



Allen-Bradley Analog Output Module

(Cat. No. 1771-OF, Series B)

Product Data



Description

The Analog Output Module converts a three digit BCD or twelve bit binary value to signals for analog devices. You may connect up to four analog devices to the output module. Such devices might be motor speed controllers, signal amplifiers, or valve positioners. All the signals should conform to the voltage or current range(s) for which the module has been calibrated. You can specify a single voltage or current range when you order. The module can be used with any Allen-Bradley PC processor employing the 1771 I/O structure.

You can use the series B output module alone or with associated Analog Output Expander Modules (cat. no. 1771-E4).

Using a maximum of 14 expander modules, you can have up to 60 outputs in your analog output system. This method is more economical than using additional 1771-OF output modules. For information about expanding the outputs of an output module refer to the Analog Output System User's Manual (publication 1771-6.5.3, dated October, 1985 or later).

Spare Allen-Bradley Parts

The term “12-bit” indicates that the resolution of the module is 1 part in 2^{12} (4096). This defines the number of units available to the module for dividing its particular voltage or current range. Conversion of the analog value to a BCD format, if selected, limits the resolution to 1 part in 1000.

The Analog Output Module (12-bit) (cat. no. 1771-OF is shipped with:

- Analog Output Module (12-bit) (cat. no. 1771-OF)
- Field Wiring Arm (cat. no. 1771-WB)
- Product Data (publication 1771-2.14)

The output module is compatible with the requirements of the Instrument Society of America Standard ISA S50.1 (1975), Compatibility of Analog Signals for Electronic Industrial Process Instruments.

Selection of Output Channel Ranges

The analog output module has four output channels. All output channels on an individual module have the same voltage or current range. The voltage and current ranges given in the specifications section are nominal. Precise voltage and current ranges for these nominal ranges are shown in tables A and B. Although the module is factory set, you can re-calibrate each point, individually, according to procedures outlined in the Analog Output Systems User’s Manual (publication 1771-6.5.3).

You can order an output module with any one of four voltage or three current output ranges (tables A and B). All outputs must be set to the same range. Order a range by specifying a two-digit code suffixed to the catalog number (table C). For example, if a 0 to +10 volt range is required, order the assembly with the number: cat. no. 1771-OF 04. If the range selection switches are changed, you should re-calibrate each output, individually.

Table A
Output Voltage Ranges

3 Digit BCD Operating Mode			
Nominal Range	BCD Output Code Range	Output Voltage Range	$\Delta V/\text{Bit}$
1 to 5 volts	000-999	1 to 4.996 volts	4mV/Bit
0 to 10 volts	000-999	0 to 9.990 volts	10mV/Bit
-10 to 10 volts	000-999	-10 to 9.980 volts	20mV/Bit
0 to 5 volts	000-999	0 to 4.995 volts	5mV/Bit
12 Bit Binary Operating Mode			
Nominal Range	Binary Output Code Range	Output Voltage Range	$\Delta V/\text{Bit}$
1 to 5 volts	0000-4095	1 to 4.9990 volts	0.98mV/Bit
0 to 10 volts	0000-4095	0 to 9.9976 volts	2.44mV/Bit
-10 to 10 volts	0000-4095	-10 to 9.9951 volts	4.88mV/Bit
0 to 5 volts	0000-4095	0 to 4.9988 volts	1.22mV/Bit

Table B
Output Current Ranges

3 Digit BCD Operating Mode			
Nominal Range	BCD Output Code Range	Output Voltage Range	$\Delta V/\text{Bit}$
4 to 20mA	000-999	4 to 19.984mA	0.016mA/Bit
0 to 20mA	000-999	0 to 19.980mA	0.020mA/Bit
-20 to 20mA	000-999	-20 to 19.960mA	0.040mA/Bit
12 Bit Binary Operating Mode			
Nominal Range	Binary Output Code Range	Output Voltage Range	$\Delta V/\text{Bit}$
4 to 20mA	0000-4095	4 to 19.9961mA	0.0039mA/Bit
0 to 20mA	0000-4095	0 to 19.9951mA	0.0049mA/Bit
-20 to 20mA	0000-4095	-20 to 19.9902mA	0.0098mA/Bit

Ordering Information

You can order an output module with any one of four voltage or three current output ranges. All outputs must be set to the same range. Order a range by specifying a two-digit code suffixed to the catalog number (table C). For example, if a 0 to +5 volt range is required, order the assembly with the number: cat. no. 1771-OF 02. If the range selection switches are changed, you should re-calibrate each output individually.

Table C
Catalog Number Range Codes, 1771-OF

1771-OF XX		②	
①	Basic Catalog No.	Identifying Code	
		Mode	Code XX
		Voltage	Range
			01 +1 to +5V DC
			02 0 to +5V DC
			03 -10 to +10V DC
			04 0 to +10V DC
		Current	05 +4 to +20mA
			06 0 to +20mA
			07 -20 to +20mA

Switch Selectable Options

Before you insert the output module into its I/O chassis slot, you must set the following switches:

- Module function
- Output range selection

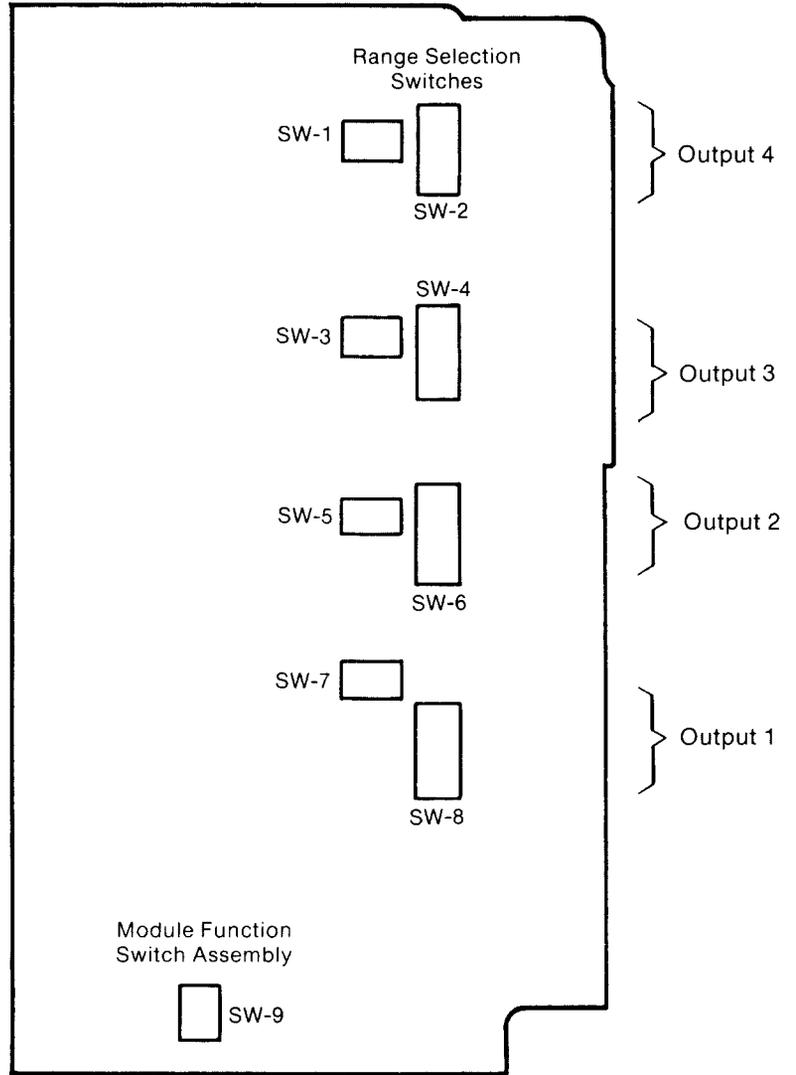
Switch Settings

Switch assemblies are located on the PC board underneath the component cover.

To select options, proceed as follows:

1. Take off the component (left side) cover by removing the four screws.
2. Identify the switch assembly (figure 1).
3. Set the switches as required by your application. The tip of a ball-point pen can be used to set the rocker arms of a switch. Do not use a pencil because the tip can break off and jam the switch.
4. Replace the cover and secure with the four screws.

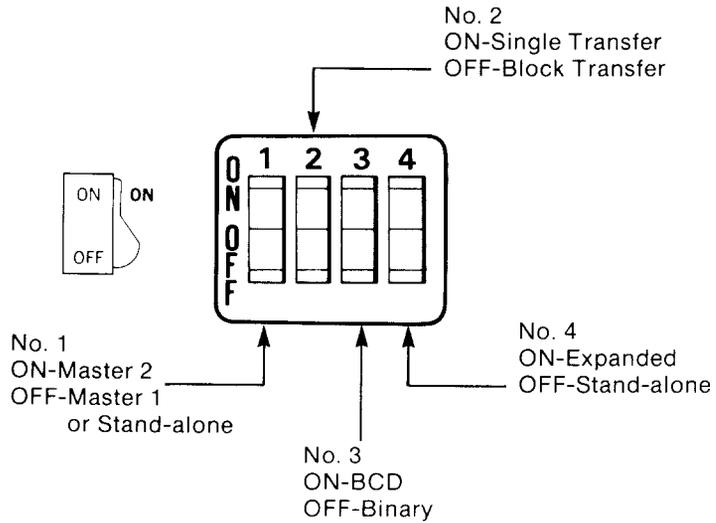
Figure 1
Switch Locations



Module Function Switch

Switch assembly SW-9 (figure 2) selects master or stand alone, block or single transfer, and 3-digit BCD or 12-bit binary mode.

Figure 2
Module Function Switch Assembly (SW-9)



11184

Master/Stand Alone

Set switches 1 and 4 for master or stand alone (figure 2 and table D).

Table D
Stand Alone/Master

Function	Switch	
	1	4
Stand Alone	Off	Off
Master 1	Off	On
Master 2	On	On

Block Transfer/Single Transfer

Set switch 2 off for block transfer or on for single transfer.

BCD/Binary

Set switch 3 on for 3-digit BCD mode or off for 12-bit binary mode.

Output Range Selection

There are two range selection switches for each output (figure 1) on this module. You can recalibrate each output, individually, by changing the range selection switches.

Important: Refer to the Analog Output System User's Manual (publication 1771-6.5.3, dated October 1985 or later) for details on setting module function and range selection switches.

Electrostatic Discharge

Under some conditions, electrostatic discharge can degrade performance or damage the module. If you observe the following precautions you can guard against electrostatic damage to the module.

- Touch a grounded object to discharge yourself before handling the module.
- Do not touch the backplane connector or connector pins.
- When you configure or replace internal components, do not touch other 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.

Diagnostics

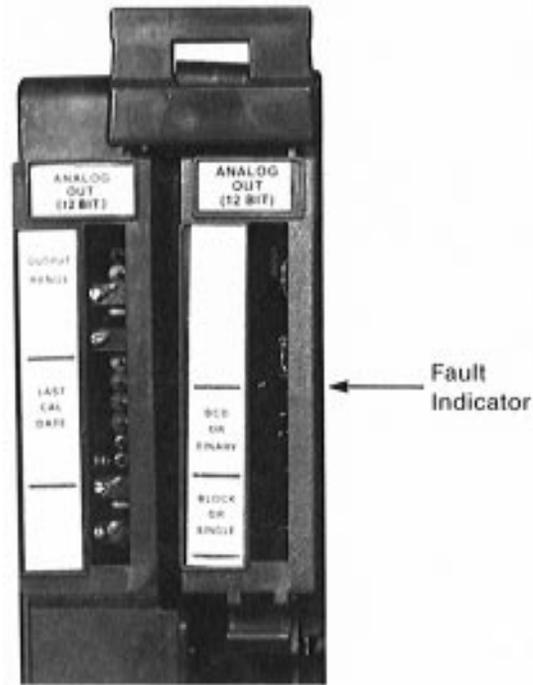
Certain diagnostic features monitor the data conversion and transmission processes for faults. This information can be displayed in several different ways:

1. Diagnostic indicator illuminates
2. Bits in the diagnostic word will be set

The 1771-OF output module has a red FAULT indicator (figure 3) which is normally off. The indicator can be examined by removing the right-hand snap off cover on the front of the module. When the PC processor is operating in the program or test mode and a fault occurs, the indicator flashes alternately on and off. When the PC processor is operating in the run mode and one of the following faults occur, the indicator is on continuously:

- Output module has failed self diagnostics
- Improper programming plug selection when the 1771-OF output module is used with a 1771-E4 expander module
- Loss of 5V DC field wiring arm voltage

Figure 3
Diagnostic Indicator



Diagnostic Word

The 1771-OF module has both single transfer and block transfer programming.

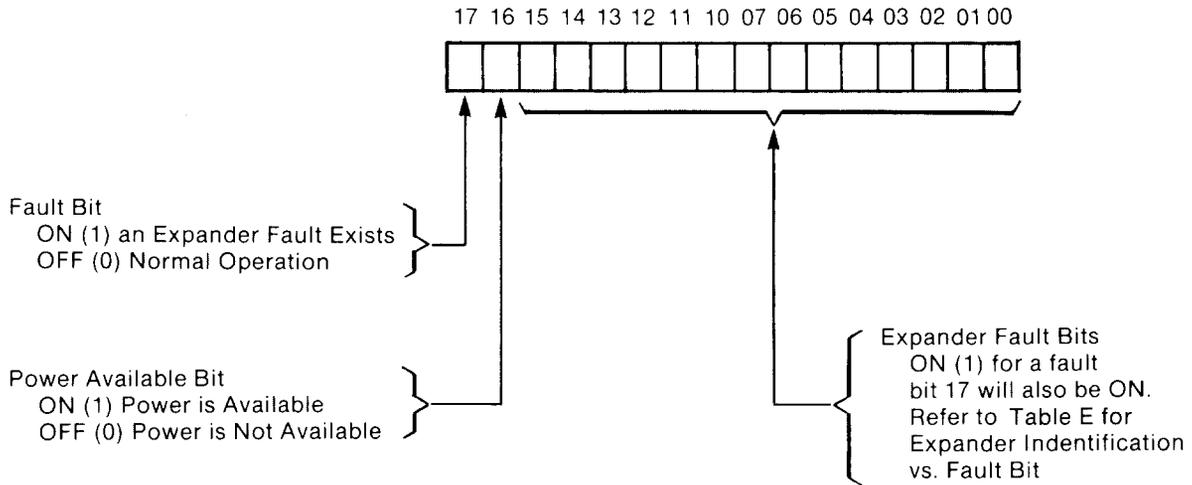
Single transfer programming shifts one word of data from the data table to the module during each program scan. Block transfer programming shifts up to 64 words of data from the data table to the module each program scan.

When the module receives output data from the processor, it generates a diagnostic word. The information the diagnostic word contains depends on which transfer was executed either a block transfer or a single word transfer.

Block Transfer Diagnostic Word

The output expander module fault bits (15-00) set on indicate a fault in output modules 1-14 (figure 4). Table E correlates the output expander module number/bit relationship. The power available bit (16) set on indicates the power available signal is present at the field wiring arm. The diagnostic bit (17) set on indicates there is a fault in an expander module.

Figure 4
Block Transfer Diagnostic Word



11190

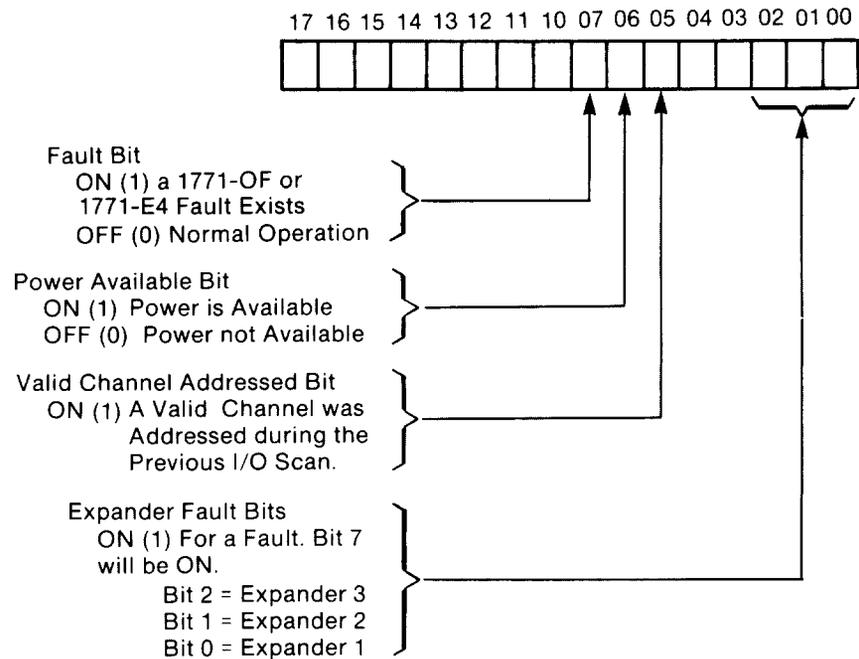
Table E
Expander Identification vs. Fault Bit

Bit	Expander No.
00	1
01	2
02	3
03	4
04	5
05	6
06	7
07	8
10	9
11	10
12	11
13	12
14	13
15	14

Single Transfer Diagnostic Word

The output expander module fault bits (02-00) set on indicate a fault in output expander module 1, 2, or 3 (figure 5). The valid channel bit (05) set on indicates a valid channel was addressed. The power available bit (06) set on indicates the power available signal is present at the field wiring arm. The diagnostic bit (07) set on indicates there is a fault in the analog output module or output expander module. Bits 03, 04 and 10 to 17 are not used.

Figure 5
Single Transfer Diagnostic Word



Power Requirements

The 1771-OF output module derives its power from two sources: the backplane power supply and your auxiliary power supply.

Backplane Power

Power is supplied through the I/O chassis backplane to the I/O modules. The 1771-OF output module requires a current of 1.4A from the 5V DC output of this power supply. The amount should be totalled with the current requirements of the other modules in the I/O chassis to avoid overloading the supply or the I/O chassis backplane.

Auxiliary Power

An auxiliary power supply operates the 1771-OF output module and provides power to your output devices. You can use the PLC Remote Power Supply (cat. no. 1778-P2) or an equivalent power supply. Specifications for an equivalent power supply are listed in table F. Using a separate supply protects the analog signals against transients caused by the switching of digital circuits.

Table F
Analog Output Module External Power Requirements

Specifications	+5 Volts	+15 Volts	-15 Volts
Current (per Analog Output Module) ¹	400mA	250mA	250mA
Voltage Tolerance	± 5%	1%	1%
Regulation (type)	Series	Series	Series
Line Regulation (for 10V AC input change)	± .02%	2mV RMS	± .02%
Load Regulation	± .04%	± .02%	± .02%
Ripple	2mV RMS	± .02%	2mV RMS
Overvoltage Protection	+7 volts	+18 volts	-18 volts

NOTE: Current requirements in the current mode are based on the equation:
Current = 170mA + (20mA x Number of Current Outputs)

¹ Current requirements in the voltage mode:

+15 Volts	-15 Volts
170mA	170mA



CAUTION: During initial power-up, the current requirements of the 1771-OF output module's +15V and -15V DC circuits momentarily surge up to 1A. Our cat. no. 1778-P2 power supply can handle this surge. Any power supply you furnish must be able to handle this surge. Power supplies with foldback current limiting are not recommended.



WARNING: Should either the +15V or -15V DC supply fail, the 1771-OF output module attempts to operate from the remaining voltage. This could result in damage to the module circuitry and unexpected changes in output.

You can use a PLC Remote Power Supply (cat. no. 1778-P2) as the external power source. When you use this power supply, you can connect module power to the field wiring arm with the Module Power Cable (cat. no. 1770-CF). You must order this power cable separately.

Wiring arm connections from this cable are shown in figure 6. Power and common connections can be jumpered from one analog input module to the next.

Important: Do not confuse the CHANNEL COMMON wire with the cable shield. The CHANNEL COMMON wire will be one of the insulated wires encased by the cable shield.

If your auxiliary power supply has a POWER AVAILABLE signal, tie it directly to the POWER AVAILABLE terminal. If it doesn't jumper the POWER AVAILABLE terminal to the POWER AVAILABLE COMMON terminal.

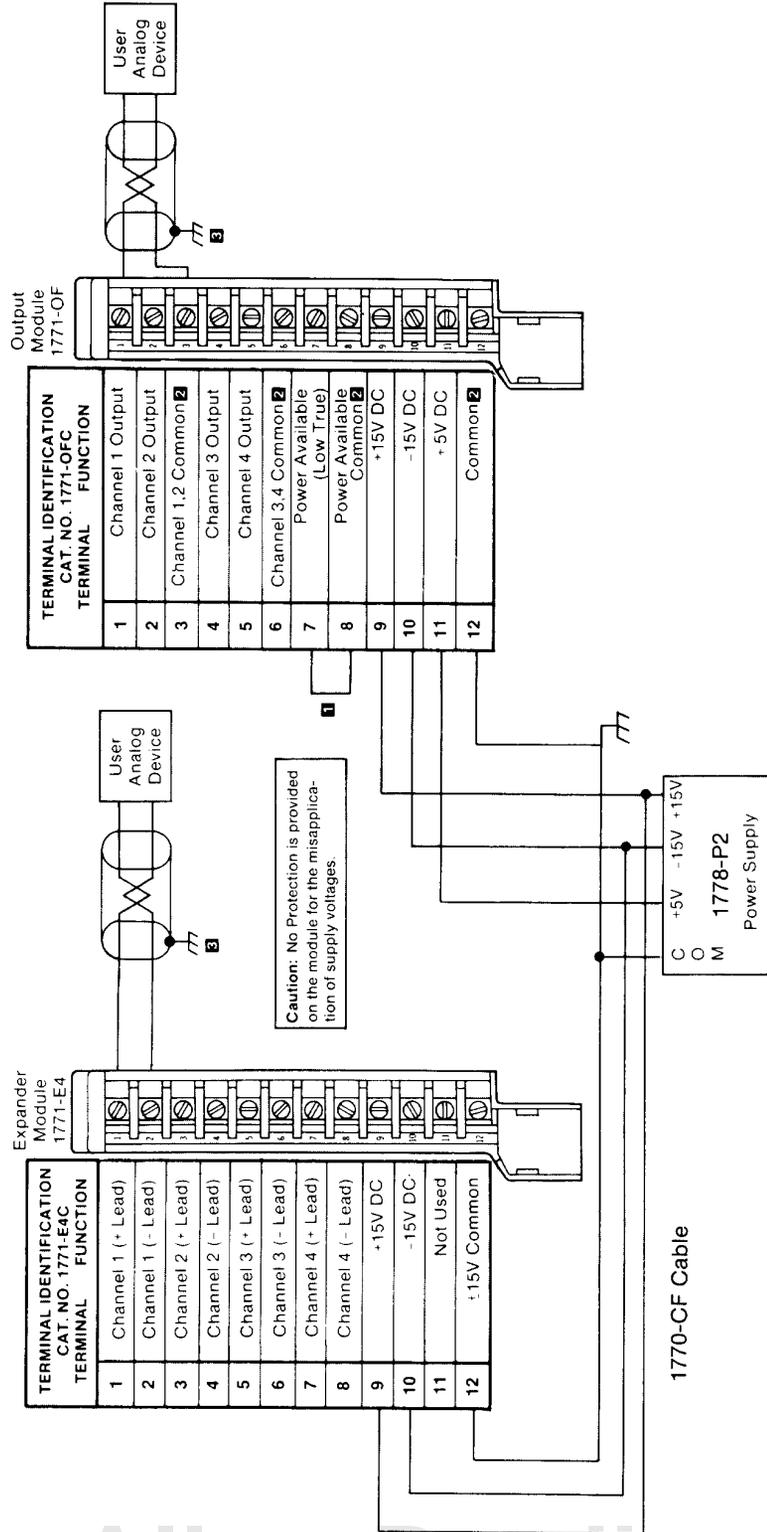
Connections

The field wiring arm functions as a terminal strip for your wiring (figure 7). It pivots on the I/O chassis and allows you to remove your 1771-OF output module without disconnecting wiring. If you are using 1771-E4 expander modules with your output module, you do not have to make connections between the terminal strips of the output module and the 1771-E4 expander module. The output module transmits digital information to the expander module through the I/O chassis backplane.

A label on the side cover identifies terminal connections. We provide additional space for you to label your outputs on the front of the module and on the field wiring arms.

Figure 6
Connection Diagram

(See Applicable Codes and Laws)



NOTE:

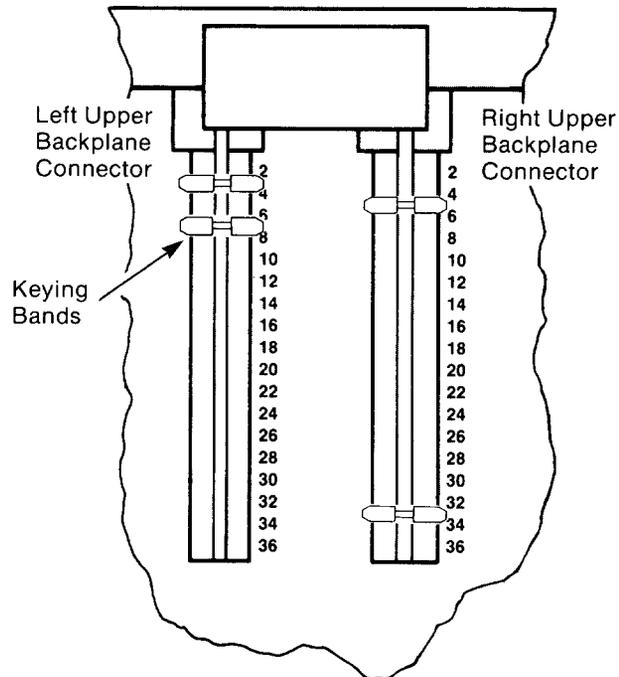
- 1 The POWER AVAILABLE and POWER AVAILABLE COMMON terminals are designed to be connected to a power supply which provides a POWER AVAILABLE signal. If your supply does not provide this signal, jumper terminals 7 and 8 together. If these terminals are not jumpered together the module will not operate.
- 2 All commons are tied together internally.
- 3 Ground cable to I/O chassis at module end only.

Keying

The 1771-OF output module is keyed to guard against installation into a wrong slot. To implement this protection, insert the keying bands supplied with the I/O chassis into the upper backplane connector in the following positions (figure 7):

- Left connector
 - Between 2 and 4
 - Between 6 and 8
- Right connector
 - Between 4 and 6
 - Between 32 and 34

Figure 7
Keying Diagram



WARNING: Remove power from the 1771 I/O chassis backplane and 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.
-

Specifications

Location

- 1771 I/O chassis
- Two adjacent slots

Outputs per Module

- 4 single-ended

Output Voltage Ranges

- 1 to 5V DC
- 0 to 5V DC
- -10 to 10V DC
- 0 to 10V DC

Output Current Ranges

- 4 to 20mA
- 0 to 20mA
- -20 to 20mA

Digital Resolution

- 3-digit BCD or 12 bit Binary

Input Range

- BCD: 000 to 999
- Binary: 0000 to 4095

Backplane Power

- 1.4A

Output Overload Protection

- Short circuit load conditions to exceed one minute
Output Impedance
- ≤ 0.25 ohms for voltage outputs exclusive of contact wiring resistance
- ≥ 1.5 megohms for current outputs

Output Current in the Voltage Mode

- 10mA (max)

Load Resistance in the Current Mode

- Up to 600 ohms (max)

Environmental Conditions

- Operational Temperature: 0° to 60° C (32° to +140° F)
- Storage Temperature: -40° to 85° C (-40° to +185° F)
- Relative Humidity: 5% to 95% (without condensation)

Opto-Electrical Isolation

- 1500V RMS (transient)

D/A Converter

- Monotonic

Settling Time

- 100 μ sec maximum for a resistive load

Internal Scan Rate

- 0.35ms/channel without output expanders
- 0.61 ms/channel with output expanders

Absolute Accuracy

Includes linearity, gain and offset at 25° C:

- $\pm 0.1\%$ of full scale
- $\pm 1/2$ LSD (BCD mode)
- $\pm 1/2$ LSB (Binary mode)

Temperature Coefficient

- ± 45 ppm/° C of full scale range

Keying

- Left connector
Between 2 and 4
Between 6 and 8
- Right connector
Between 4 and 6
Between 32 and 34



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