



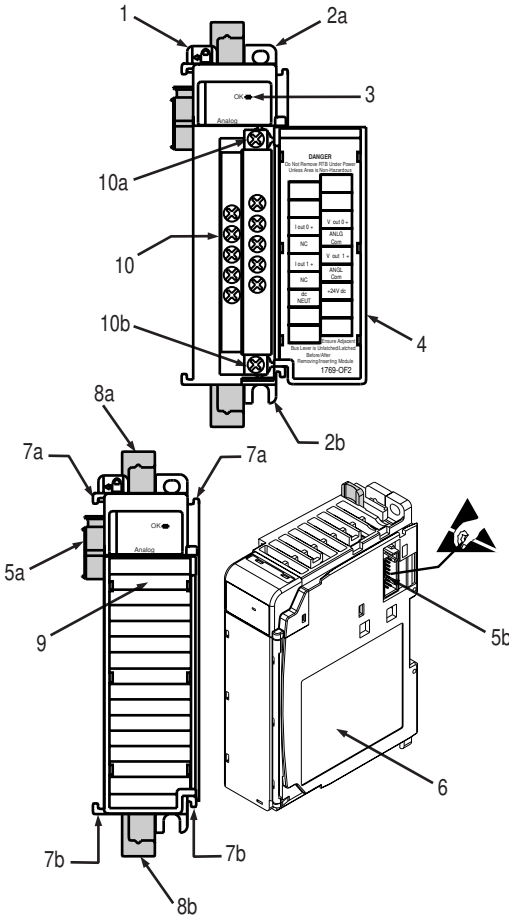
Installation Instructions

Compact™ 1769-OF2 (Series B or Later) Analog Output Module

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Module Description



Item	Description
1	bus lever (with locking function)
2a	upper panel mounting tab
2b	lower panel mounting tab
3	module status LED
4	module door with terminal identification label
5a	movable bus connector with female pins
5b	stationary bus connector with male pins
6	nameplate label
7a	upper tongue-and-groove slots
7b	lower tongue-and-groove slots
8a	upper DIN rail latch
8b	lower DIN rail latch
9	write-on label (user ID tag)
10	removable terminal block (RTB) with finger-safe cover
10a	RTB upper retaining screw
10b	RTB lower retaining screw

Module Installation

Compact 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⁾

Prevent Electrostatic Discharge

ATTENTION



Electrostatic discharge can damage integrated circuits or semiconductors if you touch bus connector pins or the terminal block. 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 bus connector or connector pins.
- Do not touch circuit components inside the module.
- If available, use a static-safe work station.
- When not in use, keep the module in its static-shield box.

(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.

Remove Power

ATTENTION

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:

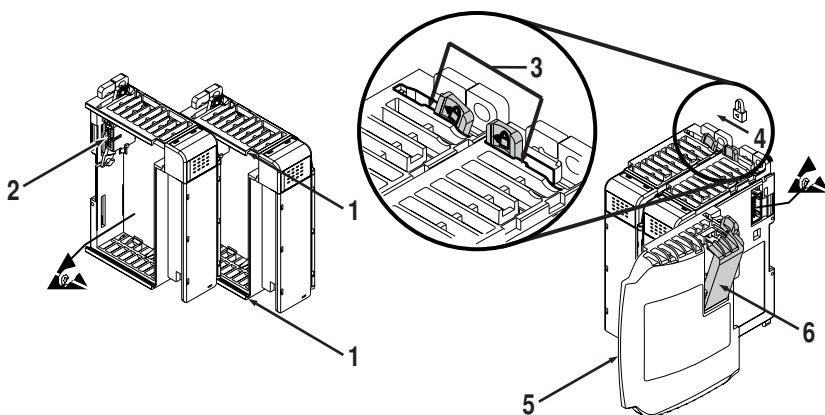
- sending an erroneous signal to your system's field devices, causing unintended machine motion
- causing an explosion in a hazardous environment

Electrical arcing causes excessive wear to contacts on both the module and its mating connector. Worn contacts may create electrical resistance.

System Assembly

The module can be attached to the controller or an adjacent I/O module *before* or *after* mounting. For mounting instructions, see “Panel Mounting” on page 6, or “DIN Rail Mounting” on page 7. To work with a system that is already mounted, see “Replacing a Single Module within a System” on page 8.

The following procedure shows you how to assemble the Compact I/O system.



1. Disconnect power.
2. Check that the bus lever of the module to be installed is in the unlocked (fully right) position.
3. Use the upper and lower tongue-and-groove slots (1) to secure the modules together (or to a controller).
4. Move the module back along the tongue-and-groove slots until the bus connectors (2) line up with each other.
5. Push the bus lever back slightly to clear the positioning tab (3). Use your fingers or a small screwdriver.
6. To allow communication between the controller and module, move the bus lever fully to the left (4) until it clicks. Ensure it is locked firmly in place.

ATTENTION

When attaching I/O modules, it is very important that the bus connectors are securely locked together to ensure proper electrical connection.

7. Attach an end cap terminator (5) to the last module in the system by using the tongue-and-groove slots as before.
8. Lock the end cap bus terminator (6).

IMPORTANT

A 1769-ECR or 1769-ECL right or left end cap must be used to terminate the end of the serial communication bus.

Mounting Expansion I/O

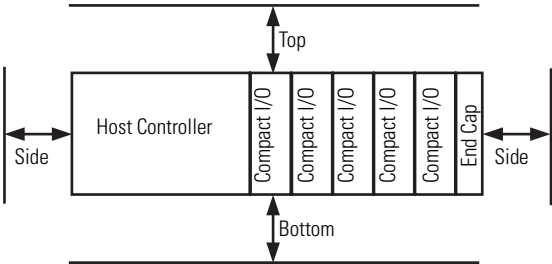
ATTENTION



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 on power up.

Minimum Spacing

Maintain spacing from enclosure walls, wireways, adjacent equipment, etc. Allow 50 mm (2 in.) of space on all sides for adequate ventilation, as shown:

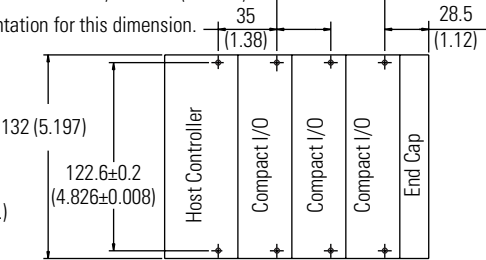


Panel Mounting

Mount the module to a panel using two screws per module. Use M4 or #8 panhead screws. Mounting screws are required on every module.

Panel Mounting Using the Dimensional Template

For more than 2 modules: (number of modules-1) X 35mm (1.38 in.)
Refer to host controller documentation for this dimension.



NOTE: All dimensions are in mm (inches).
Hole spacing tolerance: ±0.4 mm (0.016 in.)

Panel Mounting Procedure Using Modules as a Template

The following procedure allows you to use the assembled modules as a template for drilling holes in the panel. If you have sophisticated panel mounting equipment, you can use the dimensional template provided on page 6. Due to module mounting hole tolerance, it is important to follow these procedures:

1. On a clean work surface, assemble no more than three modules.
2. Using the assembled modules as a template, carefully mark the center of all module-mounting holes on the panel.
3. Return the assembled modules to the clean work surface, including any previously mounted modules.
4. Drill and tap the mounting holes for the recommended M4 or #8 screw.
5. Place the modules back on the panel, and check for proper hole alignment.
6. Attach the modules to the panel using the mounting screws.

NOTE

If mounting more modules, mount only the last one of this group and put the others aside. This reduces remounting time during drilling and tapping of the next group.

7. Repeat steps 1 to 6 for any remaining modules.

DIN Rail Mounting

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

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

Replacing a Single Module within a System

The module can be replaced while the system is mounted to a panel (or DIN rail). Follow the steps below in order:

1. Remove power. See important note on page 4.
2. On the module to be removed, remove the upper and lower mounting screws from the module (or open the DIN latches using a flat-blade or phillips-style screwdriver).
3. Move the bus lever to the right to disconnect (unlock) the bus.
4. On the right-side adjacent module, move its bus lever to the right (unlock) to disconnect it from the module to be removed.
5. Gently slide the disconnected module forward. If you feel excessive resistance, check that the module has been disconnected from the bus, and that both mounting screws have been removed (or DIN latches opened).

NOTE

It may be necessary to rock the module slightly from front to back to remove it, or, in a panel-mounted system, to loosen the screws of adjacent modules.

6. Before installing the replacement module, be sure that the bus lever on the module to be installed, and on the right-side adjacent module are in the unlocked (fully right) position.
7. Slide the replacement module into the open slot.
8. Connect the modules together by locking (fully left) the bus levers on the replacement module and the right-side adjacent module.
9. Replace the mounting screws (or snap the module onto the DIN rail).

Module Spare/Replacement Parts

- Terminal block, catalog number 1769-RTBN12 (1 per kit)
- Door Labels, catalog number 1769-RL2 Series B (2 per kit)
- Door, catalog number 1769-RD (2 per kit)

Field Wiring Connections

Grounding the Module

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

System Wiring Guidelines

Consider the following when wiring your system:

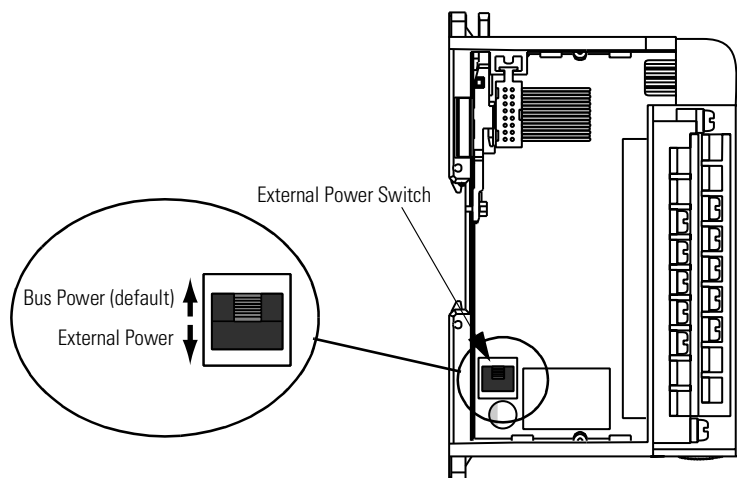
- All module commons (ANLG COM) are connected in the analog module. The analog common (ANLG COM) is not connected to earth ground inside the module.
- Do not use the analog module's NC terminals as connection points.
- Channels are not isolated from each other.
- Use Belden™ 8761, or equivalent, shielded wire.
- Under normal conditions, the drain wire and shield junction must be connected to earth ground, via a panel or DIN rail mounting screw at the analog I/O module end. Keep the shield connection to ground as short as possible.⁽¹⁾
- To ensure optimum accuracy, limit overall cable impedance by keeping your cable as short as possible. Locate the I/O system as close to your sensors or actuators as your application will permit.
- Voltage outputs (Vout 0+ and Vout 1+) of the 1769-OF2 module are referenced to ANLG COM. Load resistance for a voltage output channel must be equal to or greater than 1K Ω .
- Current outputs (Iout 0+ and Iout 1+) of the 1769-OF2 module source current that returns to ANLG COM. Load resistance for a current output channel must remain between 0 and 500 Ω .

(1) In environments where high frequency noise may be present, it may be necessary to ground the shield via a 0.1 μ F capacitor at the load end and also ground the module end without a capacitor.

External Power Switch

The 1769-OF2 (Series B or later) has an external 24V dc power switch which gives you the option of using an external power supply. The switch is located in on the lower left portion of the module's circuit board, as shown below. With this switch in the up position (default), 24V dc power is drawn from the 1769 system power supply via the 1769 I/O bus. In the down position, 24V dc power is drawn from the external power supply.

Wire the external power supply to the module via the module's terminal block. The external power supply must be rated Class 2, with a 24V dc range of 20.4 to 26.4V dc and 120 mA minimum.



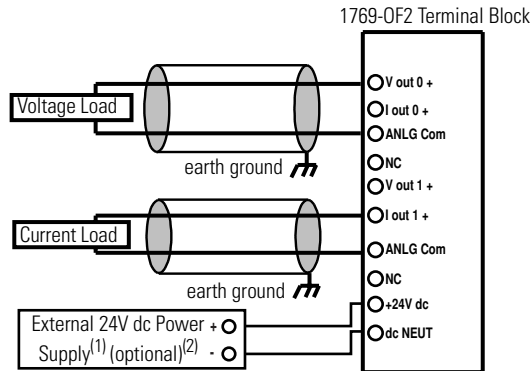
Wiring Output Devices

Basic wiring of output devices is shown below.

ATTENTION



- Miswiring of the module to an AC/DC source will damage the module.
- Be careful when stripping wires. Wire fragments that fall into a module could cause damage at power up. Once wiring is complete, ensure the module is free of all metal fragments.



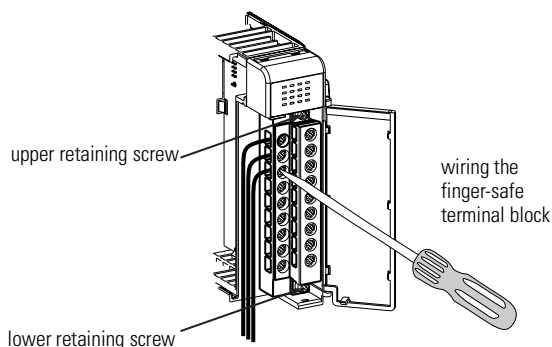
- (1) The external power supply must be rated Class 2, with a 24V dc range of 20.4 to 26.4V dc and 120 mA per 1769-OF2 module minimum.
- (2) Series B and later modules provide this option.

Labeling the Terminals

A removable, write-on label is provided with the module. Remove the label from the door, mark the 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.

Removing the Finger-Safe Terminal Block

To remove the terminal block, loosen the upper and lower retaining screws. The terminal block will back away from the module as you remove the screws. When replacing the terminal block, torque the retaining screws to 0.46 Nm (4.1 in-lbs).



Wiring the Finger-Safe Terminal Block

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

1. Loosen the terminal screws to be wired.
2. Route the wire under the terminal pressure plate. You can use the bare wire or a spade lug. The terminals will accept a 6.35 mm (0.25 in.) spade lug.

NOTE

The terminal screws are non-captive. Therefore, it is possible to use a ring lug [maximum 1/4 inch o.d. with a 0.139 inch minimum i.d. (M3.5)] with the module.

3. Tighten the terminal screw making sure the pressure plate secures the wire. Recommended torque when tightening terminal screws is 0.68 Nm (6 in-lbs).

NOTE

If you need to remove the finger-safe cover, insert a screw driver into one of the square, wiring holes and gently pry the cover off. If you wire the terminal block with the finger-safe cover removed, you will not be able to put it back on the terminal block because the wires will be in the way.

Wire Size and Terminal Screw Torque

Each terminal accepts up to two wires with the following restrictions:

Wire Type		Wire Size	Terminal Screw Torque	Retaining Screw Torque
Solid	Cu-90°C (194°F)	#14 to #22 AWG	0.68 Nm (6 in-lbs)	0.46 Nm (4.1 in-lbs)
Stranded	Cu-90°C (194°F)	#16 to #22 AWG	0.68 Nm (6 in-lbs)	0.46 Nm (4.1 in-lbs)

I/O Memory Mapping

Output Data File

For each module, slot x, words 0-1 in the output data file contain the channel 0 and channel 1 output data.

Word	Bit Position															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	SGN	Analog Output Data Channel 0														
1	SGN	Analog Output Data Channel 1														

- SGN = Sign bit in two's complement format.

Input Data File

For each module, slot x, input data file words 2-3 contain the state of the module's output data (output data echo) file words 0-1. During normal operation, these input words represent the analog values that the outputs are directed to by the control program. They are also dependent upon the:

- Program Mode configuration (if supported by the controller)
- The Fault Mode configuration (if supported by the controller)

Word	Bit Position																	
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0		
0	D0	H0	D1	H1	Not Used (Bits set to 0)										S1	S0		
1	U0	O0	U1	O1	Bits set to 0													
2	SGN	Output Data Loopback/Echo Channel 0																
3	SGN	Output Data Loopback/Echo Channel 1																

The bit definitions are as follows:

- Dx = Diagnostic bits. When set, they indicate a broken output wire or high load resistance (not used on voltage outputs).
- Hx = Hold Last State bits. When set, they indicate that the channel is in a hold last state condition.
- Sx = General Status bits. When set, these bits indicate an error (over-range, under-range, or diagnostic bit) associated with that channel or a module hardware error.
- Ux = Under-range flag bits.
- Ox = Over-range flag bits.
- SGN = Sign bit in two's complement format.

IMPORTANT

The output module's input data file reflects the analog output data echo of the module, not necessarily the electrical state of the output terminals. It does not reflect shorted or open outputs.

NOTE

It is only important to use these input words if the controller supports the Program Mode or Fault Mode function, and if it is configured to use them.

Configuration Data File

The manipulation of the bits from this file is normally done with programming software (e.g. RSLogix 500, RSNetworkx for DeviceNet, etc.) during initial configuration of the system. In that case, graphical screens are provided by the programmer to simplify configuration. However, some systems, like the 1769-ADN DeviceNet Adapter, also allow the bits to be altered as part of the control program, using communication rungs. In that case, it is necessary to understand the bit arrangement. The channel configuration words, words 0 and 1, are described on page 16. Refer to the *Compact™ Analog I/O User Manual*, publication number 1769-UM002A-EN-P for additional details.

Word/ Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Word 0	See "Channel Configuration Words" on page 16.															
Word 1	See "Channel Configuration Words" on page 16.															
Word 2	S	Fault Value - Channel 0 ⁽¹⁾														
Word 3	S	Program (Idle) Value - Channel 0														
Word 4	S	Fault Value - Channel 1														
Word 5	S	Program (Idle) Value - Channel 1														

(1) These functions are not supported by all controllers (e.g. MicroLogix 1500) using any configuration method. Refer to your controller's user manual for details.

Channel Configuration Words

Words 0 through 1 of the configuration file allow you to change the parameters of each channel independently. For example, word 0 corresponds to channel 0.

Define	These bit settings													Indicate this	
	15	14	13	12	11	10	9	8	4-7	3	2	1	0		
Program (Idle) to Fault Enable									Not Used				0	Program (Idle) Mode Data Applied ⁽¹⁾	
														1	Fault Mode Data Applied ⁽¹⁾
Not Used															(Reserved)
Program (Idle) Mode											0				Hold Last State ⁽¹⁾
											1				User-Defined Value ⁽¹⁾
Fault Mode											0				Hold Last State ⁽¹⁾
											1				User-Defined Fault Value ⁽¹⁾
Output Range Select					0	0	0	0							-10V dc to +10V dc
					0	0	0	1							0 to 5V dc
					0	0	1	0							0 to 10V dc
					0	0	1	1							4 to 20 mA
					0	1	0	0							1 to 5V dc
					0	1	0	1							0 to 20 mA
															Spare ⁽²⁾
Output Data Select		0	0	0											Raw/Proportional Data
		0	0	1											Engineering Units
		0	1	0										Scaled-for-PID	
		0	1	1										Percent Range	
														Spare ⁽²⁾	
Enable Channel	1													Enabled	
	0													Disabled	

(1) These functions are not supported by all controllers (e.g. MicroLogix 1500) using any configuration method. Refer to your controller manual for details.

(2) Any attempt to write a non-valid (spare) bit configuration into any selection field results in a module configuration error.

Specifications

General Specifications

Specification	Value
Dimensions	118 mm (height) x 87 mm (depth) x 35 mm (width) height including mounting tabs is 138 mm 4.65 in. (height) x 3.43 in (depth) x 1.38 in (width) height including mounting tabs is 5.43 in.
Approximate Shipping Weight (with carton)	300g (0.65 lbs.)
Storage Temperature	-40°C to +85°C (-40°F to +185°F)
Operating Temperature	0°C to +60°C (32°F to +140°F)
Operating Humidity	5% to 95% non-condensing
Operating Altitude	2000 meters (6561 feet)
Vibration	Operating: 10 to 500 Hz, 5G, 0.030 in. peak-to-peak Relay Operation: 2G
Shock	Operating: 30G, 11 ms panel mounted (20G, 11 ms DIN rail mounted) Relay Operation: 7.5G panel mounted (5G DIN rail mounted) Non-Operating: 40G panel mounted (30G DIN rail mounted)
Agency Certification	<ul style="list-style-type: none"> • C-UL certified (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 (UL 1604, C-UL under CSA C22.2 No. 213)
Radiated and Conducted Emissions	EN50081-2 Class A
<i>Electrical /EMC:</i>	<i>The module has passed testing at the following levels:</i>
• ESD Immunity (IEC1000-4-2)	• 4 kV contact, 8 kV air, 4 kV indirect
• Radiated Immunity (IEC1000-4-3)	• 10 V/m, 80 to 1000 MHz, 80% amplitude modulation, +900 MHz keyed carrier
• Fast Transient Burst (IEC1000-4-4)	• 2 kV, 5 kHz
• Surge Immunity (IEC1000-4-5)	• 1 kV galvanic gun
• Conducted Immunity (IEC1000-4-6)	• 10V dc, 0.15 to 80 MHz ⁽¹⁾

(1) Conducted Immunity frequency range may be 150 kHz to 30 MHz if the Radiated Immunity frequency range is 30 MHz to 1000 MHz.

Output Specifications

Specification	1769-OF2 (Series B or later)
Analog Normal Operating Ranges ⁽¹⁾	Voltage: $\pm 10\text{V}$ dc, 0 to 10V dc, 0 to 5V dc, 1 to 5V dc Current: 0 to 20 mA, 4 to 20 mA
Full Scale Analog Ranges ⁽¹⁾	Voltage: $\pm 10.5\text{V}$ dc, -0.5 to 10.5V dc, -0.5 to 5.25V dc, 0.5 to 5.25V dc Current: 0 to 21 mA, 3.2 to 21 mA
Number of Outputs	2 single-ended
Bus Current Draw (max.)	120 mA at 5V dc 120 mA at 24V dc ⁽²⁾
Heat Dissipation	2.63 Total Watts <i>(The Watts per point, plus the minimum Watts, with all points energized.)</i>
Converter Type	Sigma-Delta
Digital Resolution Across Full Range	14 bits (unipolar); 14 bits plus sign (bipolar) $\pm 10\text{V}$ dc: Sign + 14 bits, 0.64 mV 0 to +5V dc: Sign + 13 bits, 0.64 mV 0 to +10V dc: Sign + 14 bits, 0.64 mV +4 to +20 mA: Sign + 14 bits, 1.28 μA +1 to +5V dc: Sign + 13 bits, 0.64 mV 0 to +20 mA: Sign + 14 bits, 1.28 μA
Conversion Rate (all channels) max.	2.5 ms
Step Response to 63% ⁽³⁾	2.9 ms
Current Load on Voltage Output	10 mA max.
Resistive Load on Current Output	0 to 500 Ω (includes wire resistance)
Load Range on Voltage Output	> 1 k Ω at 10V dc
Max. Inductive Load (Current Outputs)	0.1 mH
Max. Capacitive Load (Voltage Outputs)	1 μF
Field Calibration	None required
Overall Accuracy ⁽⁴⁾	Voltage Terminal: $\pm 0.5\%$ full scale at 25°C Current Terminal: $\pm 0.35\%$ full scale at 25°C

(1) The over- or under-range flag will come on when the normal operating range (over/under) is exceeded. The module will continue to convert the analog input up to the maximum full scale range. The flag automatically resets when within the normal operating range.

(2) If the optional 24V dc Class 2 power supply is used, the 24V dc current draw from the bus is 0 mA.

(3) Step response is the period of time between when the D/A converter was instructed to go from minimum to full range until the device is at 63% of full range.

(4) Includes offset, gain, drift, non-linearity and repeatability error terms.

Specification	1769-OF2 (Series B or later)
Accuracy Drift with Temperature	Voltage Terminal: $\pm 0.0086\%$ FS per $^{\circ}\text{C}$ Current Terminal: $\pm 0.0058\%$ FS per $^{\circ}\text{C}$
Output Ripple ⁽¹⁾ range 0 to 50 kHz (referred to output range)	$\pm 0.05\%$
Non-linearity (in percent full scale)	$\pm 0.05\%$
Repeatability ⁽²⁾ (in percent full scale)	$\pm 0.05\%$
Output Error Over Full Temperature Range (0 to 60 $^{\circ}\text{C}$ [+32 to +140 $^{\circ}\text{F}$])	Voltage: $\pm 0.8\%$ Current: $\pm 0.55\%$
Output Offset Error (0 to 60 $^{\circ}\text{C}$ [+32 to +140 $^{\circ}\text{F}$])	$\pm 0.05\%$
Output Impedance	15 Ω (typical)
Open and Short-Circuit Protection	Yes
Maximum Short-Circuit Current	21 mA
Output Overvoltage Protection	Yes
Time to Detect Open Wire Condition (Current Mode)	10 ms typical 13.5 ms maximum
Output Response at System Power Up and Power Down	$\pm 0.5\text{V}$ dc spike for < 5 ms
Rated Working Voltage ⁽³⁾	30V ac/30V dc
Output Group to Bus Isolation	500V ac or 710V dc for 1 minute (qualification test) 30V ac/30V dc working voltage (IEC Class 2 reinforced insulation)
Module OK LED	On: module has power, has passed internal diagnostics, and is communicating over the bus. Off: Any of the above is not true.
Channel Diagnostics	Over- or under-range by bit reporting output wire broken or load resistance high by bit reporting (current mode only)

(1) Output ripple is the amount a fixed output varies with time, assuming a constant load and temperature.

(2) Repeatability is the ability of the output module to reproduce output readings when the same controller value is applied to it consecutively, under the same conditions and in the same direction.

(3) Rated working voltage is the maximum continuous voltage that can be applied at the input terminal, including the input signal and the value that floats above ground potential (for example, 10V dc input signal and 20V dc potential above ground).

Specification	1769-OF2 (Series B or later)
System Power Supply Distance Rating	8 (The module may not be more than 8 modules away from the system power supply.)
Optional 24V dc Class 2 Power Supply Voltage Range ⁽¹⁾	20.4 V to 26.4 V dc
Recommended Cable	Belden™ 8761 (shielded)
Vendor I.D. Code	1
Product Type Code	10
Product Code	32

(1) Failure to use a Class 2 power supply without regulation within these limits could result in improper module operation.

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 ATTENTION statement applies to use in hazardous locations.

WARNING



EXPLOSION HAZARD

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

Environnements dangereux

Cet équipement est conçu pour être utilisé dans des environnements de Classe 1, Division 2, Groupes A, B, C, D ou non dangereux. La mise en garde suivante s'applique à une utilisation dans des environnements dangereux.

MISE EN GARDE**DANGER D'EXPLOSION**

- La substitution de composants peut rendre cet équipement impropre à une utilisation en environnement de Classe 1, Division 2.
 - Ne pas remplacer de composants ou déconnecter l'équipement sans s'être assuré que l'alimentation est coupée et que l'environnement est classé non dangereux.
 - Ne pas connecter ou déconnecter des composants sans s'être assuré que l'alimentation est coupée ou que l'environnement est classé non dangereux.
 - Ce produit doit être installé dans une armoire.
-

For More Information

For	Refer to this Document	Pub. No.
A more detailed description of how to install and use your Compact I/O with MicroLogix 1500 programmable controller.	MicroLogix 1500 Programmable Controllers User Manual	1764-UM001A-US-P
Detailed information on installing, programming, and troubleshooting your Compact Analog I/O modules.	Compact I/O Analog Modules User Manual	1769-UM002A-EN-P
A detailed description of how to install and use your Compact I/O with the 1769-ADN DeviceNet Adapter.	1769-ADN DeviceNet Adapter User Manual	1769-UM001A-US-P
An overview of the MicroLogix 1500 system, including Compact I/O.	MicroLogix 1500 Programmable Controller with Compact I/O for Expansion	1764-SO001B-EN-P
More information on proper wiring and grounding techniques.	Industrial Automation Wiring and Grounding Guidelines	1770-4.1

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**Rockwell
Automation**

Publication 1769-IN049A-EN-P - December 2000

PN 40072-104-01(A)

Supersedes Publication 1769-IN0017A-EN-P - June 2000

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