



Android 6573 Audio Tuning Guide



Agenda

- **Introduction**

- AFE Block Diagram(MT6573)

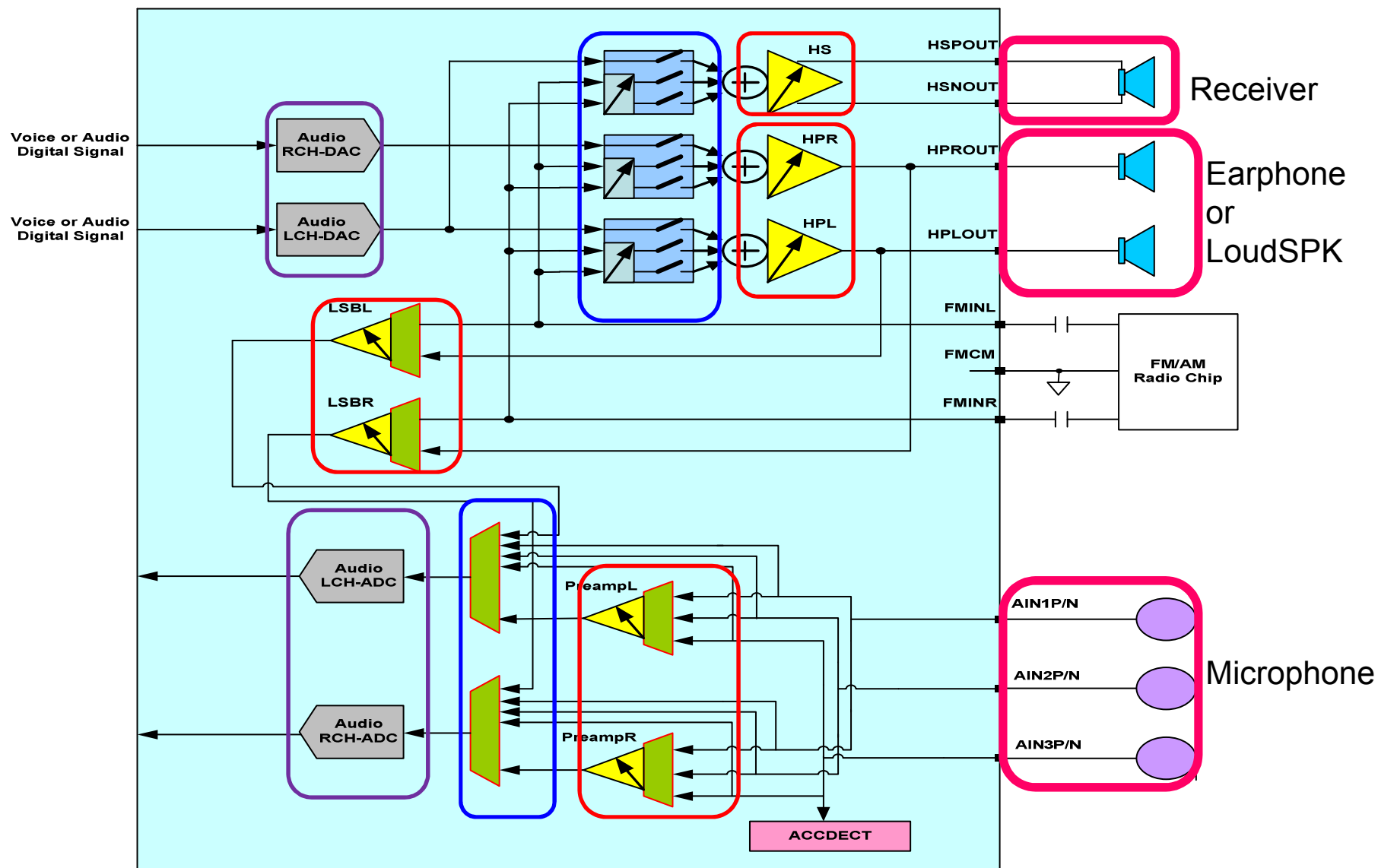
- **Audio Customization**

- Speech Fir&Enhancement parameters
 - Volume Customization design overview.
 - Volume mapping for each stream type.
 - Engineer mode
 - Meta tool

Introduction

- On MT6573, AP side control audio path, MODEM side control speech path. MODEM side works as the slave of AP side.
- AP side send command to MODEM side by CCCI message. All kinds of speech related configuration and control flow are controlled by AP side. Ex: volume setting, speech on/off, mode setting,...

Audio Block Diagram





Audio Customization



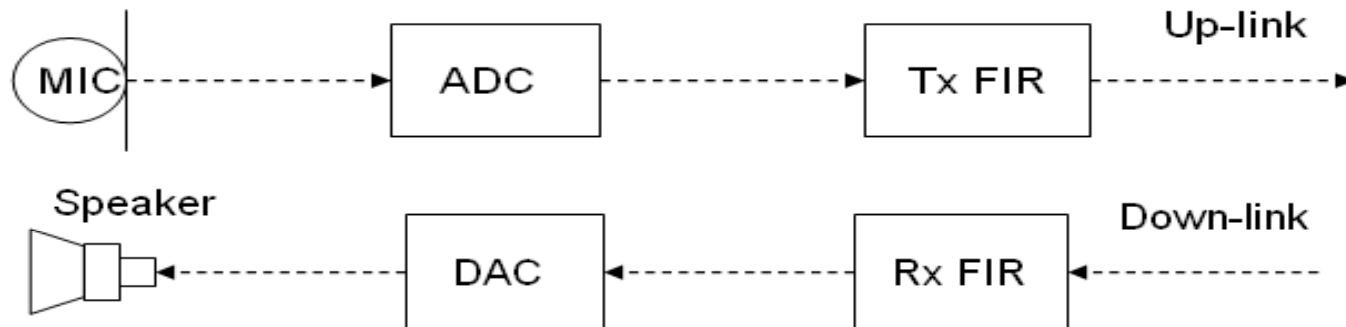
Related Customization files

File Name	Path	Description
CFG_AUDIO_File.h	/mediate/custom/common /cgen/cfgfileinc	Audio data structure definition
CFG_Audio_Default.h	/mediate/custom/common /cgen/cfgdefault	Parameters default values that defined in sph_coeff_default.h/audio_custom.h/med_audio_default.h
sph_coeff_default.h	/mediatek/custom/(%proj)/cgen/inc	Speech enhancement coefficient, W1126MP move this file to /mediatek/custom/common/cgen/inc
audio_custom.h	/mediatek/custom/(%proj)/cgen/inc	TX/RX FIR coefficient Volume(Digital Gain) of different Mode , Normal Headset ...
med_audio_default.h	/mediatek/custom/(%proj)/cgen/inc	Audio and speech volume , android stream type digital gain.
audio_custom_exp.h	/mediatek/custom/(%proj) /hal/audioflinger/audio	Max device gain , Audio parameter, defines
yusu_android_speaker.h	/mediatek/custom/ common/kernel/sound/inc	Speaker turn on/off API Need implement by speaker.c
yusu_android_speaker.c	/mediatek/custom/(%proj)/ kernel/sound/speaker	Implementation of turn on/off speaker.

Speech FIR&Enhancement Parameters

■ Speech setting Tx/Rx FIR.

- Currently, Tx/Rx FIR are stored in NVRAM. The data structure is the same as feature phone.



■ The ways of modifying FIR.

- Using SP Meta Tool.
- Modify the source code:

`\mediatek\custom\[project]\cgen\inc\Audio_custom.h`

Speech FIR&Enhancement Parameters

■ Speech Enhancement Mode Parameters.

- Currently, Parameters are stored in NVRAM. The data structure is the same as feature phone.
- Different speech enhancement algorithms are applied to different modes respectively. These algorithms are controlled by speech mode parameters

Mode Parameters	Meaning
audio_custom_param.speech_mode_para[0][8]	Normal-mode speech enhancement parameters
audio_custom_param.speech_mode_para[1][8]	Earphone-mode speech enhancement parameters
audio_custom_param.speech_mode_para[2][8]	Loudspeaker-mode speech enhancement parameters
audio_custom_param.speech_mode_para[3][8]	BT earphone-mode speech enhancement parameters
audio_custom_param.speech_mode_para[4][8]	BT cordless-mode speech enhancement parameters
audio_custom_param.speech_mode_para[5][8]	Car-kit speech enhancement parameters
audio_custom_param.speech_mode_para[6][8]	Reserved for future use
audio_custom_param.speech_mode_para[7][8]	Reserved for future use

■ The ways of modifying Parameters.

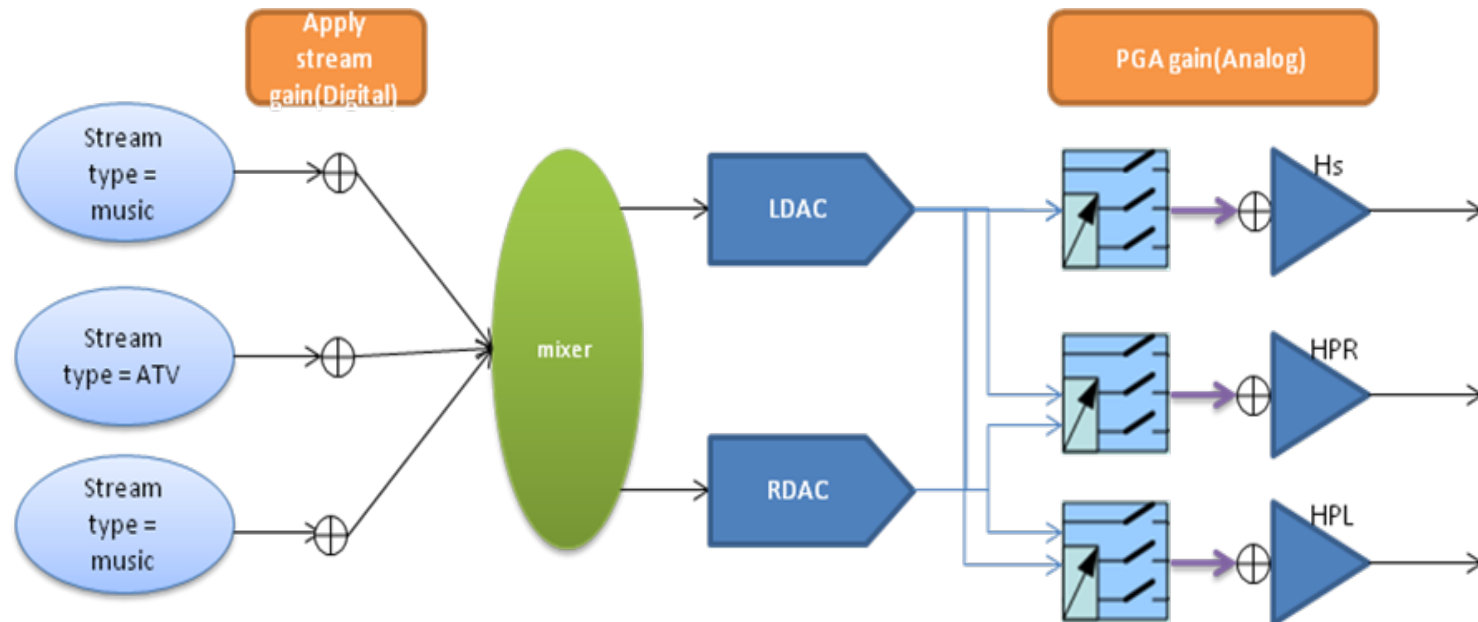
- Using SP Meta Tool.
- Using Engineer Mode.
- Modify the source code:

`\mediatek\custom\[project]\cgen\inc\sph_coeff_default.h`

Volume Customization design overview

■ Audio signal path.

- We could use Digital gain by stream type index.
- We also could use PGA gain for all the stream types that they go through this PGA.



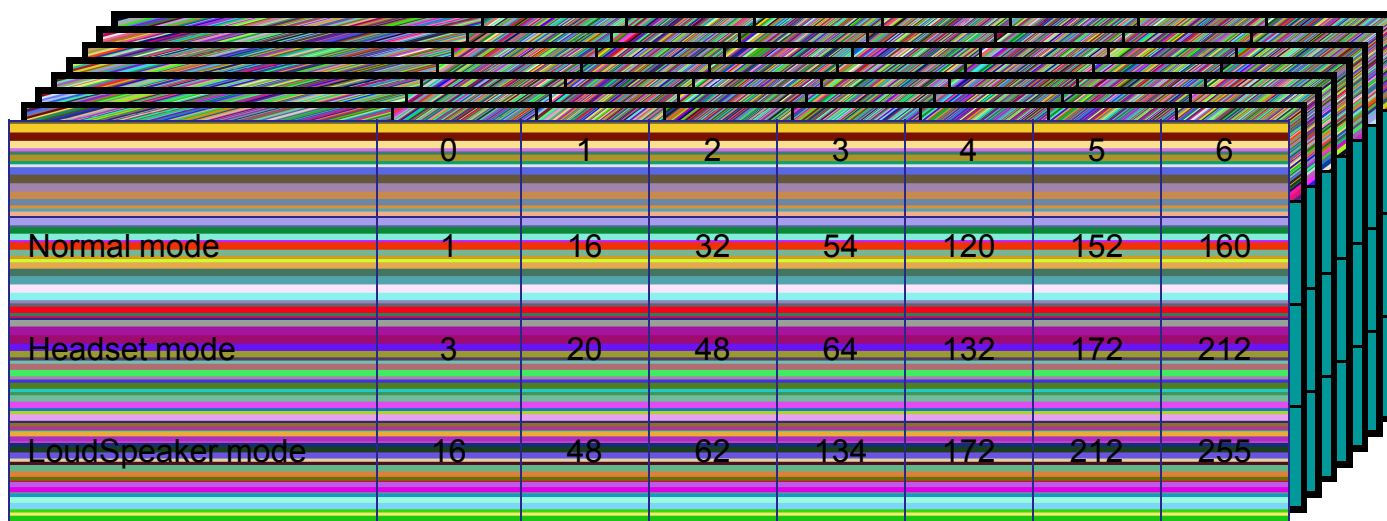
Volume Customization design overview

- AUD_VOLUME_RING(0)
 - It's only for the Stream type of RING.(the ring tone of incoming call)
- AUD_VOLUME_KEY(1)
 - Actually used for communication mode downlink volume.(VOIP call)
- AUD_VOLUME_MIC(2)
 - microphone input volume
- AUD_VOLUME_FMR (3)
 - FM radio output sound volume
- AUD_VOLUME_SPH (4)
 - Normal speech sound (downlink speech volume)
- AUD_VOLUME_SID (5)
 - side tone (loop-back sound in call)
- AUD_VOLUME_MEDIA (6)
 - Music, actually many audio is played as MUSIC, such as the tone in dial screen.
- AUD_VOLUME_MATV (7)
 - MATV, only MATV will use these parameters.

```
AUDIO_VOLUME_CUSTOM_STRUCT audio_volume_custom_default = {  
    AUD_VOLUME_RING,  
    AUD_VOLUME_KEY,  
    AUD_VOLUME_MIC,  
    AUD_VOLUME_FMR,  
    AUD_VOLUME_SPH,  
    AUD_VOLUME_SID,  
    AUD_VOLUME_MEDIA,  
    AUD_VOLUME_MATV  
};
```

Audio volume custom structure

- Each volume type supports 3 modes
 - Normal mode
 - Headset mode
 - LoudSpeaker mode
- And each mode supports 7 level steps (0-6)



	0	1	2	3	4	5	6
Normal mode	1	16	32	54	120	152	160
Headset mode	3	20	48	64	132	172	212
LoudSpeaker mode	16	48	62	134	172	212	255

Volume mapping for each stream type

—Ring

■ RingVolume customize

- Only use Handsfree mode 7 level for digital volume
- Ringtone mode max analog volume is with value Media/Normal mode[6](refer Page13 Media)

	0	1	2	3	4	5	6
Normal mode	1	16	32	54	120	152	160
Headset mode	3	20	48	64	132	144	152
Hands-free mode	0	48	62	134	172	212	255

Volume mapping for each stream type

—— Fm and MATV

■ FM Volume customize

- Handsfree mode 7 level for digital volume , output device speaker
- Handset mode 7 level for digital volume , output device headset
- **There is no normal mode for FM Radio.**

	0	1	2	3	4	5	6
Normal mode	1	16	32	54	120	152	160
Headset mode	3	20	48	64	132	172	212
Hands-free mode	0	48	62	134	172	212	255

Volume mapping for each stream type

—— Music

■ Music Volume customize

- Handsfree mode 7 level for digital volume , output device speaker
- Headset mode 7 level for digital volume , output device headset.
- Normal mode(means **AudioSystem::MODE_NORMAL**) speaker's maximum analog gain➔ Normal mode[6]
- Normal mode(means **AudioSystem::MODE_NORMAL**) headset's maximum analog gain➔ Normal mode[5]

	0	1	2	3	4	5	6
Normal mode	1	16	32	54	120	160	160
Headset mode	3	20	48	64	132	172	212
Hands-free mode	0	48	62	134	172	212	255

Volume mapping for each stream type

—— Speech

■ Voice Volume customize

- When **AudioSystem::MODE_IN_CALL** mode . All step define analog gain.
- Use gain mapping table refer to the appendix.

	0	1	2	3	4	5	6
Normal mode	0	16	32	54	120	152	160
Headset mode	0	20	48	64	100	130	152
Hands-free mode	0	48	62	134	142	150	172

Volume mapping for each stream type

—— Microphone gain

■ Incall microphone gain

- Normal → Normal[3]
- Headset → headset[3]
- Handsfree → handsfree[3]

■ Idle

- Headset → Headset [4]
- Handsfree → Handsfree[4]

■ TTY mode → normal[0]

	0	1	2	3	4	5	6
Normal mode	64	16	32	192	192	160	168
Headset mode	0	20	48	192	192	130	152
Hands-free mode	0	48	62	192	192	150	172

Volume mapping for each stream type

—— Sidetone

■ Sidetone gain

- Normal → Normal[3]
- Headset → headset[3]
- Handsfree → handsFree[3]

	0	1	2	3	4	5	6
Normal mode	0	16	32	32	120	160	0
Headset mode	0	20	48	0	100	130	0
Hands-free mode	0	48	62	0	142	150	0

Engineer Mode 1

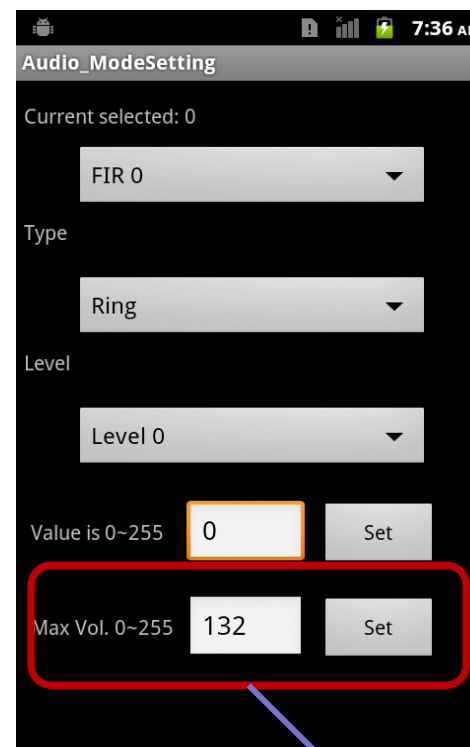
Mapping to Source code

What is the Max Volume?

Actually it is the analog gain for each out put path(headset/earpiece/Speaker).

Android change these gain only when:1, mode change(e.g. ring tone->in call);2,device changed.

It means that analog gain will not be changed while changing the volume level in APP(only digital gain changed) except in MODE_IN_CALL. In the mode of MODE_IN_CALL, we change the analog gain directly.



Because there is no normal mode for music(only headset & handsfree mode),so we define these 3 parameters as the max volume for different mode.

	0	1	2	3	4	5	6
Media							
Normal mode	1	16	32	54	120	148	148
Headset mode	3	20	48	64	132	172	152
Hands-free mode	0	48	62	134	172	212	255

Meta tool 1-custom volume

Mapping to Engineer Mode

Custom volume setting | Quick Speech Tuning

Normal | Headset | Handfree

7 Level

Volume Gain

Tone | Key Tone | Microphone | FM | Speech | Side Tone | Media | MATV

Media

Level 0	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
100	148	148	148	132	0	148

Volume 132

Audio_ModeSetting

Current selected: 0

FIR 0

Type

Ring

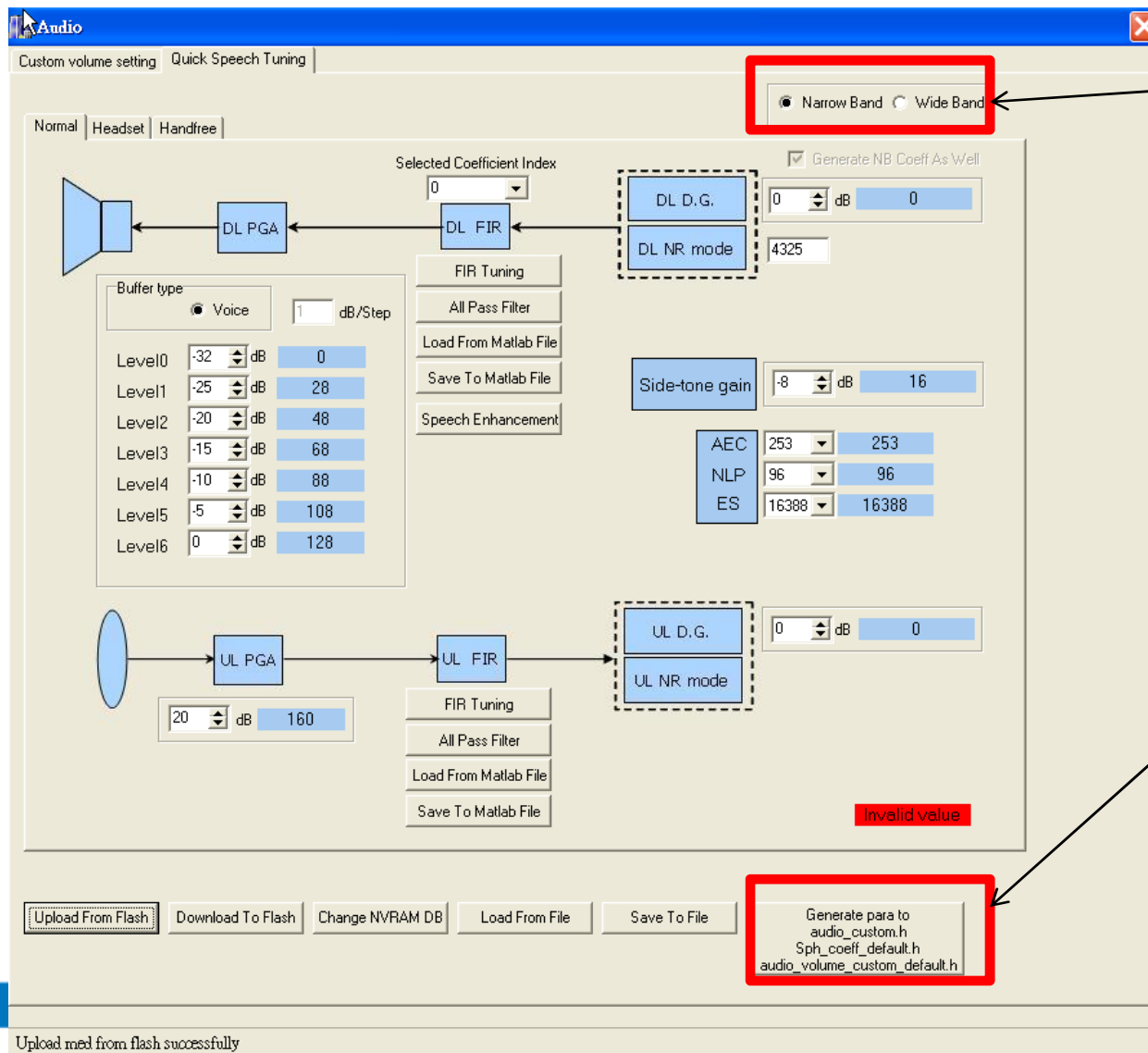
Level

Level 0

Value is 0~255 0 Set

Max Vol. 0~255 132 Set

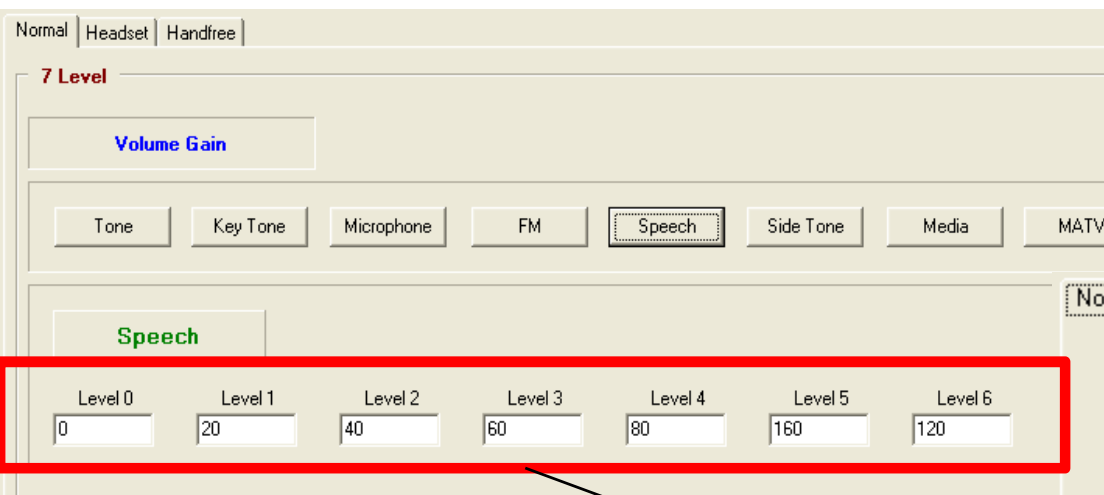
Meta tool 2-quick speech tuning



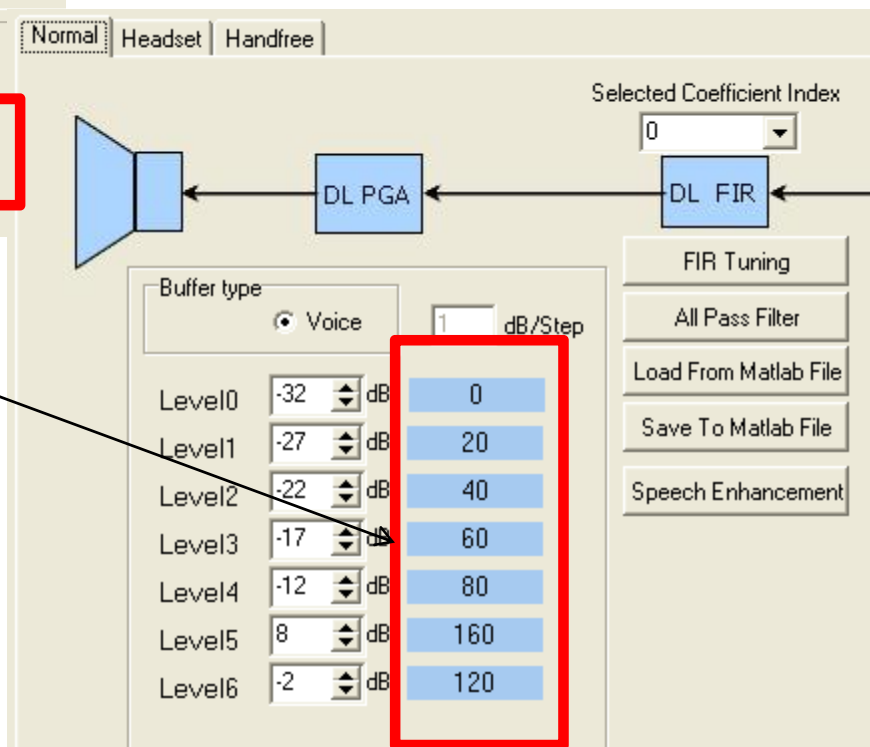
Fro Narrow Band/Wide Band choose

Generate File:
Audio_Custom.h
Sph_coeff_default.h
Audio_Volume_cust
om_default.h

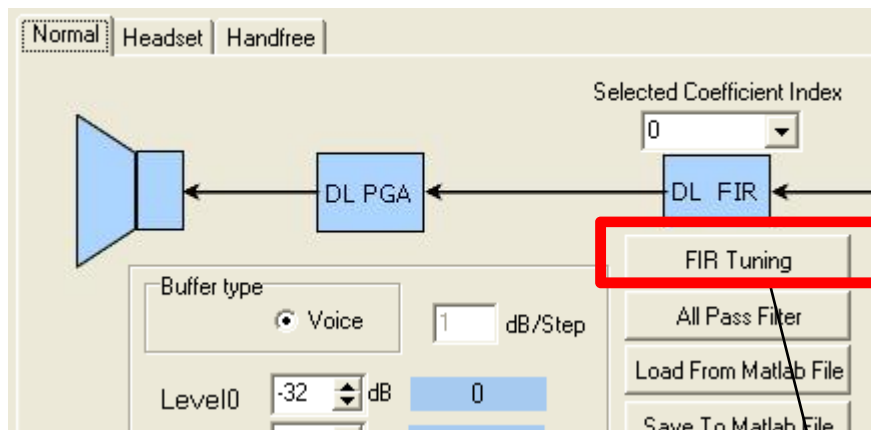
Meta tool 2-quick speech tuning



How to map the volume gain?
Please refer to the Appendix.



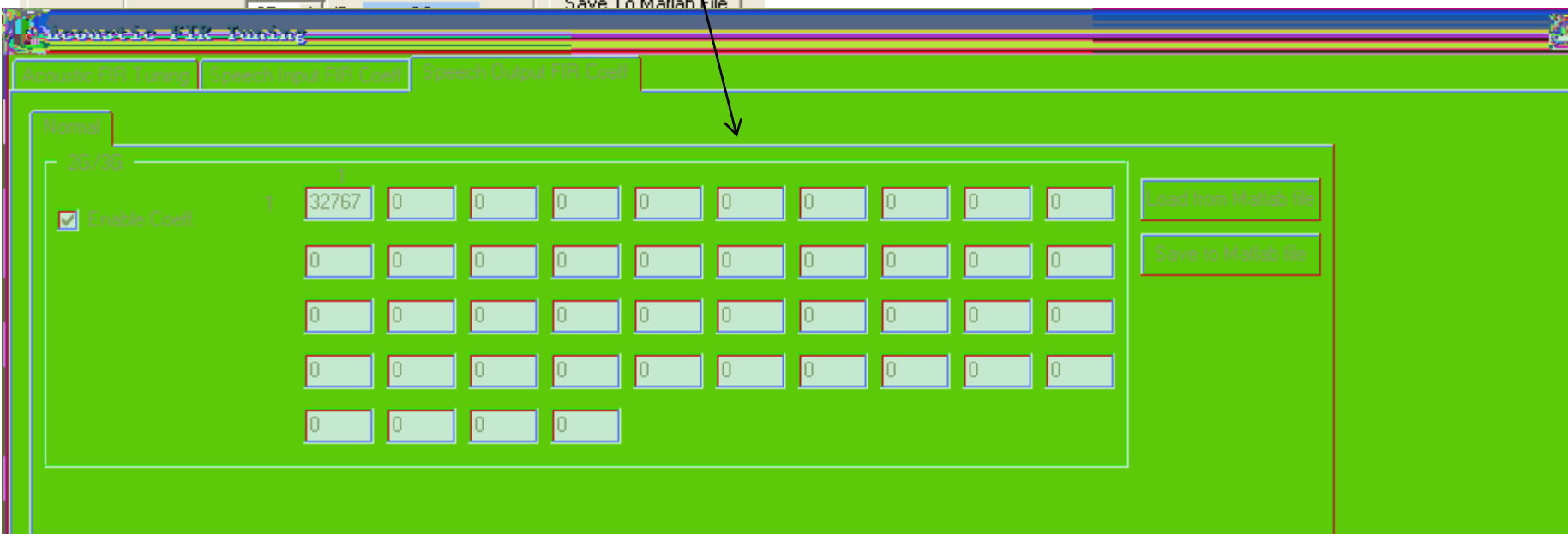
Meta tool 3-FIR tuning



Choose Normal/Headset/HandFree Mode;

Select DL FIR index. There are 6 DL FIR can be selected for each mode

FIR parameter tuning please refer to the appendix 2.



Others

——External amplifier&Headset

- Change file list

File Path :

alps\mtk\src\custom\[Project Name]\kernel\sound\speaker\ yusu_android_speaker.c

- API
 - void Sound_Speaker_Turnon(int channel); //turn on loudspeaker
 - void Sound_Speaker_Turnoff(int channel); // turn off loudspeaker
 - void Sound_Headset_Turnon(void); // turn on headset amp
 - void Sound_Headset_Turnoff(void);// turn off headset amp
- These API are called by sound driver to turn on/off loud speaker when loud speaker mode.

MEDIATEK

Thanks.

www.mediatek.com



Appendix1. Analog gain range and setting in NVRAM setting

DL (Voice/ Audio buffer)

Gain range	NVRAM setting	Gain range	NVRAM setting	Gain range	NVRAM setting
8dB	160	-6dB	104	-20dB	48
7dB	156	-7dB	100	-21dB	44
6dB	152	-8dB	96	-22dB	40
5dB	148	-9dB	92	-23dB	36
4dB	144	-10dB	88	-24dB	32
3dB	140	-11dB	84	-25dB	28
2dB	136	-12dB	80	-26dB	24
1dB	132	-13dB	76	-27dB	20
0dB	128	-14dB	72	-28dB	16
-1dB	124	-15dB	68	-29dB	12
-2dB	120	-16dB	64	-30dB	8
-3dB	116	-17dB	60	-31dB	4
-4dB	112	-18dB	56	-32dB	0
-5dB	108	-19dB	52		

The maximum allowable DL PGA gain is 5dB w/o distortion

The suggested UL PGA gain is 34dB

UL

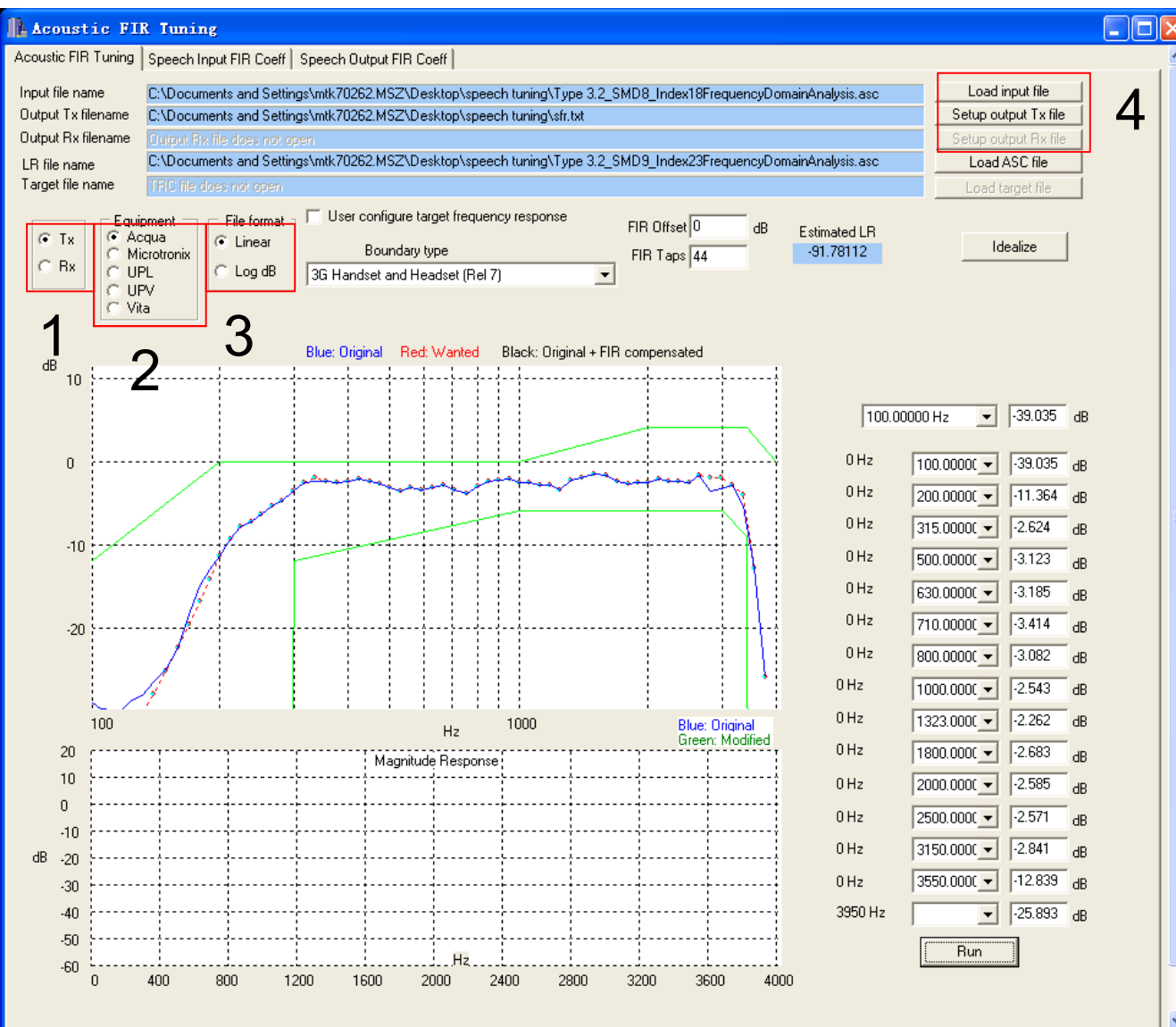
Gain range	NVRAM setting	Gain range	NVRAM setting	Gain range	NVRAM setting
49dB	252	27dB	164	5dB	76
48dB	248	26dB	160	4dB	72
47dB	244	25dB	156	3dB	68
46dB	240	24dB	152	2dB	64
45dB	236	23dB	148	1dB	60
44dB	232	22dB	144	0dB	56
43dB	228	21dB	140	-1dB	52
42dB	224	20dB	136	-2dB	48
41dB	220	19dB	132	-3dB	44
40dB	216	18dB	128	-4dB	40
39dB	212	17dB	124	-5dB	36
38dB	208	16dB	120	-6dB	32
37dB	204	15dB	116	-7dB	28
36dB	200	14dB	112	-8dB	24
35dB	196	13dB	108	-9dB	20
34dB	192	12dB	104	-10dB	16
33dB	188	11dB	100	-11dB	12
32dB	184	10dB	96	-12dB	8
31dB	180	9dB	92	-13dB	4
30dB	176	8dB	88	-14dB	0
29dB	172	7dB	84		
28dB	168	6dB	80		

Appendix1. Digital gain range and setting in NVRAM setting

- The formula of calculating the digital gain is
 - $\text{Digital gain} = 20 \log \left(\frac{\text{NVRAM setting}}{255} \right)$
- The mapping table is as below

Gain range	NVRAM setting	Gain range	NVRAM setting
0dB	255	-28dB	10
-2dB	208	-30dB	8
-4dB	161	-32dB	6
-6dB	128	-34dB	5
-8dB	102	-36dB	4
-10dB	81	-38dB	3
-12dB	64	-42dB	2
-14dB	51	-46dB	1
-16dB	40		
-18dB	32		
-20dB	26		
-22dB	20		
-24dB	16		
-26dB	13		

Appendix2 FIR tuning

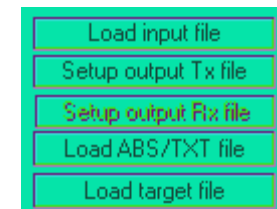
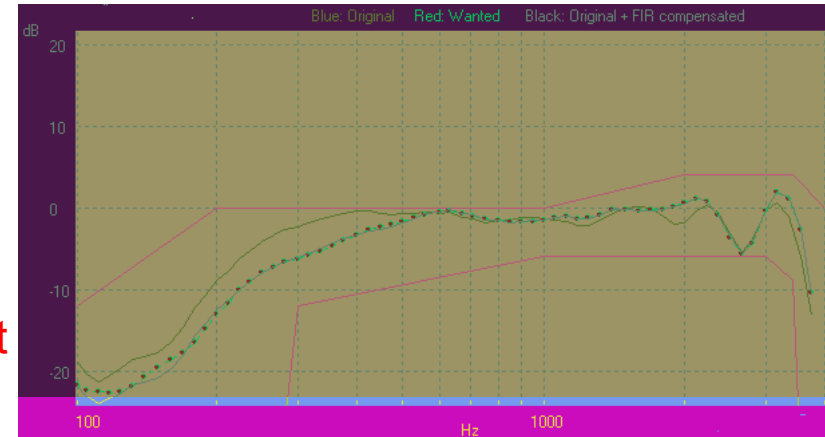


4 according to the following step

1. If tune UL choose TX; if tune DL, please choose RX
2. Choose Equipment Acqua or UPV ext.
3. If use Acqua, It must be the same settings as in Acqua (linear or log)
4. Load the input file and define output file name in "txt"

Appendix2 FIR Tuning

- Load input file
 - Load the trc file (generated by UPL) / txt file (modified the file generated by ACQUA), **Blue-line in the right figure**
- Load target file
 - META can approach this target curve by pressing “Run”, **Dot-line in the right figure**
- Setup output Tx/Rx file
 - Save the generated FIR coefficient to the specified file
- Load ABS/TXT file
 - Load the abs file (generated by UPL) / txt file (modified the file generated by ACQUA)
 - This file is used to calculate the SLR/RLR before or after applying the FIR



Appendix2 FIR Tuning

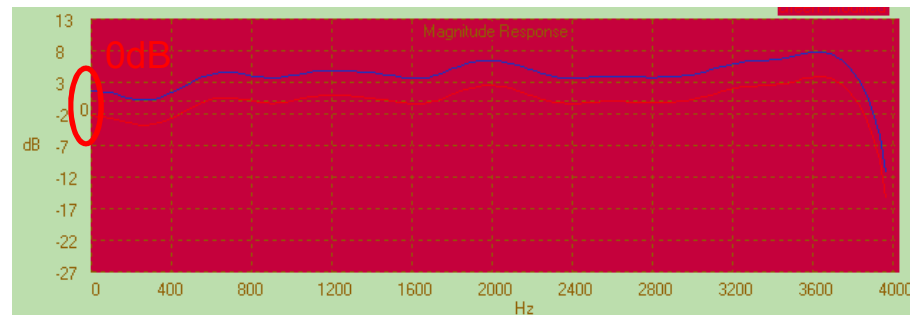
- Tx/Rx
 - Select Tx/Rx path
 - “Setup output Tx file” will be disable while Rx is select, vice versa
- Equipment
 - Select the equipment
 - The equipment should be correctly selected or some functions will malfunction
- Boundary type
 - Select the preferred mask
- Estimated LR
 - The LR (loudness ratio) will be automatically estimated after you press “Run” button
- Ideal
 - The “Ideal” means the target curve is the average of the upper limited + lower limited
 - The “Load target file” is the extended feature of the “Ideal”

The screenshot displays the FIR Tuning software interface with the following elements:

- Tx/Rx Selection:** Radio buttons for Tx (selected) and Rx.
- Equipment Selection:** Radio buttons for Acqua (selected), Microtronix, UPL, UPV, and Vita.
- File format:** Radio buttons for Linear (selected) and Log dB.
- Boundary type:** A dropdown menu showing "3G Handset and Headset (Rel 7)".
- Estimated LR:** A green box displaying the value "7.66168".
- Idealize Button:** A blue button labeled "Idealize".

Appendix2 FIR Tuning

- FIR offset
 - User can offset FIR gain
 - The target is the gain below the 1kHz should be under / equal to 0dB
 - Figure at the right side shows the original FIR (blue one), and the FIR which is offset -4dB (red one)
 - Note: the SLR/RLR will be changed if offset is set
- FIR Taps
 - Use 44 (For Narrow Band) or 90 (for Wide Band) taps to implement the FIR



FIR Offset	<input type="text" value="0"/>	dB
FIR Taps	<input type="text" value="44"/>	