TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

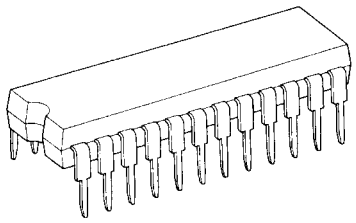
TA2149BN, TA2149BFN

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.

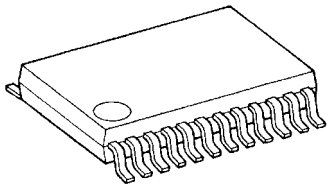
This is suitable for Digital Tuning System Applications. FM Local Oscillation Voltage is set up low relativity, for NEW FCC.

TA2149BN



SDIP24-P-300-1.78

TA2149BFN



SSOP24-P-300-0.65A

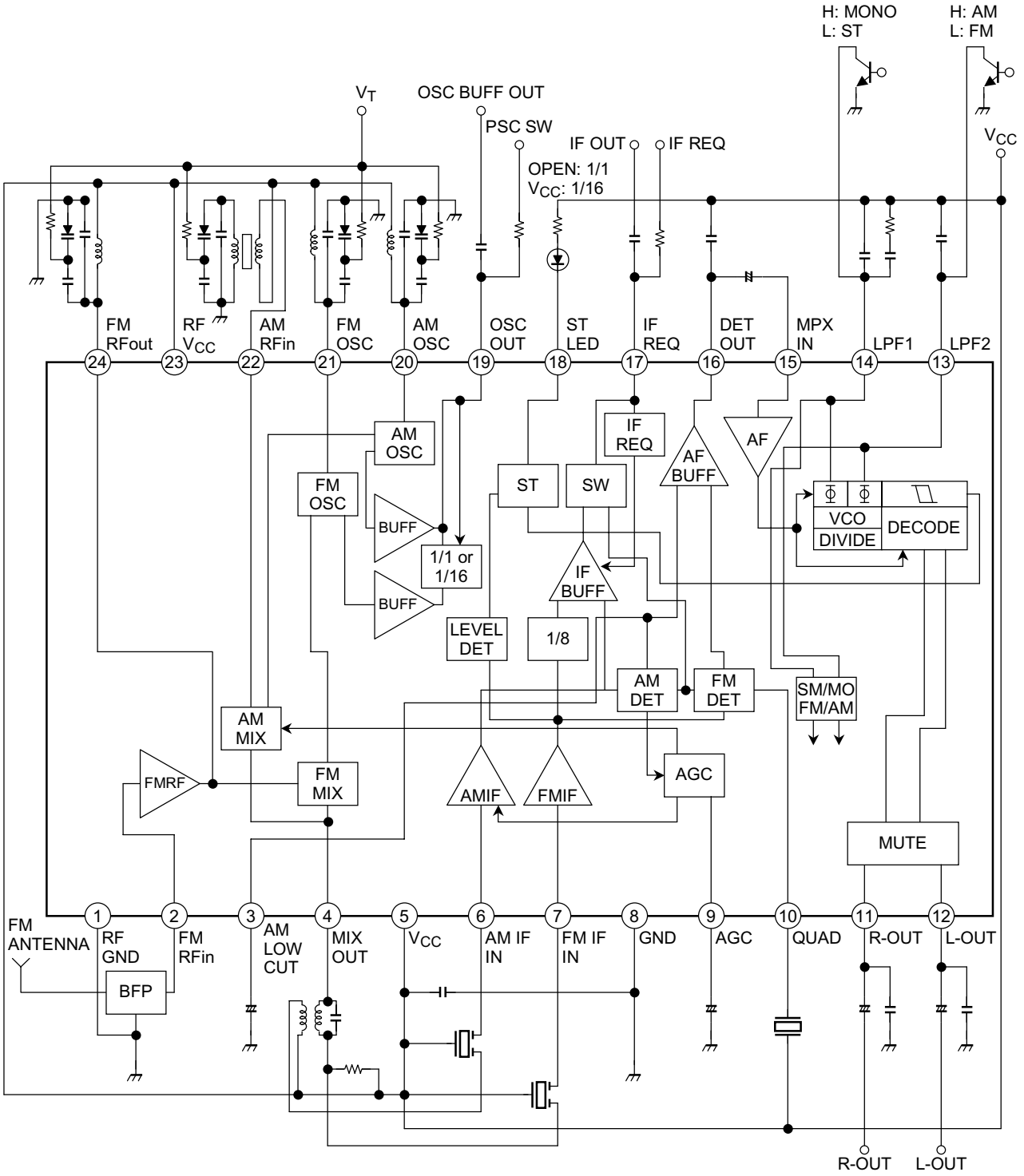
Weight:
SDIP24-P-300-1.78: 1.2 g (Typ.)
SSOP24-P-300-0.65A: 0.14 g (Typ.)

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 V, Ta = 25°C)
  I_{CCq} (FM) = 13 mA (Typ.)
  I_{CCq} (AM) = 8.5 mA (Typ.)
- Operating Supply voltage range: V_{CC} = 1.8~7 V (Ta = 25°C)

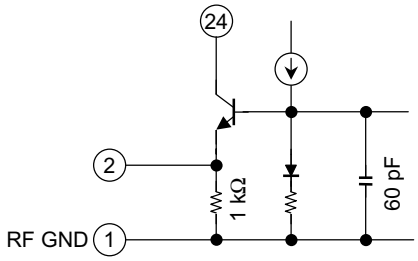
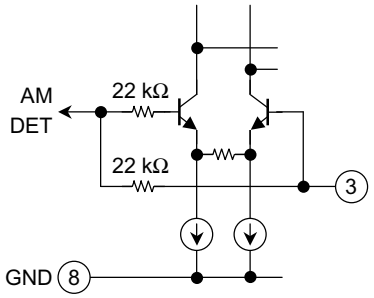
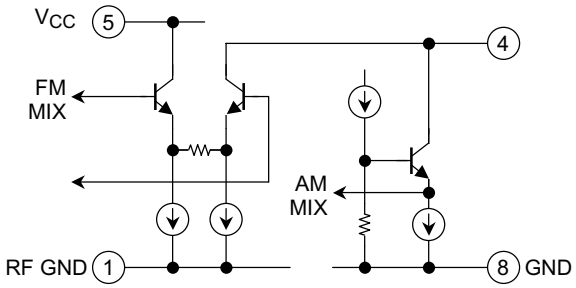
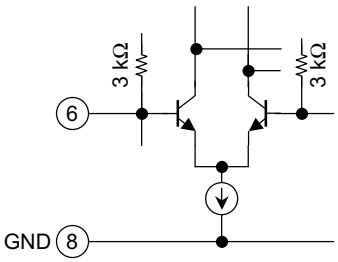
Note 1: Handle with care to prevent devices from deteriorations by static electricity.

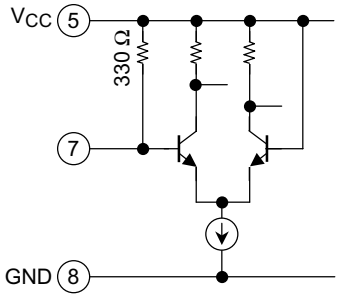
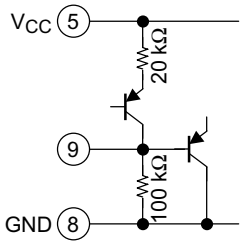
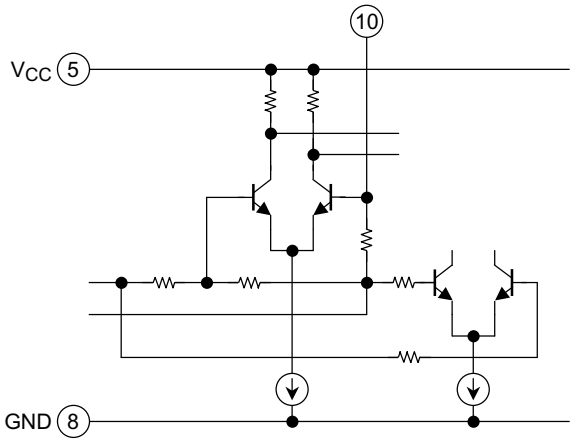
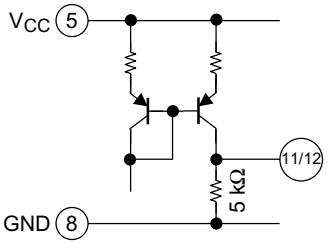
Block Diagram

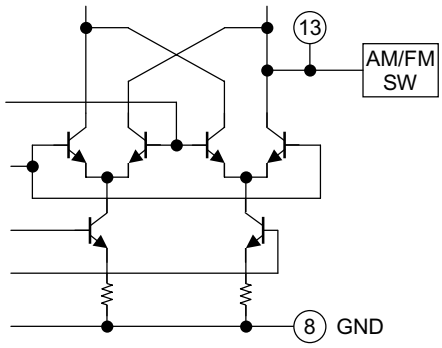
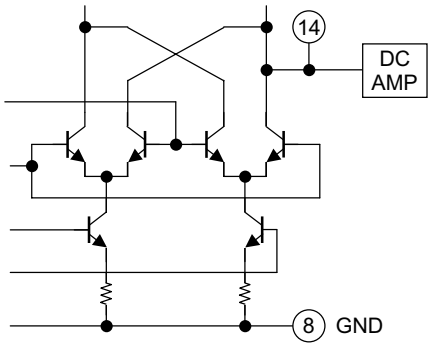
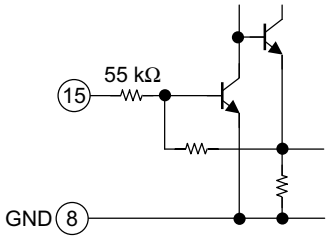
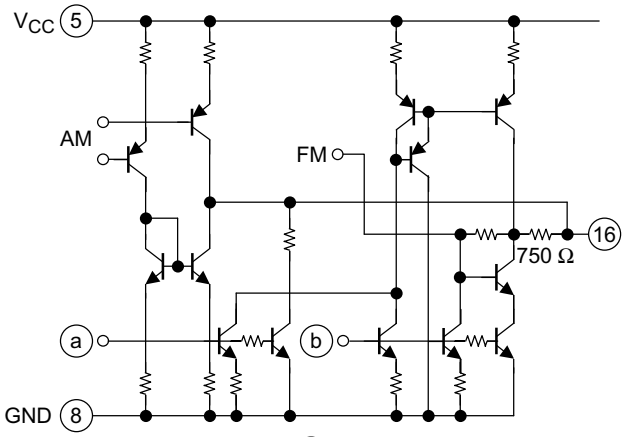


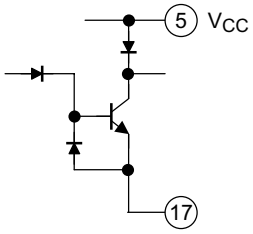
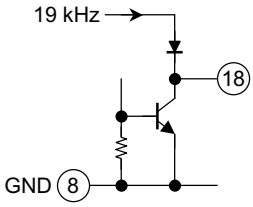
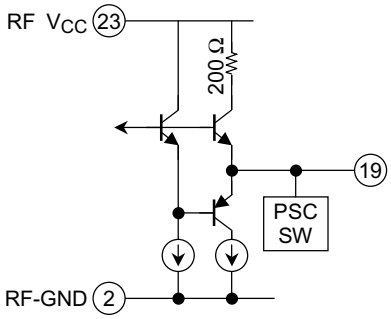
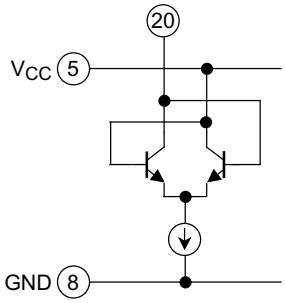
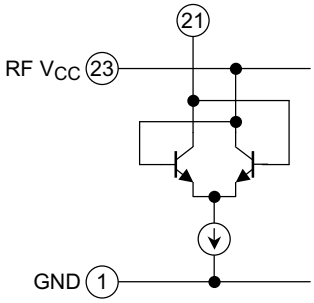
Explanation of Terminals

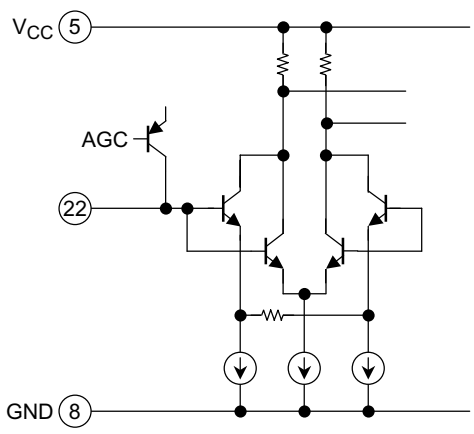
(Terminal Voltage: Typical terminal voltage at no signal with test circuit, V_{CC} = 3 V, Ta = 25°C)

PIN No.	Characteristic	Internal Circuit	Terminal Voltage (Typ.) (V)	
			AM	FM
1	RF GND (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} (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 (GND for AM, FM IF, MPX)	—	0	0
9	AGC		0	0
10	QUAD		2.5	2.2
11 12	R-OUT L-OUT		1.2	1.2

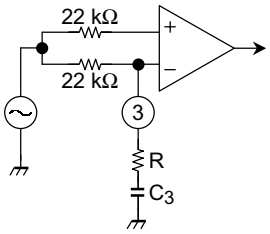
PIN No.	Characteristic	Internal Circuit	Terminal Voltage (Typ.) (V)	
			AM	FM
13	LPF2 • LPF terminal for phase detector • Bias terminal AM/FM SW circuit V_{13} = GND → AM V_{13} = OPEN → FM		0	2.2
14	LPF1 • LPF terminal for synchronous detector • VCO stop terminal V_{14} = GND → VCO STOP		0.7	2.4
15	MPX IN		0.7	0.7
16	DET OUT		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_{CC} (V_{CC} 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



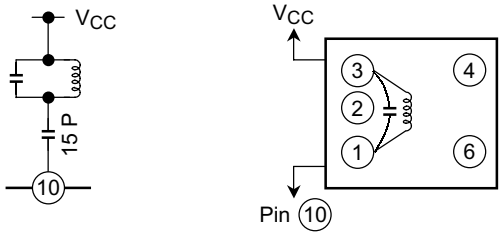
- The AM Low-Cut action is carried out by the bypass of the high frequency component of the positive-feedback signal at the AF AMP stage.
  The external capacitor: C_3 by-pass this component.
- The cut-off frequency fL is determined by the internal resistance 22 kΩ (Typ.) and the external capacitor C_3 as following;

$$f_L = \frac{1}{2\times\pi\times22\times10^3\times C_3}(\text{Hz})$$

- In the case of the AM Low-Cut function is not needed, set up the value of C_3 over 1 μF.
  In the condition of $C_3 \geqq 1$ 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

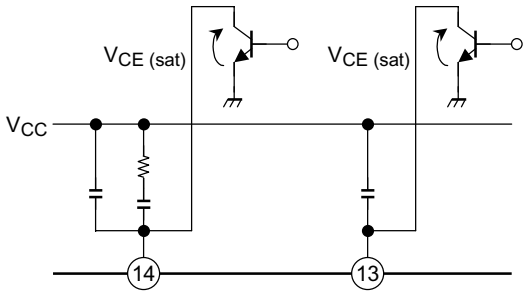
For the FM detection circuit, detection coil is able to use instead of ceramic discriminator.
Recommended circuit and recommended coil are as follows. (In this case, please take care that V_{in} (lim.) falls a little.)



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. 600BEAS-10018Z

3. FM/AM switch and forced monaural switch.

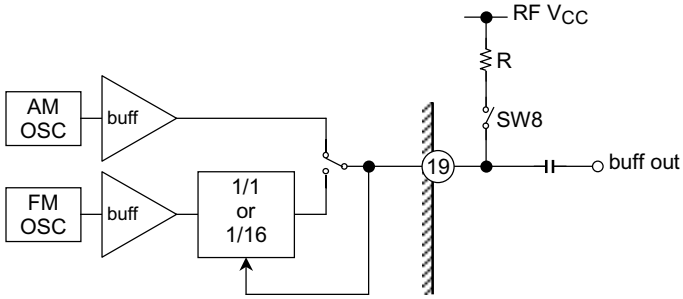
- FM/AM switchover and stereo/forced monaural switchover are done by pin 13 and pin 14.
- FM/AM switch (pin 13)
  V13: Low (Active Low, V_{th} = 0.2 V (Typ.), I_{th} 30 μA (Typ.) → AM
  V13: OPEN → FM
- Stereo/forced monaural switch (pin 14)
  V14: Low (Active Low, V_{th} = 0.2 V (Typ.), I_{th} 30 μA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



4. V_{CC} Line

This ICs have two voltage supply terminals, V_{CC} (for AM, FM IF, MPX stage) and RF V_{CC} (for FM RF stage). Set up the potential difference between V_{CC} and RF V_{CC} 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.

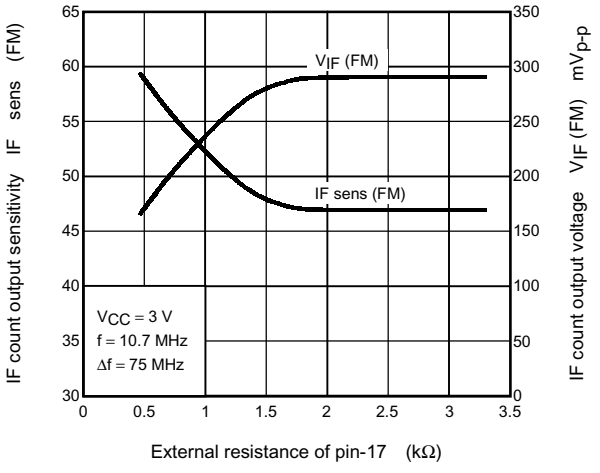


Divider of FM OSC ON/OFF switching is controlled by external pull-up resistor of pin 19.
In case of Divider of FM OSC is used, it is necessary to set up the value of R under 470 Ω (typ.).
When R is over 470 Ω, it is feared that Divider is not operating. (At this time, buffer output frequency is equal 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_{CC}	8	V
LED current		ILED	10	mA
LED voltage		VLED	8	V
Power dissipation	TA2149BN	P_D (Note 2)	1200	mW
	TA2149BFN		500	
Operating temperature		T_{opr}	−25~75	°C
Storage temperature		T_{stg}	−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_{CC} = 3 V, F/E: f = 98 MHz, f_m = 1 kHz FM IF: f = 10.7 MHz, Δf = ±75 kHz, f_m = 1 kHz AM: f = 1 MHz, MOD = 30%, f_m = 1 kHz MPX: f_m = 1 kHz)

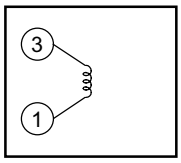
Characteristic		Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Supply current		$I_{CC\ (FM)}$	—	V_{in} = 0, FM mode	—	13	16.5	mA
		$I_{CC\ (AM)}$	—	V_{in} = 0, AM mode	—	8.5	11.0	
F/E	Input limiting voltage	$V_{in\ (lim)}$	—	V_{in} = 60dBμV EMF, −3dB limiting	—	10	—	dBμV EMF
	Local OSC buffer output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

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

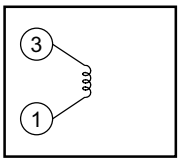
Coil Data

Coil No.	Test Freq.	L (μH)	Co (pF)	Qo	Turns					Wire (mmϕ)	Reference
					1-2	2-3	1-3	1-4	4-6		
L_1 FM RF	100 MH**z**	—	—	79	—	—	$2\frac{1}{2}$	—	—	0.16UEW	Toko Co., Ltd. 666SNF-305NK
L_2 FM OSC	100 MH**z**	—	—	76	—	—	2	—	—	0.16UEW	Toko Co., Ltd. 666SNF-306NK
T_1 AM OSC	796 kH**z**	268	—	65	19	95	—	—	—	0.05UEW	Toko Co., Ltd. 5PNR-5146Y
T_2 AM IFT	455 kH**z**	—	470	60	—	—	109	—	7	0.05UEW	Toko Co., Ltd. 5PLG-5147X

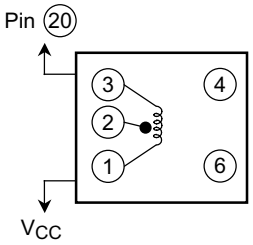
L_1: FM RF



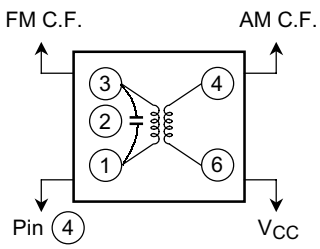
L_2: FM OSC



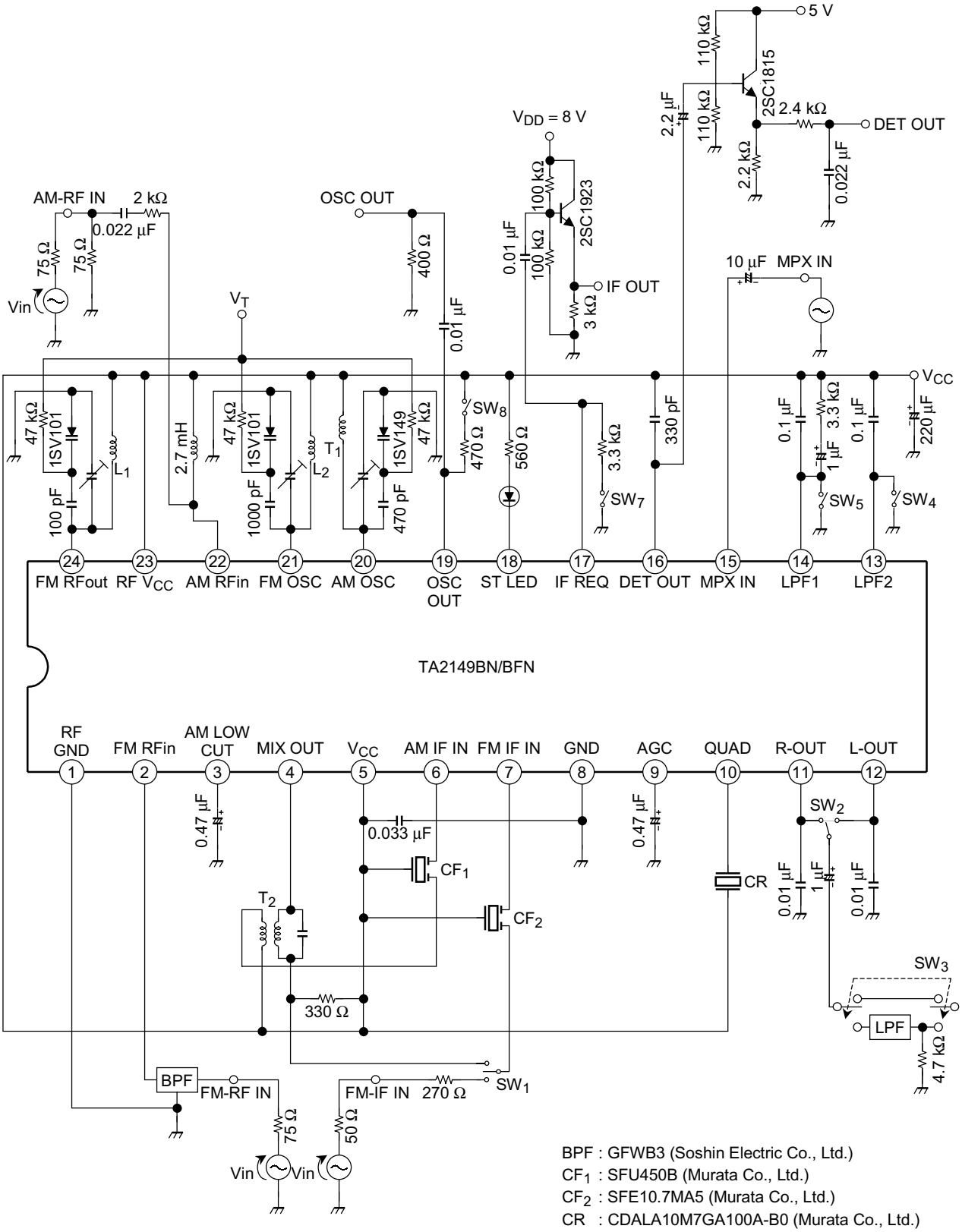
T_1: AM OSC



T_2: AM IFT



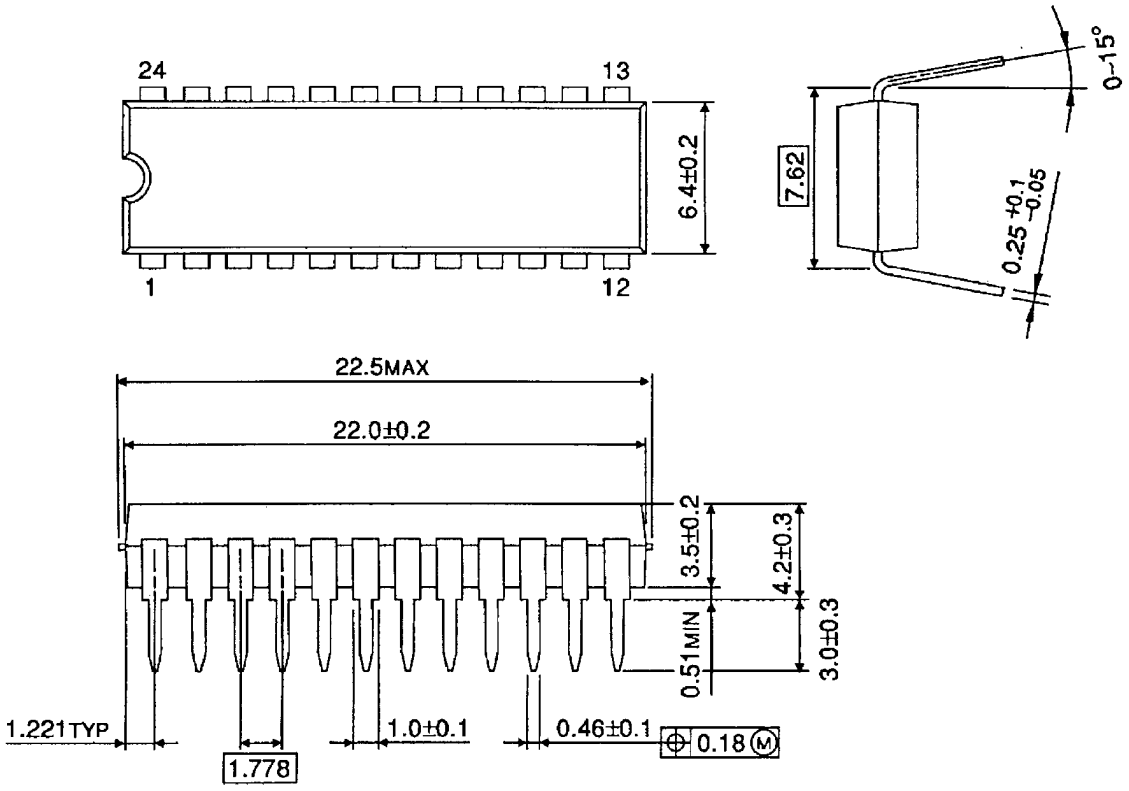
Test Circuit



BPF : GFWB3 (Soshin Electric Co., Ltd.)
CF_1 : SFU450B (Murata Co., Ltd.)
CF_2 : SFE10.7MA5 (Murata Co., Ltd.)
CR : CDALA10M7GA100A-B0 (Murata Co., Ltd.)

Package Dimensions

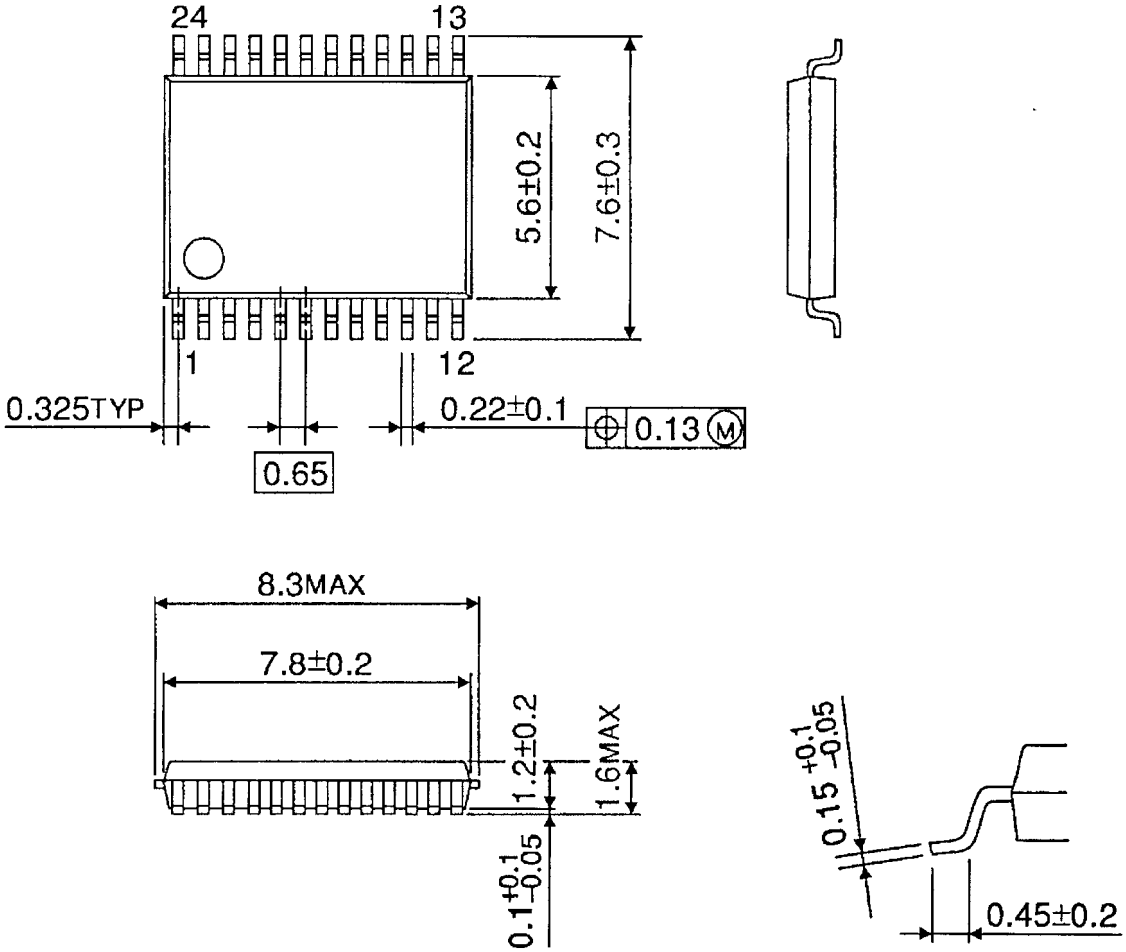
SDIP24-P-300-1.78 Unit : mm



Weight: 1.2 g (Typ.)

Package Dimensions

SSOP24-P-300-0.65A Unit : mm



Weight: 0.14 g (Typ.)