Low Power FM IF Amplifier

Description

CXA1002M/N is an FM IF amplifier most suitable for cellular and FM radios.

Features

- Includes all the functions needed for cellular radios such as FM detecting circuit, RSSI, IF amplifier and others.
- Wide operating voltage range 4.5 to 9.5 V and low current consumption.
  (During Vcc=5 V, Icc=2.5 mA Typ.)
- Built-in audio output buffer circuit reduces external parts to a minimum.
- Wide range RSSI and excellent temperature characteristics.
- Compact 16 pin SOP and 16 pin VSOP package.

Functions

- IF amplifier and limiter
- RSSI (Received Signal Strength Indicator)
- FM detecting circuit

Structure

Bipolar silicon monolithic IC

Absolute Maximum Ratings (Ta=25°C)

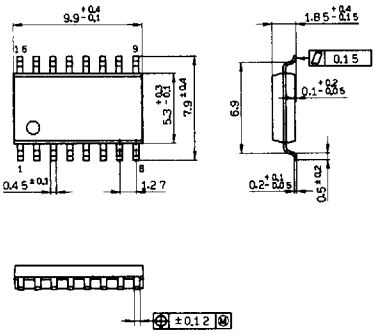
• Supply voltage	Vcc	17		V
• Operating temperature	Tstg	−35 to	+85	°C
• Storage temperature	Topr	−55 to	+150	°C
• Allowable power dissipation	PD	500		mW

Recommended Operating Condition

• Supply voltage	Vcc	4.5 to	9.5	V

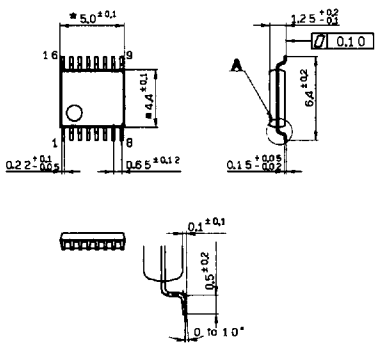
Package Outline Unit: mm

CXA1002M 16 pin SOP (Plastic)



SOP-16P-LO1

CXA1002N 16 pin VSOP (Plastic)



Note) The size marked * does not include the remaining resin.

VSOP-16P-LO1

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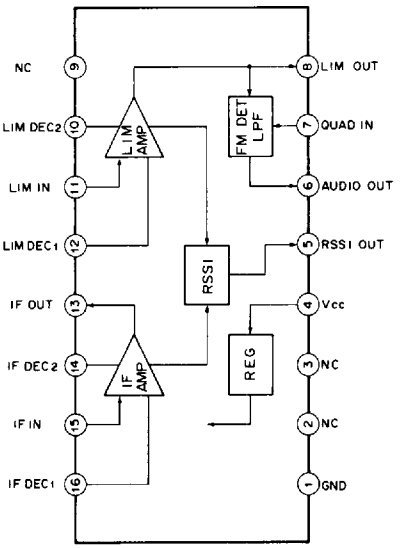
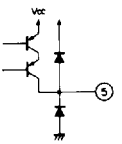
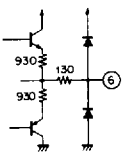
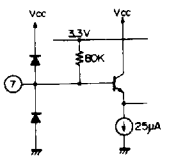
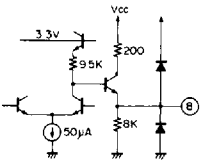
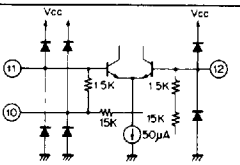
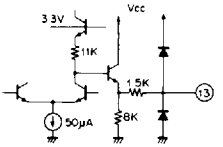
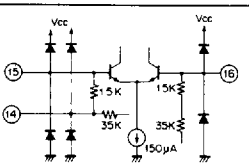
80518-YA

Block Diagram and Pin Configuration (Top View)



Pin Description and Equivalent circuit

No.	Symbol	Voltage (Typ)	Equivalent Circuit	Description
1	GND	0 V		Ground pin
4	Vcc	5.0 V		Supply pin
5	RSSI OUT			The current output corresponds to the input signal level to IF and LIM amplifiers.
6	AUDIO OUT	2.5 V		FM detected signal is output.
7	QUAD IN	3.3 V		Input pin of quadrature detecting circuit.

No.	Symbol	Voltage (Typ)	Equivalent Circuit	Description
8	LIM OUT	1.7 V		Output pin of limiter.
10 11 12	LIM DEC2 LIM IN LIM DEC1	1.7 V 1.7 V 1.7 V		Input and decoupling pin of limiter. Connect pins 10 and 12 to GND by means of a capacitor (0.01 to 0.047 μF).
13	IF OUT	1.6 V		Output pin of IF amplifier.
14 15 16	IF DEC2 IF IN IF DEC1	1.6 V 1.6 V 1.6 V		Input and decoupling pin of IF amplifier. Connect pins 14 and 16 to GND by means of a capacitor (0.01 to 0.047 μF).

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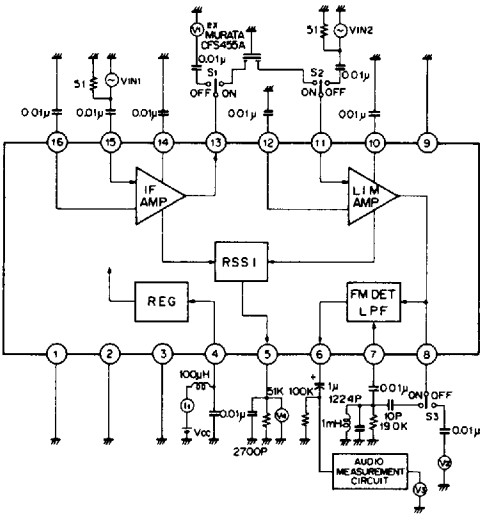
Electrical Characteristics

See the Electrical Characteristics Test Circuit
Ta=25°C, Vcc=5 V, 0 dBm=223.6 mVrms

No.	Item	Symbol	SW turned ON	Input signal No.	Remarks	Test Point	Min.	Typ.	Max.	Unit
1	Consumption current	Icc				I_1	2.0	2.5	3.0	mA
2	IF amp voltage gain	VG1		V_{IN_1}: 455kHz −50 dBm		V_1	34	36	38	dB
3	Limiter voltage gain	VG2		V_{IN_2}: 455kHz −90 dBm		V_2	70	72	74	dB
4	Limiter output voltage	VO2		V_{IN_2}: 455kHz −20 dBm		V_2	500	570	640	mVp-p
5	Audio output voltage	VO3	S3	V_{IN_2}: 455kHz −20 dBm	f_{AUDIO} = 1 kHz DEV = ±8 kHz FM	V_3	115	195	245	mVrms
6	Audio output distortion	VD3		V_{IN_2}: 455kHz −20 dBm	f_{AUDIO} = 1 kHz DEV = ±8 kHz FM	V_3			1	%
7	Audio output S/N	SN3		V_{IN_2}: 455kHz −20 dBm		V_3	40			dB
8	Audio output AMRR	AR3		V_{IN_2}: 455kHz −20 dBm	f_{AUDIO} = 1 kHz MOD = ±80% AM	V_3	30			dB
9	RSSI output voltage L	VO4L	S1, S2	V_{IN_1}: 455kHz −100 dBm		V_4	0 25	0.40	0.55	V
10	RSSI output voltage H	VO4H	S1, S2	V_{IN_1}: 455kHz −20 dBm		V_4	1.50	1.85	2.20	V

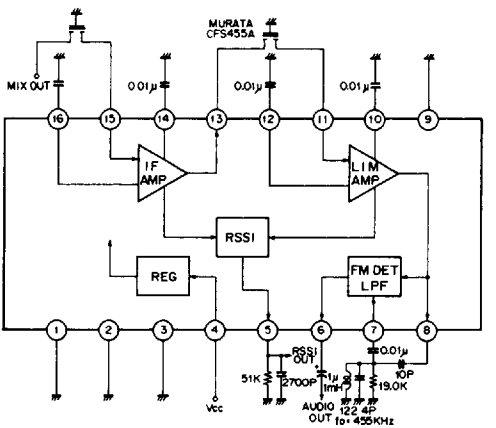
Electrical Characteristics Test Circuit



Operation

Signals passing through the filter and input through pin 15, amplified at IF amplifier and output through pin 13. IF amplifier output is subjected again to band limitation, to amplitude limitation at the limiter amplifier and output through pin 8. The limiter amplifier output is phase shifted at the LC resonance circuit and after undergoing quadrature detection, audio signals are output from pin 6.
For RSSI, at IF and limiter amplifiers stages, a current corresponding to the input levels is obtained, added up and output from pin 5.
RSSI voltage output is obtained by connecting a suitable I to V conversion circuit (resister and capacitor parallel circuit) to pin 5.

Application Circuit



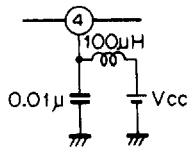
Notes on Usage

Voltage gain of IF amplifier in CXA1002M/N is about 36 dB. Voltage gain of the limiter amplifier is rather high at 72 dB. Please take the following precautions:

1. Decouple pin 4 (Vcc) with L and C as near to the pins as possible.
2. Be sure to ground pins 2, 3 and 9 (NC).
3. Separate input line from the output line as far as possible, and make the wiring short.
4. Decoupling capacitors of IF amplifier (pins 14, 16) and limiter amplifier (pins 10, 12) should be grounded as close to the respective pins as possible.
5. Work out the GND pattern to obtain an impedance as low as possible.
6. Electrostatic separation of the limiter amplifier input and output parts by setting up and shield plate gives better efficiency. (Mark use of pin 1 GND and pin 9 NC)

Application Note

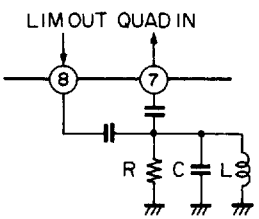
1) Supply
With the built-in voltage regulator, CXA1002M/N has wide operating power supply voltage range from +4.5 to 9.5 V (Typ. 5.0 V). Within the above supply voltage range, there are almost no changes in the characteristics.
Decouple pin 4 (Vcc) with L and C. (See Fig. below)



Decoupling

2) Filter
The most suitable band pass filter to be connected between pins 13 and 11 of CXA1002M/N should have the following specifications.
- I/O impedance : 1.5 kΩ ±10%
- Insertion loss (center frequency): <6 dB

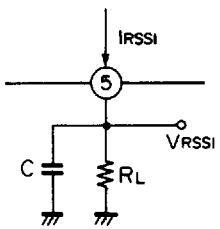
3) Phase shifter
To execute quadrature FM detection, the limiter output (pin 8) phase is shifted 90° by means of the RLC parallel resonance circuit or the discriminator and input through pin 7.
The Fig. below show the phase shifter made up by the RLC parallel resonance circuit. In this case set L, C value so that the 2nd IF signal frequency and the parallel resonance frequency become similar. As R value sets the audio output level, select this value so as to obtain the required output.



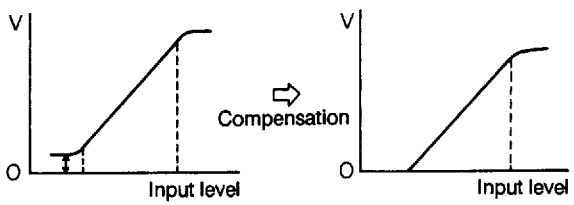
RLC Phase Shifter

4) Audio output
FM modulated audio and data signals are demodulated at the previous stage and output from pin 6 (Audio out).

5) RSSI
RSSI is function that detects the magnitude of the input signal level. In CXA1002M/N, it is output with current, and increases almost uniformly within the range of IF input level −100 to 0 dBm (2.24 μ to 224 mVrms). It is almost free from the supply voltage and temperature influence. However the output current is distributed within a range of ±20% by means of the resistance inside the IC.
When voltage output is required, it performs I to V conversion by means of a resistance. The value of that resistance is determined by RSSI's maximum output current and the maximum allowable voltage of pin 5. With RSSI's maximum output current at about 60 μA (Typ. 45 μA) and the allowable maximum voltage (performance guaranteed maximum voltage) at Vcc −1.8 V, select the resistance according to the supply voltage and the required output voltage.
When an output voltage of Vcc −1.8 V and above is required use the function after amplifying by means of an operational amplifier.
When the RSSI output voltage is required at AMPS which is the cellular radio standard. A uniform increase from 0 V is defined. However, for CXA1002M/N as there is an offset of about 0.3 to 0.5 V (Vcc=5 V, RL=51 kΩ), arrange to start from 0 V by using an offset compensation circuit.

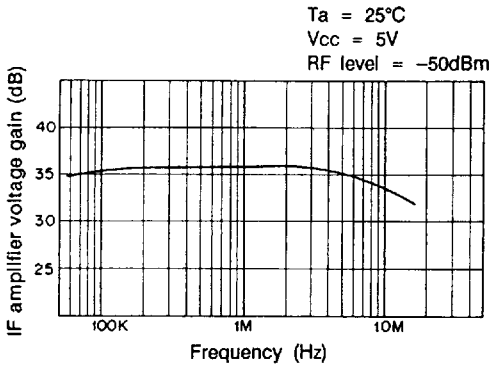


RSSI I to V circuit

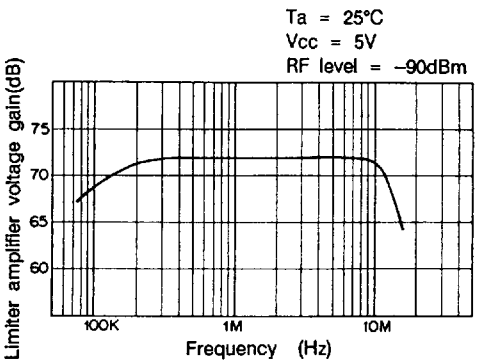


RSSI output voltage offset compensation

IF amplifier voltage gain frequency characteristics

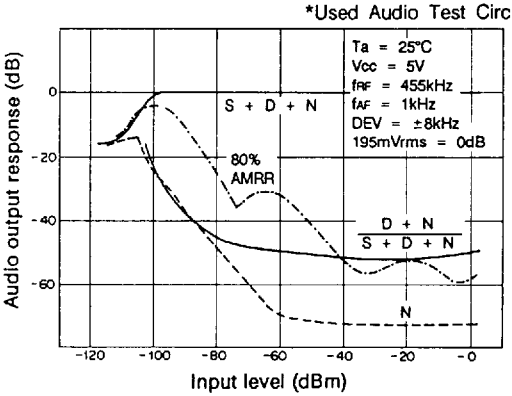


Limiter amplifier voltage gain frequency characteristics

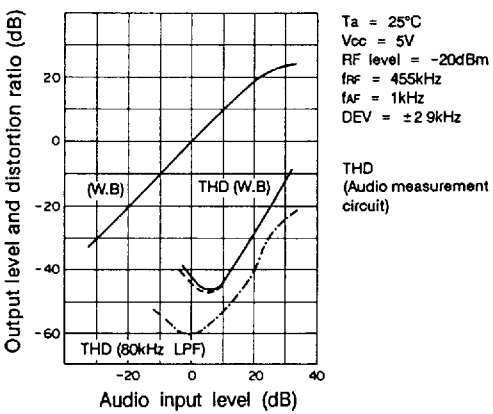


Audio demodulation characteristics (IF IN/AUDIO OUT)

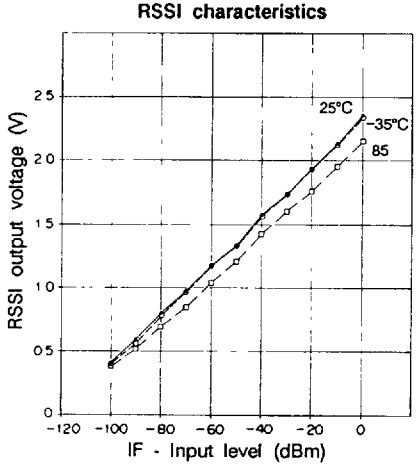
*Used Audio Test Circuit



Audio I/O characteristics

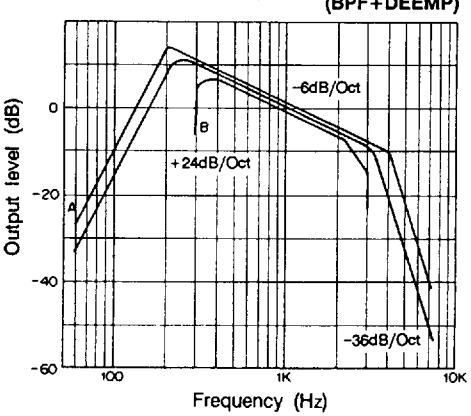


RSSI characteristics

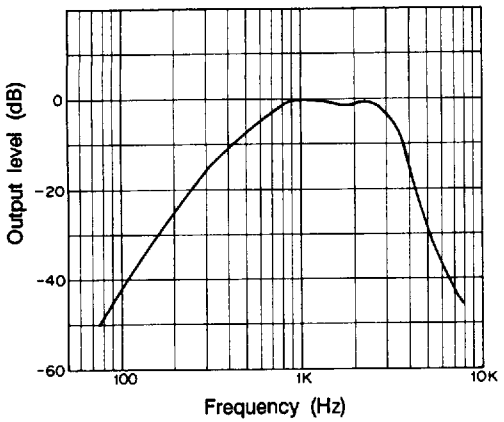


RX-audio filter frequency characteristics (A-B AMPS Standard)

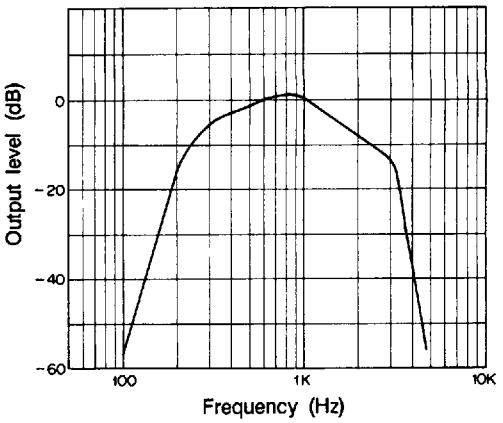
(BPF+DEEMP)



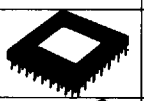
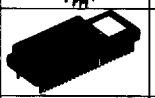
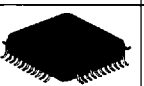
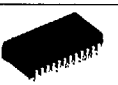
C-message filter frequency characteristics



Audio test circuit frequency characteristics



Package Name

Type		Package name		Package	Features			
		Symbol	Description		Material*	Lead pitch	Lead shape	Lead pull out direction
Inserted	Standard	DIP	DUAL IN-LINE PACKAGE		P C	2.54mm (100MIL)	Through Hole Lead	2-direction
		SIP	SINGLE IN LINE PACKAGE		P	2.54mm (100MIL)	Through Hole Lead	1-direction
		ZIP	ZIG ZAG IN-LINE PACKAGE		P	2.54mm (100MIL) Zig-Zag in-line	Through Hole Lead	1-direction
		PGA	PIN GRID ARRAY		C	2.54mm (100MIL)	Through Hole Lead	Package under side
		PIGGY BACK	PIGGY BACK		C	2.54mm (100MIL)	Through Hole Lead	2-direction
	Shrink	SDIP	SHRINK DUAL IN-LINE PACKAGE		P	1.778mm (70MIL)	Through Hole Lead	2-direction
		SZIP	SHRINK ZIG-ZAG IN-LINE PACKAGE		P	1.778mm (70MIL) Zig-Zag in-line	Through Hole Lead	1-direction
Surface mounted	Standard flat package	QFP	QUAD FLAT L LEADED PACKAGE		P C	1.0mm 0.8mm 0.65mm	Gull-Wing	4-direction
		SOP	SMALL OUTLINE L-LEADED PACKAGE		P	1.27mm (50MIL)	Gull-Wing	2-direction
	Standard 2-direction chip carrier	SOJ	SMALL OUTLINE J-LEADED PACKAGE		P	1.27mm (50MIL)	J-Lead	2-direction
	Shrink flat package	VQFP	VERY SMALL QUAD FLAT PACKAGE		P	0.5mm	Gull-Wing	4-direction
		VSOP	VERY SMALL OUTLINE PACKAGE		P	0.65mm	Gull-Wing	2-direction
		TSOP	THIN SMALL OUTLINE PACKAGE		P	0.5mm (0.55mm)	Gull-Wing	2-direction
	Standard chip carrier	QFJ	QUAD FLAT J-LEADED PACKAGE		P	1.27mm (50MIL)	J-Lead	4-direction
		QFN	QUAD FLAT NON-LEADED PACKAGE		C	1.27mm (50MIL)	Leadless	Package under side

*P·····Plastic, C···Ceramic

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