MSXB 064 & 065 Accessory Board Manual

Signal Conditioning Board

Version 1.20

Microstar Laboratories, Inc.

Contents

MSXB 064 & MSXB 065 - Signal Conditioning Boards

The Analog Input Expansion Boards, part number MSXB 064 and MSXB 065, provide signal conditioning and sample-and-hold amplifiers for 8 channels of differential inputs. In addition, the MSXB 065 also provides anti-alias filtering. It has a four-pole, low-pass, differential Butterworth filter for each of the 8 channels. The cutoff of the filter is set in a hardware module.

Input signals are connected to the MSXB 064 or the MSXB 065 by means of a DB-37 connector. The number of input channels can be expanded to as many as 240 by using up to 30 MSXB 064 or MSXB 065 boards or both.

Microstar Laboratories has several models of MSXB 064 and MSXB 065 expansion boards available. Both expansion boards are compatible with the backplane in the standard industrial enclosures and optionally can be built in a stand-alone or single-board external enclosure configuration. The expansion boards mount directly in a standard Microstar Laboratories industrial enclosure fitted with a 68-line analog backplane.

Basic Models

The MSXB 064 and MSXB 065 expansion boards are currently available in the backplane models. A DAP board is connected to the MSXB 064 and MSXB 065 boards by installing them into an analog backplane mounted in an industrial enclosure.

Table 1 shows all MSXB 065 expansion board models. Other cutoff frequencies may be available. Contact your Microstar Laboratories representative to determine all available models.

Table 1. MSXB 065 Basic Models

Product Name	Cutoff Frequency
MSXB065-03-100-E2K	100 Hz
MSXB065-03-250-E2K	250 Hz
MSXB065-03-500-E2K	500 Hz
MSXB065-03-1K-E2K	1 kHz
MSXB065-03-2.5K-E2K	2.5 kHz
MSXB065-03-5K-E2K	5 kHz
MSXB065-03-10K-E2K	10 kHz
MSXB065-03-25K-E2K	25 kHz
MSXB065-03-50K-E2K	50 kHz

Installation

The backplane models of Signal Conditioning board connect directly to the analog backplane via connector J1. The MSXB 064 or MSXB 065 board installs into any available slot in the analog backplane.

When installing the expansion board, push the board firmly into the slot and make sure the board is securely connected to the backplane.

Warning: Never connect or disconnect any expansion board from the analog backplane or the Data Acquisition Processor while power is applied to any of them.

Warning: The MSXB 065 board is only compatible with the filter module MSFM001. Do not use any other filter module.

Hardware Configuration

Figure 1 shows the component placement outlines of the Signal Conditioning board. The connectors and headers are labeled with the letter J.
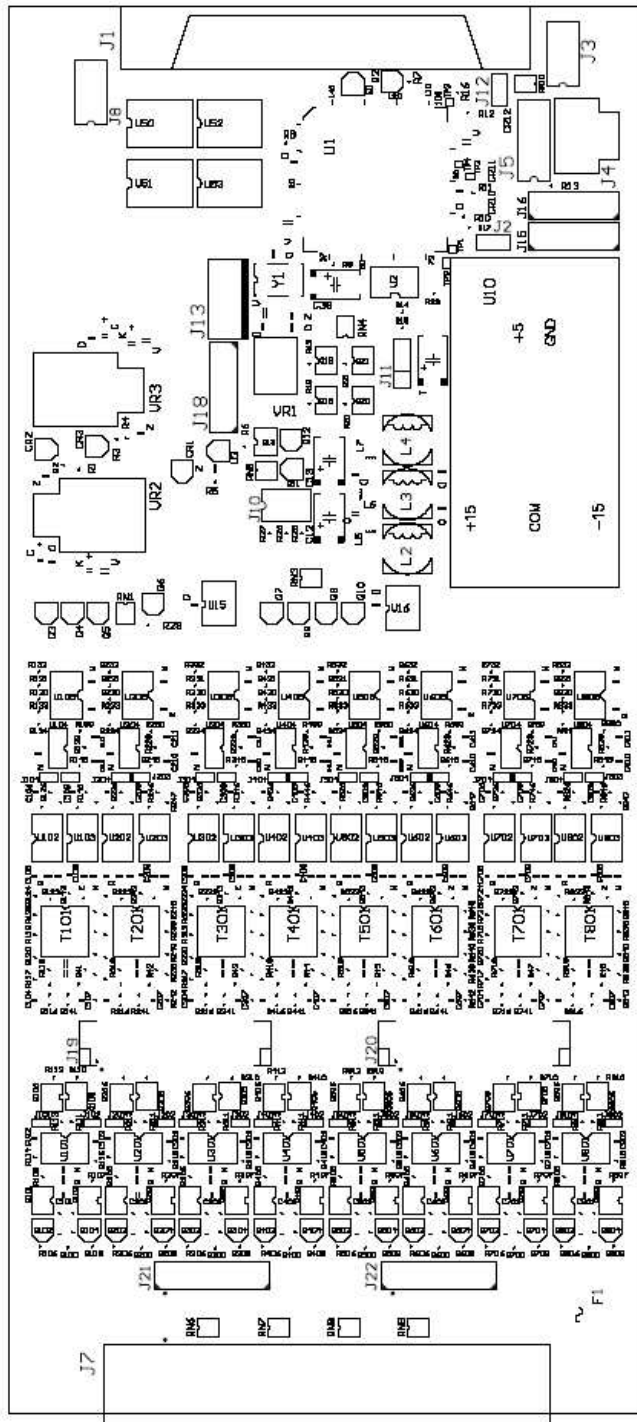
Figure 1. Layout of the Signal Conditioning Board.

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Connecting Analog Input Signals

The input signals are connected to the DB-37 connector, J7, which is a male connector that is compatible with the discrete wire cable kit MSCBL092-01K. Figure 2 shows the pinout of connector J7 (looking into the board) with each pin labeled with the signal name.

J7

Left				Right
D0-	20		1	D0+
GD0-	21		2	GD0+
D1-	22		3	D1+
GD1-	23		4	GD1+
D2	24		5	D2+
GD2-	25		6	GD2+
D3	26		7	D3+
GD3-	27		8	GD3+
D4-	28		9	D4+
GD4-	29		10	GD4+
D5-	30		11	D5+
GD5-	31		12	GD5+
D6-	32		13	D6+
GD6-	33		14	GD6+
D7-	34		15	D7+
GD7-	35		16	GD7+
DAC1 Return	36		17	DAC1 OUT
DAC0 Return	37		18	DAC0 OUT
			19	Reserved

Figure 2. Analog I/O Connector.

Input Address Range

Each MSXB 064 or MSXB 065 Signal Conditioning board can support 8 differential inputs. Up to 30 boards can connect to a single DAP, providing 240 differential analog inputs. Each analog input expansion board, including the MSXB 064 or MSXB 065 board, must be configured to recognize a unique input address range. The jumper setting on connector J5 selects the board address ranges as shown in Figure 3 and Table 2.
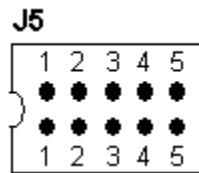
Figure 3. Input Range Selection Header

Table 2. Input Range Configuration.

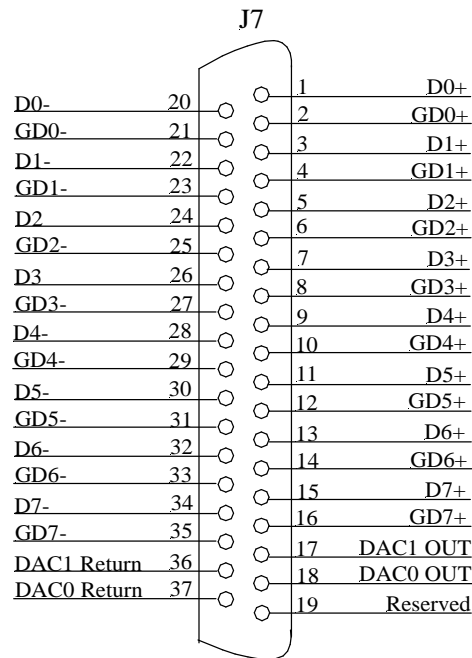| Signal Channel Range	Board Number	Shunts
D0 – D7	0	1, 2, 3, 4, 5
D8 – D15	1	1, 2, 3, 4
D16 – D23	2	1, 2, 3, 5
D24 – D31	3	1, 2, 3
D32 – D39	4	1, 2, 4, 5
D40 – D47	5	1, 2, 4
D48 – D63	6	1, 2, 5
D56 – D63	7	1, 2
D64 – D71	8	1, 3, 4, 5
D72 – D79	9	1, 3, 4
D80 – D87	10	1, 3, 5
D88 – D95	11	1, 3
D96 – D103	12	1, 4, 5
D104 – D111	13	1, 4
D112 – D119	14	1, 5
D120 – D127	15	1
D128 – D135	16	2, 3, 4, 5
D136 – D143	17	2, 3, 4
D144 – D151	18	2, 3, 5
D152 – D159	19	2, 3
D160 – D167	20	2, 4, 5
D168 – D175	21	2, 4

D176 – D183	22	2, 5
D184 – D191	23	2
D192 – D199	24	3, 4, 5
D200 – D207	25	3, 4
D208 – D215	26	3, 5
D216 – D223	27	3
D224 – D231	28	4, 5
D232 – D239	29	4

Each jumper setting on connector J5 selects an address range of 8 input channels. When using multiple MSXB 064 or/and MSXB 065 filter boards, every input expansion board in the system must have a unique address range.

There are two special expansion address ranges, D240 to D247 and D248 to D255. The first expansion address is reserved and must not be used. The second address range, D248 to D255, puts the sample-and-hold amplifiers into track mode.

The input addressing is enabled by installing a shunt on pin pair 3 of header J10. If the shunt is removed, the board is always on; it passes outputs to the DAP board as long as it is powered.

Pin Group Select

Some of the DAP boards, such as the DAP 4400a and the DAP 5400a, have more than one analog-to-digital converter onboard and sample a pin group of several channels simultaneously. Each MSXB 064 or MSXB 065 board can be configured for the odd- or even-number channels at header J11. Contact Microstar Laboratories for information on using the MSXB 064 or MSXB 065 with the DAP 4400a or the DAP 5400a.
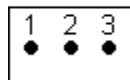
J11

Figure 4. Pin Group Select Header.

Pins	Channels in pin group
1-2	Even-number channels
2-3	Odd-number channels

Power Requirements

Each MSXB 064 or MSXB 065 filter board requires less than 2 Amps at +5 Volts DC. It draws power from the 68-line connector on the analog backplane. A DAP board can typically supply a total of 2 Amps at its +5V connection. If the total current required by the expansion boards in the system exceeds 2 Amps, an external power supply should be connected to the backplane of the industrial enclosure. One model of the industrial enclosure contains a built-in power supply that connects to an AC power outlet.

External Power Option

On the external-power model of the Signal Conditioning board, connector J4 provides connection for a +5V external power. Connector J4 is a single-row header on 0.156-inch centers located by the DC-to-DC converter. J4 is Molex part number 26-60-4030, which mates with the Molex part number 09-50-3031. Microstar can provide a cable, part number MSCBL033, that connects the 5VDC power of a PC to J4. The pin-out of connector J4 is shown below.

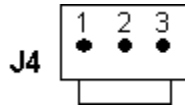*Figure 5. External Power Connector.*

Pin	Signal
1	+5V
2	Ground
3	Not Used

To turn an internal-power model of the expansion board into using an external power, the traces at J3 need to be cut. J3 is located next to J4.

Simultaneous Sample and Hold Option

The sample-and-hold feature is enabled by default by installing a shunt on header J2. Removing the shunt bypasses the sample-and-hold feature and thus disables the simultaneous sampling. Header J2 is located by the DC-to-DC converter, above the header J15.

When the sample-and-hold amplifiers are enabled, reading from any pin in the address range of D248 to D255 places all the channels on all connected Signal Conditioning board(s) into track mode, which provides settling time between samples. This is a dummy reading and the value from this input channel pipe should be ignored. Reading from any pin in the lower address range of D0 to D239 gives a value corresponding to an input signal, as held on the last transition from track mode to hold mode.

The Signal Conditioning board(s) should be held in track mode for a minimum of 4 microseconds before switching to hold mode, which means the DAP board should sample any pin within D248 to D255 continuously for at least 4 μs before sampling an input signal. This is to provide adequate settling time for large voltage wings.

Analog Outputs

When the shunts are installed on header **J8**, DAC0 and DAC1 pins on the 68-line connector **J1** are connected to the DB37 connector **J7**. This is the default setting. The two outputs can be disconnected on **J7** by removing the shunts on **J8**.
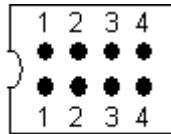
J8

Figure 6. Analog Output Header.

Pin Pair	Signal
1	DAC1
2	DAC1 Ground
3	DAC0
4	DAD0 Ground

Gain Settings

The MSXB 064 and MSXB 065 boards provide the gains of 1, 5, and 25, selectable at the header J10. The valid settings of header J10 and the corresponding gains are shown in the following diagram and table.
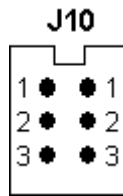
Figure 7. Gain Setting and Addressing Enabled Header.

Shunt at pin pair(s)	Gain
1 and 2 (1-1, 2-2)	1
2	5
1	25

By default shunts are installed on pin pairs 1 and 2 for a unity gain. If no shunt is installed on either pin pair 1 or 2, the gain is undefined.

Pin pair 3 is for disabling the input addressing. Refer to the section on Input Address Range for more information.

Clocking and Triggering Connections

Clocking and triggering signals can be connected to the Signal Conditioning board. External clock and trigger signals connected to the MSXB 064 or the MSXB 065 board must be in the standard TTL range of 0 to 5 volts. See the Data Acquisition Processor manual for more information about hardware clocking and triggering.

Connectors J15 and J16 on MSXB 064 (or MSXB 065) provide access to the external clock and trigger signals from the Data Acquisition Processor. J15 and J16 are Molex part number 53014-0610. The mating connector consists of a shell and discrete crimp pins; the shell is Molex part number 51004-0600 and the crimp pins are Molex part number 50011-8100. The schematic diagrams for connectors J15 and J16 are shown below:

	J15			J16	
INCLK	6		OUTCLK	6	
GND	5		GND	5	
IXTIN	4		OXTIN	4	
GND	3		GND	3	
IXCIN	2		OXCIN	2	
GND	1		GND	1	
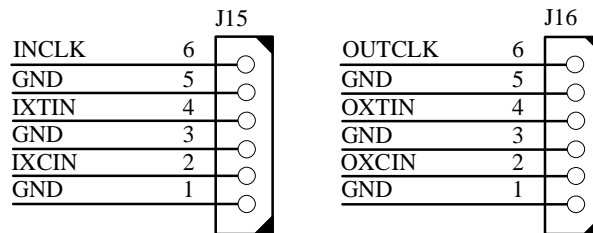
Figure 8. External Clock and Trigger Signals

Pin	Signal
INCLK	Internal Input Clock – Output
IXTIN	External Input Trigger – Input
IXCIN	External Input Clock – Input
OUTCLK	Internal Output Clock – Output
OXTIN	External Output Trigger – Input
OXCIN	External Output Clock – Input

Filter Modules

For the MSXB 065 board, two filter modules are installed at connectors J19 and J20. The board is compatible with filter module MSFM001, which has various cutoff frequencies. Please contact Microstar Laboratories for the available filter frequencies.

Software Configuration

The following is a typical input procedure definition. The input procedure MslInput acquires the signals on D0, D1, D2, ..., and D7 sequentially. The TIME command sets the sampling time to 4.0 microseconds. Since the input configuration samples nine pins, including one pin in the range of D248 to D255 for the track mode, each pin is sampled every 36 microseconds or at approximately 27.8 kS/s. The MERGE command sends the input data from input channels to the binary communications pipe $BINOUT:

```
RESET
IDEF MslInput 9
  SET IP0  D248
  SET IP1  D0
  SET IP2  D1
  SET IP3  D2
  SET IP4  D3
  SET IP5  D4
  SET IP6  D5
  SET IP7  D6
  SET IP8  D7
  TIME 4.0
  END
PDEF MslProc
  MERGE (IP(1 .. 8), $BINOUT)
  END
START MslInput, MslProc
```

Note that data from input channel pipe 0 are ignored. The only function of the SET IP0 D248 command is to place the sample-and-hold amplifiers into track mode.

As described in the section on Simultaneous Sample and Hold Option, the board must be held in track mode for a minimum of 4 microseconds. That does not mean the value for the TIME command has to be at least 4. A pin between D248 and D255 can be sampled more than once to achieve a higher sample rate per channel. For the example above, the pin D248 (or any channel in D248-D255) can be sampled twice to reduce the sample time to 2.0 microseconds to fulfill the minimum time for track mode. In that case, the input definition becomes the following:

```
IDEF MslInput 10
  SET IP0  D248
  SET IP1  D248
  SET IP2  D0
  SET IP3  D1
  SET IP4  D2
  SET IP5  D3
  SET IP6  D4
  SET IP7  D5
  SET IP8  D6
  SET IP9  D7
  TIME 2.0
  END
```

The number of inputs is increased from 9 to 10. The sample time interval per channel is now 20 microseconds, which translates to a sample rate of 50 kS/s, compared to the 27.8 kS/s from the first input definition with D248 sampled once.

Appendix A. Connectors at a Glance

Table 3. Connectors and Headers.

| Header	Description
J1	68-pin connector to the DAP
J2	Enables sample-and-hold amplifiers
J3	Determines whether the board is externally powered
J4	3-pin Molex Connector for external power
J5	Determines the input address range
J7	DB37 connector for analog inputs and outputs
J8	Connects analog outputs between J1 and J7
J10	Determines gain setting and enables input addressing
J11	Selects channels in a pin group
J12	Internal use
J13	Internal use – for programming EEPROM
J15	Input clock and trigger
J16	Output clock and trigger
J18	Internal use
J19	Connects to filter module for MSXB 065
J20	Connects to filter module for MSXB 065
J21	Lower 4-channel differential signals
J22	Higher 4-channel differential signals

Appendix B. Mechanical Layout
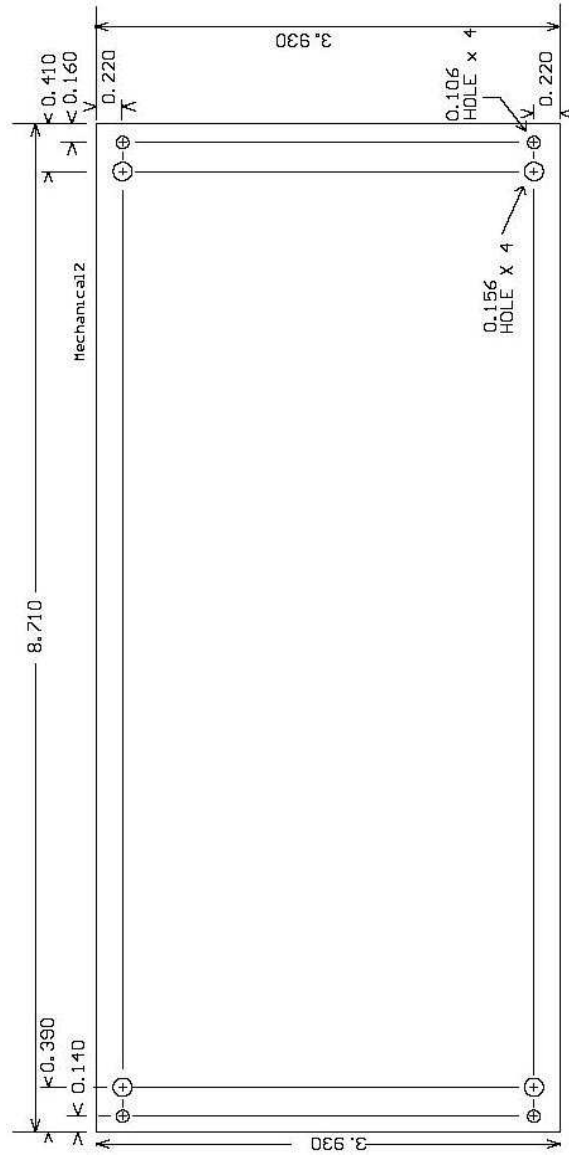
Figure 9. Dimensions of the Board.