

TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT SILICON MONOLITHIC

# TA2009F, TA2009P

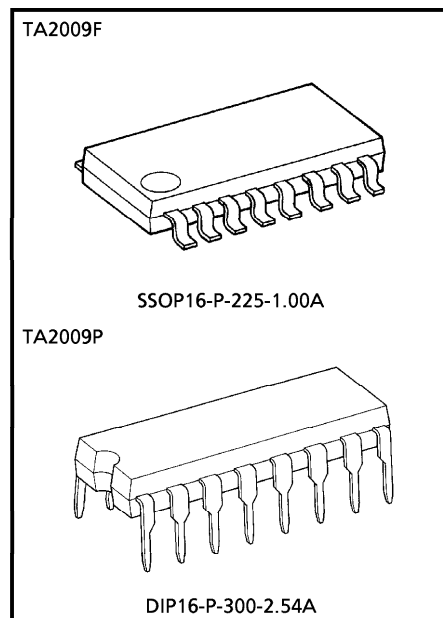
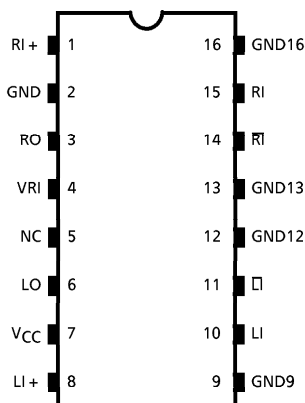
## FILTER IC FOR $\Sigma$ - $\Delta$ MODULATION SYSTEM DA CONVERTER

TA2009F, TA2009P are an analog filter IC for  $\Sigma$ - $\Delta$  modulation system DA converter.  
 Using the TA2009F, TA2009P in combination the TC9237BF, TC9237BN (the  $\Sigma$ - $\Delta$  modulation system DA converter with a built-in digital filter), it is possible to construct a DA conversion system with less external parts.

### FEATURES

- Built-in CR for LPFs and output (differential) amplifiers for the left and right channel.
- Single power supply operation.
- Noise distortion factor and S/N ratio are as follows (when operating at +5V single power supply) :  
 Noise distortion factor : -93dB (Typ.)  
 S/N : 100dB (Typ.)

### PIN CONNECTION (Top view)



Weight  
 SSOP16-P-225-1.00A : 0.14g (Typ.)  
 DIP16-P-300-2.54A : 1.00g (Typ.)

980508EBA2

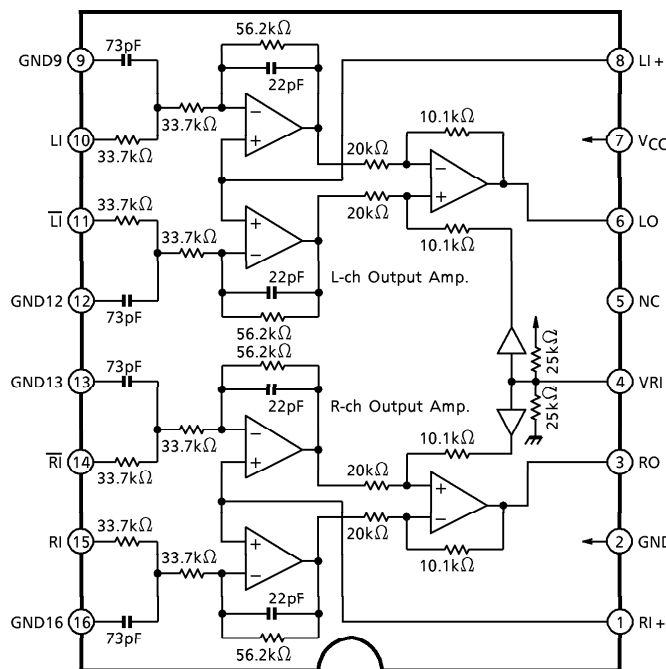
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BLOCK DIAGRAM



DESCRIPTION OF PIN FUNCTIONS

PIN No.	SYMBOL	I/O	FUNCTION & OPERATION	REMARKS
1	RI +	I	R channel operational amplifier forward input terminal. Connect to VRI.	—
2	GND	—	Ground terminal.	—
3	RO	O	R channel analog output terminal.	—
4	VRI	—	Reference voltage terminal. ( $V_{CC}/2$ )	See the block diagram
5	NC	—	Non-connecting terminal.	—
6	LO	O	L channel analog output terminal.	—
7	VCC	—	Supply voltage terminal.	—
8	LI +	I	L channel operational amplifier forward input terminal. Connect to VRI.	—
9	GND9	—	Ground terminal for L channel reverse input side filter.	—
10	LI	I	L channel forward input terminal.	Connect to LO of TC9237BF, TC9237BN
11	LI-bar	I	L channel reverse input terminal.	Connect to LO of TC9237BF, TC9237BN
12	GND12	—	Ground terminal for L channel forward input side filter.	—
13	GND13	—	Ground terminal for R channel forward input side filter.	—

PIN No.	SYMBOL	I/O	FUNCTION & OPERATION	REMARKS
14	$\bar{R}I$	I	R channel reverse input terminal.	Connect to RO of TC9237BF, TC9237BN
15	RI	I	R channel forward input terminal.	Connect to RO of TC9237BF, TC9237BN
16	GND16	—	Ground terminal for R channel reverse input side filter.	—

**MAXIMUM RATINGS** (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V <sub>CC</sub>	11	V
Power Dissipation	TA2009F	350 (*)	mW
	TA2009P	1388 (**)	
Operating Temperature	T <sub>opr</sub>	-35~85	°C
Storage Temperature	T <sub>stg</sub>	-55~150	°C

(\*) Reduce 2.8mW/°C at Ta = above 25°C.

(\*\*) Reduce 11.2mW/°C at Ta = above 25°C.

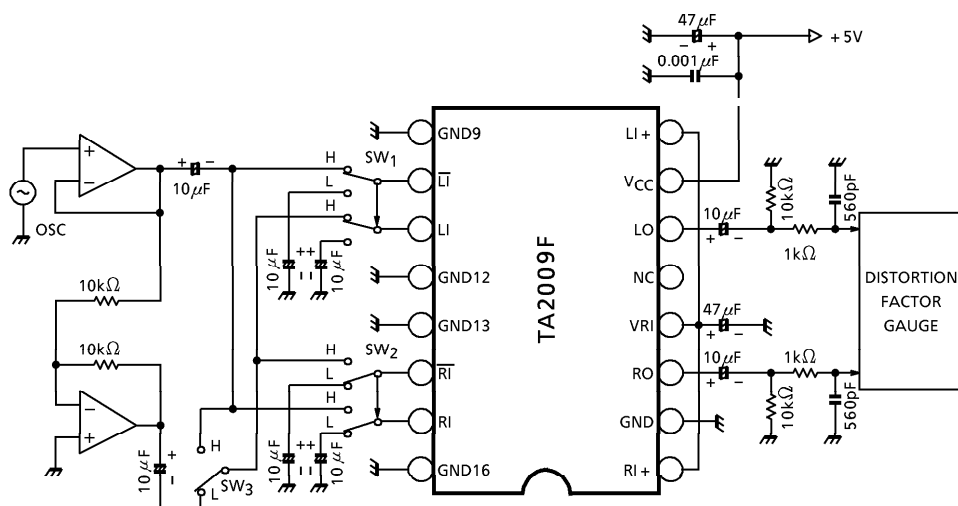
**ELECTRICAL CHARACTERISTICS** (Unless otherwise specified, V<sub>CC</sub> = 5V, Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Operating Supply Voltage	V <sub>CC</sub>	—	Ta = -35~85°C	4.5	5.0	10	V
Operating Supply Current	I <sub>CCQ</sub> (1)	—	At no signal	7.5	10.0	12.5	mA
	I <sub>CCQ</sub> (2)	—	At signal, V <sub>CC</sub> = 10V	8.2	11.0	13.8	
Reference Voltage	V <sub>RI</sub>	—	—	2.45	2.50	2.55	V
Noise Distortion Factor	THD (1)	1	1kHz, V <sub>O</sub> = 970mV <sub>rms</sub>	—	-93	-90	dB
	THD (2)		10kHz, V <sub>O</sub> = 970mV <sub>rms</sub>	—	-93	-90	
	THD (3)		1kHz, V <sub>O</sub> = 97mV <sub>rms</sub>	—	-78	-75	
Cross Talk	CT	1	1kHz, V <sub>O</sub> = 970mV <sub>rms</sub>	—	-100	-95	dB
Attenuation	ATT (1)	1	40kHz, V <sub>O</sub> = 10dBV <sub>rms</sub>	0.51	0.71	1.41	dB
	ATT (2)		80kHz, V <sub>O</sub> = 10dBV <sub>rms</sub>	1.50	2.70	4.50	
Max. Output Level	V <sub>omax</sub>	1	1kHz, THD = 1%	1.20	1.25	—	V <sub>rms</sub>
Differential Balance	G <sub>VB</sub>	1	1kHz, 1.1dBV <sub>rms</sub> In-phase input	—	—	-40	dB
LR Output Difference	G <sub>VD</sub>	1	1kHz, 1.1dBV <sub>rms</sub> Differential input	—	0	0.5	dB

(Note 1) When the TC9237BF, C9237BN and +5V single power supply are operated : Full scale = 970mV<sub>rms</sub> (Typ).

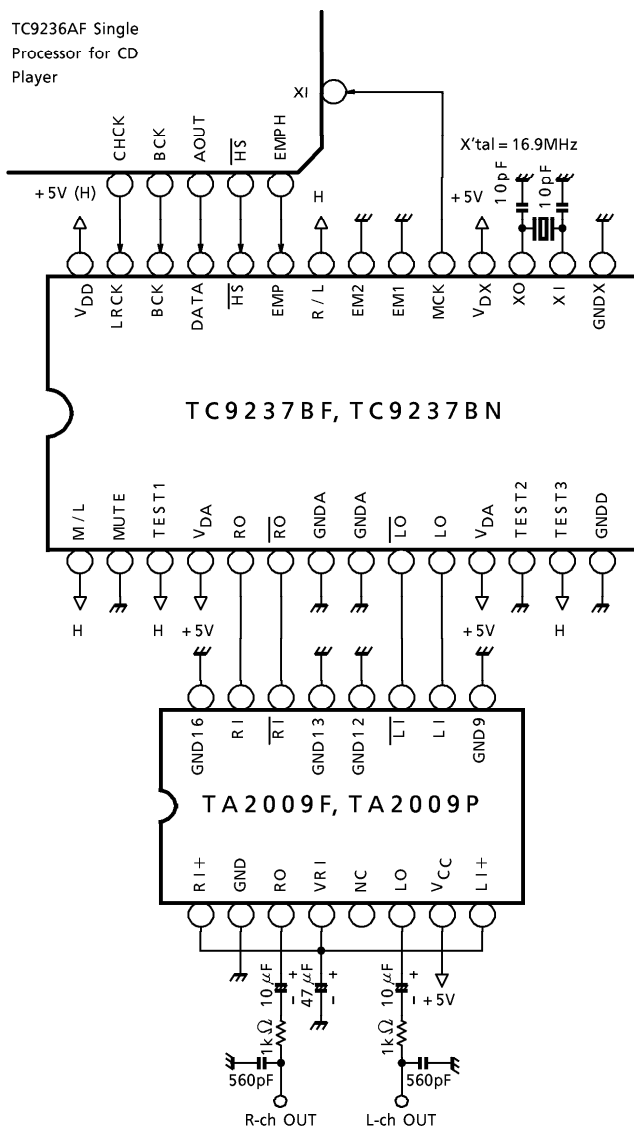
(Note 2) Measuring circuit-1 : indicates the measuring circuit.

TEST CIRCUIT-1



SW <sub>1</sub>	SW <sub>2</sub>	SW <sub>3</sub>	MEASURING ITEM
L	L	—	Operating supply voltage, Reference voltage
L	H	L	Cross talk (R→L)
H	L	L	Cross talk (L→R)
H	H	L	Noise distortion factor, Attenuation, Maximum output level, LR output difference
H	H	H	Difference balance

APPLICATION CIRCUIT EXAMPLE

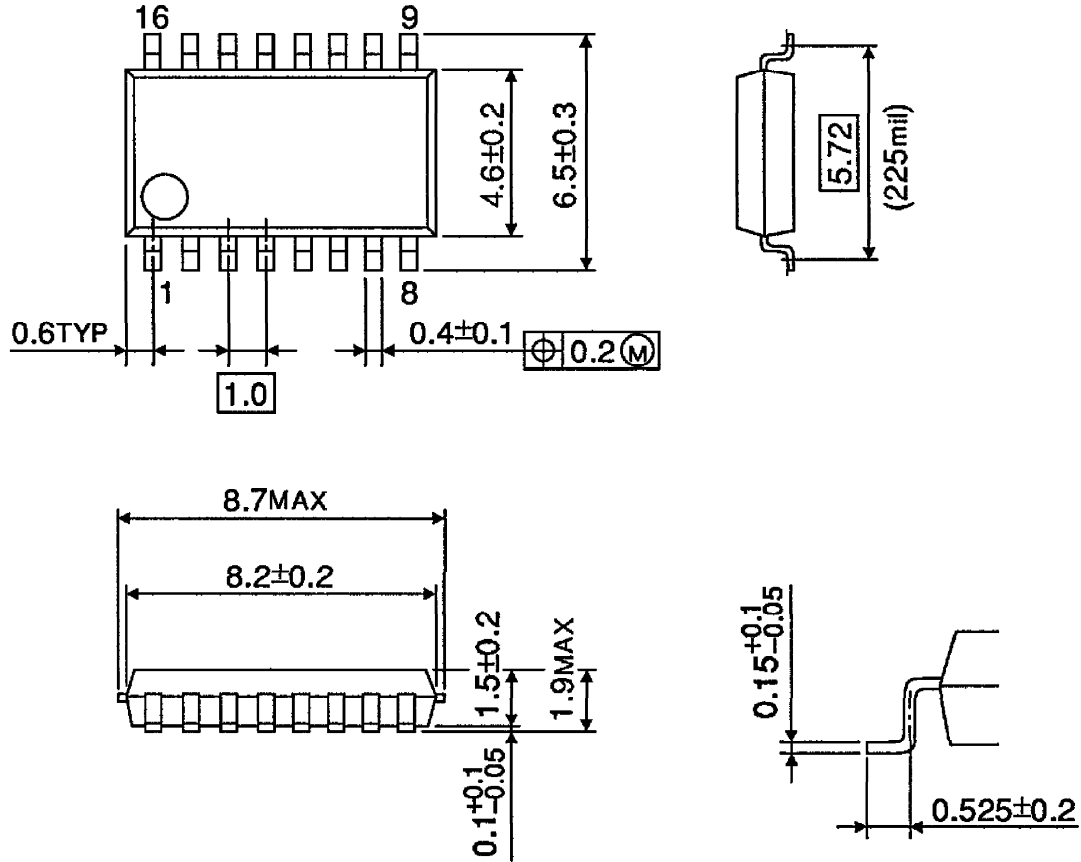


(Cautions)

- Quality of crystal oscillation waveform largely effects S/N ratio. Further, this is also true when system clock is input externally through the XI terminal of pin⑩.
- Suppress glitch of input signals (LRCK, BCK, DATA) as could as possible.
- The wiring between the TC9237BF, TC9237BN output and the analog filter amplifier input must be made the shortest
- The capacitor between V<sub>DA</sub> and GND<sub>A</sub> shall be connected as close to the pin as possible.

OUTLINE DRAWING  
SSOP16-P-225-1.00A

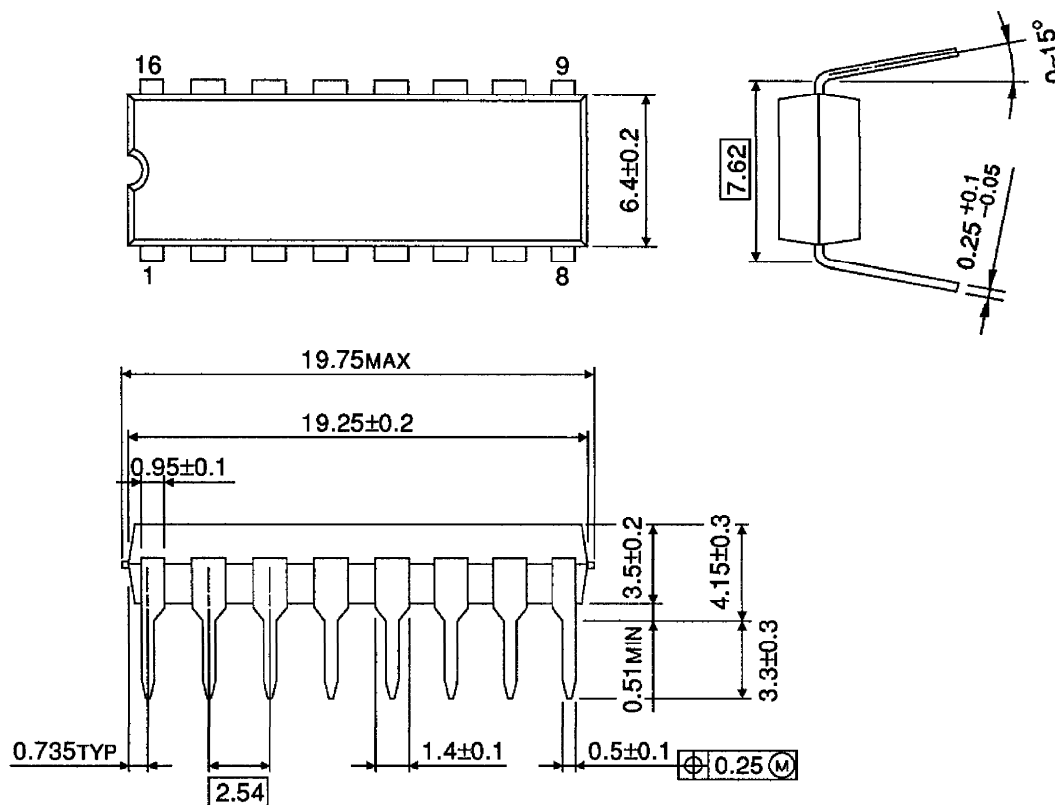
Unit : mm



Weight : 0.14g (Typ.)

OUTLINE DRAWING  
DIP16-P-300-2.54A

Unit : mm



Weight : 1.00g (Typ.)