MSXB 038 Accessory Board Manual

Digital Input/Ouput Expansion Board

Version 1.40

Microstar Laboratories, Inc.

Contents

MSXB 038: Digital Expansion Board

The Microstar Laboratories Digital Input/Output Expansion Board, part number MSXB 038, provides the Data Acquisition Processor with 16 digital inputs and 16 digital outputs with termination connection points. By using multiple Digital Input/Output Expansion Boards, the Data Acquisition Processor can be expanded to control up to 128 digital inputs and 1024 digital outputs.

The Digital Input/Output Expansion Board is available in different models that allow various system configurations. The Digital Input/Output Expansion Board can be connected directly to the Data Acquisition Processor by means of a cable, or it can be connected to the Digital Backplane for use inside an Industrial Enclosure. The Digital Input/Output Expansion Board can also be enclosed in a single board External Enclosure. Table 1 below shows all current MSXB 38 expansion board models. Other models may be available. Contact your Microstar Laboratories representative to determine all available models.

Table 1. Basic models

PRODUCT NAME	INPUT/OUTPUT CONNECTION
MSXB038-07	Wago terminal, right angle 100-line connector
MSXB038-08	Screw terminal, right angle 100-line connector
MSXB038-09	Wago terminal, veritical 100-line connector
MSXB038-10	Wago terminal, I/O connector is not installed
MSXB038-11	Wago terminal, right angle HD-62 connector

Hardware Configuration

The Digital Input/Output Expansion Board can be connected to a Data Acquisition Processor using a 100-line cable adapter board, part number MSCBL046-01 and a 100-line cable, part number MSCBL054-01 or MSCBL056-01. The MSCBL046-01 cable adapter board attaches to the Digital Input/Output Port of the Data Acquisition Processor. The MSCBL054-01 or MSCBL056-01 cable connects the digital adapter board to connector J1 of the Digital Input/Output Expansion Board.

The Digital Input/Output Expansion Board also can be connected directly to the Data Acquisition Processor by means of a 100-line adapter ribbon cable, part number MSCBL058-01.

The backplane model of the Digital Input/Output Expansion Board connects directly to the Digital Backplane. Please refer to the documentation on the Digital Backplane on how to connect the Digital Backplane to the Data Acquisition Processor.

Note**:** The Digital Input/Output Expansion Board should not be connected to or disconnected from a Data Acquisition Processor while the Data Acquisition Processor is powered.

Note: The backplane model of the board should not be connected or disconnected to the Digital Backplane while the Digital Backplane is powered.

Board Layout

The following diagrams show the layout of the Digital Input/Output Expansion Board:
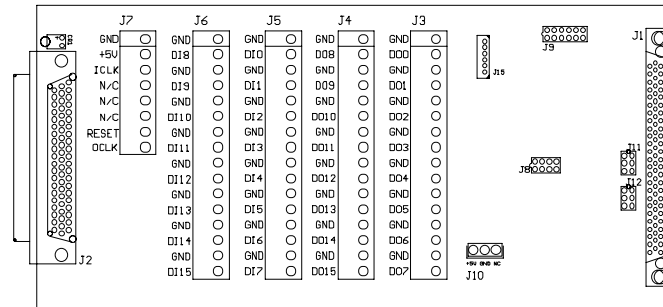
Figure 1. MSXB 038 with 62-pin input/output connector
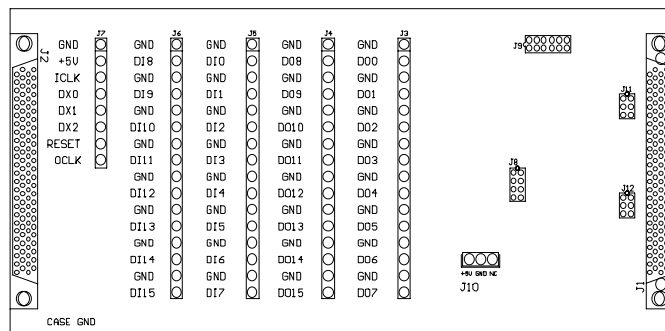
Figure 2. MSXB 038 with 100-pin input/output connector

Input/Output Connector Options

Input/output signals can be connected to the MSXB 038 by means of a Wago terminations or a HD-62 connector on the front panel or a 100-line connector on the front panel. Wago terminations are provided by J3, J4, J5 and J6 as shown in Figure 1 and Figure 2 above. Figure 3 shows the pinout of the 62-pin input/output connector, and Figure 4 shows the pinout of the 100-pin input/output connector.

```
                                      21  +5 VOLTS (FUSED)
                                      42  +5 VOLTS (FUSED)
              DOUT15  62              20  DOUT7
                                      41  DIGITAL GROUND (FUSED)
              DOUT14  61              19  DOUT6
                                      40  DIGITAL GROUND (FUSED)
              DOUT13  60              18  DOUT5
                                      39  DIGITAL GROUND (FUSED)
              DOUT12  59              17  DOUT4
                                      38  DIGITAL GROUND (FUSED)
              DOUT11  58              16  DOUT3
                                      37  DIGITAL GROUND (FUSED)
              DOUT10  57              15  DOUT2
                                      36  DIGITAL GROUND (FUSED)
               DOUT9  56              14  DOUT1
                                      35  DIGITAL GROUND (FUSED)
               DOUT8  55              13  DOUT0
                                      34  DIGITAL GROUND (FUSED)
             RESERVED  54             12  RESERVED
                                      33  DIN10
             RESERVED  53             11  RESERVED
                                      32  DIGITAL GROUND (FUSED)
  DIGITAL GROUND (FUSED)  52          10  RESERVED
                                      31  DIN9
                DIN15  51              9  DIN4
                                      30  DIGITAL GROUND (FUSED)
  DIGITAL GROUND (FUSED)  50           8  DIGITAL GROUND (FUSED)
                                      29  DIN8
                DIN14  49              7  DIN3
                                      28  DIGITAL GROUND (FUSED)
  DIGITAL GROUND (FUSED)  48           6  DIGITAL GROUND (FUSED)
                                      27  DIN7
                DIN13  47              5  DIN2
                                      26  DIGITAL GROUND (FUSED)
  DIGITAL GROUND(FUSED)  46            4  DIGITAL GROUND (FUSED)
                                      25  DIN6
                DIN12  45              3  DIN1
                                      24  DIGITAL GROUND (FUSED)
  DIGITAL GROUND (FUSED)  44           2  DIGITAL GROUND (FUSED)
                                      23  DIN5
                DIN11  43              1  DIN0
                                      22  DIGITAL GROUND (FUSED)
```

Figure 3. Pinout for the 62-pin Input/Output connector

MSXB 038: Digital Expansion Board

```
        RESERVED  | 51 • • 50 | RESERVED
   DIGITAL GROUND  | 52 • • 49 | +5 VOLTS
         DOUT 15   | 53 • • 48 | DIGITAL GROUND
         DOUT 14   | 54 • • 47 | DIGITAL GROUND
         DOUT 13   | 55 • • 46 | DIGITAL GROUND
         DOUT 12   | 56 • • 45 | +5 VOLTS
         DOUT 11   | 57 • • 44 | DIGITAL GROUND
         DOUT 10   | 58 • • 43 | DIGITAL GROUND
         DOUT 9    | 59 • • 42 | DIGITAL GROUND
         DOUT 8    | 60 • • 41 | +5 VOLTS
         DOUT 7    | 61 • • 40 | DIGITAL GROUND
         DOUT 6    | 62 • • 39 | DIGITAL GROUND
         DOUT 5    | 63 • • 38 | DIGITAL GROUND
         DOUT 4    | 64 • • 37 | +5 VOLTS
         DOUT 3    | 65 • • 36 | DIGITAL GROUND
         DOUT 2    | 66 • • 35 | DIGITAL GROUND
         DOUT 1    | 67 • • 34 | DIGITAL GROUND
         DOUT 0    | 68 • • 33 | +5 VOLTS
INTERNAL OUTPUT CLK - OUTPUT | 69 • • 32 | DIGITAL GROUND
        RESERVED  | 70 • • 31 | DIGITAL GROUND
        BRESET#   | 71 • • 30 | DIGITAL GROUND
        RESERVED  | 72 • • 29 | +5 VOLTS
        RESERVED  | 73 • • 28 | DIGITAL GROUND
        RESERVED  | 74 • • 27 | DIGITAL GROUND
        RESERVED  | 75 • • 26 | DIGITAL GROUND
        RESERVED  | 76 • • 25 | +5 VOLTS
        RESERVED  | 77 • • 24 | DIGITAL GROUND
        RESERVED  | 78 • • 23 | DIGITAL GROUND
        RESERVED  | 79 • • 22 | DIGITAL GROUND
            DX2   | 80 • • 21 | +5 VOLTS
            DX1   | 81 • • 20 | DIGITAL GROUND
            DX0   | 82 • • 19 | DIGITAL GROUND
INTERNAL INPUT CLK - OUTPUT | 83 • • 18 | DIGITAL GROUND
         DIN 15   | 84 • • 17 | +5 VOLTS
         DIN 14   | 85 • • 16 | DIGITAL GROUND
         DIN 13   | 86 • • 15 | DIGITAL GROUND
         DIN 12   | 87 • • 14 | DIGITAL GROUND
         DIN 11   | 88 • • 13 | +5 VOLTS
         DIN 10   | 89 • • 12 | DIGITAL GROUND
         DIN 9    | 90 • • 11 | DIGITAL GROUND
         DIN 8    | 91 • • 10 | DIGITAL GROUND
         DIN 7    | 92 • •  9 | +5 VOLTS
         DIN 6    | 93 • •  8 | DIGITAL GROUND
         DIN 5    | 94 • •  7 | DIGITAL GROUND
         DIN 4    | 95 • •  6 | DIGITAL GROUND
         DIN 3    | 96 • •  5 | +5 VOLTS
         DIN 2    | 97 • •  4 | DIGITAL GROUND
         DIN 1    | 98 • •  3 | DIGITAL GROUND
         DIN 0    | 99 • •  2 | DIGITAL GROUND
        +5 VOLTS  |100 • •  1 | DIGITAL GROUND
```

Figure 4. Pinout for the 100-line Input/Output connector

Input and Output Specifications

The Digital Input/Output Expansion Board has termination connection points for both input and output connections. All input connections are labeled DIx, where x is the input number; x ranges from 0 to 15. Each input connection has an adjacent ground connection, labeled GND.

The inputs are FCT TTL; they sink no more than 1 microamp for a "1" input and source no more than 0.5 milliamps for a "0" input. An input voltage greater than 2 volts is interpreted as a "1" and an input voltage less than 0.8 volts is interpreted as a "0."

Digital input pins may have signals applied when the Data Acquisition Processor is off.

Note: If a voltage greater than 5 volts or less than 0 volts is applied to an input, damage to the Digital Input/Output Expansion Board or the entire system may occur.

All output connections on the Digital Input/Output Expansion Board are labeled DOx, where x is the output number; x ranges from 0 to 15. Each output has an adjacent ground connection, labeled GND. The outputs are FCT TTL; they can sink no more than 48 milliamps for a "0" output and can source no more than 15 milliamps for a "1" output. The output voltage for a "1" is at least 2.0 volts and the output voltage for a "0" is at most 0.5 volts.

Note: If the output current exceeds maximum ratings, damage to the Digital Input/Output Expansion Board may occur.

All input and output ground connections are electrically connected on the Digital Input/Output Expansion Board and are connected to the Data Acquisition Processor ground. All signals connected to a Digital Input/Output Expansion Board must share the PC's ground as a common reference.

Clocking and Control Signals

The Data Acquisition Processor internal input clock and output clock outputs are available on the Digital Input/Output Expansion Board. Digital expansion control signals also are available.

100-pin Input/Output connector model

The connections shown on J7 of Figure 2 above are labeled as follows:
- ICLK = Input Clock Output
- OCLK = Output Clock Output
- DX0–DX2 = Digital Expansion Control Signals

62-pin Input/Output connector model

The connections shown on J7 of Figure 1 are labeled as follows:
- ICLK = Input Clock Output
- OCLK = Output Clock Output

The digital expansion control signals are available on J15 as shown in Figure 5 below. Pin 1 of J15 is toward the middle of the Digital Input/Output Expansion board.
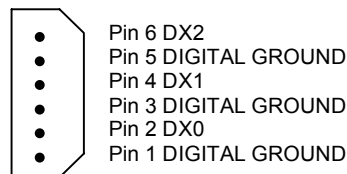
```
Pin 6 DX2
Pin 5 DIGITAL GROUND
Pin 4 DX1
Pin 3 DIGITAL GROUND
Pin 2 DX0
Pin 1 DIGITAL GROUND
```

Figure 5. Pinout of J15

Operation

At power up and during reset the outputs of the Digital Input/Output Expansion Board's expansion ports will track the digital outputs of the Data Acquisition Processor. After power up or a hardware reset, the Digital Input/Output Expansion Board's outputs will come up in a known state of either all high or all low depending on the configuration of the Data Acquisition Processor it is connected to. See the Data Acquisition Processor connector chapters for information on how to configure the digital outputs of the Data Acquisition Processor.

Multiple Digital Input/Output Expansion Boards

Several Digital Input/Output Expansion Boards can be connected together to provide additional digital expansion. When more than one Digital Input/Output Expansion Board is used, the J1 connectors of all Digital Input/Output Expansion Boards are tied together. Contact your Microstar Laboratories product supplier for information about special cables that provide this feature.

Input Address

Each Digital Input/Output Expansion Board must be configured to recognize a specific input address. Header J8 selects this address.

J8

```
      ┌─────────┐
  1   │  •   •  │  1
  2   │  •   •  │  2
  3   │  •   •  │  3
  4   │  •   •  │  4
      └─────────┘
```
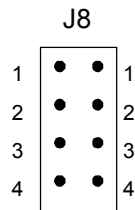
Figure 6. Input Address Selection Header

Pin 1 of header J8 is next to the J8 label on the Digital Input/Output Expansion Board. The input address is selected according to the following table:

Table 2. Input Address Selection

Input Address	J8 Jumpers
B0	4, 3, 2, 1
B1	4, 3, 2
B2	4, 3, 1
B3	4, 3
B4	4, 2, 1
B5	4, 2
B6	4, 1
B7	4
Disable	Remove 4

No more than eight Digital Input/Output Expansion Boards can be used for digital input expansion. If more than eight Digital Input/Output Expansion Boards are connected to the Data Acquisition Processor then the Digital Input/Output Expansion Boards not being used for input expansion must have their input expansion disabled by removing the shunt 4 from J8.

Digital inputs

DAPL automatically generates addressing control signals, as specified by `SET` commands in the input procedure. The following input procedure reads 16-bit values from the Digital Input/Output Expansion Board:

```
RESET
  IDEF A 1
  SET IPIPE0 B0
  TIME 10000
  END
PDEF B
  PRINT
  END
START A, B
```

Note that the input address of the board in the previous example is set to B0 with all four shunts installed on header `J8`.

Output Address

Each Digital Input/Output Expansion Board must be configured to recognize a specific output address. Header `J9` of the Digital Input/Output Expansion Board selects this address.
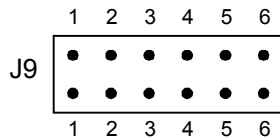

Figure 7. Output Address Selection Header

Pin 1 of header `J9` is closest to the left edge of the Digital Input/Output Expansion Board. The output address is selected according to the following table:

Table 3. Output Address Selection

Output Address	J9 Jumpers	Output Address	J9 Jumpers
0	6, 5, 4, 3, 2, 1	1	6, 5, 4, 3, 2
2	6, 5, 4, 3, 1	3	6, 5, 4, 3
4	6, 5, 4, 2, 1	5	6, 5, 4, 2
6	6, 5, 4, 1	7	6, 5, 4
8	6, 5, 3, 2, 1	9	6, 5, 3, 2
10	6, 5, 3, 1	11	6, 5, 3
12	6, 5, 2, 1	13	6, 5, 2
14	6, 5, 1	15	6, 5
16	6, 4, 3, 2, 1	17	6, 4, 3, 2
18	6, 4, 3, 1	19	6, 4, 3
20	6, 4, 2, 1	21	6, 4, 2
22	6, 4, 1	23	6, 4
24	6, 3, 2, 1	25	6, 3, 2
26	6, 3, 1	27	6, 3
28	6, 2, 1	29	6, 2
30	6, 1	31	6
32	5, 4, 3, 2, 1	33	5, 4, 3, 2
34	5, 4, 3, 1	35	5, 4, 3
36	5, 4, 2, 1	37	5, 4, 2
38	5, 4, 1	39	5, 4
40	5, 3, 2, 1	41	5, 3, 2
42	5, 3, 1	43	5, 3
44	5, 2, 1	45	5, 2
46	5, 1	47	5
48	4, 3, 2, 1	49	4, 3, 2
50	4, 3, 1	51	4, 3
52	4, 2, 1	53	4, 2
54	4, 1	55	4
56	3, 2, 1	57	3, 2
58	3, 1	59	3
60	2, 1	61	2
62	1	63	none

Digital output can be expanded past the maximum limit for digital input. For Digital Input/Output Expansion Boards that expand digital output beyond the maximum digital input range, the digital inputs must be disabled by removing the shunt 4 on J8.

Digital Outputs

To use digital output, the DAPL command `OUTPORT` is required. The output port type of the Digital Input/Output Expansion Board is zero.

The following DAPL listing outputs the 16-bit values in pipe `P0` to the Digital Input/Output Expansion Board asynchronously:

```
OUTPORT 0 TYPE=0

RESET
PIPES P0
PDEF B
  DIGITALOUT(P0, 0)
   END
START B
```

Note that the output address of the board in the previous example is set to `B0` with all six shunts installed on header `J9`.

Synchronous Digital Output Expansion

Synchronous digital 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 digital outputs are synchronous on all Digital Input/Output Expansion Boards. See the description of `DEXPAND` in the DAPL manual for more information.

External Power Option

The Digital Input/Output Expansion Board typically requires 0.46 A 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 boards 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 1 Amp of current may be drawn from the +5V power supply or returned to Ground through the Wago connectors or J2.

The Digital Input/Output Expansion Board allows an external +5 Volts power supply to be connected through connector J10. Connector J10 is a single row header on .156-inch centers. J10 is Molex part number 26-60-4030, which mates with Molex part number 09-50-3031.
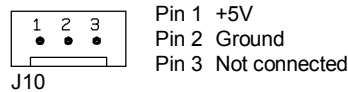
```
        1  2  3      Pin 1  +5V
        •  •  •      Pin 2  Ground
                     Pin 3  Not connected
      J10
```

Figure 8. External Power Connector

When an external +5 Volts power supply is connected to the board, all six shunts on jumper headers J11 and J12 must be removed. Jumper headers J11 and J12 are located near connector J1 on the right side of the board. Removing all the shunts from J11 and J12 disconnects the Data Acquisition Processor's +5V power supply from the board's +5V power supply.

Warning: When using an external power supply, all shunts on J11 and J12 must be removed. Otherwise the external power supply or the host PC power supply could be damaged.

External Enclosure Option

The Digital Input/Output Expansion Board is available with a single-board external enclosure option. The external enclosure provides shielding and is compatible with the European Community directive 89/336/EEC.

The single-board external enclosure has several possible end panels that allow for different external connection options for the Digital Input/Output Expansion Board. Contact your Microstar Laboratories product supplier for more information on available end panels.

Backplane Connector Option

A Digital Input/Output Expansion Board is available with a backplane connector installed in `J1` instead of a cable connector. This allows the Digital Input/Output Expansion Board to be used with a Digital Backplane. The backplane version of connector `J1` plugs directly into an empty slot on the Digital Backplane.

See the Digital Backplane manual for more information on how to install backplane boards into a Digital Backplane and how to connect the Digital Backplane to the Data Acquisition Processor.