Mini-Circuits

Full Fan-Out Splitter / Attenuator Matrices

User Manual

ZT-8RFX8

ZT-16RFX8

ZT-24RFX8

Mini-Circuits®

Full Fan-Out Splitter / Attenuator Matrices - User Manual
Rev 5

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1. INTRODUCTION

Mini-Circuits' full fan-out / fully non-blocking matrices use a combination of programmable attenuators and splitter / combiners to provide a completely flexible set of paths between the input and output ports. The configuration is analogous to a switch matrix except any individual path can be "on" (0 dB attenuation), or "off" (max attenuation), or any specific path loss in-between. In addition, all inputs can connect simultaneously to all outputs and all paths are bi-directional.

2. CONTACTS

We're here to support you every step of the way. For technical support and assistance, please find the following points of contact for your convenience:

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Email: chiman@minicircuits.com	**Email: Lee@uk.minicircuits.com**

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3. SYSTEM SUMMARIES

3.1. ZT-8RFX8

3.1.a. Simplified Functional Block Diagram
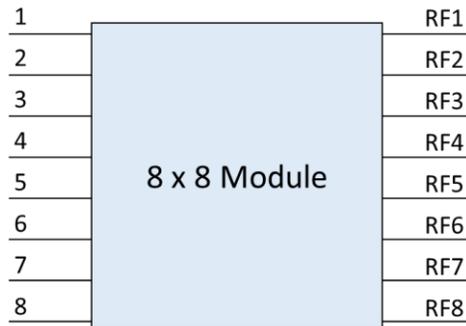
- 8 inputs and 8 outputs, interconnected via splitters and combiners
- All paths are bi-directional
- Each internal path has an independent programmable attenuator (64 total)
- Each input can connect to each output in any combination and with precisely controlled path loss

3.1.b. Full System Block Diagram

![Mini-Circuits® logo]
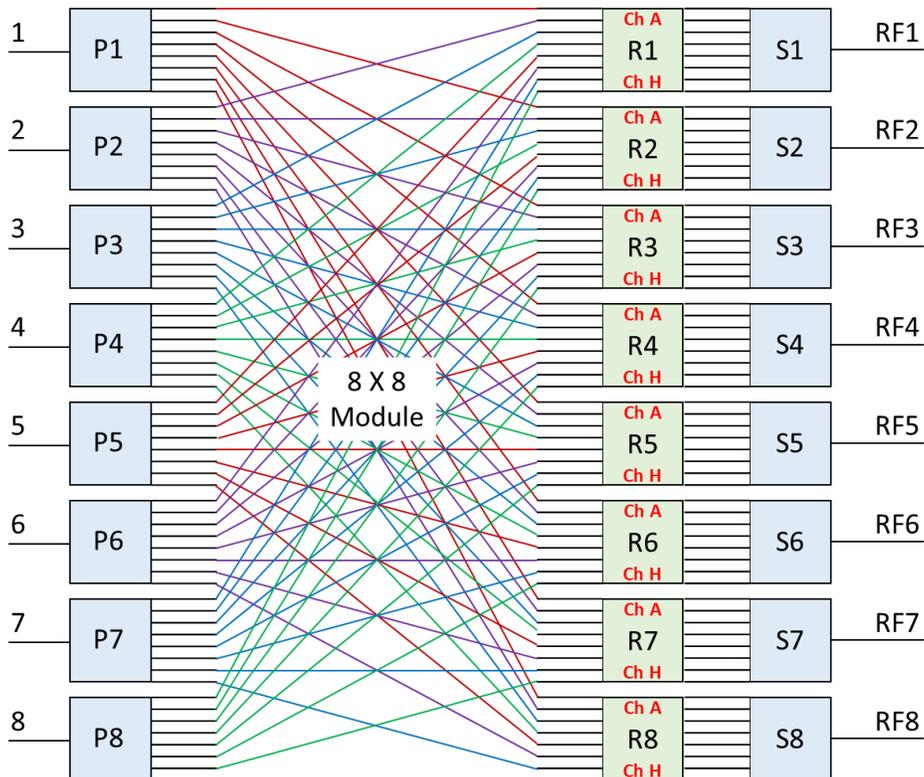
3.2. ZT-16RFX8

3.2.a. Simplified Functional Block Diagram
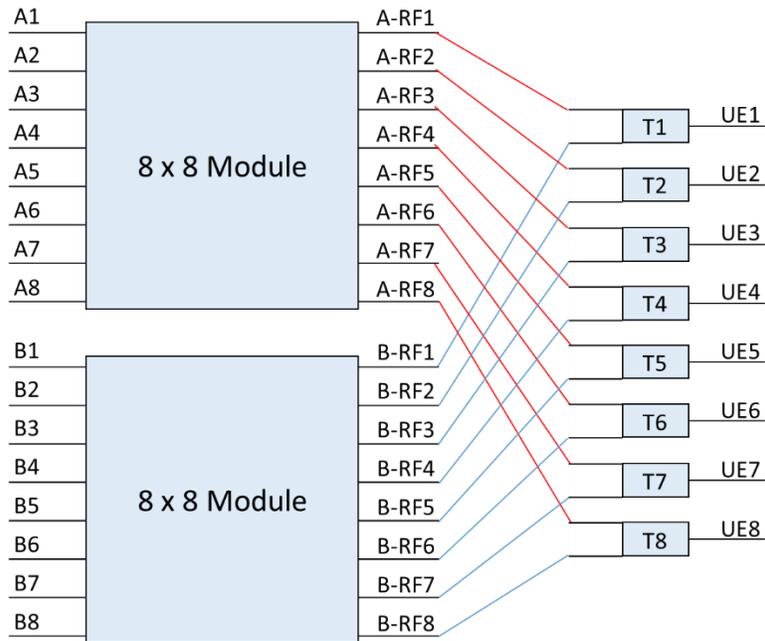
- A pair of 8 x 8 modules operate as per ZT-8RFX8
- T1 to T8 are 2-way splitter / combiners used to route the UE1-UE8 ports into both modules
- External connections are made between the 8 x 8 modules and the 2-way splitter / combiners (16 total)
- The complete system has 16 inputs and 8 outputs
- All paths are bi-directional
- Each internal path has an independent programmable attenuator (128 total)
- Each input can connect to each output in any combination and with precisely controlled path loss

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## 3.2.b. Complete System Block Diagram
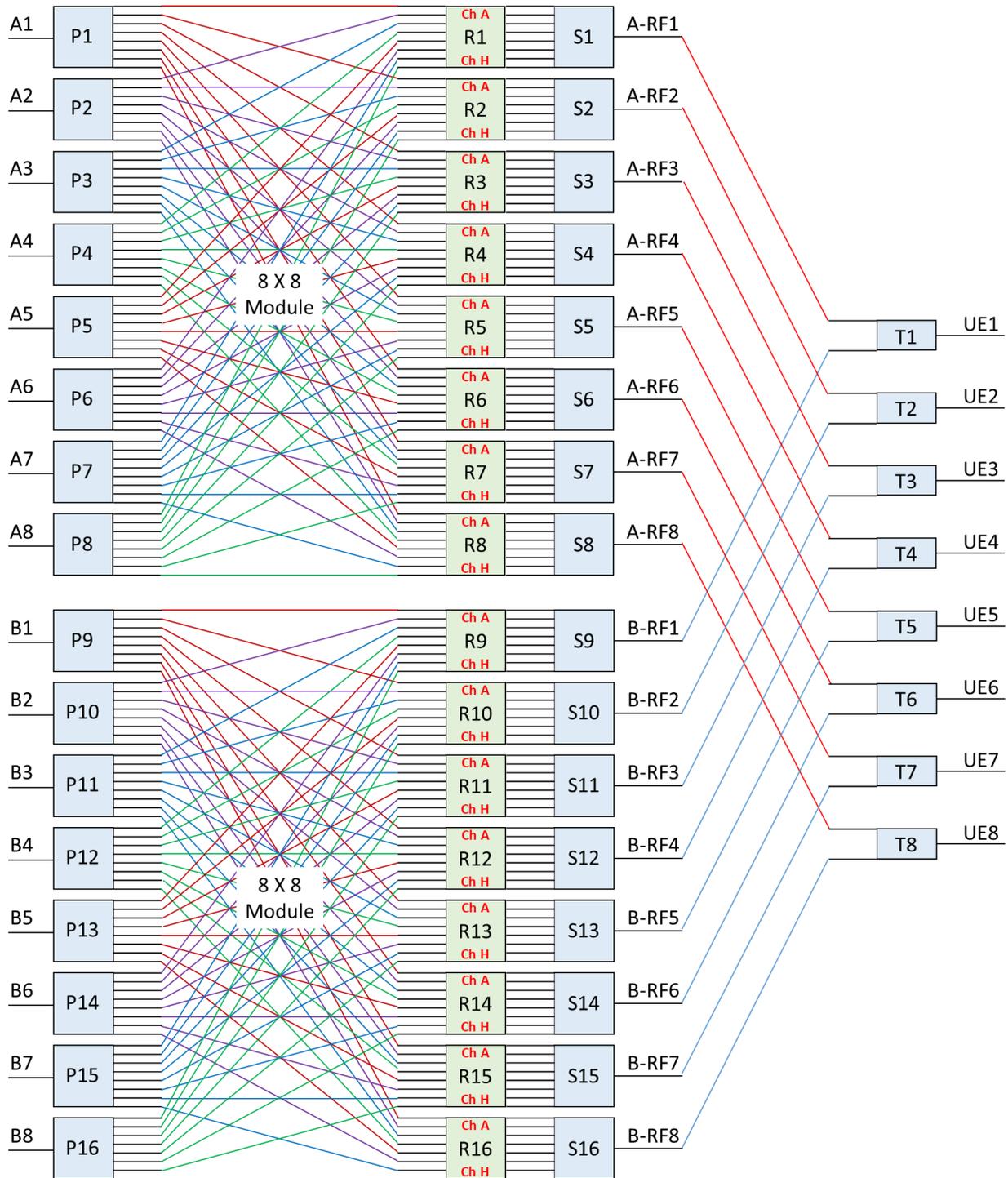
3.3. ZT-24RFX8

3.3.a. Simplified Functional Block Diagram
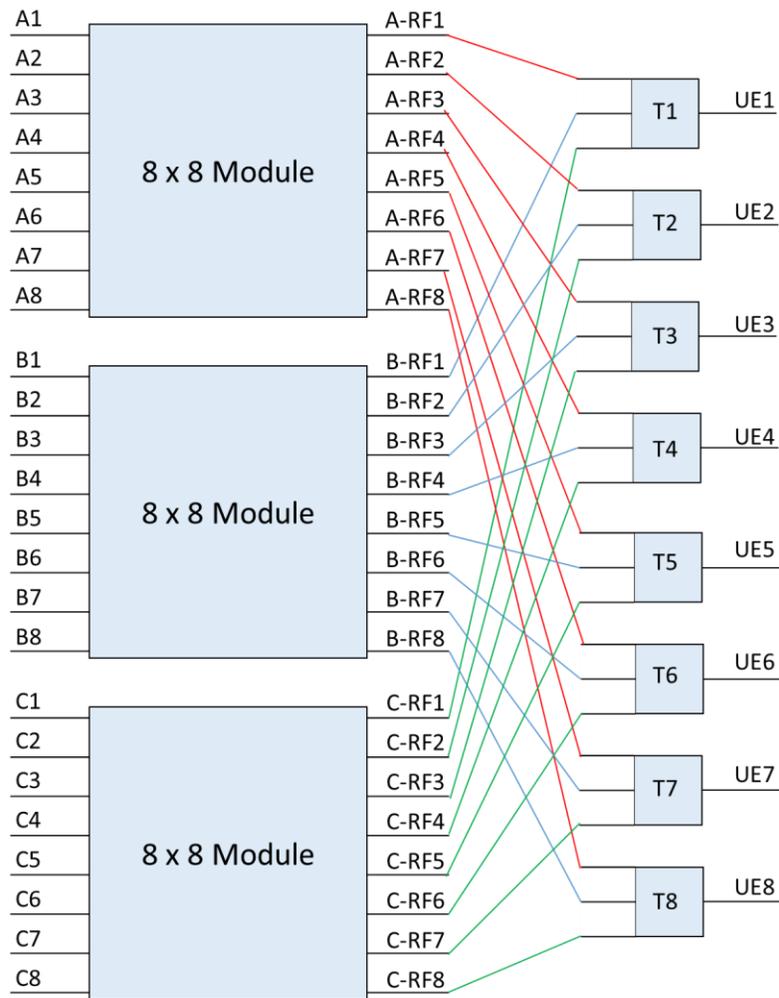
- Three 8 x 8 modules each operate as per ZT-8RFX8
- T1 to T8 are 3-way splitter / combiners used to route the UE1-UE8 ports into all 3 modules
- External connections are made between the 8 x 8 modules and the 3-way splitter / combiners (24 total)
- The complete system has 24 inputs and 8 outputs
- All paths are bi-directional
- Each internal path has an independent programmable attenuator (192 total)
- Each input can connect to each output in any combination and with precisely controlled path loss

3.3.b. Complete System Block Diagram
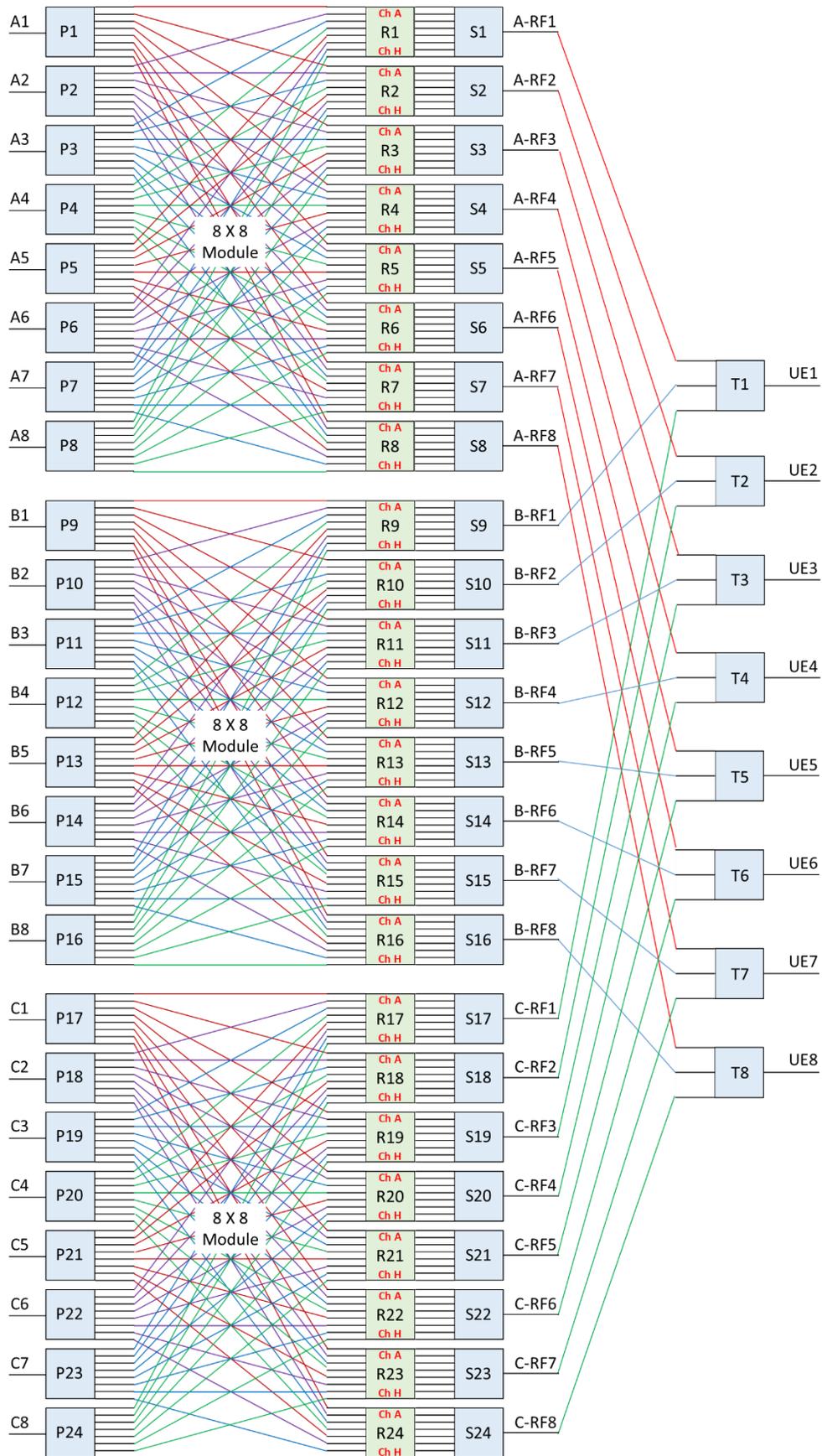
4. HARDWARE INSTALLATION

4.1. Installation within Rack Cabinet

The system can be installed within a standard 19-inch rack cabinet. Due to the weight the system must be supported by means other than the front panel, by side rails or on a high grade equipment shelf.

Caution: Due to the weight of the system it is recommended that 4 people handle the unit when lifting on to the rack cabinet.

Where side handles are fitted to the system, these can be removed by unscrewing the 2 external screws from each handle. The front and rear handles should be left in place to facilitate lifting the system into the rack cabinet, these can then also be removed in the same way if required.

The system should be secured in place by fitting appropriate screws through the front panel mounting holes.

## 4.2. Installation on top of Rack Cabinet

The system can be securely mounted on the top surface of a suitable rack cabinet with the accessories provided by Mini-Circuits and the instructions below.

1. Prepare the fastener strips:
    a. Make sure the top surface of the cabinet and bottom of the base plate are cleaned prior to installation
    b. Join two 120" 3M fastener stripes together so the strips are fully locked
    c. Cut the joined 120" strips into 5 pieces of 24" each
    d. Position the strips on to the top surface of the rack cabinet as shown
    e. Trim as required to take account of any wiring in the way
    f. Remove the protective film from the bottom of the strips and secure to the top of the cabinet, press firmly for 30 seconds
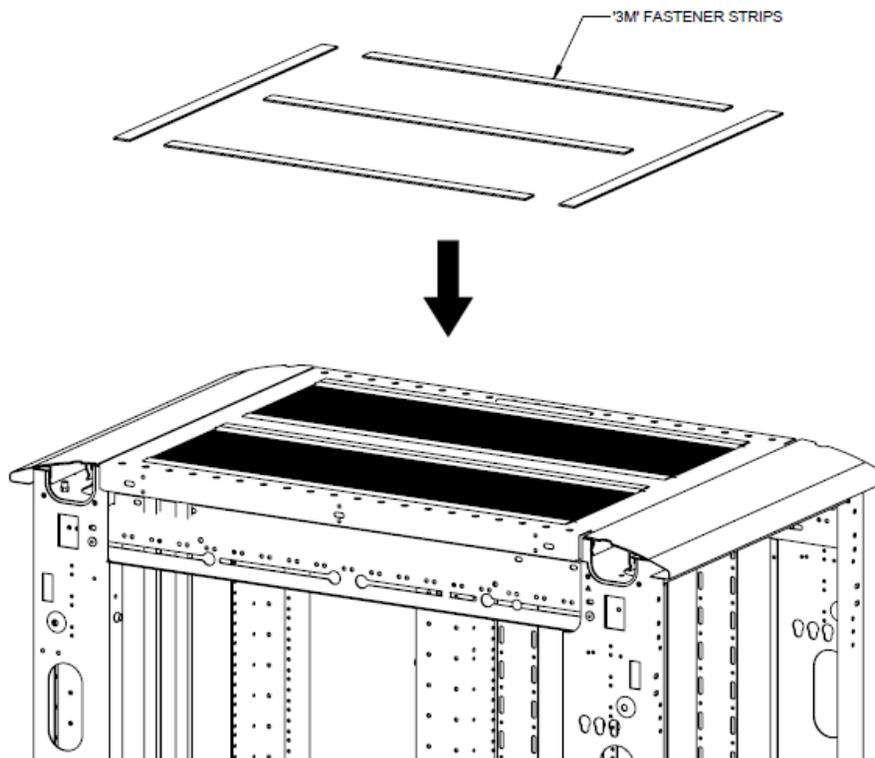
2. Attach the base plate:
   a. Remove the protective film from the top of the fastener strips
   b. Place the base plate on top of the strips and press down firmly for 30 seconds
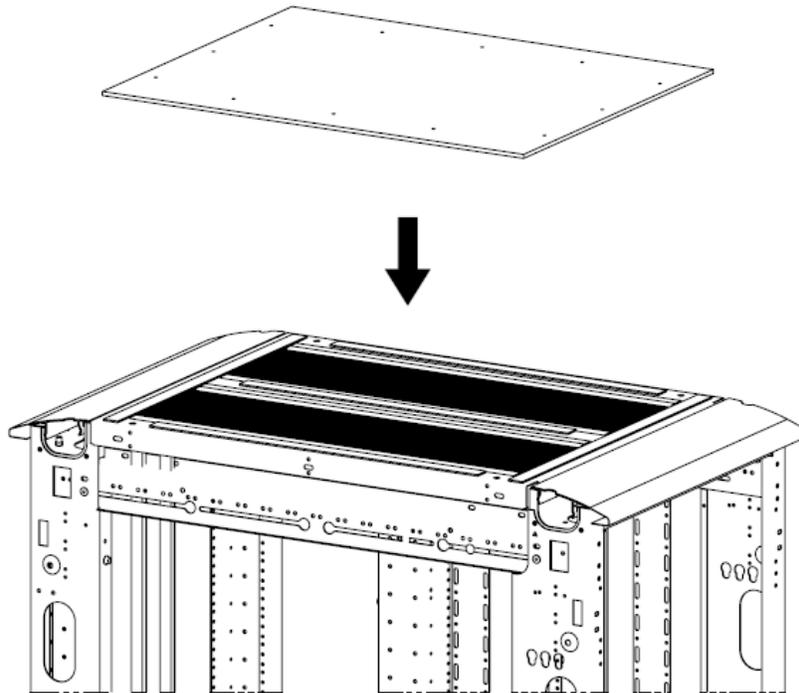
3. Mount the unit:

   Caution: Due to the weight of the system it is recommended that 4 people handle the unit when lifting on to the rack cabinet.
   a. Place the unit on top of the base plate
   b. Line up the unit so the tapped holes on the base plate are visible on all 4 sides
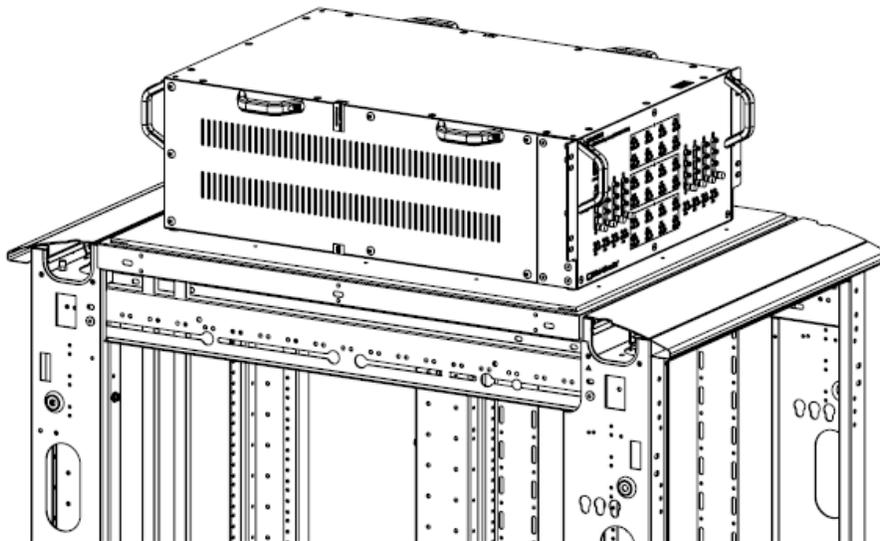
4. Secure the unit:
    a. Place the 4 support angles on top of the cabinet, against all 4 edges of the unit
    b. Secure the support angles using the M5 8mm hex screws
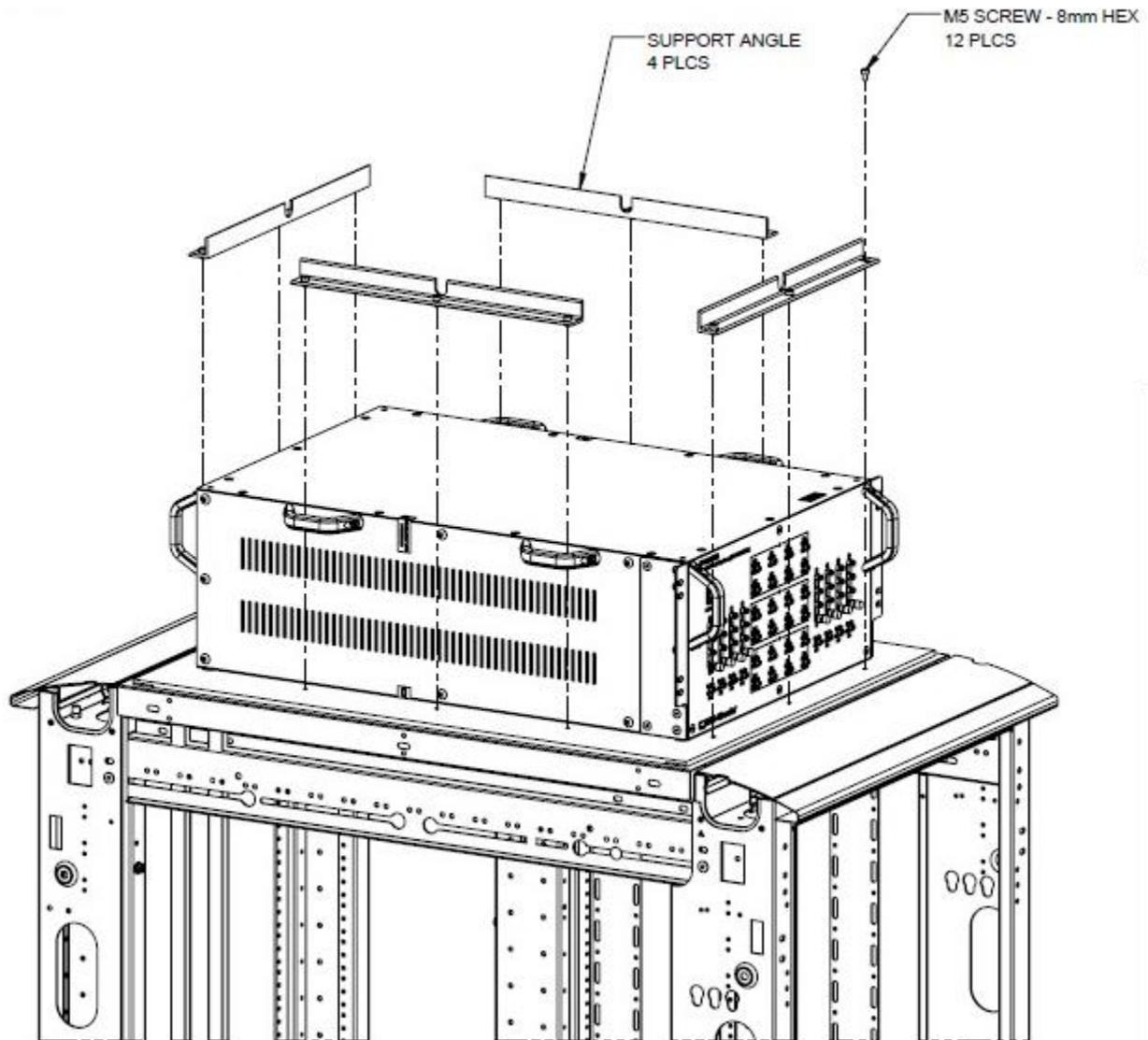
5. SOFTWARE INSTALLATION

5.1. Download Links

Download links can be found on the datasheet of your specific model. There are generally two links, one for just the Mini-Circuits' GUI software installation and one for the full software package.

The GUI Software download includes only the Setup.exe and supporting files for installation of the GUI.

The Full Software Package includes the GUI Software, .NET and ActiveX DLLs, ReadMe Files, and SCPI Lists for controlling the product.

You can download the latest software packages and programming manual on our website. Simply go to our website, click on **Tools and Resources** at the top menu, then click on **Software Download**. Here you'll find various software for our many products. Simply select the family your product belongs to.

Direct Link to the Multi-Channel Programmable Attenuators Software Downloads:
https://www.minicircuits.com/softwaredownload/multiatt.html

5.2. Installation Steps

1. Unzip the downloaded .zip folder
2. Double click on the Setup.exe file or Install.exe file depending on your download selection
3. Simply follow the prompts to install the software
   a. You will need to indicate where you wish to install the program
4. After installation, a shortcut will be made on your desktop
   a. You can also find the program in the start menu under the Mini-Circuits folder

6. GRAPHICAL USER INTERFACE

6.1. Connection Screen

The ZT-8RFX8, ZT-16RFX8, and the ZT-24RFX8 all use the same GUI. The ZT-8RFX8 uses 8x 8-channel attenuators (GUI will display 16 rows, 4 channels per row), the ZT-16RFX8 uses 16x 8-channel attenuators, and the ZT-24RFX8 uses 24x 8-channel attenuators.

When you first open the program, you'll be asked to select how you want to connect to your unit. You may connect to it via USB or Ethernet (HTTP, Telnet, or SSH).

After selecting the connection method, a pop up will indicate all attenuation changes processed by the unit is being logged and saved in the specified location (see figure 9). You'll also be asked to log in to your profile. If this is the first time that you're accessing your equipment, the Admin profile is the only existing profile and there is no password. Simply press on **OK** to get started.
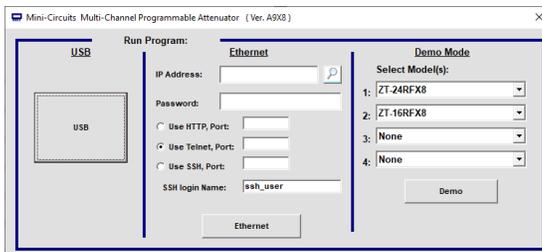
Figure 1: Connection Screen
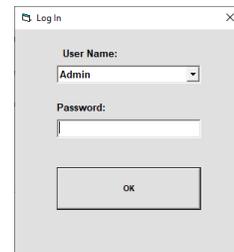
Figure 2: Profile Log In

Figure 3: Command Log Notification

6.2. Main Screen

Figure 10 shows the various sections of the GUI. Each section will be described in more detail below.
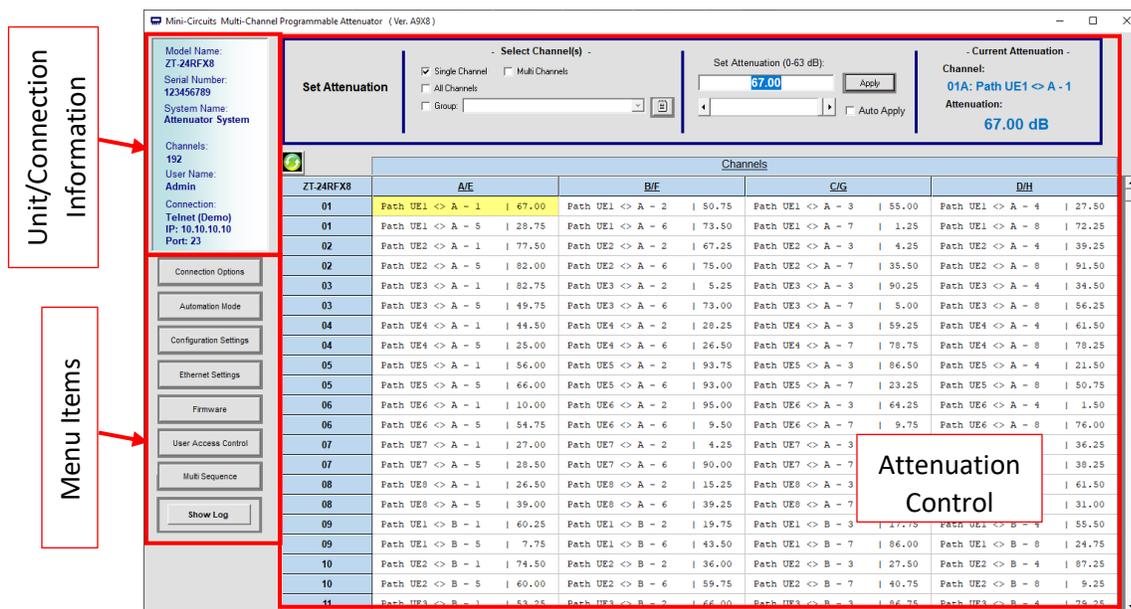
Figure 4: Main Screen

6.3. Unit/Connection Information

This section (Figure 11) simply lists the Model Name, Serial Number, System Name (which can be changed within the **Configuration Settings Menu**), # of Channels in the unit, User Name of the connected profile, and the Connection Type. If the connection is HTTP, Telnet, or SSH, it'll also include the IP Address and the port that it's connecting through.

6.4. Attenuation Control

The Attenuation Control section is the main portion of the GUI. This is where you can change the attenuation of each channel of your unit. You can either change the attenuation of a single channel at a time, multiple channels, all channels at once, or a specific group of channels.

Every 2 rows consist of a single "8-Channel Unit". The first row would be channels A, B, C, and D from left to right. The second row would be channels E, F, G, and H.

There is also a "Refresh" button above the model name of your unit. This button can be used to refresh your connection to your units. This will not change the attenuation states of any of the channels.

Model Name:
ZT-24RFX8
Serial Number:
123456789
System Name:
Attenuator System
Channels:
192
User Name:
Admin
Connection:
Telnet (Demo)
IP: 10.10.10.10
Port: 23

Figure 5: Unit/Connection Information

To change the attenuation of a single channel, simply click on the channel on the table that you want to change. For multiple channels you'll have to have that option selected, then simply click on all the channels you want to control. For group control, simply select the group you wish to control via the drop down. Please go to section 4.5 on how to create / edit groups.

ZT-24RFX8	Channels			
	A/E	B/F	C/G	D/H
01	Path UE1 <> A – 1 | 67.00	Path UE1 <> A – 2 | 50.75	Path UE1 <> A – 3 | 55.00	Path UE1 <> A – 4 | 27.50
01	Path UE1 <> A – 5 | 28.75	Path UE1 <> A – 6 | 73.50	Path UE1 <> A – 7 | 1.25	Path UE1 <> A – 8 | 72.25
02	Path UE2 <> A – 1 | 77.50	Path UE2 <> A – 2 | 67.25	Path UE2 <> A – 3 | 4.25	Path UE2 <> A – 4 | 39.25
02	Path UE2 <> A – 5 | 82.00	Path UE2 <> A – 6 | 75.00	Path UE2 <> A – 7 | 35.50	Path UE2 <> A – 8 | 91.50
03	Path UE3 <> A – 1 | 82.75	Path UE3 <> A – 2 | 5.25	Path UE3 <> A – 3 | 90.25	Path UE3 <> A – 4 | 34.50
03	Path UE3 <> A – 5 | 49.75	Path UE3 <> A – 6 | 73.00	Path UE3 <> A – 7 | 5.00	Path UE3 <> A – 8 | 56.25
04	Path UE4 <> A – 1 | 44.50	Path UE4 <> A – 2 | 28.25	Path UE4 <> A – 3 | 59.25	Path UE4 <> A – 4 | 61.50
04	Path UE4 <> A – 5 | 25.00	Path UE4 <> A – 6 | 26.50	Path UE4 <> A – 7 | 78.75	Path UE4 <> A – 8 | 78.25
05	Path UE5 <> A – 1 | 56.00	Path UE5 <> A – 2 | 93.75	Path UE5 <> A – 3 | 86.50	Path UE5 <> A – 4 | 21.50
05	Path UE5 <> A – 5 | 66.00	Path UE5 <> A – 6 | 93.00	Path UE5 <> A – 7 | 23.25	Path UE5 <> A – 8 | 50.75
06	Path UE6 <> A – 1 | 10.00	Path UE6 <> A – 2 | 95.00	Path UE6 <> A – 3 | 64.25	Path UE6 <> A – 4 | 1.50
06	Path UE6 <> A – 5 | 54.75	Path UE6 <> A – 6 | 9.50	Path UE6 <> A – 7 | 9.75	Path UE6 <> A – 8 | 76.00
07	Path UE7 <> A – 1 | 27.00	Path UE7 <> A – 2 | 4.25	Path UE7 <> A – 3 | 28.00	Path UE7 <> A – 4 | 36.25
07	Path UE7 <> A – 5 | 28.50	Path UE7 <> A – 6 | 90.00	Path UE7 <> A – 7 | 93.00	Path UE7 <> A – 8 | 38.25
08	Path UE8 <> A – 1 | 26.50	Path UE8 <> A – 2 | 15.25	Path UE8 <> A – 3 | 15.50	Path UE8 <> A – 4 | 61.50
08	Path UE8 <> A – 5 | 39.00	Path UE8 <> A – 6 | 39.25	Path UE8 <> A – 7 | 67.75	Path UE8 <> A – 8 | 31.00
09	Path UE1 <> B – 1 | 60.25	Path UE1 <> B – 2 | 19.75	Path UE1 <> B – 3 | 17.75	Path UE1 <> B – 4 | 55.50
09	Path UE1 <> B – 5 | 7.75	Path UE1 <> B – 6 | 43.50	Path UE1 <> B – 7 | 86.00	Path UE1 <> B – 8 | 24.75
10	Path UE2 <> B – 1 | 74.50	Path UE2 <> B – 2 | 36.00	Path UE2 <> B – 3 | 27.50	Path UE2 <> B – 4 | 87.25
10	Path UE2 <> B – 5 | 60.00	Path UE2 <> B – 6 | 59.75	Path UE2 <> B – 7 | 40.75	Path UE2 <> B – 8 | 9.25
11	Path UE3 <> B – 1 | 53.25	Path UE3 <> B – 2 | 66.00	Path UE3 <> B – 3 | 86.75	Path UE3 <> B – 4 | 79.25

Figure 6: Attenuation Control Section

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To actually change attenuation, all you have to do is type in the attenuation you wish in the provided area at the top and then press **Apply**. Or you can have *Auto Apply* checked and whenever you type in a new number, it'll be automatically applied to all selected channels. Alternatively, you can also use the scroll bar to change their attenuations.

On the top right of the GUI, it shows the current attenuation of a single channel (or it'll say Multi Channels if multiple channels are selected). The channel is displayed in a specific format which is explained in Figure 13. If you only have 1 unit connected that is not daisy chained to any other unit, the Device # will not be shown.

Each channel controls the attenuation of a specific path and so a default label has been assigned to each channel corresponding to the input and output of that path. If you prefer to use your own labels, you can change the label of a channel by double clicking on that channel. A new window will appear that'll let you input your own custom name with a limit of 20 characters.

Figure 7: Channel Format

Figure 8: Custom Name Input

6.5. Creating / Editing Groups

You can create groups of channels that you wish to control together. This is similar to the Multi Channels option, but you can save and load the group for future use. To create or edit a group, simply press on the button next to the groups drop down. The top section will change into the **Create / Edit Groups** section.

To create a new group, simply type in the name on the provided area and then select all the channels that you wish to group together. Once done, press on **Save** and the group will be saved. The group is saved to the unit and all profiles may access them. However, if the profile was not given control to a specific channel that is included in the group, that channel will not change and an error will appear indicating that profile does not have access to that channel.

To edit a group, press on the drop down and select the group you wish to edit. Select or de-select your choice of channels and then press **Save**.

Press on **Exit** to be brought back to the main screen.

Figure 15 shows an example where I created a group named "UE1 to A Paths". I've selected each channel that controls the attenuation values between the "UE1" Port and each of the eight "A" Ports (Channels 01A, 01B, … , 01G, & 01H).

Figure 9: Create / Edit Groups Section

6.6. Menu Items

Figure 10: Menu Items

Figure 16 shows all the Menu Items available on the main screen. Each lead to their own specific section or window within the GU.

Connection Options: opens up the Connections Screen shown in Figure 7

Automation Mode: opens up the Sweep and Hop Mode functions

Configuration Settings: opens up the settings menu

Ethernet Settings: opens up the settings for Ethernet control. This button is only accessible when connected via USB. It will be greyed out if connected via Ethernet

Firmware: opens up a window that shows firmware information and allows for updates

User Access Control: opens up the profile management window

Multi Sequence: opens up the Multi Sequencing window

Show Log: opens up the User's Activities Log window

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6.7. Automation Mode

This section allows for Sweep and Hop Modes for multiple channels or groups. On the top is the **Start** and **Stop** buttons for the automation. It also has the **Show Attenuators Matrix** and **Show Automation Control** buttons. These simply shows either the matrix on the Attenuation Control Section or the Automation Control Section.

On the right are 3 sections: Timing, Control Mode, and File sections. The Timing section allows you to set how long you want your automation to run. It can either be continuously until manually stopped, for a certain amount of time, or for a number of cycles. It also allows you to select if you want the sequence to be bi-directional. For example, a sequence of 0 – 90 (45dB steps) with bi-Directional unchecked will run like the following: 0dB, 45dB, 90dB, 0dB, 45dB, 90dB, 0dB, etc. If bi-directional was checked, then it will run like the following: 0dB, 45dB, 90dB, 45dB, 0dB, 45dB, etc.

Control Mode allows you to choose High Speed mode or PC Control mode. High Speed mode enables minimum dwell time, but the GUI cannot display the current attenuation of the channels in the attenuator matrix. Since the GUI cannot track the attenuator's progress, Timing is disabled and can only stay on Continuous. In PC Control, the minimum dwell time is higher, but it allows the GUI to display the attenuations and Timing is enabled.

The File section allows you to save, load, and create a new automation file. These files can be saved on your computer and re-called back into the GUI so that you don't have to re-enter all the parameters of your automation again and again.

Figure 11: Automation Mode Section

6.7.a. Sweep Mode

Sweep mode allows you to create up to four sequences (one in High Speed Mode), each controlling either a single channel, all channels, or a group of channels that you've created. Each sequence can have different Start, Stop, and Step values, but the dwell time is the same for all four sequences.
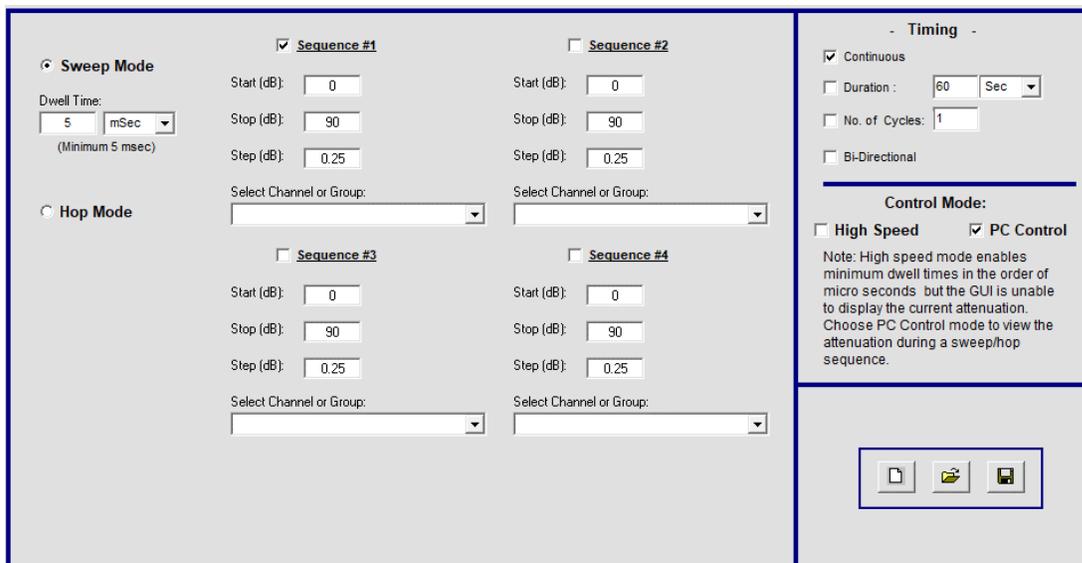
Figure 12: Sweep Mode
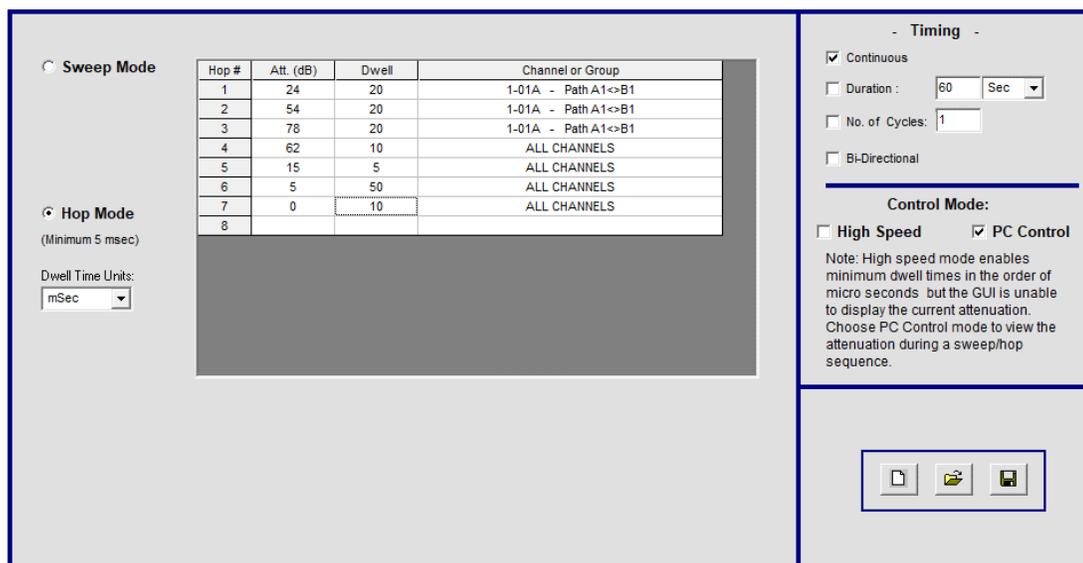
Figure 13: Hop Mode

6.7.b. Hop Mode

Hop mode allows you to set any attenuation and any dwell time (within the limits) per step. It also doesn't have to be the same channel or group. In essence this is a more customizable sweep mode. The only limit is that the time units need to be the same (mSec, Sec, Min, Hour).

To exit Automation Mode, simply press on the **Manual Mode** button (which replaced the **Automation Mode** button). This will bring you back to the main screen for manual control.

6.8. Configuration Settings

The **Configuration Settings** brings up a new window where you can adjust the Attenuators Channels Settings and the Manual Attenuation Scroll Bar.

You can also set up a Custom System Name for the unit at the top. The Custom System Name is simply a custom name that you can use for the set up. This can be helpful when you have multiple of these units that you're connecting to remotely and you're not sure which is which. For example, let's say you have 2 systems where System 1 is located in Lab 1 and System 2 is in Lab 4. You can name System 1 as "Lab 1" and System 2 as "Lab 4" to differentiate them. By default, each unit has the name "Attenuator System". This name will come up when you're search to connect to the unit via Ethernet which is talked about in **Sections 4.10** and **4.11**.

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Attenuators Channels Settings lets you setup the attenuation you want the unit to have on start-up (power up). There are 3 options: set the last defined attenuation, set the attenuation to a specific value, or to set the max attenuation (which is the factory default). You'll have to select each module individually to change its settings and press **Save** for each module.

The Manual Attenuation Scroll Bar simply changes the value that changes when you use the scroll bar to change the attenuation on the main screen. A course tune is when you press on the bar to change the attenuation and a fine tune is when you press on either of the 2 arrows on each end of the scroll bar.
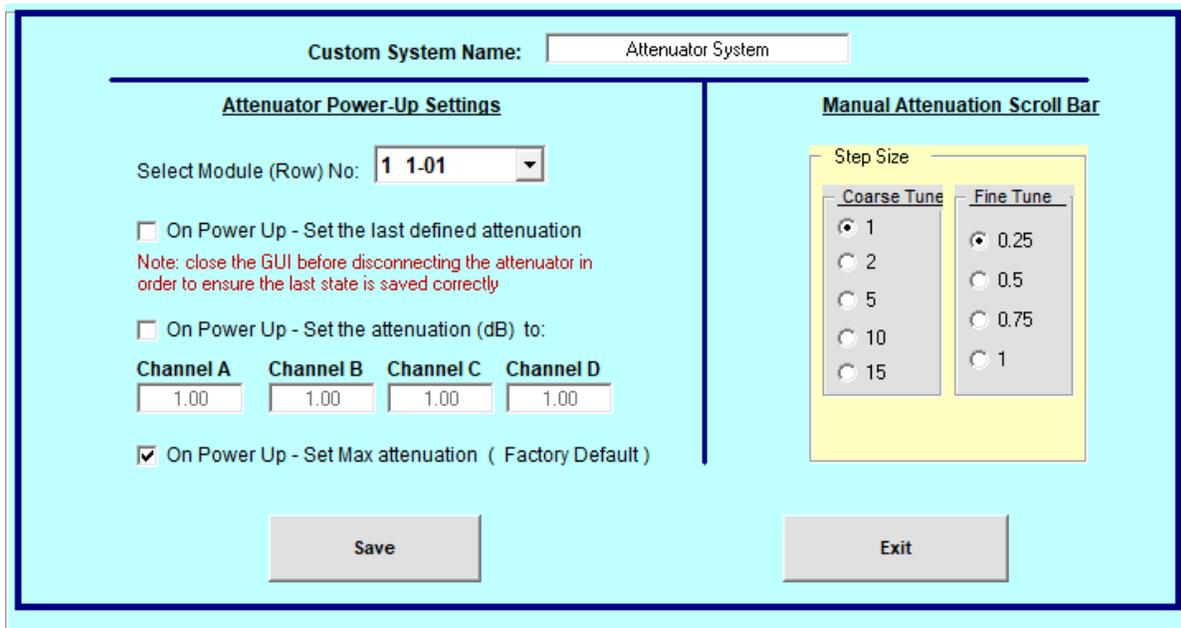
Figure 14: Configuration Settings

6.9. Firmware

The **Firmware** button opens up the window on the left. Here you'll find various information including the model name, serial number, and the firmware revision that your unit has. You can also update the firmware here; however, you can only update the firmware while connected via USB. If you require the latest firmware version, please contact Mini-Circuits (TestSolutions@minicircuits.com).
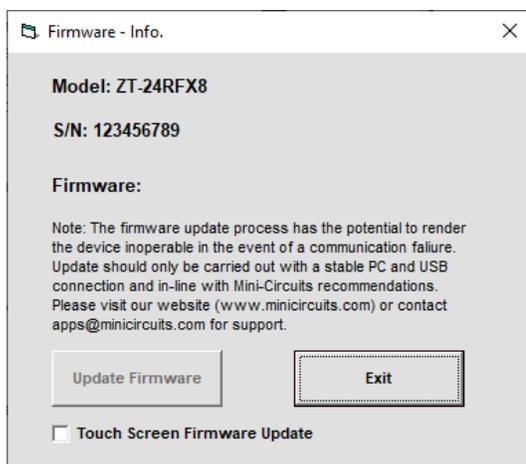
Figure 15: Firmware

To update the firmware, follow the instructions below:

1. Disconnect the unit from all connections except for the USB connection to the computer that you have the firmware file (.hex) located (this includes all daisy chained units)
2. Open the GUI and connect to the unit via USB
3. Press on the **Firmware** button located on the left of the GUI screen
4. If you are updating the firmware of the touch screen, click on the **Touch Screen Firmware Update** checkbox
5. Press on the **Update Firmware** button and then find the firmware file (the file has a **.hex** extension)
6. Press **O.K.**
7. **While the firmware is updating, DO NOT disconnect the USB. Doing so will corrupt the unit.**

![Mini-Circuits logo]

6.10. Ethernet Settings

All models with Ethernet capability are configured with DHCP enabled by default so in most cases a dynamic IP address will be issued by the network's DHCP server on connection. If you wish to change the system's Ethernet configuration (assign a static IP address for example) then you'll need to connect the system via USB and click on the GUI's **Ethernet Settings** button to bring up the Ethernet Device – Configuration window.
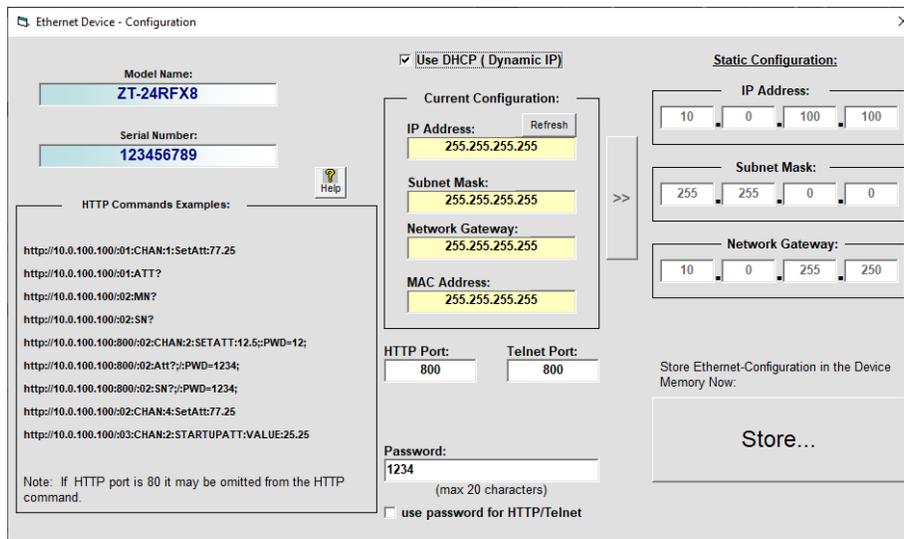

Figure 16: Ethernet Device - Configuration Window

In this window you can either select DHCP or set a static configuration. If DHCP is enabled but the IP Address in the Current Configuration section states "0.0.0.0" it indicates that the system has not yet been assigned an IP address by the network; wait a moment and then click on **Refresh** to try again. Press on **Store…**, will also update the configuration and also save the settings. If an IP address still cannot be retrieved, please check the Ethernet connection and consult your network administrator.

The Ethernet configuration screen also allows you to change the HTTP, Telnet, and SSH (if available) ports of the connection and set a password. Note that SSH protocol needs a login and password.

Once everything is properly set, press on **Store…** to save your settings.
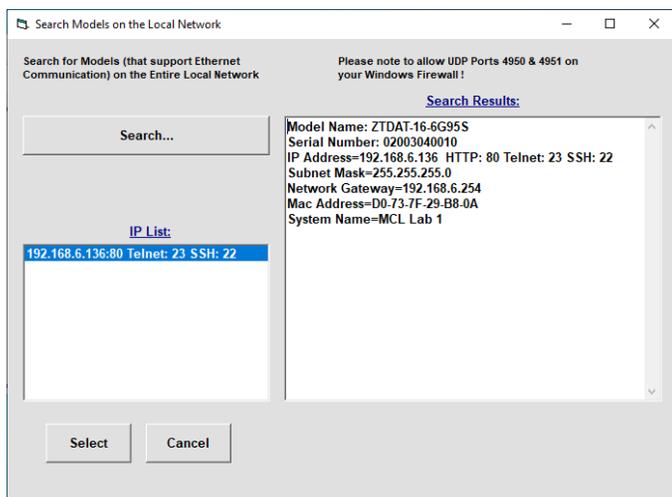
Figure 17: Available Connections via Ethernet

6.11. Connecting via Ethernet

To connect via Ethernet, press on the **Magnifying Glass** in the *Connection Options* window (Figure 7). The window to the right will appear and displays all available units that can be connected via Ethernet. You may need to press **Search** a few times for your unit to show up. Once it appears, you can double click on the selection and the IP Address on the *Connection Options* window will auto-populate. Fill in the password if there is one and then select HTTP, Telnet, or SSH. If selecting SSH, you'll need to fill in the login name as well. Fill in the port # for the connection and then press on **Ethernet**.

6.12. User Access Control

This button is only enabled for the Admin profile. The Admin can use this section to create and edit different profiles for different users.

Initially you'll have to choose to either *Store on Device* or *Save to File*. Once you've selected, press on **Save** to save the current permissions file. By default, there should only be the Admin profile with no password and access to all attenuator channels. To create new profiles, there should be extra blank spaces. If there aren't any, simply press the Enter key from the previous profile.

If you chose to *Store on Device*, the permissions file is stored on the device. Any user can use the box as long as they have the password for any of the profiles that the Admin has created.

If you chose to *Save to File* then the permissions file is stored in a directory either on your computer or your servers. This file will automatically be called when the GUI opens as long as the unit has access to the file location. If the file is saved onto a computer, but then the unit is moved and connected to a different computer then a new permissions file needs to be created.

In the example in Figure 24, the Admin decided to save the permission file onto the device itself. He creates a password for himself and then creates a new profile named Jason. He adds a password to Jason's profile and then assigns attenuator channels 01A, 01B, 02A, and 02B to him. Jason can now log into the device with his username and password, but he will only be able to control the four attenuator channels assigned to his profile.
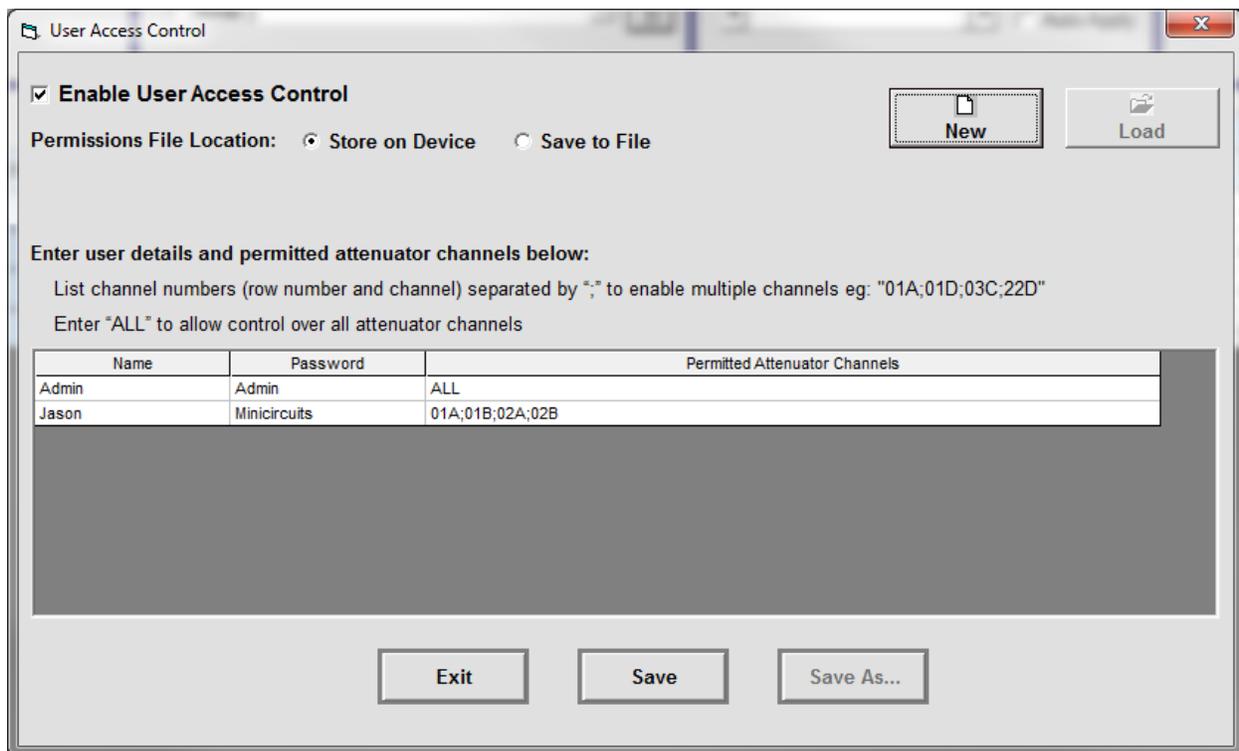
Figure 18: User Access Control Window

To create a new file, simply press on **New**. To load (you can only load if you selected *Save to File*) simply press on **Load**.

To assign attenuator channels, you will need to enter the channel number and letter and then separate each specific channel with a semi-colon (;).

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6.12.a. User Access Control Examples

Below are 2 examples on using the User Access Control feature.

6.12.a.i. Example 1

The Admin (John) connects his laptop via USB to the unit for the first time. He needs to create a password for his Admin profile and also create a new one for his co-worker Jason. After opening the *User Access Control* window, he decides to *Store on Device*. He then adds a password to his Admin profile and then creates a new profile for Jason (see Figure 25). He then disconnects his laptop from the unit and tells Jason his username and password. Jason goes over to the unit, connects his laptop and will have to use his username and password to have access to the unit. Once logged in he can only access the channels assigned to him: 01A, 01B, 02A, and 02B (see Figure 26).
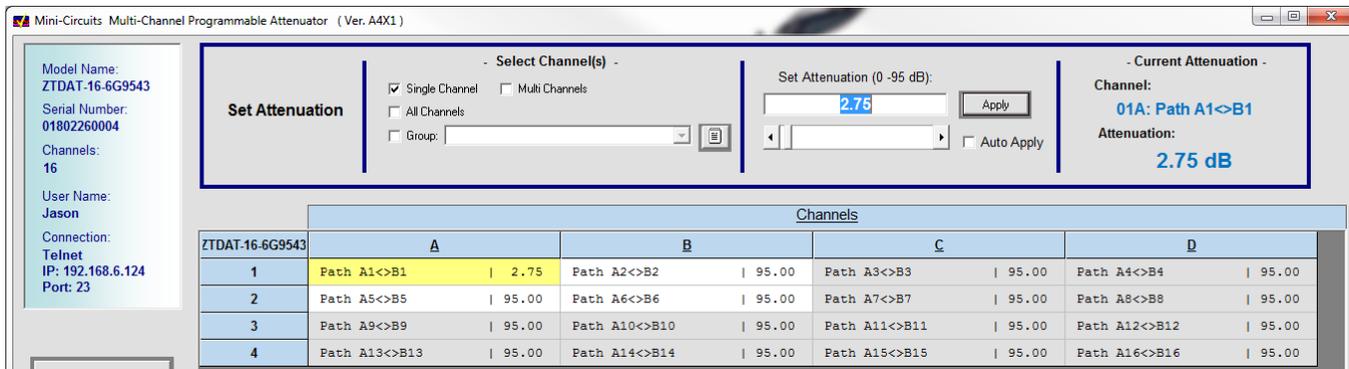
Figure 19: Jason's Profile

6.12.a.ii. Example 2

Same scenario as Example 1, except this time John decides to save the file to his laptop's Documents folder by selecting *Save to File* (see Figure 26). He now needs to leave his laptop connected to the unit and let Jason log onto his profile using John's laptop. Later John takes his laptop away. Jason then connects his laptop to the unit, but can now create his own permissions file with himself as the Admin since the permissions file that was created previously was stored on John's laptop.
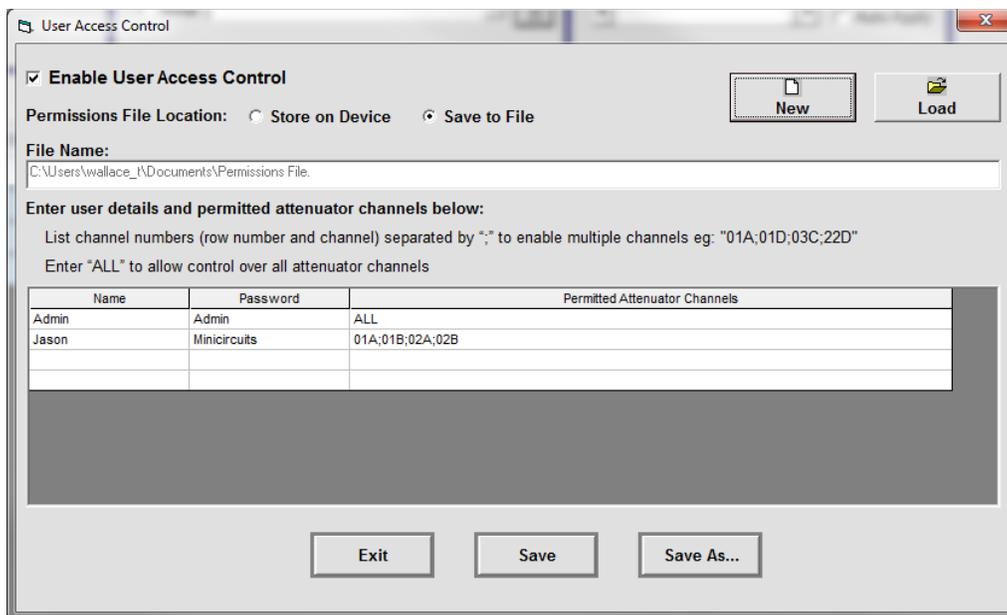
Figure 20: User Access Control Window

6.13. Multi Sequence

The Multi Sequence feature allows you to set various sweep or hop sequences for up to 10 channels or groups. Each sequence can be different or the same depending on your application. They can also run at differing times without interfering with each other.

In Figure 27 for example, if I had a test running for Path A1<>B1 previously and now I have a new test that needs to make use of Path A2<>B2 and Path A13<>B13, I can start running Sequence 2 and 3 without interrupting the already running Sequence 1.

To setup a sequence, simply press **Show** and the Sequence Settings (Figure 28) will appear. This is where you'll setup the sweep or hop sequence that you would like to perform on the specific channel or group. This works exactly like the Sweep and Hop functions we covered in Section 4.7.
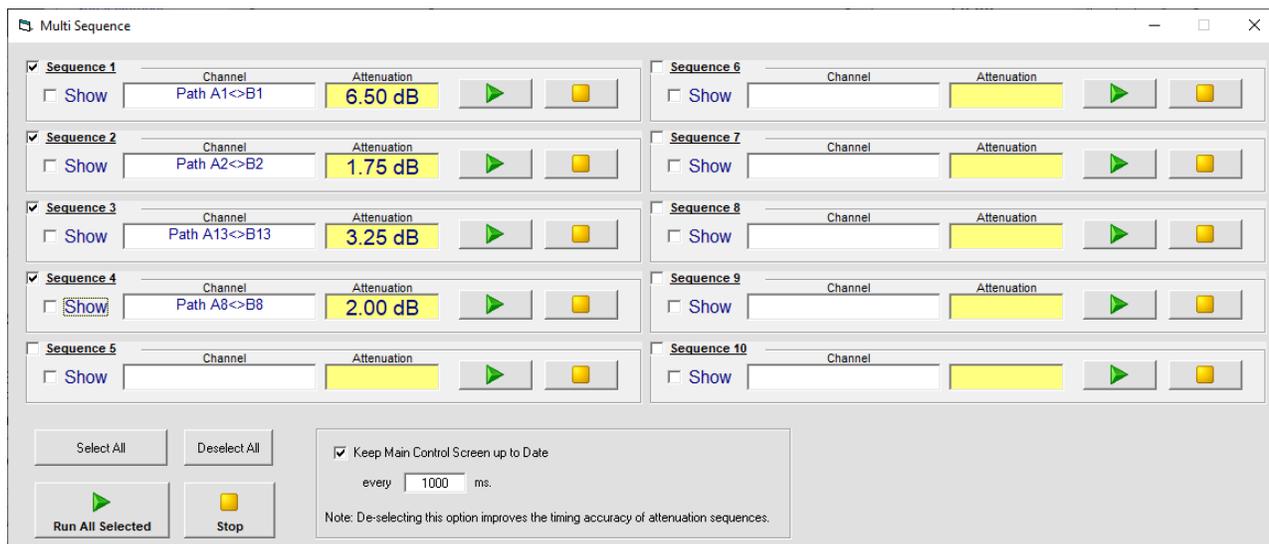
Figure 21: Multi Sequence Main Screen
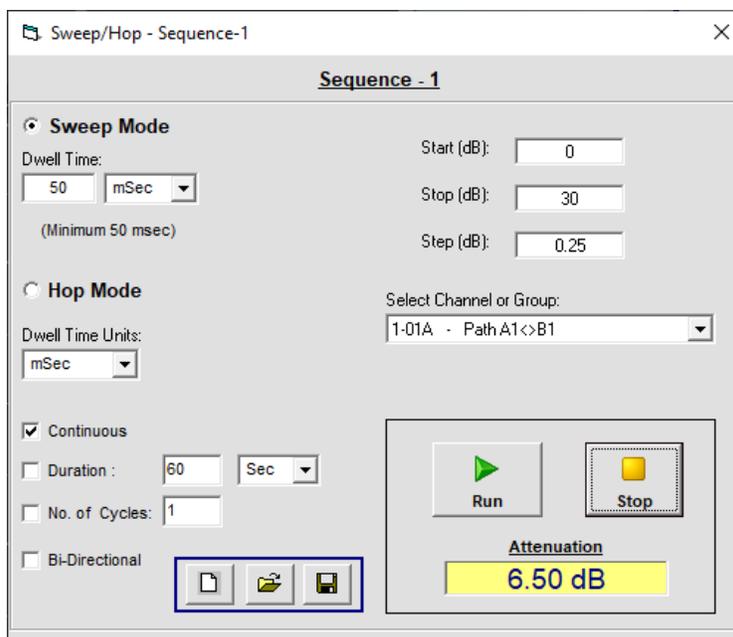
Figure 22: Sequence Settings

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6.14. Show Log

The **Show Log** button does exactly what it says. It brings up a new window that gives you a history log of all commands sent to the specific unit.

This log is automatically saved for all users in the designated file at the bottom of the screen. As you can see, only the Admin profile has access to change the save location and to enable or disable the history logging. The default save is a Microsoft Access (.LDB) file, but you can save the file as a CSV file by pressing **CSV** button. A CSV file is accessible via Microsoft Excel.

On the right-hand side of the screen you have various options you can use to affect what is displayed with the GUI (this does not affect the save file). You can designate how much history to display and also sort the table by Timestamp or by User Name. You can copy what is shown by pressing **Copy to Clipboard** or, as stated above, save to a CSV file by pressing **CSV**.

When the table updates, new lines of commands are placed at the very top which pushes the table down. The **Pause – Update Log Table** pauses the table from updating. When enabled, this allows for easier viewing of previous entries lower on the table. When this feature is disabled again, the table will update with all commands made while enabled.

Figure 23: History Log