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# YAMAHA® LSI

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## YSS906

ASR2P



Analog Surround

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### ■ INTRODUCTION

YSS906 is an LSI for processing signals that uses Yamaha's original wide surround technology, "YMERISION™", and the tone control/loudness circuit that is built-in the device.

This LSI has the following features.

1. In addition to normal stereophonic input signal processing function, this LSI uses the pseudo-stereophonic sound processing function to give listeners a feeling of extended sound field.
2. Offers the wide surround effect by using "YMERISION™" technology.
3. Use of tone control/loudness function can emphasize specific tones.

When reproducing music in compact audio appliances such as the arcade game or other game applications, YSS906 is particularly suited to meeting the need of adding a feeling of extended sound field or emphasizing specific bass or treble tones. This LSI does not require use of the microcomputer, A/D and D/A functions and memories because it uses analog signals without converting them to digital signal.

### ■ FEATURES

- Wide Surround : Surround function through the use of amplitude/phase conversion circuit
- Tone control : Bass (100 Hz +/- 10 dB), Treble (10 kHz +/- 10 dB) (recommended )
- Loudness : -30dB (recommended)  
Note: Either the tone control or loudness can be selected.
- Other features : Stereophonic/Monaural enabling/disabling switch  
Wide surround enabling/disabling switch  
Wide control of wide surround  
Tone control enabling/disabling switch  
Bass/Treble tone control  
Every control is made through the voltage at pins.
- Operating voltage: Wide operating voltage from 3.0 to 5.5 V
- Package : 20SKDIP (YSS906-N)
- Process : Silicon gate CMOS process

YMERISION™ is Yamaha's registered trade mark.

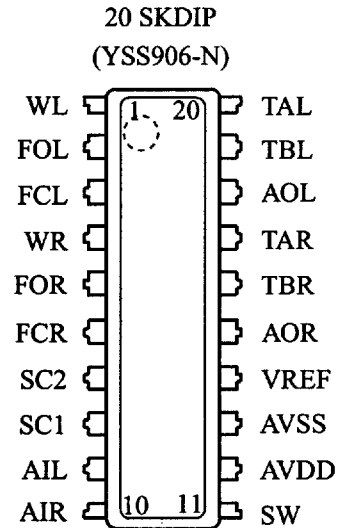
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YAMAHA CORPORATION

YSS906CATALOG
CATALOG No.:LSI-4SS906A2
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## ■ PIN CONFIGURATION



## ■ PIN FUNCTION

Pin No.	I/O	Pin name	Function
1	I	WL	3D Lch Wide Input
2	O	FOL	3D Lch Filter Output
3	O	FCL	3D Lch Capacitor
4	I	WR	3D Rch Wide Input
5	O	FOR	3D Rch Filter Output
6	O	FCR	3D Rch Capacitor
7	O	SC2	Pseudo Stereo Filter Capacitor 2
8	O	SC1	Pseudo Stereo Filter Capacitor 1
9	I	AIL	Lch Input
10	I	AIR	Rch Input
11	I	SW	Pseudo Stereo, 3D and Tone Control ON/OFF Input
12		AVDD	Power Supply
13		AVSS	Ground
14	O	VREF	Voltage Reference
15	O	AOR	Rch Output
16	I	TBR	Rch Tone Control(B)
17	O	TAR	Rch Tone Control(A)
18	O	AOL	Lch Output
19	I	TBL	Lch Tone Control(B)
20	O	TAL	Lch Tone Control(A)

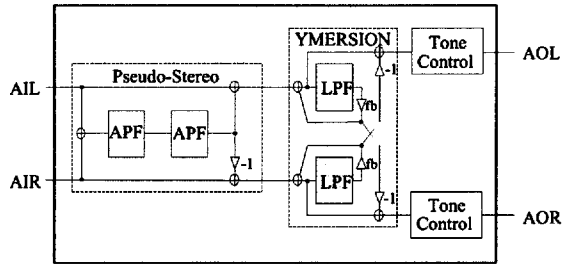
## ■ DESCRIPTION OF PIN FUNCTION

Pin name (Pin No.)	Function
1. WL (1) WR (4)	Left channel Wide Surround input Right channel Wide Surround input The Wide Surround effect is obtained by inputting the signal from FOL(No.2) and FOR(No.5) to WL and WR respectively after adjusting their output levels.
2. FOL (2) FOR (5)	Left channel filter output      Refer to the above section. Right channel filter output
3. FCL (3) FCR (6)	Left channel filter capacitor connection Right channel filter capacitor connection A capacitor of 0.018 $\mu$ F is to be connected between each of FCL to Ground and FCR to Ground.
4. SC2 (7) SC1 (8)	pseudo-stereophonic filter capacitor connection pseudo-stereophonic filter capacitor connection A capacitor of 0.047 $\mu$ F is to be connected between SC1 and Ground. A capacitor of 0.0082 $\mu$ F is to be connected between SC2 and Ground.
5. AIL(9) AIR(10)	Left channel analog signal input Right channel analog signal input Left channel signal is to be inputted to AIL through a capacitor of 10 $\mu$ F. Right channel signal is to be inputted to AIR through a capacitor of 10 $\mu$ F.
6. SW(11)	Stereophonic/monaural selection, Wide Surround and Tone Control A lead of the three resistors, 50 k $\Omega$ , 100 k $\Omega$ and 200 k $\Omega$ , is to be connected to this pin, and the other end of the parts is connected to either AVDD or AVSS to ON/OFF the function. When 50 k $\Omega$ , 100 k $\Omega$ and/or 200 k $\Omega$ resistor is connected to AVDD, stereophonic / monaural selection, Wide Surround and/or Tone Control is enabled respectively, or when connected to AVSS, these functions are disabled accordingly.
7. AVDD(12)	Power supply This pin applies voltage between +3.0 V and +5.5 V DC inclusive with respect to the potential of AVSS. A capacitor of 10 $\mu$ F is to be connected between this pin and AVSS(13).
8. AVSS(13)	Ground      Provides a reference for AVDD and analog signal.
9. VREF(14)	Operating voltage Outputs a voltage that is equal to the difference between the potentials at AVDD and AVSS divided by 2, or (AVDD - AVSS)/2, that is used as a reference voltage for the internal circuit of this LSI. A capacitor of 10 $\mu$ F is to be connected between this pin and AVSS(13).
10. AOR(15) AOL(18)	Right channel analog signal output Left channel analog signal output A capacitor is to be connected to AOR and AOL pins before outputting analog signals.
11. TBR(16) and TAR(17) TBL(19) and TAL(20)	Right channel tone control input Left channel tone control input Right channel tone control circuit is formed by connecting AOR(15), TBR(16) and TAR(17) pins through a circuit that includes capacitors and resistors. Left channel tone control circuit is formed by connecting AOL(18), TBL(19) and TAL(20) pins through a circuit that includes capacitors and resistors.

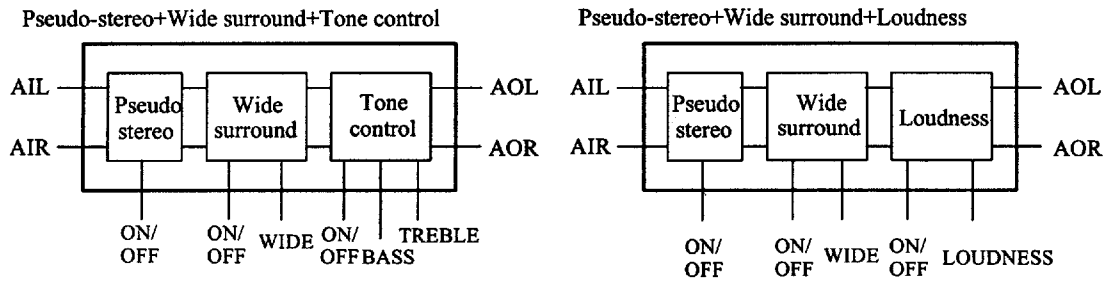
(Refer to the example of application presented in the next page.)

## ■ BLOCK DIAGRAM

Flow diagram



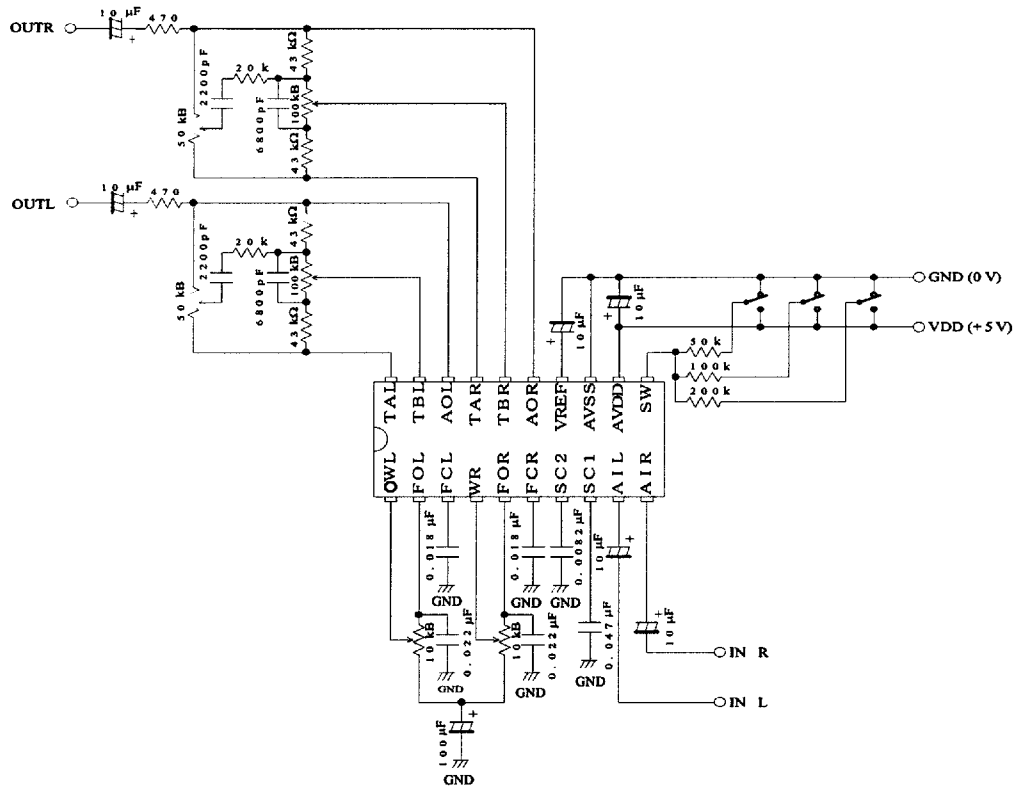
Function diagram



## ■ EXAMPLE OF APPLICATION

This section presents an example of application of YSS906 that makes Wide Surround and tone controls through variable resistors.

A recommended application of YSS906 (ASR2P)

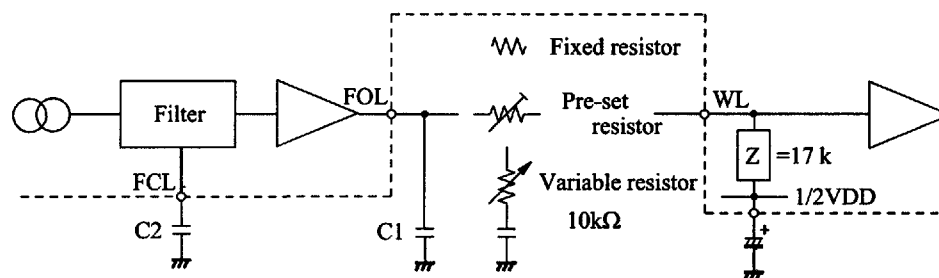


YSS906 can be made different characteristics with external components at various values.

## ■ REFERENTIAL INFORMATION FOR CREATING SOUNDS

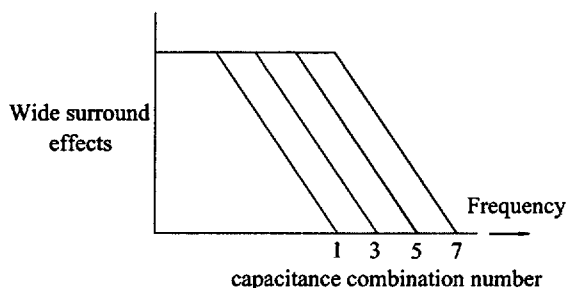
### 1. Wide Surround effect

The characteristic of Wide Surround is determined by two types of capacitors, C1 and C2 (standard capacitors of 0.022  $\mu\text{F}$  and 0.018  $\mu\text{F}$ ) that decide the response of the filter and a resistor (fixed or variable) that decides the amount of crosstalk. An equivalent circuit of "Wide Surround" function is as shown below.



The resistance determines the attenuation in amplitude of the signal outputted from FOL before it is inputted to WL. Smaller resistance make the effect of Wide Surround higher. The resistance of "0(zero)" makes the amount of the crosstalk equal to the one obtained at maximum value of the variable resistor. The amount of the crosstalk can be determined based on the specific taste of the customer. However, higher crosstalk makes the amplitude of the out-phase component larger, thus the crosstalk higher than a certain level may make the sound unpleasant. It is recommended to set the crosstalk level in the range from -3 dB to -10 dB with respect to its maximum value. Two types of capacitors, C1 and C2 (see above diagram) determine the cutoff frequency of the filter. The cutoff frequency is decreased by reducing the capacitance while maintaining the ratio C1/C2 nearly constant. Higher cutoff frequency of the filter makes the sound brighter. Recommended combinations of the capacitors, C1 and C2 are as follows.

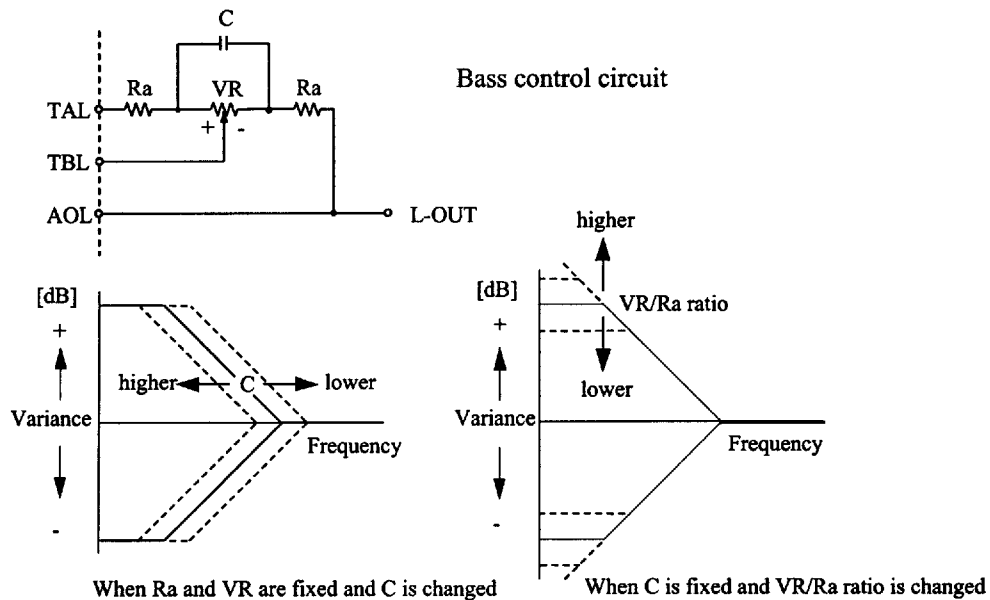
1. 0.022  $\mu\text{F}$  and 0.018  $\mu\text{F}$  (standard)
2. 0.018  $\mu\text{F}$  and 0.015  $\mu\text{F}$
3. 0.015  $\mu\text{F}$  and 0.012  $\mu\text{F}$
4. 0.012  $\mu\text{F}$  and 0.010  $\mu\text{F}$
5. 0.010  $\mu\text{F}$  and 8200 pF
6. 8200 pF and 6800 pF
7. 6800 pF and 5600 pF (lower limit)



Use any of the above combinations so that a favorite tone is obtained.

## 2. Determination of capacitance and resistance for Tone Control function

Tone level change vs. frequency characteristics are as follows when the resistance and capacitance are used as parameters.



$R_a$  is the resistor shown in the "Bass control circuit diagram"

The range of level change is recommended to be +/-10 dB as a standard, and to be +/-15 dB or less.

## 3. Designing boards and selecting components

Designing the boards that include YSS906 requires no special care. Selection of components to be used with the device can be made in the same way as normal audio circuits. Use of ceramic capacitors is not recommended for pseudo-stereo, Wide Surround and tone control because of their thermal characteristics. Polyester film (Mylar) capacitors are recommended for this purpose.

## 4. Enabling/disabling functions through SW(11)

This LSI uses the built-in seven comparators to determine the voltage created by the combined resistance of 50 k $\Omega$ , 100 k $\Omega$  and 200 k $\Omega$  resistors, and enables or disables the functions based on the result of the comparison. The following table presents the voltages determined by the comparators and functions enabled or disabled by the voltages.

Resistors, and pins to be connected to			Voltage at SW pin	Pseudo -stereo	Wide Surround	Tone control
50k $\Omega$	100k $\Omega$	200k $\Omega$				
VDD	VDD	VDD	VDD	ON	ON	ON
VDD	VDD	VSS	6/7 VDD	ON	ON	OFF
VDD	VSS	VDD	5/7 VDD	ON	OFF	ON
VDD	VSS	VSS	4/7 VDD	ON	OFF	OFF
VSS	VDD	VDD	3/7 VDD	OFF	ON	ON
VSS	VDD	VSS	2/7 VDD	OFF	ON	OFF
VSS	VSS	VDD	1/7 VDD	OFF	OFF	ON
VSS	VSS	VSS	VSS	OFF	OFF	OFF

ON: Enabled  
OFF: Disabled

Be sure to connect the recommended 50 k $\Omega$ , 100 k $\Omega$  and 200 k $\Omega$  resistors to VDD or VSS according to the combination of the functions to be used, and apply an appropriate voltage to SW(11) pin accordingly by referring to the above table. (The combination of the functions to be used cannot be selected normally if any of the resistors is left unconnected. Connect every resistor as specified by the table even if one or more of the functions is not used.) The switch for selecting a voltage on SW pin must be operated so that the specified voltage can be attained within 30  $\mu$ sec.

## 5. Inputting monaural signals

When obtaining the pseudo-stereophonic effect by inputting monaural signals, supply the same signal to AIL and AIR pins, and connect 50 k $\Omega$  resistor to VDD so that the pseudo-stereo function is enabled.

## 6. Current

This LSI takes current of 15 mA when VDD = 5 V. Since current generally changes in proportion to voltage, the current becomes 9 mA when this LSI is used with VDD = 3 V.

### \*Note:

Enabling pseudo-stereo, Wide Surround and/or Tone Control functions increases the gain of internal circuit so that the output signal are clipped easily. Therefore, the level of the input signal should be determined properly to avoid the clipping of the signal. The rise of the gain of the internal circuit should increase the level of outputted noise so that apparent S/N ratio is reduced. This phenomena is not abnormal.

(The S/N ratio becomes approximately 82 dB when the pseudo-stereo is enabled, Wide Surround is set to 50 %, and tone control is +3 dB for treble and +6 dB for bass.)

## ■ ELECTRICAL CHARACTERISTICS

### 1. Absolute Maximum Ratings

Item	Symbol	min.	max.	unit
Power supply voltage	AVDD	AVSS-0.5	AVSS+7.0	V
Input voltage	Vin	AVSS-0.5	AVDD+0.5	V
Output voltage	Vout	AVSS-0.3	AVDD+0.3	V
Storage temperature	Tstg	-50	125	°C

### 2. Recommended Operating Conditions

Item	Symbol	min.	typ.	max.	unit
Power supply voltage	AVDD	3.0	5.0	5.5	V
Operating temperature	Top	-40	25	85	°C

### 3. Analog characteristics (Conditions : Ta= 25 °C, VDD= 5.0 V)

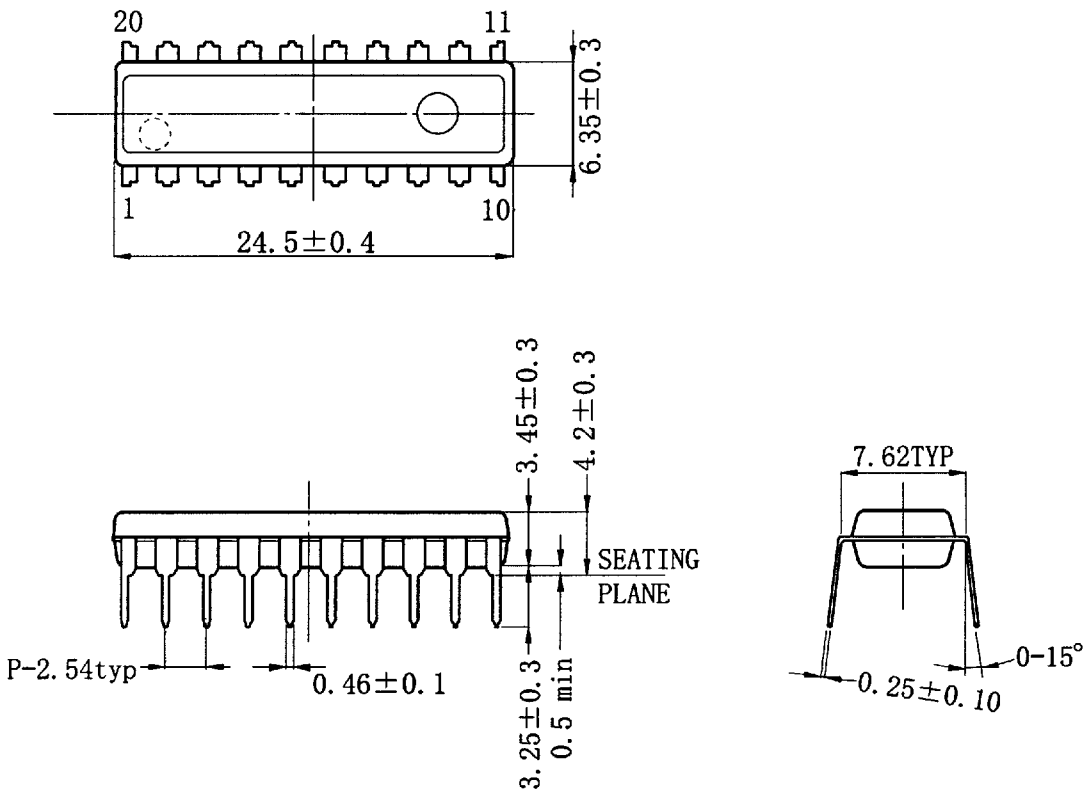
Item	Condition	min.	typ.	max.	unit
Current	VDD=5V	-	15	-	mA
Analog max. input voltage	VDD=5V	-	-	1.0	Vrms
S/N ratio	IHF-A	-	95	-	dB
Distortion factor	Input : 1 Vrms Pseudo-stereo, Wide Surround, Tone Control are disabled.	-	0.0025	-	%
Gain variation		-	-	0.5	dB
Frequency response	10Hz - 50 kHz	-3.0	-	0.5	dB
Input impedance		-	30	-	kΩ
Input capacitance		-	-	15	pF
Center voltage		-	2.5	-	V



## EXTERNAL DIMENSIONS

YSS906-N (SKDIP)

U-PK20NP5-05-1



Plastic body dimensions do not include burr of resin.  
UNIT: mm