

Model 5110 Mic/Line Input Module

User Guide

Issue 7, October 2014

This User Guide is applicable for serial numbers
M5110-00201 and later with firmware version 3.2 and higher

Copyright © 2014 by Studio Technologies, Inc., all rights reserved
www.studio-tech.com

This page intentionally left blank.

Table of Contents

Introduction.....	5
Installation	7
Configuration	8
Operation.....	9
Technical Notes	11
Specifications	13
Appendix A—Interconnection Details.....	14
Appendix B—Model 5110 Front Panel and Printed Circuit Board (PCB) Dimensions.....	16

This page intentionally left blank.

Introduction

The Model 5110 Mic/Line Input Module is a compact, self-contained 2-channel module intended for use in custom broadcast, live-performance, and general audio applications. Offering a “building block” of resources, the Model 5110 provides two channels of high-performance audio capability in an easy-to-use yet technically sophisticated package. The module’s basic functions include selectable input gain, 48 volt phantom power, status LED indicators, and analog and digital audio outputs. Module operation requires only an externally-provided source of 12 volts DC. Advanced features include user control “lock out” and remote monitoring and control capability.

General Highlights

The Model 5110 requires an external source of nominal 12 volts DC for operation. The acceptable input voltage range is 10 to 18 allowing a variety of power sources to be utilized. Internal power supply circuitry within the Model 5110 creates the voltages required for the analog and digital circuitry.

Standard connectors are used throughout the Model 5110. Input audio connections are made using gold-plated 3-pin female XLR connectors. A DIN 1.0/2.3 coaxial connector is used to interface with the digital audio output. The 2-channel analog audio outputs use a 5-position, 0.1-inch “header” connector. The DC power input and data bus signals use a 4-position, 0.1-inch header. Low-cost IDC (insulation displacement) mating connectors allow simple interconnection with the analog audio outputs, DC input, and local data bus signals.

For compliance with international broadcast audio level standards two versions of the Model 5110 are available. The Model 5110S supports the SMPTE® audio standards which have an analog audio reference level of +4 dBu and a digital audio reference level of –20 dBFS (SMPTE RP155). The Model 5110E supports applications that require European Broadcast Union (EBU) compliance where the analog audio reference level is 0 dBu and the digital audio reference level is –18 dBFS (EBU R68).

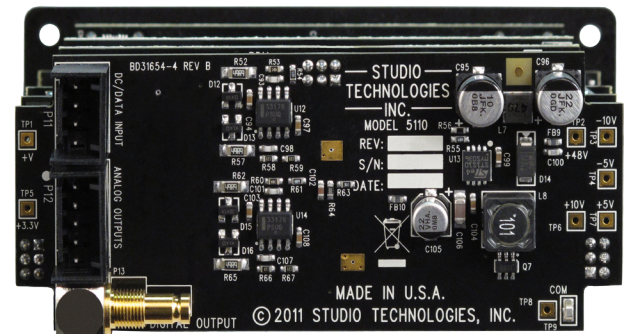


Figure 1. Model 5110S Mic/Line Input Module Front and Back Views

Applications

Applications for the Model 5110 include sports broadcasting booth packages, remote news gathering “fly-packs,” stadium audio/video interface (I/O) locations, and government/corporate/performance space infrastructure projects. The number of Model 5110 modules used in a project can vary widely—from one to dozens. And in each case the Model 5110’s performance will be completely “pro” with audio quality, reliability, and installation flexibility matching that of large-scale consoles, routers, and transport resources. Typical applications will find the Model 5110’s analog and digital outputs being interfaced with inputs on fiber-optic transport modules, audio/video routers, and broadcast/production consoles.

Model 5110 Mic/Line Input Modules do not include a mounting enclosure or chassis. They are intended for mounting in custom 19-inch rack panels, equipment boxes, broadcast furniture, or other specialized settings. It is expected that integration firms will create applications that use Model 5110 modules as part of complete broadcast, production, corporate, and government solutions.

Mic/Line Inputs

Two microphone or line-level audio signals can be connected to the Model 5110’s front panel XLR connectors. Using the front-panel pushbutton switches, the sensitivity of each input can be adjusted to one of four gain settings: line (0 dB), 15 dB, 30 dB, or 45 dB. To support high-performance microphones +48 volt phantom power can be selected as required. Status LEDs are provided to display the current settings of the sensitivity and phantom power. A 7-segment LED level meter is also provided for each channel.

Six pushbutton switches on the Model 5110’s front panel allow rapid selection of the input gain and phantom power on/off status. A simple button-press sequence allows the six pushbutton switches to be temporarily “locked out” to prevent accidental adjustment. This can be very useful in field applications, helping to ensure that unauthorized Model 5110 performance changes are not made. An LED indicator will light to alert users that pushbutton switch functionality has been disabled.

Analog and Digital Outputs

The Model 5110’s audio performance is simply excellent. The low-noise, wide dynamic-range preamplifier sections ensure that input audio quality is preserved. The outputs of the mic-preamp circuitry are routed to two analog audio output sections. These provide line-level, balanced (differential), capacitor-coupled outputs.

The audio from the mic-preamps is also routed to high-performance analog-to-digital conversion (ADC) sections that support a sample rate of 48 kHz with a bit depth of 24. A precision voltage reference assists the ADC circuits in performing accurate conversion. The signals, now in the digital domain, are formatted into AES3 digital audio. This 2-channel digital bit stream is output as a 75 ohm unbalanced signal for direct connection into broadcast applications.

All audio inputs and outputs were carefully designed for use in permanent as well as field applications. Extensive filtering on the inputs minimizes the chance that radio frequency (RF) energy will interfere with audio input sources. Other components were included to address ESD (“static”) and DC overload situations. The DC power input is protected from accidental polarity reversal.

Remote Control Capability

With an optional Model 5190 Remote Access Module up to 16 Model 5110 modules can be remotely monitored and controlled. Using the 5190's Ethernet interface personnel using a standard web browser will be able to access all the Model 5110's standard functions, including input sensitivity, phantom power on/off, and pushbutton switch lock out. In addition to the standard functions, the 5190 will allow more features to be utilized. These include expanded input sensitivity adjustment, channel text labeling, and module identification. A local 2-wire RS-485 data bus is used to interface the Model 5190 Remote Access Module with the one or more Model 5110 Mic/Line Input Modules.

Installation

Integration of the Model 5110 into the selected application is quite simple, only requiring connecting to the analog and digital audio outputs along with DC power. Some applications will also require connection to the RS-485 data bus. The audio signals have a nominal level of either +4 or 0 dBu, depending on the Model 5110 version being installed. The DC power source is nominal 12 volts with an acceptable range of 10 to 18 volts. The RS-485 data bus is a single pair of wires that would interconnect the Model 5110, along with other Model 5100-Series modules, to a remote access card. After the connections have been completed, the module can then be secured into the designated mounting location.

Analog Audio Outputs

Associated with each of the Model 5110's two audio output channels is a balanced (differential), line-level analog output. The circuitry is electronically balanced and capacitor coupled. The nominal output level of a Model 5110S (SMPTE) version module is +4 dBu with a maximum output level of +24 dBu. The nominal level of a Model 5110E (EBU) version module is 0 dBu with a maximum level of +18 dBu.

Connections to the audio outputs are made using a 5-position header connector located on the Model 5110's rear-most circuit board. Refer to Figure 2 for details. For details on appropriate mating connectors refer to Appendix A located at the end of this document.

For connection to balanced inputs on related equipment the signal + (high) and signal – (low) connections should be used. Pin 1, common/shield, may or may not need to be connected as dictated by the specific installation.

When interfacing the outputs to unbalanced inputs on associated equipment connect only to the Model 5110's signal + (high) and common/shield. Do not make any connections to the Model 5110's – (low) terminals.

Pin Number	Function
1	Common/Shield
2	+ CH1
3	– CH1
4	+ CH2
5	– CH2

Figure 2. Analog Audio Outputs for Model 5110 Units with Serial Numbers 00201 and Later (black-colored circuit boards)

Digital Audio Output

The Model 5110's two audio output channels are available in digital form by way of a DIN 1.0/2.3-compliant receptacle. This receptacle is located adjacent to the analog audio output connector. This is an AES3-compliant unbalanced 75 ohm signal that will transport audio, when using good-quality coaxial cable, several thousands of feet.

The digital audio output signal has a sample rate of 48 kHz and a bit depth of 24. The nominal level of the digital audio output is –20 dBFS for Model 5110S (SMPTE) modules and –18 dBFS for Model 5110E (EBU) modules.

DC Input and Data Bus

A 4-position header is used to connect DC power and a local RS-485 serial data bus to the Model 5110. Two pins on the mating connector are used to connect a source of nominal 12 volts DC. The acceptable range is 10 to 18 volts DC with a maximum current of 300 milliamperes at 12 volts DC. For remote control operation two pins on the mating connector will implement the data bus connection from a Studio Technologies' Model 5190 Remote Access Module.

The mating connector is compatible with the AMP MTA-100 series of IDC receptacles. For 22 AWG wire the closed-end-style receptacle is AMP 3-643813-4; the feed-through-style receptacle, used for busing connections, is AMP 3-644540-4. The body color for both receptacles is red, following the convention of the MTA-100 series for compatibility with 22 AWG wire. Refer to Appendix A of this guide for additional connector details.

-
1. – DC (Common)
 2. + DC (10-18 volts)
 3. + Data (RS-485)
 4. – Data (RS-485)
-

Figure 3. DC Input and Data Bus Connections

Mounting

The Model 5110 is intended for mounting into an installation-specific enclosure or rack panel. Refer to Appendix B for the unit's dimensions and mounting screw locations. Please contact the factory to discuss mounting options.

Configuration

RS-485 Address

A data bus address must be configured for applications that implement remote control of Model 5110 functions. While up to 16 Model 5100-Series modules can "share" the RS-485 data bus, each module must have a unique address. Selecting the device's address involves setting four configuration switches located on one side of the module. The switches are a "piano key" type with their up position being defined as off and their down position defined as on. Refer to Figure 4 for details.

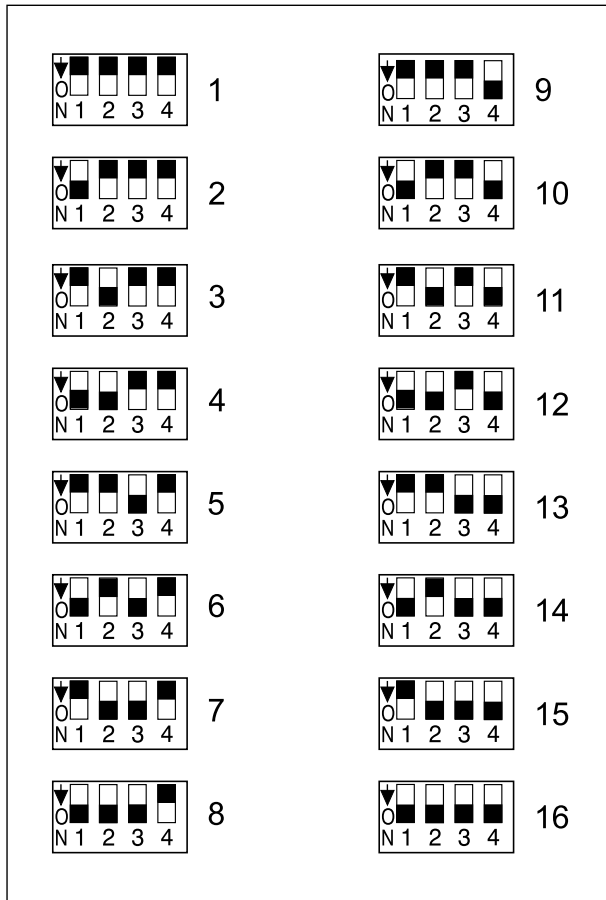


Figure 4. RS-485 Address Settings

Operation

Power Up

Upon 12 volt DC power being applied to the Model 5110 the front-panel LEDs will perform a “walk-through” test, with each LED lighting briefly in sequence. Then the LEDs will light in a pattern that represents the version number of the firmware (embedded software) that is loaded into the module. Upon completion, the module will begin normal operation.

Connecting Input Signals

Two 3-pin female XLR connectors are provided to interface signals with the Model 5110’s mic/line inputs. Signals with a wide range of nominal levels can be successfully connected. For balanced signals pin 2 should be connected to signal + (high) and pin 3 should be signal – (low). Pin 1 should be connected to the cable shield.

Unbalanced signals can also be connected. In most cases signal + (high) should be connected to pin 2 and common/shield should be connected to both pins 1 and 3 of the 3-pin male XLR mating connector. If this connection arrangement results in hum or noise it’s possible that connecting signal + (high) to pin 2 and signal common/shield only to pin 3 may be effective.

Input Sensitivity Selection

Two pushbutton switches are associated with each mic/line input and are used to adjust the sensitivity of the input circuitry. In the line position the Model 5110 will provide 0 dB of gain which results in unity input-to-output performance. A connected signal that has a level of 0 dBu will result in a 0 dBu signal on the analog output. The signal level of the digital output will depend on the version of Model 5110 module. With a Model 5110S module and an input level of 0 dBu, the digital output level will be –24 dBFS. With a Model 5110E module the digital output level will be –18 dBFS.

Use the up and down pushbutton switches to adjust the input sensitivity from the choices of line (0 dB), 15, 30, and 45 dB. In applications that use a Model 5190 Remote Access Module an expanded gain range with a step size of 3 dB is possible. Refer to the Remote Control Section later in this guide for details.

The Model 5110 is not intended to precisely control the gain applied to an input signal. The goal is to amplify the input signal such that it can be effectively transported to the next piece of audio equipment in the chain. Gain should be applied only so that the signal can reach a level that ensures a good signal-to-noise ratio is maintained while minimizing the risk of signal overload. The Model 5110's output signals will be connected, either directly or via associated audio transport equipment, to inputs on an audio console which will have precise control of the signal levels.

Level Meters

Associated with each mic/line input is a 7-segment LED level meter. These meters are provided for use during input sensitivity setting as well as being useful for general signal monitoring. The labeling of the meters refers to the level in reference to the module's analog reference level. For the Model 5110S (SMPTE) version the analog reference level is +4 dBu. For the Model 5110E (EBU) version the analog reference level is 0 dBu. So for example, a signal that is sufficient to just cause the "6" LED to light will represent an analog output level that is 6 dB above analog nominal. This will equate to +10 dBu for the Model 5110S and +6 dBu for the Model 5110E. This will also represent digital output levels of -14 dBFS for the Model 5110S and -12 dBFS for the Model 5110E.

Phantom Power

To support high-performance microphones, the Model 5110 can provide a source of +48 volt DC phantom power. A pushbutton switch is associated with each

channel and allows phantom power on/off control. For maximum flexibility phantom power is available in all four input sensitivity settings (line, 15, 30, and 45 dB). While phantom power would not typically be used in the line setting it's still available for special applications.

Pushbutton Switch "Lock Out"

To prevent unauthorized changes to the Model 5110's input sensitivity and phantom power settings a pushbutton switch "lock-out" function is provided. Simply press and hold both +48V (phantom) pushbutton switches for about two seconds to enable (or disable) the pushbutton switch lock-out function. Whenever the pushbutton switch lock-out function is active the Data/Lock LED, located on the bottom right side of the front panel, will light.

Remote Control

A Model 5190 Remote Access Module allows up to 16 Model 5110 Mic/Line Input Modules, or a combination of up to 16 Model 5110 and other compatible 5100-Series modules, to be monitored and controlled using a standard web browser. Whenever the Model 5190 is actively communicating with a Model 5110 the latter's Data/Lock LEDs will flash in response. The Model 5190 will continually communicate with each module about once per second. A module identify function can be enabled which will cause the front-panel LEDs on a specific Model 5110 to flash on and off for a few seconds. This is provided so that on-site personnel can confirm which specific module is being remotely controlled.

The Model 5190's GUI allows text naming of the module and two mic/line input channels. These names are stored in the Model 5190 and help a user better understand a remotely-located module installation or deployment. The on/off state of the phantom power for each mic/line input channel can be observed and changed if desired. The state of the button lockout function can be observed and modified.

Gain Range and Step Size

As previously discussed in this guide, using the pushbutton switches on the front panel allows the sensitivity of each mic/line input to be selected from among four values: 0, +15, +30, and +45 dB. Selections on the GUI associated with the Model 5190 allow much greater control over the input sensitivity. This allows the gain step size to be changed from the default 15 dB to be 3 dB. And, in addition to more precise control, when the step size is selected for 3 dB the gain range expands to 9 to 60 dB in 3 dB steps; of course 0 dB is still available.

Changing the step size to 3 dB will impact how the front-panel buttons perform and the way in which the LEDs will display. When the Model 5110 is configured for a 3 dB step size the pushbuttons switches, as expected, will change the input sensitivity by 3 dB with each press. The exception is when moving down from 9 dB or up from 0 dB as there is no setting for 3 or 6 dB. (19 steps allow settings of 0, 9, 12, 15, etc. up to 60 dB.) When the sensitivity of an input is set for 0, 15, 30, or 45 dB their associated status LEDs will light as expected. But if the sensitivity is set to a value between these four exact values two LEDs will light. For example, if the sensitivity is set for 9 dB then both

the 0 and the 15 LEDs will light. If the sensitivity is set for 36 dB then both the 30 and 45 LEDs will light. If the sensitivity is set for 45 dB or greater (45 to 60 dB in 3 dB steps) the 45 LED will be lit. While this may be a little confusing at first it does provide the most information that the simple front panel LEDs can provide.

Technical Notes

Firmware Version Display

After the Model 5110's power-up sequence has completed, the module's LEDs are used to automatically display the firmware (embedded software) version number. This is useful when working with factory personnel on application support and troubleshooting situations. The seven level meter LEDs associated with channel 1 audio are used to display the major version number with a range of 1 through 7. The seven level meter LEDs associated with channel 2 audio are used to display the minor version number which ranges from 0 to 7. (No channel 2 LEDs lit indicates minor version number 0.) The firmware version number will display for approximately one second after the power-up sequence has completed but before normal operation will begin. Refer to Figure 5 for a detailed view of the LEDs and the corresponding firmware version numbering scheme.

Note that while it's easy to determine which firmware version is loaded into the Model 5110 a trip back to the factory is required to update it. The 8-bit microcontroller that provides the unit's logic "horsepower" also includes internal FLASH memory. This nonvolatile memory is used to store the operating firmware (embedded software).

Re-programming this memory requires using a specialized programming unit. While not outrageous in price, it still costs in the range of US\$500. The programmer uses a ribbon cable and socket to interface with a 6-pin “header” on one of the Model 5110’s printed circuit board. And, as you would guess, once connected reprogramming takes only a matter of seconds. But unfortunately the programmer is not something that would be found in a typical “field shop” or repair facility.

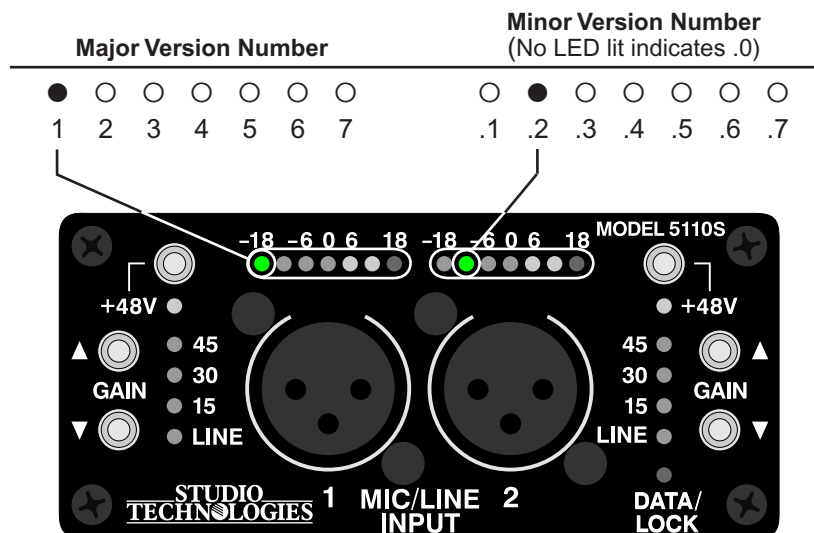


Figure 5. Detail of front panel showing the level meter LEDs that display the firmware (embedded software) version. In this example, the firmware version is 1.2.

Specifications

Mic/Line Inputs: 2

Input Sensitivity, 15 dB Steps (Default):

selectable for line (0 dB), 15, 30 or 45 dB gain

Input Sensitivity, 3 dB Steps (Selected via GUI):

selectable for line (0 dB), 9 to 60 dB in 3 dB steps

Maximum Input Level: +24 dBu

Type: electronically balanced

Impedance: approximately 3 k ohms

CMRR: 61 dB at 60 Hz

Channel-to-Channel Crosstalk: <-106 dB at 10 kHz

Phantom Power: 48 volts DC, nominal, meets IEC 61938 P48 standard

Digital Audio Output: 1 (2-channel)

Type: AES3, unbalanced, 75 ohms

Sample Rate/Bit Depth: 48 kHz/24

Frequency Response: ±0.2 dB, 20 Hz to 20 kHz

Dynamic Range (A Weighted): 112 dB, input sensitivity set for Line (0 dB gain), 15 dB gain, or 30 dB gain; 103 dB at 45 dB gain

Distortion: 0.0008% (-101 dB) with output at -1 dBFS, 22 Hz to 22 kHz, 30 dB gain

Nominal Output Level: -20 dBFS (Model 5110S); -18 dBFS (Model 5110E)

Analog Audio Outputs: 2

Type: electronically balanced, capacitor-coupled, intended to drive balanced loads of 2 k ohms or greater

Nominal Level: +4 dBu (Model 5110S), 0 dBu (Model 5110E)

Maximum Level: +24 dBu into 10 k ohms

Source Impedance: 200 ohms, nominal, differential

Frequency Response: ±0.5 dB, 20 Hz to 16 kHz; -1.5 dB at 20 kHz)

Dynamic Range (A Weighted): 107 dB, input sensitivity set for Line (0 dB gain), 15 dB gain, or 30 dB gain; 102 dB at 45 dB gain

Distortion: 0.002% (-93 dB) with output at +23 dBu, 22 Hz to 22 kHz, 30 dB gain)

Meters: 2, 7-segment LED, modified VU ballistics

Remote Control Capability: mic gain, phantom power, pushbutton switch lock out. Requires remote access module for implementation.

Connectors:

Mic/Line Inputs: 2, 3-pin female XLR, no latch

AES3 Digital Audio Output: 1, DIN 1.0/2.3-compliant coaxial

Analog Audio Outputs: 1, 5-position male header. Refer to Appendix A for mating connector details.

DC Input/Data: 1, 4-position male header. Refer to Appendix A for mating connector details.

Power Requirement: 12 volts DC nominal, 300 milliamperes max; acceptable range 10-18 volts DC, 330 milliamperes max at 10 volts

Dimensions (Overall):

3.75 inches wide (9.5 cm)

1.69 inches high (4.3 cm)

2.30 inches deep (5.8 cm)

Mounting: requires custom implementation; no mounting method provided. Refer to Appendix B for details.

Weight: 0.2 pounds (91 g)

Specifications and information contained in this User Guide subject to change without notice.

Appendix A—Interconnection Details

The required mating receptacles are from the TE Connectivity (formerly AMP) MTA-100 series of IDC (insulation displacement) connectors. This series was selected because of its low-cost and wide range of offerings. Separate connectors are offered for compatibility with 22, 24, 26, and 28 AWG (American Wire Gauge) insulated wire. The connector color indicates its AWG-compatibility. Unfortunately, with flexibility can come some confusion. The MTA-100 offers a number of different connectors that will work with the Model 5110's analog audio outputs and DC input/data headers. Before obtaining receptacles it's important to determine two things: wire gauge and wiring arrangement.

Analog Audio Outputs (one connector required)

- For 22 AWG wire this receptacle (red in color) is recommended:
TE Connectivity (AMP) 3-643813-5
Digi-Key part number A31109-ND (www.digikey.com)
Mouser part number 571-3-643813-5 (www.mouser.com)
- For 24 AWG wire this receptacle (white in color) is recommended:
TE Connectivity (AMP) 3-643814-5
Digi-Key part number A31020-N
Mouser part number 571-3-643814-5

DC Input/Data (one connector required)

- For 22 AWG wire this receptacle (red in color) is recommended:
TE Connectivity (AMP) 3-644540-4
Digi-Key part number A31122-ND
Mouser part number 571-3-644540-4

Tools for Connecting Wires to the Mating Receptacles

For applications where just a few Model 5100-Series modules are going to be installed a manual IDC termination tool is recommended. While requiring a steady hand to achieve reliable wire connections to the mating receptacles, the price, at less than US\$40, is fairly reasonable:

- “T Handle” termination hand tool:
TE Connectivity (AMP) 59803-1
Digi-Key part number A9982-ND
Mouser part number 571-598031

Appendix A—Interconnection Details, continued

Tools for Connecting Wires to the Mating Receptacles, continued

For applications where a larger number of Model 5100-Series modules are going to be installed it's worth considering a semi-automatic termination tool. The recommended tool consists of a handle assembly and crimp die for MTA-100 receptacles. The total price for both, approximately US\$300 as of this writing, is steep but the performance that this tool assembly provides is excellent. We feel that the time savings and reliability of the connections warrants the price when many terminations are going to be made:

- Handle Tool, Pistol Grip:
 - TE Connectivity (AMP) 58074-1
 - Digi-Key part number A2031-ND*
 - Mouser part number 571-580741*
- Crimp Head Die Assembly for MTA-100 Receptacles:
 - TE Connectivity (AMP) 58246-1
 - Digi-Key part number A1998-ND*
 - Mouser part number 571-58246-1*

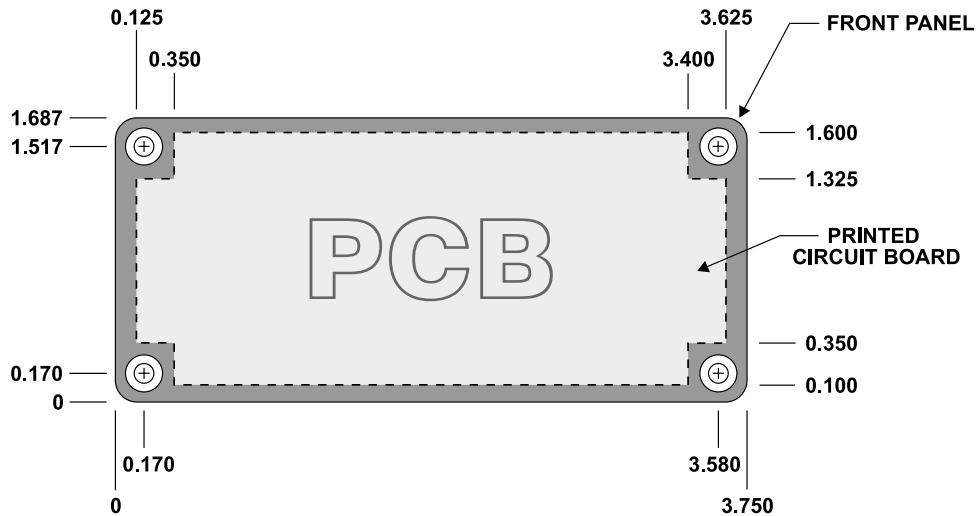
Headers on the Printed Circuit Board

The actual part numbers of the header connectors that are soldered into the Model 5110's printed circuit board are provided in this section. But do not order these part numbers with the intent of interconnecting signals with the Model 5110! We are providing these details only so that interested technical personnel can have the full background on the Model 5110's interconnect system. The appropriate mating receptacles are detailed in a previous section of this Appendix.

- Analog Audio Outputs (one header):
 - TE Connectivity (AMP) 2-644486-5 (**DO NOT ORDER THIS NUMBER!**)
- DC Input/Data (one header):
 - TE Connectivity (AMP) 2-644486-4 (**DO NOT ORDER THIS NUMBER!**)

Appendix B—Model 5110 Front Panel and Printed Circuit Board (PCB) Dimensions

STUDIO TECHNOLOGIES, INC.
MODEL 5100-SERIES SINGLE-WIDTH FRONT PANEL
AND PRINTED CIRCUIT BOARD DIMENSIONS
(DIMENSIONS SHOWN IN INCHES)
(AS OF SEPTEMBER 2013, APPLIES TO
MODELS 5110, 5120, 5121, 5130, 5132, 5134, 5150, 5152, 5154, 5180, AND 5190)



NOTES:

- 1) OPENING MUST BE MADE IN CUSTOM-MOUNTING ARRANGEMENT SO THAT PCB IS ALLOWED TO FREELY PASS THROUGH.
- 2) FRONT-PANEL MOUNTING LOCATIONS DIMENSIONED FOR #4 COUNTERSUNK SCREWS (4 PLACES). UNDERCUT FLAT-HEAD MACHINE SCREWS RECOMMENDED.
- 3) RECOMMENDED MOUNTING-HOLE LOCATIONS SHOULD BE DRILLED AND TAPPED FOR 4-40 SCREW THREADS (4 PLACES).

WARNING:
THIS DRAWING SHOWS THE DIMENSIONS OF THE PRINTED CIRCUIT BOARD.
PANEL OPENING MUST BE MADE LARGER TO ALLOW PCB TO PASS THROUGH!
CONTACT FACTORY IF YOU HAVE QUESTIONS.

