PicoScope

Virtual Instrument

User Manual

Version 2.0 rev 3

by

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Contents

1 Introduction

This is the user manual for PicoScope for DOS. For information about PicoScope for Windows, please consult the help file which can be accessed directly from the program.

PicoScope for DOS is a powerful but easy to use program which enables you to use the Pico Technology range of analog to digital converters (ADCs) to provide the functions of a storage oscilloscope, a spectrum analyser and a digital meter.

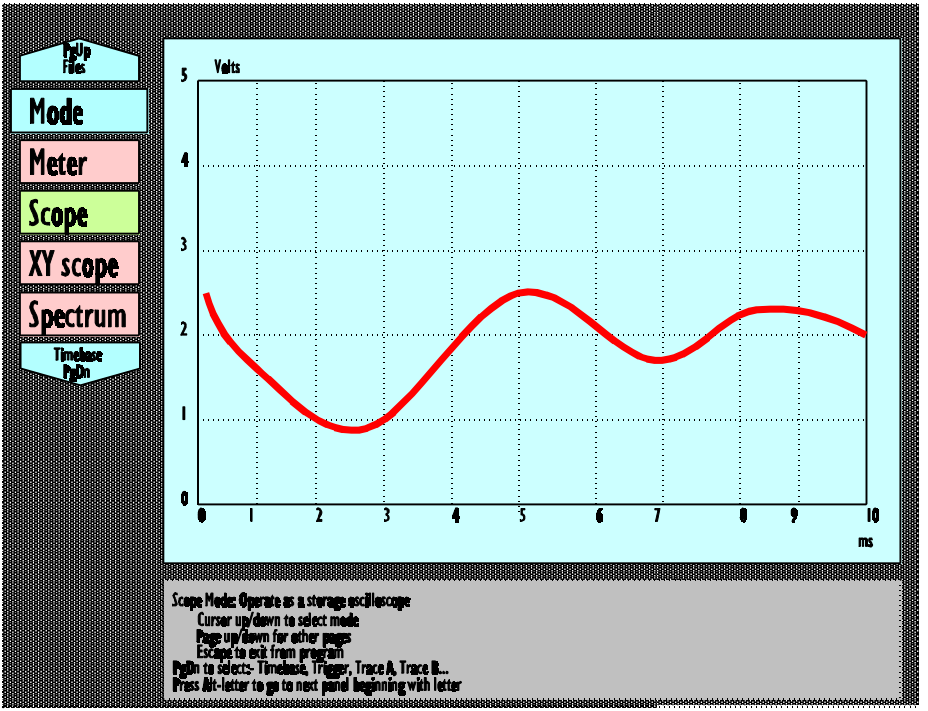
The first section of this manual gives a quick guide to using each of the main functions: the remainder of the manual describes in detail each of the control panels.

Please read the file README.DOC on the floppy disk for any updates to this manual since printing.

2 Getting started

PicoScope may be run from either floppy or hard disk, but you must install it before use. To install the program from drive A:, type A:INSTALL. The computer will ask you for the name of the directory to copy the files into.

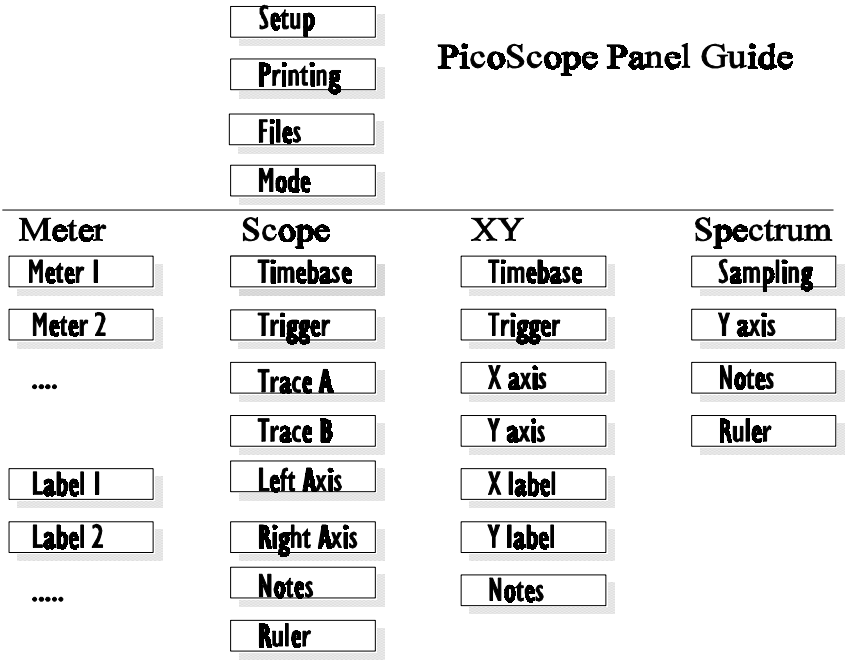
To run the program, go to the directory you specified and type PS. For monochrome displays, type PS -b. The logo and copyright notice should appear on the computer screen: press any key to clear the copyright notice.



The screen should now look like this. The first time you run the program, it will start up in oscilloscope mode. The majority of the screen is an oscilloscope trace. At the left there is the Mode panel - the title (mode), four buttons - marked Meter, Scope, XY scope and Spectrum - and pointers to the next and previous panels. At the bottom of the screen is a help window: once you become more familiar with PicoScope, you can use the **F1** key to turn off the help window and have a larger oscilloscope display. Pressing the **F1** key again brings back the help window when you need it.

The Scope button is highlighted - you can use the cursor up and down keys to move the highlight up and down. As you do so, the mode will change to whichever button is highlighted.

The mode panel is only one of several panels: different functions are available for each mode, so each mode has a different set of panels. To move to other panels, press **PgUp** to go back the previous panel and **PgDn** to go to the next panel. Once you become more familiar with the panels, you can go directly to a particular panel by holding down the **Alt** key and typing the first letter of the panel name. All the meters begin with M, so you would have to enter Alt-M five times to get to meter 5. To prevent this problem, you can type **Alt** and the meter number, for example - eg **Alt**-3 for Meter 3.



Each panel has a number of buttons. There are three main sorts of buttons:

- selection
- number
- text.

For a selection button, pressing the space bar advances to the next option. '+' and cursor right also move to the next option: '-' and cursor left move back an option.

For a number button, you can either increase the number value by typing in '+' for large increments or cursor right for small increments. '-' and cursor left have the same effect for decreasing the value. For some number buttons, you can also type in the value that you require.

For a text button, type in the text that you require and press **Enter**. For more than one line of text, press **Tab** after the end of each line.

3 Command line parameters

When you start up PicoScope, there are a number of controls that you can specify on the command line. For most applications, the program will run normally without any command line options. The following line shows a command line which uses all of the options.

```
ps -b -p1 -a278 -sFRED
```

- `-b` specify that the screen is black and white
- `-p1` use printer port 1 for the ADC
- `-a278` use the printer port at address 278 for the ADC
- `-sFRED` use the setup file FRED (see SETUP panel)

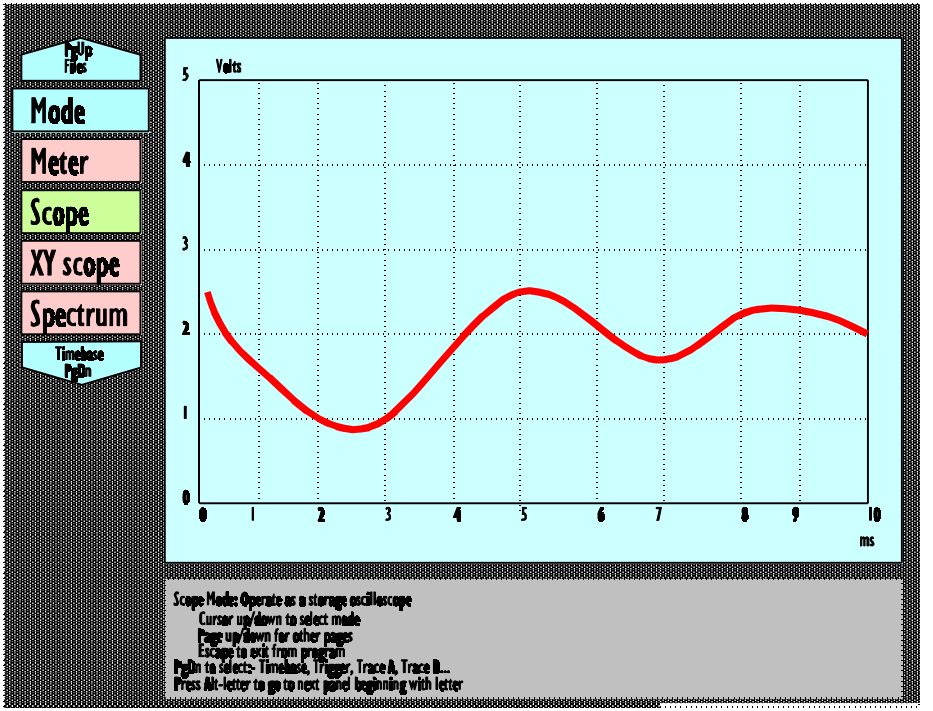
Note that the -a and -p options would not normally be used at the same time.

4 Modes of Operation

This section gives a brief introduction to using PicoScope in each operating mode, and the facilities available.

4.1 Using PicoScope as an oscilloscope

When the Scope button is highlighted on the Mode panel, PicoScope works like a storage oscilloscope.



Press **PgDn** to go to the **Timebase** panel, then use the **Timebase** button to specify the time per division. This can be from 100µs to 5 seconds (100µs is not available for all ADCs). The computer will display data continuously as it is collected. It is best to start off with a longer time per

division than you expect to use, to make sure that you do not miss anything. Once you have found what you wish to observe, you can then reduce the time per division until the event you wish to observe is big enough to see clearly.

If the trace is jumping back and forth in each successive display, you can either stop the update or use the trigger facility. To stop the update, press the **Run** button- it changes to Stopped when you press it,

The trigger facility tells the computer to display the trace at the same place on the screen each time. Press **PgDn** to go to the **Trigger** panel. To specify a trigger event - for example, when channel 4 rises past 50%. To do this, go to the trigger panel and set **Channel** to 4, **Threshold** to 50% and **Direction** to **Rising**. Picoscope will now only refresh the display when this trigger event occurs. The trigger channel need not be one of the traces you are displaying.

You can specify that the display will start a certain fixed time before or after the trigger event, by adjusting the trigger delay. A **Delay** of minus 50% is very useful, as the trigger event will appear in the middle of the screen.

If you have an event which only occurs occasionally, you can set the trigger **Mode** to single: the computer will collect only one trace after the trigger occurs, then it will stop, leaving the event on the display.

You can zoom in on just a small part of the display using the **Multiplier** and **Offset** buttons. The buttons on the **Timebase** panel control the size and position of the display in the X direction. The same buttons on the **Trace** panel affect the Y direction. These can be used both whilst collecting the data and once you have collected a trace.

You can add labels to the Y axis, and add a heading and notes to the trace.

If you wish to measure the time interval between two points, go to the **Rulers** panel. There are two rulers - X and O - which can be moved independently. As you move the rulers, the computer calculates and displays the time interval between them.

Once you have a trace which displays exactly what you are interested in, you can save the trace to disk or print it out. Note that, to print out a trace, you must have the PICO.DRV file available in the current directory.

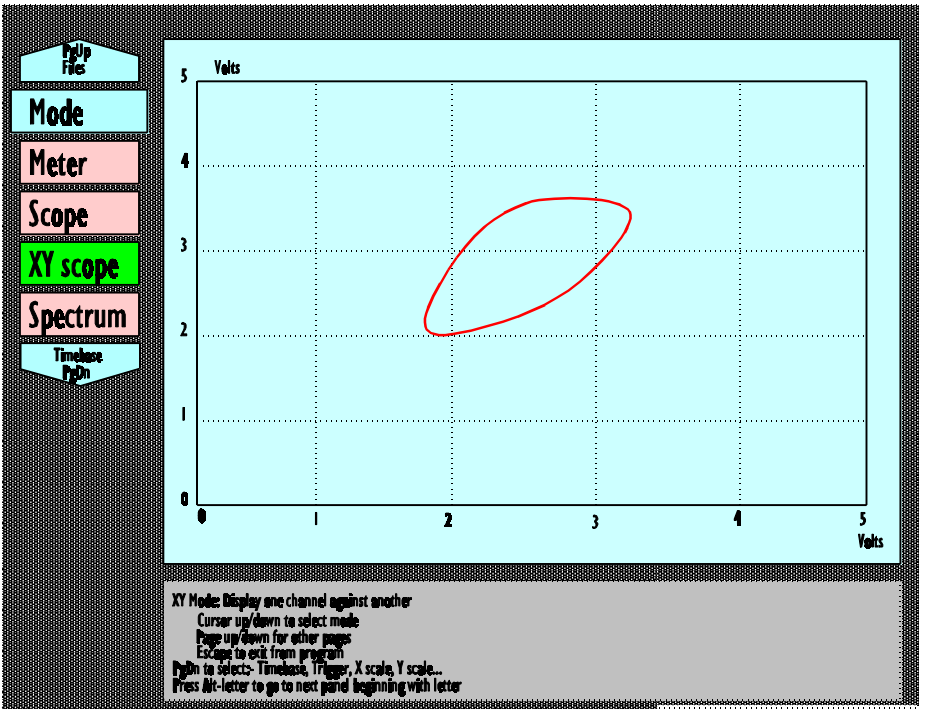
If you have saved a number of traces, you can look through them by selecting the directory, then moving to the **Load** button. Each time you press the space bar, the computer displays the next trace in this directory.

You can use the **Save text file** option to save data in a format suitable for entry into a spreadsheet or database.

If you use the same settings every time, you can save them to a setup file using the **Save setup** button on the **Setup** panel.

4.2 Using PicoScope as an XY scope

When the Scope button is highlighted on the Mode panel, PicoScope displays a graph of one input channel against another. This is useful for comparing the input and output signals of a circuit when looking for phase differences, non-linearity or clipping. This function is available only on multi-channel ADCs.



Initially, the computer displays channel 1 along the X axis and channel 2 on the Y axis.

If you press **PgDn**, the computer displays the **Timebase** panel: you can set the total time for each scan, and specify whether successive points are to be joined. This is useful if both parameters vary continuously over the

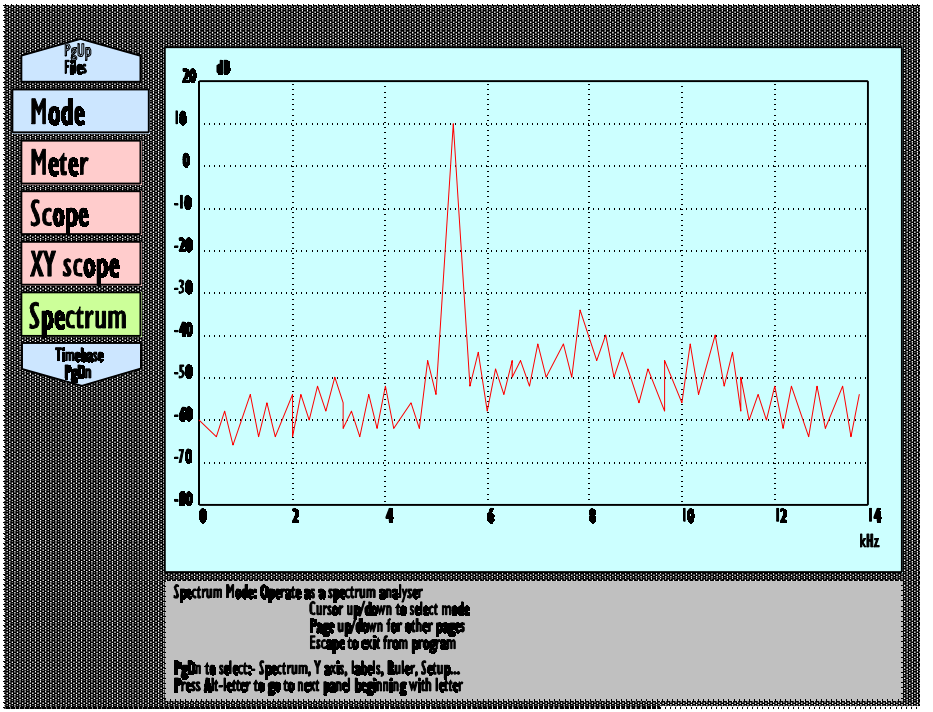
whole scan, but gives a spider's web if both channels dot about all over the place.

Press **PgDn** again for triggering. This is the same as for the Oscilloscope function: it enables you to control when the scan will start.

The next four panels enable you to label the X and Y axes, either with voltages or with user-defined parameters. This might be useful if, for example, you wanted a plot of stress against strain.

4.3 Using PicoScope as a spectrum analyser

When the spectrum button is highlighted on the mode panel, PicoScope operates as a spectrum analyser.



Press **PgDn** for the **Sampling** panel. You can now specify the minimum and maximum frequency that you wish to monitor. PicoScope will now display the selected frequency range, updating the display continuously.

The X scale is the frequency: the Y scale is the amplitude at that frequency. Note that, if you specify a higher maximum frequency than can be measured, the X scale will show the specified range but the spectrum will not reach all the way to the maximum frequency.

The y scaling involves a number of approximations to speed up the display, and should be used only for comparison rather than absolute measurement. 0dB is approximately the signal level generated by a 1V peak to peak sine wave.

If you press **PgDn** again, you can define the labels and scaling for the Y axis. You can select **Log** or **Volts** scaling: If you change the label mode to **User-defined**, you can calibrate the scale to match the parameters that you are measuring.

Note that, as with other digital sampling systems, a frequency above half the sampling rate will look like a lower frequency- this effect is called aliasing. If PicoScope is not displaying the results that you would expect, try increasing or decreasing the maximum frequency slightly. If the peak appears to change frequency, it is probably caused by aliasing.

If the display is changing too rapidly to see clearly, you can freeze the display using the **Run/Stop** button. Alternatively, you can turn **Average** on: PicoScope will then display the average of 16 cycles. This will improve the display for continuous signals, but will give a blurred result for rapidly changing inputs.

If you wish to measure a frequency or amplitude exactly, you can move a ruler to the required frequency: the computer will display the frequency and amplitude at the current ruler position.

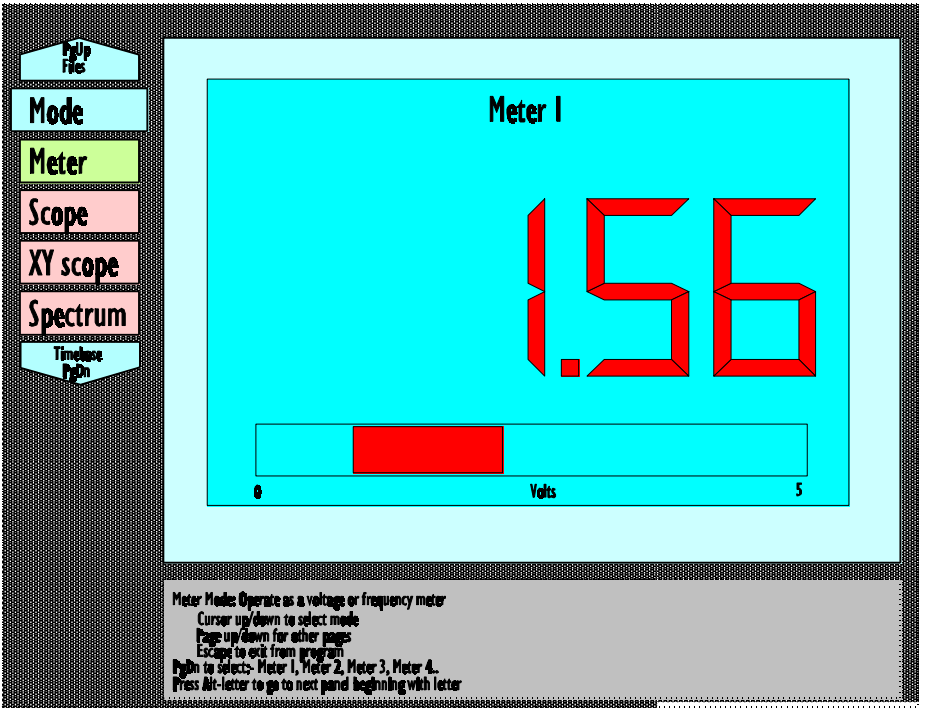
When you have a picture which you wish to record, you can add a title and notes to the graph: you can also save it to a file or print it out. You can also

use the **Save text file** option to save data in a format suitable for entry into a spreadsheet or database.

If you use the same settings every time, you can save them to a setup file using the **Save setup** button on the **Setup** panel.

4.4 Using PicoScope as a digital meter

When the meter button is highlighted on the mode panel, PicoScope operates as a digital meter.



Initially, the computer displays a single meter with the title "Meter 1" ("Meter" for single channel ADCs) and units "Volts". The digital display shows the DC voltage for channel 1. The bar below the display shows the minimum and maximum voltage measured during a period: There will be thin line for a DC signal, and a wide bar representing the peak-to-peak voltage for an AC signal.

Press **PgDn** to move to the panel for **Meter 1**. The meter is currently set to **DC Volts**: you can now change the measurement to **AC volts** or **Frequency**.

Press **PgDn** again to move to the panel for **Meter 2**. This is initially off (Channel is Off). If you press the Channel button, this changes to channel 1 for meter 2: the screen splits into two, each half showing a separate meter. PgDn again goes to Meter 3: you can have up to 16 meters. You can have more than one meter showing the same channel, for example to display both the AC voltage and frequency of a channel.

After all of the Meter panels are the Label panels: you can use these to add a title or to define your own scaling for a meter, for example to show a reading in degrees Celsius.

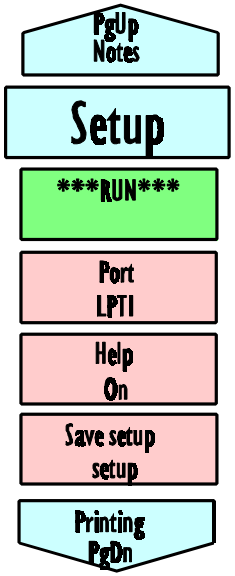
There are a up to 12 meter and 12 label panels: pressing **PgDn** to go through these panels would take a long time. To go directly to the panel for a particular meter, hold down the **Alt** key and press the number key for the first digit of the meter you require.

If you use the same settings every time, you can save them to a setup file using the Save setup button on the Setup panel.

5 Common Panels

This section describes the panels that are available in all modes of operation.

5.1 Setup



The setup panel affects all modes of PicoScope. You can select the printer port for the ADC, specify whether help text is to be displayed at the bottom of the screen and save the current setup (ports, mode, timebase, scaling etc) so that it can be reloaded later.

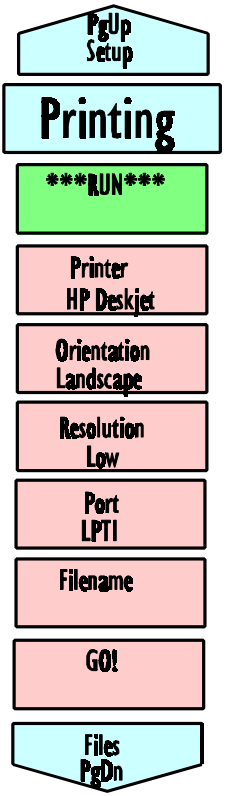
Run stops and restarts the current display. The button changes to **Stopped** when you press it.

Port specifies which printer port to use for the ADC. The program will automatically detect which ports are available: press the space bar till the port that you wish to use is highlighted.

Help specifies whether help text is to be displayed at the bottom of the screen. Once you become more familiar with the program, you may wish to turn it off in order to have a larger display. The **F1** key can also be used to turn help on or off in any panel.

Save Setup enables you to save most of the details about the way you are using the program. To save the setup, type in a filename and press **Enter**. If you use the filename SETUP, the program will automatically load the file at start-up. If you use a different name (eg MYMETER) you can run PicoScope using your setup by typing in PS -sMYMETER.

5.2 Printing



The printing panel enables you to produce printed copies of scope, XY and spectrum analyser output. If you have the additional graphics drivers, you can also generate graphics files suitable for import into word processors. The file PICO.DRV must be in the current directory.

For the standard printer drivers, the **Printer** can be Epson FX, Epson LQ, HP Laserjet or HP Deskjet. If your printer is not one of these, it is probably compatible with one of them: consult your printer manual. If in doubt, try Epson FX for dot matrix printers and HP Laserjet for laser printers.

Orientation can be **Landscape** or **Portrait**.

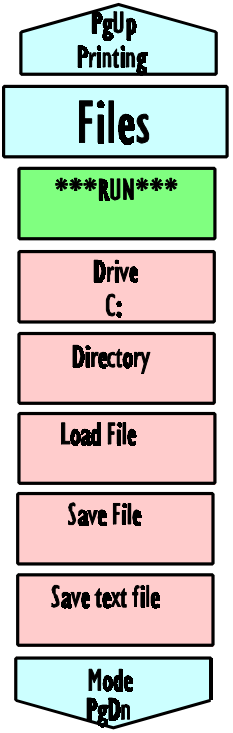
Resolution can be **Low**, **Medium** or **High**. **High** resolution gives the best quality output, but takes longer to print.

Port specifies where to send the printed output. It can be either **LPT1**, **LPT2** or **File**. If you specify **File**, you must enter a filename before starting to print (see next button).

Filename is used when you select **File** output. Type in the filename and press **Enter**.

Go starts printing the current graph, using the specified print options. The computer will display a small window saying '0% complete - <Esc> to cancel'. As the graph is generated and printed, the percent complete will increase. Press **Esc** to cancel printing..

5.3 Files



The files panel enables you to save a scope or spectrum analyser trace and re-load it at a later date.

The **Drive** button enables you to select which of the drives on your system to use. press the space bar to move between drives. Note that this will not have any effect until you move to the Directory button: this is in case you select a disk drive that is not currently occupied.

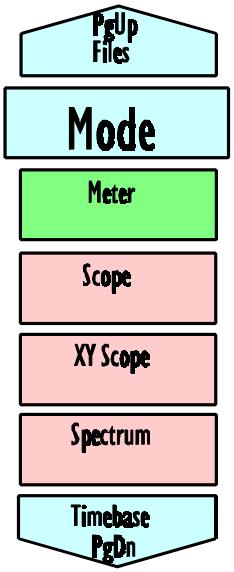
The **Directory** button enables you to select a directory. Pressing the space bar moves to the next directory at the same level: cursor left goes up a level and cursor right goes down a level.

Load File selects a file in the current directory. If you are in scope mode, pressing the space bar loads and displays the next scope file in the current directory.

Save File is used to save the current trace. Type in the filename, then press **Enter**. The file will be saved in the current directory.

Save Text File is the same as **Save File**, but saves the data as a text file, suitable for loading into spreadsheets and databases.

5.4 Mode



This panel enables you to specify which type of instrument you require.

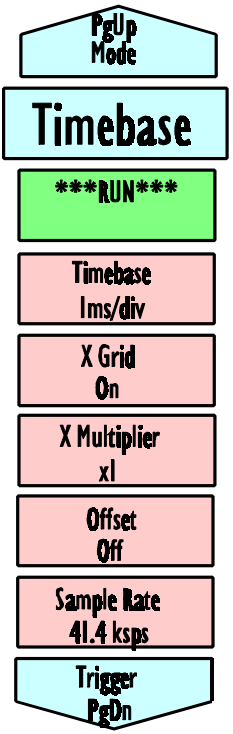
The **meter** provides voltage and frequency measurement. The **scope** displays one or two channels against time: the **XY scope** displays one channel against another. The **spectrum** analyser displays a graph of signal strength against frequency.

Move the highlight to the operating mode that you wish to use: the highlighted mode will become active.

6 Oscilloscope panels

This section describes in detail the panels associated with the oscilloscope function.

6.1 Timebase



This panel enables you to specify the timebase and related functions for the oscilloscope mode.

The **Run/Stop** option must be on **RUN** to collect data. If you wish to freeze the display, press the space bar to select **STOP**. Note that, for timebases greater than 50ms/div, the computer stops collecting immediately you press the button, leaving the trace half-finished. If you want to collect a whole trace, change the **Trigger mode** to **Single** (see next panel).

The **Timebase** enables you to specify the time per division - from **100µs/div** to **5s/div**. Press the space bar or +/- to select the timebase that you require. Note that not all ADCs support 100µs/div. If you require a shorter time per division than is available, you can use the **Multiplier** to magnify a portion of the displayed trace.

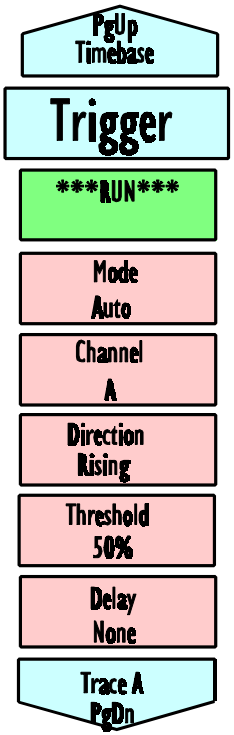
The **Grid** button is used to turn the grid **ON** or **OFF**.

The **Multiplier** enables you to zoom in on a small part of the display. The options are **x1**, **x2**, **x5** and **x10**. If you select **x2**, the first half of the trace is magnified to fill the whole width of the screen: you can then use the offset to pan across the trace to look at the second half.

The **Offset** may be used only if the multiplier is greater than 1. It enables you to select which part of the display is to be magnified.

The **Sample rate** button is for information only: it shows the sampling rate currently being used.

6.2 Trigger



The trigger panel is used to specify when the computer should start collecting the next trace. You first specify a trigger event (threshold and direction) then specify whether you wish to collect data at, before or after the event.

Run/Stop must be set to RUN. If you set the trigger mode to **Single**, this will be set to **Stopped** after each cycle. Press **Space** to restart.

The **Trigger Mode** can be **None**, **Auto**, **Repeat** or **Single**. For **None** the computer starts collecting the new cycle as soon as it has finished displaying the previous cycle. For **Auto**, the computer waits for up to 10 times the trace period for a trigger. If no trigger has been found within this time, a trace is displayed anyway. For **Repeat**, the computer waits for a trigger, displays the trace, then waits for the next trigger, et cetera. For **Single**, the computer waits for a trigger, displays the trace and stops: press **Run/Stop** to restart.

The **Channel** specifies which channel to use to the trigger input. It can be one of the channels you are displaying, or a different channel.

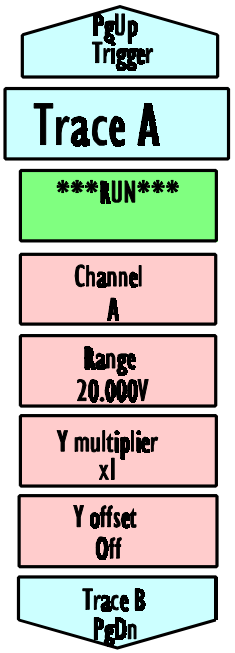
The remaining buttons are only valid for **Auto**, **Repeat** or **Single**.

The **Direction** is either **Rising**, **Falling**, **Above** or **Below**. For **Rising** trigger, the trigger occurs when the input signal passes from below the threshold to above the threshold. For falling trigger, the trigger occurs when the input signal passes from above the threshold to below it.

The **Threshold** is the ADC value at which the trigger will occur. A marker appears on the screen to show the current level. Press +/- for large increments or cursor left/right for small increments.

The **Delay** enables you to specify what part of the trace to display in relation to the trigger. It can go from -100% to 1000%. If the delay is zero, the trigger will appear at the left hand side of the screen. -50% puts the trigger in the centre of the display: +200% enables you to see what happened two display periods after the trigger. The timebase at the bottom of the display shows the time with respect to the trigger.

6.3 Trace / Trace A / Trace B



When using a single channel ADC, PicoScope can display one trace. With multi-channel ADCs, PicoScope can display two traces, called A and B. These panels enable you to select the channel, range, multiplier and offset for each of the traces.

The **Run/Stop** button enables you to stop and restart the display update.

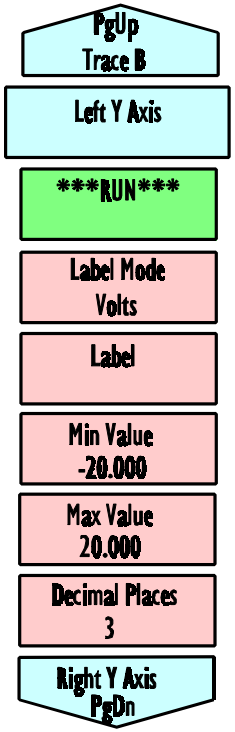
The **Channel** is used to specify which input channel is to be used for this trace.

Range is used to set the input voltage range (not available on ADCs which have a fixed input voltage).

Y Multiplier can be **x1**, **x2**, **x5** or **x10**: **x20** and **x50** are also available for the higher resolution ADCs. This can be used to magnify the y scale for the trace. If **x2** is selected, the middle of the trace is expanded to fill the screen: the **Y offset** can then be used to move upwards to display the upper part of the trace.

The **Y Offset** can be used only when the multiplier is greater than 1. It is used to select which horizontal strip of the trace to magnify.

6.4 Left/Right Y axis



This panel contains buttons to customise the scaling of the scope Y axes. There are axes at the left and right of the display: normally, the Left axis is used for trace A and the right axis for trace B.

The **Label Mode** specifies the type of axis scaling: the options are **None**, **Volts** or **User defined**. Normally, the left axis is **Volts** and the right axis is **None**.

If you select **None**, the axis scale is omitted. When the axis is omitted, the scope trace expands to fill the space that was occupied by the axis.

If you select **Volts**, the program automatically adjusts the scale according to the settings of the range, multiplier and offset for the corresponding trace (Left is A, Right is B).

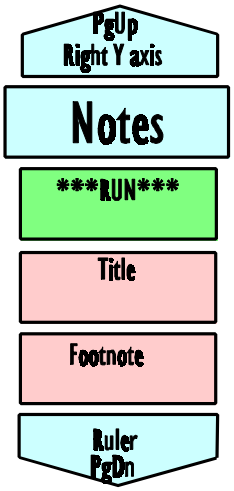
If you select **User-defined**, the program uses the remaining buttons on this panel to set the scaling: note that the scale will not change if you alter the input voltage range.

The **Label** is intended to be the units (eg Celsius) of the scaled parameter that you are measuring.

The **Min Value** and **Max Value** are the numbers at the bottom and top respectively of the Y axis when the multiplier is **x1** and the offset is 0.

Decimal Places specifies how many decimal places to use for the numbers on the Y axis.

6.5 Notes



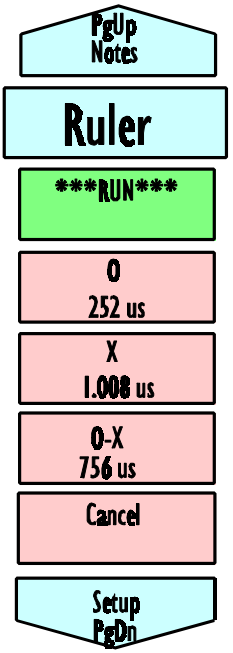
This panel contains buttons which can be used to annotate the current scope trace. The title and footnote will appear both on the display and on printed output.

The **Title** appears at the top of the display.

The **Footnote** appears at the bottom of the trace, outside the grid.

Both title and footnote can be more than one line: press **Tab** to start the next line.

6.6 Ruler



There are two rulers, called 0 and X. They can be used to mark events and to measure the time between two events. If the rulers are at any position other than 0 ms, they will appear on the screen and on printed graphs as vertical lines.

The **O position** is used to control the O ruler. Move it using +/- for large increments or cursor left/right for small increments. The number on the button is the time from the O ruler to the trigger event.

The **X position** is used to control the X ruler. Move it using +/- for large increments or cursor left/right for small increments. The number on the button is the time from the X ruler to the trigger event.

The **O-X** button cannot be modified: it shows the distance between the O and X rulers.

The **Cancel** button removes both rulers from the display.

7 XY scope panels

This section describes in detail the panels associated with the XY oscilloscope function. Note that the XY scope mode is available only for multi-channel ADCs.

7.1 Timebase

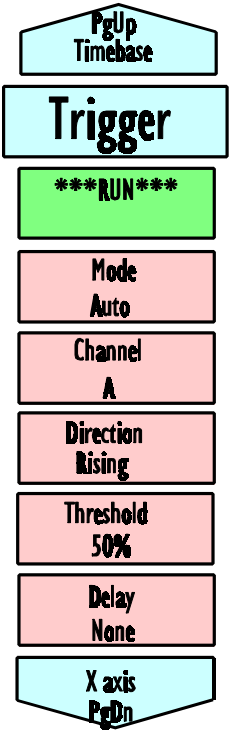
This panel enables you to specify the timebase and related functions for the oscilloscope mode.

The **Run/Stop** option must be on **RUN** to collect data. If you wish to freeze the display, press the space bar to select **STOP**.

The **Timebase** enables you to specify the total time for a scan of 1000 points. It can be from **1ms** to **1s**. Press the space bar or +/- to select the timebase that you require. Note that not all ADCs support the higher speeds: the program will collect fewer points if the ADC cannot keep up.

Join specifies whether successive points should be joined. This is useful if the measured parameters cycle only a few times during each scan, but gives a 'spiders web' if the parameters do not change smoothly.

7.2 Trigger



The trigger panel is used to specify when the computer should start collecting the next trace. First, specify a trigger event (threshold and direction), then specify whether data is to be collected starting at the trigger event, or before or after the event.

The **Run**/**Stopped** button must be set to **Run**. If you set the trigger mode to **Single**, this will be set to **Stopped** after each cycle. Press **Space** to restart.

The **Mode** can be **None**, **Auto**, **Repeat** or **Single**. For **None** the computer starts collecting the new cycle as soon as it has finished displaying the previous cycle. For **Auto**, the computer waits for up to 10 times the trace period for a trigger. If no trigger has been found within this time, a trace is displayed anyway. For **Repeat**, the computer waits for a trigger, displays the trace, then waits for the next trigger, et cetera. For **Single**, the computer waits for a trigger, displays the trace and stops: press **Run/Stop** to restart.

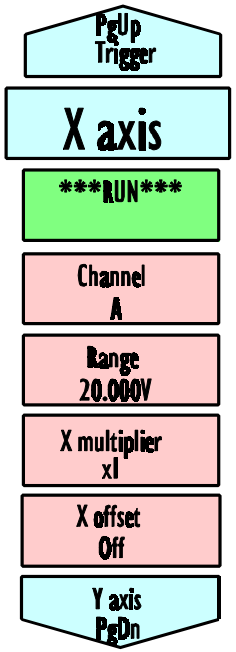
The **Channel** specifies which channel to use to the trigger input. It can be one of the channels you are displaying, or a different channel.

The **Direction** is either **Rising**, **Falling**, **Above** or **Below**. For **Rising** trigger, the trigger occurs when the input signal passes from below the threshold to above the threshold. For **Falling** trigger, the trigger occurs when the input signal passes from above the threshold to below it.

The **Threshold** is the ADC value at which the trigger will occur. Press +/- for large increments or cursor left/right for small increments.

The **Delay** enables you to specify what part of the trace to display in relation to the trigger, as a percentage of the scan time. It can go from -100% to 1000%.

7.3 X Axis / Y Axis



The **X axis** and **Y axis** panels enable you to select the channel, range, multiplier and offset for each of the axis. The channel and range take effect only whilst the XY scope is running: the multiplier and offset can be changed while the scope is stopped, so that you can examine in more detail the trace you have collected.

The **Run/Stop** button enables you to stop and restart the display update.

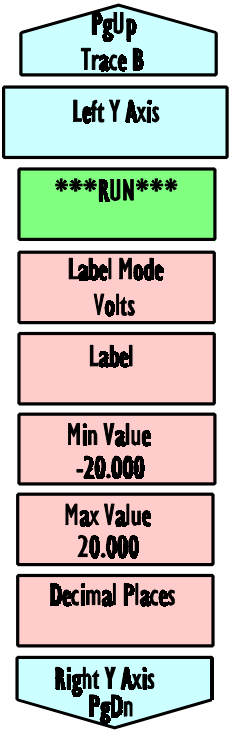
The **Channel** is used to specify which input channel is to be used for this axis.

Range is used to set the input voltage range (not available on ADCs which have a fixed input voltage).

Multiplier can be **x1**, **x2**, **x5**, **x10**, **x20** or **x50**:the last two are available only on high-resolution ADCs. This can be used to magnify the y scale for the trace. If **x2** is selected, the middle of the axis is expanded to fill the screen: the **Y offset** can then be used to display other parts of the axis.

The **Y Offset** can be used only when the multiplier is greater than 1. It is used to select which horizontal or vertical strip of the axis to magnify.

7.4 X Label/Y Label



This panel contains buttons to customise the scaling of the X and Y axes.

The **Label Mode** specifies the type of axis scaling: the options are **None**, **Volts** or **User defined**. Normally, the left axis is **Volts** and the right axis is **None**.

If you select **None**, the axis scale is omitted. The space is used to draw the scope trace is wider.

If you select **Volts**, the program automatically adjusts the scale according to the settings of the range, multiplier and offset.

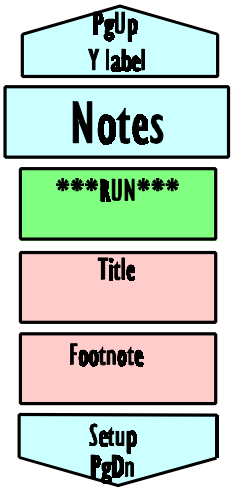
If you select **User-defined**, the program uses the remaining buttons on this panel to set the scaling. Note that the scaling will not change if you alter the input voltage range.

The **Label** is intended to be the units (eg Celsius) of the scaled parameter that you are measuring.

The **Min Value** and **Max Value** are the numbers at the bottom and top respectively of the axis when the multiplier is **x1** and the offset is zero.

Decimal Places specifies how many decimal places to use for the numbers on the Y axis.

7.5 Notes



This panel contains buttons which can be used to annotate the current XY scope trace. The title and footnote will appear both on the display and on printed output.

The **Title** appears at the top of the display.

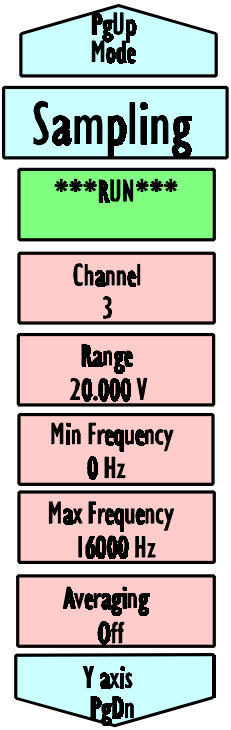
The **Footnote** appears at the bottom of the trace, outside the grid.

Both title and footnote can be more than one line: press **Tab** to start the next line.

8 Spectrum Analyser Panels

This section describes in detail the panels associated with the spectrum analyser function.

8.1 Sampling



The spectrum analyser sampling panel is used to control the sampling parameters when running in spectrum analyser mode.

The **Run/Stop** button is used to freeze the display temporarily and to restart it again.

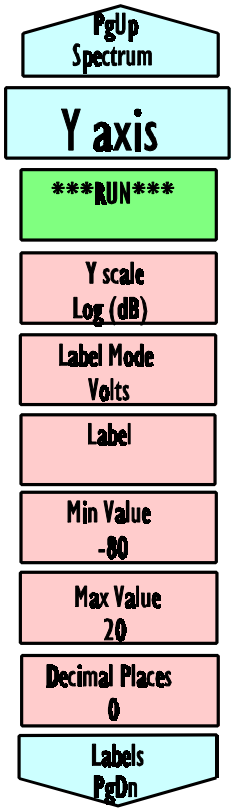
The **Channel** button is present only for multi-channel ADCs. It enables you to specify which channel you wish to monitor.

The **Range** button enables you to select the input voltage range (not available on fixed voltage ADCs).

Min frequency and **Max frequency** are the frequency values on the left and right sides of the display respectively.

With **Average OFF**, the display is updated each cycle. With it **ON**, the display is a moving average of 16 cycles. This reduces the effect of noise, but it means that the display responds very slowly to changes in input signal.

8.2 Y axis



The Y axis panel enables you to select log or linear scaling for the Y axis, and to replace the Volts/dB calibrations with your own.

The **Y scale** can be **Log (dB)** or **Volts**. The log display is useful when you require a large dynamic range: the Volts option is useful if you need to make linear comparisons between signal strengths.

The **Label Mode** specifies the type of axis scaling: the options are **None**, **Volts/dB** or **User defined**.

If you select **None**, the axis scale is omitted. The space is used to draw the scope trace is wider.

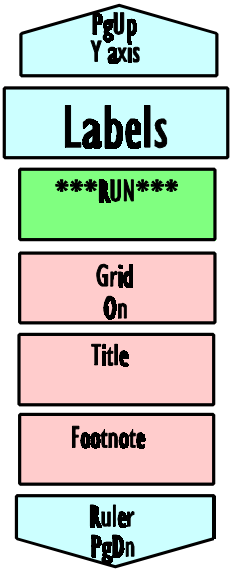
If you select **Volts/dB**, the program automatically adjusts the scale according to the settings of the range on the sampling panel.

If you select **User defined**, the program uses the remaining buttons on this panel to set the scaling.

The **Label** is intended to be the units of the scaled parameter that you are measuring.

The **Min Value** and **Max Value** are the numbers at the bottom and top respectively of the Y axis. Decimal Places specifies how many decimal places to use for the numbers on the Y axis.

8.3 Notes



This panel enables you to control the grid and to attach notes to the display. The title and footnote will appear both on the display and on printed output.

The **Grid** button enables you to turn the grid **Off** or **On**.

The **Title** appears at the top of the display.

The **Footnote** appears at the bottom of the trace, outside the grid.

Both title and footnote can be more than one line: press **Tab** to start the next line.

8.4 Ruler

The spectrum analyser ruler can be used to highlight points of interest on a spectrum and to give a precise reading of frequency and amplitude.

The **Frequency** button is used to control the position of the ruler. Move it using +/- for large increments or cursor left/right for small increments. The number on the button is the frequency at the current ruler position.

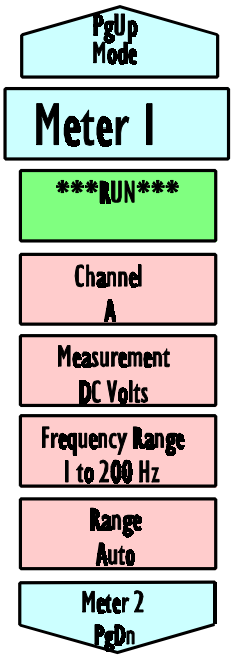
The **Amplitude** button cannot be modified: it shows the amplitude at the current ruler position.

The **Cancel** button removes the ruler from the display.

9 Meter panels

This section describes in detail the panels associated with the meter function.

9.1 Meter / Meter 1 / Meter 2...



The meter panel is used to control the settings for a meter display. You can display between one and 12 meters: the more meters you turn on, the smaller they get. To turn off a meter, set the channel to **Off**.

The **Run/Stop** button enables you to pause or restart the display. Press the space bar to stop or restart.

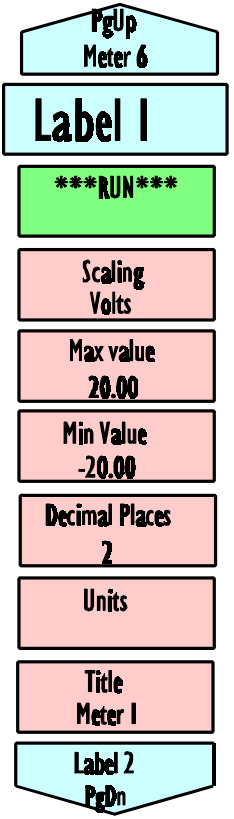
The **Channel** button selects which channel is to be used for this meter. Set the channel to **Off** if you wish to turn the meter off.

The **Measurement** can be **DC volts**, **AC Volts** or **Frequency**. If you select **AC volts**, the program displays the RMS voltage, excluding any DC component.

The **Frequency Range** can be either **1 to 200Hz** or **100 to max**. If you select the wrong range, the program may give misleading results.

The **Range** specifies the input voltage range (not applicable for fixed input ADCs). You can select a particular range, eg **20V,** or **Auto**. If you select **Auto**, the computer automatically adjusts the input voltage range for maximum resolution.

9.2 Label 1



This panel enables you to specify the title and scaling for the meter.

The **Scaling** can be **Volts/Hz** or **User Defined**. If you select **Volts/Hz**, the meter will display the voltage or frequency as selected by the meter panel. if you select **User defined**, it uses the buttons on this panel to set the scaling.

Maximum Value specifies the value to appear on the meter when the ADC value or frequency is maximum.The maximum frequency is 200Hz in low range and depends on the ADC in high range- check the value that is displayed on the meter bar when scaling is **Hz.**

Minimum Value specifies the value to appear on the meter when the ADC value is minimum or the frequency is zero.

If you are just displaying voltages, this will normally be the maximum and minimum voltage for the ADC. If you are measuring, say, temperature using a device which outputs 10mV per degree Celsius, you should enter the temperature corresponding to maximum voltage.

Decimal Places enables you to select the number of decimal places displayed.

Units can be used to specify the text displayed next to the meter value. Normally, it will be V for Volts. Title specifies the title for this meter.

Index