5503 RTD Analog Input Module

Installation, Operation and Maintenance Setup Manual

5/19/2011

Schneider Electric

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.

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 5503 RTD Analog Input module.

Validity Notes

This document is valid for all versions of the 5503 RTD 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 5503 RTD input modules add four RTD inputs to the 5000 input/output system. Up to sixteen Model 5503 modules may be connected to the I/O bus, for a total of 64 RTD inputs per bus. These inputs are used with four wire RTDs that conform to the 0.00385 ohms/ohm/°C calibration standard.

The 5503 module can be user configured for six different input ranges. These input ranges are scaled and linearized to cover resistance ranges from 0 to 400 ohms and RTDs from –200ºC to 800ºC.

The 5503 module provides 5mA excitation current with a 12.5% duty cycle. The high excitation current along with the low duty cycle results in high accuracy while minimizing self-heating errors.

The 5503 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 5503 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.

Field Wiring

The 5503 module provides four RTD inputs for use with 4-wire RTDs. ***Figure 1: Typical 5503 RTD Field* Wiring** shows how to wire these RTDs.

The 5503 module supports four, 4 wire RTDs. Each RTD has its own Sense + (S+), Sense – (S–) and Excitation Current +(I+) terminal. The four RTDs share two Excitation Current – (I–) terminals. The I+ and I– terminals supply the excitation current to the RTD. The S+ and S– terminals return the sensed voltage the 5503 module.

The 5503 module can be used with 3 wire RTDs, with reduced accuracy. 4 wires should be used from the terminal block to as close as possible to the RTD. The error obtained using a 3 wire RTD depends on the resistance between the RTD element and the point at which the Sense and Excitation wires are separate.

An external 24-volt supply powers the isolated RTD input circuits. A 5000 power supply, SCADAPack or TeleSAFE Micro16 normally sources this voltage. A range of voltages can be tolerated. Refer to the specifications for details.

In systems where multiple 5000 modules and other devices are connected the 24 volt power supply, it is possible for noise to be coupled into the 24 volt power supply. For these reasons it is recommended that the negative side of the 24 volt supply be connected to the panel or chassis ground. This connection can be made on the 5000 power supply, SCADAPack or TeleSAFE Micro16 terminal blocks or as part of the panel wiring.

Controller, modem and I/O modules use screw termination style connectors for termination of field wiring. They accommodate solid or stranded wires from 22 to 12 AWG.

The connectors are removable. This allows module replacement without disturbing the field wiring. Leave enough slack in the wiring for the connector to be removed.

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.

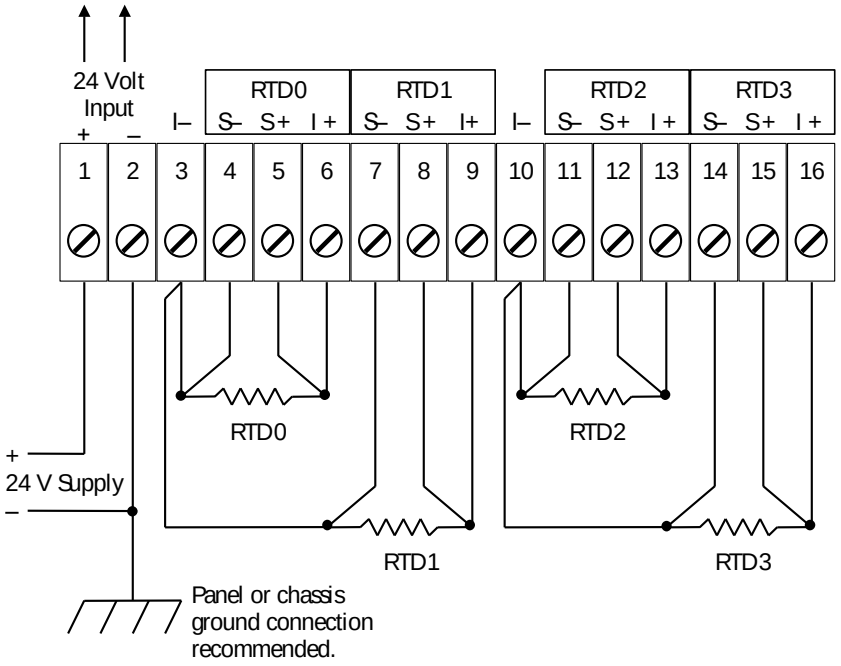

Figure 1: Typical 5503 RTD Field Wiring

Field wiring on older module versions

The initial release of the 5503 module has the polarity of the excitation and sense terminals opposite to the polarities shown in ***Figure 1: Typical 5503 RTD Field Wiring***. The RTD wiring is identical between the two versions, only the polarity of the signals has been changed.

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 5503 module has four RTD inputs. It responds to eight analog input channel addresses. The values of the RTD inputs are returned at the first four channels. The value that is returned for channels at offset 4 to 7 are identical to those at offset 0 to 3, respectively.

Each analog input module has a unique set of channels. The three address switches labeled 1, 2 and 4 set the module address. The switch labeled 8 is not used currently. 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: 5503 Analog Input Module Address* Switches** shows the switch setting for each of the 8 module addresses.

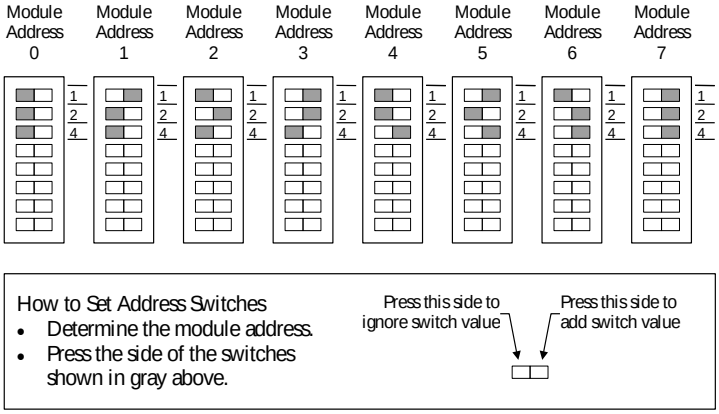

Figure 2: 5503 Analog Input Module Address Switches

RTD Range Selection

The 5503 module measures resistance in the 0 to 400 ohm range and scales and linearizes the data depending on the RTD range selected. These ranges are summarized in the table below.

Range	RTD Range	Resolution in ºC	Resolution % full scale
0 to 200ºC	0	0.052ºC	0.026%
–100 to+100ºC	1	0.051ºC	0.025%

Range	RTD Range	Resolution in ºC	Resolution % full scale
–200 to 0ºC	2	0.049ºC	0.024%
0 to 800ºC	3	0.058ºC	0.007%
0 to 400ºC	4	0.054ºC	0.014%
0 to 400 ohms	5	0.02 ohms	0.005%

Figure 3: 5503 Module RTD Range Switches shows the switch settings for the 6 possible ranges.

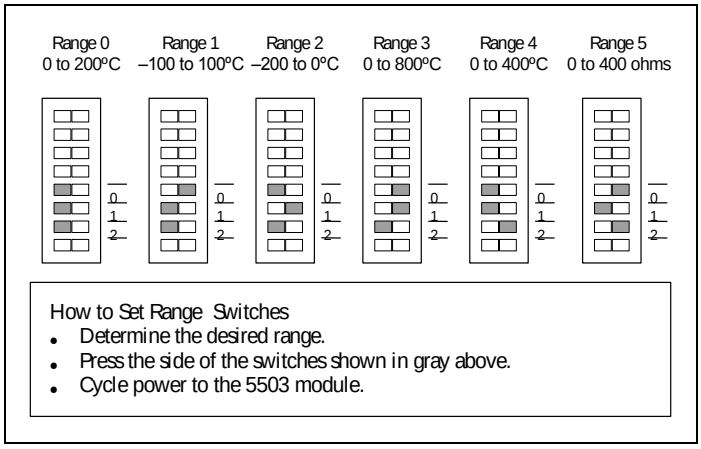

Figure 3: 5503 Module RTD Range Switches

The RTD range switches are read at reset and power up only. If the switch setting has been changed, the new range will not be in effect until the bus controller power has been cycled or the bus controller has generated a reset.

Operation and Maintenance

Data Format

5000 analog input and output modules use 16 bit signed numbers (15 bits plus sign). Modules with less than 16 bit resolution normalize the data into the 16 bit format.

The 5503 module has a 20000, unipolar, analog to digital (A/D) converter. There are 20000 A/D counts in the 0 to 400 ohm input range. The RTD ranges use a fraction of the 20000 counts. The counts are scaled and linearized to provide output data in a 16 bit signed format.

For example on the 0 to +200ºC range, the resistance range of 100 to 175.84 ohms is covered. This represents an ADC output of 5000 to 8794, or 3792 counts out of 20000. After scaling and linearization, a temperature of 130ºC will generate an output of (130/200) X 32768=21299.

The table below shows the 5503 module output value for several input signals based on the 0 to +200ºC range.

Temperature	Condition	Output
<0ºC	operating	0
0ºC	operating	0
0.05ºC	operating	8
100ºC	operating	16384
130ºC	operating	21299
199.95ºC	operating	32760
200ºC	operating	32767
NA	open RTD	32767
NA	+24V off	0

Special Conditions

The 5503 module output data has two special conditions.

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

Linearization

The 5503 module spans and linearizes the output data for the RTD range selected. Linearization is accomplished by dividing the temperature vs. resistance curve into 8 segments and extrapolating to generate an output that is a function of temperature. The worst case errors are obtained at the midpoint of

these segments, are positive and are range dependent. Refer to the following table for a summary of the linearization errors.

Range	Linearization Errors
0 to 200ºC	+0.020%
–100 to+100ºC	+0.025%
–200 to 0ºC	+0.035%
0 to 800ºC	+0.061%
0 to 400ºC	+0.025%
0 to 400 ohms	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 range.
Inputs read 32767.	Check for open RTD. Check range.
Reading is constant.	Check that the analog input is not forced.
Appears to be on wrong range.	Reset is required from the bus controller to read the RTD range switches.

Calibration

The 5503 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 are two potentiometers for calibration of the analog inputs.

- The GAIN potentiometer (R14) adjusts the gain.
- The ZERO potentiometer (R3) adjusts the offset.

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

To calibrate the module:

- Install 4 test resistors on P4. These resistors should be tested on a high quality multimeter, capable of making 4 wire resistance measurements to an accuracy of 0.02 ohms. The test resistors should include values near full scale (350-400 ohms) and near zero scale (0 ohms).
- The RTD range should be 0 - 400 ohms.
- Adjust the ZERO potentiometer for the correct reading on the 0 ohm resistor. Adjust the potentiometer clockwise only as much as necessary to get the correct reading.
- Adjust the GAIN potentiometer for the correct reading on the 350-400 ohm resistor.

Specifications

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

Inputs	4 RTD	
RTD Type	4 wire for specified accuracy 3 wire for reduced accuracy	
Calibration	based on 100 ohms at 0ºC 0.00385 ohms/ohm/ºC	
Ranges	0 to 200°C –100 to +100°C –200 to 0°C	0 to 800°C 0 to 400°C 0 to 400 ohms
Resolution	0.02 ohms approx. 0.05°C	
Accuracy on RTD ranges	percent of full scale over full temperature range including linearization errors: +0.10%/–0.05%	
Accuracy on 0 to 400 ohms	percent of full scale over full temperature range: ±0.03%	
Excitation Current	5mA, 12.5% duty cycle	
Line resistance	100 ohms max., in each line	
Converter type	20000 count, integrating	
Isolation	500VAC from the logic power	
Transient Protection	MOVs on each input	
Response Time	300ms typical for 10% to 90% signal change	
Power Requirements	5V at 40mA 18 to 28V at 30mA	
Terminations	16 pole, removable terminal block 12 to 22 AWG 15 amp contacts	
Dimensions	4.25 inch (108 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	Suitable for use in Class I, Division 2, Groups A, B, C and D Hazardous Locations. Temperature Code T4 CSA certified to the requirements of: • CSA Std. C22.2 No. 213-M1987 - Hazardous Locations. • UL Std. No. 1604 - Hazardous (Classified) Locations.
Safety	CSA (cCSAus) certified to the requirements of: CSA C22.2 No. 142-M1987 and UL508. (Process Control Equipment, Industrial Control Equipment) UL (cULus) listed: UL508 (Industrial Control Equipment)