



NJU25008

TruSurround™ Digital Audio Processor



Description

The NJU25008 is a 24-bit digital signal processor dedicated to decoding a stereo audio source and creating the sensation of being surrounded by multiple speakers. Based on patented technology from SRS Labs, TruSurround™ utilizes Head Related Transfer Functions (HRTFs) to envelop the listener with full 360° surround coming from only a pair of speakers. One of the distinguishing advantages of TruSurround is a broad "sweet spot," offering effective virtual surround within an area up to 75% between the speakers and some surround effect outside the area between the speakers. Additionally, because TruSurround is based on the proprietary SRS® (Sound Retrieval System®) 3D Sound technology, when a standard stereo source is fed into the NJU25008, the resulting output is an expanded sound image that minimizes the speakers as the point source of audio information, presenting good stereo separation independent of listener position.

In addition to 3D virtual surround sound processing, the NJU25008 is also a full featured Dolby™ Pro Logic™ decoder with 5 output channels (L, R, SL, SR, C) plus optional subwoofer (0.1) channel. Audio functions are also included in the NJU25008: digital filters for electronic speaker crossovers and digital tone control with separate bass and treble settings. Applications that can benefit from the NJU25008 include TVs, self-powered multimedia speakers, and A/V stereo systems used for home theater.

Features

- ◆ SRS TruSurround 3D Surround Processing
 - 360° surround from two speakers
 - Wide listening area
- ◆ Dolby Pro Logic Decoder With Optional Subwoofer Output
 - 5.0 or 5.1ch output (L,R,SL,SR,C,SW)
 - On-chip digital surround delay, 30ms max.
- ◆ Dolby 3 Stereo With Optional Subwoofer Output
 - 3.0 or 3.1ch output (L,R,C,SW)
- ◆ System Level Audio Management
 - Bass Management
 - Subwoofer filter
 - Front high pass filters
 - Default or programmable cutoff frequencies
 - Tone Control
 - Independent bass and treble
 - +15dB to -16dB in 1dB steps
 - Master Volume Control
 - Clipping Indicator
- ◆ Mono-to-Stereo Synthesis
- ◆ A Ready-To-Use DSP-Based 3D Audio Solution
 - Includes on-chip memory

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Figure 1 NJU25008 Block Diagram

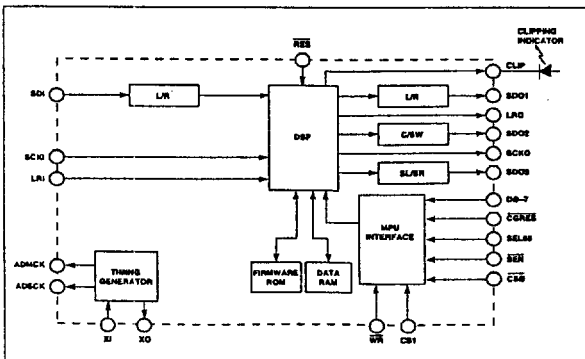
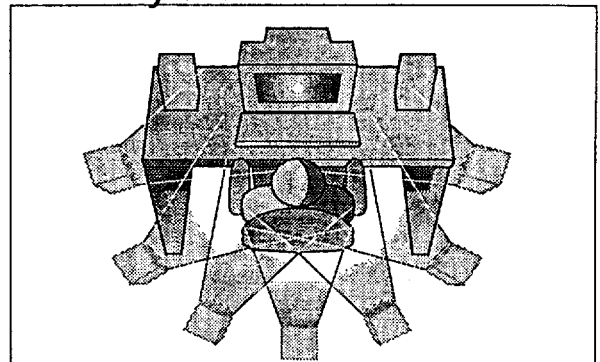


Figure 2 TruSurround™ Virtual Surround System





SRS TruSurround Mode

Surround information from the audio source is extracted by the Dolby Pro Logic decoder processing in the NJU25008. Head Related Transfer Functions (HRTFs), based on the natural characteristics of the human hearing system, are used on both Front and Rear Surround channels to synthesize virtual surround speakers to the side and rear of the listener. The Front HRTFs have frequency tailoring of the difference signals (L-R) to extend the sound image past the physical boundaries of the actual speakers. A different set of frequency coefficients are applied to the Rear HRTFs that have a much greater peak and valley differ-

ences and center frequencies. These are chosen to cause the rear channels to virtualize behind the listener. The virtualized surround is then mixed back into the Left and Right output along with Phantom Center. There is also a Subwoofer Output with low pass crossover filter that is active in all modes.

The NJU25008 initializes in TruSurround mode with \dot{P} S audio data format for use with a codec (A/D+D/A), and does not need a microprocessor for 2ch 3D Surround.

Figure 3 SRS TruSurround Processing

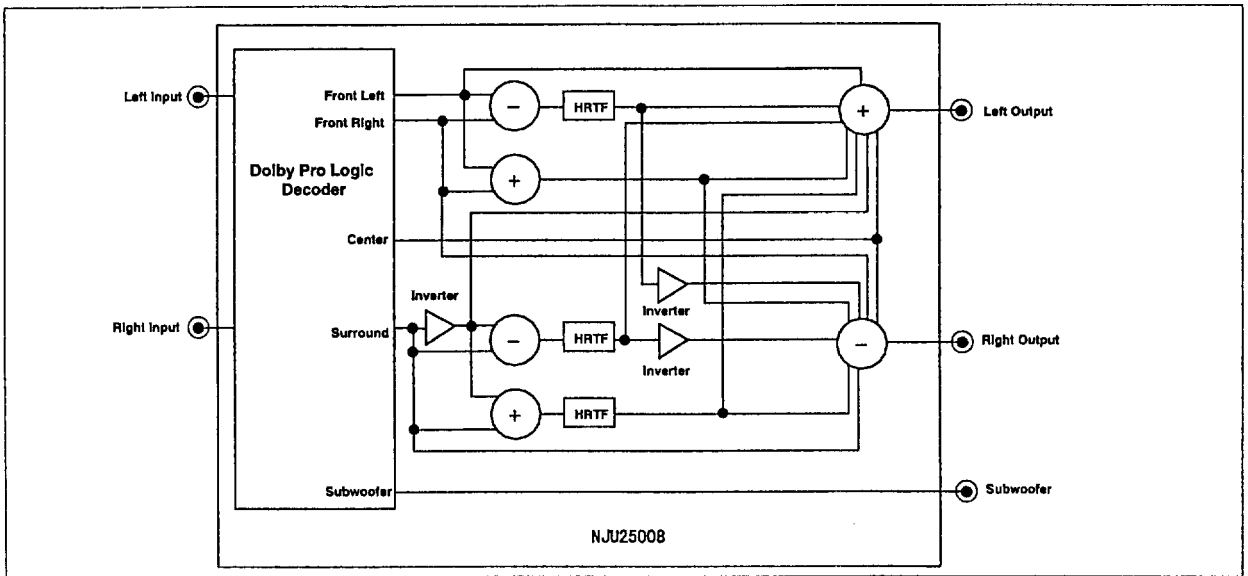


Figure 4 TruSurround Listening Area

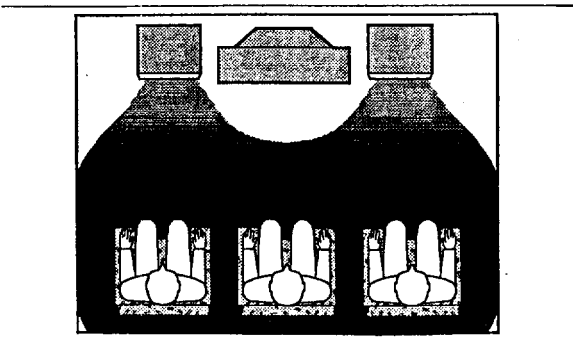
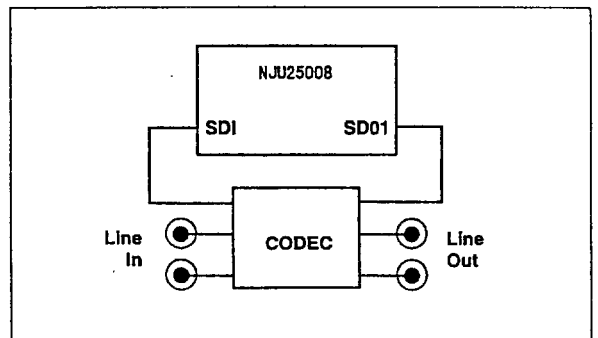


Figure 5 Minimum System Without Microcontroller





Functional Description

Digital Audio Data Interface

Three digital audio data formats are supported: left justified, right justified, and I²S. The data is always MSB first, two's complement. Either 16-bit or 18-bit data can be accommodated. The polarity of the L/R clocks (LRI, LRO) is programmable along with the active edge of the serial bit clocks (SCKI, SCKO). A master clock (ADMCK) and serial bit clock (ADSCK) output for the A/D and D/A converters are provided by an internal, programmable clock generator for synchronous operation with the DSP clock (768Fs). Asynchronous data rates are possible as long as the output is slaved to the input and it is close to the three supported sampling frequencies (32 kHz, 44.1 kHz, and 48 kHz).

There is one stereo digital audio input and three stereo digital outputs for L and R Front channels, L and R Surrounds, Center and Subwoofer. All three serial data outputs must have identical

data formats. In each data format mode, SCLK and LRCLK polarities are independently programmable for input and output. Audio data width (16/18 bits), SCK and MCK frequencies (32/64Fs, 256/384Fs, respectively) must be the same for both input and output.

Serial Data Formats

There are three serial data formats supported for interfacing an A/D and three D/As to the digital audio interface: Left Justified, Right Justified, or I²S mode. In Left Justified Mode, the data is positioned at the left or "front" side of the L/R pulse. In Right Justified Mode, the data is at the right or "rear" of the L/R pulse. Sometimes this mode is called Japanese Mode or EIAJ Mode. The I²S Mode is similar to Left Justified Mode, except that the data is delayed one SCLK period and the sense of LRI and LRO is inverted.

Figure 8 Audio Serial Data Formats

