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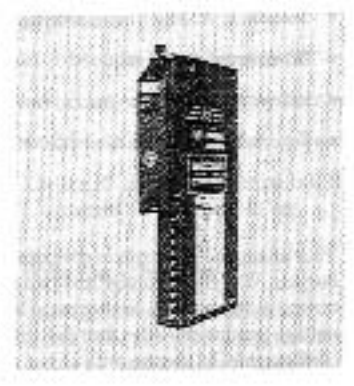
Analog Output Module

Cat. No. 1771-OFE1, -OFE2, -OFE3)

Product Data



Description

The Analog Output Module converts 12-bit binary or four digit BCD values to analog signals at its four outputs. There are two versions of the Analog Output Module; a voltage version (1771-OFE1) and a current version (1771-OFE2).

The OFE1 has three configuration plug selectable ranges:

- 1-5 volts DC
- 0-10 volts DC
- +10 volts DC

The OFE2 provides a 4-20mA output and the OFE3, a 0-50mA output. You may connect up to four peripheral devices to the output module, such as valve positioners, motor speed controllers, signal converters or recorders. All inputs of the analog devices should conform to the voltage or current ratings of each module output channel.

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The analog output module uses block transfer exclusively for transferring data. The output module may be used with any programmable controller having block transfer capabilities.

Write Block Transfer programming moves up to 13 words of data from the processor to the module for digital to analog conversion in one scan. This information is converted to analog signals and sent to the appropriate output channels. A Read Block Transfer moves five words of data from the module to the processor data table. The Read Block Transfer is for debugging purposes.

Features

- Selectable scaling to engineering units
- No external power required
- Independent module – no expanders required
- Four individually isolated differential outputs

Output Channels

Your analog output module provides four individually isolated differential outputs. We offer a voltage and two current versions of the module. The current versions have outputs rated at 4 to 20mA and 0 to 50mA. The voltage version provides four individual outputs, which are user configurable, to operate with any of three voltage ranges (Table A). All voltage output channels require the insertion of configuration plugs by the user before the module is placed in a 1771 I/O rack. The module has 1500V opto-electrical isolation which protects the rest of the system from damage due to overvoltage at the module outputs. Each module output is individually isolated from the others up to 1000V rms.

Table A
Output Ranges and Resolution

Nominal Range	Unscaled Code Range	Actual	Output Range ΔV/bit or ΔI/bit
1 to 5 volts	0 to 4095	1 to 5.00V ±0.1%	0.976mV/bit
0 to 10 volts	0 to 4095	0 to 10.00V ± 0.1%	2.44mV/bit
-10 to +10 volts	-4095 to + 4095	-10 to +10.00V ±0.1%	2.44mV/bit
4 to 20 mA	0 to 4095	4 to 20.00 mA ±0.1%	0.0039mA/bit
0 to 50 mA	0 to 4095	0 to 50.00 mA ±0.1%	0.0122mA/bit

Data Transfer

The analog output module can be used with any processor that uses block transfer programming. Block transfer programming moves up to 13 output words from the processor to the modules memory in one scan utilizing a Write Block Transfer instruction. These words are then fed into the analog output modules digital to analog converter (DAC) to be changed into the voltages or current required to drive your equipment. A Read Block Transfer moves five words from the modules memory to the processor data table for debugging purposes. The Read Block Transfer is also performed in one scan.

The module inhibits block transfer signals for a short period after the application of module power to:

- prevent the possibility of bad data being transmitted to the central processor
- control the power-up of the DC to DC converter
- check the modules microprocessor EPROM and RAM
- allow for cycle time of the power supply and Processor Enable line

The length of this time period is 0.1msec to 10 seconds depending on the programmable controller in use.

Write Block Transfer

The write block is a maximum of 13 words long. Each word is made up of 16 bits. The first four words are data words corresponding to channels 1 through 4, respectively (figure 1).

These first four words receive the BCD or binary data from the processor and transfer it to the DAC.

Word five of the write block is called the configuration word. The configuration word contains information on the sign of the minimum and maximum scaling values, sign of the data words and the format of the data (BCD or binary). Refer to the 1771-OFE Users Manual (publication 1771-6.5.30) for individual bit settings. Note that PLC-5s number individual bits in decimal, not octal. For PLC-2 processors, the format bit is bit 17. For PLC-5 processors, the bit position is 15.

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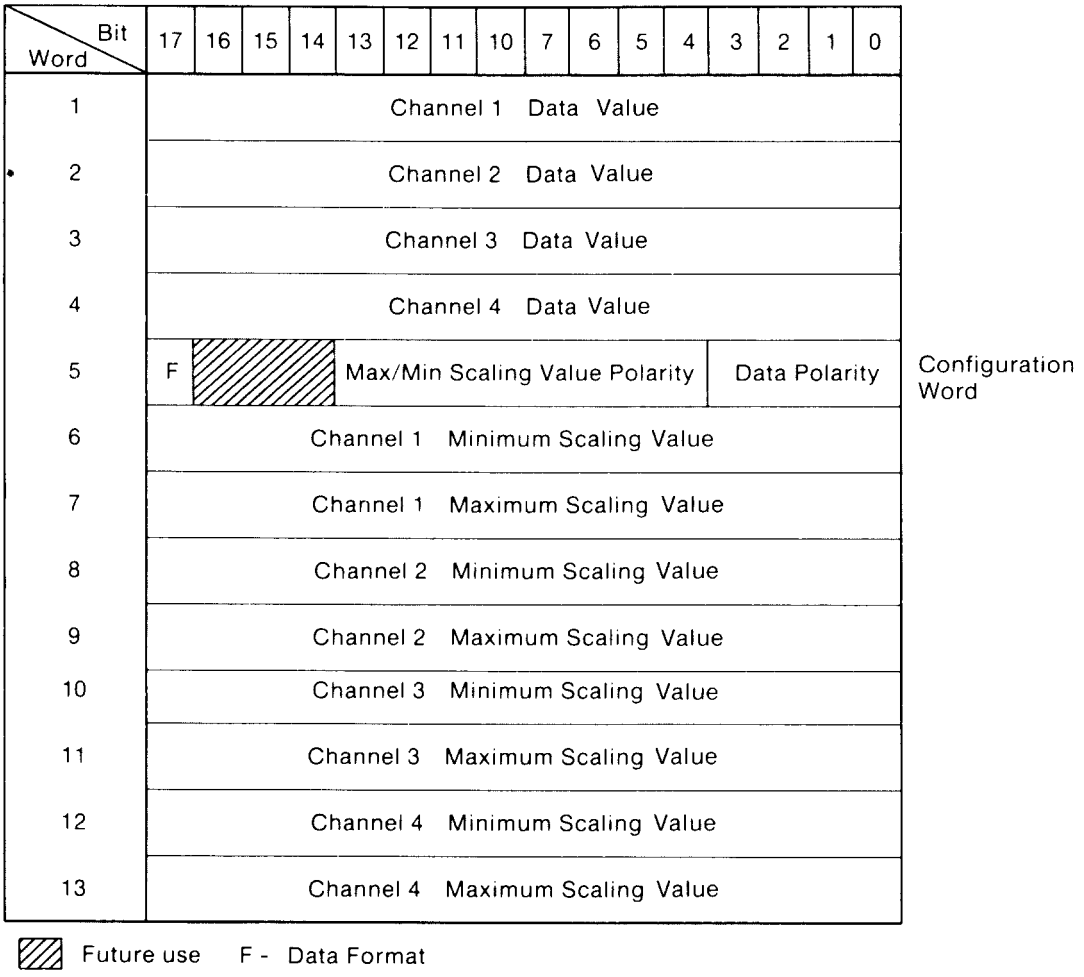
Figure 1
Word Assignment for Write Block Transfer



Scaling

Your module can perform linear conversion of raw data to engineering units, for example; gallons/minute, degrees C, degrees F, and pounds/square inch. Unscaled data in the input module has a range of 0 through 4095. The resolution of this data is 12-bit binary corresponding to one part in 4095. The resolution of scaled values is the same as for raw data, one part in 4095 regardless of the chosen scaling. Each output channel can be scaled independent of the other channels. Use words 6 through 13 of the Write Block Transfer to enter the minimum and maximum scaling value for each of the four channels, using the same format with which you are writing the data, either BCD or binary. Select the sign of the minimum and maximum scaling values using WORD 5, bits 13 through 4.

For example, if the 1 to 5 volt range is selected for channel 1 and you desire the output to correspond to 100°C to 500°C, the following minimum and maximum scaling values would be entered into words 6 and 7:

WORD 6= 0100
WORD 7 = 0500

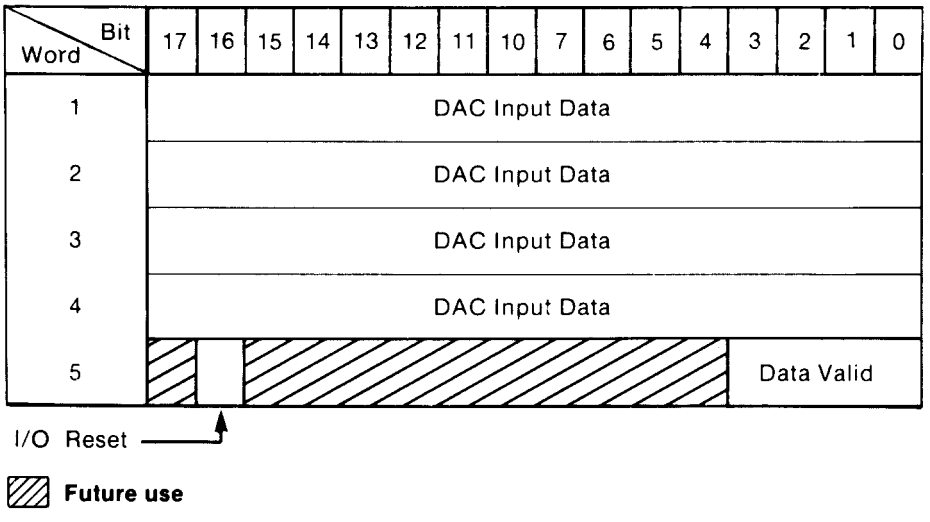
An analog output signal of 2.5 volts would generate an output of 250°C (word 1 = 0250 BCD).

Important: If scaling is performed, a full 13 word block transfer must be performed regardless of the number of channels that actually need scaling.

Read Block Transfer

The module allows a five word Read Block Transfer (figure 2). If a read block transfer request is for other than five words, the module will ignore the incorrect module control byte (MCB) and still perform a read block transfer of five words. The five words are intended only for rudimentary program or hardware debugging. (The user program in a PLC-2 that utilizes the read block transfer must make sure that bits 6 and 7 of the MCB are not set simultaneously.) The first four words of the Read Block Transfer show the actual 12 bits of data sent to the DACs. The fifth word contains the status of each DAC word, i.e., whether data is out of range or scaling is improperly programmed, and whether I/O RESET has been established (when the processor is in the PROG/TEST or RUN mode).

Figure 2
Word Assignment for Read Block Transfer



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Diagnostics

Your module has diagnostic features which monitor the digital to analog conversion and transmission processes for faults. The 1771-OFE analog output module has a red FAULT indicator (figure 3) which is normally off. If a fault occurs,the red diagnostic LED will stay lit and the green run LED will not turn on.

Figure 3
Diagnostic Indicator

If a self-test fault occurs, the Input Image Table word of the programmable controller which corresponds to the location (address) of the module indicates the diagnostic code 00000000 (00 hex). The write block transfer is also inhibited. The outputs will stay at their present state because writing to the digital to analog converter will result in unpredictable signals sent to the outputs.

Write block transfer is inhibited and the same code is sent (00000000, 00 hex) if a block length of more than 13 words is requested.

Power Requirements

System power is supplied through the I/O chassis backplane. The module requires 1.4A at 5V from the backplane. This amount should be totaled with the current requirements of other modules in the rack to avoid overloading the supply or exceeding the backplane capacity.

Wiring

WARNING: Disconnect and lockout AC power to the controller and system power supplies before removing or installing your output module. Failure to do so could result in damage to the module circuitry.

Make wiring connections to the field wiring arm using Belden 8761 or equivalent cable (figures 4 and 5). The wiring arm (1771-WC) pivots on the I/O chassis to connect with terminals on the front of the module. The wiring arm allows you to remove the module from the chassis without disconnecting wiring. Ground the foil shield and stranded drain wire at one end of the cable only. The best ground for this connection is usually the enclosure ground at an I/O chassis mounting bolt or stud. Cut and tape the shield to insulate it from any electrical contact at the input device end of the cable.

The single ground at the chassis must be the only electrical contact of the shield. Recommended maximum cable length for voltage mode output devices is 50 feet. This recommendation is based on considerations of signal degradation and noise immunity in typical industrial environments. Cable length for current mode output devices need not be as restrictive.(Current mode analog signals are less sensitive than voltage signals to noise induced along transmission cables.)

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Figure 4
Connection of Analog Devices to the 1771-WC Field Wiring Arm

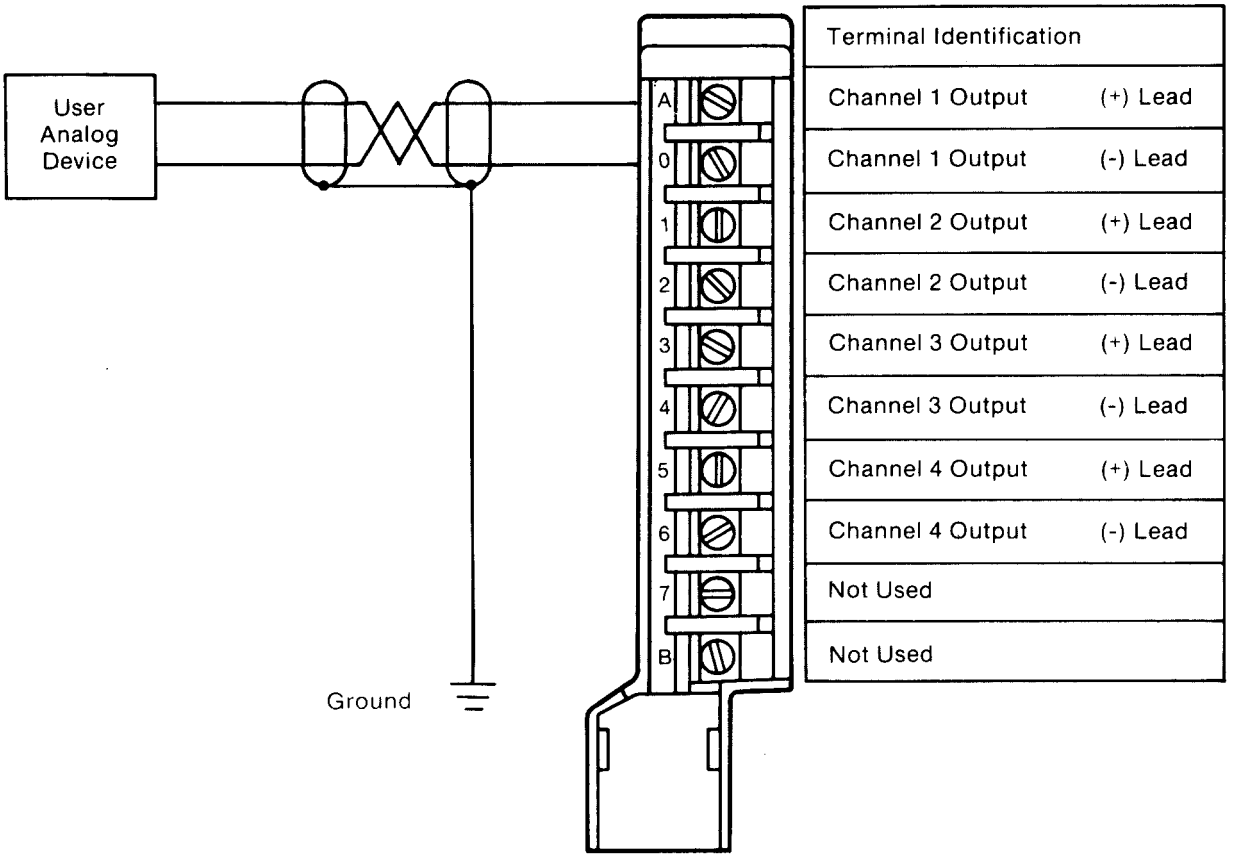
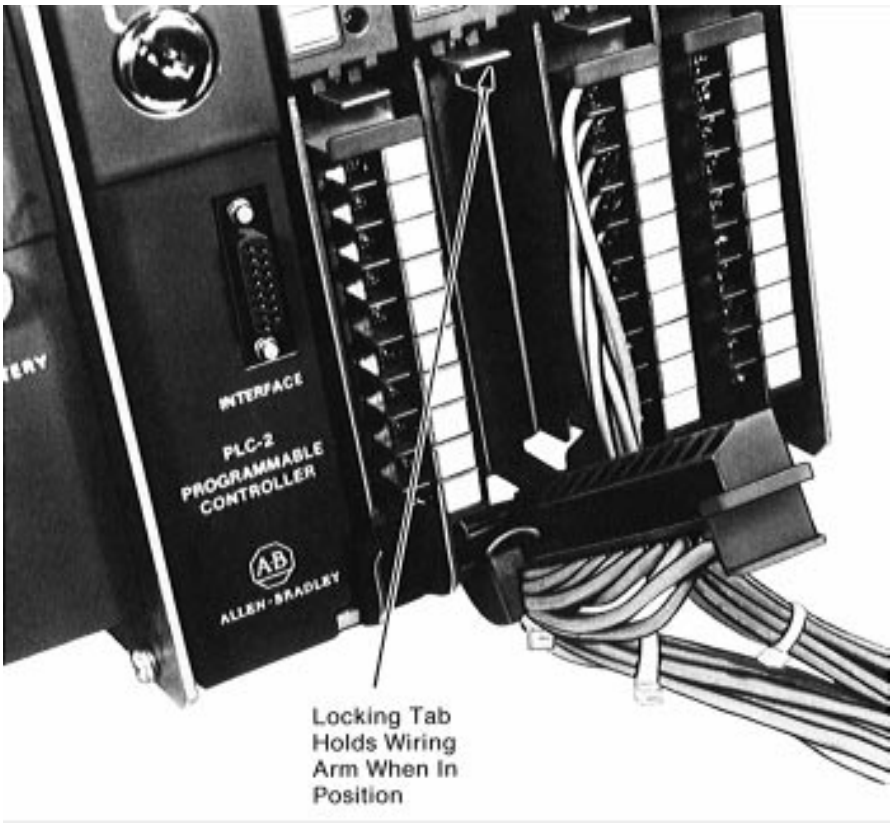


Figure 5
Field Wiring Arm Installed



Module Grouping

Your module may be placed in any I/O module slot of the I/O chassis. Group analog output modules together within an I/O chassis whenever possible to minimize noise. Avoid placing analog modules close to AC modules or high voltage DC modules.

See your processor user's manual for any placement restrictions relating to high-density discrete modules placed in the same I/O group as an analog module.

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Keying

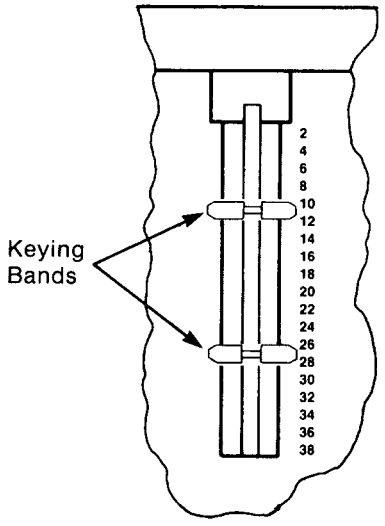
Initially, the analog output module may be inserted into any I/O module group in the I/O chassis. However, once a group has been designated for a module, care should be taken so that other types of modules are not placed into these slots. Plastic keying bands, shipped with the I/O chassis, provide an easy method for keying I/O slots to accept only one type of module. Allen-Bradley strongly recommends the use of these keying bands.

This type of I/O module is slotted in two places on the rear edge of the board. The position of the keying bands on the backplane connector must correspond to these slots to allow insertion of the module. Any I/O rack connector may be keyed to receive the module assembly. Snap the keying bands onto the upper backplane connectors between these numbers printed on the backplane (figure 6).

- Between 10 and 12
- Between 26 and 28

The position of these bands may be changed if subsequent system design and rewiring makes insertion of a different type of module necessary. Use needle-nose pliers to insert or remove keying bands.

Figure 6
Keying Band Positions



Specifications

Outputs per Module	4 1000V individually isolated
Module Location	Single slot in 1771 I/O chassis
Output Voltage Ranges (nominal)	+1 to +5V dc -10 to +10V dc 0 to +10V dc
Output Current Ranges (nominal)	+4 to +20mA 0 to 50mA
Isolation	1000V rms between output channels
Digital Resolution	12 – bit binary – 1 part in 4096
Output Capacitance	0.01∝F (voltage ranges) 0.022∝F (current ranges)
Input from Processor	0 to 9999 for positive voltage ranges, ± 9999 for bipolar output ranges, in BCD or binary
Output Impedance	Less than 0.25 ohms for voltage outputs exclusive of contact wiring resistance Greater than 0.5 megohms for current outputs
Output Current (maximum)	10mA in voltage mode
Maximum Output Resistance in Current Mode	Up to 1200 ohms load resistance
Field Wiring Arm	Cat. No. 1771-WC
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% (noncondensing)
Backplane Power	OFE1 – 10A steady state; 1.5A surge OFE2 – 1.25 A steady state; 1.5A surge OFE3 – 2.4A steady state; 2.6A surge
Electrical-Optical Isolation	1500V isolation (transient) between the output circuit and the control logic (system side)
Output Overload Protection	All outputs are protected against short circuit load conditions not to exceed one minute.
D/A Converter Specifications Settling Time	0.8msec maximum for a resistive load
Internal Scan Rate	8.0msec for all channels using BCD data and scaling 1.6msec 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 LSD (Binary mode)
Temperature Coefficient	+50ppm/°C of full scale

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