# DKM-430

## MULTIPLE NETWORK ANALYSER

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## DESCRIPTION

**DATAKOM DKM-430** is a precision instrument allowing the measurement, recording and remote monitoring of 10 3-phased or 30 single-phased feeders (or any combination of these two). The number and flexibility of current inputs allow the unit to be used in a variety of applications like power distribution network monitoring, ISO50001 energy efficiency or home and factory automation.

The unit can be mounted on a DIN rail or backplane. It can be easily adapted to existing panels.

Current inputs of the unit are designed for 0.1A output current transformers (CTs). CTs are shipped together with the unit and can be installed on cables in order to minimize space occupation in distribution cabinets.

Each CT can be assigned to any phase voltage and any virtual analyzer. Inputs can be moved between analyzers without modifying connections.

Independently adjustable current limits for each phase provide pre-alarms and help to reduce energy failures.

All measurement values and program parameters may be displayed on the graphic LCD screen.

The unit logs all fault conditions together with date and time information. The internal real time clock is capable of running 10 years without energy.

The astronomical relay function calculates sunrise and sunset times precisely for daylight based applications.

Any fault or warning signal can be connected to digital inputs of the unit. Input functions are selected from list.

Any function can be assigned to relay outputs of the unit. Relays may be remotely operated through the central monitoring program.

The isolated RS-485 MODBUS RTU data port is unaffected by ground potential differences and allows safe transmission of information to monitoring and automation systems.

The optional internal GPRS modem allows remote monitoring and control of the distribution panel without the use of any additional module.

Parameter setting of the unit is made either manually or through the USB port using the free PC program.

The unit records electrical parameters in its 1MB internal memory with programmed period. Records are read through Modbus.

## FEATURES

*Equivalent to 10 3-phase analyzers*
*True RMS measurements*
*0.5% measurement precision*
*Internal record memory: 1MB*
*Internal battery backed-up real time clock*
*Astronomical relay function*
*Isolated RS-485 serial port*
*MODBUS-RTU communication*
*Internal GPRS modem (optional)*
*2 programmable relay outputs*
*2 optically isolated programmable inputs*
*Active-reactive energy counters*
*USB port for programming*
*Free programming software*
*Graphic LCD, 128x64 pixels*
*Wide supply range:85-305VAC / 88-450VDC*
*DC supply version available*
*Wide operating temperature range*

## MEASUREMENTS

**VOLTAGE INPUTS:**
- P-N and P-P voltages: V1-V2-V3-U12-U23-U31
- Harmonics: Voltage inputs, 2-17 harmonics

**EACH CT INPUT:**
- Current: In
- Active/reactive/apparent powers: Pn-Qn-Sn
- Power factor: COSn
- Current harmonics 2-17

**EACH VIRTUAL ANALYSER:**
- Total active/reactive/apparent power: ∑P-∑Q-∑S
- Total power factor: ∑cos
- Active and reactive counters: Pn-Qn

## COPYRIGHT NOTICE

## ABOUT THIS DOCUMENT

This document describes minimum requirements and necessary steps for the successful installation of the DKM-430 family units.

Follow carefully advices given in the document. These are often good practices for the installation which reduce future issues.

For all technical queries please contact Datakom at below e-mail address:

**datakom@datakom.com.tr**

## QUERRIES

If additional information to this manual is required, please contact the manufacturer directly at below e-mail address:

**datakom@datakom.com.tr**

Please provide following information in order to get answers to any question:

- Device model name (see the back panel of the unit),
- Complete serial number (see the back panel of the unit),
- Firmware version (read from the display screen),
- Measuring-circuit voltage and power supply voltage,
- Precise description of the query.

## RELATED DOCUMENTS

| FILENAME | DESCRIPTION |
|---|---|
| 500-Rainbow Installation | Rainbow Plus D-500 D-700 Installation Guide |
| 500-Rainbow Usage | Rainbow Plus D-500 D-700 Usage Guide |
| 500-Rainbow Scada Installation | Rainbow Scada Installation Guide |
| 500-Rainbow Scada Usage | Rainbow Scada Usage Guide |

## REVISION HISTORY

| REVISION | DATE | AUTHOR | DESCRIPTION |
|---|---|---|---|
| 01 | 15.06.2015 | MH | First edition |

## TERMINOLOGY

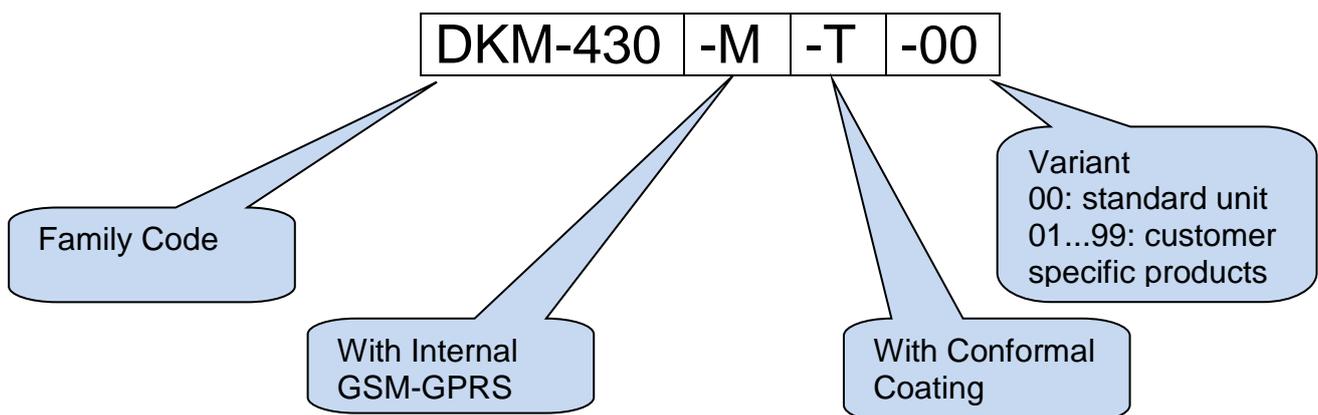**CAUTION:** Potential risk of injury or death.

**WARNING:** Potential risk of malfunction or material damage.

**ATTENTION:** Useful hints for the understanding of device operation.

## ORDERING CODES

The D-500 family units are available in various options and peripheral features. Please use below information for ordering the correct version:

| DKM-430 | -M | -T | -00 |

Family Code

With Internal GSM-GPRS

With Conformal Coating

Variant
00: standard unit
01...99: customer specific products

**SAFETY NOTICE**
**Failure to follow below instructions**
**will result in death or serious injury**

- Electrical equipment should be installed only by qualified specialist. No responsibility is assured by the manufacturer or any of its subsidiaries for any consequences resulting from the non-compliance to these instructions.

- Check the unit for cracks and damages due to transportation. Do not install damaged equipment.

- Do not open the unit. There are no serviceable parts inside.

- Fuses must be connected to the power supply and phase voltage inputs, in close proximity of the unit.

- Fuses must be of fast type (FF) with a maximum rating of 6A.

- Disconnect all power before working on equipment.

- When the unit is connected to the network do not touch terminals.

- Short circuit terminals of unused current transformers.

- Any electrical parameter applied to the device must be in the range specified in the user manual. Although the unit is designed with a wide safety margin, over-range parameters may reduce lifetime, alter operational precision or even damage the unit.

- Do not try to clean the device with solvent or the like. Only clean with a dump cloth.

- Verify correct terminal connections before applying power.

- Only for panel base mounting.

Current measurement is made with CTs provided together with the module.
Do not apply direct connection, do not use 1A/5A current transformers.

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## 1. INSTALLATION INSTRUCTIONS

**Before installation:**

- Read the user manual carefully, determine the correct connection diagram.

- Install to the panel base or DIN rail. In order to install to panel base, pull mounting tabs at corners.

- Make electrical connections with plugs removed from sockets, then place plugs to their sockets.

- Be sure that adequate cooling is provided.

- Be sure that the temperature of the environment will not exceed the maximum operating temperature in any case.

- Be sure that the unit is not subject to water spill.

**Below conditions may damage the device:**

- Incorrect connections.

- Incorrect power supply voltage.

- Voltage at measuring terminals beyond specified range.

- Voltage applied to digital inputs over specified range.

- Current at measuring terminals beyond specified range.

- Overload or short circuit at relay outputs

- Connecting or removing data terminals when the unit is powered-up.

- High voltage applied to communication ports.

- Ground potential differences at non-isolated communication ports.

- Excessive vibration, direct installation on vibrating parts.

> ⚠️ **Current measurement is made with CTs provided together with the module.**
>
> **Do not apply direct connection, do not use 1A/5A current transformers.**

**Below conditions may cause abnormal operation:**

- Power supply voltage below minimum acceptable level.

- Power supply frequency out of specified limits

- Phase order of voltage inputs not correct.

- Current transformers not matching related phases.

- Current transformer polarity incorrect.

- Missing grounding.

## 2. MOUNTING

### 2.1. DIMENSIONS

**Dimensions:** 158x90x60mm (6.22"x3.55"x2.36")
**Installation:** Panel base or DIN rail
**Weight:** 350g (0.77 lb)

### 2.2. ELECTRICAL INSTALLATION

> ⚠ **Do not install the unit close to high electromagnetic noise emitting devices like contactors, high current busbars, switchmode power supplies and the like.**

Although the unit is protected against electromagnetic disturbance, excessive disturbance can affect the operation, measurement precision and data communication quality.

- **ALWAYS remove plug connectors when inserting wires with a screwdriver.**

- **Fuses must be connected to the power supply and phase voltage inputs, in close proximity of the unit.**

- **Fuses must be of fast type (FF) with a maximum rating of 6A.**

- **Use cables of appropriate temperature range.**

- **Use adequate cable section, at least 0.75mm$^2$ (AWG18).**

- **Follow national rules for electrical installation.**

- **Current transformers must have 0.1A output.**

> ⚠ **Current measurement is made with CTs provided together with the module.**
>
> **Do not apply direct connection, do not use 1A/5A current transformers.**

## 3. TERMINAL DESCRIPTIONS

### 3.1. BATTERY VOLTAGE INPUT

| | |
|---|---|
| **Supply voltage:** | **AC SUPPLY VERSIONS:** 85-305VAC, 45-65Hz, 88-450VDC<br>**DC SUPPLY VERSIONS:** 19-150VDC |
| **Reverse voltage:** | Non polarized inputs, works in both polarizations. |
| **Maximum input power:** | 6W |
| **Typical operating current:** | 250mA  @ 12VDC. (all options passive, digital outputs open)<br>125mA  @ 24VDC. (all options passive, digital outputs open) |
| **Maximum operating current:** | 30mA  @ 230VAC. (all features active, digital outputs open)<br>60mA  @ 110VDC. (all features active, digital outputs open) |

### 3.2. AC VOLTAGE INPUTS

| | |
|---|---|
| **Measurement method:** | True RMS |
| **Sampling rate:** | 2048 Hz |
| **Harmonic analysis:** | up to 17th harmonic |
| **Input voltage range:** | 5 to 300 VAC (phase-neutral) |
| **Measurement range:** | 0 to 330VAC ph-N (0 to 570VAC ph-ph) |
| **Input impedance:** | 4.5M-ohms |
| **Display resolution:** | 0.1VDC |
| **Accuracy:** | 0.5% + 1 digit @ 230VAC ph-N (±2VAC ph-N)<br>0.5% + 1 digit @ 400VAC ph-ph (±3VAC ph-ph) |

| | |
|---|---|
| **Frequency range:** | 45 to 65 Hz |
| **Frequency display resolution:** | 0.01 Hz |
| **Frequency accuracy:** | 0.2% + 1 digit  (±0.1 Hz @ 50Hz) |

## 3.3. AC CURRENT INPUTS

| | |
|---|---|
| **Measurement method:** | True RMS |
| **Sampling rate:** | 2048 Hz |
| **Harmonic analysis:** | up to 17th harmonic |
| **CT secondary rating:** | 100mA |
| **Measurement range:** | 5/0.1 to 5000/0.1A minimum |
| **Input impedance:** | 1 ohm |
| **Burden:** | 10 mW |
| **Maximum continuous current:** | 500mA |
| **Measurement range:** | 0.5 to 120mAA |
| **Display resolution:** | 0.1A |
| **Accuracy:** | 0.5% + 1 digit @ 100mA |

**SELECTING THE CT ACCURACY CLASS:**

The CT accuracy class should be selected in accordance with the required measurement precision. The accuracy class of the Datakom controller is 0.5%. Thus 0.5% class CTs are advised for the best result.

### CONNECTING CTs:

Be sure of connecting each CT to the related phase input with the correct polarity. Mixing CTs between phases will cause faulty power and pf readings.

Many combinations of incorrect CTs connections are possible, so check both order of CTs and their polarity. Reactive power measurement is affected by incorrect CTs connection in similar way as active power measurement.

### CORRECT CT CONNECTIONS
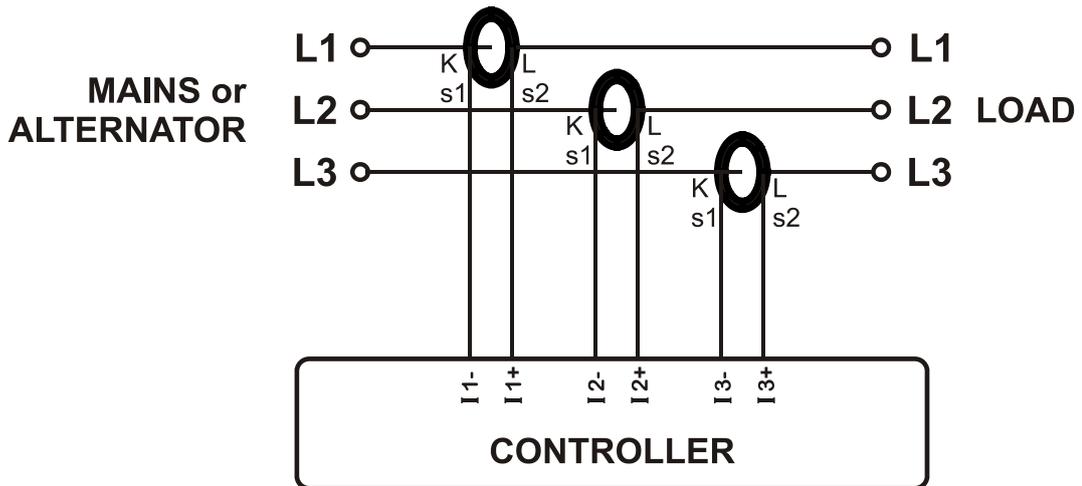


Let's suppose that the network is loaded with 100 kW on each phase. The load Power Factor (PF) is 1. Measured values are as follows:

|          | kW    | kVAr  | kVA   | pf   |
|----------|-------|-------|-------|------|
| Phase L1 | 100.0 | 0.0   | 100   | 1.00 |
| Phase L2 | 100.0 | 0.0   | 100   | 1.00 |
| Phase L3 | 100.0 | 0.0   | 100   | 1.00 |
| **Total** | **300.0** | **0.0** | **300** | **1.00** |

**EFFECT OF POLARITY REVERSAL**
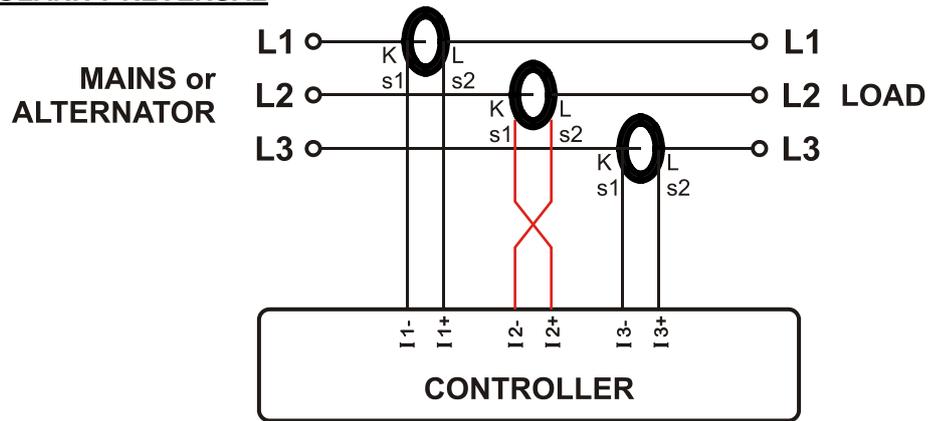


The network is still loaded with 100 kW On each phase. The load Power Factor (PF) is 1.
PF in phase L2 will show -1,00 due to reverse CT polarity. The result is that total network power displayed by the controller is 100 kW.
Measured values are as follows:

| | kW | kVAr | kVA | pf |
|---|---|---|---|---|
| **Phase L1** | 100.0 | 0.0 | 100 | 1.00 |
| **Phase L2** | -100.0 | 0.0 | 100 | -1.00 |
| **Phase L3** | 100.0 | 0.0 | 100 | 1.00 |
| **Total** | **100.0** | **0.0** | **300** | **0.33** |

**EFFECT OF PHASE SWAPPING**
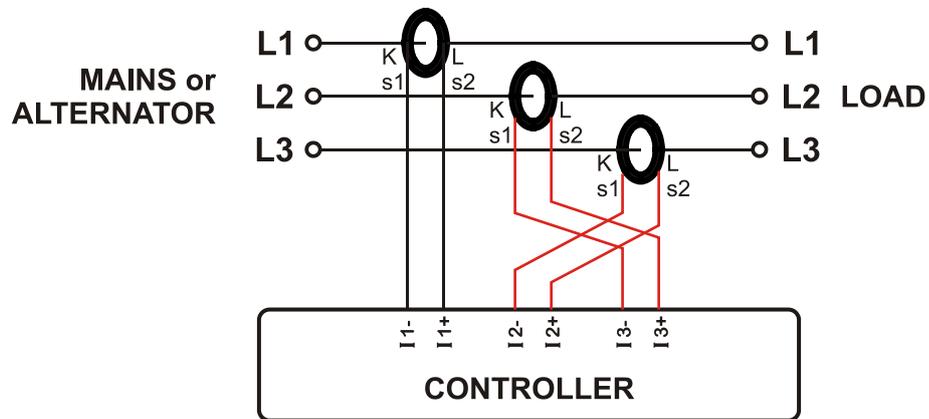


The network is still loaded with 100 kW on each phase. The load Power Factor (PF) is 1.
PF in phases L2 and L3 will show -0,50 due to phase shift between voltages and currents which is caused by CT swapping. The result is that total network power displayed by controller is 0 kW.
Measured values are as follows:

| | kW | kVAr | kVA | pf |
|---|---|---|---|---|
| **Phase L1** | 100.0 | 0.0 | 100 | 1.00 |
| **Phase L2** | -50.0 | 86.6 | 100 | -0.50 |
| **Phase L3** | -50.0 | -86.6 | 100 | -0.50 |
| **Total** | **0.0** | **0.0** | **300** | **0.0** |

## 3.4. DIGITAL INPUTS

| | |
|---|---|
| **Number of inputs:** | 2 inputs, all configurable |
| **Input type:** | Opto-isolated digital input |
| **Function selection:** | from list |
| **Contact type:** | Normally open or normally closed (programmable) |
| **Minimum pulse duration:** | 250ms |
| **Active level:** | 85-305VAC |
| **Isolation:** | 1000VAC, 1 minute |
| **Noise filtering:** | yes |

## 3.5. RELAY OUTPUTS

| | |
|---|---|
| **Structure:** | Relay output, normally open contact. One terminal is internally connected to the common terminal for both relays. |
| **Max switching current:** | 5A @250VAC |
| **Max switching voltage:** | 250VAC |
| **Max switching power:** | 1250VA |

## 3.6. RS-485 PORT

| | |
|---|---|
| **Structure:** | RS-485, isolated. |
| **Connection:** | 3 wires (A-B-GND).  Half duplex. |
| **Baud rate:** | 2400-115200 bauds, selectable |
| **Data type:** | 8 bit data, no parity, 1 bit stop |
| **Termination:** | External 120 ohms required |
| **Common mode voltage:** | -0.5 VDC to +7VDC, internally clamped by transient suppressors. |
| **Max distance:** | 1200m @ 9600 bauds (with 120 ohms balanced cable) |
| | 200m @ 115200 bauds (with 120 ohms balanced cable) |
| **Isolation:** | 1000VAC, 1 minute |

The RS-485 port features MODBUS-RTU protocol. Multiple modules (up to 128) can be paralleled on the same RS-485 bus for data transfer to automation or building management systems.

The RS-485 port provides also a good solution for distant PC connection where RainbowPlus program will enable programming, control and monitoring.

## 3.7. USB PORT



USB Connector

USB A to B Cable
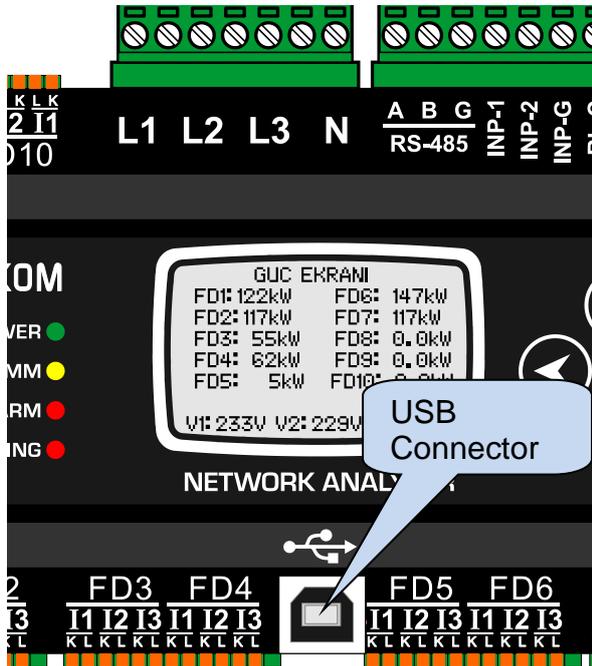
| Description: | USB 2.0, not isolated, HID mode |
|---|---|
| Data rate: | Full Speed 1.5/12 Mbits/s, auto detecting |
| Connector: | USB-B (printer connector) |
| Cable length: | Max 6m |
| Functionality: | Modbus, FAT32 for firmware upgrade (boot loader mode only) |

The USB-Device port is designed to connect the module to a PC. Using the RainbowPlus software, programming, control of the genset and monitoring of measured parameters are achieved.

The RainbowPlus software can be downloaded from **www.datakom.com.tr** website.

The connector on the module is of USB-B type. Thus A to B type USB cable should be used. This is the same cable used for USB printers.

For more details about programming, control and monitoring please refer to RainbowPlus user manual.



**If USB connector provides also power supply to the unit. During computer connection additional supply is not required.**

## 3.8. GSM MODEM (OPTIONAL)

The optional internal GSM modem offers the advantage of being internally powered and is fully compatible with the unit. It does not require any special setup.

The 1800/1900 MHz magnetic antenna together with its 2 meter cable is supplied with the internal modem option. The antenna is intended to be placed outside of the genset panel for the best signal reception.
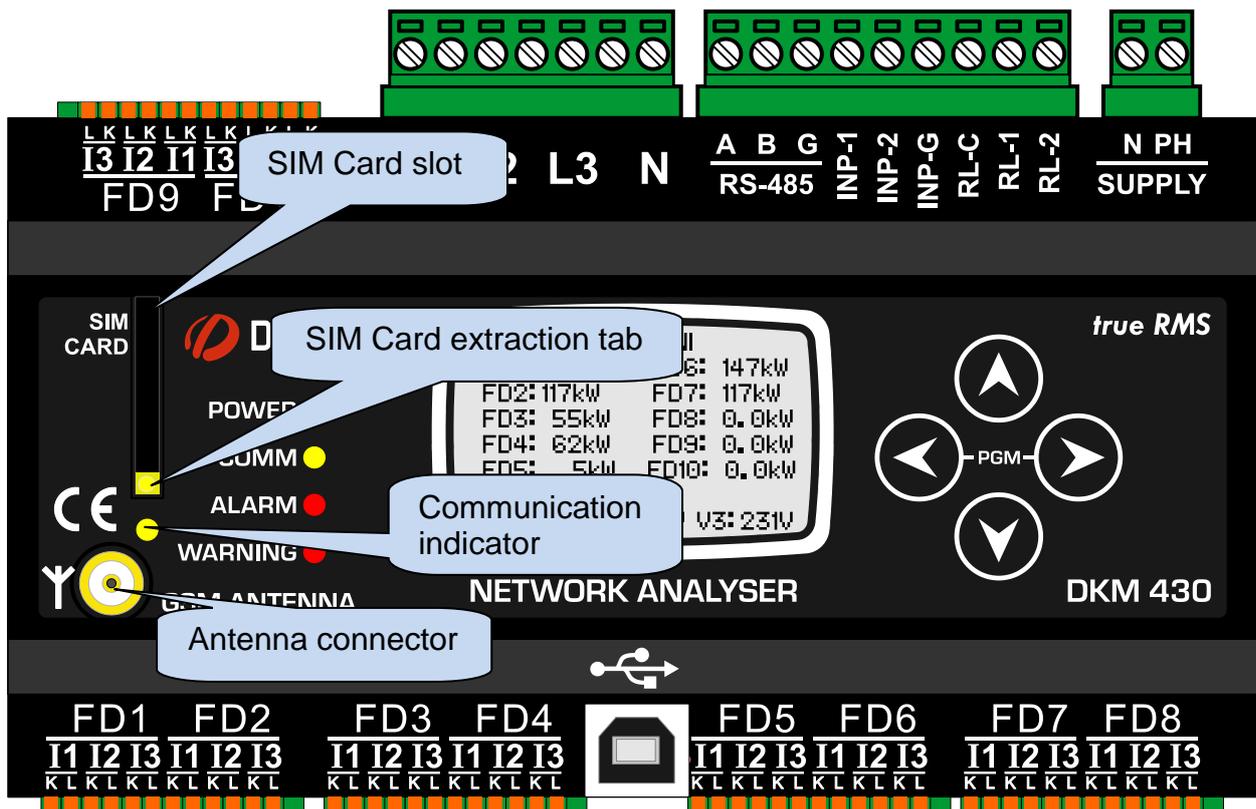


The module requires a GPRS enabled SIM card for full functionality. Voice-only type SIM cards will usually not function properly.

Please refer to **GSM Modem Configuration Guide** for more details.

| Description: | Quad-band GSM/GPRS 850/900/1800/1900MHz module. |
|---|---|
| | GPRS multi-slot class 12/10<br>GPRS mobile station class B |
| | Compliant to GSM phase 2/2+. |
| | – Class 4 (2 W @850/ 900 MHz)<br>– Class 1 (1 W @ 1800/1900MHz) |
| **Functionality:** | Web Client, SMTP, Modbus TCP/IP (client), SMS, e-mail |
| **Operating temp range:** | -40°C to +85 °C |
| **Data speed:** | max. 85.6 kbps (download), 85.6 kbps (upload) |
| **SIM card type:** | external SIM 3V/1.8V, GPRS enabled |
| **Antenna:** | Quad band, magnetic, with 2m cable |
| **Module certificates:** | CE, FCC, ROHS, GCF, REACH |

# 4. CONNECTION DIAGRAM
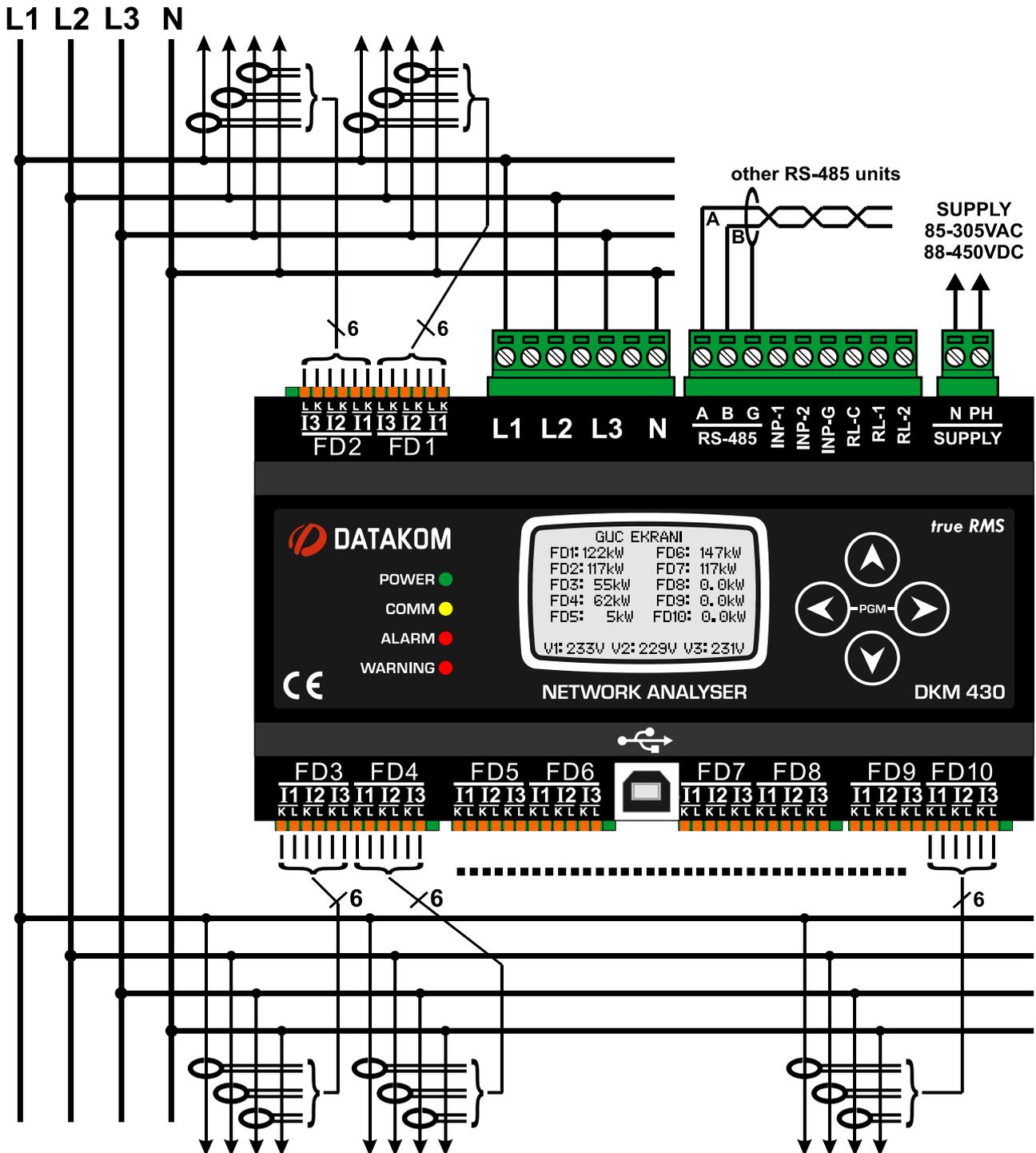
## 5. TECHNICAL SPECIFICATIONS

**Supply Input:**
> 85 - 305VAC, 50/60Hz,
> 88 - 450VDC
> Optional 19-150VDC

**Measurement Inputs:**
> **Voltage:**   7 - 300 V AC (P-N)
>                      14 - 520 V AC (P-P)
> **Current:** 0.001 – 0.12 A AC
> **Frequency:** 45 - 65 Hz

**Accuracy:**
> **Voltage:**        0.5% + 1 digit
> **Current:**        0.5% + 1 digit
> **Frequency:** 0.5% + 1 digit
> **Power** (kW,kVAr)**:** 1.0%  + 2 digit
> **Cos:**             0.5% + 1 digit

**Measurement Range:**
> **CT range:**    5A to 6500A
> **VT range:**    1.0**/**1 to 5000.0**/**1
> **kW range:**   1.0 kW to 5000 MW

**Power Consumption:**      < 6 VA

**Loading:**
> **Voltage Input:** < 0.02VA per phase
> **Current Input:** < 0.02VA per phase

**Relay Outputs:** 5A @ 250V AC

**Digital Inputs:**
> **Active level:**    85 – 305VAC
> **Min pulse:**      250ms.
> **Isolation:**       1000V AC, 1 minute

**Serial Port:**
> **Signal type:**    RS-485
> **Protocol:**        Modbus RTU
> **Data Rate:**      2400-115200b adjustable
> **İsolation:**        1000V AC, 1 minute

**Operating Temp. Range:** -20°C to +70 °C (-4°F to 158°F)

**Max Relative Humidity:** 95%, non-condensing

**Case Material:**   Flame retardant, ROHS compliant, high temp. ABS/PC (UL94-V0)

**Installation:** DIN rail or backpanel

**Dimensions:**  158x90x60mm (WxHxD)

**Weight:** 350 gr

| <u>AB Directives:</u> | <u>Reference Standards:</u> |
|---|---|
| 2006/95/EC (LVD) | EN 61010 (safety) |
| 2004/108/EC (EMC) | EN 61326 (EMC) |

# 6. DESCRIPTION OF CONTROLS

## 6.1. FRONT PANEL FUNCTIONALITY
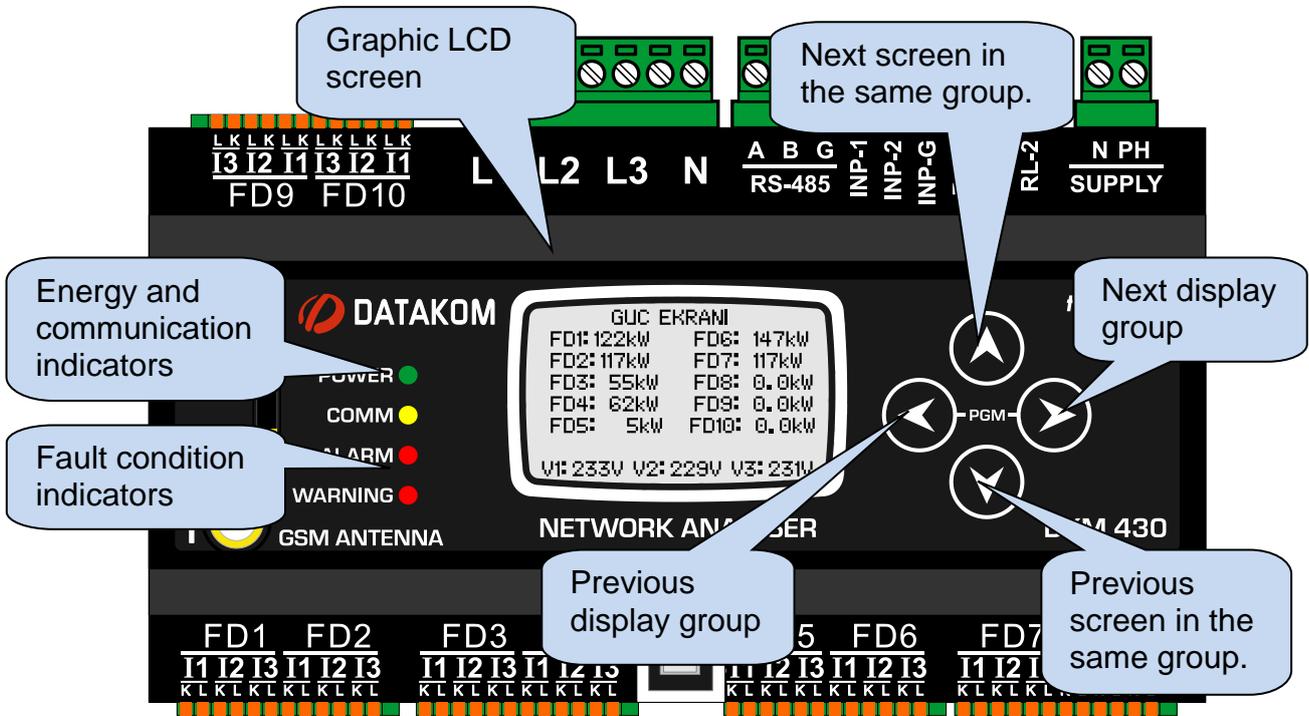


## 6.2. PUSHBUTTON FUNCTIONS

| BUTTON | FUNCTION |
|---|---|
| ∨ | Selects previous display screen in the same display group. |
| ◄ | Selects previous display group. |
| ► | Selects next display group. |
| ∧ | Selects next display screen in the same display group. |
| ◄ ► | When held pressed for 5 seconds, enters PROGRAMMING mode. |

## 6.3. LED FUNCTIONS

**POWER:** Turns on as long as energy is supplied to the unit.

**COMM:** Flashes when the RS-485 Modbus communication is active.

**ALARM:** Turns on in case of high level alarm (trip condition).

**UYARI:** Turns on in case of warning.

## 6.4. SCREEN SCROLLING

The unit performs a detailed set of AC measurements. Displaying these parameters are organized under PARAMETER GROUPS and subgroups.

Switching between parameter groups are made with ◄ and ► buttons.

Each depression of the ► button switches the screen to the next parameter group. After the last group, the first group is displayed again.

Each depression of the ◄ button switches the screen to the previous parameter group. After the first group, the last group is displayed again.

Switching within the same group is performed with ▼ and ▲ buttons.

Each depression of the ▲ button switches the screen to the next display in the same group. After the last display, the first display comes again.

Each depression of the ▼ button switches the screen to the previous display in the same group. After the first display, the last display comes again.

The list of **parameter groups** are below:

**Channel Measurement Screens:** Voltage, current, kW, kVA, kVAr, pf and reactive ratio of each input channel.

**Channel Counter Screens:** Instantaneous current, demand current, demand power, active and reactive energy counters of each input channel.

**Main busbar voltages and frequency:** Phase-neutral, phase-phase and average voltages of the main busbar in different screens.

**GSM Modem Parameters:** Signal level, counters, connection status, IP addresses, etc...

**Status Group:** Various information as date-time, firmware version, identity, configuration, etc...

**User Screens:** Screens in this group are configured by the user.

**Oscilloscope Screen:** In this group, waveforms of currents and voltages may be visualized as an oscilloscope. All phase-neutral and phase-phase voltages and each current input are avalable. Thanks to this feature, waveform distorsions and harmonic components are displayed in graphichal form.

**Harmonic Analysis Result Tables:** In this group, THDs of currents and voltages are displayed with 0.1% precision. All phase-neutral and phase-phase voltages and each current input are avalable.

# 7. WAVEFORM DISPLAY & HARMONIC ANALYSIS

The unit features waveform display together with a precision harmonic analyzer for both voltages and currents. Both phase to neutral and phase to phase voltages are available for analysis, thus 36 channels in total are possible.

**Available channels are:**
Main busbar volts: V1, V2, V3, U12, U23, U31
Currents: I1, I2, I3,….,I29,I30
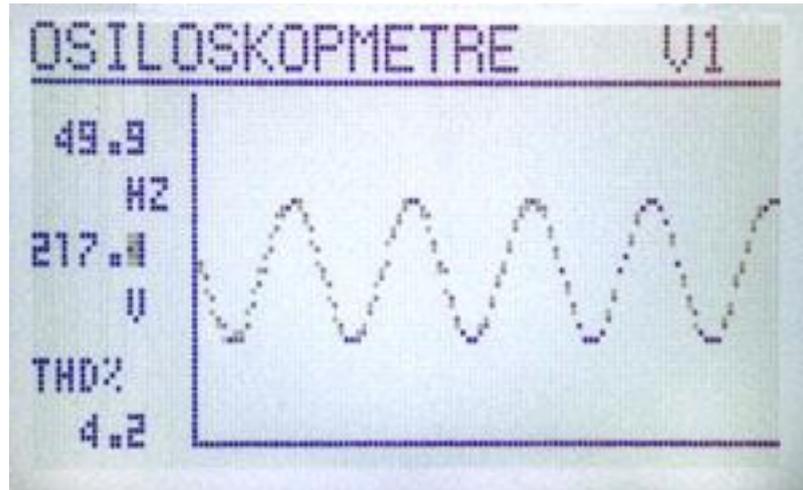


*Scopemeter Display*

The waveform display memory is of 100 samples length and 13 bit resolution, with a sampling rate of 2048 s/s. Thus one cycle of a a 50Hz signal is represented with 41 points. The vertical scale is automatically adjusted in order to avoid clipping of the signal.

The waveform is displayed on the device screen, and with more resolution on PC screen through the RainbowPlus program.

The display memory is also available in the Modbus register area for third party applications. For more details please check chapter "**MODBUS Communications**".

The waveform display is updated twice a second. All channels may be scrolled using ⚫⚫ buttons.

The harmonic analyzer consists on a Fast Fourier Transform (FFT) algorithm which is run twice a second on the selected channel.

The sample memory is 1024 samples length and 13 bits resolution with a sampling rate of 2048 s/s.

The unit is able to analyze up to 900Hz and up to 17th harmonic, whichever is smaller.



*Alphanumeric Harmonics Table*

All harmonics are displayed with 0.1% resolution.

On RainbowPlus program, harmonics and waveform are displayed on a single screen with more resolution.
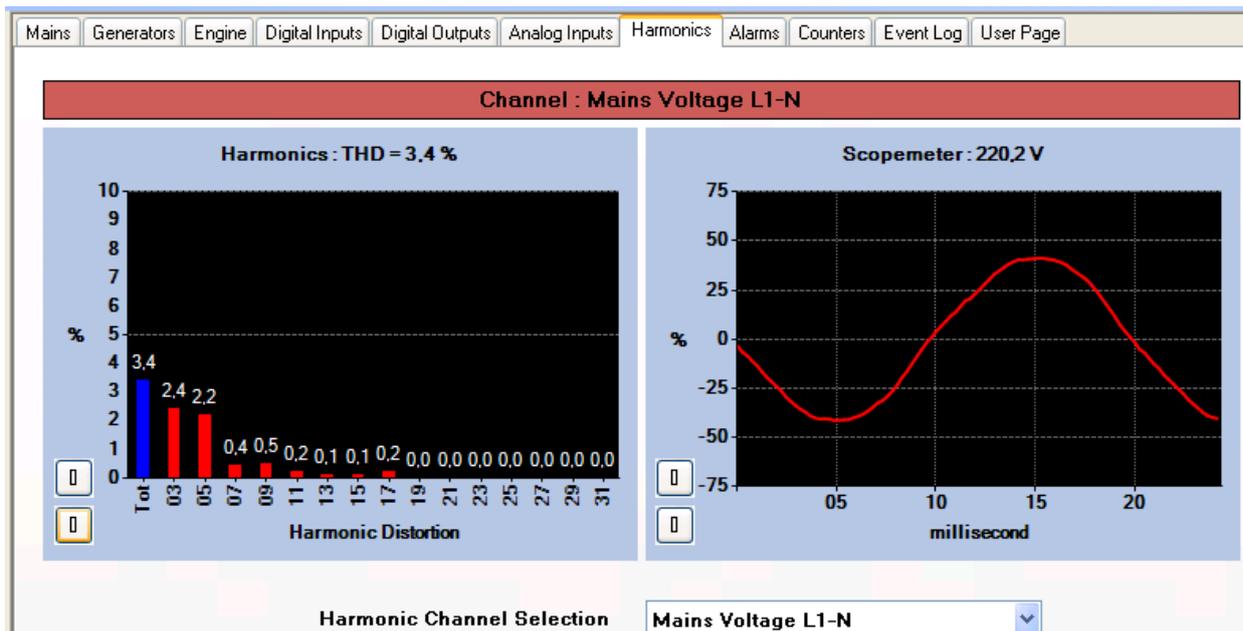


*RainbowPlus Scada section: Harmonic Analysis and Waveform Display*

## 8. ASTRONOMIC RELAY FUNCTIONALITY

Thanks to its internal astronomical relay function, the unit calculates sunrise and sunset times with precision using geographical coordinates and date.

Using the astronomical relay function it is possible turn on/off lights and activate various equipment depending on sunrise and sunset.



*Astronomical relay display screen*

Astronomical relay parameter setting is performed through LOCATION SETUP group of the programming menu.

The date-time information is picked-up from the internal real time clock circuit.

Geographical position information is programmed by direct entry of latitude and longitude.

The unit is capable of activating a relay following sunrise and sunset times. The delay before sunrise and the delay after sunset are programmable.

## 9. PROTECTIONS AND ALARMS

Measured analog values outside of programed limits cause an ALARM condition.

Alarms cause below, actions to be taken:

- The **ALARM** led to turn on steadily,
- The **Alarm** digital output to operate.

> **If a fault condition occurs, the display will automatically switch to the ALARM LIST page.**

**Alarms operate in a first occurring basis:**

-If an alarm is present, following alarms will not be accepted,

Alarms may be of **LATCHING** type following programming. For latching alarms, even if the alarm condition is removed, the alarms will stay on and disable the operation of the genset.

Most alarms have programmable trip levels. See the programming chapter for adjustable alarm limits.

# 10. PROGRAMMING

The program mode is used to adjust timers, operational limits and the configuration of the unit.

Although a free PC program is provided for programming, every parameter may be modified through the front panel, regardless of the operating mode.

When modified, program parameters are automatically recorded into a non-erasable memory and take effect immediately.

The program mode will not affect the operation of the unit. Thus programs may be modified anytime.

## 10.1. ENTERING THE PROGRAMMING MODE

To **enter the program mode**, press together , ◀ and ▶ buttons for 5 seconds.

When the program mode is entered, below password entry screen will be displayed.



Hold these two buttons pressed for 5 seconds

A 4 digit password must be entered using ▼ ◀ ▶ ▲ buttons.

The ▼ , ▲ buttons modify the value of the current digit. The ▼ , ▲ buttons navigate between digits.

The unit supports 3 password levels. The level_1 is designed for field adjustable parameters. The level_2 is designed for factory adjustable parameters. The level_3 is reserved. It allows recalibration of the unit.

The password level-1 is factory set to '**1234**' and the password level-2 is factory set to '**9876**'.

⚠ **Passwords are not front panel adjustable.**

If a wrong password is entered, the unit will still allow access to the program parameters, but in read-only mode.

## 10.2. NAVIGATING BETWEEN MENUS

The program mode is driven with a two level menu system. The top menu consists on program groups and each group consists on various program parameters.

When program mode is entered, a list of available groups will be displayed. Navigation between different groups are made with ⓥ and ⓐ buttons. Selected group is shown in reverse video (black on white). In order to enter inside a group, please press ⓡ button. In order to exit from the group to the main list please press ⓛ button.
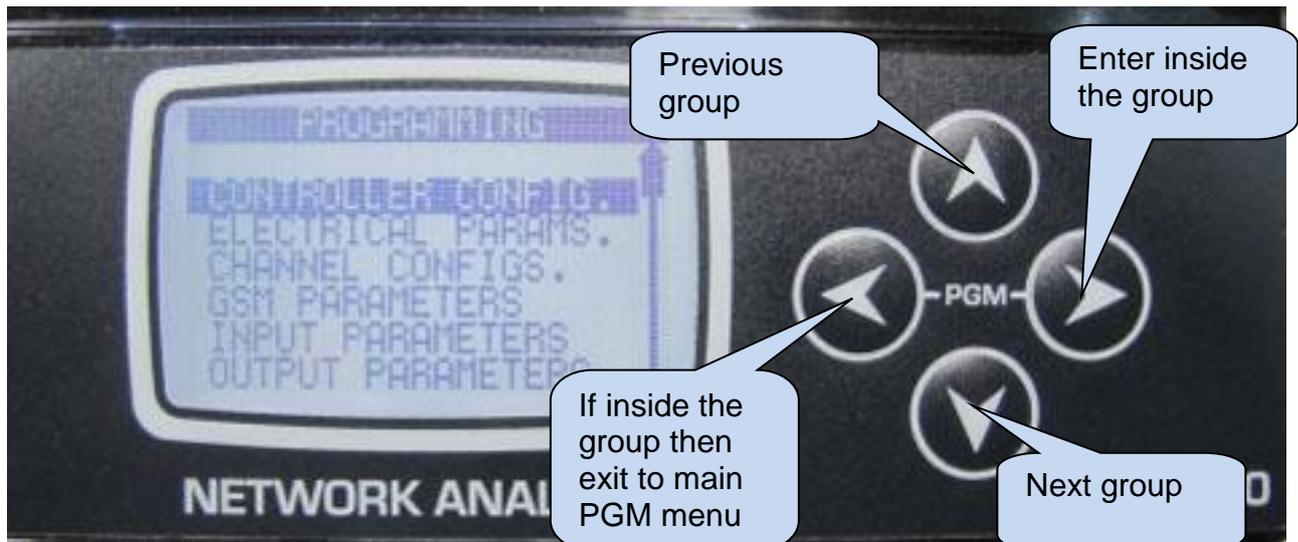


Navigation inside a group is made also with ⓥ and ⓐ buttons. A list of available parameters will be displayed. Selected parameter is shown in reverse video (black on white). In order display/change the value of this parameter, please press ⓡ button. Parameter value may be increased and decreased with ⓥ and ⓐ buttons. If these keys are hold pressed, the program value will be increased/decreased by steps of 10. When a program parameter is modified, it is automatically saved in memory. If ⓡ button is pressed, next parameter will be displayed. If ⓛ button is pressed, then the list of parameters in this group will be displayed.
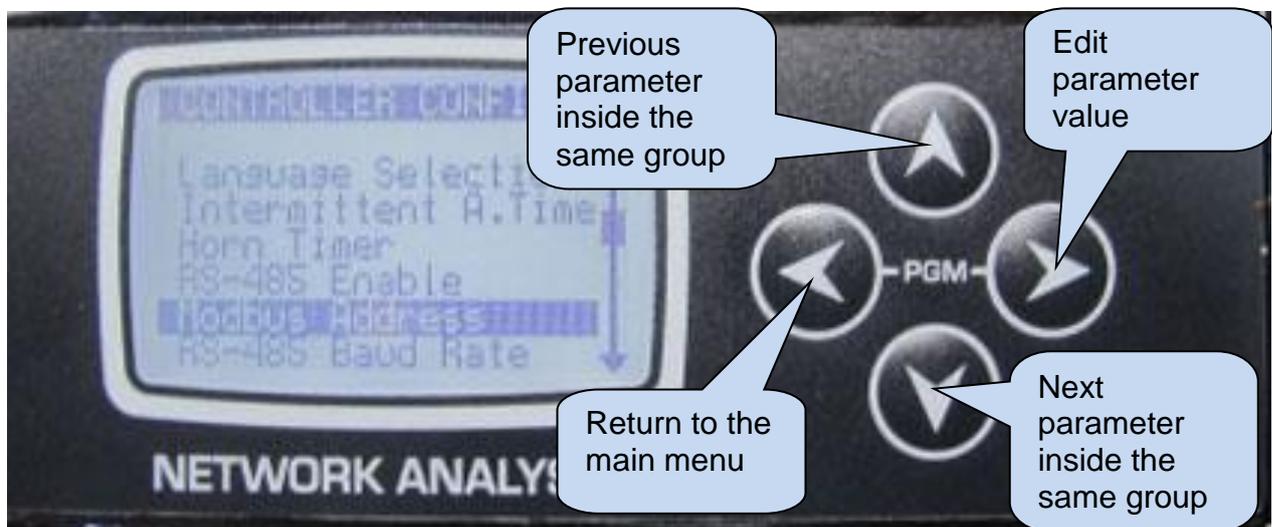
## 10.3. MODIFYING PARAMETER VALUE



Return to the upper menu

Increase parameter value

Decrease parameter value
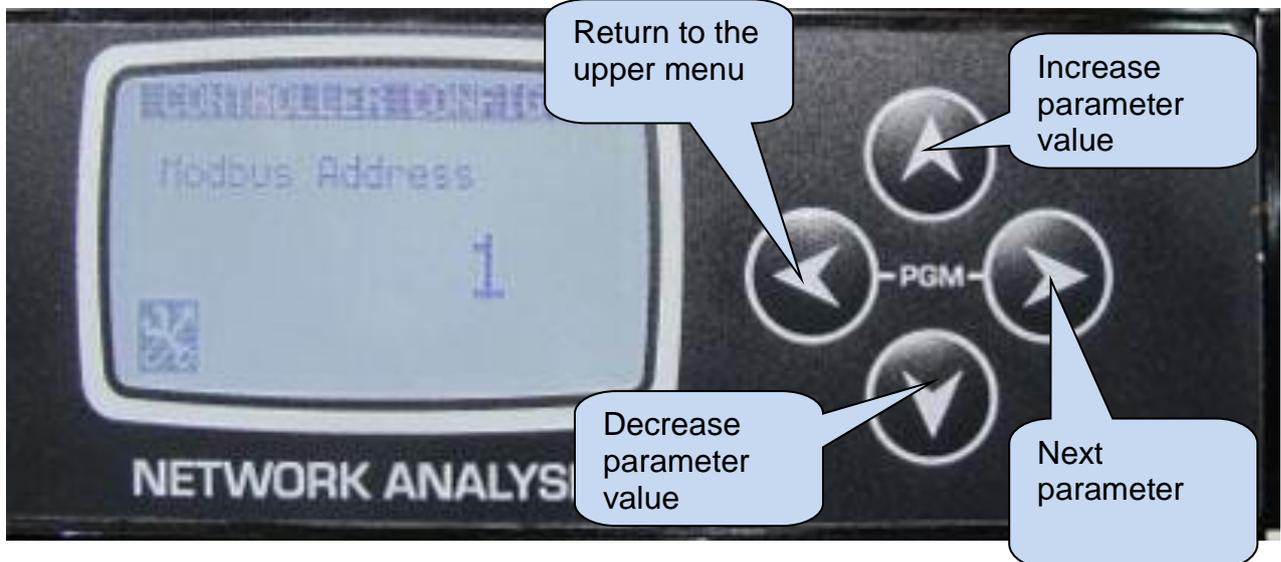
Next parameter

## 10.4. PROGRAMMING MODE EXIT

To **exit the program mode** press one of the mode selection keys. If no button is pressed during 2 minutes the program mode will be cancelled automatically.



Hold these two buttons pressed for 5 seconds
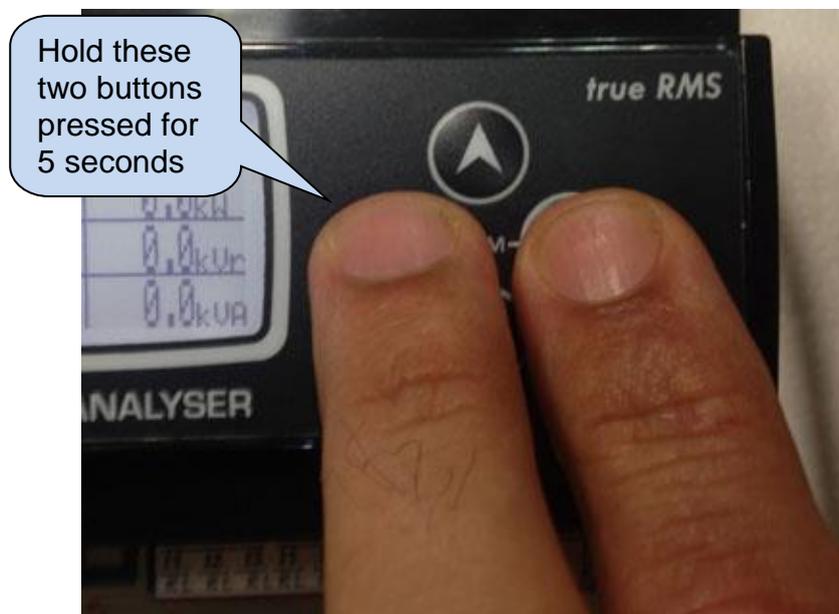
## 11. PROGRAM PARAMETER LIST

## 11.1. CONTROLLER CONFIGURATION GROUP

| Parameter Definition | Unit | Min | Max | Factory Set | Description |
|---|---|---|---|---|---|
| LCD Contrast | - | 30 | 50 | 39 | This parameter is used to set LCD contrast. Adjust for the best viewing angle. |
| Language | - | 0 | 1 | 0 | 0: English language selected.<br>1: Local language selected. This language may depend on the country where the unit is intended to be used. |
| Intermittent Alarm Timer | sec | 0 | 250 | 60 | If Intermittent Relay parameter is 1, then the HORN relay is activated and deactivated with this period. |
| Horn Timer | sec | 0 | 120 | 60 | This is the period during which the HORN relay is active. If the period is set to 0, this will mean that the period is unlimited. |
| RS-485 Enable | - | 0 | 1 | 1 | 0: RS-485 port disabled<br>1: RS-485 port enabled |
| Modbus Address | - | 0 | 240 | 1 | This is the modbus controller identity used in Modbus communication. |
| RS-485 Baud Rate | bps | 2400 | 115200 | 9600 | This is the data rate of the RS-485 Modbus port. |
| Intermittent Alarm Relay | - | 0 | 1 | 0 | 0: continuous<br>1: intermittent |
| LCD Backlight Delay | min | 0 | 1440 | 60 | If no button is pressed during this period, then the unit will reduce the LCD screen backlight intensity in for economy. |
| Flashing Relay ON Timer | min | 0 | 1200 | 0 | Flashing relay ON state duration timer. |
| Flashing Relay OFF Timer | min | 0 | 1200 | 0 | Flashing relay OFF state duration. |
| Internal Record Timer | sec | 2 | 3600 | 900 | Defines the data recording period to internal memory. Shorter periods will cause the internal memory to roll-up more often. |

## 11.2. ELECTRICAL PARAMETERS GROUP

| Parameter Definition | Unit | Min | Max | Factory Set | Description |
|---|---|---|---|---|---|
| Current Transformer Primary | Amp | 1 | 5000 | 500 | This is the rated value of current transformers. All transformers must have the same rating. The secondary of the transformer will be 0.1 Amps. |
| Voltage Transformer Ratio | - | 0 | 5000 | 1.0 | This is the voltage transformer ratio. This value will multiply all voltage and power readings. If transformers are not used, the ratio should be set to 1.0 |
| Alarm Mute Timer | sec | 0 | 10 | 1 | If the alarm is selected **non-latching**, then the alarm condition disappears this timer after the alarm signal goes off. |
| Mains Phase Order Check Enable | - | 0 | 1 | 0 | 0: mains phase order checking disabled 1: if mains phase order is faulty, then an alarm occurs. |
| Low Voltage Alarm Limit | V | 0 | 65000 | 0 | If the voltage of any phase falls below this limit, this will cause an alarm. If this limit is 0 then low voltage alarm is not controlled. |
| High Voltage Alarm Limit | V | 0 | 65000 | 0 | If the voltage of any phase goes above this limit, this will cause an alarm. If this limit is 0 then high voltage alarm is not controlled. |
| Voltage Fail Timer | sec | 0 | 255 | 1 | If the voltage goes outside limits during this timer, a voltage alarm will occur. |
| Voltage Alarm Lock Enable | - | 0 | 1 | 1 | 0: alarm non latching 1: latching alarm |
| Frequency Low Alarm | Hz | 0 | 400 | 0 | If the frequency goes under this limit, this will cause an alarm. If this limit is 0 then the alarm is not controlled. |
| Frequency High Alarm | Hz | 0 | 400 | 0 | If the frequency goes above this limit, this will cause an alarm. If this limit is 0 then the alarm is not controlled. |
| Frequency Alarm Duration | sec | 0 | 255 | 1 | If the frequency goes outside of the limits during this timer, a frequency alarm will occur. |
| Frequency Alarm Lock Enable | - | 0 | 1 | 1 | 0: alarm non latching 1: latching alarm |
| Active Power Low Alarm | kW | 0 | 400 | 0 | If the active power of any channel goes under this limit, this will cause an alarm. If this limit is 0 then the alarm is not controlled. |
| Active Power High Alarm | kW | 0 | 400 | 0 | If the active power of any channel goes above this limit, this will cause an alarm. If this limit is 0 then the alarm is not controlled. |
| Active Power Alarm Duration | sec | 0 | 255 | 1 | If the active power of any channel goes outside of the limits during this timer, an active power alarm will occur. |
| Active Power Alarm Lock Enable | - | 0 | 1 | 1 | 0: alarm non latching 1: latching alarm |

## 11.2. ELECTRICAL PARAMETERS GROUP (continued)

| Parameter Definition | Unit | Min | Max | Factory Set | Description |
|---|---|---|---|---|---|
| Reactive Power Capacitive Alarm | kVAr | 0 | 400 | 0 | If the reactive power of any channel is capacitive and goes above this limit, this will cause an alarm. If this limit is 0 then the alarm is not controlled. |
| Reactive Power Inductive Alarm | kVAr | 0 | 400 | 0 | If the reactive power of any channel is inductive and goes above this limit, this will cause an alarm. If this limit is 0 then the alarm is not controlled. |
| Reactive Power Alarm Duration | sec | 0 | 255 | 1 | If the reactive power of any channel goes outside of the limits during this timer, a reactive power alarm will occur. |
| Reactive Power Alarm Lock Enable | - | 0 | 1 | 1 | 0: alarm non latching 1: latching alarm |
| Power Factor Capacitive Alarm | - | 0.000 | 1.000 | 0.000 | If the power factor of any channel is capacitive and goes below this limit, this will cause an alarm. If this limit is 0 then the alarm is not controlled. |
| Power Factor Inductive Alarm | - | 0.000 | 1.000 | 0.000 | If the power factor of any channel is inductive and goes below this limit, this will cause an alarm. If this limit is 0 then the alarm is not controlled. |
| Power Factor Alarm Duration | sec | 0 | 255 | 1 | If the power factor of any channel goes outside of the limits during this timer, a power factor alarm will occur. |
| Power Factor Alarm Lock Enable | - | 0 | 1 | 1 | 0: alarm non latching 1: latching alarm |
| Current High Alarm | A | 0 | 5000 | 0 | If the current of any channel goes above this limit, this will cause an alarm. If this limit is 0 then the alarm is not controlled. |
| Current High Alarm Duration | sec | 0 | 255 | 1 | If the current of any channel goes outside of the limits during this timer, a current alarm will occur. |
| Current Alarm Lock Enable | - | 0 | 1 | 1 | 0: alarm non latching 1: latching alarm |
| THD-V Alarm | % | 0 | 100 | 0 | If theTHD of any voltage goes above this limit, this will cause an alarm. If this limit is 0 then the alarm is not controlled. |
| THD-V Alarm Duration | sec | 0 | 255 | 1 | If the THD of any voltage goes outside of the limits during this timer, a THD-V alarm will occur. |
| THD-V Alarm Lock Enable | - | 0 | 1 | 1 | 0: alarm non latching 1: latching alarm |

## 11.2. ELECTRICAL PARAMETERS GROUP (continued)

| | | | | | |
|---|---|---|---|---|---|
| THD-I Alarm | % | 0 | 100 | 0 | If theTHD of any current channel goes above this limit, this will cause an alarm. If this limit is 0 then the alarm is not controlled. |
| THD-I Alarm Duration | sec | 0 | 255 | 1 | If the THD of any current channel goes outside of the limits during this timer, a THD-I alarm will occur. |
| THD-I Alarm Lock Enable | - | 0 | 1 | 1 | 0: alarm non latching<br>1: latching alarm |
| Voltage Unbalance Alarm | % | 0 | 100 | 0 | If the Voltage Unbalance goes above this limit, this will cause an alarm. If this limit is 0 then the alarm is not controlled. |
| Voltage Unbalance Alarm Duration | sec | 0 | 255 | 1 | If the Voltage Unbalance goes outside of the limits during this timer, a THD-I alarm will occur. |
| Voltage Unbalance Alarm Lock Enable | - | 0 | 1 | 1 | 0: alarm non latching<br>1: latching alarm |
| Demand Interval | min | 0 | 1000 | 15 | This is the period used in demand calculations. |
| Counter Unit | - | 0 | 1 | 1 | 0: kWh<br>1: MWh |

## 11.3. CHANNEL CONFIGURATION

In this group, every current channel is adjusted independently and assigned to any analyzer unit.

A general CT ratio is provided for the ease of configuration. If the related channel's CT parameter is left 0, then the general CT ratio is used. Each channel's CT ratio may also be independently adjusted.

Each current input can be matched to any voltage phase. CT inputs may be reversed.

## 11.4. GSM MODEM PARAMETERS

| Parameter Definition | Unit | Min | Max | Factory Set | Description |
|---|---|---|---|---|---|
| Modem Selection | - | 0 | 4 | 0 | **0:** not used<br>**1:** Internal GSM modem |
| GPRS Connection Enable | - | 0 | 1 | 0 | **0:** GPRS disabled<br>**1:** GPRS enabled |
| Ping Period | sec | 30 | 900 | 120 | The unit will check the availability of the internet connection with this interval. |
| Modbus over IP Port | - | 0000 | 65535 | 502 | Internal Modbus TCP/IP server port. The unit answers only queries coming from this port number. |
| Site ID | The site identity string is designed to identify the current controller. This is the site Id string sent at the beginning of SMS messages, e-mails and web page headers for the identification of the genset sending the message. Any 20 character long string may be entered. | | | | |
| Serial Number | The engine serial number string is designed to identify the current controller.This string is added to GSM-SMS messages, e-mails, web page headers etc… Any 20 character long string may be entered. | | | | |
| SMS Enable | - | 0 | 1 | 0 | **0:** SMS messages disabled<br>**1:** SMS messages enabled |
| SMS on Output Change | - | 0 | 1 | 0 | **0:** no SMS on any output relay change<br>**1:** SMS sent on output relay change. |
| SMS on IP Change | - | 0 | 1 | 0 | This parameter controls SMS sending when IP address of GPRS connection is changed. No warnings generated.<br>**0:** no SMS on IP change<br>**1:** SMS sent on IP change |
| SMS Commands Enabled | - | 0 | 1 | 0 | 0: SMS commands not accepted<br>1: SMS commands are accepted but from listed telephone numbers only. |
| SMS Phone Numbers | These telephone number buffers accept up to 16 digits and are used for SMS sending. | | | | |
| E-mail server port | - | 0000 | 65535 | 587 | Server port used in e-mail sending. |
| E-mail on IP Change | - | 0 | 1 | 0 | This parameter controls e-mail sending when IP address of GPRS or ethernet connection is changed. No warnings generated.<br>0: no e-mail on IP change<br>1: e-mail sent on IP change |

## 11.4. GSM MODEM PARAMETERS (continued)

| Parameter Definition | Unit | Min | Max | Factory Set | Description |
|---|---|---|---|---|---|
| E-mail account name | -----@yahoo.com | | | | When the unit sends e-mails to users, this string will apeear at the sender domain. |
| E-mail Account Password | d500_1234 | | | | The password for the e-mail account should be written to this parameter. |
| E-posta Sunucu Adı | smtp.mail.yahoo.com | | | | Kullanılan mail hesabının ait olduğu mail server adresi bu parametreye tanımlanmalıdır. |
| E-mail Adresi-1<br>E-mail Adresi-2<br>E-mail Adresi-3 | -<br>-<br>- | | | | The unit is capable of sending e-mails to 3 different addresses. |
| Rainbow Scada Refresh Rate | sec | 0 | 65535 | 5 | The unit will update the distant monitoring terminal with this rate. |
| Rainbow Scada Address-1 Port | - | 0 | 65535 | 0 | This is the port number of the first monitoring terminal address. |
| Rainbow Scada Address-2 Port | - | 0 | 65535 | 0 | This is the port number of the second monitoring terminal address. |
| Ping Address | www.google.com | | | | In order to check internet connection availability, the unit will periodically "ping" this address. |
| APN User Name | The APN (access point name) username may be required by the GSM operator. However some GSM operators may allow access without username.<br>The exact information should be obtained from the GSM operator.<br>Please search the GSM operator's website with "APN" string. | | | | |
| APN Password | If the APN (access point name) username is required by the GSM operator, most probably the APN password will also be required. However some GSM operators may allow access without password.<br>The exact information should be obtained from the GSM operator.<br>Please search the GSM operator's website with "APN" string. | | | | |
| APN Name | The APN (access point name) is always required by the GSM operator.<br>The exact information should be obtained from the GSM operator.<br>Please search the GSM operator's website with "APN" string. | | | | |
| SMS Service Center Number | The SMS service center number may be required by the GSM operator. However some GSM operators may allow SMS sending without SMS service center number.<br>The exact information should be obtained from the GSM operator.<br>Please search the GSM operator's website with "sms service center" string. | | | | |

⚠️ **Please enter phone numbers starting from the first character. Do not leave any blanks.**

## 11.5. DIGITAL INPUT PARAMETERS

The unit has 2 digital inputs. Only parameters of one input are explained below. Other input have identical parameter set.

The input name is freely programmable, thus the input can be adapted to any functionality through programming.

> ⚠️ **The input name entry is made through RainbowPlus program only.**

Each digital input has below programmable parameters:

| Parameter Definition | Unit | Min | Max | Factory Set | Description |
|---|---|---|---|---|---|
| Input Function | - | 0 | 99 | | Selects between predefined input functions. Selected input name is displayed in the line below. If this parameter is set to 0 then the input name string can be freely entered. **0:** User function-1 **1:** User function-2 **2:** Alarm Mute **3:** High Temperature **4:** Panel Lock |
| Action | - | 0 | 3 | | **0:** alarm |
| Sampling | - | 0 | 3 | | **0:** always |
| Latching | - | 0 | 1 | | **0:** non-latching. The fault disappears when cause is removed. **1:** latching. The fault persists even if the cause is removed. Requires manual reset. |
| Contact type | - | 0 | 1 | | **0:** Normally open **1:** Normally closed |
| Response delay | - | 0.1 | 10 | | This is the delay between the fault signal comes and the alarm occurs. |

## 11.6. DIGITAL OUTPUT PARAMETERS

The parameters below define the functions of relay outputs. The unit has 2 relay outputs. All relays have programmable functions, selected from a list.

> ⚠ **Below is a short list for reference purposes. Please use the RainbowPlus program for complete selection list.**

## OUTPUT FUNCTION LIST

| No | Description | No | Description | No | Description |
|----|-------------|----|-------------|----|-------------|
| 1 | Horn | 31 | Currentunbalance Alarm | | |
| 2 | Flashing relay | 32 | Unbalance alarm | | |
| 3 | Phase order alarm | 33 | User input alarm-1 | | |
| 4 | Voltage alarm | 34 | User input alarm-2 | | |
| 5 | Voltages OK | 35 | Button 1 simulation | | |
| 6 | Internal alarm | 36 | Button 2 simulation | | |
| 7 | Input alarm | 37 | Button 3 simulation | | |
| 8 | Warning | 38 | Button 4 simulation | | |
| 9 | Internal input alarm | 39 | Input-1 simulation | | |
| 10 | kWh tick | 40 | Input-2 simulation | | |
| 11 | kVArh tick | 41 | User output 1 | | |
| 12 | Low voltage alarm | 42 | User output 2 | | |
| 13 | High voltage alarm | 43 | Astronomical relay | | |
| 14 | Low frequency alarm | 44 | | | |
| 15 | High frequency alarm | 45 | | | |
| 16 | Frequency alarm | 46 | | | |
| 17 | Low kW alarm | 47 | | | |
| 18 | High kW alarm | 48 | | | |
| 19 | kW alarm | 49 | | | |
| 20 | kVAr Capacitive alarm | 50 | | | |
| 21 | kVAr inductive alarm | 51 | | | |
| 22 | kVAr alarm | 52 | | | |
| 23 | Pf capacitive alarm | 53 | | | |
| 24 | Pf inductive alarm | 54 | | | |
| 25 | Pf alarm | 55 | | | |
| 26 | High current alarm | 56 | | | |
| 27 | THD-V alarm | 57 | | | |
| 28 | THD-I alarm | 58 | | | |
| 29 | THD alarm | 59 | | | |
| 30 | Voltage Unbalance A. | 60 | | | |

## 11.7. USER INPUT SCREENS

In this group various texts are entered. These texts appear at top of user screens, as special names for digital inputs or analyzer module names.

## 11.8. DEMAND AND COUNTERS

In this group, restarting of demand periods and counter value settings are performed.

## 11.9. USER SCREENS

4 available user defined screens are configured through this menu.



There are 2 different character sizes that can be selected. (5x7 and 10x14 pixels)

1) Please select character size with ⓥ and ⓐ buttons, then press ⑤.

2) Please select the value to display through "SELECT AN ITEM" menu, then press ⑤.
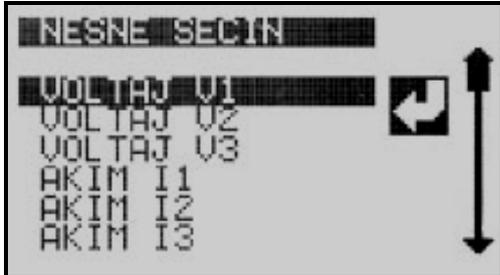


For the next item to display, the menu returns to the character size selection menu. Above steps 1 and 2 may be repeated until the screen is full.

As long as the user stays in the user screen menu, the current appearance of the screen will be on display.



When all available space is occupied, the menu is automatically exited.

If required, the menu may be exited without filling the screeen by holding ⑤ button pressed for 3 seconds.

## 11.10. DEVICE CALIBRATION



The unit is calibrated during factory production, but it is possible to calibrate again.

Please select "**DEVICE CALIBRATION**" menu from PROGRAMMING section.

Then select the input with ⬇ and ⬆ buttons and press ➤.

Then adjust the coefficient in order to display the correct measured value on the screen and press ➤ button in order to save the new calibration and return to PROGRAMMING section.
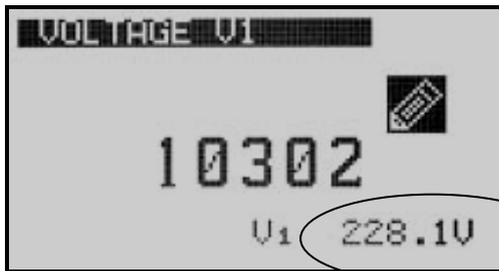


MEASURED
VALUE

## 11.11. ADJUST DATE AND TIME

These parameters allow adjusting the battery backup real time clock of the module. Once set, the clock will continue to run even if supply power is removed from the unit.

| Parameter Definition | Unit | Min | Max | Description |
|---|---|---|---|---|
| Date | - | 01 | 31 | Current day of the month. |
| Month | - | 01 | 12 | Current month. |
| Year | - | 00 | 99 | Last two digits of the current year. |
| Hours | - | 00 | 23 | Current hour of the day. |
| Minutes | - | 00 | 59 | Current minute of the hour. |
| Seconds | - | 00 | 59 | Current second of the minute. |

## 11.12. CHANGE PASSWORD

The unit has 3 different password levels. Each password consists on a 4 digit number.

⚠️ **Passwords can only be modified at factory.**

## 11.13. RETURN TO FACTORY SETTİNGS

When this menu is selected, the unit will ask for confirmation.

Please adjust required selection with ⊻ and ⊼ buttons, then press ▶ in order to return to PROGRAMMING section.

⚠️ **It is not possible to restore previous parameter settings.**

## 11.14. LOCATION SETUP

Parameters adjusted in this section are used in the astronomical relay function.

| Parameter Definition | Unit | Min | Max | Factory Set | Description |
|---|---|---|---|---|---|
| TIME SOURCE | - | - | - | RTC | The unit picks up the date&time information only from the internal RTC. |
| LOCATION SOURCE | - | - | - | SET | This parameter determines the source for geographical location information. The unit supports only manual entry. |
| LATITUDE | degrees | 66S | 66N | 41,000N | This parameter defines the latitude as degrees. **NOTE:** Sunrise and sunset cannot be calculated for latitudes beyon polar circles. |
| LONGITUDE | degrees | 180W | 180E | 36,444E | This parameter defines the longitude in degrees. |
| TIME ZONE | hour | -12 | +12 | +2 | The effective time zone. For eastern longitudes the sign is positive. For wastern longitudes the sign is negative. Central Europe is generally +1 time zone. |
| SUNRISE OFFSET | minute | | | 30 | Defines the delay before sunrise that the astronomical relay will turn off. |
| SUNSET OFFSET | minute | | | 30 | Defines the delay after sunset that the astronomical relay will turn on. |
| PLATE CODE | - | 1 | 100 | 34 | Available for Turkey only. Latitudes and longitutes may be automatically selected from list. |

## 12. INTERNAL RECORD MEMORY

The 1MB internal memory of the unit holds 200 records of 512 bytes long.

The record period is adjusted by program parameter.

Records can only be read through Modbus.

## 13. CENTRAL MONITORING OF UNITS

Please see related document: **Rainbow Scada Usage Guide.**

## 14. E-MAIL SENDING

Please see related document: **Ethernet Configuration Guide for D-500 D-700**.

## 15. SMS COMMANDS

⚠ SMS messages are accepted only from phone numbers recorded in the *GSM PARAMETERS>SMS TEL NUMBERS* tab.
Answers to SMS messages will be sent to **all** phone numbers in the list.

⚠ SMS messages must be written exactly as below, without any preceding blanks.
Only **UPPERCASE** characters are permitted.

| COMMAND | DESCRIPTION | ANSWER |
|---|---|---|
| **GET IP** | If GPRS connection is active, the controller will reply by an SMS message indicating the IP address of the GSM modem. | *IP: 188.41.10.244* |
| **GPRS 1** | Activates the GPRS connection | **GPRS enabled!** |
| **GPRS 0** | Stops the GPRS connection | **GPRS disabled!** |
| **RESET ALARMS** | Clears alarms of the controller. The operating mode is not modified. | **Alarms cleared!** |
| **REBOOT** | Performs a hard reset on the controller | no answer |
| **MODEM RESET** | Performs a hard reset on the modem | no answer |

# 16. MODBUS COMMUNICATIONS

The unit offers the possibility of MODBUS communication through below carriers:
-RS485 serial port, with adjustable baud rate between 2400 and 115200 bauds
-MODBUS-TCP/IP through GPRS (85/85kb), client mode through Rainbow Scada only

The MODBUS properties of the unit are:
-Data transfer mode: RTU
-Serial data: selectable baud rate, 8 bit data, no parity, 1 bit stop
-Modbus-TCP/IP: GPRS Class 12.
-Supported functions:
   -Function 3 (Read multiple registers)
   -Function 6 (Write single register)
   -Function 16 (Write multiple registers)

Each register consists of 2 bytes (16 bits). A larger data structure will contain multiple registers.

The Modbus communications requires a slave address to be assigned to each device in the Modbus network. This address ranges between 1 and 240 and allows the addressing of different slave devices in the same network.

> **Each device in the same RS-485 serial network must be assigned a different slave address. Otherwise the Modbus communications will not be performed.**

> **Devices using Modbus-TCP/IP with different <u>IP or port</u> addresses may use any slave address. It is advised to set these slave addresses to the default setting which is 1.**

## 16.1. PARAMETERS REQUIRED FOR RS-485 MODBUS OPERATION

**Modbus Slave Address:** may be set between 1 and 240
**RS-485 Enable:** must be set to 1 (or checkbox enabled)
**RS-485 Baud Rate:** selectable between 2400 and 115200 bauds. All devices in the same network must use the same Baud Rate.

Selecting a higher baud rate will allow faster communication, but will reduce the communication distance. Selecting a lower baud rate will increase the communication distance, but will cause slower response times. Typically 9600 bauds will allow 1200m distance with special balanced 120 ohms cable.

## 16.2. DATA FORMATS

**16bit variables:** These variables are stored in a single register. Bit_0 denotes the LSB and bit 15 denotes the MSB.
**32 bit variables:** These variables are stored in 2 consecutive registers. The high order 16 bits are in the first register and the low order 16 bits are in the second register
**Bit arrays:** Arrays larger than 16 bits are stored in multiple registers. The LSB of the first register is bit_0. The MSB of the first register is bit_15. The LSB of the second register is bit_16. The MSB of the second register is bit_31, and so on.

## 16.3. EXCHANGE BUFFER

Large blocks of information are transferred to other systems in smaller parts through this area. For example, the record memory of the unit is read through the exchange buffer in parts.

| ADDRESS (decimal) | R / W | DATA SIZE | COEFF. | DESCRIPTION |
|---|---|---|---|---|
| 4096-4611 | R/W | 16bit | - | Exchange buffer (516 registers) |

## 16.4. DATE-TIME AND LOCATION ARRAY

| ADDRESS (decimal) | R / W | DATA SIZE | COEFF. | DESCRIPTION |
|---|---|---|---|---|
| 8192 | R / W | 32bit | - | Year (0-4095) |
| 8193 | R / W | 32bit | - | Month (1-12) |
| 8194 | R / W | 32bit | - | Date (1-31) |
| 8195 | R / W | 32bit | - | Day of Week (0-6) |
| 8196 | R / W | 32bit | - | Hours (0-23) |
| 8197 | R / W | 32bit | - | Minutes (0-59) |
| 8198 | R / W | 32bit | - | Seconds (0-59) |

| ADDRESS (decimal) | R / W | DATA SIZE | COEFF. | DESCRIPTION |
|---|---|---|---|---|
| 8192 | R/W | 16bit | - | Year (0-4095) |
| 8193 | R/W | 16bit | - | Month (1-12) |
| 8194 | R/W | 16bit | - | Date (1-31) |
| 8195 | R/W | 16bit | - | Day of Week (0-6) |
| 8196 | R/W | 16bit | - | Hours (0-23) |
| 8197 | R/W | 16bit | - | Minutes (0-59) |
| 8198 | R/W | 16bit | - | Seconds (0-59) |
| 8199-8200 | R/W | 32bit | - | Latitude |
| 8201-8202 | R/W | 32bit | - | Longitude |
| 8203 | R/W | 16bit | - | Sunrise (hour, minute) |
| 8204 | R/W | 16bit | - | Sunset (hour, minute) |

## 16.5. COUNTERS ARRAY

This area contains energy counters and demand registers.

| ADDRESS (decimal) | R / W | DATA SIZE | COEFF. | DESCRIPTION |
|---|---|---|---|---|
| 12288 | R/W | 32bit | 10 | Input-01 active energy counter |
| 12290 | R/W | 32bit | 10 | Input -02 active energy counter |
| ...... | R/W | 32bit | 10 | ....... |
| ...... | R/W | 32bit | 10 | ....... |
| 12346 | R/W | 32bit | 10 | Input -30 active energy counter |

| ADDRESS (decimal) | R / W | DATA SIZE | COEFF. | DESCRIPTION |
|---|---|---|---|---|
| 12348 | R/W | 32bit | 10 | Input -01 reactive energy counter |
| 12350 | R/W | 32bit | 10 | Input -02 reactive energy counter |
| ...... | R/W | 32bit | 10 | ....... |
| ...... | R/W | 32bit | 10 | ....... |
| 12406 | R/W | 32bit | 10 | Input -30 reactive energy counter |

| ADDRESS (decimal) | R / W | DATA SIZE | COEFF. | DESCRIPTION |
|---|---|---|---|---|
| 12408 | R/W | 32bit | 1 | Demand Counter |
| 12410 | R/W | 32bit | 1 | Demand period |
| 12412 | R/W | 32bit | 10 | Input -01 current demand |
| 12414 | R/W | 32bit | 10 | Input -02 current demand |
| ...... | R/W | 32bit | 10 | ....... |
| ...... | R/W | 32bit | 10 | ....... |
| 12470 | R/W | 32bit | 10 | Input -30 current demand |
| 12472 | R/W | 32bit | 10 | Input -01 active power demand |
| 12474 | R/W | 32bit | 10 | Input -02 active power demand |
| ...... | R/W | 32bit | 10 | ....... |
| ...... | R/W | 32bit | 10 | ....... |
| 12530 | R/W | 32bit | 10 | Input -30 active power demand |

## 16.6. COMMAND ARRAY

Bu alan üzerinden cihaza çeşitli komutlar gönderilebilir.

| ADDRESS (decimal) | R / W | DATA SIZE | COEFF. | DESCRIPTION |
|---|---|---|---|---|
| 16385 | W | 16bit | - | Key press |
| 16386 | W | 16bit | - | Return to factory settings |
| 16387 | W | 16bit | - | Reset counters |
| 16388 | W | 16bit | - | Write to memory |
| 16389 | W | 16bit | - | Read record |
| 16390 | W | 16bit | - | Go to boot mode |
| 16391 | W | 16bit | - | Write to energy counter |
| 16392 | W | 16bit | - | Reset demands |
| 16401 | W | 16bit | - | Read SFM page |
| 16402 | W | 16bit | - | Goto auto calibration |
| 16403 | W | 16bit | - | Reset unit |
| 16404 | W | 16bit | - | Oscilloscope channel number |
| 16405 | W | 16bit | - | Reset calibration |

## 16.7. MEASUREMENTS ARRAY

Modbus üzerinden okunabilen en önemli kayıtların listesi aşağıdadır.

| ADDRESS (decimal) | R / W | DATA SIZE | COEFF. | DESCRIPTION |
|---|---|---|---|---|
| 20480 | R | 32bit | x10 | Phase L1 voltage |
| 20482 | R | 32bit | x10 | Phase L2 voltage |
| 20484 | R | 32bit | x10 | Phase L3 voltage |
| 20486 | R | 32bit | x10 | Phase L1-L2 voltage |
| 20488 | R | 32bit | x10 | Phase L2-L3 voltage |
| 20490 | R | 32bit | x10 | Phase L3-L1 voltage |
| 20492 | R | 32bit | x10 | Input-01 current |
| 20494 | R | 32bit | x10 | Input-02 current |
| ..... | R | 32bit | x10 | ....... |
| ..... | R | 32bit | x10 | ....... |
| 20550 | R | 32bit | x10 | Input-30 current |
| 20552 | R | 32bit | x100 | Input-01 active power (kW) |
| 20554 | R | 32bit | x100 | Input-02 active power (kW) |
| ..... | R | 32bit | x100 | ....... |
| ..... | R | 32bit | x100 | ....... |
| 20610 | R | 32bit | x100 | Input-30 active power (kW) |
| 20612 | R | 32bit | x100 | Input-01 reactive power (kVAr) |
| 20614 | R | 32bit | x100 | Input-02 reactive power (kVAr) |
| ..... | R | 32bit | x100 | ....... |
| ..... | R | 32bit | x100 | ....... |
| 20670 | R | 32bit | x100 | Input-30 reactive power (kVAr) |
| 20672 | R | 32bit | x100 | Input-01 apparent power (kVA) |
| 20674 | R | 32bit | x100 | Input-02 apparent power (kVA) |
| ..... | R | 32bit | x100 | ....... |
| ..... | R | 32bit | x100 | ....... |
| 20730 | R | 32bit | x100 | Input-30 apparent power (kVA) |
| 20732 | R | 32bit | x10 | Average Phase-Neutral voltage |
| 20734 | R | 32bit | x10 | Average Phase-Phase voltage |
| 20736 | R | 32bit | x1000 | Input-01 power factor (cos) |
| 20738 | R | 32bit | x1000 | Input-02 power factor (cos) |
| ..... | R | 32bit | x1000 | ....... |
| ..... | R | 32bit | x1000 | ....... |
| 20794 | R | 32bit | x1000 | Input-30 power factor (cos) |
| 20796 | R | 32bit | x1000 | Input-01 reactive power ratio(%) |
| 20798 | R | 32bit | x1000 | Input-02 reactive power ratio(%) |
| ..... | R | 32bit | x1000 | ....... |
| ..... | R | 32bit | x1000 | ....... |
| 20854 | R | 32bit | x1000 | Input-30 reactive power ratio(%) |
| 20856 | R | 32bit | x100 | Mains frequency |
| 20858 | R | 32bit | x10 | Internal supply voltage |

## 16.8. ANALYZER BLOCKS

The unit offers 15 virtual analyzers. Any current input can be assigned to any analyzer block.

The sum of inputs assigned to an analyzer are displayed under this analyzer.

The definition of a sample analyzer block and starting addresses of each analyzer are given below. Each block is the copy of the sample block.

| ADDRESS (decimal) | R / W | DATA SIZE | COEFF. | DESCRIPTION |
|---|---|---|---|---|
| +00 | R | 32bit | - | Analyzer konfigürasyonu |
| +02 | R | 32bit | x100 | Analyzer total active power (kW) |
| +04 | R | 32bit | x100 | Analyzer total reactive power (kVAr) |
| +06 | R | 32bit | x100 | Analyzer total apparent power (kVA) |
| +08 | R | 32bit | x1000 | Analyzer total power factor (cos) |
| +10 | R | 32bit | x1000 | Analyzer total reactive power ratio(%) |

| ADDRESS (decimal) | R / W | DATA SIZE | COEFF. | DESCRIPTION |
|---|---|---|---|---|
| 20860 | R | - | - | Analyzer -01 start address |
| 20872 | R | - | - | Analyzer -02 start address |
| 20884 | R | - | - | Analyzer -03 start address |
| 20896 | R | - | - | Analyzer -04 start address |
| 20908 | R | - | - | Analyzer -05 start address |
| 20920 | R | - | - | Analyzer -06 start address |
| 20932 | R | - | - | Analyzer -07 start address |
| 20944 | R | - | - | Analyzer -08 start address |
| 20956 | R | - | - | Analyzer -09 start address |
| 20968 | R | - | - | Analyzer -10 start address |
| 20980 | R | - | - | Analyzer -11 start address |
| 20992 | R | - | - | Analyzer -12 start address |
| 21004 | R | - | - | Analyzer -13 start address |
| 21016 | R | - | - | Analyzer -14 start address |
| 21028 | R | - | - | Analyzer -15 start address |

## 16.9. DIGITAL INPUTS AND OUTPUTS

| | | | | |
|---|---|---|---|---|
| 21040 | R | 16 bit | - | Dijital Input statuses (2 LSb bits) |
| 21041 | R | 16 bit | - | Dijital çıkış statuses (2 LSb bits) |

## 16.10. HARMONIC ANALYSIS

The unit analyses harmonics of 30 current inputs and 6 voltage inputs. The harmonic analysis result buffer is identical for each channel.

The definition of a sample block and starting addresses of each block are given below. Each block is a copy of the sample block.

| ADDRESS (decimal) | R / W | DATA SIZE | COEFF. | DESCRIPTION |
|---|---|---|---|---|
| +00 | R | 16bit | x100 | Harmonic-02 percentage |
| +01 | R | 16bit | x100 | Harmonic-03 percentage |
| +02 | R | 16bit | x100 | Harmonic-04 percentage |
| +03 | R | 16bit | x100 | Harmonic-05 percentage |
| +04 | R | 16bit | x100 | Harmonic-06 percentage |
| +05 | R | 16bit | x100 | Harmonic-07 percentage |
| +06 | R | 16bit | x100 | Harmonic-08 percentage |
| +07 | R | 16bit | x100 | Harmonic-09 percentage |
| +08 | R | 16bit | x100 | Harmonic-10 percentage |
| +09 | R | 16bit | x100 | Harmonic-11 percentage |
| +10 | R | 16bit | x100 | Harmonic-12 percentage |
| +11 | R | 16bit | x100 | Harmonic-13 percentage |
| +12 | R | 16bit | x100 | Harmonic-14 percentage |
| +13 | R | 16bit | x100 | Harmonic-15 percentage |
| +14 | R | 16bit | x100 | Harmonic-16 percentage |
| +15 | R | 16bit | x100 | Harmonic-17 percentage |
| +16 | R | 16 bit | - | Channel number |
| +17 | R | 16bit | x100 | THD percentage |

| ADDRESS (decimal) | R / W | DATA SIZE | COEFF. | |
|---|---|---|---|---|
| 21045 | R | - | - | L1 voltage Harmonics |
| 21063 | R | - | - | L2 voltage Harmonics |
| 21081 | R | - | - | L3 voltage Harmonics |
| 21099 | R | - | - | U12 voltage Harmonics |
| 21117 | R | - | - | U23 voltage Harmonics |
| 21135 | R | - | - | U31 voltage Harmonics |
| 21153 | R | - | - | Current-01 Harmonics |
| 21171 | R | - | - | Current-02 Harmonics |
| ..... | | | | ..... |
| ..... | | | | ..... |
| 21675 | R | - | - | Current-30 Harmonics |

## 16.11. OSCILLOGRAPHIC RECORDS

The unit kepps waveforms of 30 current channels and 6 voltage channels.

The required channel number should be written to "**COMMAND ARRAY>Oscilloscope Channel Number**" .

| ADDRESS (decimal) | R / W | DATA SIZE | COEFF. | DESCRIPTION |
|---|---|---|---|---|
| 21693 | R | 16 bit | - | Oscilloscope channel (0-5:voltages, 6-35:Currents) |
| 21694-21793 | R | 100x16bit | - | Oscilloscope point value (16 bit signed integer). Each register gives the value of a point on thew X axis. The graphic is represented by a total number of 100 points. |

## 16.12. DEVICE INFORMATION

| ADDRESS (decimal) | R / W | DATA SIZE | COEFF. | DESCRIPTION |
|---|---|---|---|---|
| 21802 | R | 16 bit | - | Device type (always 0x0430) |
| 21803 | R | 16 bit | - | Firmware version |

## 16.13. ALARM INFORMATION

| ADDRESS (decimal) | R / W | DATA SIZE | COEFF. | DESCRIPTION |
|---|---|---|---|---|
| 22323 | R | 32 bit | - | Bit_00: high voltage alarm<br>Bit_01: low voltage alarm<br>Bit_02: high frequency alarm<br>Bit_03: low frequency alarm<br>Bit_04: high THD-V alarm<br>Bit_05: voltage unbalance alarm<br>Bit_06: Phase order alarm<br>Bit_07: digital Input-1 alarm<br>Bit_08: digital Input-2 alarm<br>Bit_09: panel alarm<br>Bit_10: high temperature alarm<br>Bit_11..31: - |
| 22325 | R | 32 bit | - | Bit_00: Input-01high active power alarm<br>Bit_01: Input-02 high active power alarm<br>Bit_02: ...<br>Bit_03: ...<br>Bit_29: Input-30 high active power alarm<br>Bit_30-31: - |
| 22327 | R | 32 bit | - | Bit_00: Input-01low active power alarm<br>Bit_01: Input-02 low active power alarm<br>Bit_02: ...<br>Bit_03: ...<br>Bit_29: Input-30 low active power alarm<br>Bit_30-31: - |

| ADDRESS (decimal) | R / W | DATA SIZE | COEFF. | DESCRIPTION |
|---|---|---|---|---|
| 22329 | R | 32 bit | - | Bit_00: Input-01 high reactive power alarm<br>Bit_01: Input-02 high reactive power alarm<br>Bit_02: ...<br>Bit_03: ...<br>Bit_29: Input-30 high reactive power alarm<br>Bit_30-31: - |
| 22331 | R | 32 bit | - | Bit_00: Input-01 low reactive power alarm<br>Bit_01: Input-02 low reactive power alarm<br>Bit_02: ...<br>Bit_03: ...<br>Bit_29: Input-30 low reactive power alarm<br>Bit_30-31: - |
| 22333 | R | 32 bit | - | Bit_00: Input-01 inductivecos alarm<br>Bit_01: Input-02 inductivecos alarm<br>Bit_02: ...<br>Bit_03: ...<br>Bit_29: Input-30 inductivecos alarm<br>Bit_30-31: - |
| 22335 | R | 32 bit | - | Bit_00: Input-01 capacitivecos alarm<br>Bit_01: Input-02 capacitivecos alarm<br>Bit_02: ...<br>Bit_03: ...<br>Bit_29: Input-30 capacitivecos alarm<br>Bit_30-31: - |
| 22337 | R | 32 bit | - | Bit_00: Input-01 high Current alarm<br>Bit_01: Input-02 high Current alarm<br>Bit_02: ...<br>Bit_03: ...<br>Bit_29: Input-30 high Current alarm<br>Bit_30-31: - |
| 22339 | R | 32 bit | - | Bit_00: Input-01 high THD-I alarm<br>Bit_01: Input-02 high THD-I alarm<br>Bit_02: ...<br>Bit_03: ...<br>Bit_29: Input-30 high THD-I alarm<br>Bit_30-31: - |

## 17. DECLARATION OF CONFORMITY

The unit conforms to the EU directives
-2006/95/EC (low voltage)
-2004/108/EC (electro-magnetic compatibility)
Norms of reference:
EN 61010  (safety requirements)
EN 61326  (EMC requirements)

The CE mark indicates that this product complies with the European requirements for safety, health environmental and customer protection.

**UL / CSA Conformity:**
certification testing in progress
UL 508, Edition 17
UL 2200, 1st Edition.
UL 840 Edition 3
CSA C22.2 NO. 14 - Edition 10

## 18. MAINTENANCE

**DO NOT OPEN THE UNIT !**

**There are NO serviceable parts inside the unit.**

Wipe the unit, if necessary with a soft damp cloth. Do not use chemical agents

## 19. DISPOSAL OF THE UNIT

Following **DIRECTIVE 2002/96/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 27 January 2003 on waste electrical and electronic equipment (WEEE)**, this unit should be stored and disposed separately from the usual waste.

## 20. ROHS COMPLIANCE

The european ROHS directive restricts and prohibits the use of some chemical materials in electronic devices.

Following the "**DIRECTIVE 2011/65/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment",** this product is listed in annex-I under category: "**Monitoring and control instruments including industrial monitoring and control instruments**" and exempted from ROHS directive.

However Datakom is not using any ROHS uncompliant electronic components in the production. Only the solder contains lead. The switching to unleaded soldering is in progress.

## 21. TROUBLESHOOTING GUIDE

> ⚠️ **Below is a basic list of most often encountered troubles. More detailed investigation may be required in some cases.**

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**KW and cosΦ readings are faulty although the Amp readings are correct:**

-Current transformers are not connected to the correct inputs or some of the CTs are connected with reverse polarity. Determine the correct connections of each individual CT in order to obtain correct KW and cosΦ for the related phase, and then connect all CTs. Please review chapter "**AC CURRENT INPUTS**"

> ⚠️ **Short circuit outputs of unused Current Transformers.**

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**The unit is inoperative:**

Measure the supply voltage between supply terminals.
Check that the unit's supply voltage is adequate to operating conditions.
If OK, turn all fuses off, then turn all the fuses on, starting from the supply fuse. Then test the unit again.

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**Some program parameters are skipped:**

These parameters are reserved for factory setting and cannot be modified.

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