

TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

TA2009F, TA2009P

Filter IC For Σ - Δ Modulation System DA Converter

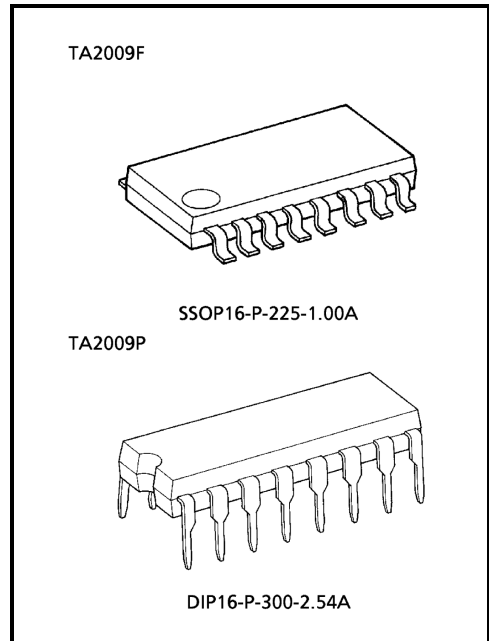
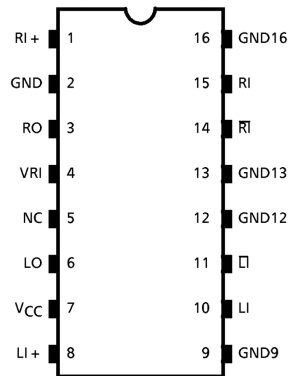
TA2009F, TA2009P are an analog filter IC for Σ - Δ modulation system DA converter.

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

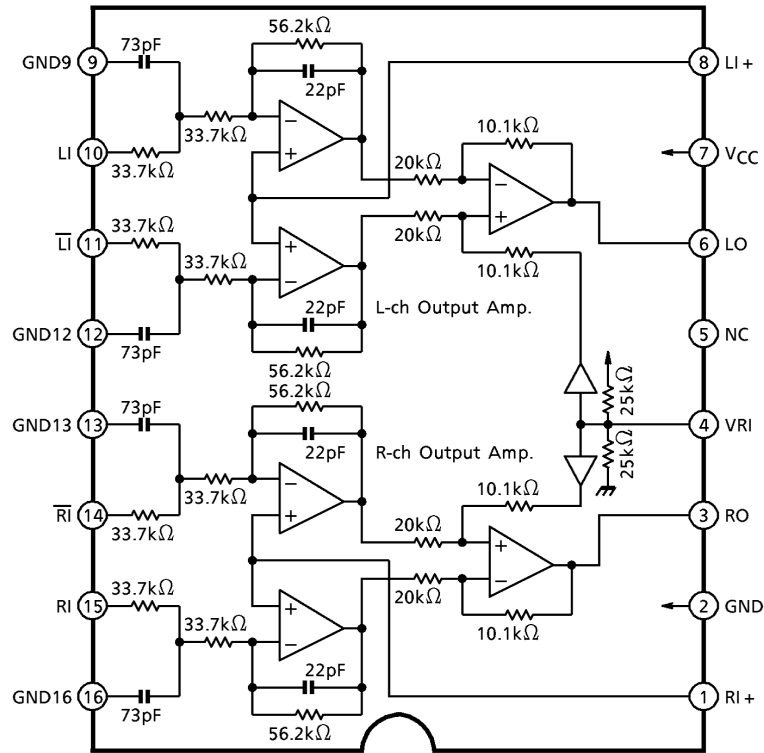
- Built-in CR for LPFs and output (differential) amplifiers for the left and right channel.
- Single power supply operation.
- Noise distortion factor and S / N ratio are as follows (when operating at +5V single power supply):
 Noise distortion factor: -93dB (typ.)
 S / N: 100dB (typ.)

Pin Connection (top view)



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

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 | V _{CC} | — | 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.

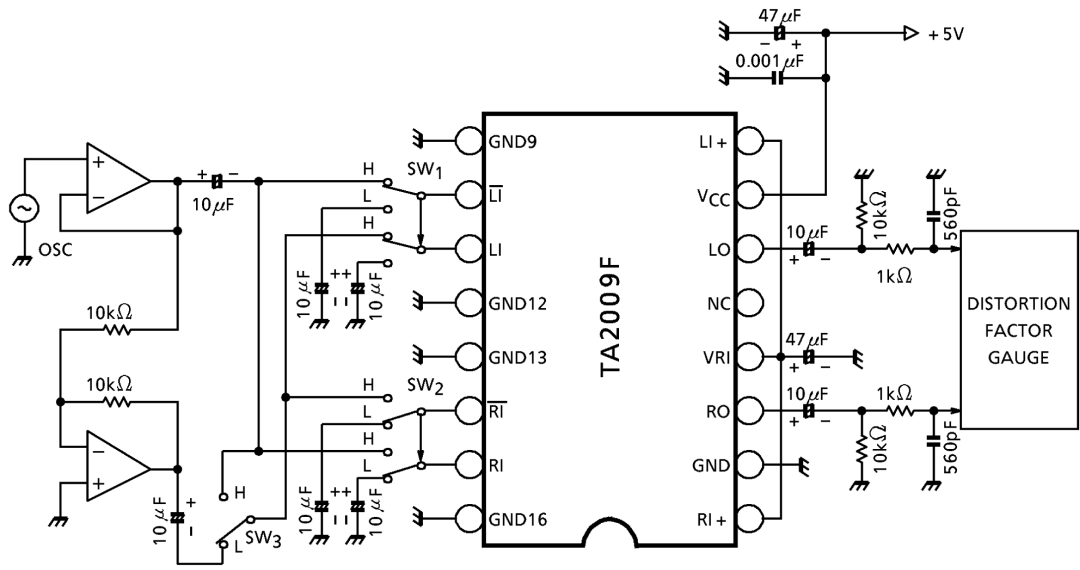
Electrical Characteristics (unless otherwise specified, V_{CC} = 5V, Ta = 25°C)

| Characteristic | Symbol | Test Circuit | 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.)

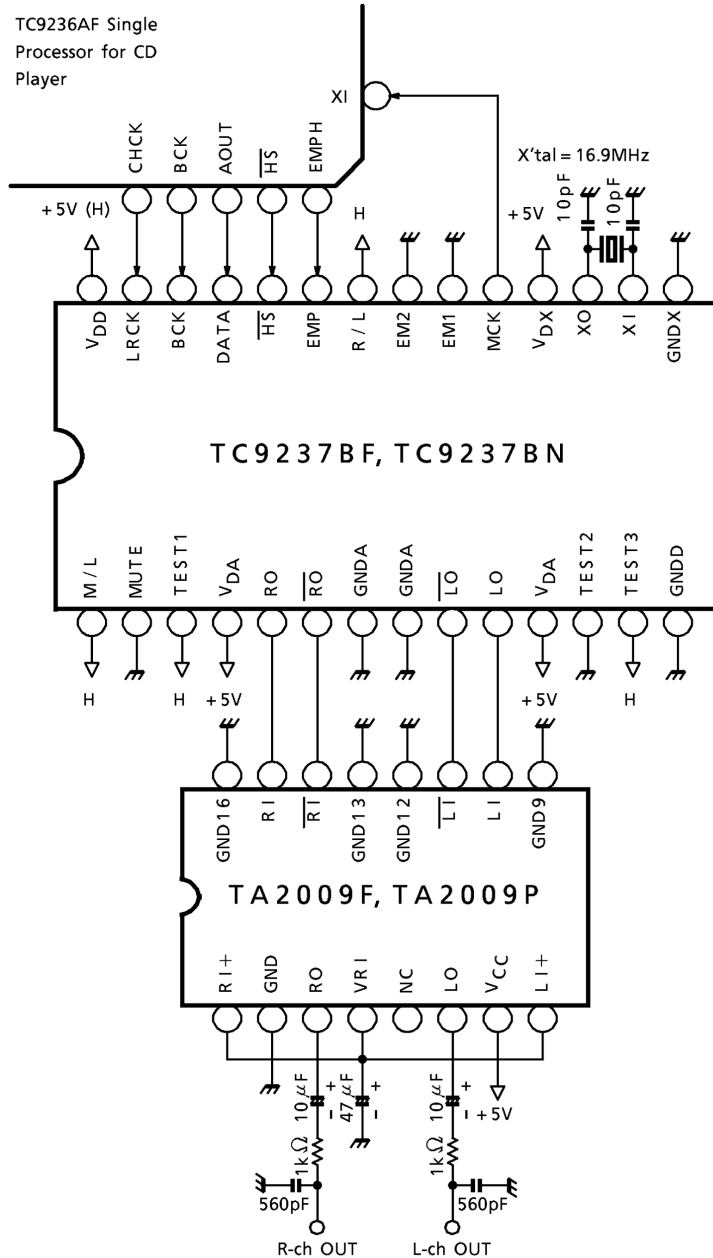
(Note 2) Measuring circuit-1: Indicates the measuring circuit.

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



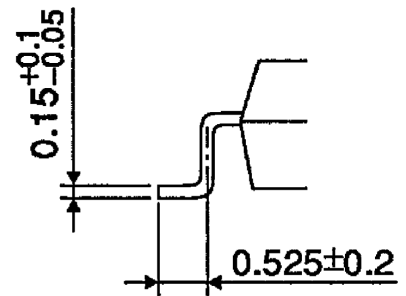
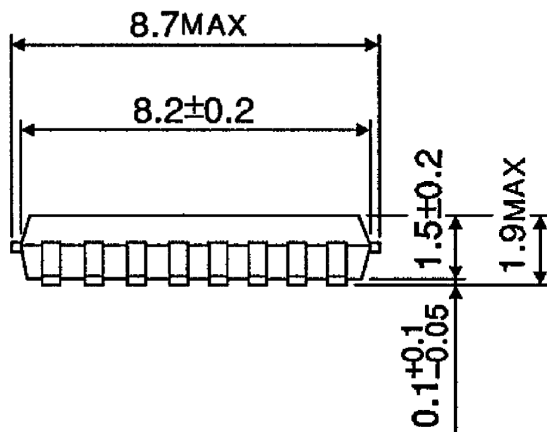
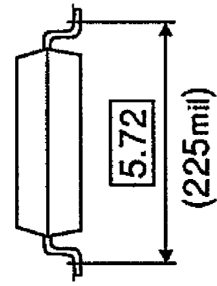
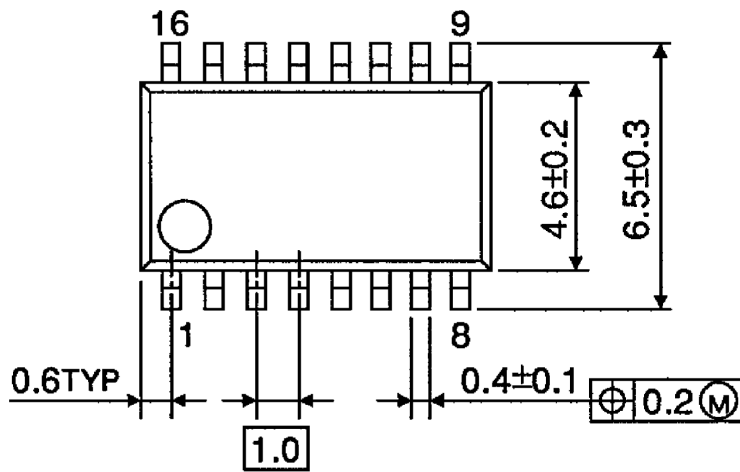
(Cautions)

- 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(16).
- 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 VDA and GND A shall be connected as close to the pin as possible.

Package Dimensions

SSOP16-P-225-1.00A

Unit : mm

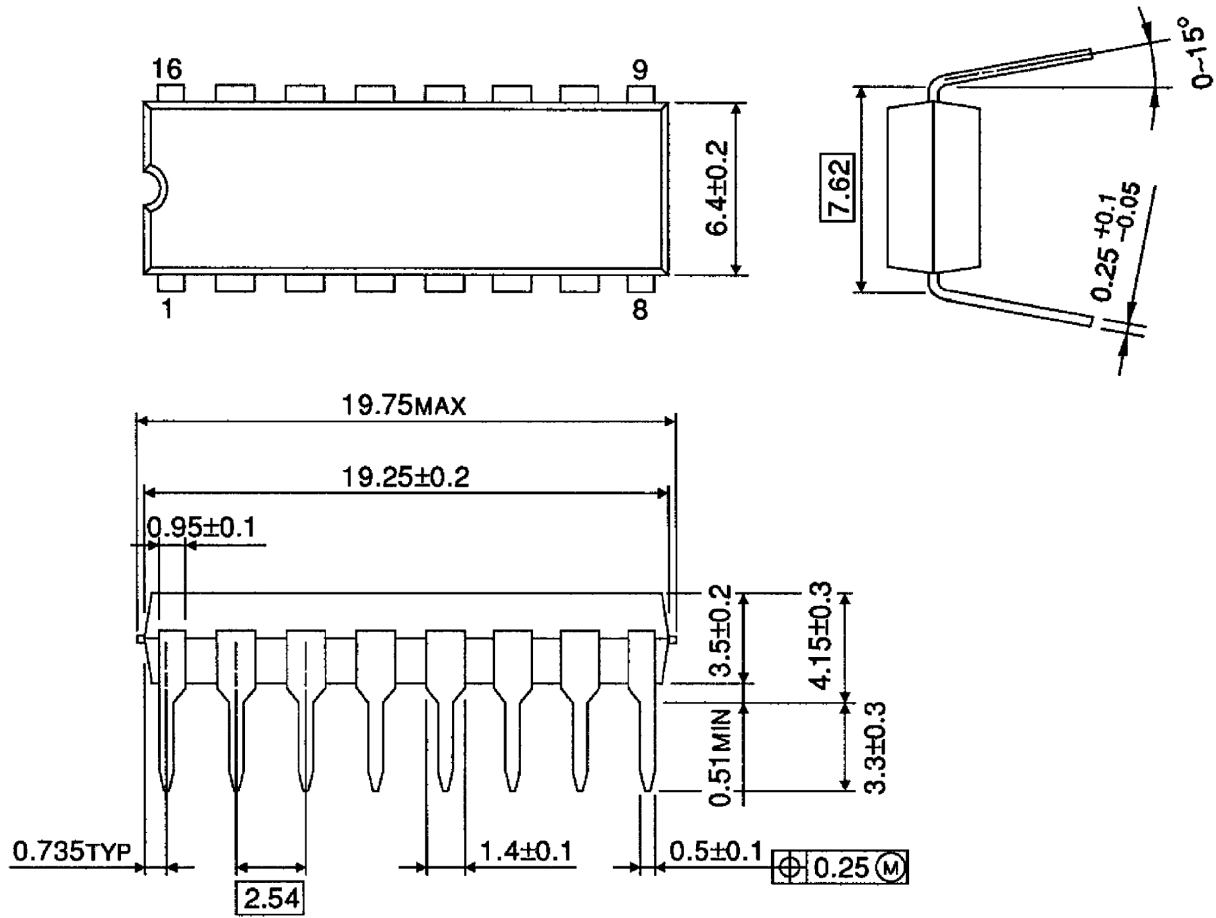


Weight: 0.14g (typ.)

Package Dimensions

DIP16-P-300-2.54A

Unit : mm



Weight: 1.00g (typ.)

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