KS 90-1 *programmer*
KS 92-1 *programmer*

Universal Program Controller

Up to 16 programs with 16 segments each
4 control (event) tracks
Plain text program names
BluePort® Front interface and BlueControl software
Maintenance manager and error list
Two universal inputs
Day & Night display shows plain text and bargraphs
Manual gain scheduling
Self-Tuning to the setpoint without oscillation

advanced line

- Universal continuous/switching version, i.e. reduced stocks
- 100 ms cycle time, i.e. also suitable for fast control loops
- 20 ms as shortest pulse-length
- Two freely configurable analog output, e.g. as process value output
- Customer-specific Linearization for all sensors
- Settings can be blocked via password and internal switch for high security
- Extended temperature range up to 60 °C allows mounting close to the process
- Easy 2-point or offset measurement correction
- Monitoring of heating current and output circuit
- Emergency operation after sensor break by means of the „output hold“ function
- Logical combination of digital outputs, e.g. for general alarm
- RS 422/485 Modbus RTU interface
- PROFIBUS-DP interface
- Customer specific data-set
- Built-in transmitter power supply
- Splash-water proof front (IP 65)

APPLICATIONS

- chamber ovens
- melting and pot furnaces
- climatic and test chambers
- driers
- heat treatment
- test beds
- textile treatment (dyeing)
- glas industry (tempering)

DESCRIPTION

The program controller KS 9x-1 is intended for universal, precise, and cost-effective control tasks in all branches of industry. For this, the unit provides simple 2-point (on/off) control, continuous PID control, or 3-point stepping control. The process value signal is connected via a universal input. A supplementary analog input can be used for heating current measurement, as an external set-point inputor for position feedback mesaurement of motorized stepping controllers.
The optional 3rd input is an universal input that can be used for several functions, e.g. temperature dependend setpoint correction or differential control.

Outputs

Every KS 9x-1 has four process outputs, either relays or up to 2 universal outputs that can be used for operating a solid-state relay, a continuous current/voltage output or to energize a two-wire transmitter. Optionally there are two additional optocoupler outputs.

Plug-in module

KS 9x-1 program controllers are built as plug-in modules. This enables them to be replaced very quickly without tools, and without disturbing the wiring.

Self-tuning during start-up and to the setpoint

This new function determines the optimum settings for fast line-out without overshoot. With three-point controller configuration, the „cooling“ parameters are determined separately, thus ensuring an optimum match to the process.
By pushing a button the controller determines the best control parameters at the actual setpoint without oscillation, and a minimal deviation of the process value.

Customer specific data-set

A customer specific data-set can be generated and stored e.g. during commisioning.
Later the operator can overwrite settings by resetting to the customer specific data-set.

Display and operation

The „day & night“ display of the KS 9x-1 is charactrized by particularly high contrast in both dark and bright surroundings.
The status fields show operating conditions, control mode, and error messages reliably. The display is in plain text and can show various process values numerically or as a bargraph.

Front interface and Engineering Tools

Control parameter adjustment in seconds has now also been implemented in the KS 90 class of instruments. Via the BlueControl software incl. its simulation functions, and especially the convenient BluePort® front panel interface, the required set-up for a specific control task can be determined without a detailed study of the operating instructions. Off cause almost all adjustments can be done comfortably over the instrument front. (see page , BlueControl)

Password protection

If required, access to the various operating levels can be protected with a password. Similarly, access to a complete level can be blocked.

TECHNICAL DATA

INPUTS

SURVEY OF THE INPUTS

Input	**Used for**
INP1	x1 (default process value) as INP2
INP2	Heating current, ext. set-point or ext. correction, position feedback Yp, 2nd process value x2, ext.correcting variable Y.E, input for additional limit signalling and indication
INP3 (option)	as for INP2
di1 di2 di3 (option)	Program run/stop, program reset, operation disabled, controller off, disabled auto/manual function, reset of stored alarms, switch-over to ... second set-point SP.2, external set-point SP.E, fixed correcting variable Y2, ext. correcting variable Y.E, manual operation, parameter set 1 ↔ 2, process value INP1 ↔ X2

Table 1 Thermocouple ranges

Thermocouple		Range		Accuracy	Resolution (∅)
L	Fe-CuNi (DIN)	-100...900°C	-148...1652°F	≤ 2 K	0,1 K
J	Fe-CuNi	-100...1200°C	-148...2192°F	≤ 2 K	0,1 K
K	NiCr-Ni	-100...1350°C	-148...2462°F	≤ 2 K	0,2 K
N	Nicrosil/Nisil	-100...1300°C	-148...2372°F	≤ 2 K	0,2 K
S	PtRh-Pt 10%	0...1760°C	32...3200°F	≤ 2 K	0,2 K
R	PtRh-Pt 13%	0...1760°C	32...3200°F	≤ 2 K	0,2 K
T	Cu-CuNi	-200...400°C	-328...752°F	≤ 2 K	0,05 K
C	W5%Re-W26%Re	0...2315°C	32...4199°F	≤ 2 K	0,4 K
D	W3%Re-W25%Re	0...2315°C	32...4199°F	≤ 2 K	0,4 K
E	NiCr-CuNi	-100...1000°C	-148...1832°F	≤ 2 K	0,1 K
B(1)	PtRh-Pt6%	0(400)...1820°C	32(752)...3308°F	≤ 3 K	0,3 K
special		-25....75 mV		≤ 0,1 %	0,01 %

(1)) values applied above 400°C

Table 2 Resistance transducers

Type	Sensor current	Range		Accuracy	Resolution (∅)
Pt100		-200...850°C	-328...1562°F	≤ 1 K	0,1 K
Pt1000		-200...200°C	-328...392°F	≤ 2 K	0,1 K
KTY 11-6*		-50...150 °C	-58...302 °F	≤ 2 K	0,05 K
special		0...4500 Ω			
special	0,2 mA	0...450 Ω **			
Poti		0...160 Ω **		≤ 0,1 %	0,01 %
Poti		0...450 Ω **			
Poti		0...1600 Ω			
Poti		0...4500 Ω			

*   corresponds to spezial 0...4500 Ω
** lead resistance included

Table 3 Current and voltage

Range	Input resistance	Accuracy	Resolution (∅)
0-10 Volt	≈ 110 kΩ	≤ 0,1 %	0,6 mV
-2,5...115 mV	≥ 1MΩ	≤ 0,1 %	6 µV
-25...1150 mV	≥ 1MΩ	≤ 0,1 %	60 µV
0-20 mA	20 Ω	≤ 0,1 %	1,5 µA

PROCESS VALUE INPUT INP1

Resolution:	> 14 bit
Decimal point:	0 to 3 decimals
Digital input filter:	adjustable 0,0...100,0 s
Scanning cycle:	100 ms
Measured value correction:	2-point or offset correction
Special (-linearization):	15 segments
Standard table:	temperature sensor KTY 11-6

Thermocouples (Table 1)

Internal and external temperature compensation

Input impedance:	1 MΩ
Effect of source resistance:	1 µV/Ω

Cold junction compensation

Max. additional error	± 0,5 K

Sensor break monitoring

Sensor current:	1 µA

Operating sense configurable (see page)

Special thermocouple

Together with the linearization, the measuring range -25...75mV can be used for connecting thermocouples that are not included in table 1.

Resistance thermometer

Connection:	3-wire
Lead resistance:	max. 30 Ω
Input circuit monitor:	Break and short circuit

Current and voltage signals

Span start, end of span:	anywhere within measuring range
Scaling:	selectable -1999...9999
Special linearization:	15 segments, adaptable with BlueControl
Decimal point:	adjustable
Input circuit monitor:	12,5% below span start (2mA, 1V)

SUPPLEMENTARY INPUT INP2

Resolution:	> 14 bit
Scanning cycle:	100 ms

Heating current measurement

via current transformer

Measuring range:	0...50 mA AC
Scaling:	adjustable -1999..0,000..9999 A

Current measurement range

Input resistance	approx. 120 Ω
Span:	configurable within 0 to 20mA
Scaling:	adjustable -1999...9999
Input circuit monitor:	12,5% below span start (4..20mA → 2mA)

Potentiometer

Ranges see Table 2

Connection:	2-wire
Lead resistance:	max. 30 Ohm
Input circuit monitor:	Break

SUPPLEMENTARY INPUT INP3 (OPTION)

Resolution:	> 14 bit
Scanning cycle:	100 ms

Technical data as for INP1 except the 10V range.

CONTROL INPUTS DI1, DI2

Configurable as direct or inverse switch or push-button!
Connection of a potential-free contact suitable for switching „dry" circuits.

Switched voltage:	5 V
Switched current:	100 µA

CONTROL INPUTS DI2, DI3 (OPTION)

The digital input di2 located on the A-card and di2 located on the option card are or-linked.
Configurable as switch or push-button!
Optocoupler input for active triggering

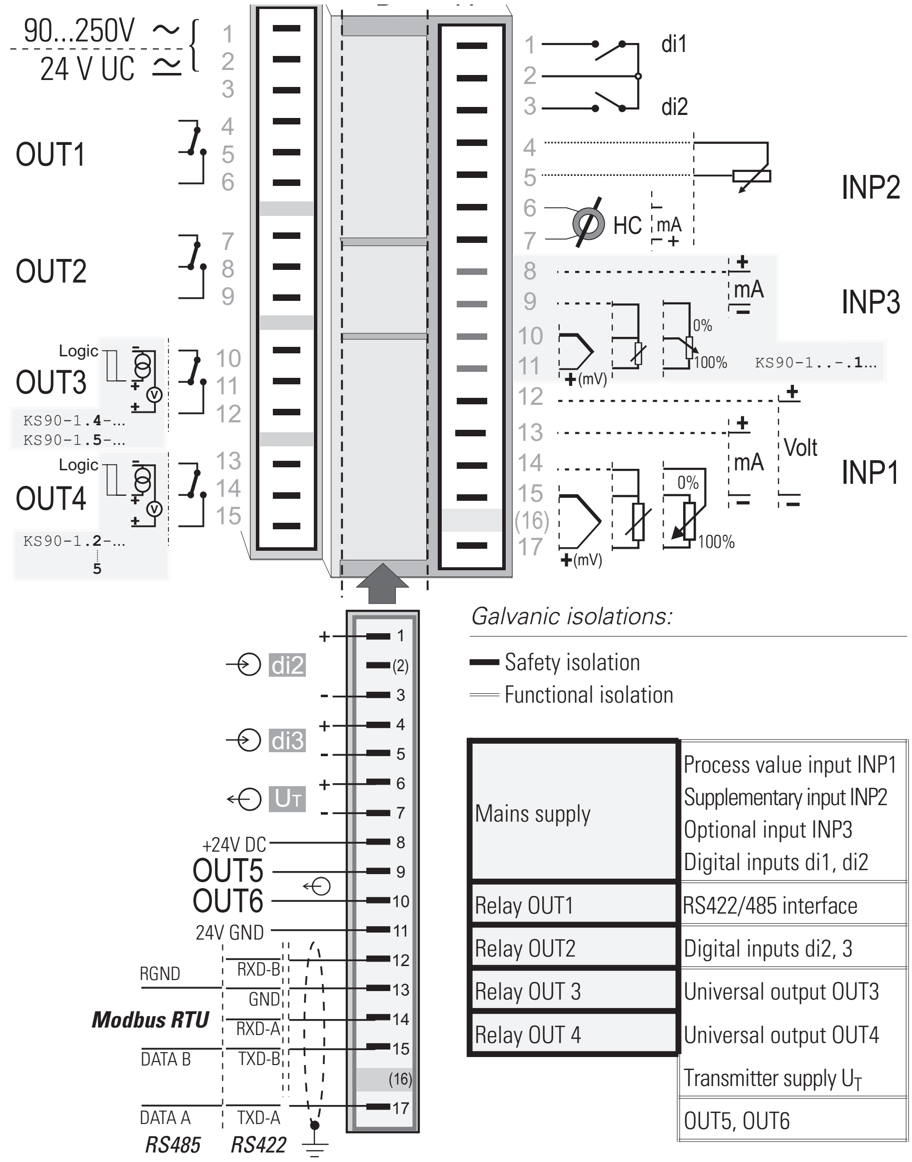
Nominal voltage:	24 V DC, external
Current sink (IEC 1131 Type 1)	
Logic „0":	-3...5 V
Logic „1":	15...30 V
Current requirement:	approx. 5 mA

TRANSMITTER SUPPLY U_T (OPTION)

Output:	22 mA / 18 V

The analog outputs OUT3/OUT4 and the transmitter supply U have different voltage potentials. Therefore, with analog outputs, you must not set up an external galvanic connection between OUT3/4 and U.

Electrical connections:



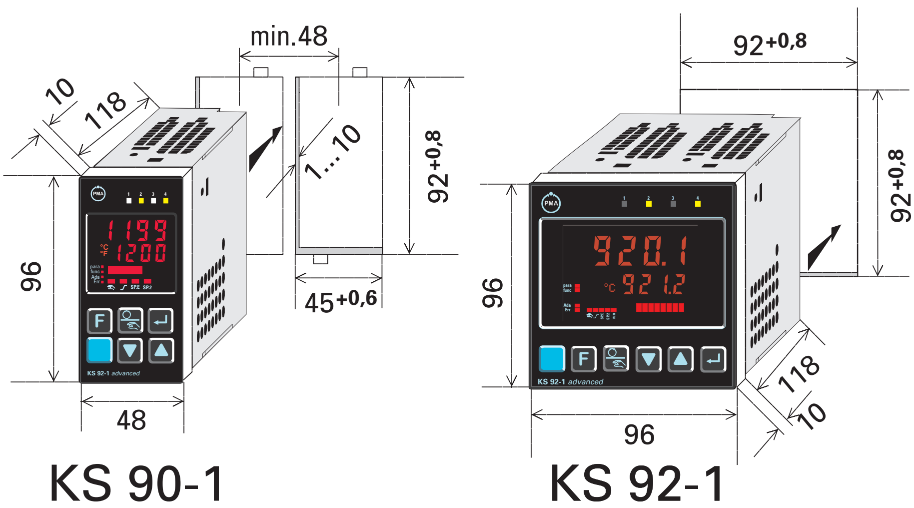
OUTPUTS

SURVEY OF THE OUTPUTS

Output	Used for
OUT1,2 (relays)	Control output heating/cooling or Open/Close, limit contacts, alarms, control (event) tracks, program end, operator call *
OUT3,4 (relays or logic)	as OUT1 and OUT2
OUT3,4 (continuous)	Control output, process value, meassured values INP1/2/3, set-point, control deviation, position feedback Yp, transmitter supply 13 V / 22 mA
OUT5 OUT6 (Optocoupler)	as OUT1 and OUT2 *OPTION*

** All logic signals can be OR-linked !*

Dimensions (mm):



RELAY OUTPUTS OUT1..OUT4

Contacts:	Potential-free changeover contact
Max. contact rating:	500 VA, 250 VAC, 2A at 48...62 Hz, resistive load
Min. contact rating:	6 V, 1 mA AC/DC
Duty cycle electric:	for I = 1A/2A: ≥ 800,000 / 500,000 ($\alpha\tau \sim$ 250V / (resistive load))

Note:
If the relays operate external contactors, these must be fitted with RC snubber circuits to manufacturer specifications to prevent excessive switch-off voltage peaks.

OUT3 , OUT4 AS UNIVERSAL OUTPUT

Galvanically isolated from the inputs.

Freely scalable	
Resolution:	11 bit
DA-converter limiting frequency T_{90}:	50 ms
Limiting frequency of the complete continuous controller:	> 2 Hz

Current output

0/4...20 mA, configurable.

Signal range:	0...approx. 22 mA
Load:	500
Load effect:	none
Resolution:	22 µA (0,1%)
Error:	40 µA (0,2%)

Voltage output

0/2...10V, configurable

Signal range:	0...11 V
Load:	≥ 2 kΩ
Load effect:	none
Resolution:	11 mV (0,1%)
Error:	20 mV (0,2%)

OUT3, OUT4 used as transmitter supply

Output:	22 mA / 13 V

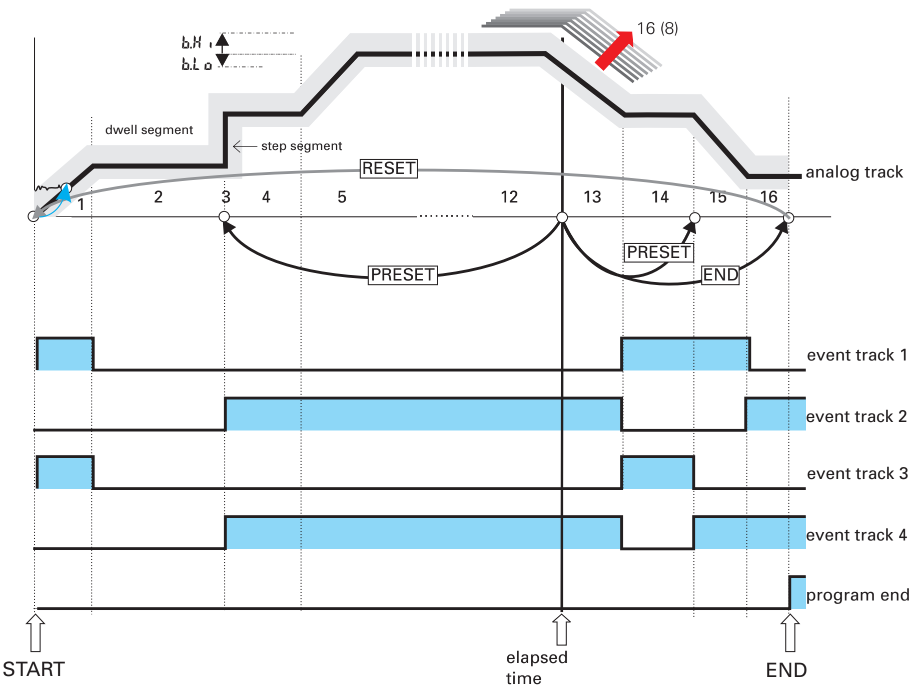
OUT3 used as logic output

Load 500	0/ 20 mA
Load > 500	0/> 13 V

OUTPUTS OUT5, OUT6 (OPTIONAL)

Galvanically isolated opto-coupler outputs.
Grounded load:
common positive control voltage.
Output rating: 18...32 VDC; =70 mA
Internal voltage drop: =1 V with I_{max}
Protective circuit: built-in against short circuit, reversed polarity.
Node: For inductive load a free-wheel diode has to be connected externally.

Programmer functions:



FUNCTIONS

PROGRAMMER

programs:	8 or 16 (depending on version)
control (event) tracks:	4
segments:	15 each
types of segments:	ramp (setpoint and time) ramp (setpoint and ramp) dwell segment (dwell time) step segment (with limit monitoring suppression) end segment

All types of segments can be combined with "wait at the end and operator call".

time base:	configurable hours:minutes or minutes:seconds
max. segment duration:	9999 hours = 1 year 51 days
max. programm duration:	16 x 9999 hours = > 18 years
ramp:	0,01°C/h (/min) to 9999°C/h (/min)
program names:	8 characters, adjustable with BlueControl Software
bandwidth control	upper and lower bandwidth (b.L o , b.H i) configurable for each program

CONTROLLER

Control behaviour

- Signaler with asymmetric adjustable switching differential (ON/OFF controller)
- PID controller (2-point and continuous)
- Delta / Star / Off or 2-point controller with switch over from partial to full load
- 2 x PID (heating/cooling)
- 3-point stepping controller with or without position feedback
- Continuous controller with internal positioner (stepping controller)

Two parameter sets for manual gain scheduling. Self-tuning control parameters or adjustable manually via front keys or BlueControl software.

Behaviour with 2- and 3-point controllers

- *Standard behaviour:*
  For precise matching of the required output value at the output signal limits, the controller changes the cycle times for heating and cooling automatically and continuously.
- *With constant cycle times:*
  The length of the shortest heating and cooling pulse is adjustable >20ms.

Set-point functions

- Adjustable set-point gradient (rate) 0,01...9999 °C/min
- Set-point control
- Program control
- Programm control with external correction
- Set-point/cascade control

- Set-point/cascade control with external correction

Process value calculation

- Standart (xeff = INP1)
- Ratio (INP1/X2)
- Difference (INP1-X2)
- Max (INP1, X2)*
- Min (INP1, X2)*
- Mean value (INP1, X2)*
- Switch-over between INP1 and X2

** applicable if redundant sensors are necessary. Control works with the remaining sensors, if one of them fails.*

Behaviour with sensor break or short circuit:

- Control outputs switched off
- Switch-over to a safe output value
- Switch-over to a mean output value
- With the measured value functions min, max and mean value, control is continued with the remaining measured value.

SPECIAL FUNCTIONS

Modbus Master

The KS 9x-1 can be configured as Modbus Master. This enables it to transmit user-specified signals or parameters cyclically to all connected Slave controllers. For example, the following applications are possible:

- Digital setpoint broadcast (→ Bild)
- Set-point shifting relative to the set-point adjusted in the Slave
- matching of control parameters, limit contacts, etc.
- Limiting the output value (override control OVC)
- ...

LIMIT SIGNALLING FUNCTIONS

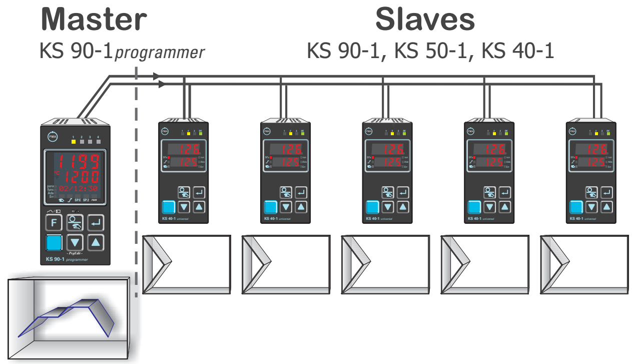
Max., Min. or Max./Min. monitoring with adjustable hysteresis.

Signals which can be monitored:

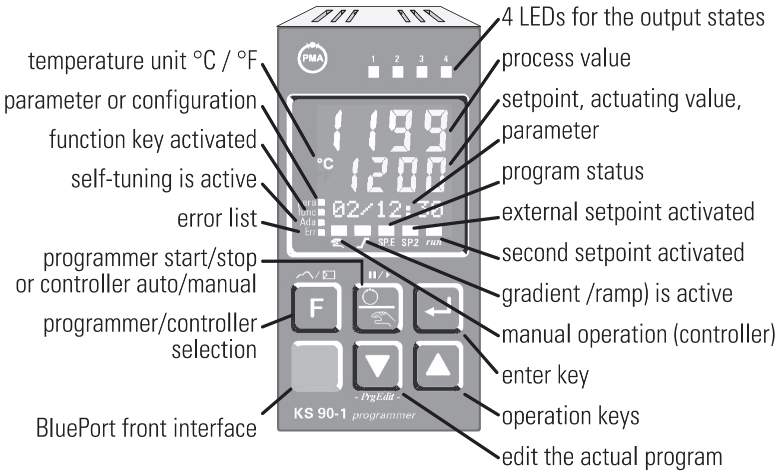
- Process value
- Control deviation
- Control deviation with suppression during start-up or set-point changes
- Effective set-point
- Output signal Y
- Input values of INP1, INP2, INP3
- Difference INP1 - X2. This function allows to detect aged thermocouples.

During a step segment limit monitoring is suppressed!

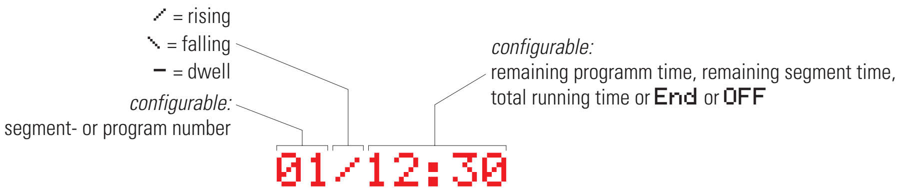
Modbus Master function sends the setpoint to the slave controllers:



Display and operation:



Programmer status indication:



Functions

- Input signal monitoring
- Input signal monitoring with latch (reset via front key or digital input)
- Rate of change monitoring (/min)
- Adjustable discriminator time of 0...9999 seconds

Several limit signals or alarms can be OR-linked before being output. Applications: Release of a brake with motor actuators, general alarms, etc.

ALARMS

Heating current alarm

- Overload and short circuit
- Open circuit and short circuit

Limit value adjustable 0...9999 A

Control loop alarm

Automatic detection if there is no response of the process to a change of output value.

Sensor break or short circuit

Depending on selected input type, the input signal is monitored for break and short circuit.

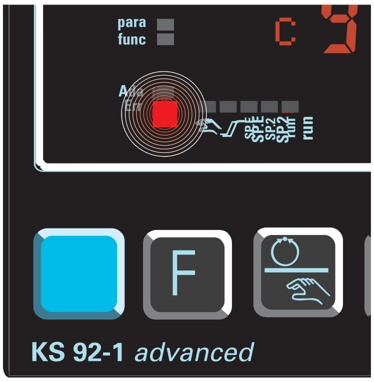
MAINTENANCE MANAGER

Display of error signals, warnings, and latched limit messages in the error list. Signals are latched, and can be reset manually.

Possible signals in the error list:

Sensor break, short circuit, reversed polarity
Heating current alarm
Control loop alarm
Fault during self-tuning
latched limit messages
Re-calibration warning
Maintenance interval of actuator
Internal fault (RAM, EEPROM, ...)

Flashing Error symbol indicates active alarm in the error list:



OPERATION AND DISPLAY

Display KS 90-1 programmer

Integrated day&night display

process value:	4 x 7 segment 10,5 mm
lower display:	4 x 7 segment 7,8 mm
text display:	8-character dot matrix used for displaying e.g. the program status

Display KS 92-1 programmer

LCD display module with red backlighting

process value:	4 x 7 segment 15,2 mm
lower display:	4 x 7 segment 10,8 mm
text display:	8-character dot matrix used for displaying e.g. the program status

Operating functions

The functions of the -key are configurable:

Function	
Y.2 (2nd output value)	X
SP.E (external setpoint)	X
Manual operation	X
C.OFF (controller function off)	X
Reset of latched limits and error list	X

Several functions can be combined e.g. SP.2 and parameter set switch-over (gain scheduling) with only one key.

POWER SUPPLY

Depending on version:

AC SUPPLY

Voltage:	90...260 VAC
Frequency:	48...62 Hz
Power consumption	approx. 8 VA

UNIVERSAL SUPPLY 24 V UC

AC voltage:	20,4...26,4 VAC
Frequency:	48...62 Hz
DC voltage:	18...31 V DC
Power consumption:	approx: 8 VA (W)

BEHAVIOUR WITH POWER FAILURE

Configuration, parameters, and adjusted set-points, control mode:
Non-volatile storage in EEPROM

BLUEPORT® FRONT INTERFACE

Connection of PC via PC adapter (see „Accessories"). The BlueControl software is used to configure, set parameters, and operate the KS 9x-1.

BUS INTERFACE (OPTION)

RS 422/485 INTERFACE

Galvanically isolated

Physical:	RS 422/485
Protocol:	Modbus RTU
Transmission speed: 2400, 4800, 9600, 19.200 bits/s	
Address range:	00...99
Number of controllers per bus:	32

Repeaters must be used to connect more controllers.

PROFIBUS DP

➢ see data sheet 9499-737-44813

ENVIRONMENTAL CONDITIONS

Protection modes

Front panel:	IP 65
Housing:	IP 20
Terminals:	IP 00

Permissible temperatures

For specified accuracy:	0...60°C
Warm-up time:	< 15 minutes
Temperature effect:	< 100ppm/K
For operation:	-20...65°C
For storage:	-40...70°C

Humidity

75% yearly average, no condensation

Shock and vibration

DIN EN 60068-2-6

Frequency:	10...150 Hz
Unit in operation:	1g or 0,075 mm
Unit not in operation:	2g or 0,15 mm

DIN EN 60068-2-27

Shock:	15g
Duration:	11ms

Electromagnetic compatibility

Complies with EN 61 326-1

- Complies with the immunity requirements for continuous, unattended operation
- Complies with the emmission requirements class B for rural areas
- Surge disturbances may increase the measurement error and lead to error messages

GENERAL

Housing

Material:	Makrolon 9415, flame-retardant
Flammability class:	UL 94 VO, self-extinguishing

Plug-in module, inserted from the front

Safety tests

Complies with EN 61010-1 (VDE 0411-1):
Over voltage category II
Contamination class 2
Working voltage range 300 VAC
Protection class II

Certifications (KS 92-1 applied for)

cUL certification

(Type 4x, indoor use)
File: E 208286

For compliance with cUL certificate,the following information must be taken into account:
Use 60 / 75 or 75°C copper (Cu) wire only .
Tighten the terminal- screws with a torque of 0,5 - 0,6 Nm
Ambient temperature: ≤ 40°C
Power supply: ≤ 250 V AC

Electrical connections

Depending on version:

- Flat-pin connectors 1 x 6,3 mm or 2 x 2,8 mm to DIN 46 244
- Screw terminals for conductor cross-section from 0,5 to 2,5 mm²

Mounting

Panel mounting with two fixing clamps at top/bottom or left/right
Close mounting possible

Mounting position:	not critical
Weight:	0,27 kg (9.52 oz)

Accessories supplied with unit

Operating instructions
2 fixing clamps

ACCESSORY EQUIPMENT

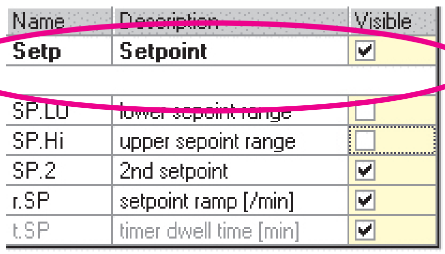
BlueControl (Engineering Tool)

PC-based program for configuring, setting parameters, and operating (commissioning) the KS 9x-1*programmer*. Moreover, all the settings are saved, and can be printed on demand.
Depending on version, a powerful data acquisition module is available, complete with trend graphics.

Visibility mask

The BlueControl software can be used to blind out parameters in the instrument. Thus, only allowed parameters can be changed on side.
Safety relevant parameters are invisible!

Two parameters are blinded out:

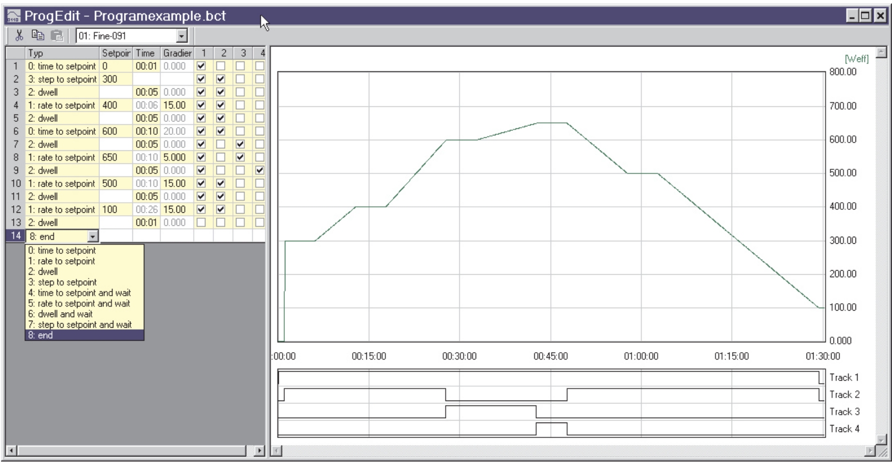


Name	Description	Visible
Setp	Setpoint	☑
SP.LO	lower sepoint range	☐
SP.Hi	upper sepoint range	☐
SP.2	2nd setpoint	☑
r.SP	setpoint ramp [/min]	☑
t.SP	timer dwell time [min]	☑

BlueControl, versions and functionality:

Functionality	Mini	Basic	Expert
parameter and configuration setting	yes	yes	yes
controller and loop simulation	yes	yes	yes
download: transfer of an engineering to the controller	yes	yes	yes
online mode / visualization	SIM only	yes	yes
defining an application specific linearization	yes	yes	yes
configuration in the extended operating level	yes	yes	yes
upload: reading an engineering from the controller	SIM only	yes	yes
basic diagnostic functions	no	no	yes
saving data file and engineering	no	yes	yes
printer function	no	yes	yes
online documentation, help	yes	yes	yes
implementation of measurement value correction	yes	yes	yes
data acquisition and trend display	SIM only	yes	yes
wizard function	yes	yes	yes
extended simulation	no	no	yes
customer-specific default data-set	no	no	yes
programeditor (KS 90-1programmer only)	no	no	yes

The programeditor in the BlueControl expert version:



Simulation

The built-in simulation serves to test the controller settings, but can also be used for general training and observing the interaction between controller and control loop.

Software requirements

Windows 95/98/NT/2000.

Configurations that can only be implemented via the BlueControl software (not via the front-panel keys):

- Generating 8-bit program names
- Customer-specific linearizations
- Activating customer specific data-set
- Enable „forcing“ for inputs/outputs
- Adjustment of limits for operating hours and switching cycles
- Switch-over to 60 Hz mains frequency
- Master/slave configuration
- Disable operator actions and operating levels, plus password definition
- Prevent automatic optimization of cycle times T1, T2

Hardware requirements:

A PC adapter (see „Accessories“) is required for connecting the controller.

Updates and demo software can be downloaded from:
www.pma-online.de

ORDERING INFORMATION

K S 9 0 - 1 _ _ - _ _ _ _ _ - _ 00

KS 90-1 Format 48 x 96	**0**
KS 92-1 Format 96 x 96	**2**
Flat-pin connectors	**0**
Screw terminals	**1**
90..250V AC, 4 relays	**0**
24VAC / 18..30VDC, 4 relays	**1**
90..250V AC, 3 relays + mA/logic	**2**
24VAC / 18..30VDC, 3 relays +mA/logic	**3**
90..250V AC, 2 relays + 2xmA/logic	**4**
24VAC / 18..30VDC, 2 relays + 2xmA/logic	**5**
no option	**0**
RS422/485 + U_T + di2, di3 + OUT5, OUT6	**1**
PROFIBUS-DP + U_T + di2/di3 + OUT5/OUT6	**2**
INP1 and INP2	**0**
INP1, INP2 and INP3	**1**
Program controller with 8 programs	**1**
Program controller with 16 programs	**2**
Standard configuration	**0**
Configuration to specification	**9**
no manual	**0**
manual german	**D**
manual english	**E**
manual french	**F**
Standard	**0**
cUL certified (with screw terminals only)	**U**
Unit / front according to customer specification	**XX**

ACCESSORIES

Description		**Order no.**
Current converter 50A AC		9404-407-50001
PC adapter, for connecting the BlueControl software to the BluePort®		9407-998-00001
Standard rail adapter		9407-998-00061
Operating manual KS 9x-1	English	9499-040-62911
	German	9499-040-62918
	French	9499-040-62932
Operating manual KS 9x-1dp	English	9499-040-66111
	German	9499-040-66118
BlueControl Mini	English/ German/ French	www.pma-online.de
BlueControl Basic	English/ German/ French	9407-999-11001
BlueControl Expert	English/ German/ French	9407-999-11011
Datasheet KS 9x-1	English	9498-737-40613
	German	9498-737-40633
Datasheet KS 9x-1dp	English	9498-737-44813
	German	9498-737-44833
Engineering set KS 9x-1 PROFIBUS	English	9407-999-10501
	German	9407-999-10511
Sub-D connector for flat-pin connectors		9407-998-07001
Sub-D connector for screw terminals		9407-998-07011

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