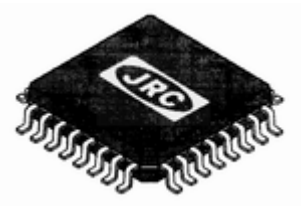
Digital Signal Processor for TV

■Package



NJU26101FR1

■ General Description

The NJU26101 is a digital signal processor that provides the function of AGC, 3D Sound, Sound Enhancement, Tone Control, and Digital Volume.

The NJU26101 is suitable for audio products such as TV, CD radio-cassette, speakers system, and others.

■ FEATURES

- Software

- 3D sound : eala(NJRC Original Surround), simulated stereo
  SRS 3D Stereo, SRS 3D Mono, SRS TruSurround
  BBE ViVA, BBE ViVA+
- Sound Enhancement: : SRS TruBass
  BBE, BBE Mach3Bass
- AGC
- Tone Control
- Master Volume with Smooth control
- WatchDog Clock Output

- Hardware

- 24bit Fixed-point Digital Signal Processing
- Maximum System Clock Frequency : 38MHz Max.
- Digital Audio Interface : 2 Input ports / 1 Output port
- Digital Audio Format : I^2S 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^2C 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

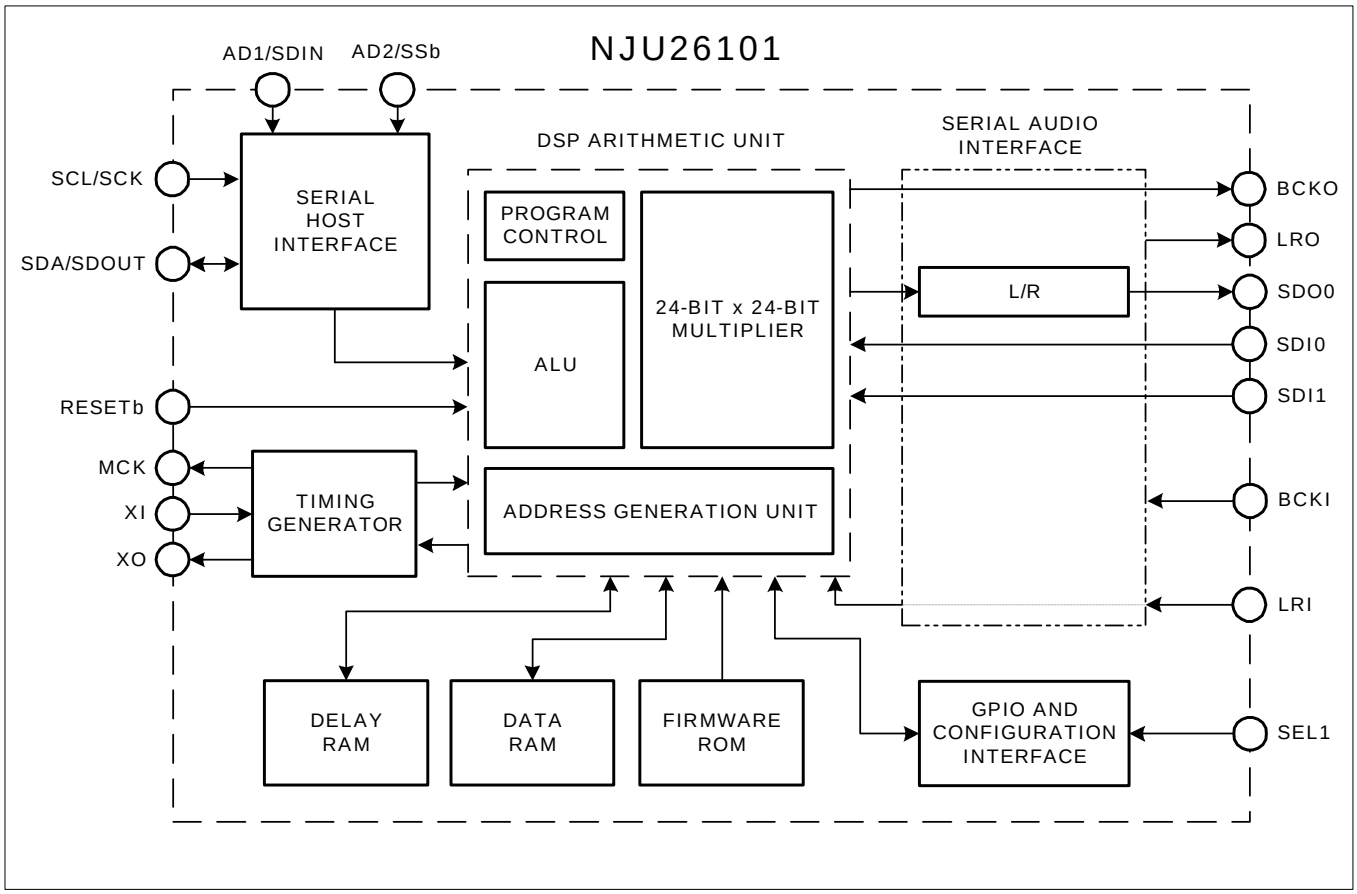


Fig. 1 NJU26101 Block Diagram

■ DSP Block Diagram

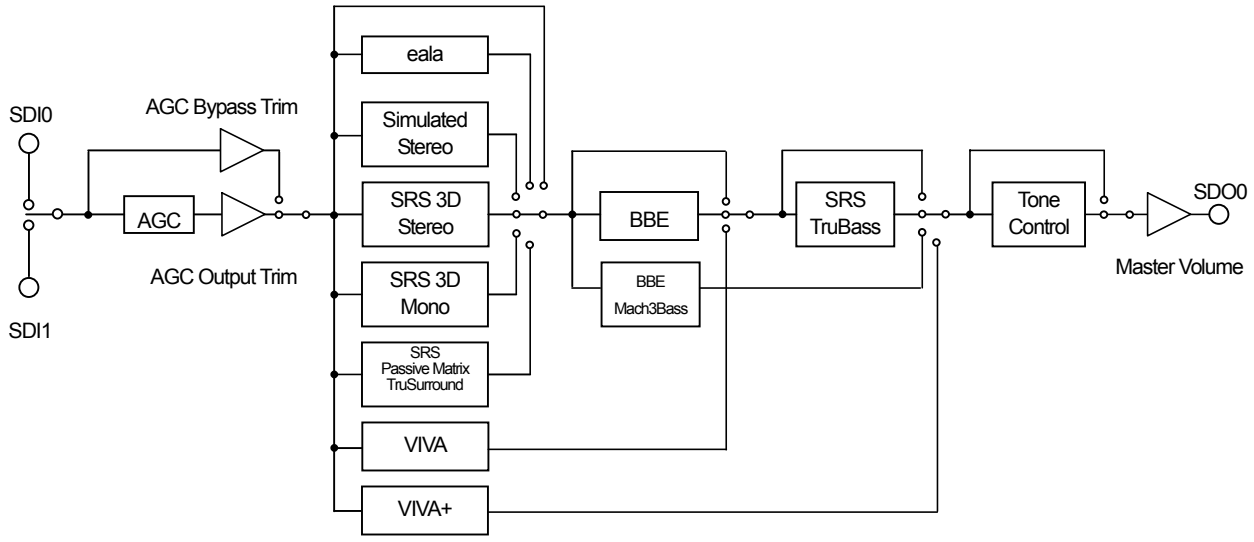


Fig. 2 NJU26101 Function Diagram

■ Pin Configuration

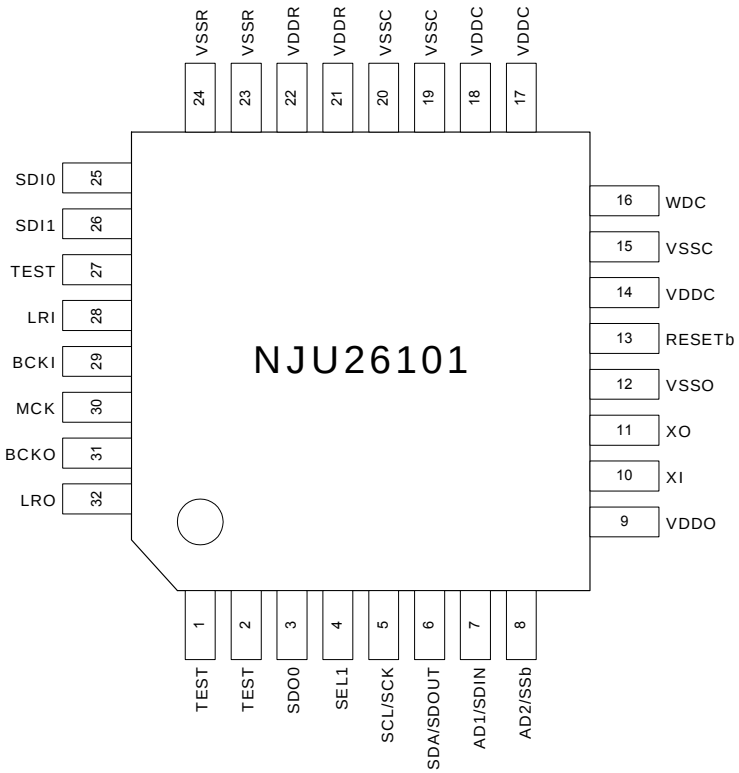


Fig. 3 NJU26101 Pin Configuration

■ Pin Description

Table 1 Pin Description

No.	Symbol	I/O	Description
1 2	TEST	O	Open
3	SDO0	O	Audio Data Output L/R
4	SEL1 *1	I	Select I^2C or Serial bus
5	SCL/SCK	I	I^2C Clock / Serial Clock
6	SDA/SDOUT	I/O	I^2C I/O / Serial Output
7	AD1/SDIN	I	I^2C Address / Serial Input
8	AD2/SSb	I	I^2C 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 18	VDDC	--	Core Power Supply +2.5V
19 20	VSSC	--	Core GND
21 22	VDDR	--	I/O Power Supply +2.5V
23 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 NJU26101 audio interface provides industry standard serial data formats of I^2S, MSB-first left-justified or MSB-first right-justified. The NJU26101 audio interface provides two data inputs, SDI0, SDI1 and a data output, SDO0 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

■ Host Interface

The NJU26101 can be controlled via Serial Host Interface (SHI) using either of two serial bus format : 4-Wire serial bus or I^2C 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^2C bus
		"High"	4-Wire serial bus

Table 5 Serial Host Interface Pin Description

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

Note : SDA /SDOUT pin is a bi-directional open drain.
SDA /SDOUT output is normal CMOS output in case of 4-Wire Serial bus mode and SSb="Low".
SDA /SDOUT output is Hi-Z state in case of 4-Wire Serial bus mode and SSb="High". This pin requires a pull-up resister in both 4-Wire serial and I^2C bus mode.

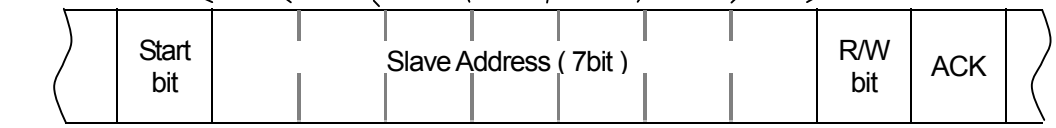
■ I²C bus

When the NJU26101 is configured for I²C bus communication during the Reset initialization sequence. I²C 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 NJU26101. An address can be arbitrarily set up by the AD1 and AD2 pins. The I²C address of AD1/AD2 is decided by connection of AD1/AD2 pins.

Table 6 I²C bus SLAVE Address

bit7	bit6	bit5	bit4	bit3	AD2 bit2	AD1 bit1	R/W bit0
0	0	1	1	1	0	0	R/W
0	0	1	1	1	0	1	
0	0	1	1	1	1	0	
0	0	1	1	1	1	1	



* SLAVE address is 0 when AD1/2 is “Low”. SLAVE address is 1 when AD1/2 is “High”.

Note : In case of the NJU26101, only single-byte transmission is available. The serial host interface supports “Standard-Mode (100kbps)” I²C 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.

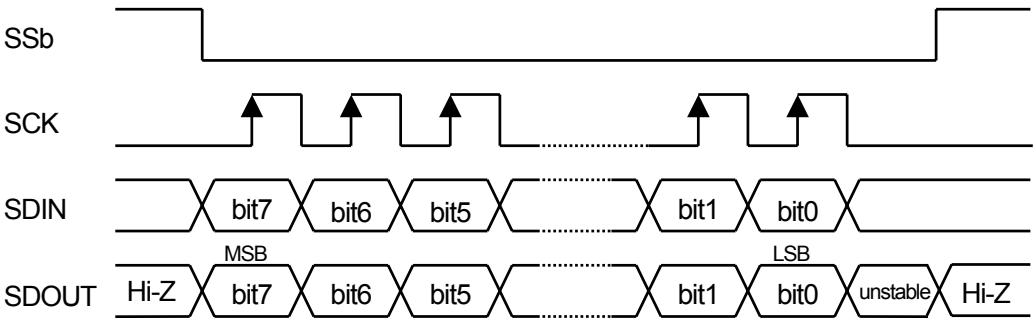


Fig. 4 4-Wire Serial Interface Timing

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 NJU26101 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	276ms
44.1KHz	200ms
48 KHz	184ms

The NJU26101 generates a clock pulse through the WDC terminal after resetting the NJU26101. The WDC clock is useful to check the status of the NJU26101 operation. For example, a microcomputer monitors the WDC clock and checks the status of the NJU26101. When the WDC clock pulse is lost or not normal clock cycle, the NJU26101 does not operate correctly. Then reset the NJU26101 and set up the NJU26101 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.

■ NJU26101 Command Table

Table 8 NJU26101 Command

No.	Command
1	System State
2	Version No.
3	Input Select / Fs Select
4	Input mono mode / Smooth Control
5	Tone Control (Bass @100Hz)
6	Tone Control (Treble @10KHz)
7	Channel Balance
8	Firmware Mode Select
9	AGC Ratio / Boost
10	AGC Threshold Level
11	AGC Output Trim
12	AGC Attack Time / Release Time
13	AGC Noise Compressor Threshold Level
14	AGC Bypass Trim
15	Eala Surround Gain
16	SRS 3D Stereo Space / Center
17	BBE VIVA / VIVA+ Surround Gain
18	BBE Counter / BBE Process (BBE I)
19	BBE Level / BBE HF Adjust (BBE III)
20	BBE Mach3Bass fo / Q
21	BBE Mach3Bass Gain
22	SRS TruBass Speaker Size
23	SRS TruBass Bass / Punch
24	Master Volume
25	Master Volume Boost / Dither
26	NOP

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

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