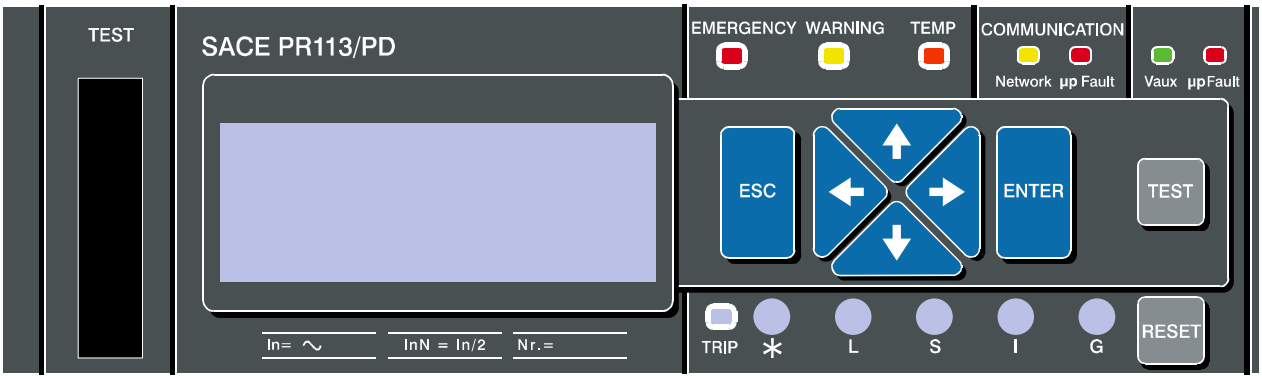
# Instruction manual

# PR113/PD-M Modbus™ System Interface

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| Author<br>Autore | LB-DTA | | L2572 | | Title<br>Titolo | **PR113/PD-M Modbus™ System Interface** | ENG |
| ABB | | | | | Doc. No<br>N. Doc. | **RH0296001** | Tot. Pag.<br>1/78 |

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# 1. General

This document describes the Modbus interface regarding:

- Network Management of the device (installation, configuration, …)
- Application Objects and Slave Variables

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| | | | |
|---|---|---|---|
| Modbus | 984 | P190 | SM85 |
| ModConnect | BM85 | RR85 | SQ85 |
| Modcom | BP85 | SA85 | |

## 1.1 Applicability

This document applies to the Communication Unit of the PR113/PD-Modbus (also called PR113/PD-M) device only.
It could be used as a starting point for other Modbus device too.

## 1.2 Applicable Documents

[1] Schneider Automation Inc., '*Modicon MODBUS Protocol Reference Guide*', June 1996, rev. J, PI-MBUS-300
http://www.modicon.com/techpubs/toc7.html

## 1.3 Acronyms and Definitions

### *1.3.1 Acronyms*

| | |
|---|---|
| **ADC** | **Analog Digital Converter** |
| **AI** | **Analog Input** |
| **AO** | **Analog Output** |
| **AppObj** | **Application Object** |
| **CB** | **Circuit Breaker (ACB EMAX family)** |
| **CP** | **Configuration Parameter** |
| **CT** | **Current Transformer** |
| **CU** | **Communication Unit (PR113/D-M)** |
| **DI** | **Digital Input** |
| **DCP** | **Dialogue (CU) Configuration Parameter** |
| **DO** | **Digital Output** |
| **ETT** | **Electronic Trip Test** |
| **In** | **Nominal current** |
| **LSb** | **Least Significant bit** |
| **LSB** | **Least Significant Byte** |
| **MSb** | **Most Significant bit** |
| **MSB** | **Most Significant Byte** |
| **PCP** | **Protection Configuration Parameter** |
| **PU** | **Protection Unit (PR113/P)** |
| **OR** | **(Main) Opening Release** |
| **SOR** | **Shunt Opening Release** |
| **Tpgr** | **Protection X Trip Time Delay (used for Protection X Zone Selectivity Time)** |
| **UVR** | **Under Voltage Release** |

### *1.3.2 Definitions*

**ALARM** there are two types of alarm:

| Alarm Type | Definition |
|---|---|
| Alarm | It's similar to a status. It will be frozen after a protection trip into the "Trip Report" structures.<br>A Trip Reset is NOT necessary to reset it.<br>Ex. L Pre-Alarm, S Alarm, ... |
| Trip | Only a command can reset it, i.e. a new alarm won't be signalled until the reset.<br>Ex. L Tripped, S Tripped, ... |

Trips are reset after a Trip Reset command.

**BUFFER** Meaningful part of a Modbus Map section.

It's defined by the device Modbus Map.

**CB RESET** command equal to a Trip Reset.

**COIL** the least digital information container (i.e. one bit)

**COMMUNICATION UNIT** PR113/D-M electronic board that implements the Modbus interface

**DEVICE** Protection and Communication Unit (i.e. the PR113/PD-M)

**EVENT** information that signals a normal (foreseen) device behaviour.

Typically, the producer of an event is the device, while the consumer (who resets it) is the system.

Reset of an event is automatically done after a read operation from the system.

**ITEM** a Digital (coil) or an Analog (register) Modbus data type

**OPERATION** every CB status transition toward OPEN state. It doesn't matter which is the starting state (TRIPPED or CLOSED).

**OTHER TRIPS** sum of CB status transitions toward the TRIPPED state, either from the OPEN or CLOSED starting state, but not caused by the protection.

So they are all the transitions caused by an electronic trip test, under voltage release and secondary shunt opening release.

**PARAMETER** information that allows configuration of a device functionality (e.g. a protection algorithm).

**PERSISTENCE** 'volatile/non-volatile' attribute concerning information, i.e. the information is/is not still available after a power fail/HW reset/...

| PERSISTENCE | Description |
|---|---|
| Temporary (default) | Information is NOT still available after a power fail/HW reset/... |
| Permanent | Information is still available after a power fail/HW reset/... |

For example, parameters and trip data have this attribute set to PERMANENT, while states/events/alarms settings are TEMPORARY.

**PROTECTION TRIPS** sum of real protection trips (Σ LSIG trips).
'Real' means 'not caused by the Test Unit PR010/T.
Trips that come up when:

- Test Unit connected
- CB closed and/or currents NOT equal to zero

are considered 'real'.
In fact, in his case the Test Unit can only read values and can NOT simulate a trip.

**PROTECTION UNIT** PR113/P electronic board that implements protection algorithms

**PROTECTION X TRIPS** sum of trip of protection X (e.g. L, S, I, G).

**REGISTER** the least analogue information container (one word = 2 bytes)

**STATUS** information that represents the dynamics of a functionality (e.g. the CB or a protection algorithm). It can be managed (i.e. set/reset) only by the device itself.

**TRIP COMMAND FAIL** after a protection trip, with relevant opening command to the release, CB stays in CLOSED state. In this case, the CU tries to open the CB using the YO.

**TRIP RESET** event (Any Alarm) /alarm reset of any information related to the (last) trip.
It doesn't change the 'real' CB status (i.e. the CB is OPEN) but it changes the 'virtual' CB status from TRIPPED to OPEN.

**(PROCESS) VARIABLE** information strictly connected to device functionality. Examples are:

- commands
- states/events
- alarms
- measurements
- historical/statistical data
- ...

# 2. Introduction

It has been decided to describe the device according to the Modbus protocol [1] and a high level description for different functionality called *Application Object (AppObj)*.
These AOs manage the reporting of the Protection Unit information to the remote system. This information is polled by the Communication Unit to the Protection Unit according to the Internal Bus Protocol.
Moreover the Communication Unit manages the Internal Bus sharing with the Test Unit (e.g. PR010/T) according to the Master Token Protocol.

## 2.1 Modbus Protocol and Map Organisation

### *2.1.1 Communication parameters*

1. Transmission mode: RTU (2 four bits hexadecimal chars for each byte).

2. Serial parameters:

| Start Bit | Data Bits | Parity Bit | Stop Bit |
|---|---|---|---|
| 1 | 8 (LSb first) | 1 (even ǀ odd) | 1 |

**Table 1. Serial parameters**

Please note that mode and serial parameters MUST be the same for all devices on a Modbus network.
Only the parity parameter is modifiable.

3. Baud Rate: [ 9600 ǀ 19200 ].

**DEFAULT VALUES**: Even Parity, Baud Rate = 19200

### *2.1.2 Device RTU Framing*

| START | SLAVE ADDRESS | FUNCTION | DATA | CRC CHECK | END |
|---|---|---|---|---|---|
| T1 – T2 – T3 – T4 | 8 bits | 8 bits | n * 8 | 16 bits | T1 – T2 – T3 – T4 |

**Table 2. Modbus message**

Up to 256 bytes can be sent.

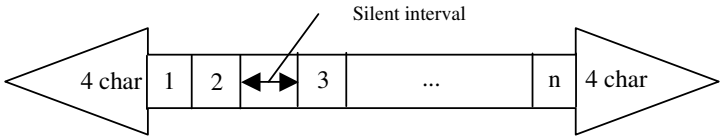
The allowed inter-character silent interval is been relaxed from ‘at least 2 characters’ to ‘at least 4 characters’ (the same silent interval to recognise the end of a message). This means:

#### 2.1.2.1 Silent interval < 4 char between two characters inside the message

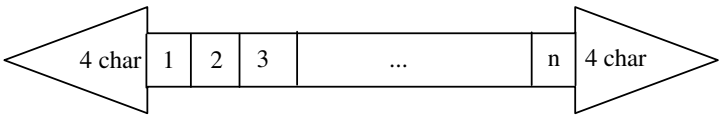
In this case the receiver filters the silent interval and the following characters will be appended to those already received.
The difference from the protocol specification is:

1. Silent interval < 2 char between two characters inside the message

**Transmitter**



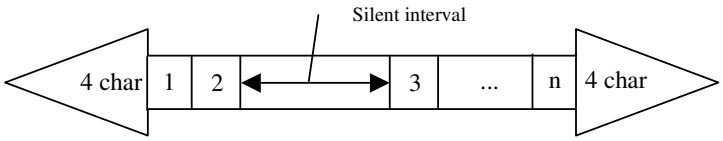

**Receiver**



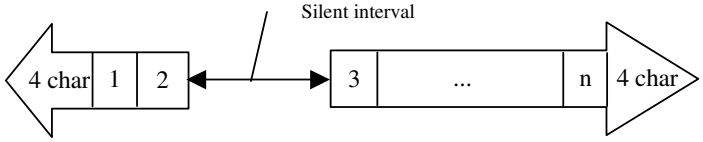

The behaviour is exactly as specified by the protocol.

2. Silent interval ≥ 2 char and < 4 char between two characters inside the message
The received characters are NOT flushed and the following ones will be appended.

**Transmitter**




**Receiver**




Note that after flushing, the standard protocol specification allows:

- reception of the remaining characters of a partially received message;
- reception of a completely new message.

The device behaviour **doesn't cover the second case** because it always appends new incoming characters to the previous ones, leading to a CRC error.
So the behaviour is exactly the same if and only if the incoming characters are NOT a new message. In this case the received packet will lead to a CRC error and the CRC error counter will be incremented.

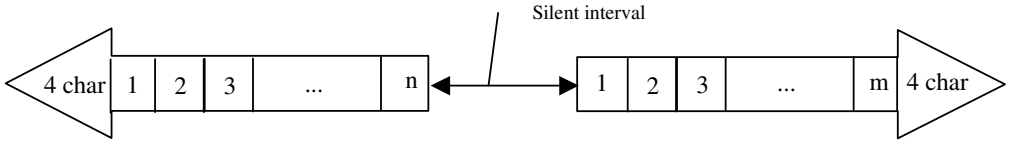
#### 2.1.2.2 Silent interval ≥ 4 char between two characters inside the message

If the message transmission is NOT ended, all the previously received characters are managed as a message because this is exactly the protocol specification regarding the end of a message.

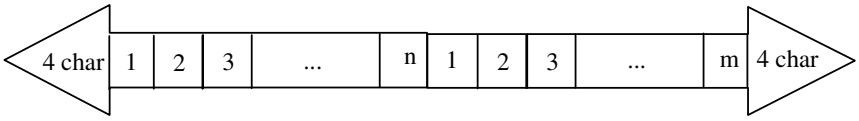
#### 2.1.2.3 New frame before 4 character silent interval at the end of a frame

In this case the receiver filters the silent interval and the following characters (of the new frame) will be appended to those already received (see case 2 of par. 2.1.2.1).
This will lead to a CRC error.

**Transmitter**




**Receiver**




So the CRC error counter will count both the 'real' CRC errors and the inter-character errors.

### *2.1.3 Response Timeout*

The reported timeouts have been measured over more than 100 samples (normal responses) in the following conditions:

- device in 'normal' status, i.e. only measurements are periodically updated and NO alarm conditions are satisfied

| | Minimum (ms) | Medium (ms) | Maximum (ms) |
|---|---|---|---|
| Single COIL Read | 18.35 | 19 | 20.99 |
| Multiple COILS (69) Read | 23.6 | 25 | 26.2 |
| Single REGISTER Read | 18.35 | 18.8 | 21.4 |
| Multiple REGISTERS (98) Read | 130 | 131.2 | 134.87 |

**Table 3. Response Timeout**

Please note that the multiple items read has been performed on maximum number of items allowed by the device map, in particular:

- 69, status / events, alarms, trips
- 98, present parameters in use

The minimum suggested response timeout for **periodically polled information** is 25 ms.

### *2.1.4 Reception checks*

After reception, the device performs the following checks:

- CRC,
- Max Message Length allowed (256 bytes),
- Slave Address.

If any of this information is not correct, the received message is discarded and no response message is sent back to the Master.

### *2.1.5 Function Codes*

The following standard functions have to be supported:

| Code | HEX Code | Name | Applies to |
|---|---|---|---|
| 01 | 0x01 | Read Coil Status | DO |
| 02 | 0x02 | Read Input Status | DI |
| 03 | 0x03 | Read Holding Register | AO |
| 04 | 0x04 | Read Input Register | AI |
| 05 | 0x05 | Force Single Coil | DO |
| 06 | 0x06 | Preset Single Register | AO |
| 08 | 0x08 | Diagnostic<br>Sub-function: 0 (0x00) | |
| 15 | 0x0F | Force Multiple Coils | DO |
| 16 | 0x10 | Preset Multiple Registers | AO |
| 17 | 0x11 | Report Slave ID | |

**Table 4. PR113/PD-M function codes**

All other NOT supported function codes lead to an Exception response 'ILLEGAL_FUNCTION'.

These functions can be grouped into two different categories:

1. Data Management functions.
   Functions applied to device data into the Modbus Map (codes 01, 02, 03, 04, 05, 06, 15 and 16).

2. Network / Device Management functions.
   Functions applied to device that can:
   - request / setting general information
   - change the device behaviour / status
   - …

   Function code 08 and 17 belong to this category.

#### 2.1.5.1 08 (0x08) Diagnostic

The function uses a two-byte sub-function code field in the query to define the type of test to be performed.
Most of the diagnostic queries use a two-byte data field to send diagnostic data or control information to the slave.

| Sub-function Hi | Sub-function Lo | Data Hi | Data Lo |
|---|---|---|---|
| | | | |

**Table 5. 'Diagnostic' query data field structure**

where the only supported sub-function code is:

| Sub-function code | HEX code | Name | Description |
|---|---|---|---|
| 00 | 0x00 | Return Query Data | The data passed in the information field will be returned to the Master via the addressed Modbus Slave. The entire message returned should be identical to the message transmitted by the Master, field-per-field. |

**NOTE**: the protocol specification on data field ('Any', pages 74 – 75, 77) is NOT clear. The device allows both a generic field length (i.e. more than two bytes) and a generic value range.

#### 2.1.5.2 17 (0x11) Report Slave ID

A normal response has some fields defined and others device dependent:

| Byte Count | Slave ID | Run Indicator Status | Additional Data ... |
|---|---|---|---|
| | | | |

**Table 6. 'Report Slave ID' response data field structure**

where:

- 'Byte Count' depends on 'Additional Data'. Its minimum value is 2.
- 'Slave ID' is the identifier of the device of a specific manufacturer (i.e. devices from different manufacturers could have the same 'Slave ID'):

| Slave ID | Device |
|---|---|
| 12 = 0x0C | PR113/PD-M |

**Table 7. Slave ID**

- 'Run Indicator Status' reports the current Slave Run status, fixed to ON (0xFF).

### *2.1.6 Data Addressing (Map organisation)*

Two different data addressing types are implemented:

1. Standard Modbus addressing
2. ABB SACE addressing (old ABB SACE Modbus Communication Units)

| Standard | | | ABB | |
|---|---|---|---|---|
| **Starting Address** | **Item Address** | **Data Type** | **Starting Address** | **Item Address** |
| 0<br>…<br>9999 | 1<br>…<br>10000 | DO | 1<br>…<br>10000 | 1<br>…<br>10000 |
| 0<br>…<br>9999 | 10001<br>…<br>20000 | DI | 10001<br>…<br>20000 | 10001<br>…<br>20000 |
| | | | | |
| 0<br>…<br>9999 | 30001<br>…<br>40000 | AI | 30001<br>…<br>40000 | 30001<br>…<br>40000 |
| 0<br>…<br>9999 | 40001<br>…<br>50000 | AO | 40001<br>…<br>50000 | 40001<br>…<br>50000 |

It is possible to configure it using the 'Network Info' menu of the HMI.

The organisation of every section of the map (i.e. DO, DI, AI, AO) can be partitioned into different areas, called '*buffers*', containing a contiguous number of item. For example

| Item Address | Item Value |
|---|---|
| 1 | |
| … | |
| 27 | |
| 28 | |
| 29 | |
| 30 | |
| 31 | |
| … | |
| … | |
| 10000 | |

defines a DO buffer starting at 27 and with length 5 (grey cells are map items not defined for the device).

Please note that:

| Item Address | Item Value |
|---|---|
| 1 | |
| … | |
| 27 | |
| 28 | |
| 29 | |
| 30 | |
| 31 | |
| 32 | |
| … | |
| 10000 | |

defines two different DO buffers. The first one starts at 27 with length 2, while the second one starts at 30 with length 3.

It's possible to query a buffer as a whole or a portion of it, but **it's NOT possible to query two buffers within the same message: an exception response will rise up.**

#### 2.1.6.1 Standard Modbus Addressing

In Modbus messages Start Address is always referred to zero.

Every single item in these sections is identified by a LOGICAL ABSOLUTE ADDRESS in the following ranges:

| Data | Logical Absolute Address Range | Offset / Reference (decimal) | Offset / Reference (hex) |
|---|---|---|---|
| DO | 00001 – 10000 (MAX_DO_ADDR) | 00000 (DO_OFFSET) | 0x0000 |
| DI | 10001 – 20000 (MAX_DI_ADDR) | 10000 (DI_OFFSET) | 0x2710 |
| AI | (MIN_AI_ADDR) 30001 – 40000 (MAX_AI_ADDR) | 30000 (AI_OFFSET) | 0x7530 |
| AO | 40001 – 50000 (MAX_AO_ADDR) | 40000 (AO_OFFSET) | 0x9C40 |

**Table 8. Modbus logical memory map**

Please note that when the Master specifies the 'Starting Address' into the Modbus message, it uses a LOGICAL RELATIVE ADDRESS, calculated from the LOGICAL ABSOLUTE ADDRESS:

Starting Address = LOGICAL RELATIVE ADDRESS
= LOGICAL ABSOLUTE ADDRESS – XX_OFFSET –1
= Item Address – XX_OFFSET –1

**Equation 1.**

So the Logical Relative Address Range is 00000 – 09999 (= 0x270F, MAX_RELATIVE_ADDR) for all data types.

Moreover, items like 10005, 40001, ... are addressed like 0005, 0001, ... because the function code uniquely identifies the portion of Modbus map they belong to.

Example
Coil with LOGICAL ABSOLUTE ADDRESS = 13 will be addressed by the Master with the LOGICAL RELATIVE ADDRESS = 12.

Register with LOGICAL ABSOLUTE ADDRESS = 32475 will be addressed by the Master with the LOGICAL RELATIVE ADDRESS = 32475 – 30000 – 1 = 2474.

So the device performs the following check on the Starting Address field:

- Starting Address range between 0 and 9999
- Starting Address belongs to a valid part of the section pointed by the Function Code

#### 2.1.6.2 ABB SACE Addressing

The item address is:

Starting Address = LOGICAL ABSOLUTE ADDRESS = Item Address

The device performs the following check on the Starting Address field:

- Starting Address congruency with the section pointed by the Function Code (see Table 8).
- Starting Address belongs to a valid part of the pointed section

### *2.1.7 Data Field*

The data field is formed by an 'header' part and a data value part: following points consider only the header part of this field.

In some function, there could be a 0 length data field (i.e. the message contains only the function code like in the 'Report Slave ID' function).

There is no restriction to max data length except the maximum message length (256 bytes).

#### 2.1.7.1 Query

| **Number of items [2 bytes] (except writing functions 5 and 6)** | **Byte Count (only for writing functions 15 and 16) [1 byte]** |
|---|---|
| How many items to read/write | How many data bytes follow |

**Table 9. Query data field structure**

| Function Code | Data Type | Max number of items | Max byte count | Min message length | Max message length |
|---|---|---|---|---|---|
| 1 | DO | 2008 (251 * 8) | N/A | 8 | 8 |
| 2 | DI | 2008 (251 * 8) | N/A | 8 | 8 |
| 3 | AO | 125 | N/A | 8 | 8 |
| 4 | AI | 125 | N/A | 8 | 8 |
| 5 | DO | N/A (1 fixed) | N/A | 8 | 8 |
| 6 | AO | N/A (1 fixed) | N/A | 8 | 8 |
| 15 | DO | 1976 (247 * 8) | 247 | 10 | 256 |
| 16 | AO | 123 | 246 | 11 | 256 |

The device performs the following checks on the above-mentioned fields:

- Max number of items, conforming to the Function Code
- Byte Count congruency with the Number of Items
- Data value field length congruency with the Byte Count

Moreover, also the following checks are performed:

- (Starting Address + Number Of Items) belongs to the section pointed by the Function Code
- (Starting Address + Number Of Items) belongs to a valid part of the pointed section

#### 2.1.7.2 Response

1. Read function codes

| Byte Count (only for writing functions 15 and 16) [1 byte] |
|---|
| How many data bytes follow |

**Table 10. Read function response data field structure**

| Function Code | Data Type | Max number of items | Max byte count | Min message length |
|---|---|---|---|---|
| 1 | DO | 2008 (251 * 8) | 251 | 6 |
| 2 | DI | 2008 (251 * 8) | 251 | 6 |
| 3 | AO | 125 | 250 | 7 |
| 4 | AI | 125 | 250 | 7 |

2. Single item Write function codes (5, 6)
   It' simply an echo of the query message.

3. Multiple items Write function codes (15, 16)

| Starting Address [2 bytes] | Number of items [2 bytes] |
|---|---|
| Starting item | How many items to read/write |

**Table 11. Multiple items Write function response data field structure**

So the message length is fixed and equal to 8.

### *2.1.8 Exception Responses*

In this case, the MSb of the function code in the response message is set to one and an error code is added.

| Error Code | Error Name | Meaning |
|---|---|---|
| 01 | ILLEGAL FUNCTION | The function code received in the query is not an allowable action for the slave.<br>If a 'Poll Program Complete' command is issued, this code indicates that no program function preceded it. |
| 02 | ILLEGAL DATA ADDRESS | The data address received in the query is not an allowable address for the slave. |
| 03 | ILLEGAL DATA VALUE | A value contained in the query data field in not an allowable value for the slave. |
| 06 | SLAVE DEVICE BUSY | The slave is processing a long-duration program command.<br>The master should retransmit the message later when the slave is free. |

**Table 12. Exception response error codes**

No response is sent by the slave device if there is a communication error (i.e. a parity o a CRC error).

| Error Code | Error Name | When |
|---|---|---|
| 01 | ILLEGAL FUNCTION | 1. The message is too short (i.e. there is NO Function Code field!), with right CRC.<br>2. Device does NOT support the received Function Code.<br>Please note that this means that the Function Code 2 (Read Input Status, DI) will NOT lead to this Exception. |
| 02 | ILLEGAL DATA ADDRESS | 1. The message is too short (i.e. there is NO Starting Address field!), with right CRC.<br>2. Starting Address is > 10000 (Standard Addressing Type).<br>3. Starting Address is outside a map section (ABB SACE Addressing Type).<br>4. Starting Address doesn't belong to any buffer. |
| 03 | ILLEGAL DATA VALUE | 1. The message is too short, with right CRC.<br>2. The message is too long, with right CRC.<br>3. Diagnostic function: sub-function is not supported (≠ 0)<br>4. The Number of Items is NOT in range (= 0 or > Max number of items, see 2.1.7).<br>5. Byte Count is different from the number of bytes calculated using the number of items and the relevant data type.<br>6. The whole query requested buffer (Starting Address + Number of Items) doesn't belong to a device map buffer.<br>7. Force Single Coil function: the value is different from 0x0000 or 0xFF00.<br>8. Command value: it is different from '1'.<br>9. DCP Installation Date value: not valid |
| 06 | SLAVE DEVICE BUSY | 1. Start-up (before complete polling of PU information)<br>2. Commands inhibition (see par. 6.2.3) |

## 2.2 Installation and Configuration

At the first start-up, the device is NOT configured for communication to the remote system.
The communication parameters to be defined are:

| Communication Parameters | Allowed Values | Start Up Values |
|---|---|---|
| Slave Address | {1 … 247} \| 255 (UNCONFIGURED) | 255 (UNCONFIGURED) |
| Baud Rate | 9600 \| 19200 bit/s | 19200 bit/s |
| Parity | Even \| Odd | Even |
| Addressing Type | Standard \| ABB SACE | Standard |

These parameters can be changed if and only if the Operating Mode is LOCAL, using the LCD Display of the device.

If the device is NOT configured (i.e. Slave Address = 255), no query is processed and the warning message 'MODBUS Not Configured' is displayed in the first line of the LCD Display.

# 3. Start-up behaviour

At start up, the Communication Unit needs about 5 seconds to update the information coming from the Protection Unit. During this time, the data are not available to the remote system: the Communication Unit returns a "SLAVE DEVICE BUSY" exception response to any query coming from it.

If an "Internal Bus Fault" condition occurs during the Start-up, preventing from information update, the CU sets all the information to default values, letting the remote system to read the data:

| Data Type | Default Values | Description |
|---|---|---|
| States/Events/Alarms/Trips (but IB Status) | 0 | No alarm pending: the only one set is "IB Fault" |
| IB Status | 1 | This value are readable only when a "IB fault" condition occurs at start up |
| CB States | Value read from I/O | They don't depend on Internal Bus communication |
| Parameters | 0xFF | Values out of allowed ranges |
| Measurements | 0xFF | Values out of allowed ranges → Not reliable data |
| Communication Statistics | 0 | They are updated run-time |
| PU Process Statistics | 0xFF | Data not available |
| CU Process Statistics | Value read from EEPROM | They don't depend on Internal Bus communication |

# 4. Operating Mode

The device can operate in two different modes, Local and Remote. The mode can be selected by means of a dedicated menu of the device (PU). The default value at start up is “Local”.

## 4.1 Local Operating Mode

From the remote point of view, the device has the following behaviour:

| Actions forbidden | Actions allowed |
|---|---|
| No remote parameterisation allowed | Consultation of measurements |
| No remote command allowed | Consultation of configuration parameters of the device |
| | Consultation of protection unit information |

## 4.2 Remote Operating Mode

From the remote point of view, the device has the following behaviour:

| Actions forbidden | Actions allowed |
|---|---|
| None | Remote parameterisation allowed |
| | Remote command allowed |
| | Consultation of measurements |
| | Consultation of configuration parameters of the device |
| | Circuit Breaker commands (open / close) |
| | Trip Reset / CB Reset |

# 5. Configuration parameters programming model

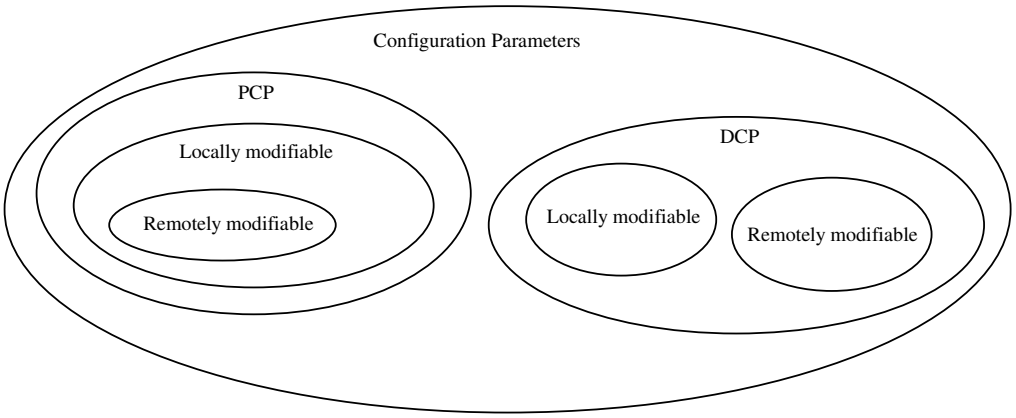



**Figure 1. Configuration parameters categories**

## 5.1 Local programming state

Every time the PU stores a new parameter configuration, the CU updates it and if something has changed, propagates towards the remote system the event “Parameters changed”.

PR113 is considered to be in “Local Programming” state when at least one of the following situations is verified:

1. PR113/PD Operating Mode = LOCAL

2. Test Unit Connected
   When the Test Unit disconnection occurs, the CU reads the configuration parameters to update them towards the remote system.

## 5.2 Remote programming model

It is possible to configure two different kinds of configuration parameters:

a) Protection Configuration Parameters (PCP) relevant to the PU
b) Dialogue Configuration Parameters (DCP) relevant to the CU

All these configuration parameters are readable, while only some of them are remotely modifiable.

All configuration parameters are Items. They can be:

- READ ONLY (the system can't modify them)
  The configuration parameter is associated only to an Input Item (DI / AI)
- READ/WRITE (the system can modify them)
  The configuration parameter is associated both to an Input (DI / AI) **and** to an Output (DO / AO) Item

Obviously, "READ/WRITE" configuration parameters are a subset of those "READ ONLY".

### *5.2.1 Programming Model*

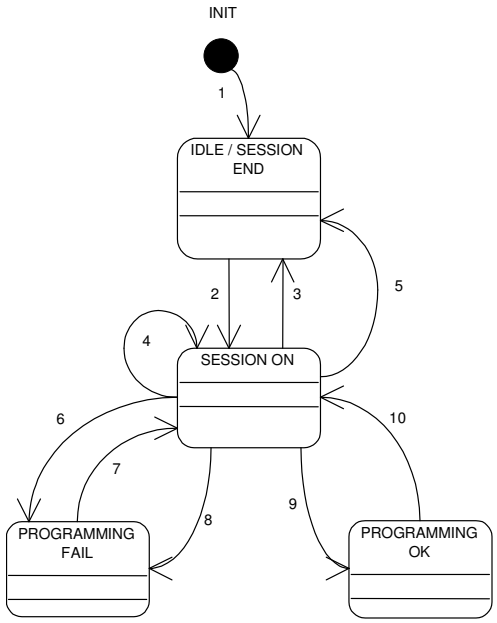



**Figure 2. Remote Programming Model state chart**

| STATE NAME | STATE DESCRIPTION | PROGRAMMING OK Item | PROGRAMMING FAIL Item |
|---|---|---|---|
| INIT | Initial state | 0 | 0 |
| IDLE / SESSION END | Session is ended | 0 | 0 |
| SESSION ON | Session is active | 1 | 1 |
| PROGRAMMING OK | Session ended without errors | 1 | 0 |
| PROGRAMMING FAIL | Session ended with errors | 0 | 1 |

| TRANSITION | INITIAL STATE | FINAL STATE | TRANSITION CONDITION |
|---|---|---|---|
| 1 | INIT | IDLE / SESSION END | Start-up |
| 2 | IDLE / SESSION END | SESSION ON | 'Start programming' command received from system. |
| 3 | SESSION ON | IDLE / SESSION END | 'Abort programming' command received from system. |
| 4 | SESSION ON | SESSION ON | 'Start programming' command received from system. |
| 5 | SESSION ON | IDLE / SESSION END | Session timeout (1 hour) |
| 6 | SESSION ON | PROGRAMMING FAIL | 'Stop programming' command received from system **and** errors detected (see also 'Programming Fail Code'). |
| 7 | PROGRAMMING FAIL | SESSION ON | 'Start programming' command received from system. |
| 8 | SESSION ON | PROGRAMMING FAIL | A 'local' aborting event has occurred:<br>1. Internal Bus Fault<br>2. Operating Mode from REMOTE to LOCAL |
| 9 | SESSION ON | PROGRAMMING OK | 'Stop programming' command received from system **and** NO errors detected. |
| 10 | PROGRAMMING OK | SESSION ON | 'Start programming' command received from system. |

The actions associated to each transition are:

| TRANSITION | ACTION |
|---|---|
| 1 | N/A |
| 2 | 1. Set the programming items.<br>2. Copy the 'Present parameters' buffer into 'New Parameters'. |
| 3 | Reset the programming items. |
| 4 | Copy the 'Present parameters' buffer into 'New Parameters'. |
| 5 | Reset the programming items. |
| 6 | 1. If needed, PU programming.<br>2. If there is NO error and it's needed, CU programming.<br>3. If there is an error, reset the 'Programming OK' item **and** write the 'Programming Fail Code' item. |
| 7 | 1. Set the 'Programming OK' item.<br>2. Copy the 'Present parameters' buffer into 'New Parameters'. |
| 8 | Reset the 'Programming OK' item. |
| 9 | 1. If needed, PU programming.<br>2. If there is NO error and it's needed, CU programming.<br>3. If there is NO error, reset the 'Programming Fail' item **and** set the 'Parameter Changed' item |
| 10 | 1. Set the 'Programming Fail' item.<br>2. Copy the 'Present parameters' buffer into 'New Parameters'. |

**NOTE**: When the CU is in SESSION ON state, the Internal Bus is NOT shared with the Test Unit, i.e. the Master Token is not released from the CU to the Test Unit.

# 6. Commands

The CU manages two different command 'sources':

1. Remote Operator Station, i.e. a remote command from the system (remote command)
2. Local Operator, i.e. an action performed locally on the relay and / or the circuit breaker (local command)

From now on, the word 'command' means 'remote command'.

## 6.1 Command Categories

Remote commands handled by CU can be organised in three different categories:

a) Protection Unit Slow Commands: they are the commands requiring a significant amount of time for being executed due to an 'heavy' interaction with the PU
   - Start Programming
   - Stop Programming
   - Request Waveforms Start
   - Historical Trip Data Acquisition Start

b) Protection Unit Fast Commands: they are the commands requiring a negligible amount of time for being executed, even if there is an interaction with the PU
   - Abort Programming
   - Wink
   - Trip Reset / CB Reset
   - LC1 Open Reset
   - LC2 Open Reset
   - LC2 Number of AR Reset
   - Energy Counter Reset

c) Circuit Breaker Commands: they are commands concerning only the Circuit Breaker
   - CB Open
   - CB Close
   - CB Reset

Only the value '1' is allowed for a command.
If a different value is sent, an exception response 'ILLEGAL_DATA_VALUE' will be returned.

The commands concerning only the PU (e.g. Trip Reset) and not the Circuit Breaker are independent from CB states.

### *6.1.1 Wink Command*

The "wink" command is used for recognising a device by making its display flash (also a warning message is displayed).
The command is sent from the remote system and has a toggle behaviour, i.e., to stop the LCD display flashing another "wink" command has to be sent.
See the following finite state machine:

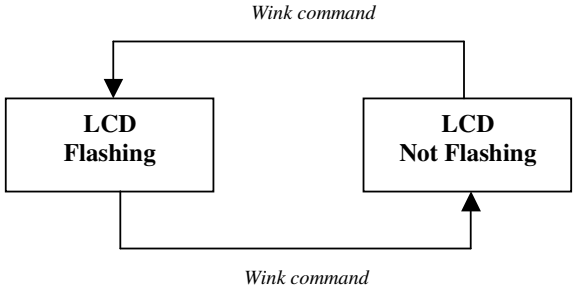



**Figure 3. Wink Command behaviour**

### *6.1.2 Trip Reset / CB Reset*

These commands are equivalent. In fact, both reset:

1. the internal CU states
2. the relevant PU states and magnetic flag
3. the external signalling unit (e.g. PR010/K)

This is also the behaviour of the CU when a LOCAL Trip Reset command is issued by pressing the frontal 'RESET' push button.

### *6.1.3 Request Waveforms Start*

This command allows the acquisition of waveforms and harmonics. To be properly managed, the command requires two information that are set through the following parameters:

- *ADC channel to be analyzed*: this parameter selects the channel (and consequently the measurement) to be analysed to acquire the waveforms. The allowed values are:

| Channel | Description |
|---|---|
| 0 | No channel selected (default) |
| 1 | Current phase L1 |
| 2 | Current phase 2 |
| 3 | Current phase 3 |
| 4 | Neutral Current |
| 5 | Voltage phase 1 |
| 6 | Voltage phase 2 |
| 7 | Voltage phase 3 |
| 8 | Ground Current |

**Table 13, ADC channel for waveforms / harmonics analysis**

If no channel is selected, the command can't be executed and an exception response 'SLAVE_DEVICE_BUSY' is returned.

- *Harmonics request*: this parameter allows to enable the acquisition of harmonics

| | |
|---|---|
| 0 | Harmonics acquisition disable (default) |
| 1 | Harmonics acquisition enable |

If not set, its value is zero (harmonics not requested).

#### 6.1.3.1 Waveforms/Harmonics value transformation

The Communication Unit acquires these data in a raw format (Protection Unit format). The transformation in engineering format is due to the remote system. The transformation algorithms are:

**1. Waveforms - Current Channel**

$$Output[A] = \frac{sample * In}{181}$$

**Equation 2. Waveforms transformation functions - Current channel**

where:

Output [A] transformed value expressed in ampere
sample value read from Protection Unit
In Nominal Current

**2. Waveforms - Voltage Channel**

$$Output[V] = \frac{sample * Un}{1200}$$

**Equation 3. Waveform transformation function - Voltage channel**

where:

| | |
|---|---|
| Output [V] | transformed value expressed in volt |
| sample | value read from Protection Unit |
| Un | Nominal Voltage |

**3. Harmonics**

$$Output[\%] = \frac{sample}{10}$$

**Equation 4. Harmonics transformation function**

where:

| | |
|---|---|
| Output [%] | transformed value expressed in percentage of fundamental frequency |
| sample | value read from Protection Unit |

NOTE: if the net frequency is 60 Hz, the 20$^{th}$ harmonic is not available and the Protection Unit returns 0xFFFF.

#### 6.1.3.2 'Request Waveforms Start' command model

The proper procedure to acquire the waveforms and the harmonics (if requested) is:

a) Select the channel to analyze (1 to 8)
b) Select the request of harmonics (enable = 1 / disable = 0)
c) Send the command

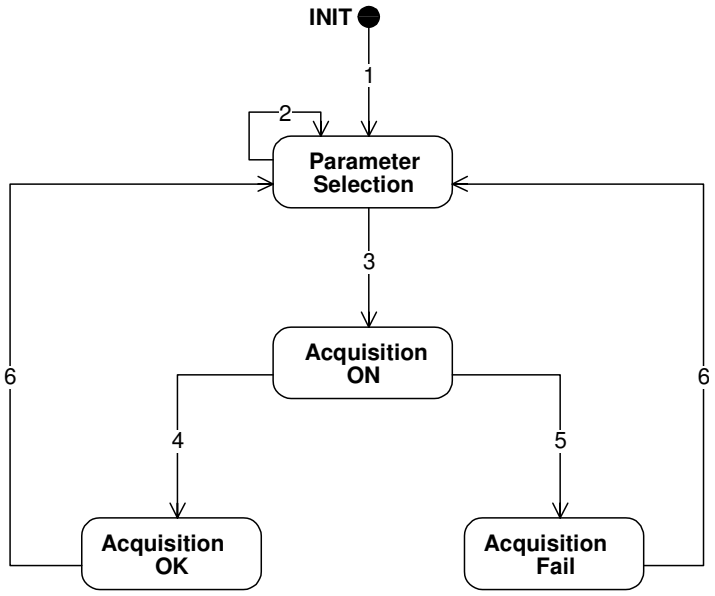



**Figure 4. Request Waveforms Start Model state chart**

| STATE NAME | STATE DESCRIPTION | ACQUISITION OK Item | ACQUISITION FAIL Item |
|---|---|---|---|
| INIT | Initial state | 0 | 0 |
| PARAMETERS SELECTION | Choose channel and waveforms | 0 | 0 |
| ACQUISITION ON | Begin acquisition | 1 | 1 |
| ACQUISITION OK | Acquisition ended without errors | 1 | 0 |
| ACQUISITION FAIL | Acquisition ended with errors | 0 | 1 |

| TRANSITION | INITIAL STATE | FINAL STATE | TRANSITION CONDITION |
|---|---|---|---|
| 1 | INIT | PARAMETERS SELECTION | Start-up |
| 2 | PARAMETERS SELECTION | PARAMETERS SELECTION | Wait for correct selection of parameters |
| 3 | PARAMETERS SELECTION | ACQUISITION ON | Command received from remote system |
| 4 | ACQUISITION ON | ACQUISITION OK | Acquisition ended without errors |
| 5 | ACQUISITION ON | ACQUISITION FAIL | Acquisition ended with errors |
| 6 | ACQUISITION OK / ACQUISITION FAIL | PARAMETERS SELECTION | New parameters selection occurs |

| TRANSITION | ACTION |
|---|---|
| 1 | N.A. |
| 2 | 1. Set parameters (channel and harmonics request)<br>1.1. If channel invalid → SLAVE DEVICE BUSY |
| 3 | Set acquisition items |
| 4 | Reset 'Acquisition Fail' item |
| 5 | Reset 'Acquisition OK' item |
| 6 | N.A. |

### *6.1.4 "Historical Trip Data Acquisition Start" management*

This command allows the acquisition of the last ten trip events recorded by Protection Unit. The Communication Unit provides them in a temporal order, from oldest to newest.

#### 6.1.4.1 'Historical Trip Data Acquisition Start' command model

The proper procedure to acquire the trip data is:

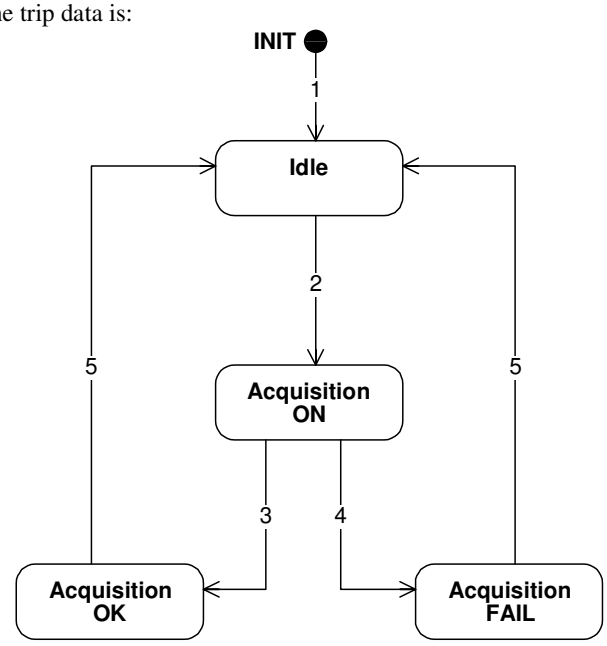



**Figure 5. 'Historical Trip Data Acquisition Start' Model state chart**

| STATE NAME | STATE DESCRIPTION | ACQUISITION OK Item | ACQUISITION FAIL Item | TRIP DATA AVAILABLE item |
|---|---|---|---|---|
| INIT | Initial state | 0 | 0 | 1 |
| ACQUISITION ON | Begin acquisition | 1 | 1 | 0 |
| ACQUISITION OK | Acquisition ended without errors | 1 | 0 | 1 |
| ACQUISITION FAIL | Acquisition ended with errors | 0 | 1 | 1 |

| TRANSITION | INITIAL STATE | FINAL STATE | TRANSITION CONDITION |
|---|---|---|---|
| 1 | INIT | IDLE | Start-up |
| 2 | IDLE | ACQUISITION ON | Command received from remote system |
| 3 | ACQUISITION ON | ACQUISITION OK | Acquisition ended without errors |
| 4 | ACQUISITION ON | ACQUISITION FAIL | Acquisition ended with errors |
| 5 | ACQUISITION OK / ACQUISITION FAIL | IDLE | Session ended |

| TRANSITION | ACTION |
|---|---|
| 1 | N.A. |
| 2 | 1. Reset 'Trip Data Available' item<br>2. Set acquisition items |
| 3 | Reset 'Acquisition Fail' item |
| 4 | Reset 'Acquisition OK' item |
| 5 | N.A. |

### *6.1.5 Remote 'CB Close' command after Trip Command Fail*

When a "Trip Command Fail" condition occurs (see its definition in par. 1.3.2), the CB reaches the "Open" position: in this situation the only allowed remote command is "Trip Reset". Only after it, the "Close" command is accepted.

## 6.2 Commands management

### *6.2.1 Commands completion*

After receiving a command, the CU verifies the inhibition conditions and sends the response.
If there is an error, an exception response is sent and the requested command is NOT processed.

Even if there is an error or not, during this time, the relevant command item is NOT reset, signalling that the command is pending, and command completion will be signalled by the relevant item reset.

If there is NO error, the command result is signalled in the following way:

| | **Command result** |
|---|---|
| ***Start Programming*** | Programming OK = Programming Fail = 1 (i.e. Remote programming session ON) |
| ***Abort Programming*** | Programming OK = Programming Fail = 0 (i.e. Remote programming session OFF) |
| ***Stop Programming*** | 1. Programming result = OK<br>• Programming OK = 1, Programming Fail = 0<br>• Parameter changed = 1<br>2. Programming result = FAIL<br>• Programming OK = 0, Programming Fail = 1<br>3. Nothing changed<br>• Programming OK = Programming Fail = 0 |
| ***Wink*** | 1. LCD Display flashing ON / OFF<br>2. Warning message on the first line of the LCD Display |
| ***CB Reset*** | 1. CB Tripped reset, if previously set (mutually exclusive with Trip Command Fail Item)<br>2. Trip Command Fail reset, if previously set (mutually exclusive with CB Tripped Item)<br>3. Relevant Trip Item reset → Any Trip reset<br>4. Magnetic flags reset<br>5. Signalling Unit reset, if present |
| ***Trip Reset*** | 1. CB Tripped reset, if previously set (mutually exclusive with Trip Command Fail Item)<br>2. Trip Command Fail reset, if previously set (mutually exclusive with CB Tripped Item)<br>3. Relevant Trip Item reset → Any Trip reset<br>4. Magnetic flags reset<br>5. Signalling Unit reset, if present |
| ***CB Open*** | CB Open / Closed = 0, if CB Undefined = 0 |
| ***CB Close*** | CB Open / Closed = 1, if CB Undefined = 0 |
| ***LC1 Open Reset*** | Relevant Alarm Item reset → Any Alarm reset, if no more alarms are set |
| ***LC2 Open Reset*** | Relevant Alarm Item reset → Any Alarm reset, if no more alarms are set |
| ***LC2 Nr. AR Reset*** | 1. Relevant Alarm Item reset → Any Alarm reset, if no more alarms are set<br>2. Number of auto-reclosure = 0 |
| ***Energy Counter Reset*** | 1. Energy measurements set to zero |
| ***Request Waveforms Start*** | 1. Acquisition result = OK<br>• Acquisition OK = 1, Acquisition Fail = 0 (data successfully acquired)<br>2. Acquisition result = FAIL<br>• Acquisition OK = 0, Acquisition Fail = 1 (data not acquired) |
| ***Historical Trip Data Acquisition Start*** | 1. Acquisition result = OK<br>• Acquisition OK = 1, Acquisition Fail = 0 ; Historical Trip Available = 1 (data successfully acquired)<br>2. Acquisition result = FAIL<br>• Acquisition OK = 0, Acquisition Fail = 1 ; Historical Trip Available = 1 (data not acquired) |

| **LEGENDA** | | Slow Command Type |
|---|---|---|
| | | Circuit Breaker Command Type |
| | | Fast Command Type |

**Table 14. Command results**

### *6.2.2 CB commands execution*

In case of CB command (i.e. 'CB Open' and 'CB Close'), the command implies an external actor (i.e. a power actuator) for its completion.
Because of this, a particular event is defined, 'CB Command Executed', that signals the end of the CU command processing.

This event is reset before the CU starts driving the external actor and it's set after the CU has completed driving the external actor:

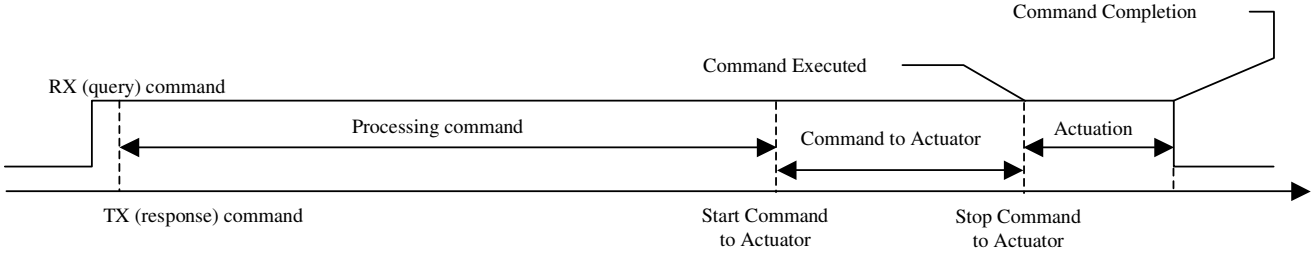



**Figure 6. 'Command Executed' event (Executed before completion)**

Please note that also the following situation is allowed:

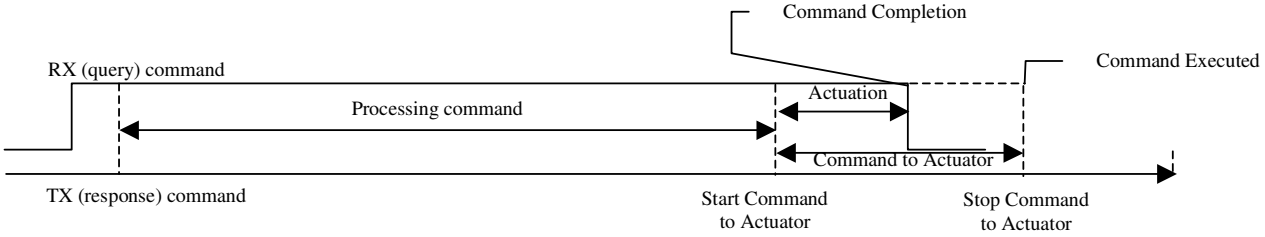



**Figure 7. 'Command Executed' event (Completed before execution)**

This situation represents an electromechanical dynamics faster than the electronic command or an electronic command longer than what the actuator needs.

In this case, both 'CB Command Executed' and CB status (related to the command) events are set for a little period of time.

In both situations, this event tells the system that:

1. the command is correctly received (normal response);
2. the SW has correctly processed it ('Command Executed' reset);
3. the SW has correctly driven the actuator ('Command Executed' set).

So this event could be helpful to analyse CB command failures.

### *6.2.3 Commands inhibition*

There are three different levels of command inhibition conditions:

1. functional conditions (highest)
   Ex.: Abort / Stop Programming command outside a remote programming session.
2. feasibility conditions
   Ex.: programming commands with the Test Unit connected
3. security conditions (lowest)
   Ex.: remote command in Operating Mode = LOCAL

Moreover, inside a command category only one command at a time can be processed, i.e. if there is another pending command belonging to the same category of the issued command, the latter will be refused.

| | Operating Mode LOCAL | IB Fault | Test Unit Connected | CB Undefined | CB Isolated | Ready To Trip | CB Tripped | Pending Command | Functional conditions |
|---|---|---|---|---|---|---|---|---|---|
| ***Start Programming*** | **X** | **X** | **X** | | | | | **X** | |
| ***Abort Programming*** | **X** | **X** | **X** | | | | | **X** | **Programming Session ON** |
| ***Stop Programming*** | **X** | **X** | **X** | | | | | **X** | **Programming Session ON** |
| ***Wink*** | **X** | **X** | **X** | | | | | **X** | |
| ***CB Reset*** | **X** | **X** | **X** | | | | | **X** | |
| ***Trip Reset*** | **X** | **X** | **X** | | | | | **X** | |
| ***CB Open*** | **X** | | | | **X** | | | **X** | |
| ***CB Close*** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | |
| ***LC1 Open Reset*** | **X** | **X** | **X** | | | | | **X** | **LC1 enabled** |
| ***LC2 Open Reset*** | **X** | **X** | **X** | | | | | **X** | **LC2 enabled** |
| ***LC2 NR. AR Reset*** | **X** | **X** | **X** | | | | | **X** | **LC2 enabled** |
| ***Energy Counter Reset*** | **X** | **X** | **X** | | | | | **X** | |
| ***Request Waveforms Start*** | **X** | **X** | **X** | | | | | **X** | |
| ***Historical Trip Data Acquisition Start*** | **X** | **X** | **X** | | | | | **X** | |

| **LEGENDA** | | Slow Command Type |
|---|---|---|
| | | Circuit Breaker Command Type |
| | | Fast Command Type |

**Table 15. Conditions for commands' inhibition**

The refused command is signalled via an exception response 'SLAVE_DEVICE_BUSY', that means 'the device is not ready to perform the requested command'.

**NOTE**: there is a little probability that a command is NOT be executed and no exception response sent when an inhibition condition rises up after the normal response has been sent.
This behaviour is due to different period of time (milliseconds) between query message processing (leading to the normal or exception response) and the requested command management.

## 6.3 Local Commands management

The CU manages six local commands:

1. CB Open
2. CB Close
3. Trip Reset
4. Test Open Release (YO)
5. Test Close Release (YC)
6. Local programming session (ENTER, ESCAPE)

### *6.3.1 CB Open*

A local user performs this command when he switches manually the circuit breaker from CLOSED to OPEN.

The CU manages this command in the following way:

- CB status change
- Number of CB manual operation update

### *6.3.2 CB Close*

A local user performs this command when he switches manually the circuit breaker from OPEN to CLOSED.

The CU manages this command in the following way:

- CB status change
- If the CB was in TRIPPED (virtual) state, reset the relevant event and perform a Trip Reset.

### *6.3.3 Trip Reset*

A local user performs this command when he presses the frontal RESET push button.

The CU manages this command as the remote command, except that there is no completion.

### *6.3.4 Test Open Release (YO)*

This command is performed by a local user when, after selecting the menu 'Other functions … CB Info … CB I/O' and setting 'Test YO/YC = YO', he presses the frontal TEST push button.

The CU manages this command in the following way:

- drive the relevant release
- CB status change
- Number of CB manual operation update
- 'Test YO/YC = Off'

### *6.3.5 Test Close Release (YC)*

This command is performed by a local user when, after selecting the menu 'Other functions … CB Info … CB I/O' and setting 'Test YO/YC = YC', he presses the frontal TEST push button.

The CU manages this command in the following way:

- drive the relevant release
- CB status change
- 'Test YO/YC = Off'

### *6.3.6 Local programming session*

When Operating Mode is LOCAL and after password entry, a local programming session is opened when a local user changes at least one of the communication parameters into the 'Other functions … Network Info' page.

This session is closed by pressing either the ENTER or the ESC push button when the storing page is displayed.

The CU manages the ENTER pressing in the following way:

- Permanently store relevant communication parameters
- Update relevant in use communication parameters

# 7. Human-Machine Interface / Local User Interface

The HMI is based on:

1. LCD Display (visualisation)
2. Keyboard (UP, DOWN, LEFT, RIGHT, ENTER, ESC, TEST push buttons)
3. Network LED (controlled by software), also called TX LED
4. µp Fault LED (controlled by hardware), also called Watchdog LED

CU manages:

- push buttons
- timeouts
- passwords

conforming to PU relevant management.

NOTE: all the pages described into these paragraphs are showed in the English version.

## 7.1 LCD Display and Keyboard Management

Besides Operating Mode, the device could be in two different states:

– READ (Default), where data entry is disabled.
  Please note that after a 60 seconds timeout the page with current values will be displayed.
– EDIT, where data entry is enabled.
  Please note that after a 120 seconds timeout the page with current values will be displayed.

The device status is READ when entering a page without modifiable parameters.
In a page with modifiable parameters, press the **<ENTER>** (↵) key to change the device status.
A "User Password" (Default: 0001) is requested to enter the 'EDIT' state, except when this password is '0000'.

# 8. Modbus Map description

All the information is divided among the different application objects.
The criteria for the subdivision are:

1. The handling of all protection configuration parameters is entrusted to the AppObj "Node Object", which reads and writes them. In this document, however, the configuration parameters are allotted to the pertaining Application Objects. For example, the configuration parameter "Protection L Threshold" can be found into the description of the AppObj "Protection L" even if its handling is completely delegated to the AppObj "Node Object".
2. AppObj "Node Object", Circuit Breaker and Load Controller handles the command input slave variables.
3. The output slave variables are organised in buffers: for every AppObj are showed the buffers and those variables inside them that the AppObj handles. The remote system can choose how to read the variables, on the assumption that it is always possible to read either all the information or single information contained in a buffer, but can not query outside of it.

The Modbus map is contained in par. 9.

## 8.1 Buffers

These are the buffers defined for this device:

| Buffer Name | Buffer Type | Items Number | Description |
|---|---|---|---|
| One buffer for each command (but "Request Waveforms Start") | Analog Output | 1 Register | Remote commands |
| "Request Waveforms Start" command | Analog Output | 3 Register | Contains also channel and harmonics request |
| Reports | Digital Input | 69 Coils | States, Events, Alarms and Trips reports |
| Trip Reports | Digital Input | 69 Coils | States, Events, Alarms and Trips reports after trip |
| Statistics | Analog Input | 23 Registers | Communication and Process Statistics |
| Programming Fail Code | Analog Input | 1 Register | Code of the wrong configuration parameters |
| Run-time Measurements | Analog Input | 67 Registers | Run time measurements |
| Trip Measurements | Analog Input | 20 Registers | Measurements after trip |
| Present Parameters (in use) | Analog Input | 98 Registers | Reading Parameters |
| Waveforms Measurements | Analog Input | 120 Registers | Waveforms measurements |
| Harmonics Measurements | Analog Input | 20 Registers | Harmonics measurements |
| Historical Trip Data | Analog Input | 230 Registers | Last ten trips report |
| Historical Measurements | Analog Input | 15 Registers | The newest among five measurements |
| New Parameters | Analog Output | 71 Registers | Writing Parameters |

### *8.1.1 Reports*

| STATES / EVENTS | ALARMS | TRIPS |
|---|---|---|
| Any Alarm | Harmonic distortion | L tripped |
| Any Trip | Unbalanced phases | S tripped |
| CB tripped | Contact Wear Pre-Alarm | I tripped |
| CB open/closed | Contact Wear Alarm | G tripped |
| CB undefined | L Pre-alarm | T tripped |
| CB connected/isolated | L Alarm (timing / tripping) | D tripped |
| Springs charged/discharged | S Alarm (timing / tripping) | UN tripped |
| Trip Command Fail | G Alarm (timing / tripping) | UV tripped |
| Electronic Trip Test | G Blocked Trip | OV tripped |
| Simulated Trip from Test Unit | T Pre-Alarm | RV tripped |
| I.B. Fault | T Alarm | RP tripped |
| Local/Remote Operating Mode | T Blocked Trip | |
| Test Unit connected | LC1 Alarm (timing to open) | |
| Programming OK | LC1 Load open | |
| Programming Fail | LC2 Alarm (timing to open) | |
| Parameter changed | LC2 Load open | |
| CB Command executed | LC2 Max number of AR reached | |
| Trip data available | Iw Alarm | |
| LC2 is timing to close | Rogowsky Ne Continuity Check | |
| LC2 Load closed | Rogowsky L3 Continuity Check | |
| Acquisition OK | Rogowsky L2 Continuity Check | |
| Acquisition Fail | Rogowsky L1 Continuity Check | |
| Historical Trip available | Frequency Check | |
| Historical Measurements Update | SA Continuity Check | |
| | D Alarm (timing/tripping) | |
| | UN Alarm (timing / tripping) | |
| | UN Blocked Trip | |
| | UV Alarm (timing / tripping) | |
| | UV Alarm after Trip | |
| | OV Alarm (timing / tripping) | |
| | OV Alarm after Trip | |
| | RV Alarm (timing / tripping) | |
| | RV Alarm after Trip | |
| | RP Alarm (timing / tripping) | |

**Table 16. Reports Buffer**

(1) 'Any Trip' is set if any of trip item is set. It is reset after local or remote 'Trip Reset' / 'CB Reset'.
(2) 'Any Alarm' is set if any of alarm item is set. It is reset when all the alarm items are equal to 0.
(3) If the CB is opened by a trip (real or electronic test), also 'CB tripped' is set.
(4) CB contacts mapping:

| | | |
|---|---|---|
| CB open/closed | 0 = Open | 1 = Closed |
| CB inputs error | 0 = No Error | 1 = Error |
| CB connected/isolated | 0 = Isolated | 1 = Connected |
| Springs charged/discharged | 0 = Discharged | 1 = Charged |

(5) If 'CB undefined' is set, 'CB open/closed' reports the last CB state before transition to undefined.
(6) Operating Mode mapping:

Local/Remote Operating Mode 0 = Remote 1 = Local

(7) 'Test Unit Connected' and 'Simulated Trip from Test Unit'

| | Test Unit Connected | Simulated Trip from Test Unit |
|---|---|---|
| Test Unit Disconnected | 0 | 0 |
| Test Unit Connected | 1 | 0 |
| Start Test Session by Test Unit | 1 | 1 |
| End Test Session by Test Unit | 1 | 0 |

NOTE: when the Test Unit ends the test session, it visualizes a page asking if a report has to be provided. In this particular condition, the Test Unit can't support the communication with the Communication Unit and it is possible to have the following signalling towards the remote system because the Protection Unit keeps the signalling 'Simulated Trip from Test Unit' on:

| Test Unit Connected | Simulated Trip from Test Unit |
|---|---|
| 0 | 1 |

If the report is requested, this condition persists for the whole duration of this operation.

As soon as the Test Unit leaves the report page, the Test Unit starts again to communicate with Communication Unit and the signalling towards the remote system is:

| Test Unit Connected | Simulated Trip from Test Unit |
|---|---|
| 1 | 0 |

(8) Remote Programming Status:

| Programming OK | Programming Fail | Description |
|---|---|---|
| 0 | 0 | Idle / Remote programming session OFF |
| 0 | 1 | Programming Fail |
| 1 | 0 | Programming OK |
| 1 | 1 | Remote programming session ON |

(9) 'Trip Data available' is always ON, but when the PU is storing trip currents after a trip. The data are considered to be available after a period of about 50 ms.

(10) If all these conditions are satisfied:
- start-up or Load Management Type is changed from LM1 (Open – Open) to LM2 (Open – Close)
- LC2 is CLOSED
- current satisfies auto-reclosure conditions

both 'LC2 is timing to close' and 'LC2 Load closed' are set for a little period of time (see parameter 'LC2 Closing Time').

(11) Waveforms and Historical Trip Data Acquisition Status:

| Acquisition OK | Acquisition Fail | Description |
|---|---|---|
| 0 | 0 | Idle / Remote acquisition session OFF |
| 0 | 1 | Acquisition Fail |
| 1 | 0 | Acquisition OK |
| 1 | 1 | Remote acquisition session ON |

(12) 'Historical Trip available' is always ON, but when the CU is reading historical trip data from PU. The data are considered to be available when the PU sends the relevant event (about 250 ms after trip).

(13) 'Historical Measurements Update' is set to 1 when the CU has read from PU the historical measurements. After the request, the data are available in:
- waveforms: about 100 ms
- harmonics: about 1 s

(14) If all these conditions are satisfied:
- start-up
- LCx is OPEN (before start-up)
- current satisfies opening conditions

both ‘LCx is timing to open’ and ‘LCx Load open’ are set for a little period of time (see parameter ‘LCx Opening Time’).

(15) If ‘L Alarm (timing / tripping)’ is set, ‘L Pre-alarm’ is reset.

(16) If ‘X tripped’ is set, the relevant ‘X Alarm (timing / tripping)’ is reset.

(17) ‘G Alarm (timing / tripping)’ and ‘G Blocked Trip’ are mutually exclusive, depending on the relevant configuration parameter.

(18) ‘T Alarm (timing / tripping)’ and ‘T Blocked Trip’ are mutually exclusive, depending on the relevant configuration parameter.

(19) ‘UN Alarm (timing / tripping)’ and ‘UN Blocked Trip’ are mutually exclusive, depending on the relevant configuration parameter.

(20) ‘UV Alarm after Trip’ can be set to 1 even if ‘UV Trip’ is set, because the alarm condition is still pending

(21) ‘OV Alarm after Trip’ can be set to 1 even if ‘OV Trip’ is set, because the alarm condition is still pending

(22) ‘RV Alarm after Trip’ can be set to 1 even if ‘RV Trip’ is set, because the alarm condition is still pending

### *8.1.2 Trip Reports*

Their structure is the same as “Reports”, described in par. 8.1.1.

### *8.1.3 Statistics*

| **Communication Statistics** |
|---|
| Number of received messages (Bus Message Count) |
| Number of received messages with char/frame error (Bus Communication Error Count) |
| Number of responses (Slave Message Count) |
| Number of Slave Busy responses (Slave Busy Count) |
| Number of exception responses (Bus Exception Error Count) |

| **Process Statistics** |
|---|
| CB contact wear |
| CB number of operations |
| CB number of manual opens |
| CB number of protection trips |
| CB number of protection trips fail |
| CB number of other trips (trip test) |
| Protection L number of trips |
| Protection S number of trips |
| Protection I number of trips |
| Protection G number of trips |
| Protection T number of trips |
| Number of auto reclosure |
| Protection D number of trips |
| Protection UN number of trips |
| Protection UV number of trips |
| Protection OV number of trips |
| Protection RV number of trips |
| Protection RP number of trips |

**Table 17. Statistics Buffer**

### *8.1.4 Programming Fail Code*

During a programming session, both the Communication Unit and the Protection Unit make some checks on the configuration parameters to find possible errors. The relevant codes are subdivided into three categories:

| System Error Codes | Error Type |
|---|---|
| 0 | NO ERROR |
| 1 – 1000 | Parameter errors detected by PU |
| 1001 – 2000 | Parameter errors detected by CU |
| 2001 – 3000 | Other errors detected by CU |

Inside every block, the error codes are not consecutive to let spaces for further upgrades. Homogeneous blocks are indicated with the colour of the cells.

The not used error code are intentionally NOT described because they are used into the other devices (e.g. PR112/PD-M), so that two different devices have the same code for the same error.

| System Error Code | PR113/PD-M |
|---|---|
| 0 | NO ERROR |
| 1 | Relay EEPROM Busy |
| 2 | Relay EEPROM Writing |
| 11 | S Alarm |
| 12 | G Alarm |
| 13 | L Alarm |
| 14 | D Alarm |
| 15 | OV Alarm |
| 16 | UV Alarm |
| 17 | RV Alarm |
| 18 | RP Alarm |
| 19 | UN Alarm |
| 31 | Th 'S' ≤ Th 'L' |
| 32 | Th 'I' ≤ Th 'S' |
| 33 | Th 'I' ≤ Th 'D' |
| 34 | Th 'D' ≤ Th 'L' |
| 36 | ZS 'D' ON with ZS 'S' ON |
| 37 | ZS 'G' ON with ZS 'D' ON |
| 38 | LC ON with L curve IEC255-3 |
| 39 | Relay P2 selected with CU present |
| 40 | LC2 Open Th < LC1 Open Th |
| 41 | LC2 Open Th < LC2 Close Th |
| 42 | Number AR > Max Nr AR |
| 43 | Th G > 1200 A (UL only) |
| 44 | StartUp Th G > 1200 A (UL only) |
| 47 | D Protection not available |

| | |
|---|---|
| 1009 | K Unit Presence Out Of Range |
| 1010 | Relay K51/1 Out Of Range |
| 1011 | Relay K51/2 Out Of Range |
| 1012 | Relay K51/3 Out Of Range |
| 1013 | Relay K51/4 Out Of Range |
| 1014 | Relay K51/6 Out Of Range |
| 1015 | Relay K51/7 Out Of Range |
| 1016 | Relay K51/8 Out Of Range |
| 1017 | Relay P1 Out Of Range |
| 1018 | Savings Period Out Of Range |
| 1019 | Warning Current Out Of Range |

| | |
|---|---|
| 1020 | Start Up Threshold Enable Out Of Range |
| 1021 | Start Up Time Out Of Range |
| 1030 | L Curve Type Out Of Range |
| 1031 | L Threshold Out Of Range |
| 1032 | L Threshold IEC 255-3 Out Of Range |
| 1033 | L Time Delay Out Of Range |
| 1034 | L Time Delay IEC 255-3 Out Of Range |
| 1035 | L Thermal Memory Out Of Range |
| 1040 | S Status Out Of Range |
| 1041 | S Curve Type Out Of Range |
| 1042 | S Threshold Out Of Range |
| 1043 | S Time Delay Out Of Range |
| 1044 | S Thermal Memory Out Of Range |
| 1045 | S Zone Selectivity Out Of Range |
| 1046 | S Zone Selectivity Time Out Of Range |
| 1047 | S Start Up Threshold Out Of Range |
| 1050 | I Status Out Of Range |
| 1051 | I Threshold Out Of Range |
| 1052 | I Start Up Threshold Out Of Range |
| 1060 | G Status Out Of Range |
| 1061 | G Curve Type Out Of Range |
| 1062 | G Threshold Out Of Range |
| 1063 | G Time Delay Out Of Range |
| 1064 | G Trip Enable Out Of Range |
| 1065 | G Zone Selectivity Out Of Range |
| 1066 | G Zone Selectivity Time Out Of Range |
| 1067 | G Start Up Threshold Out Of Range |
| 1070 | T Trip Enable Out Of Range |
| 1080 | Load Control Status Out Of Range |
| 1081 | Load Control Type Out Of Range |
| 1082 | LC1 Opening Threshold Out Of Range |
| 1083 | LC2 Opening Threshold Out Of Range |
| 1084 | LC Opening Threshold Out Of Range |
| 1085 | LC Closing Threshold Out Of Range |
| 1086 | LC Closing Time Out Of Range |
| 1087 | AR Max Number Out Of Range |
| 1095 | D Status Out Of Range |
| 1096 | D Threshold Out Of Range |
| 1097 | D Backward Time Delay Out Of Range |
| 1098 | D Forward Time Delay Out Of Range |
| 1099 | D Direction Out Of Range |
| 1100 | D Zone Selectivity Out Of Range |
| 1101 | D Zone Selectivity Time Out Of Range |
| 1102 | D Start Up Threshold Out Of Range |
| 1105 | UN Status Out Of Range |
| 1106 | UN Threshold Out Of Range |
| 1107 | UN Time Delay Out Of Range |
| 1108 | UN Trip Enable Out Of Range |
| 1115 | UV Status Out Of Range |
| 1116 | UV Threshold Out Of Range |
| 1117 | UV Time Delay Out Of Range |
| 1125 | OV Status Out Of Range |
| 1126 | OV Threshold Out Of Range |
| 1127 | OV Time Delay Out Of Range |
| 1135 | RV Status Out Of Range |
| 1136 | RV Threshold Out Of Range |

| | |
|---|---|
| 1137 | RV Time Delay Out Of Range |
| 1145 | RP Status Out Of Range |
| 1146 | RP Threshold Out Of Range |
| 1147 | RP Time Delay Out Of Range |

| | |
|---|---|
| 2001 | Abort Program - IB Error |
| 2002 | Abort Program - Local |
| 2003 | Abort Program - Query Error |
| 2004 | Abort Program - CU Flash Error |

**Table 18. Programming Fail Error Code**

### *8.1.5 Run-time Measurements*

| |
|---|
| RMS current phase L1 |
| RMS current phase L2 |
| RMS current phase L3 |
| RMS current neutral |
| RMS current ground |
| RMS voltage phase L1 |
| RMS voltage phase L2 |
| RMS voltage phase L3 |
| RMS residual voltage |
| RMS line voltage L1-L2 |
| RMS line voltage L2-L3 |
| RMS line voltage L1-L3 |
| RMS active power phase L1 |
| RMS active power phase L2 |
| RMS active power phase L3 |
| RMS total active power |
| RMS reactive power phase L1 |
| RMS reactive power phase L2 |
| RMS reactive power phase L3 |
| RMS total reactive power |
| RMS apparent power phase L1 |
| RMS apparent power phase L2 |
| RMS apparent power phase L3 |
| RMS total apparent power |
| Cos Φ1 |
| Cos Φ2 |
| Cos Φ3 |
| Total Cos Φ |
| Line Frequency |
| Peak Factor phase 1 |
| Peak Factor phase 2 |
| Peak Factor phase 3 |
| Peak Factor neutral |
| Active Energy |
| Reactive Energy |
| Apparent Energy |

**Table 19. Run-time Measurements Buffer**

At start-up, all values are set to the full range scale value (0xFFFFFFFF = VALUE NOT AVAILABLE).

#### 8.1.5.1 Currents

If any current is < 10% of In (0.1*In), the value is considered to be not reliable and the value provided to the remote system is 0.
If phase / neutral current is ≥ 16*In, 16*In is returned.
If the Ground current is ≥ 4*In, the full range scale value (0xFFFFFFFF = VALUE NOT AVAILABLE) is returned.

#### 8.1.5.2 Voltages
If any voltage is < 3% of Un (0.03*Un), the value is considered to be not reliable and the value provided to the remote system is 0.
If phase / residual voltage is ≥ 0.69*Un, 0.69*Un is returned.
If any line voltage is ≥ 1.38*Un, 1.38*Un is returned.
The values are provided as hundredths of Volt.

#### 8.1.5.3 Powers
Power measurements are signed: this is provided to the remote system towards a signed decimal value (referring to IEC61131-3 it is defined as DINT).
If MSb is 1, the value is negative: to obtain the absolute value a 2's complement operation is required.
If any power is < 0.006*In*Un, the value is considered to be not reliable and the value provided to the remote system is 0.
If any power is ≥ 11*In*Un, 11*In*Un is returned.

#### 8.1.5.4 Power Factors (Cos Φ)
Power Factors are signed: this is provided to the remote system towards a signed decimal value (referring to IEC61131-3 it is defined as INT).
If MSb is 1, the value is negative: to obtain the absolute value a 2's complement operation is required.
If the value is considered to be not reliable the value provided to the remote system is 0.
The values are provided as hundredths.

#### 8.1.5.5 Line Frequency
The values are provided as tenths of Hertz.

#### 8.1.5.6 Peak Factors
If the value is considered to be not reliable the value provided to the remote system is 0.
The values are provided as hundredths.

#### 8.1.5.7 Energies
Energy measurements are signed: this is provided to the remote system towards a signed decimal value (referring to IEC61131-3 it is defined as DINT).
If MSb is 1, the value is negative: to obtain the absolute value a 2's complement operation is required.

### *8.1.6 Trip Measurements*

| |
|---|
| Trip current phase L1 |
| Trip current phase L2 |
| Trip current phase L3 |
| Trip current neutral |
| Trip current ground |
| Trip voltage phase L1 |
| Trip voltage phase L2 |
| Trip voltage phase L3 |
| Trip residual voltage |
| Trip total active power |

**Table 20. Trip Measurements Buffer**

#### 8.1.6.1 Trip currents
If any current is < 10% of In (0.1*In), the value is considered to be not reliable and the value provided to the remote system is 0.
If phase / neutral current is ≥ 16*In, 16*In is returned.
If the Ground current is ≥ 4*In, the full range scale value (0xFFFFFFFF = VALUE NOT AVAILABLE) is returned.

#### 8.1.6.2 Trip voltages
If any voltage is < 3% of Un (0.03*Un), the value is considered to be not reliable and the value provided to the remote system is 0.
If phase / residual voltage is ≥ 0.69*Un, 0.69*Un is returned.
The values are provided as hundredths of Volt.

#### 8.1.6.3 Trip total active power
Power measurement is signed: this is provided to the remote system towards a signed decimal value (*signed int*).

If the value is represented in hexadecimal format, the first two bytes are set to 0xFFFF, while the last two contains the value. To get the proper value is necessary to apply the bitwise complement operation.

If power is < 0.006*In*Un, the value is considered to be not reliable and the value provided to the remote system is 0.
If power is ≥ 11*In*Un, 11*In*Un is returned.

### *8.1.7 Present Parameters (in use)*

| |
|---|
| Slave ID (PCP) |
| Product Execution (PCP) |
| Product Standard Reference (PCP) |
| Relay Serial Number (PCP) |
| Protection Unit SW Version (PCP) |
| Communication Unit SW Version (DCP) |
| Slave Address (DCP) |
| Addressing Type (DCP) |
| Baud Rate (DCP) |
| Even / Odd Parity (DCP) |
| HMI Language (PCP) |
| Line Frequency (PCP) |
| Neutral Selection (PCP) |
| Ground Toroid Internal / External Selection (PCP) |
| External Ground Toroid Current (PCP) |
| Int. toroid value / Protection Unit Nominal Current (In) (PCP) |
| CB Type (PCP) |
| CB Serial Number (DCP) |
| Protection Unit Nominal Voltage (In) (PCP) |
| Date of Installation (DCP) |
| Measurement Store Time (PCP) |
| Warning Current (Iw) (PCP) |
| Unit K present / not present (PCP) |
| PR010/K Relay K51/1 (PCP) |
| PR010/K Relay K51/2 (PCP) |
| PR010/K Relay K51/3 (PCP) |
| PR010/K Relay K51/4 (PCP) |
| PR010/K Relay K51/6 (PCP) |
| PR010/K Relay K51/7 (PCP) |
| PR010/K Relay K51/8 (PCP) |
| PR113 Relay P1 (PCP) |
| Start Up Threshold Disable (PCP) |
| Start Up Threshold Validity Time (PCP) |
| Protection L Curve Type (PCP) |
| Protection L Threshold (PCP) |
| Protection L Trip Delay Time (PCP) |
| Protection L Thermal Memory (PCP) |
| Protection S Disable (PCP) |
| Protection S Curve Type (PCP) |
| Protection S Threshold (PCP) |
| Protection S Trip Delay Time (PCP) |
| Protection S Thermal Memory (PCP) |
| Protection S Zone Selectivity (PCP) |
| Protection S Zone Selectivity Time (PCP) |
| Protection S Start-up Threshold (PCP) |
| Protection D Disable (PCP) |
| Protection D Threshold (PCP) |
| Protection D Backward Trip Delay Time (PCP) |
| Protection D Forward Trip Delay Time (PCP) |
| Protection D Direction (PCP) |
| Protection D Zone Selectivity (PCP) |
| Protection D Zone Selectivity Time (PCP) |
| Protection D Start-up Threshold (PCP) |
| Protection I Disable (PCP) |

| |
|---|
| Protection I Threshold (PCP) |
| Protection I Start-up threshold (PCP) |
| Protection G Disable (PCP) |
| Protection G Curve Type (PCP) |
| Protection G Threshold (PCP) |
| Protection G Trip Delay Time (PCP) |
| Protection G Block Trip (PCP) |
| Protection G Zone Selectivity (PCP) |
| Protection G Zone Selectivity Time (PCP) |
| Protection G Start-up Threshold (PCP) |
| Protection UN Disable (PCP) |
| Protection UN Threshold (PCP) |
| Protection UN Trip Delay Time (PCP) |
| Protection UN Block Trip (PCP) |
| Protection UV Disable (PCP) |
| Protection UV Threshold (PCP) |
| Protection UV Trip Delay Time (PCP) |
| Protection OV Disable (PCP) |
| Protection OV Threshold (PCP) |
| Protection OV Trip Delay Time (PCP) |
| Protection RV Disable (PCP) |
| Protection RV Threshold (PCP) |
| Protection RV Trip Delay Time (PCP) |
| Protection RP Disable (PCP) |
| Protection RP Threshold (PCP) |
| Protection RP Trip Delay Time (PCP) |
| Protection T Block Trip (PCP) |
| Load Management Disable (PCP) |
| Load Management Type (PCP) |
| Load Controller 1 Opening Threshold (PCP) |
| Load Controller 2 Opening Threshold (PCP) |
| Load Controller 2 Closing Threshold (PCP) |
| Load Controller 2 Closing Delay (PCP) |
| Load Controller 2 Max Auto-Reclosure Number (PCP) |

**Table 21. Present Parameters Buffer**

Please note that the following parameter value sets depend from another parameter:

| Parameter value set selector | Parameter value set |
|---|---|
| Protection L curve type | Protection L threshold, Protection L trip delay time |
| Protection S curve type | Protection S threshold, Protection S trip delay time |
| Protection G curve type | Protection G threshold, Protection G trip delay time |
| Load Management Type | Load Controller 2 opening threshold |

So if the parameter value set selector is changed, the relevant parameter values change according to the new selector value.

### *8.1.8 Waveforms Measurements*

This buffer is composed of 120 registers: each of them contains the value sampled by PU. The remote system must convert them into engineering format using “Equation 2. Waveforms transformation functions - Current channel” or ”Equation 3. Waveform transformation function - Voltage channel” according to the channel selected.
Once read by remote system, they are reset by Communication Unit.

### *8.1.9 Harmonics Measurements*

This buffer is composed of 20 registers: each of them contains the value calculated by PU on the basis of waveform samples.
Once read by remote system, they are reset by Communication Unit.

### *8.1.10 Historical Trip Data*

| |
|---|
| Historical Openings N° 1 (oldest) |
| Historical Openings N° 2 |
| Historical Openings N° 3 |
| Historical Openings N° 4 |
| Historical Openings N° 5 |
| Historical Openings N° 6 |
| Historical Openings N° 7 |
| Historical Openings N° 8 |
| Historical Openings N° 9 |
| Historical Openings N° 10 (newest) |

**Table 22. Historical Trip Data - Buffer**

Every record is 23 registers long and so composed:

| | |
|---|---|
| Trip current phase L1 | 2 registers |
| Trip current phase L2 | 2 registers |
| Trip current phase L3 | 2 registers |
| Trip current neutral | 2 registers |
| Trip current ground | 2 registers |
| Trip voltage phase L1 | 2 registers |
| Trip voltage phase L2 | 2 registers |
| Trip voltage phase L3 | 2 registers |
| Trip residual voltage | 2 registers |
| Trip total active power | 2 registers |
| Number of openings | 1 register |
| Open Type (see “Table 24”) | 1 register |
| Contact Wear | 1 register |

**Table 23. Historical Trip Data – Record**

| | |
|---|---|
| 0 | NO TRIP |
| 1 | L TRIP |
| 2 | S TRIP |
| 3 | D TRIP |
| 4 | D forward TRIP |
| 5 | D backward TRIP |
| 6 | I TRIP |
| 7 | PALETTE TRIP |
| 8 | G TRIP |
| 9 | UN TRIP |
| 10 | UV TRIP |
| 11 | OV TRIP |
| 12 | RV TRIP |
| 13 | RP TRIP |
| 14 | OT TRIP |

**Table 24. Historical Trip Data - Open Type Codes**

### *8.1.11 Historical Measurements*

| |
|---|
| Historical Measurements - Last Mean Active Power |
| Historical Measurements - Last Max Active Power |
| Historical Measurements - Last Max Current + phase |
| Historical Measurements - Last Max Voltage + phase |
| Historical Measurements - Last Min Voltage + phase |

**Table 25. Historical Measurements Buffer**

Every record is 3 register long, whose structure is the following one

| *BYTE 0* | *BYTE 1* | *BYTE 2* | *BYTE 3* | *BYTE 4* | *BYTE 5* |
|---|---|---|---|---|---|
| HEADER | | VALUE | | | |

The content of every field depends on the data represented.
Once read by remote system, they are reset by Communication Unit.

#### 8.1.11.1 Last Mean Active Power

| | |
|---|---|
| *HEADER* | 5 - No phase |
| *VALUE* | See par. 8.1.6.3 |

#### 8.1.11.2 Last Max Active Power

| | |
|---|---|
| *HEADER* | 5 - No phase |
| *VALUE* | See par. 8.1.6.3 |

#### 8.1.11.3 Last Max Current + phase

| | |
|---|---|
| *HEADER* | 1 - Phase 1<br>2 - Phase 2<br>3 - Phase 3<br>4 - Neutral |
| *VALUE* | See par. 8.1.6.1 |

#### 8.1.11.4 Last Max Voltage + phase

| | |
|---|---|
| *HEADER* | 1 - Phase 1<br>2 - Phase 2<br>3 - Phase 3 |
| *VALUE* | See par. 8.1.6.2 |

#### 8.1.11.5 Last Min Voltage + phase

| | |
|---|---|
| *HEADER* | 1 - Phase 1<br>2 - Phase 2<br>3 - Phase 3 |
| *VALUE* | See par. 8.1.6.2 |

#### 8.1.11.6 Period Change

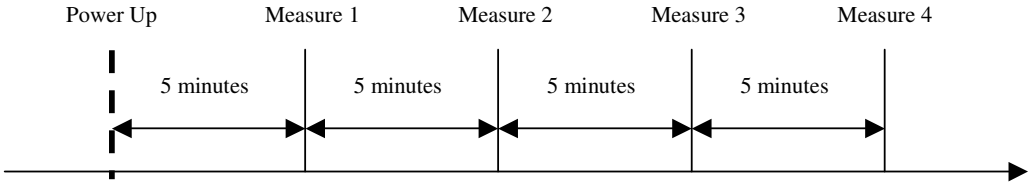
The Protection Unit records also every time the store measurement time is changed. This event is recorded on each one of the five measurements.

| *BYTE 0* | *BYTE 1* | *BYTE 2* | *BYTE 3* | *BYTE 4* | *BYTE 5* |
|---|---|---|---|---|---|
| HEADER | | VALUE 1 | | VALUE 2 | |

| | |
|---|---|
| *HEADER* | 7 – Period Change |
| *VALUE 1* | Period previously in use<br>0 → 5 minutes<br>1 → 15 minutes<br>2 → 30 minutes<br>3 → 60 minutes<br>4 → 120 minutes |
| *VALUE 2* | Period passed before change (expressed in minutes) |

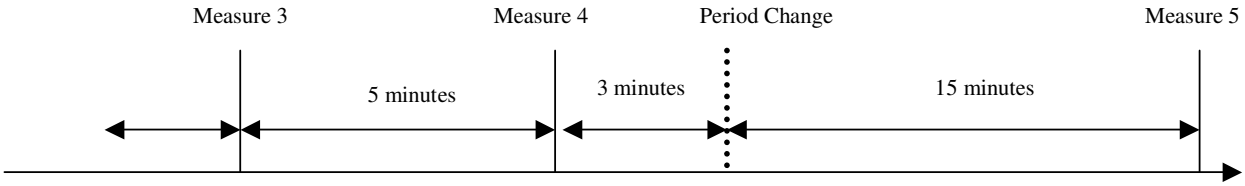
*8.1.11.6.1 Relative Time handling*

The remote system can obtain the relative time among different measurement. The time reference is given by the last Power Up record. The following records are divided by a time equal to the store time in use.
For example, at power up the store time is 5 minutes: a new record is stored after 5 minutes:




Measure 4 occurs 20 minutes after Power Up.

When a period change occurs, the temporal distance between the last record and the period change record is given by the value contained into VALUE 2 field; besides, the record following to the period change record will be recorded after the time defined into the new store time value.
For example, three minutes after record "Measure 4", a period change occurs and the new store time is 15 minutes:




Measure 5 occurs 18 minutes after Measure 4 and 38 minutes after Power Up.

If the remote system has an absolute time reference, it can calculate the absolute time of every record.

**8.1.11.7 Power Up**

The Protection Unit records also every power up of the relay. This event is recorded on each one of the five measurements.

| | |
|---|---|
| *HEADER* | 6 – Power Up |
| *VALUE* | All zero |

### *8.1.12 New Parameters*

| |
|---|
| Date of Installation (DCP) |
| Measurement Store Time (PCP) |
| Warning Current (Iw) (PCP) |
| Unit K present / not present (PCP) |
| PR010/K Relay K51/1 (PCP) |
| PR010/K Relay K51/2 (PCP) |
| PR010/K Relay K51/3 (PCP) |
| PR010/K Relay K51/4 (PCP) |
| PR010/K Relay K51/6 (PCP) |
| PR010/K Relay K51/7 (PCP) |
| PR010/K Relay K51/8 (PCP) |
| PR113 Relay P1 (PCP) |
| Start Up Threshold Disable (PCP) |
| Start Up Threshold Validity Time (PCP) |
| Protection L Curve Type (PCP) |
| Protection L Threshold (PCP) |
| Protection L Trip Delay Time (PCP) |
| Protection L Thermal Memory (PCP) |
| Protection S Disable (PCP) |
| Protection S Curve Type (PCP) |
| Protection S Threshold (PCP) |
| Protection S Trip Delay Time (PCP) |
| Protection S Thermal Memory (PCP) |
| Protection S Zone Selectivity (PCP) |
| Protection S Zone Selectivity Time (PCP) |
| Protection S Start-up Threshold (PCP) |
| Protection D Disable (PCP) |
| Protection D Threshold (PCP) |
| Protection D Backward Trip Delay Time (PCP) |
| Protection D Forward Trip Delay Time (PCP) |
| Protection D Direction (PCP) |
| Protection D Zone Selectivity (PCP) |
| Protection D Zone Selectivity Time (PCP) |
| Protection D Start-up Threshold (PCP) |
| Protection I Disable (PCP) |
| Protection I Threshold (PCP) |
| Protection I Start-up threshold (PCP) |
| Protection G Disable (PCP) |
| Protection G Curve Type (PCP) |
| Protection G Threshold (PCP) |
| Protection G Trip Delay Time (PCP) |
| Protection G Block Trip (PCP) |
| Protection G Zone Selectivity (PCP) |
| Protection G Zone Selectivity Time (PCP) |
| Protection G Start-up Threshold (PCP) |
| Protection UN Disable (PCP) |
| Protection UN Threshold (PCP) |
| Protection UN Trip Delay Time (PCP) |
| Protection UN Block Trip (PCP) |
| Protection UV Disable (PCP) |
| Protection UV Threshold (PCP) |
| Protection UV Trip Delay Time (PCP) |
| Protection OV Disable (PCP) |
| Protection OV Threshold (PCP) |

| |
|---|
| Protection OV Trip Delay Time (PCP) |
| Protection RV Disable (PCP) |
| Protection RV Threshold (PCP) |
| Protection RV Trip Delay Time (PCP) |
| Protection RP Disable (PCP) |
| Protection RP Threshold (PCP) |
| Protection RP Trip Delay Time (PCP) |
| Protection T Block Trip (PCP) |
| Load Management Disable (PCP) |
| Load Management Type (PCP) |
| Load Controller 1 Opening Threshold (PCP) |
| Load Controller 2 Opening Threshold (PCP) |
| Load Controller 2 Closing Threshold (PCP) |
| Load Controller 2 Closing Delay (PCP) |
| Load Controller 2 Max Auto-Reclosure Number (PCP) |

**Table 26. New Parameters Buffer**

# 9. Modbus Logical Map

In this section are contained all the Modbus variables, both in Input and in Output, handled by CU and accessible from the remote system. They are divided according to their Modbus data type: Analog/Digital, Input/Output.

## 9.1 Digital Output

Not applicable.

## 9.2 Digital Input

### *9.2.1 Buffer "Reports"*

This buffer contains all States / Events / Alarms / Trips reports during run-time:

| Section | Absolute Address | Relative Address | Relative Address – 1 | Relative Address – 1 (HEX) | Number of items |
|---|---|---|---|---|---|
| **Reports** | **10001** | **0001** | **0000** | **0000** | **69** |

and these are the relevant items:

| Section | Absolute Address | Relative Address | Relative Address - 1 | Relative Address – 1 (HEX) | Number of items | Description | Comments |
|---|---|---|---|---|---|---|---|
| **States/Events** | **10001** | **0001** | **0000** | **0000** | **24** | | |
| | 10001 | 0001 | 0000 | 0000 | 1 | Any Alarm | |
| | 10002 | 0002 | 0001 | 0001 | 1 | Any Trip | |
| | 10003 | 0003 | 0002 | 0002 | 1 | CB tripped | |
| | 10004 | 0004 | 0003 | 0003 | 1 | CB open/closed | |
| | 10005 | 0005 | 0004 | 0004 | 1 | CB undefined | |
| | 10006 | 0006 | 0005 | 0005 | 1 | CB connected/isolated | |
| | 10007 | 0007 | 0006 | 0006 | 1 | Springs charged/discharged | |
| | 10008 | 0008 | 0007 | 0007 | 1 | Trip command fail | |
| | 10009 | 0009 | 0008 | 0008 | 1 | Electronic Trip Test | |
| | 10010 | 0010 | 0009 | 0009 | 1 | Simulated Trip from Test Unit | |
| | 10011 | 0011 | 0010 | 000A | 1 | I.B. Fault | |
| | 10012 | 0012 | 0011 | 000B | 1 | Local/Remote Operating Mode | |
| | 10013 | 0013 | 0012 | 000C | 1 | Test Unit connected | |
| | 10014 | 0014 | 0013 | 000D | 1 | Programming OK | |
| | 10015 | 0015 | 0014 | 000E | 1 | Programming Fail | |
| | 10016 | 0016 | 0015 | 000F | 1 | Parameter changed | Event |
| | 10017 | 0017 | 0016 | 0010 | 1 | CB command executed | Event |
| | 10018 | 0018 | 0017 | 0011 | 1 | Trip data available | |
| | 10019 | 0019 | 0018 | 0012 | 1 | LC2 is timing to close | |
| | 10020 | 0020 | 0019 | 0013 | 1 | LC2 Load closed | |
| | 10021 | 0021 | 0020 | 0014 | 1 | Acquisition OK | |
| | 10022 | 0022 | 0021 | 0015 | 1 | Acquisition Fail | |
| | 10023 | 0023 | 0022 | 0016 | 1 | Historical Trip available | |
| | 10024 | 0024 | 0023 | 0017 | 1 | Historical Measurements Update | |
| **Alarms** | **10025** | **0025** | **0024** | **0018** | **34** | | |
| | 10025 | 0025 | 0024 | 0018 | 1 | Harmonic distortion > 2.1 | |
| | 10026 | 0026 | 0025 | 0019 | 1 | NOT USED (*) | |
| | 10027 | 0027 | 0026 | 001A | 1 | Contact wear Pre-alarm | |
| | 10028 | 0028 | 0027 | 001B | 1 | Contact wear Alarm | |
| | 10029 | 0029 | 0028 | 001C | 1 | L Pre-alarm | |
| | 10030 | 0030 | 0029 | 001D | 1 | L Alarm (timing / tripping) | |
| | 10031 | 0031 | 0030 | 001E | 1 | S Alarm (timing / tripping) | |
| | 10032 | 0032 | 0031 | 001F | 1 | G Alarm (timing / tripping) | |
| | 10033 | 0033 | 0032 | 0020 | 1 | G Blocked Trip | |
| | 10034 | 0034 | 0033 | 0021 | 1 | T Pre-alarm | |
| | 10035 | 0035 | 0034 | 0022 | 1 | T Alarm | |
| | 10036 | 0036 | 0035 | 0023 | 1 | T Blocked Trip | |
| | 10037 | 0037 | 0036 | 0024 | 1 | LC1 Alarm (timing to open) | |
| | 10038 | 0038 | 0037 | 0025 | 1 | LC1 Load open | |
| | 10039 | 0039 | 0038 | 0026 | 1 | LC2 Alarm (timing to open) | |
| | 10040 | 0040 | 0039 | 0027 | 1 | LC2 Load open | |
| | 10041 | 0041 | 0040 | 0028 | 1 | LC2 Max number of AR reached | |
| | 10042 | 0042 | 0041 | 0029 | 1 | Iw Alarm | |
| | 10043 | 0043 | 0042 | 002A | 1 | Rogowsky Ne Continuity Check | |
| | 10044 | 0044 | 0043 | 002B | 1 | Rogowsky L3 Continuity Check | |
| | 10045 | 0045 | 0044 | 002C | 1 | Rogowsky L2 Continuity Check | |
| | 10046 | 0046 | 0045 | 002D | 1 | Rogowsky L1 Continuity Check | |
| | 10047 | 0047 | 0046 | 002E | 1 | Frequency Check | |
| | 10048 | 0048 | 0047 | 002F | 1 | SA Continuity Check | |
| | 10049 | 0049 | 0048 | 0030 | 1 | D Alarm (timing / tripping) | |
| | 10050 | 0050 | 0049 | 0031 | 1 | UN Alarm (timing / tripping) | |
| | 10051 | 0051 | 0050 | 0032 | 1 | UN Blocked Trip | |
| | 10052 | 0052 | 0051 | 0033 | 1 | UV Alarm (timing / tripping) | |
| | 10053 | 0053 | 0052 | 0034 | 1 | UV Alarm after Trip | |
| | 10054 | 0054 | 0053 | 0035 | 1 | OV Alarm (timing / tripping) | |
| | 10055 | 0055 | 0054 | 0036 | 1 | OV Alarm after Trip | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 10056 | 0056 | 0055 | 0037 | 1 | RV Alarm (timing / tripping) |
| | 10057 | 0057 | 0056 | 0038 | 1 | RV Alarm after Trip |
| | 10058 | 0058 | 0057 | 0039 | 1 | RP Alarm (timing / tripping) |
| **Trips** | **10059** | **0059** | **0058** | **003A** | **11** | |
| | 10059 | 0059 | 0058 | 003A | 1 | L tripped |
| | 10060 | 00060 | 0059 | 003B | 1 | S tripped |
| | 10061 | 00061 | 0060 | 003C | 1 | I tripped |
| | 10062 | 00062 | 0061 | 003D | 1 | G tripped |
| | 10063 | 00063 | 0062 | 003E | 1 | T tripped |
| | 10064 | 00064 | 0063 | 003F | 1 | D tripped |
| | 10065 | 00065 | 0064 | 0040 | 1 | UN tripped |
| | 10066 | 00066 | 0065 | 0041 | 1 | UV tripped |
| | 10067 | 00067 | 0066 | 0042 | 1 | OV tripped |
| | 10068 | 00068 | 0067 | 0043 | 1 | RV tripped |
| | 10069 | 00069 | 0068 | 0044 | 1 | RP tripped |

**Table 27. DI – Buffer 'Reports'**

(*) The absolute address 10026 is not used in this application. It is left blank because it is used in the PR112/PD-M application.

### *9.2.2 Buffer "Trip Reports"*

This buffer is the copy, at trip time, of the above reports.

| Section | Absolute Address | Relative Address | Relative Address – 1 | Relative Address – 1 (HEX) | Number of items |
|---|---|---|---|---|---|
| **Trip Reports** | **10201** | **0201** | **0200** | **00C8** | **69** |

and these are the relevant items:

| Section | Absolute Address | Relative Address | Relative Address - 1 | Relative Address – 1 (HEX) | Number of items | Description | Comments |
|---|---|---|---|---|---|---|---|
| **States/Events** | **10201** | **0001** | **0000** | **0000** | **24** | | |
| | 10201 | 0201 | 0200 | 00C8 | 1 | Any Alarm | |
| | 10202 | 0202 | 0201 | 00C9 | 1 | Any Trip | |
| | 10203 | 0203 | 0202 | 00CA | 1 | CB tripped | |
| | 10204 | 0204 | 0203 | 00CB | 1 | CB open/closed | |
| | 10205 | 0205 | 0204 | 00CC | 1 | CB undefined | |
| | 10206 | 0206 | 0205 | 00CD | 1 | CB connected/isolated | |
| | 10207 | 0207 | 0206 | 00CE | 1 | Springs charged/discharged | |
| | 10208 | 0208 | 0207 | 00CF | 1 | Trip command fail | |
| | 10209 | 0209 | 0208 | 00D0 | 1 | Electronic Trip Test | |
| | 10210 | 0210 | 0209 | 00D1 | 1 | Simulated Trip from Test Unit | |
| | 10211 | 0211 | 0210 | 00D2 | 1 | I.B. Fault | |
| | 10212 | 0212 | 0211 | 00D3 | 1 | Local/Remote Operating Mode | |
| | 10213 | 0213 | 0212 | 00D4 | 1 | Test Unit connected | |
| | 10214 | 0214 | 0213 | 00D5 | 1 | Programming OK | |
| | 10215 | 0215 | 0214 | 00D6 | 1 | Programming Fail | |
| | 10216 | 0216 | 0215 | 00D7 | 1 | Parameter changed | Event |
| | 10217 | 0217 | 0216 | 00D8 | 1 | CB command executed | Event |
| | 10218 | 0218 | 0217 | 00D9 | 1 | Trip data available | |
| | 10219 | 0219 | 0218 | 00DA | 1 | LC2 is timing to close | |
| | 10220 | 0220 | 0219 | 00DB | 1 | LC2 Load closed | |
| | 10221 | 0221 | 0220 | 00DC | 1 | Acquisition OK | |
| | 10222 | 0222 | 0221 | 00DD | 1 | Acquisition Fail | |
| | 10223 | 0223 | 0222 | 00DE | 1 | Historical Trip available | |
| | 10224 | 0224 | 0223 | 00DF | 1 | Historical Measurements Update | |
| **Alarms** | **10225** | **0225** | **0224** | **0018** | **34** | | |
| | 10225 | 0225 | 0224 | 00E0 | 1 | Harmonic distortion > 2.1 | |
| | 10226 | 0226 | 0225 | 00E1 | 1 | NOT USED (*) | |
| | 10227 | 0227 | 0226 | 00E2 | 1 | Contact wear Pre-alarm | |
| | 10228 | 0228 | 0227 | 00E3 | 1 | Contact wear Alarm | |
| | 10229 | 0229 | 0228 | 00E4 | 1 | L Pre-alarm | |
| | 10230 | 0230 | 0229 | 00E5 | 1 | L Alarm (timing / tripping) | |
| | 10231 | 0231 | 0230 | 00E6 | 1 | S Alarm (timing / tripping) | |
| | 10232 | 0232 | 0231 | 00E7 | 1 | G Alarm (timing / tripping) | |
| | 10233 | 0233 | 0232 | 00E8 | 1 | G Blocked Trip | |
| | 10234 | 0234 | 0233 | 00E9 | 1 | T Pre-alarm | |
| | 10235 | 0235 | 0234 | 00EA | 1 | T Alarm | |
| | 10236 | 0236 | 0235 | 00EB | 1 | T Blocked Trip | |
| | 10237 | 0237 | 0236 | 00EC | 1 | LC1 Alarm (timing to open) | |
| | 10238 | 0238 | 0237 | 00ED | 1 | LC1 Load open | |
| | 10239 | 0239 | 0238 | 00EE | 1 | LC2 Alarm (timing to open) | |
| | 10240 | 0240 | 0239 | 00EF | 1 | LC2 Load open | |
| | 10241 | 0241 | 0240 | 00F0 | 1 | LC2 Max number of AR reached | |
| | 10242 | 0242 | 0241 | 00F1 | 1 | Iw Alarm | |
| | 10243 | 0243 | 0242 | 00F2 | 1 | Rogowsky Ne Continuity Check | |
| | 10244 | 0244 | 0243 | 00F3 | 1 | Rogowsky L3 Continuity Check | |
| | 10245 | 0245 | 0244 | 00F4 | 1 | Rogowsky L2 Continuity Check | |
| | 10246 | 0246 | 0245 | 00F5 | 1 | Rogowsky L1 Continuity Check | |
| | 10247 | 0247 | 0246 | 00F6 | 1 | Frequency Check | |
| | 10248 | 0248 | 0247 | 00F7 | 1 | SA Continuity Check | |
| | 10249 | 0249 | 0248 | 00F8 | 1 | D Alarm (timing / tripping) | |
| | 10250 | 0250 | 0249 | 00F9 | 1 | UN Alarm (timing / tripping) | |
| | 10251 | 0251 | 0250 | 00FA | 1 | UN Blocked Trip | |
| | 10252 | 0252 | 0251 | 00FB | 1 | UV Alarm (timing / tripping) | |
| | 10253 | 0253 | 0252 | 00FC | 1 | UV Alarm after Trip | |
| | 10254 | 0254 | 0253 | 00FD | 1 | OV Alarm (timing / tripping) | |
| | 10255 | 0255 | 0254 | 00FE | 1 | OV Alarm after Trip | |
| | 10256 | 0256 | 0255 | 00FF | 1 | RV Alarm (timing / tripping) | |
| | 10257 | 0257 | 0256 | 0100 | 1 | RV Alarm after Trip | |
| | 10258 | 0258 | 0257 | 0101 | 1 | RP Alarm (timing / tripping) | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Trips** | **10259** | **0259** | **0258** | **0102** | **11** | |
| | 10259 | 0259 | 0258 | 0102 | 1 | L tripped |
| | 10260 | 0260 | 0259 | 0103 | 1 | S tripped |
| | 10261 | 0261 | 0260 | 0104 | 1 | I tripped |
| | 10262 | 0262 | 0261 | 0105 | 1 | G tripped |
| | 10263 | 0263 | 0262 | 0106 | 1 | T tripped |
| | 10264 | 0264 | 0263 | 0107 | 1 | D tripped |
| | 10265 | 0265 | 0264 | 0108 | 1 | UN tripped |
| | 10266 | 0266 | 0265 | 0109 | 1 | UV tripped |
| | 10267 | 0267 | 0266 | 010A | 1 | OV tripped |
| | 10268 | 0268 | 0267 | 010B | 1 | RV tripped |
| | 10269 | 0269 | 0268 | 010B | 1 | RP tripped |

**Table 28. DI – Buffer 'Trip Reports'**

(*) The absolute address 10226 is not used in this application. It is left blank because it is used in the PR112/PD-M application.

## 9.3 Analog Input

### *9.3.1 Buffer "Statistics"*

| Section | Absolute Address | Relative Address | Relative Address – 1 | Relative Address – 1 (HEX) | Number of items |
|---|---|---|---|---|---|
| **Statistics** | **30001** | **0001** | **0000** | **0000** | **17** |

and these are the relevant items:

| Section | Absolute Address | Relative Address | Relative Address - 1 | Relative Address – 1 (HEX) | Number of items | HIGH byte | LOW byte | Description | Comments | Range | Unit of Meas. | Persistence |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Communication Statistics** | **30001** | **0001** | **0000** | **0000** | **5** | | | | | | | |
| | 30001 | 0001 | 0000 | 0000 | 1 | | | Number of received messages | Bus Message Count | 0 - 65535 | | |
| | 30002 | 0002 | 0001 | 0001 | 1 | | | Number of received messages with char/frame error | Bus Communication Error Count | 0 - 65535 | | |
| | 30003 | 0003 | 0002 | 0002 | 1 | | | Number of responses | Slave Message Count | 0 - 65535 | | |
| | 30004 | 0004 | 0003 | 0003 | 1 | | | Number of Slave Busy responses | Slave Busy Count | 0 - 65535 | | |
| | 30005 | 0005 | 0004 | 0004 | 1 | | | Number of exception responses | Bus Exception Error Count | 0 - 65535 | | |
| **Process Statistics** | **30006** | **0006** | **0005** | **0005** | **18** | | | | | | | |
| | 30006 | 0006 | 0005 | 0005 | 1 | N/A | | CB contact wear | | 0 - 100 | % | Permanent (PU) |
| | 30007 | 0007 | 0006 | 0006 | 1 | | | CB number of operations | | 0 - 65535 | | Permanent (PU) |
| | 30008 | 0008 | 0007 | 0007 | 1 | | | CB number of manual opens | | 0 - 65535 | | Permanent (CU) |
| | 30009 | 0009 | 0008 | 0008 | 1 | | | CB number of protection trips | | 0 - 65535 | | Permanent (CU) |
| | 30010 | 0010 | 0009 | 0009 | 1 | | | CB number of protection trips fail | | 0 - 65535 | | Permanent (CU) |
| | 30011 | 0011 | 0010 | 000A | 1 | | | CB number of other trips (trip test) | | 0 - 65535 | | Permanent (CU) |
| | 30012 | 0012 | 0011 | 000B | 1 | | | Protection L number of trips | | 0 - 65535 | | Permanent (CU) |
| | 30013 | 0013 | 0012 | 000C | 1 | | | Protection S number of trips | | 0 - 65535 | | Permanent (CU) |
| | 30014 | 0014 | 0013 | 000D | 1 | | | Protection I number of trips | | 0 - 65535 | | Permanent (CU) |
| | 30015 | 0015 | 0014 | 000E | 1 | | | Protection G number of trips | | 0 - 65535 | | Permanent (CU) |
| | 30016 | 0016 | 0015 | 000F | 1 | | | Protection T number of trips | | 0 - 65535 | | Permanent (CU) |
| | 30017 | 0017 | 0016 | 0010 | 1 | N/A | | Number of auto-reclosure | | 0-9 | | Permanent (PU) |
| | 30018 | 0018 | 0017 | 0011 | 1 | | | Protection D number of trips | | 0 - 65535 | | Permanent (CU) |
| | 30019 | 0019 | 0018 | 0012 | 1 | | | Protection UN number of trips | | 0 - 65535 | | Permanent (CU) |
| | 30020 | 0020 | 0019 | 0013 | 1 | | | Protection UV number of trips | | 0 - 65535 | | Permanent (CU) |
| | 30021 | 0021 | 0020 | 0014 | 1 | | | Protection OV number of trips | | 0 - 65535 | | Permanent (CU) |
| | 30022 | 0022 | 0021 | 0015 | 1 | | | Protection RV number of trips | | 0 - 65535 | | Permanent (CU) |
| | 30023 | 0023 | 0022 | 0016 | 1 | | | Protection RP number of trips | | 0 - 65535 | | Permanent (CU) |

**Table 29. AI – Buffer 'Statistics'**

'Persistence = PERMANENT' means that value is saved into non-volatile memory (into PU or CU).

### *9.3.2 Buffer "Programming Fail Code"*

| Section | Absolute Address | Relative Address | Relative Address – 1 | Relative Address – 1 (HEX) | Number of items |
|---|---|---|---|---|---|
| **Programming Fail Code** | **30051** | **0051** | **0050** | **0032** | **1** |

and these are the relevant items:

| Section | Absolute Address | Relative Address | Relative Address - 1 | Relative Address – 1 (HEX) | Number of items | HIGH byte | LOW byte | Description | Comments | Range | Unit of Meas. | Persistence |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Programming Fail Code** | **30051** | **0051** | **0050** | **0032** | **1** | | | Programming Fail Error Code | | see par 8.1.4 | | |

**Table 30. AI – Buffer 'Programming Fail Code'**

### *9.3.3 Buffer "Run-time Measurements"*

| Section | Absolute Address | Relative Address | Relative Address – 1 | Relative Address – 1 (HEX) | Number of items |
|---|---|---|---|---|---|
| **Run-time Measurements** | **30101** | **0101** | **0100** | **0064** | **67** |

and these are the relevant items:

| Section | Absolute Address | Relative Address | Relative Address - 1 | Relative Address - 1 (HEX) | Number of items | HIGH byte | LOW byte | Description | Comments | Range | Unit of Meas. | Persistence |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Run-time Measurements** | **30101** | **0101** | **0100** | **0064** | **67** | | | | | | | |
| | 30101 | 0101 | 0100 | 0064 | 2 | | | RMS current phase L1 | | | A | |
| | 30103 | 0103 | 0102 | 0066 | 2 | | | RMS current phase L2 | | | A | |
| | 30105 | 0105 | 0104 | 0068 | 2 | | | RMS current phase L3 | | | A | |
| | 30107 | 0107 | 0106 | 006A | 2 | | | RMS current neutral | | | A | |
| | 30109 | 0109 | 0108 | 006C | 2 | | | RMS current ground | | | A | |
| | 30111 | 0111 | 0110 | 006E | 2 | | | RMS voltage phase V1 | Scaled*100 (see par 8.1.5.2) | | V | |
| | 30113 | 0113 | 0112 | 0070 | 2 | | | RMS voltage phase V2 | Scaled*100 (see par 8.1.5.2) | | V | |
| | 30115 | 0115 | 0114 | 0072 | 2 | | | RMS voltage phase V3 | Scaled*100 (see par 8.1.5.2) | | V | |
| | 30117 | 0117 | 0116 | 0074 | 2 | | | RMS voltage residual | Scaled*100 (see par 8.1.5.2) | | V | |
| | 30119 | 0119 | 0118 | 0076 | 2 | | | RMS concatenate voltage 12 | Scaled*100 (see par 8.1.5.2) | | V | |
| | 30121 | 0121 | 0120 | 0078 | 2 | | | RMS concatenate voltage 23 | Scaled*100 (see par 8.1.5.2) | | V | |
| | 30123 | 0123 | 0122 | 007A | 2 | | | RMS concatenate voltage 31 | Scaled*100 (see par 8.1.5.2) | | V | |
| | 30125 | 0125 | 0124 | 007C | 2 | | | Active Power phase 1 | Signed (see par 8.1.5.3) | | W | |
| | 30127 | 0127 | 0126 | 007E | 2 | | | Active Power phase 2 | Signed (see par 8.1.5.3) | | W | |
| | 30129 | 0129 | 0128 | 0080 | 2 | | | Active Power phase 3 | Signed (see par 8.1.5.3) | | W | |
| | 30131 | 0131 | 0130 | 0082 | 2 | | | Active Power total | Signed (see par 8.1.5.3) | | W | |
| | 30133 | 0133 | 0132 | 0084 | 2 | | | Reactive Power phase 1 | Signed (see par 8.1.5.3) | | VAR | |
| | 30135 | 0135 | 0134 | 0086 | 2 | | | Reactive Power phase 2 | Signed (see par 8.1.5.3) | | VAR | |
| | 30137 | 0137 | 0136 | 0088 | 2 | | | Reactive Power phase 3 | Signed (see par 8.1.5.3) | | VAR | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 30139 | 0139 | 0138 | 008A | 2 | | Reactive Power total | Signed (see par 8.1.5.3) | VAR |
| | 30141 | 0141 | 0140 | 008C | 2 | | Apparent Power phase 1 | Signed (see par 8.1.5.3) | VA |
| | 30143 | 0143 | 0142 | 008E | 2 | | Apparent Power phase 2 | Signed (see par 8.1.5.3) | VA |
| | 30145 | 0145 | 0144 | 0090 | 2 | | Apparent Power phase 3 | Signed (see par 8.1.5.3) | VA |
| | 30147 | 0147 | 0146 | 0092 | 2 | | Apparent Power total | Signed (see par 8.1.5.3) | VA |
| | 30149 | 0149 | 0148 | 0094 | 1 | N/A | Power Factor cos f1 | Scaled*100 (see par 8.1.5.4) | |
| | 30150 | 0150 | 0149 | 0095 | 1 | N/A | Power Factor cos f2 | Scaled*100 (see par 8.1.5.4) | |
| | 30151 | 0151 | 0150 | 0096 | 1 | N/A | Power Factor cos f3 | Scaled*100 (see par 8.1.5.4) | |
| | 30152 | 0152 | 0151 | 0097 | 1 | N/A | Power Factor cos f total | Scaled*100 (see par 8.1.5.4) | |
| | 30153 | 0153 | 0152 | 0098 | 1 | N/A | Frequency | Scaled*10 (see par 8.1.5.5) | Hz |
| | 30154 | 0154 | 0153 | 0099 | 2 | | Peak Factor phase 1 | Scaled*100 (see par 8.1.5.6) | |
| | 30156 | 0156 | 0155 | 009B | 2 | | Peak Factor phase 2 | Scaled*100 (see par 8.1.5.6) | |
| | 30158 | 0158 | 0157 | 009D | 2 | | Peak Factor phase 3 | Scaled*100 (see par 8.1.5.6) | |
| | 30160 | 0160 | 0159 | 009F | 2 | | Peak Factor neutral | Scaled*100 (see par 8.1.5.6) | |
| | 30162 | 0162 | 0161 | 00A1 | 2 | | Active Energy | Signed (see par 8.1.5.7) | kWh |
| | 30164 | 0164 | 0163 | 00A3 | 2 | | Reactive Energy | Signed (see par 8.1.5.7) | kVARh |
| | 30166 | 0166 | 0165 | 00A5 | 2 | | Apparent Energy | Signed (see par 8.1.5.7) | kVAh |

**Table 31. AI – Buffer 'Run-time Measurements'**

### *9.3.4 Buffer "Trip Measurements"*

| Section | Absolute Address | Relative Address | Relative Address – 1 | Relative Address – 1 (HEX) | Number of items |
|---|---|---|---|---|---|
| **Trip Measurements** | **30201** | **0201** | **0200** | **00C8** | **20** |

and these are the relevant items:

| Section | Absolute Address | Relative Address | Relative Address - 1 | Relative Address - 1 (HEX) | Number of items | HIGH byte | LOW byte | Description | Comments | Range | Unit of Meas. | Persistence |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Trip Measurements** | **30201** | **0201** | **0200** | **00C8** | **20** | | | | | | | |
| | 30201 | 0201 | 0200 | 00C8 | 2 | | | Trip current phase L1 | | | A | Permanent (PU) |
| | 30203 | 0203 | 0202 | 00CA | 2 | | | Trip current phase L2 | | | A | Permanent (PU) |
| | 30205 | 0205 | 0204 | 00CC | 2 | | | Trip current phase L3 | | | A | Permanent (PU) |
| | 30207 | 0207 | 0206 | 00CE | 2 | | | Trip current neutral | | | A | Permanent (PU) |
| | 30209 | 0209 | 0208 | 00D0 | 2 | | | Trip current ground | | | A | Permanent (PU) |
| | 30211 | 0211 | 0210 | 00D2 | 2 | | | Trip voltage phase L1 | Scaled*100 (see par 8.1.6.2) | | V | Permanent (PU) |
| | 30213 | 0213 | 0212 | 00D4 | 2 | | | Trip voltage phase L2 | Scaled*100 (see par 8.1.6.2) | | V | Permanent (PU) |
| | 30215 | 0215 | 0214 | 00D6 | 2 | | | Trip voltage phase L3 | Scaled*100 (see par 8.1.6.2) | | V | Permanent (PU) |
| | 30217 | 0217 | 0217 | 00D8 | 2 | | | Trip residual voltage | Scaled*100 (see par 8.1.6.2) | | V | Permanent (PU) |
| | 30219 | 0219 | 0218 | 00DA | 2 | | | Trip active power total | Signed (see par 8.1.6.3) | | W | Permanent (PU) |

**Table 32. AI – Buffer 'Trip Measurements'**

### *9.3.5 Buffer "Present Parameters"*

| Section | Absolute Address | Relative Address | Relative Address – 1 | Relative Address – 1 (HEX) | Number of items |
|---|---|---|---|---|---|
| **Present parameters** | **30301** | **0301** | **0300** | **012C** | **98** |

and these are the relevant items:

| Section | Absolute Address | Relative Address | Relative Address - 1 | Relative Address - 1 (HEX) | Number of items | HIGH byte | LOW byte | Description | Comments | Range | Default | Mapped in |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Present parameters** | **30301** | **0301** | **0300** | **012C** | **98** | | | | | | | |
| | 30301 | 0301 | 0300 | 012C | 1 | N/A | | Slave ID (DCP) | | | 12 | |
| | 30302 | 0302 | 0301 | 012D | 1 | N/A | | Product execution | fixed LSIG | [ LSI \| LSIG ] | LSIG | [ 0 \| 1 ] |
| | 30303 | 0303 | 0302 | 012E | 1 | N/A | | Product Standard Reference | | [ IEC \| UL ] | IEC | [ 0 \| 1 ] |
| | 30304 | 0304 | 0303 | 012F | 5 | | | Relay Serial Number | One byte for each character | | | |
| | 30309 | 0309 | 0308 | 0134 | 1 | | | PU SW version | 'major'.'minor' | | | |
| | 30310 | 0310 | 0309 | 0135 | 1 | | | CU SW version (DCP) | 'major'.'minor' | | | |
| | 30311 | 0311 | 0310 | 0136 | 1 | N/A | | Slave Address (DCP) | | [ 255 (UNCONFIGURED) \| {1 … 247} ] | 255 | |
| | 30312 | 0312 | 0311 | 0137 | 1 | N/A | | Addressing Type (DCP) | | [ Standard \| ABB SACE ] | Standard | [ 0 \| 1 ] |
| | 30313 | 0313 | 0312 | 0138 | 1 | N/A | | Baud rate (DCP) | | [ 9600 \| 19200 ] | 19200 | |
| | 30314 | 0314 | 0313 | 0139 | 1 | N/A | | Even / Odd parity (DCP) | | [ Even \| Odd ] | Even | [ 0 \| 1 ] |
| | 30315 | 0315 | 0314 | 013A | 1 | N/A | | HMI Language | | [ English \| Italiano \| Francais \| Deutsch \| Espanol ] | English | {0 …4} |
| | 30316 | 0316 | 0315 | 013B | 1 | N/A | | Line Frequency | | [ 50 \| 60 ] Hz | 50 | |
| | 30317 | 0317 | 0316 | 013C | 1 | N/A | | Neutral selection | | [ 50 \| 100 \| 150 \| 200 ] % | 50% | |
| | 30318 | 0318 | 0317 | 013D | 1 | N/A | | Ground Toroid int. / ext. selection | | [ Internal \| External ] | Internal | [ 0 \| 1 ] |
| | 30319 | 0319 | 0318 | 013E | 1 | N/A | | Ext. ground toroid | | [ 100 \| 250 \| 400 \| 800 ] A | 100 | |
| | 30320 | 0320 | 0319 | 013F | 1 | | | Int. toroid value / PU nominal current In | | **IEC**: [ 250 \| 400 \| 800 \| 1250 \| 1600 \| 2000 \| 2500 \| 3200 \| 4000 \| 5000 \| 6300 ] A<br>**UL**: [ 250 \| 400 \| 800 \| 1200 \| 1600 \| 2000 \| 2500 \| 3200 \| 3600 \| 4000 \| 5000 ] A | 250 | |
| | 30321 | 0321 | 0320 | 0140 | 1 | N/A | | CB type | | see Table 34 | 0 [E1B-(A)800] | see Table 34 |
| | 30322 | 0322 | 0321 | 0141 | 5 | | | CB Serial Number (DCP) | One byte for each character | | | |
| | 30327 | 0327 | 0326 | 0146 | 1 | N/A | | PU nominal voltage Un | | [100 \| 115 \| 120 \| 190 \| 208 \| 220 \| 230 \| 240 \| 277 \| 347 \| 380 \| 400 \| 415 \| 440 \| 480 \| 500 \| 550 \| 600 \| 660 \| 690 \| 910 \| 950 \| 1000] / √(3) V | 100 / √ 3 | |

**Table 33. AI – Buffer 'Present parameters', Part 1**

| Parameter Value | ANSI | IEC |
|---|---|---|

| | | |
|---|---|---|
| 0 | E1B-A800 | E1_800 |
| 1 | E1B-A1200 | E1_1250 |
| 2 | E2B-A1600 | E2B1600 |
| 3 | E2N-A1200 | E2B2000 |
| 4 | E2N-A1600 | E2N1250 |
| 5 | E3N-A2000 | E2N1600 |
| 6 | E3N-A2500 | E2N2000 |
| 7 | E3S-A1200 | E2L1250 |
| 8 | E3S-A1600 | E2L1600 |
| 9 | E3S-A2000 | E3N2500 |
| 10 | E3S-A2500 | E3N3200 |
| 11 | E3H-A1200 | E3S1250 |
| 12 | E3H-A1600 | E3S1600 |
| 13 | E3H-A2000 | E3S2000 |
| 14 | E3H-A2500 | E3S2500 |
| 15 | E3V-A1200 | E3S3200 |
| 16 | E3V-A1600 | E3H1200 |
| 17 | E3V-A2000 | E3H1600 |
| 18 | E3V-A2500 | E3H2000 |
| 19 | E4S-A3200 | E3H2500 |
| 20 | E4S-A3600 | E3H3200 |
| 21 | E4H-A3200 | E3L2000 |
| 22 | E4H-A3600 | E3L2500 |
| 23 | E4V-A3200 | E4S4000 |
| 24 | E4V-A3600 | E4H3200 |
| 25 | E6H-A4000 | E4H4000 |
| 26 | E6H-A5000 | E6H5000 |
| 27 | E6V-A4000 | E6H6300 |
| 28 | E6V-A5000 | E6V3200 |
| 29 | | E6V4000 |
| 30 | | E6V5000 |
| 31 | | E6V6300 |

**Table 34. 'CB Type' range**

| Section | Absolute Address | Relative Address | Relative Address - 1 | Relative Address - 1 (HEX) | Number of items | HIGH byte | LOW byte | Description | Comments | Range | Default | Mapped in |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30328 | 0328 | 0327 | 0147 | 3 | | | Date of installation (DCP) | DD,<br>MM,<br>YYYY | DD = 1 – 31<br>MM = 1 – 12<br>YYYY = 0 – 65535 | 00/00/0000 | |
| | 30331 | 0331 | 0330 | 014A | 1 | N/A | | Measurement store time | | [5 \| 15 \| 30 \| 60 \| 120] min | 60 | |
| | 30332 | 0332 | 0331 | 014B | 1 | N/A | | Warning current Iw | | [ OFF (0) \| {0.3 … 3} In, step 0.05 ] | OFF | scaled *100 |
| | 30333 | 0333 | 0332 | 014C | 1 | N/A | | Unit K present / not present | | [ Not Present \| Present ] | Not Present | [ 0 \| 1 ] |
| | 30334 | 0334 | 0333 | 014D | 1 | N/A | | Load Management Type | | [ LM1 (Open-Open) \| LM2 (Open-Close) ] | LM1 (Open-Open) | [ 0 \| 1 ] |
| | 30335 | 0335 | 0334 | 014E | 1 | N/A | | PR010/K K51/1 Contact configuration | | see Table 36 | Off | {0…49} |
| | 30336 | 0336 | 0335 | 014F | 1 | N/A | | PR010/K K51/2 Contact configuration | | see Table 36 | Off | {0…49} |
| | 30337 | 0337 | 0336 | 0150 | 1 | N/A | | PR010/K K51/3 Contact configuration | | see Table 36 | Off | {0…49} |
| | 30338 | 0338 | 0337 | 0151 | 1 | N/A | | PR010/K K51/4 Contact configuration | | see Table 36 | Off | {0…49} |
| | 30339 | 0339 | 0338 | 0152 | 1 | N/A | | PR010/K K51/6 Contact configuration | | see Table 36 | Off | {0…49} |
| | 30340 | 0340 | 0339 | 0153 | 1 | N/A | | PR010/K K51/7 Contact configuration | | see Table 36 | Off | {0…49} |
| | 30341 | 0341 | 0340 | 0154 | 1 | N/A | | PR010/K K51/8 Contact configuration | | see Table 36 | Off | {0…49} |
| | 30342 | 0342 | 0341 | 0155 | 1 | N/A | | PR113 P1 Contact configuration | | see Table 36 | L preal. | {0…49} |
| | 30343 | 0343 | 0342 | 0156 | 1 | N/A | | Start Up threshold disable | | Disabled \| Enabled | Disabled | [1 \| 0] |
| | 30344 | 0344 | 0343 | 0157 | 1 | N/A | | Start Up threshold validity time | | {0.1 … 1.5}s, step 0.05 | 0.1 | scaled *100 |
| | 30345 | 0345 | 0344 | 0158 | 1 | N/A | | Protection L curve type | | **Standard**: t = k / i^(2)<br>**IEC255-3**: t = k/(i^(0.02) - 1)<br>**IEC255-3**: t = k / (i - 1)<br>**IEC255-3**: t = k / (i^(2) - 1) | t = k / i^(2) | {0…3} |
| | 30346 | 0346 | 0345 | 0159 | 1 | N/A | | Protection L threshold | | {0.40 …1.00}In, step 0.01 | 1.00 | scaled *100 |
| | 30347 | 0347 | 0346 | 015A | 1 | N/A | | Protection L trip delay time | | **Standard:** {3 … 144}s, step 3<br>**IEC255-3**: {0.2 … 10} step 0.1 | **Standard:** 144<br>**IEC255-3**: 10 | **Standard:** scaled *1<br>**IEC255-3**: scaled *10 |
| | 30348 | 0348 | 0347 | 015B | 1 | N/A | | Protection L thermal memory | | [ OFF \| ON ] | OFF | [ 0 \| 1 ] |
| | 30349 | 0349 | 0348 | 015C | 1 | N/A | | Protection S disable | | [ Disabled \| Enabled ] | Disabled | [ 1 \| 0 ] |
| | 30350 | 0350 | 0349 | 015D | 1 | N/A | | Protection S curve time constant | | [ Definite Time \| Inverse Time ] | Definite Time | [ 0 \| 1 ] |
| | 30351 | 0351 | 0350 | 015E | 1 | N/A | | Protection S threshold | | {0.6 …10}In, step 0.1 | 0.6 | scaled *10 |
| | 30352 | 0352 | 0351 | 015F | 1 | N/A | | Protection S trip delay time | | **IEC**: {0.03, 0.05 … 0.75}s, step 0.01<br>(0.03 only with Definite Time curve)<br>**UL**: {0.03, 0.05 … 0.40}s, step 0.01<br>(0.03 only with Definite Time curve) | 0.03 | scaled *100 |
| | 30353 | 0353 | 0352 | 0160 | 1 | N/A | | Protection S thermal memory | | [ OFF \| ON ] | OFF | [ 0 \| 1 ] |
| | 30354 | 0354 | 0353 | 0161 | 1 | N/A | | Protection S zone selectivity | | [ OFF \| ON ] | OFF | [ 0 \| 1 ] |
| | 30355 | 0355 | 0354 | 0162 | 1 | N/A | | Protection S zone selectivity time | | [Tpgr \| {0.04…0.2}s, step 0.005] | 0.04 | scaled*1000 |
| | 30356 | 0356 | 0355 | 0163 | 1 | N/A | | Protection S start up threshold | | [OFF (0) \| {0.6 … 10}In, step 0.1] | OFF | scaled*10 |

**Table 35. AI – Buffer 'Present parameters', Part 2**

| Parameter Value | Parameter Meaning |
|---|---|
| 0 | -------- |
| 1 | L prealarm |
| 2 | L timing |
| 3 | S timing |
| 4 | D timing |
| 5 | G timing |
| 6 | G alarm |
| 7 | UV timing |
| 8 | UV alarm |
| 9 | V < UV Threshold |
| 10 | OV timing |
| 11 | OV alarm |
| 12 | V > OV Threshold |
| 13 | RV timing |
| 14 | RV alarm |
| 15 | V0 > RV Threshold |
| 16 | RP timing |
| 17 | UN timing |
| 18 | UN warning |
| 19 | L trip |
| 20 | S trip |
| 21 | D trip |
| 22 | I trip |
| 23 | G trip |
| 24 | T trip |
| 25 | UV trip |
| 26 | OV trip |
| 27 | RV trip |
| 28 | RP trip |
| 29 | UN trip |
| 30 | Any trip |
| 31 | T prealarm (warning) |
| 32 | T alarm |
| 33 | S ZS: IN |
| 34 | S ZS: OUT |

| | |
|---|---|
| 35 | G ZS: IN |
| 36 | G ZS: OUT |
| 37 | LC1 set |
| 38 | LC2 set |
| 39 | Harmonic Distorsion |
| 40 | Frequency Out |
| 41 | Iw threshold |
| 42 | RCC alarm |
| 43 | CCC alarm |
| 44 | CCC, RCC alarm |
| 45 | Trip backup |
| 46 | YO backup |
| 47 | CB close |
| 48 | CB error |
| 49 | No Internal Bus |

**Table 36. Relay Configuration Parameters**

| Section | Absolute Address | Relative Address | Relative Address - 1 | Relative Address - 1 (HEX) | Number of items | HIGH byte | LOW byte | Description | Comments | Range | Default | Mapped in |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30357 | 0357 | 0356 | 0164 | 1 | N/A | | Protection D disable | | Disabled \| Enabled | Disabled | [1 \| 0] |
| | 30358 | 0358 | 0357 | 0165 | 1 | N/A | | Protection D threshold | | {0.6 …10}In, step 0.1 | 0.6 | scaled*10 |
| | 30359 | 0359 | 0358 | 0166 | 1 | N/A | | Protection D backward trip delay time | | {0.2 … 0.75}s, step 0.01 | 0.2 | scaled*100 |
| | 30360 | 0360 | 0359 | 0167 | 1 | N/A | | Protection D forward trip delay time | | {0.2 … 0.75}s, step 0.01 | 0.2 | scaled*100 |
| | 30361 | 0361 | 0360 | 0168 | 1 | N/A | | Protection D direction | | Forward \| Backward | Forward | [0 \| 1] |
| | 30362 | 0362 | 0361 | 0169 | 1 | N/A | | Protection D zone selectivity | | OFF \| ON | OFF | [0 \| 1] |
| | 30363 | 0363 | 0362 | 016A | 1 | N/A | | Protection D zone selectivity time | | [Tpgr \| {0.13…0.5}ms, step 0.01] | 0.13 | scaled*100 |
| | 30364 | 0364 | 0363 | 016B | 1 | N/A | | Protection D start up threshold | | [ OFF (0) \| {0.6 … 10.0}In, step 0.1 ] | OFF | scaled*10 |
| | 30365 | 0365 | 0364 | 016C | 1 | N/A | | Protection I disable | | Disabled \| Enabled | Disabled | [1 \| 0] |
| | 30366 | 0366 | 0365 | 016D | 1 | N/A | | Protection I threshold | | {1.5 …15}In, step 0.1 | 1.5 | scaled*10 |
| | 30367 | 0367 | 0366 | 016E | 1 | N/A | | Protection I start up threshold | | [ OFF (0) \| {1.5 … 15}In, step 0.1 ] | OFF | scaled*10 |
| | 30368 | 0368 | 0367 | 016F | 1 | N/A | | Protection G disable | | [ Disabled \| Enabled ] | Disabled | [ 1 \| 0 ] |
| | 30369 | 0369 | 0368 | 0170 | 1 | N/A | | Protection G curve time constant | | [ Definite Time \| Inverse Time ] | Definite Time | [ 0 \| 1 ] |
| | 30370 | 0370 | 0369 | 0171 | 1 | N/A | | Protection G threshold | | {0.2 …1.00}In, step 0.02 | 0.2 | scaled *100 |
| | 30371 | 0371 | 0370 | 0172 | 1 | N/A | | Protection G trip delay time | | **IEC**: {0.10 … 1.00} s, step 0.05<br>**UL**: {0.10 … 0.40} s, step 0.05 | 0.10 | scaled *100 |
| | 30372 | 0372 | 0371 | 0173 | 1 | N/A | | Protection G block trip | | [ Trip not allowed \| Trip allowed ] | Trip allowed | [ 1 \| 0 ] |
| | 30373 | 0373 | 0372 | 0174 | 1 | N/A | | Protection G zone selectivity | | [ OFF \| ON ] | OFF | [ 0 \| 1 ] |
| | 30374 | 0374 | 0373 | 0175 | 1 | N/A | | Protection G zone selectivity time | | [Tpgr \| {0.04…0.2}s, step 0.005] | 0.04 | scaled*1000 |
| | 30375 | 0375 | 0374 | 0176 | 1 | N/A | | Protection G start up threshold | | [ OFF (0) \| {0.2 … 1.0}In, step 0.02 ] | OFF | scaled*100 |
| | 30376 | 0376 | 0375 | 0177 | 1 | N/A | | Protection UN disable | | Disabled \| Enabled | Disabled | [1 \| 0] |
| | 30377 | 0377 | 0376 | 0178 | 1 | N/A | | Protection UN threshold | | {10 … 90}%, step 10 | 10% | |
| | 30378 | 0378 | 0377 | 0179 | 1 | N/A | | Protection UN trip delay time | | {0.5 … 60} s, step 0.5 | 0.5 | scaled*10 |
| | 30379 | 0379 | 0378 | 017A | 1 | N/A | | Protection UN block trip | | [ Trip not allowed \| Trip allowed ] | Trip allowed | [ 1 \| 0 ] |
| | 30380 | 0380 | 0379 | 017B | 1 | N/A | | Protection UV disable | | Disabled \| Enabled | Disabled | [1 \| 0] |
| | 30381 | 0381 | 0380 | 017C | 1 | N/A | | Protection UV threshold | | {0.6 … 0.95}Un, step 0.01 | 0.6 | scaled*100 |
| | 30382 | 0382 | 0381 | 017D | 1 | N/A | | Protection UV trip delay time | | {0.1 … 5}s, step 0.1 | 0.1 | scaled*10 |
| | 30383 | 0383 | 0382 | 017E | 1 | N/A | | Protection OV disable | | Disabled \| Enabled | Disabled | [1 \| 0] |
| | 30384 | 0384 | 0383 | 017F | 1 | N/A | | Protection OV threshold | | {1.05 … 1.2}Un, step 0.01 | 1.05 | scaled*100 |
| | 30385 | 0385 | 0384 | 0180 | 1 | N/A | | Protection OV trip delay time | | {0.1 … 5}s, step 0.1 | 0.1 | scaled*10 |
| | 30386 | 0386 | 0385 | 0181 | 1 | N/A | | Protection RV disable | | Disabled \| Enabled | Disabled | [1 \| 0] |
| | 30387 | 0387 | 0386 | 0182 | 1 | N/A | | Protection RV threshold | | {0.1 … 0.4}Un, step 0.05 | 0.1 | scaled*100 |
| | 30388 | 0388 | 0387 | 0183 | 1 | N/A | | Protection RV trip delay time | | {0.5 … 30}s, step 0.5 | 0.5 | scaled*10 |
| | 30389 | 0389 | 0388 | 0184 | 1 | N/A | | Protection RP disable | | Disabled \| Enabled | Disabled | [1 \| 0] |
| | 30390 | 0390 | 0389 | 0185 | 1 | N/A | | Protection RP threshold | | {-0.01 … -0.3}Pn, step -0.02 | -0.1 | scaled*100 |
| | 30391 | 0391 | 0390 | 0186 | 1 | N/A | | Protection RP trip delay time | | {0.5 … 25}s, step 0.1 | 0.5 | scaled*10 |
| | 30392 | 0392 | 0391 | 0187 | 1 | N/A | | Protection T block trip | | [ Trip not allowed \| Trip allowed ] | Trip allowed | [ 1 \| 0 ] |

**Table 37. AI – Buffer 'Present parameters', Part 3**

| Section | Absolute Address | Relative Address | Relative Address - 1 | Relative Address - 1 (HEX) | Number of items | HIGH byte | LOW byte | Description | Comments | Range | Default | Mapped in |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30393 | 0393 | 0392 | 0188 | 1 | N/A | | Load Controller disable | | Disabled \| Enabled | OFF | [1 \| 0] |
| | 30394 | 0394 | 0393 | 0189 | 1 | N/A | | Load Controller 1 opening threshold | | [ OFF (0) \| {0.50 … 1.00}*ITh(L), step 0.01 ] | OFF (0) | scaled*100 |
| | 30395 | 0395 | 0394 | 018A | 1 | N/A | | Load Controller 2 opening threshold | | [ OFF (0) \| {0.50 … 1.00}*ITh(L), step 0.01 ] | OFF (0) | scaled*100 |
| | 30396 | 0396 | 0395 | 018B | 1 | N/A | | Load Controller 2 closing threshold | | [ OFF (0) \| {0.50 … 1.00}*ITh(L), step 0.01 ] | OFF (0) | scaled*100 |
| | 30397 | 0397 | 0396 | 018C | 1 | N/A | | Load Controller 2 closing delay | | {10 … 120}s, step 5 | 10 | |
| | 30398 | 0398 | 0397 | 018D | 1 | N/A | | Load Controller 2 max auto-reclosure number | | {1 … 9} | 3 | |

**Table 38. AI - Buffer 'Present parameters', Part 4**

**LEGENDA**
Ith(L) Protection L Threshold

### *9.3.6 Buffer "Waveforms Measurements"*

| Section | Absolute Address | Relative Address | Relative Address – 1 | Relative Address – 1 (HEX) | Number of items |
|---|---|---|---|---|---|
| **Waveforms Measurements** | **30401** | **0401** | **0400** | **0190** | **120** |

and these are the relevant items:

| Section | Absolute Address | Relative Address | Relative Address - 1 | Relative Address - 1 (HEX) | Number of items | HIGH byte | LOW byte | Description | Comments | Range | Default | Mapped in |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Waveforms Measurements** | **30401** | **0401** | **0400** | **0190** | **120** | | | | | | | |
| | 30401 | 0401 | 0400 | 0190 | 20 | | | Waveform Block 1 | | | | |
| | 30421 | 0421 | 0420 | 01A4 | 20 | | | Waveform Block 2 | | | | |
| | 30441 | 0441 | 0440 | 01B8 | 20 | | | Waveform Block 3 | | | | |
| | 30461 | 0461 | 0460 | 01CC | 20 | | | Waveform Block 4 | | | | |
| | 30481 | 0481 | 0480 | 01E0 | 20 | | | Waveform Block 5 | | | | |
| | 30501 | 0501 | 0500 | 01F4 | 20 | | | Waveform Block 6 | | | | |

**Table 39. AI - Buffer 'Waveforms Measurements'**

### *9.3.7 Buffer "Harmonics Measurements"*

| Section | Absolute Address | Relative Address | Relative Address – 1 | Relative Address – 1 (HEX) | Number of items |
|---|---|---|---|---|---|
| **Harmonics Measurements** | **30601** | **0601** | **0600** | **0258** | **20** |

and these are the relevant items:

| Section | Absolute Address | Relative Address | Relative Address - 1 | Relative Address - 1 (HEX) | Number of items | HIGH byte | LOW byte | Description | Comments | Range | Default | Mapped in |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Harmonics Measurements** | **30601** | **0601** | **0600** | **0258** | **20** | | | | | | | |

### *9.3.8 Buffer "Historical Trip Data"*

| Section | Absolute Address | Relative Address | Relative Address – 1 | Relative Address – 1 (HEX) | Number of items |
|---|---|---|---|---|---|
| **Historical Trip Data** | **30701** | **0701** | **0700** | **02BC** | **230** |

and these are the relevant items:

| Section | Absolute Address | Relative Address | Relative Address - 1 | Relative Address - 1 (HEX) | Number of items | HIGH byte | LOW byte | Description | Comments | Range | Default | Mapped in |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Historical Trip Data** | **30701** | **0701** | **0700** | **02BC** | **230** | | | | | | | |
| | 30701 | 0701 | 0700 | 02BC | 23 | | | Historical Openings N° 1 (oldest) | | | | |
| | 30724 | 0724 | 0723 | 02D3 | 23 | | | Historical Openings N° 2 | | | | |
| | 30747 | 0747 | 0746 | 02EA | 23 | | | Historical Openings N° 3 | | | | |
| | 30770 | 0770 | 0769 | 0301 | 23 | | | Historical Openings N° 4 | | | | |
| | 30793 | 0793 | 0792 | 0318 | 23 | | | Historical Openings N° 5 | | | | |
| | 30816 | 0816 | 0815 | 032F | 23 | | | Historical Openings N° 6 | | | | |
| | 30839 | 0839 | 0838 | 0346 | 23 | | | Historical Openings N° 7 | | | | |
| | 30862 | 0862 | 0861 | 035D | 23 | | | Historical Openings N° 8 | | | | |
| | 30885 | 0885 | 0884 | 0374 | 23 | | | Historical Openings N° 9 | | | | |
| | 30908 | 0908 | 0907 | 038B | 23 | | | Historical Openings N° 10 (newest) | | | | |

### *9.3.9 Buffer "Historical Measurements"*

| Section | Absolute Address | Relative Address | Relative Address – 1 | Relative Address – 1 (HEX) | Number of items |
|---|---|---|---|---|---|
| **Historical Measurements** | **31001** | **1001** | **1000** | **03E8** | **15** |

and these are the relevant items:

| Section | Absolute Address | Relative Address | Relative Address - 1 | Relative Address - 1 (HEX) | Number of items | HIGH byte | LOW byte | Description | Comments | Range | Default | Mapped in |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Historical Measurements** | **31001** | **1001** | **1000** | **03E8** | **15** | | | | | | | |
| | 31001 | 1001 | 1000 | 03E8 | 3 | | | Historical Measurements - Last Mean Active Power | | | | |
| | 31004 | 1004 | 1003 | 03EB | 3 | | | Historical Measurements - Last Max Active Power | | | | |
| | 31007 | 1007 | 1006 | 03EE | 3 | | | Historical Measurements - Last Max Current + phase | | | | |
| | 31010 | 1010 | 1009 | 03F1 | 3 | | | Historical Measurements - Last Max Voltage + phase | | | | |
| | 31013 | 1013 | 1012 | 03F4 | 3 | | | Historical Measurements - Last Min Voltage + phase | | | | |

## 9.4 Analog Output

### *9.4.1 Buffer "CB Open" command*

| Section | Absolute Address | Relative Address | Relative Address – 1 | Relative Address – 1 (HEX) | Number of items |
|---|---|---|---|---|---|
| **CB Open** | **40001** | **0001** | **0000** | **0000** | **1** |

and these are the relevant items:

| Section | Absolute Address | Relative Address | Relative Address - 1 | Relative Address - 1 (HEX) | Number of items | HIGH byte | LOW byte | Description | Comments |
|---|---|---|---|---|---|---|---|---|---|
| **CB Open** | **40001** | **0000** | **0000** | **0000** | **1** | | | | |
| | 40001 | 0001 | 0000 | 0000 | 1 | N/A | | CB Open | Mutually exclusive to other CB commands |

**Table 40. AO – Buffer 'CB Open' Command**

### *9.4.2 Buffer "CB Close" command*

| Section | Absolute Address | Relative Address | Relative Address – 1 | Relative Address – 1 (HEX) | Number of items |
|---|---|---|---|---|---|
| **CB Close** | **40003** | **0003** | **0002** | **0002** | **1** |

and these are the relevant items:

| Section | Absolute Address | Relative Address | Relative Address - 1 | Relative Address - 1 (HEX) | Number of items | HIGH byte | LOW byte | Description | Comments |
|---|---|---|---|---|---|---|---|---|---|
| **CB Close** | **40003** | **0003** | **0002** | **0002** | **1** | | | | |
| | 40003 | 0003 | 0002 | 0002 | 1 | N/A | | CB Close | Mutually exclusive to other CB commands |

**Table 41. AO – Buffer 'CB Close' Command**

### *9.4.3 Buffer "CB Reset" command*

| Section | Absolute Address | Relative Address | Relative Address – 1 | Relative Address – 1 (HEX) | Number of items |
|---|---|---|---|---|---|
| **CB Reset** | **40005** | **0005** | **0004** | **0004** | **1** |

and these are the relevant items:

| Section | Absolute Address | Relative Address | Relative Address - 1 | Relative Address - 1 (HEX) | Number of items | HIGH byte | LOW byte | Description | Comments |
|---|---|---|---|---|---|---|---|---|---|
| **CB Reset** | **40005** | **0005** | **0004** | **0004** | **1** | | | | |
| | 40005 | 0005 | 0004 | 0004 | 1 | N/A | | CB Reset | Mutually exclusive to other 'Fast' commands. |

**Table 42. AO – Buffer 'CB Reset' Command**

### *9.4.4 Buffer "Start programming session" command*

| Section | Absolute Address | Relative Address | Relative Address – 1 | Relative Address – 1 (HEX) | Number of items |
|---|---|---|---|---|---|
| **Start Programming session** | **40007** | **0007** | **0006** | **0006** | **1** |

and these are the relevant items:

| Section | Absolute Address | Relative Address | Relative Address - 1 | Relative Address - 1 (HEX) | Number of items | HIGH byte | LOW byte | Description | Comments |
|---|---|---|---|---|---|---|---|---|---|
| **Start Programming session** | **40007** | **0007** | **0006** | **0006** | **1** | | | | |
| | 40007 | 0007 | 0006 | 0006 | 1 | N/A | | Start Programming session | Mutually exclusive to other 'Slow' commands. They require an EEPROM operation to the PU. |

**Table 43. AO – Buffer 'Start programming session' Command**

### *9.4.5 Buffer "Abort programming session" command*

| Section | Absolute Address | Relative Address | Relative Address – 1 | Relative Address – 1 (HEX) | Number of items |
|---|---|---|---|---|---|
| **Abort Programming session** | **40009** | **0009** | **0008** | **0008** | **1** |

and these are the relevant items:

| Section | Absolute Address | Relative Address | Relative Address - 1 | Relative Address - 1 (HEX) | Number of items | HIGH byte | LOW byte | Description | Comments |
|---|---|---|---|---|---|---|---|---|---|
| **Abort Programming session** | **40009** | **0009** | **0008** | **0008** | **1** | | | | |
| | 40009 | 0009 | 0008 | 0008 | 1 | N/A | | Abort Programming session | Mutually exclusive to other 'Fast' commands. |

**Table 44. AO – Buffer 'Abort programming session' Command**

### *9.4.6 Buffer "Stop programming session" command*

| Section | Absolute Address | Relative Address | Relative Address – 1 | Relative Address – 1 (HEX) | Number of items |
|---|---|---|---|---|---|
| **Stop Programming session** | **40011** | **0011** | **0010** | **000A** | **1** |

and these are the relevant items:

| Section | Absolute Address | Relative Address | Relative Address - 1 | Relative Address - 1 (HEX) | Number of items | HIGH byte | LOW byte | Description | Comments |
|---|---|---|---|---|---|---|---|---|---|
| **Stop Programming session** | **40011** | **0011** | **0010** | **000A** | **1** | | | | |
| | 40011 | 0011 | 0010 | 000A | 1 | N/A | | Stop Programming session | Mutually exclusive to other 'Slow' commands. They require an EEPROM operation to the PU. |

**Table 45. AO – Buffer 'Stop programming session' Command**

### *9.4.7 Buffer "Trip Reset" command*

| Section | Absolute Address | Relative Address | Relative Address – 1 | Relative Address – 1 (HEX) | Number of items |
|---|---|---|---|---|---|
| **Trip Reset** | **40013** | **0013** | **0012** | **000C** | **1** |

and these are the relevant items:

| Section | Absolute Address | Relative Address | Relative Address - 1 | Relative Address - 1 (HEX) | Number of items | HIGH byte | LOW byte | Description | Comments |
|---|---|---|---|---|---|---|---|---|---|
| **Trip Reset** | **40013** | **0013** | **0012** | **000C** | **1** | | | | |
| | 40013 | 0013 | 0012 | 000C | 1 | N/A | | Trip Reset | Mutually exclusive to other 'Fast' commands. |

**Table 46. AO – Buffer 'Trip Reset' Command**

### *9.4.8 Buffer "LC1 Open Reset" command*

| Section | Absolute Address | Relative Address | Relative Address – 1 | Relative Address – 1 (HEX) | Number of items |
|---|---|---|---|---|---|
| **LC1 Open Reset** | **40015** | **0015** | **0014** | **000E** | **1** |

and these are the relevant items:

| Section | Absolute Address | Relative Address | Relative Address - 1 | Relative Address - 1 (HEX) | Number of items | HIGH byte | LOW byte | Description | Comments |
|---|---|---|---|---|---|---|---|---|---|
| **LC1 Open Reset** | **40015** | **0015** | **0014** | **000E** | **1** | | | | |
| | 40015 | 0014 | 0014 | 000E | 1 | N/A | | LC1 Open Reset | Mutually exclusive to other 'Fast' commands. |

**Table 47. AO – Buffer 'LC1 Open Reset' Command**

### *9.4.9 Buffer "LC2 Open Reset" command*

| Section | Absolute Address | Relative Address | Relative Address – 1 | Relative Address – 1 (HEX) | Number of items |
|---|---|---|---|---|---|
| **LC2 Open Reset** | **40017** | **0017** | **0016** | **0010** | **1** |

and these are the relevant items:

| Section | Absolute Address | Relative Address | Relative Address - 1 | Relative Address - 1 (HEX) | Number of items | HIGH byte | LOW byte | Description | Comments |
|---|---|---|---|---|---|---|---|---|---|
| **LC2 Open Reset** | **40017** | **0017** | **0016** | **0010** | **1** | | | | |
| | 40017 | 0017 | 0016 | 0010 | 1 | N/A | | LC2 Open Reset | Mutually exclusive to other 'Fast' commands. |

**Table 48. AO – Buffer 'LC2 Open Reset' Command**

### *9.4.10 Buffer "LC2 Number of Auto-reclosure Reset" command*

| Section | Absolute Address | Relative Address | Relative Address – 1 | Relative Address – 1 (HEX) | Number of items |
|---|---|---|---|---|---|
| **LC2 Number of Auto-reclosure Reset** | **40019** | **0019** | **0018** | **0012** | **1** |

and these are the relevant items:

| Section | Absolute Address | Relative Address | Relative Address - 1 | Relative Address - 1 (HEX) | Number of items | HIGH byte | LOW byte | Description | Comments |
|---|---|---|---|---|---|---|---|---|---|
| **LC2 Number of Auto-reclosure Reset** | **40019** | **0019** | **0018** | **0012** | **1** | | | | |
| | 40019 | 0019 | 0018 | 0012 | 1 | N/A | | LC2 Number of Auto-reclosure Reset | Mutually exclusive to other 'Fast' commands. |

**Table 49. AO – Buffer 'LC2 Number of Auto-reclosure Reset' Command**

### *9.4.11 Buffer "Wink" command*

| Section | Absolute Address | Relative Address | Relative Address – 1 | Relative Address – 1 (HEX) | Number of items |
|---|---|---|---|---|---|
| **Wink** | **40021** | **0021** | **0020** | **0014** | **1** |

and these are the relevant items:

| Section | Absolute Address | Relative Address | Relative Address - 1 | Relative Address - 1 (HEX) | Number of items | HIGH byte | LOW byte | Description | Comments |
|---|---|---|---|---|---|---|---|---|---|
| **Wink** | **40021** | **0021** | **0020** | **0014** | **1** | | | | |
| | 40021 | 0021 | 0020 | 0014 | 1 | N/A | | Wink | Mutually exclusive to other 'Fast' commands. |

**Table 50. AO – Buffer 'Wink' Command**

### *9.4.12 Buffer "Energy Counter Reset" command*

| Section | Absolute Address | Relative Address | Relative Address – 1 | Relative Address – 1 (HEX) | Number of items |
|---|---|---|---|---|---|
| **Energy Counter Reset** | **40023** | **0023** | **0022** | **0016** | **1** |

and these are the relevant items:

| Section | Absolute Address | Relative Address | Relative Address - 1 | Relative Address - 1 (HEX) | Number of items | HIGH byte | LOW byte | Description | Comments |
|---|---|---|---|---|---|---|---|---|---|
| **Energy Counter Reset** | **40023** | **0023** | **0022** | **0016** | **1** | | | | |
| | 40023 | 0023 | 0022 | 0016 | 1 | N/A | | Energy Counter Reset | Mutually exclusive to other 'Fast' commands. |

### *9.4.13 Buffer "Historical Trip Data Acquisition Start" command*

| Section | Absolute Address | Relative Address | Relative Address – 1 | Relative Address – 1 (HEX) | Number of items |
|---|---|---|---|---|---|
| **Historical Trip Data Acquisition Start** | **40025** | **0025** | **0024** | **0018** | **1** |

and these are the relevant items:

| Section | Absolute Address | Relative Address | Relative Address - 1 | Relative Address - 1 (HEX) | Number of items | HIGH byte | LOW byte | Description | Comments |
|---|---|---|---|---|---|---|---|---|---|
| **Historical Trip Data Acquisition Start** | **40025** | **0025** | **0024** | **0018** | **1** | | | | |
| | 40025 | 0025 | 0024 | 0018 | 1 | N/A | | Historical Trip Data Acquisition Start | Mutually exclusive to other 'Slow' commands. They require an EEPROM operation to the PU. |

### *9.4.14 Buffer "Request Waveforms Start" command*

| Section | Absolute Address | Relative Address | Relative Address – 1 | Relative Address – 1 (HEX) | Number of items |
|---|---|---|---|---|---|
| **Request Waveforms Start** | **40027** | **0027** | **0026** | **001A** | **3** |

and these are the relevant items:

| Section | Absolute Address | Relative Address | Relative Address - 1 | Relative Address - 1 (HEX) | Number of items | HIGH byte | LOW byte | Description | Comments |
|---|---|---|---|---|---|---|---|---|---|
| **Request Waveforms Start** | **40027** | **0027** | **0026** | **001A** | **3** | | | | |
| | 40027 | 0027 | 0026 | 001A | 1 | N/A | | Requets Harmonics | |
| | 40028 | 0028 | 0027 | 001B | 1 | N/A | | Select channel | |
| | 40029 | 0029 | 0028 | 001C | 1 | N/A | | Request Waveforms Start | Mutually exclusive to other 'Slow' commands. They require an EEPROM operation to the PU. |

### *9.4.15 Buffer "New Parameters"*

| Section | Absolute Address | Relative Address | Relative Address – 1 | Relative Address – 1 (HEX) | Number of items |
|---|---|---|---|---|---|
| **New parameters** | **40328** | **0328** | **0327** | **0147** | **71** |

and these are the relevant items:

| Section | Absolute Address | Relative Address | Relative Address - 1 | Relative Address - 1 (HEX) | Number of items | HIGH byte | LOW byte | Description | Comments | Range | Default | Mapped in |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 40328 | 0328 | 0327 | 0147 | 3 | | | Date of installation (DCP) | DD,<br>MM,<br>YYYY | DD = 1 – 31<br>MM = 1 – 12<br>YYYY = 0 – 65535 | 00/00/0000 | |
| | 40331 | 0331 | 0330 | 014A | 1 | N/A | | Measurement store time | | [5 \| 15 \| 30 \| 60 \| 120] min | 60 | {0…4} |
| | 40332 | 0332 | 0331 | 014B | 1 | N/A | | Warning current Iw | | [ OFF (0) \| {0.3 … 3} In, step 0.05 ] | OFF | scaled *100 |
| | 40333 | 0333 | 0332 | 014C | 1 | N/A | | Unit K present / not present | | [ Not Present \| Present ] | Not Present | [ 0 \| 1 ] |
| | 40334 | 0334 | 0333 | 014D | 1 | N/A | | Load Management Type | | [ LM1 (Open-Open) \| LM2 (Open-Close) ] | LM1 (Open-Open) | [ 0 \| 1 ] |
| | 40335 | 0335 | 0334 | 014E | 1 | N/A | | PR010/K K51/1 Contact configuration | | see Table 36 | Off | {0…49} |
| | 40336 | 0336 | 0335 | 014F | 1 | N/A | | PR010/K K51/2 Contact configuration | | see Table 36 | Off | {0…49} |
| | 40337 | 0337 | 0336 | 0150 | 1 | N/A | | PR010/K K51/3 Contact configuration | | see Table 36 | Off | {0…49} |
| | 40338 | 0338 | 0337 | 0151 | 1 | N/A | | PR010/K K51/4 Contact configuration | | see Table 36 | Off | {0…49} |
| | 40339 | 0339 | 0338 | 0152 | 1 | N/A | | PR010/K K51/6 Contact configuration | | see Table 36 | Off | {0…49} |
| | 40340 | 0340 | 0339 | 0153 | 1 | N/A | | PR010/K K51/7 Contact configuration | | see Table 36 | Off | {0…49} |
| | 40341 | 0341 | 0340 | 0154 | 1 | N/A | | PR010/K K51/8 Contact configuration | | see Table 36 | Off | {0…49} |
| | 40342 | 0342 | 0341 | 0155 | 1 | N/A | | PR113 P1 Contact configuration | | see Table 36 | L preal. | {0…49} |
| | 40343 | 0343 | 0342 | 0156 | 1 | N/A | | Start Up threshold disable | | Disabled \| Enabled | Disabled | [1 \| 0] |
| | 40344 | 0344 | 0343 | 0157 | 1 | N/A | | Start Up threshold validity time | | {0.1 … 1.5}s, step 0.05 | 0.1 | scaled *100 |
| | 40345 | 0345 | 0344 | 0158 | 1 | N/A | | Protection L curve type | | **Standard**: t = k / i^(2)<br>**IEC255-3**: t = k/(i^(0.02) - 1)<br>**IEC255-3**: t = k / (i - 1)<br>**IEC255-3**: t = k / (i^(2) - 1) | t = k / i^(2) | {0…3} |
| | 40346 | 0346 | 0345 | 0159 | 1 | N/A | | Protection L threshold | | {0.40 …1.00}In, step 0.01 | 1.00 | scaled *100 |
| | 40347 | 0347 | 0346 | 015A | 1 | N/A | | Protection L trip delay | | **Standard:** {3 … 144}s, step 3<br>**IEC255-3**: {0.2 … 10} step 0.1 | **Standard:** 144<br>**IEC255-3**: 10 | **Standard:** scaled *1<br>**IEC255-3**: scaled *10 |
| | 40348 | 0348 | 0347 | 015B | 1 | N/A | | Protection L thermal memory | | [ OFF \| ON ] | OFF | [ 0 \| 1 ] |

**Table 51. AO – Buffer 'New parameters', Part 1**

| Section | Absolute Address | Relative Address | Relative Address - 1 | Relative Address - 1 (HEX) | Number of items | HIGH byte | LOW byte | Description | Comments | Range | Default | Mapped in |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 40349 | 0349 | 0348 | 015C | 1 | N/A | | Protection S disable | | [ Disabled \| Enabled ] | Disabled | [ 1 \| 0 ] |
| | 40350 | 0350 | 0349 | 015D | 1 | N/A | | Protection S curve time constant | | [ Definite Time \| Inverse Time ] | Definite Time | [ 0 \| 1 ] |
| | 40351 | 0351 | 0350 | 015E | 1 | N/A | | Protection S threshold | | {0.6 …10}In, step 0.1 | 0.6 | scaled *10 |
| | 40352 | 0352 | 0351 | 015F | 1 | N/A | | Protection S trip delay time | | **IEC**: {0.03, 0.05 … 0.75}s, step 0.01 (0.03 only with Definite Time curve)<br>**UL**: {0.03, 0.05 … 0.40}s, step 0.01 (0.03 only with Definite Time curve) | 0.03 | scaled *100 |
| | 40353 | 0353 | 0352 | 0160 | 1 | N/A | | Protection S thermal memory | | [ OFF \| ON ] | OFF | [ 0 \| 1 ] |
| | 40354 | 0354 | 0353 | 0161 | 1 | N/A | | Protection S zone selectivity | | [ OFF \| ON ] | OFF | [ 0 \| 1 ] |
| | 40355 | 0355 | 0354 | 0162 | 1 | N/A | | Protection S zone selectivity time | | [Tpgr \| {0.04…0.2}s, step 0.005] | 0.04 | scaled*1000 |
| | 40356 | 0356 | 0355 | 0163 | 1 | N/A | | Protection S start up threshold | | [OFF (0) \| {0.6 … 10}In, step 0.1] | OFF | scaled*10 |
| | 40357 | 0357 | 0356 | 0164 | 1 | N/A | | Protection D disable | | Disabled \| Enabled | Disabled | [1 \| 0] |
| | 40358 | 0358 | 0357 | 0165 | 1 | N/A | | Protection D threshold | | {0.6 …10}In, step 0.1 | 0.6 | scaled*10 |
| | 40359 | 0359 | 0358 | 0166 | 1 | N/A | | Protection D backward trip delay time | | {0.2 … 0.75}s, step 0.01 | 0.2 | scaled*100 |
| | 40360 | 0360 | 0359 | 0167 | 1 | N/A | | Protection D forward trip delay time | | {0.2 … 0.75}s, step 0.01 | 0.2 | scaled*100 |
| | 40361 | 0361 | 0360 | 0168 | 1 | N/A | | Protection D direction | | Forward \| Backward | Forward | [0 \| 1] |
| | 40362 | 0362 | 0361 | 0169 | 1 | N/A | | Protection D zone selectivity | | OFF \| ON | OFF | [0 \| 1] |
| | 40363 | 0363 | 0362 | 016A | 1 | N/A | | Protection D zone selectivity time | | [Tpgr \| {0.13…0.5}ms, step 0.01] | 0.13 | scaled*100 |
| | 40364 | 0364 | 0363 | 016B | 1 | N/A | | Protection D start up threshold | | [ OFF (0) \| {0.6 … 10.0}In, step 0.1 ] | OFF | scaled*10 |
| | 40365 | 0365 | 0364 | 016C | 1 | N/A | | Protection I disable | | Disabled \| Enabled | Disabled | [1 \| 0] |
| | 40366 | 0366 | 0365 | 016D | 1 | N/A | | Protection I threshold | | {1.5 …15}In, step 0.1 | 1.5 | scaled*10 |
| | 40367 | 0367 | 0366 | 016E | 1 | N/A | | Protection I start up threshold | | [ OFF (0) \| {1.5 … 15}In, step 0.1 ] | OFF | scaled*10 |
| | 40368 | 0368 | 0367 | 016F | 1 | N/A | | Protection G disable | | [ Disabled \| Enabled ] | Disabled | [ 1 \| 0 ] |
| | 40369 | 0369 | 0368 | 0170 | 1 | N/A | | Protection G curve time constant | | [ Definite Time \| Inverse Time ] | Definite Time | [ 0 \| 1 ] |
| | 40370 | 0370 | 0369 | 0171 | 1 | N/A | | Protection G threshold | | {0.2 …1.00}In, step 0.02 | 0.2 | scaled *100 |
| | 40371 | 0371 | 0370 | 0172 | 1 | N/A | | Protection G trip delay time | | **IEC**: {0.10 … 1.00} s, step 0.05<br>**UL**: {0.10 … 0.40} s, step 0.05 | 0.10 | scaled *100 |
| | 40372 | 0372 | 0371 | 0173 | 1 | N/A | | Protection G block trip | | [ Trip not allowed \| Trip allowed ] | Trip allowed | [ 1 \| 0 ] |
| | 40373 | 0373 | 0372 | 0174 | 1 | N/A | | Protection G zone selectivity | | [ OFF \| ON ] | OFF | [ 0 \| 1 ] |
| | 40374 | 0374 | 0373 | 0175 | 1 | N/A | | Protection G zone selectivity time | | [Tpgr \| {0.04…0.2}s, step 0.005] | 0.04 | scaled*1000 |
| | 40375 | 0375 | 0374 | 0176 | 1 | N/A | | Protection G start up threshold | | [ OFF (0) \| {0.2 … 1.0}In, step 0.02 ] | OFF | scaled*100 |
| | 40376 | 0376 | 0375 | 0177 | 1 | N/A | | Protection UN disable | | Disabled \| Enabled | Disabled | [1 \| 0] |
| | 40377 | 0377 | 0376 | 0178 | 1 | N/A | | Protection UN threshold | | {10 … 90}%, step 10 | 10% | |
| | 40378 | 0378 | 0377 | 0179 | 1 | N/A | | Protection UN trip delay time | | {0.5 … 60} s, step 0.5 | 0.5 | scaled*10 |
| | 40379 | 0379 | 0378 | 017A | 1 | N/A | | Protection UN block trip | | [ Trip not allowed \| Trip allowed ] | Trip allowed | [ 1 \| 0 ] |
| | 40380 | 0380 | 0379 | 017B | 1 | N/A | | Protection UV disable | | Disabled \| Enabled | Disabled | [1 \| 0] |
| | 40381 | 0381 | 0380 | 017C | 1 | N/A | | Protection UV threshold | | {0.6 … 0.95}Un, step 0.01 | 0.6 | scaled*100 |
| | 40382 | 0382 | 0381 | 017D | 1 | N/A | | Protection UV trip delay time | | {0.1 … 5}s, step 0.1 | 0.1 | scaled*10 |

**Table 52. AO – Buffer 'New parameters', Part 2**

| Section | Absolute Address | Relative Address | Relative Address - 1 | Relative Address - 1 (HEX) | Number of items | HIGH byte | LOW byte | Description | Comments | Range | Default | Mapped in |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 40383 | 0383 | 0382 | 017E | 1 | N/A | | Protection OV disable | | Disabled \| Enabled | Disabled | [1 \| 0] |
| | 40384 | 0384 | 0383 | 017F | 1 | N/A | | Protection OV threshold | | {1.05 … 1.2}Un, step 0.01 | 1.05 | scaled*100 |
| | 40385 | 0385 | 0384 | 0180 | 1 | N/A | | Protection OV trip delay time | | {0.1 … 5}s, step 0.1 | 0.1 | scaled*10 |
| | 40386 | 0386 | 0385 | 0181 | 1 | N/A | | Protection RV disable | | Disabled \| Enabled | Disabled | [1 \| 0] |
| | 40387 | 0387 | 0386 | 0182 | 1 | N/A | | Protection RV threshold | | {0.1 … 0.4}Un, step 0.05 | 0.1 | scaled*100 |
| | 40388 | 0388 | 0387 | 0183 | 1 | N/A | | Protection RV trip delay time | | {0.5 … 30}s, step 0.5 | 0.5 | scaled*10 |
| | 40389 | 0389 | 0388 | 0184 | 1 | N/A | | Protection RP disable | | Disabled \| Enabled | Disabled | [1 \| 0] |
| | 40390 | 0390 | 0389 | 0185 | 1 | N/A | | Protection RP threshold | | {-0.01 … -0.3}Pn, step -0.02 | -0.1 | scaled*100 |
| | 40391 | 0391 | 0390 | 0186 | 1 | N/A | | Protection RP trip delay time | | {0.5 … 25}s, step 0.1 | 0.5 | scaled*10 |
| | 40392 | 0392 | 0391 | 0187 | 1 | N/A | | Protection T block trip | | [ Trip not allowed \| Trip allowed ] | Trip allowed | [ 1 \| 0 ] |
| | 40393 | 0393 | 0392 | 0188 | 1 | N/A | | Load Controller disable | | Disabled \| Enabled | OFF | [1 \| 0] |
| | 40394 | 0394 | 0393 | 0189 | 1 | N/A | | Load Controller 1 opening threshold | | [ OFF (0) \| {0.50 … 1.00}*ITh(L), step 0.01 ] | OFF (0) | scaled*100 |
| | 40395 | 0395 | 0394 | 018A | 1 | N/A | | Load Controller 2 opening threshold | | [ OFF (0) \| {0.50 … 1.00}*ITh(L), step 0.01 ] | OFF (0) | scaled*100 |
| | 40396 | 0396 | 0395 | 018B | 1 | N/A | | Load Controller 2 closing threshold | | [ OFF (0) \| {0.50 … 1.00}*ITh(L), step 0.01 ] | OFF (0) | scaled*100 |
| | 40397 | 0397 | 0396 | 018C | 1 | N/A | | Load Controller 2 closing delay | | {10 … 120}s, step 5 | 10 | |
| | 40398 | 0398 | 0397 | 018D | 1 | N/A | | Load Controller 2 max auto-reclosure number | | {1 … 9} | 3 | |

**Table 53. AO – Buffer 'New parameters', Part 3**

**LEGENDA**

Ith(L) Protection L Threshold