USER MANUAL

SPECTRUM CONTROLS

An Allient Company

User's Manual Pub. 0300247-03 Rev. A0

1762 Combo Module
4 Channels In/4 Channels Out

Catalog Number: 1762sc-IF4OF4

Important Notes

1. Please read all the information in this owner's guide before installing the product.
2. The information in this owner's guide applies to hardware Series A and firmware version 1.00 or later.
3. This guide assumes that the reader has a full working knowledge of the relevant processor.

Notice

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Table of Contents

Preface

Read this preface to familiarize yourself with the rest of the manual. This preface covers the following topics:

- Who should use this manual
- How to use this manual
- Related publications
- Conventions used in this manual
- Rockwell Automation support

Who Should Use This Manual

Use this manual if you are responsible for designing, installing, programming, or troubleshooting control systems that use Allen-Bradley I/O and/or compatible controllers, such as MicroLogix 1100, 1200, or 1400.

How to Use This Manual

As much as possible, we organized this manual to explain, in a task-by-task manner, how to install, configure, program, operate, and troubleshoot a control system using the 1762sc-IF4OF4.

Related Documentation

The table below provides a listing of publications that contain important information about Allen-Bradley PLC systems.

Document Title	Document Number
MicroLogix™ 1200 User Manual	1762-UM001
MicroLogix™ 1200 Technical Data	1762-TD001
MicroLogix 1200 and MicroLogix 1500 Programmable Controllers Instruction Set Reference Manual	1762-RM001
Allen-Bradley Programmable Controller Grounding and Wiring Guidelines	1770-4.1

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 (US/global, English only)
- United Kingdom +44 0 1908 635 230 (EU phone, UK local)
- Australia, China, India, and other East Asia locations: 1-800-722-778 or +61 39757 1502
- Mexico 001-888-365-8677
- Brazil 55-11-5189-9500 (general support)
- Europe +49-211-41553-630 (Germany/general support)

or send an email to support@spectrumcontrols.com

Documentation

If you would like a manual, you can download a free electronic version from the Internet 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.
- 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 1762sc-IF4OF4 Combo module contains 4 analog output channels and 4 analog input channels. The 4 analog output channels (Ch 0 through 3) can be configured for either voltage or current. The first two input channels (Ch 4 and 5) can be configured for current only. The second pair of input channels (Ch 6 and 7) can be configured for current, voltage or thermocouple. This chapter includes information about:

- General description
- Input/Output types and ranges
- Data formats and filter frequencies
- Hardware features
- System overview and module operation

Section 1.1 General Description

The combo supports current, voltage and thermocouple input types, and current or voltage output types. The module digitally converts and stores analog data from any of the three input types mentioned above. The module also converts the digital value stored in each output channel's command word, to an analog current or voltage signal. Each input or output channel is individually configured via software for a specific input/output type, data format, and provides open-circuit, over-range, under-range detection, and indication.

Section 1.2 Output Types and Ranges

The table below lists the output types and their associated ranges.

Table 1-1. Output Types

Output Type	Range (Over Range)
Voltage	0 to 5 V (0 to 5.5 V)
	1 to 5 V (0 to 5.5 V)
	±10 V (-11 V to +11 V)
	0 to 10 V (0 V to 11 V)
Current	4 to 20 mA (3.92 to 20.4 mA)
	0 to 20 mA (0 to 20.4 mA)

NOTE	Channel 0 through 3 can be configured for voltage or current and support voltage and current ranges defined in Table 1-1. The module is shipped with channels 6 and 7 in current mode (DIP switches inside unit both down as shown below). The channel **1** switch below is associated with module channel **6**, and channel switch **2** is associated with module channel **7**. Move each switch to the up position to achieve voltage input for each respective channel. Refer to Figure 1-1 to view DIP switch location (item 10). 

Section 1.3 Input Types and Ranges

The table below lists the input types and their associated ranges.

Table 1-2. Input Types

Input Type	Range
E Type Thermocouple	-200 to 1000 ˚C (-328 to 1832 ˚F)
J Type Thermocouple	-180 to 1200 ˚C (-292 to 2192 ˚F)
K Type Thermocouple	-200 to 1370 ˚C (-328 to 2498 ˚F)
T Type Thermocouple	-190 to 400 ˚C (-310 to 752 ˚F)
Voltage	0 to 5 V (0 to 5.5 V)
	1 to 5 V (0 to 5.5 V)
	±10 V (-11 to +11 V)
	0 to 10 V (0 to 11 V)
Current	4 to 20 mA (3.92 to 20.4 mA)
	0 to 20 mA (0 to 20.4 mA)

NOTE	Channels 4 and 5 can be configured for current inputs only and support current input ranges as shown in Table 1-2.

NOTE	Channels 6 and 7 can be configured for either current or voltage inputs. Current support includes input ranges as shown in Table 1-2. Voltage input ranges include both thermocouple and voltages as defined in Table 1-2.

Section 1.4 Data Formats

For input channels, the data can be configured for:

- Engineering units ×1
- Engineering units ×10
- Scaled-for-PID
- Raw/proportional data

For output channels, the data can be configured for:

- Engineering units
- Scaled for PID
- Raw/proportional data
- Percent range

Section 1.5 Filter Frequencies

For input channels, the module uses a digital filter that provides high frequency noise rejection for each input signal. The filter for each channel is programmable allowing you to select from four different filter frequencies:

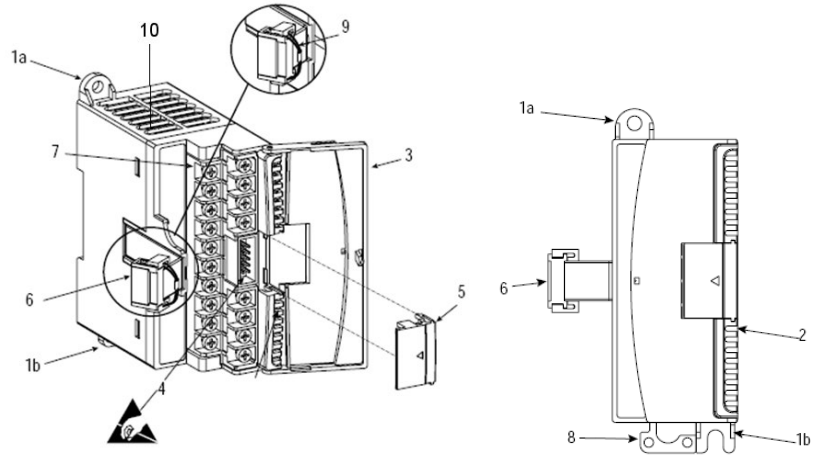
- 4 Hz
- 17 Hz
- 62 Hz
- 470 Hz

Section 1.6 Hardware Features

Channels are wired as differential inputs or single-ended outputs. One cold junction compensation (CJC) sensor comes installed under the terminal block (and is not accessible to the user) to enable accurate readings when using thermocouple input types. The CJC sensor compensates for offset voltages introduced into the input signal as a result of the cold junction where the thermocouple wires come into contact with the terminal block.

Module configuration is done via the controller's programming software. The module configuration is stored in the memory of the controller. Refer to your controller's user manual for more information. The illustration below shows the module's hardware features.

Figure 1-1. Hardware Features



Item	Description
1a	Upper panel mounting tab
1b	Lower panel mounting tab
2	Power diagnostic LED
3	Module door with terminal identification label
4	Bus connector (male)
5	Bus connector cover
6	Flat ribbon cable with bus connector (female)
7	Terminal block
8	DIN rail latch
9	Pull loop
10	Ch 6 and Ch 7 DIP switch. Voltage/Current selection. Shipped with current selected (DIP switches in Down position as shown). 

1.6.1 LED Indicator

The 1762 combo module uses a single green LED to show operational status of the module. The status LED has the following blink codes:

Blink Code	Description
Blinks rapid green	The module is not in run mode.
Solid Green	Startup has completed, all internal tests have passed, and the module has received a valid configuration from the PLC.
Off	Hardware error.

Section 1.7 System Overview

The module communicates to the controller through the bus interface. The module also receives 5 VDC and 24 VDC power through the bus interface.

NOTE	An external power supply is required for all 2-wire input transmitters.

1.7.1 Module Power-up

At power-up, the module performs a check of its internal circuits, memory, and basic functions. During this time, the module status LED is blinking rapid green. If no faults are found during power-up diagnostics, the module status LED is turned on.

After power-up checks are complete, the module waits for valid channel configuration data. If an invalid configuration is detected, the module will generate a PLC fault. Once a channel is properly configured and enabled, it continuously converts the input or output data to a value within the range selected for that channel.

Each time a channel is updated by the combo module, that data value is tested for an open-circuit, short-circuit or “input/output data not valid” condition. If such a condition is detected the channel data value will fail to a user-defined state defined in the module configuration settings. For more details, refer to Chapter 3.

Using the module’s input and output image table, the controller reads or writes the two’s complement binary data to and from the module. This typically occurs at the end of the program scan or when commanded by the control program. If the controller and the module determine that the data transfer has been made without error, the data is used in the control program.

1.7.2 Module Operation

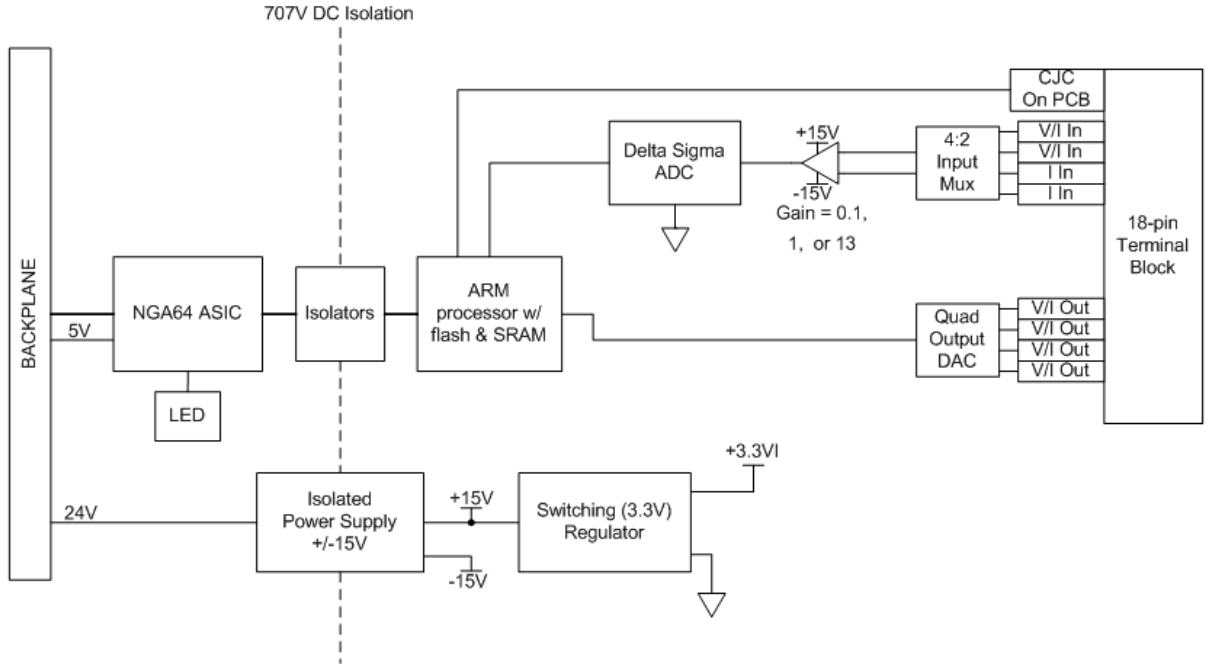
Input Channels

When the module receives the input from an analog device, the module’s circuitry multiplexes the input into an A/D converter. The converter reads the signal and converts it as required for the type of input. If thermocouples are being used, the module continuously samples the CJC sensor, and compensates for temperature changes at the terminal block cold junction, between the thermocouple wire and the terminal connector.

Output Channels

The module’s output channel uses a digital-to-analog (D/A) converter to read the digital output data from the controller and convert it to an analog output signal.

See the block diagram below.



Chapter 2
Installation and Wiring

This chapter will cover:

- Compliance to European union directives
- Power requirements
- General considerations
- Mounting
- Field wiring connections
- Module Indicators

Section 2.1 Compliance to European Union Directives

This product is approved for installation within the European Union and EEA regions. It has been designed and tested to meet the following directive.

2.1.1 EMC Directive

The 1762sc-IF4OF4 module 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:

- IEC 61000-6-4 Electromagnetic compatibility (EMC)–Part 6-4: Generic standards–Emission standard for industrial environments
- IEC 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 2.2 Power Requirements

The module receives power through the bus interface from the +5 VDC/±24 VDC system power supply. The maximum current drawn by the module is shown in the table below.

5 VDC	24 VDC
30 mA	3.4 W Max (140 mA max at 24 V)

Use the table below to determine the maximum number of IF4OF4 modules that can be installed in a MicroLogix system.

Table 2-1. Maximum Number of Modules Per Controller

Controller	Max 5 V Bus Current	Max 24 V Bus Current	Max # of IF4OF4 Modules
ML1100	800	700	4
ML1200 (24 pt.)	400	350	3
ML1200 (40 pt.)	600	500	3
ML1400 (All)	1500	1500	7

Section 2.3 General Considerations

1762 I/O is suitable for use in an industrial environment when installed in accordance with these instructions. Specifically, this equipment is intended for use in clean, dry environments Pollution degree 2[1] and to circuits not exceeding Over Voltage Category II[2](IEC 60664-1)[3].

2.3.1 Hazardous Location Considerations

This equipment is suitable for use in Class I, Division 2, Groups A, B, C, D or non-hazardous locations only. The following WARNING statement applies to use in hazardous locations.

WARNING	EXPLOSION HAZARD
	• Substitution of components may impair suitability for Class I, Division 2. Touch a grounded object to discharge static potential. • Do not replace components or disconnect equipment unless power has been switched off or the area is known to be non-hazardous. Touch a grounded object to discharge static potential. • This product must be installed in an enclosure. Touch a grounded object to discharge static potential. • All wiring must comply with N.E.C. article 501-4(b). Touch a grounded object to discharge static potential.

[1] Pollution Degree 2 is an environment where, normally, only non-conductive pollution occurs except that occasionally a temporary conductivity caused by condensation shall be expected.
[2] Over Voltage Category II is the load level section of the electrical distribution system. At this level, transient voltages are controlled, and do not exceed the impulse voltage capability of the product's insulation.
[3] Pollution Degree 2 and Over Voltage Category II are International Electrotechnical Commission (IEC) designations.

2.3.2 Prevent Electrostatic Discharge

WARNING 	Electrostatic discharge can damage integrated circuits or semiconductors if you touch analog I/O module bus connector pins or the terminal block on the input module. 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 connectors or pins on component boards. • 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.

2.3.3 Remove Power

WARNING 	Remove power before removing or inserting this module. When you remove, or insert, a module with power applied, an electrical arc may occur. An electrical arc can cause personal injury or property damage by: • Sending an erroneous signal to your system's field devices, causing unintended machine motion. • Causing an explosion in a hazardous environment. • Electric arcing causes excessive wear to contacts on both the module and its mating connector and may lead to premature failure.

2.3.4 Selecting a Location

Reducing Noise

Most applications require installation in an industrial enclosure to reduce the effects of electrical interference. Analog inputs and outputs are highly susceptible to electrical noise. Electrical noise coupled to the analog inputs or outputs will reduce the performance (accuracy) of the module. Group your modules to minimize adverse effects from radiated electrical noise and heat. Consider the following conditions when selecting a location for the analog module. Position the module:

- Away from sources of electrical noise such as hard-contact switches, relays, and AC motor drives.
- Away from modules which generate significant radiated heat. Refer to the module's heat dissipation specification.

In addition, route shielded, twisted-pair analog input and output wiring away from any high voltage I/O wiring.

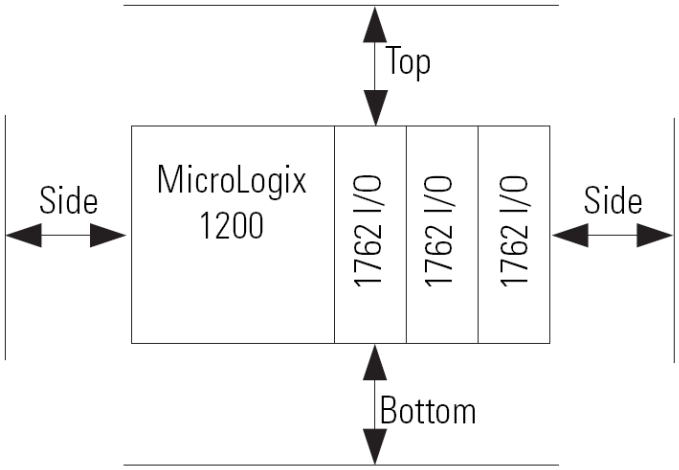
Section 2.4
Mounting

WARNING	Do not remove protective debris strip until after the module and all other equipment near the module is mounted and wiring is complete. Once wiring is complete, and the module is free of debris, carefully remove protective debris strip. Failure to remove strip before operating can cause overheating.

2.4.1 Minimum Spacing

Maintain spacing from enclosure walls, wireways, adjacent equipment, etc. Allow 50.8 mm (2 in.) of space on all sides for adequate ventilation, as shown:

Figure 2-1. Minimum Spacing



NOTE	1762 expansion I/O may only be mounted horizontally.

WARNING	During panel or DIN rail mounting of all devices, be sure that all debris (metal chips, wire strands, etc.) is kept from falling into the module. Debris that falls into the module could cause damage when power is applied to the module.

2.4.2 DIN Rail Mounting

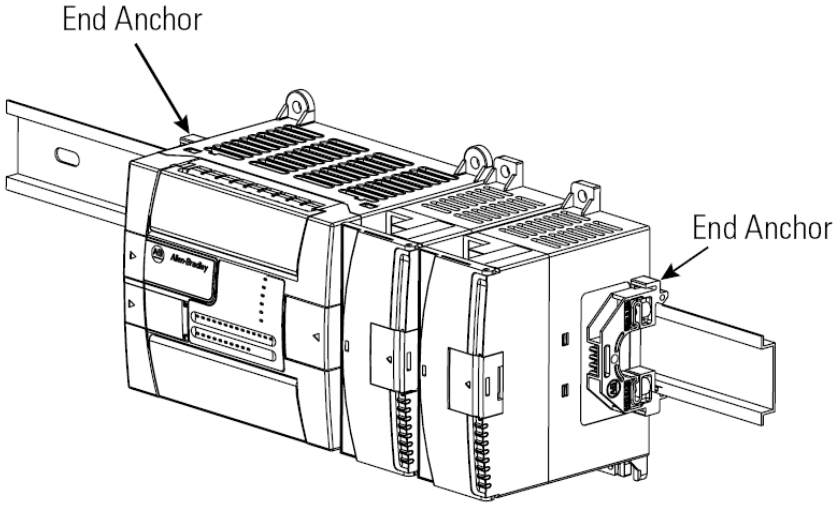
The module can be mounted using the following DIN rails: 35 × 7.5 mm (EN 50 022 - 35 × 7.5) or 35 × 15 mm (EN 50 022 - 35 × 15).

Before mounting the module on a DIN rail, close the DIN rail latch. Press the DIN rail mounting area of the module against the DIN rail. The latch will momentarily open and lock into place.

Use DIN rail end anchors (Allen-Bradley part number 1492-EA35 or 1492-

EAH35) for environments with vibration or shock concerns.

Figure 2-2. End Anchor Placement

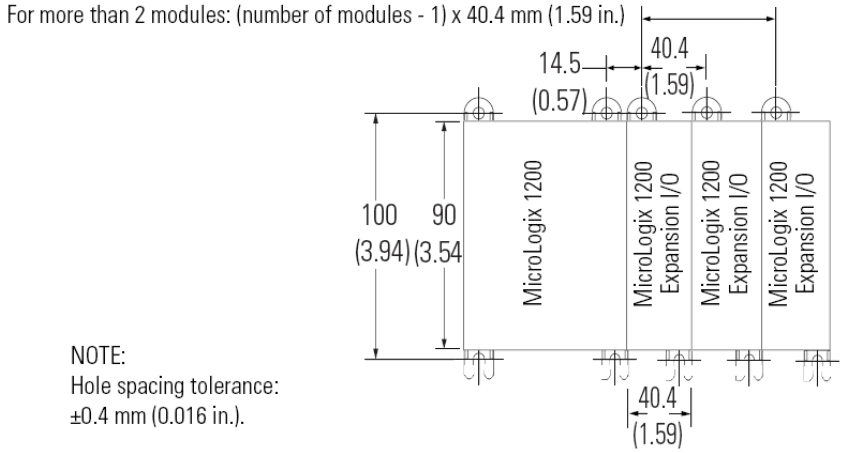


NOTE	For environments with extreme vibration and shock concerns, use the panel mounting method described below, instead of DIN rail mounting.

2.4.3 Panel Mounting

Use the dimensional template shown below to mount the module. The preferred mounting method is to use two M4 or #8 Pan Head screws per module. M3.5 or #6 Pan Head screws may also be used, but a washer may be needed to ensure a good ground contact. Mounting screws are required on every module.

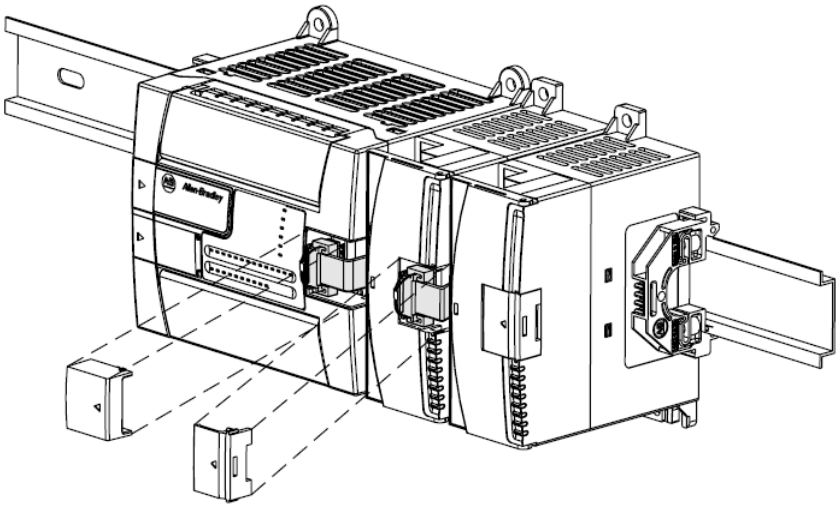
Figure 2-3. Mounting Dimensions



Section 2.5 System Assembly

The expansion I/O module is attached to the controller or another I/O module by means of a ribbon cable *after* mounting as shown below.

Figure 2-4. Expansion IO Attachment



NOTE	Use the pull loop on the connector to disconnect modules. Do not pull on the ribbon cable.

WARNING	EXPLOSION HAZARD • In Class I, Division 2 applications, the bus connector must be fully seated, and the bus connector cover must be snapped in place. • In Class I, Division 2 applications, all modules must be mounted in direct contact with each other as shown in the graphic. If DIN rail mounting is used, an end stop must be installed ahead of the controller, and after the last 1762 I/O module.

Section 2.6 Field Wiring Connections

Consider the following when wiring your system:

General

- Power and input wiring must be in accordance with Class 1, Division 2 wiring methods, Article 501-4(b) of the National Electric Code, NFPA 70, and in accordance with the authority having jurisdiction.
- Input and output channels are not isolated from one another.
- Use Belden™ 8761, or equivalent, shielded wire.

- To ensure optimum accuracy, limit overall cable impedance by keeping a cable as short as possible. Locate the module as close to input devices as the application permits.
- Digital and analog power must be supplied by an Isolated Secondary Limited Energy Low Voltage source.

Inputs

- If multiple power supplies are used with analog inputs, the power supply commons must be connected.
- For a thermocouple, use the shielded, twisted-pair thermocouple extension lead wires specified by the thermocouple manufacturer. Using the incorrect type of thermocouple extension wire or not following the correct polarity will cause invalid readings.
- The module does not provide loop power for analog inputs. Use a power supply that matches the input transmitter specifications.

Outputs

- Load resistance for a voltage output channel must be equal to or greater than 1 KΩ.
- Load resistance for a current output channel must remain between 0 and 500 Ω.

Grounding

WARNING 	The possibility exists that a grounded or exposed thermocouple can become shorted to a potential greater than that of the thermocouple itself. Due to possible shock hazard, take care when wiring grounded or exposed thermocouples.

WARNING 	USE SUPPLY WIRES SUITABLE FOR 20 °C ABOVE SURROUNDING AMBIENT TEMPERATURE.

WARNING 	UTILISER DES FILS D'ALIMENTATION QUI CONVIENNENT A UNE TEMPERATURE DE 20 °C AU-DESSUS DE LA TEMPERATURE AMBIANTE.

- This product is intended to be mounted to a well-grounded mounting surface such as a metal panel. Additional grounding connections from the module's mounting tabs or DIN rail (if used) are not required unless the mounting surface cannot be grounded.
- Under normal conditions, the drain wire (shield) should be connected to the metal mounting panel (earth ground). Keep shield connection to earth ground as short as possible.
- Ground the shield drain wire at one end only. The typical location is as follows:

- For grounded thermocouples or millivolt sensors, this is at the sensor end.
- For insulated/ungrounded thermocouples, this is at the module end. Contact your sensor manufacturer for additional details.

- Refer to Industrial Automation Wiring and Grounding Guidelines, Allen-Bradley publication 1770-4.1, for additional information.

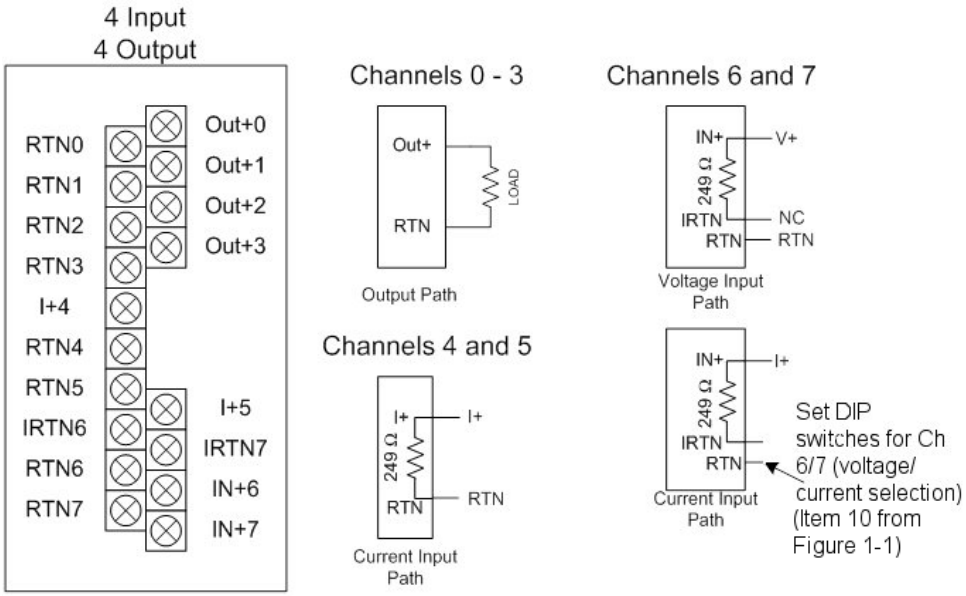
Noise Prevention

- Route field wiring away from any other wiring and as far as possible from sources of electrical noise, such as motors, transformers, contactors, and ac devices. Generally, allow at least 15.2 cm (6 in.) of separation for every 120 V of power.
- Routing field wiring in a grounded conduit can reduce electrical noise.
- If field wiring must cross ac or power cables, ensure that they cross at right angles.
- To limit the pickup of electrical noise, keep thermocouple and millivolt signal wires as far as possible from power and load lines.
- If noise persists for a device, try grounding the opposite end of the cable shield or ground both ends of the shield.

2.6.1 Wiring Diagram

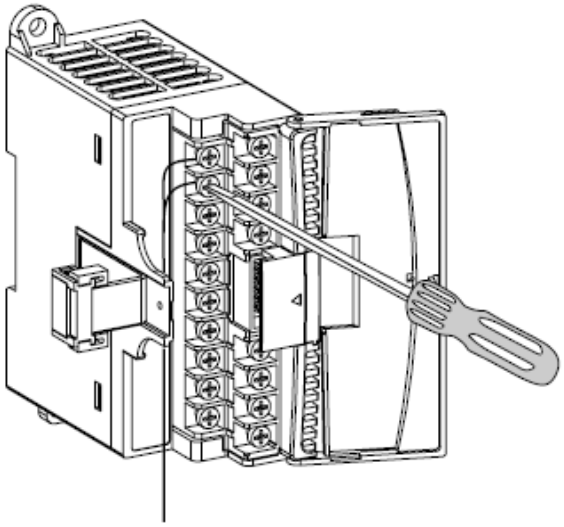
Refer to the following wiring diagrams for field wiring connections.

Figure 2-5. Wiring Diagram



2.6.2 Wiring the Finger-Safe Terminal Block

Figure 2-6. Wiring



WARNING	Be careful when stripping wires. Wire fragments that fall into a module could cause damage when power is applied. Once wiring is complete, ensure the module is free of all metal fragments.

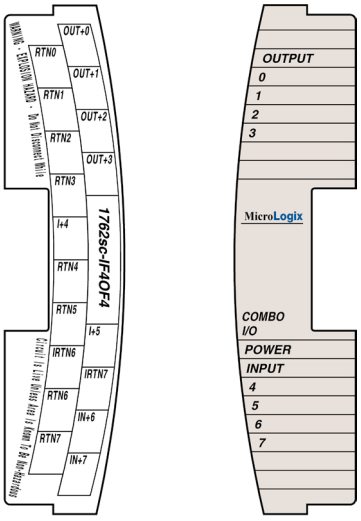
When wiring the terminal block, keep the finger-safe cover in place.

1. Refer to previous section for proper field wiring connections.
2. Route the wire under the terminal pressure plate. You can use the stripped end of the wire or a spade lug. The terminals will accept a 6.35 mm (0.25 in.) spade lug. See Figure 2-5.
3. Tighten the terminal screw making sure the pressure plate secures the wire. Recommended torque when tightening terminal screws is 0.904 Nm (8 in-lbs).
4. After wiring is complete, remove the debris shield.

2.6.3 Terminal Door Label

A removable, write-on label is provided with the module. Remove the label from the door, mark your unique identification of each terminal with permanent ink, and slide the label back into the door. Your markings (ID tag) will be visible when the module door is closed. See figure below.

Figure 2-7. Door Label



Section 2.7
Module Indicators

The 1762 combo module uses a single green LED to show operational status of the module. The table below shows the possible blink codes.

Blink Code	Description
Blinks rapid green	The module is not in run mode.
Solid Green	Startup has completed, all internal tests have passed, and the module has received a valid configuration from the PLC.
Off	Hardware error.

Chapter 3
Configuring the 1762sc-IF4OF4 Using RSLogix 500

This chapter covers the following subjects:

- Things you should know
- Module memory map
- Add module to Logix 500
- Module configuration
- Reading input data
- Module update time

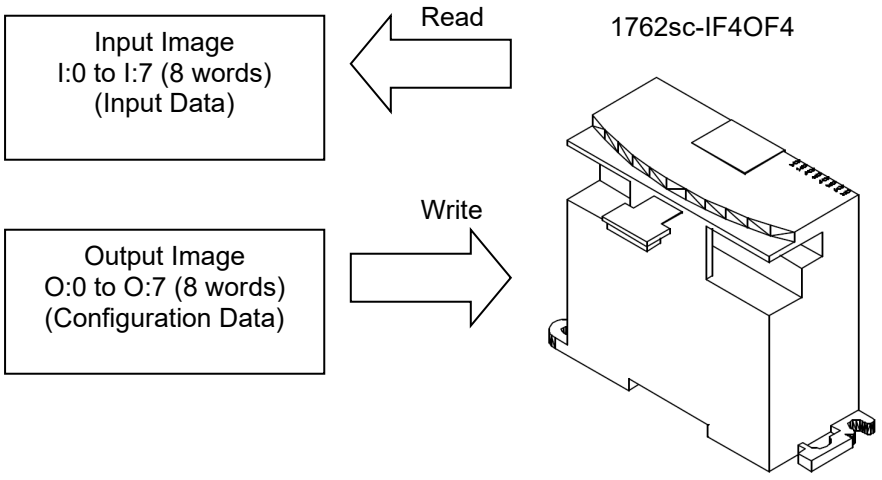
Section 3.1 Things You Should Know

This chapter describes how to configure the IF4OF4 module for the MicroLogix 1100, 1200, and 1400 system using RSLogix 500 programming software.

Section 3.2 Module Memory Map

The module uses 8 input words and 8 output words for input data and configuration. The following figure describes the data mapping for the module.

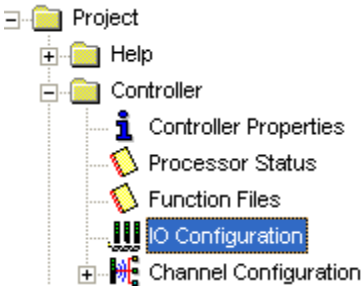
Figure 3-1. Module Memory Map



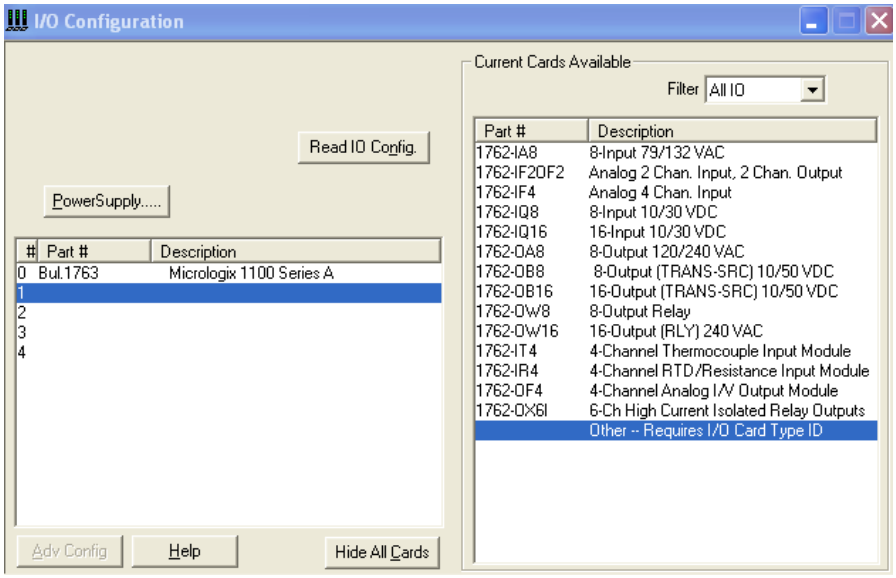
Section 3.3 Add Module to Logix 500

The following procedure describes how to add the IF4OF4 module to the RSLogix 500 programming software.

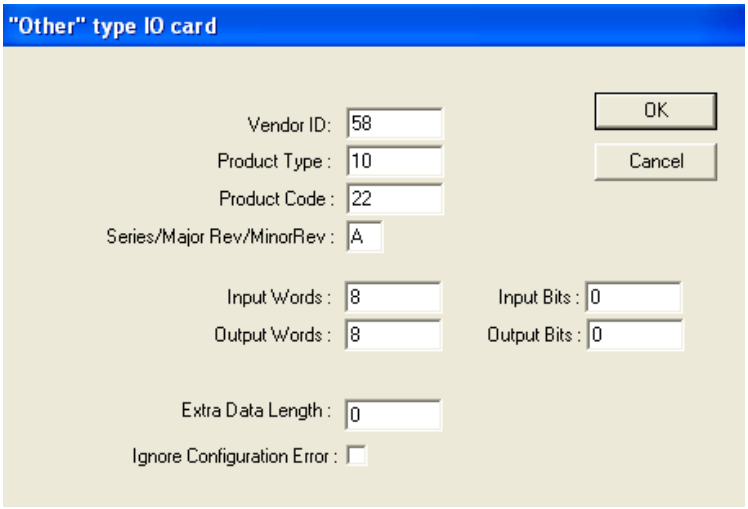
1. Create a new RSLogix 500 project and select either a Micro 1100, 1200, or 1400 processor.
2. Double-click **I/O Configuration** from the project tree.



3. Select the first empty slot and then double-click the **Other—Requires I/O Card Type ID** option, from the I/O configuration screen.



4. Enter the module profile data as shown in the figure below and click **OK**.



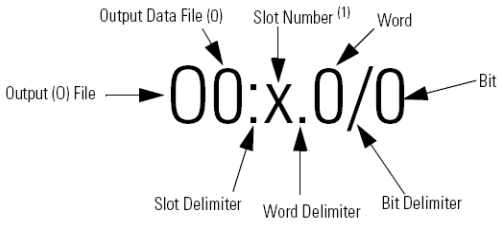
5. Repeat steps 1 through 4 for additional modules.

Section 3.4 Module Configuration

The IF4OF4 is configured using the output data table within RSLogix 500.

3.4.1 Output Data File (Configuration Data)

The output data file is used to configure the advanced settings of the module including input type, output type, data format, filter settings, etc. Use the addressing scheme below to locate the 8 output words needed to configure the module.



1. I/O located on the controller (embedded I/O) is slot 0. I/O added to the controller (expansion I/O) begins with slot 1.

The table below shows the general layout for the 8 output words used for configuration.

Table 3-1. Output File

Register	Function
Output File (Used for Module Configuration)	
O:e.0	Channel 0 Data Word
O:e.1	Channel 1 Data Word
O:e.2	Channel 2 Data Word
O:e.3	Channel 3 Data Word
O:e.4	Low byte: Channel 0 Configuration Register (Output)[1] High byte: Channel 1 Configuration Register (Output) [1]
O:e.5	Low byte: Channel 2 Configuration Register (Output) [1] High byte: Channel 3 Configuration Register (Output) [1]
O:e.6	Low byte: Channel 4 Configuration Register (Input) [2] High byte: Channel 5 Configuration Register (Input) [2]
O:e.7	Low byte: Channel 6 Configuration Register (Input) [3] High byte: Channel 7 Configuration Register (Input) [3]
[1] See Table 3-2, [2] See Table 3-4, [3] See Table 3-5	

3.4.2 Output Channel Configuration (Channels 0 through 3)

The table below describes the configuration options for analog output channels 0 through 3.

Table 3-2. Configuration for Output Channels 0 through 3

To Select		Make these bit settings							
		7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Output Type	4 to 20 mA						**0**	**0**	**0**
	0 to 20 mA						0	0	1
	-10 to 10 V						0	1	0
	0 to 10 V						0	1	1
	1 to 5 V						1	0	0
	0 to 5 V						1	0	1
	Reserved						1	1	0
	Channel Disabled						1	1	1
Data Format	Scaled for PID				**0**	**0**			
	Engineering Units				0	1			
	Percent Range				1	0			
	Raw/Proportional Data				1	1			
Unused		0	0	0					

Table 3-3 lists the number of counts for each of the supported input channel data ranges.

Table 3-3. Output Channel Data Ranges

Output Range	Output Value	Condition	Raw/Prop	EU	PID	% FS
4..20 mA	20.40 mA	High Limit	32767	20400	16793	10250
	20.00 mA	High Range	31176	20000	16383	10000
	4.00 mA	Low Range	-32450	4000	0	0
	3.92 mA	Low Limit	-32768	3920	-82	-50
0..20 mA	20.40 mA	High Limit	32767	20400	16711	10200
	20.00 mA	High Range	31482	20000	16383	10000
	0.00 mA	Low Limit/Range	-32768	0	0	0
+/-10 V	11.00 VDC	High Limit	32767	11000	17202	11000
	10.00 VDC	High Range	29788	10000	16383	10000
	-10.00 VDC	Low Range	-29788	-10000	0	-10000
	-11.00 VDC	Low Limit	-32768	-11000	-819	-11000
0 to 5 V	5.50 VDC	High Limit	32767	5500	18021	11000
	5.00 VDC	High Range	26809	5000	16383	10000
	0.00 VDC	Low Range	-32768	0	0	0
	0.00 VDC	Low Limit	-32768	0	0	0
0 to 10 V	11.00 VDC	High Limit	32767	11000	18021	11000
	10.00 VDC	High Range	26809	10000	16383	10000
	0.00 VDC	Low Range	-32768	0	0	0
	0.00 VDC	Low Limit	-32768	0	0	0
1 to 5 V	5.50 VDC	High Limit	32767	5500	18431	11250
	5.00 VDC	High Range	26809	5000	16383	10000
	1.00 VDC	Low Range	-20853	1000	0	0
	0.00 VDC	Low Limit	-32768	000	-4096	-2500

3.4.3 Input Channel Configuration (Channels 4 and 5)

Channels 4 and 5 are current only channels. The table below describes the configuration options for channels 4 and 5.

Table 3-4. Configuration for Input Channels 4 and 5

To Select		Make these bit settings							
		7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Filter Frequency (Ignored if Display CJC)	17 Hz							**0**	**0**
	4 Hz							0	1
	62 Hz							1	0
	470 Hz							1	1
Data Format	Engineering Units ×1					**0**	**0**		
	Engineering ×10					0	1		
	Raw/Proportional Data					1	0		
	Scaled for PID					1	1		
Input Type	4 to 20 mA			**0**	**0**				
	0 to 20 mA			0	1				
	Reserved			1	0				
	Channel Disabled			1	1				
Open Circuit (For Module)[4]	Upscale		**0**						
	Zero		1						
Temperature Scale (For Module)[4]	Deg C	**0**							
	Deg F	1							

3.4.4 Input Channel Configuration (Channels 6 and 7)

Channels 6 and 7 can be configured for current or voltage, including thermocouple inputs. The following table describes the configuration options for channels 6 and 7.

Table 3-5. Configuration for Input channels 6 and 7

To Select		Make these bit settings							
		7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Filter Frequency (Ignored if Display CJC)	17 Hz							**0**	**0**
	4 Hz							0	1
	62 Hz							1	0
	470 Hz							1	1
Data Format	Engineering Units ×1					**0**	**0**		
	×10					0	1		
	Raw/Proportional Data					1	0		
	Scaled for PID					1	1		
Input Type	4 to 20 mA	**0**	**0**	**0**	**0**				
	0 to 20 mA	0	0	0	1				
	-10 to 10 V	0	0	1	0				
	0 to 10 V	0	0	1	1				
	1 to 5 V	0	1	0	0				

[4] This is a module-wide setting which is only recognized within the configuration for Channel 4. The corresponding bit in Channel 5 is ignored.

To Select		Make these bit settings							
		7	6	5	4	3	2	1	0
	0 to 5 V	0	1	0	1				
	Type J TC	0	1	1	0				
	Type K TC	0	1	1	1				
	Type E TC	1	0	0	0				
	Type T TC	1	0	0	1				
	Type J TC CJC Disabled	1	0	1	0				
	Type K TC CJC Disabled	1	0	1	1				
	Type E TC CJC Disabled	1	1	0	0				
	Type T TC CJC Disabled	1	1	0	1				
	Display CJC channel temp	1	1	1	0				
	Channel Disabled	1	1	1	1				

Table 3-6 lists the number of counts for each of the supported input channel data ranges.

NOTE	The engineering unit data formats represent real engineering temperature units provided by the module to the controller. The raw/proportional counts, scaled-for-PID and percent of full-scale data formats may yield the highest effective resolutions, but may also require that you convert channel data to real engineering units in your control program.

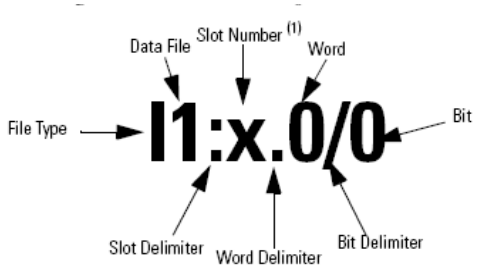
Table 3-6. Input Channel Data Ranges

Input Range	Input Value	Condition	EU ×1	EU ×10	Raw Prop	PID
J Thermocouple	1200.00 °C	High Limit	12000	1200	32767	16383
	1200.00 °C	High Range	12000	1200	32767	16383
	-180.00 °C	Low Range	-1800	-180	-32768	0
	-180.00 °C	Low Limit	-1800	-180	-32768	0
K Thermocouple	1370.00 °C	High Limit	13700	1370	32767	16383
	1370.00 °C	High Range	13700	1370	32767	16383
	-200.00 °C	Low Range	-2000	-200	-32768	0
	-200.00 °C	Low Limit	-2000	-200	-32768	0
E Thermocouple	1000.00 °C	High Limit	10000	1000	32767	16383
	1000.00 °C	High Range	10000	1000	32767	16383
	-200.00 °C	Low Range	-2000	-200	-32768	0
	-200.00 °C	Low Limit	-2000	-200	-32768	0
T Thermocouple	400.00 °C	High Limit	4000	400	32767	16383
	400.00 °C	High Range	4000	400	32767	16383
	-190.00 °C	Low Range	-1900	-190	-32768	0

Input Range	Input Value	Condition	EU ×1	EU ×10	Raw Prop	PID
	-190.00 °C	Low Limit	-1900	-190	-32768	0
0.. V	5.50 VDC	High Limit	5500	550	32767	18201
	5.00 VDC	High Range	5000	500	32767	16383
	0.00 VDC	Low Range	0	0	-32768	0
	0.00 VDC	Low Limit	0	0	-32768	0
1..5 V	5.50 VDC	High Limit	5500	550	32767	18431
	5.00 VDC	High Range	5000	500	32767	16383
	1.00 VDC	Low Range	1000	100	-32768	0
	0.00 VDC	Low Limit	0	0	-32768	-4096
±10 V	11.00 VDC	High Limit	11000	1100	32767	17202
	10.00 VDC	High Range	10000	1000	32767	16383
	-10.00 VDC	Low Range	-10000	-1000	-32768	0
	-11.00 VDC	Low Limit	-11000	-1100	-32768	-819
0..10 V	11.00 VDC	High Limit	11000	1100	32767	17202
	10.00 VDC	High Range	10000	1000	32767	16383
	0.00 VDC	Low Range	0	0	-32768	0
	0.00 VDC	Low Limit	0	0	-32768	0
4..20 mA	20.40 mA	High Limit	20400	2040	32767	16793
	20.00 mA	High Range	20000	2000	32767	16383
	4.00 mA	Low Range	4000	400	-32768	0
	3.92 mA	Low Limit	3920	392	-32768	-82
0..20 mA	20.40 mA	High Limit	20400	2040	32767	16711
	20.00 mA	High Range	20000	2000	32767	16383
	0.00 mA	Low Range	0	0	-32768	0
	0.00 mA	Low Limit	0	0	-32768	0
CJC	85.00 °C	High Limit	8500	850	32767	16383
	85.00 °C	High Range	8500	850	32767	16383
	-25.00 °C	Low Range	-2500	-250	-32768	0
	-25.00 °C	Low Limit	-2500	-250	-32768	0

Section 3.5 Read Input Data

The input data file contains module status information and analog input data for each of the four input channels. Analog input data is read for each channel, converted to a scaled digital value, and stored in the input file. Use the addressing scheme below to locate the 8 input words used for channels 0 through 7, respectively.



1. I/O located on the controller (embedded I/O) is slot 0. I/O added to the controller (expansion I/O) begins with slot 1.

The layout for the input file is shown below.

Table 3-7. Input Data File Layout

		Bits															
	Word	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
General Status	I:e.0	-	-	-	-	-	-	-	-	S7	S6	S5	S4	S3	S2	S1	S0
Output Status	I:e.1	-	LD3	U3	O3	-	LD2	U2	O2	-	LD1	U1	O1	-	LD0	U0	O0
Input Status	I:e.2	-	OC7	U7	O7	-	OC6	U6	O6	-	OC5	U5	O5	-	OC4	U4	O4
CJC Temperature	I:e.3	16 Bit Word															
Input Channel 4 Data	I:e.4	16 Bit Word															
Input Channel 5 Data	I:e.5	16 Bit Word															
Input Channel 6 Data	I:e.6	16 Bit Word															
Input Channel 7 Data	I:e.7	16 Bit Word															

- = Not used: Bit set to 0.

S<×> = General status bit: If a bit is set (1) then there is an error associated with that channel (that is, under/over range).

U<×> = Under range flag bits: Applies to all input/output types.

Inputs:

When set to 1, indicates input signal is below the value in the “Low Range” column indicated by the table above. However, the module

will continue to convert analog data to the minimum “Low Limit” value. Bit is automatically reset (0) by the module when the under-range condition clears.

For input data types 0-20 mA, 0-10 V, and 0-5 V, the under- range flag bits will be set when the data value is 0.

Outputs:

When set to 1, indicates the output word value set by the user is below the “Low Range” value (depending on the data format). The channel will output voltage or current (depending on the output type) down to the “Low Limit” value.

O<x> = Over range flag bits: Applies to all input/output types.

Inputs:

When set to 1 indicates input signal is above the “High Range” value. Module will continue to convert analog data to the maximum “High Limit” value. Bit is automatically reset (0) by the module when the over range condition clears.

Outputs:

When set to 1, indicates the output word value set by the user is above the “High Range” value (determined by the format). The channel will output voltage or current (depending on the output type) up to the “High Limit” value.

LD<x> = Load Error: This applies only to output channels. If the channel is configured for voltage, this bit indicates a short circuit. If configured for current, an open circuit is indicated. The error bit is cleared (0) at the time the condition is cleared.

OC<x> = Open Circuit: This bit is only valid for 1-5 V, 4-20 mA ranges. When set to 1, an open circuit has been detected.

Inputs:

Open circuit detection is only available for input channels configured for 4-20 mA current or 1-5 V voltage. The remainder of the input ranges will float near 0 V or 0 mA when an open wire condition occurs. For each input channel, the user is given the option of reporting upscale or 0 (see configuration words). For 4-mA range, an open wire condition will be set for any value less than 2.0 mA. For 1-5 V range, an open wire condition will be set for any voltage below 0.5 V. Thermocouple ranges will display appropriate temperatures for an input voltage near 0 V.

NOTE	A special case exists when channels 6 or 7 are configured to display CJC temperature. If either channel is configured to display the CJC temperature, the associated OC bit will indicate an open-circuit condition, if one exists, for the CJC sensor itself.

Outputs:

Open circuit detection is available for output channels in current mode. For current outputs, open wire may not be detected when the output is driven at or near zero.

NOTE	Input word 3 will always display the raw CJC temperature in degrees C, Engineering units, and so no channel configuration is needed.

Section 3.6 Module Update Time

The module update time is determined by the number of input channels enabled and by the filter frequency selected for each channel.

ADC Filter Frequency	Filter Frequency (-3 dB point)	Conversion Time	Module update
470 Hz	109 Hz	20 ms	= sum of conversion times for each enabled channel
62 Hz	14 Hz	45 ms	
17 Hz	4 Hz	135 ms	
4 Hz	1 Hz	495 ms	

Getting Technical Assistance

Note that your module contains electronic components which are susceptible to damage from electrostatic discharge (ESD). An electrostatic charge can accumulate on the surface of ordinary plastic 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 / metalized 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:

USA - 425-746-9481

Declaration of Conformity

Available upon request

Appendix A
Module Specifications

General Specifications

Specification	Value		
Dimensions	90 mm (height) × 87 mm (depth) 40 mm (width) Height including mounting tabs is 110 mm 3.54 in. (height) × 3.43 in. (depth) × 1.58 in. (width) Height including mounting tabs is 4.33 in.		
Approximate Shipping Weight (with carton)	281 g (0.619 lbs.)		
Storage Temperature	-40 °C to +85 °C (-40 °F to +185 °F)		
Operating Temperature	-20 °C to +60 °C (-4 °F to +140 °F)		
Operating Humidity	5% to 95% non-condensing		
Operating Altitude	2000 meters (6561 feet)		
Vibration	Operating: 10 to 500 Hz, 5 G, 0.030 in. max. peak-to-peak		
Shock	Operating: 30 G		
Bus Current Draw (max.)	30 mA at 5 VDC Max 3.4 W Max (140 mA max at 24 V)		
Heat Dissipation	3.0 W Total Max		
Resolution	16 bits (Integer Format)		
Channel Update Time	Filter Setting	Conversion Time	Module Update time[5]
	470 Hz	20 ms	= Conversion time * (1+ number of enabled channels)
	62 Hz	45 ms	
	17 Hz	135 ms	
	4 Hz	495 ms	
Input Group to System Isolation	Channel to Rack: 707 VDC for 1 minute Optical and magnetic Channel to Channel: Input channels are differential as long as all pins are within 13 V dc of the output return lines.		
Module Power LED	On: indicates power is applied and module not faulted.		

[5] The module update time is purely the sum of conversion times for each enabled channel. The extra addition of 1 is not necessary.

Specification	Value
Recommended Cable	Belden™ 8761 (shielded)
Specification	Value
Vendor I.D.	58
Product Type	10
Product Code	22
Agency Certification	C-UL listed (under CSA C22.2 No. 142) UL 508 listed CE compliant for all applicable directives
Hazardous Environment Class	Class I, Division 2, Hazardous Location, Groups A, B, C, D (ISA 12.12.01, C-UL under CSA C22.2 No. 213) Operating Temperature Code T4a
Radiated and Conducted Emissions	EN61131-2
Electrical /EMC:	The module has passed testing at the following levels:
ESD Immunity (IEC61000-4-2)	4 kV contact, 8 kV air, 4 kV indirect
Radiated Immunity (IEC61000-4-3)	10 V/m, 80 to 1000 MHz, 80% amplitude modulation, +900 MHz keyed carrier
Fast Transient Burst (IEC61000-4-4)	2 kV, 5 kHz
Surge Immunity (IEC61000-4-5)	1 kV galvanic gun
Conducted Immunity (IEC61000-4-6)	10 V, 0.15 to 80 MHz[6]

Regulatory

UKCA

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

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

[6] Conducted Immunity frequency range may be 150 kHz to 30 MHz if the Radiated Immunity frequency range is 30 MHz to 2700 MHz.

Input Specifications

Specification	Value	
Number of Inputs	2 Current only and 2 Current/Voltage/Thermocouple	
A/D Converter Type	Delta Sigma	
Common Mode Rejection	75 dB for 4 Hz and 17 Hz Filters	
Normal Mode Rejection	4 Hz Filter	74 dB minimum at 50 and 60 Hz
	17 Hz Filter	65 dB minimum at 50 and 60 Hz
	62 Hz Filter	First notch at 31 Hz, typically 30 dB
	470 Hz Filter	First notch at 237 Hz, typically 35 dB
Non-linearity (in percent full scale)	±0.1%	
Input Impedance	Current Terminal: 249Ω	
Current Input Protection	±42 mA	
Voltage Input Protection	±28 V[7]	

[7] The input voltage on any input pin must be within ±13 VDC of the output return lines for normal operation.

Specification	Value
Calibrated Accuracy	
Thermocouple Inputs	Linearization per ITS-90 System accuracy at 25 °C (4 and 17 Hz filters): Type J (-180 °C to 1200 °C): ±1.0 degrees C maximum Type K (-200 °C to 1370 °C): ±2.0 degrees C maximum Type E (-200 °C to 1000 °C): ±1.0 degrees C maximum Type T (-190 °C to 400 °C): ±2.0 degrees C maximum System accuracy at -20-60 C (4 and 17 Hz filters): Type J (-180 °C to 1200 °C): ±5.0 degrees C maximum Type K (-200 °C to 1370 °C): ±6.0 degrees C maximum Type E (-200 °C to 1000 °C): ±4.5 degrees C maximum Type T (-190 °C to 400 °C): ±4.0 degrees C maximum The above limits do not include the cold junction compensation or thermocouple sensor errors.
CJC Profile Accuracy	±4.0 degrees C maximum Temperature correlation to target terminal
CJC Sensor Accuracy	±1.0 degrees C maximum Reading/Conversion of the sensor -20 °C to 80 °C input values
CJC Repeatability	±0.5 degrees C maximum for -20 °C - 80 °C input values

Specification	Value
Voltage Inputs	System accuracy at 25 °C (4 and 17 Hz filters): ±3 mV maximum for 0-5 V inputs ±3 mV maximum for 1-5 V inputs ±10 mV maximum for 0-10 V inputs ±10 mV maximum for ±10 V inputs System accuracy at -20 °C -60 °C (4 and 17 Hz filters): ±6 mV maximum for 0-5 V inputs ±6 mV maximum for 1-5 V inputs ±20 mV maximum for 0-10 V inputs ±20 mV maximum for ±10 V inputs
Current Inputs	System accuracy at 25° C (4 and 17 Hz filters): ±20 uA maximum for 0-20 mA inputs ±20 uA maximum for 4-20 mA inputs System accuracy at -20 °C - 60 °C (4 and 17 Hz filters): ±50 uA maximum for 0-20 mA inputs ±50 uA maximum for 4-20 mA inputs

Input Repeatability

Input Repeatability (at 25°C)	4 Hz Filter	17 Hz Filter	62 and 470 Hz Filters typical values[8]
Thermocouples			
Type J	±0.3 °C	±0.3 °C	Not Recommended
Type K	±0.4 °C	±0.4 °C	Not Recommended
Type T	±0.3 °C	±0.3 °C	Not Recommended
Type E	±0.3 °C	±0.3 °C	Not Recommended
Voltage Inputs	±1 mV	±2 mV	±4 mV
Current Inputs	±2 µA	±2 µA	±6 µA

[8] These filters do not reject 50/60 Hz. Repeatability for these filters is strongly dependent on how much 50/60 Hz noise is in the system.

Output Specifications

Specification	Description
Number of Outputs	4 channels of current or voltage
Accuracy - Voltage Outputs	System accuracy at 25 °C: ±20 mV maximum System accuracy at -20-60 °C: ±50 mV maximum
Accuracy - Current Outputs	System accuracy at 25 °C: ±50 uA maximum System accuracy at -20-60 °C: ±75 uA maximum
Output Resolution	
Voltage Output	400 µV per bit average when using RAW format in ±10 V range and 0-10 V range 185 µV per bit average when using RAW format in 0-5 or 1-5 V ranges
Current Output	380 nA per bit when using RAW format for all current ranges
Differential Nonlinearity	1 LSB (see resolution for LSB size)
Output Ripple	<15 mV ripple for voltage or current
Output Impedance	Current: >1 Mohm, Voltage: <1 ohm (MRD)
Output Load	Current: 0 ohm min, 500 ohm max, Voltage: >=1 Kohm at 10 V output (10 mA), includes wire resistance.
Maximum Output Inductive and Capacitive Load	0.1 mH 1 µF
Output Settling Time	<1 ms to 63% of full scale
Output Channel glitch)	Current mode = < ±1 V for 20 ms at maximum load Voltage mode = < ±0.4 V for 20 ms and < ±- 1 V for 1.5 ms with 1 Kohm load.
Output Protection	±24 V at 25 °C for 1 minute on any channel, with any range and value.
Output Short Circuit Protection	Yes, continuous. (IEC 1131-2 requirement) with any range and value.

Index

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