# High Density Thermocouple Input Module

## Product Specifications and Installation Data

## 1 DESCRIPTION

The Horner APG HE697THM160 offers 16 channels of thermocouple input with 0.1°C resolution. Ten thermocouple types are currently supported; J, K, N, T, E, R, S, B, C, and JX (extended J). Thermocouple type is selectable on a channel-by-channel basis. The module allows the direct connection of thermocouple sensors, without the need for external signal conditioners and standard analog input modules. The thermocouple voltage is converted to a digital value, cold junction compensated, and the appropriate temperature value is reported directly to %AI registers in 0.1° or 0.5° increments. The temperature value may be reported in °C or °F increments. Various configuration parameters, as well as high and low setpoints for each channel, are available using %AQ output registers. **Recommended wire size is 24 AWG.** THM160 requires a power supply to provide ± 12V and 5V to the backplane.

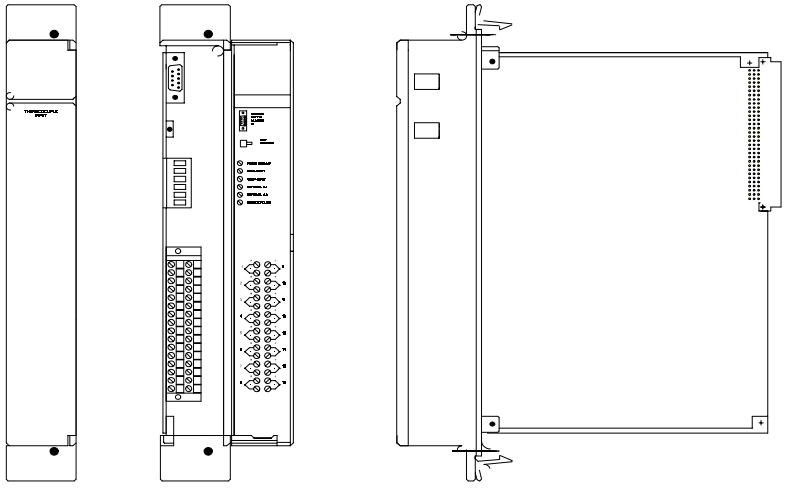

**Figure 1 – HE697THM160 Module**

## 2 SPECIFICATIONS

| Table 1 – HE697THM160 Specifications | | | |
|---|---|---|---|
| **Specification** | **HE697THM160** | **Specification** | **HE697THM160** |
| Number of Channels | 16 | Input Impedance | >20Mohms |
| Types Supported | J, K, N, T, E, R, S, B, C, JX | Maximum Safe Overload | +/-35V (from floating common) |
| Cold Junction Comp. | Internal (AD592)<br>External (AD592) Future Option | Common Mode Range | +/-11 V (from floating common) |
| Resolution | 0.1°C or 0.1°F | Common Mode Rejection | >100dB |
| Accuracy | +/-0.5°C typical (J, K, N, T) | A/D Conversion Type | 16-bit, Successive Approx. |
| Operating Temperature | 0 to 60°C (32 to 140°F) | Channel Scan Rate | 960 channels/second |
| Relative Humidity | 5% to 95% non-cond. | Isolation | 500VDC Bus Isolation |
| **Requirements** | | | |
| Backplane Voltages | +/-12V, 5V | Software Version | Release 5.0 or later |
| CPU Version | Relaease 5.5 or later | Module Placement | Main or Expansion Rack |

## 3 RACK CONFIGURATION

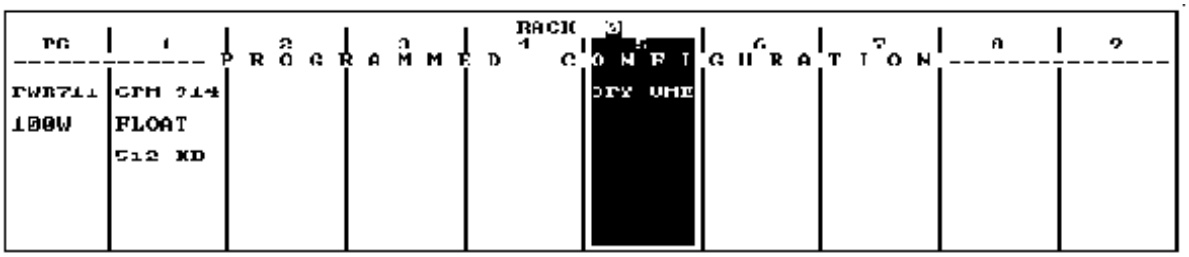


**Figure 2 - Foreign Module Configuration**

To reach this screen, select I/O Configuration (F1), cursor over to the slot containing the module and select VME (F7), VME (F1), and 3RD Party VME Module (2).

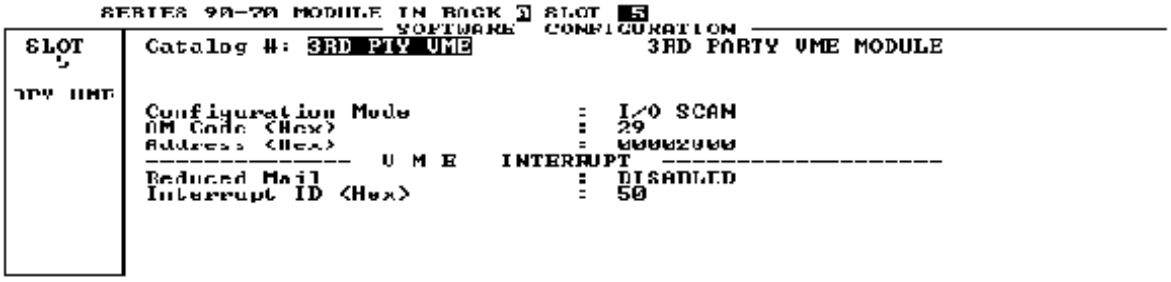


**Figure 3 - Foreign Module Configuration**

To reach this screen, select I/O SCAN for Configuration Mode, then change Reduced Mail from ENABLED to DISABLED. The configuration software will automatically select the correct numbers for AM Code, Address and Interrupt ID based on rack and slot location. If these numbers are incorrect the module should be deleted and reconfigured.

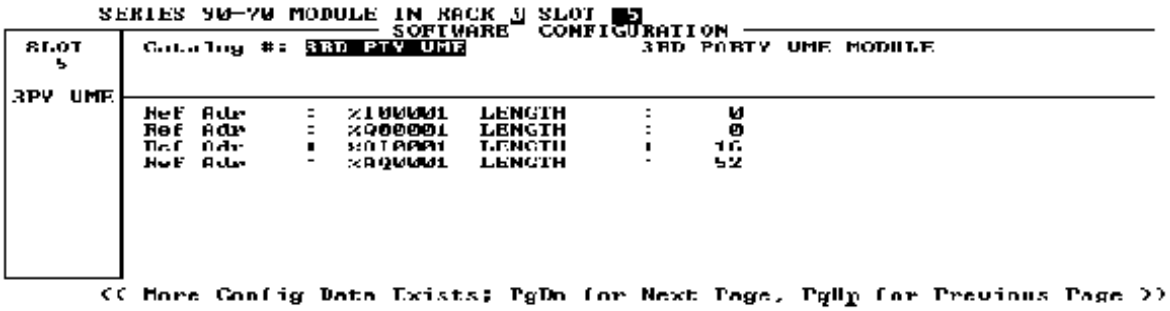


**Figure 4 - Foreign Module Configuration**

To reach this screen, press the page down key. Select the correct Reference Address for both the %AI registers and the %AQ registers. Enter 16 for %AI Length and 52 for %AQ Length.

# 4 MODULE CONFIGURATION

| Table 2 – I/O Map Table | |
|---|---|
| Module Configuration (Filtering, Temperature format, Open Circuit Detection, Cold Junction Compensation) | %AQ0001 through %AQ0004 |
| Channel Configuration (Thermocouple Type, Low and High Setpoints) | %AQ0005 through %AQ0052 |
| Temperature Values | %AI0001 through %AI0016 |

| Table 3 – Module Configuration. %AQ0001-0004 (Filtering, Resolution, Open Circuit Burnout and Cold Junction Compensation) | | |
|---|---|---|
| **Register** | **Function** | **Configuration** |
| %AQ0001 | Digital Filtering | 0 = No Filtering = 0.017 Second Scan Time<br>1 = 2 Samples/Update = .035 Second Scan Time<br>2 = 4 Samples/Update = .070 Second Scan Time<br>3 = 8 Samples/Update = .140 Second Scan Time<br>4 = 16 Samples/Update = .280 Second Scan Time<br>5 = 32 Samples/Update = .560 Second Scan Time<br>6 = 64 Samples/Update = 1.20 Second Scan Time<br>7 = 128 Samples/Update = 2.40 Second Scan Time |
| %AQ0002 | Temperature Format | 0 = 0.5° Celsius Resolution<br>1 = 0.5° Fahrenheit Resolution<br>2 = 0.1° Celsius Resolution<br>3 = 0.1° Fahrenheit Resolution |
| %AQ0003 | Open Circuit Detection | 0 = Upscale Burnout<br>1 = Downscale Burnout |
| %AQ0004 | Cold Junction Compensation | 0 = Internal<br>1 = External Current, -1uA/°K<br>2 = External voltage, 1mV/°K |

## 5 DIGITAL FILTERING

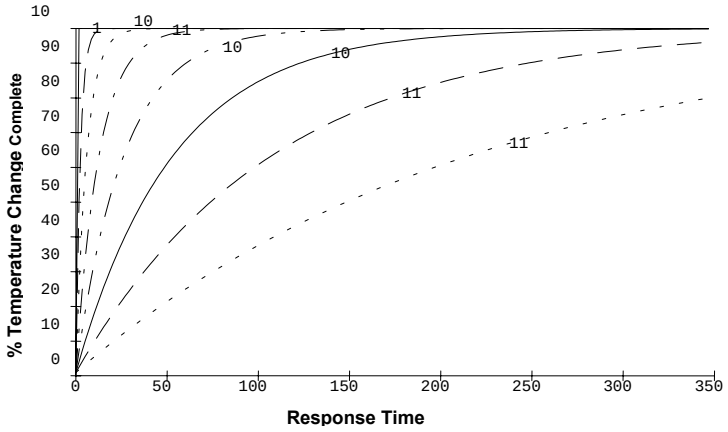


**Figure 5 - Digital Filtering**

The effect of digital filtering (set with %AQ0001) on the module's response to a temperature change. (%temperature change completed vs. time).

# 6 CHANNEL CONFIGURATION

| Table 4 – Channel Configuration. %AQ0005-00052 (Thermocouple Type, Low Alarm Setpoint and High Alarm Setpoint | | | | | | | |
|---|---|---|---|---|---|---|---|
| %AQ | Function | %AQ | Function | %AQ | Function | %AQ | Function |
| 5 | Thermocouple Type Channel 1 | 17 | Thermocouple Type Channel 5 | 29 | Thermocouple Type Channel 9 | 41 | Thermocouple Type Channel 13 |
| 6 | Low Alarm Setpoint Channel 1 | 18 | Low Alarm Setpoint Channel 5 | 30 | Low Alarm Setpoint Channel 9 | 42 | Low Alarm Setpoint Channel 13 |
| 7 | High Alarm Setpoint Channel 1 | 19 | High Alarm Setpoint Channel 5 | 31 | High Alarm Setpoint Channel 9 | 43 | High Alarm Setpoint Channel 13 |
| 8 | Thermocouple Type Channel 2 | 20 | Thermocouple Type Channel 6 | 32 | Thermocouple Type Channel 10 | 44 | Thermocouple Type Channel 14 |
| 9 | Low Alarm Setpoint Channel 2 | 21 | Low Alarm Setpoint Channel 6 | 33 | Low Alarm Setpoint Channel 10 | 45 | Low Alarm Setpoint Channel 14 |
| 10 | High Alarm Setpoint Channel 2 | 22 | High Alarm Setpoint Channel 6 | 34 | High Alarm Setpoint Channel 10 | 46 | High Alarm Setpoint Channel 14 |
| 11 | Thermocouple Type Channel 3 | 23 | Thermocouple Type Channel 7 | 35 | Thermocouple Type Channel 11 | 47 | Thermocouple Type Channel 15 |
| 12 | Low Alarm Setpoint Channel 3 | 24 | Low Alarm Setpoint Channel 7 | 36 | Low Alarm Setpoint Channel 11 | 48 | Low Alarm Setpoint Channel 15 |
| 13 | High Alarm Setpoint Channel 3 | 25 | High Alarm Setpoint Channel 7 | 37 | High Alarm Setpoint Channel 11 | 49 | High Alarm Setpoint Channel 15 |
| 14 | Thermocouple Type Channel 4 | 26 | Thermocouple Type Channel 8 | 38 | Thermocouple Type Channel 12 | 50 | Thermocouple Type Channel 16 |
| 15 | Low Alarm Setpoint Channel 4 | 27 | Low Alarm Setpoint Channel 8 | 39 | Low Alarm Setpoint Channel 12 | 51 | Low Alarm Setpoint Channel 16 |
| 16 | High Alarm Setpoint Channel 4 | 28 | High Alarm Setpoint Channel 8 | 40 | High Alarm Setpoint Channel 12 | 52 | High Alarm Setpoint Channel 16 |

| Table 5 – Thermocouple Type Configuration (J, K, N, T, E, R, S, B, C and JX) | | |
|---|---|---|
| **%AQ Value** | **Thermocouple Type** | **Temperature Range** |
| 0 | J | -210°C to 760°C |
| 1 | K | -270°C to 1372°C |
| 2 | N | -270°C to 1300°C |
| 3 | T | -270°C to 400°C |
| 4 | E | -270°C to 1000°C |
| 5 | R | 0°C to 1768°C |
| 6 | S | 0°C to 1768°C |
| 7 | B | 0°C to 1820°C |
| 8 | C | 0°C to 2320°C |
| 9 | J Extended | -178°C to 982.3°C |

# 6 TEMPERATURE INPUT

| Table 6 – Temperature Values. %AI0001-00016 | | | |
|---|---|---|---|
| **Register** | **Value** | **Register** | **Value** |
| %AI0001 | Temperature Channel 1 | %AI0009 | Temperature Channel 9 |
| %AI0002 | Temperature Channel 2 | %AI0010 | Temperature Channel 10 |
| %AI0003 | Temperature Channel 3 | %AI0011 | Temperature Channel 11 |
| %AI0004 | Temperature Channel 4 | %AI0012 | Temperature Channel 12 |
| %AI0005 | Temperature Channel 5 | %AI0013 | Temperature Channel 13 |
| %AI0006 | Temperature Channel 6 | %AI0014 | Temperature Channel 14 |
| %AI0007 | Temperature Channel 7 | %AI0015 | Temperature Channel 15 |
| %AI0008 | Temperature Channel 8 | %AI0016 | Temperature Channel 16 |

| Table 7 – Temperature Scaling. %AQ0002 | | |
|---|---|---|
| **%AQ0002 Value** | **Temperature Format** | **Scaling Formula** |
| 0 | 0.5°C | °C = %AI / 2 |
| 1 | 0.5°F | °F = %AI / 2 |
| 2 | 0.1°C | °C = %AI / 10 |
| 3 | 0.1°F | °F = %AI / 10 |

# 7 EXTERNAL COLD JUNCTION

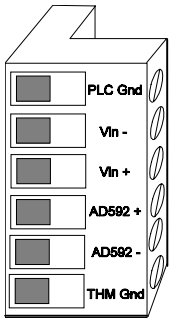


**Figure 6 – External CJ and Ground Connector**

**PLC Gnd:** PLC Frame ground connection. Do not connect thermocouple grounds or shields to this point due to isolation barrier crossing.

**Vin -:** Voltage common for external cold junction compensation. Not currently supported.

**Vin +:** Voltage positive for external cold junction compensation. Not currently supported.

**AD592 +:** Positive input for AD592 for external cold junction compensation. Not currently supported.

**AD592 -:** negative input for AD592 for external cold junction compensation. Not currently supported.

**THM Gnd:** Floating ground for thermocouple shields. This ground is isolated 500VDC from PLC ground.

**NOTE:** The 9-pin female D-sub connector and the reset push-button are used for factory calibration and configuration only.

# 8 WIRING / INSTALLATION

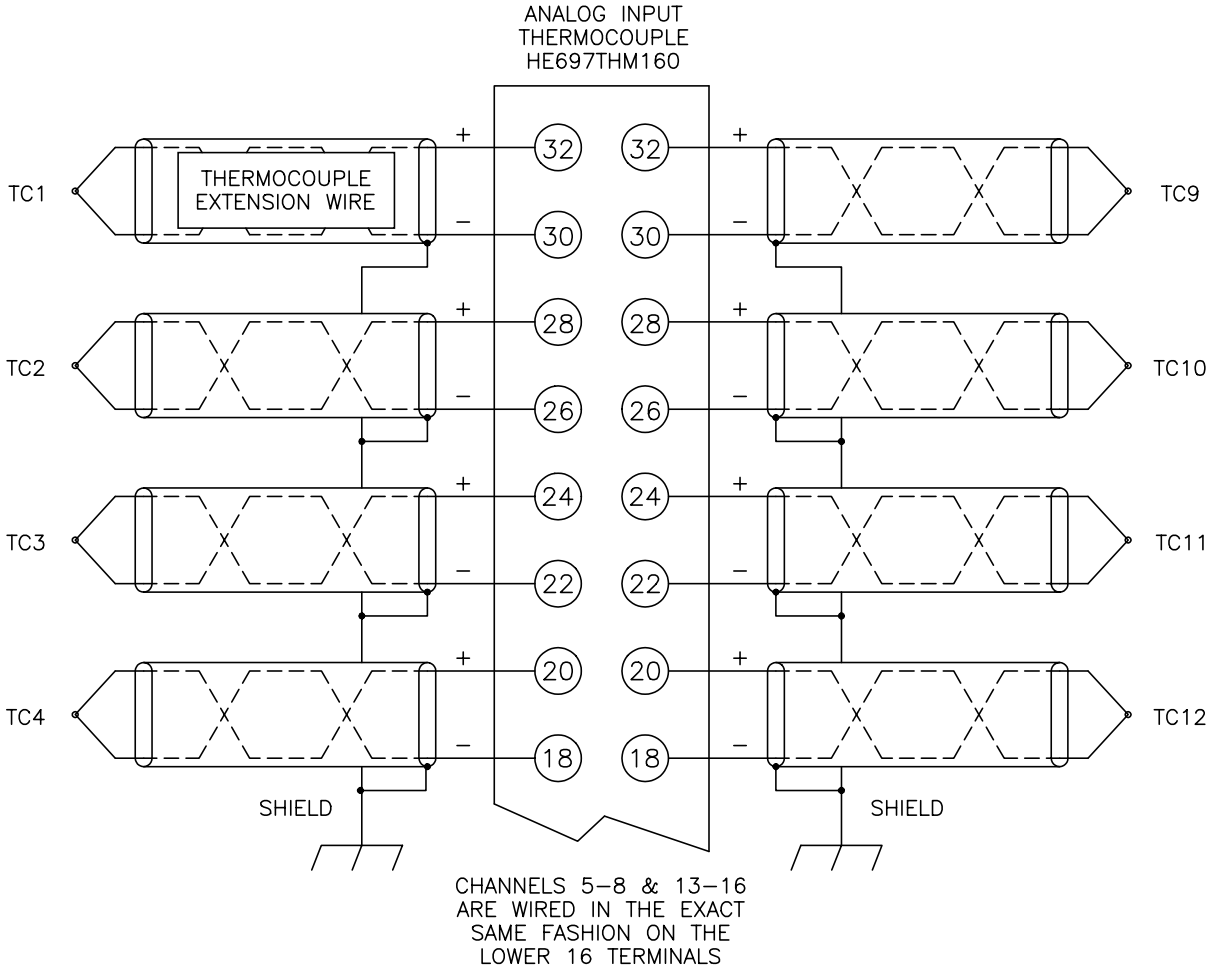


**Figure 7 – HE697THM160 Wiring**

## 8.1 Installation Requirements

Special care must be taken with grounded junction sensors to avoid applying a voltage potential to the thermocouple junction. Extension wire of the proper Thermocouple type must be used. Keep total wire resistance less than 100Ω to maintain rated accuracy. Extension wiring should be routed in its own conduit. Shielded, twisted pair extension wiring offers best noise immunity. If shielded wiring is used, a good earth ground connection is critical. **Unused thermocouple inputs should be shorted together to avoid channel to channel cross-talk. Recommended wire size for terminal strip is 24 AWG.**

# 9 TECHNICAL ASSISTANCE

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