

TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT SILICON MONOLITHIC

TA2009F, TA2009P

FILTER IC FOR Σ - Δ MODULATION SYSTEM DA CONVERTER

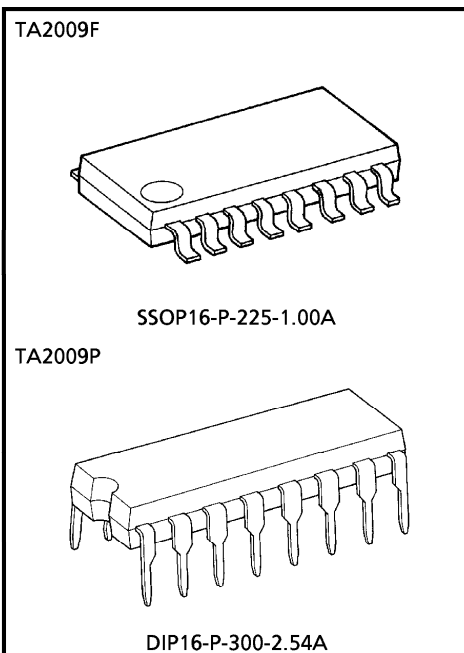
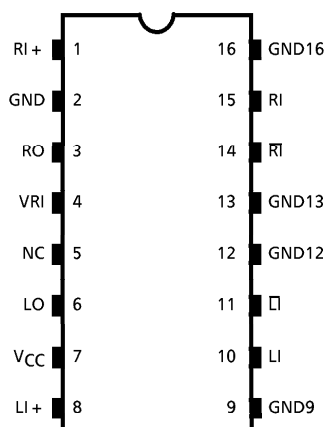
TA2009F, TA2009P are an analog filter IC for Σ - Δ modulation system DA converter.

Using the TA2009F, TA2009P in combination the TC9237BF, TC9237BN (the Σ - Δ 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)



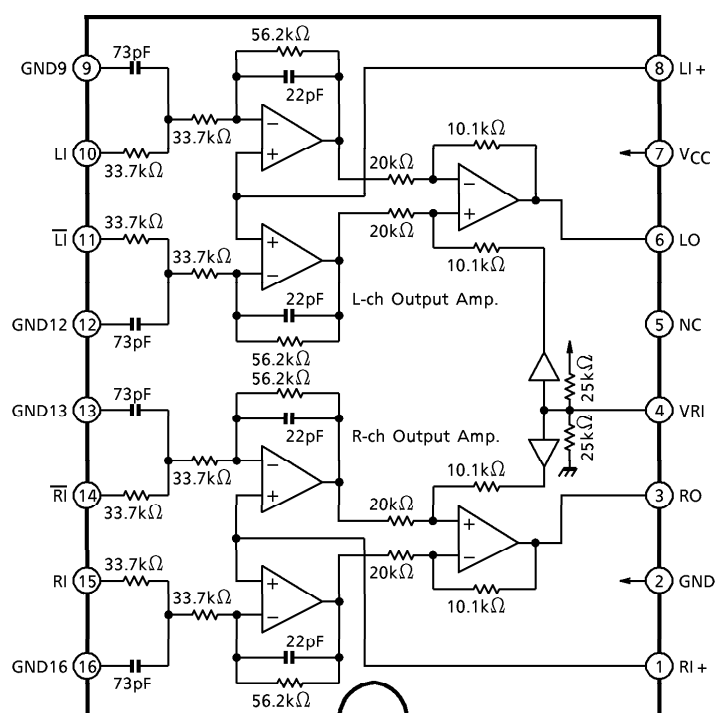
Weight

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

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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	$\overline{\text{LI}}$	I	L channel reverse input terminal.	Connect to $\overline{\text{LO}}$ 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	$\overline{\text{RI}}$	I	R channel reverse input terminal.	Connect to $\overline{\text{RO}}$ 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 _{CC}	11	V
Power Dissipation	TA2009F	350 (*)	mW
	TA2009P	1388 (**)	
Operating Temperature	T _{opr}	−35~85	°C
Storage Temperature	T _{stg}	−55~150	°C

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

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

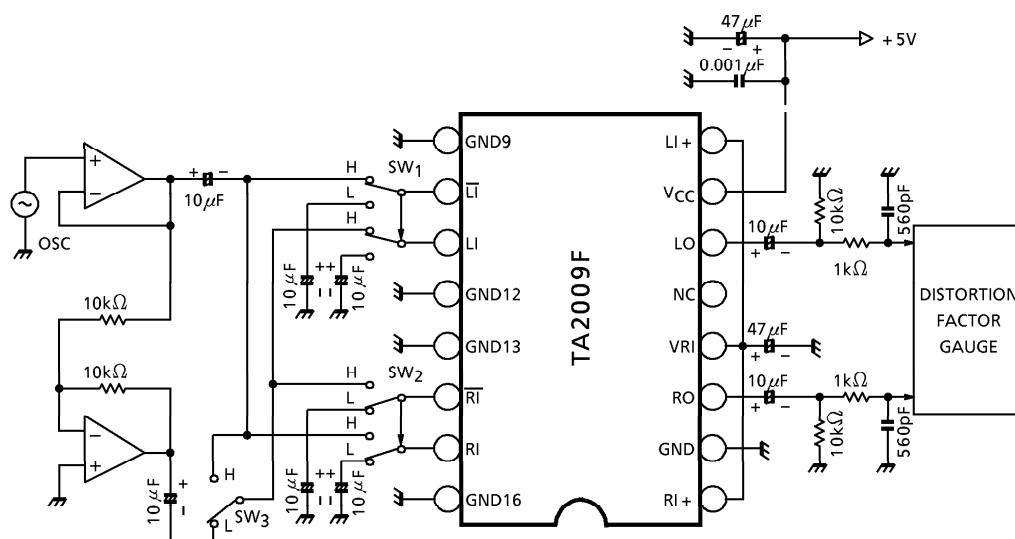
ELECTRICAL CHARACTERISTICS (Unless otherwise specified, V_{CC} = 5V, Ta = 25°C)

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

(Note 1) When the TC9237BF, C9237BN and +5V single power supply are operated
: Full scale = 970mV_{rms} (Typ.).

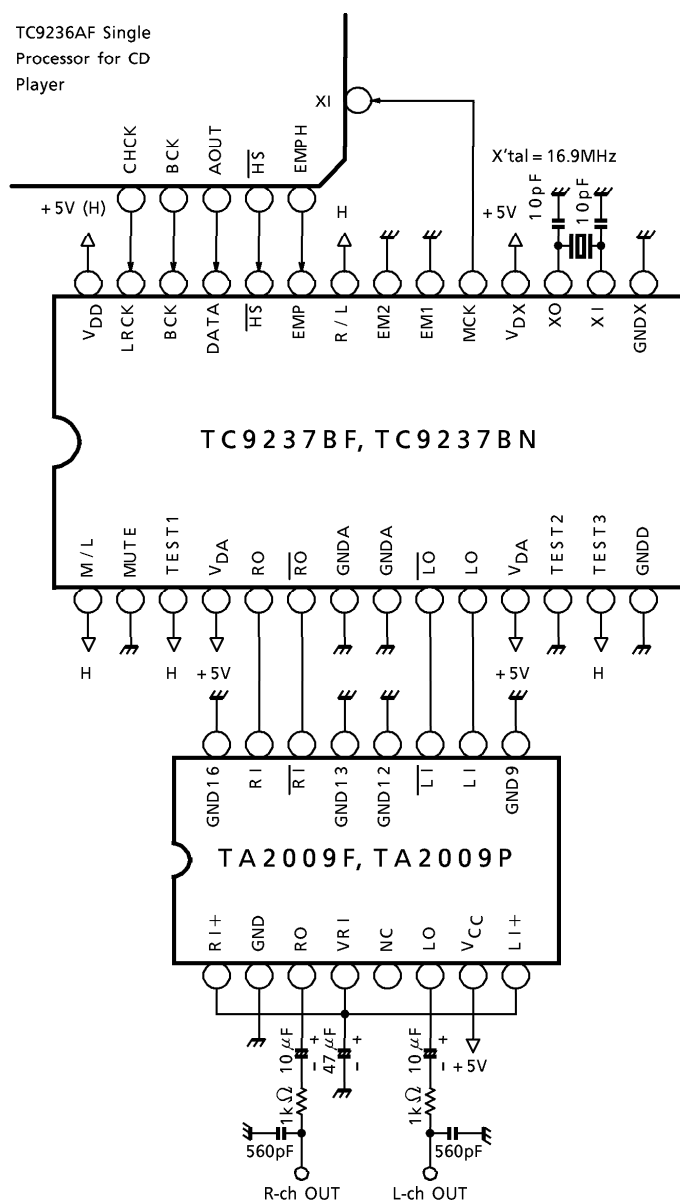
(Note 2) Measuring circuit-1 : indicates the measuring circuit.

TEST CIRCUIT-1



SW ₁	SW ₂	SW ₃	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



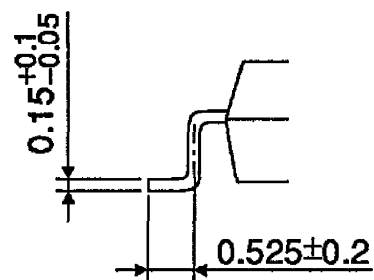
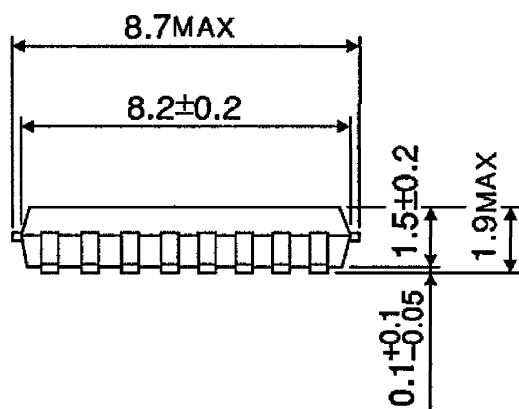
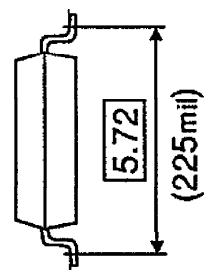
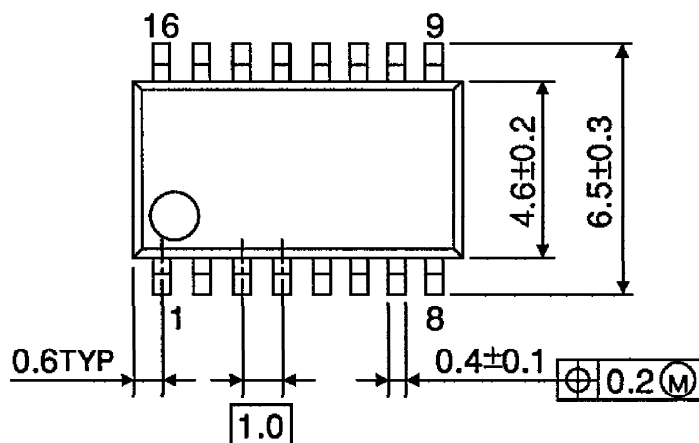
(Cautions)

- 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 pin^⑩.
- 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_{DA} and GND_A shall be connected as close to the pin as possible.

OUTLINE DRAWING

SSOP16-P-225-1.00A

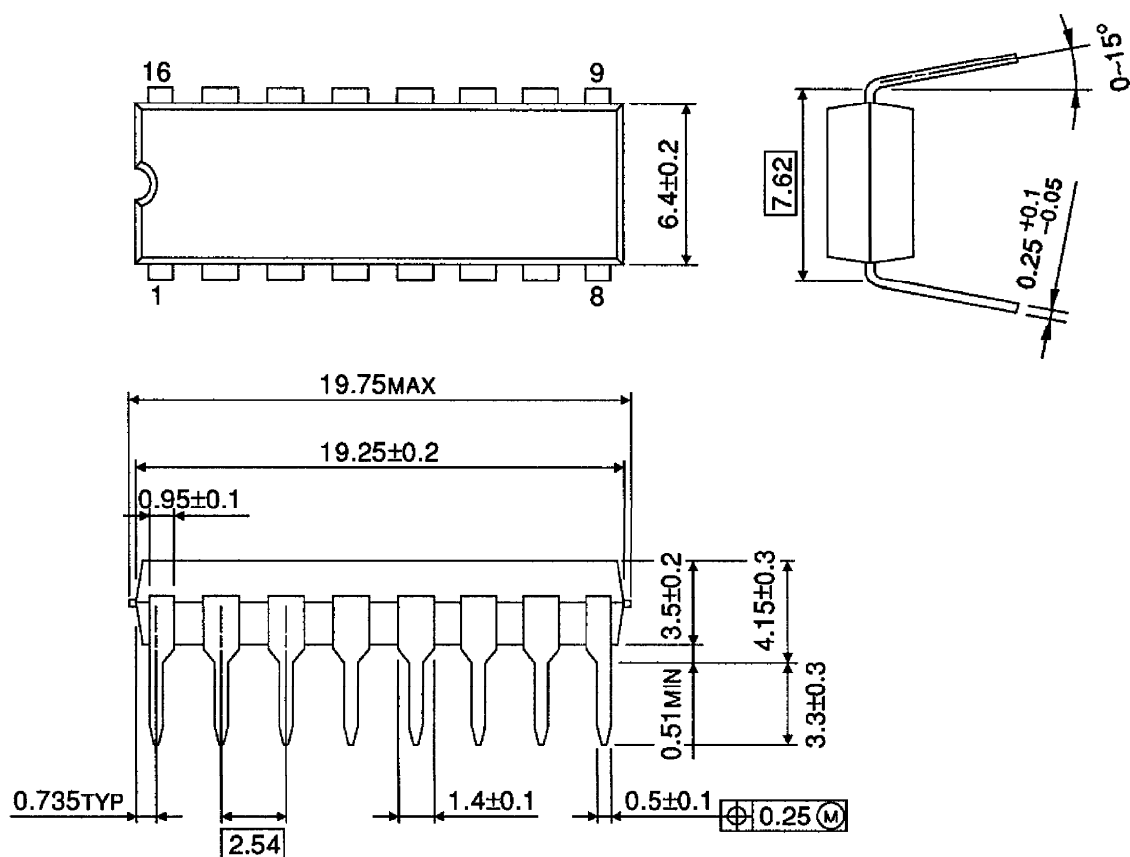
Unit : mm



Weight : 0.14g (Typ.)

OUTLINE DRAWING
DIP16-P-300-2.54A

Unit : mm



Weight : 1.00g (Typ.)