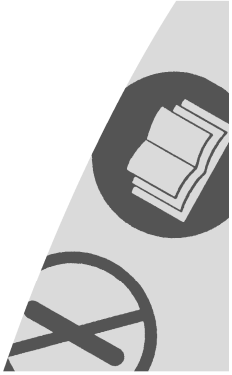
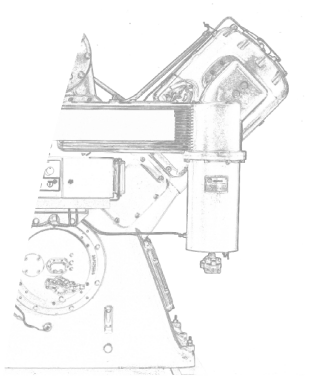
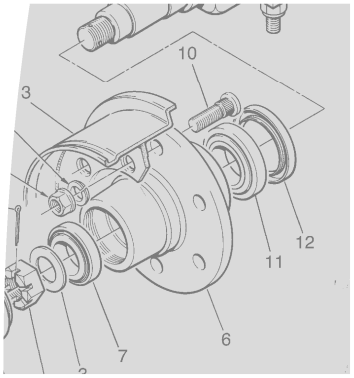
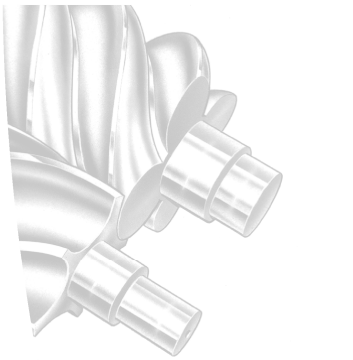
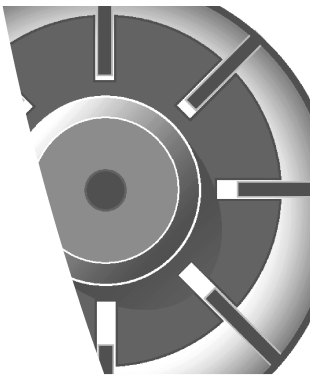
GARDNER DENVER









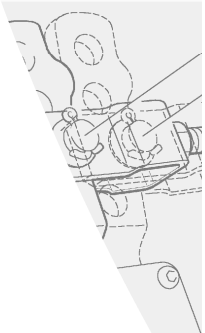


GD Connect 12
Intelligent interconnected control

Programmer guide ModBus-RTU

MODBUS

Valid for the GD Connect 12 software versions 2.1x



GB US Id. Nr. ZS1060130 / 01

Attention !

This document is only valid for the software version(s)
of the GD Connect 12 that is listed on the front page.

Subject to revision that refers to technical progress.

Table of contents

1. General ModBus specifications

1.1 Introduction for programmers

If you already know how the MODBUS RTU protocol works regarding

- Node-Adress
- Function code
- Message Data Start Adress
- Message Data
- CRC Checksum

you can skip direct to chapter "3. General information GD Connect 12".
Otherwise please read the following MODBUS informations first.

1.2 Where to find MODBUS Information on the Internet?

General information about modbus: www.modbus.org

1.3 General

The MODBUS is a protocol of master-slave type. Only one master can be used in a network: It polls individual slaves as designated in the program. The slaves answer received calls according to the protocol.

ModBus exists in two modes: ASCII and RTU (Remote Terminal Unit). All devices on a MODBUS network must working in the same mode.

The ModBus-RTU mode is to provide a flexible way of industrial machine controllers with low memory, low processor capacities and with less density on the communication network.

1.4 Communication link

MODBUS is independent of the underlying physical layer. It is traditionally implemented using RS232, RS422, or RS485 over a variety of media (fiber, radio,…). We recommend the use of the RS485 industry standard in master-slave or a network supporting up to 32 nodes.

The controller(s) will always be the slave(s) in the communication link. An appropriate master running ModBus protocol in RTU mode should be used.

1.5 Byte transfer format

ModBus-RTU runs in asynchronous serial data format. The baudrate of the GD Connect 12 interface can be adjusted in range of 2400 .. 38400 baud.

The bit sequence in the character frame is:

- 1 start bit
- 8 data bits
- 1 stop bit

1.6 Message format

General

The bytes of the ModBus-RTU message must be send in one message. The RTU mode allows only a maximum pause of 1.5 byte-times in-between 2 bytes.

The slave must answer each master message.

Basic Format

The master call has the following basic format:

The message content consists of several parts:

▪ Message destination address	1byte	
▪ Function code	1 byte	
▪ Message data start address	2 bytes	(HByte first)
▪ Message data	2 or more bytes	(HByte first)
▪ Message CRC checksum	2 bytes	(LByte first)

Attention !
L- and HBytes in the CRC are reversed in comparison with the other words.

Message Destination Address

The address designates a recipient on the MODBUS net.

Function code

The function code defines the slave operation requested – to read input values and send them to master or write the data in registers etc. Although several types of function codes are defined by ModBus. We only handle the function codes working with registers. These are:

- 03h : READING HOLDING REGISTERS
- 10h : WRITE MULTIPLE REGISTERS

Any other function codes request generates the ILLEGAL FUNCTION exception response.

Message Data Start Address

The message data start address word designates the initial address from which the data is going to be processed. The hi-byte comes before the lo-byte.

1. General ModBus specifications

Message Data

The message data content depends on the function code.

- READING HOLDING REGISTERS (03h)
  1 word for designating the size (in words) of the data zone to be processed. This is the number of word-registers to read.

- WRITE MULTIPLE REGISTERS (10h)
  1word - 1 byte - 2 words. Being 1 word for the register size, 1 byte for the number of following bytes and 2 words of data for writing 2 words to a register.

Message CRC Checksum

The CRC is a check-word generated by means of A001h polynomial.

The Cyclical Redundancy Check (CRC) field is two bytes, containing a 16-bit binary value. The CRC value is calculated by the transmitting device, which appends the CRC to the message. The receiving device recalculates a CRC during receipt of the message, and compares the calculated value to the actual value it received in the CRC field. If the two values are not equal, an error results. The CRC is started by first preloading a 16-bit register to all 1's. Then a process begins of applying successive eight-bit bytes of the message to the current contents of the register. Only the eight bits of data in each character are used for generating the CRC. Start and stop bits, and the parity bit, do not apply to the CRC.

During generation of the CRC, each eight-bit character is exclusive ORed with the register contents. The result is shifted in the direction of the least significant bit (LSB), with a zero filled into the most significant bit (MSB) position. The LSB is extracted and examined. If the LSB was a 1, the register is then exclusive ORed with a preset, fixed value. If the LSB was a 0, no exclusive OR takes place. This process is repeated until eight shifts have been performed. After the last (eighth) shift, the next eight-bit character is exclusive ORed with the register's current value, and the process repeats for eight more shifts as described above. The final contents of the register, after all the characters of the message have been applied, is the CRC value.

Generating a CRC:

Step 1 Load a 16-bit register with FFFF hex (all 1's). Call this the CRC register.

Step 2 Exclusive OR the first eight-bit byte of the message with the low order byte of the 16-bit CRC register, putting the result in the CRC register.

Step 3 Store the LSB and shift the CRC register one bit to the right (toward the LSB), zerofilling the MSB. Extract and examine the stored LSB.

Step 4 ~~If the LSB is 0, repeat Step 3 (another shift).~~ If the LSB is 1, Exclusive OR the CRC register with the polynomial value A001 hex (1010 0000 0000 0001).

Step 5 Repeat Steps 3 and 4 until eight shifts have been performed. When this is done, a complete eight-bit byte will have been processed.

Step 6 Repeat Steps 2 ... 5 for the next eight-bit byte of the message. Continue doing this until all bytes have been processed.

Result: The final content of the CRC register is the CRC value.

Step 7 When the CRC is placed into the message, its upper and lower bytes must be swapped as described below.

Placing the CRC into the Message
When the 16-bit CRC (two eight-bit bytes) is transmitted in the message, the low order byte will be transmitted first, followed by the high order byte.

Note:
This discriptions above how to generate the CRC is an original text found at the ModBus-Organisation pages. We found this discription is not clear. We added the underlined text and ~~deleted~~ some words.

1.7 Message acknowledgment

The slave does not need to answer immediately, it depends on the masters 'slave response timeout' setting. Typical less than 200ms are foreseen.

If the slave device did not receive a valid message due to a communication error (parity or CRC failure), no response is returned, and the master will eventually process a timeout condition.

1.8 Message answer from slave to master

General

The format of the slave answer is similar to the call format:

- Answer slave address 1byte
- Answer function code 1 byte
- Answer data at least 2 bytes (hi-byte first)
- Answer CRC checksum 2 bytes (lo-byte first)

The address and function code fields are identical with the called ones. The message answer data depends on the requested function code. The CRC checksum is calculated as the message one.

Answer Slave Address

This is the address of the slave unit.

Answer function code

This is identical as the message one on a valid received message for the unit; otherwise an exception function code response could be generated.

The **exception code** response message has two fields that differentiate it from a normal response:

Function code (1byte):
In a normal response, the slave echoes the function code of the original query in the function code field of the response. All function codes have a most significant bit (MSB) of 0 (their values are all below 80 hexadecimal). In an exception response, the slave sets the MSB of the function code to 1. This makes the function code value in an exception response exactly 80 hexadecimal higher than the value would be for a normal response.
With the function code's MSB set the master's application program can recognize the exception response and can examine the data field for the exception code.

Data Field (1byte):
In a normal response, the slave may return any information that was requested in the query. In an exception response, the slave returns an exception code in the data field. This defines the slave condition that caused the exception.

Exception codes are:

Code	*Name*	*Description*
01h	Illegal function	The requested function code is not supported of the slave.
02h	Illegal data address	The slave does not support the requested message start address
03h	Illegal data value	The requested message data value is not supported by the slave
04h	Slave device failure	The slave could not execute the request

Answer Data

Answer on READING HOLDING REGISTERS (Function code 03h)

The answer data message consists of one byte indicating how many bytes will follow, and an even pair of the bytes with the contents of the requested register.

This is at least 3 bytes answer data: 1byte for bytecount and at least 2 bytes data packed as two bytes per register. For each register, the first byte contains the high order bits and the second contains the low order bits.

Answer on WRITE MULTIPLE REGISTERS (Function code 10h)

The normal response returns the slave address, function code, starting address, and quantity of registers preset. This is 4 bytes: 2 for address, 2 for the quantity.

Answer CRC Checksum

Is calculated on the same matter of the CRC message checksum

1.9 ModBus Troubleshooting

Problem:
No or bad response on the ModBus message

Solution:
- Check if the controller is set to the correct slave address
- Check if the controller is set to the correct baudrate
- Check if the controller is properly set for ModBus RTU protocol
- Check if the master is working in ModBus RTU mode
- Check the settings of the baudrate, paritybit and number of stopbits
- Check RS485 wiring, polarity…

Problem:
Last character of ModBus message is corrupted

Solution:
- Check all items mentioned above
- Add a delay of 1 or 2ms after last character before releasing RTS signal

Problem:
The ModBus message is reflected in the answer

Solution:
- You should use a network without echo of the TX to the RX line and vice versa

2. Gardner Denver terminal program

You will find in the ModBus-Package a terminal program to test the communication to any serial device.

Start the program and adjust the Settings field first.

- COM — Choose serial port
- Baud Rate — Choose baud rate
- Add ModBus CRC — Yes: Program calculates and adds the CRC; No: No CRC will be added
- Open Port — Opens the communication port

If port opened you can input hexadezimal numbers into Send field.

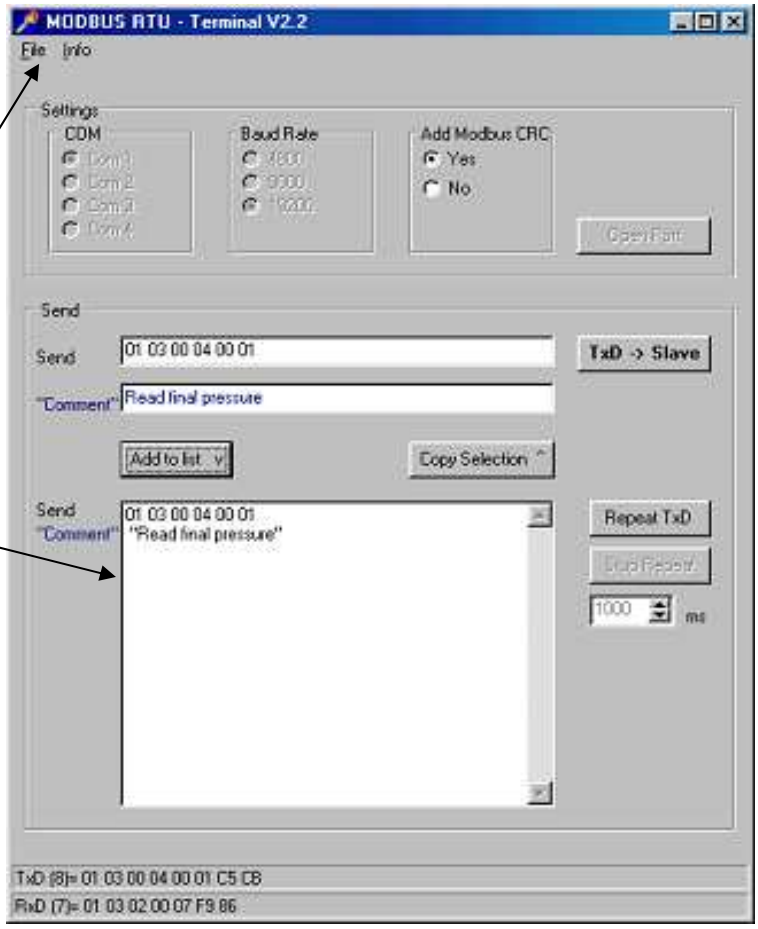
Press TxD -> Slave to send the datas. See in the status line transmitted (TxD) and received (RxD) bytes showing the number of bytes also.

Further buttons in Send field:

- Add to list — Copies the marked bytes in Send field + comments for later use into memo field.
- Copy selection — Copies the marked bytes + comment from memo field into Send field.
- Repeat TxD — Start polling with desired cycle [ms]

To save your datas in memo field please use File\Save dialog.

To load datas into memo field use File\Open dialog.



The shown hardcopy e.g. read the final pressure of adress no. 01 where the pressure is actual 0.7bar.

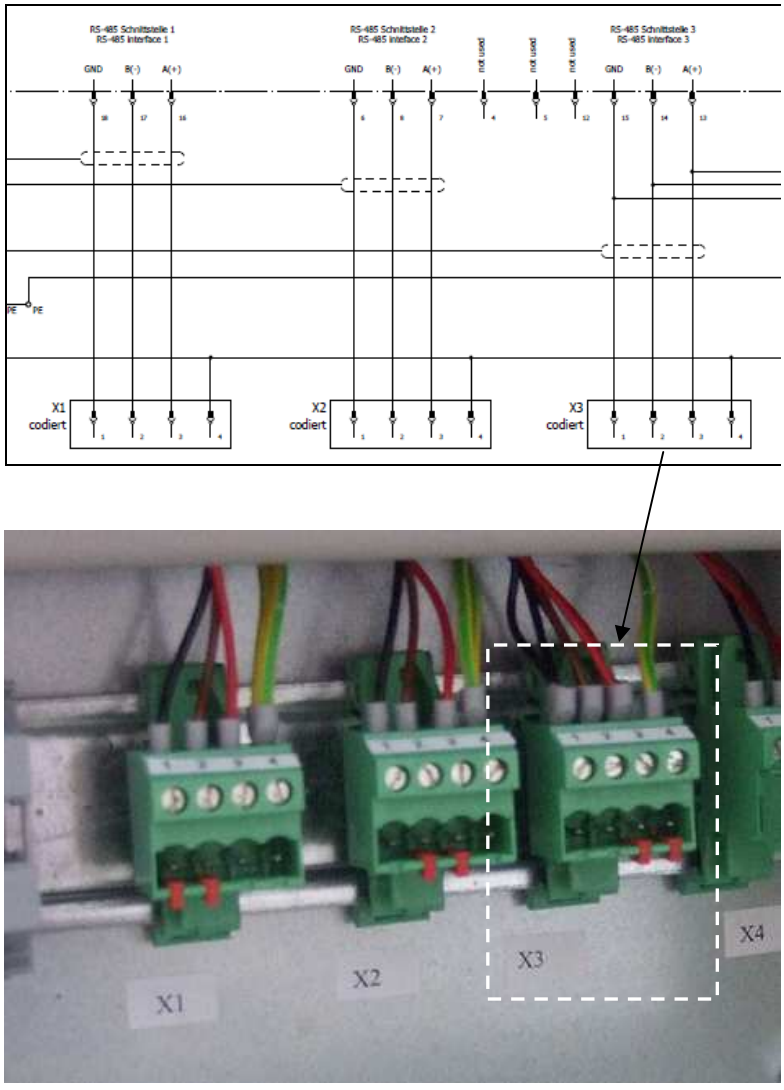
3.1 Communication Link

RS485 interface to be used on the GD Connect 12: RS485-3

RS485-3 connector in the control cabinet of the GD Connect 12:

- Pin X3,1 : GND
- Pin X3,2 : B(–)
- Pin X3,3 : A(+)
- Pin X3,4: Shield

It is sufficient to connect the controllers via a shielded twisted pair cable.



3.2 Adjust the ModBus-RTU parameters at the GD Connect 12

The values for protocol, baudrate and address of the RS485-3 interface of the GD Connect 12 are to find in the menu "Adjustments GD Connect 12" – submenu "RS485 interface".

The menu item "Protocol / module" has to be adjust to "ModBus-RTU".

See user manual how to navigate through the menus and how to adjust values in the menues.

Default settings for baudrate and address are:

- Baudrate: 9600 Adjustable range: 2400 / 4800 / 9600 / 19200 / 38400 Baud
- Address 10h Adjustable range: 10h / 20h / .. / F0h

3.3 Byte Transfer Format

Character Frame:

- 1 start bit
- 8 data bits
- 1 stop bit

3.4 Data Coding

- [Bitmask] = 8 bit UNSIGNED
- [Byte] = 8 bit UNSIGNED
- [Word] = 16 bit UNSIGNED
- [DWord] = 32 bit UNSIGNED

4. ModBus addresses GD Connect 12

4.1 Addresses for function code ”03h” / READ HOLDING REGISTERS

GD Connect 12 status register

Register:	0000h	Status GD Connect 12	[Bitmask]

Bit 0: Regulation switched on
Bit 1: Collective warning
Bit 2: Collective fault
Bit 3: Regulation active
Bit 4: (not used)
Bit 5: (not used)
Bit 6: (not used)
Bit 7: (not used)

Bit 8: Collective warning Compressors
Bit 9: Collective fault Compressors
Bit 10: Collective signal Compressor motor on
Bit 11: Collective signal Compressor On-Load
Bit 12: Collective signal Compressor off
Bit 13: (not used)
Bit 14: (not used)
Bit 15: (not used)

Explanations:

Bit 0 Indicates, if the regulation of the GD Connect 12 is switched on.

0 = Regulation switched off
The compressors are not controlled by the GD Connect 12 and operate with their internal adjustments.

1 = Regulation switched on
The regulation of the GD Connect 12 is switched on.

Bit 1 Collective signal of all warnings, that could be indicate in the installation.
Bit 2 Collective signal of all faults, that could be indicate in the installation.

Bit 3 Indicates, if the regulation of the GD Connect 12 is active.

0 = Regulation not active
The compressors are not controlled by the GD Connect 12 and operate with their internal adjustments.

Causes:
- The regulation of the GD Connect 12 is switched off (Bit 0 = 0)
- A fault of the GD Connect 12 is active (e.g. fault of the pressure sensor)

1 = Regulation active
The regulation of the GD Connect 12 is switched on and active.

Bit 8 On or several compressors are indicating a warning.
Bit 9 On or several compressors are indicating a fault.
Bit 10 On or several compressors the motor is running (On-Load or Off-Load).
Bit 11 On or several compressors are On-Load.
Bit 12 On or several compressors are switched off.

4. ModBus addresses GD Connect 12

GD Connect 12 warning and fault registers (Address range 1)

Register: 0001h Warning register 1 [Bitmask]

Bit 0: Warning Line pressure min.
Bit 1: Warning Line pressure max.
Bit 2: (not used)
Bit 3: (not used)
Bit 4: Warning Dryer 1
Bit 5: Warning Dryer 2
Bit 6: Warning Dryer 3
Bit 7: Warning Dryer 4

Bit 8: Warning Battery
Bit 9: Warning Dew point [1)]
Bit 10: (not used)
Bit 11: Warning SD card
Bit 12: Warning External
Bit 13: (not used)
Bit 14: (not used)
Bit 15: (not used)

[1)] Warning, that was caused by a **digital** input of the GD Connect 12 or an Extension module.

The warnings "Dew point 1..8" (see Warning and fault registers (Address range 2)) will be caused by an **analog** input of the GD Connect 12 or an Extension module.

Register: 0002h Warning register 2 [Bitmask]

Bit 0: Warning Filter 1
Bit 1: Warning Filter 2
Bit 2: Warning Filter 3
Bit 3: Warning Filter 4
Bit 4: Warning Bekomat 1
Bit 5: Warning Bekomat 2
Bit 6: Warning Bekomat 3
Bit 7: Warning Bekomat 4

Bit 8: Warning Extension module 1
Bit 9: Warning Extension module 2
Bit 10: Warning Extension module 3
Bit 11: Warning Extension module 4
Bit 12: (not used)
Bit 13: Warning "Signal at DI-1" [2)]
Bit 14: Warning "Signal at DI-2"
Bit 15: Warning "Signal at DI-3"

[2)] The GD Connect 12 can not assign a message that was caused by closing a digital input, because the input is programmed to the function "Free".

Register:	0003h	Warning register 3	[Bitmask]

Bit 0: Warning "Signal at DI-1 Ext.mod. 1"
Bit 1: Warning "Signal at DI-2 Ext.mod. 1"
Bit 2: Warning "Signal at DI-3 Ext.mod. 1"
Bit 3: Warning "Signal at DI-4 Ext.mod. 1"
Bit 4: Warning "Signal at DI-5 Ext.mod. 1"
Bit 5: Warning "Signal at DI-6 Ext.mod. 1"
Bit 6: Warning "Signal at DI-7 Ext.mod. 1"
Bit 7: Warning "Signal at DI-8 Ext.mod. 1"

Bit 8: Warning "Signal at DI-1 Ext.mod. 2"
Bit 9: Warning "Signal at DI-2 Ext.mod. 2"
Bit 10: Warning "Signal at DI-3 Ext.mod. 2"
Bit 11: Warning "Signal at DI-4 Ext.mod. 2"
Bit 12: Warning "Signal at DI-5 Ext.mod. 2"
Bit 13: Warning "Signal at DI-6 Ext.mod. 2"
Bit 14: Warning "Signal at DI-7 Ext.mod. 2"
Bit 15: Warning "Signal at DI-8 Ext.mod. 2"

Register:	0004h	Warning register 4	[Bitmask]

Bit 0: Warning "Signal at DI-1 Ext.mod. 3"
Bit 1: Warning "Signal at DI-2 Ext.mod. 3"
Bit 2: Warning "Signal at DI-3 Ext.mod. 3"
Bit 3: Warning "Signal at DI-4 Ext.mod. 3"
Bit 4: Warning "Signal at DI-5 Ext.mod. 3"
Bit 5: Warning "Signal at DI-6 Ext.mod. 3"
Bit 6: Warning "Signal at DI-7 Ext.mod. 3"
Bit 7: Warning "Signal at DI-8 Ext.mod. 3"

Bit 8: Warning "Signal at DI-1 Ext.mod. 4"
Bit 9: Warning "Signal at DI-2 Ext.mod. 4"
Bit 10: Warning "Signal at DI-3 Ext.mod. 4"
Bit 11: Warning "Signal at DI-4 Ext.mod. 4"
Bit 12: Warning "Signal at DI-5 Ext.mod. 4"
Bit 13: Warning "Signal at DI-6 Ext.mod. 4"
Bit 14: Warning "Signal at DI-7 Ext.mod. 4"
Bit 15: Warning "Signal at DI-8 Ext.mod. 4"

Register:	0005h	Fault register	[Bitmask]

Bit 0: Internal fault Analog Input
Bit 1: (not used)
Bit 2: (not used)
Bit 3: (not used)
Bit 4: (not used)
Bit 5: (not used)
Bit 6: (not used)
Bit 7: (not used)

Bit 8: Fault VSD module
Bit 9: (not used)
Bit 10: (not used)
Bit 11: (not used)
Bit 12: (not used)
Bit 13: (not used)
Bit 14: (not used)
Bit 15: (not used)

Futher warning and fault registers see "GD Connect 12 warning and fault registers (Address range 2)" from register 00D6h.

4. ModBus addresses GD Connect 12

Measured values GD Connect 12

Register:	0006h	Line pressure 1	(1/10 bar)	[Word]
	0007h	Line pressure 2	(1/10 bar)	[Word]
	0008h	Volume flow	(1/10 m³/min)	[Word]

Explanations:

Line pressure 1: Line pressure at the analog input AI-1 of the GD Connect 12
Line pressure 2: Line pressure at the analog input AI-2 of the GD Connect 12

Volume flow: The volume flow which is used to regulate the compressors.
This could be assigned to of the volume flow 1..8
or could be calculated on the basis of the line pressure gradient.

Compressor status registers

Register:	0009h	Bit 0-7: Status Compressor 2	[Byte]
		Bit 8-15: Status Compressor 1	[Byte]

1 = Compressor is loaded
2 = Compressor is running
3 = Compressor is blowing down
4 = Compressor is in standby
5 = Compressor is switched off
6 = Compressor has a fault
7 = Compressor is set to maintenance
8 = The communication to the compressor has a fault
9 = Software update necessary

	000Ah	Bit 0-7: Status Compressor 4	[Byte]
		Bit 8-15: Status Compressor 3	[Byte]
	000Bh	Bit 0-7: Status Compressor 6	[Byte]
		Bit 8-15: Status Compressor 5	[Byte]
	000Ch	Bit 0-7: Status Compressor 8	[Byte]
		Bit 8-15: Status Compressor 7	[Byte]
	000Dh	Bit 0-7: Status Compressor 10	[Byte]
		Bit 8-15: Status Compressor 9	[Byte]
	000Eh	Bit 0-7: Status Compressor 12	[Byte]
		Bit 8-15: Status Compressor 11	[Byte]

Compressor warning registers

Register:	000Fh	Warnings compressor 1	[Bitmask]
		Bit 0: Compressor warning or service	
		Bit 1: (not used)	
		Bit 2 Warning Remote load	
		Bit 3: Warning Remote off-load	
		Bit 4: (not used)	
		Bit 5: (not used)	
		Bit 6: (not used)	
		Bit 7: (not used)	
		Warnings compressor 2	[Bitmask]
		Bit 8: Compressor warning or service	
		Bit 9: (not used)	
		Bit 10 Warning Remote load	
		Bit 11: Warning Remote off-load	
		Bit 12: (not used)	
		Bit 13: (not used)	
		Bit 14: (not used)	
		Bit 15: (not used)	
	0010h	Bit 0-7: Warnings compressor 3	[Bitmask]
		Bit 8-15: Warnings compressor 4	[Bitmask]
	0011h	Bit 0-7: Warnings compressor 5	[Bitmask]
		Bit 8-15: Warnings compressor 6	[Bitmask]
	0012h	Bit 0-7: Warnings compressor 7	[Bitmask]
		Bit 8-15: Warnings compressor 8	[Bitmask]
	0013h	Bit 0-7: Warnings compressor 9	[Bitmask]
		Bit 8-15: Warnings compressor 10	[Bitmask]
	0014h	Bit 0-7: Warnings compressor 11	[Bitmask]
		Bit 8-15: Warnings compressor 12	[Bitmask]

Explanations:

"Warning Remote load"
The compressor 1 was switched to load, but there is no appropriate feedback.

"Warning Remote off-load"
The compressor 1 was switched to off-load, but there is no appropriate feedback.

Compressor percentage load

Register:				
	0015h	Bit 0-7 Percentage load compressor 2	(%)	[Byte]
		Bit 8-15: Percentage load compressor 1	(%)	[Byte]
	0016h	Bit 0-7: Percentage load compressor 4	(%)	[Byte]
		Bit 8-15: Percentage load compressor 3	(%)	[Byte]
	0017h	Bit 0-7: Percentage load compressor 6	(%)	[Byte]
		Bit 8-15: Percentage load compressor 5	(%)	[Byte]
	0018h	Bit 0-7: Percentage load compressor 8	(%)	[Byte]
		Bit 8-15: Percentage load compressor 7	(%)	[Byte]
	0019h	Bit 0-7: Percentage load compressor 10	(%)	[Byte]
		Bit 8-15: Percentage load compressor 9	(%)	[Byte]
	001Ah	Bit 0-7: Percentage load compressor 12	(%)	[Byte]
		Bit 8-15: Percentage load compressor 11	(%)	[Byte]

Current profile

Register:				
	001Bh	Current profile / Activated by		[Byte]
		Bit 0..7: Active Profile (1..12) 0 = Air station off by timer control		
		Bit 8: Activated by timer control		[Bitmask]
		Bit 9: Activated by digital input		
		Bit 10: Activated by RS485 interface		
		Bit 11..15: (not used)		
	001Ch	Bit 0-7: Max. pressure	(1/10 bar)	[Byte]
		Bit 8-15: Max. pressure warning	(1/10 bar)	[Byte]
	001Dh	Bit 0-7: Min. pressure warning	(1/10 bar)	[Byte]
		Bit 8-15: Min. pressure	(1/10 bar)	[Byte]
	001Eh	Receiver volume	(1/10 m^3)	[Word]
	001Fh	Priorities compressor 1..4		[Bitmask]
		Bit 0: Priority compressor 1 = High		
		Bit 1: Priority compressor 1 = Normal		
		Bit 2: Priority compressor 1 = Low		
		Bit 3: Priority compressor 1 = Off		
		Bit 4: Priority compressor 2 = High		
		Bit 5: Priority compressor 2 = Normal		
		Bit 6: Priority compressor 2 = Low		
		Bit 7: Priority compressor 2 = Off		
		Bit 8: Priority compressor 3 = High		
		Bit 9: Priority compressor 3 = Normal		
		Bit 10: Priority compressor 3 = Low		
		Bit 11: Priority compressor 3 = Off		
		Bit 12: Priority compressor 4 = High		
		Bit 13: Priority compressor 4 = Normal		
		Bit 14: Priority compressor 4 = Low		
		Bit 15: Priority compressor 4 = Off		
	0020h	Priorities compressor 5..8		[Bitmask]
	0021h	Priorities compressor 9..12		[Bitmask]

Compressor relative hours

Register:	0022h	Compressor 1 Relative total hours	[Word]
	0023h	Compressor 1 Relative load hours	[Word]
	0024h	Compressor 2 Relative total hours	[Word]
	0025h	Compressor 2 Relative load hours	[Word]
	0026h	Compressor 3 Relative total hours	[Word]
	0027h	Compressor 3 Relative load hours	[Word]
	0028h	Compressor 4 Relative total hours	[Word]
	0029h	Compressor 4 Relative load hours	[Word]
	002Ah	Compressor 5 Relative total hours	[Word]
	002Bh	Compressor 5 Relative load hours	[Word]
	002Ch	Compressor 6 Relative total hours	[Word]
	002Dh	Compressor 6 Relative load hours	[Word]
	002Eh	Compressor 7 Relative total hours	[Word]
	002Fh	Compressor 7 Relative load hours	[Word]
	0030h	Compressor 8 Relative total hours	[Word]
	0031h	Compressor 8 Relative load hours	[Word]
	0032h	Compressor 9 Relative total hours	[Word]
	0033h	Compressor 9 Relative load hours	[Word]
	0034h	Compressor 10 Relative total hours	[Word]
	0035h	Compressor 10 Relative load hours	[Word]
	0036h	Compressor 11 Relative total hours	[Word]
	0037h	Compressor 11 Relative load hours	[Word]
	0038h	Compressor 12 Relative total hours	[Word]
	0039h	Compressor 12 Relative load hours	[Word]

Explanations:

These are the total and loaded hours since a user-specified time.

Thus it can be seen as the time since this newly added operating hours of the GD Connect 12 to individual compressors have been distributed.

The relative hours can be reseted at the panel of the GD Connect 12 or by the ModBus communication (see chapter 3.6).

Compressor absolute hours

Register:	003Ah	Compressor 1 Absolute total hours	[Word]
	003Bh	Compressor 1 Absolute load hours	[Word]
	003Ch	Compressor 2 Absolute total hours	[Word]
	003Dh	Compressor 2 Absolute load hours	[Word]
	003Eh	Compressor 3 Absolute total hours	[Word]
	003Fh	Compressor 3 Absolute load hours	[Word]
	0040h	Compressor 4 Absolute total hours	[Word]
	0041h	Compressor 4 Absolute load hours	[Word]
	0042h	Compressor 5 Absolute total hours	[Word]
	0043h	Compressor 5 Absolute load hours	[Word]
	0044h	Compressor 6 Absolute total hours	[Word]
	0045h	Compressor 6 Absolute load hours	[Word]
	0046h	Compressor 7 Absolute total hours	[Word]
	0047h	Compressor 7 Absolute load hours	[Word]
	0048h	Compressor 8 Absolute total hours	[Word]
	0049h	Compressor 8 Absolute load hours	[Word]
	004Ah	Compressor 9 Absolute total hours	[Word]
	004Bh	Compressor 9 Absolute load hours	[Word]
	004Ch	Compressor 10 Absolute total hours	[Word]
	004Dh	Compressor 10 Absolute load hours	[Word]
	004Eh	Compressor 11 Absolute total hours	[Word]
	004Fh	Compressor 11 Absolute load hours	[Word]
	0050h	Compressor 12 Absolute total hours	[Word]
	0051h	Compressor 12 Absolute load hours	[Word]

Explanations:

These are the total and loaded hours as they are listed in the compressor controls.

Statistics

Register:	0052h	Total delivered volume	(m³)	[DWord]
	0054h	Line pressure* max.	(1/10 bar)	[Word]
	0055h	Line pressure* min.	(1/10 bar)	[Word]
		* Line pressure, on which the GD Connect 12 is regulating to.		
	0056h	Volume flow max.	(1/10 m³/min)	[Word]
	0057h	Volume flow min.	(1/10 m³/min)	[Word]

The statistics can be reseted at the panel of the GD Connect 12 or by the ModBus communication (see chapter 3.6).

GD Connect 12 software version

Register:	0058h	Bit 0-7: ASCII character "A"	[Byte]
		Bit 8-15: ASCII character "S"	[Byte]
	0059h	Bit 0-7: ASCII character "_"	[Byte]
		Bit 8-15: ASCII character "M"	[Byte]
	005Ah	Bit 0-7: Version (e.g. 1.00)	[Byte]
		Bit 8-15: ASCII character "V"	[Byte]
	005Bh	Bit 0-7: Revision (e.g. 1.00)	[Byte]
		Bit 8-15: (not used)	[Byte]

Compressor informations

Register: 0060h Compressor 1: Control [Word]

1 =	Compressor module (STD)	24 =	GD Pilot MK (ESM)
2 =	Compressor module (VSD)	31 =	GD Pilot (ESM)
3 =	DELCOS 1000	33 =	GD Pilot (VS)
4 =	DELCOS 3100-L	41 =	GD Pilot MK (VS)
5 =	DELCOS 3100-LSR		
6 =	DELCOS 3100-LRS		
7 =	DELCOS 3100-DH		
8 =	DELCOS 3100-DHSR		
9 =	DELCOS 3100-DHRS		
10 =	DELCOS 3100-R		
11 =	DELCOS Pro-L		
12 =	DELCOS Pro-LSR		
13 =	DELCOS Pro-LRS		
14 =	DELCOS XL-L		
16 =	DELCOS XL-LRS		
21 =	DELCOS 3100-LRS (V2)		

0061h	Compressor 1: Volume flow max.	(1/10 m³/min)	[Word]
0062h	Compressor 1: Volume flow min.	(1/10 m³/min)	[Word]
0063h	Compressor 1: Volume flow current	(1/10 m³/min)	[Word]

0064h .. 0067h	Compressor 2
0068h .. 006Bh	Compressor 3
006Ch .. 006Fh	Compressor 4
0070h .. 0073h	Compressor 5
0074h .. 0077h	Compressor 6
0078h .. 007Bh	Compressor 7
007Ch .. 007Fh	Compressor 8
0080h .. 0083h	Compressor 9
0084h .. 0087h	Compressor 10
0088h .. 008Bh	Compressor 11
008Ch .. 008Fh	Compressor 12

Measured values GD Connect 12 / Extension modules

Register:				
	0090h	Line pressure 3	(1/10 bar)	[Word]
	0091h	Line pressure 4	(1/10 bar)	[Word]
	0092h	Line pressure 5	(1/10 bar)	[Word]
	0093h	Line pressure 6	(1/10 bar)	[Word]
	0094h	Line pressure 7	(1/10 bar)	[Word]
	0095h	Line pressure 8	(1/10 bar)	[Word]
	0096h	Volume flow 1	(1/10 m³/min)	[Word]
	0097h	Volume flow 2	(1/10 m³/min)	[Word]
	0098h	Volume flow 3	(1/10 m³/min)	[Word]
	0099h	Volume flow 4	(1/10 m³/min)	[Word]
	009Ah	Volume flow 5	(1/10 m³/min)	[Word]
	009Bh	Volume flow 6	(1/10 m³/min)	[Word]
	009Ch	Volume flow 7	(1/10 m³/min)	[Word]
	009Dh	Volume flow 8	(1/10 m³/min)	[Word]
	009Eh	Temperature 1	(°C)	[Word]
	009Fh	Temperature 2	(°C)	[Word]
	00A0h	Temperature 3	(°C)	[Word]
	00A1h	Temperature 4	(°C)	[Word]
	00A2h	Temperature 5	(°C)	[Word]
	00A3h	Temperature 6	(°C)	[Word]
	00A4h	Temperature 7	(°C)	[Word]
	00A5h	Temperature 8	(°C)	[Word]
	00A6h	Dew point 1	(°C)	[Word]
	00A7h	Dew point 2	(°C)	[Word]
	00A8h	Dew point 3	(°C)	[Word]
	00A9h	Dew point 4	(°C)	[Word]
	00AAh	Dew point 5	(°C)	[Word]
	00ABh	Dew point 6	(°C)	[Word]
	00ACh	Dew point 7	(°C)	[Word]
	00ADh	Dew point 8	(°C)	[Word]

Menu "Regulation"

Register:				
	00AEh	Suppress warning Pmin	(min)	[Word]
	00AFh	Bit 0-7: Cut-out delay	(s)	[Byte]
		Bit 8-15: Cut-in delay	(s)	[Byte]
	00B0h	Bit 0-7: Compens. total hours		[Byte]
		0 = Absolute		
		1 = Relative		
		Bit 8-15: (not used)		[Byte]
	00B1h	Bit 0-7: Determinate volume flow		[Byte]
		0 = Line pressure		
		1 = Volumen flow 1		
		2 = Volumen flow 2		
		3 = Volumen flow 3		
		4 = Volumen flow 4		
		5 = Volumen flow 5		
		6 = Volumen flow 6		
		7 = Volumen flow 7		
		8 = Volumen flow 8		
		Bit 8-15: Regulate pressure to		[Byte]
		0 = Line pressure 1		
		1 = Line pressure 2		
		2 = Max. pressure		
		3 = Min. pressure		

Menu "Timer control"

Register:			
	00B2h	Bit 0-7: Channel 1: Day of week	[Bitmask]
		Bit 0: Monday	
		Bit 1: Tuesday	
		Bit 2: Wednesday	
		Bit 3: Thursday	
		Bit 4: Friday	
		Bit 5: Saturday	
		Bit 6: Sunday	
		Bit 7: (not used)	
		Bit 8-15: Channel 1: Profile	[Byte]
	00B3 h	Bit 0-7: Channel 1: Switch on (minute)	[Byte]
		Bit 8-15: Channel 1: Switch on (hour)	[Byte]
	00B4 h	Bit 0-7: Channel 1: Switch off (minute)	[Byte]
		Bit 8-15: Channel 1: Switch off (hour)	[Byte]
	00B5h..00B7h	Channel 2	
	00B8h..00BAh	Channel 3	
	00BBh..00BDh	Channel 4	
	00BEh..00C0h	Channel 5	
	00C1h..00C3h	Channel 6	
	00C4h..00C6h	Channel 7	
	00C7h..00C9h	Channel 8	
	00CAh..00CCh	Channel 9	
	00CDh..00CFh	Channel 10	
	00D0h..00D2h	Channel 11	
	00D3h..00D5h	Channel 12	

GD Connect 12 warning and fault registers (Address range 2)

Register: 00D6h Warning register 5 [Bitmask]

Bit 0: Warning Temperature 1 min.
Bit 1: Warning Temperature 2 min.
Bit 2: Warning Temperature 3 min.
Bit 3: Warning Temperature 4 min.
Bit 4: Warning Temperature 5 min.
Bit 5: Warning Temperature 6 min.
Bit 6: Warning Temperature 7 min.
Bit 7: Warning Temperature 8 min.

Bit 8: Warning Temperature 1 max.
Bit 9: Warning Temperature 2 max.
Bit 10: Warning Temperature 3 max.
Bit 11: Warning Temperature 4 max.
Bit 12: Warning Temperature 5 max.
Bit 13: Warning Temperature 6 max.
Bit 14: Warning Temperature 7 max.
Bit 15: Warning Temperature 8 max.

Register: 00D7h Warning register 6 [Bitmask]

Bit 0: Warning Dew point 1
Bit 1: Warning Dew point 2
Bit 2: Warning Dew point 3
Bit 3: Warning Dew point 4
Bit 4: Warning Dew point 5
Bit 5: Warning Dew point 6
Bit 6: Warning Dew point 7
Bit 7: Warning Dew point 8

Bit 8-15: (not used)

Register: 00D8h Warning register 7 [Bitmask]

Bit 0: Warning Line pressure 1 min.
Bit 1: Warning Line pressure 2 min.
Bit 2: Warning Line pressure 3 min.
Bit 3: Warning Line pressure 4 min.
Bit 4: Warning Line pressure 5 min.
Bit 5: Warning Line pressure 6 min.
Bit 6: Warning Line pressure 7 min.
Bit 7: Warning Line pressure 8 min.

Bit 8: Warning Line pressure 1 max.
Bit 9: Warning Line pressure 2 max.
Bit 10: Warning Line pressure 3 max.
Bit 11: Warning Line pressure 4 max.
Bit 12: Warning Line pressure 5 max.
Bit 13: Warning Line pressure 6 max.
Bit 14: Warning Line pressure 7 max.
Bit 15: Warning Line pressure 8 max.

Register:	00D9h	Warning register 8	[Bitmask]

Bit 0: Warning Sensor Line pressure 1
Bit 1: Warning Sensor Line pressure 2
Bit 2: Warning Sensor Line pressure 3
Bit 3: Warning Sensor Line pressure 4
Bit 4: Warning Sensor Line pressure 5
Bit 5: Warning Sensor Line pressure 6
Bit 6: Warning Sensor Line pressure 7
Bit 7: Warning Sensor Line pressure 8

Bit 8: Warning Sensor Volume flow 1
Bit 9: Warning Sensor Volume flow 2
Bit 10: Warning Sensor Volume flow 3
Bit 11: Warning Sensor Volume flow 4
Bit 12: Warning Sensor Volume flow 5
Bit 13: Warning Sensor Volume flow 6
Bit 14: Warning Sensor Volume flow 7
Bit 15: Warning Sensor Volume flow 8

Register:	00DAh	Warning register 9	[Bitmask]

Bit 0: Warning Sensor Temperature 1
Bit 1: Warning Sensor Temperature 2
Bit 2: Warning Sensor Temperature 3
Bit 3: Warning Sensor Temperature 4
Bit 4: Warning Sensor Temperature 5
Bit 5: Warning Sensor Temperature 6
Bit 6: Warning Sensor Temperature 7
Bit 7: Warning Sensor Temperature 8

Bit 8: Warning Sensor Dew point 1
Bit 9: Warning Sensor Dew point 2
Bit 10: Warning Sensor Dew point 3
Bit 11: Warning Sensor Dew point 4
Bit 12: Warning Sensor Dew point 5
Bit 13: Warning Sensor Dew point 6
Bit 14: Warning Sensor Dew point 7
Bit 15: Warning Sensor Dew point 8

Register:	00DBh	Warning register 10	[Bitmask]

Bit 0: Warning Dryer 5
Bit 1: Warning Dryer 6
Bit 2: Warning Dryer 7
Bit 3: Warning Dryer 8
Bit 4: Warning Dryer 9
Bit 5: Warning Dryer 10
Bit 6: Warning Dryer 11
Bit 7: Warning Dryer 12

Bit 8: Warning Filter 5
Bit 9: Warning Filter 6
Bit 10: Warning Filter 7
Bit 11: Warning Filter 8
Bit 12: Warning Filter 9
Bit 13: Warning Filter 10
Bit 14: Warning Filter 11
Bit 15: Warning Filter 12

Register:	00DCh	Warning register 11	[Bitmask]

Bit 0: Warning Bekomat 5
Bit 1: Warning Bekomat 6
Bit 2: Warning Bekomat 7
Bit 3: Warning Bekomat 8
Bit 4: Warning Bekomat 9
Bit 5: Warning Bekomat 10
Bit 6: Warning Bekomat 11
Bit 7: Warning Bekomat 12

Bit 8: (not used)
Bit 9: (not used)
Bit 10: (not used)
Bit 11: (not used)
Bit 12: (not used)
Bit 13: (not used)
Bit 14: (not used)
Bit 15: (not used)

Register:	00DDh	Fault register 2	[Bitmask]

Bit 0: Fault Sensor Line pressure 1
Bit 1: Fault Sensor Line pressure 2
Bit 2: (not used)
Bit 3: (not used)
Bit 4: (not used)
Bit 5: (not used)
Bit 6: (not used)
Bit 7: (not used)

Bit 8: Fault Sensor Volume flow 1
Bit 9: Fault Sensor Volume flow 2
Bit 10: Fault Sensor Volume flow 3
Bit 11: Fault Sensor Volume flow 4
Bit 12: Fault Sensor Volume flow 5
Bit 13: Fault Sensor Volume flow 6
Bit 14: Fault Sensor Volume flow 7
Bit 15: Fault Sensor Volume flow 8

Register:	00DEh	Fault register 5 Bit 0-15: (not used)	[Bitmask]

Register:	00DFh	Fault register 6 Bit 0-15: (not used)	[Bitmask]

Explanations:

Warning Sensor:
The failure of the sensor has not caused a deactivation of the regulation of the compressors by the GD Connect 12, i.e. the compressors will continue to be regualted by the GD Connect 12.

Fault Sensor:
The failure of the sensor has caused a deactivation of the regulation of the compressors by the GD Connect 12, i.e. the compressors will run with their internal settings.

Menu "Profiles"

Register:				
	00E0h	Bit 0-7: Profile 1: Max. pressure	(1/10 bar)	[Byte]
		Bit 8-15: Profile 1: Max. pressure warning	(1/10 bar)	[Byte]
	00E1h	Bit 0-7: Profile 1: Min. pressure warning	(1/10 bar)	[Byte]
		Bit 8-15: Profile 1: Min. pressure	(1/10 bar)	[Byte]
	00E2h	Profile 1: Receiver volume	(1/10 m³)	[Word]
	00E3h	Priorities compressor 1..4		[Bitmask]

Bit 0:	Priority compressor 1	= High
Bit 1:	Priority compressor 1	= Normal
Bit 2:	Priority compressor 1	= Low
Bit 3:	Priority compressor 1	= Off
Bit 4:	Priority compressor 2	= High
Bit 5:	Priority compressor 2	= Normal
Bit 6:	Priority compressor 2	= Low
Bit 7:	Priority compressor 2	= Off
Bit 8:	Priority compressor 3	= High
Bit 9:	Priority compressor 3	= Normal
Bit 10:	Priority compressor 3	= Low
Bit 11:	Priority compressor 3	= Off
Bit 12:	Priority compressor 4	= High
Bit 13:	Priority compressor 4	= Normal
Bit 14:	Priority compressor 4	= Low
Bit 15:	Priority compressor 4	= Off

00E4h	Priorities compressor 5..8	[Bitmask]
00E5h	Priorities compressor 9..12	[Bitmask]

00E6h..00EBh	Profile 2
00ECh..00F1h	Profile 3
00F2h..00F7h	Profile 4
00F8h..00FBh	Profile 5
00FCh..0103h	Profile 6
0104h..0109h	Profile 7
010Ah..010Fh	Profile 8
0110h..0115h	Profile 9
0116h..011Bh	Profile 10
011Ch..0121h	Profile 11
0122h..0127h	Profile 12

Current system time

Register:	0138h	Bit 0-7: Day	[Byte]
		Bit 8-15: Day of week (0 = Monday .. 6 = Sunday)	[Byte]
	0139h	Bit 0-7: Year	[Byte]
		Bit 8-15: Month	[Byte]
	013Ah	Bit 0-7: Minute	[Byte]
		Bit 8-15: Hour	[Byte]
	013Bh	Bit 0-7: (not used)	[Byte]
		Bit 8-15: Second	[Byte]

Reset time relative operating hours

Register:	0140h	Bit 0-7: Month	[Byte]
		Bit 8-15: Day	[Byte]
	0141h	Bit 0-7: Hour	[Byte]
		Bit 8-15: Year	[Byte]
	0142h	Bit 0-7: Minute	[Byte]
		Bit 8-15: (Not used)	[Byte]

Reset time statistics

Register:	0143h	Bit 0-7: Month	[Byte]
		Bit 8-15: Day	[Byte]
	0144h	Bit 0-7: Hour	[Byte]
		Bit 8-15: Year	[Byte]
	0145h	Bit 0-7: Minute	[Byte]
		Bit 8-15: (not used)	[Byte]

Measured values compressors

Compressor 1

Register:	0160h	Line Pressure		(mbar)	[Word]
	0161h	Final Pressure	(1.Stufe)	(mbar)	[Word]
	0162h	Final Temperature	(1.Stufe)	(℃)	[Word]
	0163h	Final Pressure	2.Stufe	(mbar)	[Word]
	0164h	Final Temperature	2.Stufe	(℃)	[Word]
	0165h	Line Temperature		(℃)	[Word]
	0166h	Oil Pressure		(mbar)	[Word]
	0167h	Oil Temperature		(℃)	[Word]
	0168h	Cooling water temperature Inlet		(℃)	[W ord]
	0169h	Cooling water temperature Outlet		(℃)	[Word]
	016Ah	Heatsink temperature Frequenzy convert. (1.Stufe)		(℃)	[Word]
	016Bh	Heatsink temperature Frequenzy convert. 2.Stufe		(℃)	[Word]
	016Ch	(not used)			
	016Dh	(not used)			
	016Eh	(not used)			
	016Fh	(not used)			

Compressor 2	Register 0170h … 017Fh
Compressor 3	Register 0180h ... 018Fh
Compressor 4	Register 0190h … 019Fh
Compressor 5	Register 01A0h … 01AFh
Compressor 6	Register 01B0h … 01BFh
Compressor 7	Register 01C0h … 01CFh
Compressor 8	Register 01D0h … 01DFh
Compressor 9	Register 01E0h … 01EFh
Compressor 10	Register 01F0h … 01DFh
Compressor 11	Register 0200h … 020Fh
Compressor 12	Register 0210h ... 021Fh

Is a compressor in status

- Maintenance
- Fault communication
- Software update necessary

the measured values of it will be set to FFFFh.

4.2 Addresses for function code ”10h” / WRITE MULTIPLE REGISTERS

Activate profile

Register:	0000h	Profile		[Word]
		Bit 0..7:	(not used)	
		Bit 8..15:	1..12	Profile 1..12
			13	Air station off
			14	Activate timer control

This register must be updated latest all 60 seconds.

Reset datas

Register:	0001h	Reset statistic datas	[Word]

F000h Reset statistic datas

Attention !
After reset with command "F000h", this register has to be reset to the value "0000h".

	0002h	Reset relative hours	[Word]

F000h Reset relative hours

Attention !
After reset with command "F000h", this register has to be reset to the value "0000h".

	0003h	Reset warning and fault messages	[Word]

F000h Reset warning and fault messages

Attention !
After reset with command "F000h", this register has to be reset to the value "0000h".

4.3 Examples

Read line pressure 1

Request: 10 03 00 06 00 01 [CRC]

- Slave address
- Function code
- Register address
- Number registers to read
- CRC checksum

Answer: 10 03 02 00 79 [CRC]

Message data = 79h = 121 = 12,1bar

Activate profile #2

Request: 10 10 00 00 00 01 02 00 03 [CRC]

- Slave address
- Function code
- Register address
- Number registers to write
- Number bytes to write
- Profile to activate
- CRC checksum

Answer: 10 10 00 00 00 01 [CRC]

- Register address
- Numbers of registers written

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