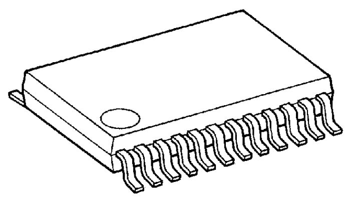
TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT SILICON MONOLITHIC

TA31180FNG

FILTERLESS IF DETECTOR IC FOR CORDLESS TELEPHONE

This IF detector IC includes the external 2nd IF ceramic filter and the external discriminator in itself and that realized to be able to eliminate the external parts extremly.



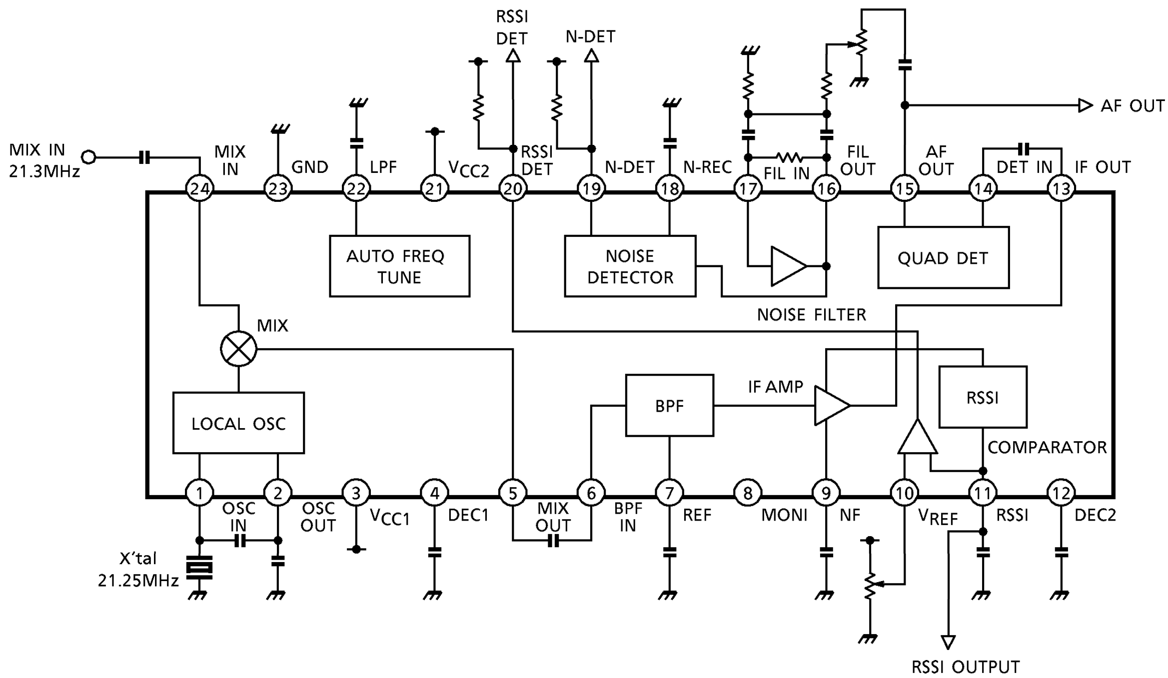
SSOP24-P-300-0.65A

Weight : 0.14g (Typ.)

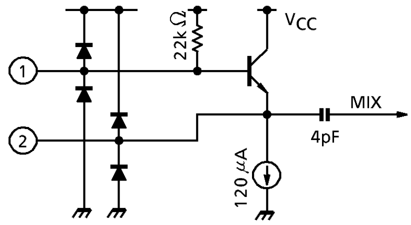
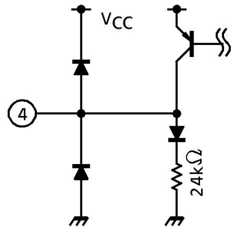
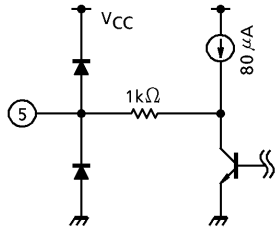
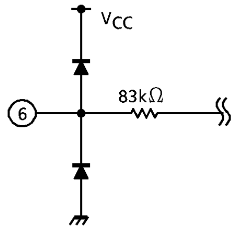
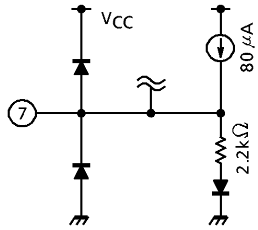
FEATURES

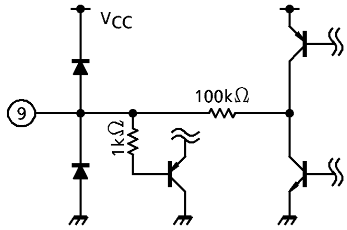
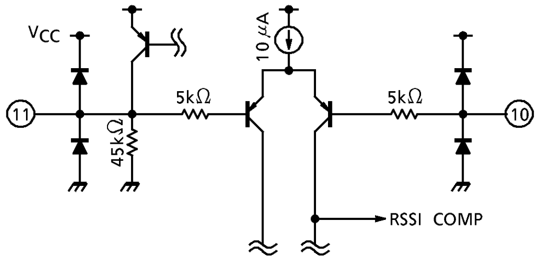
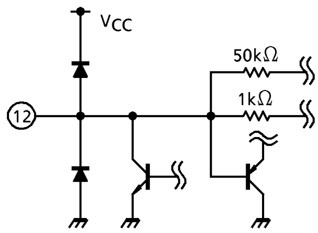
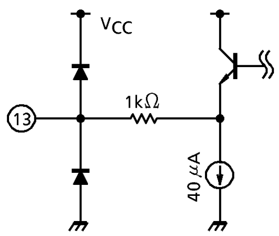
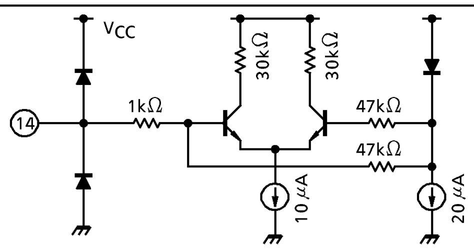
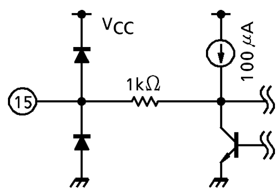
- No need of the external ceramicfilter and discriminator
- Low voltage operation : V_{CC} = 1.8V~5.5V
- High sensitivity : 12dB sensitivity 20dBμV EMF (50Ω Input)
- Built-in noise detector circuit
- RSSI function
- Small package : SSOP24 pin (0.65mm pitch)

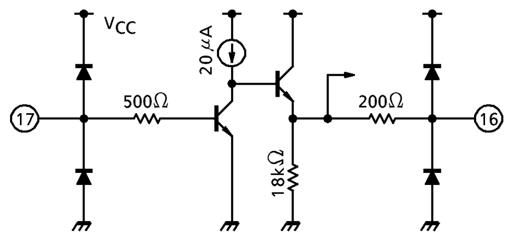
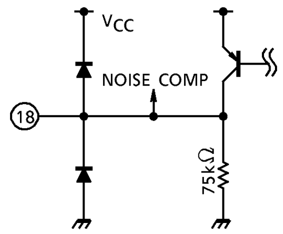
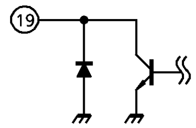
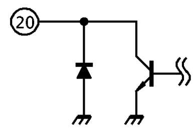
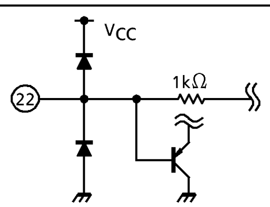
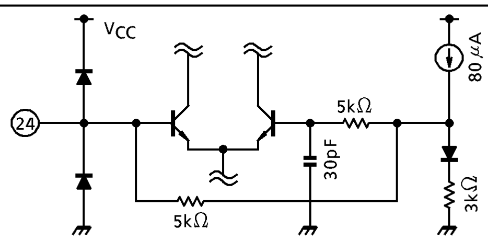
BLOCK DIAGRAM



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

PIN No.	PIN NAME	FUNCTION	INTERNAL EQUIVALENT CIRCUIT
1	OSC IN	LOCAL OSC input / output terminals. Colpitts oscillator is formed by internal emitter follower and external crystal. And external local signal injection is possible from pin 1 or pin 2.	
2	OSC OUT		
3	V_{CC1}	Power supply terminal.	—
4	DEC1	AGC terminal for MIX conversion gain. This terminal connects capacitor to GND.	
5	MIX OUT	MIX Output terminal. Output impedance is around 1.1kΩ.	
6	BPF IN	Internal BPF input terminal.	
7	REF	Internal BPF decoupling terminal for DC bias. This terminal connects capacitor to GND.	
8	MONI	Use at open as this terminal connects to internal circuit.	—

PIN No.	PIN NAME	FUNCTION	INTERNAL EQUIVALENT CIRCUIT
9	NF	IF AMP decoupling terminal for DC bias. This terminal connects capacitor to GND.	
10	V_{REF}	Refference power supply terminal.	
11	RSSI	This terminal outputs DC level according to input signal level to IF AMP. Dynamic range is around 80dB.	
12	DEC2	QUAD DET AFC terminal. This terminal connects to capacitor to GND.	
13	IF OUT	Output terminal of IF AMP.	
14	DET IN	QUAD DET input terminal.	
15	AF OUT	Demodulated output terminal. Output impedance is around 1.1kΩ.	

PIN No.	PIN NAME	FUNCTION	INTERNAL EQUIVALENT CIRCUIT
16	FIL OUT	FIL AMP input / output terminal. Compose the BPF by putting the external capacitance and Resistance and this terminal connects to rectifire circuit internally by internal decouppling capacitance.	
17	FIL IN		
18	N-REC	Rectifire to direct current by external capacitance after amplifiering the FIL AMP output to around 20dB.	
19	N-DET	Operating as comparator of N-REC terminal output voltage, and doing the judgement of NOISE DET. Hysteresis width is around 100mV and this terminal is from open collector.	
20	RSSI DET	This terminal outputs the result of comparator between V_{REF} terminal input voltage and RSSI terminal output voltage. If V_{REF} is less than RSSI, then RSSI DET is set to "L". This output is from open collector.	
21	V_{CC2}	Power supply terminal for AUTO FREQ TUNE block.	—
22	LPF	Decoupling terminal of the circuit, that tuning the internal BPF f_0 automatically. This terminal connects capacitor to GND.	
23	GND	GND terminal.	—
24	MIX IN	1st IF signal input terminal.	

DESCRIPTION

1. BPF (band pass filter)

   1st IF from MIX input terminal is converted to 2nd IF 50kHz by mixing 2nd MIX and LOCAL OSC 21.250MHz to be input to BPF.
   This BPF is of high Q with center frequency $f_0 = 50$kHz, −3dB band width BW = 8kHz and attenuation 57dB and these factors are cause of selectivity characteristics and demodulation output distortion characteristics.
   This IC is of automatic frequency tuning system that stabilize the center frequency f_0 drift of internal BPF for 2nd IF by temprature and parameter tolerance and this function is executed by control circuit with internal clock as reference frequency from LOCAL OSC. Clock frequency signal source should be required high accuracy for 2nd local frequency as the signal source of referency clock 21.250MHz, because selectivity characteristics and demodulation output distortion characteristics depend on clock frequency.

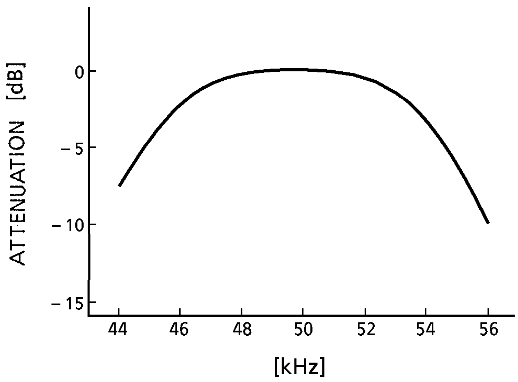


Fig.1 BPF characteristics

2. LOCAL OSC external injection method

   Inputting from pin1 as shown in Fig.2, add resistor R21 to pin2 and set the input signal so that signal level at pin1 is 95~105dBμV. A built-in BUFFER amp minimizes leakage from MIX.
   Inputting from pin2 as shown in Fig.3, set the injection level at pin2 between 95dBμV and 105dBμV.

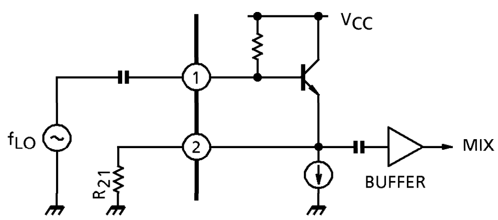


Fig.2

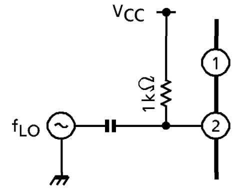


Fig.3

3. NOISE FILTER AMP

NOISE FILTER AMP can construct BPF as Fig.4. Setting constants forrow as below equation (1)~(3).

(1) $f_0 = \dfrac{1}{2\pi\sqrt{R_1 (R_2 // R_3) C^2}}$

(2) $G_V = R_1 / 2R_2$

(3) $Q^2 = \dfrac{R_3}{4 (R_2 // R_3)}$

at $R_2 \gg R_P$

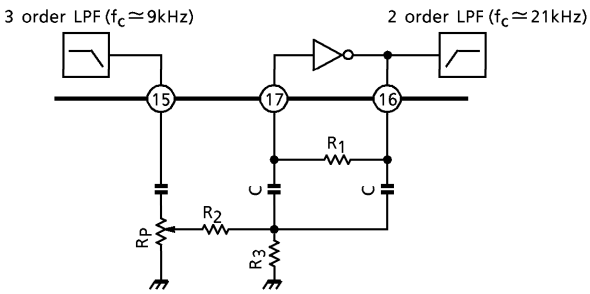


Fig.4

In case of the setting level of NOISE DET being low, NOISE DET may operate incorrectly in the cause of carrier leak components of IF frequency 50kHz.
In this case get the NOISE DET filter set to LPF to be able to eliminate carrier leak components.

(1) $f_0 = \dfrac{1}{2\pi R\sqrt{C_1\ C_2}}$

(2) $G_V = \dfrac{1}{2\omega\ C_2\ R_4}$

(3) $Q^2 = \dfrac{C_1}{4C_2}$

at $R_4 \gg R$、 $\omega = 2\pi f$

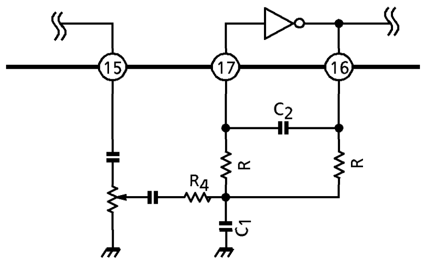


Fig.5

4. Noise detection rise time

The rise time is a proportion of time constant 7.5ms of the smoothing capacitor $C_{181} = 0.1\mu F$ of the noise rectifier and internal resistor 75kΩ. Although decreasing the capacitance of C_{181} can shorten the rise time, note that the NOISE DET output fluctuation may increase. This should be taken into account before use.

5. RSSI COMPARATOR

The result of RSSI COMPARATOR is output to RSSI DET (20pin) by comparing RSSI terminal output voltage with V_{REF} terminal input voltage.
Hysteresis range is around 30mV. When $V_{RSSI} > V_{REF}$, RSSI DET is "L" level.
Reference voltage V_{REF} can be set by the external resistance R_{101}.

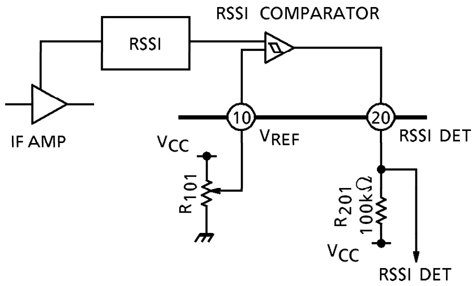


Fig.6

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	7	V
Power Dissipation	P_D	780	mW
Operating Temperature	T_{opr}	−20~+70	°C
Storage Temprature	T_{stg}	−55~+150	°C

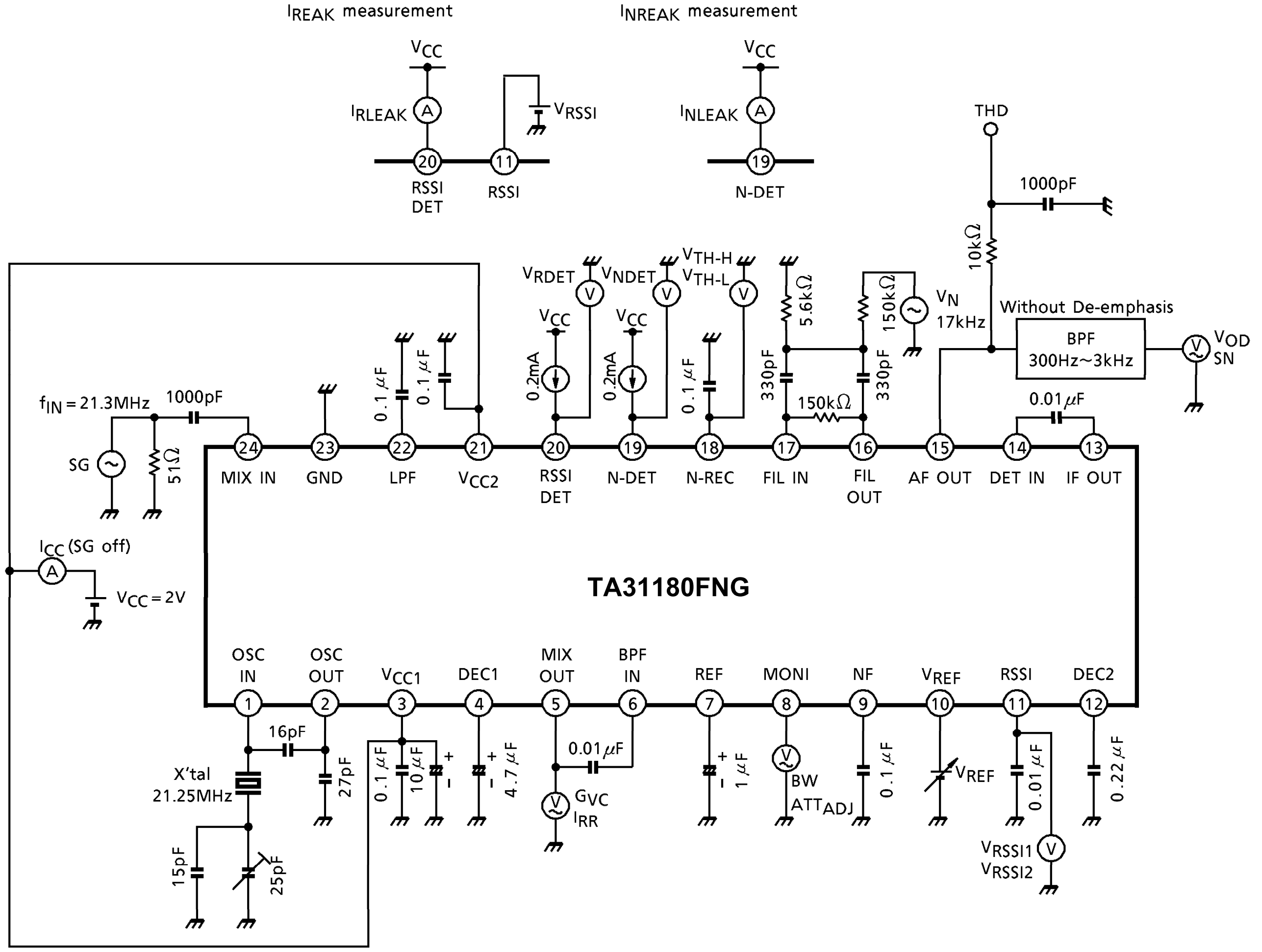
ELECTRICAL CHARACTERISTICS (Unless otherwise specified V_{CC} = 2.0V, f_{IN} = 21.30MHz, Δf = ±1.5kHz, f_{MOD} = 1kHz, Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Power Supply Voltage	V_{CC}	—	—	1.8	2.0	5.5	V
Current Consumption	I_{CC}	1	No Signal	4.3	6.7	9.0	mA
MIX Operating Frequency	f_{IN}	—	—	—	21.30	—	MHz
MIX Image Rejection Ratio	I_{RR}	1	V_{IN} = 70dBμVEMF, Pin4 GND	20	35	—	dB
MIX Conversion Gain	G_{VC}	1	V_{IN} = 60dBμV, Pin4 GND	26	29.5	—	dB
MIX Intercept Point	I_P	—	—	—	103	—	dBμVEMF
MIX Input Impedance	R_{IN}	—	—	—	5	—	kΩ
	C_{IN}	—	—	—	3	—	pF
12dB Sensitivity	12dB SN	—	—	—	20	—	dBμVEMF
Demodulation Output Level	V_{OD}	1	V_{IN} = 80dBμVEMF	110	140	170	mV_{rms}
SN Ratio	SN	1	V_{IN} = 80dBμVEMF	40	54	—	dB
AM Rejection Ratio	AMR	—	AM = 30%, V_{IN} = 80dBμVEMF	—	38	—	dB
Demodulation Output Distortion	THD	1	V_{IN} = 80dBμVEMF	—	−35	−30	dB
Demodulation Output Cut-off Frequency	f_C	—	−3dB	—	3	—	kHz
Pass Band Width	BW	1	−3dB	6	8	—	kHz
Rejection Level at Adjacent Channel	ATT_{ADJ}	1	f_{SEP} = ±12.5kHz, f_{MOD} = 400Hz	50	57	—	dB
LOCAL OSC Input Level	V_{LO}	—	—	95	100	105	dBμV

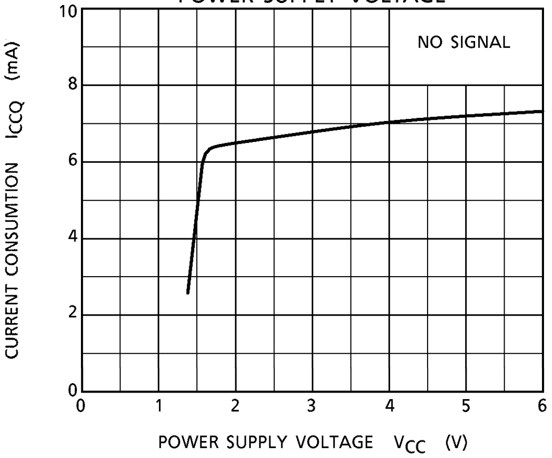
ELECTRICAL CHARACTERISTICS (Unless otherwise specified $V_{CC} = 2.0V$, $f_{IN} = 21.30MHz$, $\Delta f = \pm 1.5kHz$, $f_{MOD} = 1kHz$, $Ta = 25°C$)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
RSSI Output Voltage	V_{RSSI1}	1	$V_{CC} = 3V$, $V_{IN} = 20dB\mu VEMF$	0.3	0.6	0.9	V
	V_{RSSI2}		$V_{CC} = 3V$, $V_{IN} = 90dB\mu VEMF$	1.8	2.2	2.6	V
RSSI COMPARATOR Reference Input Range	V_{REF}	—	—	0.3	—	$V_{CC} - 1$	V
RSSI COMPARATOR Hysteresis Width	V_{HYS}	—	—	—	30	—	mV
RSSI COMPARATOR Output Voltage	V_{RDET}	1	$I_{SINK} = 0.2mA$	—	0.1	0.5	V
RSSI COMPARATOR Output Leak Current	I_{RLEAK}	1	$V_{RDET} = V_{CC}$, $V_{RSSI} > V_{REF}$	—	0	5	μA
NOISE DET Output Voltage	V_{NDET}	1	$I_{SINK} = 0.2mA$	—	0.1	0.5	V
NOISE DET Output Leak Current	I_{NLEAK}	1	$V_{NDET} = V_{CC}$	—	0	5	μA
Noise Comparator Detect Level	V_{TH-H}	1	—	—	0.5	0.7	V
	V_{TH-L}		—	0.3	0.4	—	V

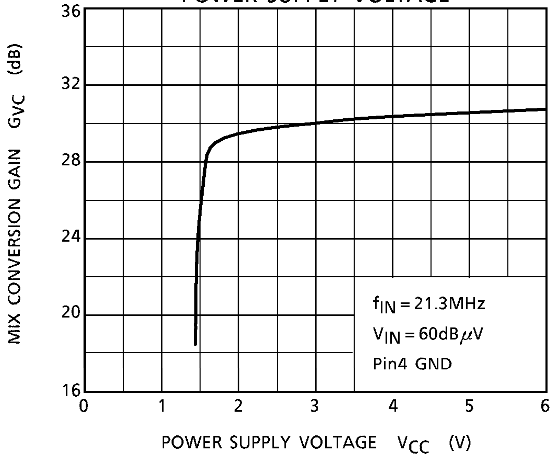
TEST CIRCUIT 1



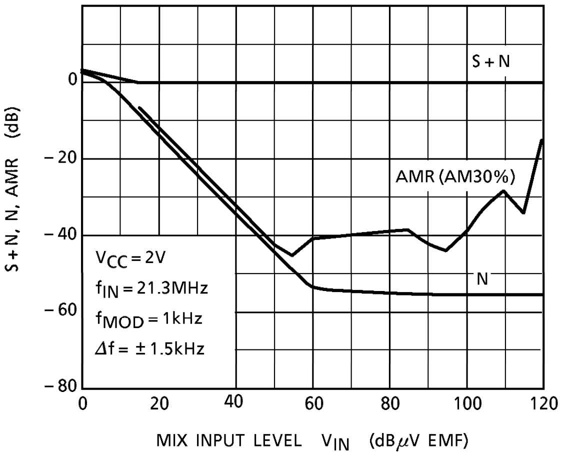
CURRENT CONSUMPTION – POWER SUPPLY VOLTAGE



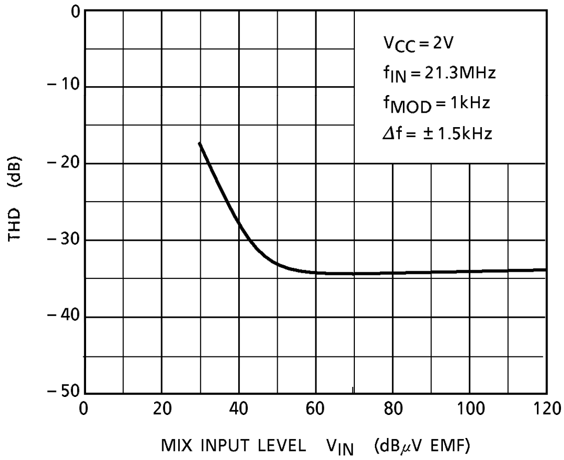
MIX CONVERSION GAIN – POWER SUPPLY VOLTAGE



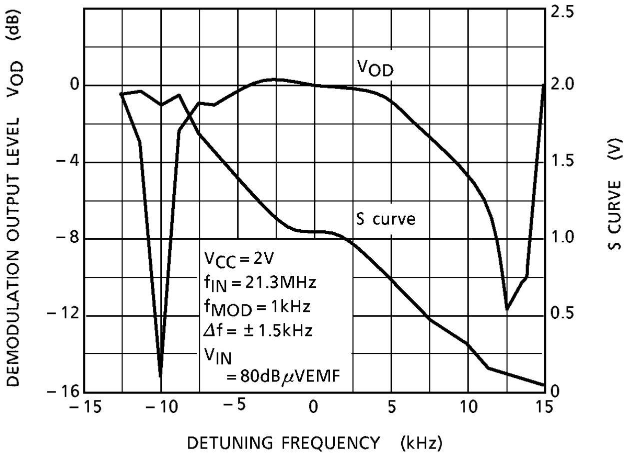
SN, AMR CHARACTERISTICS (INPUT 50Ω)



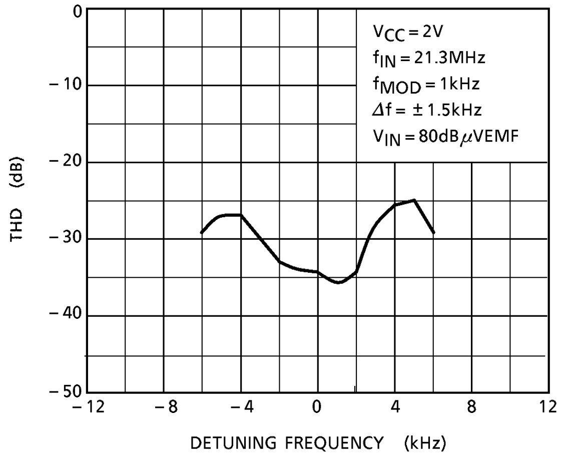
THD CHARACTERISTICS (INPUT 50Ω)

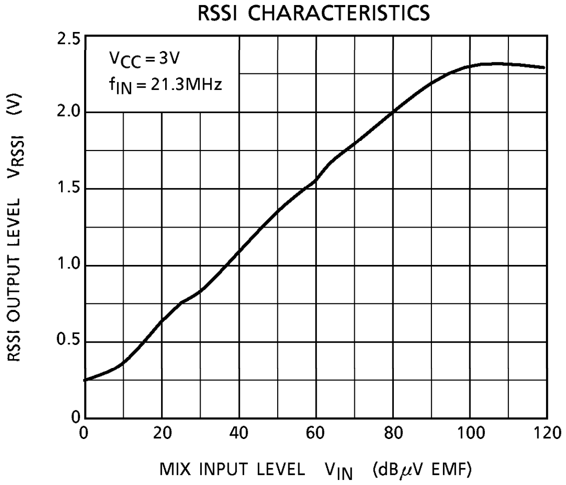


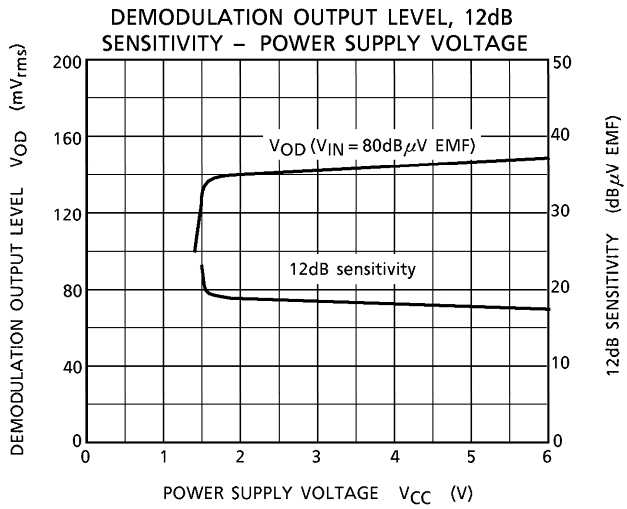
DETUNING CHARACTERISTICS

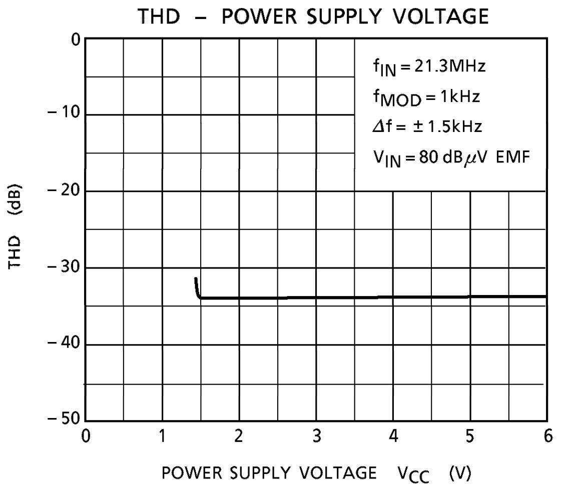


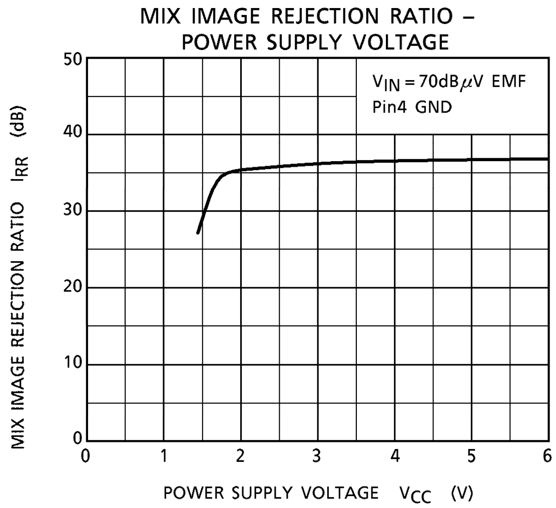
THD DETUNING CHARACTERISTICS



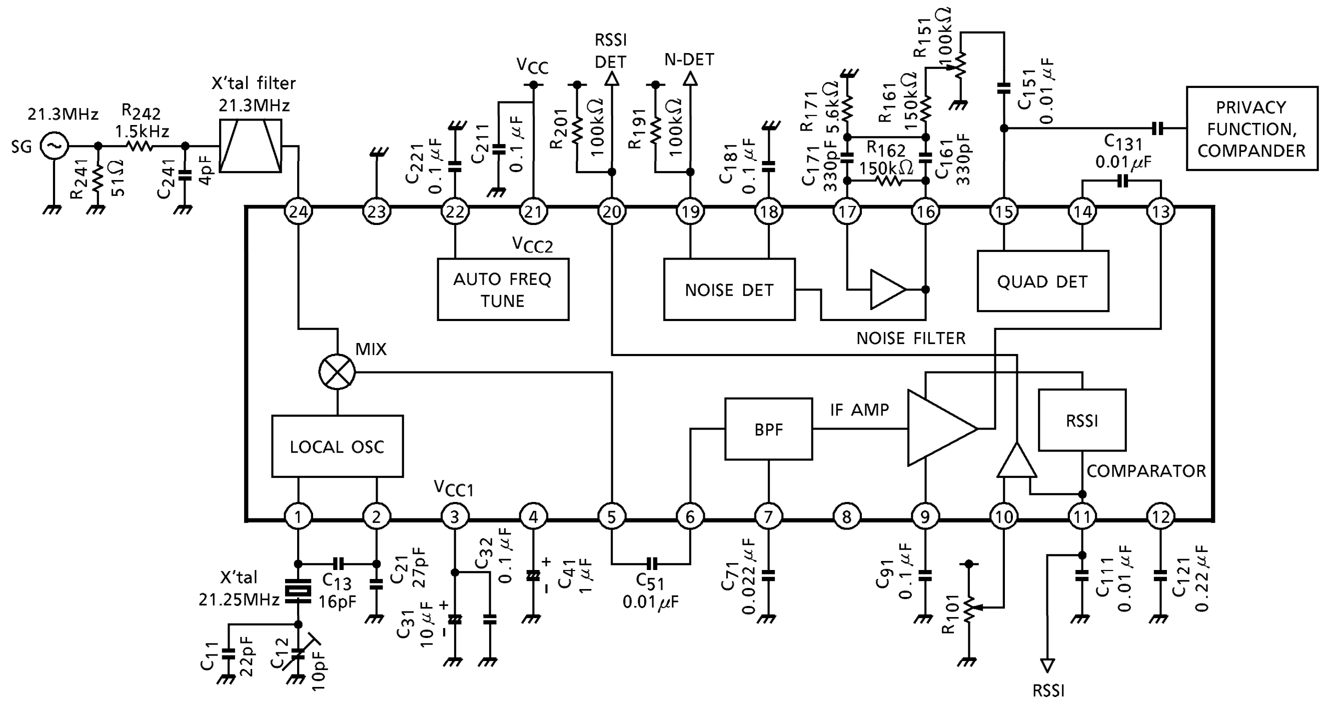

RSSI CHARACTERISTICS
V_{CC} = 3V
f_{IN} = 21.3MHz
RSSI OUTPUT LEVEL V_{RSSI} (V)
2.5
2.0
1.5
1.0
0.5
0
0
20
40
60
80
100
120
MIX INPUT LEVEL V_{IN} (dBμV EMF)


DEMODULATION OUTPUT LEVEL, 12dB SENSITIVITY – POWER SUPPLY VOLTAGE
DEMODULATION OUTPUT LEVEL V_{OD} (mV_{rms})
12dB SENSITIVITY (dBμV EMF)
V_{OD} (V_{IN} = 80dBμV EMF)
12dB sensitivity
200
160
120
80
40
0
50
40
30
20
10
0
0
1
2
3
4
5
6
POWER SUPPLY VOLTAGE V_{CC} (V)


THD – POWER SUPPLY VOLTAGE
f_{IN} = 21.3MHz
f_{MOD} = 1kHz
Δf = ± 1.5kHz
V_{IN} = 80 dBμV EMF
THD (dB)
0
– 10
– 20
– 30
– 40
– 50
0
1
2
3
4
5
6
POWER SUPPLY VOLTAGE V_{CC} (V)

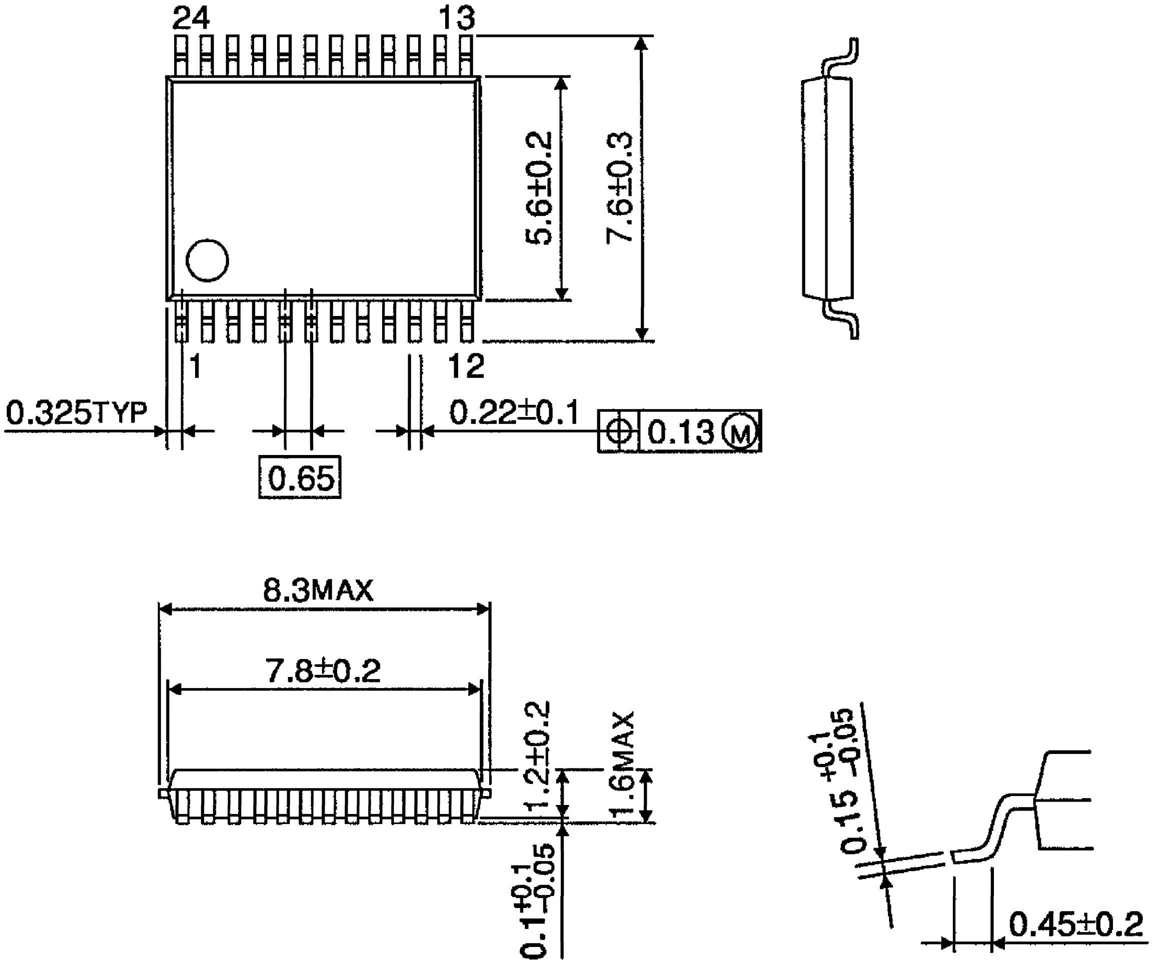

MIX IMAGE REJECTION RATIO – POWER SUPPLY VOLTAGE
V_{IN} = 70dBμV EMF
Pin4 GND
MIX IMAGE REJECTION RATIO I_{RR} (dB)
50
40
30
20
10
0
0
1
2
3
4
5
6
POWER SUPPLY VOLTAGE V_{CC} (V)

APPLICATION CIRCUIT



PACKAGE DIMENSIONS

SSOP24-P-300-0.65A UNIT : mm



Weight : 0.14g (Typ.)

About solderability, following conditions were confirmed

- Solderability

(1) Use of Sn-63Pb solder Bath
- solder bath temperature = 230°C
- dipping time = 5 seconds
- 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 = 5 seconds
- the number of times = once
- use of R-type flux