ELREHA
ELEKTRONISCHE REGELUNGEN GMBH

Cold Storage Controller for Electronc Expansion Valves

EVP (2)3160

Technical Manual **5311276-04/06E**1
from Software Version **1.0**

Brief Description

- Controller for standard cold storages or cold storages with pulse-width modulated expansion valves or expansion valves with thermal drive
- Suitable for Stepping Motor Expansion valves (with EVS slave module)
- Controls temperature, defrost device, evaporator fans, roller blinds, etc. of 1 control circuit
- Up to 3 evaporators with a single device
- 2 control methods selectable:
  - 2 temperature sensors / pressure transmitter + temp. sensor
- Autoadaptive valve control, i.e. the device adapts itself to the evaporator and to changing operating conditions
- The control functions work in cooperation with the condenser pressure optimization system of the VPR compressor compound central unit
- Intelligent defrost control, able to learn. Works with the 2 standard temperature sensors only
- Defrost Start fully automatic, by 8 release times or manually
- Defrost cycle is pulsed, controlled by evap sensor (variable intervals)
- Automatic recognition of the leading evaporator at cold storages with multiple evaporators
- Emergency Mode if sensor or defrost recognition fails. Autoreset if malfunction is repaired.
- Use of Latency Heat by intelligent fan control

Contents

CONNECTION INFORMATION & SAFETY INSTRUCTIONS

Please read before Start-up

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. 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 • The device doesn't work
- After a long-time storage under unfavorable conditions
- After inadequate shipping conditions

- Limit of Application: This product is not designed nor manufactured for use 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 described applications.**

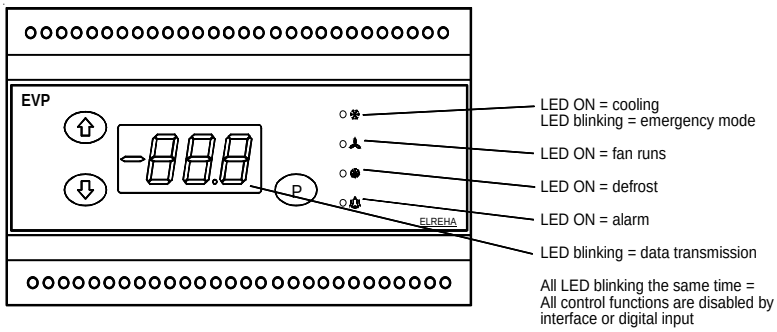
- **Electrical installation and putting into service must be done from authorized personnel.**
- Please note the local safety instructions and standards !
- Before installation: Check the limits of the controller and your application. Before starting up we recommend you to read the manual for use, since only by doing so you can avoid damage or malfunction and you will benefit all the advantages offered by this product.

- **During installation and wiring never work when the electricity is not cut-off !**
- **Never operate unit without housing.**
- Connect 'PE' terminal carefully to ground because otherwise the operation of the internal noise filter will be disabled.
- Mounting the controller close to power relays is unfavourable in case of the electro-magnetic interference.
- Before applying voltage to the controller:
  Make sure that all wiring has been made in accordance with the wiring diagram in this manual.
  Check, if the supply voltage corresponds to the value printed on the type label.
- Respect the environmental limits for temperature and humidity. Outside these limits malfunctions may occur.
- Observe the maximum admitted current rate for the relays (see technical data). Compare with the peak start-up current of the controlled devices (fan, compressor,etc.)
- Use shielded cable for sensor elongation only. Don't install them in parallel with high-current cables to prevent inductive interference. A wire gauge of min. 0,5mm² is sufficient.
- Shielding must be connected to PE at the end near the EVP
- TF-type sensors are not designed for a longtime immersion in water, in such a case, always use dip-fittings.
- Take care that the wiring of interface lines meets the requirements

Operating / Operating Elements

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

Operating Elements



Programming

All parameters of the **EVP** are distributed on different pages.
While normal operation or if no key is pushed 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

Manual Defrost

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.

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 .

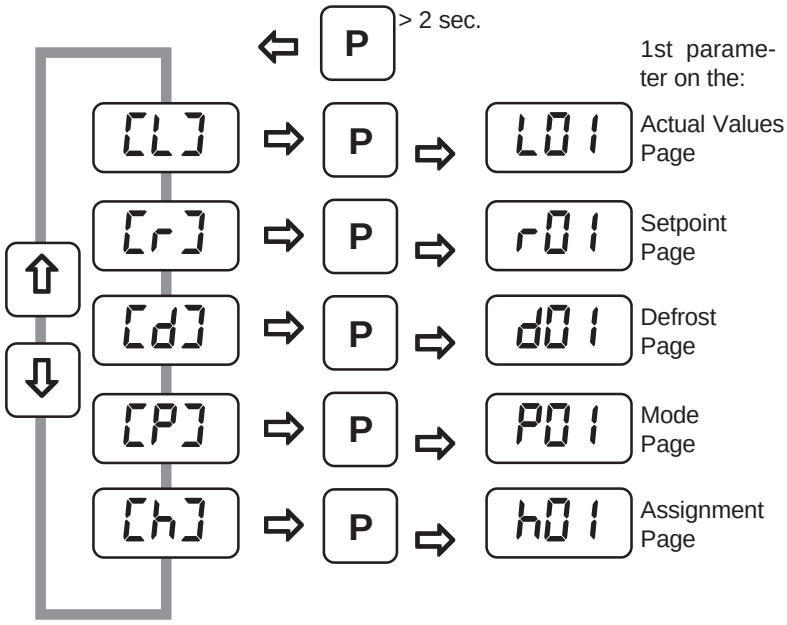
This code number is always 88. Enter it by the up/ down keys and confirm it by pressing "P" again.

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

Selection and changing of parameters

key	action
P (> 2 seconds)	Page name will be displayed
⇧ ⇩	Select desired page
P	Enter the page
⇧ ⇩	Select parameter
P	Prepare programming. Eventually, you will be asked for the access code (C00, see above).
⇧ ⇩	Change value. If you hold the key, the values change faster and faster
P	Confirm programming
P (> 2 seconds)	Page name will be displayed again

Parameter Pages



Display of actual values and states

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

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 the temperature value based on the pressure transmitter value and the selected refrigerant. With "**P31**"-"**P35**" (Mode Page) this displays can be calibrated.

Expansion Valve Status Display
"**L52**" shows the current, average aperture size from 0...100 % and additionally the actual state of the valve.

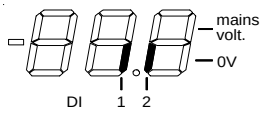
cUt = Restart of the evaporator after abnormal operating conditions (cutoff)
Pdo = Pumpdown of the refrigerant (cooling relay ON for 30 sec.)

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

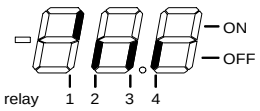
Time information
The Actual Values Page contains all runtime- / remaining time information, so the times up to the start of a function can be read.

Status displays

State of the digital inputs



State of the relays



Temperature Sensors

As temperature sensor only **TF 501** type sensors (1000 ohms@0°C) can be used.

'Permanent Parameter' - Function (Basic Display)

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 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 automatically. Additionally the display flashes.
Always the last **15** errot messages keep memorized with date and time of their appearance and can be read-out via data interface.

Error Codes	
----	no error
In I	first initialisation of the controller or data lost
hrd	hardware failure
on	mains supply cut off
oFF	mains supply switched on
chA	safety chain open
tXb	sensor X broken
tXc	sensor X short
If a sensor is short or broken, a time delay of 5 seconds takes effect before an alarm will be activated.	
th I	alarm sensor, overtemperature
tLo	alarm sensor, undertemperature
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).
oPc	alarm at digital input X
dor	door X is open
dbt	number of defrost cycles without termination by temperature exceeded, maybe too many ice or heater malfunction.
HoS	communication error Master
SLx	communication error Slave x
SEL	error in assignment page, e.g. function programmed too often
Adr	network address already exists
StE	communication error EVS-expansion module
bAt	battery error at the EVS-expansion module, replace battery

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 (*4 relays, 4 sensors, 2 digital inputs, 1 analogue output*) can be configured to work with any integrated control function or control circuits.

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 and 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.

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

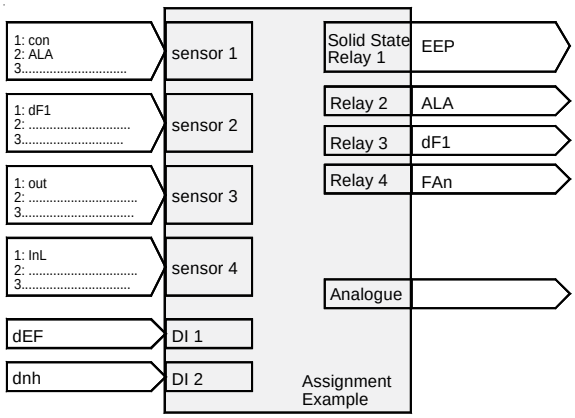
Relay Outputs
Each relay can be used to control one of the possible functions. The same function can even be assigned to multiple relays.

Relay output #1 is a Solid State Relay with a lower contact rating than the standard relay outputs. Normally, this output is used to drive 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

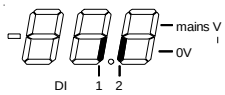
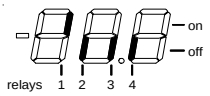
Hereby we use the example from above: A cold storage with an evaporator with Electronic Expansion Valve.

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 before
enter access code	"⇧"	C88	
confirm	"**P**"	any	
select function	"⇧⇩"	EEP	EEP = electronic expansion valve
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	"⇧⇩"	ALA	ALA = alarm relais
confirm	"**P**"	h02	parameter # will be displayed again

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

Parameter Pages

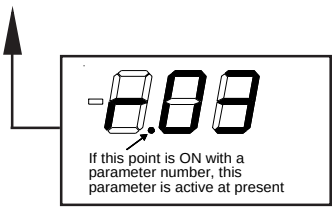
Actual Values Page CL3

Param.	Disp.	Note	Range	Default values
L01	X	Actual temperature at sensor 1 (can be corrected +/- 10K) The tasks of the sensors will be fixed by parameters on the Assignment Page	± 100°C	Actual value of outlet sensor
L02	X	Actual temperature at sensor 2	dto.	Actual value
L03	X	Actual temperature at sensor 3	dto.	off
L04	X	Actual temperature at sensor 4	dto.	off
L05	X	Actual temp (calculated from pressure value)	dto.	
L06	X	Actual value of the pressure transmitter	bar	
L09	X	Act. Superheat value (outlet - pressure resp. outlet - inlet)	K	
L10	X	Current active setpoint	°C	
L11	X	Current active hysteresis	K	
L12	X	Defrost state	0=standby, 1=pumpdown, 2=break before defrost, 3=defrost running, 4=break after defrost 5=fan start-up delay (freeze-on time)	
L13	X	Defrost state of slave modules. 1= 1 sla. still defrosting	0, 1	
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	
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 % of the selected range	0-100%	
L52	X	State of the Electronic Expansion Valve, current aperture size in % or state	e.g. 10, 50, 70, etc. cUt = cutoff Pdo = pumpdown	
L53	X	State of the Stepping Motor Valve, current aperture size in % or state	e.g. 10, 50, 70, etc.	
L55	X	Battery state of EVS-stepping motor module	--- = no information 0 = discharged/defective, 1 = OK	
L60	X	State of digital inputs DI1 and DI2		
L61	X	States of relays 1-4		

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

Setpoint Page [r3]

Param.	!	Note	Range	Default Value	Your Value
r01		Setpoint Layer	1, 2	1	
r02	!	Setpoint 1 (day)	-100/+100°C	-2.0°C	
r03	!	Setpoint 2 (night)	-100/+100°C	-2.0°C	
r04	!	Setpoint 1 (day), Setpoint Layer 2	-100/+100°C	-2.0°C	
r05	!	Setpoint 2 (night), Setpoint Layer 2	-100/+100°C	-2.0°C	
r10		Hysteresis	0,1...20K	2 K	
r15		Fan threshold	-100/+100°C	100°C	
r16		Hysteresis of fan threshold	0,1...20K	2 K	
r22		Fan start-up 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	!	Upper alarm threshold (relative to the current setpoint)	0...50 K	7.0 K	
r42	!	Upper alarm threshold , layer 2 (relative to.. see above)	0...50 K	7.0 K	
r43	!	Lower alarm threshold (Value for lower temperature limitation and alarm) **cannot be switched off**	-100/+100°C	- 5°C	
r44	!	Lower alarm threshold, layer 2	-100/+100°C	- 5°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	
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 resp. current at the analogue output if this digital input is activated	0.0...100.0 %,	0%	



Defrost Page [d]

Param.	Disp.	Note	Range	Default Value	Your Value
d01		Fan during defrost	on, oFF	oFF	
d02		Defrost Mode	Etn = external only, Int = extern+intern RdA = adaptive	Int	
d03		Fan operation before defrost (defrost forerun)	0...15 minutes	3 minutes	
d04	X	Time up to defrost (in 10-minutes steps)	48.0 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	
d17		Defrost release time 7 (in 10-minutes steps)	00.0 - 23.5, oFF	oFF	
d18		Defrost release time 8 (in 10-minutes steps)	00.0 - 23.5, oFF	oFF	
d31		Defrost termination temperature	0.0°C...100°C	8.0°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 break after defrost (drain time)	0...30 minutes	0 min.	
d36	X	Duration of last defrost cycle	minutes		
d37		Number of time limited defrost cycles without alarm	oFF, 1-15	3	
d38		Break before defrost	0...15 minutes	0 min	
d50		Manual defrost initialization	on = manually ON oFF = man. OFF		

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

Mode Page CP3

Param.	Disp.	Note	Range	Default Val.	Yout Values
P01		Assigned to compressor compound # (0 = not assigned)	0, 1, 2,	1	
P02		Fan operation mode	Int = Interval PEr = Permanent Add = Special mode pos. room temp. + latency heat utilisation	Int	
P03		Cooling mode (!note correct relay wiring)	rEF = refrigeration, FrE = freezing	FrE	
P04		Emergency mode (if sensor fails) in % of max. power	0...100%	0%	
P11		Frame heater, period time	10...60 minutes	15 min.	
P12		Frame heater, pulse width (day operation)	0...100%	100%	
P13		Frame heater, pulse width (night operation)	0...100%	100%	
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 of sensor 1	+/-10.0K adjustable	0.0K	
P32		Calibration of sensor 2	+/-10.0K adjustable	0.0K	
P33		Calibration of sensor 3	+/-10.0K adjustable	0.0K	
P34		Calibration of sensor 4	+/-10.0K adjustable	0.0K	
P35		Calibr. of temp. calculated by pressure/refrigerant	+/-10.0K adjustable	0.0K	
P41		Undertemperature Alarm Function	on, oFF	on	
P42		Briefing hour	0...23 o'clock, oFF	9 o'clock	
P43	X	Current Error Message			
P51		Analog output delivers 0V/mA if control sensor temp. =	-/+ 100°C	-100°C	
P52		Analog output delivers 10V/20mA if ctr. sensor temp. =	-/+ 100°C	+100°C	
P53		Lower limit of pressure transmitter	-1,0...+90,0 bar	0,0 bar	
P54		Upper limit of pressure transmitter	-1,0...+90,0 bar	+25,0 bar	
P55		Used refrigerant 0= OFF, control by temperature sensors only - Parameters marked by "**Disp**" are for information only and cannot be changed.	1 = NH3, 2 = R134a, 3 = R22, 4 = R23, 5 = R404a, 6 = R507, 7 = R402A, 8 = R402B, 9 = R407C (wet steam), 10 = R407C (dew point), 11 = R123, 12 = R290, 13 = CO2, 14 = R502	0	
P56		The EVP slaves got the pressure information from	0 = own input 1 = input of the master	0	
P57		Used stepping motor valve (sporlan types, steps)	---, SER (1596) S30 (3064), S-- (6386)	---	
P58		Lower voltage limit of pressure transmitter input If voltage falls short of this threshold = „broken“ error message	0,0...10,0 V 0 V		
P59		Upper voltage limit of pressure transmitter input If voltage exceeds this threshold = „short circuit“ error message	0,0...10,0 V 10,0 V		
P60		Superheat Setpoint, depends on evaporator	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 (Proportional band) of Expansion Valve Control	0,1...20,0 K	8,0 K	
P63		I-Part of the Expansion Valve Control	1...999 sec.	240 sec.	
P78	X	Software vers. of the connected EVS Exp. Module			
P79	X	Software version of the EVP			
P81		Standard of summer/winter switching	oFF = switched oFF, on = ON, EU since 1996		
P82-P84		Year - Month - Day			
P85-P87		Hour - Minute - Second			
P90		Address of the EVP controller device in a network	0 - 78	78	
P91		Data transfer speed in Baud	aut(o), 12 (1200)... 115(115200)	aut(o)	
P92		Master/Slave Mode	HS0= standard HS1= master+1 slave module *up to* HS5= master + 5 slave modules SL1= slave address 1...SL5= slave address 5	HS0	

Assignment Page Ch3

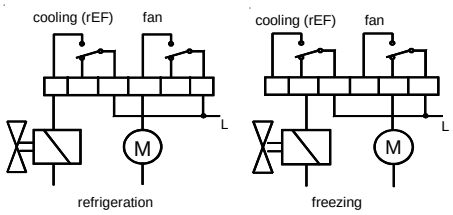
Param.	Disp	Note	Range	Default Value	Your Value
h01		Function of relay 1 (Solid State Relay) (Expansion Valve)	---, on = continuous on, rEF = cooling, dF1 = defrost 1, dF2 = defrost 2, dF3 = defrost 3, FAn = fan, ALA = alarm, FrA = frame heater, roL = roller blind, Lit = light, HEA = heater, EEP = EExValve Un1 = Relay OFF with "controller OFF", continuous ON while normal opration	EEP	
h02		Function of relay 2 (Fan)	do.	FAn	
h03		Function of relay 3 (Defrost 1)	do.	dF1	
h04		Function of relay 4	do.	---	
h11		Function (a) of sensor 1	--- = switched off, con = control sensor, dF1 = defrost limit. sensor 1, dF2 = defrost limit. sensor 2, dF3 = defrost limit. sensor 3, ALA = alarm sensor, dIS = display only sensor, inL = inlet sensor, out = outlet sensor FAn = outlet sensor	con	
h12		Function (b) of sensor 1	do.	---	
h13		Function (c) of sensor 1	do.	---	
h21		Function (a) of sensor 2	do.	con	
h22		Function (b) of sensor 2	do.	ALA	
h23		Function (c) of sensor 2	do.	---	
h31		Function (a) of sensor 3	do.	---	
h32		Function (b) of sensor 3	do.	---	
h33		Function (c) of sensor 3	do.	---	
h41		Function (a) of sensor 4	do.	---	
h42		Function (b) of sensor 4	do.	---	
h43		Function (c) of sensor 4	do.	---	
h52		Analogue outputs work as/deliver	--- = 0V / 0 mA, 20 = 2V / 4 mA 100 = 100% (10V resp. 20 mA), Ud1 = act. value image (0...10V), Id1 = act. value image (4...20mA), UP_ = PID-T1 control (0...10V), 0% in case of failure, IP_ = PID-T1 Regler (4...20mA), 0% in case of failure, UPr = PID-T1 control inv. (0...10V) IPr = PID-T1 control inv. (4..20mA) UEP = for electr. exp.valve (0...10V) IEP = for electr. exp.valve (4/20mA) UP¯ = PID-T1 control (0...10V), 100% in case of failure,, IP¯ = PID-T1 Regler (4...20mA), 100% in case of failure	---	
h61		Function of digital input DI 1	--- = switched off dEF = external defrost, dnL = night operation, act. low dnH = night operation, 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 = Analog outp. switch to a fixed value rLL = Cooling lock, act. low rLH = Cooling lock, act. high rFL = Forced cooling, act. low rFH = Forced cooling, act. high		
h62		Function of digital input DI 2	dto.		

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

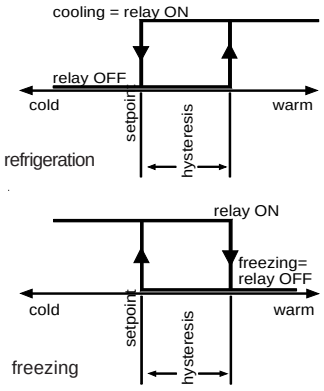
Cooling

Temperature sensors
If necessary, 2 control sensors can be assigned at the same time, the warmest starts cooling.

Cooling control by Solenoid Valve / Compressor
Cooling is controlled by switching the output relay (assigned to "rEF"). In case of power loss or controller defects the output contacts must switch in a position which is safe for the application. For this reason we use the N/O-contact in refrigeration applications (fail-safe: open contacts). For freezing applications we use the N/C-contacts (fail-safe: closed contacts), 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.



The control relay can be locked via data interface.

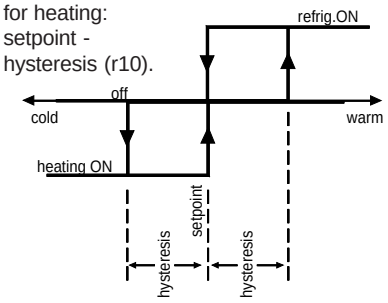
Undertemperature Limitation
Can be used e.g. for refrigerated shelfs with roller blinds to limit the temperature at the air outlet during night operation. When the temperature at the alarm sensor decreases the limit set by "**r43**" (resp. "**r44**", setpoint page) cooling will switch off.
This value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

The undertemperature limitation cannot be switched off.

Heating function

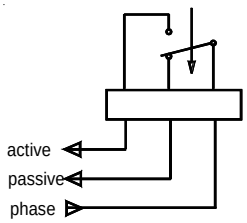
One relay is able to work as a heat relay. Then the control setpoint is the cut-off point of heating and cooling at the same time. Cut-in will be:

- 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, that means that after the controller has been switched on, the alarm 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 alarm sensors for a circuit (e.g. 4x "**ALA**"). If the temperature at one of the alarm sensors exceed the threshold value "**r41**" (resp. "**r42**", Setpoint Page), an alarm will be initiated after the delay time "**r45**".

Undertemperature 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.
This setting works as threshold for the "Under-temperature Limitation" function at the same time.
Undertemperature 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 „**d32**" (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 am day 1 up to 10:59 am 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, after a power loss "**r34**" delays cooling. 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**" (Set-point 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 input can be configured for external switching, selectable as "**dnL**" (active low) or "**dnh**" (active high). While the input is active, 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 sets (layers) of setpoints, where the first layer of setpoint is used during normal operation and the alternative layer of setpoints with other temperatures is used e.g. for different products stored only sometimes. For each layer there are parameters available for setpoints, night setpoints, warning offsets and low temperature warning. Even here the currently used setpoint is marked by a lighted decimal point in the parameter display.

Toggling between the setpoint layers

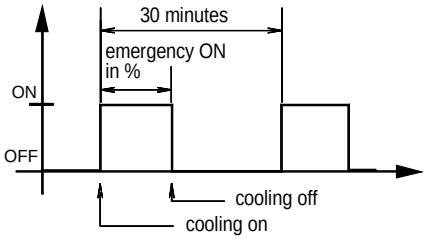
1. internal: by parameter „**r01**" (Setpoint Page)
2. external: assign function „**SEt**" to a digital input. If connected to mains phase, the 2nd layer is in use.

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 the 30 minutes period.



Temperature control with Electronic Expansion Valves

The EVP 3160 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 thermal expansion valve.

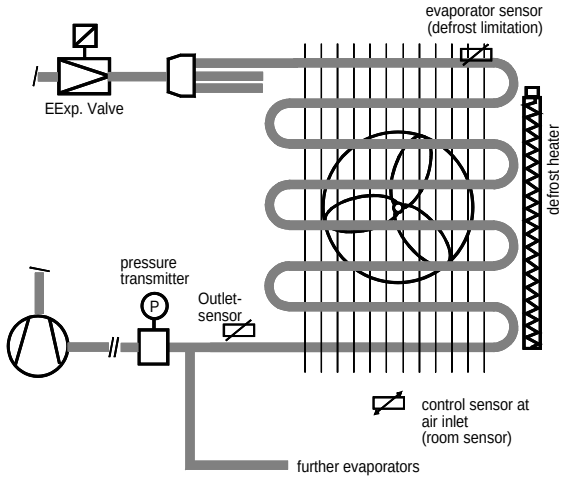
Expansion Valves

The EVP is able to drive the following valve types:
1. pulse-width modulated, cycling expansion valves
2. valves with thermal drive
3. stepping motor valves (with EVS expansion module only)

Both, valves with AC input as well as with DC input can be used (types 1+2).
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 up to 5% is possible.

Sensor Positions

Pressure Transmitter/ Temperatur Sensor method



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. Each with Temperature Sensor 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 will be defined by the control algorithm. Disturbances like suction pressure fluctuations and flashgas will be filtered out.

1. Pressure /Temperature method

To capture the superheat, a pressure transmitter (2-10V output) and a temperature sensor (TF 501) 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.

Parameterization

L05 ..... Display of the temperature which is calculated from pressure value and refrigerant
P55 ..... Method is active as soon as an refrigerant is selected.
P53 ..... Lower limit of the pressure transm. („-1.0“, relative pressure)
P54 ..... Upper limit of the pressure transm. („+9.0“, relative pressure)
P58 ..... Lower voltage limit of pressure transmitter input (2V, below this limit an error message will be generated).
P59 ..... Upper voltage limit of pressure transmitter input (10V).
P60 ..... Superheat setpoint (depends on evaporator)
P61 ..... MOP-setpoint (Maximum Opening Pressure, i.e. limitation of the evaporation temperature at the outlet).

The settings of **P60/P61** depend on the used compressors and evaporators.
P62 ..... P-part of the EEx-Valve Control
P63 ..... I-part of the EEx-Valve Control
The factory settings for P62/P63 are nearly ideal for almost all kind of cold storages, so change them carefully!

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

2. Temperature sensor method

To capture the superheat, 2 temperature sensors 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 more parameterization for the expansion valve necessary.

Stepping Motor Valves

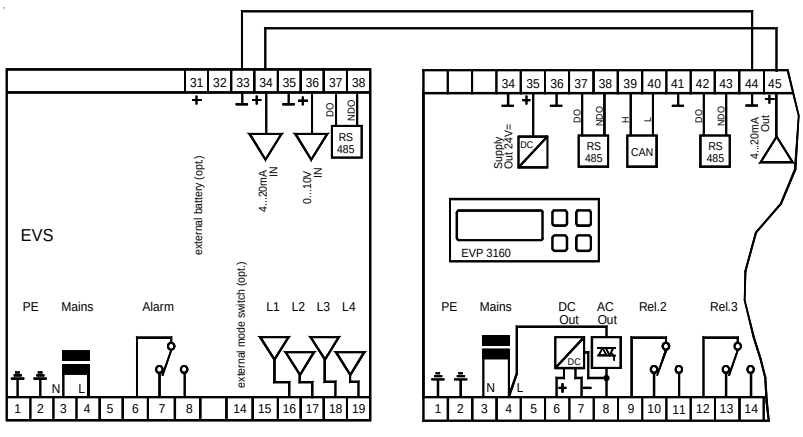
The controller is able to drive stepping motor valves for superheat control. This kind of valves can be connected via an EVS expansion module only, which addtionally contains emergency batteries and emergency functions to close the valve at any time.

The EVS expansion module can be connected via the analogue 4...20mA- output.
See EVS manual for more information.

Electronic Expansion Valve and Single-Compressor plants

We recommend the Pressure/Temperature Method for plants with just a single compressor.
The compressor can be controlled by an external suction pressure switch or the control relay of the EVP. By this, special operating modes and an automatic "pumpdown" function are possible.

Connection of the EVS-Expansion Module for Stepping Motor Valves



Digital Inputs (Optocoupler Inputs)

Switching OFF the controller unit

Sometimes it is necessary to switch off cold storages completely including the controller, but if the controller works in a network, the bus-master detects a malfunction and generates an alarm. To prevent this, the unit can 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, this avoids further evaporation. If the door is open for **> 3 minutes**, cooling stops. All other functions continue working.
If the door is open for more than "**r62**" minutes, the unit generates the error message "**rdo**", cooling restarts and an alarm message will be forwarded. "**L31**" shows the remaining time up to the alarm message.

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 when door is opened, the controller adds the time to the total opening time of that 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.

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.

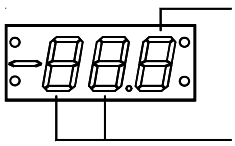
Defrost

The EVP 3160 allows different defrost methods. Up to 3 defrost relays can be assigned. This relay output(s) then control electric heaters or fans.
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**"..."**d18**" (Defrost Page) you set six (8) 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 minute 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 threshold. 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 'adaptive' defrost

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 chilliness can be blown to the storage.
The defrost heaters must deliver less energy, because the evaporator is already warmed up.

Defrost termination by temperature
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 termination temperature "**d31**" (Defrost Page).
If 2 defrost sensors are assigned, both sensors must achieve the termination 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 at the "Briefing Hour" **P42**. 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 (**d37=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 between "**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:

- better distribution of the heat energy in the evaporator
- defrost limitation temperature can be set to a lower value
- less humidity in the chamber
- save of energy

Real Time Clock

The built-in real time clock has a buffer for typ. 3 years 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.

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), but 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.

Parametrisation 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.
- set parameter "**d03**" (*defrost forerun*) to several minutes, so the fan will be started before defrost heater starts.
- set parameter "**r23**" (*fan trailing delay,* setpoint page) to the time the fan must continue running after cut-off of the cooling relay.

Process Sequence

1. While the time period set by "**d05**", the controller decides itself about the perfect defrost time. Once icing is detected, defrost is prepared and begins either immediately or at the next allowed time.
2. Fan runs if cooling is switched off and defrost heater is still switched off.
3. The fan stops and the heater starts
4. With multiple evaporators, each one has its own defrost sensor and heater relay, to provide it with individual heat energy. The most bad evaporator (**leading evaporator**) will be recognized automatically.
5. While temperatures [setpoint + hysteresis >= 2,5°C], the controller saves energy by aggrandized use of the fan (more airflow) to reduce icing.
6. After achieving a defined evaporator temperature, the heater will be cut on/off in calculated periods.
7. Defrost heater cut off, limit temp. is reached.
8. Drain time runs, cooling/fan still off
9. Freeze-on active, cooling ON, fan still off
10. Fan starts, normal operation mode

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 room sensor and evaporator sensor. The controller uses the value of these sensors, their difference, the historic curves of their 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 *defrost forerun* (**d03**, 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 necessary heat energy to defrost.

Defrost start
If all eight defrost times are set to OFF, the controller decides itself about a defrost start.

- *Further time influence*
  If you want to prevent a defrost event from starting at certain day-times use the „*defrost time..*" parameters 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 time*" before starting defrost.
- *External command*
  Assign one of the digital inputs to „*manual defrost*". By applying voltage to that input it is possible to start defrosting at any time.

Defrost heating
When the *pulse defrost threshold* "**d34**" is achieved, the heater is 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 "**d31**".
This procedure fits in the same way for the case of several evaporators in the chamber.
By this way, defrost periods will take longer, but will be more efficient.

Special mode for room temperatures >2,5°C
Evaporators can be de-iced by forced air already at temperatures from 2°C.
When cooling stops, fans turn ON until ice and frost are melted.
Thus humidity stays in the chamber which will improve the quality of certain goods like meat or vegetables. Additonally to the compulsatory "**r23**" (*fan off delay,* 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.

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 roomsensor is sufficient. E.g. for a chamber with 3 evaporators you need 4 sensors only:

- (1) control sensor
- (3) 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, e.g. 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
In extreme cases, 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 defrosts with the interval which corresponds 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 starts defrost every 24 / 4 = 6 hours until a cycle will be finished by the evaporator sensor and not by timer. Independent from this procedure, an error 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 to flow to the drainage. Then cooling starts now, but the fans still stay OFF until "**r22**" has expired to allow the evaporator to cool down and to prevent the fans from blowing warm and humid air or water drops into the chamber.

Analogue Output

An analogue output can be used for regulation purposes or to provide a remote display with an actual value image. The signal is available at 2 outputs as a DC-Voltage or a DC-Current-Signal. 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" = "- - -" output signal is 0V resp. 0 mA (fixed)
"h52" = "20" output signal is 2V resp. 4 mA (fixed)
"h52" = "100 output signal is 10V resp. 20mA (fixed)

Transmission of actual values to remote displays or similar

"h52" = "Udl" Image of the value of cooling sensor 1.
P51 = With this actual value the output delivers 0V
P52 = With this act. value the output delivers 10V
"h52" = "Idl" Image of the value of cooling sensor 1.
P51 = With this actual value the output delivers 4 mA
P52 = With this actual value the output delivers 20mA

Control with the analog output signal (PID-control)

"h52" = "UP" PID-controller whose output signal represents an addition of the components P, I, D and T1, U-output.
"h52" = "UPr" PID-controller, like above, but inverted signal (rising temperature, falling signal)
"h52" = "IP" PID-controller whose output signal represents an addition of the components P, I, D and T1, I-output 4...20mA.
"h52" = "IPr" PID-controller, like above, but inverted signal. (rising temperature, falling signal), I-output 4...20mA.

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)

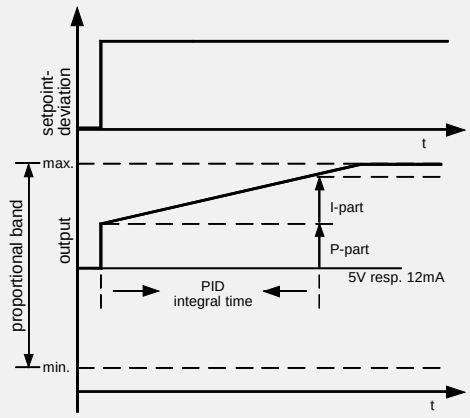
How to influence the analog output manually

For certain operations (e.g. manual closing of a valve drive) it may be useful to set the output signal to a fixed value. 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.

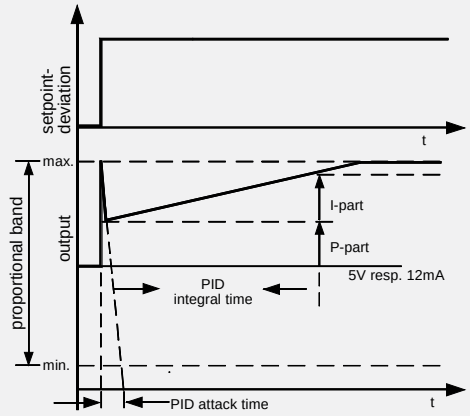
"**h61/h62**" (Assignment Page) set to "**AnA**" = configure digital input 1 or 2
"**L50**" (Setpoint Page) = amount of the output in % of the selected range, if the digital input is activated.

Example:
Digital input DI1 is configured at "**h61**" to the value "**AnA**", "**r63**" is set to "50".
- The U-output delivers 5V DC
- The I-output delivers 10mA

Control Characteristic



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



PID-control, T1-part de-activated

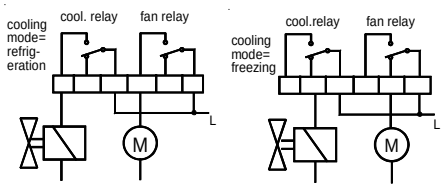
Electronic Expansion Valves with analogue input

The analogue outputs of the EVP are able to control expansion valves with analog inputs. Therefore, "**h52**" must be set to "**UEP**" (If the U-output is used) oder "**IEP**" (I-output).

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**" = Latency heat utilization by special fan control (see chapter "Special mode for room temperatures >2,5°C" on page 12)

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**" (Set-point Page). This avoids that water drops are blown into the chamber. "**L35**" (Actual Values Page) shows the remaining time up to the fan will switch on.

Thermostatic Fan Control

If a sensor is assigned to the function "**FAn**", the fan works subject to the parameters "**r15**" (fan threshold) and "**r16**" (hysteresis of the fan threshold). The fan stops, if the temperature at the sensor "**FAn**" increases **r15**+**r16** and restarts with reaching again the value set by **r15**.

Examples of 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*
   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 "**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

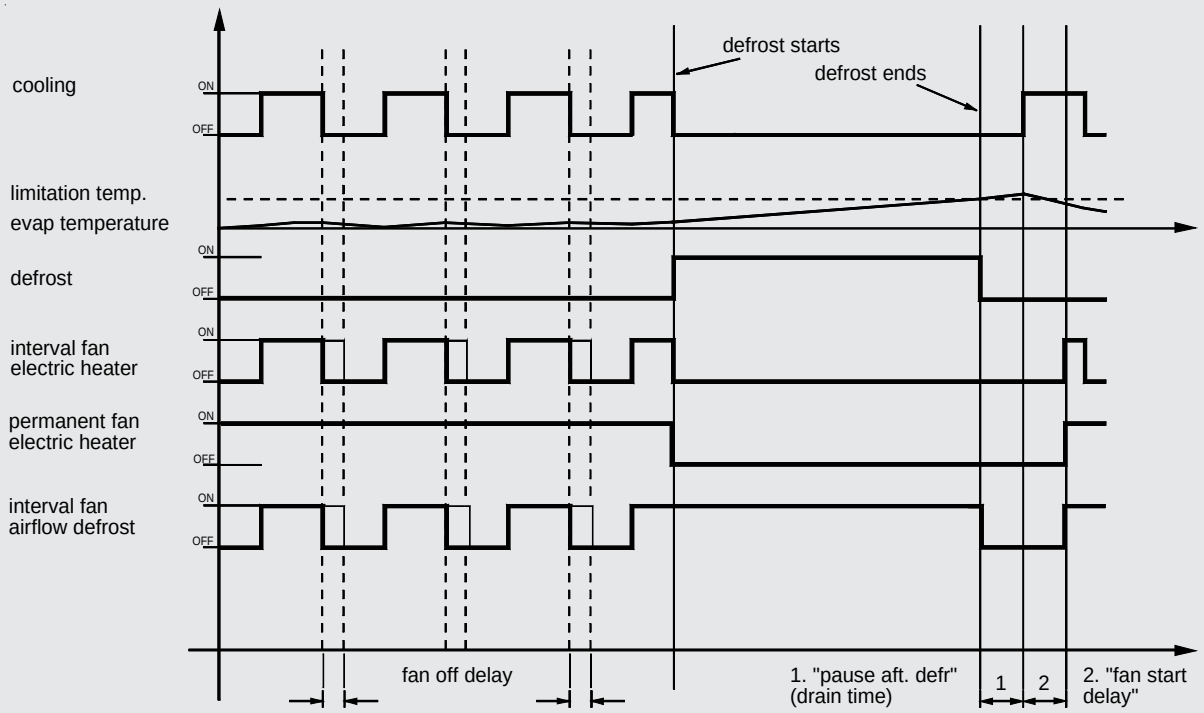
1. Fan operation mode P02 = "Add"

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 chilliness blow into the room which reduces the number of compressor starts.

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.

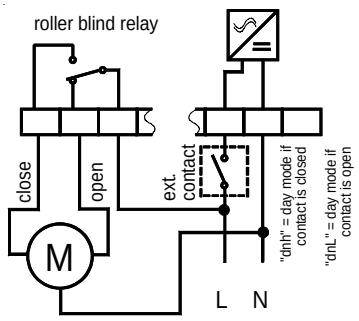
Internal control:

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**".

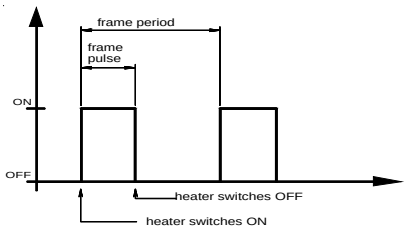


If the digital input is activated, the relay switches on and closes the roller blind. After de-activating the digital input, the relay switches off and opens the roller blind via its N/C-contact.

Frame Heater control

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



Cascading controller units to extend cold storages

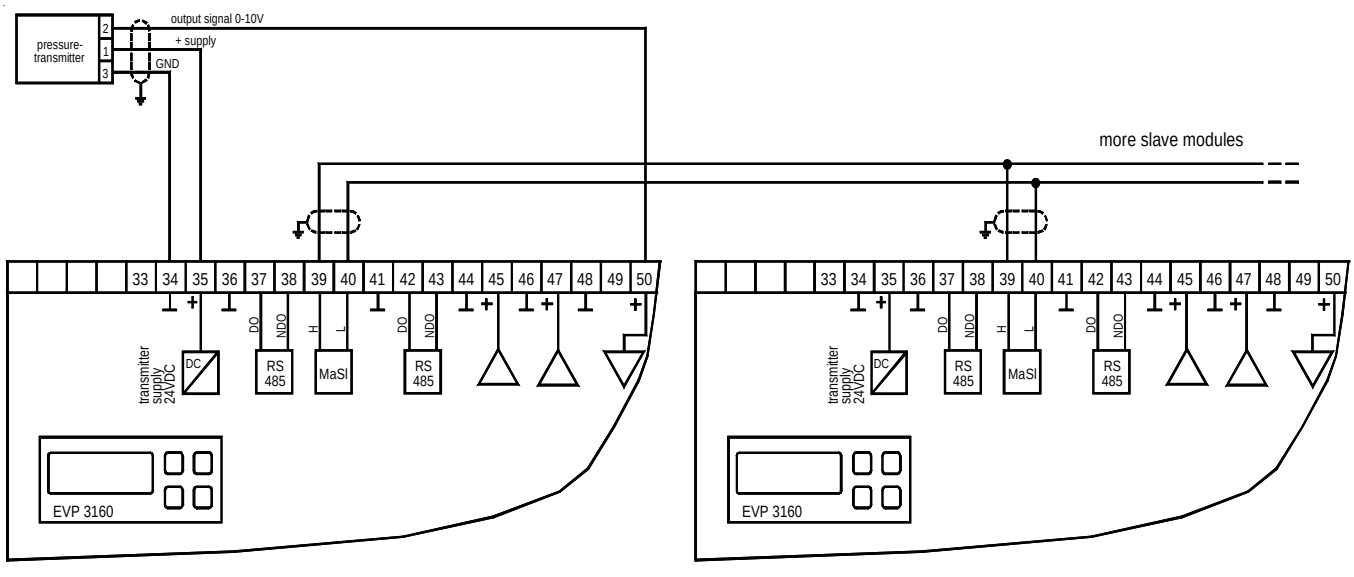
To control multiple evaporators, up to 5 EVP units can be added as slave modules (cascading). The units transmit their information via the "MaSL" data interface.

All necessary information, e.g. like the actual value of the pressure transmitter, is transmitted via this interface, so the transmitter must be connected to the master unit only.

Necessary settings:

Master Unit:	Depending on the number of slaves "**P92**" (Mode Page) must be set to "HS1"..."HS5".
Slave Unit:	Each slave gets at "**P92**" (Mode Page) an individual address "SL1" ..."SL5"

Principle of Cascading



Networking of controllers

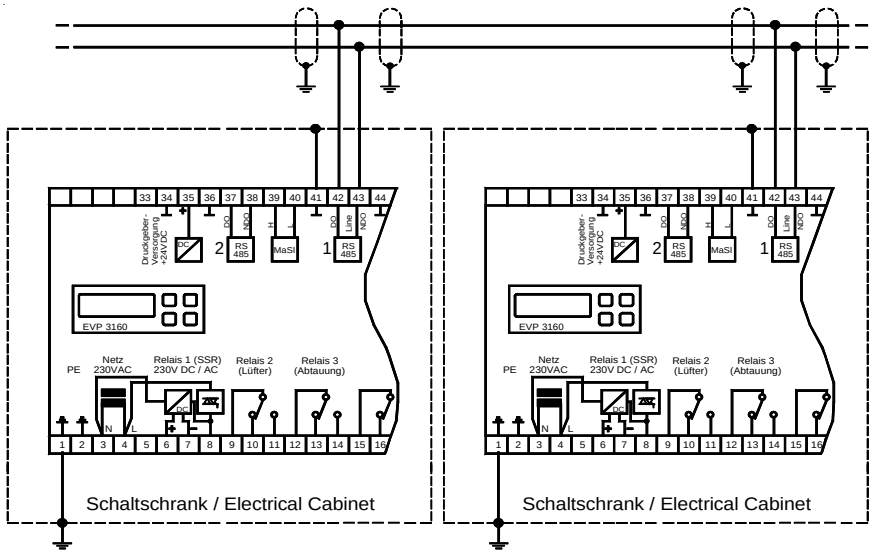
The EVP can be networked together with other ELREHA-control devices. For this duty, we have developed *E-LINK*, a transmission protocol, transmitted on a two-wire bus-system based on the RS-485-Standard. With E-LINK up to **78** controllers can be assembled.
Each controller in a network has its individual address ("**P90**", Mode Page).
The standard data transmission speed is 9600 Baud, but can be changed if necessary (**P91**, Mode Page). If the controller is used outside a network, the address is of no importance.

Remote control from Frontend Systems
The EVP controllers can be operated remotely via interface when they are connected to Front-end 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 „Cool-vision", 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 or an interface converter of the SSC-serie must be used.

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.



Connection of Remote Displays

The EVP 3160 controller is prepared for connecting series TAA xx15 Remote Displays. These displays are able to show all 5 measured actual values.
The TAA display must be connected to the RS-485-2 interface (terminals 37/38).
Up to 4 TAA xx15 can be connected, each TAA is able to display any sensor value.

Power Supply
The TAA can be supplied by the EVP-controller or by an external transformer.

The controller is able to supply 1 TAA Remote Display max.!

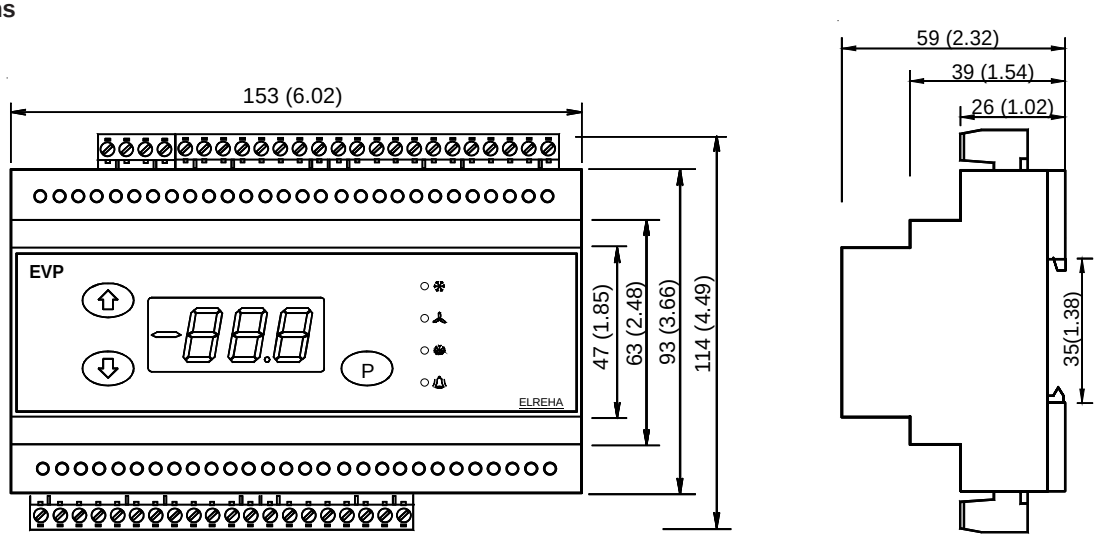
Parameterizing
The EVP controller needs no special settings. At the TAA the # of the sensor to display must be set by an incremental switch at the rear side of the housing.

Display while a defrost cycle
If the controller works in a defrost cycle, the TAA Remote Display holds the last temperature value, measured at the beginning of the defrost. After termination of the defrost event, a real temperature value will be displayed after the following preconditions:

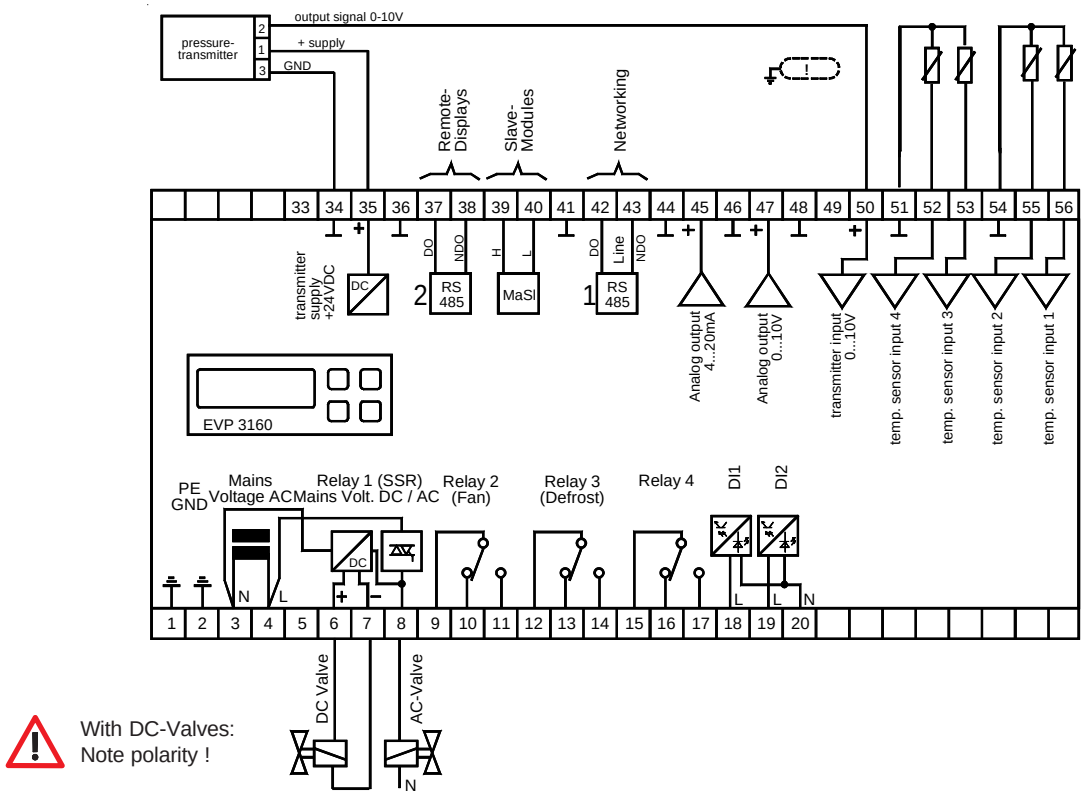
- The measured actual value is less than the displayed value + 2K
- After the alarm delay extension is run down

For further information please read the manual of the used TAA Remote Display.

Dimensions

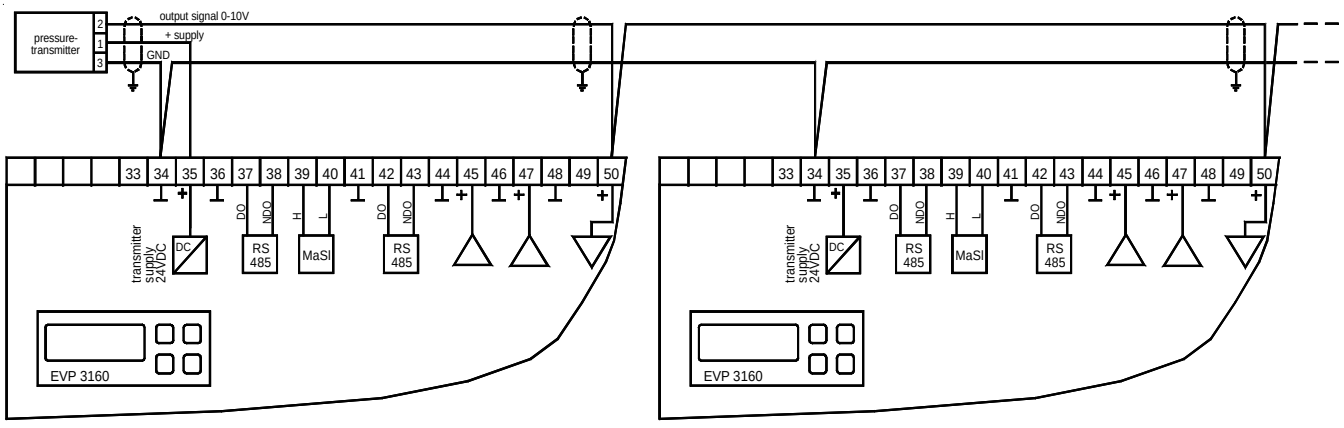


Wiring



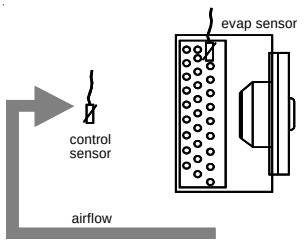
Connection of a pressure transmitter to multiple controller units

This units control different cold storages and are not connected in a master/slave mode.

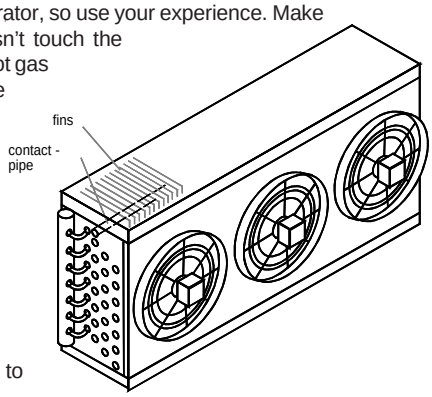


Sensor Positions

The controller needs correct temperature information to work correctly, but sensor positions are not critical.
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 termination sensor, evaporator sensor**) should be assembled in the tube specified for this purpose. If the evaporator has not such a tube, assemble it between the fins in the upper part and assure good thermal exchange. It should be placed at the position where the ice remains the longest time while a defrost cycle. This depends on type and manufacturer of the evaporator, so use your experience. Make sure that the sensor doesn't touch the heater or any piping with hot gas defrost, it must have some distance to this heat sources.
We indicate that remaining ice in an evaporator even after defrost period is due to sensors which have not enough thermal contact or which are installed at a wrong place. If you encount icing you should place the defrost sensor to this area.



Sensors for intelligent (adaptive) defrost
To detect icing the EVP doesn't need additional sensors. The control sensor and the defrost sensor are sufficient.
Please note that the emergency defrost mode is not able to prevent ice-clusters or slow glacieration in case of an incorrect sensor position.

After start-up, checking the sensor positions is essential !!

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 examples on page 4)
- Correct the displayed temperature values if necessary ("**P31**"-"**P35**", 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)

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 the 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

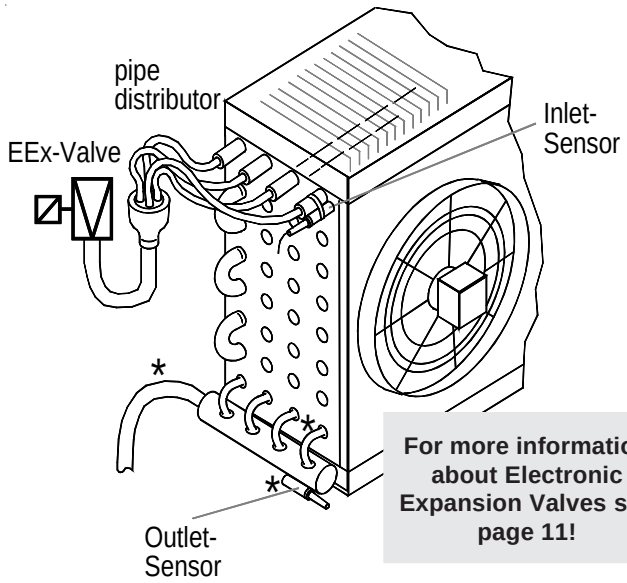
Sensor positions for EEx-Valve Control using Pressure Transmitter / Temperature Sensor Method

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.

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.

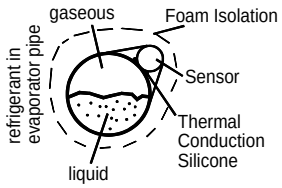
Sensor positions for EEx-Valve control using Temperature Sensors Method



For more information about Electronic Expansion Valves see page 11!

***** = 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.

Technical Data

Supply Voltage EVP 3160 ..... 230V / 50Hz, appr. 3VA
EVP 23160 ..... 115V / 60Hz, appr. 3VA
Ambient Temperature ..... 0...+50°C
Max. Air Humidity ..... 85% r.F., not condensing
Analogue Inputs ..... 4x Temperature Sensors TF 501, 1x pressure transmitter 0...10V DC
Digital Inputs ..... 2x mains voltage, 3mA max.
Relay Outputs ..... 3x SPDT isolated, 8A res/3A ind./250V
Output for EEx-Valve ..... 1x Solid-State-Relay (SSR) 1A / 250VAC or 400mA / 250VDC

Transmitter Supply ..... 24VDC ±10%, 40mA max.
Analogue Outputs ..... 1x 0...10V, 1x 4...20mA
Display / Setting Ranges ..... see Parameter Pages
Digital Display ..... LED red, character height 13mm (.51 inch)
Indicators ..... LED, 3mm
Data Interfaces ..... 2x RS 485, 1x CAN
Data storage ..... unlimited
Real Time Clock ..... automatic summer/winter switch typ. 3 years clock backup
Housing ..... plastic with foil keypad for EN 50022 rail mounting, pluggable screw terminals 2,5 mm²

EG-Konformitätserklärung *EG-Statement of Conformity*

CE –

Für das beschriebene Erzeugnis wird hiermit bestätigt, daß bei bestimmungsgemäßem Gebrauch die Anforderungen eingehalten werden, die in der Richtlinie des Rates zur Angleichung der Rechtsvorschriften der Mitgliedsstaaten über die elektromagnetische Verträglichkeit (89/336/EWG) und der Niederspannungsrichtlinie (73/23/EWG) sowie der Änderungsrichtlinien (93/68/EWG) festgelegt sind.
Diese Erklärung gilt für alle Exemplare, auf die sich die vorliegende Bedienungsanleitung (die selbst Bestandteil dieser Erklärung ist) bezieht.
We state the following: When operated in accordance with the technical manual, the criteria have been met that are outlined in the guidelines of the council for alignment of statutory orders of the member states on electro-magnetic consistency (89/336/EWG) and the Low Voltage Directive (73/23/EWG) as amended by (93/68/EWG). This declaration is valid for those products covered by the technical manual which itself is part of the declaration.
Zur Beurteilung des Erzeugnisses hinsichtlich elektromagnetischer Verträglichkeit und der Niederspannungsrichtlinie wurden jeweils die aktuellen Ausgaben der betreffenden Grund- und Fachgrundnormen herangezogen.
To meet the requirements, the currently valid versions of the relevant standards have been used.

Diese Erklärung wird verantwortlich vom Hersteller/Importeur
This statement is made from the manufacturer / importer

ELREHA Elektronische Regelungen GmbH
D-68766 Hockenheim
(Name / Anschrift / *name / adress*)

abgegeben durch:
by:

Werner Roemer, Technischer Leiter, *Technical Director*

Hockenheim.....**2.12.2005**.....
Ort/*city* Datum/*date* Unterschrift/*sign*

This manual, which is part of the product, has been set up with care and our best knowledge, but mistakes are still possible. If you have any problems, difficulties or questions please don't hesitate asking our technical support.
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: 26.1.07, tkd/jr	checked: 26.1.07, ek/jk	approved: 26.1.06, mv/sha