


|   |  |                                  |  |
|---|--|----------------------------------|--|
|  | <p><b>MRU SWG100biogas</b><br/>(including -EX and syngas)</p> <p><b>Modbus/Profibus</b><br/><b>Slave Specification</b></p> | Release no<br><b>17</b>          | date of last modification<br><b>02.03.2020</b> |
| laid down by<br>Matthias Erck   |  | valid since<br><b>02.03.2020</b> | replaces release no<br><b>16</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-barometric [hPa] (=mbar)                          |
| 30   | 60               | FL        | P-barometric [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] or [%] (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  |                  | FL        | N2 [%]   |
| Status & measurement values of sample point 1               |                  |           |  |
| 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] or [%] (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  |                  | FL        | N2 [%]   |
| Status & measurement values of sample point 2 (optional)    |                  |           |  |
| 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] or [%] (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   |                  | FL        | N2 [%]   |
| Status & measurement values of sample point 3-10 (optional) |                  |           |  |
| 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 H <sub>2</sub> S) is currently purged                 |
| 9     | One sensor (e.g. CO or H <sub>2</sub> S) is currently cut-off the sample gas |
| 10    | Sniffing case gas (only EX analysers)  |
| 11    | Stand-By   |
| 12    | Auto-Calibration   |
| 13-27 | reserved for later applications (reads zero)                                 |
| 28-31 | External Control's state, range 0..15  |

Some status examples:

| Decimal | Hexadec. | Binary         | state description   |
|---------|----------|----------------|---|
| 1       | 0001h    | 0000 0000 0001 | Power-On (self-test)  |
| 5       | 0005h    | 0000 0000 0101 | First Air Purging (Power-On + Air Purging)                    |
| 24      | 0018h    | 0000 0001 1000 | Preparing meas. smp.pt.1 (Gas Sampling + smp.pt.1)            |
| 16      | 0010h    | 0000 0001 0000 | Measuring sample point 1                                      |
| 528     | 0210h    | 0010 0001 0000 | Measuring sample point 1 (H <sub>2</sub> S sensor is cut-off) |
| 40      | 0028h    | 0000 0010 1000 | Preparing meas. smp.pt.2 (Gas Sampling + smp.pt.2)            |
| 32      | 0020h    | 0000 0010 0000 | Measuring sample point 2                                      |
| 48      | 0030h    | 0000 0011 0000 | Measuring sample point 3                                      |
| 18      | 0012h    | 0000 0001 0010 | Measuring sample point 1 + System-Alarm                       |
| 0       | 0000h    | 0000 0000 0000 | Adjustment (user interaction at the analyser)                 |
| 1024    | 0400h    | 0100 0000 0000 | Sniffing case gas (only EX analysers)                         |
| 2048    | 0800h    | 1000 0000 0000 | Stand-By  |

## 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 |