Modbus interface SINEAX DM5

Content

The basics of the **MODBUS®** communication are summarized in the document **"Modbus Basics. PDF"** (see documentation CD or on our website https://www.camillebauer.com)

GMC INSTRUMENTS

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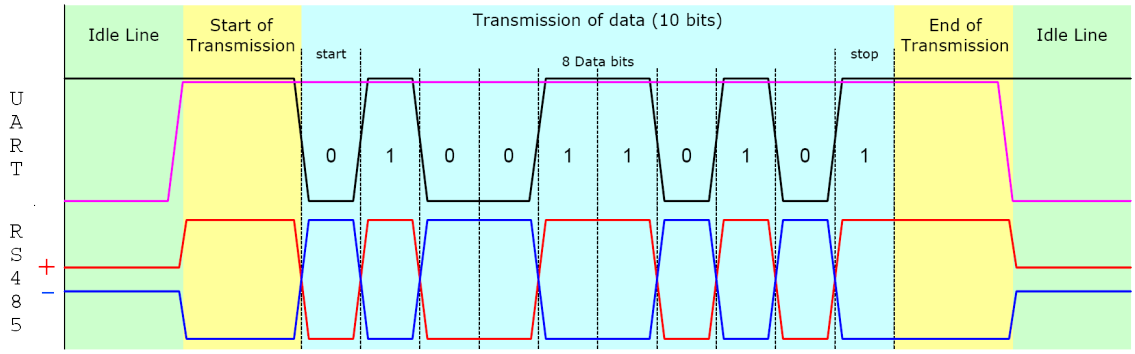
1 EIA-RS-485 Standard

The EIA-RS 485 standard defines the physical layer of the Modbus interface.

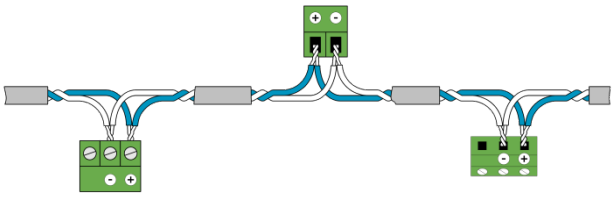
1.1 Coding

The data will be transferred serially via the 2-wire bus. The information is coded in NRZ code as a differential signal. The positive polarity signals a logical 1, the negative polarity signals a logical 0.

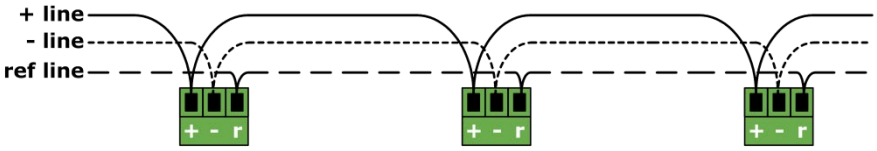


1.2 Connections

We recommend using a shielded and twisted two-wire bus cable. Shielding improves the electromagnetic compatibility (EMC). The notation of the wires A resp. B are contradictory depending on the information source.

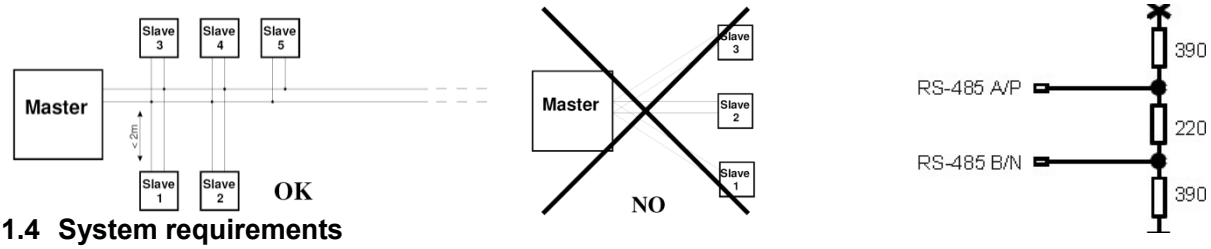


The potential difference of all bus members must not exceed ± 7V. Therefore the use of a shield or of a third wire (ref line) for potential equalization is recommended.



1.3 Topology

On both ends of the bus cable a termination resistor must be provided. In addition to the bus termination resistors a resistor R_U (Pull-up) must be connected to the supply voltage and a resistor R_D (Pull down) to the reference potential. By means of these two resistors a defined idle state of the line is ensured if no bus member is sending data.



1.4 System requirements

Cable	: twisted 2-wire line, characteristic impedance 100 up to 130 Ω, min. 0.22mm^2 (24AWG)
Cable length	: maximum of 1'200m, depending on the transfer rate
Members	: maximum of 32 per segment
Baud rate	: 2'400, 4'800, 9'600, 19'200, 38'400, 57'600, 115'200 Baud
Mode	: 11 Bit format - 2 stop bits, no parity or 1 stop bit with odd/even parity
	10 Bit format - 1 stop bit, no parity (possible, but not in accordance with Modbus standard)

2 Coding and addressing

Addressing

Modbus groups different data types as references. The telegram functions 03H (Read Holding Register) and 10H (Preset Multiple Registers) e.g. use register addresses starting at 40001. The reference 4xxxx is implicit, i.e. is given by the used telegram function. Therefore for addressing the leading 4 is omitted. Another specialty in Modbus telegrams: The register numeration starts at 1, but the addressing starts at 0.

Example: Measurement U1N on register address 40102

- Address declaration (see chapter 5.1): 40102
- Real address: 102 (offset 1)
- Address used in telegram: 101 (offset 0)

Serializing

The Modbus specification defines the telegrams to be sequences of data bytes. For the correct serializing of the bytes (MSB or LSB First), the appropriate physical layer (RS485, Ethernet) is responsible. The RS485 (UART, COM) transmits the „Least Significant Bit“ first (LSB First) and adds the synchronization and parity bits (start bit, parity bit and stop bit).

Reading bit information: Function 0x01, Read Coil Status

Bits are represented within a byte in a conventional way, MSB (Bit 7) on the most left and LSB (Bit 0) most right (0101’1010 = 0x5A = 90).

Example: Reading coil 13 and 14 (state of LED A and B) of device 17:

Byte	Request		Answer	
1	Slave address	0x11	Slave address	0x11
2	Function code	0x01	Function code	0x01
3	Start address	0x00	Byte count	0x01
4	12 = Coil 13	0x0C	Byte 1	**0x02**
5	Number of registers:	0x00	Checksum	crc_l
6	13..14 = 2	0x02	CRC16	crc_h
7	Checksum	crc_l		
8	CRC16	crc_h		

The start address of the request plus the bit position in the answer byte 1 corresponds to the coil address. Started bytes are filled with zeros.

	Hex	Binary	-	-	-	-	-	-	Coil 14	Coil 13
Byte 1	0x02	00000010b	-	-	-	-	-	-	ON	OFF

Reading byte information

Modbus does not know a data type Byte or Character (see address space). Strings or byte arrays will be mapped into holding registers (2 bytes per register) und transferred as „Character streams“.

Example: Device description text (**„DM5S“**) on address 40034 and following (terminated by 0)

Byte	Request		Answer		
1	Slave address	0x11	Slave address	0x11	
2	Function code	0x03	Function code	0x03	
3	Start address	0x00	Byte count	0x06	
4	(34-1)	0x21	Byte 1	**0x4D**	‚M‘
5	Number of registers:	0x00	Byte 2	**0x44**	‚D‘
6	3	0x03	Byte 3	**0x53**	‚S‘
7	Checksum	crc_l	Byte 4	**0x35**	‚5‘
8	CRC16	crc_h	Byte 5	**0x00**	0
9			Byte 6	**0x00**	0
10			Checksum	crc_l	
11			CRC16	crc_h	

Reading single or multiple registers: Function 0x03, Read Holding Register

Register or words will be transferred in accordance with the „Big Endian“ format.

Example: Reading meters 1 and 2 on address 41282 up to 41289 of device 17

Byte	Request		Answer	
1	Slave address	0x11	Slave address	0x11
2	Function code	0x03	Function code	0x03
3	Startadresse (1282-1)	0x05	Byte Count	0x08
4		0x01	Byte 1	**0x00**
5	Number of registers: 4	0x00	Byte 2	**0x06**
6		0x04	Byte 3	**0x00**
7	Checksum CRC16	crc_l	Byte 4	**0x32**
8		crc_h	Byte 5	**0x04**
9			Byte 6	**0x12**
10			Byte 7	**0x00**
11			Byte 8	**0x25**
12			Checksum CRC16	crc_l
13				crc_h

- Meter 1: 0x00320006 = 3276806
- Meter 2: 0x00250412 = 2425874

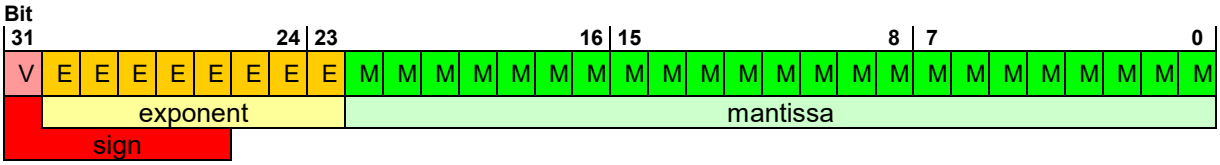
The assignment of the unit and the position of the decimal point to the meters are done using static scaling factors. For more details see Energy meters.

Reading float numbers (REAL): Function 0x03, Read Holding Register

There is no representation for floating point numbers in the Modbus specification. But as a matter of principle any desired data structure can be casted to a sequence of 16Bit registers.

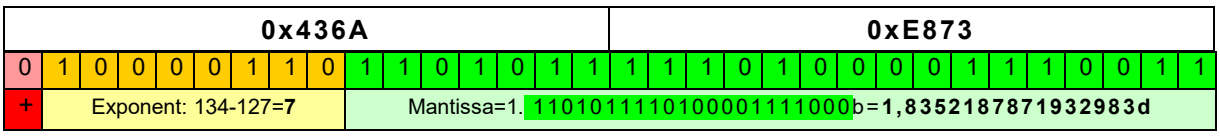
The IEEE 754 Standard as the most often used standard for the representation of floating numbers is normally applied.

- The first register contains the bits 0 – 15 of the 32 bit number (bit 0…15 of the mantissa).
- The second register contains the bits 16 – 31 of the 32 bit number (sign, exponent and bit 16-22 of the mantissa).



Example: Reading voltage U1N on register address 41102 of device 17.

Byte	Request		Answer	
1	Slave address	0x11	Slave address	0x11
2	Function code	0x03	Function code	0x03
3	Startadresse (1102-1)	0x04	Byte Count	0x04
4		0x4D	Byte 1	**0xE8**
5	Number of registers: 2	0x00	Byte 2	**0x73**
6		0x02	Byte 3	**0x43**
7	Checksum CRC16	crc_l	Byte 4	**0x6A**
8		crc_h	Checksum CRC16	crc_l
9				crc_h



- **U1N** = $+2^{7} * 1{,}8352187871932983$ **= 234,908V**

3 Mapping

3.1 Address space

The address space may be divided in 4 address spaces in accordance with the 4 data types.

Space	Access	Address range	Function code	
Coil / 0x	readable / writable	00001 – 09999	0x01 0x05 0x0F	Read Coil Status Force Single Coil Force Multiple Coils
Discrete input / 1x	read only	10001 – 19999	0x02	Read Input Status [1)]
Input register / 3x	read only	30001 – 39999	0x04	Read Input Register [1)]
Holding register / 4x	readable / writable	40001 – 49999	0x03 0x06 0x10	Read Holding Register Force Single Register [1)] Preset Multiple Register

1) not implemented

To reduce the number of commands the device image has been mapped using „Holding register“ if possible. Quantities normally addressed as a single bit information are implemented as „Coil“ or „Discrete input“.

3.2 Used addresses

Address	# Reg.	Description	Access
40001 – 40033	33	Device information	R
40034 – 40073	40	Device description text, unique device identification	RW
Measurement data DM5			
40100 – 40203	104	Instantaneous values general	R
40210 – 40217	8	Instantaneous values of analog outputs	RW
40250 – 40281	32	Scaling factors meters	RW
40282 – 40345	64	Meter contents	RW
40346 – 40346	1	Tariff of meters	RW
40700 – 40819	120	Free selectable measurements (Modbus image)	R
42000 – 42011	12	THD voltages and currents	R
42100 – 42459	360	Individual harmonics 2^{nd} up to 31^{st} for voltages and currents	R
Parameterization and service functions DM5			
44000 – 44017	18	Parameters of measurement input	RW
44020 – 44099	80	Parameters of analog outputs	RW
44100 – 44103	4	Parameters of Modbus	RW
44400 – 44432	33	Parameters of the security system	RW
44440 – 44469	30	Parameters of free selectable measurements (Modbus image)	RW
45000 – 45047	48	Parameters of meters	RW
45301 – 45302	2	Simulation mode	RW
48300 – 48309	10	Service functions	RW
48310 – 48311	2	Factory reset	RW
13 – 14		Status of LEDs	R
13 – 14		Setting LED status (remote interface)	RW
513 – 516		Reset slave pointer of bimetal currents	W
1000 – 1031		Reset of meters	W

Access: R = readable, W = writable

3.3 Used Syntax

Address	Start address of described data block (Register, Coil or Input Status)
Time	Register address of a timestamp, typically of a minimum / maximum value
Reset coil	Coil register address to reset a corresponding measured quantity
Name	Unique name of a variable or structure
Type	**Data type of variable** U: unsigned INT: integer with 8, 16 or 32 Bit REAL (float) CHAR[..]: String with/without termination (NULL) TIME: seconds since 1.1.1970 COIL: Bit information
Default	Value when delivering, after a hardware reset or if quantity is not available
Description	Description of the quantity
14 **2L** **3G** **3U** **3A** **4U** **4O**	Availability of the measured quantities, depending on the connected system **14** = Single phase system or 4-wire balanced load or 3-wire balanced load, phase shift (DM5S only) **2L** = two phase system (split phase) **3G** = 3-wire balanced load **3U** = 3-wire unbalanced load **3A** = 3-wire balanced load, Aron connection **4U** = 4-wire unbalanced load **4O** = 4-wire unbalanced load, Open-Y connection

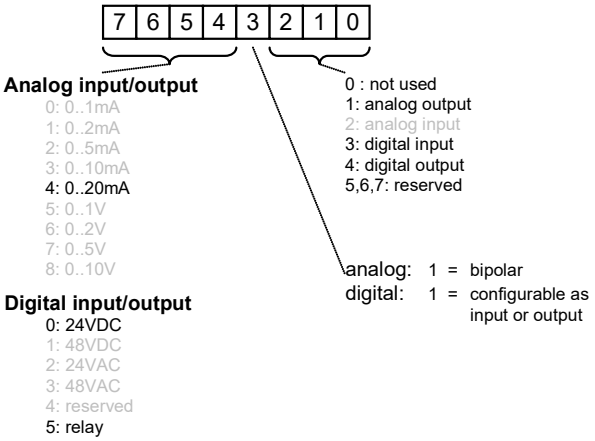
4 Device information

4.1 Hardware and firmware

Address	Name	Type	#	Description
40001	HW_IO_INFO	UINT8		**Type of available I/O channels**
			0	Analog output 1
			1	Analog output 2
			2	Analog output 3
			3	Analog output 4
			4	Reserved
			5	Reserved
			6	Reserved
			7	Reserved

The configuration of I/Os bases upon the structure shown opposite.

The value 0xFF is used as a place holder for IOs which do not exist.



Address	Name	Type	#	Description
40005	HW_OPTIONS	UINT32		Bit Meaning 0 SINEAX DM5S 1 SINEAX DM5F 2,3 reserved 4 with display 5 with Modbus RS485 6…15 reserved
40006	HW_OPT_INP	UINT16		Bit Hardware option 0 Input U1 1 Input U2 2 Input U3 3 Input I1 4 Input I2 5 Input I3 6,7 reserved **Bit 8..15** 0 Frequency range 45…65Hz
40007	NLB_NR	UINT16		NLB number. If not 0 the device is a special version (hardware and / or firmware)

40026	FW_MU	UINT32		Firmware version measurement unit Byte 3 | Byte 2 | Byte 1 | Byte 0 **V1.00. XXXX**

4.2 Device identification

The type of the connected device may be identified using the function ***Report Slave ID*** (0x11).

Device address	Function	CRC	
ADDR	0x11	Low-Byte	High-Byte

Device answer:

Device address	Function	#Bytes	Device ID	Data1	Data2	CRC	
ADDR	0x11	3	<sid>			Low-Byte	High-Byte

0x01	0x00	VR660	Temperature controller
0x02	0x00	A200R	Display unit temperature controller
0x03	0x01	CAM	Measurement unit power quantities
0x04	0xFF	A*PLUS*	Multifunctional display unit
0x05	0x00	V604s	Universal transmitter
0x05	0x01	VB604s	Universal transmitter
0x05	0x02	VC604s	Universal transmitter
0x05	0x03	VQ604s	Universal transmitter
0x07	0x00	VS30	Temperature transmitter
0x08	0x00	DM5S	Multi-transducer DM5S
0x08	0x01	DM5F	Multi-transducer DM5F
0x0A	0xFF	HW730	Angular transmitter
0x0B	0xFF	AM1000	Multifunctional display unit
0x0C	0xFF	AM2000	Multifunctional display unit
0x0D	0xFF	AM3000	Multifunctional display unit
0x0E	0xFF	PQ3000	Power quality display unit
0x0F	0xFF	PQ5000	Power quality measurement unit
0x10	0xFF	DM5000	Measurement unit power quantities
0x11	0xFF	CU3000	Multif. display unit with CODESYS
0x12	0xFF	CU5000	Multif. measurement unit with CODESYS
0x13	0xFF	PQ1000	Power quality display unit
0x1F	0xFF	PQ5000-MOBILE	Mobile power system analysis unit

The value for Data2 is reserved for future extensions.

4.3 Device description

The subsequent texts may be both read or written.

Address	Name	Type	#	Default	Description
40034	DEV_DESC	CHAR[48]	0	„DM5S“ resp. „DM5F“	**Device description text** If the text length is <48 characters the string must be terminated by 0. No validation is performed in the device.
40058	DEV_TAG	CHAR[32]	0	„DM5S“ resp. „DM5F“	**Unique device description** This parameter serves to identify the respective device in a system. Only the following characters may be used: ’A’…’Z’, ’a’…’z’, ’0’…’9’, ’_’ Also no numbers or symbols can be used at the beginning. The string must be terminated by 0.

4.4 Measurement input configuration

Address	Name	Type	#	Default	Description
44000	INPUT_SYS	UINT8	0	00h	System configuration *Value* *Meaning* 0x00 Single phase system 0x05 two phase system (split phase) 0x01 3-wire system, balanced load 0x11 3-wire system, balanced load, U=U12 (DM5S only) 0x21 3-wire system, balanced load, U=U23 (DM5S only) 0x31 3-wire system, balanced load, U=U31 (DM5S only) 0x13 3-wire system, unbalanced load 0x03 3-wire system, unbalanced load, Aron connection 0x02 4-wire system, balanced load 0x04 4-wire system, unbalanced load 0x14 4-wire system, unbalanced load, Open-Y connection
			1	0	reserved
44001	INPUT_CFG	UINT16	0	010Ah	Settings Bit Meaning 0 1 0, 1 Freq.measurement 0 Voltage via… 1 Current 2 **automatically** 2 Sampling freq. **adaptive** fix 3 Rotation left-hand **right-hand** 4 Quadrant **L-C-L-C** L-L-C-C ind-cap-ind-cap ind-ind-cap-cap 5 not used 6 Freq.measurement **filtered** fast 7 Autoscale U **Off** On 8 Autoscale I Off **On** 7 DM5S: Autoscale U **Off** On DM5F: Autoscale U **Off** not possible 8 DM5S: Autoscale I Off **On** DM5F: Autoscale U **Off** not possible … 15 DM5F: Emulation DM5S **Off** On
44002	MAIN_FREQ	REAL	0	50.0	Nominal frequency in Hz The value must be in the range 45…65Hz.
44004	IN_VOLTAGE	REAL	0	398.3717	Nominal voltage primary (L-L) V (50 … 1E9)
44006			1	398.3717	Nominal voltage secondary (L-L) V (50 … 832)
44008	IN_CURRENT	REAL	0	5.0	Nominal current primary A (0.1 … 200’000)
44010			1	5.0	Nominal current secondary A (0.1 … 7.5)
44012	IN_VOLT_MAX	REAL	0	478.046	maximum voltage secondary (L-L) V (50 … 832)
44014	IN_CURR_MAX	REAL	0	7.5	maximum current secondary A (0.1 … 7.5)
44016	EFF_MEAN_TP	UINT16	0	8 (DM5S) bzw. 0 (DM5F)	Number of cycles RMS values averaging DM5S: 4,8,16,32 … 1024 cycles DM5F: ½=-1, ½(1)=0,1,2,3,4,8,16,32 … 1024 cycles
44017	IB_MEAN_TP	UINT16	0	15	Low-pass filter time constant for bimetal current: 1.. 60 [min]

Modifying parameters of the measurement input configuration may also impact the remaining device programming, which is not described in this document.

By modifying the system configuration (INPUT_SYS) e.g. measured quantities used for analog outputs or the Modbus image, may become invalid (no longer measurable). This way unexpected results may occur.

A modification of the transformer ratios (IN_VOLTAGE, IN_CURRENT) has no influence on measurement ranges set for analog outputs. The values will not be changed proportionally. If you don’t modify these values it may happen, that e.g. analog outputs go to their boundaries.

5 Measurements DM5S

5.1 General instantaneous values

Address	Name	14	2L	3G	3U	3A	4U	4O	Type	Description
40100	U	●	●	-	-	-	-	-	REAL	System voltage
40102	U1N	-	●	-	-	-	●	●		Voltage phase L1 to N
40104	U2N	-	●	-	-	-	●	●		Voltage phase L2 to N
40106	U3N	-	-	-	-	-	●	●		Voltage phase L3 to N
40108	U12	-	-	●	●	●	●	●		Voltage phase L1 to L2
40110	U23	-	-	●	●	●	●	●		Voltage phase L2 to L3
40112	U31	-	-	●	●	●	●	●		Voltage phase L3 to L1
40114	UNE	-	-	-	-	-	●	●		Zero displacement voltage in 4-wire systems
40116	I	●	-	●	-	-	-	-	REAL	System current
40118	I1	-	●	-	●	●	●	●		Current in phase L1
40120	I2	-	●	-	●	●	●	●		Current in phase L2
40122	I3	-	-	-	●	●	●	●		Current in phase L3
40124	IN	-	●	-	-	-	●	●		Neutral current (calculated)
40126	P	●	●	●	●	●	●	●	REAL	Active power system (P = P1 + P2 + P3)
40128	P1	-	●	-	-	-	●	●		Active power phase 1 (L1 – N)
40130	P2	-	●	-	-	-	●	●		Active power phase 2 (L2 – N)
40132	P3	-	-	-	-	-	●	●		Active power phase 3 (L3 – N)
40134	Q	●	●	●	●	●	●	●	REAL	Reactive power system (Q = Q1 + Q2 + Q3)
40136	Q1	-	●	-	-	-	●	●		Reactive power phase 1 (L1 – N)
40138	Q2	-	●	-	-	-	●	●		Reactive power phase 2 (L2 – N)
40140	Q3	-	-	-	-	-	●	●		Reactive power phase 3 (L3 – N)
40142	S	●	●	●	●	●	●	●	REAL	Apparent power system S
40144	S1	-	●	-	-	-	●	●		Apparent power phase 1 (L1 – N)
40146	S2	-	●	-	-	-	●	●		Apparent power phase 2 (L2 – N)
40148	S3	-	-	-	-	-	●	●		Apparent power phase 3 (L3 – N)
40150	F	●	●	●	●	●	●	●	REAL	System frequency
40152	PF	●	●	●	●	●	●	●	REAL	PF = P / S, Power factor system PF
40154	PF1	-	●	-	-	-	●	●		Power factor phase 1 (L1 – N)
40156	PF2	-	●	-	-	-	●	●		Power factor phase 2 (L2 – N)
40158	PF3	-	-	-	-	-	●	●		Power factor phase 3 (L3 – N)
40160	QF	●	●	●	●	●	●	●	REAL	QF = Q / S, Reactive power factor system
40162	QF1	-	●	-	-	-	●	●		Reactive power factor phase 1 (L1 – N)
40164	QF2	-	●	-	-	-	●	●		Reactive power factor phase 1 (L2 – N)
40166	QF3	-	-	-	-	-	●	●		Reactive power factor phase 1 (L3 – N)
40168	LF	●	●	●	●	●	●	●	REAL	sign(Q)·(1 – abs(PF)), Load factor system
40170	LF1	-	●	-	-	-	●	●		Load factor phase 1 (L1 – N)
40172	LF2	-	●	-	-	-	●	●		Load factor phase 2 (L2 – N)
40174	LF3	-	-	-	-	-	●	●		Load factor phase 3 (L3 – N)
40176	UM	●	●	●	●	●	●	●	REAL	Average value of voltages
40178	IM	●	●	●	●	●	●	●		Average value of currents
40180	IMS	●	●	●	●	●	●	●		Average value of currents with sign of P
40182	IB	●	-	●	-	-	-	-	REAL	Bimetal current in balanced load systems
40184	IB1	-	●	-	●	●	●	●		Bimetal current in phase L 1
40186	IB2	-	●	-	●	●	●	●		Bimetal current in phase L2
40188	IB3	-	-	-	●	●	●	●		Bimetal current in phase L3
40190	BS	●	-	●	-	-	-	-	REAL	Slave pointer bimetal current in balanced load systems
40192	BS1	-	●	-	●	●	●	●		Slave pointer bimetal current in phase L 1
40194	BS2	-	●	-	●	●	●	●		Slave pointer bimetal current in phase L2
40196	BS3	-	-	-	●	●	●	●		Slave pointer bimetal current in phase L3
40198	UF12	-	-	●	●	●	●	●	REAL	Phase angle voltage U1-U2
40200	UF23	-	-	●	●	●	●	●		Phase angle voltage U2-U3
40202	UF31	-	-	●	●	●	●	●		Phase angle voltage U3-U1

The phase angles are used for wiring check only and will not be offered as fully calculated measurements to the user.

5.2 Instantaneous values of analog outputs

Address	Name	Type	Default	Description
40210	AOUT1	REAL	0.0	Present value of analog output 1 [mA]
40212	AOUT2		0.0	Present value of analog output 2 [mA]
40214	AOUT3		0.0	Present value of analog output 3 [mA]
40216	AOUT4		0.0	Present value of analog output 4 [mA]

5.3 Free selectable Modbus image

In this memory area all measurements are provided, which have been arranged in the free Modbus image. Therefore sequence and content are user specified.

Address	Name	Type	Default	Description
40700	MOD_IMAGE	REAL[60]	0.0	Measurements in Float format Measured quantities as defined by the user

5.4 Present LED states

Address	Name	Type	Description
13	LED_A	COIL	Present state of LED A
14	LED_B	COIL	Present state of LED B

5.5 Instantaneous values of harmonic analysis (DM5S only)

Address	Name	14[1)]	2L	3G	3U	3A	4U	4O	Type	Description
42000	THD_U1x	U	U1N	U12	U12	U12	U1N	U1N	REAL	Total Harmonic Distortion [%]
42002	THD_U2x	-	U2N	U23	U23	U23	U2N	U2N		Total Harmonic Distortion [%]
42004	THD_U3x	-	-	U31	U31	U31	U3N	U3N		Total Harmonic Distortion [%]
42006	THD_I1	I	I1	I	I1	I1	I1	I1	REAL	Total Harmonic Distortion [%]
42008	THD_I2	-	I2	-	I2	I2	I2	I2		Total Harmonic Distortion [%]
42010	THD_I3	-	-	-	I3	I3	I3	I3		Total Harmonic Distortion [%]

Address	Name	14[1)]	2L	3G	3U	3A	4U	4O	Type	Description
42100	H2_U1X	U	U1N	U12	U12	U12	U1N	U1N	REAL	Content of 2nd harmonic [%]
	.....									.....
	H31_U1X									Content of 31st harmonic [%]
42160	H2_U2X	-	U2N	U23	U23	U23	U2N	U2N	REAL	Content of 2nd harmonic [%]
	.....									.....
	H31_U2X									Content of 31st harmonic [%]
42220	H2_U3X	-	-	U31	U31	U31	U3N	U3N	REAL	Content of 2nd harmonic [%]
	.....									.....
	H31_U3X									Content of 31st harmonic [%]
42280	H2_I1X	I	I1	I	I1	I1	I1	I1	REAL	Content of 2nd harmonic [%]
	.....									.....
	H31_I1X									Content of 31st harmonic [%]
42340	H2_I2X	-	I2	-	I2	I2	I2	I2	REAL	Content of 2nd harmonic [%]
	.....									.....
	H31_I2X									Content of 31st harmonic [%]
42400	H2_I3X	-	-	-	I3	I3	I3	I3	REAL	Content of 2nd harmonic [%]
	.....									.....
	H31_I3X									Content of 31st harmonic [%]

[1)] Not available for system type „3-wire balanced load, phase shift“

6 Energy meters (DM5S only)

6.1 General

Meters are generally provided as 32-Bit integer numbers without sign, because only this way it's assured that no resolution gets lost if the meter content increases. The values have a maximum of 9. In case of a carry to the 10^{th} digit a reset of the meter content to zero is performed.

To convert the 9-digit numbers to the physical, primary side meter content they must be scaled. This is done using a **scaling factor per meter**, which implies the position of the decimal point and the basic unit of the meter quantity. If the configuration of the device is not modified this factor remains unchanged and therefore must be read only once.

$$\text{Physical meter value} = \text{Meter content} * 10^{X} \ [\text{Wh or varh}]$$

Example: $P_{incoming\ HT}$ = 12056; CNTR_EXP = 4

Meter content: 12056×10^{4} [Wh] $= 12056 \times 10^{6} \times 10^{-2}$ [Wh] = **120.56 [MWh]**

↑ [MWh] ↑ 2 post decimal positions

Factor	-3	-2	-1	0	1	2	3	4	5	6	7	8	9
Resolution	1m	1.00	1.0	1	1.00 k	1.0 k	1 k	1.00 M	1.0 M	1 M	1.00 G	1.0 G	1 G

6.2 Scaling factors of the meters

Address	Name	Type	Default	Description	
40250	MET_EXP_1	INT16	0	Scaling factor meter 1	(Range: -3…9)
40251	MET_EXP_2			Scaling factor meter 2	(Range: -3…9)
40252	MET_EXP_3			Scaling factor meter 3	(Range: -3…9)
40253	MET_EXP_4			Scaling factor meter 4	(Range: -3…9)
40254	MET_EXP_5			Scaling factor meter 5	(Range: -3…9)
40255	MET_EXP_6			Scaling factor meter 6	(Range: -3…9)
40256	MET_EXP_7			Scaling factor meter 7	(Range: -3…9)
40257	MET_EXP_8			Scaling factor meter 8	(Range: -3…9)
40258	MET_EXP_9			Scaling factor meter 9	(Range: -3…9)
40259	MET_EXP_10			Scaling factor meter 10	(Range: -3…9)
40260	MET_EXP_11			Scaling factor meter 11	(Range: -3…9)
40261	MET_EXP_12			Scaling factor meter 12	(Range: -3…9)
40262	MET_EXP_13			Scaling factor meter 13	(Range: -3…9)
40263	MET_EXP_14			Scaling factor meter 14	(Range: -3…9)
40264	MET_EXP_15			Scaling factor meter 15	(Range: -3…9)
40265	MET_EXP_16			Scaling factor meter 16	(Range: -3…9)
40266	MET_EXP_17			Scaling factor meter 17	(Range: -3…9)
40267	MET_EXP_18			Scaling factor meter 18	(Range: -3…9)
40268	MET_EXP_19			Scaling factor meter 19	(Range: -3…9)
40269	MET_EXP_20			Scaling factor meter 20	(Range: -3…9)
40270	MET_EXP_21			Scaling factor meter 21	(Range: -3…9)
40271	MET_EXP_22			Scaling factor meter 22	(Range: -3…9)
40272	MET_EXP_23			Scaling factor meter 23	(Range: -3…9)
40273	MET_EXP_24			Scaling factor meter 24	(Range: -3…9)
40274	MET_EXP_25			Scaling factor meter 25	(Range: -3…9)
40275	MET_EXP_26			Scaling factor meter 26	(Range: -3…9)
40276	MET_EXP_27			Scaling factor meter 27	(Range: -3…9)
40277	MET_EXP_28			Scaling factor meter 28	(Range: -3…9)
40278	MET_EXP_29			Scaling factor meter 29	(Range: -3…9)
40279	MET_EXP_30			Scaling factor meter 30	(Range: -3…9)
40280	MET_EXP_31			Scaling factor meter 31	(Range: -3…9)
40281	MET_EXP_32			Scaling factor meter 32	(Range: -3…9)

6.3 Meter contents

Address	Reset	Name	Type	Default	Description
40282	1000	METER_1	UINT32	0	Meter 1
40284	1001	METER_2			Meter 2
40286	1002	METER_3			Meter 3
40288	1003	METER_4			Meter 4
40290	1004	METER_5			Meter 5
40292	1005	METER_6			Meter 6
40294	1006	METER_7			Meter 7
40296	1007	METER_8			Meter 8
40298	1008	METER_9			Meter 9
40300	1009	METER_10			Meter 10
40302	1010	METER_11			Meter 11
40304	1011	METER_12			Meter 12
40306	1012	METER_13			Meter 13
40308	1013	METER_14			Meter 14
40310	1014	METER_15			Meter 15
40312	1015	METER_16			Meter 16
40314	1016	METER_17			Meter 17
40316	1017	METER_18			Meter 18
40318	1018	METER_19			Meter 19
40320	1019	METER_20			Meter 20
40322	1020	METER_21			Meter 21
40324	1021	METER_22			Meter 22
40326	1022	METER_23			Meter 23
40328	1023	METER_24			Meter 24
40330	1024	METER_25			Meter 25
40332	1025	METER_26			Meter 26
40334	1026	METER_27			Meter 27
40336	1027	METER_28			Meter 28
40338	1028	METER_29			Meter 29
40340	1029	METER_30			Meter 30
40342	1030	METER_31			Meter 31
40344	1031	METER_32			Meter 32

By setting the reset coils 1000…1031 the associated meter content will be reset.

6.4 Present tariff of meters

The device supports up to 16 tariffs, the individual tariffs 1 up to 15 and the uniform tariff.

To each meter a tariff is assigned. The appropriate runs only if the assigned tariff number corresponds to the value set on METER_TARIFF. Meters with uniform tariff runs independently of the current active tariff.

The tariff may be changed via Modbus interface, by overwriting the existing tariff situation. To rule out possible manipulations this operation may be locked during device configuration by means of the security system.

Value	Name	Type	Description
40346	METER_TARIFF	UINT16	**Tariff situation** (readable and writable) 0: Uniform tariff 1…15: Tariff 1 up to 15

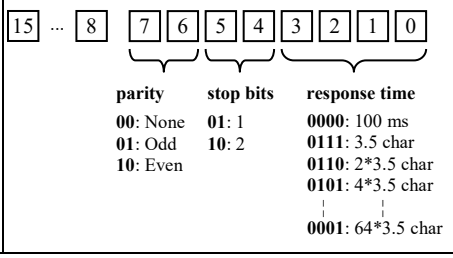
7 Modbus interface

To assure that each device may be accessed, independent of the used hardware, the response time has a factory setting of **100 ms**. A faster response time may be set via the register COM_OPTIONS (or by using the CB-Manager).

The response time is the delay a device waits until it sends an answer to a request. In accordance with the Modbus standard this at least the time it takes to transmit 3.5 characters. This time allows the master (PC) to perform the switching of the data direction (from send to receive), but also serves to recognize the beginning of a new telegram.

Especially the switching of the data direction on master side depends on the used hardware (PC, RS485 interface or interface converter). If the response time is selected too short the response of the device may not be recognized. In this case the response time have to be prolonged. Take into account, that the telegram sent to change the response time possibly is not acknowledged due to the insufficient response time previously set. The new response time is set after the device has received the telegram.

Modbus settings

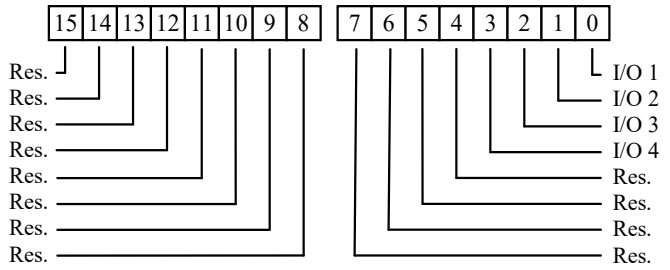
Address	Name	Type	Offset	Default	Description
44100	COM_ADDRESS	UINT8	0 1	1 0	Modbus address 1...247 always 0
44101	COM_BAUD	UINT32	0	19'200	Baud rate, valid values are: 2'400, 4'800, 9'600, 19'200, 38’400, 57'600, 115'200
44103	COM_OPTIONS	UINT16	0	0x0020	Configuration of the Modbus interface 

8 Simulation mode

By means of the simulation analog outputs values may be predefined. This mode is suited especially to test subsequent circuits during commissioning.

Once started the simulation mode can be stopped in two ways:

- ► setting the register SIM_MOD to 0
- ► switching off the power supply

Address	Name	Type	Description
45301	SIM_IO	UINT16	Bit mask for simulation 

8.1 Simulation of analog outputs

For all channels selected in SIM_IO a value may be predefined

Address	Name	Type	Description
41210	AOUT1	REAL	Analog output 1 in mA
41212	AOUT2	REAL	Analog output 2 in mA
41214	AOUT3	REAL	Analog output 3 in mA
41216	AOUT4	REAL	Analog output 4 in mA

9 Remote interface

All LEDs **not used** for the normal device functionality may be used for other purposes. Driving is performed via the configuration interface, e.g. by means of a Modbus master software.

Address	Name	Type	Description
13	LED1	COIL	State LED A
14	LED2	COIL	State LED B