Audio

Dolby AC-3 Surround

DTS Coherent Acoustics™

Dolby Pro Logic / Lucasfilm Home THX

Dolby Pro Logic Surround

Sound Retrieval Systems (SRS)

Motorola 24-Bit Symphony™ DSPs

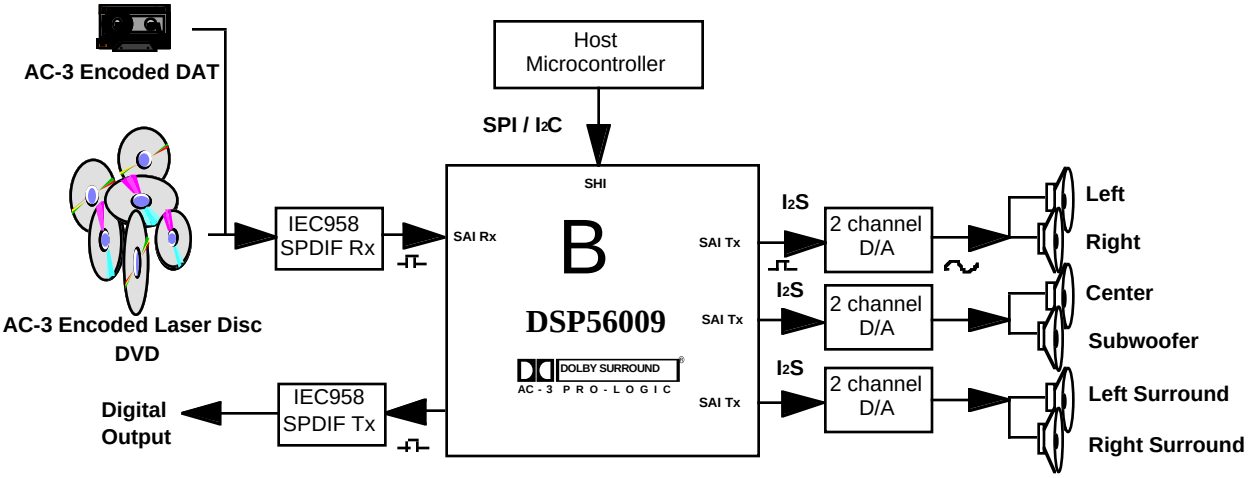
Motorola's 24-bit Symphony DSPs are designed specifically to meet industry standards for all multi-channel digital audio. Because of its robust, high-quality 24-bit DSP56000 core architecture and on-chip peripherals, the Symphony family offers the qualities needed to satisfy all multi-channel digital audio formats at an attractive low cost.

Why 24-bit? In the world of digital audio, the consumer market demands the highest sound quality at low cost. The currently popular 16-bit DSPs are not suitable to achieve the required minimum 96dB sound quality, even though they are cost effective. During the decoding process, the extra bits a 24-bit processor provides are needed to accommodate the overhead that results from A/D conversion and/or mathematical rounding. In other words, the D/A conversion stage needs more than a 16-bit data path to properly pass 16-bits of digital audio to achieve the minimum CD sound quality. A 32-bit architecture could easily surpass the minimum requirements, but are cost-prohibitive as a solution.

Conclusion? Motorola's 24-bit Symphony DSPs offer the ideal solution for multi-channel digital audio at a reasonably low cost. The family has earned a reputation as the 'de facto' standard in professional audio applications; resulting in close ties between Motorola and industry leaders like Dolby Laboratories Inc., Lucasfilm Ltd., Digital Theater Systems (DTS), and Sound Retrieval Systems (SRS).

Digital Audio System Implementations

Dolby AC-3 Surround using the DSP56009



Application Description

Dolby AC-3 Surround

Dolby AC-3 is a high quality, low-bit rate coding technique for 5.1 channel audio. AC-3 is Dolby's third generation audio coding technology, providing multi-channel audio transmission at data rates as low as 64 kbits/second per channel. Although AC-3 algorithms are independent of the number of channels coded, current implementations have standardized on the SMPTE-recommended 5.1 channel arrangement: five full bandwidth channels representing Left, Right, Center, Left Surround, and Right Surround plus a limited bandlimited low-frequency Subwoofer channel. AC-3 audio coding algorithm uses psychoacoustic models and frequency-domain masking effects to achieve data compression ratios as high as 14:1 which help convey this channel arrangement with a high degree of transparency at data rates as low as 320 kbps.

Dolby AC-3 is the home theater standard derived from the Dolby Digital surround system found in movie theaters. Because of its well-accepted name in the industry, Dolby AC-3 has paved the way to establish the industry standard for multi-channel digital audio that surpasses all surround sound technology to even better enhance the currently popular Dolby Pro Logic Surround (Dolby AC-3 Pro Logic). It is for this reason that Dolby AC-3 has become the primary multi-channel digital audio format for the upcoming Digital Versatile Disc (DVD).

Motorola DSP

DEVICE	TYPE	MAX POWER	MIPS	ma/MIP	PKG	PINS	TECH.	PRICE
		(mA at 5V)	(max)	(min)				(10K units)
DSP56009	24-bit fx. pt	140	40.5	3.46	QFP	80	0.65 u	$22.00

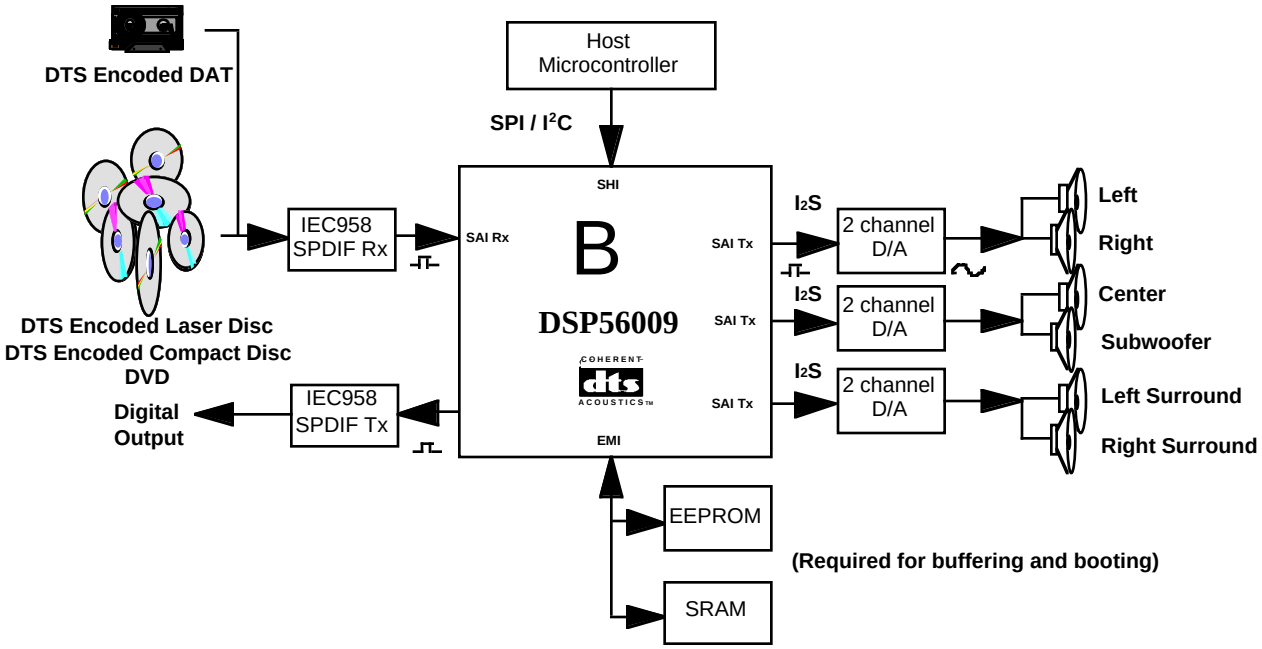
MEMORY				PERIPHERALS				
RAM		ROM		SERIAL	CODEC	DEBUG	TIMER	HOST
512	8.75k	10k	4.75k	3	-	OnCE	-	1

- High 24-bit quality, better signal-to-noise ratio (107 dB SNR)
- Requires no external memory
- Smaller package
- Pin compatible with other Symphony DSPs
- Lower power consumption
- Faster DSP, more MIPs

Development Tools

DSP56009EVM

DTS Coherent Acoustics™ using the DSP56009



Application Description

DTS Coherent Acoustics™

DTS Technology is a division of Digital Theater Systems L.P., the world's leading supplier of digital sound for motion pictures. The DTS theatrical system was introduced in 1993 in Steven Speilberg's "Jurassic Park", which has won two Academy Awards for sound.
In 1994, based on the wide acceptance of DTS' digital sound experience in the movie theaters, the company created a new business unit, DTS Technology, which gave birth to a broad based and flexible audio standard for home theater known as Coherent Acoustics. Coherent Acoustics, like the widely accepted Dolby AC-3, is similarly based on the SMPTE-recommended 5.1 channel arrangement: five full bandwidth channels representing Left, Right, Center, Left Surround, and Right Surround plus a limited bandlimited low-frequency Subwoofer channel. However, Coherent Acoustics strives to set an universal audio platform which allows play back encoded audio at bit rates ranging from 32 kbits/second up to 4 Mbits/second (far beyond CD-quality 16-bits, 96 dB SNR). It is capable of operating in a wide range of applications including DVD, laserdisc, multi-track CD, DBS, digital radio, HDTV, multimedia, etc.

It provides multiple modes of operation, including lossless coding for the most demanding applications. DTS Coherent Acoustics relies on their flexibility and uncompromising quality to achieve the highest and most attractive multi-channel digital audio technology for both professional and consumer audio components.

DTS audio systems are currently available in more than 5,000 theaters worldwide. The DTS digital sound process has been used with over 1000 films to date, with laserdiscs, compact discs, and soon DVD to provide the medium to bring DTS into the living rooms. Simply based upon DTS' demands for the highest quality DSPs, Motorola is currently the only DSP supplier which houses this "Jurassic Park" technology. 24-bit Motorola DSP (notably DSP56009) with DTS embedded in ROM will be available in the second half of 1996 for mass distribution.

Motorola DSP

DEVICE	TYPE	MAX POWER	MIPS	ma/MIP	PKG	PINS	TECH.	PRICE
		(mA at 5V)	(max)	(min)				(10K units)
DSP56009	24-bit fx. pt	140	40.5	3.46	QFP	80	0.65 u	$22.00

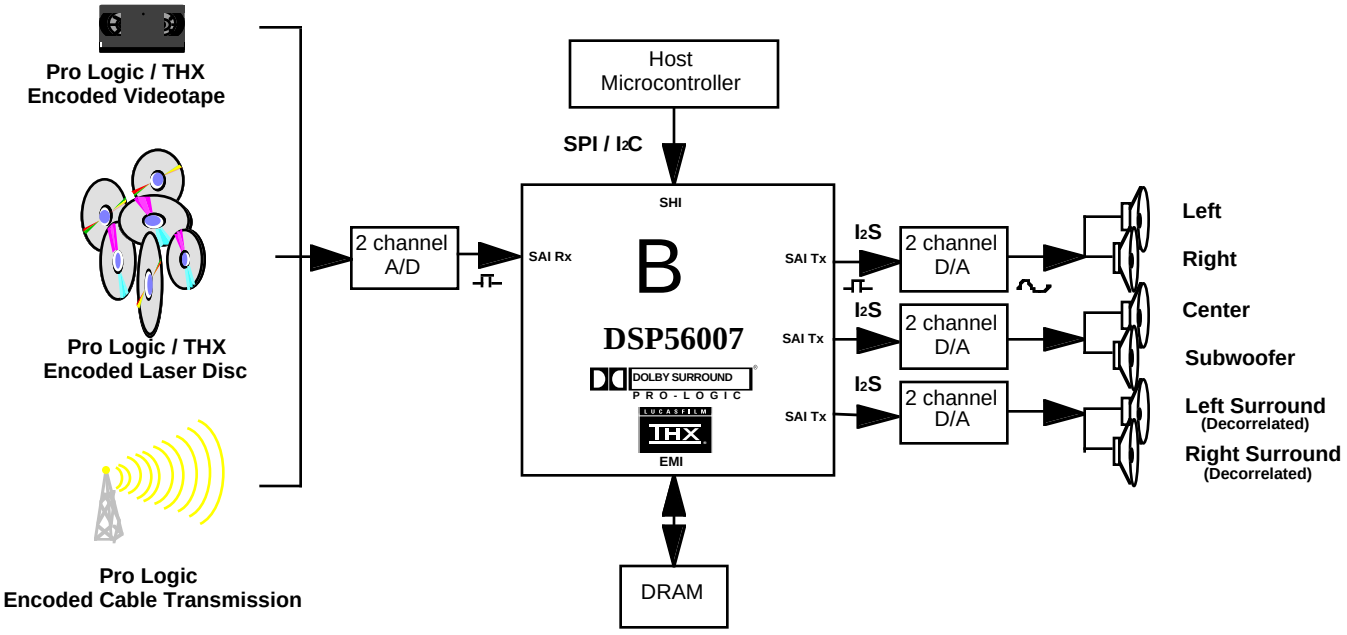
MEMORY				PERIPHERALS				
RAM		ROM		SERIAL	CODEC	DEBUG	TIMER	HOST
512	8.75k	10k	4.75k	3	-	OnCE	-	1

- High 24-bit quality demanded and preferred by DTS
- Small package
- Pin compatible with other Symphony DSPs
- Low power consumption
- Only DSP solution available

Development Tools

DSP56004ADS
DSP56009EVM

Dolby Pro Logic / Lucasfilm Home THX using the DSP56007



(Required for Delays as specified by both Dolby and Lucasfilm)

Application Description

Lucasfilm Home THX

Lucasfilm Home THX Audio System is an audio enhancement technology for multi-channel home entertainment systems. The system incorporates decorrelation techniques and a series of patented electronic and loudspeaker developments designed to reproduce all multi-channel sources accurately in the home. The driving force behind the creation of Home THX was the inability of conventional home audio components to reproduce film soundtracks as they were originally created by the film makers. THX for movie theaters matches components and acoustical modifications to individual theater sizes and shapes. The objectives are: to achieve clear dialogue, a high degree of sound localization, non-localized but pervasive surround envelopments, wide frequency response and wide dynamic range.

Originally developed as an enhancement analog algorithm for Dolby Pro Logic (i.e. THX4.0), Motorola was the first to provide an all digital single-chip solution. The DSP56007, which is pin-compatible with the DSP56004 and DSP56009, has provided both Dolby Pro Logic and Lucasfilm THX4.0 to not only achieve low system implementation cost, but as well as the 24-bit digital quality that was unachievable using an ASIC implementation.

Lucasfilm is expanding to meet the latest multi-channel audio trend: Dolby AC-3 Surround. As the arrival of DVD nears, Lucasfilm will provide for both the A/V and DVD markets the new 5.1 version better known to the industry now as Lucasfilm THX5.1. Motorola has already taken the initiative to continue to work jointly with Lucasfilm to help bring about Lucasfilm THX5.1 on a DSP56004 platform. Because Dolby AC-3 is already available as a purely digital implementation, the DSP56004 will be able to interface flawlessly with Motorola's current DSP56009 solution.

Motorola DSP

DEVICE	TYPE	MAX POWER (mA at 5V)	MIPS (max)	ma/MIP (min)	PKG	PINS	TECH.
DSP56007	24-bit fx. pt	90	33	2.5	QFP	80	0.65u

MEMORY				PERIPHERALS				
RAM		ROM		SERIAL	CODEC	DEBUG	TIMER	HOST
Program	Data	Program	Data					
-	3K	6.4K	1K	3	-	OnCE	-	1

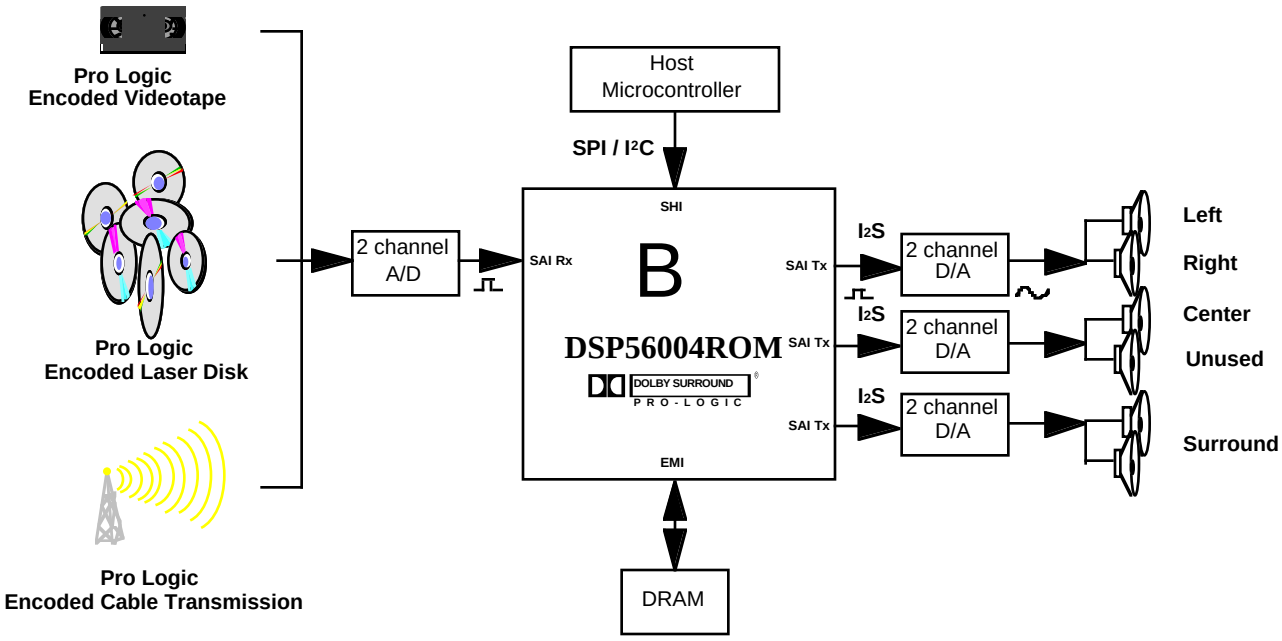
PRICE (10K units)	APPLICATION AREAS
$15.00	low cost/consumer

- High 24-bit quality, better signal-to-noise ratio
- First and only single DSP solution on the market
- Pin compatible and easy upgradability with other Symphony DSPs
- Allows flexibility to interface to A/D and D/A converters

Development Tools

DSP56004ADS
DSP56009EVM

Dolby Pro Logic Surround using the DSP56004ROM



(Required for 30msec Delay as specified by Dolby)

Application Description

Dolby Pro Logic Surround

Dolby Pro Logic Surround takes advantage of the "Haas" or precedence effect to help reduce the perception of leakage signals from surround speakers. Dolby Pro Logic Surround incorporates the "Haas" effect with directional enhancement techniques and additional center and surround channel outputs to improve soundfield localization over a wider viewing area. The improvements in soundfield localizations and the use of the center speaker are also available for stereo televisions not offering a surround mode. This four channel decoder works with all conventionally mixed stereo soundtracks as well as surround encoded formats.

Dolby Pro Logic Surround has established a foundation in the A/V Home Theater market and has been a reference surround sound technology that has drawn the distinct line between conventional stereo A/V receivers and A/V receivers for Home Theater. Dolby Pro Logic Surround has proven to be an affordable Home Theater solution for consumers who are just content with minimal speaker living room layout without having to spend the extra cost or even to make more space available for additional speakers to incorporate a higher-end system like Dolby AC-3 Surround and/or Lucasfilm Home THX.

Motorola introduced the DSP56004 because of its realization to provide for the A/V receiver market a high-quality 24-bit DSP solution at a very low competitive cost while competitors have relied mostly on various ASIC implementations. The key here is that DSP56004 provides the A/V manufacturers a high-quality 24-bit digital implementation with the price range of an ASIC solution. Motorola currently provides Dolby Pro Logic Surround for both DSP56004 (RAM solution) and DSP56004ROM, DSP56007 with Lucasfilm Home THX, and DSP56009 with Dolby AC-3 Surround.

Motorola DSP

DEVICE	TYPE	MAX POWER (mA at 5V)	MIPS (max)	mA/MIP (min)	PKG	PINS	TECH.
DSP56004ROM	24-bit fx. pt	130	33	2.5	QFP	80	0.65u

MEMORY (words)				PERIPHERALS				
RAM		ROM		SERIAL	CODEC	DEBUG	TIMER	HOST
Program	Data	Program	Data					
256	512	2.5K	512	3	-	OnCE	-	1

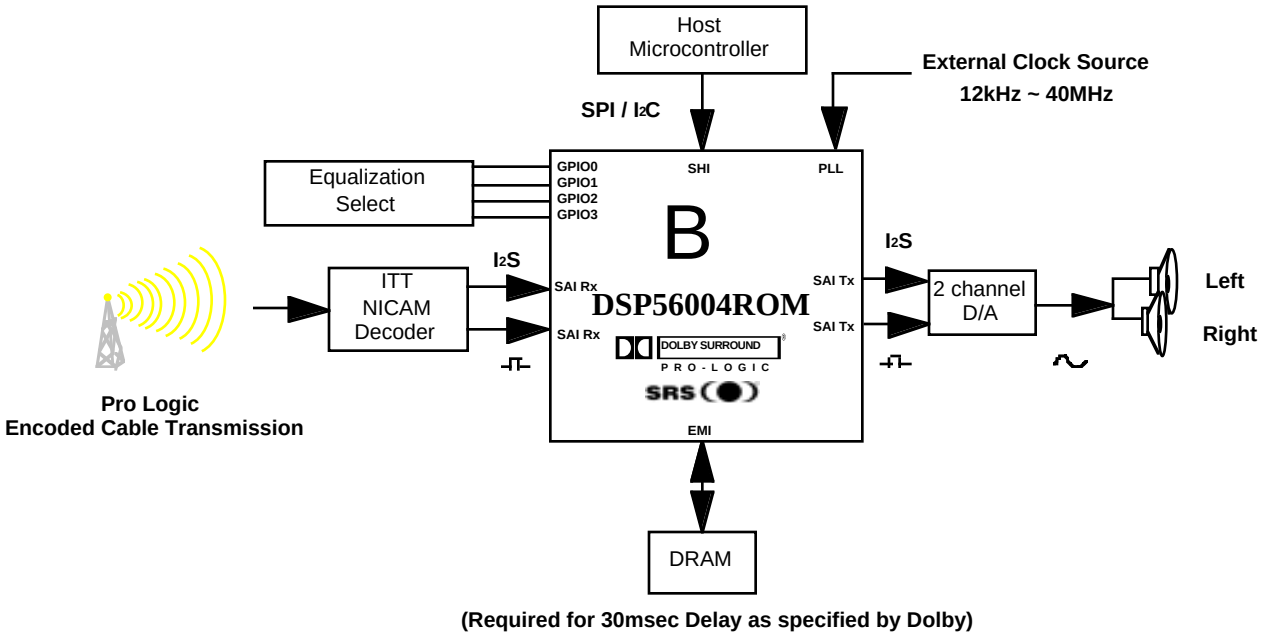
PRICE (10K units)
$10.00

- High 24-bit quality, best signal-to-noise ratio and channel separation
- Small package
- Low power consumption
- Pin compatible and easy upgradability with other Symphony DSPs
- Allows flexibility to interface to A/D and D/A converters

Development Tools

DSP56004ADS
DSP56009EVM

Dolby Pro Logic Surround / SRS using the DSP56004ROM (exclusively for European TV applications)



(Required for 30msec Delay as specified by Dolby)

Application Description

Sound Retrieval Systems (SRS)

SRS, the Sound Retrieval System, replaces stereo as the method of accurately reproducing sound and is rapidly becoming the standard 3-D audio technology. It creates a three dimensional sound image from any audio source with only two conventional stereo speakers. Whether the signal is mono, stereo, or surround sound encoded, SRS expands the material and immerses the listener in three-dimensional sound.

SRS was developed with research dedicated specifically on the psychoacoustics of sound and the dynamics of the human hearing system. SRS differs from stereo and traditional sound expansion techniques because it is based on the human hearing system. It retrieves the spatial information from recordings and restores the original three-dimensional sound field. As a result, the reproduced sound is much closer to a live performance. Like live performance, SRS has no critical listening position (sweet spot). Listeners can move around the room and continue to be immersed in full-three dimensional sound. As a result, speakers become no longer the discernible source of sound. Consequently, SRS does not rely on encoding or decoding, and does not alter the original program material by adding any form of time delay of phase shift.

Motorola sees SRS technology as a value-added feature for TV and car audio applications. Some TV manufacturers have already made SRS available for consumers in the U.S. Currently Motorola plans to market the DSP56004ROM solution (depicted above) targeted specifically for the TV market for both U.S. and Europe. Motorola DSP hopes to offer this as the next step solution for European TV manufacturers who are already using the widely accepted DSP56004ROM for Dolby Pro Logic.

Motorola DSP

DEVICE	TYPE	MAX POWER (mA at 5V)	MIPS (max)	mA/MIP (min)	PKG	PINS	TECH.
DSP56004ROM	24-bit fx. pt	130	33	2.5	QFP	80	0.65u

MEMORY (words)				PERIPHERALS				
RAM		ROM		SERIAL	CODEC	DEBUG	TIMER	HOST
Program	Data	Program	Data					
256	512	2.5K	512	3	-	OnCE	-	1

PRICE (10K units)
$10.00

- High 24-bit quality, better signal-to-noise ratio
- First and only single DSP solution on the market
- Pin compatible and easy upgradability with other Symphony DSPs
- Small package
- Allows flexibility to interface to A/D and D/A converters

Development Tools

DSP56004ADS
DSP56009EVM