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# Pro-16

# **Universal Industrial Controller**

BluePort Front interface 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

• 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

- 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 costeffective 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 threepoint 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.



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# **TECHNICAL DATA**

# **INPUTS**

# PROCESS VALUE INPUT INP1

Resolution:	> 14 bit
Decimal point:	0 to 3 decimals
Digital input filter:	adjustable 0,0009999 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:  $\leq 1 \ \mu A$ Operating sense configurable (see page 4)

#### Resistance thermometer

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

Current and voltage signals

Span start, end of span: anywhere within measuring range

#### Table 1. Thermocouple ranges

Т	hermocouple	Range		Accuracy	Resolution (Ø)
L	Fe-CuNi (DIN)	-100900°C	-1481652°F	≤ 2 K	0.1 K
J	Fe-CuNi	-1001200°C	-1482192°F	≤ 2 K	0.1 K
к	NiCr-Ni	-1001350°C	-1482462°F	≤ 2 K	0.2 K
Ν	Nicrosil/Nisil	-1001300°C	-1482372°F	≤ 2 K	0.2 K
S	PtRh-Pt 10%	01760°C	323200°F	≤ 2 K	0.2 K
R	PtRh-Pt 13%	01760°C	323200°F	≤ 2 K	0.2K
	special	-2575 mV		≤1%	0.01%

#### Table 2. Resistance transducers

Туре	Sensor current	Range		Accuracy	Resolution (Ø)
Pt100		-200850°C	-3281562°F	≤1 K	0.1 K
Pt1000	0.2 mA	-200200°C	-328392°F	≤ 2 K	0.1 K
KTY 11-6*		-50150°C	-58302°F	≤ 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 (Ø)
0-10 Volt	≈ 110 KΩ	≤ 0.1 %	0.6 mV
0-20 mA	49 $\Omega$ (voltage requirement ≤ 2.5 V)	≤ 0.1 %	1.5 µA

# **Electrical Connections**



Scaling:selectable -1999...9999Linearization:16 segments, adaptable<br/>with BlueControlDecimal point:adjustableInput circuit monitor:12.5% below span start<br/>(2mA, 1V)Resolution:> 14 bitScanning cycle:100 ms<br/>Better 0.1%

Heating current measurement via current transformer Measuring range: 0...30 mA AC Scaling: adjustable -1999..0,000..9999 A

Accuracy:

 Remote setpoint measurement range

 Input resistance:
 approx. 120Ω

 Span:
 configurable within

 0 to 20mA

 Scaling:
 adjustable -1999...9999

 Input circuit monitor:
 12.5% below span start

 (4..20mA 2mA)

0.25%

# 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
-	Current sink (IEC 1131
	Type 1)
Logic	"0": -35 V
Logic	"1": 1530 V
Current requirement	nt: approx. 5 mA

# OUTPUTS

# SURVEY OF THE OUTPUTS

Output used for:

#### Relay - option 1-3

Contacts: Max contact rating: Min contact rating: Duty cycle:	Potential free changeover 2A@ 250V 4862Hz 6V, 1mA I = 1A/2A 250,000/150,000 @ 250V resisitive	

Duai reiay – optio	
Contacts:	2 NO contacts with
	shared common
Max contact rating:	2A@ 250V 4862Hz
Min contact rating:	6V, 1mA
Duty cycle:	I = 1A/2A
	500,000/200,000 @
	250V resisitive

#### SSR - option 1-3

Voltage

10 V into 500 Ω minimum

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



# 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

#### Current output

0/4mA20 mA, con	figurable.
Signal range:	0approx. 22 mA
Load:	≤ 500 Ω
Load effect:	none
Resolution:	(0.1%)
Error:	(0.2%)
0-10 v	
Signal range:	011 V
Load:	≥ 2K Ω
Resolution:	≤ 0.1 %
Error:	≤ 0.2 %
Physical: RS485, at 19200 bps.	1200, 2400, 4800,

19200 bps. Protocol: Modbus RTU Communications Option 3 or A

#### 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:

9600 or

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 SPE 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.

# 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,)

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# **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)	х
SP.2 (2nd setpoint)	х
Y.2 (2nd output value)	х
SP.E (external setpoint)	х
Manual operation	х
C.OFF (controller function off)	х
Lock of manual key	х
Reset of latched limits and error list	х
Boost	х
Parameter set 1/2	х
Programmer run/stop	х

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:	90260 VAC
Frequency:	4862 Hz
Power consumption approx. 7 VA	

#### UNIVERSAL SUPPLY 24 V UC

AC voltage:	20,426,4 VAC
Frequency:	4862 Hz
DC voltage:	1831 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:	0099					
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:	060°C
Warm-up time:	< 15 minutes
Temperature effect:	< 100ppm/K
For storage:	-2070°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

(Type 1, indoor use) File: E 208286

# Terminals

5mm Combicon

# Mounting

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

Mounting position: not critical Weight: 0.2 kg

# 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: Pro-4	no	no	yes		

The "Universal BlueControl<sup>©</sup>" Software comprises all functions of the Expert-version. All BluePort devices can be triggered via this software.

# 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 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
- $\bullet$  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



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# **Product Ordering Code**

Model Code	KS20	-	1	x	x	-	x	х	x	)	C	x	x	-	01
Model Type															
1/16 Din Universal Industrial Controller															
Supply Voltage															
100-240V AC				0											
24VAC 50/60Hz or 18 to 30VDC				1											
Heater Current / Transmitter Power Supply					. 🗡										
TPS					Т										
HC / mA					Н										
Option 1															
Relay (switch over)							R								
Single SSR							A								
Dual SSR							Y								
Linear mA/VDC Output							L								
Option 2								•							
Not fitted								0							
Relay (switch over)								R							
Dual Relay								D							
Single SSR								А							
Dual SSR								Y							
Option 3															
Not fitted									0						
Relay (switch over)									R						
Single SSR									A						
Dual SSR									Y						
Linear mA/VDC Output									L						
RS485									С						
Option A											1				
Not fitted										C	)				
RS485										(	0				
Dual Isolated digital input										E	3				
Language															
German (Full or Concise Manual)												1			
English (Full or Concise Manual)												2			
French (Full or Concise Manual)												3			
Italian (Concise Manual Only)												4			
Spanish (Concise Manual Only)												5			
Packing Options													V		
Single pack with concise manual													0		
Single pack with full manual													5		



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