

# **MSXB075 & MSXB076 Signal Interface Module Manual**

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*Isolated Analog Output Modules*

*Version 1.10*

**Microstar Laboratories, Inc.**

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Part Number MSXB076M100

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## Hardware Architecture

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### System Configuration

The backplane model of the MSXB075 or MSXB076 connects directly to the digital backplane (MSXB034 or MSXB035) of an industrial enclosure or DAPserver. This allows one or more MSXB076 modules, or other digital expansion modules, to be installed in an industrial enclosure and be connected to one DAP board. The digital interface board (MSXB033) in the enclosure then connects to the DAP board via a MSCBL076-01 and a MSCBL054.

Other models are available. Contact your Microstar Laboratories representative to determine all available models.

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Note: The backplane model of the module should not be connected or disconnected to the digital backplane while the digital backplane is powered.

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### Power Requirements

The MSXB075 or MSXB076 module typically requires 170mA at +5 Volts DC. The Data Acquisition Processor can typically supply 1.5A to 2.0A at +5 Volts. The total power consumption of all expansion modules must not exceed the power availability of the Data Acquisition Processor. Please refer to the hardware documentation of the Data Acquisition Processor for more specific power availability information. If the total power consumption exceeds the power availability of the Data Acquisition Processor, then external power must be used.

No more than 10 mA may be drawn from the MSXB075 or MSXB076 or returned to ground through J2.

### Isolation

The design of the MSXB075 and MSXB076 provides 300V of channel-to-channel and channel-to-ground isolation. The outputs of the modules are isolated from the ground of the DAP board.

### Analog Output Specifications

There are four and eight digital-to-analog converters on the MSXB075 and MSXB076 modules, respectively. The default output range is +/-10V. The output current should not exceed 1mA per channel.

If the output range of +/-5V is selected (via the utility program), the resolution is reduced to 15-bit.

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Note: If the output current exceeds maximum ratings, damage to the module may occur.

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## Board Layout

The MSXB075 and MSXB076 are 3U boards measuring 100 mm by 220 mm, or 3.93" by 8.76". The following diagrams show the layout of the MSXB076. The layout of the MSXB075 is similar to that of the MSXB076.

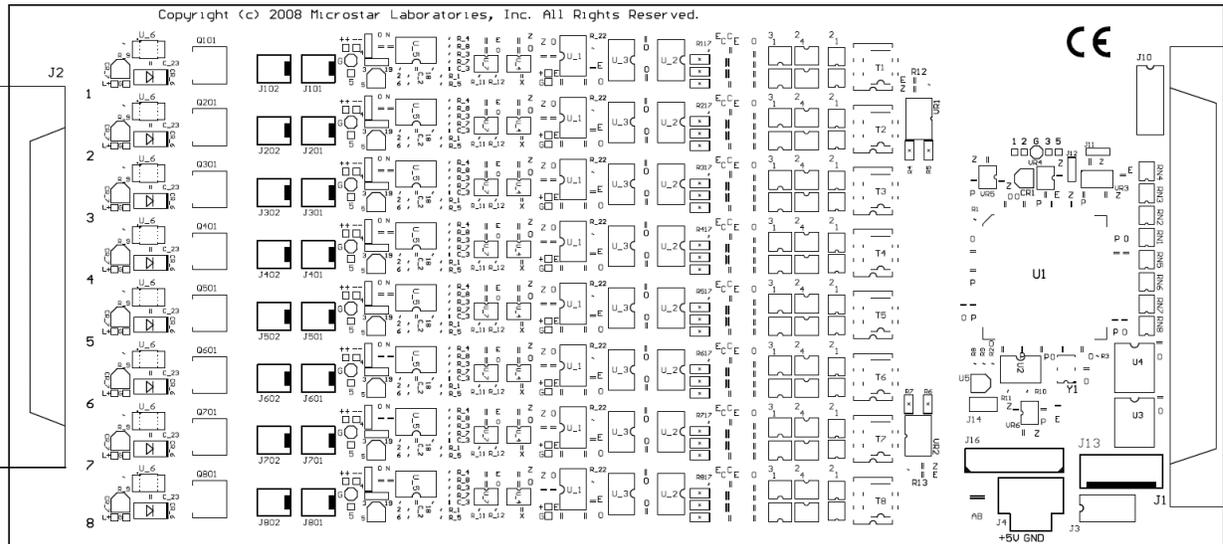


Figure 1. Layout of the MSXB076

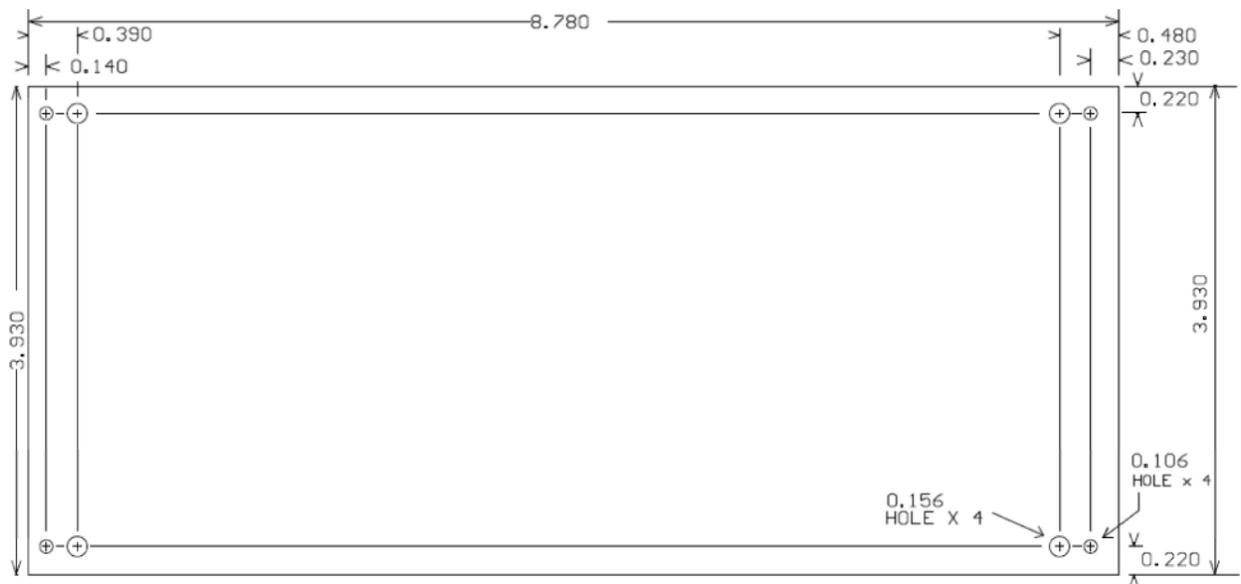


Figure 2. Dimensions of the module

## Output Connector Options

Output signals are available at the female DB37 connector at J2 or at the optional 2-pin headers Jx01. Each MSXB075 or MSXB076 is built with either option. The pinout of the 37-pin connector (looking into the connector) and the optional connectors are shown below. For the MSXB075, the pins for DACOUT5 through DACOUT8 and the corresponding grounds are not connected.

The female DB37 connector mates with the discrete wire cable kit MSCBL092-02K.

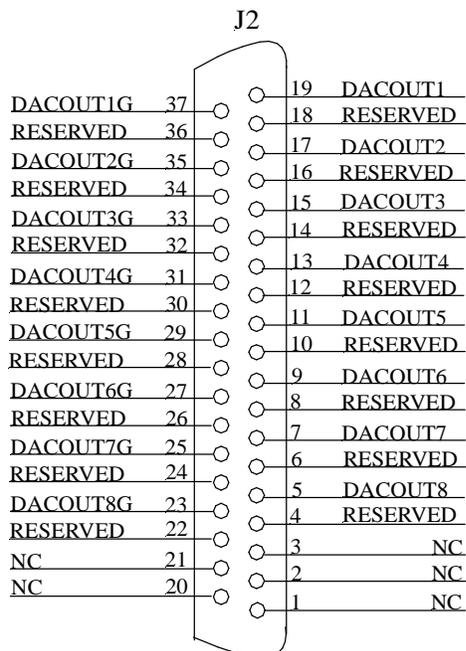


Figure 3. Pinout of the 37-pin output connector

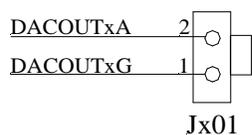


Figure 4. Pinout of the optional 2-pin headers.

## Software Configuration

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The MSXB075 and MSXB076 modules are configured by the Signal Interface Module configuration utility. The parameters are listed below:

- Board ID
- Output and Update addresses
- Initial outputs

The utility is available for download at [www.mstarlabs.com](http://www.mstarlabs.com). Refer to the utility manual for more information on the interface.

### Hardware Setup

To configure a MSXB075 or MSXB076, the shunt on its write-protect header J14 needs to be removed before running the configuration utility and replaced afterwards. The MSXB075 or MSXB076 should be connected to a DAP board that has been installed with Accel32 or DAPcell Server. If more than one signal interface module (MSXB075/76 or other model) is connected to a DAP, only one module can be configured at a time. The settings of the other modules can be viewed but cannot be changed. If more than one module have the shunt on its write-protect header removed, the results are unspecified.

### Board ID

Each MSXB075 or MSXB076 module must have a unique Board ID ranging from 1 to 255. The Board ID is used to identify the module and configure the addresses in the utility program. It can be changed using the utility program. The default Board ID is equal to the lower eight bits of the module's serial number. If two or more modules have the same Board ID, the results are unspecified.

## Output Address

Each analog output module should have a unique output address range. A MSXB075 uses four ports (e.g. B0 to B3) and a MSXB076 eight ports (e.g. B0 to B7). Up to sixteen MSXB075 or eight MSXB076 modules can be connected to a DAP for 63 outputs (i.e. B0 to B62). Port 63 is reserved as the broadcast port. For the MSXB075 or MSXB076 module that is configured for the last output address range, the last output channel (i.e. port 63) should not be used.

When using the DACOUT command to asynchronously update the outputs, the port addresses specified for the command differ from the output addresses numerically by two because DACOUT uses ports 0 and 1 for the DACs onboard of the DAP board. Tables 1 and 2 show the correspondence between the output and DACOUT port addresses for the MSXB075 and MSXB076. Refer to the DAPL Examples for using DACOUT with an expansion module.

**Table 1. Output and DACOUT Port Addresses for MSXB075**

<i>Output Address</i>	<i>DACOUT Port Address</i>
0 – 3	2 – 5
4 – 7	6 – 9
8 – 11	10 – 13
12 – 15	14 – 17
16 – 19	18 – 21
20 – 23	22 – 25
24 – 27	26 – 29
28 – 31	30 – 33
32 – 35	34 – 37
36 – 39	38 – 41
40 – 43	42 – 45
44 – 47	46 – 49
48 – 51	50 – 53
52 – 55	54 – 57
56 – 59	58 – 61
60 – 63*	62 – 65

\*Port 63 (and DACOUT port address 65) is reserved as the broadcast port.

**Table 2. Output and DACOUT Port Addresses for MSXB076**

<i>Output Address</i>	<i>DACOUT Port Address</i>
0 – 7	2 – 9
8 – 15	10 – 17
16 – 23	18 – 25
24 – 31	26 – 33
32 – 39	34 – 41
40 – 47	42 – 49
48 – 55	50 – 57
56 – 63*	58 – 65*

\*Port 63 (and DACOUT port address 65) is reserved as the broadcast port.

## Update Address

In addition to the output address, each module has an update address between 0 and 62 for simultaneous update. With more than one module, the modules with the same update address (but different output addresses) are updated simultaneously. The update address can be any address, but should be the last address written to (i.e. the last port in the TWOWRITE or DEXPAND command) in order to allow all channels to load new values before the update occurs. Refer to the DAPL Configuration section for examples.

## Initial Outputs

The initial value of each output after the DAP board is powered up can be specified at the utility program.

## DAPL Configuration

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The digital outputs of a DAP board can be updated asynchronously or synchronously. Different DAPL commands are used for the two cases. With the MSXB075 and MSXB076, the outputs can also be updated simultaneously across multiple modules. This section discusses the special command for synchronous outputs and shows examples on configuring the DAP board to work with the MSXB075 or MSXB076 for analog outputs.

## TWOWRITE Command for Output Expansion

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TWOWRITE encodes multiple channels for synchronized output expansion. It is used by output modules part numbers MSXB075 and higher. For each word of output, the data and address are encoded into two words that are sent to the digital output port for TWOWRITE. With DEXPAND, the data and address are encoded into four words. The MSXB075 and MSXB076 are compatible with both commands. For older expansion boards, use DEXPAND only. See the description of DEXPAND in the DAPL manual for more information.

The command module TWOWRTM.DLM has to be downloaded to the DAP board before TWOWRITE can be used. The module can be downloaded from Control Panel | Data Acquisition Processor | Modules | Add or by using the DAPIO32 function DapModuleLoad or DapModuleInstall in a PC program. Go to [www.mstarlabs.com](http://www.mstarlabs.com) to download a copy of the module.

**TWOWRITE** (<in\_pipe>, <output\_vector>, <out\_pipe>)

### Parameters

<in\_pipe>

Input word pipe.  
WORD PIPE

<output\_vector>

A vector containing a list of the output ports to which data should be sent.  
VECTOR

<out\_pipe>

Output channel pipe.  
WORD PIPE

### Description

TWOWRITE encodes data and address information for transfer to a digital or analog module through the Data Acquisition Processor digital port. <output\_vector> is a vector containing a list of the expanded output ports to which data should be sent. <in\_pipe> is a word pipe that contains data to be sent. Data must appear in the order of the list in <output\_vector>. For each data value read from <in\_pipe>, two encoded words specifying the output pin number and the data are written to <out\_pipe>, which is typically an output channel pipe assigned to digital output port B0.

The encoding generates a data stream in groups of two WORD values. The data values from <in\_pipe> are in every other value in <out\_pipe>. The <output\_vector> specifies a list of output ports. The port numbers must be within the range 0 through 62 as supported by the output modules. TWOWRITE is used only for synchronous output expansion.

See example #2 under DAPL Examples for more information.

### Example

```
TWOWRITE(P1, (4, 5, 6, 7), OPIPE0)
```

Prepare multiplexed data from pipe P1 for synchronized updating. Encode the data to send it to ports 4, 5, 6, and 7 on the output module. Transfer the data to the Data Acquisition Processor's digital connector through output channel pipe OPIPE0.

## Example #1 – Asynchronous Outputs

The following DAPL configuration sends the values in three user pipes P0, P1, and P2 to the first three expansion ports on a MSXB076 that is configured for output addresses B0 through B7.

```
OUTPORT 0..7 TYPE=1

RESET
PIPES P0, P1, P2
PDEF B
  P0 = 16384      // half the full voltage scale, e.g. 5V on a 10V range
  P1 = 32767     // the maximum voltage, e.g. 10V on a 10V range
  P2 = 0
DACOUT(P0, 2)
DACOUT(P1, 3)
DACOUT(P2, 4)
END
START B
```

With asynchronous output updates, the `OUTPORT` command must be used. The output port type of an analog output expansion module is 1. The `DACOUT` command bypasses normal output clocking and sends data directly to the hardware parts.

The command `DACOUT` uses “0” and “1” for DAP board’s onboard analog outputs. For the analog output expansion modules, `DACOUT` uses “2” for output expansion port 0, “3” for output expansion port 1, and so on. Refer to the section on Output and Update Addresses for more information.

## Example #2 – Synchronous Outputs with No Simultaneous Updates

Synchronous analog output expansion uses a special protocol which is implemented by the DAPL command TWOWRITE. Refer to an earlier section on the TWOWRITE command for more information.

The system has two MSXB076 modules with different update addresses, and therefore, the analog outputs are not updated simultaneously among the modules. Assume that we want to update the first two outputs for each module. The DAPL configuration for such a system is shown below:

```
OUTPORT 0..15 TYPE=1 //0 to 7 for the first module and 8 to 15 for the second

RESET
PIPES P0, P1, P2, P3, POUT
PDEF B
  P0 = 16384      // half the full voltage scale, e.g. 5V on a 10V range
  P1 = 32767      // the maximum voltage, e.g. 10V on a 10V range
  P2 = 0
  P3 = -16384     // -5V on a 10V range
MERGE(P0,P1,P2,P3 POUT)
TWOWRITE(POUT, (0,1,8,9), OP0)
END
ODEF C 1
  SET OP0 B0
  TIME 1000
END
START B, C
```

The MERGE command merges four streams of data into pipe POUT. The TWOWRITE command then converts the output data in POUT to the output expansion format of the output expansion module and places the result in output channel pipe OP0. The list (0,1,8,9) specifies that the analog outputs are at addresses 0, 1, 8, and 9.

An output procedure sends the data in output channel pipe OP0 to the expansion modules connected to the analog output port every 1000 microseconds, or 1 milliseconds. TWOWRITE produces two output values for every input value. The output channel pipe OP0 contains four channels of data and each channel of data has an additional value from TWOWRITE. The effective update interval of each channel is then 8 milliseconds (1 ms \* 4 channels \* 2 values / channel). The update rate is then 125 Hz.

The effective update rate of an output channel can be calculated by the following equation:

$$\text{Update rate per channel} = 1 / (\text{TIME value} * \text{number of output channels} * 2)$$

If the DEXPAND command is used in place of TWOWRITE, the value “2” should be changed to “4” in the equation above. That means the update rate per channel is halved. For applications that require a high update rate, the TWOWRITE command is recommended.

### **Example #3 – Synchronous Outputs with Simultaneous Updates**

Consider the hardware from example #2 with the update addresses changed to 2 for both modules. Since the update addresses are the same, the outputs on the two modules are simultaneously updated. The update address should have the same value as the last output address.

The DAPL configuration for this example is the same as that from example #2.