AN7397K, AN7397S

Spatializer IC for I²C bus

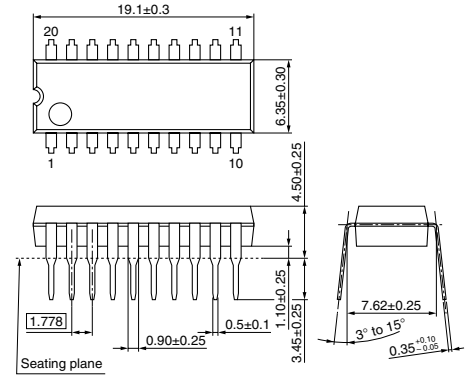
■ Overview

Spatializer Audio Processor is a signal processing technology, monopolized by Desper Products, Inc., that was developed for commercial electronics and multimedia markets, and is based on Desper's "PRO Spatializer" that is a 3-D audio production system for business use. The AN7397K, AN7397S utilizes the innovative technology adopted in that system, and provides sound enhancement effect and sound expansion with the conventional 2-speaker stereo system.

■ Features

- Provides deep 3-D sound with conventional 2-speaker system.
- The audio signal recorded through this IC can be reproduced with usual stereo system.
- Performs optimal processing to the sound source recorded with surround-effect so as not to give double effects.
- Sound localization can be varied.
- A pseudo stereo effect for the monaural audio signal is achieved.
- Positions and moves each sound source on 270° arc in real time.
- An on-chip serial control bus (i.e., I²C) to vary space-effect and change modes.

AN7397K Unit: mm



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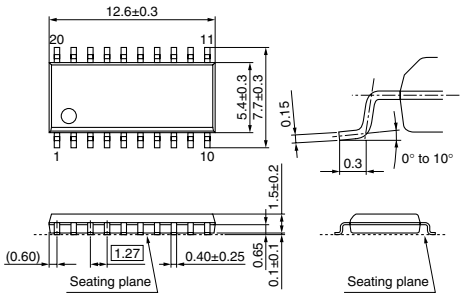
AN7397S Unit: mm



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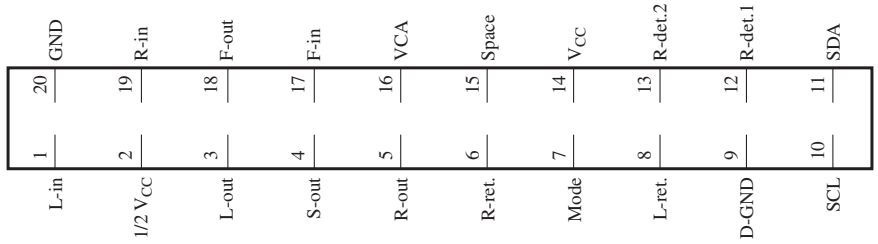
■ Applications

- Televisions, videos, audio equipment, DVDs, personal computers, and game machines

■ Pin Assignment



Note) Spatializer® and the device trademark of circle-in-square ● are owned by Desper Products Inc..
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■ Pin Descriptions

Pin No.	Description	Pin No.	Description
1	L-in	11	SDA
2	1/2 V_{CC}	12	R-det.1
3	L-out	13	R-det.2
4	S-out	14	V_{CC}
5	R-out	15	Space
6	R-ret.	16	VCA
7	Mode	17	F-in
8	L-ret.	18	F-out
9	D-GND	19	R-in
10	SCL	20	GND

■ Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Supply voltage	V_{CC}	7.0	V
Supply current	I_{CC}	100	mA
Power dissipation *2	P_D	230	mW
Operating ambient temperature *1	T_{opr}	–25 to +75	°C
Storage temperature *1	T_{stg}	–55 to +125	°C

Note) ∗1: Except for the operating ambient temperature and storage temperature, all ratings are for T_a = 25°C.
∗2: The power dissipation shown is the value for T_a = 75°C

■ Recommended Operating Range

Parameter	Symbol	Range	Unit
Supply voltage	V_{CC}	4.5 to 6.8	V

■ Electrical Characteristics at V_{CC} = 5 V, f = 1 kHz, T_a = 25°C ± 2°C

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Total circuit current	I_{TOTAL}	V_{IN} = 0 mV	18	25	32	mA
Maximum output voltage *3	V_{OUT1}	L-in, R-in THD = 1%	0.8	1.0	—	V[rms]
Output noise voltage 1 *1, 4	V_{NO1}	L-out, R-out R_G = 4.7 kΩ	—	20	50	µV[rms]
Voltage gain 1 *3	G_{V1}	L-out, R-out V_{IN} = 400 mV	–2	0	2	dB
Total harmonic distortion 1 *2, 3	THD_1	L-out, R-out V_{IN} = 400 mV	—	0.05	0.2	%
Output noise voltage 2 *1, 5	V_{NO2}	S-out R_G = 4.7 kΩ	—	80	200	µV[rms]
Voltage gain 2 *6	G_{V2}	S-out V_{IN} = 60 mV	343	450	685	mV[rms]
Total harmonic distortion 2 *2, 6	THD_2	S-out V_{IN} = 60 mV	—	0.15	0.3	%
I²C interface						
Sink current at ACK	I_{ACK}	Maximum value of sink current of pin 11 at ACK	2.0	10	—	mA
SCL/SDA signal input high- level	V_{IHI}		2.5	—	3.5	V
SCL/SDA signal input low- level	V_{ILO}		0	—	0.5	V
Input-enable maximum frequency	f_{Imax}		—	—	100	Kbit/s

Note) *1: In measuring, the filter with A-characteristic curve is used.

*2: In measuring, the filter for the range of 15 Hz to 30 kHz (12 dB/OCT) is used.

*3: Mode: ST, L-in + R-in, VCA (I²C data: BFH)

*4: Mode: ST, VCA (I²C data: BFH)

*5: Mode: ST, VCA (I²C data: 80 H)

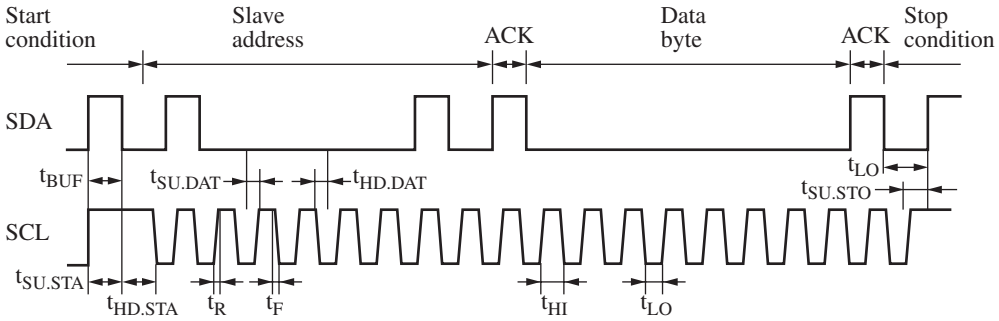
*6: Mode: ST, VCA (I²C data: 80 H) for either L-in or R-in

• Design reference data

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
I²C interface						
Bus free before start	t_{BUF}		4.0	—	—	µs
Start condition set-up time	$t_{SU, STA}$		4.0	—	—	µs
Start condition hold time	$t_{HD, STA}$		4.0	—	—	µs
SCL/SDA low period	t_{LO}		4.0	—	—	µs
SCL high period	t_{HI}		4.0	—	—	µs
SCL/SDA rise time	t_R		—	—	1.0	µs
SCL/SDA fall time	t_F		—	—	0.35	µs
Data set-up time (Write)	$t_{SU, DAT}$		0.25	—	—	µs
Data hold time (Write)	$t_{HD, DAT}$		0	—	—	µs
Acknowledge set-up time	$t_{SU, ACK}$		—	—	3.5	µs
Acknowledge hold time	$t_{HD, ACK}$		0	—	—	µs
Stop condition set-up time	$t_{SU, STO}$		4.0	—	—	µs
DAC						
6-bit DAC DNLE	L_6	1 LSB = (Data (max.) – Data (00))/63	0.1	1.0	1.9	$\frac{LSB}{step}$

■ Electrical Characteristics at V_{CC} = 5 V, f = 1 kHz, T_a = 25°C ± 2°C (continued)

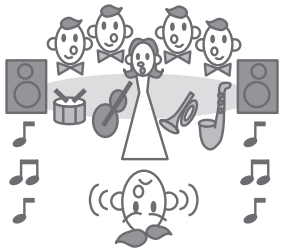
• DAC timing chart



■ Conceptual Explanation of Spatializer Operation

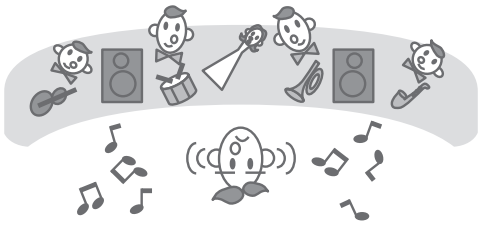
• Normal stereo

All sounds are heard from only between two speakers, right and left.



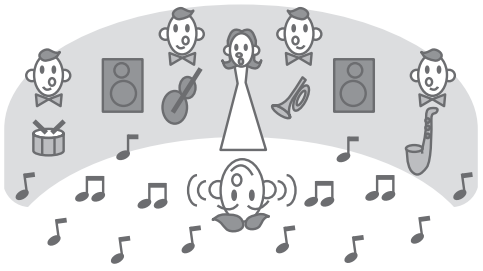
• Conventional surround

The sound expands toward the outside of the speaker system, but the sound position comes apart mostly in the conventional systems.

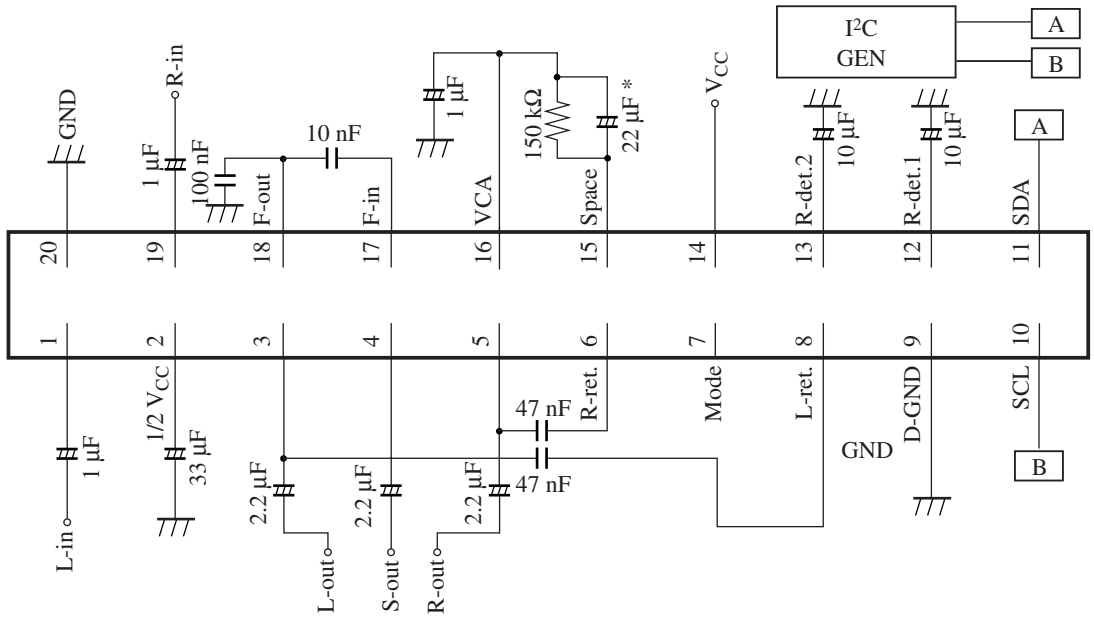


• Spatializer

The sound expands toward the outside of the two speakers, and yet their positions are stable and an expanded, deep sound are gotten.



■ Application Circuit Example (Basic circuitry)



Note) When switching noise occurs at mode switching, insert a capacitor between pin 7 and GND.

*: For the capacitor of 22 µF, use that of a non-polar type.

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