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Modbus TCP Protocol for Nimbus - SLC CUBE4 7-20 kVA, V 1.0

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MODBUS FUNCTION CODES.

The NIMBUS supports the following function codes:

- 01H - Read Coils
- 02H - Read Discrete Inputs
- 03H - Read Holding Registers
- 04H - Read Input Registers
- 05H - Write Single Coil

Please note a UPS must support this type of commands - the currently available function codes depend on the connected UPS. In general, standard UPS systems provide the functions 03H and 04H. The NIMBUS is designed not to distinct between these two functions.

Furthermore, the NIMBUS supports a query speed up to 38400 baud to allow a flexible integration into existing IT environments.

Communication Example:

The following tables contain the general command descriptions and examples with Modbus RTU framing.

Query

SLAVE NO	FUNCTION CODE	ADDRESS OF FIRST WORD TO READ		WORD COUNT		CHECKSUM LRC OR CRC
1 byte	1 byte	High byte	Low byte	High byte	Low byte	1 or 2 byte(s)

Answer

SLAVE NO	FUNCTION CODE	BYTE COUNT	HIGH BYTE OF FIRST WORD	LOW BYTE OF FIRST WORD	BYTES WITH CONTENTS OF N WORDS	CHECKSUM LRC OR CRC
1 byte	1 byte	1 byte	1 byte	1 byte	n * 2 bytes	1 or 2 byte(s)

Read Words (Functions 03h and 04h):

- Example: Read Words, Function 04h

Read one word at address 63h (= 99 decimal):

Query

BYTE	1	2, 3	4, 5	6, 7	8, 9	10, 11	12, 13	14, 15	16	17
Meaning	Leading colon	Slave number	Function code	address of first word to read		word count to read		LRC	Carriage return	line feed LF
				high byte	low byte	high byte	low byte			
HEX	[3A]	[30][31]	[30][34]	[30][30]	[36][33]	[30][30]	[30][31]	[39][37]	[0D]	[0A]

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Answer

BYTE	1	2, 3	4, 5	6, 7	8, 9	10, 11	12, 13	14	15
Meaning	leading colon	Slave number	function code	byte count	contents of the word high byte	LRC low byte	carriage return	line feed LF	
HEX	[3A]	[30][31]	[30][34]	[30][32]	[31][32]	[33][34]	[42][33]	[0D]	[0A]

HEX: Hexadecimal values of the data

→ The word at address contains the value 1234h = 4660 decimal.

Example: Read Words, Function 04h, RTU Mode

Read one word at address 63h (= 99 decimal) (The word at address contains the value 1234h = 4660 decimal.):

Query

BYTE		1	2	3	4	5	6	7	8	
Meaning	silent interval ≥ 3,5 characters	Slave number	function code	address of first word to read		word count to read		CRC		silent interval ≥ 3.5 characters
				high byte	low byte	high byte	low byte	low byte	High byte	
RTU HEX		[01]	[04]	[00]	[63]	[00]	[01]	[C1]	[D4]	

Answer

BYTE		1	2	3	4	5	6	7	
Meaning	silent interval ≥ 3.5 characters	Slave number	function code	byte count	Contents of the word		CRC		Silent interval ≥ 3.5 characters
					high byte	low byte	low byte	high byte	
RTU HEX		[01]	[04]	[02]	[12]	[34]	[B4]	[47]	

Modbus error codes

Excepted broadcast messages, where the master device sends requests to the slave device, the master expects a clear and valid response from the slave he queried. If the answer does not match with expected specifications, the packet will be discarded with a corresponding error message.

There are several possible events that may occur when a slave answers to a master's request:

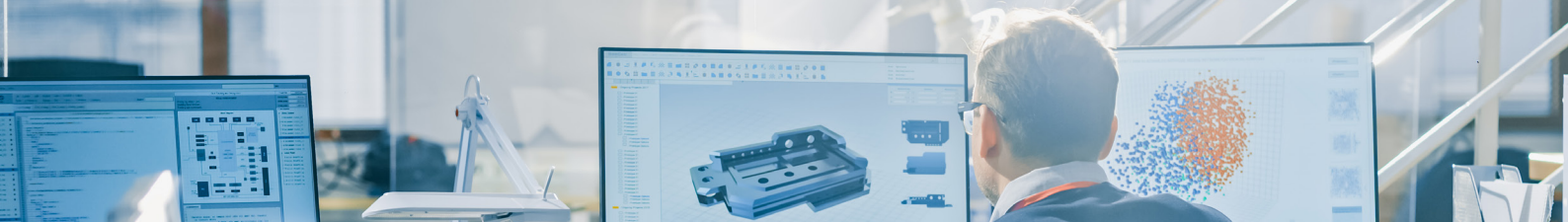
1. The slave responds accordingly with a data packet that is both, correct and valid.

The master will handle it accordingly.

2. The slave unit does not receive the request the master device sends.

This event occurs, for example, in case of a communication error. from the point of view of the master the request was not answered. As a consequence, the master will assume an appropriate timeout incident.

3. Master or slave will send invalid queries / answers.



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Such a phenomenon can occur if the termination resistors are not set up correctly: Although data is being sent, there are clear parity, LRC, or CRC errors within the data packet. Since invalid packets are discarded, the slave will usually ignore an invalid request without answering. However, the master's reaction will differ: In general, he will handle a faulty slave response with a corresponding timeout message.

4. The slave receives a valid request that cannot be answered.

This occurs if a requested register does not exist. If the slave unit receives a valid request, but the requested readings are not available, the slave unit will respond a specific exception message in order to inform the master about the reason for this error.

The NIMBUS provides these error codes:

❑ 02H Illegal Data Address.

The address data obtained with the valid request is not a valid address servable by the slave.

❑ 03H Illegal Data Value

A contained value inside a valid request is not an allowed for this slave.

❑ 06H Slave device busy

The slave has received a valid request, but is currently busy with a time-consuming or time-critical process. As a result, he cannot serve the master for now. For the master, there is no reason to assume a timeout- he will repeat the request some time later.

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Please note: The type U/S defines if the answer contains has a mathematical sign(+/-) or not. Type U means unsigend (without a mathematical sign), type S means sigend (with a mathematical sign). The answer may be true or false. Some clients (f.e. MODBUS Poll) use MODBUS addresses with a valid range between 0-65535. Some clients use as the valid range 1-65536, so it may be necessary to add 1 to the address.

type_reg	address_reg	type_cod_reg	num_reg	description_reg	multiplying_factor	units	cloud_sensor_type	cloud_sensor_subtype	sensor_group	backup
r	2	ascii	6	UPS serial number	5	---	info	misc	System	false
r	18	dec	1	desc.dsp1_firmware_number	1	---	info	misc	System	false
r	19	dec	1	desc.dsp1_firmware_version	1	---	info	misc	System	false
r	21	dec	1	desc.mcu_firmware_number	1	---	info_cloud	misc	System	false
r	22	dec	1	desc.mcu_firmware_version	1	---	info	misc	System	false
r	24	dec	1	desc.in_phase	1	/1=Mono Phase/.3=Tri Phase	info_cloud	misc	System	false
r	25	dec	1	desc.out_phase	1	/1=Mono Phase/.3=Tri Phase	info_cloud	misc	System	false
r	26	dec	1	UPS Type	1	0=Standby/1=Line Interactive/././././././10=Online	info	misc	System	false
r	27	dec	1	desc.ups_work_mode	1	0=None/1=Power On/2=Standby/3=Bypass/4=Line/5=Batteries/6=Battery Test/7=Fault/8=Converter/9=ECO	info_cloud	misc	System	false
r	28	dec	1	actions.bat_test.result_ok	1	0=Fail/1=Pass	info_cloud	misc	System	false
r	29	dec	1	alarm.mute	1	0=Off/1=On	info	misc	System	false
r	30	dec	1	desc.shutdown_act	1	0=Off/1=On	info	misc	System	false
r	31	dec	1	desc.test_inProgress	1	0=Off/1=On	info	misc	System	false
r	32	dec	1	desc.byp_mode	1	0=Off/1=On	cloud	misc	misc	false
r	400	a_bin	1	alarm.epo_active	1	0=False/1=True	alarm	alarm	Alarm	false
r	401	a_bin	1	desc.ups_failed	1	0=False/1=True	alarm	alarm	Alarm	false
r	402	a_bin	1	alarm.bat_low	1	0=False/1=True	alarm	alarm	Alarm	false
r	403	a_bin	1	desc.utility_fail	1	0=False/1=True	alarm	alarm	Alarm	false
r	404	ascii	8	desc.warning_status_inq_1	8	---	alarm	alarm	Alarm	false
r	415	ascii	8	desc.warning_status_inq_2	8	---	alarm	alarm	Alarm	false
r	426	ascii	2	desc.last_fault_code_inq	2	---	alarm	alarm	Alarm	false
rw	480	dec	1	desc.cloud_ic	1	0: Off/1: On	data_cloud	misc	misc	false
r	500	dec	1	desc.in_volt_r	0.1	V	data_cloud_plot	voltage	Input	false
r	501	dec	1	desc.in_volt_s	0.1	V	data_cloud_plot	voltage	Input	false
r	502	dec	1	desc.in_volt_t	0.1	V	data_cloud_plot	voltage	Input	false
r	503	dec	1	desc.in_freq	0.1	Hz	data_cloud	frequency	Input	false
r	504	dec	1	desc.byp_volt_r	0.1	V	data_cloud_plot	voltage	Bypass	false
r	505	dec	1	desc.byp_volt_s	0.1	V	data_cloud_plot	voltage	Bypass	false
r	506	dec	1	desc.byp_volt_t	0.1	V	data_cloud_plot	voltage	Bypass	false

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type_reg	address_reg	type_cod_reg	num_reg	description_reg	multiplying_factor	units	cloud_sensor_type	cloud_sensor_subtype	sensor_group	backup
r	507	dec	1	desc.byp_cur_r	0.1	A	data_cloud_plot_mono_s	current	Bypass	false
r	508	dec	1	desc.byp_cur_s	0.1	A	data_cloud_plot	current	Bypass	false
r	509	dec	1	desc.byp_cur_t	0.1	A	data_cloud_plot	current	Bypass	false
r	510	dec	1	desc.byp_freq	0.1	Hz	data_cloud	frequency	Bypass	false
r	511	dec	1	desc.out_volt_r	0.1	V	data_cloud_plot	voltage	Output	false
r	512	dec	1	desc.out_volt_s	0.1	V	data_cloud_plot	voltage	Output	false
r	513	dec	1	desc.out_volt_t	0.1	V	data_cloud_plot	voltage	Output	false
r	514	dec	1	desc.out_freq	0.1	Hz	data_cloud	frequency	Output	false
r	515	dec	1	desc.out_cur_r	0.1	A	data_cloud_plot_mono_s	current	Output	false
r	516	dec	1	desc.out_cur_s	0.1	A	data_cloud_plot	current	Output	false
r	517	dec	1	desc.out_cur_t	0.1	A	data_cloud_plot	current	Output	false
r	518	dec	1	desc.load_per_r	0.1	%	data_cloud	load	Output	false
r	519	dec	1	desc.load_per_s	0.1	%	data_cloud	load	Output	false
r	520	dec	1	desc.load_per_t	0.1	%	data_cloud	load	Output	false
r	521	dec	1	desc.load_total	0.1	%	data_cloud	load	Output	false
r	522	dec	1	desc.max_load_r	0.1	%	data	load	Output	false
r	523	dec	1	desc.max_load_s	0.1	%	data	load	Output	false
r	524	dec	1	desc.max_load_t	0.1	%	data	load	Output	false
r	525	dec	1	desc.total_max_load	0.1	%	data	load	Output	false
r	526	dec	1	desc.app_load_r	0.1	%	data_mono_s	load	Output	false
r	527	dec	1	desc.app_load_s	0.1	%	data	load	Output	false
r	528	dec	1	desc.app_load_t	0.1	%	data	load	Output	false
r	529	dec	1	desc.total_app_load	0.1	%	data	load	Output	false
r	530	dec	1	desc.act_load_r	0.1	%	data_mono_s	load	Output	false
r	531	dec	1	desc.act_load_s	0.1	%	data	load	Output	false
r	532	dec	1	desc.act_load_t	0.1	%	data	load	Output	false
r	533	dec	1	desc.total_act_load	0.1	%	data	load	Output	false
r	534	dec	1	desc.out_app_r	1	VA	data_cloud_plot_mono_s	power	Output	false
r	535	dec	1	desc.out_app_s	1	VA	data_cloud_plot	power	Output	false
r	536	dec	1	desc.out_app_t	1	VA	data_cloud_plot	power	Output	false
r	537	dec	1	desc.out_acp_r	1	W	data_cloud_plot_mono_s	power	Output	false

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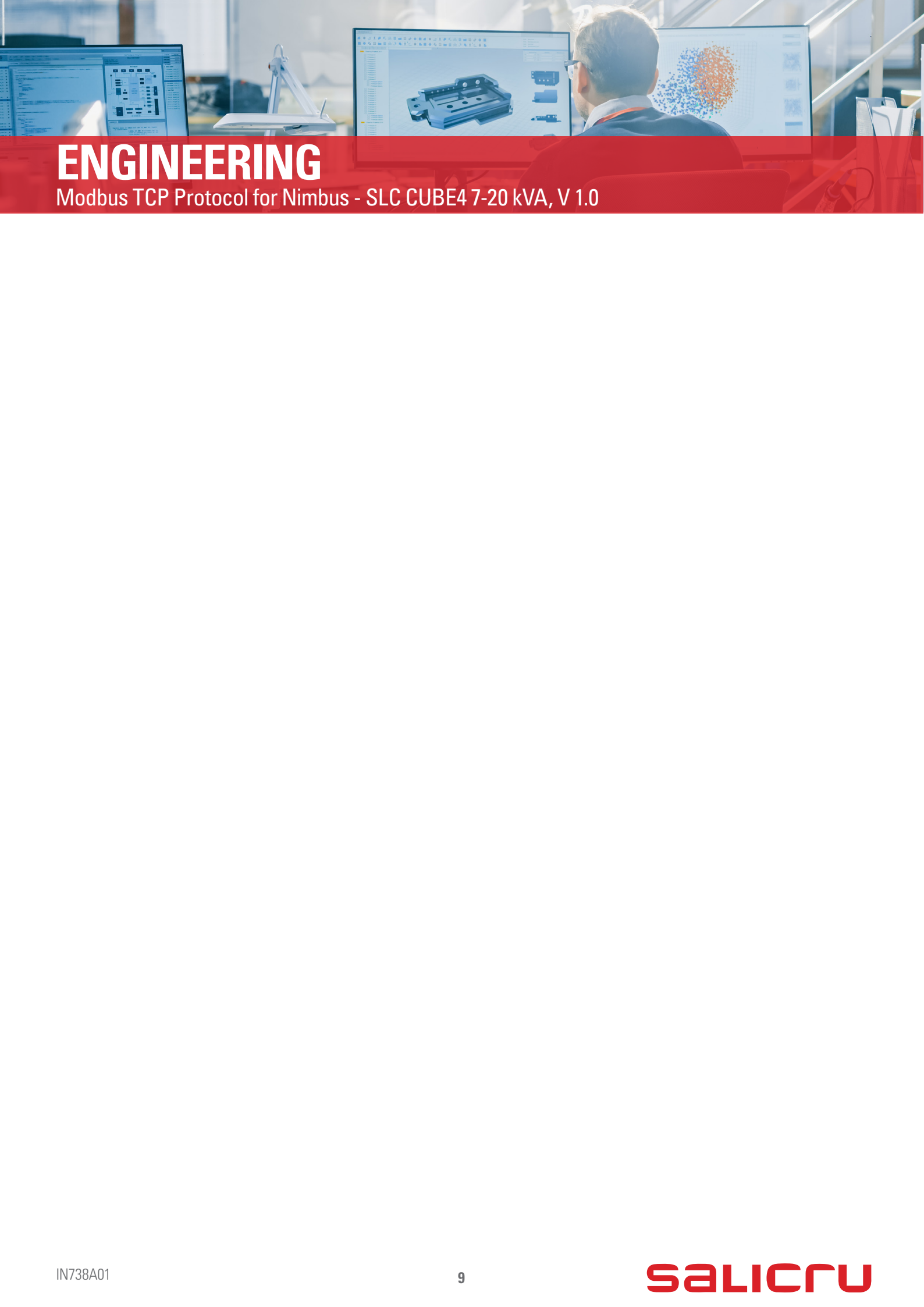
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type_reg	address_reg	type_cod_reg	num_reg	description_reg	multiplying_factor	units	cloud_sensor_type	cloud_sensor_subtype	sensor_group	backup
r	538	dec	1	desc.out_acp_s	1	W	data_cloud_plot	power	Output	false
r	539	dec	1	desc.out_acp_t	1	W	data_cloud_plot	power	Output	false
r	540	dec	1	desc.pos_batt_volt	0.1	V	data_cloud	voltage	Battery	false
r	541	dec	1	desc.batt_pos_discharging_cur	0.1	A	data_cloud	current	Battery	false
r	542	dec	1	desc.batt_pos_charging_cur	0.1	A	data_cloud	current	Battery	false
r	543	dec	1	desc.neg_batt_volt	0.1	V	data_cloud	voltage	Battery	false
r	544	dec	1	desc.batt_neg_discharging_cur	0.1	A	data_cloud	current	Battery	false
r	545	dec	1	desc.batt_neg_charging_cur	0.1	A	data_cloud	current	Battery	false
r	546	dec	1	info.float_volt_sys	1	V	data_cloud	misc	Battery	false
r	547	dec	1	desc.shutdown_volt	1	V	data_cloud	misc	Battery	false
r	548	dec	1	warning.batt_v_low	1	V	data_cloud	misc	Battery	false
r	549	dec	1	warning.batt_volt_high	1	V	data_cloud	misc	Battery	false
r	550	dec	1	desc.cur_max_charger	1	A	data_cloud	misc	Battery	false
r	551	dec	1	desc.inv_volt_r	0.1	V	data	voltage	Inverter	false
r	552	dec	1	desc.inv_volt_s	0.1	V	data	voltage	Inverter	false
r	553	dec	1	desc.inv_volt_t	0.1	V	data	voltage	Inverter	false
r	554	dec	1	desc.cur_load_r	0.1	A	data_mono_s	current	Inverter	false
r	555	dec	1	desc.cur_load_s	0.1	A	data	current	Inverter	false
r	556	dec	1	desc.cur_load_t	0.1	A	data	current	Inverter	false
r	557	dec	1	desc.inv_freq	0.1	Hz	data	frequency	Inverter	false
r	558	dec	1	desc.dc_bus_pos_volt	0.1	V	data	internal_data	Inverter	false
r	559	dec	1	desc.dc_bus_neg_volt	0.1	V	data	internal_data	Inverter	false
r	560	dec	1	desc.pfc_temp	0.1	°C	data_cloud	internal_data	Inverter	false
r	561	dec	1	desc.inv_temp	0.1	°C	data_cloud	internal_data	Inverter	false
r	562	dec	1	desc.byp_temp	0.1	°C	data	internal_data	Bypass	false
r	563	dec	1	desc.max_temp	0.1	°C	data_cloud	internal_data	Other	false
r	564	dec	1	desc.env_temp	0.1	°C	data_cloud	internal_data	Other	false
r	700	dec	1	info.input_volt	1	V	info	voltage	Input	false
r	701	dec	1	desc.volt_line_high	0.1	V	info_cloud	voltage	Input	false
r	702	dec	1	desc.volt_line_low	0.1	V	info_cloud	voltage	Input	false
r	703	dec	1	desc.freq_line_high	0.1	Hz	info	frequency	Input	false
r	704	dec	1	desc.freq_line_low	0.1	Hz	info	frequency	Input	false
r	710	dec	1	desc.byp_line_high	0.1	V	info_cloud	voltage	Bypass	false
r	711	dec	1	desc.byp_line_low	0.1	V	info_cloud	voltage	Bypass	false
r	712	dec	1	desc.byp_freq_high	0.1	Hz	info	frequency	Bypass	false
r	713	dec	1	desc.byp_freq_low	0.1	Hz	info	frequency	Bypass	false

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type_reg	address_reg	type_cod_reg	num_reg	description_reg	multiplying_factor	units	cloud_sensor_type	cloud_sensor_subtype	sensor_group	backup
r	720	dec	1	info.out_power	1	W	info	power	Output	false
r	721	dec	1	register_settings.out_power_factor	1	---	info	misc	Output	false
r	722	dec	1	desc.out_nom_volt_m	1	V	info_cloud	voltage	Output	false
r	723	dec	1	info.output_volt	0.1	V	internal_data	voltage	Output	false
r	724	dec	1	info.output_freq	0.1	Hz	info	frequency	Output	false
r	730	dec	1	info.batt_num	1	---	info	misc	Battery	false
r	731	dec	1	desc.batt_shutdown_volt	0.1	V	info	voltage	Battery	false
r	732	dec	1	warning.batt_v_low	0.1	V	info	voltage	Battery	false
r	733	dec	1	warning.batt_volt_high	0.1	V	info_cloud	voltage	Battery	false
r	734	dec	1	desc.batt_cell_number	1	---	info	misc	Battery	false
r	735	dec	1	info.batt_cap	1	%	data_cloud	misc	Battery	false
r	736	dec	1	info.batt_backup_time	1	min	data_cloud	misc	Battery	false
r	737	dec	1	desc.pos_batt_volt	0.1	V	info	voltage	Battery	false
r	738	dec	1	desc.neg_batt_volt	0.1	V	info	voltage	Battery	false
r	739	dec	1	info.nom_volt_cell	1	V	info	voltage	Battery	false
r	740	dec	1	desc.shutdown_time_sec	0.1	s	info	misc	Battery	false
r	741	dec	1	desc.shutdown_time_min	0.1	min	info	misc	Battery	false
r	742	dec	1	desc.batt_volt_rating	0.1	V	info	voltage	Battery	false
r	1000	dec	1	desc.aud_alarm	1	---	info	misc	Active	false
r	1001	dec	1	desc.batt_warning_mute	1	---	info	misc	Active	false
r	1002	dec	1	desc.high_efficiency_mode	1	---	info	misc	Active	false
r	1003	dec	1	desc.byp_forbidden	1	---	info	misc	Active	false
r	1004	dec	1	desc.inv_short_clear_func	1	---	info	misc	Active	false
r	1005	dec	1	desc.byp_ups_off	1	---	info	misc	Active	false
r	1006	dec	1	desc.byp_aud_warning	1	---	info	misc	Active	false
r	1007	dec	1	desc.auto_restart	1	---	info	misc	Active	false
r	1008	dec	1	desc.conv_mode	1	---	info	misc	Active	false
r	1009	dec	1	desc.warning_mute	1	---	info	misc	Active	false



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