

7SF/7SC Temperature Controllers

ADVANTAGE EZ Series 7SF and 7SC 1/16 DIN Temperature Controllers

- **Dual 4 Digit LED Display**
- **Universal Input (6 T/C, RTD, mV, V, mA)**
- **Autotuning**
- **NEMA 4X**
- **100 to 240 Vac Switching Power Supply**
- **Algorithms for Heat or Heat/Cool Control**
- **Up to 2 Independent Alarms Configurable with Automatic or Manual Reset**
- **Output "Turn Off" Function**
- **4-20 mA Retransmission (7SC)**



Also available
with DIN rail
mount



The Advantage EZ 1/16 DIN Controllers are configurable autotuning controllers for applications where heater breakdown, RS-485 communication and 4 digit display are required.

Optional Features

- Opto-isolated RS-485 Serial Communication Interface with 3 Protocols
- Instrument Configurable by Keyboard or Through Serial Link
- 2 Independent Setpoints Selectable from External Input Contact
- Heater Breakdown Alarm
- Heater Breakdown Alarm and Load Current Display in Engineering Units
- DIN Rail Mount

Introduction

The Barber-Colman Series 7 establishes a new class of microprocessor based temperature controllers. As part of the Series 7 family, the 7SF and 7SC offer expanded feature sets allowing complete system safety and data collection capabilities. Designed specifically for equipment manufacturers who need heater breakdown notification or communications to data acquisition equipment, the 7SF and 7SC offer a variety of standard features commonly found as options on our competitors controllers. NEMA 4X faceplates allow these units to be used in applications where washdowns and dust conditions exist.

These controllers are light and compact (1/16 DIN size). They are easily able to perform in the most demanding applications with reliable control.

Even operators without skills in temperature process control or knowledge of PID control parameters, can obtain perfect process control. For the best results in control, simply:

- wire the instrument
- configure setpoint and alarm thresholds
- initiate the autotune function

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7SF Specifications

Case:	ABS grey. Self-extinguishing degree V-0 according to UL-94.
Front Protection:	Designed and tested for IP65 and NEMA 4X for indoor locations (with gasket installed).
Installation:	Panel mounting by means of brackets; or DIN rail.
Rear Terminal Block:	Up to 15 screw terminals, with safety rear cover.
Dimensions:	48 x 48 mm (1.890 x 1.890 in.) according to DIN 43700; 122 mm (4.803 in.) depth.
Weight:	250 grams maximum (1 pound)
Power Supply	Switch Mode. 100 to 240 Vac. 50/60 Hz (+10% to -15% of the nominal value) or 24 Vac/Vdc ($\pm 10\%$ of the nominal value).
Power Consumption:	8 VA.
Insulation Resistance:	Greater than 100 M Ω according to IEC 348.
Isolation Voltage:	1500 Vrms according to IEC 348.
D/A Conversion:	Dual slope integration.
Noise Immunity:	a) Electrical fast transient/burst requirements: Severity Level 3 (according to IEC 801-4). b) Electric discharge requirements: Severity Level 8 (according to IEC 801-2).
Sampling Time:	- For linear inputs - 250 ms. - For TC or RTD inputs - 500 ms.
Accuracy:	$\pm 0.2\%$ full scale value @ 25 °C and nominal power supply voltage.
Common Mode Rejection Ratio:	120 dB @ 50/60 Hz.
Normal Mode Rejection Ratio:	60 dB @ 50/60 Hz.
Operating Temperature:	From 0 to 50 °C.
Storage Temperature:	From -20 to 70 °C.
Humidity:	From 20% to 85% RH non-condensing.
Protection:	a) WATCH DOG for automatic reset. b) DIP Switches for configuration and calibration parameters.

Inputs (All inputs are factory calibrated and selectable by front keyboard.)

Thermocouples Type:	J, K, L, R, S and N are keyboard configurable.
Engineering Units:	°C and °F keyboard configurable.
Sensor Break:	Downscale or upscale programmable.
Reference Junction:	Automatic compensation for ambient temperature between 0 and 50 °C.
Reference Junction Drift:	0.1 °C/°C.
Input Impedance:	Greater than 1 M Ω .
Calibration:	According to IEC 584-1
Standard Ranges:	

TC Type	Range		
		R	0 to 1760 °C
L	0 to 400.0 °C	S	0 to 1760 °C
L	0 to 900 °C	L	0 to 1650 °F
J	0 to 400.0 °C	J	0 to 1830 °F
J	0 to 1000 °C	K	0 to 2190 °F
K	0 to 400.0 °C	N	0 to 2550 °F
K	0 to 1200 °C	R	0 to 3200 °F
N	0 to 1400 °C	S	0 to 3200 °F

NOTE: For TC inputs, the minimum span is 300 °C or 600 °F, which makes it possible to increase the sensitivity of the control parameters.

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7SF Specifications (continued)

RTD Input

RTD Type:	Pt 100 3 wire connection.
Calibration:	According to DIN 43760.
Line Resistance:	Max 20 Ω /wire with no appreciable error.
Engineering Units:	$^{\circ}\text{C}$ and $^{\circ}\text{F}$ keyboard configurable.
Sensor Break:	Open sensor detection and one or more open wires. Sensor short circuit detection.
Standard Ranges:	

$^{\circ}\text{C}$	$^{\circ}\text{F}$
-199.9 to 400.0 $^{\circ}\text{C}$	-199.9 to 400.0 $^{\circ}\text{F}$
-200 to 800 $^{\circ}\text{C}$	-330 to 1470 $^{\circ}\text{F}$

NOTE: For RTD inputs, the minimum span is 100 $^{\circ}\text{C}$ or 200 $^{\circ}\text{F}$, which makes it possible to increase the sensitivity of the control parameters.

mAdc and Vdc Linear Inputs

mAdc Input (Standard):	0 to 20 mAdc and 4 to 20 mAdc keyboard configurable.
Input Impedance:	Less than 5 Ω .
Vdc Input:	0 to 5 Vdc and 1 to 5 Vdc, configurable. Input impedance greater than 200 K Ω . 0 to 10 Vdc and 2 to 10 Vdc, configurable. Input impedance greater than 400 K Ω . 0 to 60 mVdc and 12 to 60 mV, configurable. Input impedance greater than 1 M Ω .
Read-out:	Keyboard configurable from -1999 to 4000.
Decimal Point:	Configurable in any position
Standard Ranges:	

Input	Impedance
0 to 20 mA	Less than 5 Ω
4 to 20 mA	Less than 5 Ω
0 to 60 mV	Greater than 1 M Ω
12 to 60 mV	Greater than 1 M Ω
0 to 5 V	Greater than 200 k Ω
1 to 5 V	Greater than 200 k Ω
0 to 10 V	Greater than 400 k Ω
2 to 10 V	Greater than 400 k Ω

Current Transformer Input for OUT 1 Heater Breakdown Detection

(Optional, 7SF only)

This feature allows measurement of the OUT 1 load current by means of a current transformer and signals an alarm condition when the current is below a pre-programmed threshold value.

Input Range:	50 mAac.
Scaling:	Configurable from 10 Amps to 100 Amps (with a 1 Amp step).
Resolution:	- for full scale up to 20 Amps: 0.1 Amp. - for full scale from 21 Amps to 100 Amps: 1 Amp.
Active Period:	- for relay output: NO or NC configurable. - for SSR output: logic level 1 or 0 configurable.

Minimum On time to perform the measurement:	50 ms.
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NOTE: The heater breakdown detection feature precludes the use of logic inputs and external setpoint selection.

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7SF Specifications (continued)

Logic Inputs

The 7SF is equipped with a logic input used to select between the main and auxiliary setpoint (SP or SP2). Use an external contact with a contact rating greater than 0.5 mA, 5Vdc. The instrument needs 100 ms to recognize a contact status variation.

NOTE: This function excludes the current transformer input (Output 1 heater breakdown alarm).

Setpoints

- Two setpoints are available:** - Main Setpoint (SP).
- Auxiliary Setpoint (SP2).
- Setpoint Transfer:** Transfer between SP1 and SP2 can be driven by logic input (contact closure). The transfer can be by a step or by a ramp with two different configurable rates of change (ramp up and ramp down).
- Setpoint Limiters:** Setpoint low limit and setpoint high limit are configurable.

Control Action

- Algorithm:** PID + Smart AT.
Type: One (heating) or two (heating/cooling) control outputs.
Proportional Band: Configurable
- From 1.0% to 100.0% of the input span for process with one control output.
- From 1.5% to 100% of the input span for process with two control outputs.
Setting the PB equal to zero changes the control action to ON/OFF.
- Hysteresis (for ON/OFF control action):** Configurable from 0.1% to 10.0% of the input span.
Integral Time: Configurable from 20 seconds to 20 minutes or excluded.
Derivative Time: Configurable from 1 second to 10 minutes or excluded.
Integral Preload: Configurable:
- for 1 control output, from 0 to 100% of the output range.
- for 2 control outputs, from -100% to +100% of the heating/cooling output range.
- Out 1 (heating) Cycle Time:** From 1 to 200 seconds.
AUTO/MANUAL Mode: Selectable by front pushbutton or logic input.
AUTO/MANUAL Transfer: Bumpless.

Two Control Outputs (heating/cooling)

- Relative Cooling Gain:** Keyboard configurable from 0.20 to 1.00.
Cooling Cycle Time: From 1 to 200 seconds.
Overlap/Deadband: Keyboard configurable from -20% (deadband) to +50% (overlap) of the proportional band.

Note: By setting the proper cooling medium (air, oil or water) during configuration, the instrument will automatically set the cooling (OUT 2) parameters.

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7SF Specifications (continued)

Control Outputs

Type:	Time Proportioning.
Direct/Reverse Action:	Keyboard configurable.
Output Level Indication:	Separate displays for the Output 1 level (heating) and the Output 2 level (cooling).
Output Status Indication:	Two LED indicators (OUT 1 and OUT 2) are lit when their respective output is ON.
Output Level Limiter:	- For 1 control output: From 0 to 100% of the output span. - For 2 control outputs: From -100 to 100% of the main (heating) output span. This function may operate at instrument startup for a configurable time. To avoid thermal shock and/or preheating, it can be left active.

Relay Outputs

Output Cycle Time:	Configurable from 1 to 99 seconds.
Output 1:	SPDT contact. The selection of the NO or NC contact is made by jumper.
Contact Rating:	3 Amps at 250 Vac on resistive load.
Output 2 (Cooling):	SPST contact with rated current 2 Amps at 250 Vac on resistive load.
Logic Voltage for SSR Driver (Output 1 Only):	Vout less than 0.5 Vdc.
Logic Level 0:	14 Vdc \pm 20% @ 17 mA max.
Logic Level 1:	24 Vdc \pm 20% @ 1 mA max.
Output Safety Value:	When the instrument detects an out of range or a sensor break condition, it can force the output to a configurable safety value.

Output "Turn Off" Function

This function disables the control output allowing the instrument to operate as an indicator. When control is resumed, "turn off" is disabled and the instrument will operate as follows: the integral component of the output signal will be set to zero, the soft start function will be enabled, and the alarm masking function will be enabled.

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7SF Specifications (continued)

Alarms

This instrument is equipped with two independent outputs configurable as:

- Heating + Alarm 1
- Heating + Cooling

An optional output is available as Alarm 2 or the heater breakdown alarm output.

Output Action:	Direct or reverse function configurable.
Alarm Functions:	Each alarm can be configured as process alarm, band alarm or deviation alarm.
Alarm Reset:	Automatic or manual reset programmable on each alarm.
Alarm Masking:	Each alarm can be configured as masked alarm or standard alarm. Alarm masking allows suppression of alarm indicators at startup and after a setpoint change.
Alarm Indication:	Two indicators show when the respective alarm is ON.
Alarm Outputs:	Two SPST relays. Contact rated at 2 Amps, 250 Vac on resistive load.

Process Alarm

Operating Mode:	High or low configurable.
Alarm Setpoint:	Configurable in engineering units within the entire range.
Hysteresis:	Configurable from 0.1% to 10.0% of the input span.

Band Alarm

Operating Mode:	Inside or outside band configurable.
Alarm Setpoint:	Configurable from 0 to 500 units.
Hysteresis:	Configurable from 0.1% to 10.0% of the input span.

Deviation Alarm

Operating Mode:	High or low configurable.
Alarm Setpoint:	Configurable from -500 to +500 units.
Hysteresis:	Configurable from 0.1% to 10.0% of the input span.

Heater Breakdown Alarm

Operating Mode:	(Can be used only for instruments with heater breakdown input option.) Low alarm.
Alarm Setpoint:	Configurable in engineering units within the readout span.

Serial Interface (Optional)

Type:	RS-485.
Protocol Type:	MODBUS, JBUS, or Barber-Colman proprietary polling/selecting.
Baud Rate:	Keyboard configurable from 600 to 19200 BAUD.
Byte Format:	7 or 8 bit configurable.
Parity:	Even, odd or none configurable.
Stop Bit:	One.
Address:	- From 1 to 31 for Barber-Colman protocol. - From 1 to 255 for all other protocols.
Output Voltage Levels:	According to EIA standard.

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7SC Specifications

Same as 7SF except:

Output 1

Type:	Opto-isolated 0-20 mA or 4-20 mA configurable.
Function:	Programmable as: - control output (heating or cooling). - retransmission of the measured value. - retransmission of the operating setpoint.
Scaling:	Configurable from -1999 to 9999.
Maximum Load:	500 Ω .
Resolution:	- 0.1% when used as control output. - 0.05% when used as analog retransmission.
Digital Filter:	A digital filter for the retrans out is available (with the same time constant as the readout).
Output Level Indication (as control output only):	From 0.0 to 100.0%.
Output Status Indication:	The OUT 1 indicator flashes with a duty cycle proportional to the output level.

Output 2

Type:	SPST relay contact (NO or NC selectable by jumper) with rated current 2 Amps at 250 Vac on resistive load.
Function:	Configurable as: - Control output (heating or cooling). - Alarm 1 output.

Output 3

Type:	Relay with SPST contact with rated current 2 Amps at 250 Vac on resistive load.
Function:	Configurable as: - Control output (heating or cooling). - Alarm 2 output.

Power Consumption

10 VA. For details, refer to the relay output model numbers.

Inputs

This instrument is equipped with universal input capable of measuring 7 TC Types, RTD, mA, mV and Volt signals. The only difference between the 7SF model and the 7SC is the addition of the TC Type T with the following ranges:

TC Type	Ranges	
T	0 to 400.0 °C	0 to 750 °F

Control Action

Proportional Band:	Configurable from 1.0% to 200.0% of the input span. Setting a PB equal to zero sets the control action to ON/OFF.
Integral Time:	Configurable from 1 second to 20 minutes (or off).

NOTE: The Heater Breakdown Alarm is not available in the 7SC.

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7SC Specifications (continued)

Noise Immunity

This instrument conforms to EEC 89/336 directive regarding electromagnetic compatibility.

Emission:

Generic emission standard EN 50081-2
Basic emission standard EN 55011

Immunity:

Generic immunity standard EN 50082-2, Basic immunity standard:
a. Electrical discharge requirements: Severity Level 3 (according to IEC 801-2).
b. Electrical fast transient/burst requirements: Severity Level 3 (according to IEC 801-2).
c. Radiated electromagnetic field immunity between 27 MHz - 500 MHz, 10 V/m (according to IEC 801-3).

Operator Interface (7SF Shown)







Upper Display

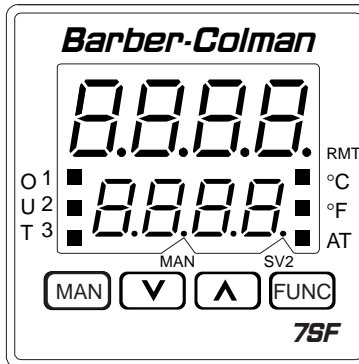
Shows the actual measured value or (during configuration), the value of the selected parameter.

Lower Display

Shows the operating setpoint; the output level; the heater current (in Amps); and the abbreviated name of the selected parameter.

Keyboard Description

-  Decreases the selected parameter.
-  Increases the selected parameter.
-  Displays in sequence all the parameters and saves the new settings or displays the output level and the heater current.
-  Switches from auto to manual mode and vice versa.
-  Start the default parameters loading procedure.
-  Enable/disable the output power OFF function.



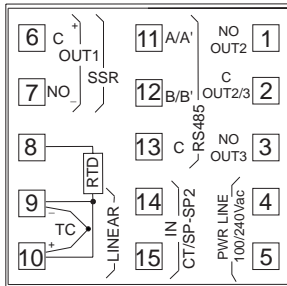
Indicators

- RMT** Lit when the instrument is under the control of the serial link.
- SV2** Flashing at a slow rate when SP2 is used. Flashing at a higher rate when a setpoint from serial link is used.
- AT** Lit or flashing (according to the different self-tuning phases) when Smart AT is operating.
- MAN** Lit when the instrument operates in manual mode.
- °C/°F** When the input sensor is a TC or RTD, one of these indicators is lit to show the selected engineering units.
- OUT1** Lit when the main output is ON.
- OUT2** Lit when:
 - Output 2 is used as cooling output and is ON; or,
 - Output 2 is configured as alarm and the instrument detects an alarm or the alarm has not been reset.
- OUT3** Lit when alarm 2 is in alarm state. Flashing at a slow rate when the heater current is lower than the programmed threshold (HBD). Flashing at a higher rate when the HBD alarm and alarm 2 are both in alarm state.

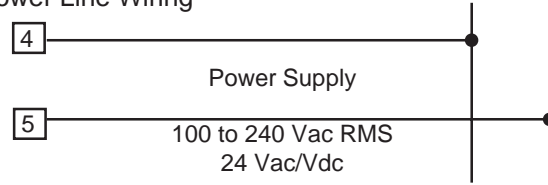
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Wiring

Rear Terminal Block

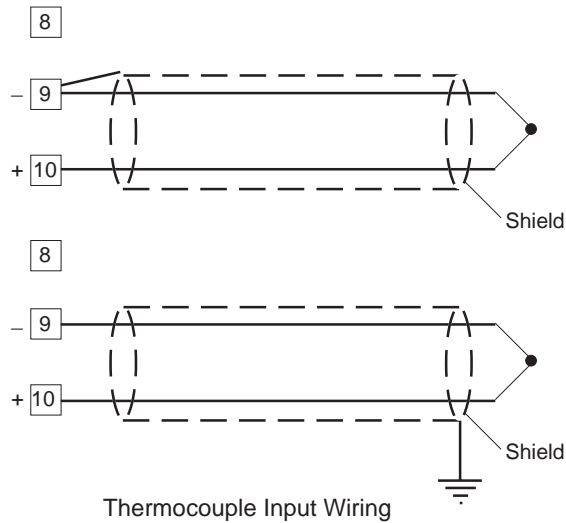


Power Line Wiring



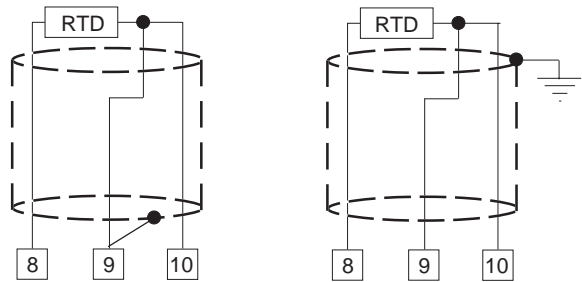
NOTE: To avoid electric shock, connect power line at the end of the wiring procedure.

Input Wiring



Thermocouple Input Wiring

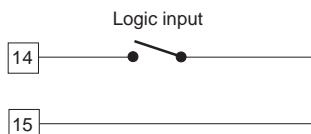
NOTE: Do not run input wires together with power cables. For TC wiring use proper compensating cable, preferably shielded. If shielded cable is used, it should be grounded at one point only.



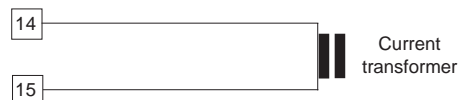
NOTE: Do not run RTD wires together with power cables. If shielded cable is used, it should be grounded at one point only. Use copper wires of appropriate size (see "Product Specifications"). The resistance of the 3 wires must be the same.

Any external components (like zener diodes etc.) connected between sensor and input terminals may cause errors in measurement due to excessive or unbalanced line resistance, or possible leakage currents.

Logic Input Wiring



Current Transformer Wiring



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Wiring (continued)

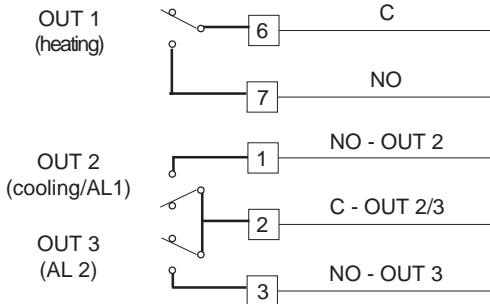
OUTPUTS

RELAY OUTPUTS

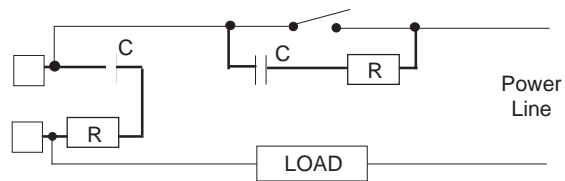
The relay outputs are protected with a varistor. The contact rating for the main output is 3 Amp/250 Vac on resistive load. The contact rating for OUT 2 and OUT 3 is 1 Amp/250 Vac on resistive load.

INDUCTIVE LOADS

High voltage transients may occur when switching inductive loads. These transients may introduce disturbances which can affect the performance of the instrument. The internal varistor assures protection up to 0.5 Amp of inductive component of the load. The same problem may occur when a switch is used in series with the internal contacts. In this case, it is recommended to install an additional RC network across the external contact as shown.



Relay Output Wiring



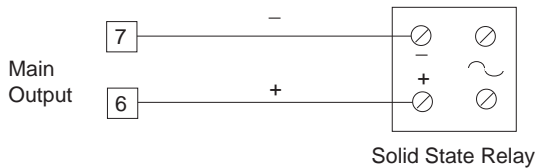
External Switch in Series with the Internal Contact

The value of capacitor (C) and resistor (R) are shown in the following table.

Load Current	C (uF)	R (Ω)	Resistance Power (W)	Resist. and Capac. Voltage
< 150 mA	0.1	22	2	260
< 0.5 Amp	0.33	47	2	260
< 1 Amp	0.47	47	2	260

Relay output wiring must be as far away as possible from input or communication cables.

VOLTAGE OUTPUTS FOR SSR DRIVE



SSR Drive Output Wiring

Logic voltage for SSR drive.

Logic status 1: 24V \pm 20% @ 1 mA
14 V \pm 20% @ 20 mA

Logic status 0: Less than 0.5 V

NOTE: This output is not isolated. Isolation between instrument output and power supply must be assured by the external solid state relay.

See "Controller Mounting Dimensions" at the end of this section