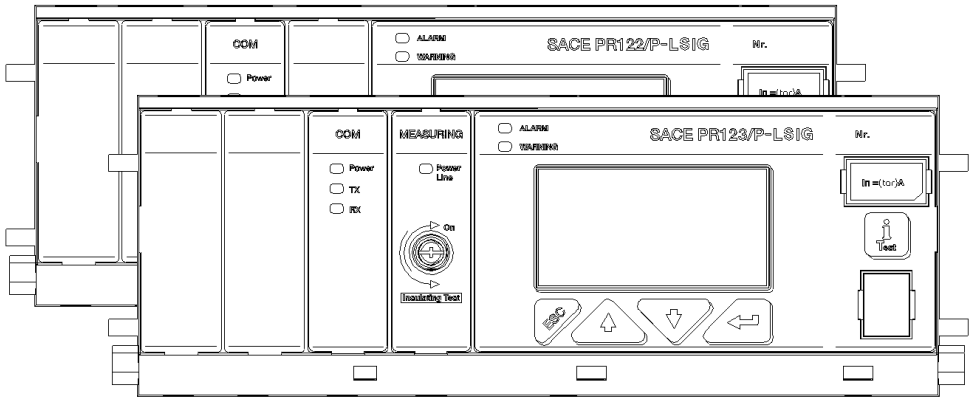
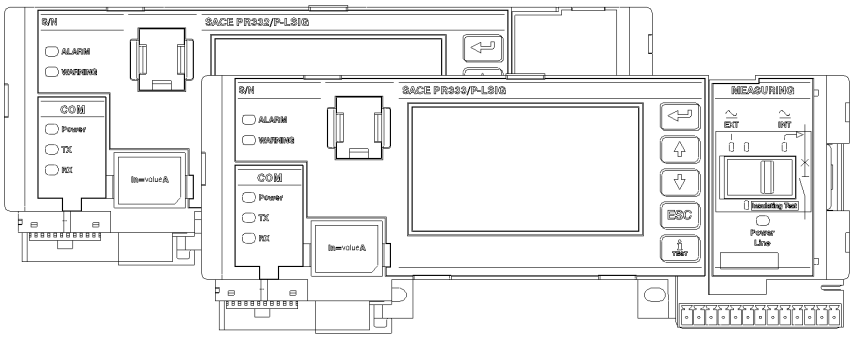
1SDH000556R0001 B0431

Modbus System Interface

Modbus system Interface for
Protection relays PR122/P and PR123/P + communication module PR120/D-M, mounted on CB New Emax
Protection relays PR332/P and PR333/P + communication module PR330/D-M, mounted on CB Emax X1, Tmax T7 and Tmax T8





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1. INTRODUCTION

The documents refer to the system bus Modbus interface of relays PR122/P and PR123/P mounted on New Emax power circuit breaker, and PR332/P and PR333/P mounted on Emax X1, Tmax T7 and Tmax T8 power circuit breaker.

1.1 SCOPE

The aim of this document is to indicate the addresses of all measures, parameters and information available in PR122/3 and PR332/3 relays.
Moreover it explains the procedure to read information and to program the parameters of the above mentioned protection units.

1.2 APPLICABILITY

This document applies to the device PR122/P - PR123/P equipped with the communication module PR120/D-M, and PR332/P - PR333/P equipped with the communication module PR330/D-M.
This version of the document refer to relays SW version 2.0 or major.

1.3 ACRONYM AND DEFINITION

1.3.1. Acronym

CB	Circuit Breaker
PR12x	Both protection relays PR122/P and PR123/P
PR33x	Both protection relays PR332/P and PR333/P
AI	Analog Input
AO	Analog Output
LSb	Least Significant Bit
LSB	Least Significant Byte
MSb	Most Significant Bit
MSB	Most Significant Byte
BOOL	Bit or Boolean (IEC 61131-3)
BYTE	Byte (IEC 61131-3)
WORD	Word (IEC 61131-3)
DWORD	Double word (IEC 61131-3)
LWORD	Long Word (IEC 61131-3)
SINT	Short Integer (IEC 61131-3)
USINT	Unsigned Short Integer (IEC 61131-3)
INT	Single Integer (IEC 61131-3)
UINT	Unsigned Integer (IEC 61131-3)
DINT	Double Integer (IEC 61131-3)
UDINT	Unsigned Double Integer (IEC 61131-3)
LINT	Long Integer (IEC 61131-3)
ULINT	Unsigned Long Integer (IEC 61131-3)
STRING	Text String (IEC 61131-3)
UNICODE	Unicode (IEC 61131-3)

1.3.2. Definitions

ALARM: there are two types of alarm:

Alarm Type	Definition
Alarm	It's similar to a status. A Trip Reset is NOT necessary to reset it. 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. Ex. L Tripped, S Tripped, ...

Table 1 Alarms type

BUFFER: meaningful part of a Modbus Map section. It's defined by the Modbus Map of the device.

CB RESET: event (Any Trip) /alarm reset of any information related to the (last) trip.

DEVICE: Protection Unit

EVENT: information that signals a normal (foreseen) device behaviour. Typically, the producer of an event is the device, while the consumer is the system.

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

PROTECTION TRIPS: sum of real protection trips (Σ LSIG trips). 'Real' means 'not caused by the Test Unit.

PROTECTION UNIT: PR122/3 and PR332/3 electronic device that implements protection algorithms

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

REMOTE SYSTEM: a device (SCADA) which behaves as Modbus Master on the external bus. It polls the information provided by the device and sends to it commands and parameters.

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 device tries to open the CB by starting a back-up procedure. Meanwhile, the device tries also to open the CB using the YO (through the I/O).

TRIP RESET: command equal to CB Reset

1.4 BIBLIOGRAPY

Schneider Automation Inc., 'Modicon MODBUS Protocol Reference Guide'

2. MODBUS PROTOCOL

2.1 Communication Parameters

Baud rate	Address	Addressing type	Physical protocol
9600/19200	1 ÷ 247	Standard / ABB	E, 8, 1 / O, 8, 1 / N, 8, 2 / N, 8, 1

The default unit configuration is:

Baud rate	Address	Addressing type	Physical protocol
19200	247	Standard	E, 8, 1

Table 2 and 3 Available and default communication parameters

2.2 Device RTU Framing

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

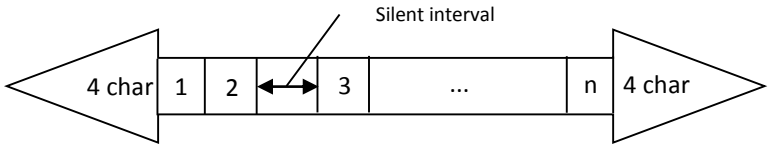
2.2.1. Silent interval < 4 char between two characters inside the message

In this case the receiver filters the silent interval and the following characters will be appended to those already received.

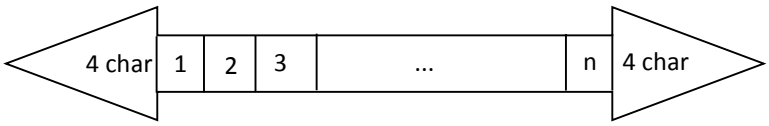
The difference from the protocol specification is:

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

Transmitter



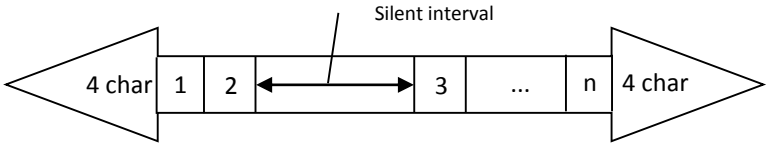
Receiver



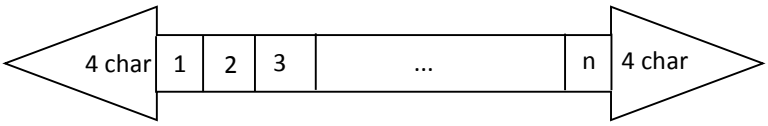
The behaviour is exactly as specified by the protocol.

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

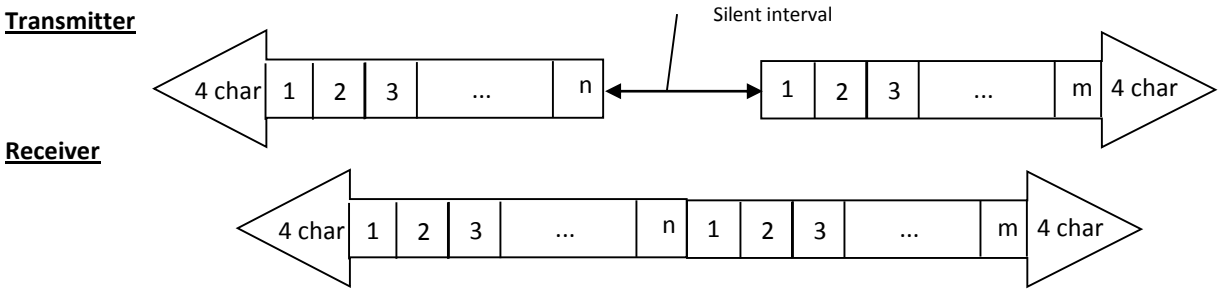
The device behaviour **doesn't cover the second case** because it always appends new incoming characters to the previous ones, leading to a CRC error.
So the behaviour is exactly the same if and only if the incoming characters are NOT a new message. In this case the received packet will lead to a CRC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

2.2.2. 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.

2.2.3. 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.
This will lead to a CRC error.



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

2.3 Unit identification

Unit	Slave ID
PR122/P	0x51
PR123/P	0x52
PR332/P	0x55
PR333/P	0x56
PR332/P MM	0x25

Table 4 Unit identification

2.4 Available Modbus functions

Function Code		Name	Applicable to
03 (03h)		Read Holding Registers	AO
04 (04h)		Read Input Registers	AI
06 (06h)		Write Single Register	AO
Funct. Code	**Subf. Code**	**Name**	**Applicable to**
08 (08h)	00 (00H)	Diagnostic Loop back	---
Function Code		**Name**	**Applicable to**
16 (10h)		Write Multiple Registers	AO
17 (11h)		Report Slave ID	---
70 (46h)		Read Extended Registers	Extended Reg.

Table 5 Available Modbus functions

Note: *all queries must respect the limitation of maximum modbus message length of 256 byte*

Legend:

AA = slave address (1 247)
cl = byte low of CRC
ch = byte high of CRC

2.4.1. Function 03 (03h) Read Holding Registers

Query

Addr	Function	Starting address		Number of registers		Crc	
AA	03h	High	Low	High	Low	ch	cl

***Note**: number of registers ≤ 125*

Response

Addr	Function	Byte count	Register value		…	Register value		Crc	
AA	03h	nn	High	Low	…	High	Low	ch	cl

Table 6 and 7 Function 3 query and response

2.4.2. Function 04 (04h) Read Input Registers

Query

Addr	Function	Starting address		Nr of input registers		Crc	
AA	04h	High	Low	High	Low	ch	cl

***Note**: number of registers ≤ 125*

Response

Addr	Function	Byte count	Input register		…	Input register		Crc	
AA	04h	nn	High	Low	…	High	Low	ch	cl

Table 8 and 9 Function 4 query and response

2.4.3. Function 06 (06h) Write Single Register

Query

Addr	Function	Register address		Register value		Crc	
AA	06h	High	Low	High	Low	ch	cl

Response (echo of query)

Addr	Function	Register address		Register value		Crc	
AA	06h	High	Low	High	Low	ch	cl

Table 10 and 11 Function 6 query and response

2.4.4. Function 08 (08h) Diagnostic

Query

Addr	Function	Sub function		Data	…	Crc	
AA	08h	00h	00h	yy	…	ch	cl

***Note**: 0 ≤ Number of data bytes ≤ 250, any value*

Response (echo of query)

Addr	Function	Sub function		Data	…	Crc	
AA	08h	00h	00h	yy	…	ch	cl

Table 12 and 13 Function 8 query and response

2.4.5. Function 16 (10h) Write Multiple Registers

Query

Addr	Funct	Starting addr		Num of registers		Byte count	Reg value		…	Reg value		Crc	
AA	10h	High	Low	High	Low	Nn	High	Low	…	High	Low	ch	cl

***Note**: number of registers ≤ 123*

Response

Addr	Function	Starting address		Number of register		Crc	
AA	10h	High	Low	High	Low	ch	cl

Table 14 and 15 Function 16 query and response

2.4.6. Function 17 (11h) Report slave ID

Query

Addr	Function	Crc	
AA	11h	ch	Cl

Response

Addr	Function	Byte count	Slave ID	Run indicator	Sw Version		Events addr		Device Ser Nr	Crc	
AA	11h	16h	ID	0FFh	High	Low	High	Low	16 byte (ASCII)	ch	cl

Table 16 and 17 Function 17 query and response

2.4.7. Function 70 (46h) Read Extended Registers

Query

Addr	Function	Byte count	Ref type	File number		Starting address		Number of registers		Crc	
AA	46h	07h	06h	High	Low	High	Low	High	Low	ch	cl

***Notes**:*

1. *File number ≤ 3*
2. *Starting address ≤ 65535*
3. *Number of registers ≤ 125*

Response

Addr	Funct	Byte count	Ref type	Reg value		…	Reg value		Crc	
AA	46h	Nn	06h	High	Low	…	High	Low	ch	cl

Table 18 and 19 Function 70 query and response

2.5 Exception responses

Illegal function:

Addr	Function	Exception code	Crc	
AA	Function + 80h	01h	ch	cl

Illegal data address:

Addr	Function	Exception code	Crc	
AA	Function + 80h	02h	ch	cl

Illegal data value:

Addr	Function	Exception code	Crc	
AA	Function + 80h	03h	ch	cl

Slave device failure:

Addr	Function	Exception code	Crc	
AA	Function + 80h	04h	ch	cl

Slave device busy:

Addr	Function	Exception code	Crc	
AA	Function + 80h	06h	ch	cl

Table 20, 21, 22, 23 and 24 Exception responses

2.5.1. Exception occurrences

		Exception				
		01 Illegal function	02 Illegal data address	03 Illegal data value	04 Slave device failure	06 Slave device busy
QUERY FUNCTION	03		Starting address not valid	- Invalid query length - Requested number of register too large - Address out of modbus map		
	04		Starting address not valid	- Invalid query length - Requested number of register too large - Address out of modbus map		Reading attempt of busy non-volatile memory at present
	06		- Starting address not valid - Write of TIME information not allowed with this function	Invalid query length		- Local state - Programming session already open - Programming session not open
	08			- Sub function ≠ 00 00 - Invalid query length		
	16		Starting address not valid	- Invalid query length - Number of register too large - Address out of modbus map - Command not available - Command parameter filed not valid - Wrong Time	Parameters error check after a stop programming session command	- Local state - Programming session already open - Programming session not open - Command acceptance conditions not verified
	17			Invalid query length		
	70		Starting address not valid	- Invalid query length - Requested number of register too large - Address out of modbus map - Field Ref Type not correct - Field Byte count not correct		Reading attempt of busy data logger
	Other	Function not available				

Table 25 Exception responses

3. MODBUS MAP

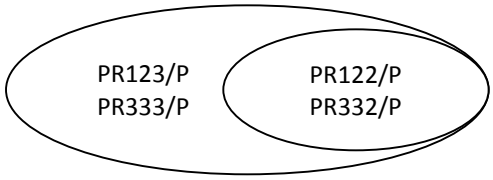
Data format LINT (Acronym 1.3.1) (4 byte = 2 word = 2 register) is transferred with low significant part at lower modbus address (LOW-HIGH)

Register i	LS word
Register i + 1	MS word

Instead within WORD data the most significant byte is transferred first (as in MODBUS RTU standard)

MS byte	LS byte

Since the PR122/P and PR332/P information set is a subset of PR123/P and PR333/P set, it was decided to represent them in only one general map from which is possible to deduce information of each device.



For this purpose in each table it was foreseen a column named PR12x/PR33x in which, row by row, are shown the device and the product execution where the information has mean. The explanation of how to read column PR12x/PR33x follows:

PR12x PR33x	***Meaning***
3	Information available for PR123/P and PR333/P LSI/LSIG and NOT available for other units
3 G	Information available for PR123/P and PR333/P LSIG and NOT available for other units
2/3 S	Information available for PR122/P and PR332/P LSI/LSIG, PR123/P and PR333/P LSI/LSIG and NOT available for other units
2/3 G	Information available for PR122/P and PR332/P LSIG, PR123/P and PR333/P LSIG and NOT available for other units
2/3	Information available for PR122/P and PR332/P LI/LSI/LSIG, PR123/P and PR333/P LSI/LSIG
2/3 Rc	The contained information in the line is worth for PR122/P, PR332/P and PR123/P,PR333/P Rc versions and is NOT AVAILABLE for the other units
$2^{33x}/3^{33x}$	The contained information in the line is worth for PR332/P and PR333/P versions and is NOT AVAILABLE for the PR122/P and PR123/P units
$2^{\sout{33x}}/3^{\sout{33x}}$	The contained information in the line is worth for PR122/P and PR123/P versions and is NOT AVAILABLE for the PR332/P and PR333/P units
MM	The contained information in the line is worth for PR332/P MM unit and is NOT AVAILABLE for all the others units
~~*MM*~~	Not available for PR332/P MM unit

Table 26 Code meaning

WARNING: Parameters declared NOT AVALAIBLE for a unit are treated in the same way than the others, they are saved and checked in validity range but they are not used by the protections.
Reading parameters declared NOT AVAILABLE could return not consistent data in respect to the ones previously programmed.

Example:

Program on PR122 the directional protection (NOT AVAILABLE for PR122) with the following data:

- *Prot D configuration = 0x0001 (Prot enable = ON)*
- *Prot D Prot threshold Forward = 1 In*

Programming will be accepted because data is valid but D protection will remain disabled, therefore reading the parameters just programmed will return:

- *Prot D configuration = 0x0000 (Prot enable = OFF)*
- *Prot D Prot threshold Forward = 1 In*

3.1 Unit configuration

3.1.1. Protection

The following table shows the available protections for each type of device and possible necessary conditions:

	PR122/P - PR332/P					PR123/P - PR333/P	
	LI	**LSI**	**LSIG**	**LSIRc**	**LSIG MM([5])**	**LSI**	**LSIG**
L	✳	✳	✳	✳	✳	✳	✳
S		✳	✳	✳	✳	✳	✳
S2						✳	✳
D						MEAS([1])	MEAS([1])
I	✳	✳	✳	✳	✳	✳	✳
G			NOSGR		✳		✳
MCR	✳([4])	✳([4])	✳([4])	✳([4])		✳([4])	✳([4])
MM					✳		
Gext			SGR				SGR
Gext (Idn)			RCM	RCM([1])			RCM([1])
U	✳	✳	✳	✳	✳	✳	✳
UV	MEAS	MEAS	MEAS			MEAS([1])	MEAS([1])
OV	MEAS	MEAS	MEAS			MEAS([1])	MEAS([1])
RV	MEAS QP	MEAS QP	MEAS QP			MEAS([1]) QP	MEAS([1]) QP
RP	MEAS	MEAS	MEAS			MEAS([1])	MEAS([1])
UF	MEAS	MEAS	MEAS			MEAS([1])	MEAS([1])
OF	MEAS	MEAS	MEAS			MEAS([1])	MEAS([1])
T	✳	✳	✳	✳	✳	✳	✳
LC	✳([2])	✳([2])	✳([2])	✳([2])	✳([2])	✳([2])	✳([2])
Hw prot.	✳	✳	✳	✳	✳	✳	✳
Phase rotation([3])						MEAS([1])	MEAS([1])
CosΦ module([3])						MEAS([1])	MEAS([1])
Frequency Error([3])	MEAS	MEAS	MEAS			MEAS([1])	MEAS([1])
Harm distortion([3])	✳	✳	✳	✳	✳	✳	✳

Table 27 Protections

Legend:

- ✳: Available without condition
- **NOSGR:** External Toroid absent (Ext Toroid Type (addr 1032) = 0)
- **SGR:** External Toroid = Source Ground Return (Ext Toroid Type (addr 1032) = 1)
- **RCM:** External Toroid = Residual Current (Ext Toroid Type (addr 1032) = 2) + Measuring Module present
- **MEAS:** Measuring Module present
- **QP:** "CB 4 pole" otherwise neutral voltage present (Unit configuration (addr 1020) bit 5 = 1)
- **([1]):** Measuring Module always present on PR122 LSIRc, PR332 LSIRc and PR123, PR333
- **([2]):** Load control always enabled on state bits but feasible only if present signaling module or output unit on local bus (ex: Flex Interface)
- **([3]):** Warning functions.
- **([4]):** Activable in alternative to I protection, and only with CB X1 type.
- **([5]):** LSIG MM version available only with PR332/P MM

3.1.2. MEASURES

The following table shows the available measures for each type of device and possible necessary conditions:

	PR122/P - PR332/P					PR123/P - PR333/P	
	LI	**LSI**	**LSIG**	**LSIRc**	**LSIG MM**	**LSI**	**LSIG**
Line currents	✳	✳	✳	✳	✳	✳	✳
Neutral current	Ne	Ne	Ne	Ne	Ne	Ne	Ne
Ground current			NOSGR		✳		✳
External toroid ground current			SGR or RCM	RCM(1)			SGR or RCM(1)
Line to neutral voltages	MEAS QP	MEAS QP	MEAS QP		MEAS QP	MEAS(1) QP	MEAS(1) QP
Line to line voltages	MEAS	MEAS	MEAS		MEAS	MEAS(1)	MEAS(1)
Line to neutral power	MEAS QP	MEAS QP	MEAS QP		MEAS QP	MEAS(1) QP	MEAS(1) QP
Total power	MEAS	MEAS	MEAS		MEAS	MEAS(1)	MEAS(1)
Power factor	MEAS	MEAS	MEAS		MEAS	MEAS(1)	MEAS(1)
Net frequency	MEAS	MEAS	MEAS		MEAS	MEAS(1)	MEAS(1)
Peak factor	✳	✳	✳	✳	✳	✳	✳
Neutral crest factor	Ne	Ne	Ne	Ne	Ne	Ne	Ne
Energy	MEAS	MEAS	MEAS			MEAS(1)	MEAS(1)
Trip history	✳	✳	✳	✳	✳	✳	✳
Log event history	✳	✳	✳	✳	✳	✳	✳
Measures history	✳	✳	✳	✳	✳	✳	✳
Contact wear	✳	✳	✳	✳	✳	✳	✳
Current waveform						✳	✳
Neutral current waveform						Ne	Ne
Line to line voltage waveform						MEAS(1)	MEAS(1)
Current harmonics						✳	✳
Neutral current harmonics						Ne	Ne
Line to line voltage harmonics						MEAS(1)	MEAS(1)
Data logger	✳	✳	✳	✳	✳	✳	✳

Table 28 Active measures

Legend:

- **✳:** Available without condition
- **QP:** "CB 4 pole" otherwise neutral voltage present (Unit configuration (addr 1020) bit 5 = 1)
- **MEAS:** Module Measuring present
- **(1):** Measuring Module always present on PR122 LSIRc, PR332 LSIRc and PR123, PR333
- **Ne:** Neutral connection present (CB 4 pole o 3 pole + neutral)
- **NOSGR:** External Toroid absent (Ext Toroid Type (addr 1032) = 0)
- **SGR:** External Toroid = Source Ground Return (Ext Toroid Type (addr 1032) = 1)
- **RCM:** External Toroid = Residual Current (Ext Toroid Type (addr 1032) = 2) + Measuring Module present.

3.2 REGISTERS MAP

Relative Address	*AI [30001]*	*AO [40001]*			
	Function 4 (2.4.2)	*Function:*	*16 (2.4.5)*	*3 (2.4.1)*	*6 (2.4.3)*
0	STATISTICAL DATA (4.2)	COMMANDS (4.1)			
50	PROGR. FAIL ERROR CODE (4.3)				
100	STATE(4.4)	TIME (*)			
200	RUN TIME MEASURES (4.5)				
600	HARMONICS MEASURES (4.7)				
700	INFORMATION (4.8)				
800	LOCAL BUS DATA AREA (4.9)				
1000	***PAR. CONFIG1 ACTUAL (4.10)***				
1020	***PAR. CONFIG2 ACTUAL (4.11)***				
1050	***PAR. CONFIG3 ACTUAL (4.12)***	PAR. CONFIG3 NEW (*)			
1100	***PAR. PROT. SET1 ACTUAL (4.13)***	PAR. PROT SET1 NEW (*)			
1200	***PAR. PROT. SET2 ACTUAL (4.13)***	PAR. PROT SET2 NEW (*)			
2000	***TRIP HISTORY (4.14)***				
2500	***MEASURES HISTORY (4.15)***				
3300	***LOG EVENTS (4.16)***				
4000	WAVEFORMS (4.17)				

Table 29 Registers map

WARNING: ***NON-VOLATILE memory*** : could be busy (busy exception response)
(*) Parameters that can be written only during an open programming session

Example of table reading:

RUN-TIME MEASURES analog input absolute address: 30001+ offset (200) = 30201
The relative address is offset (200) = 200

3.3 LOGGER MAP (extended registers)

WARNING: Addressing type "ABB" cannot be used for these registers, therefore the address field will be always included between 1 and 65536 for all addressing methods

File Number	*Sample Number*	*Extended Reg. (60000)*			*PR12x PR33x*
		Function 70			
		Rel. address	*Description*	*Notes*	
File 0 (Old)	Samples 0 (Old)	0	L1 current sample	(1)	2/3
		1	L2 current sample	(1)	2/3
		2	L3 current sample	(1)	2/3
		3	Ne current sample	(1)	2/3
		4	External Ground (SGR/Rc sensor) current sample	(4)	2/3 G
		5	L1 MSP current sample	(2)	2/3
		6	L2 MSP current sample	(2)	2/3
		7	L3 MSP current sample	(2)	2/3
		8	Ne MSP current sample	(2)	2/3
		9	V1 voltage sample	(3)	2/3
		10	V2 voltage sample	(3)	2/3
		11	V3 voltage sample	(3)	2/3
		12	Input/Output status	See Table 31 TAB_INPUT_OUTPUT	2/3
		13	Alarms 1 status	See Table 33 TAB_ALARM_1	2/3
		14	Alarm 2 status	See Table 34 TAB_ALARM_2	2/3
		15	Trip 1 status	See Table 32 TAB_TRIP	2/3
	Samples 1	16 ÷ 31	"	"	2/3
	…	…	"	"	2/3
	Samples 4095 (New)	65519 ÷ 65535	"	"	2/3
File 1	Samples 0 ÷ Samples 4095	0 ÷ 65535	"	"	2/3
File 2	Samples 0 ÷ Samples 4095	0 ÷ 65535	"	"	2/3
File 3 (New)	Samples 0 ÷ Samples 4095	0 ÷ 65535	"	"	2/3

Table 30 Logger map

Notes:

(1) Signal derivative samples (538 rms means 1In rms @ 50Hz)

(2) Signal derivative samples

For PR12x and PR33x with DSP version before of 2.05:

If net frequency = 50Hz 1 means 72,6 Arms @ 50Hz

If net frequency = 60Hz 1 means 72,6 Arms @ 60Hz

For PR33x with DSP version 2.05:

If net frequency = 50Hz 1 means 52,3 Arms @ 50Hz

If net frequency = 60Hz 1 means 52,3 Arms @ 60Hz

(3) Signal samples (750 rms means 71,04Vrms)

(4) If SGR connected

Signal derivate samples (552 rms means 46,84 Arms @ 50Hz for Toroid of 100/250A)

Signal derivate samples (552 rms means 160 Arms @ 50Hz for Toroid of 400/800A)

If Rc connected

Signal samples (371 rms means 1 Arms)

Bit	Description
0	Local bus Relay 1 contact
1	Local bus Relay 2 contact
2	Local bus Relay 3 contact
3	Local bus Relay 4 contact
4	---
5	Local bus Relay 6 contact
6	Local bus Relay 7 contact
7	Local bus Relay 8 contact
8	Relay P1 contact
9	Relay P2 contact
10	Relay P3 contact
11	Relay P4 contact
12	S zone selectivity input
13	S zone selectivity output
14	G zone selectivity input
15	G zone selectivity output

Table 31 TAB_INPUT_OUTPUT

Bit	Description
0	L tripped
1	S tripped
2	S2 tripped
3	I tripped
4	Iinst tripped
5	G tripped
6	G ext tripped
7	T tripped
8	D tripped
9	U tripped
10	UV tripped
11	OV tripped
12	RV tripped
13	RP tripped
14	UF tripped
15	OF tripped

Table 32 TAB_TRIP

Bit	Description
0	Harmonic distortion > 2.1
1	Contact Wear Pre-alarm
2	Contact Wear Alarm
3	L Pre-alarm
4	L Timing
5	S Timing
6	S2 Timing
7	G Timing
8	G Alarm (Blocked Trip)
9	G Ext Timing
10	G Ext Alarm (Blocked Trip)
11	T Pre-alarm
12	T Alarm
13	T Alarm (Blocked Trip)
14	D Timing
15	U Timing

Table 33 TAB_ALARM_1

Bit	Description
0	U Alarm (Blocked Trip)
1	UV Timing
2	UV Alarm (Blocked Trip)
3	OV Timing
4	OV Alarm (Blocked Trip)
5	RV Timing
6	RV Alarm (Blocked Trip)
7	RP Timing
8	RP Alarm (Blocked Trip)
9	UF Timing
10	UF Alarm (Blocked Trip)
11	OF Timing
12	OF Alarm (Blocked Trip)
13	Frequency Error
14	Iw Warning
15	LC1 Alarm

Table 34 TAB_ALARM_2

4. DESCRIPTION OF REGISTERS

4.1 COMMANDS

Rel addr	*# of item*	*Name*	*Notes*	*PR12x PR33x*
0	1	COMMAND TYPE	Table 36 TAB_COMMANDS	2/3
1	1	COMMAND PARAMETER	Table 36 TAB_COMMANDS	2/3

Table 35 Commands

To execute a command it is requested to write together to COMMAND TYPE field the number desired and to COMMAND PARAMETER field the optional parameter value (0 if not needed) with 17odbus function 16 also if the parameters value is not necessary.

Example 1*: to send "Trip reset" command, write "01" at COMMAND TYPE address and "00" at COMMAND PARAMETER address (parameter not necessary for this command).*

Example 2*: to send "Waveform + harmonics acquisition start" Command on L2 phase, write "16" at COMMAND TYPE address and "02" at COMMAND PARAMETER address.*

Following the command list table with pertinent command parameters.

Value	*Command type*	*Parameter*	*PR12x PR33x*
0	Dummy command	don't care	2/3
1	Trip reset	don't care	2/3
2	Signaling reset	don't care	2/3
3	Communication statistics reset	don't care	2/3
4	Log events reset	don't care	2/3
5	Start programming session	don't care	2/3
6	Abort programming session	don't care	2/3
7	Stop programming session	don't care	2/3
8	CB Open	don't care	2/3
9	CB Close	don't care	2/3
10	CB reset	don't care	2/3
11	Wink toggle command	don't care	2/3
12	History measure reset	don't care	2/3
13	Energy counters reset	don't care	2/3
14	Data logger trigger restart	don't care	2/3
15	Data logger stop	don't care	2/3
16	Waveform + harmonics acquisition start	Table 37 TAB_WAV	3
17	Waveform + harmonics acquisition stop	don't care	3

Table 36 TAB_COMMANDS

Value	*Channel*
0	---
1	L1
2	L2
3	L3
4	NE
5	V12
6	V23
7	V31

Table 37 TAB_WAV

4.2 STATISTICAL DATA

Rel addr	*# of item*	*Description*	*Representation*	*Notes*	*PR12x PR33x*
0	1	Received message number	0 ÷ 65535	*NOT updated in self-supply* Received msg n° = Received msg n° with crc error + Sent msg n° + Received broadcast msg n°.	2/3
1	1	Received message number with crc error	0 ÷ 65535	*NOT updated in self-supply*	2/3
2	1	Sent message number	0 ÷ 65535	*NOT updated in self-supply* Total exception response number included	2/3
3	1	Slave Busy exception number responses	0 ÷ 65535	*NOT updated in self-supply*	2/3
4	1	Total exception response number	0 ÷ 65535	*NOT updated in self-supply* Slave Busy exception number response included	2/3
5	1	Contact wear	0 ÷ 65000 (100% = 65000) CW > 100% → 65000	*Updated in self-supply too*	2/3
6	1	Total trip protection number	0 ÷ 65535	*Updated in self-supply too* Protection trip fail number included	2/3
7	1	Total operation number	0 ÷ 65535	*NOT updated in self-supply* Total operation n° = Manual operation n° + protection trip n° + protection trip fail n° + trip test n°.	2/3
8	1	Manual operation number	0 ÷ 65535	*NOT updated in self-supply*	2/3
9	1	Total trip protection number	0 ÷ 65535	*NOT updated in self-supply* Protection trip fail number NOT included	2/3
10	1	Trip protection fail number	0 ÷ 65535	*NOT updated in self-supply*	2/3
11	1	Trip test number	0 ÷ 65535	*NOT updated in self-supply*	2/3

Table 38 Statistical Data

WARNING: Registers from address 0 to 4 compose the communication statistics, registers from address 6 to 11 compose CB operation statistics

4.3 PROGR FAIL ERROR CODE

Rel addr	*# of item*	*Description*	*Note*	*PR12x PR33x*
50	1	Programming Fail Error Code	**0:** No error **1 ÷ 999:** See Table 40 TAB_PAR_ERR_CODE Fail Error refer to **SET 1** (1xxx) and **SET 2** (2xxxx) **x001:** L Th ≥ S Th **x002:** S Th ≥ I Th **x003:** L Th ≥ S2 Th **x004:** S2 Th ≥ I Th **x005:** L Th ≥ D Th **x006:** D Th ≥ I Th **x007:** (Only with CB UL) G Th > 1200A **x008:** (Only with CB UL) Startup G Th > 1200A **x009:** Selettivita di zona D attiva contemp. A sel zona S o S2 o G o Gext **x010:** (Only with CB UL) Tempo S > 400 ms **x011:** (Only with CB UL) Tempo S2 > 400 ms **x012:** (Only with CB UL) Tempo G > 400 ms **x013:** (Only with CB UL) Tempo Gext > 400 ms **x014:** (Only with CB UL) Curva L diversa da $I^2t=k$ Common: **3001:** Error during language exchange **3002:** Error on Rc Sense **3003:** Error on internal neutral configuration	2/3

Table 39 Program Fail Error

Par error code			Parameters address
min	max	Step	
0	1	2	Not used
3	4	5	1020
6	7	8	1050
12	13	14	1021
15	16	17	1022
18	19	20	1023
21	22	23	1024
24	25	26	1025
27	28	29	1026
30	31	32	1051
33	34	35	1083
60	61	62	1028
63	64	65	1029
66	67	68	Reserved
69	70	71	Reserved
72	73	74	1095
75	76	77	1096
78	79	80	1084
81	82	83	1085
84	85	86	1086
87	88	89	1087
90	91	92	1088
93	94	95	1089
96	97	98	1090
99	100	101	1091
102	103	104	1092
105	106	107	1093
108	109	110	1027
111	112	113	1094
114	115	116	1032
117	118	119	1097
120	121	122	1098
123	124	125	1052
126	127	128	1067
129	130	131	1053
132	133	134	1054
135	136	137	1055
138	139	140	1056
141	142	143	1057
144	145	146	1058
147	148	149	1059
150	151	152	1060
153	154	155	1061
156	157	158	1062
159	160	161	1063
162	163	164	1064
165	166	167	1065
168	169	170	1066
171	172	173	1068
174	175	176	1069
177	178	179	1070
180	181	182	1071
183	184	185	1072
186	187	188	1073
189	190	191	1074
192	193	194	1075

Par error code			Parameters address
min	max	Step	
195	196	197	1076
198	199	200	1077
201	202	203	1078
204	205	206	1079
207	208	209	1080
210	211	212	1081
213	214	215	1082
240	241	242	1100
243	244	245	1101
246	247	248	1102
249	250	251	1104
252	253	254	1103
255	256	257	1105
258	259	260	1106
261	262	263	1107
264	265	266	1108
267	268	269	1110
270	271	272	1112
273	274	275	1109
276	277	278	1111
279	280	281	1113
282	283	284	1114
285	286	287	1115
288	289	290	1116
291	292	293	1118
294	295	296	1117
297	298	299	1119
300	301	302	1120
303	304	305	1121
306	307	308	1122
309	310	311	1125
312	313	314	1123
315	316	317	1124
318	319	320	1126
321	322	323	1127
324	325	326	1128
327	328	329	1129
330	331	332	1130
333	334	335	1131
336	337	338	1132
339	340	341	1133
342	343	344	1134
345	346	347	1136
348	349	350	1138
351	352	353	1135
354	355	356	1137
357	358	359	1139
360	361	362	1140
363	364	365	1141
366	367	368	1142
369	370	371	1143
372	373	374	1145
375	376	377	1147
378	379	380	1144
381	382	383	1146
384	385	386	1148
387	388	389	1149

Par error code			Parameters address
min	max	Step	
390	391	392	1176
393	394	395	1177
396	397	398	1178
399	400	401	1150
402	403	404	1151
405	406	407	1152
408	409	410	1153
411	412	413	1154
414	415	416	1155
417	418	419	1156
420	421	422	1157
423	424	425	1158
426	427	428	1159
429	430	431	1160
432	433	434	1161
435	436	437	1162
438	439	440	1163
441	442	443	1164
444	445	446	1165
447	448	449	1166
450	451	452	1167
453	454	455	1168
456	457	458	1169
459	460	461	1170
462	463	464	1171
465	466	467	1172
468	469	470	1173
471	472	473	1174
474	475	476	1175
477	478	479	1179
480	481	482	1180
483	484	485	1181
486	487	488	1200
489	490	491	1201
492	493	494	1202
495	496	497	1204
498	499	500	1203
501	502	503	1205
504	505	506	1206
507	508	509	1207
510	511	512	1208
513	514	515	1210
516	517	518	1212
519	520	521	1209
522	523	524	1211
525	526	527	1213
528	529	530	1214
531	532	533	1215
534	535	536	1216
537	538	539	1218
540	541	542	1217
543	544	545	1219
546	547	548	1220
549	550	551	1221
552	553	554	1222
555	556	557	1225
558	559	560	1223

Par error code			Parameters address
min	max	Step	
561	562	563	1224
564	565	566	1226
567	568	569	1227
570	571	572	1228
573	574	575	1229
576	577	578	1230
579	580	581	1231
582	583	584	1232
585	586	587	1233
588	589	590	1234
591	592	593	1236
594	595	596	1238
597	598	599	1235
600	601	602	1237
603	604	605	1239
606	607	608	1240
609	610	611	1241
612	613	614	1242
615	616	617	1243
618	619	620	1245
621	622	623	1247
624	625	626	1244
627	628	629	1246
630	631	632	1248
633	634	635	1249
636	637	638	1276
639	640	641	1277
642	643	644	1278
645	646	647	1250
648	649	650	1251
651	652	653	1252
654	655	656	1253
657	658	659	1254
660	661	662	1255
663	664	665	1256
666	667	668	1257
669	670	671	1258
672	673	674	1259
675	676	677	1260
678	679	680	1261
681	682	683	1262
684	685	686	1263
687	688	689	1264
690	691	692	1265
693	694	695	1266
696	697	698	1267
699	700	701	1268
702	703	704	1269
705	706	707	1270
708	709	710	1271
711	712	713	1272
714	715	716	1273
717	718	719	1274
720	721	722	1275
723	724	725	1279
726	727	728	1280
729	730	731	1281

Table 40 TAB_PAR_ERR_CODE

Legend:

min: the code inserted is lower than the minimum available (ex: Par Err Code=252 ⇒ inserted at address 1103 a value< 300)

max: the code inserted is higher than the maximum available (ex: Par Err Code=253 ⇒ inserted at address 1103 a value > 14400)

step: the code inserted has not the requested step (ex: Par Err Code=254 ⇒ inserted at address 1103 a value = 302)

4.4 STATE

Symbols (↑) and (↕) marks state bits whose variation are traced in the events log; (↑) means that variation from 0 to 1 is traced, instead (↕) means that variation from 1 to 0 is traced too.

Rel addr	*# of item*	*Name*	*Bit*	*Description*	*Notes*	*PR12x PR33x*	*Custom Byte N°*
100	1	STATE 1 GLITCH Note 4	BIT 0 (↑)	Parameter changed	1 = Parameter(s) changed	2/3	1
			BIT 1	Historical Measure Update	1 = History measures updated	2/3	
			BIT 2	Waveform available	1 = Waveform available	3	
			BIT 3 (↑)	Signaling Reset	1 = Signaling reset	2/3	
			BIT 4	Trip Reset	1 = Trip Reset Command executed	2/3	
			BIT 5	CB Reset	1 = CB Reset Command executed	2/3	
			BIT 6	Dummy Command	1 = Dummy Command executed	2/3	
			BIT 7	Energy Reset	1 =Energy Reset Command executed	2/3	
			BIT 8	Dual Set Change	1 = Dual Set Changed	3	2
			BIT 9	---	---	---	
			BIT 10	---	---	---	
			BIT 11	---	---	---	
			BIT 12	---	---	---	
			BIT 13	---	---	---	
			BIT 14	---	---	---	
			BIT 15	---	---	---	
101	1	STATE 2 FLAGS	BIT 0	Any Alarm / Timing / Warning	OR of alarms	2/3	3
			BIT 1	Any Trip	OR of Trips (latched)	2/3	
			BIT 2	CB tripped	1 = CB tripped	2/3	
			BIT 3 (↕)	CB connected / isolated	0 = Isolated, 1 = Connected	2/3	
			BIT 4 (↕)	CB open/closed	0 = Open, 1 = Closed	2/3	
			BIT 5 (↕)	CB undefined	1 = Undefined	2/3	
			BIT 6 (↕)	No communication on Local Bus	1 = No communication on LB	2/3	
			BIT 7	Springs charged/discharged	0 = Discharged, 1 = Charged	2/3	
			BIT 8 (↑)	Trip command fail	1 = Trip command failed	2/3	4
			BIT 9 (↕)	Local / Remote Operating Mode	0 = Local, 1 = Remote	2/3	
			BIT 10	Programming OK	1 = Programming OK	2/3	
			BIT 11	Programming Fail	1 = Programming Failed	2/3	
			BIT 12	Internal Bus programming session	1 = Bus SSI session open	2/3	
			BIT 13	Test Bus programming session	1 = Bus Test session open	2/3	
			BIT 14	Local Bus programming session	1 = Bus Local session open	2/3	
			BIT 15	System Bus programming session	1 = Bus Ext session open	2/3	
102	1	STATE 3 FLAGS	BIT 0 (↕)	Test Session	1 = Test session open	2/3	5
			BIT 1 (↕)	Test Unit connected	1 = Test unit connected	2/3	
			BIT 2	BT unit present	1 = BT unit present	2~~33x~~/3~~33x~~	
			BIT 3	Signaling module present	1 = Signaling module present	2/3	
			BIT 4	Dialog unit present	1 = Dialog unit present	2/3	
			BIT 5	Measuring unit present	1 = Measuring unit present	2/3	
			BIT 6	Display Off for high temp	1 = Display Off	2/3	
			BIT 7	Waiting Trigger	1 =Waiting trigger	2/3	
			BIT 8	Data logger Triggered	1 = Triggered	2/3	6
			BIT 9	Data logger stopped	1 = Stopped	2/3	
			BIT 10 (↕)	Active Dual Set	0 = SET1, 1 = SET2	3	
			BIT 11	Wink ON	0 = OFF, 1 = ON	2/3	
			BIT 12	Signaling Module Input Status	0 = Not active, 1 = Active	2~~33x~~/3~~33x~~	
			BIT 13	KK function	0 = OFF, 1 = ON	2/3	
			BIT 14	Waveform session status	1 = Busy	3	
			BIT 15	Local Bus Digital Input	0 = OFF, 1 = ON	2/3	

(continues)

Rel addr	# of item	Name	Bit	Description	Notes	PR12x PR33x	Custom Byte N°
103	1	STATE 4 ALARM	BIT 0 (↕)	Harmonic distortion > 2.1		2/3	7
			BIT 1 (↕)	Contact Wear Pre-alarm		2/3	
			BIT 2 (↕)	Contact Wear Alarm		2/3	
			BIT 3 (↕)	L Pre-alarm		2/3	
			BIT 4 (↕)	L Timing		2/3	
			BIT 5 (↕)	S Timing		2/3 S	
			BIT 6 (↕)	S2 Timing		3 S	
			BIT 7 (↕)	G Timing		2/3 G	
			BIT 8 (↕)	G Alarm (Blocked Trip)		2/3 G	8
			BIT 9 (↕)	G Ext Timing		2/3 G ~~MM~~	
			BIT 10 (↕)	G Ext Alarm (Blocked Trip)		2/3 G ~~MM~~	
			BIT 11 (↕)	T Pre-alarm		2/3	
			BIT 12 (↕)	T Alarm		2/3	
			BIT 13 (↕)	T Alarm (Blocked Trip)		2/3	
			BIT 14 (↕)	D Timing		3	
			BIT 15 (↕)	U Timing		2/3	
104	1	STATE 5 ALARM	BIT 0 (↕)	U Alarm (Blocked Trip)		2/3 ~~MM~~	9
			BIT 1 (↕)	UV Timing			
			BIT 2 (↕)	UV Alarm (Blocked Trip)			
			BIT 3 (↕)	OV Timing			
			BIT 4 (↕)	OV Alarm (Blocked Trip)			
			BIT 5 (↕)	RV Timing			
			BIT 6 (↕)	RV Alarm (Blocked Trip)			
			BIT 7 (↕)	RP Timing			
			BIT 8 (↕)	RP Alarm (Blocked Trip)			10
			BIT 9 (↕)	UF Timing			
			BIT 10 (↕)	UF Alarm (Blocked Trip)			
			BIT 11 (↕)	OF Timing			
			BIT 12 (↕)	OF Alarm (Blocked Trip)			
			BIT 13 (↕)	Frequency Error		2/3	
			BIT 14 (↕)	Iw Warning		2/3	
			BIT 15 (↕)	LC1 Alarm		2/3	
105	1	STATE 6 ALARM	BIT 0 (↕)	LC2 Alarm		2/3	11
			BIT 1 (↕)	L1 Sensor Error		2/3	
			BIT 2 (↕)	L2 Sensor Error		2/3	
			BIT 3 (↕)	L3 Sensor Error		2/3	
			BIT 4 (↕)	Ne Sensor Error		2/3	
			BIT 5 (↕)	Gext Sensor Error		2/3 G ~~MM~~	
			BIT 6 (↕)	SA Error		2/3	
			BIT 7 (↕)	Rating Plug Error		2/3	
			BIT 8 (↕)	Installation Error		2/3	12
			BIT 9	Internal Error		2/3	
			BIT 10 (↕)	Power Factor Error		3	
			BIT 11 (↕)	Phase Cycle Error		3	
			BIT 12	Invalid Date		2/3	
			BIT 13 (↕)	Configuration Error	(neutral setting, parameters incongruecy,…)	2/3	
			BIT 14 (↕)	CB Status Error	1 = Error	2/3	
			BIT 15	Local Bus Analog Value	0 = under/equal threshold 1 = over threshold	2/3	

(continues)

Rel addr	# of item	Name	Bit	Description	Notes	PR12x PR33x	Custom Byte N°
106	1	STATE 7 INPUTS / OUTPUTS	BIT 0	Local bus Relay 1 contact	0 = open, 1 = closed	2/3 ~~MM~~	13
			BIT 1	Local bus Relay 2 contact	0 = open, 1 = closed		
			BIT 2	Local bus Relay 3 contact	0 = open, 1 = closed		
			BIT 3	Local bus Relay 4 contact	0 = open, 1 = closed		
			BIT 4	---	---	---	
			BIT 5	Local bus Relay 6 contact	0 = open, 1 = closed	2/3 ~~MM~~	
			BIT 6	Local bus Relay 7 contact	0 = open, 1 = closed		
			BIT 7	Local bus Relay 8 contact	0 = open, 1 = closed		
			BIT 8	Relay P1 contact	0 = open, 1 = closed	2/3 ~~MM~~	14
			BIT 9	Relay P2 contact	0 = open, 1 = closed	2~~3x~~/3~~3x~~	
			BIT 10	Relay P3 contact	0 = open, 1 = closed		
			BIT 11	Relay P4 contact	0 = open, 1 = closed		
			BIT 12	S zone selectivity input	1 = input active	2/3 S ~~MM~~	
			BIT 13	S zone selectivity output	1 = output active		
			BIT 14	G zone selectivity input	1 = input active	2/3 G ~~MM~~	
			BIT 15	G zone selectivity output	1 = output active		
107	1	STATE 8 LATCHED Note 5	BIT 0 (↑)	L tripped	1 = L trip	2/3	15
			BIT 1 (↑)	S tripped	1 = S trip	2/3 S	
			BIT 2 (↑)	S2 tripped	1 = S2 trip	3 S	
			BIT 3 (↑)	I tripped	1 = I trip	2/3	
				MCR tripped	1 = MCR trip	2/3	
			BIT 4 (↑)	Iinst tripped	1 = Iinst trip	2/3	
			BIT 5 (↑)	G tripped	1 = G trip	2/3 G	
			BIT 6 (↑)	G ext tripped	1 = G ext trip	2/3 G ~~MM~~	
			BIT 7 (↑)	T tripped	1 = T trip	2/3	
			BIT 8 (↑)	D tripped	1 = D trip	3	16
			BIT 9 (↑)	UN tripped	1 = UN trip	2/3 ~~MM~~	
			BIT 10 (↑)	UV tripped	1 = UV trip		
			BIT 11 (↑)	OV tripped	1 = OV trip		
			BIT 12 (↑)	RV tripped	1 = RV trip		
			BIT 13 (↑)	RP tripped	1 = RP trip		
			BIT 14 (↑)	UF tripped	1 = UF trip		
			BIT 15 (↑)	OF tripped	1 = OF trip		
108	1	STATE 9 LATCHED Note 5	BIT 0 (↑)	Electronic Trip Test	1 = electronic trip test	2/3	17
			BIT 1 (↑)	Simulated Trip from Test Unit	1 = simulated trip	2/3	
			BIT 2 (↑)	External Input Trip	1 = trip from external input	2~~3x~~/3~~3x~~	
			BIT 3 (↑)	Hardware Error Trip	1 = trip of Hardware error	2/3	
			BIT 4	---	---	---	
			BIT 5	---	---	---	
			BIT 6	---	---	---	
			BIT 7	---	---	---	
			BIT 8	---	---	---	18
			BIT 9	---	---	---	
			BIT 10	---	---	---	
			BIT 11	---	---	---	
			BIT 12	---	---	---	
			BIT 13	---	---	---	
			BIT 14	---	---	---	
			BIT 15	TRIP command Fail	1= TRIP command Failed	2/3	

Table 41 State

Notes:

- *GLITCH registers are automatically cleared after reading.*
- *LATCHED registers are set when the associated event happens; they are reset only by "CB RESET" or "TRIP RESET" commands*

4.5 TIME

Rel addr	*# of item*	*Name*	*Description*	*PR12x PR33x*
100	1	Day	Number of days from 31/12/1999	2/3
101	1	Hour & minute	MSB = Hour, LSB = minute	
102	1	Second	0 - 59	
103	1	Millisecond	0 - 999	

Table 42 Time

WARNING: Has shown in REGISTERS MAP(3.2), the TIME update could be done only using 23odbus function 16. In order to modify the Time it is necessary to open the programming session, the data come immediately modified and not at the and of the programming session as it happens for the normal parameters, therefore the abandonment (abort) of the programming session do not cancel the carried out modification

It's recommended to update simultaneously all four TIME registers

4.6 RUN-TIME MEASURES

The measure limits shown in column "Notes" are depicted in MEASURE LIMITS AND REPRESENTATION (6.8).

Rel addr	*# of item*	*Name*	*Description*	*Notes*	*PR12x PR33x*
200	2	Maximum current (rms)	[A]	Not available → 2^{32}-1 $I < I_{MIN} \rightarrow 0$ $I > I_{MAX} \rightarrow I_{MAX}$	2/3
202	1	Maximum current phase	0→ Not available, 1→L1, 2→L2, 3→L3, 4→Ne	Not available → 0	2/3
203	2	L_1 phase Current (rms)	[A]	Not available → 2^{32}-1 $I < I_{MIN} \rightarrow 0$ $I > I_{MAX} \rightarrow I_{MAX}$	2/3
205	2	L_2 phase Current (rms)			
207	2	L_3 phase Current (rms)			
209	2	Ne phase Current (rms)			
211	2	Internal Ground current (rms)		Not available → 2^{32}-1 $I < I_{MIN} \rightarrow 0$	2/3 G
213	2	External Ground current (rms)	[A *10^{-2}]	Not available → 2^{32}-1 $I < I_{MIN} \rightarrow 0$ $I > I_{MAX} \rightarrow I_{MAX}$	2/3 G ~~MM~~
215	1	V_1 line to neutral voltage (rms)	[V *10^{-1}]	Not available → 2^{16}-1 $V < V_{MIN} \rightarrow 0$ $V > V_{MAX} \rightarrow V_{MAX}$	2/3
216	1	V_2 line to neutral voltage (rms)	[V *10^{-1}]		
217	1	V_3 line to neutral voltage (rms)	[V *10^{-1}]		
218	1	V_0 residual voltage (rms)	[V *10^{-1}]		
219	1	V_{12} line to line voltage (rms)	[V *10^{-1}]		
220	1	V_{23} line to line voltage (rms)	[V *10^{-1}]		
221	1	V_{31} line to line voltage (rms)	[V *10^{-1}]		
222	2	L_1 phase active power	[kW *10^{-1}] (signed)	Not available → 2^{31}-1 $\mid P \mid < P_{MIN} \rightarrow 0$ $P > P_{MAX} \rightarrow P_{MAX}$ $P < -P_{MAX} \rightarrow -P_{MAX}$	
224	2	L_2 phase active power	[kW *10^{-1}] (signed)		
226	2	L_3 phase active power	[kW *10^{-1}] (signed)		
228	2	Total active power	[kW *10^{-1}] (signed)		
230	2	L_1 phase reactive power	[kVAR *10^{-1}] (signed)		
232	2	L_2 phase reactive power	[kVAR *10^{-1}] (signed)		
234	2	L_3 phase reactive power	[kVAR *10^{-1}] (signed)		
236	2	Total reactive power	[kVAR *10^{-1}] (signed)		
238	2	L_1 phase apparent power	[kVA *10^{-1}] (signed)		
240	2	L_2 phase apparent power	[kVA *10^{-1}] (signed)		
242	2	L_3 phase apparent power	[kVA *10^{-1}] (signed)		
244	2	Total apparent power	[kVA *10^{-1}] (signed)		
246	1	Total power factor	[10^{-2}] (signed)	Not available → 2^{15}-1	
247	1	Frequency	[Hz *10^{-1}]	Not available → 2^{16}-1 $F < F_{MIN} \rightarrow F_{MIN}$ $F > F_{MAX} \rightarrow F_{MAX}$	

(continues)

Rel addr	# of item	Name	Description	Notes	PR12x PR33x
248	1	L_1 phase peak factor	[10^{-2}]	Not available → 2^{16}-1	2/3
249	1	L_2 phase peak factor	[10^{-2}]		
250	1	L_3 phase peak factor	[10^{-2}]		
251	1	Ne phase peak factor	[10^{-2}]		
252	2	Positive Active Energy	[KWh] (signed)	E < -2^{31} → -2^{31} E > 2^{31}-1 → 2^{31}-1	2/3
254	2	Negative Active Energy	[KWh] (signed)		
256	2	Total Active Energy	[KWh] (signed)		
258	2	Positive Reactive Energy	[KVARh] (signed)		
260	2	Negative Reactive Energy	[KVARh] (signed)		
262	2	Total Reactive Energy	[KVARh] (signed)		
264	2	Total Apparent Energy	[KVAh] (signed)		

Table 43 Run-Time measures

4.7 HARMONIC MEASURES

Rel addr	*# of item*	*Name*	*Description*	*PR12x PR33x*
600	1	Total Harmonic Distortion (THD)	[‰]	3
601	1	1th Harmonic ratio = 1000 ‰	[‰]	
602	1	2th Harmonic ratio	[‰]	
….	….	….	[‰]	
640	1	40th Harmonic ratio	[‰]	

Table 44 Harmonic measures

4.8 INFORMATION

Rel addr	*# of item*	*Name*	*Range*	*Description*	*PR12x PR33x*
700	1	Slave ID			2/3
701	1	SW version	Major + minor		2/3
702	1	Product Standard reference	0 ÷ 1	0→IEC, 1→UL1066	2^{33x}/3^{33x}
			0 ÷ 2	0→IEC, 1→UL1066, 1→UL489	2^{33x}/3^{33x}
703	1	3/4 pole CB	0 ÷ 1	0 → 3 Pole, 1 → 4 Pole	2^{33x}/3^{33x}
		3/4/2 pole CB	0 ÷ 2	0 → 3 Pole, 1 → 4 Pole, 2 → 2 Pole	2^{33x}/3^{33x}
704	1	In (nominal current)	100 ÷ 6300	[A]	2/3
705	1	CB type	See Table 62 TAB_CB_TYPE	See Table 62 TAB_CB_TYPE	2^{33x}/3^{33x}
			See Table 63 TAB_CB_TYPE_33x	See Table 63 TAB_CB_TYPE_33x	2^{33x}/3^{33x}
706	8	CB Serial Number	ASCII format characters	ASCII format characters	2/3
714	1	Data logger max file	0 ÷ 3	0 ÷ 3	2/3
715	1	Data logger max address	0 ÷ 65535	0 ÷ 65535	2/3
716	1	Data logger Trigger	0 ÷ 4	0 = None (free running) 1 = Any Alarm 2 = L Timing 3= Any Trip 4 = Custom	2/3
717	1	Day of Data logger trigger	Number of days from 31/12/1999		2/3
718	1	Hours & minutes of Dlog trigger	Hours & minutes	MSB = Hours, LSB = minutes	2/3
719	1	Second of Dlog trigger	Seconds		2/3
720	1	Millisecond of Dlog trigger	Milliseconds		2/3
723	6	CB name	ASCII format characters		2/3

Table 45 Information

4.9 LOCAL BUS DATA AREA

Rel addr	*# of item*	*Name*	*Range*	*Description*			*PR12x PR33x*
800	1	Accessory Bus status	0x0000 ÷ 0x0003	Bit	Bit = 0	Bit = 1	2/3
				0	Bus Warning OFF	Bus Warning ON	
				1	Bus Alarm OFF	Bus Alarm ON	
				2(1)	Digital Input OFF	Digital Input ON	
801	1	Analog Value	0 ÷ 65535	0 ÷ 65535			2/3
802	25	Local Bus Data Area	0 ÷ 65535	Used by Accessory unit			2/3

Table 46 Local bus data area

Note: *digital input value (Addr.800, bit 2) is reported in STATE relay.*

Local bus data area is an exchange buffer between system bus and devices connected to the accessory bus (e.g. PR035/MM).

4.10 CONFIGURATION1

Rel addr	*# of item*	*Name*	*Range*	*Description*	*PR12x PR33x*
1000	1	Product execution	0 ÷ 3	0→LI, 1→LSI, 2→LSIG, 3→LSIRc	2/3
1001	8	Relay Serial Number	ASCII format characters	---	2/3

Table 47 Configuration 1

4.11 PARAMETERS CONFIGURATION2

Rel addr	*# of item*	*Name*	*Range*	*Description*			*PR12x PR33x*
1020	1	Unit configuration	0x0000 ÷ 0x003F	Bit	Bit = 0	Bit = 1	
				0	Not Used	Not Used	2/3
				1	Local Bus Unit = absent	Local Bus Unit = present	2/3
				2	VT = absent	VT = present	2/3
				3	Neutral Protection = OFF	Neutral Protection = ON	2/3
				4	Power Direction = Bottom → Top	Power Direction = Top → Bottom	2/3
				5	Neutral Voltage = absent	Neutral Voltage = present	2/3
				6	Operating mode = Local	Operating mode = Remote	2/3
1021	1	Language	0 ÷ 4	0 = ENG 1 = ITA 2 = FRA 3 = GER 4 = SPA			2/3
1022	1	Neutral selection	0 ÷ 3	0 = 50 % 1 = 100 % 2 = 150 % 3 = 200 %			2/3
1023	1	Ext. ground toroid	0 ÷ 3	0 = 100 A 1 = 250 A 2 = 400 A 3 = 800 A			2/3 G ~~MM~~
1024	1	Nominal voltage Un	See Table 58 TAB_UN	See Table 58 TAB_UN			2/3
1025	1	VT secondary voltage	0 ÷ 5	0 = 100 V 1 = 110 V 2 = 115 V 3 = 120 V 4 = 200 V 5 = 230 V			2/3
1026	1	Net Frequency	0 ÷ 1	0 = 50 Hz 1 = 60 Hz			2/3
1027	1	Plant Configuration	0 ÷ 1	0 = 3P 1 = 3P+N			2/3
1028	1	Slave Address (external bus only)	1 ÷ 247	1 ÷ 247			2/3
1029	1	Addressing Type (external bus only)	0 ÷ 1	0 = standard 1 = ABB			2/3
1030	1	Baud rate (external bus only)	0 ÷ 1	0 = 9600 1 = 19200			2/3
1031	1	Protocol Type (external bus only)	0 ÷ 3	0 = “E,8,1” 1 = “O,8,1” 2 = “N,8,2” 3 = “N,8,1”			2/3
1032	1	Ext Toroid Type	0 ÷ 2	0 = None 1 = Source Ground Return 2 = Rc			2/3 G

Table 48 Configuration 2

4.12 PARAMETERS CONFIGURATION3

Rel addr	*# of item*	*Name*	*Range*	*Description*			*PR12x PR33x*
1050	1	Configuration	0x0000 ÷ 0x007F	Bit	Bit = 0	Bit = 1	
				0	Par set = set A	Par set = set B	3
				1	Dual Setting = OFF	Dual Setting = ON	3
				2	Harm Dist Warn = OFF	Harm Dist Warn = ON	2/3
				3	Phase Rotation Warn = OFF	Phase Rotation Warn = ON	3
				4	Phase Rotation Cycle = 123	Phase Rotation Cycle = 321	3
				5	CosFi Module Warning = OFF	CosFi Module Warning = ON	3
				6	Dual set CB close disable	Set B on CB close	3
				7	Dual set Vaux disable	Set B on Vaux OFF	3
				8	Dual Set Local Bus disable	Set B on Local Bus Digital Input ON	3
1051	1	Measurement store time	5 ÷ 120 step 5 [min]	5 ÷ 120 min			2/3
1052	1	Loc Bus Relays Unit Contact configuration	See Table 60 TAB_RELAYS_K51_CONFIG	See Table 60 TAB_RELAYS_K51_CONFIG			2/3
1053	1	Loc Bus Relay 1 Function	0 ÷ 65535	See Table 59 TAB_RELAYS_FUNCTION			
1054	1	Loc Bus Relay 1 Delay	0.00 ÷ 100.00 step 0.01 [s]	0 ÷ 10000 [s*10^{-2}]			
1055	1	Loc Bus Relay 2 Function	0 ÷ 65535	See Table 59 TAB_RELAYS_FUNCTION			
1056	1	Loc Bus Relay 2 Delay	0.00 ÷ 100.00 step 0.01 [s]	0 ÷ 10000 [s*10^{-2}]			
1057	1	Loc Bus Relay 3 Function	0 ÷ 65535	See Table 59 TAB_RELAYS_FUNCTION			
1058	1	Loc Bus Relay 3 Delay	0.00 ÷ 100.00 step 0.01 [s]	0 ÷ 10000 [s*10^{-2}]			
1059	1	Loc Bus Relay 4 Function	0 ÷ 65535	See Table 59 TAB_RELAYS_FUNCTION			
1060	1	Loc Bus Relay 4 Delay	0.00 ÷ 100.00 step 0.01 [s]	0 ÷ 10000 [s*10^{-2}]			
1061	1	Loc Bus Relay 6 Function	0 ÷ 65535	See Table 59 TAB_RELAYS_FUNCTION			
1062	1	Loc Bus Relay 6 Delay	0.00 ÷ 100.00 step 0.01 [s]	0 ÷ 10000 [s*10^{-2}]			
1063	1	Loc Bus Relay 7 Function	0 ÷ 65535	See Table 59 TAB_RELAYS_FUNCTION			
1064	1	Loc Bus Relay 7 Delay	0.00 ÷ 100.00 step 0.01 [s]	0 ÷ 10000 [s*10^{-2}]			
1065	1	Loc Bus Relay 8 Function	0 ÷ 65535	See Table 59 TAB_RELAYS_FUNCTION			
1066	1	Loc Bus Relay 8 Delay	0.00 ÷ 100.00 step 0.01 [s]	0 ÷ 10000 [s*10^{-2}]			
1067	1	P Relays Contact configuration	See Table 61 TAB_P_RELE_CONFIG	See Table 61 TAB_P_RELE_CONFIG			2/3 ~~MM~~
1068	1	P1 Function	0 ÷ 65535	See Table 59 TAB_RELAYS_FUNCTION			
1069	1	P1 Delay	0.00 ÷ 100.00 step 0.01 [s]	0 ÷ 10000 [s*10^{-2}]			
1070	1	P2 Function	0 ÷ 65535	See Table 59 TAB_RELAYS_FUNCTION			$2^{\sim\sim 33 \sim\sim}/3^{\sim\sim 33 \sim\sim}$
1071	1	P2 Delay	0.00 ÷ 100.00 step 0.01 [s]	0 ÷ 10000 [s*10^{-2}]			
1072	1	P3 Function	0 ÷ 65535	See Table 59 TAB_RELAYS_FUNCTION			
1073	1	P3 Delay	0.00 ÷ 100.00 step 0.01 [s]	0 ÷ 10000 [s*10^{-2}]			
1074	1	P4 Function	0 ÷ 65535	See Table 59 TAB_RELAYS_FUNCTION			
1075	1	P4 Delay	0.00 ÷ 100.00 step 0.01 [s]	0 ÷ 10000 [s*10^{-2}]			
1076	1	Programmable Input configuration	0x0000 ÷ 0x0001	0 = Active low 1 = Active high			
1077	1	Programmable Input Function	0 ÷ 5	0 = Generic 1 = External TRIP 2 = Trip reset 3 = Set B (PR123/P only) 4 = Dial Local 5 = Reset Signaling Module 6 = Energy reset			
1078	1	Programmable Input Delay	0.00 ÷ 100.00 step 0.01 [s]	0 ÷ 10000 [s*10^{-2}]			

(continues)

Rel addr	*# of item*	*Name*	*Range*	*Description*	*PR12x PR33x*
1079	1	Data Logger Configuration	0x0000 ÷ 0x0001	0 = Data Logger = OFF 1 = Data Logger = ON	2/3
1080	1	Data Logger Trigger Type	Standard: 0 ÷ 3 Custom 256 ÷ 65535 (see RELAYS AND DATA LOGGER "CUSTOM" SETTING)	Standard: 0 = None (free running) 1 = Any Alarm 2 = L Timing 3 = Any Trip	
1081	1	Data Logger Stop Delay	0.00 ÷ 10.00 step 0.01 [s]	0 ÷ 1000 [s*10^{-2}]	
1082	1	Data Logger Frequency	0 ÷ 3	0 = 600 Hz 1 = 1200 Hz 2 = 2400 Hz 3 = 4800 Hz	
1083	1	CosFi Module Threshold	0.50 ÷ 0.95 step 0.01	50 ÷ 95 [10^{-2}]	3
1084	5	CB TAG name	ASCII format characters		2/3
1089	5	User data	ASCII format characters		2/3
1094	1	Dual set CB close time	0.20 ÷ 50.00 step 0.10 [s]	20 ÷ 5000 [s*10^{-2}]	3
1095	1	Date of installation CB	Number of days from 31/12/1999		2/3
1096	1	Date of last maintenance CB	Number of days from 31/12/1999		2/3
1097	1	Local Bus Analog Value Threshold	0 ÷ 65535	0 ÷ 65535	2/3
1098	1	Startup current activation threshold	0.10 ÷ 10.00 step 0.10 [In]	10 ÷ 1000 [In*10^{-2}]	2/3

Table 49 Configuration 3

4.13 PARAMETERS PROTECTION SET1 / SET2 (only for PR123/P - PR333/P)

The following table shows parameters included in protection SET1 and SET2 areas.
Column "*Rel addr*" reports SET1 addresses (1100 ÷ 1178); SET2 addresses (1200 ÷ 1278) can be obtained adding 100 to SET1 addresses.

Rel addr	*# of item*	*Name*	*Range*	*Description*			*PR12x PR33x*
1100	1	Prot L configuration		Bit	Bit = 0	Bit = 1	
				0	---	---	---
				1	---	---	---
				2	---	---	---
				3	---	---	---
				4	Thermal memory = OFF	Thermal memory = ON	2/3
1101	1	Prot L curve type	0 ÷ 3	0: $I^2t = k$ 2: 13,5*b/(i-1) 1: 0,14/($i^{0.02}$-1) 3: 80*b/(i^2-1)			2/3
1102	1	Prot L threshold	0.40 ÷ 1.00 step 0.01 [In]	40 ÷ 100 [In*10^{-2}]			2/3
1103	1	Prot L time	3 ÷ 144 step 3 [s]	300 ÷ 14400 [s*10^{-2}]			
1104	1	Prot L threshold IEC255	0.40 ÷ 1.00 step 0.01 [In]	40 ÷ 100 [In*10^{-2}]			2/3
1105	1	Prot L time IEC255	3 ÷ 144 step 3 [s]	300 ÷ 14400 [s*10^{-2}]			
1106	1	Prot S configuration		Bit	Bit = 0	Bit = 1	
				0	Prot disable	Prot enable	2/3 S
				1	---	---	---
				2	Start Up Th= OFF	Start Up Th= ON	2/3 S
				3	Zone selectivity= OFF	Zone selectivity= ON	2/3 S
				4	Thermal memory= OFF	Thermal memory= ON	2/3 S
1107	1	Prot S curve type	0→ T=k, 1→ $I^2t = k$	0 ÷ 1			2/3 S
1108	1	Prot S threshold T=k/I^2	0.6 ÷ 10.0 step 0.1 [In]	60 ÷ 1000 [In*10^{-2}]			
1109	1	Prot S time T=k/I^2	0.05 ÷ 0.8 step 0.01[s]	5 ÷ 80 [s*10^{-2}]			
1110	1	Prot S threshold T=k	0.6 ÷ 10.0 step 0.1 [In]	60 ÷ 1000 [In*10^{-2}]			
1111	1	Prot S time T=k	0.05 ÷ 0.8 step 0.01[s]	5 ÷ 80 [s*10^{-2}]			
1112	1	Prot S start up threshold	0.6 ÷ 10.0 step 0,1 [In]	60 ÷ 1000 [In*10^{-2}]			2/3 S
1113	1	Prot S start up time	0.10 ÷ 30.00 step 0.01 [s]	10 ÷ 3000 [s*10^{-2}]			
1114	1	Prot S zone selectivity time	0.04 ÷ 0.20 step 0.01 [s]	4 ÷ 20 [s*10^{-2}]			
1115	1	Prot S2 configuration		Bit	Bit = 0	Bit = 1	
				0	Prot disable	Prot enable	3 S
				1	---	---	
				2	Start Up Th= OFF	Start Up Th= ON	
				3	Zone selectivity= OFF	Zone selectivity= ON	
				4	---	---	
1116	1	Prot S2 threshold T=k	0.6 ÷ 10.0 step 0.1 [In]	60 ÷ 1000 [In*10^{-2}]			
1117	1	Prot S2 time T=k	0.05 ÷ 0.8 step 0.01[s]	5 ÷ 80 [s*10^{-2}]			
1118	1	Prot S2 start up threshold	0.6 ÷ 10.0 step 0,1 [In]	60 ÷ 1000 [In*10^{-2}]			
1119	1	Prot S2 start up time	0.10 ÷ 30.00 step 0.01 [s]	10 ÷ 3000 [s*10^{-2}]			
1120	1	Prot S2 zone selectivity time	0.04 ÷ 0.20 step 0.01 [s]	4 ÷ 20 [s*10^{-2}]			
1121	1	Prot D configuration		Bit	Bit = 0	Bit = 1	
				0	Prot disable	Prot enable	3
				1	---	---	
				2	Start Up Th= OFF	Start Up Th= ON	
				3	Zone selectivity= OFF	Zone selectivity= ON	
				4	---	---	
1122	1	Prot D threshold	0.6 ÷ 10.0 step 0.1 [In]	60 ÷ 1000 [In*10^{-2}]			
1123	1	Prot D time Forward	0.2 ÷ 0.8 step 0.01 [s]	20 ÷ 80 [s*10^{-2}]			
1124	1	Prot D time Backward	0.2 ÷ 0.8 step 0.01 [s]	20 ÷ 80 [s*10^{-2}]			
1125	1	Prot D start up threshold	0.6 ÷ 10.0 step 0.1 [In]	60 ÷ 1000 [In*10^{-2}]			
1126	1	Prot D start up time	0.10 ÷ 30.00 step 0.01[s]	10 ÷ 3000 [s*10^{-2}]			
1127	1	Prot D zone selectivity time	0.13 ÷ 0.50 step 0.01 [s]	13 ÷ 50 [s*10^{-2}]			
1128	1	Prot I configuration		Bit	Bit = 0	Bit = 1	
				0	Prot disable	Prot enable	2/3
				1	---	---	---
				2	Start Up Th= OFF	Start Up Th= ON	2/3
				3	---	---	---
				4	---	---	---
1129	1	Prot I threshold	1,5 ÷ 15 step 0.1 [In]	150 ÷ 1500 [In*10^{-2}]			2/3
1130	1	Prot I start up threshold	1,5 ÷ 15 step 0.1 [In]	150 ÷ 1500 [In*10^{-2}]			2/3
1131	1	Prot I start up time	0.10 ÷ 30.00 step 0.01[s]	10 ÷ 3000 [s*10^{-2}]			~~MM~~

(continues)

Rel addr	# of item	Name	Range	Description			PR12x PR33x
1130	1	Prot MM configuration		Bit	Bit = 0	Bit = 1	
				0	Prot disable	Prot enable	MM
				1	--	--	
1131	1	Prot MM threshold	1,5 ÷ 4 step 0.1 [In]	150 ÷ 400 [In*10^{-2}]			
1132	1	Prot G configuration		Bit	Bit = 0	Bit = 1	
				0	Prot disable	Prot enable	2/3 G
				1	Trip disable	Trip enable	2/3 G
				2	Start Up Th= OFF	Start Up Th= ON	
				3	Zone selectivity= OFF	Zone selectivity= ON	
				4	---	---	---
1133	1	Prot G curve type	0→ T=k, 1→ I^{2}t = k	0 ÷ 1			2/3 G
1134	1	Prot G threshold T=k/I^2	0.10 ÷ 1.00 step 0.02 [In]	10 ÷ 100 [In*10^{-2}]			2^{33x}/3^{33x} G
			0.20 ÷ 1.00 step 0.02 [In]	20 ÷ 100 [In*10^{-2}]			2^{33x}/3^{33} G
1135	1	Prot G time T=k/I^2	0.10 ÷ 1.00 step 0.05 [s]	10 ÷ 100 [s*10^{-2}]			2/3 G
1136	1	Prot G threshold T=k	0.10 ÷ 1.00 step 0.02 [In]	10 ÷ 100 [In*10^{-2}]			2^{33x}/3^{33x} G
			0.20 ÷ 1.00 step 0.02 [In]	20 ÷ 100 [In*10^{-2}]			2^{33x}/3^{33} G
1137	1	Prot G time T=k	0.10 ÷ 1.00 step 0.05 [s]	10 ÷ 100 [s*10^{-2}]			2/3 G
1138	1	Prot G start up threshold	0.20 ÷ 1.00 step 0.02 [In]	20 ÷ 100 [In*10^{-2}]			2/3 G
1139	1	Prot G start up time	0.10 ÷ 30.00 step 0.01[s]	10 ÷ 3000 [s*10^{-2}]			
1140	1	Prot G zone selectivity time	0.04 ÷ 0.20 step 0.01 [s]	4 ÷ 20 [s*10^{-2}]			
1141	1	Prot Ext G configuration		Bit	Bit = 0	Bit = 1	
				0	Prot disable	Prot enable	2/3 G ~~MM~~
				1	Trip disable	Trip enable	
				2	Start Up Th = OFF	Start Up Th = ON	
				3	Zone selectivity= OFF	Zone selectivity = ON	
				4	---	---	
1142	1	Prot Ext G curve type	0→ T=k, 1→ I^{2}t = k	0 ÷ 1			
1143	1	Prot Ext G threshold T=k/I^2	0.10 ÷ 1.00 step 0.02 [InGext]	20 ÷ 100 [InGext *10^{-2}]			
1144	1	Prot Ext G time T=k/I^2	0.10 ÷ 1.00 step 0.05 [s]	10 ÷ 100 [s*10^{-2}]			
1145	1	Prot Ext G threshold T=k	0.10 ÷ 1.00 step 0.02 [InGext]	20 ÷ 100 [InGext *10^{-2}]			
1146	1	Prot Ext G time T=k	0.10 ÷ 1.00 step 0.05 [s]	10 ÷ 100 [s*10^{-2}]			
1147	1	Prot Ext G start up threshold	0.10 ÷ 1.00 step 0.02 [InGext]	20 ÷ 100 [InGext *10^{-2}]			
1148	1	Prot Ext G start up time	0.10 ÷ 30.00 step 0.01 [s]	10 ÷ 3000 [s*10^{-2}]			
1149	1	Prot Ext G zone selectivity time	0.04 ÷ 0.20 step 0.01 [s]	4 ÷ 20 [s*10^{-2}]			
1150	1	Prot U configuration		Bit	Bit = 0	Bit = 1	
				0	Prot disable	Prot enable	2/3
				1	Trip disable	Trip enable	
				2	---	---	
				3	---	---	
				4	---	---	
				5	Current selection	Voltage selection	
1151	1	Prot U threshold	2 ÷ 90 step 1 [%]	2 ÷ 90 [%]			
1152	1	Prot U time	0.5 ÷ 60 step 0.5 [s]	50 ÷ 6000 [s*10^{-2}]			
1153	1	Prot UV configuration		Bit	Bit = 0	Bit = 1	
				0	Prot disable	Prot enable	2/3 ~~MM~~
				1	Trip disable	Trip enable	
				2	---	---	
1154	1	Prot UV threshold	0.50 ÷ 0.95 step 0.01 [Un]	50 ÷ 95 [Un*10^{-2}]			
1155	1	Prot UV time	0.1 ÷ 5.0 step 0.1 [s]	10 ÷ 500 [s*10^{-2}]			
1156	1	Prot OV configuration		Bit	Bit = 0	Bit = 1	
				0	Prot disable	Prot enable	2/3 ~~MM~~
				1	Trip disable	Trip enable	
				2	---	---	
1157	1	Prot OV threshold	1.05 ÷ 1.20 step 0.01 [Un]	105 ÷ 120 [Un*10^{-2}]			
1158	1	Prot OV time	0.1 ÷ 5.0 step 0.1 [s]	10 ÷ 500 [s*10^{-2}]			
1159	1	Prot RV configuration		Bit	Bit = 0	Bit = 1	
				0	Prot disable	Prot enable	2/3 ~~MM~~
				1	Trip disable	Trip enable	
				2	---	---	
1160	1	Prot RV threshold	0.10 ÷ 0.40 step 0.05 [Un]	10 ÷ 40 [Un*10^{-2}]			
1161	1	Prot RV time	0.5 ÷ 30.0 step 0.5 [s]	50 ÷ 3000 [s*10^{-2}]			

(continues)

Rel addr	# of item	Name	Range	Description			PR12x PR33x
				Bit	Bit = 0	Bit = 1	
				0	Prot disable	Prot enable	
				1	Trip disable	Trip enable	
1162	1	Prot RP configuration		2	---	---	2/3 ~~MM~~
				3	---	---	
				4	---	---	
1163	1	Prot RP threshold	-0.10 ÷ -0.30 step 0.02 [Pn_t]	10 ÷ 30 [$-Pn_t *10^{-2}$]			
1164	1	Prot RP time	0.5 ÷ 25.0 step 0.1 [s]	50 ÷ 2500 [$s*10^{-2}$]			
				Bit	Bit = 0	Bit = 1	
				0	Prot disable	Prot enable	
				1	Trip disable	Trip enable	
1165	1	Prot UF configuration		2	---	---	2/3 ~~MM~~
				3	---	---	
				4	---	---	
1166	1	Prot UF threshold	0,90 ÷ 0.99 step 0.01 [Fn]	90 ÷ 99 [$Fn *10^{-2}$]			
1167	1	Prot UF time	0.5 ÷ 3.0 step 0.1 [s]	50 ÷ 300 [$s*10^{-2}$]			
				Bit	Bit = 0	Bit = 1	
				0	Prot disable	Prot enable	
				1	Trip disable	Trip enable	
1168	1	Prot OF configuration		2	---	---	2/3 ~~MM~~
				3	---	---	
				4	---	---	
1169	1	Prot OF threshold	1,01 ÷ 1.10 step 0.01 [Fn]	101 ÷ 110 [$Fn*10^{-2}$]			
1170	1	Prot OF time	0.5 ÷ 3.0 step 0.1 [s]	50 ÷ 300 [$s*10^{-2}$]			
				Bit	Bit = 0	Bit = 1	
				0	---	---	
1171	1	Prot T configuration		1	Trip disable	Trip enable	2/3
				2	---	---	
				3	---	---	
				4	---	---	
				Bit	Bit = 0	Bit = 1	
				0	Iw Th disabled	Iw Th enabled	
1172	1	Load control configuration	0x0000 ÷ 0x0007	1	LC1 Th disabled	LC1 Th enabled	2/3
				2	LC2 Th disabled	LC2 Th enabled	
1173	1	Warning current Iw	0.30 ÷ 10.00 step 0.05 [In]	30 ÷ 1000 [$In*10^{-2}$]			
1174	1	LC1 threshold	50 ÷ 100 step 1 [$\%I_1$]	50 ÷ 100 [$\%I_1$]			
1175	1	LC2 threshold	50 ÷ 100 step 1 [$\%I_1$]	50 ÷ 100 [$\%I_1$]			
				Bit	Bit = 0	Bit = 1	
				0	---	---	
				1	---	---	
1176	1	Prot Rc configuration	Not Used	2	---	---	2/3 Rc ~~MM~~
				3	---	---	
				4	---	---	
1177	1	Prot Rc threshold	See Table 51 TAB_TH_Rc	See Table 51 TAB_TH_Rc			
1178	1	Prot Rc time	See Table 52 TAB_Time_Rc	See Table 52 TAB_Time_Rc			
				Bit	Bit = 0	Bit = 1	
1179	1	MCR Config		0	MCR disable	MCR enable	
1180	1	MCR Threshold	6 ÷ 15 step 0.1[In]	600 ÷ 1500 [$In*10^{-2}$]			2/3
1181	1	MCR Time	0.04 ÷ 0.5 step 0.01 [s]	4 ÷ 50 [$s*10^{-2}$]			

Table 50 Set 1/ Set 2

Value	Threshold
0	3 A
1	5 A
2	7 A
3	10 A
4	20 A
5	30 A

Table 51 TAB_TH_Rc

Value	Time
0	0.06 [s]
1	0.10 [s]
2	0.20 [s]
3	0.30 [s]
4	0.40 [s]
5	0.50 [s]
6	0.80 [s]

Table 52 TAB_Time_Rc

4.14 TRIP HISTORY

Rel addr	*# of item*	*Name*		*Description*	*PR12x PR33x*
2000	19	Trip history N° 1 (new)	0	MARKER (0 = valid)	2/3
			1	See Table 54 TAB_TRIP_TYPE	
			2	Trip Number	
			3	Date (Number of days from 31/12/1999)	
			4	Date (MSB = ore, LSB = min)	
			5	Date (seconds)	
			6	Date (ms)	
			7÷8	Current phase L1	
			9÷10	Current phase L2	
			11÷12	Current phase L3	
			13÷14	Current phase Ne	
			15	Contact wear	
			16	See Table 54 TAB_TRIP_TYPE	
			17	See Table 54 TAB_TRIP_TYPE	
			18	See Table 54 TAB_TRIP_TYPE	
2019	19	Trip history N° 2		"	
…	19	Trip history N° 3		"	
…	19	Trip history N° 4		"	
…	19	Trip history N° 5		"	
…	19	Trip history N° 6		"	
…	19	Trip history N° 7		"	
…	19	Trip history N° 8		"	
…	…	….		"	
2361	19	Trip history N° 20 (old)		"	

Table 53 Trip History

Trip type	*word 1*	*word 16*	*word 17*	*word 18*
L	1	In Active threshold = value / 512	see address 1100	see address 1101
S	2	In Active threshold = value / 512	mS selected time	see address 1106
S2	3	In Active threshold = value / 512	mS selected time	see address 1115
D	4	In Active threshold = value / 512	see address 1121	see address 1020
D FW	5	In Active threshold = value / 512	see address 1121	see address 1020
D BW	6	In Active threshold = value / 512	see address 1121	see address 1020
I / MM	7	0x0000	In Active threshold = value / 512	see address 1128
MCR		0xABCD	In Active threshold = value / 512	mS selected time
G	8	Internal Ground Current (rms) Low	Internal Ground Current (rms) High	In Active threshold = value / 512
G_EXT	9	External Ground Current (rms) Low	External Ground Current (rms) High	InExt Active threshold = value / 1085 (100A) InExt Active threshold = value / 2720 (250A) InExt Active threshold = value / 1270 (400A) InExt Active threshold = value / 2540 (800A)
T	10	°C temperature = value * 0.073855	see address 705	see address 704
UV	11	V12 line to line voltage (rms)	V23 line to line voltage (rms)	V31 line to line voltage (rms)
OV	12	V12 line to line voltage (rms)	V23 line to line voltage (rms)	V31 line to line voltage (rms)
RV	13	V0 residual voltage (rms)	---	---
RP	14	Total Active Power Low	Total Active Power High	---
UF	15	Frequency	Hz Active threshold = value / 100	mS selected time
OF	16	Frequency	Hz Active threshold = value / 100	mS selected time
UN Current	17	0xABCD	% Active threshold = value / 10	mS selected time
UN Voltage		V12 line to line voltage (rms)	V23 line to line voltage (rms)	V31 line to line voltage (rms)
EXT	18	see address 1078	see address 1076	see address 1077
Rc	19	Rc Current (rms) Low	Rc Current (rms) High	Amp. Active threshold = value / 166.7
Rc TEST	20	Rc Current (rms) Low	Rc Current (rms) High	Amp. Active threshold = value / 166.7
Hw Trip	21	see address 105	---	---
Iinst	22	see address 704	see address 705	see address 105

Table 54 TAB_TRIP_TYPE

4.15 MEASURE HISTORY

Rel addr	# of item	Name	Description		PR12x PR33x
2500	24	Measure history n° 1 (new)	0	MARKER (0 = valid)	2/3
			1	History code: 0 = NORMAL_HISTORY 1 = POWER_UP 2 = NEW_PERIOD	
			2	Period from last save (minutes)	
			3	Number of days from 31/12/1999	
			4	MSB = Hour, LSB = minute	
			5	Total mean active power (LSW)	
			6	Total mean active power (MSW)	
			7	Total maximum active power (LSW)	
			8	Total maximum active power (MSW)	
			9	Maximum current phase (0=L1, 1=L2, 2=L3, 3=Ne)	
			10	Maximum current (LSW)	
			11	Maximum current (MSW)	
			12	Maximum line to line voltage phase (0=V_{12}, 1=V_{23}, 2=V_{31})	
			13	Maximum line to line voltage	
			14	Minimum line to line voltage phase (0=V_{12}, 1=V_{23}, 2=V_{31})	
			15	Minimum line to line voltage	
			16	Total mean reactive power (LSW)	
			17	Total mean reactive power (MSW)	
			18	Total maximum reactive power (LSW)	
			19	Total maximum reactive power (MSW)	
			20	Total mean apparent power (LSW)	
			21	Total mean apparent power (MSW)	
			22	Total maximum apparent power (LSW)	
			23	Total maximum apparent power (MSW)	
2524	24	Measure history n° 2	"		
2548	24	Measure history n° 3	"		
…	24	…	"		
3052	24	Measure history n° 24	"		
3076	24	Measure history n° 25 (old)	"		

Table 55 Measure History

4.16 LOG EVENTS

Rel addr	# of item	Name	Description	PR12x PR33x
3300	6	Log event n° 1 (new)	MARKER (0 = valid)	2/3
			See Table 64 TAB_LOG_EVENTS	
			Number of days from 31/12/1999	
			MSB = Hour, LSB = minute	
			Seconds	
			Milliseconds	
3306	6	Log event n° 2	"	
3312	6	Log event n° 3	"	
…	6	…	"	
3768	6	Log event n° 79	"	
3774	6	Log event n° 80 (old)	"	

Table 56 Log events

4.17 WAVEFORMS

Rel addr	# of item	Name	Description	PR12x PR33x
4000	128	Buffer waveform channel: L1 or U12	[A], [V *10^{-1}]	3
4128	128	Buffer waveform channel: L2 or U23	[A], [V *10^{-1}]	
4256	128	Buffer waveform channel: L3 or U31	[A], [V *10^{-1}]	
4384	128	Buffer waveform channel: NE	[A]	

Table 57 Waveforms

5. TABLES

Value	*VT nominal*
0	100
1	115
2	120
3	190
4	208
5	220
6	230
7	240
8	277
9	347
10	380
11	400
12	415
13	440
14	480
15	500
16	550
17	600
18	660
19	690
20	910
21	950
22	1000
23	1150

Table 58 TAB_UN

Value	*Description*
0	None
1	L pre-alarm
2	L timing
3	S timing
4	L trip
5	S trip
6	I trip
7	G trip
8	Any trip
9	Any Alarm
10	LC1
11	LC2
256 ÷ 65535	Custom (see RELAYS AND DATA LOGGER "CUSTOM" SETTING)

Table 59 TAB_RELAYS_FUNCTION

	Bit = 0	*Bit = 1*
Bit 0	Relay K51/1 not latched	Relay K51/1 latched
Bit 1	Relay K51/2 not latched	Relay K51/2 latched
Bit 2	Relay K51/3 not latched	Relay K51/3 latched
Bit 3	Relay K51/4 not latched	Relay K51/4 latched
Bit 4	Relay K51/6 not latched	Relay K51/6 latched
Bit 5	Relay K51/7 not latched	Relay K51/7 latched
Bit 6	Relay K51/8 not latched	Relay K51/8 latched
Bit 7	Contact K51/1 NO	Contact K51/1 NC
Bit 8	Contact K51/2 NO	Contact K51/2 NC
Bit 9	Contact K51/3 NO	Contact K51/3 NC
Bit 10	Contact K51/4 NO	Contact K51/4 NC
Bit 11	Contact K51/6 NO	Contact K51/6 NC
Bit 12	Contact K51/7 NO	Contact K51/7 NC
Bit 13	Contact K51/8 NO	Contact K51/8 NC

Table 60 TAB_RELAYS_K51_CONFIG

	Bit = 0	*Bit = 1*
Bit 0	Relay P1 not latched	Relay P1 Latched
Bit 1	Relay P2 not latched	Relay P2 Latched
Bit 2	Relay P3 not latched	Relay P3 Latched
Bit 3	Relay P4 not latched	Relay P4 Latched
Bit 4	Contact P1 NO	Contact P1 NC
Bit 5	Contact P2 NO	Contact P2 NC
Bit 6	Contact P3 NO	Contact P3 NC
Bit 7	Contact P4 NO	Contact P4 NC

Table 61 TAB_P_RELE_CONFIG

Value	CB type	Value	CB type	Standard
0	E1B800/3P	1	E1B800/4P	IEC
2	E1B1000/3P	3	E1B1000/4P	IEC
4	E1B1250/3P	5	E1B1250/4P	IEC
6	E1B1600/3P	7	E1B1600/4P	IEC
8	E1N800/3P	9	E1N800/4P	IEC
10	E1N1000/3P	11	E1N1000/4P	IEC
12	E1N1250/3P	13	E1N1250/4P	IEC
14	E1N1600/3P	15	E1N1600/4P	IEC
16	E2B1600/3P	17	E2B1600/4P	IEC
18	E2B2000/3P	19	E2B2000/4P	IEC
20	E2N1000/3P	21	E2N1000/4P	IEC
22	E2N1250/3P	23	E2N1250/4P	IEC
24	E2N1600/3P	25	E2N1600/4P	IEC
26	E2N2000/3P	27	E2N2000/4P	IEC
28	E2S800/3P	29	E2S800/4P	IEC
30	E2S1000/3P	31	E2S1000/4P	IEC
32	E2S1250/3P	33	E2S1250/4P	IEC
34	E2S1600/3P	35	E2S1600/4P	IEC
36	E2S2000/3P	37	E2S2000/4P	IEC
38	E2L1250/3P	39	E2L1250/4P	IEC
40	E2L1600/3P	41	E2L1600/4P	IEC
42	E3N2500/3P	43	E3N2500/4P	IEC
44	E3N3200/3P	45	E3N3200/4P	IEC
46	E3S1000/3P	47	E3S1000/4P	IEC
48	E3S1250/3P	49	E3S1250/4P	IEC
50	E3S1600/3P	51	E3S1600/4P	IEC
52	E3S2000/3P	53	E3S2000/4P	IEC
54	E3S2500/3P	55	E3S2500/4P	IEC
56	E3S3200/3P	57	E3S3200/4P	IEC
58	E3H800/3P	59	E3H800/4P	IEC
60	E3H1000/3P	61	E3H1000/4P	IEC
62	E3H1250/3P	63	E3H1250/4P	IEC
64	E3H1600/3P	65	E3H1600/4P	IEC
66	E3H2000/3P	67	E3H2000/4P	IEC
68	E3H2500/3P	69	E3H2500/4P	IEC
70	E3H3200/3P	71	E3H3200/4P	IEC
72	E3V800/3P	73	E3V800/4P	IEC
74	E3V1250/3P	75	E3V1250/4P	IEC
76	E3V1600/3P	77	E3V1600/4P	IEC
78	E3V2000/3P	79	E3V2000/4P	IEC
80	E3V2500/3P	81	E3V2500/4P	IEC
82	E3V3200/3P	83	E3V3200/4P	IEC
84	E3L2000/3P	85	E3L2000/4P	IEC
86	E3L2500/3P	87	E3L2500/4P	IEC
88	E4S4000/3P	89	E4S4000/4P	IEC
90	---	91	E4S/f4000/4P	IEC
92	E4H3200/3P	93	E4H3200/4P	IEC
94	---	95	E4H/f3200/4P	IEC
96	E4H4000/3P	97	E4H4000/4P	IEC
98	---	99	E4H/f4000/4P	IEC
100	E4V3200/3P	101	E4V3200/4P	IEC
102	E4V4000/3P	103	E4V4000/4P	IEC
104	E6H4000/3P	105	E6H4000/4P	IEC
106	E6H5000/3P	107	E6H5000/4P	IEC
108	---	109	E6H/f5000/4P	IEC
110	E6H6300/3P	111	E6H6300/4P	IEC
112	---	113	E6H/f6300/4P	IEC
114	E6V-A6000/3P	115	E6V-A6000/4P	UL
116	E6V4000/3P	117	E6V4000/4P	IEC
118	E6V5000/3P	119	E6V5000/4P	IEC
120	E6V6300/3P	121	E6V6300/4P	IEC
122	E1B-A800/3P	123	E1B-A800/4P	UL
124	E1B-A1200/3P	125	E1B-A1200/4P	UL
126	E2B-A1600/3P	127	E2B-A1600/4P	UL

Value	CB type	Value	CB type	Standard
128	E2N-A1200/3P	129	E2N-A1200/4P	UL
130	E2N-A1600/3P	131	E2N-A1600/4P	UL
132	E2S-A1200/3P	133	E2S-A1200/4P	UL
134	E2S-A1600/3P	135	E2S-A1600/4P	UL
136	E3N-A2000/3P	137	E3N-A2000/4P	UL
138	E3N-A2500/3P	139	E3N-A2500/4P	UL
140	E3S-A1200/3P	141	E3S-A1200/4P	UL
142	E3S-A1600/3P	143	E3S-A1600/4P	UL
144	E3S-A2000/3P	145	E3S-A2000/4P	UL
146	E3S-A2500/3P	147	E3S-A2500/4P	UL
148	E3H-A1200/3P	149	E3H-A1200/4P	UL
150	E3H-A1600/3P	151	E3H-A1600/4P	UL
152	E3H-A2000/3P	153	E3H-A2000/4P	UL
154	E3H-A2500/3P	155	E3H-A2500/4P	UL
156	E3V-A1200/3P	157	E3V-A1200/4P	UL
158	E3V-A1600/3P	159	E3V-A1600/4P	UL
160	E3V-A2000/3P	161	E3V-A2000/4P	UL
162	E3V-A2500/3P	163	E3V-A2500/4P	UL
164	E4S-A3200/3P	165	E4S-A3200/4P	UL
166	E4S-A3600/3P	167	E4S-A3600/4P	UL
168	E4H-A3200/3P	169	E4H-A3200/4P	UL
170	E4H-A3600/3P	171	E4H-A3600/4P	UL
172	E4V-A3200/3P	173	E4V-A3200/4P	UL
174	E4V-A3600/3P	175	E4V-A3600/4P	UL
176	E6H-A4000/3P	177	E6H-A4000/4P	UL
178	E6H-A5000/3P	179	E6H-A5000/4P	UL
180	E6V-A4000/3P	181	E6V-A4000/4P	UL
182	E6V-A5000/3P	183	E6V-A5000/4P	UL
184	---	185	E6H/f4000/4P	IEC
186	E1N-A800/3P	187	E1N-A800/4P	UL
188	E1N-A1200/3P	189	E1N-A1200/4P	UL
190	E2N-A800/3P	191	E2N-A800/4P	UL
192	E2S-A800/3P	193	E2S-A800/4P	UL
194	E2H-A800/3P	195	E2H-A800/4P	UL
196	E2H-A1200/3P	197	E2H-A1200/4P	UL
198	E2H-A1600/3P	199	E2H-A1600/4P	UL
200	E3S-A800/3P	201	E3S-A800/4P	UL
202	E3S-A3200/3P	203	E3S-A3200/4P	UL
204	E3H-A800/3P	205	E3H-A800/4P	UL
206	E3H-A3200/3P	207	E3H-A3200/4P	UL
208	E3V-A800/3P	209	E3V-A800/4P	UL
210	E3V-A3200/3P	211	E3V-A3200/4P	UL
212	---	213	E4H-A/f3200/4P	UL
214	---	215	E4H-A/f3600/4P	UL
216	E4L-A3200/3P	217	E4L-A3200/4P	UL
218	E4L-A3600/3P	219	E4L-A3600/4P	UL
220	---	221	E6H-A/f4000/4P	UL
222	---	223	E6H-A/f5000/4P	UL
224	E6L-A4000/3P	225	E6L-A4000/4P	UL
226	E6L-A5000/3P	227	E6L-A5000/4P	UL
228	E3X-A800/3P	229	E3X-A800/4P	UL
230	E3X-A1200/3P	231	E3X-A1200/4P	UL
232	E3X-A1600/3P	233	E3X-A1600/4P	UL
234	E3X-A2000/3P	235	E3X-A2000/4P	UL
236	E6X-A4000/3P	237	E6X-A4000/4P	UL
238	E6X-A5000/3P	239	E6X-A5000/4P	UL
240	---	241	E6X-A/f4000/4P	UL
242	---	243	E6X-A/f5000/4P	UL
244	E1B-A250/3P	245	E1B-A250/4P	UL
246	E1N-A250/3P	247	E1N-A250/4P	UL
248	E2S-A250/3P	249	E2S-A250/4P	UL
250	E2H-A250/3P	251	E2H-A250/4P	UL
252	E1N250/3P	253	E1N250/4P	IEC
254	E2S250/3P	255	E2S250/4P	IEC

Table 62 TAB_CB_TYPE

Value	*CB type*	*Value*	*CB type*	*Standard*
0	T7S800 /3P	1	T7S800 /4P	IEC
2	T7S1000/3P	3	T7S1000/4P	IEC
4	T7S1250/3P	5	T7S1250/4P	IEC
6	T7S1600/3P	7	T7S1600/4P	IEC
8	T7H800 /3P	9	T7H800 /4P	IEC
10	T7H1000/3P	11	T7H1000/4P	IEC
12	T7H1250/3P	13	T7H1250/4P	IEC
14	T7H1600/3P	15	T7H1600/4P	IEC
16	T7L800 /3P	17	T7L800 /4P	IEC
18	T7L1000/3P	19	T7L1000/4P	IEC
20	T7L1250/3P	21	T7L1250/4P	IEC
22	T7L1600/3P	23	T7L1600/4P	IEC
24	T7V800 /3P	25	T7V800 /4P	IEC
26	T7V1000/3P	27	T7V1000/4P	IEC
28	T7V1250/3P	29	T7V1250/4P	IEC
30	T7S1200/3P	31	T7S1200/4P	UL489
32	T7H1200/3P	33	T7H1200/4P	UL489
34	T7L1200/3P	35	T7L1200/4P	UL489
36	X1B630/3P	37	X1B630/4P	IEC
38	X1B800/3P	39	X1B800/4P	IEC
40	X1B1000/3P	41	X1B1000/4P	IEC
42	X1B1250/3P	43	X1B1250/4P	IEC
44	X1B1600/3P	45	X1B1600/4P	IEC
46	X1N630/3P	47	X1N630/4P	IEC
48	X1N800/3P	49	X1N800/4P	IEC
50	X1N1000/3P	51	X1N1000/4P	IEC
52	X1N1250/3P	53	X1N1250/4P	IEC
54	X1N1600/3P	55	X1N1600/4P	IEC
56	X1L630/3P	57	X1L630/4P	IEC
58	X1L800/3P	59	X1L800/4P	IEC
60	X1L1000/3P	61	X1L1000/4P	IEC
62	X1L1250/3P	63	X1L1250/4P	IEC
64	X1B800/3P	65	X1B800/4P	UL1066
66	X1B1200/3P	67	X1B1200/4P	UL1066
68	X1N800/3P	69	X1N800/4P	UL1066
70	X1N1200/3P	71	X1N1200/4P	UL1066
72	X1L800/3P	73	X1L800/4P	UL1066
74	X1L1200/3P	75	X1L1200/4P	UL1066
76	X1B800/3P	77	X1B800/4P	UL489
78	X1B1200/3P	79	X1B1200/4P	UL489
80	X1B1600/3P	81	X1B1600/4P	UL489
82	X1N800/3P	83	X1N800/4P	UL489
84	X1N1200/3P	85	X1N1200/4P	UL489
86	X1N1600/3P	87	X1N1600/4P	UL489
88	X1L800/3P	89	X1L800/4P	UL489
90	X1L1200/3P	91	X1L1200/4P	UL489
92	X1V800/3P	93	X1V800/4P	UL489
94	X1V1200/3P	95	X1V1200/4P	UL489
96	T8L2000/3P	97	T8L2000/3P	IEC
98	T8L2500/3P	99	T8L2500/3P	IEC
100	T8L3200/3P	101	T8L3200/3P	IEC
102	T8V2000/3P	103	T8V2000/3P	IEC
104	T8V2500/3P	105	T8V2500/3P	IEC
106	T8V3200/3P	107	T8V3200/3P	IEC
108	T8V1600/3P	109	T8V1600/3P	UL489
110	T8V2000/3P	111	T8V2000/3P	UL489
112	T8V2500/3P	113	T8V2500/3P	UL489
114	T8V3000/3P	115	T8V3000/3P	UL489
116	T7S1000/3P	117	T7S1000/3P	UL489
118	T7H1000/3P	119	T7H1000/3P	UL489
120	T7L1000/3P	121	T7L1000/3P	UL489
122	T7X800/3P	123	T7X800/3P	IEC

Table 63 TAB_CB_TYPE_33x

Value	Event type
0	Parameters changed
1	Signaling reset
2	CB isolated
3	CB connected
4	CB open
5	CB closed
6	CB status defined
7	CB status undefined
8	Internal bus OK
9	Internal bus fault
10	Trip command fail
11	Local mode operating mode
12	Remote mode operating mode
13	Test session closed
14	Test session opene
15	Test unit not connected
16	Test unit connected
17	Set B OFF
18	Set B ON
19	Harmonic distortion OFF
20	Harmonic distortion ON
21	Cw Pre-alarm OFF
22	Cw Pre-alarm ON
23	Cw Alarm OFF
24	Cw Alarm ON
25	L Pre-alarm OFF
26	L Pre-alarm ON
27	L Timing OFF
28	L Timing ON
29	S Timing OFF
30	S Timing ON
31	S2 Timing OFF
32	S2 Timing ON
33	G Timing OFF
34	G Timing ON
35	G Alarm OFF
36	G Alarm ON
37	Gext Timing OFF
38	Gext Timing ON
39	Gext Alarm OFF
40	Gext Alarm ON
41	T Warning OFF
42	T Warning ON
43	T Alarm OFF
44	T Alarm ON
45	T Alarm Block OFF
46	T Alarm Block ON

Value	Event type
47	D Timing OFF
48	D Timing ON
49	U Timing OFF
50	U Timing ON
51	U Alarm OFF
52	U Alarm ON
53	Uv Timing OFF
54	Uv Timing ON
55	Uv Alarm OFF
56	Uv Alarm ON
57	Ov Timing OFF
58	Ov Timing ON
59	Ov Alarm OFF
60	Ov Alarm ON
61	Rv Timing OFF
62	Rv Timing ON
63	Rv Alarm OFF
64	Rv Alarm ON
65	Rp Timing OFF
66	Rp Timing ON
67	Rp Alarm OFF
68	Rp Alarm ON
69	Uf Timing OFF
70	Uf Timing ON
71	Uf Alarm OFF
72	Uf Alarm ON
73	Of Timing OFF
74	Of Timing ON
75	Of Alarm OFF
76	Of Alarm ON
77	Freq Alarm OFF
78	Freq Alarm ON
79	I-warning Alarm OFF
80	I-warning Alarm ON
81	Load control threshold nr.1 OFF
82	Load control threshold nr.1 ON
83	Load control threshold nr.2 OFF
84	Load control threshold nr.2 ON
85	Sensor continuity check 1 Alarm OFF
86	Sensor continuity check 1 Alarm ON
87	Sensor continuity check 2 Alarm OFF
88	Sensor continuity check 2 Alarm ON
89	Sensor continuity check 3 Alarm OFF
90	Sensor continuity check 3 Alarm ON
91	Sensor continuity check Ne Alarm OFF
92	Sensor continuity check Ne Alarm ON
93	Sensor continuity check Gext Alarm OFF

Value	Event type
94	Sensor continuity check Gext Alarm ON
95	Trip coil continuity check Alarm OFF
96	Trip coil continuity check Alarm ON
97	Rating Plug Alarm OFF
98	Rating Plug Alarm ON
99	Installation error OFF
100	Installation error ON
101	Power factor error OFF
102	Power factor error ON
103	Phase cycle error OFF
104	Phase cycle error ON
105	Configuration error ON
106	Configuration error OFF
107	CB status error OFF
108	CB status error ON
109	L tripped
110	S tripped
111	S2 tripped
112	I tripped
113	Iinst tripped
114	G tripped
115	Gext tripped
116	T tripped
117	D tripped
118	U tripped
119	UV tripped
120	OV tripped
121	RV tripped
122	RP tripped
123	UF tripped
124	OF tripped
125	Electronic trip test
126	Simulated trip from test unit
127	External input trip
128	Hardware Error Trip
129	24dc auxiliary supply On
130	Trip Reset
131	History Trip Reset
132	History Measure Reset
133	Energy Reset
134	PR120/V supply On
135	Test connector supply On

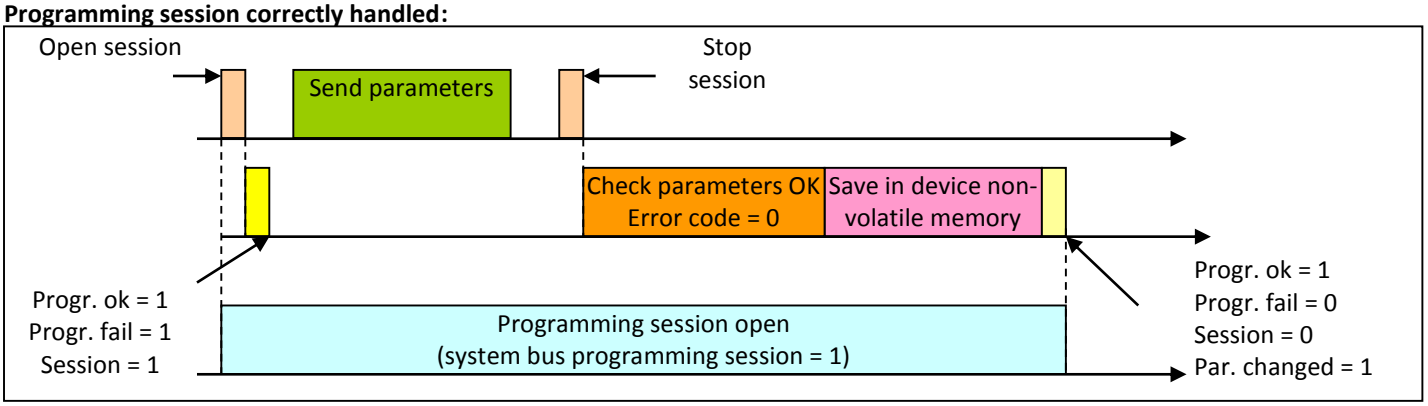
Table 64 TAB_LOG_EVENTS

6. APPENDIX

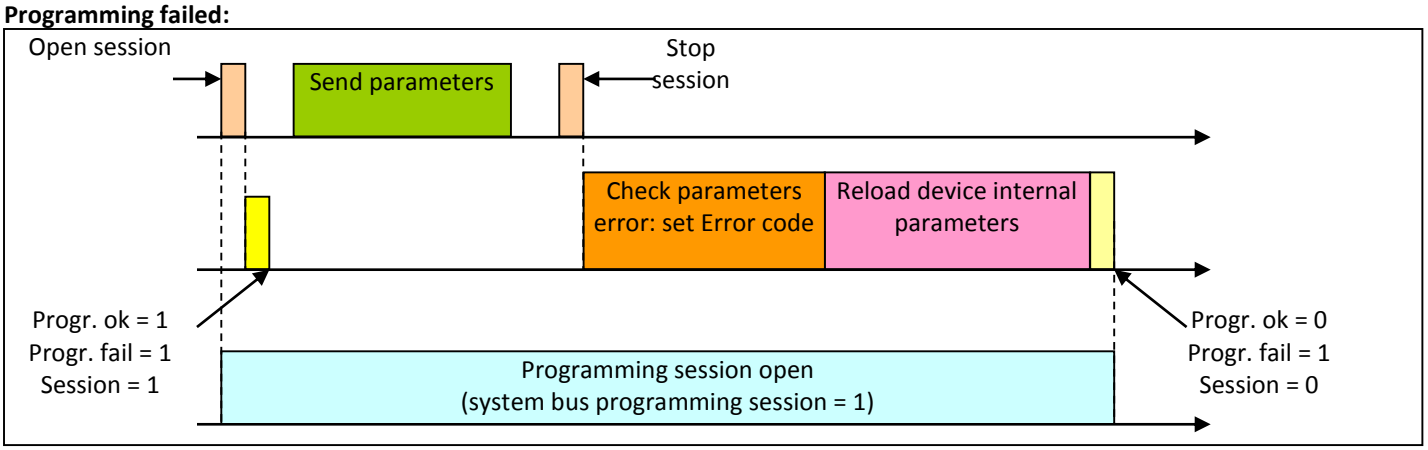
6.1 PARAMETER PROGRAMMING

WARNING: Through the system bus it is allowed to open a programming session only in REMOTE functioning mode. There is a validity programming session timeout of 5minutes once expired the session is aborted; to extend it of 5 more minutes more it is sufficient to re-send an open programming session command

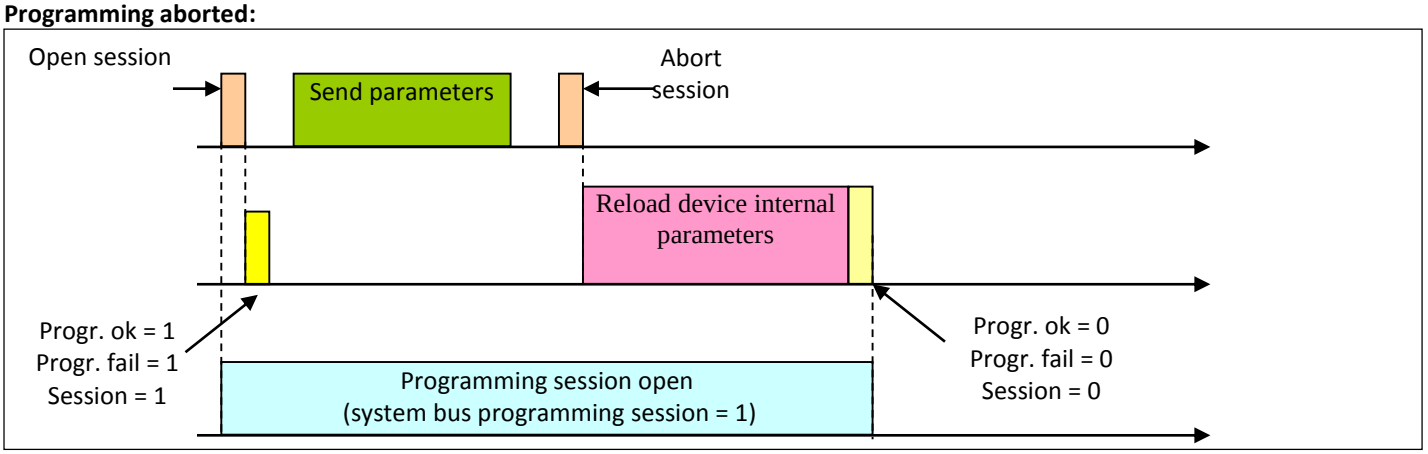
Programming session correctly handled:



Programming failed:



Programming aborted:



6.2 RELAYS AND DATA LOGGER "CUSTOM" SETTING

Through the system bus it is possible to configure data logger trigger and programmable relays function in a more sophisticated mode, in the following way:

Writing in "**Data logger Trigger Type"** or "**Loc Bus Relay X Function"** or "**PX Function"** registers (a value greater than list values) is possible to configure custom functionality as described in the following table.

WORD (bits)															
15	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
OR AND	Byte placement (offset from 0x100 address) in the STATE; numeration start from 1.							Bits mask to be monitored in the byte							

Table 65 relay and Datalogger custom setting

Bit 7 ÷ 0: bit mask used bye trigger or function.
Bit 14 ÷ 8: byte offset in the device STATE.
Bit 15: if 0 means OR function among selected bits (mask), if 1 means AND function.

Example 1: *to configure data logger trigger type to stop when at least one of the listed conditions occur (L tripped, S tripped, I tripped and G tripped) the value to write is:*
Bit 7 ÷ 0 = 00101011 (1 in correspondence of desired bits).
Bit 14 ÷ 8 = 00001111 = 15 (byte containing conditions is the 15th of STATE).
Bit 15 = 0 (OR function).

Therefore Data logger Trigger Type = 0x0F2B

Example 2: *to configure data logger trigger type to stop when all the listed conditions occur (UV Timing, RV Timing and RP timing) the value to write is:*
Bit 7 ÷ 0 = 10100010 (1 in correspondence of desired bits).
Bit 14 ÷ 8 = 0001001 = 9 (byte containing conditions is the 15th of STATE).
Bit 15 = 1 (AND function).

Therefore Data logger Trigger Type = 0x19A2

6.3 MEASURE HISTORY DATA STRUCTURE

The measure history log (0) contains the following information:

- Marker
- History code
- Saving period
- Day
- Hour + minute
- Total mean active power
- Total maximum active power
- Maximum current and relative phase
- Maximum line voltage and relative phase
- Minimum line voltage and relative phase

The Marker (word length) is a general code for all non-volatile memory structure used to distinguish valid data (marker = 0x0000) from not valid data (marker = 0x5555)

The history code has 3 types of recorded data:

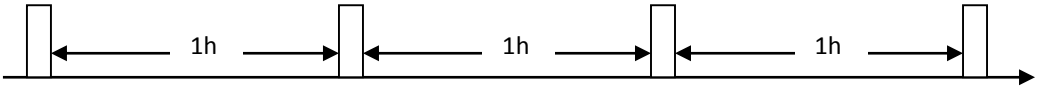
Nr. 0 = Normal record.
Nr. 1 = First record after a supply power-up.
Nr. 2 = First record after a saving period change.

Saving period mean, in the case nr.0 and nr.2, the elapsed time in minutes from previous record.
In case nr.1 an almost empty structure is recorded only to show power supply returns; only Marker and History code have mean.

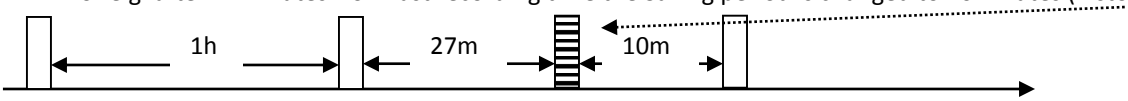
Day, hour and minutes are the time-stamp of structure recording time.

Could take place the following situations with e.g. saving period = 1hour.

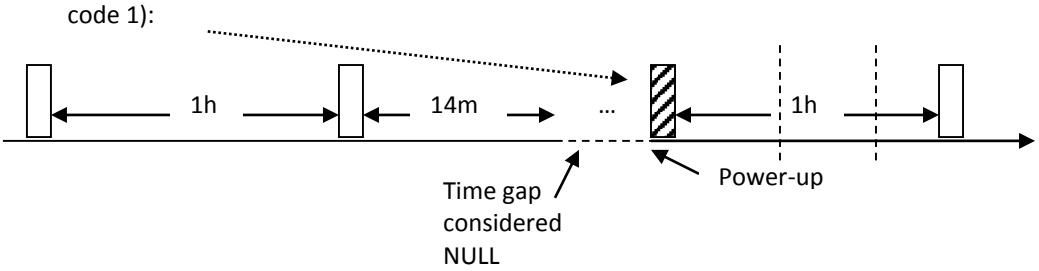
1. Normal situation (history code 0):



2. For e.g. after 27minutes from last recording time the Saving period is changed to 10minutes (history code 2):



3. For e.g. after 14minutes from last recording time there is an auxiliary power supply failure and then a new power-up (history code 1):



6.4 WAVEFORM AND HARMONICS

Sending a "start acquisition waveform + harmonics" command the acquisition of waveform samples (4.17) and the relative harmonics calculation can be obtained.

There are two available commands:

1. Start acquisition:
   the waveform device resource is allocated to system bus, samples are acquired simultaneously from several channel and the harmonic calculation starts on selected channel. When calculation finish the glitch STATE bit "waveform available" is set.
2. Stop acquisition:
   the waveform device resource is released and become available for other requests (e.g. from HMI device); an eventual harmonic calculation in progress will be concluded before releasing the resource.

Start acquisition command need a parameter field defining on which channel the harmonic calculation takes place; following table explains parameter and result link.

Parameter value	Table 57 Waveforms	Table 44 Harmonic measures
(L1)	Samples from L1, L2, L3 and Ne currents acquired simultaneously.	L1 harmonic calc
(L2)		L2 harmonic calc
(L3)		L3 harmonic calc
(Ne)		Ne harmonic calc
(V12)	Samples from V12, V23, and V31 line voltages acquired simultaneously.	V12 harmonic calc
(V23)		V23 harmonic calc
(V31)		V31 harmonic calc

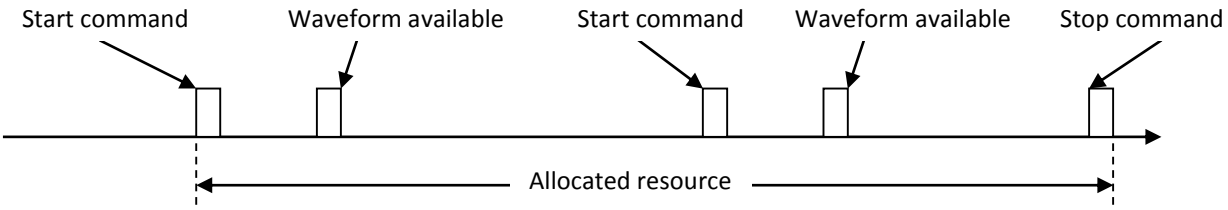
Table 66 waveform and harmonics

WARNING: All currents or all line voltages are acquired simultaneously but only for the selected channel there will be the harmonic calculation. Therefore sending a start command on a different channel (in the same current or voltage block) allows to don't start a new acquisition but only to calculate harmonics; sending command on the same channel it will generate a refresh of all samples before harmonic calculation.

Sequence example:

start L1 : L1, L2, L3, Ne samples acquisition and L1 harmonic calc
start L2 : only L2 harmonics calc; no new sample acquisition
start L2 : new samples acquisition (refresh functionality) and L2 harmonic calc
start V23 : line voltages samples acquisition and V23 harmonic calc

Resource allocation diagram:



WARNING: While the resource is allocated none could use it (an exception busy response will be returned); the STATE flag "waveform session status" show the allocation
There is a 5minutes allocation timeout of resource once expired the resource is released. To continue the resource allocation 5minutes more it is sufficient to send a new start acquisition command before timeout ending

6.5 CB STATE INFORMATION

The device using the following dedicated input reports CB state:

- CB open
- CB close
- CB connected / withdrawn
- Springs charged

The device filters and checks CB state producing the following information:

- CB open / close
- CB state undefined
- CB state error
- CB connected / withdrawn
- Springs charged / discharged

State	Value		Notes
	0 = Open	1 = Close	
CB open/close	Input CB open = 1 + Input CB close = 0 + NO flowing current	Input CB open = 0 + Input CB close = 1	Filtered by 30 ms
State	**Value**		**Notes**
	0 = Open	**1 = Close**	
CB undefined	Input CB open = 1 + Input CB close = 0 + NO flowing current OR Input CB open = 0 + Input CB close = 1	Input CB open = Input CB close	Filtered by 30 ms
State	**Value**		**Notes**
	0 = Open	**1 = Close**	
CB error	Other cases	Input CB open = 1 + Input CB close = 0 + Current flowing	Filtered by 30 ms
State	**Value**		**Notes**
	0 = Open	**1 = Close**	
CB connected	Input CB connected = 0	Input CB connected = 1	Filtered by 1000 ms
State	**Value**		**Notes**
	0 = Open	**1 = Close**	
Springs	Input charged springs = 0	Input charged springs = 1	Filtered by 200 ms

Table 67 CB state information

6.6 STATISTICAL DATA

Device produces same statistical data relevant to system bus communication and to CB operations:

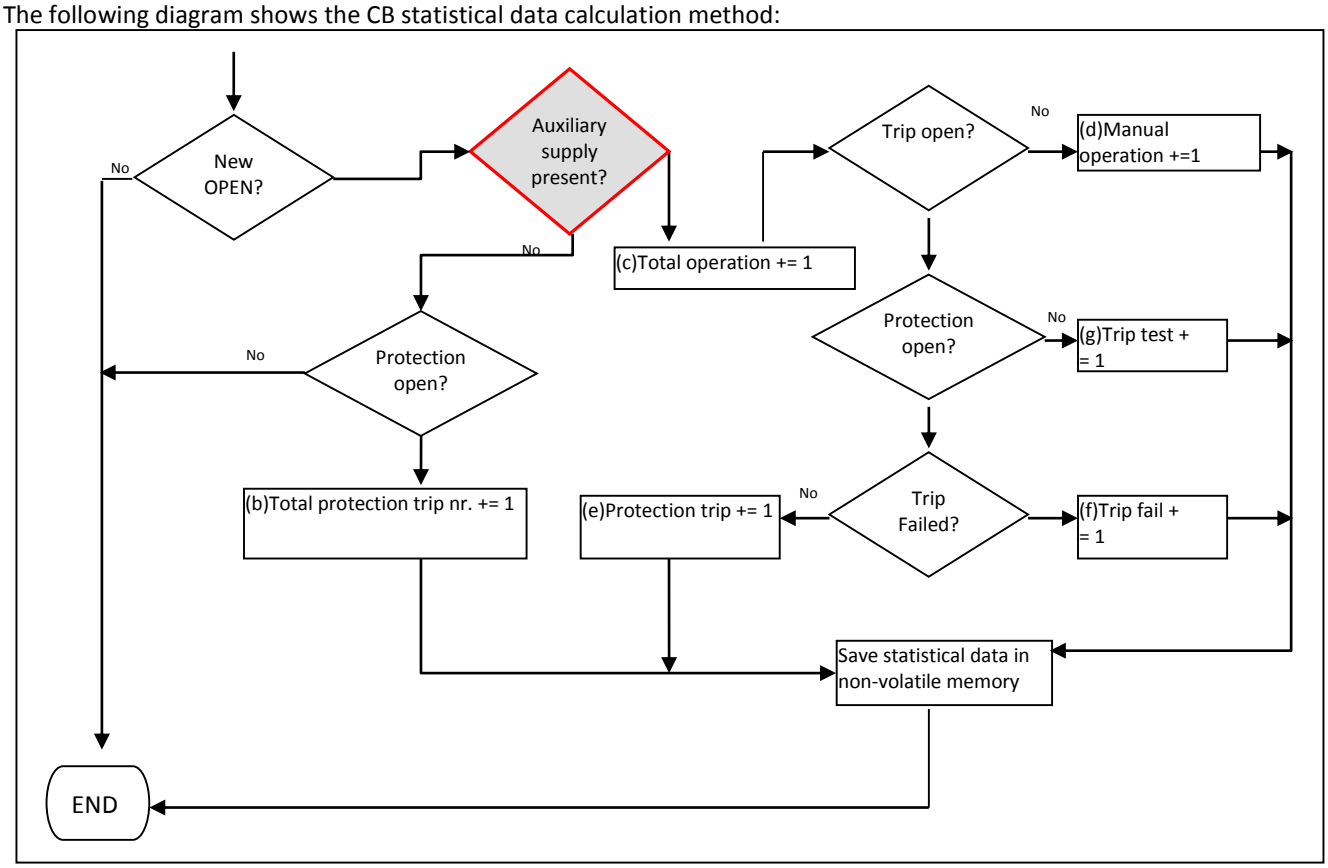
1. **communication statistical data**
   a. received messages nr.
   b. received messages nr. With crc error
   c. set messages nr.
   d. Slave Busy exception responses nr.
   e. Total exception responses nr.

   Must be: a = b + c + nr. Broadcast messages
   Data described above is NOT updated in self-supply device mode.

2. **CB operation statistical data**
   a. Contact wear
   b. Total Protection Trip number

3. **CB operation statistical data NOT updated in self-supply device mode**
   c. total operation nr.
   d. manual operation nr.
   e. protection trip nr.
   f. protection trip fail nr.
   g. trip test nr.

The relationship between them: $c = d + e + f + g$, $b \geq e + f$.
The following diagram shows the CB statistical data calculation method:



6.7 COMMANDS EXECUTION CONDITIONS

To the condition below reported must be appended:

1. commands are accepted only in REMOTE operation device mode.
2. with TEST unit connected only “CB OPEN” command is accepted

Command type	Action	Acceptance conditions
Dummy command	No action	-
Trip reset	Reset trip STATE bits	-
Signaling reset	Reset signaling module and local bus unit STATE bits	-
Communication statistics reset	Reset statistical data	-
Log events reset	Reset events data	-
Start programming session	Open programming session	NO protection timings
Abort programming session	Abort programming session	Programming session opened
Stop programming session	End programming session	Programming session opened, NO consistency check errors, NO protection timings
CB Open	Activate YO	CB connected, CB open command NOT executing, CB close command NOT executing
CB Close	Activate YC	CB connected, CB OPEN, CB NOT undefined, NO trip executing, CB open command NOT executing, CB close command NOT executing
CB reset	Reset trip STATE bits	-
Wink toggle command	LCD backlight wink ON or OFF	-
History measure reset	Reset measure data	-
Energy counters reset	Reset Energy data	-
Data logger trigger restart	Waiting trigger status	NO trip execution, Data logger enabled, Triggered acquisition completed.
Data logger stop	Trigger immediately	NO trip execution, Data logger enabled, Triggered acquisition completed.
Waveform + harmonics acquisition start	Open waveform acquisition session	PR123 unit, I max current ≤ 2 In, Imin. Current ≥ 0.1 In, NE sensor present for NE, L1, L2, L3 sensor connected, PR120/V module present for V12, V23, V31
Waveform + harmonics acquisition stop	End waveform acquisition session	PR123 unit, Waveform session opened.

Table 68 Commands acceptance conditions

6.8 MEASURE LIMITS AND REPRESENTATION

Measure	Special value	Description	Modbus data	Local HMI value
Currents	Not available	Sensor disconnected	0xFFFFFFFF	_ _ _
	Too low	I < Imin	0	• • •
	Saturation	I > Imax	Imax	I > xxx A
Internal ground current	Not available	Sensor disconnected, I_G > Igmax	0xFFFFFFFF	_ _ _
	Too low	I_G < Igmin	0	• • •
External ground current	Not available	External toroid absent, Sensor disconnected	0xFFFFFFFF	_ _ _
	Too low	I_{GEXT} < I_{GEXT}min	0	• • •
	Saturation	I_{GEXT} > I_{GEXT}max	Imax	I > xxx A
Rc current	Not available	Rc toroid absent, Toroid disconnected	0xFFFFFFFF	_ _ _
	Too low	I_{RC} < I_{RC} min.	0	• • •
	Saturation	I_{RC} > I_{RC} max.	Imax	I > xxx A
Maximum current phase	Not available	All sensors disconnected, All current values < Imin	0	_ _ _
Voltages	Not available	PR120/V module absent	0xFFFF	_ _ _
	Too low	V < Vmin	0	• • •
	Saturation	V > Vmax	Vmax	V > xxx V
Active, reactive and phase power (P1, P2, P3, Q1, Q2, Q3, S1, S2, S3)	Not available	PR120/V module absent, Sensor disconnected, I < Imin, V < Vmin	0x7FFFFFFF	_ _ _
	Too low	| P | < Pmin	0	• • •
	Positive saturation	P > Pmax	Pmax	P > xxx kW
	Negative saturation	P < - Pmax	- Pmax	P < xxx kW
Total power (P,Q, S)	Not available	All phase power not available	0x7FFFFFFF	_ _ _
Active, reactive and apparent energy	Positive saturation	E > 2^{31}-1	0x7FFFFFFF	E > xxx kWh
	Negative saturation	E < -2^{31}	0x80000000	E < xxx kWh
Total cosΦ	Not available	S or P not available | S | or | P | < Pmin S or P > Pmax S or P < -Pmax	0x7FFF	_ _ _
Peak factor	Not available	Sensor disconnected, I < Imin Peak	0xFFFF	_ _ _
Frequency (see note)	Not available	PR120/V module absent or V<Vmin	0xFFFF	_ _ _
	Too low	F < minimum frequency	Minimum frequency	Freq < Freq min
	Too high	F > maximum frequency	Maximum frequency	Freq > Freq max
Harmonic amplitude	Not available	Amplitude < Harm min	0	• • •
	Saturation	Amplitude > Harm max	Harm max	> Harm max
Contact wear	Saturation	CW > 100%	65000	100%

Table 69 Measure limits and representation

Legend:

Imin	= 0,05 In	Vmin	= 5,7 V
Imin Peak	= 0,2 In	Vmax	= 922V
Imax	= 16 In	Pmin	= 0,5 In * 5,7 V
Igmin	= 0,1 In	Pmax	= 16 In * 922V
Igmax	= 16 In	Fmin	= 29,5 Hz (with hysteresis up to 31 Hz)
IG_{EXT}min	= 0,1 In	Fmax	= 80,5 Hz (with hysteresis up to 79 Hz)
IG_{EXT}max	= 4 In	Harm min	= 2 %
I_{RC}min	= 2 InRc	Harm max	= 500 %
I_{RC}max	= 32,5 InRc		

***Note**: the measure of frequency is subject hysteresis in the intervals 29,5 Hz ÷ 31 Hz and 79 Hz ÷ 80,5 Hz, therefore it is valid in the range 31 Hz ≤ freq ≤ 79 Hz.*

6.9 CONTACT WEAR

The contact wear is calculated as the usury sum owed at every single CB open and it's explicit in % (0 ÷ 100[%]):
It's available in format 0 ÷ 65000 (0=0%, 65000=100%), therefore to obtain the percentage is necessary to divide the value for 650.

7. REVISION HISTORY

7.1 B0431 (04/05/2016)

Added	
1	Par.**2.3**: added Slave ID for PR332/P MM
2	Par.**3**: inserted codes for PR332/P MM on the table
3	Par.**3.1**: inserted references and notes to PR332/P MM
5	Par.**4.4**, **4.6**, **4.11**, **4.12**, **4.13**, **4.14**: completed compatibility column with references to PR332/P MM
1	Par.**4.13**: added 1130 and 1131 alternative to startup threshold I
2	Par.**4.14**: inserted trip MM as alternative to I
6	Added Revision History section
Modified	
1	
Deleted	
1	

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