

# **Message Board Controller**

*Model MBC-1.5*

**– INSTALLATION AND OPERATION –**

*This documentation is valid for  
Message Board Controller 1.5 hardware revision 0 with firmware version 1.5*

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## Section I — Safety Information



**WARNING!**

***Only qualified technical personnel should attempt to install the MBC-1.5 Message Board Controller. An attempt to install this device by a person who is not technically qualified could result in a hazardous condition to the installer or other personnel, and/or damage to the MBC-1.5 or other equipment. Ensure that safety precautions are made before installing this device.***

The MBC-1.5, as any electronic device, can fail in unexpected ways and without warning. Do not use the MBC-1.5 in applications where a life-threatening condition could result if it were to fail.

The MBC-1.5 is designed for indoor use in a dry location. Installation and operation in other locations could be hazardous. Use only the original wall-plug power supply supplied with the unit.

The purchaser and user of the MBC-1.5 bears sole responsibility for determining suitability of this equipment for the intended use. Because this equipment can fail in an unpredictable or unexpected way, even in normal use, Sine Systems, Inc. cannot be held responsible for damages, either direct or indirect, resulting from use of this equipment.

## Section 2 — System Description

### 2.1 General Description

The MBC-1.5 has 16 logic-level inputs, a display output and a programming console input/output. When an MBC-1.5 input is activated, a message is displayed on the associated display device. The programming console port can also be used to drive a display when it is not being used for programming tasks.

The MBC-1.5 is housed in a small aluminum chassis with LED indicators for power and data I/O. The 16 logic signals connect via removable screw-terminal connectors. The power supply and data transmission connect through device specific connectors.

The MBC-1.5 Message Board Controller is designed for use with a specific display--the Beta-Brite by Adaptive Micro Systems. The combination of the MBC-1.5 and one or more of these message boards forms an easily interfaced, general purpose information display system suitable for use in broadcast studios or other industrial and commercial applications. Other display devices by AMS may work with the MBC-1.5 since the communication protocol is shared.

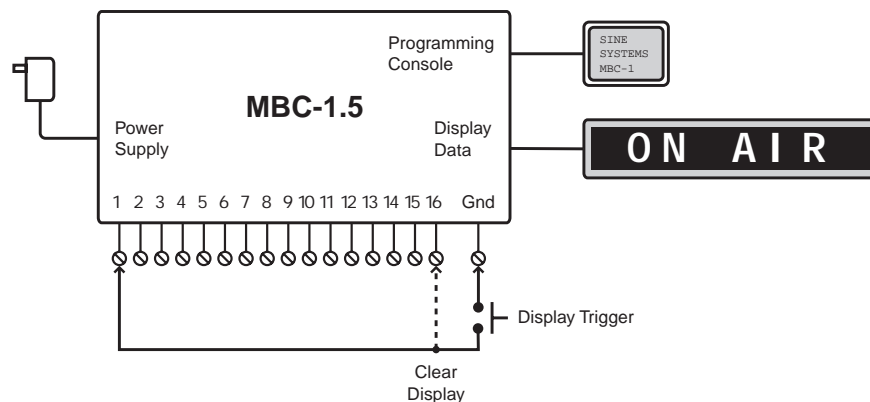


Figure 2.1; MBC-1.5 conceptual diagram

Messages are programmed in the Beta-Brite memory. When an input is activated on the MBC-1.5, it sends a message to the Beta-Brite to display the corresponding message. Each of the inputs on the MBC-1.5 can be programmed to one of three display modes:

- Latched--a momentary input activates a display that remains active until cleared
- Momentary--a display is active as long as the corresponding input is held low
- Stretched--a display is active as long as the input is held low, plus 6 seconds

The logic inputs are prioritized to avoid conflicts when multiple messages are requested. Input 1 has the highest priority and input 15 has the lowest priority. For example, if inputs 7 and 12 are activated at the same time, message number 7 will be displayed. When input 7 is released, message number 12 will be displayed if it is still active.

All logic inputs are activated by a pull-down to ground. External sources can be contact closures, open collectors or 5, 12, 15 and 24-volt logic-level sources. The input impedance of the display inputs is 22 K ohms.

The MBC-1.5 is powered by an external 9-volt DC wall-plug supply (included).

## Section 3 — Installation



**WARNING!**

*Only qualified technical personnel should attempt to install the MBC-1.5. An attempt to install this device by a person who is not technically qualified could result in a hazardous condition to the installer or other personnel, and/or damage to the MBC-1.5 or other equipment. Ensure that safety precautions are made before installing this device.*

### 3.1 System Requirements

The Message Board Controller package contains these items:

- Message Board Controller model MBC-1.5
- 6-conductor, silver-satin modular cable (7 ft.)
- 9-conductor, RS-232 data cable (6 ft.)
- 9-pin, male D connector with hood
- 9 volt DC power supply
- flat-blade screwdriver
- Operation manual

One or more Beta-Brite or compatible display devices are required for operation. Displays may be ordered with the MBC-1.5 or acquired from other sources. Access to a personal computer with a serial port and terminal software, such as HyperTerminal, is required to setup the MBC-1.5. The computer is not required once setup is complete.

Optional cable packages are available for display connections. Cable/connector selection is based on the type and number of display connections made. Optional USB to RS-232 adapters are also available for computers that do not have an RS-232 serial port.

The display clear function is usually connected to a momentary pushbutton within reach of the operator. Due to the vast number of button styles and mounting positions, the push button must be supplied by the installer.

### 3.2 Installing the Unit

The MBC-1.5 should be installed in a place that is convenient to the input devices. AC power sources should be near both the MBC-1.5 control unit and the display device(s). External device connections to the MBC-1.5 are made via removable screw terminals. Power and data transmit through device specific connectors.

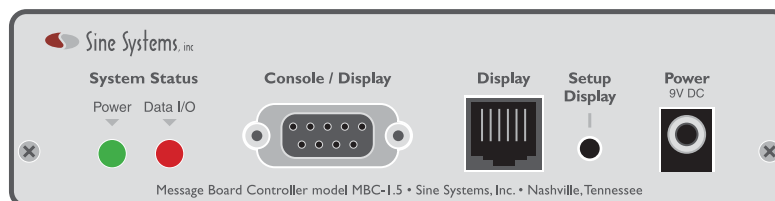


Figure 3.1; MBC-1.5 panel connections

#### 3.2.1 Status Indicators

There are two LED indicators on the MBC-1.5. The “Power” LED lights when power is applied to the unit and the “Data I/O” LED lights when data is transmitted to either the display or the programming console.

### 3.2.2 Power Connection

The MBC-1.5 is powered by a 9 volt DC supply. Do not apply power to any devices until all connections are made.

### 3.2.3 Console Connection

The 9-pin D connector is used to connect the MBC-1.5 to a computer for setting up the logic inputs. This connection can also be used to drive displays when long cables are required and/or multiple displays are connected.

For setup tasks, a 9-pin serial data cable (provided) should be connected to a computer and to the port labeled "Console / Display" on the MBC-1.5. The computer must have an RS-232 serial port available for this connection. A USB connection with an appropriate serial port adapter may also work with drivers and support from the host PC.

*The console programming cable does not need to be connected for normal operation.*

Programming the logic inputs is discussed later in this section of the manual.

### 3.2.4 Single Display Connection

An RJ-12 modular type connector is available for direct connections to a single Beta-Brite display. A crossover, or reverse, cable is needed when this connection is used. A crossover cable flips the conductor pairs: 1-6, 2-5, 3-4. This connection should only be used for short cable runs. Detailed information on cable types and lengths follows.

When a single display is used and the cable run is relatively short, less than 50 feet, a 6-conductor silver satin crossover cable terminated at both ends with RJ-12 modular style connectors should work. This cable is readily available, easy to use and cheap. This is the plug and play solution when installing an MBC-1.5. Simply snap a modular connector into both the MBC-1.5 and the Beta-Brite and the display connection is made.

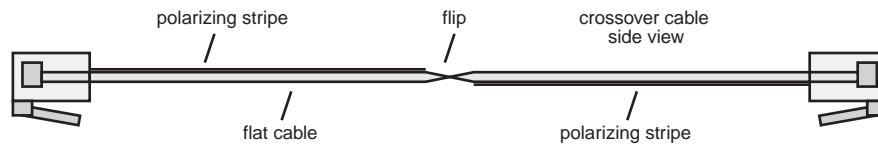


Figure 3.2; Crossover cable with modular connectors

A cable of this type is included with the MBC-1.5. The cable is 7 feet long and is suitable for setup and testing.

### 3.2.5 Multiple Display Connections

The MBC-1.5 contains a high capacity output stage that is capable of driving several Beta-Brite message displays. There is no absolute rule to determine the number of displays that can be connected. The number of displays is a function of the total length of cable used to connect the displays and the type of cable used.

When short runs of cable are used, the MBC-1.5 can theoretically drive more displays than a typical installation will need. The number of displays drops significantly, when longer cable runs are used. In most cases, the MBC-1.5 should still be able to drive several displays. The guidelines in the next section regarding long cable runs are particularly critical when more than one display is connected.

Only one display can be connected to the RJ-12 modular connector. When multiple displays are used, the 9-pin D connector is used and a custom cable must be made. Cable connectors and adapters are available separately.

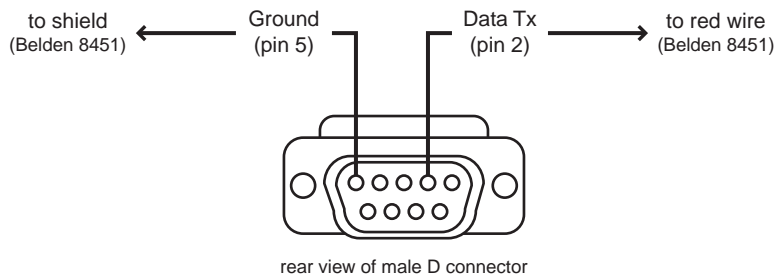


Figure 3.3; Shielded cable to 9 pin D connector for display(s)

When multiple displays are used, if one display is located within 50 feet of the MBC-1.5, connect that display using the RJ-12 modular connector. Connect the rest of the displays that are farther away to the 9 pin D connector. All displays will receive the same commands from the MBC-1.5 no matter which data connector is used.

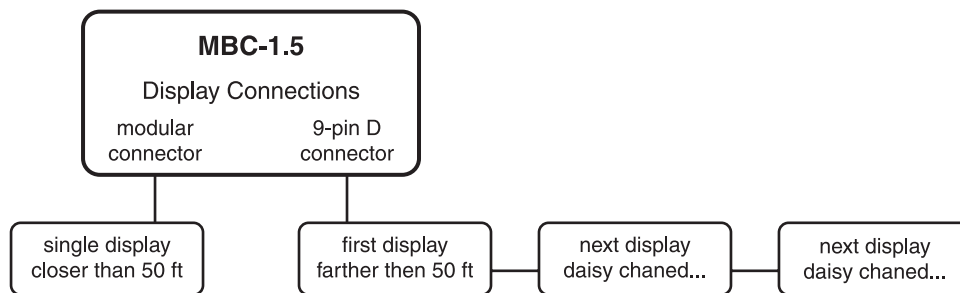


Figure 3.4; Multiple display connection diagram

With multiple displays, the goal is to keep the total cable length as short as possible. In many cases, displays can be daisy chained to each other rather than wired directly back to the MBC-1.5. This minimizes the overall cable load.

### 3.2.6 Long Cables / Multiple Display Cables

An installation where the display is more than 50 feet from the MBC-1.5 requires shielded cable. Unshielded, silver satin modular cable may work beyond that length but it is not the best choice. Signal loss in the cable may result in reliability issues. Shielded cable cannot be terminated with modular connectors so the display is attached to the 9-pin D connector on the MBC-1.5. At the display end, an adapter box converts the shielded cable back to a modular connector for the display. The adapter is part of an cable kit for the MBC-1.5.

At installations where the display is 50 to 250 feet from the MBC-1.5, foil shielded cable such as Belden 8451 is recommended. Only one conductor and the shield are used—the unused wire can be cut off. Usually the red wire is used and the black wire is discarded.

Signal loss in the cable becomes a much larger concern when the display is farther than 250 feet from the MBC-1.5 controller. The RS-232 specification was not intended for cables longer than 25 feet. Foil shielded, twisted pair cable is recommended in this case.

Cable runs in excess of 1000 feet usually require a short-haul modem. A short-haul modem boosts the signal and allows the display to be located over a mile from the MBC-1.5.

### 3.2.7 Cable Termination

When shielded cable is used, it should be terminated with a 9-pin D connector at the end that will attach to the MBC-1.5. The Beta-Brite only receives data so two conductors are needed. Use an insulated conductor for the data connection and use the shield for the data ground connection.

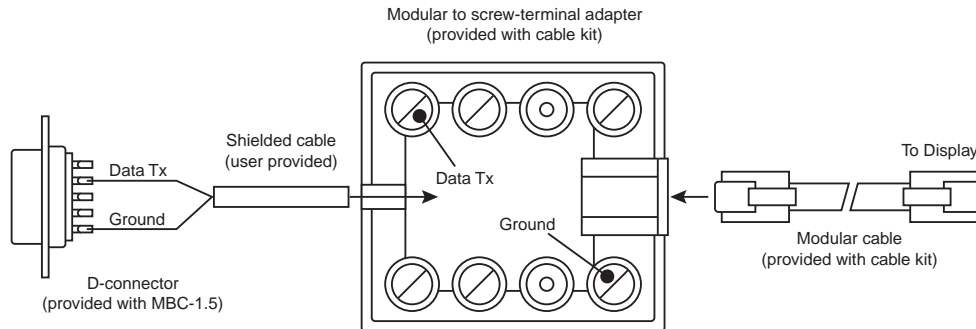


Figure 3.5; Connecting a shielded cable to a modular jumper for the display

The Beta-Brite has a modular connector that does not accommodate shielded cable. A short RJ-12 cable and an RJ-12 to screw-terminal adapter are included in the cable kit. These form a simple and reliable connection between the shielded cable run and the modular jack on the Beta-Brite.

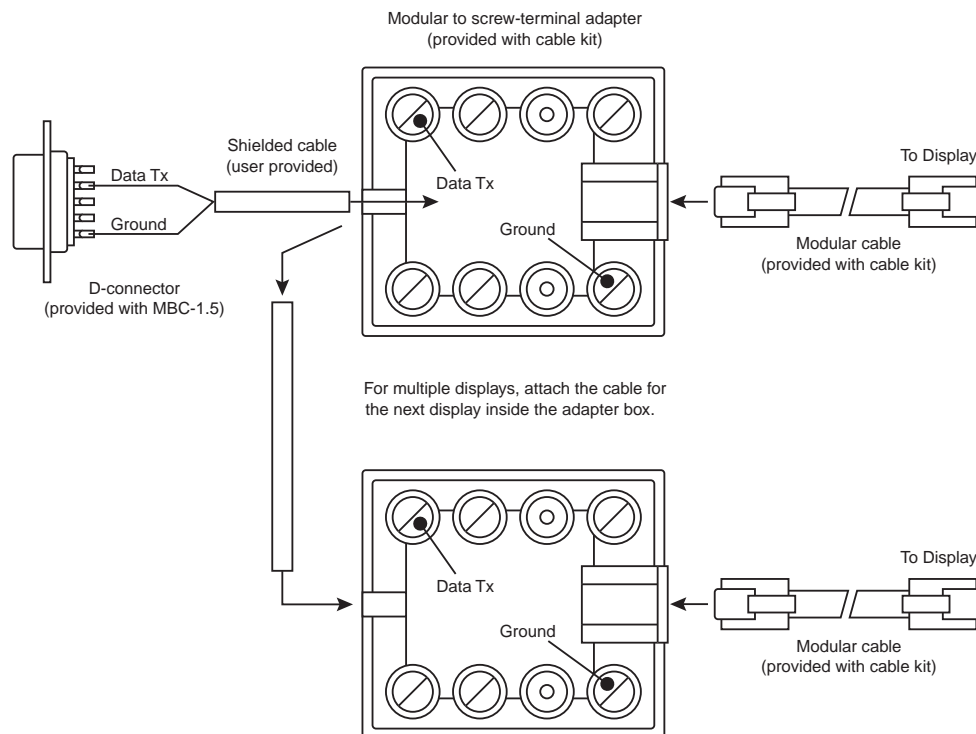


Figure 3.6; Connecting a shielded cable to a modular jumper for the display

Multiple displays are connected between the adapter boxes. Each display connects to the adapter of the previous.



### 3.2.8 Device Input Connections

The MBC-1.5 has 16 inputs. Inputs 1 through 15 are display input and input 16 clears the display. All inputs are connected through removable screw terminal connectors.

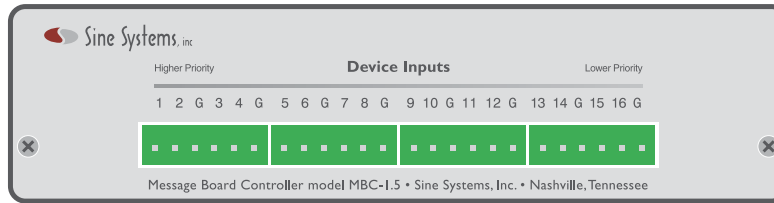


Figure 3.7; Device input connections

A logic-low, pull-down to ground, activates an input. The schematic below shows the internal configuration of the inputs. Each input has a 22 K pull-up resistor. The CMOS gate is protected by a pair of clamp diodes and the 22 K series resistor limits the current during clamping. The internal clamping allows the inputs to be connected to a voltage up to 50 volts DC. The inputs have transient protection up to  $\pm 350$  volts.

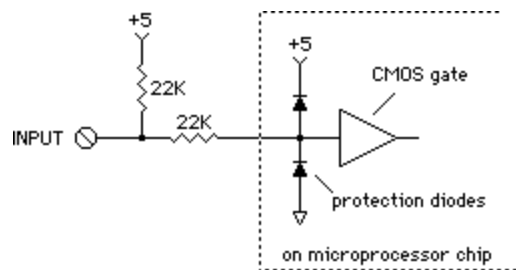


Figure 3.8; Electrical configuration of MBC-1.5 logic-level input

The inputs can be activated with a relay contact connection to ground, an open-collector driver, +5, +12 and +15 volt logic-levels, or it can "piggy-back" on an external control circuit. When connecting to control circuitry with logic-levels greater than +5 volts (+12 for example) be sure the MBC-1.5's internal 22K resistor connected to +5 volts does not prevent the external circuitry from working properly. Also, be sure the ground potential of the MBC-1.5 is at the same potential of the external equipment's ground.

The diagram below shows how the MBC-1.5 can be connected to, for example, a higher voltage control signal.

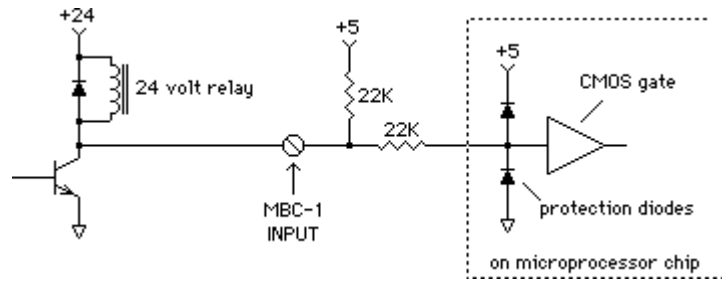


Figure 3.9; MBC-1.5 input tied to a shared 24-volt control signal

The external device, in this case a relay, is of sufficiently low impedance that 22 K resistor connected to +5 volts has negligible effect.

Input number 16, the clear-display input, is typically connected to a normally open pushbutton (not included) at a location convenient to the operator. All other inputs have internal de-bouncing. They must remain stable for 30 milliseconds to trigger.

### 3.2.9 Telephone Ring Detection / Ground Isolation

For telephone ring detection or other applications where ground isolation is required, the model OC-2 Optocoupler is available. The OC-2 can isolate two display inputs with a sensitive, bipolar opto-isolator. The inputs to the OC-2 may be AC or DC coupled. The following is a schematic diagram of the OC-2:

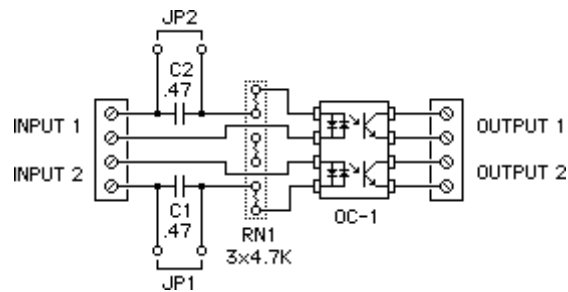


Figure 3.10; Optional OC-2 opto-isolator

### 3.3 Programming the Display

All display information (text, pictures, colors, fonts, etc.) is stored in the display device. The Beta-Brite display ships from the factory with no messages programmed except for a demonstration sequence that initiates at power up. A hand-held infrared programmer is included with the Beta-Brite that allows you to compose and store a variety of display messages. Messages stored in the Beta-Brite will remain in memory for several days without power.

Stored messages in the Beta-Brite are identified with a single letter "A...Z" (TEXT A, TEXT B, etc.). Stored messages are recalled with this identifier. When the MBC-1.5 inputs 1-15 are activated text messages TEXT A...TEXT O respectively are displayed.

The MBC-1.5 can store a list of commonly used displays into the Beta-Brite. These messages can be used as is or they can be used as a starting point for customized programming.

To load the Beta-Brite with the factory message set, connect the Beta-Brite display to the MBC-1.5 as described earlier in this documentation. Apply power up the MBC-1.5 and the Beta-Brite. Wait several seconds for the power up self-test display to complete. Press and hold the button labeled "Display Setup" on the MBC-1.5 for 3 seconds.

The load sequence will take several seconds to complete; the Beta-Brite will beep 3 times when the procedure is complete. During the load sequence, the Beta-Brite may show random displays--this is normal.

As a precaution against accidental display erasure and reprogramming, the load sequence is only available for one minute after power up. *The "Display Setup" button deactivates one minute after system power up.*

The table below shows the messages that are stored in display memory by the load sequence.

Input	Priority	Message Location	Message Duration	Display Content
1	1	TEXT A	Until cleared	FIRE
2	2	TEXT B	Until cleared	TRANSMITTER OFF
3	3	TEXT C	Input duration	ON AIR
4	4	TEXT D	Until cleared	Audio Failure
5	5	TEXT E	Until cleared	Security Alert
6	6	TEXT F	Until cleared	EAS Alert
7	7	TEXT G	Until cleared	Weather Bulletin
8	8	TEXT H	Until cleared	News Bulletin
9	9	TEXT I	Until cleared	Recording
10	10	TEXT J	Input + 5 seconds	Hotline
11	11	TEXT K	Until cleared	Front Door
12	12	TEXT L	Until cleared	Back Door
13	13	TEXT M	Input duration	APPLAUSE
14	14	TEXT N	Input duration	Quiet Please
15	15	TEXT O	Input duration	Taping
16	max	TEXT P	[idle display]	[blank]

It is generally easier to use the load sequence to clear and format the Beta-Brite memory and then edit the messages as needed.

## 3.4 Programming the MBC-1.5

The MBC-1.5 can be programmed to accommodate different input sources. Detecting a ringing telephone line is distinctly different from detecting a constant relay closure and it should be treated differently. Each of the inputs on the MBC-1.5 can be programmed with its own display mode:

- 5 seconds display
- 10 seconds display
- 15 seconds display
- 30 seconds display
- 45 seconds display
- 60 seconds display
- Input signal duration--similar to "momentary" mode in the MBC-1
- Input signal + 5 seconds--similar to "stretched" mode in the MBC-1
- Display until cleared--similar to "latched" mode in the MBC-1

The original MBC-1 had 3 display input modes shown below. The MBC-1.5 expands on these by adding some fixed timed display modes.

- Latched--a momentary input activates a display that remains active until cleared
- Momentary--a display is active as long as the corresponding input is held low
- Stretched--a display is active as long as the input is held low, plus 6 seconds

Latched mode is useful for high priority messages such as weather bulletins. A momentary input will cause the display to come on and stay on until an operator acknowledges it by clearing the display.

Momentary mode is best for things like an ON AIR display. The display follows the control signal. For example, a mic relay can activate the ON AIR display when the mic is on and deactivate the display when the mic is off.

Stretched mode is similar to momentary mode but the display is extended a few seconds longer than the input signal. The display starts when the input is activated but it stays on for 5 seconds after the input signal ceases. This is useful to indicate short input signals or fluctuating signals like a ringing telephone line. The 5-second timer starts when the input signal stops. If the signal repeats, the timer restarts.

The timed display modes are exactly that. The display will last as long as the timer indicates no matter what the state of the input signal is. The timer starts when the input signal first appears and runs to completion.

### 3.4.1 Input Priority

The MBC-1.5 inputs are prioritized to avoid a display conflict when multiple input signals are present. Lower numbered inputs are higher priority. However, despite its larger number the clear display input, #16, has a higher priority than all other inputs.

When more than one input signal activates at the same time, the lowest numbered input signal activates first. If a higher number display is active and a lower numbered input becomes active, the display will change to indicate the lower numbered, higher priority, input. The status of the lower priority display will be maintained in memory and when the higher priority display clears, the lower priority display will continue.

If several inputs are active, the display will show the next highest priority message that is pending until all messages have expired or have been cleared. See *Clearing Displays* below for more details.

### 3.4.2 Clearing Displays

The MBC-1.5 clear display input, #16, is used to clear the active display. This input is usually tied to a *momentary* switch that allows personnel to acknowledge and clear the display. It does not matter what display mode is programmed for the input, the clear command immediately terminates the highest priority display. If other inputs are pending, the next highest priority message will be displayed.

The clear display input can also clear all pending displays at once. If several messages are pending, holding the clear input signal for approximately 3 seconds will clear all pending displays. This function, while useful in certain situations, could result in important messages being missed. It should be used sparingly if at all.

### Host Cable

As described earlier, a 9-pin straight through serial cable is required to reprogram the MBC-1.5 input display mode settings. One end should be connected to an unused serial (com) port on the host computer and the other end should be connected to the D connector labeled “Console / Display” on the MBC-1.5. A USB connection with an appropriate serial port adapter may also work with drivers and support from the host PC.

### Software Settings

Adjusting the display mode settings requires a computer with a serial port and terminal emulation software. Typically this task will be performed on a PC running Windows in which case the HyperTerminal program should be available. Other platforms should work as long as an RS-232 serial port and appropriate software are available.



Figure 3.11; HyperTerminal setup screen

Set the software communications parameters to 9600 bits per second, 8 data bits, no parity, 1 stop bit and no flow control. If HyperTerminal is used, the setup window will look similar to the image above.

### 3.4.5 Display Mode Settings

After the serial data cable is connected, the MBC-1.5 is powered and the communications software is running; press the Enter (or Return) key one or two times and a screen similar to the following should be displayed:

```
Model MBC-1.5
Version 1.50
Sine Systems, Inc.
```

```
Main Menu
```

```
[1] Program input display modes
[2] Restore factory defaults
```

```
Enter option number or [Esc] to exit:
```

Suppose one or more inputs are to be reprogrammed. Enter 1 from the main menu to access the Input Programming menu. A list of the current settings will then be displayed on the terminal. It will look similar to the following:

```
Model MBC-1.5
Input Programming
Current settings:
```

```
Input 1: Display until cleared
Input 2: Display until cleared
Input 3: Input signal duration
...
Input 15: Input signal duration
```

```
Enter number of input to modify then press [Enter] or [Esc] to exit:
```

As an example, input 7 is to be programmed for a timed display of 30 seconds. At the prompt press 7, the input number to reprogram, followed by the Enter key. A new menu will appear similar to this:

```
Input 7
Message display options:
```

```
[1] 5 seconds
[2] 10 seconds
[3] 15 seconds
[4] 30 seconds
[5] 45 seconds
[6] 60 seconds
[7] * Input signal duration
[8] Input signal + 5 seconds
[9] Display until cleared
```

```
* Current setting
```

```
Enter number from list to set display mode for this input:
```

The item with the asterisk (\*) indicates the current display mode for the selected input. Press 4 at the prompt, selected from the options list, for a timed display of 30 seconds. The Input Programming list will be updated with the new setting.

```
Model MBC-1.5
Input Programming
Current settings:

Input 1: Display until cleared
Input 2: Display until cleared
Input 3: Input signal duration
...
Input 7: 30 seconds
...
Input 15: Input signal duration

Enter number of input to modify then press [Enter] or [Esc] to exit:
```

When changes are complete, press the Esc key to return to the main menu.

The display modes programmed in the MBC-1.5 are stored in nonvolatile memory. The programming will be retained even after extended periods without power.

Continue making changes as describe above until all inputs are set to the desired display mode. When setup is complete, press the Esc key again to exit the system setup and return the MBC-1.5 to operating mode. The system cannot operate the display until setup mode is terminated—programming mode will terminate automatically after approximately 4.5 minutes of inactivity.

### 3.4.6 Restore Default Settings

The MBC-1.5 can be reset to the factory settings. From the main menu enter the option to restore factory defaults.

```
Model MBC-1.5
Version 1.50
Sine Systems, Inc.

Main Menu

[1] Program input display modes
[2] Restore factory defaults

Enter option number or [Esc] to exit:
```

In this example, press 2 to execute the system restore function. Don't worry, you will have to confirm this action before anything else happens. A screen similar to the following will be displayed with a progress indicator. The process will complete very quickly. When the process is complete, press any key to return to the main menu.

```
Model MBC-1.5

Restore system to factory default settings?

Enter [Y] to continue, [N] to cancel or [Esc] to exit:

Restoring: #.##....#....#.
System restored

Press any key to continue
```

### 3.4.7 Compatibility Issues

Some users of the previous model, the MBC-1, have experienced a compatibility problem while trying to connect to the MBC-1 using the HyperTerminal program. This issue has been resolved with MBC-1.5.

The issue usually occurs when the HyperTerminal communications settings are set incorrectly. Specifically, the 3-wire serial cable described in the documentation requires that "flow control" is set to either "none" or "software", preferably none (see Figure 3.11 above). The 3-wire serial cable does not provide the signals for hardware flow control.

The COM ports on some computers compensate for the missing flow control signals no matter what setting is used. Some systems will not work at all. This is rare but when it occurs, the only known solution is to use software other than HyperTerminal.

There are several freeware terminal emulation software programs available. A search of your favorite download site should turn up at least a few options. Tera Term Pro is a no-frills software terminal that supports direct serial connections. It is easy to install and the default settings work fine to connect with the MBC-1 and the MBC-1.5.

When using Tera Term Pro, the only adjustment needed is to select the "Serial" option and choose the COM Port that is appropriate for your computer on the "New connection" window. This window opens after Tera Term loads.

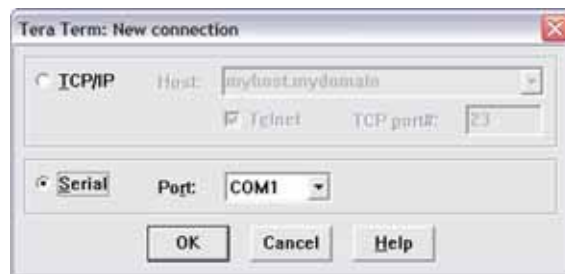


Figure 3.12; Tera Term Pro Setup Screen



## Section 4 — Circuit Description and Repair Information



**WARNING!**

*Only qualified technical personnel should install and service the MBC-1.5. An attempt to service this device by a person who is not technically qualified could result in a hazardous condition to the installer or other personnel, and/or damage to the MBC-1.5 or other equipment. Ensure that safety precautions are made before installing this device.*

### 4.1 Circuit Description

The heart of the MBC-1.5 is a Motorola MC68HC711 microcontroller. This device contains the microprocessor, program ROM, nonvolatile EEPROM, timers, serial interface and parallel input/output. The 9-volt DC wall plug power supply is regulated by a 78M05 (or equivalent) voltage regulator. The resulting 5-volt DC supply powers all active components in the MBC-1.5

Pin 2 of U5, MN1381S or equivalent, should be approximately equal to the +5 volt supply. If the supply voltage drops below approximately 4.5 volts, this device clamps pin 2 to ground and prevents the microprocessor from operating from a supply voltage that would produce erratic behavior.

The clock source for the microcontroller is an 8.00 MHz crystal. When the microcontroller is operating properly there will be a 2 MHz square wave on the microcontroller pin labeled "E" on the schematic. If this signal is not present then the processor is not running. This is typically caused by a defective power supply or a failed clock oscillator circuit.

The logic-level device inputs are pulled up to +5 volts DC and current limited by a pair of resistor networks. These signals are then accumulated by the microcontroller that assigns the correct priority to an input and triggers the appropriate message on the display device.

Serial communications with both the display device(s) and programming console are handled by the microcontroller with assistance from a MAX202, or equivalent, RS-232 level shifting IC.

A 74xx02N quad NOR IC monitors and inverts data signals between the microcontroller and RS-232 level shifter to drive the data I/O indicator LED.

When servicing the MBC-1.5, measure the output voltage of the +5 volt regulator. If the voltage is not within about +/- 0.1 volts then there is a power supply problem or another part is dragging down the supply. Carefully remove all the ICs from their sockets to help isolate the supply and test the regulator output again. Determine the failed component(s) by process of elimination.

It may be easier to return the damaged device to Sine Systems for service. The factory service policy is given below.

## 4.2 Factory Service Policy

Sine Systems, Inc. does not provide warranty or service on display devices. Service and/or warranty issues with display devices should be directed toward the appropriate vendors and/or manufacturers.

These policies are effective January 2006 and are subject to change without prior notice. Up to date service policies, instructions and rates can be found on our web site, <http://www.sinesystems.com>.

### 4.2.1 Factory Warranty

Sine Systems, Inc. guarantees our products to be free from manufacturing defect for a period of one year from the original date of purchase from Sine Systems, Inc. This warranty covers the parts and labor necessary to repair the product to factory specifications. This warranty does not cover damage by lightning, normal wear, misuse, neglect, improper installation, failure to follow instructions, accidents, alterations, unauthorized repair, damage during transit, fire, flood, tornado, hurricane or acts of God and/or nature.

### 4.2.2 Factory Return Policy

The factory return policy only applies to equipment purchased directly from Sine Systems, Inc. Equipment purchased through a third party (dealer) is subject to the return policy of the dealer and arrangements for return or exchange must be handled through the dealer.

Sine Systems policy on returns and exchanges with the factory is broken down according to the following schedule:

*30 days "no questions asked"*

During the first thirty days from the date that equipment ships from our factory we will accept it back for a full refund less shipping charges provided that the equipment is still in new, resellable condition with no cosmetic damage. This does not constitute an evaluation program. It is for legitimate purchases only.

*Fewer than 60 days, may be returned less 15% restocking fee*

Between 31 and 60 days from the time we ship the equipment, we will accept unmodified equipment back for a refund less shipping charges and 15% of the invoice cost. This is to cover the cost of restocking the items which must then be sold at a discount as reconditioned instead of new.

*No return after 60 days*

We will recondition the equipment for you according to our repair rates but we will not accept it for refund or exchange after 60 days from the initial purchase.

### 4.2.3 Factory Service Policy

Sine Systems is proud to offer same day repair service on all of our products. When we receive damaged equipment, we will repair it and ship it back the same day it arrives. Because we offer immediate service, *we do not send loaner equipment.*

We do not require prior authorization on repairs, we suggest visiting our web site, <http://www.sinesystems.com>, and filling out a service request form. The web form provides us with the data we need to process your repair efficiently and provides you with all the information you need for sending equipment to us for service.

#### 4.2.4 Warranty Service

There is no charge for repair service on items covered under warranty. You are responsible for shipping charges to return damaged equipment to us for repair. Damage due to negligence, lightning or other acts of nature are not covered under warranty.

#### 4.2.5 Service Rates

For service not covered under warranty we have a flat rate repair fee. Flat rate repairs cover only components that fail electrically. Mechanical damage will be assessed on a per repair basis. Repair charges typically fall into one of these categories. Shipping fees are not covered in the repair rate.

*Minor programming adjustments or no damage, \$50 plus shipping*

Sometimes a system works exactly like it is supposed to when we get it or it can be fixed through a simple adjustment in firmware. We will do our best to identify intermittent hardware problems and correct them. The fee covers the time it takes our technician to thoroughly inspect and test the equipment.

*Minor repairs are up to \$150 plus shipping*

Five or fewer defective components are replaced in a minor to moderate repair. This accounts for most of our repairs. These repairs may cost less depending on the components replaced and the amount of time required to complete the repair.

*Moderate repairs are \$250 plus shipping*

Six to ten defective components are replaced in a major repair. Again, we may charge less depending on the components replaced and the amount of time required to complete repairs.

*Major repairs cost more than \$250 plus shipping*

This occurs rarely but it can happen. If the equipment has blown traces and scorch marks from burned components, it's a safe bet that it will take several components and quite a bit of bench time to repair. We assess this type of repair on a per incident basis.

*Damaged beyond recognition, assessed on a per case basis*

We hope you have insurance. In cases where the board is so badly damaged that it is not worth repairing we may, at our discretion, offer to replace the destroyed circuit board. The options and costs vary widely in these cases so we will call with options.

All repairs must be billed to a credit card or shipped COD. Specify which you prefer with your request for service. At your request, we will call with the total amount of the repair (including applicable shipping charges) so that suitable payment can be arranged before a COD shipment. If you need a COD total, do not forget to include a telephone number where you can be contacted.

## Section 5 — Specifications

### 5.1 Electrical Specifications

#### 5.1.1 Ports

24 input connections: 15 devices, 1 clear and 4 ground connections, via 3.81 mm screw terminal connectors  
1 dedicated display output to Beta-Brite via RJ-12 modular connector  
1 Console programming port (RS-232 data stream) via 9-pin female D connector also used for auxiliary display  
1 Power supply input via 2.1 mm pin connector

Inputs are activated by a logic-level low to ground. Minimum input signal duration is 30 milliseconds. External sources can be switch closures, open-collectors drivers or logic-level sources. The input impedance is 22 kOhms.

#### 5.1.2 Indicators

Power: green LED  
Data I/O: red LED

#### 5.1.3 Data Format

Display communications (Beta-Brite): 4800 baud, 7 data bits, even parity, 2 stop bits  
Console communications (computer): 9600 baud, 8 data bits, no parity, 1 stop bit

#### 5.1.4 Power

Input: 100-120 Volts AC, 60 Hz, 5 watts  
Output: 9 Volts DC, 500 mA max

### 5.2 Mechanical Specifications

#### 5.2.1 Dimensions

Size: 5.5" (w) x 5.0" (l) x 1.60" (h)  
Weight: 1 lb.

#### 5.2.2 Environmental

This device does not generate a significant amount of heat. It should only be installed indoors in a dry environment.