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Audio Application Note
All-in-one DTV Processor
MSDxxxxB

Internal Use Only

REVISION HISTORY

Document	Description	Date
MSDxxxxB_audio_apn_v01	ÿ Initial release	Jun 2011
MSDxxxxB_audio_apn_v02	ÿ Updated Block Diagram	Mar 2012
MSDxxxxB_audio_apn_v03	ÿ Add SRS API and Tuning Guide	May 2012
MSDxxxxB_audio_apn_v04	ÿ Add DBX API and Tuning Guide	Aug 2012

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INTRODUCTION

Audio Features

Audio features supported in the MSDxxxxB

- 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
- Optional advanced sound available (Dolby, SRS, BBE, DBX, Audyssey, Q-Sound, etc)
- Supports digital audio format decoding:
 - MPEG-1, MPEG-2 (Layer I/II), MP3, AC-3 (Dolby Digital), WMA
 - HE-AAC v1/v2 decoding and AC-3 conversion at the same time (Dolby Pulse)
 - E-AC-3 (Dolby Digital Plus) decoding and E-AC-3 to AC-3 conversion at the same time

Input Interface¹

- Stereo (L/R) Line-in x 6
- Stereo (L/R) audio ADC x 2
- Stereo differential MIC input
- I2S input x 1
- HDMI Rx for both PCM and non-PCM format

Output Interface¹

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

¹ Maximum supported number; real input and output spec. depends on package.

AUDIO DIAGRAM

The MSDxxxxB audio block diagram is shown as below:

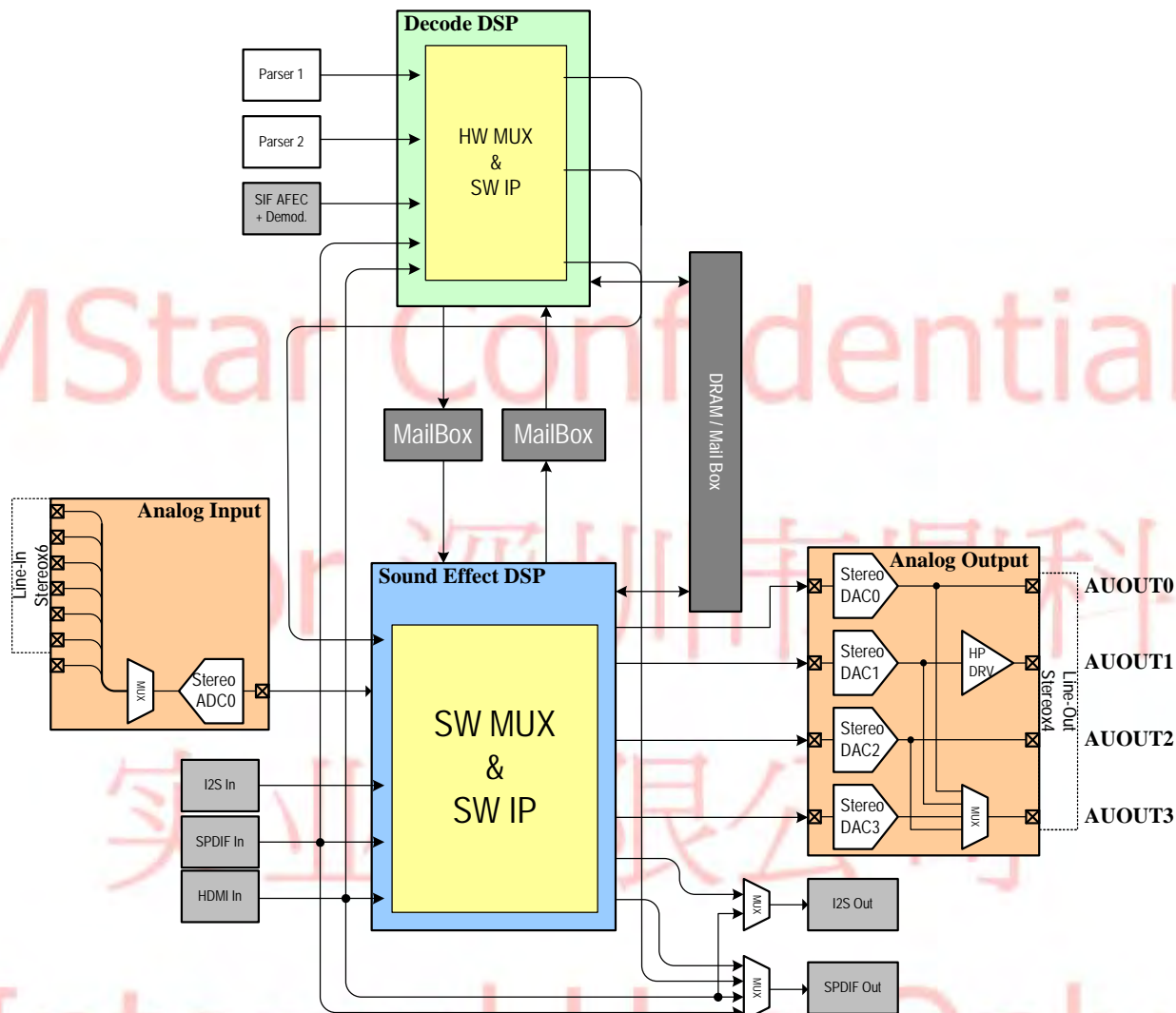


Figure-1 Audio Block Diagram

Audio Tasks

There are two DSPs in the MSDxxxxB for different audio tasks. One is Sound-Effect DSP (SE-DSP) and the other is Decoder DSP (DE-DSP). The DE-DSP handles the DTV decoder tasks and audio encoder for analog PVR application. The SE-DSP handles the audio system tasks, sound effect tasks (multiple channels for volume, pre-scale, audio delay, etc), SIF and audio description (AD) parts.

The following diagram shows the audio tasks dispatch for the two DSPs.

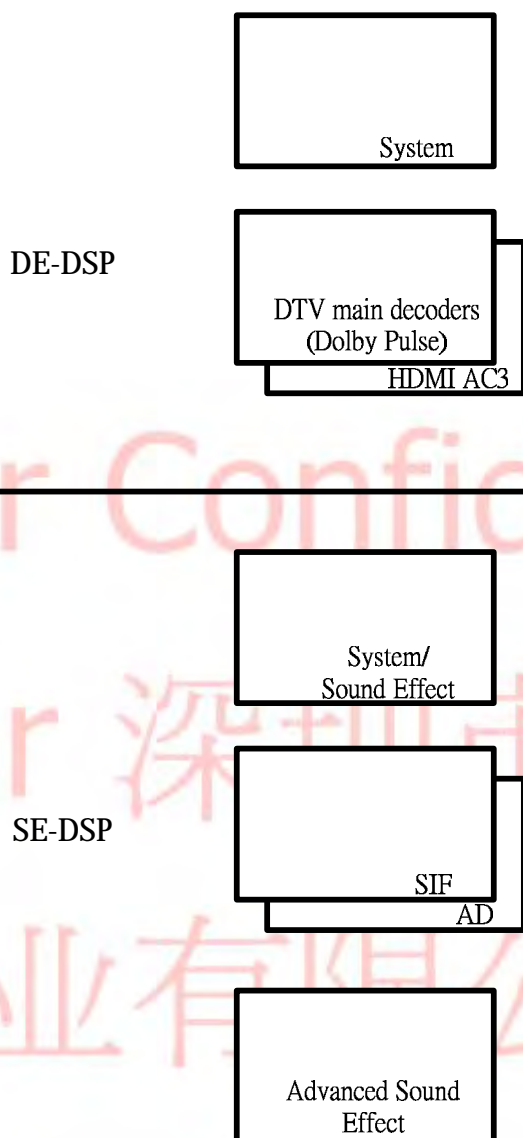


Figure-2 Audio Tasks

AUDIO PATH CONFIGURATION

There are six output paths in the MSDxxxxB. Mstar suggests applying the following configurations:

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

The following figure shows the input/output connectivity for the audio applications.

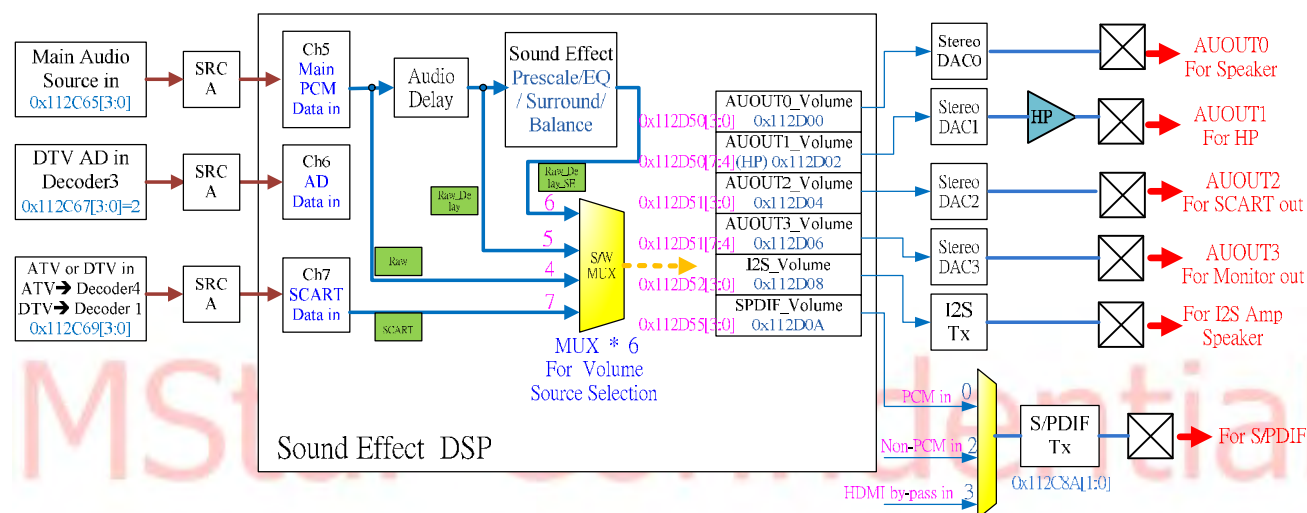


Figure-3 Audio Path

SOUND EFFECT REGISTER DEFINITION

The sound effect path is shown as below:

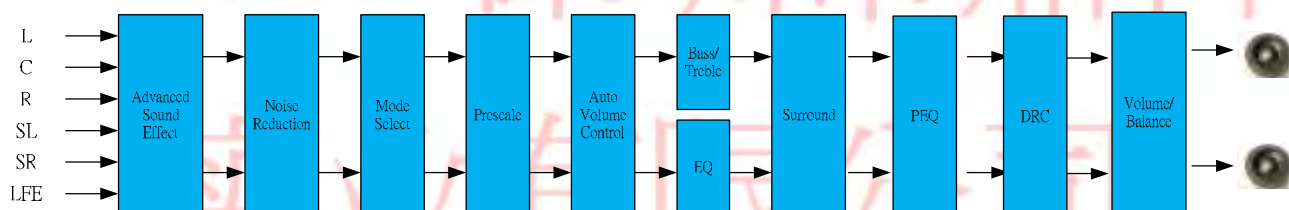


Figure-4 Sound Effect Flow

Advanced Sound Effect

The MSDxxxxB supports the following advanced sound effect

- SRS TSXT/TSHD
- Audyssey Dynamic EQ/ADV/ABX
- QSound
- DBX
- Dolby Virtual Speaker/Dolby Virtual Surround (*not ready yet*)
- BBE/BBE Viva

Noise Reduction

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

Mode Select

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

Pre-scale

Pre-scale feature is used to fine-tune the output speaker/line-out/SCART level. While adjusting pre-scale, the users should be careful and not to make 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 the 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 for adjustment in AVC algorithm.

- Y Clipping level
- Y Attach time
- Y Release time

Please refer to the 0x112D24 for more details.

There are three modes in MStar chip, L-mode, S-mode and M-mode. Please refer to the D-scope measurement for more details.

Bass/Treble

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

Graphical Equalizer (GEO)

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

Surround

The MSDxxxxB provides one surround algorithm in it. There are pseudo-stereo and delay line blocks to achieve this surround features. There are several parameters could adjust in this feature. Please refer to 0x112D16 for more details.

Dynamic Range Control (DRC)

The DRC feature is used to clip the DRC output to one specific level. There are one parameters for adjustment in DRCC algorithm.

- Y Clipping level

Please refer to the 0x112D2E 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.



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	

Audio Sound Effect Register (Bank = 112Dh)				
Index	Mnemonic	Bit	Description	
			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) N = 0x7F (mute)	
	AUOUT2_Frac_Volume	7:5	AUOUT2 Volume Fractional Control Reg.	

Audio Sound Effect Register (Bank = 112Dh)

Index	Mnemonic	Bit	Description
			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
	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
	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)

Audio Sound Effect Register (Bank = 112Dh)

Index	Mnemonic	Bit	Description
			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
	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
	BASE	7:0	Bass gain setting 0x30 = +12.00 db 0x2F = +11.75 db ... 0x01 = +0.25 db

Audio Sound Effect Register (Bank = 112Dh)

Index	Mnemonic	Bit	Description
			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 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

Audio Sound Effect Register (Bank = 112Dh)			
Index	Mnemonic	Bit	Description
112D1Ch			... 0xD0 = -12.00 db
	RESERVED	7:0	Reserved
	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
112D1Eh	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
	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
112D20h	SOUND_EFFECT_ENABLE	15:0	Default : 0x00 Access : R/W
	RESERVED	15	RESERVED
	RESERVED	14	RESERVED
	DRC	13	0 = disable 1 = enable
	AVC	12	0 = disable 1 = enable
	TONE	11	0 = disable 1 = enable
	SPATIAL	10	0 = disable 1 = enable
	RESERVED	9	RESERVED
	RESERVED	8	RESERVED

Audio Sound Effect Register (Bank = 112Dh)

Index	Mnemonic	Bit	Description
	G. EQ	7	0 = disable 1 = enable
	RESERVED	6	RESERVED
	RESERVED	5	RESERVED
	RESERVED	4	RESERVED
	RESERVED	3	RESERVED
	RESERVED	2	RESERVED
	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 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

Audio Sound Effect Register (Bank = 112Dh)

Index	Mnemonic	Bit	Description	
			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 setting0x00 = 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		
	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	

Audio Sound Effect Register (Bank = 112Dh)

Index	Mnemonic	Bit	Description
			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
	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
	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	AVC Clipping Level setting 0x00 = 0.0 dbFS 0x01 = -0.5 dbFS
			CLIPPING_LEVEL

Audio Sound Effect Register (Bank = 112Dh)

Index	Mnemonic	Bit	Description
			... 0x20 = -16 dbFS ... 0x30 = -24 dbFS ... 0x50 = -40 dbFS
112D30h	AUDIO_MODE	15:0	Default : 0x00
	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
	RESERVED	15:8	Reserved
	NR_LEVEL	7:0	Threshold to enable noise reduction 0x00 = disable NR Else, NR threshold (this value setting depend on boards)
112D34h	RESERVED	15:0	Default : 0x00
112D36h	RESERVED	15:0	Default : 0x00
112D38h	RESERVED	15:0	Default : 0x00
112D3Ah	RESERVED	15:0	Default : 0x00
112D3Ch	RESERVED	15:0	Default : 0x00
112D3Eh	RESERVED	15:0	Default : 0x00
112D40h	<u>ADV_SoundEff Reserved</u>	15:0	Default : 0x00
112D42h	<u>ADV_SoundEff Reserved</u>	15:0	Default : 0x00
112D44h	<u>ADV_SoundEff Reserved</u>	15:0	Default : 0x00
112D46h	<u>KTV_Reserved</u>	15:0	Default : 0x00
112D48h	RESERVED	15:0	Default : 0x00
112D4Ah	RESERVED	15:0	Default : 0x00
112D4Ch	RESERVED	15:0	Default : 0x00

Audio Sound Effect Register (Bank = 112Dh)

Index	Mnemonic	Bit	Description
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(*) 8 = KTV_OUT 9 = Mul_CH6 A = SPDIF
	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 8 = KTV_OUT 9 = Mul_CH6 A = SPDIF
	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 8 = KTV_OUT 9 = Mul_CH6 A = SPDIF
	AUOUT0_SEL	3:0	AUOUT0 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 8 = KTV_OUT 9 = Mul_CH6 A = SPDIF
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 8 = KTV_OUT 9 = Mul_CH6 A = SPDIF
	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 8 = KTV_OUT 9 = Mul_CH6 A = SPDIF
	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

Audio Sound Effect Register (Bank = 112Dh)

Index	Mnemonic	Bit	Description
			7 = SCART 8 = KTV_OUT 9 = Mul_CH6 A = SPDIF
	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 8 = KTV_OUT 9 = Mul_CH6 A = SPDIF
112D54h	OUT_CH_SEL3	15:0	Default : 0x00
	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 8 = KTV_OUT 9 = Mul_CH6 A = SPDIF
	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 8 = KTV_OUT 9 = Mul_CH6 A = SPDIF
	RESERVED	7:0	Reserved

Audio Sound Effect Register (Bank = 112Dh)

Index	Mnemonic	Bit	Description
112D56h	RESERVED	15:0	Default : 0x00 Access : R/W
112D58h	RESERVED	15:0	Default : 0x00 Access : R/W
112D5Ah	DIG4_Volume (KTV/Game)	15:0	Default : 0x00 Access : R/W
	DIG4_Mute	15	Software mute for DIG4 Channel 0 = normal 1 = mute
	DIG4_Integer_Volume	14:8	DIG4 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)
	DIG4_Frac_Volume	7:5	DIG4 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

Audio Sound Effect Register (Bank = 112Dh)			
Index	Mnemonic	Bit	Description
			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: It means the raw PCM data from the main application. (e.g. DTV input, HDMI input...)

Raw_Delay: It is the same type as above but extra delay involved

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

SCART: It means the ATV PCM data to SCART

Please refer to , ,  and  in Figure-3.

DECODER DSP REGISTR DEFINITION

Table-2 DE-DSP Register Table

DE-DSP 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	<u>MS 10 DDC Mode Select</u>	15:0	Default : 0x00	Access : R/W
112D82h	<u>MS 10 DDC ASOC ID Select</u>	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

DE-DSP Register (Bank = 112Dh)				
Index	Mnemonic	Bit	Description	
	RESERVED	15:7	Reserved	
	Decoder mute	6	0 = disable 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	

DE-DSP Register (Bank = 112Dh)

Index	Mnemonic	Bit	Description
112D90h	RESERVED	15:0	Default : 0x00 Access : R/W
112D92	RESERVED	15:0	Default : 0x00 Access : R/W
112D94	RESERVED	15:0	Default : 0x00 Access : R/W
112D96h	DTS Dmix Ctrl	15:0	Default : 0x00 Access : R/W
	RESERVED	15:8	Default : 0x00 Access : R/W
	DTS Dmix Ctrl	7:0	Default : 0x00 Access : R/W
112D98h	RESERVED	15:0	Default : 0x00 Access : R/W
112D9Ah	DEC_PUBLIC	15:0	Default : 0x00 Access : R/W
112D9Ch	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
112D9Eh	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
112DA0h	RESERVED	15:0	Default : 0x00 Access : R
112DA2h	RESERVED	15:0	Default : 0x00 Access : R
112DA4h	RESERVED	15:0	Default : 0x00 Access : R
112DA6h	RESERVED	15:0	Default : 0x00 Access : R
112DA8h	RESERVED	15:0	Default : 0x00 Access : R
112DAAh	DEC_PUBLIC	15:0	Default : 0x00 Access : R
112DACH	DEC_PUBLIC	15:0	Default : 0x00 Access : R
112DAEh	DEC_PUBLIC	15:0	Default : 0x00 Access : R
112DB0h	RESERVED	15:0	Default : 0x00 Access : R
112DB2h	INT_ID	15:0	Default : 0x00 Access : R
	RESERVED	15:8	Reserved
	INT_ID	7:0	DE-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

DE-DSP Register (Bank = 112Dh)

Index	Mnemonic	Bit	Description
112DB4h	SAMPFRE_ERROR	15:0	Default : 0x00 Access : R
	SPDIF_NONPCM_SAMPLE_RATE	15:8	Decoder Report SPDIF non-PCM sample rate 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
112DB6h	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)
112DB8h	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
112DBAh	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	
112DBCh	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
112DBEh	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 presents the file format needs to handshake protocol between HK and DSP

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

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) B \rightarrow FM/AM Mono B \rightarrow Mute 0x01 = FM/AM Mono 0x02 = Stereo L / R B \rightarrow FM/AM Mono 0x03 = Stereo L / L B \rightarrow FM/AM Mono 0x04 = Stereo R / R B \rightarrow FM/AM Mono 0x05 = Dual A/ B B \rightarrow FM/AM Mono 0x06 = Dual A / A B \rightarrow FM/AM Mono	

SE-DSP Register (Bank = 112Dh)

Index	Mnemonic	Bit	Description
			0x07 = Dual B / B β FM/AM Mono 0x08 = Nicam Mono β 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
	RESERVED	15:0	Reserved
112DCAh	SIF_FM_TRACKING	15:0	Default : 0x00
	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
	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
112DD0h	SE_PUBLIC	15:0	Default : 0x00
112DD2h	SE_PUBLIC	15:0	Default : 0x00
112DD4h	SE_PUBLIC	15:0	Default : 0x00
112DD6h	SE_PUBLIC	15:0	Default : 0x00
112DD8h	AD_CTRL	15:0	Default : 0x00
	AD_MIX	15	AD mix select 0 = no AD mix 1 = AD mix
	DEC_ATT	14	Decoder3 output -11dB

SE-DSP Register (Bank = 112Dh)				
Index	Mnemonic	Bit	Description	
			0 = output 0 db 1 = output -11 db	
	Audio Mix Mode	13:11	000: DTV mode 001: KTV mode 010: Game mode	
	AD_VOLUME	10:0	Bit[10] = AD Mute 1 = Mute 0 = un-Mute Bit[9:3] = AD integer volume 0x00 = +12 db 0x01 = +11 db ... 0x0C = 0 db 0x0D = -1db ... 0x7E = -114 db 0x7F = -115db Bit[2:0] = AD fractional volume 000 = -0.000 db 001 = -0.225 db 010 = -0.250 db 011 = -0.375 db 100 = -0.500 db 101 = -0.625 db 110 = -0.725 db 111 = -0.875 db	
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 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	

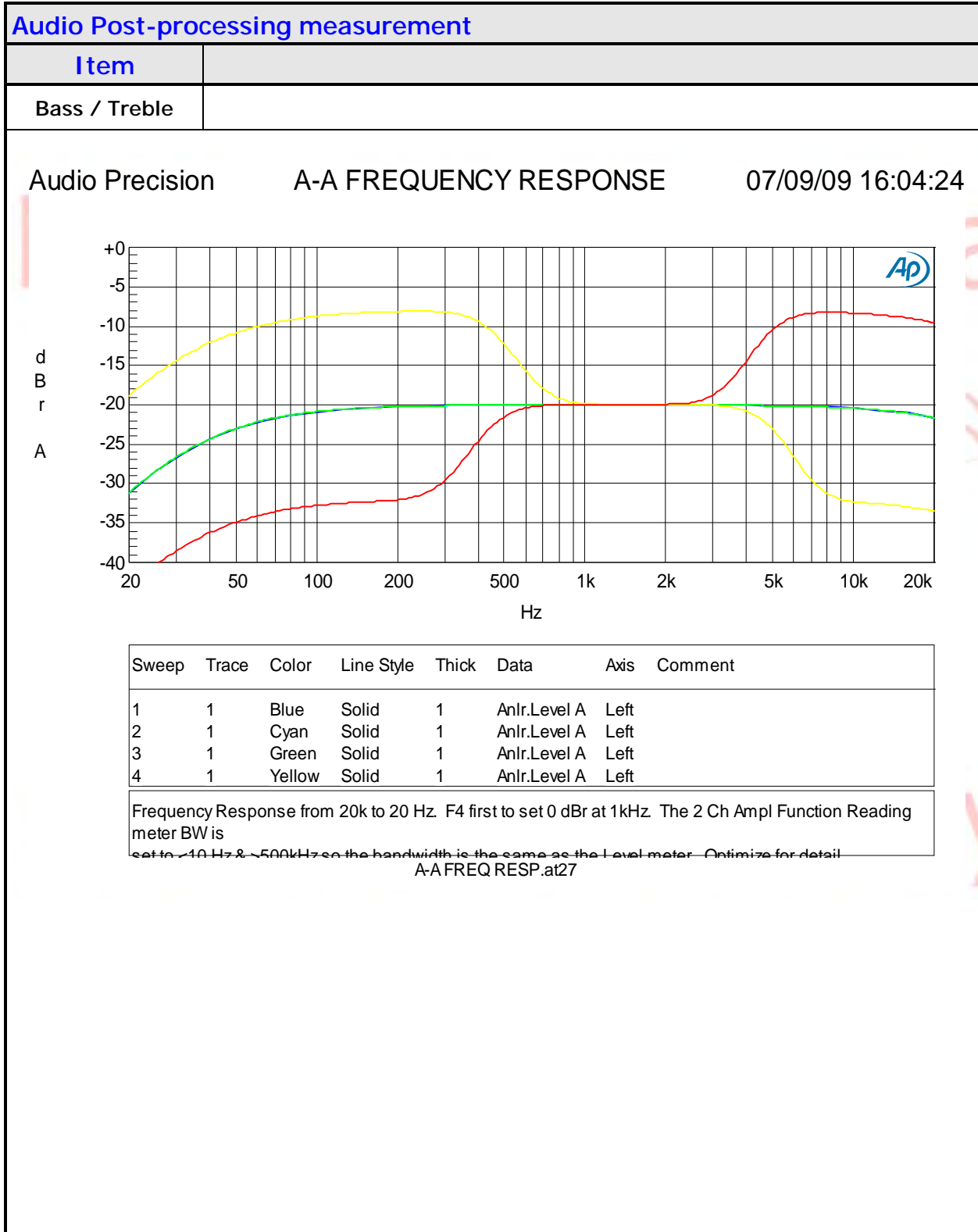
SE-DSP Register (Bank = 112Dh)				
Index	Mnemonic	Bit	Description	
112DE0h	SIF_PAL_DEC_RESULT	15:0	Default : 0x00	Access : R
	RESERVED	15:8	Reserved	
	BUSY	7	Audio SIF Standard Detection Flag 0 = standard detection finished 1 = standard detection not finished	
	SIF_STD_CODE	6:0	SIF Standard Detect Result 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	
	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	

SE-DSP Register (Bank = 112Dh)				
Index	Mnemonic	Bit	Description	
			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
	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	

SE-DSP Register (Bank = 112Dh)				
Index	Mnemonic	Bit	Description	
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 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	
	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	

The D-Scope measurement of each feature is shown as below:

D-SCOPE MEASUREMENT



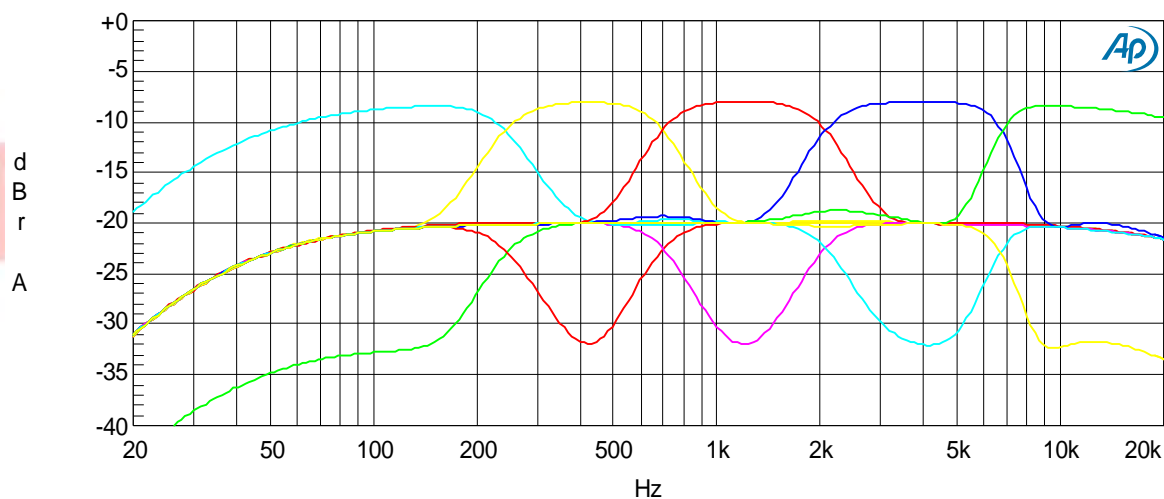
Audio Post-processing measurement

Item	
Graphic EQ 5 Band	

Audio Precision

A-A FREQUENCY RESPONSE

07/09/09 16:43:18



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

Frequency Response from 20k to 20 Hz. F4 first to set 0 dB at 1kHz. The 2 Ch Ampl Function Reading meter BW is

set to <10 Hz & >500kHz so the bandwidth is the same as the Level meter. Optimize for detail

A-A FREQ RESP.at27

Internal Use Only

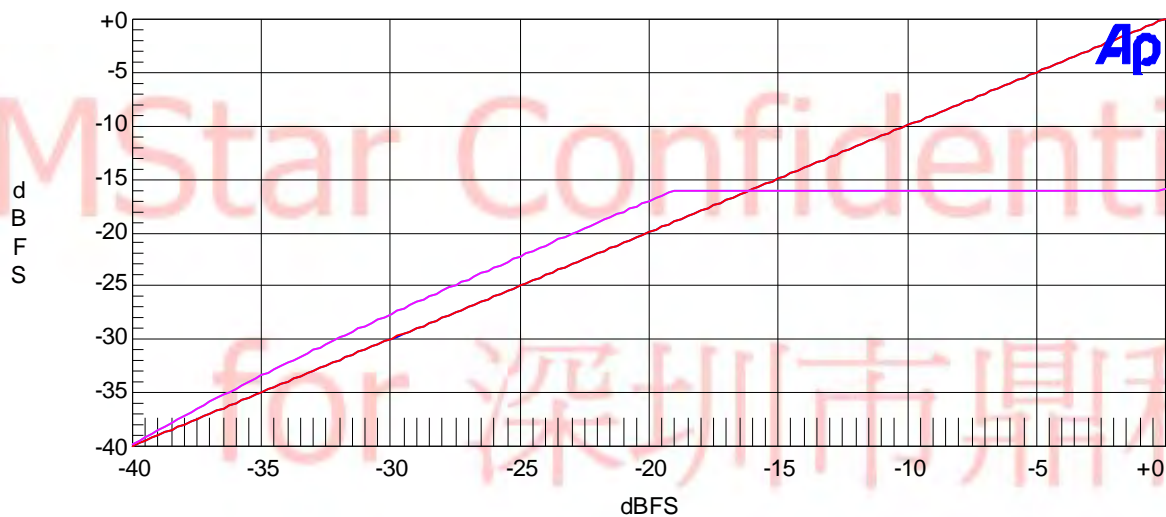
Audio Post-processing measurement

Item	
AVC	
L-mode	

Audio Precision

D-D FREQUENCY RESPONSE

03/18/09 17:36:48



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

D-D FREQ RESP.at2

Audio Post-processing measurement

Item

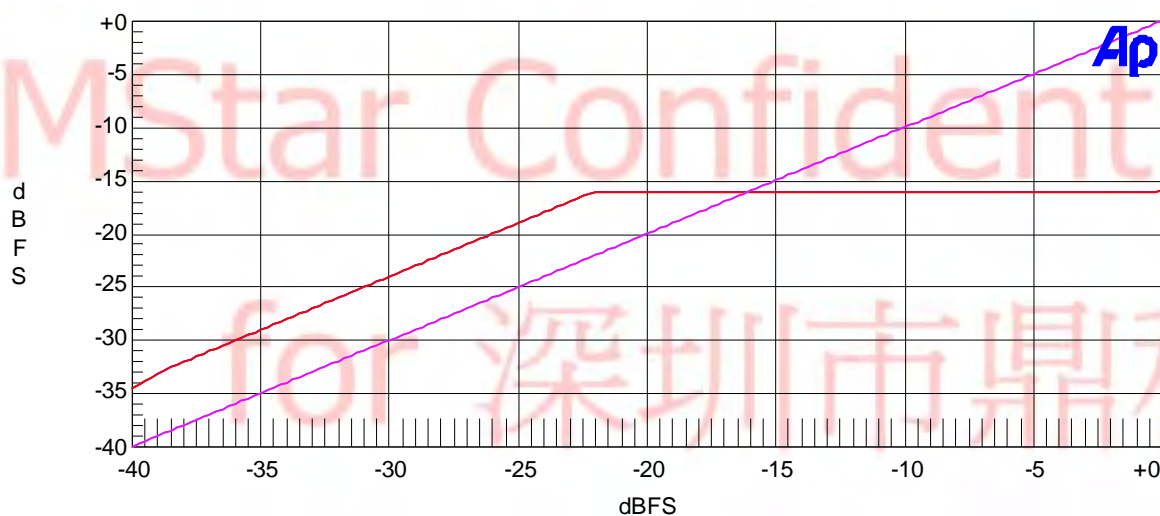
AVC

S-mode

Audio Precision

D-D FREQUENCY RESPONSE

03/18/09 17:39:37



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

D-D FREQ RESP.at2

Audio Post-processing measurement

Item

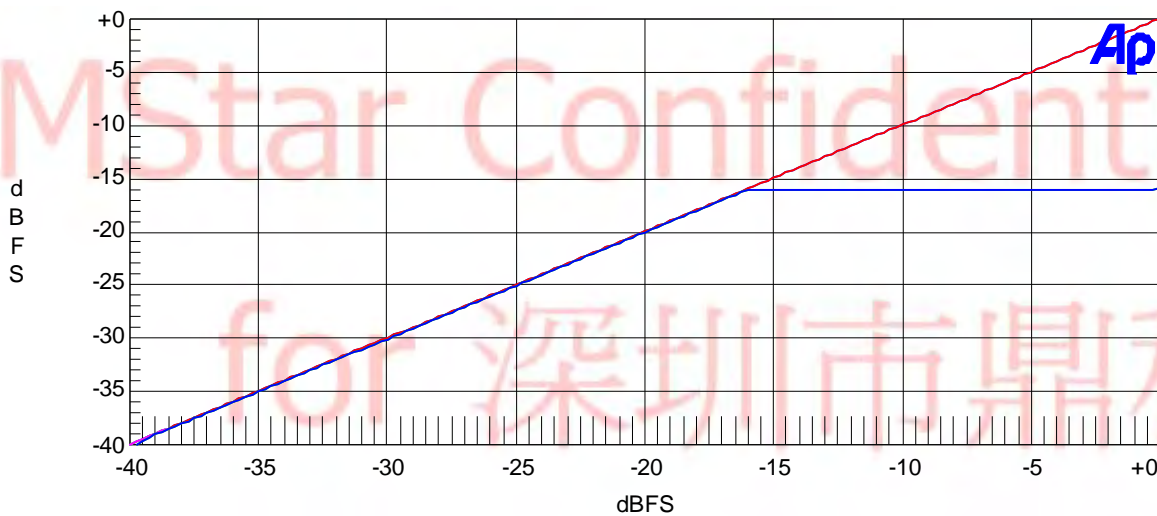
AVC

M-mode

Audio Precision

D-D FREQUENCY RESPONSE

03/18/09 17:34:00



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

D-D FREQ RESP.at2

API

Advanced Sound Effect

1.1.

Description

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

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] AUDYSSEY_: Enable
type [IN] ADV_NONE_: Disable

Return Value

None

Remarks

None

1.2.

Description

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

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
AUDYSSEY_DYNAMICVOL_	TRUE/FALSE	Enable/disable Dynamic Volume
AUDYSSEY_ABX_	TRUE/FALSE	Enable/disable ABX

Return Value

None

Remarks

None

1.3.

Description

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

Syntax

```
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

param	u16value1	Description
SRS_TSHD_SET_INPUT_GAIN_	0~10: 1.0,0.9, 0.8, ...,0 (step 0.1)	Set Input Gain
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
AUDYSSEY_DYNAMICVOL_COMPRESS_MODE_	0: Heavy mode 1: Medium mode 2: Low mode	
AUDYSSEY_DYNAMICVOL_GC_ (GCF)	0~30	actual value = value /10 + 1.0
AUDYSSEY_DYNAMICVOL_VOLSETTING_	0~40	actual value = -value (dB)
AUDYSSEY_ABX_GWET_ (HGain)	0~24	6,5.5,...0.5,0,-0.5,...-5.5,-6dB (step 0.5dB)
AUDYSSEY_ABX_GDRY_ (DryGain)	0~24	6,5.5,...0.5,0,-0.5,...-5.5,-6dB (step 0.5dB)
AUDYSSEY_ABX_FILSET_	0: filter set 1 1: filter set 2	
AUDYSSEY_DYNAMICVOL_CHCALBGAIN_0_	0~60	actual value = value - 30 (dB)
AUDYSSEY_DYNAMICVOL_CHCALBGAIN_1_	0~60	actual value = value - 30 (dB)
AUDYSSEY_VOLUME_MAX_	0~40	actual value = -value (dB)

Return Value

None

Remarks

None

TUNING

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

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

Index	Mnemonic	Bit	Description
			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
	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 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 =>

Index	Mnemonic	Bit	Description
			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

PEQ tuning

Description

In OS platform, we use console of terminal tool, ex Tera Term, to set PEQ parameters.

The steps to set PEQ is as below:

1. Enable auto test mode.

After AC power-on, press "enter" immediate so as to show prompt: << Mstar >>#.

Then, types

<< Mstar >>#add_autotest

<< Mstar >>#saveenv

<< Mstar >>#reset

to enable auto-test mode.

```

COM6:115200baud - Tera Term VT
File Edit Setup Control Window Resize Help
NAND: 256 MBytes
In: serial
Out: serial
Err: serial
Net: MSVC00B000100100455555TH0000000T

EnvFlag =:176.....CONFIG_ENV_ADDR=:7E0000
Preinit USB port[0]:
Preinit USB port[1]:
Preinit USB port[2]:
[Secure] Get Bin file from SPI: [srcAddr: 0xBF020000][len:10836][destAddr:0x80A00000]
Get Bin SUCCESS
Switch to internal SPI for AES decode
Mapi_MBX_Init
Secure_MailBox_Init
keypad_pressed is [0]
ir_pressed is [0]
pBootDB->bist_info=0x12345678
pBootDB->autophase_info=0xFFFFFFFF
pBootDB->auto_upgrade_info[8]={FF FF FF FF FF FF FF FF};
Hit any key to stop autoboot: 0
<< Mstar >>#
<< Mstar >>#
<< Mstar >># add_autotest
original: console=ttyS0,115200 ubi.mtd=3,2048 root=ubi:RFS rootfstype=ubifs ro LX_MEM=0x37
18000 EMAC_MEM=0x28000 DRAM_LEN=0x10000000 LX_MEM2=0x62480000,0x1E30000 BB_ADDR=0x7FFF000
ntdparts=edb64M-nand:256k(NPT),256k(KL_BP),5n(KL),121n(UBI),-(NA) autotest=new: console=t
tyS0,115200 ubi.mtd=3,2048 root=ubi:RFS rootfstype=ubifs ro LX_MEM=0x3718000 EMAC_MEM=0x28
000 DRAM_LEN=0x10000000 LX_MEM2=0x62480000,0x1E30000 BB_ADDR=0x7FFF000 ntdparts=edb64M-nan
d:256k(NPT),256k(KL_BP),5n(KL),121n(UBI),-(NA) autotest=true << Mstar >># saveenv
Saving Environment to spiflash...
Flash is detected (0x0503, 0xC2, 0x20, 0x17)
Write addr=0x007E0000, size=0x00010000
Write addr=0x007F0000, size=0x00010000
<< Mstar >># reset
  
```

2. Issue PEQ setting command:

After repower-on, there will show "#####auto test loop start#####".

Then we can start to issue PEQ command:

The command format is:

at+wtest = 20,10, Band, Gain, Foh, Fol, Qvalue.

(Band, Gain, Foh, Fol, Qvalue are defined in SND_SetPEQ(MS_U8 Band, MS_U8 Gain, MS_U8 Foh, MS_U8 Fol, MS_U8 QValue))

For example to set Band = 0, Gain = 180, Foh = 10, Fol = 0, Qvalue = 110

One can type: at+wtest = 20,10,0,180,10,0,110

```
COM6:115200baud - Tera Term Y1
File Edit Setup Control Window Resize Help
Start Auto Test Thread
Auto test start!!!
0x0

**MS*
MSTART
ZMSZ
0xb9
-->2c0949a8
#####auto test loop start#####
1
##### leasefail END #####
No lease, failing
at+wtest=20,10,0,180,10,0,110

**MS*
MACK
ZMSZ
0xfa
Input command : at+wtest=20,10,0,180,10,0,110
===== FLUSH COMMAND 20 SUBTYPE 10 =====
SetPEQ 0 180 10 0 110
===== FLUSH COMMAND 20 RESULT 0 =====

**MS*
MER
ZMSZ
0xc2
at+wtest=20,10,1,120,1,30,120

**MS*
```

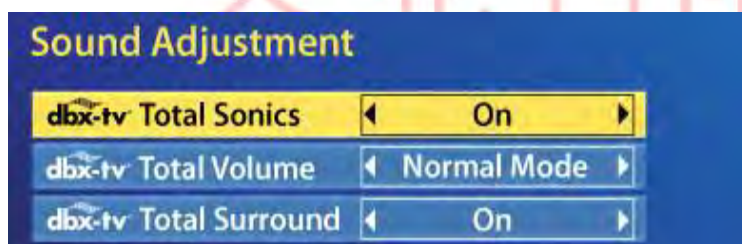
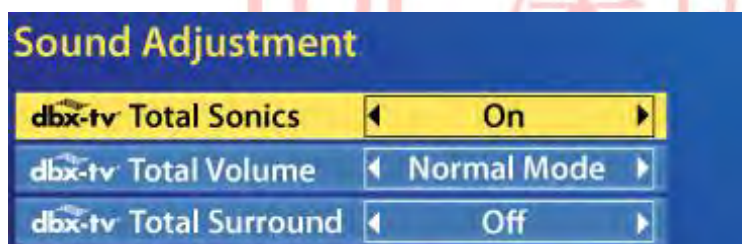
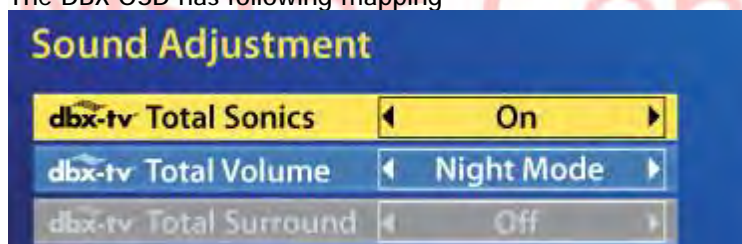

DBX API Application Note

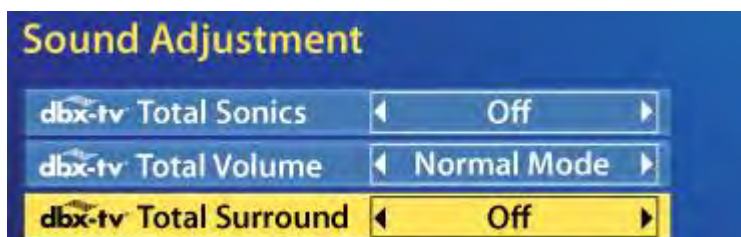
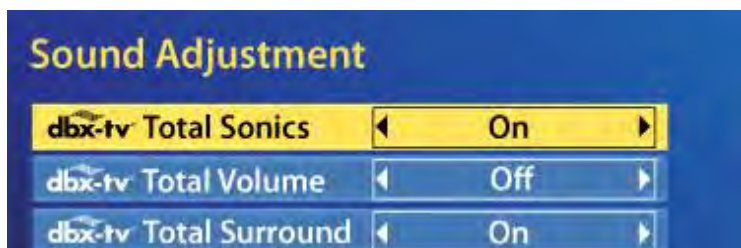
The procedure of using DBX surround:

1. Make sure the customer license the DBX logo and get the correct hash key
2. Enable the define: #define AUDIO_USE_SOUND_EFFECT_DBX **1** (That is in halADAUDIO.h)
3. Make sure reload the DBX algorithm before use it: MApi_AUDIO_SetAdvSndSys(MSAPI_AUD_ADVSND_DBX);
4. If system is Chakra2, please enable the define: #define ENABLE_AUDIO_SURROUND_DBX **ENABLE**
(That is in MApp_Audio.h)
5. If system is Supernova, please enable the define: #define AU_SUPPORT_DBX **1**
(That is in mapi_audio.h)

Link the API to the OSD

The DBX OSD has following mapping





It should have the following combinations:

TotSonMode TotVolMode TotSurMode

TotSonMode	TotVolMode	TotSurMode
TOTSON_OFF	TOTVOL_OFF	TOTSUR_OFF
TOTSON_OFF	TOTVOL_NORMAL	TOTSUR_OFF
TOTSON_OFF	TOTVOL_NIGHT	TOTSUR_OFF
TOTSON_OFF	TOTVOL_OFF	TOTSUR_ON
TOTSON_OFF	TOTVOL_NORMAL	TOTSUR_ON
TOTSON_ON	TOTVOL_OFF	TOTSUR_OFF
TOTSON_ON	TOTVOL_NORMAL	TOTSUR_OFF
TOTSON_ON	TOTVOL_NIGHT	TOTSUR_OFF
TOTSON_ON	TOTVOL_OFF	TOTSUR_ON
TOTSON_ON	TOTVOL_NORMAL	TOTSUR_ON

PS:

⊖ Be careful that if TOTVOL set to **Night**, that the TOTSUR should be set to **OFF**

Total Sonics has following select:

ON /OFF

Total Volume has following select:

Normal / Night / OFF

Total Surround has following select:

ON/ OFF

After all the select is done, please execute the API function to apply all setting:

```
void MApi_DBXTV_SetMode(EN_DBXTV_TotSonMode totsonmode, EN_DBXTV_TotVolMode totvolmode,
EN_DBXTV_TotSurMode totsurmode,MS_U32 enable);
```

```
typedef enum _DBXTV_TotSonMode
{
    TOTSON_ON      = 0,
    TOTSON_OFF
} DBXTV_TotSonMode;
```

```
typedef enum _DBXTV_TotVolMode
{
    TOTVOL_NORMAL  = 0,
    TOTVOL_NIGHT,
    TOTVOL_OFF
} EN_DBXTV_TotVolMode;
```

```
typedef enum _DBXTV_TotSurMode
{
    TOTSUR_ON      = 0,
    TOTSUR_OFF
} EN_DBXTV_TotSurMode;
```

Note: the parameter of [enable](#) always setting to 0x1F, other values only for debug used.