

	<h1>MRU SWG100biogas (including -EX)</h1>	Release no <b>13</b>	date of last modification <b>15.02.2019</b>
laid down by Matthias Erck	<h1>Modbus/Profibus Slave Specification</h1>	valid since <b>15.02.2019</b>	replaces release no <b>12</b>

## 1 General information

- The Modbus/Profibus Slave function requires the analyser firmware version V1.11.00 dated 12.07.2016 or later.
- Multi byte values are transmitted in Motorola® byte order (Big-Endian). Only the CRC16 at the end of each frame is transmitted in Intel® byte order (Little-Endian).  
In case you need Little-Endian byte order in the master's system:
  - 16bit values (occurs only in the frame): swap bytes 0<=>1
  - 32bit values (occurs only in the data): swap bytes 0<=>3 and swap bytes 1<=>2
- All addresses written in this document are decimal (not hexa-decimal)
- All readable data are 32bit values, therefore the analyser only accepts even addresses end even number of registers to be read.
- Data types (used in table below):
  - U32 32 bit unsigned integer value (0...4.294.967.295)
  - FL 32 bit floating point value (reads -1E38, when not available)
- Some values are optional (e.g. gas-cooler).

### 1.1 Special informationen about the Modbus Slave function

- The analysers are able to work as modbus slave using the RS232 or RS485 port (possibly with external RS232/RS485 adapter)
- supports RS485 interface with 2/4 wires (half/full duplex)
- supports only the binary Modbus protocol (RTU)
- supports modbus command *Read Holding Register* (command no 3)
- supports modbus command *Read Input Register* (command no 4)
- the slave modbus address is user definable from 1 to 238
- communication parameter are user definable as follows:
  - 9600 baud or 19200 baud (recommended)
  - odd, even or none parity
  - 1 or 2 stop bits
- The maximal number of 32bit-values to be read with one single read command is 63 (126 modbus registers)

## 1.2 Special informationen about the Profibus Slave function

- The Profibus Slave function requires a modbus/profibus-converter "Seneca HD67561", which is configured and installed in the analyser.
- Usually MRU sets the Profibus ID to 84.

## 2 Defined registers to be read by the master

modbus address	profibus address	data type	register content
Status & Device info			
0	0	U32	Analyser Status (more details read below)
2	4	U32	System Alarm (more details read below)
4	8	U32	Serial number
6	12	U32	Analyser type (11060 = SWG100biogas)
8	16	U32	Firmware version (e.g. 12345 = V1.23.45)
10	20	U32	Elapsed seconds since Power-On
12	24	U32	Counter Modbus Frame Error
14	28	FL	CH4 amb. [%]
16	32	FL	CH4 amb. [% LEL]
18	36	FL	T-sensor [°C/°F] (unit depends on user settings)
20	40	FL	Sample Flow [l/h]
22	44	FL	T-gascooler [°C/°F] (unit depends on user settings)
24	48	FL	Case fan rotations [rpm]
26	52	FL	Gas pump rotations [rpm]
28	56	FL	P-absolute [hPa] (= [mbar])
30	60	FL	P-absolute [inchHG]
32		U32	not (yet) defined (reads zero)
34		U32	not (yet) defined (reads zero)
36		U32	not (yet) defined (reads zero)
38		U32	not (yet) defined (reads zero)
Status & current measurement values (live values!)			
40		U32	Analyser Status (more details read below)
42		U32	System Alarm (more details read below)
44		FL	O2 [%]
46		FL	CO2 [%] (or CO2 [ppm], if CO2 [%] isn't available)
48		FL	CH4 [%] (or CH4 [ppm], if CH4 [%] isn't available)
50		FL	H2S [ppm] (optional)
52		FL	H2 [ppm] (optional)
54		FL	Net calorific value [MJ/kg]
56		FL	Gross calorific value [MJ/kg]

modbus address	profibus address	data type	register content
58		FL	Net calorific value [MJ/m <sup>3</sup> ]
60		FL	Gross calorific value [MJ/m <sup>3</sup> ]
62		FL	CO [ppm] (optional)
64		FL	CH4 [ppm] (optional, when CH4 [%] also available)
66		FL	CO2 [ppm] (optional, when CO2 [%] also available)
68		U32	not (yet) defined (reads zero)
<b>Status &amp; measurement values of sample point 1</b>			
70		U32	Analyser Status (more details read below)
72		U32	System Alarm (more details read below)
74	64	FL	O2 [%]
76	68	FL	CO2 [%] (or CO2 [ppm], if CO2 [%] isn't available)
78	72	FL	CH4 [%] (or CH4 [ppm], if CH4 [%] isn't available)
80	76	FL	H2S [ppm] (optional)
82	80	FL	H2 [ppm] (optional)
84	84	FL	Net calorific value [MJ/kg]
86	88	FL	Gross calorific value [MJ/kg]
88	92	FL	Net calorific value [MJ/m <sup>3</sup> ]
90	96	FL	Gross calorific value [MJ/m <sup>3</sup> ]
92	100	FL	CO [ppm] (optional)
94	104	FL	CH4 [ppm] (optional, when CH4 [%] also available)
96		FL	CO2 [ppm] (optional, when CO2 [%] also available)
98		U32	not (yet) defined (reads zero)
<b>Status &amp; measurement values of sample point 2 (optional)</b>			
100		U32	Analyser Status (more details read below)
102		U32	System Alarm (more details read below)
104	108	FL	O2 [%]
106	112	FL	CO2 [%] (or CO2 [ppm], if CO2 [%] isn't available)
108	116	FL	CH4 [%] (or CH4 [ppm], if CH4 [%] isn't available)
110	120	FL	H2S [ppm] (optional)
112	124	FL	H2 [ppm] (optional)
114	128	FL	Net calorific value [MJ/kg]
116	132	FL	Gross calorific value [MJ/kg]
118	136	FL	Net calorific value [MJ/m <sup>3</sup> ]
120	140	FL	Gross calorific value [MJ/m <sup>3</sup> ]
122	144	FL	CO [ppm] (optional)
124	148	FL	CH4 [ppm] (optional, when CH4 [%] also available)
126		FL	CO2 [ppm] (optional, when CO2 [%] also available)
128		U32	not (yet) defined (reads zero)
<b>Status &amp; measurement values of sample point 3-10 (optional)</b>			
130-369	152...	...	add 30/44 to the addresses for each sample point

**Note: Optional AUX values are not available via Profibus!  
(at least not with the delivered Profibus configuration)**

protocol address	data type	numb. of registers	register content
AUX-values (read by up to 10 IO-modules)			
370	FL	2	AUX-value read by IO-module 1 - Input 1
372	FL	2	AUX-value read by IO-module 1 - Input 2
374	FL	2	AUX-value read by IO-module 1 - Input 3
376	FL	2	AUX-value read by IO-module 1 - Input 4
378	FL	2	AUX-value read by IO-module 2 - Input 1
380	FL	2	AUX-value read by IO-module 2 - Input 2
382	FL	2	AUX-value read by IO-module 2 - Input 3
384	FL	2	AUX-value read by IO-module 2 - Input 4
386	FL	2	AUX-value read by IO-module 3 - Input 1
388	FL	2	AUX-value read by IO-module 3 - Input 2
390	FL	2	AUX-value read by IO-module 3 - Input 3
392	FL	2	AUX-value read by IO-module 3 - Input 4
394	FL	2	AUX-value read by IO-module 4 - Input 1
396	FL	2	AUX-value read by IO-module 4 - Input 2
398	FL	2	AUX-value read by IO-module 4 - Input 3
400	FL	2	AUX-value read by IO-module 4 - Input 4
402	FL	2	AUX-value read by IO-module 5 - Input 1
404	FL	2	AUX-value read by IO-module 5 - Input 2
406	FL	2	AUX-value read by IO-module 5 - Input 3
408	FL	2	AUX-value read by IO-module 5 - Input 4
410	FL	2	AUX-value read by IO-module 6 - Input 1
412	FL	2	AUX-value read by IO-module 6 - Input 2
414	FL	2	AUX-value read by IO-module 6 - Input 3
416	FL	2	AUX-value read by IO-module 6 - Input 4
418	FL	2	AUX-value read by IO-module 7 - Input 1
420	FL	2	AUX-value read by IO-module 7 - Input 2
422	FL	2	AUX-value read by IO-module 7 - Input 3
424	FL	2	AUX-value read by IO-module 7 - Input 4
426-241	FL	16	8 AUX-values read by IO-modules 8 & 9
442	FL	2	AUX-value read by IO-module 10 - Input 1
444	FL	2	AUX-value read by IO-module 10 - Input 2
446	FL	2	AUX-value read by IO-module 10 - Input 3
448	FL	2	AUX-value read by IO-module 10 - Input 4

**Note: User definable modbus values are not available via Profibus!  
(at least not with the delivered Profibus configuration)**

Since firmware V1.19.00 the user can configure a user definable modbus value list according to the configuration of the measurement window. This happens by a command at once. The analyzer will store this modbus configuration and won't change it until the command will be started again. The analyzer stores a list in CSV format on the SD card (if available).

protocol address	data type	numb. of registers	register content
User definable modbus values			
3000	FL	2	Live value from 1st page 1st line
3002	FL	2	Live value from 1st page 2nd line
3004	FL	2	Live value from 1st page 3rd line
3006	FL	2	Live value from 1st page 4th line
3008	FL	2	Live value from 1st page 5th line
3010	FL	2	Live value from 1st page 6th line
3012	FL	12	Live values from 2nd page 1st-6th line
3024	FL	12	Live values from 3rd page 1st-6th line
3036	FL	12	Live values from 4th page 1st-6th line
3048	FL	48	Sample point 1 values from 1st-4th page 1st-6th line
3096	FL	48	Sample point 2 values from 1st-4th page 1st-6th line
3144	FL	48	Sample point 3 values from 1st-4th page 1st-6th line
3192	FL	48	Sample point 4 values from 1st-4th page 1st-6th line
3240	FL	48	Sample point 5 values from 1st-4th page 1st-6th line
3288	FL	48	Sample point 6 values from 1st-4th page 1st-6th line
3336	FL	48	Sample point 7 values from 1st-4th page 1st-6th line
3384	FL	48	Sample point 8 values from 1st-4th page 1st-6th line
3432	FL	48	Sample point 9 values from 1st-4th page 1st-6th line
3480	FL	48	Sample point 10 values from 1st-4th page 1st-6th line

## 2.1 Analyser Status (address 0 and some mirror addresses)

The Analyser Status is a 32bit-word and must be interpreted bitwise.

Bit	Description
0	Power-On (until the first zeroing has been done)
1	System-Alarm, see table below
2	Air Purging (zeroing)
3	Gas Sampling (preparing measurement, not measurement!)
4-7	Currently sampled sample point number (1..10, reads 0 while air purging)
8	One sensor (e.g. CO or H2S) is currently purged
9	One sensor (e.g. CO or H2S) is currently cut-off the sample gas
10	Sniffing case gas (only EX analysers)
11-31	reserved for later applications (reads zero)

Some status examples:

Decimal	Hexadecimal	Binary	state description
1	0001h	000 0000 0001	Power-On (self-test)
5	0005h	000 0000 0101	First Air Purging (Power-On + Air Purging)
24	0018h	000 0001 1000	Preparing meas. smp.pt.1 (Gas Sampling + smp.pt.1)
16	0010h	000 0001 0000	Measuring sample point 1
528	0210h	010 0001 0000	Measuring sample point 1 (H2S sensor is cut-off)
40	0028h	000 0010 1000	Preparing meas. smp.pt.2 (Gas Sampling + smp.pt.2)
32	0020h	000 0010 0000	Measuring sample point 2
48	0030h	000 0011 0000	Measuring sample point 3
18	0012h	000 0001 0010	Measuring sample point 1 + System-Alarm
0	0000h	000 0000 0000	Adjustment (user interaction at the analyser)
1024	0400h	100 0000 0000	Sniffing case gas (only EX analysers)

## 2.2 Analyser System Alarm (address 2 and some mirror addresses)

The Analyser System Alarm is a 32bit-word and must be interpreted bitwise.

Bit	Description	Meas. halted
0	Mainboard Offline (some communication problems)	YES
1	Mainboard is in bootloader mode	YES
2	CH4 ambient > threshold value	YES
3	Condensate	YES
4	Sample flow < 20 l/h	-
5	Case fan rotations < 900 rpm	-
6	T-gascooler > 10°C	-
7	T-gascooler < 2°C	-
8	T-Sensor > 55°C	-
9	T-Sensor < 5°C	-
10-31	reserved for later applications (reads zero)	

Some system alarm examples:

Decimal	Hexadecimal	Binary	state description
1	0001h	0000 0001	Mainboard is offline, measurement is halted
8	0008h	0000 1000	Condensate Alarm, measurement is halted
80	0050h	0101 0000	Sample flow < 20 l/h and T-gascooler > 10°C