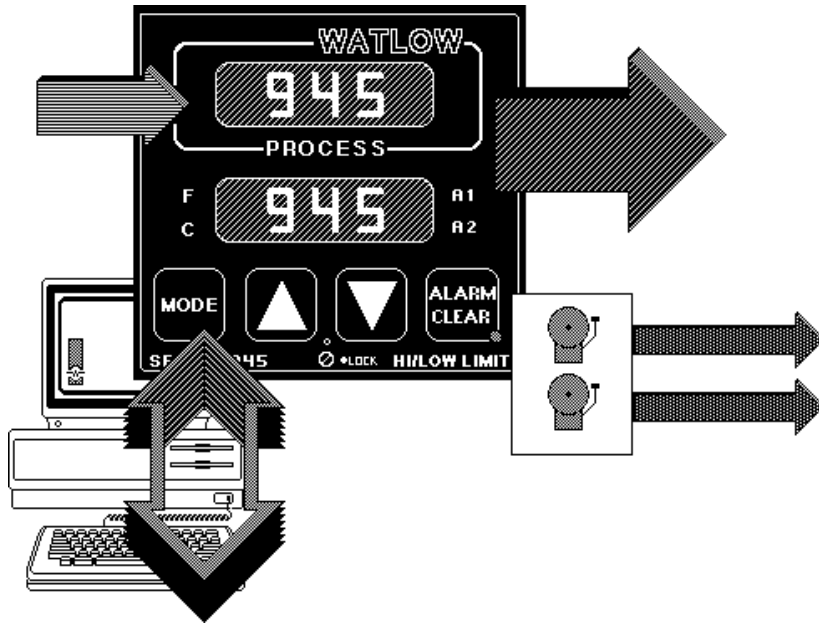# Series 945

High/Low
Limit Control

User's Manual

WATLOW

Watlow Controls, 1241 Bundy Blvd., P.O. Box 5580, Winona, MN 55987-5580, Phone: 507/454-5300, Fax: 507/452-4507
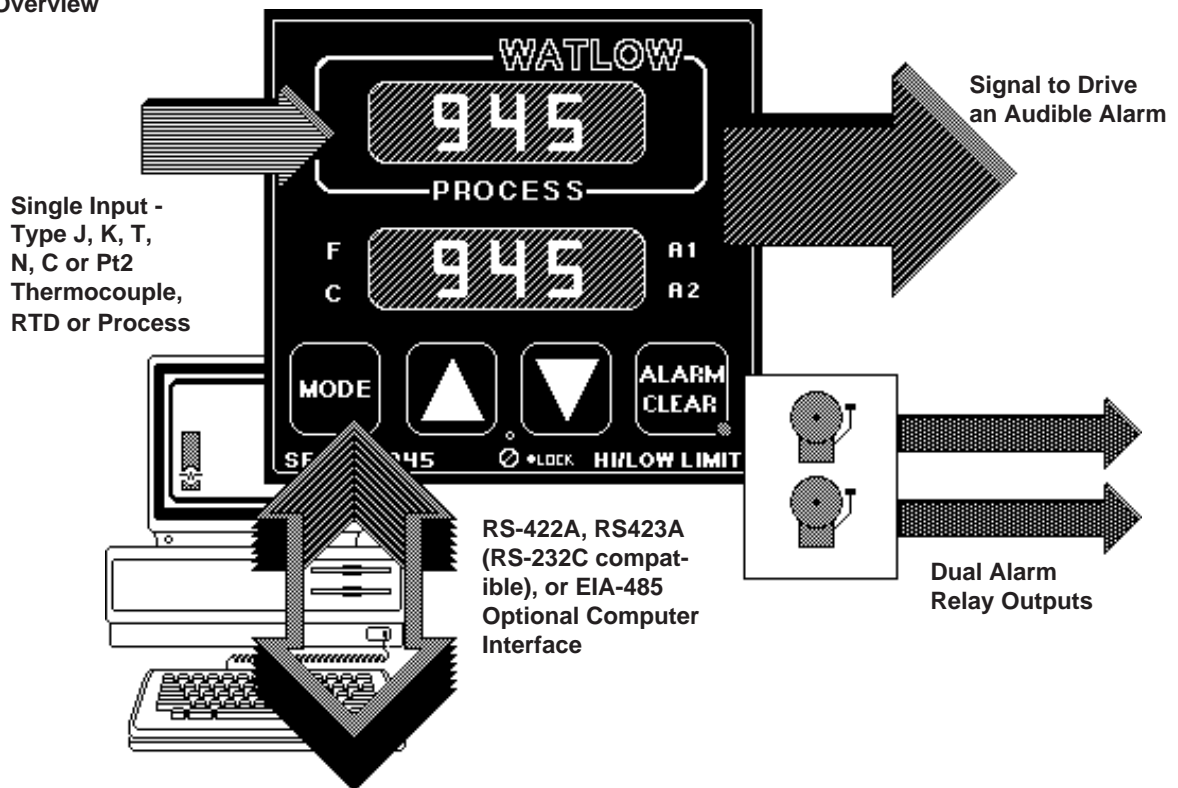
WATLOW Seri

Starting Out With The Series 945,

A Microprocessor-Based Limit Control

**Figure 1 -
Series 945 Input and
Output Overview**

**Single Input -
Type J, K, T,
N, C or Pt2
Thermocouple,
RTD or Process**

**Signal to Drive
an Audible Alarm**

**RS-422A, RS423A
(RS-232C compat-
ible), or EIA-485
Optional Computer
Interface**

**Dual Alarm
Relay Outputs**

General Description

Welcome to the Series 945, a 1/4 DIN microprocessor-based, audible alarm, dual alarm relay, single input, high-low limit control. The 945 accepts a Type J, K, T, N, C or Platinel 2 thermocouple, RTD, or process input.

The upper display provides process temperature information while the lower display provides alarm status. Output 1 is a DC signal output used to drive an external audible alarm. Output 2 and 3 are alarm relays that de-energize when a limit condition exists.

Operator-friendly features include automatic LED indicators to aid in monitoring and set-up, as well as a calibration offset at the front panel. The Series 945 automatically stores all information in a non-volatile memory.

How to Wire the Series 945

The Series 945 wiring is illustrated by model number option. Check the unit sticker on the control (see right) and compare your model number to those shown here and also the model number breakdown in the Appendix of this manual.

Series 945 internal circuits appear "inside" the line drawing of the 945, while connections and terminal designations appear "outside" the line drawing. All outputs are referenced to a de-energized state. The final wiring figure is a typical system example.

When you apply power without sensor inputs on the terminal strip, the Series 945 will display "- - - -" in the Upper display, and a "0" in the Lower display. Press the ALARM CLEAR key twice, and an ER 7 is displayed for one second. This error indicates an open sensor or A/D error. Remove power to the control and connect the sensor properly, see Page 4 and 5. All wiring and fusing must conform to the National Electric Code and to any locally applicable codes.

945A-2CA2-AJAP

| Terminal	Function
1	4-20, 0-5 +
2	4-20, Jumper to 3
3	4-20, 0-5 -
4	S1 RTD
5	S2 RTD
6	S3 RTD
7	T.C. +
8	Not Used
9	T.C. -
10	L1 240V
11	L1 120V
12	L2
13	Earth Ground
14	Not Used
15	Not Used
16	DC -
17	DC +
18	Not Used
19	Not Used
20	Not Used
21	Not Used
22	Not Used
23	Not Used
24	Com.
25	N.O. or N.C.
26	Com.
27	N.O. or N.C.

Output #1 (terminals 16, 17)
Alarm #2 (terminals 24, 25)
Alarm #1 (terminals 26, 27)

Figure 2 - 120 VAC Power Wiring

11 Fuse L1
12 L2
13 Earth Ground
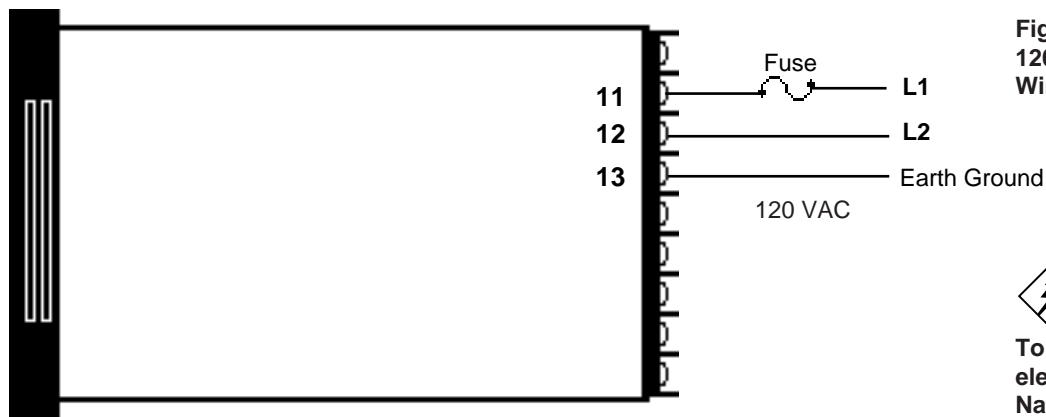120 VAC

WARNING:

To avoid potential electric shock, use National Electric Code (NEC) safety practices when wiring and connecting this unit to a power source and to electrical sensors or peripheral devices.
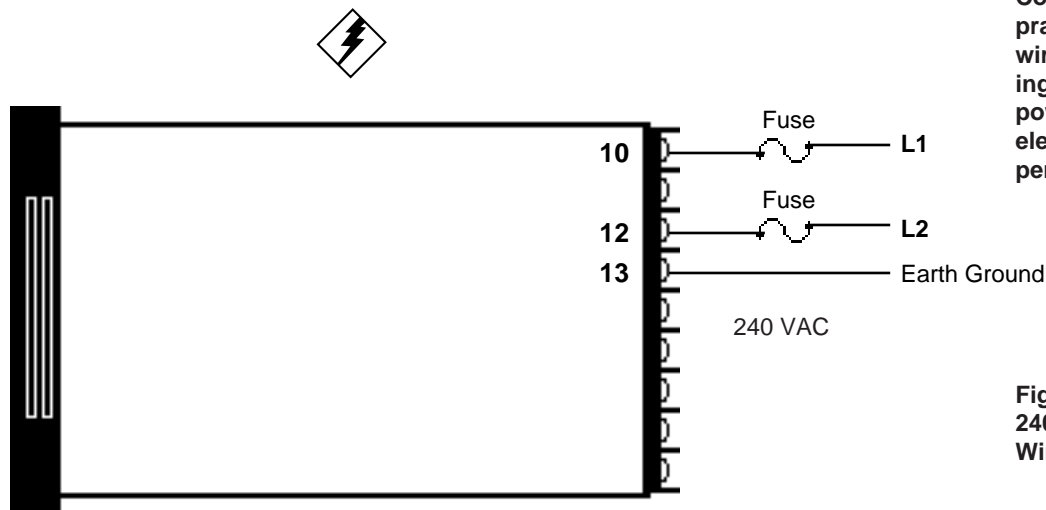
Figure 3 - 240 VAC Power Wiring

10 Fuse L1
12 Fuse L2
13 Earth Ground
240 VAC

Sensor Installation Guidelines

We suggest you mount the sensor at a location in your process or system where it reads an average temperature. Choose a point that will adequately represent the process temperature without being overly reactive.

For thermocouple inputs: Use an isolated or ungrounded thermocouple if an external 4-20mA output device with a non-isolated circuit common is connected. Extension wire must be of the same alloy as the thermocouple itself to limit errors.

For RTD Inputs: There could be a +2°F input error for every 1Ω of lead length resistance when using a 2 wire RTD. That resistance, when added to the RTD element resistance, will result in erroneous input to the instrument. To overcome this problem, use a three wire RTD sensor, which compensates for lead length resistance. When extension wire is used for a three wire RTD, all wires must have the same electrical resistance (i.e. same gauge, copper stranded).

For 0-5VDC or 4-20mA process inputs: The rL and rH settings scale the display to match the measured range of the process signal. For 0-5VDC process input, the impedance is 100KΩ. For 4-20mA process input, the impedance is 249Ω.

Thermocouple Input

Figure 4 - Thermocouple Input Wiring.

945A - **1** _ _ _ - _ 000
945A - **2** _ _ _ - _ 000
945A - **3** _ _ _ - _ 000

7   +

9   -
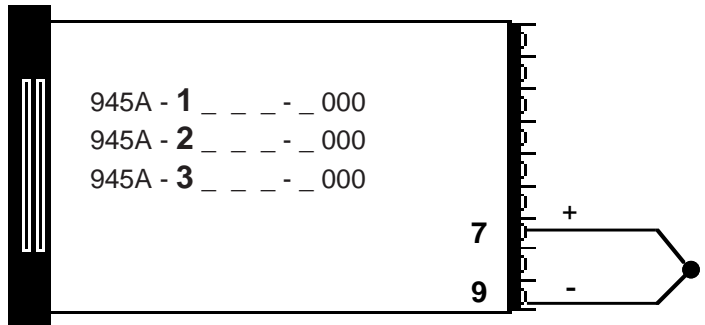
RTD, 2 or 3 Wire

Figure 5 - 2 or 3 wire RTD Input Wiring.

945A - **2** _ _ _ - _ 000

945A - **3** _ _ _ - _ 000

4
5
6

Jumper #5 to #6 for 2 Wire RTD

4
5
6

0 - 5VDC Process or Remote Set Point Input

945A - **2** _ _ _ - _ 000

945A - **3** _ _ _ - _ 000

1

3

V_{DC}

+

-

Input impedance: 100KΩ
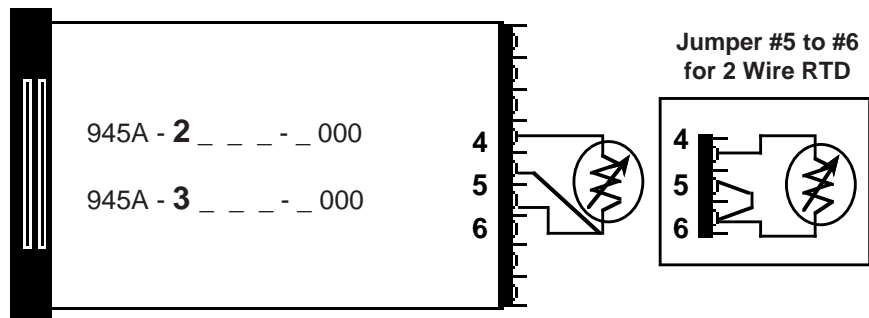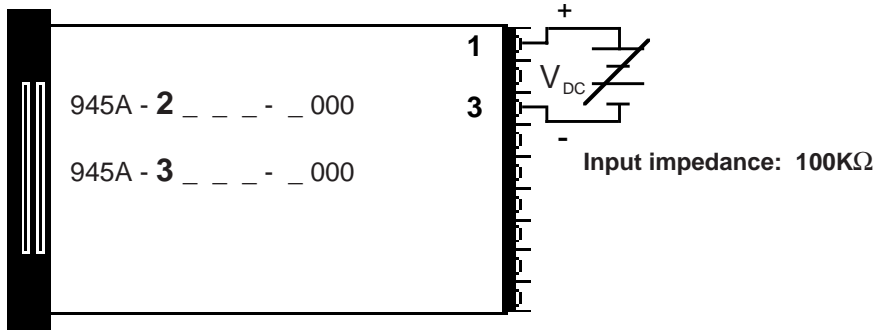
**Figure 6 -
0 - 5 VDC Process
Input Wiring.**

4 - 20mA Process or Remote Set Point Input

945A - **2** _ _ _ - _ 000

945A - **3** _ _ _ - _ 000

1
2
3

I_{DC}

+

-

4-20mA process input: 249Ω

**A jumper must be
installed between
Terminal #2 and 3.**
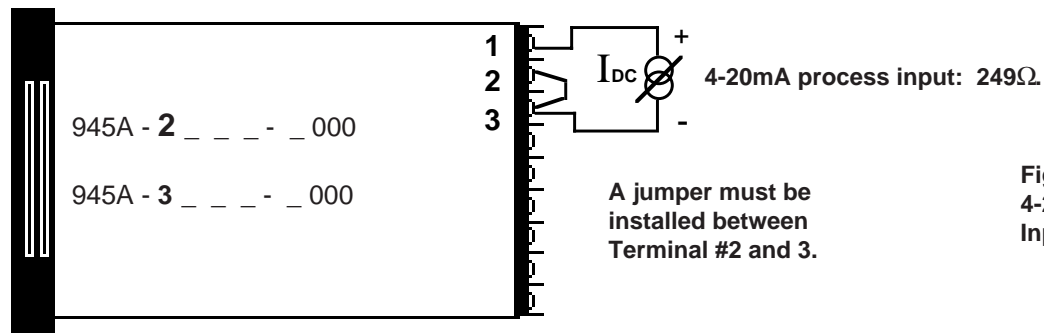
**Figure 7 -
4-20mA Process
Input Wiring.**

Output 1 - Sonalert

945A - _ **C** _ _ - _ 000

Logic
Switch

-

+

16 -

17 +

AL1
Sonalert
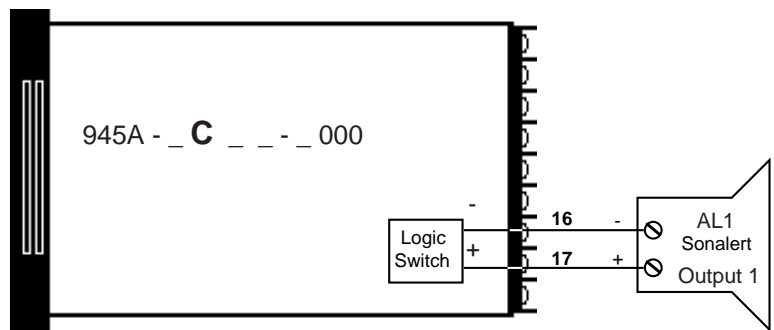
Output 1

**Figure 8 -
DC Output 1
(Open Collector).**

Alarm Wiring

Alarm Outputs, Form A or B, 6 Amp Mechanical Relay

**Figure 9 -
Alarms Option
Wiring Diagram.**

945A- _ _ _ **2** - _ 000

Off state impedance is 20KΩ minimum.

Output 3

Output 2

Fuse

24	L1
25	AL2	L2
26	L1
27	AL2	L2
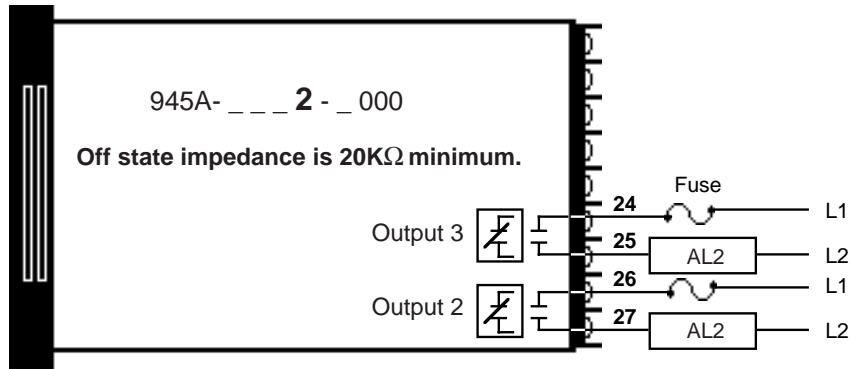
Changing the Position of an Alarm Jumper

Whenever you change the position of a jumper, follow this procedure:

1. Remove power from the Series 945. Turn the front panel screw 90°
    counterclockwise.

2. Grip the front panel bezel and pull it straight out from the control case. The
    control chassis will come out of the case as you pull the bezel.

3. Set the jumper to the position you want. See Figure 10 for jumper location.

4. Return the control chassis to the case. Be sure you have it oriented
    correctly. It will not fit in upside down, but check just the same. Press
    firmly, but gently, to seat the chassis.

Options Board
A007-1789

**Figure 10 -
Alarms Jumper
Location.**

Output 2 → AL2

A007-1828
Output 3 → AL2

N.O.
Contacts
(Form A)

N.C.
Contacts
(Form B)

Control Chassis - Top View
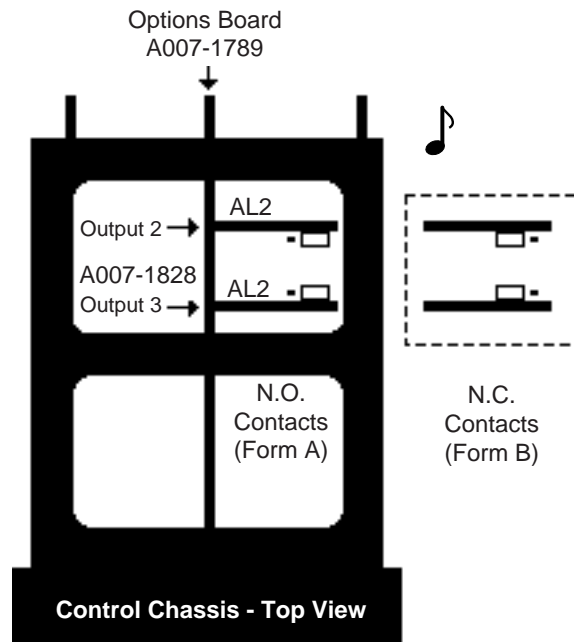
♫ **NOTE:**

**Depending on the
unit you order, your
control may have 0,
1, or 2 alarm jump-
ers.**

♪ **NOTE:**

The alarm output de-energizes upon an alarm or power interruption to the 945's power
supply. When you select **N.O. Contacts**, the contact is open when an alarm occurs.
When selecting **N.C. Contacts**, the contact closes when an alarm occurs.

Using Alarms

The Series 945 has two alarm types, Process or Deviation. A **Process alarm** sets an absolute temperature when the process exceeds that absolute temperature limit.

A **Deviation alarm** alerts the operator when the process strays too far from set point. The reference for the deviation alarm is the process value.

Both Process and Deviation alarms can be latching or non-latching. The operator must **manually reset** a **latching alarm** before the alarm will reset. The operator must also remove the condition that created the alarm. When the operator removes the condition causing the alarm, a **non-latching alarm automatically** resets the alarm output.

Flashing 'LO" or "HI" in the lower display indicates an alarm. The Lower display alternately shows information from the current parameter and the "LO" or "HI" alarm message at one second intervals. The audible alarm (Output 1) is energized and the alarm relay outputs are de-energized and the A1 and A2 LED are lit.

To silence the audible alarm (Output 1)...
•   **Press the alarm clear button once.**

To clear an alarm (Output 2 or Output 3)…
•   **First correct the alarm condition, then…**

    • If the alarm is latching…
    Clear it manually; press the ALARM CLEAR key twice as soon as the process temperature is inside the alarm limit according to the HYS parameter.

    • If the alarm is non-latching…
    The alarm will clear itself automatically as soon as the process temperature is inside the alarm limit according to the HYS parameter.

⚠️ **CAUTION:**
An alarm display will be masked by an error condition or when the control is in the Calibration or Setup Menus.
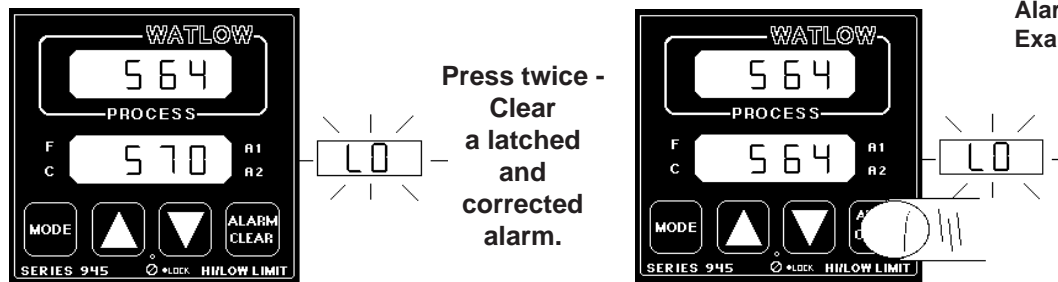

Press twice - Clear a latched and corrected alarm.

Figure 11 - Alarm Display Examples

AL1 - Indicates Sonalert Output

AL2 - Indicates Alarm 2 Outputs 2 & 3
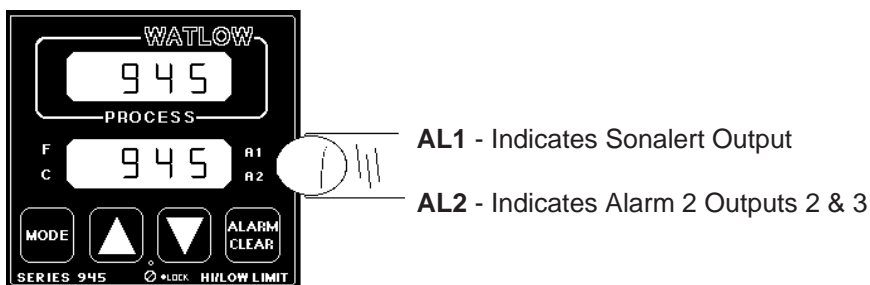
How to Use the Keys and Displays

Figure 12 - Series 945 Displays

Upper Display
Red, 0.56" high, seven segment, four digit LED display, indicating either process actual temperature, the operating parameter values, or an open sensor. When powering up, the Process display will be blank for 8 seconds.

F & C
Indicates the displayed temperature is in degrees Fahrenheit (F) or Celsius (C). If neither F or C are lit, the 945 is displaying process variable units.

Lower Display
Red 0.56" high, seven segment, four digit LED display, prompts for data in the upper display, or error and alarm codes.

A1 & A2
When lit, A1 indicates the audible alarm is active. When A2 is lit, the relay outputs are de-energized.

ALARM CLEAR Key
Pressed once, it silences the audible alarm and A1 is no longer lit. If pressed again, the alarm relays are reset, A2 is no longer lit, and the alarm message is cleared.

MODE Key
Steps the control through the Operating menu; also, in the Auto mode, enters new data selected less than 5 seconds previously .

UP Key
Increases the value of the displayed parameter. A light touch increases the value by one. Holding the key down increases the display value at a rapid rate. New data is self entering in 5 seconds.

Front Panel Locking Screw
Secures or releases the control chassis in its case.

DOWN Key
Decreases the value of the displayed parameter. A light touch decreases the value by one. Holding the key down decreases the displayed value at a rapid rate. New data is self entering in 5 seconds.

UP/DOWN keys
When pressed simultaneously for 3 seconds, the Set Up Menu will appear displaying the LOC parameter. At the LOC parameter, continue to press the UP/DOWN keys, and the Calibration Menu will appear.

How to Set the DIP Switch

The Series 945 has a Dual In-line Package (DIP) switch inside the control on the A007-1954 circuit board (middle board). The location of the board and switches appear below. The switches are clearly numbered. When Switch #1 is ON, the Setup parameters can be viewed but not changed. Switch #2 is not used. The factory default is OFF.

A007-1954

1 Hardware Lockout of
   SETUP Parameters
2 Not Used

(Factory default is OFF)

Control Chassis - Top View
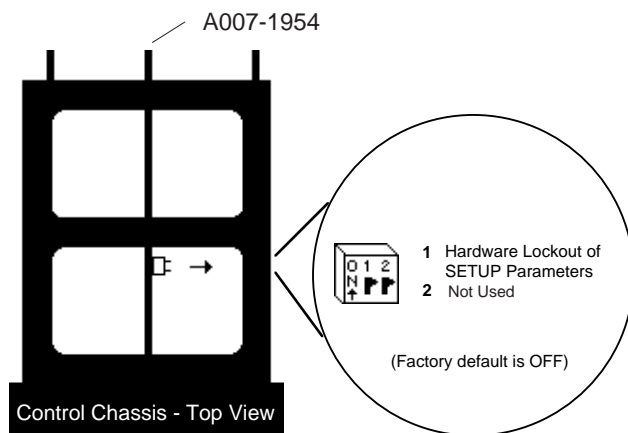
Figure 13 - DIP Switch Location and Orientation

Entering the Setup Menu

The Setup Menu displays the parameters that configure the Series 945's features to your application.

To enter the Setup Menu, press the UP and DOWN keys simultaneously for 3 seconds. The Lower display will show the LOC parameter, and the Upper display will show its current level. All keys will be inactive until you release both keys. You can get to the LOC parameter from anywhere.

Use the MODE key to cycle through the menu; use the UP/DOWN keys to select Setup data. You may not see all the parameters in this menu, depending on the unit's configuration and model number. After stepping through the menu, you will return to the control set point parameter under the Operation menu.
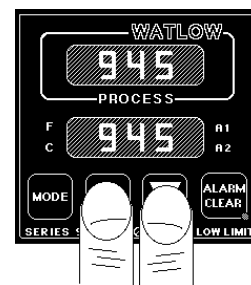
Figure 14 - Entering the Setup Menu.

Setup Parameters

When you are at the top of the menu, the Series 945 displays the user level of operation in the upper display, and the LOC parameter in the lower display.

When you press the MODE key, the value of the next parameter appears in the upper display, and the parameter itself appears in the lower display.

Shaded parameters will not always appear, depending on your control configuration.

LOC

Lock: Selects the level of operator lock-out.
Range: 0 - 2   **Default:** 0

The levels of operator lock-out are defined as follows:
LOC 0: All operating parameters may be viewed or changed.

LOC 1: No calibration offset adjustments permitted.

LOC 2: No adjustments permitted.

In

Input: Selects the sensor input type. Only those input types which are compatible with your unit will appear. See the model number information for your type.
Range: J, K (appears as H), t, n, c, Pt2, rtd, rt.d, 0-5, 420   **Default:** t

dEC

Decimal: Selects the location of the decimal point for all process related data. This parameter only appears if the In parameter is 0-5 or 420.
Range: 0, 0.0, 0.00   **Default:** 0

C _ F

Celsius _ Fahrenheit: Selects the units of temperature measurement for the control. This parameter only appears if the In parameter is a thermocouple or RTD input selection.   **Range:** C or F   **Default:** F

♪ **NOTE:**

In the deviation mode, rL and rH only effect the target set point values.

rL

Range Low: Selects the low limit of the process alarm set point and the deviation alarm target set point. See Table 1 on Page 11 for range values.
Range: Sensor range low to rH   **Default:** Low limit of sensor type

rH

Range High: Selects the high limit of the process alarm set point and the deviation alarm target set point. See Table 1 on Page 11 for range values.
Range: Sensor range high to rL   **Default:** High limit of sensor type

AtyP

Alarm 2 Type: Determines whether the Alarm 2 Outputs are a process or deviation alarm. A process alarm is set at an absolute temperature to prevent over/underrange.   **Range:** Pr or dE   **Default:** Pr

LAt

Latching : Selects whether Alarm 2 Outputs are latching or non-latching. Latching must be cleared before the alarm output will reset. Non-latching automatically resets the alarm output when the condition clears.
Range: LAt or nLA   **Default:** LAt

HYS

Hysteresis: Selects the switching hysteresis for Alarm 1 and Alarm 2.
Range: 1°F - 99°F   0.1°F - 9.9°F   **Default:** 3°F
             1°C - 55°C   0.1°C - 5.5°C
             1Unit - 99 Units   0.1 Units - 9.9 Units

rtd

RTD: Selects the RTD calibration curve for RTD inputs. This parameter will not appear unless In = rtd or rt.d. JIS = 0.003916Ω/Ω°C, DIN = 0.003850Ω/Ω°C.
Range: din or JIS   **Default:** DIN

bAUd

Baud: Represents the baud rate the serial communications is running at. Appears if your 945 has communications.
Range: 300, 600, 1200, 2400, 4800, 9600   **Default:** 1200

dAtA

Data: Allows the user to select the data bits and parity for communication. This parameter will appear if your Series 945 has communications.
Range: 7 o = 7 data bits and odd parity   **Default:** 7 o
        7 E = 7 data bits and even parity
        8 n = 8 Data bits and no parity

Protocol: Selects the communication protocol. This parameter will appear if your Series 945 has communications. FULL = ANSI X3.28 2.2 - A.3
On = XON - XOFF   **Range:** FULL or On   **Default:** FULL

| Prot |

Address: Selects the address for this unit if Prot = FULL. This parameter will appear if your Series 945 has communications. **Range:** 0 to 31   **Default:** 0

| Addr |

Log: Selects the data logging function for a printout of the data. Appears if your 945 has communications, Prot = On, and Log = tAbL or CHrt.
Range: OFF, tAbL or CHrt   **Default:** OFF

| Log |

Line: Selects the number of lines per page of data logged output. Match this parameter to the number of lines per page your printer prints. After you select the number of lines to print, a form feed character is sent to the printer, resetting the top of the page. **Range:**   10 to 127 **Default:** 65

| LinE |

Year: Select the current year for the data logging header. Appears if Prot = On and Log = tAbL or CHrt. Parameter resets to default after a power interruption.
Range: 0 to 99   **Default:** 92

| YEAr |

Month: Select the current month for the data logging header. Appears if Prot = On and Log = tAbL or CHrt. Parameter resets to default after a power interruption. **Range:** 1 to 12   **Default:** 01

| Mon |

Day: Select the current day for the data logging header. Appears if Prot = On and Log = tAbL or Chrt. Parameter resets to default after a power interruption
Range: 1 to 31 **Default:** 01

| Day |

Hour: Represents the 24 hour time-of-day clock setting for hours. Appears if Prot = On and Log = tAbL or CHrt Parameter resets to default after a power interruption. **Range:** 0 to 23   **Default:** 0

| Hour |

Minutes: Represents the 24 hour time-of-day clock setting for minutes. Appears if Prot = On and Log = tAbL or CHrt. Parameter resets to default after a power interruption. **Range:** 0 to 59   **Default:** 0

| Min |

Interval: Selects the time interval for the logging function. The logging interval is in tenth of a minute increments. Appears if your 945 has communications, Prot = On, and Log = tAbL or CHrt.
Range: 0.0 to 60.0 minutes   **Default:** 0.0

| Int |

Tag: Selects what variables are to be transmitted out during the data logging function. Any combination of process, set point and alarms may be "tagged" for logging. Appears if your Series 945 has communications, Prot = On, and Log = tAbL. P = Process   t = Target Set Point   A = Alarm Set Points
Range: PtA, Pt -, P-A, P-- -tA, -A-, --t, ---   **Default:** ---

| tAg |

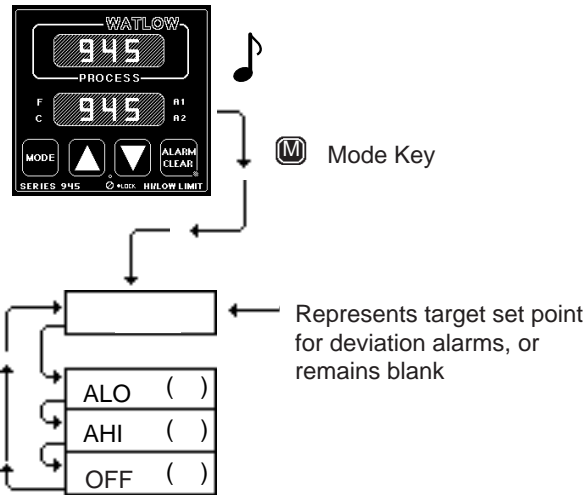| Input Type	Sensor Range Low	Sensor Range High
J	32°F/0°C	1382°F/750°C
K (appears as H)	-328°F/-200°C	2282°F/1250°C
t	-328°F/-200°C	662°F/350°C
n	32°F/0°C	2282°F/1250°C
c	797°F/425°C	4200°F/2315°C
Pt2	32°F/0°C	2543°F/1395°C
rtd (1°)	-328°F/-200°C	1112°F/600°C
rt.d (0.1°)	-99.9°F/-99.9°C	392.0°F/200.0°C
0-5 (VDC)	-5.00/-50.0/-500	35.00/350.0/3500
420 (mA)	-5.00/-50.0/-500	35.00/350.0/3500

Table 1 - Input Ranges.

Setup Menu

Use this page as a master copy for configuring your Series 945.
Do not enter any values here; make photocopies instead.

**Table 2 -
Setup Menu
Prompts and
Descriptions.**

Setup Parameters	Value	Range	Factory Default
LOC		0 - 2	0
In		J, K (appears as H), t, n, c, Pt2, rtd, rt.d, 0-5, 420 Dependent on model number.	t
dEC		0, 0.0, or 0.00 Dependent on input type.	0
C _ F		C or F Will not appear if In = 0-5 or 420.	F
rL		rL to rH	Input selection dependent.
rH		rH to rL	Input selection dependent.
AtyP		Pr or dE	Pr
LAt		LAt or nLA	LAt
HYS		1°F - 99°F, 1°C - 55°C, 1U - 99U 0.1°F - 9.9°F, 0.1°C - 5.5°C, 0.1U - 9.9U	3°F
rtd		JIS or din	DIN
bAUd		300, 600, 1200, 2400, 4800, 9600	1200
dAtA		7 o = Odd parity, 7 E = Even parity 8 n = 8 data bits and no parity	7 o
Prot		FULL or On	FULL
Addr		0 to 31	0
Log		OFF, tAbL or CHrt	OFF
LinE		10 to 127	65
YEAr		0 to 99	92
Mon		1 to 12	01
Day		1 to 31	01
Hour		0 to 23	0
Min		0 to 59	0
Int		0.0 to 60.0 minutes	0.0
tag		PtA, Pt, P-A, P--, -tA, -t-, --A, --- P = Process, T = Target A = Alarm Set points	---

M Mode Key

Represents target set point for deviation alarms, or remains blank

♪ **NOTE:**
The Upper display will always return to the process value after 1 minute without key strokes.

Figure 15 - The Operation Menu.

Operation Parameters

Target Set Point or Blank: Displays the target set point while using deviation alarm only. Display remains blank while in the process alarm mode.

Alarm Low: This parameter represents the low process alarm or low deviation alarm for the mechanical relay alarms.
Range: 0 to -999°F/0 to -999°C/0 to -999 Units **Default:** -999°F
If AtyP = Pr: **Range:** rL to AHI   **Default:** rL

ALO

Alarm High: This parameter represents the high process alarm or high deviation alarm for the mechanical relay alarms.
Range: 0 to 999°F/0 to 999°C/0 to 999 Units   **Default:** 999°F
If AtyP = Pr: **Range:** ALO to rH   **Default:** rH

AHI

Calibration Offset: Adds or subtracts degrees from the input signal.
Range: ± 180°F / ± 100°C   **Default:** 0

OFF

Operation Menu

Use this page as a master copy for your Series 945 Operation Parameters.
Do not enter any values here; make photocopies instead.

Table 3 - Operation Menu Prompts and Descriptions.

| Operation Parameters		Value	Range	Factory Default
Target Set Point			See explanation above.	
ALO-	Deviation **dE** Process **Pr**		-999° to 0° rL to AHI	-999 rL
AHI-	Deviation **dE** Process **Pr**		0° to 999° ALO to rH	999° rH
OFF			± 180°F / ± 100°C	0

Before attempting to calibrate, make sure you have the proper equipment called for in each procedure.

Entering the Calibration Menu

Enter the Calibration Menu to change the configuration of the dFL (default language) parameter. Several parameters are dependent on the dFL parameter, they are listed below. It is a good idea to change this parameter, if necessary, before entering the Setup menu. The factory configures your unit to your preference, but can be changed at any time.

In the Calibration menu, various input signals must also be supplied in order for the control to go through its auto calibration. The calibration menu can only be entered from the LOC parameter in the Setup menu. Press the UP/DOWN keys simultaneously for 3 seconds. (±1 second). The CAL parameter appears in the lower display with "no" in the upper display.

Figure 16 - Entering the Calibration Menu.
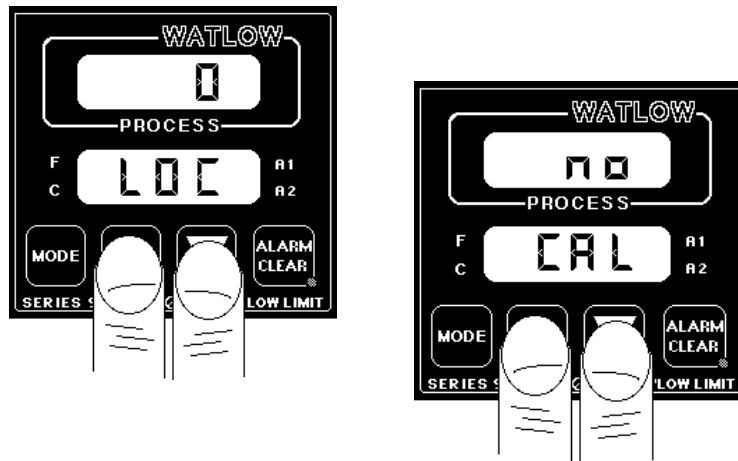
♪ **NOTE:**

Calibration values are not retained unless you are in the MANUAL mode. Do not enter the MANUAL mode until you are at the correct input parameters.

♫ **NOTE:**

While in the Calibration Menu, all outputs are OFF, except the 4-20mA output.

Any inadvertent change in the displayed data, when pressing the UP/DOWN keys, is ignored. Press the UP/DOWN keys to change the upper display to "yES." Press the MODE key to enter the calibration sequence.

Upon entering the calibration menu, the top display window indicates CAL. The upper display continues to indicate CAL while the operator walks through the entire calibration parameter list. The control uses the lower display to prompt the user as to what the input should be. The rSt parameter restores the factory calibration values to the Series 945. If you calibrate your control incorrectly, you have the option to default to the original values. Once you leave the CAL menu, the values are entered.

The dFL parameter allows you to select either U.S. parameters which include displaying rate, reset, °F, and proportional band in degrees or units, or select SI (System International). The parameters displayed here are integral, derivative, °C, and proportional band in % of span.

Once the information has been properly established and maintained for 5 to 10 seconds, the MODE key may then be used to display the next parameter. After the final input is established, press the MODE key twice to return the unit to the configuration menu at the top of the parameter list.

Calibration Menu

CAL	( )	YES to calibrate, No skips to display test.
tCL	( )	Input 0.00mV for low thermocouple input.
tCH	( )	Input 50.00mV (16.035 for r, S or b units) for high thermocouple input.
tC	( )	Connect a "J" T/C compensator, with inputs shorted. T/C units only.
rLO	( )	Connect the JIS RTD low resistance per model number.
rHI	( )	Connect the JIS RTD high resistance per model number.
O U	( )	Set the voltage source to 0.000 volts.
5 U	( )	Set the voltage source to 5.000 volts.
4 A	( )	Set the current source to 4.00mA.
20A	( )	Set the current source to 20.00mA.
4tYP	( )	Select "rEly."
rst	( )	Restores factory calibration values.
dISP	( )	Factory use only.
dFL	( )	Select US (rate, reset, proportional band in degrees or units, °F) or SI (integral, derivative, proportional band in % of span, °C).
MEM	( )	Factory use only.

**Figure 17 -
Calibration Menu**

⚠️

**Before attempting to calibrate,
make sure you have the proper
equipment called for in each procedure.**

**The Series 945 is calibrated and tested
before leaving the factory.**

T/C and RTD

Thermocouple Field Calibration Procedure

Equipment Required:
• Type "J" or "R" Reference Compensator with reference junction at 32°F/0°C, **OR** Type "J" or "R" Thermocouple Calibrator set at 32°F/0°C.
• Precision millivolt source, 0-50mV min. range, 0.01mV resolution

Setup And Calibration ♪

1. Connect the AC line voltage L1, L2, and ground to the proper terminals.

2. Connect the millivolt source to Terminal #9 Negative and Terminal #7 Positive on the Series 945 terminal strip. Use regular 20 - 24 gauge wire.

3. Apply power to the unit and allow it to warm up for 15 minutes. **After warm-up** put the unit in the CAL menu. See Page 14.

♪ **NOTE**

Before calibration on an installed control, make sure all data and parameters are documented. See Setup, and Operation Tables, Pages 12 and 13.

4. Press ALARM CLEAR twice to enter the calibration mode. The unit is calibrating when the ALARM CLEAR LED is ON. Make sure the LED is on **only** when you are in the correct parameters. See Figure 16.

5. At **tcL**, enter 0.00mV from the millivolt source to the control. Allow 10 seconds to stabilize. Press MODE.

6. At **tcH**, enter 50.00mV for type "J" units or 16.035mV for type "R" units from the millivolt source to the 945. Allow at least 10 seconds to stabilize. Press MODE.

7. At **tc**, disconnect the millivolt source, and connect the reference compensator or T/C calibrator to Terminal #9 Negative, and Terminal #7 Positive on the 945 terminal strip. Allow 10 seconds to stabilize. The unit leaves CAL if 1 minute passes between key activations. Press ALARM CLEAR twice to exit the calibration mode. To conclude, advance to the next prompt or exit the CAL menu.

♫ **IMPORTANT:**

When the ALARM CLEAR LED is ON the unit is automatically calibrating. Your sequence is VERY important. Always move to the next parameter before changing the calibration equipment.

RTD Field Calibration Procedure

Equipment Required:
• 1KΩ precision decade resistance box with 0.01 ohms resolution.

Setup And Calibration ♪

1. Connect the AC line voltage L1, L2, and ground to the proper terminals.

2. Connect the decade resistance box to Terminal #4, 5 and 6 on the ter-minal strip. Use regular 20 - 24 gauge wire of the same length and type.

3. Apply power to the unit and allow warm up for 15 minutes. **After warm-up** put the unit in the CAL menu. See Page 14. Press MODE until **rLO** s displayed.

♫ 4. Press ALARM CLEAR twice to enter the calibration mode. The unit is calibrating when the ALARM CLEAR LED is ON. Make sure the LED is on **only** when you are in the correct parameters. See Figure 16.

5. At **rLO** set the decade resistance box to the correct low setting below. This can be calibrated to JIS or DIN. Allow 10 seconds to stabilize. Press MODE.

Table 4 - RTD Settings.

	Calibration	Low	High
945A-2XX0-0000	1°	17.31	317.33
945A-3XX0-0000	0.1°	59.59	177.13

6. At **rHI**, set the decade resistance box to the correct high setting. Allow at least 10 seconds to stabilize. The unit leaves the CAL mode if 1 minute passes between key activations. Press ALARM CLEAR twice to exit the calibration mode. To conclude, advance the MODE key to the next prompt or exit the CAL menu.

0 - 5 Volt Input Field Calibration Procedure

Equipment Required:
• Precision voltage source 0-5 volt minimum range with 0.001 volt resolution.

Setup And Calibration

1. Connect the AC line voltage L1, L2, and ground to the proper terminals on the 945.

2. Connect the voltage/current source to Terminal #1 and #3 on the Series 945 terminal strip. Use regular 20 - 24 gauge wire.

3. Apply power to the unit and allow it to warm up for 15 minutes. **After warm-up** put the unit in the CAL menu. See Page 14. Press the MODE key until **OU** is displayed.

4. Press ALARM CLEAR twice to enter the calibration mode. The unit is calibrating when the ALARM CLEAR LED is ON. Make sure the LED is on **only** when you are in the correct parameters. See Figure 16.

5. At the **OU** parameter, set the voltage/current source to 0.000volts. Allow at least 10 seconds to stabilize. Press the MODE key.

6. At the **5U** parameter, set the voltage/current source to 5.000 volts. Allow at least 10 seconds to stabilize. The unit leaves the CAL mode if 1 minute passes between key activations. Press ALARM CLEAR twice to exit the calibration mode. To conclude the 0-5 Volt calibration, advance the MODE key to the next prompt or exit the CAL menu.

NOTE
Before calibration on an installed control, make sure all data and parameters are documented. See Setup and Operation Tables, Pages 12 and 13.

4-20mA Input Field Calibration Procedure

Equipment Required:
• Precision current source 0-20mA minimum range with 0.01 mA resolution.

Setup And Calibration

1. Connect the AC line voltage L1, L2, and ground to the proper terminals on the Series 945. Jumper for correct line voltage. See Chapter 2.

2. Connect the voltage/current source to Terminal #1 and #3. Jumper Terminal #2 to #3 on the Series 945 terminal strip. Use regular 20 - 24 gauge wire.

3. Apply power to the unit and allow it to warm up for 15 minutes. **After warm-up** put the unit in the CAL menu. See Page 14. Press the MODE key until **4A** is displayed.

4. Press the ALARM CLEAR key twice to enter the calibration mode. The unit is calibrating when the ALARM CLEAR LED is ON. Make sure the LED is on **only** when you are in the correct parameters. See Figure 16.

5. At the **4A** parameter, set the mA source to 4.00mA. Allow at least 10 seconds to stabilize. Press the MODE key.

6. At the **20A** parameter, set the voltage/current source to 20.00mA. Allow at least 10 seconds to stabilize. The unit leaves the CAL mode if 1 minute passes between key activations. Press ALARM CLEAR twice to exit the calibration mode. To conclude, advance the MODE key to the next prompt or exit the CAL menu.

IMPORTANT: When the ALARM CLEAR LED is ON the unit is automatically calibrating. Your sequence is VERY important. Always move to the next prompt before changing the calibration equipment.

Specifications

Control Mode
- High/Low limit.
- RS-422A,RS423A, or EIA-485 data communications available.

Operator Interface
- Membrane front panel.
- Dual, four digit 0.56" LED displays.
- MODE, UP, DOWN, and ALARM CLEAR keys.

Input
- Thermocouple, RTD, and electrical process input.
- Automatic cold junction compensation for thermocouple.
- RTD input 2 or 3 wire, platinum, 100 ohm @ 0°C software selectable, JIS curve #3916 (0.003916 Ω/Ω/°C) or DIN curve #3850 (0.003850 Ω/Ω/°C).
- Sensor break protection de-energizes control outputs to protect the system.
- Grounded or ungrounded sensors.
- °F, °C, or process variable units are user selectable.
- Operating ranges user selectable.

J t/c:	32	to	1382°F	or	0	to	750°C
K t/c:	-328	to	2282°F	or	-200	to	1250°C
T t/c:	-328	to	662°F	or	-200	to	350°C
N t/c:	32	to	2282°F	or	0	to	1250°C
C t/c:	797	to	4200°F	or	425	to	2315°C
PT2	32	to	2543°F	or	0	to	1395°C
1° RTD:	-328	to	1112°F	or	-200	to	600°C
0.1° RTD:	-99.9	to	392.0°F	or	-99.9	to	200.00°C
0-5VDC:	-500	to	3500 units				
4-20mA:	-500	to	3500 units				

Sonalert, Alarm 1, Output 1
- Switched DC (Open Collector), 500Ω minimum load resistance, 1KΩ load, 9mA minimum, 22mA maximum, non-isolated. Energized in alarm state.

Alarm 2, Output 2
- Electromechanical relay, Form A or B, 6A @ 115/230VAC, 6A @ 28VDC, 1/8 hp, @ 115 VAC, 125VA @ 115VAC. Off state impedance is 20KΩ minimum.

Alarm 2, Output 3
- Electromechanical relay, Form A or B, 6A @ 115/230VAC, 6A @ 28VDC, 1/8 hp @ 115VAC, 125VA @ 115VAC. Off state impedance is 20KΩ minimum.

Accuracy
- Calibration Accuracy and Sensor Conformity: ±0.1% of span, ± 1 LSD, 77°F ±5°F (25°C ±3°C) ambient and rated line voltage ± 10%.
- Accuracy Span: 1000°F or 540°C minimum.
- Temperature Stability: 0.1°F/°F (0.1°C/°C) change in ambient.
- Voltage Stability: ± 0.01% of span /% of rated line voltage.

Terminals
- #6 compression type screw terminals.

Communications
- Serial data communications.
- RS-422A or RS-423A (RS-232C compatible) or EIA-485.
- ANSI X3.28 protocol, or XON/XOFF protocol.
- Isolated.
- Data logging.
- #6 compression type screw terminals.

Power
- 120/240VAC + 10%, -15%, 50/60Hz, ± 5%.
- 16VA maximum.
- Data retention upon power failure via non volatile memory.

Operating Environment
- 32 to 149°F/0 to 65°C.
- 0 to 90% RH, non-condensing.

Dimensions
- Height: 3.8 in.   97 mm
- Width: 3.8 in.   97 mm
- Overall depth: 7.0 in.   178 mm
- Behind panel depth: 6.0 in.   153 mm
- Weight: 2.5 lb. max.   0.4 kg

Series 945 Model Number Information

The Series 945 Model Number, listed on your unit sticker, is defined below.

$$9\,4\,5\,A - 1\,C\,A\,2 - A\,J\,A\,P$$

Control
Series 945 =   1/4 DIN, single input,
High/Low limit, dual alarms,
dual digital displays.

Input Type
1   =   Type J, K, T, N, C, PT2 thermocouple
2   =   Type J, K, T, N, C, PT 2 thermocouple,
RTD 1°, 4-20mA, 0-5VDC
3   =   Type J, K, T, N, C, PT 2 thermocouple,
RTD 0.1°, 4-20mA, 0-5VDC

Alarm 1
Output 1 Type
C   =   Switched DC, (Open Collector), non-isolated

Alarm 2
Output 2 & 3 Type
2   =   Dual, Mechanical Relay, 6A, Form A or B

Communications
A   =   None
B   =   Isolated RS-423/RS-422
D   =   EIA-485