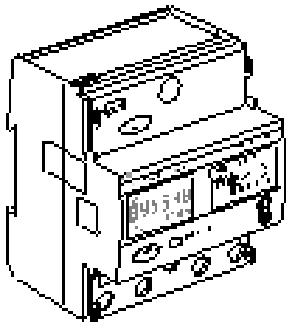

DELTAsingle User's Manual

Rev D

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TABLE OF CONTENTS

1 GENERAL

This manual contains information about the DELTAsingle, which is a family of electronic electricity meters manufactured by ABB Automation Technologies AB.

The purpose of this manual is to give the user a good overview and understanding of the many functions and features the DELTAsingle offers. It also describes general metering aspects. The end goal is to help the user to use the meter in the most optimal and correct way and to give the proper service and support to maintain the highest stability and lifetime.

The degree of the DELTAsingle functions is controlled by its hardware (electronic boards, mechanics, etc), software (resided in a small computer inside the meter) and the meter type specific programming done when it is produced (stored in a non-volatile EEPROM memory).

Features (both hardware and software) which are not standard (incorporated in all meters) are pointed out in the manual as options.

WARNING! The voltages connected to the DELTAsingle are dangerous and can be lethal. Therefore it must be insured that the terminals are not touched during operation. When installing the DELTAsingle all voltages must be switched off.

2 PRODUCT DESCRIPTION

This chapter contains a description of the basic functions and practical handling of the DELTAsingle. Functionality regarding communication is described in chapter 6.

2.1 FAMILY OVERVIEW

General Presentation
DELTAsingle is an electronic electricity meter for single phase metering. As option the meter has an internal clock for handling tariffs. The setting is done with push buttons or via communication. DELTAsingle is intended for mounting on a DIN rail and is designed in accordance with the ABB ProM standard.

General Features
DELTAsingle is an active energy, single phase meter for direct metering up to 80A. The LCD display has 6 digits, 6 mm high to ensure easy reading.

DELTAsingle is made compact, only 4 modules to save space in the installation.

In case of power failure, the meter is equipped with a super capacitator power backup that will run the clock for minimum 48 hours (meters with internal clock only).

A red LED at the front flashes proportionally to the energy consumed.

DELTAsingle has a temperature range from –40 to +55º C (storage +70º C).

Communication
DELTAsingle has 3 ways to communicate depending on type.
- Display at front
- Pulse output (option)
- IR interface for serial communication (together with serial communication adapter)

Programming
Selection of information to be shown on the display is easily achieved by using push buttons. The programming push button can be sealed by using accessories.

Tariffs
The DELTAsingle range includes 1, 2 and 4 tariff meters.

Type Approval
DELTAsingle meter types are tested and approved according to IEC 62052-11, 62053-21 and IEC 62054-21**,** Measurement instrument directive (MID), category A & B, electrical environmental class E2 and electrical environmental class M2 EN 50470-1, EN 50470-3 category A & B
These standards cover all technical aspects of the meter like climate conditions, electromagnetic compatibility (EMC), electrical requirements, mechanical requirements and accuracy.

2.2 METER PARTS

The different parts of the meter are depicted below, accompanied by a short description of each part.

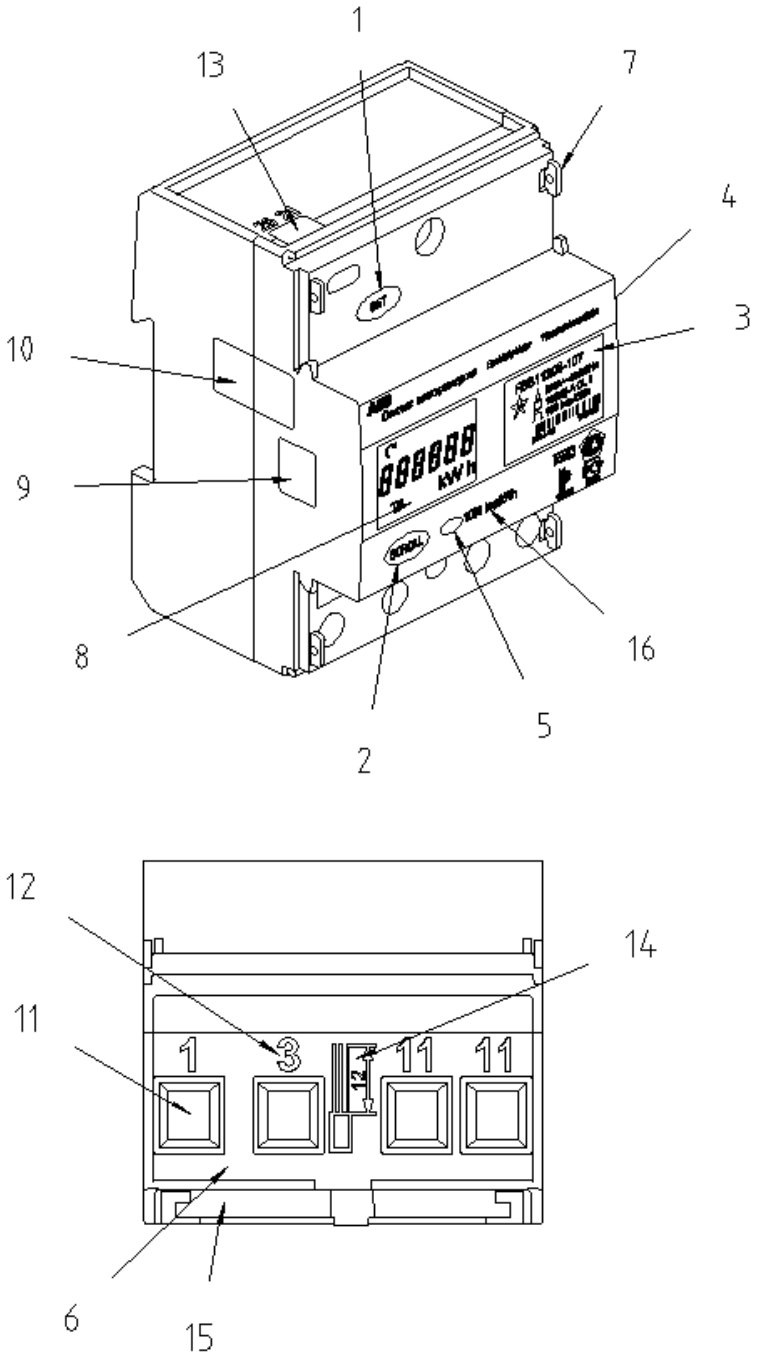


Fig. 2-1 Meter parts

-Position 1: SET button
Used when programming the meter.

-Position 2: SCROLL button
Used when viewing different information and programming the meter.

-Position 3: Product label
Label with information about the meter.

-Position 4: Label with wiring diagram for the terminals.

-Position 5 and 16: LED and LED frequency
The meter has a red Light Emitting Diode that flashes in proportion to the consumed energy.

-Position 6: Terminal block.
The voltage and current measured by the meter is connected here.

-Position 7: Sealing points
The meter can be provided with two sealable covers with two sealable points on each, where thread seals can be used to seal the meter (covers all meter connections and the SET button).

-Position 8: LCD
A 6-digit Liquid Crystal Display showing data and settings.

-Position 9: Optical port
For use of external communication devices.

-Position 10: Sealing tape
A piece of tape sealing the meter, which will leave traces on the meter in case it is broken.

-Position 11: Terminals
Made for solid, stranded and flexible cables.

-Position 12: Numbering of terminals

-Position 13: Pulse output
Terminals for pulse output.

-Position 14 Stripping length
Showing the stripping length of the cables.

-Position 15: DIN-rail lock
Used for fixing the meter on the DIN-rail.

2.3 METER TYPES

The DELTAsingle product family is divided into two groups:

- Direct connected meters for current ≤ 80A
- Direct connected meters for current ≤ 80A with tariffs

The meter type is reflected on the product label, see figure below.

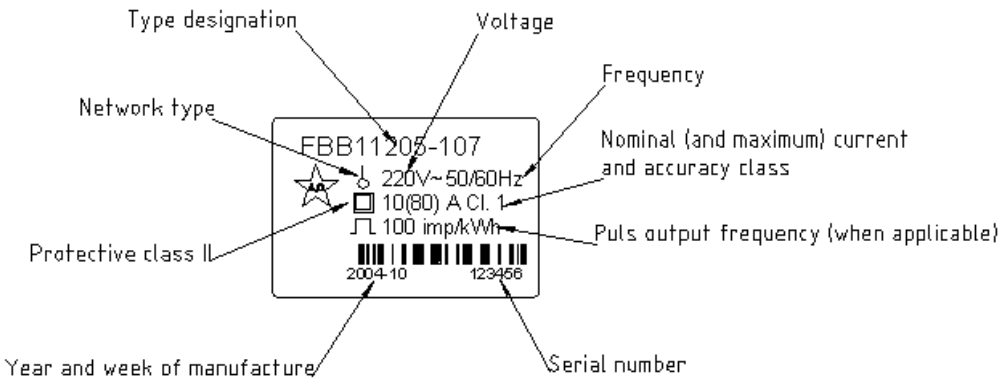


Fig. 2-2 Product label

A meter is identified by its type designation. For explanation of the positions in the type designation see further down in this chapter.

2.3.1 NETWORK TYPE

The network type symbol tells the number of measurement elements the meter contains. One voltage and one current is measured and used in the energy measurement.

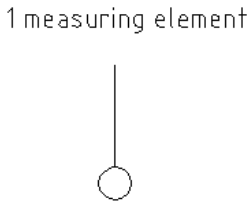


Fig. 2-3 Network symbol

The meter is used in single phase metering system with 2 wires.

2.3.2 TYPE DESIGNATION

DELTAsingle

Pos	1	2	3	4	5	6-8	9-11
Base							
Delta Single	F						
Measurement							
Active - Direct connected		B					
Communication							
Pulseoutput, IR-port			B				
IR-port			U				
Accuracy							
Class 1				1			
Voltage							
1 x 230 V					1		
Options							
None						000	
Verification with inspection						200	
2 tariffs (Internal clock)						005	
4 tariffs (Internal clock)						006	
Internal clock only (no tariffs)						007	
Customization							
None							
Elster RU							-107
Standard RU							-108

2.4 ENERGY INDICATOR

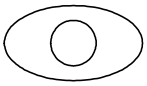


Fig. 2-4 Energy indicator

The red LED (Light Emitting Diode) on the front is an indicator that flashes in proportion to the energy. Every pulse means that a certain amount of energy has been registered, that is, it has a certain energy pulse frequency. This frequency is marked on the front of the meter.

2.5 BUTTONS

The DELTAsingle has two user buttons, one on the front called SCROLL and one called SET. The SET button can be sealed using the accessory short cover.

2.5.1.1 SET BUTTON

The SET button is used for programming, that is, to reach Set mode, activate a change operation and to confirm a changed setting.

2.5.1.2 SCROLL BUTTON

With the SCROLL button the different information displayed can be viewed, such as going to different display modes or proceeding to the next quantity. No settings can be altered solely by this button.

The SCROLL button has two different functions depending on how long time it is pressed:

-Short scroll
When the SCROLL button is pressed for up to two seconds, it displays the next value. This can be used to enter single step mode, that is, to manually scroll through the different display items. While being in single step mode the "hand" on the LCD (☞) is on.

-Long scroll
When the SCROLL button is pressed for between two and ten seconds it steps between modes. When a long scroll is performed in Normal mode the DELTAsingle switches to Alternative mode. When a long scroll is performed in Alternative mode the meter switches back to Normal mode. A long scroll in Set mode lets you step back. This can be used, for example, to exit a pending set operation without altering the setting.

Notes:

The activity starts when the button **is released**.

Do not press more than one button at a time.

There is always a time out time (two minutes). If a button is not pressed during this time the DELTAsingle meter steps back to Normal mode.

If the scroll button is pressed for more than **ten seconds** the DELTAsingle meter ignores it.

2.6 DISPLAY INFORMATION

From the display it is possible to view information such as energy consumption, active settings, error status etc. The most important information is either displayed continuously or automatically displayed sequentially one quantity at a time. Information that is not necessary to be viewed all the time can be displayed by using the SCROLL button.

The display has 6 characters of 7-segment type with a height of 6 mm and a number of other specific segments to display unit, tariff and status information. The illustration below shows all segments (forming characters and symbols) that can appear on the display in different display modes.

Note: In every mode, the energy continues to be measured, the energy registers are updated and the meter generates pulses.

2.6.1 DISPLAY OVERVIEW

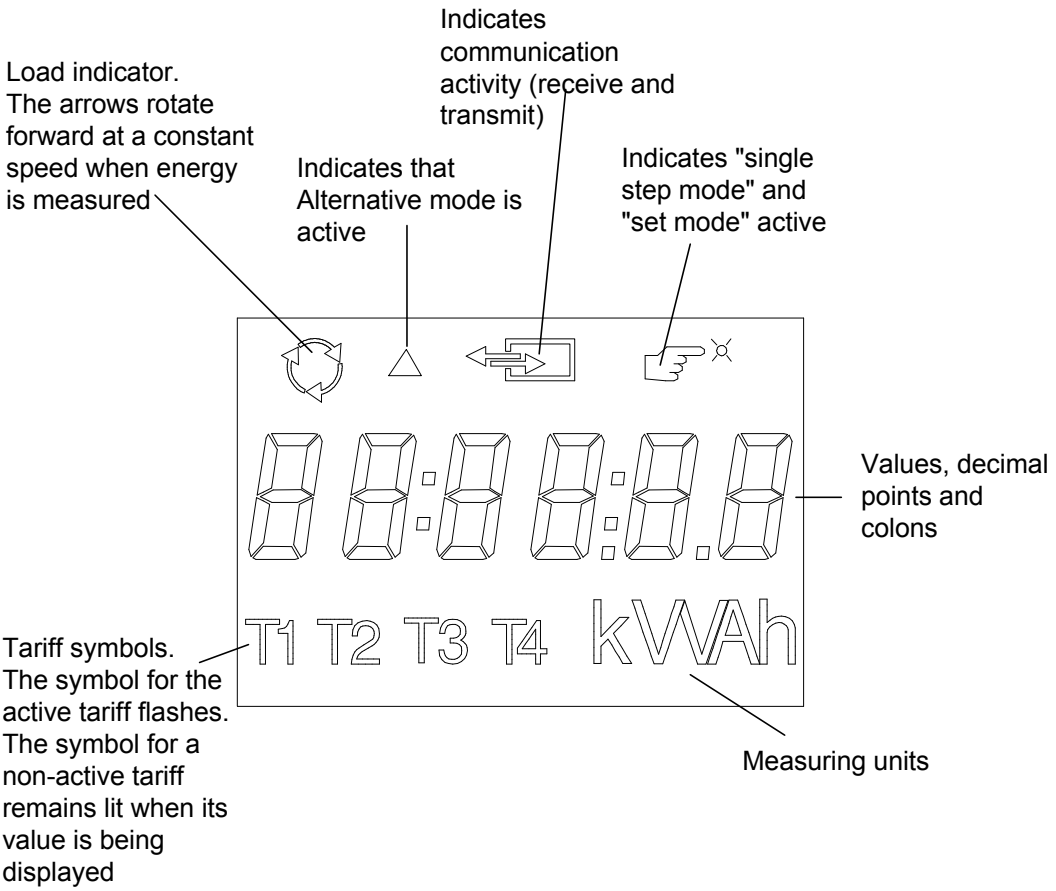


Fig. 2-5 DELTAsingle meter LCD

2.6.2 7-SEGMENT CHARACTERS, COLONS, DECIMAL POINTS AND UNIT

All energy values are displayed by using the 6 characters, decimal points and the unit segments. Time and date are displayed by using the 6 characters and the colons. The figure below shows examples where the energy (21583 kWh) and the time is displayed (hour 9, minute 7 and seconds 48).

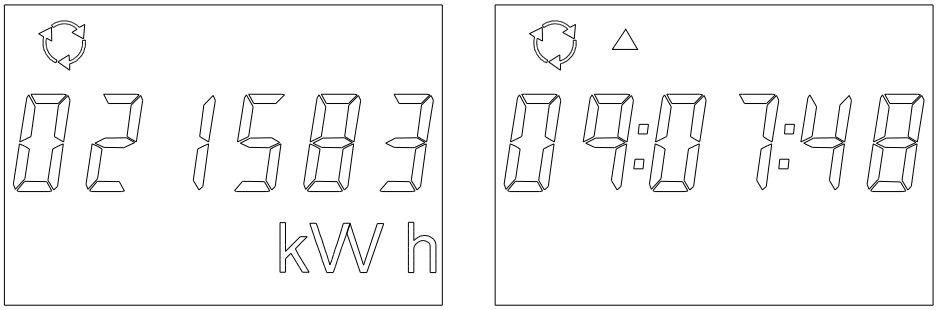


Fig. 2-6 Display of active energy and time

2.6.3 INDICATION OF ACTIVE TARIFF

Fig. 2-7 Tariff indicators

Active tariff (option) is indicated with a constant flashing of the tariff indicator, for example "T1" for tariff 1. When a value for a tariff which is not active is displayed its indicator remains lit.

The only time when the active tariff is not blinking is when a total energy register is displayed or an LCD test is pending (all segments on).

2.6.4 LOAD INDICATOR

Fig. 2-8 Load indicator

There are three arrows, which will rotate as soon as the current is above the start current level. The rotating speed is constant and independent of the measured energy. If the metering is below the start current level all the arrows are constantly on and not rotating.

If the energy is positive the arrows are rotating in the forward direction and if the energy is negative the arrows are rotating backwards.

2.6.5 COMMUNICATION STATUS

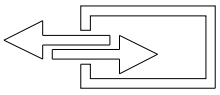


Fig. 2-9 Communication status

The M-bus communication status is indicated by the communication segments on the LCD which consists of two arrows going into and out of the meter (illustrated as a box). When the meter detects a valid message addressed to itself it sets the receive segment on (the arrow going into the box) and when it sends out a message it sets the transmit segment on (the arrow going out of the box).

2.7 DISPLAY MODES

The DELTAsingle meter display system is divided into different display modes. In Normal and Alternative mode different values and settings is displayed. They are distinguished from each other by the small triangle at the upper part of the LCD which is off in Normal mode and continuously on in Alternative mode. There is also a Set mode where different programmable settings can be modified. Some information are always displayed on the LCD, irrespective of active mode. Below in the figure is depicted the display system with its different modes and the different information displayed.

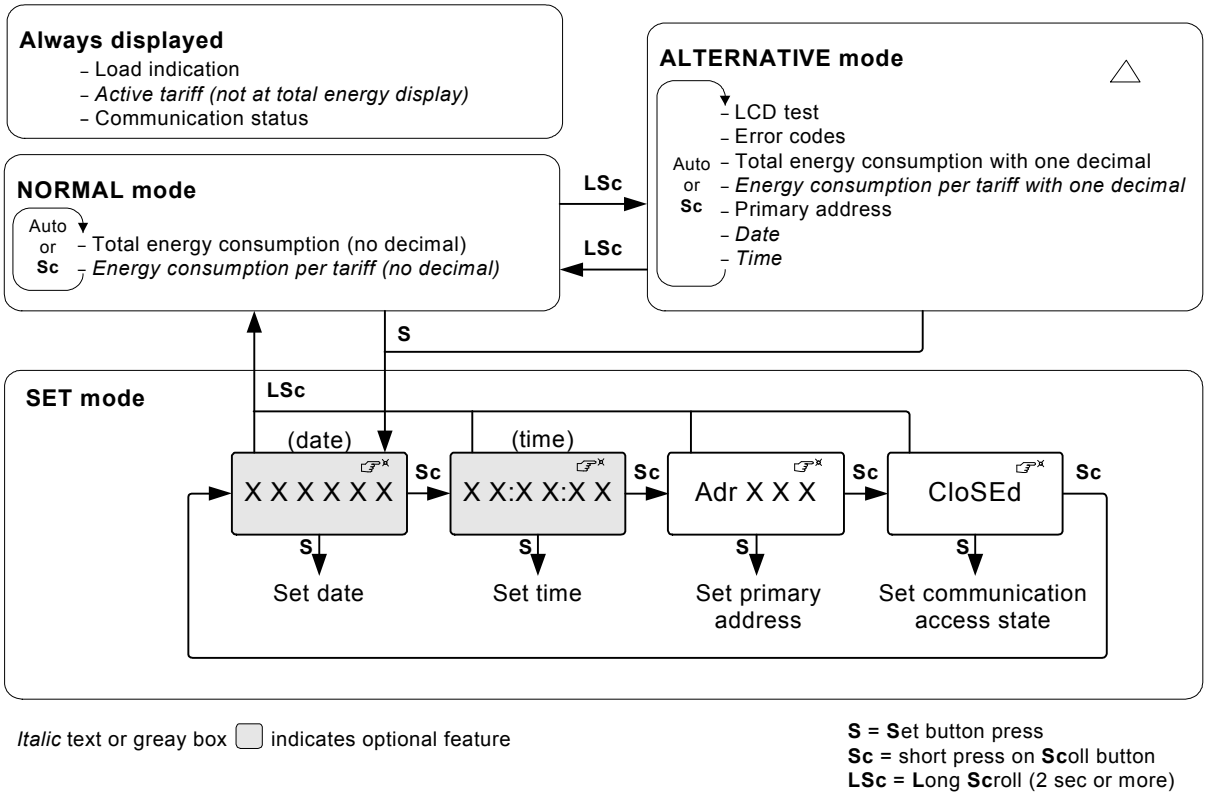


Fig. 2-10 Display system

2.7.1 NORMAL MODE

Normal mode is the normal display condition where the most important quantities, normally the energies, are displayed sequentially and automatically one at a time. Normally each quantity is being displayed for 6 seconds. When the last quantity has been displayed it will start all over again displaying the first quantity. If the SCROLL button is pressed shortly it is possible to single step and view a quantity for longer time.

All meters will be in Normal mode after power up.

Normal mode will always be reached via the timeout function if no buttons are pressed for some time.

The Normal mode can only be interrupted by entering the Set mode or the Alternative mode.

Below is described the format for the energy display in Normal mode.

2.7.1.1 Energy display in Normal mode

In Normal mode the energy registers are displayed in kWh without decimals. In tariff meters the tariff indicators are used to indicate which tariff energy register that are displayed (see section 2.6.3), see example in figure below where the tariff 2 active energy register is displayed (T1 is blinking indicating that tariff 1 is the currently active tariff).

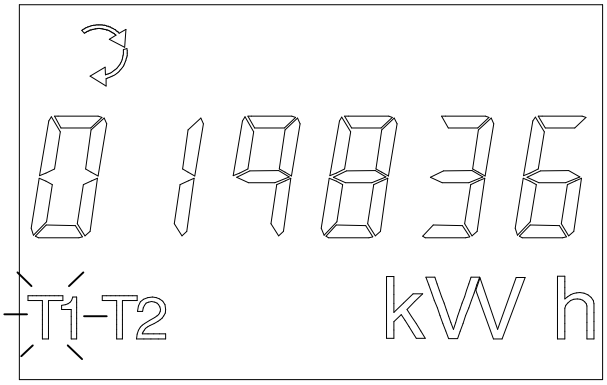


Fig. 2-11 Normal Mode energy display

2.7.2 ALTERNATIVE MODE

The Alternative mode is reached from Normal mode by pressing the SCROLL button for more than two seconds (long scroll).

The DELTAsingle meter indicates being in Alternative mode by the triangle (△) being permanently lit.

If no button is pressed after entering Alternative mode the different display items will be automatically displayed one at a time in sequence. If the scroll button is pressed shortly it single steps (”hand” symbol ☞ on) and each item can be viewed longer time.

Below is described the information shown in Alternative mode.

2.7.2.1 LCD test

The first displayed item in Alternative mode is a display test where all LCD segments are set, see figure below.

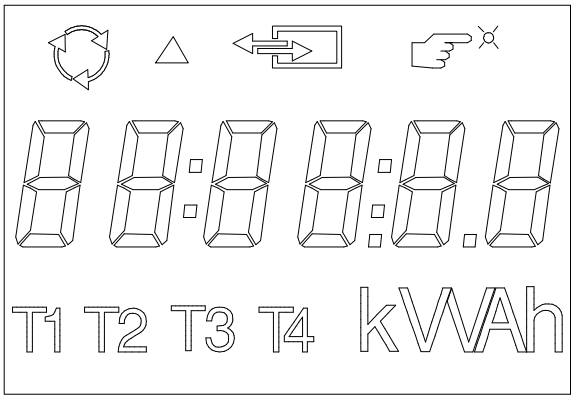


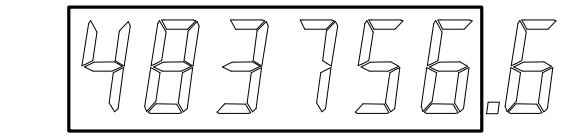
Fig. 2-12 LCD test

2.7.2.2 Error information

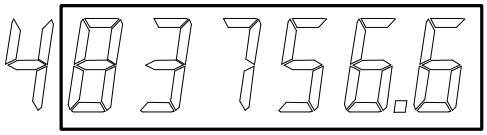
After the LCD test any internal meter errors are displayed. If no errors are detected the text “no Err” is displayed. The error codes are displayed as “Err xxx” (error code xxx). For explanation of the error codes, se chapter 6.

2.7.2.3 Energy display in Alternative mode

In Alternative mode the energy registers are displayed in kWh with 1 decimal, see figure below which illustrate the difference between Normal and Alternative mode.



Normal mode



Alternative mode

Fig. 2-13 Energy display in Normal/Alternative mode

In tariff meters the tariff indicators are used to indicate which tariff energy register that are displayed (see section 2.6.3).

2.7.2.4 Primary address

The M-bus primary address is displayed as "Adr xxx" where xxx is the primary address.

2.7.2.5 Date

The set date (option) is displayed. If time has not been set ------ is displayed.

2.7.2.6 Time

The set time (option) is displayed. If time has not been set --:--:-- is displayed.

2.7.3 SET MODE

Set mode is reached by pressing the SET button while being in Normal or Alternative mode. For a flowchart on Set mode see figure 2-10 in section 2.7 (optional settings are in *italic* style). After reaching Set mode the different set items and its respective setting can be viewed by pressing the scroll button (short scroll). To activate the change procedure the SET button is pressed when the set item to be changed is displayed. The "hand" symbol (☞) is flashing while the change procedure is active. Doing a "long scroll" while the set operation is pending lets you to exit without altering the setting.

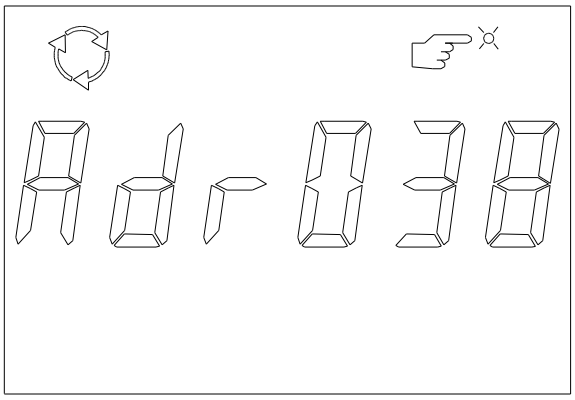
When all settings have been done the Normal mode is reached by doing a "long scroll".

Below are listed the different settings that can be modified in Set mode and the change operation procedure.

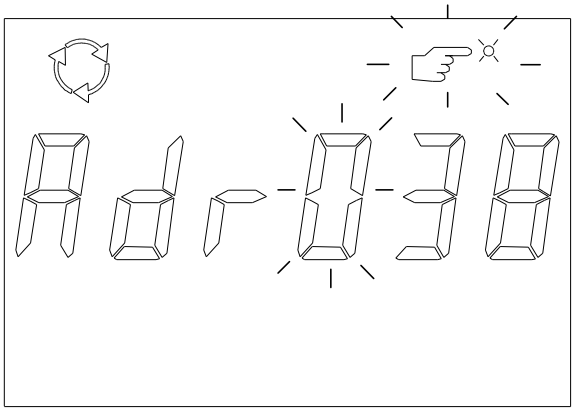
2.7.3.1 Primary address

Allows setting of the M-bus primary address.

When the SET button is pressed while the primary address is displayed in Set mode



the "hand" symbol (☞) and the first digit starts flashing

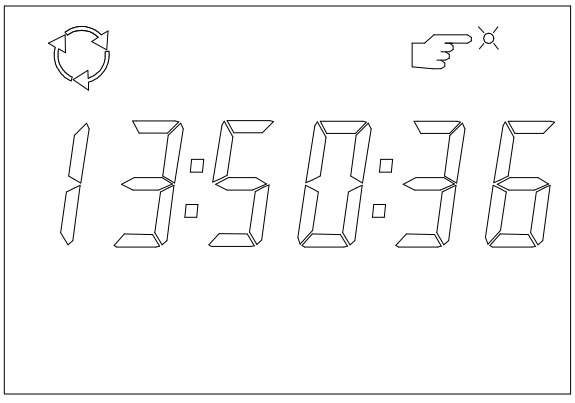


The first digit is increased by 1 for every short press on the SCROLL button. Possible values for the first digit are 0-2. The chosen value is confirmed by pressing the SET button. The same procedure is then done for the 2 other digits (possible values for these two digits are 0-9). When the last digit is confirmed the meter will start to use the new address. It is only possible to select valid addresses (1 to 250).

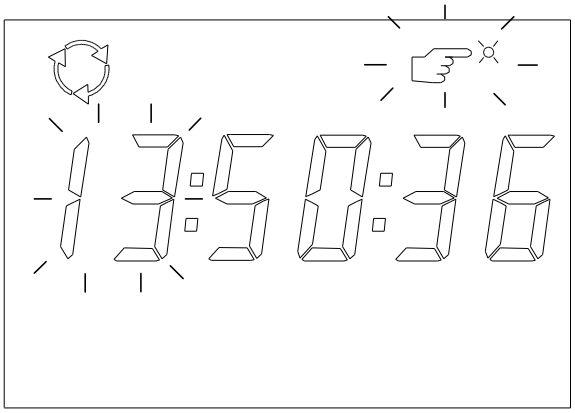
2.7.3.2 Time

Allows setting of the time.

When the SET button is pressed while the time (hour:minute:second) is displayed in Set mode

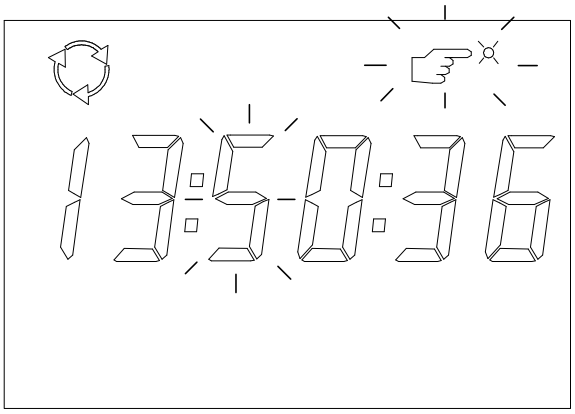


the "hand" symbol (☞) and the hour digits starts flashing

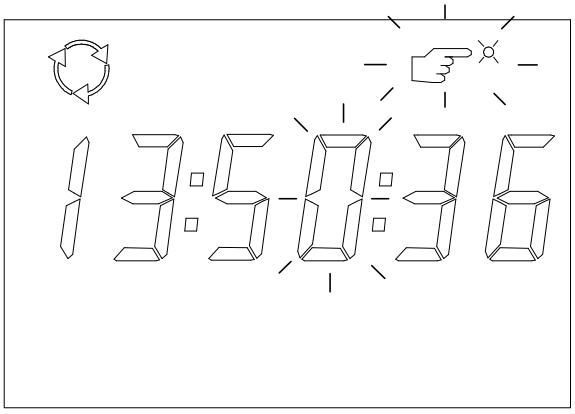


The hour digits are increased by 1 for every short press (possible values 0-23) on the SCROLL button. The chosen value is confirmed by pressing the SET button.

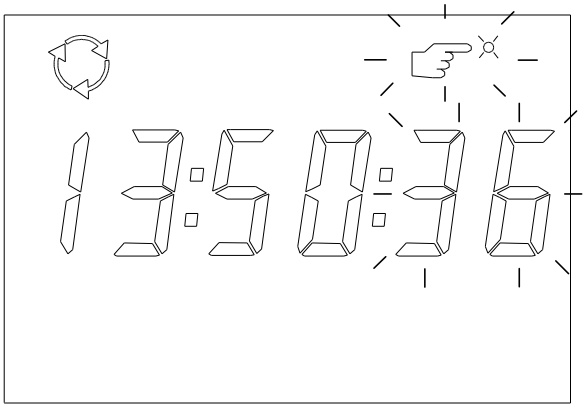
The minute tens digit then starts flashing and is increased for every short press (possible values 0-5) on the SCROLL button. The chosen value is confirmed by pressing the SET button.



The minute unit digit then starts flashing and is increased for every short press (possible values 0-9) on the SCROLL button. The chosen value is confirmed by pressing the SET button.



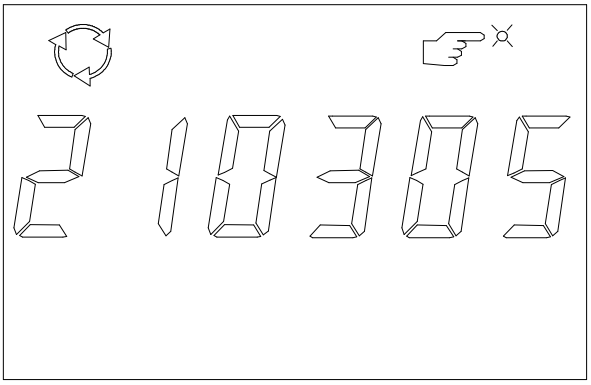
The second digits then starts flashing and is set to zero at every short press on the SCROLL button. The second digits are confirmed by pressing the SET button which completes the time set operation.



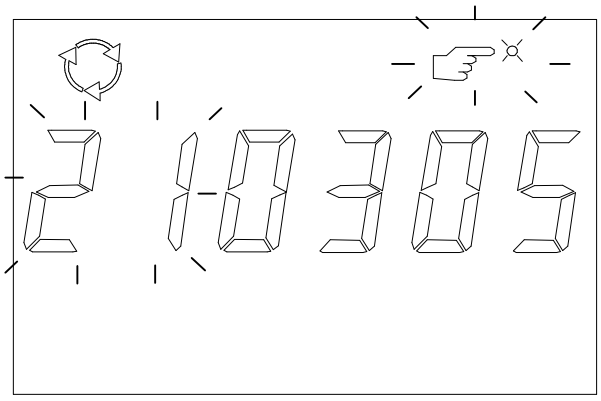
2.7.3.3 Date

Allows setting of the date.

When the SET button is pressed while the date (day:month:year) is displayed in Set mode

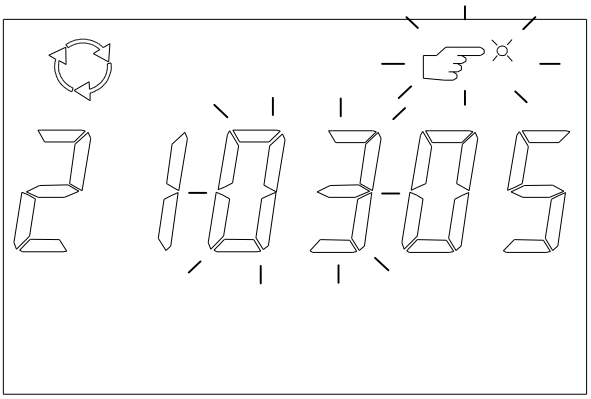


the "hand" symbol (☞) and the day digits starts flashing

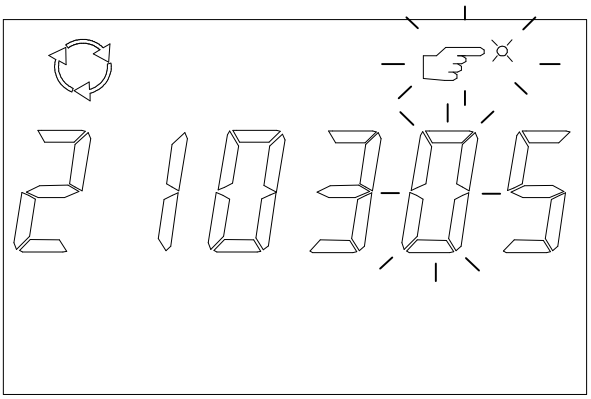


The day digits are increased by 1 for every short press (possible values 1-31) on the SCROLL button. The chosen value is confirmed by pressing the SET button.

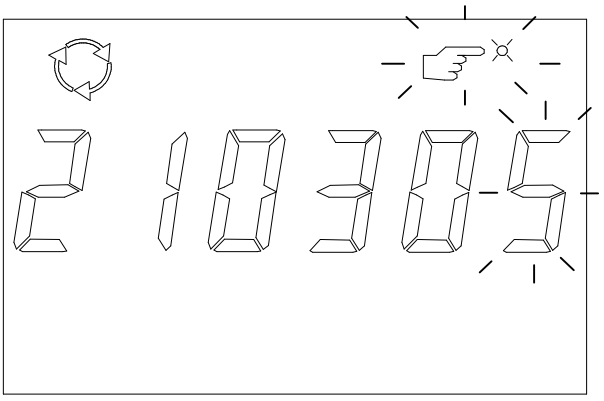
The month digits then starts flashing and is increased for every short press (possible values 1-12) on the SCROLL button. The chosen value is confirmed by pressing the SET button.



The year tens digit then starts flashing and is increased for every short press (possible values 0-9) on the SCROLL button. The chosen value is confirmed by pressing the SET button.



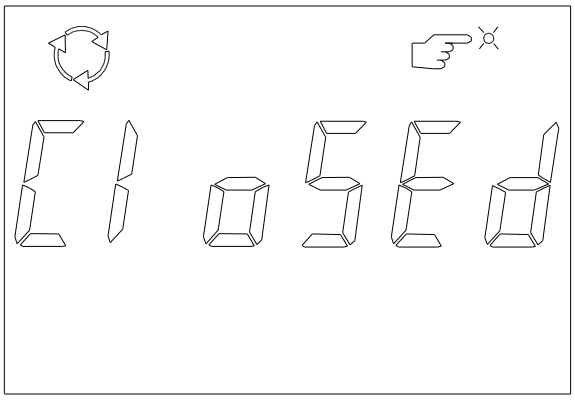
The year unit digit then starts flashing and is increased at every short press (possible values 0-9) on the SCROLL button. When the chosen value is confirmed by pressing the SET button the new date is set.



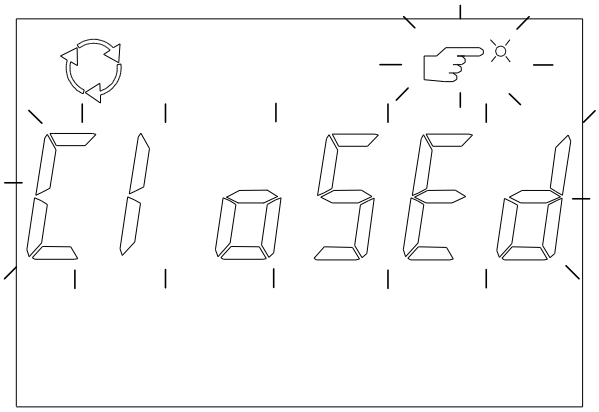
2.7.3.4 Communication port

Allows opening the communication port for setting date/time and programming of the tariff switch schedule.

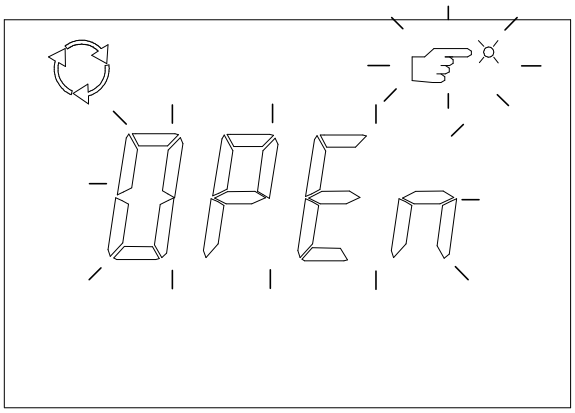
When the SET button is pressed while the state of communication port access rights is displayed in Set mode



the "hand" symbol (☞) and the current state starts flashing



For every short press on the SCROLL button the state switches between "open" and "closed"



When the chosen state is confirmed by pressing the SET button the state is set.

2.8 PULSE OUTPUT

As an option the DELTAsingle meter can be equipped with an pulse output for active energy. The pulse output sends out a certain amount of pulses per kilowatt hour.

The pulse output is galvanically isolated from the rest of the electronics in the meter.
It fulfil the the IEC standard 62053-31 and DIN 43 864 standard (often called S0).

The output have a maximum voltage and current specified to 40 Volt DC and 100 mA. It is built with a transistor and an optocoupler of transistor type and is polarity dependent. The equivalent circuitry of the output is depicted below.

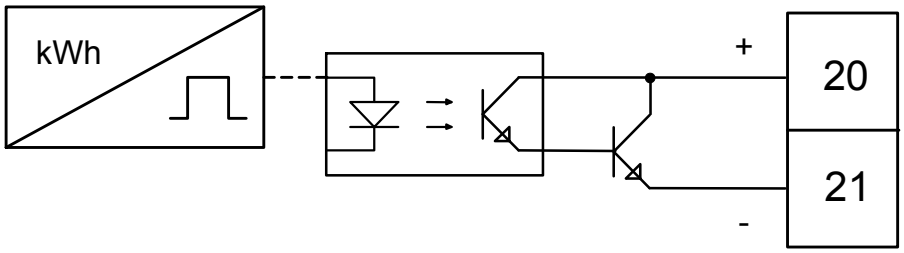


Fig. 2-14 Pulse output equivalent schematic diagram

2.9 ELECTRONICS

The energy measuring is realized electronically, see figure below where the electronics is depicted in a block diagram.

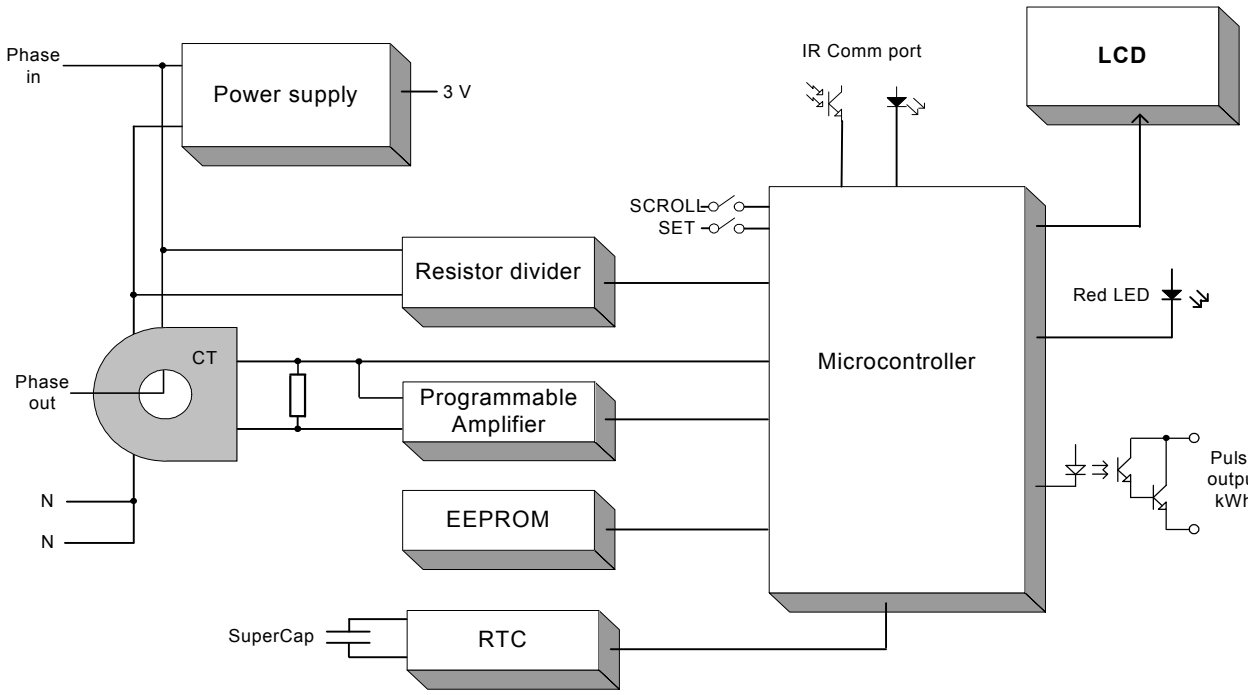


Fig. 2-15 Electronics block diagram

The meter hardware can be divided into the following parts:

- A microcontroller that performs the energy calculation. The voltage and current signals are sampled by A/D-converters incorporated in the microcontroller and multiplied together digitally to get the energy. The meter is calibrated via registers to fulfill the accuracy class requirements stated in IEC 62053-21. The microcontroller also handles the real-time clock (RTC), LCD, EEPROM, 2 buttons, red LED, programmable amplifier, infrared (IR) communication interface and the pulse output.

- An LCD (Liquid Crystal Display) for display of accumulated energy, time/date, status information etc.

- The current is measured with a current transformer (CT) through which the current to measure flows. The output current from the transformer flows through a load resistor which produces a voltage which is fed to the microcontroller. At low currents the signal is amplified with a programmable amplifier.

- The mains voltage is divided by a resistor divider and fed into the microcontroller.

- 2 push buttons called SCROLL and SET to control the display on the LCD and for programming of time and date etc. The SCROLL button is in most cases used to display the next quantity or item in a sequence, whereas the SET button is used for programming the meter.

- A power supply that generate a voltage that feeds the electronics (microcontroller, EEPROM etc).

- A real-time clock (option) that keeps track of time and date. The time and date is used to control the tariff switching and for storing the energy values on a monthly basis.

- A super capacitor that serves as power backup for the real-time clock when the mains voltage is absent (meters with internal clock only).
- A red LED (Light Emitting Diode) that flashes with a certain energy pulse frequency (impulses/kWh).
- An optoisolated pulse output which give a certain amount of pulses per kWh (option).
- EEPROM for storing energy (1 total and up to 4 tariff registers for active energy), calibration- and initialization values for the microcontroller and for meter specific values which are used by the firmware in the microcontroller.
- An infra-red communication interface consisting of a phototransistor and a LED for connection to an external communication unit.

2.10 DIMENSIONS

Below the dimensions for the meter are displayed. The dimensions in the terminal block conform to the standard DIN 43857.

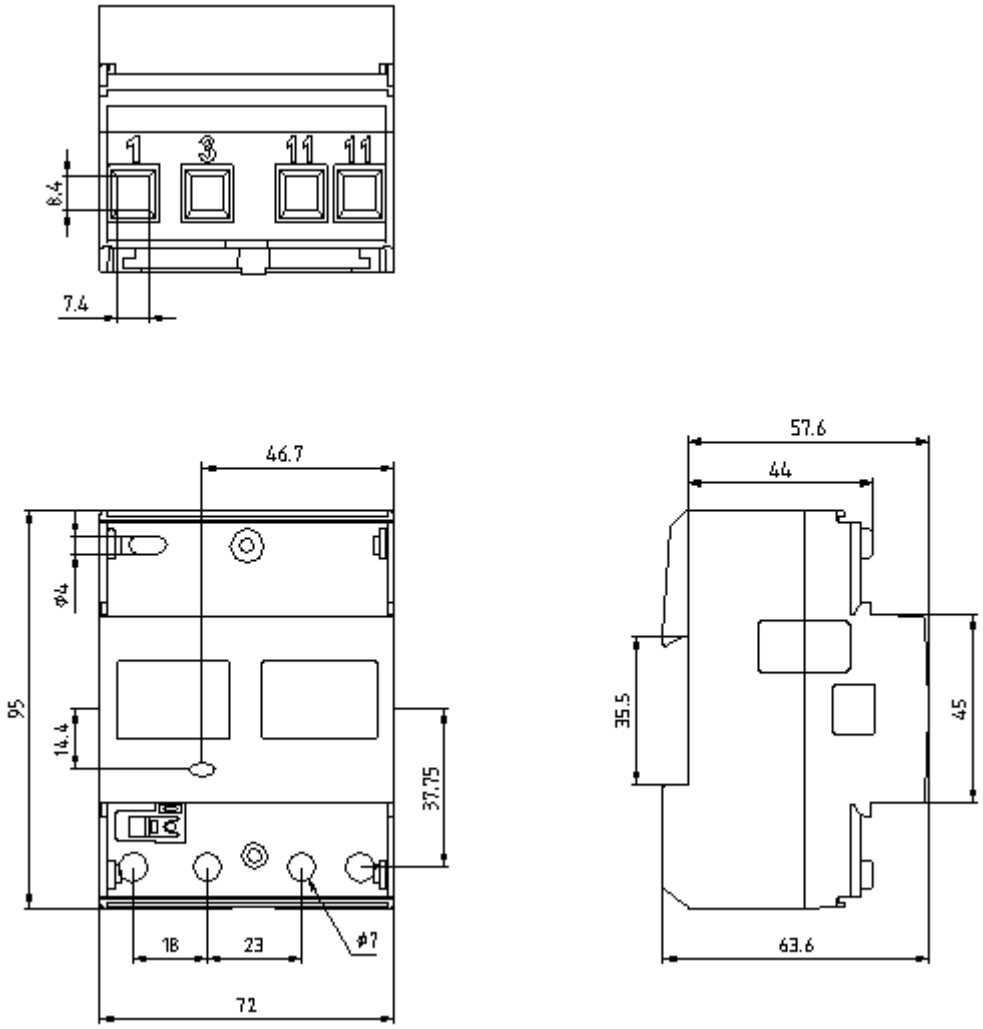


Fig. 2-16 Meter dimensions

3 TECHNICAL DATA

3.1 VOLTAGE/CURRENT INPUTS

Nominal voltage: 220-240 V
Voltage range: -20% to +15% of nominal voltage.
Power dissipation voltage circuit: 1.3 VA
Power dissipation current circuit: Less than I^2 * k VA where I is current in amperes and k is less than 0.0005 (typically 0.00015)
Current: Base current 10 A, maximum current 80 A
Starting current: 25 mA
Terminal wire area: 4.0 - 25 mm^2
Recommended tightening torque: 4 Nm

3.2 GENERAL DATA

Frequency: 50/60 Hz ± 5%
Accuracy: According to IEC 62052-11, IEC 62053-21 Cl. 1
EN 50470-1, EN 50470-3 category A & B

Display of energy: LCD with 6 digits, height 6 mm

3.3 MECHANICAL DATA AND TESTS

Material: Polycarbonate in transparent top. Glass reinforced polycarbonate in bottom.
Protection class: II
Glow wire test according to IEC 695-2-1
Dust and water protection acc. to IEC 60529 protection class IP51 mounted in protective enclosure
IP20 on terminal block without protective enclosure
Weight: 0.217 kg

3.4 ENVIRONMENT DATA AND TESTS

Operating temperature range: -40°C to +55°C
Storage temperature range: -40°C to +70°C
Humidity: 75% yearly average, 95% on 30 days/year
Resistance to heat and fire: Terminal 960°C, cover 650°C (IEC 60695-2-11)

3.5 PULSE OUTPUT (OPTION)

Current: 0 - 100 mA
Voltage: max 40 V DC (polarity dependent)
Terminal wire area: 0 - 2.5 mm^2
Pulse output freq: 100 imp/kWh as standard
Pulse width: 100 ms as standard
Recommended tightening torque: 0.5 Nm

3.6 VISIBLE PULSE INDICATOR

Red LED with frequency: 1000 imp/kWh
Pulse width: 40 ms

3.6.1 STANDARDS

IEC 62052-11, IEC 62053-21 Measurement instrument directive (MID), category A & B, electrical environmental class E2 and electrical environmental class M2
EN 50470-1, EN 50470-3 category A & B

Pulse output according to IEC 62053-31 (S0, DIN 43864)
Time keeping according to IEC 62054-21

3.7 ELECTROMAGNETIC COMPATIBILITY (EMC) AND INSULATION PROPERTIES

According to IEC 62052-11, IEC 62053-21:
Impulse voltage test: 6 kV 1.2/50μs (IEC 600-60).
Fast transient burst test: 4 kV (IEC 61000-4-4).
Immunity to electromagnetic HF-Fields: 80 MHz - 2 GHz at 10 V/m (IEC61000-4-3)
Immunity to conducted disturbance: 150kHz – 80MHz (IEC 61000-4-6)
Radio frequency emission according to CISPR 22 class B
Electrostatic discharge (ESD): 15 kV for (IEC 61000-4-2).

3.8 CLOCK (OPTION)

Clock backup: Super Cap. 48h
Clock accuracy: Using net frequency: ±5s / 30 days at nominal frequency and normal operating conditions.
Using crystal: ±0.5s / day at reference temperature.
Temperature dependence: ±0.15s / °C / day.
In backup: ±1s / day at reference temperature.
Temperature dependence: ±0.30s / °C / day.

4 INSTALLATION

WARNING! The voltages connected to the DELTAsingle are dangerous and can be lethal. Therefore all voltages must be switched off when installing the DELTAsingle.

4.1 MOUNTING

The DELTAsingle can be mounted in different ways. Below is described the most common ways.

For some of the mounting alternatives additional accessories are needed (for part numbers see chapter 7).

4.1.1 DIN-RAIL MOUNTED

The DELTAsingle is aimed to be mounted on a DIN-rail designed according to the standard CEI/IEC 715. In this case no extra accessories are needed and the meter is fastened on the rail so that the metal snap piece on the back of the meter snaps onto the rail.

4.1.2 WALL MOUNTED

The recommended way to mount the meter on a wall is to mount a separate DIN rail (see picture below) on the wall and mount the meter on this.

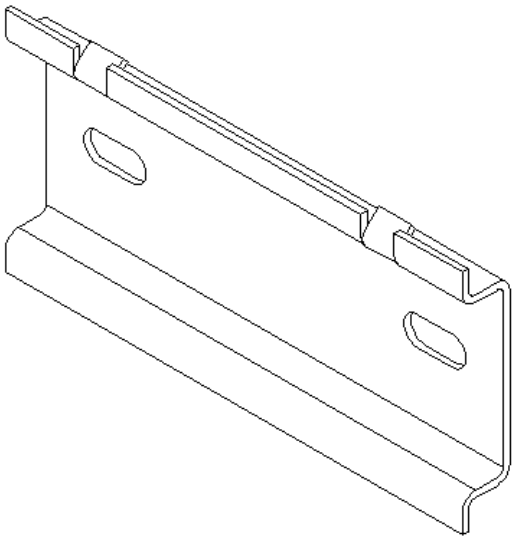


Fig. 4-1 DIN-rail used for wall mounting

4.2 WIRING DIAGRAMS

Below is described how to connect the meters to the electricity network. The DELTAsingle must always be protected by fuses on the incoming side.

4.2.1 VOLTAGE AND CURRENT

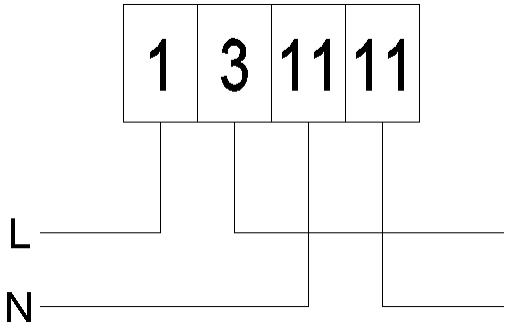


Fig. 4-2 Wiring diagram

4.2.2 PULSE OUTPUT (WHEN APPLICABLE)

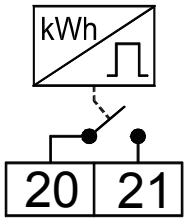


Fig. 4-3 Pulse output connection diagram

5 MEASUREMENT METHOD

The DELTAsingle is a direct connected single phase meter measuring the active energy consumption in a 2-wire installation, see figure below.

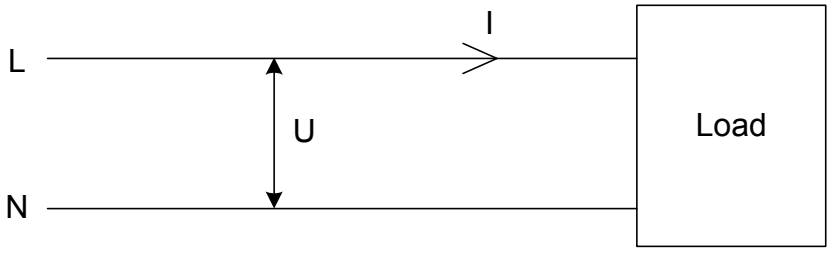


Fig. 5-1 Single phase measurement.

The metering calculation in the meter is done digitally by a microcontroller according to the formula:

$$E = \sum_{n=0,1,2...} k \bullet u(n \bullet T) \bullet i(n \bullet T)$$

k is a calibration constant, u the voltage and i the current. The voltage and current signals are sampled regularly (once every time interval T) by an analog-to-digital converter and via software multiplied together to give an amount of energy. This energy is accumulated to an energy register E which keeps track of the total energy (or accumulated in several registers if it is tariff meter).

6 COMMUNICATION

Reading a meter through a communication interface gives a number of advantages compared to manual reading:

- The time it takes to read a number of meters is much shorter. This makes it also possible to perform continuous readings.
- The risk of getting wrong values because of mistakes during manual reading is reduced to a minimum.
- The values are stored electronically, which makes it easier to process them further.

All DELTAsingle have an optical interface on the left side of the meter. For communication via the optical interface the M-Bus protocol is used.

This chapter describes the M-Bus communication.

6.1 M-BUS

The M-Bus (Meter Bus) is a bus system for the remote reading of meters. It is a master-slave system for communication on twisted pair where all meters are slaves.

6.1.1 COMMUNICATION OBJECTS

Register	Description
Active Energy, Total	Total cumulative Active Energy (current and stored)
Active Energy, Tariff 1	Cumulative Active Energy Tariff 1 (current and stored)
Active Energy, Tariff 2	Cumulative Active Energy Tariff 2 (current and stored)
Active Energy, Tariff 3	Cumulative Active Energy Tariff 3 (current and stored)
Active Energy, Tariff 4	Cumulative Active Energy Tariff 4 (current and stored)
Power fail counter	Read and reset power fail counter
Current tariff	Read current tariff
Manufacturer	Manufacturer information
Error flags	Read and reset error flags
Tariff switch table	Read and write tariff structure
Time & Date	Read and set time and date
Password	Give and change password

6.1.2 PHYSICAL INTERFACE

The physical interface allows serial half-duplex asynchronous communication. Since the bus has a master-slave structure, where there must and can be only one master, the meters cannot communicate with each other.

6.1.2.1 Optical interface

The DELTAsingle has an optical interface located on the left side. Physical characteristics of the interface correspond to the standard IEC 61107. Communication speed is 2400 bps.

6.1.3 PROTOCOL DESCRIPTION

The M-Bus protocol is based on the international standard IEC 870, but it do not use all of the specified functions.

When there is no communication on the bus it is in Mark-state.
Each communicated byte consists of eleven bits. The bits are one start-bit (space), eight data bits, one parity bit (even) and one stop bit (mark). The least significant bit is transmitted first.

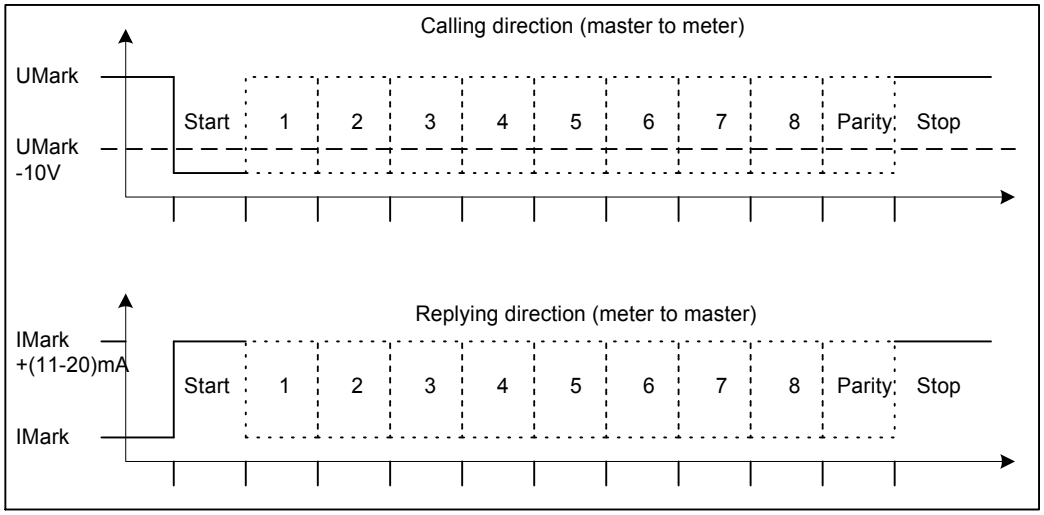


Fig. 6-1 Transmission of a Character in Calling and Replying Direction

6.1.3.1 Telegram formats

The telegram formats are structured according to format class FT1.2. The FT1.2 format fulfils the data integrity class I2, including a Hamming Distance of four. Three telegram formats are used. The start character identifies the different telegram formats.

Single Character	Short Frame	Long Frame
E5h	Start (10h)	Start (68h)
	C-field	L-field
	A-field	L-field
	Check Sum	Start (68h)
	Stop (16h)	C-field
		A-field
		CI-field
		User Data (0-252 byte)
		Check Sum
		Stop (16h)

Telegram Formats

- **Single Character** - The Single Character format consists of a single character (E5h) and is used to acknowledge received telegrams.
- **Short Frame** - The Short Frame format is identified by its start character (10h) and consists of five characters. Besides the C- and A-fields it includes the checksum and the stop character 16h.
- **Long Frame** - The Long Frame format is identified by its start character (68h) and consists of a variable number of characters. After the start character the L-field is transmitted twice, then the start character once again followed by the C-, A- and CI-fields. The user data (0 - 252 bytes) is transmitted after the CI-field followed by the check sum and the stop character (16h).

6.1.3.1.1 Field descriptions

All fields used in the telegram frames have a length of one byte (8 bits).

- Length Field (L-field)
The L-field gives the quantity of the user data inputs plus 3 (for the C-, A- and CI-fields). It is transmitted twice in telegrams using the long frame format.

- Control Field (C-field)
The C-field contains information of the direction of the data flow, error handling and besides labeling the functions and the actions caused by them, the control field specifies the direction of data flow, and is responsible for various additional tasks in both the calling and replying directions.

Bit number	7	6	5	4	3	2	1	0
To the meter	0	PRM	FCB	FCV	F3	F2	F1	F0
From the meter	0	PRM	0	0	F3	F2	F1	F0

Coding of the Control Field

- The primary message bit (PRM) is used to specify the direction of data flow. It is set to 1 when a telegram is sent from a master to the meter and to 0 in the other direction.
- The frame count bit valid (FCV) is set to 1 by the master to indicate that the frame count bit (FCB) is used. When the FCV is set to 0, the meter ignores the FCB.
- The FCB is used to indicate successful transmission procedures. A master shall toggle the bit after a successful reception of a reply from the meter. If the expected reply is missing, or the reception of it is faulty, the master resends the same telegram with the same FCB. The meter answers, to a REQ_UD2-request with toggled FCB and a set FCV, with a RSP_UD containing the next telegram of a multi-telegram answer. If the FCB is not toggled it will repeat the last telegram. The actual values will be updated in a repeated telegram. On receipt of a SND_NKE the meter clears the FCB. The meter uses the same FCB for primary addressing, secondary addressing and point-to-point communication.
- The bits 0 to 3 (F0, F1, F2 and F3) of the control field are the function code of the message.

Name	C-field (binary)	C-field (hex)	Telegram	Description
SND_NKE	0100 0000	40	Short Frame	Initialization of Meter
SND_UD	01F1 0011	53/73	Long Frame	Send User Data to Meter
REQ_UD2	01F1 1011	5B/7B	Short Frame	Request for Class 2 Data
RSP_UD	0000 1000	08	Long Frame	Data Transfer from Meter to Master after Request

Function Codes

- Address Field (A-field)
The address field is used to address the recipient in the calling direction, and to identify the sender of information in the receiving direction. The size of this field is one byte, and can therefore take values from 0 to 255.
- The address 0 is given to meters at manufacturing.
- The addresses 1 to 250 are given to the meters as individual primary addresses. The address can be set either via the bus or via the buttons (see chapter 2.7.3). The primary address can be viewed in *Alternative Mode* and is displayed as "Adr xxx" with xxx being the primary address.
- The addresses 251 and 252 are reserved for future use.
- The address 253 (FDh) is used by the secondary addressing procedure.
- The address 254 (FEh) is used for point-to-point communication. The meter replies with its primary address.
- The address 255 (FFh) is used for broadcast transmissions to all meters. None of the meters replies to a broadcast message.

- Control Information Field (CI-field)
The CI-field codes the type and sequence of application data to be transmitted in the frame. Bit two (counting begins with bit 0, value 4), called M-bit or Mode bit, in the CI-field gives information about the used byte sequence in multi-byte data structures. For communication with the DELTAsingle meter, the

Mode bit shall not be set (Mode 1) meaning the least significant byte of a multi-byte record is transmitted first.

CI	Application
51h	Data send
52h	Selection of slaves

CI-field codes to use by the master

The meter uses code 72h in the CI-field for responses to requests for user data.

-User Data
The User Data contains the data to be sent to the recipient.

Fixed Data Header	Data Records	MDH
12 Byte	Variable number of bytes	1 Byte

Structure of the User Data meter to master

Data Records
variable number of bytes

Structure of the User Data master to meter

Fixed Data Header

Identification No	Manufacturer	Version	Medium	Access No	Status	Signature
4 Byte	2 Byte	1 Byte	1 Byte	1 Byte	1 Byte	2 Byte

Structure of the Fixed Data Header

- **Identification Number** is the 8-digit serial number of the meter (BCD coded).
- **Manufacturer** is set to 0442h meaning ABB.
- **Version** specifies the version of the protocol implementation.
- **Medium** byte is set to 02h to indicate electricity.
- **Access Number** is a counter that counts successful accesses.
- **Status** byte is used to indicate the meter status.

Bit	Meaning
0	Meter busy
1	Internal error
2	Power low
3	Permanent error
4	Temporary error
5	Installation error [1)]
6	NOT USED
7	NOT USED

[1)] DELTAsingle specific

- **Signature** is set to 00 00h.

Data Records
The data, together with information regarding coding, length and the type of data is transmitted in data records. The maximum total length of the data records is 234 bytes.

Data Record Header (DRH)				Data
Data Information Block (DIB)		Value Information Block (VIB)		
DIF	DIFE	VIF	VIFE	
1 Byte	0-10 Bytes	1 Byte	0-10 Bytes	0-n Bytes

Structure of a Data Record (transmitted from left to right)

Each data record consists of a data record header (DRH) and the actual data. The DRH in turn consists of the data information block (DIB) to describe the length, type and coding of the data, and the value information block (VIB) to give the value of the unit and the multiplier.

Data Information Block (DIB)
The DIB contains at least one byte (Data Information Field, DIF), and is in some cases expanded with, a maximum of 10, DIFE's (Data Information Field Extension).

Bit 7	6	5	4	3	2	1	0
Extension Bit	LSB of storage number	Function Field		Data Field : Length and coding of data			

Structure of the Data Information Field (DIF)

- The **Extension Bit** is set when next byte is a DIFE.
- The **LSB of storage number** is normally set to 0 to indicate actual value (1 = stored value).
- The **Function Field** is always set to 00 indicating instantaneous value.
- The **Data Field** shows the format of the data.

Code	Meaning	Length in Byte
0000	No data	0
0001	8 Bit Integer	1
0010	16 Bit Integer	2
0100	32 Bit Integer	4
0111	64 Bit Integer	8
1010	4 digit BCD	2
1011	6 digit BCD	3
1100	8 digit BCD	4
1101	Variable length (ASCII)	Variable
1110	12 digit BCD	6

Coding of the Data Field

Bit 7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Extension Bit	Unit	Tariff		Storage Number			

Structure of the Data Information Field Extension (DIFE)

- The **Extension Bit** is set when next byte is a DIFE.
- **Unit** is used on power and energy values to tell what type of power/energy the data is.
- **Tariff** is used on energy values to give tariff information. (0 = Total, 1-4 = Tariff 1-4)
- **Storage Number** is normally set to 0 to indicate actual value. (>0 = stored value)

- **Value Information Block (VIB)**

The VIB follows a DIF or DIFE without a set extension bit. It contains one Value Information Field (VIF) and is in some cases expanded with up to 10, Value Information Field Extensions (VIFE).

Bit 7	6	5	4	3	2	1	0
Extension Bit	Value Information						

Structure of the Value Information Field (VIF)

Value Information contains information about the value (unit, status etc).
The Extension Bit is set when next byte is a VIFE.

In case of VIFE = FFh the next VIFE is manufacturer specific. The manufacturer specific VIFE has the same construction as a VIF. If the extension bit, of the manufacturer specific VIFE, is set the next byte is a standard VIFE otherwise it is the first data byte.

VIF-Code	Description	Range Coding	Range
E000 0nnn	Energy	$10^{(nnn-3)}$ Wh	0.001Wh to 10000Wh
E111 1010	Bus Address		0 to 250
E110 1101	Time Point	Time & Date	See telegrams 6.1.5.2
1111 1011	Extension of VIF-codes		Not used by DELTAsingle
1111 1101	Extension of VIF-codes		True VIF is given in the first VIFE and is coded using Table FD
1111 1111	Manufacturer Specific		Next VIFE is manufacturer specific

Codes for Value Information Field (VIF)

Codes for Value Information Field Extension (VIFE) used with extension indicator FDh
If the VIF contains the extension indicator FDh the true VIF is contained in the first VIFE.

VIFE-Code	Description
E001 0110	Password
E001 0111	Error Flags (binary)

Table FD

Codes for Value Information Field Extension (VIFE)
The following values for VIFE's are defined for an enhancement of VIF's other than FDh and FBh:

VIFE-Code	Description
E110 1011	Date / Time of
1111 1111	Next VIFE is manufacturer specific

Manufacturer specific VIFE-Codes

VIFE-Code	Description
E001 0011	Tariff

VIFE-Codes for reports of record errors (meter to master)

VIFE-Code	Type of Record Error	Error Group
E000 0000	None	
E001 0101	No data available (undefined value)	
E001 1000	Data error	Data Errors

VIFE-Codes for object actions (master to meter)

VIFE-Code	Action	Description
E000 0000	Write (Replace)	Replace old with new data
E000 0111	Clear	Set data to zero
E000 1101	Disable	Delete from readout

Data
The Data follows a VIF or a VIFE without the extension bit set.

Manufacturer Data Header (MDH)
The manufacturer data header (MDH) is made up by the character (0Fh or 1Fh). 1Fh indicates that more data will follow in the next telegram. 0Fh indicates that all data has been read.

Manufacturer specific data
Manufacturer specific data is sent immediately after the MDH. In DELTAsingle this is used for handling reading and writing the tariff structure. The commands are sent using SND_UD. The syntax for the commands is [VIF (2 bytes)][data (0-196 bytes)].

- **Write tariff structure**. The VIF for this command is 80 1A. The data to be sent is the first 196 bytes of the tariff structure.

- **Continue write tariff structure**. The VIF for this command is 80 1B. The data to be sent is the remaining part of the tariff structure with a maximum of 196 bytes at a time.

- **Read tariff structure**. The VIF for this command is 80 1C. With this command no data is sent. The tariff structure is read from the meter using REQ_UD2 until the entire tariff structure is received.

The procedure for sending a new tariff structure to the meter is:
1. Master: Send Password
2. Meter: Confirm with ACK
3. Master: Send Write tariff structure
4. Meter: Confirm with ACK
5. Master: Send Continue write tariff structure
6. Meter: Confirm with ACK

-Check Sum
The Check Sum is used to recognize transmission and synchronization faults. It is calculated from the arithmetical sum, of the bytes from the control field to the last user data, without taking carry digits into account.

6.1.3.2 Communication process

The Data Link Layer uses two kinds of transmission services:

Send / Confirm	SND / CON
Request / Respond	REQ / RSP

After the reception of a correct telegram the meter waits maximum 180ms before answering. A received telegram is considered as correct if it passes the following tests:

- Start /Parity /Stop bits per character
- Start /Check Sum /Stop characters per telegram format
- The second Start character, the parity of the two field lengths, and the number of additional characters received (= L Field + 6) with a long frame

Send / Confirm Procedure

SND_NKE

This procedure serves to start up after the interruption or beginning of communication. If the meter was selected for secondary addressing it will be deselected. The value of the frame count bit FCB is cleared in the meter, i.e. it expects that the first telegram from a master with FCV=1 contains a FCB=1. The meter either confirms a correct reception with the single character acknowledge (E5h) or omits the confirmation if it did not receive the telegram correctly.

SND_UD

This procedure is used to send user data to the meter. The meter either confirms a correct reception with the single character acknowledge (E5h) or omits the confirmation if it did not receive the telegram correctly.

Request / Respond Procedure

REQ_UD2 / RSP_UD

The master requests data from the meter using the REQ_UD2 telegram. The meter will either transfer its data with RSP_UD, or gives no response indicating that the request has not been received correctly or that the address does not match. The meter indicates to the master that there is more data in the next telegram by sending 1Fh as the last user data.

6.1.3.2.1 Selection and Secondary Addressing

It is possible to communicate with the meter using secondary addressing. The secondary addressing takes place with help of a selection:

68h	0Bh	0Bh	68h	53h	FDh	52h	ID1-4	Man 1-2	Gen	Med	CS	16h

Structure of a telegram for selecting a meter

The master sends a SND_UD with the control information 52h to the address 253 (FDh) and fills the specific meter secondary address (identification number, manufacturer, version and medium) with the values of the meter that is to be addressed. The address FDh and the control information 52h is the indication for the meter to compare the following secondary address with its own, and to change into the selected state should it match. In this case the meter answers the selection with an acknowledgement (E5h), otherwise it doesn't reply. Selected state means that the meter can be addressed with the bus address 253 (FDh).

During selection individual positions of the secondary addresses can be occupied with wildcards. Such a wildcard means that this position will not be taken into account during selection. In the identification number each individual digit can be wild-carded by a wildcard nibble Fh while the fields for manufacturer, version and medium can be wild-carded by a wildcard byte FFh.

The meter will remain selected until it receives a selection command with non-matching secondary addresses, a selection command with CI=56h, or a SND_NKE to address 253.

6.1.4 TELEGRAMS

The communication can be divided in two parts. One part is reading data from the meter and the other part is sending data to it. This section describes typical telegrams sent to and received from the DELTAsingle.

The data readout procedure starts when the master sends a REQ_UD2 telegram to the meter. The meter responds with a RSP_UD telegram. A typical readout is a multi-telegram readout. The last DIF in the user data part of the telegram is 1F to indicate that there is more data in the next telegram.

Using SND_UD telegrams data can be sent to the meter. The following is possible to perform with SND_UD telegrams:

- Set RTC time and date
- Set RTC date
- Set primary address
- Password
- Change Password
- Reset error flags
- Disable error flags
- Reset power fail counter
- Switch to/from crystal drive
- Write tariff structure
- Continue write tariff structure
- Read tariff structure
- Close meter

6.1.5 MINIMUM REQUEST TIME

It is not possible for the master to send several REQ_UD2 telegram to the meter without allowing for a small delay. This delay is dependent on the main voltage. The table below shows the allowed minimum time between requests. A second request sent within the minimum allowed time will be ignored by the meter.

Voltage(VAC)	*Minimum time (ms)*
220-280	50
215	**150**
210	150
205	**250**
200	250
195	**350**
190	350
185	**450**
180	450
175	**550**
170	Not possible

6.1.5.1 Read out telegrams

First telegram (containing current data) at normal read out (REQ_UD2) *)

Byte No	Size (in bytes)	Value	Description	Explanation
1	1	68	Start character	[always same]
2	1	6E	L-field, calculated from C field to last user data	0x6E = 110 bytes (byte no 5 to 114)
3	1	6E	L-field, repeated	[same as above]
4	1	68	Start character	[always same]
5	1	08	C-field, RSP_UD	0000 1000 | | | | ++++- Function, 8 = User data | | | +-------- DFC, 0 = can accept further data | | +--------- ACD, 0 = class 2 data | +---------- Direction, 0 = from meter +---------- [always 0]
6	1	xx	A-field, address	Primary address 1-250, 0 = No primary address
7	1	72	CI-field, variable data respond, LSB first	0111 0010 ++++ +|++- Variable data respond +---- Mode 1 = LSB first
8-11	4	xxxxxxxx	Identification Number, 8 BCD digits	Serial number. LSB first, 12 34 56 78 sent as 78 56 34 12
12-13	2	4204	Manufacturer: ABB	ABB = 0442, LSB first gives 4204
14	1	10	Version	Protocol version, decided by ABB
15	1	02	Medium, 02 = Electricity	02 = electricity
16	1	xx	Number of accesses	Increased by 1 after every respond (RSP_UD)
17	1	xx	Status	00xx xxxx | | | | | | | +- Application busy | | | | | | +-- Any application error (application = internal) | | | | | +---- Power low | | | | +----- Permanent error | | | +-------- Temporary error | | +--------- Installation error (specific to manufacturer) | +---------- Not used (specific to manufacturer) +---------- Not used (specific to manufacturer)
18-19	2	0000	Signature (0000 = no encryption)	[always same]
20	1	0E	DIF size, 12 digit BCD	0000 1110 | | | | ++++- 12 digit BCD | | ++-------- Instantaneous value | +---------- LSB of storage number +---------- No DIFE follows
21	1	ED	VIF for timepoint with format s, m, h, D, M, Y	1110 1101 | | | | | | | +- Both time and date, not just date |+++ +++-- Timepoint +----------VIFE will follow
22	1	xx	VIFE, status	0xxx xxxx |+++ ++++- Error code +---------- No VIFE follows
23-28	6	xxxxxxxxxxxx	Time and date	s, m, h, D, M, Y
29	1	0E	DIF size, 12 digit BCD	0000 1110 | | | | ++++- 12 digit BCD | | ++-------- Instantaneous value | +---------- LSB of storage number +---------- No DIFE follows
30	1	84	VIF for units kWh with resolution 0,01kWh 2dec	1000 0100 | | | | |+++- 0b100 = 4, 10^(4-3) = 10 = 0.01k |+++ +----- Unit is Wh +---------- VIFE will follow
31	1	xx	VIFE, status	0xxx xxxx |+++ ++++- Error code +---------- No VIFE follows
32-37	6	xxxxxxxxxxxx	Active energy, Total	kWh with two decimals and LSB first

*) Notice that the telegram structure may differ in different protocol versions. Any remote reading system should decode the telegram according to M-Bus standard, not according to the specific telegram stated here.

Byte No	Size (in bytes)	Value	Description	Explanation
38	1	8E	DIF size, 12 digit BCD	1000 1110 | | | | ++++- 12 digit BCD | | ++-------- Instantaneous value | +---------- LSB of storage number +------------ DIFE will follow
39	1	10	Tariff 1	0001 0000 | | | | ++++- Storage number, continued | | ++-------- Tariff 1 | +---------- Same device, no sub unit +------------ No DIFE follows
40	1	84	VIF for units kWh with resolution 0,01kWh 2dec	1000 0100 | | | | |+++- 0b100 = 4, 10^(4-3) = 10 = 0.01k |+++ +----- Unit is Wh +------------ VIFE will follow
41	1	xx	VIFE, status	0xxx xxxx |+++ ++++- Error code +------------ No VIFE follows
42-47	6	xxxxxxxxxxxx	Active energy, Tariff 1	kWh with two decimals and LSB first
48	1	8E	DIF size, 12 digit BCD	1000 1110 | | | | ++++- 12 digit BCD | | ++-------- Instantaneous value | +---------- LSB of storage number +------------ DIFE will follow
49	1	20	Tariff 2	0010 0000 | | | | ++++- Storage number, continued | | ++-------- Tariff 2 | +---------- Same device, no sub unit +------------ No DIFE follows
50	1	84	VIF for units kWh with resolution 0,01kWh 2dec	1000 0100 | | | | |+++- 0b100 = 4, 10^(4-3) = 10 = 0.01k |+++ +----- Unit is Wh +------------ VIFE will follow
51	1	xx	VIFE, status	0xxx xxxx |+++ ++++- Error code +------------ No VIFE follows
52-57	6	xxxxxxxxxxxx	Active energy, Tariff 2	kWh with two decimals and LSB first
58	1	8E	DIF size, 12 digit BCD	1000 1110 | | | | ++++- 12 digit BCD | | ++-------- Instantaneous value | +---------- LSB of storage number +------------ DIFE will follow
59	1	30	Tariff 3	0011 0000 | | | | ++++- Storage number, continued | | ++-------- Tariff 3 | +---------- Same device, no sub unit +------------ No DIFE follows
60	1	84	VIF for units kWh with resolution 0,01kWh 2dec	1000 0100 | | | | |+++- 0b100 = 4, 10^(4-3) = 10 = 0.01k |+++ +----- Unit is Wh +------------ VIFE will follow
61	1	xx	VIFE, status	0xxx xxxx |+++ ++++- Error code +------------ No VIFE follows
62-67	6	xxxxxxxxxxxx	Active energy, Tariff 3	kWh with two decimals and LSB first

Byte No	Size (in bytes)	Value	Description	Explanation
68	1	8E	DIF size, 12 digit BCD	1000 1110 | | | | ++++- 12 digit BCD | | ++-------- Instantaneous value | +---------- LSB of storage number +---------- DIFE will follow
69-70	2	8010	Tariff 4	1000 0000 | | | | ++++- Storage number, continued | | ++-------- Tariff 4 (LSB) | +---------- Same device, no sub unit +---------- DIFE will follow
				0001 0000 | | | | ++++- Storage number, continued | | ++-------- Tariff 4 (MSB) | +---------- Same device, no sub unit +---------- No DIFE follows
71	1	84	VIF for units kWh with resolution 0,01kWh 2dec	1000 0100 | | | | |+++- 0b100 = 4, 10^(4-3) = 10 = 0.01k |+++ +----- Unit is Wh +---------- VIFE will follow
72	1	xx	VIFE, status	0xxx xxxx |+++ ++++- Error code +---------- No VIFE follows
73-78	6	xxxxxxxxxxxx	Active energy, Tariff 4	kWh with two decimals and LSB first
79	1	01	DIF size, 8 digit int	0000 0001 | | | | ++++- 8 digit int | | ++-------- Instantaneous value | +---------- LSB of storage number +---------- No DIFE follows
80-81	2	FF93	Active tariff	1111 1111 |+++ ++++- VIFE and data is manufacturer specific +---------- VIFE will follow
				1001 0011 |+++ ++++- Active tariff (decided by ABB) +---------- VIFE will follow
82	1	xx	VIFE, status	0xxx xxxx |+++ ++++- Error code +---------- No VIFE follows
83	1	0x	Currently active tariff	Currently active tariff
84	1	07	DIF size, 64 bit integer	0000 0111 | | | | ++++- 64 bit integer | | ++-------- Instantaneous value | +---------- LSB of storage number +---------- No DIFE follows
85-86	2	FD97	Error codes	1111 1011 ++++ ++++- True VIF according to table $FD follows in VIFE
				1001 0111 |+++ ++++- Error flags, binary +---------- VIFE will follow
87	1	xx	VIFE, status	0xxx xxxx |+++ ++++- Error code +---------- No VIFE follows
88-95	8	xxxxxxxxxxxx xxxx	Error flags, represented binary	Error flags, as defined by ABB

Byte No	Size (in bytes)	Value	Description	Explanation
96	1	01	DIF size, 8 bit integer	0000 0001 |||| ++++- 8 bit integer || ++-------- Instantaneous value | +---------- LSB of storage number +------------ No DIFE follows
97-98	2	FF98	Power fail counter	1111 1111 |+++ ++++- VIFE and data is manufacturer specific +------------ VIFE will follow
				1001 1000 |+++ ++++- Power fail counter (decided by ABB) +------------ VIFE will follow
99	1	xx	VIFE, status	0xxx xxxx |+++ ++++- Error code +------------ No VIFE follows
100	1	xx	Power fail counter	Number of power fails
101	1	0D	DIF size, variable length	0000 1101 |||| ++++- Variable length || ++-------- Instantaneous value | +---------- LSB of storage number +------------ No DIFE follows
102-103	2	FD8E	Firmware version	1111 1011 ++++ ++++- True VIF according to table $FD follows in VIFE
				1000 1110 |+++ ++++- Firmware version +------------ VIFE will follow
104	1	xx	VIFE, status	0xxx xxxx |+++ ++++- Error code +------------ No VIFE follows
105	1	08	ASCII string, 8 characters	0000 1000 ++++ ++++- ASCII string, 8 characters
106-113	8	xxxxxxxxxxxx xxxx	Firmware version	Firmware version with LSB first
114	1	xF	DIF this is the last telegram / More data can be read (monthly values)	000x 1111 |||| ++++- Special function ||| +-------- 0 = End of telegram ||| 1 = More data will follow in next telegram +++--------- [always same]
115	1	xx	CS checksum, calculated from C field to last data	Checksum on byte no 5 to 114
116	1	16	Stop character	[always same]

Following telegrams (containing stored data) at normal read out (REQ_UD2) *)

Byte No	Size (in bytes)	Value	Description	Explanation
1	1	68	Start character	[always same]
2	1	4E	L-field, calculated from C field to last user data	0x4E = 78 bytes (byte no 5 to 82)
3	1	4E	L-field, repeated	[same as above]
4	1	68	Start character	[always same]
5	1	08	C-field, RSP_UD	0000 1000 | | | | ++++- Function, 8 = User data | | | +-------- DFC, 0 = can accept further data | | +--------- ACD, 0 = class 2 data | +---------- Direction, 0 = from meter +----------- [always 0]
6	1	xx	A-field, address	Primary address 1-250, 0 = No primary address
7	1	72	CI-field, variable data respond, LSB first	0111 0010 ++++ +|++- Variable data respond +---- Mode 1 = LSB first
8-11	4	xxxxxxxx	Identification Number, 8 BCD digits	Serial number. LSB first, 12 34 56 78 sent as 78 56 34 12
12-13	2	4204	Manufacturer: ABB	ABB = 0442, LSB first gives 4204
14	1	10	Version	Protocol version, decided by ABB
15	1	02	Medium, 02 = Electricity	02 = electricity
16	1	xx	Number of accesses	Increased by 1 after every respond (RSP_UD)
17	1	xx	Status	00xx xxxx | | | | | | | +- Application busy | | | | | | +-- Any application error (application = internal) | | | | | +---- Power low | | | | +----- Permanent error | | | +-------- Temporary error | | +--------- Installation error (specific to manufacturer) | +---------- Not used (specific to manufacturer) +----------- Not used (specific to manufacturer)
18-19	2	0000	Signature (0000 = no encryption)	[always same]
20	1	xE	DIF size, 12 digit BCD	1x00 1110 | | | | ++++- 12 digit BCD | | ++-------- Instantaneous value | +---------- LSB of storage number +----------- DIFE will follow
21	1	0x	DIFE, storage number continued	0000 xxxx | | | | ++++- Storage number, continued | | ++-------- No tariff | +---------- Same device, no sub unit +----------- No DIFE follows
22	1	ED	VIF for timepoint with format s, m, h, D, M, Y	1110 1101 | | | | | | | +- Both time and date, not just date |+++ +++-- Timepoint +----------VIFE will follow
23	1	EB	VIFE, Timepoint here is valid for whole message. This energy was stored at end of month	1110 1011 | | | | | | | +- End of | | | | | +|--- First |+++ +--+-- Date / time of +----------VIFE will follow
24	1	xx	VIFE, status	0xxx xxxx |+++ ++++- Error code +----------- No VIFE follows
25-30	6	xxxxxxxxxxxx	Time and date, historical value. Midnight at first day in month, if not error/power fail then.	s, m, h, D, M, Y

*) Notice that the telegram structure may differ in different protocol versions. Any remote reading system should decode the telegram according to M-Bus standard, not according to the specific telegram stated here.

Byte No	Size (in bytes)	Value	Description	Explanation
31	1	xE	DIF size, 12 digit BCD	1x00 1110 | | | | ++++- 12 digit BCD | | ++-------- Instantaneous value | +---------- LSB of storage number +------------ DIFE will follow
32	1	0x	DIFE, storage number continued	0000 xxxx | | | | ++++- Storage number, continued | | ++-------- No tariff | +---------- Same device, no sub unit +------------ No DIFE follows
33	1	84	VIF for units kWh with resolution 0,01kWh 2dec	1000 0100 | | | | |+++- 0b100 = 4, 10^(4-3) = 10 = 0.01k |+++ +----- Unit is Wh +------------ VIFE will follow
34	1	xx	VIFE, status	0xxx xxxx |+++ ++++- Error code +------------ No VIFE follows
35-40	6	xxxxxxxxxxxx	Active energy, Total	kWh with two decimals and LSB first
41	1	xE	DIF size, 12 digit BCD	1x00 1110 | | | | ++++- 12 digit BCD | | ++-------- Instantaneous value | +---------- LSB of storage number +------------ DIFE will follow
42	1	1x	Tariff 1	0001 xxxx | | | | ++++- Storage number, continued | | ++-------- Tariff 1 | +---------- Same device, no sub unit +------------ No DIFE follows
43	1	84	VIF for units kWh with resolution 0,01kWh 2dec	1000 0100 | | | | |+++- 0b100 = 4, 10^(4-3) = 10 = 0.01k |+++ +----- Unit is Wh +------------ VIFE will follow
44	1	xx	VIFE, status	0xxx xxxx |+++ ++++- Error code +------------ No VIFE follows
45-50	6	xxxxxxxxxxxx	Active energy, Tariff 1	kWh with two decimals and LSB first
51	1	xE	DIF size, 12 digit BCD	1x00 1110 | | | | ++++- 12 digit BCD | | ++-------- Instantaneous value | +---------- LSB of storage number +------------ DIFE will follow
52	1	2x	Tariff 2	0010 xxxx | | | | ++++- Storage number, continued | | ++-------- Tariff 2 | +---------- Same device, no sub unit +------------ No DIFE follows
53	1	84	VIF for units kWh with resolution 0,01kWh 2dec	1000 0100 | | | | |+++- 0b100 = 4, 10^(4-3) = 10 = 0.01k |+++ +----- Unit is Wh +------------ VIFE will follow
54	1	xx	VIFE, status	0xxx xxxx |+++ ++++- Error code +------------ No VIFE follows
55-60	6	xxxxxxxxxxxx	Active energy, Tariff 2	kWh with two decimals and LSB first

Byte No	Size (in bytes)	Value	Description	Explanation
61	1	xE	DIF size, 12 digit BCD	1x00 1110 | | | | ++++- 12 digit BCD | | ++-------- Instantaneous value | +---------- LSB of storage number +---------- DIFE will follow
62	1	3x	Tariff 3	0011 xxxx | | | | ++++- Storage number, continued | | ++-------- Tariff 3 | +---------- Same device, no sub unit +---------- No DIFE follows
63	1	84	VIF for units kWh with resolution 0,01kWh 2dec	1000 0100 | | | | |+++- 0b100 = 4, 10^(4-3) = 10 = 0.01k |+++ +----- Unit is Wh +---------- VIFE will follow
64	1	xx	VIFE, status	0xxx xxxx |+++ ++++- Error code +---------- No VIFE follows
65-70	6	xxxxxxxxxxxx	Active energy, Tariff 3	kWh with two decimals and LSB first
71	1	xE	DIF size, 12 digit BCD	1x00 1110 | | | | ++++- 12 digit BCD | | ++-------- Instantaneous value | +---------- LSB of storage number +---------- DIFE will follow
72-73	2	8x10	Tariff 4	1000 xxxx | | | | ++++- Storage number, continued | | ++-------- Tariff 4 (LSB) | +---------- Same device, no sub unit +---------- DIFE will follow
				0001 0000 | | | | ++++- Storage number, continued | | ++-------- Tariff 4 (MSB) | +---------- Same device, no sub unit +---------- No DIFE follows
74	1	84	VIF for units kWh with resolution 0,01kWh 2dec	1000 0100 | | | | |+++- 0b100 = 4, 10^(4-3) = 10 = 0.01k |+++ +----- Unit is Wh +---------- VIFE will follow
75	1	xx	VIFE, status	0xxx xxxx |+++ ++++- Error code +---------- No VIFE follows
76-81	6	xxxxxxxxxxxx	Active energy, Tariff 4	kWh with two decimals and LSB first
82	1	xF	DIF this is the last telegram / More data can be read (more monthly values)	000x 1111 | | | | ++++- Special function | | | +-------- 0 = End of telegram, no DIFE will follow | | | 1 = More data will follow in next telegram +++--------- [always same]
83	1	xx	CS checksum, calculated from C field to last data	Checksum on byte no 5 to 82
84	1	16	Stop character	[always same]

6.1.5.2 Sending data to the meter

Set RTC time and date, MFS
(By ABB customized data format)

Byte No	Size (in bytes)	Value	Description	Explanation
1	1	68	Start character	[always same]
2	1	B	L-field, calculated from C field to last user data	No of bytes between byte no 5 and byte no 15
3	1	0B	L-field, repeated	[same as above]
4	1	68	Start character	[always same]
5	1	53/73	C-field, SND_UD	01x1 0011 | | | | ++++- Function, 3 = Send user data | | | +------- FCV, 1 = FCB is valid | | +--------- FCB, Alternate for successive transfers | +----------- Direction, 1 = to meter +------------ [always 0]
6	1	xx	A-field, address	Primary address 1-250, 0 = No primary address
7	1	51	CI-field, data send, LSB first	0101 0001 ++++ +|++- Data send +---- Mode, 0 = Mode 1 (LSB first)
8	1	0E	DIF size, 12 digit BCD	0000 1110 | | | | ++++- 12 digit BCD | | ++-------- Instantaneous value | +----------- LSB of storage number +------------ No DIFE follows
9	1	6D	VIF for timepoint with format s, m, h, D, M, Y	0110 1101 | | | | | | | +- Both time and date, not just date |+++ +++--- Timepoint +------------ No DIFE follows
10-15	6	xxxxxxxxxxxx	Time and date	s, m, h, D, M, Y
16	1	xx	CS checksum, calculated from C field to last data	Checksum on bytes between byte no 5 and byte no 15
17	1	16	Stop character	[always same]

Set RTC time and date

Byte No	Size (in bytes)	Value	Description	Explanation
1	1	68	Start character	[always same]
2	1	0A	L-field, calculated from C field to last user data	No of bytes between byte no 5 and byte no 13
3	1	0A	L-field, repeated	[same as above]
4	1	68	Start character	[always same]
5	1	53/73	C-field, SND_UD	01x1 0011 | | | | ++++- Function, 3 = Send user data | | | +------- FCV, 1 = FCB is valid | | +--------- FCB, Alternate for successive transfers | +----------- Direction, 1 = to meter +------------ [always 0]
6	1	xx	A-field, address	Primary address 1-250, 0 = No primary address
7	1	51	CI-field, data send, LSB first	0101 0001 ++++ +|++- Data send +---- Mode, 0 = Mode 1 (LSB first)
8	1	04	DIF size, 32 bit integer	0000 0100 | | | | ++++- 32 bit integer | | ++-------- Instantaneous value | +----------- LSB of storage number +------------ No DIFE follows
9	1	6D	VIF for timepoint with format m, h, D, M, Y	0110 1101 | | | | | | | +- Both time and date, not just date |+++ +++--- Timepoint +------------ No DIFE follows
10-13	4	xxxxxxxx	Time and date	m, h, D, M, Y formatted as data type F
14	1	xx	CS checksum, calculated from C field to last data	Checksum on bytes between byte no 5 and byte no 13
15	1	16	Stop character	[always same]

Set RTC date

Byte No	Size (in bytes)	Value	Description	Explanation
1	1	68	Start character	[always same]
2	1	07	L-field, calculated from C field to last user data	No of bytes between byte no 5 and byte no 11
3	1	07	L-field, repeated	[same as above]
4	1	68	Start character	[always same]
5	1	53/73	C-field, SND_UD	01x1 0011 | | | | ++++- Function, 3 = Send user data | | | +------- FCV, 1 = FCB is valid | | +--------- FCB, Alternate for successive transfers | +----------- Direction, 1 = to meter +------------ [always 0]
6	1	xx	A-field, address	Primary address 1-250, 0 = No primary address
7	1	51	CI-field, data send, LSB first	0101 0001 ++++ +|++- Data send +---- Mode, 0 = Mode 1 (LSB first)
8	1	02	DIF size, 16 bit integer	0000 0010 | | | | ++++- 16 bit integer | | ++-------- Instantaneous value | +----------- LSB of storage number +------------ No DIFE follows
9	1	6C	VIF for timepoint with format Y, M, D	0110 1100 | | | | | | | +- Just date, not time |+++ +++--- Timepoint +------------ No VIFE follows
10-11	2	xxxx	Date	D, M, Y formatted as data type G
12	1	xx	CS checksum, calculated from C field to last data	Checksum on bytes between byte no 5 and byte no 11
13	1	16	Stop character	[always same]

Set primary address

Byte No	Size (in bytes)	Value	Description	Explanation
1	1	68	Start character	[always same]
2	1	06	L-field, calculated from C field to last user data	No of bytes between byte no 5 and byte no 10
3	1	06	L-field, repeated	[same as above]
4	1	68	Start character	[always same]
5	1	53/73	C-field, SND_UD	01x1 0011 | | | | ++++- Function, 3 = Send user data | | | +------- FCV, 1 = FCB is valid | | +--------- FCB, Alternate for successive transfers | +----------- Direction, 1 = to meter +------------ [always 0]
6	1	xx	A-field, address	Primary address 1-250, 0 = No primary address
7	1	51	CI-field, data send, LSB first	0101 0001 ++++ +|++- Data send +---- Mode, 0 = Mode 1 (LSB first)
8	1	01	DIF size, 8 bit integer	0000 0001 | | | | ++++- 8 bit integer | | ++-------- Instantaneous value | +----------- LSB of storage number +------------ No DIFE follows
9	1	7A	VIF for bus address	0111 1010 |+++ ++++- Bus address +------------ No VIFE follows
10	1	xx	New primary address	New primary address, LSB first
11	1	xx	CS checksum, calculated from C field to last data	Checksum on bytes between byte no 5 and byte no 10
12	1	16	Stop character	[always same]

Password
(Sent before protected command)

Byte No	Size (in bytes)	Value	Description	Explanation
1	1	68	Start character	[always same]
2	1	0E	L-field, calculated from C field to last user data	No of bytes between byte no 5 and byte no 18
3	1	0E	L-field, repeated	[same as above]
4	1	68	Start character	[always same]
5	1	53/73	C-field, SND_UD	01x1 0011 | | | | ++++- Function, 3 = Send user data | | | +------- FCV, 1 = FCB is valid | | +--------- FCB, Alternate for successive transfers | +----------- Direction, 1 = to meter +------------ [always 0]
6	1	xx	A-field, address	Primary address 1-250, 0 = No primary address
7	1	51	CI-field, data send, LSB first	0101 0001 ++++ +|++- Data send +---- Mode, 0 = Mode 1 (LSB first)
8	1	07	DIF size, 64 bit integer	0000 0111 | | | | ++++- 64 bit integer | | ++-------- Instantaneous value | +----------- LSB of storage number +------------ No DIFE follows
9-10	2	FD16	VIF for password	0xFD = True VIF in next byte, coded according to extension table $FD
				0001 0110 |+++ ++++- Password +------------ No VIFE follows
11-18	8	xxxxxxxxxxxx xxxx	Current password	Current password, LSB first
19	1	xx	CS checksum, calculated from C field to last data	Checksum on bytes between byte no 5 and byte no 18
20	1	16	Stop character	[always same]

Change password

Byte No	Size (in bytes)	Value	Description	Explanation
1	1	68	Start character	[always same]
2	1	0F	L-field, calculated from C field to last user data	No of bytes between byte no 5 and byte no 19
3	1	0F	L-field, repeated	[same as above]
4	1	68	Start character	[always same]
5	1	53/73	C-field, SND_UD	01x1 0011 | | | | ++++- Function, 3 = Send user data | | | +------- FCV, 1 = FCB is valid | | +--------- FCB, Alternate for successive transfers | +----------- Direction, 1 = to meter +------------ [always 0]
6	1	xx	A-field, address	Primary address 1-250, 0 = No primary address
7	1	51	CI-field, data send, LSB first	0101 0001 ++++ +|++- Data send +---- Mode, 0 = Mode 1 (LSB first)
8	1	07	DIF size, 64 bit integer	0000 0111 | | | | ++++- 64 bit integer | | ++-------- Instantaneous value | +----------- LSB of storage number +------------ No DIFE follows
9-10	2	FD96	VIF for password	0xFD = True VIF in next byte, coded according to extension table $FD
				1001 0110 |+++ ++++- Password +------------ VIFE will follow
11	1	00	Replace with new	0000 0000 |+++ ++++- Replace old data with new +------------ No VIFE follows
12-19	8	xxxxxxxxxxxx xxxx	New password	New password, LSB first
20	1	xx	CS checksum, calculated from C field to last data	Checksum on bytes between byte no 5 and byte no 19
21	1	16	Stop character	[always same]

Reset error flags

Byte No	Size (in bytes)	Value	Description	Explanation
1	1	68	Start character	[always same]
2	1	0F	L-field, calculated from C field to last user data	No of bytes between byte no 5 and byte no 19
3	1	0F	L-field, repeated	[same as above]
4	1	68	Start character	[always same]
5	1	53/73	C-field, SND_UD	01x1 0011 | | | | ++++- Function, 3 = Send user data | | | +------- FCV, 1 = FCB is valid | | +--------- FCB, Alternate for successive transfers | +----------- Direction, 1 = to meter +------------ [always 0]
6	1	xx	A-field, address	Primary address 1-250, 0 = No primary address
7	1	51	CI-field, data send, LSB first	0101 0001 ++++ +|++- Data send +---- Mode, 0 = Mode 1 (LSB first)
8	1	07	DIF size, 64 bit integer	0000 0111 | | | | ++++- 64 bit integer | | ++-------- Instantaneous value | +----------- LSB of storage number +------------ No DIFE follows
9-10	2	FD97	Error codes	1111 1011 ++++ ++++- True VIF according to table $FD follows in VIFE 1001 0111 |+++ ++++- Error flags, binary +------------ VIFE will follow
11	1	07	Clear	0000 0111 |+++ ++++- Clear data +------------ No VIFE follows
12-19	8	xxxxxxxxxxxx xxxx	Error flags, represented binary	Error flags, as defined by ABB
20	1	xx	CS checksum, calculated from C field to last data	Checksum on bytes between byte no 5 and byte no 19
21	1	16	Stop character	[always same]

Disable error flags

Byte No	Size (in bytes)	Value	Description	Explanation
1	1	68	Start character	[always same]
2	1	0F	L-field, calculated from C field to last user data	No of bytes between byte no 5 and byte no 19
3	1	0F	L-field, repeated	[same as above]
4	1	68	Start character	[always same]
5	1	53/73	C-field, SND_UD	01x1 0011 | | | | ++++- Function, 3 = Send user data | | | +------- FCV, 1 = FCB is valid | | +--------- FCB, Alternate for successive transfers | +----------- Direction, 1 = to meter +------------ [always 0]
6	1	xx	A-field, address	Primary address 1-250, 0 = No primary address
7	1	51	CI-field, data send, LSB first	0101 0001 ++++ +|++- Data send +---- Mode, 0 = Mode 1 (LSB first)
8	1	07	DIF size, 64 bit integer	0000 0111 | | | | ++++- 64 bit integer | | ++-------- Instantaneous value | +----------- LSB of storage number +------------ No DIFE follows
9-10	2	FD97	Error codes	1111 1011 ++++ ++++- True VIF according to table $FD follows in VIFE 1001 0111 |+++ ++++- Error flags, binary +------------ VIFE will follow
11	1	0D	Disable	0000 1101 |+++ ++++- Delete data from readout +------------ No VIFE follows
12-19	8	xxxxxxxxxxxx xxxx	Error flags, represented binary	Error flags, as defined by ABB
20	1	xx	CS checksum, calculated from C field to last data	Checksum on bytes between byte no 5 and byte no 19
21	1	16	Stop character	[always same]

Reset power fail counter

Byte No	Size (in bytes)	Value	Description	Explanation
1	1	68	Start character	[always same]
2	1	07	L-field, calculated from C field to last user data	No of bytes between byte no 5 and byte no 11
3	1	07	L-field, repeated	[same as above]
4	1	68	Start character	[always same]
5	1	53/73	C-field, SND_UD	01x1 0011 | | | | ++++- Function, 3 = Send user data | | | +------- FCV, 1 = FCB is valid | | +--------- FCB, Alternate for successive transfers | +----------- Direction, 1 = to meter +------------ [always 0]
6	1	xx	A-field, address	Primary address 1-250, 0 = No primary address
7	1	51	CI-field, data send, LSB first	0101 0001 ++++ +|++- Data send +---- Mode, 0 = Mode 1 (LSB first)
8	1	00	DIF size, no data	0000 0000 | | | | ++++- No data | | ++-------- Instantaneous value | +----------- LSB of storage number +------------ No DIFE follows
9-10	2	FF98	Power fail counter	1111 1111 |+++ ++++- VIFE and data is manufacturer specific +------------ VIFE will follow
				1001 1000 |+++ ++++- Power fail counter (decided by ABB) +------------ VIFE follows
11	4	07	VIFE, clear counter	0000 0111 |+++ ++++- Clear data +------------ No VIFE follows
12	1	xx	CS checksum, calculated from C field to last data	Checksum on bytes between byte no 5 and byte no 11
13	1	16	Stop character	[always same]

Switch to/from crystal drive

Byte No	Size (in bytes)	Value	Description	Explanation
1	1	68	Start character	[always same]
2	1	07	L-field, calculated from C field to last user data	No of bytes between byte no 5 and byte no 11
3	1	07	L-field, repeated	[same as above]
4	1	68	Start character	[always same]
5	1	53/73	C-field, SND_UD	01x1 0011 | | | | ++++- Function, 3 = Send user data | | | +------- FCV, 1 = FCB is valid | | +--------- FCB, Alternate for successive transfers | +----------- Direction, 1 = to meter +------------ [always 0]
6	1	xx	A-field, address	Primary address 1-250, 0 = No primary address
7	1	51	CI-field, data send, LSB first	0101 0001 ++++ +|++- Data send +---- Mode, 0 = Mode 1 (LSB first)
8	1	01	DIF size, 8 bit integer	0000 0001 | | | | ++++- 8 bit integer | | ++-------- Instantaneous value | +----------- LSB of storage number +------------ No DIFE follows
9-10	2	FF6B	VIF for change meter communication status	1111 1111 |+++ ++++- VIFE and data is manufacturer specific +------------ VIFE will follow
				0110 1011 |+++ ++++- Change RTC status (decided by ABB) +------------ No VIFE follows
11	4	0x	01 = Use net frequency 02 = Use internal crystal	0000 00xx | | | | | | ++ Setting ++++ ++--- [always same]
12	1	xx	CS checksum, calculated from C field to last data	Checksum on bytes between byte no 5 and byte no 11
13	1	16	Stop character	[always same]

Write tariff structure *)

Byte No	Size (in bytes)	Value	Description	Explanation
1	1	68	Start character	[always same]
2	1	CA	L-field, calculated from C field to last user data	No of bytes between byte no 5 and byte no 206
3	1	CA	L-field, repeated	[same as above]
4	1	68	Start character	[always same]
5	1	53/73	C-field, SND_UD	01x1 0011 | | | | ++++- Function, 3 = Send user data | | | +------- FCV, 1 = FCB is valid | | +--------- FCB, Alternate for successive transfers | +----------- Direction, 1 = to meter +------------ [always 0]
6	1	xx	A-field, address	Primary address 1-250, 0 = No primary address
7	1	51	CI-field, data send, LSB first	0101 0001 ++++ +|++- Data send +---- Mode, 0 = Mode 1 (LSB first)
8	1	0F	DIF, manufacturer specific data follows	0000 1111 |+++ ++++- Manufacturer specific data +------------ No DIFE follows
9-10	2	801B	VIF for write tariff structure	1000 0000 |+++ ++++- [always same] +------------ VIFE will follow
				0001 1011 |+++ ++++- Write tariff structure (decided by ABB) +------------ No VIFE follows
11-206	196	xxxxx…		Tariff data
207	1	xx	CS checksum, calculated from C field to last data	Checksum on bytes between byte no 5 and byte no 206
208	1	16	Stop character	[always same]

Continue write tariff structure *)

Byte No	Size (in bytes)	Value	Description	Explanation
1	1	68	Start character	[always same]
2	1	xx	L-field, calculated from C field to last user data	No of bytes between byte no 5 and byte no n-1
3	1	xx	L-field, repeated	[same as above]
4	1	68	Start character	[always same]
5	1	53/73	C-field, SND_UD	01x1 0011 | | | | ++++- Function, 3 = Send user data | | | +------- FCV, 1 = FCB is valid | | +--------- FCB, Alternate for successive transfers | +----------- Direction, 1 = to meter +------------ [always 0]
6	1	xx	A-field, address	Primary address 1-250, 0 = No primary address
7	1	51	CI-field, data send, LSB first	0101 0001 ++++ +|++- Data send +---- Mode, 0 = Mode 1 (LSB first)
8	1	0F	DIF, manufacturer specific data follows	0000 1111 |+++ ++++- Manufacturer specific data +------------ No DIFE follows
9-10	2	801C	VIF for continue write tariff structure	1000 0000 |+++ ++++- [always same] +------------ VIFE will follow
				0001 1100 |+++ ++++- Continue write tariff structure (decided by ABB) +------------ No VIFE follows
11 - n-1		xxxxx…		Tariff data
n	1	xx	CS checksum, calculated from C field to last data	Checksum on bytes between byte no 5 and byte no n-1
n+1	1	16	Stop character	[always same]

*) Next read out (REQ_UD2) will give status of command (success/failure)

Read tariff structure

Byte No	Size (in bytes)	Value	Description	Explanation
1	1	68	Start character	[always same]
2	1	06	L-field, calculated from C field to last user data	No of bytes between byte no 5 and byte no 10
3	1	06	L-field, repeated	[same as above]
4	1	68	Start character	[always same]
5	1	53/73	C-field, SND_UD	01x1 0011 | | | | ++++- Function, 3 = Send user data | | | +------- FCV, 1 = FCB is valid | | +--------- FCB, Alternate for successive transfers | +----------- Direction, 1 = to meter +------------ [always 0]
6	1	xx	A-field, address	Primary address 1-250, 0 = No primary address
7	1	51	CI-field, data send, LSB first	0101 0001 ++++ +|++- Data send +---- Mode, 0 = Mode 1 (LSB first)
8	1	0F	DIF, manufacturer specific data follows	0000 1111 |+++ ++++- Manufacturer specific data +------------ No DIFE follows
9-10	2	801C	VIF for read tariff structure	1000 0000 |+++ ++++- [always same] +------------ VIFE will follow
				0001 1100 |+++ ++++- Read tariff structure (decided by ABB) +------------ No VIFE follows
11	1	xx	CS checksum, calculated from C field to last data	Checksum on bytes between byte no 5 and byte no 10
12	1	16	Stop character	[always same]

Close meter

Byte No	Size (in bytes)	Value	Description	Explanation
1	1	68	Start character	[always same]
2	1	07	L-field, calculated from C field to last user data	No of bytes between byte no 5 and byte no 11
3	1	07	L-field, repeated	[same as above]
4	1	68	Start character	[always same]
5	1	53/73	C-field, SND_UD	01x1 0011 | | | | ++++- Function, 3 = Send user data | | | +------- FCV, 1 = FCB is valid | | +--------- FCB, Alternate for successive transfers | +----------- Direction, 1 = to meter +------------ [always 0]
6	1	xx	A-field, address	Primary address 1-250, 0 = No primary address
7	1	51	CI-field, data send, LSB first	0101 0001 ++++ +|++- Data send +---- Mode, 0 = Mode 1 (LSB first)
8	1	01	DIF size, 8 bit integer	0000 0001 | | | | ++++- 8 bit integer | | ++-------- Instantaneous value | +----------- LSB of storage number +------------ No DIFE follows
9-10	2	FF6A	VIF for change meter communication status	1111 1111 |+++ ++++- VIFE and data is manufacturer specific +------------ VIFE will follow
				0110 1010 |+++ ++++- Change communication status (decided by ABB) +------------ No VIFE follows
11	4	01	Close	0000 0001 |+++ ++++- Password level 1 +------------ Close
12	1	xx	CS checksum, calculated from C field to last data	Checksum on bytes between byte no 5 and byte no 11
13	1	16	Stop character	[always same]

6.1.6 ERROR/INFORMATION FLAGS

Byte	Bit	Code	Type	Description
1	0	100	Checksum	Checksum error tariff 1, active energy
	1	101		Checksum error tariff 2, active energy
	2	102		Checksum error tariff 3, active energy
	3	103		Checksum error tariff 4, active energy
	4	104		Checksum error total energy, active energy
	5	105		Checksum error monthly values, active energy
	6	106		Checksum error on critical non energy block
	7	107		Checksum error on non critical non energy block
2	0	200	Checksum	Checksum error tariff 1, reactive energy
	1	201		Checksum error tariff 2, reactive energy
	2	202		Checksum error tariff 3, reactive energy
	3	203		Checksum error tariff 4, reactive energy
	4	204		Checksum error total energy, reactive energy
	5	205		Checksum error monthly values, reactive energy
	6	206		
	7	207		
3	0	300	Installation	Any of U1-U3 voltage above meter specification
	1	301		Any of U1-U3 voltage below meter specification
	2	302		Any of I1-I3 current above meter specification
	3	303		Frequency outside meter specification
	4	304		U1 missing
	5	305		U2 missing
	6	306		U3 missing
	7	307		Phase connected to neutral
4	0	400	Installation	Negative power element 1
	1	401		Negative power element 2
	2	402		Negative power element 3
	3	403		Negative power total
	4	404		External data input signal out of specification
	5	405		
	6	406		
	7	407		

Byte	Bit	Code	Type	Description
5	0	500	Configuration	Pulses merged
	1	501		Date not set
	2	502		Time not set
	3	503		Tariffs set wrong
	4	504		
	5	505		
	6	506		
	7	507		
6	0	600	Info	Single phase meter
	1	601		Two element meter
	2	602		Three element meter
	3	603		Active energy
	4	604		Reactive energy
	5	605		
	6	606		
	7	607		
7	0	700	Hardware	Main EEPROM failed
	1	701		Extended EEPROM failed
	2	702		Vref is not VDD/2
	3	703		Temperature sensor error
	4	704		RTC-circuit error
	5	705		MCU-circuit error
	6	706		
	7	707		
8	0	800	Internal	Internal system variable 1 (ABB use only)
	1	801		Internal system variable 2 (ABB use only)
	2	802		Internal system variable 3 (ABB use only)
	3	803		Internal system variable 4 (ABB use only)
	4	804		Internal system variable 5 (ABB use only)
	5	805		Internal system variable 6 (ABB use only)
	6	806		Internal system variable 7 (ABB use only)
	7	807		Internal system variable 8 (ABB use only)

6.1.7 INSTALLATION

The primary address can be set via the communication (see 6.1.4) or with the buttons (see 2.7.2.4).

6.1.8 PASSWORD PROTECTION

6.1.8.1 General

The communication can be in three different modes:

Mode	*Description*	*Shown in LCD*
0	Open for al communication	OPEn
1	Password protected	CloSed
2	Closed for al protected communication	CloSed

Protected communication are:

- Setting of date
- Setting of time
- Writing tariff structure
- Changing timekeeping source between net frequency and internal crystal

If the set password is 0000000000000000 any password is accepted, it is also accepted to not sending any password at al, just sending the commands directly. If password is set to anything else, and the meter is in mode 1, the correct password must be sent and then the desired command must

be sent within two seconds. No other command must be sent in-between the sent password and the protected command.

6.1.8.2 How to set meter in different modes

Mode 0
To move to mode 0 the SET button must be used to change status to "OPEn".

Mode 1
With the SET button changing to "CloSed", the meter enters mode 1. If the meter is in mode 2 it is not needed to first save the setting OPEn, it is enough to just scroll the setting between CloSed, OPEn, CloSed and then save.

Mode 2
Mode 2 can be entered by sending the M-Bus command "Close meter".

6.1.8.3 Default setting

At delivery, the password is set to 0000000000000000, and the meter is in mode 2. If any internal error occurs in the meter that affects protection the meter will automatically be set to mode 2.
There is no timeout in any mode. Once set in one mode, the meter remains in that mode.

7 ACCESORIES

Accessory	ABB part number
Serial Comm. Adapter (M-Bus)	99 837 090
Serial Comm. Adapter (RS232)	99 837 091
DIN-rail (for wall-mounting)	99 839 501
Enclosure 6 modules (for wall mounting)	09 809 50
Covers for sealing	09 808 90

8 SERVICE AND MAINTENANCE

8.1 RECALIBRATION

It should not be necessary to recalibrate the meter during its lifetime as it is an electronic meter with no moving parts. Electronics, voltage and current sensors that do not naturally degrade or change with time under specified environmental conditions. If a degradation in the accuracy is observed the meter has probably been partly damaged (for example due to lightning strike or extreme environmental conditions etc) and should be sent for repair or exchanged.

8.2 CLEANING

If the meter is dirty and needs to be cleaned, use lightly moistened tissue with a water based mild detergent. Make sure no liquid goes into the meter as this could damage the meter.