Technical Manual
Universal Stage Controller

ELREHA

USP x130

No. 5310902-15/04$_1$ E
from Software Vers. 1.2x

Features Overview

- Stage Controller, configurable for controlling
  Compressors,
  Condenser Fans,
  Brine Chillers or
  Heat Pumps.
- usable both for single- and network operation
- **6** sensor inputs,
  6 relay outputs,
  4 digital inputs (mains voltage)
- Analogue outputs
- Cascadable for up to 12 stages
- Configurable inputs and outputs
- 3 standard cases

Standard Functions

- LC-Display, dot-matrix, plain text
- Operating by 4 keys
- Suitable both for single- and multistage machines
- Analogue outputs deliver actual value images or control deviation (P, PI, PID) for driving machines via frequency inverter
- Monitoring function with inverter bypass contact
- Machines can be operated manually
- Individual forward / backrun delays or
- Autoadaption of delay times
- Digital inputs configurable as machine feedback inputs or as alarm inputs
- 2nd setpoint (night setpoint) controlled by internal real time clock or digital input
- Service functions
- Switch optimization functions, e.g. for noise reduction
- Setpoint shift by temperature sensor or standardized signal
- Suitable for Dual Circuit Condensers

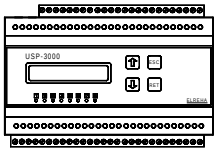
Start-up description from page 25

Please always note Safety Instructions !

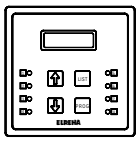
Contents

Type Overview

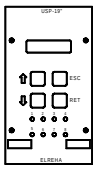
- **USP 3130**
  Standard type
  for 35mm-DIN rail, 230V
- **USP 23130**
  like above, 110V



- **USP 5130**
  Standard type
  for panel mounting (96x96mm)
- **USP 25130**
  like above, 110V



- **USP 19130**
  Standard type for
  19"-subracks, 14 HP
- **USP 29130**
  like above, 110V



All types include the same functionality.

Icons used in this manual

- Common danger note
  If you don't aware this information, material damage or data loss may occur !
- Attention, mains voltage
  If you don't aware this information, you may be harmed with danger of death !
- Important Information

COMMON SAFETY NOTES

Please read before Start-up

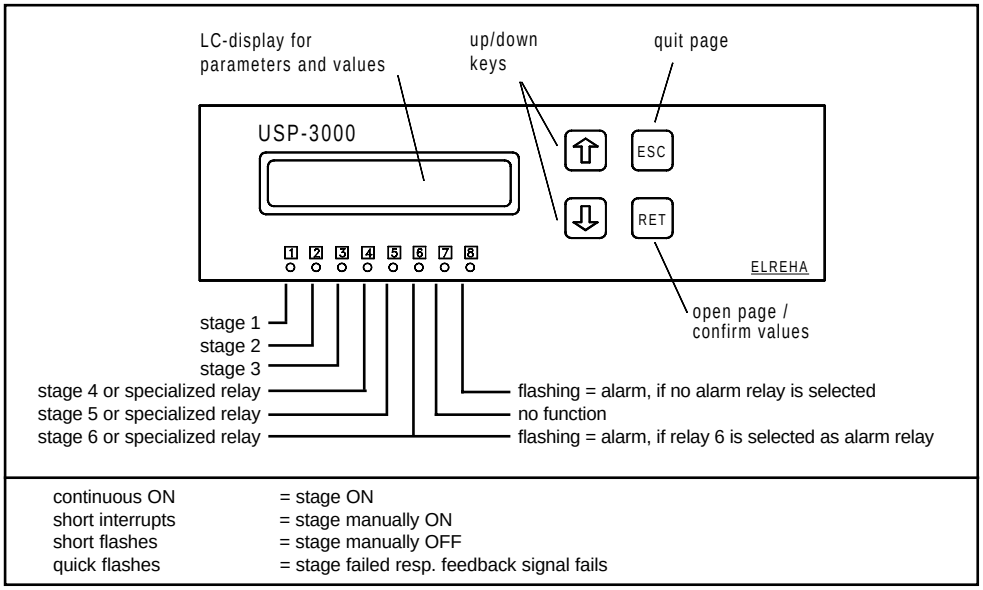
- Electrical installation and putting into service must be done from authorized personnel.
- Read this manual before using the product !
- Keep this manual
- Please note the local safety instructions !
- Before using the controller, please check if the unit fits the application.
- Before applying voltage 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 unit's type label.
- While mounting, make sure that the unit is disconnected from mains voltage

Operating / Operating Elements

Here you see the operating elements of the USP 3130 (number and functions of the elements are identical at other types).

The unit can be operated by 4 keys, all parameters will be displayed in plain text on the backlighted LC-display.

The meaning of the LED indicators depend on the selected configuration.



continuous ON	= stage ON
short interrupts	= stage manually ON
short flashes	= stage manually OFF
quick flashes	= stage failed resp. feedback signal fails

Programming

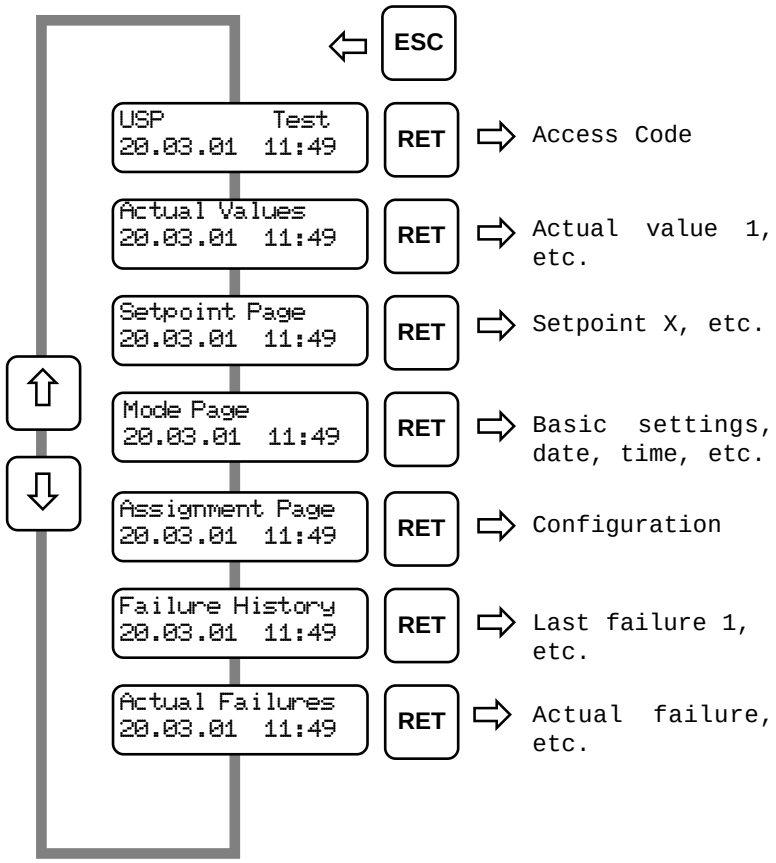
All readable and adjustable values (parameters) are organized on pages. While normal operation or if no key is pushed during 3 minutes, the display shows the following informations:

1st priority:	current failure, if present.
2nd Priorität:	operation state (e.g. 'OFF' or 'manual')
3rd Priorität:	selected 'Permanent Parameter'-Display

Selecting and changing of parameters:

Key	Action
ESC	only if no page name is displayed
⇧ ⇩	select desired page
RET	enter page
⇧ ⇩	select parameters within the page
RET	start programming, parameter name flashes. you will be asked for an access code (see chapter next page).
⇧ ⇩	adjust desired value. If you hold the key, the values run faster.
RET	exit programming mode
ESC	brings you back to the page menu.

Parameter Pages



Access Protection / Access Code

User Levels

To avoid that unauthorized persons are able to change parameters, the parameters are access protected until the correct code is entered. 3 different operator levels exist:

1. **Customer Level**
   On this level, setpoints can be adjusted, but it is not possible to change the configuration of the unit.

2. **Service Level** (change to it with Code 2)
   The serviceman is able to access to more data, necessary for start-up and service.

3. **Configuration Level** (change to it with Code 3)
   All informations and parameters are accessible, the unit can be configured.

Only the accessible parameters will be displayed on the single levels.

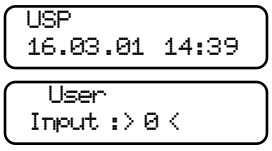
After you have switched on the unit the first time, you are on level 3 (Configuration Level) and all parameters can be adjusted.

Using the Access Protection

The parameter '*User Level*' is factory set to 'no' (Mode Page). Thus you will see all parameters, the same as if the 'Configuration-Level' would be active.
After runup, you protect the controller unit effectively by changing parameter '*User Level*' (Mode Page) to „yes". If you don't touch any key for at least 3 minutes or if you switch off power for a moment, protection will be activated. Thus only the parameters of the **Customer Level** can be displayed. All other parameters are hidden now and can be accessed only by knowing the code.

To return from customer level to the higher levels do as follows:

- Select 'Basic Display',
- Push key 'Ret',
- Enter Code for desired user level.



As long as parameter '*User Level*' is not reset to 'no', the unit switches back to the **customer level** if no key is hit for about 3 minutes.

Codes

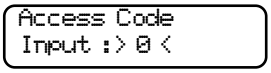
Code 2: ..... Fixed Code, Number is - **88** -
(for entering service level)

Code 3: ..... **month + hour + 20** (for entering config. level)
Example:
(Note: Real-time clock must be set to the correct time and date before.) You want to change a parameter at a day in june at 9:35 in the morning. Identification Code = 6 + 9 +20 = **35**.

Access Code

Almost all parameters, except the setpoints, are protected by a simple password.

If you have to change a parameter and you have pressed the 'Ret'-key, this display appears:



The controller now expects the input of a code-number.

This code-no. (Code 1) is related from the actual time of the day as the sum of the

hour (0 to 23) plus 10

Example:
At 9:35 a.m. the code is 9 + 10 = 19.
At 21:35 (9:35 p.m.) the code would be 21 + 10 = 31.

If you have pressed no key for about 3 minutes, the parameters are locked again automatically.

Parameter Pages

Actual values	**Dis onl**	**Le vel**	**Values Range** [default values]	**Comment**
ActVal.1 [function] [value] e.g Istw.1 Regel 24.1C 5.49bar		1-3	The functions, which can be assigned to this input (on Assignment Page): ---- = input OFF, Display, Control, SetpShft, LimWarm, LimCold, Frezprot, PressoFW, PressoBR.	Actual value of analogue input 1, 4-20mA calibration is possible within +/- 1 bar resp. +/- 10K Pressure will be displayed in [bar], if Control(sensor) is selected but no refrigerant table. Pressure and calculated temperature will be displayed, if Control(sensor) and a refrigerant table is selected. Values in brackets depend on assignment.
ActVal.2 [Funct][value]		1-3		Actual value of analogue input 2, 4-20mA
ActVal.3 [Funct][value]		1-3		Actual value of analogue input 3, 0-10V
ActVal.4 [Funct][value]		1-3		Actual value of analogue input 4, Temperature sensor
ActVal.5 [Funct][value]		1-3		Actual value of analogue input 5, Temperature sensor
ActVal.6 [Funct][value]		1-3		Actual value of analogue input 6, Temperature sensor
State Act Setp	X	1-3	== Neutral, >> Forward, << Backrun (further informations on page 16)	State of the stage controller, actual value and setpoint in °C, if a refrigerant table is selected. Without a selected refrigerant, pressure resp. selected physical unit will be displayed
Control setpoint	X	1-3	the active setpoint at this point in time	flashes if located outside the range limits
Relay runtime 1		2-3	hh:mm:ss (max. > 100 years !) This counters can be reset	Run-time counter of relay 1
Relay runtime 2		2-3		Run-time counter of relay 2
Relay runtime 3		2-3		Run-time counter of relay 3
Relay runtime 4		2-3		Run-time counter of relay 4
Relay runtime 5		2-3		Run-time counter of relay 5
Relay runtime 6		2-3		Run-time counter of relay 6
Relay runtime 7		2-3		Run-time counter of relay 7
Relay runtime 8		2-3		Run-time counter of relay 8
Relay runtime 9		2-3		Run-time counter of relay 9
Relay runtime 10		2-3		Run-time counter of relay 10
Relay runtime 11		2-3		Run-time counter of relay 11
Relay runtime 12		2-3		Run-time counter of relay 12
Time to Service		3	max 10000h, [oFF]	Number of hours up to next service check
Day/Night operat.	X	1-3	day or night	Controller works with day or night-settings
State of LoadLim	X	1-3		Number of enabled motors if peak load limitation is active
Analog value	X	1-3		in % of the preset range
Optoc.-states Optoc.-states 1000 ---- OC1-OC4 OC5-OC8	X	1-3	1 = mains voltage present, 0 = no voltage	States of the digital inputs 1-4 at this unit and the digital inputs 5-8 at the slave unit.
Relay states Relay states 111100 ------ Rel.1-Rel.6 Rel.7-Rel.12	X	1-3	1 = relay activated, 0 = relay de-activated	States of the relay outputs 1-6 at this unit and relay outputs 7-12 at the slave unit.
Stage states Stage states EEEE	X	1-3	**.** = stage OFF, automatic operation **e** = stage ON, automatic operation, but feedback signal not present **E** = stage ON, automatic operation, **1** = switched ON manually, **0** = switched OFF manually **<** = manually OFF demanded **>** = manually ON demanded **S** = fault, no feedback signal	States of the single stages

Setpoint Page	**Values range** [default values]	**Comment**	**Your Values**
Setpoint	Values will be displayed with the physical unit selected for the single sensor input. If the value is [bar] and a refrigerant table is selected, pressure and calculated temperature will be displayed at the same time.	Control setpoint if used as a compressor control, setpoint for machine 1 in other applications	
Setpoint 2	The values in brackets are factory set. Please note that some parameters may get different values by changing 'Load Default', **see page 11.**	Control setpoint for machine 2	
Setpoint 3		Control setpoint for machine 3	
Setpoint 4		Control setpoint for machine 4	
Setpoint 5		Control setpoint for machine 5	
Setpoint 6	pressure range -1.00 to +99.99 bar	Control setpoint for machine 6	
Setpoint 7	temperature range -100 to +100°C	Control setpoint for machine 7	
Setpoint 8	[-10.0°C / 1.01 bar]	Control setpoint for machine 8	
Setpoint 9	Setpoints 2-12 are used for condenser fan-,	Control setpoint for machine 9	
Setpoint 10	chiller and heat pump control	Control setpoint for machine 10	
Setpoint 11	[0,0°C / 1.93 bar]	Control setpoint for machine 11	
Setpoint 12		Control setpoint for machine 12	
Control LimLow	[-100,0°C / -1.00 bar]	The lowest usable control setpoint	
Control LimHigh	[+100,0°C / +38.70 bar]	The highest usable control setpoint. Setpoints will be limited to these values automatically.	
Setpoint offset	[0,0 K]	This is the value, the setpoint is currently shifted by night operation and/or external control signal	
Night shift	+/- 50K [0,0 K]	Amount, all setpoints will be shifted while night operation.	
Contr. hysteresis	0,1...50K [2,0 K]	Neutral zone if used as compressor control, hysteresis of the single stages at other apps.	
FastBR lower val	[-100,0°C / -1.00 bar]	Actual value **below** this limit => Fast backrun / no alarm message	
FastBR upper val	[+100,0°C / +38.70 bar]	Actual value **above** this limit => Fast backrun / no alarm message	
Alarm limit low	[-100,0°C / -1.00 bar]	**Below** this limit => alarm message	
Alarm limit high	[+100,0°C / +38.70 bar]	**Above** this limit => alarm message	
TempLimit cold	[+4,0°C]	If the limitation sensor **cold** falls short of this value => forced backrun with time delays, no alarm messages	
TempLimit warm	[+65,0°C]	If the limitation sensor **warm** exceeds this value => forced backrun with time delays, no alarm messages	
Temp Limit hyst.	0,1...50,0 K [1,0 K]	Hysteresis of the limitation setpoints	
Freezprot setp	[2.0°C]	Freeze protection sensor **below** this setp. => Fast backrun / no alarm message	
Freezprot hyst	0,1...50,0 K [1,0 K]	Hysteresis of the freeze protection setpoint	
Ext.SetpOffs LL	-50,0...+50,0 K [0,0 K]	Offset of the control setpoint, if the value measured by 'SetpShft'-sensor is less or equal to 'extShift at LL'	
Ext.SetpOffs UL	-50,0...+50,0 K [0,0 K]	Offset of the control setpoint, if the value measured by 'SetpShft'-sensor is higher or equal to 'extShift at UL'	
extShift at LL	[15,0°C] at sensor input 'SetpShft'	Lower range boundary for setpoint shift	
extShift at UL	[30,0°C] at sensor input 'SetpShft'	Upper range boundary for setpoint shift	

Setpoint Page	**Values range** [default values]	**Comment**	**Your Values**
ForwardDelay S1	00:01...30:00 mm:ss [01:00]	Forward delay for the 1st stage	
BackrunDelay S1	00:01...30:00 mm:ss [00:05]	Backrun delay for the 1st stage	
ForwDelay S2-12	00:01...30:00 mm:ss [01:00] not visible if 'delay mode' = individual	Forward delay for stages 2...12	
BckrDelay S2-12	[00:05]	Backrun delay for stages 2...12	
ForwardDelay S 2	00:01...30:00 mm:ss [01:00]	Forward delay Stage 2	
BackrunDelay S 2	00:01...30:00 mm:ss [00:05]	Backrun delay Stage 2	
ForwardDelay S 3	not visible if 'delay mode' =	Forward delay Stage 3	
BackrunDelay S 3	common or autoadaptive	Backrun delay Stage 3	
ForwardDelay S 4		Forward delay Stage 4	
BackrunDelay S 4		Backrun delay Stage 4	
ForwardDelay S 5		Forward delay Stage 5	
BackrunDelay S 5		Backrun delay Stage 5	
ForwardDelay S 6		Forward delay Stage 6	
BackrunDelay S 6		Backrun delay Stage 6	
ForwardDelay S 7		Forward delay Stage 7	
BackrunDelay S 7		Backrun delay Stage 7	
ForwardDelay S 8		Forward delay Stage 8	
BackrunDelay S 8		Backrun delay Stage 8	
BackrunDelay S 9		Forward delay Stage 9	
BackrunDelay S 9		Backrun delay Stage 9	
ForwardDelay S 10		Forward delay Stage 10	
BackrunDelay S 10		Backrun delay Stage 10	
ForwardDelay S 11		Forward delay Stage 11	
BackrunDelay S 11		Backrun delay Stage 11	
ForwardDelay S 12		Forward delay Stage 12	
BackrunDelay S 12		Backrun delay Stage 12	
PID IntegralTime	OFF, 00:00 to 10:00 min:sec [10 sec.]		
PID Attack Time	OFF, 00:00 to 00:10 min:sec [OFF]		
PID Delay	OFF, 0,1 to 10 sec. [OFF]		

- Parameters which are marked with "**Dis onl**" are for information only and cannot be changed.
- Parameters which are not suggestive for a configuration will not be displayed.
- The numbers in column "**Code**" describe the user levels on which this parameters are visible.

Mode Page	**Values range** [default values]	**Comment**	**Your Values**
Load default		In controller units with newer software you will find this parameter at the top position of the 'Assignment Page' resp. as a part of the start-up mode	
Operation mode	[Automatic], Manual Backrun, Manual Neutral, Manual Forward	For service purposes: affects like a M/0/A-switch for the control sequence	
Manual ON M 1	[Automatic], ON, OFF	M/0/A-switch for machine 1	
Manual ON M 2		M/0/A-switch for machine 2	
Manual ON M 3	assigned LED : flashes 10:1 on/off if stage	M/0/A-switch for machine 3	
Manual ON M 4	is switched manually ON	M/0/A-switch for machine 4	
Manual ON M 5	assigned LED: flashes 1:10 on/off if stage	M/0/A-switch for machine 5	
Manual ON M 6	is switched manually OFF	M/0/A-switch for machine 6	
Manual ON M 7		M/0/A-switch for machine 7 (slave contr. unit)	
Manual ON M 8		M/0/A-switch for machine 8 (slave contr. unit)	
Manual ON M 9		M/0/A-switch for machine 9 (slave contr. unit)	
Manual ON M 10		M/0/A-switch for machine 10 (slave contr. unit)	
Manual ON M 11		M/0/A-switch for machine 11 (slave contr. unit)	
Manual ON M 12		M/0/A-switch for machine 12 (slave contr. unit)	
Load Limitation 1	1-12 motor(s) [0 motors]	# of motors/machines which are able to run while digital input 'load limitation 1' is active	
Load Limitation 2	[2 motors]	# of motors/machines which are able to run while digital input 'load limitation 2' is active	
Hysteresis Pos.	[symmetrical], above setpoint, below setp.	valif for the hysteresis values of all stages	
Application	[refrigeration], heating	refrigeration = forward if actual value rises heating = forward if actual value falls	
Setpoint Mode	[common], coupled, absolute	'common' used foor compressor control. (only setp.1 visible). If set to 'coupled' or 'absolute' each stage has its indiv. setpoint	
Delay Mode	common, individual, [autoadaptive]	common = Fw/Br-delays will be divided in 'delay for the 1st stage' and 'delay for all other stages. Individual = each stage has its own delay times. autoadaptive = like 'common', but the unit calculates the delay times itself.	
DelayAdaptFactor	1...8, [2]	Influence of the autoadaption	
Sequence Change	oFF, [Compr.Runtime], Compr.OFF Time, Compr.Runtime -M1, Compr.OFFtime-M1	"oFF" = Stages switch in numerical order "...-M1" = Machine 1 switches independent from the sequence change function.	
Switch Optimizat	[oFF], Switch frequency, Load equalize., BRun Power Fans	see text	
Forced Feedback	yes, [no]	'yes' = if a machine delivers no feedback signal, all following machines will be disabled.	
fluid flow reset	yes, [no]		
Contin. Run max.	[24:00 hh:mm], oFF	max. continuous runtime of the machines	
Idle time min	max. 30:00 mm:ss [00:30]	minimum idle time for the machines	
Refrigerant	— = no table (pressure display only), NH3, [R134a], R22, R23, R404A (HP62/FX70), R507(AZ50), R402A(HP80), R402B(HP81), R407C/suct., R407C/cond., R123, R290, CO2	The refrigerant table which is used for calculating temperature values.	

Mode Page	**Values range** [default values]	**Comment**	**Your Values**
4/20mA LowVal 1	-10,00...+70,00 [-1.00 bar]	Measured value with 4 mA into input 1	
4/20mA HighVal 1	-10,00...+70,00 [9.00 bar]	Measured value with 20 mA into input 1	
4/20mA Unit 1	bar, °C, %, V, mA [bar]	physical dimension for input 1	
4/20mA LowVal 2	-10,00...+70,00 [-1.00 bar]	Measured value with 4 mA into input 2	
4/20mA HighVal 2	-10,00...+70,00 [9.00 bar]	Measured value with 20 mA into input 2	
4/20mA Unit 2	bar, °C, %, V, mA [bar]	physical dimension for input 2	
0/10V LowVal	-10,00...+70,00 [-1.00 bar]	Measured value with 0V at input 3	
0/10V HighVal	-10,00...+70,00 [9.00 bar]	Measured value with 10V at input 3	
0/10V Unit	[bar], °C, %, V, mA	physical dimension for input 3	
AnalogOutp.LowVal	[-1.0°C / 1.83 bar]	With this pressure- or temperature value at the control sensor, the analogue output delivers 0/4mA resp. 0/2V (0% output)	
AnalogOutp.HghVal	[1.0°C / 2.04 bar]	With this pressure- or temperature value at the control sensor, the analogue output delivers 20mA resp. 10V (100% output)	
Delay Optocpler 1	00:01...10:00 mm:ss [00:01]	Delay time for digital input (optocoupler) 1	
Delay Optocpler 2		Delay time for digital input (optocoupler) 2	
Delay Optocpler 3		Delay time for digital input (optocoupler) 3	
Delay Optocpler 4		Delay time for digital input (optocoupler) 4	
Delay Optocpler 5	Optocpler 5-8 are the inputs at the slave unit	Delay time for digital input (optocoupler) 5	
Delay Optocpler 6		Delay time for digital input (optocoupler) 6	
Delay Optocpler 7		Delay time for digital input (optocoupler) 7	
Delay Optocpler 8		Delay time for digital input (optocoupler) 8	
Night shift ON	[oFF], 00:00...23:59	Startup time for night operation mode	
Night shift OFF	[oFF], 00:00...23:59	Point in time the night operat. mode ends	
ServiceMess at	[8 h], 0h...23h	Point in time the unit sends a message	
Calibration 1	+/- 1,00 [bar]	Correction factor for Input 1: 4/20mA,	
Calibration 2	only possible, if this inputs are assigned.	Correction factor for Input 2: 4/20mA	
Calibration 3	If not, the corresponding display shows [oFF]	Correction factor for Input 3: 0/10V	
Calibration 4	+/- 10,00 [°C]	Correction factor for Input 4, Temp.sensor	
Calibration 5		Correction factor for Input 5, Temp.sensor	
Calibration 6		Correction factor for Input 6, Temp.sensor	
Sensor Selection	TF 201 (PTC), [TF 501] (Pt1000)	The type of temperature sensors connected to inputs 4-6	
Unit/Pos. Name	any text [USP]	Name of the unit which also appears at the superior system	
User Level	yes, [no]	yes = access protection after run-up	
Software Version	e.g. USP 1.02	Current software version	
Summer/Winter sw.	[EU from 96], no	Standards for the summer/winter-switch no = switched oFF	
current Time			
current Date			
Sprache/language	[deutsch], english, francais, netherlands	The display language	
Baudrate	1200...[9600, N, 8,1]	Data transmission speed	
Adress in netwk	0...[78]	Adress of the unit in a network	

Assignment Page	**Values range** [default values]	**Comment**	**Your Values**
start-up mode	[OFF], ON,	This mode guides you through a standard start-up procedure quickly. 'Fine-tuning' must be done later. - **Additional safety query** -	
Operation Mode	[Stand alone], Master, Slave	Master = controls a 2nd unit, Slave = unit will be controlled by a master	
Alarm Relay	[yes], no	yes = relay #6 of the master is alarm relay	
CompMalfct Relay	yes, [no]	yes = a relay of the master unit is configured as malfunction relay	
Bypass Relay (Speed Relay)	yes, [no]	yes = a relay of the master unit is config. for to bypass a frequency inverter	
Function Input 1	---- = oFF, Control, Display,	The function of the 4-20mA-input 1	
Function Input 2	SetpShft, LimWarm, LimCold,Frezprot,	The function of the 4-20mA-input 2	
Function Input 3	PressoFW, PressoBR,	The function of the 0-10V-input 3	
Function Input 4		The function of temp.sensor input 4	
Function Input 5		The function of temp.sensor input 5	
Function Input 6		The function of temp.sensor input 6	
No. Stages M 1	0-12, [1]	Number of stages of the 1st machine	
No. Stages M 2	[1]	Number of stages of machine 2	
No. Stages M 3	[1]	Number of stages of machine 3	
No. Stages M 4	[1]	Number of stages of machine 4	
No. Stages M 5	[0]	Number of stages of machine 5	
No. Stages M 6	0-12, [0]	Number of stages of machine 6	
No. Stages M 7	[0]	Number of stages of machine 7	
No. Stages M 8	[0]	Number of stages of machine 8	
No. Stages M 9	[0]	Number of stages of machine 9	
No. Stages M 10	[0]	Number of stages of machine 10	
No. Stages M 11	[0]	Number of stages of machine 11	
No. Stages M 12	[0]	Number of stages of machine 12	
Inverted Stages	0-6 [0]	# of relays which drive machines with its N/O-contact. 1=relay 1, 2=relay 1+2,...	
Function Optoc.1	---- = oFF, Load Limitat. 1,	[LIM1] Function of digital input 1	
Function Optoc.2	Load Limitat. 2, night op.actlow,	[LIM2] Function of digital input 2	
Function Optoc.3	forced backr Low, Low pressure,	Function of digital input 3	
Function Optoc.4	High pressure, Flow switch,	Function of digital input 4	
Function Optoc.5	Feedback M1 - Feedback M8, Freeze	Function of digital input 5	
Function Optoc.6	Protection, night op.actHgh,	Function of digital input 6	
Function Optoc.7	forced backr Hgh	Function of digital input 7	
Function Optoc.8	(Optocouplers 5-8 => located at slave unit)	Function of digital input 8	
Analog Function	[0V / 0mA], 2V / 4mA, 10V / 20 mA, ActualVal 0-10V, ActualVal 4-20 mA, PID-T1 0-10V, PID-T1 4-20mA, PID-T1 10-0V, PID-T1 20-4mA,	Fixed output signals respective control signals of the analogue output	
012: LIM1 LIM2 034: Nght PrLo	Lim1, Lim2, Nght, FOBR, PrLo, PrHi, FlwM, ExFr, Fed1 - Fed8	Task overview of digital inputs 1-2 and 3-4	
056: --- --- 078: --- ---		Task overview of digital inputs 5-6 and 7-8 (slave unit)	
R13: 1.1 2.1 3.1 R46: 4.1 5.1 Alm	Will be displayed in format **X.Y**. **X** = Machine, **Y** = Stage of this machine. Example: 1.2 = Machine 1, 2nd stage. Alm = alarm relay, Mal = malfunction relay, Bri= Bypass relay, - - - = switched oFF	Task overview of relays 1-3 and 4-6	
R79: --- --- --- R02: --- --- ---		Task overview of relays 7-9 and 10-12 (slave unit)	

Assignment and Configuration

In USP-Stage Controllers, the inputs are not assigned to fixed tasks. Because the unit contains more functions than available inputs, this inputs will be assigned to the needed functions while start-up.
This "**free ressource assignment**" allows to adapt the controller unit to more exceptional applications. The assignment of the functions is defined by the parameters on the 'Assignment Page'.
The assignment can be made via keypad or via data connection from a PC.

Analog-(Sensor-)-Inputs

Each sensor can fulfill each function, even thoug the electrical characteristics of the inputs are fixed:

Input 1 : 4-20mA delivered from pressure transmitters or from foreign products.
(Parameter "*ActVal.1*", Actual Values Page)
Input 2 : 4-20mA delivered from pressure transmitters or from foreign products.
(Parameter "*ActVal.2*", Actual Values Page)
Input 3 : 0-10V delivered from pressure transmitters or from foreign products.
(Parameter "*ActVal.3*", Actual Values Page)
Input 4 : Temperature sensor TF 201 or TF 501
(Parameter "*ActVal.4*", Actual Values Page)
Input 5 : Temperature sensor TF 201 or TF 501
(Parameter "*ActVal.5*", Actual Values Page)
Input 6 : Temperature sensor TF 201 or TF 501
(Parameter "*ActVal.6*", Actual Values Page)

Each assignment can be made individually, but it's helpful if you initiate a 'Guided Start-up' and select your application by parameter "*Load default*". With this, the most important parameters and inputs will be pre-configured at the same time:

Parameters and values changed by "*Load default*".

	Compound control	Condenser-fan-control	Chiller HVAC	Heat Pump control
Function Inp.1	Control	Control	- - -	- - -
Function Inp.2	- - -	- - -	- - -	- - -
Function Inp.3	- - -	- - -	- - -	- - -
Function Inp.4	- - -	- - -	Control	Control
Function Inp.5	- - -	- - -	LimCold	LimWarm
Function Inp.6	- - -	- - -	FrezProt	- - -
Setpoint Mode	common	absolute	coupled	coupled
Refrigerant	R134a	R134a	---	---
Setpoint 1	-10,0°C	30,0°C	10,0°C	30,0°C
Setpoint 2	---	35,0°C	2,0 K	-5,0 K
Setpoint 3	---	40,0°C	2,0 K	-5,0 K
Setpoint 4	---	45,0°C	2,0 K	-5,0 K
Setpoint 5	---	50,0°C	2,0 K	-5,0 K
Application	refrigeration	refrigeration	refrigeration	heating
4/20mA LowVal1	-1.00bar	0 bar	---	---
4/20mA HighVal1	+9.00 bar	25 bar	---	---

Optocoupler Inputs (Digital inputs)

Each digital input can fulfill each available function. This function then defines the characteristic of the input.

Assignment - Overview

The last 4 parameters on the assignment page show the functions which are currently assigned to the relays and digital inputs.

Relays

The output relays will be assigned in logical order as long as no relay is reserved for special tasks.

Examples:

4 single machines:
Relay 1 = Machine 1
Relay 2 = Machine 2
Relay 3 = Machine 3
Relay 4 = Machine 4

2x 3-stage machines:
Relay 1 = Machine 1
Relay 2 = Machine 1, Stage 2
Relay 3 = Machine 1, Stage 3
Relay 4 = Machine 2
Relay 5 = Machine 2, Stage 2
Relay 6 = Machine 2, Stage 3

3x 3-stage machines:
Relay 1 = Machine 1
Relay 2 = Machine 1, Stage 2
Relay 3 = Machine 1, Stage 3
Relay 4 = Machine 2
Relay 5 = Machine 2, Stage 2
Relay 6 = Machine 2, Stage 3
Relay 1 (slave unit) = Machine 3
Relay 2 (slave unit) = Machine 3, Stage 2
Relay 3 (slave unit) = Machine 3, Stage 3

If relays are reserved for special tasks, the assigment of the relays differ. Example:

2x 3-stage machines + ComprMalfunction Relay + Alarm Relay

Relay 1 = Machine 1
Relay 2 = Machine 1, Stage 2
Relay 3 = Machine 1, Stage 3
Relay 4 = Machine 2
Relay 5 = ComprMalfunction Relay
Relay 6 = Alarm Relay
Relay 1 (slave unit) = Machine 2, Stage 2
Relay 2 (slave unit) = Machine 2, Stage 3

Specialized Relays

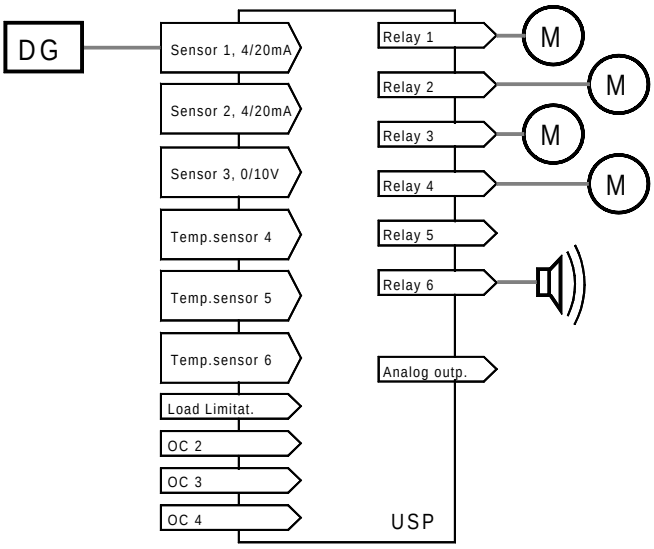
The relays 3-6 are able to take over special tasks. They can work as alarm relay, bypass relay for bridging frequency inverters or as malfunction relay. Specialized relays are exclusively available at the master unit. The assignment occurs in a unique order:

Function	Relay 6	Relay 5	Relay 4
Alarm rel. only	Alarm	--	--
Bypass relay only	Bypass	--	--
Malfunction rel. only	CompMalfc	--	--
Alarm + Malfunct.	Alarm	CompMalfc	--
Alarm + Bypass	Alarm	Bypass	--
Alarm + Malfct. + Bypass	Alarm	CompMalfc	Bypass
Malfunct. + Bypass	CompMalfc	Bypass	--

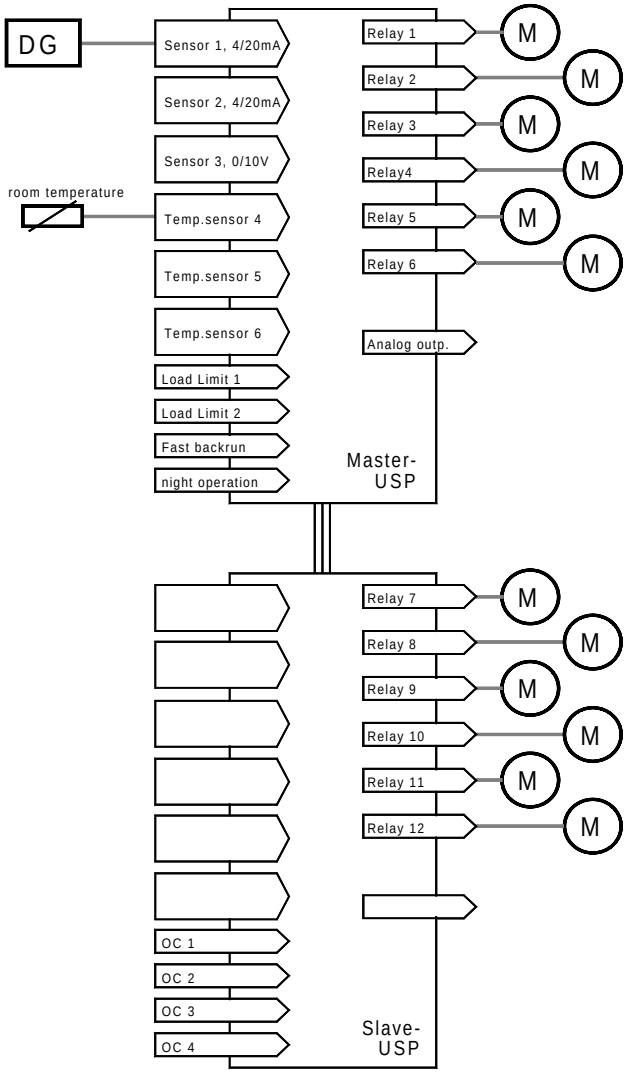
Parameters

Parameters of functions which are not assigned will not be displayed to improve the survey.

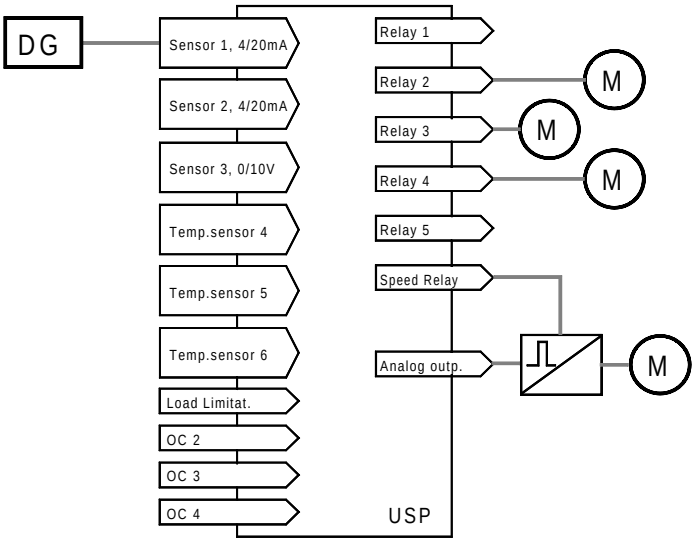
Application Examples (simplified figures)



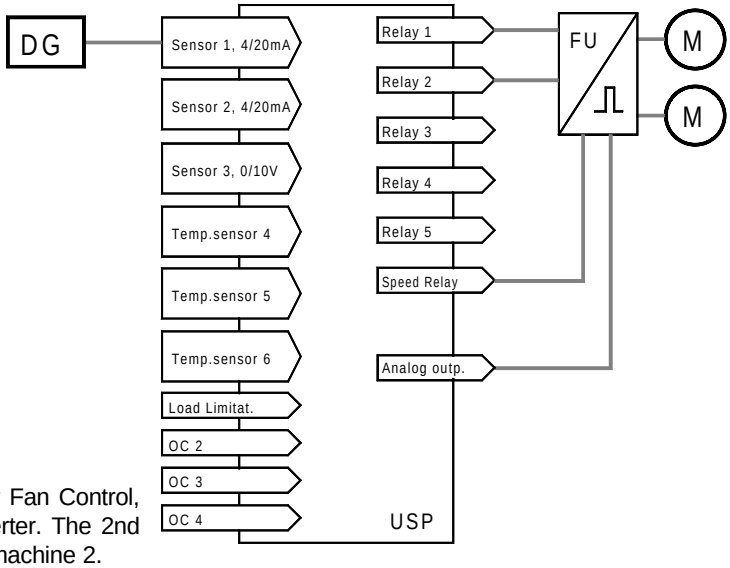
Compressor-Compound Control or Condenser Fan Control, 4 single machines, pressure controlled



Compressor-Compound Control or Condenser Fan Control, 12 machines. The setpoint will be shifted by a room temperature. There are 2 controller units in master/slave mode necessary

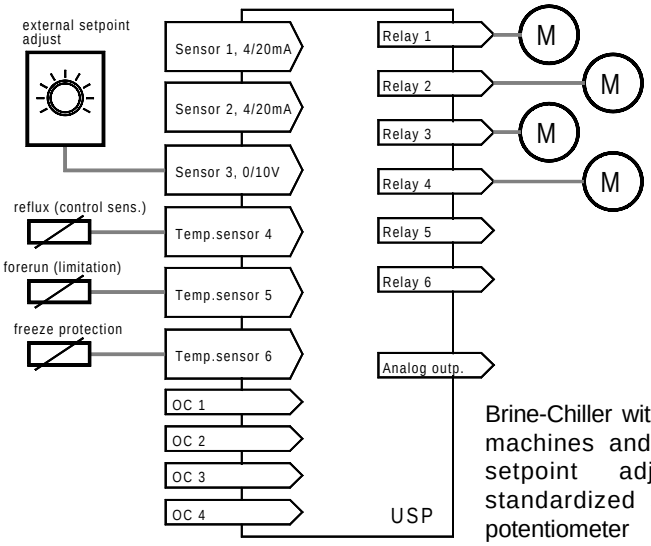


Compressor-Compound Control or Condenser Fan Control, 4 machines, the 1st machine will be supplied by a frequency inverter. A bypass relay will bridge the inverter in case of malfunction.

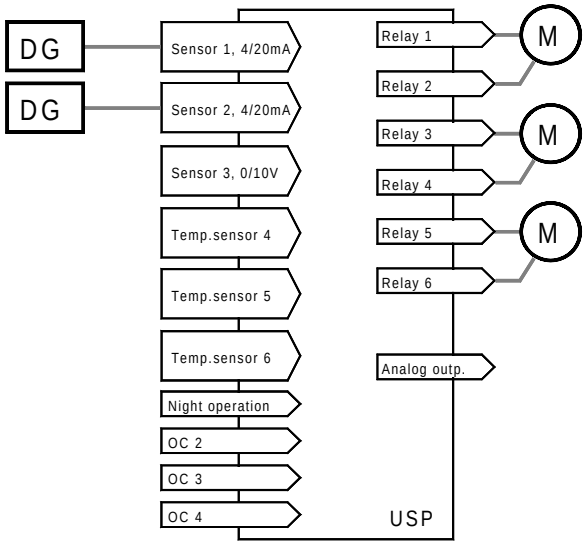


Compressor-Compound Control or Condenser Fan Control, both motors are provided by a frequency inverter. The 2nd motor will be enabled by the relay contact for machine 2.
A bypass relay will bridge the inverter in case of malfunction.

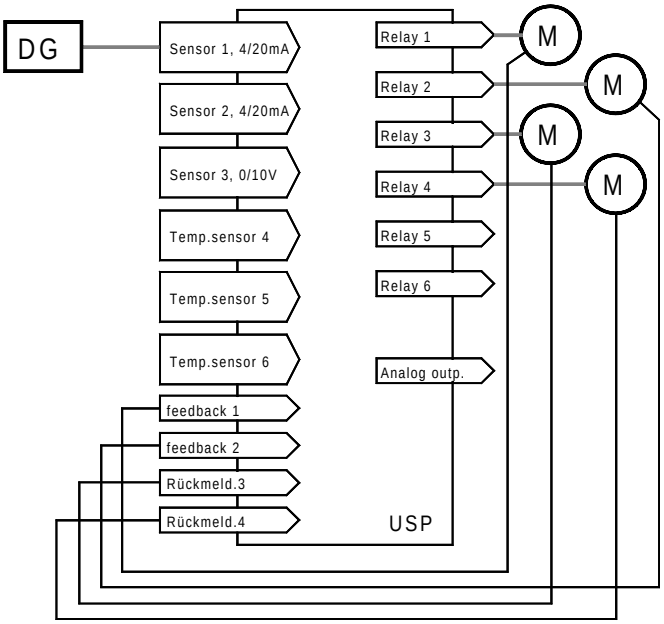
Application Examples (simplified figures)



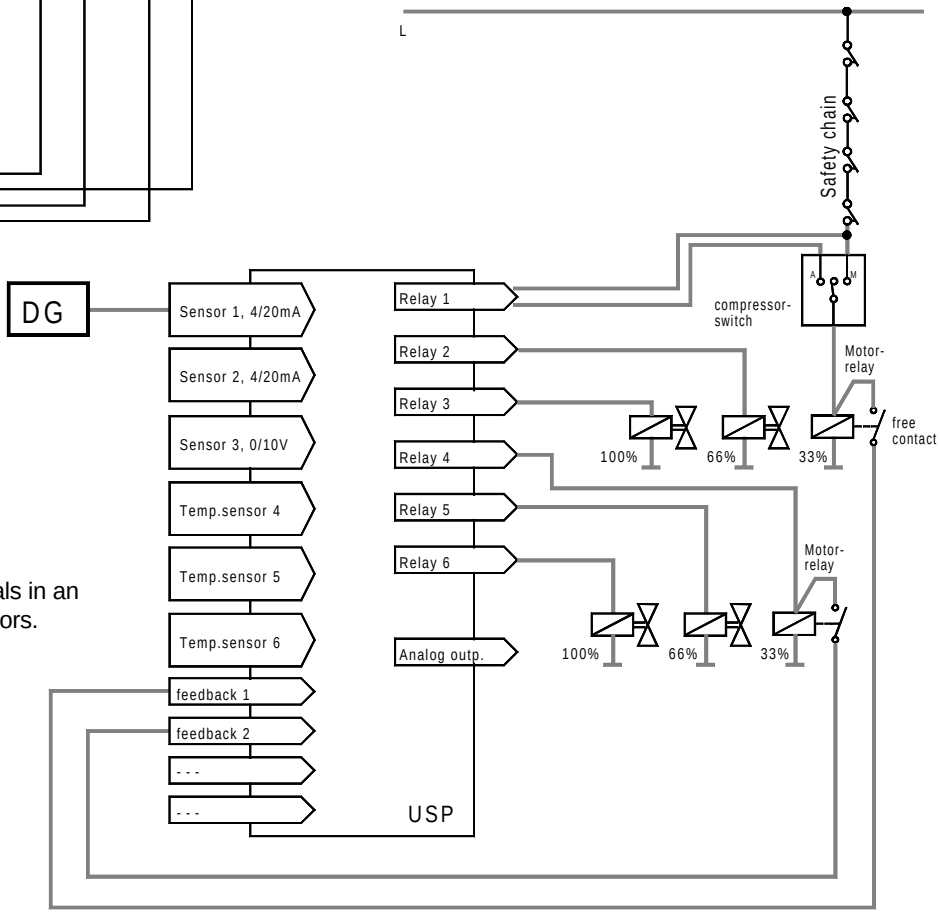
Brine-Chiller with 4 single machines and external setpoint adjust by standardized signal or potentiometer



Condenser fan control with 3 dual stage fans in a dual-circuit condenser.
The pressure transmitter with the currently highest value will be used for control (CSD-Function).



Compressor-Compound Control or Condenser Fan Control.
4 single, pressure controlled machines with feedback signals.



Example for generating feedback signals in an application with two 3-stage compressors.

Failure Messages / Failure Memory

All failures will be memorized with date and time of their appearance. To display this messages, 2 pages exist:

Actual Failures Page

The "*Actual Failures*"-page contains all current failures in a short form. To make more than one current failure visible, use the 'up/ down'-keys. If a sensor is short or broken, this message also appear in the actual value display.

Historic Failures

On the "*Hist.Failures*"-page you will always find **the last 15 failures** memorized with date and time of their appearance.

Failure Codes	
----	no failure
Init	first initiation of the controller or data lost
Hard	hardware failure
On	mains supply switched on
Off	mains supply cut off
Serv	service interval increased
MaSl	no master/slave communication
Fbk1-Fbk8	feedback signals (1-8) not present
SBr1-SBr6	sensor input (1-6) broken
Ssh1-Ssh6	sensor input (1-6) short circuit

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

Brid	frequency inverter bridged by bypass relay
FoBR	forced backrun by a digital input assigned to this function
PrLo	quick backrun by a digital input assigned to the function 'suction pressure'
PrHi	quick backrun by a digital input assigned to the function 'overpressure'
FlwM	quick backrun by a digital input assigned to the function 'flow monitor'
ExFr	quick backrun by a digital input assigned to the function 'Freeze Protection'
AlmL	Alarm: control sensor too cold resp. pressure too low
AlmH	Alarm: control sensor too warm resp. pressure too high
Frez	freeze protection sensor too cold
Aloc	Assignment failure, e.g. if more stages are programmed than available. Example: 1 unit, alarm relay = yes and 6 stages programmed

The failure messages will be listed by their priorities. The assignment failure has the highest priority, because this involves an elementary setting.

Service Functions

Service Interval / Service Message

This is a function for a service contractor which wants to be reminded for the next service survey.
Adjust the hours up to the next service survey at parameter "*Time to Service*" (Actual Values Page). This time will be decreased always if a machine runs. If it is run down to '0', a failure message will be generated a the point in time set by "*ServiceMess at*" (Mode Page). This message is present for 1 hour.
After that, the timer will be increased to 250 hours. After it is run down, the failure message will be generated again.
This will be repeated until the timer is reset by the serviceman after the service survey.

Runtime Counters for machines

see page 16.

Common Functions

Display language

The language used in the display can be changed to german, english, french and dutch by parameter "*Sprache/Language*" (Mode Page).

Real Time Clock

The built-in clock of the controller is equipped with a battery buffer, which allows the clock to work for 3 years minimum after mains voltage is switched off. Date and time can be set on the "Mode Page". An automatic summer/winter-switch "*Summer/ Winter sw.*" (Mode Page) considers the european regulations from 1996, but can also be switched off.

Unit Text, Unit Name

The controller unit can be equipped with a name consisting of 16 characters max, which allows a clear identification of the unit at superior systems (e.g. "freeze unit").
This name appears on the PC screen or the display of the SMZ Alarm Central.

How to change the text:

- Select **"Unit/Pos. name"** (Mode Page)

- **"Ret"** Start programming, 1. character position flashes.
- "⇧ ⇩" select desired character
- **"Ret"** select next character position
- "⇧ ⇩" select desired character and so on...
- **"Ret"** after the last character position, the entry of text is finished

If the unit will be configured by "*Load default*", at "*Unit/Pos.Name*" the matching texts appear.

Analog Inputs

Analog Inputs
The controller owns 6 analogue inputs with fixed electrical characteristics but assignable functions. The parameters "*ActVal. x*" (Actual Values Page, x = number of the input) show the measured value of the input. If little deviations appear, the values can be calibrated here. The parameters "*Calibration 1-6*" (Mode Page) show the corrected offset.
Analog inputs which are not assigned will not displayed.

Inputs for Standardized Signals
The inputs 1-3 handle standardized signals of transducers/transmitters (e.g. pressure transmitters) or other sources. The parameters "*.....LowVal x*" describe the pressure value at 4mA resp. 0V input signal and "*.....HighVal x*" decribes the value at 20mA resp. 10V input signal (Mode Page).

Example:
A pressure transmitter which delivers 4mA at -1 bar and 20mA at +9 bar is connected to input 1.
"*4/20mA LowVal 1*" = '-1,0'
"*4/20mA HIghVal 1*" = '9,0'

For each of this inputs you can set the unit of measurement for the displayed valueby parameter "*.....Unit x*" (Mode Page), the measurement unit [bar] is factory set.
If a refrigerant table is selected, pressure and calculated temperature will displayed at the same time.

Pressure Priority Function (CSD-Function)
If the controller unit has to control dual circuit condensers, even 2 pressure transmitters are necessary. In this case the inputs 1 and 2 will be provided by **2 equal** 4/20mA pressure transmitters. Both inputs must get the functions "*Control*".
In this case the pressure transmitter with the highest measured value takes effect on fan control.

Temperature Sensor Inputs
The inputs 4-6 handle temperature sensors. Always the same sort of sensors must be used, a mixed connection is impossible. The types
TF 201 (PTC) or
TF 501 (Pt1000)
can be used, select type at "*Sensor Selection*" (Mode Page).

Neutral Zone Pressostat (Pressure Switch)
It is possible to assign the functions of a pressostat to each input.
Normally, you use two of the temperature sensor inputs to configure them with the functions "*PressoFW*" and "*PressoBR*" (see examples at appendix which uses the inputs 5 and 6).

Refrigerant Tables

If the controller unit will be used for refrigeration techniques, one work with temperature values. For this purpose the USP contains a number of the most important refrigerant tables (see listing on page 8).

If you select a refrigerant table (parameter "*Refrigerant*", Mode Page) the controller unit calculates and displays the temperature value depending on measured pressure.

In this case the controller unit uses the temperature values for control purposes.

If a refrigerant table is selected, the display shows pressure and temperature values at the same time. While adjusting a setpoint, pressure- and temperature value changes at the same time.

Digital inputs (Optocoupler Inputs)

The digital inputs of the USP are suitable for mains voltage. Because optocouplers separate the electronic circuits from mains voltage, the inputs are also called Optocoupler Inputs.
Each digital input is able to handle various tasks. If an input is not needed, it must be switched off.
Each input owns an individual time delay which determines the reaction time on a connected signal ("*Delay Optocpler x*", Mode Page).
This delay is suggestive if disturbances from external devices like flow monitors or freeze protectors must be detected.
If the input reacts on voltage (active high) or no voltage (active low) depends on the assigned function.

The Functions

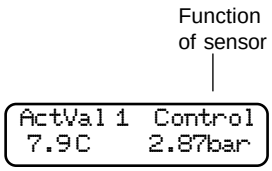
- "*Load Limitation x*",
  mains voltage = Limitation is active, stages will switch off in 1 second steps. (see chapter 'Stage Controller')
- "*Night op.actLow*" (see 'Setpoints')
  0V = night operation mode on
  mains voltage = normal operation
- "*Night op.actHgh*" (see 'Setpoints')
  mains voltage = night operation mode on
  0V = normal operation
- "*Forced backr low*" (see 'Setpoints')
  mains voltage = normal operation
  0V = a backrun of the stage controller is forced, all stages switch off with the set backrun delays.
- "*Forced backr Hgh*" (see 'Setpoints')
  0V = normal operation
  mains voltage = a backrun of the stage controller is forced, all stages switch off with the set backrun delays.
- "*Low Pressure*"
  mains voltage = normal operation
  0V = alarm, stages will switch off in 1 second steps.
- "*High Pressure*"
  mains voltage = normal operation
  0V = alarm, stages will switch off in 1 second steps.
- "*FreezeProtection*"
  mains voltage = normal operation
  0V = alarm, stages will switch off in 1 second steps.
- "*Feedback M x*"
  0V = feedback signal not present
  mains voltage = feedback signal from machine x
  (see 'Stage Controller').
- "*Flow switch*"
  mains voltage = normal operation
  0V = alarm, stages will switch off in 1 second steps.

Will be used only if machine 1 is a pump (excluded from sequencing by "*Sequence change*"= ...'- M1').
If the pump is switched off, no machine stage is able to switch on, because there is now fluid flow and so the flow switch remains initiated.
To correct that, use parameter "*fluid flow reset*" (Mode Page). 'ON' effects, that a machine resp. the pump will switch ON after the 'Minimum Idle Time' has been run down.
At the same time, the USP monitors the signal of the input 'flow switch'. If the signal of the flow switch is still available after the delay time of the input 'flow switch' has been run down, the machine stages switch OFF again.

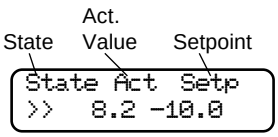
Display of Actual Values and States

All actual values are shown on the "*Actual Values*"-Page.

"*ActVal.1*" - "*ActVal. 6*" show the measured values of the 6 analog inputs. Because each input can handle each task, the display shows also the actual task of the sensor. The measured value can be corrected here, if necessary. The set correction factors can be read at '*Calibration 1-6'* (Mode Page). Values of inputs, which are not assigned, will not be displayed.



The parameter "*State Act Setp.*" displays the most important states at the same time.



Status:

'>>' :	Forward
'==' :	Neutral
'<<' :	Backrun
'B<' :	Backrun, released by limitation 'Warm'
'C<' :	Backrun, released by limitation 'Cold'
'F<' :	Backrun, released by 'Freeze protection' setpoint
'M<' :	Backrun, released by digital input or M/0/A-switch
'L<' :	Backrun, released by 'Load Limitation'
'F<' :	Backrun, released by 'Forced Feedback'
'B<' :	Fast backrun, realeased by falling short of the limit
'T<' :	Fast backrun, realeased by exceeding limit

"*Control setpoint*" shows the active setpoint at this time, which is an addition of the preset setpoint and the offset values and e.g. external setpoint shift by a temperature sensor or standardized signals.

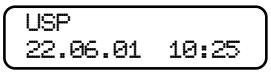
Runtime Counters
The runtimes of all machines will be added and can be read at "*Relay runtime x*". This counters can be reset, e.g. if a machine was replaced.

Furthermore, the 'Actual Values'-page delivers informations about the states of each digital input, each relay and every machine.

"Permanent Parameter" - Function (Basic Display)

After switching on the controller, the display will indicate the 'permanent parameter' after some seconds (or in case of a failure it will display the actual failure):

e.g.



This will also be shown if you have selected some parameters and 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 becomes dark for a moment, after that the selected parameter will be shown as 'basic display'.

Setpoints and Switching Characteristic

The kind of predefine the setpoint depends on the application. The USP-controller offers the following options, which are defined by parameter "*Setpoint Mode*" (Mode Page):

Compressor- /Compound Control

"*Setpoint Mode*" = common
"*Application*" = refrigeration

The control setpoint will be adjusted by "*Setpoint*" (Setpoint Page) as temperature value or pressure value. No access code necessary.

Forward (Stages will switch ON)
=> If the actual value exceeds the setpoint (**+** hysteresis) and the delay time is run down.

Neutral State
If the actual value is located within the hysteresis range "*Contr.hysteresis*" (Setpoint Page), then the controller is in neutral state and no stage will switch on or off.

Backrun (Stages will switch OFF)
=> If the actual value falls short of the setpoint (**-** hysteresis) and the delay time is run down.

Compressor- /Compound- / Fan Control

Input sensor: **Pressostat**,
"*Setpoint Mode*", "*Setpoint*" and "*Contr. hysteresis*" are out of order.
The switching points of 'Forward', 'Backrun' and the neutral zone are defined by the external pressure switch (Pressostat).

Forward (Stages will switch ON)
=> If the input with the function "PressoFW" is activated and the delay time is run down.

Neutral State
If the inputs with the functions 'PressoFW' and 'PressoBR' have no signal, then the controller unit is in neutral state and no stage will switch on or off.

Backrun (Stages will switch OFF)
=> If the input with the function "PressoBR" is activated and the delay time is run down.

Heat Pumps / Air Compressors

"*Setpoint Mode*" = coupled
"*Application*" = heating

The control setpoint will be adjusted by "*Setpoint*" (Setpoint Page) as temperature value. No access code necessary.

Forward (Stages will switch ON)
=> If the actual value falls short of the setpoint (**-** hysteresis) and the delay time is run down.

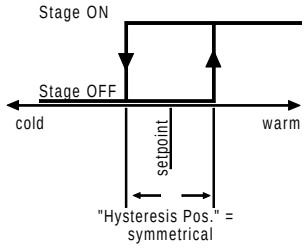
Neutral State
If the actual value is located within the hysteresis range "*Contr.hysteresis*" (Setpoint Page), then the controller is in neutral state and no stage will switch on or off.

Backrun (Stages will switch OFF)
=> If the actual value exceeds the setpoint (**+** hysteresis) and the delay time is run down.

Condenser Fan Control

"*Setpoint Mode*" = absolute
"*Application*" = refrigeration

The setpoints of the single stages are defined by "*Setpoint x*" (Setpoint Page) as absolute temperature- resp. pressure values. No access code necessary.



Forward (Stages will switch ON)
If the actual value increases the individual setpoint (**+** hysteresis), then the corresponding stage will switch on after the delay time is run down.

Neutral State
If the actual value is located within the hysteresis range "*Contr.hysteresis*" (Setpoint Page), then the controller is in neutral state and no stage will switch on or off.

Backrun (Stages will switch OFF)
If the actual value falls short of the individual setpoint (**-** hysteresis) then the corresponding stage will switch off after the delay time is run down.

Brine/Chiller Control

"*Setpoint Mode*" = coupled
"*Application*" = refrigeration

The setpoint for the first stage is defined by "*Setpoint*" (Setpoint Page) as an absolute temperature value. The switching points of the further stages are defined in relative distances to the previous stages. If "*Setpoint*" will be shifted, the setpoints of the following stages will be shifted the same amount.

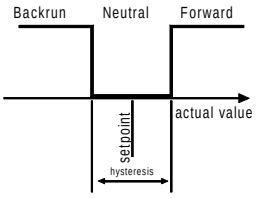
Forward (Stages will switch ON)
If the actual value increases the individual setpoint (**+** hysteresis), then the corresponding stage will switch on after the delay time is run down.

Neutral State
If the actual value is located within the hysteresis range "*Contr.hysteresis*" (Setpoint Page), then the controller is in neutral state and no stage will switch on or off.

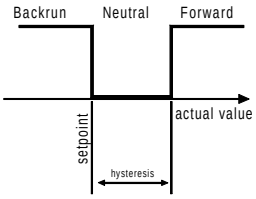
Backrun (Stages will switch OFF)
If the actual value falls short of the individual setpoint (**-** hysteresis) then the corresponding stage will switch off after the delay time is run down.

Hysteresis Positions

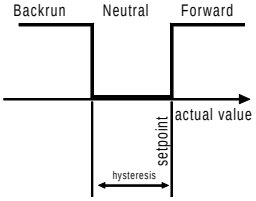
The hysteresis (neutral zone) can be positioned symmetrical around the setpoints, above and below the setpoints (Parameter "*Hysteresis Pos.*", Mode Page).



"Hysteresis Pos." = symmetrical



"Hysteresis Pos." = above setp.



"Hysteresis Pos." = below setp.

Precondition of this examples: "*Application*" = 'Refrigeration'

Inverting the switching direction

The parameter "*Application*" (Mode Page) defines the switching direction.

'refrigeration': rising actual value = Forward.
Standard value for using the controller unit as compressor-, fan- or chiller controller.

'heating': falling actual value = Forward
Value for controlling heat pumps or air compressors.

Manual Operation of the Controller:

For service- or test purposes it can be suggestive to enforce on/off switching of all stages without opening screw terminals or simulating pressures at an input. "*Operation Mode*" (Mode Page) allows this state, e.g. set to 'Manual Forward', the control algorithm will be forced to forward mode and all stages will switch on after their delay times have been run down. Additionally, each machine can be switched on or off manually.

Control Setpoint Limits

Because the control setpoint can be adjusted without prior identification, you can restrict the setpoint range by parameters "*Control LimHigh*" and "*Control LimLow*".
This option protects the enduser from adjusting an 'unsafe' setpoint while 'playing' with parameters.

Night Operation

Night Operation ON/OFF
The night operation mode can be enabled by the built-in clock or by a control- (OC)-input, assigned with function "Night op.....". The OC-input has 1st priority, that means if activated, the set switch times will be disabled. The switch times can be set by "*Night shift ON*" and "*Night shift OFF*". Please set both parameters to OFF if this times are not necessary.

Control function while night operation mode
If night operation mode is enabled, all setpoints will be shifted by the offset "*Night shift*" (Setpoint Page). "*Setpoint offset*" (Setpoint Page) shows the amount, the setpoint is currently shifted by the night operation mode or other shift functions.

Threshold Values

There are various threshold values available for the different applications. Values, which are not meaningful for the single application, will not be displayed.

"*FastBR lower val*" (used with compressors)
If the control sensors value **falls short** of this limit => fast backrun / no alarm message

"*FastBR upper val*" (used with heat pumps)
If the control sensor **increases** this limit => fast backrun / no alarm message

"*Alarm limit low*"
If the control sensor value **falls short** of this limit => alarm message

"*Alarm limit high*"
If the control sensor **increases** this limit => alarm message

"*Temp Limit cold*" (used with chillers)
If the sensor 'LimCold' **falls short** of this limit => forced feedback with time delays, no alarm message

"*Temp Limit warm*" (used with heat pumps)
If the sensor 'LimWarm' **increases** this limit => forced feedback with time delays, no alarm message

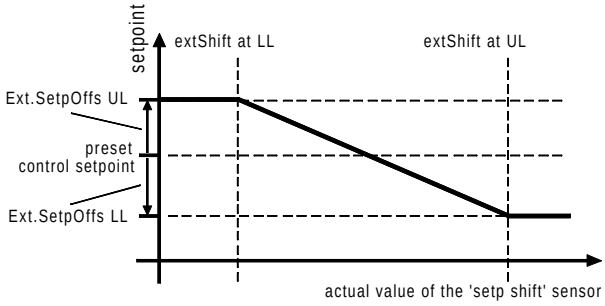
"*Freezprot setp*" (used with chillers)
If the sensor 'Frezprot' **falls short** of this limit => fast backrun / alarm message

"*Temp Limit hyst.*" defines the hysteresis of the two limitation setpoints, "*Freezprot hyst*" defines the hysteresis of the freeze protection setpoint. The parameter "*Hysteresis Pos.*" (Mode Page) is also valid here.

Setpoint Optimization, Setpoint Shift

An automatic or manual shift of the setpoint can be useful e.g. for the following applications:

- Suction pressure optimization of compressor units depending on room temperature or outdoor temperature
- Optimization of a heat pump depending on outdoor temperature
- Remote shift of the setpoint by standardized signals or potentiometer.



Setpoint shift by example 1

Each available input can be used for setpoint shift by allocating the function "*SetpShft*" to this input. The parameters "*ext.SetpOffs LL*" and "*ext.SetpOffs UL*" (Setpoint Page) define the range, a shift is possible within. "*extShift at LL*" and "*extShift at UL*" define the amount of the offset at this range limits.

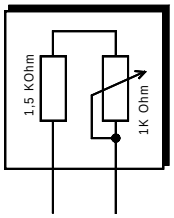
Example 1:

External setpoint shift by a temperature. This temperature must shift all control setpoints by ±10K in the range within 15...25°C. At 20°C works the preset setpoint, at 25°C the setpoint is decreased to its minimum. Settings:

- One of the inputs 3-6 is assigned to the function "SetpShft".
- "*extShift at LL*" = 15.0°C
- "*extShift at UL*" = 25.0°C
- "*Ext.SetpOffs UL*" = +10.0K
- "*Ext.SetpOffs LL*" = -10.0K

Example 2:

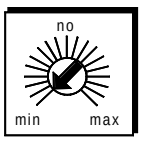
External setpoint shift by a potentiometer. In this case a potentiometer simulates a temperature sensor. The settings of the example depend on the shown potentiometer, which consists of standard elements. For other pots you must change the parameters "*extShift at LL*" and "*extShift at UL*".
Mid position of the pot = no setpoint shift
End positions of the pot = shift by ± 5K.



external potentiometer, this arrangment has 1500 ohms minimum, 2500 ohms maximum.

Settings:

- Allocate the function '*SetpShft* to the input with the potentiometer (inputs 4-6).
- "*Sensor Selection*" = TF 201
- "*extShift at LL*" = -10.0°C
- "*extShift at UL*" = 55.0°C
- "*Ext.SetpOffs UL*" = +5.0K
- "*Ext.SetpOffs LL*" = -5.0K



All setpoints will be decreased by 5K

All setpoints will be increased by 5K

Example 3:

External setpoint shift by a standardized 4-20mA-signal at input 1. This signal should be displayed as a current signal, that means actual value 1 should be displayed as "XX mA".

Settings:

- "*Function Input 1*" = "SetpShft"
- "*4/20mA Unit 1*" = mA
- "*extShift at LL*" = 4.0 mA
- "*extShift at UL*" = 20.0 mA
- "*Ext.SetpOffs LL*" = 0.0K
- "*Ext.SetpOffs UL*" = 8.0K

Example 4:

Like example 3, but with a standardized 4-20mA-signal which represents a temperature (e.g. if signal is delivered by a temperature transducer). 4mA correlate with 0°C, 20mA correlate with 10°C. With 4 mA the preset setpoint works, with 20mA the setpoint should rise by 8K max.

Settings:

- "*Function Input 1*" = "SetpShft"
- "*4/20mA LowVal 1*" = 0.00 °C
- "*4/20mA HighVal 1*" = 10.00 °C
- "*4/20mA Unit 1*" = °C
- "*extShift at LL*" = 0.0 °C
- "*extShift at UL*" = 10.0 °C
- "*Ext.SetpOffs LL*" = 0.0K
- "*Ext.SetpOffs UL*" = 8.0K

Setpoint shift informations:

As for night operation mode the parameter "*Setpoint offset*" (Setpoint Page) shows the amount of the offset caused by an analog input.
If night operation mode and external shift are active at the same time, this parameter displays the sum of both offsets.

Stage Controller

Connection of machines
The USP-unit is able to control 6 machines, 12 machines are possible by adding a second USP-unit (if no special relays are configured).
For correct operation, the controller must know type and number of the connected machines, this will be done by "*No. Stages M 1*" - "*No. Stages M 12*" (Assignment Page).
"*No. Stages M 1*" = '1' means that the first machine is a single machine, connected to relay 1. If the first machine has three stages, e.g. motor and 2 valves, "*No. Stages M 1*" must be set to '3'. Relay 1 = motor ON, relay 2 = 1st valve, relay 3 = 2nd valve. Not necessary stages must be set to '0'. If more stages are set than available, an 'Aloc'-failure will be generated.
Configuration examples you will find in chapter "**Assignment and Configuration**".

Assign machines always continuously, without a gap !

wrong: "*No. Stages M 1*" = 1
"*No. Stages M 2*" = 0
"*No. Stages M 3*" = 1
"*No. Stages M 4*" = 1

correct: "*No. Stages M 1*" = 1
"*No. Stages M 2*" = 1
"*No. Stages M 3*" = 1
"*No. Stages M 4*" = 0

Multistage Machines:
These are compressors or fans with additional power stages.
Example 1: A fan with 2 speeds. The 1st stage switches the fan ON, the 2nd stage switches to high speed.
Example 2: A 6-cylinder-compressor. The 1st stage switches the motor ON, but only 2 cylinders work, the others are without effect because of open valves. The further stages switch this valves up to all 6 cylinders work.

Inverted stages for emergency operation
Normally, the machines will be switched by the N/O-contacts of the output relays. To enable an emergency operation in case of mains voltage loss or in case of controller damage, machines can be switched by the N/C-contacts (master unit only). "*Inverted Stages*" (Assignment Page) defines the number of this relays.

Machines with feedback signals
To detect the real state of a machine, the safety chain must be monitored by a digital input (OC-input) which got the task "*Feedback M x*". The stage controller then switches a machine on and waits for a mains voltage feedback signal at the configured OC-input. If no feedback signal appears, the machine will be switched off and the controller selects a new one.
The period, the controller waits for the feedback signal, is defined by "*Delay Optocpler x*" (Mode Page) for this input.
If it was unsuccesful to switch on a machine, this machine will be demanded again after 2 minutes first.

Failure messages with Malfunction Relay
A relay, which is configured as 'Compressor Malfunction Relay', will be enabled if more than 30% of the feedback signals are not present even though the stage relays are switched on.

Manual operation of machines

Each single machine can be switched on/off manually by "*Manual ON M x*" (Mode Page). If a machine is switched on continuously, the matching LED indicates this state by short interrupts. If the machine is switched off, the LED indicates this by short flashes.

Automatic Base Load Switch (Sequencing)

The sequence change function cares for approximately equal runtimes of the connected machines. The controller considers automatically the modified sequences if multistage machines are used.
The parameter "*Sequence Change*" (Mode Page) defines the type of changing the base load:

- "*Sequence Change*" = 'oFF'
  The function is switched off, all stages switch in numerical order:
  >> 1 2 3 4 5 6 << 6 5 4 3 2 1
- "*Sequence Change*" = 'Compr.Runtime'
  While 'Forward'-mode always the machine with the least runtime will be preferred.
- "*Sequence Change*" = 'Comp.OFF Time'
  While 'Forward'-mode always the machine with the longest idle time will be preferred.
- "*Sequence Change*" = 'Compr.Runtime -M1'
  While 'Forward'-mode always the machine with the least runtime will be preferred, but except the first machine (including evtl. power stages). So machine 1 is the first which switches on and the last which switches off.
- "*Sequence Change*" = 'Comp.OFF Time -M1'
  While 'Forward'-mode always the machine with the longest idle time will be preferred, but except the first machine (including evtl. power stages).

Excluding machine 1 from sequence change can be suggestive if e.g.:

- the first machine is actuated by an AC-inverter but all other machines by relay contacts.
- a weak machine should work as a leading machine.
- a pump should be switched with the first stage (brine/chiller applications).

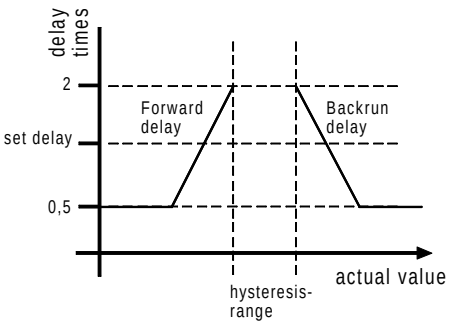
Forward-/Backrun Time Delays

The characteristic of the time delays depend on the application. The parameter "*Delay Mode*" (Mode Page) defines these characteristics.

- "*Delay Mode*" = common
  The delay times for the first stage can be defined by "*ForwardDelay S1*" and "*BackrunDelay S1*". For all other stages the delays set by "*ForwDelay S2-12*" and "*BckrDelay S2-12*" are valid.
- "*Delay Mode*" = individual
  The delay times for the first stage can be defined by "*ForwardDelay S1*" and "*BackrunDelay S1*". Each further machine has its individual delay time set by "*Forward Delay S x*" and "*Backrun Delay S x*").
- "*Delay Mode*" = autoadaptive
  This mode serves for reduced switching cycles of a compound system.
  The delay times for the first stage can be defined by "*ForwardDelay S1*" and "*BackrunDelay S1*". For all other stages the delays set by "*ForwDelay S2-12*" and "*BckrDelay S2-12*" are valid. These are the minimum-delays which are used by the control algorithm.
  If the suction pressure and the setpoint differ only a little bit, the switching cycles of the compound should be reduced. If the suction pressure changes quickly, the compound must deliver the necessary power quickly too. For this purpose, variable forward-/backrun delays are qualified, which depend on the setpoint deviation.

  This forward-/backrun delays start running as soon as the suction pressure leaves the neutral range (hysteresis range).
  At the bounds of the range the delay times will be increased maximum by the value set by "*DelayAdaptFactor*" (Mode Page), so the control speed will be braked.
  The farther the distance between actual value and hysteresis range, the more shortened the delay times will be, maximum by the value set by "*DelayAdaptFactor*".

  Example with "*DelayAdaptFactor*" = 2:



Optimization Procedures

These procedures are defined by parameter "*Switch Optimizat*" (Mode Page).

- "*Switch Optimizat*" = 'Switch frequency'
  This function takes effect with multistage machines at backrun mode. The machines run longer in the part load region, for it they have an reduced switching interval.

- "*Switch Optimizat*" = 'Load equalize'
  This function also takes effect with multistage machines. All machines will switch on with low power first. If more power is necessary, all machines switch to the 2nd stage at first, then to the 3rd, etc. In backrun mode all power stages will be disabled before a machine switches off.

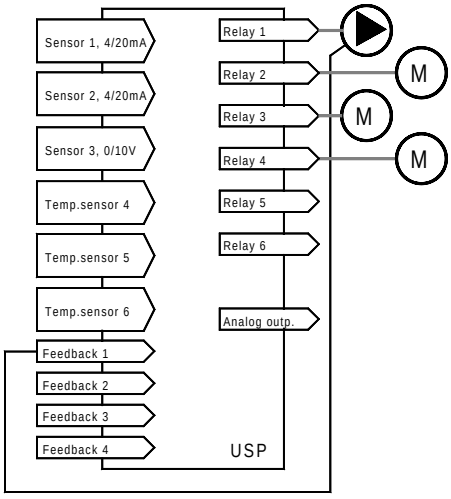
- "*Switch Optimizat*" = 'BR Power Fans'
  If power fans with 2 speeds are used, the controller may not switch from high speed to low speed directly.
  With this function, in backrun mode stage 2 an 1 switch off together, if power is demanded furthermore, stage 1 switches on again (delayed).

Forced Feedback

Some applications need that a apecific device is active before further stages are allowed to switch on. Switching on this stages without the running device could get useless or harmful. Such devices could be media pumps, oil pumps or similar.
If the feedback signal of this device is connected to an OC-input assigned to the function '*Feedback M x*' and parameter "*Forced Feedback*" is set to 'yes', then the following stages will not switch on, if the feedback signal of the device is not present.

"*Forced Feedback*" only works, if the function is set to 'yes' and feedback signals are used.

Example:
Application, where machine 1 is a circulation pump and the other machines are compressors. The compressors may start first if the pump runs.
- Assign an OC-input with function "*Feedback M1*"
- Switch pump with relay 1
- If a sequence change is necessary, set 'Sequence Change' to '*Compr.Runtime -M1*' or '*Compr.OFFtime -M1*'
- '*Forced Feedback*' = yes



Maximum Machine Runtime

In applications with constant power request it is possible that a machine runs continuously multiple days or weeks yet. Then this machine has a high runtime, while other machines switch on rarely. To prevent this case, the parameter "*Contin.Run max.*" (Mode Page) defines a time interval after that a machine switch off by force. If there is furthermore an energy demand, the controller switches on another machine (please compare chapter 'Sequence Change').

Minimum Idle Time

This is the time the controller must wait before switching on a machine again. This pause time is defined by "*Idle time min*" (Mode Page). The minimum idle times differ from type to type and can be found in the technical manuals of the manufacturers, e.g.:

Bitzer:	Minimum time between Stop/Start appr. 6-10 minutes, power compressors only
Dorin:	max. 6-10 starts per hour
DWM:	max. 8 starts per hour

Attention, this values may not longer valid, please always note the actual data of the manufacturers!

Peak Load Limitation

Some applications need that the power consumption can be limited at specific points in time, e.g. by a signal of the power supply company at times with high charges.
If one or two OC-inputs get the function "*Load Limitat x*" (Assignment Page), then the parameter "*Load Limitation x*" (Mode Page) defines the number of machines which are able to run after the inputs are activated.

Example: 6 single compressors
OC-input 1 = *Load Limitat* 1
OC-input 2 = *Load Limitat* 2
Param. "*Load Limitation 1*" = 4
Param. "*Load Limitation 2*" = 2

If all 6 machines run and input OC1 will be activated:
2 machines will be disabled.
If input OC 2 will be activated alone or additionally:
Only 2 machines are still able to run.

The signal disables the machines first, which are switched off anyway, and then the ones with the highest runtimes. The backrun starts immediately with the set backrun delays.
If the signal disappears, the stages switch on (if necessary) after the set delay times.

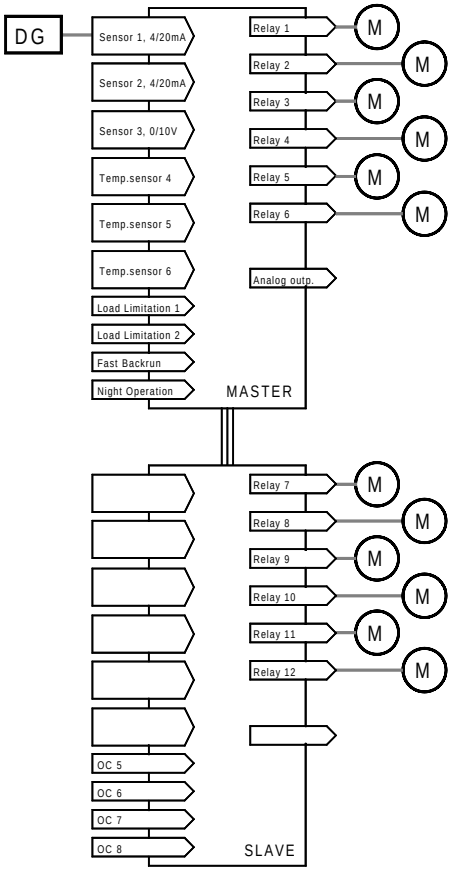
Master/Slave Operation if more than 6 stages are necessary

The USP-controller unit is able to control up to 6 stages/machines. If your application has more stages, a 2nd controller unit can be added. Both units are connected by a 3-wire, shielded cable.

The controller units then work in 'Master/ Slave'-Mode. The 'Slave'-unit adds 6 more stages as well as the digital inputs 5-8.
To enable this arrangement, parameter '*Operation Mode*' (Assignment Page) of the master unit must be set to 'Master', the same parameter at the slave unit must be set to 'Slave'.

The controller units will be operated from the master units display and keypad, on the display of the slave unit only the current operation mode appears.

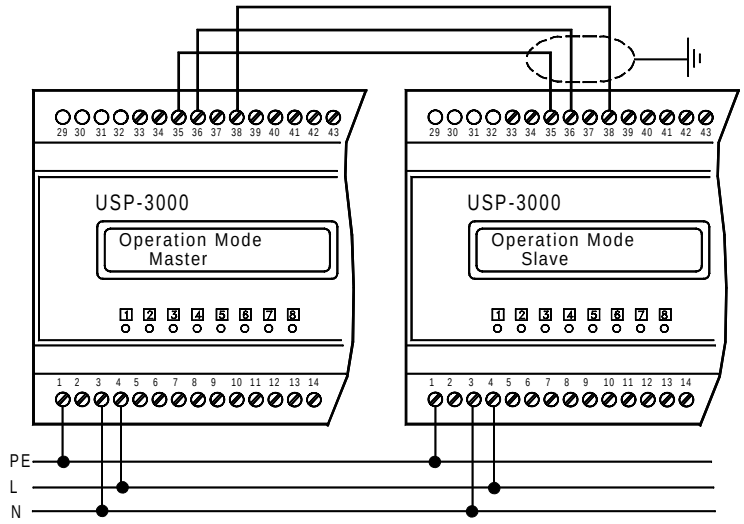
The relays of the slave unit are able to switch stages only, special functions cannot be assigned.



In master/slave mode, the interfaces of the slave unit are disabled.

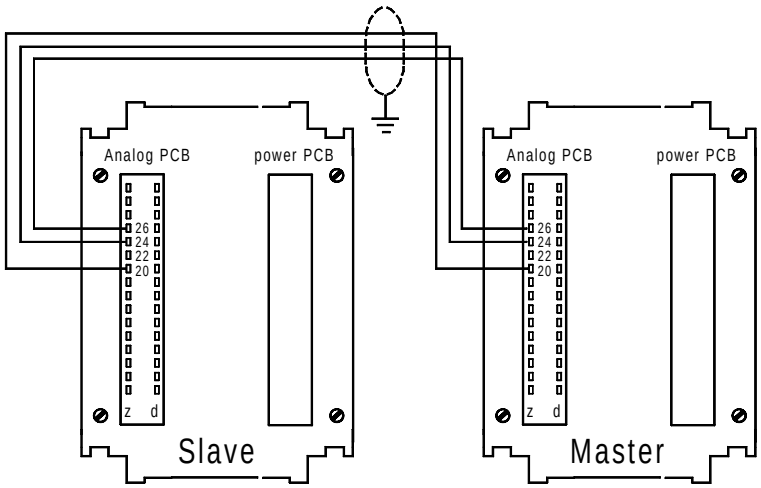
Sensors can be connected to the master unit only .

Necessary Connections for master/slave mode of 2 USP 3130



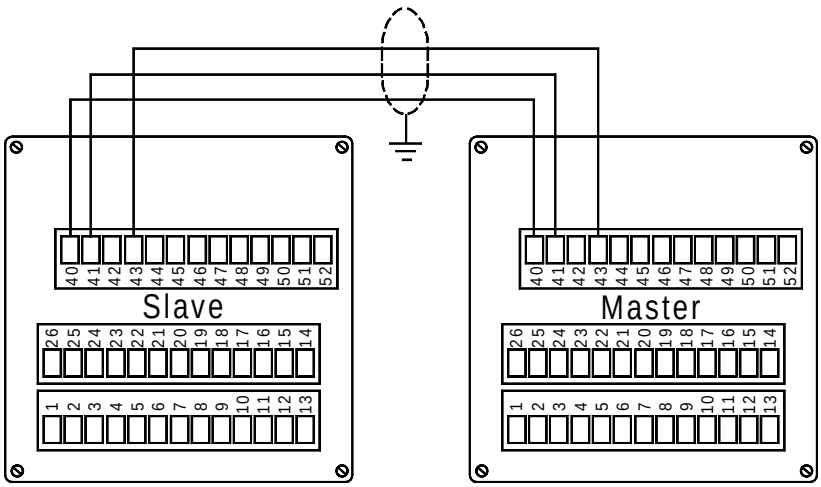
The control sensor (e.g. pressure transmitter) is only connected to the master unit

Master/Slave operation of 2 USP 19130



The control sensor (e.g. pressure transmitter) is only connected to the master unit

Master/Slave operation of 2 USP 5130



The control sensor (e.g. pressure transmitter) is only connected to the master unit

Analog Output

The USP contains an analog output which can be used for regulation or to provide a remote display with an actual value image. The signal is available as a DC-Voltage or a DC-Current-Signal. To define the characteristic of the output, these parameters are available:

" Analog Function" ..... (Assignment Page) defines the characteristic of the output.
" PID IntegralTime"..... integral time (I-part, Setpoint Page)
" PID Attack Time"..... derivative time (D-part)
" PID delay" ..... actuator response time (T1-part)
"*AnalogOutp.LowVal*" . Value at the 'Control'-sensor, with which the lowest voltage/current signal will be delivered.
"*AnalogOutp.HghVal*" . Value at the 'Control'-sensor, with which the highest voltage/current signal will be delivered.

This both parameters (Mode Page) define the proportional band for the parameter values "ActualVal 0-10V" und "ActualVal 4-20mA".

Test Functions

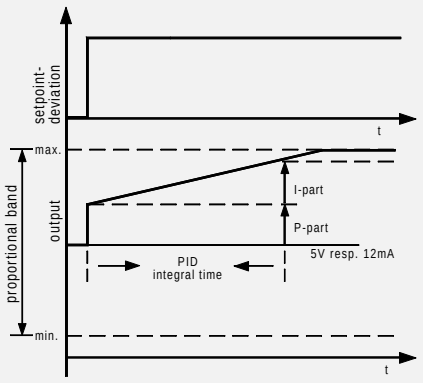
"Analog Function" = **0V/0mA**:
voltage output = 0V, current output = 0 mA fixed
"Analog Function" = **2V/4mA**:
voltage output = 2V, current output = 4 mA fixed
"Analog Function" = **10V/20mA**:
voltage output = 10V, current output = 20mA fixed

Forwarding the actual value to remote display resp. proportional control

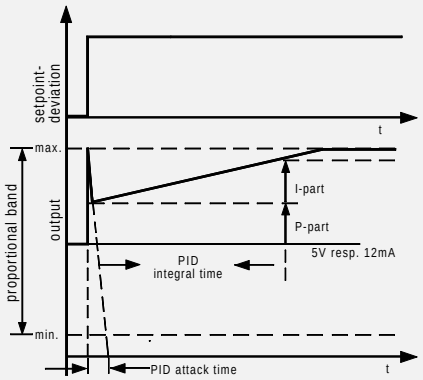
"Analog Function" = **ActualVal 0-10V**:
Outputs deliver an image of the actual value at the 'Control'-sensor.
Voltage output:
0V while an actual value like set by "*AnalogOutp.LowVal*
10V while an actual value like set by "*AnalogOutp.HghVal*"
Current output:
0mA while an actual value like set by "*AnalogOutp.LowVal*
20mA while an actual value like set by "*AnalogOutp.HghVal*"

"Analog Function" = **ActualVal 4-20mA**:
Outputs deliver an image of the actual value at the 'Control'-sensor.
Voltage output:
2V while an actual value like set by "*AnalogOutp.LowVal*
10V while an actual value like set by "*AnalogOutp.HghVal*"
Current output:
4mA while an actual value like set by "*AnalogOutp.LowVal*
20mA while an actual value like set by "*AnalogOutp.HghVal*"

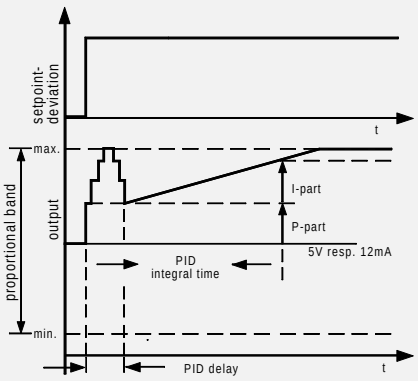
Control Characteristic



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



PID-control, T1-part
de-activated



PID-control,
with T1-low-pass filter

Functional Informations

"*Analog value*" (Actual Values Page) shows the up to date output signal as a value in % of the selected range.

Example 1:
If you have set parameter '*Analog Function*' to 'ActualVal 0-10V', the display shows 50 % if 5 V are delivered.

Example 2:
If you have set parameter '*Analog Function*' to 'ActualVal 4-20mA' and the output delivers 6 V, then the display shows also 50%, because in this case the output has a range of 2-10V (8V).

Speed Control of Machines by the Analog Output

PID-control of machines

In practice, 2 types of variable applications are usual:

- All motors are controlled by a frequency inverter (e.g. Frigopol DUO-compound).
- Only 1 motor is controlled by a frequency inverter, all others are switched conventionally.

In all cases, the number of machines (compressors) must be preset by parameter "*No. Stages M x*" (Assignment Page). Frequency Inverters are driven by the following control variants:

"Analog Function" = **PID-T1 0-10V**:
PID-controller with 0-10V DC-signal. The output signal corresponds to an addition of the components P, I, D and T1
"Analog Function" = **PID-T1 4-20mA**:
PID-controller with 4/20 mA-signal. The output signal corresponds to an addition of the components P, I, D and T1
"Analog Function" = **PID-T1 10-0V**:
PID-controller like above, but with inverted voltage output 10-0V DC (rising temperature = falling voltage).
"Analog Function" = **PID-T1 20-4mA**:
PID-controller like above, but with inverted current output 20/4 mA (rising temperature = falling current)

Control Sequence, if all machines are speed-controlled:

Forward Mode

1. Machine starts running speed-controlled
2. Actual value exceeds the hysteresis range and the analog output delivers 100% => Forward delay starts.
3. Before the forward delay ends, the analog output falls to 0%.
4. The next stage switches on and releases the next machine by its relay output.
5. The analog output continues delivering a speed control signal.
6. If power is still neccesary, step 2 is being repeated.

Here the shutdown of the analog output prevents the application from a power branch if the 2nd machine starts with high speed.

Neutral

If the analog output signal is located within its range (neither 0% nor 100%) or the actual value is located within the hysteresis range, the controller works in neutral zone.

Backrun Mode

1. Actual value falls short of the hysteresis range and the analog output delivers 0% => Backrun delay starts.
2. After the end of the backrun delay, one stage will be switched off.
3. PID-control works continuously
4. This is being repeated until all stages are switched off.

Control Sequence, if only one machine is speed-controlled:

Forward Mode

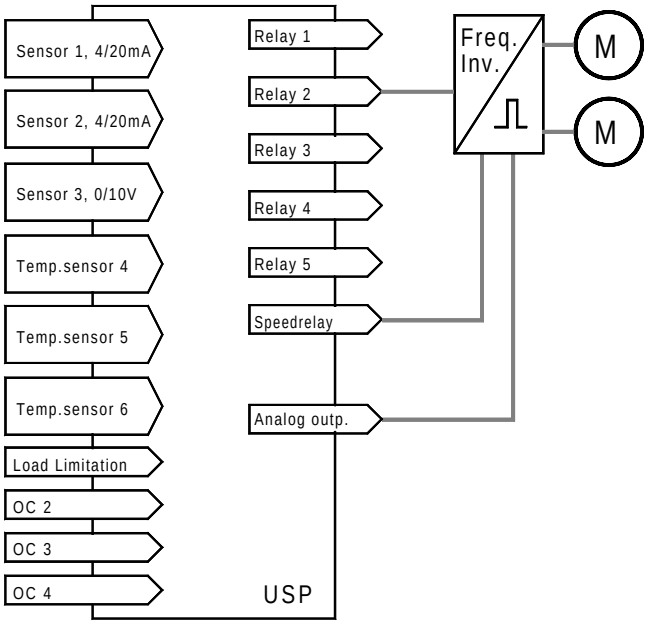
1. Machine starts running speed-controlled
2. Actual value exceeds the hysteresis range and the analog output delivers 100% => Forward delay starts.
3. Before the forward delay ends, the analog output falls to 0%.
4. The next stage switches the next machine on.
5. The analog output continues delivering a speed control signal.
6. If power is still neccesary, step 2 is being repeated.

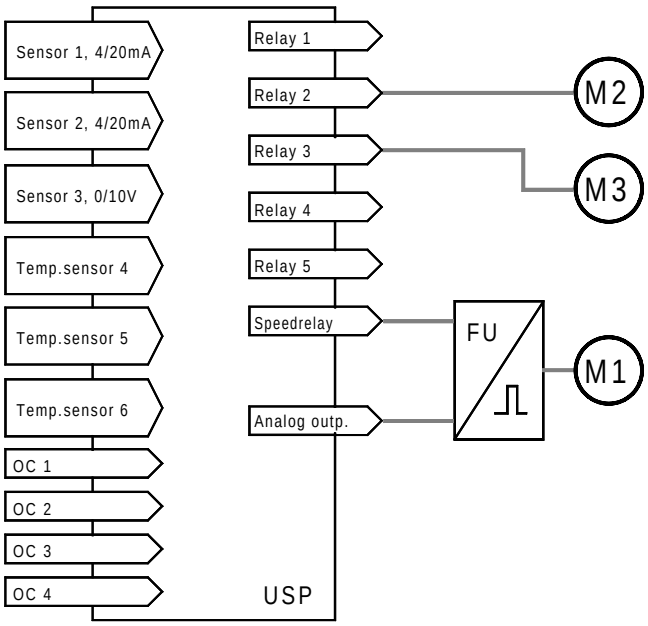
Neutral and backrun see above

Here the shutdown of the analog output prevents the application from a power branch if the next machine switches on.
The speedcontrolled machine 'filles' so to say the 'gap' between the stages.

Safety Function: Inverter Bypass by relay

If the setpoint deviation is present for a long time, it might possible that the frequency inverter is defect or the machines cannot deliver their full power.
With an additional relay output ("*Bypass Relay*" = yes, Assignment Page) you get the tool to bridge the inverter in case of a failure or to let it work with a fixed frequency.
A failure case occurs, if a setpoint deviation is present for more than 90 minutes (fixed time). Then the bypass relay will be disabled to bypass the inverter safely. At the same time a failure message will be generated.





Networking of controllers via *E-LINK*

E-LINK

The USP-controller can be networked together with other ELREHA-control devices. For this duty ELREHA has developed E-LINK, a transmission protocol, which will be transmitted on a two-wire bus-system based on the RS-485-Standard. With E-LINK up to **78** controllers can be assembled. The standard transmission speed is 9600 baud, but can be changed by '*Baudrate*' (Mode Page) if necessary.
Each controller in a network has its individual adress („*Adress in netwk*", Mode Page). This adress is necessary for selecting the right controller when a data package is transmitted on the network bus. If the controllers are used outside a network, the adress is of no importance.

Interfaces while Master/Slave-Operation

In master/slave-mode, the interfaces of the slave unit are disabled. Communication is only possible via the interfaces of the master unit.

Remote control with SMZ

The USP controller series can be operated via interface if they are connected to a SMZ 3130 communication module. The SMZ will display exactly the same as at the USP's display; the keys of the SMZ work as if they where the keys of the USP. So you can get alarm messages from your equipment and you can control the device remotely.

Configuration / Service via PC

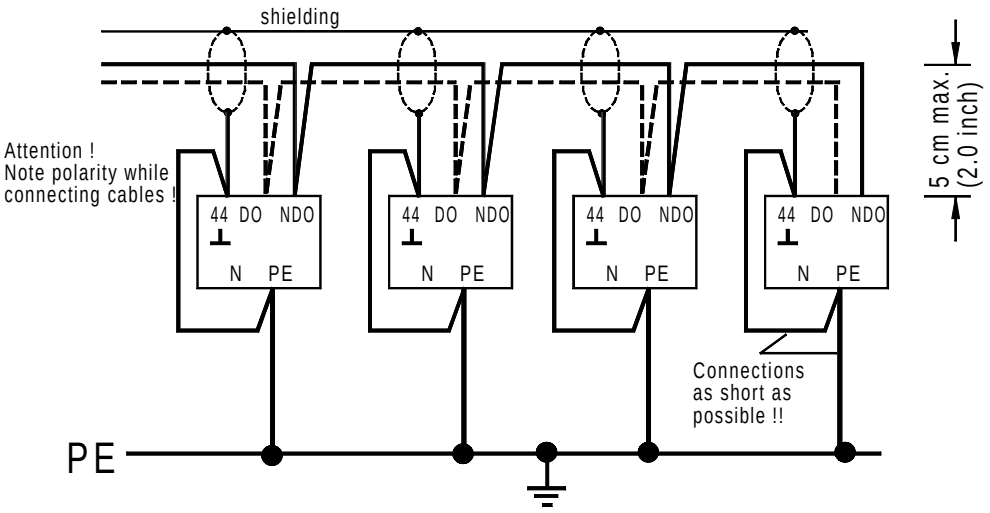
The controller units can be linked to a PC via RS 232 or RS 485 interface where the ELREHA-software „Coolvision" runs. From there you can change parameters, save them on the hard disk (download) and send it to other controllers (upload).

Wiring of data lines

The scheme beside shows briefly, how dataline wiring of several controllers is made. The shield has to be grounded to the PE-contact and to the GND contact of the RS485-interface at each controller!
This assures good interference suppression, even for long datalines between the controllers.

GND-terminals

USP 3130 ..... term. 44
USP 5130 ..... term. 40
USP 19130 ... term.d32, analog PCB



Start-up

For all examples we imply that the controller unit is switched on the first time and so contains the factory settings. Please note how the unit must be operated via keypad (page 3).

- Perform wiring as planned.
- If you switch on the controller, after a few seconds the display will show the 'Basic Display' or an actual failure message, the backlight of the display is off. If you press any key, the backlight switches on.
- If the controller has been switched on the first time, the controller expects a language spec, the display shows parameter "*Sprache/language*" (Mode Page).

The USP offers 3 start-up methods:

- Guided Start-up
- Start-up by using the parameter listings
- Start-up by PC-software

Guided Start-up

A help function guides you through a standard start-up procedure. After you have started this help function, the controllers display shows a number of parameters which must be adjusted and then confirmed by "RET". So there is no need for searching the necessary parameters. After all steps are worn out, the controller unit is ready for the most standard applications. The display then shows the states from the 'Actual Values' Page.

For a better survey, the controller doesn't process the parameters for the 'fine tuning', they must be set normally.

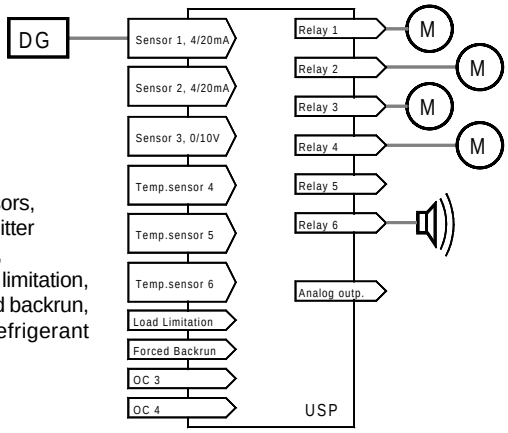
Start of the 'Guided Start-up':

- Set "*start-up mode*" (Assignment Page) to 'ON' position.
- Answer safety query
- Select '*Load default*' :
  - 'without' =
    No factory settings will be loaded, the actual settings remain unchanged.
  - 'Compound control' =
    Settings for a typical compound controller will be loaded, the current settings will be changed.
  - 'Condens. Control' =
    Settings for a typical condenser controller will be loaded, the current settings will be changed.
  - 'Chiller/HVAC' =
    Settings for a typical chiller controller will be loaded, the current settings will be changed.
  - 'Heat Pump Contr.' =
    Settings for a typical heat pump controller will be loaded, the current settings will be changed.

Factory settings you will find on page 11.

If you want to check or to change parameters after you have worn out the 'guided start-up', then restart the function with '*Load default*' = 'without'.
The set parameters then keep unchanged.

Examples of parameter settings for compressor unit control



Example 1:
4 single compressors,
1 pressure transmitter
4-20mA at input 1,
input OC 1 = load limitation,
input OC 2 = forced backrun,
1 alarm relay, refrigerant R134a

Parameter Settings

- "*current Time*" (Mode Page)
- "*current Date*" (Mode Page)
- "*Sommer/Winter sw*" (Mode Page)

While you set the further parameters, you will be asked for an 'Access Code', which depends on the current time (hour + 10).

Assign functions to inputs (assignment page)

- "*alarm relay*" yes
- "*function input 1*" control
- "*function input 2*" off
- "*function input 3*" off
- "*function input 4*" off
- "*function input 5*" off
- "*function input 6*" off
- "*No.stages M1*" 1
- "*No.stages M2*" 1
- "*No.stages M3*" 1
- "*No.stages M4*" 1
- "*function optoc.1*" load limitation 1
- "*function optoc.2*" forced backrun

Control characteristic and refrigerant

- "*Application*" refrigeration
- "*Refrigerant*" R134a
- "*Setpoint Mode*" common

Fixing the used pressure transmitter (Mode Page):

- "*4/20mA LowVal 1*" = _ _ _ _
  This is the pressure which is displayed if the transmitter delivers 4 mA.
  If you use a DG 0/10 GSW: Set -1.0 bar (relative to ambient pressure)

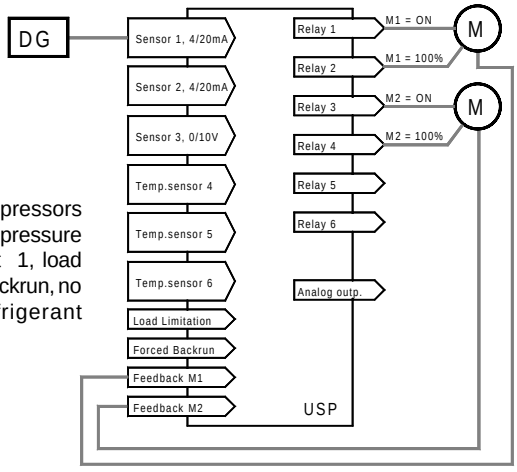
- "*4/20mA HIghVal 1*" = _ _ _ _
  This is the pressure which is displayed if the transmitter delivers 20 mA.
  If you use a DG 0/10 GSW: Set 9.0 bar (relative to ambient pressure)

Control setpoints (Setpoint Page)

- "*Setpoint*" in °C (factory set even the middle of the neutral zone)
- "*Contr.hysteresis*" in K (range of the neutral zone)
- "*Forward Delay S1*" (Forward delay of the 1st stage)
- "*Backrun Delay S1*" (Backrun delay of the 1st stage)
- "*ForwDelay S2-12*" (Forward delay of all other stages)
- "*BackrDelay S2-12*" (backrun delay of all other stages)

Display correction

The actual pressure value can be calibrated by "*Calibration 1*" (Mode Page). Because in practice deviations > 1 bar are impossible, please check in this case if you have confound the absolute/relative pressure values of the pressure transmitter.



Example 2:
2 dual-stage compressors with feedback, 1 pressure transmitter at input 1, load limitation, forced backrun, no alarm relay, refrigerant R404A

Parameter Settings

- "*current Time*" (Mode Page)
- "*current Date*" (Mode Page)
- "*Sommer/Winter sw*" (Mode Page)

While you set the further parameters, you will be asked for an 'Access Code', which depends on the current time (hour + 10).

Assign functions to inputs (assignment page)

- "*alarm relay*" no
- "*function input 1*" control
- "*function input 2*" off
- "*function input 3*" off
- "*function input 4*" off
- "*function input 5*" off
- "*function input 6*" off
- "*No.stages M1*" 2
- "*No.stages M2*" 2
- "*No.stages M3*" 0
- "*function optoc.1*" load limitation 1
- "*function optoc.2*" forced backrun
- "*function optoc.3*" feedback M1
- "*function optoc.4*" feedback M2

Control characteristic and refrigerant

- "*Application*" refrigeration
- "*Refrigerant*" R404a
- "*Setpoint Mode*" common

Next step: Which pressure transmitter is used ? (Mode Page):

- "*4/20mA LowVal 1*" = _ _ _ _
  The pressure which is displayed if the transmitter delivers 4 mA.
  If you use a DG 0/10 GSW: Set -1.0 bar (relative to ambient pressure)

- "*4/20mA HighVal 1*" = _ _ _ _
  This is the pressure which is displayed if the transmitter delivers 20 mA.
  If you use a DG 0/10 GSW: Set 9.0 bar (relative to ambient pressure)

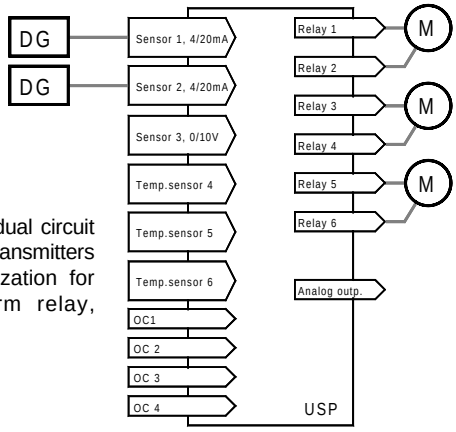
Control setpoints (Setpoint Page)

- "*Setpoint*" in °C (factory set even the middle of the neutral zone)
- "*Contr.hysteresis*" in K (range of the neutral zone)
- "*Forward Delay S1*" (Forward delay of the 1st stage)
- "*Backrun Delay S1*" (Backrun delay of the 1st stage)
- "*ForwDelay S2-12*" (Forward delay of all other stages)
- "*BackrDelay S2-12*" (backrun delay of all other stages)

Display correction

The actual pressure value can be calibrated by "*Calibration 1*" (Mode Page). Because in practice deviations > 1 bar are impossible, please check in this case if you have confound the absolute/relative pressure values of the pressure transmitter.

Settings for a typical condenser fan stage controller



Example:
3 dual-stage fans in a dual circuit condenser, 2 pressure transmitters 4-20mA, switch optimization for power fans, no alarm relay, refrigerant R134a

Parameter Settings

- "*current Time*" (Mode Page)
- "*current Date*" (Mode Page)
- "*Sommer/Winter sw*" (Mode Page)

While you set the further parameters, you will be asked for an 'Access Code', which depends on the current time (hour + 10).

Assign functions to inputs (assignment page)

- "*alarm relay*" no
- "*function input 1*" control
- "*function input 2*" control
- "*function input 3*" off
- "*function input 4*" off
- "*function input 5*" off
- "*function input 6*" off
- "*No.stages M1*" 2
- "*No.stages M2*" 2
- "*No.stages M3*" 2
- "*No.stages M4*" 0
- "*function optoc.1*" up to "*function optoc.4*" - - -

Control characteristic and refrigerant (Mode Page)

- "*Application*" refrigeration
- "*Refrigerant*" R134a
- "*Setpoint Mode*" absolute
- "*Switch Optimizat*" BRun Power Fans

Which pressure transmitter is used ? (Mode Page):

- "*4/20mA LowVal 1*" = _ _ _ _
  This is the pressure which is displayed if the transmitter delivers 4 mA. If you use a DG 0/25 GSW: set 0.0 bar
- "*4/20mA HighVal 1*" = _ _ _ _
  This is the pressure which is displayed if the transmitter delivers 20 mA. If you use a DG 0/25 GSW: set 25.0 bar

- "*4/20mA LowVal 2*" = _ _ _ _ Pressure value of the 2nd transmitter
- "*4/20mA HighVal 2*" = _ _ _ _ "

Control setpoints (Setpoint Page)

- "*Setpoint 1*" in °C (Fan 1 switches on)
- "*Setpoint 2*" in °C (Fan 1 high speed)
- "*Setpoint 3*" in °C (Fan 2 switches on)
- "*Setpoint 4*" in °C (Fan 2 high speed)
- "*Setpoint 5*" in °C (Fan 3 switches on)
- "*Setpoint 6*" in °C (Fan 3 high speed)

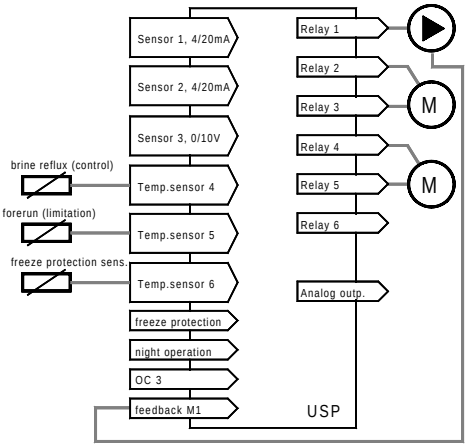
- "*Contr.hysteresis*" in K (around each setpoint)
- "*Forward Delay S1*" (Forward delay of the 1st stage)
- "*Backrun Delay S1*" (Backrun delay of the 1st stage)
- "*ForwDelay S2-12*" (Forward delay of all other stages)
- "*BackrDelay S2-12*" (backrun delay of all other stages)

Display correction

The actual pressure values can be calibrated by "*Calibration 1*" and "*Calibration 2*" (Mode Page)

Settings for a typical brine/chiller stage controller

Example:
1 brine pump with feedback and 2 dual stage compressors, if the pump doesn't work, the compressors may not switch on. 3 TF 201-temperature sensors, alarm relay , external freeze-protection switch, night shift by 2K initiated by an external clock.



- Perform wiring as planned:
  - Control sensor (brine reflux) at sensor input 4
  - Limitation sensor (brine forerun) at sensor input 5
  - Freeze protection sensor at sensor input 6
  - External freeze protection switch at OC1 (0V = activated)
  - External night shift contact at OC 2 (0V = activated)
  - Feedback signal of the pump at OC4 (mains voltage = feedback present)

Parameter Settings

- "*current Time*" (Mode Page)
- "*current Date*" (Mode Page)
- "*Sommer/Winter sw*" (Mode Page)

While you set the further parameters, you will be asked for an 'Access Code', which depends on the current time (hour + 10).

- "*alarm relay*" yes
- "*function input 1*" off
- "*function input 2*" off
- "*function input 3*" off
- "*function input 4*" control
- "*function input 5*" lim.cold
- "*function input 6*" frezprot
- "*No.stages M1*" 1
- "*No.stages M2*" 2
- "*No.stages M3*" 2
- "*No.stages M4*" 0
- "*function optoc.1*" freeze protection
- "*function optoc.2*" night op.actLow
- "*function optoc.3*" - - -
- "*function optoc.4*" feedback M1

Control characteristic (Mode Page)

- "*Application*" refrigeration
- "*Setpoint Mode*" coupled
- "*Sequence change*" Runtime -M1 (Excludes pump from sequencing)
- "*Refrigerant*" - - -
- "*Forced Feedback* " = 'yes'
- "*Sensor Selection*" = 'TF201 (PTC)'

Control setpoints (Setpoint Page)

- "*Setpoint* " in °C (brinepump switches on)
- "*Setpoint 2*" in K (M 1 switches on at this distance to the pump)
- "*Setpoint 3*" in K (2nd stage of M 1 switches on at this distance to the motor)
- "*Setpoint 4*" in K (M 2 switches on at this distance to the 2nd stage of machine 1)
- "*Setpoint 5*" in K (2nd stage of machine 2 switches on at this distance to the motor)
- "*Night shift*" = 2.0 K (shift setpoint by this value at night operation)
- "*Contr.hysteresis*" in K (around each setpoint)
- "*Forward Delay S1*" (Forward delay of the pump)
- "*Backrun Delay S1* " (Backrun delay of the pump)
- "*ForwDelay S2-12*" (Forward delay of all other stages)
- "*BackrDelay S2-12*" (Backrun delay of all other stages)

Display correction

The actual temperature value can be calibrated by "*Calibration 4*" to "*Calibration 6*"(Mode Page).

Run-up with a PC

If you switch on the controller, after a few seconds the display shows the 'Basic Display' or an actual failure message, the backlight of the display is off. If you press any key, the backlight switches on.
If the controller has been switched on the first time, the controller expects a language spec, the display shows parameter "*Sprache/language*" (Mode Page).

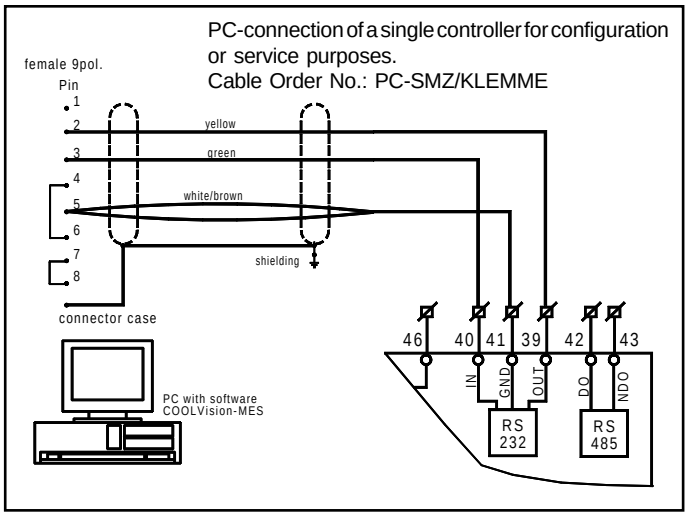
Run-up in a network

- Set "*Adress in Netwk*" (Mode Page)
- Check "*Baudrate*" (Mode Page), must be '9600'
- Set parameters from screen or upload parameter.

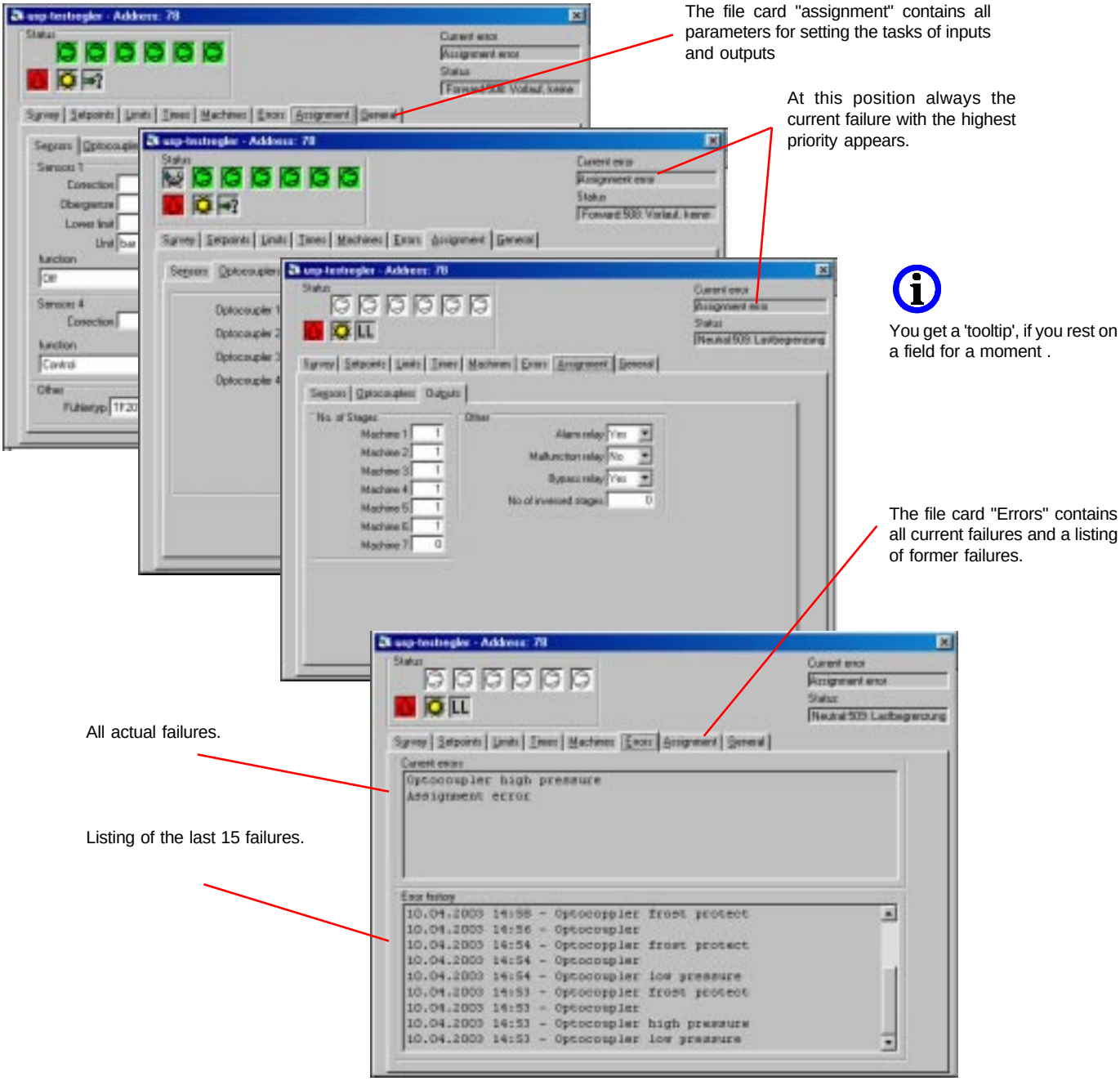
Run-up with a PC/Laptop

Run-up of the controller can be made by the software "COOLVision-MES" (**from vers. 1.64.9**). In this case a single controller unit must be connected to the PC via its RS-232-interface.

- Set "*Adress in Netwk*" (Mode Page)
- Operate the USP-unit from the PC's display.



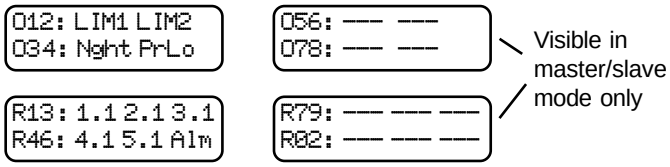
USP-windows in COOLVision-MES



How to check configuration and current states

Configuration:

Note the last parameters on the assignment page:



States of control

- "*State Act Setp*" (Actual Values Page)
- "*Control seipoint*" (Actual Values Page)
- "*Day/Night operat.*" (Actual Values Page)
- "*State of LoadLim*" (Actual Values Page)
- "*Analog value*" (Actual Values Page)

States of inputs/outputs:

- "*Optoc.-states*" (Actual Values Page)
- "*Stage states*" (Actual Values Page)
- "*Relay states*" (Actual Values Page)

Failure messages

Actual failure messages appear by the controller opens the 'Actual Failue'-Page. Resolved failures are recorded on the 'Hist.Failures'-Page.

Reset the USP-unit to factory settings

- Switch off controller unit
- Press and hold key "RET", switch unit on
- Wait until "• • • •" appears on display, then press keys "RET" and "⇩" quickly one after the other.
- "INIT" appears on display
- **After a few seconds, all data are erased and all parameters are reset to factory settings.**

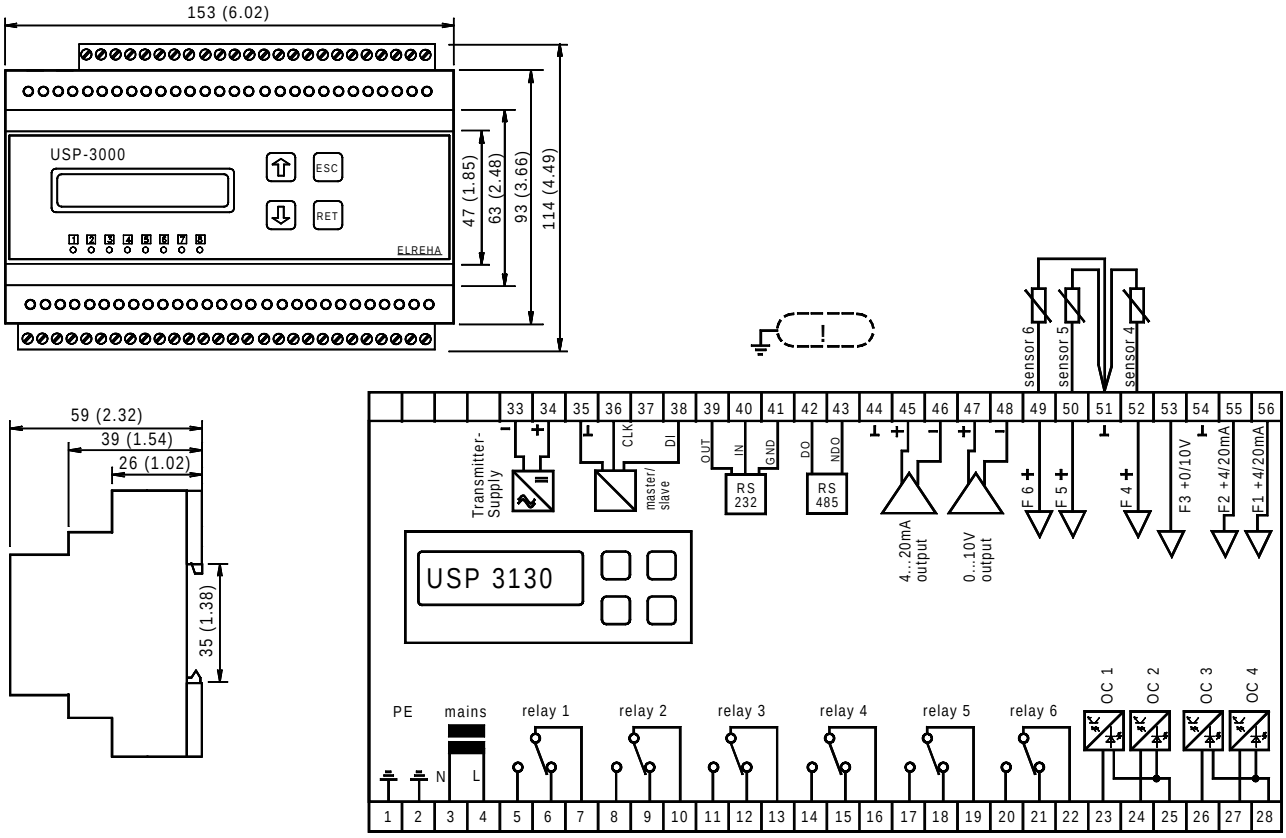
Troubleshooting

This chapter will be extended in future

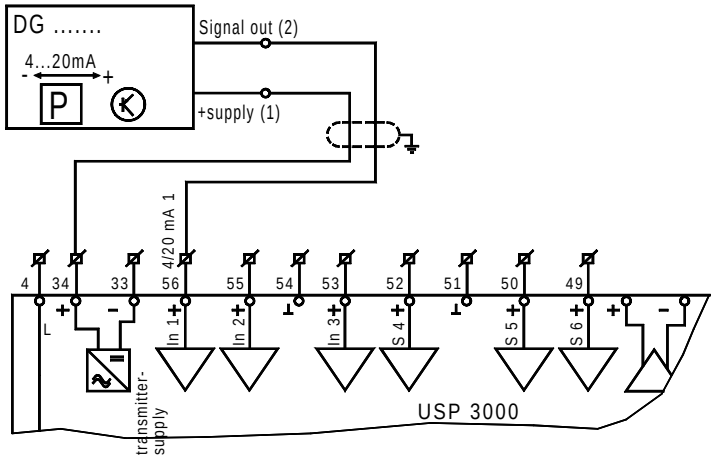
Failure	**Reason**
Extreme temperature deviations resp. short/broken message even though the sensor is connected correctly	Have you selected the correct sensor type ? Pre-set is TF 501
Deviation > 1 bar with pressure transmitters	extremely rare in practice, please check if there is a confusion of absolute/relative-pressure values of the pressure transmitter.
An actual value of a sensor/transmitter does not appear on display	Sensor is not assigned to a function (Assignment Page)
A specific parameter is not readable even though it is documented in this manual	This parameter is suppressed, because it is not necessary for the set configuration. *Example*: Actual value 1 will not be displayed if input 1 is not assigned to a function.
Forward/Backrun times are not equal to the preset times	The controller unit decides self-employed, because 'Delay Mode' is set to 'autoadaptive'
Controller does not accept access code (hour + 10)	Check correct setting of the internal clock
No stage will switch on	Controller is in manual mode, stages are switched off manually, OC-input with forced backrun or freeze protection function has no voltage at its input

USP 3130

Dimensions and Electrical Connection USP 3130



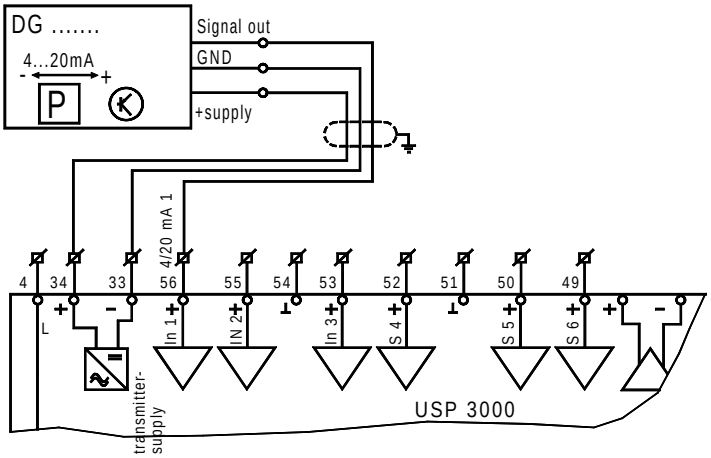
Sensor Connection USP 3130



2-wire-pressure transmitter with 4-20mA-signal at input 1, here a DG 0/10 GSW.
Settings (Assignment Page) if this sensor delivers the actual value:

"*Function Inp 1*" = 'Control'

Please compare the max. supply voltage values of controller and transmitter!



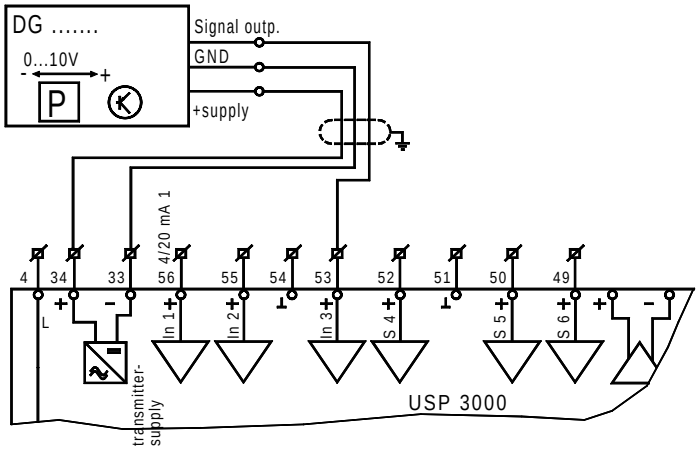
3-wire-pressure transmitter with 4-20mA-signal at input 1.
Settings (Assignment Page) if this sensor delivers the actual value:

"*Function Inp 1*" = 'Control'

Please note:
Only 1 three-wire transmitter can be connected !

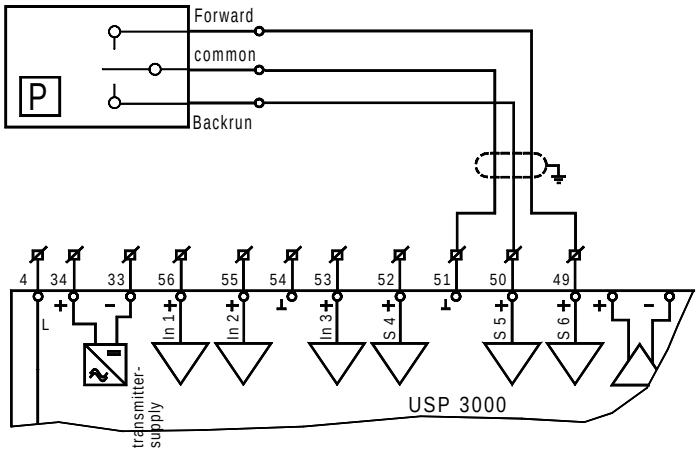
continuation >>>>>>>

Sensor Connection USP 3130 (Continuation)



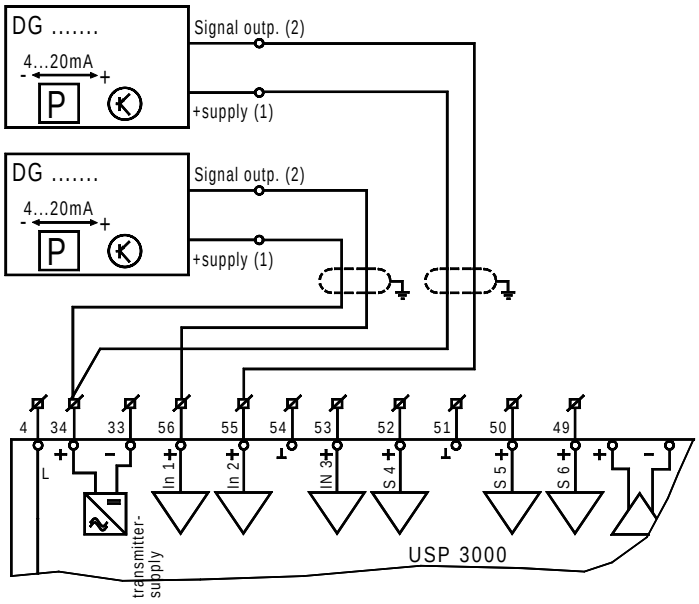
3-wire-pressure transmitter with a 0-10V-signal, such transmitters work at input 3 only.
Settings (Assignment Page) if this sensor delivers the actual value:

"*Function Inp 3*" = 'Control'



Pressostat.
Here we use the inputs 5-6 for pressostat connection. Settings (Assignment Page) if this sensor delivers the necessary informations:

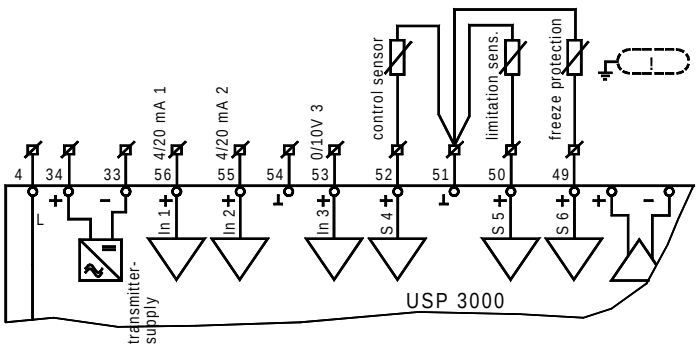
"*Function Inp 6*" = 'PressoFW'
"*Function Inp 5*" = 'PressoBR'



Two *2-wire*-transmitters with 4-20mA-signal at the inputs 1 and 2, e.g. for dual-circuit condensers. Both transmitters must be identical, the highest pressure determines control (CSD-function).
Settings (Assignment Page) :

"*Function Inp 1*" = 'Control'
"*Function Inp 2*" = 'Control'

This CSD-function can be made with 2-wire transmitters only, because it is not possible to supply two 3-wire transmitters !

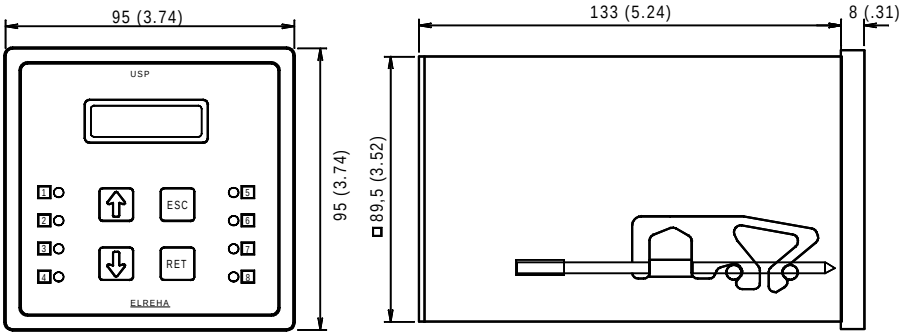


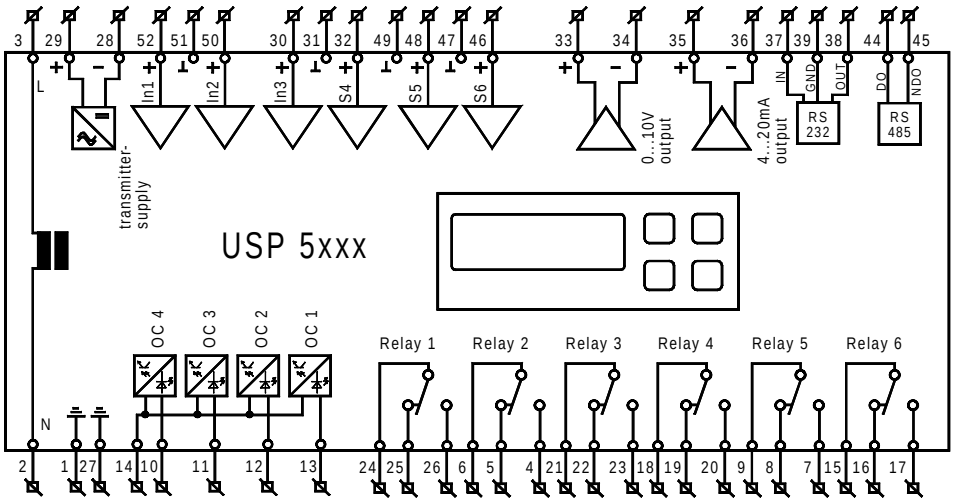
Temperature sensors
Here you can see a temperature sensor connection like used for brine/chiller systems.
Settings (Assignment Page) :

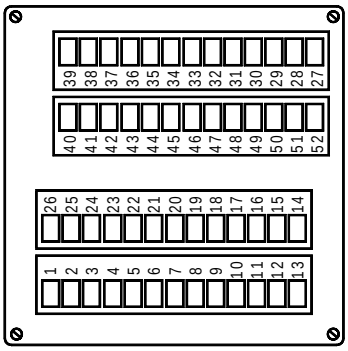
"*Function Inp 4*" = 'Control'
"*Function Inp 5*" = 'LimCold'
"*Function Inp 6*" = 'FrezProt'

USP 5130

Dimensions and Electrical Connection USP 5130

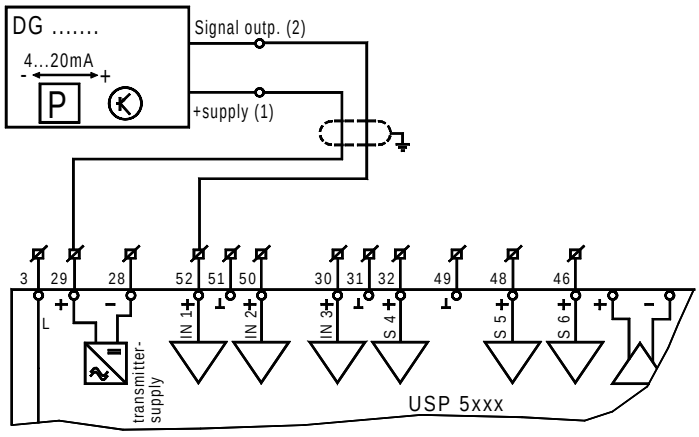






rear view

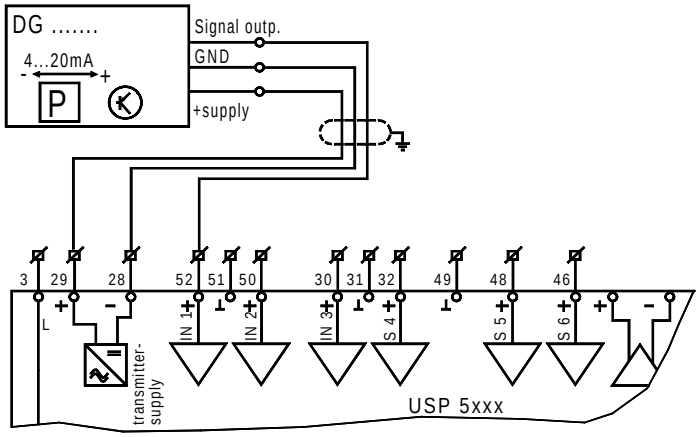
Sensor Connection USP 5130



2-wire-pressure transmitter with 4-20mA-signal at input 1, here a DG 0/10 GSW.
Settings (Assignment Page) if this sensor delivers the actual value:

"*Function Inp 1*" = 'Control'

Please compare the max. supply voltage values of controller and transmitter!



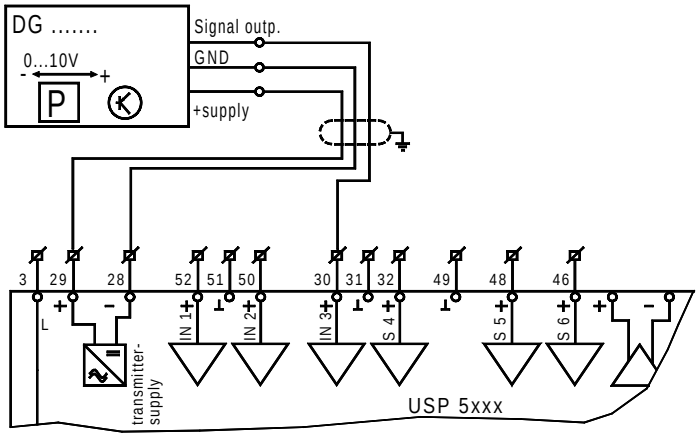
3-wire-pressure transmitter with 4-20mA-signal at input 1.
Settings (Assignment Page) if this sensor delivers the actual value:

"*Function Inp 1*" = 'Control'

Please note:
Only 1 three-wire transmitter can be connected !

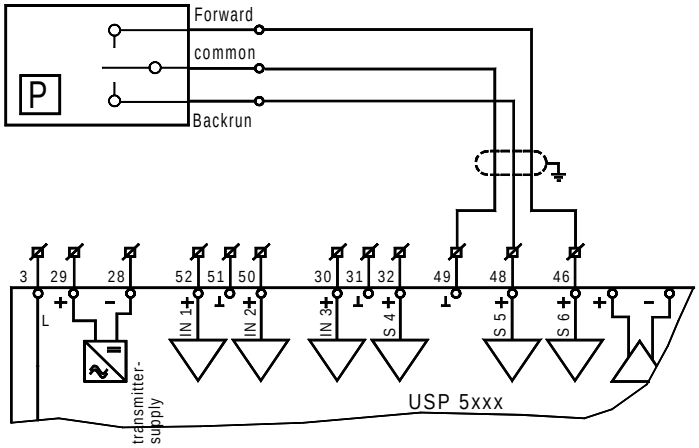
continuation >>>>>>>

Sensor Connection USP 5130 (continuation)



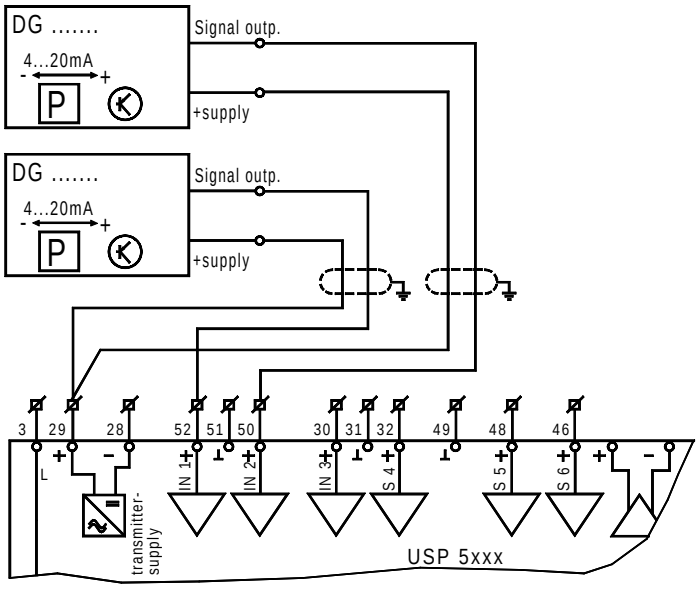
3-wire-pressure transmitter with a 0-10V-signal, such transmitters work at input 3 only.
Settings (Assignment Page) if this sensor delivers the actual value:

"*Function Inp 3*" = 'Control'



Pressostat.
Here we use the inputs 5-6 for pressostat connection. Settings (Assignment Page) if this sensor delivers the necessary informations:

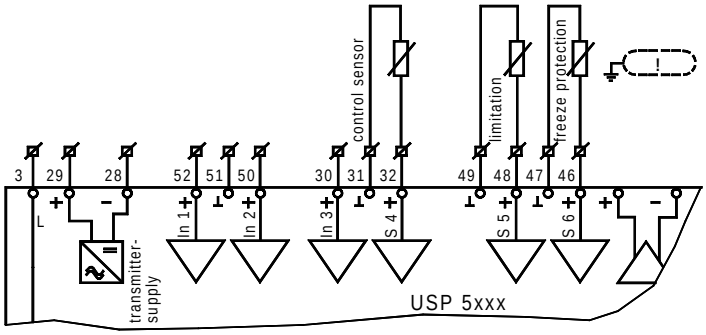
"*Function Inp 6*" = 'PressoFW'
"*Function Inp 5*" = 'PressoBR'



Two *2-wire*-transmitters with 4-20mA-signal at the inputs 1 and 2, e.g. for dual-circuit condensers. Both transmitters must be identical, the highest pressure determines control (CSD-function).
Settings (Assignment Page) :

"*Function Inp 1*" = 'Control'
"*Function Inp 2*" = 'Control'

This CSD-function can be made with 2-wire transmitters only, because it is not possible to supply two 3-wire transmitters !

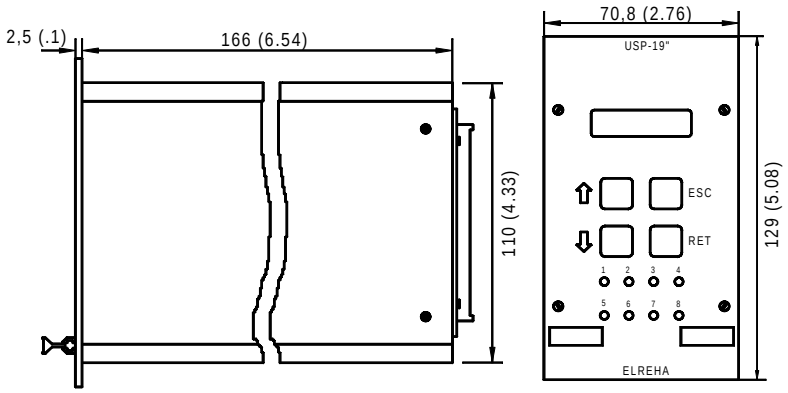


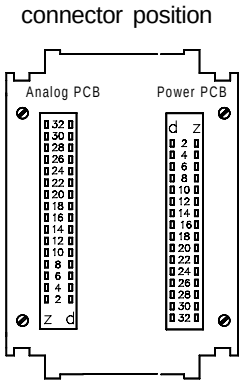
Temperature sensors
Here you can see a temperature sensor connection like used for brine/chiller systems.
Settings (Assignment Page) :

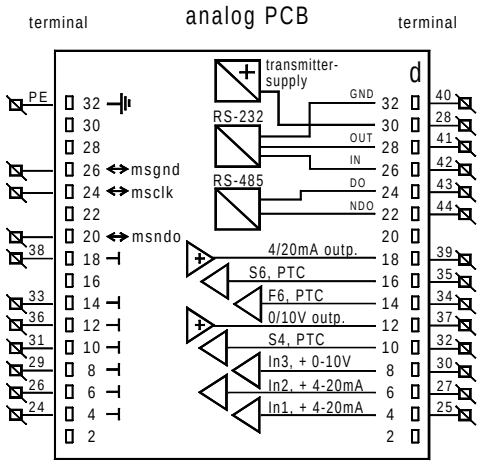
"*Function Inp 4*" = 'Control'
"*Function Inp 5*" = 'LimCold'
"*Function Inp 6*" = 'FrezProt'

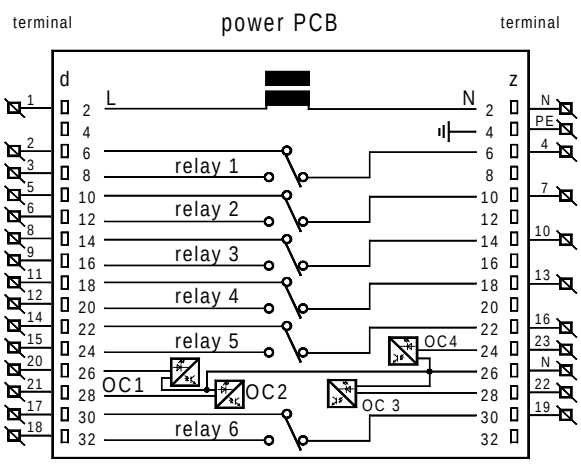
USP 19130

Dimensions and Electrical Connection USP 19130

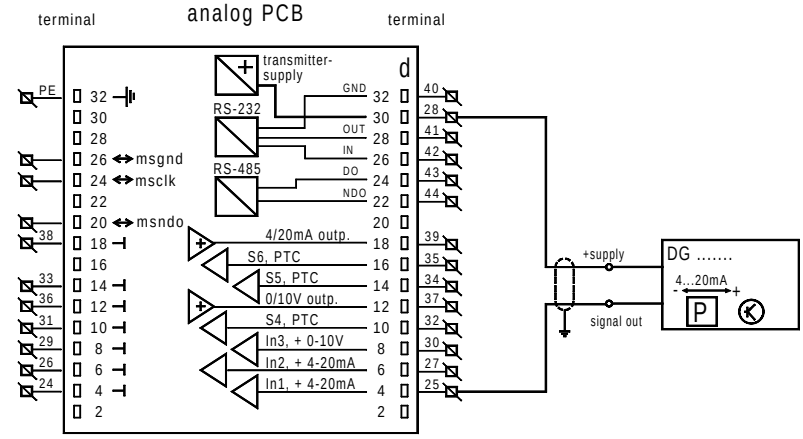








Sensor Connection USP 19130

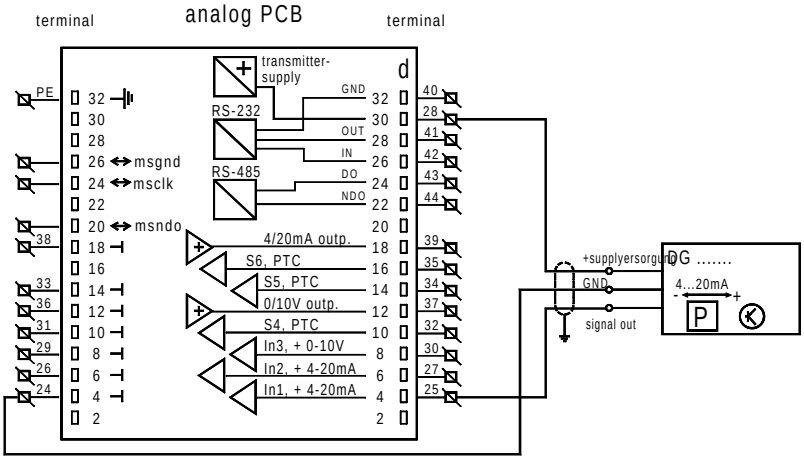


2-wire-pressure transmitter with 4-20mA-signal at input 1, here a DG 0/10 GSW.
Settings (Assignment Page) if this sensor delivers the actual value:

"*Function Inp 1*" = 'Control'

Connectors are equal to DIN 41612, type „F“, rear view. The 'terminal'-numbers are used in ELREHA-prewired subracks.

Please compare the max. supply voltage values of controller and transmitter!



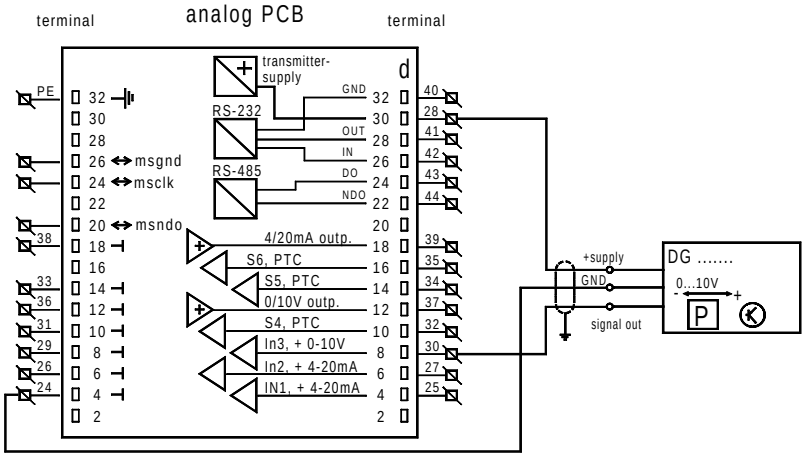
3-wire-pressure transmitter with 4-20mA-signal at input 1.
Settings (Assignment Page) if this sensor delivers the actual value:

"*Function Inp 1*" = 'Control'

Please note:
Only 1 three-wire transmitter can be connected !

continuation >>>>>>>

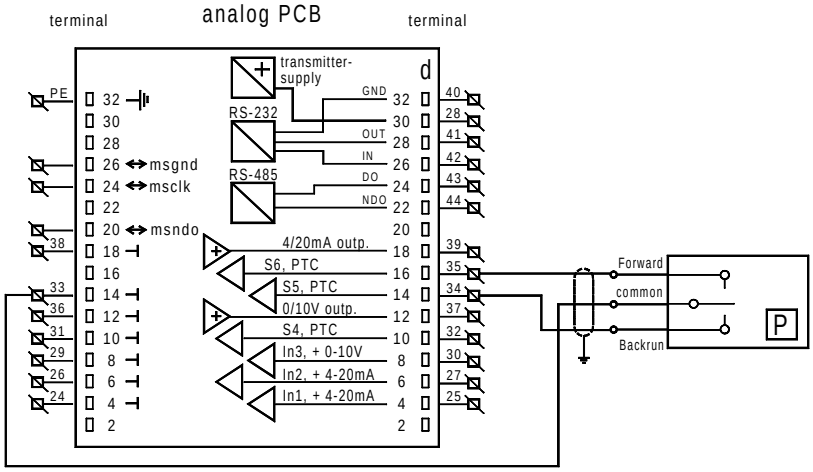
Sensor Connection USP 19xxx (Continuation)



3-wire-pressure transmitter with a 0-10V-signal, such transmitters work at input 3 only.
Settings (Assignment Page) if this sensor delivers the actual value:

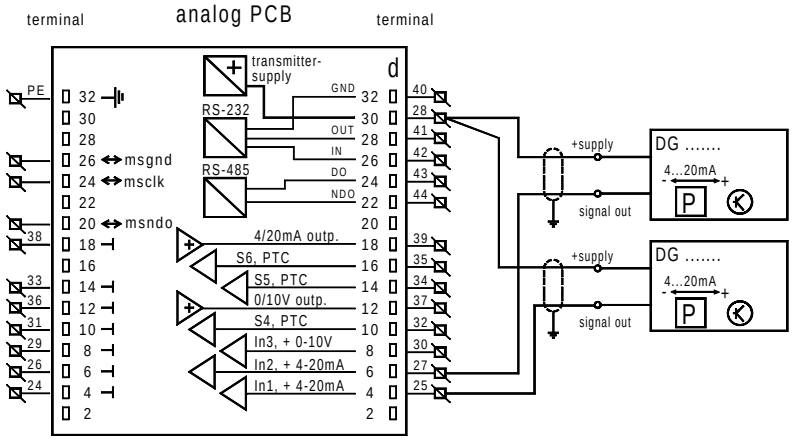
"*Function Inp 3*" = 'Control'

Connectors are equal to DIN 41612, type „F“, rear view.
The 'terminal'-numbers are used in ELREHA-prewired subracks.



Pressostat.
Here we use the inputs 5-6 for pressostat connection. Settings (Assignment Page) if this sensor delivers the necessary informations:

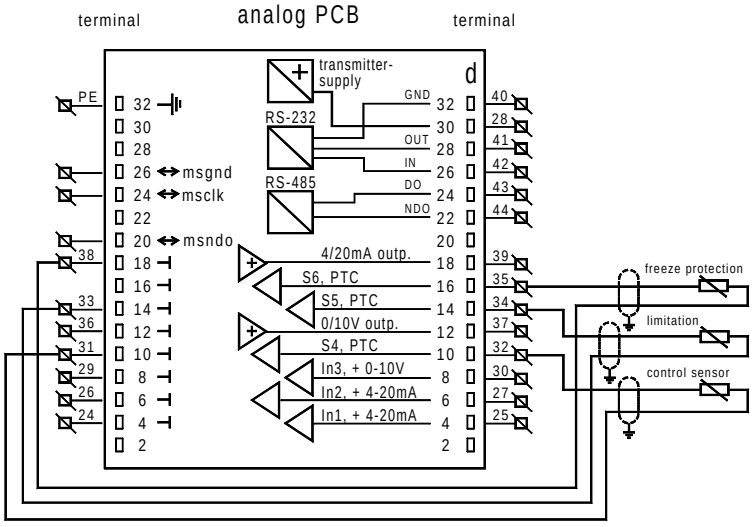
"*Function Inp 6*" = 'PressoFW'
"*Function Inp 5*" = 'PressoBR'



Two *2-wire*-transmitters with 4-20mA-signal at the inputs 1 and 2, e.g. for dual-circuit condensers. Both transmitters must be identical, the highest pressure determines control (CSD-function).
Settings (Assignment Page) :

"*Function Inp 1*" = 'Control'
"*Function Inp 2*" = 'Control'

This CSD-function can be made with 2-wire transmitters only, because it is not possible to supply two 3-wire transmitters !



Temperature sensors
Here you can see a temperature sensor connection like used for brine/chiller systems.
Settings (Assignment Page) :

"*Function Inp 4*" = 'Control'
"*Function Inp 5*" = 'LimCold'
"*Function Inp 6*" = 'FrezProt'

Technical Data

Supply voltage ..... see type overview, page 2
Power consumption ..... appr. 5VA
Ambient temperature ..... 0...+60°C (32...140°F)
Max. air humidity ..... 85% r.H., not condensing
Inputs ..... 2x 4-20 mA, Ri = 100 ohms
1x 0-10V DC, Ri = > 10kohms
3x TF 201 (PTC) or Pt 1000 (TF 501)
Control-(OC)-inputs ..... 4x mains voltage~, max. 3 mA
Relay outputs ..... 6x SPDT, potential free
contact rating 8A cosphi=1/250VAC
Analog outputs ..... 1x 0...10V, max. 3 mA
1x 0/4...20mA
transmitter supply ..... 24V DC, +/- 20%, 40mA max.

Attention: If all relays are disabled, at some controller units the transmitter supply voltage may be up to 33V !

Ranges ..... see parameter pages
Interfaces ..... 1x RS 232, 1x RS 485
Data storage ..... typ. 10 years without mains voltage
Real time clock ..... x-tal, with automatic summer/winter switch
Case USP 3130 ..... plastic case for DIN-rails, IP30, with foil keypad, pluggable screw terminals
USP 5130 ..... plastic case for panel mounting, 96 x 96 mm, pluggable screw terminals, protection IP 54 from front
USP 19130 ..... 19"-Al-cassette, IP 30

Accessories

- Pressure transmitter (2-wire) DG 0/10 GSW (0...10 bar) or Pressure transmitter (2-wire) DG 0/25 GSW (0...25 bar)
- Temperature sensors TF 201 (PTC) or TF 501 (Pt1000), the quantity depends on application
- PC-Software "**COOLVision**", Module "**COOLVision-MES**" for remote control and configuration Module "**COOLVision-Analyse**" and "**COOLVision-SMM**" for recording, visualization and alarm forwarding.

USP 19130:

- Female connectors with solder tags or flat plugs
- 19"-subrack or panel case

EG-Statement of Conformity

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).
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 confirmity testing with regard to electromagnetic consistency :

EN 61000-4-1, EN 61000-4-2, EN 61000-4-3*, EN 61000-4-4, EN 61000-4-5, EN 55011 B, EN 50081, part 1 and 2; EN 50082, part 1 and 2, EN 61010 part 1, EN 61010-1/A2 part 1/A1

This statement is made from the manufacturer / importer

ELREHA Elektronische Regelungen GmbH
68766 Hockenheim, Germany
(*name / adress*)

by:

Klaus Birkner,.....

Development and Leader of the EMC-Lab.....

Hockenheim.....**09.01.2002**.....
city *date* *sign*

**The conformity with IEC 1000-4-3 is derived from the IEC 1000-4-2 and IEC 1000-4-4 test results. The correlation with IEC 1000-4-3 is based on test results which are located on site at the manufacturer.*

Connection- & Installation Notes

Please always note Safety Informations on page 2 !

- 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 unit's type label. Please pay attention to the specified Temperature-/Humidity Limits. Outside these limits malfunctions may occur.
- Please note maximum load of relay contacts (see technical data).
- Important ! Please note the start-up peaks and current timing of the load.
- Sensor leads should be shielded cable with one end of the shielding connected to ground. This avoids irregular switching caused by electro-magnetic interference.
- Always connect the PE terminal to PE !
- **Please note maximum load of relay contacts (see technical data).**
- Important ! Please also note the start-up peaks and current timing of the load.
- The used temperature sensors must be equal, a mixed connection of different types is impossible.
- The USP is able to provide one 3-wire transmitter or two 2-wire transmitters.
  Connecting two 3-wire transmitters may damage the USP!
- The wire gauge of the sensor cables is not critical, if they should be lenghtened, 1 sqmm are adequate.
- Mounting the controller close to power relays is unfavourable in case of the electro-magnetic interference.
- Please note the common regulations for installing data wires.
- Please note that TF-type temperature sensors are not intended for prolonged use in water or moist environments. The sensor sheath is waterproof, but water can migrate through the cable jacket over long term immersion. Please always use dip-fittings.

- **Never operate unit without housing.**

ELREHA
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D-68766 Hockenheim
Schwetzinger Str. 103

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Internet ..... www.elreha.de
e-mail ..... team@elreha.de

This manual, which is part of the product, has been set up with care and our best knowledge, nevertheless, mistakes may be 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. You will find this version number also on the „Mode Page" at parameter „Software Version".

set-up:	10.4.03	checked:	10.4.03	released:	10.4.03
by:	tkd/jr	by:	mv/jk	by:	mv/mh