



**"Results You Can Count On"**

**Model 458-SM-2-16**

**Transparent Switching Module**

**Rev. B**

**7/30/2011**



*The 458-SM-2-16 shown installed in the 458-3SLB (not included).*



## Customer Support

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## Warranty

### Included With Your Purchase

#### ***One-year Warranty***

- Telebyte will furnish parts and labor for the repair or replacement of products found by Telebyte to be defective in material or workmanship during the warranty period.<sup>1</sup>

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## **Equipment Returns**

Out of warranty equipment may be returned, prepaid, to the Hauppauge, N.Y. customer service facility. Return shipping charges will be billed to the customer. The repaired unit will have a 90-day warranty. In those cases where "no trouble" is found, a reduced charge will be billed to cover handling, testing, and packaging. Whether in or out of warranty, a Return Material Authorization number (RMA) is required and may be obtained by going to [www.telebytebroadband.com](http://www.telebytebroadband.com) and opening a technical support case.

Please be sure to reference the RMA number on the outside container.



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## 1.0 Specifications

<b>Product Specifications</b>	
<b>Signal Switching Capability</b>	<p><i>Multiplexing:</i></p> <ul style="list-style-type: none"> <li>• 16 balanced input lines to 1 of 2 balanced output lines (16x1); or</li> <li>• 16 balanced input lines to both balanced output lines (8x2)</li> </ul> <p><i>Demultiplexing:</i></p> <ul style="list-style-type: none"> <li>• 1 balanced input line to 16 balanced output lines (1x16); or</li> <li>• 2 balanced input lines to 8 balanced output lines each (2x8)</li> </ul>
<b>Insertion Loss</b>	<p>Less than 0.5 dB from DC to 30 MHz            Less than 1 dB up to 60 MHz</p>
<b>Noise Floor</b>	Less than -140 dBm/Hz from DC to 30MHz
<b>Tip and Ring Balance</b>	<p>Better than 53 dB up to 12 MHz            Degrading by 20 dB per decade from 12 MHz to 30 MHz</p>
<b>Return Loss</b>	26 dB minimum up to 30 MHz (100-ohm reference)
<b>Crosstalk Between Lines</b>	Maximum -90 dB up to a minimum frequency of 30 MHz
<b>Temperature</b>	<p>Operating: 0°C to 50°C (32°F to 122°F)            Storage -20°C to 70 °C (-18°F to 158°F)</p>
<b>Operating Relative Humidity</b>	0% to 95% relative humidity (non-condensing)
<b>Dimensions</b>	<p>Overall: 12.21"H x 0.86"W x 20.85"D            (310mm H x 22mm W x 529mm D)</p>
<b>Connectors</b>	16 RJ-45's on front, 2 RJ-45's on back
<b>Relay Cycles of Operation</b>	5,000,000 cycles
<b>Toxic Materials</b>	Complies with RoHS Directive

Specifications are subject to change without notice. Made in USA.



## 2.0 Description

### 2.1 General Description

The Model 458-SM-2-16 Transparent Switching Module (referred to as the Switching Module throughout this document) is a transparent, electronically neutral multiplexing device that allows up to sixteen incoming lines to share (be directed to) one or two independent output channels.

The Switching Module is bi-directional and does not contain active electronic components in the signal path between input and output connectors. Therefore, it may be used in the reverse direction as a demultiplexer to direct one channel to one of sixteen independent lines, or two independent channels to one of eight independent lines.

A high-level block diagram of the Model 458-SM-2-16 as a Multiplexer connected to a Telebyte Line Simulator (Local Loop Simulator) is shown in Figure 1. The Matrix Block switching is accomplished by double coil state-stable 'latch' relays that are powered and switched by logic commands generated by the firmware interface to select or change the input to output paths. The Telebyte Line Simulators use the same state-stable relays to allow the selection of line lengths for each of its various Channels. Therefore, the loss of power to the Switching Modules and Line Simulators do not change settings allowing the Switching Modules and Line Simulators to continue functioning during power loss and at power recovery at its last setting.

The 458-3SLA (3-Slot) Chassis shown on the front cover would utilize one Switching Module with each Line Simulator, which allows the various input signals to be selected by the Module and provided to the input Channels of the Line Simulator. However, the Switching Module may be used alone or in any mixed combination, and located in any desired slot of the chassis enclosure.

Figure 1 shows a high-level block diagram of the Model 458-SM-2-16

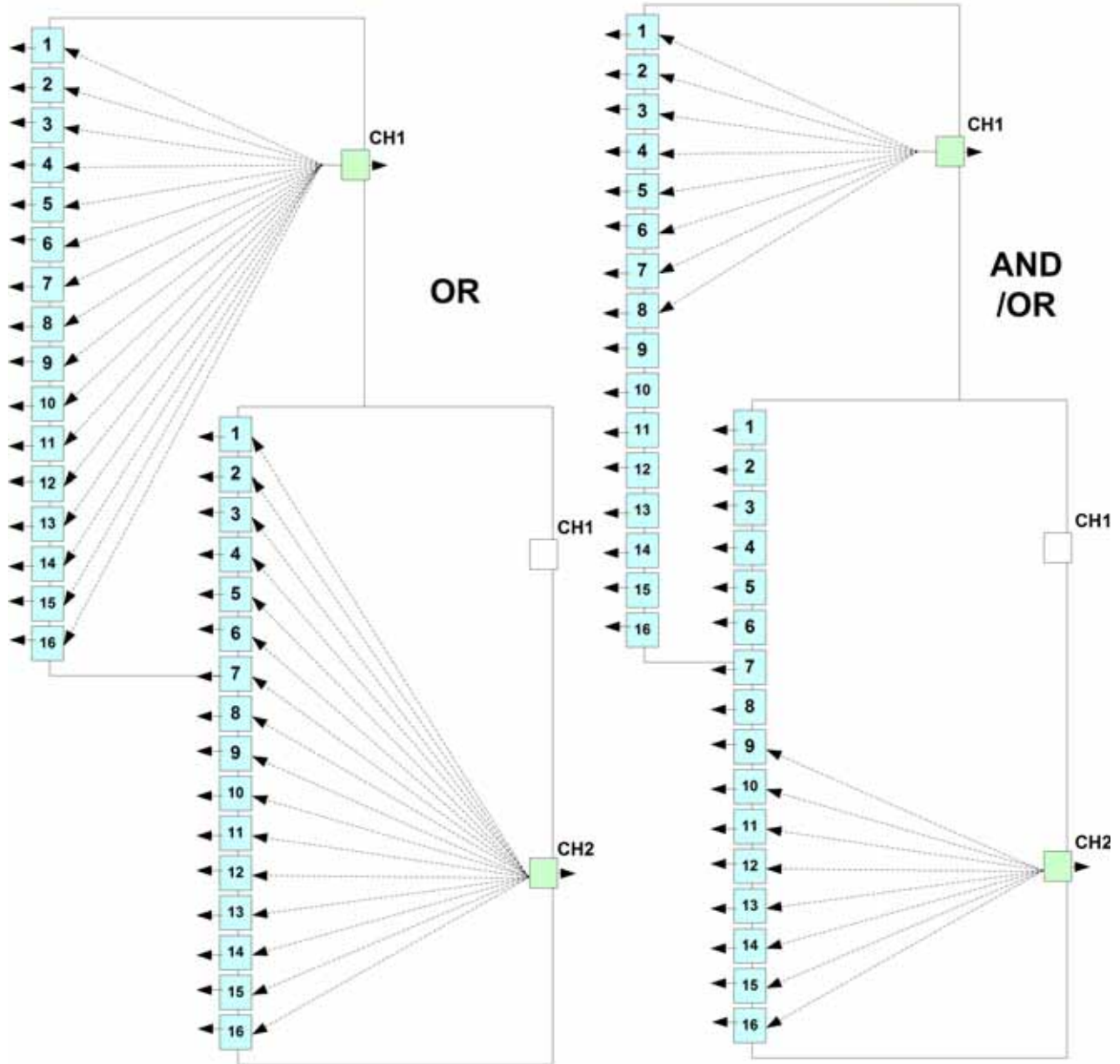
**Model 458-SM-2-16**  
**2 x 16 Transparent Switching Module**

**1 x 16 Configurations:**

- #1: Output CH1 to Input Signal 1-16
- #2: Output CH2 to Input Signal 1-16

**1 x 8 Configurations:**

- #1: Output CH1 to Input Signal 1-8 AND/OR
- #2: Output CH2 to Input Signal 9-16



All unconnected  
ports terminated in 100 ohms

**Figure 1:** High Level Block Diagram of Model 458-SM-2-16





## 2.2 Operation as a Multiplexer

The front of the Switching Module contains sixteen RJ-45 connectors in two groups of eight RJ-45's. Therefore, each Switching Module can accept and multiplex up to sixteen independent incoming differential lines to one or two outgoing differential lines.

The rear of the Switching Module has two R-J45 Output Connectors where each connector can be assigned to one differential Input Signal. Therefore, two of the sixteen Input Signals can be multiplexed to the two Output Connectors, and the two Switching Module outputs can be directly connected to two independent channel inputs of the Telebyte family of Local Loop Simulators, or other similar devices.

The Switching Module operates in three possible modes:

- In the first mode, the Output Channel 1 RJ-45 rear connector can select any of the 16 incoming lines (Input Signals) from the 16 RJ-45 front connectors. Selection of incoming lines 9 through 16 is allowed only when the Output Channel 2 rear RJ-45 connector path is disabled.
- In the second mode, the Output Channel 2 RJ-45 rear connector can select any of the 16 incoming lines (Input Signals) from the 16 RJ-45 front connectors. Selection of incoming lines 1 through 8 is allowed only when the Output Channel 1 rear RJ-45 connector path is disabled.
- In the third mode, the block of 16 incoming lines (Input Signals) are partitioned into two groups of 8 signal inputs. The Output Channel 1 RJ-45 rear connector can select any of the incoming lines 1 through 8, and the Output Channel 2 rear RJ-45 connector can simultaneously select any of the incoming lines 9 through 16.

Switching between modes is permitted only when the specified Output Channel is selected. This prevents a channel from being discontinued when not specified in a command. Therefore, when switching modes it may be necessary to disable the other channel (see Truth Table).

The selection and control of the paths from input to output is through firmware installed on the Telebyte 458-CM that is associated with the 458-CC-16 (16-Slot) chassis, or on the 458-3SL/3SLA (3-Slot) chassis. The commands are provided in the Appendix. The basic command consists of three numbers:

- The physical slot location of the Module in the chassis to be changed. The location of slot 1 is at the left side of the 458-CC-16 (16-Slot) chassis and is the top slot of the 458-3SL/3SLA (3-Slot) chassis.
- The Output Channel (output connector 1 or 2) that the signal is to go to. The location of Channel 1 is the upper connector at the rear of the Switching Module.
- The Input Signal (1 through 16) that is to be selected to go to the selected Output Channel, including no signal. Input Signal 1 is the upper RJ-45 connector of the upper RJ-45 block, and Input Signal 16 is the bottom RJ-45 connector of the lower RJ-45 block on the front of the Switching Module.

The same Input Signal of each of the sixteen inputs is prevented from being routed to more than one Output Connector by two different control systems, which prevents impedance division.

- The Matrix Block relay logic is configured as an 'exclusive or' (XOR) so that only one input can be switched to only one output.
- The firmware logic that controls the selection prevents the selection of more than one input of the group for each output, and prevents the input from use at any other output.



To minimize input signal reflections and source noise, all unselected input signal lines are terminated with a 100-ohm 0.25 watt resistor, and all unselected channel output lines are source terminated with a 100-ohm 0.25 watt resistor.

### **2.3 Operation as a Demultiplexer**

Model 458-SM-2-16 Transparent Switching Module may also be used as a demultiplexer. The paths between the input and output connectors are bi-directional, which allow signals to flow in either direction without a change in the signal characteristics. Therefore, two input signals may be connected to the RJ-45 rear connectors, and provide the selection of up to sixteen outputs at the front 16 RJ-45 connector lines. The selection of the paths and the firmware control logic in the demultiplexer configuration is identical to the control logic and selection when used as a multiplexer. The paths are:

- Mode 1: The upper RJ-45 rear connector input signal may connect to any one of the front 16 RJ-45 differential lines when the lower-rear RJ-45 is not selected.
- Mode 2: The lower RJ-45 rear connector input signal may connect to any one of the front 16 RJ-45 differential lines when the upper-rear RJ-45 is not selected.
- Mode 3: The upper RJ-45 rear connector input signal may connect to any one of the front RJ-45 connectors 1 through 8 differential lines and the lower RJ-45 rear connector input signal may connect to any one of the front RJ-45 connectors 9 through 16 differential lines.



## 3.0 Mechanical Specifications

The Model 458-SM-2-16 mechanical design is based on the mechanical dimensions of the Telebyte Line Simulator product line. These units fit into the Telebyte 458-CC-16 (16-Slot) chassis and 458-3SLA (3-Slot) chassis which can be mounted in a 19-inch rack.

The overall dimensions of the 458-SM-2-16 are provided in the Specifications section and include the front and rear panels and handle dimensions.

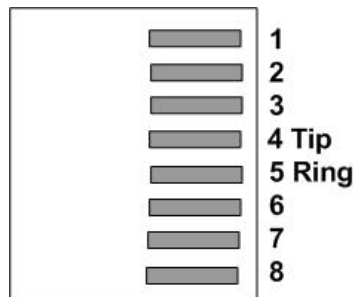
The Switching Module contains sixteen RJ-45 connectors on the front panel that provide sixteen connection paths, and two RJ-45 connectors on the rear panel that provide two connection paths.

When used in a Telebyte Model 458-CC-16 with 458-CM or a 458-3SLA chassis, a front panel LCD is available for monitoring the selection or status of each Switching Module path.

## 4.0 Connector Interface

### 4.1 Pin Numbering RJ-45

The pin numbering and location of connections to the RJ-45 connector is shown in Figure 2. The front sixteen input connectors are grouped in two blocks of eight RJ-45 connectors each.



**Figure 2:** RJ-45 Connector Pin Location



## 5.0 Environmental Specifications

All components used for the Transparent Switching Module exceed the specified temperature range of operation and storage. The continuous power consumption of the components on each Module is less than 0.05 watts and intermittent short peaks of 2.5 watts when banks of relays are being switched. These power levels are insignificant and do not contribute to temperature rise of the module or its location of use.



## 6.0 Control

### 6.1 Transparent Switching Module Commands

The Transparent Switching Module Commands are applicable to RS232 and IEEE modes.

#### 6.1.1 Command Codes And Responses

##### 6.1.1.1 Codes

**M** = Module Number

A two digit number, with leading 0, that selects the physical location/slot of the Module in the chassis (01, 02...16 for a 458-CC-16 chassis and 01, 02, 03 for a 458-3SLA chassis)

**H** = Channel Number

A one-digit number that selects one of the two rear (RJ-45) output channel connectors (referred to as Output Channel 1 or Output Channel 2).

**I** = Input Signal Number

A one- or two-digit number that selects one of the sixteen front (RJ-45) connectors (and 0) associated with signal inputs to its Matrix Block, for connection to the selected Output Channel. The examples refer to these as Input Signal 1-16.

**A** = Reset

Resets ALL Input Signals and Output Channels of the selected Module to no signal input and no channel output, and terminates each input and output in 100 ohms.

**SC** = Set Connection

Sets the selected Module Slot location to the selected Output Channel and the selected Input Signal.

**RC** = Read Connection

Reads the selected Input Signal at the selected Module and Channel.

##### 6.1.1.2 Responses

\* Indicates that a command is valid and completed execution.

? [###] \_\_\_\_\_ Indicates an invalid condition.

? [###] **Card Not Found** Indicates that a Module is not at the specified location.

? [###] **Invalid Card Number** Indicates that the Module number is outside of the system range.

? [###] **Invalid Channel Number** Indicates that the Output Channel number is outside of the Module range.

? [###] **Invalid Command** Indicates any error not covered by the above responses.

The bracketed numbers are internal control numbers.

Display responses are as above but abbreviated.\



## 6.1.2 Command Sequence

### Set Connection Command

**SC:M:H:I**

Sets Module location/slot **M** and Output Channel number **H** to Input Signal number **I**, or to **0** (terminated).  
The response is \* when the Command is accepted and execution is completed, or an Invalid Command statement.

### Read Connection Command

**RC:M:H**

Requests the Input Signal setting from Module location/slot **M**, Output Channel number **H**.  
The response is **M:H:I** where M is the Module location/slot, H is the Output Channel number, and I is the Input Signal number, or an Invalid Command statement.

### Channel Reset Command

**SC:M:H:0**

Sets Module location/slot **M** and Output Channel number **H** to 0 (no Line Number). Output Channel H differential line is terminated with a 100-ohm resistor.  
The response is \* when execution is completed, or an Invalid Command statement.

### Module Reset Command

**SC:M:A:0**

Sets Module location/slot **M**, ALL Output Channels to **0** (no Line Number). Each differential Input Signal and Output Channel source of the Module is terminated with a 100-ohm resistor.  
The response is \* when execution is completed, or an Invalid Command statement.

### Valid Module Commands (see Truth Table)

Output Channel 1 may be assigned to any Input Signal number 1-16 when Output Channel 2 is not assigned to an Input Signal.

Output Channel 1 may be assigned to any Input Signal number 1-8 when Output Channel 2 is assigned to any Input Signal number 9-16.

Output Channel 2 may be assigned to any Input Signal number 1-16 when Output Channel 1 is not assigned to an Input Signal.

Output Channel 2 may be assigned to any Input Signal number 9-16 when Output Channel 1 is assigned to any Input Signal number 1-8.



## 6.2 Transparent Switching Module Truth Tables

**Table 1 - Input Line Group Selection vs. Output Channel 1-2 for Input Signals 1-16 in Mode 3**

0 = not selected input line; no active output signal is available.

1 = selected input line; an active output signal is available.

T = Invalid Selection or indeterminate.

Channel 1 allows line 1-16 to be selected and is limited to lines 1-8 when Channel 2 is active in lines 9-16.

Channel 2 allows line 1-16 to be selected and is limited to lines 9-16 when Channel 1 is active in lines 1-8.

Line Input Selects				Active Outputs	
Channel 2 Select		Channel 1 Select		Channel 1	Channel 2
Line 9-16	Line 1-8	Line 9-16	Line 1-8		
0	0	0	0	0	0
0	0	0	1	1	0
0	0	1	0	1	0
0	0	1	1	T	0
0	1	0	0	0	1
0	1	0	1	T*	T**
0	1	1	0	T*	T**
0	1	1	1	T	T**
1	0	0	0	0	1
1	0	0	1	1	1
1	0	1	0	T*	T**
1	0	1	1	T	T**
1	1	0	0	0	T
1	1	0	1	T*	T
1	1	1	0	T*	T
1	1	1	1	T	T

\* If Channel 1 is selected first it disables Channel 2 from using the same Line group.

\*\* If Channel 2 is selected first it disables Channel 1 from using the same Line group.





### 6.3 Example Commands

The below examples are for Input Signals 1-16 and Output Channels 1-2, for the Module in location/slot 5 of the enclosure. Each example is dependent on the prior example selection state. A table is displayed that shows the same examples in a different format.

**EXAMPLE STATEMENT**

**CODE/RESPONSE**

**Example 1**

- Read the Input Signal number that is at Output Channel 2, of the Module in slot 5  
Response is: Input Signal is (0) reset/inactive and terminated.

**RC:05:2**  
**05:2:0**

**Example 2**

- Set Input Signal 3 to Output Channel 1, at the Module in slot 5.  
Response is: command completed.  
Note: Valid as Output Channel 2 of Ex 1 is inactive.

**SC:05:1:3**  
**\***

**Example 3**

- Set Input Signal 6 to Output Channel 2, at the Module in slot 5.  
Response is: invalid.  
Note: Input Signal 6 cannot be selected by Output Channel 2 as the Module is in Mode 1.

**SC:05:2:6**  
**? [###] Invalid Connection**

**Example 4**

- Set Input Signal 10 to Output Channel 2, at the Module in slot 5.  
Response is: command completed.  
Note: Output Channel 1 connection is unchanged. The Module is in Mode 3 with both Output Channel 1 and 2 active.

**SC:05:2:10**  
**\***

**Example 5**

- Set Module in slot 5, Output Channel 1, to 0.  
Response is: command completed.  
Note: Output Channel 2 is unchanged. Output Channel 1 is terminated in 100 ohms and Input Signal 3 is terminated in 100 ohms.

**SC:05:1:0**  
**\***

**Example 6**

- Terminate all Input Signals/all Output Channels of the Module in slot 5.  
Response is: command completed.  
**Note:** All 16 Input Signals and 2 Output Channels of the Module are set to a 100-ohm termination.

**SC:05:A:0**  
**\***

**Examples Shown Above, in Table Format**

Command	Slot (1-3 or 1-16) (2 Digits)	Output Channel (1-2 or A for ALL) (1 Digit)	Input Signal (1-16 or 0) (1 or 2 Digits)
RC	05	2	
SC	05	1	3
SC	05	2	6
SC	05	2	10
SC	05	1	0
SC	05	A	0



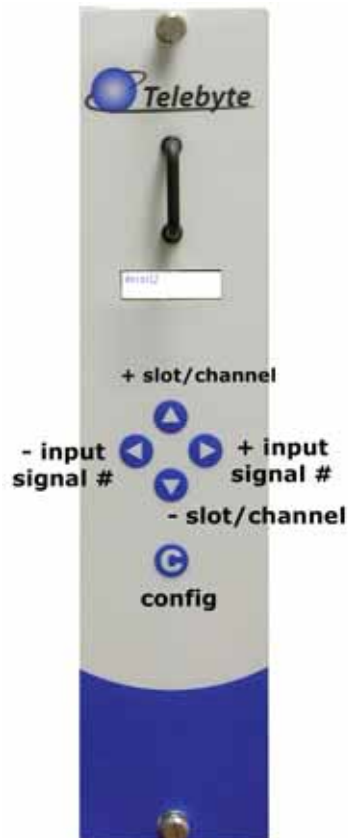
## 6.4 Manual/Keypad Controls

### 6.4.1 LCD/Keypad (458-3SLB)



The example above shows a setting of “slot 01, rear channel 1, input signal 12”

### 6.4.2 LCD/Keypad (458-CC-16/458-CM)



The example above shows a setting of “slot 01, rear channel 1, input signal 12”



## Keypad Controls (458-SM-2-16)

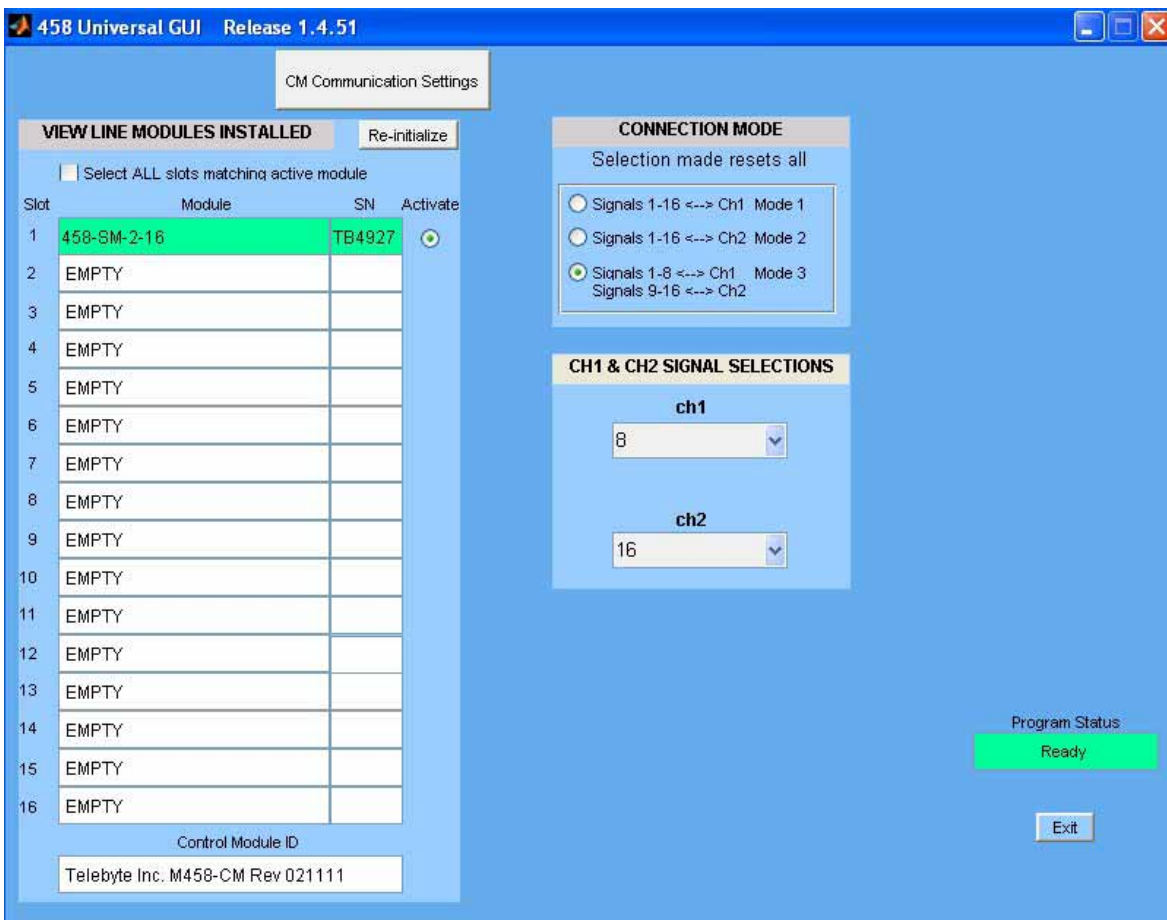
1. **Up Arrow:** increase slot/channel number
2. **Down Arrow:** decrease slot/channel number
3. **Left Arrow:** decrease input signal number
4. **Right Arrow:** increase input signal number
5. **C:** Config switch used to access second menu for communications settings such as RS232 baud rates, GPIB addresses, etc.

Baud Rates: 19200, 9600, 4800, 2400, 1200, 600

GPIB Addresses: 1 – 30

- Please note the information in this section pertains to the 458-SM-2-16 only. If using a loop simulator in the same chassis, the values shown for the slot containing the loop simulator will relate to selections appropriate for product installed. For example, the right and left arrows will increase and decrease line lengths for slot 2 if a loop simulator is installed in slot 2.

## 6.5 458 Universal Graphical User Interface



- Refer to the 458 Universal Graphical User Interface Reference Manual for more information.