

## SRS CS 5.1 & Passive Matrix TruSurround XT Decoder

### ■ Package

### ■ General Description

The NJU26110 is a digital signal processor that provides the function of Circle Surround II 5.1 / TruSurroundXT and Mono-to-Stereo.

The NJU26110 processes the stereo matrix-encoded signal into spacious sound of 5.1 channels by Circle Surround II 5.1. Also non matrix-encoded audio signal can be processed into effective spacious sound.

The decoded 2-channel signal can be converted into spacious 2-channel virtual surround output by the TruSurroundXT technology.



**NJU26110FR1**

### ■ FEATURES

#### - Software

- 5.1-Channel signal outputs by Circle Surround II 5.1
- SRS Focus
- LFE by SRS TruBass
- 2-Channel outputs by SRS TruSurroundXT
- Mono-to-Stereo function
- Master Volume
- WatchDog Clock Output

#### - Hardware

- 24bit Fixed-point Digital Signal Processing
- Maximum System Clock Frequency : 38MHz Max.
- Digital Audio Interface : 2 Input ports / 3 Output ports
- Digital Audio Format : I<sup>2</sup>S 24bit, Left-justified, Right-justified, BCK : 32/64fs
- Master / Slave Mode : Master Mode MCK 1/2 fclk, 1/3 fclk  
ex. MCK = 384Fs(1/2) or MCK = 256Fs(1/3) at fclk=768Fs
- Power Supply : 2.5V
- Input terminal : 3.3V Input tolerant
- Package : QFP32-R1 (Pb-Free)
- Two kinds of micro computer interface : I<sup>2</sup>C bus (standard-mode/100kbps)  
: Serial interface (4 lines: clock, enable, input data, output data)

The detail hardware specification is described in the "NJU26100 Series Hardware Data Sheet".

## Function Block Diagram

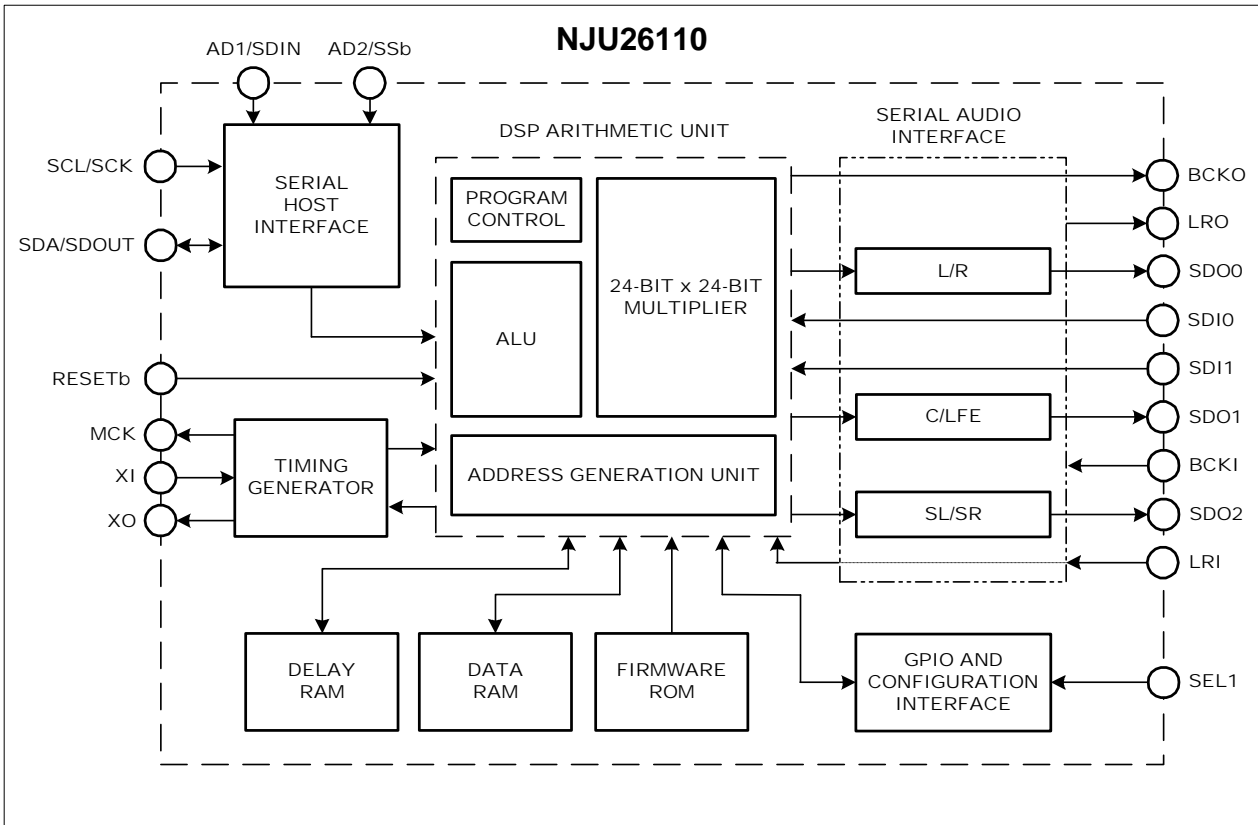


Fig. 1 NJU26110 Block Diagram

## DSP Block Diagram

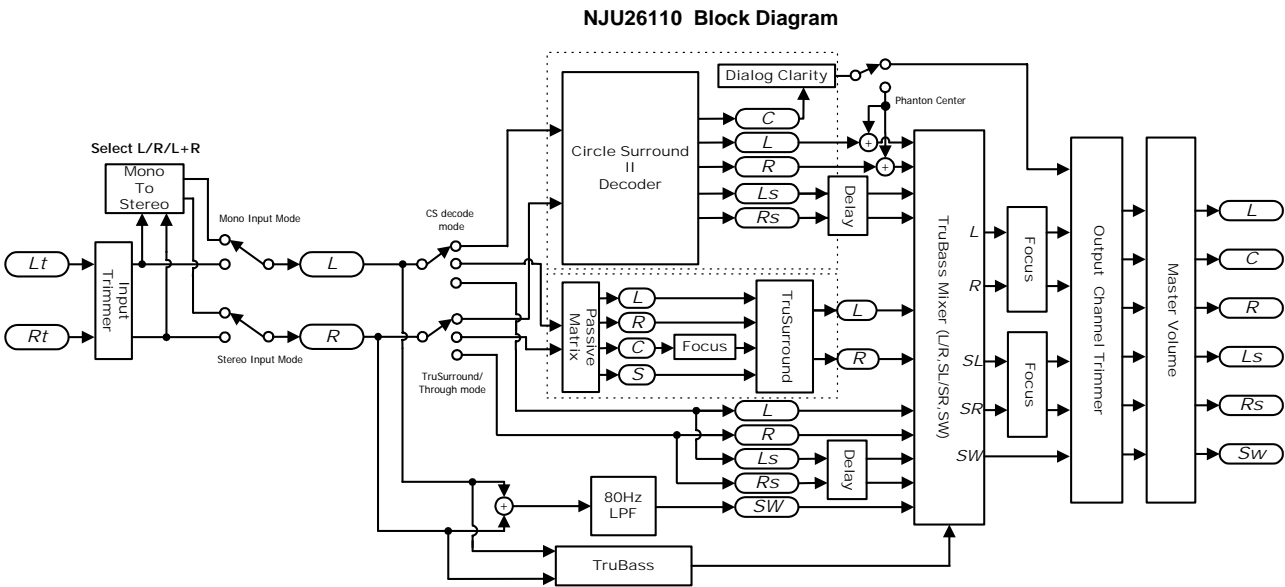


Fig. 2 NJU26110 Function Diagram

## Pin Configuration

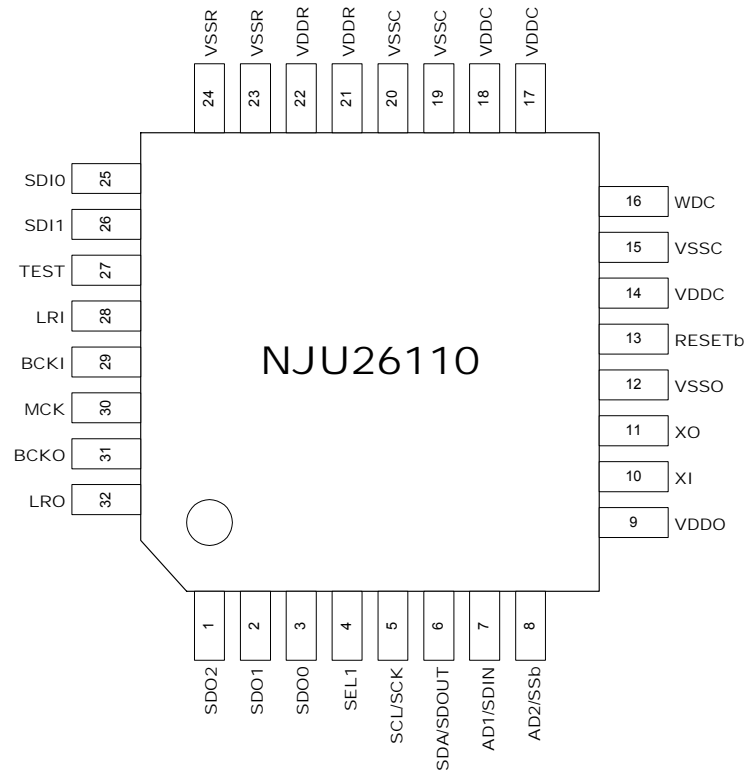


Fig. 3 NJU26110 Pin Configuration

## Pin Description

Table 1 Pin Description

No.	Symbol	I/O	Description
1	SDO2	O	Audio Data Output 2 SL/SR
2	SDO1	O	Audio Data Output 1 C/SW
3	SDO0	O	Audio Data Output 0 L/R
4	SEL1 *1	I	Select I <sup>2</sup> C or Serial bus
5	SCL/SCK	I	I <sup>2</sup> C Clock / Serial Clock
6	SDA/SDOUT	I/O	I <sup>2</sup> C I/O / Serial Output This pin requires a pull-up resistance.
7	AD1/SDIN	I	I <sup>2</sup> C Address / Serial Input
8	AD2/SSb	I	I <sup>2</sup> C Address / Serial Enable
9	VDDO	--	OSC Power Supply +2.5V
10	XI	I	X'tal Clock Input
11	XO	O	OSC Output
12	VSSO	--	OSC GND
13	RESETb	I	RESET (active Low)
14	VDDC	--	Core Power Supply +2.5V
15	VSSC	--	Core GND
16	WDC *2	O	Clock for Watch Dog Timer

No.	Symbol	I/O	Description
17	VDDC	--	Core Power Supply +2.5V
18	VSSC	--	Core GND
19	VSSC	--	Core GND
20	VSSC	--	Core GND
21	VDDR	--	I/O Power Supply +2.5V
22	VDDR	--	I/O Power Supply +2.5V
23	VSSR	--	I/O GND
24	VSSR	--	I/O GND
25	SDI0	I	Audio Data Input 0 L/R
26	SDI1	I	Audio Data Input 1 L/R
27	TEST	I	Connect to GND
28	LRI	I	LR Clock Input
29	BCKI	I	Bit Clock Input
30	MCK	O	Master Clock Output
31	BCKO	O	Bit Clock Output
32	LRO	O	LR Clock Output

- \* I : Input,
- O : Output,
- I/O: Bi-directional
- \*1 SEL1 : Input
- \*2 WDC : Output

## ■ Digital Audio Interface

The NJU26110 audio interface provides industry standard serial data formats of I<sup>2</sup>S, MSB-first left-justified or MSB-first right-justified. The NJU26110 audio interface provides two data inputs, SDI0, SDI1 and three data outputs, SDO0, SDO1, SDO1, as shown in table 2, table 3 and Fig.2. An audio interface input and output data format become the same data format.

**Table 2 Serial Audio Input Pin**

Pin No.	Symbol	Description
25	SDI0	Audio Data Input 0 L / R
26	SDI1	Audio Data Input 1 L / R

**Table 3 Serial Audio Output Pin**

Pin No.	Symbol	Description
3	SDO0	Audio Data Output 0 L / R
2	SDO1	Audio Data Output 1 C /SW
1	SDO2	Audio Data Output 2 SL/SR

## ■ Host Interface

The NJU26110 can be controlled via Serial Host Interface (SHI) using either of two serial bus format : 4-Wire serial bus or I<sup>2</sup>C bus.(Table 4) Data transfers are in 8 bit packets (1 byte) when using either format. Serial Host Interface Pin Description.(Table 5)

**Table 4 Serial Host Interface Pin Description**

Pin No.	Symbol	Setting	Host Interface
4	SEL1	"Low"	I <sup>2</sup> C bus
		"High"	4-Wire serial bus

**Table 5 Serial Host Interface Pin Description**

Pin No.	Symbol (I <sup>2</sup> C bus / Serial)	I <sup>2</sup> C bus Format	4-Wire Serial bus Format
5	SCL / SCK	Serial Clock	Serial Clock
6	SDA / SDOOUT	Serial Data Input/Output (Open Drain Input/Output)	Serial Data Output (CMOS)
7	AD1 / SDIN	I <sup>2</sup> C bus address Bit1	Serial Data Input
8	AD2 / SSb	I <sup>2</sup> C bus address Bit2	Serial enable

**Note :** SDA/SDOOUT pin is a bi-directional open drain.

SDA/SDOOUT output is normal CMOS output in case of 4-Wire Serial bus mode and SSb="Low".

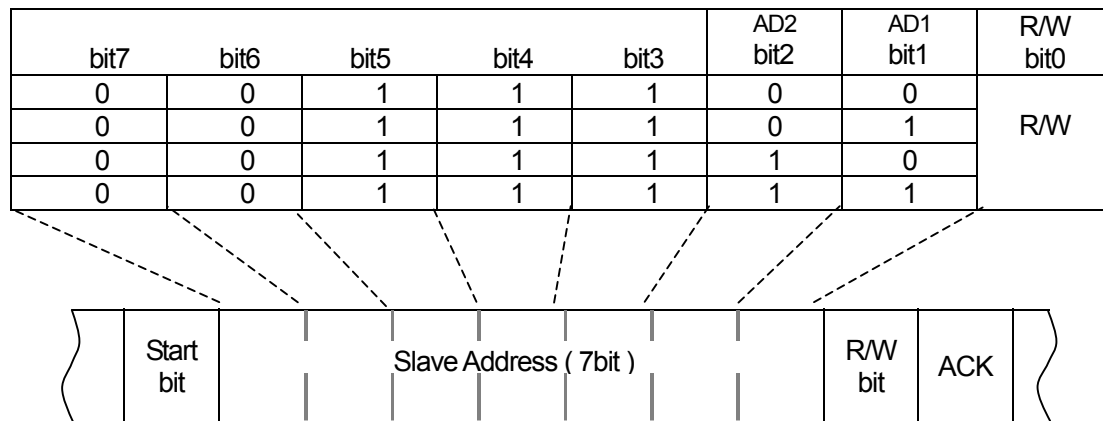
SDA /SDOOUT output is Hi-Z state in case of 4-Wire Serial bus mode and SSb="High". This pin requires a pull-up resistor in both 4-Wire serial and I<sup>2</sup>C bus mode.

## ■ I<sup>2</sup>C bus

When the NJU26110 is configured for I<sup>2</sup>C bus communication during the Reset initialization sequence. I<sup>2</sup>C bus interface transfers data to the SDA pin and clocks data to the SCL pin.

AD1 and AD2 pins are used to configure the seven-bit SLAVE address of the serial host interface. (Table 6) This offers additional flexibility to a system design by four different SLAVE addresses of the NJU26110. An address can be arbitrarily set up by the AD1 and AD2 pins. The I<sup>2</sup>C address of AD1/AD2 is decided by connection of AD1/AD2 pins.

**Table 6 I<sup>2</sup>C bus SLAVE Address**



\* SLAVE address is 0 when AD1/2 is "Low". SLAVE address is 1 when AD1/2 is "High".

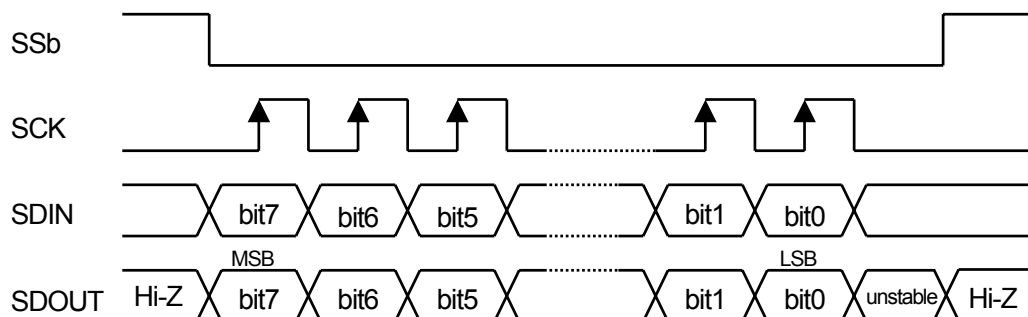
**Note :** In case of the NJU26110, only single-byte transmission is available. The serial host interface supports "Standard-Mode (100kbps)" I<sup>2</sup>C bus data transfer.

## ■ 4-Wire Serial Interface

The serial host interface can be configured for 4-Wire Serial bus communication by setting SEL1 pin ="High" during the Reset initialization sequence.

SHI bus communication is full-duplex; a write byte is shifted into the SDIN pin at the same time that a read byte is shifted out of the SDOUT pin. Data transfers are MSB first and are enabled by setting the Slave Select pin Low ( SSb=0 ). Data is clocked into SDIN on rising transitions of SCK. Data is latched at SDOUT on falling transitions of SCK except for the first byte (MSB) which is latched on the falling transitions of SSb.

SDOUT is Hi-Z in case of SSb = "High". SDOUT is CMOS output in case of SSb = "Low". SDOUT needs a pull-up resistor when SDOUT is Hi-Z.



**Fig. 4 4-Wire Serial Interface Timing**

**Note:** When the data-clock is less than 8 clocks, the input data is shifted to LSB side and is sent to the DSP core at the transition of SSb="High". When the data-clock is more than 8 clocks, the last 8 bit data becomes valid. After sending LSB data, SDOUT transmits the MSB data which is received via SDIN until SSb becomes "High". SDOUT is Hi-Z in case of SSb = "High". SDOUT is CMOS output in case of SSb = "Low". SDOUT needs a pull-up resistor to prevent SDOUT from becoming floating level.

## ■ WatchDog Clock

The NJU26110 outputs clock pulse through WDC (No.16) pin during normal operation. The output toggle cycle (Low/High) from a WDC pin changes with sampling frequencies. (Table 7)

**Table7 WatchDog Clock Output Cycle**

Sampling Frequencies	WDC Output Cycle (Low/High) Time
32 KHz	256ms
44.1KHz	186ms
48 KHz	171ms

The NJU26110 generates a clock pulse through the WDC terminal after resetting the NJU26110. The WDC clock is useful to check the status of the NJU26110 operation. For example, a microcomputer monitors the WDC clock and checks the status of the NJU26110. When the WDC clock pulse is lost or not normal clock cycle, the NJU26110 does not operate correctly. Then reset the NJU26110 and set up the NJU26110 again.

**Note:** If input and output of a audio signal stop and an audio interface stops, WDC can't output.  
That is because it has controlled based on the signal of an audio interface.


## ■ NJU26110 Command Table

**Table 8 NJU26110 Command**

No.	Command
1	Set Task
2	CSII Mode
3	TruBass Mode
4	TruBass Base Control
5	Focus Mode
6	Focus Control
7	Mono Input Select
8	Sample Rate
9	Rear Space Gain
10	4 Ch. Stereo Mode
11	Delay
12	Master Volume
13	Input Trimmer
14	Left Volume
15	Right Volume
16	Left Volume
17	Center Volume
18	SL Volume
19	SR Volume
20	SubWoofer Volume
21	System Status
22	TruBass Base Control SW
23	TruBass Base Control SL / SR
24	Focus Control L / R
25	Focus Control SL / SR
26	NOP

**Notes :** In respect to detail command information, request New Japan Radio Co., Ltd. and permission of a licenser (SRS Labs. Inc.) is required.

## ■ License Information

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