Harmonics and THD

7. SYSTEM MODES

7.1 Connection mode

The connection mode of the **M2x3** is menu-configurable. The following options are available:

- 1b - single phase connection,
- 3b - three-phase, three-wire connection with balanced load,
- 4b - three-phase, four-wire connection with balanced load,
- 3u - three-phase, three-wire connection with unbalanced load
- 4u - three-phase, four-wire connection with unbalanced load.

7.1.1 Valid measurements

The following tables list the valid measurements for each connection type.

Key: ● – measured , ○ − calculated, × − not supported

	TABLE 8-1 : BASIC MEASUREMENTS	Parameter	Unit	Connection				
				1b	3b	3u	4b	4u
Phase	Voltage U_1	U1	V	●	×	×	●	●
	Voltage U_2	U2	V	×	×	×	○	●
	Voltage U_3	U3	V	×	×	×	○	●
	Average voltage $U^{\sim}$	U⅄	V	×	×	●	○	●
	Current I_1	I1	A	●	●	●	●	●
	Current I_2	I2	A	×	○	●	○	●
	Current I_3	I3	A	×	○	●	○	●
	Current I_n	In	A	×	○	●	○	●
	Total current I_t	I	A	●	○	○	○	●
	Average current I_a	Iavg	A	×	○	○	○	●
	Active power P_1	P1	W	●	×	×	●	●
	Active power P_2	P2	W	×	×	×	○	●
	Active power P_3	P3	W	×	×	×	○	●
	Total active power P_t	P	W	●	●	●	○	●
	Reactive power Q_1	Q1	var	●	×	×	●	●
	Reactive power Q_2	Q2	var	×	×	×	○	●
	Reactive power Q_3	Q3	var	×	×	×	○	●
	Total reactive power Q_t	Q	var	●	●	●	○	●

	TABLE 8-2 : BASIC MEASUREMENTS	Parameter	Unit	Connection Type				
				1b	3b	3u	4b	4u
Phase	Apparent power S_1	S1	VA	●	×	×	●	●
	Apparent power S_2	S2	VA	×	×	×	○	●
	Apparent power S_3	S3	VA	×	×	×	○	●
	Total apparent power S_t	S	VA	●	●	●	○	●
	Power factor PF_1	PF1/ePF1		●	×	×	●	●
	Power factor PF_2	PF2/ePF2		×	×	×	○	●
	Power factor PF_3	PF3/ePF3		×	×	×	○	●
	Total power factor $PF^{\sim}$	PF/ePF		●	●	●	○	●
	Power angle φ_1	φ1	°	●	×	×	●	●
	Power angle φ_2	φ2	°	×	×	×	○	●
	Power angle φ_3	φ3	°	×	×	×	○	●
	Total power angle $\varphi^{\sim}$	φ	°	●	●	●	○	●
	THD of phase voltage U_{f1}	U1%	%THD	●	×	×	●	●
	THD of phase voltage U_{f2}	U2%	%THD	×	×	×	○	●
	THD of phase voltage U_{f3}	U3%	%THD	×	×	×	○	●
	THD of phase current I_1	I1%	%THD	●	●	●	●	●
	THD of phase current I_2	I2%	%THD	×	○	●	○	●
	THD of phase current I_3	I3%	%THD	×	○	●	○	●
Phase-to-phase	Phase-to-phase voltage U_{12}	U12	V	×	●	●	○	●
	Phase-to-phase voltage U_{23}	U23	V	×	●	●	○	●
	Phase-to-phase voltage U_{31}	U31	V	×	●	●	○	●
	Average phase-to-phase voltage (U_{ff})	$U_{\triangle}$	V	×	×	×	○	●
	Phase-to-phase angle φ_{12}	φ12	°	×	×	×	○	●
	Phase-to-phase angle φ_{23}	φ23	°	×	×	×	○	●
	Phase-to-phase angle φ_{31}	φ31	°	×	×	×	○	●
	Voltage unbalance U_u	Uu	%	×	●	●	×	●
	THD of phase-to-phase voltage THD_{U12}	U12%	%THD	×	●	●	○	●
	THD of phase-to-phase voltage THD_{U23}	U23%	%THD	×	●	●	○	●
	THD of phase-to-phase voltage THD_{U31}	U31%	%THD	×	●	●	○	●
Energy	Counters 1−4	E1, E2, E3, E4	Wh Vah varh	●	●	●	●	●
	Active tariff	Atar		●	●	●	●	●
	Cost by meters	E1$, E2$, E3$, E4$	XXXX	●	●	●	●	●
	Total cost			●	●	●	●	●

	TABLE 8-2 : BASIC MEASUREMENTS	Parameter	Unit	Connection Type				
				1b	3b	3u	4b	4u
Max. values MD	MD current I_1	I1	A	×	○	●	○	●
	MD current I_2	I2	A	×	○	●	○	●
	MD current I_3	I3	A	●	●	●	●	●
	MD active power P (positive)	P+	W	●	●	●	●	●
	MD active power P (negative)	P−	W	●	●	●	●	●
	MD reactive power Q−L	Q ≡	var	●	●	●	●	●
	MD reactive power Q−C	Q ǂ	var	●	●	●	●	●
	MD apparent power S	S	VA	●	●	●	●	●

	TABLE 8-3 : MIN/MAX MEASUREMENTS	Connection Type				
		1b	3b	3u	4b	4u
Instantaneous / Maximal / Minimal values	Voltage U_1	●	×	×	●	●
	Voltage U_2	×	×	×	○	●
	Voltage U_3	×	×	×	○	●
	Phase-to-phase voltage U_{12}	×	●	●	○	●
	Phase-to-phase voltage U_{23}	×	○	●	○	●
	Phase-to-phase voltage U_{31}	×	○	●	○	●
	Phase current I_1	●	●	●	●	●
	Phase current I_2	×	○	●	○	●
	Phase current I_3	×	○	●	○	●
	Active power P_1	●	×	×	●	●
	Active power P_2	×	×	×	○	●
	Active power P_3	×	×	×	○	●
	Common active power P	×	●	●	○	●
	Apparent power S_1	●	×	×	●	●
	Apparent power S_2	×	×	×	○	●
	Apparent power S_3	×	×	×	○	●
	Common apparent power S	×	●	●	○	●
	Frequency f	●	●	●	●	●
	Internal temperature	●	●	●	●	●

Key ● –measured, ○ − calculated, × − not supported

	TABLE 8-4 : HARMONIC MEASUREMENTS	Connection type				
		1b	3b	3u	4b	4u
Harmonics up to 31/63	Phase voltage U_1	●	×	×	●	●
	Phase voltage U_2	×	×	×	○	●
	Phase voltage U_3	×	×	×	○	●
	Phase-to-phase voltage U_{12}	×	●	●	○	●
	Phase-to-phase voltage U_{23}	×	●	●	○	●
	Phase-to-phase voltage U_{31}	×	●	●	○	●
	Phase current I_1	●	●	●	●	●
	Phase current I_2	×	○	●	○	●
	Phase current I_3	×	○	●	○	●

Key: ● – measured, ○ − calculated, × − not supported

	TABLE 8-5 : GRAPHICAL DISPLAY	Connection type				
		1b	3b	3u	4b	4u
Time / FFT	Phase voltage U_1	●	×	×	●	●
	Phase voltage U_2	×	×	×	○	●
	Phase voltage U_3	×	×	×	○	●
	Phase-to-phase voltage U_{12}	×	●	●	○	●
	Phase-to-phase voltage U_{23}	×	●	●	○	●
	Phase-to-phase voltage U_{31}	×	●	●	○	●
	Phase current I_1	●	●	●	●	●
	Phase current I_2	×	○	●	○	●
	Phase current I_3	×	○	●	○	●

Key: ● – measured, ○ − calculated, × − not supported

	TABLE 8-6 : POWER QUALITY	Connection Type				
		1b	3b	3u	4b	4u
Quality parameters	Frequency variations 1 / 2	●	●	●	●	●
	Voltage variations 1 / 2	●	●	●	●	●
	Voltage unbalances	●	×	×	●	●
	Voltage dips	×	×	×	○	●
	Voltage interruptions	×	×	×	○	●
	Long interruptions	×	●	●	○	●
	Transients	×	●	●	○	●
	Flickers Pst / Plt	×	●	●	○	●
	Temporary overvoltages	●	●	●	●	●
	THD's	×	○	●	○	●
	Harmonics	×	○	●	○	●

Key: ● – measured, ○ − calculated, × − not supported

NOTE: For 3b and 3u connection mode, only phase−to−phase voltages are measured. Because of that, factor √3 is applied to calculation of quality considering nominal phase voltage.
For 4u connection mode measurements support is same as for 1b.

7.2 Power mode

The power mode is used for the signing of power measurements. The user cannot set the **M2x3** power mode. It is defined as follows:

- When displaying active power, a positive sign indicates export power (a consumer) whilst a negative sign indicates import power (a generator).
- When displaying reactive power, a coil symbol indicates an inductive load (a consumer) whilst a capacitor symbol indicates a capacitive load (a generator).

7.3 Operating energy quadrants

The operating energy quadrants are used to determine which types of energy are added to the energy counters. The user may modify the operating energy quadrants via the remote communications interface or by using the front menu and buttons.

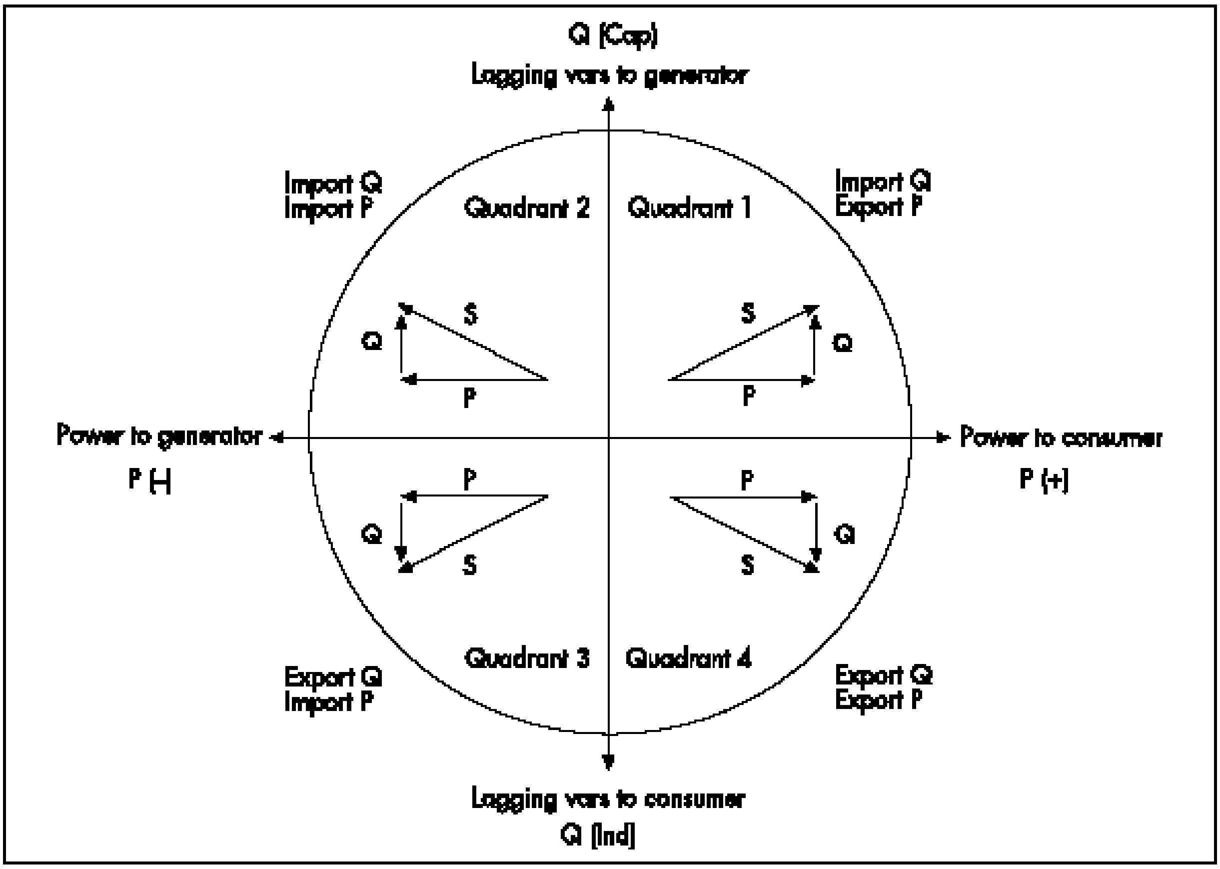


FIGURE 8-1 : POWER FLOW

8. INSTRUMENTATION

8.1 Measurements

With the increase in harmonics present in today's power systems, due to the increased use of electronic loads such as computers, variable frequency drives, etc. it is important, when accurate monitoring of electrical parameters is required, to use a measuring technique that allows for their presence. Conventional measurement methods, that use a mean sensing technique, respond to the mean or average of the input waveform. This is only accurate when the input waveform approaches a pure sinusoid.

The **M2x3** uses a true RMS (root-mean-square) measurement technique that provides accurate measurement with harmonics present up to the 63rd. The **M2x3** reads 128 samples per cycle and the true RMS measurement is obtained using these sampled values.

Individual harmonics up to 31st (or 63$^{rd)}$ on the **M233/M243** and 63rd on the **M253** can be displayed using the QDSP Software and downloaded on the communications.

The **M2x3** display can display the measured values in a number of pre-set display views or the user can customise the display. An example is shown in figure 9.1 below.

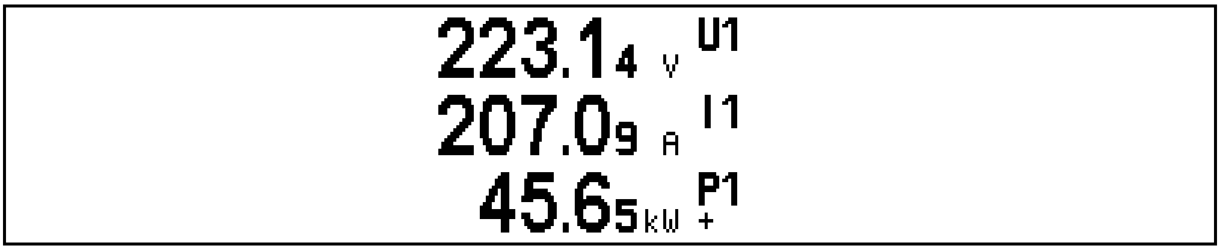


FIGURE 9-1 : PRESET DISPLAY SHOWING VOLTAGE, CURRENT AND POWER IN PHASE 1

8.2 Glossary

The following terms and symbols are used:

TABLE 9-1 : SYMBOLS	
MD	Sample factor
M_P	Averaging interval
U_f	Phase voltage (U_1, U_2 or U_3)
U_{ff}	Phase-to-phase voltage (U_{12}, U_{23} or U_{31})
N	Total number of samples in a period
n	Sample number ($0 \leq n \leq N$)
x, y	Phase number (1, 2 or 3)
i_n	Current sample n
u_{fn}	Phase voltage sample n
u_{fFn}	Phase-to-phase voltage sample n
φ_f	Power angle between current and phase voltage f (φ_1, φ_2 or φ_3)
U_u	Voltage unbalance
U_c	Agreed supply voltage

TABLE 9-2 : GLOSSARY	
Term	Explanation
RMS	Root Mean Square value
Flash	Type of a memory module that keeps its content in case of power supply failure
Ethernet	IEEE 802.3 data layer protocol
MODBUS / DNP3	Industrial protocol for data transmission
Memory Card	Multi-Media Card (MMC) or SD Card
QDSP	Software for iSTAT family
AC	Alternating voltage
PA	Power angle (angle between current and voltage)
PF	Power factor
THD	Total harmonic distortion
MD	Measurement of average values in time interval
Harmonic voltage − harmonic	Sine voltage with frequency equal to integer multiple of basic frequency
Hand-over place	Connection spot of consumer installation in public network
Flicker	Voltage fluctuation causes changes of luminous intensity of lamps, which causes the so-called flicker affect
RTC	Real Time Clock
Sample factor	Defines a number of periods for measuring calculation on the basis of measured frequency
Averaging interval	Defines frequency of refreshing displayed measurements on the basis of a Sample factor

8.3 Supported Measurements

The measurements that the **M2x3** family supports will depend on the model selected and whether the measurements are available on the display or over the communications. The following tables show which measurements are available on each **M2x3** model.

	TABLE 9-3 : MEASUREMENTS	M203	M213	M233	M243	M253
Phase	Voltage U_1, U_2, U_3 in $U^{\sim}$	●	●	●	●	●
	Current I_1, I_2, I_3, I_n, I_t in I_a	●	●	●	●	●
	Active power P_1, P_2, P_3, and P_t	●	●	●	●	●
	Reactive power Q_1, Q_2, Q_3, and Q_t	●	●	●	●	●
	Apparent power S_1, S_2, S_3, and S_t	●	●	●	●	●
	Power factor PF_1, PF_2, PF_3 and $PF^{\sim}$	●	●	●	●	●
	Power angle φ_1, φ_2, φ_3 and $\varphi^{\sim}$	●	●	●	●	●
	THD of phase voltage U_{f1}, U_{f2} and U_{f3}	×	×	●	●	●
	THD of power angle I_1, I_2 and I_3	×	×	●	●	●
Phase−to−phase	Phase-to-phase voltage U_{12}, U_{23}, U_{31}	●	●	●	●	●
	Average phase-to-phase voltage U_{ff}	●	●	●	●	●
	Phase-to-phase angle φ_{12}, φ_{23}, φ_{31}	●	●	●	●	●
	Voltage unbalance U_u	×	×	●	●	●
	THD of phase−to−phase voltage	×	×	●	●	●
Energy	Counter 1	×	●	●	●	●
	Counter 2	×	●	●	●	●
	Counter 3	×	●	●	●	●
	Counter 4	×	●	●	●	●
	Total	×	●	●	●	●
	Active tariff	×	●	●	●	●
	Cost by counters	×	×	●	●	●
	Total cost	×	×	●	●	●
Maximal values MD	Phase current I_1	×	○	●	●	●
	Phase current I_2	×	○	●	●	●
	Phase current I_3	×	○	●	●	●
	Active power P (Positive)	×	○	●	●	●
	Active power P (Negative)	×	○	●	●	●
	Reactive power Q − L	×	○	●	●	●
	Reactive power Q − C	×	○	●	●	●
	Apparent power S	×	○	●	●	●

● –measured × − not supported

	TABLE 9-4 : MEASUREMENTS	M203	M213	M233	M243	M253
Min./max. measurements	Voltage U_1	×	×	●	●	●
	Voltage U_2	×	×	●	●	●
	Voltage U_3	×	×	●	●	●
	Phase-to-phase voltage U_{12}	×	×	●	●	●
	Phase-to-phase voltage U_{23}	×	×	●	●	●
	Phase-to-phase voltage U_{31}	×	×	●	●	●
	Phase current I_1	×	×	●	●	●
	Phase current I_2	×	×	●	●	●
	Phase current I_3	×	×	●	●	●
	Active power P_1	×	×	●	●	●
	Active power P_2	×	×	●	●	●
	Active power P_3	×	×	●	●	●
	Common active power P	×	×	●	●	●
	Apparent power S_1	×	×	●	●	●
	Apparent power S_2	×	×	●	●	●
	Apparent power S_3	×	×	●	●	●
	Common apparent power S	×	×	●	●	●
	Frequency f	×	×	●	●	●
	Internal temperature	×	×	●	●	●
Other functions	Frequency	●	●	●	●	●
	Internal temperature	●	●	●	●	●
	RTC date	×	×	●	●	●
	RTC	×	×	●	●	●
	Time graphs (I_1, I_2, I_3,U_1, U_2, U_3, U_{12}, U_{23} and U_{31})	×	×	●	●	●
	FFT graphs (I_1, I_2, I_3,U_1, U_2, U_3, U_{12}, U_{23} and U_{31})	×	×	×	×	●
	Phase voltage harmonics	×	×	To 31st or 63rd	To 31st or 63rd	To 63rd
	Phase−to−phase voltage harmonics	×	×	To 31st or 63rd	To 31st or 63rd	To 63rd
	Current harmonics	×	×	To 31st or 63rd	To 31st or 63rd	To 63rd
	Analysis in compliance with EN 50160	×	×	×	×	●

● – thermal function ○ – measured × − not supported

8.3.1 Voltage

All versions of the **M2x3** except for the 3-phase 3-wire versions, measure the true RMS value of the phase voltages (U_a, U_b, U_c) connected to the unit. The three line voltages (U_{ab}, U_{bc}, U_{ca}), average phase voltage (U) and average line voltage (U_Δ) are calculated from these measured parameters. For 3-phase 3-wire balanced systems, the **M2x3** creates a virtual neutral internally.

The 3-phase 3-wire versions of the **M2x3** measure the true RMS value of the phase to phase voltage.

$U_f = \sqrt{\dfrac{\sum_{n=1}^{N} u_n^2}{N}}$	$U_{xy} = \sqrt{\dfrac{\sum_{n=1}^{N} (u_{xn} - u_{yn})^2}{N}}$
V rms Phase calculation N = 128 samples in one period (up to 65Hz) N = 128 samples in M periods (above 65Hz), eg at 400Hz, n=7	**V rms Phase to Phase calculation** N = samples in one period Ux,Uy = phase voltages Uf

The available phase, line and average voltages (instantaneous, minimum and maximum values), can be viewed on the **M2x3** display or via the remote communications link.

The voltage unbalance is measured as:

$U_u = \sqrt{\dfrac{1-\sqrt{3-6\beta}}{1+\sqrt{3-6\beta}}} \cdot 100\%$ $\beta = \dfrac{U_{12fund}^4 + U_{23fund}^4 + U_{31fund}^4}{\left(U_{12fund}^4 + U_{23fund}^4 + U_{31fund}^4\right)^2}$
Voltage unbalance Ufund = first harmonic of the phase to phase voltage

8.3.2 Current

The **M2x3** measures the true RMS value of the phase currents (I_a, I_b, I_c) connected to the unit. The neutral current (I_n), the average of all phase currents and the sum of all phase currents (I_t) are calculated from the three phase currents.

The available phase currents, average current and neutral current (instantaneous, minimum and maximum values) can be viewed on the **M2x3** display or via the remote communications link whilst the sum of all phase currents is only available via the remote communications link.

$$I_{RMS} = \sqrt{\frac{\sum_{n=1}^{N} i_n^2}{N}}$$	$$I_n = \sqrt{\frac{\sum_{n=1}^{N} \left(i_{1n} + i_{2n} + i_{3n}\right)^2}{N}}$$
I rms calculation N = 128 samples in one period (up to 65Hz) N = 128 samples in M periods (above 65Hz), eg at 400Hz, n=7	**RMS Neutral calculation** i-n samples in phase current 1,2 or 3 N = 128 samples in a period (up to 65Hz)

8.3.3 Angles between Phases

Angles between phases indicate the angles between the vectors of phase voltages. A positive mark indicates correct phase sequence, while a negative mark indicates an opposite phase sequence of the measured system.

The Phase Angles can be viewed on the **M2x3** display or via the remote communications link.

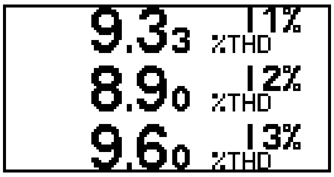
8.3.4 Frequency

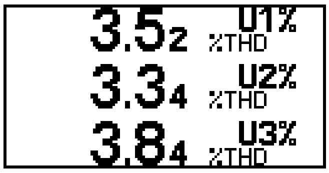
The system frequency is calculated from the time period of the measured voltage and can be viewed from both the **M2x3** display (also the frequency with instantaneous 10 second average) and the remote communications link.

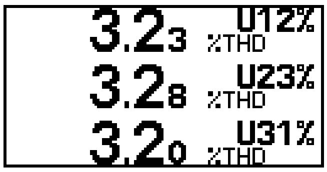
8.3.5 Harmonics

The percentage total harmonic distortion (%THD) value is the ratio of the sum of the powers of the harmonic frequencies above the fundamental frequency to the power of the fundamental frequency. This sum of the powers is a geometric total, formed by taking the square root of the sum of the squares of the amplitude of each of the harmonics.

The **M2x3** provides %THD values for each phase current, each phase voltage, and for the line voltages (instantaneous, minimum and maximum values).

<table>
<tr><td>$$I_f THD(\%) = \frac{\sqrt{\sum_{n=2}^{63} In^2}}{I_1} \cdot 100$$</td><td>
</td></tr>
<tr><td>Current THD calculation
I1 = value of first harmonic
N = number of harmonic</td><td>M2x3 display</td></tr>
</table>

<table>
<tr><td>$$U_f THD(\%) = \frac{\sqrt{\sum_{n=2}^{63} Un^2}}{U_1} \cdot 100$$</td><td>
</td></tr>
<tr><td>Phase Voltage THD calculation
U1 = value of first harmonic
N = number of harmonic</td><td>M2x3 display</td></tr>
</table>

<table>
<tr><td>$$U_{ff} THD(\%) = \frac{\sqrt{\sum_{n=2}^{63} Un^2}}{U_1} \cdot 100$$</td><td>
</td></tr>
<tr><td>Line to Line Voltage THD calculation
U1 = value of first harmonic
N = number of harmonic</td><td>M2x3 display</td></tr>
</table>

The **M233** and **M243** can display harmonics up to the 31^{st} (or 63^{rd}) on the display and via QDSP; the values are also available via the communications.

The **M253** Power Quality Analyser that can record up to the 63^{rd} Harmonic values as part of the EN50160 Compliance monitoring. The harmonic values can be shown on the display, via QDSP and via the communications.

8.4 Power, power factor and energy

8.4.1 Power

The **M2X3** provides accurate measurement of active (P_a, P_b, P_c, P_t), reactive (Q_a, Q_b, Q_c, Q_t) and apparent power (S_a, S_b, S_c, S_t). For a four-wire system the powers are calculated both for each phase separately and as a total. For a three-wire system only total power values are measured.

- Total active power (P_t).

$$P_f = \frac{1}{N} \cdot \sum_{n=1}^{N} \left(u_f N_n \times i_f N_n \right)$$
Active Power
N = number of periods
n = a number of samples in a period
f = phase designation

$$P_t = P_1 + P_2 + P_3$$
Total Active Power
t = total power
1,2,3 phase designation

- Total reactive power (Q_t).
  - Reactive Power by Phases (Standard)

$$Q_f = \mathrm{Sign}Q_f(\phi) \times \sqrt{S_f^2 - P_f^2}$$
Reactive Power
Sf = apparent power by phase
Pr = active power by phase

- Reactive Power by Phases (Delayed current method)

$$Q_f = \frac{1}{N} \cdot \sum_{n=1}^{N} \left(u_{f\,n} \times i_{f\,[n+N/4]} \right)$$
Reactive Power
N − a number of samples in a period
n − sample number (0 ≤ n ≤ N)
f − phase designation

$$Q_t = Q_1 + Q_2 + Q_3$$
Total Reactive Power
Qf = reactive power by phase

- Total apparent power (S_t).

$$S_f = U_f \times I_f$$
Apparent Power
Uf = phase voltage
If = phase current

$$S_t = S_1 + S_2 + S_3$$
Total Apparent Power
Sf = apparent power by phase

- Power direction.

When displaying active power, a positive sign indicates export power (a consumer) whilst a negative sign indicates import power (a generator).

When displaying reactive power, a coil symbol indicates an inductive load (a consumer) whilst a capacitor symbol indicates a capacitive load (a generator).

All the available power parameters can be viewed using either the M2x3 display or via the remote communications link.

$$\begin{aligned} &\mathrm{Sign}Q_f(\varphi) \\ &\varphi \in [0° - 180°] \Rightarrow \mathrm{Sign}Q_f(\varphi) = +1 \\ &\varphi \in [180° - 360°] \Rightarrow \mathrm{Sign}Q_f(\varphi) = -1 \end{aligned}$$
Reactive Power direction
Q_f − reactive power (by phases)
φ − power angle

$$\begin{aligned} \varphi_s &= a\tan 2(P_t, Q_t) \\ \varphi_s &= [-180°, 179{,}99°] \end{aligned}$$
Total Power angle

8.4.2 Power factor

The power factor is calculated as a quotient of active and apparent power for each phase separately (cosφa, cosφb, cosφc) and as a total (cosφt). A positive sign and a coil symbol denotes an inductive load (a consumer) whilst a negative sign and a capacitor symbol defines a capacitive load (a generator).

$$PF = \frac{P}{S}$$
Power Factor

All available power factor parameters can be read from the **M2x3** display or via the remote communications link.

8.4.3 Energy

Four counters are available so that energy in each of the four quadrants can be measured. The configuration of the four counters can be adapted to the customer's needs via the front menu or via the remote communications link.

All four energy measurements may be viewed using either the **M2x3** display or a remote communications link.

- Energy Tariff Price

The tariff calculation used in the Cost Management function is derived as follows:

$$\text{Price in tariff} = \text{Price} \cdot 10^{\text{Tarif price exponent}}$$

Energy Tariff Price

8.4.4 Demand Measurements

The **M2x3** (with the exception of the **M203**) provides maximum demand values from a variety of average demand values (fixed window, sliding window and thermal) for the following electrical parameters:

TABLE 9-5 **: DEMAND VALUES**	**M203**	**M213**	**M233**	**M243**	**M253**
Max Demand		●TF	●	●	●
Tariff Clock			●	●	●
Cost Management			●	●	●

NOTE: TF = thermal function

8.4.5 Real time clock (energy clock)

The **M233**, **M243** and **M253** are provided with a built-in real time clock. It is intended for registration of time of the occurrence of Maximum demands, and for synchronisation of the time interval. The clock is also used by the Cost Management feature when allocating different cost or tariff structures throughout the day and for periodic (seasonal) times throughout the year.

8.4.6 Maximum demands (MDs)

The **M2x3** (with the exception of the **M203**) stores the maximum demand value since last reset and its corresponding time stamp. The unit also displays the present or 'dynamic' maximum demand.

8.4.7 Average demands

8.4.7.1 Fixed window

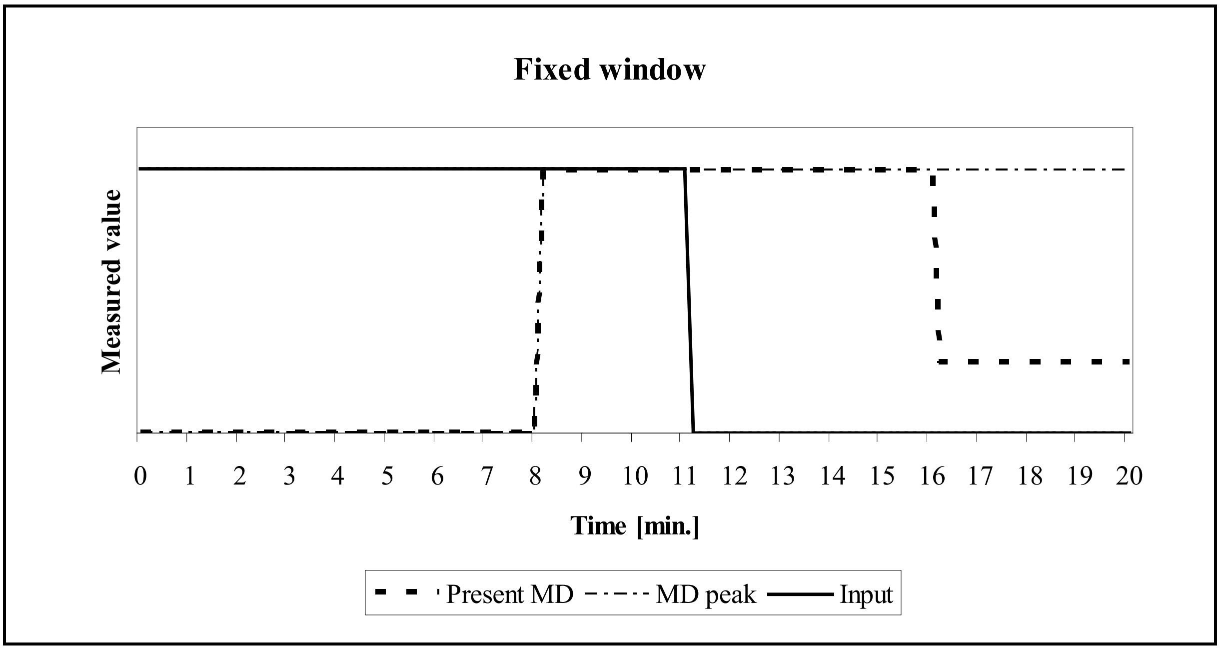
The fixed interval method calculates an average demand value over a fixed time period. The period can be set over the family 1 to 255 minutes. This is available in the **M233**, **M243** and **M253** as a selectable function.

»TIME IN A PERIOD« will actively show the remaining time until the end of the period, until a current MD and maximal MD from the last reset are calculated. When displays for Pt(+/−), Qt(L/C), St, I1, I2 and I3 are updated, a new period and measurement of new average values are started. »TIME IN A PERIOD« then shows 0 of X min.

A new period also starts after a longer interruption of power supply (more than 1 s). If time constant is set to one of the values of 2, 3, 4, 5, 6, 10, 12, 15, 20, 30 or 60 minutes, »TIME IN A PERIOD« is set to such value that one of the following intervals will be terminated at a full hour. In other cases of time constants, »TIME IN A PERIOD« is set to 0.

Example:

Mode: Fixed window
Time constant: 8 min.
Current MD and maximal MD: Reset at 0 min.



8.4.7.2 Sliding window

The sliding window technique allows the user to divide the time period into a number of sub-periods. The average demand value over the demand period is displayed, however, after the initial demand period has elapsed, the demand value will be updated by the addition of a further sub-period, thus creating a 'sliding window' measurement.

For example if the total period is 30 minutes (consisting of 5 sub-periods of 6 minutes duration), after the first 5 sub-periods have elapsed a new window will be added and the oldest window will be deleted, thus creating a sliding window.

A new period also starts after a longer interruption of power supply (more than 1 s). If time constant is set to one of the values of 2, 3, 4, 5, 6, 10, 12, 15, 20, 30 or 60 minutes, »TIME IN A PERIOD« is set to such value that one of the following intervals will be terminated at a full hour. In other cases of time constants, »TIME IN A PERIOD« is set to 0

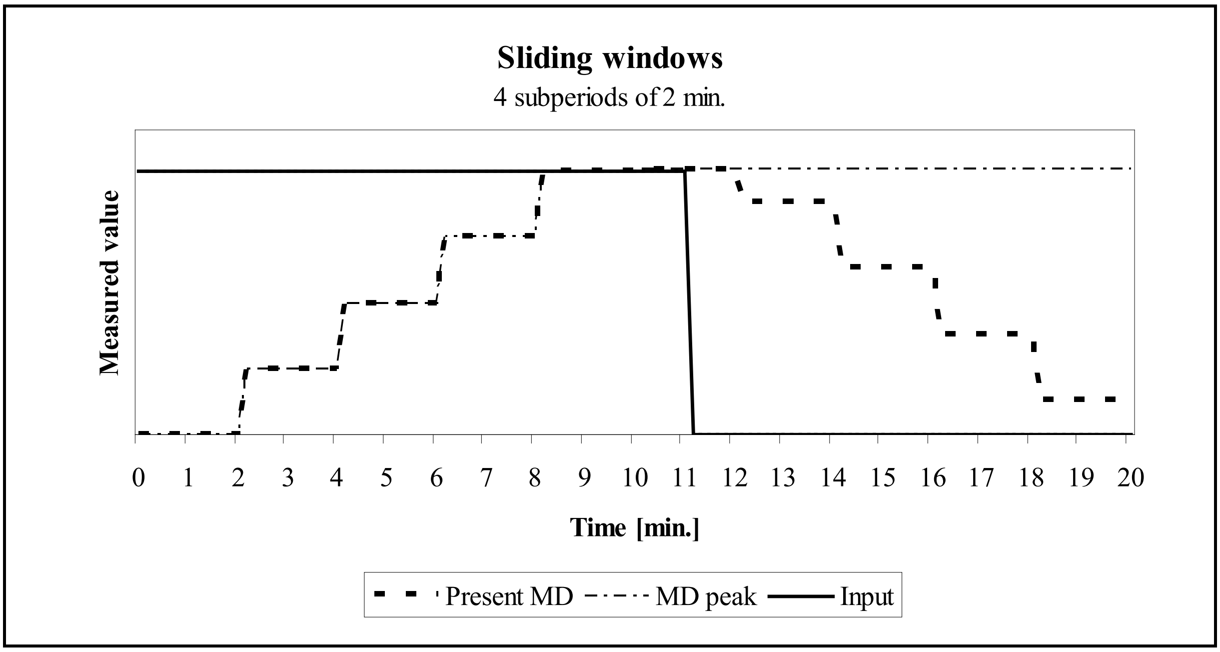
The number of sub-periods may be set between 2 to 15, with each period set between 1 to 255 minutes.

This is available in the **M233**, **M243** and **M253** as a selectable function.

Example:

Mode: Sliding windows
Time constant: 2 min.
No. of sub-periods: 4
Current MD and maximal MD: Reset at 0 min.

A complete period lasts for 8 minutes and consists of 4 sub-periods that are 2 minutes long. An current MD and a maximal MD are reset at 0 min. "TIME IN A PERIOD" is data for a sub-period so that the values for an current MD and a maximal MD are regenerated every two minutes. After 4 sub-periods (1 complete period) the oldest sub-period is eliminated when a new one is added, so that average (a window) always covers the last 4 sub-periods.



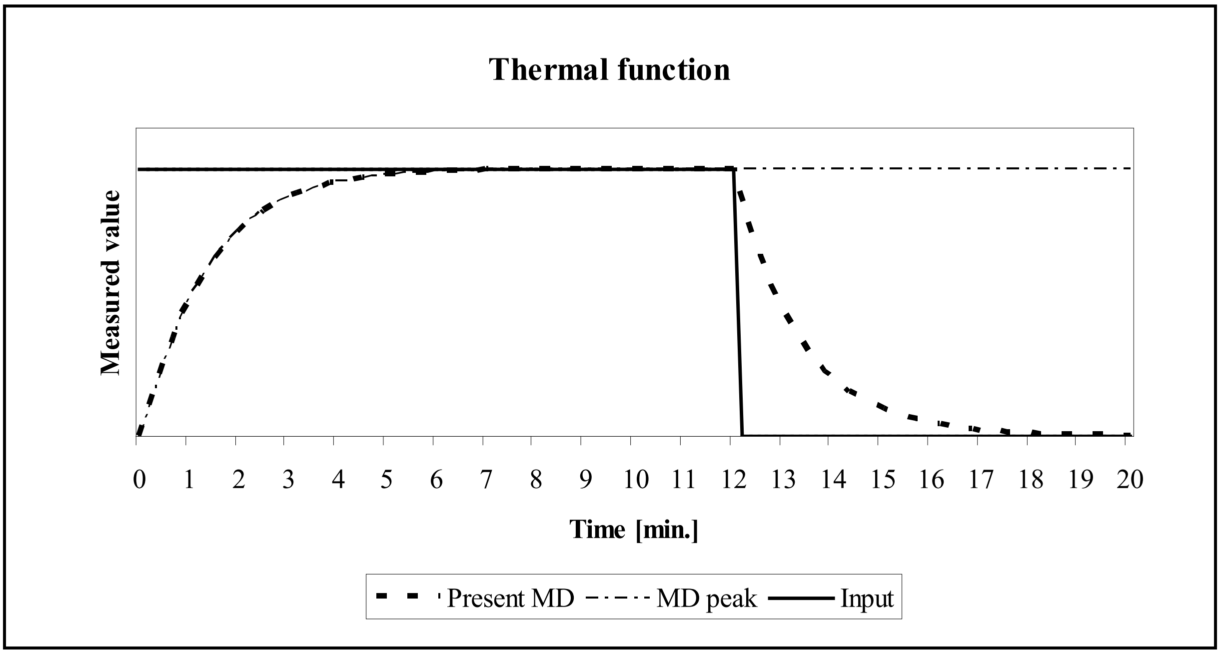
8.4.7.3 Thermal Demand

The thermal demand option will provide an exponential thermal characteristic, based on the bimetal element principal. Maximum demand and the time of its occurrence are stored in the unit. Note that the **M213** only has this technique.

Maximal values and time of their occurrence are stored in **M2x3.** A time constant (t. c.) can be set from 1 to 255 minutes and is 6−time thermal time constant (t..c. = 6 * thermal time constant).

Example:

Mode: Thermal function
Time constant: 8 min.
Current MD and maximal MD: Reset at 0 min.



8.4.7.4 Resetting Min/Max values

The Min/Max demand values can be reset using either manual or automatic modes. The automatic mode can reset the period each day at midnight (time 00:00), weekly (Monday at 00:00), monthly (first day at 00:00) or yearly (first day of the year at 00:00)

8.5 Power Quality

The **M253** provides a quality of supply monitor that complies with the European standard EN50160. This power quality standard is used to monitor electrical systems and ensure that it falls within a number of different limits ensuring that the user has a consistent and correct supply of electricity. The **M253** has 2MB of non-volatile memory reserved for storing data with a capacity for storing 170,000 variations from standard.

The EN50160 standard monitors the following electrical characteristics:

- Frequency and voltage variations
- Voltage unbalances, interruptions and dips
- Long and Transient (fast) interruptions
- Flicker, short and long term
- Individual Harmonics and %THD

All the Power Quality settings, extraction and tabulation of findings require the **QDSP Professional** software.

The following definitions are used in Power Quality applications:

Un = nominal supply voltage for the electrical system

Uc = agreed supply voltage for the electrical system, this may be the same as Un.

The Power Quality information can be displayed on the graphical LCD display, see section 12.3 for the available options and section 12.7 for the Power Quality report functions.

8.5.1 Frequency and Voltage variations

All frequency and voltage variations are averaged over a 10 second interval. The measured value is defined as a % from the nominal value and the number of variations over time is also defined by the user.

8.5.2 Voltage Interruptions and dips

All interruptions and dips are defined as a % change from the nominal voltage, the difference is that an interruption is classified as falling to 1% of nominal whilst a dip is generally about 90% of nominal. The time that the variation occurs is also classified over time, generally between ½ cycle to 1 minute.

8.5.3 Fast Voltage changes

A limit is defined as the number of variations within a pre-set time period, each variation is measured as a %change from the nominal slope over time (%Un/t).

8.5.4 Flicker – short term

Short term flicker intensity is measured over a 10 minute period and is calculated as:

$$P_{50S} = \left(P_{30} + P_{50} + P_{80}\right)/3$$
$$P_{10S} = \left(P_{6} + P_{8} + P_{10} + P_{13} + P_{17}\right)/5$$
$$P_{3S} = \left(P_{2,2} + P_{3} + P_{4}\right)/3$$
$$P_{1S} = \left(P_{1,7} + P_{1} + P_{1,5}\right)/3$$
$$P_{st} = \sqrt{\begin{array}{l}0,0314P_{0,1} + 00525P_{1S} + 0,0657P_{3S}\\ + 0,28P_{10S} + 0,08P_{50S}\end{array}}$$

Flicker – short term intensity

P_x − flicker levels that are exceeded by x% in a 10-minute period (e.g. $P_{0,1}$ represents a flicker level that is exceeded by 0.1% samples)

8.5.5 Flicker – long term

$$P_{lt} = \sqrt[3]{\sum_{i=1}^{12} \frac{P_{sti}^3}{12}}$$

Flicker – long term intensity

Calculated from twelve successive values of short-term flicker intensity in a two-hour period

9. HARDWARE

9.1 Communications

The **M2x3** can be supplied with either an RS232/RS485, USB or Ethernet electrically isolated communications that must be specified at ordering. The communication protocols that are available are MODBUS RTU and TCP, which are detailed in a separate manual. The communications service enables remote viewing of measurements and viewing and setting of system parameters. Figure 10-1 shows the DB9 connector on the rear of the **M2x3** case, Serial via terminals, Ethernet and/or USB connectors can replace the DB9 connector.

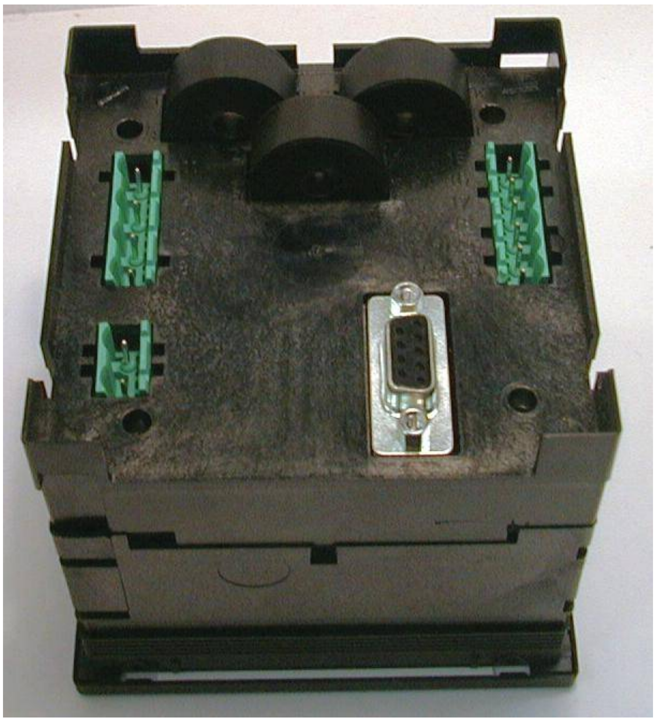


FIGURE 10-1 : M2X3 REAR CASE VIEW

9.1.1 RS232 /RS485 Communications

The **M233, M243** and **M253** communicating meters have the option of either a rear mounted DB9 9 pin connecter that is used for both of the RS232 and RS485 communications, or separate terminals for RS232 or RS485 communications.

The DB9 port has to be user wired as either RS232 or RS485 since the port cannot support both options at the same time. With the terminal connections, although connectors for both RS232 and RS485 are provided only one connector can be wired at one time.

WARNING: DO NOT ATTEMPT TO CONNECT USING RS232 AND RS485 COMMUNICATIONS AT THE SAME TIME AS DAMAGE CAN OCCUR. LEAVE THE UNUSED PINS IN DB9 AND ON TERMINALS UNCONNECTED.

The connection of RS232 communications has a maximum cable length is 15 metres.

Two-wire RS485 communications enables simultaneous connection to a maximum of 32 communicating devices, over distances of 1000m. For long cable distances a terminating resistor (120 ohm) may have to be connected between the 2 wires at the extreme ends of the cable network.

Connection information will be shown on the label as depicted in table 10-1.

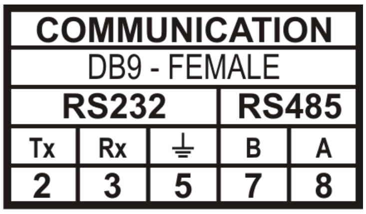
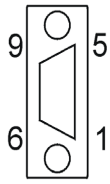
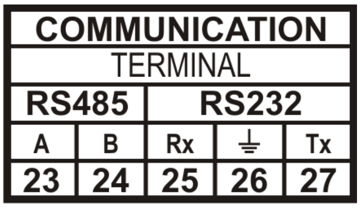
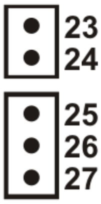
Connection	DB9 connector
	
Connection	**Terminals**
	

TABLE 10-1 : RS232/RS485 CONNECTIONS

9.1.2 Ethernet Communications

The **M233, M243** and **M253** communicating meters can have a rear mounted RJ45 Ethernet connecter.

If both Ethernet and USB ports are fitted they can be used simultaneously allowing interrogation locally and remotely at the same time.

Note that each **M2x3** will have a unique MAC number indicated on the label that can be used when configuring the Ethernet communications.

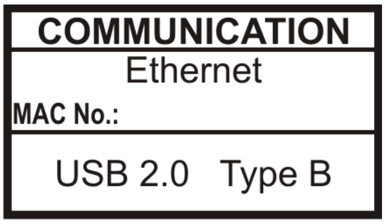
Connections


TABLE 10-1B : ETHERNET/USB

9.1.3 USB Communications

The **M233, M243** and **M253** communicating meters can be supplied with a USB port, via a rear mounted USB type B connector.

USB communication serves as a fast peer-to-terminal data link. The instrument is detected by the host as a USB 2.0 compatible device.

If both Ethernet and USB ports are fitted they can be used simultaneously allowing interrogation locally and remotely at the same time.

9.2 Inputs and Outputs

The **M2x3** (with the exception of the **M203**) can be supplied with two hardware modules situated on the rear of the case. These ports can be factory configured to one of the following options as shown in table 10-2:

TABLE 10-2 : I/O OPTIONS	M203	M213	M233	M243	M253
2x energy contacts		●	●	●	●
2x tariff inputs		●	●	●	●
2x alarm contacts			●	●	●
2x analogue outputs			●	●	●
1x Watchdog & 1x alarm contact			●	●	●
1x bistable alarm contact			●	●	●
2x digital inputs			●	●	●
2x analogue input			●	●	●
2x pulse input			●	●	●
1x RS485 port			●	●	●
1x RS232 port			●	●	●

Since each hardware module is independent from the other, the **M2x3** can be supplied with two different module (for example 2 energy contacts and 2 alarm contacts) or with two similar module (for example 4 analogue outputs or 4 tariff inputs).

I/O hardware module 1 uses terminals 15/16/17 and module 2 uses 18/19/20.

9.2.1 Energy Pulse Outputs

The 2 energy pulsed outputs that can be used for external monitoring of energy consumption. The energy measuring via the pulsed outputs corresponds to the basic energy measurement on the **M2x3** display. The pulsed outputs' energy measurement can be adapted to the customer's needs via the remote communications link.

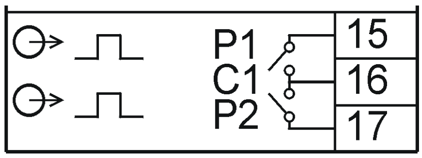
Connections


TABLE 10-3 : DUAL ENERGY CONTACTS

The hardware module has three terminals, the energy contacts will share a common connection but each contact can be individually set. When both hardware modules are used for energy contacts, the **M2x3** will provide a maximum of 4 independent outputs.

9.2.2 Tariff (inputs)

The 2 tariff inputs can be used for signalling different tariff periods. The tariff period would be used in conjunction with the Cost Management feature to determine the financial value of energy being monitored. This corresponds to the energy costs on the **M2x3** display. The tariff structure can be adapted to the customer's needs via the remote communications link.

The hardware module has three terminals (see table 10-4), the tariff voltage input is 230Vac ± 20% and share a common connection but each input can be individually set. When both hardware modules are used for tariff applications, the **M2x3** will provide a maximum of 4 independent inputs.

Connections

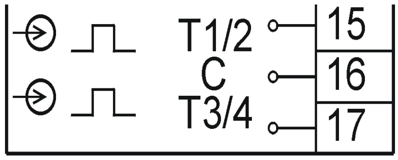


TABLE 10-4 : TARIFF INPUTS

9.2.3 Alarm and bistable Contacts (outputs)

The 2 alarm contacts can be used for external monitoring of an alarm condition. The alarms can be set via the front menu on the **M2x3** display or can be adapted to the customer's needs via the remote communications link.

The hardware port has three terminals (see table 10-5), the alarm contacts will share a common connection but each contact can be individually set. When both hardware ports are used for the alarm contacts, the **M2x3** will provide a maximum of 4 independent outputs.

Connections

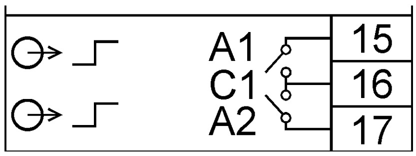


TABLE 10-5 : ALARM CONTACTS

Alternatively the **M2x3** can be supplied with each port as a bistable or change-over contact, in this application there will be a maximum of 2 independent outputs, see table 10-6.

Connections

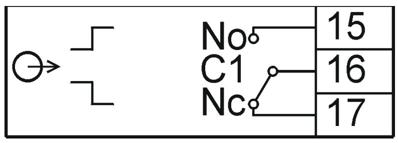


TABLE 10-6 : BISTABLE ALARM

9.2.4 Analogue (outputs)

The **M2x3** hardware port can be supplied as 2 analogue outputs, each of which can be set within the range 0…20mA. The analogue output can be configured to represent any of the instantaneous measured values. The outputs can be set via the front menu on the **M2x3** display or can be adapted to the customer's needs via the remote communications link.

Connections

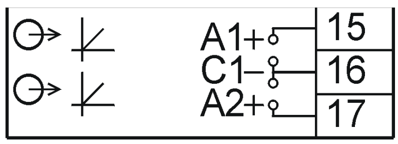


TABLE 10-7 : ANALOGUE OUTPUTS

The hardware port has three terminals (see table 10-7), the analogue outputs will share a common connection but each output can be individually set. When both hardware ports are used as an analogue output, the **M2x3** will provide a maximum of 4 independent outputs.

9.2.5 Digital Inputs

The **M2x3** hardware port can be supplied as 2 digital inputs able to read the status of the line. Various voltage values are available, see the ordering cortec. The status of a digital input is defined as one of the 32 alarms available on the system, and can be monitored remotely via the communications.

The hardware port has 3 terminals (see table 10-8) sharing an input common terminal.
When both hardware ports are used as a digital input, the **M2x3** will provide a maximum of 4 independent inputs.

Connections

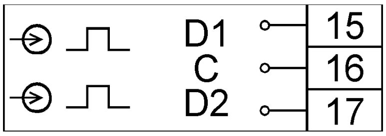


TABLE 10-8 : DIGITAL INPUTS

9.2.6 Watchdog Output and Alarm Output (Combined)

The **M2x3** can be supplied with a module that combines a Watchdog output and an Alarm Relay. The Alarm relay operates as if it is a part of an Alarm Output module.

The module has 3 terminals (see TABLE 10-9) sharing an output common terminal.

When both hardware ports use this module, the **M2x3** can have 2 Watchdog outputs and 2 Alarm outputs.

Connections

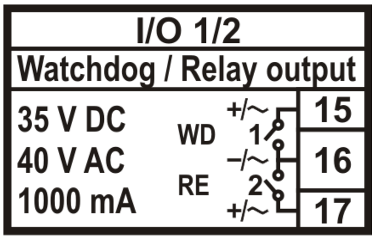


TABLE 10-9: WATCHDOG AND ALARM OUTPUTS

9.2.7 Analogue Input

The **M2x3** hardware port can be supplied as 2 analogue inputs. Various options are available, see the ordering cortec.

The module has 3 terminals (see TABLE 10-10).

When both hardware ports are analogue inputs, the **M2x3** can provide a maximum of 4 analogue inputs.

Connections

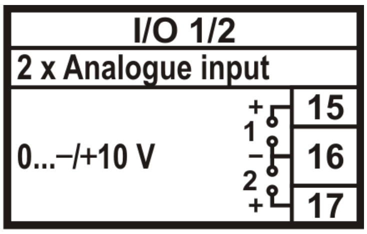


TABLE 10-10: ANALOGUE INPUTS

9.2.8 Pulse Input

The **M2x3** hardware port can be supplied as 2 pulse inputs

The module has 3 terminals (see TABLE 10-11).

When both hardware ports are pulse inputs, the **M2x3** can provide a maximum of 4 pulse inputs.

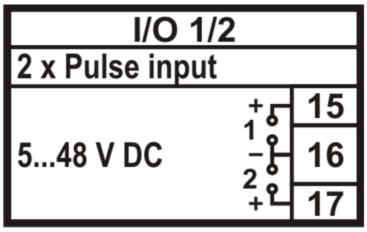
Connections


TABLE 10-11: PULSE INPUTS

9.2.9 2nd RS485 Communications (COM2)

The **M2x3** hardware port 2 can be supplied as a second RS485 communications port (COM2) which is completely independent of the main communications port (COM1)

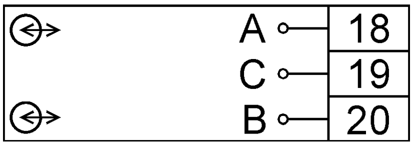
Connections


TABLE 10-12 : RS485 (COM2)

The hardware port has 3 terminals (see table 10-12) to provide a RS485 port. Only one additional RS485 port (COM2) can be fitted and it must be in hardware port 2.

9.2.10 2nd RS232 Communications (COM2)

The **M2x3** hardware port 2 can be supplied as a second RS232 communications port (COM2) which is completely independent of the main communications port (COM1)

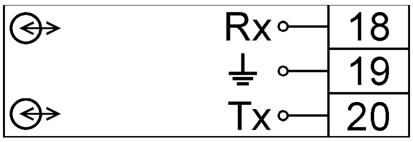
Connections


TABLE 10-13 : RS232 (COM2)

The hardware port has 3 terminals (see table 10-13) to provide a RS232 port. Only one additional RS232 port (COM2) can be fitted and it must be in hardware port 2.

9.3 Memory Card

All the **M2x3** family have a memory card slot located on the front display where the memory card is inserted, see figure 10-2. Section 11.5 describes the operation of the memory card.

The memory card slot on all **M2x3** products will accept a MultiMediaCard (MMC). In addition, **M233**, **M243** and **M253** products using Version ‘C’ Hardware will also accept an SD card. Cards with memory sizes up to 1GB are supported.

The memory card is only used for transferring data; it cannot be used as an extension to the logging memory of the meter. Therefore the memory card should not be left in the slot in the meter and the slot cover should be fitted to prevent ingress of moisture and dust.

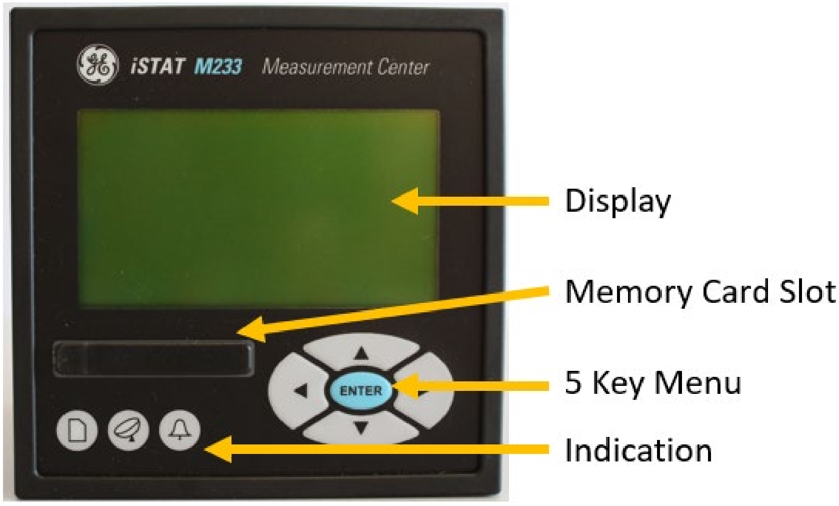


FIGURE 10-2 : M2X3 FRONT PANEL

The memory card is used to load the **M2x3** settings and to extract records from the **M243** and **M253**. This means that the settings for all the **M2x3** can be made off line using QDSP and loaded in to the **M2x3**, including the **M203** and **M213** which are non-communicating.

The options available for the memory card are fully described in section 11.5: Memory Card Status, Save Data, Load Settings and Software Update.

Memory Card Status: the **M2x3** can check the status of the memory card ensuring that it is correctly located in the front slot and that it can be read from and written to.

Save Data: Where the **M2x3** has a recording function, such as the **M243** data logger or the **M253** Power Quality recorder, this data can be saved to the memory card for off line analysis using the QDSP software.

Load Settings: the settings for the **M2x3** are compiled in QDSP using a .msf file suffix. This file can be saved on a computer or onto the memory card. The memory card is then inserted into the **M2x3** and these settings loaded into the **M2x3**. The **M2x3** will only load the appropriate .msf file so that the settings from one meter cannot be inadvertently loaded into another inappropriate meter.

Software Update: QDSP has an upgrade function for the **M2x3** firmware. This firmware can be saved onto the memory card and then transferred to the **M2x3** so that the meter firmware can be upgraded. This removes the need for the **M2x3** (especially non communicating versions) to be returned to the factory for an upgrade.

9.4 Auxiliary Supply

The **M2x3** family can either have an AC auxiliary voltage that has to be specified or a single Universal ac/dc auxiliary voltage supply.

Parameter	AC Auxiliary Voltage	Universal Auxiliary Voltage
AC Nominal Voltage	57.7V, 63.5V, 100V, 110V, 230V or 400Vac	48 – 276V ac
Frequency	45 – 65Hz	40 – 70Hz
DC Nominal Voltage	n/a	20 – 300Vdc
Burden	< 8 VA	< 12 VA

TABLE 10-14: AUXILIARY SUPPLY

9.4.1 Inputs and Supply

The **M2x3** has an auto-ranging voltage and current input with a nominal 500V and 5A. Since the **M2x3** also has a fully configurable connection mode the default information is shown as 4u (3 phase 4 wire unbalanced) and the default connection diagram also shows this connection. This information is combined with the auxiliary supply and shown on the label as follows; the different wiring connections are shown in section 15.

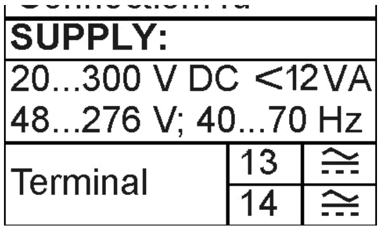


TABLE 10-15: UNIVERSAL POWER SUPPLY

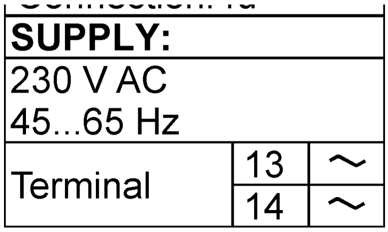


Table 10-16: AC POWER SUPPLY

10. PROGRAMMING THE M2X3

The basic programming **M2x3** can be programmed using the display and keypad on the device. The **M233**, **M243** and **M253**, which are always fitted with communications, can also be programmed using the QDSP software. There are many options on the **M233**, **M243** and **M253** that can only be programmed using the QDSP software. See section 14 for details.

10.1 Menu introduction

The settings, measurements and functions of the **M2x3** can be accessed from either the front panel or the remote communications link. The menu structure of the **M2x3** is navigated using the five keys on the front panel as shown in figure 11-1 below:

FIGURE 11-1: M2X3 FRONT VIEW

Throughout this section the following symbols are used to relate to pressing the corresponding key on the front panel.

Key	Left	Right	Down	Up	Enter
Symbol	⮜	⮞	⮟	⮝	OK

The **M2x3** is supplied with the Level 1 and Level 2 passwords set to AAAA. AAAA passwords offer no level of protection; all measurements and settings can be modified. The passwords must be changed from AAAA to activate password level protection.

M253 **Network Analyser**	Figure 11-2a initial power up display

When the **M2x3** is first connected to the auxiliary power system, the user is greeted with the message shown in Figure 11-2a above. This information will be displayed for a few seconds before the main menu is shown, see Figure 11-2b below.

The display is divided into 3 parts separated by two horizontal lines; Top, Main and Bottom. The Top display tells the operator the name of the main display, the bottom display provides display specific information and the main display shows the functions for that main display screen.

The bottom display cycles through date & time, temperature and web site address.

Main Menu **Measurements** **Settings** **Resets** **MMC Card** **Info** **Installation** **01.05.2010 12:43:36**	Figure 11-2b Main Menu display Bottom display

When first switched on or during operation, the main menu of the **M2x3** can be accessed to pressing the **OK** key, this is shown in Figure 11-2b and gives the user 6 options; Measurements, Settings, Resets, MMC card, Info (Information) and Installation (not shown). Navigation is done by pressing the DOWN⌄or UP⌃ keys and then pressing the **OK** key to make a selection. The menu cycles round from Installation back to Measurements.

10.2 Measurement Navigation

Figure 11-3 illustrates the measurement menu structure. The user can browse through the 7 available menus using the direction keys, by pressing the DOWN⮟or UP⮝ keys and then pressing the **OK** key to make a selection. The ⮜LEFT key is pressed to return to the Main Menu

Measurements	Figure 11-3
	Menu name
Present Values	Measurements display
Min/Max Values	
Alarms	
Graphs time	
Graphs FFT	
Power Supply Quality	
Demo Cycling	
<- Main Menu	Back to main menu

Figure 11-4 illustrates the present value menu structure. The user can browse through the 10 available menus using the direction keys, by pressing the DOWN⮟or UP⮝ keys and then pressing the **OK** key to make a selection. The ⮜LEFT key is pressed to return to the Measurement Menu

Present Values	Figure 11-4
	Menu name
Voltage	Present Value display
Current	
Power	
PF & power angle	
Frequency	
Energy	
MD values	
THD	
Custom	
Review	
<- Main Menu	Back to main menu

table 11-1 illustrates the Measurement Menu information structure. The user can browse through all the available menus using the direction keys. Pressing the **OK** key returns to the Measurement Menu

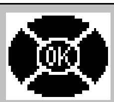
	**Information**	**◄Left**								**Right►**
^	Voltage		Phase Voltage	Line Voltage						
	Current	Average Current	Phase Current							
	Power	W, VA and VAr total	W per phase	VA per Phase	VAr per phase					
	PF and power angle	PF total Power angle total	PF per Phase	Power angle per Phase						
	Frequency	Frequency								
	Energy	Counters 1 & 2	Counters 3 & 4	Counter 1 history	Counter2 history	Counter3 history	Counter4 history	Energy Price		
	MD values	w	w	va	va	var	var	Iphase1	Iphase2	Iphase3
	THD	Phase Current	Phase Voltage	Line Voltage						
	Custom	User defined 1	User defined 2	User defined 3						
v	Overview	Voltage current, Watts and VArs	Voltage current, Watts and VArs	Voltage current, Watts and VArs						

TABLE 11-1 : MEASUREMENT MENU INFORMATION STRUCTURE

10.3 Settings Navigation

Figure 11-5 illustrates the settings menu structure. The user can browse through the 8 available menus using the direction keys, by pressing the DOWN▼or UP▲ keys and then pressing the **OK** key to make a selection. The ◀LEFT key is pressed to return to the Main Menu

	Figure 11-5
Settings	Menu name
General **Date & Time** **Connection** **Communication** **LCD** **Security** **Energy** **Inputs/Outputs**	Settings display
<- Main Menu	Back to main menu

table 11-2 illustrates the Settings Menu information structure. The user can browse through all the available menus using the direction keys. Pressing the **OK** key returns to the Settings Menu. The settings that appear will depend on the model and the optional modules fitted.

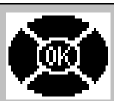
	**◄Left**							**Right►**
▲	General	Date & Time	Connection	Communication	LCD	Security	Energy	Inputs/ Outputs
	Language	Date	Connection mode	Device address	Contrast	Password level 1	Active tariff	I/O 1
	Currency	Time	VT primary	Baud rate	Backlight	Password level 2	Common en. component	I/O 2
	Temperature unit	Date format	VT secondary	Parity	Backlight time off	Password lock time		I/O 3
	MD mode	Auto S/W time	CT primary	Stop bit	Demo cycling period	Lock instrument		I/O 4
	MD time constant		CT secondary		Custom screen 1	Unlock instrument		
	Average interval				Custom screen2			
▼	Min/Max reset mode				Custom screen3			

TABLE 11-2 : SETTINGS MENU INFORMATION STRUCTURE.

10.4 Resets Navigation

Figure 11-6 illustrates the resets menu structure. The user can browse through the 6 available menus using the direction keys, by pressing the DOWN⮟or UP⮝ keys and then pressing the **OK** key to make a selection. The ⮜LEFT key is pressed to return to the Main Menu

Resets display	Figure 11-6
Resets	Menu name
Min/Max Values **Energy Counters** **MD Values** **Last Period MD** **Synchronise MD** **Reset alarm output**	Resets display
<- Main Menu	Back to main menu

table 11-3 illustrates the Resets Menu information structure. The user can browse through all the available menus using the direction keys. Pressing the **OK** key returns to the Resets Menu. The settings that appear will depend on the model and the optional modules fitted.

	⮜Left					**Right⮞**
⮝	Min/max values	Energy counters	MD values	Last period MD	Synchronise MD	Reset Alarm output
	No/Yes	All energy counters	No/Yes	No/Yes	No/Yes	No/Yes
		All cost counters				
		Energy counter E1				
		Energy counter E2				
		Energy counter E3				
		Energy counter E4				
		Cost counter E1				
		Cost counter E2				
		Cost counter E3				
⮟		Cost counter E4				

TABLE 11-3 : RESETS MENU INFORMATION STRUCTURE

10.5 Memory Card Navigation

Figure 11-7 illustrates the Memory card menu structure; the same controls apply to the SD Card if accepted. The user can browse through the 4 available menus using the direction keys, by pressing the ⮟DOWN or ⮝ UP keys and then pressing the **OK** key to make a selection. The ⮜LEFT key is pressed to return to the Main Menu

Memory Card **MMC info** **Save data** **Load settings** **Software update** **<- Main Menu**	Figure 11-7 Menu name Memory Card display Back to main menu

table 11-4 illustrates the MMC Menu information structure. The user can browse through all the available menus using the direction keys. Pressing the **OK** key returns to the MMC Menu. The settings that appear will depend on whether the MMC card is inserted. If the MMC is not inserted the message MMC not inserted! will appear.

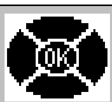
	⮜Left			Right⮞
⮝	MMC info	Save data	Load settings	Software update
	?	Recorder A	?	?
		Recorder B		
		Alarms		
		Q details		
		Q reports		
⮟				

TABLE 11-4 : MMC MENU INFORMATION STRUCTURE

10.6 Info Navigation

Figure 11-8 illustrates the Product Identify display; this is also the default display during power up. This will not refresh back to the main menu so the user has to press the ⮜ LEFT key to get back to the Main Menu.

M253 **Network Analyser**	Figure 11-8 Product Identify Initial power up display and Info display

Figure 11-9 illustrates the Product Information display. This is viewed by pressing either pressing the ⮟DOWN or ⮝ UP keys;. Pressing the ⮜ LEFT key to takes the user back to the Main Menu.

Info **Ser.#: MCxxxxxx** **S.ver: 1.14** **H.ver: b** **Date: 14.04.2010** **Run: 0d 14h 47'** **<- Main Menu**	Figure 11-9 Product Information Back to main menu

The information shown on the Product Information display is:

Ser.#: MCxxxxxx this is the **M2x3** serial number.

S.ver: 1.14: this is the software version loaded in the **M2x3**

H.ver: b this is the hardware version of the **M2x3**

Date: 14.04.2010: this is the date that the **M2x3** software was last upgraded

Run: 0d 14h 47': this is the total time that the **M2x3** has been operating

10.7 Installation Navigation

Figure 11-10 illustrates the Installation menu structure. The user presses **OK** key to make a selection. The ⮜LEFT key is pressed to return to the Main Menu

Installation **Welcome to the** **Installation wizard.** **Press OK to continue** **<- Main Menu**	Figure 11-10 Installation Wizard display Back to main menu

The Installation Wizard is described in section 12.1

11. MEASUREMENT MENU FUNCTIONS

11.1 Installation Wizard

The Installation Wizard is designed to take the user through the minimum functions necessary to install the **M2x3**. By pressing the **OK** key the following functions can be set: Language; Date: Time: Connection Mode: VT Primary: VT Secondary: CT Primary: CT Secondary: Device Address: Baud Rate: Parity: Stop Bit.

From the Installation Wizard located on the Main Menu, press **OK** to activate the Wizard.

Installation

Welcome to the

Installation wizard.

Press OK to continue

<- Main Menu

Figure 12-1

Installation Wizard display

Back to menu

Figure 12-2 shows the Language setting structure. The selection is made by pressing either the ⌄DOWN or ⌃ UP keys until the desired language is selected and then press **OK** key to make a selection.

Language

- ● **English**
- O **Francais**
- O **Deutch**
- O **Espanol**
- O **Russian**
- O **Dansk**
- O **Italian**
- O **US English**

OK Select

Figure 12-2

Language display

Figure 12-3 shows the Date setting structure, the format is date: month: year. An underscore shows the position of the curser. Move along the date by using the ➤RIGHT or ◀LEFT key, changes are made by pressing either the ⌄DOWN or ⌃ UP keys until the desired setting is shown, then press **OK** key to confirm. The ◀LEFT key can be pressed to return to the Language menu.

Date

DD.MM.YYYY

01.05.2010

OK Select

Figure 12-3

Date display

Figure 12-4 shows the Time setting structure, the format is hours: minutes: seconds. An underscore shows the position of the curser. Move along the date by using the ➤RIGHT or ⮜LEFT key, changes are made by pressing either the ⮟DOWN or ⮝ UP keys until the desired setting is shown, then press **OK** key to confirm. The ⮜LEFT key can be pressed to return to the Date setting.

Time **14:17:01** **14.17.01** **OK Select**	Figure 12-4 Time display

Figure 12-5 shows the Connection Mode setting structure. The selection is made by pressing either the ⮟DOWN or ⮝ UP keys until the desired connection mode is selected and then press **OK** key to confirm. The ⮜LEFT key can be pressed to return to the Time setting.

Connection ● **1b (1W)** ○ **3b (1W3)** ○ **4b (1W4)** ○ **3u (2W3)** ○ **4u (3W4)** **OK Select**	Figure 12-5 Connection display

Figure 12-6 shows the VT Primary setting structure. An underscore shows the position of the curser. Move along by using the ➤RIGHT or ⮜LEFT key, changes are made by pressing either the ⮟DOWN or ⮝ UP keys until the desired setting is shown, then press **OK** key to confirm. When the curser is under the decimal point, the engineering units (V, KV) can be changed. The ⮜LEFT key can be pressed to return to the Connection Mode setting.

VT primary **_275.0KV** **OK Select**	Figure 12-6 VT Primary display

Figure 12-7 shows the VT Secondary setting structure. An underscore shows the position of the curser. Move along by using the ➤RIGHT or ⮜LEFT key, changes are made by pressing either the ⮟DOWN or ⮝ UP keys until the desired setting is shown, then press **OK** key to confirm. The ⮜LEFT key can be pressed to return to the VT Primary setting.

VT secondary

_110.0V

OK Select

Figure 12-7

VT Secondary display

Figure 12-8 shows the CT Primary setting structure. An underscore shows the position of the curser. Move along by using the ➤RIGHT or ⮜LEFT key, changes are made by pressing either the ⮟DOWN or ⮝ UP keys until the desired setting is shown, then press **OK** key to confirm. When the curser is under the decimal point, the engineering units (A, KA) can be changed. The ⮜LEFT key can be pressed to return to the VT Secondary setting.

CT primary

_2800.0A

OK Select

Figure 12-8

CT Primary display

Figure 12-9 shows the CT Secondary setting structure. An underscore shows the position of the curser. Move along by using the ➤RIGHT or ⮜LEFT key, changes are made by pressing either the ⮟DOWN or ⮝ UP keys until the desired setting is shown, then press **OK** key to confirm. The ⮜LEFT key can be pressed to return to the CT Primary setting.

CT secondary

_5.0A

OK Select

Figure 12-9

CT Secondary display

Figure 12-10 shows the Device address setting structure. An underscore shows the position of the curser. Move along by using the ➤RIGHT or ⮜LEFT key, changes are made by pressing either the ⮟DOWN or ⮝ UP keys until the desired setting is shown, then press **OK** key to confirm. The ⮜LEFT key can be pressed to return to the CT secondary setting. The default address is 33.

Device address

_33

OK Select

Figure 12-10

Device address display

Figure 12-11 shows the Baud Rate setting structure. Changes are made by pressing either the ⌄DOWN or ⌃ UP keys until the desired setting is shown, then press **OK** key to confirm. The ‹LEFT key can be pressed to return to the Device Address setting.

Baud rate ● **9600 bits/s** ○ **19200 bits/s** ○ **38400 bits/s** ○ **57600 bits/s** ○ **115200 bits/s** **OK Select**	Figure 12-11 Baud rate display

Figure 12-12 shows the Parity setting structure. Changes are made by pressing either the ⌄DOWN or ⌃ UP keys until the desired setting is shown, then press **OK** key to confirm. The ‹LEFT key can be pressed to return to the Baud Rate setting.

Parity ● **No** ○ **Old** ○ **Even** **OK Select**	Figure 12-12 Parity display

Figure 12-13 shows the Stop Bit setting structure. Changes are made by pressing either the ⌄DOWN or ⌃ UP keys until the desired setting is shown, then press **OK** key to confirm. The ‹LEFT key can be pressed to return to the Parity setting.

Stop Bit ● **1** ○ **2** **OK Select**	Figure 12-13 Stop Bit display

Figure 12-14 shows the Installation Completed display. Press **OK** key to confirm all the changes and complete the installation.

Installation **Installation** **Completed** **OK Main Menu**	Figure 12-14 Installation Complete display Back to main menu

11.2 Demo Cycling

The function polls through a number of different displays that show the different features that are in the **M2x3**. The features shown will depend on the model of **M2x3** that is used.

Figure 12-15 illustrates the Measurement menu structure. The user can browse through the 7 available menus using the direction keys, by pressing either the DOWN˅or UP˄ keys and then pressing the **OK** key to select the Demo Cycling Menu.

Measurements	Figure 12-15 Menu name
Present Values **Min/Max Values** **Alarms** **Graphs time** **Graphs FFT** **Power Supply Quality** **Demo Cycling**	Measurements display
<- Main Menu	Back to main menu

Figure 12-16 illustrates the Demo Cycling setting. The user presses the **OK** key to activate the Demo Cycling feature.

Measurements	Figure 12-16 Menu name
Cycling Period **4 sec,** **Press OK**	Demo Cycling setting
<- Measurements	Back to measurement menu

The Demo Cycling feature will then show various features of the **M2x3**, for example the **M253** Network Analyser will cycle through the following information:

- Meter identify
- Info page
- Memory status
- Quality report summary (current and last period)
- Graphical Voltage harmonic
- Alarm groups and status
- Voltage actual, maximum and minimum values
- Current actual, maximum and minimum values
- Energy values
- Cost management information
- MD values
- THD information

The user presses the **OK** key to deactivate the Demo Cycling feature.

11.3 Graphical display

The graphical function actives a graphical display on the front of the **M2x3** that shows the instantaneous voltage and current waveform, either the RMS value or the harmonic content.

Figure 12-17 illustrates the measurement menu structure. The user can browse through the 7 available menus using the direction keys, by pressing either the DOWN▼or UP▲ keys and then pressing the **OK** key to select the Graphs time or Graphs FFT setting.

Display	Figure 12-17
Measurements	Menu name
Present Values	Measurements display
Min/Max Values	
Alarms	
Graphs time	
Graphs FFT	
Power Supply Quality	
Demo Cycling	
<- Main Menu	Back to main menu

Figure 12-18 illustrates the Graphs time menu structure. The user can browse through the 7 available menus using the direction keys, by pressing the DOWN▼or UP▲ keys and then pressing the **OK** key to select the Graphs time or Graphs FFT setting.

Display	Figure 12-18
Graphs time	Menu name
Phase Voltage	Graphs display
Current	
<- Measurements	Back to measurement menu

11.4 Cost Energy Management

The first operation is to activate the tariff structure. Figure 12-19 shows the main menu, select the settings menu. From this menu scroll down to select the Energy Menu.

Display	Figure 12-19
Main Menu	
Measurements	Main Menu display
Settings	
Resets	
MMC Card	
Info	
Installation	
01.05.2010 12:43:36	Bottom display

Figure 12-20 illustrates the Energy menu structure. The user can browse through the 2 available menus using the direction keys, by pressing the DOWN▼or UP▲ keys and then pressing the **OK** key to make a selection. The ◄LEFT key is pressed to return to the Settings Menu.

Energy	Figure 12-20
Active Tariff	Energy Menu
Common en. exponent	
Tariff 1	Back to Setting menu

Figure 12-21 illustrates the Active Tariff menu structure. The user can browse through the 5 available menus using the direction keys, by pressing the DOWN▼or UP▲ keys and then pressing the **OK** key to make a selection. The ◄LEFT key is pressed to return to the Settings Menu.

Active tariff	Figure 12-21
● Tariff Input	Active Tariff
○ Tariff 1	
○ Tariff 2	
○ Tariff 3	
○ Tariff 4	
○ Tariff Clock	
OK Select	Back to Setting menu

Figure 12-22 illustrates the Common en.exponent menu structure. The user can browse through the 5 available menus using the direction keys, by pressing the DOWN▼or UP▲ keys and then pressing the **OK** key to make a selection. The ◄LEFT key is pressed to return to the Energy Menu.

Common en.exponent	Figure 12-22
● -3 0.001W (Var, VA)	Common energy exponent
○ -2 0.01W (Var, VA)	
○ -1 0.1W (Var, VA)	
○ 0 1W (Var, VA)	
○ +1 0.01kW (Var, VA)	
○ +2 0.1kW (Var, VA)	
○ +3 1kW (Var, VA)	
○ +4 0.01MW (Var, VA)	
OK Select	Back to Energy menu

The energy tariff structure can only be configured using QDSP.

11.5 Power Quality Recorder Report

The **M253** incorporates a power quality measurement function that monitors compliance to the European standard EN50160. To make the Power Quality settings and to extract the data and generate the reports the QDSP Professional software is required.

The power quality measurements can also be viewed using the **M2x3** display and keypad.

Figure 12-23 illustrates the measurement menu structure. The user can browse through the 7 available menus using the direction keys, by pressing the DOWN⮟or UP⮝ keys and then pressing the **OK** key to select the Power Supply Quality Menu.

Display	Figure 12-23
Measurements	Menu name
Present Values	Measurements display
Min/Max Values	
Alarms	
Graphs time	
Graphs FFT	
Power Supply Quality	
Demo Cycling	
<- Main Menu	Back to main menu

Figure 12-24 illustrates the Power Supply Quality Menu settings. The user selects a report on either the Actual (or current) and previous time periods. Press the **OK** key to select the required option.

Display	Figure 12-24
Power Supply Quality	Menu name
Actual period	Power Supply Quality display
Previous period	
<- Measurements	Back to measurement menu

Figure 12-25 illustrates page 1 of 4 from Actual Period report. The Previous period report uses the same format as this and the next illustrations. The user moves through the report information using the ➤RIGHT or ⮜LEFT keys. Press the **OK** key to return to the Power Supply Quality Menu.

Display		Figure 12-25
Actual period		Menu name
Start	**:01.05.2006**	Actual period summary display
End	**:06.05.2006**	
Status	**:Not comp**	
Compila	**:X**	
Period:	**18/2006**	

Figure 12-26 illustrates page 2 of 4 from Actual Period report. The user moves through the report information using the ➤RIGHT or ◀LEFT keys. Press the **OK** key to return to the Power Supply Quality Menu.

Actual period	
Frequency 1	**: X**
Frequency 2	**: X**
Unbalance	**: X**
Voltage 1	**: ✓**
Voltage 2	**: X**
Period:	**18/2006**

Figure 12-26

Menu name

Actual period summary display

Figure 12-27 illustrates page 3 of 4 from Actual Period report. The user moves through the report information using the ➤RIGHT or ◀LEFT keys. Press the **OK** key to return to the Power Supply Quality Menu.

Actual period	
THD	**: ✓**
Harmonics	**: X**
Short flicker	**: ✓**
Long flicker	**: X**
Transients	**: X**
Period:	**18/2006**

Figure 12-27

Menu name

Actual period summary display

Figure 12-28 illustrates page 4 of 4 from Actual Period report. The user moves through the report information using the ➤RIGHT or ◀LEFT keys. Press the **OK** key to return to the Power Supply Quality Menu.

Actual period	
Overvoltage	**: ✓**
Dips	**: X**
Short inter.	**: ✓**
Long inter	**: X**
Period:	**18/2006**

Figure 12-28

Menu name

Actual period summary display

12. M2X3 SETTINGS USING KEYPAD/DISPLAY

M2x3 settings can be remotely modified using the QDSP software, or with the use of the keypad on the **M2x3**.

All settings in the **M2x3** can be modified using the QDSP software, but only the basic settings can be programmed using the keypad and display. See section 14 for full details.

The Installation Wizard described in 12.1 is designed to take the user through the minimum functions necessary to install the **M2x3**; the following functions can be set:

Language

Date & Time

Connection Mode: VT Primary: VT Secondary: CT Primary: CT Secondary

Device Address: Baud Rate: Parity: Stop Bit

All these functions can be set individually from the settings menu. Each setting is described in the following sections.

12.1 Setting Navigation

Figure 13-1 illustrates the Settings menu structure. The user can browse through the 6 available menus using the direction keys, by pressing the DOWN▼or UP▲ keys and then pressing the **OK** key to make a selection. The ◄LEFT key is pressed to return to the Main Menu

Resets	Figure 13-1 Menu name
General **Date & Time** **Connections** **Communication** **LCD** **Security** **Energy** **Inputs and Outputs**	Resets display
<- Main Menu	Back to main menu

12.2 General Navigation

Figure 13-2 illustrates the General menu structure. The user can browse through the 7 available menus using the direction keys, by pressing the DOWN⮟or UP⮝ keys and then pressing the **OK** key to make a selection. The ⮜LEFT key is pressed to return to the Settings Menu

Display	Figure 13-2
General	Menu name
Language	General display
Currency	
Temperature Unit	
MD mode	
MD Time constant	
Average interval	
Min/Max reset mode	
English	Back to settings menu

Figure 12-1 in the Installation Wizard section describes the language selection. Once selected, the language option appears in the lower menu when the cursor highlights the language option.

Figure 13-3 illustrates the Currency setting. The user can enter the 3 characters of to describe the unit of currency that they require. This is used with the Energy cost management application. Pressing the DOWN⮟or UP⮝ keys scrolls through the alphabet. The ⮞RIGHT or ⮜LEFT keys are used to move the cursor. Press the **OK** key to return back to the General Menu

Display	Figure 13-3
Currency	Menu name
	Currency display
EUR	
OK Select	Back to General menu

Figure 13-4 illustrates the Temperature Unit setting. The user can select either Centigrade or Fahrenheit as the unit of measure.. Press the **OK** key to return back to the General Menu

Display	Figure 13-4
Temperature Unit	Menu name
	Temperature Unit display
● **°C**	
O **°F**	
OK Select	Back to General menu

Figure 13-5 illustrates the MD Mode setting. The user can select from 6 different methods of calculating MD or Maximum Demand. Pressing the DOWN▼or UP▲ keys scrolls through the options. Press the **OK** key to return back to the General Menu

	Figure 13-5
MD Mode	Menu name
● **Thermal**	MD mode display
○ **Fixed Window**	
○ **2 sliding wind.**	Note for clarity the range from 5th to 14th sliding window are not shown.
○ **3 sliding wind.**	
○ **4 sliding wind.**	
- - - - - - - - - - - - - -	
○ **15 sliding wind.**	
OK Select	Back to General menu

Figure 13-6 illustrates the MD time constant setting. The user can select a time constant setting from 1minute up to 255 minutes. Pressing the DOWN▼or UP▲ keys scrolls through the options. Press the **OK** key to return back to the General Menu

	Figure 13-6
MD Time constant	Menu name
	MD time constant display
_15 min.	
OK Select	Back to General menu

Figure 13-7 illustrates the Average Interval setting. The user can select from 6 different settings, from 8 periods to 256 periods. Pressing the DOWN▼or UP▲ keys scrolls through the options. Press the **OK** key to return back to the General Menu

	Figure 13-7
Average Interval	Menu name
● **8 periods**	Average Interval display
○ **16 periods**	
○ **32 periods**	
○ **64 periods**	
○ **128 periods**	
○ **256 periods**	
OK Select	Back to General menu

Figure 13-8 illustrates the Min/Max reset mode setting. The user can select from 5 different settings, manual, day, week, month and year. Pressing the DOWN⮟or UP⮝ keys scrolls through the options. Press the **OK** key to return back to the General Menu

Average Interval

● **Manual**
○ **Day**
○ **Week**
○ **Month**
○ **Year**

OK Select

Figure 13-8

Menu name

Average Interval display

Back to General menu

12.3 Date & time Navigation

Figure 13-9 illustrates the Date & Time menu structure. The user can browse through the 4 available menus using the direction keys, by pressing the DOWN⮟or UP⮝ keys and then pressing the **OK** key to make a selection. The ⮜LEFT key is pressed to return to the General Menu

Date & time

Date
Time
Date format
Automatic S/W time

04:05:2006

Figure 13-9

Menu name

Date & time display

Back to General menu

Figure 12-2 in the Installation Wizard section describes date setting. This is shown in the lower menu when the cursor highlights the Date option.

Figure 12-3 in the Installation Wizard section describes time setting. This is shown in the lower menu when the cursor highlights the time option.

Figure 13-10 illustrates the Date format setting. The user can select from 2 options: Day:Month:Year or Month:Day:Year, by pressing the DOWN⮟or UP⮝ keys and then pressing the **OK** key to make a selection. The ⮜LEFT key is pressed to return to the General Menu

Date format

● **DD:MM:YYYY**
○ **MM:DD:YYYY**

OK Select

Figure 13-10

Menu name

Date format display

Back to General menu

Figure 13-11 illustrates the Automatic s/w time setting. The user can activate the automatic summer/winter time setting. This is used with the Energy cost management application. Press the DOWN⮟or UP⮝ keys to select and press **OK** confirm selection. The ⮜LEFT key is pressed to return to the General Menu

Automatic s/w time

● **No**

○ **Yes**

OK Select

Figure 13-11

Menu name

Date format display

Back to General menu

12.4 LCD Navigation

Figure 13-12 illustrates the LCD menu structure. The user can browse through the 7 available settings using the direction keys, by pressing the DOWN⮟or UP⮝ keys and then pressing the **OK** key to make a selection. The ⮜LEFT key is pressed to return to the Settings Menu

LCD

Contrast

Back Light

Back Light time off

Demo cycling period

Custom screen 1

Custom screen 2

Custom screen 3

0

Figure 13-12

Menu name

LCD display

Back to Settings menu

Contrast: this is adjusted using the DOWN⮟or UP⮝ keys until the desired contrast has been reached, the scale is from -10 to +10 with being the normal value. Pressing the **OK** key confirms the selection. The numeric value is shown in the lower menu when the Contrast setting is selected.

Back Light: this is adjusted using the DOWN⮟or UP⮝ keys until the desired lighting has been reached, the scale is from 1 to +10. Pressing the **OK** key confirms the selection. The numeric value is shown in the lower menu when the Back Light setting is selected.

Back Light time off: this is adjusted using the DOWN⮟or UP⮝ keys until the desired time off setting has been reached. The setting is from 0 to 60 minutes. Pressing the **OK** key confirms the selection. The numeric value is shown in the lower menu when the Back Light time off setting is selected.

Demo cycling period: this is adjusted using the DOWN⮟or UP⮝ keys until the desired time period has been reached. The setting is from 1 to 60 seconds. Pressing the **OK** key confirms the selection. The numeric value is shown in the lower menu when the Demo Cycling period setting is selected.

Figure 13-13 illustrates the Custom screen menu structure. The user can browse customise 3 screens to show important information. The desired measurement is selected using the DOWN˅or UP˄ keys and then pressing the **OK** key to confirm. The RIGHT˃ or LEFT˂ keys are used to move the cursor to the next measurement. Pressing the **OK** key confirms the selection and returns to the LCD Menu

LCD

U1 **U2** **U3**

OK Select

Figure 13-13

Menu name

LCD display

Back to LCD menu

12.5 Security Navigation

Figure 13-14 illustrates the Security menu structure. The user can browse through the 5 available settings using the direction keys, by pressing the DOWN˅or UP˄ keys and then pressing the **OK** key to make a selection. The ˂LEFT key is pressed to return to the Settings Menu

Security

Password level 1

Password level 2

Password lock time

Lock instrument

Unlock instrument

Not Set

Figure 13-14

Menu name

Security display

Back to Settings menu

Figure 13-15 illustrates the Password level 2 setting. The user can change the password, which is 4 characters long, by pressing the DOWN˅or UP˄ keys and then pressing the **OK** key to make a selection. The ˂LEFT key is pressed to return to the Security Menu. Password level 1 has the same structure.

Password level 2

A * * *

OK Select

Figure 13-15

Menu name

Security display

Back to Security menu

There are 3 levels of security:

L0 – no password required so the user can view and change any of the M2x3 settings.

L1 – level 1 password: the user can only change the following settings: Date format, Date and Time setting, Automatic summer/winter time on/off setting, reset all the maximum demand measurements, synchronise maximum demand on/off setting, and alarm relays on/off setting.

L2 – level 2 password: the user cannot change any of the settings without a password.

If the password is lost or forgotten, ask GE Grid Solutions technical support for the factory allocated password and provide the serial number of the **M2x3** instrument.

Password lock time: this is adjusted using the DOWN▼or UP▲ keys until the desired lock time setting has been reached. The setting is from 0 to 60 minutes. Pressing the **OK** key confirms the selection. The numeric value is shown in the lower menu when the Password Lock time setting is selected.

Lock instrument: by entering the password the security is activated. This is adjusted using the DOWN▼or UP▲ keys until each desired character is displayed, then RIGHT➤ or LEFT◀ keys for each position. Pressing the **OK** key confirms the selection. The Enabled Level ? will appear in the lower menu when the Lock instrument or unlock instrument setting is selected.

12.6 Inputs and Outputs

Figure 13-16 illustrates the Settings menu structure. To select the Input/Output options the user presses the DOWN▼or UP▲ keys and then pressing the **OK** key to select **Inputs and Outputs**. The ◀LEFT key is pressed to return to the Main Menu

Settings

General
Date & Time
Connections
Communication
LCD
Security
Energy
Inputs and Outputs

<- Main Menu

Figure 13-16

Input/Output display

Back to main menu

Figure 13-17 illustrates the I/O menu structure. To select the Input/Output options the user presses the DOWN▼or UP▲ keys and then pressing the **OK** key to select. The bottom menu indicates what type of I/O is fitted in each of the four modules. The ◀LEFT key is pressed to return to the Setting Menu

Inputs/Outputs

I/O 1
I/O 2
I/O 3
I/O 4

Relay alarm output

Figure 13-17

Input/Output display

Back to Setting menu

Figure 13-18a illustrates the I/O option structure. To select the Input/Output options the user presses the DOWN▼or UP▲ keys and then pressing the **OK** key to select. The bottom menu indicates what type of I/O is fitted. The ◄LEFT key is pressed to return to the I/O Menu .

I/O 1 **Energy Counter** **No of pulses** **Pulse length** **Tariff Selector** **Counter 1**	Figure 13-18a Input/Output option Back to I/O menu

The Energy counter is fully configured by setting the energy counter:

This maps which energy counter is used for each pulsed contact and whether the alarm is enabled. When the alarm function is enabled the options for alarm groups and an output signal appear on the menu structure. The alarm group menu is shown in Figure13-18b.

Alarm Groups **G1 G2 G3 G4** **OK to select**	Figure 13-18b Alarm groups Back to I/O option menu

This output signal has a number of options as shown in Figure 13-18c, press the DOWN▼or UP▲ keys to move between options and then pressing the **OK** key to select

Output Signal ● **Permanent** ○ **Pulsed 1 sec** ○ **Always ON** ○ **Always OFF** ○ **Normal Inverse** **OK select**	Figure 13-18c Output Signal Back to I/O option menu

The analogue output is configured using the QDSP setting software see section 14.

13. M2X3 SETTINGS USING QDSP SOFTWARE

13.1 Introduction

M2x3 settings can be remotely modified using the QDSP software, when connected to a PC, or with the use of the keypad on the **M2x3**.

All settings in the **M2x3** can be modified using the QDSP software, but only the basic settings can be programmed using the keypad and display. The settings that can be modified using the **M2x3** keypad are indicated by (KD) in the sections below.

13.2 QDSP Software

QDSP is a software tool for complete monitoring of measuring instruments, connected to a PC via serial, USB or TCP/IP communication. A user-friendly interface consists of five segments: devices management, instrument settings, real-time measurements, data analysis and software upgrading.

A separate QDSP manual is available that defines the operation of QDSP in detail.

13.2.1 Devices Management

The communications parameters for any connected device can be modified. Also included are browsers which scan the communications networks attached to the PC and identify all of the devices connected with their addresses and communications parameters. This can be done on RS232, RS485, USB and Ethernet connections.

13.2.2 Instrument settings

The instrument settings are organized in a tree structure and they can be modified simply as required. In addition to transferring settings to the instrument, QDSP can also store the data to settings files and read it back when required.

13.2.3 Real time measurements

All measurements can be displayed in real time in a table or graphically. Harmonics and their time-reconstruct signals are displayed graphically.

If further processing of the measurement data is required it can be copied via a clipboard and inserted into standard Windows formats.

13.2.4 Data Analysis

Analysis can be performed on the recorded data in the **M243** and **M253**. Recorded values can be displayed in a tabular or graphical form. The events that triggered alarms can be analysed or a report on supply voltage quality can be made. All data can be exported to an Access database, Excel worksheet or a text file.

13.2.5 Software upgrading

It is suggested that the latest version of QDSP should always be used and if the system is also connected to the internet if will define if an upgrade is available for download.

13.3 Setting Procedure

In order to modify the settings with QDSP the current parameters must be loaded first. Instrument settings can be acquired via a communications link or they can be loaded off-line from a file on a local disk. The QDSP contains sample settings files for each product variant that can be downloaded to show the range of settings available for the specific product. These files can be modified and then stored under a different name allowing an instrument configuration to be generated off-line without an instrument attached, and downloaded at a later date.

Settings are displayed in the QDSP setting window, the left part displays a hierarchical tree structure of settings, the right hand part displays parameter values of the chosen setting group, see Figure 14-1.

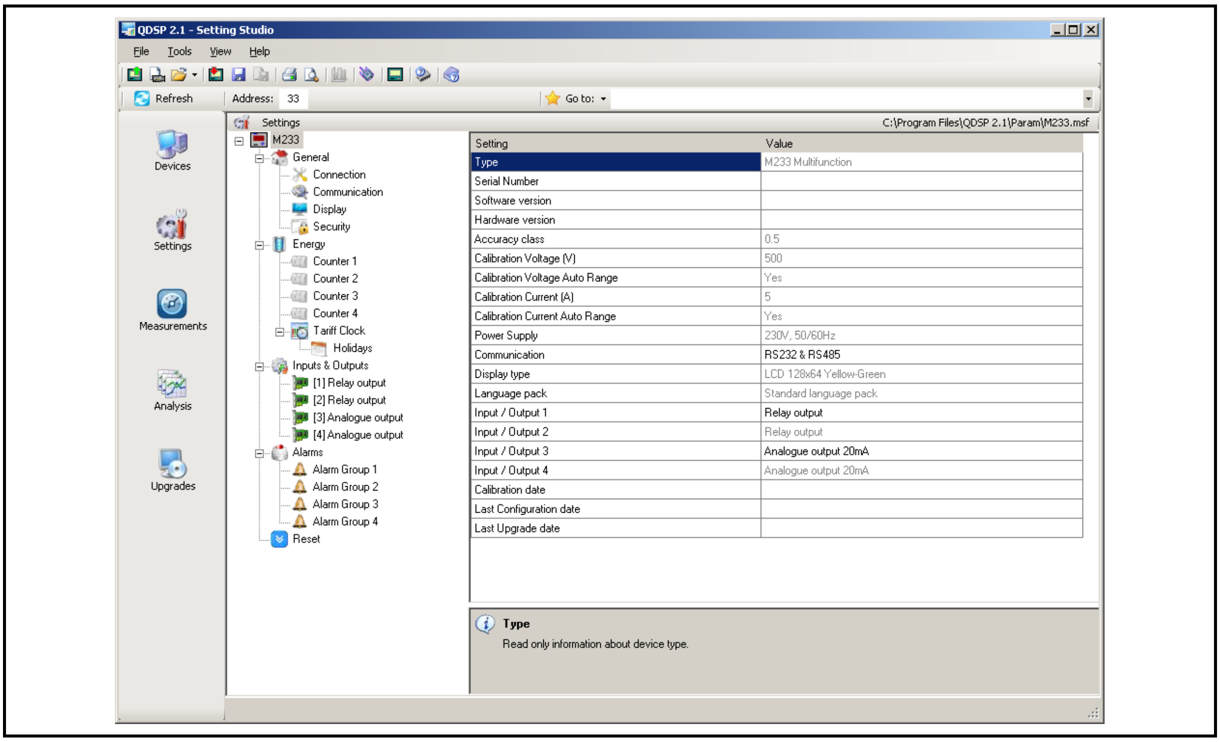


FIGURE 14-1: QDSP INTERFACE

13.4 General Settings

General Settings are essential for the operation of the **M2x3**. They are divided into three additional sublevels (Connection, Communication, and Security).

13.4.1 Description and Location

These are two parameters that are extended for easier recognition of a particular instrument. They allow for the identification or location to be defined where measurements are performed.

13.4.2 Average Interval

The averaging interval defines the refresh rate of measurements for communications and **M2x3** display.

13.4.3 Currency (KD)

Define currency for evaluating energy costs. A currency designation consists of up to 4 letters taken from the English or Russian alphabet and numbers and symbols stated in the table below.

English	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z
Symbols		!	"	#	$	%	&	'	(	)	*	+	,	-	.	/	0 to 9			:	;	<	=	>	?	@
Russian	А	Б	В	Г	Д	Е	Ж	З	И	Й	К	Л	М	Н	О	П	Р	С	Т	У	Ф	Х	Ц	Ч	Ш	Щ
	а	б	в	г	д	е	ж	з	и	й	к	л	м	н	о	п	р	с	т	у	ф	х	ц	ч	ш	щ

13.4.4 Temperature unit (KD)

Choose temperature units for display °C or °F.

13.4.5 Date Format (KD)

Set a date format

13.4.6 Date and Time (KD)

Set the date and time of the meter, Setting is important for correct data storage operation, maximum values (MD), etc.

13.4.7 Auto Summer/Winter time (KD)

If selected, the time will automatically shift to Winter or Summer time when required.

13.4.8 Maximum Demand calculation (MD mode) (KD)

The **M2x3** provides maximum demand values from a number of different demand values.

- Thermal Function
- Fixed Window
- Sliding Windows (up to 15)

See section 9.4 for details.

13.4.9 Resetting Min/Max (KD)

Defines how and when the stored Min/Max values will be reset.

The reset can either be Manual or in Automatic mode (daily, weekly, monthly or yearly reset)

In Automatic mode the resets are performed at the beginning of the defined period at midnight.

- Daily – every day at 00:00
- Weekly – every Monday at 00:00
- Monthly – the first day of the month at 00:00
- Yearly – the first day of the year (1st January) at 00:00

13.4.10 Starting Current for PF and PA (mA)

At all measuring inputs noise is usually present. It usually has consistent amplitude and its influence on the accuracy of the measurement increases as the amplitude of the signal to be measured decreases. It is also present when measuring signals are not connected and can give false readings for all subsequent calculations.

By setting a starting current for Total Power Factor and Power Angle, a minimum level is defined where the measurements and calculations commence, reducing the effect of any input noise.

13.4.11 Starting current for all powers (mA)

By setting a Minimum Starting Current, a level is defined where the measurements of Current and calculation of all powers commence, reducing the effect of any input noise.

13.4.12 Calculation of Harmonics

The selection of the reference for the calculation of harmonics is important for the calculation of the absolute values. It is possible to select harmonics

- As a percentage of the RMS signal value where a value is calculated for all harmonics
- Or relative to the fundamental (first harmonic) where all other harmonics are calculated relative to the 1st harmonic.

13.4.13 Reactive power calculation

Two different principles of reactive power and energy calculation are used:

Standard method:

With this method a reactive power and energy are calculated based on assumption that all power (energy) that is not active is reactive.

$Q^2 = S^2 - P^2$

This means also that all higher harmonics will be measured as reactive power (energy).

Delayed current method:

With this method, reactive power (energy) is calculated by multiplication of voltage samples and delayed current samples.

$Q = U \times I|_{+90°}$

With this method, reactive power (energy) represents only true reactive component of apparent power (energy).

13.5 Connection

The setting of the connection parameters must reflect the actual applications or the measurements will not be valid.

All of the settings in this section should be defined before the settings for the analogue and alarm outputs, as changes to this section may automatically change the measurements and output settings.

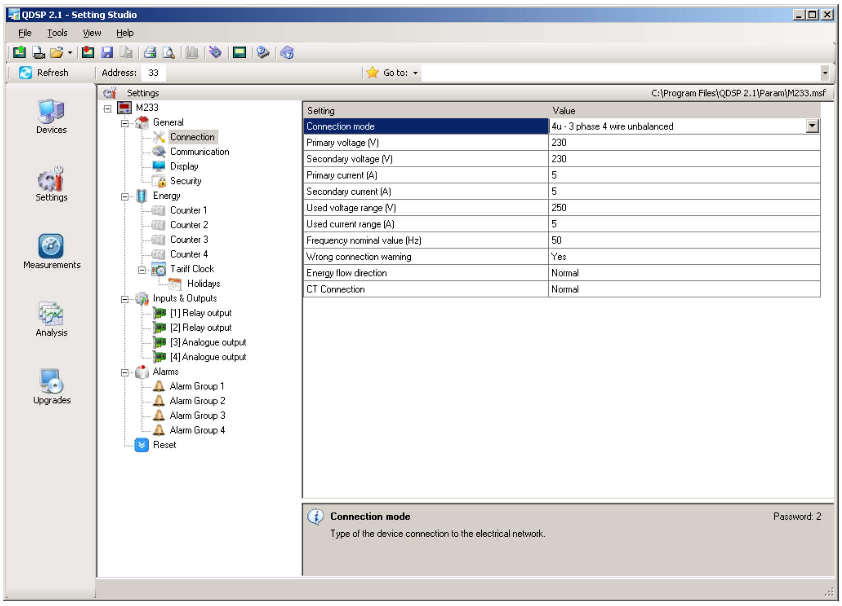


FIGURE 14-2: CONNECTION

13.5.1 Connection (KD)

When the connection is selected, the load connection and the supported measurements are defined (see section 8).

When the Connection is modified all other settings must be reviewed to ensure that they are still valid for the new Connection selected.

13.5.2 Setting of current and voltage ratios (KD)

The details of the application must be known to define these settings; all other measurements depend on them. Values with up to 5 numerical digits and a maximum of 3 decimal places can be input.

Settings range	VT primary	VT secondary	CT primary	CT secondary
Maximum value	1638,3 kV	13383 V	1638,3 kA	13383 A
Minimum value	0,1 V	1 mV	0,1 A	1 mA

13.5.3 Used Voltage and Current Range

The setting of this range is connected with the setting of all alarms, analogue outputs and the display (calculation) of energy and measurement recording. Using a value that matches the expected measurement range (with overload) will achieve the highest quality of measurements.

If the ‘Used’ ranges are changed after the analogue or alarm settings have been defined, then the analogue and alarm settings will be modified automatically, as defined below. It may be necessary to modify the settings for the analogue and alarm outputs.

The ‘Used’ ranges are used to set the default scaling for the analogue output, which can be subsequently changed to meet the application requirements. Internally the analogue settings are also stored as a percentage of the ‘Used’ ranges. If the ‘Used’ ranges are subsequently changed the analogue output settings will be correspondingly changed to maintain the settings as the same percentage of the ‘Used’ range.

Although the alarm settings are defined in real values on QDSP, the alarms are also calculated as a percentage of the ‘Used’ range. If the ‘Used’ ranges are subsequently changed the alarm settings will be correspondingly changed to maintain the settings as the same percentage of the ‘Used’ range.

13.5.4 Nominal Frequency

A valid frequency measurement is within ± 32Hz of the nominal frequency. This setting is only used for alarms and recorders.

13.6 Communication

The settings displayed depend on the hardware options on the specific instrument connected or the settings in the specific settings file that is being worked on off-line.

13.6.1 Serial Communication parameters (COM1) (KD)

These parameters are important for the correct operation in RS485 networks or connections with PC via RS232 communications. Factory settings for communication are #33\19200 (or 115200),n,8,2 (address 1 to 247\data rate 2400 to 115200 b/s, parity, data bits, stop bit).

13.6.2 Ethernet Communication

13.6.2.1 Device Address (KD)

The device address should be maintained at the default value of 33.

13.6.2.2 IP address (KD)

The communication interface should have a unique IP address in the Ethernet network. Two modes for assigning IP are described

- Fixed IP address: In most installations a fixed IP address is required. A system provider usually defines IP addresses. An IP address should be within a valid IP range, unique for your network and in the same sub-network as your PC.
- DHCP: An automatic method of assigning IP addresses (DHCP) is used in most networks. If you are not sure if DHCP is used on your network, check it with your system provider.

13.6.2.3 Local Port (KD)

Use a non-reserved port number from 1025 to 65535. Do not set the Local Port to any of the reserved port numbers.

If using Redirector software, the port number should be between 14000 and 14009.

Port numbers	Function
1 – 1024, 9999, 30718, 33333	Reserved numbers
14000 – 14009	Reserved for Redirector

Factory settings for Ethernet Communications are:

IP Address	DHCP (automatically)
TCP Port	10001
Subnet Mask	255.255.255.0

13.6.3 USB

The **M2x3** will be identified as a USB device when connected to a USB port on the PC, refer to the separate **QDSP** manual for details of the driver installation.

13.7 Security

Parameter settings are divided into 2 groups for regarding security level:

1. If the passwords are set to 'AAAA' (default) there is no restriction to the access of parameter settings.
2. At the first level (PL1), the settings for the real time clock and the reset of the energy registers and MD can be accessed.
3. At the second level (PL2), access is given to all parameter settings.
4. Change to the language setting is possible without inputting a password. When language is changed to or from Russian, character transformation has to be taken in to account, see section 14.4.3.
5. A Backup password (BP) is used if the passwords at level 1 (PL1) and level2 (PL2) have been forgotten, and it is different for each device depending on the serial number of the instrument. The BP password is available from GE Grid Solutions technical support, and is entered instead of password PL1 and/or PL2. The serial number is stated on the product label or can be read with QDSP and must be supplied when requesting the BP.

13.7.1 Password setting (KD)

A password consists of four capital letters taken from the British alphabet from A to Z. When setting a password, only the letter being set is visible, while the others are covered with an asterisk.

Two passwords (PL1, PL2) and the time after which they become active, can be set.

13.7.2 Password modification (KD)

A password can be modified; however only the password whose access has been unlocked (password entered) can be modified.

To disable a password previously set, modify the password back to 'AAAA'.

13.8 Energy

The parameters defining the energy measurement and totalising can be modified. After modifications have been done the energy meters must be reset or all subsequent energy measurements will be incorrect.

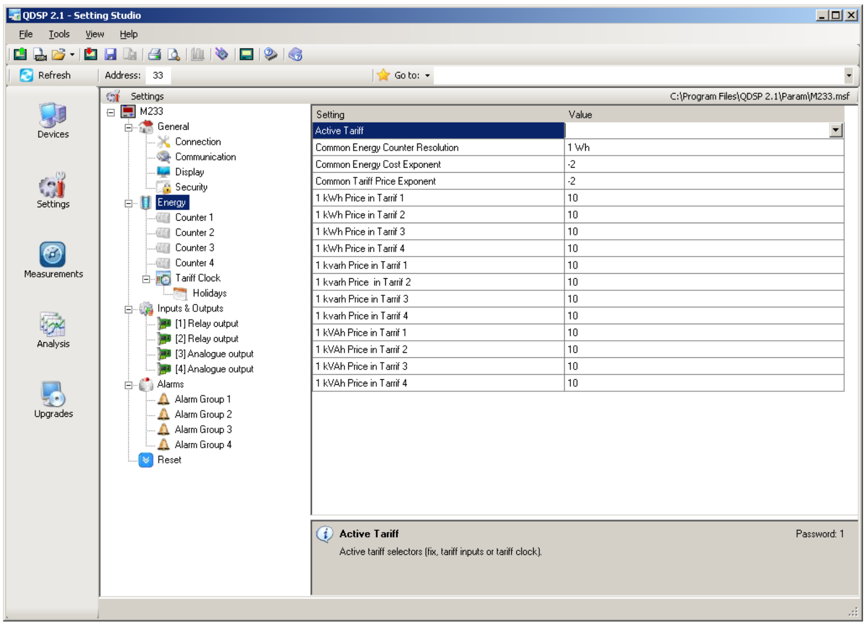


FIGURE 14-3: ENERGY

13.8.1 Active Tariff (KD)

When active tariff is set, one of the tariffs is defined as active, switching between tariffs is done with a tariff clock or a tariff input. For the operation of the tariff clock other parameters of the tariff clock that are accessible only via the communications must be set correctly.

13.8.2 Common Energy Exponent

The Common energy exponent defines the minimum energy value that can be displayed on the energy counter. On the basis of this and a counter divider, a basic calculation factor for energy is defined (-3 is 10^{-3}Wh=mWh, 4 is 10^{4}Wh = 10 kWh). The Common energy exponent also affects the setting of pulse outputs and alarm outputs when the instrument is being used as an energy meter.

The Table below defines recommended values for the Common Energy exponent, where the counter divider is at its default value of 10.

Current / Voltage	1 A	5 A	50 A	100 A	1000 A
110 V	−1	0	1	1	2
230 V	0	0	1	2	3
1000 V	0	1	2	3	4
30 kV	2	2	3	4	4*

* - Counter divider should be at least 100

13.8.3 Common exponent of energy cost

Defines the number of decimal places used for the energy cost calculation and storage. The cost exponent is used for recording the cost without decimal places.

13.8.4 Common exponent of tariff price and energy price in tariffs

The exponent and price represent the energy price (active, reactive, common) in a tariff. The price exponent is used for recording the price without decimal places.

13.8.5 Measured Energy

Each counter is enabled or disabled and can be configured to read any energy value from a drop down selection. The Energy counters can operate in all four quadrants; this is chosen using a graphical interface as shown in Figure 14-4.

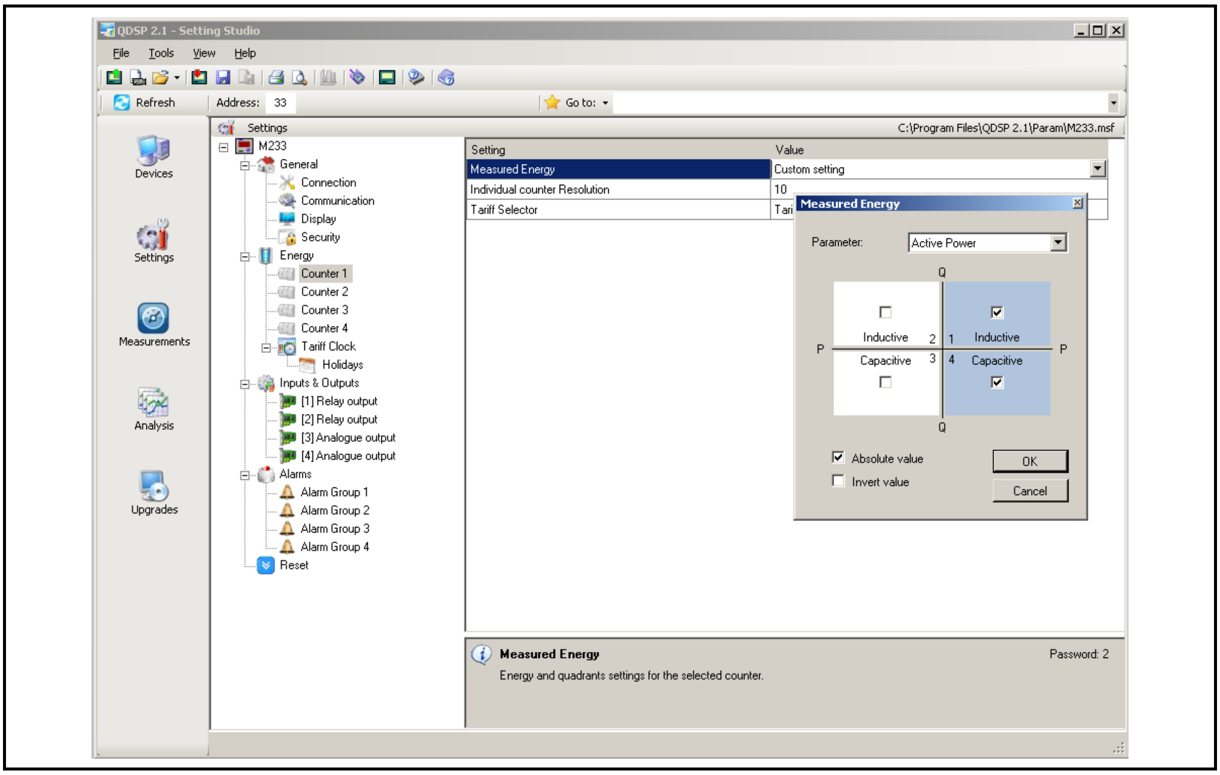


FIGURE 14-4: MEASURED ENERGY

13.8.6 Counter Divider

The counter divider defines the precision of a specific counter, according to settings of the Common energy exponent.

An example for 12.345kW of consumed active energy in the first tariff (price 0.1567 €/kWh):

Common energy exponent	0	2	2
Counter divider	1	1	100
Common energy cost exponent	−2	−3	0
Common tariff price exponent	−4	−4	−4
Price for energy in tariff 1	1567	1567	1567
Unit	EUR	EUR	EUR
Example of result, display	12.345 kWh 1.93 EUR	12.3 kWh 1.934 EUR	0.01 MWh 1 EUR

13.8.7 Tariff selector

The tariffs selected to be applicable to the specified counter can be defined.

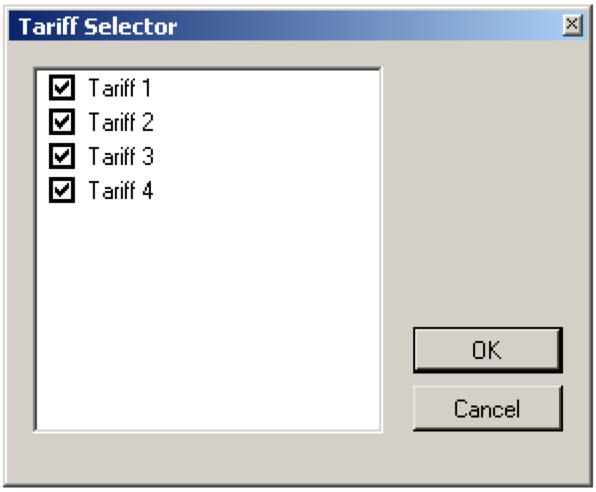


FIGURE 14-5: TARIFF SELECTION

13.8.8 Tariff Clock

Basic Characteristics of the program tariff clock:

- 4 tariffs (T1 to T4)
- Up to 4 specific times in each day for tariff switching
- A combination of valid days in a week or holidays for each program
- Combining of day groups (use of more than 4 specific times for certain days in a week)
- Separate settings for 4 seasons a year
- Up to 20 settable dates for holidays

Figure 14-6 shows the QDSP Tariff menu. This enables a full tariff structure with 4 seasons and 4 day groups that are configurable. Within each day or season times can also be specified to show rates within the period. The Holiday sub menu is used to specify tariff holidays.

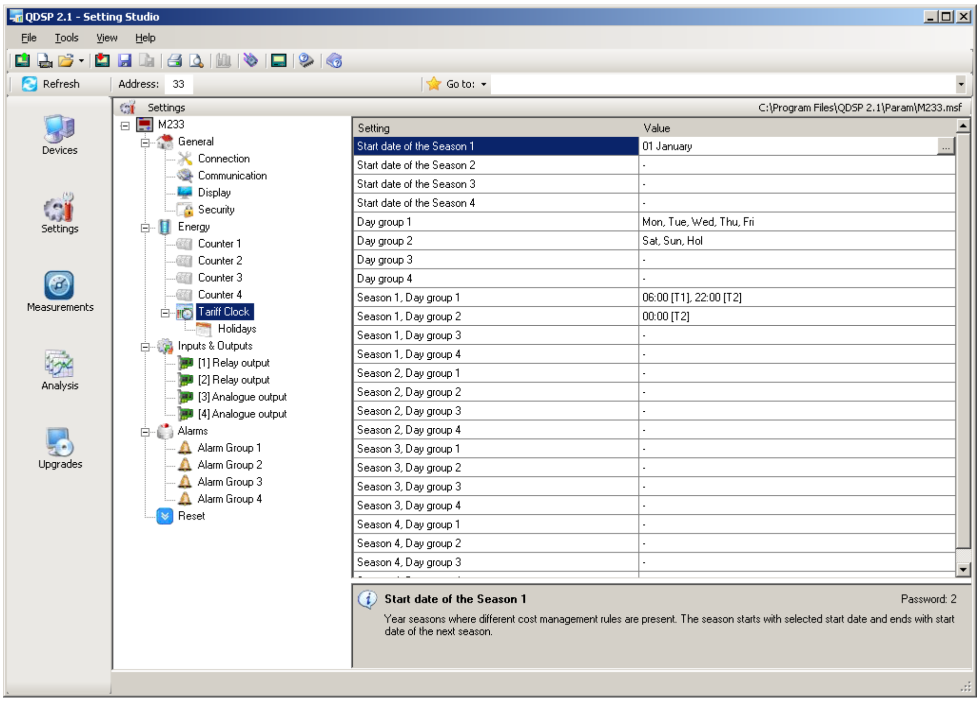


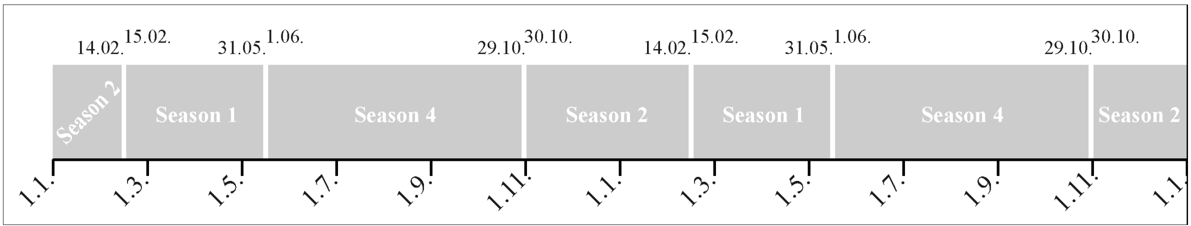
FIGURE 14-6: TARIFF STRUCTURE

The order of seasons and starting dates is not important, except when 2 dates are the same. In that case the season with the highest number will have priority, while the season with a lower number will never be active.

If the actual date is before the first starting date defined for any period, the period with the last starting date becomes active.

Example of settings

Season	Season start day
Season 1:	15.02
Season 2:	30.10
Season 3:	–
Season 4:	01.06
Date	**Active season**
01.01. – 14.02.	2 (last in the year)
15.02. – 31.05.	1
01.06. – 29.10.	4
30.10. – 31.12.	2



Several daily groups can be active simultaneously, which enables more than 4 time slots in one day (Combination of day programs)

13.9 Inputs and Outputs

The module settings displayed will depend on the I/O modules built in to the instrument or defined in the settings file if working off-line.

13.9.1 Analogue output module

Each of up to four analogue outputs is fully programmable.

13.9.1.1 Output parameter

Define the Measured or calculated parameter that is to be output on the specific analogue output.

13.9.1.2 Output range

The analogue output can be configured to one of six hardware output ranges within which the analogue output will operate. To ensure the highest accuracy for the output, the range selected should be the lowest that covers the required analogue output range.

DC current output	DC voltage output
-1…0…1 mA	-1…0…1 V
-5…0…5 mA	
-10...0...10 mA	-10…0…10 V
-20...0...20 mA	

13.9.1.3 Output Signal

This defines the actual range and output curve shape of the required analogue signal. Up to 5 break points can be programmed to achieve the required curve.

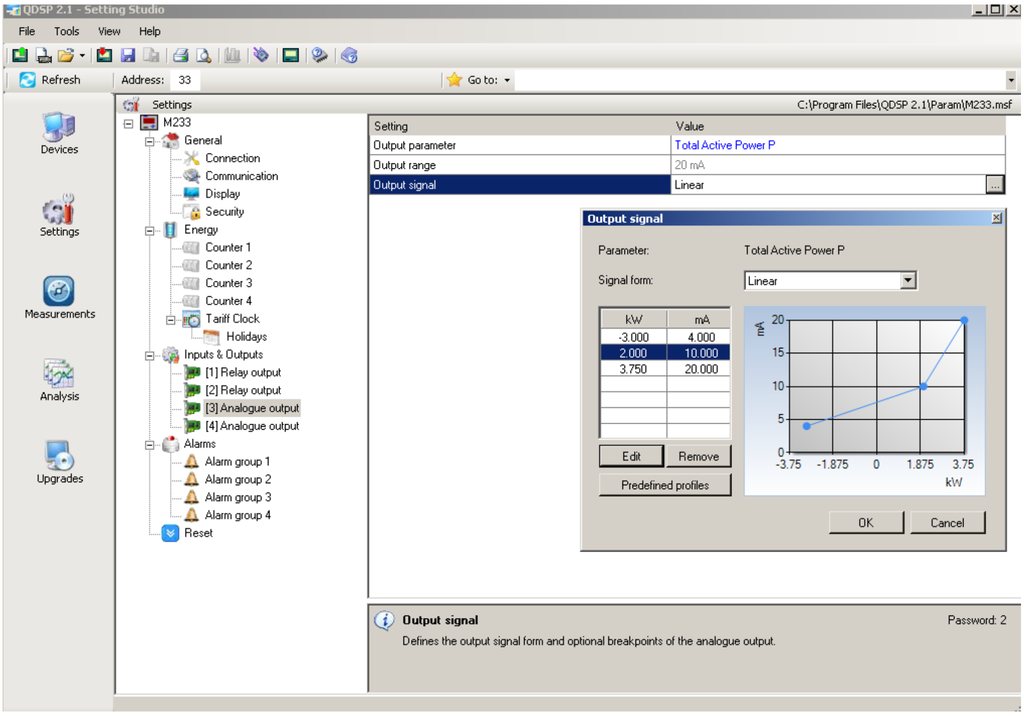


FIGURE 14-7: ANALOGUE OUTPUT SETTINGS

If the Analogue output signal is modified from the full linear range, the accuracy of the output may be reduced due to the reduction in the overall output range.

Note: If the 'Used' ranges are changed after the analogue settings have been defined, then the analogue settings will be modified automatically, see section 14.5.3. It may be necessary to subsequently modify the settings for the analogue outputs.

13.9.1.4 Average interval for analogue output

Defines the time interval over which the measurement used for an analogue output will be averaged.

13.9.2 Alarm/Digital Output Module (KD)

Alarm groups that are connected with an alarm module and a signal shape are defined

An alarm module can also function as a pulse output with limited pulse length (min 10ms) or a general purpose digital output. The settings for the pulse option are defined in the same way as for the pulse module. A parallel RC filter with a time constant of at least 150 μs (R*C ≥ 250 μs) should be fitted when connected to a sensitive pulse counter, to attenuate the relay transient signals.

13.9.2.1 Output signal

The alarm/digital output can be configured for a number of different signal shapes:

- Normal – The relay is closed until the alarm condition is fulfilled.
- Normal Inverse – The relay is open until the alarm condition is fulfilled.
- Holds – The relay is closed when the alarm condition is fulfilled, and remains closed until it is reset via communication.
- Pulse – an impulse of the defined length is sent when the alarm condition is fulfilled.
- Always switched ON / OFF – The relay is switched ON or OFF irrespective of the alarm condition. This enables remote control via communication to be implemented.

13.9.3 Pulse Output Module (KD)

The pulse output module is either defined to an Energy counter or it can be used as an alarm output with limited current load (max 20mA).

When used as a pulse output the number of pulses per energy unit, pulse length and the tariffs in which the output is active are set.

Pulse parameters are defined in EN 62053 – 31, and the following is a simplified rule that satisfies the specification, where 'e' is multiplier.

$$1{,}5 \ldots 15 \text{ eW} \rightarrow 100 \text{ p}/1 \text{ eWh}$$

Examples

Expected power	→	Pulse output settings
150 − 1500 kW	→	1 p/1kWh
1,5 − 15 MW	→	100 p/1MWh
15 − 150 MW	→	10 p/1MWh
150 − 1500 MW	→	1 p/1MWh

13.9.4 Tariff input module

There are no settings for the tariff input; they operate by setting the active tariff. With two tariff inputs available a maximum of 4 tariffs can be selected.

13.9.5 Digital Input module

There are no settings for the digital input; they operate by acting as an input to the Alarms 1 to 32. The input therefore can be used to trigger a software alarm and is available via the communications and can be stored in the alarm data recorder.

13.9.6 Watchdog Output module (KD)

The purpose is to detect potential malfunction of the transducer or auxiliary power supply failure. This module can be set for normal operation (relay in close position) or for test purposes to open position (manual activation). After test the module should be set back to normal operation.

13.9.7 Analogue Input module

Three analogue input options are available for acquisition of low voltage DC signals from external sensors. According to the application requirements it is possible to choose current, voltage or resistance (temperature) analogue input options. They all use the same input terminals.

QDSP allows setting of an appropriate calculation factor, exponent and required unit for representation of primary measured value (temperature, pressure, flux…etc.)

<u>DC current range:</u>

Range setting allows bipolar ±20 mA or ±2 mA max. input value

<u>DC voltage range:</u>

Range setting allows bipolar ±10 V or ±1 V max. input value

<u>Resistance / temperature range:</u>

Range setting allows 2000Ω or 200 Ω maximum input value.

It is also possible to choose temperature sensor (PT100 or PT1000) with direct translation into temperature (-200°C to +850°C). Since only two-wire connection is possible it is recommended that the wire resistance is also set, when long leads are used.

The measured input can be used to set alarms or generate an analogue output with different scaling. The value is available via communications and can be stored in the data recorder.

13.9.8 Pulse Input module

There are no settings for the Pulse Input module. It acts as a General purpose pulse counter from external meters (water, gas, heat …). Its value can be assigned to any of the four energy counters.

13.9.9 2nd Communications module (COM2) (KD)

The module is fitted as RS485 or RS232 communications and is fitted as Module 2.

The module settings define parameters that are important for the operation. Factory settings for the communication parameters are #33\19200 (or 115200),n,8,1 (address 1 to 247\rate 2400 to 115200, parity, data bits, stop bit).

The COM2 communications port has a device address that is set independently of that used by COM1. This allows two independent communications networks to be connected to the same transducer.

13.10 Alarms

There are 32 alarms available split into 4 alarm groups. On the **M243** and **M253** changes in the status of any alarm can be stored into the Alarm recorder.

13.10.1 Alarm setting

For each of the 4 alarm groups a time constant of maximum values in thermal mode, a delay on time and alarm deactivation hysteresis can be defined.

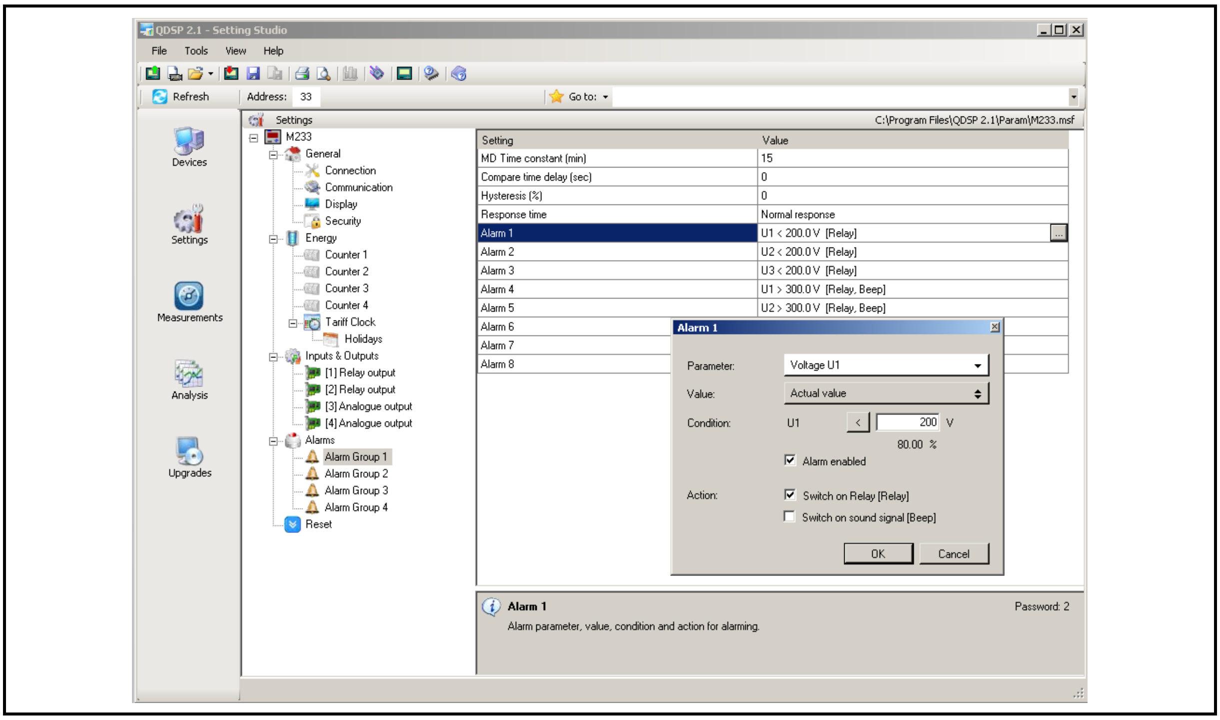


FIGURE 14-8: QDSP ALARM SETTINGS

For each individual alarm a parameter, value (actual value or MD- thermal) and the condition for alarm switching are defined. In addition it is defined if a relay is to be switched and, a beep on alarm.

Note: If the ‘Used’ ranges are changed after the alarm settings have been defined, then the alarm settings will be modified automatically, see section 14.5.3. It may be necessary to subsequently modify the settings for the alarm outputs.

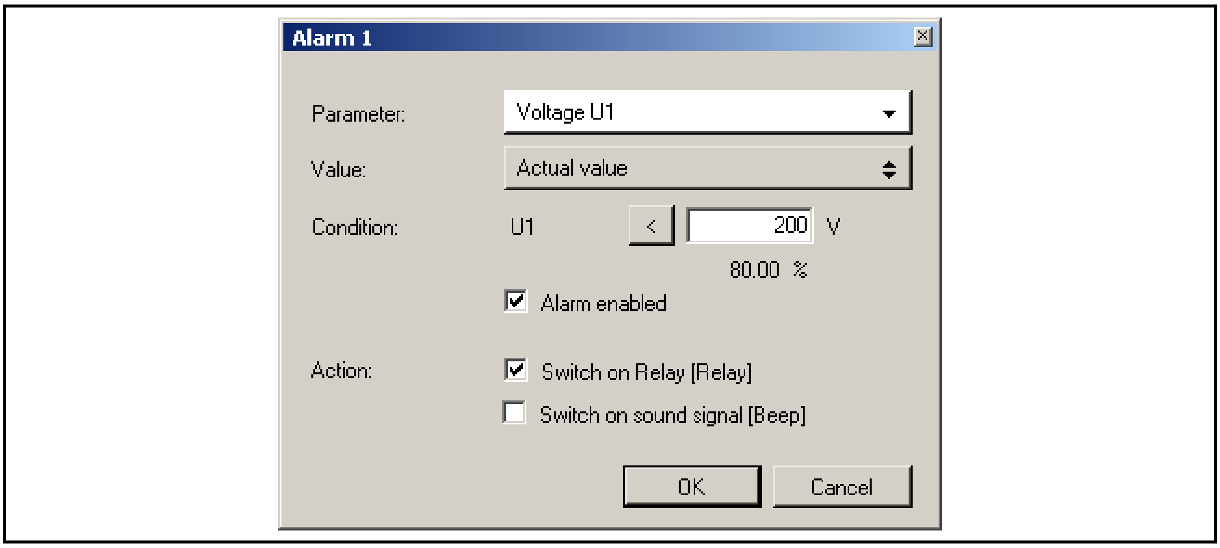


FIGURE 14-9: ALARM SETTINGS

If a digital input module is fitted to the unit, then the status of the input can be defined as the parameter.

13.10.2 Types of Alarm

13.10.2.1 Visual Alarm

When an alarm is switched on, a red LED on the front of the device will blink.

13.10.2.2 Audible alarm

When an alarm is switched on, an audible alarm is given by the device (a beep). It can be switched off by pressing any key on the front plate.

13.10.2.3 Alarm Output (pulse)

According to the alarm signal shape the output relay will behave as shown below.

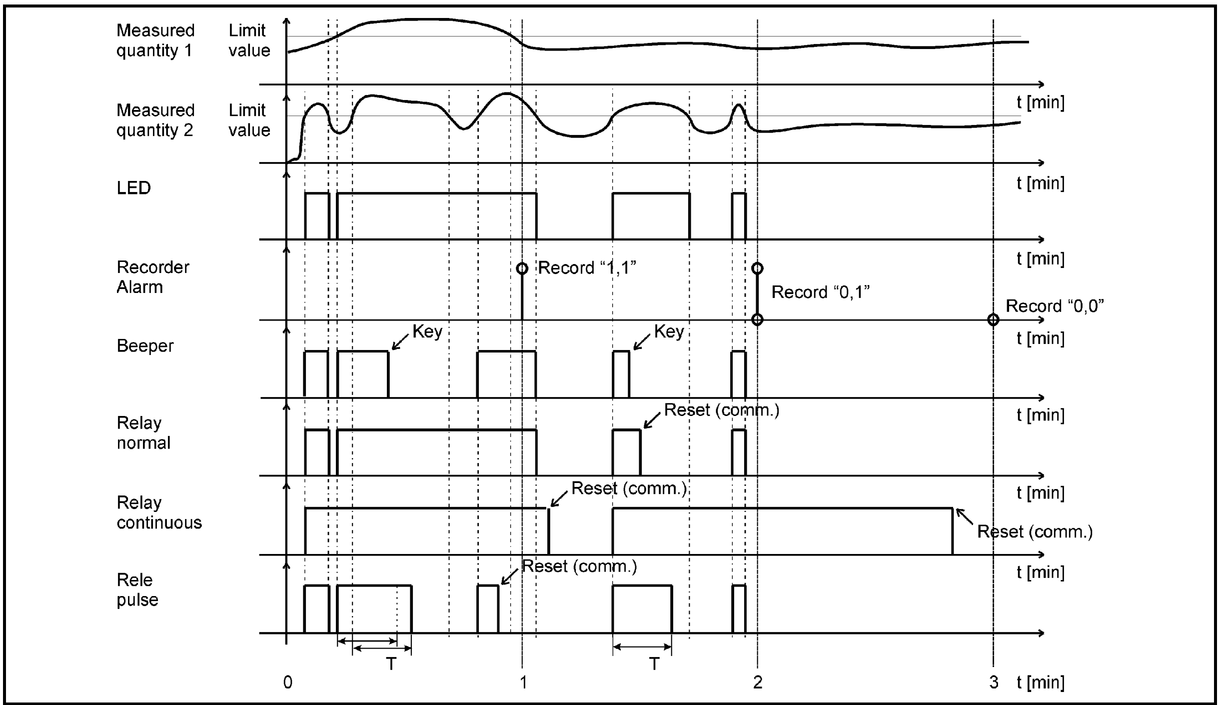


FIGURE 14-10: ALARM OUTPUTS

13.11 Memory

Measurements, alarms, reports and details of supply voltage quality can be stored in the 8MB of internal memory on the **M243** and **M253**. All records stored in the memory are accessible using QDSP.

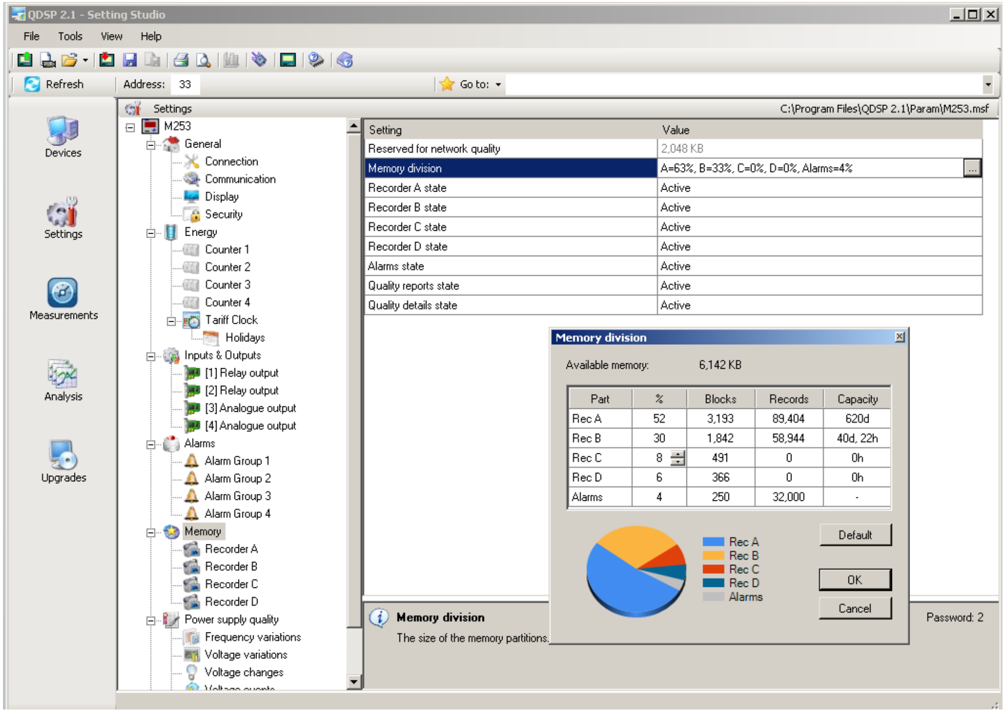


FIGURE 14-11: MEMORY SETTINGS

13.11.1 Memory division

The internal memory is divided into up to 5 partitions, recorders A - D and Alarms, whose size can be defined by the customer, see Figure 14-11. Recorders A – D are intended for recording measurements, while alarms are recorded in a separate partition. The **M253** has 2 additional partitions for recording reports and details on the quality of supply voltage.

13.11.2 Memory clearing

There is usually no need to clear the memory as it works in cyclic mode in FIFO method with the oldest records being overwritten when new records are stored. If you need to clear memory then follow these steps:

- Read the instrument readings with QDSP and set “Recorder state” in Memory to ‘stopped’.
- Download the changes to the device and open Memory info form and then click on Clear memory button.
- Select memory partitions to be cleared on Memory form and click OK.
- Set “Recorder state” setting back to ‘Active’.

13.12 Data Recorders

The **M243** and **M253** have up to four data recorders, which can only be configured using the QDSP software. These recorders are independent from each other and each can be configured to record up to 16 different values. The Maximum Demand Integration time can be set between 1 and 255 minutes and the Recorder sample time can be set between 1 and 255 minutes.

Figure 14-12 shows the QDSP Data Recorder menu. This shows the 16 different record values for each of the recorders, each of which is configurable to any ac measurement or analogue /digital input to the **M2x3**.

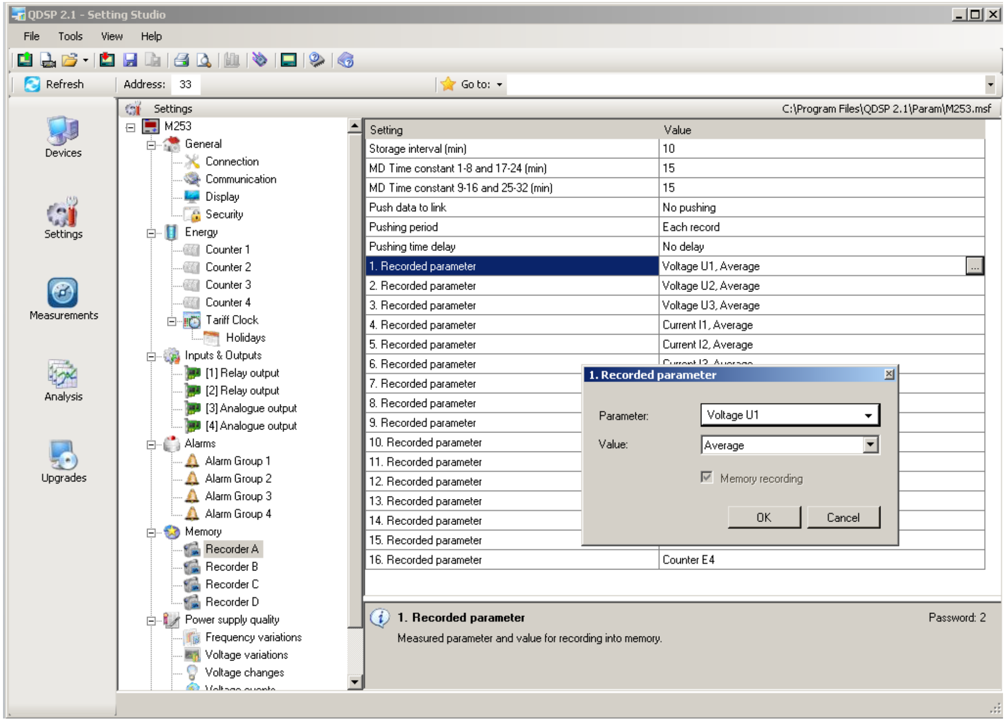


FIGURE 14-12: DATA RECORDER

13.12.1 Storage interval

The storage interval sets a time interval for readings to be recorded. This can be different for each recorder partition.

13.12.2 MD Time constant

When maximum demand values are to be recorded, this setting sets a period for calculation of maximum and minimum value in thermal mode (Minimum (MD) or Maximum (MD)). Different parameters can be set for Recorded parameters 1-8 and 9-16.

13.12.3 Recorded quantities

For each measurement to be recorded it is possible to set the required quantity and its type.

Parameter
The required monitoring quantity can be selected from a list of supported measurements. Besides the primary electrical quantities, auxiliary quantities from the input modules can also be selected.

Value
The type of the selected quantity to be recorded can be defined.

- **Minimum and Maximum** value represents minimum or maximum of the recorded averaged values within the selected storage interval. Note that the minimum and maximum values are not single period values but an average (0.1 s to 5 s).

- **Minimum (MD) and Maximum (MD)** value represents the calculation of a MD value with applied thermal function.
- **Average** value represents the calculated average value within the selected storage interval
- **Actual** value represents the first momentary value within the selected storage interval. Note that momentary values are not a single period value but an average (0.1 s to 5 s). (recommended for Pst and Plt measurements)
- **Minimum and Maximum (Period)** values represent the minimum or maximum values within the selected storage interval calculated in a single period. This function allows recording of very fast changes.

13.13 Power Quality Recorder Report

The **M253** has a power quality measurement function that monitors compliance to the European standard EN50160. The power quality features can be set on the **M253** and this then determines what data is communicated.

The EN 50160 standard deals with voltage characteristics of electricity supplied by public distribution systems. This specifies the limits or values within which a customer can expect voltage characteristics to lie. Within this definition the **M253** Network Analyser supervises the compliance of distribution systems with the EN 50160 standard.

Based on the requirements stated in the standard, default parameters are set in the meter according to which supervision of all required parameters is done. Parameters can also be changed in detailed setting of individual characteristics.

The **M253** has 2MB of non-volatile memory reserved for storing power quality data with a capacity for storing 170,000 variations from standard.

The EN50160 standard monitors the following electrical characteristics:

- Frequency and voltage variations
- Voltage unbalances, interruptions and dips
- Long and Transient (fast) interruptions
- Flicker, short and long term
- Individual Harmonics and %THD

All the Power Quality settings, extraction and tabulation of findings require the **QDSP** software.

The following definitions are used in Power Quality applications:

Un = nominal supply voltage for the electrical system

Uc = agreed supply voltage for the electrical system, this may be the same as Un.

13.13.1 Power Supply Quality

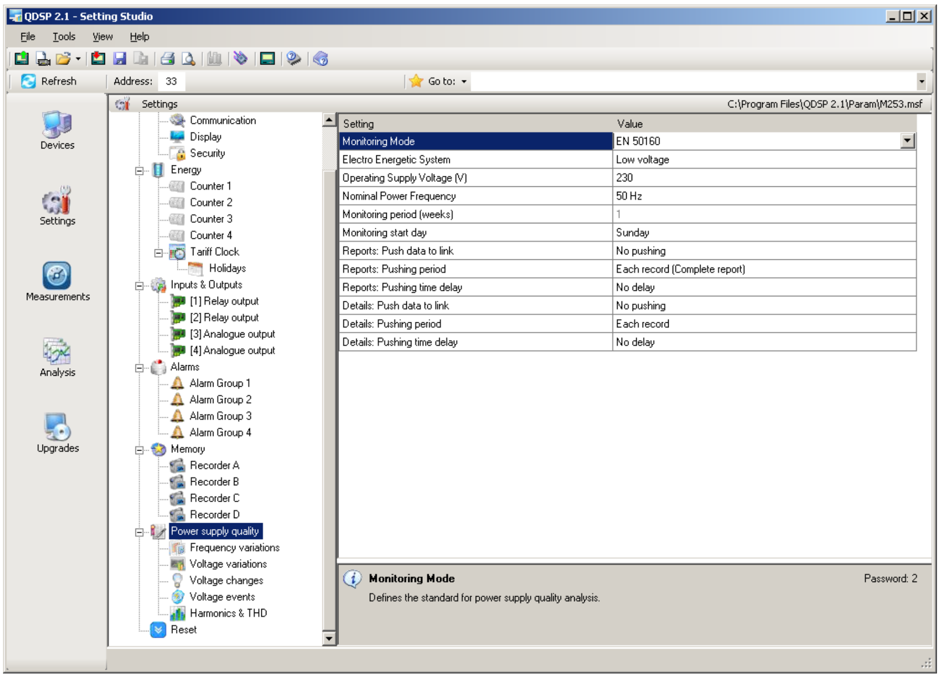


FIGURE 14-13: POWER SUPPLY QUALITY

Basic parameters are defined that influence other settings

13.13.1.1 Monitoring mode

This defines that the instrument performs measurements for network compliance with the standard.

13.13.1.2 Electric energetic system

Public distribution system and if necessary all default settings are selected.

13.13.1.3 Nominal supply voltage

A value that is usually equal to nominal network voltage is entered.

13.13.1.4 Nominal power frequency

Nominal frequency of supply voltage is selected.

13.13.1.5 Monitoring period

For a report of electric voltage quality a monitoring period is defined. A number of monitored weeks are entered.

13.13.1.6 Monitoring start day

A starting day in the week is selected. It starts at 00:00 (midnight). The selected day will be the first day in a report.

13.13.1.7 Voltage Hysteresis

Hysteresis for voltage dips, interruptions and overvoltages is set in percentage from nominal voltage.

13.13.2 Frequency Variations

All frequency measurements are performed in 10-second averaging intervals. There are two variation classes and for each a variation is defined as a percentage of nominal and also the percentage of measurements which have to be within the variation limits (required quality).

13.13.3 Voltage Variations

All Voltage measurements are performed in 10-second averaging intervals. There are two variation classes and for each a variation is defined as a percentage of nominal and also the percentage of measurements which have to be within the variation limits (required quality).

13.13.4 Dips and Interruptions

Limits for voltage dips and interruptions are defined as a percentage of the nominal voltage. A threshold between short-term and long-term interruptions is defined in seconds. And also the allowable number of dips and interruptions are defined by other parameters.

13.13.5 Rapid Voltage Changes

The limits and the number of allowable changes are defined.

13.13.6 Temporary overvoltages, flickers.

There are two types of flicker: short-term flicker intensity (P_{st}) and long-term flicker intensity (P_{lt}) for each a monitoring period, performance limit and required signal quality are defined.

13.13.7 Harmonics and THD

The permitted limits for the first 25 harmonic components and the THD are defined with the required quality in the monitoring period.

13.13.8 Resetting quality parameter reports

Some quality parameter reports are made on a weekly basis and other on yearly basis. The parameter reports are reset at the end of each observed period. Weekly based reports will be reset every week. Even if the instruments' location or mode of operation is altered, the weekly report will reset at the end of the week. But yearly reports will not be reset until the end of the year. Therefore when required the yearly reports must be reset manually.

In order to reset reports choose setting <Power supply quality>< Monitoring mode> and change the value to "No monitoring". Download settings to instrument. Then choose the same setting and change the value back to "EN50160". Again download the settings to the instrument. Then all yearly reports (anomaly counters) will have been reset

13.14 Reset Operations

13.14.1 Reset Min/Max values (KD)

All Min/Max values are reset.

13.14.2 Set energy counters (KD)

All or individual energy counters are reset.

13.14.3 Reset Energy counter costs (KD)

All or individual energy costs are reset.

13.14.4 Reset maximal MD values (KD)

13.14.4.1 Thermal mode

Current and stored MD's are reset.

13.14.4.2 Fixed Interval / Sliding Window

The values in the current time interval, in all sub-windows and stored MD are reset. At the same time, synchronization of the time interval to the beginning of the first sub-window is also performed.

13.14.5 Reset the last MD period (KD)

13.14.5.1 Thermal mode

Current MD value is reset.

13.14.5.2 Fixed interval / Sliding windows

Values in the current time interval and in all sub-windows for sliding windows are reset. In the same time, synchronization of the time interval is also performed.

13.14.6 MD synchronization (KD)

13.14.6.1 Thermal mode

In this mode, synchronization does not have any influence.

13.14.6.2 Fixed interval / Sliding Windows

Synchronisation sets time in a period or a sub-period for sliding windows to 0 (zero). If the interval is set to 2, 3, 4, 5, 6, 10, 12, 15, 20, 30 or 60 minutes, time set in a period is set to such a value that some intervals will be terminated at completed hour.

Example:

Time constant (interval)	15 min	10 min	7 min
Synchronization start time	10:42	10:42	10:42
Time in a period	12 min	2 min	0 min
First final interval	10:45	10:50	10:49

13.14.7 Reset alarm output (KD)

All alarm outputs are reset.

14. COMMUNICATIONS

14.1 Communications ports

The **M233**, **M243** and **M253** are fitted with a primary communications (COM1) port and an optional secondary port (COM2).

COM1 can be RS232/RS485, USB, Ethernet, or Ethernet and USB

COM2 can be RS232 or RS485

Both communications ports can be used for settings and the monitoring of data, they operate completely independently of each other.

The communication parameters of the **M2x3** can be obtained by using the keypad and display or by using the 'Scan the network' feature in the QDSP setting software.

14.2 QDSP Setting and Monitoring Software

See the separate QDSP Manual for details of how to Install and use the QDSP Software.

14.3 MODBUS

For details, see the separate **M2x3 & I500** Communications Manual.

14.4 DNP3

The implementation of DNP3 in the **M2x3** is basic and some DNP3 Masters may have difficulty interfacing to the **M2x3**.

For details, see the separate **M2x3 & I500** Communications Manual.

15. SUPPORT POWER FOR REAL TIME CLOCK OPERATION

To maintain the operation of the Real Time Clock (not in **M203**, **M213**) during periods when the Auxiliary power supply is not connected an internal power source is required.

M2x3 products using Hardware version 'B' or earlier use a replaceable battery. M2x3 products labelled as Hardware version 'C' use a super capacitor that is not replaceable.

15.1 Battery Replacement

The measuring centre may contain a lithium battery. It is used to power the Real Time Clock (date and time) in the device when the auxiliary power supply is not connected. The Life time of the battery is approximately 6 years (typical) but high temperatures and humidity can shorten the battery's life.

When the battery is expired and the power supply is interrupted, the flashing battery indicator appears in the top right corner of the display (before that it is not visible). **The Battery has no effect on other functionality of the device, except date and time.**

It is recommended that the instrument is sent back in the factory for battery replacement. Please note that the battery is soldered in to the PCB.

15.1.1 Instructions for replacement

1. Disconnect the instrument from measuring grid and power supply (Caution! - Read the safety section!) and take it out of the panel.
2. Remove frame [1] from the instrument (see Figure 16.1)
3. Pull out front assembly [2+3]
4. Remove PCB [3] from case [2] (Read section on 'HANDLING OF ELECTRONIC EQUIPMENT')
5. Remove the battery (soldered) from the board, be careful to use proper tools, and replace it with the same model (Varta, type 6032 CR2032 SLF)
6. To put the instrument together follow steps 2 to 4 in reverse order
7. Set device date and time.

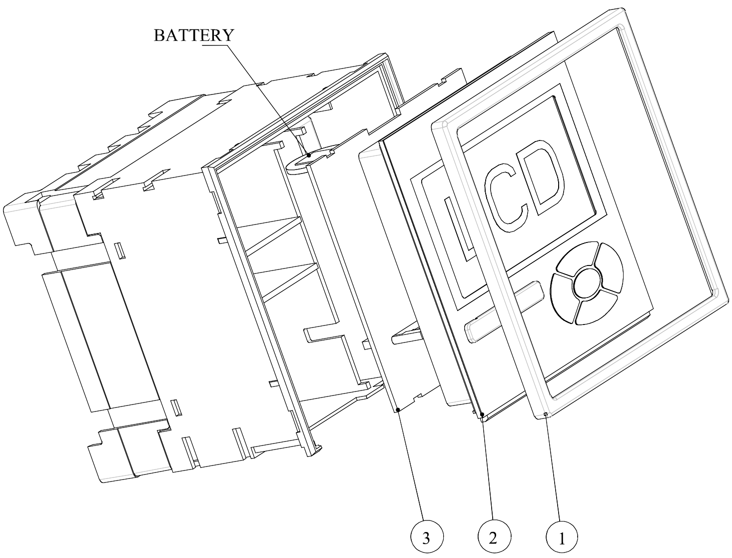


FIGURE 16-1: BATTERY REPLACEMENT

15.2 Operation with the Super Capacitor

A Super Capacitor has the advantage that it should never need to be replaced during the life of the product it is fitted in.

But, unlike a battery which could support the operation of the clock for a long time period, the Super Capacitor, when fully charged, can only support the clock for a period of 72 hours when auxiliary power is not connected, after which the clock will stop working. When power is re-connected the clock will need to be reprogrammed, and this can be easily done using the product keypad or the QDSP setting software.

When powering up an **M2x3** after the clock has stopped working, the clock setting will be displayed showing that it needs to be set. A message will be displayed on QDSP, if connected, defining that the clock needs to be set. And the status of the clock can be checked by an external SCADA to confirm if the clock needs to be set.

Only the clock operation is affected, all settings and data are maintained in non-volatile memory, which does not require any power to maintain the data.

The **M2x3** will continue to operate correctly when the clock has stopped, except that any measurements which are stored with a time stamp will have an incorrect time stamp and Energy Tariffs based on time and date will not give the correct results. This is the same if a battery fails or the Super Capacitor becomes discharged.

16. TECHNICAL DATA

INPUTS AND SUPPLY		
Voltage Input	Nominal Rating (Un)	230 V_{LN}, 415 V_{LL}
	Max. allowed value	277 V_{LN}, 480 V_{LL} permanently 2 x Un for 10 seconds
	Minimum range	2.0V sinusoidal
	Burden	<0.1 VA per phase
Current Input	Nominal current (In)	5A
	Rating (Auto-ranging)	1A/5A
	Overload	3 x In continuously 25 x In for 3 seconds 50 x In for 1 second
	Minimal range	Starting current for power
	Maximum range	12.5A sinusoidal
	Burden	<0.1 VA per phase
Frequency	Nominal Frequency (Fn)	50/ 60Hz
	Measuring range	16 to 400Hz
	Rating	10 to 1000 Hz
Supply - Universal	Nominal AC voltage	48 to 276Vac
	Nominal frequency	40 to 70Hz
	Nominal DC voltage	20 to 300Vdc
	Burden	< 12 VA
Supply - AC	Nominal AC voltage	57.7V, 63.5V, 100V, 110V, 230V, 400V, 500V
	Nominal frequency	40 to 65Hz
	Burden	< 8 VA
Battery (If fitted)	Type	CR2032 Li battery
	Nominal voltage	3V
	Life	Approx. 6 years @ 23C

CONNECTIONS	
Permitted conducer cross sections	Maximum conductor cross section
Voltage terminals (4)	≤ 5mm^2 one conductor
Current terminals (3)	≤ 6mm diameter conductor with insulation
Supply (2)	≤ 2.5mm^2 one conductor
Modules (2 x 3)	≤ 2.5mm^2 one conductor

ACCURACY		**(of range unless specified)**
RMS Current	1A	Class 0.2 or 0.5
(I_1, I_2, I_3, Iavg, I_n)	5A	Class 0.2 or 0.5
RMS Line Voltage	75V L-N	Class 0.2 or 0.5
(U_1, U_2, U_3, Uavg)	250V L-N	Class 0.2 or 0.5
RMS Phase-Phase Voltage	120V L-L	Class 0.2 or 0.5
(U_{12}, U_{23}, U_{31}, Uavg)	400V L-L	Class 0.2 or 0.5
Frequency		
F (current)	50Hz	0.01Hz
F (10 second average)	50Hz	0.01Hz
Power Angle	−180…0…180°	Class 0.5
Power Factor	−1…0…+1	
	U = 50 … 120 % U_n	
	I = 2 % … 20 % I_n	Class 2.0
	I = 20 % … 200 % I_n	Class 1.0
Maximum Demand	Calculated from U and I	Class 1.0
THD	5 to 500V	Class 0.5
	0 to 400%	Class 0.5
Power		
Active W	Calculated from U and I	Class 0.2 or 0.5
Reactive VAR: Q, apparent VA : S	Calculated from U and I	Class 0.5 or 1
Energy		
Active Energy	Calculated from U and I	Class 0.5S or 1 to EN 62053-22
Reactive Energy	Calculated from U and I	Class 2 to EN 62053-23
Real Time clock (if powered)		1minute per month (30ppm)
Analogue Output (internal supply)	0….20mA	± 200 µA

MODULES		
Alarm module	No of outputs	2
Watchdog/Alarm module	Rated Voltage	48 V AC/DC (+40%)
	Max switching current	1000 m A
	Insulation	1000V ac between open contacts
		4000V ac between coil and contacts
	Pulse	Max 4000 imp/hour, Min width 100ms
	Modes	Normal, pulsed or permanent
Bi-stable alarm module	No of outputs	1
	Max. switching power	40 VA
	Max. switching voltage AC	40 V
	Max. switching voltage DC	35 V
	Max switching current	1 A
	Modes	Normal, pulsed or permanent
Energy Pulse module	No of outputs	2
	Maximum voltage	40 V AC/DC
	Maximum Current	30 mA
Analogue Output module	No of outputs	2
	Maximum load	150Ω
	Output range	0 … 20mA
Tariff Module	No of inputs	2
	Voltage	230V/110V ± 20% AC
Pulse Input Module	No of inputs	2
	Rated voltage	5 - 48 V DC (± 20%)
	Max. current	8 mA (at 48 VDC + 20%)
	Min. pulse width	0.5 ms
	Min. pulse periode	2 ms
	SET voltage	40...120 % of rated voltage
	RESET voltage	0...10 % of rated voltage
Digital Input Module	No of inputs	2
	Voltage	230V/110V ± 20% AC/DC
2nd Communications Module	No. of channels	1
RS232/RS485	Type of Connection	Direct / Network
	Maximum connection length	3 m / 1000 m

MODULES		
Analogue Input module	Number of Inputs	2
	Nominal input range 1 Nominal input range 2 input resistance accuracy temperature drift conversion resolution Analogue input mode	–20…0…20 mA (±20%) –2…0…2 mA (± 20%) 20 Ω 0.5 % of range 0.1% / °C (for range 2 only) 16 bit (sigma-delta) internally referenced Single-ended
	Nominal input range1 Nominal input range 2 input resistance accuracy temperature drift conversion resolution Analogue input mode	–10…0…10 V (±20%) –1…0…1 V (±20%) 100 kΩ 0.5 % of range 0.1% / °C (for range 2 only) 16 bit (sigma-delta) internally referenced Single-ended
	Nominal input range (low)* Nominal input range (high)* connection accuracy conversion resolution Analogue input mode	0 - 200 Ω (max. 400 Ω) PT100 (-200°C–850°C) 0 – 2 kΩ (max. 4 kΩ) PT1000 (-200°C–850°C) 2-wire 0.5 % of range 16 bit (sigma-delta) internally referenced Single-ended
	* Low or high input range and primary input value (resistance or temperature) are set by the QDSP setting software	

COMMUNICATION				
	Ethernet	USB	RS232	RS485
Connection	Direct	Direct	Direct	Network
Max connection length	-	-	3M	1000M
Terminals	RJ45	USB-B	DB9 female or terminals	
Transmission mode	Asynchronous			
Protocol	MODBUS TCP / RTU & DNP3 (autodetect)	MODBUS RTU / DNP3 (autodetect)		
Insulation	3.7KV, 1 minute between terminals and all other circuits			
Transfer rate	10/100Mb/s (autodetect)	USB 2.0	2400 to 115200b/s	

ELECTRONIC FEATURES		
LCD	Type	Graphic, 128 x 64 pixels
	Refresh time	200mS
Response time	Input to LCD	Calculated during averaging interval setting (8 to 256 periods), resetting (64 periods) typically 1.28 seconds at 50Hz
	Input to communications	
	Input to relay output	
Memory	M243 (sampling period 1 to 60min)	8MB (recorder A, recorder B, alarm recorder)
	M253 (sampling period 1 to 60min)	8MB (recorder A, recorder B, alarm recorder, Power Quality reports)
LED	Memory Card	Green for activity
	Communications	Green for transmission
	Alarm	Red for alarm

SAFETY FEATURES		
General	In compliance with EN61010-1:2004 600Vrms, installation category II 300Vrms, installation category III Pollution degree 2	
Test voltage	3.7KV, 1minute In compliance with EN61010-1:2004	
EMC	Directive on electromagnetic compatibility 2004/108/EC In compliance with EN 61326-1: 1998	
Protection	In compliance with EN60529:1997 Front with protection cover for Memory Card slot fitted: IP52 Rear with protection cover: IP20	
Ambient conditions	Climatic	class 3, in compliance with EN62052-11:2004 and EN62052-21:2005
	Temperature	Operation -5 to +55C Storage -25 to +70C
	Humidity	≤ 90%RH
	Height	0 to 2000M
Enclosure	DIN	PC incombustibility – self extinguishing in compliance with UL94VO
	Mass	Approx 600g

17. WIRING DIAGRAMS AND CASE DIMENSIONS

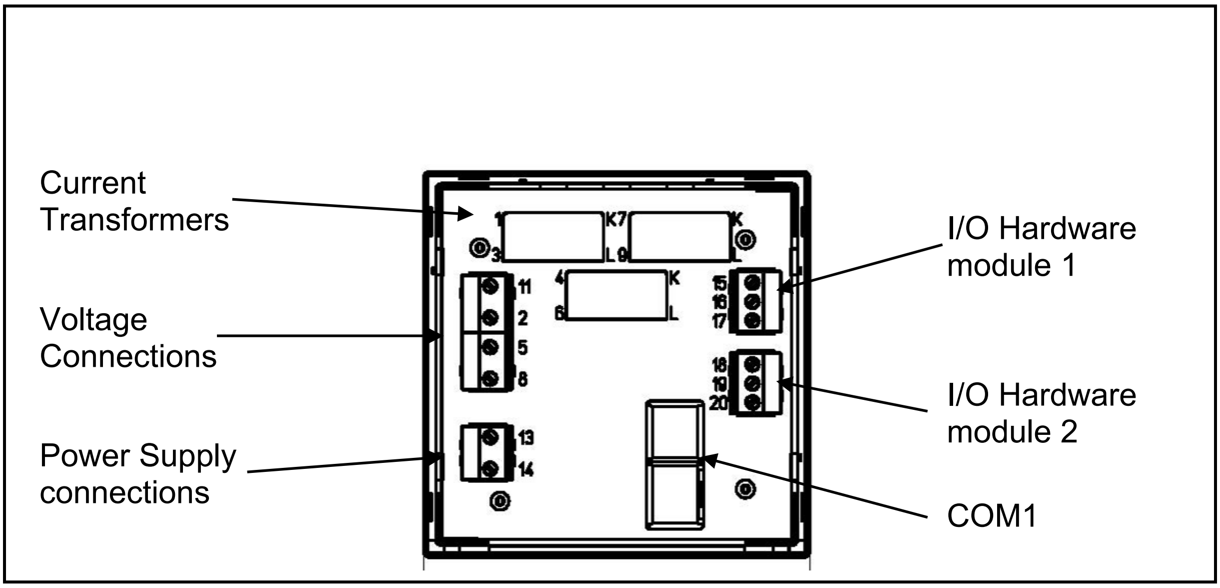


FIGURE 18-1: CONNECTIONS

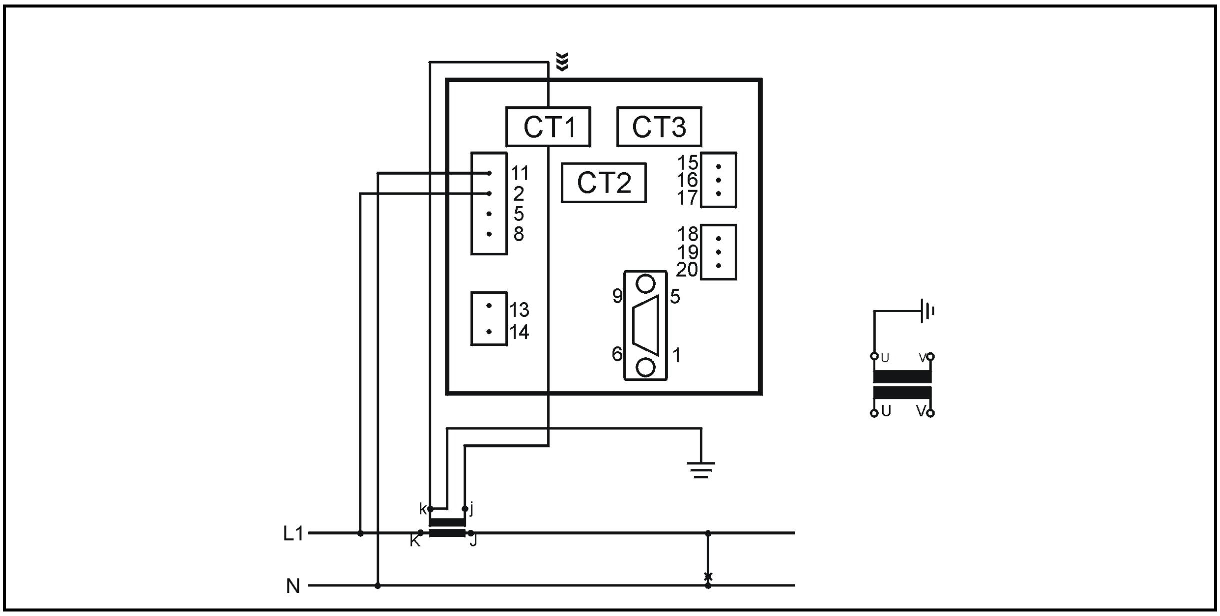


FIGURE 18-2: EXTERNAL WIRING DIAGRAM: SINGLE PHASE (1B)

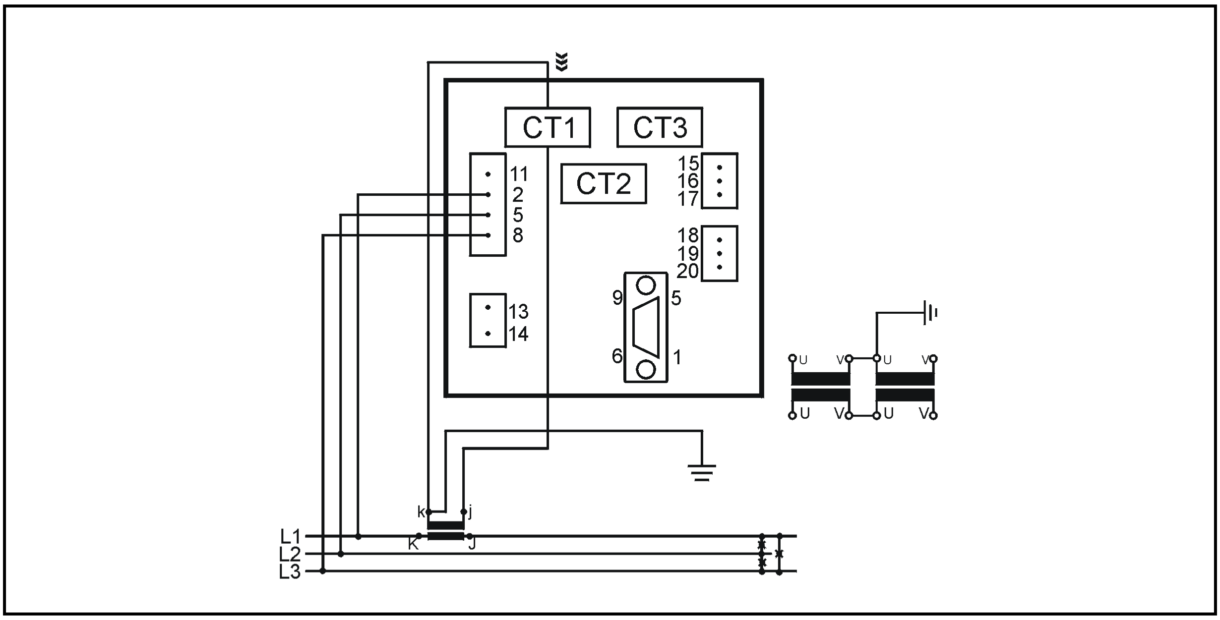


FIGURE 18-3: EXTERNAL WIRING DIAGRAM: 3-PHASE, 3-WIRE BALANCED LOAD (3B)

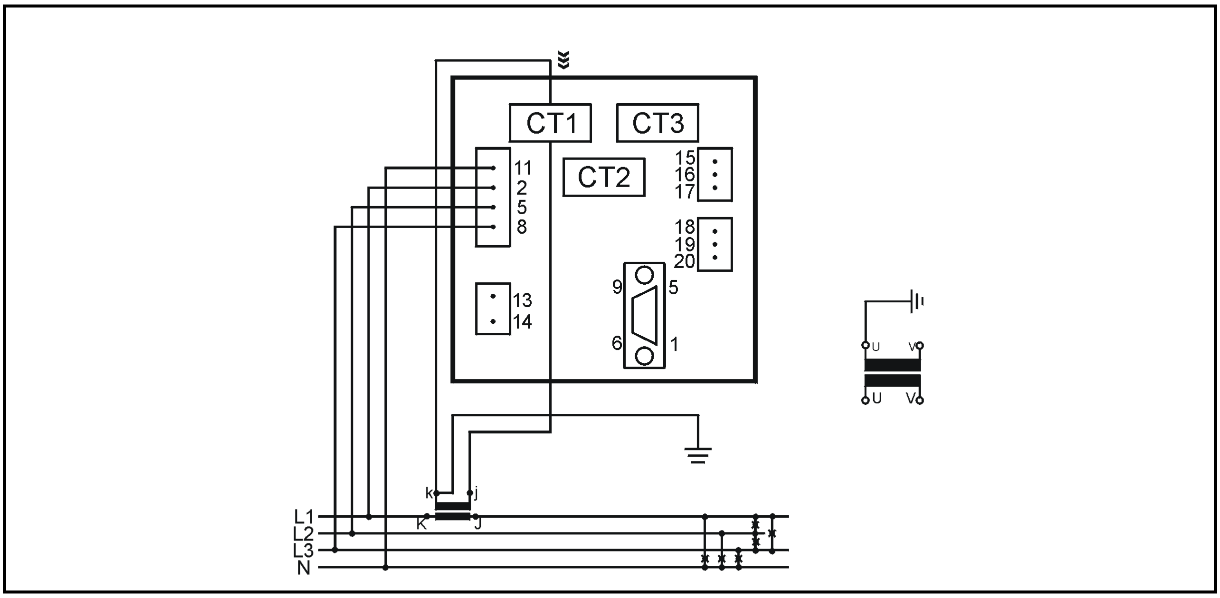


FIGURE 18-4: EXTERNAL WIRING DIAGRAM: 3-PHASE, 4-WIRE BALANCED LOAD (4B)

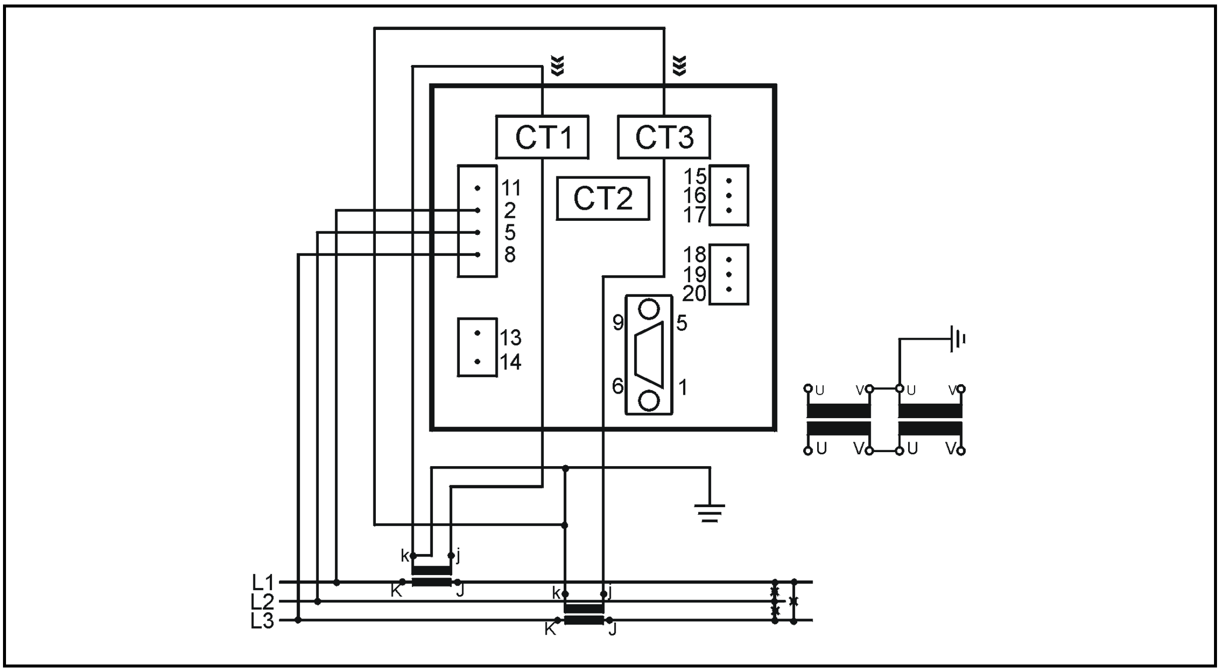


FIGURE 18-5: EXTERNAL WIRING DIAGRAM: 3-PHASE, 3-WIRE UNBALANCED LOAD (3U)

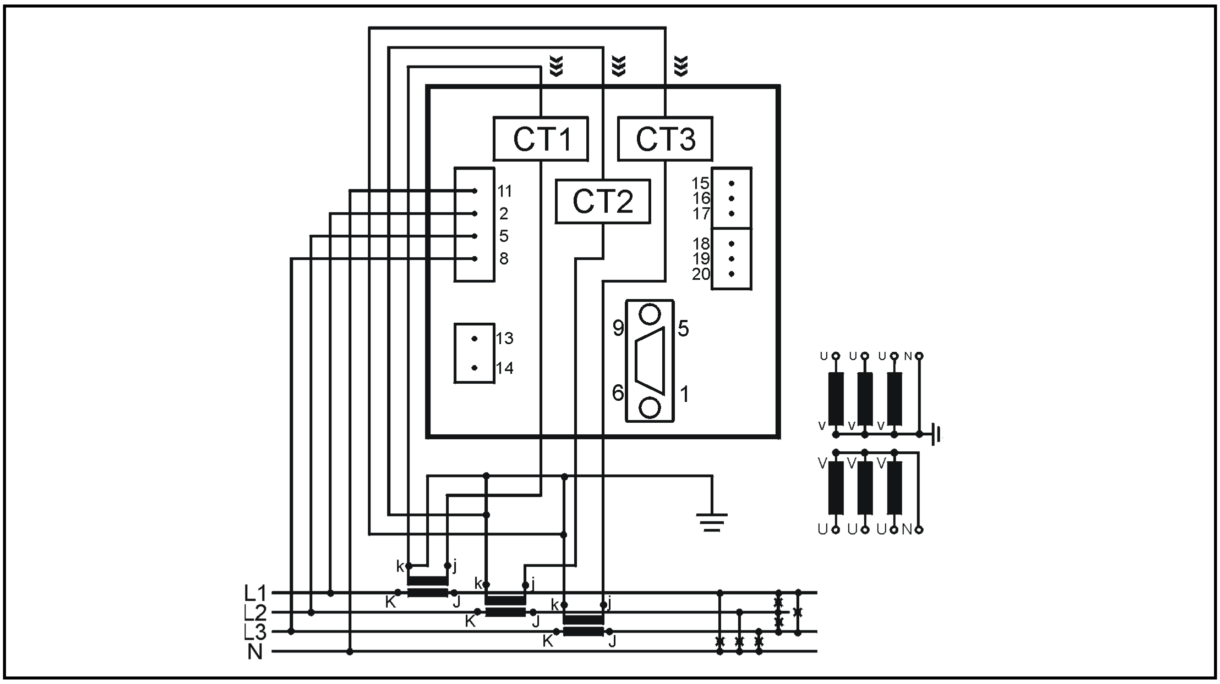


FIGURE 18-6: EXTERNAL WIRING DIAGRAM: 3-PHASE, 4-WIRE UNBALANCED LOAD (4U)

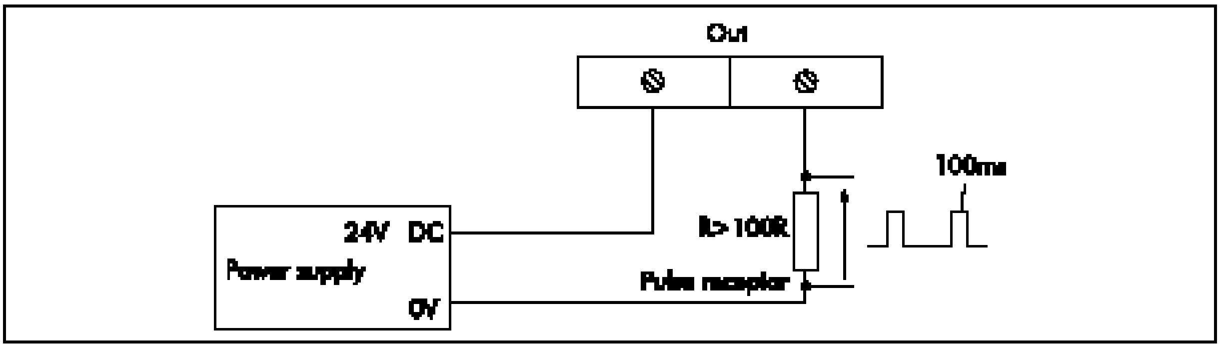


FIGURE 18-7: TYPICAL CONNECTIONS FOR PULSE OUTPUT

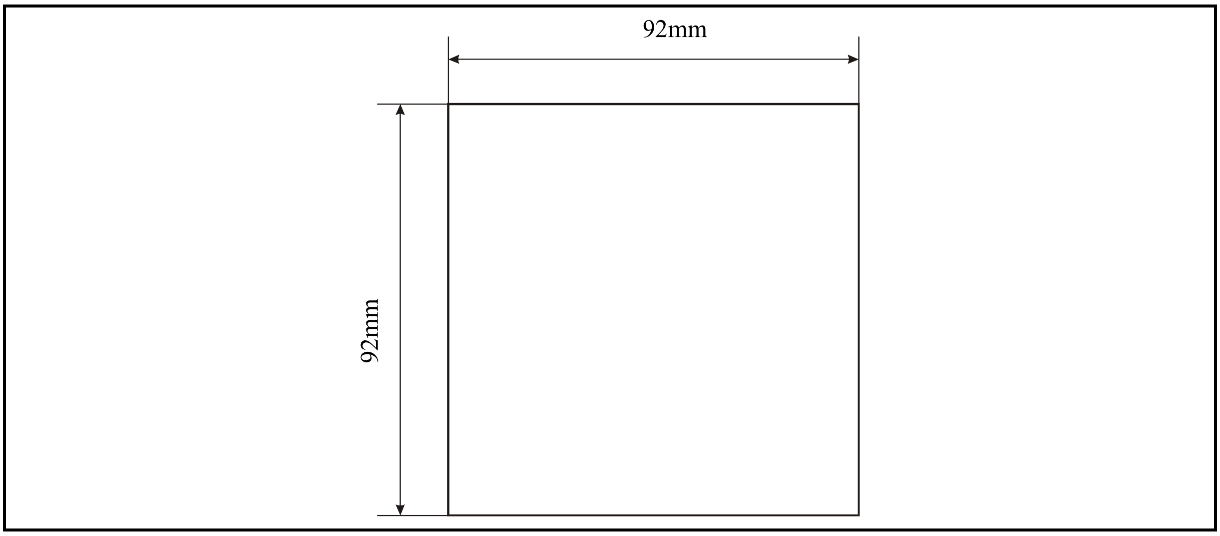


FIGURE 18-8: CUT OUT

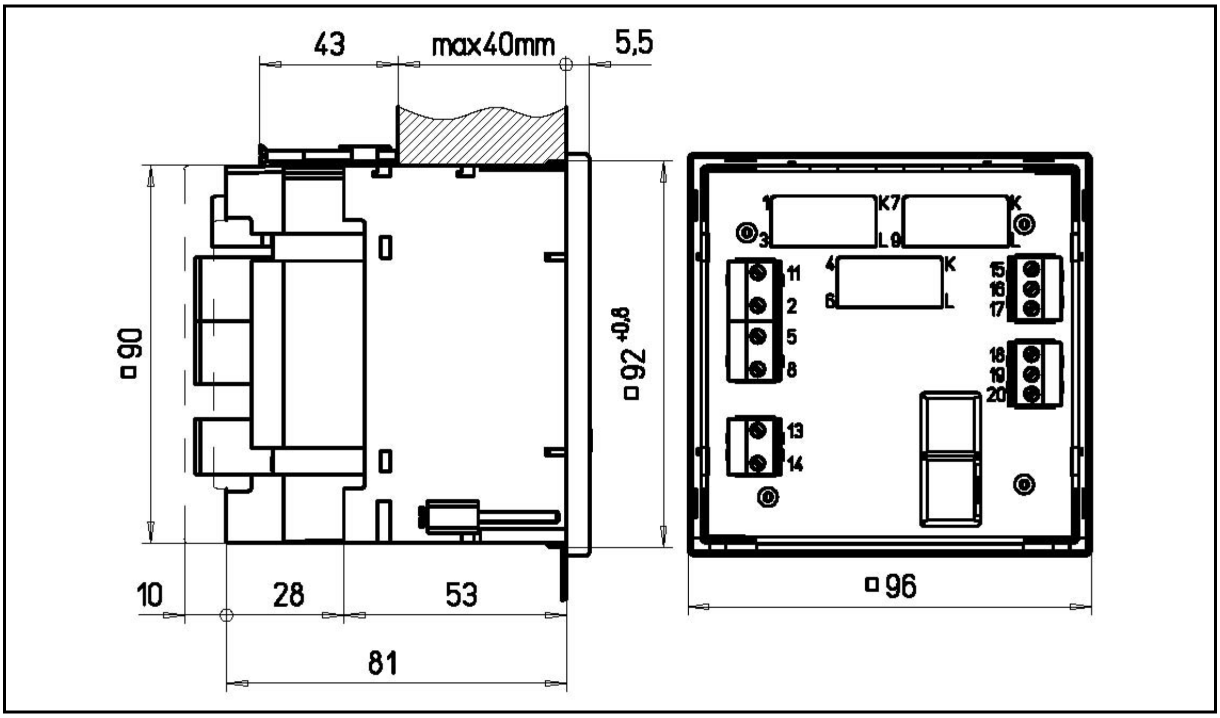


FIGURE 18-9: CASE DIMENSIONS

18. RELATED DOCUMENTS

Ref	Document
1	M2x3 and I500 Communications Manual
2	QDSP: iSTAT Configuration and Analysis Software Manual

Imagination at work

Grid Solutions
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Redhill Business Park
Stafford, ST16 1WT, UK
+44 (0) 1785 250 070
www.gegridsolutions.com/contact

iSTAT M2x3/EN/M/F