Atlas Copco Airpower NV

ELEKTRONIKON MkIV

User Guide : Elektronikon MkIV Modbus

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00	01/08/2002	First edition	CTE
01	14/01/2003	Second edition	CTE-PDJ
		Added exception code Command Refused (07)	
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05	06/07/2005	Change AV4000 to ZH	CTE-PDJ
06	29/08/2005	Special alarms	CTE-PDJ
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Preface

This document describes how to implement a Modbus connection to the Elektronikon MkIV compressor controller network.

Table of Contents

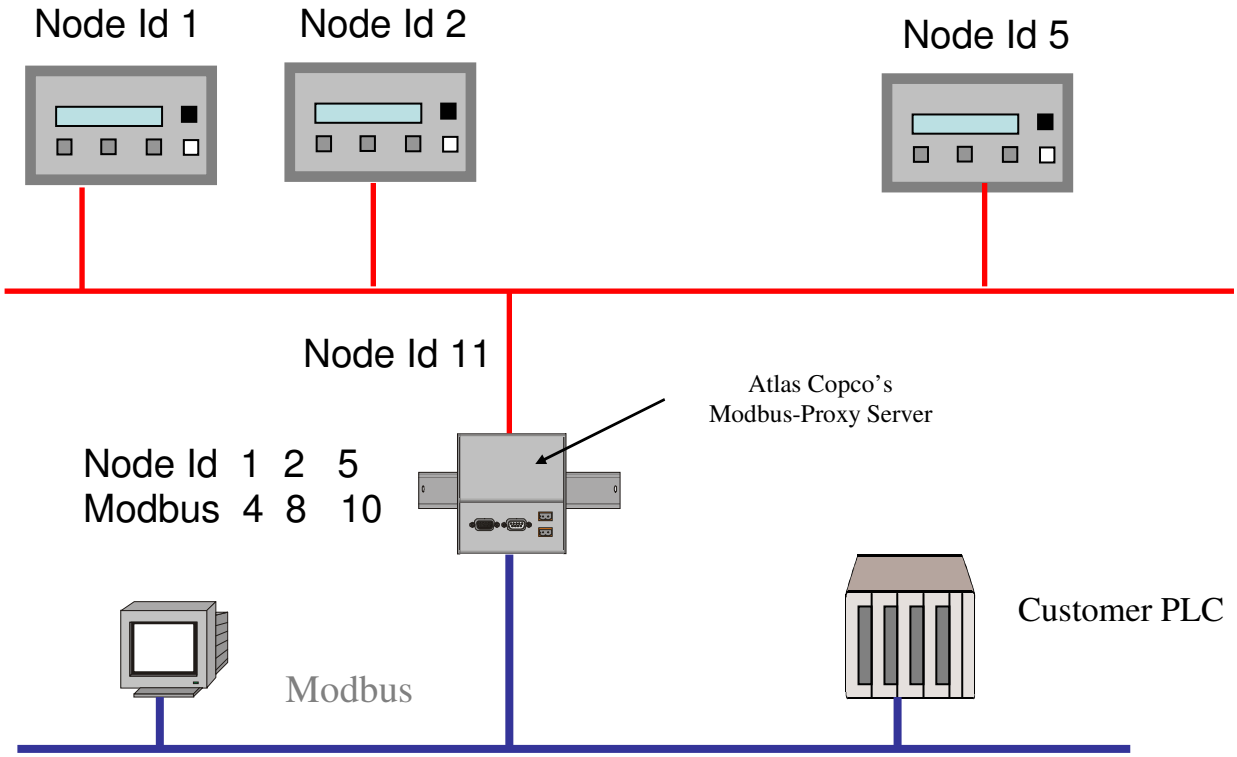
1. The Physical set-up

1.1 Modbus & the Network

In the Elektronikon MkIV system all compressors in an installation can be connected by a data and/or control network. This is done according the Compressor Network Cabling Instruction (9820 3585 00). This instruction explains what connectors and cables should be used to interconnect the different compressors/controllers in the network. Basically this is a CAN-based local network.

In order to setup a modbus connection to one or several of the compressors in this network, a special module as to be inserted in this network.

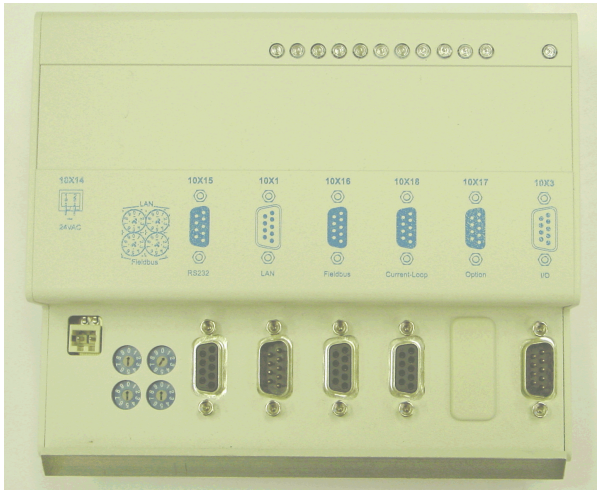
This module will then behave as a modbus-proxy that allows access to all compressors in the network, whereby each compressor has its own modbus address (proxy concept).



In this drawing the proxy is used to access the compressors with Node Id 1,2 and 5, by using the modbus addresses 4,8 and 10. (This proxy-conversion table has to be set with proper tools). The Node Id the Proxy itself if 11 on the CAN side.

1.2 The Module (Combox-S)

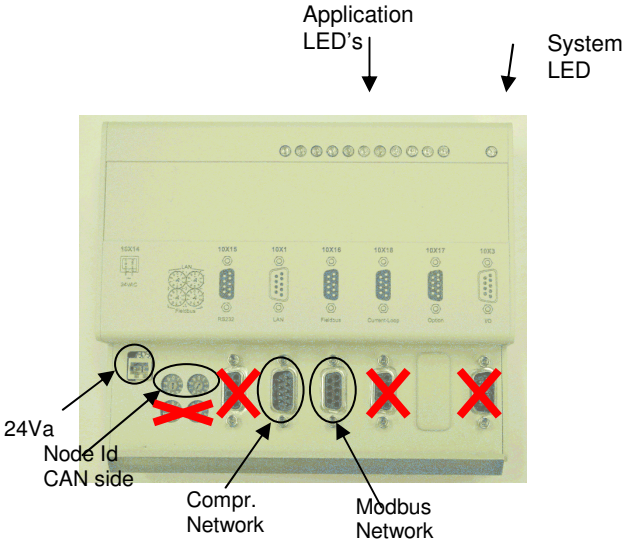
For the modbus connection a so-called Combox-S module has to be used (AC n° 19000711 41). This is a general purpose serial communication module. By downloading the correct software in it, it will perform the modbus proxy function.



Because this is a general purpose module, not all connections/switches will be used for this connection.
For modbus the following will be used

- 10x14 :
  - to connect a 24Vac supply
- 2 top address switches (LAN)
  - to set the Atlas Copco Lan address (= CAN side address !!), the Fieldbus switches are NOT used, because the Modbus addresses (proxy) are defined by software and programmed with an external (PC) software.
- 10x1:
  - to connect to the compressor network (CAN)
- 10x16 :
  - to connect the RS485 modbus line

The other connectors/switches are NOT used for this application



The module itself can be mounted on a DIN-rail inside one of the compressor cubicles, or on a separate location. Before installation check the available power of the 24Vac transformer, if connecting to an already supplied transformer inside a cubicle..

1.3 LED's

The module also has a number of LED's on type. They are used as follows :

System LED

Blinking : no program loaded or not running
Lit continuously : program running OK

Application LED's from left to right

1. not used
2. not used
3. CAN receive (Combox receives CAN message)
4. CAN transmit (Combox transmits CAN message)
5. Modbus receive (Combox receives Modbus message)
6. Modbus transmit (Combox transmits Modbus message)
7. not used
8. not used
9. not used
10. Modbus Mode
11. not used

1.4 Connector lay-out

1.4.1 Power Supply

This is a two pole Wago (type …) connector. Power supply is 24Vac, 10VA

1.4.2 LAN connector

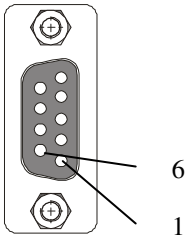
Connect here the cable of the compressor network, according AC instruction : Compressor Network Cabling Instruction (9820 3585 00).

1.4.3 Modbus connection

The module supports the RS485A variant of modbus, with the following pin-layout and termination requirements as specified

Pin Assignment Modbus

Sub-D 9 pole female

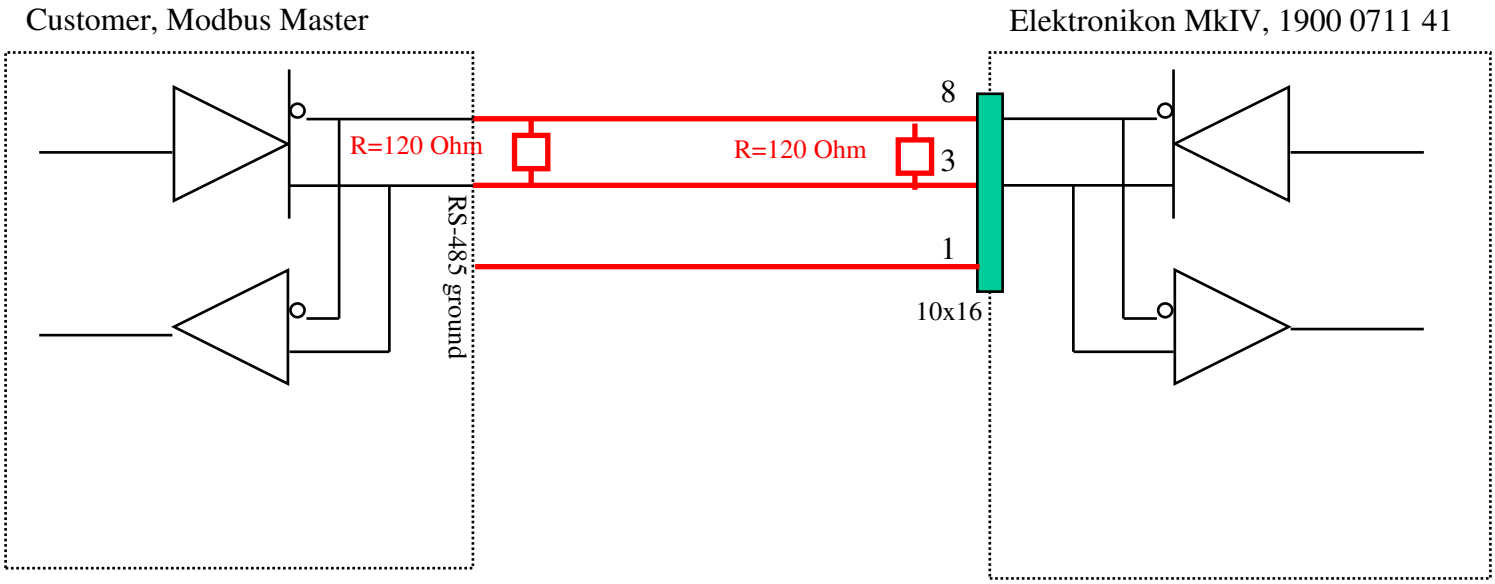


Pin	Function
1	GND
2	Reserved
3	TxD/RxD +
4	RTS
5	GND*
6	+5V*
7	Reserved
8	TxD/RxD -
9	Reserved

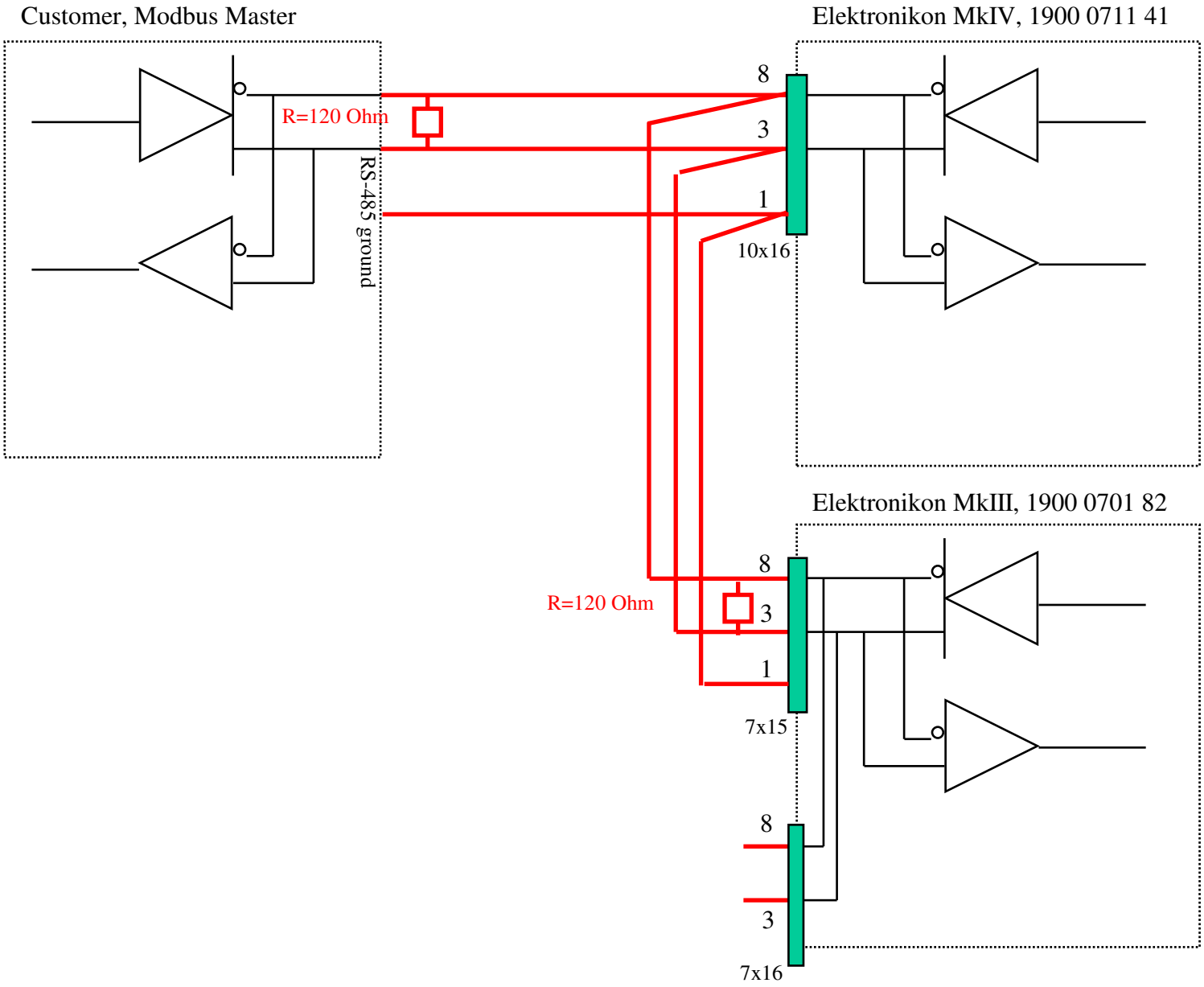
* galvanic isolated

1.5 RS485 connections

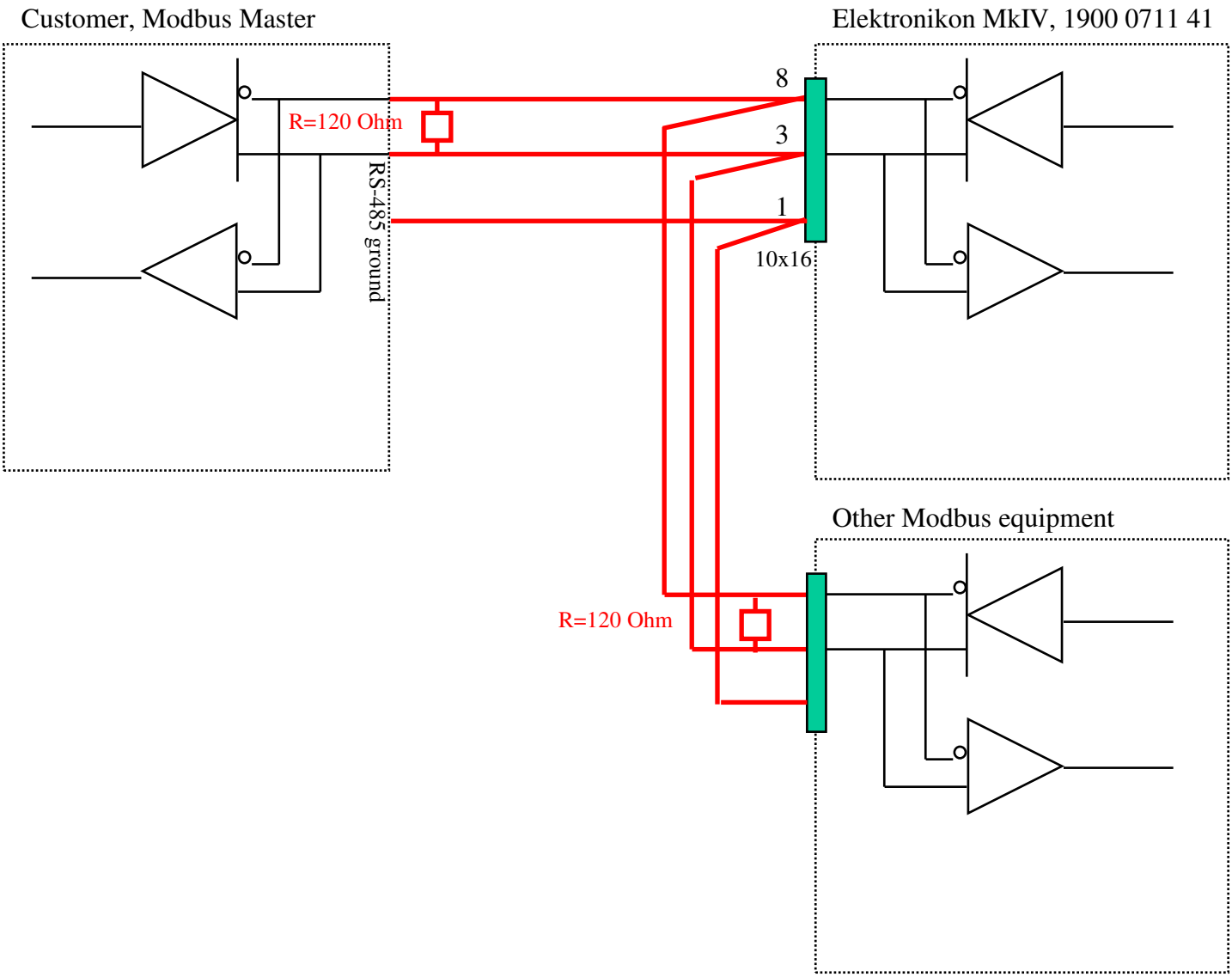
1.5.1 Modbus with MKIV



1.5.2 Modbus with MKIV and MKIII



1.5.3 Modbus with MKIV and Other Equipment



1.6 Software downloading

Before the module can be used for a modbus connection the appropriate software must be loaded. This can be done by AC Service personal with the AC Field Downloading Program (FDP). The programs/settings are available in a the Communication Devices database 1900 0712 51 (filename 1900071251_xxxx.DS4, xxxx = edition)

With this program it is also possible to program the modbus/CAN address conversions.

After programming , put power off/on of the combox-S to activate the modbusaddresses.
Before powering the Combox –S module , check all cables.

2. Modbus protocol implementation

2.1 Supported modbus specification

The Combox-S when downloaded with the proper modbus software supports the following modbus- variant

- RTU mode of transmission
- Coding system : binary
- Mode : half duplex (RS485)
- Number of start bits : 1
- Number of data bits : 8
- Baudrate : 300,600,1200,2400,4800,9600*,19200*,38400
- Parity control : even*,odd*,none *
- Number of stop bits : 1 or 2
- Error checking : CRC-16

* These parameters are defined during downloading of the controller.
Frame synchronization in the RTU mode is done by simulating a synchronous message. The slave device monitors the elapsed time between receipt of characters. If three character time elapsed without a new character, then the device assumes that the message is completed and the next byte will be the address

The message frame format is following :

T1 T2 T3	ADDRESS	Message body	CRC	T1 T2 T3

2.2 Supported Modbus functions

The Elektronikon MkIV modbus implemenentation supports the following message type , depending on the type of data involved (see details below)

Function 01 : read coil status
Function 03 : read holding register
Function 06 : preset single register
Function 08 : loop back test

2.3 Modbus registers and coils for Data Reading

2.3.1 System Overview

2.3.1.1 General Compressor Condition

Function to be used : Read Coil Status (01)

Modbus Coil	Status Information	**Load/Unload TURBO PET**	**VSD**
0001	Stopped (=0) / Running (=1)	**X**	**X**
0002	Unload (=0)/ Load (=1)	**X**	
0003	General Warning	**X**	**X**
0004	General Shutdown-Warning	**X**	**X**
0005	General Shutdown	**X**	**X**
0006	General Service	**X**	**X**
0007	General Start Failure	**X**	**X**
0008	Emergency Stop	**X**	**X**
0009	Manual (=0) /Automatic (=1)	**X**	**X**
0010	Local (=0)/ Remote (=1)	**X**	**X**

2.3.1.2 Detailed General Compressor Condition

Function to be used : Read Holding Register (03)

Modbus register (HEX)	Modbus register (DEC)	High Byte	Low Byte
191	0401	CMS	COM
192	0402	CS	CCM
193	0403	GENERAL STATUS	
194	0404	CS_MCC	ZH status
195	0405	Surge Nr(s) [9999]	
196	0406	BOV actual Position %	IGV actual Position %

Parameter	Bit Coded	
General status	0	Pre – Warning
	1	General Warning
	2	General Shutdown-Warning
	3	General Shutdown
	4	General Service
	5	General Start Failure
	6	Emergency Stop
	7	Manual/Automatic (COS1)
	8	Local/Remote
	9	Timer Not Active/Active
	10	Pre-warning Service Running Hours
	11	Pre-warning Service Accumulated M3
AV4000 Status	0	Shutdown to surge
	1	Oil heater On
	2	Oil Pump On
	3	Manual valve control active
	4	Opening IGV limited due to high motor current
	5	Regulation Type (0 = constant pressure / 1 = auto-dual)
	6	Idling Timer (0 = disabled / 1 = enabled)

CCM (Compressor Controller Mode)	CCM2a CCM2b CCM2e CCM3a CCM3b CCM3e CCM4a CCM4b CCM4c (Speed control) CCM4d (MCC) CCM4e	00 10 40 01 11 41 02 12 22 32 42	Hex
CMS (Compressor Mechanical State)	Stopped Unloaded Loaded	01 02 04	bit 0 bit 1 bit 2

2.3.1.2.1 C.C.M.

2 Local Control (Keyboard)

This mode has 2 variants
- 2a local pressure control
- 2b External Load/Unload control (Pressure Switch)
- 2e 4-20 mA external speed control

3 Remote Control (Digital)

This mode has 3 variants
- 3a local pressure control
- 3b External Load/Unload control (Pressure Switch)
- 3e 4-20 mA external speed control

4 Remote Control (Communication remote)

This mode has 5 variants
- 4a local pressure control
- 4b remote setpoint control (Control over CAN)
- 4c remote speed control (Control over CAN)
- 4d MCC (ES4i) control
- 4e 4-20 mA external speed control

2.3.1.2.2 Status for Fixed Speed , AQ Fixed Speed , ES002

STATE name	STATE Number (DEC)	Description
A	1	Compressor Off
C	3	Motor Stopped
D	4	Motor Stopped
E	5	Automatically Unloaded
F	6	Automatically Unloaded
G	7	Automatically Loaded
H	8	Manually Unloaded
I	9	Programmed Stop
J	10	Programmed Stop
K	11	Programmed Stop
L	12	Programmed Stop
M	13	Programmed Stop
N	14	Shutdown
P	16	Compressor is Starting
Q	17	Compressor is Starting
R	18	Compressor is Starting
S	19	Manually Unloaded
T	20	Unload due to overpressure
V	22	Initializing

2.3.1.2.3 Status for MCC

STATE name	STATE Number	Description
A	1	Ready for Start
B	2	Central Control Regulating
C	3	Central Control Stopped
D	4	Start Impossible

2.3.1.2.4 Status for VSD , AQ VSD , PET VSD Booster , ZB VSD

STATE name	STATE Number (DEC)	Description
A	1	Compressor Off
C	3	Motor Stopped
D	4	Motor Stopped
E	5	Motor Started
F	6	Automatically Unloaded
G	7	Automatically Speed Control
I	9	Programmed Stop
J	10	Programmed Stop
K	11	Programmed Stop
L	12	Motor Stopped
N	14	Shutdown
P	16	Compressor is Starting
Q	17	Programmed Stop
V	22	Initializing

2.3.1.2.5 Status for ZH Turbo

STATE name	STATE Number (DEC)	Description
A	1	Compressor Off
C	3	Motor Stopped
D	4	Motor Stopped
E	5	Motor Started
F	6	Automatically Unloaded
G	7	Automatically Loaded
H	8	Manually Unloaded
I	9	Programmed Stop
J	10	Programmed Stop
K	11	Programmed Stop
L	12	Programmed Stop
N	14	Shutdown
P	16	Compressor is Starting
Q	17	Programmed Stop
R	18	Compressor is Starting
S	19	Manually Unloaded
U	21	Automatic Unload due to Surge
V	22	Initializing
X	24	Minimum Load
Y	25	Full Load
Z	26	Minimum Minimum Load

2.3.1.2.6 Status for SF (Multi)

STATE name	STATE Number (DEC)	Description
A	1	**Compressor Off**
G	3	**Compressor Running**
V	22	**Initializing**

2.3.1.2.7 Status for PET Fixed Speed

STATE name	STATE Number (DEC)	Description
A	1	**Compressor Off**
C	3	**Motor Stopped**
D	4	**Motor Stopped**
E	5	**Automatically Unloaded**
F	6	**Automatically Unloaded**
G	7	**Automatically loaded 100%**
H	8	**Manually Unloaded**
I	9	**Programmed Stop**
J	10	**Programmed Stop**
K	11	**Programmed Stop**
L	12	**Programmed Stop**
M	13	**Programmed Stop**
N	14	**Shutdown**
P	16	**Compressor is Starting**
Q	17	**Compressor is Starting**
R	18	**Compressor is Starting**
S	19	**Manually Unloaded**
T	20	**Unload due to overpressure**
V	22	**Initializing**

2.3.1.2.8 Status for BD Dryer (Stand alone) AIF

STATE name	STATE Number (DEC)	Description
A	0	Stopped
A1	1	Shifting1
A2	2	Pressure relief
A3	3	Start blower
A4	4	Heating Seq 1 (main on, regulating on)
A5	5	Heating Seq 1 (main on, regulating off)
A6	6	Heating Seq 1 (main off, regulating off)
A7	7	Cooling Seq1: blower on
A8	8	Cooling Seq2: blower off
A9	9	Heating Seq 2 (main on, regulating on)
A10	10	Heating Seq 2 (main on, regulating off)
A11	11	Heating Seq 2 (main off, regulating off)
A12	12	Cooling Seq3: cooling air valve open
A13	13	Pressure equalisation
A14	14	A:Split Flow Cool / B:Split Flow Ads
A15	15	Waiting
B1	16	Shifting
B2	17	Pressure relief
B3	18	Start blower
B4	19	Heating Seq 1 (main on, regulating on)
B5	20	Heating Seq 1 (main on, regulating off)
B6	21	Heating Seq 1 (main off, regulating off)
B7	22	Cooling Seq1: blower on
B8	23	Cooling Seq2: blower off
B9	24	Heating Seq 2 (main on, regulating on)
B10	25	Heating Seq 2 (main on, regulating off)
B11	26	Heating Seq 2 (main off, regulating off)
B12	27	Cooling Seq3: cooling air valve open
B13	28	Pressure equalization
B14	29	A:Split Flow Ads / B:Split Flow Cool.
B15	30	Waiting
V	31	Recovering from power failure / Init
N	32	Shutdown
A16	33	StartingReg1
A17	34	StartingReg2
B16	35	StartingReg1
B17	36	StartingReg2
A18	37	Shifting2
A19	38	OpenRegValve
B18	39	Shifting2
B19	40	OpenRegValve

2.3.1.2.9 Status for BD Dryer (Stand alone) All

STATE name	STATE Number (DEC)	Description
A	1	Stopped / Stopped
A1	2	Shifting / Shifting
A2	3	Pressure relief / Adsorbing
A3	4	Start blower/ Adsorbing
A4	5	Start blower / Adsorbing
A5	6	Heating Seq 1 / Adsorbing
A6	7	Heating Seq 1 / Adsorbing
A7	8	Heating Seq 1 / Adsorbing
A8	9	Cooling Seq1 / Adsorbing
A9	10	Cooling Seq2 / Adsorbing
A10	11	Heating Seq 2 / Adsorbing
A11	12	Heating Seq 2 / Adsorbing
A12	13	Heating Seq 2 / Adsorbing
A13	14	Cooling Seq3 / Adsorbing
A14	15	Pressure equalisation
A15	16	A:Split Flow Cool / B:Split Flow Ads
A16	17	Waiting
A17	18	DryerStarting1 / Adsorbing
A18	19	DryerStarting2 / Adsorbing
B1	20	Shifting / Shifting
B2	21	Adsorbing / Pressure relief
B3	22	Adsorbing / Start blower
B4	23	Adsorbing / Start blower
B5	24	Adsorbing / Heating Seq 1
B6	25	Adsorbing / Heating Seq 1
B7	26	Adsorbing / Heating Seq 1
B8	27	Adsorbing / Cooling Seq1
B9	28	Adsorbing / Cooling Seq2
B10	29	Adsorbing / Heating Seq 2
B11	30	Adsorbing / Heating Seq 2
B12	31	Adsorbing / Heating Seq 2
B13	32	Adsorbing / Cooling Seq3
B14	33	Adsorbing / Pressure equalisation
B15	34	A:Split Flow Cool / B:Split Flow Ads
B16	35	Adsorbing / Waiting
B17	36	Adsorbing / DryerStarting1
B18	37	Adsorbing / DryerStarting2
N	38	Shutdown
V	39	ARAVF

2.3.1.2.10 Status for CD Dryer (Stand alone)

STATE name	STATE Number (DEC)	Description
A	1	Dryer off
A0	2	Exhaust vessel A / Shifting
A1	3	Regenerating vessel A
A2	4	Pressurizing vessel A
B0	5	Exhaust vessel B / Shifting
B1	6	Regenerating vessel B
B2	7	Pressurizing vessel B
W	8	Purge saving
V	9	Power on, checking auto restart conditions (ARAVF)

2.3.1.2.11 Status for FD-Fixed Speed & FD-VSD Dryer (Stand alone)

STATE name	STATE Number (DEC)	Description
A	1	Dryer off
C	3	Dryer stopped
E	5	Dryer starting
G	7	Dryer running
N	14	Dryer shutdown
P	16	Checking permissive start condition(s) (Dryer Starting)
V	22	Power on, checking auto restart conditions (ARAVF)

2.3.1.2.12 Status for MD-Fixed Speed Dryer (Stand alone)

STATE name	STATE Number (DEC)	Description
A	1	Dryer off
N	14	Dryer shutdown
V	22	Power on, checking auto restart conditions (ARAVF)

2.3.2 Inputs & Outputs

2.3.2.1 Analogue Inputs – Sensors & Calculated

The Elektronikon MkIV supports up to 55 analogue sensor inputs and 5 additional analogue calculated (virtual) inputs. Each input has a 'value' and a 'status' register assigned.
The contents of these registers depend on the actual type of sensor that is connected. This can be different for every type of compressor. E.g. standard compressors may have 1 to 4 pressure inputs, 1 to 10 temperature inputs, up to 7 SPM inputs,… Also, features and options may increment the number of sensors that are actually installed on your compressor.
Before using the modbus system it is therefore required to find out what sensors are really connected to your compressors. This can e.g. be done with the FDP program. This program has a function that lists the sensors + modbus registers for a selected compressor type (including features and options).

Once the list of sensors is known, the contents of the registers can be interpreted as described below.

2.3.2.2 Registers

Sensor Inputs
Function to be used : Read Holding Register (03)

Modbus register	Information
0001	Analogue Input 1 – Status
0002	Analogue Input 1 – Value
0003	Analogue Input 2 – Status
0004	Analogue Input 2 – Value
0005	Analogue Input 3 – Status
0006	Analogue Input 3 – Value
…	…
0109	Analogue Input 55 – Status
0110	Analogue Input 55 – Value

Calculated (virtual) Inputs
Function to be used : Read Holding Register (03)

Modbus register	Information
0111	Calculated Input 1 – Status
0112	Calculated Input 1 – Value
0113	Calculated Input 2 – Status
0114	Calculated Input 2 – Value
0115	Calculated Input 3 – Status
0116	Calculated Input 3 – Value
……	……..
0129	Calculated Input 10 – Status
0130	Calculated Input 10 – Value

2.3.2.3 "Status" register Interpretation

High order byte = **00**
Low order byte = **Input Status**

The Input Status must be interpreted as **Binary data (bit coded)**.
Each part (bit) of the data (byte) is indicating a specific item that applies on the Input function. In the following table, an overview is given of all bits together with the corresponding meaning and interpretation.

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Function Description	Input Set/Not Set	Sensor Error	Permissive Start	Service	Shutdown	Shutdown Warning	Warning	Pre-Warning
Bit "1"	Set	Active	Active	Active	Active	Active	Active	Active
Bit "0"	Not Set	Not Active	Not Active	Not Active	Not Active	Not Active	Not Active	Not Active

2.3.2.4 "Value" register Interpretation

This depends on the type of inputs.

2.3.2.4.1 Pressure Input

The Pressure Input Value is a 2 byte integer, and contains the actual reading in mbar (0.001 bar)
For negative values, standard 2-complement notation is used.

Example: Value = 7040 decimal or 0x1B80 hexadecimal = 7.040 bar.
Value = -1000 decimal (2-complement) or 0xFC18 = -1.000 bar

For sensor error the value the value 32767 or 7FFF (hex) is returned.

On some high pressure compressors (with working pressures above 30 bar) a special Pressure Input can be defined that returns data in cBar (0.01 bar) in stead of mBar.

2.3.2.4.2 Temperature Input

The Temperature Input Value is a 2 byte integer, and contains the actual reading in 0.1°C
For negative values, standard 2-complement notation is used.

Example: Value = 855 decimal or 0x0357 hexadecimal = 85.5 °C
Value = -250 decimal (2-complement) or 0xFF06 = -25.0 °C

For sensor error the value the value 32767 or 7FFF (hex) is returned.

2.3.2.4.3 Vibration Input

The Vibration Input Value is a 2 byte integer, and contains the actual reading in 0.01µm
For sensor error the value the value 32767 or 7FFF (hex) is returned.

2.3.2.4.4 Level Input

The Level Input Value is a 2 byte integer, and contains the actual reading in 0.1mm
For sensor error the value the value 32767 or 7FFF (hex) is returned.

2.3.2.4.5 Conductivity Input

The Conductivity Value is a 2 byte integer, and contains the actual reading in 1 µS/cm
For sensor error the value the value 32767 or 7FFF (hex) is returned.

2.3.2.4.6 SPM Input

The SPM Input Value is a 2 byte register that must be seen as 2 x 1 byte.

- Byte 1 : carpet value (in dB)
- Byte 2 : peak value (in dB)

Example: Value = 0x1120 = > carpet value = 0x11, peak value = 0x20

For sensor error the value the value 0X7FFF (hex) is returned.
SPM values cannot be negative

2.3.2.4.7 Current Input

The Current Input Value is a 2 byte integer, and contains the actual reading in 0.1 A
For sensor error the value the value 32767 or 7FFF (hex) is returned.

2.3.2.4.8 Speed Input

The Speed Input Value is a 2 byte integer, and contains the actual reading in 1 rpm
For sensor error the value the value 32767 or 7FFF (hex) is returned.

2.3.2.5 Special Alarms

The Elektronikon MkIV supports up to 32 special alarms
Before using the modbus system it is therefore required to find out which special alarms are activated.
This can e.g. be done with the FDP program. This program has a function that lists the special alarms + modbus registers for a selected compressor type .

Once the list of sensors is known, the contents of the registers can be interpreted as described below.

Function to be used : Read 03

NodeAddress	Profibus Parameters	Data 4 Bytes			
B1	**B2 B3**	**B4**	**B5**	**B6**	**B7**
	0601	Not used	Not used	Not used	Status
	…….				
	0632	Not used	Not used	Not used	Status

Parameter	Bit	
Status	0	Not Used
	1	Not Used
	2	Warning
	3	Not Used
	4	Not Used
	5	Not Used
	6	Shutdown
	7	Not Used

2.3.2.6 Digital (Voltage free contacts) Inputs

The Elektronikon MkIV supports up to 21 digital (voltage free) inputs. Each input has a 'value' and a 'status' register assigned.
The contents of these registers is for digital inputs always the same, if the input is used. Before using the modbus system it is therefore required to find out what inputs are used on your compressors. This can e.g. be done with the FDP program. This program has a function that lists the digital inputs + modbus registers for a selected compressor type (including features and options).

Once the list of inputs is known, the contents of the registers can be interpreted as described below.

Function to be used : Read Holding Register (03)

Modbus register (Hex)	Modbus register (Dec)	Information
C9	0201	Digital Input 1 – Status
CA	0202	Digital Input 1 – Value
CB	0203	Digital Input 2 – Status
CD	0204	Digital Input 2 – Value
CE	0205	Digital Input 3 – Status
CF	0206	Digital Input 3 – Value
	…	…
F1	0241	Digital Input 21 – Status
F2	0242	Digital Input 21 – Value

2.3.2.7 "Status" register Interpretation

High order byte = **00**
Low order byte = **Input Status**

The Input Status must be interpreted as **Binary data**.
Each part (bit) of the data (byte) is indicating a specific item that applies on the Input function. In the following table, an overview is given of all bits together with the corresponding meaning and interpretation.

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Function Description	Input Set/Not Set	Sensor Error	Permissive Start	Service	Shutdown	Shutdown Warning	Warning	Pre-Warning
Value "1"	Set	Active	Active	Active	Active	Not used	Active	Active
Value "0"	Not Set	Not Active	Not Active	Not Active	Not Active	Not used	Not Active	Not Active

2.3.2.8 "Value" register Interpretation

Value: 00 Digital input is **Open**
Value: 01 Digital input is **Closed**

2.3.2.9 Analogue Outputs (Only for Turbo)

The Elektronikon MkIV supports up to 2 analogue outputs.

2.3.2.10 Registers

Function to be used : Read Holding Register (03)

Modbus register (Hex)	Modbus register (Dec)	Information	unit
2BD	0701	Analogue Output 1 -Value	* 0.1 %
2BE	0702	Analogue Output 2 -Value	* 0.1 %

2.3.3 Counters

2.3.3.1 Compressor Counters

The Elektronikon MkIV supports up to 33 counters (32-bit counters). Each input as 2 x 16bit 'value' register assigned, to allow a 32-bit value to be read.
Not all types of compressors use all types of counters. The list in this chapter provides an overview of the used counters / compressor type, and the units that are used

Function to be used : Read Holding Register (03)

Modbus register (Hex)	Modbus register (Dec)	Information
12D+12E	0301+0302	Running Hours
12F+130	0303+0304	Loaded Hours
131+132	0305+0306	Motor Starts
133+134	0307+0308	Module Hours
135+136	0309+0310	Accumulated Volume
137+138	0311+0312	Load Relay 1
139+13A	0313+0314	VSD 1-20% RPM
13B+13C	0315+0316	VSD 20-40% RPM
13D+13E	0317+0318	VSD 40-60% RPM
13F+140	0319+0320	VSD 60-80% RPM
141+142	0321+0322	VSD 80-100% RPM
143+144	0323+0324	Not yet used
145+146	0325+0326	50 % loaded hours
147+148	0327+0328	Load relay 2
149+14A	0329+0330	Counter application Specific
	…..	……..
16D+16E	0365+0366	Counter application Specific

Example Running Hours

	Higher Byte	Lower Byte
301	B4	B3
302	B2	B1

DWORD : Running Hours → B4 B3 B2 B1
00 2C 93 45 → 2921285 sec → 811 hrs

An Example to calculate the VSD %Counters

16#3007,1,16#23,7,0,4,**65**	Running Hours
16#3007,2,16#23,7,0,4,56	
16#3007,3,16#23,7,0,4,4	
16#3007,4,16#23,7,0,4,63542	
16#3007, 75,16#23, ,0,4,0	
16#3007,6,16#23,7,0,4,3	
16#3007,7,16#23,7,0,4,41	1 - 20%
16#3007,8,16#23,7,0,4,13	20 - 40 %
16#3007,9,16#23,7,0,4,3	40 - 60 %
16#3007,10,16#23,7,0,4,11	60 - 80 %
16#3007,11,16#23,7,0,4,7	80 - 100 %

1 -20%	41 s				
20 - 40 %	13 s	-->	13*100/**65** = **20**	--> **20%**	**(round off downwards if the value is lower then xx,50 else round**
40 - 60 %	3 s	-->	3*100/**65** = **4,61**	--> **5%**	**off upwards)**
60 - 80 %	1 s	-->	11*100/**65** = **1,53**	--> **2%**	
80 - 100 %	7 s	-->	7*100/**65** = **10,76**	--> **11%**	
				----------	
				40 %	

100 % - 40 % = 60%

1 -20%	41 s	60%

2.3.3.1.1 Counters for Fixed Speed

	Modbus address	Description	Unit
FIXED	0301+0302	Running Hours	s
	0303+0304	Loaded Hours	s
	0305+0306	Motor Starts	Number
	0307+0308	Module Hours	s
	0309+0310		
	0311+0312	Load Relay	Number
	0313+0314		
	0315+0316		
	0317+0318		
	0319+0320		
	0321+0322		
	0323+0324		
	0325+0326		
	0327+0328		

	Modbus Address	Description	Unit
SPECIFIC	0329+0330	Dryer Low Load Warnings	Number
	0331+0332		
	0333+0334		
	0335+0336		
	0337+0338		
	0339+0340		
	0341+0342		
	0343+0344		
	0345+0346		
	0347+0348		
	0349+0350		
	0351+0352		
	0353+0354		
	0355+0356		
	0357+0358		
	0359+0360	Motor Rotations	Number
	0361+0362	Malfunctions Pres/Temp	Number
	0363+0364	Malfunctions Fail Pulse	Number
	0365+0366	Regreasing Actions	Number

2.3.3.1.2 Counters for VSD

	Modbus address	Description	Unit
FIXED	0301+0302	Running Hours	s
	0303+0304		
	0305+0306	Motor Starts	Number
	0307+0308	Module Hours	S
	0309+0310	Accumulated Volume	1000m^3
	0311+0312		
	0313+0314	VSD 1-20 % RPM	%
	0315+0316	VSD 20-40 % RPM	%
	0317+0318	VSD 40-60 % RPM	%
	0319+0320	VSD 60-80 % RPM	%
	0321+0322	VSD 80-100 % RPM	%
	0323+0324		
	0325+0326		
	0327+0328		

	Modbus Address	Description	Unit
SPECIFIC	0329+0330	Dryer Low Load Warnings	Number
	0331+0332		
	0333+0334		
	0335+0336		
	0337+0338		
	0339+0340		
	0341+0342		
	0343+0344		
	0345+0346		
	0347+0348		
	0349+0350		
	0351+0352		
	0353+0354		
	0355+0356		
	0357+0358		
	0359+0360	Motor Rotations	Number
	0361+0362	Malfunctions Pres/Temp	Number
	0363+0364	Malfunctions Fail Pulse	Number
	0365+0366	Regreasing Actions	Number

2.3.3.1.3 Counters for ZB VSD

	Modbus address	Description	Unit
FIXED	0301+0302	Running Hours	s
	0303+0304		
	0305+0306	Motor Starts	Number
	0307+0308	Module Hours	S
	0309+0310	Accumulated Volume	1000m^3
	0311+0312		
	0313+0314	VSD 1-20 % RPM	%
	0315+0316	VSD 20-40 % RPM	%
	0317+0318	VSD 40-60 % RPM	%
	0319+0320	VSD 60-80 % RPM	%
	0321+0322	VSD 80-100 % RPM	%
	0323+0324	Accumulated Volume Tout > 60°C	
	0325+0326		
	0327+0328		

	Modbus Address	Description	Unit
SPECIFIC	0329+0330		
	0331+0332		
	0333+0334		
	0335+0336		
	0337+0338		
	0339+0340		
	0341+0342		
	0343+0344		
	0345+0346		
	0347+0348		
	0349+0350		
	0351+0352		
	0353+0354		
	0355+0356		
	0357+0358		
	0359+0360		
	0361+0362		
	0363+0364		
	0365+0366		

2.3.3.1.4 Counters AQ Fixed Speed

	Modbus address	Description	Unit
FIXED	0301+0302	Running Hours	s
	0303+0304	Loaded Hours	s
	0305+0306	Motor Starts	Number
	0307+0308	Module Hours	s
	0309+0310		
	0311+0312	Load Relay	Number
	0313+0314		
	0315+0316		
	0317+0318		
	0319+0320		
	0321+0322		
	0323+0324		
	0325+0326		
	0327+0328		

	Modbus Address	Description	Unit
SPECIFIC	0329+0330	Drain Time	s
	0331+0332	Fill Time	s
	0333+0334		
	0335+0336		
	0337+0338		
	0339+0340		
	0341+0342		
	0343+0344		
	0345+0346		
	0347+0348		
	0349+0350		
	0351+0352		
	0353+0354		
	0355+0356		
	0357+0358		
	0359+0360		
	0361+0362		
	0363+0364		
	0365+0366		

2.3.3.1.5 Counters for AQ VSD

	Modbus address	Description	Unit
FIXED	0301+0302	Running Hours	s
	0303+0304		
	0305+0306	Motor Starts	Number
	0307+0308	Module Hours	S
	0309+0310	Accumulated Volume	1000m^3
	0311+0312		
	0313+0314	VSD 1-20 % RPM	%
	0315+0316	VSD 20-40 % RPM	%
	0317+0318	VSD 40-60 % RPM	%
	0319+0320	VSD 60-80 % RPM	%
	0321+0322	VSD 80-100 % RPM	%
	0323+0324		
	0325+0326		
	0327+0328		

	Modbus Address	Description	Unit
SPECIFIC	0329+0330	Drain Time	s
	0331+0332	Fill Time	s
	0333+0334		
	0335+0336		
	0337+0338		
	0339+0340		
	0341+0342		
	0343+0344		
	0345+0346		
	0347+0348		
	0349+0350		
	0351+0352		
	0353+0354		
	0355+0356		
	0357+0358		
	0359+0360	Motor Rotations	Number
	0361+0362	Malfunctions Pres/Temp	Number
	0363+0364	Malfunctions Fail Pulse	Number
	0365+0366	Regreasing Actions	Number

2.3.3.1.6 Counters for PET VSD

	Modbus address	Description	Unit
FIXED	0301+0302	Running Hours	s
	0303+0304		
	0305+0306	Motor Starts	Number
	0307+0308	Module Hours	S
	0309+0310	Accumulated Volume	1000m^3
	0311+0312		
	0313+0314	VSD 1-20 % RPM	%
	0315+0316	VSD 20-40 % RPM	%
	0317+0318	VSD 40-60 % RPM	%
	0319+0320	VSD 60-80 % RPM	%
	0321+0322	VSD 80-100 % RPM	%
	0323+0324		
	0325+0326		
	0327+0328		

	Modbus Address	Description	Unit
SPECIFIC	0329+0330		
	0331+0332		
	0333+0334		
	0335+0336		
	0337+0338		
	0339+0340		
	0341+0342		
	0343+0344		
	0345+0346		
	0347+0348		
	0349+0350		
	0351+0352		
	0353+0354		
	0355+0356		
	0357+0358		
	0359+0360		
	0361+0362		
	0363+0364		
	0365+0366		

2.3.3.1.7 Counters for Turbo

	Modbus address	Description	Unit
FIXED	0301+0302	Running Hours	s
	0303+0304	Loaded Hours	s
	0305+0306	Motor Starts	Number
	0307+0308	Module Hours	s
	0309+0310		
	0311+0312	Load Relay	Number
	0313+0314		
	0315+0316		
	0317+0318		
	0319+0320		
	0321+0322		
	0323+0324		
	0325+0326		
	0327+0328		

	Modbus Address	Description	Unit
SPECIFIC	0329+0330		
	0331+0332		
	0333+0334		
	0335+0336		
	0337+0338		
	0339+0340		
	0341+0342		
	0343+0344		
	0345+0346		
	0347+0348		
	0349+0350		
	0351+0352		
	0353+0354		
	0355+0356		
	0357+0358		
	0359+0360		
	0361+0362		
	0363+0364		
	0365+0366		

2.3.3.1.8 Counters PET Fixed Speed

	Modbus address	Description	Unit
FIXED	0301+0302	Running Hours	s
	0303+0304	Loaded Hours	s
	0305+0306	Motor Starts	Number
	0307+0308	Module Hours	s
	0309+0310		
	0311+0312	Load Relay	Number
	0313+0314		
	0315+0316		
	0317+0318		
	0319+0320		
	0321+0322		
	0323+0324		
	0325+0326	50 % loaded hours	s
	0327+0328	Load relay 2	Number

	Modbus Address	Description	Unit
SPECIFIC	0329+0330		
	0331+0332		
	0333+0334		
	0335+0336		
	0337+0338		
	0339+0340		
	0341+0342		
	0343+0344		
	0345+0346		
	0347+0348		
	0349+0350		
	0351+0352		
	0353+0354		
	0355+0356		
	0357+0358		
	0359+0360		
	0361+0362		
	0363+0364		
	0365+0366		

2.3.3.1.9 Counters for SF (Multi)

	Modbus address	Description	Units
FIXED	0301+0302	Running Hours	s
	0303+0304		
	0305+0306		
	0307+0308	Module Hours	s
	0309+0310		
	0311+0312		
	0313+0314		
	0315+0316		
	0317+0318		
	0319+0320		
	0321+0322		
	0323+0324		
	0325+0326		
	0327+0328		

	Modbus Address	Description	Unit
SPECIFIC	0329+0330	Running Hours Element 1	S
	0331+0332	Running Hours Element 2	S
	0333+0334	Running Hours Element 3	S
	0335+0336	Running Hours Element 4	S
	0337+0338	Motor Starts Element 1	Number
	0339+0340	Motor Starts Element 2	Number
	0341+0342	Motor Starts Element 3	Number
	0343+0344	Motor Starts Element 4	Number
	0345+0346	Shutdowns Element 1	Number
	0347+0348	Shutdowns Element 2	Number
	0349+0350	Shutdowns Element 3	Number
	0351+0352	Shutdowns Element 4	Number
	0353+0354		
	0355+0356		
	0357+0358		
	0359+0360		
	0361+0362		
	0363+0364		
	0365+0366		

2.3.3.1.10 Counters for CD Dryer

	Modbus address	Description	Units
FIXED	0301+0302	Running Hours	s
	0303+0304		
	0305+0306		
	0307+0308	Module Hours	s
	0309+0310		
	0311+0312		
	0313+0314		
	0315+0316		
	0317+0318		
	0319+0320		
	0321+0322		
	0323+0324		
	0325+0326		
	0327+0328		

	Modbus Address	Description	Unit
SPECIFIC	0329+0330		
	0331+0332		
	0333+0334		
	0335+0336		
	0337+0338		
	0339+0340		
	0341+0342		
	0343+0344		
	0345+0346		
	0347+0348		
	0349+0350		
	0351+0352		
	0353+0354		
	0355+0356		
	0357+0358		
	0359+0360		
	0361+0362		
	0363+0364		
	0365+0366		

2.3.3.1.11 Counters for BD dryer (All)

	Modbus address	Description	Unit
FIXED	0301+0302	Running Hours	s
	0303+0304		
	0305+0306		
	0307+0308	Module Hours	s
	0309+0310		
	0311+0312		
	0313+0314		
	0315+0316		
	0317+0318		
	0319+0320		
	0321+0322		
	0323+0324		
	0325+0326		
	0327+0328		

	Modbus Address	Description	Unit
SPECIFIC	0329+0330	Actual State Time	s
	0331+0332	Programmed State Time	s
	0333+0334	Actual Half Cycle Time	s
	0335+0336	Programmed Half Cycle Time	s
	0337+0338		
	0339+0340		
	0341+0342		
	0343+0344		
	0345+0346		
	0347+0348		
	0349+0350		
	0351+0352		
	0353+0354		
	0355+0356		
	0357+0358		
	0359+0360		
	0361+0362		
	0363+0364		
	0365+0366		

2.3.3.1.12 Counters for FD VSD dryer

	Modbus address	Description	Unit
FIXED	0301+0302	Running Hours	s
	0303+0304		
	0305+0306	Motor Starts	Number
	0307+0308	Module Hours	s
	0309+0310		
	0311+0312		
	0313+0314		
	0315+0316		
	0317+0318		
	0319+0320		
	0321+0322		
	0323+0324		
	0325+0326		
	0327+0328		

	Modbus Address	Description	Unit
SPECIFIC	0329+0330		
	0331+0332		
	0333+0334		
	0335+0336		
	0337+0338		
	0339+0340		
	0341+0342		
	0343+0344		
	0345+0346		
	0347+0348		
	0349+0350		
	0351+0352		
	0353+0354		
	0355+0356		
	0357+0358		
	0359+0360		
	0361+0362		
	0363+0364		
	0365+0366		

2.3.3.1.13 Counters MD dryer

	Modbus address	Description	Unit
FIXED	0301+0302		
	0303+0304	Loaded Hours	s
	0305+0306		
	0307+0308	Module Hours	s
	0309+0310		
	0311+0312		
	0313+0314		
	0315+0316		
	0317+0318		
	0319+0320		
	0321+0322		
	0323+0324		
	0325+0326		
	0327+0328		

	Modbus Address	Description	Unit
SPECIFIC	0329+0330	Dryer Low Load Warnings	Number
	0331+0332		
	0333+0334		
	0335+0336		
	0337+0338		
	0339+0340		
	0341+0342		
	0343+0344		
	0345+0346		
	0347+0348		
	0349+0350		
	0351+0352		
	0353+0354		
	0355+0356		
	0357+0358		
	0359+0360		
	0361+0362		
	0363+0364		
	0365+0366		

2.3.3.1.14 Counters for ES002

	Modbus address	Description	Unit
FIXED	0301+0302	Running Hours	s
	0303+0304	Loaded Hours	s
	0305+0306	Motor Starts	Number
	0307+0308	Module Hours	s
	0309+0310		
	0311+0312	Load Relay	Number
	0313+0314		
	0315+0316		
	0317+0318		
	0319+0320		
	0321+0322		
	0323+0324		
	0325+0326		
	0327+0328		

	Modbus Address	Description	Unit
SPECIFIC	0329+0330		
	0331+0332		
	0333+0334		
	0335+0336		
	0337+0338		
	0339+0340		
	0341+0342		
	0343+0344		
	0345+0346		
	0347+0348		
	0349+0350		
	0351+0352		
	0353+0354		
	0355+0356		
	0357+0358		
	0359+0360		
	0361+0362		
	0363+0364		
	0365+0366		

2.3.3.2 Multi Compressor Controller Counters

The Elektronikon MkIV contains 4 counters (32-bit counters) to perform the MCC load balancing between up to 4 compressors. Each such counter as 2 x 16bit 'value' register assigned, to allow a 32-bit value to be read.
Only units where the MCC master function is active contain real data for this registers.

Function to be used : Read Holding Register (03)

Modbus register (Hex)	Modbus register (Dec)	Information	unit
1F5+1F6	501+502	Compressor 1 counter	s
1F7+1F8	503+504	Compressor 2 counter	s
1F9+1FA	505+506	Compressor 3 counter	s
1FB+1FC	504+507	Compressor 4 counter	s

Data interpretation is the same as for the other counters

2.3.4 Special

2.3.4.1 VSD motor data

The Elektronikon MkIV on VSD units contains some important data about the motor speed.This data can be read over the modbus system.

Function to be used : Read Holding Register (03)

Modbus register (Hex)	Modbus register (Dec)	Information	unit
321	0801	Required motor speed	rpm
322	0802	Actual motor speed motor 1	rpm
323	0803	Actual motor speed motor 2	rpm
324	0804	Actual motor speed motor 3	rpm

Each register contains a 16-bit value that is directly readable as the equivalent rpm.

2.4 ES800 Data Readout

2.4.1 Analogue Inputs

Modbus register (Hex)	Modbus register (Dec)	Information
4B1	1201	Analogue Input 1 – Value
4B2	1202	MPL Number for Analogue Input 1
4B3	1203	Analogue Input 2 – Value
4B4	1204	MPL Number for Analogue Input 2

Parameter	Value	Selections
MPL-number	0 ⇔32000	Unique reference number
Actual value	-32767 ⇔ 32767	Actual measurement in technical units

Remarks:

- Fixed relation between sub-indices and physical input (first analogue input = sub-index 1)
- ES800 supports only 2 analogue inputs
- The MPL-number is unique and specifies the type of measurement and technical unit

Description	Type	MPL number
Net pressure	Pressure [mbar]	4501
Net pressure back-up	Pressure [mbar]	4502

- When an input is not used (not active, not exist) the MPL-number and value are 0.
- When the input measurement is in ‘error’, the value “7FFF” is returned.
- See also pressure input

2.4.2 Digital Inputs

Modbus register (Hex)	Modbus register (Dec)	Information	
		Word	
		Byte1	Byte2
4E3	1251	Status	Value
4E4	1252	MPL Number for Digital Input 1	
….	…….		
…..	…….		
501	1281	Status	Value
502	1282	MPL Number for Digital Input 16	

Parameter	Value	Selections
MPL-number	0 ⇔32000	Unique reference number
Status	0 ⇔ 1	0 = not used 1 = active input
Actual value	0 ⇔ 1	Actual input status 0=open / 1=closed

Remarks:

- Fixed relation between sub-indices and physical input (first digital input = sub-index 1)
- Maximum 16 digital inputs are supported by the ES800

Description	MPL number
Local/Remote	4700
SPS selection 1	4701
SPS selection 2	4702
Motor status DL1	4704
Load status DL1	4705
Motor status DL2	4706
Load status DL2	4707
Motor status DL3	4708
Load status DL3	4709
Motor status DL4	4710
Load status DL4	4711
Motor status DL5	4712
Load status DL5	4713
Motor status DL6	4714

- The 4th input of the remote control DIOE is not used => Status in sub-index 4 will be 0

2.4.3 Digital Outputs

Modbus register (Hex)	Modbus register (Dec)	Information	
		Word	
		Byte1	Byte2
515	1301	Status	Value
516	1302	MPL Number for Digital Output 1	
……	…….		
…….	…….		
533	1331	Status	Value
534	1332	MPL Number for Digital Output 16	

Parameter	Value	Selections
MPL-number	0 ⇔32000	Unique reference number
Status	0 ⇔ 1	0 = not used 1 = active input
Actual value	0 ⇔ 1	Actual input status 0=open / 1=closed

Remarks:

- Fixed relation between sub-indices and physical input (first digital input = sub-index 1)
- Maximum 16 digital outputs are supported by the ES800

Description	MPL number
System Alarm	4800
Net Pressure Alarm	4801
Net Pressure Warning	4802
Local / Central Control	4803
Local / Remote DL1	4804
Load / Unload DL1	4805
Local / Remote DL2	4806
Load / Unload DL2	4807
Local / Remote DL3	4808
Load / Unload DL3	4809
Local / Remote DL4	4810
Load / Unload DL4	4811
Local / Remote DL5	4812
Load / Unload DL5	4813
Local / Remote DL6	4814
Load / Unload DL6	4815

2.4.4 System Data

Modbus register (Hex)	Modbus register (Dec)	Information	
		Byte1	Byte2
547	1351	Active Parameter Set	# Compressors
548	1352	Regulation Control (SPS)	Active SS
549	1353	ARAVF Status	System Info
54A	1354	Not Used	Control Mode

Definitions:

Regulation control and Active SPS
- Value 1 = central stopped
- Value 2 = central regulating SPS1 active
- Value 4 = central regulating SPS2 active
- Value 8 = central regulating SPS3 active
- Value 16 = local control / no central regulation
- Value 32 = system alarm (must be reset)

Active Sequence Scheme: number from 1 to 8

Active Parameter set:
- Value 1 = parameter set 1 is used
- Value 2 = parameter set 2 is used
- Value 4 = parameter set 3 is used
- Value 8 = parameter set 4 is used
- Value 16 = parameter set 5 is used

connected compressors: number from 0 to 8

Control Mode: start/stop commands are only valid if coming from
- 1 = local
- 2 = digital remote
- 4 = LAN remote

ARAVF status
- 1 = not active
- 2 = active
- 4 = active (infinite)

System Information (bit coded data):
- Bit 00: Week timer active
- Bit 01: System stop enabled
- Bit 02: Pressure low alarm triggered
- Bit 03: Pressure low warning triggered
- Bit 04: Pressure high alarm triggered
- Bit 05: Pressure high warning triggered

2.5 ES Millennium Data Readout

2.5.1 Analogue Inputs

Modbus register (Hex)	Modbus register (Dec)	Information
4B1	1201	Analogue Input 1 – Value
4B2	1202	MPL Number for Analogue Input 1
4B3	1203	Analogue Input 2 – Value
4B4	1204	MPL Number for Analogue Input 2
…….	……..	
4D7	1239	Analogue Input 20 – Value
4D8	1240	MPL Number for Analogue Input 20

Parameter	Value	Selections
MPL-number	0 ⇔32000	Unique reference number
Actual value	-32767 ⇔ 32767	Actual measurement in technical units

- When an input is not used (not active, not exist) the MPL-number and value are 0.
- When the input measurement is in 'error', the value "7FFF" is returned.
- See also pressure input

2.5.2 Digital Inputs

Modbus register (Hex)	Modbus register (Dec)	Information	
		Word	
		Byte1	Byte2
4E3	1251	Status	Value
4E4	1252	MPL Number for Digital Input 1	
……	…….		
……	…….		
501	1281	Status	Value
502	1282	MPL Number for Digital Input 16	

Parameter	Value	Selections
MPL-number	0 ⇔32000	Unique reference number
Status	0 ⇔ 1	0 = not used
		1 = active input
Actual value	0 ⇔ 1	Actual input status
		0=open / 1=closed

2.5.3 Digital Outputs

Modbus register (Hex)	Modbus register (Dec)	Information	
		Word	
		Byte1	Byte2
515	1301	Status	Value
516	1302	MPL Number for Digital Output 1	
…..;	…….		
……..	…….		
533	1331	Status	Value
534	1332	MPL Number for Digital Output 16	

Parameter	Value	Selections
MPL-number	0 ⇔32000	Unique reference number
Status	0 ⇔ 1	0 = not used
		1 = active input
Actual value	0 ⇔ 1	Actual input status
		0=open / 1=closed

2.5.4 System Data

Modbus register (Hex)	Modbus register (Dec)	Information
		WORD
55B	1371	Status Display Word1
55C	1372	Status Display Word2
55D	1373	Status ControlWord1
55E	1374	Status ControlWord2
55F	1375	Display Commands Word1
560	1376	Display Commands Word2
561	1377	Control Commands Word1
562	1378	Control Commands Word2

Definitions:

Status Display Word1

Bit 01: Local controle
Bit 02: ES Controle
Bit 03: Central Stop

Status Control Word1

Bit 00: Not used
Bit 01: Not used
Bit 02: Not used
Bit 03: Not used
Bit 04: Not used
Bit 05: SPS1 manual active
Bit 06: SPS2 manual active
Bit 07: SPS3 manual active
Bit 08: Fixed(0)/Offset(1) Level (Warning/Shutdown)
Bt 09: SPS manual(0)/auto(1)
Bit 10: SPS0 auto active
Bit 11: SPS1 auto active
Bit 12: SPS2 auto active
Bit 13: SPS3 auto active
Bit 14: Not all compressors config needed for integration
Bit 15: new SPS

Status Control Word2

Bit 00: Not used
Bit 01: Not used
Bit 02: Not used
Bit 03: Not used
Bit 04: Not used
Bit 05: Not used
Bit 06: Energy Saving
Bit 07: Capacity Group Management
Bit 08: Forced Sequence
Bit 09: Equal wear
Bit 10: pressure deviation shutdown
Bit 11: pressure deviation warning
Bit 12: H pressure shutdown
Bit 13: H pressure warning
Bit 14: L pressure warning
Bit 15: L pressure shutdown

Display Commands Word1

Bit 01: Local controle
Bit 02: ES Controle
Bit 03: Central Stop

2.6 Modbus registers for parameters change

2.6.1 Load/Unload Pressure Band change

It is possible to change the operating pressure band inside the Elektronikon MkIV, or to switch between the two available pressure bands. These registers are only valid for Load/Unload compressors

Functions to be used :
For reading : Read Holding Register (03)
For writing :Preset Single Register (06)

Modbus register (Hex)	Modbus register (Dec)	Description
425	1061	Pressure Band Selection
426	1062	Loading pressure band 1
427	1063	Unloading Pressure band 1
428	1064	Loading pressure band 2
429	1065	Unloading Pressure band 2

Pressure Band Selection : 1 = band 1, 2 = band 2

Attention : when writing values the following relations should be maintained :
Loading pressure < unloading pressure (per band)
Loading pressure should not be below the minimum setting that was factory defined.
Unloading pressure should not be above the maximum setting that was factory defined.

Values not fulfilling this will be refused.

2.6.2 VSD Setpoint change

It is possible to change the operating set point inside the Elektronikon MkIV, or to switch between the two available pressure set points. These registers are only valid for VSD compressors

For reading : Read Holding Register (03)
For writing :Preset Single Register (06)

Modbus register (Hex)	Modbus register (Dec)	Description
41B	1051	Setpoint Selection
41C	1052	Setpoint 1
41D	1053	Setpoint 2

Setpoint Selection : 1 = Setpoint 1, 2 = Setpoint 2

The set point must be within the limits that are factory defined for your machine type.

Values not fulfilling this will be refused by the MKIV.

2.6.3 MCC Pressure Band change

In Elektronikons where the MCC master function is active it is possible to change the operating pressure band for this master, or to switch between the two available pressure bands.

Functions to be used :
For reading : Read Holding Register (03)
For writing :Preset Single Register (06)

Modbus register (Hex)	Modbus register (Dec)	Description
439	1081	MCC Pressure Band Selection
43A	1082	MCC Loading pressure band 1
43B	1083	MCC Unloading Pressure band 1
43C	1084	MCC Loading pressure band 2
43D	1085	MCC Unloading Pressure band 2

Pressure Band Selection : 0 = band 1, 1 = band 2

Attention : when writing values the following relations should be maintained :

Loading pressure < unloading pressure (per band)

Values not fulfilling this will be refused by the MKIV.

2.6.4 PET L/U Regulation Band Change

Functions to be used :
For reading : Read Holding Register (03)
For writing :Preset Single Register (06)

Modbus register (Hex)	Modbus register (Dec)	Description
443	1091	Pressure Band Selection
444	1092	Regulation Method
445	1093	100 % Loading Pressure band1
446	1094	50 % Loading Pressure band1
447	1095	100 % Unloading Pressure band1
448	1096	50 % Unloading Pressure band1
449	1097	100 % Loading Pressure band2
44A	1098	50 % Loading Pressure band2
44B	1099	100 % Unloading Pressure band2
44C	1100	50 % Unloading Pressure band2

Pressure Band Selection : 1 = band 1, 2 = band 2

Regulation Method : 1 0 - 100 %
2 0 - 50 %
3 0 – 50 – 100 %

The values must be within the limits that are factory defined for your machine type.

Values not fulfilling this will be refused by the MKIV.

2.6.5 ZH Turbo Regulation Setpoint and Band change

Functions to be used :
For reading : Read Holding Register (03)
For writing :Preset Single Register (06)

Modbus register (Hex)	Modbus register (Dec)	Description
457	1111	Setpoint selection
458	1112	Setpoint 1
459	1113	Load offset 1
45A	1114	Unload offset1
45B	1115	Setpoint 2
45C	1116	Load offset 2
45D	1117	Unload offset2

Setpoint Selection : 1 = Setpoint 1, 2 = Setpoint 2

The values must be within the limits that are factory defined for your machine type.

Values not fulfilling this will be refused by the MKIV.

2.7 Modbus registers for remote control

2.7.1 Control Commands

2.7.1.1 Compressor Control Mode Selection

The Elektronikon MkIV has a number of control modes that define the behaviour of a compressor in relation to external inputs (pressure reading, start/stop commands,…).
Each mode has a main type (= number 1 to 4), and a sub-type (a,b,c,..). The number of sub-types is different for each main type.

When Modbus has to be used to control a compressor the main type ust be set to 4 (=remote control over communication line). This has to be done through the display, select "LAN Control". By default the compressor will then enter the "4a" mode.

Through Modbus it is now possible to activate the other sub-types.

Functions to be used : writing method: Preset Single Register – Function 06

Modbus register (Hex)	Modbus register (Dec)	Value to write	Description	Accepted in mode
7D2	2002	1	Switch from 4a or 4c to 4b	4a – 4c
		2	Switch from 4b or 4c to 4a	4b
		3	Switch from 4a or 4b to 4c	4a – 4b

Note
Mode 4a : remote control of start/stop but pressure control is done by the controller
Mode 4b : remote control of start/stop and pressure control is done from remote (Supervisory control) (also for VSD → setpoint control)
Mode 4c : remote control of start/stop with external speed (only vsd) → speed control)

	Switch from 4a to 4b	Switch from 4b to 4a
Fixed Speed	X	X
VSD	X	X
VSD Throttle Valve	X	X
AQ Fixed Speed	X	X
AQ VSD	X	X
ZH Turbo	X	X
PET Fixed Speed	X	X
PET VSD	X	X
WCO Fixed Speed	X	X
WCO VSD	X	X
SF (Multi)		
BD Dryer (AII)		
FD VSD Dryer		
MD Dryer		
ES002		

	Switch from 4a to 4c	Switch from 4c to 4a
Fixed Speed		
VSD	X	X
VSD Throttle Valve	X	X
AQ Fixed Speed		
AQ VSD	X	X
ZH Turbo		
PET Fixed Speed		
PET VSD	X	X
WCO Fixed Speed		
WCO VSD	X	X
SF (Multi)		
BD Dryer (AII)		
FD VSD Dryer		
MD Dryer		
ES002		

	Switch from 4b to 4c	Switch from 4c to 4b
Fixed Speed		
VSD	X	X
VSD Throttle Valve	X	X
AQ Fixed Speed		
AQ VSD	X	X
ZH Turbo		
PET Fixed Speed		
PET VSD	X	X
WCO Fixed Speed		
WCO VSD	X	X
SF (Multi)		
BD Dryer (AII)		
FD VSD Dryer		
MD Dryer		
ES002		

2.7.1.2 Compressor Commands

The commands that are described here are only available in the defined Compressor Control Modes.
Carefully consult the control concept of the compressors before using them.

Functions to be used : writing method: Preset Single Register – Function 06

Modbus register (Hex)	Modbus register (Dec)	Value to write	Command	Accepted in mode
7D1	2001	1	Start	4a / 4b
		2	Stop	4a / 4b
		3	Load	4a / 4b
		4	Unload	4b (in 4a = Manual unload)
		5	MCC Start System	4a / 4d
		6	MCC Stop System	4d
		7	MCC Local	4d
		8	50 % Load (PET L/U Booster)	4b
		9	Not used	
		10	Start water-cooling pump (PET L/U or VSD Booster + PETPACK functionality is active)	4b
		11	Stop water-cooling pump (PET L/U or VSD Booster + PETPACK functionality is active)	4b
7D4	2004	1	Reset Shutdown	In all Modes
		2	Reset Start Failures	In all Modes
7D5	2005 (ES8)+(ES130)	1	System Stop	LAN control & Stop enabled
	(ES8)+(ES130)	2	SPS1	LAN control
	(ES8)+(ES130)	3	SPS2	LAN control
	(ES8)+(ES130)	4	SPS3	LAN control
	(ES8)+(ES130)	5	System to local	LAN control
	(ES8)	6	System Reset	LAN control
7D6	2006 (ES8)	1	Switch to Sequence Scheme 1	LAN control
		2	Switch to Sequence Scheme 2	LAN control
		3	Switch to Sequence Scheme 3	LAN control
		4	Switch to Sequence Scheme 4	LAN control
		5	Switch to Sequence Scheme 5	LAN control
		6	Switch to Sequence Scheme 6	LAN control
		7	Switch to Sequence Scheme 7	LAN control
		8	Switch to Sequence Scheme 8	LAN control

	Start Command	Stop Command	Load Command	Unload Command
Fixed Speed	X	X	X	X
VSD	X	X		
VSD Throttle Valve	X	X		
AQ Fixed Speed	X	X	X	X
AQ VSD	X	X		
ZH Turbo	X	X	X	X
PET Fixed Speed	X	X	X	X
PET VSD	X	X		
WCO Fixed Speed	X	X	X	X
WCO VSD	X	X		
SF (Multi)	X	X		
CD Dryer	X	X		
BD Dryer (AII)	X	X		
FD VSD Dryer	X	X		
MD Dryer	X	X		
ES002				

2.7.2 VSD – external setpoint/speed control

On VSD units extended external control is possible whereby either the main motor speed of the pressure set point is directly controlled from remote over Modbus.
This can be done with the following Modbus registers

-> reading method: Read Holding Registers – Function 03
-> writing method: Preset Single Register – Function 06

Modbus register (Hex)	Modbus register (Dec)	Description
42F	1071	External Setpoint
430	1072	External Speed

2.7.3 Reset Initial Settings (Analogue , Digital , Counter Inputs)

-> writing method: Preset Single Register – Function 06

Modbus register (Hex)	Modbus register (Dec)	Description
835	2101	Reset Initial Settings

2.8 Communication examples

2.8.1 Analogue - Digital Inputs

-> reading method: Read Holding Registers – Function 03

Example: read from Analogue input 1, Status and Value
Query

Field Name	**Example (Hex)**
Device Id Nr	04
Function	03
Starting Address High	00
Starting Address Low	00
Number of points High	00
Number of points Low	02
CRC	C4 5E

Response

Field Name	**Example (Hex)**
Device Id Nr	04
Function	03
Byte Count	04
Data register 0001	00 80 Status
Data register 0002	1D 15 (= Value : 7505 mbar)
CRC	DF CA

Example: read from Digital input 1, Status and Value
Query

Field Name	**Example (Hex)**
Device Id Nr	22
Function	03
Starting Address High	00
Starting Address Low	C8
Number of points High	00
Number of points Low	02
CRC	42 46

Response

Field Name	**Example (Hex)**
Device Id Nr	22
Function	03
Byte Count	04
Data register 0001	00 88 Status (Set , Shutdown)
Data register 0002	00 00 (Input → Open)
CRC	68 DB

2.8.2 Commands description

-> writing method: Preset Single Register – Function 06

Example: Send a Start command
Query

Field Name	Example (Hex)
Slave address	01
Function	06
Register Address High	07
Register Address Low	D0
Preset Data High	00
Preset Data Low	01
CRC	

Response

Field Name	Example (Hex)
Slave address	01
Function	06
Register Address High	07
Register Address Low	D0
Preset Data High	00
Preset Data Low	01
CRC	

2.8.3 Present System Status

-> reading method: Coil Status – Function 01

Example: Read present compressor status (= read 8 coils)
Query

Field Name	Example (Hex)
Slave address	01
Function	01
Starting Address High	00
Starting Address Low	00
Number of points High	00
Number of points Low	08
CRC	3D CC

Response

Field Name	Example (Hex)
Slave address	01
Function	01
Byte Count	01
Data Coils 1 to 8	00 (Coils 1 to 8 are = 0)
CRC	51 88

2.8.4 Loopback Test

Query

Field Name	Example (Hex)
Device Id Nr	04
Function	08
Starting Address High	00
Starting Address Low	00
Number of points High	A5
Number of points Low	37
CRC	

Response

Field Name	Example (Hex)
Device Id Nr	04
Function	08
Starting Address High	00
Starting Address Low	00
Number of points High	A5
Number of points Low	37
CRC	

3. Exception Responses

3.1 Function Code – Data Field

In a normal response, the slave echoes the function code of the orginal query.

In an exception response 80hex is added to the function code.
At the same time an **exception code** is added in the Data Field.

3.2 Exception Codes

Code	Name	Meaning
01	Illegal Function	The function code received in the query is not an allowable action for the slave.
02	Illegal Data Address	The data address received in the query is not an allowable address for the slave
03	Illegal Data Value	A value contained in the query data field is not an allowable value for the slave
06	Reprogramming Refused	Command Refused because previous command was not yet executed
07	Command Refused	Command Refused because previous command was not yet executed
08	Data Not Available	Check communication cable between MKIV and Combox-S .
09	Illegal Command	An unknown command is being sent

3.3 Example

Example: read from Analogue input 1, Status and Value
Query

Field Name	Example (Hex)
Slave address	01
Function	09 **(Wrong function, should be 03)**
Starting Address High	00
Starting Address Low	00
Number of points High	00
Number of points Low	02
CRC	5C 0A

Response

Field Name	Example (Hex)
Slave address	01
Function	89 **(Exception reply)**
Exception Code	01 **(Illegal Function in query)**
CRC	86 50