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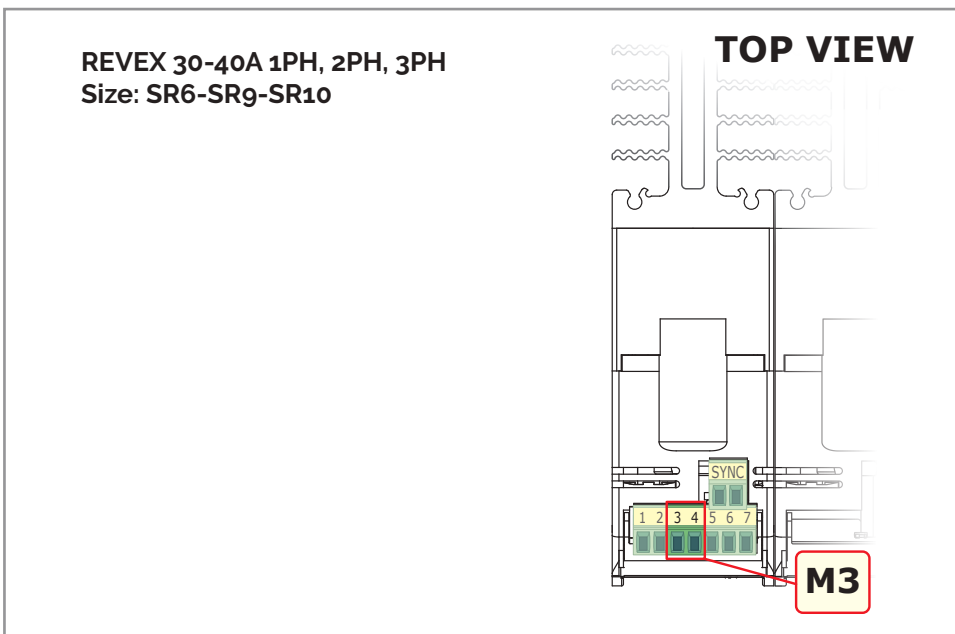
1 MODBUS-RTU communication protocol

1.1 Communication Terminals 30-40A (SR6-SR9-SR10)

1.1.1 RS485 standard Serial Port

Terminal M3	Description
3	RS485 A+
4	RS485 B-

The serial communication port RS485 is available on the Command terminals.
 On this port may be done a network up to 127 REVEX.



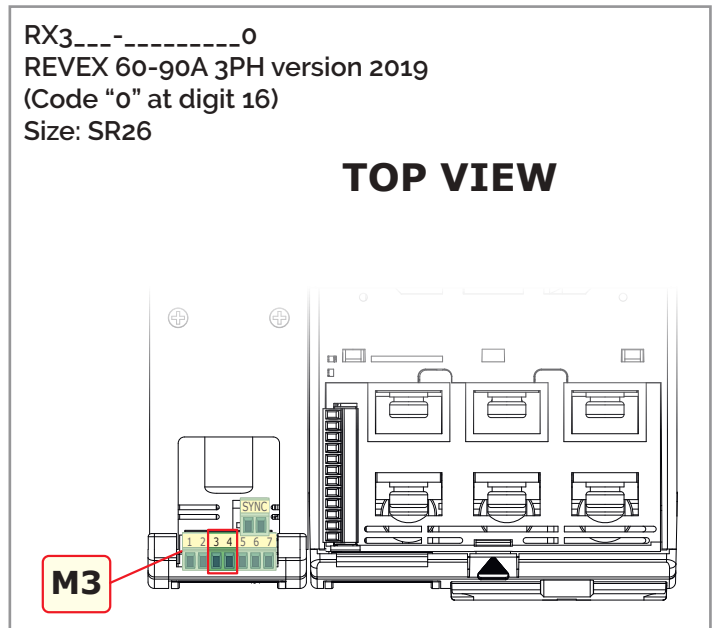
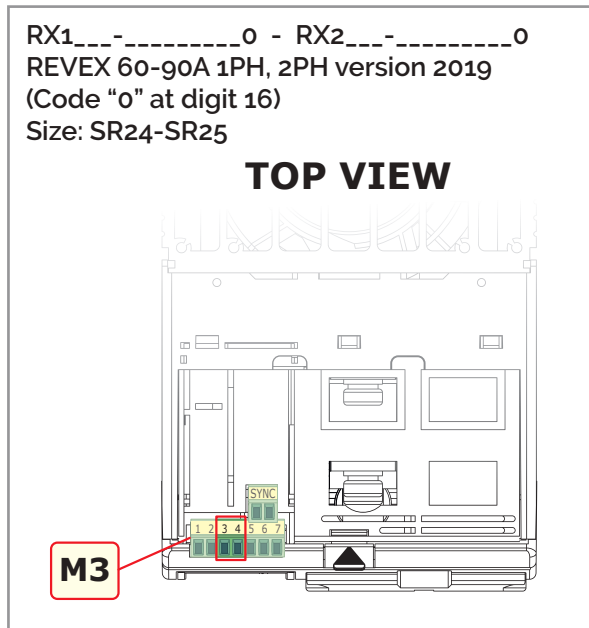
1.2 Communication Terminals 60-90A (SR24-SR25-Sr26)

1.2.1 RS485 standard Serial Port on REVEX units with Code "0" at digit 16: RX____-____0

(REVEX 60-90A 1PH and REVEX 60-90A 2PH and 3PH 2019 version)

Terminal M3	Description
3	RS485 A+
4	RS485 B-

The serial communication port RS485 is available on the Command terminals.
On this port may be done a network up to 127 REVEX.

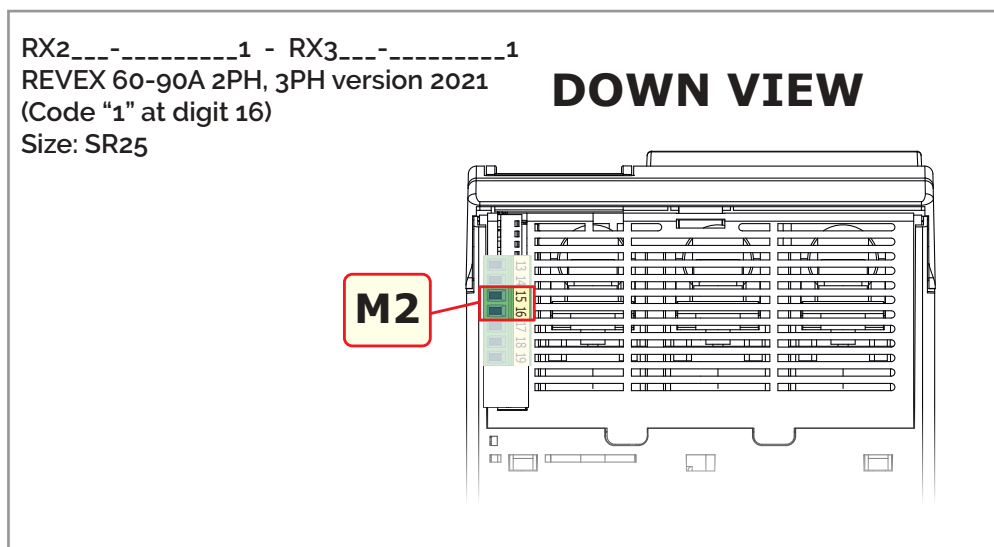


1.2.2 RS485 standard Serial Port on REVEX units with Code "1" at digit 16: RX____-____1

REVEX 60-90A 2PH and 3PH 2021 version

Terminal M2	Description
15	RS485 A+
16	RS485 B-

The serial communication port RS485 is available on the Command terminals.
On this port may be done a network up to 127 REVEX.

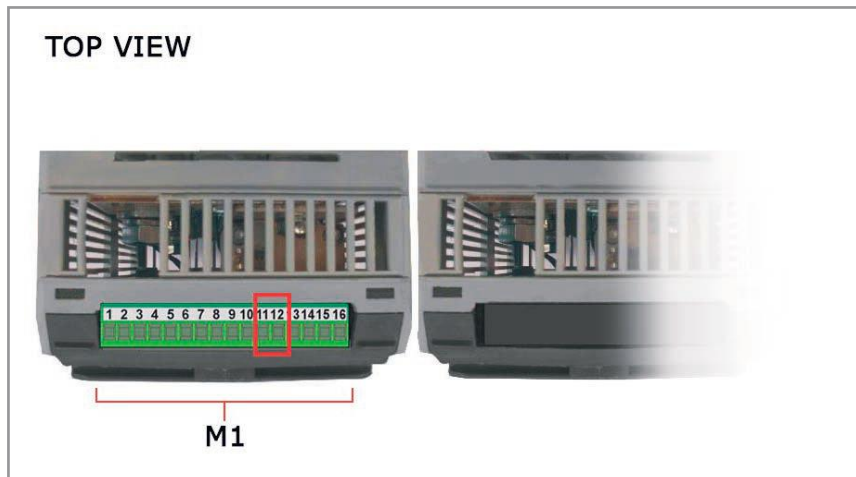


1.3 Communication Terminals 120-210A (from SR12 to SR17)

1.3.1 RS485 standard Serial Port

Terminal M1	Description
11	RS485 B
12	RS485 A

The serial communication port RS485 is available on the Command terminals. On this port may be done a network up to 127 REVEX.



1.4 MODBUS communication

The serial communication port of the thyristor unit is two-wire RS485 type. This port use an half-duplex system.

While a Unit is transmitting the transmission line is activated, otherwise the transmission line is in high impedance.

The serial communication port allows to communicate between the thyristor units and a MASTER device (ex. a computer or a terminal). The cable must be rated for use to data transfer.

1.5 MODBUS RTU Protocol

The communication is based on the standard industrial MODBUS RTU with the following restrictions:



The Baud rate can be 9600-19200-38400-115200 Baud (Standard 19200).

The following MODBUS functions are supported:

Function	Description
03/04	Read Holding Registers (max 121 reg.)
06	Preset Single Registers
16	Preset Multiple Registers (max 25 reg.)



The unit support the Broadcast messages:

It's possible to send a Broadcast message using the address 0, all the units respond to the message without sending back any reply.

1.6 Message Format

The transmission format is a 1 bit start, 8 data bit, and 1 bit stop with no parity verification. A message for either a Query or a Response is made up of an inter-message gap followed by a sequence of data characters. The inter-message gap is at least 3.5 character times. The first Byte of each message is always the address of the unit that is a value from 1 to 255 or 0 for the broadcast messages, the second is always the function number, and the rest of the message depends of the function demand.



When a slave receives a message, the unit sends an answer with the same structure but with the information requested.

Each message is followed by CRC (Cyclic Redundancy Check) with two bytes. The CRC identifies the incongruity situations of the message, in this case the receiver ignores the message. The CRC is calculated in accordance with a formula that implies a recursive division of the data by a polynomial. The polynomial divisor is:

$$2^{16} + 2^{15} + 2^2 + 1 \text{ (Hex 18005)}$$

but is modified in two ways:

- Since the bits order are reversed, then the binary pattern is also reversed, and the most significant bit (MSB) is the right-most bit.
- Since interest only the remainder, the right-most bit could be discarded.

Therefore, the polynomial divisor has value: Hex A001

Normal bit order:



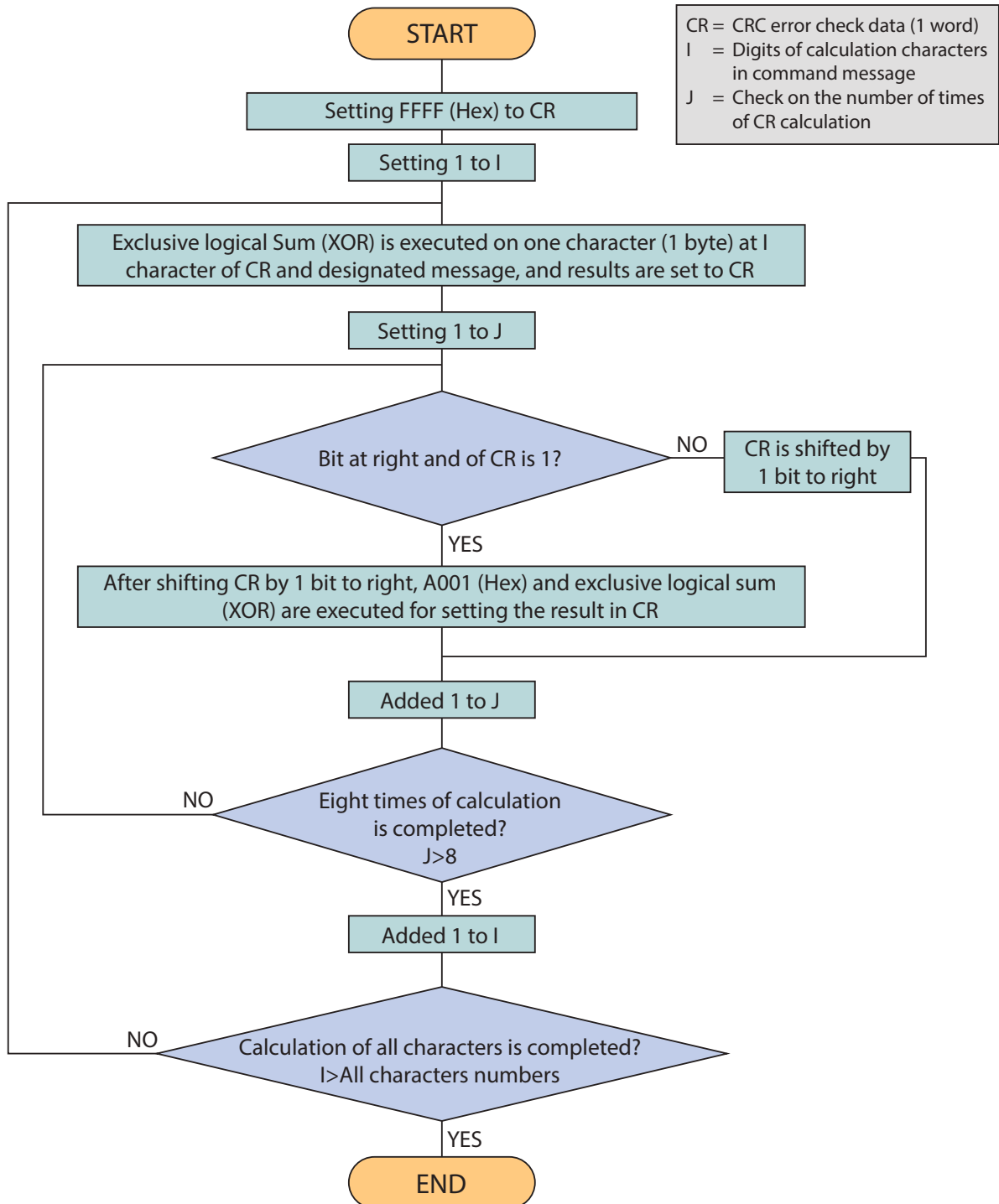
Reversed bit order:



N.B.: With the reversed bit order, also the CRC16 returns the with the reversed bit order



The following flowchart shows how to organize the CRC 16 bit.



1.5.1 C Language CRC 16 Example

```

static short CRC16 (unsigned char *p_first,unsigned char *p_last)
{
    unsigned int crc=0xffff;
    short j;
    for (;p_first<=p_last;p_first++)
    {
        crc ^= *p_first;
        for(j=8;j>0;j--)
        {
            if(crc & 0x0001)
            {
                crc = crc >> 1;
                crc ^= 0xA001;
            }
            else
            {
                crc = crc >> 1;
            }
        }
    }
    return (crc);
}
    
```

**1.7 Read Holding Registers (function 03 /03Hex) -
Read InputRegisters (function 04/04Hex)**

This function reads the instantaneous values of a specified number of parameters from an address. The message is composed by 8 Byte:

- one Byte is for the address
- one Byte for the function (03/04Hex)
- two Byte for the address of the first parameter to read
- two Byte for the total number of parameters to read (max **121**)
- two Byte for the CRC

Address Unit	Function	Address of the First Parameter		N° of read Parameter		CRC 16	
		HI	LO	HI	LO	LO	HI
	3/4 3/4Hex						

The answer is an echo of the first two Byte (address and function), one byte with the number of byte following (CRC excluded), the demanded values and finally two Byte for the CRC.

Address Unit	Function	N° of Byte	First Parameter Value			Last Parameter Value		CRC 16	
			HI	LO		HI	LO	LO	HI
	3/4 3/4Hex	2 - 32							

1.8 Preset Multiple Registers (function 16/10Hex)

This function could write maximum 25 parameters for each message.

The message is composed by:

- one Byte for the address
- one Byte for the function (10 Hex)
- two Byte for first parameter address to write
- two Bytes for the N° of parameters
- one Byte with the number of following Bytes
- values to write, two Byte for the CRC:

Address Unit	Function	Address of the First Parameter		N° of the parameter		N° of Byte	Value to Write		→
	16 10Hex	HI	LO	HI	LO	2	HI	LO	→
		→ First Value to Write		Last Value to Write		CRC 16			
		HI	LO	HI	LO	LO	HI		

The answer is an echo of the first two Byte (address and function), two Byte for first written parameter, two Byte with the N° of parameters, fixed to 1 (0001 Hex), two Byte for the CRC.

Address Unit	Function	Address of the First Parameter		N° of the Parameter		CRC 16	
	16 10Hex	HI	LO	0	1	LO	HI

1.9 Preset single register (function 06/06Hex)

This function writes a single Modbus paramter.

The message is composed by 8 Bytes:

- one Byte for the address,
- one Byte for the function (6 Hex),
- two Bytes for the parameter address to write
- two bytes for the value to write
- two Bytes for the CRC

Address Unit	Function	Address of the First Parameter		Value to Write		CRC 16	
	6 6Hex	HI	LO	HI	LO	LO	HI

The normal response is a complete echo of the received message.

1.10 Error and exception responses

If a message contains an altered character, if fails the CRC, or if the received message contains a syntax error (for example the number of the byte or of the words is not correct), then the unit will ignore the message.

If the received message is correct but contains a not valid value, the unit will send an answer of exception (5 byte):

Address Unit	Function	Error Code	CRC 16	
			LO	HI

The byte with the function number, represent the function number of the message that has caused the error with the first Bit set to 1 (ex. the function 3 becomes 0x83) The error code could be one of the followings:

Error Code	Name	Cause
1	ILLEGAL FUNCTION	Function not supported
2	ILLEGAL DATA ADDRESS	Address out of range
4	FAILURE IN ASSOCIATED DEVICE	Too Many parameter request

1.11 Address Configuration

The thyristor unit is assigned a unique device address by the user in the range 1 (default) to 247 using the parameter P115 *Addr* in the Hardware menu. This address is used to recognise Modbus Queries intended for this instrument.

The thyristor unit does not respond to modbus queries that don't have the same assigned address.

1.12 Parameter List

Par	Min	Max	Min UM	Max UM	UM	Write Enable	Access Level	1PH	2/3PH	Description
1	0	65535				X	0	X	X	Change User Access Level Level 0: Par 1 = 0 Level 1: Par 1 = 1111 (dec) Level 2: Par 1 = 2222 (dec) Level 3: Par 1 = 3333 (dec)
2	0	1					1	X	X	Used to temporarily disable Field Communications 0 = Enabled 1 = Disabled
3							0	X	X	
4							0	X	X	
5										Not used
6										Not used
7	0	9999					-	X	X	Used for factory reset (wipes all EEPROM except serial number)
8	0	65535				X	3	X	X	Used to save or restore default configuration
9	0	65535	0	655.35	Hz		0	X	X	Frequency of the power input
10	0	1023	0	1023	V		0	X	X	Average (RMS) voltage of all phases
11	0	1023	0,0	102.3	A		0	X	X	Average (RMS) current of all phases
12	0	1023	0	1023	%		0	X	X	Average (RMS) power output
13	0	1023	0	1023	Sw		0	X	X	Status bitmask Bit 0 ShortCut Alarm Bit 1 Heat Break Alarm Bit 2 ON/OFF unit Bit 3 Not used Bit 4 Current Limit Alarm Bit 5 Thermal Alarm Bit 6 Communication Alarm (WD) Bit 7 Not used Bit 8 Digital input 1 status Bit 9 Digital input 2 status Bit 10 Phase unbalanced Bit 11 Not used Bit 12 Not used Bit 13 Not used Bit 14 Bakeout in function Bit 15 Thermal Alarm Active

Par	Min	Max	Min UM	Max UM	UM	Write Enable	Access Level	1PH	2/3PH	Description
14	0	255	0	1023	Sw	X	0	X	0	Command bitmask Bit 0 Not used Bit 1 Digital reference 0 = from analogue input 1 = from communication/keyb Bit 2 Unit enable 1= Enable 0= Disable Bit 3 0 = Normal Operation 1 = Alarm reset Bit 4 Current line switch 0 = from analogue input 1 = from communication/keyb Bit 5 Not used Bit 6 Save factory Bit 7 Load factory Bit 8 Not used Bit 9 Not used Bit 10 Not used Bit 11 Not used Bit 12 Not used Bit 13 Not used Bit 14 Not used Bit 15 Not used
15	0	1023	0,0	100.0	%	X	0	X	X	Remote set point for unit
16	0	255	0	100	%	X	0	X	X	Indicates the percentage by which the power demand set point is scaled
17	0	1023	0	100	%	X	0	X	No	Digital current limit value 0 = From analogue Input 1 = From communication/keyb
18	0	1023	0	1023	Sw	X	0	X	Only ZC BF	Firing mode options Zero cross 1 Single Cycle 2 Burst Firing 3 Phase Angle 4 Phase Angle + Soft Start 20 Half Cycle 10 Burst Cycle + Soft Start 19 Burst Firing + Delay Trigger 35 Burst Firing + Delay Trigger + Safety Ramp Peak 227 Burst Firing + Delay Trigger + Saftyramp 99 Half Cycle + Soft Start 74
19	0	1023	0	1023	Sw	X	0	X	X	Control Mode (Feed-back) VOLTAGE 32 VOLTAGE ² 0 CURRENT 64 CURRENT ² 2 POWER 128 NO_FEEDBACK 1
20	0	255	0	255	-	X	0	X		Number of cycles to fire in burst fire mode
21	0	255	0	255	-	X	0	X	No	Number of half cycles with a delay in burst fire mode

Par	Min	Max	Min UM	Max UM	UM	Write Enable	Access Level	1PH	2/3PH	Description
22	0	90	0	90	.	X	0	X	No	Degrees of delay from zero cross when the first cycle is triggered to on when in Delay Trigger Mode. (Delay for a transformer is 45 degrees)
23	0	255	0	255	x50ms	X	0	X	No	Number of 50 msec periods over which soft start is active
24	0	255	0	255	x50ms	X	0	X	No	Number of 50 msec periods that make up the fixed time base (Cycle time) calculation
25	0	1024	0	1024	HC	X	0	X	X	How many half cycles to use for soft start
26	0	255	0	255	-	X	1	X	X	Proportional term for the primary feedback loop
27	0	255	0	255	-	X	1	X	X	Integral term for the primary Feedback loop
28	0	255	0	255	x50ms	X	1	X	X	Number of 50 msec periods after the heater break is detected before the alarm is triggered
29	0	100	0	100	%	X	1	X	X	Threshold of resistance that activates the HB alarm as a percentage of the nominal load resistance
30	0	3	0	3	Sw	X	1	X	X	Baud rate for primary (RS485) Modbus port
31	0	255	0	255	Addr	X	1	X	X	Address for primary (RS485) Modbus port
32	0	5	0	5	Sw	X	1	X	No:4.7	Defines the function activated when: 0 = Enable thyristor 2 = Change to V feedback 3 = Change digital reference from AI/communication 4 = Force PA firing 5 = Select reference 1/2 6 = Not used 7 = Bakeout enable 8 = Fast enable thyristor Digital Input 1
33	0	5	0	5	Sw	X	1	X	No:4.7	Defines the function activated when: 0 = Enable thyristor 2 = Change to V feedback 3 = Change digital reference from AI/communication 4 = Force PA firing 5 = Select reference 1/2 6 = not used 7 = Bakeout enable 8 = Fast enable thyristor Digital Input 2
34	0	65535	0	65535	Sw	X	1	X		Defines the function of the output relay Bit 0 HB alarm Bit 1 SC alarm Bit 2 I LIM Alarm Bit 3 \ Bit 4 Modbus Watchdog

Par	Min	Max	Min UM	Max UM	UM	Write Enable	Access Level	1PH	2/3PH	Description
35	0	1023	0	1023	Sw	X	1	X	X	Analogue Input Calibration 0 = Normal operation 1 = Store low analogue input value 2 = Store high analogue input value
36	0	65535	0	65535	Sw		-	X	X	Unit type (1PH, 2PH, 3PH) 7 = REVEX 1PH 8 = REVEX 2PH 9 = REVEX 3PH 10 = REVEX 3PH PA
37	0	1023	0	1023	V	X	0	X	X	Nominal value for the line voltage input.
38	0	9999	0	999.9	A	X	0	X	X	Nominal load Current.
39	0	9999	0	999.9	A		-	X	X	Current transformer amperage rating
40										Not Used
41	0	1023	0	1023	V		-	X	X	Unit rating (max voltage rating for the product ex: 480, 600, 690)
42	0	1023	0	1023	V		-	X	X	Used to calibrate the aux voltage
43	0	1023	0	1023	V		0	X	X	Aux voltage
44	0	3	0	3	Sw	X	1	X		Analog input 1 type 1 = 0-10 V 2 = 4-20 mA 3 = 0-20 mA
45										Not used
46	0	65535	0	655.35	ohm		0	X	X	Indicates the resistance of the load. Based on a calculation of the Vrms load voltage divided by the Irms load current. (Average Irms in multi-phase unit)
47	0	65535	0	65535	V		0	X	X	Average (RMS) voltage input
48	0	65535	0	65535	-		0	X	X	Version number (X.XX.X)
49	0	65535	0	65535	-		0	X	X	Year and week of release (YYW/W)
50										Not used
51										Not used
52	0	1	0	1		X	0	X	X	Selector for the current limit type 0 = RMS 1 = PEAK
53										Not Used
54	0	4096	0	4096	A		0	X	X	Measured RMS Current - phase 1
55	0	4096	0	4096	A		0	No	X	Measured RMS Current - phase 2
56	0	4096	0	4096	A		0	No	X	Measured RMS Current - phase 3
57	0	1023	0	1023	-		0	X	X	Internal use
58	0	1023	0	1023	-		0	X	X	Internal use
59	0	1023	0	1023	-		0	X	X	Internal use

Par	Min	Max	Min UM	Max UM	UM	Write Enable	Access Level	1PH	2/3PH	Description
60	0	1023	0	1023	Sw	X	1	X	X	Output value displayed when the Thyristor unit starts up 0 = I current 1 = V voltage 2 = P power
61	0	65535	0	65535	-	X	1	X	X	Selects which analogue input is used for the SP input 0 = Analogue Input 1 1 = Analogue Input 2
62	0	9999	0	9999	A		-	X	X	Thyristor unit Amperage Rating
63	0	255	0	255	-	X	1	X	No	Proportional term for the current limit loop
64	0	255	0	255	-	X	1	X	No	Integral term for the current limit loop
65	0	65535			x50mS	X	0	X	No	Once the output turns off, how much time must pass before safety ramp will be re-enabled
66	0	65535			x50mS	X	0	X	No	Time for the safety rmap
67	1	9999	0	99.99			-	X	X	Current transformer gain correction
68										Not used
69										Not used
70										Not used
71										Not used
72										Not used
73										Not used
74										Not used
75										Not used
76										Not used
77										Not used
78										Not used
79										Not used
80										Not used
81										Not used
82										Not used
83										Not used
84										Not used
85										Not used
86										Not used
87										Not used
88										Not used
89										Not used
90										Not used
91										Not used

Par	Min	Max	Min UM	Max UM	UM	Write Enable	Access Level	1PH	2/3PH	Description
92										Not used
93										Not used
94										Not used
95										Not used
96										Not used
97										Not used
98	0	9995	0	9995	ms	X	2	No	X	Delay for zero cross of phase 1
99	0	9995	0	9995	ms	X	2	No	X	Delay for zero cross of phase 2
100	0	9995	0	9995	ms	X	2	No	X	Delay for zero cross of phase 3
101	0	1	0	1	Sw	X	1	X	No	Enable the current limit 0 = off 1 = on
102	0	1000	0	1000	ratio		0	X	X	Power Factor of the output power
103										Not used
104										Not used
105	0	3	0	3		X	1	X	X	Process signal type for analogue input 2 1 = 4-20 mA 2 = 0-10 V 3 = 0-20 mA
106	0	4096	0	4096			-	X	X	stored calibration value (internal use)
107	0	4096	0	4096			-	X	X	
108	0	4096	0	4096			-	X	X	
109	0	4096	0	4096			-	X	X	
110	0	4096	0	4096			-	X	X	
111	0	4096	0	4096			-	X	X	
112	0	4096	0	4096			-	X	X	
113	0	4096	0	4096			-	X	X	
114	0	4096	0	4096			-	X	X	
115	0	4096	0	4096			-	X	X	
116	0	2	0	2	Sw	X	1	X	No	Function associated with AN2 0 = Current Limit 1 = Feed-back 2 = External input
117	0	9999	0	9999			-	X	X	Gain for power set point
118	0	9999	0	9999			-	X	X	Gain for measured power rtx (VxI)
119										Not used
120										Not used
121	0	65535					0	X	X	Thyristor unit type (=8)

Par	Min	Max	Min UM	Max UM	UM	Write Enable	Access Level	1PH	2/3PH	Description
122	0	1024				X	1	X	X	If PROFIBUS is mounted, this is the external address that is used to communicate over PROFIBUS
123	0	65535			kVA	X	X	X	X	Real Time power consumption calculation (read only, can set to 0 to reset total count)
124	0	65535				X	X	X	X	Retransmission gain
125										Not used
126										Not used
127	0	1200	0	120	°C			X	X	Temperature of the SCR (if NTC, you will see the value, 0 = Okay 1 = Alarm
128	0	1200	0	120	°C	X	3	X	X	SCR Temp. alarm set (setting to 0 disables this alarm)
129	0	4096	0	4096			-	X	X	Calibration value for AI1
130	0	4096	0	4096			-	X	X	
131	0	65535			kW		0	X	X	Real time power consumption calculation
132										Not used
133										Not used
134										Not used
135										Not used
136										Not used
137	0	1000	0	100,0			0	X	X	Current value of analog input 2 in percent
138	0	1000	0	100,0			0	X	X	Current value of analog input 1 in percent
139										Not used
140	0	1					0	X	No	Enable bakeout function (0 - off / 1 - on)
141										Not used
142	0	1				X	1	X	X	Enable to Modbus watchdog
143	0	255			s	X	1		X	Watch dog alarm time
144	0	9999			min	X	1	X	No	Bakeout total ramp time
145	0	9999			A	X	1	X	No	Bakeout current limit
146	0	9999			min	X	1	X	No	Time to wait while off before bakeout is needed again
147	0	1024					0	X	X	Scaled AN1 value (0-1024)
148	0	1024					0	X	X	Scaled AN2 value (0-1024)
149	0	9999					-	X	X	Serial Number
150	0	9999					-	X	X	
151	0	9999					-	X	X	
152	0	9999					-	X	X	

Par	Min	Max	Min UM	Max UM	UM	Write Enable	Access Level	1PH	2/3PH	Description
153	0	1000					0	X	X	Internal use
154										Not used
155										Not used
156										Not used
157										Not used
158										Not used
159	0	65535					0	X	X	16 bit CRC of Modbus map



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