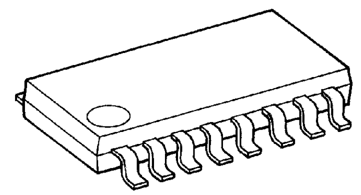
TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT SILICON MONOLITHIC

TA31136FG,TA31136FNG

FM IF DETECTOR IC FOR CORDLESS TELEPHONE

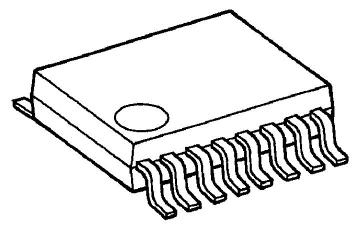
Low operation voltage FM IF detector IC. This IC is suitable for cordless telephone.

TA31136F



SSOP16-P-225-1.00A

TA31136FN



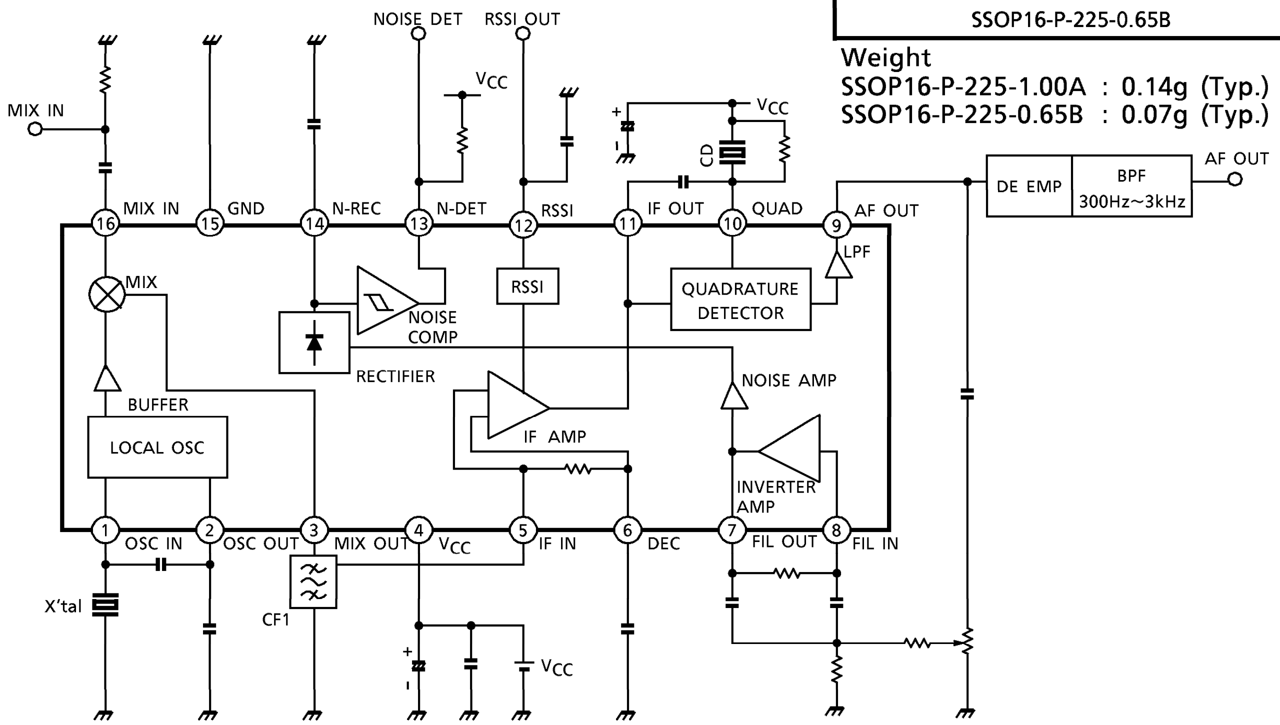
SSOP16-P-225-0.65B

Weight
SSOP16-P-225-1.00A : 0.14g (Typ.)
SSOP16-P-225-0.65B : 0.07g (Typ.)

FEATURES

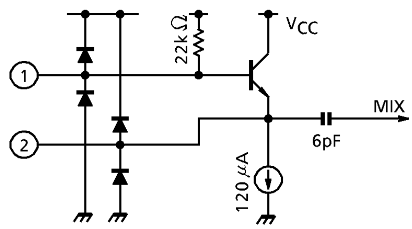
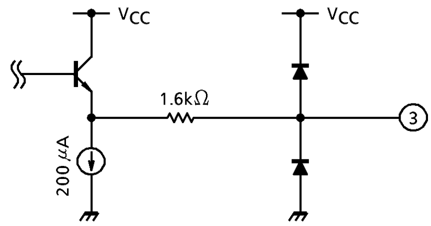
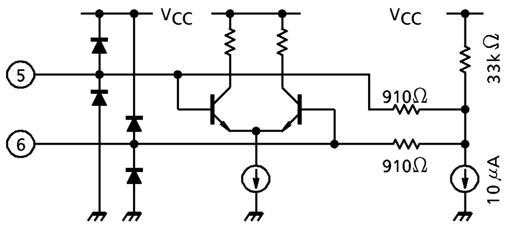
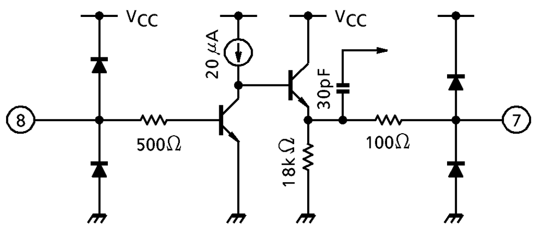
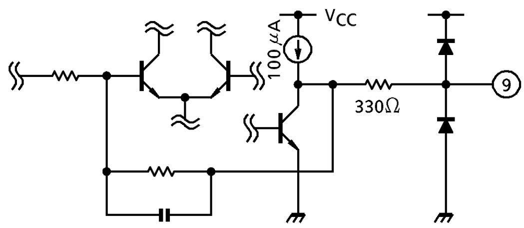
- Low operating voltage : V_{CC} = 1.8~5.5V
- Excellent temperature characteristics
- High sensitivity
  12dB sensitivity : 11dBμV EMF (Input 50Ω)
- High intercept point : 96dBμV (Input 50Ω)
- Quadrature detector, both ceramic and coil discriminators are usable
- Built-in 2nd MIX
  Operating frequency : 10~100MHz
- Built-in noise detection circuit
- RSSI function
- Very small package

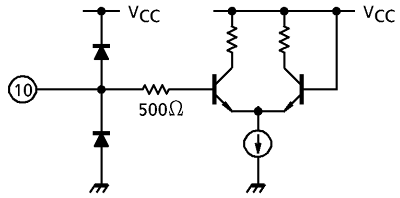
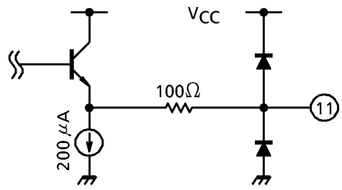
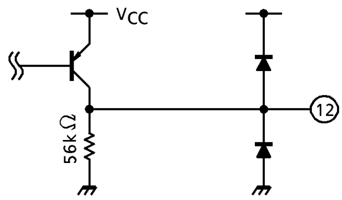
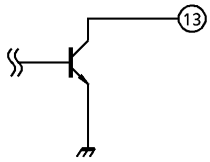
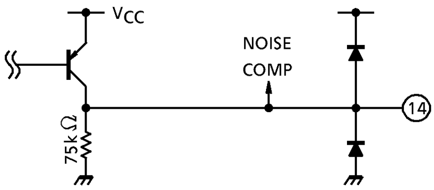
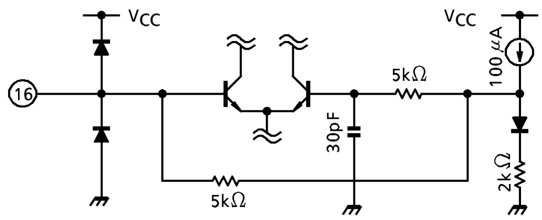
BLOCK DIAGRAM



TA31136FNG Package is Pb-Free.

PIN FUNCTION (The values of resistor and capacitor are typical.)

PIN No.	PIN NAME	FUNCTION	INTERNAL EQUIVALENT CIRCUIT
1	OSC IN	Local oscillator input and output terminals. Colpitts oscillator is formed by internal emitter follower and external X'tal. And external injection is possible from pin 2 or pin 1.	
2	OSC OUT		
3	MIX OUT	MIX output terminal. Output impedance is around 1.8kΩ.	
4	V_{CC}	Power supply	—
5	IF IN	2nd IF input and decoupling for bias. Input impedance is around 1.8kΩ.	
6	DEC		
7	FIL OUT	INVERTER AMP input and output terminals. BPF is composed of external capacitors and resistors. Connected internally to rectifier circuit by coupling capacitor.	
8	FIL IN		
9	AF OUT	Demodulate signal output terminal. Carrier leak is small as LPF is built-in. Output impedance is around 360Ω.	

PIN No.	PIN NAME	FUNCTION	INTERNAL EQUIVALENT CIRCUIT
10	QUAD	Phase shift signal input terminal of FM demodulator.	
11	IF OUT	Output terminal of IF AMP.	
12	RSSI	This terminal outputs DC level according to input signal level to IF AMP. Dynamic range is around 70dB.	
13	N-DET	The result of noise detection is output by comparing output voltage of N-REC terminal with internal refrence. Hysteresis range is about 100mV and output is open collector.	
14	N-REC	After output of INVERTER AMP amplified around 20dB, noise signal is rectified by external capacitor.	
15	GND	GND terminal.	—
16	MIX IN	1st IF signal input terminal. Input impedance is around 4kΩ at 21.7MHz.	

DESCRIPTION

1. Local oscillator external injection method

   Inject as shown in Figure 1, setting the injection level between 95dBμV and 100dBμV. A built-in BUFFER amp. minimizes leakage from the mixer.
   Input from pin 1 is possible as shown in Figure 2. However, when the input frequency is high, the level at pin 2 may not be sufficient, causing a decrease in sensitivity.
   In such a case, add resistor R_{51} and set the input signal so that signal level at pin 2 is 95~100dBμV.
   The input capacitance of pins 1 and 2 is respectively 1.5pF (typ.) and 4.6pF (typ.).

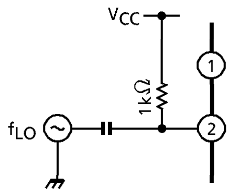


Figure 1

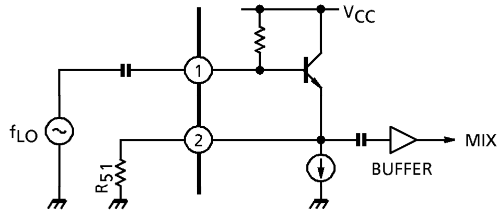


Figure 2

2. Overtone oscillation

   Figure 3 shows the basic configuration of the local oscillation circuit using overtone oscillation. The C_{51} and L_1 tuning circuits prevent crystal fundamental oscillation. Therefore, set C_{51} and L_1 to inductive at the fundamental frequency and capacitive at the overtone frequency.
   Since the level at pin 2 may decrease and the sensitivity may fall at high frequency as with external injection, adjust the oscillation level using R_{51}.

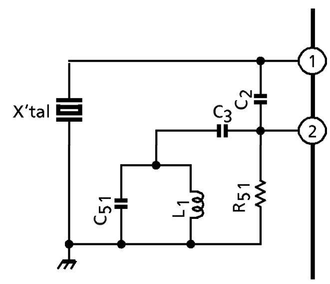
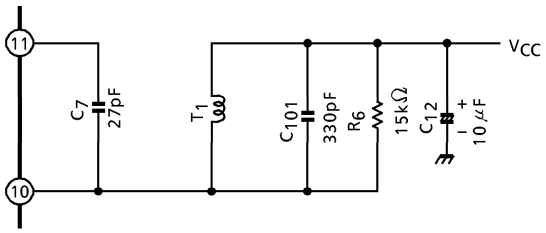


Figure 3

3. Detection circuit

   Detection stage is quadrature method.
   Oscillator is ceramic discriminator on reference application. In case of using coil, connect as shown in Figure 4. In this case, demodulation output V_{OD} is about 80mV_{rms}. Demodulation output can be increased by raising damping resistance R_3. However, be careful because the temperature dependency of the modulation output also increases.
   Center frequency f_0 and demodulation output depends largely on phase shifter and C_7. For C_7, use a capacitor with good temperature characteristics.
   In case of coil, especially C_{101}, use a capacitor with good temperature characteristics.



T_1 : 5114-JPS-010 (SUMIDA)

Figure 4

4. Demodulation output distortion factor

Demodulation output distortion factor is about −43dB when ceramic discriminator CDB450C24 used, is about −50dB when coil 5114-JPS-010 used. (IF 100dBμV EMF input, measured pin 9 before when input from MIX demodulation output distortion factor depends largely on a ceramic filter band and a group delay characteristic. Select ceramic filter adequately.

5. INVERTER AMP usage

The INVERTER AMP can be used to form a band pass filter as shown in Figure 4.
Set constants as in equations (1) to (3). However, because a low pass filter and a high pass filter are built in, it is recommended that center frequency f_0 be about 30kHz.

(1) $f_0 = \dfrac{1}{2\pi\sqrt{R_3 (R_4 /\!/ R_5) C^2}}$

(2) $G_V = R_3 / 2R_4$

(3) $Q^2 = \dfrac{R_3}{4 (R_4 /\!/ R_5)}$

at $R_4 \gg Rp$

Example R_3 = 150kΩ, R_4 = 330kΩ,
R_5 = 3.3kΩ, Rp = 20kΩ (VR)
C = 220pF provide ;
$f_0 \simeq$ 31kHz, $G_V \simeq$ −13dB
$Q \simeq 12$

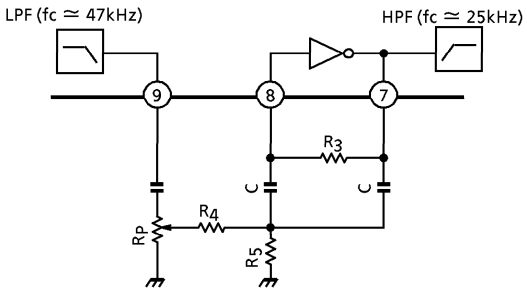


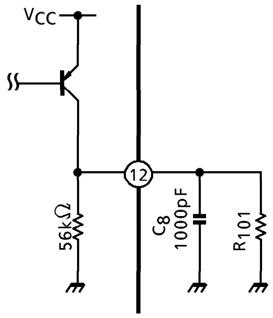
Figure 5

6. Noise detection rise time

The rise time is a proportion of time constant 7.5ms of the smoothing capacitor C_9 = 0.1μF of the noise rectifier and internal resistor 75kΩ. Although decreasing the capacitance of C_9 can shorten the rise time, note that the noise detection output fluctuation may increase. This should be taken into account before use.

7. RSSI function

A DC voltage corresponding to the input level of IF input pins (pin 5) is output to the RSSI pin (P21). While the linear range is about 80dB when $V_{CC} = 2V$, the range can be expanded to 80dB as in Figure 6.
However, in such a case, note that the temperature characteristics of the RSSI output may alter due to a disparity between the temperature coefficient of the external resistor and the internal resistance of the IC.



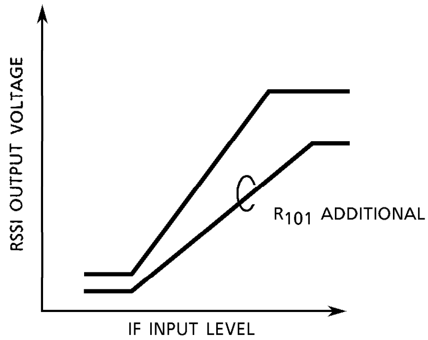


Figure 6

8. DC voltages for pins (Typical values for reference)

$V_{CC} = 2.0V$

PIN No.	PIN NAME	VOLTAGE	PIN No.	PIN NAME	VOLTAGE
1	OCS IN	1.98	9	AF OUT	—
2	OSC OUT	1.33	10	QUAD	2.0
3	MIX OUT	0.74	11	IF OUT	1.14
4	V_{CC}	2.0	12	RSSI	—
5	IF IN	1.67	13	N-DET	—
6	DEC	1.67	14	N-REC	—
7	FIL OUT	0.67	15	GND	0.0
8	FIL IN	0.65	16	MIX IN	0.94

(UNIT : V)

MAXIMUM RATINGS ($Ta = 25°C$)

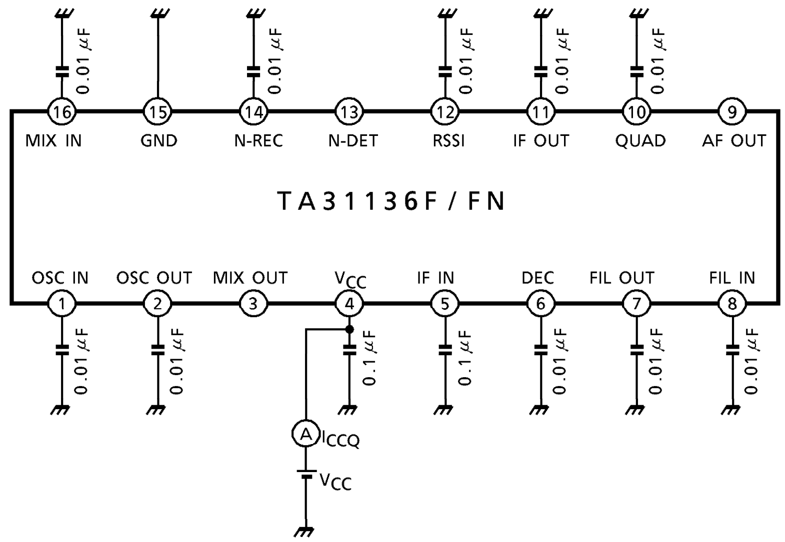
CHARACTERISTIC		SYMBOL	RATING	UNIT
Supply Voltage		V_{CC}	7	V
Power Dissipation	TA31136F	P_D	370	mW
	TA31136FN		560	
Operating Temperature		T_{opr}	−30~85	°C
Storage Temperature		T_{stg}	−50~150	°C

ELECTRICAL CHARACTERISTICS
(Unless otherwise specified, $V_{CC} = 2.0V$, $f_{IN\ (MIX)} = 21.7MHz$, $f_{IN\ (IF)} = 450kHz$, $\Delta f = \pm 1.5kHz$, $f_{MOD} = 1kHz$, $Ta = 25°C$)

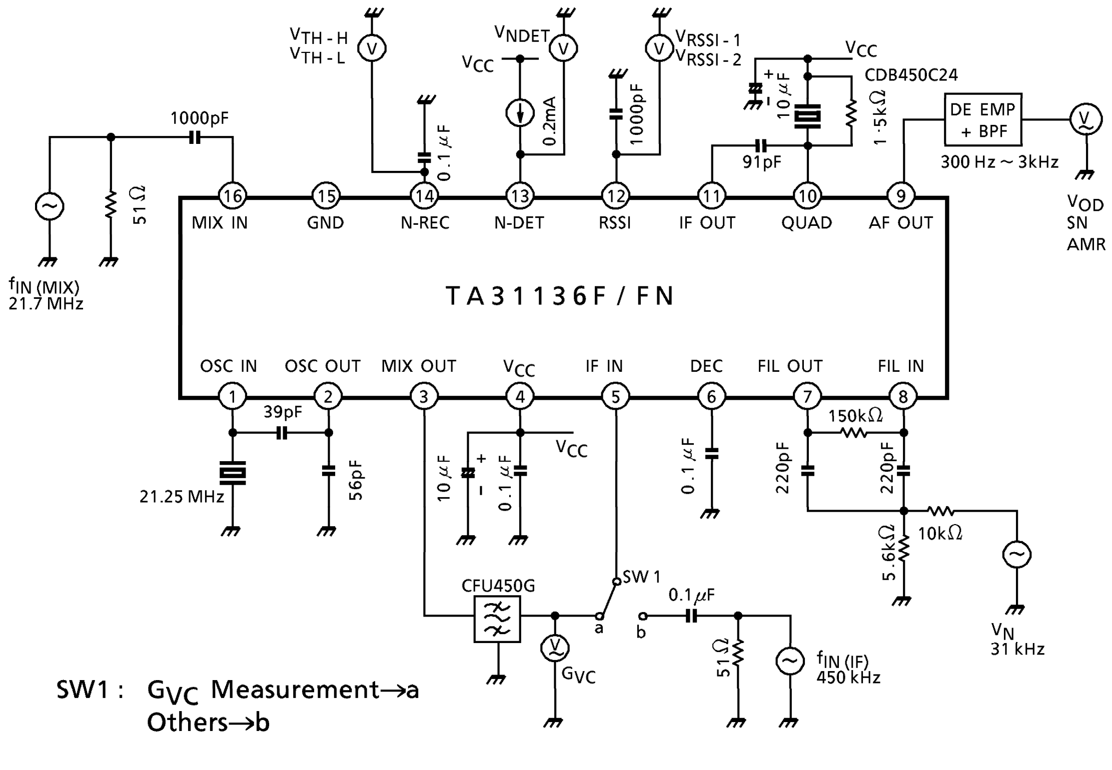
CHARACTERISTIC		SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Power Supply Voltage		V_{CC}	—	—		1.8	2.0	5.5	V
Current Consumption		I_{CCQ}	1	—		—	3.2	4.6	mA
Mixer Conversion Gain		G_{VC}	2	Measured through ceramic filter. $V_{IN\ (MIX)} = 46dB\mu V$		15	18	21	dB
Mixer Intercept Point		P_{IM}	—	Input 50Ω		—	96	—	dBμV
Mixer Input Impedance		$R_{IN\ (MIX)}$	—	—		—	5.5	—	kΩ
		$C_{IN\ (MIX)}$	—			—	2.8	—	pF
Mixer Output Resistance		$R_{O\ (MIX)}$	—	—		1.2	1.8	2.4	kΩ
12dB Sensitivity		12dB SN	—	—		—	11	—	dBμV
Demodulation Output Level		V_{OD}	2	$V_{IN\ (IF)} = 80dB\mu V$		70	100	130	mV_{rms}
SN Ratio		SN	2	$V_{IN\ (IF)} = 80dB\mu V$		43	65	—	dB
AM Rejection Ratio		AMR	2	$V_{IN\ (IF)} = 80dB\mu V$, $AM = 30\%$		—	40	—	dB
IF AMP. Input Resistance		$R_{IN\ (IF)}$	—	—		1.2	1.8	2.4	kΩ
RSSI Output Voltage		$V_{RSSI\text{-}1}$	2	$V_{CC} = 3V$	$V_{IN\ (IF)} = 30dB\mu V$	200	360	520	mV
		$V_{RSSI\text{-}2}$	2		$V_{IN\ (IF)} = 100dB\mu V$	1.4	2.0	2.6	V
Noise Detection Output Voltage		V_{NDET}	2	I SINK = 0.2mA		—	0.1	0.5	V
Noise Detection Output Leak Current		I_{LEAK}	—	$V_{NREC} = 0.6V$, $V_{NDET} = 2V$		—	0	5	μA
Noise Detection Level	"H" Level	$V_{TH\text{-}H}$	2	—		—	0.5	0.7	V
	"L" Level	$V_{TH\text{-}L}$				0.3	0.4	—	

All AC levels are indicated by open level (EMF).

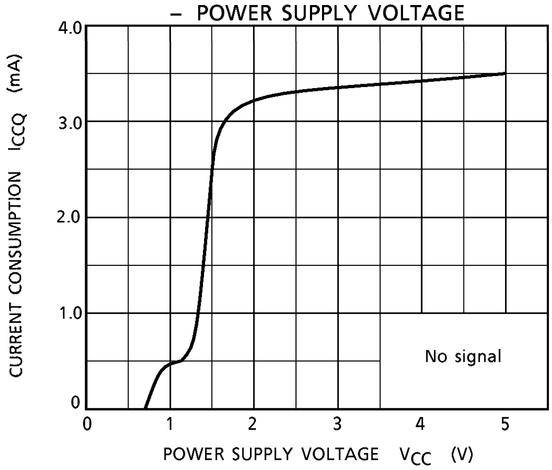
TEST CIRCUIT 1



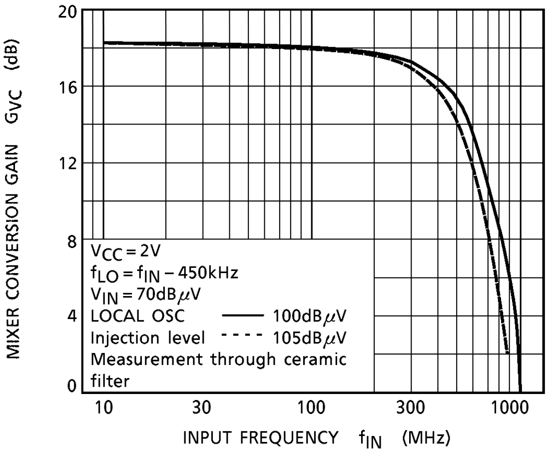
TEST CIRCUIT 2



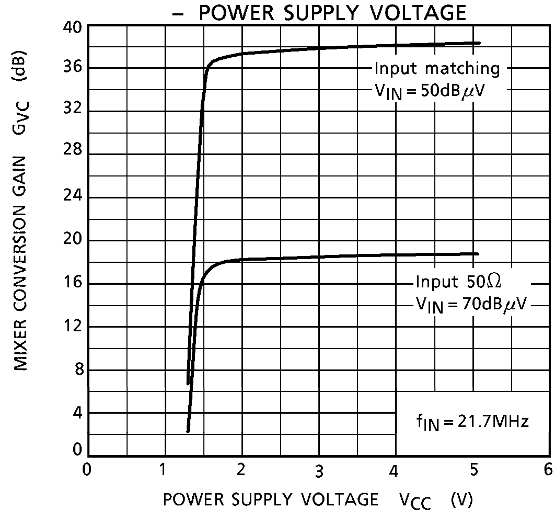
CURRENT CONSUMPTION – POWER SUPPLY VOLTAGE



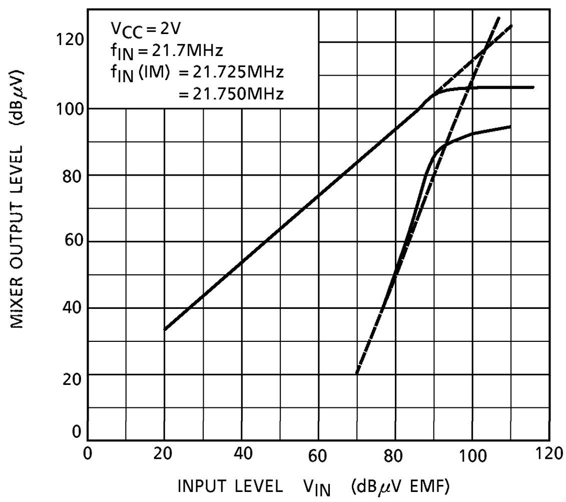
MIXER FREQUENCY CHARACTERISTICS



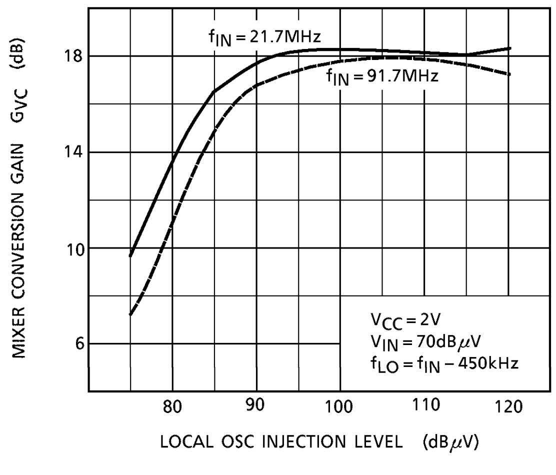
MIXER CONVERSION GAIN – POWER SUPPLY VOLTAGE



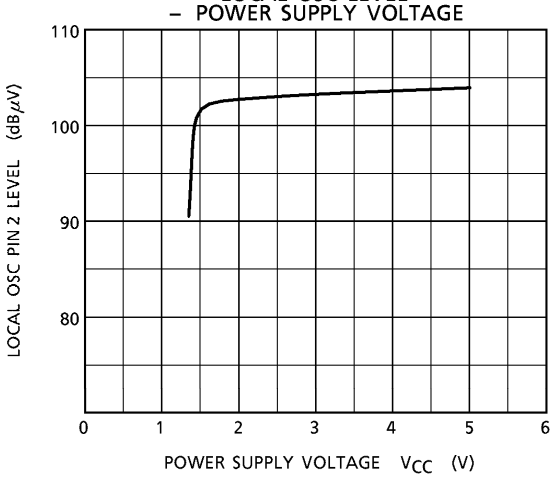
MIXER INTERCEPT POINT CHARACTERISTICS



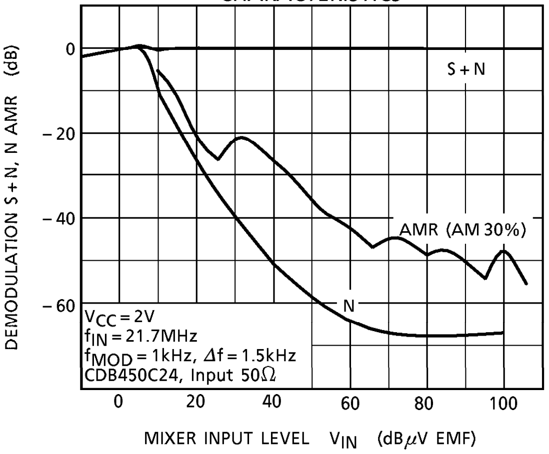
MIXER CONVERSION GAIN – LOCAL OSC INJECTION LEVEL



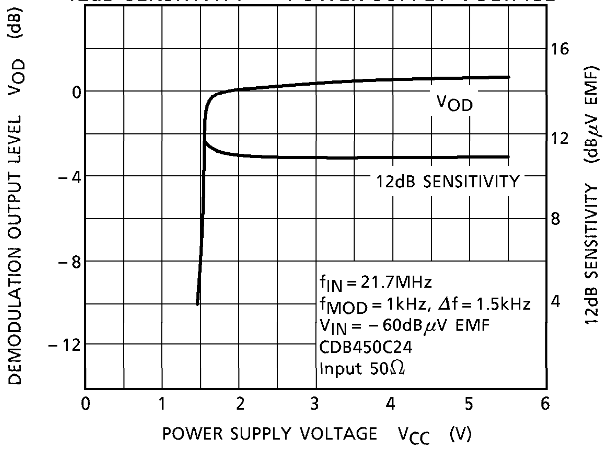
LOCAL OSC LEVEL – POWER SUPPLY VOLTAGE



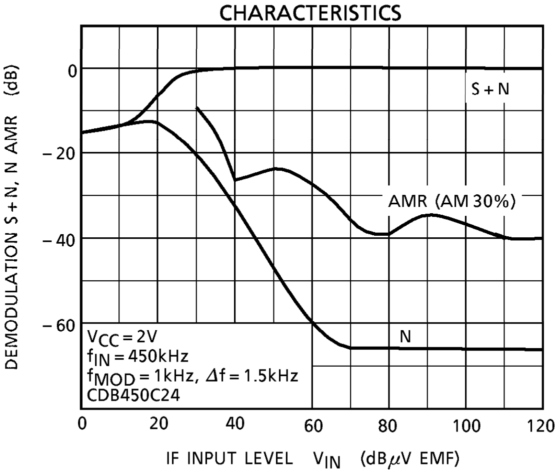
MIXER INPUT DEMODULATION CHARACTERISTICS



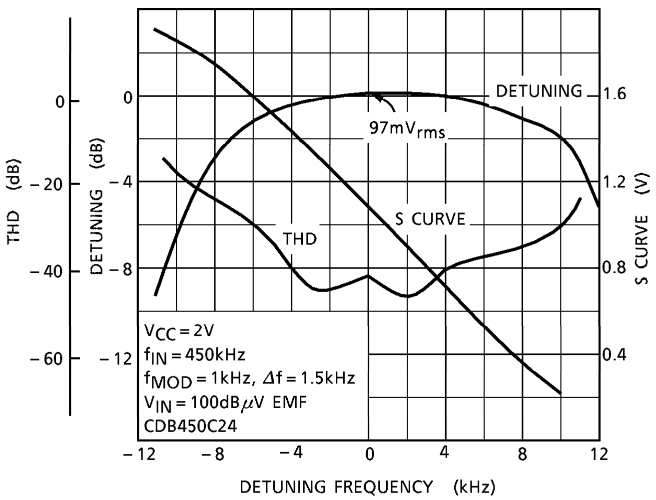
DEMODULATION OUTPUT LEVEL V_{OD}, 12dB SENSITIVITY – POWER SUPPLY VOLTAGE



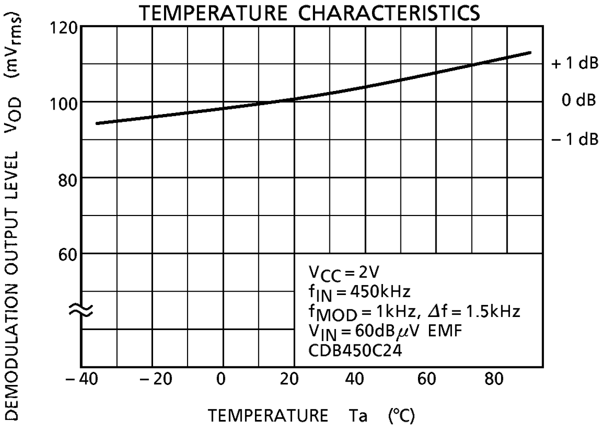
IF INPUT DEMODULATION CHARACTERISTICS



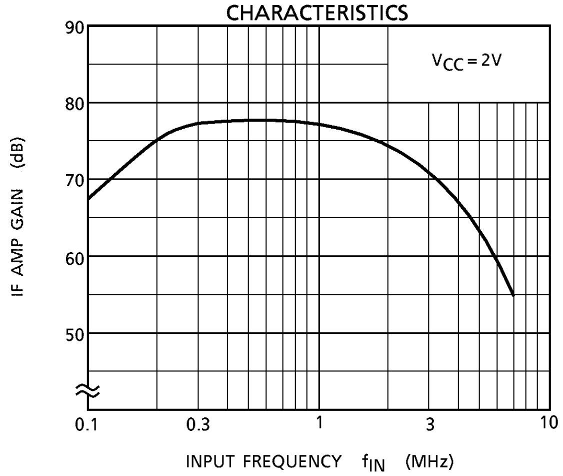
IF INPUT DETUNING CHARACTERISTICS



DEMODULATION OUTPUT LEVEL TEMPERATURE CHARACTERISTICS



IF AMP GAIN FREQUENCY CHARACTERISTICS



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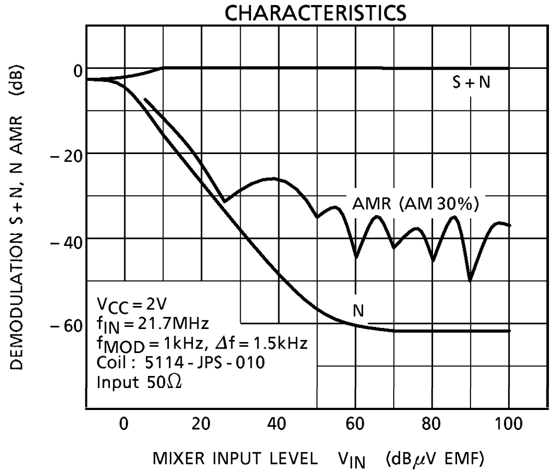
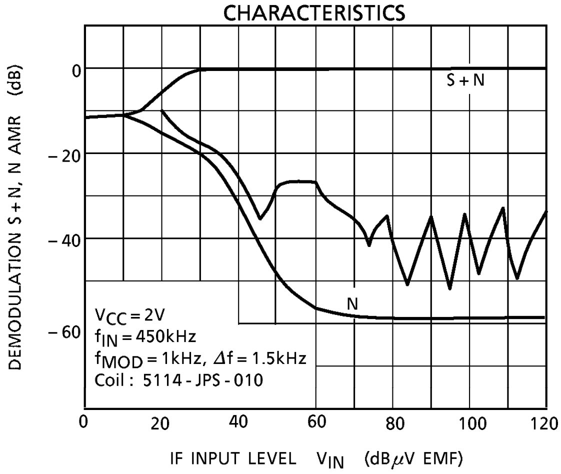
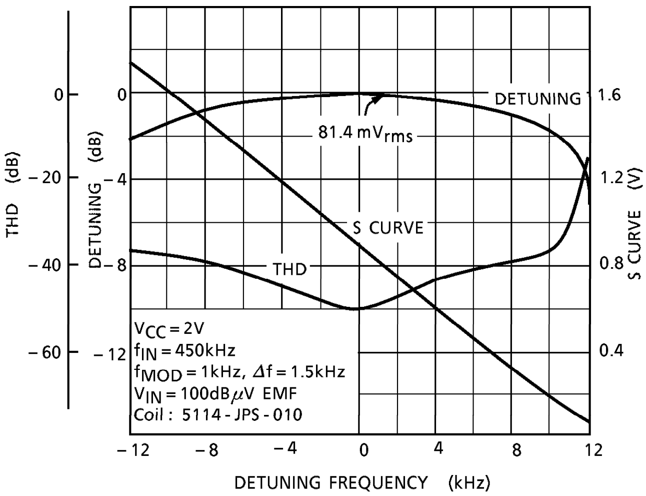
MIXER INPUT DEMODULATION CHARACTERISTICS



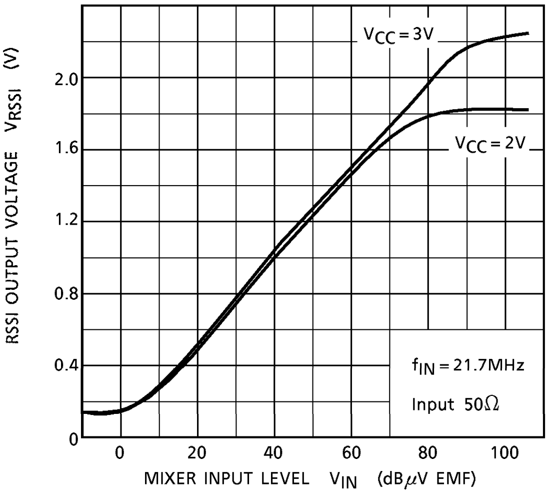
IF INPUT DEMODULATION CHARACTERISTICS



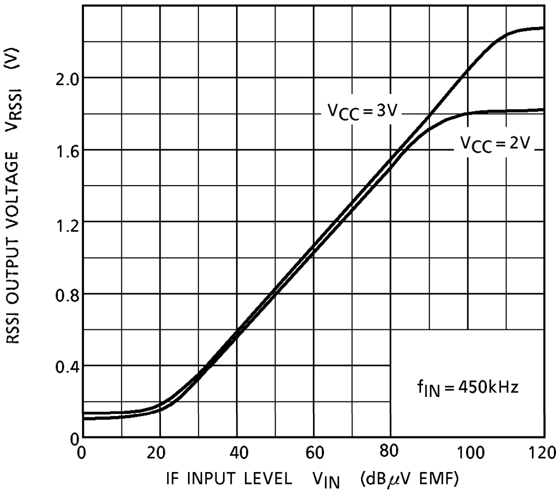
IF DETUNING CHARACTERISTICS



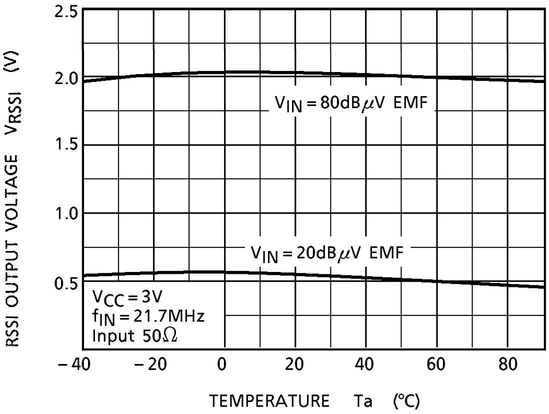
MIXER INPUT RSSI CHARACTERISTICS



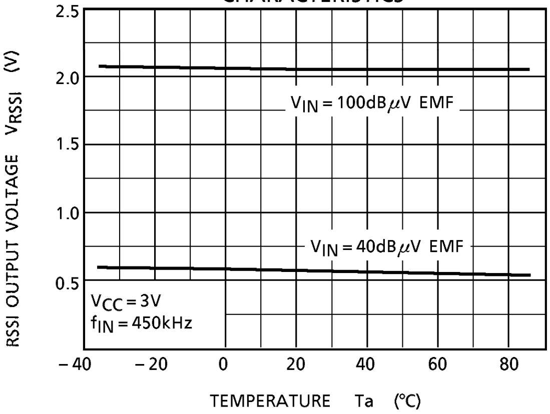
IF INPUT RSSI CHARACTERISTICS



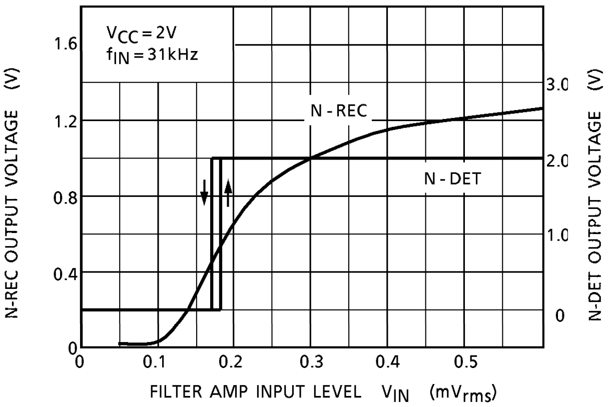
MIXER INPUT RSSI TEMPERATURE CHARACTERISTICS



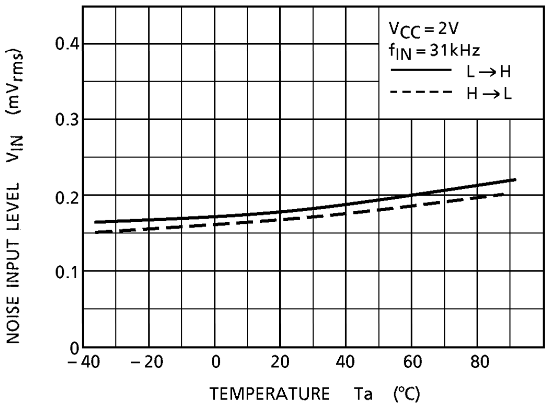
IF INPUT RSSI TEMPERATURE CHARACTERISTICS



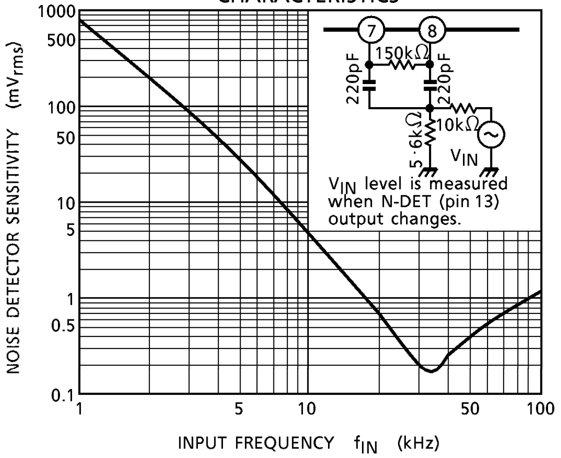
NOISE DETECTION CHARACTERISTICS



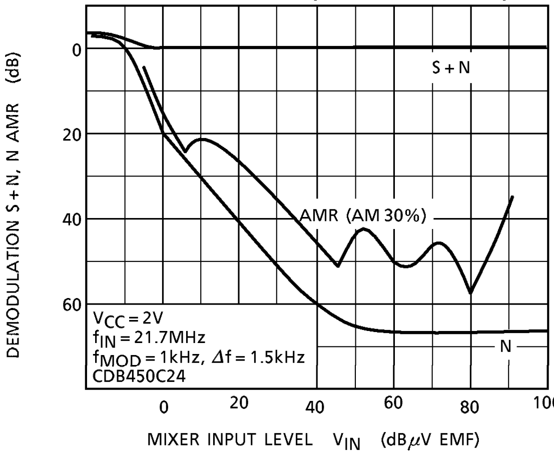
NOISE DETECTION TEMPERATURE CHARACTERISTICS



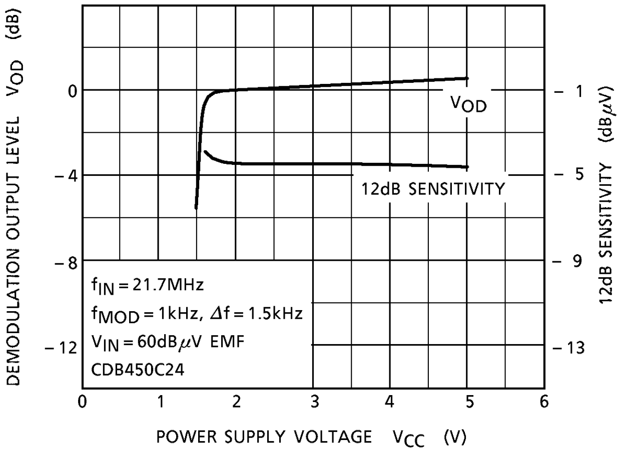
NOISE DETECTION FREQUENCY CHARACTERISTICS



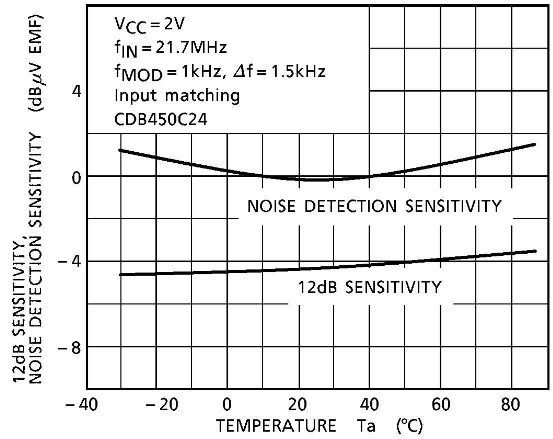
MIXER INPUT DEMODULATION CHARACTERISTICS (INPUT MATCHING)



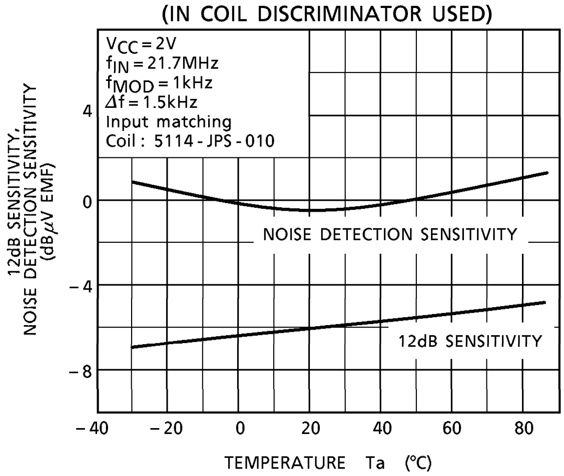
DEMODULATED OUTPUT 12dB SENSITIVITY – POWER SUPPLY VOLTAGE



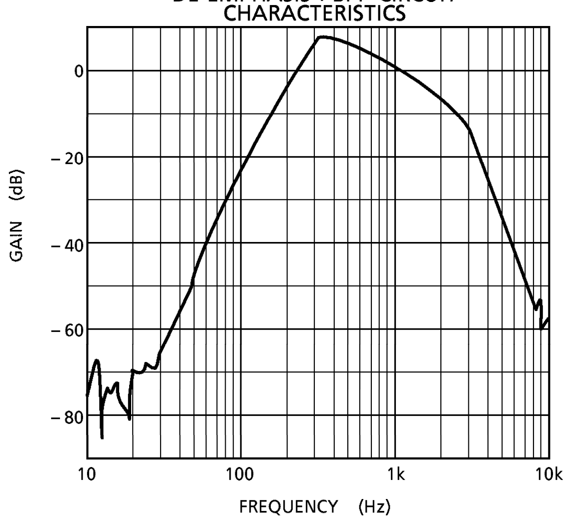
NOISE DETECTION SENSITIVITY, 12dB SENSITIVITY – TEMPERATURE



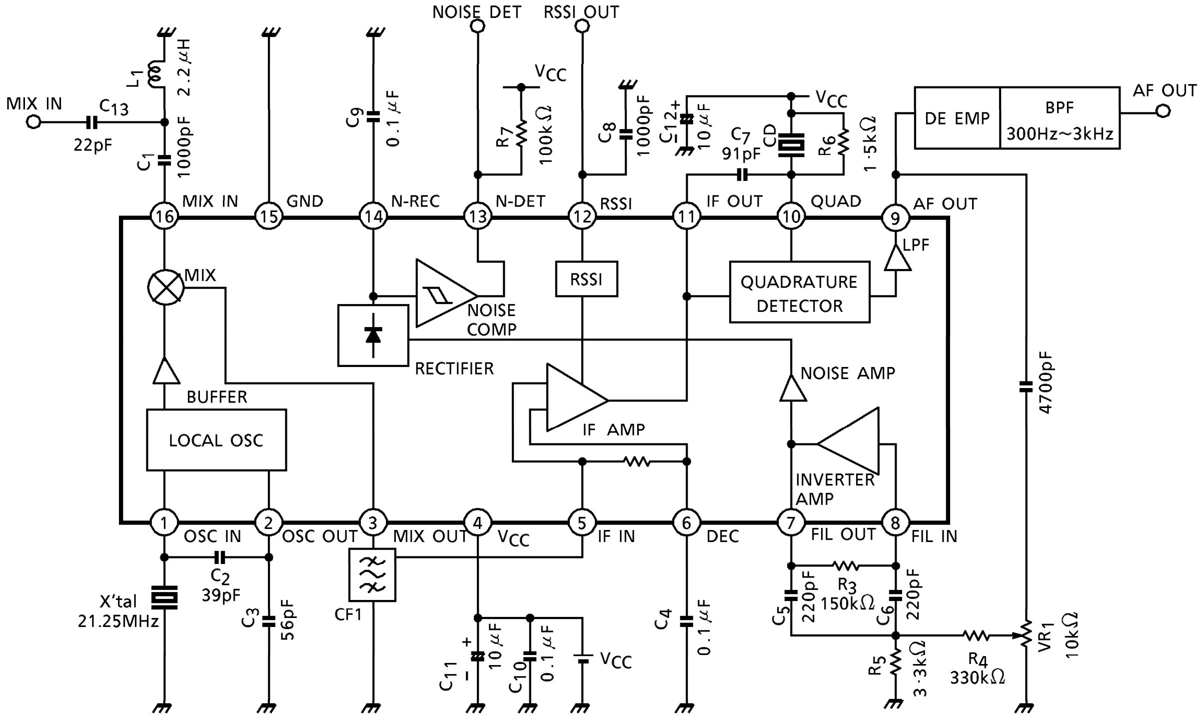
NOISE DETECTION SENSITIVITY, 12dB SENSITIVITY – TEMPERATURE (IN COIL DISCRIMINATOR USED)



DE-EMPHASIS + BPF CIRCUIT CHARACTERISTICS



APPLICATION CIRCUIT

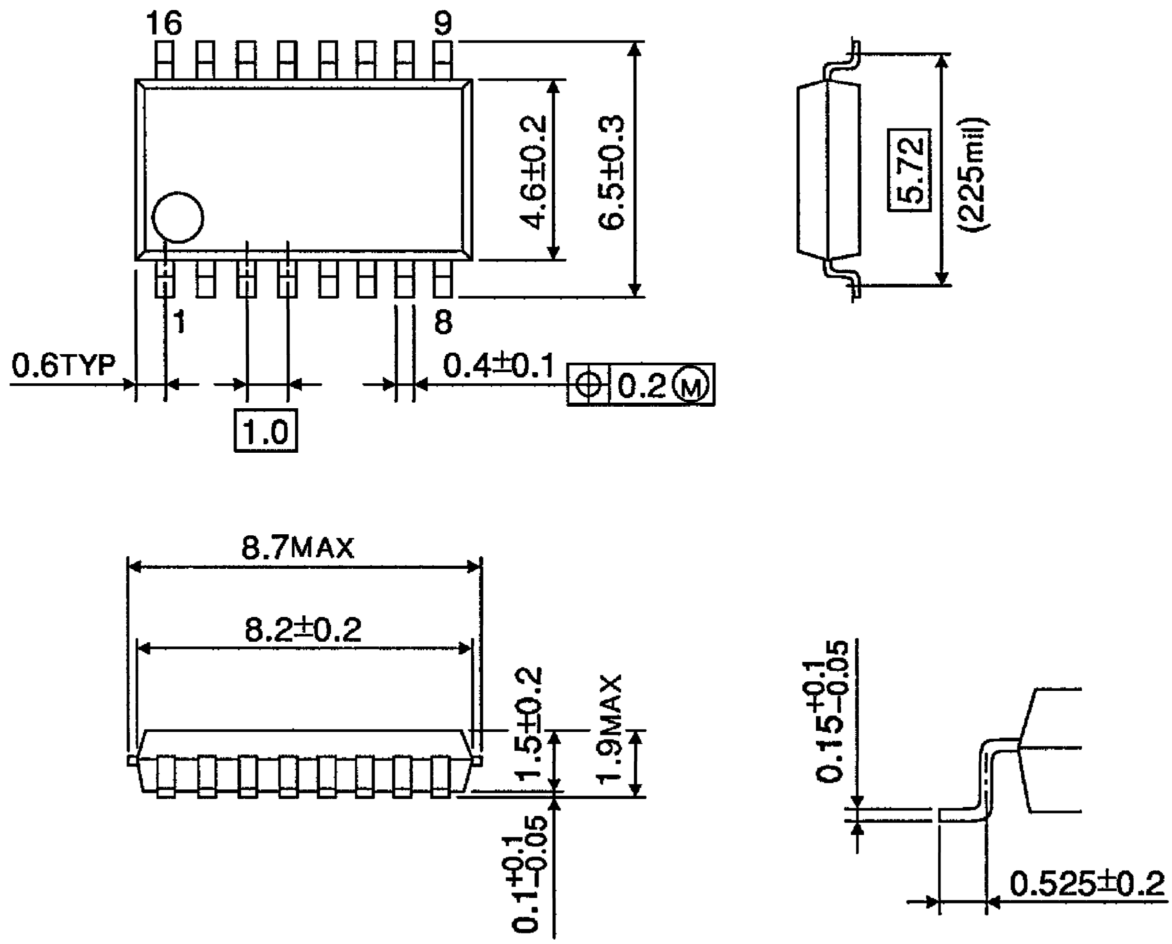


CD : CDB450C24 (MURATA)
CF1 : CFW450G (MURATA)

PACKAGE DIMENSIONS

SSOP16-P-225-1.00A

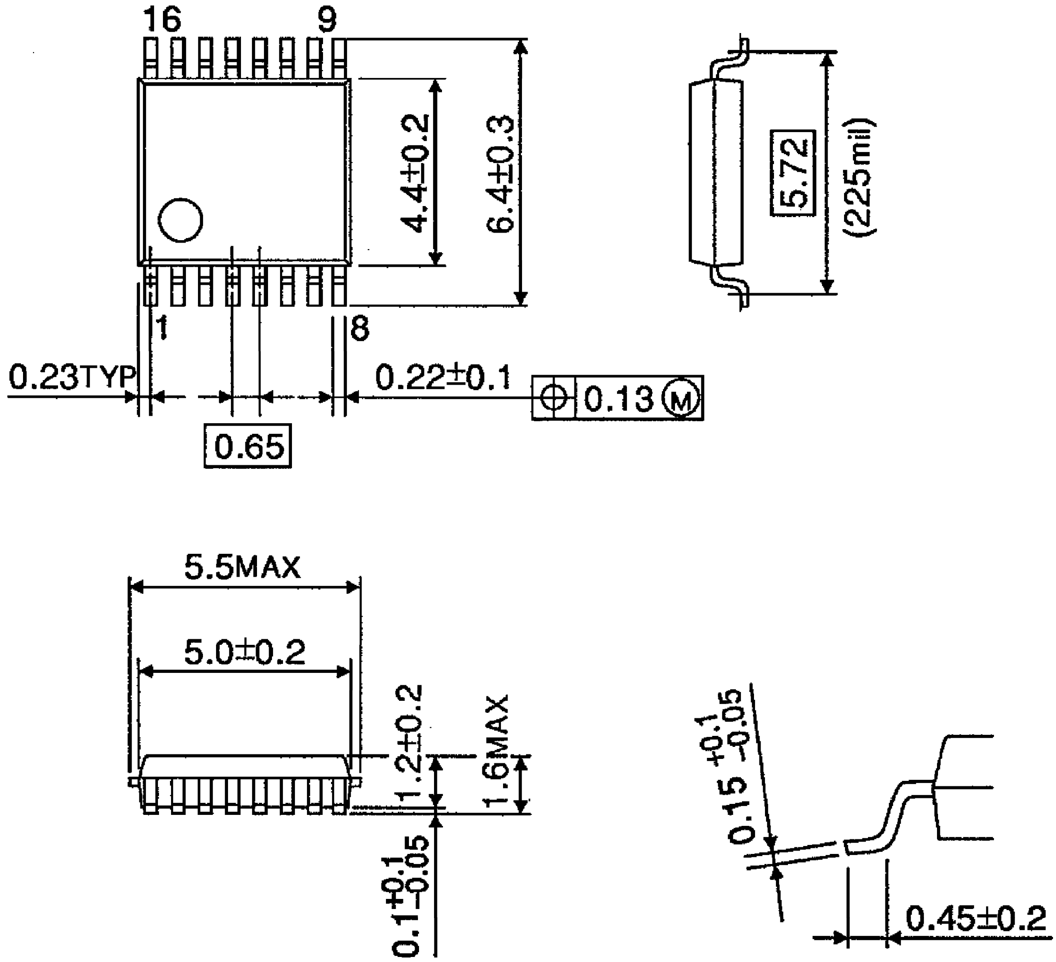
Unit : mm



Weight : 0.14g (Typ.)

PACKAGE DIMENSIONS

SSOP16-P-225-0.65B Unit : mm



Weight : 0.07g (Typ.)

Notice for Pb free product

About solderability, following conditions were confirmed

- Solderability

(1) Use of Sn-63Pb solder bath
- Solder bath temperature = 230°C
- Dipping time = 5seconds
- The number of times = once
- Use of R-type flux

(2) Use of Sn-3.0Ag-0.5Cu solder bath
- Solder bath temperature = 245°C
- Dipping time = 5seconds
- The number of times = once
- Use of R-type flux