

REFERENCE GUIDE

SG-150-1

Compressor control module for the OSKA95103-K compressor
Original document
Preliminary v 1.0C

CM-SW-01

Electrical skilled installer

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1. Read this first!

The contents of this manual are subject to change without further notice.

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Disposing of the parts of the CM-SW-01:

	INFORMATION FOR USERS ON THE CORRECT HANDLING OF WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT (WEEE)
-----------------------------------------------------------------------------------	------------------------------------------------------------------------------------------------------

In reference to European Union directives and the related national legislation, please note that:


1. WEEE cannot be disposed of as municipal waste and such waste must be collected and disposed of separately
2. The public or private waste collection systems defined by local legislation must be used. In addition, the equipment can be returned to the distributor at the end of its working life when buying new equipment
3. The equipment may contain hazardous substances: the improper use or incorrect disposal of such may have negative effects on human health and on the environment
4. The symbol (crossed-out wheeled bin) shown on the product or on the packaging and on the instruction sheet indicates that the equipment must be disposed of separately
5. In the event of illegal disposal of electrical and electronic waste, the penalties are specified by local waste disposal legislation.

Reading instructions

The following symbols are used to draw the reader's attention to different warning levels.

	Important information
-------------------------------------------------------------------------------------	-----------------------

	Danger!! General danger
-------------------------------------------------------------------------------------	-------------------------

	Danger!! High voltage. Danger of electrical current or voltage
-------------------------------------------------------------------------------------	----------------------------------------------------------------

1.1 Reference guide



Before installation, the user should be thoroughly familiarized with this reference guide, especially with purposes, installation and operation.

Special care should be taken when installing and connecting external equipment (PTC sensor, high voltage etc.) and handling the modules correctly according to protection against ESD (Electro Static Discharge).



Installation of the CM-SW-01 must be performed by authorized personnel only. All warranties are excluded in case installation is performed by unauthorized personnel or in case the CM-SW-01 has not been correctly installed.

1.2 Safety



The CM-SW-01 is a protection device and not a safety component according to the Machinery Directive and cannot be used in “medical” or “life support” equipment

Before commissioning, the service technician shall ensure that personal safety requirements are met in conformity with the Machinery Directive and local legislation based on safety estimations.



Electrical plant failures are to be immediately solved, even though no immediate danger exists; the CM-SW-01 and motor must be without power.



Before soldering or welding on the compressor, all connections on the CM-SW-01 must be secured against overvoltage!

2. Definitions

BEST	BEST Software
CR	Capacity Regulation
DOL	Direct On Line (motor start)
ESD	Electro Static Discharge
FI	Frequency inverter
HP	High Pressure
HW	Hardware/electronics.
I/O	Input / Output (electrical signals in and out of a unit)
LP	Low Pressure
Modbus	Application-layer messaging protocol - http://www.modbus.org/specs.php
NC	Normally Closed (relay)
NO	Normally Open (relay)
NTC	Negative Temperature Coefficient (sensor element)
PTC	Positive Temperature Coefficient (sensor element)
PW	Part winding (motor start)
Y/Δ	Star/delta (motor start)

3. Functions

The CM-SW-01 compressor module has a number of built-in functions to protect, diagnose, control and communicate the status of the OS.KA95 screw compressor.

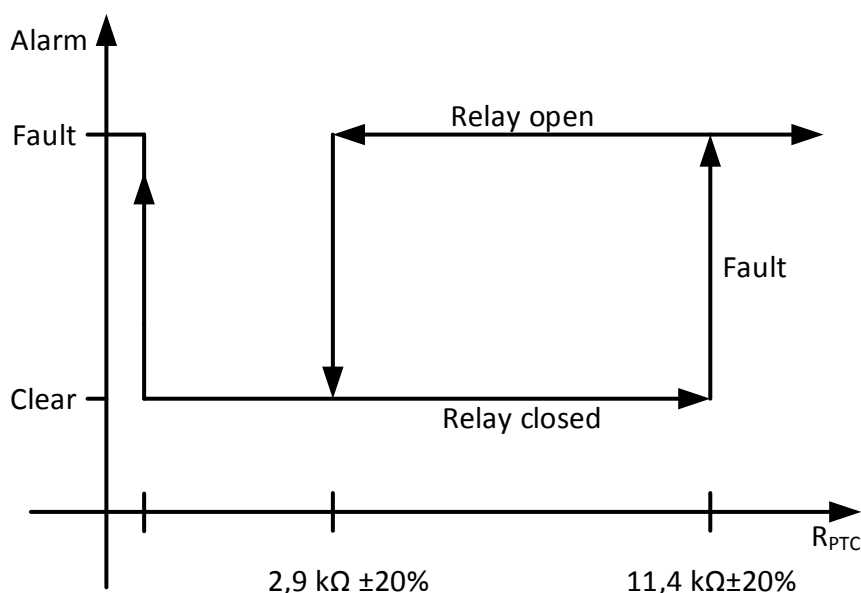
3.1 Control functions

Via the BEST Software, the CM-SW-01 can be configured to take care of control functions. The CM-SW-01 thereby secures the safe operation of the OS.KA95 screw compressor.

3.2 Monitoring and diagnosis

3.2.1 Motor temperature

One of the functions of the CM-SW-01 is to protect the compressor motor against overload. By monitoring the resistance in a PTC sensor mounted in the motor windings, the CM-SW-01 will lockout and stop the motor if the resistance increases above the limit as shown below.



When the lockout has been activated, the two start relays K1 and K2 are released immediately to stop the compressor.

There is a restart blocking function to prevent the motor from being started too soon after having been overheated.

If the CM-SW-01 is locked, an external reset must be performed by either powering off the device for minimum 5 seconds or sending a reset command on the serial bus.

When power is turned on to the CM-SW-01 module, the PTC resistance is measured:

- If PTC resistance is below the reset limit $2,9 \text{ k}\Omega$:
No alarm: The relays are energized immediately (if no other faults are present)
- If PTC resistance is between $2,9 \text{ k}\Omega$ and $11,4 \text{ k}\Omega$:
Alarm: The relays are first energized when below $2,9 \text{ k}\Omega$ (compressor motor has cooled down)
- If PTC resistance is above $11,4 \text{ k}\Omega$:
Alarm lock: The relays are not energized and the module is locked

3.2.2 Discharge temperature

A temperature sensor is mounted on the discharge side of the compressor; the CM-SW-01 will open the relays and break the safety chain if the discharge temperature threshold is exceeded.

3.2.3 Oil supply

The oil supply monitor is configured for oil level (OLC-D1) monitoring. Actual status is always accessible via Modbus.

If an oil level fault is detected, the status is immediately updated via Modbus. However, the first 90 seconds after compressor start, the fault signal is not activated. If the oil level is still too low, the CM-SW-01 releases the fault relay and locks out immediately.

The OLC-D1 module (24 V version) must be used for the oil level detection.

A warning signal is set immediately if the compressor is running and the OLC input is open.

The oil fault alarm must be externally reset by either powering off the device for minimum 5 seconds or sending a reset command on the serial bus.

3.2.4 Short-cycling warning

To protect the motor windings, the module will give a warning if the compressor is started too many times within 1 hour, but the compressor will not be locked.

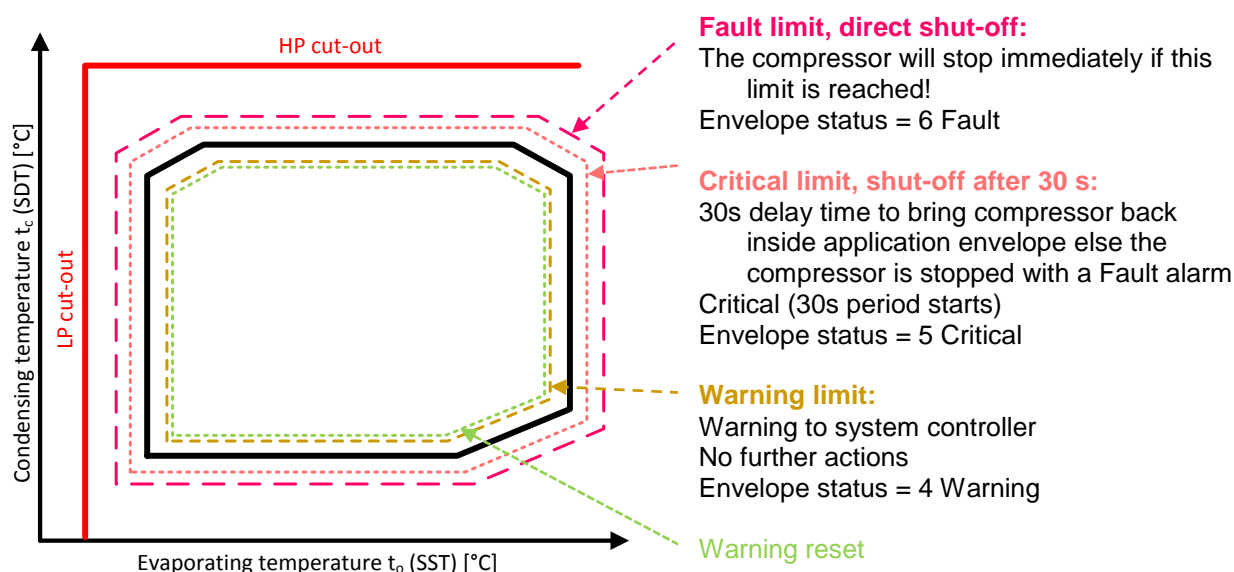
3.2.5 Application limits

The application limits function monitors if the operating conditions of the compressor is within the safe operation area limits – as shown in the BITZER Software when doing compressor calculations. The BITZER Software can be downloaded from BITZER's homepage, www.bitzer.de.

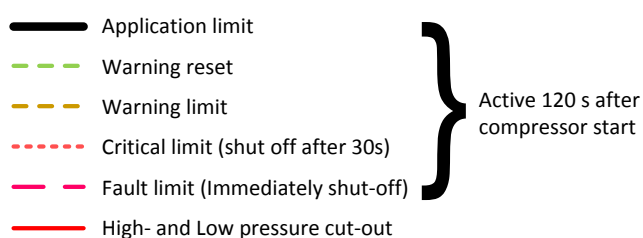
The operating point is determined by the saturated suction and discharge gas temperatures, which are calculated from the suction and discharge gas pressure based on the selected refrigerant.

The figure below shows the multi-level monitoring of the application limits and behaviour when a limit is reached.

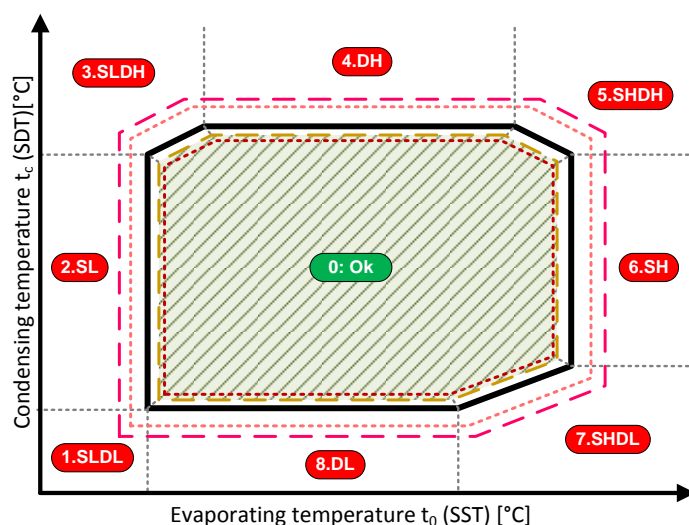
Active warning, critical and faults are set inactive when the operating point again is within the reset-limit.



HP cut-out and LP cut-out are configured in the BEST Software.



There are nine zones in the application limit as shown on the figure below.
Zone zero (the green-shaded area) is the normal, safe operation area within the application limits.



Zone number, description and alarm number:

Zone 1: SST Low, SDT Low	3001
Zone 2: SST Low	3002
Zone 3: SST Low, SDT High	3003
Zone 4: SDT High	3004
Zone 5: SST High & SDT High	3005
Zone 6: SST High	3006
Zone 7: SST High & SDT Low	3007
Zone 8: SDT Low	3008

Zone 0: Normal operation within application limit and no alarms

t_0 (SST) = Evaporating temperature
 t_c (SDT) = Condensing temperature

A warning and a fault will be given if the warning level or fault level is reached.

Please also see envelope faults '30-*' in section 9 Alarm system.

After a stop due to fault limit, the fault can be reset when the compressor is stopped. If timed resets are enabled, the CM-SW-01 will perform a timed reset otherwise an external reset is required. The CM-SW-01 will start the compressor again if the start command is active or when it is applied again.

Please observe:



There is no Application limits monitoring the first period after start of the compressor.
The period varies for the compressor type, can be up to 120 s.
Envelope status = 2 – Start up

Section 10.4.2 Status – compressor lists two parameters that relate to the application envelope:

- Envelope Status** lists the status of the compressor and if there should be warnings related to the envelope:
 Envelope status 4 – warning means the operating point of the compressor is between the warning limit and the critical limit.
 Envelope status 5 – critical means the operating point of the compressor is between the critical limit and the fault limit and is only allowed to be there for 30 seconds from this warning became active.
 Envelope status 6 – fault means the compressor is stopped since the operating point of the compressor has been outside the critical limit for more than 30 seconds or has exceeded the fault limit
- Envelope Zone** shows in which zone the compressors operating point is right now or if a fault is active, in which zone the operating point was **when** the fault was set.
 The zones are listed above.
 The zone is zero if the operating point is within the warning limit and no envelope faults are active.

4. Datalog

The built-in data logger stores operation data, sensor data, alarms and events for further analysis using the BEST Software.

The data are stored in the data logger flash memory at regular intervals together with counters and statistics data collected and summarized over time. The lifetime of the different data varies.

The datalog contains the following type of entries

- Alarms
- Events
- Datalog information
- Periodic data
- Statistics and counters

4.1.1 Alarms

Information logged:

- Timestamp
- Alarm code and text
- Severity, can be Fault, Critical or Warning
- Set or Clear

Critical and warnings have Set and Clear entries. E.g.

23-11-2015 03:58	4301: Motor Temperature High - Warning - Set
...	
23-11-2015 04:02	4301: Motor Temperature High - Warning - Clear

For faults only Set entries are found. E.g.:

07-11-2015 11:01	3431: High Pressure Switch - Fault - Set
-------------------------	-------------------------------------------------

When all faults are successfully reset and the CM-SW-01 is no longer in fault state, there is an entry like this:

02-12-2015 10:45	0: No Fault - Fault - Clear
-------------------------	------------------------------------

Lifetime of alarm entries: 365 days.

4.1.2 Events

Possible events:

- Power Up
- Power Down
- Extern alarm reset
- Compressor Start
- Compressor Stop
- Service tool connect

Lifetime of events: 30 days

4.1.3 Datalog information

If bad sections are found in the datalog storage during download, an event is entered, telling that this has happened. If possible, information is added about the number of log entries that was lost.

4.1.4 Periodic data

Data are stored on a regularly basis.

10 seconds interval when the compressor is running, 60 seconds when stopped.

3 seconds interval for fault traces.

Lifetime of events: 1 – 3 weeks

4.1.5 Statistics and counters

Every midnight at 0:00 and at every Power Down a number of entries with counters or statistics are logged. Every one of these entries has a timestamp and some specific data as described below.

4.1.6 Accumulated operation counters

All accumulated since first power up

- No of PowerUps
- No of Motor Starts
- Operating Hours
- Motor Operating Hours

Lifetime: 365 days

4.1.7 Capacity load

- Device Operating Time – number of minutes, that is basis for the next values
- Cap.Load 0 – percentage of the time, where the compressor was at standstill
- Cap.Load 11-20 – percentage of the time, where the compressor had a load in the range 11-20 %
- ...
- Cap.Load 91-100 – percentage of the time, where the compressor had a load in the range 91-100 %

Lifetime: 365 days

4.1.8 Daily counters

- Device Power Ups
- Compressor Starts
- Number of Faults
- Number of Criticals
- Number of Warnings
- Device Operating Time
- Compressor Runtime
- Fault Runtime
- Critical Runtime
- Warning Runtime
- Capacity Usage Rate

Lifetime: 365 days

4.1.9 Runtime statistic

- Number of runs 0-4 min
- Number of runs 5-9 min
- Number of runs 10-19 min
- Number of runs 20-29 min
- Number of runs 30-59 min
- Number of runs 60-119 min
- Number of runs 120-299 min
- Number of runs >300 min

Lifetime: 365 days

4.1.10 Compressor start statistic

- starts/h
- 2-4 starts/h
- 5-9 starts/h
- 10-14 starts/h
- 15-19 starts/h
- >20 starts/h

Lifetime: 365 days

5. Control of the CM-SW-01

Control commands and setpoint can be given to the CM-SW-01 via different interfaces

Digital inputs:	Start/stop
Analogue input:	Setpoint
Serial control:	Commands and setpoint

The commands from the different interfaces are merged and the resulting "Control Word" can be read via the serial Interface.

The capacity is limited between 10 % and 100 % even if the sum of the setpoints may be below 10 % or above 100 %.

The serial protocol is Modbus (RTU). Modbus can be connected for example for monitoring only but still using the digital and analogue inputs for control of the CM-SW-01. Most common is to monitor and control the CM-SW-01 via the Modbus interface.

The serial control is inactive by default. Please see section 5.2 Enable serial control.

5.1 Commands and setpoint

The basic operation of the CM-SW-01 is controlled by

- Commands: Start and stop
- Setpoint – analogue or serial control
- Setting of serial control parameters
 - "Serial Control Source"; default is none: 0 – 10V input
See parameter in section 10.5.1 Configuration – application
 - Setting of the refrigerant (if not done via the BEST Software)

Commands and setpoint can be given via the digital and analogue inputs or by combining the digital and analogue inputs with values from the serial interface. See later in this section.

5.1.1 Command Start

The Start command becomes active when a start signal is given via digital input or serial control.

If the compressor is started too many times per hour, the CM-SW-01 will give a warning but the compressor will be allowed to start

The capacity of the compressor will normally match the setpoint. Details are described below.

When the motor is running and the start condition is removed (Start is set to inactive), the compressor is stopped.

5.1.2 Setpoint – and speed changes

The setpoint is a value in the range -100 % to +100 %. There is no ramping of a capacity change request. The setpoint from the analogue input and the serial control are added. E.g. the analogue signal could be an offset and the serial control could be the fine tuning.

Analogue control: Apply a 0 – 10V capacity signal (0 – 100%) to the CN13 Cap. Input.

Serial control: Set the capacity request in parameter Serial Setpoint (-100 % – +100%)

Please see section 10.3.1 Control – application for the parameter to use for the setpoint.

5.2 Enable serial control

The serial control is inactive by default.

To enable the serial control set the parameter to 1 (COM1 Modbus).

To disable serial control:

Set parameter "Serial Control Source" to 0 (= None).

5.3 Required signals to start the compressor

Min. signals required to start the compressor via the CM-SW-01

5.3.1 Digital and analogue signals

Serial Control Source = 0 (None)

Start command CN2:Relay C	Setpoint CN13:Cap. Input	Compressor State
–	–	Stopped
Off	–	Stopped
On	0 – 100%	Running

Note: Please observe max number of starts per hour

5.3.2 Serial control (Modbus)

Serial Control Source = 1 (Modbus)

Start command Control Word	Setpoint Serial Setpoint	Compressor state
–	–	Stopped
Off	–	Stopped
On	±100 %	Running

Note: Please observe max number of starts per hour

Control commands can be given to the CM-SW-01 via the Serial Control Word. The bit definitions are shown in the table below.

The protocol used is Modbus (RTU). Modbus register definitions are listed in section 10.3 Parameters.

5.4 Control Word bit definitions

Bit	Function	Description
0-2	Reserved	Must be set to 1
3	Operation enable	Enable operation (0=off, 1 = enabled)
4	Reserved	Must be set to 1
5	Reserved	Must be set to 1
6	Start	Start command is active when bit = 1
7	Reset	Reset alarm command is active when bit is set from 0 to 1. Positive edge triggered.
8-9	Reserved	
10	Data valid	Instruct controller to accept control word. Otherwise all other bits are ignored. The resulting control word will always have this set. Please see section 10.3.1 Control – application
11-15	Reserved	

The data valid bit must be set to update the serial control word and the serial setpoint.

The Control Word is the active control word.

Use the Serial Control Word for configuration of the CM-SW-01.

5.4.1 Data valid bit

When the data valid bit is set to “1” setpoint and commands are accepted from the serial control interface.

When the data valid bit is set to “0” all other bits in the control word and the setpoint are ignored. This means that if the start command was active just before the data valid bit is set to “0” the command remains active until the data valid bit is set to “1” and the start bit is set to “0”.

Please note that the Serial Control Source must be 1 (Modbus).

5.5 Examples of Serial Control Word setups:

Command	Hexadecimal value	Decimal value	Binary							
			Reserved	Data valid	Reserved	Reset	Start	Reserved	Operation enable	Reserved
No command	43F	1087	0000 0	1	00	0	0	11	1	111
Start	47F	1151	0000 0	1	00	0	1	11	1	111
Reset	4BF	1215	0000 0	1	00	1	0	11	1	111
Stop	437	1079	0000 0	1	00	0	0	11	0	111

'No command' is the neutral value allowing digital control.

The neutral value of the control word is 43F hex (= 1087 dec = 10000111111 binary)

To start the compressor, the control word must be 47F hex (= 1151 dec = 10001111111 binary)

To disable this interface: Please see section 10.5.1 Configuration – application.

In the status word the actual status of the CM-SW-01 can be seen.

5.6 Status Word bit definitions

CM-SW-01 Status Word

Bit	Function	Description
0	Control ready	The control is ready to switch on 0: Control not operational 1: The control is ready for operation
1	Operation ready	The CM-SW-01 is ready to operate 0: Output is not ready 1: Output is ready
2	Operation enabled	0: Output is off. Compressor is stopped 1: Compressor is on
3	Fault	0: No fault present 1: A fault is present. The compressor is stopped
4	Reserved	
5	Reserved	
6	Start disabled	0: Start is enabled. 1: Start is disabled
7	Warning	0: No warning present 1: A warning is present. The CM-SW-01 continues operation, but attention may be required
8	On reference	0: The compressor is ramping or not running 1: The compressor is operating at setpoint
9	Reserved	
10	Reserved	
11	Running	0: Compressor is not running 1: The compressor is running
12	Start active	0: Start command is not given OR start is prohibited 1: Start command is given (e.g. start signal is given, setpoint > 0 %) and Operation is enabled
13	Critical	0: No critical present 1: A critical is present. The CM-SW-01 is close at its limits and may soon stop the compressor
14-15	Reserved	

5.7 Setting the serial setpoint

The serial setpoint is set via the Modbus holding register 111:

Name	Possible values	Default	Description	Modbus type & addr
Serial Setpoint (Control.SerSetpoint)	-100.00 % - 100.00 % scale 100 sint16	0 %	Capacity setpoint written by serial communication	HR 111

5.8 Serial Control Timeout Function

If the communication is interrupted, the CM-SW-01 can be configured for different reactions to this interrupt

- None – continue operation
- Stop – stop operation
- Fault – Stop and signal fault alarm

Default function is to let the CM-SW-01 continue without any changes (None).

The timeout for activation and the different reactions of the Serial Control Timeout Function can be adjusted. Every update of the Serial control word resets the timeout function.

Default timeout is 60 seconds.

Please see section 10.5.1 Configuration – application for further information.

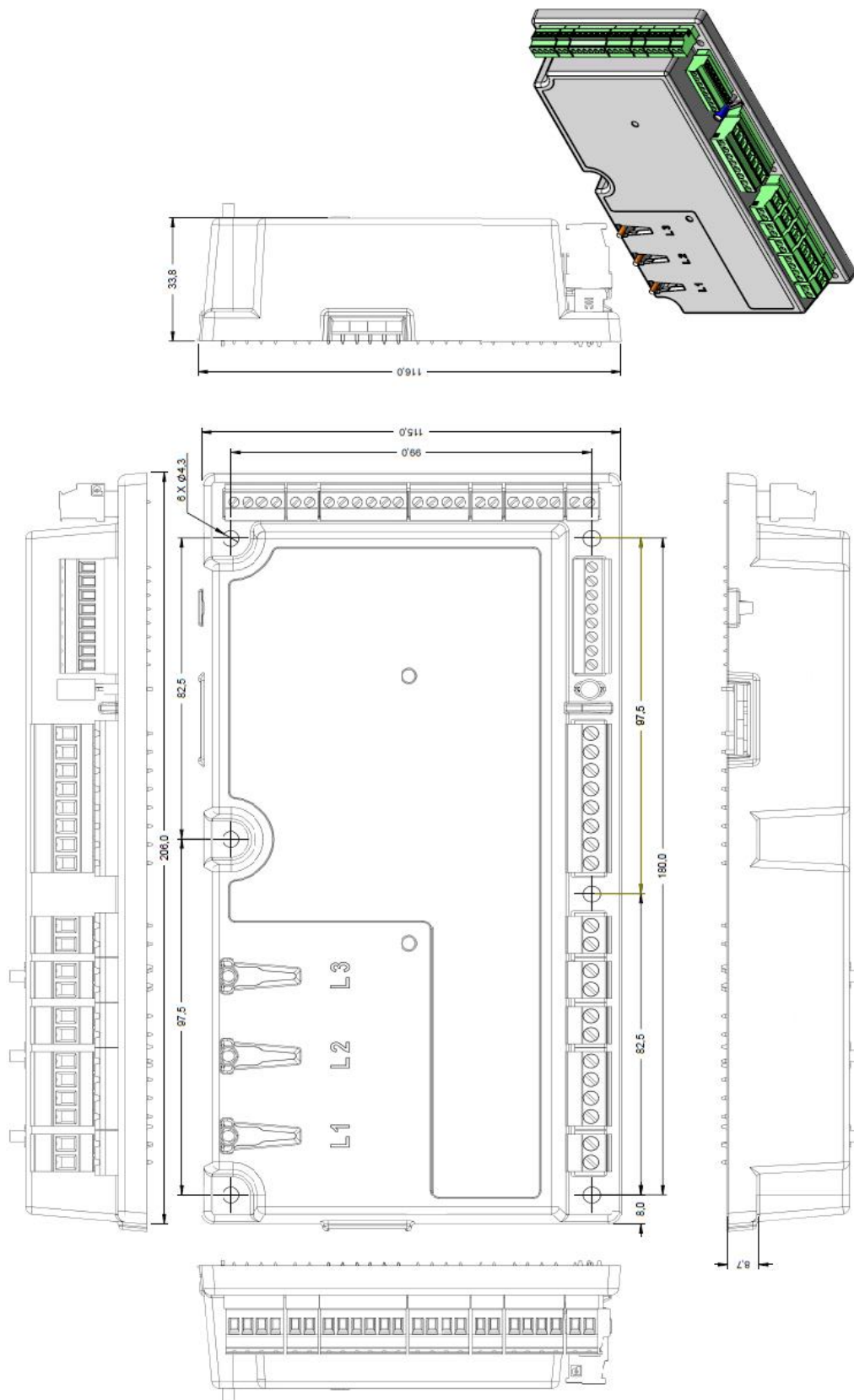
6. I/O List for CM-SW-01

Connector	Name	Type/ Function	Logic	Description
Supply CN1	L N	Supply	-	Supply for CM-SW-01 and control outputs; 115 V-230 V; +10% ~ -15%, 50/60 Hz; max 500 VA with external components Fuse 8A T @115VAC; 4A T@230VAC
Contactor Control CN2	K1 Ctrl	Motor Start	NO	Activate K1 contactor 115 V-230 V; +10% ~ -15%, 50/60 Hz; max 2,5A; C300 max 100.000 cycles; D300 max 350.000 cycles
	K2 Ctrl	Motor Start	NO	Activate K2 contactor 115 V-230 V; +10% ~ -15%, 50/60 Hz; max 2,5A; C300 max 100.000 cycles; D300 max 350.000 cycles
	Relay C	Input	NO	Compressor run signal 115 V-230 V; +10% ~ -15%, 50/60 Hz
Fault CN2	Relay NC	Input	NC	Fault relay; 115 V-230 V; +10% ~ -15%, 50/60 Hz; max 2,5A; C300 max 100.000 cycles
HP Switch CN3	HPS-1 HPS-2	Output Input	NO	115 V-230 V; +10% ~ -15%, 50/60 Hz; max 2,5A; 115 V-230 V; +10% ~ -15%, 50/60 Hz
Control output CN4	Control 1 N	Output Neutral	NO	Future use 115 V-230 V; +10% ~ -15%, 50/60 Hz; max 2A ⁽¹⁾
Control Output CN5	Control 2 N	Output Neutral	NO	Additional fan 115 V-230 V; +10% ~ -15%, 50/60 Hz; max 2A ⁽¹⁾
Control Output CN6	CR+ N	Output Neutral	NO	CR+ slider valve 115 V-230 V; +10% ~ -15%, 50/60 Hz; max 2A ⁽¹⁾
	CR- N	Output Neutral	NO	CR- slider valve 115 V-230 V; +10% ~ -15%, 50/60 Hz; max 2A ⁽¹⁾
	Vi+ N	Output Neutral	NO	Vi+ slider valve 115 V-230 V; +10% ~ -15%, 50/60 Hz; max 2A ⁽¹⁾
	Vi- N	Output Neutral	NO	Vi- slider valve 115 V-230 V; +10% ~ -15%, 50/60 Hz; max 2A ⁽¹⁾
	INIT- INIT+ Start/stop- Start/stop+ +24V supply GND	Supply Ground	Serial	Slider position sensor RS422 interface +24 VDC ±10%; max 100 mA 0 V ground
	+24V Supply GND Signal	Supply Ground Input	NO	+24 VDC ±10%; max 100 mA 0 V ground Oil level signal. Sourcing to ground; max 24 VDC; max 20 mA 0V ground for Signal
Oil Sensor 1 CN9	GND	Ground		
Motor PTC CN10	PTC-1 PTC-2	Signal Signal	Temperature Temperature	Motor temperature 0 – 50 kΩ; PTC sensor according to DIN 44081/44082 1 – 9 in series. Max. total resistance: < 1,8 kΩ Short circuit fault detection implemented Rtrig: 11,4 kΩ ±20% Rreset: 2,9 kΩ ±20%
Taux CN11	Signal GND	Input Ground	Temperature	Auxiliary temperature. PT1000 sensor; -40°C ~ +100°C; accuracy: ±2°C 0V
Tdis	Signal	Input	Temperature	Discharge temperature.

Connector	Name	Type/ Function	Logic	Description
CN11	GND	Ground		PT1000 sensor; 0°C ~ +200°C; accuracy: ±2°C 0V
Pdis CN12	+5V Supply Signal GND	Supply Input Ground	Pressure	Discharge pressure. Sensata 2CP5-71-47 (rel) or equivalent +5 VDC; max 10 mA 1 - 35 bar abs.; 0 - 5V ratio metric; accuracy ±1% F.S. 0V
Psuc CN12	+5V Supply Signal GND	Supply Input Ground	Pressure	Suction pressure. Sensata 2CP5-71-49 (abs) or equivalent +5 VDC; max 10 mA 0 - 13 bar abs.; 0 - 5V ratio metric; accuracy ±1% F.S. 0V
Cap. Input 0-10V CN13	Input GND	Input Ground	Capacity	0 – 100 % capacity; 0 – 10 V input; Rin 39 kΩ; accuracy ±2% 0V for Capacity input only; 100 Ω safety Rin
RS485 CN14	DATA+ DATA- Supply In GND	RS485 RS485 Supply Ground	Serial Serial Optional Ground	Modbus (RTU) serial communication; DATA+ Modbus (RTU) serial communication; DATA- Optional 24 VDC supply Ground for serial communication

Note (1): Max 500 VA total for the 6 control outputs.

7. Drawings



Mounting is inside a new element for the terminal box. Size of the element depends on the compressor model.

8. Standards

The CM-SW-01 is manufactured according to the following standards

- 2011/65/EU RoHS
- 2014/35/EC Low voltage directive
- 2014/30/EC EMC directive

The following standards have been used

- EN 61010-1:2010 Safety requirement for electrical equipment for measurement and control
- EN 61000-6-2:2005 Generic EMC Immunity for industrial environment
- EN 61000-6-3:2007 Generic EMC Emission for residential, commercial and light-industrial environments

9. Alarm system

Both warning, alarm and locked states are visible via LEDs and via the serial communication bus. Via the serial communication bus, more information regarding an alarm is available as listed in the table below.

9.1 Alarm severity types

There are the following alarm severity types:

Fault:

- If a fault-level alarm condition is detected, the CM-SW-01 will open the relays for the motor contacts and stop the compressor motor.
- A fault is logged in the fault log.

Critical:

- If a critical-level alarm condition is detected, operation may continue but for a limited time or with reduced performance.

Warning:

- A warning is signalled when a condition occurs which may require attention but is not severe enough to stop operation of the compressor. The compressor keeps running.

Warnings, Criticals and Faults can be active at the same time as they may have separate alarm and reset limits.

9.2 Fault reset types

Below are listed the different methods to reset faults.

A reset will dismiss faults only if the fault condition has disappeared.

An external-reset resets both externally alarms and timed resettable alarms; a timed reset however, can only reset timed resettable alarms.

Restart: Cleared by a power cycle of the CM-SW-01

Extern reset: The fault is cleared if the fault condition has disappeared when the reset command is received

Timed reset: Timed reset is an automatic, repetitive, timed reset.
Timed resets will be issued with an interval of "Timed Reset Timeout" time as long as a timed resettable fault is present.

Auto: Automatic reset of faults when the fault condition disappears.

9.3 Alarm list

Alarm No.	Text	Warning	Critical	Fault	Fault type
10-*	System - Operation				
1000	Too many identical timed reset faults in 24 hours	No	No	Yes	Extern
1001	Too many timed reset faults in 1 hour	No	No	Yes	Extern
11-*	System - Communication				
1100	Serial Control Timeout	Yes	No	Yes	Timed
12-*	System - Supply				
1200	Mains Failure	No	No	Yes	Timed
20-*	Application - Operation				
2000	LOCKED	No	No	Yes	Extern
27-*	Application - SW Configuration				
2700	Setup Fault	No	No	Yes	Restart
30-*	Compressor - Operation				
3001	Envelope: SST Low, SDT Low	Yes	Yes	Yes	Timed
3002	Envelope: SST Low	Yes	Yes	Yes	Timed
3003	Envelope: SST Low, SDT High	Yes	Yes	Yes	Timed
3004	Envelope: SDT High	Yes	Yes	Yes	Timed
3005	Envelope: SST High, SDT High	Yes	Yes	Yes	Timed
3006	Envelope: SST High	Yes	Yes	Yes	Timed
3007	Envelope: SST High, SDT Low	Yes	Yes	Yes	Timed
3008	Envelope: SDT Low	Yes	Yes	Yes	Timed
3010	Envelope: Startup Timeout	No	No	Yes	Timed
3011	Envelope: Configuration Failure	No	No	Yes	Restart
3022	Too Many Compressor Starts	Yes	No	No	N/A
3024	Minimum Compressor Stop Time Not Respected	Yes	No	No	N/A
3025	Minimum Compressor Run Time Not Respected	Yes	No	No	N/A
3026	Minimum Compressor Start To Start Time Not Respected	Yes	No	No	N/A
3027	Compressor Start without being fully unloaded	Yes	No	No	N/A
33-*	Compressor - Temperature				
3302	Discharge Temperature High	Yes	Yes	Yes	Timed
34-*	Compressor - Pressure				

Alarm No.	Text	Warning	Critical	Fault	Fault type
3400	Suction Pressure Low	No	No	Yes	Timed
3411	Discharge Pressure High	No	No	Yes	Timed
3431	High Pressure Switch	No	No	Yes	Extern
35-*	Compressor - Other Input				
3500	Oil Level Low	No	Yes	Yes	Extern
3501	Oil Fault Level	No	Yes	Yes	Extern
3502	Oil Pressure Low	No	Yes	Yes	Extern
3503	Oil Stop Valve	No	Yes	Yes	Extern
3520	Oil Injection Has No Effect	Yes	No	Yes	Extern
42-*	Motor - Supply				
4201	Motor Phase Loss	No	No	Yes	Timed
4202	Motor Phase Sequence	No	No	Yes	Extern
4220	Motor frequency low	No	No	Yes	Extern
4221	Motor frequency high	No	No	Yes	Extern
43-*	Motor - Temperature				
4301	Motor Temperature High	Yes	Yes	Yes	Extern
4302	Motor Temperature Cooldown	No	No	Yes	Timed
58-*	Device - Electronics Fault				
5851	HW: 24V	No	No	Yes	Restart
67-*	Device - SW Configuration				
6700	Config Data: No File	No	No	Yes	Restart
6701	Config Data: CRC Error	No	No	Yes	Restart
6702	Config Data: Wrong Version	No	No	Yes	Restart
6703	Config Data: Read Only	No	No	Yes	Restart
68-*	Device - Electronics Fault				
6810	HW: 3.3V	No	No	Yes	Restart
6811	HW: User 5V	No	No	Yes	Restart
6813	HW: 24V	No	No	Yes	Restart
69-*	Device - Other				
6900	Datalog error	Yes	No	No	N/A
73-*	Sensor - Temperature				

Alarm No.	Text	Warning	Critical	Fault	Fault type
7304	Sensor: Motor Thermistor	No	Yes	Yes	Timed
7308	Sensor: Discharge Temperature	No	No	Yes	Timed
7320	Sensor: Aux Temperature	No	No	Yes	Timed
74-*	Sensor - Pressure				
7401	Sensor: Suction Pressure	No	No	Yes	Timed
7402	Sensor: Discharge Pressure	No	No	Yes	Timed
7403	Sensor: Suction Pressure Signal Low	No	No	Yes	Timed
7404	Sensor: Suction Pressure Signal High	No	No	Yes	Timed
7405	Sensor: Discharge Pressure Signal Low	No	No	Yes	Timed
7406	Sensor: Discharge Pressure Signal High	No	No	Yes	Timed
75-*	Sensor - Other Input				
7510	Sensor: Oil protection	No	No	Yes	Timed
7511	Sensor: Oil protection 2	No	No	Yes	Timed
7580	Slider: No pulses detected, so we suppose that the sensor is not connected	Yes	No	No	N/A
7581	Slider: One or more sensor magnets are missing	Yes	No	No	N/A
7582	Slider: Something was wrong with the data samples	Yes	No	No	N/A
7583	Slider: Too many magnets were detected	Yes	No	No	N/A
7584	Slider: Slider position out of bounds	Yes	No	No	N/A
82-*	Actuator - Supply				
8200	Output Current: Total Value Low	Yes	No	No	N/A
8201	Output Current: Total Value High	Yes	No	No	N/A
8202	Output Current: Oil Heater Low	Yes	No	No	N/A
8203	Output Current: Oil Heater High	Yes	No	No	N/A
8204	Output Current: Head Fan Low	Yes	No	No	N/A
8205	Output Current: Head Fan High	Yes	No	No	N/A
8206	Output Current: Control 1 Low	Yes	No	No	N/A
8207	Output Current: Control 1 High	Yes	No	No	N/A
8208	Output Current: Control 2 Low	Yes	No	No	N/A
8209	Output Current: Control 2 High	Yes	No	No	N/A
8210	Output Current: CR+ Low	Yes	No	No	N/A
8211	Output Current: CR+ High	Yes	No	No	N/A

Alarm No.	Text	Warning	Critical	Fault	Fault type
8212	Output Current: CR- Low	Yes	No	No	N/A
8213	Output Current: CR- High	Yes	No	No	N/A
8214	Output Current: Vi+ Low	Yes	No	No	N/A
8215	Output Current: Vi+ High	Yes	No	No	N/A
8216	Output Current: Vi+ Low	Yes	No	No	N/A
8217	Output Current: Vi- High	Yes	No	No	N/A
8218	Output Current: HW Trip	No	No	Yes	Extern
85-*	Actuator - Other Input				
8580	Slider: Moving Vi slider failed	Yes	No	No	N/A
8581	Slider: Moving CR slider failed	Yes	No	No	N/A
8582	Slider: Gap between the two sliders	Yes	No	No	N/A
8583	Slider: Gap between zero and Vi slider	Yes	No	No	N/A

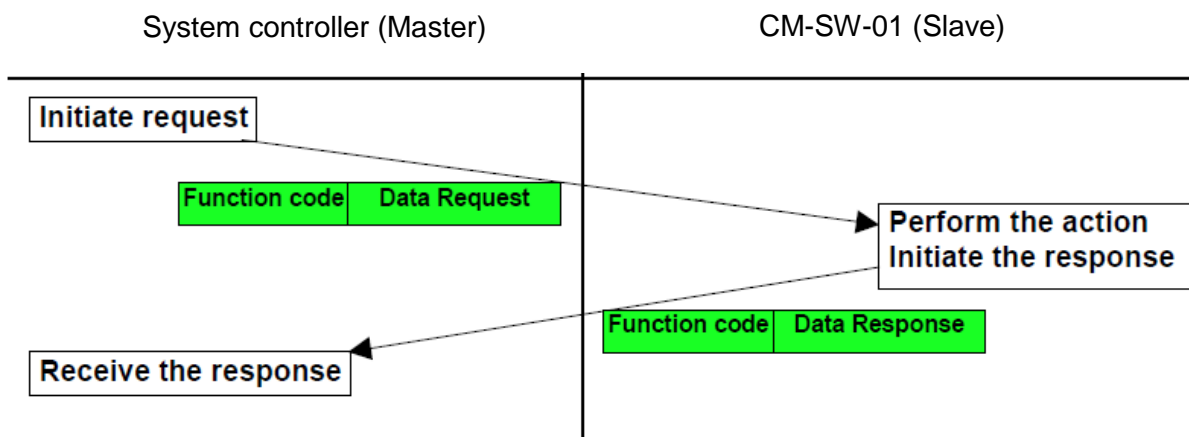
10. Programming and monitoring

10.1 Introduction

For monitoring and controlling the CM-SW-01, there is a built-in Modbus (RTU) interface.

10.2 Serial communication

Communication with the CM-SW-01 is via Modbus (RTU). Configuration and reading of status from the CM-SW-01 is described in the following sections.



10.2.1 Modbus (RTU) configuration

Specification of the protocol:

Protocol: Modbus (RTU mode). See <http://www.modbus.org/specs.php>
 Modbus address: Default address 48 (30 hex), can be changed to 1 – 247.
 Baud rate: Default 19200; 4800, 9600, 19200, 38400 and 115200 are selectable.
 Number of data bits: 8
 Parity: Default Even; None and Odd are selectable
 Number of stop bits: Default 1; 2 (only 2 if Parity is set to None)

Setup of communication configuration is done via the BEST Software using COM1.

Setting of the parameters via BEST or Modbus: Address, Baud rate and Parity will not result in immediate changes of the communication. The setting will be made active by cycling power to the module.

10.2.2 Data values, scaling and data types

Following is a description of used scaling and data types.

Scale 1, 10 and 100 refers to where the decimal point is implied, as a decimal value cannot be transmitted via Modbus.

Scale 1: The value is the exact value

Scale 10: To transmit a value it must be multiplied by 10; i.e. 12.3 -> 123

A received value must be divided by 10; i.e. 123 -> 12.3

Scale 100: To transmit a value it must be multiplied by 100; i.e. 1.23 -> 123

A received value must be divided by 100; i.e. 123 -> 1.23

uint8: unsigned 8-bit integer

uint16: unsigned 16-bit integer

sint16: signed 16-bit integer

uint32: unsigned 32-bit integer

10.2.3 Reading and writing 32 bit values via Modbus

32 bit values must be read as two consecutive Modbus registers.

For example, if the fault word in the input registers 11000-11001 should be read.

B3	B2	B1	B0
MSB			LSB

	Register A		Register A+1	
Transmitted	First			Last
Default	B1	B0 (LSB)	B3 (MSB)	B2

Function code 10hex write multiple registers should be used.

10.2.4 Modbus function codes

The following function codes have been implemented from the standard Modbus protocol:

Function	Code (hexadecimal)	Code (decimal)	Remarks
Read Holding Registers	03	03	
Read Input Register	04	04	
Write Single Register	06	06	
Diagnostics	08	08	Sub-functions ⁽¹⁾ 0, 10-18 & 20 (decimal) 0, 0A-12, 14 (hexadecimal)
Get Comm Event counter	0B	11	
Write Multiple Registers	10	16	
Read/Write Multiple Registers	17	23	

Note1: Not all sub-functions return a value.

All input registers can also be read as holding registers.

10.2.5 Modbus exception codes

Code	Name	Meaning
01	Illegal function	The function code is not valid.
02	Illegal data address	The specified register is not valid
03	Illegal data value	The value is not allowed
04	Slave device failure	Unrecoverable error in slave.

10.3 Parameters

The parameters are separated into logical groups. Setup of the parameters is possible via either Modbus or the BEST Software.

Name: Parameter name.
Possible values: Parameter unit, scale and range for some parameters.
Default: The default settings of the parameters.
Description: Description of the parameter and specific settings for some parameters marked with italics.
Modbus type & addr.: Modbus register address and type of register.
IR is an Input register.
HR is a Holding register.
Please observe that register addresses are used in this manual

The parameters are subject to changes.

10.3.1 Control – application

The group contains parameters related to control of the compressor

Name	Possible values	Default	Description	Modbus type & addr
Setpoint (Control.Setpoint)	unit % scale 100 sint16	-	Active capacity setpoint	IR 100
Actual Value (Status.CapacityAvg)	unit % scale 100 sint16	-	Average capacity delivered	IR 101
Control Word (Control.ControlWord)	unit None scale 1 uint16	-	Active control word	IR 102
Status Word (Control.StatusWord)	unit None scale 1 uint16	-	Operation status word	IR 103
Serial Control Word (Control.SerCtrlWord)	0 - expr scale 1 uint16	expr	Control word written by serial communication	HR 110
Serial Setpoint (Control.SerSetpoint)	-100.00 % - 100.00 % scale 100 sint16	0 %	Capacity setpoint written by serial communication	HR 111

10.4 Status data

10.4.1 Status – alarm

The group contains information about current state of alarms

Name	Possible values	Default	Description	Modbus type & addr
Number of active alarms	unit None scale 1 uint16	-	Number of active alarms	IR 11100
Number of listed alarms that has not yet been cleared	unit None scale 1 uint16	-	Number of listed alarms that has not yet been cleared	IR 11101
Highest state of any listed alarm	unit None scale 1 uint8	-	Highest state of any listed alarm (0=Clear, 1=Inactive, 2=Active, 3=Set)	IR 11102
Highest severity level of any active alarm	unit None scale 1 uint8	-	Highest severity level of any active alarm (0=None, 1=Log, 2=Event, 4=Info, 8=Warning, 16=Critical, 32=Fault)	IR 11103
Locked	unit None scale 1 uint8	-	If locked, the CM-SW-01 is waiting for external reset command or restart (0=No, 1=Yes)	IR 11104
Reset level required to clear any active alarm	unit None scale 1 uint8	-	Reset level required to clear any active alarm (0=NA, 1=Auto, 2=Timer, 3=Extern, 4=Restart)	IR 11105
Code of highest ranked alarm (AlarmStatus.Alarm1)	unit None scale 1 uint16	-	Code of highest ranked alarm	IR 11201
Code of second highest ranked alarm (AlarmStatus.Alarm2)	unit None scale 1 uint16	-	Code of second highest ranked alarm	IR 11202
AlarmStatus.Alarm3	unit None scale 1 uint16	-		IR 11203
AlarmStatus.Alarm4	unit None scale 1 uint16	-		IR 11204
AlarmStatus.Alarm5	unit None scale 1 uint16	-		IR 11205
AlarmStatus.Alarm6	unit None scale 1 uint16	-		IR 11206
AlarmStatus.Alarm7	unit None scale 1 uint16	-		IR 11207

Name	Possible values	Default	Description	Modbus type & addr
AlarmStatus.Alarm8	unit None scale 1 uint16	-		IR 11208
AlarmStatus.Alarm9	unit None scale 1 uint16	-		IR 11209
AlarmStatus.Alarm10	unit None scale 1 uint16	-		IR 11210

The registers AlarmStatus.Alarm 1 .. Alarm10 are 16 bit values. The bit decoding is as follows:

Bit	Description
0 .. 9	Index number (not display code) Please refer to cross reference table below
10..12	Alarm severity: 0: None, 1: Log, 2: Info, 3: Warning, 4: Critical, 5: Fault
13..13	(reserved)
14..15	Alarm state: 0: Clear, 1: Inactive, 2: Active, 3: Set (condition is present)

Cross reference table between alarm number and internal alarm index.

Alarm number	Index number	Description
0	0	No Fault
1000	119	Too many identical timed resets in 24 hours
1001	120	Too many timed resets in 1 hour
1100	1	Serial Control Timeout
1200	2	Mains Failure
2000	72	LOCKED
2700	73	Setup Fault
3001	3	Envelope: SST Low, SDT Low
3002	4	Envelope: SST Low
3003	5	Envelope: SST Low, SDT High
3004	6	Envelope: SDT High
3005	7	Envelope: SST High, SDT High
3006	8	Envelope: SST High
3007	9	Envelope: SST High, SDT Low
3008	10	Envelope: SDT Low
3010	11	Envelope: Startup Timeout
3011	12	Envelope: Configuration Failure
3022	74	Too Many Compressor Starts
3024	98	Minimum Compressor Stop Time Not Respected

Alarm number	Index number	Description
3025	99	Minimum Compressor Run Time Not Respected
3026	100	Minimum Compressor Start To Start Time Not Respected
3027	71	Compressor Start without being fully unloaded
3302	78	Discharge Temperature High
3400	68	Suction Pressure Low
3411	69	Discharge Pressure High
3431	90	High Pressure Switch
3500	15	Oil Level Low
3501	133	Oil Flow
3502	134	Oil Pressure Low
3503	137	Oil Stop Valve
3520	102	Oil Injection Has No Effect
3900	16	Locked Rotor
4201	18	Motor Phase Loss
4202	19	Motor Phase Sequence
4220	135	Motor Frequency Low
4221	136	Motor Frequency High
4301	20	Motor Temperature High
4302	84	Motor Temperature Cooldown
5851	39	HW: 24V
6700	49	Config Data: No File
6701	50	Config Data: CRC Error
6702	51	Config Data: Wrong Version
6703	52	Config Data: Read Only
6810	54	HW: 3.3V
6811	55	HW: User 5V
6813	70	HW: 24V
6900	91	Datalog error
7304	62	Sensor: Motor Thermistor
7308	85	Sensor: Discharge Temperature
7320	86	Sensor: Aux Temperature
7401	87	Sensor: Suction Pressure
7402	88	Sensor: Discharge Pressure
7403	94	Sensor: Suction Pressure Signal Low
7404	95	Sensor: Suction Pressure Signal High
7405	96	Sensor: Discharge Pressure Signal Low
7406	97	Sensor: Discharge Pressure Signal High
7510	89	Sensor: Oil protection
7511	80	Sensor: Oil protection 2
7580	121	Slider: No Sensor Detected
7581	122	Slider: Less Than Two Magnets Detected
7582	123	Slider: Sample Data Invalid
7583	124	Slider: More Than Two Magnets Detected
7584	125	Slider: Position Invalid
8200	92	Output Current: Total Value Low
8201	93	Output Current: Total Value High
8202	103	Output Current: Oil Heater Low

Alarm number	Index number	Description
8203	104	Output Current: Oil Heater High
8204	105	Output Current: Additional fan (Head fan) Low
8205	106	Output Current: Head Fan High
8206	107	Output Current: CR-1 Low
8207	108	Output Current: CR-1 High
8208	109	Output Current: CR-2 Low
8209	110	Output Current: CR-2 High
8210	111	Output Current: CR-3 Low
8211	112	Output Current: CR-3 High
8212	113	Output Current: Unloader Low
8213	114	Output Current: Unloader High
8214	115	Output Current: Oil Inj Low
8215	116	Output Current: Oil Inj High
8216	117	Output Current: Liquid Inj Low
8217	118	Output Current: Liquid Inj High
8218	140	Output Current: HW Trip
8580	126	Slider: Vi Position Control
8581	127	Slider: CR Position Control
8582	128	Slider: Gap between Vi and CR
8583	129	Slider: Gap between Zero and Vi

10.4.2 Status – compressor

The group contains status information for the compressor

Name	Possible values	Default	Description	Modbus type & addr
Suction Pressure	unit bar(a) scale 100 sint16	-	Suction Pressure	IR 12001
Discharge Pressure	unit bar(a) scale 100 sint16	-	Discharge Pressure	IR 12002
Evaporating Temperature (SST)	unit °C scale 10 sint16	-	Calculated saturated suction temperature (SST)	IR 12003
Condensing Temperature (SDT)	unit °C scale 10 sint16	-	Calculated saturated discharge temperature (SDT)	IR 12004
Envelope Status	unit None scale 1 uint8	-	Envelope operation status (0=Stopped, 1=Starting, 2=Running, 3=Stopping, 4=Warning - inside envelope, 5=Critical - outside envelope, 6=Fault)	IR 12005
Envelope Zone	unit None scale 1 uint8	-	Actual zone of operation (0=Inside, 1=SST Low, SDT Low, 2=SST Low, 3=SST Low, SDT	IR 12006

Name	Possible values	Default	Description	Modbus type & addr
			<i>High, 4=SDT High, 5=SST High, SDT High, 6=SST High, 7=SST High, SDT Low, 8=SDT Low)</i>	
Discharge temperature	unit °C scale 10 sint16	-	Discharge temperature	IR 12010
AUX temperature	unit °C scale 10 sint16	-	AUX temperature	IR 12011
High Pressure Switch	unit None scale 1 uint8	-	High pressure switch (0=Off, 1=On)	IR 12022
Crank Case Oil Heater	unit None scale 1 uint8	-	Crank case oil heater (0=Off, 1=On)	IR 12023
Oil injection valve	unit None scale 1 uint8	-	Oil injection valve (0=Off, 1=On)	IR 12024
Oil Sensor 1	unit None scale 1 uint8	-	Oil Sensor 1 (0=Off, 1=On)	IR 12025
Oil Sensor 2	unit None scale 1 uint8	-	Oil Sensor 2 (0=Off, 1=On)	IR 12026
Motor start is requested	unit None scale 1 uint8	-	Motor start is requested (0=Off, 1=On)	IR 12027
Liquid injection cooling valve	unit None scale 1 uint8	-	Liquid injection cooling valve (0=Off, 1=On)	IR 12029

Note 1: For future compressor versions

10.4.3 Status – motor

The group contains status information for the motor

Name	Possible values	Default	Description	Modbus type & addr
Motor overheat thermistor resistance (PTC)	unit Ohm scale 1 uint16	-	Motor overheat thermistor resistance (PTC) ¹⁾	IR 13001
Estimated motor power consumption	unit kW scale 10 uint16	-	Estimated motor power consumption ¹⁾	IR 13002
Motor drive frequency (speed)	unit Hz scale 10 uint16	-	Motor drive frequency (speed) ¹⁾	IR 13003
Motor phase detection state	unit None scale 1 uint8	-	Motor phase detection state ¹⁾ (0=STOP, 1=RUN, 2=REVERSE, 3=L1_LOSS, 4=L2_LOSS, 5=L3_LOSS, 6=L1_L3_LOSS, 7=FREQ_LOW, 8=FREQ_HIGH, 9=ERROR)	IR 13004
Motor phase current	unit A scale 100 sint16	-	Motor phase current ¹⁾	IR 13005
Motor start contactor 1	unit None scale 1 uint8	-	Motor start contactor 1 (0=Off, 1=On)	IR 13006
Motor start contactor 2	unit None scale 1 uint8	-	Motor start contactor 2 (0=Off, 1=On)	IR 13007

Note 1: For future compressor versions

10.4.4 Status – device

The group contains operating state for the CM-SW-01

Name	Possible values	Default	Description	Modbus type & addr
System operating state	unit None scale 1 uint8	-	System operating state (0=CONFIG, 1=INPUT, 2=STARTUP, 3=READY, 4=SUSPEND, 5=SERVICE, 6=PRODUCTION)	IR 14000

10.4.5 Status – IO

The group contains status information for I/O of the CM-SW-01

Name	Possible values	Default	Description	Modbus type & addr
Control Output Current	unit A scale 100 sint16	-	Control output current	IR 15150
State of the Operation LED	unit None scale 1 uint8	-	State of the Operation LED (0=OFF, 1=ON, 2=SLOW_SHORT, 3=SLOW_MED, 4=SLOW_LONG, 5=FAST_SHORT, 6=FAST_MED, 7=FAST_LONG)	IR 15990
State of the Warning LED	unit None scale 1 uint8	-	State of the Warning LED (0=OFF, 1=ON, 2=SLOW_SHORT, 3=SLOW_MED, 4=SLOW_LONG, 5=FAST_SHORT, 6=FAST_MED, 7=FAST_LONG)	IR 15991
State of the Fault LED	unit None scale 1 uint8	-	State of the Fault LED (0=OFF, 1=ON, 2=SLOW_SHORT, 3=SLOW_MED, 4=SLOW_LONG, 5=FAST_SHORT, 6=FAST_MED, 7=FAST_LONG)	IR 15992
State of the Communication LED	unit None scale 1 uint8	-	State of the Communication LED (0=OFF, 1=ON, 2=SLOW_SHORT, 3=SLOW_MED, 4=SLOW_LONG, 5=FAST_SHORT, 6=FAST_MED, 7=FAST_LONG)	IR 15993

10.5 Configuration data

10.5.1 Configuration – application

The group contains information for the application

Name	Possible values	Default	Description	Modbus type & addr
Year	expr - expr scale 1 uint16	0 y	Year	HR 20100
Month and Day	257 - 3103 scale 1 uint16	0	Month and Day	HR 20101

Name	Possible values	Default	Description	Modbus type & addr
Hour and Minute	0 - 5947 scale 1 uint16	0	Hour and Minute	HR 20102
Millisecond	0 ms - 59999 ms scale 1 uint16	0 ms	Millisecond	HR 20103
Serial Control Source	unit None scale 1 uint8	-	Serial Control Source (0=None, 1=COM1 (MODBUS))	IR 20300
Serial Control Timeout Function	unit None scale 1 uint8	-	Serial Control Timeout Function (0=None, 1=Stop, 2=Fault)	IR 20301
Serial Control Timeout Time	unit s scale 1 uint16	-	Serial Control Timeout Time	IR 20302

10.5.2 Configuration – compressor

The group contains configuration information for the compressor

Name	Possible values	Default	Description	Modbus type & addr
Refrigerant selection	unit None scale 1 uint8	-	Refrigerant selection (0=NONE, 8=R717)	IR 22100
Dedicated OEM functionality selection	unit None scale 1 uint8	-	Dedicated OEM functionality selection (0=NONE)	IR 22200
Mains supply voltage specification (single phase)	unit V scale 1 uint16	-	Mains supply voltage specification (single phase)	IR 22300

10.5.3 Configuration – COM1

The group contains information for the serial communication

Name	Possible values	Default	Description	Modbus type & addr
COM1 Address	1 - 247 scale 1 uint8	48	Device address for Modbus connection	HR 65409
COM1 Baudrate	1 - 132 scale 1 uint8	2	Communication speed (1=9600, 2=19200, 3=115200, 129=300, 130=1200, 131=4800, 132=38400)	HR 65410

Name	Possible values	Default	Description	Modbus type & addr
COM1 Stop Bits	1 - 2 scale 1 uint8	1	Number of stop bits (1=1 Stopbit, 2=2 Stopbits)	HR 65411
COM1 Parity	0 - 2 scale 1 uint8	1	Parity check (0=None, 1=Even, 2=Odd)	HR 65412

Setting of the parameters Address, Baud rate and Parity via BEST Software or Modbus will not result in immediate changes of the communication. The setting will be made active by cycling power to the module.

10.5.4 Logs – application

The group contains runtime counters for the application

Name	Possible values	Default	Description	Modbus type & addr
Device Operating Hours	unit h scale 1 uint32	-	Device Operating Hours	IR 30000-30001
Compressor Running Hours	unit h scale 1 uint32	-	Compressor Running Hours	IR 30010-30011
Compressor Start Count	unit None scale 1 uint32	-	Compressor Start Count	IR 30012-30013
Power Up Count	unit None scale 1 uint32	-	Number of module power cycles	IR 30020-30021

10.5.5 Info – compressor type

The group lists the compressor type

Name	Possible values	Default	Description	Modbus type & addr
Compressor type selection	unit None scale 1 uint16	3067	Compressor type selection (0=NONE, 3067=OSKA95103-K)	IR 42100

11. Trouble shooting

- Check if there is power to the unit according to specification.
If the power is ok,
- Turn off the power for 5 seconds and see if the relays are energized after power on and applying the run signal again.
- If not energized:



turn off all the power to avoid risk of injury!

- Un-mount one of the cables to the PTC element in the motor
- If the measured resistance is above $11.4 \text{ k}\Omega \pm 20\%$, the temperature of the PTC-sensor is above the threshold limit and the fault relay has been released to protect the motor or installation.
- If the measured resistance is more than $1 \text{ M}\Omega$, there is a broken connection to the PTC-sensor and the relays will not be engaged.
- If the measured resistance is close to zero Ω , there is a short circuit on the PTC-sensor cables and there is no overheat protection!
- If all three phases are within range and resistance is below $2.9 \text{ k}\Omega \pm 20\%$, the compressor module may be defect and needs replacement.
- Application limits
Via the serial communication the actual zone where the warning or alarm is raised can be read via the BEST Software.
- Verify using BEST Software that CM-SW-01 is configured for the correct compressor and application. Also that the correct compressor start type is configured: DOL, Part winding, Star-delta.

11.1 Communications trouble shooting

- Check the communication cables for correct wiring
- Check if the communication address setting matches the selected.
Note: Address 0 is not allowed! Default address is 48.
- Check if the communication speed matches the selected. Use the BEST Software to read the settings.
- Check if communication is active. There is one LED for communication activity, please see next section.
- Please observe that all registers in the parameters are index based, meaning they start with no. 1 and not with zero.

Use BEST Software for viewing Modbus communication status.

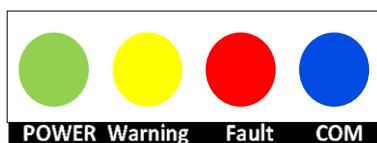
Return codes from Modbus communication if a telegram is not accepted by the CM-SW-01.

Code	Name	Meaning
01	Illegal function	The function code is not valid.
02	Illegal data address	The specified register is not valid
03	Illegal data value	The value is not allowed
04	Slave device failure	Unrecoverable error in slave

Check warning, critical and fault messages via Modbus or BEST Software.

11.2 Status LEDs

There are four LEDs, one LED for communication and three status LEDs. They are visible through the sight glass on the side of the terminal box.



LED Status		Operation Mode	Warning/Critical	Fault	Communication
Flash Frequency	Flash Period	Green	Yellow	Red	Blue
OFF	OFF	Not operational / Start-up / Terminate	No warning	No fault	No communication
Slow Flashing	Short	Service	Warning		
	Medium		Critical	Fault - Auto Resume	
	Long	Test		Fault - Timer Reset	
Fast Flashing	Short				BEST
	Medium	Terminate	Terminate	Fault - Ext. Reset / Terminate	
	Long			Fault - Restart	Modbus + BEST
ON	ON	Normal / Start-up	Start-up	Start-up	Modbus

LED pattern description

Description	
Flash frequency	Fast flashing indicates user or system action is required, slow flashing indicates user or system action may be required
Green LED	Indicates the actual mode of operation -the longer the on period the closer to normal operation -Note 2) off/fast flash indicates "terminate" due to exception or assert
Yellow LED	Indicates possible problems but the product is still operational -the longer on period the higher the severity of the alarm
Red LED	Indicates operation has stopped due to a fault -the longer the on period the higher the severity of the alarm -Slow: stopped but will resume when the fault condition is removed -Fast: user or system action is required
Normal Mode	Device is ready for "full" operation
Service Mode	A mode where configuration files, exception logs etc. can be up/downloaded
Test Mode	A mode where either automatic or manual tests can be performed
Production Mode	A mode where special functionality required for production test etc. is enabled
Start-up state	During start-up, LEDs are lit constantly according to the table below.
Terminate state	LEDs are flashing fast + medium on period in case of an assert or exception according to the table below

11.3 LED flashing patterns of the three operation status LEDs

Note: Text in **Bold** is the most normal situations/patterns

- Start-up state: During start-up, the LEDs are constant on or off depending on the state of the system. Either the yellow or the red LED will be constant on when the Control Micro is in one of the start-up states.
- Operation modes: When the unit has been initialised and is ready for operation.
- If the unit is started in normal operation mode the green LED will be constant ON.
- If the unit is started in Service mode the green LED will be flashing slowly with a short on period.
- If the unit is started in Production mode the green LED will be flashing slowly with a long on period.
- Slow flashing patterns in normal operation mode:**
 - Yellow LED is flashing: Warning or critical is active.
 - Red LED is flashing: Fault is active (It is possible to start the motor again when the fault condition disappears AND the fault has been reset).
- The faster and the longer an LED flashes the more severe the alarm
- Fast flashing of any of the 3 LEDs means that a fault has occurred and it can only be reset via external reset (digital input or serial communication) or only by a power cycle in some situation. In such a situation it may be a good idea to take a note about the flashing pattern since this could help to locate the problem.
- Alarms: Warnings, criticals and faults may be present at the same time. If a warning and a critical both are present only critical will be shown on LEDs as this is more severe than warning. Any of the fault flashing patterns may also be combined with either a warning or a critical.



= Constant on



= Constant off



= Slow flash (0.5 Hz) and long on period



= Fast flash (2 Hz) and long on period



= Slow flash (0.5 Hz) and medium on period














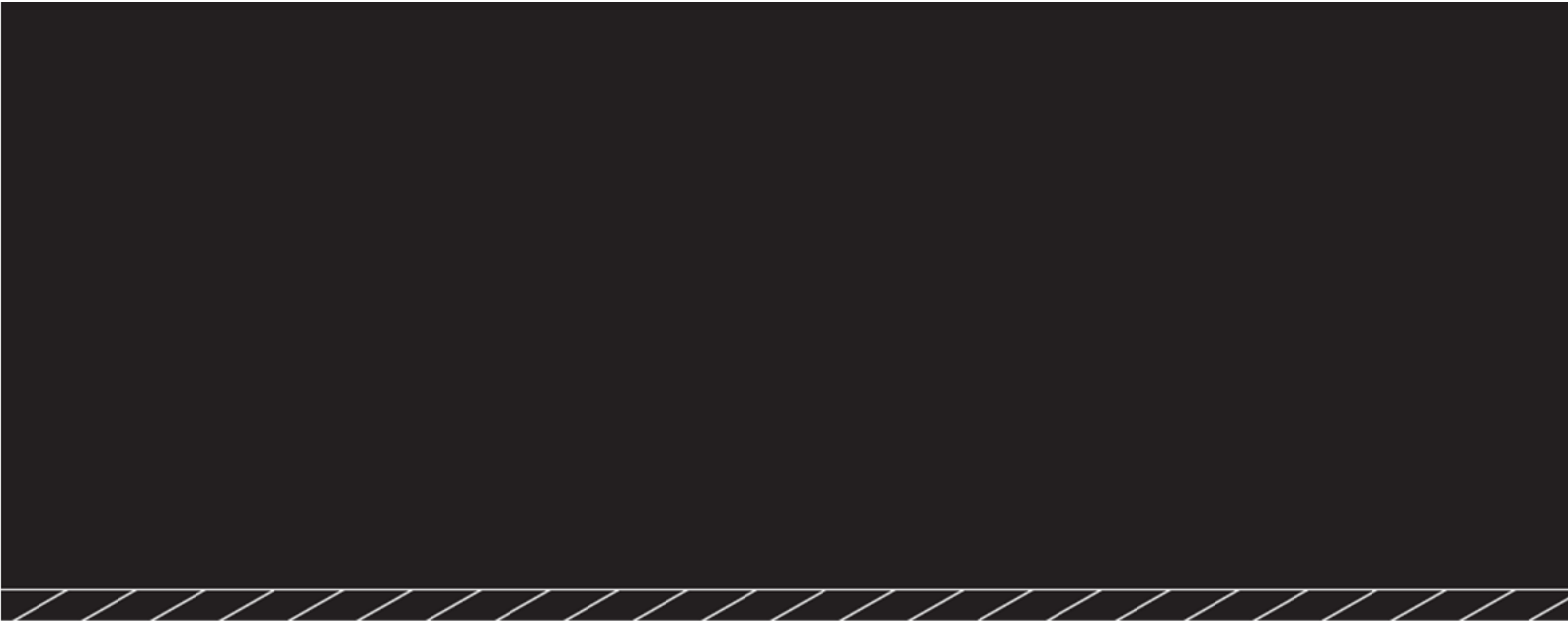
= Fast flash (2 Hz) and medium on period



= Slow flash (0.5 Hz) and short on period

An empty field indicates any other combination might be possible.

Operation Mode			
Normal operation			
Service mode			
Test mode (reserved for future use)			
Production mode			
Alarms (warning,critical,fault)		Warn/Crit	Fault
No Warning, Critical or fault			
Warning Active			
Critical Active (warning may also be active)			
Fault (auto resume reset type)			
Fault (Timed reset)			
Fault (Extern reset)			



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Subject to change

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