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MetraBus

User's Manual



Revision 2, October, 2000

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TABLE OF CONTENTS

1. INTRODUCTION 1-1

1.1 THE METRABUS CONCEPT 1-1
1.2 THE METRABUS I/O MAP AND CABLE 1-1
1.3 PROGRAMMING 1-2
1.4 PROGRAMMING I/O BOARDS 1-2
1.5 PACKAGING AND INTERCONNECTION 1-3

2. -MDB64 SERIES DRIVER BOARDS 2-1

2.1 INTRODUCTION 2-1
2.2 -MDB64 INSTALLATION 2-1
2.2.1 Installation using the InstaCal™ Software Utility 2-1
2.2.2 Setting the Base Address Switch (ISA- and PC104-MDB64 only) 2-2
2.3 METRABUS POWER 2-3
2.3.1 "5V Power" Jumper 2-3
2.3.2 Fuse (Fl) 2-3
2.3.3 Using an Auxiliary Power Supply 2-3
2.3.4 External Power Supply using the 50-pin Ribbon Cable 2-4
2.3.5 External Power Supply Using the C-POWER-X series Power Cable 2-4
2.4 INTRODUCTION TO REGISTER LEVEL PROGRAMMING FOR THE -MDB64 2-4
2.4.1 Address Pointer (ADRPTR) 2-5
2.4.2 The Data I/0 Register (DATAIO) 2-6
2.4.3 The Software RESET (MRESET) 2-6
2.4.4 Notes on the Use of Compiled or Assembled Languages 2-6
2.5 -MDB64 SPECIFICATIONS 2-6

3. MEM-32 ELECTROMECHANICAL RELAY BOARD 3-1

3.1 INTRODUCTION 3-1
3.2 INSTALLATION 3-2
*3.2.1 Insta*Cal 3-2
3.2.2 Setting the MEM-32 Board Address 3-2
3.2.3 Typical Output Connections 3-3
3.3 PROGRAMMING THE MEM-32 3-4
3.3.1 MEM-32 Register Map 3-4
3.4 USING AN AUXILIARY POWER SUPPLY 3-4
3.4.1 External Power Supply using a 50-pin Ribbon Cable 3-5
3.4.2 External Power Supply using a C-Power-X series MetraBus Power Cable 3-5
3.5 MEM-32 SPECIFICATIONS 3-5

4. MEM-8 ELECTROMECHANICAL RELAY BOARD 4-1

4.1 INTRODUCTION 4-1
4.2 INSTALLATION 4-2
*4.2.1 Insta*Cal 4-2
4.2.2 Setting the MEM-8 Board Address 4-2
4.3 PROGRAMMING THE MEM-8 4-3
4.3.1 MEM-8 Register Map 4-3
4.4 USING AN AUXILIARY POWER SUPPLY 4-3
4.4.1 External Power Supply using a 50-pin Ribbon Cable 4-5
4.4.2 External Power Supply using a MetraBus Power Cable 4-5
4.5 MEM-8 SPECIFICATIONS 4-5

5. MII-32 ISOLATED DIGITAL INPUT BOARD 5-1

5.1 INTRODUCTION 5-1

5.2 INSTALLATION 5-2
*5.2.1 Insta*Cal 5-2
5.2.2 Setting the MII-32 Board Address 5-2
5.3 CONFIGURING THE MII-32 FOR NON-STANDARD INPUTS 5-3
5.4 TYPICAL INPUT CONNECTIONS 5-3
5.5 PROGRAMMING THE MII-32 5-4
5.5.1 MII-32 Register Map 5-4
5.6 USING AN AUXILIARY POWER SUPPLY 5-4
5.6.1 External Power Supply using a 50-pin Ribbon Cable 5-5
5.6.2 External Power Supply using a MetraBus Power Cable 5-5
5.7 MII-32 SPECIFICATIONS 5-5

6. MIO-32 ISOLATED DIGITAL OUTPUT BOARD 6-1

6.1 INTRODUCTION 6-1
6.2 INSTALLATION 6-2
*6.2.1 Insta*Cal 6-2
6.2.2 Setting the MIO-32 Board Address 6-2
6.3 TYPICAL OUTPUT CONNECTIONS 6-3
6.4 PROGRAMMING THE MIO-32 6-4
6.4.1 MIO-32 Register Map 6-4
6.5 USING AN AUXILIARY POWER SUPPLY 6-4
6.5.1 External Power Supply using a 50-pin Ribbon Cable 6-5
6.5.2 External Power Supply using a C-Power-X series MetraBus Power Cable 6-5
6.6 MIO-32 SPECIFICATIONS 6-6

7. MSSR-24 ISOLATED SOLID STATE SWITCHING I/O BOARD 7-1

7.1 INTRODUCTION 7-1
7.2 INSTALLATION 7-2
*7.2.1 Insta*Cal 7-2
7.2.2 Setting the MSSR-24 Board Address 7-2
7.3 PROGRAMMING THE MSSR-24 7-3
7.3.1 MSSR-24 Register Map 7-3
7.4 USING AN AUXILIARY POWER SUPPLY 7-5
7.4.1 External Power Supply using a 50-pin Ribbon Cable 7-5
7.4.2 External Power Supply using a C-Power-X series MetraBus Power Cable 7-5
7.5 MSSR-24 SPECIFICATIONS 7-6

8. MBUS-PWR POWER SUPPLY BOARD 8-1

8.1 GENERAL 8-1
8.2 SETUP 8-1
8.3 EXTERNAL POWER SUPPLY USING THE 50-PIN RIBBON CABLE 8-2
8.4 EXTERNAL POWER SUPPLY USING THE METRABUS POWER CABLE (C-POWER-X) 8-2
8.5 THE MBUS-PWR EXPANSION/POWER CONNECTORS 8-3
8.6 POWER CONNECTOR 8-4
8.7 EXPANSION CONNECTOR 8-5
8.8 POWER DISTRIBUTION 8-5
8.9 OUTPUT GROUND JUMPER 8-6
8.10 INSTALLATION 8-7
8.11 MBUS-PWR SPECIFICATIONS 8-7

1. INTRODUCTION

ComputerBoards' MetraBus system provides a high quality, low cost method to connect a variety of real world I/O devices and signals to a personal or small computer. Based on the MetraBus system developed by Keithley MetraByte, ComputerBoards' products are fully compatible with the Keithley system, but take advantage of new technologies. ComputerBoards' system provides driver boards for the newer PC buses as well as a Windows 95/98/NT compatible software driver. Finally, Measurement Computing Corp. provides a wider assortment of options.

Controlled by a variety of host computers, the MetraBus system allows creation of large-scale analog and digital I/O systems. MetraBus systems offer an ideal I/O solution for applications that are too large for a standard plug-in board system. You can develop MetraBus systems to monitor and control thousands of individual I/O points.

1.1 The MetraBus Concept

The MetraBus concept is simple. A MetraBus driver board is installed in the host computer. A 50-conductor MetraBus cable then connects the driver board to one or more I/O boards. The cable can be up to 100 feet long, allowing the host computer and driver board to reside in a controlled environment. The I/O boards can be located remotely near the actual equipment or devices that are being monitored and/or controlled.

1.2 The MetraBus I/O Map and Cable

The MetraBus system uses a 50-conductor cable as illustrated in Figure 1-1. The cable provides all communications between MetraBus I/O boards and the host computer, and in smaller systems, is used for power distribution among the I/O boards. The MetraBus cable consists of six address lines, 4 control/status lines, 8 data lines, and 32 power and ground lines.

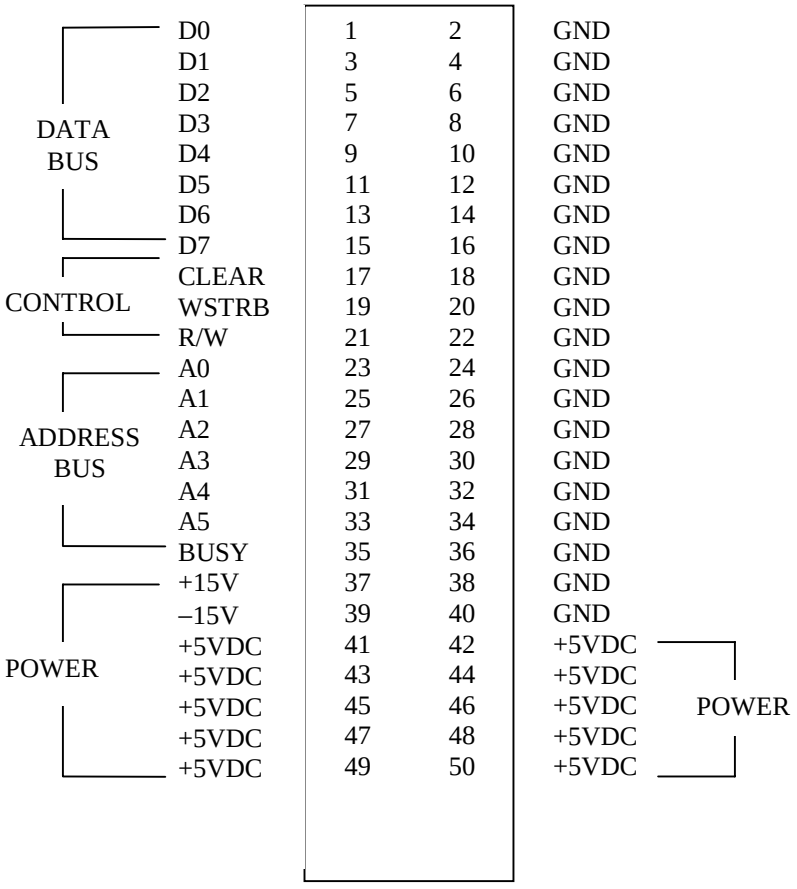


Figure 1-1. MetraBus 50-pin Conductor Map

The six address lines of the MetraBus provide 2^6 or 64 individual addresses on the MetraBus. The MetraBus data bus is eight bits wide, so each MetraBus address can control:

- eight digital I/O points
- One-bit A/D or D/A point
- One-half of a 12-bit A/D or D/A
- One, 8-bit counter/timer

1.3 Programming

Most users will take advantage of ComputerBoards' power Universal Library (UL) software to handle the bulk of the programming task. If your are using UL, please refer to the UL manual and example programs to learn how to write your program. The following section is provided for those who wish to program at the register level. Though the MetraBus is very easy to program, this should usually only be attempted by experienced programmers.

MetraBus is programmable from any PC-usable language having INPUT and OUTPUT commands capable of manipulating the I/O bus. Following is a brief example showing how this would be done in BASIC.

The following discussion will use the variables DATAIO, ADRPTR, and MRESET in order to help clarify MetraBus programming technique. These variables, generally set at the beginning of your programs for ease of manipulation, are as follows:

```
DATAIO = 768          'Declare MetraBus data I/O path
ADRPTR = 769          'Declare address pointer location
MRESET = 770          'MetraBus reset location
OUT ADRPTR, 01        'Set the address pointer to address#1
OUT DATAIO, 45        'Write data 45 to address 1
```

Set the MetraBus address pointer by issuing a single command to the MetraBus controller board. Once set, the address pointer is latched and need not be reset until a different address is required.

Writing to and reading data from a MetraBus I/O board is transparent once the address pointer is set. Issuing an OUT command will write data to the targeted I/O board. Likewise, issuing an INP command will retrieve data from the I/O board via the data I/O path.

```
OUT ADRPTR, 01          'set address to 1
OUT DATAIO, 45          'write data 45 to address 1
VAL=INP(DATAIO)         'read back data from 1
```

The MetraBus controller board and all attached MetraBus I/O boards may be reset by writing to the reset address. Here is an example in BASIC:

```
40 OUT MRESET, 00       'clear the MetraBus
```

1.4 Programming I/O Boards

MetraBus boards fall into three major categories:

- Digital in and out
- Analog in and out
- Counter/Timer

MetraBus digital I/O boards are programmed with byte-wide (8 bits) read and write commands. Driving a single digital line high or reading the status of a single line requires one bit. Therefore, eight lines (bits) are controlled

when writing or reading the digital I/O boards. Data to a MetraBus digital output board are latched and can be read back from the board. Data read-back is usable when manipulating the I/O lines, making digital programming easy.

The 12-bit analog output boards are controlled by two 8-byte ports, one byte per channel. The analog equivalent of the 8-bit data is output by the DAC on the MetraBus analog output board.

Analog input for the MetraBus is full-featured, allowing user control of application-specific parameters. Prior to reading A/D data from the MetraBus MAI-16, set the range, channel, and type (12-bit or 8-bit). An A/D conversion is triggered by software only.

1.5 Packaging and Interconnection

All MetraBus I/O boards are 19" rack-mountable using one of the ENC 19-series enclosures, a standard NEMA cabinet, or any DIN Tray CIE-Chassis-06. A 50-way, 0.05-inch-spacing ribbon cable connects the MetraBus controller/driver card to the I/O boards. Use the MetraBus cable at lengths up to 100 feet. Connectors are standard, 50-pin insulation-displacement types. Parallel architecture allows board placement at any point along the MetraBus cable.

2. -MDB64 SERIES DRIVER BOARDS

2.1 Introduction

The ISA, PCI, CPCI and PC104-MDB64 driver boards are the primary control center of the MetraBus system. The -MDB64 board controls all I/O operations between the computer and MetraBus I/O boards. The -MDB64 generates all timing and control signals and controls all system-level data and address transfers. A single -MDB64 can address up to 64 MetraBus I/O boards. See Figure 2-1 for a functional block diagram of the -MDB64 series driver board.

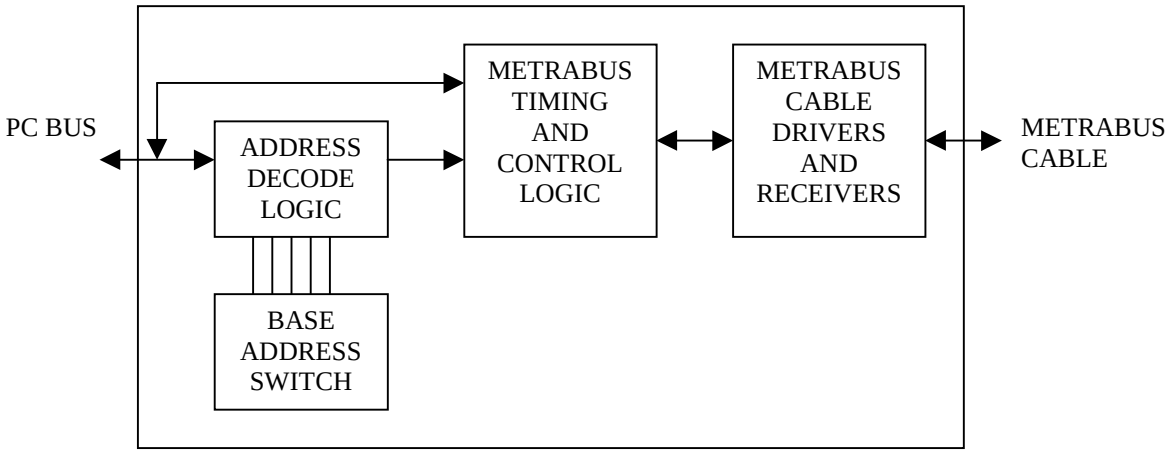


Figure 2-1. -MDB64 Driver Board Functional Block Diagram

The -MDB64 series boards may be installed in any compatible PC expansion slot. A 50-pin connector extends through the rear of the computer and connects to the MetraBus 50-pin ribbon cable. The MetraBus uses parallel bus architecture with the MetraBus cable carrying all data, address, and control signals. It also distributes power to the MetraBus I/O boards. Signal lines alternate with ground conductors in the 50-pin cable to reduce system noise. MetraBus cable lengths can be up to 100 feet from the host computer.

The MetraBus industrial data acquisition and control interface yields higher speed, greater accuracy, and total automatic operation for your applications.

2.2 -MDB64 Installation

2.2.1 Installation using the InstaCal™ Software Utility

*Insta*Cal is the installation, calibration, and test software that is supplied with all Measurement Computing Corp. I/O boards. *Insta*Cal will lead you through the complete setup of your system and will also allow you to test your installation. Information is provided below to help you configure your board if you choose not to use *Insta*Cal. For further information on *Insta*Cal, please refer to the separate S*oftware Installation Manual* you received with your order.

To use *Insta*Cal for MetraBus installation, please install the MDB-series driver board first using the “Install Board” menu. Once the -MDB64 board is installed in *Insta*Cal, MetraBus I/O boards may be installed by going to the “Install Board” menu, and selecting the “Add MetraBus Board” menu item.

2.2.2 Setting the Base Address Switch (ISA- and PC104-MDB64 only)

The following section will guide you through the setup of our -MDB64 series board if you choose not to take advantage of the *Insta*Cal utility's setup guidance. The -MDB64 uses four consecutive PC I/O address locations. These are referred to as the BASE ADDRESS, BASE ADDRESS +1, +2 and +3. The BASE ADDRESS of the ISA- and PC104-MDB64 boards is set via dip switch.. The base address switch (Figure 2-2) is preset at the factory to 768 decimal (300 hex). Setting the dip switch is described below as well as in the *Insta*Cal software utility you received with your board. (The PCI- and CPCI-MDB64 are fully plug and play with no on-board switches.)

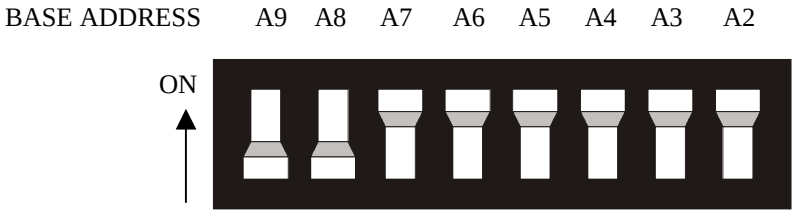


Figure 2-2. Default Base Address Switch Settings
(DOWN Selects Address; 768 decimal, 300h)

ADDRESS SWITCH	ADDRESS (DECIMAL)	ADDRESS (HEX)
A9	512	200
A8	256	100
A7	128	80
A6	64	40
A5	32	20
A4	16	10
A3	8	8
A2	4	4

NOTE: Figure 2-2. switch settings indicate a value of 512 + 256 = 768 (decimal) or 200 + 100 = 300 (hex). If I/O address 768 (300 hex) is occupied by another device, reset the base address switch to a different address. Refer to your PC manual for available addresses in the I/O space. After selecting an address, change the base address switch to match. DOWN is the OFF direction of the switches. Use the *down direction* to select address values.

2.3 MetraBus Power

2.3.1 "5V Power" Jumper

The -MDB64 provides the +5 VDC power supply voltage to the MetraBus I/O boards through the 50-pin ribbon cable. The 50-pin ribbon cable has a current rating of 1 Amp per line (at 25°C).

For applications requiring power beyond what the -MDB64 +5VDC fused circuit is capable of providing (1 Amp max.), an external power supply such as the MBUS-PWR should be used. If an external power supply is used, place the -MDB64 "5V POWER" jumper in the EXT position (2-3 in Figure 2-3). This isolates the PC's +5VDC power supply from the external power supply.

CAUTION: Failure to place the "5V POWER" jumper in the EXT position, when using an external power supply (such as MBUS-PWR), may cause fuse F1 to blow and could damage the MetraBus system and the host computer.

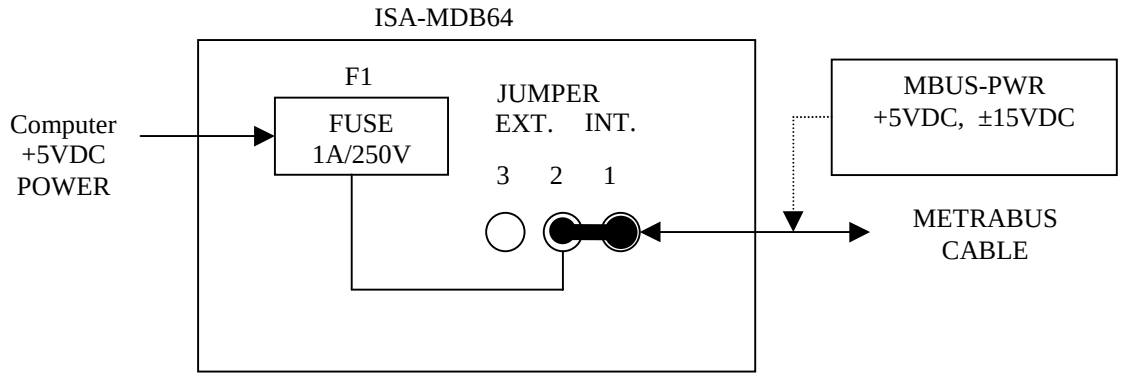


FIGURE 2-3. +5VDC Internal/External Power Jumper

Table 2-1. Power Jumper Use

5V POWER JUMPER POSITION	JUMPER LABEL	FUNCTION
1-2	INT	-MDB64 passes computer +5VDC to the MetraBus I/O boards.
2-3	EXT	-MDB64 uses an external power supply or MBUS-PWR to supply +5VDC and/or +/-15VDC to I/O boards.

2.3.2 Fuse (Fl)

The PC can supply +5 VDC to the MetraBus I/O boards via the -MDB64 and the MetraBus 50-pin ribbon cable. Fuse (F1) on the MBD64 limits the current to the I/O boards to 1 Amp maximum. For MetraBus systems using I/O boards requiring more than 1 Amp, or those using ±15 VDC, an additional power supply such as the MBUS-PWR is required.

NOTE: If the MetraBus System receives power from the PC, install fuse F1 (Littlefuse #312001, 3AG 1A fast blow) in the board and place the "5V POWER" jumper in the "INT" position (1-2).

2.3.3 Using an Auxiliary Power Supply

As previously described, the -MDB64 is capable of providing 1 Amp of +5VDC power from the PC to the MetraBus I/O board(s) via the MetraBus cable. For applications requiring more than 1 Amp of +5VDC current or a combination of +5VDC and ±15V supplies, an external power supply such as the MBUS-PWR is required.

2.3.4 External Power Supply using the 50-pin Ribbon Cable

If using the MBUS-PWR board or equivalent external power supply with the MetraBus 50-pin ribbon cable, consider the ribbon cable's power handling capability (1 Amp per line) and other potential loading issues such as IR drops and elevated ambient temperature. The total power output capability when using an external power supply (or MBUS-PWR) and a 50-pin ribbon cable would be:

- +5VDC: 10 Amps max.
- +15VDC: 1 Amp max.
- −15VDC: 1 Amp max.

NOTE: These power levels are determined by the 50-pin ribbon cable's ten +5VDC (1A max., per line limitation), along with the single ±15V power lines (1A max. per line).

2.3.5 External Power Supply Using the C-POWER-X series Power Cable

For applications that would exceed the 1 Amp/pin power limitation either of the +5VDC and ±15V supplies, Measurement Computing Corp. provides its MetraBus I/O boards with on-board power connectors P30 and P31. These power connectors can be used with a MetraBus power cable (C-POWER-X), in applications requiring power levels beyond the 50-pin ribbon cable capability. However, still consider the power cable's power handling capability, along with any potential loading issues (IR drops, ambient temperature, etc.,). The total power output capability when using an external power supply (or MBUS-PWR) and a MetraBus power cable is:

- +5VDC: 10 Amps max.
- +15VDC: 4 Amps max.
- −15VDC: 1 Amp max.

NOTE: These power levels coincide with the MBUS-PWR's maximum output power.

2.4 Introduction to Register Level Programming for the -MDB64

Most users will take advantage of ComputerBoards' power Universal Library (UL) software to handle the bulk of the programming task. If your are using UL, please refer to the UL manual and example programs to learn how to write your program. The following section is provided for those who wish to program at the register level. Though the MetraBus is very easy to program, this should usually only be attempted by experienced programmers

As previously mentioned, the PC has I/O address locations for various peripherals. The board's Base Address is located within this I/O space. The three default -MDB64 addresses and their functions are as follows:

Table 2-2. Board I/O Map

LOCATION	I/O ADDRESS (Hex)	I/O ADDRESS (Decimal)	FUNCTION
Base Address + 0	300	768	Data I/O path (DATAIO)
Base Address + 1	301	769	Address pointer (ADRPTR)
Base Address + 2	302	770	Software Reset (MRESET)

For the sake of clarity, all references to specific address locations use the variable names DATAIO, ADRPTR, and MRESET as specified in Table 2-2. Normally, variable assignments are made at the start of your program as in the following example:

```
10 DATAIO = 768        'Declares data I/O location
20 ADRPTR = 769        'Declares address pointer location
30 MRESET = 770        'Declares software RESET location
```

The following sections describe address location functions in order of usual programming use. All references to the above locations assume an -MDB64 base address of 768 decimal (300 hex).

2.4.1 Address Pointer (ADRPTR)

An address pointer selects (or points to) the specific register on a the MetraBus I/O board to be accessed. Each MetraBus I/O Board has a unique, non-overlapping board address to identify it. Writing the board address to ADRPTR sets the current MetraBus address and targets a specific register on a particular I/O board for a read or a write operation. After the address pointer is set to the proper address, data can be written to or read from that board. The examples shown are based on BASIC's INP and OUT I/O bus commands which read from and write to the I/O bus (respectively). Note that although the examples here are in BASIC, other languages supporting data I/O operations can be used. Refer to the manual for the language that you are using for the correct syntax.

The following example illustrates how to set the address pointer to a MetraBus I/O board (MEM-8) at address 12.

```
ADRPTR = 769          'Declare address pointer location
DATAIO = 768          'Declare data I/O location
MRESET = 770          'Declare MetraBus RESET location
MEM8 = 12             'Declare MEM-8 board address
OUT ADRPTR, MEM8      'Point to MEM-8 at address 12
```

After the MetraBus address pointer is set, it does not change until another OUT command changes it. Setting the address pointer is a fast operation on the personal computer bus, taking less than 10 µs.

Since the address pointer points to a MetraBus I/O board address and since it is latched on the -MDB64, it can be read back using the an I/O input command, as follows:

```
ADDRESS = INP (ADRPTR)
```

The BASIC variable ADDRESS contains the current MetraBus I/O address. If the above INP command were issued immediately after the previous OUT command given above, the ADDRESS variable would contain a value of 12. Reading the address pointer returns six bits of address information and two bits of status information (R/W and BUSY), as shown below:

Address Byte

WRITE = BASE+1

BIT	**D7**	**D6**	**D5**	**D4**	**D3**	**D2**	**D1**	**D0**
	BUSY	R/W	A5	A4	A3	A2	A1	A0

READ = BASE+1

BIT	**D7**	**D6**	**D5**	**D4**	**D3**	**D2**	**D1**	**D0**
	BUSY	R/W	A5	A4	A3	A2	A1	A0

NOTE: The -MDB64 controller board inverts the polarity of the bus control signals.

Normally, the BUSY and R/W status bits are low (non-zero). In this case, the data returned is identical to the contents of the address pointer.

2.4.2 The Data I/0 Register (DATAIO)

After the address pointer has been set, data may be written to / read from a MetraBus I/O board. All data transfer takes place through this register. Details regarding the specific register functions for each of the MetraBus I/O boards are contained in the following sections that deal with the specific I/O boards.

2.4.3 The Software RESET (MRESET)

A software reset causes all MetraBus I/O boards connected to the MetraBus cable to be reset to a known state. See the description of the specific I/O board for more details. The following example illustrates how to use the software RESET feature for all MetraBus I/O boards.

```
10  OUT MRESET, 00
20  START = TIMER
100 IF (TIMER - START)< .02 THEN 100
```

The BASIC Timer command is used to insure a wait of 20 ms for the reset pulse to settle.

2.4.4 Notes on the Use of Compiled or Assembled Languages

Execution speeds with compiled and assembled languages may call for precautions. MetraBus response times may be as long as 10 uS. After any I/O read or write, we recommend you check the status bits (R/W and Busy) prior to attempting any subsequent read or write to assure the bus has fully settled.

2.5 -MDB64 Specifications

POWER CONSUMPTION

+5V (no power supplied to MetraBus devices)	200mA typical, 300mA max.
+5V (maximum power supplied to MetraBus devices)	1.2A typical, 1.3A max.

METRABUS INTERFACE

Number of data bits	8 (I/O type)
Number of address bits	6 (I/O type, capable of addressing up to 64 devices)
Digital Input / Output	74LS540
Output High	2.4 volts min @ -15mA
Output Low	0.5 volts max. @ 24mA
Input High	2.0 volts min
Input Low	0.6 volts max.
Data Transfer Rate	80kbytes / sec max.
Control Timing	
R/W (bar)	6.4µs (±250ns) typical
WSTRB (bar)	3.2µs (±250ns) typical
CLEAR (bar)	3.2µs (±250ns) typical
Connector	
Type	50 pin header (male)
Dielectric Strength	1000Vrms
Current Rating	1A max. (per pin)

PERIPHERAL POWER (FOR METRABUS ACCESSORY BOARDS)

Voltage	+5VDC
Current	1A max. (P3 set to INT. mode)
Protection	1 Amp, 3AG fast blow fuse (INT. mode)
Miscellaneous	Locations provided for installation of EMI bypass capacitors. Read-back capability for data and address confirmation.

	5V power jumper (P3) provided to allow the use of an internal (PC) or external (MBUS-PWR) +5VDC power source. Hardware and software reset (sets address pointer to 0 and resets all devices on the MetraBus)

METRABUS RIBBON CABLE

Length	100ft. max.
Power	
+5V	10A (1A per pin) max.
+15V	1A max.
-15V	1A max.
Propagation Delay	2ns/ft, typical

ENVIRONMENTAL

Operating temperature range	0 to 70°C
Storage temperature range	-20 to 100°C
Humidity	0 to 90% non-condensing

3. MEM-32 ELECTROMECHANICAL RELAY BOARD

3.1 Introduction

MEM-32 is a 32-channel, SPST relay board for the MetraBus data acquisition and control system. The MEM-32 provides 32 electromechanical relays for computer controlled applications such as pump cycling, motor control, energy management, signal multiplexing, alarm activation, temperature cycling, etc.

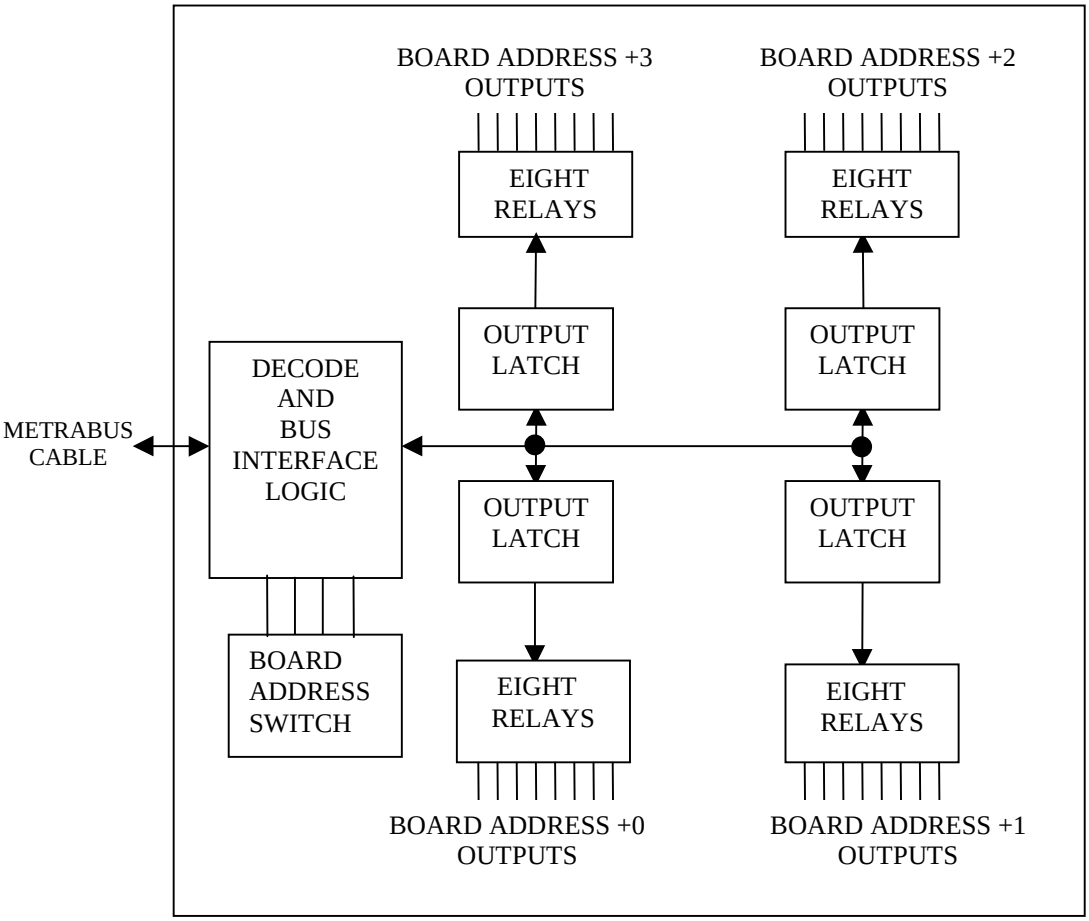


Figure 3-1. MEM-32 Functional Block Diagram

The MEM-32 boards use four consecutive addresses on the MetraBus. This allows control of up to 16 MEM-32 boards by a single MetraBus driver board, providing control to 512 independent relays. The MEM-32 board is divided into four, 8-bit ports. Writing to one of the ports loads data into the output latches and to the relays themselves. Reading data back from a port returns the data currently in the output latch without changing it. This feature allows the user to verify that data on the outputs was received correctly. All relays are set in their OFF-state at power-up and following a MetraBus software CLEAR.

The MEM-32 is connected to the MetraBus system via a 50-conductor ribbon cable that carries all address and data signals, and necessary power (+5VDC). Larger systems will benefit from the power distribution capabilities of the C-POWER-X cables and the on-board Molex power connectors.

Detachable screw terminals on the MEM-32 offer easy connection for field wiring, while accepting standard 12-22 AWG wire sizes. The MEM-32 can be mounted in a variety of enclosures including 19" rack-mount enclosures, NEMA enclosures, and DIN Rail mounting kits. Please consult a current Measurement Computing Corp. catalog (or web-site) for the latest MetraBus accessories and products.

3.2 Installation

3.2.1 *Insta*Cal

*Insta*Cal is the installation, calibration, and test software that is supplied with all Measurement Computing Corp. I/O boards. *Insta*Cal will guide you through setting the various switches on the MDB-64 boards as well as your I/O board. Information is provided below to help you configure your board if you choose not to use *Insta*Cal. For further information on *Insta*Cal, please refer to the separate S*oftware Installation Manual* you received with your order.

To use *Insta*Cal for MetraBus installation, please install the MDB-series driver board first using the "Install Board" menu. Once the -MDB64 board is installed in *Insta*Cal, MetraBus I/O boards may be installed by going to the "Install Board" menu, and selecting the "Add MetraBus Board" menu item.

3.2.2 Setting the MEM-32 Board Address

The following section is provided for those who choose not to follow the guidance of the *Insta*Cal utility software that you have received.

The I/O address for each MEM-32 connected to a single MetraBus cable must be unique and non-overlapping for the driver card to target that specific MEM-32. These addresses allow the boards in a MetraBus system to operate independently. Each MEM-32 uses four of the available 64 MetraBus addresses. These four addresses run consecutively starting from the MEM-32 board address. Figure 3-2 below shows a typical board address switch setting of 32 (decimal).

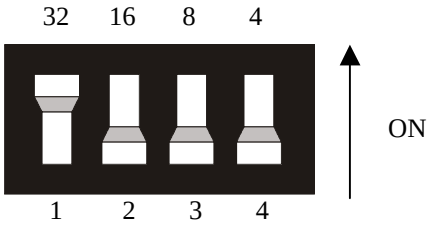


Figure 3-2. Board Address Switch

Set the board address using the following procedure:

1. The board-address DIP switch is on the far-left side of the board just above and to the left of the MetraBus connector. The numbers printed above the DIP switches indicate the values of the corresponding individual switches. The switches add a value in the ON position.

2. Select an unused board address and set the DIP switches accordingly. For example, in order to set a board address of 24, switches with corresponding values of 8 and 16 would be ON while the others remain OFF. Remember that each MEM-32 uses four consecutive addresses of the 64 addresses that are available and must be set to an unused, non-overlapping address in order to avoid bus conflicts.

3. After setting the board address, connect the MEM-32 to the -MDB64 controller card via the MetraBus cable. The MetraBus cable connector is keyed for your protection. Check the key-ways for correct alignment prior to plugging in the MetraBus cable. Remove power from the MetraBus cable before connecting any I/O boards.

4. If you have only one MEM-32 or if your MEM-32 is the last board in your system, install the resistor-terminating networks provided with your driver card in the sockets marked RN1 and RN2. These resistor networks minimize signal reflections caused by long cable lengths. They are optional, however, and are not needed for cables of 50 feet or less.

3.2.3 Typical Output Connections

The MEM-32 was designed to interface with a variety of devices, Figure 3-3. shows several output connection schemes.

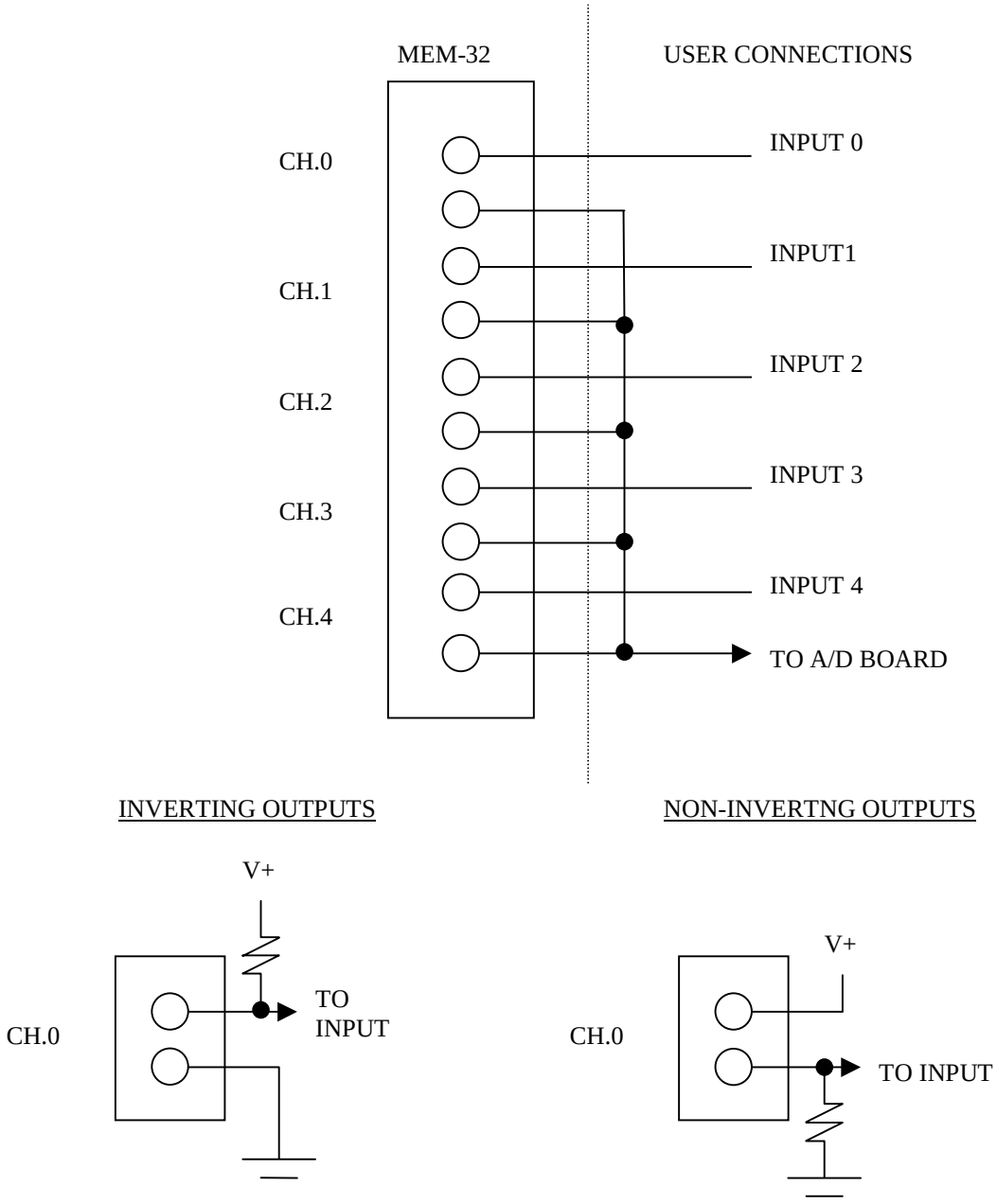


FIGURE 3-3. Typical MEM-32 Output Connections

3.3 Programming the MEM-32

The MetraBus is fully supported by Measurement Computing Corp. powerful Universal Library (UL) software driver. We highly recommend that you take advantage of the power of UL to simplify your programming task. For details on using the Universal Library please refer to the UL manual and the software examples provided.

The following is provided for those wishing to program their system based on register-level programming. Though the MetraBus has a fairly simple architecture, register-level programming should only be attempted by experienced programmers.

3.3.1 MEM-32 Register Map

The MEM-32 uses 4 consecutive registers within the MetraBus address space. We will refer to these as the Board Address, Board Address +1, Board Address + 2 and Board Address +3.

Each MEM-32 address corresponds to a bank of eight relays. These are labeled on the board as Board Address +0, +1, +2 and +3. To program relays on the MEM-32 simply select the MetraBus address of the bank of relays you would like to set (via -MDB64 Base Address + 1), and write the desired relay control word to the MEM-32 (via -MDB64 Base Address + 0). Each bit in the 8-bit data word controls a separate relay (labeled 0 through 7 corresponding to bits 0-7).

The following program assumes the -MDB64 board resides at Base Address 768, and the MEM32 board resides at MetraBus Address 4. Though written in BASIC, this program can easily be generalized to any other language.

```
DATAIO = 768                'Declare the Data I/O location (-MDB64 Base +0)
ADRPTR = 769                'Declare the Address Pointer location (-MDB64 Base +1)
MEM32 = 4                   'Declare the MEM-32 MetraBus Base Address

OUT ADRPTR, MEM32           'Point to relay bank 0 of the MEM-32
OUT DATAIO, 63              'Turn on relays 0-5, turn off relays 6 & 7
                            '(63 decimal = 0011  l l l l binary)

OUT ADRPTR, MEM32 + 3       'Point to relay bank 3 of the MEM-32
OUT DATAIO, 128             'Turn on relay 7, turn off relays 0 through 6)
                            '(128 decimal = 1 0 0 0   0 0 0 0 binary)
```

3.4 Using an Auxiliary Power Supply

Whether an auxiliary power supply is necessary or not depends upon how the MEM-32 is used (or how many are used) in your application. The user needs to determine the total amount of +5VDC current by determining the number of relays to be used (turned on at any time) plus the board's quiescent current. Calculate the current requirements from specifications in Section 3.5. As a general rule of thumb, an external power supply should be used when a MEM-32 is connected to the bus since the maximum possible current requirement for the MEM-32 exceeds the maximum allowable current supplied by the -MDB64.

CAUTION

As described in the -MDB64 user manual, the MetraBus 50-pin ribbon cable is only capable of providing 1 Amp of continuous +5VDC current from the PC to the MetraBus I/O board(s). If more than 1 Amp of +5VDC current or a combination of +5VDC and ±15VDC supplies is needed, a high quality external power supply such as the MBUS-PWR is required.

NOTE: If an external power supply is used in conjunction with the -MDB64 MetraBus controller card, place the -MDB64 "5V POWER" jumper in the EXT position.

3.4.1 External Power Supply using a 50-pin Ribbon Cable

When using the MBUS-PWR board or an equivalent external power supply in conjunction with the MetraBus 50-pin ribbon cable, **you must consider the ribbon cable's power handling capability** along with any potential loading issues (IR drops, ambient temperature, etc.,). The total power output capability for this type of setup is:

- +5VDC: 10 Amps max.
- +15VDC: 1 Amp max.
- −15VDC: 1 Amp max.

NOTE: These power levels coincide with the ribbon cable's ten +5VDC (1A max. per line) power lines, along with the single ±15VDC power lines (1 A max. per line).

3.4.2 External Power Supply using a C-Power-X series MetraBus Power Cable

For applications that would exceed the 1A/pin power limitation from either of the +5VDC and ±15VDC supplies, Measurement Computing Corp. has provided each of its MetraBus I/O boards with on-board power connectors P30 and P31. These power connectors are designed to be used with a MetraBus Power Cable (C-POWER-X), in applications requiring power levels beyond what the 50-pin ribbon cable is capable of handling. The user must still consider the power cable's power handling capability, along with any potential loading issues (IR drops, ambient temperature, etc.,). The total power output capability for this type of set-up would be as follows:

- +5VDC: 10 Amps max.
- +15VDC: 4 Amps max.
- −15VDC: 1 Amp max.

NOTE: These power levels coincide with the MBUS-PWR's maximum output power capability.

3.5 MEM-32 Specifications

POWER CONSUMPTION

+5V (relays off, all 4 banks)	350mA typical, 425mA max.
+5V (relays on, all 4 banks)	2.10A typical, 2.45A max.

RELAY SPECIFICATIONS

Number of output channels	32 (4 banks of 8 relays)
Contact Configuration	1 form C, SPST per channel
Contact Rating (resistive load)	7A/30VDC or 10A/125V AC
Contact Resistance	70 milliohms typ.
Isolation:	
Between open contacts	750VAC, 50/60HZ, 1 min.
Between coil and contacts	1500VAC, 50/60HZ, 1 min.
Operate Time	10 milliseconds max.
Release Time	5 milliseconds max.
Vibration	10 to 55 Hz (Dual amplitude 1.5mm)
Shock	10G (11 milliseconds)
Insulation Resistance	100M ohms min. (500V @ 1 minute)
Life Expectancy	10 ^7 mechanical operations, min. at rated load
Miscellaneous	Annunciator LED's provided for channel selection indication.

METRABUS INTERFACE

Digital type (banks 1-4)	74LS540
Address space requirement	4 consecutive address locations (within the 64 available address locations)
Miscellaneous	Locations provided for installation of termination resistors. Data read-back capability for data and address confirmation.

CONNECTORS

MetraBus Connector type	50 pin header (male)
Dielectric Strength	>1000Vrms
Current Rating	1A max. (per pin)
Screw Terminal Connector type	Detachable screw terminal (8 per block)
Current Rating	15A max.
Voltage Rating	300V max.
Wire sizes	12-22AWG
External Power Connector type	4 pin Molex (2 in parallel)
Current Rating	10A max.
Voltage Rating	250V AC/DC, max.

METRABUS RIBBON CABLE

Length	100ft. max.
Power	
+5V	10A (1A per pin) max.
+15V	1A max.
-15V	1A max.
Propagation Delay	2ns/ft, typical

ENVIRONMENTAL

Operating temperature range	0 to 70°C
Storage temperature range	-20 to 100°C
Humidity	0 to 90% non-condensing

PHYSICAL

Size:	16 x 4.74 inches (40.63 x 12.06 cm)
MetraBus Cable type:	HITACHI 23100 series (50-cond. flat ribbon)
Connector Type:	3M 3433

4. MEM-8 ELECTROMECHANICAL RELAY BOARD

4.1 Introduction

The MEM-8 is an 8-channel, double-pole, double-throw (DPDT) electromechanical relay board used with the MetraBus industrial data acquisition and control system. The MEM-8 uses eight pairs of SPDT electromechanical relays operating in parallel to provide a total of eight DPDT channels. Typical MEM-8 applications include pump control, motor control, energy management, signal multiplexing, alarm activation, temperature cycling, etc.

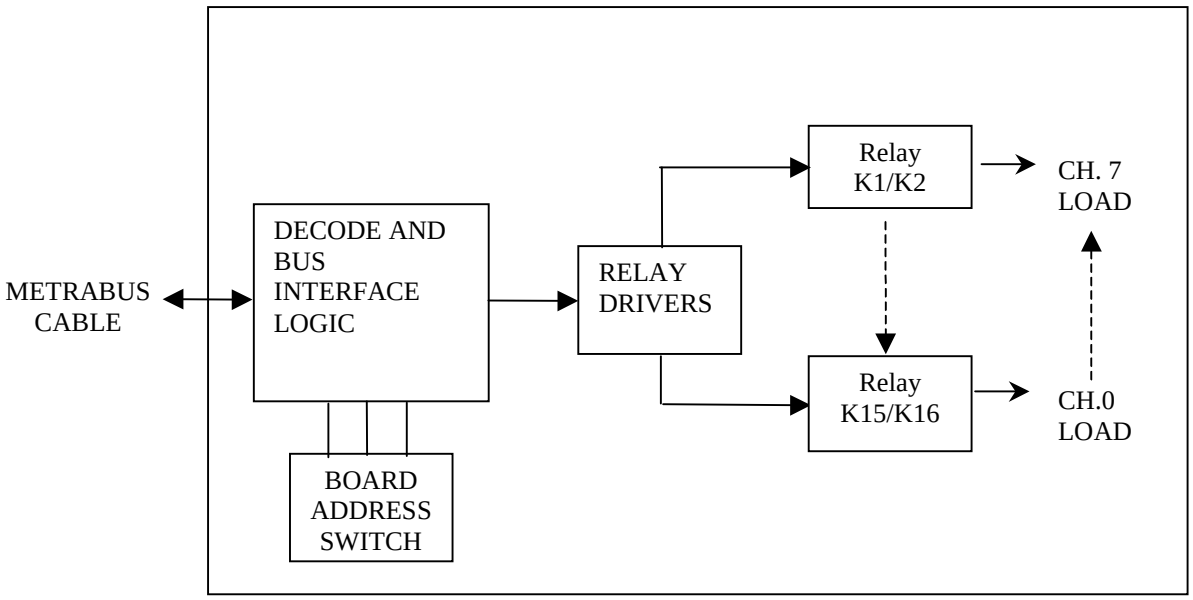


Figure 4-1. MEM-8 Block Diagram

The MEM-8 board uses a single address on the MetraBus. This allows control of up to 64 MEM-8 boards (512 relay pairs) per computer expansion slot. The MEM-8, like other MetraBus output boards, has a data read-back feature allowing the user to verify data integrity. Each relay pair on the MEM-8 also has a visual enunciator LED associated with it permitting easy verification of the relay's state. On power-up or after a MetraBus software CLEAR, all relays return to their INACTIVE (off) state.

The MEM-8 is connected to the MetraBus system via a 50-conductor ribbon cable that carries all address and data signals as well as distributing all power.

Detachable screw terminals on the MEM-8 offer easy connection for field wiring, while accepting standard 12 to 22 AWG wire sizes. The MEM-8 can be mounted in a wide array of enclosures including 19-in. rack-mount enclosures, NEMA enclosures, and DIN rail mounting kits.

Please consult a Measurement Computing Corp. catalog (or our web site) for the latest MetraBus accessories and products.

4.2 Installation

4.2.1 *Insta*Cal

*Insta*Cal is the installation, calibration, and test software that is supplied with all Measurement Computing Corp. I/O boards. *Insta*Cal will guide you through setting the various switches on the MDB-64 boards as well as your I/O board. Information is provided below to help you configure your board if you choose not to use *Insta*Cal. For further information on *Insta*Cal, please refer to the separate S*oftware Installation Manual* you received with your order.

To use *Insta*Cal for MetraBus installation, please install the MDB-series driver board first using the "Install Board" menu. Once the -MDB64 board is installed in *Insta*Cal, MetraBus I/O boards may be installed by going to the "Install Board" menu, and selecting the "Add MetraBus Board" menu item.

4.2.2 Setting the MEM-8 Board Address

The following section is provided for those who choose not to follow the guidance of the *Insta*Cal utility software that you have received.

The I/O address for each MEM-8 connected to a single MetraBus cable must be unique and non-overlapping for the driver card to target that specific MEM-8. These addresses allow the boards in a MetraBus system to operate independently. Each MEM-8 uses one of the available 64 MetraBus addresses. Figure 4-2 below shows a typical board address switch setting of 16 (decimal).

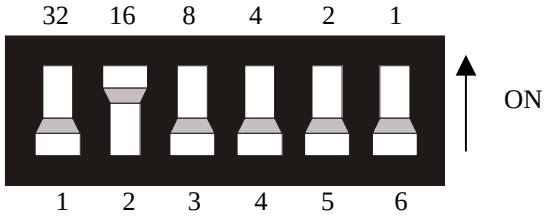


Figure 4-2. Board Address Switch

Set the board address using the following procedure:

1. The board-address DIP switch is on the far-left side of the board just above and to the left of the MetraBus connector. The numbers printed above the DIP switches indicate the values of the corresponding individual switches. The switches add a value in the ON position.

2. Select an unused board address and set the DIP switches accordingly. For example, in order to set a board address of 24, switches with corresponding values of 8 and 16 would be ON while the others remain OFF. Remember that each MEM-8 uses four consecutive addresses of the 64 addresses that are available and must be set to an unused, non-overlapping address in order to avoid bus conflicts.

3. Select an unused board address and set the DIP switches accordingly. For example, in order to set a board address of 24, switches with corresponding values of 8 and 16 would be ON while the others remain OFF. Remember that each MEM-8 uses four consecutive addresses of the 64 addresses that are available and must be set to an unused, non-overlapping address in order to avoid bus conflicts.

4. After setting the board address, connect the MEM-8 to the -MDB64 controller card via the MetraBus cable. The MetraBus cable connector is keyed for your protection. Check the key-ways for correct alignment prior to plugging in the MetraBus cable. Remove power from the MetraBus cable before connecting any I/O boards.

5. If you have only one MEM-8 or if your MEM-8 is the last board in your system, install the resistor-terminating networks provided with your driver card in the sockets marked RN1 and RN2. These resistor

networks minimize signal reflections caused by long cable lengths. They are optional, however, and are not needed for cables of 50 feet or less.

4.3 Programming the MEM-8

The MetraBus is fully supported by Measurement Computing Corp. powerful Universal Library (UL) software driver. We highly recommend that you take advantage of the power of UL to simplify your programming task. For details on utilizing the Universal Library please refer to the UL manual as well as the many software examples provided.

The following is provided for those wishing to program their system based on register level programming. Though the MetraBus is a fairly simple architecture, register level programming should only be attempted by experienced programmers.

4.3.1 MEM-8 Register Map

The MEM-8 uses one register within the MetraBus address space. Each MEM-8 board corresponds to a bank of eight relays. These are labeled on the board as CH0 through CH7.

To program relays on the MEM-8 simply select the MetraBus address of the board you would like to set (via -MDB64 Base Address + 1), and write the desired relay control word to the MEM-8 (via -MDB64 Base Address + 0). Each bit in the 8-bit data word controls a separate relay (labeled CH0 through CH7 corresponding to bits 0-7).

The following program assumes the -MDB64 board resides at Base Address 768, and the MEM8 board resides at MetraBus Address 4. Although written in BASIC, this program can easily be generalized to any other language.

```
DATAIO = 768              'Declare the Data I/O location (-MDB64 Base +0)
ADRPTR = 769              'Declare the Address Pointer location (-MDB64 Base +1)
MEM8 = 4                  'Declare the MEM-8 MetraBus Base Address

OUT ADRPTR, MEM8          'Point to the MEM-8
OUT DATAIO, 63            'Turn on relays 0-5, turn off relays 6 & 7
                          '(63 decimal = 0011  1 1 1 1 binary)

OUT DATAIO, 128           'Turn on relay 7, turn off relays 0 through 6)
                          '(128 decimal = 1 0 0 0   0 0 0 0 binary)
                          '(note that there is no need to rewrite the address
                          'on subsequent writes to the same address.
```

4.4 Using an Auxiliary Power Supply

Whether an auxiliary power supply is necessary or not depends upon how the MEM-8 is used (or how many are used) in your application.. The user will need to determine the total amount of +5VDC current by considering the amount of relays to be used (turned on at any time) plus the boards quiescent current. Calculate the current required from specifications in Section 3.3. As a general rule of thumb, an external power supply should be used when a MEM-8 is connected to the bus since the maximum possible current requirement for the MEM-8 exceeds the maximum allowable current supplied by the -MDB64.

CAUTION

As described in the -MDB64 user manual, the MetraBus 50-pin ribbon cable is only capable of providing 1 Amp of continuous +5VDC current from the PC to the MetraBus I/O board(s). For applications requiring more than 1 Amp of +5VDC current or a combination of +5VDC and ±15VDC supplies, a high quality external power supply such as the MBUS-PWR is required.

NOTE: If an external power supply is used with the -MDB64 MetraBus controller card, place the -MDB64 “5V POWER” jumper in the EXT position.

4.4.1 External Power Supply using a 50-pin Ribbon Cable

When using the MBUS-PWR board or an equivalent external power supply in conjunction with the MetraBus 50-pin ribbon cable, **you must consider the ribbon cable's power handling capability** along with any potential loading issues (IR drops, ambient temperature, etc.,). The total power output capability for this type of set-up is:

- +5VDC: 10 Amps max.
- +15VDC: 1 Amp max.
- −15VDC: 1 Amp max.

NOTE: These power levels coincide with the ribbon cable's ten +5VDC (1A max. per line) power lines, and the single ±15VDC power lines (1A max. per line).

4.4.2 External Power Supply using a MetraBus Power Cable

For applications that would exceed the 1A/pin power limitation from either of the +5VDC and ±15VDC supplies, Measurement Computing Corp. has provided each of its MetraBus I/O boards with on-board power connectors P30 and P31. These power connectors are used with a MetraBus Power Cable (C-POWER-X) in applications requiring power levels beyond what the 50-pin ribbon cable is capable of handling. The user must still consider the power cable's power handling capability, along with any potential loading issues (IR drops, ambient temperature, etc.,). The total power output capability for this type of set-up is:

- +5VDC: 10 Amps max.
- +15VDC: 4 Amps max.
- −15VDC: 1 Amp max.

NOTE: These power levels coincide with the MBUS-PWR's maximum output power capability.

4.5 MEM-8 Specifications

POWER CONSUMPTION

+5V (all relays off)	125mA typical, 150mA max.
+5V (all relays on)	1.1A typical, 1.3A max.

RELAY SPECIFICATIONS

Number of output channels	8 DPDT (8 pairs of SPDT relays)
Contact Configuration	2 form C, SPDT per channel
Contact Rating (resistive load)	7A/30VDC or 10A/125V AC
Contact Resistance	70 milliohms typ.
Isolation:	
Between open contacts	750VAC, 50/60HZ, 1 min.
Between coil and contacts	1500VAC, 50/60HZ, 1 min.
Operate Time	10 milliseconds max.
Release Time	5 milliseconds max.
Vibration	10 to 55 Hz (Dual amplitude 1.5mm)
Shock	10G (11 milliseconds)
Insulation Resistance	100M ohms min. (500V @ 1 minute)
Life Expectancy	10 ^7 mechanical operations, min. at rated load
Miscellaneous	Enunciator LED's provided for channel selection indication.

METRABUS INTERFACE

Device type	74LS540
Address space requirement	1 address location (within the 64 available address locations)
Miscellaneous	Locations provided for installation of termination resistors for MetraBus cable. Data read-back capability for data and address confirmation.

CONNECTORS

MetraBus Connector type	50 pin header (male)
Dielectric Strength	>1000Vrms
Current Rating	1A max. (per pin)
Screw Terminal Connector type	Detachable screw terminal (8 per block)
Current Rating	15A max.
Voltage Rating	300V max.
Wire sizes	12-22AWG
External Power Connector type	4 pin Molex (2 in parallel)
Current Rating	10A max.
Voltage Rating	250V AC/DC , max.

METRABUS RIBBON CABLE

Length	100ft. max.
Power	
+5V	10A (1A per pin) max.
+15V	1A max.
-15V	1A max.
Propagation Delay	2ns/ft, typical

ENVIRONMENTAL

Operating temperature range	0 to 70°C
Storage temperature range	-20 to 100°C
Humidity	0 to 90% non-condensing

PHYSICAL

Size:	16 x 4.8 inches (40.64 x 12.192 cm)
MetraBus Cable type:	HITACHI 23100 series (50-cond. flat ribbon)
Connector Type:	3M 3433

5. MII-32 ISOLATED DIGITAL INPUT BOARD

5.1 Introduction

The MII-32 is a 32-channel isolated digital input board whose channels are DTL/TTL, buffered CMOS, and zero to +5VDC compatible (Figure 5-1). Provisions are included for monitoring higher input voltages using customer-modifiable resistors. Using this board, the MetraBus system can read up to 512 digital input channels from a single computer expansion slot. Some common uses of the MII-32 include computer monitoring of relay contact status, limit switch status, automated data collection from BCD instrumentation, computerized test benches, etc.

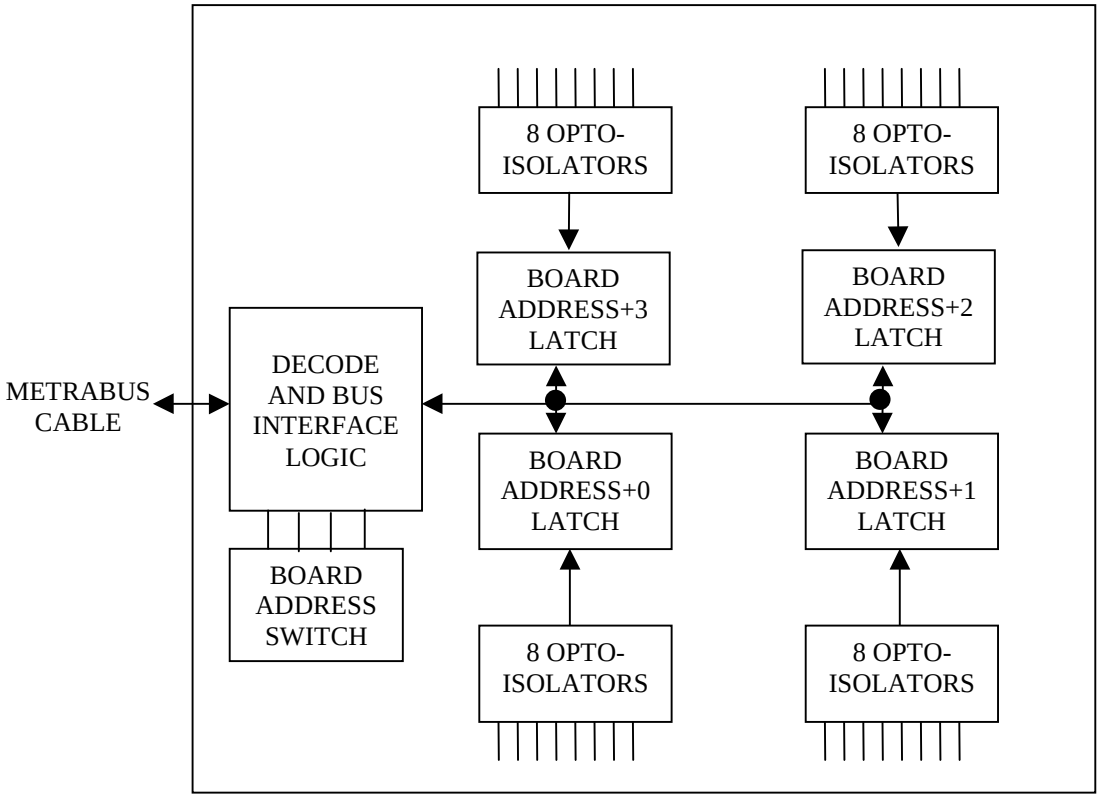


Figure 5-1. MII-32 Digital Input Board Block Diagram

The MII-32 connects directly to any of the MetraBus –MDB64 controller cards via the 50-conductor MetraBus ribbon cable. The cable carries all data, address, and status information as well as power distribution. A total of 20 ground lines are interleaved among the data and address lines to ensure noise immunity. The MetraBus system was designed to provide MetraBus cable lengths of up to 100 feet allowing the MII-32 to be positioned for easy signal connection.

The MII-32 is connected to the MetraBus system via a 50-conductor ribbon cable that carries all address, and data signals as well as distributing all power. All read-back registers are reset to zero at power-up or a software CLEAR.

Detachable screw terminals on the MII-32 offer easy connection for field wiring, while accepting standard 12 to 22 AWG wire sizes. The MII-32 can be mounted in a wide array of Measurement Computing Corp. enclosures including 19” rack mount enclosures, NEMA enclosures, and DIN Rail mounting kits. Users should consult a current Measurement Computing Corp. catalog (or web-site) for the latest MetraBus accessories and product offerings.

5.2 Installation

5.2.1 *Insta*Cal

*Insta*Cal is the installation, calibration, and test software that is supplied with all Measurement Computing Corp. I/O boards. *Insta*Cal will guide you through setting the various switches on the MDB-64 boards as well as your I/O board. Information is provided below to help you configure your board if you choose not to use *Insta*Cal. For further information on *Insta*Cal, please refer to the separate S*oftware Installation Manual* you received with your order.

To use *Insta*Cal for MetraBus installation, please install the MDB-series driver board first using the "Install Board" menu. Once the -MDB64 board is installed in *Insta*Cal, MetraBus I/O boards may be installed by going to the "Install Board" menu, and selecting the "Add MetraBus Board" menu item.

5.2.2 Setting the MII-32 Board Address

The following section is provided for those who choose not to follow the guidance of the *Insta*Cal utility software that you have received.

The I/O address for each MII-32 connected to a single MetraBus cable must be unique and non-overlapping for the driver card to target that specific MII-32. These addresses allow the boards in a MetraBus system to operate independently. Each MII-32 uses four of the available 64 MetraBus addresses. These four addresses run consecutively starting from the MII-32 board address. Setting the board address is described below. Figure 5-2. illustrates a typical board address switch setting of 32 (decimal).

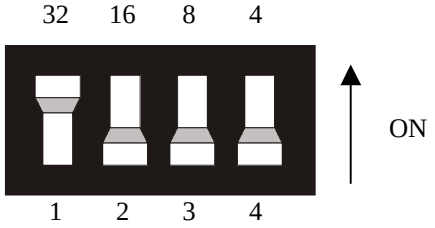


Figure 5-2. Setting the Board Address

The board address is set using the following procedure:

1. The board address DIP switches are located on the far-left side of the board, just above and to the left of the MetraBus interface connector. The numbers above the DIP switches indicate the value of the switches immediately below. The numbers have value only in the ON position.

2. Select an unused board address and set the switches accordingly. For example, to set a board address of 24, set switches with values of 8 and 16 ON. Remember that each MII-32 uses four of the 64 MetraBus I/O addresses and must be set to an unused, non-overlapping board address in order to avoid address conflicts.

3. After setting the board address, connect the MII-32 to the MetraBus cable. The MetraBus cable connector is keyed for your protection and to facilitate alignment (always remove power from the MetraBus cable prior to connecting any I/O boards).

4. If you have only one MII-32 or if your MII-32 is the last board in your system, install the resistor terminating networks provided with your controller driver card in the sockets marked RN1 and RN2. These resistor networks minimize signal reflection from long cable lengths. They are optional, however, and have little effect for cables of 50 feet or less.

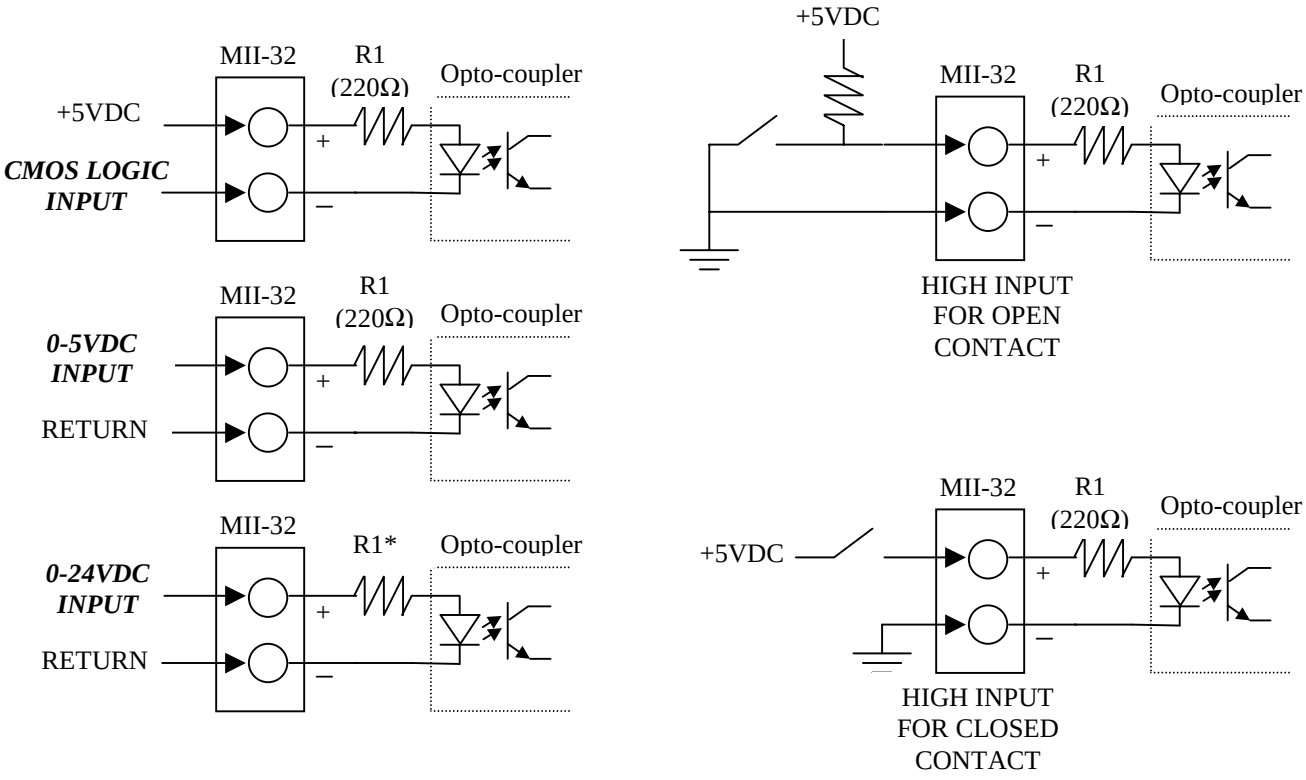
5.3 Configuring the MII-32 for Non-Standard Inputs

The MII-32 can accept input signals greater than +5VDC with a simple resistor change on each input channel. The current-limiting resistors, labeled R1-R32 on the MII-32 board, are normally 220 ohm (1/4W). The user can replace these resistors (R1-32) with components of higher value or increased power handling capability in order to accommodate the power dissipated from larger input signals. See the wiring diagrams in the "Typical Input Connection" section for actual signal hook-up.

5.4 Typical Input Connections

The MII-32 is compatible with digital inputs from a variety of input sources. To ensure proper operation of the MII-32, when wiring your input signals, follow the guidelines outlined below and refer to Figure 5-3.

TTL and CMOS outputs can sink more current than they can source. Therefore, when monitoring these outputs, supply +5VDC to the high side of the channel input and tie the output from the TTL or CMOS signal to the low side. A "low" signal from the TTL/CMOS gate then causes the MII-32 to sense a "high" thereby inverting the data. This inversion is software-correctable.



***NOTE: Resistor should be replaced with component having a value and power rating compatible with 0-24VDC logic.**

Figure 5-3. Typical Input Connections

5.5 Programming the MII-32

The MetraBus is fully supported by Measurement Computing Corp. powerful Universal Library (UL) software driver. We highly recommend that you take advantage of the power of UL to simplify your programming task. For details on utilizing the Universal Library please refer to the UL manual as well as the many software examples provided.

The following is provided for those wishing to program their system based on register level programming. Though the MetraBus is a fairly simple architecture, this should only be attempted by experienced programmers.

5.5.1 MII-32 Register Map

The MII-32 uses 4 consecutive registers within the MetraBus address space. We will refer to these as the Board Address, Board Address +1, Board Address + 2 and Board Address +3.

Each MII-32 address corresponds to a bank of 8 digital inputs. These are labeled on the board as Board Address +0, +1, +2 and +3. To read inputs on the MII-32 simply select the MetraBus address of the bank of inputs you would like to read (via -MDB64 Base Address + 1), and read the input from the MII-32 (via -MDB64 Base Address + 0). Each bit in the 8-bit data word represents a separate digital input (labeled 0 through 7 corresponding to bits 0-7).

The following program assumes the -MDB64 board resides at Base Address 768, and the MII-32 board resides at MetraBus Address 4. Though written in BASIC, this program can easily be generalized to any other language.

```
DATAIO = 768                'Declare the Data I/O location (-MDB64 Base +0)
ADRPTR = 769                'Declare the Address Pointer location (-MDB64 Base +1)
MII32 = 4                   'Declare the MII-32 MetraBus Base Address

OUT ADRPTR, MII32           'Point to relay bank 0 of the MII-32
DAT = INP(DATAIO)           'Read the inputs (read in binary where each bit
                            ‘represents a particular digital input

OUT ADRPTR, MII32 + 3       ‘Point to relay bank 3 of the MII-32
DAT = INP(DATAIO)           'Read the inputs (read in binary where each bit
                            ‘represents a particular digital inputs
```

5.6 Using an Auxiliary Power Supply

Whether an auxiliary power supply is necessary or not depends upon how many boards are connected in your application and how much power is required by each. If you are using only MII-32 boards in your application, up to three boards may draw power from the -MDB64 directly and the auxiliary supply would not be needed.

CAUTION

As described in the -MDB64 user manual, the MetraBus 50-pin ribbon cable is only capable of providing 1 Amp of continuous +5VDC current from the PC to the MetraBus I/O board(s). For applications requiring more than 1 Amp of +5VDC current or a combination of +5VDC and ±15VDC supplies, a high quality external power supply such as the MBUS-PWR is required.

NOTE: If an external power supply is used in conjunction with the -MDB64 MetraBus controller card, the -MDB64 “5V POWER” jumper must be placed in the in the EXT position.

5.6.1 External Power Supply using a 50-pin Ribbon Cable

When using the MBUS-PWR board or an equivalent external power supply in conjunction with the MetraBus 50-pin ribbon cable, **the user must consider the ribbon cable's power handling capability** along with any potential loading issues (IR drops, ambient temperature, etc.,). The total power output capability for this type of set-up would be:

- +5VDC: 10 Amps max.
- +15VDC: 1 Amp max.
- –15VDC: 1 Amp max.

NOTE: These power levels coincide with the ribbon cable's ten +5VDC (1A max. per line) power lines, along with the single ±15VDC power lines (1A max. per line).

5.6.2 External Power Supply using a MetraBus Power Cable

For applications that would exceed the 1A/pin power limitation from either of the +5VDC and ±15VDC supplies, Measurement Computing Corp. has provided each of its MetraBus I/O boards with on-board power connectors P30 and P31. These power connectors are designed to be used with a MetraBus Power Cable (C-POWER-X), in applications requiring power levels beyond what the 50-pin ribbon cable is capable of handling. The user must still consider the power cable's power handling capability, along with any potential loading issues (IR drops, ambient temperature, etc.,). The total power output capability for this type of set-up would be as follows:

- +5VDC: 10 Amps max.
- +15VDC: 4 Amps max.
- –15VDC: 1 Amp max.

NOTE: These power levels coincide with the MBUS-PWR's maximum output power capability.

5.7 MII-32 Specifications

POWER CONSUMPTION

+5V	220mA typ., 300mA max.

DIGITAL INPUT

Digital Type (banks 1-4)	ILQ2X009 Quad Optocoupler
Configuration	4 banks of 8 digital inputs
Number of input channels	32
Input High Threshold Voltage	2.2VDC min.
Input Low Threshold Voltage	1.3VDC max.
Input High Threshold Current	3.2mA, min.
Input Low Threshold Current	0.25mA max.
Input Voltage	11VDC max. (with standard 220ohm resistors)
Reverse Voltage	6V max.
Forward Current	60mA max.
Forward Voltage	1.25V typ.
Surge Current	2.5A max.
Isolation Resistance	10^12 ohms (Vio = 500V, Ta = 25°C)
Isolation Voltage	500VDC typ.

METRABUS INTERFACE

Address space requirements	4 consecutive address locations (within the 64 available address locations)
Output Device type:	74LS373
Miscellaneous	Locations provided for installation of termination resistors.

CONNECTORS

MetraBus Connector type	50 pin header (male)
Dielectric Strength	>1000Vrms
Current Rating	1A max. (per pin)
Digital Input Connector type	Detachable screw terminal
Current Rating	15A max.
Voltage Rating	300V max.
Wire sizes	12-22AWG
External Power Connector type	4 pin Molex (2 in parallel)
Current Rating	10A max.
Voltage Rating	250V AC/DC

METRABUS RIBBON CABLE

Length	100ft. max.
Power	
+5V10A (1A per pin) max.	
+15V	1A max.
-15V	1A max.
Propagation Delay	2ns/ft, typ.

ENVIRONMENTAL

Operating temperature range	0 to 70°C
Storage temperature range	-20 to 100°C
Humidity	0 to 90% non-condensing

PHYSICAL

Size:	16 x 4.8 inches (40.64 x 12.192 cm)
Cable type:	HITACHI 23100 series (50-cond. flat ribbon)
Connector Type:	3M 3433

6. MIO-32 ISOLATED DIGITAL OUTPUT BOARD

6.1 Introduction

The MI0-32 is a 32-channel digital output board for the MetraBus data acquisition and control system (Figure 6-1). The output channels are DTL/TTL, NMOS/CMOS, and zero to +5 VDC compatible. Outputs can be as high as +20 VDC. Some uses of the MIO-32 include computer control of relays, pumps, solenoids, feedback control, and programmable square wave generator.

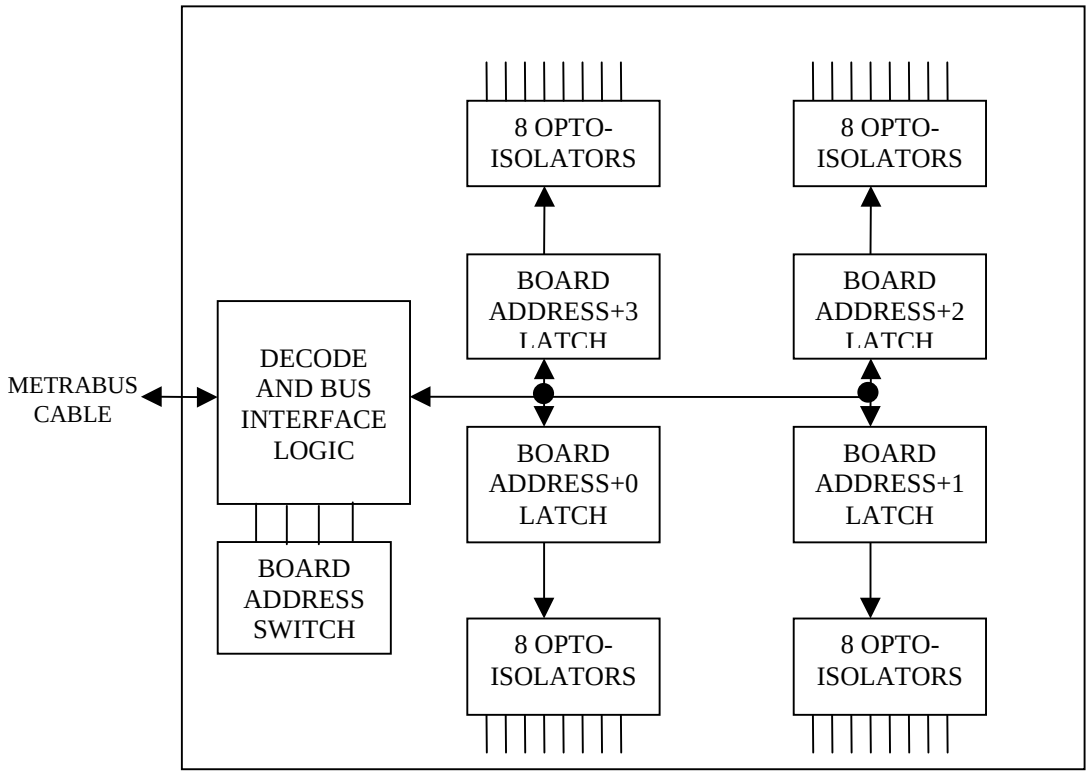


Figure 6-1. MI0-32 Block Diagram

The MIO-32 connects directly to any of the MetraBus controller cards via a 50-conductor ribbon cable. The MetraBus cable connects the MIO-32 to the -MDB64 controller card and carries all data, address, status information, and power. The MetraBus system allows control of up to 512 digital output channels from a single computer expansion slot. Twenty ground lines are interleaved among the data and address lines to improve noise immunity. MetraBus cable lengths of up to 100 feet, allowing the MIO-32 to be positioned adjacent to its point of use for easy signal connection.

All output opto-isolators are set to zero (off state) at power-up or software CLEAR.

Detachable screw terminals on the MIO-32 offer easy connection for field wiring, accepting standard 12-22 AWG wire. The MIO-32 can be mounted in a variety of enclosures including 19" rack mount enclosures, NEMA enclosures, and DIN Rail mounting kits. Users should consult a current Measurement Computing Corp. catalog (or web-site) for the latest MetraBus accessories and product offerings.

6.2 Installation

6.2.1 *Insta*Cal

*Insta*Cal is the installation, calibration, and test software that is supplied with all Measurement Computing Corp. I/O boards. *Insta*Cal will guide you through setting the various switches on the MDB-64 boards as well as your I/O board. Information is provided below to help you configure your board if you choose not to use *Insta*Cal. For further information on *Insta*Cal, please refer to the separate S*oftware Installation Manual* you received with your order.

To use *Insta*Cal for MetraBus installation, please install the MDB-series driver board first using the "Install Board" menu. Once the -MDB64 board is installed in *Insta*Cal, MetraBus I/O boards may be installed by going to the "Install Board" menu, and selecting the "Add MetraBus Board" menu item.

6.2.2 Setting the MIO-32 Board Address

The following section is provided for those who chose not to follow the guidance of the *Insta*Cal utility software that you have received.

The I/O address for each MIO-32 connected to a single MetraBus cable must be unique and non-overlapping for the driver card to target that specific MIO-32. These addresses allow the boards in a MetraBus system to operate independently. Each MIO-32 uses four of the available 64 MetraBus addresses. These four addresses run consecutively starting from the MIO-32 board address. Setting the board address is outlined below, with Figure 6-2. describing a typical board address switch setting of 32 (decimal).

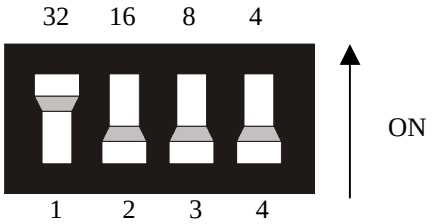


Figure 6-2. Board Address Switch

Set the board address using the following procedure:

1. The board-address DIP switch is on the far-left side of the board just above and to the left of the MetraBus connector. The numbers printed above the DIP switches indicate the values of the corresponding individual switches. The switches add a value in the ON position.

2. Select an unused board address and set the DIP switches accordingly. For example, in order to set a board address of 24, switches with corresponding values of 8 and 16 would be ON while the others remain OFF. Remember that each MIO-32 uses four consecutive addresses of the 64 addresses that are available and must be set to an unused, non-overlapping address in order to avoid bus conflicts.

3. After setting the board address, connect the MIO-32 to the -MDB64 controller card via the MetraBus cable. The MetraBus cable connector is keyed for your protection. Check the key-ways for correct alignment prior to plugging in the MetraBus cable. Remove power from the MetraBus cable before connecting any I/O boards.

4. If you have only one MIO-32 or if your MIO-32 is the last board in your system, install the resistor-terminating networks provided with your driver card in the sockets marked RN1 and RN2. These resistor networks minimize signal reflections caused by long cable lengths. They are optional, however, and are not needed for cables of 50 feet or less.

6.3 Typical Output Connections

To ensure proper operation of the MIO-32 with a variety of logic-level circuitry, follow this description and illustrations when wiring your application.

The MIO-32 provides access to emitters and collectors of the optical-coupler's outputs. This allows maximum flexibility when connecting the MIO-32 to your application. Figures 6-3a and 6-3b show typical wiring schemes.

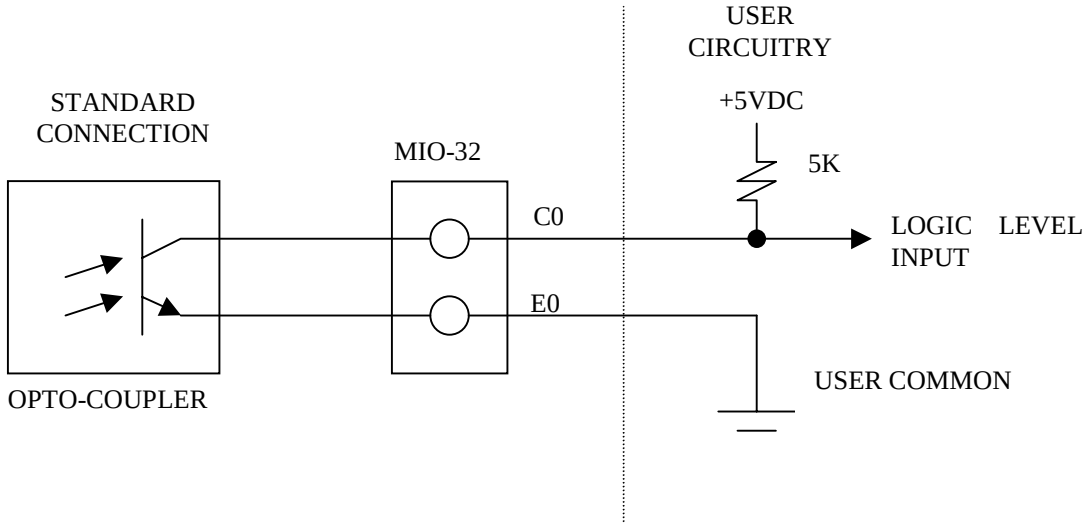


Figure 6-3a. Collector Output Connections

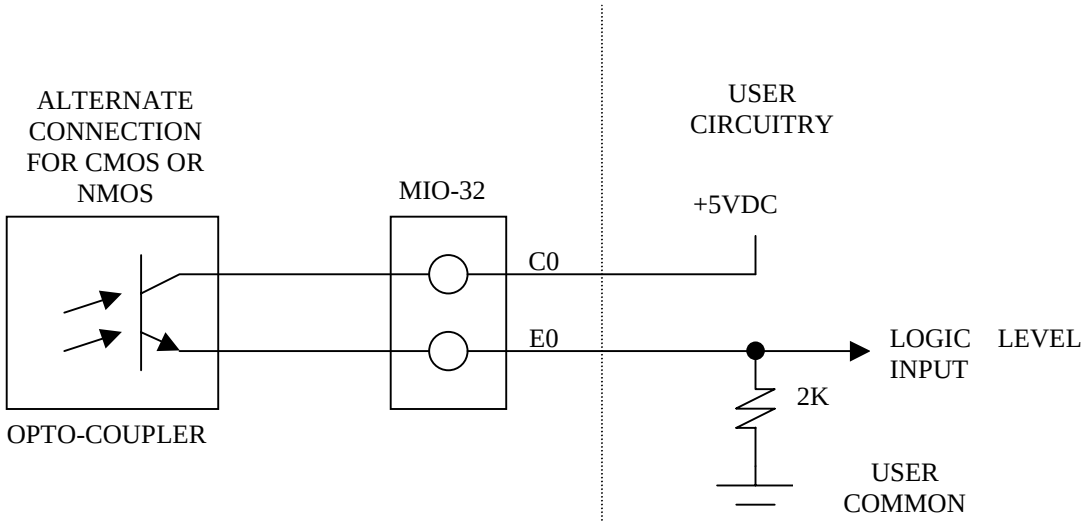


Figure 6-3b. Emitter Output Connections

A user supplied voltage source (normally +5 VDC to +20 VDC) must be used with both standard and alternative connection schemes. The output from the MIO-32 is then wired to the user's "logic level input".

Note that when using the standard (collector output) connection scheme (Fig.6-3a), a logical "OFF" command causes the opto-coupler ***not*** to conduct. With no low-resistance ground path through the opto-coupler, there will be current flow through the user's input circuitry from this "high" output. This "inversion" of logic level is easily compensated for by software.

Issuing a MetraBus system RESET command with the standard connection configuration causes all outputs to go HIGH. The alternate method shown in Figure 6-3b does not invert the data, but offers less drive current because of the 2.0kΩ ground path. It is ***not*** recommended for use with TTL inputs.

6.4 Programming the MIO-32

The MetraBus is fully supported by Measurement Computing Corp. powerful Universal Library (UL) software driver. We highly recommend that you take advantage of the power of UL to simplify your programming task. For details on utilizing the Universal Library please refer to the UL manual as well as the many software examples provided.

The following is provided for those wishing to program their system based on register level programming. Though the MetraBus is a fairly simple architecture, this should only be attempted by experienced programmers.

6.4.1 MIO-32 Register Map

The MIO-32 uses 4 consecutive registers within the MetraBus address space. We will refer to these as the Board Address, Board Address +1, Board Address + 2 and Board Address +3.

Each MIO-32 address corresponds to a bank of 8 outputs. These are labeled on the board as Board Address +0, +1, +2 and +3. To set outputs on the MIO-32 simply select the MetraBus address of the bank of outputs you would like to set (via -MDB64 Base Address + 1), and write the desired output control word to the MIO-32 (via -MDB64 Base Address + 0). Each bit in the 8-bit data word controls a separate output (labeled E0/C0 through E7/C7 corresponding to bits 0-7).

The following program assumes the -MDB64 board resides at Base Address 768, and the MIO-32 board resides at MetraBus Address 4. Though written in BASIC, this program can easily be generalized to any other language.

```
DATAIO = 768                'Declare the Data I/O location (-MDB64 Base +0)
ADRPTR = 769                'Declare the Address Pointer location (-MDB64 Base +1)
MIO32 = 4                   'Declare the MIO-32 MetraBus Base Address

OUT ADRPTR, MIO32           'Point to output bank 0 of the MIO-32
OUT DATAIO, 63              'Turn on outputs 0-5, turn off outputs 6 & 7
                            '(63 decimal = 0011  l l l l binary)

OUT ADRPTR, MIO32 + 3       'Point to output bank 3 of the MIO-32
OUT DATAIO, 128             'Turn on output 7, turn off output 0 through 6)
                            '(128 decimal = 1 0 0 0   0 0 0 0 binary)
```

6.5 Using an Auxiliary Power Supply

Whether an auxiliary power supply is necessary or not depends upon how the MIO-32 is used (or how many are used) in your application.. The user will need to determine the total amount of +5VDC current by considering the amount of outputs to be used (turned on at any time) plus the boards quiescent current. Calculate the current required from specifications in Section 6.6. As a general rule of thumb, an external power supply should be used when more than one MIO-32 is connected to the bus since the maximum possible current requirement for two MIO-32 boards exceeds the maximum allowable current supplied by the -MDB64.

CAUTION
As described in the -MDB64 user manual, the MetraBus 50-pin ribbon cable is only capable of providing 1 Amp of continuous +5VDC current from the PC to the MetraBus I/O board(s). For applications requiring more than 1 Amp of +5VDC current or a combination of +5VDC and ±15VDC supplies, a high quality external power supply such as the MBUS-PWR is required.

NOTE: If an external power supply is used in conjunction with the -MDB64 MetraBus controller card, the -MDB64 "5V POWER" jumper must be placed in the in the EXT position.

6.5.1 External Power Supply using a 50-pin Ribbon Cable

When using the MBUS-PWR board or an equivalent external power supply in conjunction with the MetraBus 50-pin ribbon cable, **the user must consider the ribbon cable's power handling capability** along with any potential loading issues (IR drops, ambient temperature, etc.,). The total power output capability for this type of set-up would be:

- +5VDC: 10 Amps max.
- +15VDC: 1 Amp max.
- –15VDC: 1 Amp max.

NOTE: These power levels coincide with the ribbon cable's ten +5VDC (1A max. per line) power lines, along with the single ±15VDC power lines (1A max. per line).

6.5.2 External Power Supply using a C-Power-X series MetraBus Power Cable

For applications that would exceed the 1A/pin power limitation from either of the +5VDC and ±15VDC supplies, Measurement Computing Corp. has provided each of its MetraBus I/O boards with on-board power connectors P30 and P31. These power connectors are designed to be used with a MetraBus Power Cable (C-POWER-X), in applications requiring power levels beyond what the 50-pin ribbon cable is capable of handling. The user must still consider the power cable's power handling capability, along with any potential loading issues (IR drops, ambient temperature, etc.,). The total power output capability for this type of set-up would be as follows:

- +5VDC: 10 Amps max.
- +15VDC: 4 Amps max.
- –15VDC: 1 Amp max.

NOTE: These power levels coincide with the MBUS-PWR's maximum output power capability.

6.6 MIO-32 Specifications

POWER CONSUMPTION

+5V (all 4 banks at all zero's)	290mA typical, 350mA max.
+5V (all 4 banks at all one's)	630mA typical, 700mA max.

DIGITAL OUTPUT

Output Device Type	ILQ2X009 Quad Optocoupler
Configuration	4 banks of 8 open collector digital outputs
Number of output channels	32
Collector Current (On)	50mA max.
Collector Current (Off)	1 µA maximum
Collector - Emitter Reverse Voltage	70V max.
Collector - Emitter Saturation Voltage	0.25V typ., 0.4V max. (Ice = 1 mA, Ib = 20µA)
Isolation resistance	10^12 ohms (Vio = 500V, Ta = 25°C)
Isolation Voltage	500VDC continuous

METRABUS INTERFACE

Address space requirement:	4 consecutive address locations (within the 64 available address locations)
Input Device Type	74LS540
Output Device Type	74LS541
Miscellaneous	Locations provided for installation of termination resistors. Data read-back capability for data and address confirmation.

CONNECTORS

MetraBus Connector type	50 pin header (male)
Dielectric Strength	>1000Vrms
Current Rating	1A max. (per pin)
Digital Output Connector type	Detachable screw terminal
Current Rating	15A max.
Voltage Rating	300V max.
Wire sizes	12-22AWG
External Power Connector type	4 pin Molex (2 in parallel)
Current Rating	10A max.
Voltage Rating	250V AC/DC

METRABUS RIBBON CABLE

Length	100ft. max.
Power	
+5V10A (1A per pin) max.	
+15V	1A max.
-15V	1A max.
Propagation Delay	2ns/ft, typ.

ENVIRONMENTAL

Operating temperature range	0 to 70°C
Storage temperature range	-20 to 100°C
Humidity	0 to 90% non-condensing

PHYSICAL

Size:	16 x 4.8 inches (40.64 x 12.192 cm)
Cable Type:	HITACHI 23100 series (50-cond. flat ribbon)
Connector Type:	3M 3433

7. MSSR-24 ISOLATED SOLID STATE SWITCHING I/O BOARD

7.1 Introduction

The MSSR-24 is a 24-channel board that provides complete optical isolation for both high and low power switching applications. Each MSSR-24 monitors and controls 24 individual I/O points via optically isolated, solid-state, plug-in modules (Figure 7-1). A variety of these modules are available for both input and output applications. Voltages of 120/130 VAC, 0 to 60 VDC, and standard European line voltages can be sensed and controlled. Some common uses of the MSSR-24 include computer control of Pump Cycling, ON/OFF Motor Control, Energy Management, Signal Multiplexing, Alarm Activation, Temperature Cycling and Product Life Cycle testing.

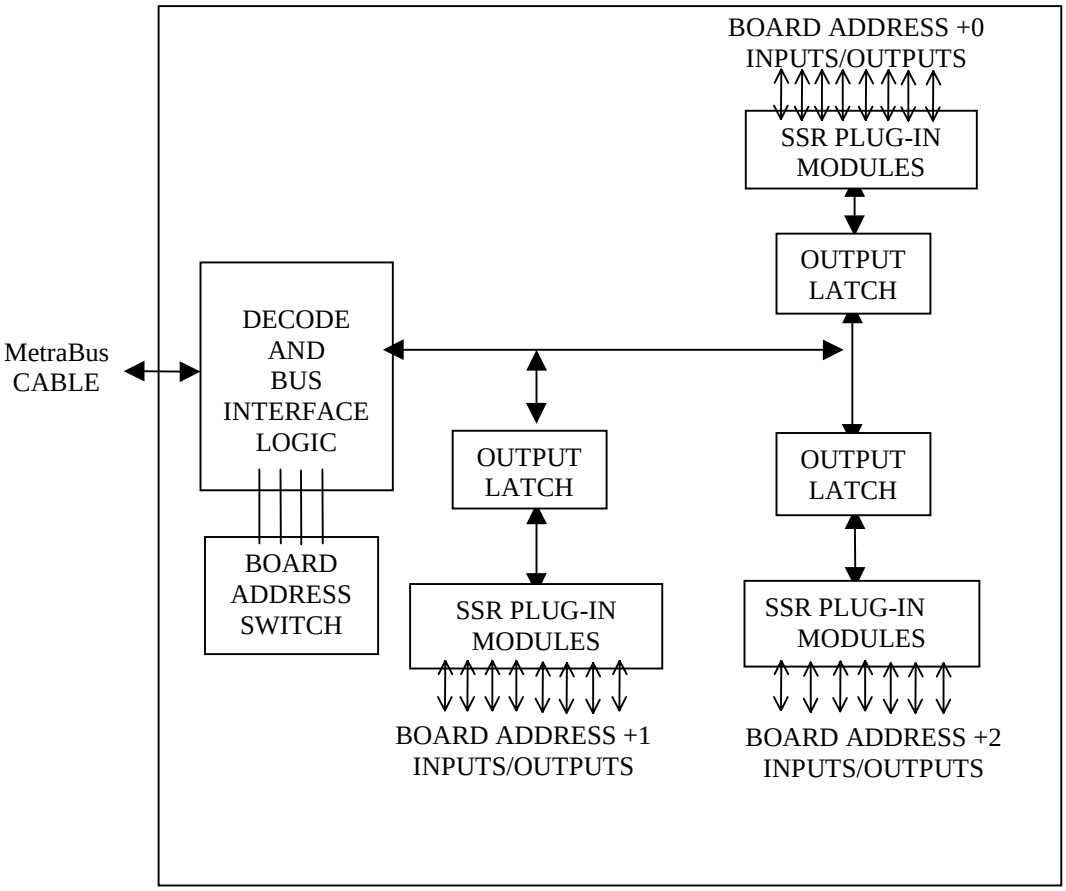


Figure 7-1. MSSR-24 Functional Block Diagram

The MSSR-24 uses three consecutive addresses on the MetraBus. This allows access to a maximum of 16 MSSR-24 boards by a single MetraBus driver board, providing control of up to 384 individual I/O points.
The MSSR-24 board has three, 8-bit ports. Writing to one of the ports loads data into the output latches and to the I/O modules themselves. Reading data from an output module returns the data currently in the output latch without changing it. This feature allows the user to verify that the data on the outputs has been received correctly. Reading from an input module returns the value of the input. All MSSR-24 modules are set to the OFF state at power-up or software CLEAR.

Detachable screw terminals on the MSSR-24 outputs offer easy connection for field wiring, accepting standard 12-22 AWG wire sizes.

7.2 Installation

7.2.1 *Insta*Cal

*Insta*Cal is the installation, calibration, and test software that is supplied with all Measurement Computing Corp. I/O boards. *Insta*Cal will guide you through setting the various switches on the MDB-64 boards as well as your I/O board. Information is provided below to help you configure your board if you choose not to use *Insta*Cal. For further information on *Insta*Cal, please refer to the separate S*oftware Installation Manual* you received with your order.

To use *Insta*Cal for MetraBus installation, please install the MDB-series driver board first using the "Install Board" menu. Once the -MDB64 board is installed in *Insta*Cal, MetraBus I/O boards may be installed by going to the "Install Board" menu, and selecting the "Add MetraBus Board" menu item.

7.2.2 Setting the MSSR-24 Board Address

The following section is provided for those who chose not to follow the guidance of the *Insta*Cal utility software that you have received.

The I/O address for each MSSR-24 connected to a single MetraBus cable must be unique and non-overlapping for the driver card to target that specific MSSR-24. These addresses allow the boards in a MetraBus system to operate independently. Each MSSR-24 uses three of the available 64 MetraBus addresses. These three addresses run consecutively starting from the MSSR-24 board address. Due to the binary nature of the address bus, the board address can only be set on even boundaries of four. This effectively means that although the MSSR-24 only uses 3 MetraBus addresses, it actually occupies four addresses. Figure 7-2 below shows a typical board address switch setting of 32 (decimal).

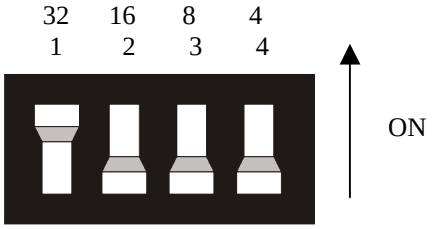


Figure 7-2. Board Address Switch

Set the board address using the following procedure:

1. The board-address DIP switch is on the far-left side of the board just above and to the left of the MetraBus connector. The numbers printed above the DIP switches indicate the values of the corresponding individual switches. The switches add a value in the ON position.

2. Select an unused board address and set the DIP switches accordingly. For example, in order to set a board address of 24, switches with corresponding values of 8 and 16 are ON. The others remain OFF. Remember that each MSSR-24 uses four consecutive addresses of the 64 addresses that are available and must be set to an unused, non-overlapping address in order to avoid bus conflicts.

3. After setting the board address, connect the MSSR-24 to the -MDB64 controller card via the MetraBus cable. The MetraBus cable connector is keyed for your protection. Check the key-ways for correct alignment prior to plugging in the MetraBus cable. Remove power from the MetraBus cable before connecting any I/O boards.

4. If you have only one MSSR-24 or if your MSSR-24 is the last board in your system, install the resistor-terminating networks provided with your driver card in the sockets marked RN1 and RN2. These resistor

networks minimize signal reflections caused by long cable lengths. They are optional, however, and are not needed for cables of 50 feet or less.

7.3 Programming the MSSR-24

The MetraBus is fully supported by Measurement Computing Corp. powerful Universal Library (UL) software driver. We highly recommend that you take advantage of the power of UL to simplify your programming task. For details on using the Universal Library, please refer to the UL manual and the software examples provided.

The following is provided for those wishing to program their system based on register-level programming. Although the MetraBus has a fairly simple architecture, it should only be attempted by experienced programmers.

7.3.1 MSSR-24 Register Map

The MSSR-24 uses three consecutive registers within the MetraBus address space. We will refer to these as the Board Address, Board Address +1 and Board Address + 2.

Each MSSR-24 address corresponds to a bank of eight I/O modules. These are labeled on the board as module 1 through 24. Table 7-1 provides mapping between board address, bit number, and module number.

Table 7-1. Board Address and Bit / Module Number Mapping

Board Address	Data Bit	Module Number
+0	0	1
+0	1	2
+0	2	3
+0	3	4
+0	4	5
+0	5	6
+0	6	7
+0	7	8
+1	0	9
+1	1	10
+1	2	11
+1	3	12
+1	4	13
+1	5	14
+1	6	15
+1	7	16
+2	0	17
+2	1	18
+2	2	19
+2	3	20
+2	4	21
+2	5	22
+2	6	23
+2	7	24

To read from or write to modules on the MSSR-24, select the MetraBus address of the bank of modules you want to access (via -MDB64 Base Address + 1). Then either write the desired output control word to the MSSR-24 or read the input data from the data register (via -MDB64 Base Address + 0). Each bit in the 8-bit data word controls or reads a separate module. Input and output modules can be mixed on the board. Reading the data from an output module returns the current state of the output latch and provides a powerful method of checking data transfer integrity. Writing to an input module performs no function per se, but be cautioned that the output latch corresponding to an input module must be set to zero for proper operation. This is very important so is stated again:

NOTE:
For proper operation of an input module, the output latch corresponding to that module location must be set to zero. This occurs upon reset, so if you have never written to a particular bank of modules, you can read them without further action. However, if you have written to a bank of modules, you must either be careful to write only zeros to locations containing input modules or your inputs will always read "ON". If in doubt, write a zero to your input module locations before performing a read.

The following program assumes the -MDB64 board resides at Base Address 768, and the MSSR-24 board resides at MetraBus Address 4. Though written in BASIC, this program can easily be generalized to any other language.

```
DATAIO = 768                'Declare the Data I/O location (-MDB64 Base +0)
ADRPTR = 769                'Declare the Address Pointer location (-MDB64 Base +1)
MSSR24 = 4                  'Declare the MSSR-24 MetraBus Base Address

OUT ADRPTR, MSSR24          'Point to module bank 0 (modules 1 to 8) of the MSSR-24
OUT DATAIO, 63              'Turn ON modules 1-6, turn OFF modules  7 & 8
                            ‘(63 decimal = 0011  1 1 1 1 binary)

OUT ADRPTR, MSSR24 + 2      ‘Point to module bank 2  (modules 17 to 24) of the MSSR-24
OUT DATAIO, 128             'Turn ON module 24, turn OFF modules 17 through 23)
                            ‘(128 decimal = 1 0 0 0   0 0 0 0 binary)
```

Assume that modules 9 through 12 are input modules, and modules 13 through 16 are output modules. Let's also assume we wish to turn ON modules 15 and 16, turn OFF 13 and 14, then read modules 9 through 12.

```
OUT ADRPTR, MSSR24 + 1      ‘Point to module bank 1 (modules 9 to 16) of the MSSR-24
OUT DATAIO, 192             'Turn on module 15 & 16, turn OFF modules 13 & 14)
                            ‘(192 decimal = 1 1 0 0   0 0 0 0 binary) note that we have
                            ‘written 0s to bits 0 to 3. This is required to assure proper
                            ‘operation of the input modules in subsequent reads
```

Assume we want to read now, and that input modules 9 and 11 are ON, and 10 and 12 are OFF.

```
INDAT=INP(DATAIO)           ‘read the input
```

INDAT would return: 197 (Binary 1 1 0 0 0 1 0 1) Note that the most significant four bits have been read from the output modules which remain at 1 1 0 0, while the least significant four bits represent the state of the input modules.

7.4 Using an Auxiliary Power Supply

Whether an auxiliary power supply is necessary or not depends upon how the MSSR-24 is used (or how many are used) in your application.. The user will need to determine the total amount of +5VDC current by considering the amount of outputs to be used (turned on at any time) plus the boards quiescent current. Calculate the current required from specifications in Section 7.5. As a general rule of thumb, an external power supply should be used when more than two MSSR-24 boards are connected to the bus since the maximum possible current requirement for three MSSR-24 boards exceeds the maximum allowable current supplied by the -MDB64.

CAUTION

As described in the -MDB64 user manual, the MetraBus 50-pin ribbon cable is only capable of providing 1 Amp of continuous +5VDC current from the PC to the MetraBus I/O board(s). For applications requiring more than 1 Amp of +5VDC current or a combination of +5VDC and ±15VDC supplies, a high quality external power supply such as the MBUS-PWR is required.

NOTE: If an external power supply is used in conjunction with the -MDB64 MetraBus controller card, the -MDB64 "5V POWER" jumper must be placed in the in the EXT position.

7.4.1 External Power Supply using a 50-pin Ribbon Cable

When using the MBUS-PWR board or an equivalent external power supply in conjunction with the MetraBus 50-pin ribbon cable, **the user must consider the ribbon cable's power handling capability** along with any potential loading issues (IR drops, ambient temperature, etc.,). The total power output capability for this type of set-up would be:

- +5VDC: 10 Amps max.
- +15VDC: 1 Amp max.
- −15VDC: 1 Amp max.

NOTE: These power levels coincide with the ribbon cable's ten +5VDC (1A max. per line) power lines, along with the single ±15VDC power lines (1A max. per line).

7.4.2 External Power Supply using a C-Power-X series MetraBus Power Cable

For applications that exceed the 1A/pin power limitation from either of the +5VDC and ±15VDC supplies, Measurement Computing Corp. has provided each of its MetraBus I/O boards with on-board power connectors P30 and P31. These power connectors are used with a MetraBus Power Cable (C-POWER-X), in applications requiring power levels beyond what the 50-pin ribbon cable is capable of handling. The user must still consider the power cable's power handling capability, along with any potential loading issues (IR drops, ambient temperature, etc.,). The total power output capability for this type of set-up is:

- +5VDC: 10 Amps max.
- +15VDC: 4 Amps max.
- −15VDC: 1 Amp max.

NOTE: These power levels coincide with the MBUS-PWR's maximum output power capability.

7.5 MSSR-24 Specifications

POWER CONSUMPTION

+5V (all modules in off state)	250mA typical, 300mA max.
+5V (all modules in on state)	375mA typical, 425mA max.

DIGITAL INPUT / OUTPUT

Number of channels	24 (3 banks of 8 individual modules)
Address space requirement	3 consecutive address locations (within the 64 available address locations), configurable at even boundaries of 4
Miscellaneous	Locations provided for installation of termination resistors for MetraBus cable. Enunciator LED's provided for channel selection indication. Data read-back capability for data and address confirmation. Individual input and output type modules are permitted within a bank, however, for proper operation, any write to a bank containing input modules should set all bits associated with input modules to a logical 0. Hot swapping of input and output relays is not permitted.

METRABUS INTERFACE

Address space requirement	3 consecutive address locations (within the 64 available address locations), configurable at even boundaries of 4
Output Device type:	74LS541
Input Device type:	74LS540
Miscellaneous	Locations provided for installation of termination resistors for MetraBus cable. Data read-back capability for data and address confirmation.

MODULE INTERFACE

Device type:	ULN2803 (Darlington transistor, open collector)

COMPATIBLE SOLID STATE RELAY MODULES

Single DC Input & Output
- SSR-ODC-05
- SSR-ODC-05A
- SSR-IDC-05
- SSR-IDC-05NP

Single AC Input & Output
- SSR-OAC-05
- SSR-OAC-05A
- SSR-IAC-05
- SSR-IAC-05

CONNECTORS

MetraBus Connector type	50 pin header (male)
Dielectric Strength	>1000Vrms
Current Rating	1A max. (per pin)
Module I/O Connector type	Detachable screw terminal
Current Rating	15A max.
Voltage Rating	300V max.

Wire sizes	12-22AWG
External Power Connector type	4 pin Molex (2 in parallel)
Current Rating	10A max.
Voltage Rating	250V AC/DC

ENVIRONMENTAL

Operating Temperature:	0 to 70°C
Storage Temperature:	–40 to 100° C

PHYSICAL

Size:	16 x 4.8 inches (40.64 x 12.192 cm)
MetraBus Cable type:	HITACHI 23100 series (50-cond. flat ribbon)
Connector Type:	3M 3433

8. MBUS-PWR POWER SUPPLY BOARD

8.1 General

The MBUS-PWR is an auxiliary power supply for the MetraBus industrial data acquisition and control system. It combines an IEC320 power input connector along with the power supply's wide input range to provide compatibility for North American 120VAC applications and European 220/240VAC applications. The MBUS-PWR is 19" rack-mountable in a standard NEMA type enclosure that meets applicable IEC, LTL, CSA, and VDE safety requirements.

The MetraBus power distribution system is modular in order to accommodate the needs of small and large data acquisition systems. This feature minimizes the cost of power supply components without limiting the size of the system. In configuring the power distribution system, first determine the power load on the basis of your intended board complement. The three basic power distribution configurations are:

- PC power
- Single auxiliary power supply
- Multiple auxiliary power supplies.

8.2 Setup

A low-power MetraBus system with I/O boards requiring less than 1 Amp of +5VDC current can use the PC to power the I/O boards directly. Using this type of configuration, the user must first install fuse F1 (1A/250V) on the -MDB64 controller board and also place the "5V POWER" jumper in the INT position. A typical low-power (<1 Amp) ISA-MDB64 set-up is shown in Figure 8-1.

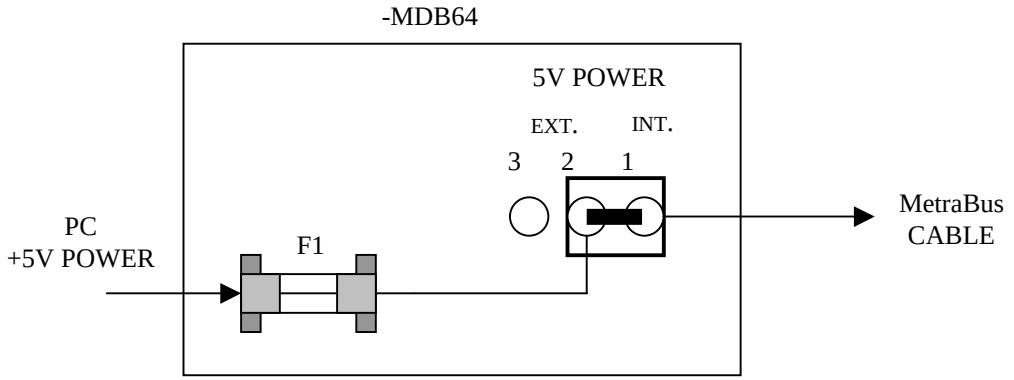


Figure 8-1. Low Power ISA-MDB64 Setup

In a medium-power MetraBus system, where the total power requirement is less than 100 Watts, the use of an auxiliary power supply such as the MBUS-PWR is required. The MBUS-PWR board would be used in applications requiring greater than 1 Amp of +5V current or for applications requiring ±15VDC supplies.

If an external power supply such as the MBUS-PWR is used, the -MDB64 "5V POWER" jumper (P3) must be placed in the EXT position (see Figure 8-2 and Table 8-1). This isolates the computer's +5VDC power supply from the external power supply.

CAUTION

Failure to place the "5V POWER" jumper (P3) in the EXT position, when using an external power supply such as the MBUS-PWR, can cause fuse F1 to blow and could damage the MetraBus system and host computer.

If total power consumption is expected to be greater than 100 Watts, multiple MBUS-PWR supplies are required. Connections for multiple MBUS-PWR boards will use the EXPANSION connectors P2 and P4, and POWER connectors P1 and P3.

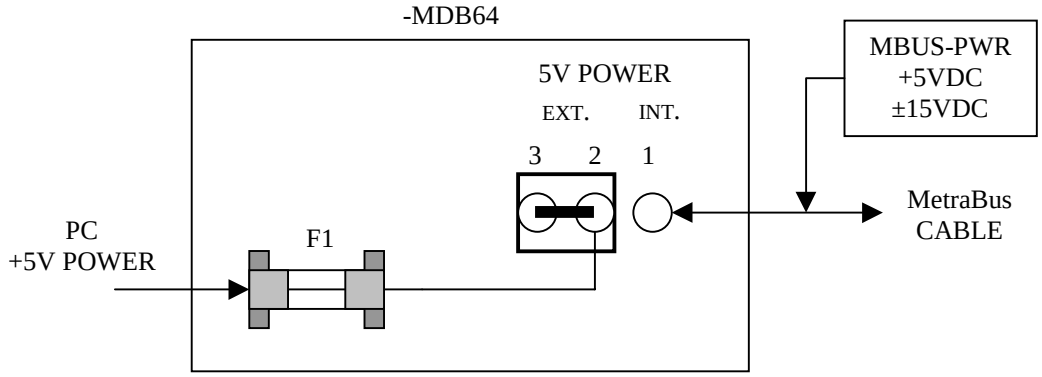


Figure 8-2. Medium/High Power ISA-MDB64 Setup

5V POWER JUMPER POSITION	JUMPER LABEL	FUNCTION
1-2	INT.	-MDB64 uses the computer to supply +5V to the MetraBus I/O boards.
2-3	EXT.	An external power supply or MBUS-PWR is used to supply +5V and/or ±15V to I/O boards.

Table 8-1. -MDB64 "5V POWER" Jumper

8.3 External Power Supply using the 50-pin Ribbon Cable

When using the MBUS-PWR board or equivalent external power supply with the MetraBus 50-pin ribbon cable, consider:

1. The ribbon cable's power handling capability (1 Amp per line).
2. Any potential loading issues (IR drops, ambient temperature, etc.).

The total power output capability when using an external power supply (or MBUS-PWR) and the 50-pin ribbon cable is:

- +5VDC: 10 Amps max.
- +15VDC: 1 Amp max.
- –15VDC: 1 Amp max.

NOTE: These power levels coincide with the 50-pin ribbon cable's ten +5V (1A max. per line) power lines, along with the single ±15V power lines (1A max. per line).

8.4 External Power Supply using the MetraBus Power Cable (C-POWER-X)

For applications that require power beyond what the 50-pin ribbon cable can provide, Measurement Computing Corp. has provided each of its MetraBus I/O boards with on-board power connectors P30 and P31. These connectors are used with Measurement Computing Corp. MetraBus power cable (C-POWER-X) in high-power applications, or applications that cannot tolerate the I * R drops associated with long ribbon cables, or the effects of elevated ambient temperatures.

When using the Measurement Computing Corp. MetraBus Power Cable (C-POWER-X), the user must consider its power handling capability and any potential loading issues (I*R drops, ambient temperature, etc.,). The total power output capability when using an external power supply (or MBUS-PWR) and a MetraBus Power Cable is:

- +5VDC: 10 Amps max.
- +15VDC: 4 Amps max.
- –15VDC: 1 Amp max.

NOTE: These power levels coincide with the MBUS-PWR's maximum output power capability.

8.5 The MBUS-PWR Expansion/Power Connectors

The MBUS-PWR provides a pair of expansion and power connectors allowing the user to split the power distribution in a MetraBus system between multiple power supplies (Figure 8-3). The EXPANSION connectors allow the bus and control signals to be daisy chained to multiple I/O boards, while isolating any further power distribution. The POWER connectors pass both the power, ground and bus/control signals.

CAUTION:
Be sure to properly estimate the total load power of each group of I/O boards, and do not connect the POWER connectors of any two MBUS-PWR boards.

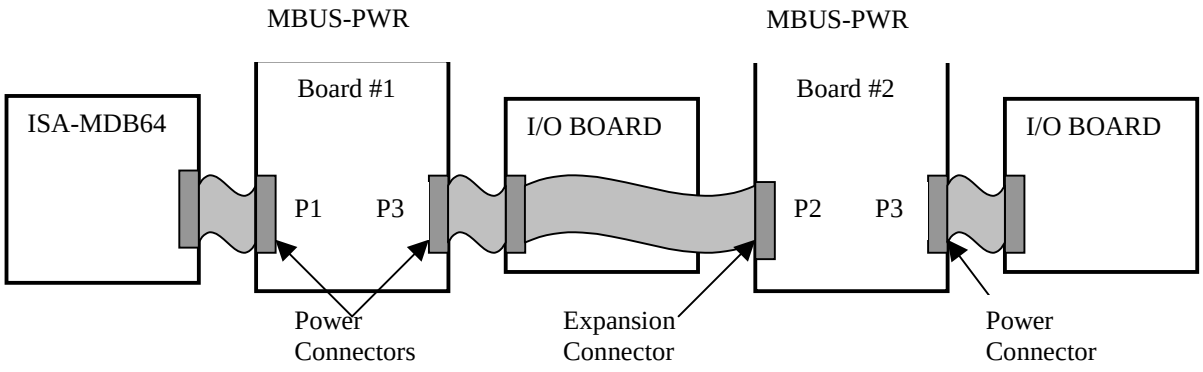


Figure 8-3. MBUS-PWR Expansion Connectors

8.6 Power Connector

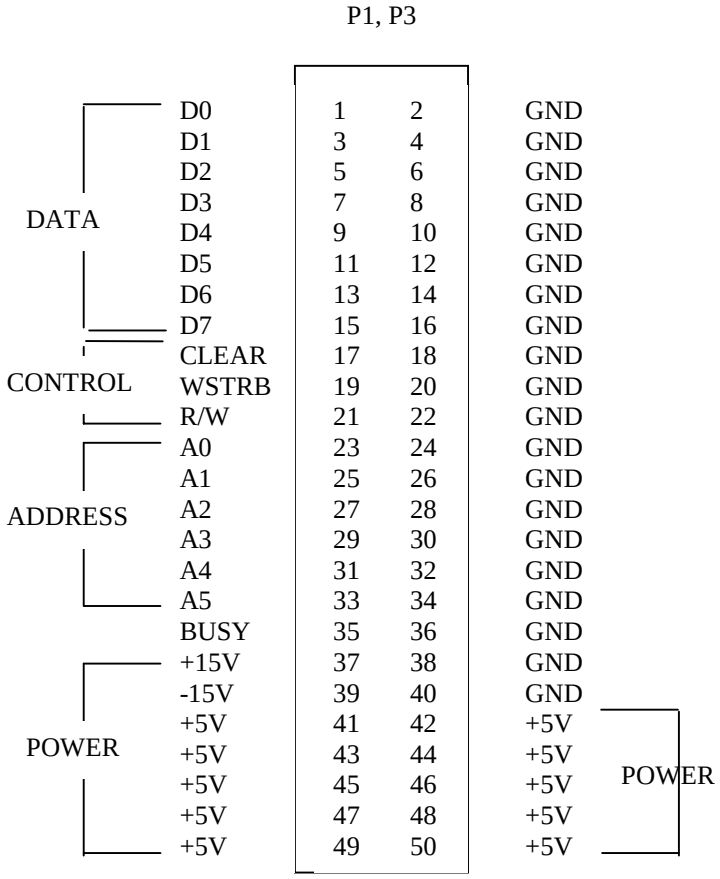


Figure 8-4. Power Connectors, P1 and P3

8.7 Expansion Connector

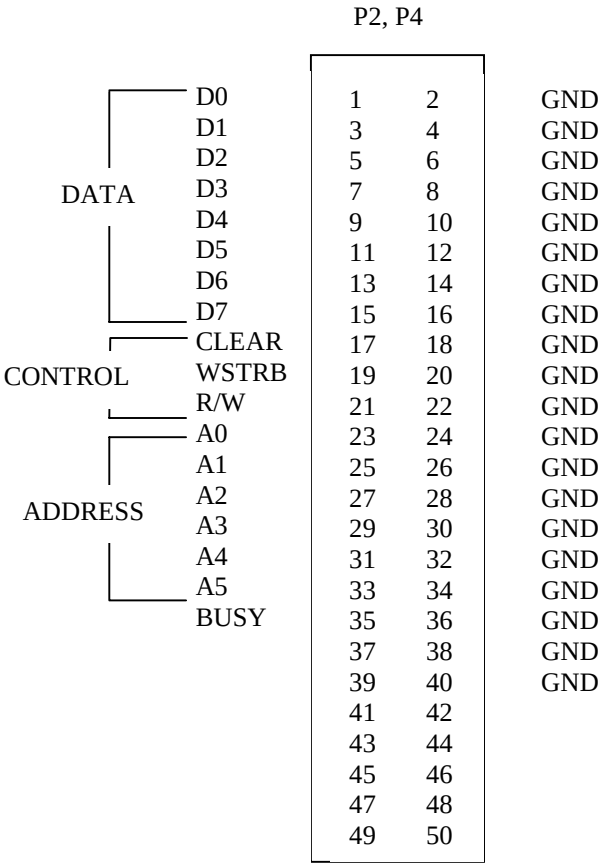


Figure 8-5. Expansion Connectors, P2 and P4

8.8 Power Distribution

The proper delivery of power to each of the loads (I/O boards) requires that the power distribution be configured in a way to avoid interaction between the loads. When considering an example such as shown in Figure 8-6, it becomes obvious that there is the potential for interaction of one load with another, depending on how much current each load (I/O board) draws. If the load furthest from the power source (load 4) draws the most current, the voltage available to it and its neighboring load could be considerably less than the voltage provided to the load connected closest to the power source (load 1).

Keep the power bus (ribbon cable) as short as possible to minimize I*R drops. Also, if possible, place the loads (I/O boards) that draw the most current closest to the power supply. This will minimize the interaction between high current and low current loads.

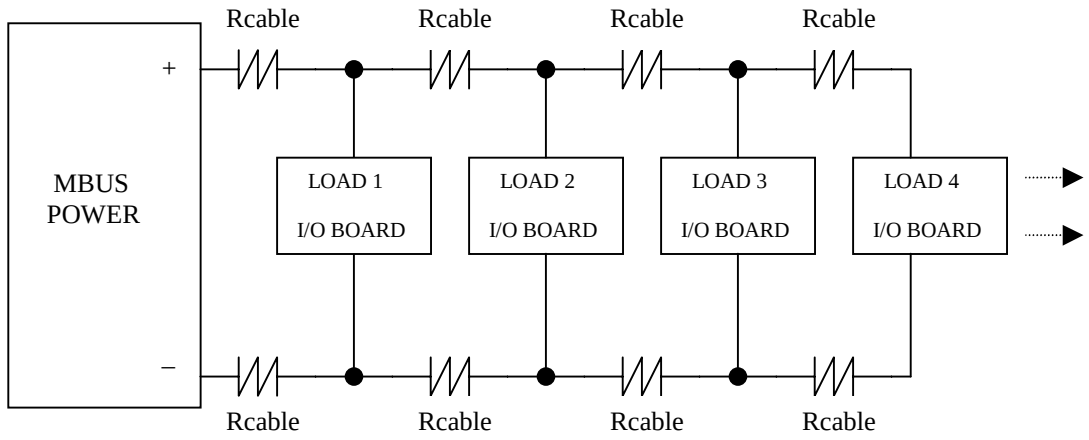


Figure 8-6. Power Distribution – Load Management

An alternate means of providing power to a distributed load system is shown in Figure 8-7. Again, the larger load is placed closest to the MBUS-PWR supply. While helping to minimize potential I*R drops, this configuration could also help to minimize system noise by limiting the interaction of power supply currents between the higher power digital I/O boards and precision type analog I/O boards.

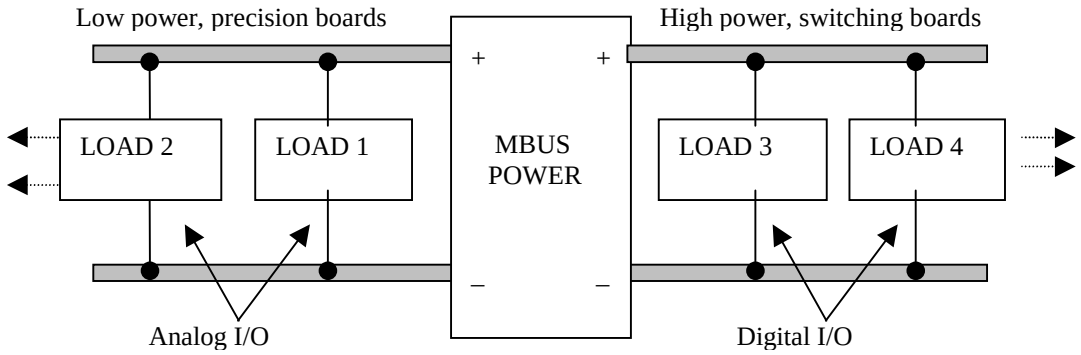


Figure 8-7. Power Distribution – Load Re-distribution

8.9 Output Ground Jumper

MetraBus power systems requirement for a reference having the same potential as earth ground is desirable for both safety and overall system performance. To provide maximum flexibility and minimize potential ground loop errors within multiple-supply systems, the MBUS-PWR boards contain an output ground jumper (3-pin header P5) which connects the MBUS-PWR chassis ground directly to the DC common of the MBUS-PWR output. (The MBUS-PWR chassis ground is always connected to the safety ground of the 120/240V line cord regardless of this jumper setting).

For most applications the user will likely elect to minimize system noise generated from potential ground loops by floating each of the MBUS-PWR connections to the common reference except for one.

8.10 Installation

CAUTION:
Perform the following installation procedure under no-power conditions.

1. Visually inspect the MBUS-PWR for loose wires, screws, or components.
2. Estimate the total load power requirement.
3. Determine the power distribution configuration and connector utilization.
4. Select an unused MetraBus cable connector and plug the cable into the power supply. Make certain to align the connector according to its key-ways.
5. Plug the line cord into the power source.
6. Turn ON power switch.

8.11 MBUS-PWR Specifications

GENERAL

Efficiency	65% min. at 110W
Hold Up Time	12ms min.
Line Regulation	±0.5% max. @ full load
In-Rush Current	15A @ 115 VAC (25°C), 30A @ 230 VAC (25°C)
Withstand Voltage	3000VAC from input to output 1500VAC from input to ground
Insulation Resistance	10M ohm min. from output to ground
Miscellaneous	Jumper selectable connection from Chassis ground to Power Output Common Meets conduction limits: FCC 20780 Level B, CISPR22 (EN55022) Level B Meets or exceeds safety specifications: UL 1950, CSA 234, IEC 950

INPUT

Voltage	90 to 132 VAC 180 to 264 VAC
Frequency	47 to 440Hz
Current	3.2A (rms) @ 115 VAC 1.8A (rms) @ 230 VAC

OUTPUT

Current	
+5 VDC	10A max.
+15 VDC	4A max.
-15 VDC	1A max.
Derating	Derate Linearly from 100% load at 50°C to 50% load at 70°C
Ouput Power	
25CFM forced air cooling	100 watts max
Convection cooling	80 watts max
Over-current Protection	All outputs protected to short circuit condition
Ripple and noise	1% peak to peak max.
Temperature Coefficient	All outputs ±0.04%/°C max.
Miscellaneous	LED indicators for power output status

CONNECTORS

MetraBus Connector type	50 pin male header (4 connectors, two of which carry power output and two with no connection to power pins)
Dielectric Strength	>1000Vrms
Current Rating	1A max. (per pin)
Power Output Connector type	4 pin Molex (2 in parallel)
Current Rating	10A max.
Voltage Rating	250V AC/DC
Auxiliary Power Output Connector	Detachable screw terminal
Current Rating	15A max.
Voltage Rating	300V max.
Wire sizes	12-22AWG

ENVIRONMENTAL

Operating temperature range	0 to 70°C
Storage temperature range	-40 to 85°C
Humidity	0 to 90% non-condensing

PHYSICAL

Size:	16 x 4.8 inches (40.64 x 12.192 cm)
MetraBus Cable type:	HITACHI 23100 series (50-cond. flat ribbon)
Connector Type:	3M 3433

The EC Declaration of Conformity

We, Measurement Computing Corp. , declare under sole responsibility that the product:

MetraBus	I/O board family for ISA, PCI, CPCI and PC/104 bus
Part Number	Description

to which this declaration relates, meets the essential requirements, is in conformity with, and CE marking has been applied according to the relevant EC Directives listed below using the relevant section of the following EC standards and other informative documents:

EU EMC Directive 89/336/EEC: Essential requirements relating to electromagnetic compatibility.

EU 55022 Class B: Limits and methods of measurements of radio interference characteristics of information technology equipment.

EN 50082-1: EC generic immunity requirements.

IEC 801-2: Electrostatic discharge requirements for industrial process measurement and control equipment.

IEC 801-3: Radiated electromagnetic field requirements for industrial process measurements and control equipment.

IEC 801-4: Electrically fast transients for industrial process measurement and control equipment.

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