

TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT SILICON MONOLITHIC

# TA2028F, TA2028P

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

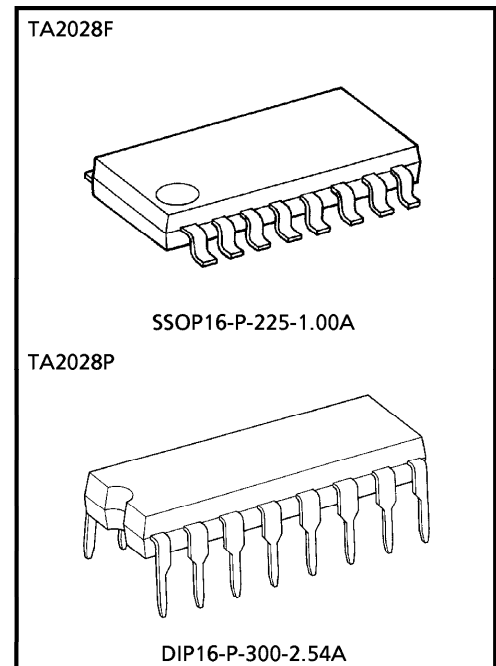
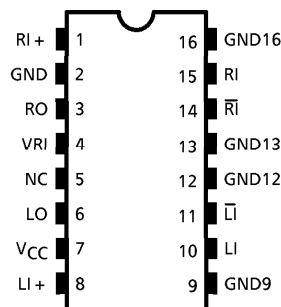
TA2028F, TA2028P are an analog filter IC for  $\Sigma$ - $\Delta$  modulation system DA converter.

Using the TA2028F, TA2028P 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.  
(+9V operation : BS tuner system)
- Noise distortion factor and S/N ratio are as follows (when operating at +5V single power supply) :
  - Noise distortion factor : -86dB (Typ.)
  - S/N : 100dB (Typ.)

### PIN CONNECTION (Top view)

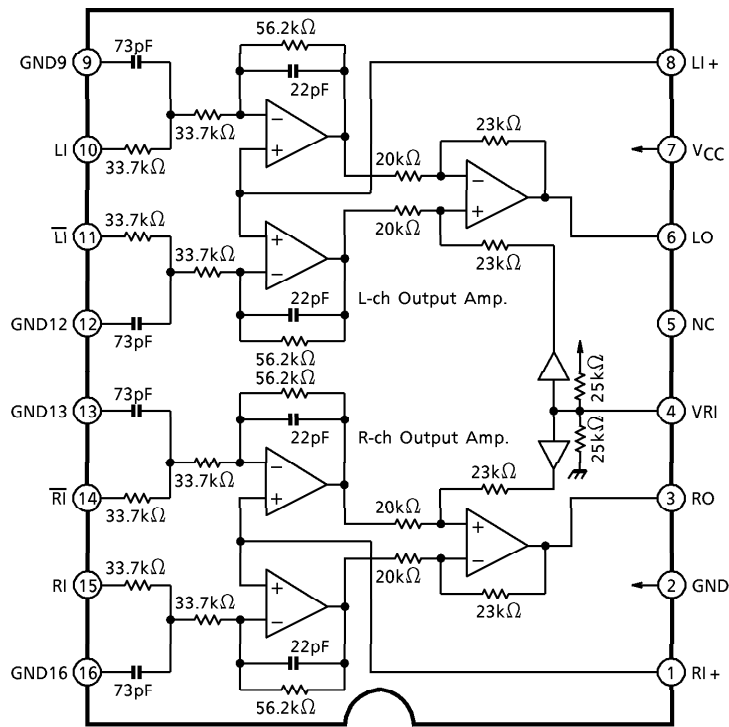


Weight  
 SSOP16-P-225-1.00A : 0.14g (Typ.)  
 DIP16-P-300-2.54A : 1.00g (Typ.)

980910EBA1

- TOSHIBA is continually working to improve the quality and the reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to observe standards of safety, and to avoid situations in which a malfunction or failure of a TOSHIBA product could cause loss of human life, bodily injury or damage to property. In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent products specifications. Also, please keep in mind the precautions and conditions set forth in the TOSHIBA Semiconductor Reliability Handbook.
- The products described in this document are subject to the foreign exchange and foreign trade laws.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA CORPORATION for any infringements of intellectual property or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any intellectual property or other rights of TOSHIBA CORPORATION or others.
- The information contained herein is subject to change without notice.

BLOCK DIAGRAM



DESCRIPTION OF PIN FUNCTIONS

PIN No.	SYMBOL	I/O	FUNCTION & OPERATION	REMARKS
1	RI +	I	R channel operational amplifier forward input pin. Connect to VRI.	—
2	GND	—	Ground pin.	—
3	RO	O	R channel analog output pin.	—
4	VRI	—	Reference voltage pin. ( $V_{CC}/2$ )	See the block diagram
5	NC	—	Non-connecting pin. NC pin is used in the open state.	—
6	LO	O	L channel analog output pin.	—
7	VCC	—	Supply voltage pin.	—
8	LI +	I	L channel operational amplifier forward input pin. Connect to VRI.	—
9	GND9	—	Ground pin for L channel reverse input side filter.	—
10	LI	I	L channel forward input pin.	Connect to LO of TC9237BF, TC9237BN
11	$\bar{L}I$	I	L channel reverse input pin.	Connect to $\bar{L}O$ of TC9237BF, TC9237BN
12	GND12	—	Ground pin for L channel forward input side filter.	—
13	GND13	—	Ground pin for R channel forward input side filter.	—
14	$\bar{R}I$	I	R channel reverse input pin.	Connect to $\bar{R}O$ of TC9237BF, TC9237BN
15	RI	I	R channel forward input pin.	Connect to RO of TC9237BF, TC9237BN
16	GND16	—	Ground pin 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	TA2028F	350 (*)	mW
	TA2028P	1388 (**)	
Operating Temperature	T <sub>opr</sub>	- 25~75	°C
Storage Temperature	T <sub>stg</sub>	- 55~150	°C

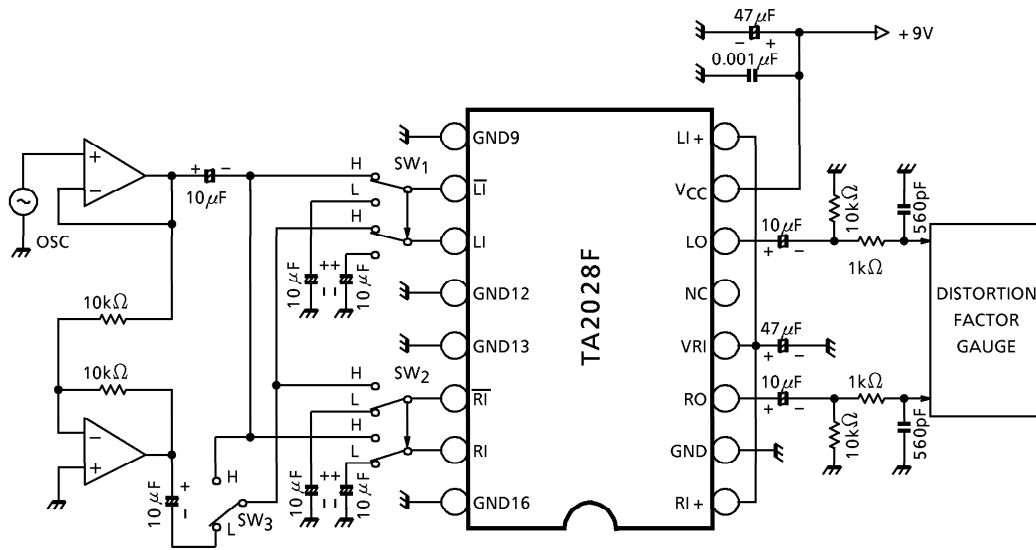
(\*) Reduce 2.8mW/°C at Ta = above 25°C.  
 (\*\*) Reduce 11.2mW/°C at Ta = above 25°C.

**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	8.0	9.0	10	V
Operating Supply Current	I <sub>CCQ</sub>	—	At no signal	8.1	11.0	13.7	mA
Reference Voltage	V <sub>RI</sub>	—	—	4.4	4.5	4.6	V
Noise Distortion Factor	THD (1)	1	1kHz, V <sub>O</sub> = 2mV <sub>rms</sub>	—	- 86	- 83	dB
	THD (2)		10kHz, V <sub>O</sub> = 2mV <sub>rms</sub>	—	- 86	- 83	
	THD (3)		1kHz, V <sub>O</sub> = 100mV <sub>rms</sub>	—	- 74	- 70	
Cross Talk	CT	1	1kHz, V <sub>O</sub> = 2mV <sub>rms</sub>	—	- 100	- 90	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%	2.5	2.6	—	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

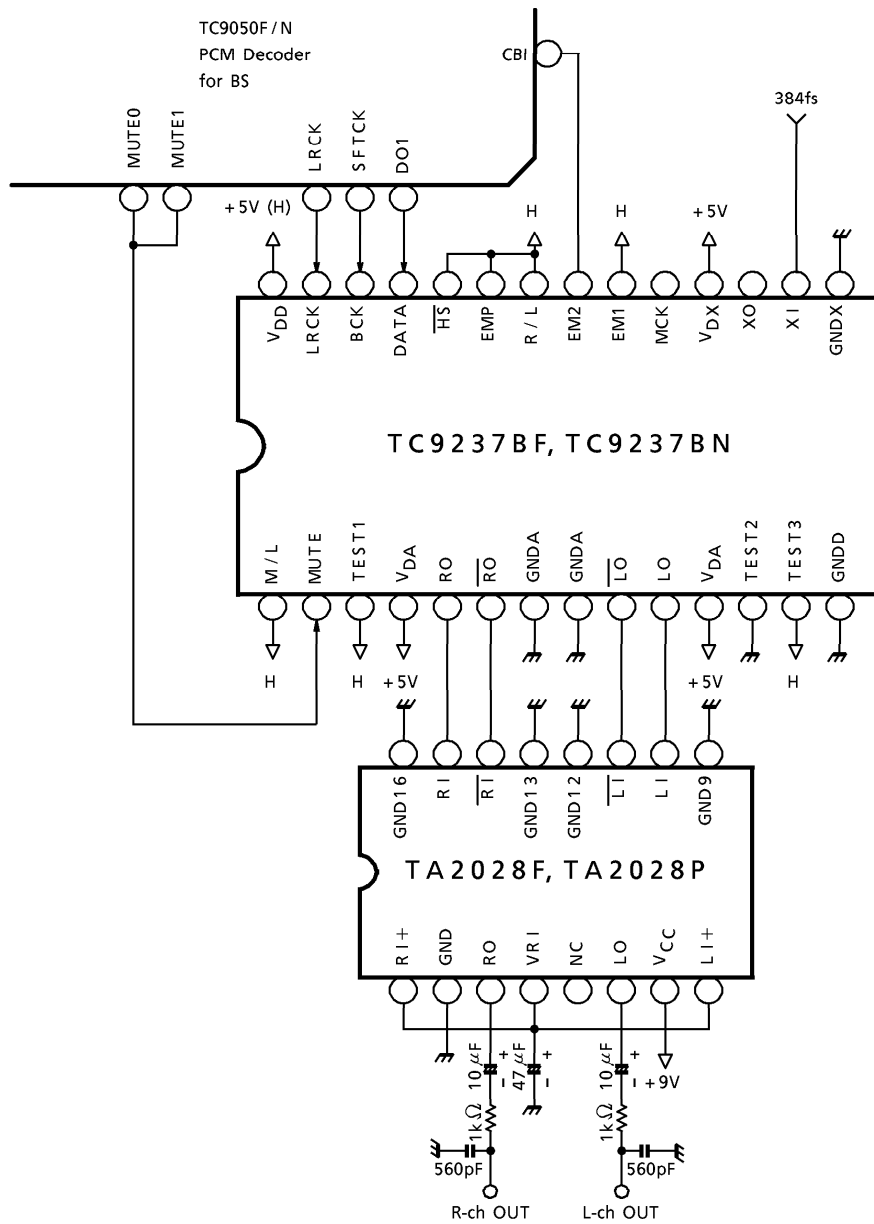
(Note 1) When the TC9237BF, TC9237BN (+5V) and +9V single power supply are operated : Full scale = 2mV<sub>rms</sub> (Typ.).  
 (Note 2) The amount of attenuations is based on 1 kHz, V<sub>O</sub> = - 10 dBV<sub>rms</sub>.  
 (Note 3) Measuring circuit-1 : indicates the measuring circuit.

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

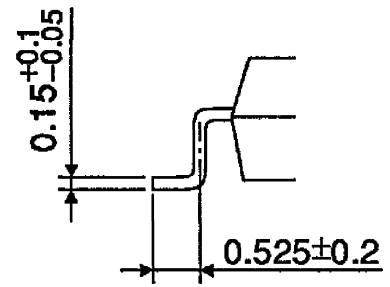
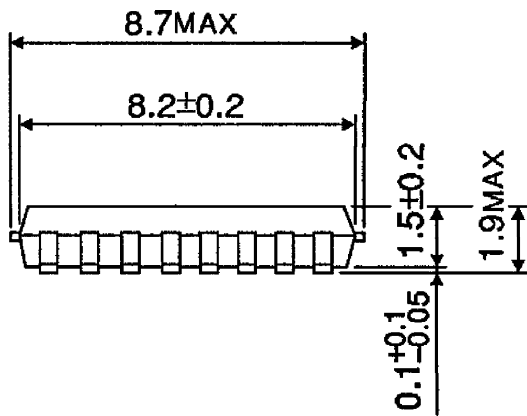
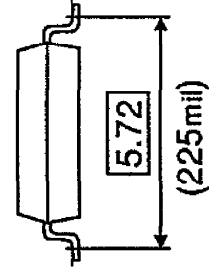
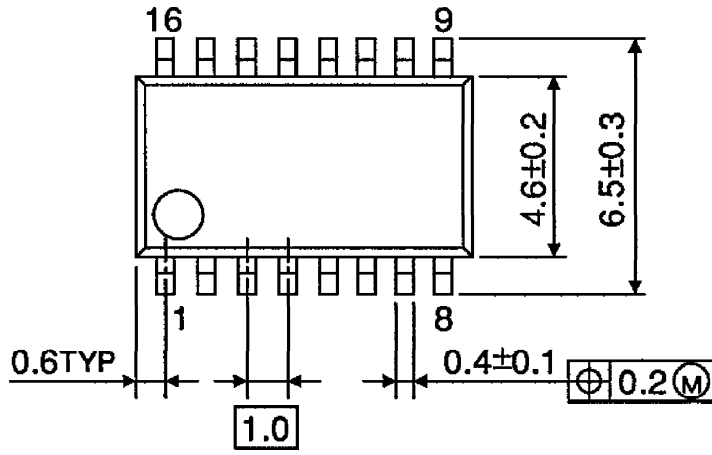


(Cautions)

- Quality of crystal oscillation waveform largely effects S/N ratio.  
Further, this is also true when system clock is input externally through the XI pin 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.
- NC pin is used in the open state.

**PACKAGE DIMENSIONS**  
SSOP16-P-225-1.00A

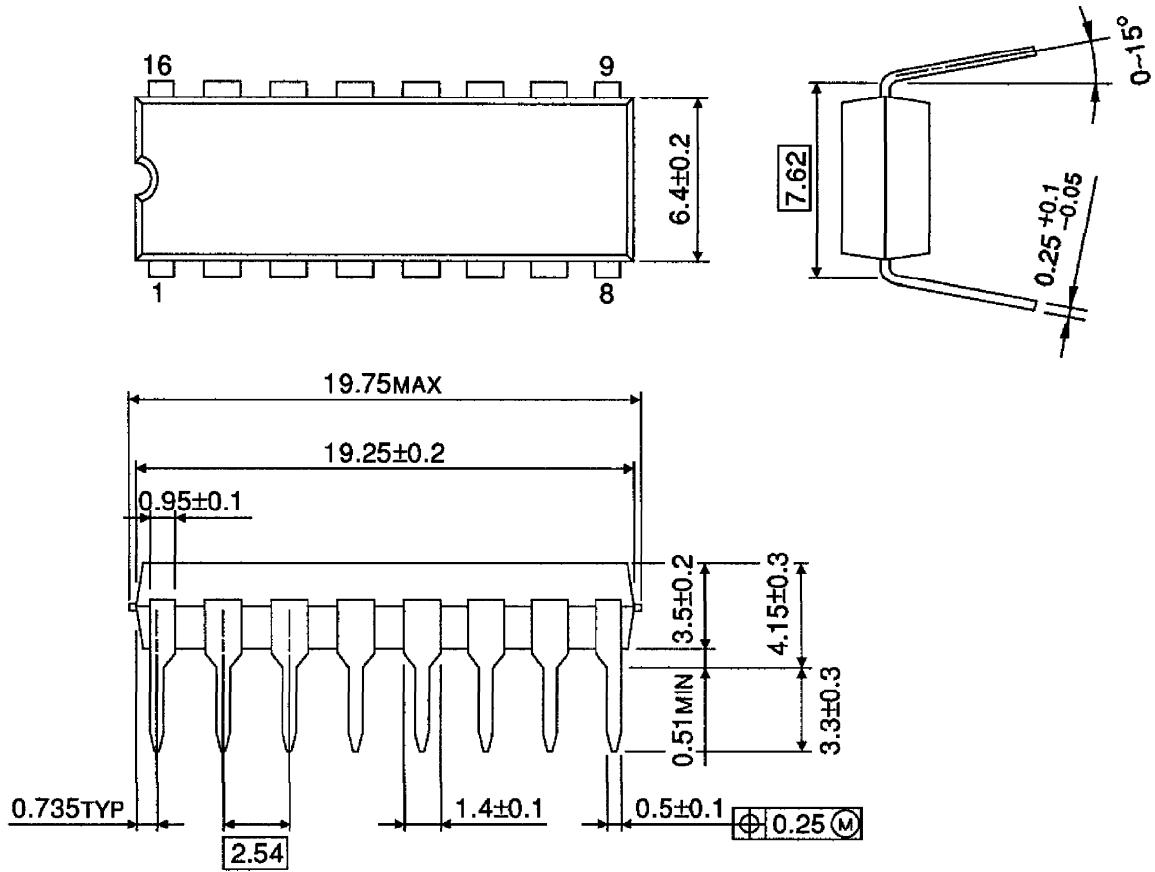
Unit : mm



Weight : 0.14g (Typ.)

**PACKAGE DIMENSIONS**  
DIP16-P-300-2.54A

Unit : mm



Weight : 1.00g (Typ.)