Reference guide

Compressor Control Module

CM-RC-01
Compressor Control Module

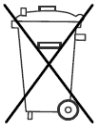
Content

1. Read this first!

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

Lodam electronics holds the copyright to this reference guide. The user shall follow any instructions given in this reference guide entirely and not only partly. Any non-following of this reference guide result in exclusion of all warranties, guarantees, and liabilities.

Disposing of the parts of the controller:



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

In reference to European Union directive 2012/19/EU 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-RC-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-RC-01 has not been correctly installed.

1.2 Safety

The CM-RC-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-RC-01 and motor must be without power.

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

2. General

The compressor control module CM-RC-01 is used for protection, control and diagnosis of primarily reciprocating compressors. It is mounted in its own housing and connected to all the sensors and components mounted on the compressor.
Its relays are used for compressor start and for the safety chain for the compressor and will open in case of a critical failure.

The module has indicator lights visible from outside of the housing. It can be used as a stand-alone control and protection module, or connected to a System Controller via the communication bus to extend possibilities.
Some basic module setup related to motor-, compressor- and refrigerant type must be done to enable all available protection functions. This is done with the BITZER BEST Software.

The CM-RC-01 module monitors and controls compressor operation according to the following functions:

- Motor overload
- Oil level or oil pressure differential
- Discharge gas temperature
- Saturated suction and discharge gas temperature based on pressure readings
- Absolute limits for low suction pressure and high discharge pressure
- Motor start with built-in timers
- Start-unloading control
- Capacity control (CRII)
- Liquid injection cooling (CIC)
- Additional fan cooling control
- Compressor application limits monitoring based on saturated gas temperatures
- Modbus communication

2.1 Support information

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3. Definitions

BEST	BEST Software
CR	Capacity Regulation
DOL	Direct On Line (motor start)
ESD	Electro Static Discharge
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)
FI	Frequency inverter
Y/Δ	Star/delta (motor start)

4. Functions

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

If the CM-RC-01 is locked due to a faulty situation, 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. If a BEST converter is connected, it must be removed during the power-off as the converter will supply power to the module.
Please see section 9 Alarm system and 11 Trouble shooting for the alarms which CM-RC-01 can set and how to clear the alarms.

Reset using the serial bus is preferable as this gives better statistical data of compressor operation without the power-cycle interruptions.

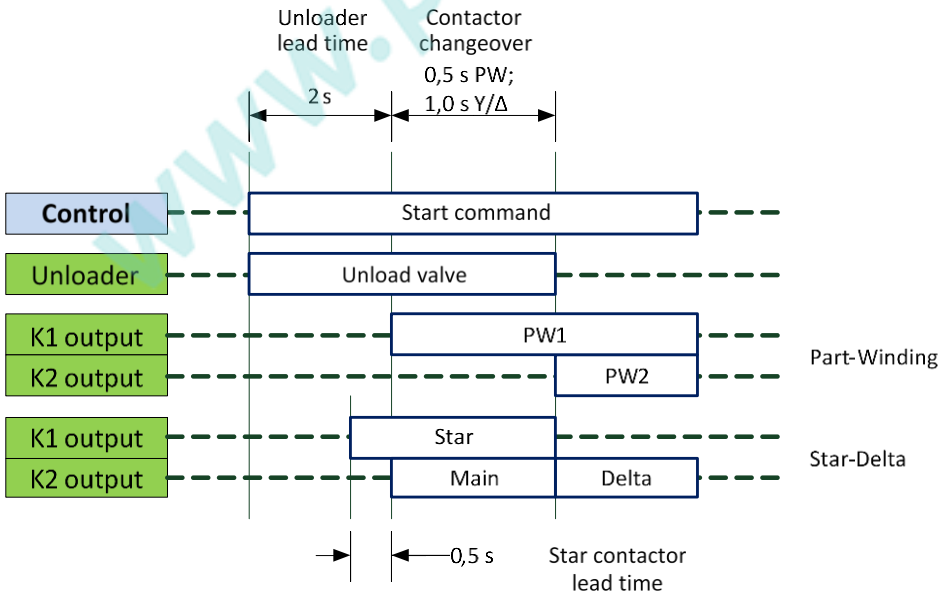
4.1 Control functions

Via the BEST Software, the CM-RC-01 can be configured to take care of control functions.
The CM-RC-01 thereby secures the safe operation of the specific compressor with the selected refrigerant.

4.1.1 Motor start

The CM-RC-01 has internal timers and relays for correct start-up sequence of the compressor for different start configurations: DOL – Direct-On-Line, PW - part winding and Y/Δ - Star-delta.
When power is applied to Relay C input on CN2, a compressor start is performed with the correct start-up sequence and timing. External timers are not needed.

CM-RC-01 handles start-unloading if this is needed by the compressor model using SU or CRII valves as illustrated below.



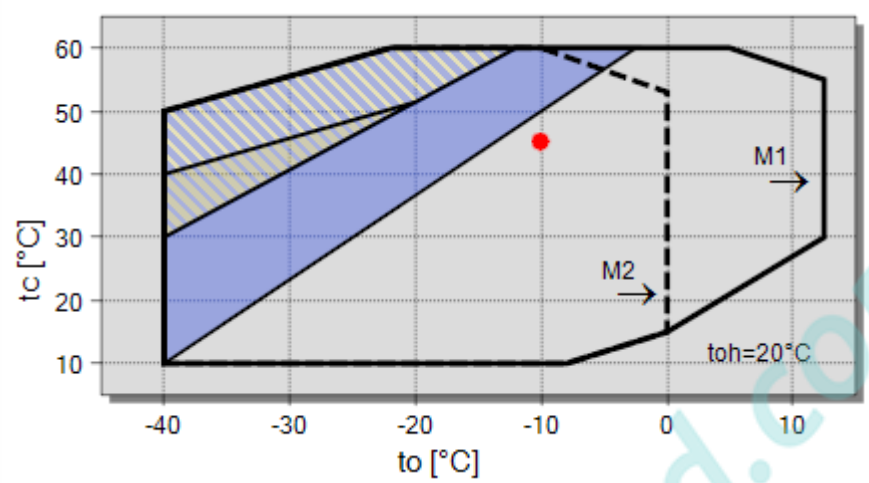
4.1.2 Oil heater

The oil heater ensures lubricity of the oil even after long standstill periods. It prevents increased refrigerant dilution in the oil and therefore a reduction of viscosity.

The oil heater is switched on during standstill and switched off during compressor operation.

4.1.3 Cylinder head and motor cooling

Under some conditions, additional cooling is needed as the sample diagram from the BITZER Software below shows



Legend

- Additional cooling & suction gas superheat ≤20K
- Additional cooling & max. suction gas temperature <0°C
- Additional cooling
- M1: motor 1
- M2: motor 2
- Operating point

The CM-RC-01 has two independent functions to apply cooling to the compressor, an additional fan and liquid injection cooling, CIC. The two functions are controlled by the CM-RC-01 module. The additional fan cooling and/or CIC are automatically applied, if the compressor is in an operating point where extra cooling is needed and the compressor is equipped with these components.

BEST Software can configure the CM-RC-01 for the mounted options.

4.1.3.1 Additional fan

The CM-RC-01 will start and stop the additional fan according to the application limits for the compressor and the selected refrigerant. The control algorithm in the CM-RC-01 starts the additional fan if the discharge gas temperature gets too high.

It is for additional cooling of the compressor motor and cylinder heads.
When started, the fan will keep running for a certain minimum period, and until the temperature drops to an acceptable level.
A warning message is displayed if the fan needs to be started too often.

4.1.3.2 Liquid injection cooling (CIC)

CIC is a cooling system to reduce the discharge gas temperature. The control algorithm for the liquid injection cooling in the CM-RC-01 starts the CIC if the discharge gas temperature gets too high.

4.1.4 Capacity control

The CM-RC-01 can control the needed capacity of the compressor by controlling the CRII valves.

The 0 – 10 V **Cap. In** input or the Modbus parameter **Serial setpoint** (see section 0) can be used to specify the needed capacity of the compressor. The compressor must be mounted with a CRII capacity regulation system.

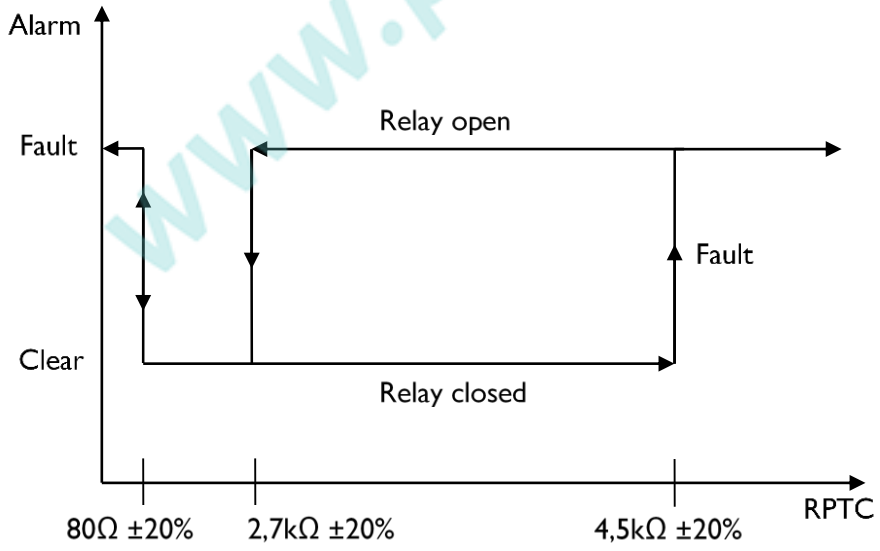
The CM-RC-01 will operate the CRII valve(s) to achieve the requested capacity with as little pressure fluctuations as possible.
The capacity range is 10 % - 100 %.

When liquid injection cooling (CIC) needs to run due to high discharge temperature, the capacity system will be forced to run with a certain minimum capacity, in order to avoid flooding of the compressor.

4.2 Monitoring and diagnosis

4.2.1 Motor temperature

One of the functions of the CM-RC-01 is to protect the compressor motor against overload.
By monitoring the resistance in a PTC sensor mounted in the motor windings, the CM-RC-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-RC-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-RC-01 module, the PTC resistance is measured:

- If PTC resistance is below the reset limit 2,7 kΩ:
  No alarm: The relays are energized immediately (if no other faults are present)
- If PTC resistance is between 2,7 kΩ and 4,5 kΩ:
  Alarm: The relays are first energized when below 2,7 kΩ
  (compressor motor has cooled down)
- If PTC resistance is above 4,5 kΩ:
  Alarm lock: The relays are not energized and the module is locked

4.2.2 Discharge temperature

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

The default thresholds for the selected reciprocating compressor are defined in the BEST software.

4.2.3 Oil supply

Depending on the compressor type, the oil supply monitor is configured for either oil level (OLC-D1) or oil pressure difference (DP-1) 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-RC-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.

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

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

4.2.4 High pressure handling

A high-pressure switch can be connected to the CN2 of the CM-RC-01. An alarm is set on CN2:Relay NC and on Modbus if the high-pressure switch opens.

4.2.5 Pressure limits (option)

In the BEST software a low pressure and a high pressure limits can be configured. If one of the limits are reached, the compressor is stopped and an alarm is issued.

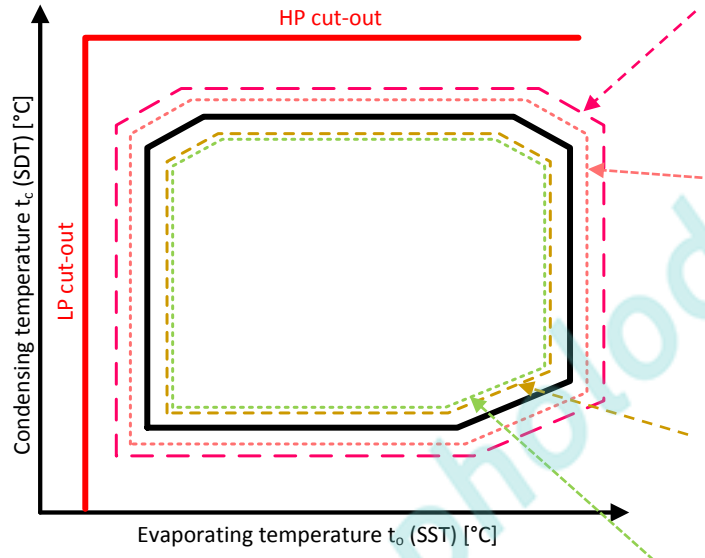
4.2.6 Application limits (option)

Optional pressure transducers are needed.
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.



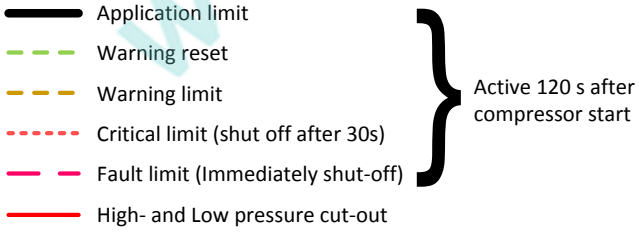
Fault limit, direct shut-off:
- The compressor will stop immediately if this limit is reached!
- Envelope status = 6 Fault

Critical limit, shut-off after 30 s:
- 30s delay time to bring compressor back inside application limit else the compressor is stopped with a Fault alarm
- Critical (30s period starts)
- Envelope status = 5 Critical

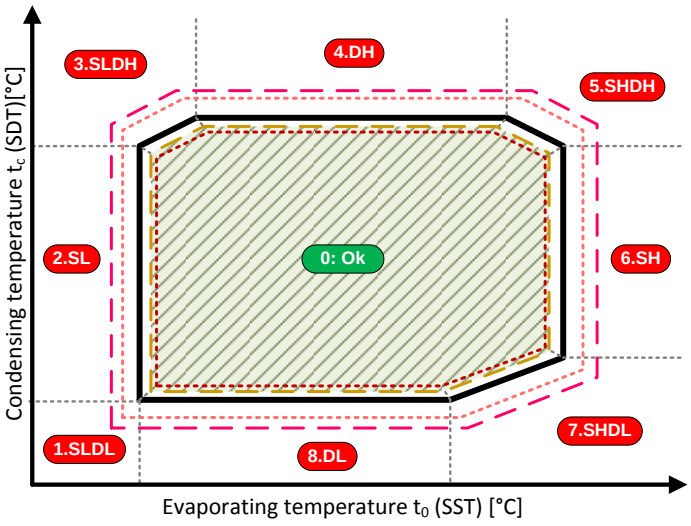
Warning limit:
- Warning to system controller
- No further actions
- Envelope status = 4 Warning

Warning reset
- Automatic clear of warning

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.

After a stop due to fault limit, the fault can be reset when the compressor is stopped. If timed resets are enabled, the CM-RC-01 will perform a timed reset otherwise an external reset is required. The CM-RC-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.

4.2.7 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.

4.3 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

4.3.1 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-RC-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.

4.3.2 Events

Possible events:

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

Lifetime of events: 30 days

4.3.3 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.

4.3.4 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

4.3.5 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.

4.3.6 Accumulated operation counters

All accumulated since first power up

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

Lifetime: 365 days

4.3.7 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

4.3.8 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

4.3.9 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

4.3.10 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

4.4 BEST software

The BEST Software is used for live monitoring of operation conditions, download of datalogs and configuration of the CM-RC-01.
The BEST Software can be downloaded from the BITZER homepage, www.bitzer.de.

4.5 Communication

Detailed status information and communication with the system controller is done via the Modbus (RTU) interface.
Please see the detailed description in section 10 Programming and monitoring.

A Bluetooth module will be added soon.

5. Control of the CM-RC-01

Control commands and setpoint can be given to the CM-RC-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 100 % 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-RC-01. Most common is to monitor and control the CM-RC-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-RC-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 10.3.7 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-RC-01 will give a waning but the compressor will be allowed to start

The speed of the motor 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 speed 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-RC-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-RC-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-RC-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 10.3.7 Configuration – application.

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

5.6 Status Word bit definitions

CM-RC-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-RC-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-RC-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-RC-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:

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

5.8 Serial Control Timeout Function

If the communication is interrupted, the CM-RC-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-RC-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 10.3.7 Configuration – application for further information.

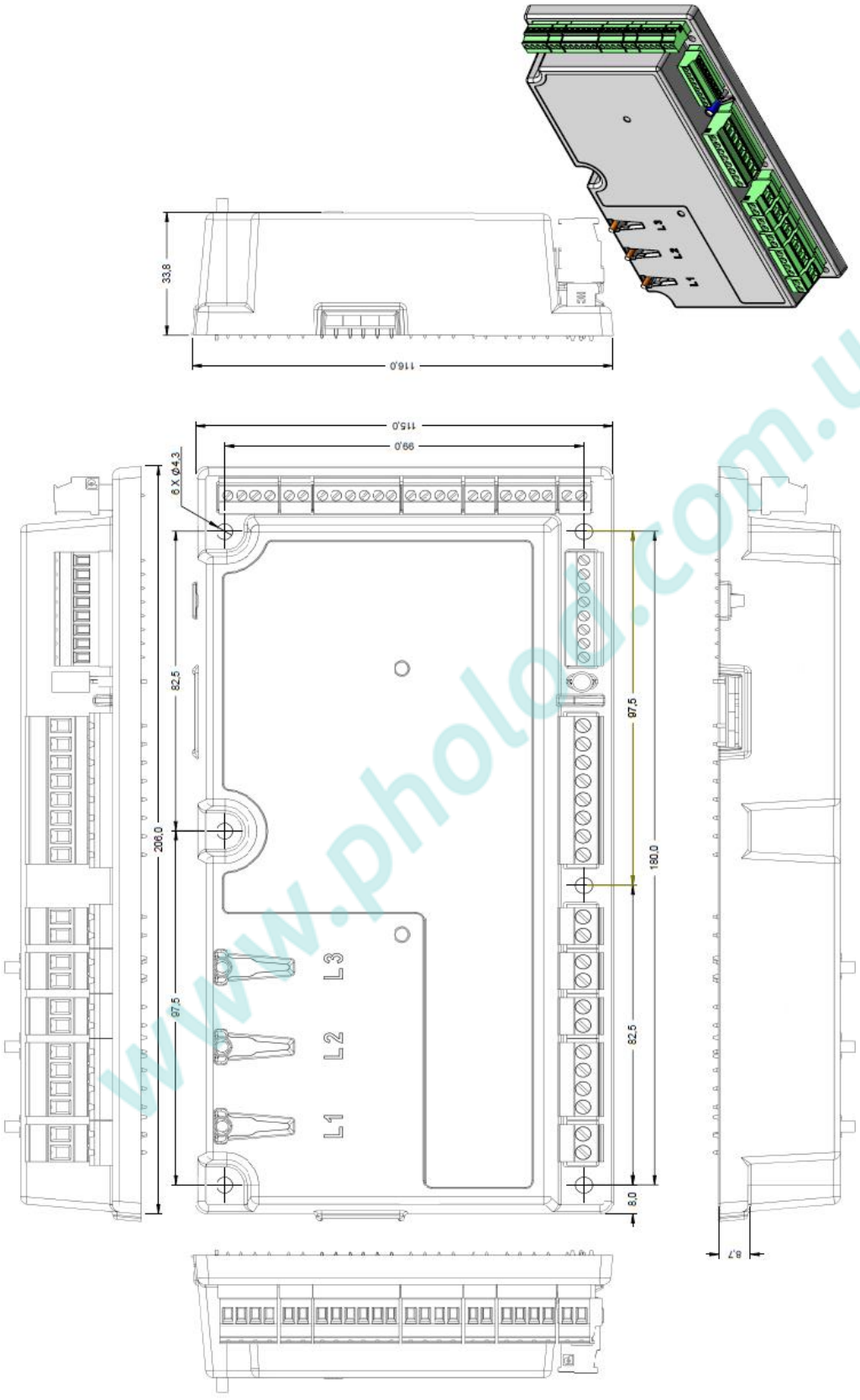
6. I/O List for CM-RC-01

Connector	Name	Type/ Function	Logic	Description
Supply CN1	L N	Supply	-	Supply for CM-RC-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	Oil Heater N	Output Neutral	NO	Oil heater 115 V-230 V; +10% ~ -15%, 50/60 Hz; max 2A(1)
Control Output CN5	Add. Fan N	Output Neutral	NO	Additional fan 115 V-230 V; +10% ~ -15%, 50/60 Hz; max 2A(1)
Control Output CN6	CRII-1 N	Output Neutral	NO	CRII-1 valve 115 V-230 V; +10% ~ -15%, 50/60 Hz; max 2A(1)
	CRII-2 N	Output Neutral	NO	CRII-2 valve 115 V-230 V; +10% ~ -15%, 50/60 Hz; max 2A(1)
	CRII-3 N	Output Neutral	NO	CRII-3 valve 115 V-230 V; +10% ~ -15%, 50/60 Hz; max 2A(1)
	Inject N	Output Neutral	NO	Injection valve 115 V-230 V; +10% ~ -15%, 50/60 Hz; max 2A(1)
Oil Sensor 1 CN9	+24V Supply GND Signal GND	Supply Ground Input Ground	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
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 below 80 Ω Rtrig: 4,5 kΩ ±20% Rreset: 2,7 kΩ ±20%
Taux CN11	Signal GND	Input Ground	Temperature	Auxiliary temperature. PT1000 sensor;-40°C ~ +100°C; accuracy: ±2°C 0V
Tdis CN11	Signal GND	Input Ground	Temperature	Discharge temperature. PT1000 sensor; 0°C ~ +200°C; accuracy: ±2°C 0V
Pdis CN12				Discharge pressure. Sensata 2CP5-71-47 (rel) or equivalent

Connector	Name	Type/ Function	Logic	Description
Psuc CN12	+5V Supply Signal GND	Supply Input Ground	Pressure	+5 VDC; max 10 mA 1 - 35 bar abs.; 0 - 5V ratio metric; accuracy ±1% F.S. 0V
	+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 product is manufactured according to the following standards.

- RoHS 2002/95/EC
- Low voltage 206/95/EC
- 61010-1 Safety requirement for electrical equipment for measurement and control
- EMC 2004/108/EC
- 61000-6-x Generic EMC

The following standards have been used

- EN 61010-1 Safety requirement for electrical equipment for measurement and control
- EN 61000-6-2 Immunity standard for industrial environments
- EN 61000-6-3 Emission standard 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-RC-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-RC-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

No.	Text	Warning	Critical	Fault	Reset 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
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
3310	Head Fan Cycle Count Per Hour Exceeded	Yes	No	No	N/A
34-*	Compressor - Pressure				

No.	Text	Warning	Critical	Fault	Reset 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
3502	Oil pressure low	No	Yes	Yes	Extern
43-*	Motor - Temperature				
4301	Motor Temperature High	Yes	Yes	Yes	Extern
4302	Motor Temperature Cooldown	No	No	Yes	Timed
58-*	FC - 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				
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

No.	Text	Warning	Critical	Fault	Reset type
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 Fault	No	No	Yes	Timed

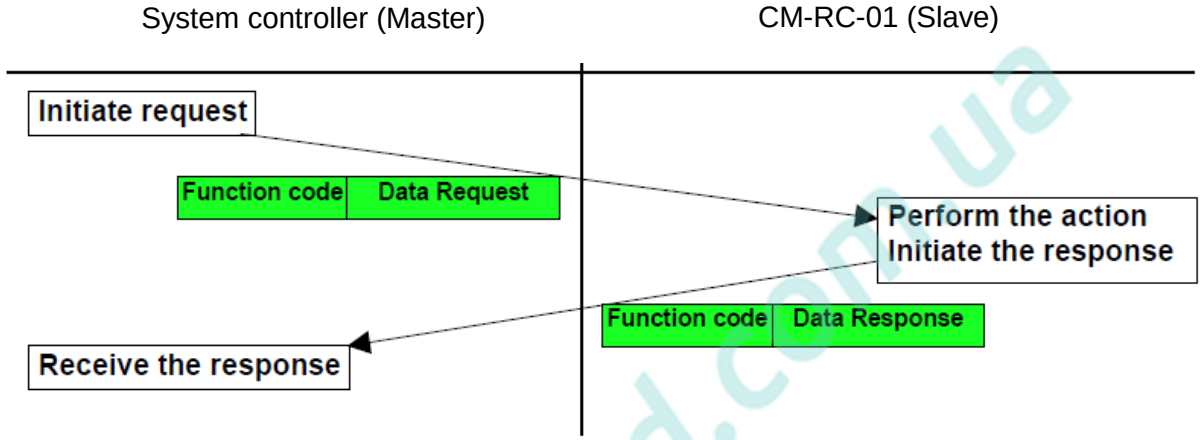
10. Programming and monitoring

10.1 Introduction

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

10.2 Serial communication

Communication with the CM-RC-01 is via Modbus (RTU). Configuration and reading of status from the CM-RC-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; 9600, 19200 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.

Please observe that register numbers are used in this manual!

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

W/R column: Read/write field. R = read (input) register; W = write (holding) register

U8: unsigned 8-bit integer
S8: signed 8-bit integer
U16: unsigned 16-bit integer
S16: signed 16-bit integer
U32: unsigned 32-bit integer
S32: signed 32-bit integer
Ch16: 8 bit ASCII character text string. Null terminated if not max length.

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

Parameters without a register number are only accessible using the service tools LMT or BEST.

Modbus type & addr.: Modbus register address and type of register.
IR is an Input register.
HR is a Holding register.
Please observe that it is registers that are listed, NOT the index.
Name column: Parameter name. The name in parenthesis is the LMT field 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.

The parameters are subject to changes.

10.3.1 Control – application

The group contains parameters related to control of the compressor.

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

10.3.2 Status – alarm

The group contains information about current state of alarms.

Modbus type & addr	Name	Possible values	Default	Description
IR 11100	**Number of active alarms** (AlarmStatus.Count)	unit None scale 1 uint16	-	Number of active alarms
IR 11101	**Number of listed alarms that has not yet been cleared** (AlarmStatus.CountList)	unit None scale 1 uint16	-	Number of listed alarms that has not yet been cleared
IR 11102	**Highest state of any listed alarm** (AlarmStatus.State)	unit None scale 1 uint8	-	Highest state of any listed alarm *(0=Clear, 1=Inactive, 2=Active, 3=Set)*
IR 11103	**Highest severity level of any active alarm** (AlarmStatus.Severity)	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 11104	**If locked, ICP is waiting for external reset command or restart** (AlarmStatus.Locked)	unit None scale 1 uint8	-	If locked, ICP is waiting for external reset command or restart *(0=No, 1=Yes)*
IR 11105	**Reset level required to clear any active alarm** (AlarmStatus.ResetLevel)	unit None scale 1 uint8	-	Reset level required to clear any active alarm *(0=NA, 1=Auto, 2=Timer, 3=Extern, 4=Restart)*
IR 11201	**Code of highest ranked alarm** (AlarmStatus.Alarm1)	unit None scale 1 uint16	-	Code of highest ranked alarm
IR 11202	**Code of second highest ranked alarm** (AlarmStatus.Alarm2)	unit None scale 1 uint16	-	Code of second highest ranked alarm
IR 11203	**AlarmStatus.Alarm3** (AlarmStatus.Alarm3)	unit None scale 1 uint16	-	
IR 11204	**AlarmStatus.Alarm4** (AlarmStatus.Alarm4)	unit None scale 1 uint16	-	
IR 11205	**AlarmStatus.Alarm5** (AlarmStatus.Alarm5)	unit None scale 1 uint16	-	
IR 11206	**AlarmStatus.Alarm6** (AlarmStatus.Alarm6)	unit None scale 1 uint16	-	
IR 11207	**AlarmStatus.Alarm7** (AlarmStatus.Alarm7)	unit None scale 1 uint16	-	
IR 11208	**AlarmStatus.Alarm8** (AlarmStatus.Alarm8)	unit None scale 1 uint16	-	
IR 11209	**AlarmStatus.Alarm9** (AlarmStatus.Alarm9)	unit None scale 1 uint16	-	

Modbus type & addr	Name	Possible values	Default	Description
IR 11210	**AlarmStatus.Alarm10** (AlarmStatus.Alarm10)	unit None scale 1 uint16	-	

10.3.3 Status – compressor

The group contains status information for the compressor.

Modbus type & addr	Name	Possible values	Default	Description
IR 12001	**Suction Pressure** (Input.Psuc)	unit bar(a) scale 100 sint16	-	Suction Pressure
IR 12002	**Discharge Pressure** (Input.Pdis)	unit bar(a) scale 100 sint16	-	Discharge Pressure
IR 12003	**Evaporating Temperature (SST)** (CompStatus.SatTempSuc)	unit °C scale 10 sint16	-	Calculated saturated suction temperature (SST)
IR 12004	**Condensing Temperature (SDT)** (CompStatus.SatTempDis)	unit °C scale 10 sint16	-	Calculated saturated discharge temperature (SDT)
IR 12005	**Envelope Status** (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 12006	**Envelope Zone** (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 High, 4=SDT High, 5=SST High, SDT High, 6=SST High, 7=SST High, SDT Low, 8=SDT Low)*
IR 12010	**Discharge temperature** (CompStatus.Tdis)	unit °C scale 10 sint16	-	Discharge temperature
IR 12011	**AUX temperature** (CompStatus.Taux)	unit °C scale 10 sint16	-	AUX temperature
IR 12022	**High Pressure Switch** (Input.HPswitch)	unit None scale 1 uint8	-	High pressure switch *(0=Off, 1=On)*
IR 12023	**Crank Case Oil Heater** (Output.OilHeater)	unit None scale 1 uint8	-	Crank case oil heater *(0=Off, 1=On)*
IR 12025	**Oil Sensor 1** (Input.OilFault)	unit None scale 1 uint8	-	Oil Sensor 1 *(0=Off, 1=On)*
IR 12026	**Oil Sensor 2** (Input.OilFault2)	unit None scale 1 uint8	-	Oil Sensor 2 *(0=Off, 1=On)*

Modbus type & addr	Name	Possible values	Default	Description
IR 12027	**Motor start is requested** (Input.StartActive)	unit None scale 1 uint8	-	Motor start is requested *(0=Off, 1=On)*
IR 12028	**Head cooling fan** (Output.HeadFan)	unit None scale 1 uint8	-	Head cooling fan *(0=Off, 1=On)*
IR 12029	**Liquid injection cooling valve** (Output.LiquidInject)	unit None scale 1 uint8	-	Liquid injection cooling valve *(0=Off, 1=On)*
IR 12030	**Compressor start unloading valve** (Output.Unloader)	unit None scale 1 uint8	-	Compressor start unloading valve *(0=Off, 1=On)*
IR 12031	**Capacity control valve CR-1** (Output.CapReg1)	unit None scale 1 uint8	-	Capacity control valve CR-1 *(0=Off, 1=On)*
IR 12032	**Capacity control valve CR-2** (Output.CapReg2)	unit None scale 1 uint8	-	Capacity control valve CR-2 *(0=Off, 1=On)*
IR 12033	**Capacity control valve CR-3** (Output.CapReg3)	unit None scale 1 uint8	-	Capacity control valve CR-3 *(0=Off, 1=On)*

10.3.4 Status – motor

The group contains status information for the motor.

Modbus type & addr	Name	Possible values	Default	Description
IR 13001	**Motor overheat thermistor resistance (PTC)** (Input.Thermistor)	unit Ohm scale 1 uint16	-	Motor overheat thermistor resistance (PTC)
IR 13002	**Estimated motor power consumption** (Input.Power)	unit kW scale 10 uint16	-	Estimated motor power consumption
IR 13003	**Motor drive frequency (speed)** (Input.PhaseFreq)	unit Hz scale 10 uint16	-	Motor drive frequency (speed)
IR 13006	**Motor start contactor 1** (Output.MotorStart1)	unit None scale 1 uint8	-	Motor start contactor 1 *(0=Off, 1=On)*
IR 13007	**Motor start contactor 2** (Output.MotorStart2)	unit None scale 1 uint8	-	Motor start contactor 2 *(0=Off, 1=On)*

10.3.5 Status – device

The group contains operating state for the CM-RC-01.

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

10.3.6 Status – IO

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

Modbus type & addr	Name	Possible values	Default	Description
IR 15150	**Control Output Current** (Input.Ioutput)	unit A scale 100 sint16	-	Control output current
IR 15990	**State of the Operation LED** (Output.OperaLight)	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 15991	**State of the Warning LED** (Output.WarningLight)	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 15992	**State of the Fault LED** (Output.FaultLight)	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 15993	**State of the Communication LED** (Output.OptLight)	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)*

10.3.7 Configuration – application

The group contains information for the application.

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

Modbus type & addr	Name	Possible values	Default	Description
HR 20102	**Hour and Minute** (DateAndTime.HourMinute)	0 - 5947 scale 1 uint16	0	Hour and Minute
HR 20103	**Millisecond** (DateAndTime.MilliSec)	0 ms - 59999 ms scale 1 uint16	0 ms	Millisecond
IR 20300	**Serial Control Source** (SerCtlCfg.SerCtrlSrc)	unit None scale 1 uint8	-	Serial Control Source *(0=None, 1=COM1 (MODBUS))*
IR 20301	**Serial Control Timeout Function** (SerCtlCfg.TimeoutFnct)	unit None scale 1 uint8	-	Serial Control Timeout Function *(0=None, 1=Stop, 2=Fault)*
IR 20302	**Serial Control Timeout Time** (SerCtlCfg.TimeoutTm)	unit s scale 1 uint16	60 s	Serial Control Timeout Time

10.3.8 Configuration – compressor

The group contains configuration information for the compressor.

Modbus type & addr	Name	Possible values	Default	Description
IR 22100	**Refrigerant selection** (Config.RfgType)	unit None scale 1 uint8	-	Refrigerant selection *(0=NONE, 1=R134a, 2=R404A, 3=R507A, 4=R407C, 5=R22, 6=R407A, 7=R407F, 9=R448A, 10=R449A, 11=R450A, 12=R513A, 13=R1234yf, 14=R1234ze)*
IR 22200	**Dedicated OEM functionality selection** (Config.OEMType)	unit None scale 1 uint8	-	Dedicated OEM functionality selection *(0=NONE)*
IR 22300	**Mains supply voltage specification (single phase)** (Config.SysVolt)	unit V scale 1 uint16	-	Mains supply voltage specification (single phase)

10.3.9 Configuration – COM1

The group contains information for the serial communication.

Modbus type & addr	Name	Possible values	Default	Description
HR 65409	**COM1 Address** (COM1.Address)	1 - 247 scale 1 uint8	48	Device address for Modbus connection
HR 65410	**COM1 Baudrate** (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 65411	**COM1 Stop Bits** (COM1.StopBits)	1 - 2 scale 1 uint8	1	Number of stop bits *(1=1 Stopbit, 2=2 Stopbits)*
HR 65412	**COM1 Parity** (COM1.Parity)	0 - 2 scale 1 uint8	1	Parity check *(0=None, 1=Even, 2=Odd)*

10.3.10 Logs – application

The group contains runtime counters for the application.

Modbus type & addr	Name	Possible values	Default	Description
IR 30000-30001	**Device Operating Hours** (Log.OperateTime)	unit h scale 1 uint32	-	Device Operating Hours
IR 30010-30011	**Compressor Running Hours** (Log.RunTime)	unit h scale 1 uint32	-	Compressor Running Hours
IR 30012-30013	**Compressor Start Count** (Log.StartCount)	unit None scale 1 uint32	-	Compressor Start Count
IR 30020-30021	**Power Up Count** (System.ResetCount)	unit None scale 1 uint32	-	Number of module power cycles

10.3.11 Info – compressortype

The group lists the compressor type

Modbus type & addr	Name	Possible values	Default	Description
IR 42100	**Compressor type selection** (Config.CprType)	unit None scale 1 uint16	-	Compressor type selection *(0=NONE, 5121=4VE-6Y, 5122=4VES-6Y, 5123=4VE-7(Y), 5124=4VES-7(Y), 5125=4VE-10(Y), 5126=4VES-10(Y), 5127=4TE-8Y, 5128=4TES-8Y, 5129=4TE-9(Y), 5130=4TES-9(Y), 5131=4TE-12(Y), 5132=4TES-12(Y), 5133=4PE-10Y, 5134=4PES-10Y, 5135=4PE-12(Y), 5136=4PES-12(Y), 5137=4PE-15(Y), 5138=4PES-15(Y), 5139=4NE-12Y, 5140=4NES-12Y, 5141=4NE-14(Y), 5142=4NES-14(Y), 5143=4NE-20(Y),*

Modbus type & addr	Name	Possible values	Default	Description
				5144=4NES-20(Y), 5145=4JE-13Y, 5146=4JE-15(Y), 5147=4JE-22(Y), 5148=4HE-15Y, 5149=4HE-18(Y), 5150=4HE-25(Y), 5151=4GE-20Y, 5152=4GE-23(Y), 5153=4GE-30(Y), 5154=4FE-25Y, 5155=4FE-28(Y), 5156=4FE-35(Y), 5157=6JE-22Y, 5158=6JE-25(Y), 5159=6JE-33(Y), 5160=6HE-25Y, 5161=6HE-28(Y), 5162=6HE-35(Y), 5163=6GE-30Y, 5164=6GE-34(Y), 5165=6GE-40(Y), 5166=6FE-40Y, 5167=6FE-44(Y), 5168=6FE-50(Y), 5169=8GE-50(Y), 5170=8GE-60(Y), 5171=8FE-60(Y), 5172=8FE-70(Y))

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 4.5 kΩ ±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 MΩ, 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 2.7 kΩ ±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-RC-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.

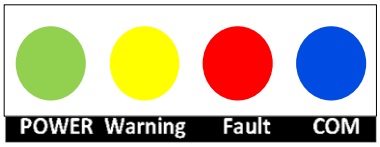
Return codes from Modbus communication if a telegram is not accepted by the CM-RC-01.

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/critical	No fault	No communication
Slow Flashing	**Short** **Medium** **Long**	Service Production Test	Warning Critical	 Fault - Auto Resume Fault - Timer Reset	
Fast Flashing	**Short** **Medium** **Long**	Terminate	Terminate	 Fault - Ext. Reset / Terminate Fault - Restart	BEST 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).

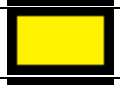
- The faster and the longer an LED flashes the more severe the alarm
- Fast flashing of any of the 3 LEDs means that a fault has occurred and it can only be reset via external reset (digital input or serial communication) or only by a power cycle in some situation. In such a situation it may be a good 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)			

Fault (Restart / power cycle)			
Start-up state			
- init ressources			
- init subscribtions			
- init configuration			
- init config ready			
Terminate state, asserts and exceptions			
Assert in code			
NMI fault (exception)			
Hard fault (exception)			
Memory management fault (exception)			
Bus fault (exception)			
Usage fault (exception)			

12. Notes

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