Oscilloscope Lab

This lab introduces you to the operation of your oscilloscope, or "scope." The scopes provided are Tektronix 7603's and a 7633. These are fine old instruments but not necessarily in prime condition. Therefore you may discover infirmities in your team's scope which can be "worked around" once you know the instrument. This also goes for their plug-ins. For this reason, it is a good idea to invest some time playing with its various modes and exploring its capabilities – and infirmities!

The 77x3 series scopes are "three holer mainframes" which accept plug-ins. The function of the mainframe itself is to produce a spot on the face of its CRT which can be controlled for intensity and position in x (horizontal) and y (vertical). It also acts as a switch for selection of vertical and triggering signals. All of the rest of the functional capability (and complexity) of the instrument is in the plug-ins. The left two holes in the mainframe are for vertical functions, while the right hole is for horizontal. These scopes can be configured to provide a broad range of capabilities by selection from a large family of 7Axx amplifier and 7Bxx time base plug-ins.

Your instruments are provided with just two kinds of general purpose plug-ins: two 7A26 dual trace amplifiers, and a 7B53 dual time bases. This provides you with substantial capability, including visual overlaying of up to four independent signals on the CRT. You are also provided with two Tektronix P6106A 10X passive probes. Why would you want to attenuate the input by a factor of 10? It allows the probe to load the circuit more lightly so as to minimize disruption of the circuit's behavior.

The object of this lab exercise is first to set you up in the simplest configuration and make some basic measurements and calibrations, then to explore some of the more useful capabilities.

WARNING: **never** insert or remove a plug-in with the scope power on!

Exercise 1: Initial set up

This procedure is like rebooting your computer in that it should initialize its state so that it is at least minimally usable. Once you know how to use the scope, you will usually skip most of this.

On the mainframe there are two sets of buttons. Vert Mode selects which of the two plug-ins in the left two holes (usually amplifiers, 7A26's in this case) is connected to the CRT's vertical deflection. Trig source selects which of these plug-ins is connected to the internal trigger input of the plug-in in the right hole (usually a time base, a 7B53 in this case). There is also an power switch, an Intensity knob which controls spot brightness, and a Graticule Illum knob which controls the brightness of the grid lines overlaying the CRT. Finally, a Beamfinder button, which when depressed shrinks the display to unconditionally fit in the viewable screen.

Set up the Mainframe as follows:

Power	On
Vert mode	Left
Trig Source	Left
Intensity	Mid-range (adjust for minimum good visibility)
Graticule Illum	Adjust to taste
Storage Mode	Non Store (7633 only)

Set up the 7B53 as follows:

Main Triggering	
Mode	Auto
Coupling	AC
Source	Int
Slope	+ (inside knob)
level	0 (outside knob)
Time/Div	
red knob	pushed in and turned CW to "Cal"
grey knob	pushed in and aligned to outer knob (black lines)
	both knobs set to .2 ms
(other)	
Mag	X1
Position	adjust to align left of trace and graticule

Set up the left 7A26 as follows:

Trigger Source	CH1
Display Mode	CH1
CH1	
(mode)	Gnd
Volts/Div	2 (and with red knob pushed in)
Position	adjust to align trace with graticule horizontal centerline of
Identify	(press to see how the CH1 trace is identified†
CH2	(not used here, but set up is similar to CH1)

† This is useful when multiple traces are being displayed.

You have a cable with a BNC connector on one end and a pair of circuit clips on the other. The red clip is the "signal" lead, connected to the inner pin of the BNC. The black clip is the "reference" lead, connected to the outer shell of the BNC. Plug this cable into the CH1 input BNC, and the red clip to a short piece of bare wire. Insert the wire into the 4V calibrator socket in the mainframe. Set the CH1 mode to DC. You should now see a square wave signal displayed on the CRT. You might need to adjust the 7B53 Main Trigger Level control to stabilize the display. This completes your initial setup.

Remember, these are old instruments, and everything may not work exactly as expected, so it would be a good idea for you to thoroughly explore all the following, even if you already know how it's *supposed* to work. Learn the peculiarities of your instrument so they don't confound you later.

Exercise 2: Exploring basic 7B53 behavior

As initially set up, you should see perhaps a little more than two cycles of square wave on the CRT. Measure the period of the wave using the graticule. You can align the rising edge of the waveform with a convenient graticule line with the Position knobs

Try changing the Time/Div settings on the 7B53 to see the effect. Also try rotating the red knob to see the effect. Normally it is good practice to leave this knob in the Cal position.

Now set the Time/Div to 1 ms, and the Mag button to X10. Again use the Position knobs to see how you can look at different parts of the waveform. The usefulness of the Fine knob more easily appreciated here.

Set Mag to X1 and Time/Div to .2 ms. Now try various combinations of Slope (+/-) and Level to see what happens. The time base is supposed to trigger when the input signal crosses a threshold set by the Level knob in the direction selected by the Slope switch. Once you understand what you're seeing, try setting Mode to Norm and see what effect that has on behavior as you vary the Slope and Level settings.

Finally, set Time/Div to .2μs (you will likely need to readjust the Intensity knob) and again explore the Slope (+/-) and Level knob behaviors.

Exercise 3: Exploring basic 7A26 behavior

Use your knowledge of the mainframe and time base to make necessary adjustments in this exercise. In particular, you should probably be set to .2 ms/div.

Try changing the CH1 Volts/Div setting to see the effect. You can also operate CH1 in an uncalibrated mode. Pushing on the red knob will unlock it so it will pop out. It can then be rotated to vary the gain. Pushing it back in will again lock it into calibrated mode where the graticule divisions match the Volts/Div setting.

Verify to yourself that the average voltage (over one cycle) of the calibrator signal is 2 volts. Switch the mode from DC to AC. "AC coupling" of a signal removes the DC component. That is, the average value over a full cycle of an arbitrarily complicated repetitive waveform is zero. Verify to yourself that this is the case her.

Summary

The more complicated usage modes may be explored after you have learned to use your function generator to make more interesting waveforms to look at. Highly recommended reading are the Tektronix instruction manuals for the 7603 (or 7633) oscilloscopes and for the 7A26 and 7B53 plug-ins, particularly the sections, "Operating Instructions." And please also observe any safety tips in the manuals.