DESCRIPTION
The Model 381 T RFI Protected Thermocouple Converter Module provides signal conversion of a thermocouple voltage input to a proportional current output. It accepts ISA type J, K, T, S, R, and E thermocouple inputs and offers a choice of standard or narrow input spans. The current output range is field selectable from two available ranges. Features include current output limiting, cold junction compensation, thermocouple break indication, and RFI protected installation.

The Converter Module is acceptable for use in both standard Series 380 and RFI protected Series 381 Card Cage Enclosures. Standard Series 380 Enclosures do not have RFI protection; input wiring is connected directly to the Converter Module, bypassing an enclosure terminal strip. When used in an RFI protected Series 381 Enclosure, the Converter Module must have its input wiring connected and temperature compensation sensor module relocated to a designated enclosure terminal strip.

MODEL DESIGNATION
Sample Model Number ___________ 381 T J 2
Model Series ___________
Thermocouple Converter ___________
Thermocouple Type
J — Iron/Constantan
K — Chromel/Alumel
T — Copper/Constantan
S — Platinum/Rhodium/Platinum
R — Platinum/Rhodium/Platinum
E — Chromel/Constantan
Input Span
1 — 2 to 5 mVdc
2 — 5 to 50 mVdc

SPECIFICATIONS
INPUT
Signal Type Thermocouple; factory wired for one of the following:
ISA type J, K, T, S, R, or E
Span Factory wired for either of the following:
Standard: 5 to 50 mVdc
Narrow: 2 to 5 mVdc

<table>
<thead>
<tr>
<th>TYPE</th>
<th>STANDARD SPAN</th>
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<tbody>
<tr>
<td>J</td>
<td>-210°C to +1200°C</td>
</tr>
<tr>
<td>K</td>
<td>-270°C to +1373°C</td>
</tr>
<tr>
<td>T</td>
<td>-270°C to +400°C</td>
</tr>
<tr>
<td>S &amp; R</td>
<td>-50°C to +1760°C</td>
</tr>
<tr>
<td>E</td>
<td>-270°C to +1000°C</td>
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</table>

<table>
<thead>
<tr>
<th>TYPE</th>
<th>NARROW SPAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>J</td>
<td>-85°C to +460°C</td>
</tr>
<tr>
<td>K</td>
<td>-120°C to +620°C</td>
</tr>
<tr>
<td>T</td>
<td>-130°C to +250°C</td>
</tr>
<tr>
<td>S &amp; R</td>
<td>-50°C to +1000°C</td>
</tr>
<tr>
<td>E</td>
<td>-100°C to +485°C</td>
</tr>
</tbody>
</table>

Impedance 200,000 Ohms minimum
Isolation Input circuit is electrically isolated from the output and power circuits, permitting it to operate at up to 100 Vdc above ground
Noise Rejection Common Mode: 130dB @ 60 Hz with 100 Ohm unbalance
Normal Mode: 40dB @ 60 Hz
RFI SUPPRESSION Module tested per SAMA PMC 33.1-1978.

MOORE PRODUCTS CO., Spring House, PA 19477
COLD JUNCTION COMPENSATION .......... Automatic compensation over whole range of ambient temperature specification

THERMOCOUPLE BREAK PROTECTION .... Upscale standard, downscale selected by cutting "UP" jumper on circuit board

OUTPUT .................................. Either of two current outputs - field selectable:

4 to 20 mA into 0 to 1000 Ohms
(0 to 900 Ohms for 24 Vdc powered enclosures)
10 to 50 mA into 0 to 400 Ohms
(0 to 360 Ohms for 24 Vdc powered enclosures)

Load Effect ................................ Less than 0.1% within permissible load range

Current Limiting ...................... Output will not exceed approximately 150% of full scale when input is overdriven

ADJUSTMENTS

Span ...................................... Standard: 5 to 50 mV
Narrow: 2 to 5 mV

Zero ...................................... Standard: -5 to -25 mV
Narrow: 2 to 5 mV

AMBIENT TEMPERATURE RANGE .......... 0°C to +50°C (+32°F to +122°F)

RESPONSE TIME .......................... 500 msec to reach 99% of output span typical

ACCURACY

Test Conditions .......................... Input: 0 to 10 mV
Output: 4 to 20 mA
Room Temperature: 25°C
Resistive Load: 500 Ohms
Resistive Source: 100 Ohms
Supply Voltage: 24 Vdc and 15 Vdc

Accuracy ................................ Standard Range: ±0.15%
Narrow Range: ±0.3%

Temperature Effect ..................... ±0.012% per °F maximum over ambient temperature range

INSTALLATION

GENERAL

The Converter Module can be installed in any slot of a standard Series 380 or RFI protected Series 381 Card Cage Enclosure. Each enclosure slot is identified by a number that matches a corresponding terminal strip. Refer to Service Instruction SD3801 which provides the physical and electrical characteristics of all Enclosures. Refer to user connection diagrams to determine converter module location within an Enclosure.

Each slot of an enclosure has safety keys which must be set before module installation. SD3801 gives a procedure for setting them. The Model 381T Thermocouple Converter Module requires the following key positions:

LEFT KEY: H (HORIZONTAL)
RIGHT KEY: V (VERTICAL)

All plug-in modules in a card cage share a common power supply. The output signals of these modules are referenced to one signal common which is also the negative bus of the power supply.

The input circuit of the Converter Module is isolated from the output circuit. Each thermocouple may be independently grounded without the possibility of creating interfering ground loops.

WARNING

Ensure that power is removed from all wire being connected.

STANDARD SERIES 380 ENCLOSURE

Input and output wiring for a Converter Module installed in a standard Series 380 enclosure is shown in Figure 1. Note that the input wiring is connected directly to the input terminals on the Converter Module; the output wiring is connected to the designated enclosure terminal strip.

RFI PROTECTED SERIES 381 ENCLOSURE

Input and output wiring for a Converter Module installed in a RFI protected Series 381 Enclosure is shown in Figure 2. Note that both the input and output wiring are connected to the designated enclosure terminal strip. The input wiring is connected to terminals 1(+), 2(-) of the terminal strip. The temperature compensation sensor module must be relocated from the converter module input terminals to the enclosure input terminals 1(+), 2(-), and 3(L) in agreement with the input wiring.
FIGURE 1 Connection Diagram - Standard Series 380 Enclosure

FIGURE 2 Connection Diagram - RFI Protected Series 381 Enclosure
CALIBRATION

GENERAL
The Thermocouple Module is normally shipped factory calibrated for a specific user designated range. Such a module requires no additional adjustment and can be put into service immediately. Modules ordered without a specific calibration request must be calibrated by the user.

To assure continued accuracy, it is recommended to check the calibration after the first 30 days of operation and then at regular intervals dictated by the severity of the operating environment or whenever an inaccuracy is suspected.

Use the following procedure to perform periodic calibration checks, or to calibrate the Module for a new range. Figure 3 shows the location of all jumper wires and trim-pots. Typical calibration hook-ups are given in Figure 4.

REQUIRED EQUIPMENT
Calibration of the Module requires the use of the following equipment:

1. Series 380 or 381 Card Cage Enclosure with power supply.
2. Thermocouple Calibration Source
   The following devices may service this purpose:
   a) Thermocouple Calibrator
      Covering the required range and thermocouple type.
      Automatic cold junction compensation desirable.

b) Precision Millivolt Source
   Output Range: 0 to 50 mVdc
   These signal sources must be adjustable to a accuracy of ±0.1% or better and provide a source resistance of 100 Ohms or less.

3. Digital Output Meter
   The following devices may serve as output meters:
   a) Digital Voltmeter
      Range: 0 to 5 Vdc
      Input Impedance: 1 Megohm (minimum)
   b) Digital Milliammeter
      Range: 0 to 50 mAdc
      Insertion Resistance: 200 Ohms (maximum)
   Both devices must have an overall accuracy of ±0.1% or better.

4. Miscellaneous and Optional Components
   a) Thermocouple Tables
   b) Thermometer
      Range: -32° F to +122° F (0°C to +50°C)
      Probe type preferred
   c) Thermocouple or Alloy Extension Wires
   d) Reference Cell
      To provide automatic temperature compensation for millivolt source.
   e) Conditioning Resistor
      To convert output current to voltage if a voltmeter is used as an output meter.

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FIGURE 3 Jumpers And Adjustments
TC CALIBRATOR
DIRECT TEMP. READOUT

WITH COLD-JUNCTION
COMPENSATION

MILLIVOLT
SOURCE

MILLIVOLT
SOURCE

MILLIVOLT
SOURCE

NOTES:
1. The Thermocouple (TC) Calibrator, the Reference Cell, and the TC wires must be compatible with the TC type of the given Module.
2. Refer to the specific equipment operating manuals for additional, more detailed application information.

FIGURE 4 Typical Calibration Hook-up Diagrams
PRELIMINARY ADJUSTMENTS

Refer to Figure 3 for the location of the three jumper wires used to select the desired operating mode described below.

1. OUTPUT RANGE

The output range of the Module is determined by the presence or absence of jumper wire J1 located on the solder side of the PC board. With jumper wire J1 intact, the output range is 10 to 50 mA; with it removed, the range is 4 to 20 mA.

Perform the necessary range selection by cutting or installing the jumper wire described above. After making a range change, the Module must always be calibrated.

2. THERMOCOUPLE BREAK INDICATION

Module has a provision to indicate a break (discontinuity) in the thermocouple. Depending on the status of the UP (T.C. Break) jumper wire, the Module’s output signal will either go up to 100% or down to 0% if a break in the thermocouple or its connecting wires should occur.

The Modules are normally shipped with an up-scale break indication (the UP jumper wire is intact). If a down-scale break indication is required, cut the UP jumper wire located on the solder side of the PC board.

Following these adjustments, plug the Module into its designated slot in the card cage, turn on the power supply, and let it warm up for five minutes before proceeding with the calibration outlined below.

PROCEDURE

The calibration procedure sets the minimum and maximum temperature points for the selected output range of the Module.

1. Connect the calibration source to the Module. Refer to Figure 4 for typical hook-up diagrams. If possible, use the same input wires that will be used with the thermocouple.

   IMPORTANT

   If the signal source is calibrated directly in degrees, be sure it uses the same type of thermocouple that is acceptable to the Module.

2. Connect the digital output meter to terminals 4 (+) and 5 (-) of the designated terminal strip on the card cage.

3. Determine the required low temperature point that should appear as 0% in the output range.

   NOTE

   If the calibrator source provides a direct temperature readout and includes cold junction compensation skip steps 4 and 5. Refer to the calibrator instruction manual for detailed calibrator adjustments.

4. Look up in the Thermocouple Table the equivalent millivoltage of the above determined low temperature point.

   NOTE

   If the calibration source includes a cold junction reference or if an external cold junction reference is being used, skip step 5 and refer to the device manufacturer’s Instruction Manual for adjustment details.

5. Compensate the above millivolt reading to 0°C or -32°F as follows:

   a) Measure the temperature of the appropriate screw terminals shown in Figure 4.

   b) Look up in the Thermocouple Table the equivalent millivoltage.

   c) Subtract the millivolt level of step 5b from the one obtained in step 4. The result is used in the next step.

   CAUTION

   A signal in excess of ±5 Volts across the input terminals may cause damage to the Module.

6. Set the calibration source to the low temperature point. This setting may be expressed directly in degrees or in the equivalent millivoltage, depending on the type of calibrator used. In either case, it must be a cold junction compensated setting (see step 5 above or refer to the calibrator instruction manual).

7. Adjust the ZERO tripot (R17) to read the 0% level on the output meter. This reading is 4mA for the 4 to 20 mA output range, 10mA for the 10 to 50 mA range, or 1 Volt if a 1 to 5 Volt conditioning resistor is used. If the ZERO tripot reaches full travel before the calibration point is reached, cut jumper wire Z to increase the adjustment range of the tripot.

8. Determine the required high temperature point that should appear as 100% in the output range.

9. Set the calibration source to the high temperature point. This setting is expressed in the same units used in step 6 and must be cold junction compensated in the same manner.

10. Adjust the SPAN tripot (R20) to read the 100% level on the output meter. This reading is 20 mA for the 4 to 20 mA output range, 50mA for the 10 to 50 mA range, or 5 Volts if a 1 to 5 Volt conditioning resistor is used. If the SPAN tripot reaches full travel before the calibration point is reached, cut jumper wire S to increase the adjustment range of the tripot.

11. Repeat steps 6, 7, 9, and 10 until proper calibration is achieved. This is necessary due to some interaction between the zero and span adjustments.

12. Simulate a broken thermocouple by disconnecting the signal source. Observe the output meter for the required output signal reaction.

This completes the calibration procedure.
MAINTENANCE

GENERAL

Required maintenance for this Module should consist of periodic cleaning, visual inspection, and calibration checks. The severity of the environment in which the Module is located will determine the required frequency of maintenance.

CLEANING

The Module should be cleaned as often as operating conditions require. The accumulation of dust and dirt on components prevents efficient heat dissipation which can cause overheating and component breakdown. Blow off accumulated dust and dirt with dry, low velocity air. Any dust or dirt that remains should be removed with a soft brush or cloth dampened with a mild detergent and water solution. Cotton-tipped swabs are useful for cleaning in narrow spaces.

CAUTION

Avoid the use of chemical agents which may damage plastic components or protective coatings.

VISUAL INSPECTION

The Module should be inspected occasionally for defects such as loose or broken connections, damaged circuit board, and heat-damaged components.

The corrective action for most visible defects is obvious. However, if a heat-damaged component is found, the cause of overheating must be corrected to prevent a recurrence of the damage.

CAUTION

Exceeding the specified ambient temperature limits can adversely affect performance and may cause damage.

TROUBLESHOOTING

If the Module does not operate properly when initially installed, check the terminal strip wiring. Most problems in new installations can be traced to wiring mistakes. Also, verify that the equipment associated with the input and output circuits is functioning and is properly calibrated.

If the trouble is traced to the Module, remove the Module and give it a full bench check. A complete schematic of the Module is given in Figure 5.

A Part No. 15378-27 Card Extender can be ordered. It extends the Module beyond the front edge of the card cage enclosure, providing easy access to both side of the Module's circuit board.

RECOMMENDED SPARES

There are no recommended spare parts for the Thermocouple Module.

WARRANTY

The Company warrants all equipment manufactured by it and bearing its name, and all repairs made by it, to be free from defects in material and workmanship under normal use and service. If any part of the equipment hereon described, and sold by the Company, proves to be defective in material or workmanship and if such part is within twelve months from date of shipment from the Company's factory, returned to such factory transportation charges prepaid, and if the same is found by the Company to be defective in material or workmanship, it will be replaced or repaired, free of charge. (i.e., Company's factory. The Company assumes no liability for the consequences of its use or misuse by Purchaser, his employees or others. A defect in the meaning of this warranty in any part of said equipment shall not, when such part is capable of being removed, repaired or replaced, operate to condemn such equipment. This warranty is expressly in lieu of all other warranties, guarantees, obligations, or liabilities, expressed or implied by the Company or its representatives. All statutory or implied warranties other than those are hereby expressly rejected and excluded.

Warranty repair or replacement requires the equipment to be returned to one of the following addresses:

- Equipment manufactured or sold by MOORE PRODUCTS CO.
  Summertown Pike
  Spring House, PA, 19477

- Equipment manufactured or sold by MOORE INSTRUMENT CO.
  MOORE INSTRUMENTS LTD.
  3141 West of Mississauga Rd. Hwy 7
  Brampton, Ontario, Canada

The warranty will be null and void if repair is attempted without prior authorization by a member of the MOORE PRODUCTS CO. Service Department.