Annex of Instruction Manual

GMA200-MT/-MW

Modbus implementation

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Table of content

Page

1. GENERAL INFORMATION 2

2. PC CONNECTION / INTERFACE 2

3. BUS STRUCTURE 3

4. PARAMETER OF COMMUNICATION 3

5. IMPLEMENTATION OF PROTOCOL 3

5.1 MODBUS FUNCTION CODES 4
5.2 TELEGRAM DESCRIPTION 4
5.2.1 READ INPUT REGISTERS 4
5.2.2 WRITE MULTIPLE REGISTERS 4
5.2.3 READ/WRITE MULTIPLE REGISTERS 5
5.2.4 EXCEPTION CODE 5
5.3 REGISTER MAP 6
5.3.1 READ INPUT REGISTERS 6
5.3.2 WRITE MULTIPLE REGISTERS 10
5.4 EXPLICIT TELEGRAM IDENTIFICATION 10
5.5 CHRONOLOGICAL SEQUENCE OF THE MEASURED VALUE REQUEST 11

6. TABLES OF GFG CODES 11

6.1 GFG TABLE OF UNITS 11
6.2 GFG TABLE OF GAS TYPES RESPECTIVELY MEASURED QUANTITIES 12

7. REFERENCES 13

1. General Information

The GMA200-MT/-MW has three RS485-busses (1 x GMA-Bus and 2x TRM-busses). The TRM bus nodes operate in the master mode and are intended for the communication with connected transmitters and relay modules. The GMA bus node may optionally be configured for master or slave mode. In the master mode it is intended for the communication with connected relay modules. In the slave mode only data can be readout from the GMA bus mode and processed by an extern master device (e.g. central unit or gateway to the control center), i.e. in this operation mode no relay modules can be managed by the GMA on the GMA bus. The communication on all busses is carried out according to the Modbus protocol in the RTU mode.
This document describes how and which data can be read from the GMA200-MT/-MW and therefore concerns only the GMA-bus in the slave operating mode.

2. PC Connection / Interface

RS485 (Multipoint)

- Bus-connection of master and slave via a two-core screened cable (clamping connection);
  e.g. bus-line 1x2x0,22mm2 BUS-LD or Bus-cable Y(St)Y 2x2x0,8

3. Bus structure

The maximum bus length should not exceed a distance of 1200m (see RS485 specification). A maximum of 64 modules can be connected to the GMA-bus. The transmission rate depends on the line length and can be set to a maximum of 230400 Baud.
The real maximum of line length and transmission rate depends very much on the construction of the network. In particular, Star topologies should be avoided due to resultant long stub lines. Advantageous is the construction of Daisy Chains. The following table shows the maximum Baud rates in dependency of the line lengths. The following example is intended to be a rough guideline.

Line length	max. Baud rate
Up to 500m	230400 Baud
Up to 1000m	115200 Baud
Up to 1200m	57600 Baud

The bus levels are defined by the master. The bus should be terminated on both sides with 120Ω termination resistor. The GMA200-MT/-MW contains terminal resistors for all three busses, which can be switched on/off by a slide switch. These switches are located near the terminals and can be seen after removing the terminal cover. They can be activated by using suitable tools (e.g. screwdriver or similar) without opening the housing of the GMA200. The switch for the GMA-bus is located directly to the left of terminal 11 on the wall mounting module. On the rail mounting module this switch is located behind the terminals 67 – 69 (see also instruction manual).

4. Parameter of communication

Bus Address	1 … 247 (in slave operating mode) Comment: Specification of the address also defines the operating mode of the bus node. The address 0 activates the master operating mode. Any other address activates the slave operating mode.
Transmission Rate	9600, 19200, 38400, 57600, 115200, 230400 Baud
Data Format	1 start bit 8 data bits 1 parity bit (even parity) with 1 stop bit (8E1)
Transmission Mode	RTU (Remote Terminal Unit) according to [MoSL]

The settings of bus address and baud rate can be done in the service menu of the GMA or via the configuration software GMA Config on a PC (see Instruction manual). The data format and the transmission mode are fixed and cannot be changed.

5. Implementation of protocol

In reference to the ISO/OSI model the Modbus protocol consists of application layer, data link layer and physical layer, as shown in the adjacent table. The odd four layers remain unused.

Layer	ISO/OSI Model	Modbus Protocol	Reference
7	Application Layer	MODBUS Application Protocol	[MAPS]
6	Presentation Layer	empty	
5	Session Layer	empty	
4	Transport Layer	empty	
3	Network Layer	empty	
2	Data Link Layer	MODBUS Serial Line Protocol	[MoSL]
1	Physical Layer	EIA/TIA-485	

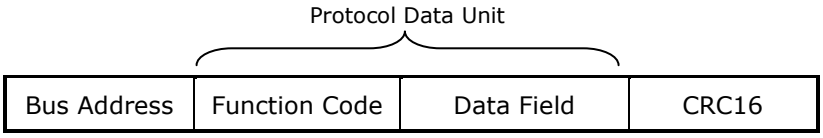
The subsequent protocol description exclusively refers to the application layer.

5.1 Modbus Function Codes

The GMA data can be read and written through the GMA-Bus. The data access is based on mapped register within the GMA, on which the Master can access to write and read data by using the following specialized Modbus function Codes [MAPS].

- **Read Input Registers 04 (0x04)**
- **Write Multiple Registers 16 (0x10)**
- **Read/Write Multiple Registers 23 (0x17)**

The registers represent 16-bit values with a 16-bit address range. The allocation of the transmission data to the register addresses will be described in section 5.3 "Register map". The following figure illustrates the universal structure of a Modbus frame, which consists of the bus address, the function code, the data field and the CRC16-modbus-checksum.



Modbus Frame Structure

5.2 Telegram Description

As illustrated in the upper figure, every telegram starts with the bus address and the function code and ends with the CRC16-modus-checksum. In between there is the application specific data field.
The CRC16-modbus-checksum is Modbus-specific and has the polynomial 0xA001 (see specifications according to [MoSL]). With the exception of the checksum all data will be transmitted in Big-Endian-Format (first MSB). The Checksum will be transmitted the Small-Endian-Format (first LSB).
Subsequently telegrams for the different general function codes and functionalities which are implemented in the GMA will be described.

5.2.1 Read Input Registers

The master sends the start address and the register number in the request for the readout of the register. The slave sends back the content of the requested register in the response.

Request	Length	Content
Bus Address	1 Byte	1 … 247
Function Code	1 Byte	0x04
Start Address	2 Bytes	0x0000 … 0x06F2
Number of Registers	2 Bytes	1 … 49
Modbus Checksum	2 Bytes	(0x0000 … 0xFFFF)

Response	Length	Content
Bus Address	1 Byte	1 … 247
Function Code	1 Byte	0x04
Number of Bytes	1 Byte	2 x N*
Register Content	N* x 2 Bytes	Daten
Modbus Checksum	2 Bytes	(0x0000 … 0xFFFF)

N* = Number of Register

5.2.2 Write Multiple Registers

The master sends the start address, the number and the content of the description of registers in the request for writing. The slave sends the start address and the number of registers as confirmation.

Request	Lenght	Content
Bus Address	1 Byte	1 … 247
Function Code	1 Byte	0x10
Start Address	2 Bytes	0x1000
Number of Registers	2 Bytes	1
Number of Bytes	1 Bytes	2
Register Content	2 Bytes	Daten
Modbus Checksum	2 Bytes	(0x0000 … 0xFFFF)

Response	Length	Content
Bus Address	1 Byte	1 … 247
Function Code	1 Byte	0x10
Start Address	2 Bytes	0x1000
Number of Registers	2 Bytes	1
Modbus Checksum	2 Bytes	(0x0000 … 0xFFFF)

5.2.3 Read/Write Multiple Registers

The Master sends the start address and the number of start address to be read, number and content of the register to be written in the request. The slave sends the content of the requested register in the response.

Request	Length	Content	
Bus Address	1 Byte	1 … 247	
Function Code	1 Byte	0x17	
Start Address (R)	2 Bytes	0x0000 … 0x06F2	(R) = Read
Number of Registers (R)	2 Bytes	1 … 49	
Start Address (W)	2 Bytes	0x0000	(W) = Write
Number of Registers (W)	2 Bytes	1	
Number of Bytes (W)	1 Bytes	2	
Register Content (W)	2 Bytes	Datta	
Modbus Checksum	2 Bytes	(0x0000 … 0xFFFF)	

Response	Length	Content	
Bus Address	1 Byte	1 … 247	
Function Code	1 Byte	0x17	
Number of Bytes	1 Byte	2 x N*	N* = Number of Registers
Register Content	N* x 2 Bytes	Data	
Modbus Checksum	2 Bytes	(0x0000 … 0xFFFF)	

5.2.4 Exception Code

If an error occurs during reading or writing, the Slave sends an exception code instead of the expected response and sets the bit with the highest value (MSB) in the function code.

Error-Response	Länge	Inhalt
Bus Address	1 Byte	1 … 247
Function Code	1 Byte	0x84 / 0x90 / 0x97
Exception Code	1 Byte	0x01 ... 0x04
Modbus Checksum	2 Bytes	(0x0000 … 0xFFFF)

In the implemented function codes the four following exception codes are possible.

Exception Code	**Designation**	**Description of Error**
0x01	Illegal Function	Invalid Function Code
0x02	Illegal Data Address	Invalid Register Address
0x03	Illegal Data Value	Invalid number of register
0x04	Slave Device Failure	Error in reading the register

5.3 Register Map

For the most part the registers are divided in two separate ranges. Only the read access of the one range is possible (Read Input Registers) while the other allows only the write access (Write Multiple Registers). Only one register (0x0000) is for both read and write access. Processes of reading and writing can also be combined (Read/Write Multiple Registers) in a communication cycle (Request ←→ Response).

5.3.1 Read Input Registers

Basically the transmission data, which can be read from the GMA, can be divided into four groups:

Register Addresses	Transmission Data
0x0000 … 0x0021	GMA Identification Parameter
0x0100 … 0x0121	GMA Status as well as measured values and status information of the transmitter respectively of the Measuring Points
0x0200 … 0x06F2	Configuration parameters according to the measuring values of the transmitter respectively of the Measuring Points

In section 5.5 "Chronological sequence of the measured value request" a description of which data should be read by the GMA can be found.

The subsequent table describes the allocation of transmission data to the register addresses and the structure of data in detail. By reading the register it should be ensured that the access to not specified register between the data segments in the register map should be denied. For this reason only a limited number of registers in dependency of the register start address can be read in a telegram.

REGISTER MAP - READ INPUT REGISTERS 04 (0x04)				
Register Address	**max. request-able Register**	**Type of register (16 Bit)**	**Parameter**	**Explanation**
0x0000	34	Unsigned	Signature	Signature for telegram identification (will be decrement after reading)
0x0001	33	Unsigned	GMA Type	Coding: *0: GMA200-MT16* *1: GMA200-MT6* *2: GMA200-MW16* *3: GMA200-MW8* *4: GMA200-MW4*
0x0002	32	Unsigned	FW Version (Main)	Firmware-Version of the Mainboard *e.g. 192 = v1.92*
0x0003	31	Unsigned	FW Version (Disp)	Firmware-Version of the Displayboard *e.g. 152 = v1.52*
0x0004	30	Unsigned	GMA Serial number	First ASCII-Character (UTF-8) of the serial number with a maximum of 10 digits
…	…	…	…	*e.g: 49,50,49,49,49,57,50,55,0,0 = „12111927"* *(here with Null-terminating)*
0x000D	21	Unsigned	GMA Serial number	Last ASCII-Character (UTF-8) of the serial number with maximum of 10 digits
0x000E	20	Unsigned	GMA Designation	First ASCII-Character (UTF-8) of the GMA-designation with a maximum of 20 digits
…	…	…	…	*e.g.: 72,65,85,83,32,51,0,0,0,0,0,0,0,0,0,0,0,0,0,0* *= "HAUS 3"*
0x0021	1	Unsigned	GMA Designation	Last ASCII-Character (UTF-8) of the GMA-designation with a maximum of 20 digits

Continue on next page

Register Address	max. request-able register	Type of register (16 Bit)	Parameter	Explanation	
0x0100	34	Unsigned	Signature	Signature for telegram identification (will be decrement after reading)	
0x0101	33	Unsigned	GMA-Status (#1)	Bit definition: b0: Startup b1: Error b2: maintenance b3: maintenance request b4: Configuration mode } 1= active; 0=inactive b5: Level on AL-Reset input 1 b6: Level on AL-Reset input 2 } 1= High, 0= Low	
0x0102	32	Unsigned	TRM-Status (#1)	Bit definition (1=active; 0=inactive): b0: Activated b1: Blocked b2: Startup b3: Error b4: maintenance b5: maintenance request b6: Configuration mode b7: Alarm 1 b8: Alarm 2 b9: Alarm 3 b10: Under-Range b11: Over-Range	Measuring point 1
0x0103	31	Signed	TRM Measuring value	Measuring value according to scaling factor, unit und type of gas *Example:* *- measuring value = 209* *- scaling factor = -1* *- unity = 2* *- type of gas = 89* *→ gas measuring value = 20,9 Vol.% O_2*	
…	…	…	…	…	Measuring points 2–15
0x0120	2	Unsigned	TRM Status	*(see register address 0x0102)*	Measuring point 16
0x0121	1	Signed	TRM Measuring value	*(see register address 0x0103)*	
0x0200	49	Unsigned	Signature	Signature for telegram identification (will be decrement after reading)	
0x0201	48	Signed	Scaling Factor	Of the TRM measuring value –3: 0,001 –2: 0,01 –1: 0,1 0: 1	Measuring point 1
0x0202	47	Unsigned	Unit	Of the TRM measuring value *Coding by number according GfG-tables of units and gas types (see section 6)*	
0x0203	46	Unsigned	Type of Gas		
…	…	…	…	…	Measuring point 2–15
0x022E	3	Signed	Scaling Factor	*(see register address 0x0201)*	Measuring point 16
0x022F	2	Unsigned	Unit	*(see register address 0x0202)*	
0x0230	1	Unsigned	Type of Gas	*(see register address 0x0203)*	

Regarding #1: See "Explanation of bit definition" at the end of this section

Continue on next page

Register Address	max. request-able register	Type of register (16 Bit)	Parameter	Explanation	
0x0300	49	Unsigned	Signature	Signature for telegram identification (will be decrement after reading)	
0x0301	48	Signed	MBB	Start and end of the measuring range according to the scaling factor	0x0301 0x0302 0x0303
0x0302	47	Signed	MBE		
0x0303	46	Unsigned	Directions of Alarm	Direction of the alarms AL3,AL2,AL1 with the bit definition b2, b1, b0. Value=1: exceeding Alarm Value=0: lower Alarm	
…	…	…	…	…	…
0x032E	3	Signed	MBB	*(see register adress 0x0301)*	0x032E 0x032F 0x0330
0x032F	2	Signed	MBE	*(see register adress 0x0302)*	
0x0330	1	Unsigned	Directions of Alarm	*(see register adress 0x0303)*	
0x0400	49	Unsigned	Signature	Signature for telegram identification (will be decrement after reading)	
0x0401	48	Signed	AL1	Alarm treshold 1, 2, 3 according to the scaling factor. (Value=0: Alarm disabled)	0x0401 0x0402 0x0403
0x0402	47	Signed	AL2		
0x0403	46	Signed	AL3		
…	…	…	…	…	…
0x042E	3	Signed	AL1	*(see register adress 0x0401)*	0x042E 0x042F 0x0430
0x042F	2	Signed	AL2	*(see register adress 0x0402)*	
0x0430	1	Signed	AL3	*(see register adress 0x0403)*	
0x0500	19	Unsigned	Signature	Signature for telegram identification (will be decrement after reading)	
0x0501	18	Unsigned	Designation of Measuring Point Text 1	First ASCII-Character (UTF-8) of text 1 with a maximum of 10 digits	0x0501 … 0x050A 0x050B … 0x0512
…	…	…	…	*e.g. 82,97,117,109,32,49,0,0,0,0 = "Raum 1"*	
0x050A	9	Unsigned	Designation of Measuring Point Text 1	Last ASCII-Character (UTF-8) of text 1 with a maximum of 10 digits	
0x050B	8	Unsigned	Designation of Measuring Point Text 2	First ASCII-Character (UTF-8) of text 2 with a maximum of 8 digits	
…	…	…	…	*e.g.: 71,97,115,108,97,98,111,114 = "Gaslabor"*	
0x0512	1	Unsigned	Designation of Measuring Point Text 2	Last ASCII-Character (UTF-8) of text 2 with a maximum of 8 digits	
0x0520	19	Unsigned	Signature	Signature for telegram identification (will be decrement after reading)	
0x0521	18	Unsigned	Designation of Measuring Point Text 1	*(see register adress 0x0501)*	Measuring point 2
…					
0x0532	1	Unsigned	Designation of Measuring Point Text 2	*(see register adress 0x0512)*	
…	…	…	…	…	Measuring point 3–15
0x06E0	19	Unsigned	Signature	Signature for telegram identification (will be decrement after reading)	
0x06E1	18	Unsigned	Designation of Measuring Point Text 1	*(see register adress 0x0501)*	Measuring point 16
…	…	…	…	…	
0x06F2	1	Unsigned	Designation of Measuring Point Text 2	*(see register adress 0x0512)*	

Explanation of bit definition

GMA-Status – Bit definition		
b0	Startup	This bit is set, when after a reset the GMA is in the startup phase. During this period self-tests and preparations for the measuring operation will be done. Thus there are no valid measuring values from the Measuring Points for evaluation available. This bit will be reset as soon as the startup phase ends.
b1	Error	This bit is set, when an active error on the GMA is existent (e.g. supply voltage outside the valid range). During this period measuring values of the Measuring Points should not be evaluated, because there is no guarantee for their validity. This bit will be reset as soon as the error(s) is (are) no longer active.
b2	Maintenance	This bit is set, when maintenance is carried out on the GMA (e.g. Test of the relay outputs) and will be reset as soon as the maintenance is done.
b3	Maintenence Request	This bit is set, when there is an active maintenance request on the GMA (e.g. excess of the inspection date) and will be reset as soon as no maintenance request is active.
b4	Configuration Operation Mode	This bit is set, when the GMA switches into the configuration operation for the change of configuration parameters. During this period measuring values of the Measuring Points should not be evaluated, because there is no guarantee for their validity. This bit will be reset as soon as the configuration mode is quit.
b5	Level on AL-Reset Input 1	This bits indicate the level on the alarmreset inputs 1= High-level: Extern switch open 0= Low-Level: Extern switch closed
b6	Level on AL-Reset Input 2	

TRM-Status - Bitdefinition		
b0	Activated	Measuring Point is active. The measuring values of inactive Measuring Points have a default value (0) and are not allowed to be evaluated.
b1	Blocked	Measuring Point is blocked. I.e. independent from the measuring signal of the Measuring Point alarms and errors won't be triggered. For this Measuring Point the need for maintenance will be signalized.
b2	Startup	Measuring Point is in the startup phase after a reset. As soon as this phase is done the bit will be reset.
b3	Error	At least one error is active. Measuring value is invalid.
b4	Maintenance	Maintenance on this Measuring Point.
b5	Maintenance Request	At least one maintenance request is active.
b6	Configuration Operation Mode	The GMA is in the configuration operation. Because the parameters can change during this operation, the validity of the measuring values cannot be guaranteed. These measuring values should not be evaluated.
b7	Alarm 1	Alarm 1 triggered
b8	Alarm 2	Alarm 2 triggered
b9	Alarm 3	Alarm 3 triggered
b10	Under Range	The measuring value is clearly under the measuring range
b11	Over Range	The measuring value is clearly over the measuring range

5.3.2 Write Multiple Registers

Only two registers can be written to either set the telegram signature or to quit active alarms of the Measuring Points.

REGISTER-MAP - WRITE MULTIPLE REGISTERS 16 (0x10)				
Register Address	**Number of transmit-able Register**	**Type of register (16 Bit)**	**Parameter**	**Explanation**
0x0000	1	Unsigned	Signatur	Signature for telegram identification (will be decrement after reading)
0x1000	1	Unsigned	Alarm Acknowledgement (AL-Reset)	Acknowledgement of active alarms of Measuring Points. A Measuring Point is allocated to every bit. On every set bit active alarms will be acknowledge according to the Measuring Point (MP) → Bit0:15 = MP1:16 example: 0x0001: Alarm acknowledgement of measuring point 1 0x0010: Alarm acknowledgement of measuring point 5 0xFFFF: Alarm acknowledgement of measuring point 1-16

5.4 Explicit Telegram Identification

For the explicit telegram identification a signature as register content in conjunction with the function code for reading and writing of registers **(Read/Write Multiple Register 0x17)** can be transmitted. Therefore the Master sends a signature with the request for writing the signature register and requires simultaneously the same signature along with further register values from the GMA, which will be send in a response to the Master thereafter. The signature, which therefore is transmitted by the Master, can be counter value, for example, which gets incremented before every request. By the comparison of the sent and the received signature by the GMA, the Master is able to recognize, if the received telegram is the response to the sent request.

All data segments start with the signature register, which can be read along with the attached data register of the single segments. In doing so the same signature gets accessed in the signature registers of the different segments. This signature can just be described by the only register with the address 0x0000 (see section 5.3 "Register map").

After reading the signature, it will automatically decremented by the GMA. If the master accesses the signature and data segments for reading repeatedly **(Read Input Registers 0x04)**, then due to automatic decrementation of signature the master is able to recognize that the responses from the GMA are ongoing created and sent telegrams.

The above described telegram identification presumes the reading of entire data segments with signature from the particular start address.

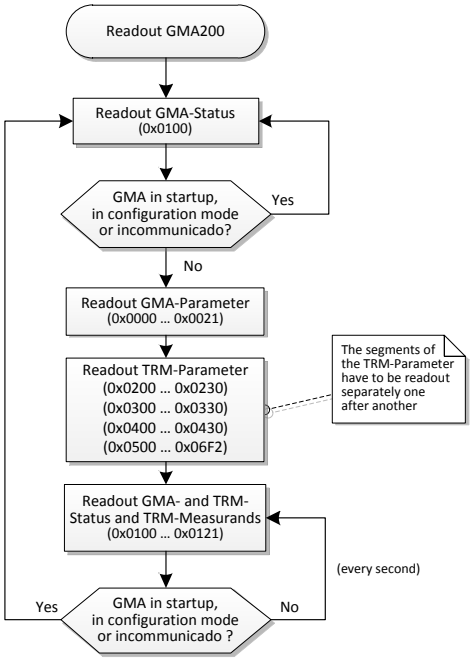
5.5 Chronological sequence of the measured value request

The configurations parameter of GMA and TRM must be read after the system start (Startup) or after configuration changes, because otherwise these data won't change. The parameters should also be read after long interruptions of communication since the executed changes which were made during the interruption could not be recognized. Every of four parameter signals should therefore be individually successively read.

Subsequently the GMA and TRM status information as well as the TRM measuring values will be cyclical read together. The cycle time therefore should not underrun one second as this period meets with the cycle time for the measurement within the GMA. If during the cyclic status the GMA switches into the configuration mode, is not available or is in startup caused by a reset, the status and measurements of the transmitter don't need to be read, because the correctness of the measurements can't be ensured due to configuration changes.

In this case the status of the GMA should be read out until the GMA quits the configuration operation or the startup phase respectively the GMA is available again.

The illustration displays an example for the chronological sequence of reading the data from the GMA.



Example for data request	Bus-Address (**#1**)	Function Code	Register Address (R)	Number of Register (R)	Register Address (W)	Number of Register (W)	Number of Bytes (W)	Register Content (W) (**#2**)	Modbus-Checksum
GMA identification parameter	0x01	0x17	0x0000	0x0022	0x0000	0x0001	0x02	0x0000	CRC16
Status and measure values	0x01	0x17	0x0100	0x0022	0x0000	0x0001	0x02	0x0001	CRC16
Measure value parameter	0x01	0x17	0x0200	0x0031	0x0000	0x0001	0x02	0x0002	CRC16
Measuring ranges	0x01	0x17	0x0300	0x0031	0x0000	0x0001	0x02	0x0003	CRC16
Alarm tresholds	0x01	0x17	0x0400	0x0031	0x0000	0x0001	0x02	0x0004	CRC16
MP designation (MP1)	0x01	0x17	0x0500	0x0013	0x0000	0x0001	0x02	0x0005	CRC16
MP designation (MP2)	0x01	0x17	0x0520	0x0013	0x0000	0x0001	0x02	0x0006	CRC16
MP designation (MP3-15)	…	…	…	…	…	…	…	…	…
MP designation (MP16)	0x01	0x17	0x06E0	0x0013	0x0000	0x0001	0x02	0x0014	CRC16

Comment (**#1**): Bus Address of GMA (variable); (**#2**): This Signature (variable) should always change

6. Tables of GfG codes

6.1 GfG table of units

No.	Code	Designation	No.	Code	Designation
1	ppm	Part per Million	**14**	A	Ampere
2	Vol%	Percent by volume	**15**	Ohm	Ohm
3	%LEL	Lower explosion level	**16**	Dig	Digit
4	ppb	Part per Billion	**23**	Grd	Degree
5	ug	Microgram	**24**	°F	Degree Fahrenheit
6	mg	Milligram	**25**	g	Gram
7	%	Percent	**26**	kg	Kilogramme
8	%%	Per mill	**27**	Pa	Pascal
9	m/s	Meter per second	**28**	kPa	Kilopascal
10	°C	Degree Celsius	**29**	Bar	Bar
11	mV	Millivolt	**30**	psi	Pound per square inch
12	V	Volt	**36**	mg/l	Milligramme per Liter
13	mA	Milliampere	**37**	slpm	Standard Liter per Minute

6.2 GfG table of gas types respectively measured quantities

No.	Additivity Formula	Gas (Substance)	No.	Additivity Formula	Gas (Substance)
1	C_3H_6O	Acetone	**51**	C_6H_{14}	n-Hexane
2	C_2H_3N	Acetonitrile	**52**	C_6H_{14}	i-Hexane
3	C_2H_2	Acetylene	**53**	$C_6H_{12}O$	Hexanone
4	C_3H_3N	Acrylnitrile	**54**	$C_6H_{12}O_2$	Isobutyl acetate
5	C_3H_9N	Aminopropane	**55**	CO_2	Carbon dioxid
6	NH_3	Ammonia	**56**	CO	Carbon monoxid
7	$C_5H_{12}O$	Amyl alkohol	**57**	$H_2+CH_4+N_2+CO+....$	Coke oven gas
8	Benzine	Benzin 60/95	**58**	$N_2+O_2+CO_2+...$	Air
9	Benzine	Benzin 80/110	**59**	CH_4	Methane
10	Gasoline	Benzin 100/140	**60**	CH_4O	Methanol
11	C_6H_6	Benzene	**61**	$C_3H_6O_2$	Methyl acetate
12	Cmb.gas	Combustible Gases and Vapors	**62**	CH_3OH	Methyl alcohol
13	$CBrF_3$	Bromtrifluormethane	**63**	$C_6H_{12}O$	Butyl methyl ketone
14	C_4H_6	1,3-Butadiene	**64**	CH_3CL	Methyl chloride
15	C_4H_{10}	n-Butane	**65**	CH_2CL_2	Methylene chloride
16	C_4H_{10}	i-Butane	**66**	$C_6H_{12}O$	MIBK Methyl isobutyl ketone
17	$C_4H_{10}O$	Butanol (n)	**67**	C_4H_8O	Ethyl methyl keton
18	C_4H_8O	MEK (Methyl ethyl ketone)	**68**	$C_3H_8O_2$	Methyl glycol
19	$C_6H_{12}O_2$	Butyl acetat (n)	**69**	$C_5H_8O_2$	Methyl methacrylate
20	$C_6H_{12}O_2$	Butyl acetat (i)	**70**	$C_4H_{10}O$	Methylpropanol
21	$C_4H_{10}O$	Butyl alcohol (n)	**71**	$CBrCLF_2$	Bromchlorodifluoromethan
22	C_4H_8	Butene	**72**	C_9H_{20}	n-Nonane
23	CL_2	Chlorine	**73**	C_8H_{18}	Octane (i)
24	CH_3CL	Chlormethane	**74**	C_8H_{18}	Octane (n)
25	HCL	Hydrogen Chloride	**75**	C_5H_{12}	Pentane (i)
26	HCN	Hydrogen Cyanide	**76**	C_5H_{12}	Pentane (n)
27	C_6H_{12}	Cyclohexane	**77**	$C_5H_{10}O$	Pentanone
28	C_5H_{10}	Cyclopentane	**78**	C_5H_{10}	Pentene
29	C_3H_6	Cyclopropane	**79**	$C_7H_{14}O_2$	Pentyl acetate
30	R12	R12 - Dichlorodifluormethan	**80**	C_2CL_4	PER (Perchlorethylene)
31	$C_2H_4CL_2$	Dichlorethan	**81**	C_3H_8	Propane
32	R21	R21 - Dichlorodifluoromethane	**82**	C_3H_8O	Propanol (i)
33	CH_2CL_2	Dichloromethane	**83**	$C_5H_{10}O_2$	Propyl acetate (i)
34	$C_3H_6CL_2$	Dichloropropane	**84**	$C_5H_{10}O_2$	Propyl acetate (n)
35	$C_4H_{11}N$	Diethylamine	**85**	C_3H_8O	Propyl alcohol (n)
36	C_2H_6O	Dimethyl Ether	**86**	C_3H_8O	Propyl alcohol (i)
37	C_3H_5CLO	Epichlorhydrin	**87**	C_3H_6	Propene
38	Nat.gas	Natural Gas	**88**	$C_3H_6CL_2$	Propylene dichloride
39	C_2H_6	Ethane	**89**	O_2	Oxygen
40	C_2H_6O	Ethanol	**90**	SO_2	Sulphur dioxide
41	$C_4H_8O_2$	Ethyl acetate	**91**	SF_6	Sulphur hexafluoride
42	C_2H_6O	Ethyl alcohol	**92**	H_2S	Hydrogen sulfide
43	C_2H_4	Ethylene	**93**	$H_2+CH_4+N_2+CO+...$	Town gas
44	C_2H_4O	Ethylene oxide	**94**	NO_2	Nitrogen dioxide
45	Gemisch	FAM-Benzin 65/95	**95**	NO	Nitrogen monoxide
46	Gemisch	Flugbenzin 40/180	**96**	C_8H_8	Styrene
47	CH_2O	Formaldehyde	**97**	$C_2H_2CL_4$	Tetrachloroethene
48	$CHCLF_2$	R22 - Chlordifluoromethane	**98**	C_7H_8	Toluol
49	He	Helium	**99**	$C_2H_3CL_3$	Trichloroethane
50	C_7H_{16}	n-Heptane	**100**	C_2HCL_3	TRI - Trichloroethylene

Continue on next page

Nr.	Summen-Formel	Gas-Bezeichnung	Nr.	Summen-Formel	Gas-Bezeichnung
101	CHF_3	R23 - Trifluormethan	**141**	Blend	Kerosene (180/220)
102	$C_4H_6O_2$	Vinyl acetate	**142**	CH_5N	Methylamine
103	C_2H_3CL	Vinyl chloride	**143**	$SiCL_4$	Silicon tetrachloride
104	H_2	Hydrogen	**144**	N_2	Nitrogen
105	H_2+CO+...	Watergas	**145**	$C_2H_3F_3$	R143a - Trifluoroethane
106	C_8H_{10}	Xylene	**146**	Blend	Diesel fuel
107	O_3	Ozone	**147**	Blend (C_2HF_5 + $C_2H_3F_3$ + $C_2H_2F_4$)	R404a (Refrigerant blend R125+R143a+R134a)
108	$COCL_2$	Phosgene			
109	PH_3	Phosphine	**148**	Br_2	Bromine
110	SiH_4	Silane	**149**	VOC	VOC
111	AsH_3	Arsine	**150**	PID	PID (Synonym for PID-Sensor)
112	CLO_2	Chlorine dioxide			
113	B_2H_6	Diborane	**151**	Blend (C_2HF_5 + $C_2H_3F_3$)	R507 (Refrigerant blend R125+R143a)
114	$C_2HCL_2F_3$	R123 – Dichloro trifluoroethane			
115	$C_4H_{10}O$	Diethyl ether	**152**	$C_3H_6O_2$	ETF - Ethylformiat
116	N_2O	Nitrous oxide	**153**	Ar	Argon
117	$C_2H_4O_2$	Acetic acid	**154**	$C_2CL_3F_3$	R113 -Trichlorotrifluoroethane
118	F_2	Fluorine	**155**	$C_2H_3F_4$	Refrigerant HFO-1234yf (2,3,3,3-Tetrafluorprop-1-en)
119	HF	Hydrogen fluoride			
120	GeH_4	Hydrogen germane	**156**	Blend (CH_2F_2 + C_2HF_5 + $C_2H_2F_4$)	R407c (Refrigerant blend R32+R125+R134a)
121	N_2H_4	Hydrazine			
122	C_6H_6O	Phenol	**157**	Blend (CH_2F_2 + C_2HF_5)	R410a (Refrigerant blend R32+R125)
123	C_3H_6O	Propylene oxide			
124	$C_2H_2F_4$	R134a - Tetrafluoroethane	**158**	NF_3	Nitrogen trifluoride
125	C_4H_8S	THT - Tetrahydrothiophene	**159**	pH	pH
126	TAL	ToxAlert	**160**	Redox	Redox
127	$C_4H_5F_5$	R365 - Pentafluorbutane	**161**	$C_4H_{10}S$	TBM (tert-Butyl mercaptan)
128	$C_5H_{10}O_3$	Ethyl lactate	**162**	HBr	Hydrogen bromide
129	NH_4+	Ammonium			
130	CCL_3F	R11 - Trichlorofluoromethane			
131	$C_3H_3F_5$	R245fa - Pentafluoropropane			
132	C_3H_4	Propyne			
133	CS_2	Carbon disulfide	**225**	Signal	Signal (universal)
134	BCL_3	Boron trichloride	**226**	Q	Volume flow
135	BF_3	Boron trifluoride	**227**	P	Pressure
136	CH_3Br	Bromomethane	**228**	m	Mass
137	$C_4H_{10}O$	2-Butanol	**229**	Wdir	Wind direction
138	CH_4+CO_2	Landfill gas	**253**	T	Temperature
139	$C_2H_4F_2$	R152a - Difluoroethane	**254**	Vair	Wind velocity
140	$C_4H_8O_2$	1,4-Dioxane	**255**	rH	Relative humidity

7. References

[MAPS] MODBUS Application Protocol Specification V1.1;
http://www.modbus.org

[MoSL] MODBUS over Serial Line – Specification & Implementation Guide V1.02;
http://www.modbus.org

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