

Chapter 6: Multiplexing

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INTRODUCTION

How does Multiplexing Work?

Multiplexers have a common connection, 'n' channel connections, and power and control connections. The control switches which channel is connected to the common connection. For use in probe muxing:

- The TDR is connected to the mux (multiplexer) common.
- The multiplexer has 'n' channels to hook up the probe cables.
- The multiplexer switches "channels" to let the TDR read different probes.

WinTDR provides use with the SDMX50 (8 channel) and VaZEC (16 channel) multiplexers.

6.2 SETTING UP THE HARDWARE

Before we begin there are three basic elements you need in order to use this program for multiplexing multiple TDR probes:

- An unused parallel port on the computer
- A parallel cable that has been correctly wired for mux communication (This chapter shows you how to make this).
- A multiplexer, type SDMX50 or VaZEC.

In the following section, we explain how the parallel cable is wired to connect your computer to the multiplexers. If you have more than one multiplexer, then wire your multiplexers in series connecting all 5 (plus ground) wires from n MUX connector to the next MUX connector. To wire these devices here at USU we use on 16/18-4 cable (3 plus ground) and a 16/18-2 for the power connection.

How to wire the Parallel Cable

To avoid damaging equipment WIRE THE MUXTIPLER WITH THE POWER OFF. After double checking the wiring, turn on the power.

The program assumes the parallel cable interface is wired as specified in figure 6.1.

Cable	Wire Color	Connection Name	Pin on Connector
To parallel	Green	SDE	Pin 4
To parallel	White	DATA	Pin 2
To parallel	Red	CLK	Pin 3
To parallel	Black	Power Ground	Pin 24

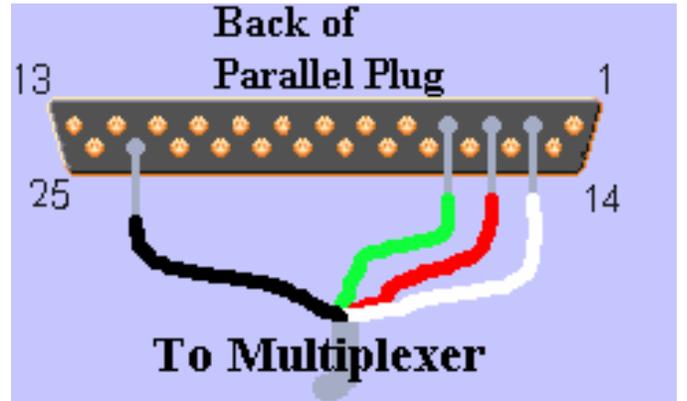


Figure 6.1

Setting Up to use the SDMX50 8 to 1

How to connect the Parallel and the Power Supply cables to the SDMX50 Mux:

Cable	Color	Connection Name	MUX Connector
To Parallel	Green	SDE	Slot c3
To Parallel	White	DATA	Slot c1
To Parallel	Red	CLK	Slot c2
To Parallel	Black	Power Ground	Slot -
To Power	Black	Power Ground	Slot -
To Power	Red	+12 V	Slot +

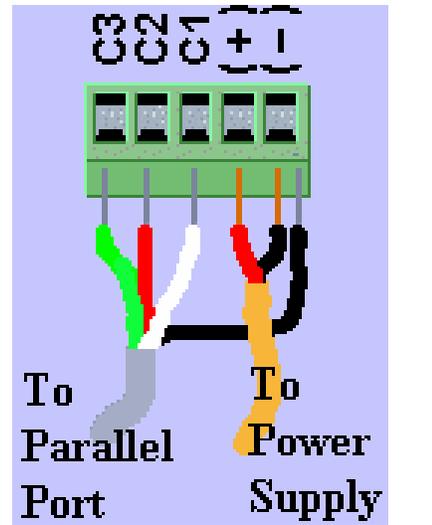


Figure 6.2

See Campbell Scientific, Inc.'s TDR 100 manual for more information.

Setting Up to use the VaZEC 16 to 1

Figure 6.3 shows how to connect the Parallel Cable and the Power Supply to a VaZEC Mux:

Cable	Color	Connection Name	MUX Connector
To Power	Black	Power Ground	Slot 1 (-)
To Parallel	Black	Power Ground	Slot 1 (-)
To Power	Red	+12 V	Slot 2 (+)
To Parallel	Green	SDE	Slot 3
To Parallel	White	DATA	Slot 4
To Parallel	Red	CLK	Slot 5

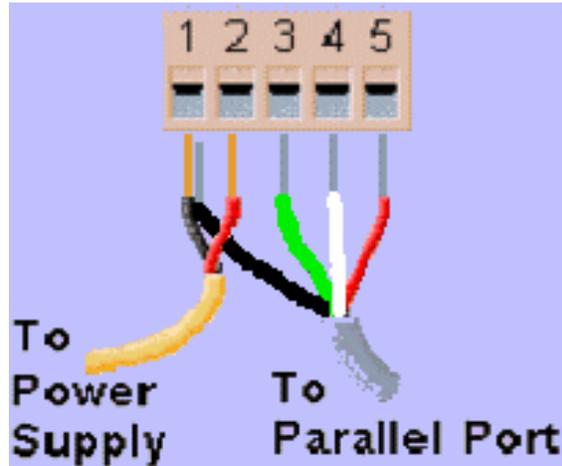


Figure 6.3

See Vadose Zone Equipment Co.'s manual for more information.

Things to Check

Check all multiplexers to see that they are in good shape. Make a point to check every channel to be used.

- Connect all probes, and label them before starting.

Labeling probes will help you quickly locate bad probes, reuse the same setup file over and over, and disassemble/reassemble the setup quickly. As you use the program, you benefit in time and accuracy by following the above.

6.2 WinTDR MULTIPLEXING WALK-THROUGH

After we have wired up the multiplexers and connected to the TDR we are ready to create a setup in WinTDR.

1. When you are in WinTDR go to **File** in the menu bar and select **New** and then **SDMX50 8 to 1** (or **VaZEC 16 to 1**), or select the corresponding icon in the tool bar. This will open the **Setup Manager** window. For this run through we will open the SDMX50 Setup.
2. The **Setup Manager** will open to the introduction tab that says in bold type "Welcome to the WinTDR Setup Manager." Select the **Mux / Probes** tab to create your setup.

3. The **Mux / Probes** page is divided into three sections *Layout (by connection)*, *Multiplexer Information*, and *Probe / ProbeList Information*.
4. The *Layout* section will already have a mux with its eight branches, we will call this mux 1. The first branch of mux 1 will be by default a *Probe List*. For this example you will have 8 branches because we are using a SDMX50, if we had opened a VaZEC setup there would be sixteen branches with a Probe List in the first branch. We will change the first branch from a ProbeList to a Probe. To do this with your mouse right click on the first branch where it says *MICI ProbeList*. This will open a drop box. Select *Add Probe* in the drop box by right clicking on *Add Probe* in the drop box. Now you have a probe in the first position.
5. Now that you have a probe you can change the probe information. To do this first select the probe by left clicking on the probe. When the probe is selected you can change the probe information in the *Probe / ProbeList Information* section in the **Setup Manager** window. For this exercise we will leave the default information.
6. To add further probes we can do as before or if our probes have similar information we can copy a similar probe and paste it to another branch. To do this right click on the probe with the desired information, this will open a drop box. In the drop box left click on *Copy Location*. Now you can past this probe to any branch of any mux in this setup by right clicking on the branch and left clicking on *Paste into Location* that appears in the drop box. Now add probes to branches 2 through 7 in mux 1.
7. To put a mux in the 8th branch right click on the 8th branch where it says *empty*. Like before this opens the drop box. Select *Add Mux* by left clicking on the text *Add Mux* in the drop box. This will create a second mux we will call mux 2. Note this will be another SDMX50 mux, you can only have SDMX50 muxes in SDMX50 mux setup, the same is true for the VaZEC mux setup, it can only have VaZEC muxes.
8. We can now add components to the second mux. To see mux 2's eight branches, with your mouse left click on the plus box directly to the left of the text reading SDMX50(2).
9. Now add probes to all eight branches of mux 2 as we did for mux 1. Your setup should now look like Figure 6.4.
10. You can see the mux number in the *Layout* section after the mux name. To be able to change the mux settings of a particular mux in WinTDR, highlight the mux by left clicking on the mux in the *Layout (by connection)* section of the **Setup Manager** window. You will see a simple diagram of jumper connections in the *Multiplexer Information* section.
11. Ensure that the Jumpers are set correctly by doing one of the following or if you are setting up more than one mux you can use a combination of the two methods.
 - a) Change the jumper settings on the mux. The *Multiplexer Information window* will tell you where to make connections for the jumper settings on the mux as shown in Figure 6.4. The jumper diagram for the SDMX50 oriented with the mux channels to the bottom. The diagram for the VaZEC has a simple schematic to orient you to where the jumpers are on the mux. The VaZEC has the jumpers on the opposite side of the

channels. Both types of muxes may have a case on them that you will have to remove in order to change the jumper settings.

- b) Change the multiplexer number in the *Multiplexer Information* window to match the jumper settings on the mux. Note each mux must have unique jumper settings.

For SDMX50

The MSD connection has exactly one vertically connection and the LSD has exactly one vertical connection. The LSD (Least Significant Digit) from right to left is worth 1,2,3,4. The MSD (Most Significant Digit) from right to left is worth 0,4,8,12. For example in Figure 6.4 we know highlighted mux has jumper set for mux #10 because the MSD is set to the third from the right (value of 8) and the LSD is set to the second to the right (value of 2), which gives a total value of 8 + 2 which is 10.

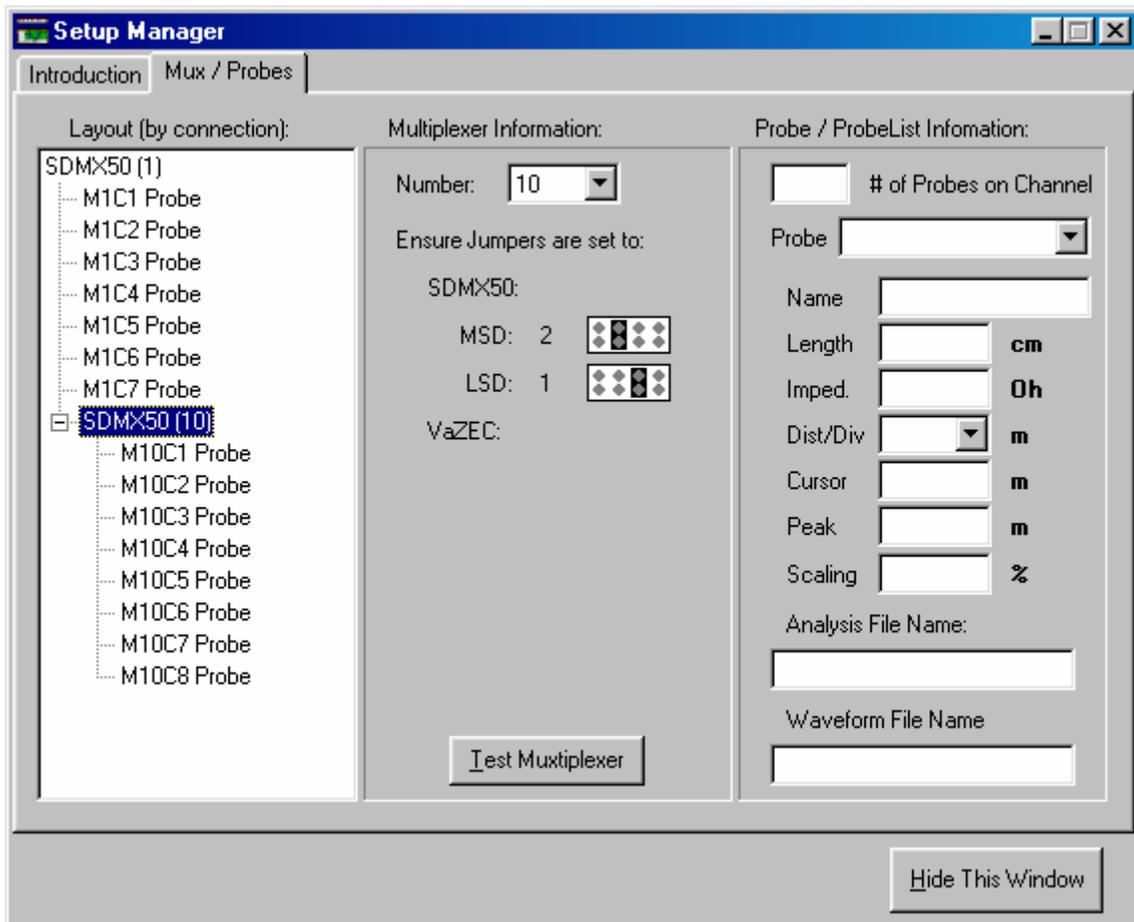


Figure 6.4 The Setup Manager for SDMX50 Mux.

FOR VaZEC

The VaZEC jumpers are more irregular. To find the mux number for the given jumper configuration just change the number in the *Multiplexer Information* section of the **Setup Manager** until the jumper configuration matches the desired jumper configuration. For example in Figure 6.5 the jumper is set in the second position from the bottom right but this position is for the third mux. The irregular mux numbering in WinTDR is setup to match the numbering in the VaZEC manual to make the manuals congruent and hopefully avoid confusion.

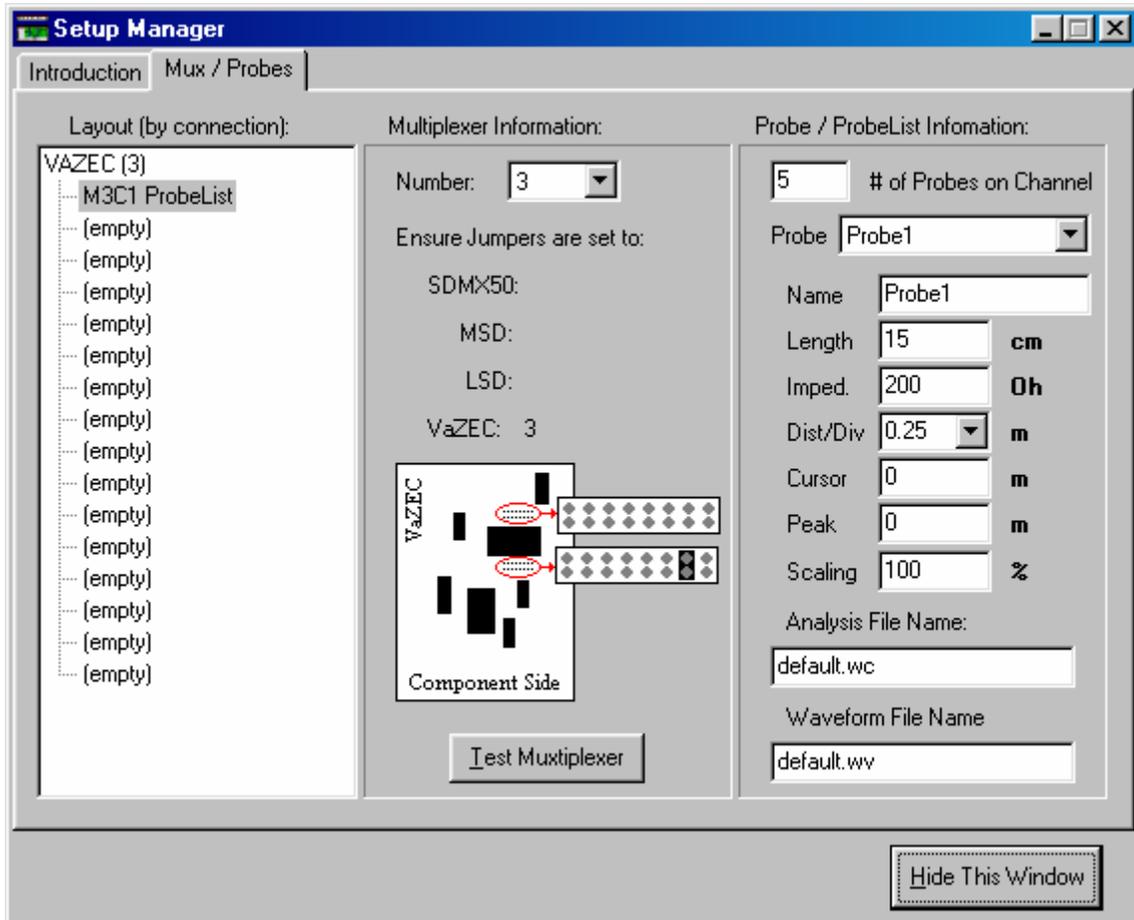


Figure 6.5 The Setup Manager for VaZEC Mux.

- Now that the jumpers are set you are ready to test them. Select the mux you wish to test by left clicking on the mux in the *Layout* section, this will highlight the mux. Now press the *Test Muxtipler* button in the **Setup Manager** to insure that the mux is set up properly. You should hear a series of 8 clicks for the SDMX50 and 16 clicks from the VaZEC mux. If you do not hear the clicks something is wrong. Check the hardware setup and double check the jumpers on the mux. The jumpers should be the same in the **Setup Manager** and on the mux.

13. You may want to change the Analysis File Name or the Waveform File Name. To do this left click on the default file name and edit the name. By default all probes and Probe Lists save to the same .wc file and .wv file.
14. When you are done click on the *Hide This Window* button. You are ready to go. To change the arrangement of probes and muxes at anytime just click on the *Show the setup Manager* icon in the upper left of the Probe Setup Window. You can also set values for probes in the Probe Setup Window.
15. Save the Setup by going to *File, Save Setup* OR by click on the disk icon.

6.4 THINGS TO BE AWARE OF

- A signal can be lost by traveling through too many different multiplexers. Try to use three or less multiplexers. Noise, generated by such things as connectors, bad cables, and multiplexers, weaken the signal. As a rule of thumb use only the best probes when multiplexing, and minimize signal degradation due to length and connections.
- Ghost reflections, waveforms appear, but the waveform is bogus. A reflection occurs at the point of entering and leaving the multiplexer. To skip this effect, simply look farther down the cable from the end of the probe.
- In version 6.1 of the software, you can only control one Mux setup at a time. A warning message will appear if two Mux setups are opened. Only the first mux will be active.