FOXBORO®

Instruction

MI 018-573
February 1997

I/A Series®
Model 718TC 1/8 DIN Temperature Controller with mA Output

SIEBE®

A Siebe Group Company

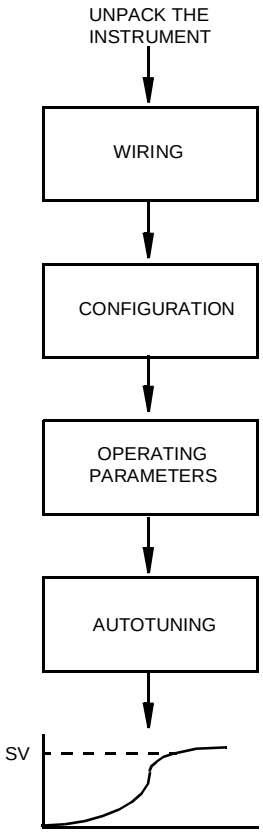
Contents

Quick Start

Guide to Simple Setup

Settng up a Model 718TC controller requires only four steps:

1. Wire the instrument (page 4).
2. Configure the instrument (page 9).
3. Check the operating mode parameters (page 25).
4. Check the autotune (Smart AT) process (page 28).



***CAUTION**: Use wire suitable for 75°C minimum.*

NOTES:
1. For supply connections, use No 16 AWG or larger wires rated for at least 75 °C.
2. Use copper conductors only.
3. Class 2 wiring must be separated a minimum of 1/4 inch from any Class 1 conductors.

1. Introduction

Overview

The Model 718TC Temperature Controller is a 1/8 DIN panel mounted single-loop controller with a 4-digit display and automatic adaptive tuning of loop parameters. It accepts measurement inputs from thermocouples of various types, RTDs, standard linear current, voltage, and millivolt signals. Two logic inputs are available to select any of four set points. Controller Output 1 may be configured as a 0-20 or 4-20 mA dc linear signal programmable for heating, cooling, or for analog retransmission. Output 1 may also be configured as a non-isolated time proportioning SSR output. Output 2 can be configured as a SPST relay (NO or NC) or as an SSR programmable for heating, cooling, or as Alarm 1. Output 3 can be configured as a SPST relay programmable for heating, cooling, or as Alarm 2. An RS-485 serial interface is provided for remote configuration and parameter setting. The alarm outputs may be configured as process, band, or deviation alarms of various types. Detailed specifications are given on page 35.

Reference Documents

Refer to the following documents for additional information on the 718TC Controller.

Document	Description
DP 018-574	Dimensional Print for 718TC Temperature Controller
PSS 2C-1B3 A	Product Specifications for 718TC Temperature Controller
MI 018-579	Serial Communication Guide for 716C and the 718TC Temperature Controllers

2. Installation

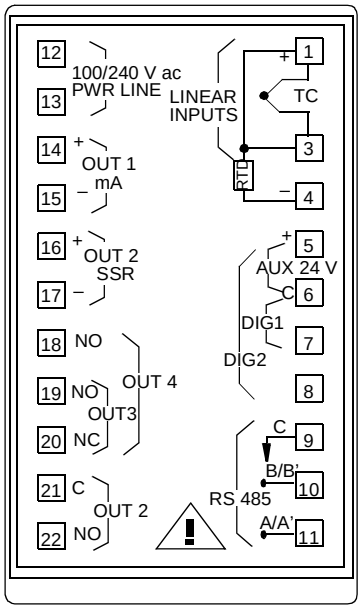
Mounting the Instrument

To install the Model 718TC instrument in a panel, do the following:

1. Make the panel cutout in accordance with DP 018-574.
2. Ensure that the square rubber gasket is in place over the instrument housing and then insert the assembly into the panel.
3. Place the white snap-in retaining bezel over the end of the housing with the heads of the Phillips head screws facing toward the rear of the housing.
4. Push the retaining bezel forward over the housing as far as possible. The tabs on the retaining bezel should snap into slots on the housing. Turn the Phillips head screws to the right as needed to make the housing snug to the panel.
5. Make wiring connections as described in the next section.

Wiring Guidelines

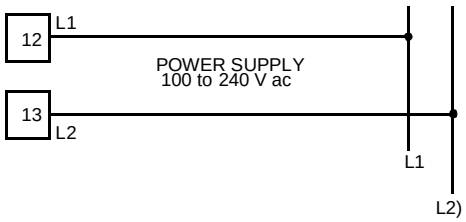
Terminal Board



NOTE: THE CONTROL OUTPUTS ARE PROTECTED AGAINST AN INDUCTIVE LOAD UP TO 0.5 A BY A VARISTOR. FOR THE OTHER OUTPUTS OR EXTERNAL CONTACTS IN SERIES WITH THE INSTRUMENT OUTPUTS, CONNECT AN EXTERNAL SNUBBER NETWORK (RC) ACROSS THE TERMINALS IN ACCORDANCE WITH THE FOLLOWING TABLE:

Load (mA)	C (μF)	R (Ω)	P (W)	Operating Voltage
<40 mA	0.047	100	1/2	260 V ac
<150 mA	0.1	22	2	260 V ac
<0.5 Amp	0.33	47	2	260 V ac

Power Line and Grounding

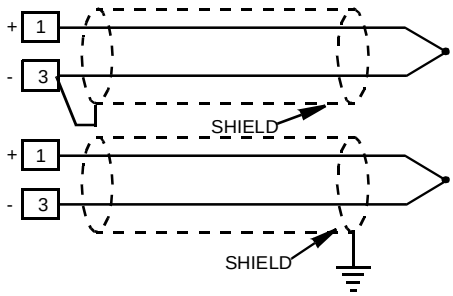


NOTES

1) BEFORE CONNECTING POWER, VERIFY THAT THE LINE VOLTAGE IS CORRECT (SEE MODEL NUMBER).

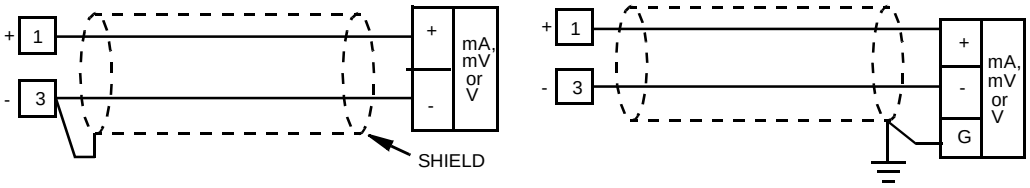
2) TO AVOID ELECTRIC SHOCK AND POSSIBLE INSTRUMENT DAMAGE, CONNECT POWER LAST.

Measuring Inputs

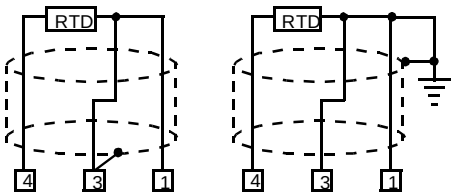


NOTES

DO NOT RUN INPUT WIRES WITH POWER CABLES.
FOR TC WIRING, USE PROPER COMPENSATING CABLE, PREFERABLY SHIELDED.
SHIELDED CABLE SHOULD BE GROUNDED AT ONE END ONLY.



NOTE**:** DO NOT RUN INPUT WIRES WITH POWER CABLES. TO AVOID GROUND LOOP CURRENTS, SHIELDED CABLE SHOULD BE GROUNDED AT ONE END ONLY

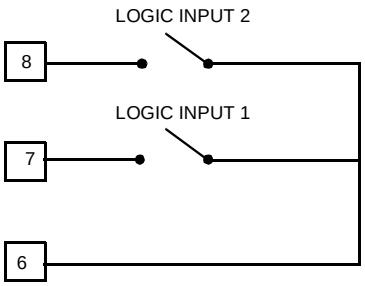


NOTE: DO NOT RUN RTD WIRES WITH POWER CABLES. SHIELDED CABLE SHOULD BE GROUNDED AT ONE END ONLY. USE THE CORRECT SIZE COPPER WIRES. THE RESISTANCES OF THE 3 WIRES MUST BE THE SAME.

ANY EXTERNAL COMPONENTS (SUCH AS ZENER DIODES, ETC.) CONNECTED BETWEEN THE SENSOR AND INPUT TERMINALS MAY CAUSE MEASUREMENT ERRORS (EXCESSIVE OR UNBALANCED LINE RESISTANCE OR POSSIBLE LEAKAGE CURRENTS)

Table 1. Color Codes for Thermocouple Compensating Cable

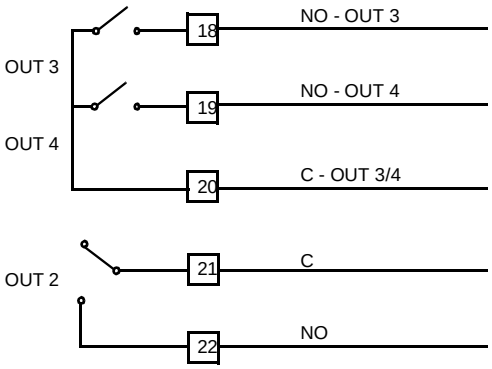
Thermocouple Material		British BS 1843	American ANSI MC 96.1	German DIN 43710	French NFE 18-001
T	Copper Constantan	+White -Blue Blue	+ Blue - Red Blue	+ Red - Brown Brown	+ Yellow - Blue Blue
J/L	Iron Constantan	+ Yellow - Blue Black	+ White - Red Black	+ Red -Blue Blue	+ Yellow - Black Black
K	Nickel Chromium Nickel Aluminum	+ Brown - Blue Red	+ Yellow - Red Yellow	+ Red - Green Green	+ Yellow - Purple Yellow
R	Platinum/Platinum 13% Rhodium	+White - Blue Green	+Black - Red Green	+ Red - White White	+White - Green Green
S	Platinum/Platinum 10% Rhodium	+White - Blue Green	+Black - Red Green	+ Red - White White	+White - Green Green
E	Chromel Constantan	+ Brown - Blue Brown	+ Violet - Red Violet	+ Red - Black Black	+ Yellow - Violet Violet
B	Platinum 30% Rh Platinum 6% Rh	- - -	+ Gray - Red Gray	+ Red - Gray Gray	- - -
N	Nicrosil/Nisil	- - -	+ Orange - Red Orange	- - -	- - -



THIS INSTRUMENT HAS FOUR SETPOINTS (SP, SP2, SP3 AND SP4). SETPOINT SELECTION CAN ONLY BE MADE WITH LOGIC INPUTS 1 AND 2 (TERMINALS 6, 7 AND 8).

Logic Input 1	Logic Input 2	Operating Set Point
open (6 - 7)	open (6 - 8)	SP
open (6 - 7)	closed (6 - 8)	SP2
closed (6 - 7)	open (6 - 8)	SP3
closed (6 - 7)	closed (6 - 8)	SP4

Relay Outputs

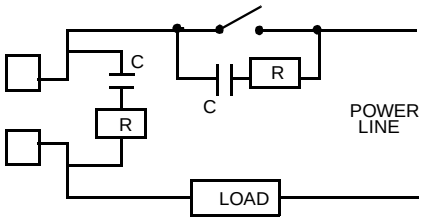


NOTES

1. RELAY OUTPUT: PROTECTED BY VARISTOR.
2. OUT 2: CONTACT RATING OF 3 AMPS/250 V ac RESISTIVE LOAD.
3. OUT 3 AND 4: CONTACT RATING OF 2 AMPS/250 Vac RESISTIVE LOAD.
4. NUMBER OF OPERATIONS: $1X10^5$ AT THE SPECIFIED RATING.

Inductive Loads

High voltage transients may occur when switching inductive loads. It is recommended to install an additional RC network across the external contacts as shown below.

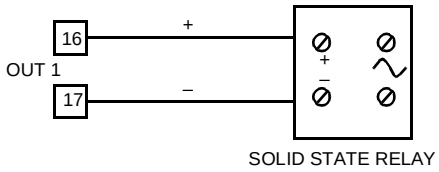


VALUES OF CAPACITOR (C) AND RESISTOR (R) ARE SHOWN IN THE FOLLOWING TABLE.

Load Current	C (μF)	R (Ω)	Power (Watts)	Resistor and Capacitor Voltage
Less than 40 mA	0.47	100	1/2	260
Less than 150 mA	0.1	22	2	260
Less than 0.5 Amp	0.33	47	2	260

THE CABLE USED FOR RELAY OUTPUT WIRING MUST BE AS FAR AWAY AS POSSIBLE FROM INPUT OR COMMUNICATION CABLES.

Voltage Outputs for SSR Drive



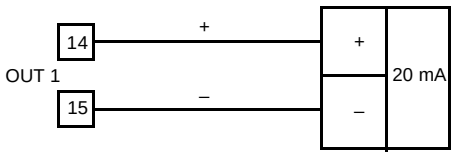
NOTES

1. THIS IS A TIME PROPORTIONING OUTPUT.
2. LOGIC VOLTAGE FOR SSR DRIVE.
3. LOGIC LEVEL 0: Vout LESS THAN 0.5 Vdc.
4. LOGIC LEVEL 1: 14 V ±20% @ 17 mA
   24 V ±20% @ 1 mA.
   MAXIMUM CURRENT = 17 mA.
5. THIS OUTPUT IS NOT ISOLATED. ISOLATION BETWEEN THE INSTRUMENT OUTPUT AND THE POWER SUPPLY MUST BE MADE BY AN EXTERNAL SOLID STATE RELAY.

Linear Output

This instrument is equipped with one linear output (OUT 1) programmable as:

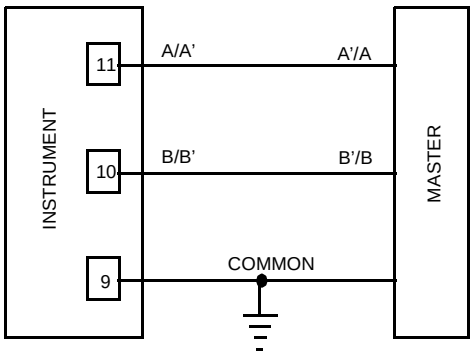
- Main output (heating or cooling).
- Secondary output (cooling).
- Analog retransmission of the measured value.
- Analog retransmission of the operating setpoint.



THIS IS AN ISOLATED ANALOG OUTPUT WITH A MAXIMUM LOAD OF 500 Ω..

Serial Interface

The RS-485 interface can connect up to 31 instruments with the remote master unit (see below).

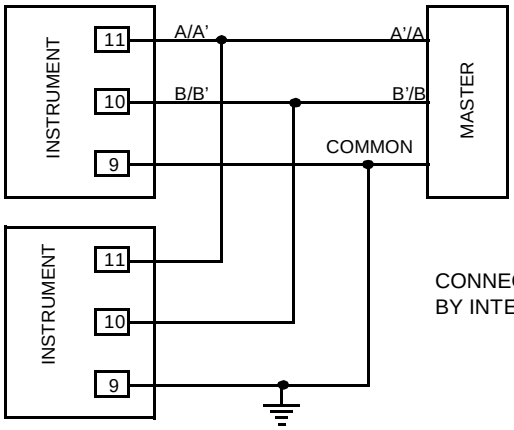


NOTES

ACCORDING TO EIA SPECIFICATIONS FOR RS-485:

1. THE "A" TERMINAL OF THE GENERATOR SHALL BE NEGATIVE WITH RESPECT TO THE “B” TERMINAL FOR A BINARY 1 (MARK OR OFF) STATE.

2. THE “A” TERMINAL OF THE GENERATOR SHALL BE POSITIVE WITH RESPECT TO THE "B" TERMINAL FOR A BINARY 0 (SPACE OR ON) STATE
.
3. MAXIMUM CABLE LENGTH: 1.5 KM (9/10 MILE) AT 9600 BAUD.



NOTE

CONNECT THE INSTRUMENT (MAXIMUM OF 31) TO THE MASTER UNIT BY INTERFACE COMMUNICATION TYPE RS-485.

3. Configuration

Preliminary Hardware Settings

1. Remove the instrument from its housing by loosening the screw in the front panel.
2. Set jumpers J1 according to the desired input type as shown in the following table.

	J1				
Input Type	**1-2**	**3-4**	**5-6**	**7-8**	**9-10**
TC-RTD	open	close	open	open	open
60 mV	open	close	open	open	open
5 V	close	open	close	open	open
10 V	open	open	close	open	open
20 mA	open	open	open	close	close

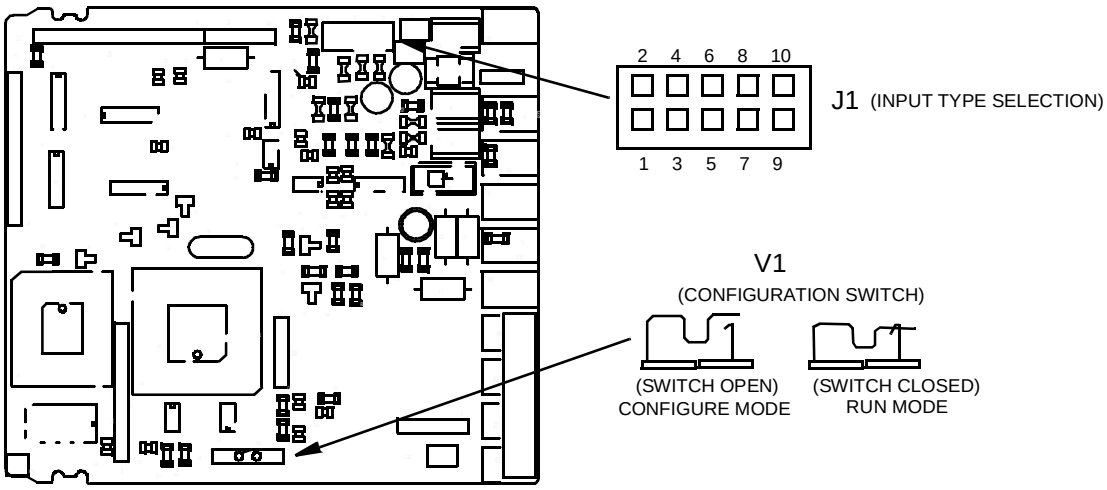


Figure 1. CPU Card, Component Side

Open Input Circuit

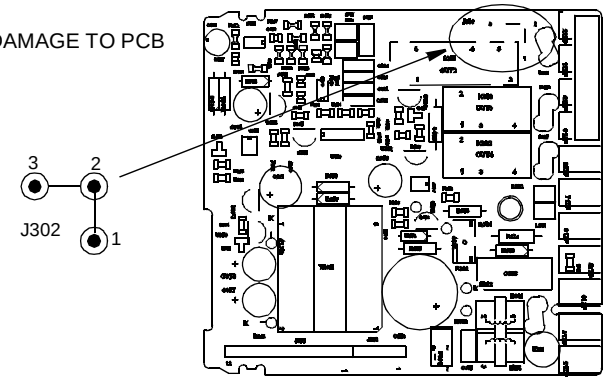
This instrument is able to identify an open circuit for TC and RTD inputs. The open circuit condition for RTD input is shown by an "overrange" indication. For TC input, an overrange indication is standard, as shown in the following table:

Overrange (STD)	CH2 = close	SH2 = open

Output 2 Type

J302 is used to set the Output 2 contact action (N.O. = 1-2 or N.C = 2-3):

CAUTION:
SOLDER CAREFULLY TO AVOID DAMAGE TO PCB OR OTHER COMPONENTS.



Configuration Key Functions

FUNC	The new setting of the selected parameter is stored and the next parameter is displayed (in increasing order).
MAN	Scrolls back through the parameters without storing the new setting.
Δ	Increases the setting of the selected parameter.
∇	Decreases the setting of the selected parameter.

Configuration Procedure

1. Remove the instrument from its case.
2. Open switch V1 (see Figure 1 on page 9).
3. Re-insert the instrument in its case.
4. Switch on power to the instrument.

   The display shows COnF.

NOTE: If "CAL" is displayed, press the Δ symbol key to return to the configuration procedure.

---

5. Press the FUNC key and proceed to check and/or modify the configuration parameters listed in the following section.

The lower display shows the code of the currently selected parameter and the upper display shows the value or status (ON/OFF) of the parameter. To change the value or status, press the Δ (increase) or ∇ (decrease) keys. Press the FUNC key to store the new value or status and display the next parameter (in ascending order). To scroll back to the previous parameter without saving, press MAN.

Configuration Parameters

Serial Configuration

For more information, refer to MI 019-579.

SEr1 = Serial Interface Protocol

OFF	No serial interface.
Ero	Poll/select using ERO controller protocol.
nbUS	Modbus
jbUS	Jbus

SEr2 = Serial Link Device Address

Not available when SEr1 = OFF.
From 1 to 95 for ERO controller protocol.
From 1 to 255 for all other protocols.

NOTE: The electrical characteristics of the RS-485 serial interface allows 31 devices maximum.

SEr3 = Baud Rate for Serial Link

Not available when SEr1 = OFF.
From 600 to 19200 baud.

NOTE: 19200 baud is displayed as 19.2.

SEr4 = Byte Format For Serial Link

Not available when SEr1 = OFF.
7E = 7 bits + even parity (For ERO controller protocol only)
7O = 7 bits + odd parity (For ERO controller protocol only)
8E = 8 bits + even parity
8O = 8 bits + odd parity
8 = 8 bits without parity

Input Configuration

NOTE: Selecting P1 = 0, 2, 4, 6, 10 or 27 sets digital filters (P44 and P45) to FLtr (Filter Enabled). For all the remaining ranges, it will set to nOFL.

P1 - Input Type and Standard Range

0	= TC type	L	range	0	to	+400.0 °C
1	= TC type	L	range	0	to	+900 °C
2	= TC type	J	range	0	to	+400.0 °C
3	= TC type	J	range	0	to	+1000 °C
4	= TC type	K	range	0	to	+400.0 °C
5	= TC type	K	range	0	to	+1200 °C
6	= TC type	T	range	0	to	+400.0 °C
7	= TC type	N	range	0	to	+1400 °C
8	= TC type	R	range	0	to	+1760 °C
9	= TC type	S	range	0	to	+1760 °C
10	= RTD type	Pt 100	range	-199.9	to	+400.0 °C
11	= RTD type	Pt 100	range	-200	to	+800 °C
12	= mV	Linear	range	0	to	60 mV
13	= mV	Linear	range	12	to	60 mV
14	= mA	Linear	range	0	to	20 mA
15	= mA	Linear	range	4	to	20 mA
16	= V	Linear	range	0	to	5 V
17	= V	Linear	range	1	to	5 V
18	= V	Linear	range	0	to	10 V
19	= V	Linear	range	2	to	10 V
20	= TC type	L	range	0	to	+1650 °F
21	= TC type	J	range	0	to	+1830 °F
22	= TC type	K	range	0	to	+2190 °F
23	= TC type	T	range	0	to	+750 °F
24	= TC type	N	range	0	to	+2550 °F
25	= TC type	R	range	0	to	+3200 °F
26	= TC type	S	range	0	to	+3200 °F
27	= RTD type	Pt 100	range	-199.9	to	+400.0 °F
28	= RTD type	Pt 100	range	-330	to	+1470 °F

P2 = Decimal Point Position

This parameter is available only when a linear input is selected (P1 = 12, 13, 14, 15, 16, 17, 18 or 19).

_ _ _ _ .= No decimal.
_ _ _ . _ = One decimal place.
_ _ . _ _ = Two decimal places.
_ . _ _ _ = Three decimal places.

P3 = Initial Scale Value

Programmable from -1999 to 4000 for linear inputs.
Programmable within the input range for TC and RTD.
When this parameter is modified, rL will also change.

P4 = Full Scale Value

Programmable from -1999 to 4000 for linear inputs.
Programmable within the input range for TC and RTD.
When this parameter is modified, rH will also change.
The initial and full scale values determine the input span used by the PID algorithm, the autotuning (Smart AT) and the alarm functions.

NOTE: Minimum input span (S = P4 - P3) is as follows:
For linear inputs, S ≥ 100 units.
For TC input with °C readout, S ≥ 300 °C.
For TC input with °F readout, S ≥ 550 °F.
For RTD input with °C readout, S ≥ 100 °C.
For RTD input with °F readout, S ≥ 200 °F.

Output and Alarm Configuration

NOTES on P5, P9 and P12:
1. Only 1 of the 3 outputs can be configured as "rEv."
2. Only 1 of the 3 outputs can be configured as "dir."
3. When no outputs are configured as a control output, the instrument operates as an indicator.

P5 = Output 1 Function

rEv	Reverse acting (Heating).
dIr	Direct acting (Cooling).
Pv.rt	Retransmits the process variable.
SP.rt	Retransmits the operating set point.

P6 = Output 1 Type

0-20	Type 0 - 20 mA.
4-20	Type 4 - 20 mA.

P7 = Retransmission - Initial Scale Value

Available only when P5 = Pv.rt or SP.rt.
Range: -1999 to 4000.

P8 = Retransmission - Full Scale Value

Available only when P5 = Pv.rt or SP.rt.
Range: -1999 to 4000.

P9 = Output 2 Function

nonE	Not used.
rEv	Used as control output with reverse action (Heating).
dir	Used as control output with direct action (Cooling).
AL1.P	Used as Alarm 1 output and is programmed as process alarm.
AL1.b	Used as Alarm 1 output and is programmed as band alarm.
AL1.d	Used as Alarm 1 output and is programmed as deviation alarm.

NOTE:
Setting P9 = rEv forces the output 2 cycle time (CY2) to:
15 seconds when P10 = rEL (Relay)
4 seconds when P10 = SSr (SSR)
Setting P9 = dir forces the output 2 cycle time (CY2) to:
10 seconds when P25 = Alrm (Air as cooling medium)
4 seconds when P25 = OIL (Oil as cooling medium)
2 seconds when P25 = H2O (Water as cooling medium)

P10 = Output 2 Type

Skipped when P9 = nonE.

rEL	Relay
SSr	SSR

NOTE:

When:	*CY2 = 15*	*- P9 = rEv (Reverse acting)*	*and*	*P10 = rEL (Relay)*
	CY2 = 4	*- P9 = rEv*	*and*	*P10 = SSr (SSR)*

P11 = Alarm 1 Operating Mode

Available only when P9 = AL1.P, AL1.b or AL1.d.

H.A.	High alarm (outside of the band) with automatic reset.
L.A.	Low alarm (inside the band) with automatic reset.
H.L.	High alarm (outside of the band) with manual reset.
L.L.	Low alarm (inside the band) with manual reset.

P12 = Output 3 Function

nonE	Output not used.
rEv	Used as control output with reverse action (Heating).
dir	Used as control output with direct action (Cooling).
AL2.P	Used as Alarm 2 output and is programmed as process alarm.

AL2.b Used as Alarm 2 output and is programmed as band alarm.
AL2.d Used as Alarm 2 output and is programmed as deviation alarm.

NOTE:
When:
CY3 = 15 - P12 = rEv

When:
CY2 = 10 - P12 = dir (Direct acting) and P25 = Alr (Air as cooling medium
CY2 = 4 - P12 = dir (Direct acting) and P25 = OIL (Oil as cooling medium)
CY2 = 2 - P12 = dir (Direct acting) and P25 = H2O (Water as cooling medium)

P13 = Alarm 2 Operating Mode

Available only when P12 = AL2.P, AL2.b or AL2.d.
H.A. High alarm (outside of the band) with automatic reset.
L.A. Low alarm (inside the band) with automatic reset.
H.L. High alarm (outside of the band) with manual reset.
L.L. Low alarm (inside the band) with manual reset.

P14 = Output 4 Function

nonE Output not used.
AL3.P Used as Alarm 3 output and is programmed as process alarm.
AL3.b Used as Alarm 3 output and is programmed as band alarm.
AL3.d Used as Alarm 3 output and is programmed as deviation alarm.

P15 = Alarm 3 Operating Mode

Available only when P14 = AL3.P, AL3.b or AL3.d.
H.A. High alarm (outside of the band) with automatic reset.
L.A. Low alarm (inside the band) with automatic reset.
H.L. High alarm (outside of the band) with manual reset.
L.L. Low alarm (inside the band) with manual reset.

P16 = Alarm 3 Programmability

Not available when P14 = “nonE.”
OPrt Set Point and hysteresis can be programmed in the operating mode.
COnF Set Point and hysteresis can be programmed in the configuration mode.

P17 = Alarm 3 Setpoint Value

Available only when P14 = AL3.P, AL3.b or AL3.d and P16 = COnF.
Range: For process alarm - Within the range limits (P3 - P4).
For band alarm - From 0 to 500 units.
For deviation alarm - From -500 to 500 units.

P18 = Alarm 3 Hysteresis

Available only when P14 = AL3.P, AL3.b or AL3.d and P16 = COnF.
Range: From 0.1% to 10.0% of the span selected with P3 and P4 parameters.

Soft Start

P19 = Soft Start Set Point

Set point setting (in engineering units), to initiate the “Soft Start” function (output power limiting) at startup.
Range: Within the readout span.

NOTE: This set point setting will not be used when tOL = InF. (See “Operating Parameters” on page 30.)

Safety

P20 = Safety Lock

0 Unlocked. The device is always unlocked and all parameters can be modified.
1 Locked. No parameters (except the set point and alarm manual reset) can be modified. For autotuning (Smart AT) status, see “P35= Autotune (Smart AT)” on page 19.
From 2 to 9999 This code number is a password used to unlock the device (set point and alarm manual reset are always unlocked). For autotune status, see “P35= Autotune (Smart AT)” on page 19.

The configuration procedure is now complete. The instrument should show “ -.-.-. “on both displays.

To exit configuration:

1. Remove instrument from housing.
2. Close Switch V1 (see Figure 1 on page 9).
3. Reinsert instrument into housing.

To access the advanced configuration parameters, do the following:

1. Using the ∆ or ∇ keys, set the code to 261.
2. Press the FUNC key.

Advanced Configuration Procedure

Control and Control Display Configuration

P21 = Power Output of the Main Control Output

Skipped when no outputs are configured as control output.
norL PID algorithm.
cnPL Complement of the PID algorithm (100 - PID algorithm).

P22 = Power Output Displayed for the Main Control Output

Skipped when no outputs are configured as control output.

norL PID algorithm calculated for the main control output.

cnPL Complement of the PID algorithm calculated for the main control output (100 - PID algorithm).

P23 = Power Output of the Secondary Control Output (Cooling)

Available only when two control outputs are programmed. Applied to the control output with direct action.

norL PID algorithm.

cnPL Complement of the PID algorithm (100 - PID algorithm).

P24 = Power Output Displayed for the Secondary Control Output (cooling)

Available only when two control outputs are programmed. Applied to the control output with direct action.

norL PID algorithm calculated for the secondary control output.

cnPL Complement of the PID algorithm calculated for the secondary control output (100 - PID algorithm).

P25 = Cooling Media

Available only when two control outputs are programmed.

AIr = Air OIL = Oil H2O = water

Changing P25 forces the cycle time and relative cooling gain to the default settings of the selected cooling media.

When:	P25 = AIr	- CYx = 10 s	and	rC = 1.00
	P25 = OIL	- CYx = 4 s	and	rC = 0.80
	P25 = H2O	- CYx = 2 s	and	rC = 0.40

P26 = Relative Cooling Gain Calculated by Autotuning (Smart AT)

Present only when two control outputs are programmed.

OFF Autotuning does not calculate rC.

ON Autotuning calculates rC.

Alarm Action Configuration

P27 = Alarm 1 Action

Available only when P9 = AL1.P, AL1.b or AL1.d.

dir Direct (relay energized in alarm condition).

rEV Reverse (relay de-energized in alarm condition).

P28 = Alarm 1 Standby

Available only when P9 = AL1.P, AL1.b or AL1.d.

OFF Standby function disabled.

ON Standby function enabled.

NOTE: If the alarm is a band or deviation alarm, the alarm is masked after a set point change or at startup until the process variable reaches the alarm set point plus or minus hysteresis. If the alarm is a process alarm, the condition is masked at startup until the process variable reaches the alarm set point plus or minus hysteresis.

P29 = Alarm 2 Action

Available only when P12 = AL2.P, AL2.b or AL2.d.
dir Direct (relay energized in alarm condition).
rEV Reverse (relay de-energized in alarm condition).

P30 = Alarm 2 Standby

Available only when P12 = AL2.P, AL2.b or AL2.d.
OFF Standby disabled.
ON Standby enabled.

P31 = Alarm 3 Action

Not available when P14 = "nonE."
dir Direct (relay energized in alarm condition).
rEV Reverse (relay de-energized in alarm condition).

P32 = Alarm 3 Standby

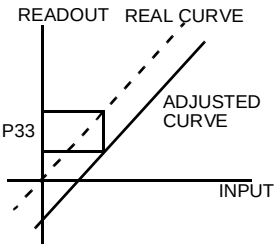
Not available when P14 = "nonE."
OFF Standby disabled.
ON Standby enabled.

Offset Configuration

P33 = OFFSET applied to the measured value

Used to apply a constant OFFSET throughout the entire range (not used for linear inputs).

- For ranges with a decimal place, P33 can be programmed from -19.9 to 19.9.
- For ranges without a decimal place, P33 can be programmed from -199 to 199.



Protected Parameters Configuration

P34 = Display Protected Parameters

Skipped when P20 = 0.
OFF Protected parameters are not displayed.
ON Protected parameters are displayed.

Smart Auto Tuning Configuration

P35= Autotune (Smart AT)

Skipped when no control outputs are configured.
0 Autotuning function disabled.
1 Autotuning enable/disable is NOT protected by safety lock (password).
2 Autotuning enable/disable is protected by safety lock (password).

P36 = Maximum Value of the Proportional Band Calculated by Autotuning

Skipped when no control outputs are configured or P35 = 0. Can be programmed to 200.0% from P37.

P37 = Minimum Value of the Proportional Band Calculated by Autotuning

Skipped when no control outputs are configured or P35 = 0. Can be programmed from 1.0% to P36.

Smart Auto-Tuning Configuration

Skipped when no control outputs are configured or P35 = 0. Can be set with keys from 00.01 (mm.ss) to 02.00 (mm.ss).

Auto-Manual Configuration

P39 = MANUAL Function

Skipped when no control outputs are configured.
OFF Manual function is disabled.
ON Manual function can be enabled/disabled by MAN key.

P40 = Device Status at Instrument Startup

Skipped when no control outputs are configured or P39 = OFF.
0 The instrument starts in AUTO mode.
1 The instrument starts in MANUAL mode with power output = 0.
2 The instrument starts in the same mode it was in prior to shutdown (if in MANUAL mode, the power output is set to zero).
3 The instrument starts in the same mode it was in prior to shutdown (if in MANUAL mode, the power output isthe last value prior to power shut down).

Timeout Configuration

P41 = Timeout Selection

This parameter sets the duration of the timeout used by the instrument during the operating mode. If no keys are pressed during the timepout period, the display automatically returns to normal display mode>
tn 10 10 seconds
tn 30 30 seconds

Output Safety Configuration

P42 = Conditions for Safety Output

Skipped when no control outputs are configured.

0 No safety output.
1 Safety output for overrange or underrange condition.
2 Safety output for overrange condition.
3 Safety output for underrange condition.

P43 = Output Safety Value

Skipped when no control outputs are configured or P42 = 0.

It can be set: From 0 to 100% when one control output is selected.
From -100% to 100% when two control outputs are selected.

Digital Filter Configuration

P44 = Digital Filter on the Measured Value

noFL. No filter.
FLtr Filter enabled:
A first order digital filter with a time constant equal to:

- 4 seconds for TC and RTD inputs.
- 2 seconds for linear inputs.

P45 = Digital Filter on the Retransmitted Value

Available only when P5 = Pv.rt.

noFL. No filter.
FLtr Filter enabled.
A first order digital filter with a time constant equal to:

- 4 seconds for TC and RTD inputs.
- 2 seconds for linear inputs.

Control Action Configuration

P46 = Control Action Type

Skipped when no control outputs are configured.

Pid Operates with a PID algorithm.
Pi Operates with a PI algorithm.

Set Point Configuration

P47 - Set Point Access

0 Only SP is accessible.
1 Only SP and SP2 are accessible.
2 All 4 set points are accessible.

Anti-Windup Configuration

P48 = Anti-Reset-Windup Extension

Range: From -30% to +30% of the proportional band.

NOTE: A positive value increases the high limit of the anti-reset-windup (over set point); a negative value decreases the low limit of the anti-reset-windup (under set point).

This completes the advanced configuration procedure. The display should show "COnF."

Default Configuration Parameters

To enter Operatingl Mode, do the following:

1. Turn off power to the controller.
2. Pull instrument out of housing.
3. Close Switch V1.
4. Reinsert instrument into housing.

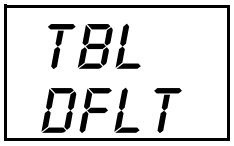
The configuration parameters can be loaded with predetermined default values. These are the settings loaded into the instrument prior to shipment from the factory. To load the default values, proceed as follows:

1. Open switch V1 (see "Configuration" on page 9).
2. The upper display shows:

3. Press the ∇ key; the lower display shows the firmware version.

4. Still holding the ∇ key, press the Δ key; the instrument shows:

5. Press the Δ key to select table 1 (European) or table 2 (American) default parameters; the display shows:



6. Press the FUNC key; the display shows:

This indicates that the loading procedure has been initiated. After about 3 seconds the procedure is complete and the instrument reverts to the "COnF" display. The following is a list of the default configuration parameters loaded during the procedure:

Parameter	Table 1 (European	Table 2 (U.S.)
SEr 1	nbUS	nbUS
SEr 2	1	1
SEr 3	19200	19200
SEr 4	8E	8E
P1	3	20
P2	----.	----.
P3	0	0
P4	400	1000
P5	rEv	rEv
P6	0-20	0-20
P7	0	0
P8	400	1000
P9	nonE	nonE
P10	rEL	rEL
P11	H.A.	H.A.
P12	nonE	nonE
P13	H.A	H.A.
P14	nonE	nonE
P15	H.A.	H.A.
P16	OPrt	OPrt
P17	0	0
P18	0.1	0.1
P19	0	0
P20	0	0
P21	norL	norL

Parameter	Table 1 (European	Table 2 (U.S.)
P22	norL	norL
P23	norL	norL
P24	norL	norL
P25	Air	Air
P26	OFF	OFF
P27	rEv	rEv
P28	OFF	OFF
P29	rEv	rEv
P30	OFF	OFF
P31	rEv	rEv
P32	OFF	OFF
P33	0	0
P34	ON	ON
P35	2	2
P36	30.0	30.0
P37	1.0	1.0
P38	00.20	00.20
P39	ON	ON
P40	0	0
P41	10	30
P42	0	0
P43	0.0	0.0
P44	nOFL.	nOFL.
P45	nOFL.	nOFL.
P46	Pid	Pid
P47	0	0
P48	10	10

4. Operation

This section describes the operating functions and procedures for the 718TC controller.

Operating Mode

To place the instrument in operating mode, do the following:

1. Remove the instrument from its case.
2. Close switch V2 (see "Preliminary Hardware Settings" on page 9).
3. Re-insert the instrument in its case.
4. Switch on power to the instrument.

Display Functions

In normal display mode, the upper display shows the measured value and the lower display shows the programmed set point.

NOTE: When the rate of change (Grd1, Grd2) is used, the displayed set point may be different from the operating set point (see "P48 = Anti-Reset-Windup Extension" on page 21).

It is possible to change the information on the lower display as follows:

1. Press and hold the FUNC key for 3 seconds, but not more than 10 seconds. The lower display shows "r." followed by the output configured as "rEv" (from 0.0 to 100.0%).
2. Press the "FUNC" key again. The lower display shows "d." followed by the output configured as "dir" (from 0.0 to 100.0%).

NOTE: The graphic symbol "¤¤.¤" means 100.0%

---

3. Press the FUNC key again. The lower display returns to the "normal display mode."

NOTE: The information appears only if the respective function is configured.

If no keys are pressed within the timeout period (see *p41????*), the display automatically returns to the "normal display mode."

To keep the desired information continuously on the lower display, press the "Δ" or "∇" keys to stop the timeout. To return to the "normal display mode," press the FUNC key again.

Set Points

The instrument has four set points (SP, SP2, SP#, and SP4). Set point selection is possible only by logic inputs 1 and 2 (Terminals 6, 7, and 8).

Table 2.

Logic Input 1	Logic Input 2	Op. Set Point
open (6 - 7)	open (6 - 8)	SP
open (6 - 7)	closed (6-8)	SP2
closed (6 - 7)	open (6 - 8)	SP3
closed (6 - 7)	closed (6-8)	SP4

Indicators

°C	Lit when the process variable is shown in degrees Celsius.
°F	Lit when the process variable is shown in degrees Fahrenheit.
SMRT	Flashes during autotuning (Smart AT). Steady when autotuning is active.
OUT1	Flashes proportionally with Output 1.
OUT2	Lit when Output 2 is ON or Alarm1 is in the alarm state.
OUT3	Lit when Output 3 is ON or Alarm2 is in the alarm state.
OUT4	Lit when Output 3 is ON or Alarm3 is in the alarm state.
REM	Lit when the instrument is in REMOTE condition (functions and parameters are controlled by serial link).
SPX	Lit when SP2, SP3, or SP4 are used. Flashes when a temporary set point from a serial link is used.
MAN	Lit when the instrument is in the MANUAL mode.

Operating Key Functions

FUNC	The new setting of the selected parameter is stored and the next parameter is displayed (in increasing order).
MAN	Scrolls back through the parameters without storing the new setting.
∆	Increases the setting of the selected parameter.
∇	Decreases the setting of the selected parameter.

NOTE: A 10 or 30 second timeout (see "P41 = Timeout Selection" on page 19) can be selected for parameter modification. If no keys are pressed during this time period, the instrument goes automatically to the "normal display mode" and the last parameter is NOT changed.

Enable/Disable the Control Outputs and Operation as a Indicator

To disable the control outputs with the instrument in the "normal display mode," press and hold (for 5 seconds) the ∆ key and the FUNC. The device then functions as an indicator. All control outputs are OFF and the word OFF is shown in the lower display (the actual output is controlled by P21 and P23). Alarms are in a "non-alarm" condition. The alarm output conditions depend on the alarm action type (see "P27 = Alarm 1 Action" on page 17,"P29 = Alarm 2 Action" on page 18, and "P31 = Alarm 3 Action" on page 18).

To restore the control status, press and hold (for 5 seconds) the ∆ key and the FUNC key a second time. If the alarm standby function has been configured, the alarms are activated. The enabling/disabling status is not lost at power down.

Manual Function

The MANUAL mode can be accessed (if P39 = On) by pressing the MAN key for 1 second. The command is accepted and executed only if the display is in the "normal display mode." When in the MANUAL mode, the MAN LED is lit and the lower display shows the power output values. The value of the "rEv" output is shown by the two most significant digits while the value of the "dir" output is shown by the two least significant digits. The decimal point between the two values flashes to indicate the instrument is in the MANUAL mode.

NOTE: *"□□" is used for "rEv" out = 100*
"□□" is used for "dir" out = 100

When in manual mode the output resolution is equal to 1%. The power output can be modified by using the ∆ and ∇ keys. Press and hold (for 2 seconds) the MAN key again to return the device to the AUTO mode.

The transfer from AUTO to MANUAL and back is bumpless (this function is not provided if the integral action is excluded). If the transfer from AUTO to MANUAL occurs during the first part of the autotuning (Smart AT) algorithm (TUNE), then it returns to MANUAL in the second part of the autotuning algorithm (ADAPTIVE). At power up, the device is in the status defined by P40.

Set Point Access

When the device is in the AUTO mode and in the "normal display mode," it is possible to directly access either set point (SP or SP2).

1. Press the ∆ or ∇ key (and hold for 2 seconds); the set point starts to change.
2. Once the desired setting is reached, wait 2 seconds before pressing a key and the new set point is used.

NOTE: When SP2, SP3, or SP4 are in operation but the device is LOCKed, direct access to the set point is not allowed.

Serial Link

This instrument can be connected to a host computer by a serial link. The host computer can put the device in either LOCAL (functions and parameters are controlled by the keys) or REMOTE (functions and parameters are controlled by serial link).

REMOTE is signified by the LED labeled REM. It is also possible to download the device configuration through the serial link with the following steps:

1. Serial parameters SEr1 through SEr4 must be properly configured from the keys.
2. The device must be in the OPERATING mode.

During downloading of the configuration, the device goes into open loop control with all outputs in the OFF state. At the end of the configuration procedure, the device performs an automatic reset and returns to closed loop control.

Autotuning (Smart AT)

Autotuning is used for automatic optimization of the control action. To enable autotuning, press the FUNC key until “Snrt” is shown. Press the ∆ or ∇ keys to set the display to “On” and then press the FUNC key. The SMRT LED turns on or begins flashing according to the selected algorithm. When autotuning is enabled, the control parameters can be displayed but not modified.

To disable autotuning, press the FUNC key until “Snrt” is shown. Press the ∆ or ∇ keys to set the display to “OFF” and press the FUNC key again. The SMRT LED turns off. Once autotuning is turned off, the instrument maintains the calculated control parameters, but allows the parameters to be modified.

NOTES:

1. Autotuning is disabled when:

a. ON/OFF control is programmed.

b. The instrument is in manual mode.

c. P35 = 0.

2. Autotuning enable/disable can be protected by a safety key password (see “P35= Autotune (Smart AT)” on page 19).

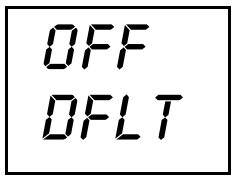
Default Parameters

Loading Default Operating Parameters

The control parameters can be loaded with predetermined default values. These are the settings loaded into the instrument prior to shipment from the factory. To load the default values proceed as follows:

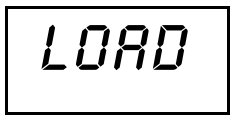
1. Close switch V1 (see “Configuration” on page 9).
2. Autotuning (Smart AT) must be disabled.

3. The upper display shows the process variable and the lower display shows the set point.
4. Hold down the ∇ key and press Δ key; the display shows:



5. Press either the ∇or Δ key; the display shows:

6. Press the FUNC key; the display shows:



This indicates that the loading procedure has been initiated. After about 3 seconds the loading procedure is complete and the instrument reverts to the "normal display mode." The following is a list of the default operating parameters loaded during the procedure.

Parameter	Default Value
SP	Minimum of range.
SnRT	Disabled.
n.SRt	OFF.
nnn	OFF.
SP2, SP3, SP4	Minimum of range.
A1, A2, A3	Minimum of range (process alarms). 0 (deviation or band alarms).
HSA1, HSA2, HSA3	0.1%.
PB	4.0%.
HYS	0.5%.
ti	4.00 (4 minutes).
td	1.00 (1 minute).
IP	30.0 for one control output. 0 for two control outputs.

Parameter	Default Value
CY2	15 seconds for relay output. 4 seconds for SSR output. When two control outputs are programmed and OUT 2 = “dir” the default values are: 10 seconds for P25 = AIr. 4 seconds for P25 = OIL. 2 seconds for P25 = H2O.
CY3	15 seconds for relay output. When two control outputs are programmed and OUT 3 = “dir” the default values are: 10 seconds for P25 = AIr. 4 seconds for P25 = OIL. 2 seconds for P25 = H2O.
rC	1.00 for P25 = AIr. 0.80 for P25 = OIL. 0.40 for P25 = H2O.
OLAP	0
rL	Initial scale value.
rH	Full scale value.
Grd 1	Infinite (step transfer).
Grd 2	Infinite (step transfer).
OLH	100%.
tOL	Infinite.
rnP	25%/second

Operating Parameters

From the “normal operating mode,” press the FUNC key. The lower display then shows the code and the upper display shows the setting or the status (ON or OFF) of the selected parameter.

Press the ∆ or ∇ keys to change the setting. Press the FUNC key again and the instrument stores the new setting and displays the next parameter. Some of the following parameters may not appear, depending on the configuration.

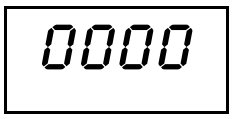
Parameter	Description
SP	Main set point (in engineering units). SP is operative when logic inputs 1 and 2 are open.
Snrt	Autotuning (Smart AT) status. ON or OFF indicates the status of the autotuning function (enabled or disabled respectively). Set ON to enable autotuning. Set OFF to disable autotuning.
n.RSt	Manual reset of the alarms. Set to ON and press FUNC to reset the alarms.

Parameter	Description
nnn	Software key for parameter protection: ON = The instrument is LOCKED. OFF = The instrument is UNLOCKED. To switch from LOCKED to UNLOCKED, enter the P20 parameter setting. To switch from UNLOCKED to LOCKED, enter any number other than the P20 parameter setting.
SP2	Auxiliary set point (in engineering units). Operative when: Logic input 1 is open, Logic input 2 is closed
SP3	Auxiliary set point (in engineering units). Operative when: Logic input 1 is closed, Logic input 2 is open.
SP4	Auxiliary set point (in engineering units). Operative when: Logic input 1 is closed, Logic input 2 is closed
AL1	Alarm 1 set point (configurable in engineering units).
HSA1	Alarm 1 hysteresis (in % of P4 - P3 span).
AL2	Alarm 2 set point (in engineering units).
HSA2	Alarm 2 hysteresis (in % of P4 - P3 span).
AL3	Alarm 3 set point (in engineering units).
HSA3	Alarm 3 hysteresis (in % of P4 - P3 span).
Pb	Proportional band (in % of P4 - P3 span).
HYS	Hysteresis for ON/OFF control action (in % of P4 - P3 span).
ti	Integral time (in minutes and seconds [mm.ss]).
td	Derivative time (in minutes and seconds [mm.ss]).
IP	Integral pre-load (in % of the output).
CY2	Output 2 cycle time (in seconds).
CY3	Output 3 cycle time (in seconds).
rC	Relative Cooling gain.
OLAP	Deadband/Overlap between H/C outputs (configurable in % of the proportional band).
rL	Setpoint low limit (in engineering units).
rH	Setpoint high limit (in engineering units).
Grd1	Ramp applied to a positive set point change (in digits per minutes).
Grd2	Ramp applied to a negative set point change (in digits per minutes).
OLH	Output high limit (in % of the output)
tOL	Time duration of the output power limiter (in minutes). Configured as Inf “always on” or in minutes.
rnP	Control output max. rate of rise (in percent per second).

Error Messages

Overrange, Underrange, and Sensor Break Indications

This device is capable of detecting process variable faults (OVERRANGE, UNDERRANGE or SENSOR BREAK). When the process variable exceeds the span limits established by configuration parameter P1, an OVERRANGE condition appears as:



An UNDERRANGE condition appears as:

When P42 is zero, the following conditions may occur if:

- The instrument is set for one output only and an OVERRANGE is detected, then OUT turns OFF (if reverse acting) or ON (if direct acting).
- The instrument is set for heating/cooling and an OVERRANGE is detected, the reverse (rEV) acting output turns OFF and the direct (dir) acting output turns ON.
- The instrument is set for one output only and an UNDERRANGE is detected, then OUT turns ON (if reverse acting or OFF (if direct acting).
- The instrument is set for heating/cooling and an UNDERRANGE is detected, the reverse (rEV) acting output turns ON and the direct (dir) acting output turns OFF.

When P42 is not zero and an out of range condition is detected, the instrument operates in accordance with P42 and P43 parameters.

The sensor break can be signalled as:

- For TC/mV input: OVERRANGE or UNDERRANGE (selected by solder jumper).
- For RTD input: OVERRANGE.
- For mA/V input: UNDERRANGE.

NOTE: On the mA/V input, a sensor break can be detected only when the range selected has a zero elevation (4-20 mA, 1-5 V, or 2-10 V). On the RTD input a special test is provided to signal an OVERRANGE when input resistance is less than 15 ohms (short circuit sensor detection).

Error Messages

On powerup, the instrument performs a self-diagnostic test. When an error is detected, the lower display shows an "Err" indication while the upper display shows the code of the detected error.

Error List

SEr	Serial interface parameter error.
100	EEPROM write error.
150	CPU error.
200	Attempt to write to protected memory.
201 - 2xx	Configuration parameter error. The two least significant digits show the number of the wrong parameter (ex. 209 Err indicates an Error in Parameter P9).
299	Error in control output selection.
301	Error in calibration of the selected input.
307	RJ input calibration error.
320	Linear output calibration error.
400	Control parameters error.
500	Auto-zero error.
502	RJ error.
510	Error during calibration procedure.

Dealing With Errors

1. When a configuration parameter error is detected, repeat the configuration procedure of that specific parameter.
2. If an error 400 is detected, simultaneously press the ∆ and ∇ keys to load the default parameters and then repeat the control parameter setup.
3. For all other errors, contact your Foxboro representative.

5. Specifications

See “Reference Documents” on page 1 for a more detailed list of specifications.

Power supply:	From 100 to 240 V ac 50/60 Hz; 24 V ac/V dc; ±10%
Power consumption:	11 VA maximum
Common mode rejection ratio:	120 dB at 50/60 Hz
Accuracy (@25°C ambient temperature):	±0.2% of the input span ±1 °C
Operating temperature:	From 0 to +50°C
Storage temperature:	-20 to +70 °C
Humidity:	From 20% to 85% RH, noncondensing
Linear output maximum load:	500 Ω
Output 2:	SPST contact with current rating 3 Amp/250 V ac on resistive load
Output 3:	SPST contact with current rating 2 Amp/250 V ac on resistive load

Index

D

E

I

K

L

M

O

P

R

S

V

W

The Foxboro Company
33 Commercial Street
Foxboro, Massachusetts 02035
United States of America

Telephone: 1-888-FOXBORO
(1-888-369-2676)

Facsimile: (508) 549-4999