MSD91G0xx_MSD3463xx
Single Chip Digital TV Solution

Audio Application Note Version 0.1

REVISION HISTORY

Revision No.	Description	Date
0.1	Ÿ Initial release	11/27/2014

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1. AUDIO DESIGN GUIDE

1.1. Introduction

1.1.1 Audio Features

Audio features supported in MSD91G0xx_MSD3463xx:

- 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 and AC-3 conversion at the same time (Dolby Pulse)
  - DTS / DTS LBR
  - FLAC
  - DRA
  - Vorbis
  - Realaudio (Cook)

1.1.2 Input Interface

- Stereo (L/R) Line-in x 5
- Stereo (L/R) audio ADC x 2
- Stereo differential MIC input x 1
- I2S input (support slave mode) x 1
- 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 MSD91G0xx_MSD3463xx audio block diagram is shown as below:

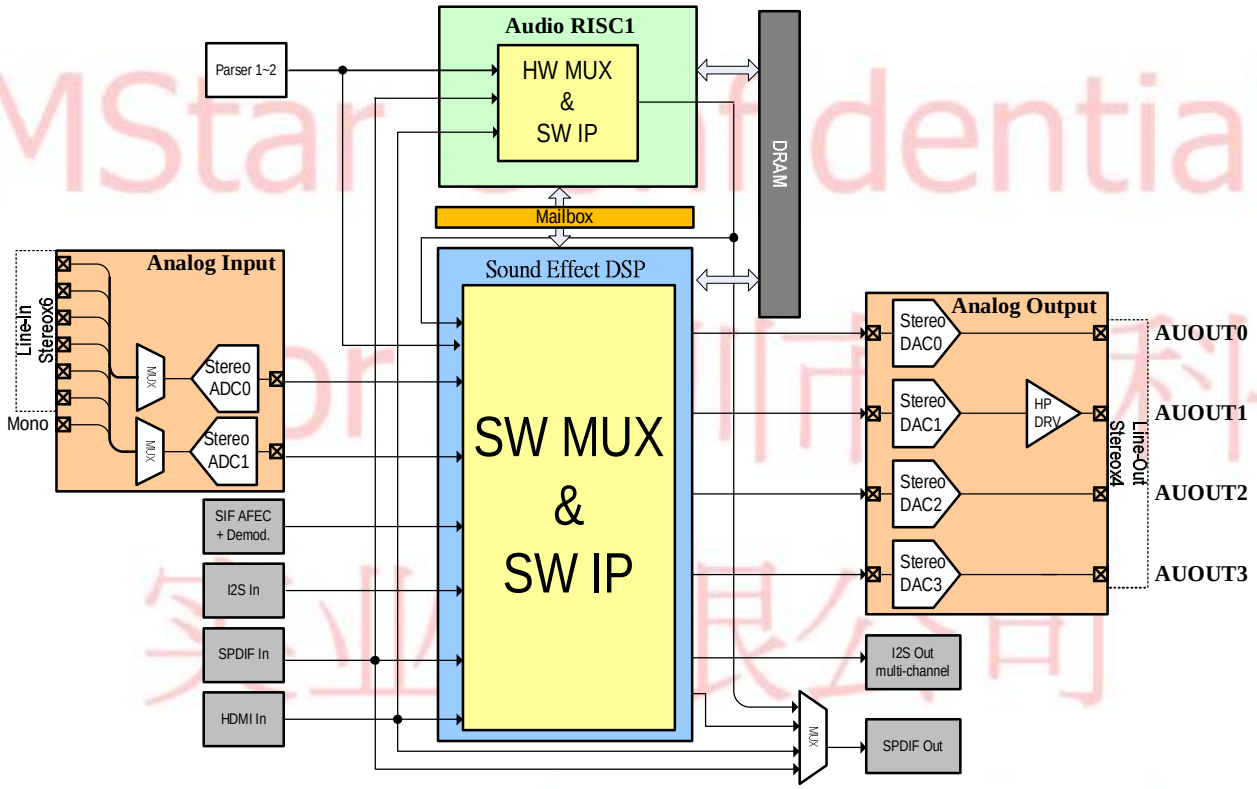


Figure 1: Audio Block Diagram

1.2.1 Audio Tasks

There are one RISC(R2) and one DSP in the MSD91G0xx_MSD3463xx for different audio tasks. Figure 2 shows audio processors task. DEC_R2 Handle all ES decoding. SE_DSP can process ATV input or some ES Encode, and handle some advanced sound effect and basic sound effect.

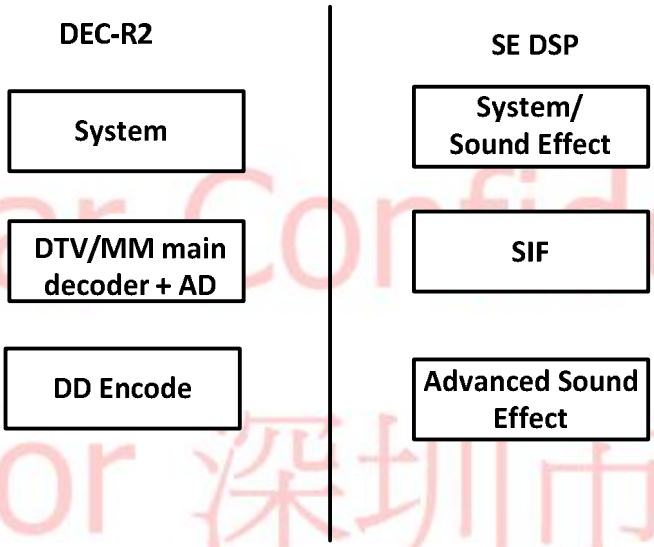


Figure 2: Audio Tasks

1.2.2 Audio Path Configuration

There are six output paths in the MSD91G0xx_MSD3463xx. 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 3 shows the input/output connectivity for the audio applications:

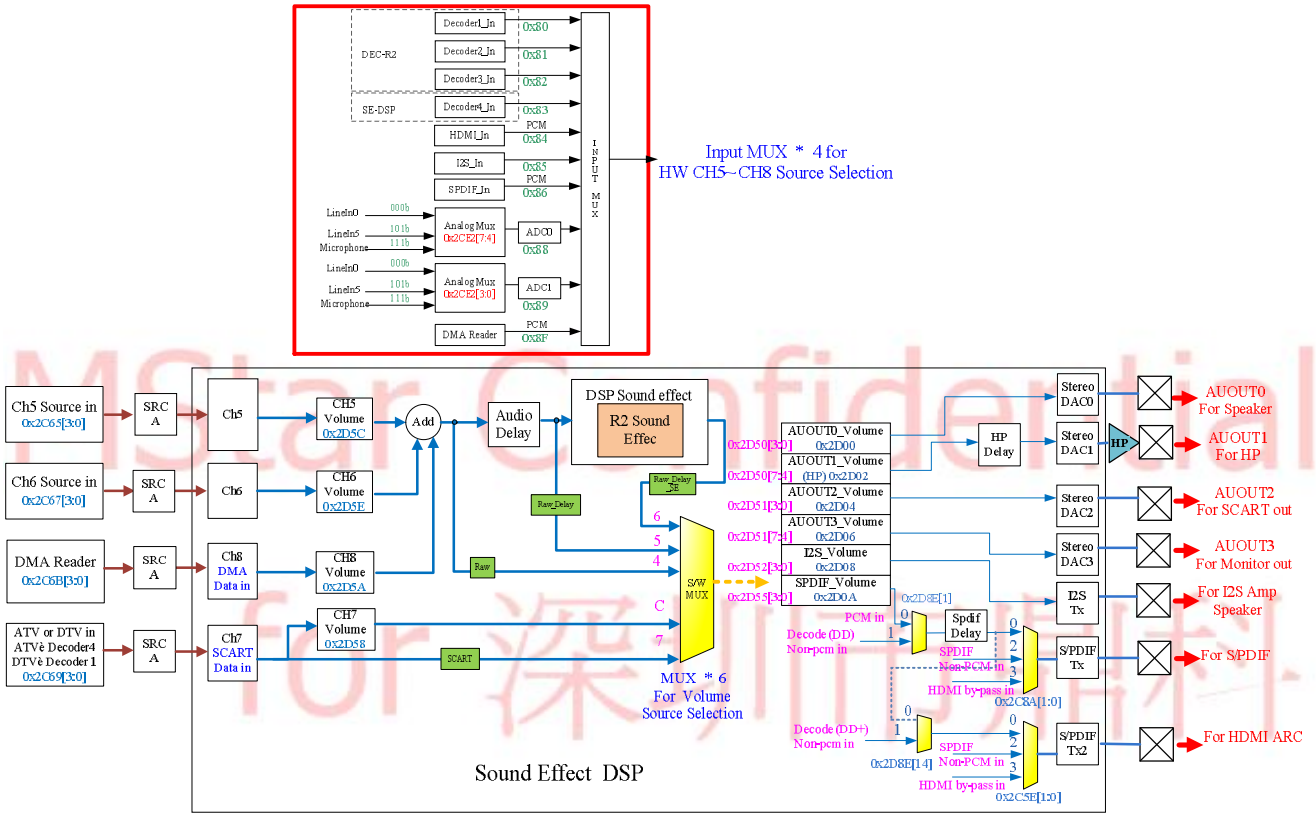


Figure 3: Audio Path

1.2.3 Sound Effect Register Definition

The sound effect path is shown as below:

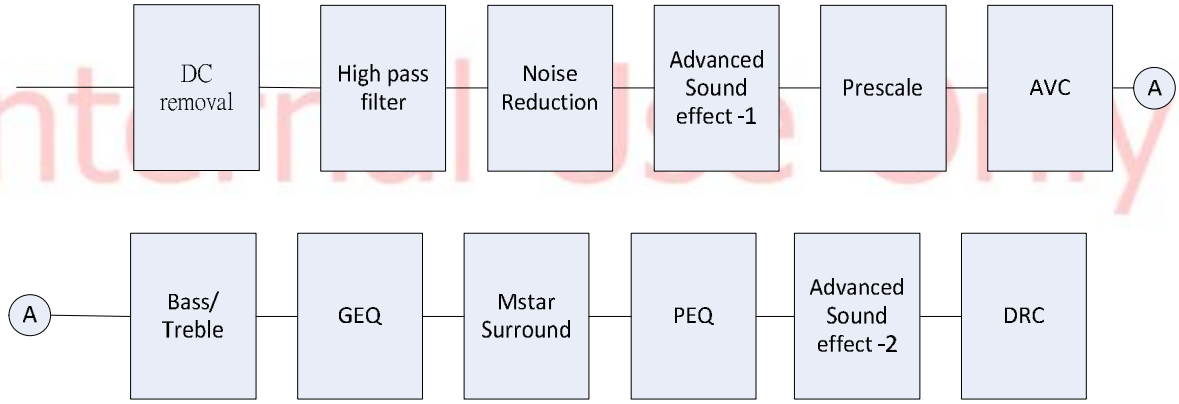


Figure 4: Sound Effect Flow

Advanced Sound Effect

The MSD91G0xx_MSD3463xx supports the following advanced sound effects:

- DTS Studio Sound

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. MSD91G0xx_MSD3463xx 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 MSD91G0xx_MSD3463xx 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.

Ÿ 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) 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	

Audio Sound Effect Register (Bank = 112Dh)				
Index	**Mnemonic**	**Bit**	**Description**	
			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) 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	

Audio Sound Effect Register (Bank = 112Dh)				
Index	**Mnemonic**	**Bit**	**Description**	
			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) 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	

Audio Sound Effect Register (Bank = 112Dh)				
Index	**Mnemonic**	**Bit**	**Description**	
			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) 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

Audio Sound Effect Register (Bank = 112Dh)				
Index	**Mnemonic**	**Bit**	**Description**	
	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 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	

Audio Sound Effect Register (Bank = 112Dh)				
Index	**Mnemonic**	**Bit**	**Description**	
			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 … 0x01 = +0.25 db 0x00 = 0 db 0xFF = -0.25 db … 0xD0 = -12.00 db	
	RESERVED	7:0	Reserved	
112D1Eh	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	
	BALANCE_R	7:0	Right Channel attenuation level (-0.25 db/step)	

Audio Sound Effect Register (Bank = 112Dh)				
Index	**Mnemonic**	**Bit**	**Description**	
			0x00 = 0 db 0x01 = -0.25 db … 0xFE = -63.5 db 0xFF = mute	
112D20h	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	
	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	

Audio Sound Effect Register (Bank = 112Dh)				
Index	**Mnemonic**	**Bit**	**Description**	
			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 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	

Audio Sound Effect Register (Bank = 112Dh)				
Index	**Mnemonic**	**Bit**	**Description**	
			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	
	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	

Audio Sound Effect Register (Bank = 112Dh)				
Index	**Mnemonic**	**Bit**	**Description**	
	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	
112D30h	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 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

Audio Sound Effect Register (Bank = 112Dh)				
Index	**Mnemonic**	**Bit**	**Description**	
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. 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)	

Audio Sound Effect Register (Bank = 112Dh)				
Index	**Mnemonic**	**Bit**	**Description**	
			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 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	

Audio Sound Effect Register (Bank = 112Dh)				
Index	**Mnemonic**	**Bit**	**Description**	
			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)	
	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)	

Audio Sound Effect Register (Bank = 112Dh)				
Index	**Mnemonic**	**Bit**	**Description**	
			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 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 refer to the Raw, Raw_Delay, Raw_Delay_SE and SCART in Figure 3.

1.3. Decoder RISC Register Definition

Table 2: DEC-R2 Register Table

DEC-R2 Register (Bank = 112Eh)				
Index	**Mnemonic**	**Bit**	**Description**	
112E98h	**DECODER1_STATUS**	**15:0**	**Default : 0x00**	**Access : R/W**
	DECODER_CMD	15:8	0x1 : DTV Play or HDMI play 0x2 : MM Ts 0x3 : MM GStreamer 0x4 : MM 0x5 : Loop mode(Test) Bit 12 = 1: AD Enable Bit 13 = 1 : Broswer Bit 14 = 1: Pause Bit 15 = 1: FreeRun	
	DECODER_TYPE	7:0	adec_type_dummy = 0x0, adec_type_ac3 = 0x1, adec_type_ac3p = 0x2, adec_type_mpeg = 0x3, adec_type_dts = 0x4, adec_type_aac = 0x5, adec_type_aacp = 0x6, adec_type_xpcm = 0x7, adec_type_vorbis = 0x8, adec_type_flac = 0x9, adec_type_wma = 0xA, adec_type_wmap = 0xB, adec_type_ra8 = 0xC, adec_type_gaac = 0xD, adec_type_ext_pcm = 0xE, adec_type_dolby_truhd_bypass = 0xF, adec_type_dra = 0x10,	
112E9Ah	**DECODER2_STATUS**	**15:0**	**Default : 0x00**	**Access : R/W**
	DECODER_CMD	15:8	0x1 : DTV Play or HDMI play 0x2 : MM Ts 0x3 : MM GStreamer 0x4 : MM 0x5 : Loop mode(Test) Bit 12 = 1: AD Enable Bit 13 = 1 : Broswer Bit 14 = 1: Pause Bit 15 = 1: FreeRun	
	DECODER_TYPE	7:0	Decoder Status	

DEC-R2 Register (Bank = 112Eh)			
Index	**Mnemonic**	**Bit**	**Description**
			adec_type_dummy = 0x0, adec_type_ac3 = 0x1, adec_type_ac3p = 0x2, adec_type_mpeg = 0x3, adec_type_dts = 0x4, adec_type_aac = 0x5, adec_type_aacp = 0x6, adec_type_xpcm = 0x7, adec_type_vorbis = 0x8, adec_type_flac = 0x9, adec_type_wma = 0xA, adec_type_wmap = 0xB, adec_type_ra8 = 0xC, adec_type_gaac = 0xD, adec_type_ext_pcm = 0xE, adec_type_dolby_truhd_bypass = 0xF, adec_type_dra = 0x10,
112E9Eh	**DEC_R2 DEBUG MSG**	**15:0**	**Default : 0x00** **Access : R/W**
	Reserved	15:8	Reserved
	Debug Index	7:0	0x0 : none 0x1 : General info(by yourself) 0x2 : Interrupt Info 0x3 : printf_DSP2_to_R2_MBOX 0x4 : printf_R2_to_DSP2_MBOX 0x5 : Dump_ddr 0x8: Print_preAsndBuf_info 0x9: print_postAsndBuf_info() 0x10 : es_info(ES1) 0x11 : es_info(ES2) 0x12 : pcm_info(ADEC1) 0x13 : pcm_info(ADEC2) 0x14 : dec_info(ADEC1) 0x15 : dec_info(ADEC2) 0x16 : avSync_info(ADEC1) 0x17 : avSync_info(ADEC2) 0x18 : PTS_table(ADEC1) 0x19 : PTS_table(ADEC2) Enable_dec_dbgMsg: 0x1a : (ADEC1, TRUE) 0x1b : (ADEC1, FALSE) 0x1c : (ADEC2, TRUE) 0x1d : (ADEC2, FALSE) 0x1e : decoder_instance(ADEC1)

DEC-R2 Register (Bank = 112Eh)			
Index	**Mnemonic**	**Bit**	**Description**
			0x1f : decoder_instance(ADEC2) 0x20 : printf_spdif_info 0x21 : dmaReader_config 0x22 : DPGA_config 0x23 : printf_security 0x24 : print_omx_info(ADEC1) 0x25 : print_omx_info(ADEC2) 0x26 : es_info(ES3) 0x27 : es_info(ES4)
112EB2h	**DEC_R2 COUNTER**	**15:0**	**Default : 0x00** **Access : R/W**
	Timer counter	15:8	DEC-R2 timer counter
	While counter	7:0	DEC-R2 alive counter

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. Sound Effect DSP Mailbox Definition

Table 3: SE-DSP Register Table

SE-DSP 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	

SE-DSP Register (Bank = 112Dh)				
Index	**Mnemonic**	**Bit**	**Description**	
			01= mode 1 (narrow bandwidth, 130k~260k) 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) ß à FM/AM Mono ß à Mute 0x01 = FM/AM Mono 0x02 = Stereo L / R ß à FM/AM Mono 0x03 = Stereo L / L ß à FM/AM Mono 0x04 = Stereo R / R ß à FM/AM Mono 0x05 = Dual A/ B ß à FM/AM Mono 0x06 = Dual A / A ß à FM/AM Mono	

SE-DSP Register (Bank = 112Dh)				
Index	**Mnemonic**	**Bit**	**Description**	
			0x07 = Dual B / B ß à FM/AM Mono 0x08 = Nicam Mono ß à 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	
112DCCh	**PIDIO_TAG**	**15:0**	**Default : 0x00**	**Access : R/W**
	PIO_ID	15:8	HK PIO ID while send PIO interrupt to SE-DSP 0xE0 : MM 0xE1 : Encode	
	MM_TAG	7:0	HK sends tag to MM decoder while assert PIO interrupt This tag should increase by 1 for every PIO interrupt	
112DCEh	**SE_PUBLIC**	**15:0**	**Default : 0x00**	**Access : R/W**
112DD0h	**SE_PUBLIC**	**15:0**	**Default : 0x00**	**Access : R/W**
112DD2h	**SE_PUBLIC**	**15:0**	**Default : 0x00**	**Access : R/W**
112DD4h	**SE_PUBLIC**	**15:0**	**Default : 0x00**	**Access : R/W**
112DD6h	**SE_PUBLIC**	**15:0**	**Default : 0x00**	**Access : R/W**
112DD8h	**SE_PUBLIC**	**15:0**	**Default : 0x00**	**Access : R/W**
112DDAh	**SE_PUBLIC**	**15:0**	**Default : 0x00**	**Access : R/W**
112DDCh	**SE_DEBUG1**	**15:0**	**Default : 0x00**	**Access : R/W**
	DEBUG_CMD	15:8	Decoder Command 0x90 = read system version	

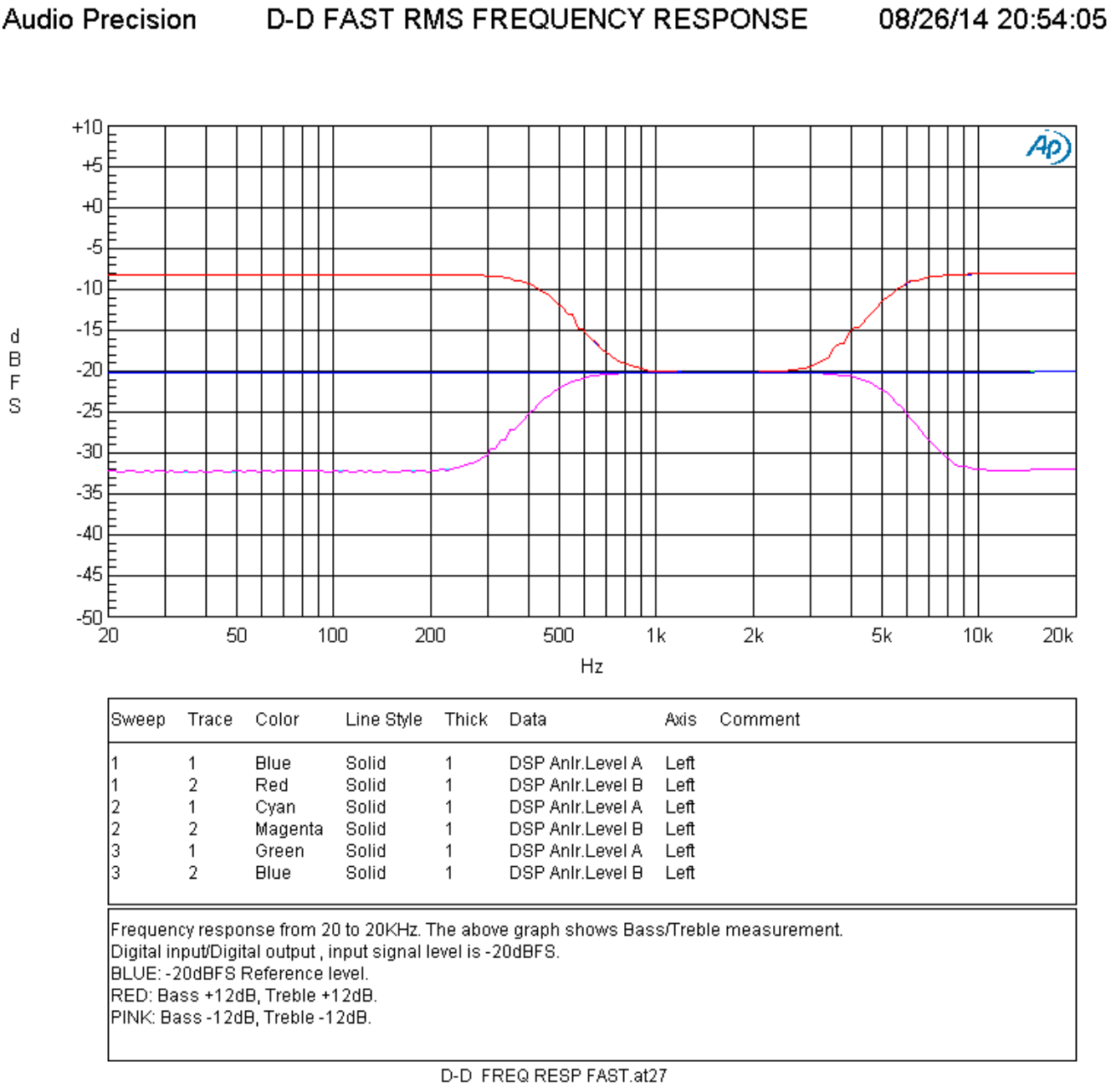
SE-DSP Register (Bank = 112Dh)				
Index	**Mnemonic**	**Bit**	**Description**	
			0x91 = read DEC1 version 0x92 = read DEC2 version 0x02 = set PM/DM address 0x03 = write DM data 0x04 = write PM data 0x05 = read DM data 0x06 = read PM data	
	DEBUG_PARAMETER1	7:0	Bit[23:16] for debug address or data	
112DDEh	**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	**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	
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	

SE-DSP Register (Bank = 112Dh)				
Index	**Mnemonic**	**Bit**	**Description**	
	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 exis 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_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)	
112DF0h	**RESERVED**	**15:0**	**Default : 0x00**	**Access : R**
112DF2h	**SE_BUFFER_STATUS**	**15:0**	**Default : 0x00**	**Access : R**

SE-DSP Register (Bank = 112Dh)				
Index	**Mnemonic**	**Bit**	**Description**	
	BUFFER_OVERFLOW	15:8	SE-DSP buffer overflow counter	
	BUFFER_UNDERFLOW	7:0	SE-DSP buffer underflow counter	
112DF4h	**PCM UPLOAD CNT**	**15:0**	**Default : 0x00**	**Access : R**
112DF6h	**INT_ID**	**15:0**	**Default : 0x00**	**Access : R**
	INT_ID	15:8	SE-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 = reserved	
	SE_ISR_CNT	7:0	SE-DSP ISR counter	
112DF8h	**SE_DSP_CNT**	**15:0**	**Default : 0x00**	**Access : R**
	SE_DSP_FREE_CNT	15:8	SE-DSP free run counter	
	SE_DSP_TIMER_CNT	7:0	SE-DSP timer counter	
112DFAh	**DECODER_ADV_STATUS**	**15:0**	**Default : 0x00**	**Access : R**
	DECODER_STATUS	15:8	Decoder Status 0x1X = BTSC 0x2X = PALSUM	
	ADV_STATUS	7:0	TBD	
112DFCh	**SE_DSP_ACK1**	**15:0**	**Default : 0x00**	**Access : R**
	SE_DSP_ACK1_H	15:8	Acknowledge data	
	SE_DSP_ACK1_L	7:0	Acknowledge data	
112DFEh	**SE_DSP_ACK2**	**15:0**	**Default : 0x00**	**Access : R**
	SE_DSP_ACK2_H	15:8	Acknowledge data	
	SE_DSP_ACK2_L	7:0	Acknowledge data	

NonPCM Control Register (Bank = 112Dh/112Eh)				
Index	**Mnemonic**	**Bit**	**Description**	
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	
112E96h	**NONPCM_SEL_CTRL**	**15:0**	**Default : 0x00**	**Access : R/W**
	Reserved	15:1	Reserved	
	ADEC_SEL	0	0: From ADEC1 / 1: From ADEC2	

1.5. Audio Precision Measurement



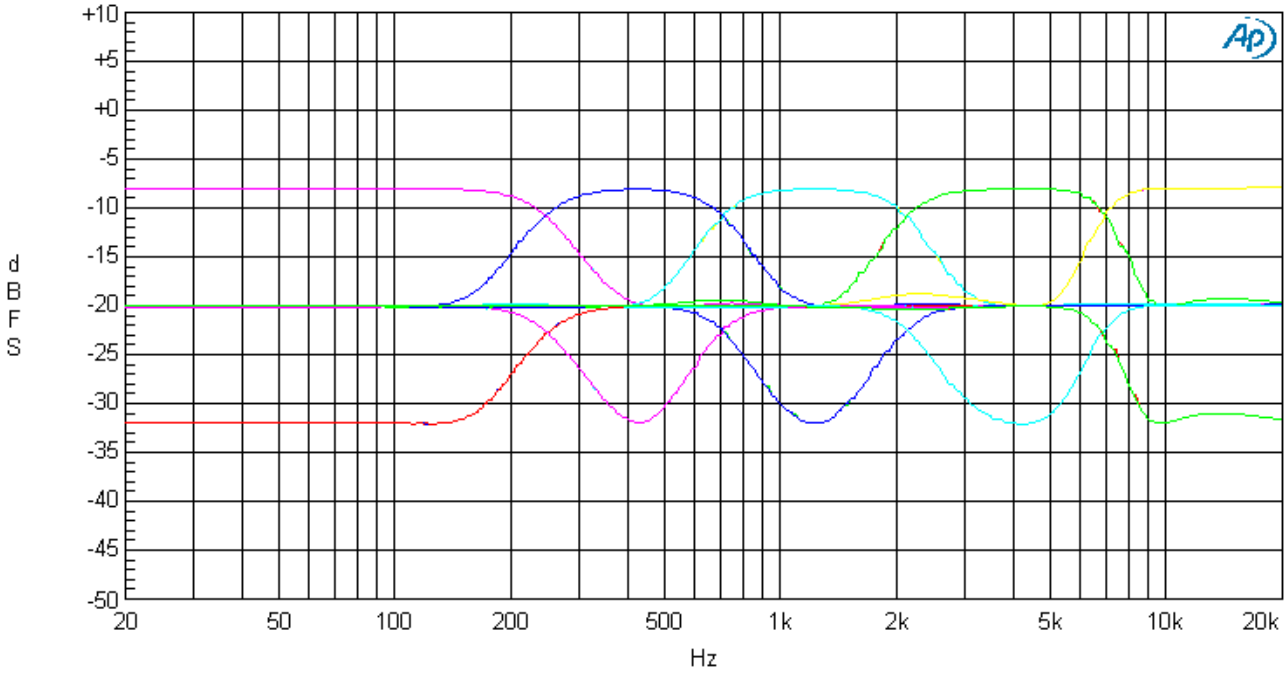
Sweep	Trace	Color	Line Style	Thick	Data	Axis	Comment
1	1	Blue	Solid	1	DSP Anlr.Level A	Left	
1	2	Red	Solid	1	DSP Anlr.Level B	Left	
2	1	Cyan	Solid	1	DSP Anlr.Level A	Left	
2	2	Magenta	Solid	1	DSP Anlr.Level B	Left	
3	1	Green	Solid	1	DSP Anlr.Level A	Left	
3	2	Blue	Solid	1	DSP Anlr.Level B	Left	

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 5: Bass/Treble Measurement

Audio Precision D-D FAST RMS FREQUENCY RESPONSE 08/26/14 21:32:13



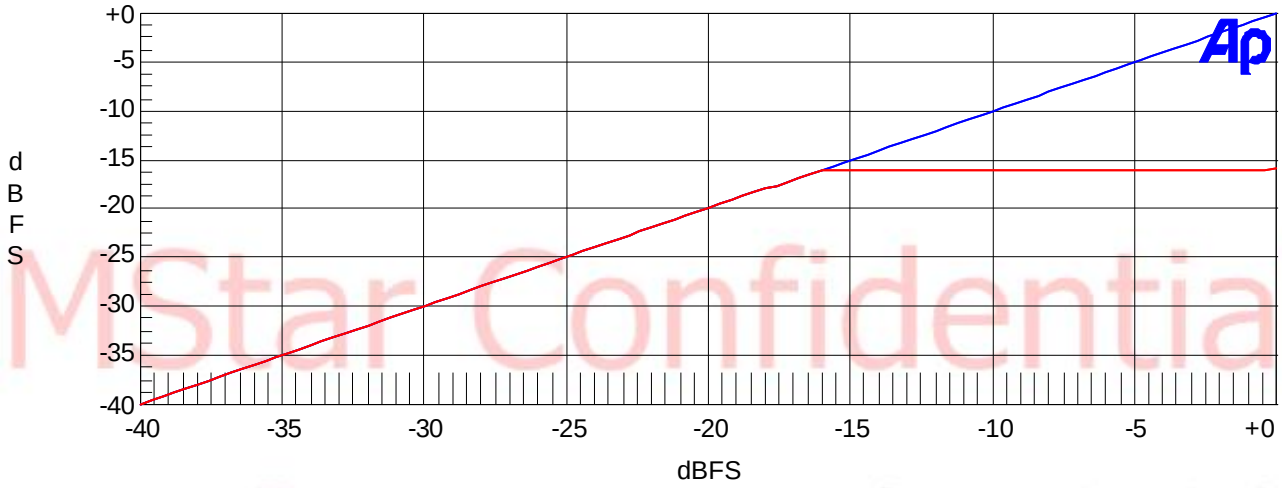
Sweep	Trace	Color	Line Style	Thick	Data	Axis	Comment
1	1	Blue	Solid	1	DSP Anlr.Level A	Left	
1	2	Red	Solid	1	DSP Anlr.Level B	Left	
2	1	Cyan	Solid	1	DSP Anlr.Level A	Left	
2	2	Magenta	Solid	1	DSP Anlr.Level B	Left	
3	1	Green	Solid	1	DSP Anlr.Level A	Left	
3	2	Blue	Solid	1	DSP Anlr.Level B	Left	
4	1	Yellow	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 6: GEQ Measurement

Audio Precision D-D AVL MEASURMENT 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

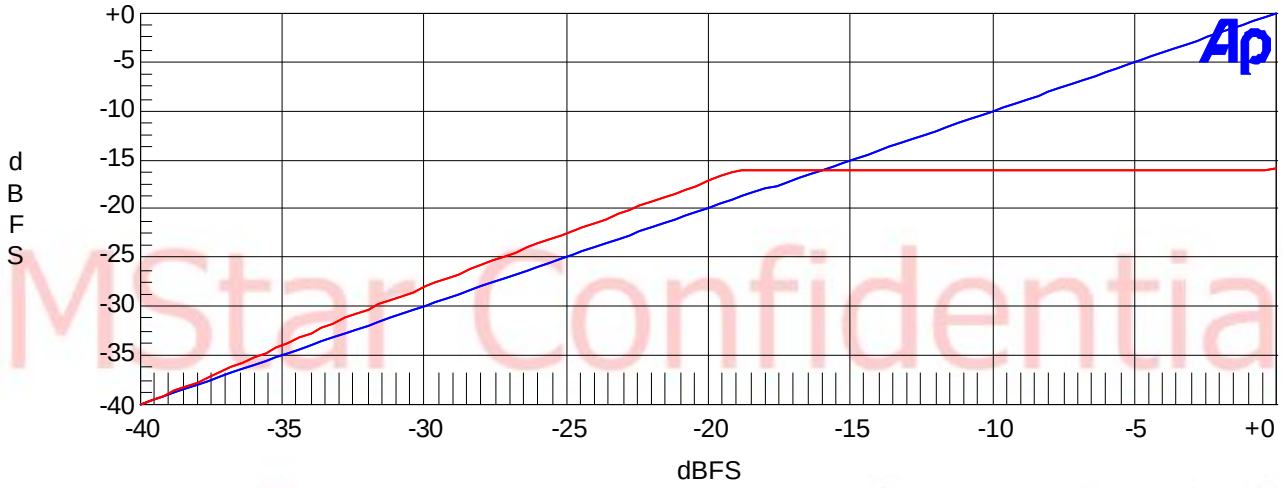
Digital input/ Digital Output. X-axis is input signal level. Y-axis is output signal level.

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

D-D AVL.at2

Figure 7: AVL with M Mode Measurement

Audio Precision D-D AVL MEASURMENT 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

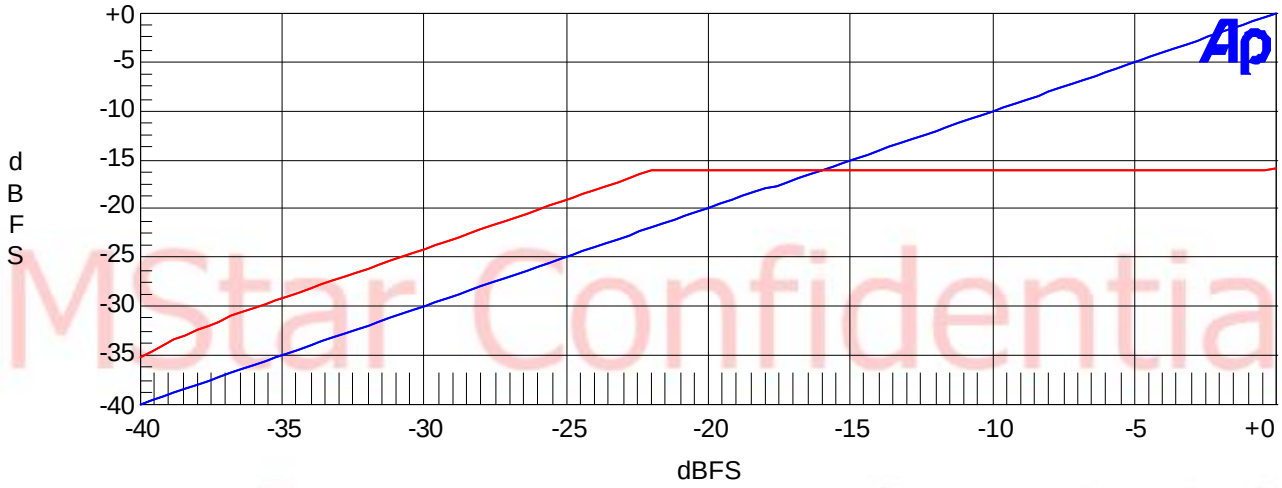
Digital input/ Digital Output. X-axis is input signal level. Y-axis is output signal level.

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

D-D AVL.at2

Figure 8: AVL with L Mode Measurement

Audio Precision D-D AVL MEASURMENT 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.

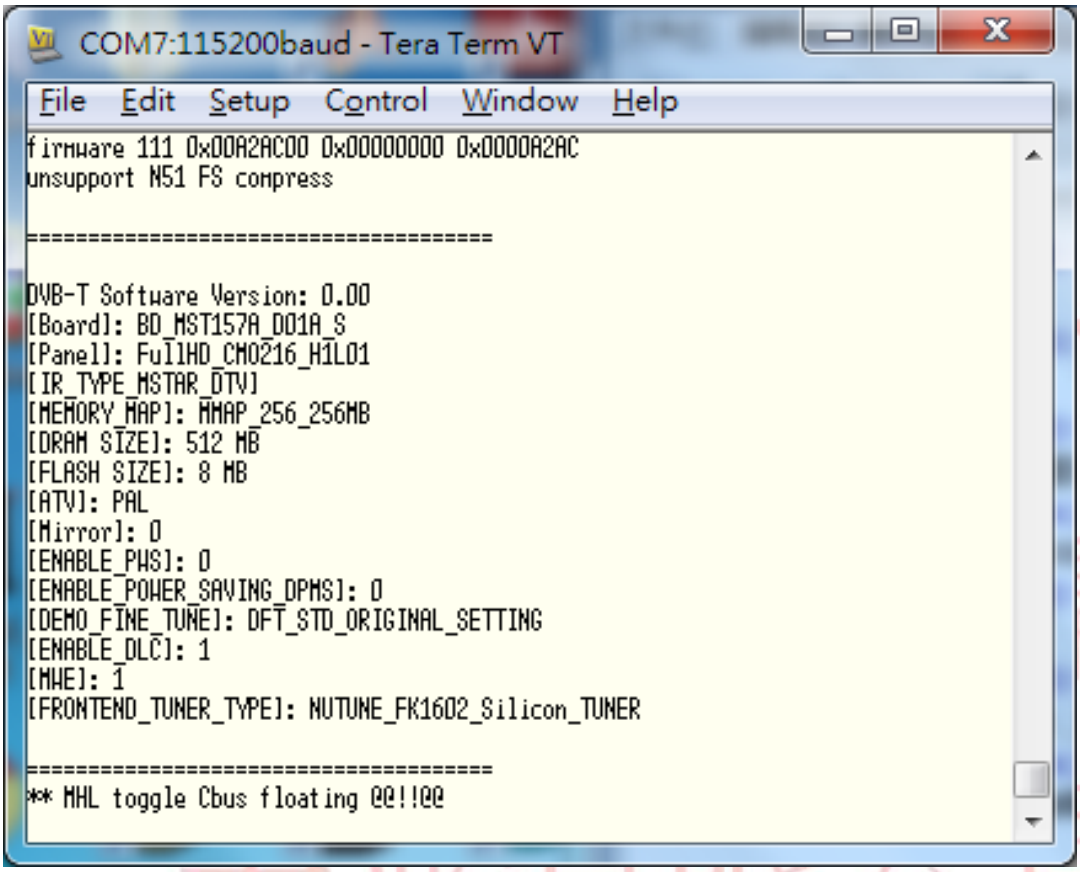
AVL with S mode:
Clipping level = -16dBFS.
AT: 100 msec.
RT: 2 sec.

D-D AVL.at2

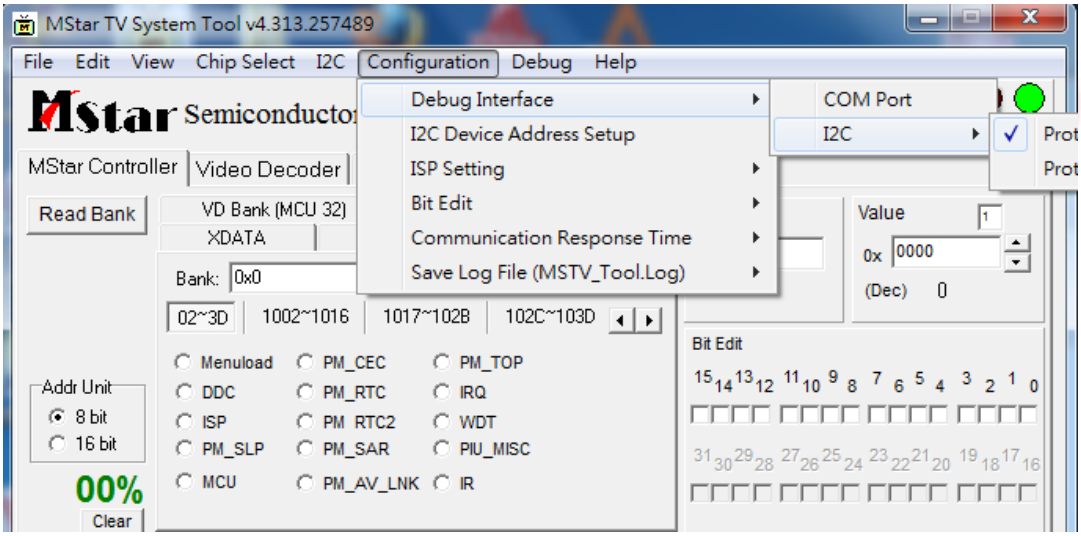
Figure 9: AVL with S Mode Measurement

1.6. PEQ Tuning

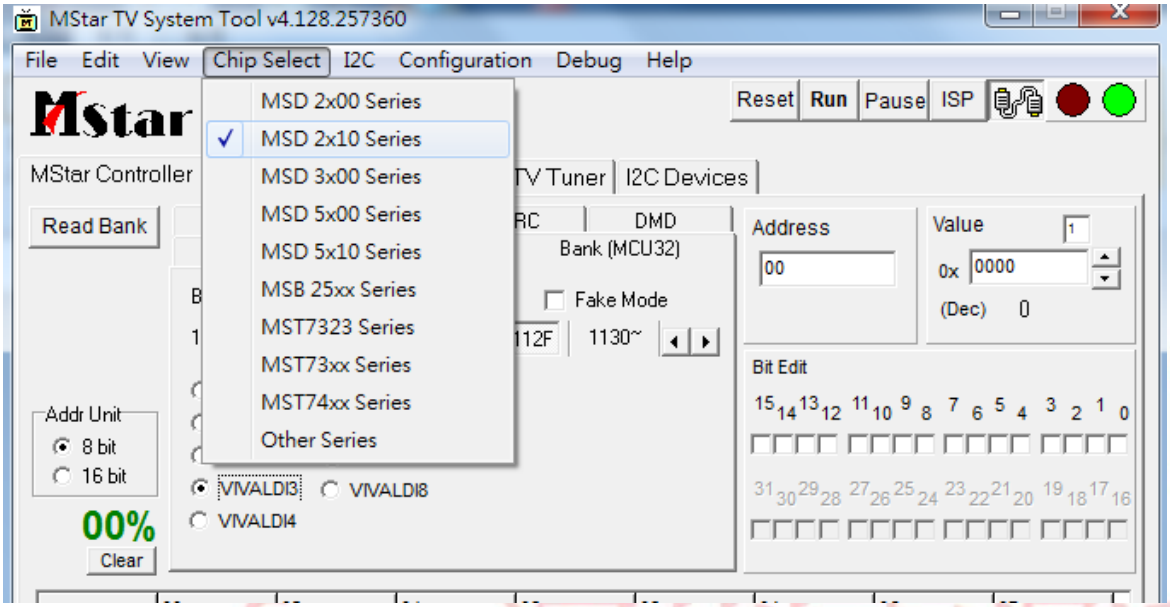
1. Open Tera Term or any console APP and type "00 11 22 33" to allow MSTV tool accessible.



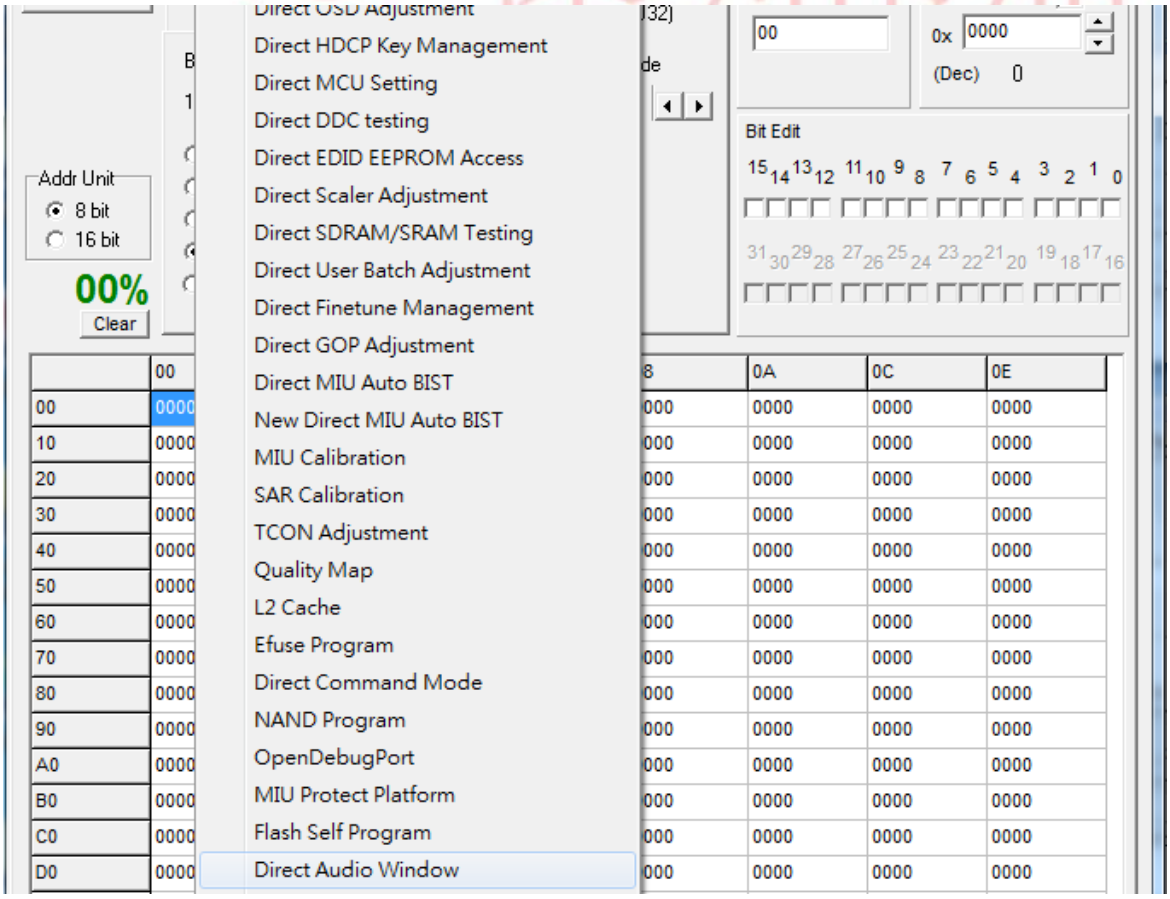
2. Set Debug Interface as "I2C".



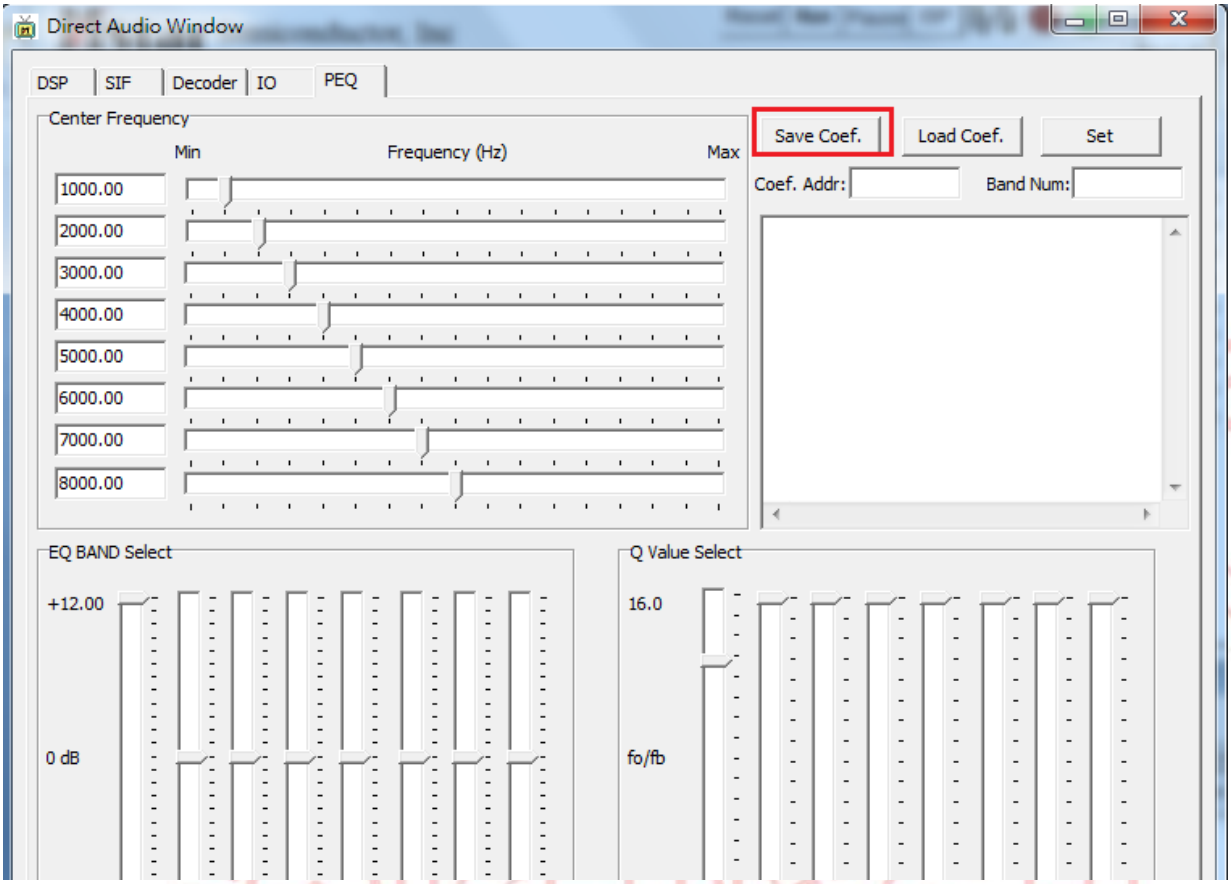
3. Set Chip as MSD 2x10 Series



4. View **à** 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

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