

5504 Thermocouple Analog Input Module

Installation, Operation and Maintenance
Setup Manual

5/19/2011



The information provided in this documentation contains general descriptions and/or technical characteristics of the performance of the products contained herein. This documentation is not intended as a substitute for and is not to be used for determining suitability or reliability of these products for specific user applications. It is the duty of any such user or integrator to perform the appropriate and complete risk analysis, evaluation and testing of the products with respect to the relevant specific application or use thereof. Neither Schneider Electric nor any of its affiliates or subsidiaries shall be responsible or liable for misuse of the information contained herein. If you have any suggestions for improvements or amendments or have found errors in this publication, please notify us.

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All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer should perform repairs to components.

When devices are used for applications with technical safety requirements, the relevant instructions must be followed. Failure to use Schneider Electric software or approved software with our hardware products may result in injury, harm, or improper operating results.

Failure to observe this information can result in injury or equipment damage.

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Safety Information

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



The addition of this 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 an imminently hazardous situation which, if not avoided, **will result in** death or serious injury.

WARNING

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

CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, **can result in** minor or moderate.

CAUTION

CAUTION used without the safety alert symbol, indicates a potentially hazardous situation which, if not avoided, **can result in** equipment damage..

PLEASE NOTE

Electrical equipment should be installed, operated, serviced, 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 and operation of electrical equipment and the installation, and has received safety training to recognize and avoid the hazards involved.

BEFORE YOU BEGIN

Do not use this product on machinery lacking effective point-of-operation guarding. Lack of effective point-of-operation guarding on a machine can result in serious injury to the operator of that machine.

 **CAUTION****EQUIPMENT OPERATION HAZARD**

Verify that all installation and set up procedures have been completed.

Before operational tests are performed, remove all blocks or other temporary holding means used for shipment from all component devices.

Remove tools, meters, and debris from equipment.

Failure to follow these instructions can result in injury or equipment damage.

Follow all start-up tests recommended in the equipment documentation. Store all equipment documentation for future references.

Software testing must be done in both simulated and real environments.

Verify that the completed system is free from all short circuits and grounds, except those grounds installed according to local regulations (according to the National Electrical Code in the U.S.A, for instance). If high-potential voltage testing is necessary, follow recommendations in equipment documentation to prevent accidental equipment damage.

Before energizing equipment:

- Remove tools, meters, and debris from equipment.
- Close the equipment enclosure door.
- Remove ground from incoming power lines.
- Perform all start-up tests recommended by the manufacturer.

OPERATION AND ADJUSTMENTS

The following precautions are from the NEMA Standards Publication ICS 7.1-1995 (English version prevails):

- Regardless of the care exercised in the design and manufacture of equipment or in the selection and ratings of components, there are hazards that can be encountered if such equipment is improperly operated.
- It is sometimes possible to misadjust the equipment and thus produce unsatisfactory or unsafe operation. Always use the manufacturer's instructions as a guide for functional adjustments. Personnel who have access to these adjustments should be familiar with the equipment manufacturer's instructions and the machinery used with the electrical equipment.
- Only those operational adjustments actually required by the operator should be accessible to the operator. Access to other controls should be restricted to prevent unauthorized changes in operating characteristics.

About The Book

At a Glance

Document Scope

This manual describes the operation and maintenance of the 5504 Thermocouple Analog Input module.

Validity Notes

This document is valid for all versions of the 5504 Thermocouple Analog Input module.

Product Related Information

 WARNING
UNINTENDED EQUIPMENT OPERATION
The application of this product requires expertise in the design and programming of control systems. Only persons with such expertise should be allowed to program, install, alter and apply this product.
Follow all local and national safety codes and standards.
Failure to follow these instructions can result in death, serious injury or equipment damage.

User Comments

We welcome your comments about this document. You can reach us by e-mail at technicalsupport@controlmicrosystems.com.

Overview

The Model 5504 Thermocouple input module adds eight thermocouple inputs to the 5000 input/output system. Up to eight model 5504 modules may be connected to the I/O bus, for a total of 64 thermocouple inputs per bus. The 5504 module can be used with J, K, E and T type thermocouples or 0 to 80 millivolt input signals.

The 5504 module provides an iso-thermal block for maintaining the thermocouple termination wiring at a known temperature. The temperature of this block is monitored to provide cold junction compensation.

The 5504 module uses a 20000 count, integrating, analog to digital (A/D) converter. A single chip microcontroller with integral watchdog timer operates the A/D, linearizes and scales the output data and communicates over the I/O bus.

Inputs are transient protected and optically isolated from the main logic power.

Installation

The installation of the 5504 module requires mounting the module on the 7.5mm by 35mm DIN rail and connecting the module to the system I/O Bus. Refer to the **System Configuration Guide**, at the beginning of this manual, for complete information on system layout, I/O Bus cable routing and module installation.

Environment Considerations

The 5504 module cold junction compensation circuitry must not be subjected to rapid temperature changes. These can occur when a cabinet door is opened. Install 5504 modules in a manner that will minimize the possibility of rapid temperature changes.

Field Wiring

The 5504 module provides eight thermocouple inputs. **Figure 1: Typical 5504 Thermocouple Field Wiring** shows how to wire the inputs.

An external 24 volt supply powers the isolated input circuits. A 5000 power supply normally sources this voltage. A range of voltages can be tolerated. Refer to section **Specifications** for details.

If an isolated 24V-power supply is used, such as a 5103 power supply, it is necessary to reference this supply to chassis ground. This connection to chassis may be built into another device being powered from the 24V power supply but is easily accomplished by connecting the -24V of one of the 5504 modules to the nearest DIN rail chassis ground. If it is necessary to have the thermocouples at a potential other than chassis ground this chassis connection can be made through a high value resistor.

Screw termination style connectors are used for termination of field wiring. They accommodate solid or stranded wires from 22 to 12 AWG.

The connectors are fixed to the circuit board and are not removable.

Remove power before servicing unit.

To remove the connector:

- Pull the connector upward from the board. Apply even pressure to both ends of the connector.

To install the connector:

- Line up the pins on the module with the holes in the connector.
- Push the connector onto the pins. Apply even pressure to both ends on the connector.

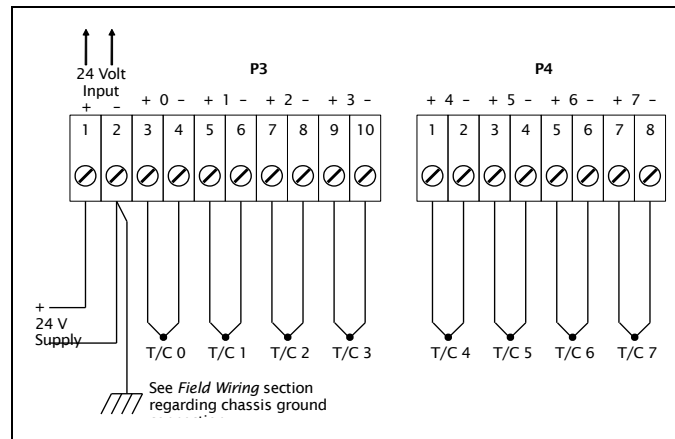


Figure 1: Typical 5504 Thermocouple Field Wiring

Address Selection

The 5000 I/O bus will support a maximum of twenty I/O (input/output) modules. 5000 I/O module types may be combined in any manner to the maximum supported by the controller used. The types of input and output modules available are:

- Digital Input modules
- Digital Output modules
- Analog Input modules
- Analog Output modules
- Counter Input modules

Each type of I/O module, connected to the I/O bus, has a unique I/O module address. Different types of I/O modules may have the same module address.

The address range supported by the SCADAPack controller module may restrict the I/O module address range. Refer to the controller manual for the maximum address supported.

The three address switches labeled 1, 2, 4 and 8 set the module address. To set the address:

- Open the three switches by pressing down the left side of the switch.
- Close the switches that total to the desired address.

Figure 2: 5504 Thermocouple Input Module Address Switches shows the switch settings for the 16 possible module addresses.

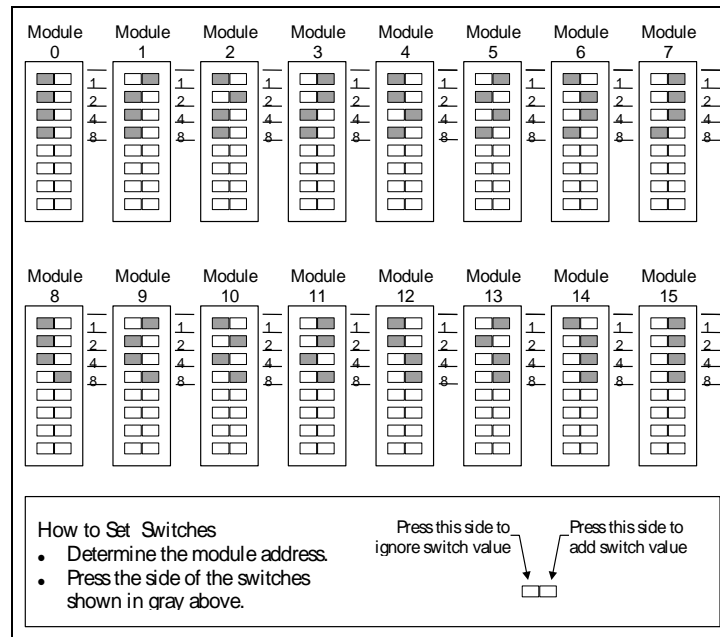


Figure 2: 5504 Thermocouple Input Module Address Switches

Thermocouple Range Selection

The 5504 module scales and linearizes input readings depending on the thermocouple range selected. These ranges are summarized in the table below.

Figure 3: 5504 Thermocouple Range Switches below shows the switch settings for the 5 possible ranges.

Input Type	Range	Resolution at 0°C	Select Range
J	-200 to 760°C	0.08°C	0
K	-270 to 1370°C	0.10°C	1
E	-270 to 1000°C	0.07°C	2
T	-270 to 400°C	0.10°C	3
Voltage	-80 to 80 mV	4 μV	4

The resolution shown above is typical of the resolution over the range for temperatures above 0°C. Thermocouples are very non-linear, especially at temperatures below -200°C.

Operation and Maintenance

Data Format

5000 analog input and output modules use 16 bit signed numbers (15 bits plus sign).

The 5504 module has a 20000 count, bipolar, analog to digital (A/D) converter. The thermocouple ranges use a fraction of the A/D range. The readings are scaled and linearized to provide output data in the 16 bit signed format.

The table below shows output values for several temperature inputs based on the J type thermocouple range.

Temperature	Condition	Output
<-200°C	operating	-8623
-200°C	operating	-8623
0°C	operating	0
0.08°C	operating	3
100°C	operating	4311
380°C	operating	16384
759.94°C	operating	32765
760°C	operating	32767
NA	open input	32767
NA	+24V off	0

Special Conditions

The 5504 module output data has two special conditions.

- If the thermocouple is open the data goes to full scale (32767).
- If the 24V power supply is off the data goes to 0.

Cold Junction Compensation

When the thermocouple wiring is terminated on a terminal block a second thermocouple is created. Cold junction compensation is necessary to remove the effects of this cold junction thermocouple.

The terminal block of the 5504 module is connected a large mass (iso-thermal block). The cold junction sensor measures the temperature of this block. The 5504 module compensates the thermocouple readings for temperature variations at the terminal block.

The cold junction compensation circuit must not be subjected to rapid temperature changes, for the circuit to function properly. These can occur when a cabinet door is opened. Install 5504 modules in a manner which will minimize the possibility of rapid temperature changes.

Linearization

The 5504 module scales and linearizes the output data for the thermocouple range selected. Linearization is accomplished by dividing the temperature vs. voltage curve into approximately 40 segments and extrapolating to generate an output that is a function of temperature.

Some thermocouples become extremely non-linear at temperatures below – 200°C. The low temperature limit on the accuracy specification reflects this limitation of the thermocouple.

Range	Temperature	Linearization Errors
J	–200 to 760°C	+0.03%
K	–230 to 1370°C	+0.03%
E	–240 to 1000°C	+0.03%
T	–240 to 400°C	+0.03%
±80mV	NA	NA

Maintenance

This module requires no routine maintenance. If the module is not functioning correctly, contact Control Microsystems Technical Support for more information and instructions for returning the module for repair.

Troubleshooting

Condition	Action
Inputs read 0.	Check +24V power. Check the range switches.
Inputs read 32767.	Check for open input. Check the range switches.
Reading is constant.	Check that the analog input is not forced.

Calibration

The 5504 module is calibrated and burned in at the factory. It does not require periodic calibration. Calibration may be necessary if the module has been repaired as a result of damage.

There is one potentiometer for calibration of the analog inputs. The GAIN potentiometer (R14) adjusts the gain.

Calibration requires that you read the converted value from the module using a communication controller, SCADAPack controller module. Refer to the controller module manual for details.

To calibrate the module:

- Set the range switches to range 4 ($\pm 80\text{mV}$).
- Short any one of the analog inputs.
- Adjust the ZERO potentiometer until a reading of 0 is obtained.
- Apply a voltage between 70 and 80 mV on any one of the analog inputs.
- Calculate the correct reading for the applied voltage using the formula:

$$reading = 32768 \times \frac{voltage}{80mV}$$

- Adjust the GAIN potentiometer until the correct reading is obtained.

The calibration may be verified by applying other voltages or voltages of the opposite polarity to the other input terminals. Use the formula above to determine the correct reading for each input voltage.

Specifications

Disclaimer: Control Microsystems reserves the right to change product specifications. For more information visit www.controlmicrosystems.com.

Inputs	8 thermocouples or millivolt signals
Thermocouple Types and Ranges	Type J –200 to 760°C Type K –270 to 1370°C Type E –270 to 1000°C Type T –270 to 400°C mV ±80mV
Resolution	0.004 mV approximately 0.10°C – refer to section Thermocouple Range Selection .
Input Resistance	1MΩ
Accuracy over –40°C to 60°C operating temperature range	Type J ±0.20% of full scale Type K ±0.20% of full scale Type E ±0.15% of full scale Type T ±0.50% of full scale mV ±0.15% of full scale All figures include linearization errors, but not cold junction compensation errors. Errors at operating temperatures from 0°C to 50°C are typically one-half those stated above. Accuracy decreases at measured temperatures below –200°C. Refer to section Linearization for details.
Cold Junction Compensation	±0.5°C maximum error from 0 to 60°C ±1°C maximum error from –40 to 0°C
Converter type	±20000 count, integrating
Common mode voltage range	±10V can be applied to the inputs, relative to the –24V power supply input.
Isolation	500 VAC from the logic power
Transient Protection	MOVs on each input
Response Time	0.5 seconds
Power Requirements	5V at 40mA 20 to 28V at 45mA

Terminations	10 pole and 8 pole two fixed terminal blocks 12 to 22 AWG 15 amp contacts
Dimensions	5.65 inch (144 mm) wide 4.625 inch (118 mm) high 1.75 inch (44 mm) deep
Mounting	7.5 x 35 DIN rail
Packaging	corrosion resistant zinc plated steel with black enamel paint
Environment	5% RH to 95% RH, non-condensing -40°C to 60°C -40°F to 140°F

Approvals and Certifications

Hazardous Locations - North America	<p>Suitable for use in Class I, Division 2, Groups A, B, C and D Hazardous Locations. Temperature Code T4</p> <p>CSA certified to the requirements of:</p> <ul style="list-style-type: none"> • CSA Std. C22.2 No. 213-M1987 - Hazardous Locations. • UL Std. No. 1604 - Hazardous (Classified) Locations.
Safety	<p>CSA (cCSAus) certified to the requirements of: CSA C22.2 No. 142-M1987 and UL508. (Process Control Equipment, Industrial Control Equipment)</p> <p>UL (cULus) listed: UL508 (Industrial Control Equipment)</p>