OSCILLOSCOPE QUICK-START INSTRUCTIONS

Introduction

Our digital oscilloscopes have good **instruction manuals**, and how to do something can usually be found by using the index. They also have, at the press of a button, **on-screen help** that is 'context-sensitive', i.e. related to the mode the 'scope is in. Furthermore, on-screen messages and labels, as well as the help information, are available in a wide variety of languages. However, in order to get you going quickly, we have written here some **simple instructions** that follow the order of operations you need for laboratory exercise 6.

Displaying a single channel

Turn the **'scope on** using the button on top at the left. **Connect a signal** to channel 1 using a cable with a so-called BNC connector (plug it in and twist to lock) at one end, and banana plugs at the other end to connect to the output of the signal generator. Turn the **signal generator on** and select a sine wave signal of about 1 kHz. Press the **AUTOSET** button on the 'scope and you should see the sine wave signal displayed — the 'scope tries to set sensible time and voltage scales automatically.

You can adjust the voltage scale by using the channel-1 (CH 1) **VOLTS/DIV** knob, and the time scale by using the horizontal **SEC/DIV** knob. This allows you to optimise the display, and to see the waveform when you change the parameters of the input signals. You can also move the display up and down or left and right with the **POSITION** knobs.

The screen displays the voltage and time settings, as well as providing a measurement of the frequency of the trigger signal. There is also information about how the scope is being triggered, which will be discussed later.

Other settings affecting the operation of the display can be viewed and altered by pressing the buttons **CH 1 MENU** or **HORIZ MENU**. You can then use the unlabelled buttons along the right-hand edge of the screen to select the settings you want.

Setting the trigger

In order to display a periodic waveform, the 'scope has to be triggered at a fixed point in its cycle. This is most often done by setting a particular voltage level, and specifying whether the signal should be rising or falling. The display can be triggered either by one of the signals being viewed (you can choose channel 1 or channel 2), or by a separate signal used only for triggering. The voltage level for triggering is set by the **TRIGGER LEVEL** knob. The trigger source and polarity can be selected by using the trigger menu, which you get by pressing the **TRIG MENU** button.

The trigger level is indicated on the screen by a horizontal arrow on the right hand edge of the display, as well as a numerical value at the bottom right of the display. A symbol indicates whether the trigger is on a rising or falling signal, as well as which input is being used. An arrow at the top edge of the screen indicates where in time the trigger is occurring.

It is well worth looking at pages 28–30 of the Tektronix instruction manual for a key to all the information that is normally available on the screen. We have photocopied these pages.

Making standard measurements

To make detailed measurements using old-fashioned analogue 'scopes required counting grid boxes on the display. Digital 'scopes automate measurements and do a far more precise job by offering two facilities: a standard set of quantities such as frequency and amplitude that are

calculated and can be displayed, and for other measurements a pair of on-screen cursors that you can move around to tell the 'scope where to measure.

To select measurements, press the **MEASURE** button in the middle of the top row of the control panel. You can select a mixture of measurements for one or both input channels, up to a maximum of five simultaneous quantities. There is a huge range available, but the most obvious ones are frequency, period, and amplitude (abbreviated to **Pk-Pk**, i.e. peak-to-peak). These will then be displayed along the right-hand edge of the screen as you alter the input signals.

Using the cursors

You can measure the horizontal distance (i.e. time) between two points on a signal, or you can measure the vertical distance (i.e. voltage). If you want both you must do them one after the other, you cannot do both at once.

Press the **CURSOR** button, below the **MEASURE** button. You then select whether to measure voltage or time, and choose channel 1 or channel 2. Two lines appear on the screen; their position is controlled by the channel-1 and channel-2 position knobs (which warn you of this by having an LED below them illuminated). The cursor measurement information appears on the screen. Delta is the distance between the two cursors, and Cursor 1 and Cursor 2 give the absolute positions of the cursors: time is referenced to the trigger position (arrow at top of screen), and voltage is with respect to 0 V.

Displaying two channels

The displays of channel 1 and channel 2 can be turned off or on independently, and other parameters set up, by pressing the **CH 1 MENU** or **CH 2 MENU** buttons. The display is helpfully colour-coded, as well as labelling each of the waveforms at its left-hand edge.

Setting up *XY* mode

Press the **DISPLAY** button (second row) and at the third item, Format, choose **XY**. In this mode the channel-1 voltage is on the horizontal (x) axis and the channel-2 voltage on the vertical (y) axis. Note that you cannot use the cursors in this mode.

Saving, printing, and using data on a PC

Screen images, as well as full numerical details of all the data points they contain, can be saved onto CompactFlash cards plugged into the 'scopes. These hold a large amount of information on small cards that need no special software, use no batteries or external power, and can be used like floppy or Zip disks.

Plug the CompactFlash card into the slot on the top rear right-hand side of the 'scope. When you have a display that you wish to save, press the **SAVE/RECALL** button (top row at left). Set the **Action** option to **Save Image**, and set the **File Format** of the graphics file to your choice; **TIFF** is probably best. Then select **Save**.

(In addition to saving a graphical picture of the screen, you can save the full numerical details of every dot on the waveforms in the form of a .csv (comma-separated) file that can be read into Microsoft Excel or PhysPlot and analysed or displayed using standard Excel facilities. To do this set the **Action** to **Save Waveform** and then **Save** to **File**.)

(The first time you use a particular CompactFlash card it has to be formatted. We have already done this with the lab's cards. To format or re-format a card, insert it into the 'scope, push the **UTILITY** button, select **File Utilities** from the menu, select **More** to show more of the menu, and select **Format**. Note that this ***erases all existing data*** on the card!)

When you are ready to transfer your files to a computer, remove the CompactFlash card by pressing the small Eject button next to it and lift it out. Take it to one of the lab's own computers (in the centre of the room, not against the walls). These are equipped with CompactFlash card-reader devices connected to the computer via a USB port at the rear. Plug the CompactFlash card into the reader.

Log in and double-click on **My Computer** and then on **Removable Disk (F:)**. You will see some folders and files. Your screen image(s) will have names like **FxxxxTEK**, where **xxxx** is a 4-digit sequential number. Double-click on the file icon to open the file in a simple image-viewer. This allows you to print it out, resize the image, and do several other simple manipulations. You can also copy the files to the computer's hard disk.

To insert the image into a Microsoft Word document, go down the **Insert** menu to **Picture** and select **From File …** . Navigate to the file you want and select it — Word will paste it in.

Mathematical manipulations and Fast Fourier Transforms

The **MATH MENU** button allows you to select some useful simple operations such as adding or subtracting the signals in channel 1 and channel 2, which can be extremely useful. (For example, a lot of high-speed electronics transmits signals differentially, i.e. the signal is the difference between the voltage on two wires.)

More adventurously, there is a facility to do a Fast Fourier Transform (FFT) on a signal. To do this:

- Display a normal (voltage vs. time) waveform.
- Centre it vertically and make sure the top and bottom of the waveform are visible, not off-scale.
- If the waveform is not regular, make sure the 'interesting' part is in the centre eight horizontal divisions of the screen. If possible, display many signal cycles.
- Push the **MATH MENU** button, set the **Operation** to **FFT**, and select the channel.
- The display now shows frequency horizontally, and the vertical amplitude represents the contribution of that frequency to the waveform.
- You can change the frequency scale by using the **SEC/DIV** knob.

Eric Eisenhandler, 29/9/04