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***
- ***2 Independent Setpoints Selectable from External Input Contact***
- ***Up to 2 Independent Alarms Configurable with Automatic or Manual Reset***
- ***Output "Turn Off" Function***
- ***4-20 mA Retransmission (7SC)***

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 Communiction Interface with 3 Protocols
- Instrument Configurable by Keyboard or Through Serial Link
- Heater Breakdown Alarm
- Heater Breakdown Alarm and Load Current Display in Engineering Units
- 24 Vac/Vdc Supply

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 with our competitors. NEMA 4X faceplates allow these units to be used in applications where washdowns and dust conditions exist.

Light and very compact (1/16 DIN size), the 7SF and 7SC are able to perform in the most demanding applications with easy yet reliable control.

To obtain the best result in control stability and reliability, it is as easy as:

- wiring the instrument
- configuring setpoint and alarm thresholds
- initiating the autotune function

In this way, all operators, with or without skills in temperature process or knowledge of PID control parameters, can obtain perfect process control.

Ordering Information

1/16 DIN Four Digit Display Controller

MODEL: 0 7 S F - 9 3 ☐ 1 ☐ - 3 0 0 - 0 - 0 0

Field No. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Fields 1 through 4. BASE
07SF - Controller ..... See Table Below

Field 5. INPUT
9 - TC types J, K, L, N, R, and S; Pt 100, 3 wire RTD;
0 to 20 mAdc and 4 to 20 mAdc;
0 to 60 mVdc and 12 to 60 mVdc;
0 to 5 Vdc or 1 to 5 Vdc;
0 to 10 Vdc or 2 to 10 Vdc
Note: All inputs are factory calibrated and selectable by keyboard. Factory set at type J.

Field 6. CONTROL ACTION
3 - PID and Smart AT

Field 7. OUTPUT 1
1 - Relay
6 - SSR

Field 8. OUTPUT 2
1 - Relay (cooling/alarm)

Field 9. OPTIONS
0 - None
1 - Alarm 2
2 - Alarm 2, plus Hbd (heater breakdown) (or logic input)
3 - Alarm 2, plus RS-485
4 - Alarm 2, plus RS-485 and Hbd (or logic input)
Note: For Hbd, order transformer separately. See below.

Field 10. POWER SUPPLY
3 - 100 to 240 Vac

Fields 11 through 15. RESERVED

Available Models

07SF-93110-300-0-00	PID with autotune, relay/relay output, 100 to 240 Vac
07SF-93111-300-0-00	PID with autotune, relay/relay output, alarm, 100 to 240 Vac
07SF-93112-300-0-00	PID with autotune, relay/relay output, alarm, Hbd alarm, 100 to 240 Vac
07SF-93113-300-0-00	PID with autotune, relay/relay output, alarm, RS-485, 100 to 240 Vac
07SF-93114-300-0-00	PID with autotune, relay/relay output, alarm, Hbd alarm, RS-485, 100 to 240 Vac
07SF-93610-300-0-00	PID with autotune, SSR/relay output, 100 to 240 Vac
07SF-93611-300-0-00	PID with autotune, SSR/relay output, alarm, 100 to 240 Vac
07SF-93612-300-0-00	PID with autotune, SSR/relay output, alarm, Hbd alarm, 100 to 240 Vac
07SF-93613-300-0-00	PID with autotune, SSR/relay output, alarm, RS-485, 100 to 240 Vac
07SF-93614-300-0-00	PID with autotune, SSR/relay output, alarm, Hbd alarm, RS-485, 100 to 240 Vac

Transformers

07ER-R1000-000-0-00	Series 07 Current Transformer, 10 Amp
07ER-R2000-000-0-00	Series 07 Current Transformer, 25 Amp
07ER-R4000-000-0-00	Series 07 Current Transformer, 50 Amp
07ER-R5000-000-0-00	Series 07 Current Transformer, 100 Amp

Ordering Information

1/16 DIN Four Digit Display Controller with Analog Output

MODEL: 0 7 S C - 9 3 7 1 □ - 3 0 0 - 0 - 0 0

Field No. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Fields 1 through 4. BASE
07SC - Controller ..... See Table Below

Field 5. INPUT
9 - TC types J, K, L, N, R, S and T; Pt 100 3 wire RTD;
0 to 20 mAdc and 4 to 20 mAdc;
0 to 60 mVdc and 12 to 60 Vdc;
0 to 5 Vdc and 1 to 5 Vdc;
0 to 10 Vdc and 2 to 10 Vdc
Note: All inputs are factory calibrated and selectable by keyboard. Factory set at type J.

Field 6. CONTROL ACTION
3 - PID and Smart AT

Field 7. OUTPUT 1
7 - 0 to 20 mAdc or 4 to 20 mAdc programmable as heating, cooling or analog retransmission

Field 8. OUTPUT 2
1 - Relay – heating, cooling, or alarm 1

Field 9. OUTPUT 3
1 - Relay – heating, cooling (when output 2 configured as alarm 1), or alarm 2
3 - Alarm 2, plus RS-485

Field 10. POWER SUPPLY
3 - 100 to 240 Vac

Fields 11 through 15. RESERVED

Available Models

07SC-93711-300-0-00	PID with autotune, linear output, alarm, 100 to 240 Vac
07SC-93713-300-0-00	PID with autotune, linear output, alarm, RS-485, 100 to 240 Vac

7SF Specifications

Case:	ABS grey. Self-extinguishing degree V-O according to UL-94.
Front Protection:	Designed and tested for IP65 and NEMA 4X for indoor locations (when panel gasket is installed).
Installation:	Panel mounting by means of brackets.
Rear Terminal Block:	Up to 15 screw terminals, with safety rear cover.
Dimensions:	48x48 mm (1.890x1.890 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 (+/-10% of the nominal value).
Power Consumption:	8 VA.
Insulation Resistance:	>100 M ohm 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:	+/-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. On RTD input, a special test is provided to signal OVERRANGE when input resistance is less than 15 Ω. (Short circuit sensor detection.)
Reference Junction:	Automatic compensation for an ambient temperature between 0 and 50 °C.
Reference Junction Drift:	0.1 °C/°C.
Input Impedance:	>M ohm.
Calibration:	According to IEC 584-1.

7SF Specifications (continued)

Standard Ranges Table

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

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

RTD Input

RTD Type:	Pt 100 3 wire connection.
Calibration:	According to DIN 43760.
Line Resistance:	Max 20 ohm/wire with no appreciable error.
Engineering Units:	°C and °F keyboard configurable.
Sensor Break:	Detection of sensor opening and of one or more wires opening. Detection of sensor short circuit.

Standard Ranges Table

°C	°F
-199.9/400.0 °C	-199.9/400.0 °F
-200/800 °C	-330/1470 °F

NOTE: For RTD inputs, it is possible to set the minimum span to 100 °C or 200 °F. In this way, it is possible to increase the sensitivity of the control parameters.

mAdc and Vdc Linear Inputs

mAdc Input (Standard):	0-20 mAdc and 4-20 mAdc keyboard configurable.
Input Impedance:	<5 Ohm.
Vdc Input:	0-5 Vdc and 1-5 Vdc configurable; input impedance: > 200 k Ohm. 0-10 Vdc and 2-10 Vdc configurable; input impedance: > 400 k Ohm. 0-60 mVdc and 12-60 mV configurable; input impedance: > 1M Ohm.
Read-out:	Keyboard configurable from -1999 to 4000.
Decimal Point:	Configurable in any position.

7SF Specifications (continued)

Standard Ranges Table

Input	Impedance
0-20 mA	<5 Ω
4-20 mA	<5 Ω
0-60 mV	>1 MΩ
12-60 mV	>1 MΩ
0-5 V	>200 kΩ
1-5 V	>200 kΩ
0-10 V	>400 kΩ
2-10 V	>400 kΩ

Current Transformer Input for OUT 1 Heater Breakdown Detection

(Optional, 7SF only)

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

Input Range:	50 mA AC.
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.

NOTE: The heater breakdown detection feature precludes the use of logic inputs and external setpoint selection.

Logic Inputs

The 7SF is equipped with a logic input to be used to select between the main setpoint and the auxiliary setpoint (SP or SP2). **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 from SP to SP2 and vice versa may be driven by logic input (contact closure). **NOTE:** The transfer may be done by a step transfer or by a ramp with two different configurable rates of rise (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 0 changes the control action to ON/OFF.

7SF Specifications (continued)

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 second 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 second 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.

Control Outputs

Type:	Time Proportioning.
Direct/Reverse Action:	Keyboard configurable.
Output Level Indication:	The instrument separately displays the Output 1 level (heating) and the Output 2 level (cooling).
Output Status Indications:	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 second 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):

Logic Level 0:	V out <0.5 Vdc.
Logic Level 1:	14 Vdc +/-20% @ 17 mA max. 24 Vdc +/-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.

7SF Specifications (continued)

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.

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 start-up and after a setpoint change.
Alarm Indications:	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

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

Band Alarm

Operationing 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

Operationing 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

Can be used only for instruments with heater breakdown input option.

Type:	Low alarm.
Alarm Setpoint:	Configurable in engineering units within the read-out 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.

7SC Specifications

Same as 7SF except:

Outputs

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 retransmission output is available (with the same time constant as the readout).
Output Level Indication (as control output only):	From 00.0 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/ 400.0 °C	0/ 750 °F

7SC Specifications (continued)

Control Action

Proportional Band:	Configurable from 1.0% to 200.0% of the input span. Setting a PB equal to 0 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.

Noise Immunity

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

Emmission:	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

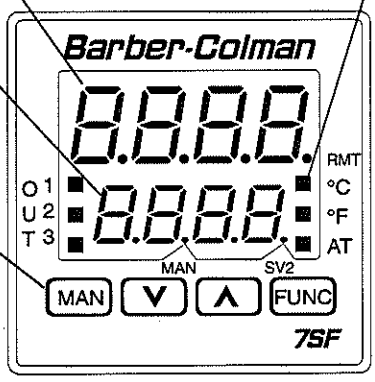
(7SF Shown)

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

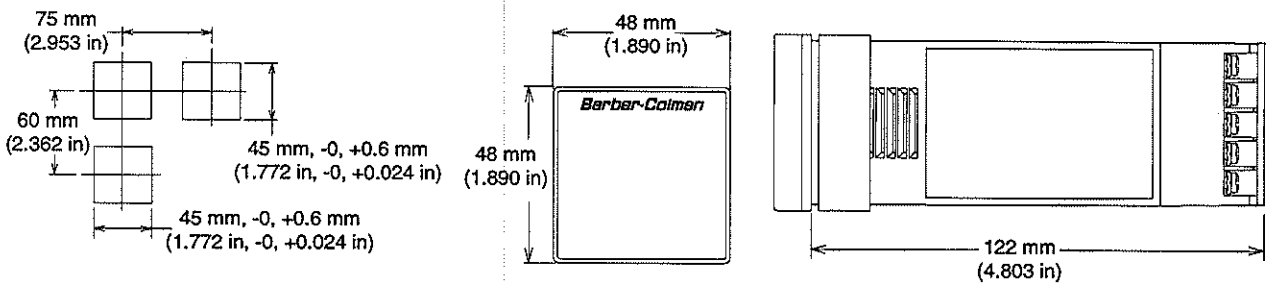
- [V] Decreases the selected parameter.
- [^] Increases the selected parameter.
- [FUNC] Displays in sequence all the parameters and saves the new settings or displays the output level and the heater current.
- [MAN] Switches from auto to manual mode and vice versa.
- [V] + [^] Start the default parameters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



Indicators

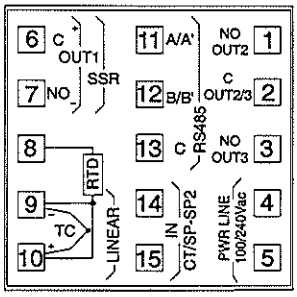
- RMT Lit when the instrument is under the control of the serial link.
- SV2 Flashing at a slow rate when SP2 is used. Flashing at a higher rate when a setpoint from serial link is used.
- AT Lit or flashing (according to the different self-tuning phases) when Smart AT is operating.
- MAN Lit when the 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.

Mounting Dimensions

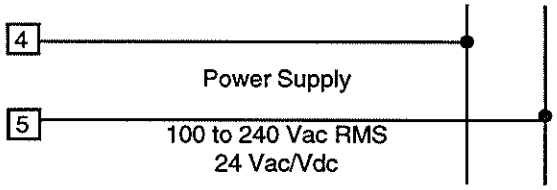


Control Wiring

Rear Terminal Block

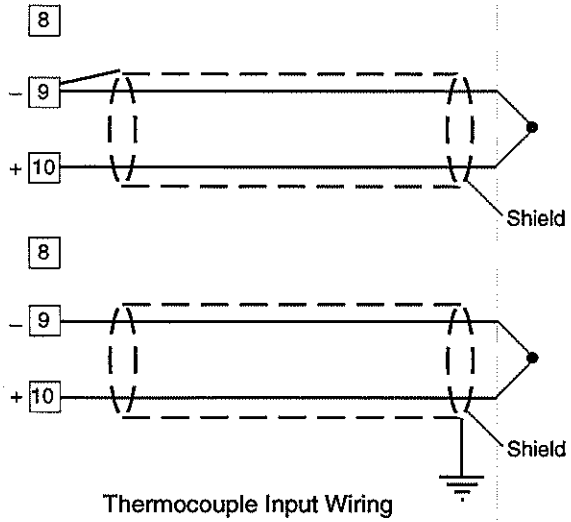


Power Line Wiring



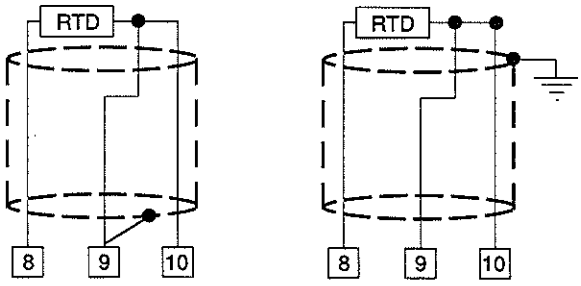
NOTE: To avoid electric shock, connect power line at the end of the wiring procedure.

Input Wiring



Thermocouple Input Wiring

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

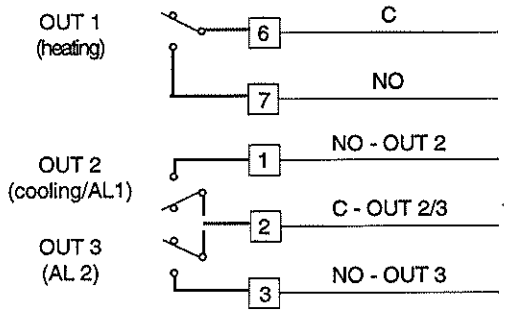
Any external components (like zener diodes etc.) connected between sensor and input terminals may cause errors in measurement due to excessive or unbalanced line resistance, or possible leakage currents.

Wiring (continued)

OUTPUTS

RELAY OUTPUTS

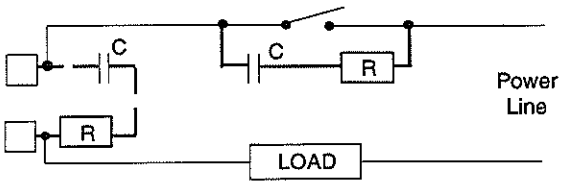
The relay outputs are protected with a varistor. The contact rating for the main output is 3 Amp/250 Vac on resistive load. The contact rating for OUT 2 and OUT 3 is 1 Amp/250 Vac on resistive load.



Relay Output Wiring

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.



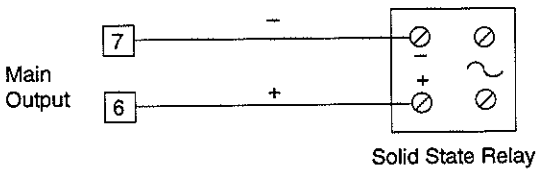
External Switch in Series with the Internal Contact

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 A	0.33	47	2	260
< 1 A	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 ±20% @ 1 mA
14 V ±20% @ 20 mA
Logic status 0: <0.5 V

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

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