Instruction

MI 018-857
October 2018

743C SERIES

FIELD STATION MICRO Controller

Calibration and Maintenance

Schneider Electric™

Contents

Figures

Tables

Important Information

Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate, service, or maintain it. The following special messages may appear throughout this manual or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of either symbol to a "Danger" or "Warning" safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER
DANGER indicates a hazardous situation which, if not avoided, **will result in** death or serious injury.

⚠ WARNING
WARNING indicates a hazardous situation which, if not avoided, **could result in** death or serious injury.

⚠ CAUTION
CAUTION indicates a hazardous situation which, if not avoided, **could result in** minor or moderate injury.

NOTICE
NOTICE is used to address practices not related to physical injury.

Please Note

Electrical equipment should be installed, operated, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction, installation, and operation of electrical equipment and has received safety training to recognize and avoid the hazards involved.

1. Calibration

General Information

Reference Documents

Table 1. Reference Documents

Document	Description
MI 018-854	743C Series FIELD STATION MICRO Controllers - Installation

Frequency of Calibration

The inputs and outputs have been calibrated in the factory to an accuracy of ±0.1%. Normally these functions do not require recalibration unless:

- Components have been changed.
- RTD or frequency (if present) measurement range has been changed.
- Controller configuration (in NOVRAM) was copied from another controller.
- OUT 2 jumper (which is positioned at factory for 4 to 20 mA output) has been repositioned for 1to 5 V dc output. (Recalibration of OUT 2 may be required to retain specified accuracy.)

Calibration Equipment Accuracy

If the measurement transmitter is used as the calibrating mA input signal source, the transmitter must be in calibration. All calibration equipment (milliammeter, voltmeter, etc.) should have an accuracy of better than ±0.1%.

Structure Diagram for Calibration and Test

The input and output calibration procedures and the operational test procedure are contained in the structure diagram (Figure 4) shown in the Structure Diagram section. Where optional procedures are accessible, this is indicated in the diagram by vertical alignment of boxes separated by arrow keys (arrow keys are discussed the following sections). For example, the “SECURE CALIB?” box at the upper left of the diagram is vertically aligned with the “SECURE TEST?” box (at the bottom of the diagram). Also, the boxes have arrow keys between them. This indicates the option of entering either the Calibration or the Test mode.

Because the locations of these procedures are in the SECURE section of the operating structure, the security passcode is required to enter these sections.

Use of Keypad to Follow Structure

In the structure diagrams, the arrow keys (Δ and ∇) move the display up or down, and the ACK key moves the display forward horizontally [indicated by an arrow (→) on the diagrams].

At any time the display can be returned to the Normal Operating mode by pressing the TAG key.

Significance of Question Mark(?) in Display

If a question mark appears in the alphanumeric display (on the right side of the lower line), it signifies that an additional decision or action is required.

The action is either to acknowledge that the parameter shown is the desired one (by pressing the ACK key), or is not the desired one (by pressing the up- or down-arrow key to get to an alternate parameter). Or, if a value is called for, to either enter or change the value with the arrow keys.

Use of Arrow Keys to Adjust Values

The arrow keys are used to adjust values that are shown on the lower alphanumeric display line. The up-arrow is used to increase values, and the down-arrow is used to decrease values.

The digits are entered from right to left. If the up- or down-arrow key is continuously pressed, numbers in the next highest significant digit will change. Releasing and then pressing the key repeatedly causes the numbers to change by one unit (in a normal counting sequence) with each depression.

2. Calibration Procedures

The sequence of listing the calibration procedures (analog input, frequency input, and outputs) is the same sequence that is used in the operating structure, as shown in the Chapter 3, “Structure Diagram”. It is recommended that the user calibrate in this same sequence. If any parameter is not to be calibrated, it can be bypassed by using the down-arrow or ACK keys, as specified in the Structure Diagram.

Current or Voltage Inputs (IN 1, IN 2, IN 3 and IN 4)

The source of the calibrating signal (from either an external or internal source) determines if the EXTERNAL or INTERNAL calibration is used. The INTERNAL calibration allows the inputs to be calibrated with the controller in the panel.

Internal Calibration

Move display to INPUTS ANALOG? location in the Structure Diagram. Proceed to INTERNAL? display. Calibration input signals are generated internally and, when ACK key is pressed, calibration is completed for all four inputs (whether used or not). Accuracy of the internal input signal is ±0.1% of span.

External Calibration

1. Connect an adjustable input source (4 to 20 mA or 1 to 5 V, as applicable) to terminals of input being calibrated (input 1, 2, 3, or 4) as shown in Figure 1.

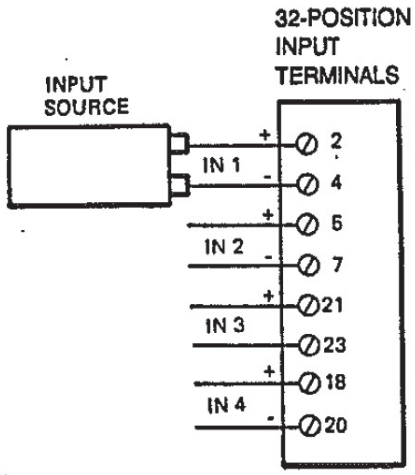
   [If the EXTERNAL calibrating signal detects an error, the controller will still use this value as 0 or 100% input. However, if the detected signal error exceeds ±4.5%, an error message (TOO HIGH or TOO LOW) will flash and the opportunity to recalibrate will be displayed again.]

2. Turn on controller power. Adjust input source to 4.000 mA or 1.000 V, as applicable, for 0% input signal.
3. Move display to INPUTS ANALOG? location. Proceed to ANALOG EXTERNAL? display. Follow the prompting which is summarized below.
4. Use ACK key to move to EXTERNAL IN 1 ZR? display.

   Press ACK key to implement 0% input signal (a 5-second countdown will elapse to allow controller to average input). IN 1 FS? will now appear on lower line.

5. Adjust input source to 20.000 mA or 5.000 V, as applicable, for 100% input signal.
6. Press ACK key to implement 100% input signal (a 5-second countdown will elapse to allow controller to average input).
7. Prompting on display for Input 2 (and then Inputs 3 and 4) is same as that for Input1. Complete this procedure for all four inputs.

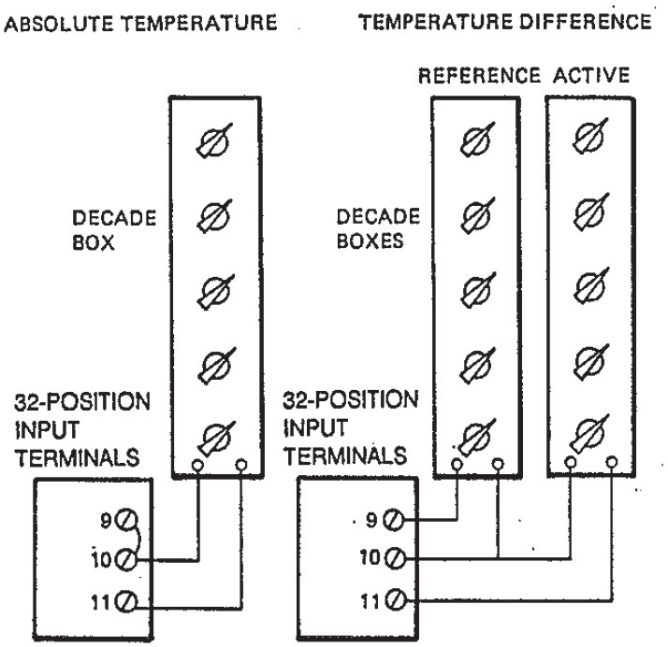
Figure 1. Terminal Connections for Current or Voltage Input Calibration



RTD Input

This calibration procedure is similar to the EXT calibration in the preceding section, except that the calibrating signals are resistances from a decade box. These resistances are applied to the terminals for absolute-temperature or for temperature-difference calibration, as shown in Figure 2.

Figure 2. Terminal Connections for Optional RTD Input Calibration



With absolute-temperature measurement, the resistances corresponding to 0 and 100% inputs can be determined from the IEC 100 or SAMA 100 curve, whichever is applicable. With temperature difference measurement, the 0 and 100% resistances listed in the applicable curve must be modified for use in the calibration procedure. (This modification is required to minimize the detected errors due to the non-compensation of the measurement.) See Chapter 4, "Controller Range Conversions" for this modification.

If the temperature range is being changed, the jumpers and potentiometers on the RTD printed wiring assembly (inside the controller) must be adjusted for the new range before calibrating the input. See Chapter 4, "Controller Range Conversions".

Frequency Inputs (F 1 and F 2)

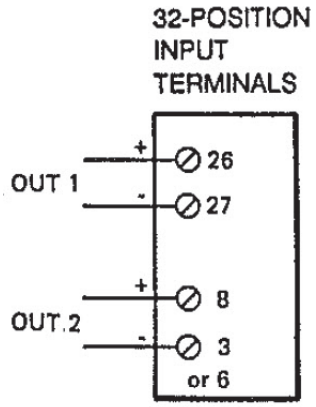
1. Move display to INPUTS FREQ? location in the Structure Diagram. Proceed to FREQ F 1? (for F 1 calibration) or FREQ F 2? (for F 2 calibration). Follow the prompting which is summarized below.
2. Press ACK key. The lower display line shows ZERO?. Press ACK key again (ZERO will move to top line).
3. Use arrow keys to enter on lower display line frequency corresponding to 0% input. Press ACK key to implement 0% calibration.
4. The lower display line now shows FS? (full scale). Press ACK key (FS will move to top line). Use arrow keys to enter on lower display line frequency corresponding to 100% (full scale) input. Press ACK key to implement 100% calibration. Note that maximum full-scale input is 9999 Hz.
5. If F 1 was just calibrated, F 2 will now appear on lower line. If F 2 is to be calibrated, repeat procedure beginning with Step 2.

OUT1 and OUT 2 (Auxiliary Output)

1. If OUT 1 is being calibrated, connect a 0 to 20 mA milliammeter to terminals indicated in Figure 3.

   OUT 2 is jumper-selectable for either 1 to 5 V dc or 4 to 20 mA dc (non-isolated). To calibrate OUT 2, connect a 0 to 5 V dc voltmeter or 0 to 20 mA ammeter, as applicable, to terminals indicated in Figure 3.

Figure 3. Terminal Connections for Output Calibration



2. Turn on controller power. Move display to CALIB OUTPUTS? location in the Structure Diagram. If OUT 1 is being calibrated, proceed to OUT 1? location. If OUT 2 is being calibrated, proceed to OUT 2? location. Follow display prompts as summarized below.
3. Press ACK key. ZERO will appear on upper display line. Use arrow keys to adjust meter reading to 0% controller output. For OUT 1, reading should be 4.000 mA. For OUT 2, reading should be 1.000 V or 4.000 mA, depending on the jumper position.

Press ACK key to implement this value. FS (full scale) will appear on lower display line.

4. Use arrow keys to adjust meter reading to 100% controller output. For OUT 1, reading should be 20.000 mA. For OUT 2, reading should be 5.000 V or 20.000 mA, depending on the jumper position. Press ACK key to implement this value.

NOTE

After desired reading appears on output meter, a value of 750 ±135 (for 0%) or 3750 ±135 (for 100%) will appear on lower line of display. These values can be used to verify that the calibrating signals are valid.

3. Structure Diagram

Each block in the Structure Diagram represents an alphanumeric display on the face of the controller. The Δ and ∇ symbols n this diagram refer to vertical movement using the up- and down-arrow keys. Conventional flow arrows (→) indicate step- by-step forward movement through the structure using the ACK key. The Structure Diagram for calibration and test procedures is shown in Figures 4 and 5.

Figure 4. Calibration and Test Structure Diagram_Part1

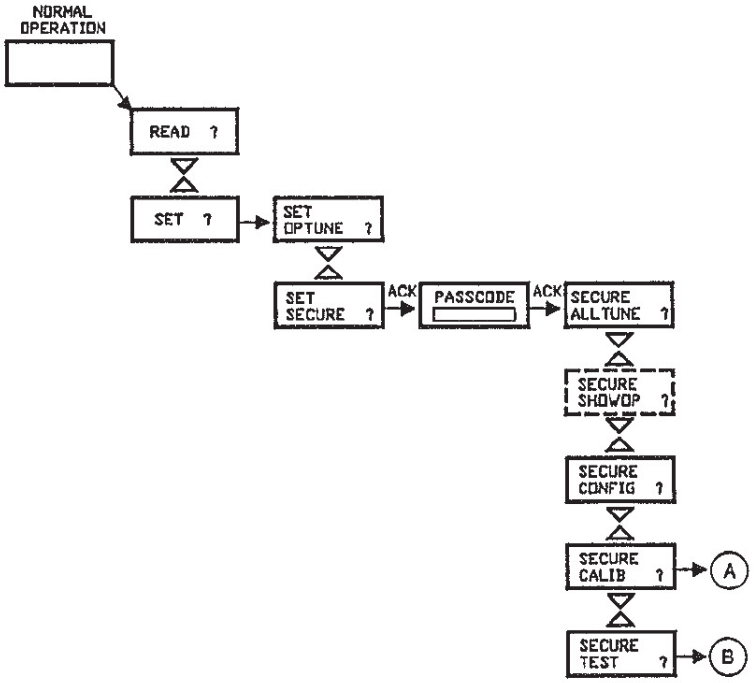
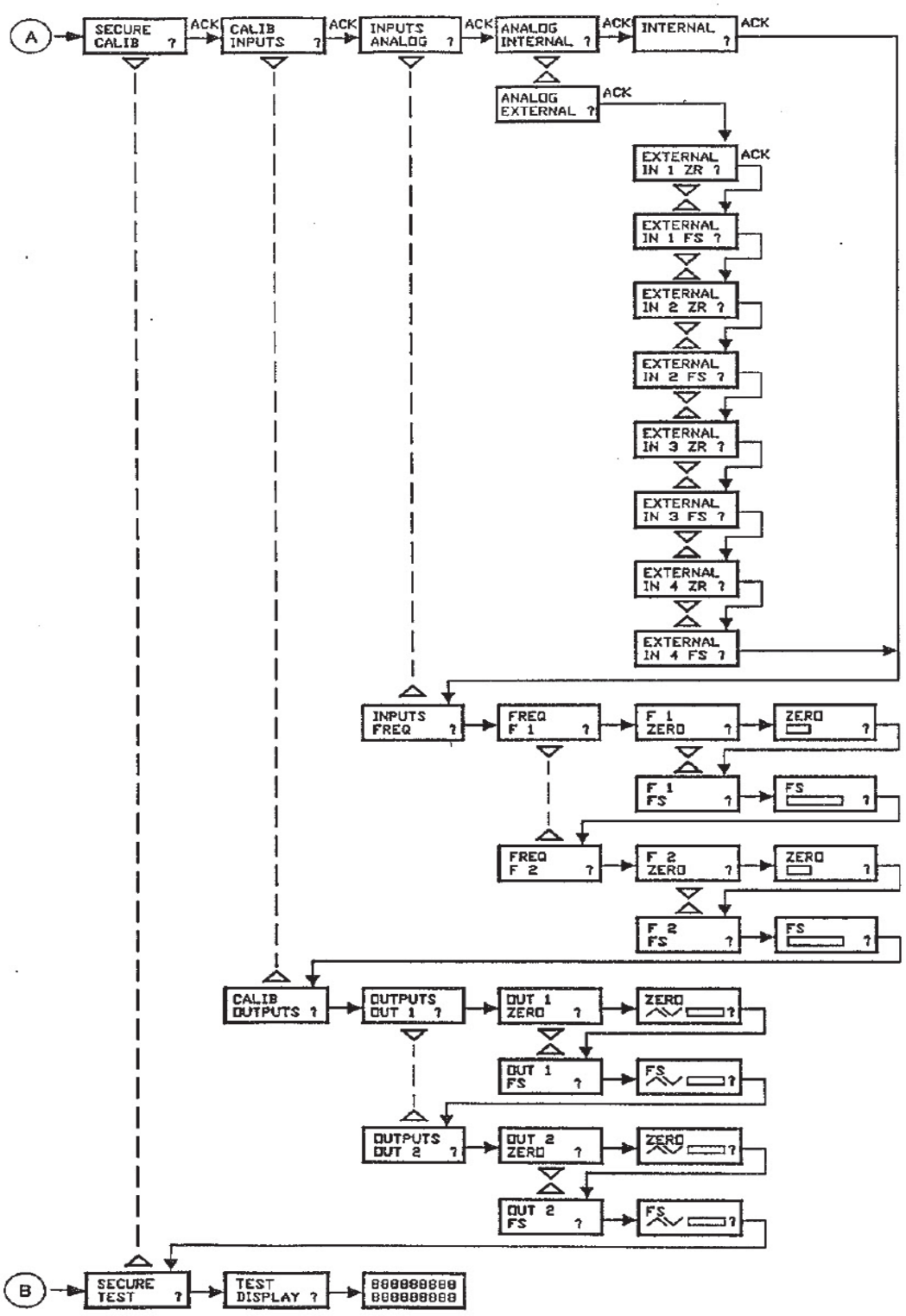


Figure 5. Calibration and Test Structure Diagram_Part2



4. Controller Range Conversions

Auxiliary Output (OUT 2) Range

The auxiliary output range is link-selectable for either 1 to 5 V dc, non-isolated. The link is located on the main PWA, as shown in Figure 6.

Before repositioning the link, turn off the power switch and disconnect the transmitter from the power source. Refer to Table 2 and reposition the link for the desired output range.

⚠ CAUTION
POTENTIAL EQUIPMENT DAMAGE Disconnect power from controller before repositioning link. Repositioning link with power connected can result in damage to components. **Failure to follow this instruction can result in equipment damage.**

Figure 6. Auxiliary Output Link Location

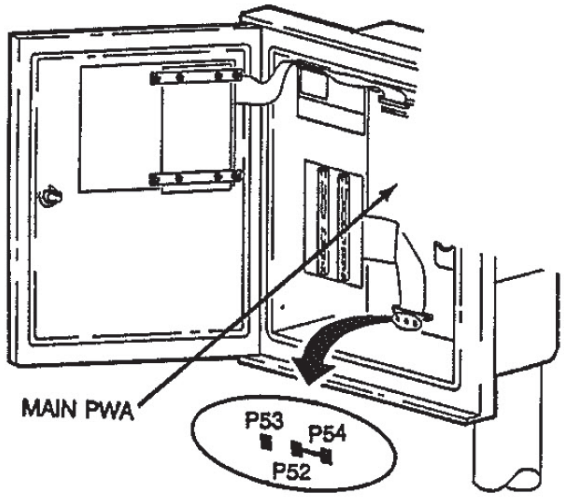


Table 2. Auxiliary Output Link Positions

Output Range	Link Range
1 to 5 V dc	P52-P54
4 to 20 mA dc	P52-P53

Current or Voltage Input Ranges

This procedure can be used to convert input ranges to accept current or voltage inputs.

If power source is connected to the controller, turn off the switch and disconnect the power.

To convert from 4 to 20 mA dc (standard) input range to 1 to 5 V dc input range, snip out the controller input resistor. Input resistor locations are shown in Figure 6. Repeat this procedure for each input being converted.

NOTE

The input resistors are located on the back side of the Input Terminals Assembly. For access to the resistors remove the four screws from the corners of the assembly.

To return from converted 1 to 5 V dc input ranges to 4 to 20 mA input ranges, obtain a wire-wound, 250 Ω (±0.1%), 2 W resistor for each input being converted. Resistors are available as Part No. N0986FK.

Solder one of the resistors across the "+" and "-" input leads of an input that is being converted as shown in Figure 7. Repeat the procedure for each input that is to be converted.

Figure 7. Adapting Input Terminals for 1 to 5 V dc

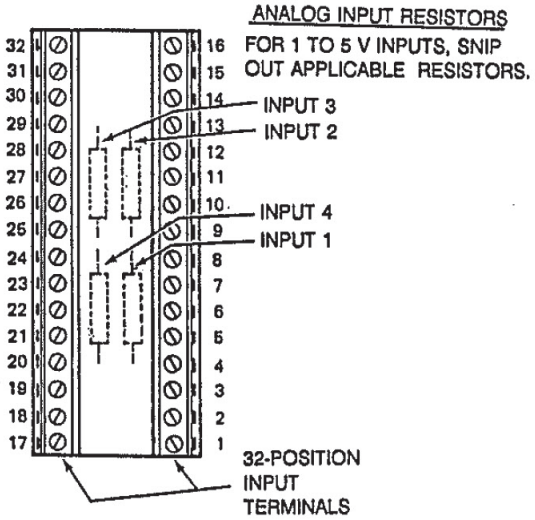
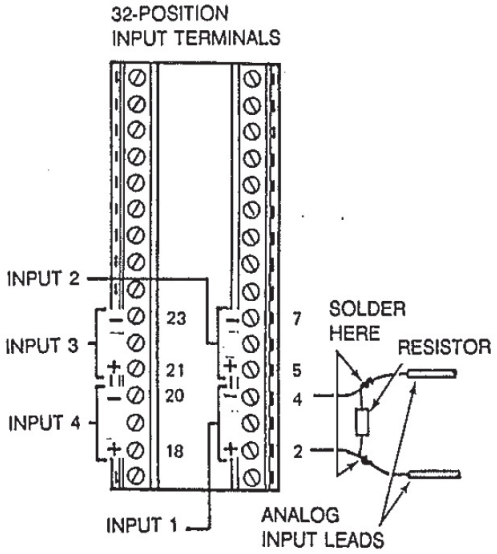


Figure 8. Adapting Input Terminals for 4 to 20mA dc



Optional RTD Input Range

When the RTD input range is changed, it may be necessary to make changes in jumper positions and/or potentiometer adjustments on the RTD printed wiring assembly (PWA) inside the controller.

Use IEC 100 or SAMA 100 curves (refer to TI 005-028 or 5-27a, whichever is applicable) to determine resistances corresponding to the desired temperature range limits.

Preliminary Steps

1. Open the controller door. If power has been applied to the controller, turn off the controller switch.
2. Connect one decade box (for absolute temperature measurement) or two decade boxes (for temperature-difference measurement) to controller terminals as shown in Figure 8.
3. Refer to Figure 9. On PWA, connect 0 to 12 V voltmeter to pins 9 (+) and 1 (-). Use miniature hook clips or internal pin connectors to make connections.
4. On PWA, connect Jumpers J1, J3, and J4 as specified in Figure 9 and Tables 2 through 4. (Jumper J4 is used only with temperature-difference measurement.)
5. On PWA, turn ZERO and SPAN Potentiometers (R27 and R28) to middle of their adjustments (about 15 turns in from either end of adjustment).
6. Turn on controller power switch. Continue with applicable procedure (absolute temperature or temperature difference) that follows.

Figure 9. Decade Box Connections to Change Optional RTD Input Range

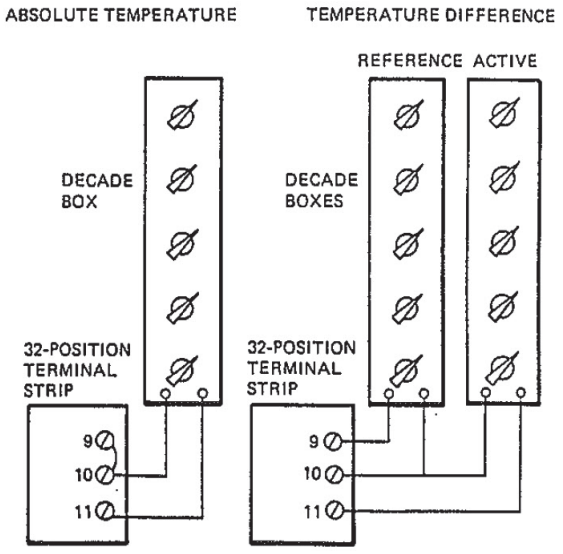


Figure 10. Jumper Positions on Optional RTD PWA

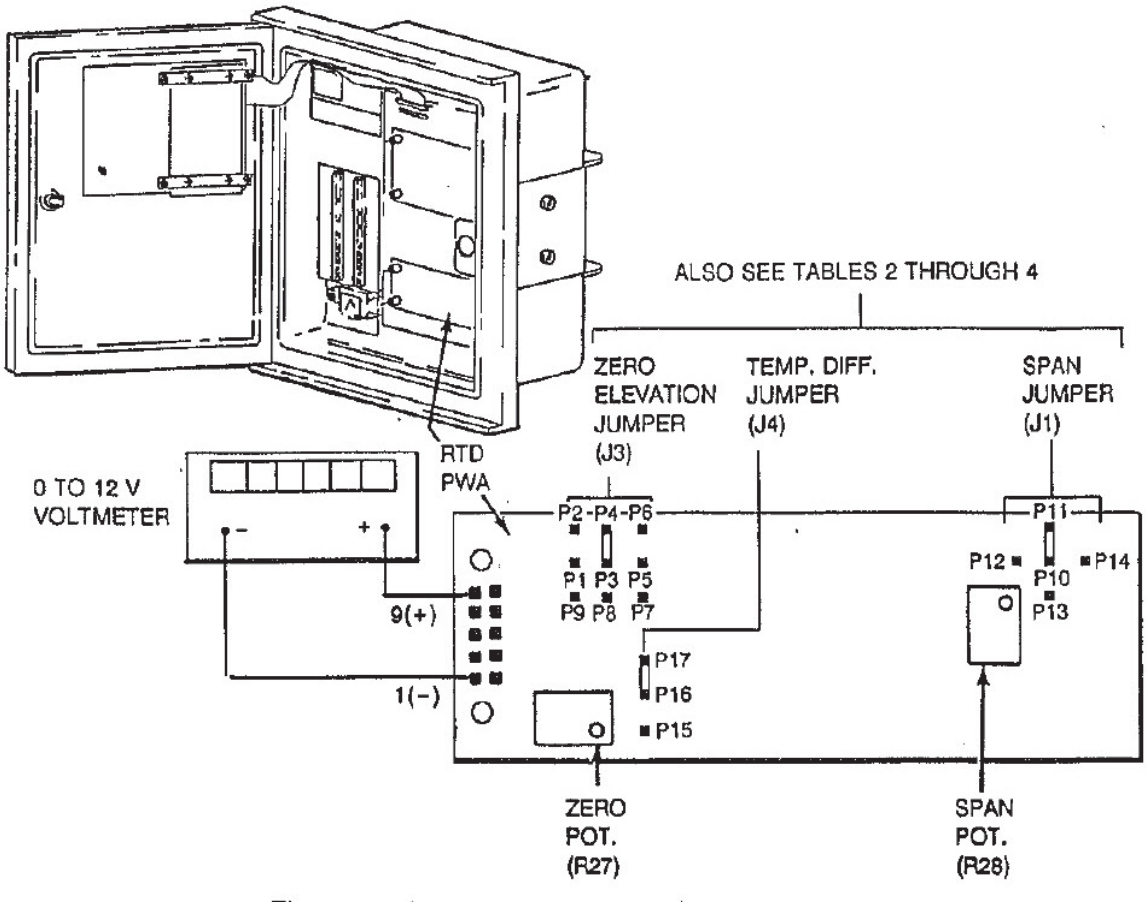


Table 3. RTD Zero Elevation Jumper Positions

Lower Range Value Temperature		Jumper Position (a) (J3)
°F	°C	
Above 1170	Above 630	P1 - P2
800 to 1170	425 to 630	P3 - P4
450 to 800	230 to 425	P5 - P6
125 to 450	55 to 230	P5 - P7
-180to +125	-120to +55	P3 - P8
-325 to -150	-200 to -100	P1 - P9

a. With temperature-difference measurement, put jumper in P1- P9 position.

Table 4. RTD Temperature-Difference Jumper Positions

Reference Temperature	Jumper Position(J4)
Greater than Lower Range Value	P15 - P16
Less than Lower Range Value	P16 - P 17

Table 5. RTD Span Jumper Positions

Temperature °F	Span Limits °C	Jumper Position (J1)
200 and 300	111 and 167	P10 - P11
300 and 500	167 and 278	P10 - P12
500 and 900	278 and 500	P10 - P13
900 and 1800	500 and 1000	P10 - P14

Absolute-Temperature Measurement

1. Do the previous "Preliminary Steps."

   In Steps 2 and 3 below, E_1 and E_2 must be between -4 and +12 V. If either is outside of these limits, adjust ZERO Potentiometer (R27) so that value is between these limits.

2. Set decade box to resistance corresponding to URV (upper-range value). Record reading of voltmeter; this is E_2 in equation in Step 4.
3. Set decade box to resistance corresponding to LRV (lower range value). Record reading of voltmeter; this is E_1 in equation.
4. Calculate E_3 in equation

   $$E_3 = (4)(E_2)/E_2\text{-}E_1$$

5. Set decade box at URV, and adjust SPAN Potentiometer (R28) so that voltmeter reads E_3.
6. Set decade box at LRV, and adjust ZERO Potentiometer (R27) so that voltmeter reads 1.000 ± 0.004V.
7. Set decade box at URV. If voltmeter does not read 5 ± 0.01 V, adjust SPAN Potentiometer (R28) to get correct reading. Repeat Steps 6 and 7 until reading is satisfactory.
8. Calibrate Input IN 1 (see Calibration Procedures).

Temperature-Difference Measurement

1. Ascertain that new range meets following limitations:
   a. Reference temperature (TREF) cannot be higher than midpoint between LRV and URV.
   b. Temperature difference (T) cannot be less than 200F (111C).
2. Do the previous "Preliminary Steps".

   In Steps 4 and 5 below, E1 and E2 must be between -4 and +12 V. If either is outside of these limits, adjust ZERO Potentiometer (R27) so that value is between these limits.

3. Set reference decade box to resistance corresponding to lower range value (R_{LRV}).

   Set measurement decade box to resistance corresponding to upper range value (R_{URV}).

4. Record voltmeter reading; this is E_2 in equation in Step 6.
5. Set both decade boxes at R_{LRV}. Record voltmeter reading; this is E_1, in equation.
6. Solve for E_3 in equation

   $E_3=(4)(E_2)/E_2-E_1$
7. Set each decade box to value specified in Step 3. Adjust SPAN Potentiometer (R28) so that voltmeter reads E_3.
8. Set both decade boxes to R_{REF}. Adjust ZERO Potentiometer (R27) so that voltmeter reads Y, where

   $Y=1+[T_{REF}-T_{LRV}/T_{URV}-T_{LRV}](4)$

   EXAMPLE: TLRV=-50F, TURV=150F, and TREF=50F[note that TREF is at middle (50%) of span].

   $Y=1+[50-(-50)/150-(-50)](4)=3V$
9. Calibrate input IN 1. Use $R_{0\%}$ and $R_{100\%}$ calculated in the following equations as the calibrating resistances for zero and full-scale, respectively.

To Calculate Calibrating Resistance

Temperature-difference is an uncompensated, nonlinear measurement. To minimize the detected error due to this nonlinearity, when calibrating the RTD input, the R_{URV} and R_{LRV} values used in the procedure above must be modified as shown in the equations below.

$$R_{0\%}=R_{REF} - (R_{URV} - R_{LRV})[T_{REF} - T_{LRV}/T_{URV} - T_{LRV}]$$

$$R_{100\%}=R_{REF} + (R_{URV} - R_{LRV})[T_{URV} - T_{REF}/T_{URV} - T_{LRV}]$$

5. Maintenance

General Information

The maintenance of 743C Series Controllers is limited to miscellaneous tests and checks, and replacement of the parts listed below. For part numbers, see Parts List 009-168.

- Power Fuse
- Memory Module (NOVRAM)
- 3 Memory Chips (ROMs)
- Display Assembly
- Keypad Assembly
- Power Transformer Assembly
- Optional RTD PWA
- Optional Output Isolation PWA
- Optional Surge Suppressor
- Various Plug-In Cables
- Miscellaneous Mechanical Parts

Miscellaneous Tests And Procedures

Replacement of Fuse

If the controller faceplate has no illumination (including the detected malfunction indicator light), it may indicate that the controller power switch has not been turned on, the power supply external to the controller has been interrupted, or the fuse inside the controller has opened.

If the controller power switch is on and the external power supply is intact, check the fuse. If necessary, replace it. To expose the fuse, open the controller door. The fuse is located near the upper left inside corner of the controller (next to the on/off switch). Replace it with the applicable slow-blow fuse in Table 6.

Table 6. Controller Power Fuses

Supply Voltage	Current	Fuse Part No.
24 V ac or dc 120 V ac 220, 240V ac	2A 0.5 A 0.3 A	C3510KX C3510KP P0156BM

Display Test

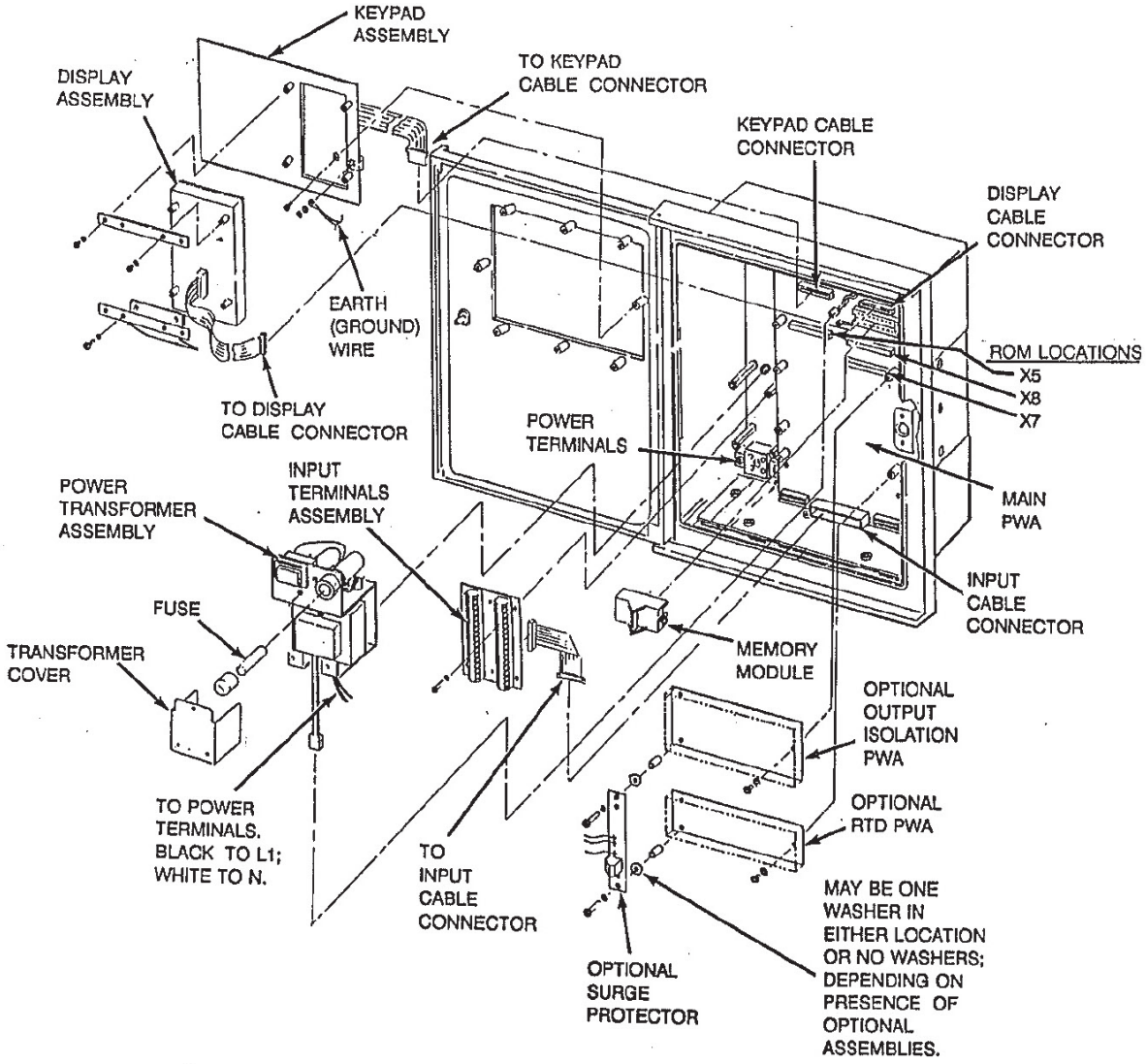
This test checks that all portions of the display can be illuminated.

The test is located at the end of the Structure Diagram. The display will show DISPLAY in the lower line. When the ACK key is pressed, if any segment of the display (except the detected controller failure indicator) is not illuminated, that segment is malfunctioning.

Disassembly Details

Figure 11 is essentially self-explanatory in showing how parts are removed and reinstalled. Refer to applicable sections that follow for additional details.

Figure 11. Controller Assembly Diagram



Precautions when Replacing ROMs

The ROMs, which are MOS devices, are very susceptible to damage from electrostatic discharge, and precautions must be taken to help protect them from potentials greater than 100 V. Procedures have been established for the storage and handling of these products to help prevent electrostatic build-up, and you must follow the recommended practices.

The ROMs (and the NOVRAM) are packed in a special conductive bag. They should be stored in this bag until they are to be installed. Because the NOVRAM is subject to more handling than the ROMs, is factory-encased in a conductive holder for additional protection.

Display Assembly Replacement

1. Be certain that the power source has been disconnected from the transmitter.
2. Refer to Figure 11. Unplug the cable from the socket in the display assembly.
3. Unscrew the four outermost screws in the display-assembly mounting brackets and lift the assembly off the keypad assembly.
4. Remove the remaining four screws from the mounting brackets.
5. To install the new display assembly, reverse this procedure.

Keypad Assembly Replacement

1. Be certain that the power source has been disconnected from the transmitter.
2. Refer to Figure 11. Remove the display assembly from the keypad assembly by removing the four outermost screws in the display-assembly mounting brackets.
3. Note the dressing of the keypad ribbon cable inside the controller. Unplug the cable from the main PWA and remove from the cable clip.
4. Loosen all eight mounting clips around the edge of the keypad assembly.
5. Remove as many mounting clips as required to lift the keypad assembly from the controller door and remove the keypad assembly.
6. To install the new keypad assembly, reverse this procedure.

Power Transformer Assembly Replacement

1. Be certain that the power source has been disconnected from the transmitter.
2. For access to the transformer power wires, the Input Terminals Assembly must be removed (see Figure 11). To remove it, remove the four mounting screws.
3. Remove the protective cover from the power terminals (below the Input Terminals Assembly). Loosen the two terminal screws holding the black and white transformer wires and remove the wires.
4. Snip the wire strap that holds the transformer wires together. Take note of the location of the wire strap on the wires so the new one can be installed in the same location.

NOTE

User must provide a new wire strap when installing transformer.

5. Unplug the remaining (secondary) transformer wires.
6. Remove the cover from the transformer.
7. Unscrew the two screws in the core of the transformer and lift the transformer assembly out of the transmitter.
8. The new transformer assembly has a nut attached to each of the mounting screws (in the transformer core) to hold them in place. Remove these nuts from the screws.
9. Position the new transformer assembly in the transmitter so that the guide tabs on the back of the assembly are inserted into the guide slots in the transmitter base.
10. Screw the assembly into the transmitter base.
11. To complete the procedure, do Steps 2 through 6 in reverse order. When connecting the transformer power wires to the power terminals, connect the black wire to the terminal labeled 'L' and the white wire to the terminal labeled 'N'. A wire strap must be provided and installed by the user as indicated in Step 4.

⚠ CAUTION

RISK OF LOSING CERTIFICATION

A wire strap must be installed on the transformer wires as mentioned in Step 4. Failure to install the wire strap may void product safety certification.

Failure to follow these instructions can cause injury or equipment damage.

Optional Surge Protector Replacement

1. Remove the surge protector wires from terminals 22, 24, and 25 of the Input Terminals Assembly (shown in Figure 11).
2. Remove the two mounting screws and associated hardware from the surge protector.
3. Install the new surge protector using the hardware removed in Step 2.
4. Dress the surge protector wires behind the Input Terminals Assembly. The wires are labeled 22, 24, and 25 on the surge protector PWA. Connect these wires to input terminals 22, 24, and 25 respectively. For details of surge protector Input wiring, see Instruction Ml 018-854.

Optional RTD or Isolated Output Printed Wiring Assembly (PWA) Replacement

These optional PWAs are installed side-by-side on the main PWA (see Figure 11). Observe the following details when either option is an original field installation:

1. If the transmitter has an optional surge protector, the surge protector must first be removed. For details, see the preceding section (it is not necessary to disconnect the surge protector wires from the input terminals).
2. Remove jumper from socket of PWA being installed. Save jumper so it can be reinstalled later if RTD option is to be removed.
3. Plug PWA into its socket. If a surge suppressor was removed in Step 1, return it to its installed position. Reinstall the mounting hardware.

Replacement of Other Parts

The procedures to remove and reinstall other replaceable parts will be obvious from Figure 11. Before removing a plug-in cable take note of its routing for correct reinstallation.

ISSUE DATES

MAY 1992
AUG 1992
OCT 2018

Vertical lines to the right of text or illustrations indicate areas changed at last issue date.

Schneider Electric Systems USA, Inc.
38 Neponset Avenue
Foxboro, MA 02035
United States of America
http://www.schneider-electric.com

Global Customer Support
Inside U.S.: 1-866-746-6477
Outside U.S.: 1-508-549-2424
https://pasupport.schneider-electric.com