WEST Control Solutions

PMA TB 45

Temperature limiter / monitor

Overview

The temperature limiter TB 45 is intended for precise, cost-effective signal monitoring & limiting tasks.

Every TB 45 is fitted with at least one universal input and two output relays.

Optionally, the TB 45 can be supplied with an analog output for display purposes.

Galvanic isolation is provided between inputs and outputs as well as from the supply voltage and the communication interfaces.

Key Features

- Configurable as limiter, monitor, or limit signaller

- Compact design, only 22.5 mmwide

- Clips onto top-hat DIN rail

- Plug-in screw terminals or spring-clamp connectors

- Dual-line LC display with additional status indicators

- Convenient 3-key operation

- System communication via bus connector fitted in top-hat rail

- BluePort® front interface

- Two universal inputs (only for device type TB45-1)

- Two relay outputs

- Two pre-alarms

- Universal output for data retransmission

Description

Mounting
The compact TB 45 is clipped onto a top-hat DIN rail, and can also be un-mounted very simply.
All connections are of the plug-in type, so that a device can be replaced very quickly without disturbing the wiring.

Display and operation
The dual-line LC display permits simultaneous indication of the measured value and all of the unit's operating functions.
Moreover, a LED and 4 other display elements give a reliable indication of operating status, operating mode, and error messages.
The user-configurable engineering unit of the measured value can be included in the display. By means of the extended Operating Level, it is possible to show any signal or parameter in the 2nd display line.

Interfaces and Engineering Tools
The limiter's settings are also configurable by means of an Engineering Tool. ® Via the BlueControl software (which includes a limiter simulation), and especially the convenient connection via the BluePort® front interface, the user can solve the task in hand without having to work through operating instructions.

Of course, practically all settings can also be made from the device front.

Moreover, the TB 45 can exchange data with superordinate PLCs and PCs via an optional RS 485 interface with Modbus RTU protocol that is fitted into the top-hat DIN rail.

Devices with option system interface can be connected to fieldbus coupler of the rail line series.

Password protection
Unauthorized access to the limit settings and the Operating Levels is prevented with a password.

TECHNICAL DATA
INPUTS
Survey of inputs

Input	Purpose
INP1	X1 (process value 1), universal input
INP2	External setpoint, heating current; Process value X1; Input for additional limit monitoring and display
(Option)	X2 (process value 2), universal input; input for additional limit monitoring and display
di1	Operation disabled; Reset of stored alarms

Input values can also be forced via interface

UNIVERSAL INPUT INP1

Resolution:	>14 bits
Decimal point:	0 to 3 decimals
Digital input filter:	adjustable 0.0. 999.9 s
Scanning cycle:	100 ms
Linearization:	15 segments, adaptable with BlueControl®
Measurement value correction:	2-point or offset

Thermocouples (Table 1)

Input resistance:	≥ 1 M Ω
Influence of source resistance:	1 µV/Ω
Input circuit monitor:	sensor break, polarity

Cold-junction compensation
- Internal
  - additional error: typical ≤ 0.5 K
  - max. ≤ +1.2 K
- External: 0 ...100 °C

Break monitoring
Sensor current: ≤ 1 úA
Operating sense configurable

Resistive sensors (Table 2)

Connection technique:	3-wire or 4-wire (TB45-1 version only)
Lead resistance (for max. span):	max. 30 Ω

Measurement span
Separated into ranges
Input circuit monitoring (current):
12.5% below span start (2 mA)
ADDITIONAL INPUT INP2 (UNIVERSAL, OPTIONAL)
Physical measurement range: 0...4,500 Ω
The BlueControl® software enables the internal characteristic curve for the KTY 11-6 temperature sensor to be adapted.

Table 1: Thermocouple input

	Thermocouple type	Measurement range		Error	Typical resol.
L	Fe-CuNi (DIN)	-100...900°C	-148...1,652°F	≤ 2K	0.1 K
J	Fe-CuNi	-100...1,200°C	-148...2,192°F	≤ 2K	0.1 K
K	NiCr-Ni	-100...1,350°C	-148...2,462°F	≤ 2K	0.2 K
N	Nicrosil/Nisil	-100...1,300°C	-148...2,372°F	≤ 2K	0.2 K
S	PtRh-Pt 10%	0...1,760°C	32...3,200°F	≤ 2K	0.2 K
R	PtRh-Pt 13%	0...1,760°C	32...3,200°F	≤ 2K	0.2 K
T**	Cu-CuNi	-200...400°C	-328...752°F	≤ 2K	0.05 K
C	W5%Re-W26%Re	0...2,315°C	32...4,199°F	≤ 3K	0.4 K
D	W3%Re-W25%Re	0...2,315°C	32...4,199°F	≤ 3K	0.4 K
E	NiCr-CuNi	-100...1,000°C	-148...1,832°F	≤ 2K	0.1 K
B*	PtRh-Pt6%	0(400)...1,820°C	32(752)...3,308°F	≤ 3K	0.3 K
Special		-25 … 75 mV		≤ 0.1%	0.01%

* Values apply from 400°C upwards.
** Values apply from -80°C upwards.

Table 2: Resistive inputs

Type	Sensor current	Measurement range		Accuracy	Typical resol. (Ø)
Pt100***		-200..100(150)°C	-328...212(302)°F	≤1 K	0.1 K
Pt100		-200...850°C	-328...1,562°F	≤ 1 K	0.1 K
Pt1000		-200...850°C	-328...1,562°F	≤ 2 K	0.1 K
KTY 11-6*		-50...150°C	-58...302°F	≤ 2 K	0.1 K
Special*		0...4,500 Ω**		≤ 0.1%	0.01%
Special*	≤ 0,25 mA	0...450 Ω**		≤ 0.1%	0.01%
Poti		0...160 Ω**		≤ 0.1%	0.01%
Poti		0...450 Ω**		≤ 0.1%	0.01%
Poti		0...1,600 Ω**		≤ 0.1%	0.01%
Poti		0...4,500 Ω**		≤ 0.1%	0.01%

*   Default setting is the characteristic for KTY 11-6 (-50...150°C)
** Including lead resistance
*** up to 150°C at reduced lead resistance (max. 160 [])

Table 3: Current and voltage input

Measurement range	Input resistance	Error	Typical resol.
0... 20 mA	20 Ω	≤ 0.1 %	1,5µA
0...10 Volt	≈ 110 kΩ	≤ 0.1 %	0.6 mV
-10...10 Volt	≈ 110 k Ω	≤ 0.1 %	1.2 mV
-5...5 Volt	≈ 110 kΩ	≤ 0.1 %	0.6 mV
-2,5...115mV*	>1 MΩ	≤ 0.1 %	6 µV
-25...1150mV*	>1 MΩ	≤ 0.1 %	60µV
-25...90mV*	>1 MΩ	≤ 0.1 %	8 µV
-500...500mV*	>1 MΩ	≤ 0.1 %	80µV
-200...200mV*	>1 MΩ	≤ 0.1 %	40µV

*For INP1: high-impedance, without break monitoring
for INP2: high impedance, break monitoring always active

Current and voltage measurement (Table 3)

Span start and span:	anywhere within the measurement range
Scaling:	freely selectable –1,999...9,999
Input circuit monitoring (current):	12.5% below span start (2 mA)

O2- measuring (option)

EMI-measuring by means of INP1 (high-imped-ance mV-inputs) suitable for probes with

– *constant sensor temperature (heated probes), setting by means of parameter*

– *measured sensor temperature (non-heated probes), measuring by means of INP2*

ADDITIONAL INPUT INP2 (UNIVERSAL, OPTIONAL)

Only for device type TB45-1

Resolution:	> 14 bits
Digital input filter:	adjustable 0.0. 999.9 s
Scanning cycle:	100 ms
Linearisation:	as for INP1 Measurement value 2-point or offset correction:
Type:	single-ended except thermocouples

Thermocouples (Table 1)
Cold-junction compensation

- Internal
  - additional error:

typical:	≤ 0.5 K
max.:	≤ 0.5 K

- External 0...100 °C

Resistive sensors (Table 2)

Connection technique:	3-wire

Measurement span
Remaining technical data as for INP1.

Current and voltage measurement (Table 3)

Remaining technical data as for INP1 except:

- Voltage input ranges –10 / 0...+10V and -5...+5V not possible.
- Millivolt input ranges: break monitoring always active.

ADDITIONAL INPUT INP2 (CURRENT)

Resolution:	>14 bits
Digital input filter:	adjustable ,0.0. 999.9 s
Scanning cycle:	100 ms
Linearization:	as for INP1
Measurement value correction:	2-point or offset
Type:	single-ended

CONTROL INPUT DI1

Configurable as direct or inverse switch or **push button!**

Contact input
Connection of potential-free contact that is suita-ble for switching 'dry' circuits.

Switched voltage:	5 V
Switched current:	1 mA

Optocoupler input

For active control signals.

Nominal voltage:	24 V DC, external supply
Logic '0':	-3...5 V
Logic '1':	15...30 V
Current demand:	max. 6 mA

OUTPUTS
SURVEY OF OUTPUTS

Output	Purpose
LC (relay)	Limit contact, alarms *
OUT2 (relay)	Limit contact, alarms, errors *
OUT3 (logic, option)	Same as OUT2
OUT3 (continu-ous, option)	Analog output (display value, Inp1, Inp2, Transmitter supply

All logic signals can be "OR-linked".

RELAY OUTPUTS LC, OUT2

Max. contact rating	500 VA, 250 VAC, 2A at 48...62 Hz, resistive load 6V,1 mA DC
Min. contact rating:	6V,1 mA DC
	Switching cyclesfor I=1A/2A:? 800,000/500,000 (at 250VAC, resistive load)

Note:

If the relays OUT1 and OUT2 operate external contactors, these must be fitted with RC snubber circuits to manufacturer specifications to prevent excessive voltage peaks at switch-off.

Current and voltage measurement (Table 3)

Remaining technical data as for INP1 except:

- Voltage input ranges –10 / 0...+10V and -5...+5V not possible.
- Millivolt input ranges: break monitoring always active.

CONTROL INPUT DI1

Configurable as direct or inverse switch or **push button!**

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Connection of potential-free contact that is suita-ble for switching 'dry' circuits.

Switched voltage:	5 V
Switched current:	1 mA

Optocoupler input
For active control signals.

Nominal voltage:	24 V DC, external supply
Logic '0':	-3...5 V
Logic '1':	15...30 V
Current demand:	max. 6 mA

Contact type:	*normally open **
Max. contact rating:	*500 VA, 250 V, 2A resistive load, 48...62 Hz,*
Min. contact rating:	*6V, 1 mA DC*
Switching cycles (electrical):	*for I=1A/2A: ? 800,000/500,000 (at 250V AC, resistive load)*

OUT3 AS UNIVERSAL OUTPUT (OPTION)

Galvanically isolated from the inputs. Parallel current/voltage output with common 'minus' ter-minal (combined use only in galvanically isolated circuits).

Freely scalable

Resolution:	14 bits
Tracking error I/U:	≤ 2%
Residual ripple:	≤±1%0...130kHz

(referred to end of span)

Current output

0/4...20 mA, configurable short-circuit proof

Control range:	-0.5...23 mA
Load:	≤ 700Ω
Load effect:	≤ 0.02%

Resolution:	≤ 1.5 µA
Error:	≤ 0.1%

Voltage output

0/2...10V, configurable, not permanently short-circuit proof

Control range:	-0.15.....V
Load:	≥ 2 kΩ
Load effect:	≤ 0.06%
Resolution:	≤ 0.75 mV
Error:	≤ 0.1%

OUT3 as transmitter supply

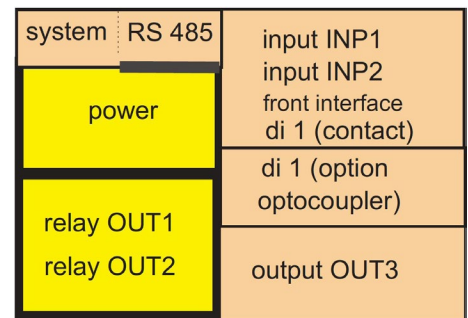Output: 22 mA / ? 13 V

OUT3 as logic signal

Load ≤ 700 Ω	0/≤ 23 mA
Load > 500 Ω	0/> 13 V

GALVANIC ISOLATION (FIG.1)

Galvanic isolation is provided between inputs and outputs as well as from the supply voltage (3-port-isolation).

Between power supply and min in-/outputs:	2.3 kV AC, 1
Between input and output:	500 V AC; 1min

Isolation:

between in-/output against earth: ≤ 33V AC

Fig.1: galvanic isolation

system	RS 485	input INP1 input INP2 front interface di 1 (contact)
power		
relay OUT1 relay OUT2		di 1 (option optocoupler)
		output OUT3

Safety isolation
functional isolation

FUNCTIONS
LC RELAY OUTPUT

Interruption of the power supply if the upper or lower limit for the process value is exceeded. Possible operation as:

Limiter

Switch-off if a limit is exceeded
Output is re-enabled when the process value is within limits again (incl. hysteresis), and the electronic latch has been released manually via the reset function.

Monitor

The KS 45 has been prepared for connecting PMATune, in order to determine the optimum control parameters, also with difficult control loops.

Limit signaller

Limit signalling function (see below)

Process value settings:

INP1, optional difference INP1-INP2, MAX/MIN (INP1, INP2), O2 measurement.

OTHER LIMIT SIGNALLING FUNCTIONS

MAX, MIN or MAX+MIN monitoring with adjustable hysteresis
2 additional alarms available.

Monitored signals
- Process value (absolute)
- Difference to limit contact LC (relative)
- Input 1
- Input 2

Functions
- Input circuit monitoring
- Input circuit monitoring with latching

Several limit and alarm signals can be "OR-linked" for output.

ALARMS

Sensor break/short circuit
Depending on the selected input type, the input circuit is monitored for break, short circuit, and reversed polarity.

Behaviour on sensor break / short circuit
- Response of the analog output is selectable (upscale / downscale)

SIGNAL LINKING (OPTION)
- Additional combinations if INP2 is fitted:
- Difference INP1 - INP2
- Max. value selection INP1, INP2
- Min- value selection INP1, INP2
- O2 measurement with constant sensor temperature (INP1: mV input)*
- O2 measurement with measured sensor temperature (INP1: mV input, INP2: temperature input)*

* Precise calculation using Nernst equation.

DISPLAY AND OPERATION

Display
LCD
dual-line plus additional display elements

Upper line
4 digits, 7-segment LCD for:
- Process value
- Limit value of LC

Lower line
5 digits, 14-segment LCD;
(Content configurable via **BlueControl®**)
- Engineering unit
- Parameters
- Extended Operating Level

Additional display elements
4 display elements (bars in the lower line of the LCD)
- Identifiers 1 & 2 : LC/OUT2 active
- Identifier TB:

   Adjusted function as temperature limiter.
- Identifier E:
   Entry has been made in the error list.

Status LED
Dual-colour

Green:	OK
Green, blinking:	no data exchange with buscoupler (only for devices with system option)
Red:	limit value Lim1/LC exceeded
Red,blinking:	internal fault, configuration mismatch

Operating functions
Only three keys at the front of the TS 45 are used to operate process values, parameters, and configuration data. Different Operating Levels and selected parameters can be disabled by means of BlueControl®.

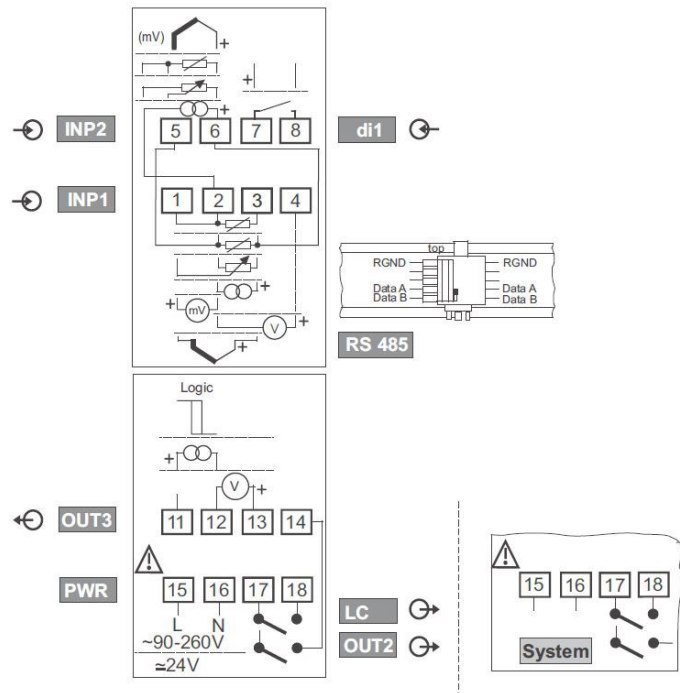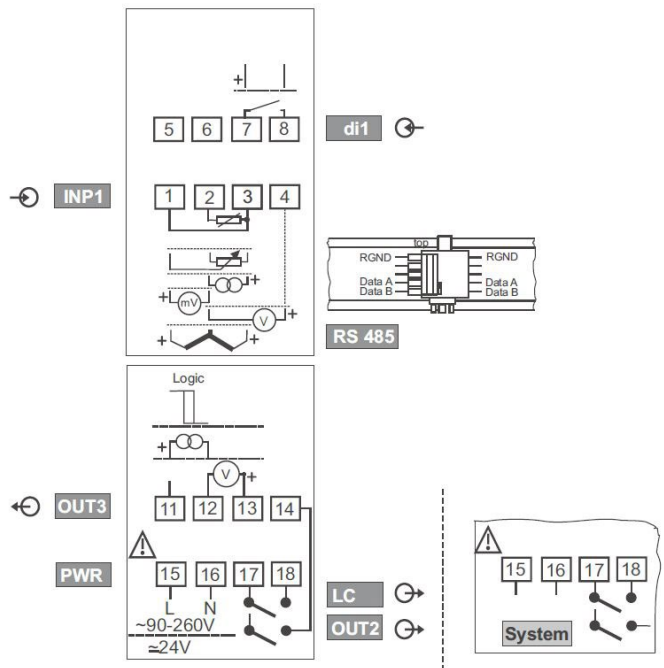*Fig. 2: Connections TB 45-1 temperature monitor*

Fig. 3: Connections TB 45-2 temperature limiter

MAINTENANCE MANAGER

Display of error messages, warnings, and stored limit value messages in the error list. Messages are stored, and can be reset manually.

Possible elements in the error list:

Sensor break, short circuit, incorrect polarity
Stored limit values
Heating current alarm
Control loop alarm
Fault during self-tuning
E.g. Re-calibration warning (message is generated when a predefined operating time is reached)
E.g. Maintenance interval for a switching device (message is generated when a predefined number of switching cycles is reached)
Internal fault (RAM, EEPROM, ...)

POWER SUPPLY

Depending on ordered version:

AC supply

Voltage:	90...250 V AC
Frequency:	48...62 Hz
Consumption:	approx. 9 VA max.

Universal supply 24 V UC*

AC supply:	18...30 V AC
Frequency:	48...62 Hz
DC supply:	18...31 V DC
Consumption:	approx. 4 VA / 3W max.

Supply only with protective low voltage (SELV)
*Devices with system option:
They are supplied via the bus connector from bus coupler or power supply module.

Behaviour with power failure

Configuration and parameter settings: Permanent storage in EEPROM

BLUEPORT® FRONT INTERFACE

Connection via bus connector fitted in the top-hat rail. Screened cables should be used.

BUS INTERFACE (OPTIONAL)
RS 485

Connection via bus connector fitted in the top-hat rail. Screened cables should be used.
Galvanically isolated

Type:	RS 485
Transmission speed:	2,400, 4,800, 9,600, 19,200, 38,400 bits/sec
Parity:	even, odd, none
Address range:	1...247
Number of controllers per bus segment:	32

Protocol:

• MODBUS RTU

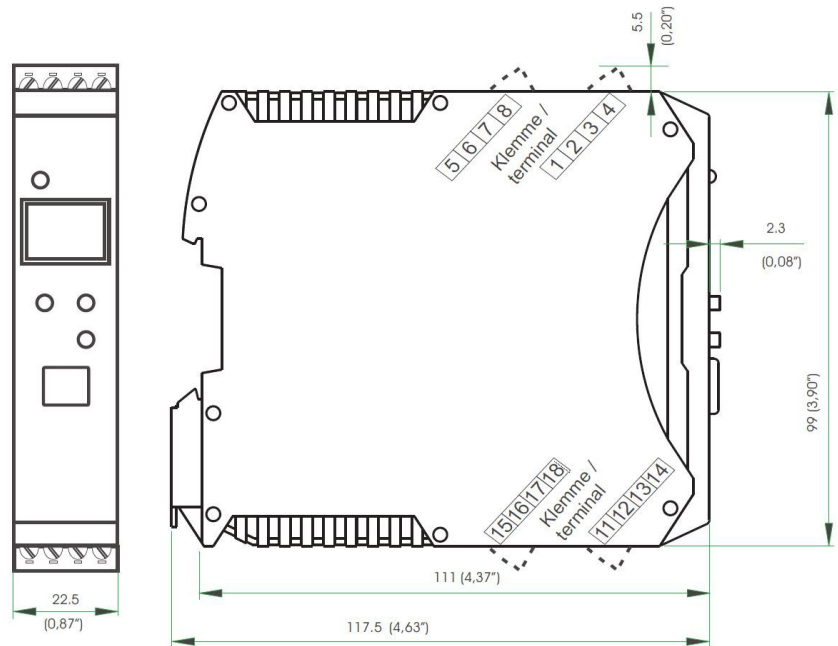### SYSTEM INTERFACE (OPTIONAL)

For connection to fieldbus couplers (see system components) Connection via bus connector fitted in the top-hat rail. Technical data see rail line data sheet

ENVIRONMENTAL CONDITIONS

Protection mode

Front panel:	IP 20
Housing:	IP 20
Terminals:	IP 20

Fig. 4: Overall dimensions (in mm)

Permissible temperatures

For specified accuracy:	-10. 55°C
Warm-up time:	< 20 minutes
Temperature effect:	ß 0.05%/ 10K

add. effect of CJ compensation:
ß 0.05% / 10 K Operating limits:

	-20...60°C
Storage:	-30...70°C

Altitude

To 2000 m above sea leveln

Humidity

Max. 95%, 75% yearly average, no condensation

Shock and vibration

Vibration test Fc (DIN EN 60 068-2-6)

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 EN 60 068-2-27)

Shock:	15 g
Duration:	11 ms

Electromagnetic compatibility

Complies with EN 61 326-1 for conti- nuous, unattended operation.
Interference radiation:

• Within the limits for Class B devices.

Immunity to interference:
Meets the test requirements for devi- ces in industrial areas.

Evaluation criteria:

• Surge interference partly has marked effects, which decay after the interference stops.
• With high levels of surge interference on 24 V AC mains leads, it is possible that the device is reset.
• With HF interference, effects up to 50 µV can occur.

GENERAL

Housing front

Material:	Polyamide
PA 6.6 Flammability class:	VO (UL 94)

Connecting terminals

Material:	Polyamide PA

Flammability class:
V2 (UL 94) for screw
terminals V0 (UL 94) for spring-clamp terminals
and bus connector

Electrical safety

CE conform
Complies with EN 61 010-1
Over-voltage category II Contamination degree 2
Protection class II

Electrical connections

Plug-in connector strips with choice of terminal
type:
Screw terminals or spring-clamp terminals, both
for lead cross-sections from 0.2 to 2.5 mm2.
(AWG24-12)

Mounting method

Clip-on rail mounting (35 mm top-hat rail to EN
50 022).
Locked by means of metal catch in housing
base.
Close-packed mounting possible.

Mounting position:	vertical

Weight:

0.18kg

Standard accessories

Operating instructions
• With 'Interface' option: bus
• connector for fitting into top-hat rail

CERTIFICATION

• Type tested to EN 14597 (replaces DIN
  3440) With certified sensors applicable for:
  - Heat generating plants with outflow
    temperatures up to 120°C to DIN 4751
  - Hot-water plants with outflow
    temperatures above 110°C to DIN 4752
  - Thermal transfer plants with organic
    transfer media to DIN 4754
  - Oil-heated plants to DIN 4755
• cULus-certification (only for device type
  TB45-1)
  (Type 1, indoor use)
  File: E 208286

Table 4: BlueControl®: Versions and functions

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/ visualisation	SIM only	Yes	Yes
Defining and application specific linearisation	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

ACCESSORIES

BlueControl® (Engineering Tool)

PC software package for configuring, parameter
setting, and operating (commissioning) the KS
45 controller. Moreover, all settings are saved
and can be printed, if required.
Depending on version, a powerful data acquisi-
tion module with trend graphics is available.

*Fig. 5: Hiding of interface parameters: only the
address is visible*

Show/hide function

The BlueControl® software enables any number
of parameters and confi- guration setting to be
shown/hidden. This ensures that only permitted
para- meters & settings can be changed in the
controller. Safety-relevant parame- ters are not
displayed.

Simulation function

The built-in simulation serves to test the settings.

Software requirements:
Windows 95/98/NT/2000/XP

**Configuration settings made only via the
BlueControl® software
(not via the controller's front keys)**

• Customer-specific linearization
• Enable forcing for inputs and outputs
• Setting the limits for operating hours and
  switching cycles
• Switch-over to 60 Hz mains frequency
• Blocking operator functions, Operating
  Levels, and password definition
• Text setting
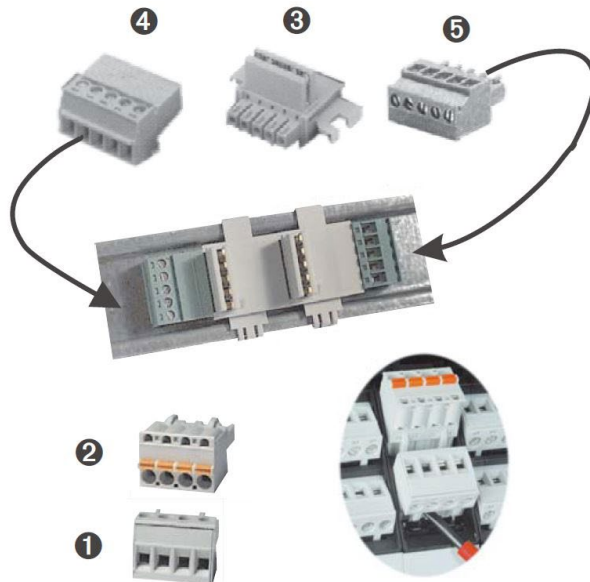• Definition of the display contents

Hardware requirements

A special PC adapter (see 'Additional Accesso-
ries') is required for connec ting to the controller

Updates and demo software from:
www.west-cs.co.uk

Fig. 6: Accessories

ACCESSORIES

Description	Quantity	Order no.
❶ Connector set with screw terminals	4 pcs.	9407-998-07101
❷ Connector set with spring-clamp terminals	4 pcs.	9407-998-07111
❸ Bus connector for fitting in top-hat rail	1 piece	9407-998-07121
❹ Plug for bus connection, inverted, connections at left, horizontal cable entry	1 piece	9407-998-07131
❺ Plug for bus connection, connections at right, vertical cable entry	1 piece	9407-998-07141

ADDITIONAL ACCESSORIES

Description	Language	Order no.
PC adapter for the BluePort ® front interface		9407-998-00001
BlueControl ® Mini	German/English	https://www.west-cs.com/resources/
BlueControl ® with Basic license rail line	German/English	9407-999-12001
BlueControl ® with Expert license rail line	German/English	9407-999-12011

ORDERING INFORMATION

Temperature monitor	T	B	4	5	-	1			-		0	0	-	00
1 universal input, 1 digital input with display and BluePort interface														
without plug-in connector terminals							0							
with screw terminal connector							1							
90...250V AC, 2 output relays,								0						
18...30VAC/18...31VDC, 2 , output relay								1						
90...250V AC, mA/V/logic + 2 relays,								2						
18...30VAC/18...31VDC, mA/V/ , logic + 2 relays								3						
without options										0				
RS 485 / MODBUS - protocol										1				
System interface (only for 24V versions)										2				
di1 as contact input											0			
di1 as optocoupler input											1			
INP2 as universal input, 0 -measurement, di1 as contact input											2			
INP2 , di1 as optocoupler input as universal input, 02-measureme											3			
Standard configuration												0		
Customer-specific configuration												9		
Standard (CE-certification)														0
UL, cUL														U
EN 14597 (DIN 3440) Temperature monitor														D

Temperature limiter TB 45	T	B	4	5	-	2			-		0	0	-	00
1 universal input, 1 digital input with display and BluePort interface														
without plug-in connector terminals							0							
with screw terminal connector							1							
90...250V AC, 2 relays,								0						
18...30VAC/18...31VDC, 2 , relay								1						
90...250V AC, mA/V/logic + 2 relays,								2						
18...30VAC/18...31VDC, mA/V/ , logic + 2 relays								3						
without options										0				
RS 485 / MODBUS - protocol										1				
System interface (only for 24V versions)										2				
di1 as contact input											0			
di1 as optocoupler input											1			
Standard configuration												0		
Customer-specific configuration												9		
EN 14597 (DIN 3440) Temperature limiter														D

Additional system components for units with system interface

Fieldbus couplers

CANopen	RL40-111-00000-U00
PROFIBUS DP/DPV1	RL40-112-00000-U00
MODBUS RTU	RL40-113-00000-U00
Ethernet MODBUS/TCP	RL40-114-00000-U00
Profinet IO	RL40-115-00000-U00

Power supply module   RL40-119-00000-U00
* see Rail Line system datasheet

Documentation

https://www.west-cs.co.uk/resources-uk/

Contact

UK

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WEST
Control Solutions

DS-TB45-2-UK-1906