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Technical Note TN-170   **Version 1.0**

MSXB 022 16-bit Analog Output Expansion Board

The Microstar Laboratories Analog Output Expansion Board, part number MSXB 022-01, has four analog outputs. Up to sixteen Analog Output Expansion Boards or Digital Input/Output Expansion Boards can be connected to a Data Acquisition Processor™. A Data Acquisition Processor can supply power for one or two Analog Output Expansion Boards. If more than two Analog Output Expansion Boards are connected to a Data Acquisition Processor, an external power supply is required.

Hardware Configuration

The Analog Output Expansion Board is connected to the Data Acquisition Processor digital I/O connector by means of a 100 line ribbon cable, part number MSCBL036-01. This cable connects the Data Acquisition Processor digital expansion port to connector J1 on the Analog Output Expansion Board.

Note: Never connect or disconnect the Analog Output Expansion Board while the Data Acquisition Processor is powered.

There are four 16-bit digital-to-analog converters on the Analog Output Expansion Board. The digital-to-analog converter outputs should drive only high impedance loads. The output current from each digital-to-analog converter is rated at ±5 milliamps, but it is recommended that this current not exceed ±1 mA.

The Analog Output Expansion Board connects to the Data Acquisition Processor digital connector. If digital input/output is needed in addition to analog output expansion, a Digital Expansion Board is required.

More Than One Analog Output Expansion Board

If more than one Analog Output Expansion Board is to be connected to a Data Acquisition Processor, a custom daisy-chain cable must be used. If more than two Analog Output Expansion Boards are to be connected to a Data Acquisition Processor, an external power supply is required. Each Analog Output Expansion Board draws about 1 amp at 5 volts. The -02 is available with the Data Acquisition Processor power disconnected and with a connector for external power.

Note: It is best to power the -02 from the host PC's power supply so that both the -02 and the Data Acquisition Processor are powered on and off at the same time. If this is not practical, then external power to the -02 should be applied before powering on the DAP and should be disconnected after powering off the DAP.

There are four address jumpers on the Analog Output Expansion Board, providing 16 possible addresses. The address jumpers are located on header J2. Because the Analog Output Expansion
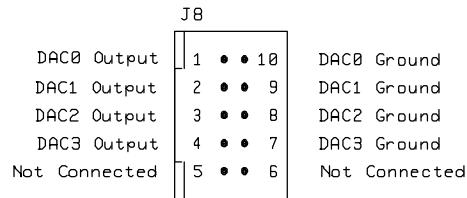
Board and the Digital Expansion Board, part number MSXB013-02, use the same addressing, only 16 boards total can be connected to a Data Acquisition Processor. Each board must have a unique address. The pin numbering of header J2 is:

```
        1  2  3  4
        ●  ●  ●  ●
        ●  ●  ●  ●
        1  2  3  4
J2
```
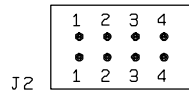
The board address range is selected by installing jumpers on header J2 as shown in the table below:

Output Address	Jumpers	DACOUT Address
0 - 3	1, 2, 3, 4	2 - 5
4 - 7	1, 2, 3	6 - 9
8 - 11	1, 2, 4	10 - 13
12 - 15	1, 2,	14 - 17
16 - 19	1, 3, 4	18 - 21
20 - 23	1, 3	22 - 25
24 - 27	1, 4	26 - 29
28 - 31	1	30 - 33
32 - 35	2, 3, 4	34 - 37
36 - 39	2, 3	38 - 41
40 - 43	2, 4	42 - 45
44 - 47	2	46 - 49
48 - 51	3, 4	50 - 53
52 - 55	3	54 - 57
56 - 59	4	58 - 61
60 - 63	none	62 - 65

The DAC outputs are available on two connectors on the Analog Output Expansion Board. One connector is an 8 point quick connect terminal block and the other is a 10 pin shrouded header. There is a ground return for each output. It is recommended that these grounds be paired with their respective outputs to minimize noise. The connections on the 8-point terminal block are clearly labeled on the circuit board. The connections on the 10-pin shrouded header are:

```
                    J8
    DAC0 Output    | 1  ● ● 10 |   DAC0 Ground
    DAC1 Output    | 2  ● ●  9 |   DAC1 Ground
    DAC2 Output    | 3  ● ●  8 |   DAC2 Ground
    DAC3 Output    | 4  ● ●  7 |   DAC3 Ground
   Not Connected   | 5  ● ●  6 |   Not Connected
```

Each digital-to-analog converter has a three-pin header with a jumper to select the output voltage range. The jumper operates in exactly the same way as those on the 1216e- and 2416e-Series Data Acquisition Processors. J3 controls DAC0, J4 controls DAC1, J5 controls DAC2, and J6 controls DAC3. The pin numbering of the headers are as follows:

```
         J3 - J6
    1 ●
    2 ●
    3 ●
```
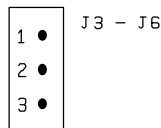
Pin 1 is closest to connector J10 and to the header label.

The jumper is placed on each header, as follows:

Jumpers	Range
1 to 2	-5 volts to +5 volts
2 to 3	-10 volts to +10 volts

The Analog Output Expansion Board is shipped with the -5 volts to +5 volts range selected.

Note: Using the 0 to +10 volt unipolar output selection requires special software support. Contact Microstar Laboratories for more information.

Software Configuration

The Analog Output Expansion Board is controlled through DAPL in the same way as output expansion is controlled with the Digital Expansion Board. To use the Analog Output Expansion Board, the DAPL OUTPORT command is required. The output port type of the Analog Output Expansion Board is one.

The command DACOUT uses zero and one for the Data Acquisition Processor on-board analog outputs. For the Analog Output Expansion Board, DACOUT uses two for analog output expansion port 0, three for output expansion port 1, and so on.

The following DAPL listing generates +5 volts DC on DAC0, 0 volts DC on DAC1, -2.5 volts DC on DAC2, and +2.5 volts DC on DAC3, provided that the DAC output control jumpers are in the ± 5 volt range as shipped from the factory:

```
OUTPORT 0..3 TYPE=1

RESET
PIPES P0, P1, P2, P3
PDEF A
   DACOUT(P0,2)
   DACOUT(P1,3)
   DACOUT(P2,4)
   DACOUT(P3,5)
   END
START A
FILL P0 32767
FILL P1 0
FILL P2 -16384
FILL P3 16384
```

In real applications, the values in pipes P0, P1, P2, and P3 typically would come from other procedures instead of from FILL commands.

Synchronous Analog Output Expansion

Synchronous analog output expansion uses a special protocol which is implemented by the DAPL command DEXPAND. For each word of output, the data and address are encoded into four words that are sent to the digital output port. If DEXPAND is used, all DAC outputs are synchronous on all Analog

Output Expansion Boards. See the description of DEXPAND in the DAPL manual and Chapter 5 of the Applications Manual for more information.