

AnaPico Calibration Tool

User Guide (v3.7)

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Setup & Installation

Running the Installer

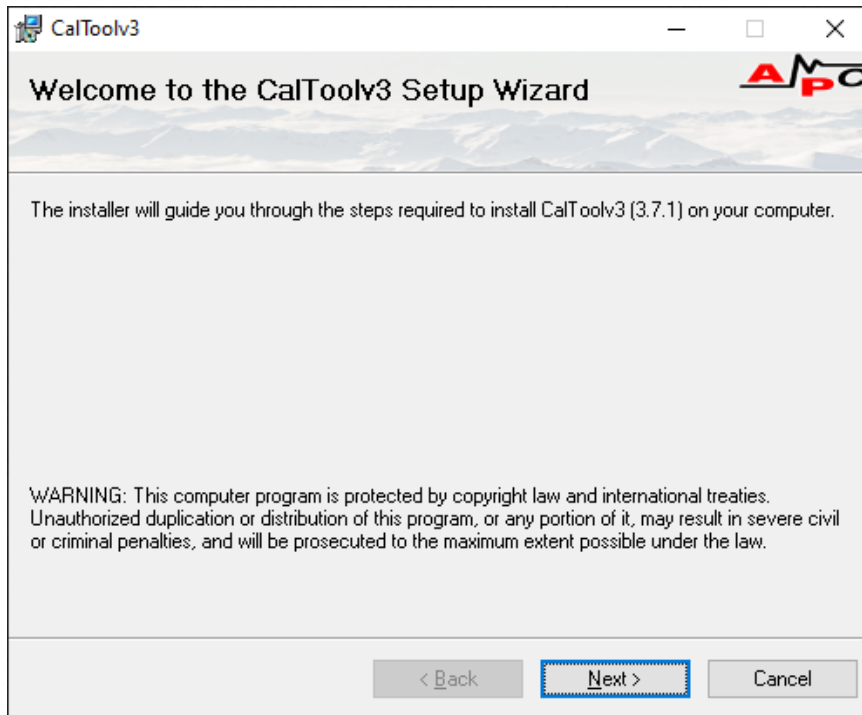


Figure 1 - Installation Wizard

- Install IVI Shared Components (minimum version 2.6.1) and Visa Shared Components (minimum version 5.12.0), which are shipped with the installation media.
- Ensure the installation PC has .NET framework version 4.7.2 or above installed.
- Run the .msi installer file which arrived with the installation media.
- Follow the installation wizard process, which requires selection of an appropriate installation location on the PC.
- After the installation is complete, the application can be launched from the Start Menu or desktop and will be called 'AnaPico Cal Tool v3'.

Connecting Instruments

- Before launching the tool, the DUT (AnaPico signal generator device) and a supported power sensor should be connected via USB to the PC.
- The power sensor should be connected to the channel of the DUT to be calibrated using the manufacturer-specified torque.

Supported power sensors are listed here:

- LadyBug LB5940L
- LadyBug LB5926L
- LadyBug LB5908L
- LadyBug LB589A

First Start-Up & Instrument Connections

Validating a License File

When the tool has been installed for the first time, the user will need to supply a license to unlock the modes of operation required. If these were not supplied with the installation media, then please contact AnaPico for a license file.

To install a license, click 'Help'->'Validate License File' and navigate to where the license file is saved – double click it. If valid, the modes of operation the license permits will become available. The application will remember the license file after restarting. Keep the original license file backed up in a safe place so the application can be installed and licensed on other PCs if needed.

Setting a device results directory

When the tool has been installed for the first time the user will be requested to supply a folder in which to export results from the calibration tool. The directory structure is as follows: [Root Export Directory] -> 'Device Type' -> 'Device Model' -> 'Device Serial Number' -> 'Channel'. The [Root Export Directory] is the folder which must be selected by the user. This directory can be changed later via the Edit menu ([see below](#)).

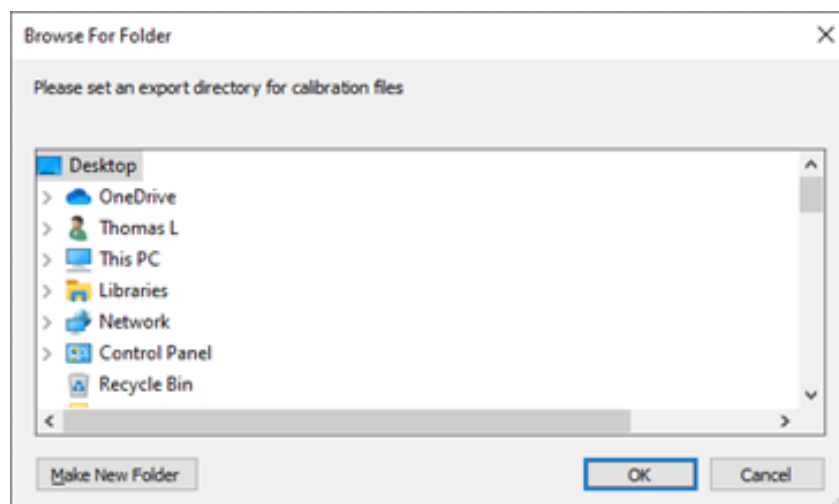


Figure 2 - Setting a device results directory path

Connecting to a Device

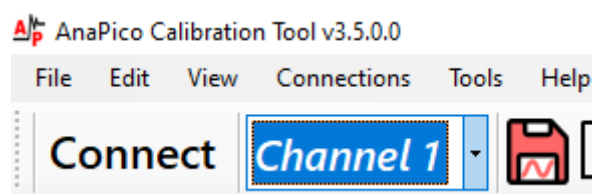


Figure 3 - Connect Button & 'Connections' menu

Select this button to open a new dialog containing a list of available signal generators and power sensors to connect to n.b. the power sensor and signal generator must be supported by the tool before connection is possible.

The connection dialog can also be accessed from the 'Connections' menu.

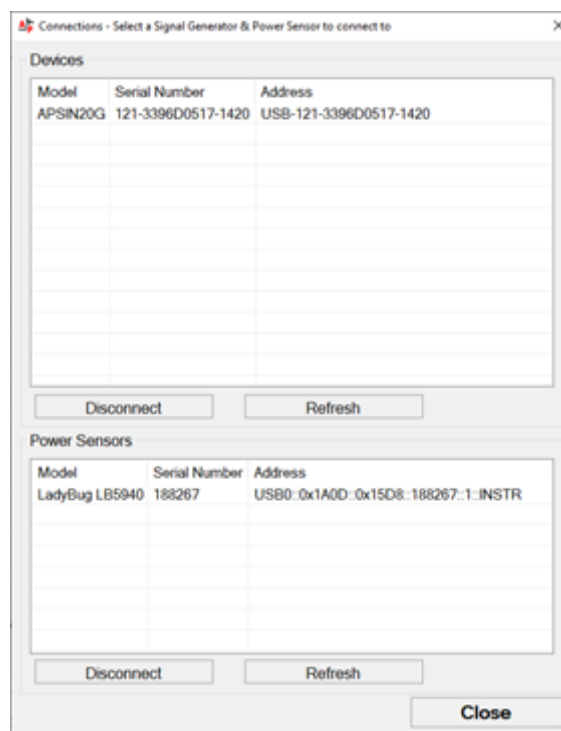


Figure 4 - Device Connections Dialog

When selecting a signal generator device, any existing datasets will be loaded and displayed within the tool. By default, the latest data will be plotted within each tab, if available (for the most recent completed task).

If a signal generator device is not supported by the tool, this will be indicated within the console output when the user tries to connect.

For the power sensor selection, only supported models will be displayed by the tool.

A successful connection must be established to both a signal generator device and a power sensor before calibration tasks can be run.

See section '[Controlling a Calibration Task](#)' for instructions on how to proceed with calibrating your device.

Application Menus

Help Menu

Select Help -> About to see details of the version of the calibration tool which is installed, as well as details of the currently connected signal generator, including firmware version and serial number.

Help -> Validate License – for information on this menu item see section '[Validating a License File](#)'.

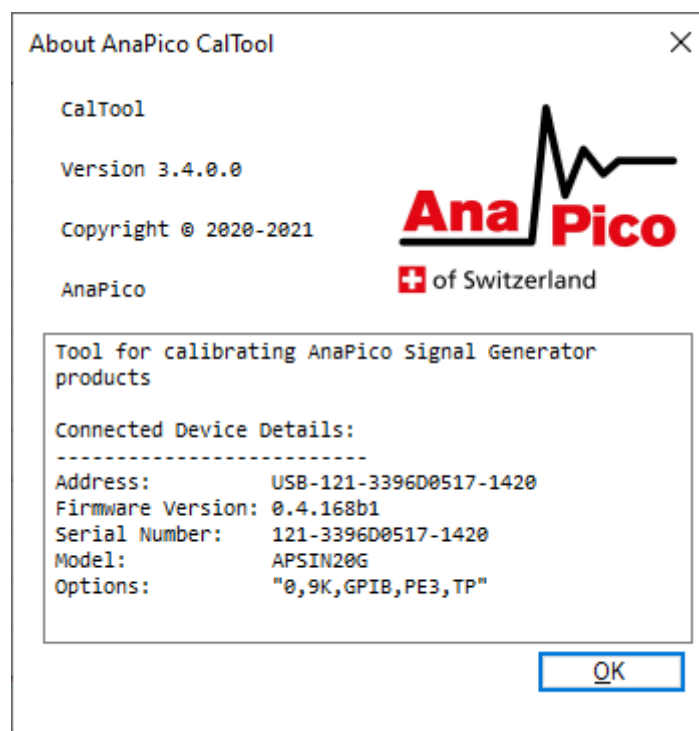


Figure 5 - About Dialog

Tools Menu

Tools -> Frequency Tuning Tool – for info. See section '[Frequency Tuning Tool](#)'.

View Menu

Select View -> Calibration Results to open the results directory of the currently connected device within windows explorer. This directory can also be accessed using the 'Open Calibration Results' button at the bottom of the window. The results directory shows files which have been exported after the completion of a calibration task.

Edit Menu

Select Edit -> Change Root Export Directory to change the top-level directory where device results are exported n.b. this will not migrate existing results from a prior directory – migration must be carried out manually by the end user.

File Menu

File -> Export Current Plot opens a save dialog to export the currently visible plot to a directory and with a file name specified by the user. By default, the file is given a unique name with a timestamp which includes the serial number and the current channel of the connected signal generator. This option can also be accessed using the button 'Export Current Plot' at the bottom of the window. *Bear in mind, this and other 'File Menu' options will only work when a signal generator is connected.*

File -> Export Local Device Files – this option is only used in cases where results from a calibration task could not be exported to the directory specified by the user. In this case these files will be backed up temporarily to a local directory. The user should click this option when the normal results directory path is again available, and the missing files will be exported to the correct location.

File -> Upload Calibration – for details on this menu item, see section '[Upload Calibration File Manually](#)'.

Calibration Info. & Visuals

Toolbar



Figure 6 - Toolbar Controls

The toolbar contains peripheral controls which are used alongside a calibration task. Most options on the toolbar are available additionally within the application menus. The individual controls are explained in more detail below (in order from left to right):

- The 'Connect' button is an alternative way to access the 'Connections' dialog (see section on ['Connect Button'](#))
- The channel selection dropdown displays the current channel of the connected signal generator being controlled (see section on ['Channel Selection'](#)) *
- 'Export Visible Plot' saves the visible plot to file - this control will load up a save dialog where you can specify a filename and file type to export *
- 'Open Device Results Directory' opens the folder where the calibration results are saved for the current device. This only works when a device is connected and calibration tasks have previously been run (see section on ['Device Results Directory'](#)) *
- 'Export Missing Files' will export any results files from calibration tasks which could not be saved to the results directory but were backed up locally instead (see ['File Menu'](#) section -> 'Export Local Device Files') *
- 'Open Calibration Manager' is a reserved function for AnaPico administrators.
- 'Open Frequency Tuning Tool' opens a separate window with controls for adjusting the frequency tuning of the connected device. This option is only available if a device is connected and if your license permits (see section on ['Frequency Tuning Tool'](#)) *
- 'Open Power Monitor' opens a separate window with controls to manually adjust the frequency and power output of the device whilst displaying a continuous reading from the connected power sensor (see section on ['Power Monitor Tool'](#)) **
- 'Reload Device Calibration' refreshes all displayed data within plot tabs for the connected device *
- 'Browse / Upload Calibration File' opens a dialog to upload a calibration file to the connected device. (See section on ['Upload Calibration File Manually'](#)) *

All controls with an asterisk () require a device to be connected first.*

*Controls with two asterisks (**) require a device and power sensor to be connected first.*

Status Bar

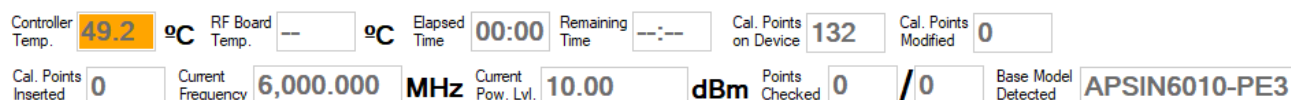


Figure 7 - Status Bar Fields

The status bar at the top of the window displays the following information:

- ‘Elapsed Time’ indicates the amount of time passed since the most recent calibration task was started and stops upon completion of the task.
- ‘Remaining Time’ gives an approximate indication of the remaining time to complete the current Adjustment or Frequency Sweep task.
- ‘Controller Temp’ displays the temperature, in degrees Celsius, of the current connected device; this field is blank when a signal generator is not connected to the tool. **The background will initially display in orange when connected to a device and will remain orange until the DUT controller temperature has reached a stable operating temperature, at which point it will turn green.**
- ‘RF Board Temp’ displays the temperature of the RF board of the selected channel. Its availability depends on device firmware version.
- ‘Cal. Points on Device’ indicates the number of calibrated frequencies within the connected device’s calibration table.
- ‘Cal. Points Modified’ indicates the number of calibration points which have been modified by the tool during an [adjustment](#) or [refinement](#) task.
- ‘Cal. Points inserted’ shows how many new calibration points have been inserted into the device’s calibration table during a [refinement](#) task.
- Current frequency and power level show the levels currently being verified, adjusted or swept over, depending on the current task being run. These fields should help you track the progress of the running task.
- Points checked shows “X/Y”, where X is the number of frequencies which have been processed so far in the running task; and Y is the total number of frequencies to be processed within the current running task. For a refinement task only, these values indicate the progress during each pass, so may be reset several times to different values.
- ‘Base Model Detected’ is for admin users only.

Plot Tabs

The plot tabs are displayed immediately beneath the status bar and contain the following plots:

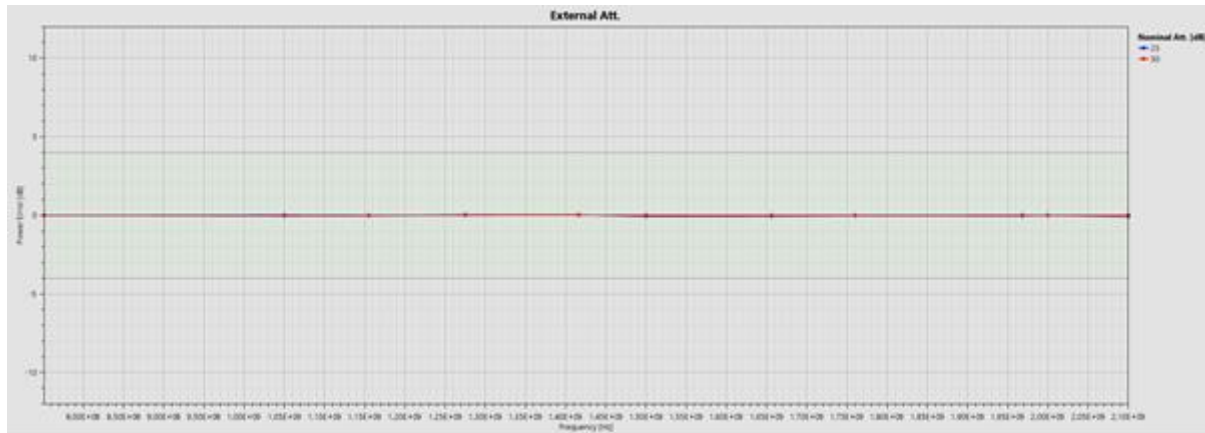


Figure 8 - External Attenuator Plot

- ‘External Att.’ shows the power error of the external attenuator stages – this plot is only updated during a verification task.

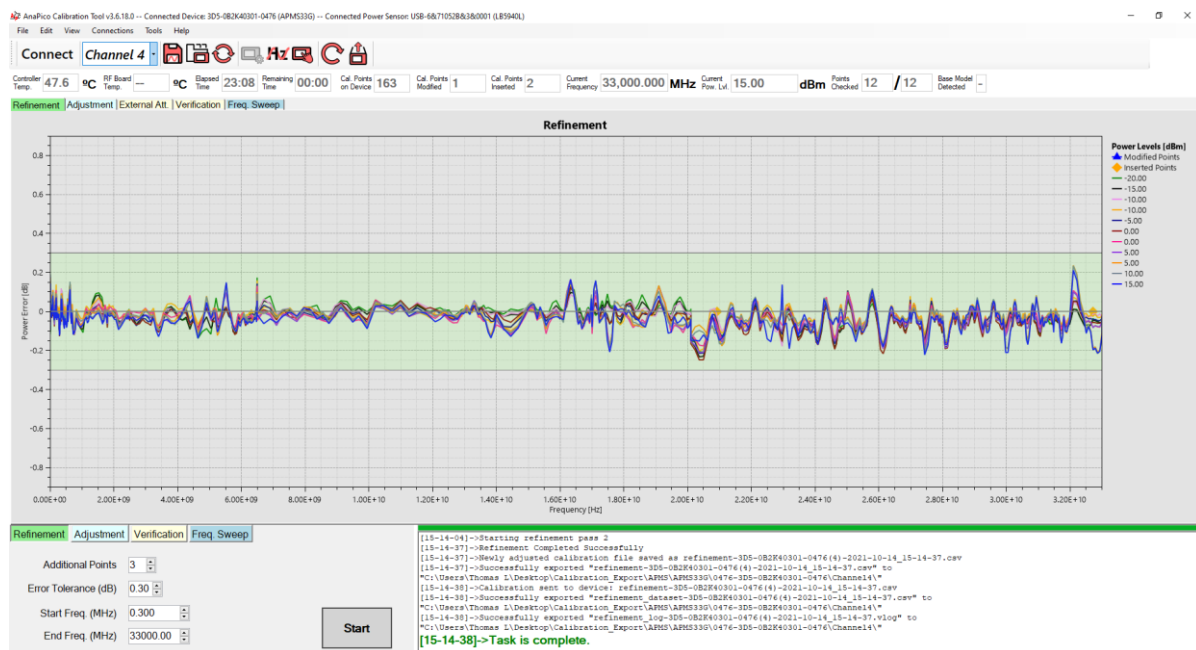


Figure 9 - Refinement Plot

- The ‘Refinement’ plot tab shows the power levels from the device calibration table, during and after a [refinement task](#), indicating the error at each power level. This plot also marks where new calibration points have been inserted into the device’s calibration table, indicated by a yellow diamond. Additionally, where existing calibration points have been corrected or

‘modified’, this is indicated with a blue triangle. Both markers after displayed about ‘0’ on the y-axis.

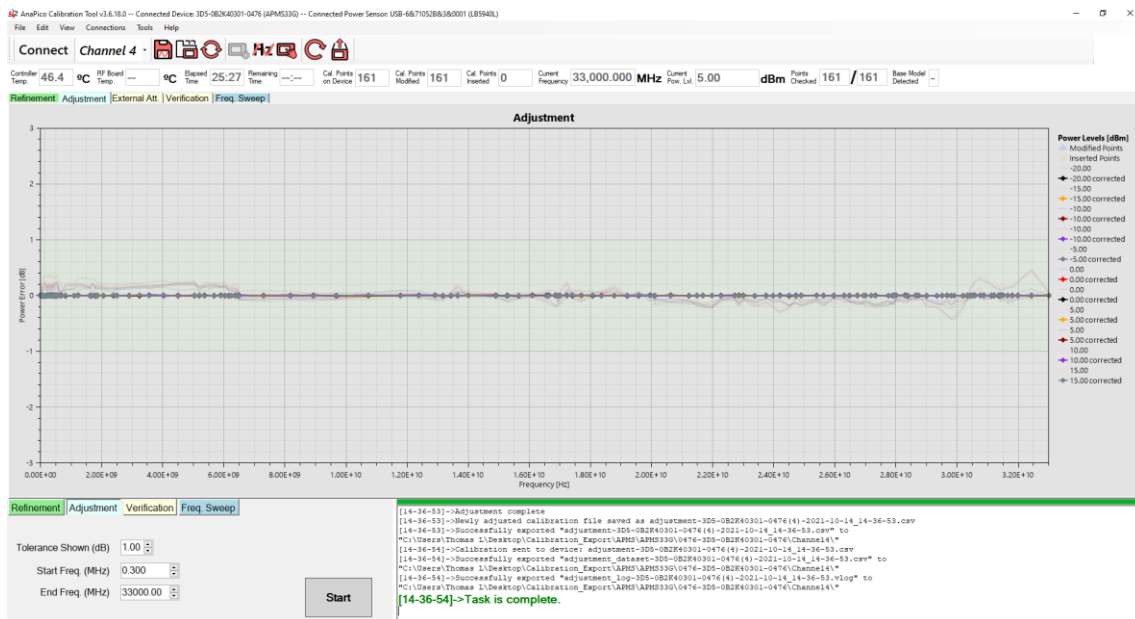


Figure 10 - Adjustment Plot

- ‘Adjustment’ shows the power levels from the device calibration table during and after an [adjustment task](#) – it indicates power error both before and after adjustment for each power level.

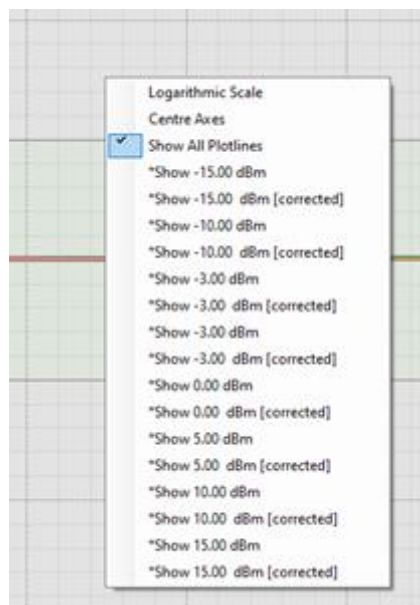


Figure 11 - Adjustment Plot Context Menu

- The user can right-click on the plot when connected to a device and select the plot line filters which will show/hide the visible plot lines. To display multiple plot lines the user can hold down the 'Ctrl' key whilst selecting those to display. These filter options are available on the refinement, verification, and freq. sweep tabs also. To remove any filter which has been applied, select the 'Show All Plotlines' option.
- Within the context menu of each plot there is also the option to 'Centre Axes' which will return the current view, so all plotted data is visible. Additionally, there is the 'Logarithmic Scale' option which will swap between a linear and logarithmic frequency scale for all plots simultaneously.

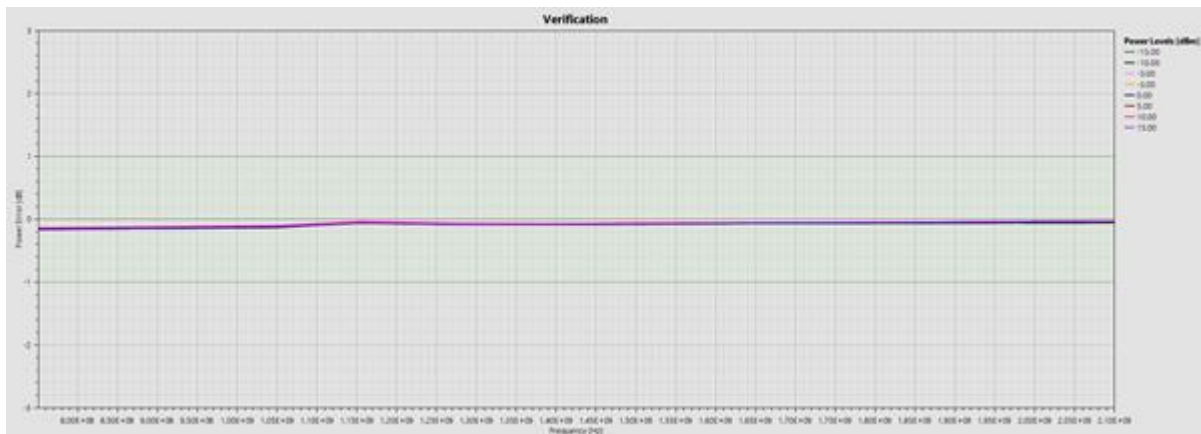


Figure 12 - Verification Plot

- 'Verification' shows the power error at each calibrated frequency and power level from the device calibration table during and after a [verification task](#).

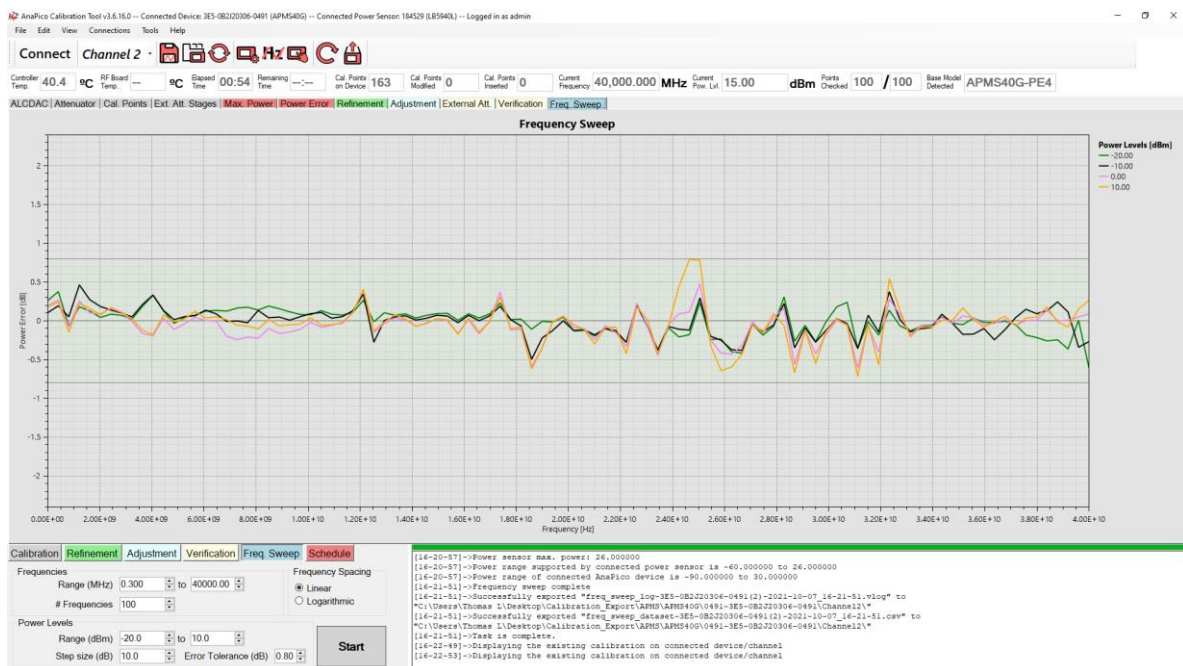


Figure 13 - Frequency Sweep Plot

- 'Frequency Sweep' shows the user-specified power levels swept across frequency as specified within the running [Freq. Sweep task](#).

Controlling a Calibration Task

Control Tabs

On the bottom-left hand side of the screen is the Control Toolbox which contains one or more of the following tabs (depending on license):

Refinement

- Provides controls for running a refinement task. A refinement will first check the existing calibration and will adjust at the pre-calibrated frequencies if the power error drops outside of the specified tolerance. It will then run one or more passes to check the power error between calibrated frequencies. If further calibration is needed at these points, new points will be calibrated and inserted into the device's calibration table. Multiple passes across the specified frequency range will occur, until no more frequencies are found where the power error is outside the tolerance specified.

The options available to the user on these tabs include:

- Additional Points – The number of frequencies to check between existing calibration points – a higher number indicates a higher resolution check, but will result in a longer refinement run.
- Error Tolerance – Specified in dB – any points discovered outside of this error range will be recalibrated or a new point inserted. An allowance is made for measurement uncertainty, so occasionally points just within the specified error range will also be recalibrated too.
- Start Freq. – The frequency in MHz to start the task from – the closest frequency less than the specified frequency within the calibration table of the device will be used as the starting frequency. [By default, the value will be the lowest calibrated frequency]
- End Freq. – The frequency in MHz to end the task at – the closest frequency greater than the specified frequency within the calibration table of the device will be used as the starting frequency. [By default, the value will be the highest calibrated frequency]

Figure 14 - Refinement Control Tab

Adjustment / Verification

- These tabs facilitate the running of an adjustment or verification task.
An adjustment will run through the specified frequency range and recalibrate each power level to achieve a reduced error across the range.
A verification task will run through the specified frequency range and measure the current error exactly on each calibrated frequency point. If run before an adjustment task, it will give an indication as to whether an adjustment is needed, or if run after an adjustment task, will verify if the adjustment was successful.

The options available to the user on these tabs include:

- Error Tolerance – This value indicates the size of the green tolerance band which is visible during the adjustment or verification task; this band is used as a visual aid to show how accurate the power output of the device is against the accuracy desired by the user.
- Start Freq. – The frequency in MHz to start the task from – the closest frequency less than the specified frequency within the calibration table of the device will be used as the starting frequency. [By default, the value will be the lowest calibrated frequency]
- End Freq. – The frequency in MHz to end the task at – the closest frequency greater than the specified frequency within the calibration table of the device will be used as the starting frequency. [By default, the value will be the highest calibrated frequency]
- Start Button begins the requested task – bear in mind that before a task can be started, the user must have first connected to a power meter and a signal generator device.

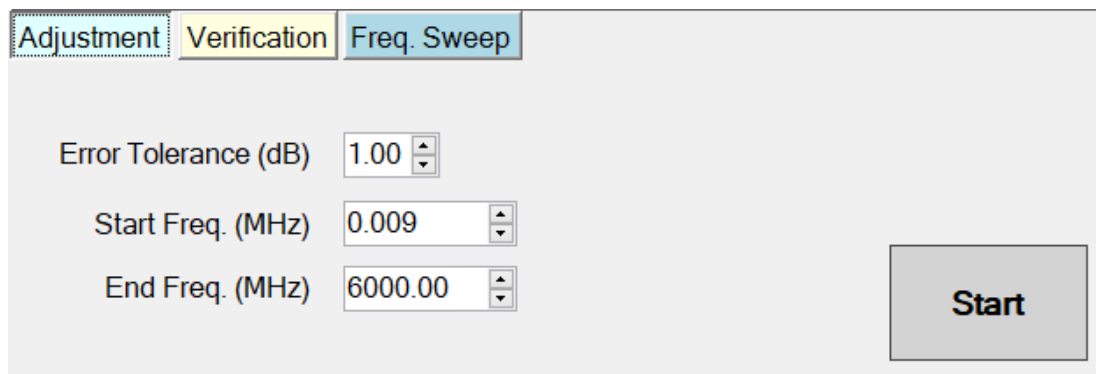


Figure 15 - Verification / Adjustment Control Tab

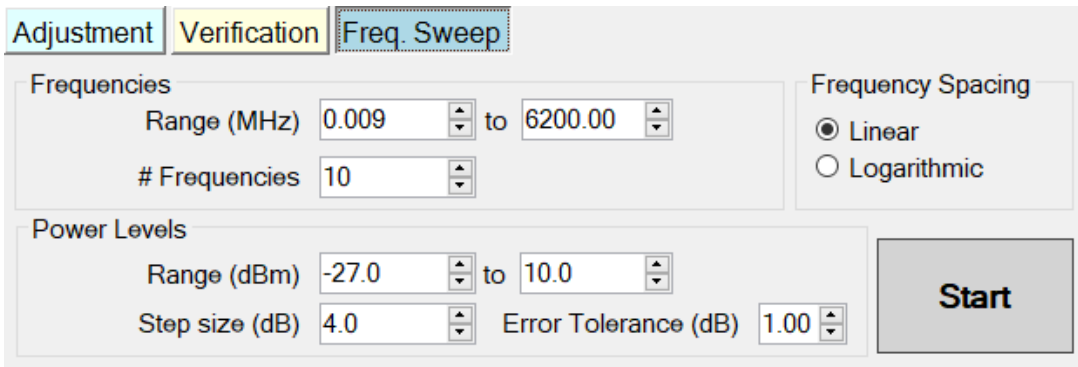
Frequency Sweep

- This tab allows the user to perform a custom sweep across frequency and power level to validate a calibration at custom power and frequency steps.

It has the following available options:

- Range (MHz) – this indicates the frequency range to sweep over, from the lowest frequency to the highest

- # Frequencies – indicates the number of frequencies to check within the specified range – for example 11 frequencies over a range of 10MHz will yield a step-size of 1MHz).
- Frequency Spacing – indicates whether to use a linear spacing of the frequency points specified or a logarithmic spacing.
- Range (dBm) – provides the power range to sweep over, from the lowest power to the highest.
- Step Size (dB) – indicates the power step size which will dictate the actual power levels which are used - i.e. a range of -10dBm to 10dBm with a step size of 5dB will result in -10, -5, 0, 5 and 10dBm used in the sweep.
- Error Tolerance – indicates the width of the green tolerance band which is displayed on the 'Freq. Sweep' plot during the frequency sweep task – this acts as a visual aid to help the user monitor the accuracy of different power levels over frequency.
- Start Button – begins the requested task with specified options.



The screenshot shows the 'Freq. Sweep' control tab with the following settings:

- Frequencies:** Range (MHz) from 0.009 to 6200.00; # Frequencies: 10.
- Frequency Spacing:** Linear (selected), Logarithmic (unselected).
- Power Levels:** Range (dBm) from -27.0 to 10.0; Step size (dB): 4.0; Error Tolerance (dB): 1.00.
- Start Button:** A large grey button labeled 'Start'.

Figure 16- Frequency Sweep Control Tab

Channel Selection

For multi-channel devices, the user can specify the device channel they wish to control by changing the selection in the dropdown – this must match the channel the intended power sensor is connected to. The selected channel will be the one controlled when tasks are run by the user. When switching channels, the plots will refresh to show data relevant to the selected channel. If data is not available for a particular device/channel combination, then some plots will remain empty.

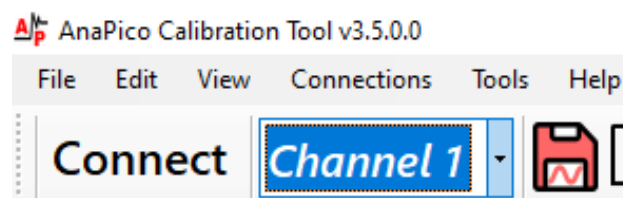


Figure 17 - Channel Selection

Analysing Results

Console Output (bottom-right)

The console shows information regarding connected devices, status and progress of running tasks including any warnings or failure messages if a task could not be completed. Whilst a task is running the user may click the console to temporarily freeze the output if they wish to read some messages in detail. Clicking the console again will hop back down to the latest information. The freezing of the output does not affect any running tasks.

Above the console is also a progress bar, which indicates the status of any calibration tasks which are currently running.

```
[18-37-48]->AnaPico Device disconnected  
[18-37-48]->Displaying the existing calibration on connected device/channel  
[18-37-51]->Connected to AnaPico Device USB-121-3396D0517-1420  
[18-37-51]->Disconnected Power Sensor USB0::0x1A0D::0x15D8::188267::1::INSTR successfully  
[18-38-03]->Connected to LadyBug Power Sensor USB0::0x1A0D::0x15D8::188267::1::INSTR
```

Figure 18 - Console Output

Device Results Directory

A device directory is created for each channel of each device when a task is performed on that device and channel number. Each of the results directories are created under the root results directory which is specified on opening after first installation, and which can be changed by the user at any time (see '[Edit Menu](#)' section). No sub-directories exist until at least one task has been successfully completed by the tool. Successful completion implies that the task has fully run from beginning to end without failures. If a failure occurs during a run then it is assumed that the integrity of the calibration task is compromised, therefore the results are not exported.

The results directory contains the following information, according to which of the below tasks was run:

Frequency Sweep

- PNG image showing the plotted sweep results
- Dataset file (.csv) containing a record of the plotted points within the sweep plot
- VLOG (text) file holding a detailed log of the frequency sweep task

Verification

- PNG image showing the plotted verification results
- [optional] PNG image showing the External Attenuator verification results (if the signal generator has an external attenuator)
- Dataset file (.csv) containing a record of the plotted points within the verification plot

- [optional] Dataset file (.csv) containing a record of the plotted points within the External Att. plot (if the signal generator has an external attenuator)
- VLOG (text) file holding a detailed log of the verification task

Adjustment

- Dataset file (.csv) containing the resultant calibration file which was uploaded to the signal generator upon completion of the adjustment task
- PNG image showing the plotted adjustment results
- Dataset file (.csv) containing a record of the plotted points within the adjustment plot
- VLOG (text) file holding a detailed log of the adjustment task

Refinement

- Dataset file (.csv) containing the resultant calibration file which was uploaded to the signal generator upon completion of the refinement task
- PNG image showing the plotted refinement results
- Dataset file (.csv) containing a record of the plotted points within the refinement plot
- VLOG (text) file holding a detailed log of the refinement task

Calibration_Export > APSINX010 > APSIN6010 > 0848-111-433600000-0848 > Channel1

Name	Date modified	Type	Size
Archive	16/04/2021 11:09	File folder	
adjustment_dataset-111-433600000-0848(1)-2021-04-16_11-07-18.csv	16/04/2021 11:07	Microsoft Excel C...	3 KB
adjustment_log-111-433600000-0848(1)-2021-04-16_11-07-18.vlog	16/04/2021 11:07	VLOG File	316 KB
adjustment-111-433600000-0848(1)-2021-04-16_11-07-18.csv	16/04/2021 11:07	Microsoft Excel C...	11 KB
adjustment-plot-111-433600000-0848(1)-2021-04-16_11-07-18.png	16/04/2021 11:07	PNG File	110 KB
calibration_log-111-433600000-0848(1)-2021-04-13_10-44-46.log	13/04/2021 10:44	Text Document	66 KB
freq_sweep_dataset-111-433600000-0848(1)-2021-04-16_11-09-20.csv	16/04/2021 11:09	Microsoft Excel C...	4 KB
freq_sweep_log-111-433600000-0848(1)-2021-04-16_11-09-20.vlog	16/04/2021 11:09	VLOG File	23 KB
freq-sweep-plot-111-433600000-0848(1)-2021-04-16_11-09-21.png	16/04/2021 11:09	PNG File	87 KB
refinement_dataset-111-433600000-0848(1)-2021-04-13_19-38-31.csv	13/04/2021 19:38	Microsoft Excel C...	0 KB
refinement_log-111-433600000-0848(1)-2021-04-13_19-38-31.vlog	13/04/2021 19:38	VLOG File	341 KB
refinement-111-433600000-0848(1)-2021-04-13_19-38-31.csv	13/04/2021 19:38	Microsoft Excel C...	8 KB
refinement-plot-111-433600000-0848(1)-2021-04-13_19-38-32.png	13/04/2021 19:38	PNG File	141 KB
verification_dataset-111-433600000-0848(1)-2021-04-16_11-08-58.csv	16/04/2021 11:08	Microsoft Excel C...	2 KB
verification_log-111-433600000-0848(1)-2021-04-16_11-08-58.vlog	16/04/2021 11:08	VLOG File	72 KB
verification-plot-111-433600000-0848(1)-2021-04-16_11-08-59.png	16/04/2021 11:08	PNG File	101 KB

Figure 19 - A typical device results directory

Dataset File Export Format

Exported dataset files entitled “freq_sweep_dataset”, “verification_dataset”, “adjustment_dataset” or “refinement_dataset” contain the following information:

- Column 1 shows the frequency in Hz
- Column 2 shows the measured relative power error in dB
- Column 3 shows the power level in dBm and the device power zone (separated by a comma)

Exported dataset files entitled “pe_error” show equivalent information in column 1 and 2, but in the 3rd column they show the nominal attenuation of the attenuator being verified (in dB).

Automatic Archiving

When a task completes successfully, the dataset files pertaining to previously completed tasks for the connected device (and channel) will be moved to a directory called ‘Archive’ within the device’s results directory. The most recent dataset files for the completed task will be exported to the device’s results directory.

Frequency Tuning Tool

The frequency tuning tool is a widget which can be accessed from the ‘Tools’ menu or via the toolbar option, only if your installed license permits.

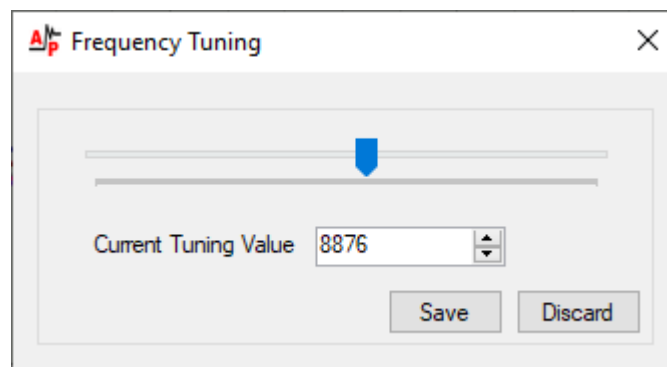


Figure 20 - Frequency Tuning Widget

The tuning widget allows for the connected device’s frequency to be tuned precisely. Use the arrow controls or the slider to tune the frequency – when you are happy with the result then click the ‘Save’ button to keep the current setting. If ‘Discard’ is clicked or the widget is closed without saving, then the tuning value will not be saved by the signal generator.

Power Monitor Tool

The Power Monitor tool can be opened from the toolbar by clicking the following icon:

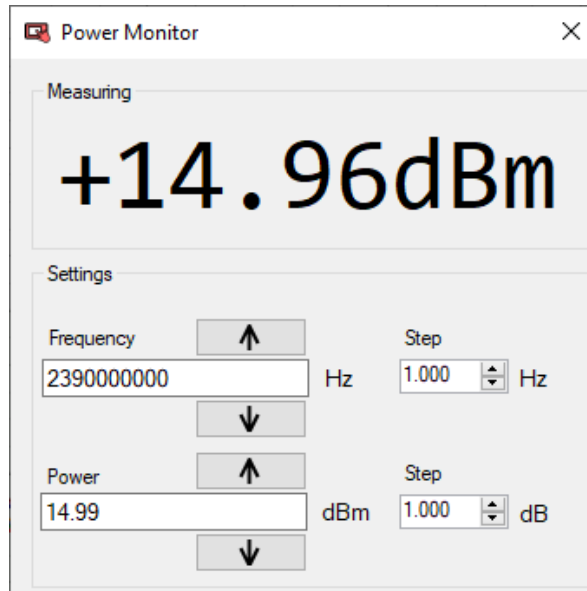


Figure 21 - Power Monitor Tool

This window allows a custom frequency and power setting to be sent to the device whilst displaying a continuous power reading from the power sensor.

For frequency setting, enter the desired frequency, followed by the units i.e. '10' followed by 'h' for Hz, 'k' for kHz, 'm' for MHz or 'g' for GHz (or omit the units to keep the current unit displayed). Press the enter key to send the frequency to the device.

For the power setting, type the desired power in dBm and then press the enter key to send the power to the device.

The up and down arrow buttons can be used to finely adjust the frequency or power settings. The step-size is governed by the 'Step' setting next to each control. The corresponding setting will be sent to the device immediately with each click.

Upload Calibration File Manually

Within the file menu, the option 'Upload Calibration' (or via the toolbar button) allows for a calibration file of choice to be uploaded to the connected signal generator. By default, an 'open file' dialog will open with the results directory of the connected device. Within the 'Archive' directory for a given device, an older calibration may be uploaded to revert the device back to a previous calibration.

When an adjustment or refinement task is run on a device, before starting, the current device calibration will be saved within the respective device's 'Archive' directory (for the channel being adjusted). These files are entitled 'calibration_backup', followed by the device serial number and a timestamp indicating when the file was created. It is possible to use the 'Upload Calibration' function to revert to one of these backed up device calibrations, for example, if the user is unhappy with the output of an adjustment.

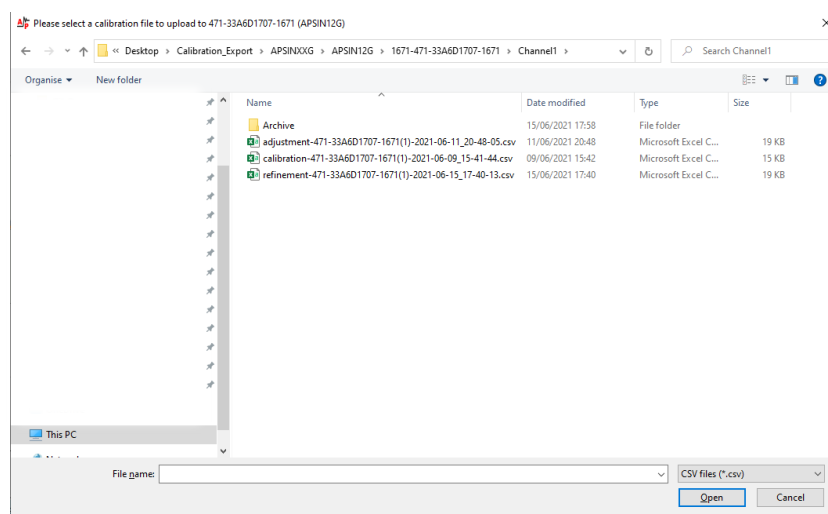


Figure 22 - Calibration File Upload Dialog