



KS 50-1 *TCont* Temperature controller for tempering units and hot runners

EXPERT functions for tempering units and hot runners

TTY or RS 485/422 interface

BluePort® front interface and BlueControl® software

Maintenance manager and error list

Start-up circuit and boost function

Self-Tuning to the setpoint without oscillation

3-point controller for water, fan and oil cooling

cULus-certified

expert line

EXPERT FUNCTIONS

- Start-up and shut-down of tempering units
- For operating hot-runner systems
- Serial TTY or RS 485/422 interface
- Start/stop functions for local and remote operation

STANDARD FUNCTIONS

- Universal continuous/switching version, i.e. reduced stocks
- 100 ms cycle time, i.e. also suitable for fast control loops
- Freely configurable analog output, e.g. as process value output
- Customer-specific linearization
- 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
- Emergency operation after sensor break by means of the „output hold“ function
- Logical combination of digital outputs, e.g. for general alarm
- Built-in transmitter power supply
- Splash-water proof front (IP 65)

APPLICATIONS

- Plastics processing
- Tempering units
- Hot runners
- Driers

DESCRIPTION

The temperature controller KS 50-1 *TCont* is intended for precise and cost-effective control tasks, primarily with tempering units and hot runners. The process value signal is connected via a universal input. A supplementary analog input can be used for heating current measurement or as an external set-point input. Every KS 50-1 *TCont* has three process outputs that can be 3 relays or 2 relays plus a universal output. This universal output can be used for operating a solid-state relay, a continuous current/voltage output or to energize a two-wire transmitter. Additionally there are two additional opto coupler outputs.

The selectable function „start-up“ ensure increased lifetime of high-performance electrical heating elements (e.g. hot runner moulds).

Plug-in module

KS 50-1 *TCont* 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 KS50-1 *TCont* determines the best control parameters at the actual setpoint. This function does not require oscillation, and performs a minimal deviation of the process value. An automatic start of the self-tuning function can be disabled.

Display and operation

Clear information are given by ten indicator LEDs in the front panel that display operating mode, I/O states, and errors. The -key switches the controller into the manual mode directly. If required, the direct switch over can be disabled or the key can be configured e.g. reset the latched alarms. Due to the flexible use of the function key, an external switch or contact is not required in many cases, e.g. because remote/local switch-over can now be done directly.

Front interface and Engineering Tools

Control parameter adjustment in seconds has now also been implemented in the KS 50 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. Of course almost all adjustments can be done comfortably over the instrument front. (see page 6, 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	x (process value)
INP2	Heating current, ext. set-point
di1	Operation disabled, switch-over to second setpoint SP.2, external setpoint SP.E, fixed output value Y2, manual operation, controller off, disabling of manual key, reset of stored alarms, boost, parameters 1 / 2, safety temperature limiter, start/stop with local operation, sensor operating mode, level alarm, flow alarm
di2	
di3	

PROCESS VALUE INPUT INP1

Resolution: > 14 Bit
 Decimal point: 0 to 3 decimals
 Limiting frequency: adjustable 0.000...9999 s
 Scanning cycle: 100 ms
 Measured value correction: 2-point or offset correction

Thermocouples (Table 1)

Input impedance: $\geq 1 \text{ M}\Omega$
 Effect of source resistance: $1 \mu\text{V}/\Omega$

Cold junction compensation

Max. additional error $\pm 0.5 \text{ K}$

Sensor break monitoring

Sensor current: $\leq 1 \mu\text{A}$
 Operating sense configurable (see page 4)

Table 1 Thermocouple ranges

Thermocouple		Range		Accuracy	Resolution (\emptyset)
L	Fe-CuNi (DIN)	-100...900°C	-148...1652°F	$\leq 2\text{K}$	0.1 K
J	Fe-CuNi	-100...1200°C	-148...2192°F	$\leq 2\text{K}$	0.1 K
K	NiCr-Ni	-100...1350°C	-148...2462°F	$\leq 2\text{K}$	0.2 K
N	Nicrosil/Nisil	-100...1300°C	-148...2372°F	$\leq 2\text{K}$	0.2 K
S	PtRh-Pt 10%	0...1760°C	32...3200°F	$\leq 2\text{K}$	0.2 K
R	PtRh-Pt 13%	0...1760°C	32...3200°F	$\leq 2\text{K}$	0.2 K
	special	-25 ... 75 mV		$\leq 0.1\%$	0.01%

Table 2 Resistance transducers

Type	Sensor current	Range		Accuracy	Resolution (\emptyset)
Pt100	0.2 mA	-200...850°C	-328...1562°F	$\leq 1 \text{ K}$	0.1 K
Pt1000		-200...850°C	-328...1562°F	$\leq 2 \text{ K}$	0.1 K
Resistance*		4500 Ω		$\leq 0.1\%$	0.01%

* The characteristic of a KTY 11-6 is preadjusted (-50...150 °C)

Table 3 Current and voltage

Range	Input resistance	Accuracy	Resolution (\emptyset)
0-10 Volt	$\approx 110 \text{ k}\Omega$	$\leq 0.1 \%$	0.6 mV
0-20 mA	49 Ω (voltage requirement $\leq 2.5 \text{ V}$)	$\leq 0.1 \%$	1.5 μA

Resistance thermometer

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

Resistance measuring range

The BlueControl® software can be used to match the input to the sensor KTY 11-6 (characteristic is stored in the controller).

Physical measuring range: 0...4500 Ohm
 Linearization segments: 16

Current and voltage signals

Span start, end of span: anywhere within measuring range
 Scaling: selectable -1999...9999
 Linearization: 16 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
 Accuracy: better 0.1%

Heating current measurement

via current transformer

Measuring range: 0...50mA 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 \rightarrow 2mA)

CONTROL INPUT DI1

Configurable as direct or invers switch or push-button !

Connection of a potential-free contact suitable for switching „dry“ circuits.

Switched voltage: 2.5 V
 Switched current: 50 μA

CONTROL INPUTS DI2, DI3

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

Output: 22 mA / $\geq 18 \text{ V}$

If the universal output OUT3 is used there may be no external galvanic connection between measuring and output circuits!

OUTPUTS

SURVEY OF THE OUTPUTS

Output	Used for
OUT1 OUT2 (relay)	Control output for heating/cooling or open/close, limit contacts, alarms, end of program, pump control *
OUT3 (relay or logic)	as OUT1 and OUT2
OUT3 (continuous)	Control output, process value, set-point, control deviation, transmitter supply 13 V / 22 mA
OUT5 OUT6 (optocoupler)	as OUT1 and OUT2

* All logic signals can be OR-linked !

RELAY OUTPUTS OUT1, OUT2

Contacts: 2 NO contacts with common connection

Max. contact rating: 500 VA, 250 VAC, 2A at 48...62 Hz, resistive load

Min. contact rating: 6V, 1 mA DC

Duty cycle electric for I = 1A/2A: $\geq 800,000 / 500,000$ (at $\sim 250V$ / (resistive load))

OUT3 USED AS RELAY OUTPUT

Contacts: Potential-free changeover contact

Max. contact rating: 500 VA, 250 VAC, 2A at 48...62 Hz, resistive load

Min. contact rating: 5V, 10 mA AC/DC

Duty cycle electric for I = 1A/2A: $\geq 1,000,000 / 600,000$ (at $\sim 250V$ / (resistive load))

Note:
If the relays OUT1...OUT3 operate external contactors, these must be fitted with RC snubber circuits to manufacturer specifications to prevent excessive switch-off voltage peaks.

OUT3 AS UNIVERSAL OUTPUT

Galvanically isolated from the inputs.

Freely scalable

Resolution: 11 Bit

Time constant of the D/A converter T_{90} : 50 ms

Limiting frequency of the continuous controller: > 2 Hz

Current output

0/4...20 mA, configurable.

Signal range: 0...approx..21.5mA

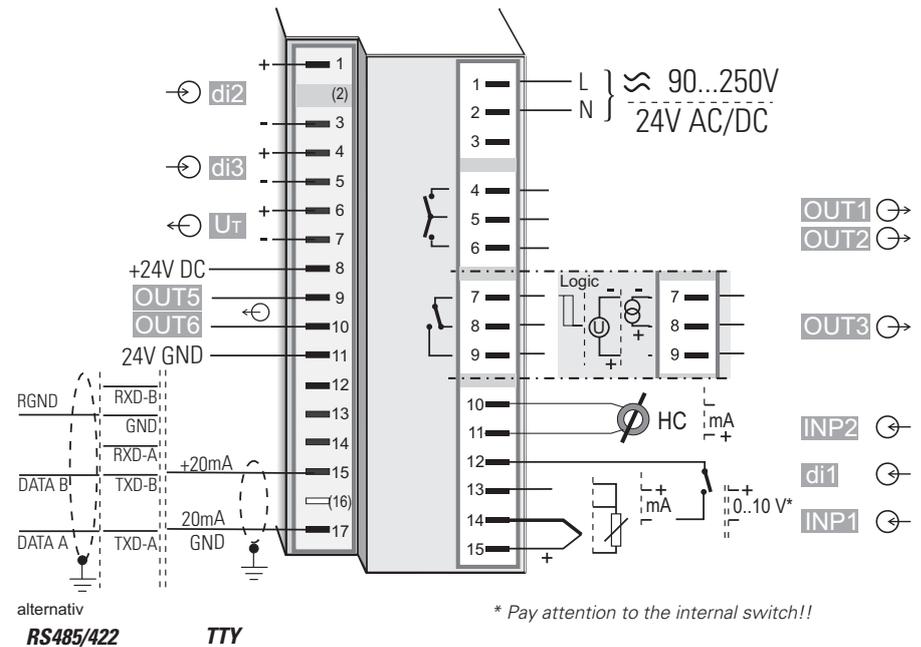
Load: $\leq 500 \Omega$

Load effect: 0.02%/100 Ω

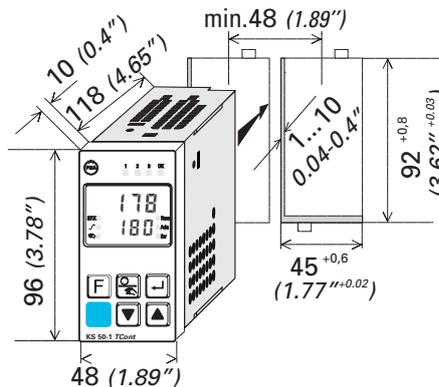
Resolution: $\leq 22 \mu A$ (0.1%)

Error: $\leq 40 \mu A$ (0.2%)

Electrical connections:



Dimensions:



Galvanic isolations:

— Safety isolation
— Functional isolation

Mains supply	Process value input INP1 Supplementary input INP2 Digital input di1
Relay outputs OUT1,2	RS485 / 422 interface TTY interface
Relay output OUT3	Digital inputs di2, 3 Universal output OUT3 Transmitter supply U_T OUT5, OUT6

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 used as transmitter supply

Output: 22 mA / ≥ 13 V

OUT3 used as logic output

Load $\leq 500 \Omega$ 0/ ≤ 20 mA

Load $> 500 \Omega$ 0/ > 13 V

OUTPUTS OUT5, OUT6

Galvanically isolated opto-coupler outputs. Grounded load: common positive control voltage.

Output rating: 18...32 VDC; ≤ 70 mA

Internal voltage drop: $\leq 1V$ 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.

FUNCTIONS

Control behaviour

- Signaler with 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

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.
- *Water cooling linear (heating=standard):*
To ensure a sufficient cooling effect, the cooling function starts only after reaching an adjustable temperature value. The pulse length is adjustable, too and remains constant for all output values.
- *Water cooling nonlinear (heating=standard):*
The general function is described above but the controller additionally takes in consideration that the water cooling is usually much stronger than the heating (thus preventing unfavorable behavior when changing from heating to cooling).

Set-point functions

- Adjustable set-point gradient 0.01...9999 °C/min
- Set-point control
- Set-point/cascade control
- Program controller with 10 segments (set-point/section time)

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 (PID controller)

SPECIAL FUNCTIONS

Boost-Function

The boost function provides a short-term increase of the set-point, e.g. with hot runner control, in order to clear nozzles of "frozen" rests of material.

Start-up circuit

For temperature control, e.g. with hot runners. High-performance heating elements with magnesium oxide insulation must be heated slowly, to remove any humidity and to prevent destruction.

LIMIT SIGNALLING FUNCTIONS

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

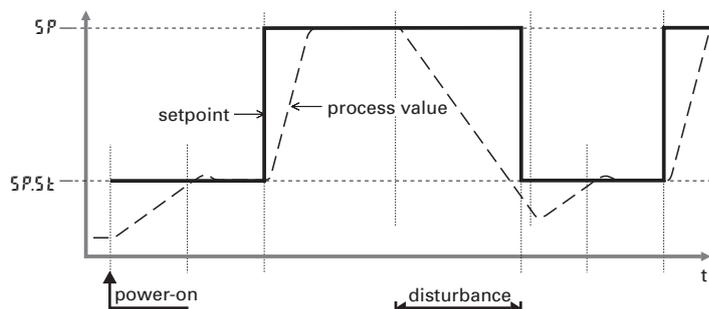
Signals which can be monitored:

- Process value
- Control deviation
- Control deviation with suppression during start-up or set-point changes
- Effective set-point
- Output signal Y
- Control deviation always compared to internal setpoint SP even if SP2 or SP.E is activated.

Functions

- Input signal monitoring
- Input signal monitoring with latch (reset via front key or digital input)
- 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
e.g. re-calibration warning (If the adjusted operating hours are exceeded a message is displayed)
e.g. maintenance interval of actuator (If the adjusted switching cycles are exceeded a message is displayed)
Internal fault (RAM, EEPROM, ...)

Blinking Error LED indicates active alarm in the error list:



Start-up circuit

When the process is controlled towards the start-up set-point, the output value is limited. The start-up set-point is kept constant during the start-up holding time. After that, the main setpoint SP is controlled. If a disturbance reduced the process value, the start-up circuit is activated again..

OPERATION AND DISPLAY

Display

Process value: LED with 7 segments, 10.5 mm
Lower display: LED with 7 segments, 7.8 mm

Operating functions

The functions of the -key and the -key are configurable:

Function		
Remote (no front operation)		X
SP.2 (2nd setpoint)		X
Y.2 (2nd output value)	X	X
SP.E (external setpoint)	X	X
Manual operation	X	X
C.OFF (controller function off)	X	X
Lock of manual key		X
Reset of latched limits and error list	X	X
Boost		X
Parameter set 1/2		X
Programmer run/stop		X

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

EXPERT FUNCTIONS

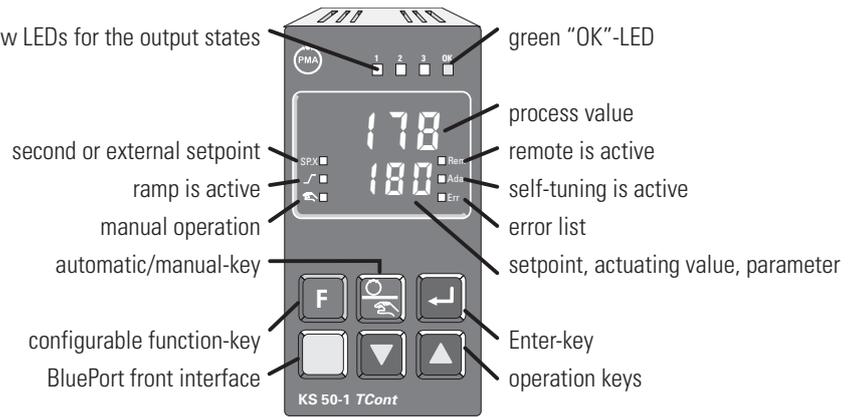
PROTOCOL

The KS 50-1 *TCont* supports a protocol that is widely used in the plastics processing industry, with specifications according to Arburg, Engel, and others.

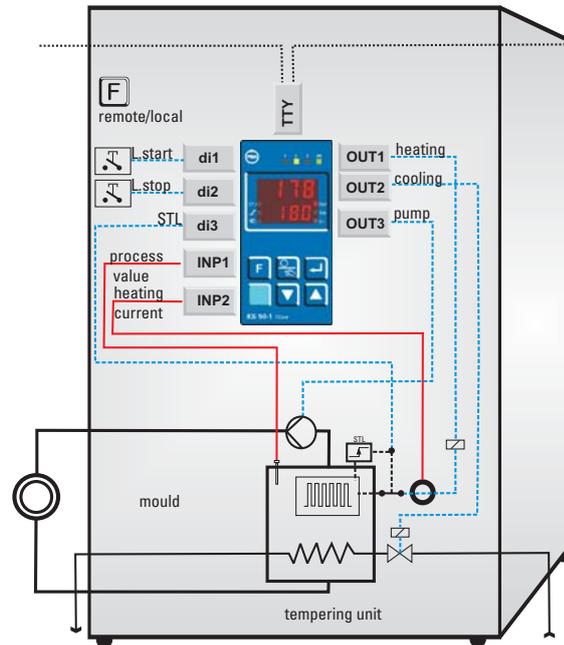
TEMPERING UNITS

- Functions:
- Start of controller operation (r)
 - Cooling to return flow temperature (k),(a),(s)
 - Switch-off (p)
 - Exchange of setpoint and process value
- Connection:
- Heating, cooling
 - Pump control
 - Safety temperature limiter (STL)
- Switch-overs:
- Remote / Local
 - Local start / stop
- Status information:
- Sensor operating mode internal/external
 - Level alarm
 - Flow alarm
- Return flow temperature:
- Adjustable via **SP.2**
- Limit value for STL:
- Adjustable via **L. r. 1**

Display and operation:



Connection example:



HOT RUNNERS

- Functions:
- Controller operation (r)
 - Positioner operation (s)
 - Disabling a channel (a)
 - Exchange of setpoint and process value
- Connection:
- Heating, cooling
- Switch-overs:
- Remote / Local

LOCAL OPERATION

Starting / stopping the controller in the local mode is possible via the inputs di1...di3 or by switching the setpoint SP on and off.

POWER SWITCH-ON

After power-up, the controller goes into the remote mode and then into the standby mode until the normal controller mode is activated.

POWER SUPPLY

Depending on version:

AC SUPPLY

Voltage: 90...260 V AC
Frequency: 48...62 Hz
Power consumption: approx. 7 VA

UNIVERSAL SUPPLY 24 V UC

AC voltage: 20.4...26.4 V AC
Frequency: 48...62 Hz
DC voltage: 18...31 V DC class 2
Power consumption: approx. 7 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 50-1 TCont.

BUS INTERFACE

RS 485/422

Screened cables must be used.

Galvanically isolated

Physical: RS 485/422
Transmission speed: 2400, 4800, 9600, 19.200 Bit/sec
Parity: Even, odd, none
Address range: 1...32
Number of controllers per segment: 32

TTY (20 MA CURRENT LOOP)

Screened cables must be used.

Galvanically isolated

Physical: 20 mA current loop
Transmission speed: 2400, 4800, 9600, 19.200 Bit/sec
Parity: Even, odd, none
Address range: 1...32
Voltage drop: ≤ 2.2V
Number of controllers per bus: ≥ 6

PROTOCOLS

Selection via parameter *P r o t*

- MODBUS RTU
- Protocol for tempering units*
- Protocol for hot runner systems*

* according to Arburg specification

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

- Meets the immunity requirements for continuous, unattended operation
- Meets the radiation requirements of Class B for rural areas
- In case of surge interference, increased measurement errors must be expected

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 V
Protection class II

Certifications

cULus-certification
(Type 1, indoor use)

File: E 208286

Electrical connections

- 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 2.5mm²

Mounting

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

Mounting position: not critical
Weight: 0.27 kg

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 50-1 TCont

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 masks

The BlueControl® software can be used to hide any number of controller parameters and configuration settings. This ensures that only certain parameters can be changed on-site. All

Only two parameters are visible.

Name	Description	Visible
Setp	Setpoint	<input checked="" type="checkbox"/>
SP.LO	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"/>
SP.bo	boost setpoint	<input type="checkbox"/>
t.bo	boost duration	<input type="checkbox"/>
Y.St	start-up setpoint	<input type="checkbox"/>
SP.St	setpoint for start-up	<input type="checkbox"/>
t.St	start-up time [min]	<input type="checkbox"/>

critical and 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 observation of 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):

- 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

ORDERING INFORMATION

KS 50-1 TCont

KS 50-1 - 03 - 46

Flat-pin connectors	0	↑				
Screw terminals	1	↑				
90..250V AC, 3 relays	0	↑				
24VAC / 18..30VDC, 3 relays	1	↑				
90..250V AC, 2 relays + mA/V/logic	2	↑				
24VAC / 18..30VDC, 2 relays + mA/V/logic	3	↑				
RS485/422 + U _r + di2/3 + OUT5/6	1	↑				
TTY + U _r + di2/3 + OUT5/6	3	↑				
Standard configuration					0	
Configuration to specification					9	
no manual						0
manual german						D
manual english						E
Standard (CE certified)						0
cULus-certified (with screw terminals only)						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 KS 50-1 (Standard)	German	9499-040-62818
Operating manual KS 50-1 (Standard)	English	9499-040-62811
Operation notes TCont	German	9499-040-64418
Operation notes TCont	English	9499-040-64411
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

BlueControl®, versions and functionality:

FUNCTIONALITY	MINI	BASIC	EXPERT
parameter and configuration setting	yes	yes	yes
controller and loop simulation	yes	yes	yes
download: trnsfer 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
programmeditor (KS 90-1prog only)	no	no	yes



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