

TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT SILICON MONOLITHIC

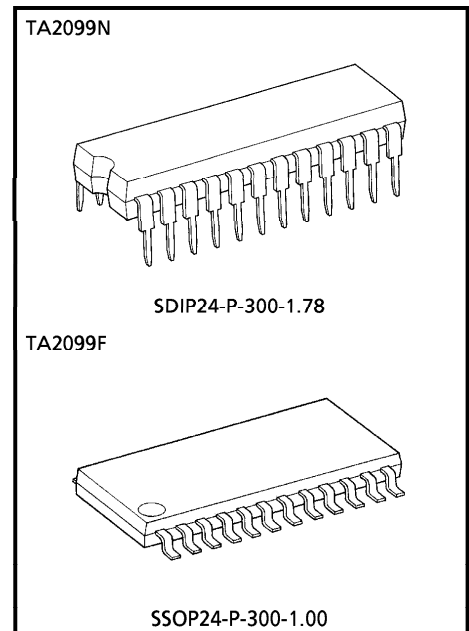
# TA2099N, TA2099F

## AM / FM IF + FM STEREO DETECTOR (FOR DIGITAL TUNING SYSTEM)

TA2099N and TA2099F are the AM / FM IF + FM Stereo Detector IC, which is designed for DTS Radios. This is included many functions and this can be used for Digital Tuning System with IF Counter.

### FEATURES

- Suitable for combination with Digital Tuning System which has IF Counter.
  - AM / FM IF Count Output for IF Counter
  - Built-in Mute Circuit for IF Count Output
  - Built-in Mute Circuit for Audio Output
  - FM IF Count Output Sensitivity is adjustable by External Resistance
- Built-in FM Narrow Detector Circuit
  - Band Width is adjustable by External Resistance
- FM LED ON Sensitivity is adjustable by External Resistance
- Built-in Resonance Circuit for FM Stereo Detector VCO
- Built-in FM Blender Control Circuit
- Built-in Anti-birdie Circuit
- Built-in AM Local OSC Buffer Output Circuit
- Operating Supply Voltage Range :  $V_{CC} = 4.0 \sim 9 \text{ V}$  ( $T_a = 25^\circ\text{C}$ )

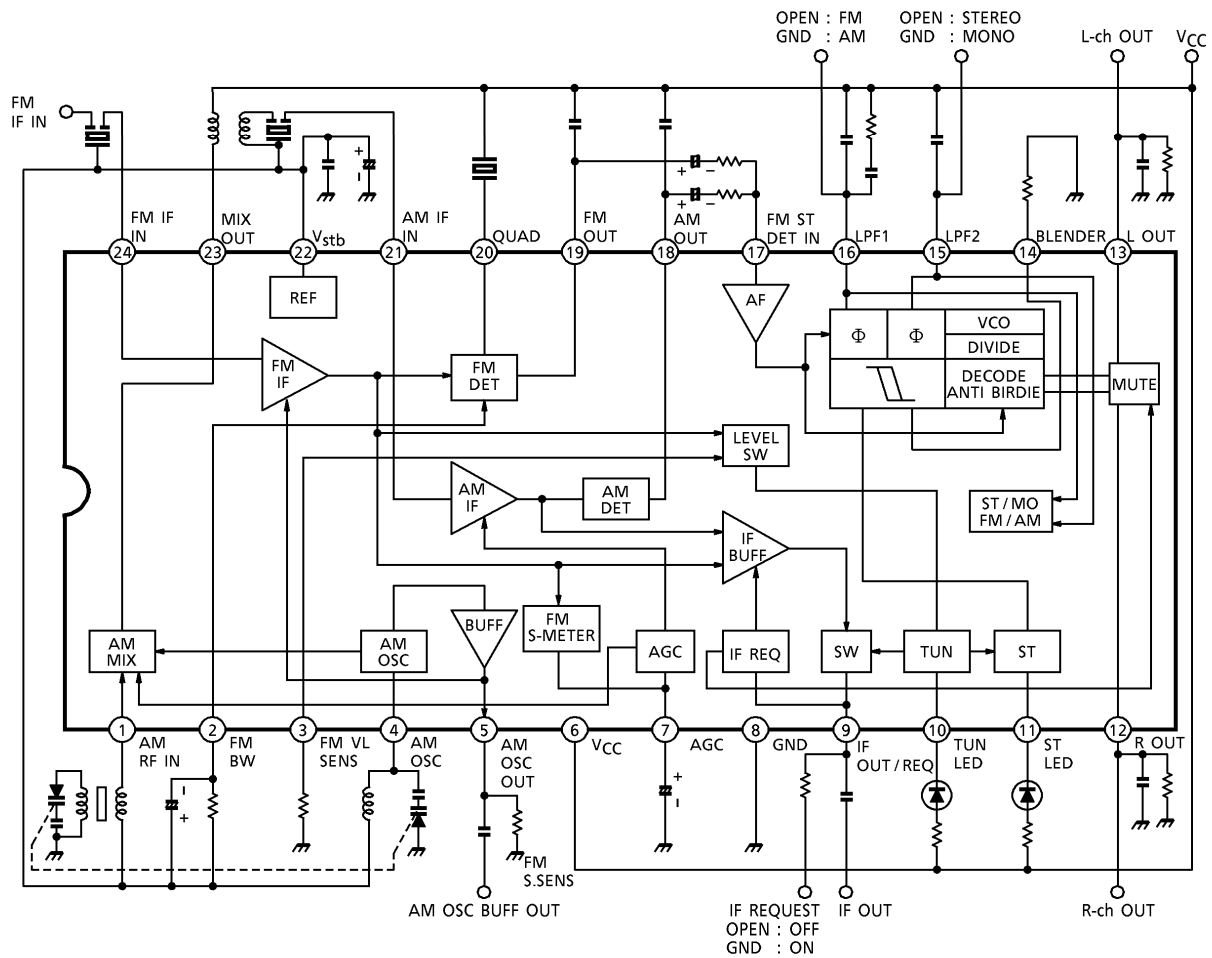


Weight  
SDIP24-P-300-1.78 : 1.2 g (Typ.)  
SSOP24-P-300-1.00 : 0.31 g (Typ.)

980910EBA1

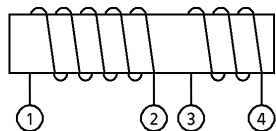
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BLOCK DIAGRAM



\* The Toshiba evaluation board uses the bar antenna shown below.

USE	f	L	Q <sub>o</sub>	NUMBER OF WINDINGS		WINDING THICKNESS (mm)	NOTE
				1-2	3-4		
MW ANT	796 kHz	220 μH	150~220	59	17	3 / 0.07 μATC	Mitsumi L-3107



**TERMINAL EXPLANATION** (Terminal voltage shows the typical value at  $T_a = 25^\circ\text{C}$ ,  $V_{CC} = 5\text{V}$ ,  $SW_3$  : OFF,  $SW_9$  : GND and non-signal test circuit)

PIN No.	CHARACTERISTIC	INTERNAL CIRCUIT	DC VOLTAGE (V)	
			FM	AM
1	AM RF IN		2.0	2.0
2	FM BW ● FM Band Width Adjust Terminal		2.0	2.0
3	FM VL SENS ● FM LED ON Sensitivity Adjust Terminal		0.1	0.1

PIN No.	CHARACTERISTIC	INTERNAL CIRCUIT	DC VOLTAGE (V)	
			FM	AM
4	AM OSC		2.0	2.0
5	AM OSC OUT / FM S.SENS ● AM OSC Buff Output Terminal ● FM IF Count Output Sensitivity Adjust Terminal		1.3	1.3
6	VCC	—	5.0	5.0
7	AGC (FM S-METER)		0.2	1.3
8	GND	—	0	0

PIN No.	CHARACTERISTIC	INTERNAL CIRCUIT	DC VOLTAGE (V)	
			FM	AM
9	IF OUT / REQ ● IF Count Output Terminal ● IF Count Output / FM ST DET Mute Circuit Control Terminal SW <sub>3</sub> : GND → ON SW <sub>3</sub> : Open → OFF		—	—
10	TUN LED		—	—
11	ST LED		—	—
12	R OUT		1.2	1.2
13	L OUT			

PIN No.	CHARACTERISTIC	INTERNAL CIRCUIT	DC VOLTAGE (V)	
			FM	AM
14	<p><b>BLENDER</b></p> <ul style="list-style-type: none"> <li>● FM Blender Control Adjust Terminal</li> </ul>		0.3	0.3
15	<p><b>LPF2</b></p> <ul style="list-style-type: none"> <li>● LPF Terminal for Synchronous Detector</li> <li>● VCO Stop Terminal</li> <li>V<sub>15</sub> = GND → VCO Stop (Monaural)</li> <li>V<sub>15</sub> = Open → VCO Run (Stereo)</li> </ul>		3.5	1.4
16	<p><b>LPF1</b></p> <ul style="list-style-type: none"> <li>● LPF Terminal for Phase Detector</li> <li>● Bias Terminal for AM / FM Switch Circuit</li> <li>V<sub>16</sub> = GND → AM</li> <li>V<sub>16</sub> = Open → FM</li> </ul>		3.5	0
17	<p><b>FM ST DET IN</b></p>		1.2	1.2

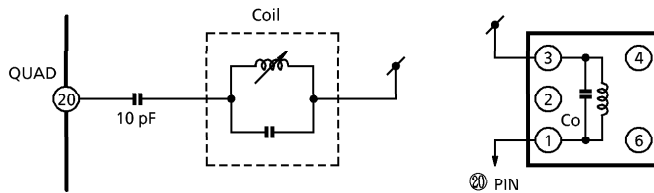
PIN No.	CHARACTERISTIC	INTERNAL CIRCUIT	DC VOLTAGE (V)	
			FM	AM
18	AM DET OUT		0	1.3
19	FM DET OUT		1.4	2.0
20	QUAD		1.8	2.3
21	AM IF IN		2.0	2.0

PIN No.	CHARACTERISTIC	INTERNAL CIRCUIT	DC VOLTAGE (V)	
			FM	AM
22	V <sub>stb</sub>		2.0	2.0
23	AM MIX OUT		5.0	5.0
24	FM IF IN		2.0	2.0



OPERATIONS IN DETAIL

1. Application circuit when using a coil demodulator

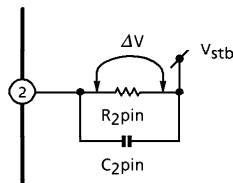


COIL DATA

	f (Hz)	C <sub>0</sub> (pF)	Q <sub>0</sub>	NUMBER OF WIRE TURNS			WIRE (mm φ)	REMARKS
				1-2	2-3	1-3		
FM DET	10.7 M	51	45			30	0.08 φ 2UEW	TOKO Co., Ltd. 600BEAS-10018Z

2. Center meter adjustment

It can be switch ΔV, pin voltages between 2-pin and 22-pin (V<sub>stb</sub>) for narrow band detection or both side of R<sub>2pin</sub> voltages, to 0V to adjust a coil. This adjustment made possible to set the voltage to center voltage and the midpoint of lighting LED band to the frequency (10.7 MHz).



Assembled C<sub>2pin</sub> and R<sub>2pin</sub> compose HPF.

$$f_c = \frac{1}{2\pi RC}$$

Select R<sub>2pin</sub> in accordance with specifications for narrow band detection and set C<sub>2pin</sub> by following that of resistance. Please take these into account.

3. Function Switching

(1) FM → AM switching

Pin 16 : Connect the LPF1 pin to GND. (Adjust using external parts so that the voltage does not exceed 0.6 V.)

(2) STEREO → MONO switching

Pin 15 : Connect the LPF2 pin to GND. (Adjust using external parts so that the voltage does not exceed 0.6 V.)

Note : When STEREO / FM is selected, the multiplex VCO frequency changes due to 0.1 μA flow.

(3) IF OUT → ON switching

Pin 9 : When the voltage on the IF OUT / REQ pin is set to 1.3 V or below (V<sub>stb</sub> (2 V) – V<sub>be</sub> (0.7 V)) and about 500 μA current flows, switch to ON. Toshiba recommends a load of 2.2 kΩ.

## 4. External Change Function

(1) Narrowband detector : When the FM IF input signal is off-center, 10.7 MHz, by a few kHz, the detector turns TUN-LED OFF.

Pin 2 : Adjusts bandwidth using the resistor of the FM BW pin. In combination with the C2 pin, the R2 pin configures an HPF. The smaller the pin 2 capacitance, the higher the HPF cutoff. Note that when low-frequency sound is input, although tuning is maintained, the detector may turn TUN-LED OFF.

(2) LED ON sensitivity adjustment

Pin 3 : Uses the FM VL SENS pin resistor value to change the ON sensitivity of TUN-LED.

(3) IF counter output sensitivity adjustment

Pin 5 : Uses the FM S. SENS pin resistor value to change the sensitivity of the IF count output at IF count ON.

\* : For the LED on sensitivity, (2) and (3) are linked.

At IF count ON (connect resistor for pin 9 to GND), the internal current depending on the pin 5 resistor value changes the IF amp gain, the S meter startup, and the IF input level (sensitivity). The LED ON sensitivity turns the LED ON by comparing the voltage which depends on the pin 3 resistor value with the S meter voltage. The change in S meter startup (sensitivity) at IF count ON causes the LED ON sensitivity set at IF count OFF to change. Therefore, confirm the LED ON sensitivity according to the seek operation specification.

(4) Blender control

Pin 14 : Changes the MPX L and R signal separation according to the input level set by the resistance.

## 5. Others

(1) Vstb

Pin 22 : Set to 2 V internally.

(2) QUAD

Pin 20 : Supports both a ceramic discriminator and a detector coil for QUAD. See 1, in Description of Operation.

Note that when a detector coil is used, S/N and the skew ratio deteriorates.

(3) L, R output

Pins 12 and 13 : L-OUT and R-OUT pins are used for current output. The external resistor is set to output impedance. This is specified when the load is 5.1 k $\Omega$  and 0.01  $\mu$ F.

(4) AGC

Pin 7 : Also used as the FM S meter.

## MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V <sub>CC</sub>	14	V
LED Current	I <sub>LED</sub>	10	mA
LED Voltage	V <sub>LED</sub>	14	V
Power Dissipation	TA2099N	P <sub>D</sub> (Note)	1200
	TA2099F		400
Operating Temperature	T <sub>opr</sub>	-25~75	°C
Storage Temperature	T <sub>stg</sub>	-55~150	°C

(Note) : Derated above 25°C in the proportion of 9.6 mW / 1°C.

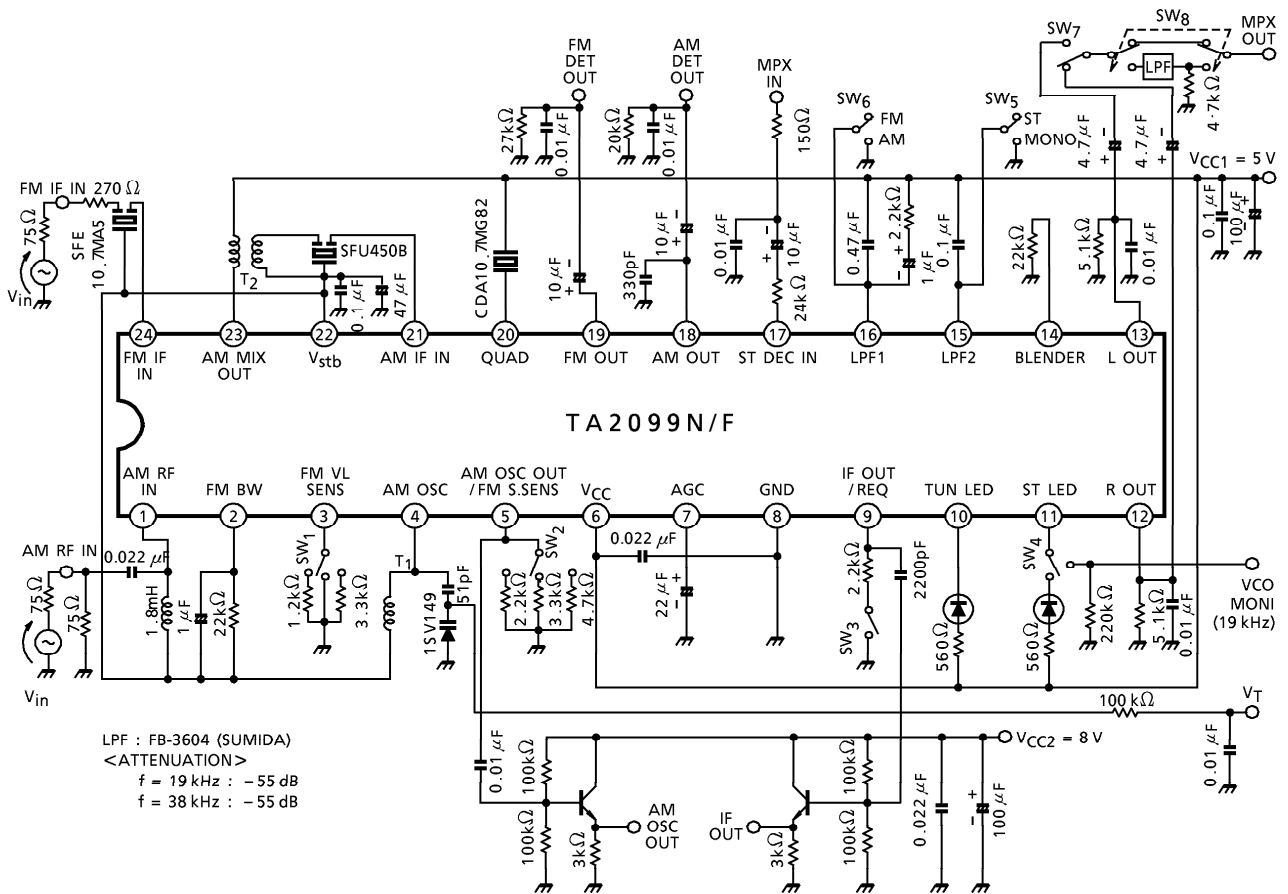
## ELECTRICAL CHARACTERISTICS

Unless otherwise specified,  $T_a = 25^\circ\text{C}$ ,  $V_{CC1} = 5\text{ V}$ ,  $SW_3 = \text{OFF}$ FM IF :  $f = 10.7\text{ MHz}$ ,  $\Delta f = \pm 22.5\text{ kHz}$ ,  $f_m = 1\text{ kHz}$ AM :  $f = 1\text{ MHz}$ ,  $\text{MOD} = 30\%$ ,  $f_m = 1\text{ kHz}$ FM ST DET :  $f_m = 1\text{ kHz}$ 

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT	
Supply Current		$I_{CC}(\text{FM})$	1	FM mode, $V_{in} = 0$	—	17	23	mA	
		$I_{CC}(\text{AM})$	1	AM mode, $V_{in} = 0$	—	14	20		
FM IF	Input Limiting Voltage	$V_{in}(\text{lim})$	1	-3 dB limiting point	37	41	45	$\text{dB}\mu\text{V EMF}$	
	Recovered Output Voltage	$V_{OD}(\text{FM})$	1	$V_{in} = 80\text{ dB}\mu\text{V EMF}$	75	100	125	$\text{mV}_{\text{rms}}$	
	Signal to noise Ratio	$S/N(\text{FM})$	1	$V_{in} = 80\text{ dB}\mu\text{V EMF}$	—	71	—	dB	
	Total Harmonic Distortion	$\text{THD}(\text{FM})$	1	$V_{in} = 80\text{ dB}\mu\text{V EMF}$	—	0.1	—	%	
	AM Rejection Ratio	AMR	1	$V_{in} = 80\text{ dB}\mu\text{V EMF}$	—	55	—	dB	
	LED ON Sensitivity	$V_L(\text{FM})$	1	$I_L = 1\text{ mA}$	$SW_1 : 0\ \Omega$	—	41	—	$\text{dB}\mu\text{V EMF}$
					$SW_1 : 1.2\text{ k}\Omega$	41	46	51	
					$SW_1 : 3.3\text{ k}\Omega$	—	54	—	
IF Count Output Voltage	$V_{IF}(\text{FM})$	1	$SW_3 : \text{ON}$ , $V_{in} = 80\text{ dB}\mu\text{V EMF}$	240	290	—	$\text{mV}_{\text{p-p}}$		
IF Count Output Sensitivity	$IF_{\text{sens}}(\text{FM})$	1	$SW_3 : \text{ON}$	$SW_2 : 2.2\text{ k}\Omega$	—	58	—	$\text{dB}\mu\text{V EMF}$	
				$SW_2 : 3.3\text{ k}\Omega$	47	53	59		
				$SW_2 : 4.7\text{ k}\Omega$	—	50	—		
AM	Gain	$G_V$	1	$V_{in} = 23\text{ dB}\mu\text{V EMF}$	28	50	82	$\text{mV}_{\text{rms}}$	
	Recovered Output Voltage	$V_{OD}(\text{AM})$	1	$V_{in} = 60\text{ dB}\mu\text{V EMF}$	70	100	130	$\text{mV}_{\text{rms}}$	
	Signal to Noise Ratio	$S/N(\text{AM})$	1	$V_{in} = 60\text{ dB}\mu\text{V EMF}$	—	45	—	dB	
	Total Harmonic Distortion	$\text{THD}(\text{AM})$	1	$V_{in} = 60\text{ dB}\mu\text{V EMF}$	—	0.5	—	%	
	LED ON Sensitivity	$V_L(\text{AM})$	1	$I_L = 1\text{ mA}$	21	26	31	$\text{dB}\mu\text{V EMF}$	
	Local OSC Buffer Output Voltage	$V_{\text{OSC}}(\text{AM})$	1	$f_{\text{OSC}} = 1.45\text{ MHz}$	350	480	—	$\text{mV}_{\text{p-p}}$	
				$f_{\text{OSC}} = 27\text{ MHz}$	—	480	—		
	IF Count Output Voltage	$V_{IF}(\text{AM})$	1	$SW_3 : \text{ON}$ , $V_{in} = 60\text{ dB}\mu\text{V EMF}$	250	370	—	$\text{mV}_{\text{p-p}}$	
IF Count Output Sensitivity	$IF_{\text{sens}}(\text{AM})$	1	$SW_3 : \text{ON}$	—	26	—	$\text{dB}\mu\text{V EMF}$		

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT	
FM ST DET	Max. Composite Input Voltage	$V_{in}$ (MAX) (STEREO)	1	L + R = 90%, P = 10% THD = 3%, SW <sub>g</sub> → LPF : ON	—	800	—	mV <sub>rms</sub>	
	Separation	Sep	1	L + R =	$f_m = 100$ Hz	—	45	—	dB
				180 mV <sub>rms</sub>	$f_m = 1$ kHz	35	45	—	
				P = 20 mV <sub>rms</sub>	$f_m = 10$ kHz	—	45	—	
	Total Harmonic Distortion	Mono	THD (MONO)	1	SW <sub>g</sub> → LPF : ON $V_{in} = 200$ mV <sub>rms</sub> (MONO)	—	0.05	—	%
		Stereo	THD (STEREO)		L + R = 180 mV <sub>rms</sub> , P = 20 mV <sub>rms</sub> SW <sub>g</sub> → LPF : ON	—	0.05	—	
	Voltage Gain		$G_V$ (ST)	1	$V_{in} = 200$ mV <sub>rms</sub> (MONO)	-2	-0.6	1	dB
	Channel Balance		C.B.	1	$V_{in} = 200$ mV <sub>rms</sub> (MONO)	-1.5	0	1.5	dB
	Stereo LED Sensitivity	ON	$V_L$ (ON)	1	Pilot input	—	10	16	mV <sub>rms</sub>
		OFF	$V_L$ (OFF)			4	8	—	
	Stereo LED Hysteresis		$V_H$	1	to LED turn-off form LED turn-on	—	2	—	mV <sub>rms</sub>
Capture Range		C.R.	1	P = 20 mV <sub>rms</sub>	—	± 4.5	—	%	
Signal to Noise Ratio		S / N (ST)	1	$V_{in} = 200$ mV <sub>rms</sub> (MONO)	—	80	—	dB	
VCO Frequency		$f_{vco} / 12$	1	Specified when SW <sub>4</sub> = ON, MPX VCO / 12	-300	19 k	+300	Hz	

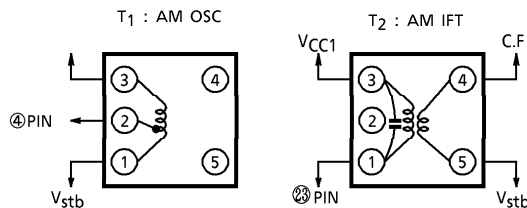
TEST CIRCUIT 1



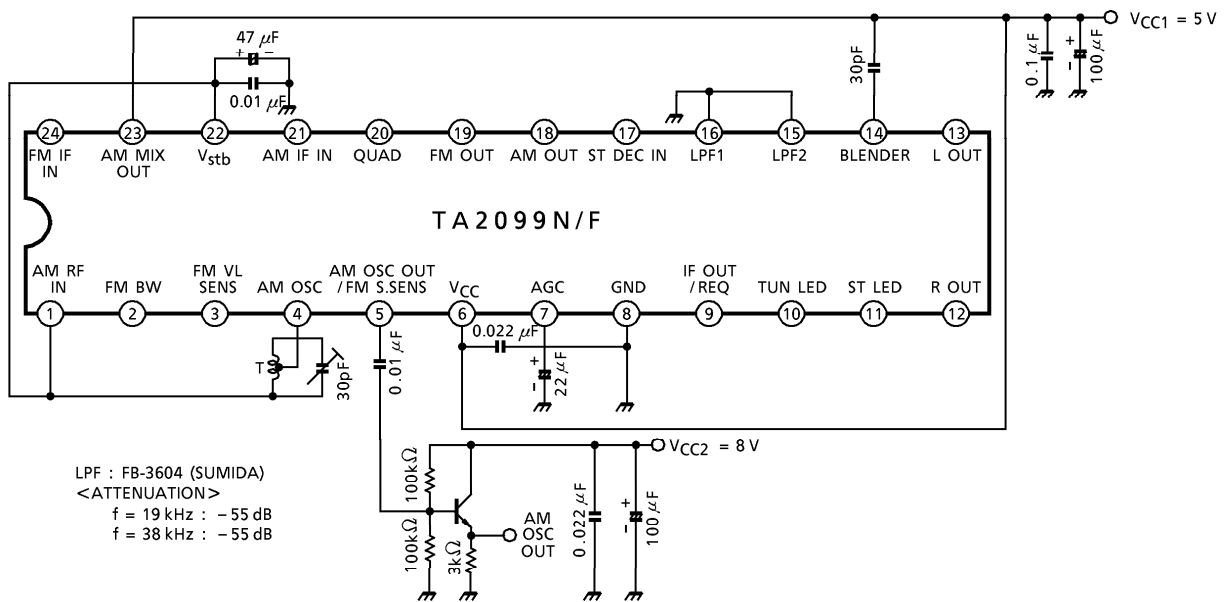
COIL DATA (TEST CIRCUIT 1)

COIL No.	f	L (μH)	C <sub>0</sub> (pF)	Q <sub>0</sub>	TURN				WIRE (mm φ)	REF. (COIL No.)
					1-2	2-3	1-3	4-6		
T <sub>1</sub> AM OSC	796 kHz	120	—	120	13	56	—	—	0.07 UEW	Ⓢ2157-2239-779 ⓉA7BRS-12552Y ⓂMJ-3273-3
T <sub>2</sub> AM IFT	455 kHz	—	330	100	—	—	110	6	0.08 UEW	Ⓢ4140-1289-311 Ⓣ7MES-11368N ⓂMJ-3337-1

- Ⓢ : SUMIDA ELECTRIC Co., Ltd.
- Ⓣ : TOKO Co., Ltd.
- Ⓜ : MITSUMI ELECTRIC Co., Ltd.



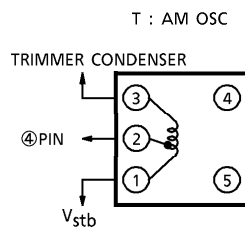
TEST CIRCUIT 2



COIL DATA (TEST CIRCUIT 2)

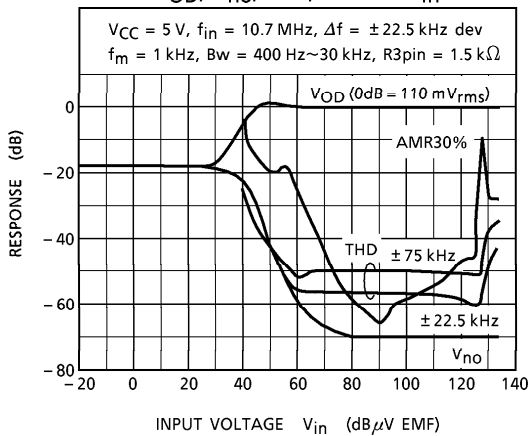
COIL No.	f	L ( $\mu$ H)	C <sub>0</sub> (pF)	Q <sub>0</sub>	TURN				WIRE (mm $\phi$ )	REF. (COIL No.)
					1-2	2-3	1-3	4-6		
T AM OSC	7.96 MHz	1.4	—	84	1	6	7	—	0.08 UEW	①7PL-1344Y

① : TOKO Co., Ltd.



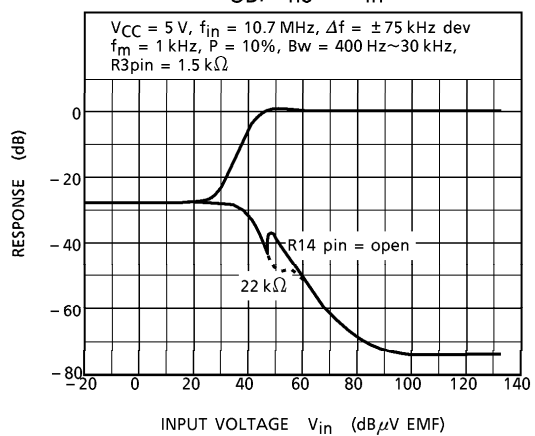
FM MONO

VOD, Vno, THD, AMR - Vin



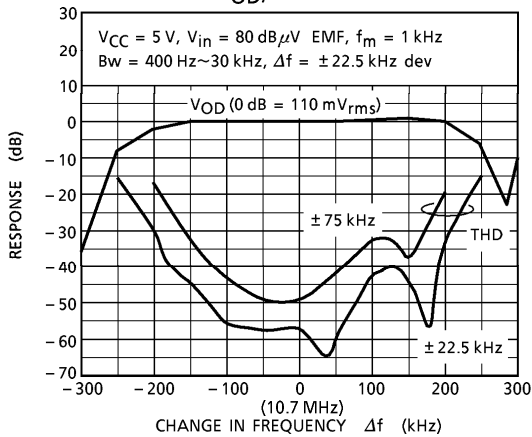
FM ST (Main)

VOD, Vno - Vin



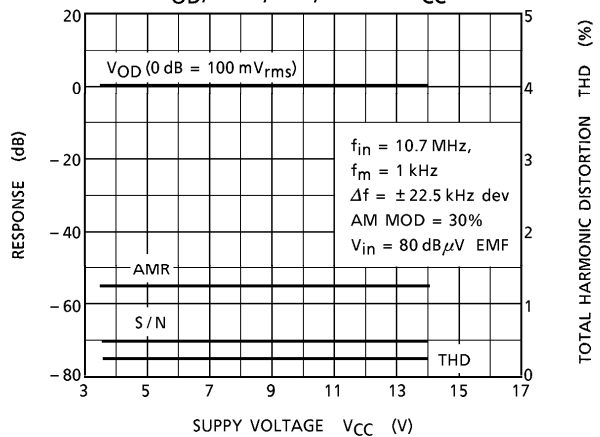
FM

VOD, THD - Δf

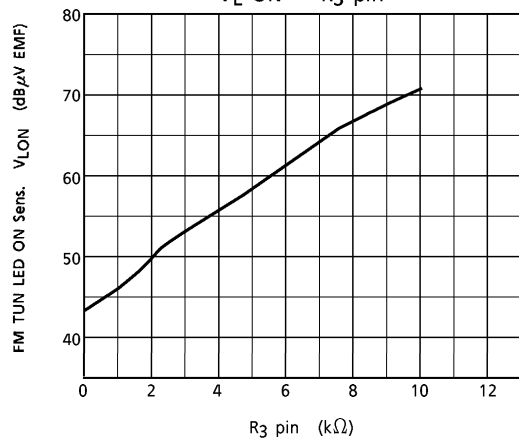


FM

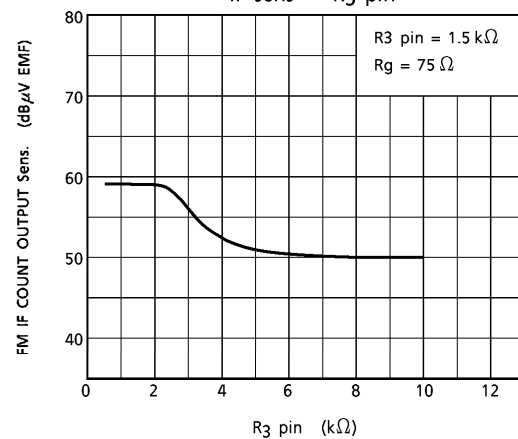
VOD, AMR, S/N, THD - VCC

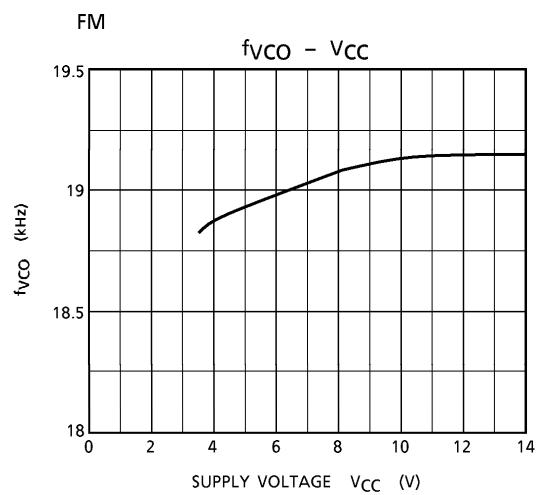
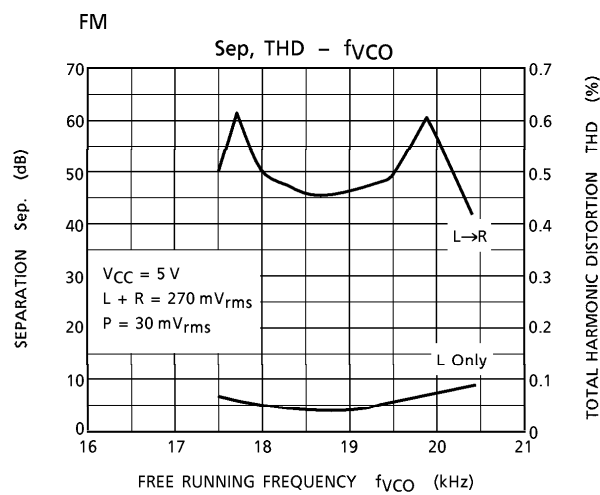
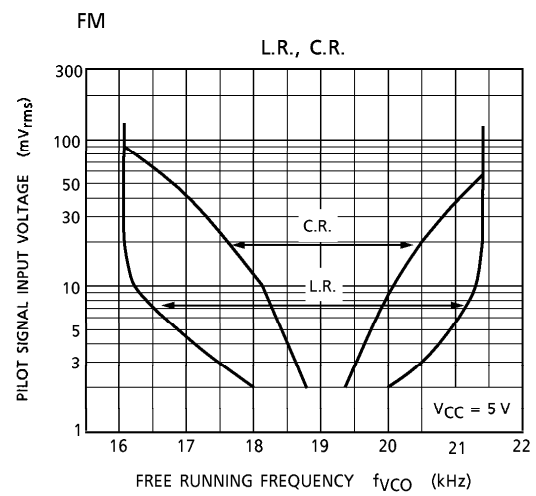
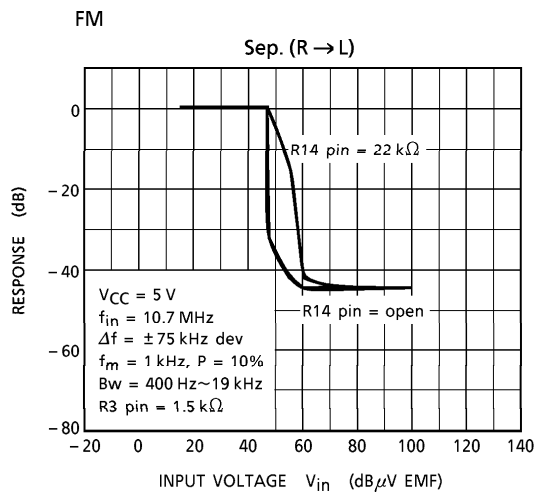
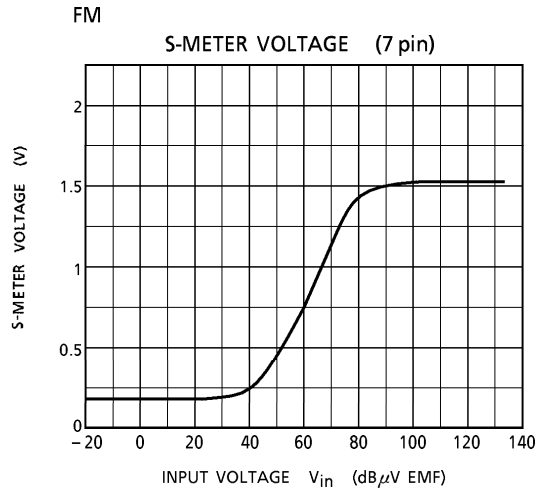
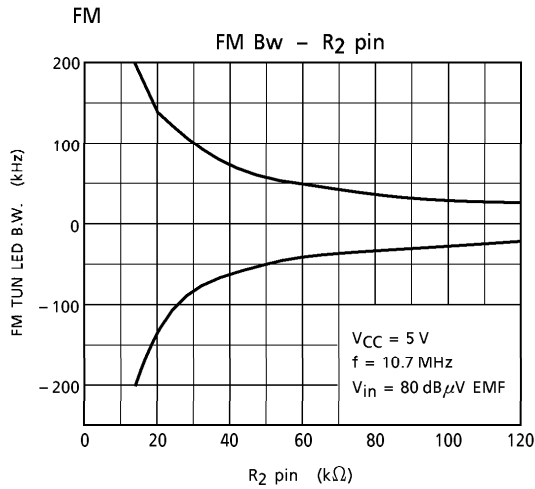


VL ON - R3 pin

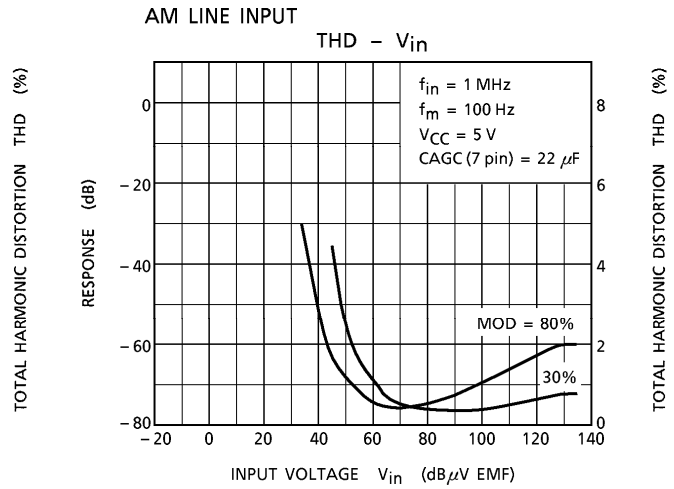
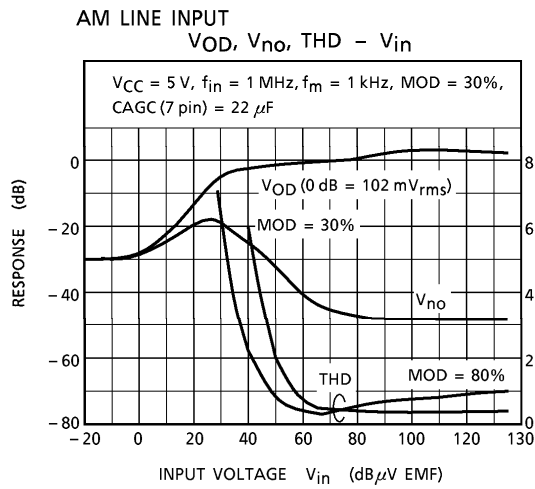
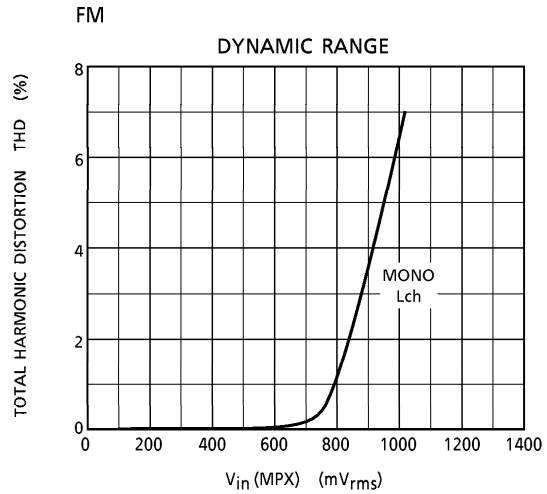
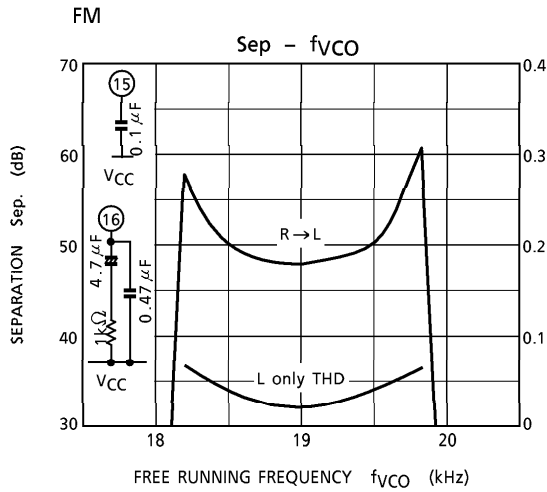


IF sens - R5 pin



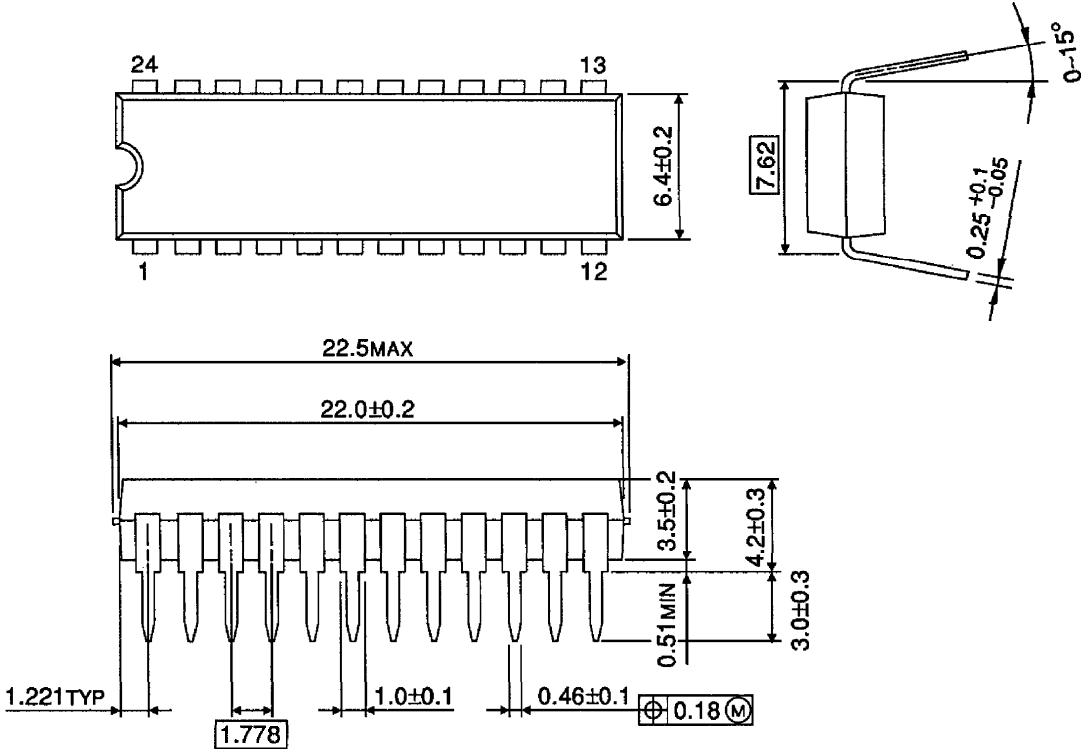






OUTLINE DRAWING  
SDIP24-P-300-1.78

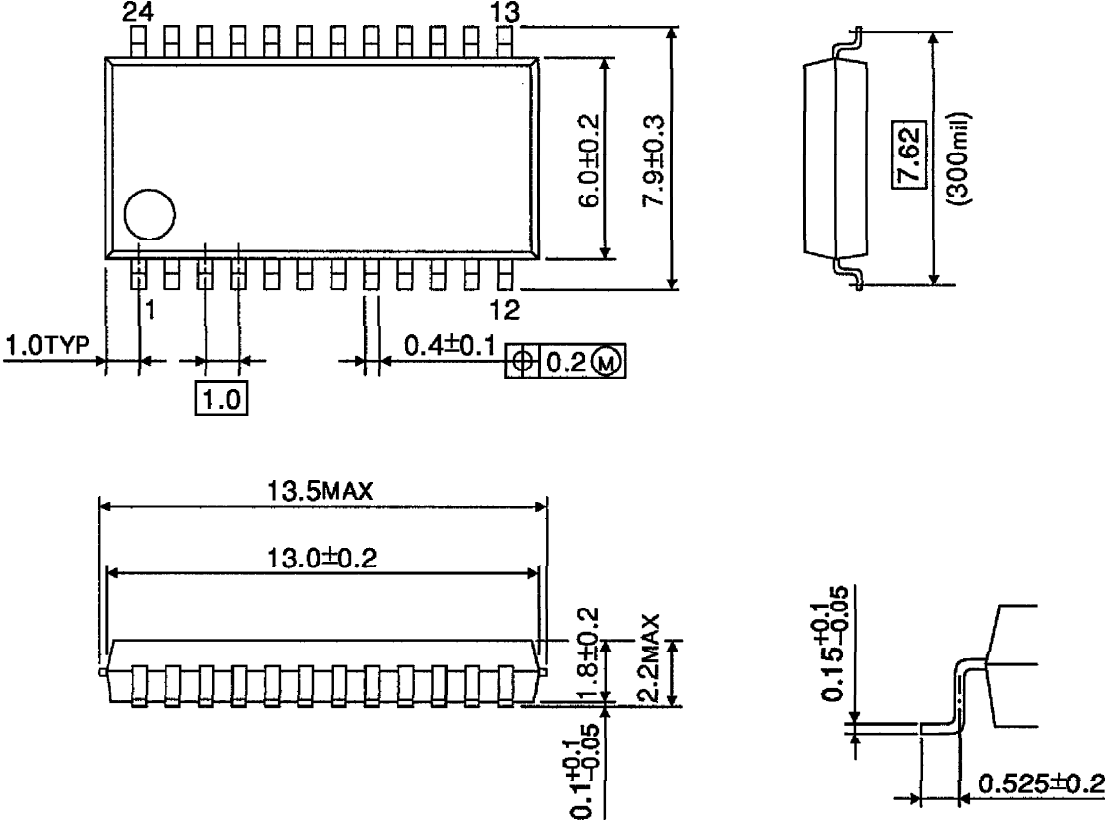
Unit : mm



Weight : 1.2 g (Typ.)

OUTLINE DRAWING  
SSOP24-P-300-1.00

Unit : mm



Weight : 0.31 g (Typ.)