

Serial Communication V1.0x

1. SERIAL COMMUNICATION

The optional RS485 serial interface allows you to address up to 247 indicators in a network, communicating remotely with a computer or master controller.

1.1 COMMUNICATION INTERFACE

- Compatible signals with RS485 standard.
- 2-wire connection between the master and up to 31 slave indicators in bus topology. It is possible to address 247 nodes with multiple outputs converters.
- Maximum communication distance: 1000 meters.
- The RS485 signals are:

D1	Bidirectional data line.
D0	Bidirectional inverted data line.
C	Optional connection that improves communication performance.

1.1.1 GENERAL CHARACTERISTICS

- Optical isolation in the serial interface;
- Programmable speed: 1200 to 115.200;
- Data bits: 8;
- Parity: None;
- Stop Bits: 1.

1.1.2 COMMUNICATION PROTOCOL

The device supports the MODBUS RTU slave protocol, available in most of the SCADA software on the market.

All configurable parameters of the indicator can be accessed (read and/or written) through registers presented in the Register Table. It is also possible to write in Broadcast mode by using 0 address.

The available Modbus commands available are as follows:

03	Read Holding Register (Reading Registers).
05	Write Single Coil (Force Digital Output status).
06	Write Single Register (Writing in Registers).

The registers are presented in a table so that multiple registers can be read in a single request.

1.2 CONFIGURATION OF SERIAL COMMUNICATION

To use serial communication, you must to configure two parameters in the device:

Baud: Baud Rate. All devices have the same Baud Rate.

Addr: Communication address of the controller. Each controller must have a unique address.

1.3 REGISTER TABLE

Registers are the internal parameters of the controller. Each parameter in the table is a 16-bit word with a signal represented in addition to 2.

HOLDING REGISTERS	PARAMETER	REGISTER DESCRIPTION
0	SP	Read: Active control SP (main SP, from ramp and soak or from remote SP). Write: To main SP. Range: From SPLL to SPHL .
1	PV	Read: Process variable. Write: Not allowed. Range: From SPLL to SPHL . The dP.Po register provides the position of the decimal point.

HOLDING REGISTERS	PARAMETER	REGISTER DESCRIPTION
2	MV	Read: Output power in automatic or manual mode. Write: Not allowed. See address 29. Range: 0 from 1000 (0.0 to 100.0 %).
6	Display value	Read: Current value shown on the display. Write: Current value shown on the display. Range: -1999 to 9999. The range depends on the parameter shown.
8	Firmware Version	Controller firmware version. If V1.00, the read value will be 100. Write: Not allowed.
9	ID	Controller identification number. Write: Not allowed. Valor: 208 (D0h).
10	Serial number	First four digits of the serial number. Write: Not allowed.
11	Serial number	Last four digits of the serial number. Write: Not allowed.
12	Status Word 1	Read: Status bits. See Table 2 . Write: Not allowed.
13	Status Word 2	Read: Status bits. See Table 2 . Write: Not allowed.
14	Status Word 3	Read: Status bits. See Table 2 . Write: Not allowed.
18	Act	Control action. Values: 0 – Reverse; 1 – Direct.
19	Actun	Auto tune. Values: 0 – oFF ; 1 – FRSE ; 2 – FULL .
20	ir	Integral Rate (in repetition/min). Range: 0 to 3000 (0.00 to 30.00).
21	dt	Derivative Time (in seconds). Range: 0 to 250.
22	Pb	Proportional Band (in percentage). Range: 0 to 5000 (0.0 to 500.0).
23	Ct	Cycle Time (PWM in seconds). Range: 5 to 1000 (0.5 to 100.0).
25	HYSL	Control Hysteresis ON/OFF. Range: 0 to SPHL - SPLL .
26	SFSE	Soft-Start time (in seconds). Range: 0 to 9999.
29	SP	Control Setpoint (Prompt Setpoint). Range: From SPLL to SPHL .
30	out 1	Function of the I/O channel. See Table 4 . I/O availability depends on the controller model.
31	out 2	
32	out 3	
33	out 4	

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HOLDING REGISTERS	PARAMETER	REGISTER DESCRIPTION
34	IEou	Value of the control output value in case of sensor error. Range: 0 to 1000 (0.0 to 100.0 %).
35	LbdE	Open Resistance Detection (Loop break detection).
39	Fu.A1	Alarm function. See Table 5.
40	Fu.A2	
43	SP.A1	Alarm Setpoint. Range: The minimum value for non-differential alarm is SP.LL or SP.LL - SP.HL for differential alarm.
44	SP.A2	
47	SP1.E	Allows the respective alarm Setpoint to appear in the operational cycle.
48	SP2.E	
51	HY.A1	Alarm hysteresis. Range: 0 to (SP.HL - SP.LL).
52	HY.A2	
55	BL.A1	Alarm initial blocking. Values: 0 - NO ; 1 - YES .
56	BL.A2	
67	FLSH	Allows the display to flash in case of alarm.
71	EYPE	Input type. Range: 0 to 3. 0 - (J) -110 to 950 °C / -166 to 1742 °F 1 - (K) -150 to 1370 °C / -238 to 2498 °F 2 - (T) -160 to 400 °C / -256 to 752 °F 3 - (S) -50 to 1760 °C / -58 to 3200 °F 4 - (Pt100) -200 to 850 °C / -328 to 1562 °F
72	un it	Temperature unit. Values: 0 - °C; 1 - °F.
73	dP.Po	PV Decimal Point Position. Values: 2 to 3. 2 > XXX.X; 3 > XXXX
74	FLtr	Analog input filter (in seconds). Range: 0 to 300.
75	SP.LL	Setpoint lower limit. Range: The minimum value depends on the input type selected in EYPE (see operation manual) for SP.HL .
76	SP.HL	Setpoint higher limit. Range: The minimum value is SP.LL and the maximum value depends on the input type selected in EYPE (see operation manual).
77	oFFS	Offset PV. Range: From SP.LL to SP.HL .
78	Raddr	Slave communication address. Range: 1 to 247.

HOLDING REGISTERS	PARAMETER	REGISTER DESCRIPTION
79	bAud	Communication Baud Rate. Values: 0 to 7. 0 - 1200 1 - 2400 2 - 4800 3 - 9600 4 - 19200 5 - 32400 6 - 57600 7 - 115200
80	PrEtY	Serial communication parity. Values: 0 - No parity; 1 - Even parity; 2 - Odd parity.
84	RUN	Activate control. Values: 0 - NO ; 1 - YES .
85	RUN.E	Enables the RUN screen in the Main cycle. Values: 0 - NO ; 1 - YES .
86	CEr	Enables automatic control. Values: 0 - Manual; 1 - Automatic.
87	CEr.E	Enables CEr screen in the Main cycle.
88	MV	MV value when CEr at 0.
89	P.SEG	Program segment running.
90	E.SEG	Remaining time of running segment.
92	E.tb	Time base for the timer. Values: 0 - MM:SS; 1 - HH:MM
95	E1	Timer 1. Range: 0 to 5999.
96	E2	Timer 2. Range: 0 to 5999.
97	E1.E	Enables Timer 1 editing in the Main cycle.
98	E.StEr	Timer start mode. Values: 0 - OFF ; 1 - SP ; 2 - F ; 3 - RUN
99	E.End	T1 output behavior at the end of T1. Values: 0 - OFF ; 1 - DN .
100	E.dir	Direction of timing from T1. 1 - Progressive counting, starting at zero. 0 - Time Countdown.
101	E.RUN	RUN behavior at the end of the timer. Values: 0 - OFF ; 1 - DN .
102	Pr.tb	Time base for the Ramp and Soak program. Values: 0 - MM:SS; 1 - HH:MM
103	H.PrG	Enables F key function. Habilita a função da tecla F.
107	Prot	Protection level.
112	RESE	Restore factory calibration.
113	CTJ	Cold junction temperature.

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HOLDING REGISTERS	PARAMETER	REGISTER DESCRIPTION
117	Tecla	Press the remote action key. 1: P Key; 2: (▲) UP Key; 4: (▼) DOWN Key; 8: (◀) BACK Key; 9: P and BACK Keys.
118	P _r n	Program being edited.
119	E P _r	Program running.
120	P _r R	Resume Program Function. Values: 0 – P _r oG; 1 – P _r SEG; 2 – t _r SEG; 3 – oFF.
123	P.E 1	Alarm event of segment 1 of program 1.
124	P.E 2	Alarm event of segment 2 of program 1.
125	P.E 3	Alarm event of segment 3 of program 1.
126	P.E 4	Alarm event of segment 4 of program 1.
127	P.E 1	Alarm event of segment 1 of program 2.
128	P.E 2	Alarm event of segment 2 of program 2.
129	P.E 3	Alarm event of segment 3 of program 2.
130	P.E 4	Alarm event of segment 4 of program 3.
131	P.E 1	Alarm event of segment 1 of program 3.
132	P.E 2	Alarm event of segment 2 of program 3.
133	P.E 3	Alarm event of segment 3 of program 3.
134	P.E 4	Alarm event of segment 4 of program 3.
135	P.E 1	Alarm event of segment 1 of program 4.
136	P.E 2	Alarm event of segment 2 of program 4.
137	P.E 3	Alarm event of segment 3 of program 4.
138	P.E 4	Alarm event of segment 4 of program 4.
139	P.E 1	Alarm event of segment 1 of program 5.
140	P.E 2	Alarm event of segment 2 of program 5.
141	P.E 3	Alarm event of segment 3 of program 5.
142	P.E 4	Alarm event of segment 4 of program 5.
143	P.tol	Tolerance for program 1.
144	LP	Program link 1.
145	P.t 1	Time of segment 1 of program 1.
146	P.t 2	Time of segment 2 of program 1.
147	P.t 3	Time of segment 3 of program 1.
148	P.t 4	Time of segment 4 of program 1.
149	P.SP 0	Initial SP of program 1.
150	P.SP 1	Final SP of segment 1.
151	P.SP 2	Final SP of segment 2.
152	P.SP 3	Final SP of segment 3.

HOLDING REGISTERS	PARAMETER	REGISTER DESCRIPTION
153	P.SP 4	Final SP of segment 4.
154	P.tol	Tolerance for program 2.
155	LP	Program link 2.
156	P.t 1	Time of segment 1 of program 2.
157	P.t 2	Time of segment 2 of program 2.
158	P.t 3	Time of segment 3 of program 2.
159	P.t 4	Time of segment 4 of program 2.
160	P.SP 0	Initial SP of program 2.
161	P.SP 1	Final SP of segment 1.
162	P.SP 2	Final SP of segment 2.
163	P.SP 3	Final SP of segment 3.
164	P.SP 4	Final SP of segment 4.
165	P.tol	Tolerance for program 3.
166	LP	Program link 3.
167	P.t 1	Time of segment 1 of program 3.
168	P.t 2	Time of segment 2 of program 3.
169	P.t 3	Time of segment 3 of program 3.
170	P.t 4	Time of segment 4 of program 3.
171	P.SP 0	Initial SP of program 3.
172	P.SP 1	Final SP of segment 1.
173	P.SP 2	Final SP of segment 2.
174	P.SP 3	Final SP of segment 3.
175	P.SP 4	Final SP of segment 4.
176	P.tol	Tolerance for program 4.
177	LP	Program link 4.
178	P.t 1	Time of segment 1 of program 4.
179	P.t 2	Time of segment 2 of program 4.
180	P.t 3	Time of segment 3 of program 4.
181	P.t 4	Time of segment 4 of program 4.
182	P.SP 0	Initial SP of program 4.
183	P.SP 1	Final SP of segment 1.
184	P.SP 2	Final SP of segment 2.
185	P.SP 3	Final SP of segment 3.
186	P.SP 4	Final SP of segment 4.
187	P.tol	Tolerance for program 5.
188	LP	Program link 5.
189	P.t 1	Time of segment 1 of program 5.
190	P.t 2	Time of segment 2 of program 5.
191	P.t 3	Time of segment 3 of program 5.

HOLDING REGISTERS	PARAMETER	REGISTER DESCRIPTION
192	P. E4	Time of segment 4 of program 5.
193	P. SP0	Initial SP of program 5.
194	P. SP1	Final SP of segment 1.
195	P. SP2	Final SP of segment 2.
196	P. SP3	Final SP of segment 3.
197	P. SP4	Final SP of segment 4.

Table 01 – Registers table

1.4 STATUS WORD

REGISTER	VALUE FORMATION
Status Word 1	bit 0 – Alarm 1 (0 – Inactive; 1 – Active) bit 1 – Alarm 2 (0 – Inactive; 1 – Active) bit 2 – Alarm 3 (0 – Inactive; 1 – Active) bit 3 – Alarm 4 (0 – Inactive; 1 – Active) bit 4 – Reserved bit 5 – Reserved bit 6 – Reserved bit 7 – Reserved bit 8 – Reserved bit 9 – Reserved bit 10 – Reserved bit 11 – Reserved bit 12 – Reserved bit 13 – Reserved bit 14 – Reserved bit 15 – Reserved
Alarms information	
Status Word 2	bit 0 – Automatic (0 – Manual; 1 – Automatic) bit 1 – Run (0 – Stop; 1 – Run) bit 2 – Control action (0 – Reverse; 1 – Direct) bit 3 – Reserved bit 4 – Auto-tune (0 – No; 1 – Yes) bit 5 – Alarm 1: Activation inhibition (0 – No; 1 – Yes) bit 6 – Alarm 2: Activation inhibition (0 – No; 1 – Yes) bit 7 – Reserved bit 8 – Reserved bit 9 – Unit (0 – °C; 1 – °F) bit 10 – Reserved bit 11 – Output 1 Status bit 12 – Output 2 Status bit 13 – Output 3 Status bit 14 – Output 4 Status bit 15 – Reserved
Information on the current configuration	

REGISTER	VALUE FORMATION
Status Word 3	bit 0 – PV conversion is too low (0 – No; 1 – Yes) bit 1 – Negative conversion after calibration (0 – No; 1 – Yes) bit 2 – PV conversion is too high (0 – No; 1 – Yes) bit 3 – Linearization limit exceeded (0 – No; 1 – Yes) bit 4 – Pt100 cable resistance is too high (0 – No; 1 – Yes) bit 5 – Auto-Zero conversion is out of range (0 – No; 1 – Yes) bit 6 – Reserved bit 7 – Cold junction conversion is out of range (0 – No; 1 – Yes) bit 8 – Reserved bit 9 – Reserved bit 10 – Reserved bit 11 – Reserved bit 12 – Reserved bit 13 – Reserved bit 14 – Reserved bit 15 – Reserved
Error flags	

Table 02 – Read values for Word Statuses

Writing to the digital output bits is only possible when the outputs are set to OFF in the I/O configuration on the controller.

COIL STATUS	OUTPUT DESCRIPTION
1	Output Status 1 (I/O1).
2	Output Status 2 (I/O2).
3	Output Status 3 (I/O3).
4	Output Status 4 (I/O4).

Table 03 – Output description

1.5 EXCEPTION RESPONSES – ERROR CONDITIONS

When receiving a command, CRC verification will be performed on the received data block.

Receiving errors are detected by the CRC, causing the controller to discard the packet and send no response to the master.

After receiving an error-free packet, the controller will process the packet, checking whether the request is valid or not, and send an error message in case of an invalid request. Response frames containing error codes have the most significant bit of the Modbus command set.

If a WRITING command sends an out of range value for a parameter, the controller will set the value for the parameter range limits, responding with a value that reflects those same limits (maximum or minimum allowed value for the parameter).

Broadcast read commands are ignored by the controller and there will be no response. You can only write in Broadcast mode.

ERROR CODES	ERROR DESCRIPTION
01	Invalid command.
02	Register number invalid or out of range.
03	Number of registers invalid or out of range.

Table 04 - Error codes in the exception response

1.6 CONFIGURATION OF I/O PARAMETERS

I/O FUNCTION	CODE		I/O TYPE
Digital Output off	0	OFF	Digital Output
PWM Control Output	1	CEI	Digital Output
Alarm 1 Output	2	A1	Digital Output
Alarm 2 Output	3	A2	Digital Output
Alarm 1 or Alarm 2	4	A1.A2	Digital Output
Timer T1	5	T1	Digital Output
Timer T2	6	T2	Digital Output
Time interval of function LBD (<i>Loop break detection</i>)	7	Lbd	Digital Output

Table 05 – Configuration of I/O parameters

1.7 CONFIGURATION OF ALARM PARAMETERS

I/O FUNCTION	CODE	
No function	0	OFF
Minimum value alarm	1	Lo
Maximum value alarm	2	Hi
Differential alarm	3	dIF
Minimum differential alarm	4	dIF.L
Maximum differential alarm	5	dIF.H
Open sensor alarm	6	i.Err
Event alarm (Ramps and Soaks)	7	rS

Table 06 – Alarms configuration