

TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

# TA2149BN,TA2149BFN

## 3 V AM/FM 1 Chip Tuner IC (for Digital Tuning System)

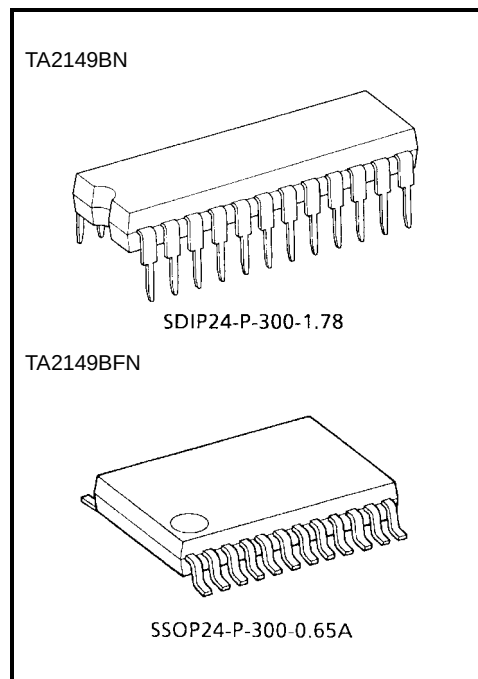
TA2149BN, TA2149BFN are AM/FM 1 chip tuner ICs, which are designed for portable Radios and 3 V Head phone Radios.

This is suitable for Digital Tuning System Applications. FM Local Oscillation Voltage is set up low relatively, for NEW FCC.

### Functions

- For NEW FCC.
- Suitable for combination with Digital Tuning System which is included IF Counter.
  - Adjustable for IF count output sensitivity by external resistance of pin 17 (FM only).
- One terminal type AM/FM IF count output for IF counter of Digital Tuning System.
  - FM: 1.3375 MHz (1/8 dividing)
  - AM: 450 kHz
- Built-in Mute Circuit for IF count output.
- For adopting ceramic Discriminator, it is not necessary to adjust the FM Quad Detector Circuit.
- Built-in FM MPX VCO circuit.
- Built-in one terminal type AM/FM Local Oscillator Buffer Output for Digital Tuning System Applications.
  - Built-in 1/16 Pre-scaler for FM Local OSC Buffer.
- Built-in AM Low cut circuit.
- Low supply current. ( $V_{CC} = 3\text{ V}$ ,  $T_a = 25^\circ\text{C}$ )
  - $I_{CCQ}(\text{FM}) = 13\text{ mA (Typ.)}$
  - $I_{CCQ}(\text{AM}) = 8.5\text{ mA (Typ.)}$
- Operating Supply voltage range:  $V_{CC} = 1.8\sim 7\text{ V}$  ( $T_a = 25^\circ\text{C}$ )

Note 1: Handle with care to prevent devices from deteriorations by static electricity.

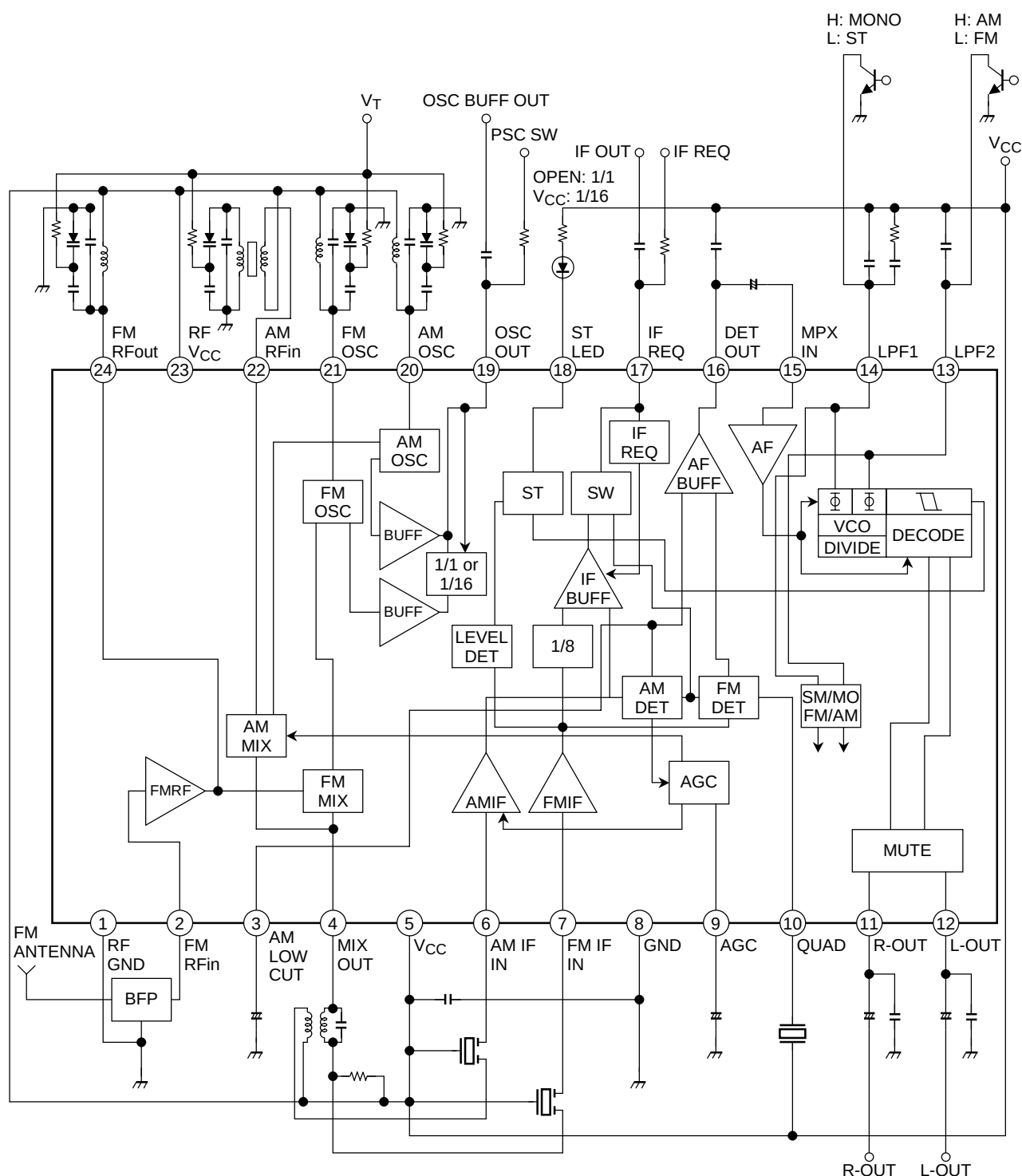


#### Weight

SDIP24-P-300-1.78: 1.2 g (Typ.)

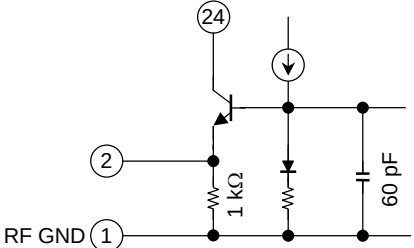
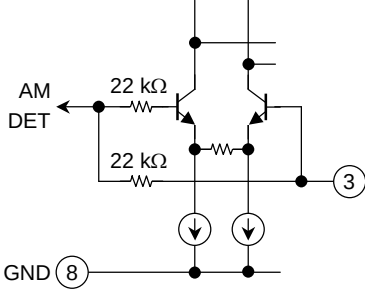
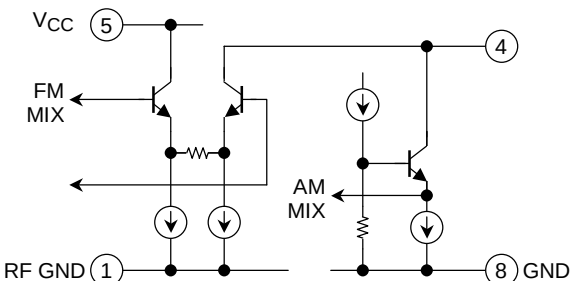
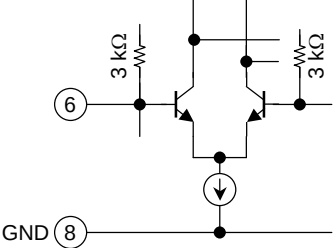
SSOP24-P-300-0.65A: 0.14 g (Typ.)

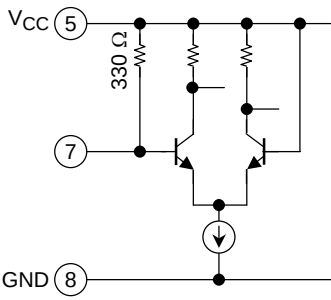
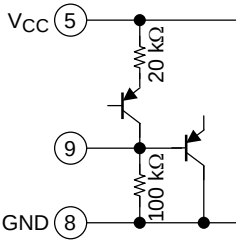
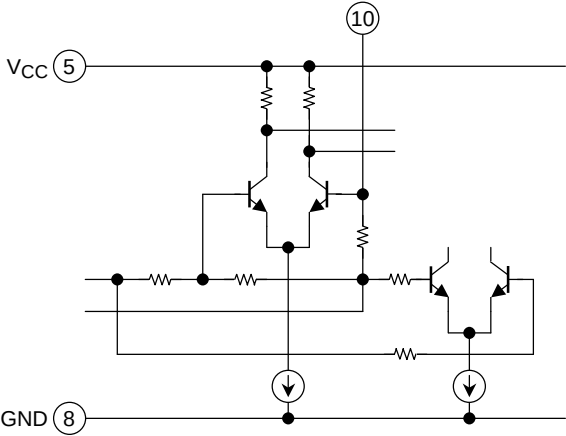
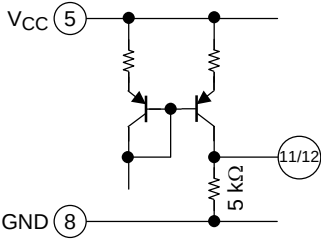
## Block Diagram



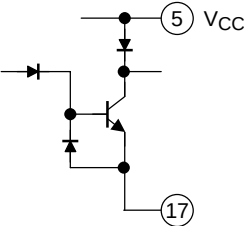
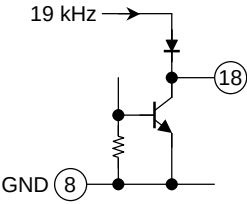
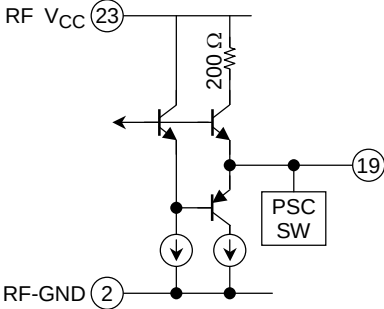
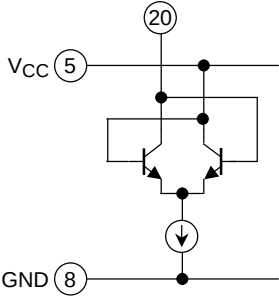
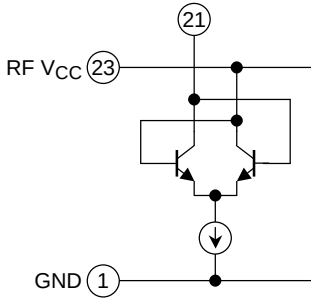
## Explanation of Terminals

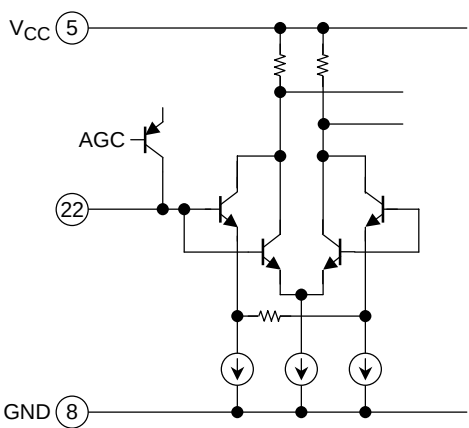
(Terminal Voltage: Typical terminal voltage at no signal with test circuit,  
 $V_{CC} = 3\text{ V}$ ,  $T_a = 25^\circ\text{C}$ )

| PIN No. | Characteristic                             | Internal Circuit                                                                     | Terminal Voltage (Typ.) (V) |     |
|---------|--------------------------------------------|--------------------------------------------------------------------------------------|-----------------------------|-----|
|         |                                            |                                                                                      | AM                          | FM  |
| 1       | RF GND<br>(GND for FM RF stage)            | —                                                                                    | 0                           | 0   |
| 2       | FM-RFin                                    |    | 0                           | 0.8 |
| 3       | AM LOW CUT                                 |   | 1.0                         | —   |
| 4       | MIX OUT                                    |  | 3.0                         | 3.0 |
| 5       | $V_{CC}$<br>( $V_{CC}$ for AM, FM IF, MPX) | —                                                                                    | 3.0                         | 3.0 |
| 6       | AM IF IN                                   |  | 2.3                         | 2.5 |

| PIN No.  | Characteristic                  | Internal Circuit                                                                     | Terminal Voltage (Typ.) (V) |     |
|----------|---------------------------------|--------------------------------------------------------------------------------------|-----------------------------|-----|
|          |                                 |                                                                                      | AM                          | FM  |
| 7        | FM IF IN                        |    | 3.0                         | 3.0 |
| 8        | GND<br>(GND for AM, FM IF, MPX) | —                                                                                    | 0                           | 0   |
| 9        | AGC                             |     | 0                           | 0   |
| 10       | QUAD                            |  | 2.5                         | 2.2 |
| 11<br>12 | R-OUT<br>L-OUT                  |  | 1.2                         | 1.2 |

| PIN No. | Characteristic                                                                                                                                                                                                                                                   | Internal Circuit                                                                                                                                       | Terminal Voltage (Typ.) (V) |     |
|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|-----|
|         |                                                                                                                                                                                                                                                                  |                                                                                                                                                        | AM                          | FM  |
| 13      | <p>LPF2</p> <ul style="list-style-type: none"><li>• LPF terminal for phase detector</li><li>• Bias terminal AM/FM SW circuit</li></ul> <p><math>V_{13} = \text{GND} \rightarrow \text{AM}</math><br/><math>V_{13} = \text{OPEN} \rightarrow \text{FM}</math></p> |                                                                                                                                                        | 0                           | 2.2 |
| 14      | <p>LPF1</p> <ul style="list-style-type: none"><li>• LPF terminal for synchronous detector</li><li>• VCO stop terminal</li></ul> <p><math>V_{14} = \text{GND} \rightarrow \text{VCO STOP}</math></p>                                                              |                                                                                                                                                        | 0.7                         | 2.4 |
| 15      | MPX IN                                                                                                                                                                                                                                                           |                                                                                                                                                        | 0.7                         | 0.7 |
| 16      | DET OUT                                                                                                                                                                                                                                                          | <p>(a) LOW <math>\rightarrow</math> FM, HIGH <math>\rightarrow</math> AM<br/>(b) LOW <math>\rightarrow</math> AM, HIGH <math>\rightarrow</math> FM</p> | 1.0                         | 0.9 |

| PIN No. | Characteristic | Internal Circuit                                                                     | Terminal Voltage (Typ.) (V) |     |
|---------|----------------|--------------------------------------------------------------------------------------|-----------------------------|-----|
|         |                |                                                                                      | AM                          | FM  |
| 17      | IF REQ         |     | —                           | —   |
| 18      | ST LED         |    | —                           | —   |
| 19      | OSC OUT        |   | 2.8                         | 2.7 |
| 20      | AM OSC         |  | 3.0                         | 3.0 |
| 21      | FM OSC         |  | 3.0                         | 3.0 |

| PIN No. | Characteristic                                          | Internal Circuit                                                                   | Terminal Voltage (Typ.) (V) |     |
|---------|---------------------------------------------------------|------------------------------------------------------------------------------------|-----------------------------|-----|
|         |                                                         |                                                                                    | AM                          | FM  |
| 22      | AM RFin                                                 |  | 3.0                         | 3.0 |
| 23      | RF V <sub>CC</sub><br>(V <sub>CC</sub> for FM RF stage) | —                                                                                  | 3.0                         | 3.0 |
| 24      | FM RFout                                                | cf. pin 1                                                                          | 3.0                         | 3.0 |

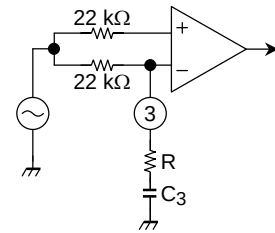
## Application Note

### 1. AM Low-Cut Circuit

- The AM Low-Cut action is carried out by the bypass of the high frequency component of the positive-feedback signal at the AF AMP stage.  
The external capacitor: C<sub>3</sub> by-pass this component.
- The cut-off frequency f<sub>L</sub> is determined by the internal resistance 22 kΩ (Typ.) and the external capacitor C<sub>3</sub> as following;

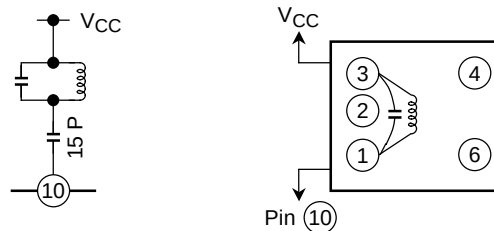
$$f_L = \frac{1}{2 \times \pi \times 22 \times 10^3 \times C_3} \text{ (Hz)}$$

- In the case of the AM Low-Cut function is not needed, set up the value of C<sub>3</sub> over 1 μF.  
In the condition of C<sub>3</sub> ≥ 1 μF, the frequency characteristic has flat response at the low frequency.
- It is possible to reduce the recovered output level at AM mode, by additional resistance between the pin 3 and GND line.



### 2. FM Detection Circuit

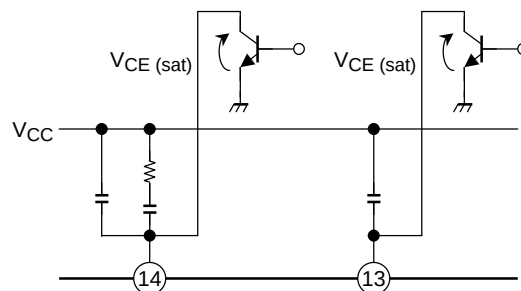
For the FM detection circuit, detection coil is able to use instead of ceramic discriminator.  
Recommended circuit and recommended coil are as follows. (In this case, please take care that V<sub>in</sub> (lim.) falls a little.)



| Test Frequency | Co (pF) | Qo | Turns |     |     |     | Wire (mmφ) | Reference                        |
|----------------|---------|----|-------|-----|-----|-----|------------|----------------------------------|
|                |         |    | 1-2   | 2-3 | 1-3 | 4-6 |            |                                  |
| 10.7 MHz       | 51      | 45 | —     | —   | 30  | —   | 0.08UEW    | Toko Co., Ltd.<br>600BEAS-10018Z |

### 3. FM/AM switch and forced monaural switch.

- FM/AM switchover and stereo/forced monaural switchover are done by pin 13 and pin 14.
- FM/AM switch (pin 13)  
V13: Low (Active Low, V<sub>th</sub> = 0.2 V (Typ.), I<sub>th</sub> 30 μA (Typ.) → AM  
V13: OPEN → FM
- Stereo/forced monaural switch (pin 14)  
V14: Low (Active Low, V<sub>th</sub> = 0.2 V (Typ.), I<sub>th</sub> 30 μA (Typ.) → Forced Monaural  
V14: OPEN → Stereo

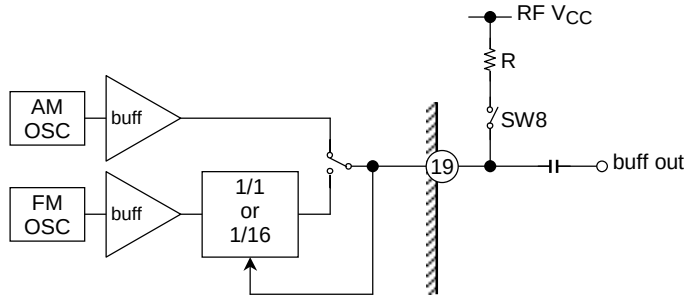




4. VCC Line

This ICs have two voltage supply terminals, VCC (for AM, FM IF, MPX stage) and RF VCC (for FM RF stage). Set up the potential difference between VCC and RF VCC 0.4 V (typ.) or less, otherwise there is the case that this IC doesn't operate normally.

5. How to control the Divider of FM OSC.

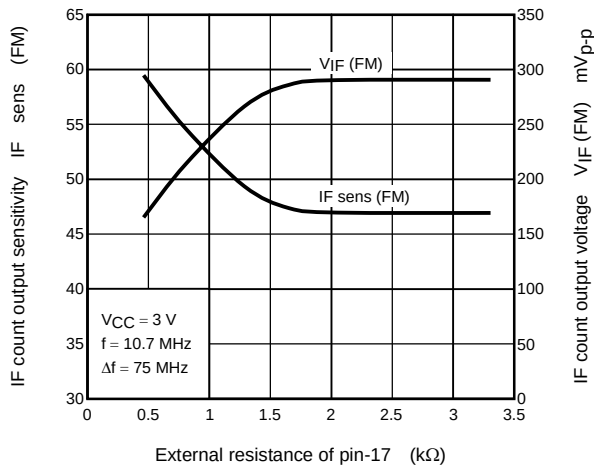


Divider of FM OSC ON/OFF switching is controlled by external pull-up resistor of pin 19. In case of Divider of FM OSC is used, it is necessary to set up the value of R under 470 Ω (typ.). When R is over 470 Ω, it is feared that Divider is not operating. (At this time, buffer output frequency is equal to FM OSC frequency.) Which ever Divider of FM OSC is used or not, AM OSC buffer frequency and output level is same.

| Mode | SW8  | Output Frequency | Output Level (Typ.) |
|------|------|------------------|---------------------|
| FM   | OPEN | 1/1 FM OSC       | 35 mVrms            |
|      | ON   | 1/16 FM OSC      | 110 mVrms           |
| AM   | OPNE | 1/1 FM OSC       | 75 mVrms            |
|      | ON   |                  |                     |

6. How to adjust the IF Count Output Sensitivity

IF count output sensitivity can be adjusted by changing the value of external resistance at pin 17. This ICs have IF signal level detector in pin 9. When DC voltage of pin 9 is high than threshold, IF count output signal come out from the pin 17. And this threshold is controlled by value of external resistance at pin 19.



## Maximum Ratings (Ta = 25°C)

| Characteristics       |           | Symbol                     | Rating  | Unit |
|-----------------------|-----------|----------------------------|---------|------|
| Supply voltage        |           | V <sub>CC</sub>            | 8       | V    |
| LED current           |           | I <sub>LED</sub>           | 10      | mA   |
| LED voltage           |           | V <sub>LED</sub>           | 8       | V    |
| Power dissipation     | TA2149BN  | P <sub>D</sub><br>(Note 2) | 1200    | mW   |
|                       | TA2149BFN |                            | 500     |      |
| Operating temperature |           | T <sub>opr</sub>           | -25~75  | °C   |
| Storage temperature   |           | T <sub>stg</sub>           | -55~150 | °C   |

Note 2: Derated above Ta = 25°C in the proportion of 9.6 mW/°C for TA2149BN of 4 mW/°C for TA2149BFN.

Electrical Characteristics (Unless otherwise specified, Ta = 25°C, V<sub>CC</sub> = 3 V,

F/E: f = 98 MHz, f<sub>m</sub> = 1 kHz

FM IF: f = 10.7 MHz, Δf = ±75 kHz, f<sub>m</sub> = 1 kHz

AM: f = 1 MHz, MOD = 30%, f<sub>m</sub> = 1 kHz

MPX: f<sub>m</sub> = 1 kHz)

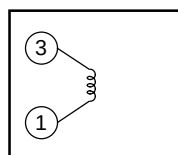
| Characteristic           |                                   | Symbol                      | Test Circuit | Test Condition                              | Min    | Typ.   | Max    | Unit              |
|--------------------------|-----------------------------------|-----------------------------|--------------|---------------------------------------------|--------|--------|--------|-------------------|
| Supply current           |                                   | I <sub>CC</sub> (FM)        | —            | V <sub>in</sub> = 0, FM mode                | —      | 13     | 16.5   | mA                |
|                          |                                   | I <sub>CC</sub> (AM)        | —            | V <sub>in</sub> = 0, AM mode                | —      | 8.5    | 11.0   |                   |
| F/E                      | Input limiting voltage            | V <sub>in</sub> (lim)       | —            | V <sub>in</sub> = 60dBμV EMF, -3dB limiting | —      | 10     | —      | dBμV EMF          |
|                          | Local OSC buffer output voltage 1 | V <sub>OSC</sub> (buff) FM1 | —            | f <sub>OSC</sub> = 108.7 MHz                | 23     | 35     | —      | mVrms             |
|                          | Local OSC buffer output voltage 2 | V <sub>OSC</sub> (buff) FM2 | —            | f <sub>OSC</sub> = 6.79375 MHz<br>SW8: ON   | 75     | 110    | —      | mVrms             |
| FM IF                    | Input limiting voltage            | V <sub>in</sub> (lim) IF    | —            | V <sub>in</sub> = 80dBμV EMF, -3dB limiting | 37     | 42     | 47     | dBμV EMF          |
|                          | Recovered output voltage          | V <sub>OD</sub>             | —            | V <sub>in</sub> = 80dBμV EMF                | 200    | 250    | 300    | mVrms             |
|                          | Signal to noise ratio             | S/N                         | —            | V <sub>in</sub> = 80dBμV EMF                | —      | 75     | —      | dB                |
|                          | Total harmonic distortion         | THD                         | —            | V <sub>in</sub> = 80dBμV EMF                | —      | 0.3    | —      | %                 |
|                          | AM rejection ration               | AMR                         | —            | V <sub>in</sub> = 80dBμV EMF                | —      | 60     | —      | dB                |
|                          | IF count output frequency         | f <sub>IF</sub> (FM)        | —            | V <sub>in</sub> = 80dBμV EMF, SW7: ON       | 1.3373 | 1.3375 | 1.3377 | MHz               |
|                          | IF count output voltage           | V <sub>IF</sub> (FM)        | —            | V <sub>in</sub> = 80dBμV EMF, SW7: ON       | 250    | 290    | 330    | mV <sub>p-p</sub> |
|                          | IF count output sensitivity       | IF sens (FM)                | —            | SW7: ON                                     | 42     | 47     | 52     | dBμV EMF          |
| AM                       | Gain                              | G <sub>V</sub>              | —            | V <sub>in</sub> = 27dBμV EMF                | 20     | 38     | 70     | mVrms             |
|                          | Recovered output voltage          | V <sub>OD</sub>             | —            | V <sub>in</sub> = 60dBμV EMF                | 60     | 85     | 108    | mVrms             |
|                          | Signal to noise ratio             | S/N                         | —            | V <sub>in</sub> = 60dBμV EMF                | —      | 41     | —      | dB                |
|                          | Total harmonic distortion         | THD                         | —            | V <sub>in</sub> = 60dBμV EMF                | —      | 0.7    | —      | %                 |
|                          | Local OSC buffer output voltage   | V <sub>OSC</sub> (buff) AM  | —            | f <sub>OSC</sub> = 1.45 MHz                 | 55     | 75     | —      | mVrms             |
|                          | IF count output voltage           | V <sub>IF</sub> (AM)        | —            | V <sub>in</sub> = 60dBμV EMF, SW7: ON       | 250    | 290    | 350    | mV <sub>p-p</sub> |
|                          | IF count output sensitivity       | IF sens (AM)                | —            | SW7: ON                                     | 33     | 38     | 43     | dBμV EMF          |
| Pin 17 output resistance |                                   | R <sub>17</sub>             | —            | FM mode                                     | —      | 0.75   | —      | kΩ                |
|                          |                                   |                             | —            | AM mode                                     | —      | 15.5   | —      |                   |

| Characteristic     |                                     |          | Symbol                       | Test Circuit                | Test Condition                                                           |                         | Min  | Typ. | Max | Unit  |
|--------------------|-------------------------------------|----------|------------------------------|-----------------------------|--------------------------------------------------------------------------|-------------------------|------|------|-----|-------|
| MPX                | Input resistance                    |          | R <sub>IN</sub>              | —                           | —                                                                        |                         | —    | 55   | —   | kΩ    |
|                    | Output resistance                   |          | R <sub>OUT</sub>             | —                           | —                                                                        |                         | —    | 5    | —   | kΩ    |
|                    | Max. composite signal input voltage |          | V <sub>in</sub> MAX (Stereo) | —                           | L + R = 90%, P = 10%,<br>SW3: LPF ON<br>f <sub>m</sub> = 1 kHz, THD = 3% |                         | —    | 700  | —   | mVrms |
|                    | Separation                          |          | Sep.                         | —                           | L + R =<br>180 mVrms,<br>P = 20 mVrms<br>SW3: LPF ON                     | f <sub>m</sub> = 100 Hz | —    | 45   | —   | dB    |
|                    |                                     |          |                              |                             |                                                                          | f <sub>m</sub> = 1 kHz  | 35   | 45   | —   |       |
|                    |                                     |          |                              |                             |                                                                          | f <sub>m</sub> = 10 kHz | —    | 45   | —   |       |
|                    | Total harmonic distortion           | Monaural | THD (Monaural)               | —                           | V <sub>in</sub> = 200 mVrms                                              |                         | —    | 0.3  | —   | %     |
|                    |                                     | Stereo   | THD (Stereo)                 | —                           | L+R = 180 mVrms,<br>P = 20 mVrms, SW3: LPF ON                            |                         | —    | 0.3  | —   |       |
|                    | Voltage gain                        |          | G <sub>V</sub>               | —                           | V <sub>in</sub> = 200 mVrms                                              |                         | -2.7 | -1.2 | 0.2 | dB    |
|                    | Channel balance                     |          | C.B.                         | —                           | V <sub>in</sub> = 200 mVrms                                              |                         | -1.5 | 0    | 1.5 | dB    |
|                    | Stereo LED sensitivity              | ON       | V <sub>L</sub> (ON)          | —                           | Pilot input (19 kHz)                                                     |                         | —    | 10   | 14  | mVrms |
|                    |                                     | OFF      | V <sub>L</sub> (OFF)         | —                           |                                                                          |                         | 5    | 8    | —   |       |
|                    | Stereo LED hysteresis               |          | V <sub>H</sub>               | —                           | To LED turn off from LED turn on                                         |                         | —    | 2    | —   | mVrms |
|                    | Capture range                       |          | C.R.                         | —                           | P = 15 mVrms                                                             |                         | —    | ±8   | —   | %     |
| Signal noise ratio |                                     | S/N      | —                            | V <sub>in</sub> = 200 mVrms |                                                                          | —                       | 80   | —    | dB  |       |
| Muting attenuation |                                     |          | MUTE                         | —                           | V <sub>in</sub> = 200 mVrms                                              |                         | —    | 80   | —   | dB    |

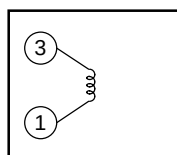
## Coil Data

| Coil No.              | Test Freq. | L ( $\mu H$ ) | Co (pF) | Qo | Turns |     |                 |     |     | Wire (mm $\phi$ ) | Reference                      |
|-----------------------|------------|---------------|---------|----|-------|-----|-----------------|-----|-----|-------------------|--------------------------------|
|                       |            |               |         |    | 1-2   | 2-3 | 1-3             | 1-4 | 4-6 |                   |                                |
| L <sub>1</sub> FM RF  | 100 MHz    | —             | —       | 79 | —     | —   | 2 $\frac{1}{2}$ | —   | —   | 0.16UEW           | Toko Co., Ltd.<br>666SNF-305NK |
| L <sub>2</sub> FM OSC | 100 MHz    | —             | —       | 76 | —     | —   | 2               | —   | —   | 0.16UEW           | Toko Co., Ltd.<br>666SNF-306NK |
| T <sub>1</sub> AM OSC | 796 kHz    | 268           | —       | 65 | 19    | 95  | —               | —   | —   | 0.05UEW           | Toko Co., Ltd.<br>5PNR-5146Y   |
| T <sub>2</sub> AM IFT | 455 kHz    | —             | 470     | 60 | —     | —   | 109             | —   | 7   | 0.05UEW           | Toko Co., Ltd.<br>5PLG-5147X   |

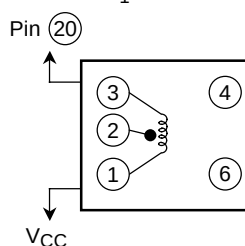
L<sub>1</sub>: FM RF



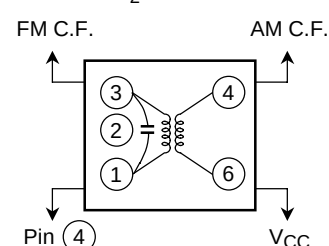
L<sub>2</sub>: FM OSC



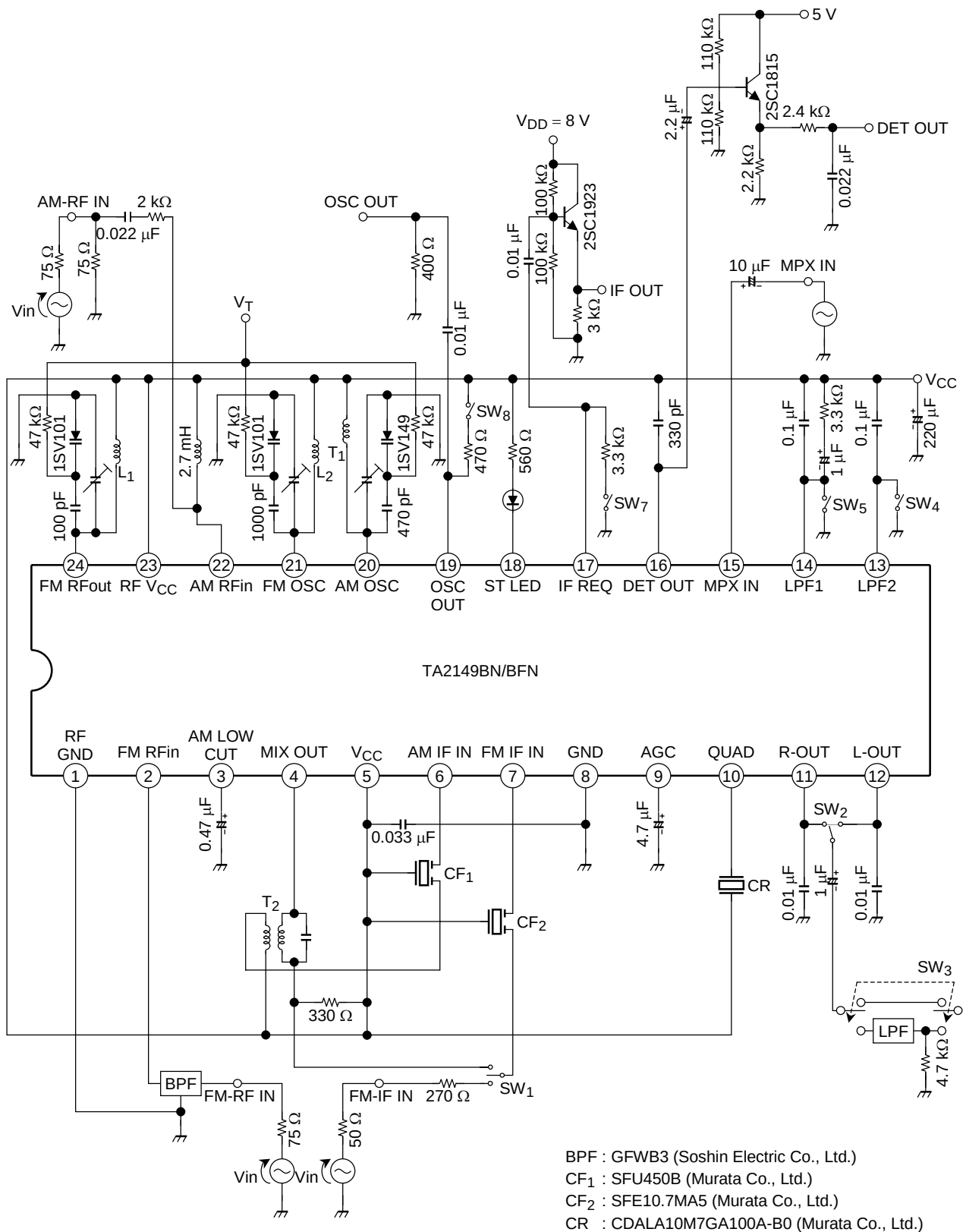
T<sub>1</sub>: AM OSC



T<sub>2</sub>: AM IFT



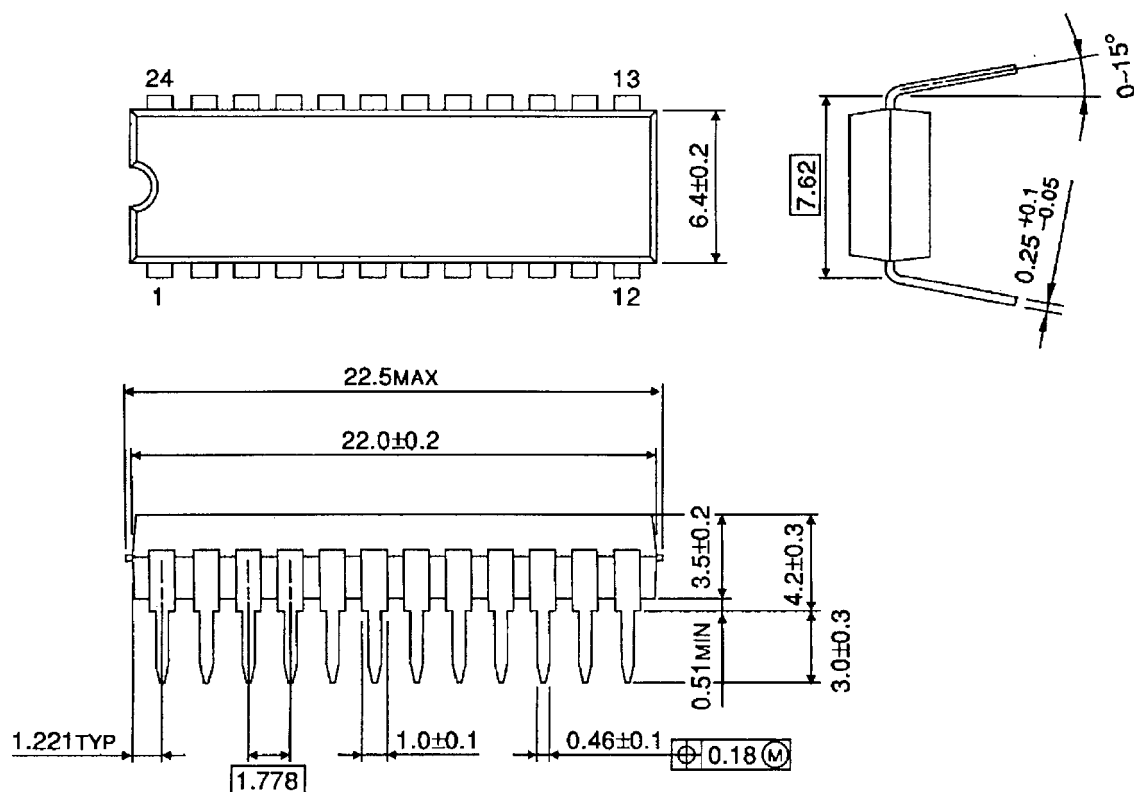
## Test Circuit



## Package Dimensions

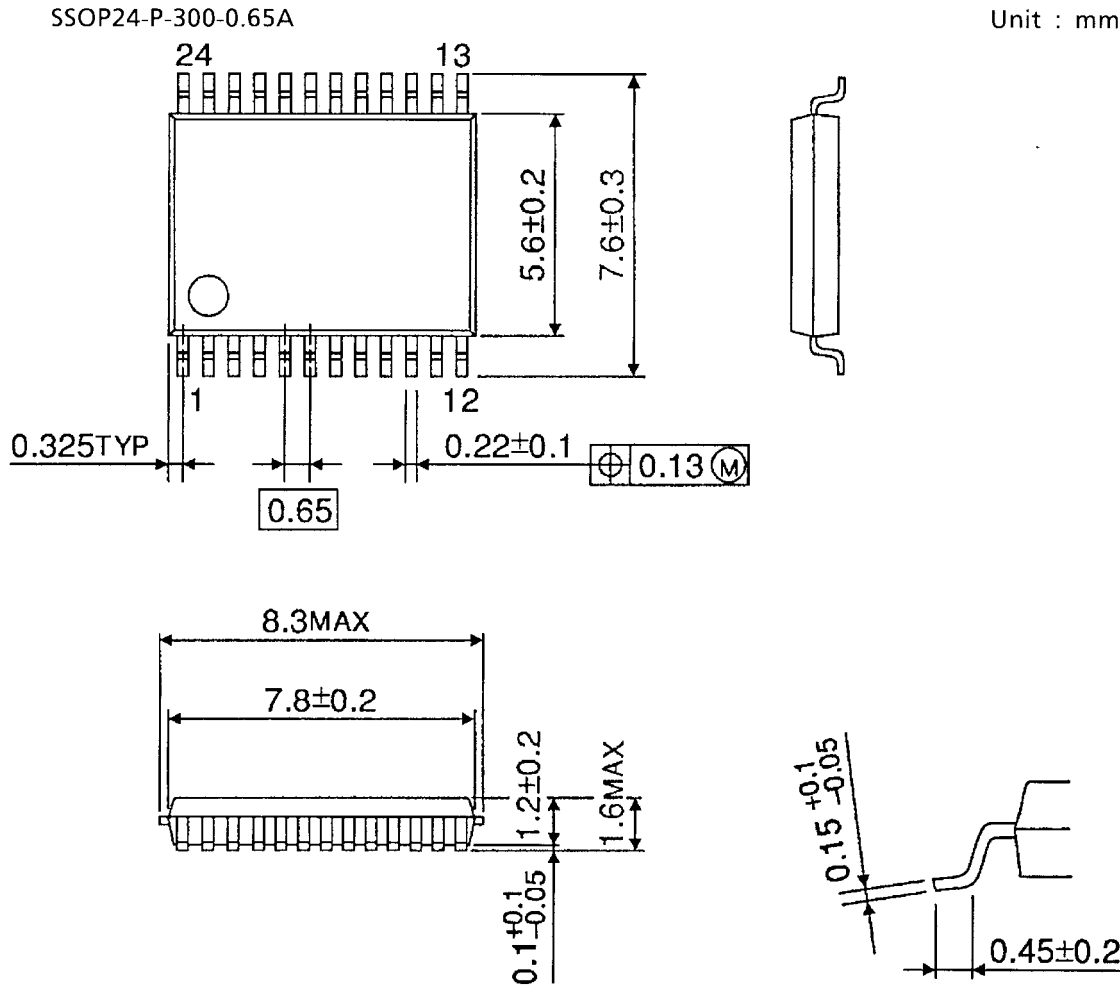
SDIP24-P-300-1.78

Unit : mm



Weight: 1.2 g (typ.)

Package Dimensions



Weight: 0.14 g (typ.)

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000707EBA

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