FM IF detector for cordless telephones
BA4116FV

The BA4116FV is an IC with an internal mixing circuit, IF circuit, wave detection circuit, RSSI circuit, and noise detection circuit. Because it can operate at low voltages, it is ideal for use in cordless telephones.

●Applications
Cordless telephones, amateur short wave radios, and other portable wireless equipment

●Features
1）Input frequencies of 10MHz to 150MHz can be accommodated.
2）Low-voltage operation. (1.8 to 5.5V)
3）Excellent temperature characteristic.

4）High sensitivity; 12dB SINAD sensitivity = 8dB μ VEMF (50Ω)
5）High intercept point. (-11dBm)
6）Small package used. (0.65mm pitch)

●Absolute maximum ratings (Ta=25℃)

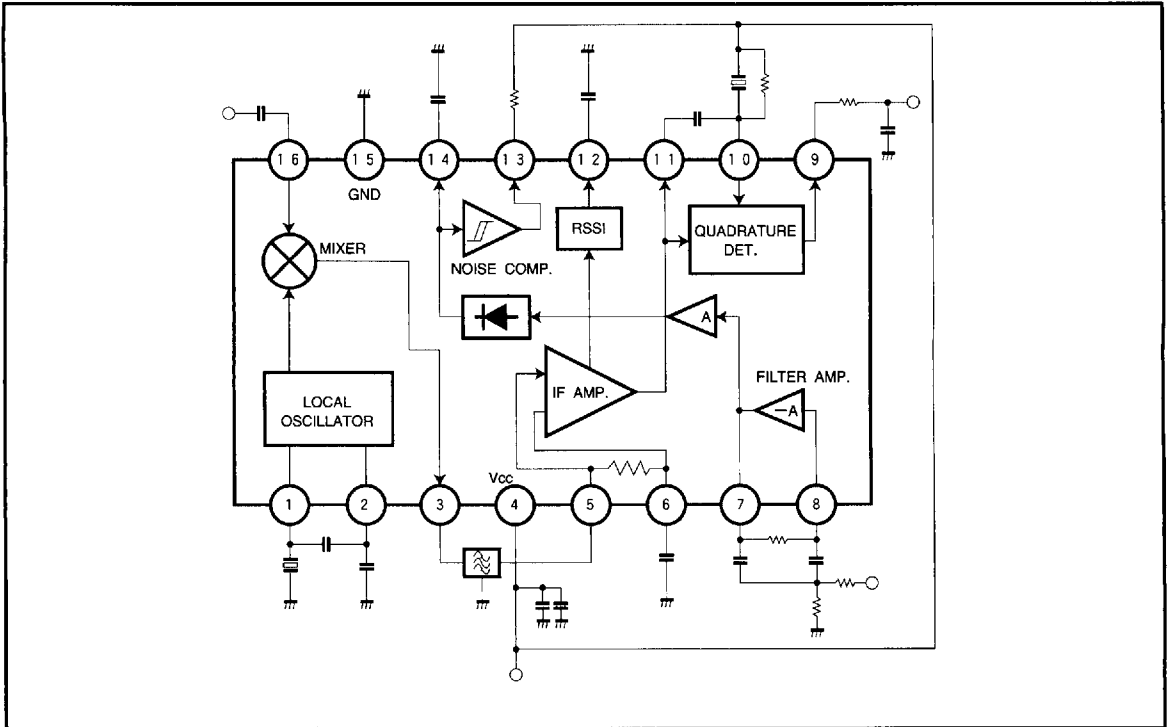| Parameter	Symbol	Limits	Unit
Power supply voltage	Vcc	7.0	V
Power dissipation	Pd	350*	mW
Operating temperature	Topr	−30～85	℃
Storage temperature	Tstg	−55～125	℃

∗ Reduced by 3.5mW for each increase in Ta of 1℃ over 25℃.

●Recommended operating conditions (Ta=25℃)

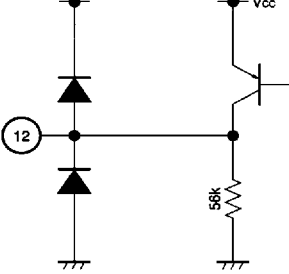| Parameter	Symbol	Min.	Typ.	Max.	Unit
Power supply voltage	Vcc	1.8	2.0	5.5	V

●Block diagram

●Pin descriptions
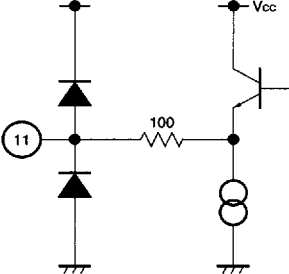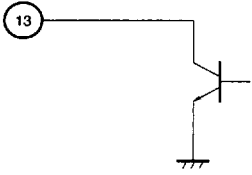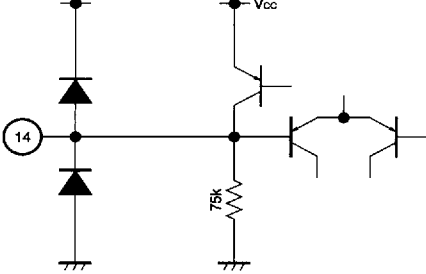
Pin No.	Function	Internal peripheral circuit	Pin voltage with no signal (V)
1	Local oscillation pin (base) Connect crystal resonator and capacitor		Vcc
2	Local oscillation pin (emitter) Connect capacitor or inject from external oscillator		Vcc—0.75
3	Mixer output pin Connect ceramic filter; output impedance is approximately 1.8 kΩ		Vcc—1.33
4	Vcc pin	——————	Vcc

●Pin descriptions
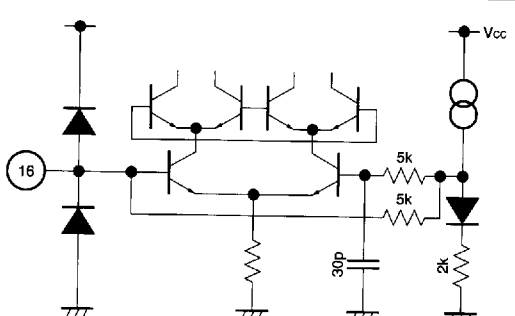
Pin No.	Function	Internal peripheral circuit	Pin voltage with no signal (V)
5	IF amplifier input pin Connect ceramic filter; input impedance is approximately 1.8 kΩ		$V_{CC}-0.33$
6	IF amplifier bypass pin Connect capacitor		$V_{CC}-0.33$
7	Filter amplifier output pin Connect constant such as BPF		0.70
8	Filter amplifier input pin Connect constant such as BPF		0.70
9	Audio demodulation output pin Connect to noise amplifier or similar device; output impedance is approximately 360 Ω		0.86
10	Discriminator pin Connect phase-shifting coil or ceramic discriminator		V_{CC}

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Pin No.	Function	Internal peripheral circuit	Pin voltage with no signal (V)
11	IF amplifier output pin Connect to phase-shifting capacitor		$V_{CC}-0.95$
12	RSSI output pin Connect to capacitor		0.4
13	Noise judgment output pin Connect to load resistance		0
14	Noise detection (rectification) pin Connect to capacitor		0
15	GND pin	————————	0

●Pin descriptions

Pin No.	Function	Internal peripheral circuit	Pin voltage with no signal (V)
16	Mixer input pin Connect 1st IF signal from DC cut; input impedance is approximately 5 kΩ		0.95

●Electrical characteristics (Unless otherwise noted, Ta=25℃, V_{CC}=2.0V, $f_{IN (Mix)}$=21.7MHz, $f_{IN (IF)}$=450kHz, $\Delta f=\pm 1.5$kHzdev, fm=1kHz, all AC levels open (EMF) display)

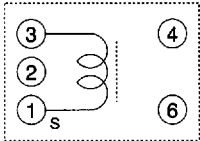| Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement Circuit
Quiescent current	I_Q	2.1	3.0	4.2	mA	No input	Fig.1
Mixer unit							
Conversion gain	G_{VC}	15	18	21	dB	Tested after ceramic filter(−3 dB loss)	Fig.1
Intercept point	I_P	—	−11	—	dBm		—
Input impedance	R_{IN}	—	5.5	—	kΩ		—
	C_{IN}	—	4.6	—	pF		—
Output impedance	R_O	1.2	1.8	2.4	kΩ		—
12 dB SINAD sensitivity	S	—	8	—	dBμV		—
IF detector unit							
Audio demodulation output	V_O	79	100	126	mVrms	$V_{IN (IF)}$ =80dBμV	Fig.1
Signal-to-noise ratio	S/N	43	63	—	dB	$V_{IN (IF)}$ =80dBμV	Fig.1
AM suppression ratio	AMR	—	40	—	dB	$V_{IN (IF)}$ =80dBμV, AM=30%	Fig.1
Input resistance	R_{IN}	1.2	1.8	2.4	kΩ		—
RSSI output voltage	V_{RSSI1}	0.7	1.0	1.45	V	V_{CC}=3V · $V_{IN (IF)}$ =50dBμV	Fig.1
	V_{RSSI2}	1.6	2.3	2.9	V	$V_{IN (IF)}$ =100dBμV	Fig.1
Noise detector unit							
Output voltage	V_{NDET}	—	0.1	0.5	V	V_{NREC}=0.2V, I_{SINK}=0.2mA	Fig.1
Output leakage current	I_{LEAK}	—	0	5	μA	V_{NREC}=0.7V, V_{NDET}=2V	Fig.1
"H" noise detection level	V_{TH-H}	0.5	0.6	0.7	V	Pin 14 voltage so that $V_{NDET} \leqq 0.5$ V	Fig.1
"L" noise detection level	V_{TH-L}	0.3	0.4	0.5	V	Pin 14 voltage so that $I_{SINK} \leqq 5 \mu A$	Fig.1
Noise detection hysteresis width	Hys	2.0	3.5	5.0	dB	Hysteresis width between V_{TH-H} and V_{TH-L} above	Fig.1

●Measurement circuit
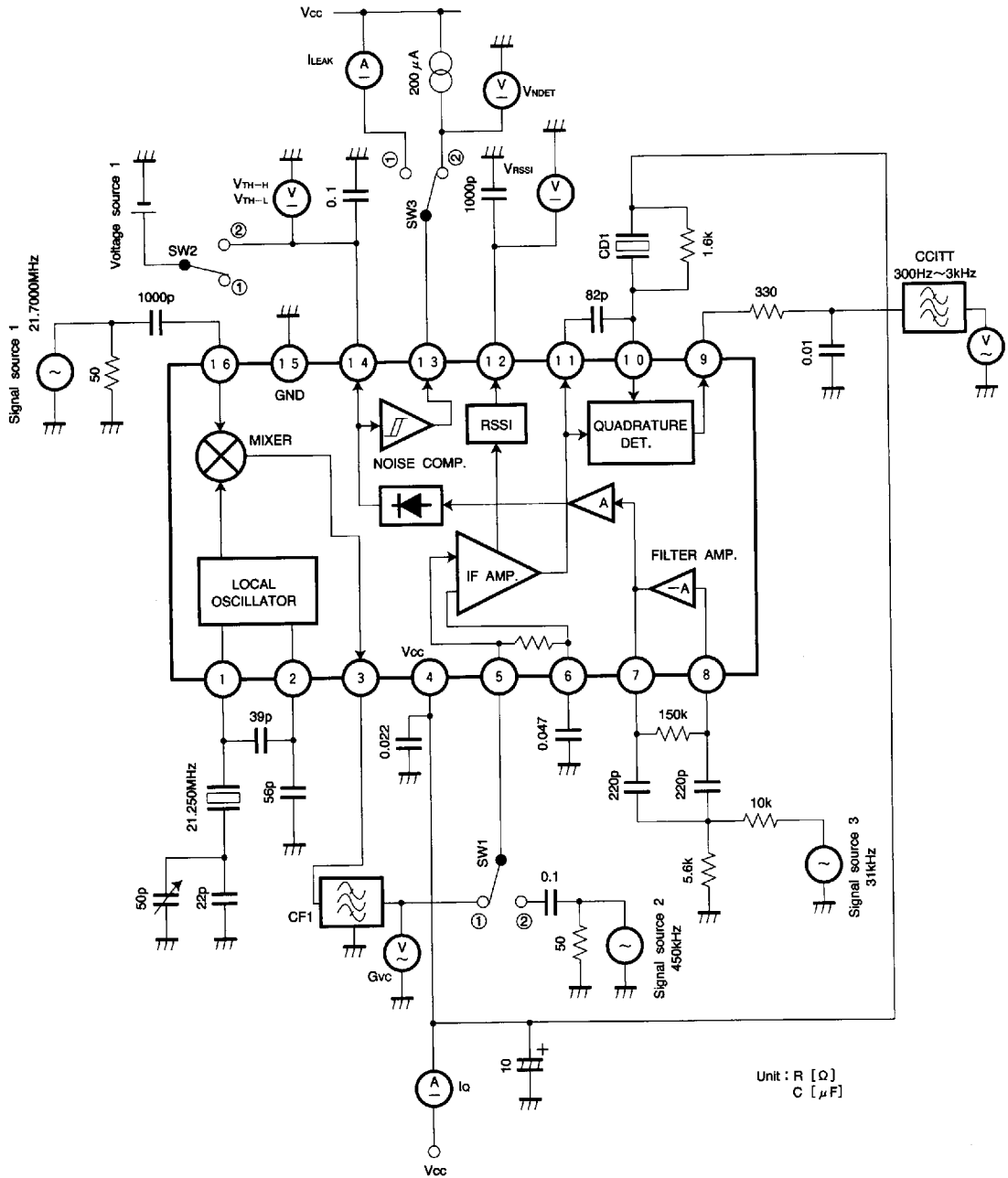
Fig. 1

●Application example
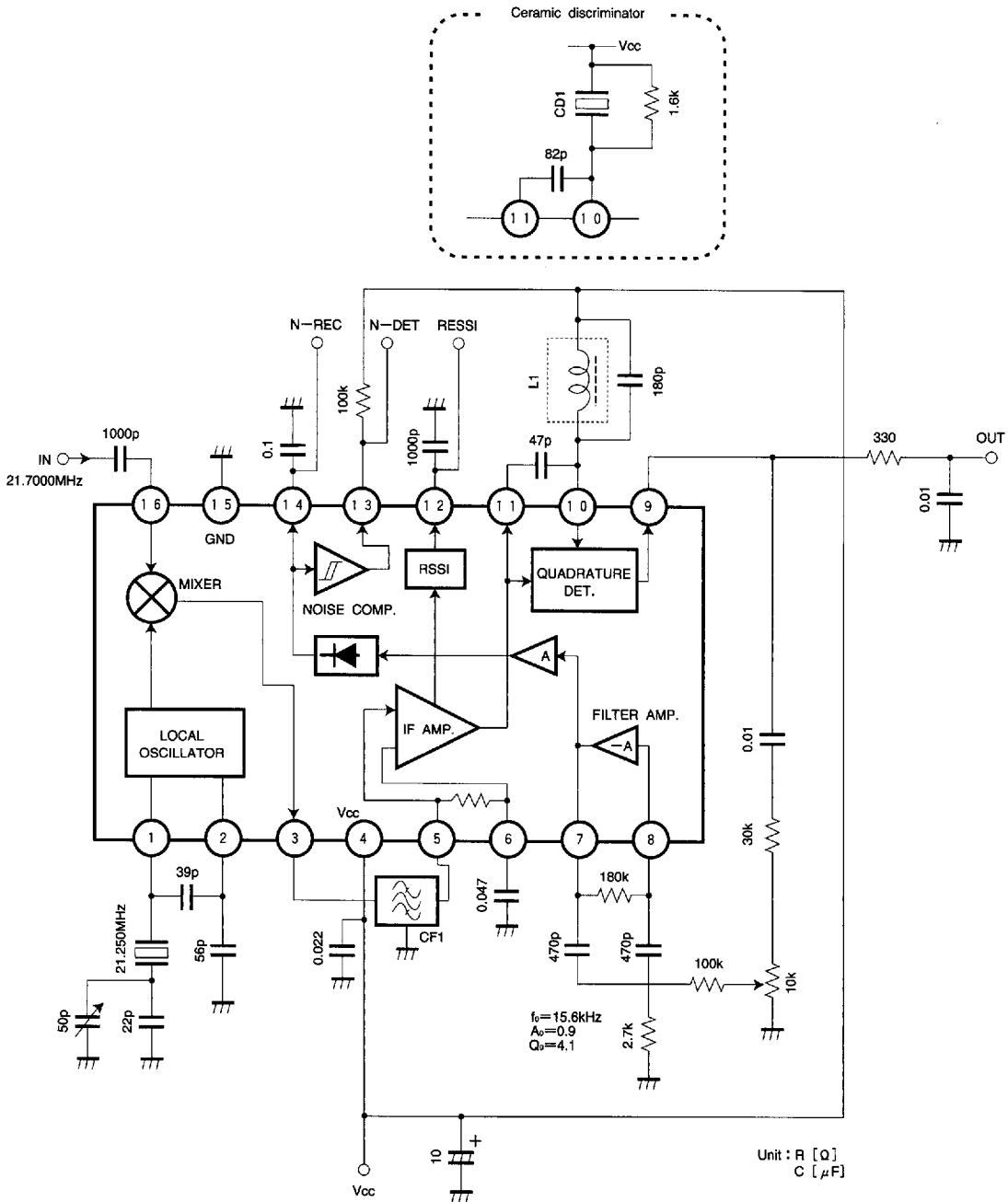
Fig. 2

●Description of external components

Part No.	Part Name	Prod. No./Mfg.	Notes
CF1	Ceramic filter	Murata: CFWM450G	6 dB band width = ±4.5 kHz min. Attenuation band width = ± 10 kHz max. Guaranteed attenuation= 35 dB min. Input loss = 6 dB max.
CD1	Ceramic discriminator	Murata: CDB450C24	
L1	Wave detection coil	Toko: 5PNR-2876Z	1–3 190T Wire type: 0.045ø, 3UEW L variable range= ±4 % Q at no load = 20 min.

●Determining the filter amplifier constant (multi-layer recovery band pass filter)

f_0 : Center frequency

Q : Center frequency f_0/band width BW

A_0 : I/O gain

The reference resistance R_0 is determined as $C_1 = C_2 = C_0$.

$R_0 = 1/2 \pi f_0 \cdot C_0$

$R_1 = R_0 \cdot Q/A_0$

$R_2 = R_0/[2Q - (A_0/Q)]$

$R_3 = 2R_0 \cdot Q$

The I/O gain can be adjusted by varying R_1, but with the $A_0 > 1$ design, please be aware that influence from the open loop characteristic of the amplifier causes offset in the center frequency f_0.
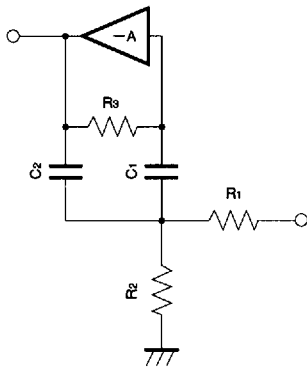
Fig. 3
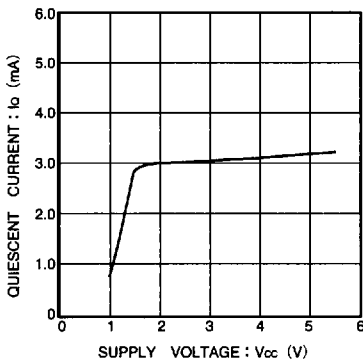
●Electrical characteristic curves

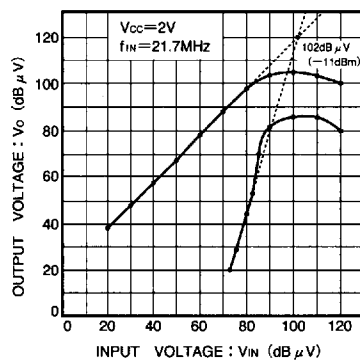Fig. 4 Quiescent current vs. supply voltage characteristic.

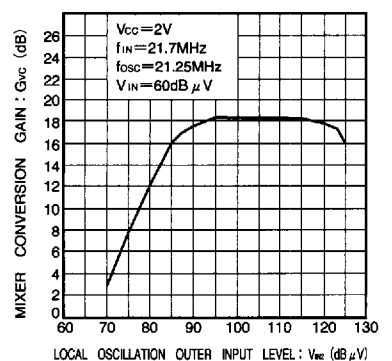Fig. 5 Mixer output voltage vs. input voltage characteristic

Fig. 6 Mixer conversion gain vs. Pin 2 OSC injection level characteristic

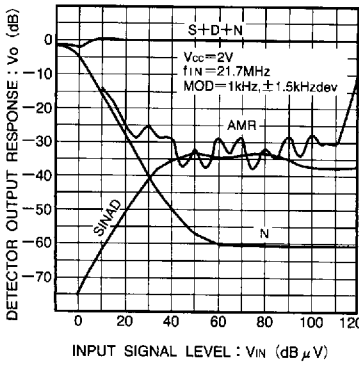● Electrical characteristics curves

Fig. 7 Detector output response,
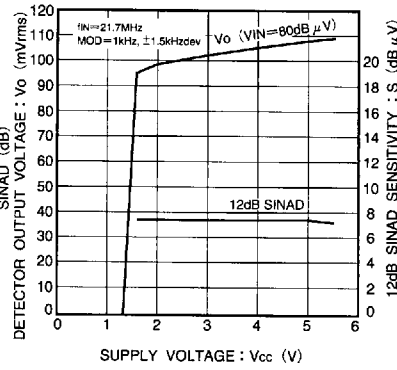AMR, INAD vs. input signal level
characteristic

Fig. 8 Detector output voltage,
12 dB SINAD sensitivity vs.
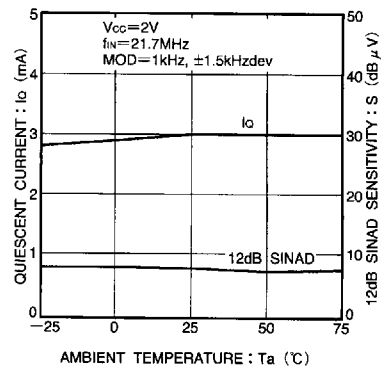power supply voltage
characteristic

Fig. 9 Quiescent current, 12 dBSINAD
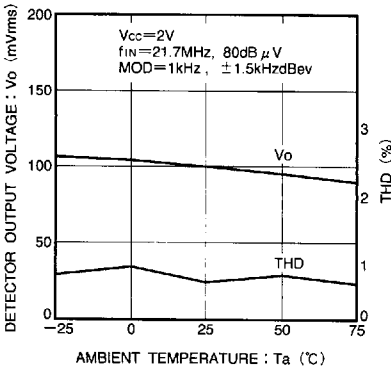sensitivity vs. ambient temperature
characteristic

Fig. 10 Detector output level,
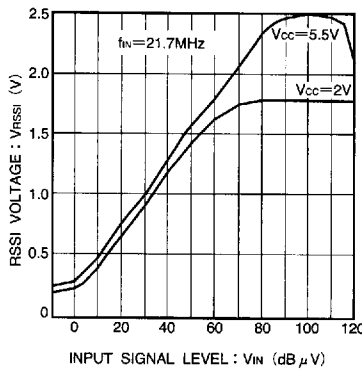THD vs. ambient temperature
characteristic

Fig. 11 RSSI voltage vs.
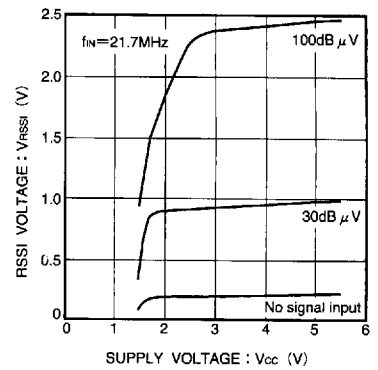input signal
level characteristic

Fig. 12 RSSI voltage vs.
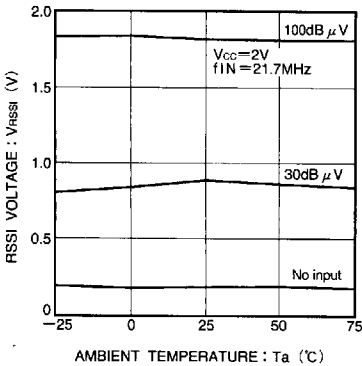supply voltage
characteristic

Fig. 13 RSSI voltage vs.
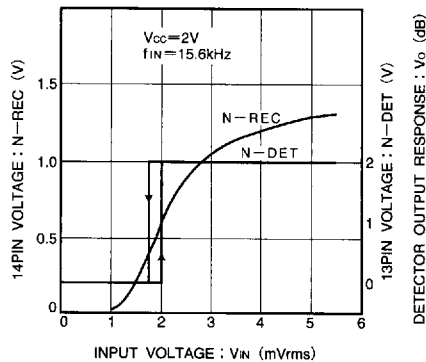ambient temperature
characteristic

Fig. 14 Pin 13 voltage,
Pin 14 voltage vs.
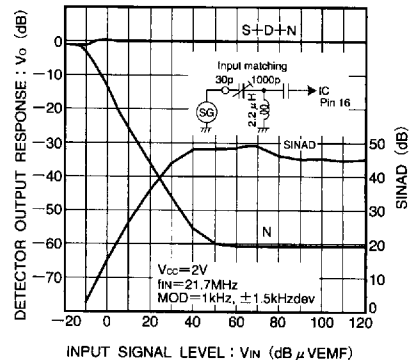noise amplifier input voltage
characteristic

Fig. 15 Detector output
response, SINAD vs. input signal
level characteristic

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●External dimensions (Units: mm)

SSOP-B16

5.0±0.2

16   9

6.4±0.3

4.4±0.2

1   8

1.15±0.1

0.1

0.65

0.22±0.1

0.3Min.

0.15±0.1

0.1