D2AUDIO APPLICATION NOTE AN09

Register Programming for the X-Series Modules

1 Introduction

The D2Audio X-series Class D amplifiers utilize a series of DSP-based functions that enable the system developer a wide variety of control over the amplifier module. Multiple configurations of these DSP functions are used to define the various models within the X-series module family. D2Audio provides a register based interface for the software control of these functions. This guide provides a quick theory behind the function, the use of the mathematical function for the register values, and sample code values. Each block or feature described in this document may not be available in all modules or arranged in the same logical order. Consult your individual product's model number and respective data sheet for exact details

2 Module Programming Basics

Addressing the Module

To read a register within module requires the base address of the controller to be followed by three bytes defining the register location. If this is a write operation, and additional three bytes of data is passed to the controller. For a read operation, the controller will respond with three bytes of data. See the "Module Control (MCI) Interface" of your module data sheet for exact hardware timing and interface specification.

Throughout the data sheet and throughout this document, the register addresses are referred in hexadecimal format. For a read operation the data will be described as a 2 digit hex address for the base address followed by a colon and then a 6 digit register address. For a write operation, a 2 digit hex address for the base, Colon, 6 digit hexadecimal register address, coma, and the 6 digit hexadecimal write date.

Examples: Read B2:00005F Write B4:00007F,004D31

Base Address

The DSP controller within the module processes four amplifier channels. Modules with five to eight amplifier channels will have two individual controllers while those with two to four channels are processed by a single controller. To address the functional registers within a module, the controller is assigned a base address and registers are assigned to a register location. For amplifiers with more than four channels, a different base address is assigned to the second controller. External hardware pins on specific modules allow for multiple module systems without a conflict of the controller base addresses. Table 1 shows a sample of module base addresses.

Module Family	**Controller for Amplifier Outputs 1-4**	**Controller for Amplifier Outputs 5-8**
XM (Master Mode)	0xB2	0xB4
XM (Slave Mode	0xB6	0xB8
XM (Listen Mode	0xBA	0xBC
XR	0xC2	0xC4
XRT	0xC2	0xC4
XS (4 Channel)	0xB2	
XS (8 Channel)	0xB2	0xB4
MXR	0xC2	0xC4
MXM	0xB2	0xB4
MXS	0xB2	
TXS	0xB2	
WXS	0xB2	

TABLE 1: Controller Base Addresses

Register Address

Each functional block in the DSP based controller is assigned a 24 bit register offset or address. Not all functions are available in all modules and the placement of the functional blocks may not be the same from model to model. For code compatibility, the address of each functional block is the same in all products. Please see appendix B for a complete list of registers and availability per product model.

Channel Assignments

The register API defines four logical channels for each controller. The speaker outputs for amplifier channels one through four are the logical channels 1-4 of the first controller. The

speaker outputs for channels five through eight of an eight channel amplifier are the logical channels 1-4 of the second controller. Figure 1 is an example for an eight channel amplifier.

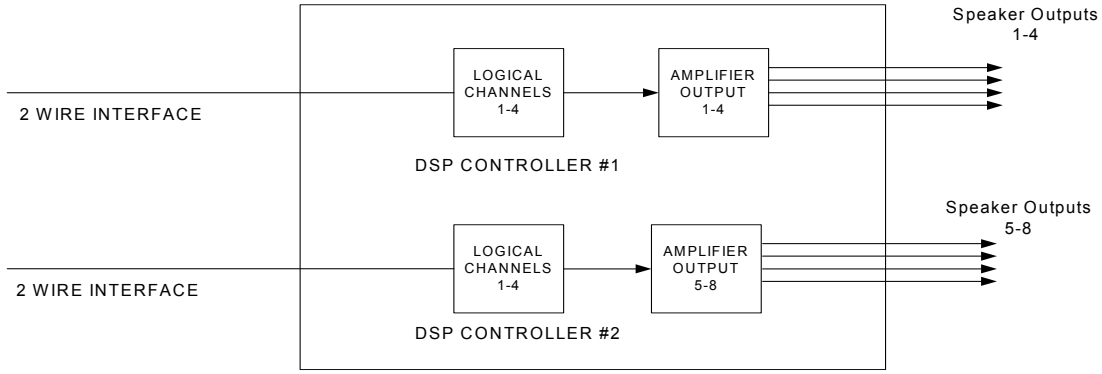

FIGURE 1: Logical Channels to Speaker Outputs

System Gain

Careful attention must be paid to the signal level at the input and at each stage through the DSP in order to prevent clipping. Changes to DSP parameters must be made only after thorough consideration of the effects on signal level throughout the entire signal path from input to output. **Though reducing the gain of the input signal will result in additional DSP headroom, this action will cause a corresponding reduction in the signal-to-noise ratio of the amplifier.**

At the input to the DSP, an attenuation of -6dB is applied to allow for headroom within the DSP processing blocks. At the DSP output, +18dB of gain is applied prior to driving the PWM amplifier outputs. Thus, with a full-scale (0 dBFS) digital input signal, -12dB of attenuation must be applied prior to the PWM output to avoid clipping.

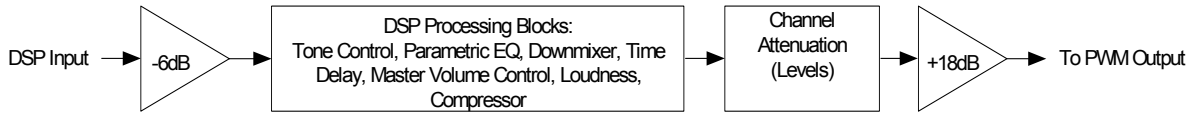

FIGURE 2: System Gain

Example Tables

Appendix A is a set of example values for each functional block within the register API. Note: The first and last entry are designed to be the minimum and maximum values. The values for each functional register are not limited to the entries listed in each table; use of the provided mathematical formulas allow the system programmer to calculate register values for parameters not listed within a given table.

3 Functional Blocks

Master Volume

The master volume is applied to all four logical channels within the controller. The use of the master volume setting may be different depending on the type and application of the amplifier module. If you are defining a multi-room distribution amplifier, it is advisable to set the master volume at a a fixed level and adjust the listening volume with the individual channel attenuator. If you are a multi-channel AVR, the channel attenuator should be set to a fixed level for each speaker and then use the master volume to set the system listening level. For a powered speaker application, the channel attenuator is useful for setting the balance level between woofer and tweeter. The master volume is then used to set the listening level.

Theory

Valid range for Master Volume is -127 to 0dB. When determining the setting of the master volume control, the total system gain through the amplifier must be taken into account. The input data to the amplifier is attenuated by 6dB before the DSP functional blocks with an additional 18dB of gain following the DSP processing blocks. This results in a system gain of +12dB. Prior to reaching the amplifier output, 12 dB reduction in gain is required to prevent clipping. This may be applied at either the Master Volume or the Channel Attenuation or a combination of both. Writing all zeros to the Master Volume register mutes all four channels.

Several options are available to avoid output clipping. In the case of a AVR system, the system controller should limit its setting of the master volume to a level between 6dB and 9dB. Most source material is not recorded at 0dB for its peak level and this allows for 3dB system gain to obtain a full scale output. The amount of system gain above 0dB should be carefully reviewed on a per system basis to avoid clipping. Individual Channel attenuation may be set up to 0dB attenuation.

For powered speakers, especially those with an external rotary encoder for volume control, should set the channel attenuator to no more than -12dB to -9dB. This allows the master volume to be set at full scale without clipping.

For a multi-room application, fix the master volume to a value between 6dB and 9dB and use the channel attenuator to set the individual zone's listening level.

NOTE: To avoid amplifier clipping, **ANY** gain in the Parametric EQ **MUST** be taken into account with the Channel Attenuation and or Master Volume control.

The Math

For a given Master Volume in dB, the appropriate parameter is a signed, 24-bit number calculated using the following equation.

$$\text{MasterVolumeParameter} = 1 - (2^{23}) \times 10^{\left\lfloor \frac{[\text{MasterVolumeLevel} - 18.06]}{20} \right\rceil}$$

Register Usage

Register Name	Minimum Value	Maximum Value	Description
MasterVolumeParameter	FFFFFFh	800000h	Master Volume for channels 1-4

Coding Example

Example: for -20dB Setting $-104878 = 1 - (2^{23}) \times 10^{\left[\frac{[-20-18.06]}{20}\right]}$

Convert -104878 to hexadecimal for a value of 0xFE6652

For an 8 channel XM module:

8 Channel XM	Base Address	Register	Value
	0xB2*	000000	FE6652
	0xB4*	000000	FE6652
* NOTE: Both controllers must be written to effect all 8 channels			
TABLE 2: Master Volume Coding Example			

Sample Master Volume register values may be found in Table 1 of Appendix A.

Channel Attenuation

The Channel Attenuator provide a 0dB to 120dB attenuation for an individual channel. The channel attenuation may be utilized to set individual drive levels for different speakers in a powered speaker configuration, zone control for a multi-room distribution amplifier, or individual amplifier levels for a multi-channel AVR system. Depending on the amplifier configuration and application, the Channel Attenuator may be used to prevent a full scale input from clipping on the amplifier output.

Theory

Valid range for Channel Attenuation is 120dB to 0dB. Writing all zeros to the Channel Attenuation register mutes the specified channel. By inverting the sign of the Channel Attenuator value the Channel Attenuator may also be used to apply a 180 degree phase shift to the signal. This is particular useful to reverse the phase by 180 degrees in powered speakers.

The Math

For a given Channel Attenuation in dB, the appropriate parameter is a signed, 24-bit negative number calculated using the following equation. Valid range for Channel

Attenuation is 0dB to 120dB. Note that channel attenuation is positive, such that a value of 0dB results in no attenuation.

$$\text{ChannelAttenuationParameter} = -\left[2^{23} \times 10^{\left(\frac{-\text{Attenuation}}{20}\right)}\right]$$

The Channel Attenuation Parameter can also be used to invert the polarity of a channel. To do this, remove the negative sign from the formula above and recalculate the Channel Attenuation Parameter:

$$\text{InvertedChannelAttenuationParameter} = 2^{23} \times 10^{\left(\frac{-\text{Attenuation}}{20}\right)}$$

Register Usage

Register Name: Channel Attenuation n Where n is channel 1 through 4

Register Name	Maximum Attenuation	Minimum Attenuation	Description
ChannelAttenuationParamter	FFFFFFh	800000h	Per-channel attenuation setting
(with polarity inversion)	000000h	7FFFFFh	Per-channel attenuation setting (with polarity inversion)

Coding Example

For 3dB attenuation non-inverting

$$-5938680 = -\left[2^{23} \times 10^{\left(\frac{-3}{20}\right)}\right]$$

Converting -5938680 to Hexadecimal = 0xA5602B

For speaker output number 6 on a XR Module

Speaker Channel	Base Address	Register	Value
6	0xC4	0x000002	0xA5602B
NOTE: 2nd Controller Logical Channel number 2			

TABLE 3: Channel Attenuation Coding Example

Equalization

The Parametric Equalization block allows the amplifier to modify the frequency response of the amplifier. The EQ may be used to compensate for variations in a listening room or resonances in a speaker application. In older analog graphic equalizer designs, the “band” or range of frequencies were fixed and required 16, 32, or more controls to obtain the desired frequency compensation. The parametric equalization allow for the frequency, shape, and gain (attenuation) of each block to be set independently. With this flexibility, one EQ block may be used to represent multiple controls of the analog system. Depending on the amplifier module, there may be a group of three and or five bands of equalization. For models that show 8 bands, it is actually a group of three and five cascaded. The registers are defined as 3 BAND and 5 BAND EQ blocks. The shape and function for each EQ block requires three parameters; Frequency, Q, and Gain. Figure 3 is an example of a 5 band equalization function.

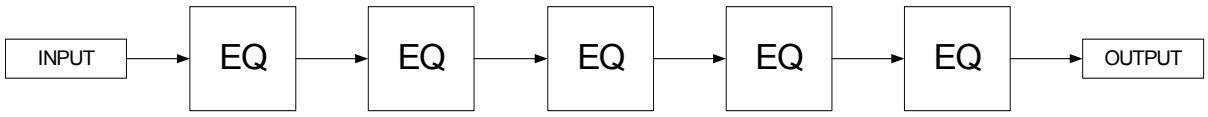

FIGURE 3: Five Band Parametric Equalization

Theory

The first of the three parameters required to define a Parametric Equalization block is the EQ Frequency parameter. This parameter is the center frequency of the filter used to defined the EQ Block. The Center Frequency may be set to any frequency between 20Hz and 24kHz. Figure 4 is an example of an EQ block at 1kHz with 6dB peaking. Figure 5 is the same filter as figure 4 but with its center frequency moved to 3kHz.

.

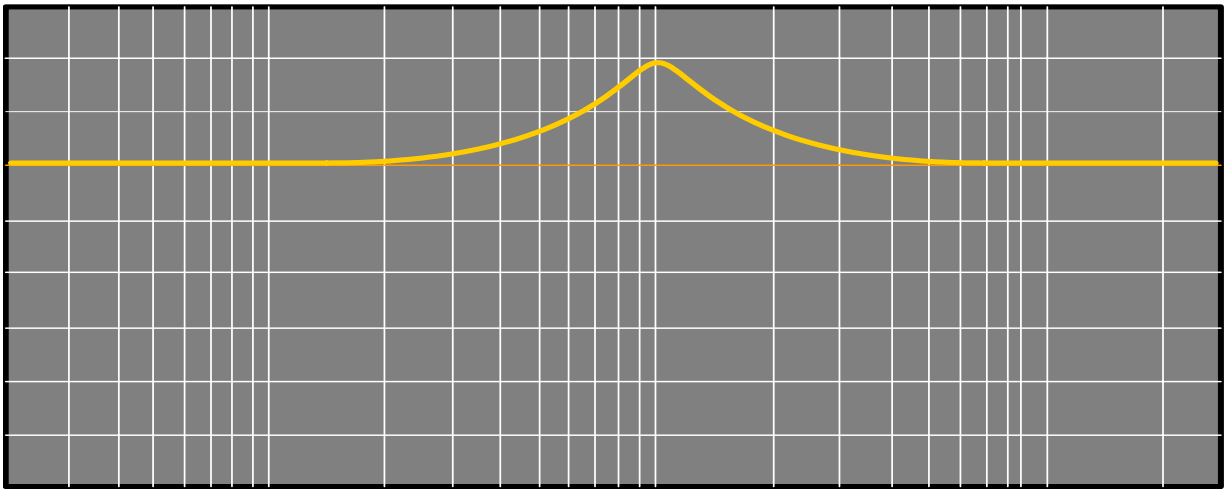

FIGURE 4: +6dB Filter at 1 kHz

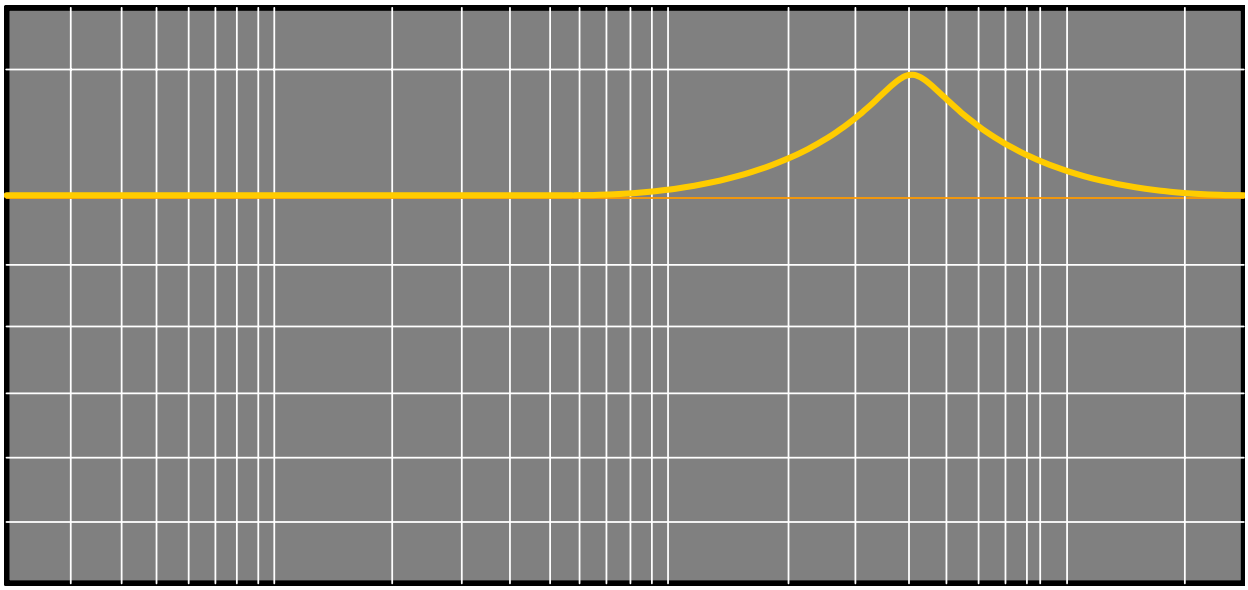

FIGURE 5: +6dB Filter at 3kHz

The second parameter is the Quality Factor. The width of a given filter is determined by its “Quality Factor” or Q for short. Figure 6 shows a series of filters with the same center frequency but varying Q factors. The higher the Q factor, the narrower the filter, the lower Q factor results in wider.

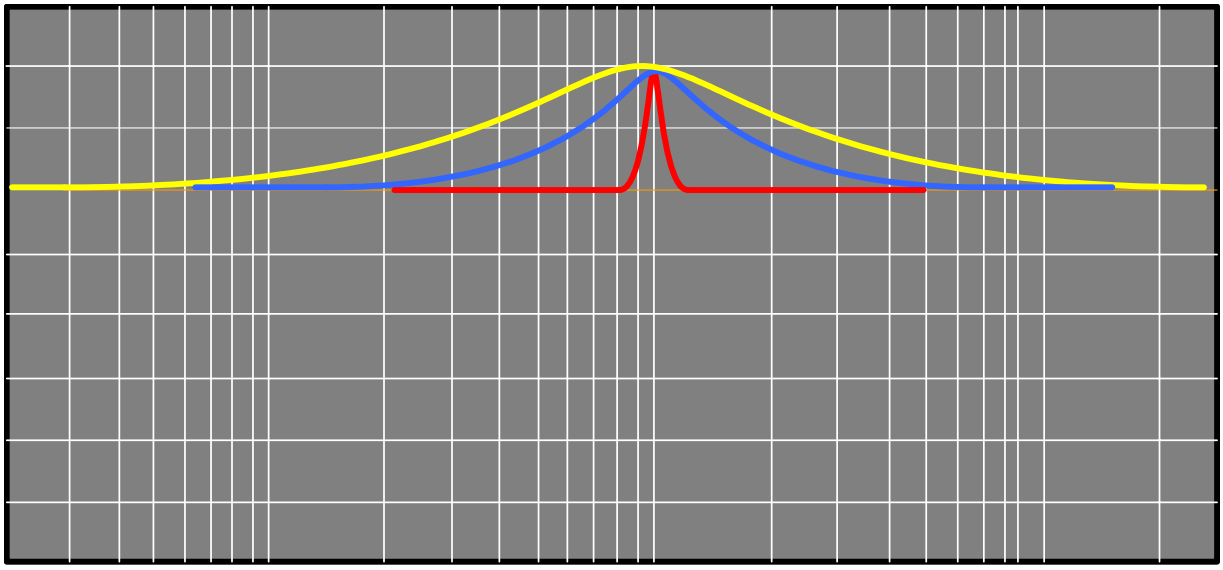

FIGURE 6: Effect of Q on Filter Shape

The third parameter is the Gain Parameter. It will determine if the EQ block will be a peak or a notch. If the Gain Parameter register is programmed with all zeros, the EQ function is disabled. The range of the Gain Parameter is -60dB >Gain Parameter<

+6dB. Figure 7 is an example where the Gain Parameter is positive and the EQ block is peaking.

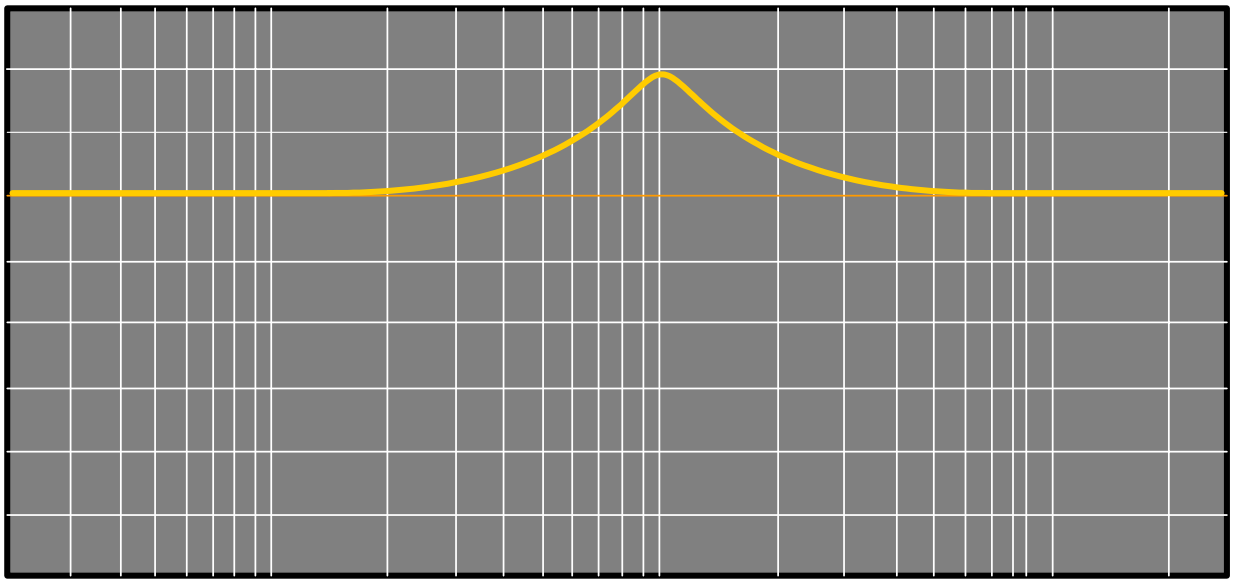

FIGURE 7: EQ Block with Gain (Peaking)

If the Gain Parameter is negative, you create a notch filter. The notch is limited to -54 dB. Figure 8 is an example of a notch filter

.

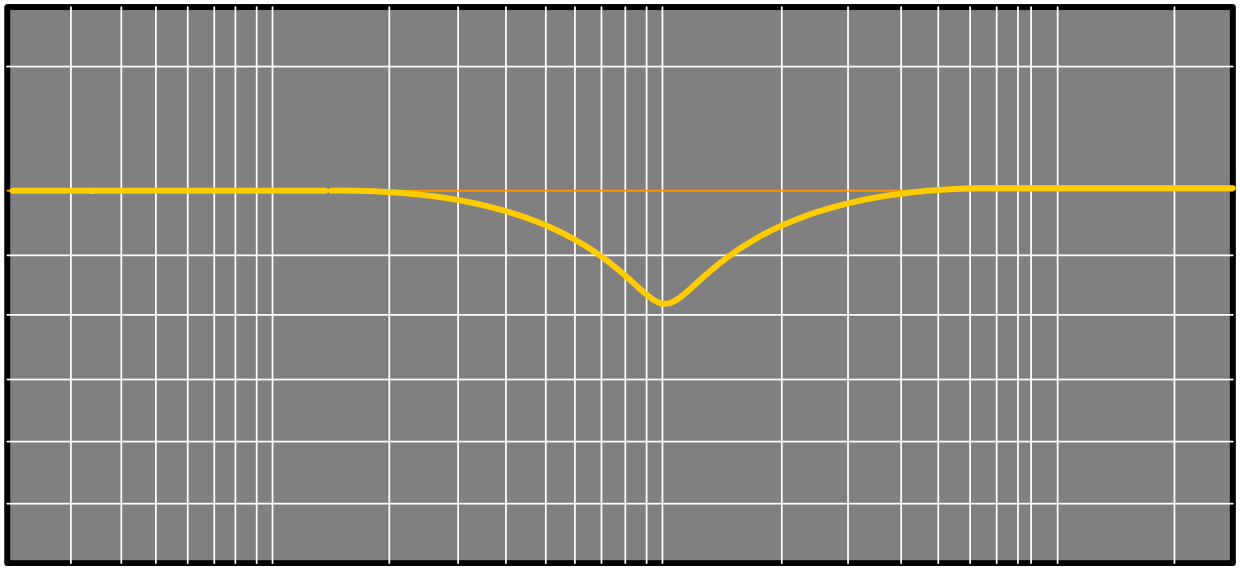

FIGURE 8: Parametric EQ Notch

The audio frequencies not defined within the filter are passed through the EQ Block unaltered. This allows multiple peaks or notches to be created independently of each other. Figure 9 is an example of two sequential EQ Blocks showing a boost and a notch.

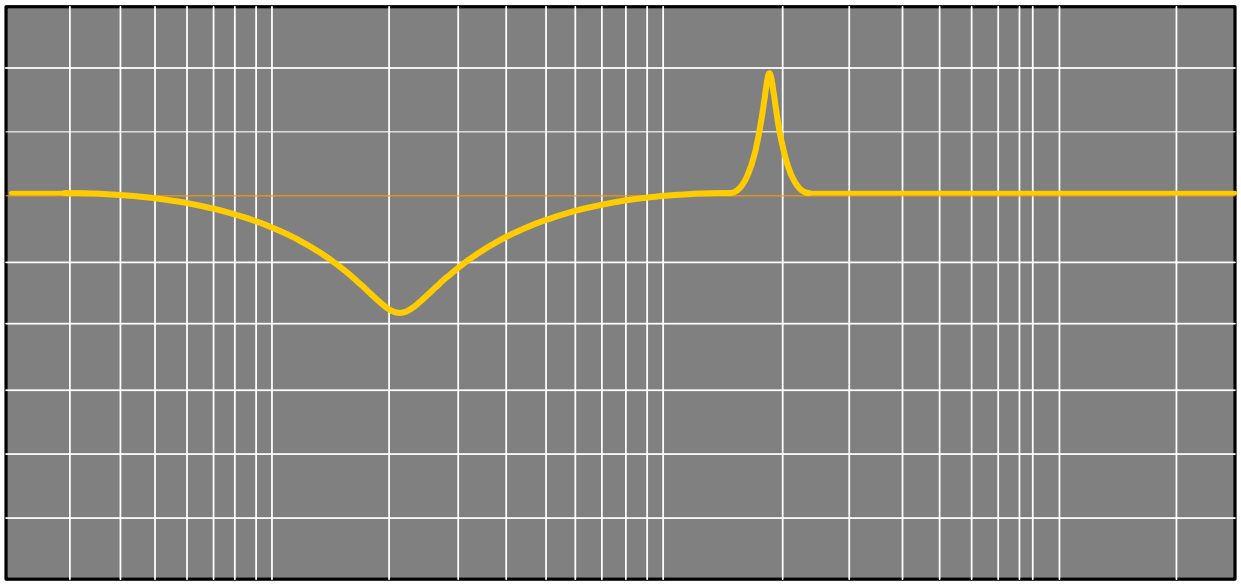

FIGURE 9: Multiple EQ Stages Showing a Boost and Notch

The Math

Determine the Q Parameter between 0.5 and 10. Note: The exact value of 0.5 results in an illegal hex value of 0x800000.

$$\text{EQQParameter} = 2^{23} \times \left(\frac{1}{2 \times \text{Q}}\right)$$

The Center Frequency is entered in Hertz between 20 hZ and 24kHz.

$$\text{EQCenterFrequencyParameter} = 2^{23} \times \text{Frequency} \times 31.25 \times 10^{-6}$$

The Gain Parameter is entered as peaking from 0 to +6dB. The Gain Parameter is entered as notching from 0 to -54dB. Entering all zeros disables the EQ stage.

$$\text{EQGainParameter} = -2^{23} \times \left[1 - 10^{\left(\frac{\text{Gain}}{20}\right)}\right]$$

Register Usage

Register Name	Minimum Value	Maximum Value	Description
EQCenterFrequency Parameter	00147Ah	600000h	Center frequency for Parametric EQ, 3, 5, or bands per channel
EQQParameter	066666h	7FFFFFh	Quality factor for Parametric EQ, 3,5,8 bands per channel
EQGainParameter	8020C5h	7F64C1h	Gain for Parametric EQ, 3,5,8 8 bands per channel

Coding Example

This example is an EQ stage for Speaker Channel 2, 5 band EQ, third EQ stage of an MXS Module. The EQ filter Q is 4.8, center frequency is 2480 Hz, and a gain of 2.2dB.

Determine the EQ Q Factor

$$855980 = 2^{23} \times \left(\frac{1}{2 \times 4.8}\right)$$

Determine the Center Frequency Parameter

$$610117 = 2^{23} \times 2480 \text{x} 31.25 \times 10^{-6}$$

Calculate the Gain Parameter

$$2418012 = -2^{23} \times \left[1 - 10^{\left(\frac{2.2}{20}\right)}\right]$$

Convert decimal values to Hexadecimal

Q = 855980 = 0x0D5555 Center Frequency = 610117 = 0x094F45
Gain PArameter = 2418012 = 0x09EB85

Speaker Channel	5 Band EQ Block	Base Address	Register	Value
2	3	0xB2	0x00003A	0x094F45
2	3	0xB2	0x00003B	0x0D5555
2	3	0xB2	0x00003C	0x09EB85
NOTE: Logical Channel 2, 5 BAND EQ, Third EQ Block				

TABLE 4: EQ Block Coding Example

Tone Control

The tone control utilizes a special class of filters referred to as shelf filters. After the transition at the “Corner Frequency” of the filter, the response remains flat. Each filter contains a first-order (6dB/octave) rolloff, with programmable corner frequency and gain. The DSP within the module will automatically provide a smooth transition between changes to the Tone Control. A low pass shelf is provided for bass and a high pass shelf is provided for treble. The shelf filters provide a range of +14dB to -10dB tone control. Figure 10 is an example of a single bass (low pass) and treble (high pass) filter.

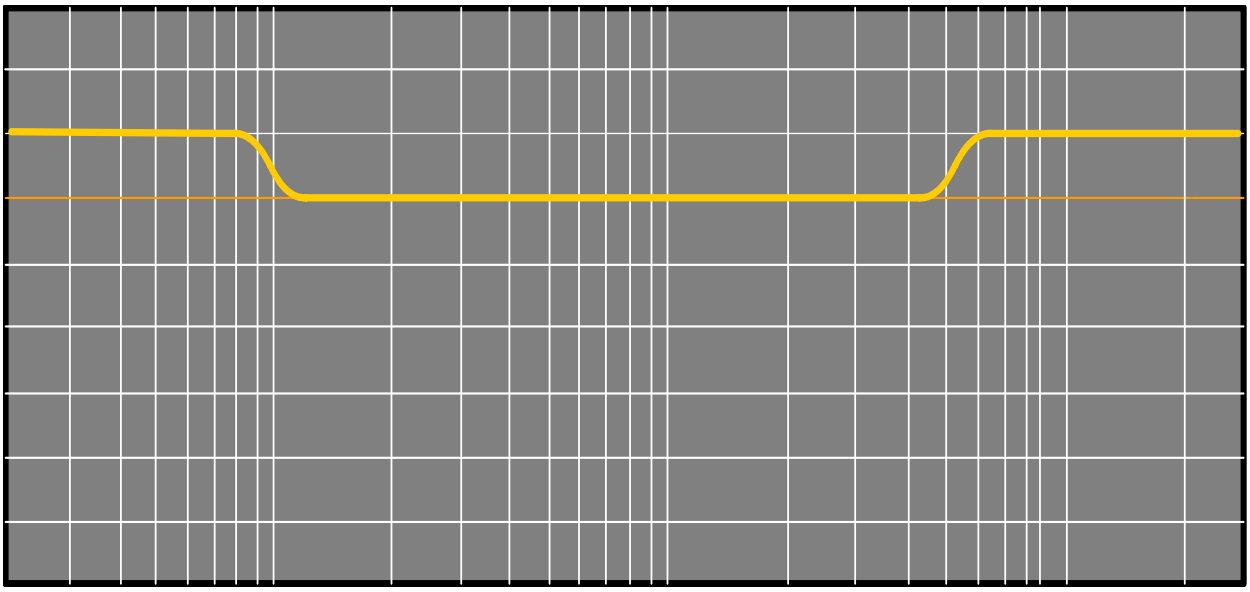

FIGURE 10: Sample Bass and Treble Tone Control

Theory

The Corner Frequency for each shelf filter is programmable from 20Hz to 24kHz. Figure 11 shows examples of various corner frequencies for the high pass and low pass shelf filters

.

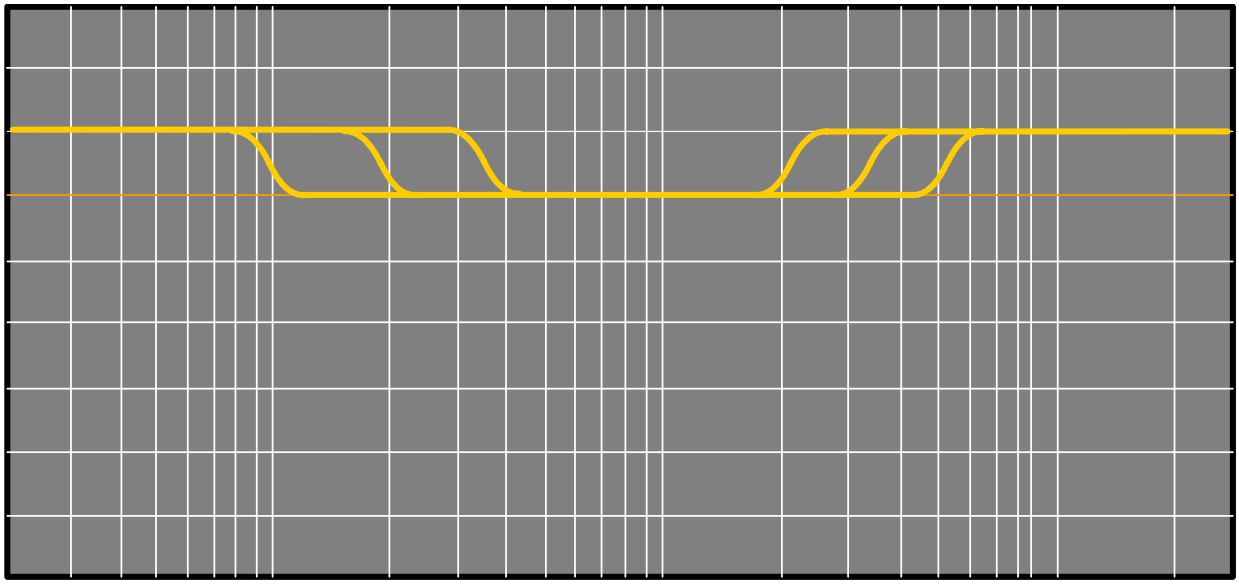

FIGURE 11: Various Tone Control Corner Frequencies

The boost (increase) or cut (attenuation) is determined by the Tone Gain Control. The cut or boost may be set up to 14dB to -14dB. Figure 12 is an example of various cut and boosts.

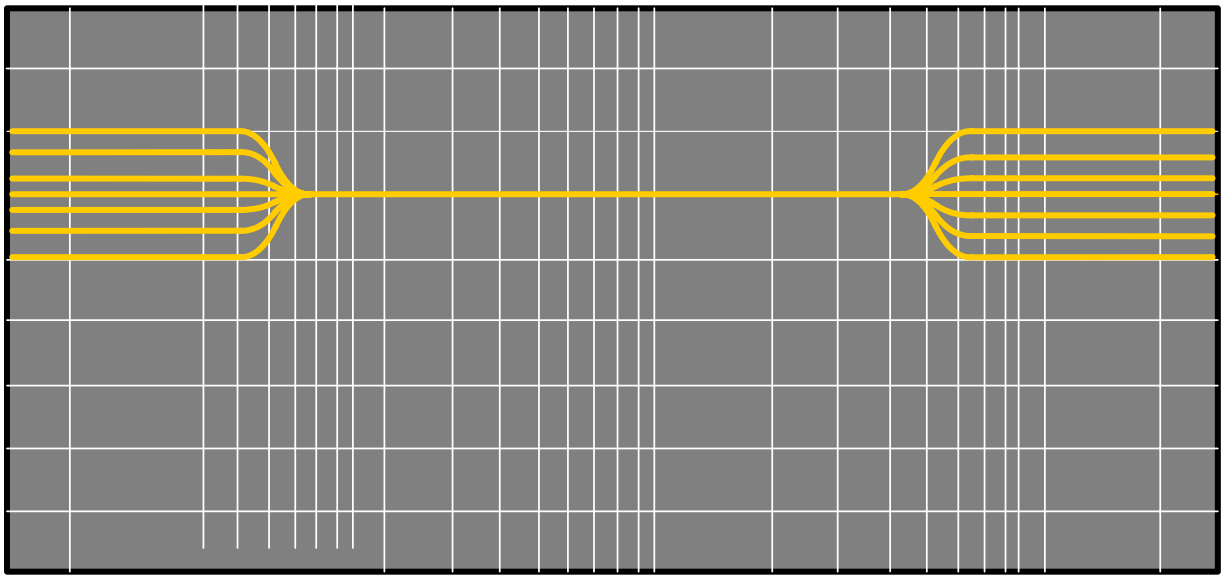

FIGURE 12: Cut or Boost Examples

The Math

The Corner Frequency of the Tone Control is defined as the frequency at which the gain of the filter is +-3dB. For a given Corner Frequency, the appropriate parameter is a signed, 24-bit number calculated using the following equations. First, determine the intermediate value Θ, then use Θ to calculate the frequency corner parameter value (note that Θ is in radians). Valid range for Corner Frequency is 20Hz to 24,000Hz.

$$\Theta(\text{radians}) = \text{Frequency} \times 9.817477 \times 10^{-5}$$

$$\text{ToneControlCornerFrequencyParameter} = 2^{23} \times \left(\frac{\sin(\Theta) - 1}{\cos(\Theta)}\right)$$

For a given Gain in dB, the appropriate parameter is a signed, 24-bit number calculated using the following equation. Valid range for Tone Control Gain is -14dB to +14dB.

$$\text{ToneControlGainParameter} = 2^{23} \times \left[\frac{10^{\left(\frac{\text{Gain}}{20}\right)} - 1}{4}\right]$$

The calculation of the Corner Frequency for the High Pass Corner Frequency (Treble) and the Low Pass Corner Frequency (Bass) are identical.

Register Usage

Register Name	Minimum Value	Maximum Value	Description
BassToneControlCorner FrequencyParameter	804047h	3504F3h	Per-channel corner frequency parameter for bass tone control shelving filter.
BassToneControlGain Parameter	C0002Ah	7FFFFFh	Per-channel gain for bass tone control shelving filter
TrebleToneControlCorner FrequencyParameter	804047h	3504F3h	Per-channel corner frequency parameter for treble tone control shelving filter.
TrebleToneControlGain Parameter	C0002Ah	7FFFFFh	Per-channel gain for treble tone control shelving filter

TABLE 5: Tone Control Register Summary

Coding Example

This example is for a Treble boost of 3dB at 12kHz for Channel 4 of an MX module.

Convert the frequency to radians and calculate the corner frequency.

$$1.178094 = 12000 \times 9.817477 \times 10^{-5}$$

$$-1668094 = 2^{23} \times \left(\frac{\sin(1.178094) - 1}{\cos(1.178094))}\right)$$

Calculate the Gain (Boost/ Cut)

$$8651539 = 2^{23} \times \left[\frac{10^{\left(\frac{3}{20}\right)} - 1}{4}\right]$$

Convert decimal values to Hexadecimal

Corner Frequency = -1668598 = 0xE68A0B
Boost/Cut = 8651539 = 0x0D3381

Channel	Treble Control	Base Address	Register	Value
4	Corner Frequency	0xB2	0x000021	0xE68A0B
4	Gain (Boost/Cut)	0xB2	0x000022	0x0D3381

TABLE 6: Tone Block Coding Example

Mixer

The mixer block allows multiple input sources to be digitally mixed on a per channel basis. The mixer block may have up to 16 inputs depending on the module model and system configuration.The output from each mixer attenuator is summed to create the mixer output. Each available input has a Mixer Attenuator that provides a 0dB to -127dB attenuation.

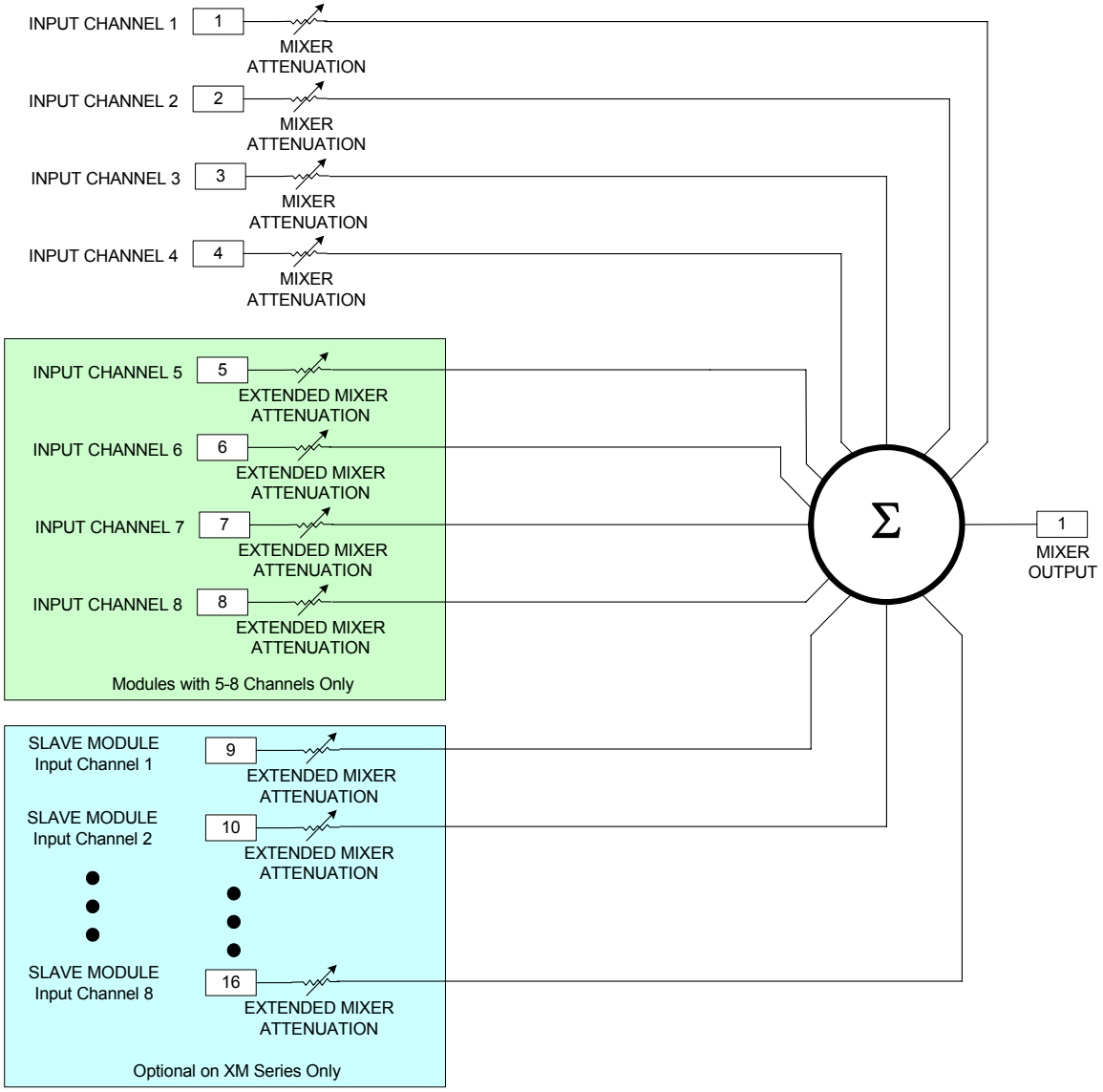

FIGURE 13: MIxer Inputs

Theory

The sum of all the inputs to the mixer must not exceed 0dB. The Mixer Attenuation allows each input to be attenuated accordingly to prevent clipping. Valid range for Mixer Attenuation is 0dB to 127 dB. Writing all zeros to the Mixer Attenuation register mutes the specified channel. For modules with parametric EQ before the mixer block; any gain in the EQ stages must be accounted for when determining the mixer attenuation.

The Math

For a given Mixer Attenuation in dB, the appropriate parameter is a signed, 24-bit negative number calculated using the following equation. Valid range for Mixer Attenuation is 0dB to -127dB. Note that mixer attenuation is positive, such that a value of 0dB results in no attenuation.

$$\text{MixerAttenuation} = -\left[2^{23} \times 10^{\left(\frac{-\text{Attenuation}}{20}\right)}\right]$$

The Mixer Attenuation Parameter can also be used to invert the polarity of a channel. To do this, remove the negative sign from the formula above and recalculate the Mixer Attenuation Parameter:

$$\text{InvertedMixerAttenuation} = 2^{23} \times 10^{\left(\frac{-\text{Attenuation}}{20}\right)}$$

Coding Example

This example uses the mixer block for Channel 1 to mix input channels 1 and 6 of a XM module.

To prevent clipping of two full scale input channels, each must be attenuated by 6dB.

Calculate the mixer attenuation value.

$$-4204263 = -\left[2^{23} \times 10^{\left(\frac{-6}{20}\right)}\right]$$

NOTE: The Channel Attenuation values listed in Appendix A also apply to the Mixer Attenuation.

Converting the mixer attenuator value to hexadecimal
Mixer Attenuator Value = -4204263 = 0xBFD919

Channel	Input Channel	Base Address	Register	Value
1	1	0xB2	0x000005	0xBFD919
1	6	0xB2	0x0000D2	0xBFD919

TABLE 7: Mixer Coding Example

Compressor / Limiter

The Compressor/Limiter block allows the amplifier to gracefully limit the dynamic range of an amplifier channel, prevent clipping on the amplifier output, or limit the maximum output power of an amplifier channel. The rate of compression, or ratio, determines the level of compression or limiting. The compression threshold and rate of compression are programmable in the Compression/Limiter block. The compression / limiting is not instantaneously applied to the input signal but is added or removed exponentially over a programmable period of time. These are referred to as the attack and decay time.

Theory

Five parameters are required to establish the Compressor / Limiter; the compression threshold, compression ratio, attack and decay, and the make-up gain.

The compression threshold is the point where compression will be applied to the input to the compressor limiter. This may be set to any point between -90 and 0 dB. The output is compressed when the rms value of the input signal rises above the compression threshold. When the rms value of the input signal falls below the compression threshold, compression is not active.

The compression ratio determines how much the gain is reduced on signal levels above the threshold level. The level is defined as the ratio of the input to output signal. If the ratio is set to 2, the input must increase by 2 dB to obtain a 1dB change in the output of the compressor / limiter. A ratio of three requires 3 dB increase for the same 1 dB change. Ratios above 10 result in hard limiting of the input signals. Figure 14 is an example of various compression ratios.

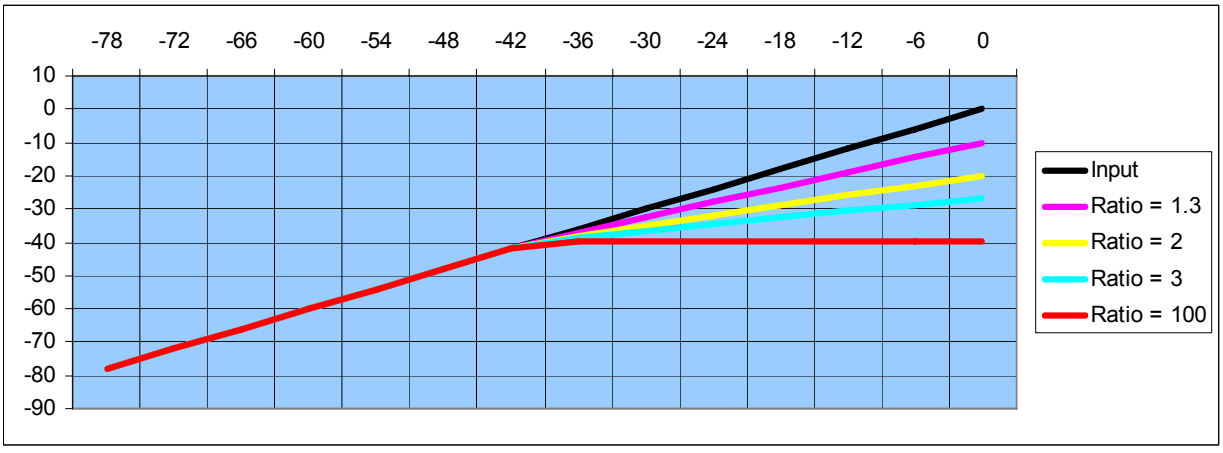

FIGURE 14: Compressor Ratios

The example in Figure 14 has the threshold level set at -40dB referenced to full scale. Note that the with a ratio of 2, the input signal is moderately compressed but with the ratio set at 10, the input is hard limited to -39.95dB.

The compression is not abruptly applied to the input signal when its average value exceeds the threshold level. An exponential time constant gradually applies and releases the compression. The rate that the compression is applied is the Attack time. The Decay time constant determines how long the compression is held after the input level falls below the compression threshold. is an example of an input signal to the compressor and the resulting output. The waveforms are exaggerated to show the effects of the Attack Time.

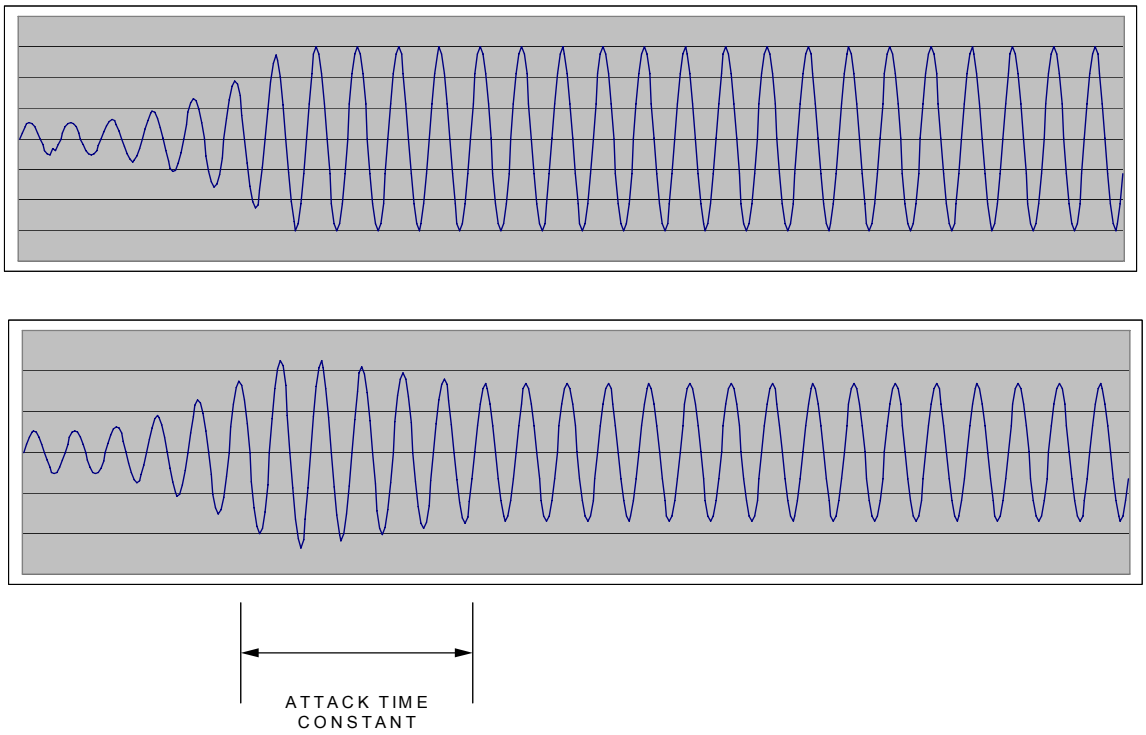

FIGURE 15: Attack Time Constant

The nature of the compressor/limiter's attack and decay timing may add dynamic distortion to any content material. Instrumentals generally require a slow attack of 10-30ms with an extended release of 200-600ms while voice material may require a very fast attack time of 1-10ms and a more moderate decay time of 200-500ms. Listening preferences and variations in source materials make the use of a compressor/limiter more of an art than an exact science.

The Math

Sample 1.

$$\text{CompressorThresholdParameter} = 2^{23} \times [(0.010381025 \times \text{Threshold}) + 0.96875]$$

$$\text{CompressorRatioParameter} = 2^{23} \times \left(1 - \left(\frac{1}{\text{Ratio}}\right)\right)$$

$$\text{CompressorMakeupGainParameter} = 2^{23} \times 10^{[(\text{Gain} \times 0.05) - 0.90309]}$$

Appendix A Register Value Tables

The following tables are a sample of register values and their respective decimal and hexadecimal values

Master Volume Value Table

Gain dB	Decimal	Hex		Gain dB	Decimal	Hex
18.06	-8388607	800001		-21	-93472.8004	FF92E0
17	-7424886.89	8EB48A		-22	-83307.6123	FFBA95
16	-6617437.29	9B06A3		-23	-74247.8789	FFDDF9
15	-5897797.09	A601BB		-24	-66173.3829	FFFD83
14	-5256417.08	AFCB1F		-25	-58976.9809	FF19A0
13	-4684786.54	B8840E		-26	-52563.1808	FF32AD
12	-4175320.29	C04A28		-27	-46846.8754	FF4902
11	-3721258.02	C737D6		-28	-41752.2129	FF5CE8
10	-3316574.59	CD64A2		-29	-37211.5902	FF6EA5
9	-2955900.11	D2E584		-30	-33164.7559	FF7E74
8	-2634448.64	D7CD30		-31	-29558.0111	FF8C8A
7	-2347954.71	DC2C4E		-32	-26343.4964	FF9919
6	-2092616.73	E011B8		-33	-23478.5571	FFA44A
5	-1865046.51	E38AAA		-34	-20925.1773	FFAE43
4	-1662224.35	E6A2F0		-35	-18649.4751	FFB727
3	-1481458.9	E9650E		-36	-16621.2535	FFBF13
2	-1320351.52	EBDA61		-37	-14813.599	FFC623
1	-1176764.43	EE0B44		-38	-13202.5252	FFCC6E
0	-1048792.29	EFFF28		-39	-11766.6543	FFD20A
-1	-934737.004	F1BCAF		-40	-10486.9329	FFD70A
-2	-833085.123	F349C3		-41	-9346.38004	FFDB7E
-3	-742487.789	F4ABA9		-42	-8329.86123	FFDF77
-4	-661742.829	F5E712		-43	-7423.88789	FFE301
-5	-589778.809	F7002E		-44	-6616.43829	FFE628
-6	-525640.808	F7FAB8		-45	-5896.79809	FFE8F8
-7	-468477.754	F8DA03		-46	-5255.41808	FFEB79
-8	-417531.129	F9A105		-47	-4683.78754	FFEDB5
-9	-372124.902	FA5264		-48	-4174.32129	FFEFB2
-10	-331656.559	FAF078		-49	-3720.25902	FFF178
-11	-295589.111	FB7D5B		-50	-3315.57559	FFF30D
-12	-263443.964	FBFAED		-51	-2954.90111	FFF476
-13	-234794.571	FC6AD6		-52	-2633.44964	FFF5B7
-14	-209260.773	FCCE94		-53	-2346.95571	FFF6D6
-15	-186503.751	FD2779		-54	-2091.61773	FFF7D5
-16	-166221.535	FD76B3		-55	-1864.04751	FFF8B8
-17	-148144.99	FDBD50		-56	-1661.22535	FFF983
-18	-132034.252	FDFC3E		-57	-1480.4599	FFFA38
-19	-117675.543	FE3455		-58	-1319.35252	FFFAD9
-20	-104878.329	FE6652		-59	-1175.76543	FFFB69

TABLE 8: Master Volume Value Table

Master Volume Value Table

Gain dB	Decimal	Hex	Gain dB	Decimal	Hex
-59	-1175.77	FFFBE9	-85	-57.978	FFFFCD
-60	-1047.79	FFFC5B	-86	-51.5642	FFFFD3
-61	-933.738	FFFCC0	-87	-45.8479	FFFFD8
-62	-832.086	FFFD1B	-88	-40.7532	FFFFDC
-63	-741.489	FFFD6C	-89	-36.2126	FFFFE0
-64	-660.744	FFFDB4	-90	-32.1658	FFFFE4
-65	-588.78	FFFDF4	-91	-28.559	FFFFE7
-66	-524.642	FFFE2D	-92	-25.3445	FFFFEA
-67	-467.479	FFFE60	-93	-22.4796	FFFFED
-68	-416.532	FFFE8D	-94	-19.9262	FFFFEF
-69	-371.126	FFFEB6	-95	-17.6505	FFFFF1
-70	-330.658	FFFEDA	-96	-15.6223	FFFFF3
-71	-294.59	FFFEFA	-97	-13.8146	FFFFF4
-72	-262.445	FFFF17	-98	-12.2035	FFFFF6
-73	-233.796	FFFF30	-99	-10.7677	FFFFF7
-74	-208.262	FFFF47	-100	-9.48793	FFFFF8
-75	-185.505	FFFF5B	-101	-8.34738	FFFFF9
-76	-165.223	FFFF6D	-102	-7.33086	FFFFFA
-77	-147.146	FFFF7D	-103	-6.42489	FFFFFB
-78	-131.035	FFFF8C	-104	-5.61744	FFFFFC
-79	-116.677	FFFF99	-105	-4.8978	FFFFFC
-80	-103.879	FFFFA4	-106	-4.25642	FFFFFD
-81	-92.4738	FFFFAE	-107	-3.68479	FFFFFD
-82	-82.3086	FFFFB7	-108	-3.17532	FFFFFE
-83	-73.2489	FFFFBF	-109	-2.72126	FFFFFE
-84	-65.1744	FFFFC7	-110	-2.31658	FFFFFF

TABLE 9: Master Volume

Channel Attenuation (Non- Inverting)

dB	Decimal	Hex	dB	Decimal	Hex	dB	Decimal	Hex
0	-8388608	8000000	41	-74764	FEDBF4	82	-666	FFFD66
1	-7476355	8DEB7D	42	-66633	FEFBB7	83	-594	FFFDAE
2	-6663308	9A5374	43	-59387	FF1805	84	-529	FFFDEF
3	-5938680	A56208	44	-52929	FF313F	85	-472	FFFE28
4	-5292854	AF3CCA	45	-47173	FF47BB	86	-420	FFFE5C
5	-4717261	B80533	46	-42043	FF5BC5	87	-375	FFFE89
6	-4204263	BFD919	47	-37471	FF6DA1	88	-334	FFFEB2
7	-3747054	C6D312	48	-33396	FF7D8C	89	-298	FFFED6
8	-3339565	CD0AD3	49	-29764	FF8BBC	90	-265	FFFEF7
9	-2976390	D2957A	50	-26527	FF9861	91	-236	FFFF14
10	-2652711	D785D9	51	-23642	FFA3A6	92	-211	FFFF2D
11	-2364231	DBECB9	52	-21071	FFADB1	93	-188	FFFF44
12	-2107123	DFD90D	53	-18780	FFB6A4	94	-167	FFFF59
13	-1877975	E35829	54	-16737	FFBE9F	95	-149	FFFF6B
14	-1673747	E675ED	55	-14917	FFC5BB	96	-133	FFFF7B
15	-1491729	E93CEF	56	-13295	FFCC11	97	-118	FFFF8A
16	-1329505	EBB69F	57	-11849	FFD1B7	98	-106	FFFF96
17	-1184922	EDEB66	58	-10561	FFD6BF	99	-94	FFFFA2
18	-1056063	EFE2C1	59	-9412	FFDB3C	100	-84	FFFFAC
19	-941217	F1A35F	60	-8389	FFDF3B	101	-75	FFFFB5
20	-838861	F33333	61	-7476	FFE2CC	102	-67	FFFFBD
21	-747635	F4978D	62	-6663	FFE5F9	103	-59	FFFFC5
22	-666331	F5D525	63	-5939	FFE8CD	104	-53	FFFFCB
23	-593868	F6F034	64	-5293	FFEB53	105	-47	FFFFD1
24	-529285	F7EC7B	65	-4717	FFED93	106	-42	FFFFD6
25	-471726	F8CD52	66	-4204	FFEF94	107	-37	FFFFDB
26	-420426	F995B6	67	-3747	FFF15D	108	-33	FFFFDF
27	-374705	FA484F	68	-3340	FFF2F4	109	-30	FFFFE2
28	-333956	FAE77C	69	-2976	FFF460	110	-27	FFFFE5
29	-297639	FB7559	70	-2653	FFF5A3	MUTE		"000000"
30	-265271	FBF3C9	71	-2364	FFF6C4			
31	-236423	FC6479	72	-2107	FFF7C5			
32	-210712	FCC8E8	73	-1878	FFF8AA			
33	-187798	FD226A	74	-1674	FFF976			
34	-167375	FD7231	75	-1492	FFFA2C			
35	-149173	FDB94B	76	-1330	FFFACE			
36	-132950	FDF8AA	77	-1185	FFFB5F			
37	-118492	FE3124	78	-1056	FFFBE0			
38	-105606	FE637A	79	-941	FFFC53			
39	-94122	FE9056	80	-839	FFFCB9			
40	-83886	FEB852	81	-748	FFFD14			

TABLE 10: Channel Attenuation (Non-Inverting)

Channel Attenuation (Inverting)

dB	Decimal	Hex	dB	Decimal	Hex	dB	Decimal	Hex
0	8388607	7FFFFF	41	74764	01240C	82	666	00029A
1	7476355	721483	42	66633	010449	83	594	000252
2	6663308	65AC8C	43	59387	00E7FB	84	529	000211
3	5938680	5A9DF8	44	52929	00CEC1	85	472	0001D8
4	5292854	50C336	45	47173	00B845	86	420	0001A4
5	4717261	47FACD	46	42043	00A43B	87	375	000177
6	4204263	4026E7	47	37471	00925F	88	334	00014E
7	3747054	392CEE	48	33396	008274	89	298	00012A
8	3339565	32F52D	49	29764	007444	90	265	000109
9	2976390	2D6A86	50	26527	00679F	91	236	0000EC
10	2652711	287A27	51	23642	005C5A	92	211	0000D3
11	2364231	241347	52	21071	00524F	93	188	0000BC
12	2107123	2026F3	53	18780	00495C	94	167	0000A7
13	1877975	1CA7D7	54	16737	004161	95	149	000095
14	1673747	198A13	55	14917	003A45	96	133	000085
15	1491729	16C311	56	13295	0033EF	97	118	000076
16	1329505	144961	57	11849	002E49	98	106	00006A
17	1184922	12149A	58	10561	002941	99	94	00005E
18	1056063	101D3F	59	9412	0024C4	100	84	000054
19	941217	0E5CA1	60	8389	0020C5	101	75	00004B
20	838861	0CCCCD	61	7476	001D34	102	67	000043
21	747635	0B6873	62	6663	001A07	103	59	00003B
22	666331	0A2ADB	63	5939	001733	104	53	000035
23	593868	090FCC	64	5293	0014AD	105	47	00002F
24	529285	081385	65	4717	00126D	106	42	00002A
25	471726	0732AE	66	4204	00106C	107	37	000025
26	420426	066A4A	67	3747	000EA3	108	33	000021
27	374705	05B7B1	68	3340	000D0C	109	30	00001E
28	333956	051884	69	2976	000BA0	110	27	00001B
29	297639	048AA7	70	2653	000A5D	111	24	000018
30	265271	040C37	71	2364	00093C	112	21	000015
31	236423	039B87	72	2107	00083B	113	19	000013
32	210712	033718	73	1878	000756	114	17	000011
33	187798	02DD96	74	1674	00068A	115	15	00000F
34	167375	028DCF	75	1492	0005D4	116	13	00000D
35	149173	0246B5	76	1330	000532	117	12	00000C
36	132950	020756	77	1185	0004A1	118	11	00000B
37	118492	01CEDC	78	1056	000420	119	9	000009
38	105606	019C86	79	941	0003AD	120	8	000008
39	94122	016FAA	80	839	000347	121	7	000007
40	83886	0147AE	81	748	0002EC	122	7	000007

TABLE 11: Channel Attenuation (Inverting)

Parametric EQ Frequency

Frequency	Decimal	Hex
20	5243	00147B
40	10486	0028F6
60	15729	003D71
80	20972	0051EC
100	26214	006666
200	52429	00CCCD
400	104858	01999A
600	157286	026666
800	209715	033333
1000	262144	040000
2000	524288	080000
4000	1048576	100000
6000	1572864	180000
8000	2097152	200000
10000	2621440	280000
12000	3145728	300000
14000	3670016	380000
16000	4194304	400000
18000	4718592	480000
20000	5242880	500000
22000	5767168	580000
24000	6291456	600000

TABLE 12: Parametric EQ Frequency

Parametric EQ Gain

Gain dB	Decimal	Hex		Gain dB	Decimal	Hex
6	8348865.417	7F64C1		-24	-7859322.62	881386
5	6528680.885	639EA8		-25	-7916881.91	8732AF
4	4906439.713	4ADDC7		-26	-7968181.68	866A4B
3	3460615.747	34CE07		-27	-8013902.64	85B7B2
2	2172023.781	212477		-28	-8054651.5	851885
1	1023564.982	0F9E4C		-29	-8090968.96	848AA8
0	0	000000		-30	-8123336.92	840C38
-1	-912253.25	F21483		-31	-8152184.9	839B88
-2	-1725299.82	E5AC8D		-32	-8177895.69	833719
-3	-2449928.33	DA9DF8		-33	-8200810.46	82DD96
-4	-3095754.17	D0C336		-34	-8221233.27	828DCF
-5	-3671347.06	C7FACD		-35	-8239435.11	8246B5
-6	-4184344.76	C026E8		-36	-8255657.52	820757
-7	-4641554.45	B92CEE		-37	-8270115.76	81CEDD
-8	-5049043	B2F52D		-38	-8283001.68	819C87
-9	-5412217.56	AD6A87		-39	-8294486.27	816FAA
-10	-5735897.23	A87A27		-40	-8304721.92	8147AF
-11	-6024377.04	A41347		-41	-8313844.45	81240C
-12	-6281484.94	A026F4		-42	-8321974.92	81044A
-13	-6510632.59	9CA7D8		-43	-8329221.2	80E7FB
-14	-6714860.66	998A14		-44	-8335679.46	80CEC1
-15	-6896879.11	96C311		-45	-8341435.39	80B845
-16	-7059103.23	944961		-46	-8346565.37	80A43B
-17	-7203685.63	92149B		-47	-8351137.46	80925F
-18	-7332544.82	901D40		-48	-8355212.35	808274
-19	-7447390.7	8E5CA2		-49	-8358844.1	807444
-20	-7549747.2	8CCCCD		-50	-8362080.89	8067A0
-21	-7640972.53	8B6874		-51	-8364965.69	805C5B
-22	-7722277.18	8A2ADB		-52	-8367536.77	805250
-23	-7794740.03	890FCC		-53	-8369828.25	80495C

TABLE 13: Parametric EQ Gain

Parametric EQ

Q	Decimal	Hex	Q	Decimal	Hex	Q	Decimal	Hex
0.50001	8388440	7FFF58	4.5	932068	0E38E4	8.5	493448	078788
0.6	6990507	6AAAAB	4.6	911805	0DE9BD	8.6	487710	07711E
0.7	5991863	5B6DB7	4.7	892405	0D9DF5	8.7	482104	075B38
0.8	5242880	500000	4.8	873813	0D5555	8.8	476625	0745D1
0.9	4660338	471C72	4.9	855980	0D0FAC	8.9	471270	0730E6
1	4194304	400000	5	838861	0CCCCD	9	466034	071C72
1.1	3813004	3A2E8C	5.1	822413	0C8C8D	9.1	460913	070871
1.2	3495253	355555	5.2	806597	0C4EC5	9.2	455903	06F4DF
1.3	3226388	313B14	5.3	791378	0C1352	9.3	451000	06E1B8
1.4	2995931	2DB6DB	5.4	776723	0BDA13	9.4	446203	06CEFB
1.5	2796203	2AAAAB	5.5	762601	0BA2E9	9.5	441506	06BCA2
1.6	2621440	280000	5.6	748983	0B6DB7	9.6	436907	06AAAB
1.7	2467238	25A5A6	5.7	735843	0B3A63	9.7	432402	069912
1.8	2330169	238E39	5.8	723156	0B08D4	9.8	427990	0687D6
1.9	2207528	21AF28	5.9	710899	0AD8F3	9.9	423667	0676F3
2	2097152	200000	6	699051	0AAAAB	10	419430	066666
2.1	1997288	1E79E8	6.1	687591	0A7DE7			
2.2	1906502	1D1746	6.2	676501	0A5295			
2.3	1823610	1BD37A	6.3	665763	0A28A3			
2.4	1747627	1AAAAB	6.4	655360	0A0000			
2.5	1677722	19999A	6.5	645278	09D89E			
2.6	1613194	189D8A	6.6	635501	09B26D			
2.7	1553446	17B426	6.7	626016	098D60			
2.8	1497966	16DB6E	6.8	616809	096969			
2.9	1446312	1611A8	6.9	607870	09467E			
3	1398101	155555	7	599186	092492			
3.1	1353001	14A529	7.1	590747	09039B			
3.2	1310720	140000	7.2	582542	08E38E			
3.3	1271001	1364D9	7.3	574562	08C462			
3.4	1233619	12D2D3	7.4	566798	08A60E			
3.5	1198373	124925	7.5	559241	088889			
3.6	1165084	11C71C	7.6	551882	086BCA			
3.7	1133596	114C1C	7.7	544715	084FCB			
3.8	1103764	10D794	7.8	537731	083483			
3.9	1075463	106907	7.9	530925	0819ED			
4	1048576	100000	8	524288	080000			
4.1	1023001	0F9C19	8.1	517815	07E6B7			
4.2	998644	0F3CF4	8.2	511500	07CE0C			
4.3	975420	0EE23C	8.3	505338	07B5FA			
4.4	953251	0E8BA3	8.4	499322	079E7A			

TABLE 14: Parametric EQ Q

Tone Control Frequency

Tone Freq	Radian	Decimal	Hex
20	0.001963	-8372153	804047
40	0.003927	-8355731	80806E
60	0.00589	-8339340	80C075
80	0.007854	-8322981	81005B
100	0.009817	-8306655	814022
200	0.019635	-8225494	827D2A
400	0.03927	-8065491	84EE2E
600	0.058905	-7908480	875380
800	0.07854	-7754349	89AD93
1000	0.098175	-7602991	8BFCD1
2000	0.19635	-6884353	96F400
4000	0.392699	-5605089	AA7920
6000	0.589049	-4483804	BB9524
8000	0.785398	-3474675	CAFB0D
10000	0.981748	-2544656	D92BF0
12000	1.178097	-1668598	E68A0B
14000	1.374447	-826206	F364A3
16000	1.570796	0	000000
18000	1.767146	826205.7	0C9B5D
20000	1.963495	1668598	1975F5
22000	2.159845	2544656	26D410
24000	2.356194	3474675	3504F3

TABLE 15: Tone Control Frequency

Tone Control Gain

Gain dB	Decimal	Hex
13.9794	8388608	7FFFFF
13	7270482	6EF051
12	6251760	5F64F0
11	5343824	518A50
10	4534625	453160
9	3813425	3A3031
8	3170656	30615F
7	2597787	27A39A
6	2087216	1FD930
5	1632170	18E7AA
4	1226610	12B771
3	865153.9	0D3381
2	543005.9	08491D
1	255891.2	03E793
0	0	000000
-1	-228063	FC8521
-2	-431325	F96B24
-3	-612482	F6A77E
-4	-773939	F430CE
-5	-917837	F1FEB4
-6	-1046086	F009BA
-7	-1160389	EE4B3C
-8	-1262261	ECBD4C
-9	-1353054	EB5AA2
-10	-1433974	EA1E8A
-11	-1506094	E904D2
-12	-1570371	E809BD
-13	-1627658	E729F6
-14	-1678715	E66285
-15	-1724220	E5B0C5

TABLE 16: Tone Control GainDecay

Compressor/Limiter Attack/Decay Time Constant

Attack/Decay Time		Attack/Decay Time		Attack/Decay Time	
1	1C2F43	80	663D	520	FC0
1.5	139BD2	85	603C	535	F4E
2	F05A4	90	5AE5	550	EE4
2.5	C2BD1	95	561E	565	E7E
3	A3A88	100	51D1	580	E1F
3.5	8D202	115	4728	595	DC3
4	7C0AF	130	3EF4	610	D6D
4.5	6EA5B	145	3872	625	D1A
5	63DCA	160	3328	640	CCC
5.5	5AFDD	175	2EC7	655	C81
6	53917	190	2B16	670	C39
6.5	4D43A	205	27EF	685	BF4
7	47D83	220	2537	700	BB3
7.5	4322A	235	22D7	715	B74
8	3F015	250	20C0	730	B38
8.5	3B5A9	265	1EE6	745	AFE
9	381A3	280	1D3E	760	AC6
9.5	35305	295	1BC1	775	A91
10	32900	310	1A6A	790	A5E
15	21D98	325	1932	805	A2C
20	1970B	340	1815	820	9FD
25	1460B	355	1711	835	9CF
30	10FEE	370	1622	850	9A2
35	E938	385	1545	865	978
40	CC29	400	1479	880	94E
45	B58A	415	13BB	895	926
50	A36E	430	130B	910	900
55	949B	445	1267	925	8DA
60	883F	460	11CD	940	8B6
65	7DC9	475	113D	955	893
70	74D1	490	10B6	970	871
75	6D0B	505	1037	985	850

TABLE 17: Attack/Decay Time Constants

Compressor/Limiter Threshold

Threshold		Threshold	
0	7C0000	42	B3CEF2
1	7D542A	44	B67747
2	7EA854	46	B91F9C
3	7FFC7F	48	BBC7F0
4	8150A9	50	BE7045
5	82A4D3	52	C1189A
6	83F8FE	54	C3C0EE
7	854D28	56	C66943
8	86A152	58	C91198
9	87F57D	60	CBB9EC
10	8949A7	62	CE6241
12	8BF1FC	64	D10A96
14	8E9A50	66	D3B2EB
16	9142A5	68	D65B3F
18	93EAFA	70	D90394
20	96934E	72	DBABE9
22	993BA3	74	DE543D
24	9BE3F8	76	E0FC92
26	9E8C4D	78	E3A4E7
28	A134A1	80	E64D3B
30	A3DCF6	82	E8F590
32	A6854B	84	EB9DE5
34	A92D9F	86	EE463A
36	ABD5F4	88	F0EE8E
38	AE7E49	90	F396E3
40	B1269D		

TABLE 18: Compressor/Limiter Threshold

Compressor/Limiter Ratio

Ratio		Ratio	
1	000000	5.75	69BD37
1.25	199999	6	6AAAAA
1.5	2AAAAA	6.25	6B851E
1.75	36DB6D	6.5	6C4EC4
2	400000	6.75	6D097B
2.25	471C71	7	6DB6DB
2.5	4CCCCC	7.25	6E5846
2.75	51745D	7.5	6EEEEE
3	555555	7.75	6F7BDE
3.25	589D89	8	700000
3.5	5B6DB6	8.25	707C1F
3.75	5DDDDD	8.5	70F0F0
4	600000	8.75	715F15
4.25	61E1E1	9	71C71C
4.5	638E38	9.25	722983
4.75	650D79	9.5	7286BC
5	666666	9.75	72DF2D
5.25	679E79	10	733333
5.5	68BA2E		

TABLE 19: Compressor/Limiter Ratio

Compressor/Limiter Make Up Gain

Make Up Gain	
0	0FFFFF
1	11F3C9
2	14248E
3	1699C0
4	195BB8
5	1C73D5
6	1FEC98
7	23D1CD
8	2830AF
9	2D1818
10	3298B0
11	38C527
12	3FB278
13	477828
14	5030A0
15	59F97F
16	64F403
17	714575
18	7F17AE

TABLE 20: Make Up Gain

Appendix B X-Series Register API Summary

Master Volume / Channel Attenuation / Mixer

D2Audio Register Set API - Summary Sheet								Rev	3		
Date	11/29/2005										
Section/ Category	**ENTRY**	**HEX**	**DEC**		**XM / MXM**	**XR / XRT**	**MXR**	**XS**	**MXS**	**TXS**	**WXS**
Master	Master Volume	0	0		Y	Y	Y	Y	-	-	-
Channel Attenuation	Channel Attenuation 1	1	1		Y	Y	Y	Y	-	-	-
	Channel Attenuation 2	2	2		Y	Y	Y	Y	-	-	-
	Channel Attenuation 3	3	3		Y	Y	Y	Y	-	-	-
	Channel Attenuation 4	4	4		Y	Y	Y	Y	-	-	-
Mixer	Mix Channel 1, Input 1	5	5		Y	-	-	Y	Y	Y	Y
	Mix Channel 1, Input 2	6	6		Y	-	-	Y	Y	Y	Y
	Mix Channel 1, Input 3	7	7		Y	-	-	Y	Y	Y	-
	Mix Channel 1, Input 4	8	8		Y	-	-	Y	Y	Y	-
	Mix Channel 2, Input 1	9	9		Y	-	-	Y	Y	Y	Y
	Mix Channel 2, Input 2	A	10		Y	-	-	Y	Y	Y	Y
	Mix Channel 2, Input 3	B	11		Y	-	-	Y	Y	Y	-
	Mix Channel 2, Input 4	C	12		Y	-	-	Y	Y	Y	-
	Mix Channel 3, Input 1	D	13		Y	-	-	Y	Y	Y	-
	Mix Channel 3, Input 2	E	14		Y	-	-	Y	Y	Y	-
	Mix Channel 3, Input 3	F	15		Y	-	-	Y	Y	Y	-
	Mix Channel 3, Input 4	10	16		Y	-	-	Y	Y	Y	-
	Mix Channel 4, Input 1	11	17		Y	-	-	Y	Y	Y	-
	Mix Channel 4, Input 2	12	18		Y	-	-	Y	Y	Y	-
	Mix Channel 4, Input 3	13	19		Y	-	-	Y	Y	Y	-
	Mix Channel 4, Input 4	14	20		Y	-	-	Y	Y	Y	-
	Mix Channel X, Input 1	127	295		-	-	-	-	-	Y	Y
	Mix Channel X, Input 2	128	296		-	-	-	-	-	Y	Y
	Mix Channel X, Input 3	129	297		-	-	-	-	-	Y	-
	Mix Channel X, Input 4	12A	298		-	-	-	-	-	Y	-
Input Mixer	Mix Channel 1, Input 1	127	295		-	-	-	-	Y	-	-
	Mix Channel 1, Input 2	128	296		-	-	-	-	Y	-	-
	Mix Channel 1, Input 3	129	297		-	-	-	-	Y	-	-
	Mix Channel 1, Input 4	12A	298		-	-	-	-	Y	-	-
	Mix Channel 2, Input 1	12B	299		-	-	-	-	Y	-	-
	Mix Channel 2, Input 2	12C	300		-	-	-	-	Y	-	-
	Mix Channel 2, Input 3	12D	301		-	-	-	-	Y	-	-
	Mix Channel 2, Input 4	12E	302		-	-	-	-	Y	-	-
	Mix Channel 3, Input 1	12F	303		-	-	-	-	Y	-	-
	Mix Channel 3, Input 2	130	304		-	-	-	-	Y	-	-
	Mix Channel 3, Input 3	131	305		-	-	-	-	Y	-	-
	Mix Channel 3, Input 4	132	306		-	-	-	-	Y	-	-
	Mix Channel 4, Input 1	133	307		-	-	-	-	Y	-	-
	Mix Channel 4, Input 2	134	308		-	-	-	-	Y	-	-
	Mix Channel 4, Input 3	135	309		-	-	-	-	Y	-	-
	Mix Channel 4, Input 4	136	310		-	-	-	-	Y	-	-

Note: For TXS "Mix Channel X = Channel 5, for WXS "Mix Channel X = Channel 3".

Master Volume / Output Trim Control (MXS, TXS, WXS)

D2Audio Register Set API - Summary Sheet					Rev	3	
Date	11/29/2005						
Section/ Category	**ENTRY**	**HEX**	**DEC**		**MXS**	**TXS**	**WXS**
Master	Master Volume (Speaker / SDOUT0)	0	0		Y	Y	Y
	Master Volume (SDOUT1 / SPDIF)	11	17		Y	Y	Y
	Master Volume (PWM)	120	288		-	Y	Y
Channel Attenuation	Channel Attenuation 1 (Speaker)	1	1		Y	Y	-
	Channel Attenuation 2 (Speaker)	2	2		Y	Y	-
	Channel Attenuation 1 (SDOUT0)	123	291		Y	Y	-
	Channel Attenuation 2 (SDOUT0)	124	292		Y	Y	-
	Channel Attenuation 3 (SDOUT1)	125	293		Y	Y	-
	Channel Attenuation 4 (SDOUT1)	126	294		Y	Y	-
	Channel Attenuation 3 (SPDIF)	121	289		Y	Y	-
	Channel Attenuation 4 (SPDIF)	122	290		Y	Y	-
	Channel Attenuation 5 (PWM)	3	3		-	Y	-
Channel Attenuation (WXS Only)	Channel Attenuation 1 (Speaker)	1	1		-	-	Y
	Channel Attenuation 2 (Speaker)	123	291		-	-	Y
	Channel Attenuation 3 (Speaker)	124	292		-	-	Y
	Secondary Channel Attenuation 2	125	293		-	-	Y
	Secondary Channel Attenuation 3	126	294		-	-	Y
	Channel Attenuation 3 (PWM)	3	3		-	-	Y

Extended Mixer Channels 1, 2 (XM, MXM, XS)

D2Audio Register Set API - Summary Sheet					Rev	3	
Date	11/29/2005						
Section/ Category	**ENTRY**	**HEX**	**DEC**		**XM**	**MXM**	**XS**
Extended Mixer	Mix Channel 1, Input 5	D1	209		Y	Y	Y
	Mix Channel 1, Input 6	D2	210		Y	Y	Y
	Mix Channel 1, Input 7	D3	211		Y	Y	Y
	Mix Channel 1, Input 8	D4	212		Y	Y	Y
	Mix Channel 1, Input 9	D5	213		Y	-	-
	Mix Channel 1, Input 10	D6	214		Y	-	-
	Mix Channel 1, Input 11	D7	215		Y	-	-
	Mix Channel 1, Input 12	D8	216		Y	-	-
	Mix Channel 1, Input 13	D9	217		Y	-	-
	Mix Channel 1, Input 14	DA	218		Y	-	-
	Mix Channel 1, Input 15	DB	219		Y	-	-
	Mix Channel 1, Input 16	DC	220		Y	-	-
	Mix Channel 2, Input 5	DD	221		Y	Y	Y
	Mix Channel 2, Input 6	DE	222		Y	Y	Y
	Mix Channel 2, Input 7	DF	223		Y	Y	Y
	Mix Channel 2, Input 8	E0	224		Y	Y	Y
	Mix Channel 2, Input 9	E1	225		Y	-	-
	Mix Channel 2, Input 10	E2	226		Y	-	-
	Mix Channel 2, Input 11	E3	227		Y	-	-
	Mix Channel 2, Input 12	E4	228		Y	-	-
	Mix Channel 2, Input 13	E5	229		Y	-	-
	Mix Channel 2, Input 14	E6	230		Y	-	-
	Mix Channel 2, Input 15	E7	231		Y	-	-
	Mix Channel 2, Input 16	E8	232		Y	-	-

Extended Mixer Channels 3, 4 (XM, MXM, XS)

D2Audio Register Set API - Summary Sheet					Rev	3	
Date	11/29/2005						
Section/ Category	**ENTRY**	**HEX**	**DEC**		**XM**	**MXM**	**XS**
Extended Mixer	Mix Channel 3, Input 5	E9	233		Y	Y	Y
	Mix Channel 3, Input 6	EA	234		Y	Y	Y
	Mix Channel 3, Input 7	EB	235		Y	Y	Y
	Mix Channel 3, Input 8	EC	236		Y	Y	Y
	Mix Channel 3, Input 9	ED	237		Y	-	-
	Mix Channel 3, Input 10	EE	238		Y	-	-
	Mix Channel 3, Input 11	EF	239		Y	-	-
	Mix Channel 3, Input 12	F0	240		Y	-	-
	Mix Channel 3, Input 13	F1	241		Y	-	-
	Mix Channel 3, Input 14	F2	242		Y	-	-
	Mix Channel 3, Input 15	F3	243		Y	-	-
	Mix Channel 3, Input 16	F4	244		Y	-	-
	Mix Channel 4, Input 5	F5	245		Y	Y	Y
	Mix Channel 4, Input 6	F6	246		Y	Y	Y
	Mix Channel 4, Input 7	F7	247		Y	Y	Y
	Mix Channel 4, Input 8	F8	248		Y	Y	Y
	Mix Channel 4, Input 9	F9	249		Y	-	-
	Mix Channel 4, Input 10	FA	250		Y	-	-
	Mix Channel 4, Input 11	FB	251		Y	-	-
	Mix Channel 4, Input 12	FC	252		Y	-	-
	Mix Channel 4, Input 13	FD	253		Y	-	-
	Mix Channel 4, Input 14	FE	254		Y	-	-
	Mix Channel 4, Input 15	FF	255		Y	-	-
	Mix Channel 4, Input 16	100	256		Y	-	-

Tone Control

D2Audio Register Set API - Summary Sheet								Rev	3		
Date	11/29/2005										
Section/ Category	**ENTRY**	**HEX**	**DEC**		**XM / MXM**	**XR / XRT**	**MXR**	**XS**	**MXS**	**TXS**	**WXS**
Tone	Channel 1 Tone Bass Corner	15	21		Y	Y	Y	Y	Y	Y	Y
	Channel 1 Tone Bass Gain	16	22		Y	Y	Y	Y	Y	Y	Y
	Channel 1 Tone Treble Corner	17	23		Y	Y	Y	Y	Y	Y	Y
	Channel 1 Tone Treble Gain	18	24		Y	Y	Y	Y	Y	Y	Y
	Channel 2 Tone Bass Corner	19	25		Y	Y	Y	Y	Y	Y	Y
	Channel 2 Tone Bass Gain	1A	26		Y	Y	Y	Y	Y	Y	Y
	Channel 2 Tone Treble Corner	1B	27		Y	Y	Y	Y	Y	Y	Y
	Channel 2 Tone Treble Gain	1C	28		Y	Y	Y	Y	Y	Y	Y
	Channel 3 Tone Bass Corner	1D	29		Y	Y	Y	Y	Y	Y	Y
	Channel 3 Tone Bass Gain	1E	30		Y	Y	Y	Y	Y	Y	Y
	Channel 3 Tone Treble Corner	1F	31		Y	Y	Y	Y	Y	Y	Y
	Channel 3 Tone Treble Gain	20	32		Y	Y	Y	Y	Y	Y	Y
	Channel 4 Tone Bass Corner	21	33		Y	Y	Y	Y	Y	Y	-
	Channel 4 Tone Bass Gain	22	34		Y	Y	Y	Y	Y	Y	-
	Channel 4 Tone Treble Corner	23	35		Y	Y	Y	Y	Y	Y	-
	Channel 4 Tone Treble Gain	24	36		Y	Y	Y	Y	Y	Y	-
	Channel 5 Tone Bass Corner	12B	299		-	-	-	-	-	Y	-
	Channel 5 Tone Bass Gain	12C	300		-	-	-	-	-	Y	-
	Channel 5 Tone Treble Corner	12D	301		-	-	-	-	-	Y	-
	Channel 5 Tone Treble Gain	12E	302		-	-	-	-	-	Y	-

Five Band Equalization Channels 1, 2 (XM, MXM, XS, MXS)

D2Audio Register Set API - Summary Sheet					Rev	3		
Date	11/29/2005							
Section/ Category	**ENTRY**	**HEX**	**DEC**		**XM**	**MXM**	**XS**	**MXS**
Equalization 5 Band	Channel 1, Block 1 Frequency	25	37		Y	Y	Y	Y
	Channel 1, Block 1 Q	26	38		Y	Y	Y	Y
	Channel 1, Block 1 Gain	27	39		Y	Y	Y	Y
	Channel 1, Block 2 Frequency	28	40		Y	Y	Y	Y
	Channel 1, Block 2 Q	29	41		Y	Y	Y	Y
	Channel 1, Block 2 Gain	2A	42		Y	Y	Y	Y
	Channel 1, Block 3 Frequency	2B	43		Y	Y	Y	Y
	Channel 1, Block 3 Q	2C	44		Y	Y	Y	Y
	Channel 1, Block 3 Gain	2D	45		Y	Y	Y	Y
	Channel 1, Block 4 Frequency	2E	46		Y	Y	Y	Y
	Channel 1, Block 4 Q	2F	47		Y	Y	Y	Y
	Channel 1, Block 4 Gain	30	48		Y	Y	Y	Y
	Channel 1, Block 5 Frequency	31	49		Y	Y	Y	Y
	Channel 1, Block 5 Q	32	50		Y	Y	Y	Y
	Channel 1, Block 5 Gain	33	51		Y	Y	Y	Y
	Channel 2, Block 1 Frequency	34	52		Y	Y	Y	Y
	Channel 2, Block 1 Q	35	53		Y	Y	Y	Y
	Channel 2, Block 1 Gain	36	54		Y	Y	Y	Y
	Channel 2, Block 2 Frequency	37	55		Y	Y	Y	Y
	Channel 2, Block 2 Q	38	56		Y	Y	Y	Y
	Channel 2, Block 2 Gain	39	57		Y	Y	Y	Y
	Channel 2, Block 3 Frequency	3A	58		Y	Y	Y	Y
	Channel 2, Block 3 Q	3B	59		Y	Y	Y	Y
	Channel 2, Block 3 Gain	3C	60		Y	Y	Y	Y
	Channel 2, Block 4 Frequency	3D	61		Y	Y	Y	Y
	Channel 2, Block 4 Q	3E	62		Y	Y	Y	Y
	Channel 2, Block 4 Gain	3F	63		Y	Y	Y	Y
	Channel 2, Block 5 Frequency	40	64		Y	Y	Y	Y
	Channel 2, Block 5 Q	41	65		Y	Y	Y	Y
	Channel 2, Block 5 Gain	42	66		Y	Y	Y	Y

Five Band Equalization Channels 3, 4 (XM, MXM, XS, MXS)

D2Audio Register Set API - Summary Sheet					Rev	3		
Date	11/29/2005							
Section/ Category	**ENTRY**	**HEX**	**DEC**		**XM**	**MXM**	**XS**	**MXS**
Equalization 5 Band	Channel 3, Block 1 Frequency	43	67		Y	Y	Y	Y
	Channel 3, Block 1 Q	44	68		Y	Y	Y	Y
	Channel 3, Block 1 Gain	45	69		Y	Y	Y	Y
	Channel 3, Block 2 Frequency	46	70		Y	Y	Y	Y
	Channel 3, Block 2 Q	47	71		Y	Y	Y	Y
	Channel 3, Block 2 Gain	48	72		Y	Y	Y	Y
	Channel 3, Block 3 Frequency	49	73		Y	Y	Y	Y
	Channel 3, Block 3 Q	4A	74		Y	Y	Y	Y
	Channel 3, Block 3 Gain	4B	75		Y	Y	Y	Y
	Channel 3, Block 4 Frequency	4C	76		Y	Y	Y	Y
	Channel 3, Block 4 Q	4D	77		Y	Y	Y	Y
	Channel 3, Block 4 Gain	4E	78		Y	Y	Y	Y
	Channel 3, Block 5 Frequency	4F	79		Y	Y	Y	Y
	Channel 3, Block 5 Q	50	80		Y	Y	Y	Y
	Channel 3, Block 5 Gain	51	81		Y	Y	Y	Y
	Channel 4, Block 1 Frequency	52	82		Y	Y	Y	Y
	Channel 4, Block 1 Q	53	83		Y	Y	Y	Y
	Channel 4, Block 1 Gain	54	84		Y	Y	Y	Y
	Channel 4, Block 2 Frequency	55	85		Y	Y	Y	Y
	Channel 4, Block 2 Q	56	86		Y	Y	Y	Y
	Channel 4, Block 2 Gain	57	87		Y	Y	Y	Y
	Channel 4, Block 3 Frequency	58	88		Y	Y	Y	Y
	Channel 4, Block 3 Q	59	89		Y	Y	Y	Y
	Channel 4, Block 3 Gain	5A	90		Y	Y	Y	Y
	Channel 4, Block 4 Frequency	5B	91		Y	Y	Y	Y
	Channel 4, Block 4 Q	5C	92		Y	Y	Y	Y
	Channel 4, Block 4 Gain	5D	93		Y	Y	Y	Y
	Channel 4, Block 5 Frequency	5E	94		Y	Y	Y	Y
	Channel 4, Block 5 Q	5F	95		Y	Y	Y	Y
	Channel 4, Block 5 Gain	60	96		Y	Y	Y	Y

Three Band Equalization (XM, MXM, XS, MXS, WXS)

D2Audio Register Set API - Summary Sheet					Rev	3			
Date	11/29/2005								
Section/ Category	**ENTRY**	**HEX**	**DEC**		**XM**	**MXM**	**XS**	**MXS**	**WXS**
Equalization 3 Band	Channel 1, Block 1 Frequency	61	97		Y	Y	Y	Y	-
	Channel 1, Block 1 Q	62	98		Y	Y	Y	Y	-
	Channel 1, Block 1 Gain	63	99		Y	Y	Y	Y	-
	Channel 1, Block 2 Frequency	64	100		Y	Y	Y	Y	-
	Channel 1, Block 2 Q	65	101		Y	Y	Y	Y	-
	Channel 1, Block 2 Gain	66	102		Y	Y	Y	Y	-
	Channel 1, Block 3 Frequency	67	103		Y	Y	Y	Y	-
	Channel 1, Block 3 Q	68	104		Y	Y	Y	Y	-
	Channel 1, Block 3 Gain	69	105		Y	Y	Y	Y	-
	Channel 2, Block 1 Frequency	6A	106		Y	Y	Y	Y	Y
	Channel 2, Block 1 Q	6B	107		Y	Y	Y	Y	Y
	Channel 2, Block 1 Gain	6C	108		Y	Y	Y	Y	Y
	Channel 2, Block 2 Frequency	6D	109		Y	Y	Y	Y	Y
	Channel 2, Block 2 Q	6E	110		Y	Y	Y	Y	Y
	Channel 2, Block 2 Gain	6F	111		Y	Y	Y	Y	Y
	Channel 2, Block 3 Frequency	70	112		Y	Y	Y	Y	Y
	Channel 2, Block 3 Q	71	113		Y	Y	Y	Y	Y
	Channel 2, Block 3 Gain	72	114		Y	Y	Y	Y	Y
	Channel 3, Block 1 Frequency	73	115		Y	Y	Y	Y	Y
	Channel 3, Block 1 Q	74	116		Y	Y	Y	Y	Y
	Channel 3, Block 1 Gain	75	117		Y	Y	Y	Y	Y
	Channel 3, Block 2 Frequency	76	118		Y	Y	Y	Y	Y
	Channel 3, Block 2 Q	77	119		Y	Y	Y	Y	Y
	Channel 3, Block 2 Gain	78	120		Y	Y	Y	Y	Y
	Channel 3, Block 3 Frequency	79	121		Y	Y	Y	Y	Y
	Channel 3, Block 3 Q	7A	122		Y	Y	Y	Y	Y
	Channel 3, Block 3 Gain	7B	123		Y	Y	Y	Y	Y
	Channel 4, Block 1 Frequency	7C	124		Y	Y	Y	Y	-
	Channel 4, Block 1 Q	7D	125		Y	Y	Y	Y	-
	Channel 4, Block 1 Gain	7E	126		Y	Y	Y	Y	-
	Channel 4, Block 2 Frequency	7F	127		Y	Y	Y	Y	-
	Channel 4, Block 2 Q	80	128		Y	Y	Y	Y	-
	Channel 4, Block 2 Gain	81	129		Y	Y	Y	Y	-
	Channel 4, Block 3 Frequency	82	130		Y	Y	Y	Y	-
	Channel 4, Block 3 Q	83	131		Y	Y	Y	Y	-
	Channel 4, Block 3 Gain	84	132		Y	Y	Y	Y	-

Eight Band Equalization Channels 1, 2 (MXR, XR, XRT, TXS)

D2Audio Register Set API - Summary Sheet					Rev	3	
Date	11/28/2005						
Section/ Category	**ENTRY**	**HEX**	**DEC**		**MXR**	**XR / XRT**	**TXS**
Equalization 8 Band	Channel 1, Block 1 Frequency	25	37		Y	Y	Y
	Channel 1, Block 1 Q	26	38		Y	Y	Y
	Channel 1, Block 1 Gain	27	39		Y	Y	Y
	Channel 1, Block 2 Frequency	28	40		Y	Y	Y
	Channel 1, Block 2 Q	29	41		Y	Y	Y
	Channel 1, Block 2 Gain	2A	42		Y	Y	Y
	Channel 1, Block 3 Frequency	2B	43		Y	Y	Y
	Channel 1, Block 3 Q	2C	44		Y	Y	Y
	Channel 1, Block 3 Gain	2D	45		Y	Y	Y
	Channel 1, Block 4 Frequency	2E	46		Y	Y	Y
	Channel 1, Block 4 Q	2F	47		Y	Y	Y
	Channel 1, Block 4 Gain	30	48		Y	Y	Y
	Channel 1, Block 5 Frequency	31	49		Y	Y	Y
	Channel 1, Block 5 Q	32	50		Y	Y	Y
	Channel 1, Block 5 Gain	33	51		Y	Y	Y
	Channel 1, Block 6 Frequency	61	97		Y	Y	Y
	Channel 1, Block 6 Q	62	98		Y	Y	Y
	Channel 1, Block 6 Gain	63	99		Y	Y	Y
	Channel 1, Block 7 Frequency	64	100		Y	Y	Y
	Channel 1, Block 7 Q	65	101		Y	Y	Y
	Channel 1, Block 7 Gain	66	102		Y	Y	Y
	Channel 1, Block 8 Frequency	67	103		Y	Y	Y
	Channel 1, Block 8 Q	68	104		Y	Y	Y
	Channel 1, Block 8 Gain	69	105		Y	Y	Y
	Channel 2, Block 1 Frequency	34	52		Y	Y	Y
	Channel 2, Block 1 Q	35	53		Y	Y	Y
	Channel 2, Block 1 Gain	36	54		Y	Y	Y
	Channel 2, Block 2 Frequency	37	55		Y	Y	Y
	Channel 2, Block 2 Q	38	56		Y	Y	Y
	Channel 2, Block 2 Gain	39	57		Y	Y	Y
	Channel 2, Block 3 Frequency	3A	58		Y	Y	Y
	Channel 2, Block 3 Q	3B	59		Y	Y	Y
	Channel 2, Block 3 Gain	3C	60		Y	Y	Y
	Channel 2, Block 4 Frequency	3D	61		Y	Y	Y
	Channel 2, Block 4 Q	3E	62		Y	Y	Y
	Channel 2, Block 4 Gain	3F	63		Y	Y	Y
	Channel 2, Block 5 Frequency	40	64		Y	Y	Y
	Channel 2, Block 5 Q	41	65		Y	Y	Y
	Channel 2, Block 5 Gain	42	66		Y	Y	Y
	Channel 2, Block 6 Frequency	6A	106		Y	Y	Y
	Channel 2, Block 6 Q	6B	107		Y	Y	Y
	Channel 2, Block 6 Gain	6C	108		Y	Y	Y
	Channel 2, Block 7 Frequency	6D	109		Y	Y	Y
	Channel 2, Block 7 Q	6E	110		Y	Y	Y
	Channel 2, Block 7 Gain	6F	111		Y	Y	Y
	Channel 2, Block 8 Frequency	70	112		Y	Y	Y
	Channel 2, Block 8 Q	71	113		Y	Y	Y
	Channel 2, Block 8 Gain	72	114		Y	Y	Y

Eight Band Equalization Channels 3, 4 (MXR, XR, XRT, TXS)

D2Audio Register Set API - Summary Sheet					Rev	3	
Date	11/28/2005						
Section/ Category	**ENTRY**	**HEX**	**DEC**		**MXR**	**XR / XRT**	**TXS**
Equalization 8 Band	Channel 3, Block 1 Frequency	43	67		Y	Y	Y
	Channel 3, Block 1 Q	44	68		Y	Y	Y
	Channel 3, Block 1 Gain	45	69		Y	Y	Y
	Channel 3, Block 2 Frequency	46	70		Y	Y	Y
	Channel 3, Block 2 Q	47	71		Y	Y	Y
	Channel 3, Block 2 Gain	48	72		Y	Y	Y
	Channel 3, Block 3 Frequency	49	73		Y	Y	Y
	Channel 3, Block 3 Q	4A	74		Y	Y	Y
	Channel 3, Block 3 Gain	4B	75		Y	Y	Y
	Channel 3, Block 4 Frequency	4C	76		Y	Y	Y
	Channel 3, Block 4 Q	4D	77		Y	Y	Y
	Channel 3, Block 4 Gain	4E	78		Y	Y	Y
	Channel 3, Block 5 Frequency	4F	79		Y	Y	Y
	Channel 3, Block 5 Q	50	80		Y	Y	Y
	Channel 3, Block 5 Gain	51	81		Y	Y	Y
	Channel 3, Block 6 Frequency	73	115		Y	Y	Y
	Channel 3, Block 6 Q	74	116		Y	Y	Y
	Channel 3, Block 6 Gain	75	117		Y	Y	Y
	Channel 3, Block 7 Frequency	76	118		Y	Y	Y
	Channel 3, Block 7 Q	77	119		Y	Y	Y
	Channel 3, Block 7 Gain	78	120		Y	Y	Y
	Channel 3, Block 8 Frequency	79	121		Y	Y	Y
	Channel 3, Block 8 Q	7A	122		Y	Y	Y
	Channel 3, Block 8 Gain	7B	123		Y	Y	Y
	Channel 4, Block 1 Frequency	52	82		Y	Y	Y
	Channel 4, Block 1 Q	53	83		Y	Y	Y
	Channel 4, Block 1 Gain	54	84		Y	Y	Y
	Channel 4, Block 2 Frequency	55	85		Y	Y	Y
	Channel 4, Block 2 Q	56	86		Y	Y	Y
	Channel 4, Block 2 Gain	57	87		Y	Y	Y
	Channel 4, Block 3 Frequency	58	88		Y	Y	Y
	Channel 4, Block 3 Q	59	89		Y	Y	Y
	Channel 4, Block 3 Gain	5A	90		Y	Y	Y
	Channel 4, Block 4 Frequency	5B	91		Y	Y	Y
	Channel 4, Block 4 Q	5C	92		Y	Y	Y
	Channel 4, Block 4 Gain	5D	93		Y	Y	Y
	Channel 4, Block 5 Frequency	5E	94		Y	Y	Y
	Channel 4, Block 5 Q	5F	95		Y	Y	Y
	Channel 4, Block 5 Gain	60	96		Y	Y	Y
	Channel 4, Block 6 Frequency	7C	124		Y	Y	Y
	Channel 4, Block 6 Q	7D	125		Y	Y	Y
	Channel 4, Block 6 Gain	7E	126		Y	Y	Y
	Channel 4, Block 7 Frequency	7F	127		Y	Y	Y
	Channel 4, Block 7 Q	80	128		Y	Y	Y
	Channel 4, Block 7 Gain	81	129		Y	Y	Y
	Channel 4, Block 8 Frequency	82	130		Y	Y	Y
	Channel 4, Block 8 Q	83	131		Y	Y	Y
	Channel 4, Block 8 Gain	84	132		Y	Y	Y

Eight Band Equalization Channel 5 (TXS)

D2Audio Register Set API - Summary Sheet					Rev	3
Date	11/28/2005					
Section/ Category	**ENTRY**	**HEX**	**DEC**		**TXS**	
Equalization 8 Band	Channel 5, Block 1 Frequency	12F	303		Y	
	Channel 5, Block 1 Q	130	304		Y	
	Channel 5, Block 1 Gain	131	305		Y	
	Channel 5, Block 2 Frequency	132	306		Y	
	Channel 5, Block 2 Q	133	307		Y	
	Channel 5, Block 2 Gain	134	308		Y	
	Channel 5, Block 3 Frequency	135	309		Y	
	Channel 5, Block 3 Q	136	310		Y	
	Channel 5, Block 3 Gain	137	311		Y	
	Channel 5, Block 4 Frequency	138	312		Y	
	Channel 5, Block 4 Q	139	313		Y	
	Channel 5, Block 4 Gain	13A	314		Y	
	Channel 5, Block 5 Frequency	13B	315		Y	
	Channel 5, Block 5 Q	13C	316		Y	
	Channel 5, Block 5 Gain	13D	317		Y	
	Channel 5, Block 6 Frequency	13E	318		Y	
	Channel 5, Block 6 Q	13F	319		Y	
	Channel 5, Block 6 Gain	140	320		Y	
	Channel 5, Block 7 Frequency	141	321		Y	
	Channel 5, Block 7 Q	142	322		Y	
	Channel 5, Block 7 Gain	143	323		Y	
	Channel 5, Block 8 Frequency	144	324		Y	
	Channel 5, Block 8 Q	145	325		Y	
	Channel 5, Block 8 Gain	146	326		Y	

Ten Band Equalization Channel 1 (WXS)

D2Audio Register Set API - Summary Sheet					Rev	3
Date	11/29/2005					
Section/ Category	**ENTRY**	**HEX**	**DEC**		**WXS**	
Equalization 10 Band	Channel 1, Block 1 Frequency	25	37		Y	
	Channel 1, Block 1 Q	26	38		Y	
	Channel 1, Block 1 Gain	27	39		Y	
	Channel 1, Block 2 Frequency	28	40		Y	
	Channel 1, Block 2 Q	29	41		Y	
	Channel 1, Block 2 Gain	2A	42		Y	
	Channel 1, Block 3 Frequency	2B	43		Y	
	Channel 1, Block 3 Q	2C	44		Y	
	Channel 1, Block 3 Gain	2D	45		Y	
	Channel 1, Block 4 Frequency	2E	46		Y	
	Channel 1, Block 4 Q	2F	47		Y	
	Channel 1, Block 4 Gain	30	48		Y	
	Channel 1, Block 5 Frequency	31	49		Y	
	Channel 1, Block 5 Q	32	50		Y	
	Channel 1, Block 5 Gain	33	51		Y	
	Channel 1, Block 6 Frequency	61	97		Y	
	Channel 1, Block 6 Q	62	98		Y	
	Channel 1, Block 6 Gain	63	99		Y	
	Channel 1, Block 7 Frequency	64	100		Y	
	Channel 1, Block 7 Q	65	101		Y	
	Channel 1, Block 7 Gain	66	102		Y	
	Channel 1, Block 8 Frequency	67	103		Y	
	Channel 1, Block 8 Q	68	104		Y	
	Channel 1, Block 8 Gain	69	105		Y	
	Channel 1, Block 9 Frequency	12E	302		Y	
	Channel 1, Block 9 Q	12F	303		Y	
	Channel 1, Block 9 Gain	130	304		Y	
	Channel 1, Block 10 Frequency	131	305		Y	
	Channel 1, Block 10 Q	132	306		Y	
	Channel 1, Block 10 Gain	133	307		Y	

XS Series Crossover Channels 1, 2

D2Audio Register Set API - Summary Sheet					Rev	3		
Date	11/28/2005							
Section/ Category	**ENTRY**	**HEX**	**DEC**		**XS**	**MXS**	**TXS**	**WXS**
Crossover	Channel 1 Crossover 1, Mode	85	133		Y	Y	Y	Y
	Channel 1 Crossover 1, Freq	86	134		Y	Y	Y	Y
	Channel 1 Crossover 1, Q	87	135		Y	Y	Y	Y
	Channel 1 Crossover 2, Mode	88	136		Y	Y	Y	Y
	Channel 1 Crossover 2, Freq	89	137		Y	Y	Y	Y
	Channel 1 Crossover 2, Q	8A	138		Y	Y	Y	Y
	Channel 1 Crossover 3, Mode	8B	139		Y	Y	Y	Y
	Channel 1 Crossover 3, Freq	8C	140		Y	Y	Y	Y
	Channel 1 Crossover 3, Q	8D	141		Y	Y	Y	Y
	Channel 1 Crossover 4, Mode	8E	142		Y	Y	Y	Y
	Channel 1 Crossover 4, Freq	8F	143		Y	Y	Y	Y
	Channel 1 Crossover 4, Q	90	144		Y	Y	Y	Y
	Channel 2 Crossover 1, Mode	91	145		Y	Y	Y	-
	Channel 2 Crossover 1, Freq	92	146		Y	Y	Y	-
	Channel 2 Crossover 1, Q	93	147		Y	Y	Y	-
	Channel 2 Crossover 2, Mode	94	148		Y	Y	Y	-
	Channel 2 Crossover 2, Freq	95	149		Y	Y	Y	-
	Channel 2 Crossover 2, Q	96	150		Y	Y	Y	-
	Channel 2 Crossover 3, Mode	97	151		Y	Y	Y	Y
	Channel 2 Crossover 3, Freq	98	152		Y	Y	Y	Y
	Channel 2 Crossover 3, Q	99	153		Y	Y	Y	Y
	Channel 2 Crossover 4, Mode	9A	154		Y	Y	Y	Y
	Channel 2 Crossover 4, Freq	9B	155		Y	Y	Y	Y
	Channel 2 Crossover 4, Q	9C	156		Y	Y	Y	Y

XS Series Crossovers Channels 3, 4, 5

D2Audio Register Set API - Summary Sheet					Rev	3		
Date	11/29/2005							
Section/ Category	**ENTRY**	**HEX**	**DEC**		**XS**	**MXS**	**TXS**	**WXS**
Crossover	Channel 3 Crossover 1, Mode	9D	157		Y	Y	Y	-
	Channel 3 Crossover 1, Freq	9E	158		Y	Y	Y	-
	Channel 3 Crossover 1, Q	9F	159		Y	Y	Y	-
	Channel 3 Crossover 2, Mode	A0	160		Y	Y	Y	-
	Channel 3 Crossover 2, Freq	A1	161		Y	Y	Y	-
	Channel 3 Crossover 2, Q	A2	162		Y	Y	Y	-
	Channel 3 Crossover 3, Mode	A3	163		Y	Y	Y	Y
	Channel 3 Crossover 3, Freq	A4	164		Y	Y	Y	Y
	Channel 3 Crossover 3, Q	A5	165		Y	Y	Y	Y
	Channel 3 Crossover 4, Mode	A6	166		Y	Y	Y	Y
	Channel 3 Crossover 4, Freq	A7	167		Y	Y	Y	Y
	Channel 3 Crossover 4, Q	A8	168		Y	Y	Y	Y
	Channel 4 Crossover 1, Mode	A9	169		Y	Y	Y	-
	Channel 4 Crossover 1, Freq	AA	170		Y	Y	Y	-
	Channel 4 Crossover 1, Q	AB	171		Y	Y	Y	-
	Channel 4 Crossover 2, Mode	AC	172		Y	Y	Y	-
	Channel 4 Crossover 2, Freq	AD	173		Y	Y	Y	-
	Channel 4 Crossover 2, Q	AE	174		Y	Y	Y	-
	Channel 4 Crossover 3, Mode	AF	175		Y	Y	Y	-
	Channel 4 Crossover 3, Freq	B0	176		Y	Y	Y	-
	Channel 4 Crossover 3, Q	B1	177		Y	Y	Y	-
	Channel 4 Crossover 4, Mode	B2	178		Y	Y	Y	-
	Channel 4 Crossover 4, Freq	B3	179		Y	Y	Y	-
	Channel 4 Crossover 4, Q	B4	180		Y	Y	Y	-
	Channel 5 Crossover 1, Mode	147	327		-	-	Y	-
	Channel 5 Crossover 1, Freq	148	328		-	-	Y	-
	Channel 5 Crossover 1, Q	149	329		-	-	Y	-
	Channel 5 Crossover 2, Mode	14A	330		-	-	Y	-
	Channel 5 Crossover 2, Freq	14B	331		-	-	Y	-
	Channel 5 Crossover 2, Q	14C	332		-	-	Y	-
	Channel 5 Crossover 3, Mode	14D	333		-	-	Y	-
	Channel 5 Crossover 3, Freq	14E	334		-	-	Y	-
	Channel 5 Crossover 3, Q	14F	335		-	-	Y	-
	Channel 5 Crossover 4, Mode	150	336		-	-	Y	-
	Channel 5 Crossover 4, Freq	151	337		-	-	Y	-
	Channel 5 Crossover 4, Q	152	338		-	-	Y	-

Delay / Compressor Limiter

D2Audio Register Set API - Summary Sheet					Rev	3					
Date	11/29/2005										
Section/ Category	**ENTRY**	**HEX**	**DEC**		**XM / MXM**	**XR / XRT**	**MXR**	**XS**	**MXS**	**TXS**	**WXS**
Delay	Channel 1Delay	B5	181		Y	Y	Y	Y	Y	Y	Y
	Channel 2 Delay	B6	182		Y	Y	Y	Y	Y	Y	Y
	Channel 3 Delay	B7	183		Y	Y	Y	Y	Y	Y	Y
	Channel 4 Delay	B8	184		Y	Y	Y	Y	Y	Y	-
	Channel 5 Delay	153	339		-	-	-	-	-	Y	-
Compressor	Reserved	B9	185		Y	Y	Y	Y	Y	Y	Y
	Channel 1 Threshold	BA	186		Y	Y	Y	Y	Y	Y	Y
	Channel 1 Compression Ratio	BB	187		Y	Y	Y	Y	Y	Y	Y
	Channel 1 Attack Time	BC	188		Y	Y	Y	Y	Y	Y	Y
	Channel 1 Release Time	BD	189		Y	Y	Y	Y	Y	Y	Y
	Channel 1 Makeup Gain	BE	190		Y	Y	Y	Y	Y	Y	Y
	Reserved	BF	191		Y	Y	Y	Y	Y	Y	Y
	Channel 2 Threshold	C0	192		Y	Y	Y	Y	Y	Y	Y
	Channel 2 Compression Ratio	C1	193		Y	Y	Y	Y	Y	Y	Y
	Channel 2 Attack Time	C2	194		Y	Y	Y	Y	Y	Y	Y
	Channel 2 Release Time	C3	195		Y	Y	Y	Y	Y	Y	Y
	Channel 2 Makeup Gain	C4	196		Y	Y	Y	Y	Y	Y	Y
	Reserved	C5	197		Y	Y	Y	Y	Y	Y	Y
	Channel 3 Threshold	C6	198		Y	Y	Y	Y	Y	Y	Y
	Channel 3 Compression Ratio	C7	199		Y	Y	Y	Y	Y	Y	Y
	Channel 3 Attack Time	C8	200		Y	Y	Y	Y	Y	Y	Y
	Channel 3 Release Time	C9	201		Y	Y	Y	Y	Y	Y	Y
	Channel 3 Makeup Gain	CA	202		Y	Y	Y	Y	Y	Y	Y
	Reserved	CB	203		Y	Y	Y	Y	Y	Y	-
	Channel 4 Threshold	CC	204		Y	Y	Y	Y	Y	Y	-
	Channel 4 Compression Ratio	CD	205		Y	Y	Y	Y	Y	Y	-
	Channel 4 Attack Time	CE	206		Y	Y	Y	Y	Y	Y	-
	Channel 4 Release Time	CF	207		Y	Y	Y	Y	Y	Y	-
	Channel 4 Makeup Gain	D0	208		Y	Y	Y	Y	Y	Y	-
	Reserved	154	340		-	-	-	-	-	Y	-
	Channel 5 Threshold	155	341		-	-	-	-	-	Y	-
	Channel 5 Compression Ratio	156	342		-	-	-	-	-	Y	-
	Channel 5 Attack Time	157	343		-	-	-	-	-	Y	-
	Channel 5 Release Time	158	344		-	-	-	-	-	Y	-
	Channel 5 Makeup Gain	159	345		-	-	-	-	-	Y	-

Loudness

D2Audio Register Set API - Summary Sheet					Rev	3					
Date	11/29/2005										
Section/ Category	**ENTRY**	**HEX**	**DEC**		**XM / MXM**	**XR / XRT**	**MXR**	**XS**	**MXS**	**TXS**	**WXS**
Loudness	LoudnessOneEnable	101	257		Y	Y	Y	Y	Y	Y	Y
	LoudOneToneLpA1	102	258		Y	Y	Y	Y	Y	Y	Y
	LoudOneToneHpA1	103	259		Y	Y	Y	Y	Y	Y	Y
	LoudnessTwoEnable	104	260		Y	Y	Y	Y	Y	Y	Y
	LoudTwoToneLpA1	105	261		Y	Y	Y	Y	Y	Y	Y
	LoudTwoToneHpA1	106	262		Y	Y	Y	Y	Y	Y	Y
	LoudnessThreeEnable	107	263		Y	Y	Y	Y	Y	Y	Y
	LoudThreeToneLpA1	108	264		Y	Y	Y	Y	Y	Y	Y
	LoudThreeToneHpA1	109	265		Y	Y	Y	Y	Y	Y	Y
	LoudnessFourEnable	10A	266		Y	Y	Y	Y	Y	Y	-
	LoudFourToneLpA1	10B	267		Y	Y	Y	Y	Y	Y	-
	LoudFourToneHpA1	10C	268		Y	Y	Y	Y	Y	Y	-
	LoudnessFiveEnable	15A	346		Y	Y	-	-	-	Y	-
	LoudFiveToneLpA1	15B	347		Y	Y	-	-	-	Y	-
	LoudFiveToneHpA1	15C	348		Y	Y	-	-	-	Y	-

TXS25-2 SoundSuite - Five Band Parametric Content/Boundary Gain Correction EQ Presets

D2Audio Register Set API - Summary Sheet					Rev	1
Date	11/30/2005					
Section/ Category	**ENTRY**	**HEX**	**DEC**		**TXS25-2**	
Equalization 5 Band	Channel 1, Block 1 Frequency	25	37		Y	
	Channel 1, Block 1 Q	26	38		Y	
	Channel 1, Block 1 Gain	27	39		Y	
	Channel 1, Block 2 Frequency	28	40		Y	
	Channel 1, Block 2 Q	29	41		Y	
	Channel 1, Block 2 Gain	2A	42		Y	
	Channel 1, Block 3 Frequency	2B	43		Y	
	Channel 1, Block 3 Q	2C	44		Y	
	Channel 1, Block 3 Gain	2D	45		Y	
	Channel 1, Block 4 Frequency	2E	46		Y	
	Channel 1, Block 4 Q	2F	47		Y	
	Channel 1, Block 4 Gain	30	48		Y	
	Channel 1, Block 5 Frequency	31	49		Y	
	Channel 1, Block 5 Q	32	50		Y	
	Channel 1, Block 5 Gain	33	51		Y	
	Channel 2, Block 1 Frequency	34	52		Y	
	Channel 2, Block 1 Q	35	53		Y	
	Channel 2, Block 1 Gain	36	54		Y	
	Channel 2, Block 2 Frequency	37	55		Y	
	Channel 2, Block 2 Q	38	56		Y	
	Channel 2, Block 2 Gain	39	57		Y	
	Channel 2, Block 3 Frequency	3A	58		Y	
	Channel 2, Block 3 Q	3B	59		Y	
	Channel 2, Block 3 Gain	3C	60		Y	
	Channel 2, Block 4 Frequency	3D	61		Y	
	Channel 2, Block 4 Q	3E	62		Y	
	Channel 2, Block 4 Gain	3F	63		Y	
	Channel 2, Block 5 Frequency	40	64		Y	
	Channel 2, Block 5 Q	41	65		Y	
	Channel 2, Block 5 Gain	42	66		Y	

TXS25-2 SoundSuite Three Band Parametric EQ for Speaker Equalization

D2Audio Register Set API - Summary Sheet					Rev	1
Date	11/30/2005					
Section/ Category	**ENTRY**	**HEX**	**DEC**		**TXS25-2**	
Equalization 3 Band	Channel 1, Block 1 Frequency	61	97		Y	
	Channel 1, Block 1 Q	62	98		Y	
	Channel 1, Block 1 Gain	63	99		Y	
	Channel 1, Block 2 Frequency	64	100		Y	
	Channel 1, Block 2 Q	65	101		Y	
	Channel 1, Block 2 Gain	66	102		Y	
	Channel 1, Block 3 Frequency	67	103		Y	
	Channel 1, Block 3 Q	68	104		Y	
	Channel 1, Block 3 Gain	69	105		Y	
	Channel 2, Block 1 Frequency	6A	106		Y	
	Channel 2, Block 1 Q	6B	107		Y	
	Channel 2, Block 1 Gain	6C	108		Y	
	Channel 2, Block 2 Frequency	6D	109		Y	
	Channel 2, Block 2 Q	6E	110		Y	
	Channel 2, Block 2 Gain	6F	111		Y	
	Channel 2, Block 3 Frequency	70	112		Y	
	Channel 2, Block 3 Q	71	113		Y	
	Channel 2, Block 3 Gain	72	114		Y	
	Channel 5, Block 1 Frequency	13E	318		Y	
	Channel 5, Block 1 Q	13F	319		Y	
	Channel 5, Block 1 Gain	140	320		Y	
	Channel 5, Block 2 Frequency	141	321		Y	
	Channel 5, Block 2 Q	142	322		Y	
	Channel 5, Block 2 Gain	143	323		Y	
	Channel 5, Block 3 Frequency	144	324		Y	
	Channel 5, Block 3 Q	145	325		Y	
	Channel 5, Block 3 Gain	146	326		Y	

TXS25-2 SoundSuite - Content EQ Presets, Channel Selection/Mixing, WideSound Effect Level, AudioAlign Position, DeepBass Level

D2Audio Register Set API - Summary Sheet					Rev	1
Date	11/30/2005					
Section/ Category	**ENTRY**	**HEX**	**DEC**		**TXS25-2**	
Content EQ Presets	PresetsAction	20011	131089		Y	
	PresetsSelection	20012	131090		Y	
Channel Selection/ Mixing	Channel 3, ThreeMix1	164	356		Y	
	Channel 3, ThreeMix2	165	357		Y	
	Channel 4, FourMix1	166	358		Y	
	Channel 4, FourMix2	167	359		Y	
	Channel 5, SubMixVol1	15D	349		Y	
	Channel 5, SubMixVol2	15E	350		Y	
	Channel 5, SubMixVol3	15F	351		Y	
WideSound Effect Level	WideSoundEffectLevel	170	368		Y	
AudioAlign Position	LeftPosition	179	377		Y	
	RightPosition	17A	378		Y	
DeepBass Level	DeepBassLevelLeft	161	353		Y	
	DeepBassLevelRight	163	355		Y	

Special Functions

D2Audio Register Set API - Summary Sheet					Rev	3					
Date	12/6/2005										
Section/ Category	**ENTRY**	**REG ADDR**			**XM / MXM**	**XR / XRT**	**MXR**	**XS**	**MXS**	**TXS**	**WXS**
System Vars	Temperature	$020010			Y	Y	Y	Y	Y	-	-
	AdvancedStatus	$020020			Y	Y	Y	Y	-	-	-
	Input Configuration Control	$020001			Y	Y	Y	Y	Y	Y	Y
	Product Id	$020003			Y	Y	Y	Y	Y	Y	Y
	Firmware Version	$020004			Y	Y	Y	Y	Y	Y	Y

Trademarks
D2Audio and D2A are registered trademarks while the D2Audio logo, D2, D2Audio SoundSuite, D2Audio DeepBass, D2Audio AudioAlign, D2Audio 360°Sound, D2Audio AFRC (Automatic Frequency Response Compensation), D2Audio Electrical Speaker Detect, D2Audio Speaker Fingerprint, D2Audio Speaker Impedance, D2Audio ARMC (Automatic Room Mode Correction), D2Audio Acoustical Speaker Detect, D2Audio Speaker Distance, D2Audio Speaker Polarity, D2Audio Sound Pressure Normalization, D2Audio, D2Audio Speaker EQ (SPEQ), D2Audio LEO (Listening Environment Optimization), D2Audio Page-In, D2Audio MultiMix, and Audio Canvas are trademarks of D2Audio Corporation. Other product names are for identification purposes and may be trademarks of their respective companies.

Nuclear and Medical Applications

D2Audio products are not authorized for use as critical components in life support systems, equipment used in hazardous environments or nuclear control systems without the express written consent of D2Audio Corporation.