

### Universal Industrial Controller



- Configuration port and BlueControl software
- Maintenance manager and error list
- Start-up circuit and boost function
  - Two switchable parameter sets
- Self-Tuning to the setpoint without oscillation
- Monitoring of heating current and output circuit
- 3-point controller for water, fan and oil cooling
  - 16 x 16 segment profiler
  - cULus

- 100 ms cycle time, i.e. also suitable for fast control loops
- 20ms as shortest pulse for very fast / strong actuators (e.g. infrared heater or water cooling)
- Freely configurable analog output, e.g. as process value output
- Customer-specific linearization for all sensors
- 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
- Programmer with 16 x 16 segments and “end” signal
- RS 485 Modbus RTU interface
- Built-in transmitter power supply
- Splash-water proof front (IP 65)

#### APPLICATIONS

- Furnaces and ovens
- Burners and boilers
- Plastics processing
- Driers
- Climatic chambers
- Heat treatment plants

#### DESCRIPTION

The universal temperature controller is intended for precise and cost-effective control tasks in all branches of industry. The unit can provide simple 2-point (on/off) control, continuous PID control, or 3-point stepping control. The process value signal from a sensor is connected to the universal input. A supplementary analog input is available for heating current measurement or as an external setpoint signal.

The function “start-up” can be selected for increased lifetime of high performance electrical heating elements (e.g. hot runner moulds).

#### Self-tuning during start-up and to the setpoint

This function determines the optimum settings for fast ramp to setpoint with no overshoot. Using three-point controller configuration, the “cooling” parameters are determined separately, ensuring an optimum performance matched to the process.

On a single keypress the controller can determine the best PID control

parameters at setpoint. This function does not require oscillation, and performs a minimal deviation of the process value.

#### Display and operation

Clear information is given by indicator LEDs in the front panel that displays operating mode and I/O states. An F key switches the controller into the several operation modes such as manual, latched alarm reset or activates the boost function directly.

#### Front interface and Engineering Tools

It is possible to adjust parameters in seconds in Pro-16 via BlueControl software with simulation function, the required set-up for a specific control task can be determined without a detailed study of the operating instructions.

Additionally most adjustments can be made easily from the instrument front. (see page 7, BlueControl)

#### Password protection

If required, the various operating levels can be protected with a password to prevent unauthorized access.

## TECHNICAL DATA

### INPUTS

#### 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

#### Thermocouples (Table 1)

Input impedance: 1 M $\Omega$   
 Effect of source resistance: 1 V/ $\Omega$

#### Cold junction compensation

Max. additional error < 0.5 K

#### Sensor break monitoring

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

#### Resistance thermometer

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

Table 1. Thermocouple ranges

Thermocouple		Range		Accuracy	Resolution ( $\emptyset$ )
L	Fe-CuNi (DIN)	-100...900°C	-148...1652°F	$\leq 2$ K	0.1 K
J	Fe-CuNi	-100...1200°C	-148...2192°F	$\leq 2$ K	0.1 K
K	NiCr-Ni	-100...1350°C	-148...2462°F	$\leq 2$ K	0.2 K
N	Nicrosil/Nisil	-100...1300°C	-148...2372°F	$\leq 2$ K	0.2 K
S	PtRh-Pt 10%	0...1760°C	32...3200°F	$\leq 2$ K	0.2 K
R	PtRh-Pt 13%	0...1760°C	32...3200°F	$\leq 2$ K	0.2K
T	Cu-CuNi	-200...400°C	-328...752°F	$\leq 2$ K	0.1 K
C	W5%Re-W26%Re	0...2315°C	32...4199°F	$\leq 2$ K	0.1 K
D	W3%Re-W25%Re	0...2315°C	32...4199°F	$\leq 2$ K	0.1 K
E	NiCr-CuNi	-100...-1000°C	-148...1832°F	$\leq 2$ K	0.1 K
B	PtRh-Pt6%	0...1820°C	32...3308°F	$\leq 3$ K	0.2 K
	special	-25...75 mV		$\leq 1$ %	0.01%

Table 2. Resistance transducers

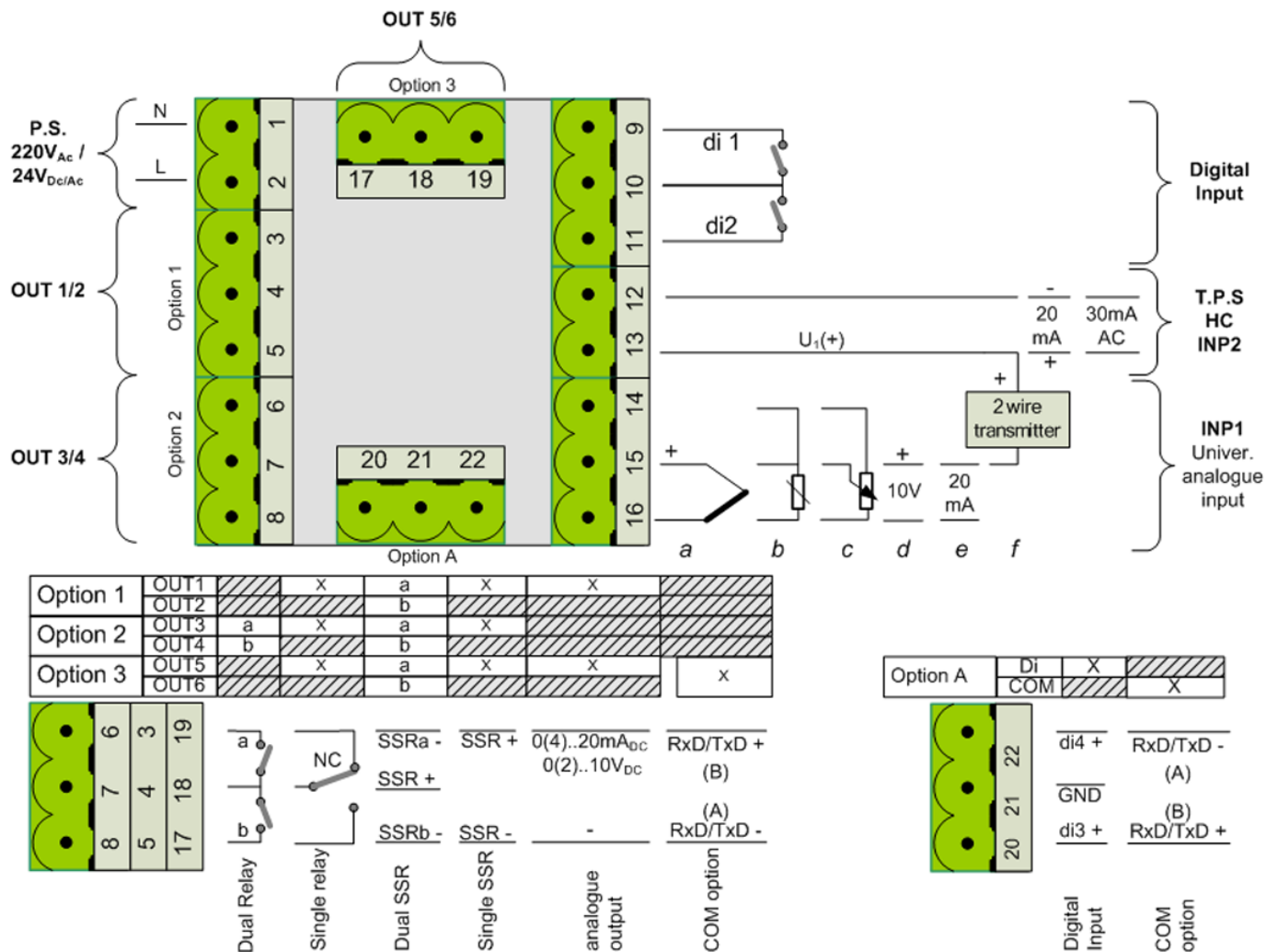
Type	Sensor current	Range		Accuracy	Resolution ( $\emptyset$ )
Pt100	0.2 mA	-200...850°C	-328...1562°F	$\leq 1$ K	0.1 K
Pt1000		-200...200°C	-328...392°F	$\leq 2$ K	0.1 K
KTY 11-6*		-50...150°C	-58...302°F	$\leq 2$ K	0.05 K

\*or special resistive input 0...4500  $\Omega$  (connecting as PT 100)

Table 3. Current and voltage

Range	Input resistance	Accuracy	Resolution ( $\emptyset$ )
0-10 Volt	$\approx 110$ K $\Omega$	$\leq 0.1$ %	0.6 mV
0-20 mA	5 $\Omega$ (voltage requirement $\leq 1.0$ V)	$\leq 0.1$ %	1.5 $\mu\text{A}$

## Electrical Connections



## 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)  
Resolution: > 14 bit  
Scanning cycle: 100 ms  
Accuracy: Better 0.1%

## CURRENT INPUT INP2

### Heating current measurement

via current transformer  
Measuring range: 0...30 mA AC  
Scaling: adjustable  
Accuracy: 0.25%

### Remote setpoint measurement

Input resistance: approx. 60Ω  
Span: configurable within 0 to 20mA  
Scaling: adjustable -1999...9999  
Input circuit monitor: 12.5% below span start (4..20mA 2mA)

## CONTROL INPUT DI1 & DI2

Configurable as direct or inverse switch or push-button!

Connection of a potential-free contact suitable for switching "dry" circuits.  
Switched voltage: 3.3 V  
Switched current: < 10mA

## CONTROL INPUTS DI3 & DI4 (OPTION)

Configurable as direct or inverse.

Nominal voltage: 24 V DC, external

## OUTPUTS

### SURVEY OF THE OUTPUTS

Output used for:

#### Relay – option 1-3

Contacts: Potential free changeover  
Max contact rating: 2A@ 250V 48...62Hz  
Min contact rating: 6V, 1mA  
Duty cycle: I = 1A/2A  
250,000/150,000 @ 250V resistive

#### Dual relay – option 2

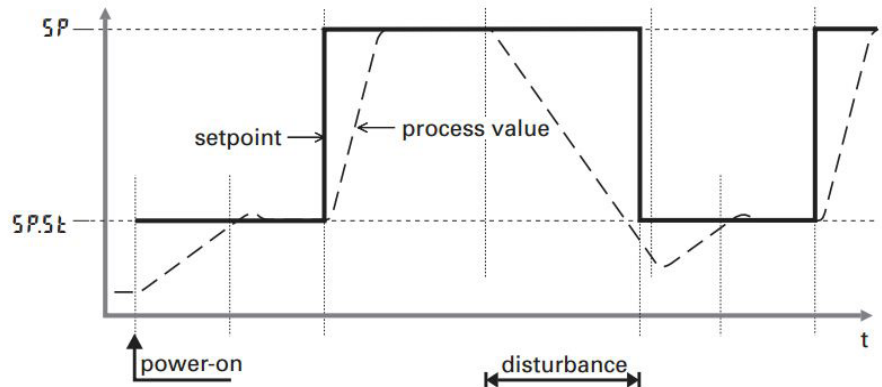
Contacts: 2 NO contacts with shared common  
Max contact rating: 2A@ 250V 48...62Hz  
Min contact rating: 6V, 1mA  
Duty cycle: I = 1A/2A  
500,000/200,000 @ 250V resistive

#### SSR - option 1-3

Voltage 10 V into 500 Ω minimum

## Start-up circuit

When the process is controlled towards the start-up setpoint, the output value is limited. The start-up setpoint 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.



## Dual SSR - option 1-3

Voltage 10 V into 500 Ω minimum

### Linear DC output option 1 & 3

0/4mA...20 mA, configurable.  
Signal range: 0...approx. 22 mA  
Load: ≤ 500 Ω  
Load effect: none  
Resolution: 0.1%  
Error: 0.2%

### 0-10 V

Signal range: 0...11 V  
Load: ≥ 2K Ω  
Resolution: ≤ 0.1 %  
Error: ≤ 0.2 %

### Transmitter supply

Output: 22 mA / ≥18 V

## 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).

### Setpoint functions

- Adjustable setpoint gradient 0,01...9999 °C/min
- Setpoint control
- Setpoint/cascade control
- Program controller with 16 x 16 segments (setpoint/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 setpoint, 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.

### Modbus Master

The Pro-16 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:

- Setpoint shifting relative to the setpoint 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 setpoint changes
- Effective setpoint
- 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)
- Several limit signals or alarms can be OR-linked before being output.

### ALARMS

#### Heating current alarm

- Overload and short circuit
- Open circuit and short circuit

Limit value adjustable 0...9999 A

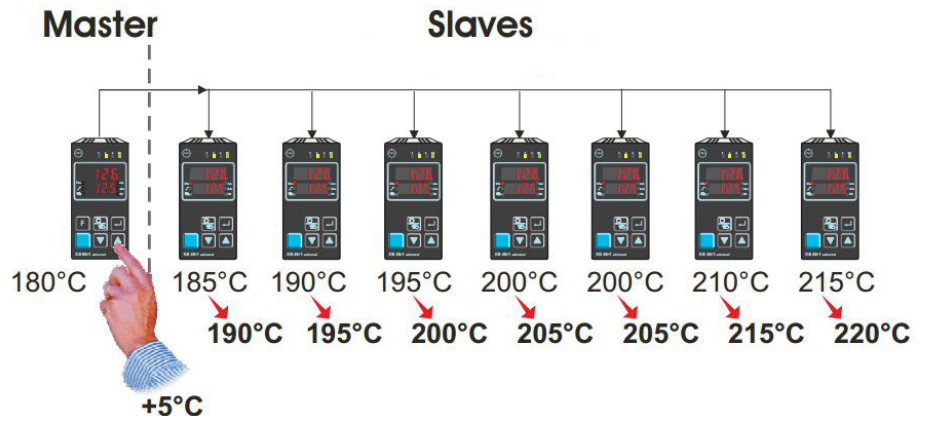
#### Control loop alarm

- 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.

### Modbus Master function supports setpoint changes e.g. in extruder applications



### 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 (If the adjusted operating hours are exceeded a message is displayed)
Maintenance interval of actuator (If the adjusted switching cycles are exceeded a message is displayed)
Internal fault (RAM, EEPROM, ...)

### 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 F-key are configurable:

Function	F
Remote (no front operation)	x
SP.2 (2nd setpoint)	x
Y.2 (2nd output value)	x
SP.E (external setpoint)	x
Manual operation	x
C.OFF (controller function off)	x
Lock of manual key	x
Reset of latched limits and error list	x
Boost	x
Parameter set ½	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.

### POWER SUPPLY

Depending on version:

#### AC SUPPLY

Voltage: 90...260 VAC  
Frequency: 48...62 Hz  
Power consumption approx. 7 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: 7 VA (W)

### BEHAVIOUR WITH POWER FAILURE

Configuration, parameters and adjusted setpoints, control mode:

Non-volatile storage in EEPROM

### BluePort INTERFACE

Connection of PC via PC adapter (see "Accessories"). The BlueControl software is used to configure, set parameters, and operate the Pro-16.

### BUS INTERFACE (OPTION 3 & A)

Galvanically isolated  
Physical: RS485  
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.

## ENVIRONMENTAL CONDITIONS

### Protection modes

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

### Permissible temperatures

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

### Humidity

75% yearly average, no condensation

## Electromagnetic compatibility

Complies with EN 61 326-1

## GENERAL

### Housing

Material:	ABS AF BO5
Flammability class:	UL 94 VO, self-extinguishing

Plug-in module, inserted from the front

### Safety tests

Complies with EN 61010-1  
Over voltage category II  
Contamination class 2  
Working voltage range 300 VAC  
Protection class II

### Certifications

cULus-certification - Applied for.

### Terminals

5mm Combicon

### Mounting

Panel mounting with quick release fixing mounting clamp (supplied).

Mounting position:	not critical
Weight:	0.2 kg

## ACCESSORY EQUIPMENT

### BlueControl (Engineering Tool)

PC-based program for configuring, setting parameters, and operating (commissioning) the Pro-16 controller.

All the settings are saved, and can be printed on demand.

A powerful data acquisition module is available, complete with trend graphics.

### Visibility mask

The BlueControl software can be used to hide any parameters in the instrument. Only

## 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 a configuration 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 a configuration from the controller	SIM only	yes	yes
Basic diagnostic functions	no	no	yes
Saving data file and configuration	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	yes	yes
Programeditor: KS 90-1	no	no	yes

The "Universal BlueControl®" Software comprises all functions of the Expert-version. All BluePort devices can be triggered via this software.

specific parameters can be changed.

Safety relevant parameters are invisible and cannot be modified!

### 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: Windows 2000, XP, VISTA, WIN7, WIN8.

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

- Customer-specific linearizations
- Enable "forcing" for inputs/outputs. Forcing allows to write the analog and digital inputs and outputs via Modbus interface.
- 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.West-CS.com](http://www.West-CS.com)

