



Lotus Communication Systems, INC.

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# Digital Step Attenuator (DSA) User Manual

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## **1 INTRODUCTION**

Lotus Digital Step Attenuator (DSA) User Manual provides general introduction, installation instructions and operation for Lotus USB programmable attenuators that include single and multiple channels.

Lotus Communication Systems, INC. (LOTUS) has developed single and multiple channel programmable attenuators, which can be controlled via standard USB.

Programmable Attenuator can operate up to 40 GHz with minimum attenuation resolution of 0.25 dB.

## 1.1 Model Section Guide

Model Name	No. Of Channels	Frequency Range	Attenuation Range (dB)	Attenuation Resolution	Max Input Power (dBm)	Control Protocols
A1Q9K6G32	1	9KHz-6GHz	31.75	0.25	+28 dBm	USB
A1Q9K6G64	1	9KHz-6GHz	63.5	0.25	+28 dBm	USB
A2Q9K6G64	2	9KHz-6GHz	63.5	0.25	+28 dBm	USB
A4Q9K6G64	4	9KHz-6GHz	63.5	0.25	+28 dBm	USB
A8Q9K6G64	8	9KHz-6GHz	63.5	0.25	+28 dBm	USB
A1Q9K8G32	1	9KHz-8GHz	31.75	0.25	+28 dBm	USB
A1Q9K8G64	1	9KHz-8GHz	63.5	0.25	+28 dBm	USB
A2Q9K8G64	2	9KHz-8GHz	63.5	0.25	+28 dBm	USB
A4Q9K8G64	4	9KHz-8GHz	63.5	0.25	+28 dBm	USB
A8Q9K8G64	8	9KHz-8GHz	63.5	0.25	+28 dBm	USB

## 2 SOFTWARE SETUP

For Windows 10 and Linux, the USB Drivers will be installed automatically. For other Windows operation systems, we need to install the USB driver.

### 2.1 Application Software

Lotus programmable Attenuator does not need to install any software. Lotus provides an executable (Windows Certified Program) file DSA.exe to download on our web site.

User can add shot cut to this executable program on the desktop in order to quickly access this control program.

## 3 USING LOTUS DSA GUI

All LOTUS attenuator models share the same GUI interface to allow easy control. To start the program, double click DSA icon and get started!

### 3.1 Starting the DSA GUI

#### 3.1.1 Startup Screen

When the DSA GUI is started, it will show the connect options to allow user to choose USB Serial Com Port or Ethernet Control.

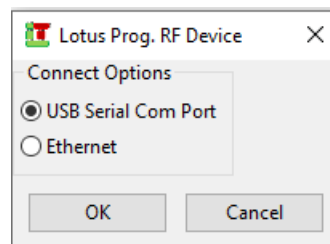


Figure 1. DSA Startup Screen

#### 3.1.2 USB Serial Com Port

LOTUS Attenuators are driver-less USB HID compatible device that uses virtual serial com port as an interface to user control. After user click OK button to select USB Serial Com Port, the USB Serial Port Configuration Screen will pop up to show the available LOTUS USB device to choose. Figure 2 show an example USB Serial Port Configuration Screen that has two Lotus USB Attenuator Devices.

When the available USB DSA device is shown, it will list the DSA Part Number, Serial Number and what Com port is connected.

For example, the selected Attenuator in Figure 2 shows Attenuator with PN: A1Q9K8G64 with SN: 194501 and is connected to COM7.

After user selects the DSA attenuator and click OK, the Attenuator Control GUI will show. The Attenuator Control GUI is configured automatically based on number of channels available for the DSA attenuator. Figure 3 shows the GUI for one channel. Figure 4 shows

the GUI for two channels. Figure 5 shows the GUI for four channels. Figure 6 shows the GUI for eight channels.

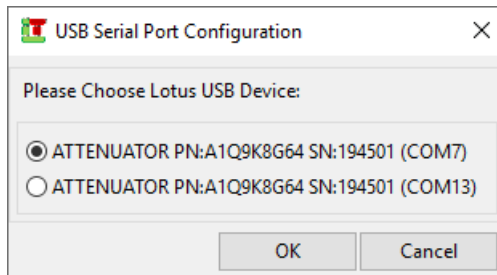


Figure 2. DSA USB Serial Port Configuration Screen

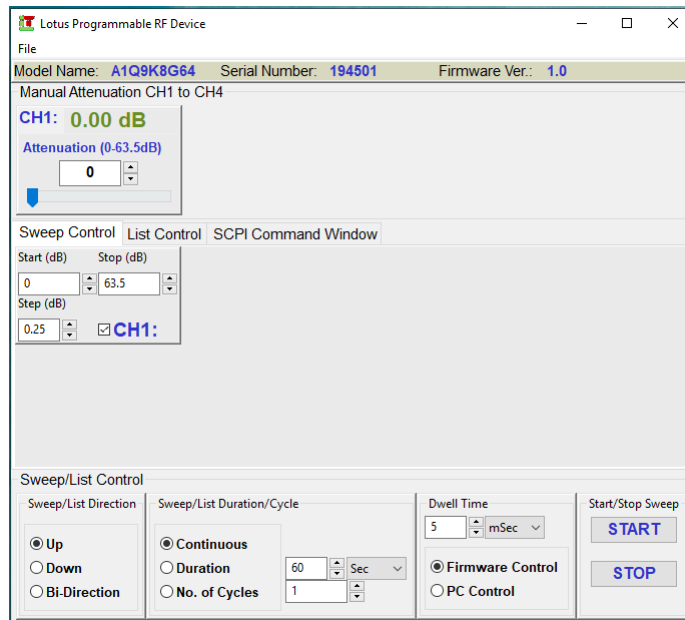


Figure 3. DSA Control GUI (one channel)

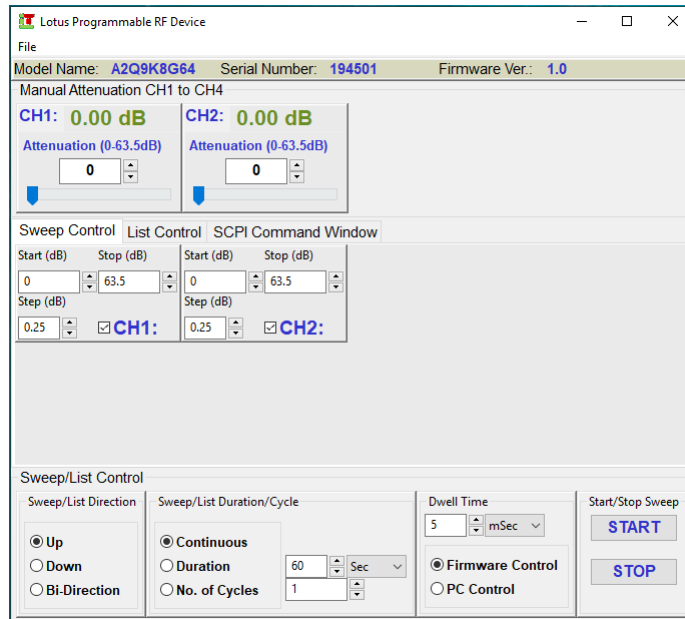


Figure 4. DSA Control GUI (two channels)

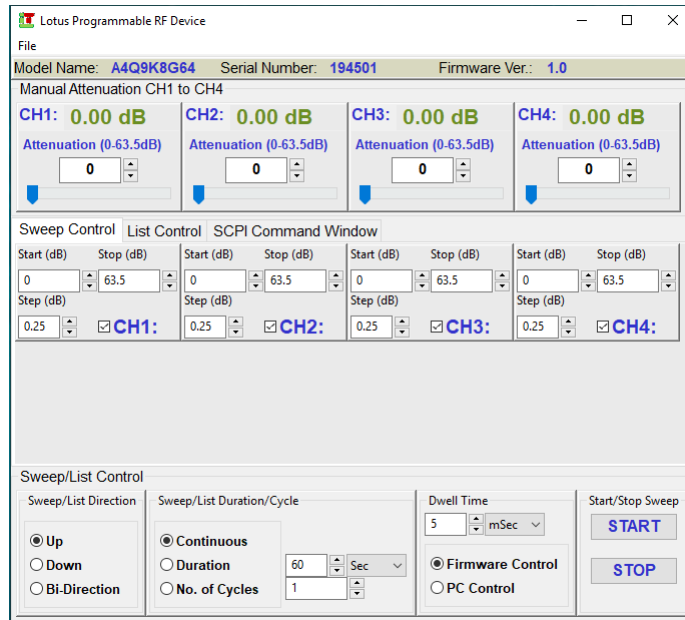


Figure 5. DSA Control GUI (four channels)

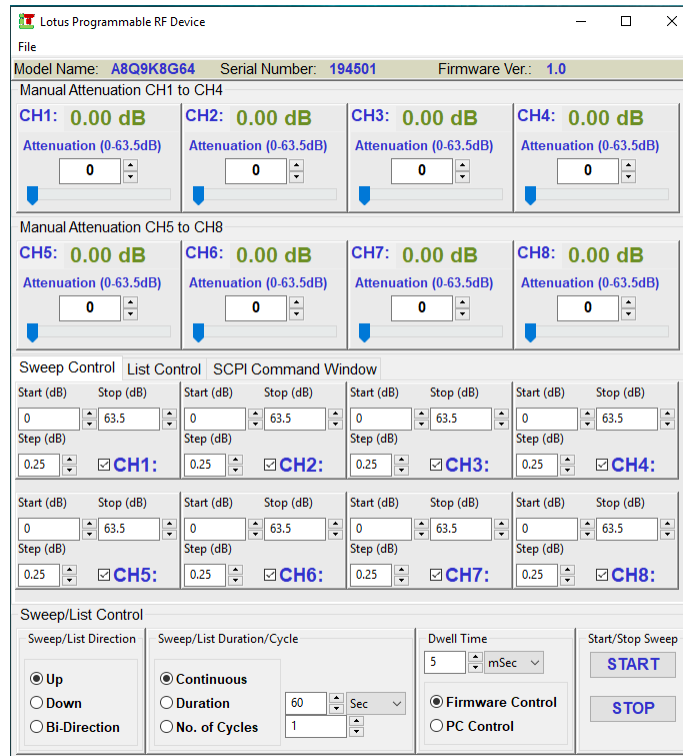


Figure 6. DSA Control GUI (eight channels)



### 3.2 Control Attenuator with GUI Program

The main screen of the DSA control GUI will appear after user selects the desired attenuator. In this section, we will illustrate how to use GUI to control Attenuator. We will use single channel as an example. When the control is related to multiple channels, we will add multiple channel examples.

Figure 7 shows a GUI for single channel with 63.5 dB attenuator control range.

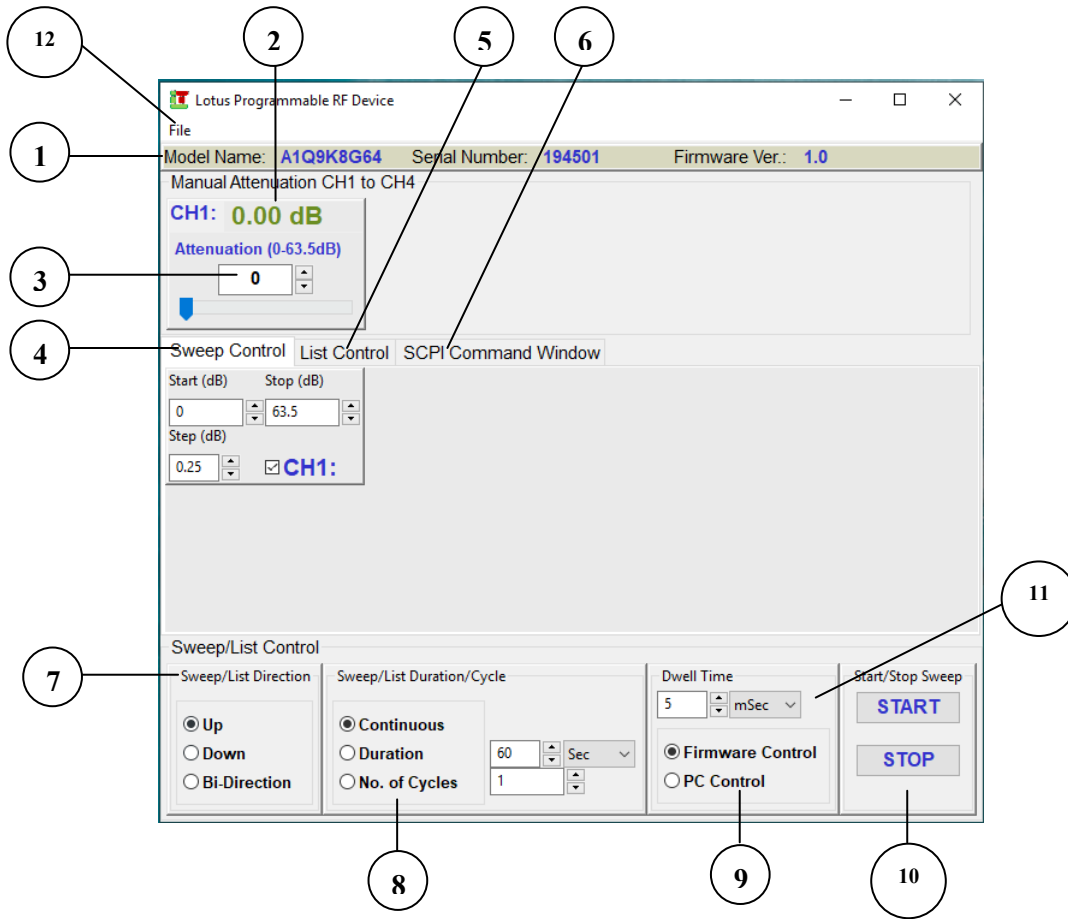


Figure 7. DSA Main GUI Screen (single channel)

### 3.3 Main GUI Screen Functions:

#	Name	Descriptions
1	Model Description	Display PN, SN, Firmware Version
2	Current Attenuation	Display the current attenuation
3	Manual Attenuator	Attenuation to be set. The value can be either changed by typing a value, or using the scroll bar and up/down arrows to change the attenuation
4	Step Sweep Control	When this Notebook is selected, allows setting an attenuation sweep with user defined start, stop, step and dwell time values
5	List Sweep Control	When this Notebook is selected, allows setting a table (or list) of user defined attenuation and dwell time for list sweeping
6	SCPI Command Window	When this Notebook is selected, allows user input SCPI command to directly control the attenuator
7	Sweep/List Direction	This allows user to select either Up, Down or Bi-Direction for Step/List Sweeping
8	Sweep Duration/Cycle	This allows user to select either Continuous, Duration or Number of Cycles for Step/List Sweeping
9	PC/Firmware Control	This allows user to select either high speed Step/List Sweep using Firmware control or PC control
10	Start & Stop	Start and Stop the automatic Step/List Sweep at the current attenuation setting.
11	Dwell Time	This allows user to select Dwell time for Step Sweep
12	File Dropdown Menu	This allows user to select Dropdown Menu to Change the Device or clear the SCPI command window

## 4 STEP AND LIST SWEEP FUNCTION

The GUI provides the ability to carry out an automatic Step Sweep or list sweep.

### 4.1 Step Sweep

In Step Sweeping, the Attenuator will sequentially sweep from a start attenuation value (default 0) to a stop value (default maximum attenuation value), with a fix step size (default minimum step size) and dwell time.

In order to configure Step Sweep, user needs to select “Sweep Control” Tab in the middle of the GUI. Then the user needs to make sure the desired channel is selected by the checkbox. Then user can select Start, Stop and Step Attenuation (dB) by typing or use the Up/Down Arrow.

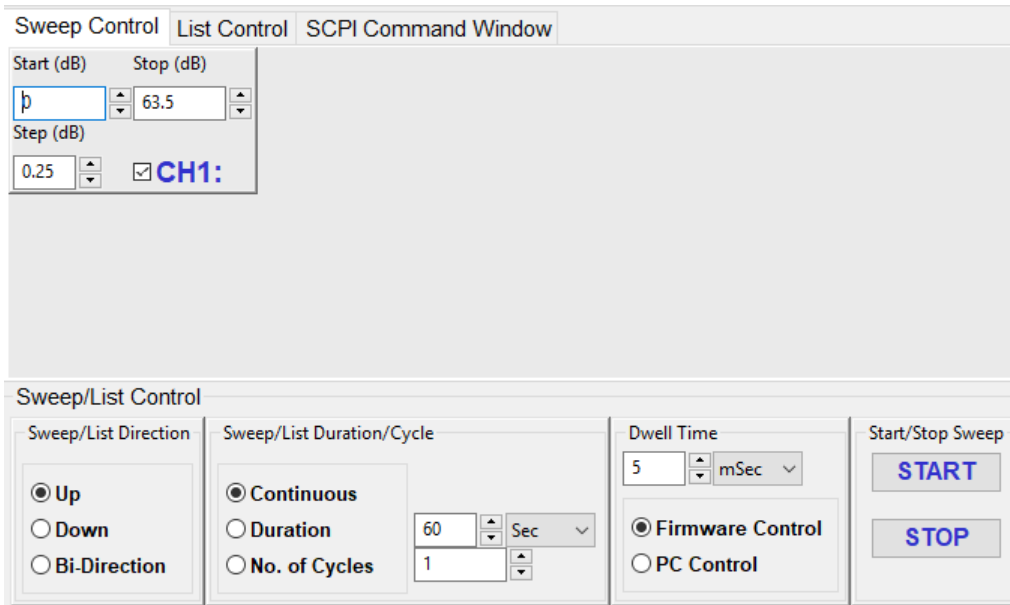


Figure 8. Sweep Control GUI (single channel)

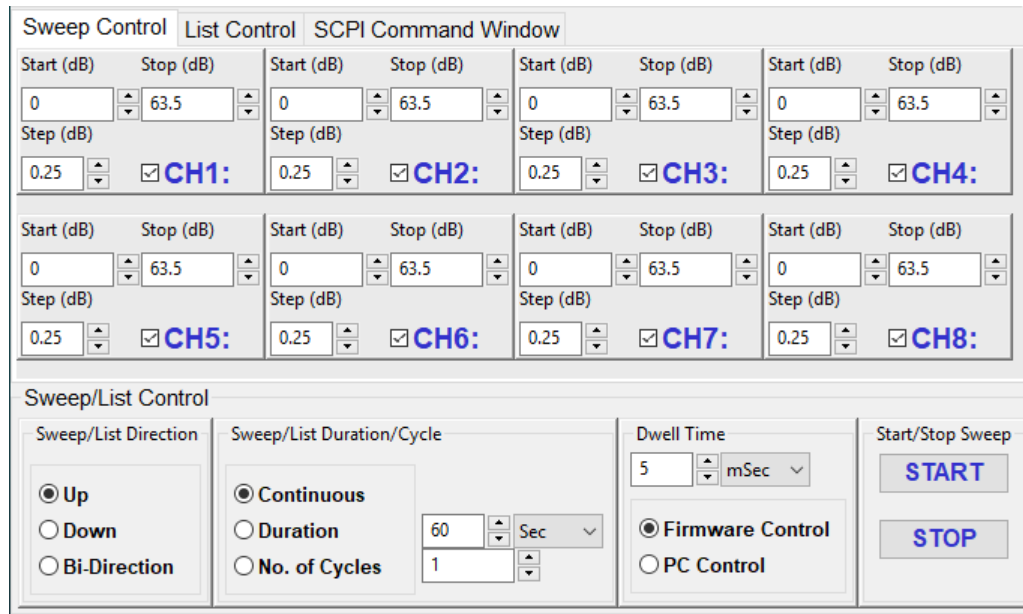


Figure 9. Sweep Control GUI (Eight channel)

After user selects the Start, Stop and Step Attenuation as shown in Figure 8, he/she can then select Sweep Direction, Sweep Duration/Cycle and Dwell Time using Sweep/List Control Window as shown in Figure 8.

## 4.2 List Sweep

In List Sweeping, the Attenuator will sweep from a List sequence of attenuation and dwell time value based on user input List table.

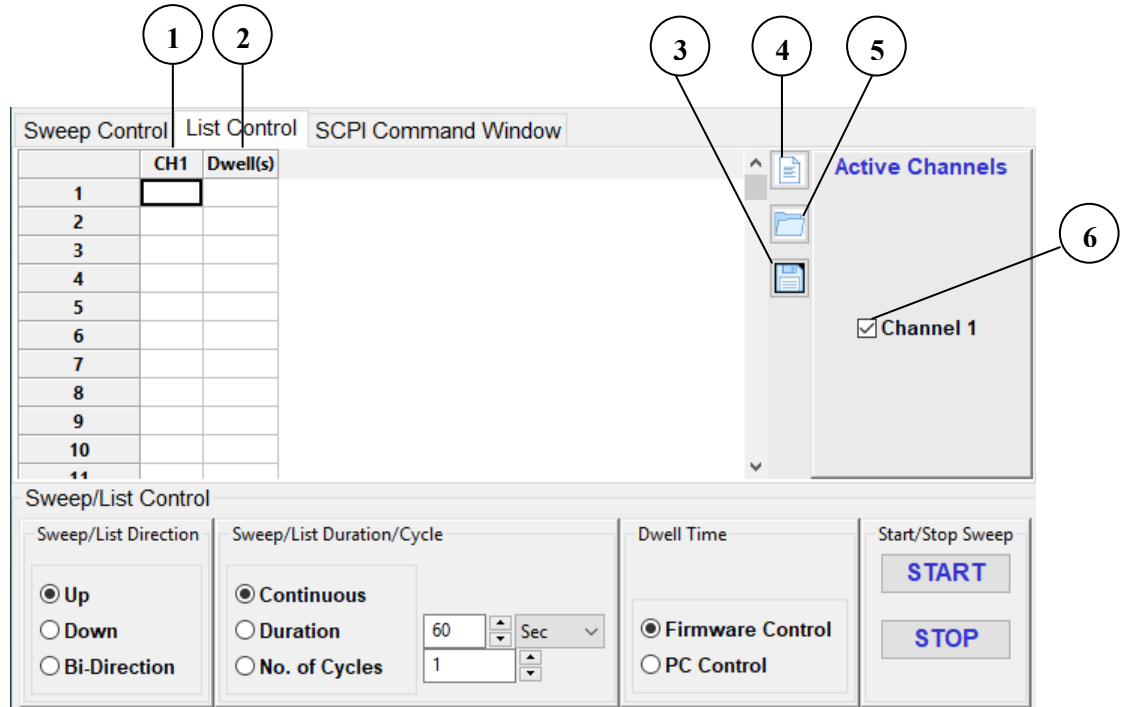


Figure 10. Sweep Control GUI (single channel)

#	Name	Descriptions
1	List Attenuation for Channel	User Input for Attenuation Value for Individual Channel
2	List Dwell Time	User Input for Dwell Time value for all Channels
3	Save CSV File	User can save the List to CSV File
4	New File	User can start New List Grid File, when this button is clicked, the input in the Grid Table will be cleared
5	Open CSV File	User can load CSV File (includes List) in the List Grid Table
6	Active Channels	User Input to select Active Channel(s) for List Sweep

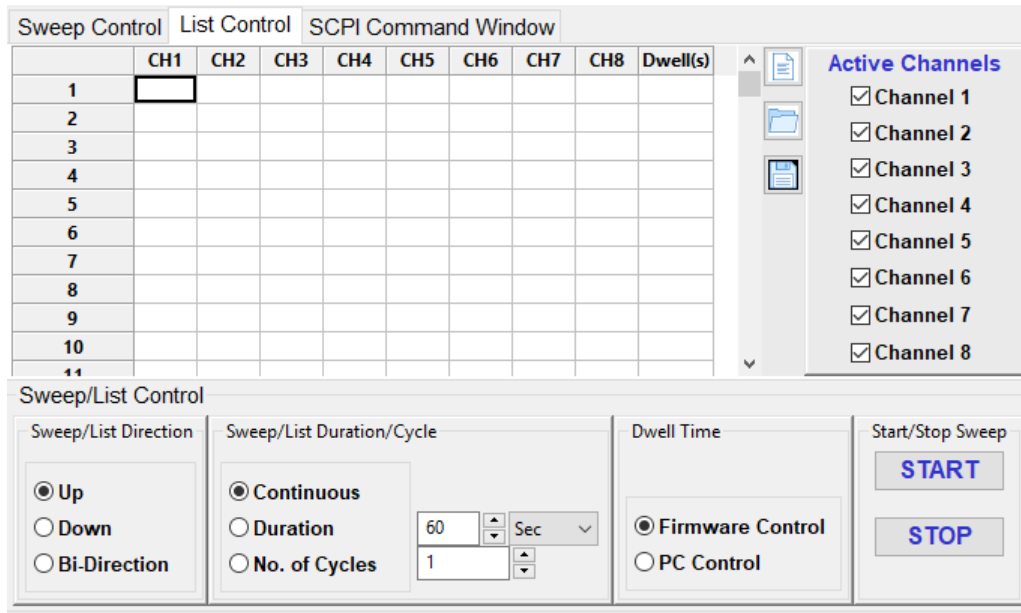


Figure 11. Sweep Control GUI (Eight channels)

The other List Sweep Controls are similar to those of Step Sweep Control. The only difference is that the Dwell Time Input is disabled in List Sweep Control since the dwell time is set in the List Grid Table instead.

Figure 11 shows a List Sweep Control GUI for Eight channels. We can see that the List Grid Table is expanded to allow Attenuation Input for eight channels. The Active Channels window is also expanded to allow section of active channels for eight channels.

### 4.2.1 List Sweep CSV File Format

LOTUS List Sweep CSV File Format is as follows:

```

Lotus Communication Systems Inc
Programmable Attenuator Sweep List CSV File
Ver 1.0
1,1
10,1
20,1
30,1
40,1
    
```

The above file set the List attenuation sweep for attenuation value at 1, 10, 20, 30 and 40 dB and dwell time at 1 second for each attenuation. User can use other Tools (e.g. EXCEL) to edit the CSV file and load the file in the LOTUS List Grid Table in Figure 11.

### 4.3 PC Control

The PC Control Mode is the default mode for all LOTUS attenuation models. In the mode, the step sweep or list sweep is managed by the GUI program. Each attenuation value for each channel is sent to the attenuator one at a time using SCPI command. Since the GUI program is the control, the program always knows exactly what attenuation is set for the

Attenuator. Thus the GUI will display the current attenuation state for all the controlled channels.

Since the GUI sends the manual SCPI command to the Attenuator, a communication delay is expected between the PC and attenuator. Typical communication delay is in the order of 5ms.

#### 4.4 Firmware Control

In Firmware control mode, we can achieve much faster attenuation sweep than PC control. In this high speed firmware control mode, the Step Sweep or List Sweep parameters are first sent to the Firmware from PC GUI program.

After the Sweep parameters are communicated from PC to Firmware, no further communication is required (other than Sweep Stop). The Firmware on the Attenuator will take full control for Step Sweep or List Sweep. This enables high speed attenuation sequences with dwell time as low as 100us for one channel Attenuator. Each extra channel will add about 100us since the Firmware needs to send more SPI command to other channels.

LOTUS Attenuator uses the current start-of-art Microprocessors with 48MHz CPU clock and high speed SPI interface (12MHz) to achieve <100us Dwell time in the Firmware Control mode. The limitation of this minimum dwell time is the Attenuator SPI interface speed.

Please note that in this high speed mode, PC will not be able to display the current attenuator state since the communication delay between PC and Attenuator is much larger than the minimum dwell time.

### 5 SCPI COMMAND WINDOW

LOTUS Programmable Attenuator GUI also provides a SCPI Command Window for direct communication with Attenuator using LOTUS simplified SCPI commands or full name commands.



Figure 12. LOTUS SCPI Command Window GUI

Figure 12 shows an example SCPI Command Window GUI. This window is the Tab after List Control Tab. Figure 12 shows a “\*IDN?” command was sent to Attenuator and Attenuator response with the Manufacture Name (LOTUS), Part Number (A1Q9K8G64), Serial Number (194501) and Firmware Version (1.0).

User can clear command window by select menu->Clear Terminal.

For details about the SCPI command, please refer to LOTUS document [3].

## 6 FIRMWARE UPDATE

LOTUS Attenuators feature an improved bootloader that makes it easier than ever to update firmware onto the attenuator. Instead of need drivers or a separate program for flashing new firmware (Jlink or others), user can simply drag a file onto a removable drive.

The first step to upload the Firmware is to triggering bootloader in the attenuator. It is easily done by double tapping the reset button when the attenuator is powered. In order to do this, the user will have to open the Attenuator to expose the Reset Button on PCB board.

Once the bootloader on Attenuator is active you will see the Attenuator Device will be re-installed into Operation system as a removable drive. The installation is automatic. The new drive will appear on your computer as LOTUSBOOT.

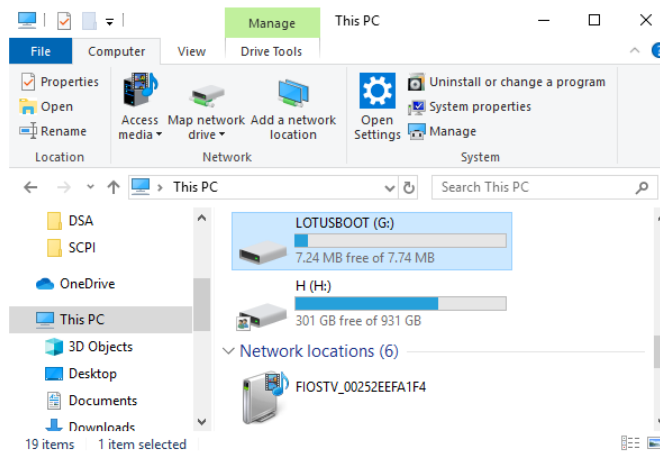


Figure 13. LOTUSBOOT Drive for Attenuator



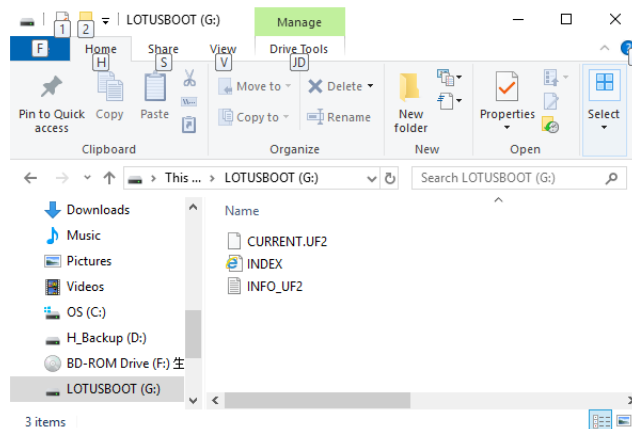


Figure 14. LOTUSBOOT Drive File List

Once the bootloader is successfully connected you can open the drive and browse the virtual file system. It should have three files:

- **CURRENT.UF2** - The current contents of the microcontroller flash.
- **INDEX.HTM** - Links to Microsoft MakeCode.
- **INFO\_UF2.TXT** - Includes bootloader version info. Please include it on bug reports for the Attenuator.

To update new Firmware, simply drag the new UF2 file onto the drive. After the file is finished copying, the bootloader will automatically restart. This usually causes a warning about an unsafe eject of the drive. However, it is not a problem. The bootloader knows when everything is copied successfully. You may get an alert from the OS that the file is being copied without its properties. You can just click **Yes**.

You may also get a complaint that the drive was ejected without warning. Don't worry about this. The drive only ejects once the bootloader has verified and completed the process of writing the new code.

After dragging the new UF2 file and the firmware is updated!

Revision Notes:

Version	Date	Comments
1.0	12/11/2019	First Full Version for Release.

**References:**

- [1]. Keysight E8257D/67D & E8663D PSG Signal Generators
- [2]. Standard Commands for Programmable Instruments (SCPI) 1993.0.
- [3]. Lotus Digital Step Attenuator SCPI Command Manual