CREATIVE

CREATIVE TECHNOLOGY LTD

X-Fi Module
## Model SB0750

Datasheet

Revision 1.0
May 2008

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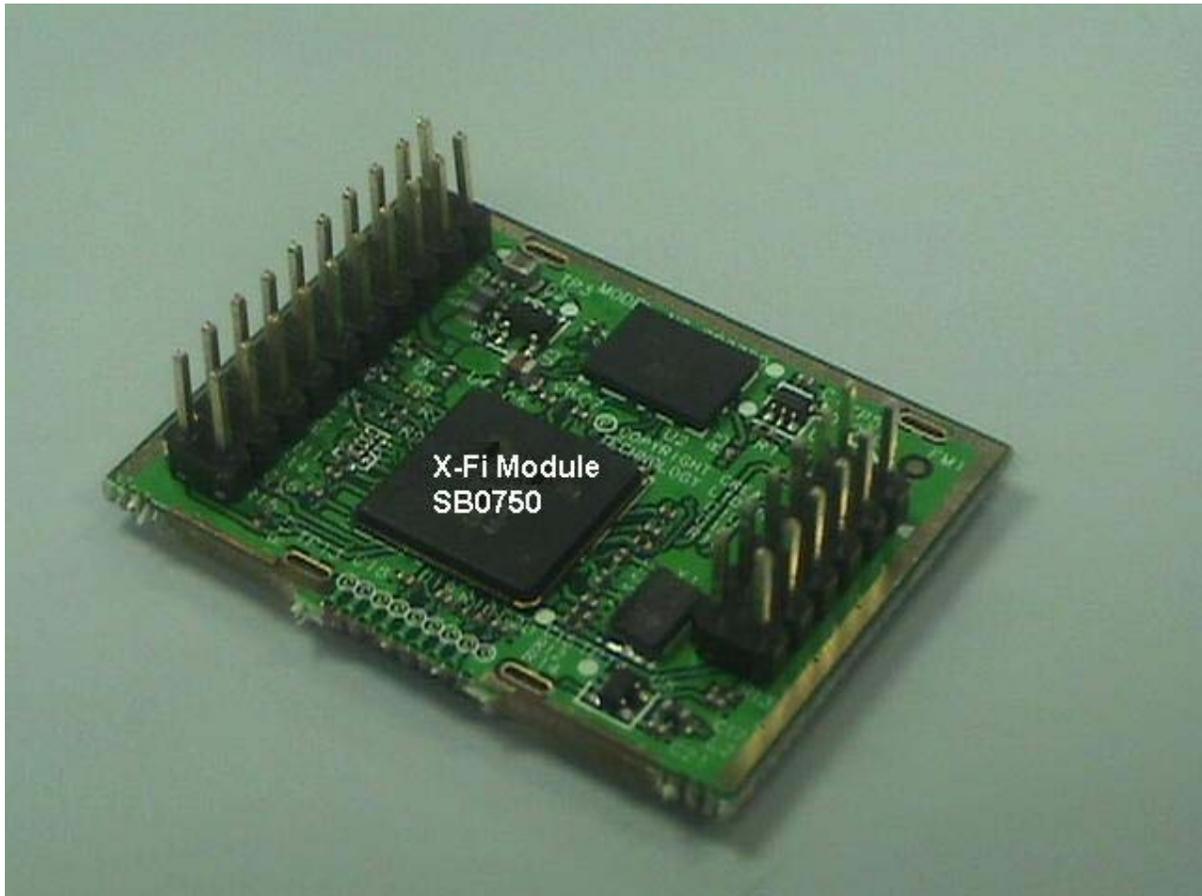
Creative Labs has a long heritage of providing top quality and leading edge audio solutions to the mass PC population with the Sound Blaster® range of both internal and external sound cards and devices.

It all began in 1981 with the founding of Creative Labs, although it would be another eight years before the Sound Blaster® card would be born. There have been many cards along the way; the Sound Blaster® 16 exploded onto the market and with the Sound Blaster® AWE32 everyone realized that a sound card could not only make "sounds" but also music. The Sound Blaster® Live! was a major leap forward bringing multi-channel audio and immense processing power to the audio platform and the Sound Blaster® Audigy® added more power and EAX® ADVANCED HD™ effects while also providing a quality of audio never experienced before.

Along the way Creative has reached out to a whole new audience with our USB Sound Blaster and PCMCIA Sound Blaster range of products. Then came a truly revolutionary new product. It's so revolutionary that the only comparison we have in terms of the leap forward being made is with Sound Blaster Live! back in 1998!

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Now in order to let other products incorporate the X-Fi effects, we have come up with a X-Fi module to interface with other products for X-Fi audio enhancement algorithm. The X-Fi module provides dramatic improvements to the recording and playback of MP3 music, accelerate and improve PC game play, enhance listening experiences for movies, and improve the capabilities, performance and quality of audio and music creation.

Key Features:

- X-Fi audio enhancement algorithm
  - o X-Fi Creative MultiSpeaker Surround 3D Headphone
  - o X-Fi Creative MultiSpeaker Surround 3DVirtual
  - o X-Fi Crystalizer^{TM}
- Selection of the X-Fi audio enhancement is through GPIO pin (level detect)
- I^{2}S input/output (16 bit, 44.1KHz or 48KHz sampling frequency) *
- Low power consumption

* The I2S ports are configured as slave.

X-Fi Creative MultiSpeaker Surround (CMSS)

X-Fi CMSS®-3D allows you to Upgrade your MP3 music and movies into surround sound with headphones or multichannel speakers.

Enjoy your stereo MP3s and movies in surround sound with X-Fi CMSS®-3D technology. Instead of performing a basic upmixing of stereo content, the Creative X-Fi Xtreme Fidelity audio processor intelligently remixes the audio into surround sound to match the speaker system you have (including headphones). It also uses advanced techniques to extract specific audio elements so your music and movies sound more alive than ever before!

Music Benefits: Convert static stereo music into amazing surround sound with multichannel speakers, plus enjoy the same surround sound experience with headphones!

Movie Benefits: When watching stereo or multichannel movies with headphones or speakers, X-Fi CMSS®-3D allows you to enjoy incredible surround sound that will amaze you.

- X-Fi CMSS®-3D Headphone: Provides a multichannel playback experience over headphones for all types of content
- X-Fi CMSS®-3D Virtual: Provides a multichannel playback experience over two loudspeakers for all types of content

X-Fi CMSS®-3DHeadphone and X-Fi CMSS®-3DVirtual technologies are designed to reproduce a natural sounding multi-channel listening experience over headphones or two loudspeakers, with both multi-channel and two-channel source formats. These new 3D audio virtualization technologies leverage Creative's considerable expertise in binaural virtualization and virtual surround sound, resulting from the combination of many years of research and development at IRCAM, UC Davis, Aureal, Sensaura and Creative's Advanced Technology Center.

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Creative's CMSS®-3DHeadphone technology helps the listener forget that he or she is wearing headphones, by delivering a compelling multi-channel listening experience, with any two-channel or multi-channel audio content. This is the result of the combination of three exclusive ingredients: HRTF filters, Environmental early reflections and Ambience extraction:

The benefits of X-Fi CMSS®-3DHeadphone may be summarized as follows:

• Timbre preservation

• Improved externalization, frontalization and front-back discrimination

• Natural sense of immersion, for both multi-channel and two-channel sources

• Reduced listening fatigue.

Creative's CMSS®-3DHeadphone technology employs patent-pending advanced signal processing algorithms to place listeners in a natural, fully immersive sound field. Whether you are listening to music, watching a movie or playing a video game, the auditory awareness of wearing headphones vanishes and is replaced by a transparent listening experience and the sensation of "being there".

Creative's CMSS®-3DVirtual technology provides a convincing multi-channel listening illusion using only two loudspeakers for a listener located at the "sweet spot", with any two-channel or multi-channel audio content. It combines the following ingredients: HRTF filters, Cross-talk canceller and Ambience extraction.

The benefits of X-Fi CMSS®-3DVirtual may be summarized as follows:

• Timbre preservation

• Convincing side and rear virtual loudspeaker localization

• Natural sense of immersion, with both multi-channel and two-channel sources

• Calibration according to the placement of the loudspeakers with respect to the listener.

X-Fi Crystalizer^{TM}

X-Fi Crystalizer^{TM} is an intelligent, automated audio-restoration processor carefully designed to bring the full benefit of audio playback to 16-bit legacy audio content. Crystalizer^{TM} selectively identifies significant transients in the original 16-bit audio playback stream and dynamically enhances these to compensate for the studio mastering compromises inherent in the limited dynamic range of CD audio.
The end result of applying Crystalizer^{TM} enhancement depends to some extent on the details of the content to which it is applied and to the user-specified degree of enhancement. In general, though, Crystalizer^{TM} produces crisper high frequencies, punchier mid-range percussion (snare drums, congas) and note onsets, and stronger kick bass hits. Most listeners experience the Crystalizer^{TM} output as a welcome improvement over their legacy CD and MP3 content.

X-Fi Crystalizer™ enhances MP3s and movies to sound better than they do on their original CD or DVD.
It is a low-impact algorithm designed to improve the dynamic range of an audio stream by enhancing the natural transients. Crystalizer can be very effective at sharpening an audio track (particularly compressed tracks, such as MP3 files), brightening sound effects, etc.

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Music Benefits: Low and high frequencies are enhanced while the dynamics are improved. Overall your music will sound cleaner, smoother and will sparkle!

Movie Benefits: Explosions, gun-shots and high-impact audio sequences sound more realistic than ever before!

The image below shows the effect of Crystalizer^{TM} on an audio sequence. You can very easily see where enhancements have been made to the audio stream! For instance the section circled in red in the "Before" image is weak and undefined, whereas in the "After" image it is much more clearly defined. You can also see how the enhancements are applied intelligently by comparing the section circled in blue. The "After" image is not as distinct an enhancement as applied in the section circled in red. This is because this section did not require such a marked enhancement.
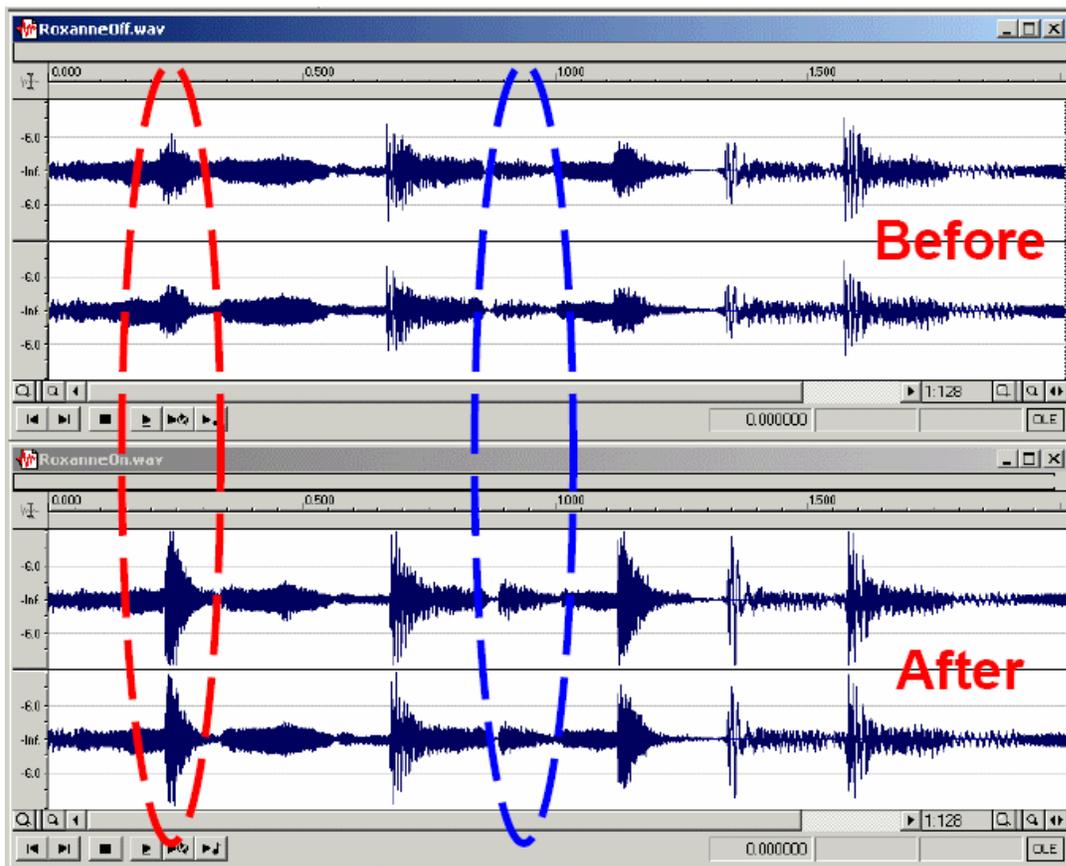
Before and After Comparison of Crystalizer^{TM} on Audio Stream

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What Others Say

"In music and movies, the X-Fi sounded head-and-shoulders above than HD Audio." - **Maximum PC**

"With many types of music, it'll be hard to go back to the way it sounded before once you've heard what it sounds like with the Crystalizer. Without it, you get the impression that you're listening to your music from behind a thick curtain." – **Tom's Hardware**

"If X-Fi has a killer app, it's headphones." – **PC Format**

"X-Fi….. transforms any boggo set of stereo headphones into a jaw-dropping surround sound system." – **PC Format**

"I can tell you this right now though, my MP3s have never sounded better with this … crystalizer. This is no marketing gimmick, it works." – **The Inquirer**

"With claims that it "enhances MP3s and movies to sound better than they do on their original CD or DVD," the 24-bit Crystalizer is easily the X-Fi's most-hyped feature." **– The Tech Report**

"Before switching on the Crystalizer, the audio would sound perfectly fine, seeming to contain nice bass and clear highs. Switching on the Crystalizer was like pulling out a set earplugs that had been dampening our ability to hear correctly." - **IGN Entertainment**
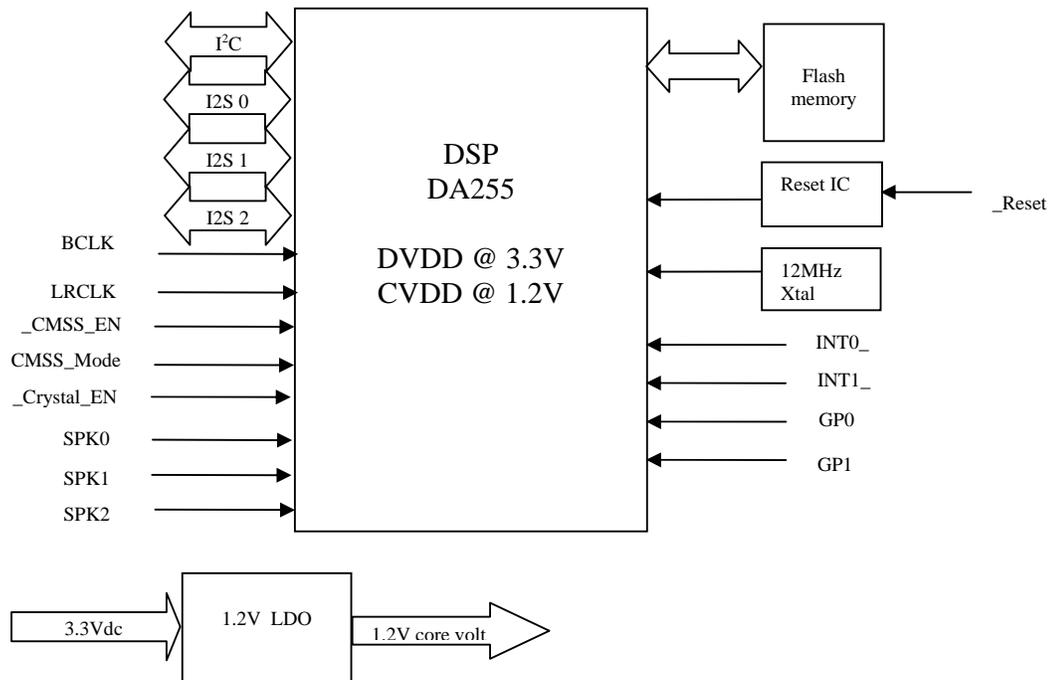
"CMSS 3D is vastly superior ... Music is actually expanded into a 3D soundstage that sounds almost infinitely more wide and surrounding, almost as if you were in the studio with the band .., we see little to no reason why anyone wouldn't run CMSS 3D on an X-Fi full-time when listening to music... Indeed, CMSS 3D is quite possibly the most perfect virtual surround-sound system for music we've ever heard."- **IGN Entertainment**

"The 3D virtualization (CMSS) is probably some of the better we've heard,... For real-time 3D virtualization, it's nice... Most importantly, it doesn't load up your music or game sounds with distortion, which is the problem we have with every single other real-time virtualization we've ever tried. This is pretty much distortion-free,.." - **ExtremeTech**

"..when using headphones, the use of the CMSS-3D feature yielded incredible results. Though you'll never get rid of a dedicated 5.1 speaker system, a good set of headphones and CMSS-3D will put a smile on your face and make you a believer." - **HotHardware**

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Block Diagram

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Application
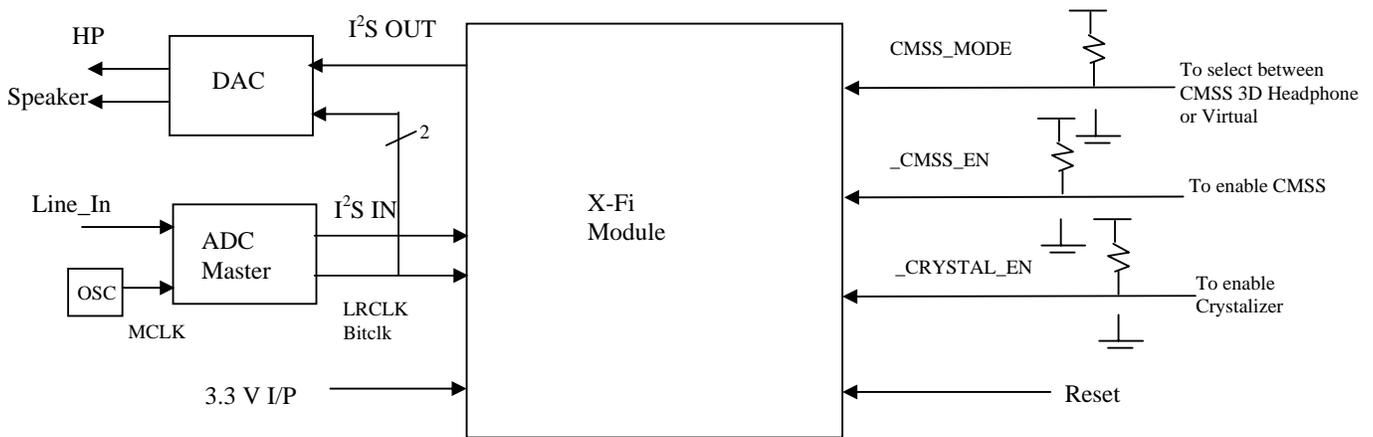
PinOut

Terminal Assignments

JP1			
Pin	Descriptions		IN/OUT
1	VDD_3.3	3.3V supply to the module.	IN
2	GND	Digital ground	-
3	SCL	I2C clock bidirectional port. Pull-up on board.	IN
4	SDA	I2C data bidirectional port. Pull-up on board	IN/OUT
5	INT0_	Negative edge triggered interrupt (Not used)	IN
6	INT1_	Negative edge triggered interrupt (Not used)	IN
7	GND	Digital ground	-
8	GND	Digital ground	-

9	DX1	Serial data transmit output of I2S1 (Not used)	OUT
10	DX0	Serial data transmit output of I2S0	OUT
11	DR1	Serial data receive input of I2S1 (Not used)	IN
12	-		-
13	GND	Digital ground	-
14	DR0	Serial data receive input of I2S0	IN
15	LRCLK	LRCLK for I2S 0~2	IN
16	GND	Digital ground	-
17	GND	Digital ground	-
18	DX2	Serial data transmit output of I2S2 (Not used)	OUT
19	BCLK	BCLK for I2S0~2	IN
20	DR2	Serial data receive input of I2S2 (Not used)	IN

JP2				
Pin	Descriptions		IN/OUT	Connection if pin not in used
1	CMSS_MODE	High – CMSS3D HP Low – CMSS3D Virtua;	IN	
2	TBA	-	-	Float
3	SPK_2	Speaker spacing configuration	IN	
4	_CMSS_EN	High – disable CMSS Low – enable CMSS	IN	
5	**KEY**	**-**		
6	GND	Digital ground		
7	SPK_1	Speaker spacing configuration	IN	
8	_CRYSTAL_EN	High – disable crystallizer Low – enable crystalizer	IN	
9	TBA			Pull up
10	GND	Digital ground		
11	_RESET [#]	Active low.	IN	
12	SPK_0	Speaker spacing configuration	`	

[#] The on board reset IC will goes low when VDD3.3 is below 2.93V. It will stay low for a min of 120ms.
_Reset is catered for manual reset incase the system needs to reset the module. The min pulse width to _Reset is 100ns

Terminal Function

CMSS and Crystalizer Selection			
Effect selection	_Crystalizer_EN	_CMSS_EN	CMSS_Mode
No effect	1	1	X
CMSS3D HP	1	0	1
CMSS3D Virtual	1	0	0
Crystalizer	0	1	X

CMSS3D HP + Crystalizer	0	0	1
CMSS3D Virtual + Crystalizer	0	0	0

Specifications

Recommended Operating Condition

Supply Voltage Operation Condition			
VDD_3.3 3.3V supply Voltage		3.3 Vrms	
I/O Operating Conditions			
V_{IH} High-level input voltage		TBA	
V_{IL} Low level input voltage		TBA	

Current Consumption

Current consumption @3.3Vdc		
TEST CONDITION		
No effect enabled	TBA	
CMSS 3D HP / Virtualizer	TBA	
Crystalizer	TBA	
CMSS 3D HP / Virtualizer + Crystalizer enabled	TBA	

Mechanical Dimensions

X-Fi module dimensions

Dimension of the module is 40x30 mm (LxW)
Please refer to the below diagram details of the layout.
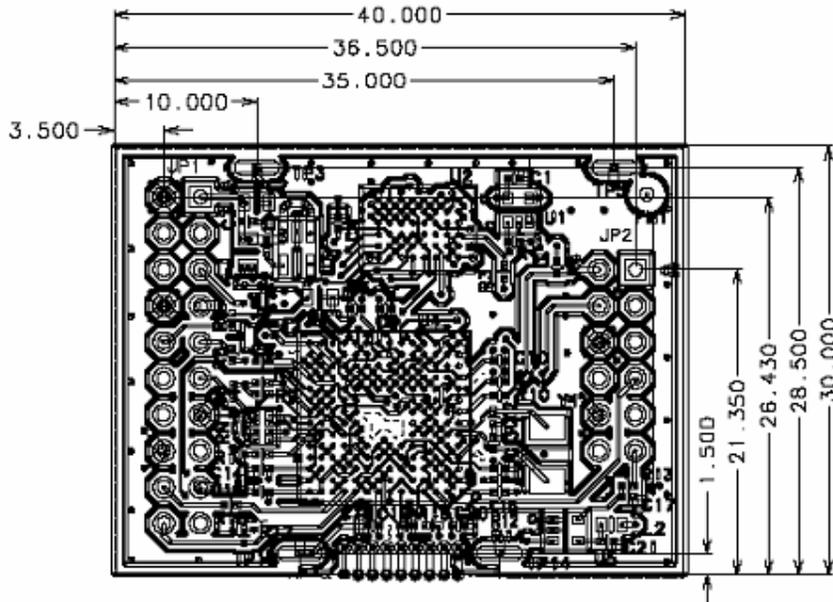
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