

TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT SILICON MONOLITHIC

# TA2028F, TA2028P

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

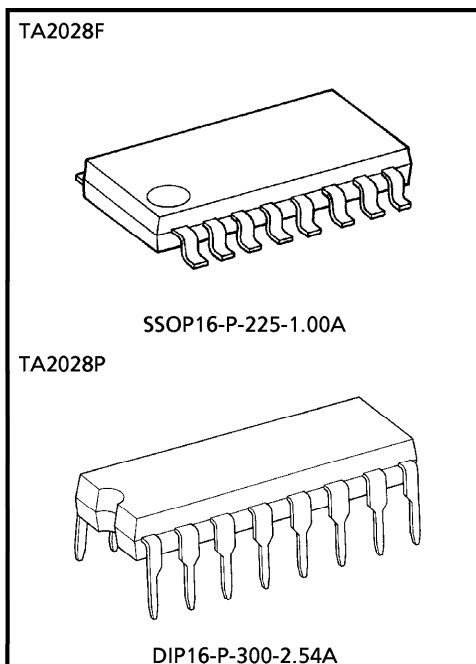
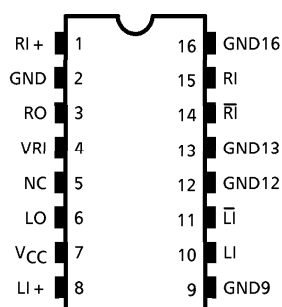
TA2028F, TA2028P are an analog filter IC for  $\Sigma$ - $\Delta$  modulation system DA converter.

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

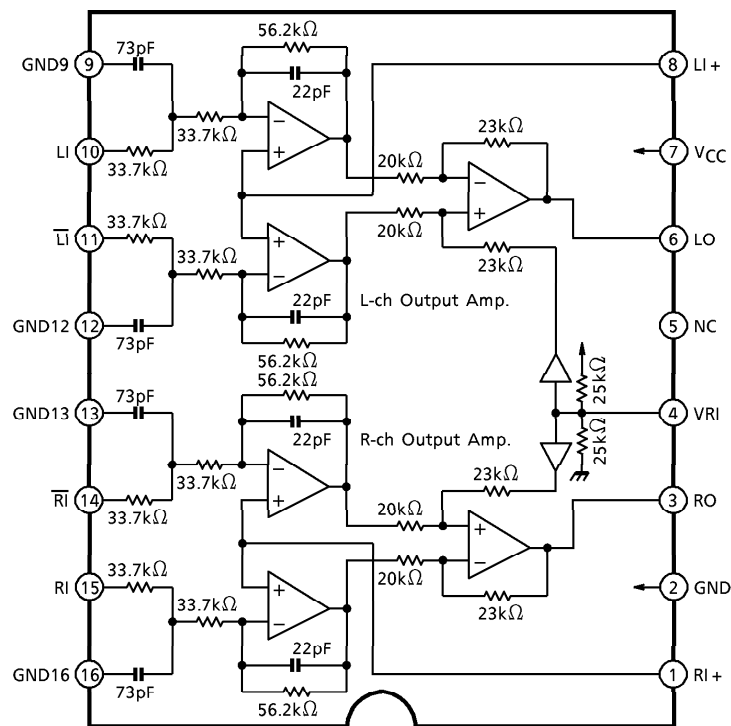
- Built-in CR for LPFs and output (differential) amplifiers for the left and right channel.
- Single power supply operation.  
(+9V operation : BS tuner system)
- Noise distortion factor and S/N ratio are as follows  
(when operating at +5V single power supply) :  
Noise distortion factor : -86dB (Typ.)  
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.)

## 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       | V <sub>CC</sub>        | —   | 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      | $\overline{\text{LI}}$ | I   | L channel reverse input pin.                                       | Connect to $\overline{\text{LO}}$ 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      | $\overline{\text{RI}}$ | I   | R channel reverse input pin.                                       | Connect to $\overline{\text{RO}}$ 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 | P <sub>D</sub>   | 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.

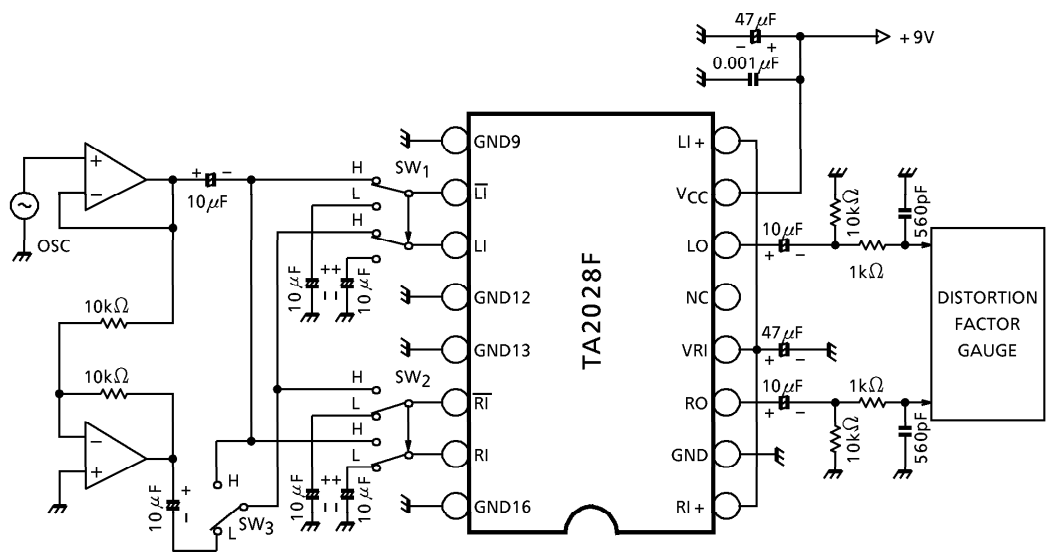
ELECTRICAL CHARACTERISTICS (Unless otherwise specified, V<sub>CC</sub> = 5V, Ta = 25°C)

| 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><br>In-phase input     | —    | —     | – 40 | dB               |
| LR Output Difference     | G <sub>VD</sub>   | 1             | 1kHz, 1.1dBV <sub>rms</sub><br>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>.

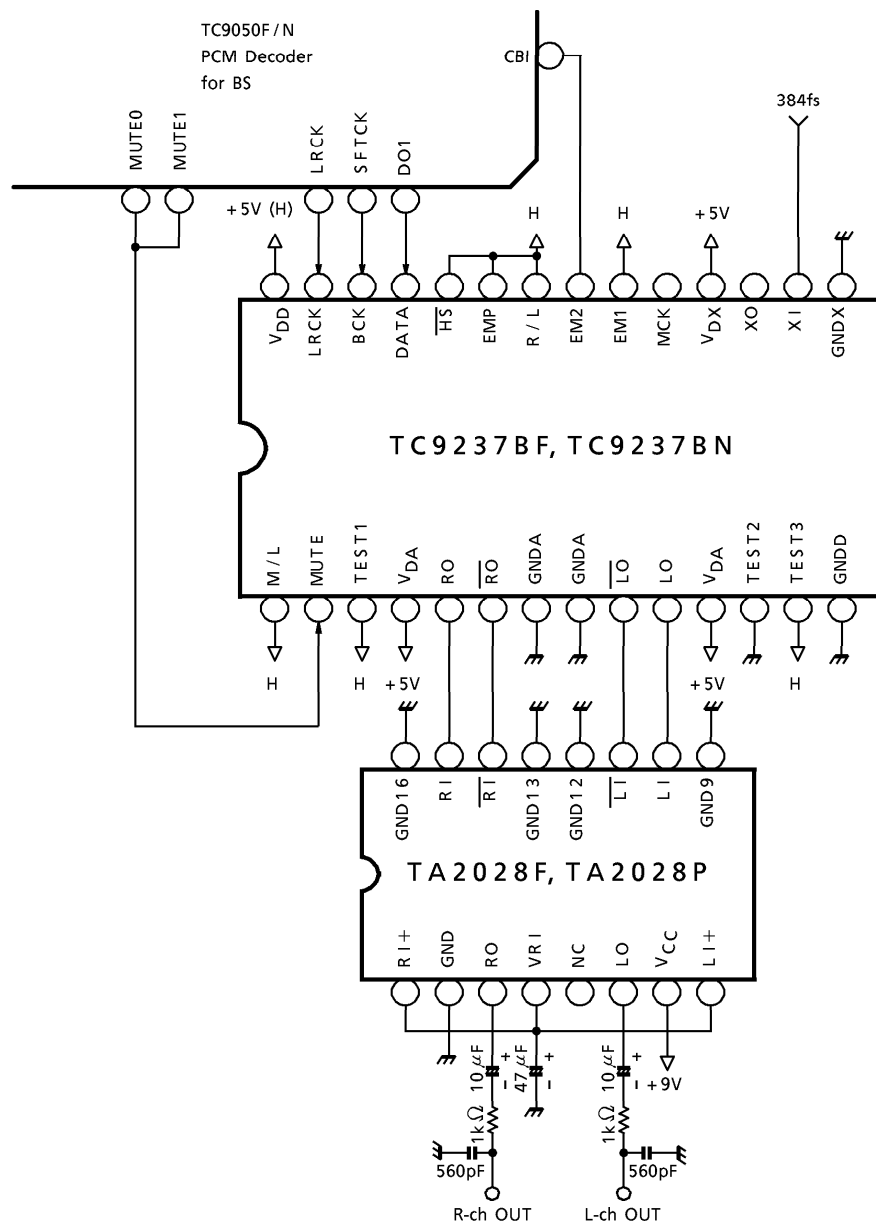
(Note 3) Measuring circuit-1 : indicates the measuring circuit.

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

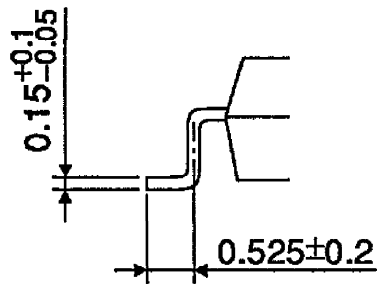
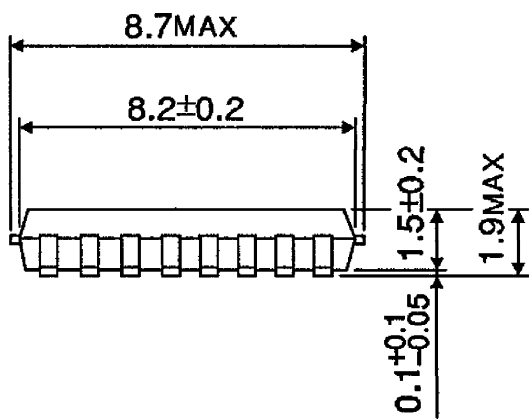
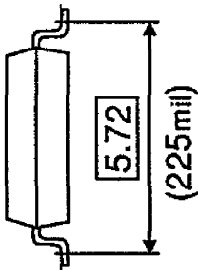
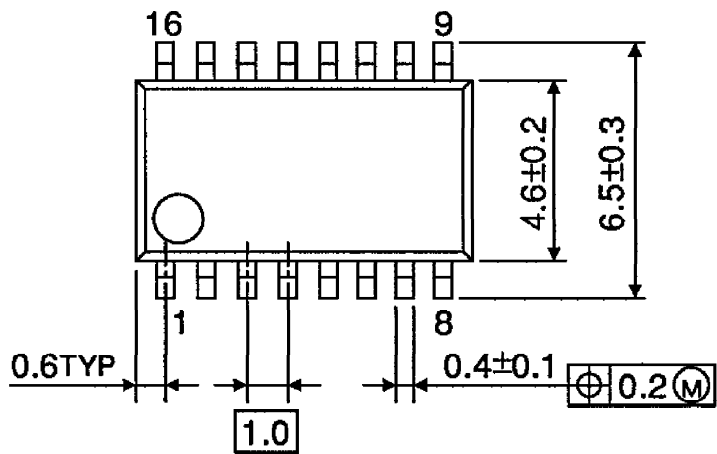


## (Cautions)

- 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 pin<sup>⑩</sup>.
- 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

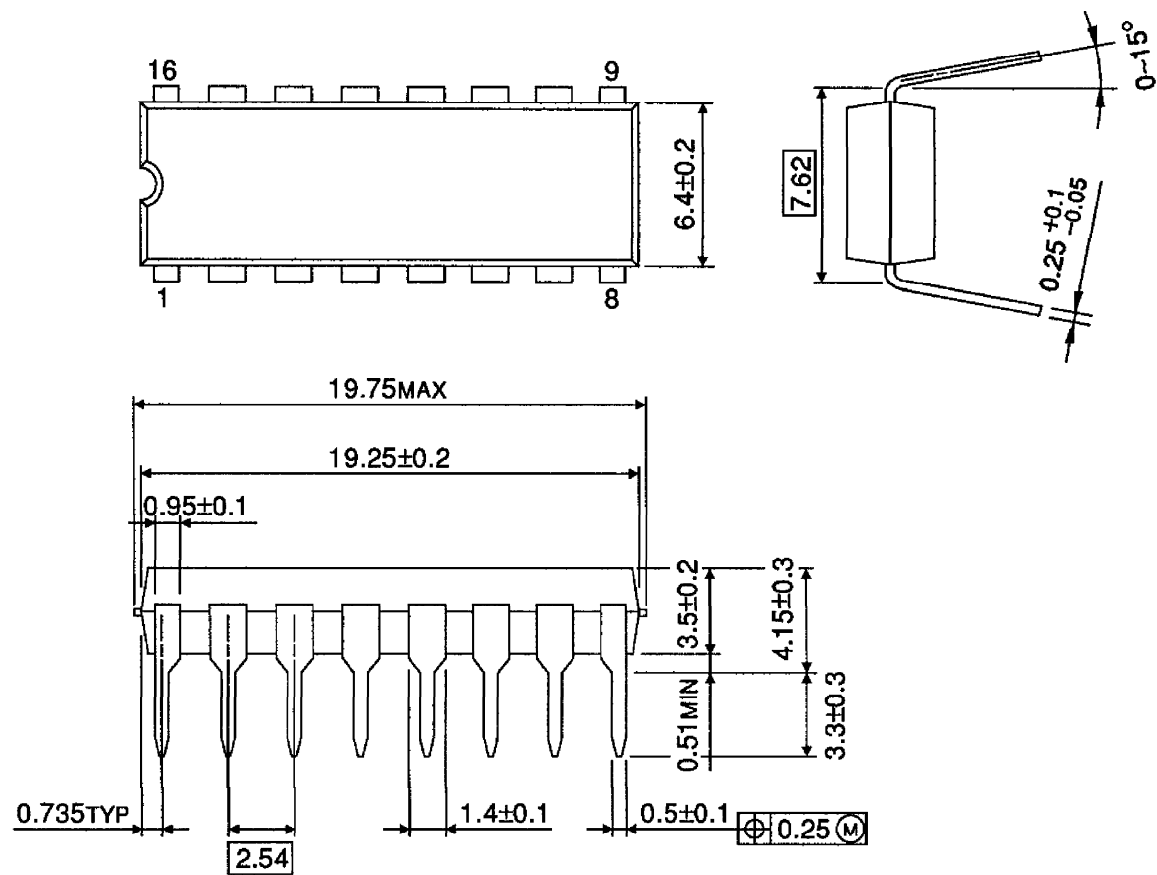
Unit : mm



Weight : 0.14g (Typ.)

PACKAGE DIMENSIONS  
DIP16-P-300-2.54A

Unit : mm



Weight : 1.00g (Typ.)

**RESTRICTIONS ON PRODUCT USE**

000707EBA

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