N2000S

Communication Protocol

1. SERIAL COMMUNICATION

1.1 COMMUNICATION INTERFACE

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

RS485 Interface

- Compatible line signals with RS485 standard
- 2 wire connection from master to up to 31 slaves indicators in a multidrop bus. It is possible address 247 nodes with multiple outputs converters.
- Maximum communication distance: 1000 meters
- The RS485 signals are:

  D1 = D: Bidirectional data line.
  D0 = $\overline{D}$:   Bidirectional inverted data line.
  C = GND: Optional connection which left communication better.

General Characteristics

- Optically isolated serial interface
- Programmable baud rate: 1200, 2400, 4800, 9600 or 19200bps.
- Data Bits: 8
- Parity: None
- Stop Bits: 1

Communication Protocol

The MOSBUS RTU slave is implemented, available in most SCADA softwares in the market.

All configurable parameters can be accessed (for reading or writing) through the Registers Table. Broadcast commands are supported as well (address 0).

The available Modbus commands are:

03 - *Read Holding Register*

05 - *Force Single Coil* (Force Digital Output state)

06 - *Preset Single Register*

The registers are arranged in a table in such a way that several registers can be read in the same request.

1.2 CONFIGURATION OF SERIAL COMMUNICATION PARAMETERS

Two parameters must be configured in the device for serial communication:

bAud: Baud rate. All devices with same baud rate.

Addr : Device communication address. Each device must have an exclusive address.

1.3 REGISTERS TABLE

Equivalent to the registers referenced as 4XXXX.

The holding registers are basically a list of the internal indicator parameters. All registers above address 12 can be read or written. The registers up to this address in more are read only. Please verify each case. Each table parameter is a 16 bits two complement signed word.

Holding Registers	Parameter	Register Description
0000	Active SV	Read: Active control SV (main SV, from ramp and soak or from remote SV). Write: to main SV Range: from **SPLL** to **SPHL**.
0001	PV	Read: Process Variable Write: not allowed. Range: From **SPLL** to **SPHL**. The **dPPo** prompt gives the decimal point position.
0002	MV	Read: Output Power in automatic or manual mode. Write: not allowed. See address 28. Range: 0 to 1000 (0.0 to 100.0 %).
0003	-	Reserved.
0004	Display value	Read: Current value shown on display. Write: Current value shown on display. Range: -1999 to 9999. The range depends on the displayed parameter.

0005	Prompt index	Read: Current prompt position in the parameters flowchart. Write: not allowed. Range: 0000h to 060Ch Prompt number format: XXYYh, where: XX→menu cycle number (see operation manual) YY→prompt number (index).
0006	Status Word 1	Read: Status bits. See table 2 Write: not allowed.
0007	Software Version	Read: The firmware version of controller. If V1.00, the read value will be 100. Write: not allowed.
0008	ID	Read: controller identification number. Write: not allowed. Values: 1 – N1100; 2 - N2000; 3 - N1500. Other values: special instruments.
0009	Status Word 2	Read: Status bits. See table 2. Write: not allowed.
0010	Status Word 3	Read: Status bits. See table 2. Write: not allowed.
0011	**Ir**	Integral Rate (in repetitions/min) Range: 0 to 3000 (0.00 to 30.00)
0012	**dt**	Derivative Time (in seconds). Range: 0 to 250
0013	**Pb**	Proportional Band (in percentage) Range: 0 to 5000 (0.0 to 500.0)
0014	-	Reserved.
0015	**ct**	Cycle Time PWM (in seconds) Range: 5 to 1000 (0.5 to 100.0)
0016	-	Reserved.
0017	**HYSt**	On/Off Control Hysteresis (in selected type engineering unit). Range: 0 to **SPHL** - **SPLL**
0018	-	Reserved.
0019	-	Reserved.
0020	-	Reserved.
0021	-	Reserved.
0022	-	Reserved.
0023	Serial number H	Serial Number High (Upper display). Range: 0 to 9999. Read only
0024	Serial number L	Serial Number Low (Lower display). Range: 0 to 9999. Read only
0025	SV	Control *Setpoint* (Prompt *Setpoint*). Range: from **SPLL** to **SPHL**.
0026	**SPLL**	*Setpoint* Low limit. Range: minimum value depends on the input type selected in **tYPE** (see op. Manual) to **SPHL**.
0027	**SPHL**	*Setpoint* High limit. Range: minimum value is **SPLL** and maximum depends on the input type selected in **tYPE** (see op. Manual).
0028	Manual MV	Manual output power (in percentage) Range: 0 to 1000 (0.0 to 100.0 %)
0029	**oFFS**	PV offset Range: from **SPLL** to **SPHL**
0030	**dPPo**	PV decimal point position Range: 0 to 3 0→X.XXX; 1→XX.XX; 2→XXX.X; 3→XXXX
0031	**SP.A1**	Alarm 1 Setpoint. Range: The minimum value is at spll for non-differential alarm or **SPLL** - **SPLH** for differential alarm The maximum value is at **SPHL** for non-differential alarm or at **SPHL** - **SPLL** for differential alarm.
0032	**SP.A2**	Alarm 2 Setpoint. Range: same as in **SP.A1**.
0033	-	Reserved.
0034	-	Reserved.
0035	**FuA1**	Alarm 1 Function. Range: 0 to 8 0→**oFF**; 1→**iErr**; 2→**rS**; 3→**rFA1**; 4→**Lo**; 5→**H1**; 6→**d1FL**; 7→**d1FH**; 8→**d1F**.

0036	FuA2	Alarm 2 Function. Range: same as in FuA1.
0037	-	Reserved.
0038	-	Reserved.
0039	HYA1	Alarm 1 Hysteresis. Range: 0 to 9999 (0.00 to 99.99 %)
0040	HYA2	Alarm 2 Hysteresis. Range: same as in HYA1.
0041	-	Reserved.
0042	-	Reserved.
0043	tYPE	PV input type Range: 0 to 18. See operation manual.
0044	Addr	Communication slave address Range: 1 to 247
0045	bAud	*Communication Baud-Rate.* Range: 0 to 4 0→1200;1→2400;2→4800;3→9600; 4→19200
0046	Auto	Control Mode. Range: 0→manual; 1→automatic.
0047	run	Enable control. Range: 0→no; 1→yes.
0048	Act	Control action. Range: 0→direct; 1→reverse.
0049	Atun	Auto tune enable. Range: 0→no; 1→yes.
0050	bLA1	Alarm 1 power-up inhibit. Range: 0→no; 1→yes.
0051	bLA2	Alarm 2 power-up inhibit Range: same as in bLA1.
0052	-	Reserved.
0053	-	Reserved.
0054	Key	Key press remote action. Range: 0 to 9 1→P ; 2→▲; 4→▼; 8→◀ ; 9→◀ and P .
0055	-	Reserved.
0056	Pot	Select if the MV value shown in the display is the internally estimated value or the measured potentiometer position. Range: 0→Internal MV; 1→Potentiometer.
0057	-	Reserved.
0058	-	Reserved.
0059	-	Reserved.
0060	-	Reserved.
0061	IoFU	IO 5 Function. Range: 0 to 16 Refer to operation manual for more details.
0062	-	Reserved.
0063	-	Reserved.
0064	-	Reserved.
0065	-	Reserved.
0066	-	Reserved.
0067	unIt	Temperature unit. Range: 0→°C; 1→°F.
0068	SErt	Time of servo excursion. Range: 15 to 600 s.
0069	SErr	Determines the dead band of servo activation.
0070	SErF	PID output filter.
0071	Segm R&P	Ramp and Soak segment to be viewed or edited. Range: 0 to 4
0072	Pr n	Number of the ramp and soak program being programmed through the controller front panel. Range: 1 to 4
0073	Pr n	Selection of the ramp and soak program to be executed Range: 0 to 4
0074	PE1	Segment 1 Event of R&S Program 1. Range: 0 to 15. See op. Manual.
0075	PE2	Segment 2 Event of R&P Program 1. Range: same as in PE1.
0076	PE3	Segment 3 Event of R&P Program 1. Range: same as in PE1.
0077	PE4	Segment 4 Event of R&P Program 1. Range: same as in PE1.
0078	PE5	Segment 5 Event of R&SP Program 1. Range: same as in PE1.
0079	PE1	Segment 1 Event of R&S Program 2. Range: 0 to 15. See op. Manual.
0080	PE2	Segment 2 Event of R&S Program 2. Range: same as in PE1.

0081	PE3	Segment 3 Event of R&S Program 2. Range: same as in PE1.
0082	PE4	Segment 4 Event of R&S Program 2. Range: same as in PE1.
0083	PE5	Segment 5 Event of R&S Program 2. Range: same as in PE1.
0084	PE1	Segment 1 Event of R&S Program 3. Range: 0 to 15. See op. Manual.
0085	PE2	Segment 2 Event of R&S Program 3. Range: same as in PE1.
0086	PE3	Segment 3 Event of R&S Program 3. Range: same as in PE1.
0087	PE4	Segment 4 Event of R&S Program 3. Range: same as in PE1.
0088	PE5	Segment 5 Event of R&S Program 3. Range: same as in PE1.
0089	PE1	Segment 1 Event of R&S Program 4. Range: 0 to 15. See op. Manual.
0090	PE2	Segment 2 Event of R&S Program 4. Range: same as in PE1.
0091	PE3	Segment 3 Event of R&S Program 4. Range: same as in PE1.
0092	PE4	Segment 4 Event of R&S Program 4. Range: same as in PE1.
0093	PE5	Segment 5 Event of R&S Program 4. Range: same as in PE1.
0094	PtoL	R&S Program 1 Tolerance Range: 0 to valor de (SPHL - SPLL).
0095	LP	Program 1 Link. Range: 0 to 7
0096	Pt1	Time 1 of Program 1. Range: 0 to 9999 minutes.
0097	Pt2	Time 2 of Program 1. Range: 0 to 9999 minutes.
0098	Pt3	Time 3 of Program 1. Range: 0 to 9999 minutes.
0099	Pt4	Time 4 of Program 1. Range: 0 to 9999 minutes.
0100	Pt5	Time 5 of Program 1. Range: 0 to 9999 minutes.
0101	PSP0	*Setpoint* 0 of Program 1. Range: From SPLL to SPHL.
0102	PSP1	*Setpoint* 1 of Program 1 Range: same as in PSP0.
0103	PSP2	*Setpoint* 2 of Program 1 Range: same as in PSP0.
0104	PSP3	*Setpoint* 3 of Program 1 Range: same as in PSP0.
0105	PSP4	*Setpoint* 4 of Program 1 Range: same as in PSP0.
0106	PSP5	*Setpoint* 5 of Program 1 Range: same as in PSP0.
0107	PtoL	R&S Program 2 Tolerance Range: 0 to valor de (SPHL - SPLL).
0108	LP	Program 2 Link Range: 0 to 7
0109	Pt1	Time 1 of Program 2. Range: 0 to 9999 minutes.
0110	Pt2	Time 2 of Program 2. Range: 0 to 9999 minutes.
0111	Pt3	Time 3 of Program 2. Range: 0 to 9999 minutes.
0112	Pt4	Time 4 of Program 2. Range: 0 to 9999 minutes.
0113	Pt5	Time 5 of Program 2. Range: 0 to 9999 minutes.
0114	PSP0	*Setpoint* 0 of Program 2. Range: From SPLL to SPHL.
0115	PSP1	*Setpoint* 1 of Program 2 Range: same as in PSP0.
0116	PSP2	Setpoint 2 of Program 2 Range: same as in PSP0.
0117	PSP3	*Setpoint* 3 of Program 2 Range: same as in PSP0.
0118	PSP4	*Setpoint* 4 of Program 2 Range: same as in PSP0.

0119	PSP5	*Setpoint* 5 of Program 1 Range: same as in PSP0.
0120	PtoL	R&S Program 3 Tolerance Range: 0 to valor de (SPHL - SPLL).
0121	LP	Program 3 Link Range: 0 to 7
0122	Pt1	Time 1 of Program 3. Range: 0 to 9999 minutes.
0123	Pt2	Time 2 of Program 3 Range: same as in Pt1.
0124	Pt3	Time 3 of Program 3 Range: same as in Pt1.
0125	Pt4	Time 4 of Program 3 Range: same as in Pt1.
0126	Pt5	Time 5 of Program 3 Range: same as in Pt1.
0127	PSP0	*Setpoint* 0 of Program 3. Range: From SPLL to SPHL.
0128	PSP1	*Setpoint* 1 of Program 3. Range: same as in PSP0.
0129	PSP2	*Setpoint* 2 of Program 3. Range: same as in PSP0.
0130	PSP3	*Setpoint* 3 of Program 3. Range: same as in PSP0.
0131	PSP4	*Setpoint* 4 of Program 3. Range: same as in PSP0.
0132	PSP5	*Setpoint* 5 of Program 3. Range: same as in PSP0.
0133	PtoL	R&S Program 4 Tolerance Range: 0 to valor de (SPHL - SPLL).
0134	LP	Program 4 Link Range: 0 to 7
0135	Pt1	Time 1 of Program 4. Range: 0 to 9999 minutes.
0136	Pt2	Time 2 of Program 4. Range: same as in Pt1
0137	Pt3	Time 3 of Program 4 Range: same as in Pt1.
0138	Pt4	Time 4 of Program 4 Range: same as in Pt1.
0139	Pt5	Time 5 of Program 4 Range: same as in Pt1.
0140	PSP0	*Setpoint* 0 of Program 4. Range: from SPLL to SPHL.
0141	PSP1	*Setpoint* 1 of Program 4 Range: same as in PSP0.
0142	PSP2	*Setpoint* 2 of Program 4 Range: same as in PSP0.
0143	PSP3	*Setpoint* 3 of Program 4. Range: same as in PSP0.
0144	PSP4	*Setpoint* 4 of Program 4. Range: same as in PSP0.
0145	PSP5	*Setpoint 5 of Program 4.* *Range: same as in psp0.*

Table 1 – Register table

1.4 REGISTERS TABLE

Register	Value Format
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 – Input 0 – I/O 5 (0- inactive; 1- active) bit 5 – Input 1 – I/O 3 (0- inactive; 1- active) bit 6 – Input 2 – I/O 4 (0- inactive; 1- active) bit 7 – Reserved bit 8 – Hardware type bit 9 – Hardware type bit 10 – Reserved bit 11 – Reserved bit 12 – Reserved bit 13 – Reserved bit 14 – Reserved bit 15 – Reserved
Status Word 2	bit 0 – Automatic (0- manual; 1- automatic) bit 1 – Run (0-stop; 1-run) bit 2 – Control Action (0-direct; 1-reverse) bit 3 – Reserved bit 4 – Auto-tune (0-no; 1-yes) bit 5 – Alarm 1 power-up inhibit (0-no; 1-yes) bit 6 – Alarm 2 power-up inhibit (0-no; 1-yes) bit 7 – Alarm 3 power-up inhibit (0-no; 1-yes) bit 8 – Alarm 4 power-up inhibit (0-no; 1-yes) 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 – Output 5 status
Status Word 3	bit 0 – Very low PV conversion (0-no; 1-yes) bit 1 – Negative conversion after calibration (0-no; 1-yes) bit 2 – Very high PV conversion (0-no; 1-yes) bit 3 – Exceeded linearization limit (0-no; 1-yes) bit 4 – Very high Pt100 cable resistance (0-no; 1-yes) bit 5 – Self zero conversion out of range (0-no; 1-yes) bit 6 – Self span conversion out of range (0-no; 1-yes) bit 7 – Cold junction conversion 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

Table 2 - Values of status words

Writing to an output bit is only possible if the output has no function assigned to it (the output is configured to OFF in Alarm Cycle).

Coil Status	Output Description
1	Output 1 Status (I/O1)
2	Output 2 Status (I/O2)
3	Output 3 Status (I/O3)
4	Output 4 Status (I/O4)
5	Output 5 Status (I/O5)

Table 3 – Coil status

1.5 EXCEPTION RESPONSES – ERROR CONDITIONS

The MODBUS RTU protocol checks the CRC in the data blocks received.

Reception errors are detected by the CRC, causing the controller to discard the packet, not sending any reply to the master.

After receiving an error-free packet, the controller processes the packet and verifies whether the request is valid or not, sending back an exception error code in case of an invalid request. Response frames containing error codes have the most significant bit of the Modbus command set.

If a WRITE command sends an out-of-range value to a parameter, the controller will clamp the value to the parameter range limits, replying with a value that reflects these limits (maximum or minimum value allowed for the parameter).

The controller ignores broadcast READ commands; the controller processes only broadcast WRITE commands.

Error Code	Error Description
01	Invalid Command
02	Invalid Register Number or out of range
03	Invalid Register Quantity or out of range

Table 4 – Error codes in exception response