Brief Description

- Stage Controller for Compressor Compounds, Brine-Chillers and Condenser Fans
- 4 stages, by adding "Slave"-device up to 8 stages possible
- For Single- and Multi-Stage Loads
- Automatic Stage Sequencing
- Autoadaptive Trend Recognition
- Inputs for 2-wire Pressure Transmitters, Pressostat and Temperature Probes
- Analogue Output 0-10V DC for Motordrives or Remote Displays
- 2nd Setpoint by internal clock
- Peak Load Limitation / Fast Back-run / Emergency Operation
- Compressor Idle Time
- Integrated operation time counters
- RS-485-Interface

Applications

- Refrigeration, Heating and Air Conditioning Technologies

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Technical Manual **5311032-05/11E**
from Software Vers. **1.9.2**

Stage Controller for Compressors, Condenser Fans or Brine Chillers

Series

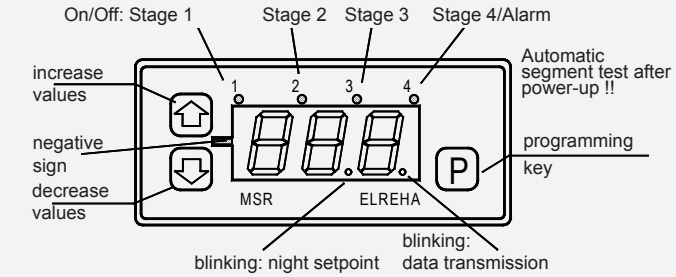
MSR 1100-2 (UL)
MSR 1100-2 S (UL)
MSR 3100-2
MSR 5100-2

Notice

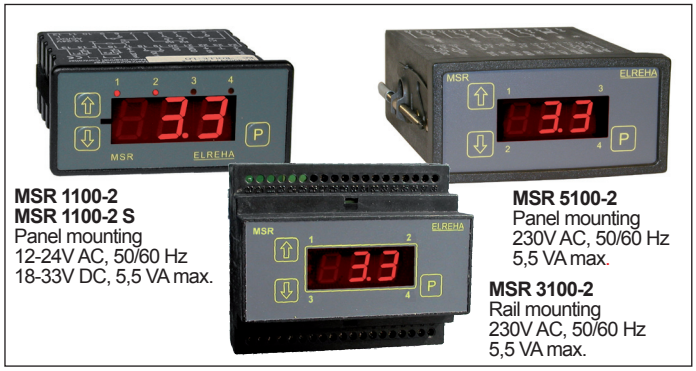
Changes of the -2 types in comparison to the older ones

- Different terminal assignment, 8 stages by 'slave' module
- Error messages now as codes + error listing
- Unlock code entry now possible at each parameter
- 4 new parameters, new codeparameter is (P58)

Operating Elements



All MSR-versions are marked in the same way



MSR 1100-2
MSR 1100-2 S
Panel mounting
12-24V AC, 50/60 Hz
18-33V DC, 5,5 VA max.

MSR 5100-2
Panel mounting
230V AC, 50/60 Hz
5,5 VA max.

MSR 3100-2
Rail mounting
230V AC, 50/60 Hz
5,5 VA max.

Parameters

All selectable parameters hold a parameter number (e.g. P03), you will find a listing on the next page.

Calling up and editing

Press key 'P' .....parameter number appears
Use '⇧/⇩' .....select desired parameter (hold key for autoscroll)
Press "P" again.....parameter value appears
Use keys '⇧/⇩'.....adjust parameter value (hold key for autoscroll)
Press 'P' again .....value is stored, back to parameter no.

Unlock Keys / Access code

To prevent un-authorized persons from editing parameter values, there is a locking function which allows only the most important parameters to be changed at any time. All other parameters must be unlocked as follows:

- enter access code before programming at parameter **P58** *or*
- directly at the parameter to be changed. If a code no. is necessary the display shows "C00". Set the matching code no. by the "⇧/⇩"-keys (70 or 80, see parameter listing) and confirm by "P".

If no key is hit for about four minutes, the access code is cancelled and the editing function is locked automatically.

Notice After entering code "70" (basic configurations), a fast backrun will be initated. The control sequences restart first after the code is changed manually (e.g. to 88) or is reset after 4 minutes automatically.

Start-up behavior

Directly after start-up the display shows a controller type number, after that a display test passes.

How to find out the current operation mode

Hold key "P" for > 2 sec. = Display shows the following values:
106 = operation mode for compressors/compounds
206 = operation mode for condenser fans
300 = operation mode for chiller sets

Setting the operation modes (see examples on the last page)

- Switch controller off
  Hold key "P", switch controller on and wait until "_ _ _" appears on the display
- Release key "P"
- Select desired configuration by "⇧"
  "**1** _ _" = for compressors (pressure controlled)
  "**2** _ _" = for condenser fans (pressure controlled)
  "**3** _ _" = for chillers (temperature controlled)
- Press "P" once to confirm
- Display shows "def", all default values are loaded
- The actual value appears, ready for start-up.

CAUTION

Please note Safety Instructions! While replacing older types please note changed functions!

Technical Data

Supply Voltage..... see above
Output Relays..... 4 x potential free
Contact Rating..... 8A resistive, 3A cos phi 0,4, 250V AC
MSR 1100-2 / S (UL)..... resistive: 120/240V AC, 8A, 30 k cycles
motor: 125/250V AC, ¼ HP, 30 k cycles
Ambient Temperature MSR 1100-2 / S. ..... -10..+65°C (14..149°F)
Ambient Temperature MSR 3100-2/5100-2. .....-10..+55°C (14..131°F)
Storage Temperature.....-30..+70°C (-22..158°F)
Relative Humidity.....max. 85% r.H., not condensing
Signal Input..... 2x TF 201 or 2x TF 501
1x 4...20 mA (Ri= 100 Ohm), Pressostat
Supply Voltage for 2-wire pressure transmitter.....
appr. 24V DC, unreg., max. 23 mA
MSR 1100-2..... DC, unreg., dep. on transformer, max. 23 mA
Display ..... LED, 7-segment, red, character height 13mm (.51 inch)
Resolution.....0,1
Control-/Display Range ..... see parameter listing
Data Storage Parameters..... ≥20 years
Clock Backup..... typ. 10 days after mains is lost
Relay Indicators..... 3 mm, red
Analog Output.....0-10 V DC, max. 3 mA
Analog Output Resolution..... 8 bit within the set benchmarks
Data Interface .....E-Link (RS-485)
Electrical Connection..... screw terminals 2,5mm²
Housing / Protection / Digital Input
MSR 1100-2.....77 x 35 mm front frame, IP 54 from front
Digital input for external, potential free contact
MSR 1100-2 S .....77 x 35 mm front frame, IP 54 from front
Digital input for external, potential free contact
MSR 3100-2..... for rail mounting, IP 30
Digital input for mains voltage, 50-60Hz, max. 3mA
MSR 5100-2.....96 x 48 mm front frame, IP 54 from front
Digital input for mains voltage, 50-60Hz, max. 3mA

Further data you will find on the parameter listing.

Accessories (please order separately)

- 2-wire pressure transmitter, Type DG 0/10 GSW, with 4-20 mA output
- 2-wire pressure transmitter, Typ DG 0/25 GSW, with 4-20 mA output
- 2x temperature sensors TF 201 (PTC) or TF 501 (Pt1000)

For type MSR 1100-2:

- Transformer 107-1300-0052 (220/ 12V / 5VA) or
- Transformer 107-1300-0018 (22V / 5VA)

Please read these instructions carefully before applying power. Your attention is drawn to the fact that the warranty is subject to the application of power sources that are within the limits specified in this manual. This documentation was compiled with utmost care, however, we cannot guarantee for its correctnesss in every respect. Technical details can be changed without notice, especially the software. Please note that the described functions are only valid for units containing the software with the version-number shown on page 1. Units with an other software number can work a little bit different. You will find this software number on the label of the unit too.

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Parameter Listing

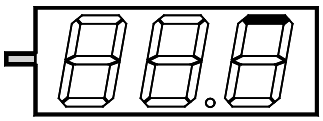
Para. No.	Oper. Mode Compress.	Fans	Br. Chillers	Code	Description	Factory Settings Compress.	Fans	Br. Chillers	Ranges
					X = Parameters visible depending on operation mode * = not available if a pressostat is used **Code 70** = control functions first starts if access code is reset (see 'operating') **cnbe** = cannot be edited by the user				
P01	X	X	X	-	Actual value control sensor (water inlet) or pressure transmitter	-	-	-	
P02			X	-	Actual value of limitation sensor (water outlet)	-	-	-	
P03	X	X	X	-	Status of forward / backward / peak load limitation				
P04*	X	X	X	-	Setpoint 1 (absolute, start of backrun)	0	0	0	within the limits P12/P13
P05		X	X	88	Setpoint 2 (relative resp. switching distance to P04)		0	0	0...10.0
P06		X	X	88	Setpoint 3 (relative resp. switching distance to P05)		0	0	0...10.0
P07		X	X	88	Setpoint 4 (relative resp. switching distance to P06)		0	0	0...10.0
P08		X	X	88	Setpoint 5 (relative resp. switching distance to P07)		0	0	0...10.0
P09		X	X	88	Setpoint 6 (relative resp. switching distance to P08)		0	0	0...10.0
P10		X	X	88	Setpoint 7 (relative resp. switching distance to P09)		0	0	0...10.0
P11		X	X	88	Setpoint 8 (relative resp. switching distance to P10)		0	0	0...10.0
P12*	X	X	X	88	Highest adjustable setpoint (for P04)	+30.0	+30.0	+50.0	-100.0..+100.0
P13*	X	X	X	88	Lowest adjustable setpoint (for P04)	-1.0	-1.0	-50.0	-100.0...P12
P14*	X	X	X	88	Hysteresis / Neutral Zone	2	2	2	0.5...10.0
P15			X	88	Limitation Value. *Below this value all stages will switch off with their fixed backrun delay*			-100.0	-100.0..+100.0
P16			X	88	Hysteresis of Limitation Value P15			2	0,2...10.0
P17*		X	X	88	Upper Alarm Limit (relative to P04/P44). *If exceeded and after delay P19 the alarm relay will be activated (if available)*	+31.0	+31.0	+100.0	-100.0..+100.0
P18*	X	X	X	88	Lower Alarm Limit. *Below this limit, all stages will switch off in 1 sec. steps, after delay P19 the alarm relay will be activated (if available)*	-1.0	-1.0	-100.0	-100.0..+100.0
P19*	X	X	X	88	Alarm Time Delay	0	0	0	0...60 min
P20	X	X	X	**70**	Power Stages of compressor resp. fan 1	1	1	1	1...4
P21	X	X	X	**70**	Power Stages of compressor resp. fan 2	0	0	0	0...3
P22	X	X	X	**70**	Power Stages of compressor resp. fan 3	0	0	0	0...3
P23	X	X	X	**70**	Power Stages of compressor resp. fan 4	0	0	0	0...3
P24	X	X	X	**70**	Power Stages of compressor resp. fan 5	0	0	0	0...3
P25	X	X	X	**70**	Power Stages of compressor resp. fan 6	0	0	0	0...3
P26	X	X	X	**70**	Power Stages of compressor resp. fan 7	0	0	0	0...3
P27	X	X	X	**70**	Power Stages of compressor resp. fan 8	0	0	0	0...3
P28	X	X	X	88	Forward Time Delay (valid for all stages)	10	10	10	0...600 sec
P29	X	X	X	88	Backrun Time Delay (valid for all stages)	10	10	10	0...600 sec
P30	X	X	X	88	Minimum Idle Time (valid for all stages)	0	0	0	0...20 min
P31	X	X	X	**70**	Switching Mode Relays K1, K4 and K8 *(a) = active on, i.e. relay switches on* *(p) = passive (active off), i.e. relay switches off*	0	0	0	0=K1(a), K4(a), K8(a) 1=K1(p), K4(a), K8(a) 2=K1(a), K4(p), K8(a) 3=K1(p), K4(p), K8(a) 4=K1(a), K4(a), K8(p) 5=K1(p), K4(a), K8(p) 6=K1(a), K4(p), K8(p) 7=K1(p), K4(p), K8(p)
P32	X	X	X	88	Number of remaining stages after peak load limitation	2	2	2	0...8
P33	X	X	X	**70**	Base Load Change (Stage Sequencing)	0	0	0	0=off, 1=on
P34	X	X	X	88	Operating mode of Digital Input DI/OK 1	0	0	0	0=off, 1=night setpoint 2=peak load lim. 3=fast backr.
P35	X	X	X	88	Operating mode of Digital Input DI/OK 2 **<u>Not available in MSR 1100-2, must be set to "0"</u>**	0	0	0	0=off, 1=night setpoint 2=peak load limitation 3=fast backrun
P36	X	X	X	**10**	Master-/Slave Mode * see functional description	1	1	1	0= additional slave unit, K4 is alarm relay, no network 1= standard, max. 4 stages, networking possible 2= additional slave unit, K8 is alarm relay, networking is not possible
P37	X	X	X	**70**	Sensor Type	4	4	1	1 = TF 201, 2 = TF 501 4 = 4...20 mA, 5=Pressostat
P38*	X	X	X	88	Calibration of control sensor or pressure transmitter	0	0	0	-10.0...+10.0
P39*			X	88	Calibration of limitation sensor			0	-10.0...+10.0
P40*	X	X		88	Upper pressure value the transmitter delivers 20 mA	30.0	30.0		-1.0...+100.0
P41*	X	X		88	Lower pressure value the transmitter delivers 4 mA	-1.0	-1.0		-1.0...P40
P42	X	X	X	-	Remaining Time forward/backrun delay	-	-	-	
P43*	X	X	X	-	Remaining Time until an alarm will be activated	-	-	-	
P44*	X	X	X	88	Night Setpoint / 2nd Setpoint (replaces P04)	0	0	0	-100.0..+100.0
P45*	X	X	X	88	ON-time of Night / 2nd Setpoint (hours)	0	0	0	0...23 h
P46*	X	X	X	88	ON-time of Night / 2nd Setpoint (minutes)	0	0	0	0... 59 min
P47*	X	X	X	88	OFF-time of Night / 2nd Setpoint (hours)	0	0	0	0...23 h
P48*	X	X	X	88	OFF-time of Night / 2nd Setpoint (minutes)	0	0	0	0... 59 min
P49	X	X	X	88	Actual Value the analog output delivers 10V *	0	0	0	-100.0...+100.0
P50	X	X	X	88	Actual Value the analog output delivers 0V *	0	0	0	-100.0...P49
P51	X	X	X	88	Mode of the analog output	0	0	0	0= off, 1= proportional, 2= anti-proportional
P52	X	X	X	--	Clock Time 'hours'	-	-	-	0...23h
P53	X	X	X	--	Clock Time 'minutes'	-	-	-	0...59 min.
P54	X	X	X	--	Clock Time 'seconds'	-	-	-	0...59 sec.
P55	X	X	X	88	Data Transmission Speed (Baudrate)	4	4	4	1 = 1200, 2 = 2400, 3 = 4800 4 = 9600, 5 = 19200, 6 = 28800, 7 = 57600
P56	X	X	X	88	Address of the controller unit in a network	78	78	78	1...78
P57	X	X	X		Current Error + Error Listing	multiple errors present: scroll by up/down keys			
P58	X	X	X	-	Access Code	00	00	00	0...99
r 01 *up to* **r 08**	X	X	X	cnbe	Operation Time Counter for relay K1 (hours = display x 10) Operation Time Counter for relay K8 (hours = display x 10)	0	0	0	9999 hours

Operation Mode Indication

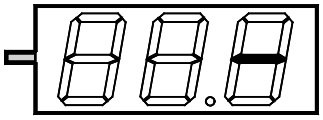
The parameter **P03** indicates the current operating state of the controller. If a 'pressostat' is selected as input source, **P03** is the standard indicator.

The following information is possible:

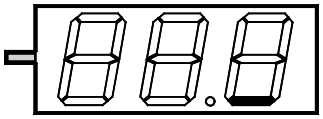
Unit is in 'forward' mode



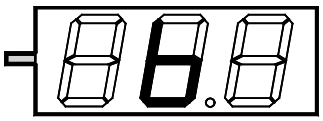
Unit is in a state of stability, no stages will switch off or on



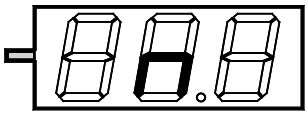
Unit is in 'backrun' mode



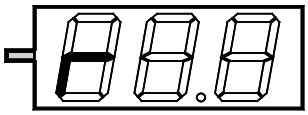
Limitation in progress



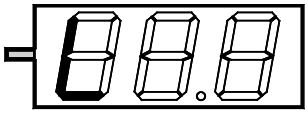
Night / 2nd Setpoint active



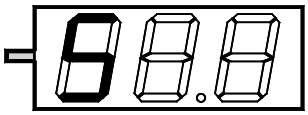
Fast Backrun



Peak load Limitation active



Minimum Idle Time still running



Failure Handling

Sensor short circuit or broken
If one of the sensors is broken, disconnected or hot-wired, or the value is located outside of its specified range, the display shows "- - -" at first. After 1 minute the display flashes and shows an error code, at the same time the alarm relay K4 will be activated (if available).

Error Codes

E00 ..... no failure
E01 ..... sensor F1 broken
E02 ..... sensor F1 hot wired
E03 ..... sensor F1 overtemperature
E04 ..... sensor F1 low temperature
E05 ..... sensor F2 broken
E06 ..... sensor F2 short circuit
E07 ..... sensor F2 overtemperature
E08 ..... sensor F2 low temperature
E09 ..... digital input 1 failure
E10 ..... digital input 2 failure
E11 ..... 4-20mA input broken (I < 3 mA)
E12 ..... 4-20mA input short circuit (I >21 mA)
E13 ..... 4-20mA input overpressure
E14 ..... 4-20mA input low pressure
E17 ..... assignment error (to many stages selected)
E18 ..... communication failure to slave module

Functional Description

Selection of Operating Mode
The MSR can be configured for controlling compressor compounds, for condenser fans and brine chiller systems. While this configuration, all adjusted parameters will be **erased** and replaced by suggestive default values. Not necessary parameters will be suppressed (see start-up examples).

Operation Mode 1 (compressor compounds)

Input signals of the controller
The input signal comes from a 2-wire pressure transmitter with a 4-20 mA-signal or a pressostat, selectable by parameter **P37**.

Actual Value and Status Display
P01 shows the pressure value of the transmitter. If the controller is configured for working with a pressostat, **P03** becomes the standard display. **P03** is a status display, which shows states like Forward/Backrun, Neutral State and others (see 'Operating'). From every state, 4 minutes after the last keypress the display switches back to the actual value.

Calibration of Transmitter and Actual Value
A pressure transmitter delivers its value by a 4-20 mA-signal. With **P40/P41** you select the pressure values which are shown and processed with 4 or 20 mA input current. With **P38** the actual value display (P01) can be adjusted.

Probe Failures
If a transmitter malfunction is identified, all stages will switch ON with the selected delay. After the alarm delay **P19** is run down, the alarm relay K4 switches (if available).

Limit values
If the pressure value falls short of the limitation value **P18**, all running stages will be de-activated in 1 second steps. After the alarm delay **P19** is run down, the alarm relay (K4) switches if available.

Operation Mode 2 (condenser fans)

Input signals of the controller
The input signal comes from a 2-wire pressure transmitter with a 4-20 mA-signal or a pressostat, selectable by parameter **P37**.

Actual Value and Status Display
P01 shows the pressure value of the transmitter. If the controller is configured for working with a pressostat, **P03** becomes the standard display.
P03 is a status display, which shows states like Forward/Backrun, Neutral State and others (see 'Operating'). From every state, 4 minutes after the last keypress the display switches back to the actual value.

Calibration of Transmitter and Actual Value
A pressure transmitter delivers its value by a 4-20 mA-signal. With **P40/P41** you select the pressure values which are shown and processed with 4 or 20 mA input current. With **P38** the actual value display (P01) can be adjusted.

Probe Failures
If a transmitter malfunction is identified, all stages will switch ON with the selected delay. After the alarm delay **P19** is run down, the alarm relay K4 switches (if available).

Limit values
If the pressure value exceeds the limitation value **P17** (which is relative to the setpoint) and the alarm delay **P19** is run down, the alarm relay (K4) switches if available.

Operation Mode 3 (Brine-Chillers)

Input signals of the controller
2 Temperature Sensors TF 201 or TF 501, selected by **P37**. The control sensor should be mounted at water reflux (brine backflow, chiller inlet). The second sensor measures the temperature limitation value at the chiller's outlet.

Actual Value and Status Display
P01 shows the inlet temperature, **P02** the outlet temperature. **P03** is a status display for Foreward/Backrun, Neutral State and others. From every state, 4 minutes after the last keypress the display switches back to the actual value.

Calibration of Sensors and Actual Value
Correct the temperature displays by **P38** and **P39**.

Probe Failures
If a probe malfunction is identified, all stages will switch OFF with their backrun delay. After the alarm delay **P19** is run down, the alarm relay K4 switches (if available).

Limit Values
Temperature Limitation
If the outlet temperature at sensor 2 falls short of **P15**, a regular backrun will be initiated and all stages will switch off after their delay (**P29**). **P16** is the hysteresis value for P15.

Frost Protection
If the inlet temperature falls short of **P18**, stages will switch off in 1 second steps. After the delay **P19** the alarm relay K4 switches (if available).

Temperature Alarm
If the inlet temperature exceeds **P17**, the alarm relay K4 switches after the alarm delay **P19**.

All Operating Modes

P43 always show the remaining time of a running alarm delay.

2nd Control Setpoint 1 / 'night'-shift
Sometimes it is desired to shift the setpoints e.g. to spare energy at night. With **P44** a 2nd setpoint 1 will be fixed and can be activated by the internal time-switch or the digital inputs DI/OK1 and DI/OK2. Within the times set by **P45** and **P48** the second setpoint is active. If not necessary, the times can be set to "0". Please note that initation by digital(OK)-input has more priority as the internal clock.

Stage Controller

The control characteristic of the stages differ depending on the *operating mode* and the *selected sensors*. To prevent the final user from adjusting the setpoints to an inadmissible value, the setpoint range can be limited by **P12** and **P13**.

Stage Controller + Pressure Transmitter (Compressors)

The control setpoint is preset by **P04** as a pressure value, no access code necessary. The hysteresis **P14** is located symmetrical around the control setpoint.

Forward (Stages on)
If the measured pressure value exceeds the setpoint **(P04 + ½ P14** (hysteresis), the forward delay **P28** starts. After this timer is run down, a stage will be switched ON and the timer starts again. Read at **P42** if a delay time is still running and when a stage will be switched on or off.

Neutral zone
If the actual pressure value is located within the hysteresis **P14** (located around the setpoint), no stage will be activated or de-activated.

Backrun (Stages will switch off)
If the actual pressure value falls short of **P04 - ½ P14**, the backrun delay **P29** starts. After this timer is run down, one stage will switch off, the timer starts again, and so on.

Stage Controller + Pressostat (Compressors or Fans)

The MSR gets the Forward/Backrun information from a Pressostat (or another potential free contact). Functions depending on analog signals are not available if this kind of probe is selected.

Forward (Stages on)
If the Pressostat is switched to 'Forward', the forward delay **P28** starts. After this timer is run down, a stage switches ON and the timer starts again. Read at **P42** if a delay time is still running and when a stage will be switched on or off.

Neutral zone
If the contacts of the Pressostat are open (mid position), then no stage will be activated or de-activated.

Backrun (Stages will switch off)
If the Pressostat is switched to 'Backrun', the backrun delay **P29** starts. After this timer is run down, one stage will switch off, the timer starts again, and so on.

Stage Controller + Pressure Transmitter (Condenser Fans)

The control setpoint is preset by **P04** as a pressure value (this is the setpoint for stage 1 at the same time), no access code necessary. The following stages switch in a distance to the previous stage (**P05-P11**). The hysteresis **P14** is located symmetrical around the setpoints.

Forward (Stages on)
If the measured pressure value exceeds one of the **setpoints + ½ P14** (hysteresis), the forward delay **P28** starts. After this timer is run down, the corresponding stage will switch and the timer starts again. **P42** shows a running delay time up to the next stage will switch.

Neutral zone
If the actual pressure value is located within the hysteresis **P14** (located around all setpoints), no stage will be activated or de-activated.

Backrun (Stages will switch off)
If the actual pressure value falls short of a **setpoint - ½ P14**, the backrun delay **P29** starts. After this timer is run down, the corresponding stage will switch off, the timer starts again, and so on.

Stage Controller for Brine-Chillers

The control setpoint is preset by **P04** as a temperature value (this is the setpoint for stage 1 at the same time), no access code necessary. The following stages switch in a distance to the previous stages (**P05-P11**). The hysteresis **P14** is located symmetrical around the setpoints.

Forward (Stages on)
If the measured temperature value exceeds one of the **setpoints + ½ P14** (hysteresis), the forward delay **P28** starts. After this timer is run down, the corresponding stage will switch and the timer starts again. **P42** shows a running delay time up to the next stage will switch.

Neutral zone
If the actual pressure value is located within the hysteresis **P14** (located around all setpoints), no stage will be activated or de-activated.

Backrun (Stages will switch off)
If the actual temperature value falls short of a **setpoint - ½ P14**, the backrun delay **P29** starts. After this timer is run down, the corresponding stage will switch off, the timer starts again, and so on.

Motor/Machine/Load Control
The MSR-unit is able to control up to 4 single motors or multi-stage machines with up to four stages. By adding a 'slave'-module up to 8 stages are possible. The kind of machines and the number of stages are fixed by parameters **P20**-**P27**. *Example:*

Compressor / Fan	*Programming*								*Relays used for Compressor / Fan*							
	P20	*P21*	*P22*	*P23*	*P24*	*P25*	*P26*	*P27*	K1	K2	K3	K4	K5	K6	K7	K8
8x single mach.	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
1x 6-stage	*6*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1.1*	*1.2*	*1.3*	*W*	*1.4*	*1.5*	*1.6*	-
1x 6-stage	*6*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1.1*	*1.2*	*1.3*	*1.4*	*1.5*	*1.6*	-	*W*
3x 2-stage	*2*	*2*	*2*	*0*	*0*	*0*	*0*	*0*	*1.1*	*1.2*	*2.1*	*W*	*2.2*	*3.1*	*3.2*	-
2x 2-stage and 2x single mach.	*2*	*2*	*1*	*1*	*0*	*0*	*0*	*0*	*1.1*	*1.2*	*2.1*	*W*	*2.2*	*3*	*4*	-

Which relay works as an alarm relay depends on the settings of P36. Rule of thumb: If the 4th stage (single operation of the unit) resp. the 8th stage (master/slave mode) is not used, this stage works as an alarm relay automatically.
P31 determines if the alarm relay works active-on or active-off.

Automatic Base Load Change (Stage Sequence Change)
The built-in base load change function (**P33**, ON/OFF) regards the relative runtimes of the single stages and cares for approximately the same motor runtimes by and by. If multistage machine types are used, only the runtime of the leading stage (= motor on) will be considered.

Load Limitation
Via one of the both digital inputs DI/OK1 and DI//OK2 a load limitation function can be initiated, e.g. for energy saving. **P32** fixes how many stages remain for control purposes after this function has been started, the stages will be disabled within a few seconds.

Minimum Idle Time
If a load is switched off by a relay, this relay can be switched on again first after the time set with **P30** is over.

Relay Switching Mode
With **P31** the switching mode of relay K1, K4 and K8 can be changed for special purposes:

P31 = 0 All relays are active ON (will switch on), *Standard setting*
P31 = 1 K1 active OFF (relay de-activated),
K4 and K8 (if available) active ON
*With this setting e.g. an **emergency operation** can be realized, compressor 1 will be controlled by the N/C so it would run continuously if the MSR fails.*
P31 = 2 K1 active ON, K4 active OFF
*Advisable if only 3 compressors/stages should be controlled and you want to use relay K4 as an active OFF **alarm relay**.*
P31 = 5 K1 active OFF, K4 active ON, K8 active OFF
Can be used for emergency operation & alarm relay controlling 7 compressors or if compressor 1 and 8 should run in emergency mode.

Trend Analysis (STAN)

The stage controllers of the series MSR contain an autoadaptive algorithm to recognize actual value tendencies (**STAN = Switch Tendency Analysis**). This algorithm effects an essential reduction of on/off cycles of the machines and a noticeable increased control accuracy. **STAN** works foreseeing, recognizes the trend of the actual value and decides about the necessity of switching on/off a machine, based on the captured data.

A typical example of a conventional control is the following state:

Machines run, the actual value approaches itself to the setpoint, the foreward delay of the next stage is still running. If the next stage will switch on now, the tendency will be increased, probably the setpoint range will be left quickly to low values. The high deviation to low values then effects mostly that multiple or all machines switch off and a quick rise of the pressure with essential overshoot of the setpoint range. The plant 'oszillates'.

This behaviour must be suppressed by increasing the switch delay times, but this makes the control slow and enables wider setpoint deviations.

STAN avoids the effects in this example: **STAN** recognizes that the actual value moves to the setpoint direction and disables that machines (stages) will switch on. If the tendency continues, the setpoint will be reached without additional power. Oszillating or essential decreasing of the setpoint range will be avoided safely.
STAN works complety autoadaptive, no parameters must be set. Because of the fuzzy logic of the algorithm, disadvantageous effects like moving setpoint deviations will be recognized, so they cannot affect the tendency analysis.

If the MSR works as a brine/chiller controller, STAN keeps disabled.

The single Advantages:
- Essential reduction of on/off cycles and so an increased lifetime of components, especially of compressors.
- More accurate, more regular control with less setpoint deviations than a standard stage controller. This affects lower energy consumption and the cold production works with a constant, high efficiency ratio.
- Expansion valves work more regular and so more efficient, based upon the lower suction resp.condenser pressure variations.
- The average 'delta T' falls. This affects a lower icing of the evaporators, and the product quality rises because of the lower de-humidifying (counters of meat/cheese, meat storages).
- The reaction times of the plant meet the demands, because the delay times must not be increased additionally to damp the switching behaviour.
- Autoadaptive, no settings necessary

Digital Inputs

The digital inputs DI/OK1 andDI/OK2 are normally (depending on type) connected to mains voltage. If this voltage is interrupted, the functions set with **P34** and **P35** will be initiated.

CAUTION The **MSR 1100-2** has only 1 digital input (DI/OK1). The function will be activated by opening an external, potential free contact connected to terminals 11 and 12. **Never connect mains voltage to these terminals, danger of destruction!**
This contact must be suitable for 5VDC/1mA).

0= Digital Input is **de-activated**
1= No voltage at the input (1100-2: contact open) changes to the **2nd (night) setpoint**.
The internal time switch has no effect, that means the digital input has a prior rank.
2= No voltage at the input (1100-2: contact open) initiates a **Peak Load Limitation.** The no. of stages remaining for control purposes must be preset by P32.
3= No voltage at the input (1100-2: contact open) starts a **Fast Backrun**, all stages will switch off in 1 sec. steps.

Note: To prevent from being activated unintended, the functions of DI/OK1 and 2 are de-activated while programming parameters P34/P35.
If the same function is selected for both inputs, then DI/OK 2 has the higher priority.

Voltage Output / Analogue Output

The MSR-Controller owns an analogue output with a 0-10 V DC-signal, which can be used both to forward an image of the actual value **P01** or as proportional controller output.

P49.... fixes the actual value the analogue output delivers 10V (resp. 0V, if P51=2) DC voltage.
P50.... fixes the actual value the analogue output delivers 0V (resp. 10V, if P51=2) DC voltage.
P51.... switches the analog output ON or OFF and determines if the voltage should rise (P51=1) or fall (P51=2) if the actual value rises.

Example for a Actual Value Forwarding:
You want to use a remote display or similar, which shows 0 bar with 0V input and 10 bar with 10V input.

P50 = "0", P49 = "+10", P51 must be "1".

Example for a Proportional Controller:
You want to control a three-way valve. This valve should be half open at 5.0 bar. If the pressure falls, the valve should open, from 4 bar the valve should be full open. If the pressure rises, the valve should be narrowed, from 6 bar it should be closed.

P50 ="4.0", P49 ="6.0", P51 ="2"

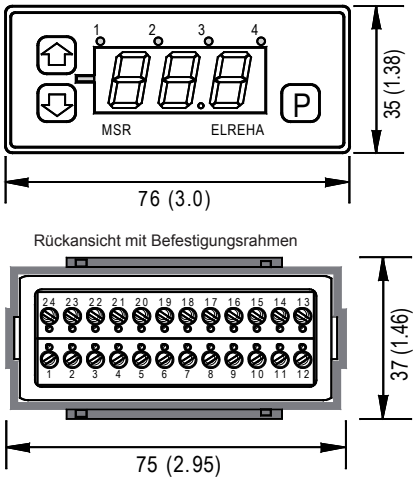
Real time clock

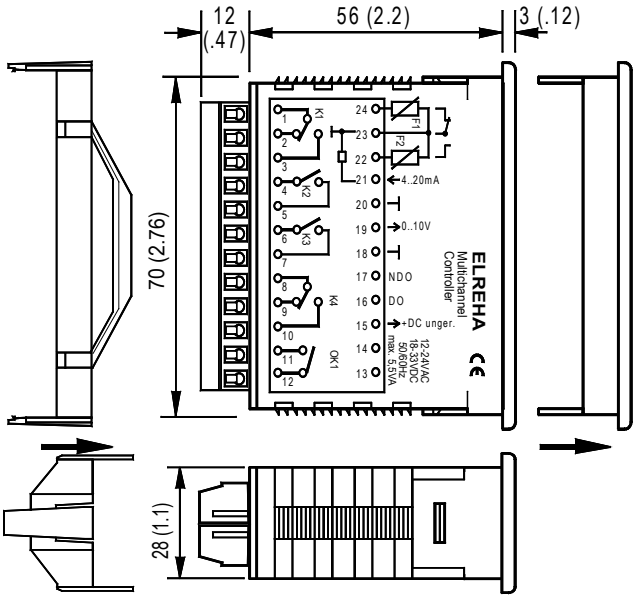
The Controller contains a real time clock (without a date function) which can be used for changing the control setpoint. The timer has a data backup for about 10 days in case of power failure. The time of the day and the date can be set by parameters **P52** - **P54**.
The time switch is de-activated if ON and OFF-time are identical.

Operation Time Counter

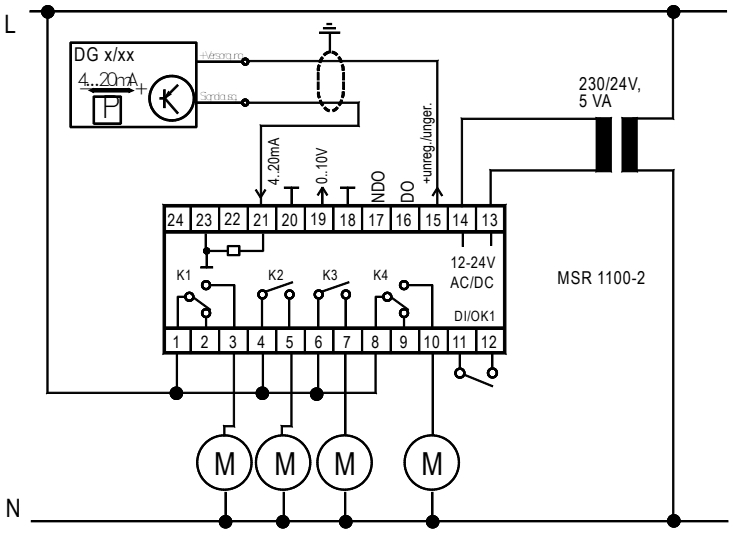
Each relay output owns an individual operation time counter. This counter measures and totalizes the time this output was activated. The values can be read at "**r01**" - "**r08**". Because the display has 3 digits only, the stored value is "*displayed value x 10*". After 9999 hours the counter will be reset to "0". A reset by the user is not possible.

MSR 1100-2 - Dimensions and Connection

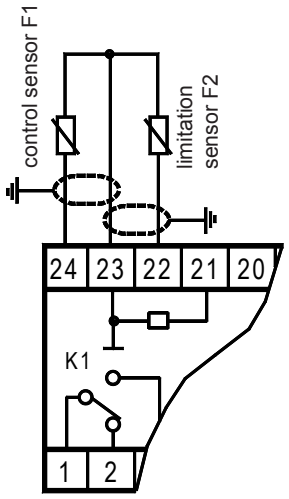




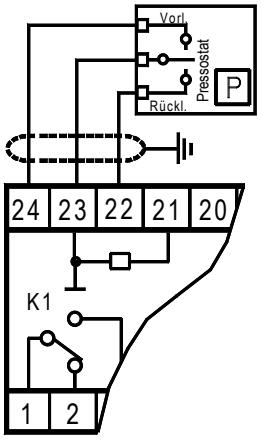
- Simplified connecting diagrams
- Dimensions in mm (inch)



MSR 1100-2 with 2-wire pressure transmitter.



temperature sensor connection for controlling a brine-chiller



pressostat connection

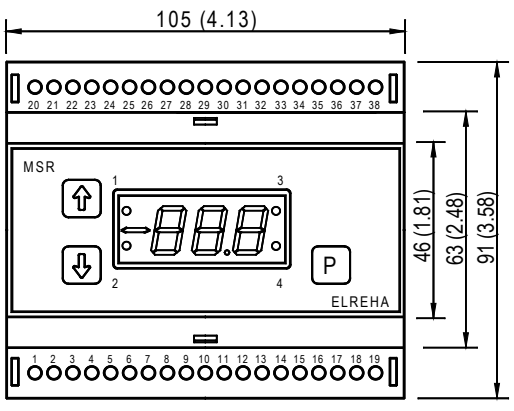
Note

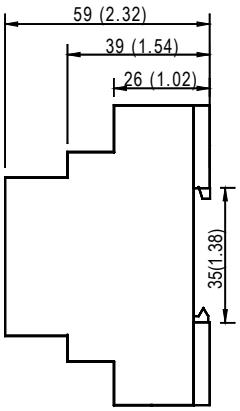
Protective Earth

Earth

Dimensions in mm, (in brackets = inches)

MSR 3100-2 / 23100-2 - Dimensions and Connection



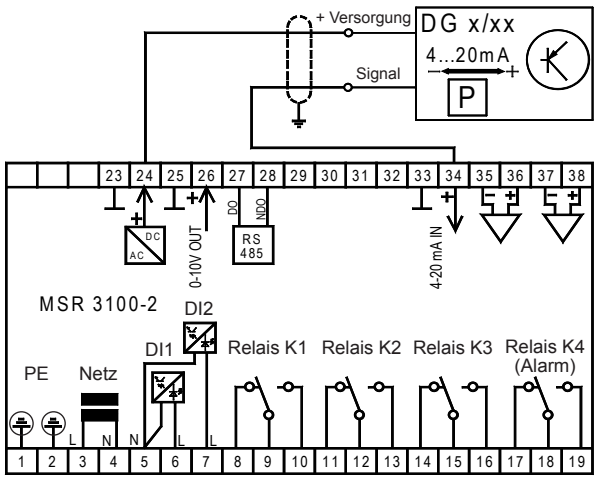


Note

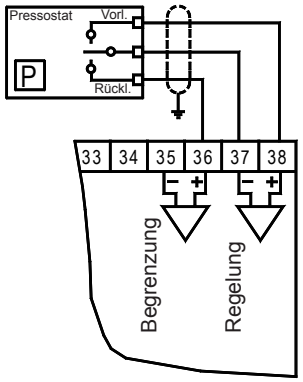
Protective Earth

Earth

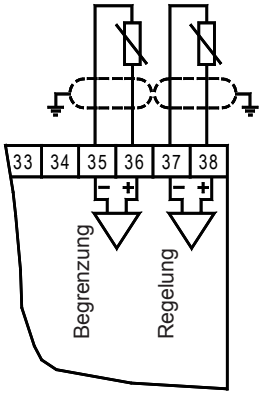
Dimensions in mm,
(in brackets = inches)



pressure transmitter connection

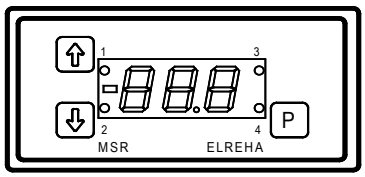


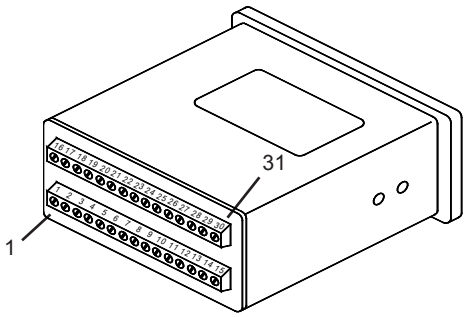
pressostat connection

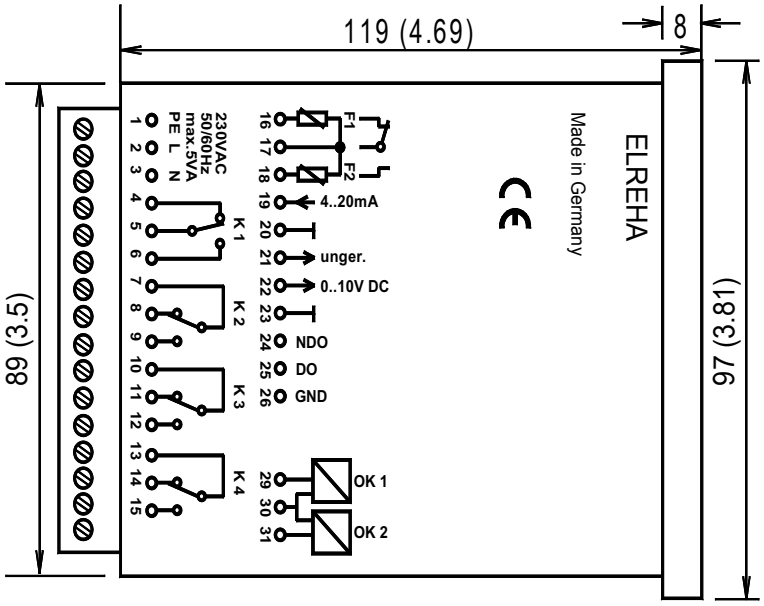


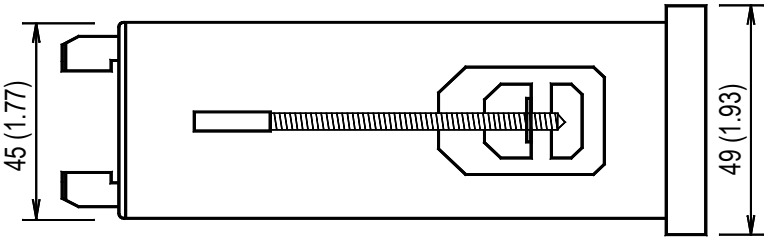
temperature sensor connection
for controlling a brine-chiller

MSR 5100-2 / 25100-2 - Dimensions and Connection









panel mounting housing dep. on DIN 43700/IEC 61554
cut-out: 92 x 45 mm (w x h)
tolerances max: +0,8 (w), +0,6 (h)

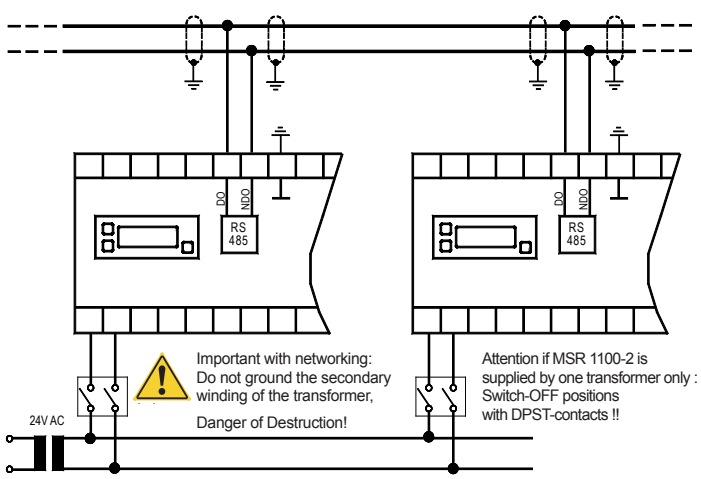
Networking of MSR Controllers

Interface
All MSR controllers can be networked via their built-in RS-485-interface. This network can be controlled by a host unit. This host can be a PC with a qualified software or a SMZ-Frontend-System which allows remote control of units and recording of all parameters.

Exception: In "master mode" (P36 = 0 or 2) the interface is used fo connecting a slave module with 4 more stages.

- Because all units are connected parallel on the data bus, every unit has its own network address (**P56**) to ensure a specific communication.
- The communication speed is fixed with **P55**, (Default value 9600 Baud).
- Connection is done by commercial databus cable.
- Shielding and ground connectors must be connected to the nearest ground terminal.
- The unshielded part of the data cable must be as short as possible.

If multiple, networked controller units are supplied from one transformer (**MSR 1100-2 only**), a double pole switch must be used to switch off the single positi-ons. If not, the unit will be supplied by a half-wave via the shielding, and the unit continues working (depending on the secondary voltage of the transformer). Please note: In this case a PC software announces a malfunction!

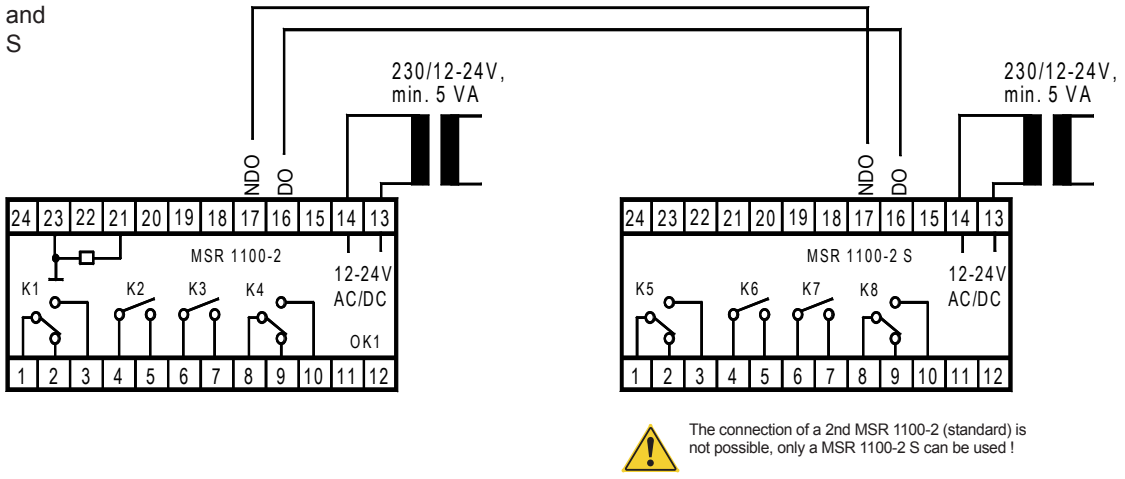


Stage extension by adding the 'Slave' module MSR 1100-2 S

Only possible in the combination MSR 1100-2 and MSR 1100-2 S !

- The MSR 1100-2 can be expanded up to 8 stages by adding a slave module MSR 1100-2 S-
- 'Master-' and 'Slave-' module must be regarded as a single unit. The MSR 1100-2 types can be supplied both by a single transformer or different transformers which must be switched together.
- The controllers must be mounted as close as possible to get a short data connection.
- Parameter P36 must be set to "0" or "2", so the MSR expects a slave module.
- While communication problems to the slave error messages "E18" appears.
- With communication problems >30 sec. the stages of the slave switch off (beginning with K8) in 1 sec. steps. When the problem is eliminated the slave switches its stages on again, beginning with K5.
- If less than 8 stages are selected, the position of the alarm relay depends on P36.

Master/Slave Connection
MSR 1100-2 and
MSR 1100-2 S



The connection of a 2nd MSR 1100-2 (standard) is not possible, only a MSR 1100-2 S can be used !

Startup Examples

MSR as Compressor Compound Controller

Requirement:

4 single compressors, stage 1 configured for emergency operation, automatic base-load change. Control setpoint 2 bar, neutral zone 0,5 bar. pressure transmitter 4-20 mA, range 0-10 bar. Night operation (2nd setpoint) within 19:00 and 7:00, 0,5 bar higher. Forward/Backrun delay 10 sec. The user want to see the actual pressure value on a remote display with 0-10V-input. While a peak load limitation via DI/OK 1, 2 stages remain for control purposes.

Please always note the Safety Instructions!

Select Operation Mode
- Switch OFF power supply
- Push and hold key 'P', switch ON power
- Hold key 'P' until '_ _ _' appears
- Release key 'P'
- Select '**1** _ _' by key '⇧' (compressor mode)
- Push key 'P' once
- 'def' appears, default values are loaded
- Actual values appear, ready for start up.

Basic Configuration

Enter Code Number '**70**'

- P20=1 (single compressor at relay K1)
- P21=1 (single compressor at relay K2)
- P22=1 (single compressor at relay K3)
- P23=1 (single compressor at relay K4)
- P31=1 (relay K1 inverted, load at N/C)
- P33=1 (base load change ON)
- P37=4 (transmitter with 4-20 mA signal)

Enter Code Number '**88**'

Adjustments
- P40=10.0 (press. value transmitter at 20 mA)
- P41=0.0 (press. value transmitter at 4 mA)
- P04=2.0 (control setpoint)
- P10=0.5 (neutral zone / hysteresis)
- P28=10 (forward delay in sec.)
- P29=10 (backrun delay in sec.)
- P32=2 (2 stages remain after peak load lim.)
- P34=2 (DI/OK 1 configured for peak load lim.)
- P44=2.5 (2nd control setpoint)
- P45=19 (2nd setpoint ON 'hours')
- P46=00 (2nd setpoint ON 'minutes')
- P47=07 (2nd setpoint OFF 'hours')
- P48=00 (2nd setpoint OFF 'minutes')
- P49=10
  (analog output delivers 10VDC at 10 bar)
- P50=0
  (analog output delivers 0V at 0 bar)
- P51=1 (analog output works proportional)

- P52=--(clock time 'hours')
- P53=--(clock time 'minutes')
- P54=--(clock time 'seconds')

Display correction

The actual pressure display **P01** can be calibrated by using **P38**.

Extension with 2 more single compressors

A "slave" module is connected, settings like above, but additionally:

- P24=1 (single compressor at relay K5)
- P25=1 (single compressor at relay K6)

- P36=2 (slave module is expected, relay K8 is now automatically an alarm relay, because it is not necessary for control purposes.

- P31=5 (Relay K1 inverted and alarm relay K8 inverted (if desired only)

MSR as Condenser Fan Controller

Requirement:

3 single fans, no emergency mode, automatic base-load change.
Control at 15, 16, 17 bar, neutral zone 0,5 bar each. Pressure transmitter 4-20 mA, range 0-25 bar. Night operation (2nd setpoint) within 20:00 and 6:30, 2 bar higher. Forward/Backrun delay 30 sec.

Please always note the Safety Instructions!

Select Operation Mode
- Switch OFF power supply
- Push and hold key 'P', switch ON power
- Hold key 'P' until '_ _ _' appears
- Let go key 'P'
- Select '**2** _ _' by key '⇧' (condens. fan mode)
- Push key 'P' once
- 'def' appears, default values are loaded
- Actual values appear, ready for start up.

Basic Configuration

Enter Code Number '**70**'

- P20=1 (single fan at relay K1)
- P21=1 (single fan at relay K2)
- P22=1 (single fan at relay K3)
- P31=0 (no emergency mode, K1 not invert.)
- P33=1 (base load change ON)
- P37=4 (transmitter with 4-20 mA signal)

Enter Code Number '**88**'

Adjustments
- P40=25.0 (press. value transmitter at 20 mA)
- P41=0.0 (press. value transmitter at 4 mA)
- P04=15.0 (control setpoint stage 1)
- P05=1.0
  (setpoint stage 2 in a distance to P04)
- P06=1.0
  (setpoint stage 3 in a distance to P05)
- P14=0.5 (neutral zone / hysteresis)
- P28=20 (forward delay in sec.)
- P29=20 (backrun delay in sec.)
- P44=17.0 (2nd control setpoint 1)
- P45=20 (2nd setpoint ON 'hours')
- P46=00 (2nd setpoint ON 'minutes')
- P47=06 (2nd setpoint OFF 'hours')
- P48=30 (2nd setpoint OFF 'minutes')

- P52=--(clock time 'hours')
- P53=--(clock time 'minutes')
- P54=--(clock time 'seconds')

Display correction

The actual pressure display **P01** can be calibrated by using **P38**.

MSR as Brine-Chiller Controller

Requirement:

2 dual-stage compressors, no emergency mode, automatic base load change.
Control at 4, 6, 8, 10 °C, hysteresis 0,5 K each. Temperature sensor TF 501, night operation (2nd setpoint) within 20:30 and 6:00, 2 K higher. Forward/Backrun delay 25 sec.

Please always note the Safety Instructions!

Select Operation Mode
- Switch OFF power supply
- Push and hold key 'P', switch ON power
- Hold key 'P' until '_ _ _' appears
- Let go key 'P'
- Select '**3** _ _' by key '⇧' (Brine-Chiller mode)
- Push key 'P' once
- 'def' appears, default values are loaded
- Actual values appear, ready for start up.

Basic Configuration

Enter Code Number '**70**'

- P20=2 (compressor 1 ON, relay K1)
  (compr. 1 power stage ON, relay K2)
- P21=2 (compressor 2 ON, relay K3)
  (compr. 2 power stage ON, relay K4)
- P31=0 (no emergency mode, K1 not invert.)
- P33=1 (base load change ON)
- P37=2 (temperature sensor TF 501)

Enter Code Number '**88**'

Adjustments
- P04=4.0 (control setpoint stage 1)
- P05=2.0
  (setpoint stage 2 in a distance to P04)
- P06=2.0
  (setpoint stage 3 in a distance to P05)
- P07=2.0
  (setpoint stage 4 in a distance to P06)
- P14=0.5 (neutral zone / hysteresis)
- P28=25 (forward delay in sec.)
- P29=25 (backrun delay in sec.)
- P44=6.0 (2nd control setpoint 1)
- P45=20 (2nd setpoint ON 'hours')
- P46=30 (2nd setpoint ON 'minutes')
- P47=06 (2nd setpoint OFF 'hours')
- P48=00 (2nd setpoint OFF 'minutes')

- P52=--(clock time 'hours')
- P53=--(clock time 'minutes')
- P54=--(clock time 'seconds')

Display correction

The 2 actual temperature displays can be calibrated by **P38** (P01, inlet temperature) and **P39** (P02, outlet temperature).

CONNECTION INFORMATION & SAFETY INSTRUCTIONS

Notice

The guarantee will lapse in case of damage caused by failure to comply with these operating instructions! We shall not be liable for any consequent loss! We do not accept liability for personal injury or damage to property caused by inadequate handling or non-observance of the safety instructions! The guarantee will lapse in such cases.

This manual contains additional safety instructions in the functional description. Please note them!

DANGER

If you notice any damage, the product may not be connected to mains voltage! Danger of Life!
A riskless operation is impossible if:

- The device has visible damages or doesn't work
- After a long-time storage under unfavourable conditions
- The device is strongly draggled or wet
- After inadequate shipping conditions
- Never use this product in equipment or systems that are intended to be used under such circumstances that may affect human life. For applications requiring extremely high reliability, please contact the manufacturer first.
- **The product may only be used for the applications described on page 1.**
- **Electrical installation and putting into service must be done from qualified personnel.**
- **During installation and wiring never work when the electricity is not cut-off ! Danger of electric shock!**
- **Never operate unit without housing. Danger of electric shock!**
- **All 'PE' terminals must be connected to ground. Danger of electric shock!** Additionally, the internal noise filter will not work, faulty indicated values may occur.
- Please note the safety instructions and standards of your place of installation!

CAUTION

- Before installation: Check the limits of the controller and the application (see tech. data). Check amongst others:
  - Make sure that all wiring has been made in accordance with the wiring diagram in this manual.
  - Supply voltage (is printed on the type label).
  - Environmental limits for temperature/humidity.
  - Maximum admitted current rate for the relays. Compare it with the peak start-up currents of the controlled loads (motors, heaters,etc.).
    Outside these limits malfunction or damages may occur.
- Sensor/probe cables must be shielded. Don't install them in parallel to high-current cables. Shielding must be connected to PE at the end close to the controller.
  If not, inductive interferences may occur.
- Please note for elongation: The wire gauge is not critical, but should have 0,5mm² as a minimum.
- Mounting the controller close to power relays is unfavourable. Strong electro-magnetic interference, malfunction may occur!
- Take care that the wiring of interface lines meets the necessary requirements.
- All used temperature sensors must be identical. Never use different types at the same time. This will not work.
- TF-type sensors are not designed for being immersed in fluids permanently. In such a case, always use dip-fittings. With extreme temperature variations, the sensor may be damaged.

Notice

Cleaning
The use of a dry, lint-free cloth and household agents is sufficient to clean the product.
Never use acids or acidic fluids! Risk of damage!

EC Declaration of Conformity

CE

*For the devices **MSR 1100-2, MSR 3100-2 and MSR 5100-2** we state the following:*
*When operated in accordance with the technical manual, the criteria have been met that are outlined in the EMC Directive **2014/30/EC** and the Low Voltage Directive **2014/35/EC**. This declaration is valid for those products covered by the technical manual which itself is part of the declaration.*

Following standards were consulted for the conformity testing to meet the requirements of EMC and Low Voltage Guidelines:

EN 55011:2016, EN 61010-1:2010, EN 61326-1:2013 **CE marking of year: 2017**

This statement is made for the manufacturer / importer

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by:

Werner Roemer, *Technical Director*

Hockenheim .....**12.6.2017**.....
City *Date* *Signature*

original set up: 13.6.17, tkd/jr	checked: 14.6.17, ek/ha	approved: 14.6.17, mv/sha		korr.