Features

- Three-phase, three stages phase overcurrent setting
- Low-set and high-set earth fault setting
- IDMT and definite time setting
- Thermal overload protection
- Trip circuit supervision
- RS232 and RS485 MODBUS-RTU communication
- Fault, alarm and tripping records with timestamp
- Multifunction programmable outputs
- Multifunction external digital inputs
<table>
<thead>
<tr>
<th>Revision</th>
<th>Date</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1.0</td>
<td>May 2012</td>
<td>First version.</td>
</tr>
<tr>
<td>V1.1</td>
<td>Aug 2013</td>
<td>Adding IRF option. Correcting MODBUS register.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Correct typo-error at Fault Records Menu, MODBUS register</td>
</tr>
<tr>
<td>V1.2</td>
<td>Jan 2014</td>
<td>Correct typo-error at Input Menu, Typical Connection Diagram</td>
</tr>
</tbody>
</table>
# Table of Contents

1.0 Introduction ........................................................................................................... 4  
   1.1 Symbols and Definitions ......................................................................................... 4  

2.0 Front Panel ............................................................................................................. 5  
   2.1 LCD Display ............................................................................................................. 5  
   2.2 Keypad .................................................................................................................. 5  
   2.3 LEDs ..................................................................................................................... 6  
   2.4 RS232 Port ............................................................................................................. 6  
   2.5 Default Display ...................................................................................................... 6  
   2.6 Alarm Condition ................................................................................................... 6  

3.0 Password ................................................................................................................. 7  
   Password Protection ................................................................................................. 7  
   Password Entry ........................................................................................................ 7  
   Changing Password ................................................................................................. 7  

4.0 Menus ..................................................................................................................... 7  
   4.1 Menu Contents .......................................................................................... 7  
   MEASUREMENTS Menu .................................................................................. 10  
   RECORDS Menu ............................................................................................ 11  
   CONFIGURATION Menu .................................................................................. 12  
   PROTECTION G1 Menu .................................................................................. 16  
   PROTECTION G2 Menu .................................................................................. 19  
   INPUT Menu ..................................................................................................... 19  
   OUTPUT Menu .................................................................................................. 21  
   COMMUNICATION Menu .................................................................................. 24  

5.0 Functions and Descriptions ................................................................................ 25  
   5.1 Circuit Breaker Failure Protection ................................................................. 25  
   5.2 Thermal Overload Protection ......................................................................... 26  
   5.3 Trip Circuit Supervision .................................................................................. 27  
   5.4 Characteristic Curves ...................................................................................... 29  

6.0 Case Dimensions .................................................................................................. 31  

7.0 Connection Diagram and Terminal ................................................................... 31  
   7.1 Terminal Connection at Rear View ............................................................... 31  
   7.2 Typical Connection Diagram ............................................................................. 33  

8.0 Technical Data ....................................................................................................... 34  

9.0 MODBUS Protocol ............................................................................................. 38  
   9.1 MODBUS Functions ....................................................................................... 38  
   9.2 MODBUS Register .......................................................................................... 40  
   9.3 MODBUS Mapping Format ............................................................................. 45
1.0 Introduction

The purpose of this manual is to provide information necessary to install, operate and maintain the MK2200L relay.

MK2200L provides protections for 3 independent phase overcurrent elements and one non-directional earth-fault element. All these elements are connected to the current transformers of the feeders to be protected.

There are 2 sets of current inputs, for 1A and 5A rated CTs.

Using the front panel, the user can easily navigate through the user friendly menu, read measurements and change settings. The relay status and alarm or trip records are displayed on the back-lit LCD also.

There is a RS232 port available on the front panel and a RS485 port on the rear terminals. Using MODBUS RTU protocol, all stored information can be read and settings can be modified with a PC loaded with Mikro setting software.

MK2200L has 4 configurable output relays. They can be activated by any of the protection functions available in the relay. There is also 1 output relay for internal fault indication. There are 2 configurable logic inputs for various functions.

1.1 Symbols and Definitions

In this manual and on the relay, unless the context otherwise requires, the following symbols and abbreviations shall apply throughout:-

AC : Alternating current
Ack : Acknowledge
Alrm : Alarm
CT : Current transformer
CBFP : Circuit Breaker Failure Protection
Chg : Change
CLPU : Cold Load Pickup
DC : Direct current
Dmd : Demand
Dmnd : Demand
DMT : Definite time
EF : Earth fault
Genrl : General
IDMT : Inverse definite minimum time
IL1 : Phase 1 current
IL2 : Phase 2 current
IL3 : Phase 3 current
Io/Is : Earth (fault) current
Invrse : Inverse
Ip : Input
IRF : Internal Relay Failure
LED : Light emitting diodes
OC : Overcurrent
OL : Overloaded
PU : Pickup
RCRD : Record
Rmote : Remote
Rst : Reset
Strt : Start
TCS : Trip circuit supervision
Thml : Thermal
2.0 Front Panel

Using the front panel, the user can easily navigate through the user friendly menu, read measurements and change settings. The relay status and alarm or trip records are displayed on the back-lit LCD also.

MK2200L Front panel

2.1 LCD Display

The LCD has 2 lines with 16 characters each. Back light is on when a key is pressed and remain on for a predefined time duration. The brightness can be adjusted to suit the lighting conditions.

2.2 Keypad

There are 6 keys on the front panel.

Up, Down, Enter and Esc are used to navigate through the menus and adjust the settings.

- **Up**: Scroll up the menus or increase setting value.
- **Down**: Scroll down the menus or decrease setting value.
- **Esc**: To exit from menus, submenus or to cancel setting value change. Press and hold for 1.5 seconds to return to default display from any submenu.
- **Enter**: To enter submenus or to confirm setting value change.
- **Clear**: To reset tripping, reset latched relay. If “CLEAR” Scroll is enabled (under Configurations-> Display menu) and during no alarm status, it can be used to scroll through Phase Overcurrent and Earth Fault settings, and to return to default display from any submenu if pressed and hold for 1.5 seconds.
- **Record**: To display Alarm records. To display successive records, press Record key again.
To display record date and time, press Enter. To exit, press Esc/Enter. To delete individual record, press Clear. To delete all records, go to the end of the records and “Clear all alarm?” will be shown, press Clear to clear.

### 2.3 LEDs

- **Aux LED**: Indicates auxiliary power to the device
- **Trip LED**: Indicates tripping.
- **Alarm LED**: Blinks to indicate non-acknowledge alarm (or tripping). Steady on when the alarm is acknowledged by pressing any key

### 2.4 RS232 Port

The front panel RS232 port has the same MODBUS RTU protocol as the RS485 port on the rear terminal, though with fixed communication settings: 38400bps, 1 stop bit, even parity, address 1.

All stored information can be read and settings can be modified with a PC loaded with the supplied Mikro setting software.

### 2.5 Default Display

By default the LCD displays the current value measured for IL1, IL2, IL3 and Io. Input and output status as well as date and time can be shown by pressing Up or Down to change the default display page. Pressing Esc always return to current value display.

As soon as an alarm or trip is detected, the display jumps to record display to show the latest record.

### 2.6 Alarm Condition

During an alarm or tripping condition, Alarm LED blinks. Alarm record pops up. Any keypress change the Alarm LED to steady on.

**Example of Alarm record title page, showing record 1 out of total 2 records.** Press Enter to enter sub page for this record. Press Record/Down to show next alarm. Press Up to show previous alarm. Press Esc to return to Default Display. Press Clear to clear the alarm. If the condition still persists, the alarm cannot be cleared.

**Date:** 03/02/2011  
**Time:** 08:23:44am

**Clear all alarm?**  
Clear=CLEAR

**Alarm record sub page, showing record date and time.** Press Esc/Enter/RECORD to return to Alarm Record title page.

**Clearing all record menu is shown when Up is pressed during display of Record 1's title page, or RECORD/Down is pressed during display of Last records title page.** Press Clear to clear all Alarm record or Esc to cancel.
3.0 Password

Password Protection
Relay settings can be view anytime but locked from being changed. A password is required for changing setting.

The password consists of four digit numbers. The factory default password is set as 0000.

The programming mode is indicated with the letter "P" on the right hand side of the display. The letter "P" remains present as long as the password is active. (2 minutes if there is no key action).

Password Entry
The input of the password is requested as soon as a modification of a parameter is made. The user enters each one of the 4 digits by using up or down key and validates each digit with Enter. If Esc is pressed in between, the password entering is terminated.

“Password OK” is shown if correct password is entered. “Password ERROR” is shown if wrong password is entered.

The display returns to the point of the preceding menu. Pressed Enter again to modify the setting.

If no key is pressed after 2 minutes, the settings are locked. A new password request is associated with any subsequent setting change.

Changing Password
To change the password, go to Op Parameter -> Password menu. Enter current password to unlock, after that the display shows current password. Press Enter again to enter the new password.

4.0 Menus
The menu is divided into 7 main menus and their corresponding submenus. To enter Main menu, press Enter during default display.

The menu can be navigated by pressing Up, Down, Enter and Esc keys. There is no need of a password when reading settings and measured values.

4.1 Menu Contents
The Main menu consists of 8 items:

1. MEASUREMENTS  
2. RECORDS  
3. CONFIGURATION  
4. PROTECTION G1  
5. PROTECTION G2  
6. INPUT  
7. OUTPUT  
8. COMMUNICATION
# Default Display and Menu Contents

## 1. MEASUREMENTS

- IL1
- IL2
- IL3
- Io
- Thermal θ
- Frequency
- IL1 Max
- IL2 Max
- IL3 Max
- Io Max
- IL1 Avg
- IL2 Avg
- IL3 Avg
- Io Avg
- Max & Avg I RST
- Timer Window

## 2. RECORDS

- 2.1 Fault Recs
- 2.2 Event Recs

## 3. CONFIGURATION

### 3.1 Op Parameter
- Password
- Description
- Firmware
- Frequency
- Active Group

### 3.2 CT Ratio
- Line CT Pri
- E/Gnd CT Pri

### 3.3 Date & Time
- Date
- Date Format
- Time
- Time Format

### 3.4 Group Select
- Chg Group by...
- Setting Group

### 3.5 Display
- LCD On Time
- LCD Brightness
- "CLEAR" Scroll?

### 3.6 Cold Load PU
- CLPU Level
- CLPU tCL
- CLPU tCL
- CLPU tCL
- CLPU tCL
- CLPU tCL

## 4. PROTECTION G1

### 4.1 Phase OC
- I>
- I>
- I> Delay Type
- I> DMT Curve
- I>
- I>>?
- I>
- I>>
- I>>?
- I>>?
- I>> Sample
- I>>?

### 4.2 Earth OC
- Io>
- Io>
- Io> Delay Type
- Io> DMT Curve
- Iko>
- Iko>
- Iko>>?
- Iko>>?

### 4.3 Thermal OL
- Thermal OL?
- Iko>
- Iko>
- Iko>
- k
- Trip
- k Alarm

## 5. PROTECTION G2

Similar to PROTECTION G1

## 6. Cold Load PU

### 3.7 Demand Alarm
- Demand Alarm?
- Irdmnd>
- Irdmnd>

* Some of the menu items are not shown if relevant functions are disabled
6. INPUT

6.1-6.2 Input 1,2

<table>
<thead>
<tr>
<th>Input Func</th>
<th>Input Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Func is Aux 1/2)</td>
<td>Aux timer</td>
</tr>
<tr>
<td>Rst Trip/Alarm</td>
<td>Rst Thermal %</td>
</tr>
<tr>
<td>(Func is Blocking)</td>
<td>TCS delay</td>
</tr>
</tbody>
</table>

7. OUTPUT

7.1 Relay 1

| Relay 1 Func | (Trip only) |
| Reset | tI> |
| tI>> | tI>>> |
| tIo> | tIo>> |
| Thml OL? | tAux 1? |
| tAux 2? | Remote? |

7.2-7.4 Relay 2-4

| Relay 2-4 Func | Reset |
| (Func is Trip) | (Func is Start) |
| tI> | I> |
| tI>> | I>> |
| tI>>> | I>>> |
| tIo> | I<> |
| tIo>> | I>> |
| Thml OL? | Thml OL(Alarm)? |
| tAux 1? | Aux 1(Alarm)? |
| tAux 2? | Aux 2(Alarm)? |
| Remote? | TCS (Alarm)? |
| Demand (Alarm)? |

7.5 Maint mode

8. COMMUNICATION

| Communication? | Baud Rate |
| Parity | Stop Bit |
| Relay Address |

* Some of the menu items are not shown if relevant functions are disabled
MEASUREMENTS Menu

Various measurement values can be read under MEASUREMENTS menu. (The values are shown for illustrative purpose).

<table>
<thead>
<tr>
<th>1.MEASUREMENTS</th>
<th>Heading of MEASUREMENTS menu. Press Enter to enter submenu content.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IL1</strong></td>
<td>52.0A Phase 1 current value. Taking into account of Line CT Pri ratio.</td>
</tr>
<tr>
<td><strong>IL2</strong></td>
<td>88.2A Phase 2 current value. Taking into account of Line CT Pri ratio.</td>
</tr>
<tr>
<td><strong>IL3</strong></td>
<td>64.2A Phase 3 current value. Taking into account of Line CT Pri ratio.</td>
</tr>
<tr>
<td><strong>Io</strong></td>
<td>4.23A Earth current value. Taking into account of E/Gnd CT Pri ratio.</td>
</tr>
<tr>
<td><strong>Thermal %</strong></td>
<td>RST=CLEAR 35% Thermal % state. Calculated on true RMS current values. Press Clear to clear the % values.</td>
</tr>
<tr>
<td><strong>Frequency</strong></td>
<td>50.01Hz Current frequency calculated from phase 1 currents.</td>
</tr>
<tr>
<td><strong>IL1 Max</strong></td>
<td>120A Peak Phase 1 current value.</td>
</tr>
<tr>
<td><strong>IL2 Max</strong></td>
<td>234A Peak Phase 2 current value.</td>
</tr>
<tr>
<td><strong>IL3 Max</strong></td>
<td>1.23kA Peak Phase 3 current value.</td>
</tr>
<tr>
<td><strong>Io Max</strong></td>
<td>1.23kA Peak Earth current value.</td>
</tr>
<tr>
<td><strong>IL1 Avg</strong></td>
<td>323A Average Phase 1 current value.</td>
</tr>
</tbody>
</table>
IL2 Avg  80.4A
Average Phase 2 current value.

IL3 Avg  78.2A
Average Phase 3 current value.

Io Avg  6.24A
Average Earth current value.

Max & Avg 1 RST
RST=CLEAR
To clear the maximum and average values of the currents. Press Clear to clear these values.

Time Window  10min
Set the value for the time window (rolling) during which maximum and average values are stored. Press Enter to change the value.

RECORDS Menu

2.RECORDS
Heading of RECORDS menu. Press Enter to enter submenu content.

Fault Records Menu

2.1 Fault Rcords
Heading of Fault Record submenu. Press Enter to enter submenu content.

t1> trip [1]
L3
Example of Fault Record title page, showing trip element, source, value and record number 1. Press Up or Down to show another record of Enter to enter sub page for this record. Press Clear to clear this record.

Date:  03/01/2011
Time:  10:19:52am
Fault record sub page 1, showing record date and time. Press down to show next sub page. Press Esc/Enter to return to Fault Record title page.

Active Set Group  1
Fault record sub page 2, showing active protection setting group during fault. Press Up/down to change sub page. Press Esc/Enter to return to Fault Record title page.
Fault record sub page 3, showing L1 current during fault. Press Up/down to change sub page. Press Esc/Enter to return to Fault Record title page.

IL1 Magnitude
4.86A

Fault record sub page 4, showing L2 current during fault. Press Up/down to change sub page. Press Esc/Enter to return to Fault Record title page.

IL2 Magnitude
4.52A

Fault record sub page 5, showing L3 current during fault. Press Up/down to change sub page. Press Esc/Enter to return to Fault Record title page.

IL3 Magnitude
15.2A

Fault record sub page 6, showing Lo current during fault. Press Up to previous sub page. Press Esc/Enter to return to Fault Record title page.

Io Magnitude
1.2A

Clearing all records
Clear all rcrds?
Clear=CLEAR

Clearing all record menu is shown when Up is pressed during display of Record 1’s title page, or Down is pressed during display of Last records title page. Press Clear to clear all record or Esc to cancel.

Event Records Menu

2.2 Event Rcrds

Heading of Fault Record submenu. Press Enter to enter submenu content.

Genrl strt [1]

Example of Event title page. Press Enter to enter sub page for this record.

Date: 03/02/2011
Time: 08:23:44am

Event record sub page, showing record date and time. Press Esc/Enter to return to Fault Record title page.

Clearing all records

Clear all rcrds?
Clear=CLEAR

Clearing all record menu is shown when Up is pressed during display of Record 1’s title page, or Down is pressed during display of Last records title page. Press Clear to clear all record or Esc to cancel.

CONFIGURATION Menu

3.CONFIGURATION

Heading of CONFIGURATION menu. Press Enter to enter submenu content.
Op parameter Menu

3.1 Op Parameter

Heading of Op Parameter submenu. Press Enter to enter submenu content.

Password

This password is required when changing relay settings. Press Enter to enter a new password. The user needs to enter existing password to unlock, after that the display shows current password. Press Enter again to enter the new password.

Description

Model name of this relay

MK2200L

Firmware

Version of the firmware.

1.0

Frequency

Set the nominal value of the line frequency. Press Enter to change this value.

50Hz

CT Ratio Menu

3.2 CT Ratio

Heading of CT Ratio menu. Press Enter to enter submenu content

Line CT Pri

Set the rated primary current of the Line/Phase CT.

500A

E/Gnd CT Pri

Set the rated primary current of the Earth/Ground CT.

200A

Note: The CT secondary should be connected to 5A or 1A CT input terminal of the relay according to Primary CT type. The display current is calculated by the formula:

\[
\text{Current at CT input terminal} / \text{CT input terminal type} \times \text{CT Pri (setting above)}
\]

For example if:
Current at CT input terminal = 3A,
CT input terminal type = 5A,
CT Pri = 200A,

The display value = 3/5 x 200 = 120A
Date & Time Menu

**3.3 Date & Time**

Heading of Date & Time menu. Press Enter to enter submenu content.

**Date**

Displays the date. Press Enter to change the date.

Date 16/09/2012

**Date Format**

Set the date format for display. Press Enter to change between DD/MM/YYYY and MM/DD/YYYY.

Date Format DD/MM/YYYY

**Time**

Displays the time. Press Enter to change the time, starts from hour, minute and am/pm (if 12 hour format is selected). Second will be reset to 0 when enter is pressed for any of the digit.

Time 10:46:23am

**Time Format**

Set the time format. Press enter to change between 12 and 24 hour.

Time Format 12-hour

Group Select Menu

**3.4 Group Select**

Heading of Group Select menu. Press Enter to enter submenu content.

Chg Group by...

Set whether the protection group setting is change by Menu or Input. One of the input function must be set to 'Select Group' if Input is selected. Press Enter to change.

Setting Group

If above is set to Menu, this will set the active protection group. Press Enter to change.

Display Menu

**3.5 Display**

Heading of Display menu. Press Enter to enter submenu content.

**LCD On Time**

Set how long the LCD backlight remains on after no key is pressed. Press Enter to change.

LCD On Time 10min

**LCD Brightness**

Set the brightness of the LCD backlight. Press Enter to change.

LCD Brightness Medium
Set if Clear key can be used (during no alarm or trip state) to scroll through the default display pages, Phase OC and Earth OC settings (for currently selected group), as well as to return to Default Display from Record display. This is useful when Up, Down, Enter and Esc key is inaccessible due to the front panel is covered and locked.

**Cold Load Pickup Menu**

Cold Load Pickup allows selected settings to be altered to respond to temporary overload conditions that may occur during cold starts. These conditions could be switching on large heating load after a extended cooling period, air conditioning, or inductive loads that draw high starting current like motor.

To enable cold load pickup, one of the input functions has to be set to Cold Load PU.

<table>
<thead>
<tr>
<th>Heading of Cold Load Pickup menu. Press Enter to enter submenu content.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3.6 Cold Load PU</strong></td>
</tr>
<tr>
<td><strong>CLPU Level</strong></td>
</tr>
<tr>
<td><strong>CLPU tCL</strong></td>
</tr>
<tr>
<td><strong>CLPU tl&gt;?</strong></td>
</tr>
<tr>
<td><strong>CLPU tl&gt;&gt;&amp;?</strong></td>
</tr>
<tr>
<td><strong>CLPU tl&gt;&gt;&amp;&gt;&amp;?</strong></td>
</tr>
<tr>
<td><strong>CLPU tlo&gt;?</strong></td>
</tr>
<tr>
<td><strong>CLPU tlo&gt;&gt;&amp;?</strong></td>
</tr>
<tr>
<td><strong>CLPU Thml OL?</strong></td>
</tr>
</tbody>
</table>

Scaling value, in percent, for the cold load pick up assigned to the selected thresholds.

Delay timer setting (tCL) for the Cold Load Pickup function.

Assign the I> time delay threshold with the cold load pick up function.

Assign the I>>& time delay threshold with the cold load pick up function.

Assign the I>>&>& time delay threshold with the cold load pick up function.

Assign the I> time delay threshold with the cold load pick up function.

Assign the I> time delay threshold with the cold load pick up function.

Assign the Thermal Overload time delay threshold (Iθ>) with the cold load pick up function.
Demand Alarm Menu

Demand alarm is used to give alarm signal when load current is higher than the threshold. The threshold is set lower than overcurrent for proper functioning.

3.7 Demand Alarm

Heading of Demand Alarm menu. Press Enter to enter submenu content.

Demand Alarm?

Set to Yes to enable demand alarm. Then the following menu is displayed.

Idmnd>

Set the value for the current threshold Idmnd>.

tdmnd>

Set the value for the time delay of Idmnd>.

PROTECTION G1 Menu

4.PROTECTION G1

Heading of PROTECTION G1 (Group 1) menu. Press Enter to enter submenu content.

Phase OC Menu

4.1 Phase OC

Heading of Phase OC (Overcurrent) menu. Press Enter to enter submenu content.

I> menu

Set to Yes to enable first phase overcurrent threshold (I>). Then the following menu is displayed.

I>?

Set the value for the current threshold I>.

NOTE: When delay type is IDMT, the maximum setting recommended should be 2.00In.

I> Delay Type

Set the time delay type of I>. Setting choices are: IDMT (inverse definite time curve) and Definite Time.

If Definite Time is selected, the following menu is displayed:
Set the value for the time delay of I> definite time.

| tl> | 1.00s |

If IDMT is selected, the following menu is displayed:

Set the type of curve.

<table>
<thead>
<tr>
<th>I&gt; IDMT Curve</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Inverse</td>
</tr>
</tbody>
</table>

Set the time multiplier setting value for the curve.

| ktl> | 0.20 |

I>> menu

Set to Yes to enable second phase overcurrent threshold (I>>). Then the following menu is displayed.

<table>
<thead>
<tr>
<th>I&gt;&gt;?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
</tr>
</tbody>
</table>

Set the value for the current threshold I>>.

<table>
<thead>
<tr>
<th>I&gt;&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.00In</td>
</tr>
</tbody>
</table>

Set the value for the time delay of I>> definite time.

<table>
<thead>
<tr>
<th>tl&gt;&gt;&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>100ms</td>
</tr>
</tbody>
</table>

I>>> menu

Set to Yes to enable third phase overcurrent threshold (I>>>). Then the following menu is displayed.

<table>
<thead>
<tr>
<th>I&gt;&gt;&gt;?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
</tr>
</tbody>
</table>

Set to yes to enable I>>> operated on current sample base. Otherwise it operates on fundamental value. Sample base method will ensure fast tripping on highly saturated current signal.

<table>
<thead>
<tr>
<th>I&gt;&gt;&gt; Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
</tr>
</tbody>
</table>

Set the value for the current threshold I>>>.

<table>
<thead>
<tr>
<th>I&gt;&gt;&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.0In</td>
</tr>
</tbody>
</table>

Set the value for the time delay of I>>> definite time.

<table>
<thead>
<tr>
<th>tl&gt;&gt;&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>30ms</td>
</tr>
</tbody>
</table>

Earth Fault Menu

Heading of Earth Fault menu. Press Enter to enter submenu content.

| 4.2 Earth Fault |
Io> menu

Set to Yes to enable first earth fault threshold (Io>). Then the following menu is displayed.

**Io>**

Set the value for the current threshold Io>.

**NOTE:** When delay type is IDMT, the maximum setting recommended should be 0.5Ion.

**Io> Delay Type**

Set the time delay type of Io>. Setting choices are: IDMT and Definite Time.

**tlo>**

Set the value for the time delay of Io> definite time.

If Definite Time is selected, the following menu is displayed:

**ktlo>**

Set the time multiplier setting value for the curve.

If IDMT is selected, the following menu is displayed:

**Io>> menu**

Set to Yes to enable second earth fault threshold (Io>>). Then the following menu is displayed.

**Io>>?**

Set the value for the current threshold Io>>.

**tlo>>**

Set the value for the time delay of Io>> definite time.

Thermal OL Menu

Heading of Thermal OL (Overload) menu. Press Enter to enter submenu content.
Set to Yes to enable thermal overload protection. Then the following menu is displayed.

**Thermal OL?**
- **Yes**

Set the value for the thermal overload Iθ>.

**Iθ>**
- 1.50ln

Set the value for the thermal time constant.

**Tθ>**
- 10min

Set the value for the k factor.

**k>**
- 1.10

Set the percentage of the thermal overload trip.

**θ Trip**
- 100%

Set the percentage of the thermal overload alarm.
(To disable this alarm, set this value to equal or higher than θ Trip %)

**θ Alarm**
- 100%

---

**PROTECTION G2 Menu**

**5.PROTECTION G2** (Group 2) menu has similar content as PROTECTION G1 (Group 1) menu. The Protection G2 settings is applied when Protection Group 2 is activated.

**INPUT Menu**

**6.INPUT**
- Heading of INPUT menu. Press Enter to enter submenu content.

**6.1 Input 1**
- Heading of Input 1 menu. Press Enter to enter submenu content.
Set the function of Input 1. Setting choices are: None, Aux 1, Aux2, Reset, Blocking, TCS, Select Group, Cold Load PU (pickup) and Sync Clock.

Aux 1 or Aux 2: The input is used as auxiliary alarm or tripping signal.

If tAux is not assigned to trip output relay (whether it is assigned to a start output relay or not), activation of the input will generate an Aux Alarm signal after time delay.

If tAux is assigned to trip output relay, the input will generate an Aux Trip signal after time delay.

Reset, Blocking, TCS: See below

Select Group: Input deactivated to select Protection Group 1, activated to select Protection Group 2.
To enable changing group by input, 3.4 Group Select->Chg Group by.. must be set to Input.

Cold Load PU: Activation of the input starts CLPU timer and increases protection threshold defined by 3.6 Cold Load PU setting.

Sync Clock: An activation of the input will set the clock to the nearest minute.

**Input 1 Func**
- **Aux 1**

Set how the input 1 is activated. For Active High, energizing the input activates the input. For Active Low, de-energizing the input activates the input.

If Aux 1 or Aux 2 is selected, the following menu is displayed:

**Input 1 Type**
- **Active High**

If Reset is selected, the following menu is displayed:

**Rst Trip/Alarm**
- **Yes**

Set to yes to enable the input to reset trip and alarm.

**Rst Thermal 0%**
- **No**

Set to yes to enable the input to reset thermal %.

If Blocking is selected, the following menu is displayed:

**Block I>?**
- **No**

Set to yes to enable blocking of I>.

**Block I>>?**
- **No**

Set to yes to enable blocking of I>>.
Set to yes to enable blocking of I>>>.

Block I>>>?
Yes

Set to yes to enable blocking of Io>.

Block Io>?
Yes

Set to yes to enable blocking of Io>>.

Block Io>>?
Yes

Set to yes to enable blocking of Thermal Overload.

Block Thml OL?
Yes

If TCS (trip circuit supervision) is selected, the following menu is displayed:

TCS delay
500ms

Set the value for the time delay of TCS. TCS alarm triggers when the input is deactivated for longer than the time delay. TCS function is enabled when the trip contact output (RL1) is not energized.

Input 2 Menu has similar content as Input 1 menu. The settings are applied to input 2.

OUTPUT Menu

Heading of OUTPUT menu. Press Enter to enter submenu content.

7.OUTPUT

Output Relay 1

Heading of output relay 1 menu. Press Enter to enter submenu content.

7.1 Relay 1

Set the function of output Relay 1. Note that Relay 1 function is locked to Trip.

Relay 1 Func
Trip

Set the reset method of relay: Auto (Unlatched), Manual (Latched).

Reset
Auto

Assign I> trip to the output relay.

tI>?
Yes
Assign I>> trip to the output relay.

Assign I>>> trip to the output relay.

Assign Io> trip to the output relay.

Assign Io>> trip to the output relay.

Assign Thermal Overload to the output relay.

Assign Aux 1 input trip to the output relay.

Assign Aux 2 input trip to the output relay.

Assign Remote trip (by communication) to the output relay.

Output Relay 2 to 4

Output Relay 2 to 4 menu has similar content. The output Relay 2 menu content is shown below:

Heading of output Relay 2 menu. Press Enter to enter submenu content.

Set the function of output Relay 2. Possible settings are: Trip, Start and CBFP.

Set the reset method of relay: Auto (Unlatched), Manual (Latched).

If relay function is set to Trip, the menu content similar to Relay 1 is shown, please refer to Output Relay 1.

If relay function is set to Start, the following menu is displayed:
Assign I> start to the output relay.

Assign I>> start to the output relay.

Assign I>>> start to the output relay.

Assign Io> start to the output relay.

Assign Io>> start to the output relay.

Assign Thermal Overload Alarm to the output relay.

Assign Aux 1 input alarm to the output relay.

Assign Aux 2 input alarm to the output relay.

Assign TCS alarm to the output relay.

Assign Demand alarm to the output relay.

If relay function is set to CBFP (Circuit Breaker Failure Protection) the following menu is displayed:

<table>
<thead>
<tr>
<th>Delay</th>
<th>200ms</th>
</tr>
</thead>
</table>

Set the value for the time delay of CBFP. This output relay is activated, if after the activation of the trip relay, the fault has not been cleared for longer than this delay.

<table>
<thead>
<tr>
<th>Include Aux?</th>
<th>No</th>
</tr>
</thead>
</table>

Set if Aux 1 or 2 input is included as fault condition. Prolonged activation or latched Aux input could cause the undesirable activation of CBFP relay.
Maintenance Mode Menu

7.5 Maint mode
(Prot disabled)

Heading of Maintenance Mode menu. Press Enter to enter submenu content.

Output 1 2 3 4
Test 0 0 0 0

Press Enter once, output 1 blinks, press Up/Down to toggle the output status. Press Enter again to test output 2, and subsequently for output 3 and 4. Press Esc to exit.

Relay IRF

7.6 Relay IRF

Heading of Relay IRF menu. When enabled, relay IRF is on when relay operates normally. If IRF output is not needed, it can be disabled to save some power.

Relay IRF

Yes

Set to Yes to enable, No to disable Relay IRF output.

COMMUNICATION Menu

Communication setting is applicable to the RS485 port on the rear terminals of the relay (the front panel RS232 port has fixed communication settings: 38400bps, 1 stop bit, even parity, address 1).

8.COMMUNICATION

Heading of COMMUNICATION menu. Press Enter to enter submenu content.

Communication?

Yes

Set to yes to enable MODBUS RTU communication.

Baud Rate

38400bps

Set the baud rate in bit per second (bps).

Parity

Even

Set the parity in the data frame.

Stop Bit

1

Set the number of stop bit in the data frame.

Relay Address

1

Set the address of the relay in the MODBUS network.
5.0 Functions and Descriptions

5.1 Circuit Breaker Failure Protection

Circuit breaker failure protection (CBFP) is used to generate a tripping signal via selected output relay after a preset time delay if the fault has not been cleared after the activation of tripping signal through trip contact relay R1. Thermal overload is excluded from fault condition for CBFP.

CBFP output is usually used to trip the upstream circuit breaker or to trip a redundant tripping circuit of the same circuit breaker.

CBFP function can be assigned to relay R2 to R4.

There is an option to enable or disable Aux 1 or 2 as a fault condition (if Aux 1 or 2 is assigned to a digital input as a tripping source). Prolonged activation or latched Aux input could cause the undesirable activation of CBFP relay, in this case set ‘Include Aux’ to ‘No’ to disable the condition.

Timing diagram for CBFP. (R4 function set to CBFP, delay 0.5s.)
5.2 Thermal Overload Protection

Thermal overload protection can be used to prevent damages to the equipment of the electrical plant. A prolonged overloading causes excessive heating, which may result in deterioration of the insulation, or in extreme cases, insulation failure.

Load current is used to calculate the heating and cooling effect of the equipment to be protected. The highest phase current is automatically used as input information for the thermal model. The thermal overload protection can be set with both alarm and trip stages, $\theta$ Trip % and $\theta$ Alarm %, with 5% below the set % for resetting.

The heating within any plant equipment, such as cables or transformers, is of resistive type ($I^2R \times t$). Thus the thermal time characteristic used in the relay is based on current squared, integrated over time.

Protection equipment is designed to operate continuously at a temperature corresponding to its full load rating, where heat generated is balanced with heat dissipated. Over-temperature conditions occur when currents in excess of rating flow for a certain period of time. It can be shown that temperatures during heating follow exponential time constants and a similar exponential decrease of temperature occurs during cooling.

In order to apply this protection element, the thermal time constant ($T_0$) of the plant equipment to be protected is therefore required.

The calculation of the Time to trip is given by:

$$T_{\text{trip}} = T_0 \ln \left( \frac{|K^2 - \theta|}{|K^2 - \theta_{\text{trip}}|} \right)$$

$T_{\text{trip}}$ = Time to trip (in seconds)
$T_0$ = Thermal time constant of the protected element (in seconds)
$K$ = $I_{\text{eq}}$ / $k.1_{0>}$
$I_{\text{eq}}$ = Equivalent current corresponding to the RMS value of the largest phase current.
$k_{0>}$ = Full load current rating given by the national standard or by the supplier.
$k$ = Factor associated to the thermal state formula.
$\theta$ = Initial thermal state. If the initial thermal state = 30% then $\theta = 0.3$
$\theta_{\text{trip}}$ = Trip thermal state. If the trip thermal state is set at 100%, then $\theta_{\text{trip}} = 1$

The settings of these parameters are available in the menus:
PROTECTION G1/G2 – Thermal OL

The calculation of the thermal state is given by the following formula:

$$\theta_{t+1} = K^2 (1 - e^{-\frac{t}{T_0}}) + \theta_t e^{-\frac{t}{T_0}}$$

$\theta$ being calculated every 20ms.
5.3 Trip Circuit Supervision

Trip Circuit Supervision (TCS) enables the trip circuit to be monitor. To enable TCS function, set one of the Digital Input function to TCS (at the INPUT Menu), Input Type as Active High and set the appropriate TCS delay time.

The continuity of trip circuit is monitor when Trip contact R1 is not energized. When the input detects no signal for a time longer than the TCS delay time, TCS alarm pops up to warn the failure of trip circuit. Three examples of application are given below.

Example 1: Trip Coil Monitoring

In this example only 52a auxiliary contact is available, the trip coil is monitored when the CB is open or closed.

Example 2: Trip Coil and Auxiliary Contacts Monitoring

In this example both 52a and 52b auxiliary contacts are available. The complete trip circuit is monitored when the CB is closed and a part of the trip circuit when the CB is open (excluding Trip coil).

It is necessary to insert resistor R1 in series with 52b, if the Trip contact R1 is latched or it stays involuntarily closed.
Examples 3: Trip Coil and Auxiliary Contacts Monitoring when CB is open or closed

In this example both 52a and 52b auxiliary contacts are available, the complete trip circuit is monitored when the CB is open or closed.

In this case it is necessary to insert resistor R1, if the Trip contact R1 is latched or it stays involuntarily closed.

Recommended Resistor R1 Value

The recommended maximum resistor R1 value for various auxiliary voltage is shown:

<table>
<thead>
<tr>
<th>Auxiliary Voltage, Ua</th>
<th>24Vdc</th>
<th>36Vdc</th>
<th>48Vdc</th>
<th>60Vdc</th>
<th>72Vdc</th>
<th>110Vdc</th>
<th>132Vdc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum R1 value (Ohm)</td>
<td>4.7k</td>
<td>9.1k</td>
<td>13k</td>
<td>16k</td>
<td>22k</td>
<td>43k</td>
<td>62k</td>
</tr>
<tr>
<td>Power rating (W)</td>
<td>1/4</td>
<td>1/4</td>
<td>1/2</td>
<td>1/2</td>
<td>1/2</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Auxiliary Voltage, Ua</th>
<th>220Vdc</th>
<th>264Vdc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum R1 value (Ohm)</td>
<td>82k</td>
<td>91k</td>
</tr>
<tr>
<td>Power rating (W)</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

For the case of example 3, the maximum R1 value should be deducted by Trip coil resistance (insignificant in most cases).

The Power rating of the resistor R1 is calculated as:

\[ P_{R1} > \frac{2 \times U_a^2}{R1} \text{ Watt} \]
5.4 Characteristic Curves

Normal Inverse

Very Inverse

Normal Inverse 1.3/10

Long-time Inverse
Extremely Inverse

Thermal Overload Curves

\(k=1.1, T_\phi=10\text{minutes}\)
6.0 Case Dimensions

7.0 Connection Diagram and Terminal

7.1 Terminal Connection at Rear View
<table>
<thead>
<tr>
<th>Connection terminal</th>
<th>Function Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5A / 1A common CT input for I_L1</td>
</tr>
<tr>
<td>2</td>
<td>5A CT input for I_L1</td>
</tr>
<tr>
<td>3</td>
<td>1A CT input for I_L1</td>
</tr>
<tr>
<td>4</td>
<td>5A / 1A common CT input for I_L2</td>
</tr>
<tr>
<td>5</td>
<td>5A CT input for I_L2</td>
</tr>
<tr>
<td>6</td>
<td>1A CT input for I_L2</td>
</tr>
<tr>
<td>7</td>
<td>5A / 1A common CT input for I_L3</td>
</tr>
<tr>
<td>8</td>
<td>5A CT input for I_L3</td>
</tr>
<tr>
<td>9</td>
<td>1A CT input for I_L3</td>
</tr>
<tr>
<td>10</td>
<td>5A / 1A common CT input for I_0</td>
</tr>
<tr>
<td>11</td>
<td>5A CT input for I_0</td>
</tr>
<tr>
<td>12</td>
<td>1A CT input for I_0</td>
</tr>
<tr>
<td>13-17</td>
<td>Not used</td>
</tr>
<tr>
<td>18</td>
<td>Termination resistor for RS485 (shorting to 20 for termination)</td>
</tr>
<tr>
<td>19</td>
<td>RS485 positive terminal</td>
</tr>
<tr>
<td>20</td>
<td>RS485 negative terminal</td>
</tr>
<tr>
<td>21</td>
<td>RS485 cable shield</td>
</tr>
<tr>
<td>22</td>
<td>Not used</td>
</tr>
<tr>
<td>23-24</td>
<td>Output contact R3</td>
</tr>
<tr>
<td>25-26</td>
<td>Output contact R4</td>
</tr>
<tr>
<td>27-28</td>
<td>Digital Input 1 (no polarity)</td>
</tr>
<tr>
<td>29-30</td>
<td>Digital Input 2 (no polarity)</td>
</tr>
<tr>
<td>31</td>
<td>Casing earth terminal</td>
</tr>
<tr>
<td>32</td>
<td>Auxiliary supply input (no polarity)</td>
</tr>
<tr>
<td>33</td>
<td>Auxiliary supply input (no polarity)</td>
</tr>
<tr>
<td>34</td>
<td>Common contact for IRF</td>
</tr>
<tr>
<td>35</td>
<td>Normally open contact for IRF</td>
</tr>
<tr>
<td>36</td>
<td>Normally closed contact for IRF</td>
</tr>
<tr>
<td>37</td>
<td>Common contact for tripping contact R1</td>
</tr>
<tr>
<td>38</td>
<td>Normally open contact for tripping contact R1</td>
</tr>
<tr>
<td>39</td>
<td>Normally closed contact for tripping contact R1</td>
</tr>
<tr>
<td>40</td>
<td>Common contact for output contact R2</td>
</tr>
<tr>
<td>41</td>
<td>Normally open contact for output contact R2</td>
</tr>
<tr>
<td>42</td>
<td>Normally closed contact for output contact R2</td>
</tr>
</tbody>
</table>
7.2 Typical Connection Diagram

Example 1: With neutral. CT secondary 5A.

Example 2: Without neutral. CT secondary 1A.
8.0 Technical Data

RATINGS

Auxiliary Supply

MK2200L-150D
Rated voltage : 30 ~ 120 V DC
Operating voltage : 24 ~ 150 V DC

MK2200L-240AD
Rated voltage : 100 ~ 240 V AC or 140 ~ 340 V DC
Operating voltage : 85 ~ 265 V AC or 110 ~ 370 V DC
Rated frequency : 50 or 60Hz
Operating frequency : 45 ~ 65 Hz
Power consumption : 8 VA max

Current Inputs
Rated current In : 1 or 5 A by connection
Frequency : 50 or 60 Hz nominal
Burden : < 0.025 VA (1A)
: < 0.3 VA (5A)
Thermal withstand : 4 x In continuous
: 40 x In for 2s
: 100 x In for 1s

Logic Inputs
Input type : Optically isolated
Rated voltage : 20 ~ 380 V DC
: 50 ~ 270 V AC
: (Series resistor 18k Ohm, 2W required for >170 V AC / 240 V DC direct input)

Output Relay
Trip Contact Relay (R1), R2, IRF Relay
Rated voltage : 250 V AC/DC
Contact arrangement : Change-over
Continuous carry : 5 A
Expected electrical life : 100,000 operations at rated load
Expected mechanical life : 5 x 10^6 operations

R3,R4
Rated load (resistive) : 5 A at 250 V AC
: 3 A at 30 V DC
Expected electrical life : 100,000 operations at rated load
Expected mechanical life : 5 x 10^6 operations

RECORDS
Fault Record : Up to 50 records.
Event Record : Up to 250 records
Alarm Record : Up to 30 records
SETTING RANGES

General
Line CT primary : 1 to 10000 A. 1 to 1000: step 1; 1000 to 10000: step 5
Earth CT primary : 1 to 10000 A. 1 to 1000: step 1; 1000 to 10000: step 5
Frequency : 50 or 60 Hz

Phase Overcurrent
I>?: Yes or No
I>: 0.1 to 25 x In. *Variable steps.
NOTE : When delay type is IDMT, the maximum setting recommended should be 2.00 x In.
I> Delay type : IDMT or Definite Time
tI> : 0 to 100 s. *Variable steps
I> IDMT curve : Normal Inverse, Very Inverse, Extremely Inverse, Long-time Inverse,
Normal Inverse 1.3/10
ktI : 0.01 to 1.00
I>?> : Yes or No
I>?> : 0.5 to 40 x In. *Variable steps
tI>?> : 0 to 100 s. *Variable steps
I>??? : Yes or No
I>>>> : 0.5 to 40 x In. *Variable steps
I>>>> Sample : Yes or No
tI>>>> : 0 to 100 s. *Variable steps

Earth Fault
Io?: Yes or No
Io>: 0.02 to 2 x Ion. *Variable steps
NOTE : When delay type is IDMT, the maximum setting recommended should be 0.5 x Ion.
Io> Delay type : IDMT or Definite Time
tIo> : 0 to 100 s. *Variable steps
Io> IDMT curve : Normal Inverse, Very Inverse, Extremely Inverse, Long-time Inverse,
Normal Inverse 1.3/10
ktIo : 0.01 to 1.00
Io>?> : Yes or No
Io>?> : 0.1 to 10 x Ion. *Variable steps
tIo>?> : 0 to 100 s. *Variable steps

Thermal Overload
Thermal OL?: Yes or No
Iφ>: 0.1 to 3.00 x In. *Variable steps
Tφ : 1 to 200 minutes. Step 1
k : 1 to 1.5. Step 0.01
θ Trip : 50 to 200%. Step 1%
θ Alarm : 50 to 200%. Step 1%

Demand Alarm
Demand Alarm?: Yes or No
Idmnd>: 0.10 to 20 x In. *Variable steps
tIdmnd> : 0.03 to 100 s. *Variable steps
Cold Load Pickup
CLPU Level : 100 to 500%.
CLPU tCL : 0.1 to 600 s

Input
Aux timer : 0 to 600 s
TCS delay : 0.1 to 10 s. *Variable steps

Output
CBFP Delay : 0.05 to 10.0 s. *Variable steps.

Communication
Communication? : Yes or No
Baud Rate : 2400, 4800, 9600, 19200 or 38400bps
Parity : None, Even or Odd
Stop Bit : 1 or 2
Relay Address : 1 to 255

*Variable steps: 0.1-1.00: step 0.01; 1.00-20: step 0.1; >20: step 1

MEASUREMENT RANGE

Phase and Earth current Display
: 0 to 999 kA. (Taking into account of CT Pri ratio)

Phase Current Secondary
5A input : 0 to 200 A
1A input : 0 to 40 A

Earth Current Secondary
5A input : 0 to 50A
1A input : 0 to 10A

Thermal \( \theta \) : 0 to 9999%
Frequency : 20 to 80 Hz

ACCURACY

Is: I>, I>>, or I>>>
Ios: Io> or Io>>

<table>
<thead>
<tr>
<th>Element</th>
<th>Range</th>
<th>Trigger</th>
<th>Reset</th>
<th>Time deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase overcurrent</td>
<td>0.1 to 40 x In</td>
<td>Is ± 2%</td>
<td>0.95 x Is ± 2%</td>
<td>DT: ±2% +30ms IDMT: ±5% +30ms (&gt;1.2 x Is)</td>
</tr>
<tr>
<td>I&gt;, I&gt;&gt;, I&gt;&gt;&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earth fault overcurrent</td>
<td>0.02 to 10 x Ion</td>
<td>Ios ± 2%</td>
<td>0.95 x Ios ± 2%</td>
<td>DT: ±2% +30ms IDMT: ±5% +30ms (&gt;1.2 x Is)</td>
</tr>
<tr>
<td>Io&gt;, Io&gt;&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal overload ( \theta )</td>
<td>0.1 to 3 x In</td>
<td></td>
<td></td>
<td>±5%</td>
</tr>
</tbody>
</table>
INSULATION

High voltage dielectric withstand test IEC60255-5 : 2kV rms, 1 minute
High voltage impulse test IEC60255-5 : 5kV, 1.2/50us

STANDARDS

Complies with IEC 60255-26 standard
Electrical fast transient IEC61000-4-4, power supply : 4kV, 5kHz
Electrical fast transient IEC61000-4-4, other inputs : 2kV, 5kHz
Surge IEC61000-4-5, IEC 60255-22-5 : 4kV common mode
Surge IEC61000-4-5, IEC 60255-22-5 : 2kV differential mode
Electrostastic discharge IEC61000-4-2, air discharge : 8 kV
Electrostastic discharge IEC61000-4-2, contact discharge : 6 kV
1MHz burst disturbance IEC60255-22-1 : 2kV Common mode
1MHz burst disturbance IEC60255-22-1 : 1kV Differential mode

Conducted Immunity IEC61000-4-6 : 10V rms @ 1kHz 80%AM, 0.15 to 80MHz
Radiated Immunity IEC61000-4-3 : 10V/m 80Mhz to 1GHz @1kHz 80% am
Conducted emissions : EN 55011 Group 1 Class B
Radiated EM Field emission : CISPR 11 Group 1 Class B

ENVIRONMENTAL CONDITIONS

Temperature : -5ºC to 55ºC
Humidity : 56 days at 93% RH and 40ºC non-condensing
Enclosure protection : IP54 when panel mounted
9.0 MODBUS Protocol
Both of the RS232 port on the front panel and the RS485 port on the rear terminals use MODBUS RTU protocol.

The RS232 front panel port is fixed to 38400bps, even parity, 1 stop bit, relay address 1. The RS485 rear port communication setting is set by the COMMUNICATION Menu from the front panel.

9.1 MODBUS Functions
The MODBUS functions described below are used:

0x03/0x04 Read Input/Holding Registers
These 2 commands have the same function

<table>
<thead>
<tr>
<th>Request</th>
<th>Communication address</th>
<th>1 byte</th>
<th>0* to 255</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Function code</td>
<td>1 byte</td>
<td>0x03/0x04</td>
</tr>
<tr>
<td></td>
<td>Starting Address</td>
<td>2 bytes</td>
<td>0x0000 to 0xFFFF</td>
</tr>
<tr>
<td></td>
<td>Quantity of Registers</td>
<td>2 bytes</td>
<td>0x0001 to 0x007d (N)</td>
</tr>
<tr>
<td></td>
<td>CRC</td>
<td>2 bytes</td>
<td>2 bytes CRC</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Response</th>
<th>Communication address</th>
<th>1 byte</th>
<th>1 to 255</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Function code</td>
<td>1 byte</td>
<td>0x03/0x04</td>
</tr>
<tr>
<td></td>
<td>Byte count</td>
<td>1 bytes</td>
<td>2 X N</td>
</tr>
<tr>
<td></td>
<td>Quantity of Registers</td>
<td>N X 2 bytes</td>
<td>Value</td>
</tr>
<tr>
<td></td>
<td>CRC</td>
<td>2 bytes</td>
<td>2 bytes CRC</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Error</th>
<th>communication address</th>
<th>1 byte</th>
<th>1 to 255</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Error code</td>
<td>1 byte</td>
<td>0x83/0x84</td>
</tr>
<tr>
<td></td>
<td>Exception code</td>
<td>1 bytes</td>
<td>0x01 or 02 or 03 or 04</td>
</tr>
<tr>
<td></td>
<td>CRC</td>
<td>2 bytes</td>
<td>2 bytes CRC</td>
</tr>
</tbody>
</table>

0x06 Write Single Register

<table>
<thead>
<tr>
<th>Request</th>
<th>Communication address</th>
<th>1 byte</th>
<th>0* to 255</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Function code</td>
<td>1 byte</td>
<td>0x06</td>
</tr>
<tr>
<td></td>
<td>Register Address</td>
<td>2 bytes</td>
<td>0x0000 to 0xFFFF</td>
</tr>
<tr>
<td></td>
<td>Register value</td>
<td>2 bytes</td>
<td>Value</td>
</tr>
<tr>
<td></td>
<td>CRC</td>
<td>2 bytes</td>
<td>2 bytes CRC</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Response</th>
<th>Communication address</th>
<th>1 byte</th>
<th>1 to 255</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Function code</td>
<td>1 byte</td>
<td>0x06</td>
</tr>
<tr>
<td></td>
<td>Register value</td>
<td>2 bytes</td>
<td>value</td>
</tr>
<tr>
<td></td>
<td>CRC</td>
<td>2 bytes</td>
<td>2 bytes CRC</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Error</th>
<th>communication address</th>
<th>1 byte</th>
<th>1 to 255</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Error code</td>
<td>1 byte</td>
<td>0x86</td>
</tr>
<tr>
<td></td>
<td>Exception code</td>
<td>1 bytes</td>
<td>0x01 or 02 or 03 or 04</td>
</tr>
<tr>
<td></td>
<td>CRC</td>
<td>2 bytes</td>
<td>2 bytes CRC</td>
</tr>
</tbody>
</table>
### 0x10 Write Multiple Registers

**Request**

<table>
<thead>
<tr>
<th>Description</th>
<th>Length</th>
<th>Range/Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication address</td>
<td>1 byte</td>
<td>0* to 255</td>
</tr>
<tr>
<td>Function code</td>
<td>1 byte</td>
<td>0x10</td>
</tr>
<tr>
<td>Starting Address</td>
<td>2 bytes</td>
<td>0x0000 to 0xFFFF</td>
</tr>
<tr>
<td>Quantity of Registers</td>
<td>2 bytes</td>
<td>0x0001 to 0x007b (N)</td>
</tr>
<tr>
<td>Byte count</td>
<td>1 byte</td>
<td>2 X N</td>
</tr>
<tr>
<td>Register value</td>
<td>N X 2 bytes</td>
<td>Value</td>
</tr>
<tr>
<td>CRC</td>
<td>2 bytes</td>
<td>2 bytes CRC</td>
</tr>
</tbody>
</table>

**Response**

<table>
<thead>
<tr>
<th>Description</th>
<th>Length</th>
<th>Range/Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication address</td>
<td>1 byte</td>
<td>1 to 255</td>
</tr>
<tr>
<td>Function code</td>
<td>1 byte</td>
<td>0x10</td>
</tr>
<tr>
<td>Quantity of Registers</td>
<td>2 bytes</td>
<td>0x0001 to 0x007b (N)</td>
</tr>
<tr>
<td>CRC</td>
<td>2 bytes</td>
<td>2 bytes CRC</td>
</tr>
</tbody>
</table>

**Error**

<table>
<thead>
<tr>
<th>Description</th>
<th>Length</th>
<th>Range/Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication address</td>
<td>1 byte</td>
<td>1 to 255</td>
</tr>
<tr>
<td>Error code</td>
<td>1 byte</td>
<td>0x90</td>
</tr>
<tr>
<td>Exception code</td>
<td>1 bytes</td>
<td>0x01 or 02 or 03 or 04</td>
</tr>
<tr>
<td>CRC</td>
<td>2 bytes</td>
<td>2 bytes CRC</td>
</tr>
</tbody>
</table>

*Note: communication address 0 is a broadcast command to all the slave. The slave will not respond with a broadcast command.*
## 9.2 MODBUS Register

<table>
<thead>
<tr>
<th>Address</th>
<th>Parameter</th>
<th>Format</th>
<th>Units and Scale</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dec</td>
<td>Hex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0000</td>
<td>F1</td>
<td>ASCII</td>
<td>00'</td>
</tr>
<tr>
<td>1</td>
<td>0001</td>
<td>F1</td>
<td>ASCII</td>
<td>02'</td>
</tr>
<tr>
<td>2</td>
<td>0002</td>
<td>F1</td>
<td>ASCII</td>
<td>01'</td>
</tr>
<tr>
<td>3</td>
<td>0003</td>
<td>F1</td>
<td>ASCII</td>
<td>00'</td>
</tr>
<tr>
<td>4</td>
<td>0004</td>
<td>F1</td>
<td>ASCII</td>
<td>XX</td>
</tr>
<tr>
<td>5</td>
<td>0005</td>
<td>F1</td>
<td>ASCII</td>
<td>XX</td>
</tr>
<tr>
<td>6</td>
<td>0006</td>
<td>F1</td>
<td>ASCII</td>
<td>XX</td>
</tr>
<tr>
<td>7</td>
<td>0007</td>
<td>F1</td>
<td>ASCII</td>
<td>XX</td>
</tr>
<tr>
<td>8-15</td>
<td>0008-000F</td>
<td>Reserved</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Measurements and relay status. Read only, Function 03h or 04h

<table>
<thead>
<tr>
<th>Address</th>
<th>Parameter</th>
<th>Format</th>
<th>Units and Scale</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>0010</td>
<td>F2</td>
<td>Bit field</td>
<td>Bit 0 - 15</td>
</tr>
<tr>
<td>17</td>
<td>0011</td>
<td>F3</td>
<td>Bit field</td>
<td>Bit 0 - 3</td>
</tr>
<tr>
<td>18</td>
<td>0012</td>
<td>F4</td>
<td>Bit field</td>
<td>Bit 0 - 1</td>
</tr>
<tr>
<td>19</td>
<td>0013</td>
<td>F5</td>
<td>Bit field</td>
<td>Bit 0 - 3</td>
</tr>
<tr>
<td>20</td>
<td>0014</td>
<td>F6</td>
<td>--</td>
<td>0=group 1, 1=group 2</td>
</tr>
<tr>
<td>21</td>
<td>0015</td>
<td>F7</td>
<td>%</td>
<td>0-9999</td>
</tr>
<tr>
<td>22</td>
<td>0016</td>
<td>F8</td>
<td>0.01 Ampere</td>
<td>0-9.99x10^7 (999kA)</td>
</tr>
<tr>
<td>23</td>
<td>0017</td>
<td>F8</td>
<td>0.01 Ampere</td>
<td>0-9.99x10^7 (999kA)</td>
</tr>
<tr>
<td>24</td>
<td>0018</td>
<td>F8</td>
<td>0.01 Ampere</td>
<td>0-9.99x10^7 (999kA)</td>
</tr>
<tr>
<td>25</td>
<td>0019</td>
<td>F8</td>
<td>0.01 Ampere</td>
<td>0-9.99x10^7 (999kA)</td>
</tr>
<tr>
<td>26</td>
<td>001A</td>
<td>F8</td>
<td>0.01 Ampere</td>
<td>0-9.99x10^7 (999kA)</td>
</tr>
<tr>
<td>27</td>
<td>001B</td>
<td>F8</td>
<td>0.01 Ampere</td>
<td>0-9.99x10^7 (999kA)</td>
</tr>
<tr>
<td>28</td>
<td>001C</td>
<td>F8</td>
<td>0.01 Ampere</td>
<td>0-9.99x10^7 (999kA)</td>
</tr>
<tr>
<td>29</td>
<td>001D</td>
<td>F8</td>
<td>0.01 Ampere</td>
<td>0-9.99x10^7 (999kA)</td>
</tr>
<tr>
<td>30</td>
<td>001E</td>
<td>F8</td>
<td>0.01 Ampere</td>
<td>0-9.99x10^7 (999kA)</td>
</tr>
<tr>
<td>31</td>
<td>001F</td>
<td>F8</td>
<td>0.01 Ampere</td>
<td>0-9.99x10^7 (999kA)</td>
</tr>
<tr>
<td>32</td>
<td>0020</td>
<td>F8</td>
<td>0.01 Ampere</td>
<td>0-9.99x10^7 (999kA)</td>
</tr>
<tr>
<td>33</td>
<td>0021</td>
<td>F8</td>
<td>0.01 Ampere</td>
<td>0-9.99x10^7 (999kA)</td>
</tr>
<tr>
<td>34</td>
<td>0022</td>
<td>F8</td>
<td>0.01 Ampere</td>
<td>0-9.99x10^7 (999kA)</td>
</tr>
<tr>
<td>35</td>
<td>0023</td>
<td>F8</td>
<td>0.01 Ampere</td>
<td>0-9.99x10^7 (999kA)</td>
</tr>
<tr>
<td>36</td>
<td>0024</td>
<td>F8</td>
<td>0.01 Ampere</td>
<td>0-9.99x10^7 (999kA)</td>
</tr>
<tr>
<td>37</td>
<td>0025</td>
<td>F8</td>
<td>0.01 Ampere</td>
<td>0-9.99x10^7 (999kA)</td>
</tr>
<tr>
<td>38</td>
<td>0026</td>
<td>F8</td>
<td>0.01 Ampere</td>
<td>0-9.99x10^7 (999kA)</td>
</tr>
<tr>
<td>39</td>
<td>0027</td>
<td>F8</td>
<td>0.01 Ampere</td>
<td>0-9.99x10^7 (999kA)</td>
</tr>
<tr>
<td>40</td>
<td>0028</td>
<td>F8</td>
<td>0.01 Ampere</td>
<td>0-9.99x10^7 (999kA)</td>
</tr>
<tr>
<td>41</td>
<td>0029</td>
<td>F8</td>
<td>0.01 Ampere</td>
<td>0-9.99x10^7 (999kA)</td>
</tr>
<tr>
<td>42</td>
<td>002A</td>
<td>F8</td>
<td>0.01 Ampere</td>
<td>0-9.99x10^7 (999kA)</td>
</tr>
<tr>
<td>43</td>
<td>002B</td>
<td>F8</td>
<td>0.01 Ampere</td>
<td>0-9.99x10^7 (999kA)</td>
</tr>
<tr>
<td>44</td>
<td>002C</td>
<td>F8</td>
<td>0.01 Ampere</td>
<td>0-9.99x10^7 (999kA)</td>
</tr>
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<td>45</td>
<td>002D</td>
<td>F8</td>
<td>0.01 Ampere</td>
<td>0-9.99x10^7 (999kA)</td>
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<tr>
<td>46</td>
<td>002E</td>
<td>F7</td>
<td>0.01 Hz</td>
<td>0-10000 (0-100Hz)</td>
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### Remote command. Write only, Function 06h

<table>
<thead>
<tr>
<th>Address</th>
<th>Parameter</th>
<th>Format</th>
<th>Units and Scale</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>256</td>
<td>0100</td>
<td>F9</td>
<td>Bit field</td>
<td>-</td>
</tr>
</tbody>
</table>

### Settings. Read/Write. Function 03h, 04h, 06h, 10h

<table>
<thead>
<tr>
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<th>Parameter</th>
<th>Format</th>
<th>Units and Scale</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>512</td>
<td>0200</td>
<td>F7</td>
<td>Ampere</td>
<td>1 - 3000</td>
</tr>
<tr>
<td>513</td>
<td>0201</td>
<td>Reserved</td>
<td></td>
<td></td>
</tr>
<tr>
<td>514</td>
<td>0202</td>
<td>F7</td>
<td>Ampere</td>
<td>1 - 3000</td>
</tr>
<tr>
<td>515</td>
<td>0203</td>
<td>Reserved</td>
<td></td>
<td></td>
</tr>
<tr>
<td>516</td>
<td>0204</td>
<td>F6</td>
<td>--</td>
<td>0-50Hz, 1=60 Hz</td>
</tr>
<tr>
<td>517</td>
<td>0205</td>
<td>F7</td>
<td>minute</td>
<td>1 - 60</td>
</tr>
<tr>
<td>518</td>
<td>0206</td>
<td>P7</td>
<td>year</td>
<td>0 - 199 (as 2000 - 2199)</td>
</tr>
<tr>
<td>519</td>
<td>0207</td>
<td>F10</td>
<td>month/day</td>
<td>0 - 12, 0 - 31</td>
</tr>
<tr>
<td>520</td>
<td>0208</td>
<td>F11</td>
<td>hour, minute</td>
<td>0 - 23, 0 - 59</td>
</tr>
<tr>
<td>521</td>
<td>0209</td>
<td>P7</td>
<td>ms</td>
<td>0 - 59999</td>
</tr>
</tbody>
</table>

*Note: For MK2200L, Device type – main is 00 02 01. Device type –sub is 00.*
<table>
<thead>
<tr>
<th>Address</th>
<th>Parameter</th>
<th>Format</th>
<th>Units and Scale</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>522</td>
<td>020A</td>
<td>Date &amp; time format (for relay display only)</td>
<td>F12</td>
<td>--</td>
</tr>
<tr>
<td>523</td>
<td>020B</td>
<td>Change Group by...</td>
<td>F13</td>
<td>--</td>
</tr>
<tr>
<td>524</td>
<td>020C</td>
<td>Setting Group</td>
<td>F6</td>
<td>--</td>
</tr>
<tr>
<td>525</td>
<td>020D</td>
<td>LCD backlight on duration</td>
<td>F7</td>
<td>minute</td>
</tr>
<tr>
<td>526</td>
<td>020E</td>
<td>LCD backlight brightness</td>
<td>F6</td>
<td>--</td>
</tr>
<tr>
<td>527</td>
<td>020F</td>
<td>Clear key to scroll settings</td>
<td>F6</td>
<td>--</td>
</tr>
<tr>
<td>528</td>
<td>0210</td>
<td>Communication? (Unused)</td>
<td>F6</td>
<td>--</td>
</tr>
<tr>
<td>529</td>
<td>0211</td>
<td>Communication Baud Rate</td>
<td>F6</td>
<td>--</td>
</tr>
<tr>
<td>530</td>
<td>0212</td>
<td>Communication Parity</td>
<td>F6</td>
<td>--</td>
</tr>
<tr>
<td>531</td>
<td>0213</td>
<td>Communication Stop bit</td>
<td>F6</td>
<td>--</td>
</tr>
<tr>
<td>532</td>
<td>0214</td>
<td>Communication Address</td>
<td>F7</td>
<td>--</td>
</tr>
<tr>
<td>533</td>
<td>0215</td>
<td>Password</td>
<td>F7</td>
<td>--</td>
</tr>
<tr>
<td>534-543</td>
<td>0216-021F</td>
<td>Reserved - read as 0, write to void</td>
<td></td>
<td></td>
</tr>
<tr>
<td>544</td>
<td>0220</td>
<td>Demand Alarm</td>
<td>F6</td>
<td>--</td>
</tr>
<tr>
<td>545</td>
<td>0221</td>
<td>Demand threshold</td>
<td>F14</td>
<td>0.01 in</td>
</tr>
<tr>
<td>546</td>
<td>0222</td>
<td>Demand+ delay time</td>
<td>F14</td>
<td>0.01s</td>
</tr>
<tr>
<td>547-559</td>
<td>0223-022F</td>
<td>Reserved - read as 0, write to void</td>
<td></td>
<td></td>
</tr>
<tr>
<td>560</td>
<td>0230</td>
<td>Cold Load Pick-up Level</td>
<td>F7</td>
<td>%</td>
</tr>
<tr>
<td>561</td>
<td>0231</td>
<td>Cold Load Pick-up IOL</td>
<td>F14</td>
<td>0.01s</td>
</tr>
<tr>
<td>562</td>
<td>0232</td>
<td>Cold Load Pick-up element</td>
<td>F15</td>
<td>Bit field</td>
</tr>
<tr>
<td>563-575</td>
<td>0233-023F</td>
<td>Reserved - read as 0, write to void</td>
<td></td>
<td></td>
</tr>
<tr>
<td>576</td>
<td>0240</td>
<td>Input 1 Function</td>
<td>F6</td>
<td>--</td>
</tr>
<tr>
<td>577</td>
<td>0241</td>
<td>Input 1 Reset Option</td>
<td>F16</td>
<td>Bit field</td>
</tr>
<tr>
<td>578</td>
<td>0242</td>
<td>Input 1 Blocked element</td>
<td>F17</td>
<td>Bit field</td>
</tr>
<tr>
<td>579</td>
<td>0243</td>
<td>Input 1 Aux delay</td>
<td>F14</td>
<td>0.01s</td>
</tr>
<tr>
<td>580</td>
<td>0244</td>
<td>Input 1 TCS delay</td>
<td>F14</td>
<td>0.01s</td>
</tr>
<tr>
<td>581</td>
<td>0245</td>
<td>Input 2 Function</td>
<td>F6</td>
<td>--</td>
</tr>
<tr>
<td>582</td>
<td>0246</td>
<td>Input 2 Reset Option</td>
<td>F16</td>
<td>Bit field</td>
</tr>
<tr>
<td>583</td>
<td>0247</td>
<td>Input 2 Blocked element</td>
<td>F17</td>
<td>Bit field</td>
</tr>
<tr>
<td>584</td>
<td>0248</td>
<td>Input 2 Aux delay</td>
<td>F14</td>
<td>0.01s</td>
</tr>
<tr>
<td>585</td>
<td>0249</td>
<td>Input 2 TCS delay</td>
<td>F14</td>
<td>0.01s</td>
</tr>
<tr>
<td>586-622</td>
<td>024A-026F</td>
<td>Reserved - read as 0, write to void</td>
<td></td>
<td></td>
</tr>
<tr>
<td>623</td>
<td>026F</td>
<td>IRF Option</td>
<td>F6</td>
<td>--</td>
</tr>
<tr>
<td>624</td>
<td>0270</td>
<td>Relay 1 Function (read only)</td>
<td>F6</td>
<td>--</td>
</tr>
<tr>
<td>625</td>
<td>0271</td>
<td>Relay 1 Reset Option</td>
<td>F6</td>
<td>--</td>
</tr>
<tr>
<td>626</td>
<td>0272</td>
<td>Relay 1 Linked element</td>
<td>F18</td>
<td>Bit field</td>
</tr>
<tr>
<td>627-628</td>
<td>0273-0274</td>
<td>Reserved - read as 0, write to void</td>
<td></td>
<td></td>
</tr>
<tr>
<td>629</td>
<td>0275</td>
<td>Relay 2 Function</td>
<td>F6</td>
<td>--</td>
</tr>
<tr>
<td>630</td>
<td>0276</td>
<td>Relay 2 Reset Option</td>
<td>F6</td>
<td>--</td>
</tr>
<tr>
<td>631</td>
<td>0277</td>
<td>Relay 2 Linked element</td>
<td>F18</td>
<td>Bit field</td>
</tr>
<tr>
<td>632</td>
<td>0278</td>
<td>Relay 2 CBFP option</td>
<td>F6</td>
<td>--</td>
</tr>
<tr>
<td>633</td>
<td>0279</td>
<td>Relay 2 CBFP delay</td>
<td>F14</td>
<td>0.01s</td>
</tr>
<tr>
<td>634</td>
<td>027A</td>
<td>Relay 3 Function</td>
<td>F6</td>
<td>--</td>
</tr>
<tr>
<td>635</td>
<td>027B</td>
<td>Relay 3 Reset Option</td>
<td>F6</td>
<td>--</td>
</tr>
<tr>
<td>636</td>
<td>027C</td>
<td>Relay 3 Linked element</td>
<td>F18</td>
<td>Bit field</td>
</tr>
<tr>
<td>637</td>
<td>027D</td>
<td>Relay 3 CBFP option</td>
<td>F6</td>
<td>--</td>
</tr>
<tr>
<td>638</td>
<td>027E</td>
<td>Relay 3 CBFP delay</td>
<td>F14</td>
<td>0.01s</td>
</tr>
<tr>
<td>639</td>
<td>027F</td>
<td>Relay 4 Function</td>
<td>F6</td>
<td>--</td>
</tr>
<tr>
<td>640</td>
<td>0280</td>
<td>Relay 4 Reset Option</td>
<td>F6</td>
<td>--</td>
</tr>
<tr>
<td>641</td>
<td>0281</td>
<td>Relay 4 Linked element</td>
<td>F18</td>
<td>Bit field</td>
</tr>
<tr>
<td>642</td>
<td>0282</td>
<td>Relay 4 CBFP option</td>
<td>F6</td>
<td>--</td>
</tr>
<tr>
<td>643</td>
<td>0283</td>
<td>Relay 4 CBFP delay</td>
<td>F14</td>
<td>0.01s</td>
</tr>
<tr>
<td>Address</td>
<td>Parameter</td>
<td>Format</td>
<td>Units and Scale</td>
<td>Range</td>
</tr>
<tr>
<td>---------</td>
<td>-----------</td>
<td>--------</td>
<td>----------------</td>
<td>-------</td>
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<tr>
<td>768</td>
<td>0300</td>
<td>Thermal Overload</td>
<td>F6</td>
<td>--</td>
</tr>
<tr>
<td>769</td>
<td>0301</td>
<td>Thermal Full Load Current, Iθ</td>
<td>F14</td>
<td>0.01 In</td>
</tr>
<tr>
<td>770</td>
<td>0302</td>
<td>Thermal Time Constant, Tθ</td>
<td>F7</td>
<td>minute</td>
</tr>
<tr>
<td>771</td>
<td>0303</td>
<td>Thermal Factor, k</td>
<td>F14</td>
<td>0.01</td>
</tr>
<tr>
<td>772</td>
<td>0304</td>
<td>Thermal Trip Threshold</td>
<td>F7</td>
<td>%</td>
</tr>
<tr>
<td>773</td>
<td>0305</td>
<td>Thermal Alarm Threshold</td>
<td>F7</td>
<td>%</td>
</tr>
<tr>
<td>774-783</td>
<td>0306-030F</td>
<td>Reserved - read as 0, write to void</td>
<td></td>
<td></td>
</tr>
<tr>
<td>784</td>
<td>0310</td>
<td>I&gt;</td>
<td>F6</td>
<td>--</td>
</tr>
<tr>
<td>785</td>
<td>0311</td>
<td>I&gt; Threshold</td>
<td>F14</td>
<td>0.01 In</td>
</tr>
<tr>
<td>786</td>
<td>0312</td>
<td>I&gt; Delay Type</td>
<td>F6</td>
<td>--</td>
</tr>
<tr>
<td>787</td>
<td>0313</td>
<td>I&gt; Definite Time</td>
<td>F14</td>
<td>0.01s</td>
</tr>
<tr>
<td>788</td>
<td>0314</td>
<td>I&gt; IDMT Curve</td>
<td>F6</td>
<td>--</td>
</tr>
<tr>
<td>789</td>
<td>0315</td>
<td>I&gt; IDMT time multiplier</td>
<td>F14</td>
<td>0.01</td>
</tr>
<tr>
<td>790-799</td>
<td>0316-031F</td>
<td>Reserved - read as 0, write to void</td>
<td></td>
<td></td>
</tr>
<tr>
<td>800</td>
<td>0320</td>
<td>I&gt;&gt;</td>
<td>F6</td>
<td>--</td>
</tr>
<tr>
<td>801</td>
<td>0321</td>
<td>I&gt;&gt; Threshold</td>
<td>F14</td>
<td>0.01 In</td>
</tr>
<tr>
<td>802</td>
<td>0322</td>
<td>tI&gt;&gt; Definite time</td>
<td>F14</td>
<td>0.01s</td>
</tr>
<tr>
<td>803-809</td>
<td>0323-032F</td>
<td>Reserved - read as 0, write to void</td>
<td></td>
<td></td>
</tr>
<tr>
<td>810</td>
<td>032A</td>
<td>I&gt;&gt;&gt;</td>
<td>F6</td>
<td>--</td>
</tr>
<tr>
<td>811</td>
<td>032B</td>
<td>I&gt;&gt;&gt; Sample</td>
<td>F6</td>
<td>--</td>
</tr>
<tr>
<td>812</td>
<td>032C</td>
<td>I&gt;&gt;&gt; Threshold</td>
<td>F14</td>
<td>0.01 In</td>
</tr>
<tr>
<td>813</td>
<td>032D</td>
<td>tI&gt;&gt;&gt; Definite time</td>
<td>F14</td>
<td>0.01s</td>
</tr>
<tr>
<td>814-815</td>
<td>032E-032F</td>
<td>Reserved - read as 0, write to void</td>
<td></td>
<td></td>
</tr>
<tr>
<td>816</td>
<td>0330</td>
<td>Earth Fault Low Set Io&gt;</td>
<td>F6</td>
<td>--</td>
</tr>
<tr>
<td>817</td>
<td>0331</td>
<td>Earth Fault Low Set Io&gt; Threshold</td>
<td>F14</td>
<td>0.01 Ion</td>
</tr>
<tr>
<td>818</td>
<td>0332</td>
<td>Earth Fault Low Set Io&gt; Delay Type</td>
<td>F6</td>
<td>--</td>
</tr>
<tr>
<td>819</td>
<td>0333</td>
<td>Earth Fault Low Set Definite Time tIo&gt;</td>
<td>F14</td>
<td>0.01s</td>
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<tr>
<td>820</td>
<td>0334</td>
<td>Earth Fault Low Set IDMT Curve</td>
<td>F6</td>
<td>--</td>
</tr>
<tr>
<td>821</td>
<td>0335</td>
<td>Earth Fault Low Set IDMT Multiplier kto&gt;</td>
<td>F14</td>
<td>0.01</td>
</tr>
<tr>
<td>822-831</td>
<td>0336-033F</td>
<td>Reserved - read as 0, write to void</td>
<td></td>
<td></td>
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<tr>
<td>832</td>
<td>0340</td>
<td>Earth Fault High Set Io&gt;&gt;</td>
<td>F6</td>
<td>--</td>
</tr>
<tr>
<td>833</td>
<td>0341</td>
<td>Earth Fault High Set Io&gt;&gt; Threshold</td>
<td>F14</td>
<td>0.01 Ion</td>
</tr>
<tr>
<td>834</td>
<td>0342</td>
<td>Earth Fault High Set tIo&gt;&gt;</td>
<td>F14</td>
<td>0.01s</td>
</tr>
</tbody>
</table>

**Protection Group 2**

<table>
<thead>
<tr>
<th>Address</th>
<th>Parameter</th>
<th>Format</th>
<th>Units and Scale</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1024-1090</td>
<td>0400-0442</td>
<td>Same as Protection Group 1 except addresses are 04xx instead of 03xx</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Address</td>
<td>Parameter</td>
<td>Format</td>
<td>Units and Scale</td>
<td>Range</td>
</tr>
<tr>
<td>---------</td>
<td>-----------</td>
<td>--------</td>
<td>----------------</td>
<td>-------</td>
</tr>
<tr>
<td>4096</td>
<td>1000</td>
<td>Fault Record 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4097</td>
<td>1001</td>
<td>Fault Record 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4145</td>
<td>1031</td>
<td>Fault Record 50</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Each Fault Record consists of 16 words:

<table>
<thead>
<tr>
<th>Word Number</th>
<th>Description</th>
<th>Format</th>
<th>Units and scale</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Year</td>
<td>F7</td>
<td>year</td>
<td>0 - 199 (as 2000 - 2199)</td>
</tr>
<tr>
<td>2</td>
<td>month, day</td>
<td>F10</td>
<td>month, day</td>
<td>0 - 12, 0 - 31</td>
</tr>
<tr>
<td>3</td>
<td>hour, minute</td>
<td>F11</td>
<td>hour, minute</td>
<td>0 - 23, 0 - 59</td>
</tr>
<tr>
<td>4</td>
<td>Milliseconds</td>
<td>F7</td>
<td>ms</td>
<td>0 - 59999</td>
</tr>
<tr>
<td>5</td>
<td>setting group</td>
<td>F7</td>
<td></td>
<td>0 - 1 (as group 1 - 2)</td>
</tr>
<tr>
<td>6</td>
<td>source &amp; threshold</td>
<td>F8</td>
<td></td>
<td>0 - 12, 0 - 10</td>
</tr>
<tr>
<td>7</td>
<td>Value high word</td>
<td>F8</td>
<td>0.01 Ampere or 0.1% thermal</td>
<td>0-9.99x10^7 (999kA) or 500-2000</td>
</tr>
<tr>
<td>8</td>
<td>Value low word</td>
<td>F8</td>
<td></td>
<td>0-9.99x10^7 (999kA)</td>
</tr>
<tr>
<td>9</td>
<td>IL1 high word</td>
<td>F8</td>
<td>0.01 Ampere</td>
<td>0-9.99x10^7 (999kA)</td>
</tr>
<tr>
<td>10</td>
<td>IL1 low word</td>
<td>F8</td>
<td>0.01 Ampere</td>
<td>0-9.99x10^7 (999kA)</td>
</tr>
<tr>
<td>11</td>
<td>IL2 high word</td>
<td>F8</td>
<td>0.01 Ampere</td>
<td>0-9.99x10^7 (999kA)</td>
</tr>
<tr>
<td>12</td>
<td>IL2 low word</td>
<td>F8</td>
<td>0.01 Ampere</td>
<td>0-9.99x10^7 (999kA)</td>
</tr>
<tr>
<td>13</td>
<td>IL3 high word</td>
<td>F8</td>
<td>0.01 Ampere</td>
<td>0-9.99x10^7 (999kA)</td>
</tr>
<tr>
<td>14</td>
<td>IL3 low word</td>
<td>F8</td>
<td>0.01 Ampere</td>
<td>0-9.99x10^7 (999kA)</td>
</tr>
<tr>
<td>15</td>
<td>Io high word</td>
<td>F8</td>
<td>0.01 Ampere</td>
<td>0-9.99x10^7 (999kA)</td>
</tr>
<tr>
<td>16</td>
<td>Io low word</td>
<td>F8</td>
<td>0.01 Ampere</td>
<td>0-9.99x10^7 (999kA)</td>
</tr>
</tbody>
</table>

Word number 6:

High byte: Fault record source code
- Bit 0: IL1
- Bit 1: IL2
- Bit 2: IL3
- 8: Io
- 9: Thermal
- 10: Aux 1
- 11: Aux 2
- 12: TCS

Low byte: Fault record threshold
- 0: tI>
- 1: tI>>
- 2: tI>>>
- 3: tIo>
- 4: tIo>>
- 5: Thermal Overload
- 6: tAux 1
- 7: tAux 2
- 8: TCS
- 9: Reserved
- 10: Remote trip
**Event Records. Read only. Function 0x03 or 0x04**

<table>
<thead>
<tr>
<th>Dec</th>
<th>Hex</th>
<th>Address</th>
<th>Parameter</th>
<th>Format</th>
<th>Units and Scale</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>8192</td>
<td>2000</td>
<td>8192</td>
<td>Record 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8193</td>
<td>2001</td>
<td>8193</td>
<td>Record 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>8441</td>
<td>20F9</td>
<td></td>
<td></td>
<td>Record 250</td>
</tr>
</tbody>
</table>

**Alarm Records. Read only. Function 0x03 or 0x04**

<table>
<thead>
<tr>
<th>Dec</th>
<th>Hex</th>
<th>Address</th>
<th>Parameter</th>
<th>Format</th>
<th>Units and Scale</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>12288</td>
<td>3000</td>
<td>12288</td>
<td>Record 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12289</td>
<td>3001</td>
<td>12289</td>
<td>Record 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>12317</td>
<td>301D</td>
<td></td>
<td></td>
<td>Record 30</td>
</tr>
</tbody>
</table>

Each Event or Alarm Record consists of 6 words:

<table>
<thead>
<tr>
<th>Word Number</th>
<th>Description</th>
<th>Format</th>
<th>Units and scale</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Year</td>
<td>F7</td>
<td>year</td>
<td>0 - 199 (as 2000 - 2199)</td>
</tr>
<tr>
<td>2</td>
<td>month, day</td>
<td>F10</td>
<td>month, day</td>
<td>0 - 12, 0 - 31</td>
</tr>
<tr>
<td>3</td>
<td>hour, minute</td>
<td>F11</td>
<td>hour, minute</td>
<td>0 - 23, 0 - 59</td>
</tr>
<tr>
<td>4</td>
<td>Milliseconds</td>
<td>F7</td>
<td>ms</td>
<td>0 - 59999</td>
</tr>
<tr>
<td>5</td>
<td>Record code</td>
<td>See below</td>
<td>record code</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Record value</td>
<td>See below</td>
<td>record value</td>
<td></td>
</tr>
</tbody>
</table>

**Word number 5:**
Event and Alarm Record code

- 0: None
- 1: I> start (Bit 0: IL1)
- 2: tI> trip (Bit 0: IL2)
- 3: I>> start (Bit 0: IL3)
- 4: tI>> trip
- 5: I>>> start (If code is Setting change)
- 6: tI>>> trip (Value is the register address of setting being changed)
- 7: tIo> start
- 8: tIo>> trip (If code is thermal alarm, thermal overload)
- 9: tIo>>> trip (Value is the % of thermal alarm or overload threshold)
- 10: tIo>> trip
- 11: Remote trip
- 12: Remote acknowledge (0: group 1)
- 13: Remote reset (1: group 2)
- 14: Setting change
- 15: Remote thermal state reset (If code is output relay latching, output relay unlatching:)
- 16: Maintenance mode (Bit 0: Output relay 1)
- 17: Thermal alarm (Bit 1: Output relay 2)
- 18: Thermal overload (Bit 2: Output relay 3)
- 19: TCS alarm (Bit 3: Output relay 4)
- 20: Group change
- 21: tAux 1 (If code is input activate, input deactivate:)
- 22: tAux 2 (Bit 0: Input 1)
- 23: tI> reset (Bit 1: Input 2)
- 24: tI>> reset
- 25: tI>>> reset
- 26: tIo> reset
- 27: tIo>> reset
- 28: Relay latching
- 29: Relay unlatching
- 30: Input activate
- 31: Input deactivate
- 32: Idemand alarm
- 33: General starting
- 34: Cold load function starting
## 9.3 MODBUS Mapping Format

<table>
<thead>
<tr>
<th>CODE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>2 bytes ASCII character</td>
</tr>
</tbody>
</table>
| F2   | Unsigned integer – Relay status  
Bit 0: Eeprom data failure  
Bit 1: Calibration failure  
Bit 2: Clock loss  
Bit 3: Clock error  
Bit 4: Adc error  
Bit 11: Back port (RS485) unread fault record  
Bit 12: Front panel (RS232) unread fault record  
Bit 13: Front panel/Back port communication  
Bit 14: Back port unread alarm record  
Bit 15: Front panel unread alarm record |
| F3   | Unsigned integer – Relay LED status  
Bit 0 and Bit 1: Trip LED. 1=on, 2=blink  
Bit 2 and Bit 3: Alarm LED. 1=on, 2=blink |
| F4   | Unsigned integer – Input status  
Bit 0: Input 1 (0=off, 1=on)  
Bit 1: Input 2 (0=off, 1=on) |
| F5   | Unsigned integer – Output relay status  
Bit 0: Output 1 (0=off, 1=on)  
Bit 1: Output 2 (0=off, 1=on)  
Bit 2: Output 3 (0=off, 1=on)  
Bit 3: Output 4 (0=off, 1=on) |
| F6   | Unsigned integer – Miscellaneous  
A numeric value representation of certain options or functions.  
Refer to 'range' column of the register for detail |
| F7   | Unsigned integer  
A numeric value of certain units  
Eg. 12 may represent 12% or 12minutes  
Refer to individual register's 'Units and Scale' and 'range' for detail |
| F8   | Unsigned long integer – Current value in multiples of 0.01 Ampere |
| F9   | Unsigned integer – Remote command  
High byte:  
1: Reset alarm/trip (also acknowledge and delete alarm record)  
2: Acknowledge alarm/trip  
3: Reset display to main page  
4: Reset thermal state  
5: Reset maximum and average measurement value  
6: Remote trip  
7: Reset panel password  
8: Delete fault record  
9: Delete event record  
10: Delete alarm record  
Low byte:  
For high byte=3: set to main display page 0-3  
For high byte=8,9 and 10: 0=Delete all record, n: delete record n |
<table>
<thead>
<tr>
<th>Format</th>
<th>Description</th>
</tr>
</thead>
</table>
| F10    | Unsigned integer  
High byte: month  
Low byte: day |
| F11    | Unsigned integer  
High byte: hour (24 hour format)  
Low byte: minute |
| F12    | Unsigned integer – Date and time format for relay display only  
High byte: Date format, 0=DD/MM/YYYY, 1=MM/DD/YYYY  
Low byte: Time format, 0=12 hour, 1=24 hour |
| F13    | Unsigned integer – Change Group by...  
0=Change group by menu, 1=change group change by level of digital input |
| F14    | Unsigned integer  
A scaled numeric value of certain units  
Eg. 123 may represent 1.23A or 1.23s  
Refer to individual resisger's 'Units and Scale' and 'range' for detail |
| F15    | Unsigned integer – Cold Load Pick-up element  
Bit 0: tI>  
Bit 1: tI>>  
Bit 2: tI>>>  
Bit 3: tIo>  
Bit 4: tIo>>  
Bit 5: Thermal overload |
| F16    | Unsigned integer – Input n reset option  
(For input function set as reset)  
Bit 0: 0= Not to reset trip/alarm, 1=to reset trip/alarm  
Bit 1: 0= Not to reset thermal state, 1=to reset thermal state |
| F17    | Unsigned integer – Input n Blocked element  
(For input function set as blocking)  
Bit 0: tI>  
Bit 1: tI>>  
Bit 2: tI>>>  
Bit 3: tIo>  
Bit 4: tIo>>  
Bit 5: Thermal overload |
| F18    | Unsigned integer – Relay n link element  
Bit 0: I>  
Bit 1: I>>  
Bit 2: I>>>  
Bit 3: Io>  
Bit 4: Io>>  
Bit 5: Thermal overload  
Bit 6: Aux 1  
Bit 7: Aux 2  
Bit 8: TCS  
Bit 9: Idemand  
Bit 10: Remote trip |