



Analog Output Module

(Catalog Number 1771-OFE)

Contents



This icon is used when additional information is available in the *Analog Output Module User Manual*, publication 1771-6.5.30.

If you need a copy of this manual, fax the enclosed User Manual Request Card to 1-800-576-6340. If you are outside the U.S., 1-330-723-4036.

Use this document as a guide when installing the 1771-OFE analog output module.

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Prevent Electrostatic Discharge

The analog output module is sensitive to electrostatic discharge.



ATTENTION: Electrostatic discharge can damage integrated circuits or semiconductors if you touch backplane connector pins. 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 work station
- When not in use, keep the module in its static-shield bag

Understand Compliance to European Union Directives

If this product has the CE mark it is approved for installation within the European Union and EEA regions. It has been designed and tested to meet the following directives.

EMC Directive

This product is tested to meet Council Directive 89/336/EEC Electromagnetic Compatibility (EMC) and the following standards, in whole or in part, documented in a technical construction file:

- EN 50081-2EMC – Generic Emission Standard, Part 2 – Industrial Environment
- EN 50082-2EMC – Generic Immunity Standard, Part 2 – Industrial Environment

This product is intended for use in an industrial environment.

Low Voltage Directive

This product is tested to meet Council Directive 73/23/EEC Low Voltage, by applying the safety requirements of EN 61131-2 Programmable Controllers, Part 2 – Equipment Requirements and Tests.

For specific information required by EN 61131-2, see the appropriate sections in this publication, as well as these Allen-Bradley publications:

Publication	Publication number
<i>Industrial Automation Wiring and Grounding Guidelines For Noise Immunity</i>	1770-4.1
<i>Guidelines for Handling Lithium Batteries</i>	AG-5.4
<i>Automation Systems Catalog</i>	B111

Understand Product Compatibility

The 1771-OFE module can be used with any 1771 I/O chassis. Compatibility and data table use is listed below.

Catalog Number	Use of Data Table				Compatibility			
	Input Image Bits	Output Image Bits	Read Block Words	Write Block Words	Addressing			Chassis Series
					1/2-Slot	1-Slot	2-Slot	
1771-OFE	8	8	5	13	Y	Y	Y	A, B

A = Compatible with 1771-A1, -A2, -A4

B = Compatible with 1771-A1B, -A2B, -A3B, -A3B1, -A4B

Y = Compatible without restriction.

Calculate Power Requirements

The analog output module receives its power through the 1771 I/O chassis backplane from the chassis power supply. It does not require any other external power supply. When planning your system, you must consider the power usage of all modules in the I/O chassis to prevent overloading the I/O chassis backplane and/or power supply. Add this to the requirements of all other modules in the I/O chassis.

Analog Module	Power Requirement
1771-OFE1	1.5A @ 5V dc
1771-OFE2	
1771-OFE3	2.5A @ 5V dc



ATTENTION: Do not insert or remove modules from the I/O chassis while system power is ON. Failure to observe this rule could result in damage to module circuitry.

Determine Module Placement in the I/O Chassis

Place your module in any I/O module slot of the I/O chassis except for the left-most slot. This slot is reserved for PC processors or adapter modules.

Group your modules to minimize adverse affects from radiated electrical noise and heat. We recommend the following.

- Group analog output and low voltage dc modules away from ac modules or high voltage dc modules to minimize electrical noise interference.
- Do not place this module in the same I/O group with a discrete high-density I/O module when using 2-slot addressing.

Allen-Bradley PLCs

Set the Configuration Jumpers on the Module

The module configuration jumpers consist of:

- the last state configuration jumper (all versions)
- the voltage range configuration jumpers (1771-OFE1 only).

The type of module you have dictates how you set the configuration jumpers.

There are three versions of the analog output module:

Catalog Number	Module Output	Output Range	
1771-OFE1	Voltage	1-5V dc 0-10V dc $\pm 10V$ dc	Selected by configuration jumpers
1771-OFE2	Current	4-20mA	Factory set
1771-OFE3	Current	0-50mA	Factory set

Current Output Versions of the Module

Current version modules (1771-OFE2 and -OFE3) have all configuration jumpers installed and require no additional configuration. The configuration jumper for the LAST STATE mode output level is in the default position (MID). Refer to the section entitled “Set the Last State Configuration Jumpers” for additional configuration information.

Voltage Output Version of the Module

If you are using the voltage output version (1771-OFE1), you must set several configuration jumpers on the module’s circuit board. You must set these jumpers before you can proceed with configuring the module. When you set these jumpers, you configure each channel for one of the three voltage ranges listed above. **The module is shipped with the jumpers in the $\pm 10V$ position.**

Important: You do not have to remove the module cover to set the LAST STATE configuration jumper. You must remove the cover to select the voltage range on the 1771-OFE1.

Set the Last State Configuration Jumpers

The LAST STATE configuration jumpers determine the value of all the module's outputs whenever communication between the module and the processor is lost. This condition occurs when a processor or adapter faults, or the processor is placed in the PROG or TEST mode, or if the remote I/O cable breaks.

This is a significant safety feature. You can choose to have the module's outputs go to the minimum, middle or maximum of their respective ranges or hold their last state if a module or system fault occurs or if the system processor changes from RUN to PROG mode.

You do this by placing the LAST STATE configuration jumpers on eight (four jumpers on sets of pins) of the stake pins marked MIN, MID or MAX on the module's circuit board. If you do not place configuration jumpers in one of these positions, the module defaults to the HOLD LAST VALUE setting.

- Important:**
- Ignore the MIN, MID, MAX markings on the printed circuit board.
 - On power-up, the module's output is disabled until the module receives the first block transfer write. The output then enables with the value that you send it in the block transfer write block.
 - We ship 1771-OFE modules with the LAST STATE configuration jumpers in the MID position.



ATTENTION: Switch 1 of the I/O rack affects the function of the configuration settings as indicated in the table below.

Rack Switch 1 Setting	Configuration Jumper Setting			
	MIN	MID	MAX	HOLD LAST STATE
Last State	Last State	Last State	Last State	Last State
Reset	Min	Mid	Max	Last State

Rack switch 1 determines what output conditions occur during a rack fault.

Allen-Bradley PLCs

To set the last state configuration jumpers, proceed as follows.



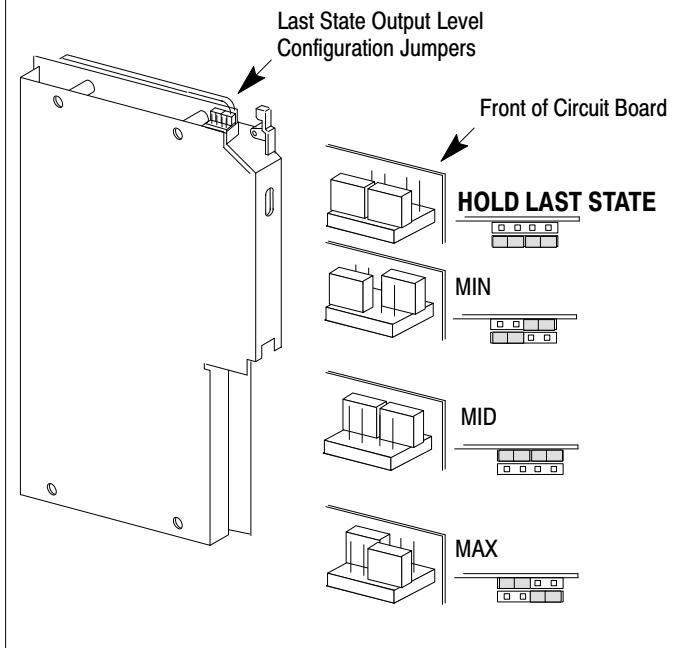
ATTENTION: Do not insert modules into or remove modules from the I/O chassis while system power is ON. Failure to observe this rule could result in damage to module circuitry and unexpected machine operation.

Output Range Selection	Minimum Value	Middle Value	Maximum Value
4-20mA	4mA	12mA	20mA
0-50mA	0mA	25mA	50mA
1-5V	1V	3V	5V
0-10V	0V	5V	10V
±10V	-10V	0V	+10V

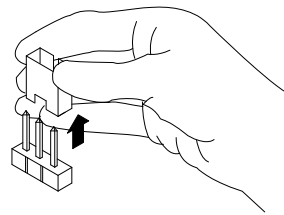
These output conditions are active **only** if the following conditions exist:

- the module faults
- the processor is in the PROGRAM or TEST mode
- rack switch 1 is in the reset position

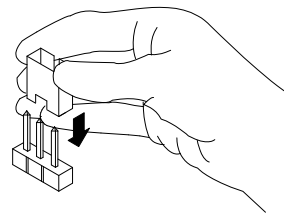
- 1** Locate the last state configuration jumpers. You do not need to remove the module cover.



- 2** Carefully pull up on the jumper to remove it from the pins.



- 3** Carefully reposition the jumper to reflect the desired values in the table to the left.



Set the Voltage Range Configuration Jumpers (1771-OFE1 only)

If you ordered the voltage output version, you must set several configuration jumpers located inside the module on the circuit board. To do this, follow these steps:

1 Remove the four screws securing the side cover to the module and remove the covers.

Circuit board

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2 Locate the configuration jumpers and set them according to your output voltage requirements.

Configuration Jumper Location	Desired Voltage Range			Output Channel
	0-10V	± 10V	1-5V	
P5	In	Out	Out	1
P6	In	Out	Out	
P7	Out	In	Out	
P8	Out	In	Out	
P9	Out	Out	In	
P10	Out	Out	In	
P13	In	Out	Out	2
P14	In	Out	Out	
P15	Out	In	Out	
P16	Out	In	Out	
P17	Out	Out	In	
P18	Out	Out	In	
P21	In	Out	Out	3
P22	In	Out	Out	
P23	Out	In	Out	
P24	Out	In	Out	
P25	Out	Out	In	
P26	Out	Out	In	
P29	In	Out	Out	4
P30	In	Out	Out	
P31	Out	In	Out	
P32	Out	In	Out	
P33	Out	Out	In	
P34	Out	Out	In	

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3 Reposition the cover and secure with the four screws removed in step 1.

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Key the Backplane Connector

Place your module in any slot in the chassis except the leftmost slot which is reserved for processors or adapters.



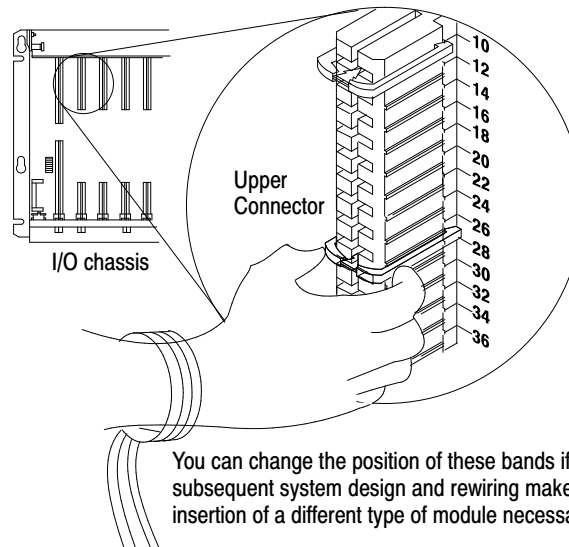
ATTENTION: Observe the following precautions when inserting or removing keys:

- insert or remove keys with your fingers
- make sure that key placement is correct

Incorrect keying or the use of a tool can result in damage to the backplane connector and possible system faults.

Position the keying bands in the backplane connectors to correspond to the key slots on the module.

Place the keying bands:
between 10 and 12
between 26 and 28



Install the Module and Field Wiring Arm

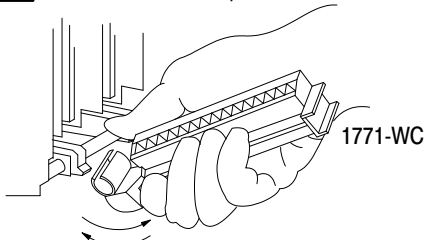


ATTENTION: Remove power from the 1771 I/O chassis backplane before you install the module. Failure to remove power from the backplane could cause:

- injury
- equipment damage due to unexpected operation
- degradation of performance

2

Attach the wiring arm (1771-WC) to the horizontal bar at the bottom of the I/O chassis.



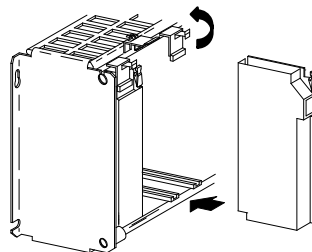
The wiring arm pivots upward and connects with the module so you can install or remove the module without disconnecting the wires.

1

Place the module in the card guides on the top and bottom of the chassis that guide the module into position.

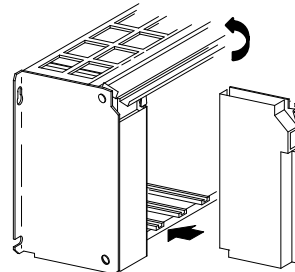
Important: Apply firm even pressure on the module to seat it into its backplane connector.

1771-A1B, -A2B, -A3B, -A3B1, -A4B I/O chassis



Snap the chassis latch over the top of the module to secure it.

1771-A1B, -A2B, -A3B1, -A4B Series B I/O chassis



Swing the chassis locking bar down into place to secure the modules. Make sure the locking pins engage.

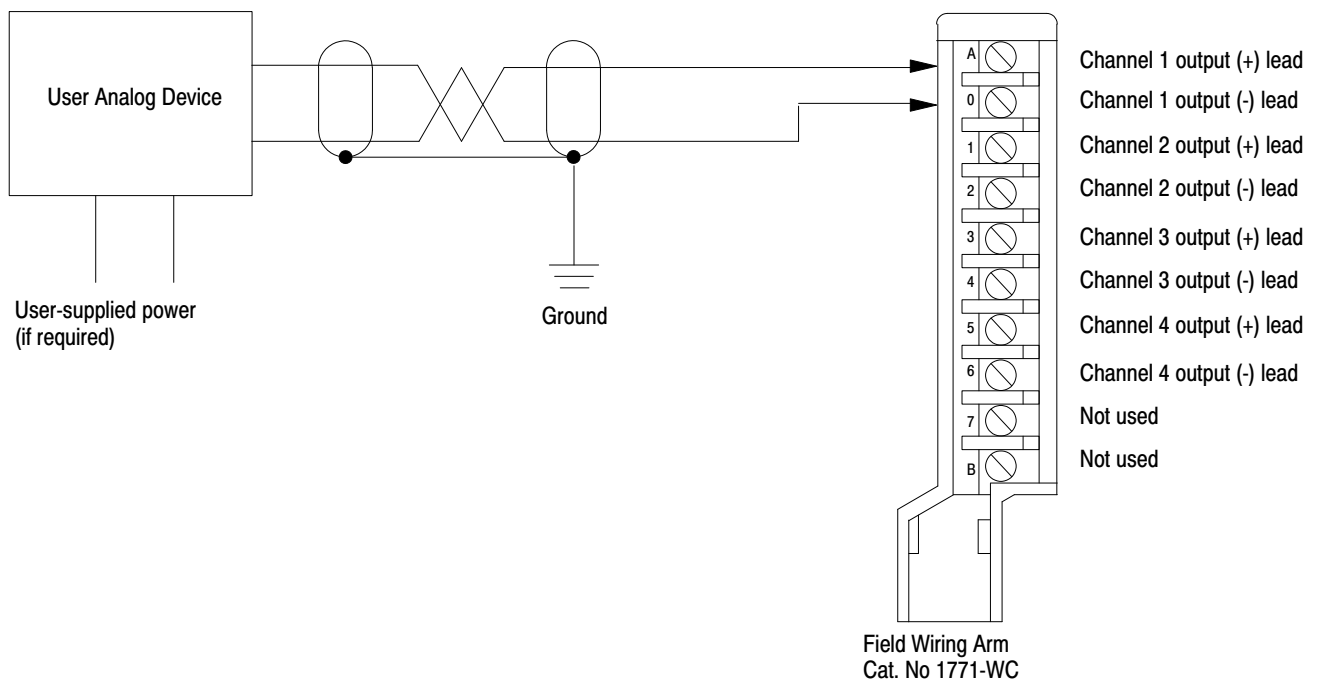
Connect Wiring to the Field Wiring Arm

Connect your I/O devices to the cat. no. 1771-WC wiring arm shipped with the module.



ATTENTION: Remove power from the 1771 I/O chassis backplane and field wiring arm before removing or installing an I/O module.

- Failure to remove power from the backplane or wiring arm could cause module damage, degradation of performance, or injury.
- Failure to remove power from the backplane could cause injury or equipment damage due to possible unexpected operation.



The module requires shielded cable for signal transmission to the analog devices. Use Belden 8761 or equivalent as described in the *Approved Vendor List*, publication ICCG-2.2. This cable consists of a single insulated, twisted-pair of conductors, covered along their entire length by a foil shield and encased in plastic. The shield reduces the effect of induced noise at any point along the cable.

Ground the Chassis and Module

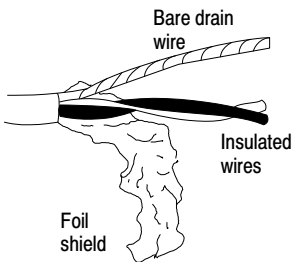
Use the following diagrams to ground your I/O chassis and analog input module. Follow these steps to prepare the cable:

- 1 Remove a length of cable jacket from the Belden 8761 cable.

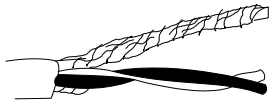


Belden 8761 Cable

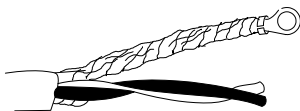
- 2 Pull the foil shield and bare drain wire from the insulated wires.



- 3 Twist the foil shield and drain wire together to form a single strand.



- 4 Attach a ground lug.

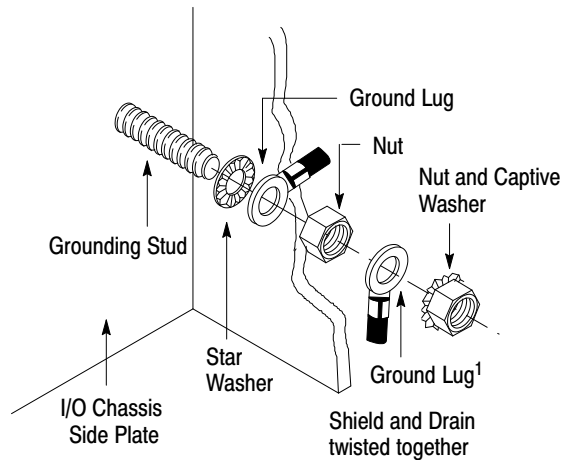


When using shielded cable wire, ground the foil shield and drain wire only at one end of the cable. We recommend that you wrap the foil shield and drain wire together and connect them to a chassis mounting bolt. At the opposite end of the cable, tape exposed shield and drain wire with electrical tape to insulate it from electrical contact.

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

Chassis Ground

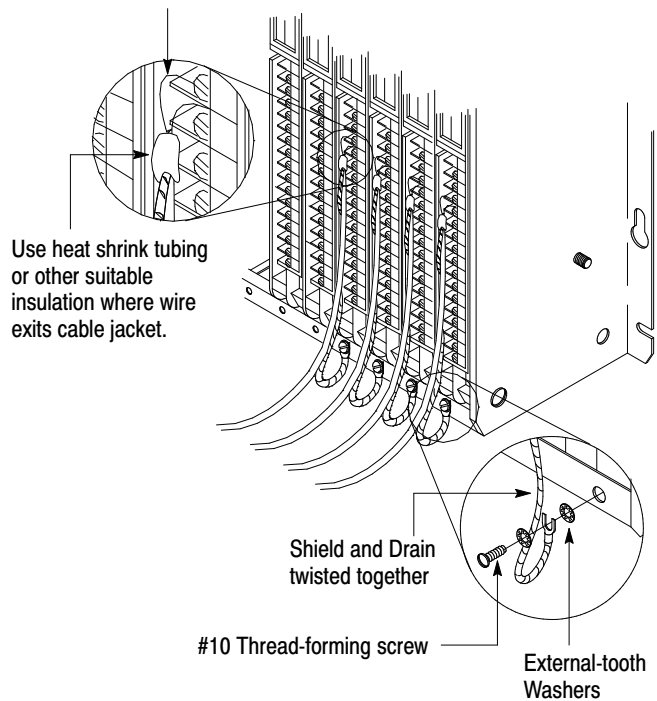
When you connect grounding conductors to the I/O chassis grounding stud, place a star washer under the first lug, then place a nut with captive lock washer on top of each ground lug.



¹Use the cup washer if crimp-on lugs are not used.

Single-point Grounding

Extend shield to termination point. Expose just enough cable to adequately terminate inner conductors.



Configure the Module



For detailed configuration information, see chapter 2 of your *Analog Output User Manual* (publication 1771-6.5.30).

Because of the many analog devices available and the wide variety of possible applications, you must configure the module to conform to the analog device and specific application that you have chosen. Use the configuration information below to configure your module to your specifications.

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00
1	Channel 1 Data Value															
2	Channel 2 Data Value															
3	Channel 3 Data Value															
4	Channel 4 Data Value															
Word 5					4	4	3	3	2	2	1	1	4	3	2	1

Data Format
1 = Binary
0 = BCD

Reserved

Maximum Scaling Value Polarity
1 = Negative
0 = Positive

1 = Channel 1
2 = Channel 2
3 = Channel 3
4 = Channel 4

Data Sign Polarity
1 = Negative
0 = Positive

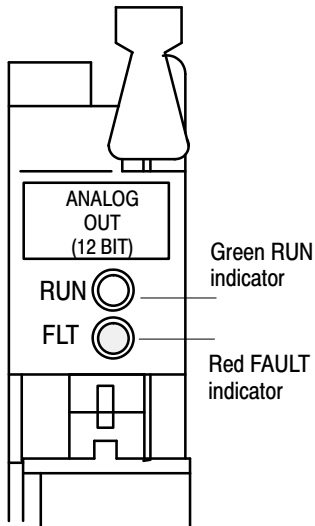
Minimum Scaling Value Polarity
1 = Negative
0 = Positive

Module Default Configuration:
Data Format – BCD
No Scaling
Data Sign Polarity – Positive

6	Channel 1 Minimum Scaling Value
7	Channel 1 Maximum Scaling Value
8	Channel 2 Minimum Scaling Value
9	Channel 2 Maximum Scaling Value
10	Channel 3 Minimum Scaling Value
11	Channel 3 Maximum Scaling Value
12	Channel 4 Minimum Scaling Value
13	Channel 4 Maximum Scaling Value

Diagnostics and Troubleshooting

The front panel of the module contains a green RUN and a red FLT (fault) indicator. Possible module fault causes and corrective actions are shown in the table below.



Indicators	Probable Cause	Recommended Action
RUN (green on) FLT (red off)	Normal operation	None
RUN (green on) FLT (red off)	Awaiting configuration Block Transfer Write	Send configuration BTW
RUN (green on) FLT (red on)	Unsuccessful power-up EEPROM fault Checksum error Hardware failure in module	Cycle power Return module for repair
RUN (green off) FLT (red off)	No power Bad internal fuse	Turn off power. Remove and reinsert module into chassis. Return power. If problem still exists, and chassis power supply is functioning properly, return the module for repair.

Read Block Transfer Status Words

The module allows a five-word read block transfer for rudimentary program or hardware debugging. If a read block transfer request is for more or less than five words, the module will not perform a read block transfer. The following table shows the word assignment for the read block transfer.




Decimal Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Octal Bit	17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00
Word 1	Channel 1 DAC Input Data															
2	Channel 2 DAC Input Data															
3	Channel 3 DAC Input Data															
4	Channel 4 DAC Input Data															
5	Not used	I/O Reset	Reserved										Data Valid			

The first four words of the read block transfer show the actual 12 bits of data sent to the module's digital-to-analog converters (DACs). The first four words in the read block transfer appear in 12-bit binary format regardless of the module's mode of operation (BCD or 12-bit binary).



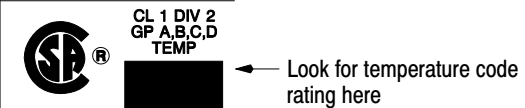



The fifth word contains the status of each DAC word; that is, whether data is out of range or scaling is improperly programmed. The fifth word also indicates that I/O RESET has been established (when the processor is in the PROG/TEST or RUN mode).

Word	Bits	Description
5	Bits 00-03	When set, indicate invalid channel data is sent to the module. These bits are not reset until a correct write block transfer is sent. Bit 03 corresponds to Channel 4, Bit 02 to Channel 3, and so on.
	Bit 16	Is the I/O RESET bit. When set, it indicates that the processor is in TEST or PROGRAM mode (i.e., block transfer data is not being written to the module).

Specifications

Description	Value
Outputs per Module	4 Individually Isolated
Module Location	Bulletin 1771 I/O Chassis – One Slot
Output Voltage Ranges (Nominal) – 1771-OFE1	+1 to +5V DC -10 to +10V DC 0 to +10V DC
Output Current (maximum)	10mA per Channel in Voltage Mode (1771-OFE1)
Output Current Ranges (Nominal)	+4 to +20mA (1771-OFE2) 0 to +50mA (1771-OFE3)
Digital Resolution	12-Bit Binary – 1 Part in 4095
Output Capacitance	0.01 μ F (Voltage Outputs) 0.022 μ F (Current Outputs)
Output Impedance	<0.25 ohms for Voltage Outputs Exclusive of Contact Wiring Resistance >1.5 megohms for Current Outputs
Max Loop Impedance in the Current Mode	1771-OFE2 – Up to 1200 ohms Load Resistance 1771-OFE3 – Up to 400 ohms Load Resistance
Output Overload Protection	All outputs are protected against short circuit load conditions not to exceed one minute.
Backplane Power	1771-OFE1 – 1.50A 1771-OFE2 – 1.50A 1771-OFE3 – 2.50A
Power Dissipation	1771-OFE1 – 7.9W 1771-OFE2 – 7.9W 1771-OFE3 – 13.1W
Thermal Dissipation	1771-OFE1 – 26.9 BTU/hr 1771-OFE2 – 26.9 BTU/hr 1771-OFE3 – 44.5 BTU/hr
Isolation Voltage	Isolation meets or exceeds UL Standard 508, and CSA Standard C22.2 No. 142.
D/A Converter Specifications Settling Time	0.8 ms Maximum for a Resistive Load
Internal Scan Rate	8.0 ms for All Channels Using BCD Data and Scaling 1.6 ms for All Channels Using Binary Data and No Scaling
Accuracy (Including Linearity, Gain, and Offset at 25°C)	+0.1% of Full Scale +1/2 LSD (BCD Mode) +1/2 LSB (BINARY Mode)
Temperature Coefficient	+50 ppm/°C of Full Scale Range
Environmental Conditions Operational Temperature: Storage Temperature: Humidity Rating:	0°C to +60°C (+32°F to +140°F) -40°C to +85°C (-40°F to +185°F) 5% to 95% (Non-Condensing)
Field Wiring Arm	Catalog No. 1771-WC
Field Wiring Arm Screw Torque	7-9 inch-pounds
Agency Certification (when product or packaging is marked)	<ul style="list-style-type: none"> •   Class 1 Div 2 Hazardous ¹ •  marked for all applicable directives

¹ CSA certification— Class I, Division 2, Group A, B, C, D or nonhazardous locations.

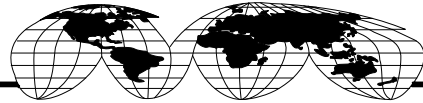
<p>CSA Hazardous Location Approval</p>	<p>Approbation d'utilisation dans des emplacements dangereux par la CSA</p>
<p>CSA certifies products for general use as well as for use in hazardous locations. Actual CSA certification is indicated by the product label as shown below, and not by statements in any user documentation.</p>	<p>La CSA certifie les produits d'utilisation générale aussi bien que ceux qui s'utilisent dans des emplacements dangereux. La certification CSA en vigueur est indiquée par l'étiquette du produit et non par des affirmations dans la documentation à l'usage des utilisateurs.</p>
<p>Example of the CSA certification product label</p> 	<p>Exemple d'étiquette de certification d'un produit par la CSA</p> 
<p>To comply with CSA certification for use in hazardous locations, the following information becomes a part of the product literature for CSA-certified Allen-Bradley industrial control products.</p> <ul style="list-style-type: none"> • This equipment is suitable for use in Class I, Division 2, Groups A, B, C, D, or non-hazardous locations only. • The products having the appropriate CSA markings (that is, Class I Division 2, Groups A, B, C, D), are certified for use in other equipment where the suitability of combination (that is, application or use) is determined by the CSA or the local inspection office having jurisdiction. 	<p>Pour satisfaire à la certification de la CSA dans des endroits dangereux, les informations suivantes font partie intégrante de la documentation des produits industriels de contrôle Allen-Bradley certifiés par la CSA.</p> <ul style="list-style-type: none"> • Cet équipement convient à l'utilisation dans des emplacements de Classe 1, Division 2, Groupes A, B, C, D, ou ne convient qu'à l'utilisation dans des endroits non dangereux. • Les produits portant le marquage approprié de la CSA (c'est à dire, Classe 1, Division 2, Groupes A, B, C, D) sont certifiés à l'utilisation pour d'autres équipements où la convenance de combinaison (application ou utilisation) est déterminée par la CSA ou le bureau local d'inspection qualifié.
<p>Important: Due to the modular nature of a PLC control system, the product with the highest temperature rating determines the overall temperature code rating of a PLC control system in a Class I, Division 2 location. The temperature code rating is marked on the product label as shown.</p>	<p>Important: Par suite de la nature modulaire du système de contrôle PLC), le produit ayant le taux le plus élevé de température détermine le taux d'ensemble du code de température du système de contrôle d'un PLC dans un emplacement de Classe 1, Division 2. Le taux du code de température est indiqué sur l'étiquette du produit.</p>
<p>Temperature code rating</p> 	<p>Taux du code de température</p> 
<p>The following warnings apply to products having CSA certification for use in hazardous locations.</p>  <p>ATTENTION: Explosion hazard —</p> <ul style="list-style-type: none"> • Substitution of components may impair suitability for Class I, Division 2. • Do not replace components unless power has been switched off or the area is known to be non-hazardous. • Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous. • Do not disconnect connectors unless power has been switched off or the area is known to be non-hazardous. Secure any user-supplied connectors that mate to external circuits on an Allen-Bradley product using screws, sliding latches, threaded connectors, or other means such that any connection can withstand a 15 Newton (3.4 lb.) separating force applied for a minimum of one minute. 	<p>Les avertissements suivants s'appliquent aux produits ayant la certification CSA pour leur utilisation dans des emplacements dangereux.</p>  <p>AVERTISSEMENT: Risque d'explosion —</p> <ul style="list-style-type: none"> • La substitution de composants peut rendre ce matériel inacceptable pour les emplacements de Classe 1, Division 2. • Couper le courant ou s'assurer que l'emplacement est désigné non dangereux avant de remplacer les composants. • Avant de débrancher l'équipement, couper le courant ou s'assurer que l'emplacement est désigné non dangereux. • Avant de débrancher les connecteurs, couper le courant ou s'assurer que l'emplacement est reconnu non dangereux. Attacher tous connecteurs fournis par l'utilisateur et reliés aux circuits externes d'un appareil Allen-Bradley à l'aide de vis, loquets coulissants, connecteurs filetés ou autres moyens permettant aux connexions de résister à une force de séparation de 15 newtons (3,4 lb. - 1,5 kg) appliquée pendant au moins une minute.

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