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℃)

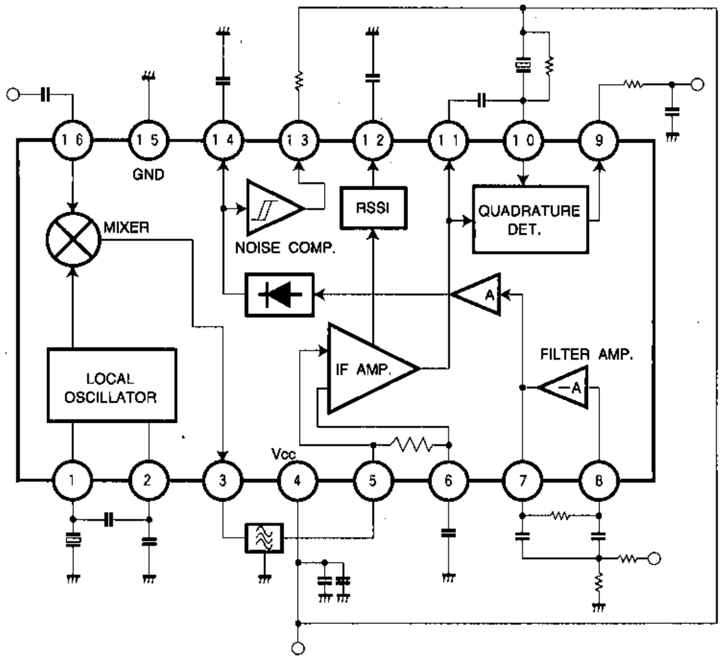
Parameter	Symbol	Limits	Unit
Power supply voltage	V_{CC}	7.0	V
Power dissipation	Pd	350*	mW
Operating temperature	Topr	−30~85	℃
Storage temperature	Tstg	−55~125	℃

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

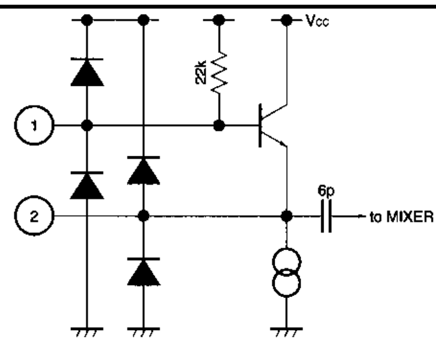
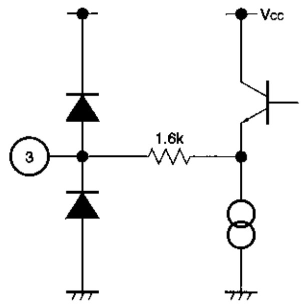
●Recommended operating conditions (Ta=25℃)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power supply voltage	V_{CC}	1.8	2.0	5.5	V

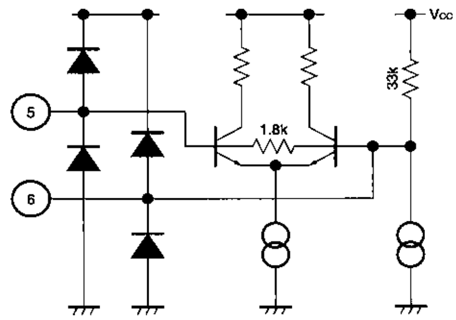
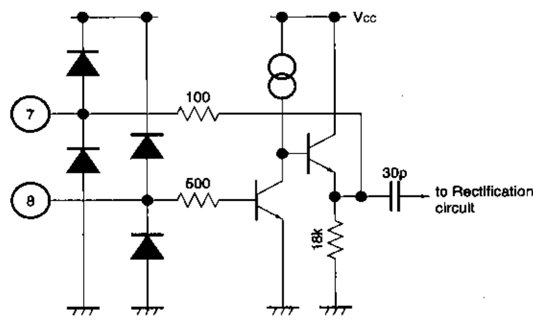
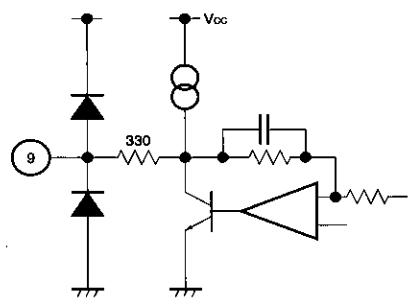
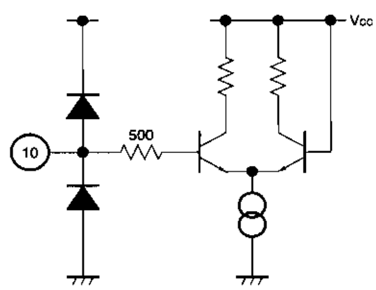
● Block diagram

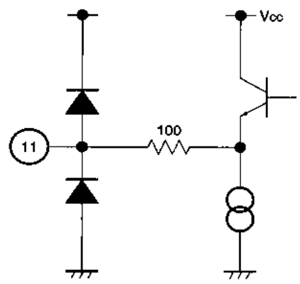
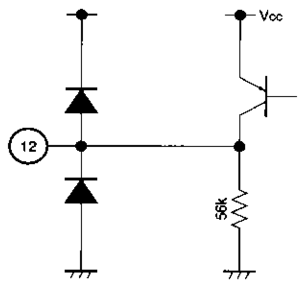
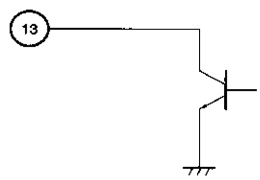
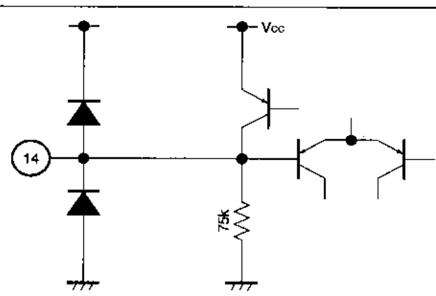


● Pin descriptions

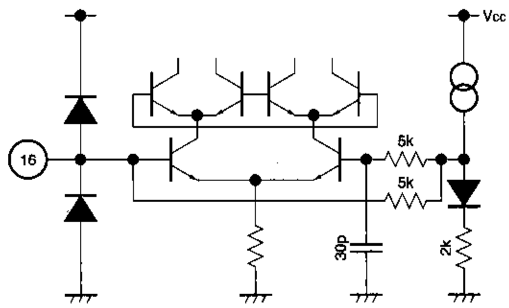
Pin No.	Function	Internal peripheral circuit	Pin voltage with no signal (V)
1	Local oscillation pin (base) Connect crystal resonator and capacitor		V_{CC}
2	Local oscillation pin (emitter) Connect capacitor or inject from external oscillator		$V_{CC}-0.75$
3	Mixer output pin Connect ceramic filter; output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

● 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		Vcc−0.33
6	IF amplifier bypass pin Connect capacitor		Vcc−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		Vcc

Pin No.	Function	Internal peripheral circuit	Pin voltage with no signal (V)
11	IF amplifier output pin Connect to phase-shifting capacitor		Vcc−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°C, V_{CC}=2.0V, $f_{IN\ (Mix)}$=21.7MHz, $f_{IN\ (IF)}$=450kHz, Δf=±1.5kHzdev, 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} ≦ 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} ≦ 5 μA		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

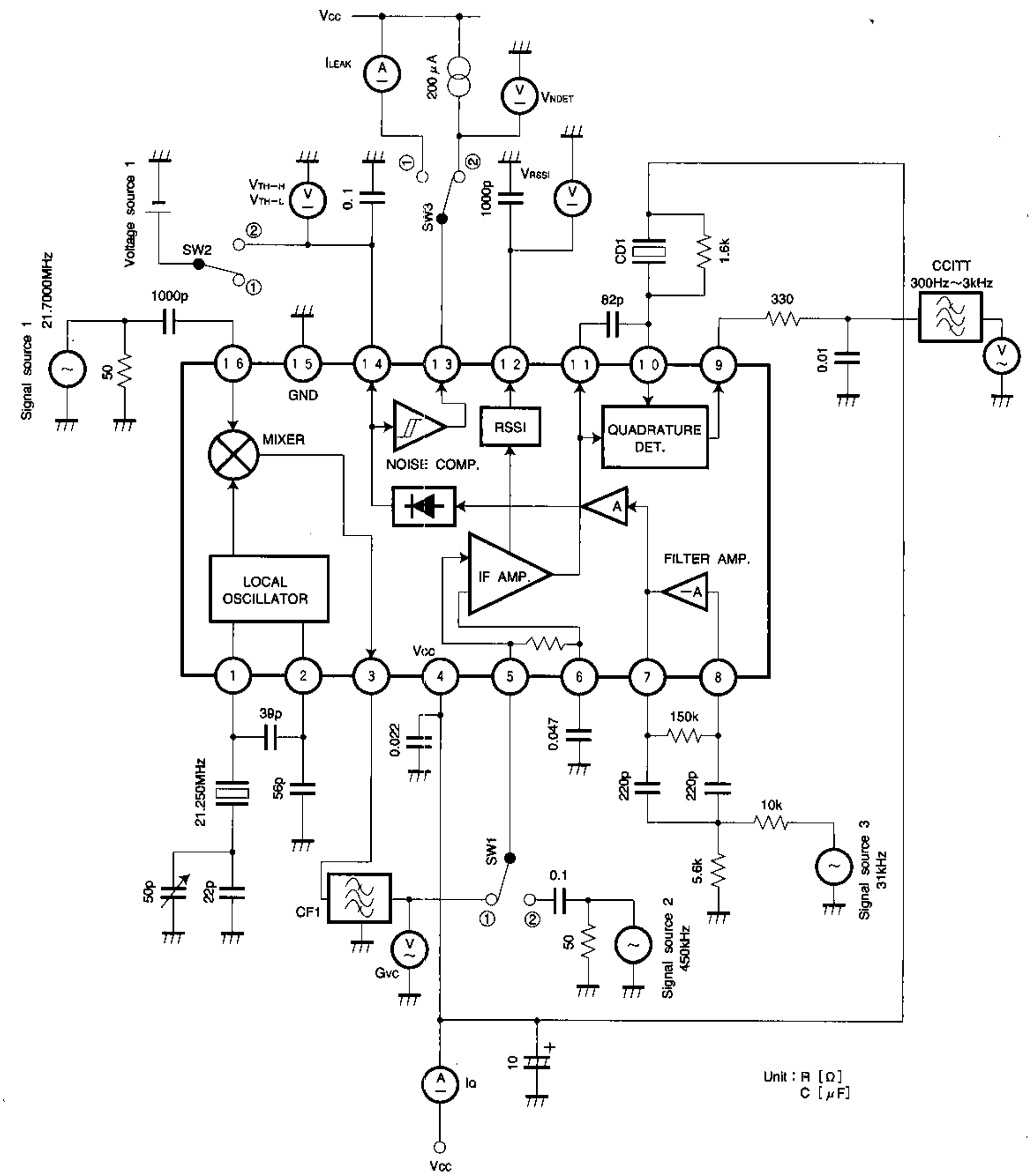


Fig. 1

●Application example

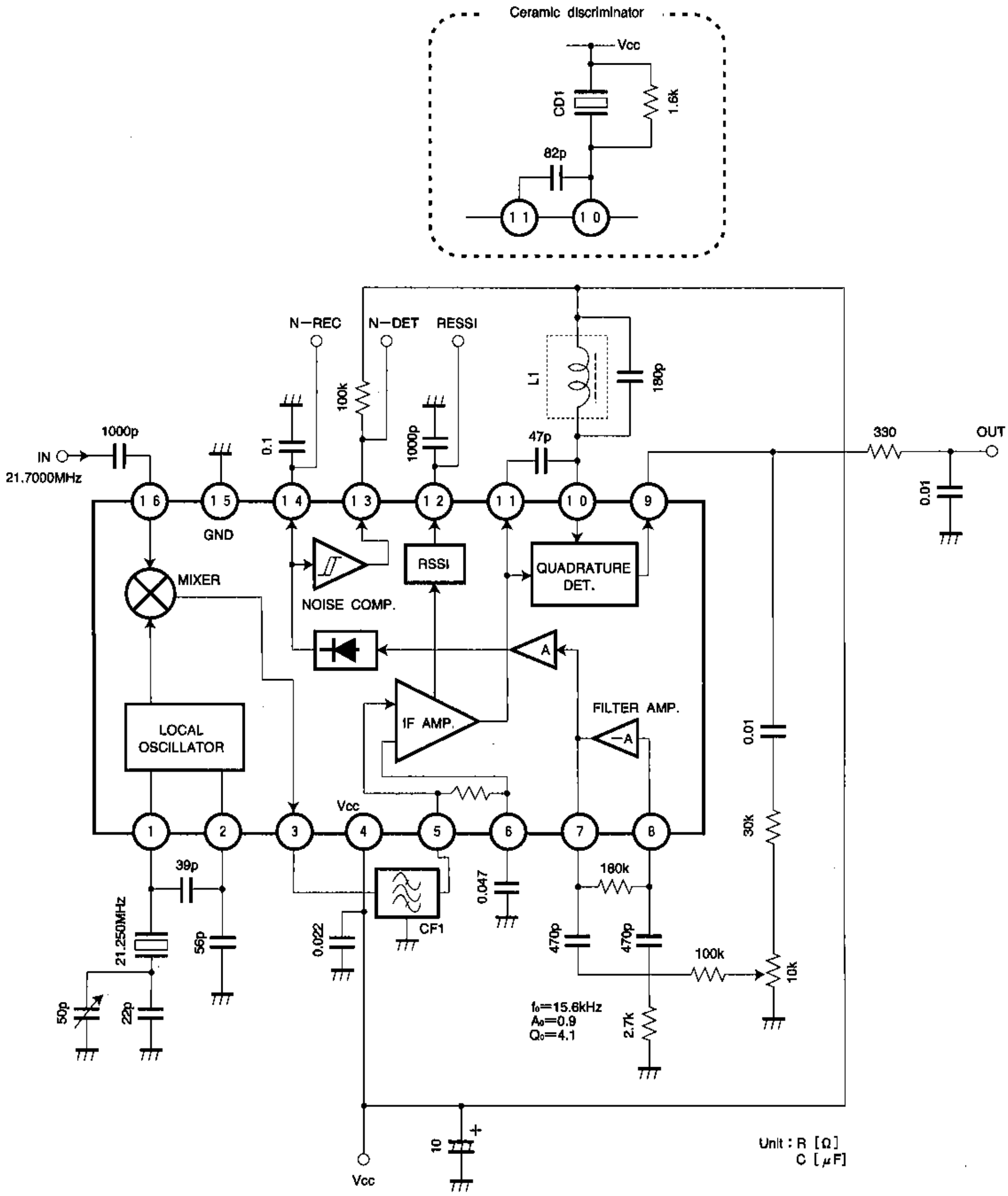
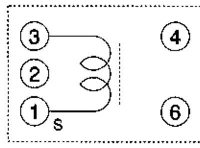


Fig. 2

●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)

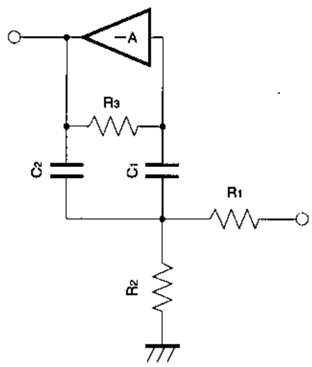


Fig. 3

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.

●Electrical characteristic curves

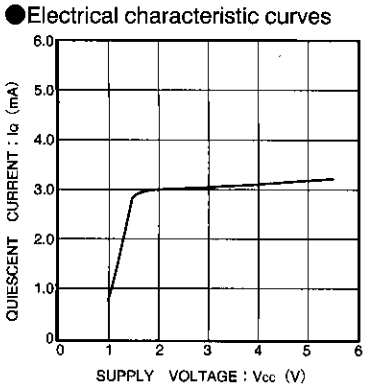


Fig. 4 Quiescent current vs. supply voltage characteristic.

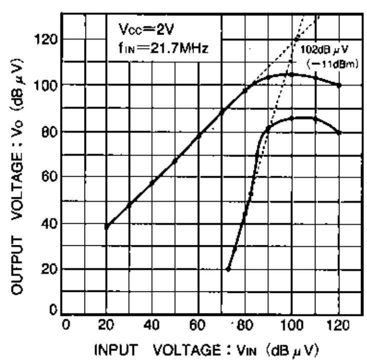


Fig. 5 Mixer output voltage vs. input voltage characteristic

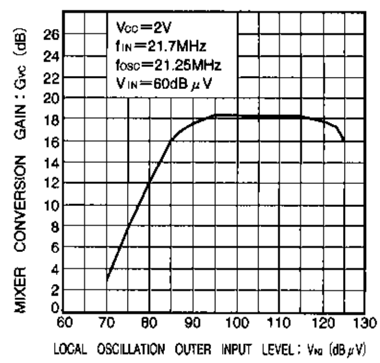


Fig. 6 Mixer conversion gain vs. Pin 2 OSC injection level characteristic

●Electrical characteristics curves

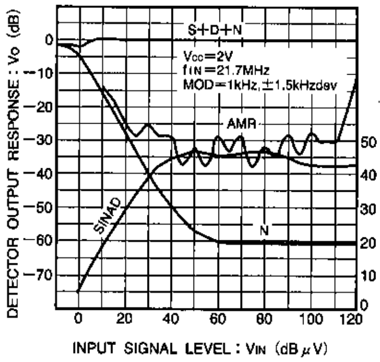


Fig. 7 Detector output response, AMR, INAD vs. input signal level characteristic

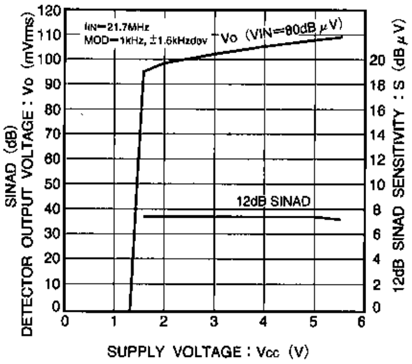


Fig. 8 Detector output voltage, 12 dB SINAD sensitivity vs. power supply voltage characteristic

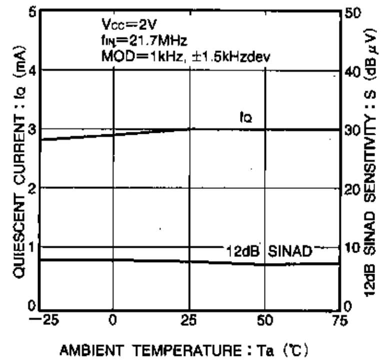


Fig. 9 Quiescent current, 12 dBSINAD sensitivity vs. ambient temperature characteristic

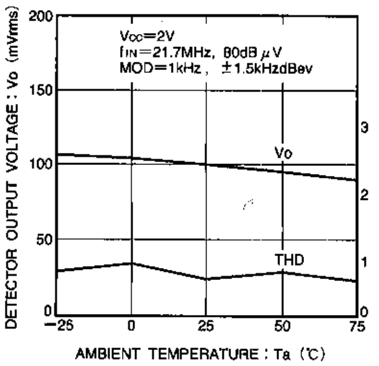


Fig. 10 Detector output level, THD vs. ambient temperature characteristic

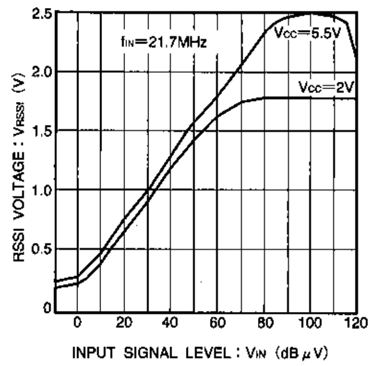


Fig. 11 RSSI voltage vs. input signal level characteristic

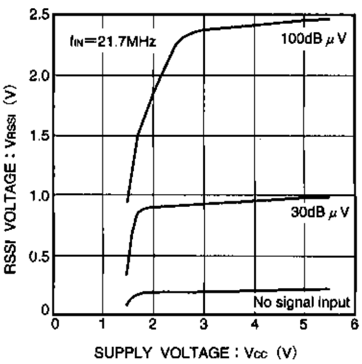


Fig. 12 RSSI voltage vs. supply voltage characteristic

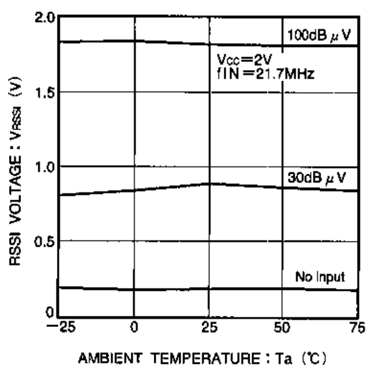


Fig. 13 RSSI voltage vs. ambient temperature characteristic

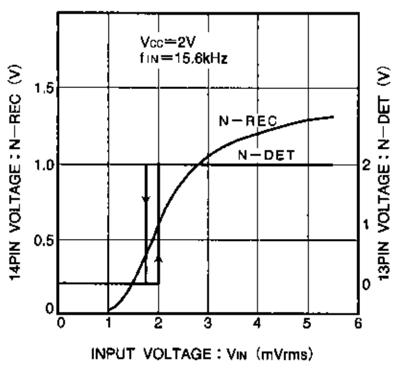


Fig. 14 Pin 13 voltage, Pin 14 voltage vs. noise amplifier input voltage characteristic

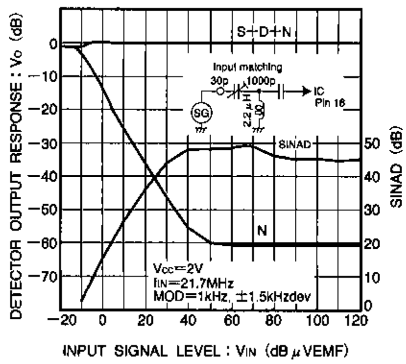
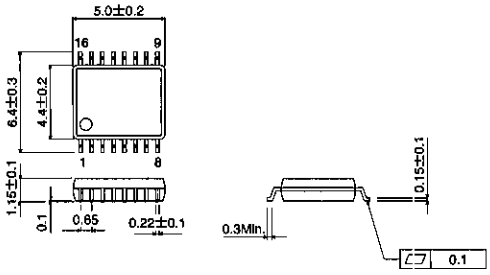


Fig. 15 Detector output response,SINAD vs. input signal level characteristic

●External dimensions (Units: mm)



SSOP-B16

Notes

- The contents described in this catalogue are correct as of March 1997.
- No unauthorized transmission or reproduction of this book, either in whole or in part, is permitted.
- The contents of this book are subject to change without notice. Always verify before use that the contents are the latest specifications. If, by any chance, a defect should arise in the equipment as a result of use without verification of the specifications, ROHM CO., LTD., can bear no responsibility whatsoever.
- Application circuit diagrams and circuit constants contained in this data book are shown as examples of standard use and operation. When designing for mass production, please pay careful attention to peripheral conditions.
- Any and all data, including, but not limited to application circuit diagrams, information, and various data, described in this catalogue are intended only as illustrations of such devices and not as the specifications for such devices. ROHM CO., LTD., disclaims any warranty that any use of such device shall be free from infringement of any third party's intellectual property rights or other proprietary rights, and further, assumes absolutely no liability in the event of any such infringement, or arising from or connected with or related to the use of such devices.
- Upon the sale of any such devices; other than for the buyer's right to use such devices itself, resell or otherwise dispose of the same; no express or implied right or license to practice or commercially exploit any intellectual property rights or other proprietary rights owned or controlled by ROHM CO., LTD., is granted to any such buyer.
- The products in this manual are manufactured with silicon as the main material.
- The products in this manual are not of radiation resistant design.

The products listed in this catalogue are designed to be used with ordinary electronic equipment or devices (such as audio-visual equipment, office-automation equipment, communications devices, electrical appliances, and electronic toys). Should you intend to use these products with equipment or devices which require an extremely high level of reliability and the malfunction of which would directly endanger human life (such as medical instruments, transportation equipment, aerospace machinery, nuclear-reactor controllers, fuel controllers, or other safety devices) please be sure to consult with our sales representatives in advance.

- Notes when exporting
  - It is essential to obtain export permission when exporting any of the above products when it falls under the category of strategic material (or labor) as determined by foreign exchange or foreign trade control laws.
  - Please be sure to consult with our sales representatives to ascertain whether any product is classified as a strategic material.