Brief Description / Applications
- Controller for all kind of Storages, such as Walk-In Coolers/Freezers, Refrigerated Shelfs, Refrigerated Counters, Refrigerated Cases, etc.
- For standard cold storages or cold storages with pulse-width modulated expansion valves or expansion valves with thermal drive
- For single or network operation
- 4 Temperature sensors, 4 Relays, 2 Digital Inputs, Analogue In-/Output

Standard Functions
- Controls temperature, defrost device, evaporator fans, roller blinds, etc.
- Up to 3 evaporators with a single device
- 2 expansion Valve control methods selectable
- Valve control is fully autoadaptive
- Foresight control and condenser pressure optimization in cooperation with the VPR compressor compounds central unit
- Intelligent defrost control, able to learn, no additional sensors
- Defrost Start fully automatic, by 6 release times or manually
- Defrost cycle is pulsed, controlled by evap sensor (variable intervals)
- Automatic recognition of the leading evaporator
- Emergency Mode if sensor or defrost recognition fails. Autoreset after repair
- Use of Latency Heat by intelligent fan control

ELREHA
ELEKTRONISCHE REGELUNGEN GMBH

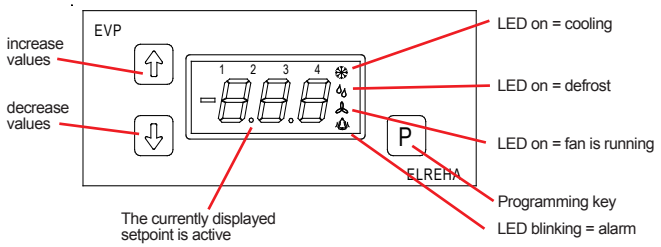
Technical Manual **5311092-00/26E**
Cold Storage Controller from SoftVers. **1.61**

Types: EVP 3150-1
EVP 3150-2

In controllers which contain older software versions, some functions may not be available!

Operating / Operating Elements

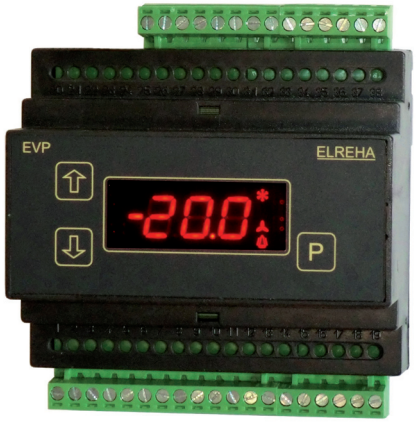
The front view of the version with an older display you will find on page 6.



The current states of the digital inputs can be read under L60, the state of the relays and the data transmission can be read under L61 (Actual Values Page).

LEDs are blinking the same time = control functions are disabled by digital input or via interface

3 keys allow programming the unit, all parameters will be displayed on the red LED-7-segment display. 4 red symbols at the right side indicate specific control functions (*not the relay states, these are displayed on the 'Actual Page' !*).



Programming

All parameters of the **EVP** are distributed on different pages.
While normal operation or if no key is pressed for about 3 minutes, the **EVP** displays the following information:

1st priority:	current failure (blinking)
2nd priority:	operating states (e.g. 'oFF')
3rd priority:	selected 'permanent parameter' display

Selecting and Changing of Parameters

key	action
P (> 2 sec.)	.....Page name will be displayed
⇧ ⇩	.....Select desired page
P	.....Enter the page
⇧ ⇩	.....Select parameter
P	.....Prepare programming. Enter access code if necessary
⇧ ⇩	.....Change value. If you hold the key, the values change faster and faster
P	.....Confirm programming
P (> 2 sec.)	.....Page name will be displayed again

Access Protection

Except the temperature setpoints, parameters can be changed only after entering a correct access code. If you want to change such a parameter after pushing the "P"-key, then the following display appears:

Now the controller expects the entry of a code number .

This code number is always 88. Enter it by the up/down keys and confirm it by pressing "P" again.

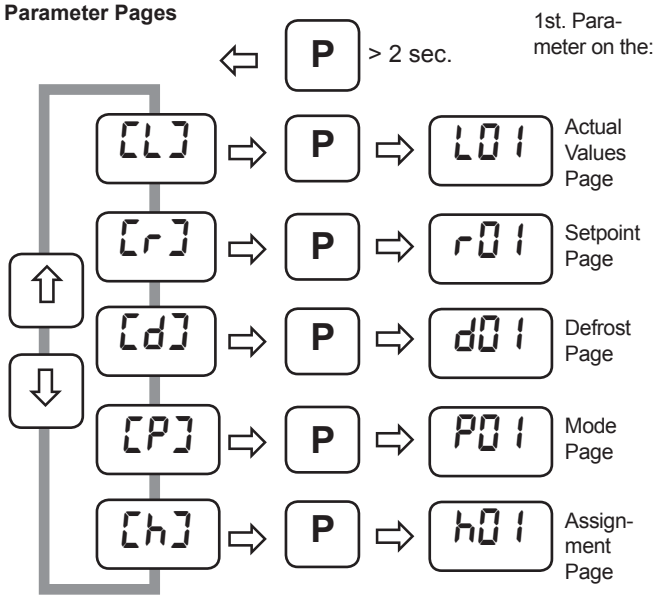
If no key is pushed for about 3 minutes, the code number must be entered again.

Manual Defrost

Start manual defrost:
- Select "**d50**" (Defrost Page),
- Set it to "**on**" and confirm.

Stop manual defrost:
- Select "**d50**" (Defrost Page),
- Set it to "**oFF**" and confirm.

Parameter Pages



CAUTION **If an older version must be replaced - please note the modified terminals!**

DANGER **Please note safety instructions !**

Notice **This may be a brief version of the technical manual. A complete version with the pages 7...16 you can find on www.elreha.de or our free INFO-CD.**

Technical Data

Supply Voltage	EVP 3150-x	230V, 50-60Hz, max. 9VA
	EVP 23150-x	115V, 60 Hz, max. 9VA
		max. 240VA with full load of the SSR-output
Ambient Temperature		0...+50°C
Max. Ambient Humidity		85% r.F., not condensing
Analogue Inputs		4x Temperature Sensors
		TF 201 (PTC) or TF 501 (Pt 1000)
		1x pressure transducer 0(2)-10V (scalable), Ri=69 kOhm
Measuring ranges of the probe inputs	TF 501 (Pt1000)	-100°C...+100°C
	TF 201 (PTC, 2 kΩ at°C)	-50°C...+100°C
	So1	-40°C...+25°C
	So2	-50°C...+50°C

The temperature ranges of the probe heads and cables must be obeserved !

Accuracy	±0.5K in range -35...25°C within the ambient temperature range 10...30°C
Digital Inputs	2x mains voltage, 3mA max.
Relay Outputs	3x SPDT isolated, 8A res/3A ind./250V
EEx-Valve Output	1x Solid-State-Relay (SSR), max. 1A / 250VAC or 230V DC / 500mA

Please note the information at the connection plan about a necessary snubber circuit at the SSR output!

Transducer Supply	22V DC ±10%, 40 mA max.
Analogue Output	0...10V or 4...20mA (selectable)
	0...10VDC, max. current typ. 1mA
	4...20 mA, max. shunt resistance 250 ohms
Display/Parameter Ranges	see parameter pages
Data Interface	RS 485
Data storage	unlimited
Real Time Clock	automatic summer/winter switch
	10 days clock backup without mains voltage
Housing	plastic with foil keypad for rail mounting (DIN EN 50022), screw terminals 2,5 mm

Accessories

- Temperature sensor TF 501, quantity depends on application
- Pressure Transducer DG 0/10 2/10V with 2-10VDC output
- PC-Software "**COOLVision**"
  Module "**COOLVision-MES**" for remote control and configuration
  Modules "**COOLVision-Analyse**" and "**COOLVision-SMM**"
  for data logging, visualization and alarm forwarding.

EC Declaration of Conformity

CE

For the device **EVP 3150-2** 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 from the manufacturer / importer by:

ELREHA, Elektronische Regelungen GmbH
D-68766 Hockenheim

by

Werner Roemer, *Technical Director*
(Name)

Hockenheim ..... **26.6.2017** .....
(City) (Date) (Signature)

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!**
- **To prevent electrical shock, the device may only be operated in a closed control cabinet or control box.**
- **Never operate unit without housing. Danger of electric shock!**
- **All 'PE' terminals must be connected to PE. 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!

Display of actual values and states

All actual values are shown on the "*Actual Values Page*" (ELJ).

Status of the controller unit
If the 4 status LED's on the front are blinking simultaneously and the display shows "oFF", the control functions are disabled by digital input or data interface.

Display of temperatures
"**L01**" -" **L04**" (Actual Values Page) show the actual temperature value of the sensors 1-4 in a range within -100... +100°C. "**L05**" shows a temperature value which is calculated from the pressure value of the transducer and the selected refrigerant table, "**L07**" shows the 'virtual' temperature value.
With "**P31**"-"**P34**" and "**P36**" (Mode Page) this displays can be calibrated.

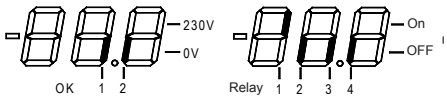
Expansion Valve Status Display
This shows the current, average aperture size from 0...100 % and additionally the actual state of the valve.

cUt = Restart of the evaporator after abnormal operating conditions (cutoff)
Pdo = Pumpdown of the refrigerant (cooling relay ON for 30 sec.)

Setpoints
The active day or night setpoints are indicated by the left decimal point switched on.

Time information
The Actual Values Page contains all runtime- / remaining time information, so the times up to the start of a function can be read.

Status of inputs/outputs
Digital-(OK)-Inputs State of the relays



Analogue Output: Parameter **L50**, value in %

Temperature Sensors
These types of temperature sensors can be used:
- **TF 201**, PTC sensor (2000 ohms@25°C)
- **TF 501**, PT1000 sensor (1000 ohms@0°C)
- customer specific sensor **So1** (-40...+25°C)
- customer specific sensor **So2** (-50...+50°C)

The type of sensor can be set by '**P35**' (Mode Page).

Notice **Please don't use the TF 201 sensor if you work with Electronic Expansion Valves.**

'Permanent Parameter' - Function

After power-up of the controller, the display will indicate the 'permanent parameter' after some seconds (or in case of a failure it will display the current failure). This can also be read if you don't touch a key for more than 3 minutes.
If you think that it is suggestive to show any sensor value as permanent parameter, do the following:

Change permanent parameter

- Select the parameter you want to have as 'permanent parameter'
- Press "⇧" and "⇩ " simultaneously. The display shows "888" for a moment, after that the selected parameter will be shown as the 'permanent parameter'.

Error Messages / Error Memory / Error Codes

If a failure occurs, the controller will show parameter **P43** with an error code with a flashing display automatically. Always the last **15** errot messages keep memorized with date and time of their appearance and can be read-out via data interface.

---- ..... no error
SEL ..... error in assignment page, e.g. function selected too often
tH1 ..... alarm sensor, overtemperature
tLo ..... alarm sensor, undertemperature
tXb ..... sensor X broken
tXc ..... sensor X hot-wired
dbt ..... number of defrost cycles without termination by temperature exceeded, maybe too many ice or heater malfunction.
rrt ..... cooling has achieved maximum runtime. This message is only active at point-in-time set by **P42** (mode page).
rdo ..... door contact is open too long. This message is only active at point-in-time set by **P42** (mode page).
dor ..... door X is open
oPc ..... alarm at digital input X
chA ..... safety chain open
hrd ..... hardware failure

If a sensor is short or broken, a time delay of 5 seconds takes effect before an alarm will be activated.

Configuration Concept

The inputs/outputs of the EVP-cold storage controller have no fixed tasks. The EVP works with a "**free configurable**" concept, this means that all available inputs and outputs (*relays, sensors, digital inputs, analogue output*) can be configured to work with any integrated control function or control circuit.

Sensors
Each sensor can fulfill each function, even up to 3 functions at the same time. (Function (a) of sensor X, Function (b) of sensor X, Function (c) of sensor X, X = sensor#). *e.g.*:
1. Control sensor /alarm sensor at the same time
2. Defrost limitation sensor and control sensor at the same time, e.g. to control a refrigerated shelf by the temperature of its air outlet.

Virtual Sensors
Up to 4 sensors can be combined to a 'virtual' sensor to realize averaging with selectable emphasis.

Digital inputs (Optocoupler inputs)
Each digital input can be assigned to one of the possible functions.

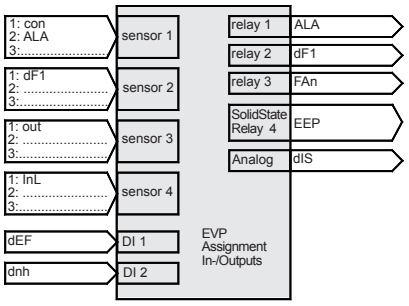
Relay Outputs
Each relay can be used to control one of the possible functions. The same function can even be assigned to multiple relays.

Notice **Relay output #4 is a Solid State Relay with a lower contact rating than the standard relay outputs. Normally, this output is used for driving Electronic Expansion Valves, but can be used for any other task if it works within the specified current range.**

Parameter
Parameters of functions which are not assigned will not appear in the parameter pages to improve survey.

Assignment
The function of each input and output can be preset on the 'assignment page'. The assignment can be done by keys or via interface.

Configuration Example for an EEx-Valve



Configuration of the controller

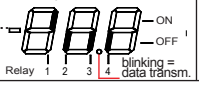
Hereby we use the example from above: A cold storage with an evaporator with Electronic Expansion Valve.

Action	Key	Display	Remarks
enter page lising	"P"	(A)	hold key for > 2 seconds
select assignment page	"⇧⇩"	(h)	
enter asssignment page	"P"	h01	h01 is the 1st parameter on the page and determines the function of relay 1
displaying the function of relay 1..	"P"	any	
new assignment of relay 1	"P"	C00	(Code expected) only if no key key is hit for about 3 minutes
enter access code	"⇧"	C88	
confirm	"P"	any	
select function	"⇧⇩"	ALA	ALA = alarm relay
confirm	"P"	h01	parameter # will be displayed again
select new in-/output	"⇩"	h02	determines the function of relay 2
displaying the function of relay 2..	"P"	any	
new assignment of relay 2	"P"	any	
select function	"⇧⇩"	dF1	dF 1= defrost relay (evaporator 1)
confirm	"P"	h02	parameter # will be displayed again

Repeat this steps until all inputs and outputs are assigned to the desired functions.

Parameter Pages

Actual Values Page [L]

Param.	Disp.	Note	Range	Factory Setting
L01 up to	X	Actual temperature at sensor 1 (can be corrected +/- 10K)	± 100°C	---
L04	X	Actual temperature at sensor 4	± 100°C	---
L05	X	Actual temp, calculated from pressure+refrigerant	± 100°C	---
L07	X	Virtual temperature value, calculated from real values and selected emphasis	± 100°C	---
L09	X	Actual Overheat Temperature	± 100°C	---
L21	X	Runtime of cooling	24.0 h:(10min) max.	00:00
L22	X	Runtime of open door	24.0 h:(10min) max.	00:00
L31	X	Remaining time of open door	240 minutes max.	
L32	X	Remaining time of temperature alarm delay	120 minuten max.	
L33	X	Remaining defrost time	minutes	
L34	X	Remaining defrost idle time	minutes	
L35	X	Remaining fan start delay time	minutes	
L36	X	Remaining compressor idle time	minutes	
L41	X	Solenoid valve	0, 1, oFF	
L42	X	State of the Electronic Expansion Valve, actual aperture size in % or state	cUt = cutoff Pdo = pumpdown	
L43	X	Day/Night Operation	on, oFF	
L44	X	Operation state of the controller unit	on, oFF	
L50	X	Actual Value of the analogue output in X% of the selected range	0-100%	
L60	X	State of digital inputs OK1 (DI1) and OK2 (DI2)		
		- Parameters marked by "**Disp**" are for information only and cannot be changed.		
L61	X	States of relays 1-4, information about data transmission		

Setpoint Page [r]

Param.		Note	Range	Factory Setting
r01		Setpoint Layer	1, 2	1
r02		Setpoint 1 (day)	-100/+100°C	-20°C
r03		Setpoint 2 (night)	-100/+100°C	-20°C
r04		Setpoint 1 (day), Setpoint Layer 2	-100/+100°C	-20°C
r05		Setpoint 2 (night), Setpoint Layer 2	-100/+100°C	-20°C
r10		Hysteresis	0,1...20K	2 K
r22		Fan start delay	0...30 (min.)	5 min.
r23		Fan trailing delay	0...30 (min.)	0 min.
r31		Runtime check cooling (in 10 minute steps)	oFF, 00.0...23.5	oFF
r32		Runtime check door (in 10 minute steps)	oFF, 00.0...23.5	oFF
r33		Minimum compressor idle time	0...30 min.	0 min.
r34		Cooling delay after mains voltage loss	0...30 min.	0 min.
r41		Alarm offset (relative to the setpoint)	0...100K	7 K
r42		Alarm offset, Layer 2 (relative to the setpoint)	0...100K	7 K
r43		Lower Alarm Limit (absolute value, threshold for low temperature limitation/alarm) **!! Function cannot be switched off.**	-100/+100°C	- 50°C
r44		Lower Alarm Limit, Layer 2 (absolute value)	-100/+100°C	- 50°C
r45		Temperature Alarm Delay	0...120 min.	45 min.
r46		Release time of safety chain	0...60 sec.	60 sec.
r51		PID proportional band	0.1...30.0	4.0
r52		PID integration time	oFF, 1...600 sec.	10 sec.
r53		PID attack time	oFF, 1...10 sec.	oFF
r54		PID delay	oFF, 0.1...10.0 sec.	oFF
r56		Actuating Variable Delay of Analogue Output (for PID only) / output delay	0...240 sec.	0 sec.
r57		Actuating Variable Delay of Analogue Output (for PID only) / step size	1...100%	100%
r58		Cooling/Heating Relay Time Period	1...240 sec.	1 sec.
r59		Cooling/Heating Relay ON-Time	1...240 sec.	240 sec.
r61		Digital inputs alarm delay	0 bis 120 min.	5 min.
r62		Digital inputs door contact delay	1 bis 240 min.	5 min.
r63		Digital input analog value: Voltage/current at the analog outp. with active digital input	0.0...100.0 %,	0%

Notice

If this point is ON while displaying a parameter number (marked with X), the parameter is active at present

Defrost Page [d]

Param.	Disp.	Note	Range	Factory Setting
d01		Fan during defrost	on, oFF	oFF
d02		Defrost Mode	Etn = external only, Int = extern+intern AdA = adaptive	Int
d03		Fan operation before defrost	0...15 minutes	3 minutes
d04	X	Time up to defrost (in 10-minutes steps)	168.0 h/min	00.0
d05		Maximum time up to defrost (10-minutes steps)	02.0...48.0 h/min	24.0 h
d11		Defrost release time 1 (in 10-minutes steps)	00.0 - 23.5, oFF	05.0
d12		Defrost release time 2 (in 10-minutes steps)	00.0 - 23.5, oFF	oFF
d13		Defrost release time 3 (in 10-minutes steps)	00.0 - 23.5, oFF	oFF
d14		Defrost release time 4 (in 10-minutes steps)	00.0 - 23.5, oFF	oFF
d15		Defrost release time 5 (in 10-minutes steps)	00.0 - 23.5, oFF	oFF
d16		Defrost release time 6 (in 10-minutes steps)	00.0 - 23.5, oFF	oFF
d31		Defrost limitation temperature	0.0°C...100°C	14.0°C
d32		Max. defrost runtime (defrost safety time)	0...240 minutes	45 min.
d33		Alarm time extension after defrost	0...60 minutes	30 min.
d34		Pulse-defrost threshold	-5,0...+100°C	100°C
d35		Cooling pause after defrost (drain time)	0...30 minutes	0 min.
d36	X	Duration of last defrost	minutes	
d37		Number of defrost cycles limited by time, then alarm	oFF, 1-15	oFF
d38	X	Break before defrost	0...15 minutes	0 min
d50		Manual defrost initialization	on, oFF	

Mode Page [P]

Param.	Disp.	Note	Range	Factory Setting
P01		Assigned to compressor compound # (0 = not assigned)	0, 1, 2, 3	1
P02		Fan operation mode	Int = Interval, PEr = Permanent Rdd = Special mode pos. room temp. + latency heat utilisation	Int
P03		Cooling mode (!note correct relay wiring)	nor = normal, in = inverted	nor
P04		Emergency mode if sensor fails in % of the max. power	0...100%	50%
P11		Frame heater, period time	10...60 minutes.....1	15 min.
P12		Frame heater, pulse width (day operation)	0...100%	100%
P13		Frame heater, pulse width (night operation)	0...100%	100%
P14	X	Current Pulse Width of the frame heater	(eventually shifted by a VPR-host)	
P21		Night operation ON at (in 10 min-steps)	00.0...23.5, oFF	oFF
P22		Night operation OFF at (in 10 min-steps)	00.0...23.5, oFF	oFF
P31		Calibration sensor 1	+/-10.0, adjustable	0.0
P32		Calibration sensor 2	+/-10.0, adjustable	0.0
P33		Calibration sensor 3	+/-10.0, adjustable	0.0
P34		Calibration sensor 4	+/-10.0, adjustable	0.0
P35		Sensor type (with EExV's only use 501 types !)	201 = TF201 501 = TF501 (Pt1000)	501
P36		Calibr. temp. value calculated by pressure/refrigerant	+/-10.0, adjustable	0.0 K
P41		Undertemperature Alarm	on, oFF	on
P42		Runtime message at (time)	0...23 o'clock, oFF	6 o'clock
P43	X	Current failure		
P51		Analogue output delivers 0V if control sensor temp. =	-/+ 100°C	-100°C
P52		Analogue output delivers 10V if control sensor temp. =	-/+ 100°C	+100°C
P53		Lower limit of pressure transmitter	-1,0...+90,0 bar	-1,0 bar
P54		Upper limit of pressure transmitter	-1,0...+90,0 bar	+9,0 bar
P55		Used refrigerant 0= switched OFF, control by temperature sensor refrigerant selected = pressure/temperature method is active	1= NH3, 2= R134a, 3= R22, 4= R23, 5= R404a, 6= R507, 7= R404a, 8= R402b, 9= R407C (wet steam), 10 = R407C (due p.), 11= R123 12 = R290, 13 = CO2, 14 = R502, 15= R 723 16= R410A , 17= R407F (due p.), 18= R449A	0
P56		Lower voltage limit of pressure transmitter input Voltage below this limit = Error message "sensor broken"	0,0...10,0 V	0 V
P57		Upper voltage limit of pressure transmitter input Voltage above this limit = Error message "sensor short circuit"	0,0...10,0 V	10,0 V
P60		Superheat (depends on evaporator) minimum value	0,0...50,0 K	8,0 K
P61		MOP (Limitation of evaporation temperature, depends on compressor resp. plant)	-100,0...+100,0°C	+100,0°C
P62		P-Part of the Expansion Valve Control	0,1...20,0 K	8,0 K
P63		I-Part of the Expansion Valve Control	1...999 sec.	240 sec
P65		Superheat, maximum value	2,0...100,0K	8,0K
P66		Limitation of EEx-valve signal	0...100%	100%
P67		Actuating Variable Delay (EEx-valve) / step size	1...100%	100%
P68		Actuating Variable Delay (EEx-valve) / output delay	0...240 sec.	0
P79	X	Software version		
P81		Standard of summer/winter switch	oFF, on = EU since '96	on
P82, P83		Year, Month		
P84, P85		Day, Hour		
P86, P87		Minute, Second		
P90		Address of the controller unit in a network	0 - 78	78
P91		Data transmission speed (Baudrate)	Aut(o), 12(00)...576(00)	96(00)

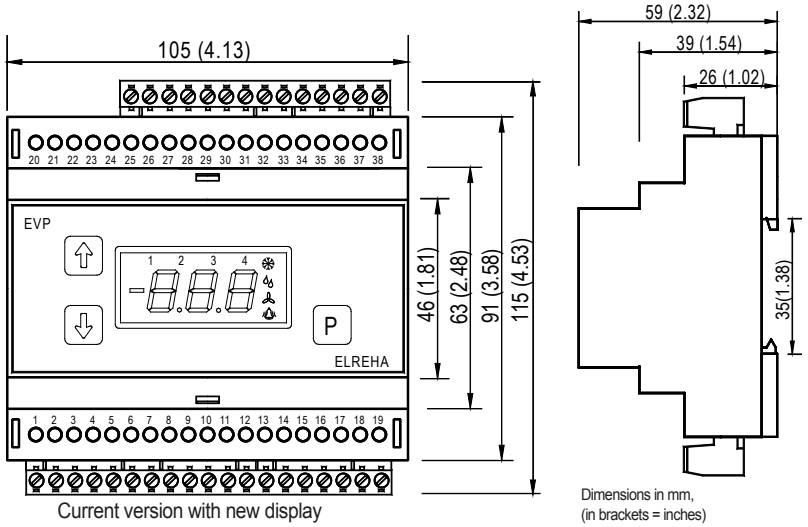
Assignment Page [h]

Param.	Disp	Note	Range	Factory Setting
h01		Function of relay 1	---, on= continuous on, rEF= cooling, dF1= defrost 1... dF3= def.3 FAn = fan, ALA = alarm, FrA = frame heater, roL = roller blind, Lit = light, HEA = heater, EEP = EExValve, Un1 = Relay OFF with "controller OFF", continuous ON while normal opration	rEF
h02		Function of relay 2	dto.	dF1
h03		Function of relay 3	dto.	FAn
h04		Function of relay 4 (Solid State Relay)	dto.	EEP
h11		Function (a) of sensor 1	--- = off, con = control sens., dF1 = defrost limit. sens 1, dF2 = defrost limit. sensor 2, dF3 = defrost limit. sensor 3, ALA = alarm sensor, di5 = display only sensor, inL = inlet sensor, out = outlet sensor	con
h12		Function (b) of sensor 1	dto.	ALA
h13		Function (c) of sensor 1	dto.	---
h17		Sensor 1, emphasis for virtual sensor	0...100%	0%
h21		Function (a) of sensor 2	dto.	dF1
h22		Function (b) of sensor 2	dto.	---
h23		Function (c) of sensor 2	dto.	---
h27		Sensor 2, emphasis for virtual sensor	0...100%	0%
h31		Function (a) of sensor 3	dto.	inL
h32		Function (b) of sensor 3	dto.	---
h33		Function (c) of sensor 3	dto.	---
h37		Sensor 3, emphasis for virtual sensor	0...100%	0%
h41		Function (a) of sensor 4	dto.	out
h42		Function (b) of sensor 4	dto.	---
h43		Function (c) of sensor 4	dto.	---
h47		Sensor 4, emphasis for virtual sensor	0...100%	0%
h71		Function (a) of the virtual sensor	dto. (the same like the real sensors)	
h72		Function (b) of the virtual sensor	..."	
h73		Function (c) of the virtual sensor	..."	
h51		Analogue output delivers	0 10 = voltage 0-10V, 420 = current 4-20mA	0 10
h52		Analogue output works as/delivers	0 = 0% (0V resp. 4 mA), 100 = 100% (10V resp. 20 mA) di5 = actual value image, P= PID-T1 control, Pr= PID-T1 control, inverted, EEP= for EEx-Valve	0
h61		Function of digital input (OK/DI) 1	---= switched off, dEF= external defrost, dnL= night operat., act. low, dnH= night operat., act. high oFL= unit oFF, act. low, oFH= unit oFF, act. high cHA= Safety chain, SEt= Setpoint layer, dor= Door contact, ALA= external alarm, AnA= Analogue output to fixed value rLL= Cooling lock, act. low, rLH= Cooling lock, act. high rFL= Cooling release, act. low, rFH= Cool. rel., act. high	---
h62		Function of digital input (OK/DI) 2	dto.	---

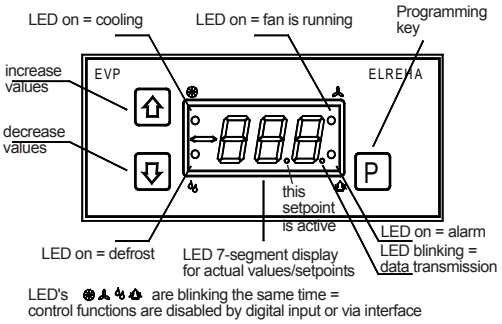
Notice

Parameters marked by "**Disp**" are for information only and cannot be changed.

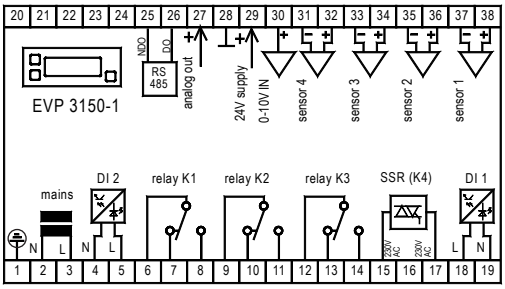
Dimensions



Front View of the Version with older Display

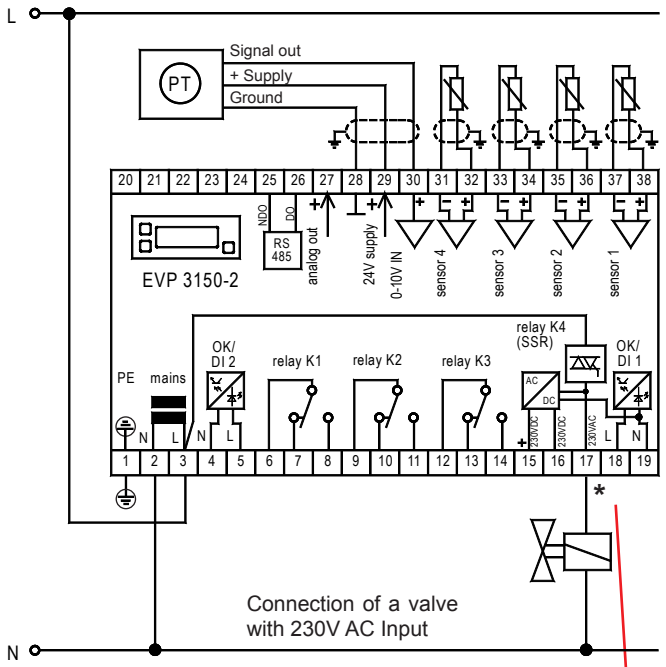


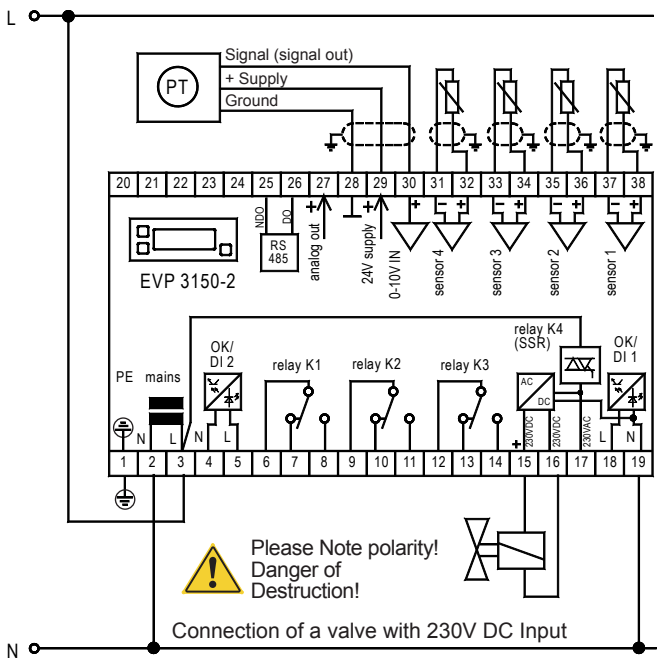
Connection EVP 3150-1

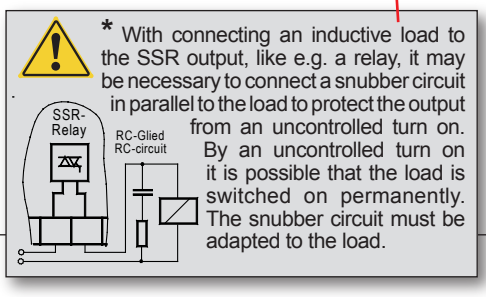


Older product, production discontinued.

Connection EVP 3150-2







Note

Protective Earth

Earth

Notice

This manual, which is part of the product, has been set up with care and our best knowledge, but mistakes are still possible. 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 of this manual. Units with an other version number may work a little bit different.

set up: 26.6.17, tkd/jr	checked: 26.6.17, ek/jk	approved: 26.6.17, mv/sha	transl.(E):	transl().....	corr.

'Physical' and 'virtual' sensors

1. Each 'physical' (real) sensor is able to fulfill up to 3 functions at the same time (see Assignment Page), any sensor is able to do the same job.
Up to 4 control sensors can be assigned the same time. If *one of them* gets warmer than setpoint + hysteresis, then cooling starts.

2. It is possible to create a 'virtual' sensor to realize different kinds of averaging, e.g. multiple sensors in a huge room or averaging of inlet and outlet sensor in a chest freezer. The 'virtual' sensor resp. value (**L07**) follows from the selectable emphasis of the sensors which must have an effect on the result (**h17, h27, h37, h47**, Assignment Page). The functions assigned to this 'sensors' (**h71, h72, h73**, Assignment Page) are the same as the functions for the 'physical' sensors.
Example: If the 'physical' sensor 1 got the function "**con**" (control sensor) and also the 'virtual' sensor, then the warmer one initiates refrigeration.

- Selection of a "virtual sensor":
  - Assignment of a function by **h71-h73**
- Selection of a 'physical' sensor which must have an effect on the result :
  - Activating of the sensor by assigning a function (e.g. display only sensor)
- Set emphasis for the selected sensor (**h17, h27, h37, h47**).

The sum of all emphasis values must be 100%. *Example*:
If sensor 1 and sensor 2 must have an effect on the result and you set "**h17**" to "30%" and "**h27**" to "60%", then you get the error message "**SEL**" (assignment error).

Further causes for the error message "**SEL**"
- The sum of all emphasis parameters is 100%, but no virtual sensor function is selected
- All 4 emphasis values are set to '0' and a 'virtual' sensor function is assigned
- A physical sensor is switched off, but an emphasis value > 0 is selected.

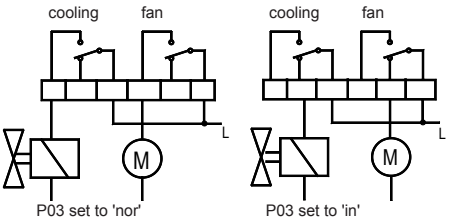
Example 1, Chest Freezer:
For the detection of the actual value, inlet and outlet sensor must be used. Sensor 1 is mounted at the suction side (inlet) and must have an 60% influence on the result. Sensor 2 is mounted at the outlet and must have an 40% influence.
- set "**h17**" to "60"
- set "**h27**" to "40"
- set "**h71**" to "con" (control sensor)

Example 2, huge room, standard application
Sensors 1-3 must measure the rooms temperature, an arithmetic average must be calculated, sensor 4 is the defrost limitation sensor in the evaporator.
- set "**h17**", "**h27**" to "33" and "**h37**" to "34"
- set "**h71**" to "con" (control sensor)
- set "**h41**" to "df1"

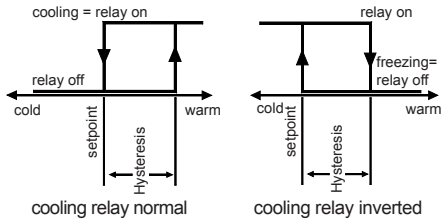
Special Function
If an emphasis parameter value is set to 100% (others to 0), up to 6 functions can be assigned to the corresponding physical sensor. This may be of interest for applications where more than 3 sensor functions are used.

Cooling

Cooling control by Solenoid Valve / Compressor
Cooling is controlled by switching the output relay contacts ON an OFF.
For freezing applications, the N/C contact can be used (inverted mode) to secure permanent cooling in case of a controller defect, adjustable by "**P03**" (Mode Page).



The point of cut-off is always the valid setpoint. If the temperature at the control sensor exceeds setpoint **+** hysteresis ("**r10**", Setpoint Page), the control relay will switch on. "**P03**" also affects to the switching characteristic of the fan relay.



Do not use 'inverted', if compressors are controlled directly. Risk of compressor damage by continuous running!

The control relay can be locked via data interface.

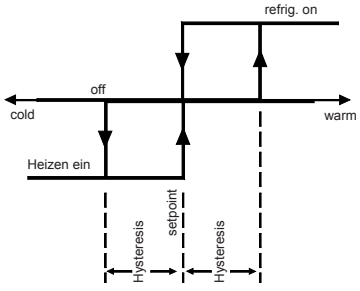
Low temperature Limitation
Can be used e.g. for refrigerated shelfs with roller blinds to limit the temperature at the air outlet during night operation. When the temperature at the alarm sensor decreases the limit set by "**r43**" (resp. "**r44**", Setpoint Page) cooling will switch off.
This value is the threshold for the low temperature alarm at the same time.

The low temperature limitation cannot be switched off.

Heating function

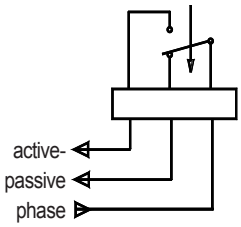
One relay is able to work as a heat relay. Then the control setpoint is the cut-off of heating and cooling at the same time. Cut-in will be:

- for cooling: setpoint + hysteresis (r10)
- for heating: setpoint - hysteresis (r10).



Temperature Alarm

If a relay gets the function "ALA", a temperature alarm will be forwarded by the 'Quiescent current' principle. After power-up of the controller, the alarm relay will be energized after ~4 sec. In case of a failure the relay will be de-energized after a delay timer ("**r45**", Setpoint Page) has been run down. LED "Alarm" shows the alarm state. If temperature comes back to the normal range, the relay will be energized again. "**L32**" shows the remaining time up to an alarm.



Overtemperature Alarm
It is possible to select max. 4 (5 with the 'virtual') alarm sensors (e.g. 4x "**ALA**"). If the temperature at one of the alarm sensors exceeds the control setpoint + the "**r41**" (resp. "**r42**", Setpoint Page) setting, an alarm will be initiated after the delay time "**r45**".

Low temperature Alarm
If the temperature at any alarm sensor gets lower than the "**r43**" (resp. "**r44**", Setpoint Page) setting, an alarm will come on with the delay explained above. This setting is an absolute value and does not refer to the control setpoint. At the same time, this setting works as threshold for the "low temperature limitation" function.
Low temperature alarm can be disabled by "**P41**" (Mode Page).

Supplementary alarm delay during defrost
After a defrost cycle the temperature may take longer to stabilize and the normal alarm delay turns out to be too short. For this reason the value of parameter „**d33**" (defrost page) will be added on to the normal alarm delay after defrosting.

Runtime Monitoring

The controller monitors the total running hours of the cooling output over 3 days. A 'day' is defined as the period within "**P42**" and 1 minute before the same point in time next day.
Example:
"**P42**" set to 11:00 am =
Monitoring time range is from 11:00 o'clock day 1up to 10:59 o'clock day 2.
The overall runtime of the cooling relay over a day will be added and stored ("**L21**", Actual Values Page). If this runtime exceeds the value set by "**r31**" three days in a sequence, this will cause an alarm at the hour programmed by "**P42**" (Mode Page). The alarm relay will be de-activated and the alarm LED switches on.

This alarm will be cancelled automatically 1 hour later.

Operation with a single compressor

If a single compressor is controlled by a refrigeration relay, it is suggestive to have an idle time to prevent the machine from damages caused by short cycle operation. The compressor can restart only after the timer "**r33**" (Setpoint Page) has been run down. The remaining time up a restart can be read at "**L36**" (Actual Values Page).

Second setpoint (night operation)

A second setpoint can be defined by "**r03**" (Setpoint Page). This can be used for night operation or other energy savings. Switching between these setpoints can be made by internal clock or by digital input. The current used setpoint is marked by a lighted decimal point in the parameter display. On the 'Actual Values Page', parameter "**L43**" shows the current state.

Internal switching
The parameters „**P21**“ and „**P22**“ determine the 2nd setpoint period. If the internal timer is not used, set both times to "**oFF**".

External switching
The digital inputs can be configured for external switching, selectable as "**dnL**" (active low) or "**dnh**" (active high). After the input has been activated, the 2nd setpoint is active all time and the internal timer is disabled. If you want to use external switching only, please set „**P21**“ and „**P22**“ to "**oFF**".

Second Set of Setpoints

The controller offers two complete setpoint sets including day/night setpoints and alarm limits.
Example Application: By an external switch it is possible to change a cold room from refrigeration to freezing for temporary storage of other products, without changing any parameters at the controller. Even here the currently used setpoint is marked by a lighted decimal point in the parameter display.

Toggling between the setpoint layers

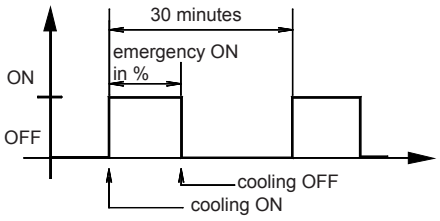
1. internal: by parameter „**r01**“ (Setpoint Page)
2. external: assign function „**SEt**“ to a digital input. If connected to mains phase, the 2nd layer is in use.

Light Control

One of the relays is able to control room lightings (function "**Llt**"). In this case, the relay switches together with the night settings.
While 'day'-operation the light relay keeps energized.

Emergency Operation

If all control sensors fail, the unit turns to an emergency mode automatically. The cooling relay cycles with a %-part (**P04**, Mode Page) of a 30 minutes period.



Digital Inputs (Optocoupler Inputs)

Switching OFF the controller unit

Sometimes it is necessary to switch off cold storages completely including the controller.
If the controller works in a network, the bus-master so detects a malfunction and generates an alarm. To prevent this, the unit must be switched OFF via digital input.

Controller OFF
If a digital input is assigned to the functions "**oFL**" or "**oFH**" and is activated by the matching signal, then all control functions will be disabled. All alarm functions are locked and the display shows "**oFF**".

Safety Chain Monitoring

When using the controller for single compressor applications, one of the digital inputs can be used to monitor the safety chain ("**chA**").
Normally the digital input is connected to phase via this chain of contacts. If the chain opens, cooling and fan will switch off, a running defrost cycle will be terminated and a new defrost cycle is impossible. Parameter "**r46**" defines the response time on the missing signal voltage.

Door Contact Input

If a digital input with the function "**dor**" is connected to phase, the evap fan stops immediately. The control range of the EEx-Valve will be changed automatically to avoid a further evaporation.
If the door is open **> 3 minutes**, cooling will be stopped. All other functions continue working.
If the door is open **> 5 minutes**, the unit generates the error message "**rdo**". After the timer "**r62**" (Setpoint Page) has been run down, cooling restarts and an alarm message will be forwarded.

Exception:
If no alarm sensor is assigned or if the temperature is above the alarm limit, cooling continues without interruption. The cooling keeps switched ON and the fan starts again, so the door opening is ignored.

Door open monitoring
Every time a door is opened, the controller adds the time to the total opening time of the present day "**L22**" (Actual Values Page). If the total opening time exceeds the value set by "**r32**" (Setpoint Page), an alarm will be generated.
The alarm message will be forwarded at the point in time determined by "**P42**" (Mode Page) and will be cancelled automatically 1 hour later. "**L31**" shows the remaining time up to the alarm message.

External Alarm

The digital inputs are able to process external alarm messages. For this, the function "**ALA**" must be assigned (Assignment Page).
While normal operation, the input is connected to mains phase. When the voltage drops down, a delay time starts ("**r61**", Setpoint Page). After this timer has been run down, an alarm will be forwarded.

Real Time Clock

The built-in real time clock has a buffer for max. 10 days without mains voltage. Date and time can be set by "**P82**"..."**P87**" (Mode Page).
An automatic summer / winter switch ("**P81**", Mode Page) considers the current EU-rules from 1996 (EU 96), but can also be switched off.

Temperature control with Electronic Expansion Valves

The EVP 3150-2 is able to control one (1) cold storage with an evaporator equipped with an Electronic Expansion Valve (EExV).
In such applications, the EExV takes over the jobs of the former solenoid valve and the compulsive thermal expansion valve.

Expansion Valves

The EVP is able to drive **pulse-width modulated, cycling expansion valves** and **valves with thermal drive**.
AC or DC type valves can be used, they are supplied by mains voltage via SSR-relay with 2 outputs.
Missmatches valve/nozzle and evaporator will be compensated in a wide range. Because the valves need no high pressure difference to open, it's possible to work with low condensation pressures, as long as the configuration allows that.
From this it follows a higher COP-value for the compressor and so an option for energy saving. The energy saving depends on outdoor temperature (if the condenser is located on the roof) and is higher in winter than in summer.
By the optimal filling of the evaporator and the more equable icing an additional energy saving of 2 - 5% is possible.

Measuring Methods

The EVP is able to work with 2 measuring methods:
1. Pressure Transmitter and Temperature Sensor at the evaporator outlet, this is equivalent to the arrangement of a thermal expansion valve.
2. 2 Temperature Sensors at the inlet and the outlet of the evaporator.

The unit always controls the 'virtual' aperture size of the valve to reach an optimal filling and so the optimal efficiency ratio of the evaporator. Period time and pulse-width of the PWM-control are defined by the control algorithm (autoadaptive), disturbances like suction pressure fluctuations and flashgas will be filtered out.

1. Pressure / Temperature method

To capture the superheat, a pressure transmitter with 2-10V output signal and a TF 501 temperature sensor at the evaporators outlet is used. The arrangement of this parts is equivalent to the components of a thermal expansion valve.

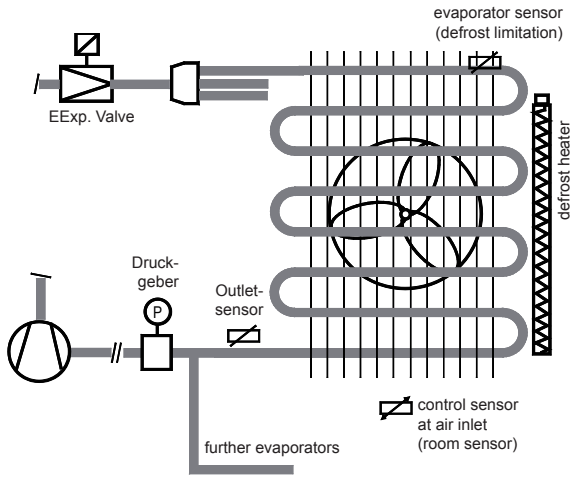
This method is strongly recommended for single machines or plants with just a few evaporators. The compressor can be controlled by an external suction pressure switch or the cooling relay of the EVP. By this, special operating modes and an automatic "pumpdown" function are possible.

Variable Overheat Control
If you get a difference by the settings of **P60** (Superheat, minimum value) und **P65** (Superheat, maximum value), then the superheat will be shifted by the control algorithm within the ON-point (setpoint+hysteresis **r10**) and the OFF-point (setpoint). If the function is disabled, the superheat value is determined by **P60** only.

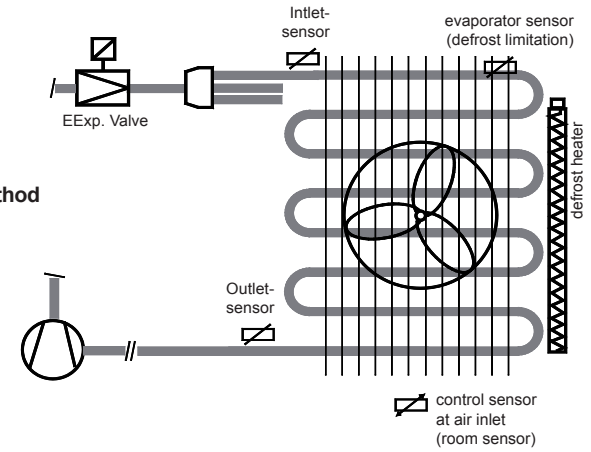
Function is disabled:
P65 (Superheat, maximum value) exceeds **P60**.
Function enabled:
P65 is below or equal to **P60**.

Sensor Positions

Pressure Transmitter/ Temperatur Sensor method



2 Temperature Sensors method



Parameterization

The following recommendations refer to the pressure transmitter "DG -1/9 2-10V".

L05 .....Display of the temperature which is calculated from pressure value and refrigerant
L09 .....Actual Overheat Value
P55 .....Method is active as soon as the used refrigerant is selected.
P53 .....Lower limit of transmitter (-1.0, relative pressure)
P54 .....Upper limit of transmitter (+9.0, relative pressure)
P56 .....Lower voltage limit of the pressure transmitter input. (2V. Below this 2V, an error message is generated).
P57 .....Upper voltage limit of the pressure transmitter input (10V).
P60 .....Superheat setpoint, minimum value (depends on evaporator)
P61 .....MOP-setpoint (Maximum Opening Pressure, i.e. limitation of the evaporation temperature at the outlet. Depends on compressor resp. plant).
P65 .....Superheat setpoint, maximum value
The settings of **P60/P61** depend on the used compressor and the used evaporator.

P62 .....P-Part of the Expansion Valve Control
P63 .....I-Part of the Expansion Valve Control
The factory settings of P62/P63 are almost ideal for all kind of cold storages, changes must be made with care.
After this basic settings, all other relevant parameters must be set.

2. Temperature sensor method

To capture the superheat, 2 temperature sensors (TF 501) are used, one at the inlet and one at the outlet of the evaporator. For this method, no pressure information is necessary.

Parameterization

P55 .....Must be set to 0, i.e. no refrigerant selected. Inlet- and outlet sensor must be assigned. No further parameterizing necessary, except standard settings.

Limitation of the EEx-Valve Signal

With this function (**P66**) the maximum opening of oversized expansion valves can be limited. It affects on all possible expansion valve output signals:
- Analogue output assigned to an EEx-Valve
- Expansion valve relay

Actuating Variable Delay for EEx-Valves

P67 (setep size) and **P68** (output delay) affect as actuating variable delay for the Electronic Expansion Valve, both for the analogue output as well as the relay output. The OFF-value (0%) will be initiated immediately with:
- Controller OFF
- Defrost initiation

Information

Parameter "**L42**" (Actual Values Page) shows the state of the EEx-valve permanently.

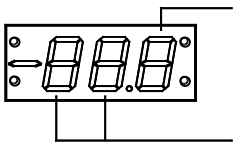
Defrost

The EVP allows several, different defrost methods. Up to 3 defrost relays can be assigned. This relay output(s) then control an electric heater or fan which defrost the evaporator(s).
Each evaporator with electric heater is monitored by a defrost termination sensor.
According to the application, the fan can stop or run during the defrost cycle.

- "**d02**" (Defrost Page) fixes the defrost initiation mode.
  - "**Etn**" : Defrost is initiated by a digital input
  - "**Int**" : Defrost can be initiated by digital input or the internal time-switch.
  - "**AdA**": Defrost is controlled by the intelligent (adaptive) defrost algorithm

Electric defrost heaters are always switched by the N/O contact of the defrost relay. "**L33**" shows the remaining time up to the end of the defrost cycle.

Defrost release by internal timer
With parameters "**d11**"..."**d16**" (Defrost Page) you set six (6) possible defrost release times. This points-in-time can be set in 10 minute steps only, that means a defrost time like 6:55 is impossible. Times on the display:



3rd position = Minutes x 10, that means no single minutes will be displayed

1st/ 2nd position = hours

The precondition for the start of a defrost cycle is that at least one of the defrost termination sensors detects a temperature below limitation temperature. If parameter "**d02**" is set to "**Etn**" (external only), a defrost cycle cannot be initiated by the timer.

Please note that this function differs with the 'adaptive' defrost method

External (Remote) Defrost Initiation
To start de-icing by a digital input, note that mains phase has to be applied for 2 seconds minimum and last not longer than the shortest possible defrost cycle.

Break before defrost
Parameter '**d38**' (defrost page) effects a delayed energizing of the heater at the beginning of the defrost cycle. By this, the rest of the evaporators chillness can be blown to the storage.
The defrost heaters must deliver less energy, because the evaporator is already warmed up.

Defrost termination by temperature
The EVP controller is able to work with up to 3 defrost relays (= evaporators). Defrost is individually teminated for each defrost output by the corresponding defrost (evaporator) sensor. This evaporator sensor must be placed at a position where, by experience, ice remains the longest time. If the temperature rises at that position, the ice in the evaporator is probably melted completely.
A defrost cycle is completed as soon as the defrost sensor has reached the defrost limitation temperature "**d31**" (Defrost Page).
If 2 defrost sensors are assigned, both sensors must achieve the limitation temperature to terminate defrost.

Defrost termination by time
If no defrost sensors are assigned or if they are out of order, the defrost cycle will be terminated after "**d32**" (Defrost Page) has been run down. "**L33**" shows the remaining time up to termination.

Defrost termination time monitoring
The unit captures the number of defrost cyles which are terminated by time (min. 1 defrost term. sensor must be assigned). If the number of defrost cycles terminated by time exceed the number programmed by "**d37**" (Defrost Page) an alarm message will be generated. With this function, massive icing or defective defrost heaters can be recognized timely and reliable.

In case of airflow-defrost without evaporator sensor, this function must be disabled ("**oFF**"), because here every defrost will be terminated by timer and no alarm message is desired.

Cooling Delay (drain time)
After defrost is terminated, the solenoid valve keeps locked for the time set by "**d35**" (Defrost Page). "**L34**" shows the remaining time up to the restart of cooling.

Manual Defrost
A manual defrost initiation is possible at any time.
To start manual defrost:
Select "**d50**" (Defrost Page),
set it to "**on**" and confirm.
Stop manual defrost
Select "**d50**" (Defrost Page),
set it to "**oFF**" and confirm.

Pulsed Defrost

To save energy it's possible to work with a pulsed (switched in intervals) defrost function.
If the evaporator temperature is located within "**d34**" (Defrost Page) and the limitation temperature "**d31**" (the value of "**d34**" must be lower than limitation temperature), the controller determines about the optimal heat distribution in the evaporator depending on the gradients of the temperature. The heater will be switched on in controlled periods until the defrost limitation temperature is reached.

The result of this procedure:

- Heat energy in the evaporator will be distributed much better
- Defrost limitation temperature can be set to a lower value
- Less of humidity in the chamber
- Save of energy

Intelligent Defrost (adaptive defrost) for Walk-In Coolers

Main Characteristics

This defrost control method, developed in co-operation with the '*GÜNTNER*' company, fits especially for **cold stores** and freezers which are closed (like walk-ins).

It is **less efficient** in applications where the limitation sensor is located in the airflow (e.g. open chest freezers).

This technique **reduces significantly the amount of energy** the refrigeration plant needs.
Especially while **difficult situations** (like high air-humidity, in cool-down chambers, while long opening times of the door of the cold storage room, uneven feeding of the cold storage room, etc.) the adaptive method protects the evaporator from glaciation safely.
Dynamic 'room-feeding' situations engage the controller to adapt itself to the new situation, without expensive adjustment by technical personnel.

Specialized sensors or additional probes are not required.

Parameterization is very easy:

- set parameter "**d02**" to value "**AdA**" (adaptive)
- set parameter "**d05**" (Defrost Page) to a value which is 2 or 3 times the normal defrost interval.
  Within this period the algorithm decides independly about the point in time to defrost. After the end of this period defrost starts in all cases.
- parameter "**d04**" (Defrost Page) shows the time up to the next defrost.
- parameters "**d34**" and "**d31**" define the range the heater will be pulsed within.

Process Sequence

1. If [setpoint + hysteresis > 2,5°C] the controller uses the fan to reduce icing.
2. In the time period set by „**d05**" the controller decides itself if and at which moment a defrost cycle is necessary. If icing is detected, the controller prepares defrost and begins either immediately or at the next allowed defrost time.
3. Cooling stops, the fan goes on turning a certain time
4. The fan stops and the defrost heater starts
5. If several evaporators are installed, each one has its own defrost sensor and heater relay, so it is individually heated.
6. After achieving a defined evaporator temperature, the heater will be cut on/ off in calculated periods. The period lenghts depend on evaporator temperature.
7. Defrost heater cut off, limit temp. is reached.
8. Cooling and fan remain still off (drain time).
9. After the end of „**d35**" cooling starts, but the fan remains still off.
10. After end of „**r22**" the fan starts and normal refrigeration goes on.

Refrigeration
Even during normal operation the fan stays on after cut-off of cooling to reduce icing.

Recognition of icing
The more ice on the fins the more increases the difference of temperature between the roomsensor and evaporator sensor. The controller uses the value of these sensors, their difference, the historic curves of these values as well as curves and duration of the past defrostings to calculate the necessity of defrosting.

Use of latent energy by airflow
We recommend to use "**d03**" (defrost forerun, defrost page) to switch on the fan several minutes ahead the defrost cycle, while cooling stops and the heater is not yet on.
Additionally, the fan is switched on automatically at a certain difference between the sensors. By this, the „cooling-energy" is brought out of the evaporator and stored in the chamber. This helps also to reduce the amount of heat energy necessary to defrost.

Defrost start
If all six parameters release times are set to Off, the controller decides itself when it starts defrost.

- *Further time influence*
  If you want to prevent that defrost starts at certain day-times use all the defrost release times and set them to points in time where defrost is allowed. If no icing is detected, these times will be ignored.
  On the other hand, once icing detected, the controller will wait for the next defrost release time before starting a defrost cycle.
- *External command*
  Assign one of the digital inputs to "**deF**". By applying voltage to that input it is possible to start defrosting at every moment.

Defrost heating
When „**d34**" is achieved, the heater will be cut off. The heat energy of the resistances will dissipate slowly and melt the ice. The length of the cut-off is calculated by the controller and as soon as some criteria are fulfilled, it will switch on the heater again. The heater will be pulsed until the temperature of the evaporator sensor reaches the defrost limitation temperature "**d31**".
This procedure fits in the same way for the case of several evaporators in the chamber.
By this way defrost period will take longer, but will be more efficient.

Several evaporators in one chamber
For certain plants it is necessary to use several evaporators in one chamber. The controller is able to control up to 3 evaporators in one chamber. Even in this case one unique room sensor is sufficient. E.g. for a chamber with 3 evaporators you need only 4 sensors:

- one controlsensor
- three defrost sensors (one for each evaporator)

If a defrost cycle is necessary, all evaporators will start defrost at the same time to avoid short circuit of air, when one is heating and the fan of another is turning. The one with the highest rate of icing determines the start of the defrost cycle. The EVP controller units are capable to **determine just this evaporator** and even to adapt it when conditions change.
Thus always the evaporator with the most ice initiates defrost start, nevertheless the quantity of energy which is necessary to defrost will be calculated for each evaporator separately.
To finish defrost cycle all evaporators must have reached the defrost limitation temperature.

Emergency Operation Mode
In cases the controller recognizes that it would be incapable or to slow to control the process, or when it gets not enough information, e.g.:

- charge of unusual very humid goods
- freezer door was open a very long time
- the evaporator is sprinkled with water
- sensor broken or shortened
- defrost terminated by the max. defrost time

the emergency operation starts.
To detect malfunction of the defrost control the unit uses the increasing of "**d05**".
If a defrost cycle is terminated by this time, the controller starts several defrost events with the interval corresponding to (¼) one quarter of the time programmed by "**d05**".

Therefore be careful in choosing the time for this parameter.

After the end of the disturbance the controller works on normally.

Example
Max time to defrost is set to 24 hours. If defrost is not terminated by the evaporator sensor, the controller will start defrost cycle every 24 / 4 = 6 hours until a cycle will be finished by the evaporator sensor and not by timer. Independent from this procedure, a failure message will be initiated.

End of defrost
When the defrost sensor has reached the defrost limitation temperature "**d31**", the heater stops and the controller waits until "**d35**" has expired, to allow the melted water drop to the drainage.
While the following 'drain-on' time ("**r22**", Setpoint Page) cooling starts, but the fan still stay OFF to prevent that the fans blow warm and humid air or water drops into the chamber.

Further information about possibilities to use latency heat you can find under "Evaporator Fan Control"

Analogue Output

The analogue output can be used for regulation purposes or to provide a remote display with an actual value image. The signal is available as a DC-Voltage or a DC-Current-Signal, fixed by "**h51**" (Assignment Page).
Parameter "**L50**" (Actual Values Page) shows the current output signal as a %-part of the selected range, "**h52**" (Assignment Page) determines the behaviour of the output:

Test functions

"h52" = "0"	output signal is 0V resp. 4 mA (fixed)
"h52" = "100	output signal is 10V resp. 20mA (fixed)

Transmission of actual values to remote displays or similar

This function allows the analogue outputs to deliver a mirror of measured actual value.
Normally a control probe will be used. If multiple probes are configured, the warmest actual value will be used. If a virtual probe is configured, this probe is used in the same way as a real probe.

"h52" = "dIS"	The output provides an image of the value of cooling sensor 1. U-output: -50°C = 0V, +100°C = 10V I-output: -50°C = 4mA, +100°C = 20mA

Control with the analog output signal (PID-control)

"h52" = "P"	PID-controller, whose output signal represents an addition of the components P, I, D and T1.
"h52" = "Pr"	PID-controller like above, but with inverted output (rising temperature = falling signal).

To adapt the controller to the process use the following parameters:

"**r51**" =	PID proportional band, located symmetrically around setpoint 1
"**r52**" =	PID-integral time (I-part)
"**r53**" =	PID-derivative time (D-part)
"**r54**" =	PID-actuator response time (T1-part)

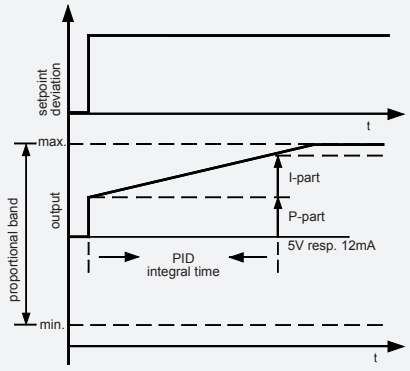
How to influence the analog output manually

For certain applications it may be useful to affect the output signal manually. Any digital input can be assigned to a function "**AnA**". Once activated, the analogue output delivers a predefined voltage- or current signal, e.g. to drive a valve to a specific position.

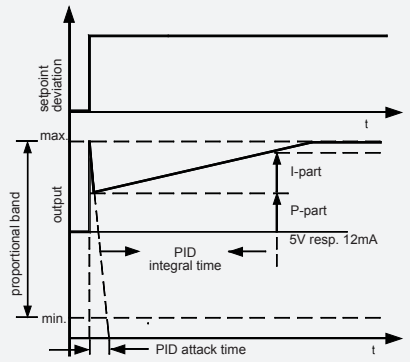
"**h61**" or "**h62**" set to "**AnA**" (Assignment Page)
= configure digital input 1 or 2
"**r63**" (Setpoint Page)
= amount of the output in % of the selected range, if the digital input is activated.

Example:
Digital input OK/DI1 is configured at "**h61**" to the value "**AnA**", "**r63**" is set to "50".
If the analogue output works as voltage output, it delivers 5V DC. If it works as current output, it delivers 12 mA.

Control Characteristic



PI-control, D and T1-parts de-activated



PID-control, T1-part de-activated

Electronic Expansion Valves with analogue input

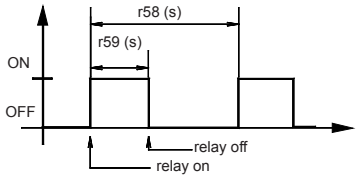
The analogue output is able to control expansion valves with analog input. Therefore, "**h52**" must be set to "**EEP**". Also in this case, "**h51**" serves as a switch for a voltage- or current output.

Actuating Variable Delay for PID

For using control processes with large reaction times the controller offers an 'Actuating Variable Delay'.

1. Analogue Output
If the controller sends a signal which initiates the analogue output to rise or to fall, then an adjustable delay time (**r56**, Setpoint Page) starts. Within this time period, the output signal is able to alter only by a specific %-part (step size, **r57**).
If "**r57**" is set to "100%" and "**r56**" to "0", then the function is disabled.

2. Relay Output
In applications with motorized actuators, the Actuating Variable Delay takes effect by clocking the cooling resp. heating relays. If the controller sends a signal to initiate a relay permanently ON, an adjustable time period "**r58**" (Setpoint Page, Cooling/Heating Relay Time Period) starts. Within this period, the relay is engaged for the time set by "**r59**" (Setpoint page, Cooling/Heating Relay ON-Time).



If "**r59**" is equal to "**r58**" or exceeds it, then the function is disabled, the relay switch as normal again.

Reaching the The OFF-value

The OFF-value (0%) will be initiated immediately with:
- defrost initiation
- solenoid valve lock
- safety chain error
- controller OFF
- cooling OFF with an open door

Important !!

Please note the decreased lifetime of the relay contacts in cycling operation. Please care for a suitable relief.

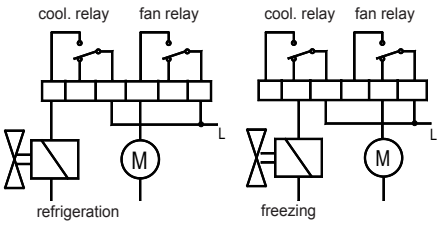
Cycle 40 sec.:
load current 0,8A res. --> 5 years
load current 1,2A res. --> 2,5 year
load current 1,9A res. --> 15 months

(Theoretical values according to the relays data sheet)

Evaporator Fan Control

Each output relay can be configured for evaporator fan control. The fan control depends on the following parameters:

P03 ..... (cooling mode, Mode Page)
"**reF**" = refrigeration, fan will be switched by the N/O-contact of the fan relay
"**FrE**" = freezing, fan will be switched by the N/C-contact



P02 .... (fan operation, Mode Page), defines the characteristic of the fan during the cooling period.
"**Int**" = fan runs together with solenoid valve/compressor
"**PEr**" = fan runs continously while cooling
"**Add**" = Using of latency heat by a special fan control + "Special mode for room temperatures > 2,5°C", as described in chapter "Intelligent Defrost".

d01 .... (fan during defrost, Defrost Page), defines the fan characteristic during the defrost cycle.
"**on**" = during defrost, fan runs continuously
"**off**" = fan is stopped during defrost.

Fan start-up (freeze-on) delay

The start-up time delay for the fan after defrosting is defined by parameter "**r22**" (Setpoint Page). This avoids that water drops will be blown into the chamber. "**L35**" (Actual Values Page) show the remaining time up to the fan will switch on.

Examples for fan operation modes

1. *fan in permanent mode*

   This mode is mainly used in refrigerated shelfs, refrigerated display counters and chest freezers

   - fan is directly connected to mains voltage, not connected to the controller unit
     or
   - a relay is reserved for fan control, "**P02**" is set to "**PEr**", "**d01**" is set to "**on**". Drain-time "**d35**" is set to "0".

2. *fan interval mode, defrost by fan*

   A relay is reserved for fan control, "**P02**" is set to "**Int**", "**d01**" is set to "**on**".

3. *fan interval mode, defrost by electric heater/ hot gaz:*

   A relay is reserved for fan control, "**P02**" is set to "**Int**", "**d01**" is set to "**oFF**". The fan runs while cooling is on, will be disabled during defrost periods and comes on after defrost with a time delay set by parameter "**r22**".

4. *fan in permanent mode and defrost by electric heater*

   A relay is reserved for fan control, "**P02**" is set to "**PEr**", "**d01**" is set to "**oFF**".
   The fan will run continously and stops during a defrost period only.

Chances to exploit Latency Heat

1. Fan operation mode P02 = "Add"

- If temperature falls, cooling and fan will stop with reaching the control setpoint.
  If the room temperature rises to a value equal to *Control Setpoint + 1/2 Hysteresis*, the fans restart under the condition that the temperature of the evaporator (detected with limitation sensor) is lower than *Control Setpoint - 1/2 Hysteresis*.
  So remaining coldness will be blown into the room which reduces the number of compressor starts.

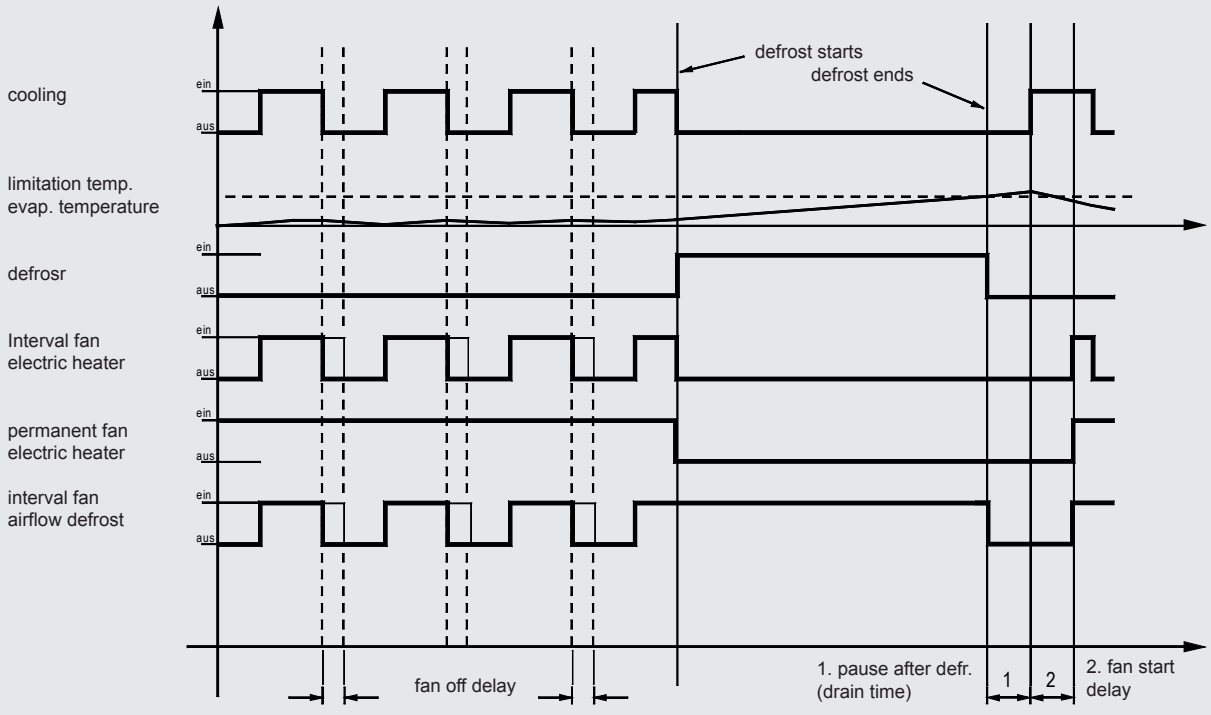
- Evaporators can be de-iced already at temperatures from 2°C by forced air.
  When cooling stops, fans are turning on until ice and frost are melted (limitation calculated within 2...5°C, cooling switches on at -3K).
  Thus humidity stays in the chamber which will improve the quality of certain goods like meat or vegetables.
  Additonally to the compulsatory "*fan trailing delay*" (**r23**, fan is forced to continue turning after cooling reached the setpoint and stopped), the fan will turn from a specific temperature [setpoint + hysteresis => +2,5°C] until the evaporator sensor has reached a certain value.

  At room temperatures [setpoint+hysteresis => +2,5°C] notify to set parameter "**d05**" to a higher value, because a defrost start is forced if this time is past.

2. Fan trailing delay

To utilize latent energy, the fan is able to run for up to further 30 minutes after the cut-off of valve or compressor ("**r23**", Setpoint Page).

Fan operation modes, defrost termination using electric heaters



Roller Blind Control

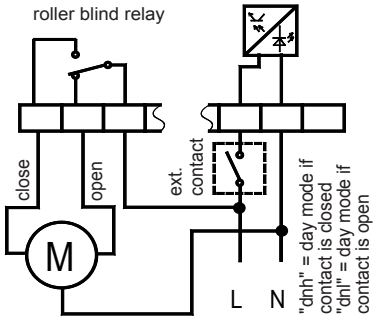
To enable the EVP to control roller blinds automatically, it is necessary to assign the function "**roL**" to a relay output. The roller blind control is coupled to the day/night-mode, so the blind will be closed in night-mode. Defrosting overrides this function and opens the roller blind during a defrost period.

Internal control:

No digital input has got the functions "**dnL**" or "**dnh**", but if yet, the input must be set to day-mode. The switch times "**P21**" (night operat. ON) and "**P22**" (night operat. OFF, Mode Page) must be programmed.
Day-Mode: Roller blind relay is de-activated, so the motor will turn the blind to the 'open'-position via the relay's N/C contact.
Night -Mode: Roller blind relay will be activated to close the blind via the N/O contact of the relay.

External control

A digital input has got the function "**dnL**" or "**dnh**". Switch times "**P21**" and "**P22**" (night operation on/off) must be set to "**oFF**".



If the digital input is activated, the relay switches on and closes the roller blind. After de-activating the digital input, the relay switches off and opens the roller blind via its N/C-contact.

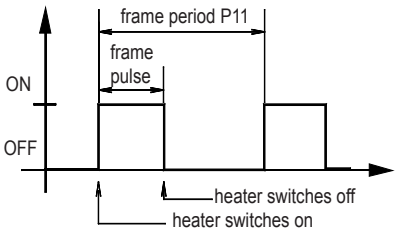
Frame Heater control

Frame heaters are used to avoid a door freezing onto the door frame. In addition it prevents condensing water around the door or on top of the frames of open chest freezers.

Power Optimization

To optimize the power requirement of the connected heaters, the controller is able to adapt the pulse ratio (within a specific range) to the current humidity of the ambient air (market temperature). The information about current market temperature and humidity the controller gets from a superior system (VPR 5240, can also be disabled ther) to calculate the absolute humidty.

If one of the relays is assigned to "**FrA**", this will control the frame heater energy with a certain frequency and pulse-width. For day and night operation you can choose different values to save energy. The corresponding parameters on Mode Page are:



- "**P11**" defines the duration of the cycle,
- "**P12**" defines the percentage of heating during day operation within each cycle. 100% = continuous heating, 0% = off
- "**P13**" defines the percentage of heating during night operation within each cycle. 100% = continuous heating, 0% = off
- "**P14**" shows the current active ON-time of the heating, which may varied by a VPR host system.

Limit values

- Temperature: 19-24°C
- Air Humidity: 40-70% r.H.

At the upper limit, the pulse ratio is equivalent to the value set by P11...P13. At the lower limit, the ON-time decreases by the half value.

Cascading controller units to extend cold storages

To control multiple evaporators, any number of EVP-units can be added. The units transmit their information via the cooling/defrost relay(s) and the digital inputs with the functions 'cooling lock' and 'forced cooling'.
Each digital input can be assigned to this functions:

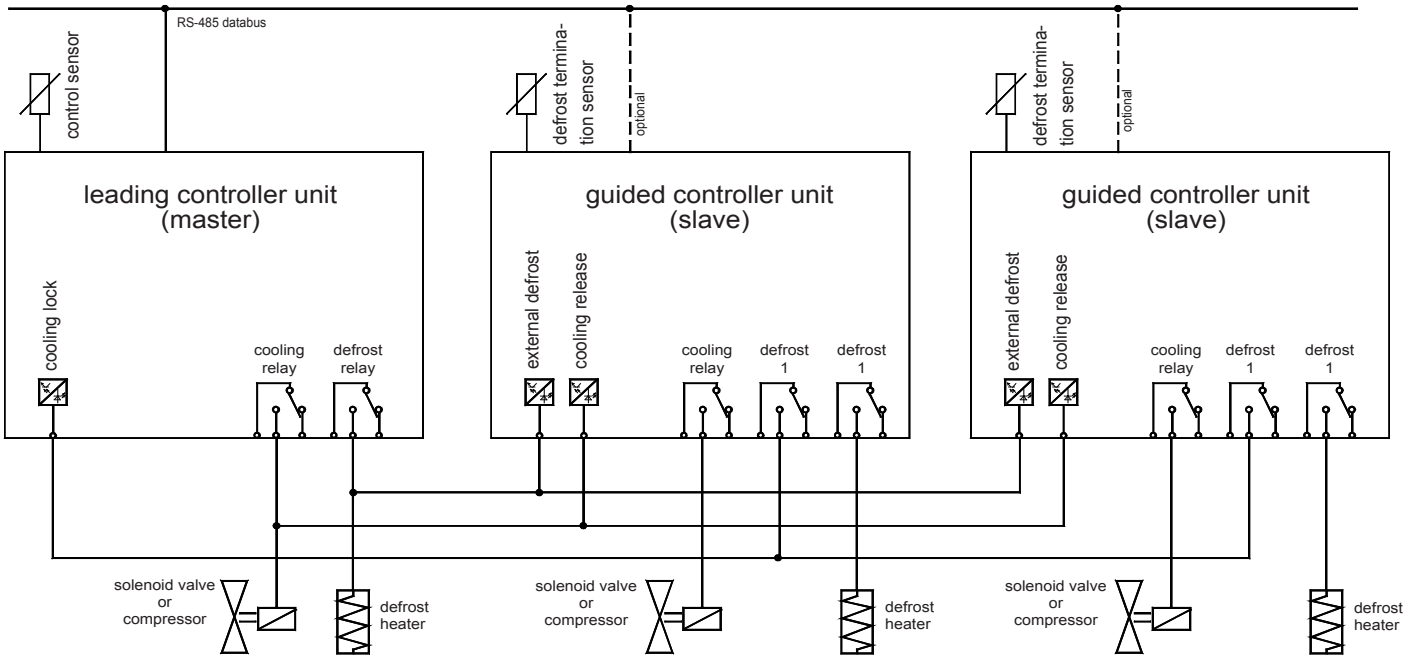
rLL (cooling lock, active low):
Cooling function of the unit is disabled if no voltage is present at the digital input

rLH (cooling lock, active high):
Cooling function of the unit is disabled if the digital input is connected to mains phase

rFL (cooling release, active low):
Cooling function of the unit is released if no voltage is present at the digital input

rFH (cooling release, active high):
Cooling function of the unit is released if the digital input is connected to mains phase

Principle of cascading:



The leading EVP-unit releases the cooling function of the 'slaves' via their input "cooling release". The 'slave' units lock the cooling function of the master unit via its input 'cooling lock', as long as a defrost cycle works.

Networking of controllers via *E-LINK*

The EVP can be networked together with other ELREHA control devices via an RS-485-2-wire databus, which enables up to 78 controllers to communicate. For communication, the *E-LINK* transmission protocol is used.
Each controller in a network has its individual address (**"P90"**, Mode Page). The data transmission rate is factory set to "Aut(o)", this means that it will be identified automatically. If necessary, the rate can also be set manually (**"P91"**, Mode Page).
This address is necessary for selecting the right controller when a data package is transmitted on the network bus. If the controller is used outside a network, these parameters are of no importance.

Remote control at Frontend Systems
EVP controllers can be operated remotely via interface when they are connected to Frontend Systems such as SMZ or VPR.
In this case, the Frontend System shows the EVP's display contents and the keys of the frontend work as if they where the keys of the EVP.

Configuration / Service via PC
The controller can be linked to a PC via its RS-485 interface. By using the PC-software „Coolvision-MES", parameters can be changed, they can be saved to the hard disk (download) and can be send to other controllers (upload).
To do this, the PC must be equipped with an RS-485 interface (internal card or an converter of the SSC-series).

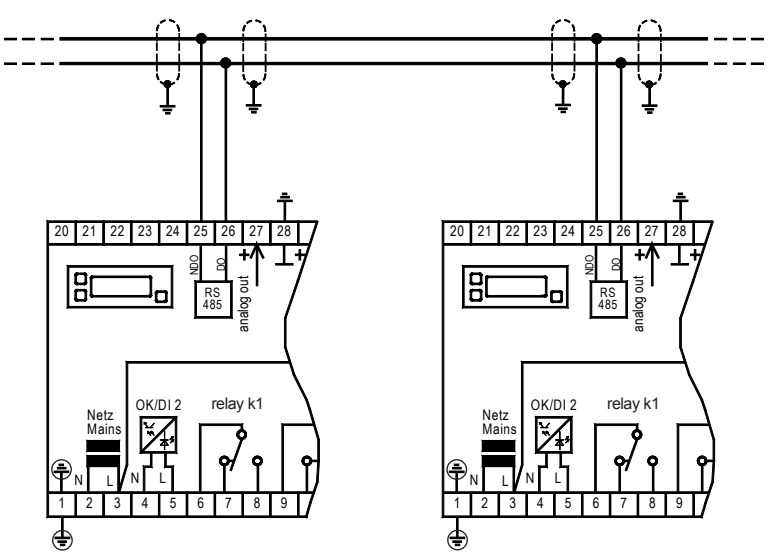
Wiring of data lines

The scheme beside shows briefly, how dataline wiring of several controllers is made. At each controller, the shield has to be connected to the nearest ground terminal. Also the ground connector of the controller and terminal #28 must be connected to the nearest ground terminal.
This will assure good interference suppression, even for long datalines between the controllers.

Note

Protective Earth

Earth



Communication with the VPR Compound Controller System

The EVP-controller can be used as intelligent cold storage controller in co-operation with the compound control system VPR.
In this case, the VPR central processing unit monitors the EVP.

When the EVP's are connected to the compound controller, each one needs an individual address (**"P90"**, Mode Page)

For the EVP's there is a possibility of assigning each controller to a certain compound (**"P01"**, Mode Page). This enables the VPR to transmit specific information to the cold storage controllers assigned to the compound where a failure occurs. Additionally, the information exchange allows different optmizing methods for suction and condensing control.
More detailed information you will find in the technical manuals of the VPR compound systems.

Behavior in case of a compound failure

If an EVP is assigned to a certain compound and a disturbance occurs, the unit responds as follows:

- The solenoid valves close
- The fan switches off
- A defrost will be terminated. A new defrost period is only possible after the compound problem is solved.
  To see if this function is released, look at **"L41"** (Actual Values Page).
  "0" = solenoid valve closed
  "1" = solenoid valve open
  "oFF" = solenoid valve closed via interface

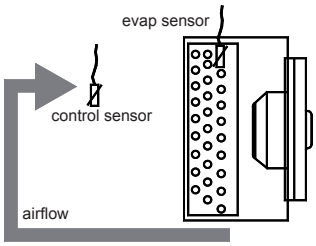
Data transmission disturbances

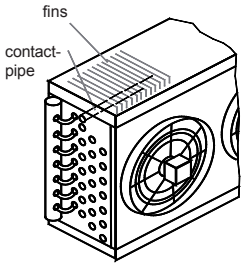
If the controller gets no new information from the VPR, it continues working with the current settings.
If there was an order from the VPR to close the solenoid valves and a technical defect interupts the data transmission for more than 30 minutes, the EVP ignores this order and starts working normally.
When data transmission is restored, the EVP will work again immediately according to the commands of the VPR.

Sensor Positions

Sensor positions are not critical in standard applications. The **control sensor** or **alarm sensor** has to be fixed behind the evaporator (air-inlet) or at a representative place in the chamber, but not in the air outlet.

The second sensor (**defrost term-ination sensor, evaporator sensor**) should be assembled in the contact pipe or within the fins of the evaporator. A good thermal exchange to the fins is important. It should be placed at the position where the ice remains the longest time while a defrost cycle.





Sensors for intelligent (adaptive) defrost

To detect icing the EVP doesn't need additional sensors. The control sensor and the defrost (evap.) sensor are sufficient. Please note that the emergency defrost mode is not able to prevent ice-clusters or slow glacieration in case of a incorrect sensor position. If ice-clusters appear, the defrost sensor must be placed at this position.

Notice **After start-up, Please check the position of the evaporator sensors accurately!!**

Installation / Start-Up

Upon applying voltage to the controller, after a few seconds the display shows the parameter which is selected as permanent display or an actual error code.

Start-up sequence

- Assign inputs/outputs to functions (see example on page 3)
- Select type of used temperature sensors ("**P35**", Mode Page), use TF 501 types for EEx-valves.
- Correct the displayed temperature values if necessary ("**P31**"-"**P34**", Mode Page).
- Set date and time ("**P81**"-"**P87**", Mode Page)
- Set defrost mode ("**d02**", Defrost Page)
- Set fan mode "**d01**" and "**P02**"
- Set cooling mode "**P03**" (Mode Page)
- See page 9 for parameterization of the pressure transmitter inputs

These are the most important steps for the basic configuration of the controller. Upon that, adapt the other parameters like temperature setpoint, hysteresis, delay times.... Refer to the previous chapters in this manual.

Start-up in a data network

- Set the address of the controller ("**P90**", Mode Page)
- Upload parameters from PC to controller

The EVP offers several status messages, which enables you to check the states of inputs and outputs:

- "**L50**", value of the analogue output
- "**L60**", state of the digital inputs DI1 and DI2
- "**L61**", state of the relays

Sensor positions for EEx-Valve Control, Pressure Transmitter / Temperature Sensor Method

The pressure transmitter must be mounted at the suction pipe, at a position where no pressure decrease can affect the measuring. The best place is close to the evaporator. If there are several evaporators, select a position from where the distance to all evaporators is as short as possible.

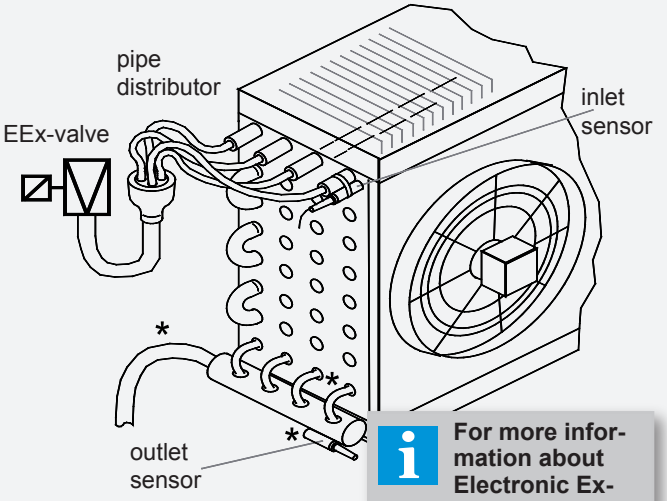
Selection of Pressure Transmitter

To detect a pressure transmitter malfunction, the signal voltage input is scalable. So you can use e.g. transmitters with an 2...10V output which makes it easier to recognize a malfunction.

Number of controllers working with the same pressure transmitter

The input resistance of the pressure transmitter input is 80 kOhm. Several inputs can be connected in parallel, but the resulting resistance must not fall below the minimum specifications of the used pressure transmitter. In practise, up to 10 controllers mostly work trouble-free.

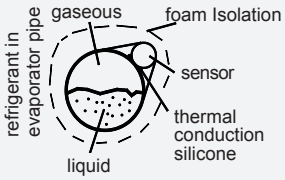
Sensor positions for EEx-Valve control, Temperature Sensors Method



For more information about Electronic Expansion Valves see page 9 !

* = alternative positions for Outlet-Sensor

Please care for a good isolation by foamed material, so that none of the sensors get contact with the airflow.



Pipe mounting

Most expedient is it to use **cable fixers**, some thermal conduction silicone cares for a good thermal flow.
Metallic fixers with high mass are not qualified.

Notice This manual, which is part of the product, has been set up with care and our best knowledge, but mistakes are still possible. 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 of this manual. Units with an other version number may work a little bit different.

set up: 26.6.17, tkd/jr	checked: 26.6.17, ek/jk	approved: 26.6.17, mv/sha	transl.(E):	transl().....	corr.