USER MANUAL

SPECTRUM CONTROLS

An Allied Motion Company

User's Manual Pub. 0300310-03 Rev. A

1756 RMS Analog Input Module

Catalog Number: 1756-RMS-SC/1756-RMSK-SC

SILVER Technology Partner

A ROCKWELL AUTOMATION PARTNER

Important Notes

Please read all the information in this owner's guide before installing the product.

The information in the guide applies to hardware version 1.001 and firmware version 1.001 or later.

This guide assumes that you have a full working knowledge of the relevant processor.

Notice

The product and services described in this owner's guide are useful in a wide variety of applications. Therefore, you and others responsible for applying the products and services described herein are responsible for determining their acceptability for each application. While efforts have been made to provide accurate information within this owner's guide, Spectrum Controls, Inc. assumes no responsibility for the accuracy, completeness, or usefulness of the information herein.

Under no circumstances will Spectrum Controls, Inc. be responsible or liable for any damages or losses, including indirect or consequential damages or losses, arising out of either the use of any information within this guide or the use of any product or service referenced herein.

No patent liability is assumed by Spectrum Controls, Inc. with respect to the use of any of the information, products, circuits, programming, or services referenced herein.

The information in this owner's guide is subject to change without notice.

Limited Warranty

Spectrum Controls, Inc. warrants that its products are free from defects in material and workmanship under normal use and service, as described in Spectrum Controls, Inc. literature covering this product, for a period of 1 year.

The obligations of Spectrum Controls, Inc. under this warranty are limited to replacing or repairing, at its option, at its factory or facility, any product which shall, in the applicable period after shipment, be returned to the Spectrum Controls, Inc. facility, transportation charges prepaid, and which after examination is determined, to the satisfaction of Spectrum Controls, Inc., to be thus defective.

This warranty shall not apply to any such equipment which shall have been repaired or altered except by Spectrum Controls, Inc. or which shall have been subject to misuse, neglect, or accident. In no case shall the liability of Spectrum Controls, Inc. exceed the purchase price. The aforementioned provisions do not extend the original warranty period of any product which has either been repaired or replaced by Spectrum Controls, Inc.

Table of Contents

Preface

NOTE	This is a re-issue of an existing manual, with some corrections, and updated Certification information.

Read this introduction to familiarize you with the rest of the owner's guide. This preface covers the following topics:

- Who should use this manual
- How to use this manual
- Rockwell Automation support
- Documentation
- Conventions used in this guide

Who Should Use This Manual

You must be able to program and operate an Allen-Bradley ControlLogix™ 1756 Controller to efficiently use your input modules. We assume that you know how to do that in this manual. If you do not, refer to the appropriate Allen Bradley manual for the associated AB controller.

How to Use This Manual

Use this guide to install, configure, and troubleshoot your ControlLogix RMS module. The RMS Module mounts to an Allen-Bradley ControlLogix 1756 Controller chassis. The module uses a Removable Terminal Block (RTB) to connect all field-side wiring.

Before you install your module you should have already:

- Installed and grounded a 1756 chassis and power supply.
- Ordered and received an RTB and its components for your application.

Rockwell Automation Technical Support

For technical support, please contact your local Rockwell Automation TechConnect Office for all Spectrum products. Contact numbers are as follows:

- USA 1-440-646-6900
- United Kingdom 01-908-635-230
- Australia 1-800-809-929
- Mexico 001-888-365-8677
- Brazil 55-11-3618-8800
- Europe +49-211- 41553-630

or send an email to support@spectrumcontrols.com

Documentation

If you would like a .PDF version of a manual, you can download a free electronic version at www.spectrumcontrols.com

Conventions Used in This Manual

The following conventions are used throughout this manual:

- Bulleted lists (like this one) provide information not procedural steps.
- Numbered lists provide sequential steps or hierarchical information.
- *Italic* type is used for emphasis.
- **Bold** type identifies headings and sub-headings.

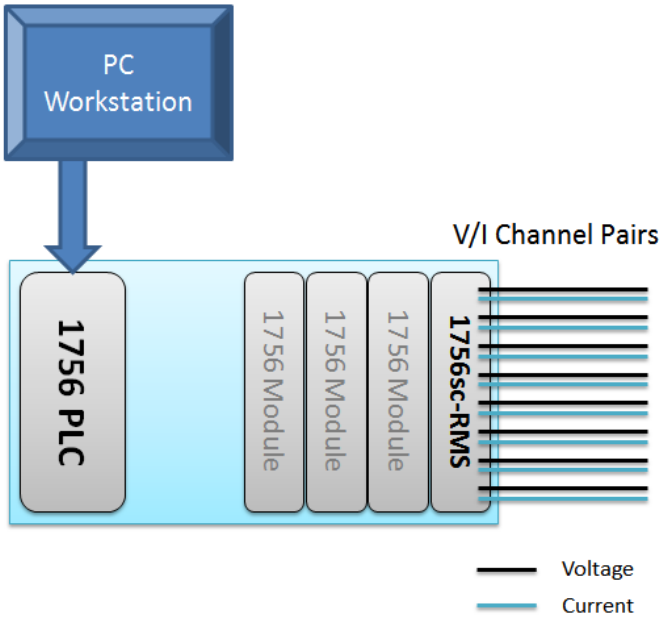
WARNING 	Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. These messages help you to identify a hazard, avoid a hazard, and recognize the consequences.

ATTENTION 	Actions ou situations risquant d'entraîner des blessures pouvant être mortelles, des dégâts matériels ou des pertes financières. Les messages « Attention » vous aident à identifier un danger, à éviter ce danger et en discerner les conséquences.

NOTE 	Identifies information that is critical for successful application and understanding of the product.

Chapter 1
Module Overview

The 1756-RMS-SC/1756-RMSK-SC 8-Channel Analog Input Modules provide RMS voltage, RMS current, real power, apparent power, and reactive power measurement for a single-phase, or any, power system. The 1756-RMS-SC is compatible with existing Allen-Bradley 1756 controllers, and occupies one standard slot in a 1756 ControlLogix series PLC as shown below:

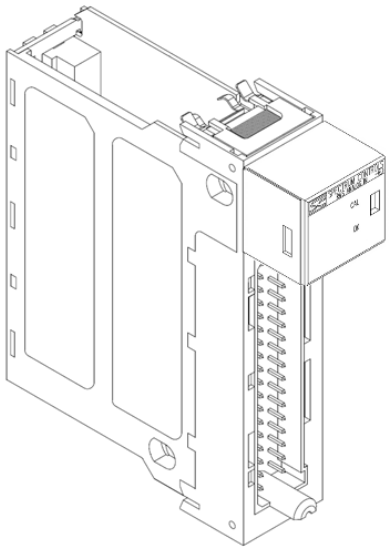


Each module provides 16 inputs (8 pairs of voltage input pairs, one corresponding to voltage, one corresponding to current) with channel-to-channel isolation.

This chapter describes the module and explains how the modules measure voltage and current for the purpose of calculating various power measurements. The following information is included:

- General Description
- Input Specifications
- Data Inputs
- Hardware Features
- System Overview and Module Operation

Section 1.1 General Description



The 1756-RMS-SC measures voltage and current input data. The module supports:

- 8, isolated, independently configurable input channel pairs.
- Four input ranges.
- Over voltage alarm.
- Custom user calibration.
- Settable RPI.
- Time stamping.
- Alarm latching.
- Fault reporting.
- LED status information.
- Downloadable firmware using ControlFlash.
- Removal and insertion under power (RIUP).

The module uses a standard 36-pin, 1756 I/O black removable terminal block. The backplane interface uses the Allen-Bradley supplied Standalone ASIC.

All power for the 1756-RMS-SC module is provided by the PLC backplane. The backplane 5.1 VDC supply powers the backplane interface hardware, and the backplane 24 VDC supply powers the analog front ends.

The 1756-RMS-SC module uses an integrated ADC and power metering processor. The module digitally converts and stores analog data from either the current or voltage input type.

Input signals to the card can be either DC or fixed frequency AC (50 or 60 Hertz, 400 Hz or more, depending on waveform) voltage signals. These modules are typically connected to the output of Potential Transformers (PT) at 5 VAC, and Current Transformers (CT) and associated load resistor at 5 VAC. The module provides four ranges of inputs.

The module is able to work with non-typical AC waveforms: specifically phase angle-fired SCR waveforms over the full range of all firing angles. Inputs are designed to prevent clamping/clipping of inputs for all firing angles. High input impedance will allow an input to be connected to two separate modules, for

redundant measurement. In this configuration, the inputs do not interfere with each other's operation.

For each pair of inputs, the Peak Voltage and Peak Current values are used to calculate Apparent Power. RMS Voltage and RMS current are used to calculate Real Power (sometimes referred to as Average Power, Active Power, or True Power).

Since the inputs to the module may include current transformer signals, front-end protection and isolation from the backplane is provided to protect against unexpected CT load resistor failures producing a voltage up to 8 kV. The module has 250 VAC, continuous, basic galvanic isolation from channel-to-channel and channel-to-frame ground, and reinforced isolation between all channels and the backplane.

Calibration of this module with an AC sine wave is initially completed at Spectrum Controls. The calibration coefficients are stored in non-volatile memory. Field calibration is also supported, allowing you to provide your own, custom, calibration providing for more accurate measurements, that take into account system component non-linearity and complex waveforms.

Section 1.2
Input Specifications

The 1756-RMS-SC has the following input specifications:

Table 1-1. Input/Performance/Environmental Requirements

Parameter	Specification
Operating Temperature	0 °C to 60 °C (32 °F to 140 °F)
Storage Temperature	-40 °C to 85 °C (-40 °F to 185 °F)
Operating Humidity	5 to 95%, noncondensing
Storage/Non-Operating Humidity	5% to 95%, non-condensing
Vibration/Operating	10 Hz to 500 Hz, 2 g, 0.030 max peak-to-peak
Operating Shock	25 g, peak acceleration, 11±1 ms pulse, half sine
Storage/Non-Operating Shock	25 g peak acceleration, 11±1 ms pulse, half sine; 35 g for panel mount.
Electrostatic Discharge	±6 kV Indirect (Coupling Plate) ±6 kV Contact Discharge (to points of initial contact) ±8 kV Air Discharge (to points of initial contact)
Radiated Immunity	10 V/M with 1 kHz sine-wave 80% AM from 80…2000 MHz 10 V/M with 200 Hz square-wave 50% Pulse 100% AM at 900 MHz 10 V/M with 200 Hz square-wave 50% Pulse 100% AM at 1890 MHz 10 V/M with 1 kHz sine-wave 80% AM from 2000…2700 MHz 3 V/M with 1 kHz sine-wave 80% AM from 2000…6000 MHz
EFT Immunity	±3 kV at 5 kHz for 5 minutes on communication ports and power ports ±3 kV at 5 kHz for 5 minutes on (PE) ground port

Parameter	Specification
Operating Altitude	2000 meters maximum
Number of Inputs	16 inputs (8 groups of two channels) of voltage and current input pairs
Module Location	1756 ControlLogix Chassis
Power Consumption	160 mA at 5.1 V
	100 mA at 24 V
Inrush Current	400 mA at 5.1 V
	450 mA at 24 V
Power Dissipation within Module	4.0 W maximum
Potential transformer Input Ranges (voltage)	5 V RMS, 10 V peak at Range 1; 7.071 V RMS, full-scale 2.5 V RMS, 5 V peak at Range 2; 3.535 V RMS, full-scale 1 V RMS, 2 V peak at Range 3; 1.414 V RMS, full-scale 0.5 V RMS, 1 V peak at Range 4; 0.7071 V RMS full-scale
Current transformer Input Ranges (current)	5 V RMS, 10 V peak at Range 1 2.5 V RMS, 5 V peak at Range 2 1 V RMS, 2 V peak at Range 3 0.5 V RMS, 1 V peak at Range 4
Surge Transient Immunity	±2 kV line-earth {CM}at 2 Ω on communications ports ±2 kV CM at 42 Ω, ±1 kV DM at 2 Ω on shielded ports
Conducted Immunity	10 V RMS with 1 kHz sine wave 80% AM from 150 kHz…80 MHz on communications, power ports, and (PE) ground
Input Impedance (resistance)	7 MΩ minimum, 500 pf maximum
Input Overvoltage Protection (current and voltage)	±50 V DC/AC continuous 8000 VAC continuous for CT with load resistor
Typical Accuracy at 25 °C with sine wave	Current and Voltage: ±0.25% full scale RMS Power: ±0.25% full scale
Typical accuracy with complex waveform, and worst =-case accuracy with sine wave (at 25 °C)	Current and Voltage: ±0.5% full scale Power: ±0.5% full scale
Gain Drift with Temperature	50 ppm/°C max
Adjacent Channel Crosstalk	±0.03% of full scale
Common Mode Rejection	±10 V maximum per channel
Isolation Voltage	250 VAC RMS continuous working voltage Basic insulation channel-to-channel and channel-to-FGND Reinforced insulation channel to backplane
RTB Screw Torque	4.4 inch-pounds (0.4 Nm)
RTB Keying	User-defined
Field Wiring Arm and Housing	36-Position RTB (1756-TBCH or TBS6H)
Enclosure Type Rating	None (open style)

Parameter	Specification
Conductors Wire Size	22-14 gauge (2 mm) stranded maximum
	3/64 inch (1.2 mm) insulation maximum

Table 1-2. Safety Test Specification Table

Safety Tests	Industry Standards
UL Safety	UL 61010-2-201 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 2-201: Particular Requirements for Control Equipment (NRAQ, NRAQ7) cUL CAN/CSA C22.2 No. 61010-1-12 (Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements)
UL Hazardous Locations	ANSI/ISA–12.12.01–2007 Nonincendive Electrical Equipment for Use in Class I, Division 2 Hazardous (Classified) Locations (NRAG) CSA C22.2 No. 213-M1987–Non-incendive Electrical Equipment for use in Class I Division 2 Hazardous Locations - March 1987 (NRAG7) Temp code T4 or better, Pollution degree 2, gas groups A, B, C, and D
CE EMC Directive	IEC 61131-2 Programmable Controllers: Third Edition 2007-02, Clause 8 IEC 61000-6-2: Generic Industrial Immunity IEC 61000-6-4: Generic Industrial Emissions
CE Low Voltage Directive	EN 61010-2-201 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use–Part 2-201: Particular Requirements for Control Equipment
ATEX	EN 60079-0:2012/A11:2013 Explosive atmospheres–Part 0: Equipment–General requirements EN 60079-15:2010 Explosive atmospheres–Part 15: Equipment protection by type of protection

Section 1.3 Regulatory Compliance

Certifications (when product is marked)[1] **cULus**	UL Listed for Class I, Division 2 Group A, B, C, D Hazardous Locations, certified for U.S. and Canada. See UL File E180101. UL Listed Industrial Control Equipment, certified for U.S. and Canada. See UL File E140954.
	Ex European Union 2014/34/EU EN 61010-2-201 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 2-201: Particular Requirements for Control Equipment ATEX Directive, compliant with: EN 60079-7; Increased Safety “ec” (Zone 2) II 3 G Ex ec IIC T4 Gc EN 60079-0: ATEX General Requirements
CCC	Certificate UL 20 ATEX 2403X This product has obtained CCC certification and meets the requirements of GB/T3836.1-2021, GB/T3836.3-2021 GBEx 2021312310000324 GBEx 2021312310000344
UKCA	CE European Union 2014/30/EU EMC Directive, compliant with: EN 61000-6-4; Industrial Emissions EN 61000-6-2; Industrial Immunity EN 61131-2; Programmable Controllers (Clause 8, Zone A & B) Electromagnetic Compatibility Regulations 2016 BS EN 61131-2, BS EN 61000-6-4, BS EN 61000-6-2 Equipment and Protective Systems Intended for use in Potentially Explosive Atmospheres Regulations 2016 BS EN 60079-0, BS EN 60079-7
CMIM	Arrêté ministériel n° 6404-15 du 29 ramadan 1436 (16 juillet 2015) NM EN 61131-2, NM EN 61000-6-4, NM EN 61000-6-2

Section 1.4 Data Inputs

Data Inputs:

- Floating point data (volts, amps, watts)
- RMS voltage and current per channel
- Peak voltage and current

[1] For the latest up-to-date information, see the Product Certification link at www.spectrumcontrols.com for Declarations of Conformity, Certificates and other certification details.

- Real power
- Apparent power
- Reactive power
- Power factor

Status functions:

- High/Low voltage alarm
- High/Low current alarm
- Voltage/current clipping alarm
- Alarm latching

Section 1.5 Hardware Features

Channels are wired as single ended voltage inputs. The same GND connects both voltage and current inputs. Open-circuit detection is not supported for the initial version of the product. ESD protection is provided: 6 kV for indirect and contact discharge, 8 kV for air discharge. Inputs are also fault-protected up to 50 VDC or AC continuous for all inputs.

Module configuration is done via RSLogix 5000 software. The following languages are supported:

- English
- French
- Spanish
- Italian
- German
- Portuguese
- Dutch
- Chinese (Simplified)
- Japanese

The module and its wiring pins are covered during installation in Chapter 2.

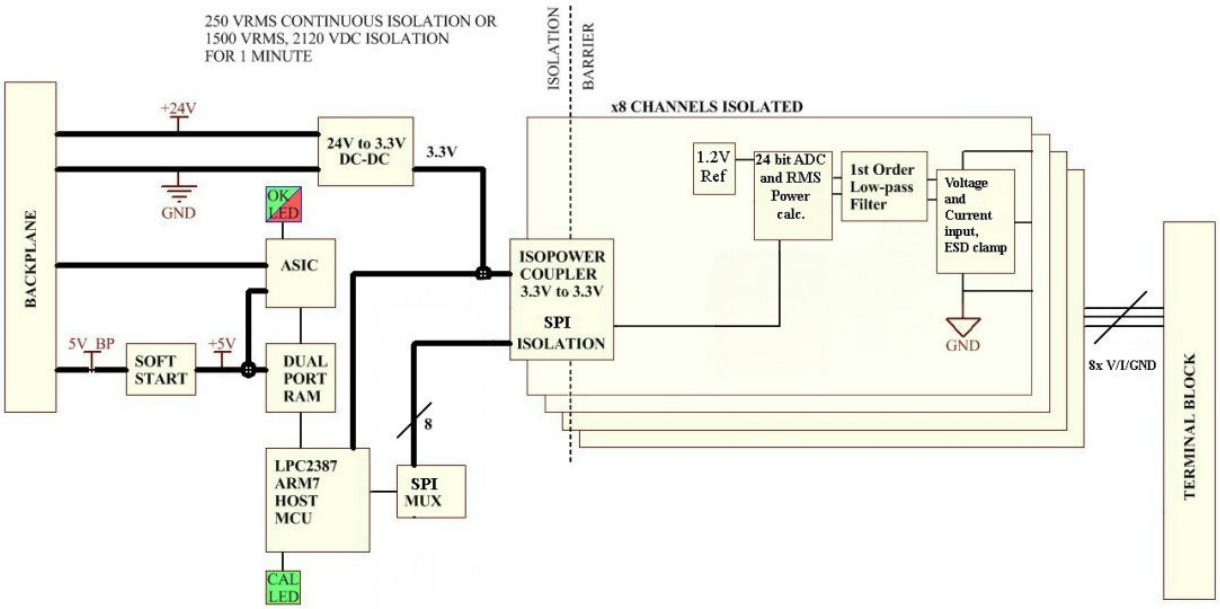
LED Indicators

The 1756-RMS-SC module uses two LEDs; one to show power or model operational status, and one for calibration. LED indicator information is provided in Chapter 2.

Section 1.6 System Overview

The module is expected to run continuously 24 hours a day, 7 days a week for an indefinite period of time. There is no need for periodic shut down and maintenance or calibration of this product. The module communicates to the controller through the bus interface. The module also receives 5 VDC and 24 VDC through the bus interface.

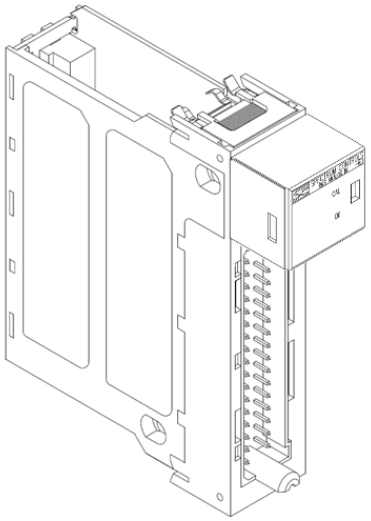
Block diagram:



Chapter 2
Installing the ControlLogix 1756-RMS-SC Module

Section 2.1
Before You Begin

Use this guide to install, configure, and troubleshoot your ControlLogix RMS module. The RMS Module mounts to an Allen-Bradley ControlLogix 1756 Controller chassis. The module uses a Removable Terminal Block (RTB) to connect all field-side wiring.



Before you install your module, you should have already:

- Installed and grounded a 1756 chassis and power supply.
- Ordered and received an RTB and its components for your application.

WARNING 	**Electrostatic discharge can damage integrated circuits or semiconductors if you touch backplane connector pins.** To prevent damage, follow these guidelines when you handle the module: • Touch a grounded object to discharge static potential. • Wear an approved wrist-strap grounding device. • Do not touch the backplane connector or connector pins. • Do not touch circuit components inside the module. • If available, use a static-safe workstation. • When not in use, keep the module in its static-shield box. .

WARNING	**Hazard of electrical arcing when removing or inserting the module while power is applied to the rack.** This module is designed so you can remove and insert it under backplane power and field-side power. When you remove or insert a module while field-side power is applied, you may cause an electrical arc. An electrical arc can cause personal injury or property damage because it may: • Send an erroneous signal to your system's field devices, causing unintended machine motion or loss of process control. • Cause an explosion in a hazardous environment. • Repeated electrical arcing also causes excessive wear to contacts on both the module and its mating connector. Worn contacts may create electrical resistance.

Section 2.2 EMC Directive

This product is tested to meet Council Directive 2014/30/EU Electromagnetic Compatibility (EMC) and the following standards, in whole or in part, documented in a technical construction file:

- EN 61000-6-4 Electromagnetic compatibility (EMC)–Part 6-4: Generic standards–Emission standard for industrial environments.
- EN 61000-6-2 Electromagnetic compatibility (EMC)–Part 6-2: Generic standards–Immunity for industrial environments.

UKCA Electromagnetic Compatibility Regulations 2016

- BS EN 61131-2, BS EN 61000-6-4, BS EN 61000-6-2.

This product is intended for use in an industrial environment.

Section 2.3 ATEX Directive

This product is tested to meet Council Directive 2014/30/U/ATEX, and the following standards, in whole or in part, documented in a technical construction file:

- EN 60079-0 Explosive atmospheres – Part 0: Equipment – General requirements.
- EN 60079-7 Explosive atmospheres – Part 7: Equipment protection by increased safety "e".

This module also meets the standards for the United Kingdom Equipment and Protective Systems Intended for use in Potentially Explosive Atmospheres Regulations 2016:

- BS EN 60079-0
- BS EN 60079-7

Section 2.4 Low Voltage Directive

This product is tested to meet Council Directive 2014/35/EU Low Voltage, by applying the safety requirements of EN 61010-2-201 Safety Requirements for

Electrical Equipment for Measurement, Control, and Laboratory Use - Part 2-201: Particular Requirements for Control Equipment.

For specific information required by EN 61010-2-201, see the appropriate sections in this publication, as well as the following Allen-Bradley publications:

- Industrial Automation Wiring and Grounding Guidelines For Noise Immunity, publication 1770-4.1
- Automation Systems Catalog, publication B111.

This equipment is classified as open equipment and must be installed (mounted) in an enclosure during operation as a means of providing safety protection.

Section 2.5 Important Power Requirements Information

This module receives power from the 1756 chassis power supply and requires 2 sources of power: 160 mA at 5 V; 100 mA at 24 V from the backplane.

5 VDC	24 VDC
160 mA	100 mA

Add this current to the requirements of all other modules in this chassis to prevent overloading the chassis backplane.

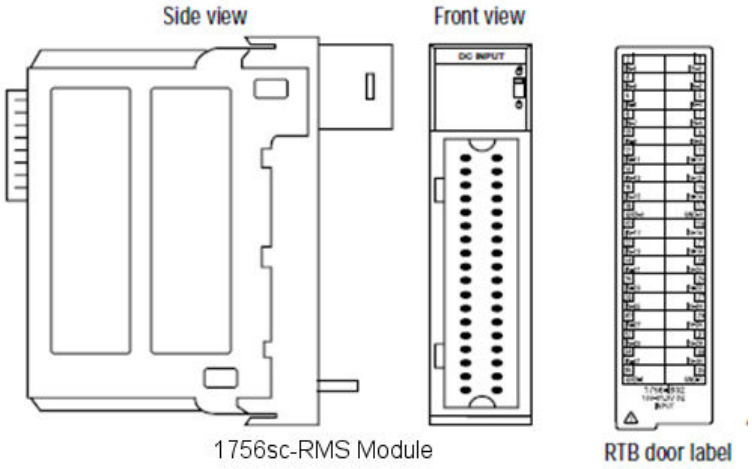
You receive the following components with your RTB:

- 1756-TBH standard-depth RTB housing.
- Wedge-shaped keying tabs and U-shaped keying bands.
- A generic RTB door label.

Use these components in all module applications. Use an optional extended-depth cover (1756-TBE) or applications requiring heavy gauge wiring.

Section 2.6 Identifying the Module Components

You receive the following two components with your order:



If you do not receive either of these components, contact your local Allen-Bradley distributor.

Section 2.7 Removable Terminal Block and Housing

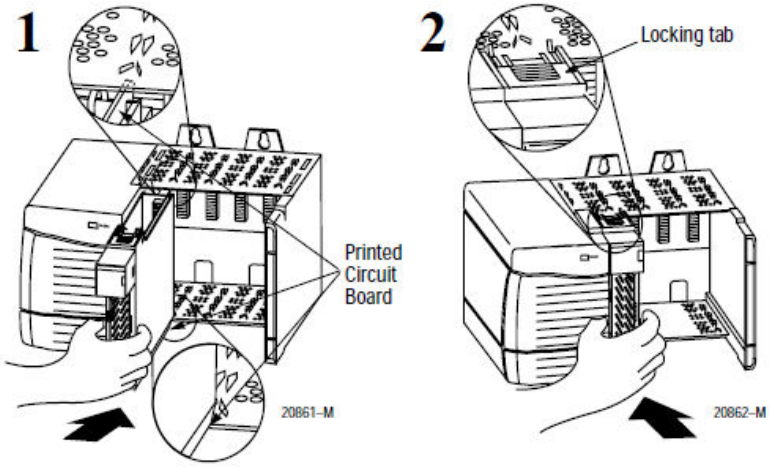
A separately-ordered RTB connects field-side wiring to the module. You cannot use your module without an RTB and its components.

Use one of the following RTBs with your module:

- 1756-TBCH 36-position Cage clamp RTB
- 1756-TBS6H 36-position Spring clamp RTB

Section 2.8
Installing the Module

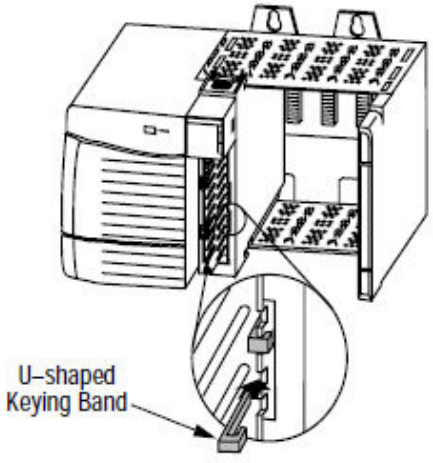
You can install the module while chassis power is applied.



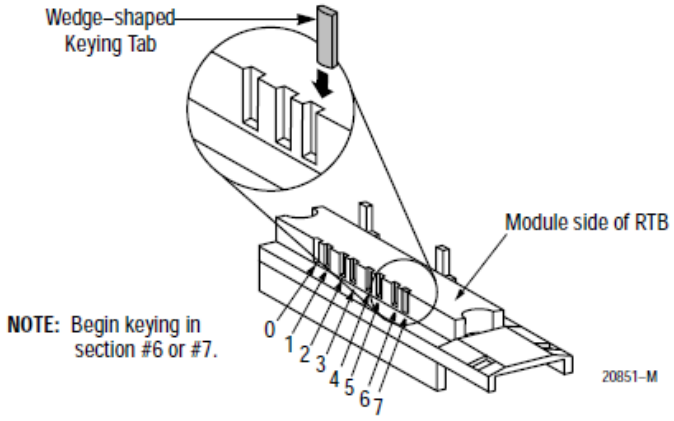
Section 2.9
Keying the Removable Terminal Block

Key the RTB to prevent inadvertently making the wrong wire connections to your module. Use a unique keying pattern for each module. You can use a minimum of one key.

1. Key the module. Insert the U-shaped band with the longer side near the terminals. Push the band onto the module until it snaps into place.



2. Key the RTB in positions that correspond to un-keyed module positions. Insert the wedge-shaped tab on the RTB with the rounded edge first. Push the tab onto the RTB until it stops.



3. Reposition the tabs to rekey future module applications.

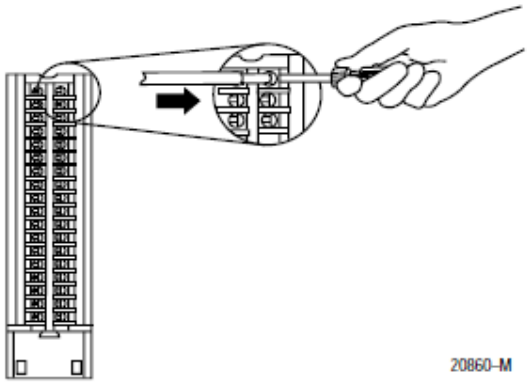
Section 2.10 Wiring the Removable Terminal Block

Wire the RTB before installing it onto the module. Use a 1/8-inch (3.2 mm) maximum flat-bladed screwdriver.

NOTE	Before wiring, pull the housing off the RTB.

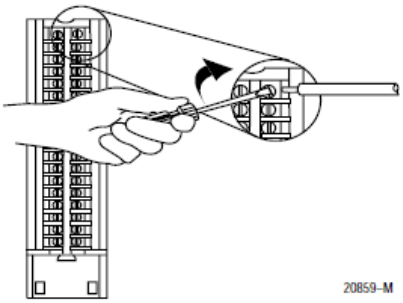
Wiring the Spring Clamp RTB

1. Strip 7/16-inch (11 mm) maximum length to wire your RTB.
2. Insert the screwdriver into the outer hole of the RTB.
3. Insert the wire into the open terminal and remove the screwdriver.



Wiring the Cage Clamp RTB

1. Strip 5/16- to 3/8-inch (8 to 9.5 mm) length to wire your RTB.
2. Insert the wire into the open terminal.
3. Turn the screw clockwise to close the terminal on the wire.

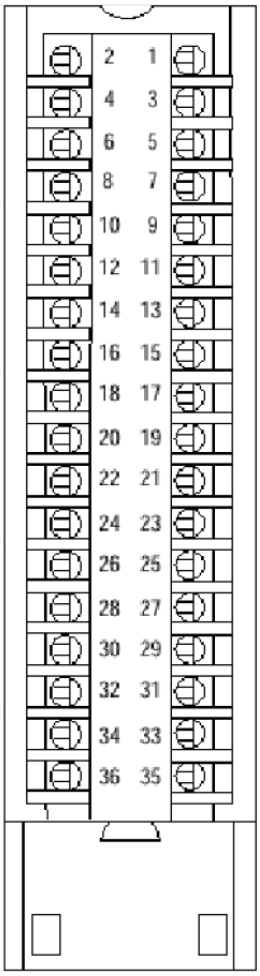


1756-RMS-SC Wiring Example

Use the following wiring example to guide you when wiring.

The analog input signals enter the module through the standard 36-pin 1756 removable terminal block:

RTB Pin#	Name
2	X0
4	GND 0
6	X1
8	GND 1
10	X2
12	GND 2
14	X3
16	GND 3
18	X4
20	GND 4
22	X5
24	GND 5
26	X6
28	GND 6
30	X7
32	GND 7
34	NC
36	NC

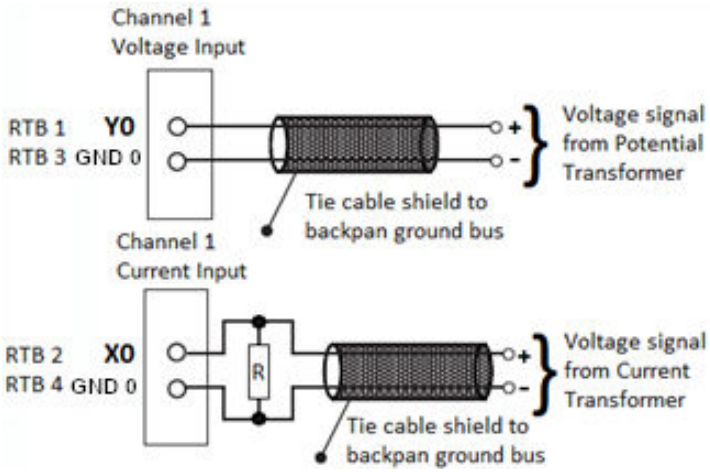


Name	RTB Pin#
Y0	1
GND 0	3
Y1	5
GND 1	7
Y2	9
GND 2	11
Y3	13
GND 3	15
Y4	17
GND 4	19
Y5	21
GND 5	23
Y6	25
GND 6	27
Y7	29
GND 7	31
NC	33
NC	35

RTB Pin#	Usage	Usage	RTB Pin#
2	Channel X0	Channel Y0	1
4	Ground 0	Ground 0	3
6	Channel X1	Channel Y1	5
8	Ground 1	Ground 1	7
10	Channel X2	Channel Y2	9
12	Ground 2	Ground 2	11
14	Channel X3	Channel Y3	13
16	Ground 3	Ground 3	15
18	Channel X4	Channel Y4	17

RTB Pin#	Usage	Usage	RTB Pin#
20	Ground 4	Ground 4	19
22	Channel X5	Channel Y5	21
24	Ground 5	Ground 5	23
26	Channel X6	Channel Y6	25
28	Ground 6	Ground 6	27
30	Channel X7	Channel Y7	29
32	Ground 7	Ground 7	31
34	Not Used	Not Used	33
36	Not Used	Not Used	35

NOTE	X (even pin #) inputs are for current, and Y (odd pin #) inputs are for voltage.



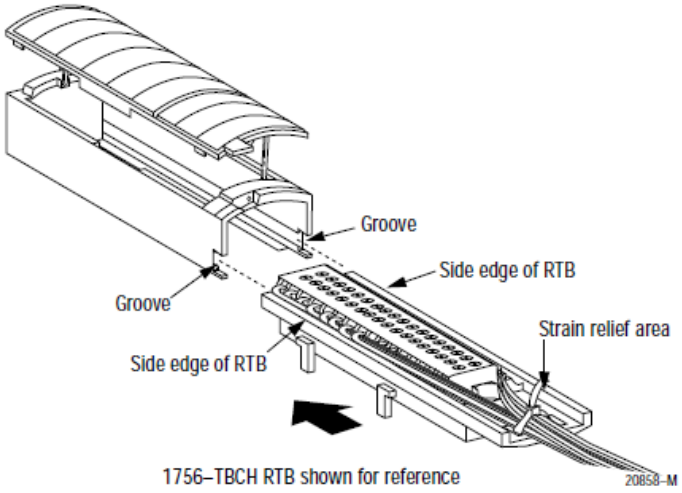
After field-side wiring is complete, secure the wires in the strain relief area of the RTB. This is the open area at the base of the RTB.

Section 2.11 Assembling the Removable Terminal Block and the Housing

To assemble the removable terminal block and its housing:

1. Align the grooves at the bottom of each side of the housing with the side edges of the RTB.

2. Slide the RTB into the housing until it snaps into place. Secure the cable in the strain relief area with a cable-tie as shown below:



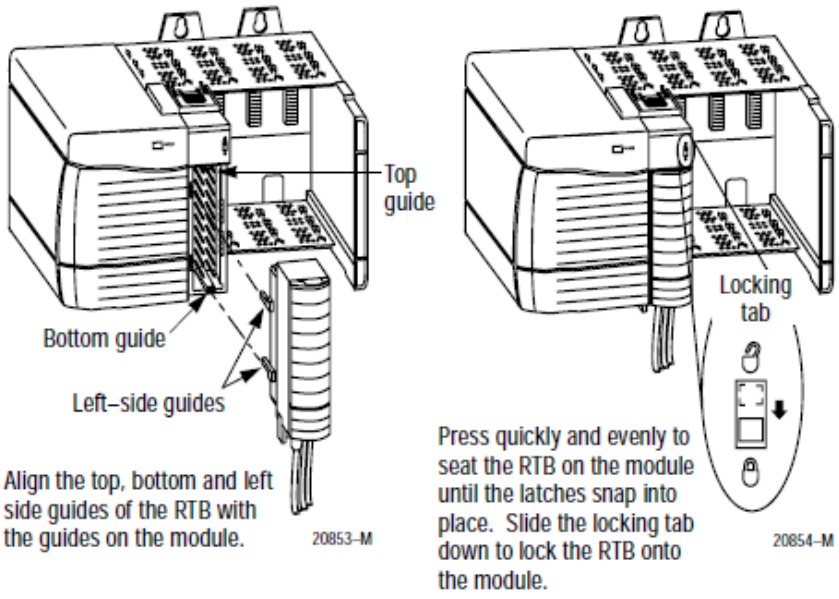
Section 2.12 Installing the Removable Terminal Block onto the Module

WARNING	**Hazard of shock to personnel.** If the RTB is installed onto the module while the field-side power is applied, the RTB will be electrically live. **Touching the RTB's terminals while power is applied may result in an electrical shock causing injury to the person involved.** To avoid this hazard, do not touch the RTB's terminals during installation.

WARNING	**Hazard of unintended machine motion or loss of process occurring during RTB insertion with field-side power applied.** **Unintended machine motion or loss of process control may cause injury to personnel or damage to equipment.** This module is designed to support Removal and Insertion Under Power (RIUP). However, when you remove or insert an RTB with field-side power applied, **unintended machine motion or loss of process control can occur**. When using this feature, exercise extreme caution.

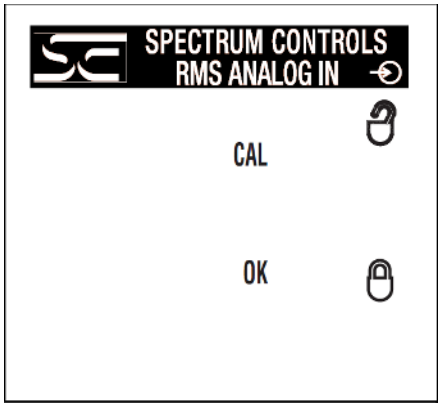
Before installing the RTB terminal, make certain:

- Field-side wiring of the RTB is completed.
- The RTB housing is snapped into place on the RTB.
- The RTB housing door is closed.
- The locking tab at the top of the module is unlocked.



Checking the Indicators

The indicators show a bi-colored LED for Module **OK** (red/green):



During power up, the module performs an indicator test. The **OK** indicator turns red for 1 second, and then turns to flashing green if it has passed the self-test.

There are two LEDs as defined below. Both the ASIC and the module software have requirements to update the LEDs.

Module State:	**OK LED State:**	**CAL LED State**	**Comments:**
Power On/Init	Solid Red	Solid Green	Initial state. LED power on test (approx. 1 sec.).
Normal operations	Blinking Green	Off	ASIC OK. No active connection or connected but module is in idle mode.
Normal operations	Solid Green	Off	Normal run mode state.

Module State:	OK LED State:	CAL LED State	Comments:
Connection lost	Blinking Red	Off	Communication between the controller and the module has been lost.
Firmware update	Blinking Red	Solid Green	Firmware update in progress.
Faulted	Solid Red	Off	Hardware failure.
Abnormal	Off	Off	Hardware failure.
Faulted	Solid Red	Blinking Green with pauses in between a blink count.	Blink Codes: (see Blink Codes table below)

Blink Codes

Code	Name	Condition
3	EEPROM CRC failed	The ASIC EEPROM CRC is not valid.
4	Invalid serial number	This code only present during manufacturing while BITE jumper is installed. Serial number is all zeroes.
6	Application CRC failed	The application code is corrupt and cannot execute.
6	Calibration data corrupt	The stored manufacturing calibration data is corrupt and cannot be read. No calibration is applied to input data.
7	Watchdog timeout	The software stopped functioning and did not update the watchdog timer.

This completes module installation. Use the information in the following section to remove the RTB and the module. Use the information in Chapter 3 to configure the module using software.

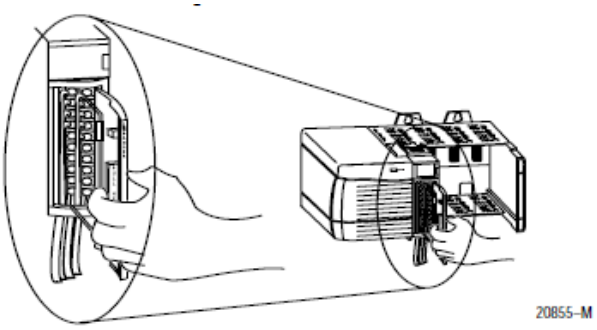
Removing the Removable Terminal Block and the Housing

WARNING 	**Hazard of shock to personnel.** If the RTB is removed from the module while the field-side power is applied, the RTB will be electrically live. Touching the RTB's terminals while power is applied may result in an electrical shock causing injury to the person involved. To avoid this hazard, do not touch the RTB's terminals during installation.

WARNING 	**Hazard of unintended machine motion or loss of process occurring during RTB insertion with field-side power applied.** **Unintended machine motion or loss of process control may cause injury to personnel or damage to equipment.** This module is designed to support Removal and Insertion Under Power (RIUP). However, when you remove or insert an RTB with field-side power applied, **unintended machine motion or loss of process control can occur**. When using this feature, exercise extreme caution.

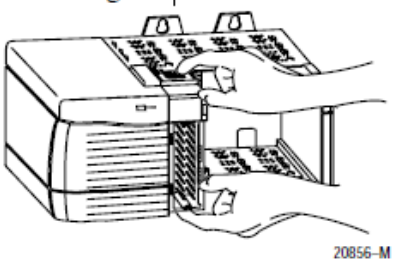
Before removing the module, you must remove the RTB as follows:

1. Unlock the locking tab at the top of the module.
2. Open the RTB door and pull the RTB off the module as shown:

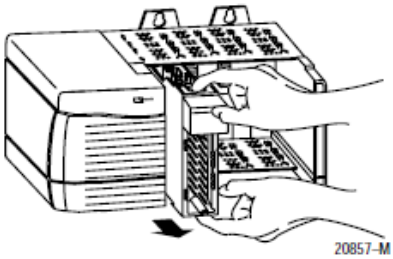


Remove the Module

1. Push in top and bottom locking tabs.



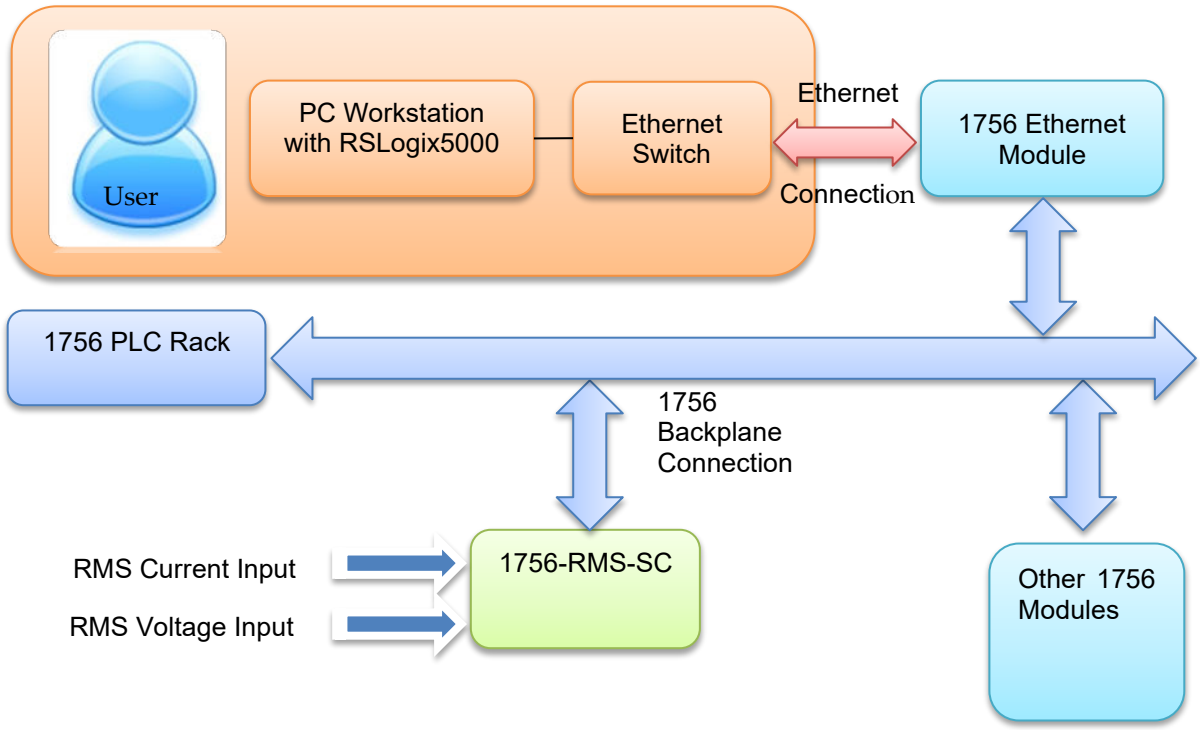
2. Pull module out of the chassis.



Chapter 3
Configuring the Module with RSLogix 5000

This chapter covers software configuration of the module. More detailed information about ControlLogix I/O Modules in general, and additional information about features described below can be found in the *ControlLogix Analog I/O Modules User Manual* Publication 1756-UM009, and in the RSLogix 5000 Online Help.

The add-on profile may be downloaded at www.spectrumcontrols.com.

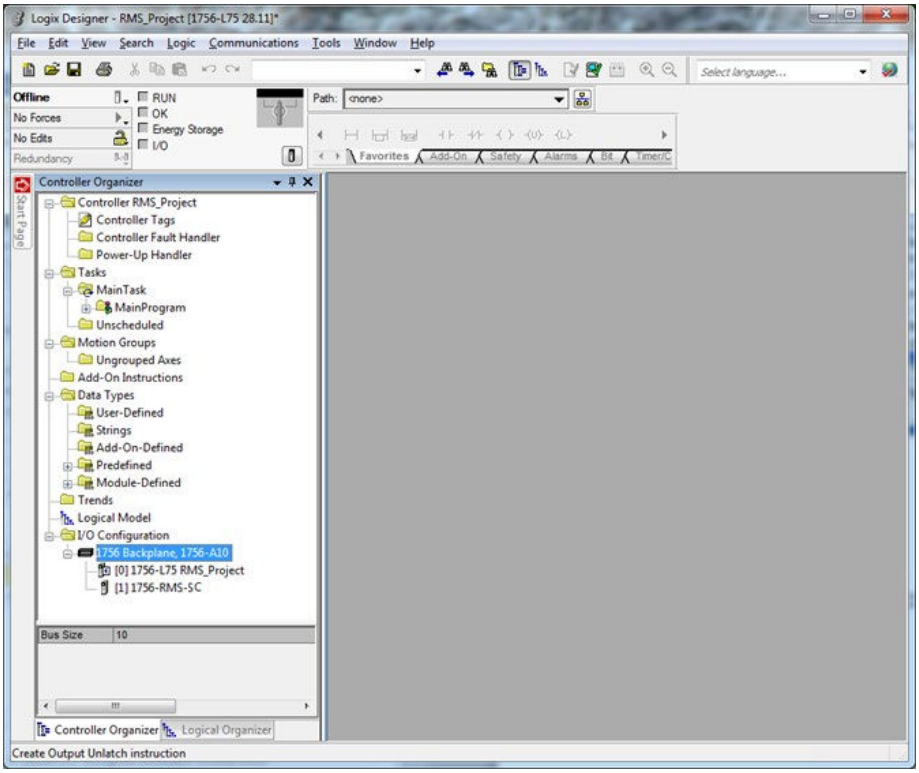


Section 3.1
Configuring the Module with Studio 5000 or RSLogix 5000

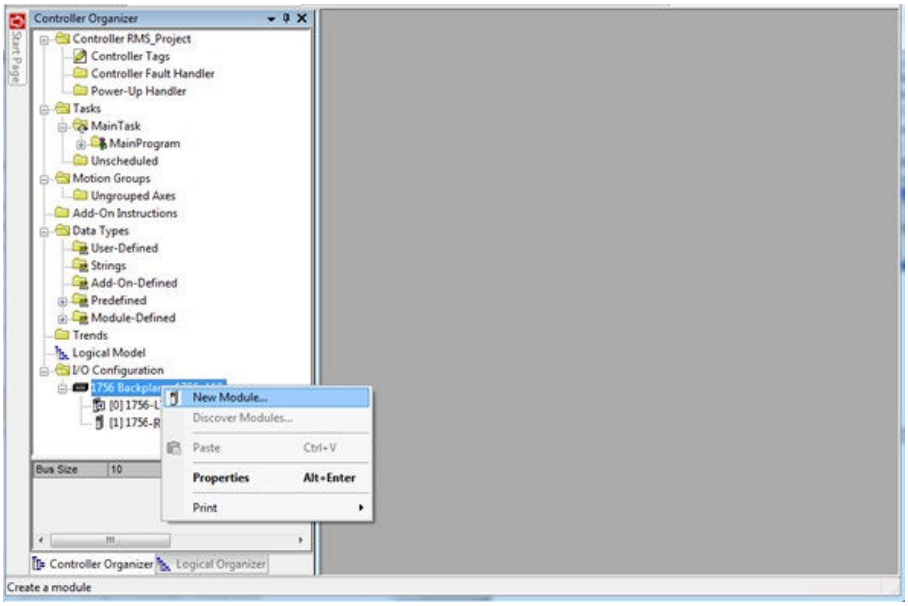
You use RSLogix 5000 software, and the appropriate Add-On Profile software to add, locate, and configure your new module. You specify whether or not to enable a change of state when the module transitions from Off to On, or from On to Off. You also determine the input filter timings, and whether or not to log input data with a timestamp.

Once you have correctly installed your module, configure it as follows. More detailed tables on configuration and/or manual calibration of your module may be found later in this chapter:

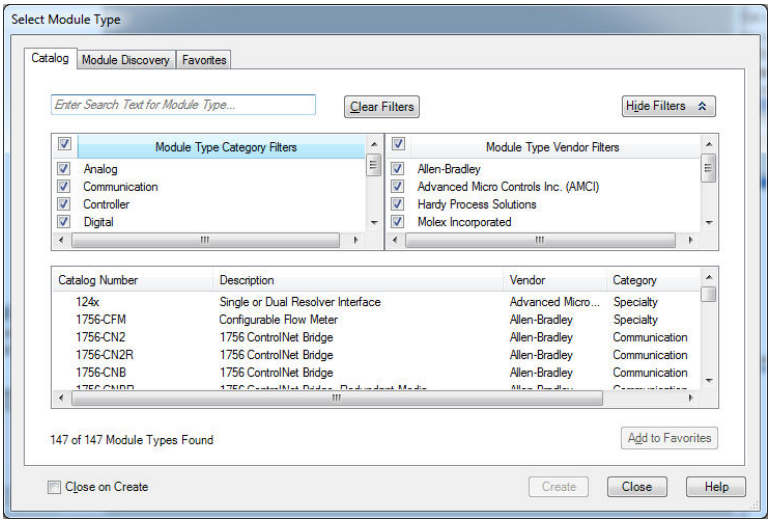
1. If needed, install a current copy of the correct AOP software.
2. Start up your RSLogix 5000 software.
3. From the **Controller Organizer:I/O Configuration** folder, select the 1756 backplane in which you just installed the new module:



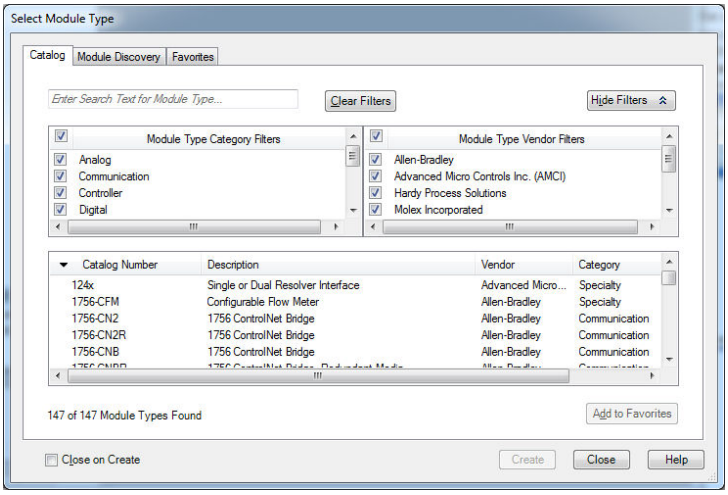
5. Right click the selected backplane or controller, and from the popup menu, select **New Module**:



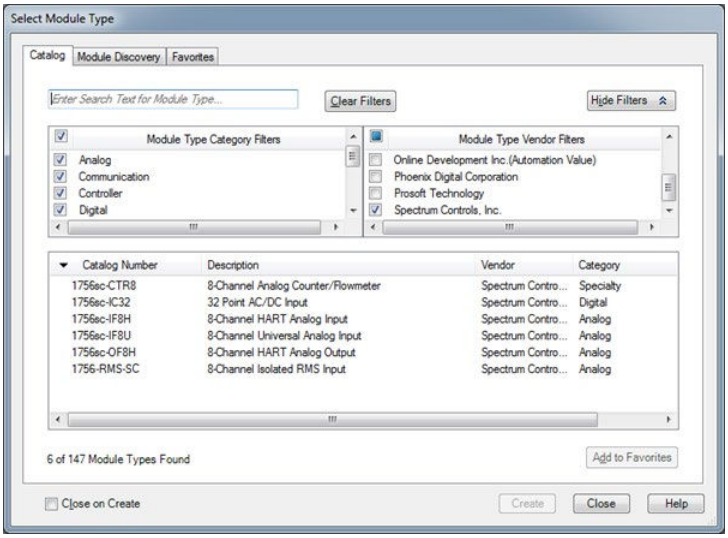
The Select Module dialog appears:



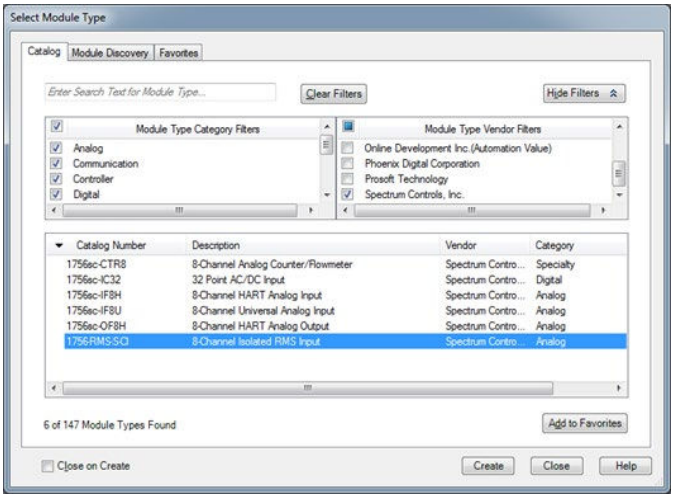
6. From this dialog, first clear your filters by clicking **Clear Filters**:



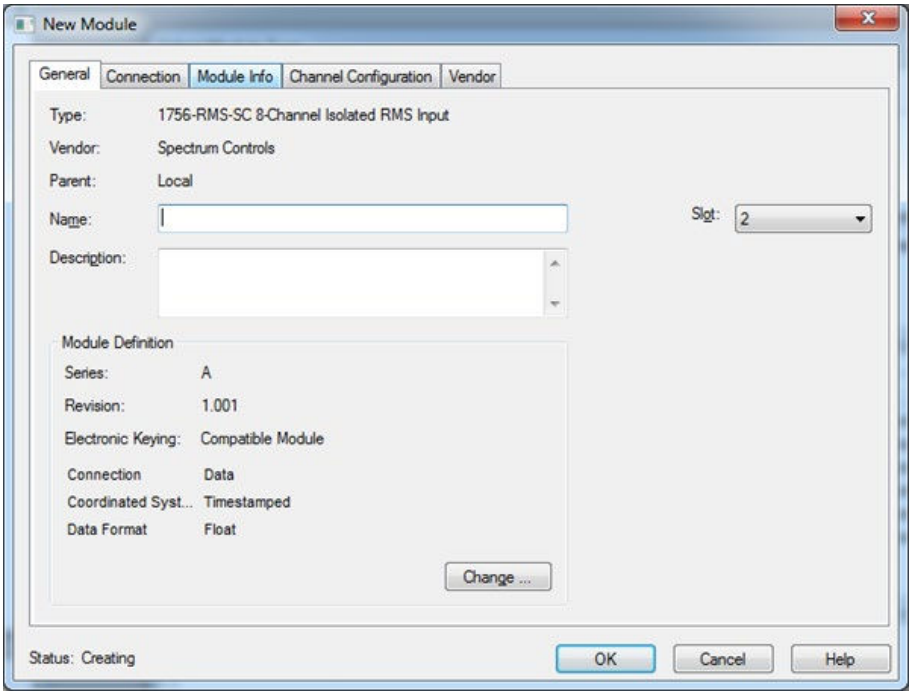
7. Scroll down the **Module Type Vendor Filters** list and from the list, select **Spectrum Controls, Inc.**:



8. The list of Spectrum modules appears. From the list, select the **1756-RMS-SC** module, and click **Create**:

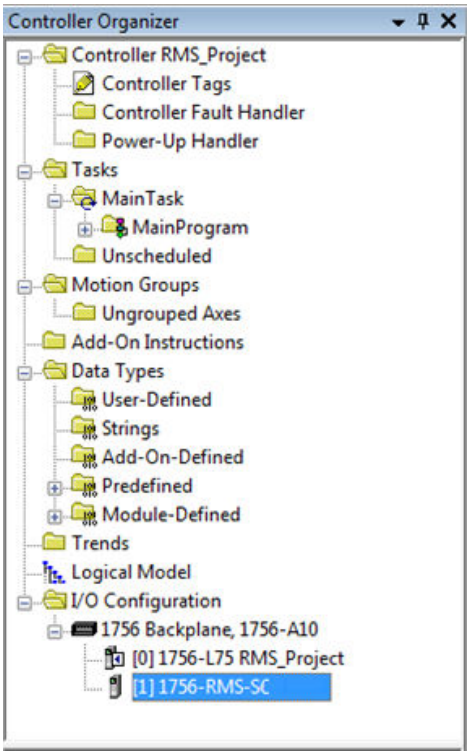


9. The New Module dialog for 1756-RMS-SC 8-Channel Isolated RMS Input appears:

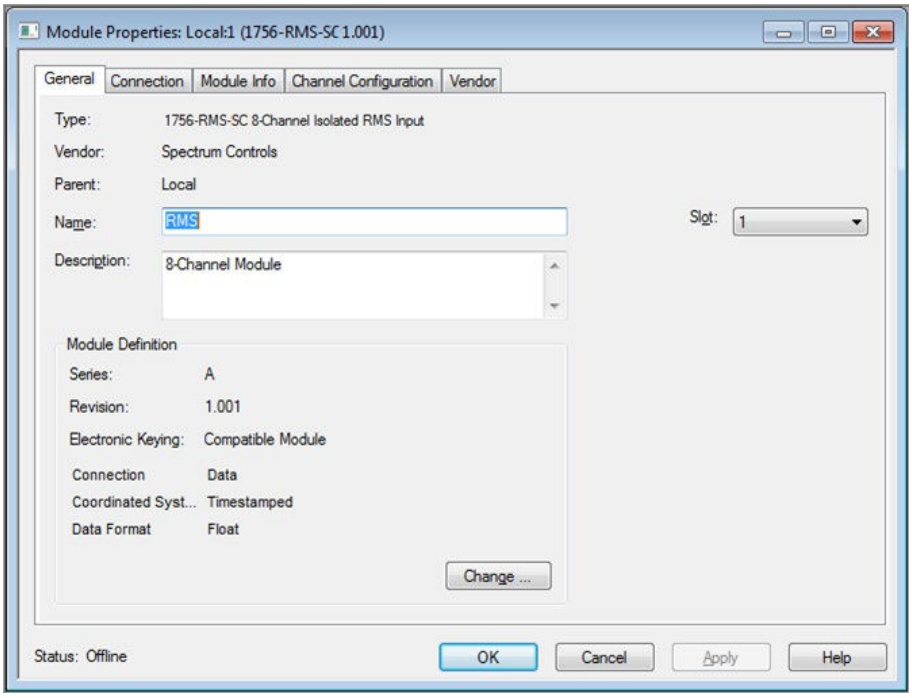


10. Enter a module name (RMS) and a description (8-Channel Module), then click **OK**.

    The module appears in your configuration:



12. Right click on the module and click **Properties**.
    The following dialog appears:



13. View and specify the following options, as needed:
    - **General Options**. See Specifying General Options, later in this section.
    - **Connection Options**. See Specifying Connection Options, later in this section.
    - **Module Info**. See Viewing Module Information, later in this section.
    - **Configuration Options**. See Specifying Configuration Options, later in this section.
    - **Vendor**. See Viewing Vendor Information, later in this section.
    - **Status**. Displays status controller has about module:
        - *Standby*. A transient state that occurs when shutting down.
        - *Faulted*. A state that occurs when a controller is unable to communicate with the module.
        - *Validating*. A transient state that occurs before a controller connects to a module.
        - *Connecting*. A state that occurs while the connection(s) to the module are being established.
        - *Running*. The module is communicating and everything is working as expected.
        - *Shutting Down*. The connection(s) between controller(s) and the module are closing.
        - *Inhibited*. The connection to the module is inhibited.
        - *Waiting*. A connection to the module has not yet been made due to one of the following:

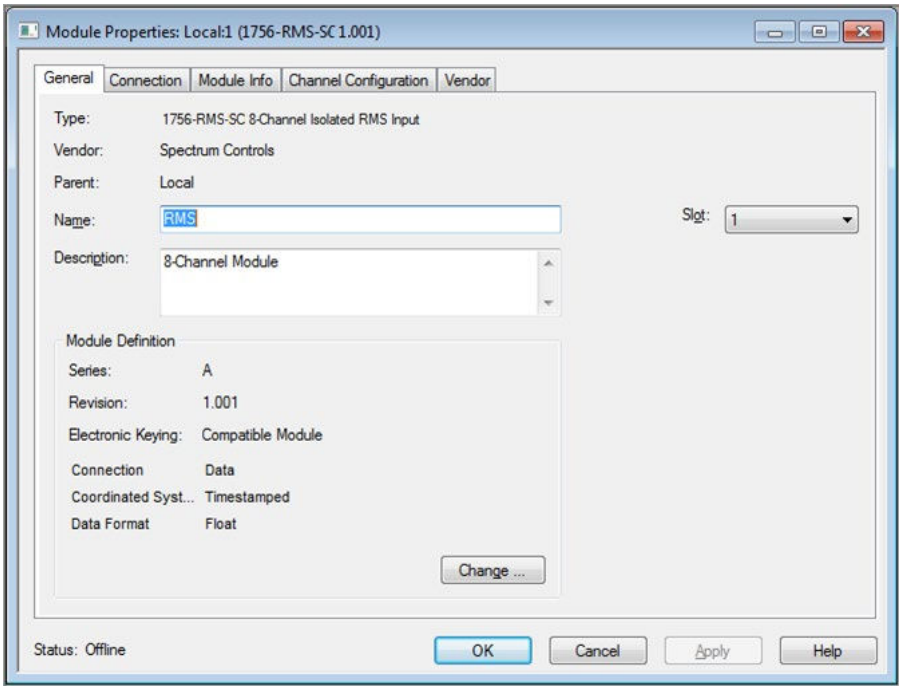
- Its parent has not yet made a connection to it.
- Its parent is inhibited.
- Its parent is faulted.

- *Offline*. You are not online.

Section 3.2 Specifying General Options

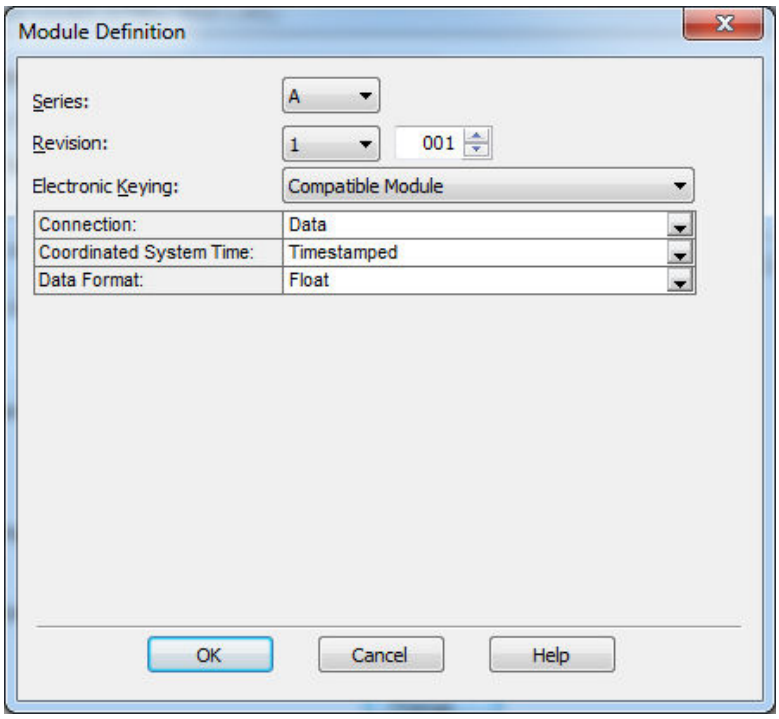
Use the General tab to view and specify module properties as follows:

1. To access, if needed, click the General tab (already defined in this example):



2. View or specify the following options:
   - **Type**. Lists the selected module for which you are specifying settings. Not editable.
   - **Vendor**. Lists the vendor name for the selected module. Spectrum Controls, Inc. is the vendor. Additional information about Spectrum and contact information is provided under the Vendor tab. Not editable.
   - **Parent.** Lists whether parent controller is local or remote. This information is necessary for certain configuration options. For further information, refer to the RSLogix online help, or the controller manual for your specific controller.
   - **Name**. Specify a name for your new module.
   - **Description**. Specify a description for your new module.
   - **Slot**. Enter the slot number for the slot in which the module is installed.

- **Module Definition**. Defines module information as follows. To change the existing settings, click **Change**. The Module Definition dialog appears:



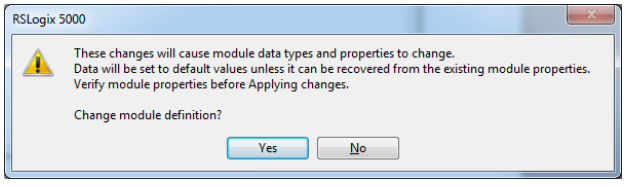
3. View or specify the settings as follows:
   - **Series**. Lists the hardware series number. Example. Series A (also shown on label). As further hardware releases occur, this letter will be incremented.
     - *Revision*. Revision is divided into major and minor revision values. The major revision indicates the revision of the interface to the module. Valid values are in the range 0 to 127. The minor revision is used to indicate the firmware revision. Valid values are in the range 0 to 255, with 1 being the default value. As releases occur, these numbers will be incremented.
     - *Electronic Keying*. This option prevents the inadvertent connection to a module of the wrong type. The following fields are checked for either an exact match, or a compatible match:
       - Vendor. Lists Spectrum Vendor ID.
       - Product Type. Checks type of product. Example: **Analog Input Module**
       - Catalog Number. Checks catalog number. Example: **1756-RMS-SC**.
       - Major Revision. Checks major revision number. Example: **1**.
       - Minor Revision. Checks minor revision number. Example: **001**
4. During initial module configuration, select one of the following keying options:
   - **Exact Match**. All of the listed parameters must exactly match or the newly installed module will reject the connection.

- **Compatible Module**. The following fields may match as follows:
  - Major revision. Field does not need to match as long as the module in the chassis is greater than, or equal to, the software's configuration's major revision.

Minor revision. Field of the physical module must be equal to, or greater than, the one specified in the software.

DANGER	**Hazard of personnel death or injury, damage to property, or economic loss if keying is disabled.** Disabling keying could lead to a module being incorrectly connected to a programmable logic controller, resulting in loss of connection and/or improper controller function. When using this feature, exercise extreme caution.

- **Disable Keying**. When selected, the controller employs no keying to check whether it is connected to a compatible module.
- **Connection**. Defines the connection between the controller and the module. From the pulldown menu, select one of the following options:
  - *Connection:* Choose between **Data** and **Listen Only**:
    - Data: Selecting this mode means that the module returns only general fault and input data to the controller.
    - Listen Only–Data. Selecting this mode allows the controller and module to establish communications without the controller sending any configuration data. In this case, the controller only listens to the module, and data coming from the module has no timestamp.
  - *Coordinated System Time*: This mode set to **Timestamped** allows the controller to access the Coordinated System Time (CST), and to timestamp general fault and input data with the value of the CST when that input data changes state. Not editable at present.
  - *Data Format*. Sets data format to **Float**. Not editable at present.
- When done making changes, to save your changes and exit, click **OK**. The software warns you that you are making changes that will change the module data types and properties, and asks you to confirm these changes before saving the changes:



  - To cancel any changes made, and exit, click **No**.
  - To apply any changes made, and continue making changes, click **Yes**.
  - To exit the Module Properties dialog, click **OK** or **Cancel**.

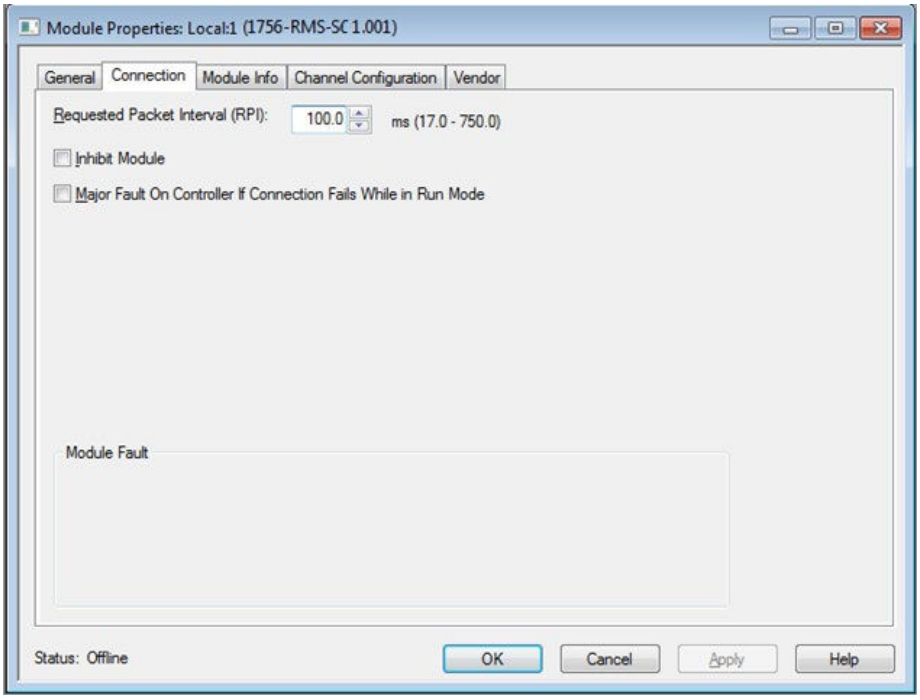
Specifying Connection Options

Use the Connection tab to define controller-to-module operation. Data that shows on this tab comes directly from the controller. You may:

- Select a requested packet interval.
- Choose to inhibit the module.
- Configure the controller so that a loss of connection to this module causes a major fault.

To access:

1. If needed, click the Connection tab:



2. View or specify the following options:

NOTE	Choose an RPI that matches the interval in which your waveform achieves 70% of full scale.

- **Requested Packet Interval (RPI)** ***number*** **ms** ***range***. The RIP is the connection update rate. It specifies that movement of data to, or from, the module will occur at least this often. The values to use for the interval are module-dependent, and the time interval that may be used changes according to whether the controller is local or remote. For more information about how this option functions, see the RSLogix 5000 online help.
- **Inhibit Module**. Using this option may have dangerous consequences. Please refer to the RSLogix online help for further options BEFORE you

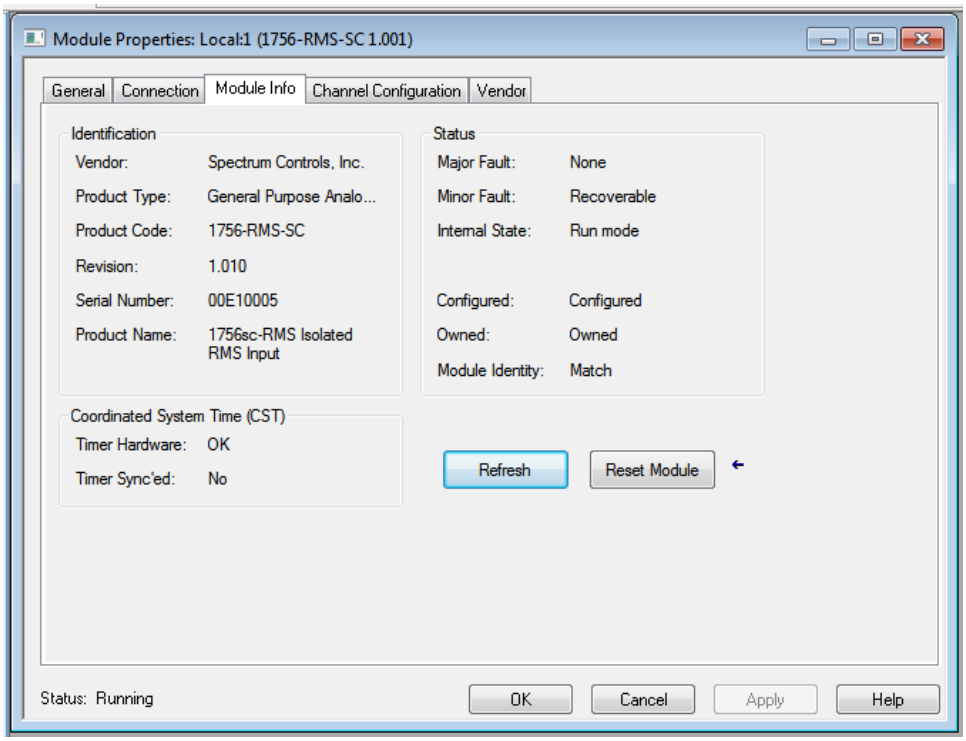
choose this option. Inhibiting the module causes the connection between the controller and module to be broken.

- **Major Fault on Controller if Connection Fails**. The option specifies that if the connection between the module and controller fails, a major fault is triggered on the connected controller.
- **Module Fault**. Displays the module fault code and text returned from the controller when a fault occurs. You see this only if you select the option above. The following error categories commonly occur. Full documentation is provided with the RSLogix 5000 online help:
  - *Connection Request Error*. The controller is attempting to make a connection to the module and has received an error. The connection was not made.
  - *Service Request Error*. The controller is attempting to request a service from the module and has received an error. The service was not performed successfully.
  - *Module Configuration Invalid*. The configuration in the module is invalid.
  - *Electronic Keying Mismatch*. Electronic keying is enabled, and some part of the keying information differs between the software and the module.
- When done making changes, to save your changes and exit, click **OK**.
- To cancel any changes made, and exit, click **Cancel**.
- To apply any changes made, and continue making changes, click **Apply**.

Viewing Module Information

Lists module and status information for the installed module. You may also use this dialog to reset a module to its power-up state. When the module is offline or you are currently creating a module, the module information does not appear.

The module information also appears blank if you select a listen-only mode as the information that appears in this dialog comes directly from the module itself.



When the module is online, the relevant fields are filled. For further information about this dialog, refer to the online help provided for the Add-On Profile.

Section 3.3 Specifying Channel Configuration Information

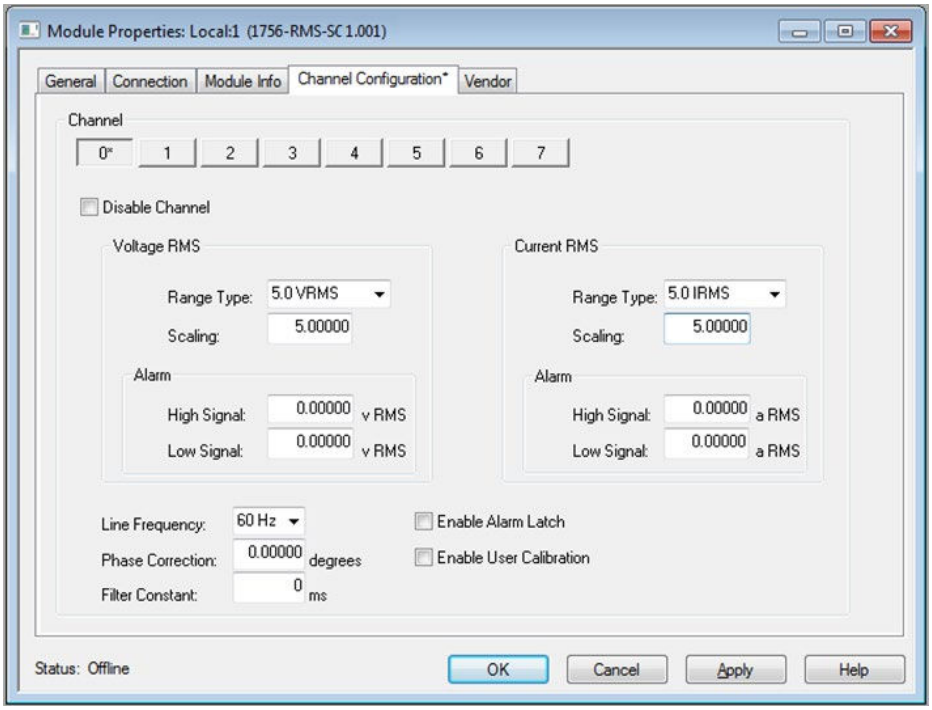
Defines all aspects of add-on profile configuration information on a per-channel basis. The tags of interest are listed and explained below:

Local:1:I.Ch0Data	{...}	{...}		SC:1756sc_RMS_Channel:I:0
Local:1:I.Ch0Data.V_StatusBits	2#0000_0000...		Binary	INT
Local:1:I.Ch0Data.V_ClipAlarm	0		Decimal	BOOL
Local:1:I.Ch0Data.V_HighAlarm	0		Decimal	BOOL
Local:1:I.Ch0Data.V_LowAlarm	0		Decimal	BOOL
Local:1:I.Ch0Data.I_StatusBits	2#0000_0000...		Binary	INT
Local:1:I.Ch0Data.I_ClipAlarm	0		Decimal	BOOL
Local:1:I.Ch0Data.I_HighAlarm	0		Decimal	BOOL
Local:1:I.Ch0Data.I_LowAlarm	0		Decimal	BOOL
Local:1:I.Ch0Data.V_RMS	0.0		Float	REAL
Local:1:I.Ch0Data.V_Peak	0.0		Float	REAL
Local:1:I.Ch0Data.I_RMS	0.0		Float	REAL
Local:1:I.Ch0Data.I_Peak	0.0		Float	REAL
Local:1:I.Ch0Data.RealPower	0.0		Float	REAL
Local:1:I.Ch0Data.ApparentPower	0.0		Float	REAL
Local:1:I.Ch0Data.ReactivePower	0.0		Float	REAL
Local:1:I.Ch0Data.PowerFactor	0.0		Float	REAL

WORD	Local:1:I.ChXData.V_StatusBits	Binary	Data from Clip, High, and Low Alarms for the channel
BOOL	Local:1:I.ChXData.V_ClipAlarm	Decimal	Voltage input clipping. The V_Peak value is greater than or equal to the V_RangeRMS full scale peak value.
BOOL	Local:1:I.ChXData.V_HighAlarm	Decimal	Voltage input >= V_HighAlarm value
BOOL	Local:1:I.ChXData.V_LowAlarm	Decimal	Voltage input <= V_LowAlarm value
WORD	Local:1:I.ChXData.I_StatusBits	Binary	Data from Clip, High and Low Alarms for the channel
BOOL	Local:1:I.ChXData.I_ClipAlarm	Decimal	Current input clipping. The I_Peak value is greater than or equal to the I_RangeRMS full scale peak value.
BOOL	Local:1:I.ChXData.I_HighAlarm	Decimal	Current input >= I_HighAlarm value
BOOL	Local:1:I.ChXData.I_LowAlarm	Decimal	Current input <= I_LowAlarm value
REAL	Local:1:I.ChXData.V_RMS	Float	Volts AC
REAL	Local:1:I.ChXData.V_Peak	Float	Peak measured voltage input value. This value can be reset.
REAL	Local:1:I.ChXData.I_RMS	Float	Amps AC
REAL	Local:1:I.ChXData.I_Peak	Float	Peak measured current input value. This value can be reset.
REAL	Local:1:I.ChXData.RealPower	Float	Watts
REAL	Local:1:I.ChXData.ApparentPower	Float	VA
REAL	Local:1:I.ChXData.ReactivePower	Float	VA
REAL	Local:1:I.ChXData.PowerFactor	Float	-1.0 and 1.0>0.0: When the current waveform is lagging the voltage waveform, the load is inductive and is defined as a positive power factor. <0.0: When the current waveform is leading the voltage waveform, the load is capacitive and is defined as a negative power factor. =0.0: The energy flow is entirely reactive, and stored energy in the load returns to the source on each cycle.

To configure up each channel:

1. Click the Channel Configuration tab:



2. View or specify the following options:
   - **Channel**. Specifies which of 8 channels (0 to 7) you wish to configure. For initial configuration, select each channel in turn.
   - **Disable Channel**. Turns channel off. Click to disable channel.

NOTE	Both Voltage and Current inputs have the same voltage input ranges. Connect the voltage input to a sensor that represents the voltage in the system. Connect the current input to a sensor that represents current in the system.

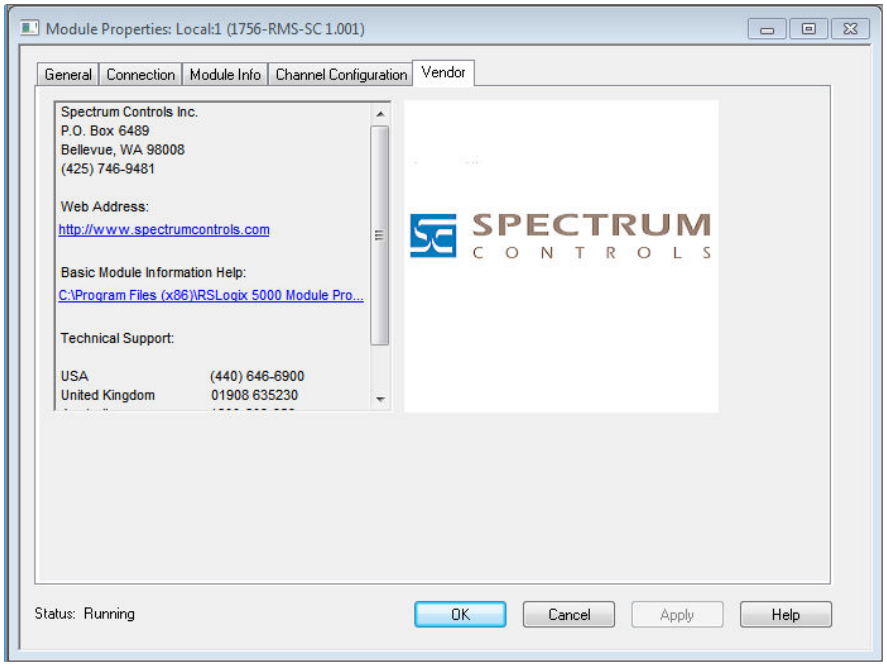
   - **Voltage RMS/Current RMS**. Specifies which VRMS range to use:
     - *Range Type*. Default setting is **5.0 VRMS**. Choose one of the following:
       - 0.5. VRMS. Values are:
         - 0.707 full scale RMS
         - 1 V full scale peak
       - 1.0. VRMS. Values are:
         - 1.414 full scale RMS
         - 2.0 V full scale peak

        - 2.5. VRMS. Values are:
            - 3.535 full scale RMS
            - 5 V full scale peak
        - 5.0. VRMS. Values are:
            - 7.070 full scale RMS
            - 10 V full scale peak
    - *Scaling*. This value is the actual value of the system based on the range setting. Default setting is **5.0 VRMS**. Example: For a Scaling value of 120 and a range set to 5 VRMS, an input signal of 5 VRMS represents 120 VRMS from the system.
- **Alarm**. (For Voltage or Current RMS.) Specify values at which to trigger the High alarm.
    - *High Signal*. Specify high value at which to trigger an alarm. Scaled VRMS measurements greater than or equal to this setting will trigger the High alarm.
    - *Low Signal*. Specify a low value at which to trigger an alarm. Scaled VRMS measurements less than or equal to this setting will trigger the Low alarm.
- **Line Frequency**. Specifies whether to use 50 Hz or 60 Hz line frequency.
- **Phase Correction**. When using current transformers, specifies phase angle correction in degrees. To disable, enter zero (0). The range of values is determined by the **Line Frequency** setting.
    - With a line frequency of 50 Hz, possible range is ±7.5°.
    - With a line frequency of 60 Hz, the range is ±-9.0°.

  Values outside of the above stated ranges will cause a configuration error.
- **Filter Constant**. Constant used in digital filter. Units are in milliseconds. To disable, enter zero (0). Maximum value is 20100 (20.1 seconds). The value represents the number of milliseconds it takes the measurement to reach 63% of a step change at the input.
- **Enable Alarm Latch**. Specifies whether to turn on alarm latching. Default is off. When enabled, an alarm will remain set even when the condition is cleared. To clear a latched alarm, toggle the corresponding "unlatch bit" in the output table.
- **Enable User Calibration**. Turns on capability for you to enter a manual calibration for the module. Default is off. If enabled, your manually entered calibration information is taken from the Output table for the selected channel. To remove your calibration information, disable the user calibration option, and reconfigure the module.
- **Apply**. Applies changes made in dialog and remains in dialog.
- **OK**. Applies changes made in dialog and exits.
- **Cancel**. Cancels entries made in dialog and exits.

Viewing Vendor Information

Lists Spectrum Controls, Inc. information, including company website and technical support telephone numbers.



Section 3.4 Configuring the Module

This section contains a more detailed treatment of the configuration outline provided at the beginning of this chapter.

Module Identity Information

The module requires no software updates as all functionality is provided by the (Standalone ASIC) SA-ASIC in standalone mode. This section provides static information such as Vendor ID, product code, and other information that does not change over the life of the module.

Your module has:

- 8, isolated, independently configurable input channel pairs
- Multiple input ranges:
  - 5 VRMS, 10 V peak at Range 1
  - 2.5 VRMS, 5 V peak at Range 2
  - 1 VRMS, 2 V peak at Range 3
  - 0.5 VRMS, 1 V peak at Range 4
- Fault reporting
- User Calibration
- Settable RPI
- Time stamping
- Alarm latching

- LED status information
- Downloadable firmware using ControlFlash
- Removal and insertion under power (RIUP)

The following sections provide more information about the attributes associated with the module. These services are part of the ControlNet specification.

User Calibration

The Voltage and Current inputs for each channel can apply a user-provided calibration. The calibration consists of three terms (A, B, and C).

These terms apply to the equation:

$Y = AX^2 + BX + C$

Where:

- A, B, and C are the terms provided by the user.
- X is the value measured by the module at the input channel.
- Y is the corrected value.

To determine the values of the three terms, the user must first configure the appropriate range and signal. UserCalEn must be set to 0 to ensure initial measurements do not apply any existing user calibration.

The V_SignalRMS and I_SignalRMS values must match the name of V_RangeRMS and I_RangeRMS respectively.

Example: If V_RangeRMS is set to 5VRMS, the V_SignalRMS must be set to 5.0. If I_RangeRMS is set to 2.5VRMS, I_SignalRMS must be set to 2.5.

You supply a Low, Medium, and High input to both the Voltage and Current inputs for the configured range.

The signals should correspond to about 5-10%, 50% and 90-95% of the range's span. The input signals should be the same used in the application. If other points are considered more appropriate, you may use different input levels.

The calibration voltage may be applied to multiple inputs at the same time (tied together) assuming they are configured for the same range.

For each voltage input (Low, Medium, and High), two values are captured: (One from a high-accuracy meter, and the other from the module itself).

NOTE	It should be observed that the method to allow you to calibrate inputs does not allow the data to follow the module. Since Output Words are used from the RSLogix project, those values will be retained at a specific location. Whenever a new module is swapped into a slot, the existing user calibration data will be used (if enabled).

Three-point Calibration

For non-linear errors in VRMS and IRMS, a three-point calibration is required.

To determine values for A, B, and C, the following six measurements must be taken.

The variable assignments apply to the formula below.

Low Input

$X1 = \text{Measured by module}$

$Y1 = \text{Measured by meter}$

Medium Input

$X2 = \text{Measured by module}$

$Y2 = \text{Measured by meter}$

High Input

$X3 = \text{Measured by module}$

$Y3 = \text{Measured by meter}$

Formula

Once all six measurements are taken, apply the values to the formulae below.

Solving for A gives:

$$A = \frac{[(Y2 - Y1)(X1 - X3) + (Y3 - Y1)(X2 - X1)]}{[(X1 - X3)(X2^2 - X1^2) + (X2 - X1)(X3^2 - X1^2)]}$$

Using A from the previous equation gives:

$$B = \frac{[(Y2 - Y1) - A(X2^2 - X1^2)]}{(X2 - X1)}$$

Using A and B above to solve for C:

$$C = Y1 - AX1^2 - BX1$$

Once all three terms have been determined, you enter them in the Output Table at the appropriate location. The configuration for the module is then set appropriately for the application with the UserCalEn bit set for the calibrated channel. Once the new configuration is sent to the module, the values placed in the Output words are read and applied to future RMS readings. The RSLogix project can be saved with the output values for future use, and the PLC should also be configured to retain its program across power cycles. If the terms require modification, the project must be saved and pushed down to the PLC to ensure the values are retained. Otherwise, the data may be lost during loss of power to the system.

Two-point Calibration

If the measurement error is linear, a two-point calibration may be performed. In this case, only Low and High measurements are required. Choose signals that are near the ends of the measurement range being calibrated (~5-10% and ~90-95% of full-scale).

Low Input

X1 = Measured by module

Y1 = Measured by meter

High Input

X2 = Measured by module

Y2 = Measured by meter

Formula

To set a linear calibration, the A term is set to 0.

$$A = 0.0$$

$$B = \frac{Y2 - Y1}{X2 - X1}$$

$$C = Y1 - BX1$$

To configure the module for the calibration terms, see the above section.

Offset Calibration

To simply apply an offset calibration, set the A and B terms to 0.0 and use term C to set the offset value.

$$A = 0.0$$

$$B = 0.0$$

$$C = (offset)$$

Section 3.5 Technical Assistance

Note that your module contains electrostatic components that are susceptible to damage from electrostatic discharge (ESD). An electrostatic charge can accumulate on the surface of ordinary wrapping or cushioning material.

In the unlikely event that the module should need to be returned to Spectrum Controls, Inc., please ensure that the unit is enclosed in approved ESD packaging (such as static-shielding/metallized bag or black conductive container). Spectrum Controls, Inc. reserves the right to void the warranty on any unit that is improperly packaged for shipment.

RMA (Return Merchandise Authorization) form required for all product returns.

For further information or assistance, please contact your local distributor, or call the Spectrum Controls technical Support at:

For Rockwell Automation Compatible I/O Products:

- USA 1-440-646-6900
- United Kingdom 01-908-635-230
- Australia 1-800-809-929
- Mexico 001-888-365-8677
- Brazil 55-11-3618-8800
- Europe +49-211- 41553-630

Section 3.6 Declaration of Conformity

Declaration available upon request.

Index

Corporate Headquarters
Spectrum Controls Inc.
1705 132nd Avenue NE, Bellevue, WA 98005 USA
Fax: 425-641-9473
Tel: 425-746-9481

Web Site: www.spectrumcontrols.com
E-mail: spectrum@spectrumcontrols.com