



# KS 90-1 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
- ⊕ 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
- ⊕ 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 90-1 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 input for position feedback measurement 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. Every KS 90-1 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 opto coupler outputs.

## Plug-in module

KS 90-1 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 KS 90-1 determines the best control parameters at the actual setpoint. This function does not require oscillation, and performs a minimal deviation of the process value.

## Display and operation

The „day & night“ display of the KS 90-1 is characterized 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 (process value)
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	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
di2	
di3 (option)	

### PROCESS VALUE INPUT INP1

Resolution: > 14 bit  
 Decimal point: 0 to 3 decimals  
 Digital input filter: adjustable 0,000...9999 s  
 Scanning cycle: 100 ms  
 Measured value correction: 2-point or offset correction  
**Special**  
 (-linearization): 16 segments  
 Standard table: temperature sensor KTY 11-6

### Thermocouples (Table 1)

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 )

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 <sup>1)</sup>	PtRh-Pt6%	0(400)...1820°C	32(752)...3308°F	≤ 3 K	0,3 K
special		-25...75 mV		≤ 0,1 %	0,01 %

<sup>1)</sup> values applied above 400°C

Table 2 Resistance transducers

Type	Sensor current	Range		Accuracy	Resolution (∅)
Pt100	0,2 mA	-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...450 Ω **			
Poti		0...160 Ω **		≤ 0,1 %	0,01 %
Poti		0...450 Ω **			
Poti		0...1600 Ω			
Poti		0...4500 Ω			

\* corresponds to special 0...4500 Ω

Table 3 Current and voltage

Range	Input resistance	Accuracy	Resolution (∅)
0-10 Volt	≈ 110 kΩ	≤ 0,1 %	0,6 mV
0-100 mV	≥ 1MΩ	≤ 0,1 %	6 μV
0-20 mA	20 Ω	≤ 0,1 %	1,5 μA

### 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: 16 segments, adaptable with BlueControl  
 Decimal point: adjustable  
 Input circuit monitor: 12,5% below span start (2mA, 1V)

The measuring range 0... 100mV can be used together with the special linearization function for connection of thermocouples with external temperature compensation!

### 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<sub>T</sub> (OPTION)**

Output: 22 mA / 18 V

If the universal outputs OUT3, 4 are used there may be no external galvanic connection between measuring and output circuits!

**OUTPUTS**

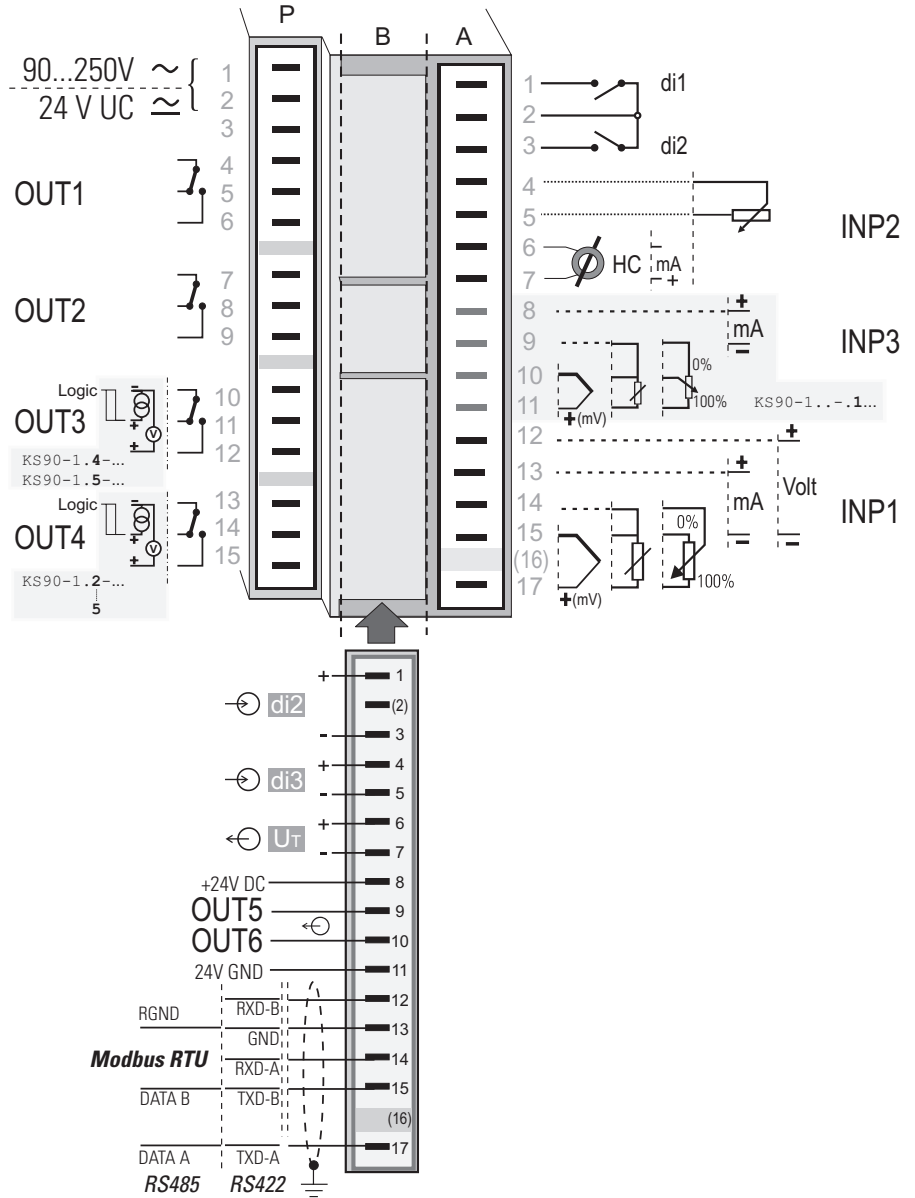
**SURVEY OF THE OUTPUTS**

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, measured values INP1/2/3, set-point, control deviation, position feedback Y <sub>p</sub> , transmitter supply 13 V / 22 mA
OUT5 OUT6 (Optocoupler)	as OUT1 and OUT2

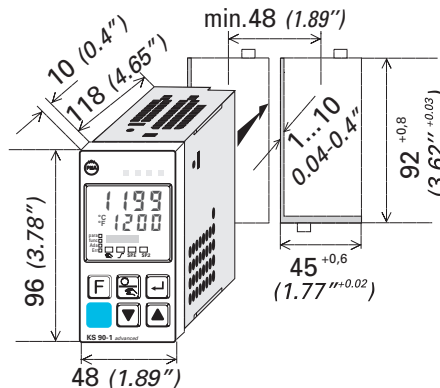
OPTION

\* All logic signals can be OR-linked !

*Electrical connections:*



*Dimensions (mm):*



*Galvanic isolations:*

— Safety isolation  
 = Functional isolation

Mains supply	Process value input INP1 Supplementary input INP2 Optional input INP3 Digital inputs di1, di2
Relay OUT1	RS422/485 interface
Relay OUT2	Digital inputs di2, 3
Relay OUT 3	Universal output OUT3
Relay OUT 4	Universal output OUT4
	Transmitter supply U <sub>T</sub>
	OUT5, OUT6

## 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
Operating life (electric):	800.000 duty cycles with max. rating

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 $\mu$ A (0,1%)
Error:	40 $\mu$ A (0,2%)

### Voltage output

0/2...10V, configurable	
Signal range:	0...11 V
Load:	$\geq 2$ k $\Omega$
Load effect:	none
Resolution:	11 mV (0,1%)
Error:	20 mV (0,2%)

## OUT3, OUT4 used as transmitter supply

Output:	22 mA / 13 V
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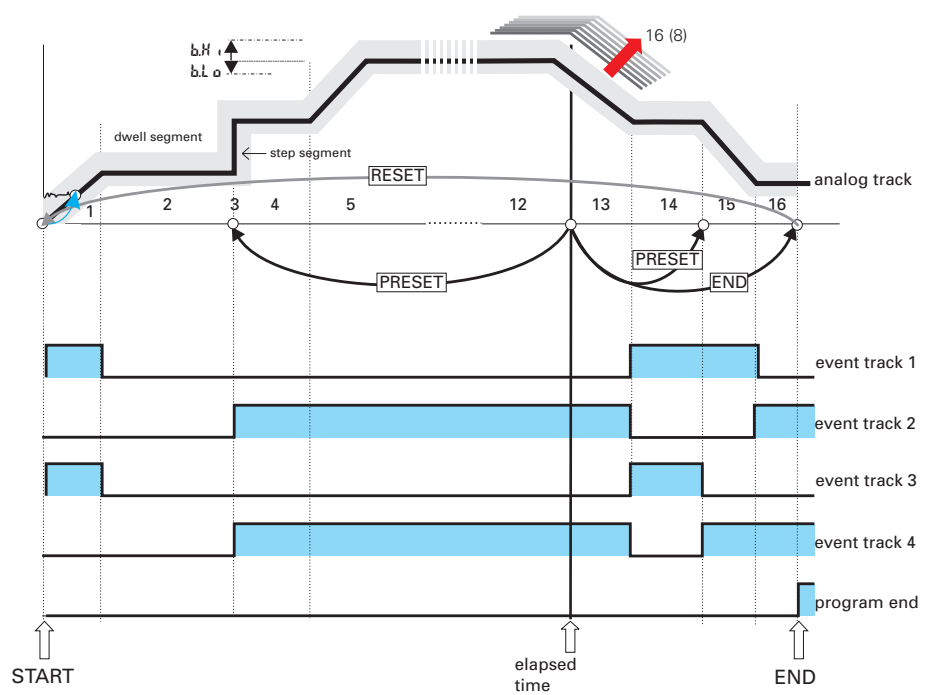
### OUT3 used as logic output

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, overload, reversed polarity (free-wheel diode for relay loads).

## Programmer functions:



## FUNCTIONS

### PROGRAMMER

programs:	8 or 16 (depending on version)
control (event) tracks:	4
segments:	16 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

## FUNCTIONS

### 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.

### 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 ( $x_{eff} = INP1$ )
- Ratio ( $INP1/X2$ )
- Difference ( $INP1-X2$ )
- Max ( $INP1, X2$ )
- Min ( $INP1, X2$ )
- Mean value ( $INP1, X2$ )
- Switch-over between  $INP1$  and  $X2$

### 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

### SPECIAL FUNCTIONS

#### Modbus Master

The KS 90-1 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:

- Set-point shifting relative to the set-point adjusted in the Slave (see picture)
- matching of control parameters, limit contacts, etc.
- Limiting the output value (override control OVC)
- ...

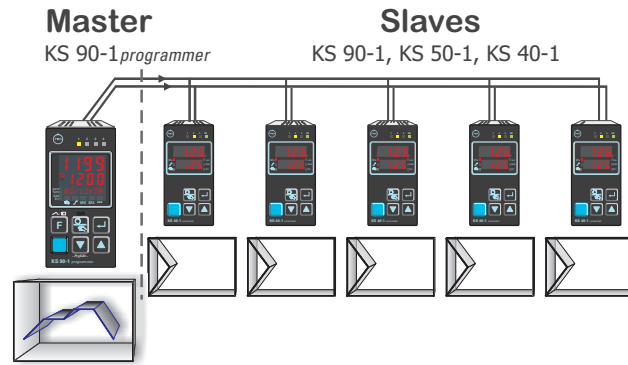
### LIMIT SIGNALLING FUNCTIONS

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

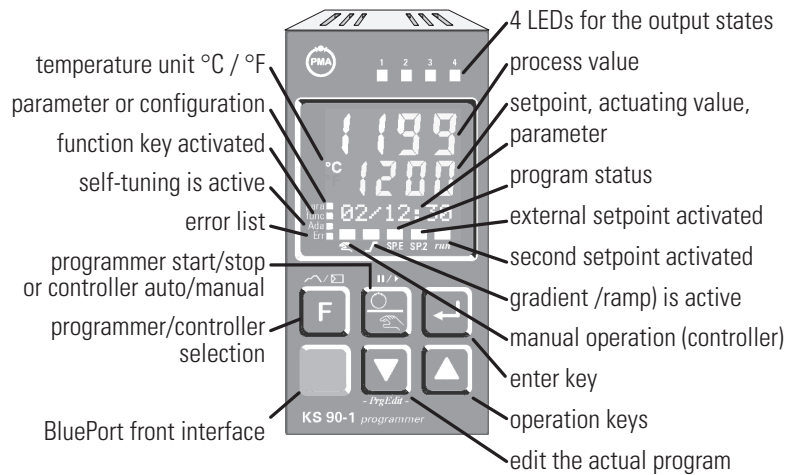
#### Signals which can be monitored:

- 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.

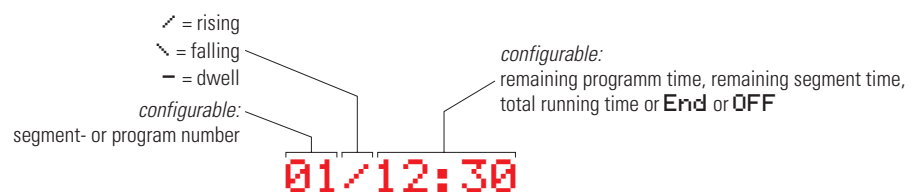
Modbus Master function sends the setpoint to the slave controllers:



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

Multi-function Day&Night display with red backlighting (adjustable)

- 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 as numeric or bargraph display

### 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 90-1.

## 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

#### Vibration test Fc (DIN 68-2-6)

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

#### Shock test Ea (DIN IEC 68-2-27)

- Shock: 15g
- Duration: 11ms

### Electromagnetic compatibility

Complies with EN 61 326-1

- Complies with the immunity requirements for continuous, unattended operation
- Complies with the emission 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 V0, 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

UL certification (applied for)

### 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 mm<sup>2</sup>

### 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 90-1 controller. 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!

### 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.

Two parameters are blinded out:

Name	Description	Visible
Setp	Setpoint	<input checked="" type="checkbox"/>
SP.LD	lower setpoint range	<input type="checkbox"/>
SP.Hi	upper setpoint range	<input type="checkbox"/>
SP.2	2nd setpoint	<input checked="" type="checkbox"/>
r.SP	setpoint ramp [/min]	<input checked="" type="checkbox"/>
t.SP	timer dwell time [min]	<input checked="" type="checkbox"/>

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

- Customer-specific linearizations
- 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:

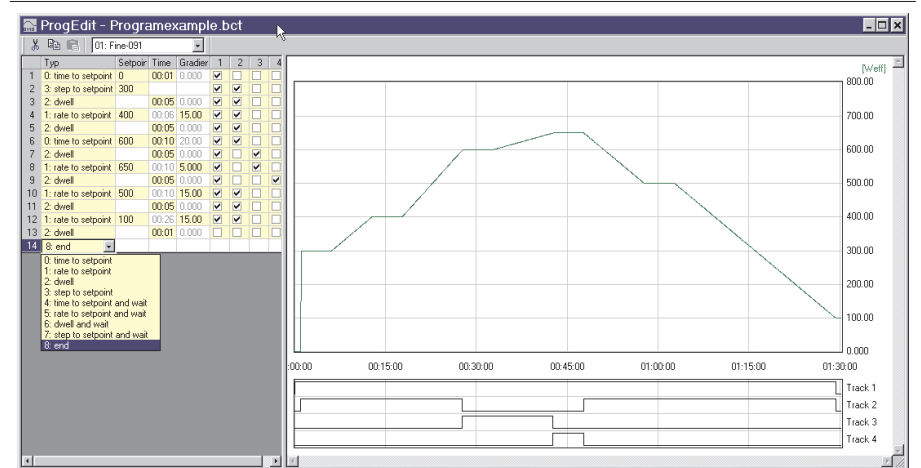
A PC adapter (see „Accessories“) is required for connecting the controller.

Updates and demo software can be downloaded from:  
[www.pma-online.de](http://www.pma-online.de)

BlueControl, versions and functionality:

Functionality	Mini	Basic	Expert
parameter and configuration setting	yes	yes	yes
controller and control loop simulation	yes	yes	yes
download: writes an engineering to the controller	yes	yes	yes
online mode/ visualisation	SIM only	yes	yes
creation of user defined linearizations	SIM only	yes	yes
configuration of extended operating level	SIM only	yes	yes
upload: reads an engineering from the controller	SIM only	yes	yes
basic diagnosis function	SIM only	yes	yes
file, save engineering data	no	yes	yes
printer function	no	yes	yes
online documentation, help system	no	yes	yes
measurement correction (calibration procedure)	no	yes	yes
program editor	SIM only	SIM only	yes
data acquisition and trend function	SIM only	SIM only	yes
network and multiuser licence	no	no	yes
personal assistant function	no	no	yes
extended simulation	no	no	yes
extended diagnostic and service functions	no	no	yes

Der Programmierer in der BlueControl Expert Version:



## ORDERING INFORMATION

	K	S	9	0	1							00
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 <sub>T</sub> + di2, di3 + OUT5, OUT6					1							
PROFIBUS-DP + U <sub>T</sub> + 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	
UL certified											U	

## 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	German	9499-040-66118
Operating manual	English	9499-040-66111
Operating manual	French	9499-040-66132
BlueControl Mini	German/English/French	www.pma-online.de
BlueControl Basic	German/English/French	9407-999-11001
BlueControl Expert	German/English/French	9407-999-11011



### PMA

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