CELLULAR

Mobile Voice Tuning (MVT) Guide

TOBY-L2 series

Application Note

Abstract

This document describes the two operational modes of the TOBY-L2 module and how to provide connectivity to customer modems.

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Product name
TOBY-L2 series

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1 About this document

1.1 Purpose

This document describes how to use the Mobile Voice Tuning (MVT) offline tool for audio testing and debugging on TOBY-L2 series modules.

1.2 Product overview

The MVT is an audio offline tool that can be used for calibrating any voice module in the Rx or Tx path. It also enables the user to design equalizer and bi-quad filters for Rx and Tx. Since this is an off-line tool, there is no need to connect it to a target.

By using this tool the user can define the equalizer parameters for required frequency responses. The equalizer is an FIR filter of 31 Taps.

It enables calibrating cellular handsets and audio parameters to ensure that mobile cellular handsets meet the minimum requirements of acoustic test cases as defined in 3GPP TS 51.010-1 [3], Section 30 (up to Release 99) or T26.

1.3 MVT tool installation

1. Install the MVT tool on the PC by running the installation execution file named: **MobileVoiceTuning_xx.yy.zz.exe**. [xx.yy.zz is the version number]
2. Continue to follow the instructions until the installation process is complete.
3. The installation, by default, places the files in this directory: **C:\Program Files (x86)\u-blox\MobileVoiceTuning**.

   The files do not have to reside in this location. It is possible to change the directory location to any other folder on the PC.

   A shortcut MVT icon is automatically created and placed on the desktop.

   There is no need to remove older versions when installing a new version. The new version overwrites the older version.
4. The installation installs also MATLAB® MCR Installer

☞ Old NVM files and database (mdb) files are not deleted during the installation.

2 Mobile Voice Tuning (MVT) tool

2.1 MVT tool main panel

Figure 1 shows the Mobile Voice Tuning (MVT) tool's main panel.
Table 1 describes the panel items and how to configure the voice module tuning.

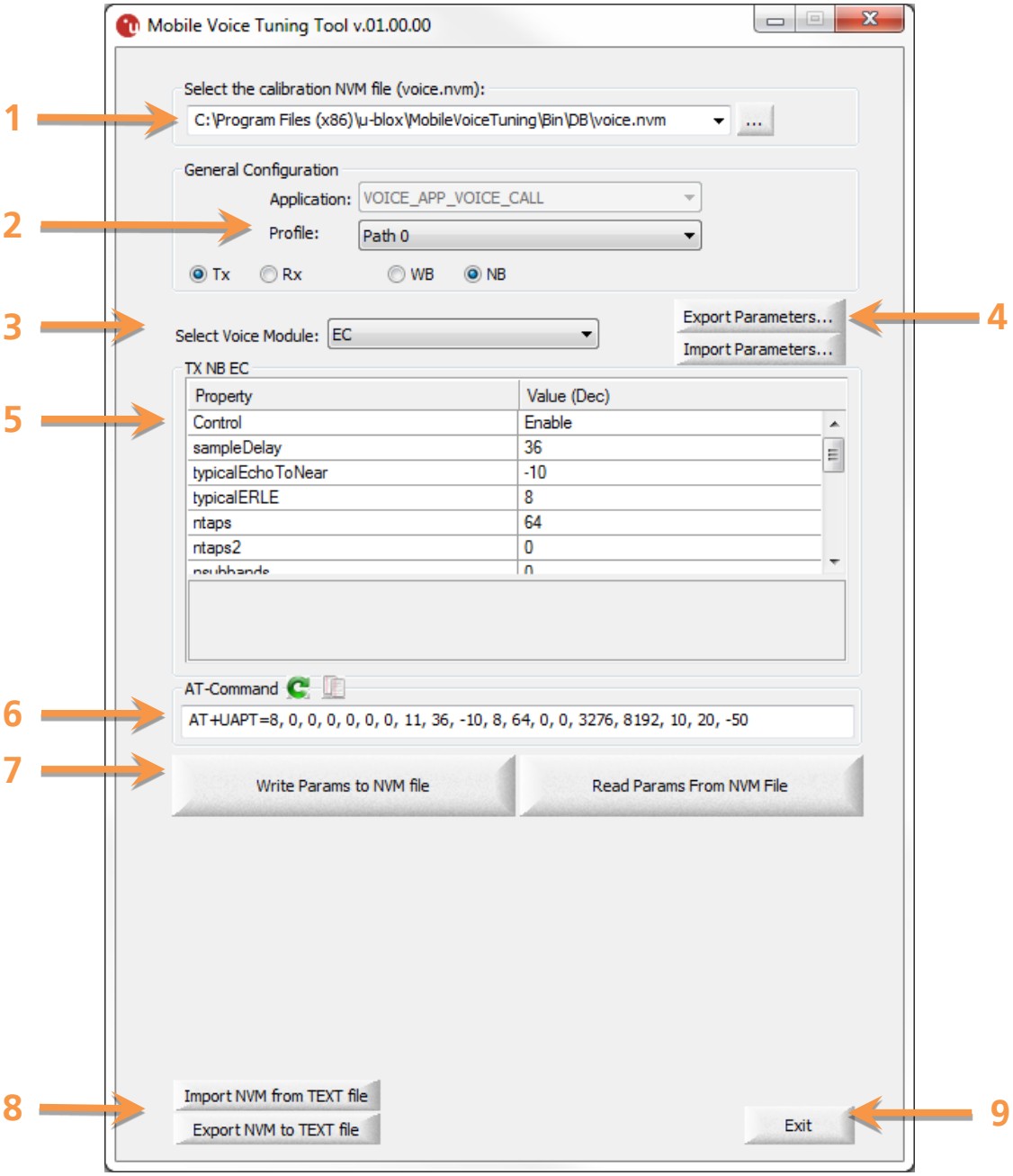


Figure 1: Mobile Voice Tuning Tool - Main Panel

Item #	Item	Description
Define NVM File Location		
1	**Calibration File Location**	Select the voice.nvm file. By default, the installation package (during installation process) places a default voice.nvm file in the following folder (**working** folder): C:\Program Files (x86)\u-blox\MobileVoiceTuning\Bin\DB\ You can load your own NVM file from any location, however, the tool will copy it to its working folder. The MVT tool always saves the updated NVM file in this working folder. ☞ An nvm file in any other folder is not saved by this MVT tool. Therefore, when calibration is done, use the updated voice.nvm file from the **working** folder. The MVT tool saves your last browse location in memory. Therefore, the next time you use the MVT tool, the browse button will open at your previously defined location.
Define General Configuration for Selected Structure		
2	**Application**	Voice Call application is supported only. This value is not editable.
2	**Profile**	There are 5 different voice tuning profiles that you can use to define tuning values. Each Application-Profile combination defines the audio data structure selected to be read or edited.

2	**Tx/Rx, WB/NB**	For the currently selected structure, define its tuning specifications:
		• Define voice direction: Select **Tx** or **Rx**
		• Select frequency band:
		  ○ WB: Wideband = 16 kHz
		  ○ NB: Narrow band = 8 kHz

Voice Module		
3	**Select Voice Module**	Select a voice module to define or modify (for the current structure): • EC - Echo Canceller • RES - Residual Echo Suppression • NS - Noise Suppressor • LPF- Low Pass Filter • HPF - High Pass Filter • EQU - Equalizer • AGC - Automatic Gain Control • DRC - Dynamic Range Control • ML - Microphone Levels
4	**Export/Import Parameters**	For the currently selected voice module parameters for the current structure: • Use Export Parameters to download parameter values to a text file. Parameter values are exported as either Hex or decimal, depending on the Value button's current state (hex or decimal, Parameter List Value.) • Use Import Parameters to upload parameter values from a text file into the MVT tool's table. You can import values in either format, hex or decimal. ☞ Use this option when you need to change a large number of parameters manually. **Text file format** • List each parameter on a separate line. • Define the parameter value in decimal format. • The number of lines must exactly match the number of parameters for the defined structure.
5	**Parameter List**	The MVT tool Voice Module table lists 2 columns: • Property: contains the parameter name. Ensure that the Control parameter for each Voice Module is set to Enable in the Value column in order to enable it in your voice path. • Value: Parameter values are shown in either Hexidecimal or Decimal notation. Click on Value (Hex) to change the view to decimal (Value (Dec)) and vice versa (this is a toggle button). Parameter values can be updated as needed directly in the table or via a text file (see Export/Import Parameters). ☞ No values are saved until you Write Params to NVM file.

Item #	Item	Description
Prepare appropriate AT Command		
6	**AT-Command**	**When changing structure number or selecting voice module, this line is automatically updated to the appropriate voice calibration AT command. The user can copy this line and paste it to a terminal to send it to target.**
6	**Refresh button**	**This button (green arrow icon) updates the AT command with values in the parameters list, after they have been changed.**
6	**Copy button**	**This button (sheets icon) copies the AT command in the clipboard, allowing to paste in the AT terminal.**
6	**Refresh button**	**This button is to verify that the AT command parameters is updated (in case of designing Equalizer or bi-quad filter)**
Write/Read Parameter File to NVM File		
7	**Read Params from NVM file**	Click this button to read the parameters from the NVM file of the current voice module selected into the MVT tool table.
7	**Write Params to NVM file**	Click this button to write the current voice module parameters in the list to the NVM file. This action saves your defined values.
8	**Import NVM from TEXT file**	Click this button to convert a text NVM file to a binary NVM file to use with this tool. Define the NVM text file location path to currently load it to the tool.
8	**Export NVM to TEXT file**	Click this button to save your current binary NVM file to a text NVM file. The text NVM file is automatically saved to same default folder location for the binary NVM file: **C:\Program Files (x86)\u-blox\MobileVoiceTuning\Bin\DB**
Exit		
9	**Exit**	Click this button to exit the MVT tool. The path to your current NVM file is saved. The next time you open the MVT tool, it will open at the folder location where your NVM file is currently stored.

Table 1: MVT Tool Main Panel Item Descriptions

2.2 Tuning the equalizer

1. Select EQU in Select Voice Module (Figure 2) to access the equalizer parameters for your currently selected structure.
2. When EQU is selected, the Equalizer Filter Design box opens on the MVT's main panel (item **10** in Figure 2).

   Use the Equalizer Filter Design box to calibrate the filter's equalizer response. The MVT tool then shows the calibrated Taps values in its Property and Value table.

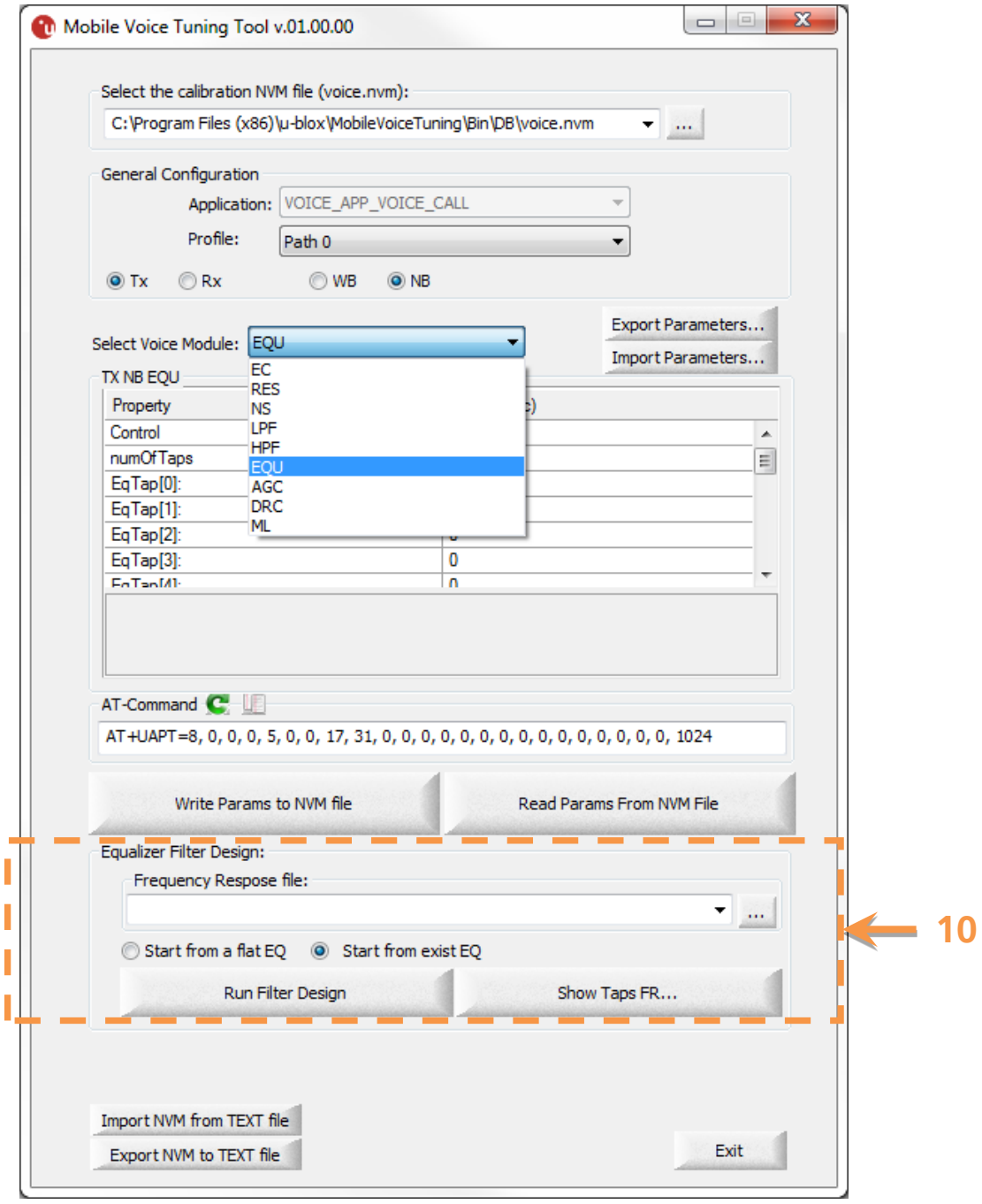
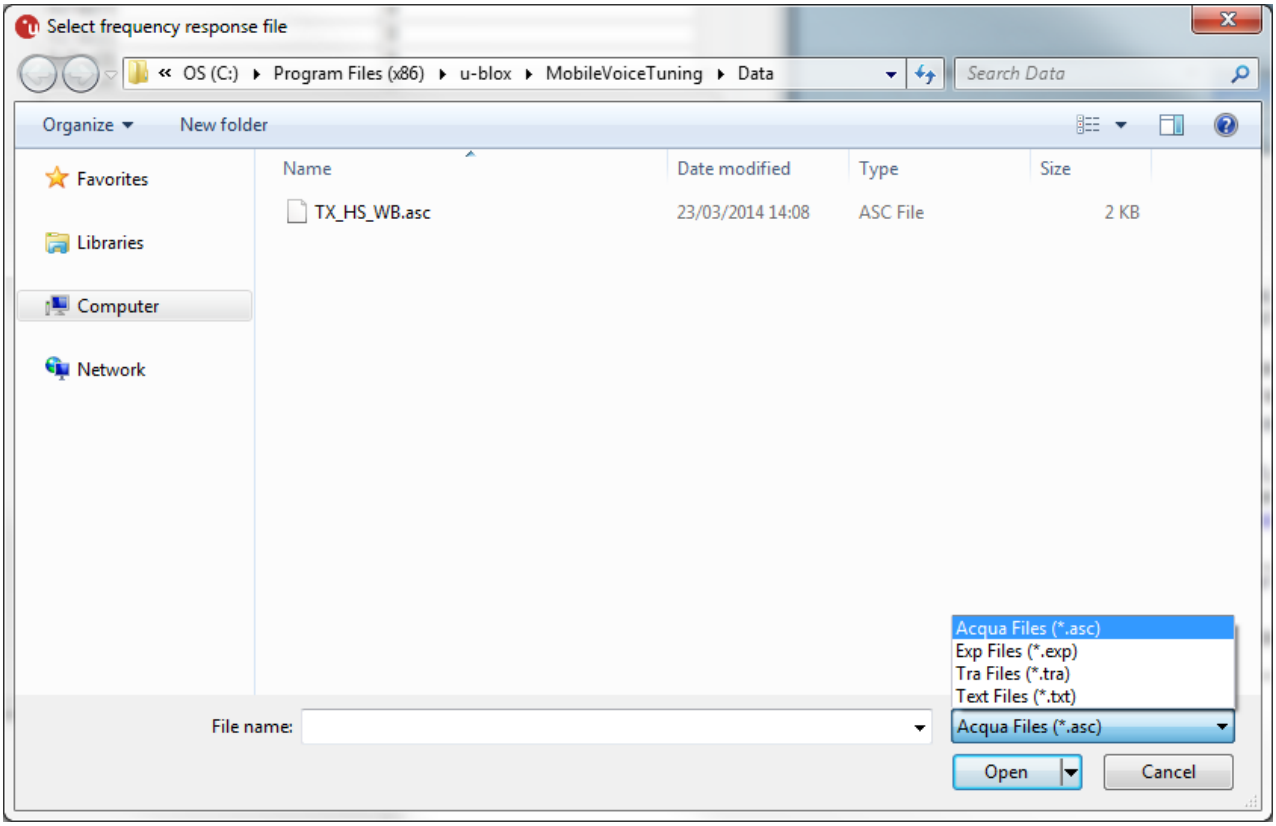


Figure 2: Using the MVT to Tune the Equalizer

This box allows the user to open a previously-defined Frequency Response file. Click the browse button to open the folder. Select a file from the folder.



The MVT tool supports these types of files:

- Acqua (*.asc) - HEAD acoustics equipment format
- Exp (*.exp) - Rohde & Schwarz UPL-16 format
- Tra (*.tra) - Rohde & Schwarz UPV format
- Text (*.txt) - any text editor can write this file. Its format requires 2 columns separated by tabs or spaces where the first (left) column defines frequencies and the second column (right) defines amplitudes.

3. Define how to run the equalizer by initiating a flat-leveled equalizer or by using existing values:
   - Start from Flat EQ - use this option to have the equalizer start with all TAPs set to 0.
   - Start from an Existing EQ - use this option to use pre-defined initial TAP values for the equalizer.
4. Click the Run Filter Design button to run the design using a MATLAB® script embedded in the MVT tool. This environment enables the user to tune the equalizer filter visually.

   See the Visual Equalizer Calibration - Graphic Display for information on how to define the equalizer.

2.2.1 Visual Equalizer Calibration - Graphic Display

Figure 3 provides a graphic representation of the filter design given by the embedded script. Moving the cursor within the graph the x,y coordinates of the cursor are shown in the top part of the graph (6). There are two light-blue bars on the left, that can be used for zooming and shifting in the Y direction (2,3).

Graphs - Color legend

- Red graphs - This is the standard mask; it defines the upper and lower limits of the total frequency response depending on the Tx/Rx path and NB/WB mode.
- Blue boxes - This graph defines the equalizer's frequency response (TX or RX, NB or WB, as selected in the MVT tool).
- Green boxes - This graph defines the total path frequency response of the Tx/Rx, NB or WB path

Use the different **View...** (1) options to show or hide the equalizer response.

Calibrating the Total Path Frequency Response

There are three ways to change the Total Path Frequency Response (green box graph), which in turn defines the equalizer's actual frequency response (blue box graph).

- Use the slider at bottom of the graph (4). This slider includes bars that can be moved up or down, or defined by typing in a number. Each time a bar is moved up or down, the equalizer and total path frequency responses are re-calculated.
- Drag the individual green boxes up or down. Actual filter response (blue boxes) define change in reaction to the updates of the "green-box" graph.
- Use **Load...>Load Desired Response** (1) from the menu line to load a previously defined Total Frequency Response from a saved text file.

Further options

- Align the peak value of the Total Frequency Response to the upper mask (item **5** checkbox)
- Centralize the Frequency Response between the lower and upper masks (item **5** checkbox)

  In either case, the distance between the mask graphs do not change.

Slider positions

You can save your slider positions to a file, or load previously saved slider positions from a file, by using the Save or Load Menu options (1) by using either of the following options:

- **Save...>Save Sliders Positions to File...**
- **Load...>Load Sliders Positions from File...**

When closing this MATLAB® window the final equalizer Taps are automatically saved. Their values are displayed in the MVT tool's Property and Value table (item **5** in Figure 1). You can also Save the equalizer's Taps to a file by using the **Save...>Save Equalizer Taps to File** menu option (1).

☞ This Save does not update the NVM file, see Saving your .

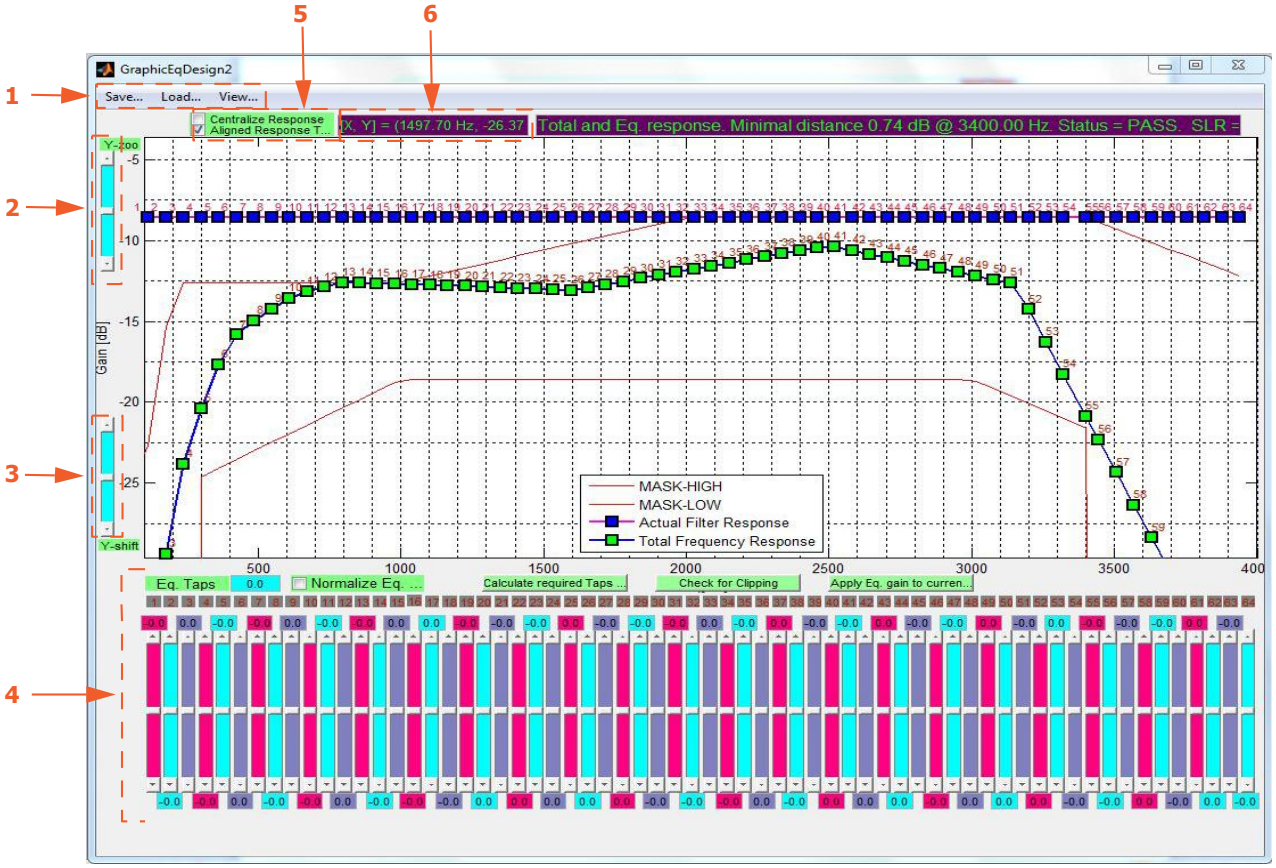


Figure 3: Graphic display of Equalizer Calibration

2.2.2 MVT property and value taps definitions

The MVT tool allows for defining 31 symmetrical Taps as follows:

- EqTap[0] to EqTap[14] can be defined via the tool.
- Since the Taps are symmetrical, EqTap[14] is identical to EqTap[16] and therefore not displayed in the table. Likewise, EqTap[13] is identical to EqTap[17], ..., EqTap[31] is identical to EqTap[0]
- EqTap[15] defines the peak tap

2.2.3 Saving your work

Once you are done calibrating the Taps, click Write Params to to save the final tuned equalizer Tap values to the NVM file.

2.3 Tuning the Bi-Quad filter

1. Select either LPF or HPF as the Selected Voice Module (see Figure 4) to access the filter parameters for your currently selected structure.
2. Once the LPF or HPF is selected, the Bi-Quad Filter Design box opens on the MVT's main panel (see item **11** in Figure 4).

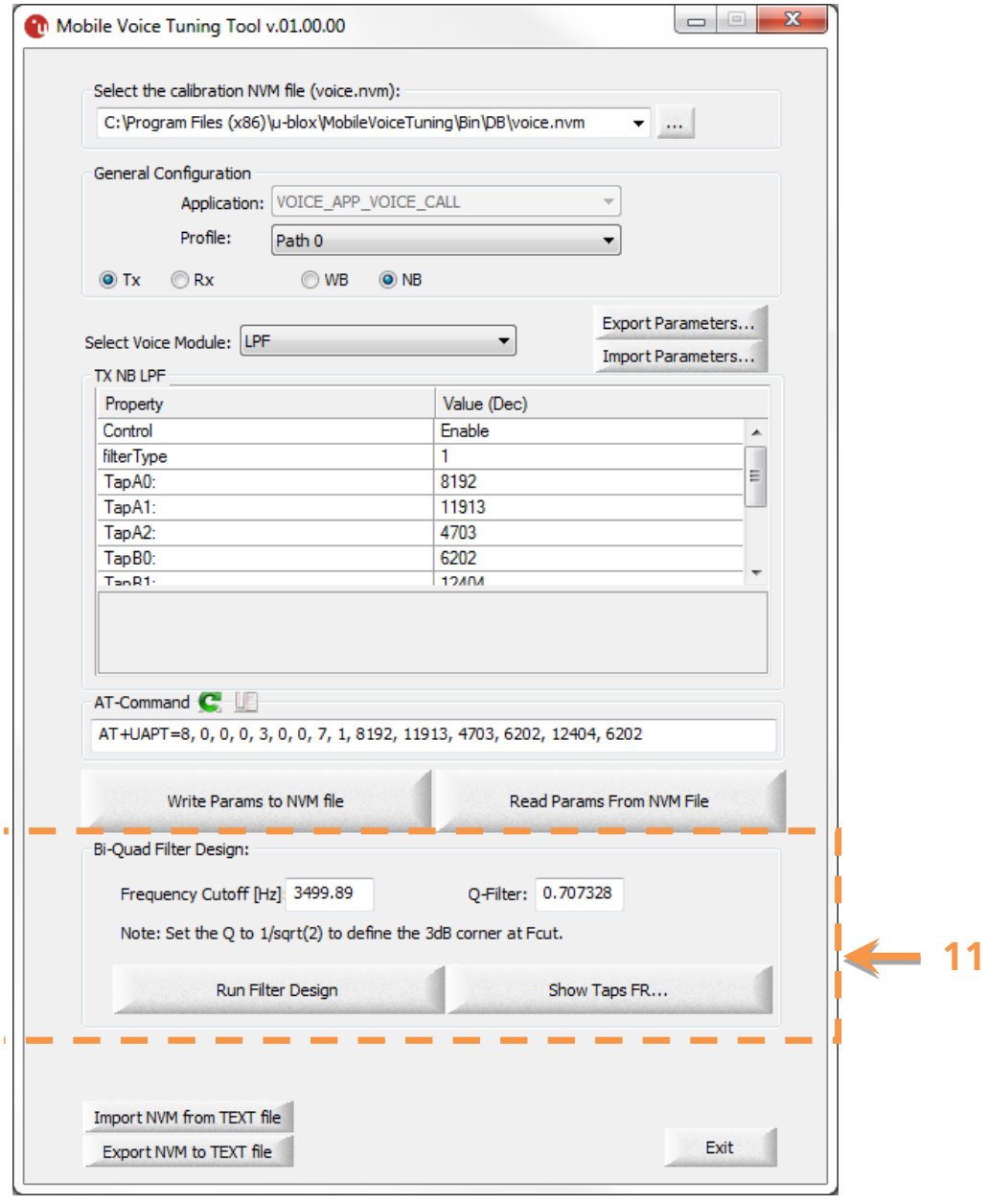
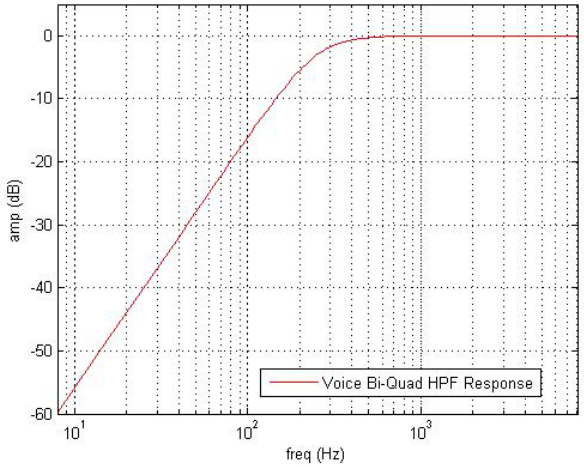


Figure 4: High Pass (HPF) and Low Pass Filter (LPF) Definitions

3. Click Show Taps FR to graphically display the frequency response of the current Taps that are defined in the MVT table list.

4. Define the bi-quad filter's cutoff frequency (in Hz). To filter noise outside of speech frequencies, use the following guidelines, depending on whether you are using a WB or NB filter.
   - Wideband (WB)
     - HPF: 0 to 300 Hz
     - LPF: 7500 to 8000 Hz
   - Narrow Band (NB)
     - HPF: 0 to 300 Hz
     - LPF: 3400 to 4000 Hz
5. Define a Q-Filter floating point between 0 and 1. The Q-Filter factor defines the sharpness of the slope. For a 3 dB attenuation at the cutoff frequency, define Q as the square root of 2 (= 0.707).
6. Click the Run Filter Design to calculate the filter Taps for the defined cutoff frequency and Q-factor. It also continues to graphically display the frequency of the calculated bi-quad Taps, and loads them into the MVT Property and Value table.

   For example, using a WB HPF with a frequency cutoff of 250 and a Q-Filter of 0.7, the graph displays the voice bi-quad HPF response via the embedded Matlab® script:



7. The MVT Property and Value table shows the filter's associated Taps.

☞ For a bi-quad filter, TapA0 is the scaling factor for all the filter Taps, and is defined as 0x1000. Furthermore, TapB0 = TapB2. If these requirements are not met, the filter is not bi-quad, but you can still see a response for the filter.

2.3.1 Saving your work

Once the bi-quad filter and Taps are defined, click the **Write Params to NVM file** button to save the settings in the NVM file.

A List of acronyms

Abbreviation / Term	Explanation / Definition
AGC	Automatic Gain Control
DRC	Dynamic Range Control
EC	Echo Canceller
EQ	Equalizer
FIR	Finite Impulse Response
HPF	High Pass Filter
LPF	Low Pass Filter
ML	Microphone Levels
NB	Narrow Band
NS	Noise Suppressor
RES	Residual Echo Suppression
WB	Wide Band

Related documents

[1] u-blox AT Commands Manual, Docu No UBX-13002752

[2] u-blox TOBY-L2 series Audio Application Note Docu No UBX-15015834

[3] 3GPP TS 51.010-1 Mobile Station (MS) conformance specification; Part 1: Conformance specification

☞ For regular updates to u-blox documentation and to receive product change notifications please register on our homepage.

Revision history

Revision	Date	Name	Status / Comments
R01	03-May-2016	ague	Initial release

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