Mini-Controller KS 10
Mini- Regler KS 10
Régulateurs miniatures KS 10

Operating manual
KS10
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English - Deutsch - Français

PHILIPS

Process and Machinery Automation

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Contents

1 KS10 - Instruction Manual

Safety Symbol ⚠

The symbol calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury or damage to or destruction of part or all of the product. do not proceed beyond a safety symbol until the indicated conditions are fully understood and met.

1.1 INTRODUCTION

The KS 10 Fuzzy Logic plus PID microprocessor controller, incorporates a bright, easy to read 4-digit LED display, indicating process value. The Fuzzy Logic technology enables a process to reach a predetermined setpoint in the shortest time, with the minimum of overshoot during power-up or external load disturbance. The units are housed in a 1/32 DIN case, measuring 24 mm x 48 mm with 98mm behind panel depth. The units features three touch keys to select the various control and input parameters. Using a unique command called " CONFIGURE LEVEL ", a supervisor has the flexibility of determining which parameters are accessible by the user. Also the scrolling sequence of parameters are fully configurable according to your requirement. This is particularly useful to OEM's, as it is easy to limit access to suit the specific application.

The KS10 is powered by 90-264VAC or 20-32 VUC supply, incorporating a 3 amp. control relay output and a 3 amp. alarm relay output as standard which can be programmed into Output 2 or dwell timer. Alternative output options include SSR drive, 0/4-20mA and 0-10 volts. The KS10 is fully programmable for PT100, thermocouple types K, J, T, E, B, R, S, N, 0-20mA, 4-20mA and voltage signal input, with no need to modify the unit.

Digital communications RS-485 or 0/4-20mA retransmission are available as an additional option. These options allow the KS10 to be integrated with supervisory control systems and software, or alternatively drive remote display, chart recorders or data-loggers.

2 Coding KS 10

KS 10 Mini-Controller with 1 alarm relay

9407	4	0	1					1

Power supply	90-264 VAC	0
	20-32 VDC	1
Control output	Relay (3 A / 240 VAC)	0
	Logic (20 mA / 24 V)	1
	Continuous 0-20 mA (≤ 500 Ω)	2
	Continuous 4-20 mA (≤ 500 Ω)	3
	Continuous 0-10 V (≥ 500 Ω)	4
Option	None	0
	Digital interface RS 485	1
	Retransmission output 4-20 mA	2
	Retransmission output 0-20 mA	3
Configuration	Basic configuration	0
	Configuration to specification	9

2.1 Configuration Minicontroller KS 10

Name	Indication	Order no.: 9407 401 ...01 Basic configuration	Remarks	Order no.: 9407 401 ...9? Configuration as: CONF-010- .... Configuration to specification	Remarks
Operating level 0					
Alarm 1 Set Point Value	ASP.1	10,0 °C	Or Dwell Time		
Ramp Rate	rAMP	0,00 °C/min			
Offset Value (P- / PD-Controller)	oFSt	0,0 %	Integral Time ti = 0		
Operating level 1					
Shift Process Value	ShiF	0,0 °C			
Proportional Band	Pb	10,0 °C	Output 1		
Integral Time	ti	120 s			
Derivative Time	td	40 s			
Hysteresis of Alarm 1	AhY.1	0,8 °C			
Hysteresis of ON-OFF control	hYSt	0,8 °C	PB = 0		
Address of the unit	Addr	0	For communication		
Operating level 2					
Low scale of Set Point range	LoSC	-17,7 °C	mA / V: Span Start		
High scale of Set Point range	hISC	537,7 °C	mA / V: Span End		
Power Limit	PL.1	100 %	Output 1		
Power Limit	PL.2	100 %	Output 2 (Cooling)		
Input Type	inPt	Type J			
Unit	unit	°C			
Resolution	rESo	1 Digit Decimal			
Control Action	ConA	Inverse (Heating)	Output 1		
Alarm 1 Mode	A1MD	Deviation High Alarm			
Alarm 1 Special Function	A1SF	None			
Cycle Time	CYC	20 s	Output 1		
Cycle Time Cooling	C.CYC	20 s	Alarm 2: Cooling		
Proportional Band Cooling	C.Pb	20,0 °C			
Dead Band Heating-Cooling	d-B	0,0 °C			
Tool Program Level					
Status of Control and Alarm	FAIL	Output 1: "OFF"			
Outputs in case of failure	SAFE	Alarm 1: "ON"			
f.e. sensor break		Alarm 2: "ON"			
		Output 2: "ON"	Cooling		
Lock parameters	LOCK	Level 0: "FREE"			
	PArA	Level 1: "FREE"			
		Level 2: "FREE"			
Configuration of the Security	CONF	As listed above			
levels for all parameters	LEVL				

3 Technical data

Mini-Controller KS 10

UNIVERSAL INPUT

Table of the input ranges				
Sensor	Type	Input range		Error*
Fe-CuNi	J	-50...999 °C	-58...1830 °F	≤ 2 K
NiCr-Ni	K	-50...1370 °C	-58...2500 °F	≤ 2 K
PtRh-Pt 10%	S	0...1750 °C	32...3182 °F	≤ 2 K
PtRh-Pt 13%	R	0...1750 °C	32...3182 °F	≤ 2 K
PtRh-Pt 6%	B	300...1800 °C	572...3272 °F	≤ 3 K
Cu-CuNi	T	-270...400 °C	-454...752 °F	≤ 2 K
Nicrosil/Nisil	N	-50...1300 °C	-58...2372 °F	≤ 2 K
NiCr-CuNi	E	-50...750 °C	-58...1382 °F	≤ 2 K
Pt 100 (DIN)		-200...400 °C	-328...752 °F	≤ 0,4 K
Linear		4-20 mA	-1999...9999	≤ 0,05 %
Linear		0-20 mA	-1999...9999	≤ 0,05 %
Linear		0-1 V	-1999...9999	≤ 0,05 %
Linear		0-5 V	-1999...9999	≤ 0,05 %
Linear		1-5 V	-1999...9999	≤ 0,05 %
Linear		0-10 V	-1999...9999	≤ 0,05 %

* Error inclusive linearity, temperature compensation, lead, offset drift

Standard current 0/4...20 mA
Input resistance: 47 Ω

Direct voltage
Input resistance: 100 kΩ

Sensor break protection
ON- or OFF-condition configurable
for the outputs

Load resistance ≤ 100 Ω

Temperature compensation
Additional error: typical 0,1 K / 10 K

Resistance 2 or 3-wire connection

Shift of process value (ShiF): -111...111 °C

Noise suppression
Normal Mode Rejection: 60 dB
Common mode Rejection: 120 dB

Sampling time 200 ms

POWER SUPPLY

90...264 VAC, 50/60 Hz
20-32 VDC optional
Power consumption: < 5 VA
(With communication: ≤ 10 VA)

OUTPUTS

Relay contact rating:
≤ 240 VAC, ≤ 3 A, resistive load

Logic output for SSR Drive:
Rating 24 V, 20 mA

Continuous output:
Galvanically isolated
Resolution 0,4 %
0-20 mA, 4-20 mA: load ≤ 500 Ω
0-10 V: load ≥ 500 Ω

CONTROL CHARACTERISTICS

Proportional band Pb: 0...200 °C
Integral action time ti: 0...3600 s
Working point (ti=0 oFSt): 0...100,0 %
Derivative action time td: 0...1000 s
Hysteresis of signaller (hYSt): 0...11,0 °C
Duty cycle (CYC): 0...99 s
Control action: Inverse („Heating") or direct („Cooling")
Upper output limit (PL.1/PL.2): 0...100 %

Set-point with ramp function
Ramp rate (rAMP): 0...55,55 °C/min
Dwell time at set-point (Alarm relay 1)
Relay On or Off
t.oon / t.ooF: 0...9999 min

ALARM RELAY

Configurable functions:
Alarm suppression on power up
Latch alarm
High/Low alarm for process value,
deviation or deviation band

Alarm set-points (ASP.1)
Absolute alarm: input range
Relative alarm: -111...111 °C
Alarm hysteresis (AHY.1): 0...11 °C

Alarm relay 2 configurable for
cooling function (three-point control action)

Cycle time cooling (C.CYC): 0...99 s
Proportional band cooling (C.Pb): 0...200 °C
Dead band heating-cooling: - 111...111 °C

COMMUNICATION

RS 485 interface
Data protocol: Modbus
Interface address (Addr): 0...31
Baudrate: 9600 Baud

Retransmission output: 0 or 4...20 mA (≤ 500 Ω)
galvanically isolated, scalable
Resolution: 0,025 %

ENVIRONMENTAL CONDITIONS

CE-marking: According to 89/336/EWG
Electrical safety: According to EN 61010-1
(VDE 0411-1)
Overvoltage category II

Pollution degree 1
Operating voltage 300 V
Protection class II
Electromagnetic radiation: Complies with EN 50081-1
Electromagnetic immunity: Complies with EN 50082-2

Protection front: IP 65, NEMA 4X
Operation temperature: -10...50 °C
Relative humidity: 0...90 %, no condensation
Vibration test: 10...55 Hz / 1 mm
Shock test: 20 g

GENERAL

Housing material: Polycarbonate, flame-retardant
Front dimensions: 48*24 mm
Depth behind panel: 75 mm
Front panel mounting dimensions:
45(+0,5)*22,2(+0,3) mm
Electrical connection:
Screw terminals: max. 2,5 mm²
Accessories: Operating instructions
Weight: 0,11 kg

4 INSTALLATION

⚠ Dangerous voltages capable of causing death are sometimes present in this instrument. Before installation or beginning any trouble shooting procedures the power to all equipment must be switched off and isolated. Units suspected of being faulty must be disconnected and removed to a properly equipped workshop for testing and repair. Component replacement and internal adjustments must be made by qualified maintenance personnel only.

⚠ Do not use this instrument in areas subject to hazardous conditions such as excessive shock, vibration, dirt, moisture, corrosive gases or oil. The ambient temperature of the areas should not exceed the maximum rating specified in Section 3.

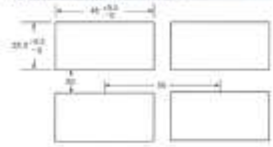
4.1 UNPACKING:

Upon receipt of the shipment remove the instrument from the carton and inspect the unit for shipping damage. If any damage due to transit is notices, report and file a claim with the carrier. Write down the type number (Typ) and the serial number (Nr.), when corresponding with our service center. See label on the controller.

4.2 MOUNTING

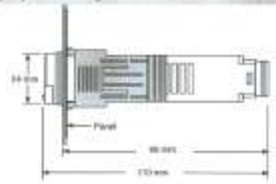
Make panel cutout to dimension shown in Figure 1.

Fig.:1 Mounting dimensions



(a) The clamp for quick mounting:
Take the clamp away and insert the controller into panel cutout install the clamp back and push it forward till the controller firmly onto the panel.

Fig.:2 The clamp for quick mounting



(b) The clamps for protection NEMA 4X / IP65:
Take both mounting clamps away and insert the controller into panel cutout. Install the mounting clamps back. Gently tighten the screws in the clamp till the controller front panel is fitted snugly in the cutout.

Fig.:3 The clamps for protection NEMA 4X / IP65

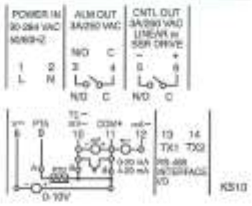
4.3 WIRING PRECAUTIONS

- Before wiring, verify the label for correct model number and options. Switch off the power when checking.
- Care must be taken to ensure that maximum voltage ratings specified in Section 3 are not exceeded.
- It is recommended that power to these instruments be protected by fuses or circuit breakers rated at the minimum value possible.
- All units should be installed inside a suitably grounded metal enclosure to prevent live parts being accessible to human hands and metal tools.
- All wiring must conform to appropriate standards of good practice and local codes and regulations. Wiring must be suitable for voltage, current, and temperature ratings of the system.
- The " stripped " leads as specified in Figure 3 below are used for power and sensor connections.
- Take care not to over-tighten the terminal screws.
- Unused control terminals should not be used as jumper points as they may be internally connected, causing damage to the unit.
- Verify that the ratings of the output devices and the inputs as specified in Table 4.1 are are not exceeded.
- Electric power in industrial environments contains a certain amount of noise in the form of transient voltages and spikes. This electrical noise can enter and adversely affect the operation of microprocessor-based controls. For this reason we strongly recommend the use of shielded thermocouple extension wire which connects from the sensor to the controller. This wire is a twisted-pair construction with foil wrap and drain wire. The drain wire is to be attached to ground at one end only

4.4 CONNECTION AND WIRING

The following connections for outputs and inputs are provided at the rear of the controller housing:

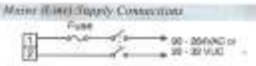
Fig.:4 Rear Terminal Connections



4.4.1 Mains (Line) Input

The controller is supplied to operate on 90-264VAC or 20-32 VUC. Check that the installation mains voltage corresponds to that indicated on the product label before connecting power to the controllers.

Fig.:5 Mains (Line) Supply Connections



⚠ This equipment is designed for installation in an enclosure which provides adequate protection against electric shock. The enclosure must be connected to earth ground.

Local requirements regarding electrical installation should be regidly observed. Consideration should be given to the prevention of unauthorised personnel from gaining access to the power terminations.

4.4.2 Thermocouple Input

Thermocouple input connections are shown in Figure 6. The correct type of thermocouple extension lead-wire or compensating cable must be used for the entire distance between the controller and the thermocouple, ensuring that the correct polarity is observed throughout. Joints in the cable should be avoided, if possible.

Fig.:6 Thermocouple Input Connections

The colour codes used on the thermocouple extension leads are shown in the following Table 4.1.

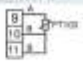
Thermocouple Type	Cable Material	British BS	American ASTM	German DIN	French NFE
T	Copper Constantan	+ white - blue * blue	+blue - red * blue	+ red - brown * brown	+ yellow - blue * blue
J	Iron / Constantan	+ yellow - blue * black	+ white - red * black	+ red - blue * blue	+ yellow - black * black
K	Nickel Chromium	+ brown - blue * red	+ yellow - red * yellow	+ red - green * green	+ yellow - purple * yellow
R S	13% Copper 10% Copper Nickel	+ white - blue * green	+ black - red * green	+ red - white * white	+ yellow - green * green
B	Platinum / Rhodium		+ grey - red * grey		

* Colour of overall sheath

4.4.3 *PT100 Ohm RTD Input*

RTD connection are shown in Figure 7, with the compensating lead connected to terminal 11. For two-wire RTD inputs, terminals 10 and 11 should be linked. The three-wire RTD offers the capability of lead resistance compensation provided that the three leads should be of same gauge and equal length.

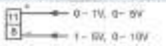
Fig.:7 RTD Input Connections



4.4.4 *DC Linear Input*

DC linear voltage and linear current connections are shown in Figure 8 and Figure 9.

Fig.:8 Linear Voltage Input Connections



Input Impedance = 100k ohm

Fig.:9 Linear Current Input Connections

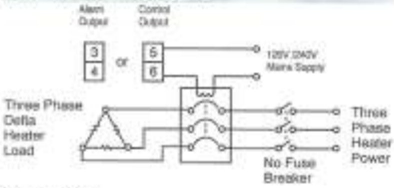
4.4.5 *Relay Output Direct Drive*

Figure 10 shows connections using the internal relay to drive a small load. The current does not exceed 3 amperes.

Fig.:10 Relay Direct Drive Connections

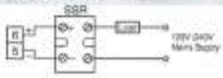
4.4.6 *Relay Output Contactor Drive*

Fig.:11 Contactor drive Connections



4.4.7 *SSR Drive Output*

Fig.:12 SSR Drive Connections

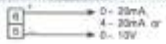


Controllers fitted with the SSR drive output produce a time-proportional non-isolated pulse voltage (0-20V nominal, output impedance 660 ohms). The connections are shown in Figure 12.

4.4.8 *Linear Output*

There are three types of linear output modules (See Section 2) can be selected for control output (OUT 1). The connections are shown in Figure 13.

Fig.:13 Linear Voltage / Current Connections



4.5 SENSOR PLACEMENT

Proper sensor placement can eliminate many problems in a control system. The probe should be placed so that it can detect any temperature change with minimal thermal lag. In a process that requires fairly constant heat output, the probe should be placed close to the heater. In processes where the heat demand is variable, the probe should be closer to the work area. Some experimenting with probe location is often required to find this optimum position.

Proper sensor type is also a very important factor in obtaining precise measurements. The sensor must have the correct temperature range to meet the process requirements. In special processes the sensor might have to have different requirements such as leak-proof, anti-vibration, antiseptic, etc.

Standard sensor limits of error are 4 degrees F (2 degrees C) or 0.75% of sensed temperature (half that for special) plus drift caused by improper protection or an over-temperature occurance. This error is far greater than controller error and cannot be corrected at the sensor except by proper selection and replacement.

5 OPERATION

5.1 FRONT PANEL DESCRIPTION

Fig.:14 Front Panel description

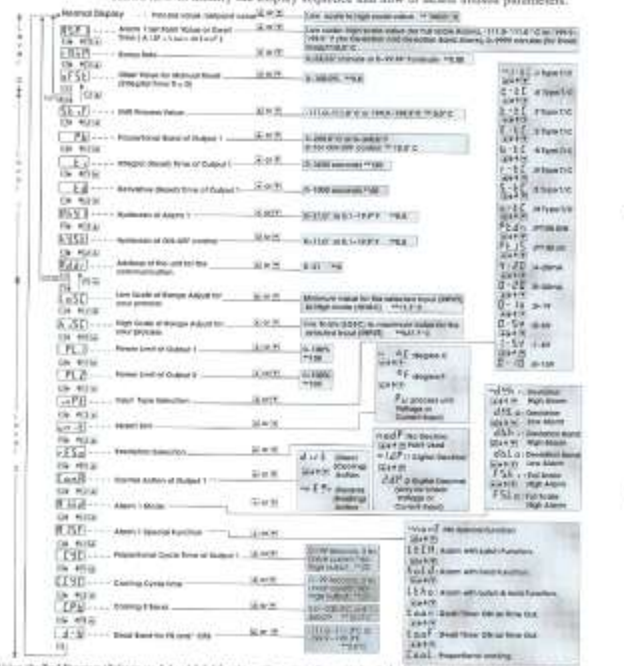
5.2 KEYPAD OPERATION

* With power on, it has to wait for 12 seconds to memorize the new values of parameters once it been changed.

TOUCHKEYS	FUNCTION	DESCRIPTION
▲	Up Key	Press and release quickly to select the desired digit of a numerical parameter to change. Press and hold to increase the value of the selected digit for a numerical parameter or to change the selection for an index parameter.
▼	Down Key	Press and release quickly to select the desired digit of a numerical parameter
[Scroll]	(Direct) Scroll Key	Select the parameter in a direct sequence. Also used to select the reset
Press [Scroll] for at least 3 seconds	Long Scroll / Enter Key	Select the protected parameters in higher security level, also used to actuate
Press [Scroll] and ▲	Reverse Scroll	Select the parameter in a reverse sequence during parameter scrolling.
Press [Scroll] and ▲ for at least 3 seconds	Lock Key	Disable keypad operation to protect all the parameters from tampering.
Press [Scroll] and ▲	Tool Program Key	Select the tool program in sequence.
Press ▲ and ▼	Reset / Exit Key	Unlock keypad operation and reset the front panel display to a normal display mode, also used to leave the tool program execution or ending the autotune and manual control execution.
Press ▲ and ▼ for at least 3 seconds	Autotune Key	Press and hold both keys for at least 3 seconds then release to start execution of autotune program.

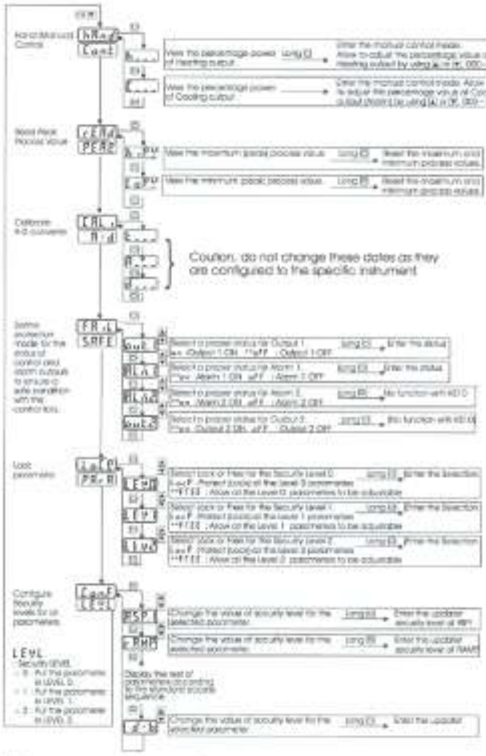
5.3 FLOW CHART OF PARAMETERS

The following chart shows a typical (default) access sequence of parameters. Note 1 shows how to modify the display sequence and how to delete unused parameters.



1.) Using the Tool Program (Refer to sec.5.4 and 5.5.5 for the configuration of security level) the display sequence and the security level for any parameter are configurable. Also any unused parameter can be removed from the display sequence to simplify the operation.
2.) Using long scroll key (press and hold ⊡ for at least 3 seconds) to select parameters in higher security level.
3.) To change the value of a numerical parameter (the value of which is denoted by a number) press and release the ▲ or ▼ key to select the desired digit, then press and hold the ▲ or ▼ key to change the value of the value selected digit. To change the value of an index parameter (The value of which is abbreviated by letters) press and hold the ▲ or ▼ key to select the desired value.
**: Denotes the default setting.

5.4 FLOW CHART OF TOOL PROGRAMS



**: Denotes the default setting.

5.5 SETTING-UP PROCEDURES

As power applied, the model number of the controller and its software version number will be displayed for 3 seconds, then all the display segments and LED indicators will be lit for 3 seconds. After the 6 seconds of initial cycle the controller enters the normal display mode, the display shows the current process value and the alternative display shows the setpoint value. The display will continuously flash in cases of:

(1) during executing autotune program
(2) during executing manual mode program
(3) warning that the next parameter is a higher level parameter as scroll key is depressed. The warning message will maintain a duration of 3 seconds. If the scroll key is released after the duration elapses the display will indicate the code of next parameter (in the display) and its value (in the alternative display), otherwise, the display will return to normal mode to indicate process value and setpoint value.

The display will blink a moment as a new value of parameter is written into the non-volatile memory. The display is also used to indicate the error messages in case of abnormal condition occurs. Subsequently, each depression of the scroll key will step down the controller through the default sequence of displays shown in Table of section 5.3. If unfortunately the desired parameter passed on the display, it can still be retained by pressing ⊡ and ▲ to prevent frustration. The sequence of displays can be reconfigured by changing the security level of parameters as described in subsequent section.

5.5.1 *Learning the Parameters*

SV - Setpoint Value
This parameter is the desired target of the process. It can be adjusted within the range defined by the Low Scale Value (LOSC) and High Scale Value (HISC). The default value is 100°C (212°F).

ASP1 - Alarm 1 Setpoint Value or Dwell Time
This sets the levels at which the alarm 1 will operate if A1SF is selected for alarm function. If A1SF is selected for dwell timer (t o o n or t o o F), ASP1 is used as setting value of dwell timer. The timer start to count as the process value reaches the setpoint value, see section 5.10 and 5.13 for more details.

RAMP - Ramp Rate
This forces the process to warm up (or cool) with a predetermined rate as power applied. Setting this parameter to zero if no ramp is needed. The process will warm up (or cool) with maximum speed.

OFST - Offset Value for Manual Reset
For those systems it is desired to perform manual reset control by setting integral time (TI) to zero, OFST is adjusted to compensate the deviation between PV and SV. If PV is too low for reverse control action (or too high for direct control action) then increase value of OFST. If TI is not zero, OFST is unchangeable.

SHIF - Shift Process Value
This value will be added to the process value so that the process value will be read with minimum error. For these process with bad circulation may use this parameter to compensate the temperature difference between sensor and the process.

PB, TI, TD - Constants for PID Control
Refer section 5.7 for an in-depth description.

AHY1 - Hysteresis Values of Alarm 1
These values define the dead bands for alarm action. As the process value exceeds the boundary of the dead band and stays within the band the alarm will remain same status.

HYST - Hysteresis Value of ON-OFF Control
This parameter defines a dead band for the ON-OFF control.

ADDR - Address of the unit for the communication
This parameter provides an identity code for the RS-485 interface. Note that it is not allowable to set the same ADDR code for those controllers communicating with same computer to prevent line contention problems. If
the controller does not use the RS-485 interface, the ADDR can be neglected.

LOSC, HISC - Low / High Scale Range
If thermocouple or PT100 is selected as input type (INPT) these parameters are used to define the range of the setpoint adjustment. Otherwise, If linear process input is selected, these parameters are used to define the range of the process value and setpoint adjustment, refer section 5.14 for more details.

PL1, PL2 - Power limit for Heating and Cooling Outputs
These parameters limit maximum heating and cooling percentage power during warm up and in proportional band. These are used only for those processes that heat or cool with full speed are dangerous or not satisfactory with the results. For normal applications these parameters are set to 100%.

INPT - Input Type selection
Select a correct type in accordance with the input connection.

UNIT - Process Unit
Select a correct unit for the process, for linear process input select Pu (Process Unit) if the unit is other than °C or °F.

RESO - Select Decimal Point Position (Resolution)
This parameter defines the position of the decimal point on the process value and setpoint.

Value	Decimal Point Position
no dP	XXXX
1dP	XXX.X
2dP	XX.XX

Note that 2dP is used only for linear process input.

CONA - Control Action of Output 1
Select rEVr (Reverse) action for heating process, that is to increase output power as the process value decreases (or setpoint increases).
Select dirt (Direct) action for cooling process, that is to increase output power as the process value increases (or setpoint decreases).

A1MD - Alarm Mode Selection for Alarm 1
Refer section 5.10 for an in-depth description.

A1SF - Alarm 1 Special Function
Select a hold function or latch function for Alarm 1. See section 5.10 for more details. Select t o o n or t o o F to reconfigure Alarm 1 output as a dwell timer. See section 5.13 for more details.

CYC, CCYC - Proportional Cycle Time of Output 1 and Cooling Output
Select a proper value for the process in accordance with the output devices fitted. See section 5.5.2 for further discussion.

CPB, DB - Cooling P Band, Cooling Dead Band
Refer section 6.10 for an in-depth description. If no cooling is fitted for the controller, these parameters may be neglected.

5.5.2 *Initial Setup*

Access the keypads to view the value of each parameter. For an undesirable value of parameter perform up and down key to obtain a correct value, then proceed to the next parameter until all parameters are verified. Note that the new value of parameters are entered into nonvolatile memory automatically.

The adjustment of proportional cycle time (CYC and CCYC) is related to the speed of process response and the output device fitted. for a faster process it is recommended to use SSR (to select SSR Drive Output) or SCR (to select linear current or voltage output) to drive the load. The relay output is used to drive magnetic contactor in a slow process. If a long cycle time is selected for a fast process an unstable result may occur. Theoretically the smaller the cycle time is selected, the better control can be achieved. But for relay output, the cycle time should be as large as possible (consistent with satisfactory control) in order to maximize relay life.

Fig.:15 Cycle time

Normal Cycle time — **Cycle time too long (oscillates)**

The follow table provides cycle time recommendations to avoid premature relay failure:

Output Device (OUT1 or Cooling Output)	Cycle Time (CYC or CCYC)	Load (resistive)
Relay	20 sec or more recommended 10 sec. minimum	2A / 250VAC or contactor
	5 sec. minimum	1A / 250VAC
Solid State Relay Drive	1-2 sec.	SSR
Linear Current / Voltage	0.1 sec.	Phase control module

Note: For an ON-OFF control (by setting PB = 0) the cycle time selection may be ignored.

5.5.3 *FAIL-SAFE Configuration*

FAIL-SAFE is a Tool Program used to define an ON or OFF status of failure for Output 1 (OUT1), Alarm 1 Output (ALM1). Press ⊡ and ▼ ,then release both keys until FAIL-SAFE is viewed in the display windows. Then press scroll key to obtain the desired output which is shown in the display. Now press and hold up or down key to change the status which is shown in the display. Note that if the desired value is different from the original one, a long scroll (pressing scroll key 3 sec.) has to be operated to enter the new value before proceeding to the next Tool Parameter. If the FAIL-SAFE status is not critical for a process as the controller fails, the configuration of this section can be omitted.

5.5.4 *LOCK Parameter*

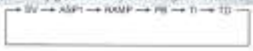
According to the flow chart shown in section 6.4, one can reach LOCK PARA and obtain LEVEL (LEV0 - LEV2) which is shown in the display and the Lock status (LOCK or FREE) is shown in the display. For example, if we select LOCK for LEV2, and press scroll key 3 seconds to enter the selection, then all the parameters configured in level 2 can not be changed. A LOCK message will be indicated in display if one attempts to change a locked (protected) parameter.

5.5.5 *Configure Security Levels of Parameters*

The user of the controller may often complain that the operation is so complicated, most of parameters are unused for them and it takes long time to get a parameter to access. You will no longer worry about this. One of the versatile functions of this controller is that the security level for each parameter can be redefined arbitrarily. One of three levels (Level 0, Level 1 and Level 2) can be assigned to any parameter. The parameters with lower level will be displayed before those parameters with higher level as one performs scroll key.

To configure level for each parameter one can follow the flow chart in section 6.4 by pressing ⊡ and ▼ keys to reach ConF LEVL, then perform ⊡ key to get the desired parameter. The display indicates the level of the parameter. Now one can change the level value for that parameter by using up key or down key. Finally press and hold ⊡ 5 seconds or longer, now the new level value is entered. If the level value is unchanged the above operation for entering can be omitted. For example: If ASP1, RAMP are configured as level 0, PB, TI, TD are configured as leve 1, and the other parameters are configured as level 3, the scrolling sequence of parameters will be as follows:

Fig.:16 Configure Security Levels of Parameters



5.6 AUTO-TUNE

⚠ The process is tuned at setpoint. The process will oscillate about the setpoint during auto-tune. Set a setpoint to a lower value if overshoot beyond the normal process value is likely to cause damage.

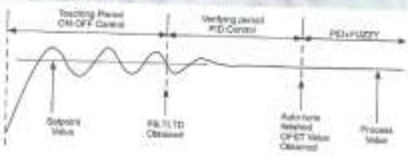
The auto-tune program is applied during:

* Initial set-up
* The setpoint is changed substantially from the previous auto-tune
* The control result is unsatisfactory

The auto-tune procedures:

* To ensure that all parameters are configured correctly.
* To ensure that PB is not zero because that ON-OFF control is not allowable to perform auto-tune.
* Set the setpoint to the normal operating process value (or to a lower value if overshoot beyond the normal process value is likely to cause damage) and use normal load conditions.
* Press and hold both up and down keys for 3 seconds then release together. The display is flashing during execution of auto-tune program.

Fig.:17 Auto-tune



Auto-tune " teaches " the controller the main characteristics of the process. It " learns" by cycling the output on and off. The results are measured and used to calculate optimum PID values which are automatically entered in nonvolatile memory.

During the second period of auto-tune the controller performs PID control to verify the results and finally an OFST value is obtained and entered in the memory.

To stop the auto-tune, press both up and down key then release together, the display will stop to flash. But if the controller has entered in the verifying period, the display will continue to flash until auto-tune is finished.

5.7 TUNING THE CONTROLLER MANUALLY

* To ensure that all parameters are configured correctly
* Set PB to zero. Set HYST to the smallest (0 °C or 0.1 °F)
* Set the setpoint to the normal operating process value (or to a lower value if overshoot beyond the normal process value is likely to cause damage) and use normal load conditions.
* Switch on the power supply to the heater. Under these conditions, the process value will oscillate about the setpoint and the following parameters should be noted:

(1) The peak to peak variation (P) of the first cycle in °C or °F (i.e. the difference between the highest value of the first overshoot and the lowest value of the first undershoot).

(2) The cycle time (T) of this oscillation in seconds (see following Figure).

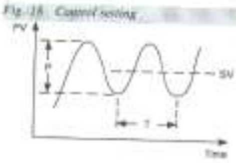
* The control setting should then be adjusted as follows:

PB = P (°C or °F)

TI = T (seconds)

TD = T/4 (seconds)

Fig.:18 Control setting



The PID parameters determined by the above procedures are just rough values. If the control results by using above values are unsatisfactory, the following rules may be used to further adjust the PID parameters:

ADJUSTMENT SEQUENCE	SYMPTON	SOLUTION
(1) Proportional Band (P)	Slow Response	Decrease PB
PB	High overshoot or Oscillations	Increase PB
(2) Integral Time (I)	Slow Response	Decrease TI
TI	Instability or Oscillations	Increase TI
(3) Derivative Time (D)	Slow Response or Oscillations	Decrease TD
TD	High Overshoot	Increase TD

Effect of PID adjustment on process response:

Fig.:20 P action

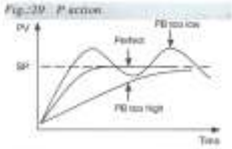


Fig.:21 I action

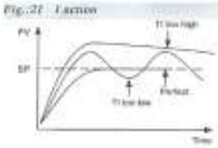
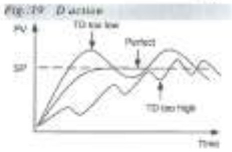


Fig.:19 D action

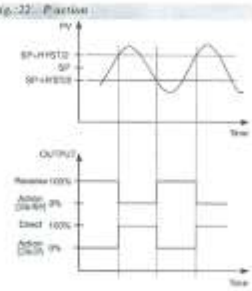


5.8 ON-OFF CONTROL

The alarm output if configured as alarm function performs an ON-OFF control basically. Adjust the P band to PB = 0, an additional channel of ON-OFF control with variable hysteresis is obtained. Hysteresis is measured with degree. It is also named differentials or deadband sometimes. Refer to following Figure for the description of ON-OFF control.

ON-OFF control may introduce excessive process variation even if the hysteresis is minimized to the smallest. If the ON-OFF control is set, parameters TI, TD and CCT will have no effect on the system, nor can the manual mode and the auto-tune program be executed.

Fig.:22 P action



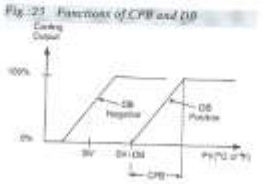
5.9 COOLING CONTROL

Cooling Control Options:

Output Configurations	Heating Output	Cooling Output	Adjustment of Parameters
ON-OFF Cooling (No Heating)	None	OUT1	CONA = DIRT HYST SV
Proportional Cooling (No Heating)	None	OUT1	CONA = DIRT PB, TI, TD, CYC, SV
Heating + ON-OFF Cooling	OUT1	ALM1	CONA = REVR A1SF = NONE A1MD = DVHI (or FSHI) AHY1, SV (or ASP1)
Heating + Proportional Cooling	OUT1	ALM1	CONA = REVR A1SF = COOL CPB, DB, CCYC, SV

Functions of CPB and DB:
The cooling P band CPB and dead band DB are measured in degree.

Fig.:25 Functions of CPB and DB



5.10 ALARM

There is a independent alarm available by adjusting the alarm special function A1SF and A2SF. The following descriptions of this section are based on Alarm 1.

* No special function: A1SF = nonE

: Alarm on

Fig.:24 Alarm

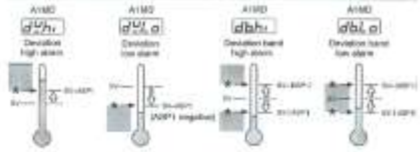
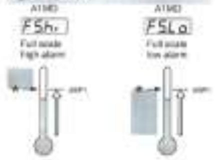


Fig.:25 Alarm



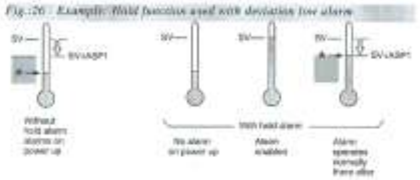
- Latch Alarm: A1SF = LtCH

When selected, the alarm output and indicator latch as the alarm occurs. The alarm output and indicator will be energized even if the alarm condition has been cleared unless the power is shut off.

- Hold Alarm: A1SF = hoLd

When selected, in any alarm mode, prevents an alarm on power up. The alarm is enabled only when the process value reaches setpoint value (SV).

Fig.:26 Example: Hold function used with deviation low alarm



- Lach & Hold Alarm: A1SF = Lt.ho

When selected, in any alarm mode, prevents an alarm on power up. The alarm is enabled only when the process value reaches setpoint value (SV). Thereafter, the alarm acts as a latch alarm described above.

- Hysteresis (AHY1) adjustment

Example: No special function used with deviation high alarm,
SV = 100 °C, ASP1 = 10 °C, AHY1 = 4 °C

Fig.:27 Example: No special function used with deviation high alarm

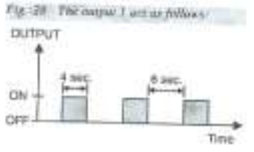
5.11 VIEWING THE OUTPUT PERCENTAGE POWER

Selecting the Tool Programs until the HAND CONTROL hAnd Cont is obtained. Press scroll key, the display will show the process value and the display will show the percentage power of output 1 such as H 5Y . To view the cooling output, press scroll key again. The lower display will show the percentage power of alarm 2 such as C 27, if alarm 2 is reconfigured as cooling output (A2SF = COOL). If alarm 2 is configured as alarm, the percentage power is invalid and should be ignored.

The range of the output percentage power is within 0 and 100 (%). If an on-off control is selected, only 0 and 100 are displayed. For a proportional control, the output percentage power represents the duty cycle of the output ON-state.

Example: H 40 is viewed with cycle time CYC = 10 sec.

Fig.:28 The output 1 act as follows:



5.12 MANUAL CONTROL

Following the procedure as in section 5.11, then press and hold the scroll key for 5 seconds and release, the controller will enter the manual control mode. The display begins to flash. The output percentage power can be adjusted by using up or down keys. Note that for an on-off control with PB = 0, the manual control is not allowable to be used. An error message oPEr will be shown in the display.

The manual control is used during:
- Teaching the process
- The controller fails

⚠ The manual control is an open loop control The process may rise to a dangerous value (temperature). Special attention to the process has to be given to prevent a system damage.

5.13 RAMP & DWELL

The controller can be configured to act as either a fixed setpoint controller or as a single ramp controller on power up. This function enables the user to set a predetermined ramp rate (RAMP) to allow the process to gradually reach setpoint temperature thus producing a " soft start " function.

A dwell timer is incorporated within the controller and the alarm 1 can be configured by setting A1SF = toon or toof to provide either a dwell function or a soak function to be used in conjunction with the ramp function.

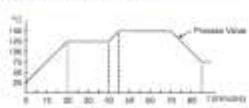
5.13.1 *Ramp Function*

If the ramp function is selected, the process will increase or decrease at a predetermined rate during initial power up, or with setpoint changes/process variations.

The ramp rate is determined by the " RAMP " parameter which can be adjusted in the range 0 to 55.55 °C / minute (99.99 °F / minute). The ramp rate function is disabled when the " RAMP " parameter is set to " 0 ".

In the example below the " RAMP " is set to 5.00 °C / minute, power is applied at zero time and the process value climbs to the 125 °C setpoint over a period of 20 minutes. This process temperature is held until the setpoint value is changed to 150 °C at 40 minutes. The process value then climbs to the new setpoint over a period of 5 minutes and the new setpoint is held. At 70 minutes the setpoint value is decreased to 75 °C and the process value falls to the new setpoint over a period of 15 minutes.

Fig.:29 Ramp Function



5.13.2 *Ramp & Soak Function*

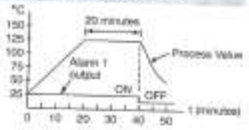
The soak function is enabled by configuring the alarm 1 to act as a dwell timer. If A1SF is set to to.on (time out on), the alarm 1 relay will now operate as a timer contact, with the contact being opened at power up and closing after the elapsed time set at parameter

ASP1. If A1SF is set to toοF (time out off), a reverse action of alarm 1 relay will perform.

If the controller power supply or output is wired through the alarm contact, the controller will operate as a guaranteed soak controller.

In the example below the " RAMP " is set to 5.00 °C / minute, A1SF = time out off, and ASP1 = 20 (minutes). Power is applied at zero time and the process climbs at 5 °C / minute to the setpoint of 125 °C. Upon reaching setpoint, the dwell timer is activated and after the soak time of 20 minutes, the alarm 1 relay will open, switching off the output. The process temperature will eventually fall at an undetermined rate.

Fig.:30 Ramp & Soak Function:



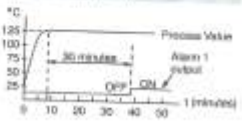
5.13.3 *Dwell Function*

The dwell function is enabled by configuring the alarm 1 to act as a dwell timer. If A1SF is set to toon (time out on), the alarm 1 relay will now operate as a timer contact with the contact being opened on initial start up. The timer begin to count down once the setpoint temperature is reached. After the setting at ASP1 has elapsed, the alarm 1 relay closes.

The dwell function may be used to operate an external device, such as a siren to alert (for example) when a soak time has been reached.

In the example below, the ramp rate has been set to " 0 ". A1SF= toon and ASP1 = 30 (minutes). Initial start up is a zero time and the process climbs to the 125 °C setpoint with a maximum rate. Once setpoint is reached, the dwell timer begins to count. After 30 minutes the alarm 1 relay closes. The controller will continue to operate as a fixed setpoint controller.

Fig.:31 Dwell Function:



5.14 RE-RANGING LINEAR PROCESS INPUTS

Select an appropriate Input Type (INPT). Define the range by adjusting LOSC and HISC. In the example below, INPT = 4-20 (mA), LOSC = 0, HISC = 100.0, RESO = 1 dP

For a 4 mA input the process value will read 0 (=LOSC), and for a 20 mA input the process value will read 100.0 (HISC). For a 10 mA input the process value will read 37.5. If the input signal is beyond the limits, an error message LLEr or HLEr will be shown in the upper display.

Fig.:32 Re-ranging:

5.15 READ PEAK PROCESS VALUES

The maximum and minimum values of the process value are continuously updated and stored in the memory as power up. Press both [scroll] and [▼] to obtain " READ PEAK " Tool Program. Press scroll key to select hiPY or LoPY which is shown in lower display. Now the upper display will show the high peak value or low peak value of the process.

To reset the values, press and hold the scroll key for 3 second and release, this moment both low peak value and high peak value will be revised by the current process value.

This Tool Program provides an useful function for monitoring the stability of the process.

5.16 LOCK / UNLOCK PARAMETERS

- Lock all the parameters
  press and hold both [scroll][▲] for 3 seconds then release, the keypad operation is disabled to protect parameters from tampering. Unlock keypad operation, press both up and down keys then release.
- Lock parameters in the menu security level Refer to section 6.6.4 for the operation

6 Calibration for quality assurance

- ❑ Safe quality assurance by calibrated controllers
- ❑ Meets DIN EN ISO 9000
- ❑ With calibration at the manufacturer factory, checking for manufacturer specification and adjustment are done simultaneously, if required.
- ❑ On-site calibration saves mounting and downtimes
- ❑ On-site calibration of the overall measuring system

Quality assurance is largely dependent of the quality of the measurement and test equipment used during development, production, final testing and service.

To ensure accuracy and reliability of measurement and test instrumentation, a correctly functioning test equipment monitoring system is required.

Test equipment monitoring must also include regular calibration of test equipment.

The measurement and test equipment must be provided with the calibration mark.

All important data and errors are specified in the calibration certificate.

We recommend calibrating controller KS10 regularly at intervals of one year at our calibration laboratory in Kassel.

6.1 Scope of supplied services:

- Calibration of measurement and test equipment
- Adjustment, if required
- Documentation of measured values in a test report
- Measurement and test equipment marking by means of adhesive label.
- Protection of the externally accessible calibration functions by a seal
- Calibration certificate

6.2 Traceability

- The calibration standards used by PMA are calibrated regularly. Traceability to calibration standards is ensured.

7 ERROR MESSAGE & DIAGNOSIS

⚠ This procedure requires access to the circuitry of a live power unit. Dangerous accidental contact with line voltage is possible. Only qualified personnel are to perform these procedures. Potentially lethal voltages are present.

Experience has proven that many control problems are not caused by a defective instrument. See chart below and Table 7.1 for some of the other common causes of failures:

- Line wires are improperly connected
- No voltage between line terminals
- Incorrect voltage between line terminals
- Connections to terminals are open, missing or loose
- Thermocouple is open at tip
- Thermocouple lead is broken
- Shorted thermocouple leads
- Short across terminals
- Open or shorted heater circuit
- Open coil in external contactor
- Burned out line fuses
- Burned out relay inside control
- Defective solid-state relays
- Defective line switches
- Burned out contactor
- Defective circuit breakers

If the points listed on the chart have been checked and the controller does not function, it is suggested that the instrument be returned to the factory for inspection.

Do not attempt to make repairs. It usually creates costly damage. Also, it is advisable to use adequate packing materials to prevent damage in shipment.

7.1 Troubleshooting

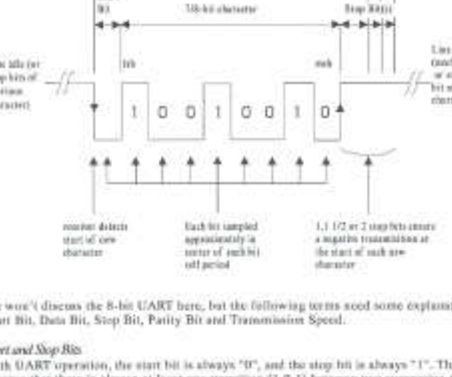
Symptom	Probable Causes (s)	Resolution (s)
1) LED's will not light	- No Power to instrument - Power supply defective	- Check power line connections - Replace power supply board
2) Process Display shows: SbEr	- Sensor break error	- Replace RTD or sensor - Use manual mode operation
3) Process Display shows: LLEr	- Input signal beyond the low range, sensor fails - Incorrect input type selected	- Replace sensor - Check sensor or thermocouple type, correct input selection
4) Process Display shows: HHEr	- Input signal beyond the high range, sensor fails - Incorrect input type selected	- Replace sensor - Check sensor or thermocouple type, correct input selection
5) Process Display shows: AdEr	- A to D module damage	- Check for outside source of damage such as transient voltage spikes.
6) Process Display shows: oPEr	- Incorrect operation of auto tune procedure. Prop. Band set to 0 - Manual mode is not allowable for an ON-OFF control system	- Repeat procedure. Increase Prop. Band to a number larger than 0. - Increase proportional band
7) Process Display shows: CSEr	- Check sum error, values in memory may have changed accidentally	- Check and reconfigure the control parameters
8) Process Display shows: [illegible]EEr	- Fail to enter data into EEPROM	-Replace Controller
9) Process Display shows: [illegible]	- Overflow error, data out of range during execution of software program	- Check if there is a noise comming in. Solve the problem by means of item (16).
10) Process Display shows: LoCK	Attempt to change a locked parameter	Unlock procedure stated in section 7.16
11) Display Unstable	- Analog portion or A-D converter defective - Thermocouple, RTD or sensor defective - Intermittent connection of sensor wiring	- Check thermocouple, RTD or sensor - Check sensor wiring connections
12) Considerable error in temperature indication	- Wrong sensor or thermocouple type. Wrong input mode selected. - Analog portion A-D converter defective	- Check sensor or thermocouple type and if proper input mode was selected
13) Display goes in reverse direction (counts down scale as process warms)	- Reversed input wiring of sensor	- Check and correct
14) No heat or output	- No heater power (output), incorrect output device used - Output device defective - Open fuse outside of the instrument	- Check output wiring and output device - Replace output fuse
15) Heat or output stays on but indicator reads normal	- Output device shorted, or power service shorted	- Check and replace
16) Display blinks, entered values change by themselves	- Electromagnetic interference (EMI), or Radio Frequency interface (RFI) - EEPROM defective	- Suppress arcing contacts in system to eliminate high voltage spike sources. Separate sensor and controller wiring from "dirty" power lines.

8 Interface

8.0.1 Asynchronous transmission

Sometimes, data must be transmitted at random intervals. This means that the receiver must be able to re-synchronize at the start of each new character received. This is done by encapsulating each piece of transmitted data (character or byte) between an additional start bit (always Low) and an additional stop bit (always High), as shown in Fig. 33. Sometimes, a parity bit is inserted between the last data bit and the stop bit. In order to understand the operating principle, please refer to a standard 8/9-bit UART (Universal Asynchronous Receiver/Transmitter), with parallel-to-serial conversion of output data, and serial-to-parallel conversion of input data.

Fig.: 33 Asynchronous transmission



We won't discuss the 8-bit UART here, but the following terms need some explanation: Start Bit, Data Bit, Stop Bit, Parity Bit and Transmission Speed.

8.0.1.1 Start and Stop Bits

With UART operation, the start bit is always "0", and the stop bit is always "1". This ensures that there is always at least one transition (1-0-1) between two successive data blocks, irrespective of the bit sequences within the block. In simple terms: The first transition (1-0, the start bit) informs the receiving device that a data block is coming, and the second transition (0-1, the stop bit) tells the receiver that the transmission is complete.

8.0.1.2 Data and Parity Bits

For UART operation with 8 or 9 bits, the actual ASCII data only requires 7 bits. The 8th bit is called the "parity bit" and is used for detecting transmission errors. For this, the binary sum of the data block is set to even or odd parity. On receipt of the block, the receiver performs the same parity function as the transmitter. If an error is detected, a corresponding alarm is given.
It is also possible to use "no parity" as a check method. We use this method, because we prefer adding a checksum to the data block rather than checking the parity of each character.

8.0.1.3 Transmission speed

The transmission speed determines how fast data is transmitted. The unit of measure is "bits per second" (bits/s or bps).
Our controllers are set to 9600 bits/s.

8.0.1.4 Communication settings on our controllers

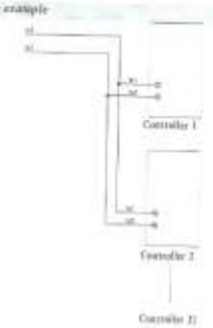
1 start bit
8 data bits (7-bit ASCII plus an 8th bit which is always "1")
1 stop bit
9600 bits/s

8.0.2 Data block (frame) synchronization

When blocks of ASCII characters (normally referred to as frames) are being transmitted, the receiver must be able to determine the start and end of each frame. This is known as frame synchronization.
For a simple method of block transmission, our protocol uses hexadecimal ASCII (0 - 9, a - f) for the frame contents. The colon [:] character indicates the start of a frame, and carriage return [CR] followed by line feed [LF] mark the end of a frame.

8.0.3 Wiring with an RS 485 interface

Fig.:34 Interface wiring example



8.1 Protocol

In the half-duplex, multidrop method, all the data terminal equipment (DTE) is connected via a two-wire circuit, as shown in Fig. 34.
This technique is normally used in applications which involve a single master computer communicating with a number of slave devices. In order to ensure reliable data transmission, a protocol is used (e.g. to prevent simultaneous transmission of two data blocks).
For our controllers, we use a character-oriented protocol which operates in a poll-modify mode as follows:
When the PC wishes to receive data from a controller, it transmits a "poll frame" to the corresponding controller address, and then waits until a "poll response frame" is received.
If the PC wants to send data to a controller, it transmits a "modify frame" to the controller, and then waits until a "modify response frame" is received.
This data link protocol is simple and reliable.

8.1.1 ASCII framing

When transmitting ASCII data blocks, the colon [:] is used to mark the beginning of a frame, whilst carriage return [CR], followed by line feed [LF] marks the end of a frame. The LF character also serves as a synchronizing character, in order to signal that the transmitting station is ready to receive an immediate reply (see Fig. 35).

Fig.:35 Format of an ASCII data block (frame)

Start of frame	ADD Address	CMD Command	PARA Parameter	DATA	CHECKSUM CS1+CS2	EOF	Ready terminator
:	2 characters	2 characters	2 characters	6 characters	2 characters	CR	LF

8.1.1.1 Address field (ADD)

The address field immediately follows the start of frame and consists of two ASCII characters which define the user-assigned controller address.
Because each controller has a unique address, only the addressed controller will respond to a frame that contains its address. Conversely, the PC knows which controller is transmitting data. The addresses must be in the range from 01 to 99.

8.1.1.2 Command field (CMD)

The command field follows the address field and consists of two ASCII characters which specify whether data are to be transmitted or received by the PC. See also Section 8.2.1.
The response from the addressed controller must contain the same command code. The "poll" code is 65, and the "modify" code is 66.

8.1.1.3 Parameter field (PARA)

Also this field contains two ASCII characters, which define the controller parameters. For this, corresponding parameter codes must be defined in every controller. See also Section 8.2.2.
The response from the addressed controller must contain the same parameter code.

8.1.1.4 Data field (DATA)

This field contains the actual data, which is expressed with 6 ASCII characters. See also Section 8.2.2.
The "+" character is not permitted to indicate a positive value, whilst the "–" character must always precede a negative value.

8.1.1.5 CHECKSUM field

The checksum is used to check for transmission faults on the RS 485 link.
It enables both the PC and the controller to detect faulty messages. Thus, the checksum protocol makes the data exchange more reliable.
The procedure for adding checksum
a) Take the sum of the ASCII characters in the "ADD", "CMD", "PARA" and "DATA" fields. Ignore the carrier of the sum.
b) Take the 2's complement of the sum.
2-comp sum = 2-comp sum + 1
The 2-comp sum is a 8-bit binary, and can be expressed with 2-Hex.
c) Thus CS1 = the hex of the first four bits of 2-comp sum, and
CS2 = the hex of the last four bits of 2-comp sum.

Fig.:36 What is the checksum, if ADD = 01, CMD = 65 and PARA = 27 ?

	Code	ASCII
ADD	0	0011 0000
	1	0011 0001
CMD	6	0011 0110
	5	0011 0101
PARA	2	0011 0010
	7	0011 0111
	Sum	0011 0101
	Comp sum	1100 1010
	+	1
	2-comp sum	1100 1011

Therefore the ASCII frame
= ":" + "016527CB" + "CR" + "LF"

Answer:
2-comp sum = Checksum = CB (hex)

Fig.:37 What is the checksum for ADD = 01, CMD = 66, PARA = 26 and DATA = -12,5 ?

	Code	ASCII
ADD	0	0011 0000
	1	0011 0001
CMD	6	0011 0110
	6	0011 0110
PARA	2	0011 0010
	6	0011 0110
DATA	-	0010 1101
	0	0011 0000
	1	0011 0001
	2	0011 0010
	.	0010 1110
	5	0011 0101
	Sum	0011 0101
	Comp sum	1100 1010
		1100 1010
	+	1
	2-comp sum	1100 1011

Then the ASCII frame
= ":" + "010626-12.5A8" + "CR" + "LF"

Answer:
2-comp sum = Checksum = A8 (hex)

8.1.2 Command Summary

8.1.2.1 Poll a parameter from a certain controller

Fig.:38 Poll frame

STA CHAR	ADD		CMD		PARA		CHECK SUM		CR	LF
:	X	X	6	5	X	X	X	X	CR	LF

A data block with the above format enables the PC to poll a parameter value from any one of the connected controllers via the RS 485 interface.
Fig. 38 shows the format of a "poll frame", whereby the following codes must be entered in the corresponding fields:

- ADD: the controller address (between 01 and 99)
- CMD: 65 (command code for polling)
- PARA: the parameter code (see the parameter code table in Section 8.2.2)
- Checksum: see Section 8.1.1.5

Fig.:39 Poll response frame

STA CHAR	ADD		CMD		PARA		DATA						CHECK SUM		CR	LF
:	X	X	6	5	X	X	X	X	X	X	X	X	X	X	CR	LF

Only the addressed controller can respond to a "poll" request from the PC. The data block shown in Fig. 39 contains the requested parameter value. Furthermore, the response frame must contain the same values in the fields "ADD", "CMD" and "PARA" as the "poll request" frame.

8.1.2.2 Transmit a parameter to a certain controller

Fig.:40 Modify frame

STA CHAR	ADD		CMD		PARA		DATA						CHECK SUM		CR	LF
:	X	X	6	6	X	X	X	X	X	X	X	X	X	X	CR	LF

A data block with the above format enables the PC to transmit a parameter value to any one of the connected controllers via the RS 485 interface.
Fig. 40 shows the format of a "modify frame", whereby the following codes must be entered in the corresponding fields:

- ADD: the controller address (between 01 and 99)
- CMD: 66 (command code for modifying)
- PARA: the parameter code (see the parameter code table in Section 8.2.2)
- DATA: the parameter value (see Section 8.1.1.4)
- Checksum: see Section 8.1.1.5

Fig.:41 Modify response frame

STA CHAR	ADD		CMD		PARA		DATA						CHECK SUM		CR	LF
:	X	X	6	6	X	X	X	X	X	X	X	X	X	X	CR	LF

Only the addressed controller can respond to a "modify" frame from the PC. The data block shown in Fig. 41 contains the requested parameter value. Furthermore, the response frame must be absolutely identical to the "modify" frame.

PARAMETERS			DATA	
PARA	Code	Description	Code	Value
MV1	27	Output value of output 1	None	0 ... 100.0%, Poll (read) only
MV2	28	Output value of output 2	None	0 ... 100.0%, Poll (read) only
ASP_2	29	Trigger point for alarm relay 2 or dwell time(A2_SF = TO_ON or TO_OFF)	XXXX.X	Lower & upper set-point limit (for absolute alarm) -110.0 ... 111.0 °C or -199.9 ... 199.9 °F (for deviation and tolerance band alarm)0 ... 999.9 minutes (for dwell time) **10 °C
AHY_2	30	Hysteresis of alarm 2	XXXX.X	0 ... 11.0 °C or 0.1 ... 19.9 °F **0.0
A2_MD	31	Operating mode of alarm 2	000000	** dv_hI : Deviation alarm (max)
			000001	dv.Lo : Deviation alarm (min)
			000002	db.hI : Tolerance band alarm (max)
			000003	db.Lo : Tolerance band alarm (min)
			000004	FS.hi : Absolute alarm (max)
			000005	FS.Lo : Absolute alarm (min)
A2_SF	32	Special functions for alarm 2	000000	** nonE : No special function
			000001	LtCh : Alarm with latch function
			000002	hoLd : Alarm with hold function
			000003	Lt.ho : Alarm with latch and hold function
			000004	to.on : Dwell timer ON at time-out
			000005	to.oF : Dwell timer OFF at time-out

Note:
1. Alarm 2 is not fitted to KS 10
2. ** marks the default setting

PARAMETERS			DATA	
PARA	Code	Description	CODE	Value
INPT	15	Input type selection	000000	J-0C : J Type T/C
			000001	** K-0C : K Type T/C
			000002	t-0C : T Type T/C
			000003	E-0C : E Type T/C
			000004	b-0C : B Type T/C
			000005	r-0C : R Type T/C
			000006	S-0C : S Type T/C
			000007	n-0C : N Type T/C
			000008	Pt_dn : Pt 100 DIN
			000009	Pt_JS : Pt 100 JIS
			000010	4-20 : 4 ... 20 mA
			000011	0-20 : 0 ... 20 mA
			000012	0-1V : 0 ... 1V
			000013	0-5V : 0 ... 5V
			000014	1-5V : 1 ... 5V
			000015	0-10V : 0 ... 10V
UNIT	16	Engineering unit	000000	** °C : Degree C
			000001	°F : Degree F
			000002	PU : Process value(voltage or current input)
RESO	17	Decimal point (resolution)	000000	no.dP : No decimal point
			000001	1.dP : 1 decimal digit
			000002	dP : 2 decimal digits (only for linear voltage or current input)
CONA	18	Control action of output 1	000000	dirt : Direct (cooling) action
			000001	** rEvr : Reverse (heating) action
A1_MD	19	Operating mode for alarm 1	000000	** dv_hI : Deviation alarm (max)
			000001	dv.Lo : Deviation alarm (min)
			000002	db.hI : Tolerance band alarm (max)
			000003	db.Lo : Tolerance band alarm (low)
			000004	FS.hI : Absolute alarm (max)
			000005	FS.Lo : Absolute alarm (min)
A1_SF	20	Special functions for alarm 1	000000	** nonE : No special function
			000001	Lt.ho : Alarm with latch function
			000002	hold : Alarm with hold function
			000003	Lt.ho : Alarm with latch and hold function
			000004	to.on : Dwell timer ON at time-out
			000005	to.oF : Dwell timer OFF at time-out
CYC	21	Proportional cycle time for output 1	XXXXXX	0 ... 99 seconds (0 for linear current/voltage output) **20
C_CYC	22	Cooling cycle time	XXXXXX	0 ... 99 seconds (0 for linear current/voltage output) **20
C_PB	23	Proportional band (cooling)	XXXX.X	0.0 ... 200.0 °C or 0.1 ... 360.0 °F **10.0 °C
D_B	24	Dead band for PB and CPB	XXXX.X	-111.0 ... 111.0 °C or -199.9 ... 199.9 °F **0.0°C
PV	25	Process value	None	Poll (read) only
SV	26	Set-point value	XXXX.X	Lower to upper adjustment range

8.2 Table of command codes

8.2.1 Tabelle der Befehlscodes

CMD	CODE	MEANING	ACTION
Poll	65	The PC addresses a particular controller, and requests a parameter value.	1. Only the PC can issue the "poll" request. It allows the PC to retrieve the parameter value from the selected controller address. Fig. 38 shows the format of the "poll frame". 2. Only the selected controller is permitted to transmit the requested data to the PC. Fig. 39 shows the format of the "poll response frame".
Modify	66	Transmission of a parameter value to a particular controller.	1. Only the PC can issue the "modify" request. It allows the PC to write the parameter value to the selected controller address. Fig. 40 shows the format of the "modify frame". 2. Only the selected controller is permitted to accept the transmitted data. Fig. 41 shows the format of the "modify response frame".

8.2.2 Table of parameter and data codes

PARAMETERS			DATA	
PARA	Code	Description	Code	Value
ASP_1	01	Trigger point for alarm relay 1 or dwell time (A1_SF = TO_ON or TO_OFF)	XXXX.X	Lower & upper set-point limit (for absolute alarm) -110.0 ... 111.0 °C or -199.9 ... 199.9 °F (for deviation and tolerance band alarm)0 ... 999.9 minutes (for dwell time) **10 °C
RAMP	02	Ramp rate	XXXX.X	0 ... 55.55 °C/minute or 0 ... 999.9 °F/minute
OFST	03	Offset value for manual reset	XXX.XX	0 ... 100 % ** 0.0
SHIF	04	Measurement value correction	XXXX.X	-111.0 ... 111.0 °C or -199.9 ... 199.9 °F ** 0.0 °C
PB	05	Proportional band for output 1	XXXX.X	0 ... 200 °C or 0 ... 360 °F 0: For 2 point control **10.0 °C
TI	06	Integral (reset) time for output 1	XXXXXX	0 ... 3600 seconds ** 120
TD	07	Derivative (rate) time of output 1	XXXXXX	0 ... 1000 seconds ** 40
AHY_1	08	Hysteresis of alarm 1	XXXX.X	0 ... 11.0 °C or 0.1 ... 19.9 °F **0.0
HYST	09	Hysteresis for 2-point control	XXXX.X	0 ... 11.0 °C or 0.1 ... 19.9 °F **0.0
ADDR	10	Controller address for communication	NONE	1 ... 99, Poll (read) only
LO_SC	11	Lower set-point adjustment limit	XXXX.X	Minimum value for the selected input (INPUT) **-17.7 °C
HI_SC	12	Upper set-point adjustment limit	XXXX.X	Maximum value for the selected input (INPUT) **537.7 °C
PL1	13	Signal limiting for output 1	XXXXXX	0 ... 100 % **100
PL2	14	Signal limiting for output 2	XXXXXX	0 ... 100 % **100

8.3 Programming examples

8.3.1 Example 1

The PC is to read the process value (PV) from controller with address (03). What is the required format of the ASCII frame for the RS 485 interface?

Answer:
- Use the "poll frame" shown in Fig. 38
- ADD = "03" ; the assigned controller address
- CMD = "65" ; poll command
- PARA = "25" ; code for process value (PV) from the table in Section 8.2.2.

Checksum = "CB" ; use the steps in section 8.1.1.5 to define the hex value of the checksum

So the ASCII frame format = ":" + "036525CB" + "CR" + "LF"

Note:

After sending the "poll frame" to the RS 485 interface, the PC must wait until it receives a "poll response frame" (Fig. 39) from the addressed controller.

8.3.2 Example 2

The PC is to write a set-point value (SV) of 99.5 to the controller with address (01). What is the required format of the ASCII frame for the RS 485 interface?

Answer:
Use the "modify frame" shown in Fig. 40
- ADD = "01" ; the assigned controller address
- CMD = "66" ; modify command
- PARA = "26" ; code for set-point (SV) from the table in Section 8.2.2.
- Checksum = "96" ; use the steps in section 8.1.1.5 to define the hex value of the checksum

So the ASCII frame format = ":" + "016626000099.596" + "CR" + "LF"

Note:
After sending the "modify frame" to the RS 485 interface, the PC must wait until it receives a "modify response frame" from the addressed controller (Fig. 41).