

MSD6AxxxAxx **All-In-One DTV Processor**

Audio Application Note Version 0.1

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REVISION HISTORY

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1. AUDIO DESIGN GUIDE

1.1. Introduction

1.1.1 Audio Features

Audio features supported in MSD6AxxxAxx:

- Supports BTSC/A2 demodulation in NTSC and A2/NICAM/FM/AM demodulation in PAL
- Supports MTS Mono/Stereo/SAP in BTSC and Mono/Stereo/Dual in A2/NICAM
- Supports digital audio format decoding:
 - MPEG-1, MPEG-2 (Layer I/II), MP3
 - AC-3 (Dolby Digital)
 - E-AC-3 (Dolby Digital Plus) decoding and E-AC-3 to AC-3 conversion at the same time
 - WMA, WMA PRO
 - HE-AAC v1/v2 decoding
 - DTS
 - FLAC
 - DRA
 - Vorbis
 - Realaudio (Cook)
 - XPCM (LPCM, A/mu-law, IMA/MS-ADPCM)

1.1.2 Input Interface

- Stereo (L/R) Line-in x 5
- Stereo (L/R) audio ADC x 2
- Stereo differential MIC input x 2
- HDMI Rx for both PCM and non-PCM format
- SPDIF digital input (IEC 60958 or IEC 61937 format) x 1

1.1.3 Output Interface

- Stereo (L/R) audio DAC x 4
 - 3 stereo analog audio outputs
 - 1 stereo headphone drive DAC output
- SPDIF digital output (IEC 60958 or IEC 61937 format) x 1
- Master I2S x 1
- HDMI 1.4 ARC (Audio Return Channel) using 2nd SPDIF output

1.2. Audio Diagram

The MSD6AxxxAxx audio block diagram is shown as below:

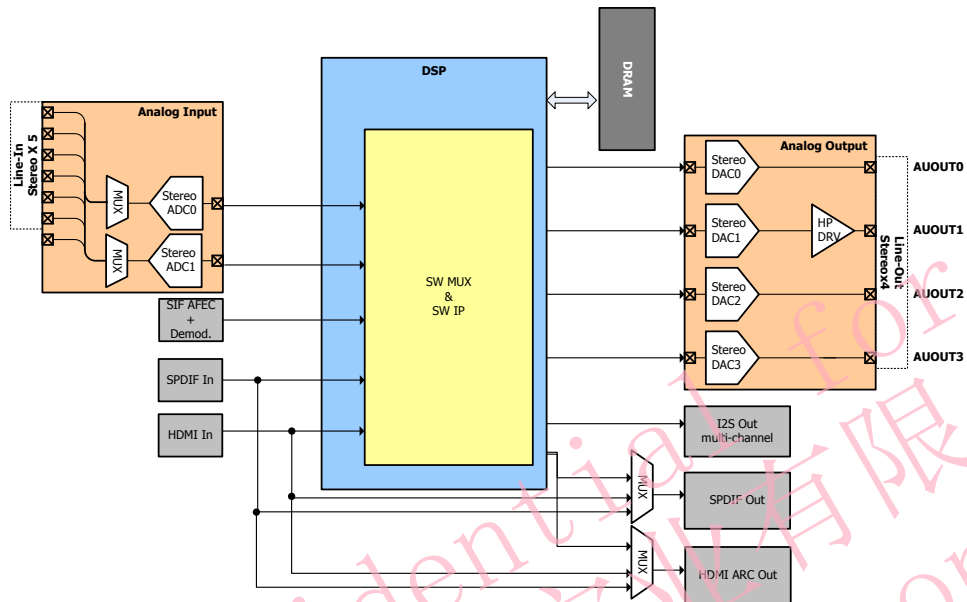


Figure 1: Audio Block Diagram

1.2.1 Audio Tasks

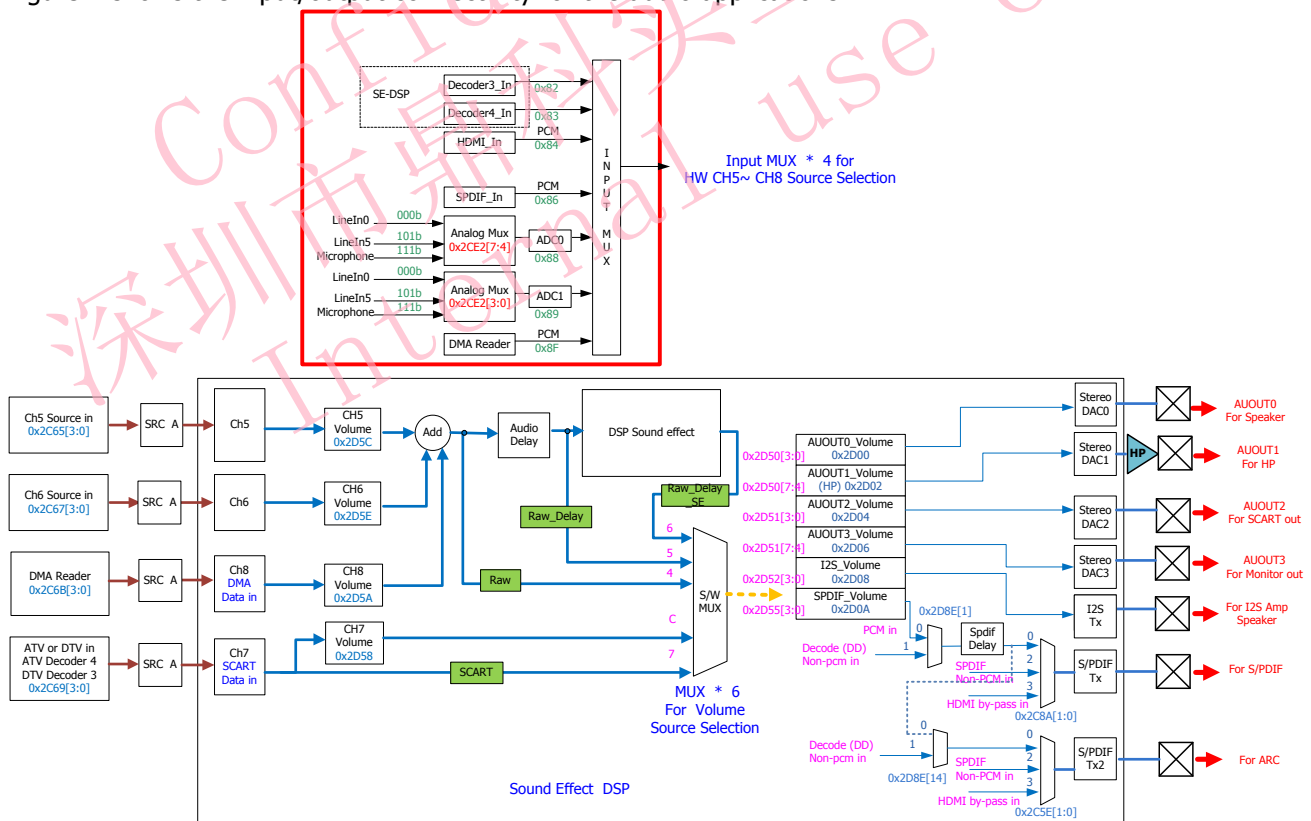
There is a single DSP in the MSD6AxxxAxx for different tasks. Sound effect tasks (volume, prescale, audio delay....) and decoder tasks (SIF, AC3, MP3...) are handled by the DSP.

1.2.2 Audio Path Configuration

There are six output paths in the MSD6AxxxAxx. MStar suggests applying the following configuration:

- AUOUT0
 - If there is no I2S DAC for speaker out, customers could use this as speaker output.
- AUOUT1
 - For headphone output only.
- AUOUT2
 - This could be configured as line-out or SCART output.
- AUOUT3
 - This could be configured as line-out or SCART output.
- I2S
 - Customers could select this for speaker output while there is an I2S DAC for the speaker.
- SPDIF
 - This is for SPDIF PCM/non-PCM output path.

Figure 2 shows the input/output connectivity for the audio applications:



1.2.3 Sound Effect Register Definition

The sound effect path is shown as below:

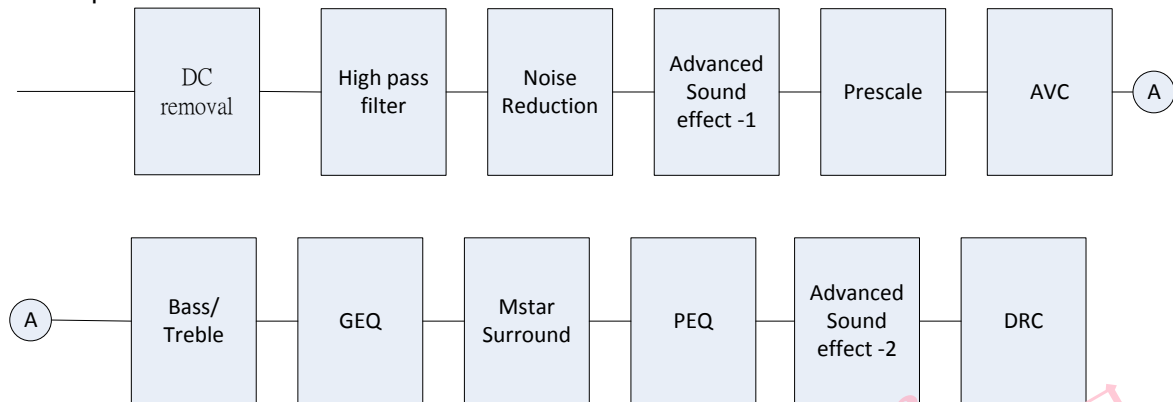


Figure 3: Sound Effect Flow

Advanced Sound Effect

The MSD6AxxxAxx supports the following advanced sound effects:

- SRS TSXT
- SRS TSHD
- SRS PureSound

Noise Reduction

Noise Reduction (NR) is used to cancel the noise floor caused by the PCB board. The threshold value depends on different board condition. Please check 0x112D32[7:0] for more details.

Mode Select

The mode select is used to allow the user to select the speaker output configuration. MSD6AxxxAxx provides 4 different speaker output configurations at this mode. Please check 0x112D30[1:0] for more details.

Pre-scale

Pre-scale feature is used to fine-tune the output speaker/line-out/SCART level. The user should be careful while adjusting pre-scale and not to induce the digital PCM into saturation at this state. The step-size of the pre-scale feature is 0.125db pre step and the adjustment range is from -13.75db to +18db. Please refer to 0x112D10[15:0] for more details.

Auto Volume Control (AVC)

The AVC feature is used to clip the AVC output to one specific level. There are three parameters available for adjustment in AVC algorithm.

- Clipping level
- Attach time
- Release time

Please refer to 0x112D24 for more details. There are three modes in MStar chip, L-mode, S-mode and M-mode. AVC feature is also called auto volume level (AVL). Please refer to the Audio Precision measurement for more details.

Bass/Treble

Please refer to 0x112D14[7:0] and 0x112D16[7:0] for more details.

Graphical Equalizer (GEQ)

Please refer to 0x112D14[15:8], 0x112D16[15:8], 0x112D18[15:8], 0x112D1A [15:8] and 0x112D1C [15:8] for more details.

Surround

The MSD6AxxxAxx provides one surround algorithm in it. There are pseudo-stereo and delay line blocks to achieve this surround feature. There are some parameters available for adjustment in this feature. Please refer to 0x112D16 for more details.

Volume/Balance

There is one specific volume control register for each audio output channels (AUOUT0 ~ AUOUT3, I2S out and SPIDF PCM out). Please refer to 0x112D00 ~ 0x112D0A for more details.

Parametric Equalizer (PEQ)

This feature needs MStar PEQ tool to set PEQ coefficients. The address of PEQ parameters is (0x1910), and the PEQ band number is 8 bands for PEQ tool tuning.

Dynamic Range Control (DRC)

The DRC feature is used to clip the Sound effect output to one specific level. There is one parameter for adjustment in DRC algorithm.

- Clipping level

Please refer to the 0x112D2E for more details.

High pass filter(HPF)

The HPF is used to filter out the low frequency component of the signal, and cut-off frequency (fc) of High pass filter is 100Hz. Please refer to the 0x112D20[2] HPF Enable/Disable for more details.

Table 1: Sound Effect Register Table

Audio Sound Effect Register (Bank = 112Dh)				
Index	Mnemonic	Bit	Description	
112D00h	AUOUT0_Volume	15:0	Default : 0x00	Access : R/W
	AUOUT0_Mute	15	Software mute for AUOUT0 Channel 0 = normal 1 = mute	
	AUOUT0_Integer_Volume	14:8	AUOUT0 Volume Integer Control Reg. Volume table with -1db per step. Gain setting = 12db – N * 1.0db (+12db ~ -114db) N = 0x00 ~ 0x0B (+12 db ~ +1 db) N = 0x0C (0db) N = 0x0D ~ 0x7E (-1 db ~ -114 db)	

Audio Sound Effect Register (Bank = 112Dh)			
Index	Mnemonic	Bit	Description
			N = 0x7F (mute)
	AUOUT0_Frac_Volume	7:5	AUOUT0 Volume Fractional Control Reg. Volume table with -0.125 db per step. N = h'000, 0db N = h'001, -0.125 db N = h'010, -0.250 db N = h'011, -0.375 db N = h'100, -0.500 db N = h'101, -0.625 db N = h'110, -0.750 db N = h'111, -0.875 db
	Reserved	4:0	Reserved
112D02h	AUOUT1_Volume	15:0	Default : 0x00 Access : R/W
	AUOUT1_Mute	15	Software mute for AUOUT1 Channel (HeadPhone output) 0 = normal 1 = mute
	AUOUT1_Integer_Volume	14:8	AUOUT1 Volume Integer Control Reg. Volume table with -1db per step. Gain setting = 12db – N * 1.0db (+12db ~ -114db) N = 0x00 ~ 0x0B (+12 db ~ +1 db) N = 0x0C (0db) N = 0x0D ~ 0x7E (-1 db ~ -114 db) N = 0x7F (mute)
	AUOUT1_Frac_Volume	7:5	AUOUT1 Volume Fractional Control Reg. Volume table with -0.125 db per step. N = h'000, 0db N = h'001, -0.125 db N = h'010, -0.250 db N = h'011, -0.375 db N = h'100, -0.500 db N = h'101, -0.625 db N = h'110, -0.750 db N = h'111, -0.875 db
	Reserved	4:0	Reserved
112D04h	AUOUT2_Volume	15:0	Default : 0x00 Access : R/W
	AUOUT2_Mute	15	Software mute for AUOUT2 Channel 0 = normal 1 = mute
	AUOUT2_Integer_Volume	14:8	AUOUT2 Volume Integer Control Reg. Volume table with -1db per step. Gain setting = 12db – N * 1.0db (+12db ~ -114db) N = 0x00 ~ 0x0B (+12 db ~ +1 db) N = 0x0C (0db) N = 0x0D ~ 0x7E (-1 db ~ -114 db)

Audio Sound Effect Register (Bank = 112Dh)				
Index	Mnemonic	Bit	Description	
			N = 0x7F (mute)	
	AUOUT2_Frac_Volume	7:5	AUOUT2 Volume Fractional Control Reg. Volume table with -0.125 db per step. N = h'000, 0db N = h'001, -0.125 db N = h'010, -0.250 db N = h'011, -0.375 db N = h'100, -0.500 db N = h'101, -0.625 db N = h'110, -0.750 db N = h'111, -0.875 db	
	Reserved	4:0	Reserved	
112D06h	AUOUT3_Volume	15:0	Default : 0x00	Access : R/W
	AUOUT3_Mute	15	Software mute for AUOUT3 Channel 0 = normal 1 = mute	
	AUOUT3_Integer_Volume	14:8	AUOUT3 Volume Integer Control Reg. Volume table with -1db per step. Gain setting = 12db – N * 1.0db (+12db ~ -114db) N = 0x00 ~ 0x0B (+12 db ~ +1 db) N = 0x0C (0db) N = 0x0D ~ 0x7E (-1 db ~ -114 db) N = 0x7F (mute)	
	AUOUT3_Frac_Volume	7:5	AUOUT3 Volume Fractional Control Reg. Volume table with -0.125 db per step. N = h'000, 0db N = h'001, -0.125 db N = h'010, -0.250 db N = h'011, -0.375 db N = h'100, -0.500 db N = h'101, -0.625 db N = h'110, -0.750 db N = h'111, -0.875 db	
	Reserved	4:0	Reserved	
112D08h	I2S_Volume	15:0	Default : 0x00	Access : R/W
	I2S_Mute	15	Software mute for I2S Channel 0 = normal 1 = mute	
	I2S_Integer_Volume	14:8	I2S Volume Integer Control Reg. Volume table with -1db per step. Gain setting = 12db – N * 1.0db (+12db ~ -114db) N = 0x00 ~ 0x0B (+12 db ~ +1 db) N = 0x0C (0db) N = 0x0D ~ 0x7E (-1 db ~ -114 db)	

Audio Sound Effect Register (Bank = 112Dh)				
Index	Mnemonic	Bit	Description	
			N = 0x7F (mute)	
	I2S_Frac_Volume	7:5	I2S Volume Fractional Control Reg. Volume table with -0.125 db per step. N = h'000, 0db N = h'001, -0.125 db N = h'010, -0.250 db N = h'011, -0.375 db N = h'100, -0.500 db N = h'101, -0.625 db N = h'110, -0.750 db N = h'111, -0.875 db	
	Reserved	4:0	Reserved	
	112D0Ah	SPDIF_Volume	15:0	Default : 0x00 Access : R/W
		SPDIF_Mute	15	Software mute for SPDIF Channel 0 = normal 1 = mute
		SPDIF_Integer_Volume	14:8	SPDIF Volume Integer Control Reg. Volume table with -1db per step. Gain setting = 12db – N * 1.0db (+12db ~ -114db) N = 0x00 ~ 0x0B (+12 db ~ +1 db) N = 0x0C (0db) N = 0x0D ~ 0x7E (-1 db ~ -114 db) N = 0x7F (mute)
		SPDIF_Frac_Volume	7:5	SPDIF Volume Fractional Control Reg. Volume table with -0.125 db per step. N = h'000, 0db N = h'001, -0.125 db N = h'010, -0.250 db N = h'011, -0.375 db N = h'100, -0.500 db N = h'101, -0.625 db N = h'110, -0.750 db N = h'111, -0.875 db
		Reserved	4:0	Reserved
	112D0Ch	SRC_Volume	15:0	Default : 0x00 Access : R/W
		SRC_Mute	15	Software mute for SRC Channel 0 = normal 1 = mute
		SRC_Integer_Volume	14:8	SRC Volume Integer Control Reg. Volume table with -1db per step. Gain setting = 12db – N * 1.0db (+12db ~ -114db) N = 0x00 ~ 0x0B (+12 db ~ +1 db) N = 0x0C (0db) N = 0x0D ~ 0x7E (-1 db ~ -114 db)

Audio Sound Effect Register (Bank = 112Dh)				
Index	Mnemonic	Bit	Description	
			N = 0x7F (mute)	
	SRC_Frac_Volume	7:5	SRC Volume Fractional Control Reg. Volume table with -0.125 db per step. N = h'000, 0db N = h'001, -0.125 db N = h'010, -0.250 db N = h'011, -0.375 db N = h'100, -0.500 db N = h'101, -0.625 db N = h'110, -0.750 db N = h'111, -0.875 db	
	Reserved	4:0	Reserved	
112D0Eh	Reserved	15:0	Default : 0x00	Access : R/W
112D10h	PRE-SCALE	15:0	Default : 0x00	Access : R/W
	RESERVED	15:8	Reserved	
	PRE-SCALE	7:0	Pre-scale setting with 0.125 db per step 00 = disable pre-scale 0x01 = -13.75 db ... 0x6F = 0 db (suggestion) ... 0xFF = +18 db	
112D12h	RESERVED	15:0	Default : 0x00	Access : R/W
112D14h	EQ1	15:0	Default : 0x00	Access : R/W
	EQ1	15:8	Center Frequency = 120 Hz 0x30 = +12.00 db 0x2F = +11.75 db ... 0x01 = +0.25 db 0x00 = 0 db 0xFF = -0.25 db ... 0xD0 = -12.00 db	
	BASS	7:0	Bass gain setting 0x30 = +12.00 db 0x2F = +11.75 db ... 0x01 = +0.25 db 0x00 = 0 db 0xFF = -0.25 db ... 0xD0 = -12.00 db	
112D16h	EQ2	15:0	Default : 0x00	Access : R/W
	EQ2	15:8	Center Frequency = 500 Hz	

Audio Sound Effect Register (Bank = 112Dh)				
Index	Mnemonic	Bit	Description	
			0x30 = +12.00 db 0x2F = +11.75 db ... 0x01 = +0.25 db 0x00 = 0 db 0xFF = -0.25 db ... 0xD0 = -12.00 db	
	TREBLE	7:0	Treble gain setting 0x30 = +12.00 db 0x2F = +11.75 db ... 0x01 = +0.25 db 0x00 = 0 db 0xFF = -0.25 db ... 0xD0 = -12.00 db	
112D18h	EQ3	15:0	Default : 0x00	Access : R/W
	EQ3	15:8	Center Frequency = 1.5 KHz 0x30 = +12.00 db 0x2F = +11.75 db ... 0x01 = +0.25 db 0x00 = 0 db 0xFF = -0.25 db ... 0xD0 = -12.00 db	
	RESERVED	7:0	Reserved	
112D1Ah	EQ4	15:0	Default : 0x00	Access : R/W
	EQ4	15:8	Center Frequency = 5.0 KHz 0x30 = +12.00 db 0x2F = +11.75 db ... 0x01 = +0.25 db 0x00 = 0 db 0xFF = -0.25 db ... 0xD0 = -12.00 db	
	RESERVED	7:0	Reserved	
112D1Ch	EQ5	15:0	Default : 0x00	Access : R/W
	EQ5	15:8	Center Frequency = 10 KHz 0x30 = +12.00 db 0x2F = +11.75 db ...	

Audio Sound Effect Register (Bank = 112Dh)				
Index	Mnemonic	Bit	Description	
112D1Eh			0x01 = +0.25 db 0x00 = 0 db 0xFF = -0.25 db ... 0xD0 = -12.00 db	
	RESERVED	7:0	Reserved	
	BALANCE	15:0	Default : 0x00	Access : R/W
	BALANCE_L	15:8	Left Channel attenuation level (-0.25 db/step) 0x00 = 0 db 0x01 = -0.25 db ... 0xFE = -63.5 db 0xFF = mute	
112D20h	BALANCE_R	7:0	Right Channel attenuation level (-0.25 db/step) 0x00 = 0 db 0x01 = -0.25 db ... 0xFE = -63.5 db 0xFF = mute	
	SOUND_EFFECT_ENABLE	15:0	Default : 0x00	Access : R/W
	RESERVED	15:14	RESERVED	
	DRC	13	0 = disable 1 = enable	
	AVC	12	0 = disable 1 = enable	
	TONE(BASS_TREBLE)	11	0 = disable 1 = enable	
	SPATIAL(SURROUND)	10	0 = disable 1 = enable	
	RESERVED	9	RESERVED	
	RESERVED	8	RESERVED	
	G. EQ	7	0 = disable 1 = enable	
	RESERVED	6:4	RESERVED	
	DC REMOVAL	3	0 = disable 1 = enable	
	HPF	2	0 = disable 1 = enable	
	RESERVED	1	RESERVED	
	P. EQ	0	0 = disable 1 = enable	
112D22h	VOLUME_ENALBE	15:0	Default : 0x00	Access : R/W
	RESERVED	15:10	Reserved	

Audio Sound Effect Register (Bank = 112Dh)				
Index	Mnemonic	Bit	Description	
	SRC_VOL_ENALBE	9	SRC Channel volume enable bit 0 = disable 1 = enable	
	SPDIF_VOL_ENALBE	8	SPDIF Channel volume enable bit 0 = disable 1 = enable	
	RESERVED	7:5	Reserved	
	I2S_VOL_ENALBE	4	I2S Channel volume enable bit 0 = disable 1 = enable	
	AUOUT3_VOL_ENABLE	3	AUOUT3 Channel volume enable bit 0 = disable 1 = enable	
	AUOUT2_VOL_ENABLE	2	AUOUT2 Channel volume enable bit 0 = disable 1 = enable	
	AUOUT1_VOL_ENABLE	1	AUOUT1 Channel volume enable bit 0 = disable 1 = enable	
	AUOUT0_VOL_ENALBE	0	AUOUT0 Channel volume enable bit 0 = disable 1 = enable	
112D24h	AVC	15:0	Default : 0x00	Access : R/W
	AT	15:13	AVC Attach Time setting h'000 = 2 sec h'001 = 1 sec h'010 = 500 ms h'011 = 400 ms h'100 = 300 ms h'101 = 200 ms h'110 = 100 ms h'111 = 20 ms	
	RT	12:10	AVC Release Time setting h'000 = 2 sec h'001 = 1 sec h'010 = 500 ms h'011 = 400 ms h'100 = 300 ms h'101 = 200 ms h'110 = 100 ms h'111 = 20 ms	
	MODE	9:8	AVC mode setting 0x00 = L mode 0x01 = S mode	

Audio Sound Effect Register (Bank = 112Dh)				
Index	Mnemonic	Bit	Description	
			0x02 = M mode	
	CLIPPING_LEVEL	7:0	AVC Clipping Level setting 0x00 = 0.0 dbFS 0x01 = -0.5 dbFS ... 0x20 = -16 dbFS ... 0x30 = -24 dbFS ... 0x50 = -40 dbFS	
112D26h	SURROUND	15:0	Default : 0x00	Access : R/W
	RESERVED	15:11	RESERVED	
	K_GAIN	10:8	000: 0.1 001: 0.2 010: 0.3 011: 0.4 100: 0.5 101: 0.6 110: 0.7 111: 0.8	
	LPF_GAIN	7:6	00: 0dB 01: 2dB 10: 4dB 11: 6dB	
	B_GAIN	5:4	00: 0.25 01: 0.3 10: 0.35 11: 0.45	
	A_GAIN	3:2	00: 0.1 01: 0.15 10: 0.2 11: 0.25	
	RESERVED	1:0	RESERVED	
112D28h	TONE_GEN	15:0	Default : 0x00	Access : R/W
	SINGLE_TONE_GEN	7:0		
112D2Ah	BALANCE_ENABLE	15:0	Default : 0x00	Access : R/W
	RESERVED	15:10	Reserved	
	SRC_BAL_ENALBE	9	SRC Channel balance enable bit 0 = disable 1 = enable	
	SPDIF_BAL_ENALBE	8	SPDIF Channel balance enable bit 0 = disable 1 = enable	
	RESERVED	7:5	Reserved	

Audio Sound Effect Register (Bank = 112Dh)				
Index	Mnemonic	Bit	Description	
	I2S_BAL_ENALBE	4	I2S Channel balance enable bit 0 = disable 1 = enable	
	AUOUT3_BAL_ENABLE	3	AUOUT3 Channel balance enable bit 0 = disable 1 = enable	
	AUOUT2_BAL_ENABLE	2	AUOUT2 Channel balance enable bit 0 = disable 1 = enable	
	AUOUT1_BAL_ENABLE	1	AUOUT1 Channel balance enable bit 0 = disable 1 = enable	
	AUOUT0_BAL_ENALBE	0	AUOUT0 Channel balance enable bit 0 = disable 1 = enable	
112D2Ch	RESERVED	15:0	Default : 0x00	Access : R/W
112D2Eh	DRC	15:0	Default : 0x00	Access : R/W
	CLIPPING_LEVEL	7:0	DRC Clipping Level setting 0x00 = 0.0 dbFS 0x01 = -0.5 dbFS ... 0x20 = -16 dbFS ... 0x30 = -24 dbFS ... 0x50 = -40 dbFS	
	AUDIO_MODE	15:0	Default : 0x00	Access : R/W
	RESERVED	15:10	Reserved	
	POWER_DOWN	9	Set audio enter power down mode 0 = normal mode 1 = power down mode	
	POWER_DOWN_1	8	Wait extra 3 sec before enter power down 0 = NO 1 = YES	
	RESERVED	7:2	Reserved	
	MODE_SEL	1:0	Output mode select h'00 = stereo h'01 = L, L h'10 = R, R h'11 = (L+R)/2, (L+R)/2	
112D32h	NOISE_REDUCTION	15:0	Default : 0x00	Access : R/W
	RESERVED	15:8	Reserved	
	NR_LEVEL	7:0	Noise Below the Threshold will enable noise reduction 0x00 = disable NR	

Audio Sound Effect Register (Bank = 112Dh)				
Index	Mnemonic	Bit	Description	
			Else, NR threshold (this value setting depend on boards)	
112D34h	RESERVED	15:0	Default : 0x00	Access : R/W
112D36h	RESERVED	15:0	Default : 0x00	Access : R/W
112D38h	RESERVED	15:0	Default : 0x00	Access : R/W
112D3Ah	RESERVED	15:0	Default : 0x00	Access : R/W
112D3Ch	RESERVED	15:0	Default : 0x00	Access : R/W
112D3Eh	RESERVED	15:0	Default : 0x00	Access : R/W
112D40h	ADV_SoundEff Reserved	15:0	Default : 0x00	Access : R/W
112D42h	ADV_SoundEff Reserved	15:0	Default : 0x00	Access : R/W
112D44h	ADV_SoundEff Reserved	15:0	Default : 0x00	Access : R/W
112D46h	KTV Reserved	15:0	Default : 0x00	Access : R/W
112D48h	RESERVED	15:0	Default : 0x00	Access : R/W
112D4Ah	RESERVED	15:0	Default : 0x00	Access : R/W
112D4Ch	RESERVED	15:0	Default : 0x00	Access : R/W
112D4Eh	RESERVED	15:0	Default : 0x00	Access : R/W
112D50h	OUT_CH_SEL1	15:0	Default : 0x00	Access : R/W
	AUOUT3_SEL	15:12	AUOUT3 output select. 0 = Mul_CH1 1 = Mul_CH2 2 = Mul_CH3 3 = Mul_CH4 4 = Raw (*) 5 = Raw_Delay(*) 6 = Raw_Delay_SE(*) 7 = SCART(*)	
	AUOUT2_SEL	11:8	AUOUT2 output select. 0 = Mul_CH1 1 = Mul_CH2 2 = Mul_CH3 3 = Mul_CH4 4 = Raw 5 = Raw_Delay 6 = Raw_Delay_SE 7 = SCART	
	AUOUT1_SEL	7:4	AUOUT1 output select. 0 = Mul_CH1 1 = Mul_CH2 2 = Mul_CH3 3 = Mul_CH4 4 = Raw 5 = Raw_Delay 6 = Raw_Delay_SE 7 = SCART	
	AUOUT0_SEL	3:0	AUOUT0 output select.	

Audio Sound Effect Register (Bank = 112Dh)				
Index	Mnemonic	Bit	Description	
			0 = Mul_CH1 1 = Mul_CH2 2 = Mul_CH3 3 = Mul_CH4 4 = Raw 5 = Raw_Delay 6 = Raw_Delay_SE 7 = SCART	
112D52h	OUT_CH_SEL2	15:0	Default : 0x00	Access : R/W
	IIS_TX4	15:12	IIS_TX4 output select. (for multi-channel IIS out, not implement yet) 0 = Mul_CH1 (not yet) 1 = Mul_CH2 (not yet) 2 = Mul_CH3 (not yet) 3 = Mul_CH4 (not yet) 4 = Raw 5 = Raw_Delay 6 = Raw_Delay_SE 7 = SCART	
	IIS_TX3	11:8	IIS_TX3 output select. (for multi-channel IIS out, not implement yet) 0 = Mul_CH1 (not yet) 1 = Mul_CH2 (not yet) 2 = Mul_CH3 (not yet) 3 = Mul_CH4 (not yet) 4 = Raw 5 = Raw_Delay 6 = Raw_Delay_SE 7 = SCART	
	IIS_TX2	7:4	IIS_TX2 output select. (for multi-channel IIS out, not implement yet) 0 = Mul_CH1 (not yet) 1 = Mul_CH2 (not yet) 2 = Mul_CH3 (not yet) 3 = Mul_CH4 (not yet) 4 = Raw 5 = Raw_Delay 6 = Raw_Delay_SE 7 = SCART	
	IIS_TX1	3:0	IIS_TX1 output select. 0 = Mul_CH1 1 = Mul_CH2 2 = Mul_CH3 3 = Mul_CH4	

Audio Sound Effect Register (Bank = 112Dh)				
Index	Mnemonic	Bit	Description	
			4 = Raw 5 = Raw_Delay 6 = Raw_Delay_SE 7 = SCART	
112D54h	OUT_CH_SEL3	15:0	Default : 0x00	Access : R/W
	SRC_IN	15:12	SRC_IN output select. 0 = Mul_CH1 1 = Mul_CH2 2 = Mul_CH3 3 = Mul_CH4 4 = Raw 5 = Raw_Delay 6 = Raw_Delay_SE 7 = SCART	
	SPDIF	11:8	SPDIF output select. 0 = Mul_CH1 1 = Mul_CH2 2 = Mul_CH3 3 = Mul_CH4 4 = Raw 5 = Raw_Delay 6 = Raw_Delay_SE 7 = SCART	
	RESERVED	7:0	Reserved	
112D56h	RESERVED	15:0	Default : 0x00	Access : R/W
112D58h	RESERVED	15:0	Default : 0x00	Access : R/W
112D5Ah	DIG8_Volume (KTV/Game)	15:0	Default : 0x00	Access : R/W
	DIG8_Mute	15	Software mute for DIG8 Channel 0 = normal 1 = mute	
	DIG8_Integer_Volume	14:8	DIG8 Volume Integer Control Reg. Volume table with -1db per step. Gain setting = 12db – N * 1.0db (-6db ~ -114db) N = 0x12 ~ 0x7E (-6 db ~ -114 db) N = 0x7F (mute)	

Audio Sound Effect Register (Bank = 112Dh)			
Index	Mnemonic	Bit	Description
	DIG8_Frac_Volume	7:5	DIG8 Volume Fractional Control Reg. Volume table with -0.125 db per step. N = h'000, 0db N = h'001, -0.125 db N = h'010, -0.250 db N = h'011, -0.375 db N = h'100, -0.500 db N = h'101, -0.625 db N = h'110, -0.750 db N = h'111, -0.875 db
	Reserved	4:0	Reserved
112D5Ch	DIG5_Volume (KTV/Game)	15:0	Default : 0x00 Access : R/W
	DIG5_Mute	15	Software mute for DIG5 Channel 0 = normal 1 = mute
	DIG5_Integer_Volume	14:8	DIG5 Volume Integer Control Reg. Volume table with -1db per step. Gain setting = 12db – N * 1.0db (-6db ~ -114db) N = 0x12 ~ 0x7E (-6 db ~ -114 db) N = 0x7F (mute)
	DIG5_Frac_Volume	7:5	DIG5 Volume Fractional Control Reg. Volume table with -0.125 db per step. N = h'000, 0db N = h'001, -0.125 db N = h'010, -0.250 db N = h'011, -0.375 db N = h'100, -0.500 db N = h'101, -0.625 db N = h'110, -0.750 db N = h'111, -0.875 db
	Reserved	4:0	Reserved
112D5Eh	DIG6_Volume (KTV/Game)	15:0	Default : 0x00 Access : R/W
	DIG6_Mute	15	Software mute for DIG6 Channel 0 = normal 1 = mute
	DIG6_Integer_Volume	14:8	DIG6 Volume Integer Control Reg. Volume table with -1db per step. Gain setting = 12db – N * 1.0db (-6db ~ -114db) N = 0x12 ~ 0x7E (-6 db ~ -114 db) N = 0x7F (mute)
	DIG6_Frac_Volume	7:5	DIG6 Volume Fractional Control Reg. Volume table with -0.125 db per step. N = h'000, 0db

Audio Sound Effect Register (Bank = 112Dh)			
Index	Mnemonic	Bit	Description
			N = h'001, -0.125 db N = h'010, -0.250 db N = h'011, -0.375 db N = h'100, -0.500 db N = h'101, -0.625 db N = h'110, -0.750 db N = h'111, -0.875 db
	Reserved	4:0	Reserved

Note:

Raw: the raw PCM data from the main application (e.g. DTV input, HDMI input...)

Raw_Delay: the same type as above but with extra delay involved

Raw_Delay_SE: the same type as above but with extra sound effect involved

SCART: the TV PCM data to SCART

Please refers to Raw, Raw_De
lay, Raw_De
lay_SE and SCART in Figure 2.

1.3. Decoder & Mailbox Register Definition

Table 2: Decoder & Mailbox Register Table

Decoder & Mailbox Register (Bank = 112Dh)				
Index	Mnemonic	Bit	Description	
112D60h	MM_DDR_ES_SIZE	15:0	Default : 0x00	Access : R
	MM_DDR_ES_SIZE	15:0	Report the residual ES size (in MIU line unit).	
112D62h	MM_DDR_PCM_SIZE	15:0	Default : 0x00	Access : R
	MM_DDR_PCM_SIZE	15:0	Report the residual PCM size (in MIU line unit).	
112D64h	RESERVED	15:0	Default : 0x00	Access : R
112D66h	MM_TIME_STAMP_H	15:0	Default : 0x00	Access : R
	MM_TIME_STAMP_H	15:0	MM Time Stamp presentation in sec unit (combine with MM_TIME_STAMP_L into a total presentation time)	
112D68h	MM_TIME_STAMP_L	15:0	Default : 0x00	Access : R
	MM_TIME_STAMP_L	15:0	MM Time Stamp presentation in 4ms unit (combine with MM_TIME_STAMP_H into a total presentation time)	
112D6Ah	DEC_MISC1	15:0	Default : 0x00	Access : R
	DEC_MISC1	15:0	For MM: MM MIU write address (in line unit) while asking MM data from storage For MM_TS: Present the PTS[32]	
112D6Ch	DEC_MISC2	15:0	Default : 0x00	Access : R
	DEC_MISC2	15:0	For MM: MM MIU write count (in line unit) while asking MM data from storage For MM_TS: Present the PTS[31:16]	
112D6Eh	DEC_MISC3	15:0	Default : 0x00	Access : R
	DEC_MISC3	15:0	For MM: MM residual PCM counter (in line unit) while playing MM file For MM_TS: Present the PTS[15:0]	
112D80h	MS 10 DDC Mode Select	15:0	Default : 0x00	Access : R/W
112D82h	MS 10 DDC ASOC ID Select	15:0	Default : 0x00	Access : R/W
112D84h	RESERVED	15:0	Default : 0x00	Access : R/W
112D86h	DEC_CTRL	15:0	Default : 0x00	Access : R/W
	RESERVED	15:7	Reserved	
	Decoder mute	6	0 = disable	

Decoder & Mailbox Register (Bank = 112Dh)				
Index	Mnemonic	Bit	Description	
			1 = enable	
	FF x 2 in MM mode	5	0 = disable 1 = enable	
	DEC_MODE_SEL	4:2	Sound mode select while decoding dual-mono mode h'000 = LL h'001 = RR h'010 = LR h'000 = (L+R)/2 (L+R)/2	
	DEC_ATT	1	Decoder1 output -11dB 0 = output 0 db 1 = output -11 db	
	AD_MIX	0	AD mix select 0 = no AD mix 1 = AD mix	
112D88h	RESERVED	15:0	Default : 0x00	Access : R/W
112D8Ah	PIOID_HDMI_CTRL	15:0	Default : 0x00	Access : R/W
	PIO_ID	15:8	HK PIO ID while send PIO interrupt to DE-DSP 0xE0 : MM 0xE1 : Encode	
	HDMI_CTRL	7:0		
112D8Ch	DEC_TAG	15:0	Default : 0x00	Access : R/W
	RESERVED	15:8		
	MM_TAG	7:0	HK sends tag to MM decoder while assert PIO interrupt This tag should increase by 1 for every PIO interrupt	
112D8Eh	SPDIF_CTRL	15:0	Default : 0x00	Access : R/W
	RESERVED	15:8	Default : 0x00	Access : R/W
		7	Dolby DRC Mode 0: Line 1: RF	
		6	Dolby Dmx Mode 0: LtRt 1: LoRo	
		5	SPDIF PCM Output -11dB	
		4	Sync STC in Ts MM Mode	
		1	SPDIF NonPCM	
		0	SPDIF Mute	
112D90h ~ 112DBFh	RESERVED	15:0	Default : 0x00	Access : R

Decoder & Mailbox Register (Bank = 112Dh)				
Index	Mnemonic	Bit	Description	
112DD0h	RESERVED	15:0	Default : 0x00	Access : R/W
112DD2h	RESERVED	15:0	Default : 0x00	Access : R/W
112DD4h	RESERVED	15:0	Default : 0x00	Access : R/W
112DD6h	RESERVED	15:0	Default : 0x00	Access : R/W
112DD8h	RESERVED	15:0	Default : 0x00	Access : R/W
112DDAh	DEC_PUBLIC	15:0	Default : 0x00	Access : R/W
112DDCh	DEC_DEBUG1	15:0	Default : 0x00	Access : R/W
	DEBUG_CMD	15:8	Decoder Command 0x90 = read system version 0x91 = read DEC1 version 0x92 = read DEC2 version 0x02 = set PM/DM address 0x03 = write DM data 0x04 = write PM data 0x05 = read DM data 0x06 = read PM data	
	DEBUG_PARAMETER1	7:0	Bit[23:16] for debug address or data	
112DDEh	DEC_DEBUG2	15:0	Default : 0x00	Access : R/W
	DEBUG_PARAMETER2	15:8	Bit[15:8] for debug address or data	
	DEBUG_PARAMETER3	7:0	Bit[7:0] for debug address or data	
112DE0h	RESERVED	15:0	Default : 0x00	Access : R
112DE2h	RESERVED	15:0	Default : 0x00	Access : R
112DE4h	RESERVED	15:0	Default : 0x00	Access : R
112DE6h	RESERVED	15:0	Default : 0x00	Access : R
112DE8h	RESERVED	15:0	Default : 0x00	Access : R
112DEAh	DEC_PUBLIC	15:0	Default : 0x00	Access : R
112DECh	DEC_PUBLIC	15:0	Default : 0x00	Access : R
112DEEh	DEC_PUBLIC	15:0	Default : 0x00	Access : R
112DF0h	RESERVED	15:0	Default : 0x00	Access : R
112DF2h	INT_ID	15:0	Default : 0x00	Access : R
	RESERVED	15:8	Reserved	
	INT_ID	7:0	DSP has only one interrupt connecting to HK, so need INT_ID to tell which algorithm asserts this interrupt 0x03 = MM file format request 0x05 = PTS report 0x13 = MPEG encoder request	
112DF4h	SAMPFRE_ERROR	15:0	Default : 0x00	Access : R
	SPDIF_NONPCM_SAMPLE_RA	15:8	Decoder Report SPDIF non-PCM sample rate	

Decoder & Mailbox Register (Bank = 112Dh)				
Index	Mnemonic	Bit	Description	
	TE		0 = 48KHz 1 = 44.1KHz 2 = 32KHz	
	ERROR_CNT	7:0	Error count for MM HK uses this error count to decide if AV need to re-sync	
112DF6h	NONPCM_PCM_LEVEL	15:0	Default : 0x00	Access : R
	SPDIF_NON_PCM_LEVEL	15:8	SPDIF non-PCM size (in MIU line unit)	
	PCM_LEVEL	7:0	Decoded PCM size (in MIU line unit)	
112DF8h	FREE_COUNTER	15:0	Default : 0x00	Access : R
	DE_DSP_FREE_CNT	15:8	DE-DSP free run counter	
	DE_DSP_TIMER_CNT	7:0	DE-DSP timer counter	
112DFAh	DECODER_STATUS	15:0	Default : 0x00	Access : R
	DECODER_STATUS	15:8	Decoder Status 0x1X = BTSC 0x2X = PALSUM 0x3X = OGG 0x4X = MPEG/MP3 0x5X = AAC/HE-AAC 0x6X = XPCM 0x7X = DD+ 0x8X = DD 0x9X = WMA/WMA Pro 0xAx = RM 0xBx = DTS X = 0, not sync Else, sync	
	RESERVED	7:0		
112DFCh	DE_DSP_ACK1	15:0	Default : 0x00	Access : R
	DE_DSP_ACK1_H	15:8	Acknowledge data	
	DE_DSP_ACK1_L	7:0	Acknowledge data	
112DFEh	DE_DSP_ACK2	15:0	Default : 0x00	Access : R
	DE_DSP_ACK2_H	15:8	Acknowledge data	
	DE_DSP_ACK2_L	7:0	Acknowledge data	

Note:

MM: MM means the file format needs to handshake protocol between MCU and DSP.

MM_TS: MM_TS means this file format feeding path is the same as TS.

1.4. SIF Related Mailbox Definition

Table 3: SIF Related Register Table

SIF Related Register (Bank = 112Dh)				
Index	Mnemonic	Bit	Description	
112DC0h	SIF_STD_SEL	15:0	Default : 0x00	Access : R/W
	RESERVED	15:8	Reserved	
	STD_SEL_SET	7:4	For SIF Pal-sum DSP code PAL Sound Standard Mode selection 1110 = Standard detection command 0000 = FM mono mode 0001 = Hi-dev mode 0010 = A2 mode 0100 = NICAM mode	
	STD_SEL	3:0	SIF audio standard selection 0000 = Standard not found 0001 = AU_SYS_M_BTSC For BTSC, bit[1]: M/N system identification control bit 0 = NTSC_M or PAL_M; 1 = PAL_N 0010 = AU_SYS_M_EIAJ 0011 = AU_SYS_M_A2 0100 = AU_SYS_BG_A2 0101 = AU_SYS_DK1_A2 0110 = AU_SYS_DK2_A2 0111 = AU_SYS_DK3_A2 1000 = AU_SYS_BG_NICAM 1001 = AU_SYS_DK_NICAM 1010 = AU_SYS_I_NICAM 1011 = AU_SYS_L_NICAM	
112DC2h	SIF_PFIR_AGC	15:0	Default : 0x00	Access : R/W
	RESERVED	15:10	Reserved	
	SIF_AGC_RESET (Non VIF mode)	9	1: SIF AGC reset	
	SIF_AGC_ENABLE (Non VIF mode)	8	0: SIF AGC Disable 1: SIF AGC Enable	
	SIF_CARRIER_DEBOUNCE	7	SIF Carrier Status De-bounce 0: Check carrier 0x10 times. If carrier changes > 0x08 times, carrier status changes. 1: Check carrier 0x200 times. If carrier changes > 0x190 times, carrier status changes.	
	HI-DEV_SEL	5:4	HIDEV CH1 PFIR Bandwidth Selection 01= mode 1 (narrow bandwidth, 130k~260k)	

SIF Related Register (Bank = 112Dh)				
Index	Mnemonic	Bit	Description	
			02= mode 2 (middle bandwidth, 165k~295K) 03= mode 3 (huge bandwidth, 200k~330k) Others = mode 2	
	A2_CH2_PFIR	1:0	A2 CH2 PFIR Bandwidth Selection 01= mode 1 (narrow bandwidth, 80k~130k) 02= mode 2 (middle bandwidth, 100k~150K) 03= mode 3 (huge bandwidth, 130k~180k) Others = mode 2	
112DC4h	SIF_BTSC_A2_SEL	15:0	Default : 0x00	Access : R/W
	RESERVED	15:8	Reserved	
	SIF_SOUND_MOD1[7:0]	7:0	SIF BTSC/A2 demodulator automatic/manual sound mode output select. 0xxxxxxx = manual sound select 00000000 = BTSC Mono 00000001 = BTSC Stereo 00000010 = BTSC SAP 00000000 = A2 Mono 00000001 = A2 Stereo 00000010 = A2 Dual B 00000011 = A2 Dual A+B 1xxxxxxx = auto sound select 10000000 = BTSC Mono <-> Mute 10000001 = BTSC Stereo <-> Mono <-> Mute 10000010 = BTSC SAP<-> Mono <-> Mute 10000000 = A2 Mono <-> Mute 10000001 = A2 Stereo <-> Mono <-> Mute 10000010 = A2 Dual B <-> Mono <-> Mute	
112DC6h	SIF_NICAM_SEL	15:0	Default : 0x00	Access : R/W
	RESERVED	15:8	Reserved	
	SIF_SOUND_MOD2[7:0]	7:0	SIF NICAM demodulator automatic sound mode output select. 00000000 = NICAM Auto Mode Nicam Sound (auto) <-> FM/AM Mono <-> Mute 0x01 = FM/AM Mono 0x02 = Stereo L / R <-> FM/AM Mono 0x03 = Stereo L / L <-> FM/AM Mono 0x04 = Stereo R / R <-> FM/AM Mono 0x05 = Dual A/ B <-> FM/AM Mono 0x06 = Dual A / A <-> FM/AM Mono 0x07 = Dual B / B <-> FM/AM Mono	

SIF Related Register (Bank = 112Dh)

Index	Mnemonic	Bit	Description
			0x08 = Nicam Mono↔ FM/AM Mono 0x80 = Force NICAM SOUND 0x82 = Force Stereo L / R 0x83 = Force Stereo L / L 0x84 = Force Stereo R / R 0x85 = Force Dual A/ B 0x86 = Force Dual A / A 0x87 = Force Dual B / B 0x88 = Force Nicam Mono
112DC8h	SIF_RESERVED	15:0	Default : 0x00 Access : R/W
	RESERVED	15:0	Reserved
112DCAh	SIF_FM_TRACKING	15:0	Default : 0x00 Access : R/W
	RESERVED	15:8	Reserved
	DK123_AUTO_CTRL	7	0: Disable 1: Enable DK1 DK2, DK3 auto detection
	VIDEO_NOTCH	2	0: Video notch filter disable (SIF mode) 1: Video notch filter enable (VIF mode)
	FC_TRACKING_ENABLE	1	0: CH1 Fc Tracking disable 1: CH1 Fc Tracking enable
	FC_TRACKING_RESET	0	1: CH1 Fc Tracking reset
	DEBUG_PARAMETER1	7:0	Bit[23:16] for debug address or data
112DE0h	SIF_PAL_DEC_RESULT	15:0	Default : 0x00 Access : R
	RESERVED	15:8	Reserved
	BUSY	7	Audio SIF Standard Detection Flag 0 = standard detection finished 1 = standard detection not finished
	SIF_STD_CODE	6:0	SIF Standard Detect Result 00h = standard not found 03h = AU_SYS_M 04h = AU_SYS_BG_A2 05h = AU_SYS_DK1_A2 06h = AU_SYS_DK2_A2 07h = AU_SYS_DK3_A2 08h = AU_SYS_BG_NICAM 09h = AU_SYS_DK_NICAM 0ah = AU_SYS_I_NICAM 0bh = AU_SYS_L_NICAM

SIF Related Register (Bank = 112Dh)

Index	Mnemonic	Bit	Description
112DE2h	SIF_BTSC_A2_REPORT	15:0	Default : 0x00 Access : R
	RESERVED	15:0	Reserved
112DE4h	SIF_BTSC_A2_CARRIER	15:0	Default : 0x00 Access : R
	RESERVED	15:8	Reserved
	DK3_STATUS	7	If enable DK123_AUTO_CTRL (0x2DCA[7]=1) 0: Sound Standard is not DK3 1: Sound Standard is DK3
	DK2_STATUS	6	If enable DK123_AUTO_CTRL (0x2DCA[7]=1) 0: Sound Standard is not DK2 1: Sound Standard is DK2
	SOUND_MOD_STATUS1	5:0	Sound Mod Status1: Bit 0 = BTSC/A2 Mono exist Bit 1 = BTSC/A2 Stereo exist Bit 2 = BTSC/A2 Sap/Dual exist Bit 3 = A2 Pilot exist Bit 4 = A2 Carrier 1 exist Bit 5 = A2 Carrier 2 exist
112DE6h	SIF_NICAM_STATUS	15:0	Default : 0x00 Access : R
	RESERVED	15:8	Reserved
	SOUND_MOD_STATUS2	7:0	SIF NICAM demodulator automatic sound mode output select Low 4 bits: NICAM state info Bit[3:0] : NICAM Standard MOD Info Bit[3:0] = 0x0 = NICAM FRAME_SEARCH State Bit[3:0] = 0x1 = NICAM FRAME_PRESYNC0 State Bit[3:0] = 0x2 = NICAM FRAME_PRESYNC1 State Bit[3:0] = 0x3 = NICAM FRAME_PRESYNC2 State Bit[3:0] = 0x4 = NICAM FRAME_PRESYNC3 State Bit[3:0] = 0x5 = NICAM LOCK State Bit[6:4]: sound mode info Bit[6:4] = 0x1 = NICAM Mono Bit[6:4] = 0x2 = NICAM Stereo Bit[6:4] = 0x3 = NICAM Dual Bit[6:4] = 0x4 = NICAM Data Bit[7]: Reserved.
112DE8h	SIF_NICAM_C1_C4	15:0	Default : 0x00 Access : R
	RESERVED	15:8	Reserved

SIF Related Register (Bank = 112Dh)

Index	Mnemonic	Bit	Description
	SIF_NICAM_C1_C4	7:0	NICAM C1 - C4 control bit
112DEAh	SIF_NICAM_STATUS	15:0	Default : 0x00 Access : R
	SIF_NICAM_STATUS	15:0	SIF_NICAM_PARITYERR CNT
112DECh	SIF_AGC_ACC_LEVEL	15:0	Default : 0x00 Access : R
	SIF_AGC_ACC_LEVEL	15:0	SIF AGC accumulated level (VIF mode only)
112DEEh	SIF_AGC_GAIN_LEVEL	15:0	Default : 0x00 Access : R
	RESERVED	15:8	Reserved
	SIF_AGC_GAIN_LEVEL	7:0	SIF AGC GAIN (VIF mode only)

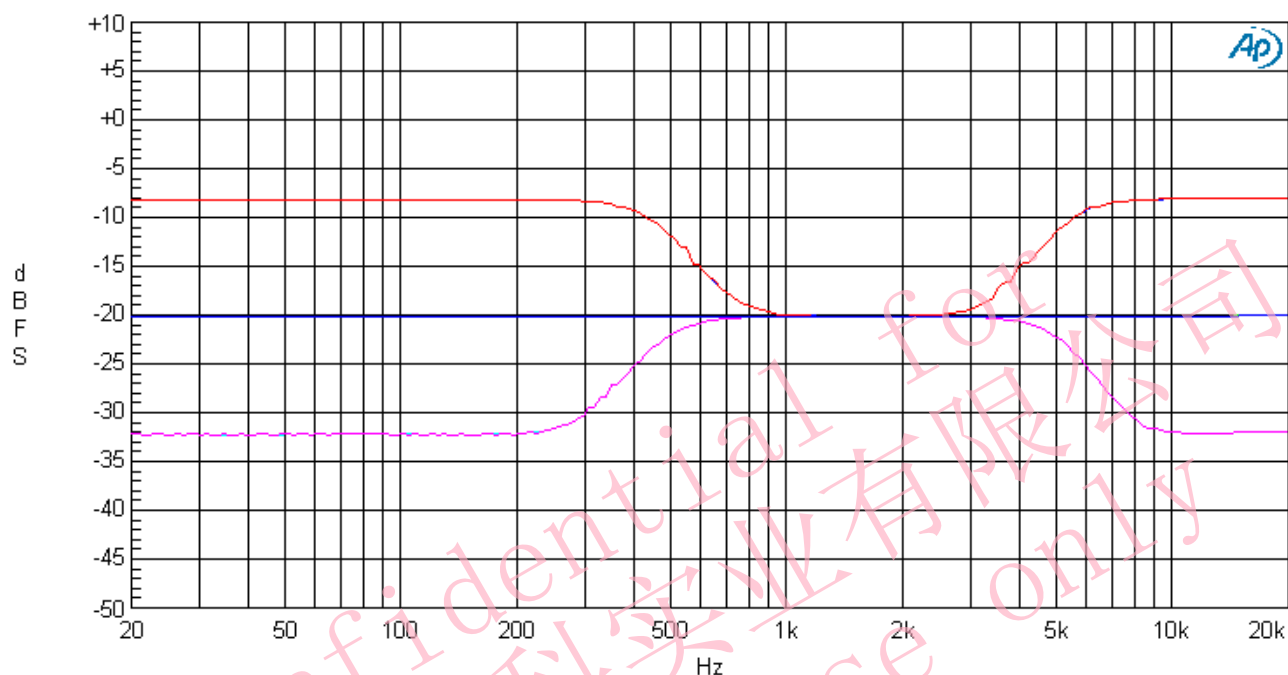
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1.5. Audio Precision

Audio Precision

D-D FAST RMS FREQUENCY RESPONSE

08/26/14 20:54:05



Sweep	Trace	Color	Line Style	Thick	Data	Axis	Comment
1	1	Blue	Solid	1	DSP Anlr.Level A	Left	
1	2	Red	Solid	1	DSP Anlr.Level B	Left	
2	1	Cyan	Solid	1	DSP Anlr.Level A	Left	
2	2	Magenta	Solid	1	DSP Anlr.Level B	Left	
3	1	Green	Solid	1	DSP Anlr.Level A	Left	
3	2	Blue	Solid	1	DSP Anlr.Level B	Left	

Frequency response from 20 to 20KHz. The above graph shows Bass/Treble measurement.
Digital input/Digital output, input signal level is -20dBFS.
BLUE: -20dBFS Reference level.
RED: Bass +12dB, Treble +12dB.
PINK: Bass -12dB, Treble -12dB.

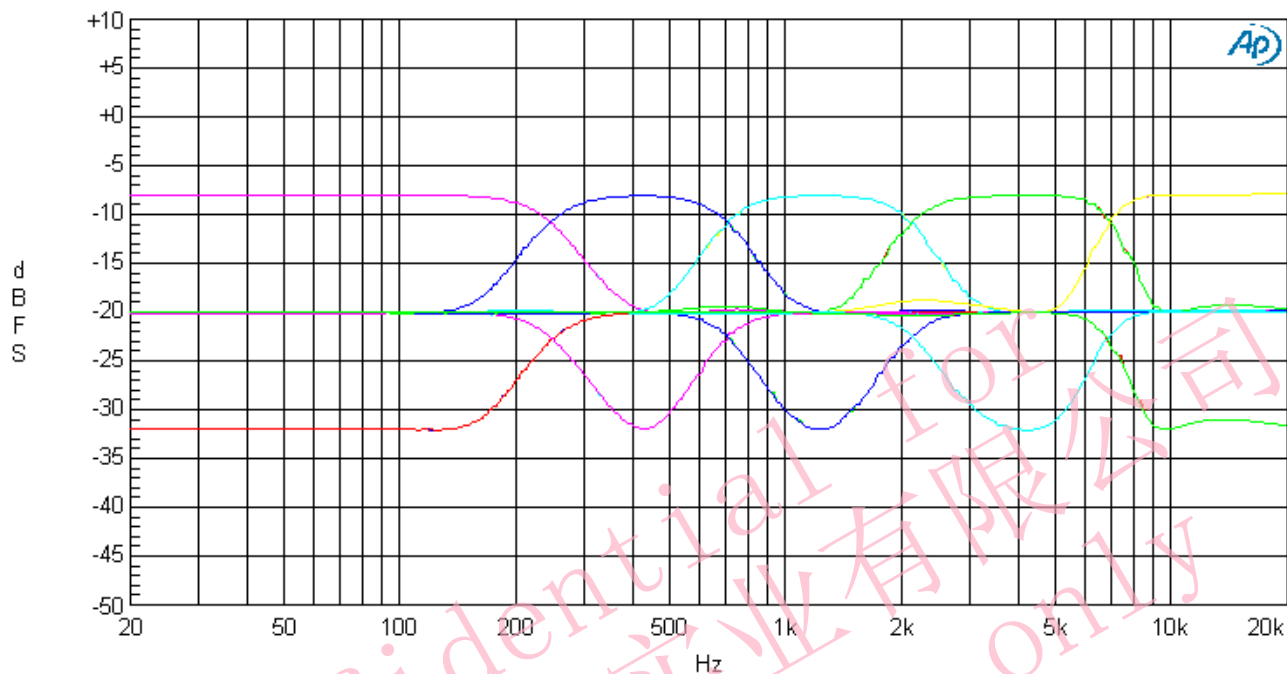
D-D FREQ RESP FAST.at27

Figure 4: Bass/Treble Measurement

Audio Precision

D-D FAST RMS FREQUENCY RESPONSE

08/26/14 21:32:13



Sweep	Trace	Color	Line Style	Thick	Data	Axis	Comment
1	1	Blue	Solid	1	DSP Anlr.Level A	Left	
1	2	Red	Solid	1	DSP Anlr.Level B	Left	
2	1	Cyan	Solid	1	DSP Anlr.Level A	Left	
2	2	Magenta	Solid	1	DSP Anlr.Level B	Left	
3	1	Green	Solid	1	DSP Anlr.Level A	Left	
3	2	Blue	Solid	1	DSP Anlr.Level B	Left	
4	1	Yellow	Solid	1	DSP Anlr.Level A	Left	

Frequency response from 20 to 20kHz. The above graph shows GEQ performance measurement.
Digital input/Digital output, input signal level is -20dBFS.
Reference level: -20dBFS.
Center frequency: EQ1(120Hz), EQ2(500Hz), EQ3(1.5kHz), EQ4(5kHz), and EQ5(10kHz).
Gain: From 12dB to -12dB.

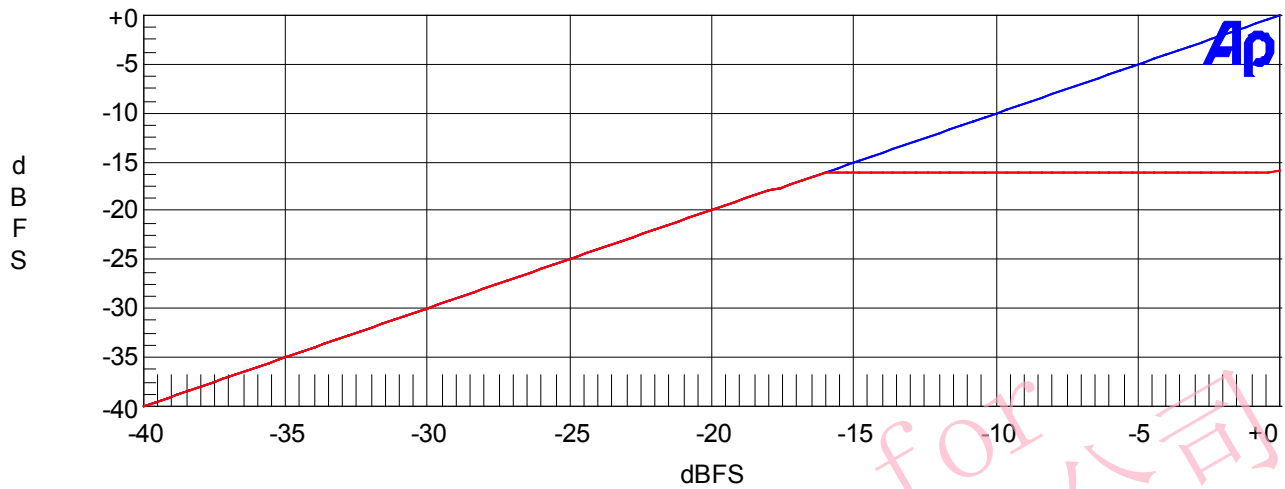
D-D_FREQ_RESP_FAST.at27

Figure 5: GEQ Measurement

Audio Precision

D-D AVL MEASUREMENT

08/28/14 18:03:50



Color	Line Style	Thick	Data	Axis
Blue	Solid	1	DSP Anlr.Level A	Left
Blue	Solid	1	DSP Anlr.Level B	Left
Red	Solid	1	DSP Anlr.Level A	Left

Digital input/ Digital Output. X-axis is input signal level. Y-axis is output signal level.

AVL with M mode:
Clipping level = -16dBFS.
AT: 100 msec.
RT: 2 sec.

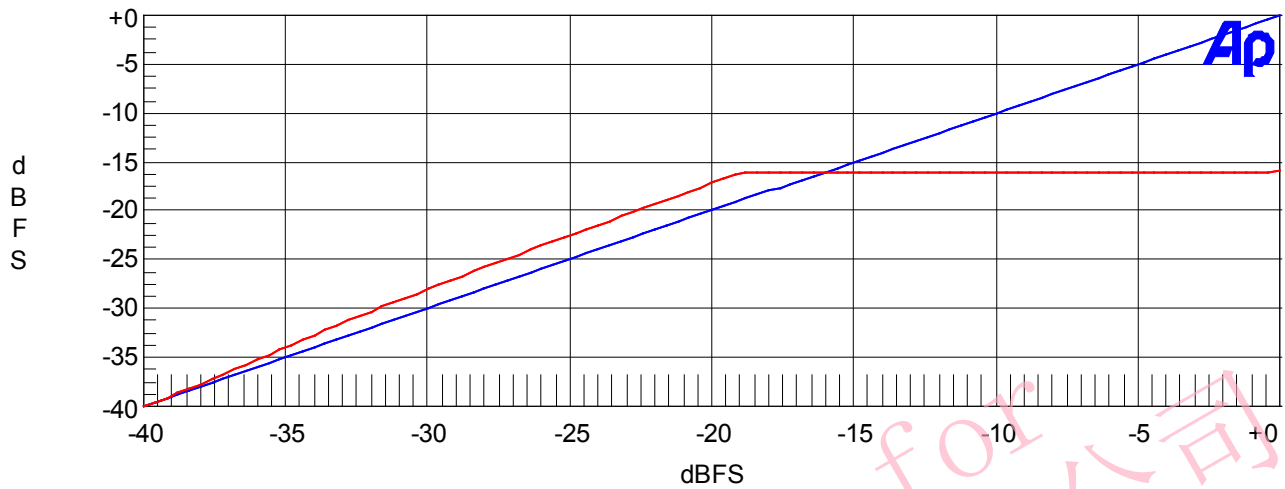
D-D AVL.at2

Figure 6: AVL with M Mode Measurement

Audio Precision

D-D AVL MEASUREMENT

08/28/14 17:35:07



Color	Line Style	Thick	Data	Axis
Blue	Solid	1	DSP Anlr.Level A	Left
Blue	Solid	1	DSP Anlr.Level B	Left
Red	Solid	1	DSP Anlr.Level A	Left

Digital input/ Digital Output. X-axis is input signal level. Y-axis is output signal level.

AVL with L mode:
Clipping level = -16dBFS.
AT: 100 msec.
RT: 2 sec.

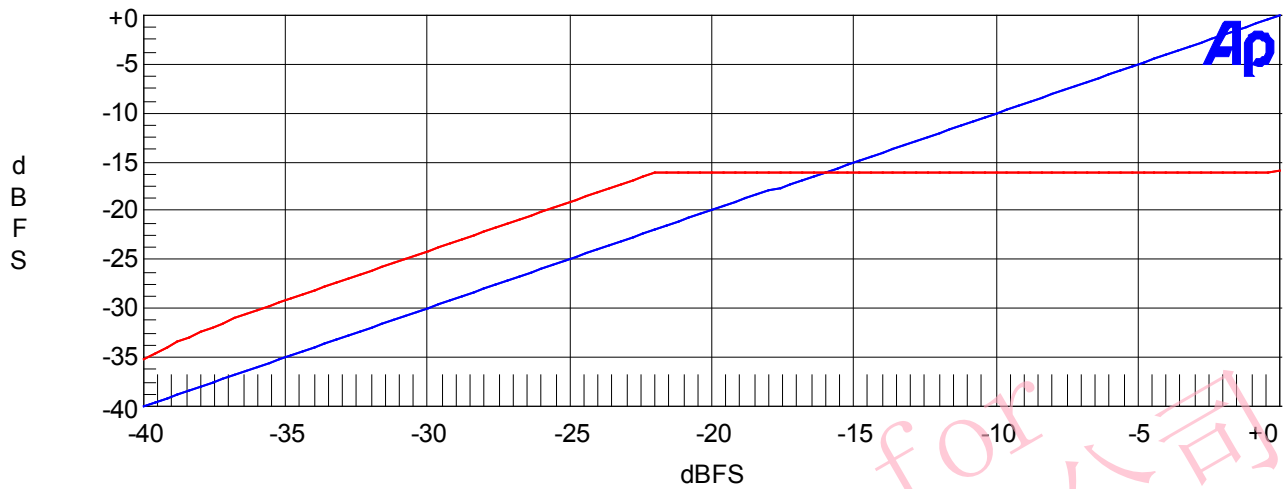
D-D AVL.at2

Figure 7: AVL with L Mode Measurement

Audio Precision

D-D AVL MEASUREMENT

08/28/14 18:01:19



Color	Line Style	Thick	Data	Axis
Blue	Solid	1	DSP Anlr.Level A	Left
Blue	Solid	1	DSP Anlr.Level B	Left
Red	Solid	1	DSP Anlr.Level A	Left

Digital input/ Digital Output. X-axis is input signal level. Y-axis is output signal level.

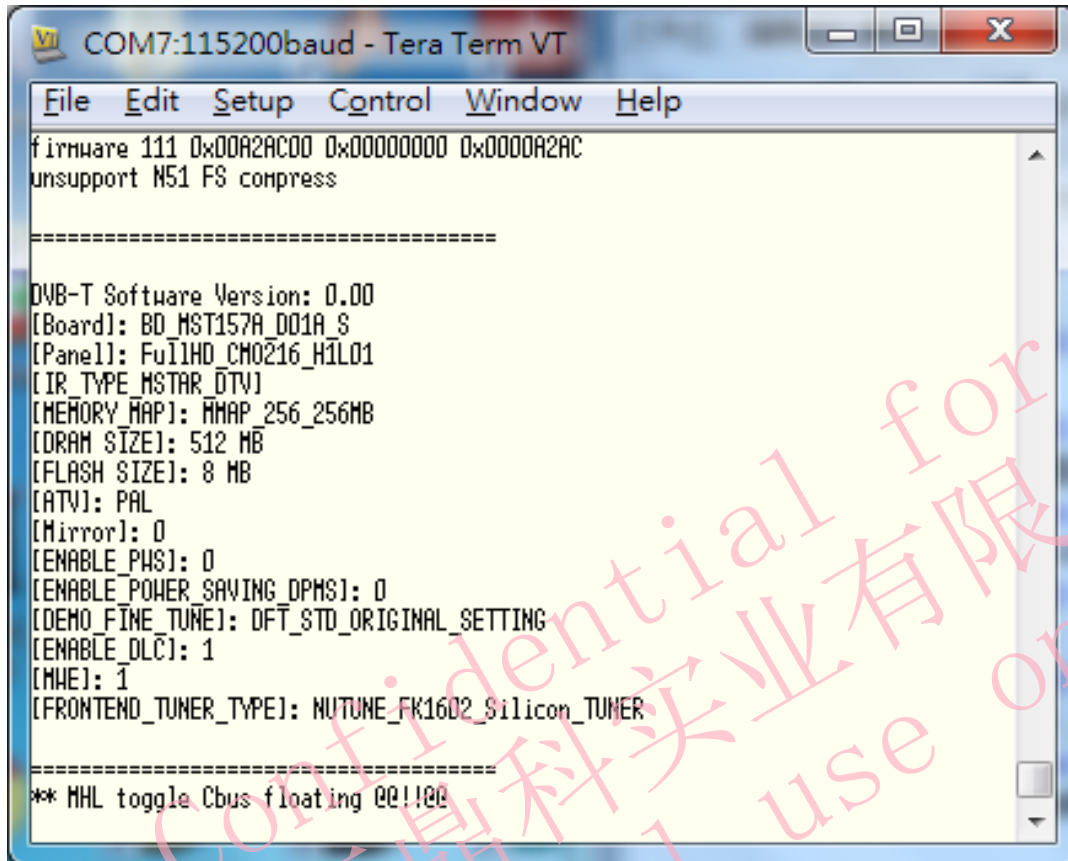
AVL with S mode:
Clipping level = -16dBFS.
AT: 100 msec.
RT: 2 sec.

D-D AVL.at2

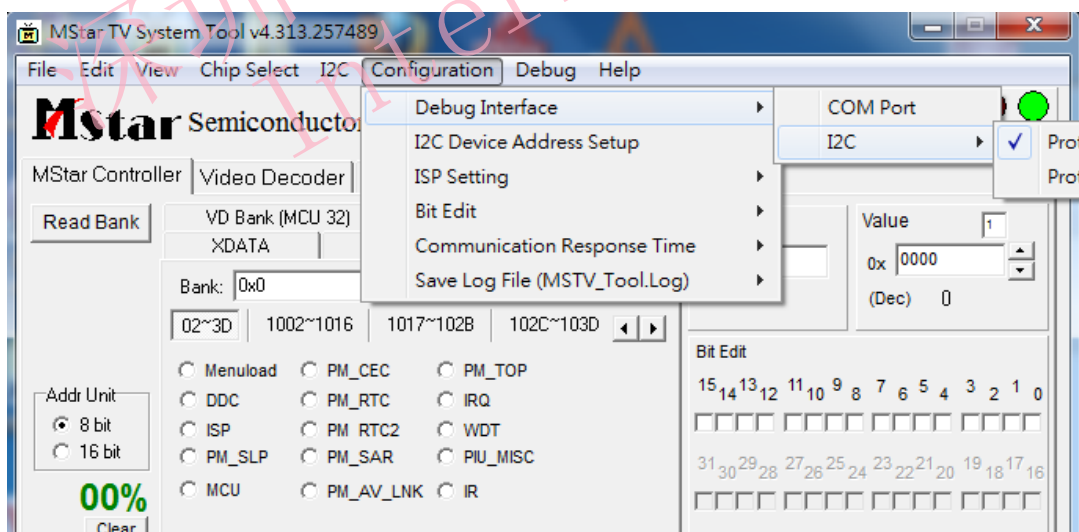
Figure 8: AVL with S Mode Measurement

1.6. PEQ Tuning

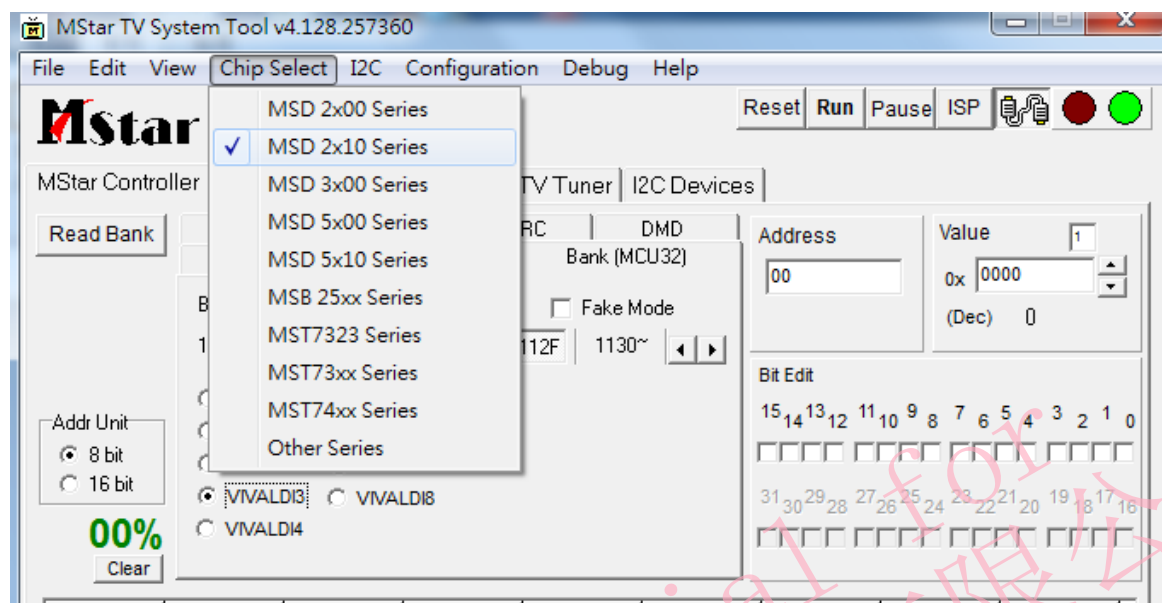
1. Open Tera Term or any console APP and type "00 11 22 33" to allow MSTV tool accessible.



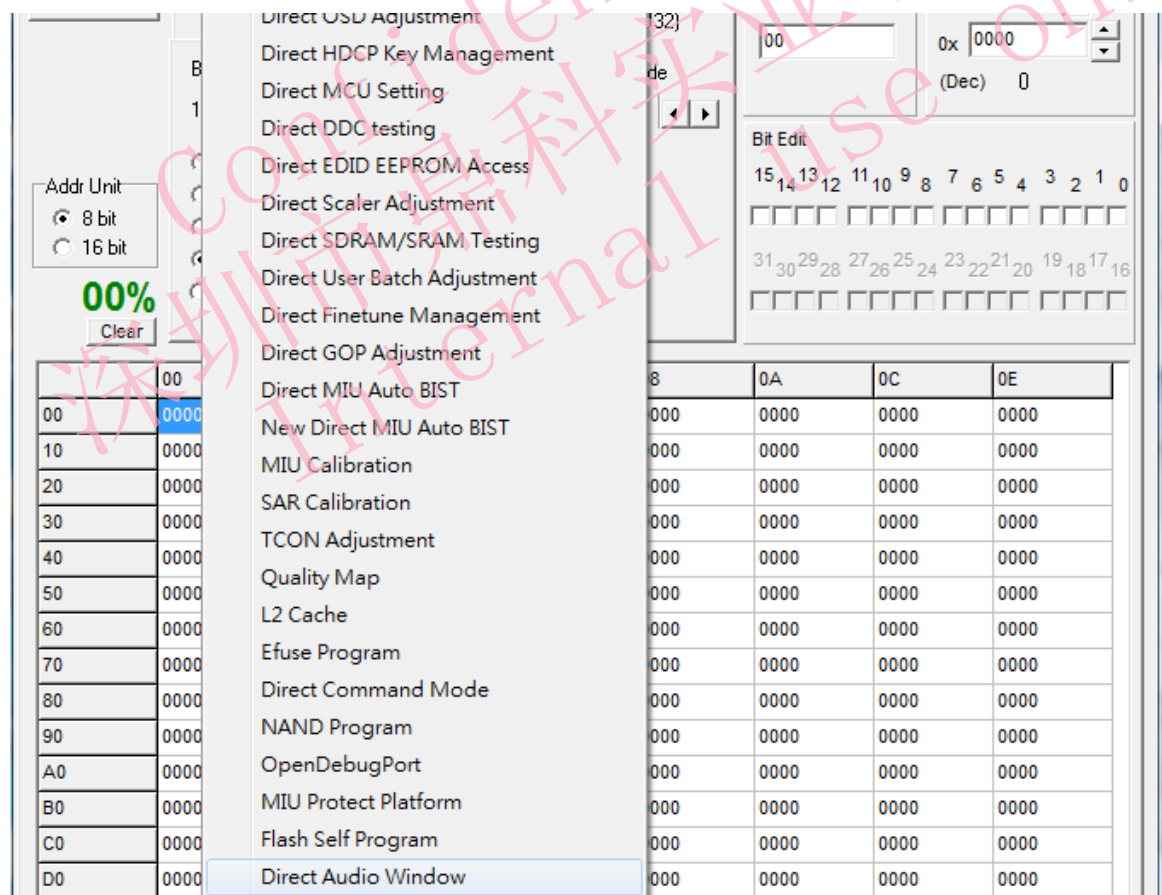
2. Set Debug Interface as "I2C".



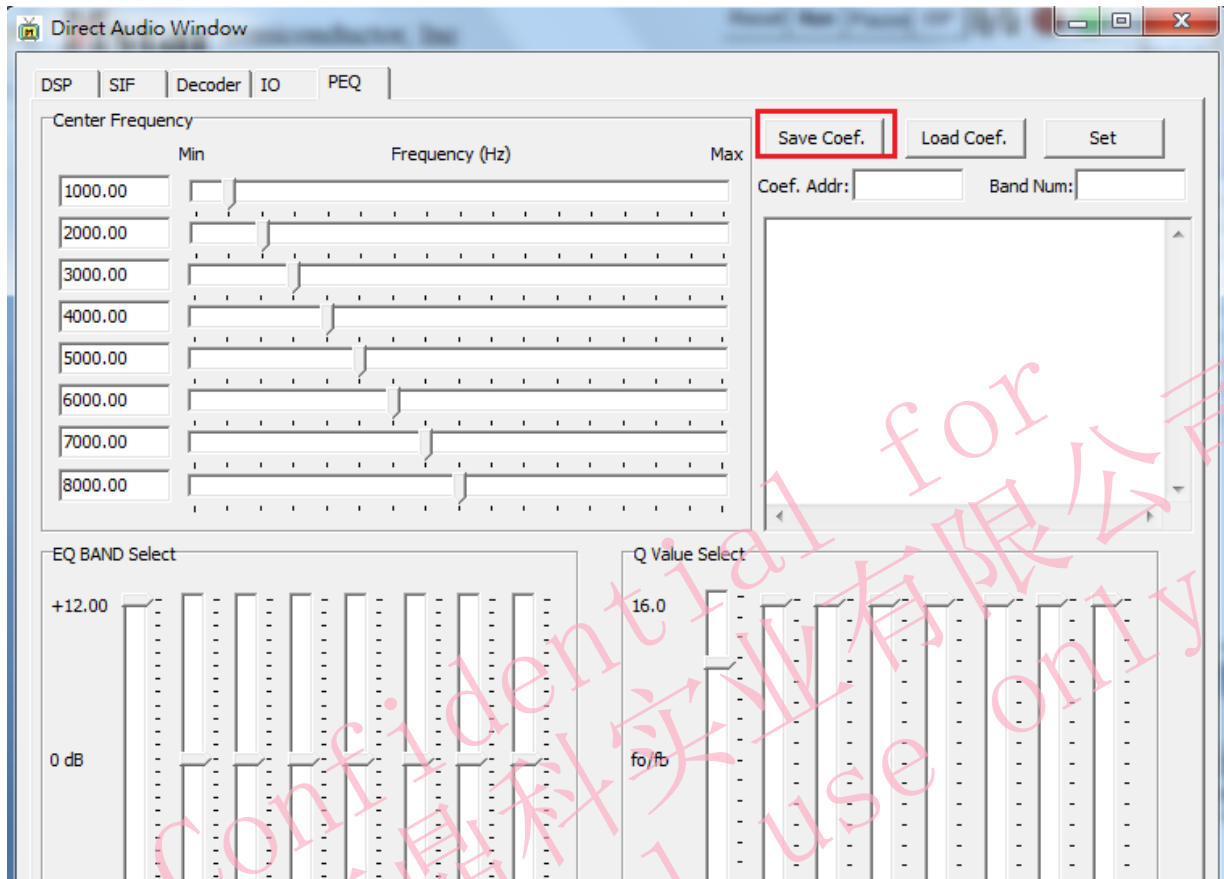
3. Set Chip as MSD 2x10 Series



4. View → Direct Audio Window

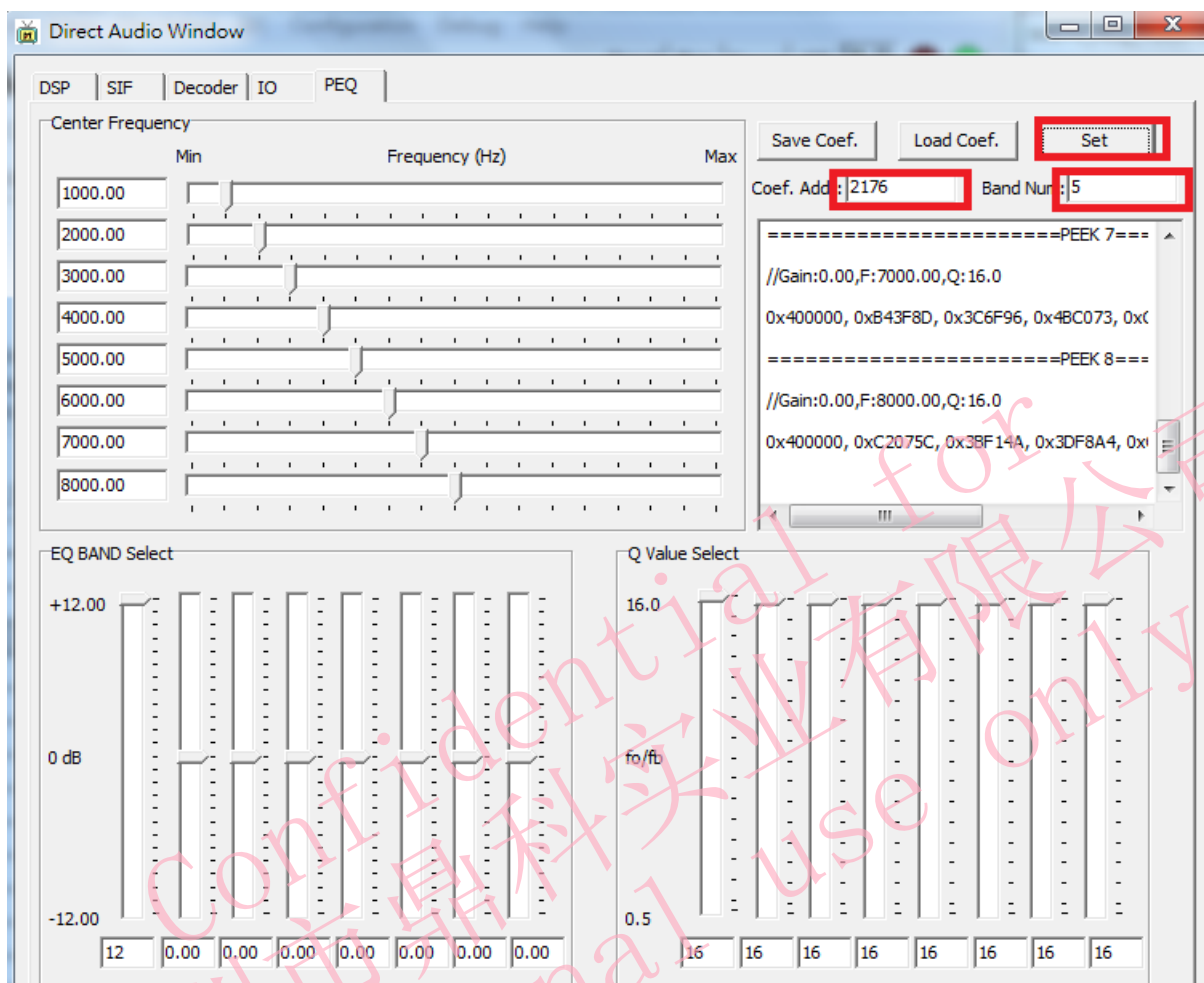


5. Drag slide bars to adjust Fc, Gain and Q of each band. Then press button "Save Coef" to save PEQ coefficients into text file.



6. Get values of "Coef Addr" and "Band Num" of each model from MStar Audio Engineer and fill them into the columns.
Ex. "Coef Addr" = 0x1910, "Band Num" = 8

- Press button "Set" to write PEQ coefficient into DSP.



2. ADVANCED SOUND EFFECT API

2.1.

Description

This function is used to enable/disable SRS-TSXT/SRS-TSHD/SRS-PURESOUND

Syntax

MAPI_BOOL mapi_audio::ADVSND_ProcessEnable(const ADVSND_TYPE_ type) const

Parameters

type [IN] SRS_TSXT_: Enable
type [IN] SRS_TSHD_: Enable
type [IN] SRS_PURESND_: Enable
type [IN] ADV_NONE_: Disable

Return Value

None

Remarks

None

2.2.

Description

This function is used to enable/disable sub-function of SRS-TSXT/SRS-TSHD/SRS-PURESOUND

Syntax

MAPI_BOOL mapi_audio::ADVSND_SubProcessEnable(const ADVFUNC_ proc, const MAPI_BOOL enable) const

Parameters

proc	enable	Description
SRS_TSXT_TRUBASS_	TRUE/FALSE	Enable/disable TSXT trubass
SRS_TSXT_DC_	TRUE/FALSE	Enable/disable TSXT DC
SRS_TSHD_TRUBASS_	TRUE/FALSE	Enable/disable TSHD trubass
SRS_TSHD_DC_	TRUE/FALSE	Enable/disable TSHD DC
SRS_TSHD_DEFINITION_	TRUE/FALSE	Enable/disable TSHD Definition
SRS_PURESOUND_HL_	TRUE/FALSE	Enable/disable PURESOUND Hard Limiter
SRS_PURESOUND_AEQ_	TRUE/FALSE	Enable/disable PURESOUND Active EQ
SRS_PURESOUND_HPF_	TRUE/FALSE	Enable/disable PURESOUND HPF
SRS_PURESOUND_TBHD_	TRUE/FALSE	Enable/disable PURESOUND TrubassHD

Return Value

None

Remarks

None

2.3.

Description

This function is used to set parameters of SRS-XT/SRS-TSHD/SRS-PURESOUND

Syntax for SRS-XT/SRS-TSHD

```
MAPI_BOOL mapi_audio::ADVSND_SetParam(const ADVSND_PARAM_ param, const MAPI_U16 u16value1, const MAPI_U16 u16value2) const
```

Parameters

param	u16value1	Description
SRS_TSXT_SET_INPUT_GAIN_	0~11 (0dB, -1dB, -2dB ... -11dB)	Set TruSurround Input Gain
SRS_TSXT_SET_DC_GAIN_	0~11 (0dB, -1dB, -2dB ... -11dB)	Set Focus Elevation level
SRS_TSXT_SET_TRUBASS_GAIN_	0~11 (0dB, -1dB, -2dB ... -11dB)	Set TruBass Gain
SRS_TSXT_SET_SPEAKERSIZE_	0~3 (100Hz, 150Hz, 200Hz, 250Hz)	Set Speak Size
SRS_TSXT_SET_INPUT_MODE_	0: k2_0 1: k1_0 2: kPassiveMatrix	
SRS_TSHD_SET_INPUT_MODE_	1: k2_0_1 (SRS 3D) 8: kLtRt_	
SRS_TSHD_SET_OUTPUT_MODE_	k2_0_0 (fixed)	
SRS_TSHD_SET_SPEAKERSIZE_	0: 40Hz 1: 60Hz 2: 100Hz 3: 150Hz 4: 200Hz 5: 250Hz 6: 300Hz 7: 400Hz	Set Speak Size
SRS_TSHD_SET_TRUBASS_CONTROL_	0~10: 1.0, 0.9, 0.8, ..., 0 (step 0.1)	Set TruBass Gain
SRS_TSHD_SET_DEFINITION_CONTROL_	0~10: 1.0, 0.9, 0.8, ..., 0 (step 0.1)	Set Definition Gain
SRS_TSHD_SET_DC_CONTROL_	0~10: 1.0, 0.9, 0.8, ..., 0 (step 0.1)	Set DC Gain
SRS_TSHD_SET_SURROUND_LEVEL_	0~10: 1.0, 0.9, 0.8, ..., 0 (step 0.1)	Set Surround Level
SRS_TSHD_SET_INPUT_GAIN_	0~10: 1.0, 0.9, 0.8, ..., 0 (step 0.1)	Set Input Gain

param	u16value1	Description
SRS_TSHD_SET_WOWSPACE_CONTROL_	0~10: 1.0,0.9, 0.8, ...,0 (step 0.1)	Set Wow Space Control
SRS_TSHD_SET_WOWCENTER_CONTROL_	0~10: 1.0,0.9, 0.8, ...,0 (step 0.1)	Set Wow Center Control
SRS_TSHD_SET_WOWHDSRS3DMODE_	0~10: 1.0,0.9, 0.8, ...,0 (step 0.1)	Set Wow SRS 3D Mode
SRS_TSHD_SET_LIMITERCONTROL_	0~10: 1.0,0.9, 0.8, ...,0 (step 0.1)	Set limiter Control
SRS_TSHD_SET_OUTPUT_GAIN_	0~10: 2.0, 1.8, 1.6,...,0 (step 0.2)	Set Output Gain

Return Value

None

Remarks

None

Syntax for SRS-PURESOUND

MAPI_BOOL mapi_audio::ADVSND_SetParam(const ADVSND_PARAM_ param, const MAPI_U32 u32value)

Parameters

param	u32value	Description
SRS_PURESOUND_HL_INPUT_GAIN_	(0x0~0x7FFFFFFF)x4	Set Hard Limiter Input Gain
SRS_PURESOUND_HL_OUTPUT_GAIN_	(0x0~0x7FFFFFFF)x4	Set Hard Limiter Output Gain
SRS_PURESOUND_HL_BYPASS_GAIN_	0x0~0x7FFFFFFF	Set Hard Limiter Bypass Gain
SRS_PURESOUND_HL_LIMITERBOOST_	(0x1~0x7FFFFFFF)x32	Set Hard Limiter Boost
SRS_PURESOUND_HL_HARDLIMIT_	0x0~0x7FFFFFFF	Set Hard Limiter Gain
SRS_PURESOUND_HL_DELAYLEN_	6~48	Set Hard Limiter Delay Length
SRS_PURESOUND_AEQ_INPUT_GAIN_	0x0~0x7FFFFFFF	Set AEQ Input Gain
SRS_PURESOUND_AEQ_OUTPUT_GAIN_	0x0~0x7FFFFFFF	Set AEQ Output Gain
SRS_PURESOUND_AEQ_BYPASS_GAIN_	0x0~0x7FFFFFFF	Set AEQ Bypass Gain
SRS_PURESOUND_HPF_FREQUENCY_	0~3 0: 60Hz 1: 80Hz 2: 100Hz 3: 120Hz	Set HPF Frequency
SRS_PURESOUND_TBHD_TRUBASS_LEVEL_	0x0~0x7FFFFFFF	Set TBHD Level
SRS_PURESOUND_TBHD_LEVEL_INDEPENDENT_EN_	0/1 (disable/enable)	Set TBHD Level Independent Enable
SRS_PURESOUND_TBHD_COMPRESSOR_LEVEL_	0x0~0x7FFFFFFF	Set TBHD Compressor Level

param	u32value	Description
SRS_PURESOUND_TBHD_SPEAKER_AUDIO_	0~8 0: 40Hz 1: 60Hz 2: 100Hz 3: 120Hz 4: 150Hz 5: 200Hz 6: 250Hz 7: 300Hz 8: 400Hz	Set TBHD Speaker Audio Frequency
SRS_PURESOUND_TBHD_SPEAKER_ANALYSIS_	0~8 0: 40Hz 1: 60Hz 2: 100Hz 3: 120Hz 4: 150Hz 5: 200Hz 6: 250Hz 7: 300Hz 8: 400Hz	Set TBHD Speaker Analysis Frequency
SRS_PURESOUND_INPUT_GAIN_	0x0~0x7FFFFFFF	Set PureSound Input Gain
SRS_PURESOUND_OUTPUT_GAIN_	0x0~0x7FFFFFFF	Set PureSound Output Gain

Return Value

None

Remarks

None

3. ADVANCE SOUND EFFECT TUNING

3.1. SRS-TSXT Tuning

Description

Register 112D42h is used to enable/disable sub-function and set parameters of SRS-TSXT for on-line tuning purpose.

Index	Mnemonic	Bit	Description
112D42h	ADVSUND_CTRL	15:0	Default : 0x00 Access : R/W
	TYPE	15:12	1 = TSInputGain 2 = FocusElevation 3 = TruBassInputGain 4 = TruBassSpeak 5 = enTrubass 6 = enDialog_clarity
	VALUE	11:8	0~11 (0db,-1db,-2db,...,-11db) when 112D42[15:12] = 1 => TSInputGain value 0~11 (0db,-1db,-2db,...,-11db) when 112D42[15:12] = 2 => FocusElevation value 0~11 (0db,-1db,-2db,...,-11db) when 112D42[15:12] = 3 => TruBassInputGain value 0~3 (100Hz, 150Hz, 200Hz, 250Hz) when 112D42[15:12] = 4 => TruBass Speak Size 0:disable, 1:enable when 112D42[15:12] = 5 => enable/disable Trubass 0:disable, 1:enable when 112D42[15:12] = 6 => enable/disable Dialog_clarity

3.2. SRS-TSHD Tuning

Description

Register 112D42h is used to enable/disable sub-function and set parameters of SRS-TSHD for on-line tuning purpose.

Index	Mnemonic	Bit	Description
112D42h	ADVSUND_CTRL	15:0	Default : 0x00 Access : R/W
	TYPE	15:8	1 = SetInputMode 3 = SpeakerSize 4 = TruBassControl 5 = DefinitionControl 6 = FOCUSControl 7 = SurroundLevel 9 = InputGain A = WowSpaceControl B = WowCenterControl C = WOWHDSRS3DMode D = LimiterControl E = OutputGain F = enTrubass 10 = enDefinition 11 = enDialog_clarity 12 = enTruSurroundHD 13 = enLimiter 14 = enSRS3D
112D42h	VALUE	7:0	0:k2_0_1, 8:kLtRt when 112D42[15:8] = 1 => SetInputMode 0, 1, ..., 7 (40Hz, 60Hz, ..., 400Hz) when 112D42[15:8] = 3 => TruBass Speak Size 0~10 (1.0, 0.9, ..., 0.1, 0) when 112D42[15:8] = 4 => TruBassControl 0~10 (1.0, 0.9, ..., 0.1, 0) when 112D42[15:8] = 5 => DefinitionControl 0~10 (1.0, 0.9, ..., 0.1, 0) when 112D42[15:8] = 6 => FOCUSControl 0~10 (1.0, 0.9, ..., 0.1, 0) when 112D42[15:8] = 7 => SurroundLevel 0~10 (1.0, 0.9, ..., 0.1, 0) when 112D42[15:8] = 9 => InputGain 0~10 (1.0, 0.9, ..., 0.1, 0) when 112D42[15:8] = A => WowSpaceControl 0~10 (1.0, 0.9, ..., 0.1, 0) when 112D42[15:8] = B => WowCenterControl 0: kSrsSRS3DMono, 2: kSrsSRS3DStereo, 3: kSrsSRS3DExtreme when 112D42[15:8] = C => WOWHDSRS3DMode

Index	Mnemonic	Bit	Description
			0~10 (1.0, 0.9, ..., 0.1, 0) when 112D42[15:8] = D => LimiterControl 0~10 (2.0, 1.8, ..., 0.2, 0) when 112D42[15:8] = E => OutputGain 0:disable, 1:enable when 112D42[15:8] = F => enable/disable Trubass 0:disable, 1:enable when 112D42[15:8] = 10 => enable/disable Definition 0:disable, 1:enable when 112D42[15:8] = 11 => enable/disable Dialog_clarity 0:disable, 1:enable when 112D42[15:8] = 12 => enable/disable TruSurroundHD 0:disable, 1:enable when 112D42[15:8] = 13 => enable/disable Limiter 0:disable, 1:enable when 112D42[15:8] = 14 => enable/disable SRS3D

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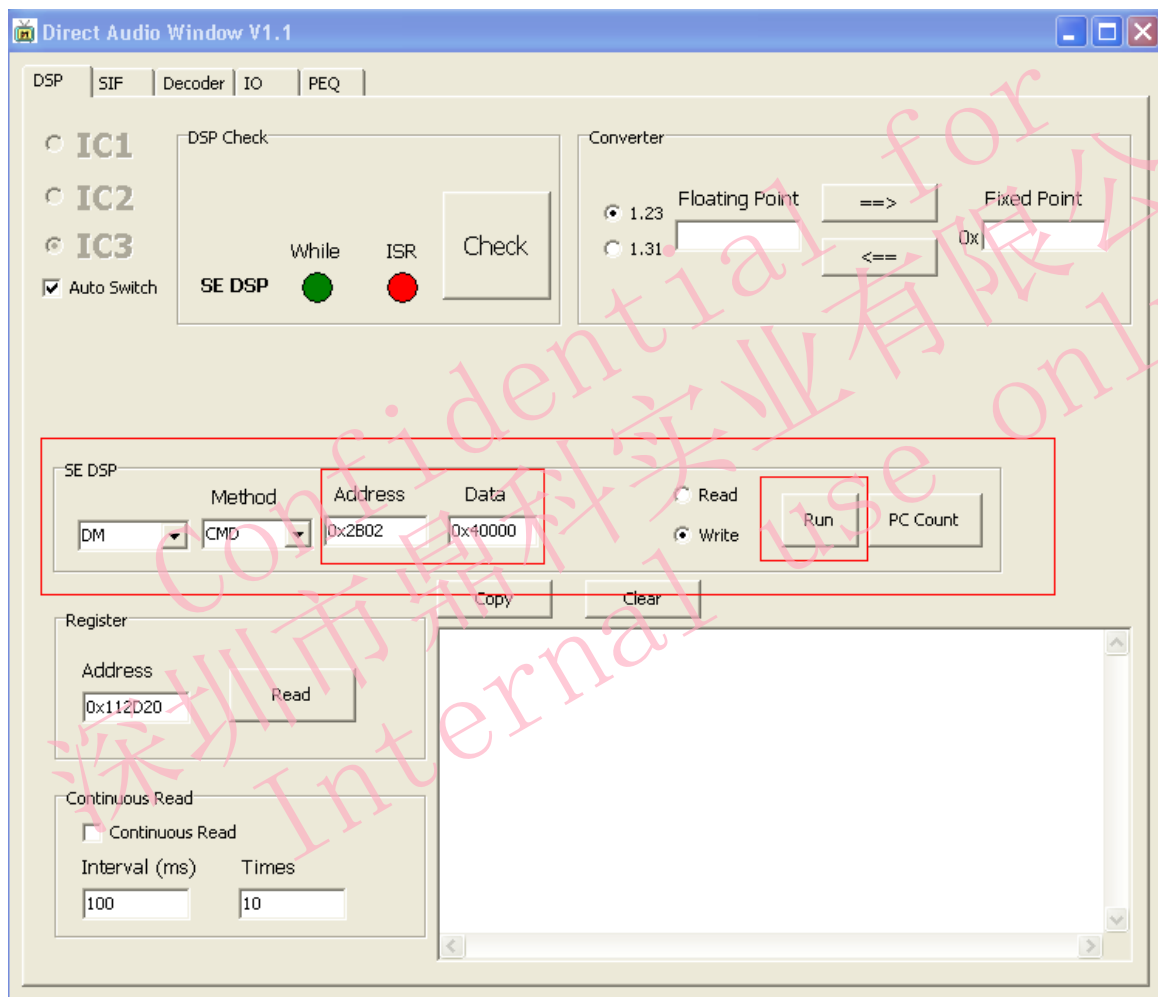
3.3. SRS-PURESOUND Tuning

3.3.1. Tuning Method for Adjusting Parameters

Description

We use Direct Audio Window in MSTV Tool to set Hard Limiter and HPF parameters.
The steps are as below:

1. Open Direct Audio Window in MSTV : View -> Direct Audio Window
2. Ask MStar audio RD for the base address of the parameters (depends on models).
3. Adjust the settings as below.



Address Item

Address = Base address + Offset

Base address: Please ask MStar audio RD (or refer to the definition, DSP2_DM_SEG2_ADDR in audio_comm.h).

Offset: The offset numbers of each parameter are as below

Data Item

Please refer to the table below for the range of each parameter.

Parameter	Offset	Data Range
PureSound Input Gain	2	0x0~0x7FFFFFFF
PureSound Output Gain	3	0x0~0x7FFFFFFF
PureSound Bypass Gain	4	0x0~0x7FFFFFFF
TruBass HD Control Level	6	0x0~0x7FFFFFFF
TruBass HD SpeakerSize Audio	7	0~8 (40, 60, 100, 120, 150, 200, 50, 300, 400Hz)
TruBass HD SpeakerSize Analysis	8	0~8 (40, 60, 100, 120, 150, 200, 50, 300, 400Hz)
TruBass HD Compressor Control	9	0x0~0x7FFFFFFF
TruBass HD Level Independent Enable	10	0/1
High Pass Filter Frequency	12	0~3 (60, 80, 100, 120 Hz)
Hard Limiter Input Gain	25	0x0~0x7FFFFFFF
Hard Limiter Output Gain	26	0x0~0x7FFFFFFF
Hard Limiter Bypass Gain	27	0x0~0x7FFFFFFF
Hard Limiter Limiterboost Gain	28	0x0~0x7FFFFFFF
Hard Limiter Limiter Control	29	0x0~0x7FFFFFFF
Hard Limiter Delay Length	30	6~48
AEQ Input Gain	32	0x0~0x7FFFFFFF
AEQ Output Gain	33	0x0~0x7FFFFFFF
AEQ Bypass Gain	34	0x0~0x7FFFFFFF

Example

Set Hard Limiter Input Gain = 0x 6FFFFFFF (If base address is 0x2E00)

Address = 0x2E00 + 25 = 0x2E19

Data = 0x 6FFFFFFF

3.3.2. Enable/Disable Tuning Methods

Description

We use 0x112D bank register 0x44 in MSTV Tool to enable/disable Hard Limiter and HPF.

0x112D_44 bit4 is for AEQ

0 : disable, 1 : enable

0x112D_44 bit8 is for HPF

0 : disable, 1 : enable

0x112D_44 bit9 is for HardLimiter

0 : disable, 1 : enable

0x112D_44 bit11 is for TruBassHD

0 : disable, 1 : enable

	00	02	04	06	08	0A	0C	0E
00	8C00	8C00	8C00	8C00	8C00	0C00	0000	0C00
10	0000	0000	0000	0000	0000	0000	0000	0000
20	C800	013F	0000	0000	0000	8411	0000	0000
30	0000	0000	0000	0000	0000	0000	0000	0000
40	0000	0000	0000	0000	0000	0000	0000	0000
50	FFF6	FFF6	0446	0000	0000	0C00	0C00	0C00
60	0000	0000	0000	0000	0000	0000	0000	0000
70	0000	0000	0000	0000	0000	0000	0000	0000
80	0000	0000	0000	0000	0000	0000	0000	0000
90	0000	0000	0000	0000	0000	0000	0000	0000
A0	0000	0000	0000	0000	0000	0000	0000	0000
B0	0000	0000	0000	0000	0000	0000	0000	0000
C0	0000	0000	0000	0000	0000	0000	0000	0000
D0	0000	0000	0000	0000	0000	0000	F300	0000
E0	0000	0000	0000	0000	0000	0000	0000	0000
F0	0000	00A9	0000	4E00	5980	0000	0000	0000