RTD EXPANDER BOARD
MYCRO 383 MULTI-POINT DISPLAY STATION

INSTRUCTION INVOLVED
SD383, MYCRO 383 Multi-Point Display Station, Installation and Service Instruction, issue 1.

SUBJECT
RTD Expander Board

INTRODUCTION
An RTD Expander Board, shown in Figure 1, may be added to a Model 383B Multi-Point Display Station equipped with 40 screw terminals at the rear of the station, or it may be ordered as part of the Model 383R RTD Input Station.

The Board is capable of processing low level voltages over a range of -300°F to 1200°F (-185°C to 650°C) from a 100 Ω platinum resistance temperature detector (RTD). Temperature values can be displayed either as a percentage of the full-scale temperature value or directly in degrees Fahrenheit or Celsius (F or C appears in the alphanumeric display).

SPECIFICATIONS
RTD Expander Board:

- RTD Types: Platinum, 100 Ω, US or DIN
- Range Limits: -300°F to 1200°F (-185°C to 650°C)
- Low Range: -300°F to 800°F (-185°C to 430°C)
- High Range: -275°F to 1200°F (-170°C to 650°C)
- Span: 25°F to 1200°F (14°C to 665°C)
- Accuracy: ±0.2°F for spans less than 200°F
- ±0.1% of span for spans greater than 200°F
- Ambient Temperature Effect (100°F change): ±1°F, less than ±0.75% of span
- Overvoltage Protection: ±30 Vdc
- Input Impedance: 1 Megohm minimum
- Update Rate: 500 msec
- Normal Mode Rejection: 6 dB @ 2 Hz; 60 dB @ 60 Hz

MOORE PRODUCTS CO., Spring House, Pa. 19477
INSTALLATION

Install an RTD Expander Board according to the directions in SD383, section 2.6.3, Expander Board. No jumper-plugs or switches have to be set.

IMPORTANT

The current RTD Expander Board has software level BBA. It must be installed in an MPU Base Board with same software level. If Base Board is level BAA, upgrade it to level BBA by replacing U20 with a new PROM (order P/N 16040-108).

WIRING GUIDELINES

Refer to Figure 2 for typical 2-wire, 3-wire, and 4-wire RTD wiring connections.

All electrical connections are made to the terminals at the rear of the Station. Refer to Figure 2-4 in SD383 for rear terminal locations; Table 1 shows their assignments for the MYCRO 383R RTD Input Station.

<table>
<thead>
<tr>
<th>REAR TERMINAL</th>
<th>RTD ASSIGNMENT</th>
<th>REAR TERMINAL</th>
<th>RTD ASSIGNMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>Excitation 1</td>
<td>D1</td>
<td>Excitation 5</td>
</tr>
<tr>
<td>C2</td>
<td>(+) Input 1</td>
<td>D2</td>
<td>(+) Input 5</td>
</tr>
<tr>
<td>C3</td>
<td>(-) Common 1 &amp; 2</td>
<td>D3</td>
<td>(-) Common 5 &amp; 6</td>
</tr>
<tr>
<td>C4</td>
<td>(+) Input 2</td>
<td>D4</td>
<td>(+) Input 6</td>
</tr>
<tr>
<td>C5</td>
<td>Excitation 2</td>
<td>D5</td>
<td>Excitation 6</td>
</tr>
<tr>
<td>C6</td>
<td>Excitation 3</td>
<td>D6</td>
<td>Excitation 7</td>
</tr>
<tr>
<td>C7</td>
<td>(+) Input 3</td>
<td>D7</td>
<td>(+) Input 7</td>
</tr>
<tr>
<td>C8</td>
<td>(-) Common 3 &amp; 4</td>
<td>D8</td>
<td>(-) Common 7 &amp; 8</td>
</tr>
<tr>
<td>C9</td>
<td>(+) Input 4</td>
<td>D9</td>
<td>(+) Input 8</td>
</tr>
<tr>
<td>C10</td>
<td>Excitation 4</td>
<td>D10</td>
<td>Excitation 8</td>
</tr>
</tbody>
</table>

NOTES:
1. An Expander Board is required to accept RTD inputs.
2. Up to 8 separate inputs may be configured under function blocks FB18 through FB25.
3. Resistance inputs of 100 to 200 Ohms are applied across each set of 3 terminals.
4. Figure 2 shows wiring diagrams for 2-wire, 3-wire, and 4-wire RTDs.
FIGURE 2 RTD Connections

2-WIRE CONNECTION

3-WIRE CONNECTION

4-WIRE CONNECTION
CALIBRATION

An RTD Expander Board is calibrated at the factory when it is shipped with a Model 383R RTD Input Station. Recalibration should not be required unless the Expander Board or the Base Board is replaced; however, initial calibration is necessary if the user installs an RTD Expander Board in a Model 383B Multi-Point Display Station. Periodic recalibration is not necessary.

This section contains a list of required equipment and the procedure for calibrating an RTD Expander Board to accept low level input voltages over a range from -300°F to 1200°F (-185°C to 650°C) from a 100 Ω platinum resistance temperature detector. Inputs to the RTD Expander Board are calibrated under function blocks FB18 through FB25. The calibration parameters and related values are shown in Table 2.

The engineering units (°F or °C), type of curve (DIN or US), and actual operating temperature range are entered as soft (‘S’) configuration parameters after calibration is completed. Refer to AD383-10, User’s Manual, for the configuration procedure.

IMPORTANT

When setting the soft (‘S’) configuration parameter SFB (filter breakpoint frequency), rotate the Pulser Knob to select 10.00 Hz for the shortest response time.

When configuration and calibration are complete, each function block outputs a scaled and linearized signal using the values entered in configuration, so that the 0-100% signal represents a specific operating range.

REQUIRED EQUIPMENT

Calibration of an RTD Expander Board requires the use of the following equipment:

1. Model 383R RTD Input Station or Model 383B Multi-Point Display Station with MPU Base Board and RTD Expander Board Installed.

2. A resistance decade box capable of providing the Zero Input (100.00 Ω) and the Full Scale (200.00 Ω) resistance values.

3. Three 2-foot lengths of 18 gauge (AWG) insulated copper wire for connecting the decade box to the RTD input terminals. Install a solder-on spade terminal at each wire end that connects to the Station’s terminal screw.

Insure that all connections at both the box and the Station have minimum contact resistance. The three equal lengths of 18-gauge (AWG) wire provide equal resistance in each lead of the three wire hook-up.
PROCEDURE

The calibration procedure involves storing the Zero Input value of 100.00 Ω and the Full Scale Input value of 200.00 Ω into the Base Board memory.

IMPORTANT

Do not use alligator clips to make connections on either end, since contact resistance can alter the calibration accuracy.

1. Obtain or fabricate eight 3" to 6" long jumper wires having soldered-on spade terminals on each end.

2. Connect such a jumper wire between 'Excitation' and the '(+) Input' terminal of each RTD input channel (see Table 1, Rear Terminal Assignments).

3. Verify that the Base Board's 'C' (calibration) mode switch is enabled. Refer to Figure 5-3 in SD383.

4. Verify Station's input power requirement. Apply power to station. Allow the station to warm up for one hour before proceeding with the remaining calibration steps.

   NOTE

   For maximum accuracy, the Station (with jumpers installed per steps 1 and 2 above) should be powered-up for 16 hours prior to performing the calibration.

5. Consult Table 2 for the rear terminal connections for the function block to be calibrated.

   IMPORTANT

   Make sure NOT to disconnect (even momentarily) any of the eight jumper wires installed in step 2 while performing the calibration.

6. Connect the resistance decade box, via the three 2 foot wires and using the 3-wire connection (see Figure 2), to the 'Excitation', '(+) Input', and '(-) Common' terminals of the first RTD channel to be calibrated.

7. At these same RTD terminals, carefully disconnect one side of the previously installed jumper wire without disturbing the decade box connections.

8. Press ENTER CONF button to enter configuration at MENU level.

9. Rotate Pulser Knob to select 'C' (calibration) mode on left digit position of alphanumeric display. If 'CX' appears in the display, the lockout switch on the Base Board must be enabled.
<table>
<thead>
<tr>
<th>RTD#</th>
<th>FB#</th>
<th>CALIB. PARAM.</th>
<th>CALIBRATION DESCRIPTION</th>
<th>CALIBRATION VALUE</th>
<th>REAR TERMINALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>18</td>
<td>CZ18</td>
<td>Zero Input</td>
<td>100.00 Ohms</td>
<td>C1 Exc</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CF18</td>
<td>Full Scale</td>
<td>200.00 Ohms</td>
<td>C2 In (+)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CV18</td>
<td>Verify Input</td>
<td>-3.3 - 103.3%</td>
<td>C3 Comm</td>
</tr>
<tr>
<td>2</td>
<td>19</td>
<td>CZ19</td>
<td>Zero Input</td>
<td>100.00 Ohms</td>
<td>C5 Exc</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CF19</td>
<td>Full Scale</td>
<td>200.00 Ohms</td>
<td>C4 In (+)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CV19</td>
<td>Verify Input</td>
<td>-3.3 - 103.3%</td>
<td>C3 Comm</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>CZ20</td>
<td>Zero Input</td>
<td>100.00 Ohms</td>
<td>C6 Exc</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CF20</td>
<td>Full Scale</td>
<td>200.00 Ohms</td>
<td>C7 In (+)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CV20</td>
<td>Verify Input</td>
<td>-3.3 - 103.3%</td>
<td>C8 Comm</td>
</tr>
<tr>
<td>4</td>
<td>21</td>
<td>CZ21</td>
<td>Zero Input</td>
<td>100.00 Ohms</td>
<td>C10 Exc</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CF21</td>
<td>Full Scale</td>
<td>200.00 Ohms</td>
<td>C9 In (+)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CV21</td>
<td>Verify Input</td>
<td>-3.3 - 103.3%</td>
<td>C8 Comm</td>
</tr>
<tr>
<td>5</td>
<td>22</td>
<td>CZ22</td>
<td>Zero Input</td>
<td>100.00 Ohms</td>
<td>D1 Exc</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CF22</td>
<td>Full Scale</td>
<td>200.00 Ohms</td>
<td>D2 In (+)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CV22</td>
<td>Verify Input</td>
<td>-3.3 - 103.3%</td>
<td>D3 Comm</td>
</tr>
<tr>
<td>6</td>
<td>23</td>
<td>CZ23</td>
<td>Zero Input</td>
<td>100.00 Ohms</td>
<td>D5 Exc</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CF23</td>
<td>Full Scale</td>
<td>200.00 Ohms</td>
<td>D4 In (+)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CV23</td>
<td>Verify Input</td>
<td>-3.3 - 103.3%</td>
<td>D3 Comm</td>
</tr>
<tr>
<td>7</td>
<td>24</td>
<td>CZ24</td>
<td>Zero Input</td>
<td>100.00 Ohms</td>
<td>D6 Exc</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CF24</td>
<td>Full Scale</td>
<td>200.00 Ohms</td>
<td>D7 In (+)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CV24</td>
<td>Verify Input</td>
<td>-3.3 - 103.3%</td>
<td>D8 Comm</td>
</tr>
<tr>
<td>8</td>
<td>25</td>
<td>CZ25</td>
<td>Zero Input</td>
<td>100.00 Ohms</td>
<td>D10 Exc</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CF25</td>
<td>Full Scale</td>
<td>200.00 Ohms</td>
<td>D9 In (+)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CV25</td>
<td>Verify Input</td>
<td>-3.3 - 103.3%</td>
<td>D8 Comm</td>
</tr>
</tbody>
</table>
10. To set in Zero Input value:

A. Press STEP DOWN button to enter FUNCTION BLOCK level and rotate Pulser Knob to select the desired two-digit number of the function block undergoing calibration.

B. Press STEP DOWN button to enter PARAMETER level and rotate Pulser Knob until ‘CZx’ appears in alphanumeric display, where xx is the selected FB number.

C. Press STEP DOWN button to enter VALUE level; ‘CAL’ appears in 4-1/2 digit display.

D. Switch the resistance decade box to 100.00 Ω.

E. Wait at least 15 seconds to allow the hardware filter voltage to stabilize before proceeding to the next step.

F. Press STORE button to lock in desired value; ‘CAL’ blinks when value is stored.

12. To set in Full Scale Input value:

A. Press STEP UP button to enter the PARAMETER level and rotate Pulser Knob to select ‘CFxx’ on alphanumeric display, where xx is the selected FB number.

B. Press STEP DOWN button; ‘CAL’ appears in 4-1/2 digit display.

C. Switch the resistance decade box to 200.00 Ω.

D. Wait at least 15 seconds to allow the hardware filter voltage to stabilize before proceeding to next step.

E. Press STORE button to lock in desired value; ‘CAL’ blinks when value is stored.

13. To verify calibration:

A. Press STEP UP button to enter the PARAMETER level and rotate Pulser Knob to select ‘CVxx’ on alphanumeric display, where xx is the selected FB number.

B. Verify that the resistance decade box is set to 200.00 Ω.

C. Press STEP DOWN button. **100.00 (percent)** should appear in 4-1/2 digit display since input resistance is set to 100% of the Full Scale Input value.

D. Switch the resistance decade box to the Zero Input value of 100.00 Ω. **0.00 (percent)** should appear in 4-1/2 digit display to indicate that input resistance is set to 0% of the Full Scale Input value.
14. Repeat steps 5 through 13 if this function block fails calibration verification; otherwise, proceed to Step 15.

15. To calibrate and verify additional function blocks, press STEP UP button to enter Function Block level and perform steps 5 through 14 for each remaining function block; otherwise, calibration is complete.

16. Lock out the 'C' (calibration) mode switch on the Base Board and replace Display Assembly.

17. Remove power from Station and disconnect the decade box and all the jumpers. The Station may now be wired up for service or stored as a spare.

CIRCUIT DESCRIPTION

The RTD Expander Board can accommodate up to eight 100 Ω RTDs. It provides excitation current and accepts a low level voltage signal from each RTD connected to the rear terminals of the Multi-Point Display Station. It will accept 2-, 3-, and 4-wire RTDs as shown in Figure 2. Each input signal is converted to a digital value and transferred to the RTD Base Board for further processing by the MPU. It is then stored in the Display Station's data base as an RTD Input under the function block number assigned to that input. Twice a second, the MPU reads the digital value from the Expander Board and updates the data base.

Refer to the block diagram of the RTD Expander Board shown in Figure 3 while reading the following circuit description. The physical layout of the Board is shown in Figure 1.

A constant current of 0.25 mA is established through the field connected RTD by the action of the Current Source and the Current Sink. As a result, when the temperature changes over the range of -300°F to 1200°F, the RTD resistance changes correspondingly to produce a voltage between 7 mV and 170 mV. The Gain/Offset stage conditions this analog voltage to meet the input requirements of the A/D Converter and Register, which uses two bytes (16 bits) for data and one byte for status information. The range of voltages is from -2.5 Vdc (at the Current Sink) to +2.5 Vdc (at the Current Source).

During the analog to digital conversion process, a serial clock pulse SCK is generated by the Decoder and Control Logic circuits and sent simultaneously to each of the eight A/D Converters and Registers. Eight clock pulses shift one byte of information into the next Register in sequence; for example, 24 clock pulses will shift the entire contents of A/D Converter and Register 1 into A/D Converter and Register 2. The digital output line (MISO) of each Converter and Register becomes the digital input line (MOSI) to the next successive circuit, so that the eight Registers of the A/D Converters function as a single 24-byte register whose contents is shifted in response to the serial clock pulses.
FIGURE 3 RTD Expander Board, Block Diagram
The digital output of Converter and Register 8 is then sent through the Decoder and Control Logic circuits to the Data Bus. Operating programs stored in the PROM permit the MPU on the Base Board to perform the following functions:

1. Linearization
2. Calibration
3. Filtering
4. Output Scaling

Data Bus output from the PROM is then directed to the Display Station’s Base Board through the Buffer circuitry.

MAINTENANCE

Refer to section 6.0 in SD383 for detailed maintenance instructions.

Troubleshooting the RTD Expander Board is via error codes which may appear on the alphanumeric display of a Multi-Point Display Station in response to a failed power-up diagnostic test or to an on-line station error. These error codes, including the type of test or error check, station response, problem confirmation, and corrective action, are listed in the tables of section 6.0.

If an error code designates the RTD Expander Board as faulty, replace it according to section 6.5, Assembly Replacement, and return it to the factory for repair as specified in section 6.8, Maintenance Records.

RECOMMENDED SPARE AND REPLACEMENT PARTS

It is recommended that one spare RTD Expander Board Kit, P/N 16042-11, be stocked for every 1 to 10 boards in service.

Refer to section 6.8 for ordering information and shipping instructions.