



## UA31136

## LINEAR INTEGRATED CIRCUIT

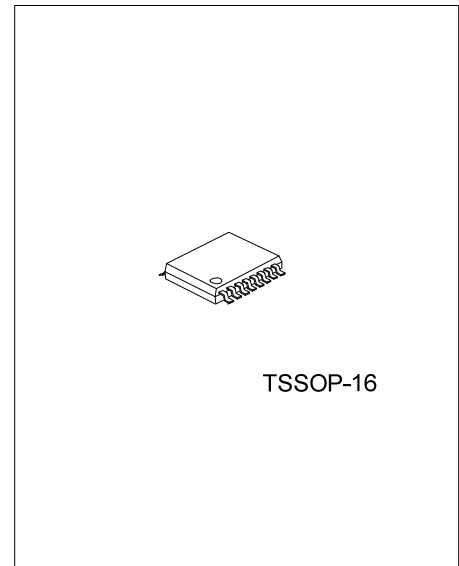
### FM IF DETECTOR IC FOR CORDLESS TELEPHONE

#### DESCRIPTION

The UTC **UA31136** is a low operation voltage FM IF detector IC that includes an Oscillator, Mixer, Limiting Amplifier, Quadrature Detector and Noise Detector, it is suitable for cordless telephone.

#### FEATURES

- \* Low operation voltage:  $V_{CC} = 1.8 \sim 5.5V$
- \* Excellent temperature characteristics
- \* High sensitivity  
12dB sensitivity: 11dB $\mu$ V EMF (Input 50 $\Omega$ )
- \* High intercept point: 96dB $\mu$ V (Input 50 $\Omega$ )
- \* Quadrature detector, both ceramic and coil discriminators are usable.
- \* Built-in 2nd MIX  
Operating frequency: 10 ~ 100MHz
- \* Built-in noise detection circuit
- \* RSSI function



Lead-free: UA31136L  
Halogen-free: UA31136G

#### ORDERING INFORMATION

Ordering Number			Package	Packing
Normal	Lead Free	Halogen Free		
UA31136-P16-R	UA31136L-P16-R	UA31136G-P16-R	TSSOP-16	Tape Reel
UA31136-P16-T	UA31136L-P16-T	UA31136G-P16-T	TSSOP-16	Tube

<p>UA31136L-P16-R</p> <p>(1)Packing Type (2)Package Type (3)Lead Plating</p>	<p>(1) R: Tape Reel, T: Tube (2) P16: TSSOP-16 (3) G: Halogen Free, L: Lead Free, Blank: Pb/Sn</p>
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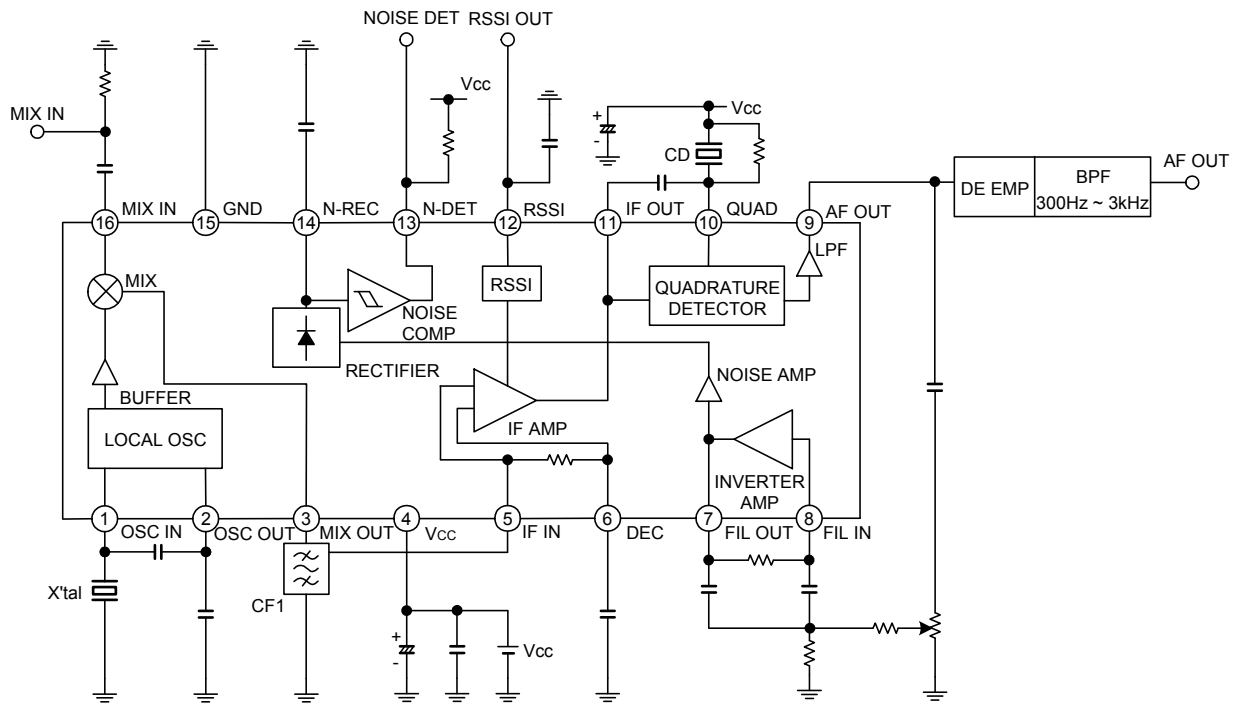
■ PIN DESCRIPTION (The values of resistor and capacitor are typical.)

PIN No.	PIN NAME	FUNCTION	INTERNAL EQUIVALENT CIRCUIT	VOLTAGE
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.		1.98
2	OSC OUT			1.33
3	MIX OUT	MIX output terminal. Output impedance is around 1.8kΩ.		0.74
4	V <sub>CC</sub>	Power supply		2.0
5	IF IN	2nd IF input and decoupling for bias. Input impedance is around 1.8kΩ.		1.67
6	DEC			1.67
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.		0.67
8	FIL IN			0.65
9	AF OUT	Demodulate signal output terminal. Carrier leak is small as LPF is built-in. Output impedance is around 360Ω.		
10	QUAD	Phase shift signal input terminal of FM demodulator.		2.0

### ■ PIN DESCRIPTION (Cont.)

PIN No.	PIN NAME	FUNCTION	INTERNAL EQUIVALENT CIRCUIT	VOLTAGE
11	IF OUT	Output terminal of IF AMP.		1.14
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 reference. 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.		0.0
16	MIX IN	1st IF signal input terminal. Input impedance is around 4kΩ at 21.7MHz.		0.94

## ■ BLOCK DIAGRAM



### ■ ABSOLUTE MAXIMUM RATINGS (Ta = 25°C)

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V <sub>CC</sub>	7	V
Power Dissipation	P <sub>D</sub>	560	mW
Junction Temperature	T <sub>J</sub>	125	°C
Operating Temperature	T <sub>OPR</sub>	-30 ~ +85	°C
Storage Temperature	T <sub>STG</sub>	-50 ~ +150	°C

Note: Absolute maximum ratings are those values beyond which the device could be permanently damaged.

Absolute maximum ratings are stress ratings only and functional device operation is not implied.

### ■ ELECTRICAL CHARACTERISTICS

(V<sub>CC</sub> = 2.0V, f<sub>IN(MIX)</sub> = 21.7MHz, f<sub>IN(IF)</sub> = 450kHz, Δf = ±1.5kHz, f<sub>MOD</sub> = 1kHz, Ta = 25°C, unless otherwise specified.)

PARAMETER	SYMBOL	TEST CIRCUIT	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
Power Supply Voltage	V <sub>CC</sub>			1.8	2.0	5.5	V	
Noise Detection Output Voltage	V <sub>NDET</sub>	2	I <sub>SINK</sub> = 0.2mA		0.1	0.5	V	
Noise Detection Level	High	V <sub>TH</sub>			0.5	0.7	V	
	Low	V <sub>TL</sub>		0.3	0.4			
RSSI Output Voltage	V <sub>RSSI1</sub>	2	V <sub>CC</sub> = 3V	V <sub>IN(IF)</sub> = 30dBμV	200	360	520	mV
	V <sub>RSSI2</sub>	2			V <sub>IN(IF)</sub> = 100dBμV	1.4	2.0	2.6
Demodulation Output Level	V <sub>OD</sub>	2	V <sub>IN(IF)</sub> = 80dBμV	80	100	120	mV	
Current Consumption	I <sub>Q</sub>	1			3.2	4.6	mA	
Noise Detection Output Leak Current	I <sub>O(LEAK)</sub>		V <sub>NREC</sub> = 0.6V, V <sub>NDET</sub> = 2V		0	5	μA	
IF AMP. Input Resistance	R <sub>IN(IF)</sub>			1.2	1.8	2.4	kΩ	
Mixer Output Resistance	R <sub>O(MIX)</sub>			1.2	1.8	2.4	kΩ	
Mixer Input Impedance	R <sub>IN(MIX)</sub>				5.5		kΩ	
	C <sub>IN(MIX)</sub>				2.8		pF	
SN Ratio	SN	2	V <sub>IN(IF)</sub> = 80dBμV	43	65		dB	
Rejection Ratio	RR	2	V <sub>IN(IF)</sub> = 80dBμV, AM = 30%		40		dB	
Mixer Conversion Gain	G <sub>VC</sub>	2	Measured via ceramic filter. V <sub>IN(MIX)</sub> = 46dBμV	15	18	21	dB	
Mixer Intercept Point	P <sub>IM</sub>		Input 50Ω		96		dBμV	
12dB Sensitivity	12dB SN				11		dBμV	

Note: All AC levels are indicated by open lever (EMF).

## FUNCTION DESCRIPTION

### 1. Local oscillator external injection method

Figure 1 and Figure 2 show external injection from pin 2 or pin 1 is possible. In both case, the level at PIN 2 is between 95dB $\mu$ V and 100dB $\mu$ V. When Local oscillator injected from PIN 1, then the input frequency is increased, the level on pin 2 may not be sufficient, causing a decrease in sensitivity. In such a case, add resistor R<sub>51</sub>. A built-in BUFFER amp. minimizes leakage from the mixer.

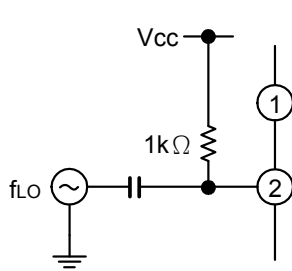


Figure 1

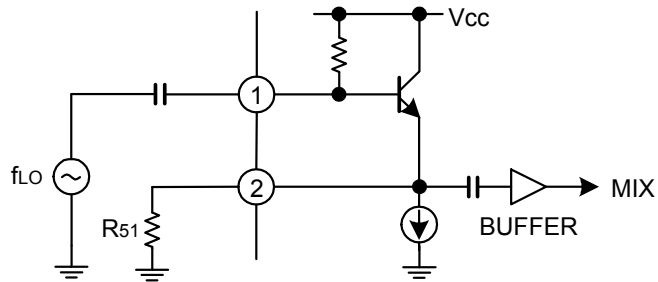


Figure 2

### 2. Overtone oscillation

The basic configuration of the local oscillation circuit using overtone oscillation is shown as Fig 3. The C<sub>51</sub> and L<sub>1</sub> tuning circuits prevent crystal fundamental oscillation. Therefore, set C<sub>51</sub> and L<sub>1</sub> 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<sub>51</sub>.

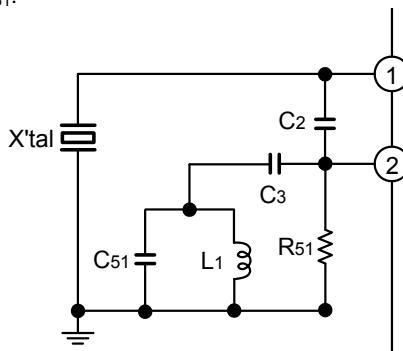


Figure 3

### 3. Detection circuit

Detection stage is quadrature method. Both ceramic and coil discriminator are suitable. The case of using coil is shown in Figure 4, in this case, L1 and C101 composing a phase shifter, demodulation output V<sub>OD</sub> is about 80mVrms. V<sub>OD</sub> will be increased as raising damping resistance R6. Center frequency f<sub>0</sub> and demodulation output depends largely on phase shifter and C<sub>7</sub>. For C<sub>7</sub> and C<sub>101</sub> use a capacitor with good temperature characteristics.

Detector is ceramic discriminator on reference application.

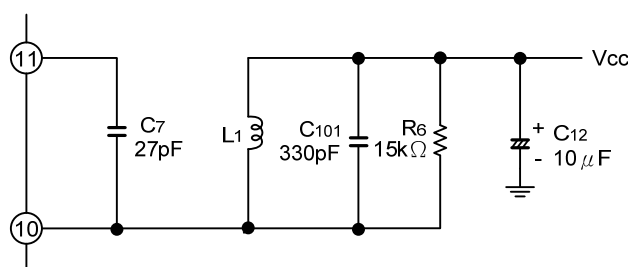


Figure 4

L1: 5114-JPS-010  
(SUMIDA)

## FUNCTION DISCRIPTION(Cont.)

### 4. INVERTER AMP usage

Figure 5 shows the INVERTER AMP can be used to from a band pass filter.

Set constants as in equations (1) ~ (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.

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

$$(2) G_V = R_3 / 2R_4$$

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

at  $R_4 \gg R_p$

Example  $R_3 = 150k\Omega$ ,  $R_4 = 330k\Omega$ ,  
 $R_5 = 3.3k\Omega$ ,  $R_p = 20k\Omega$  (VR)

$C = 220pF$  provide;

$f_0 \approx 31kHz$ ,  $G_V \approx -13dB$

$Q \approx 12$

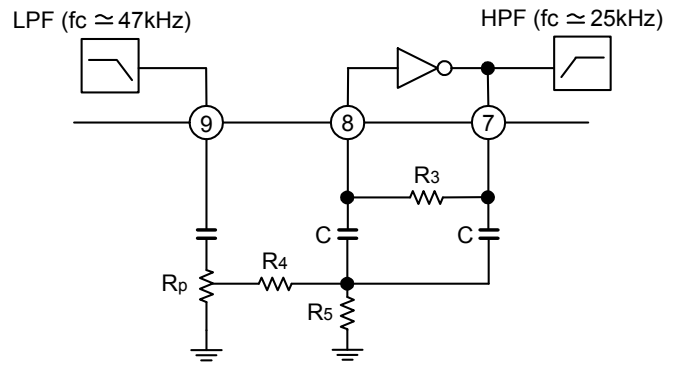
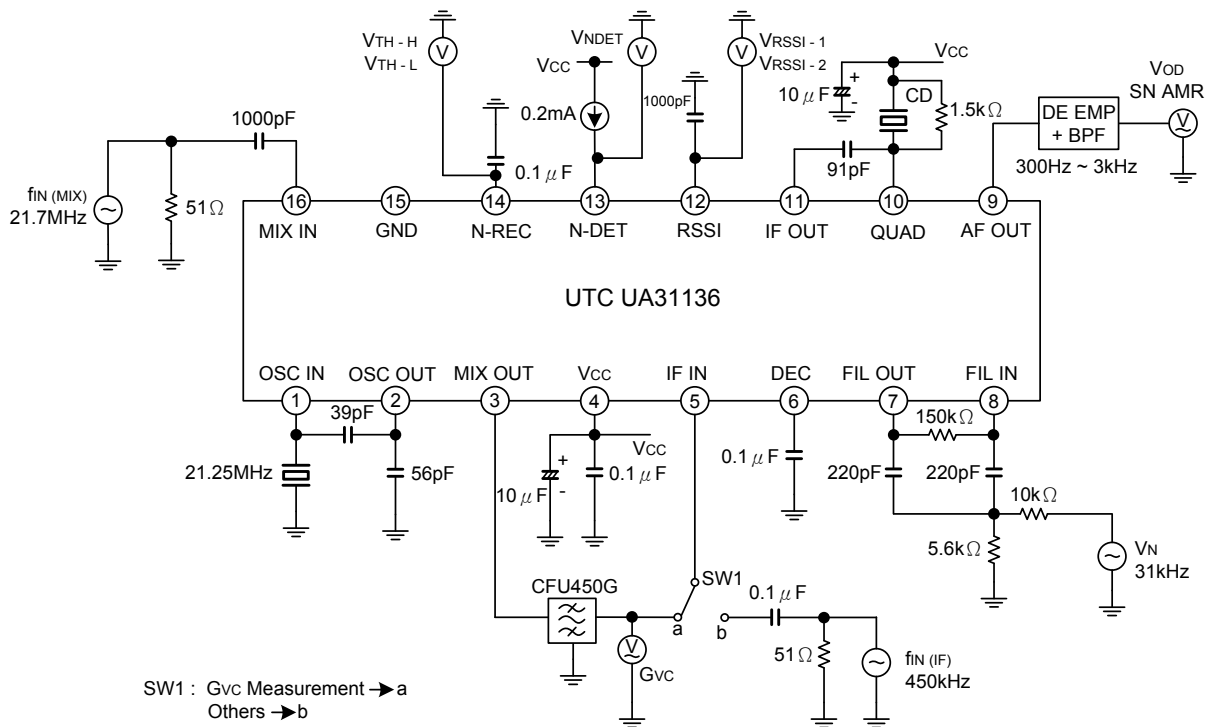
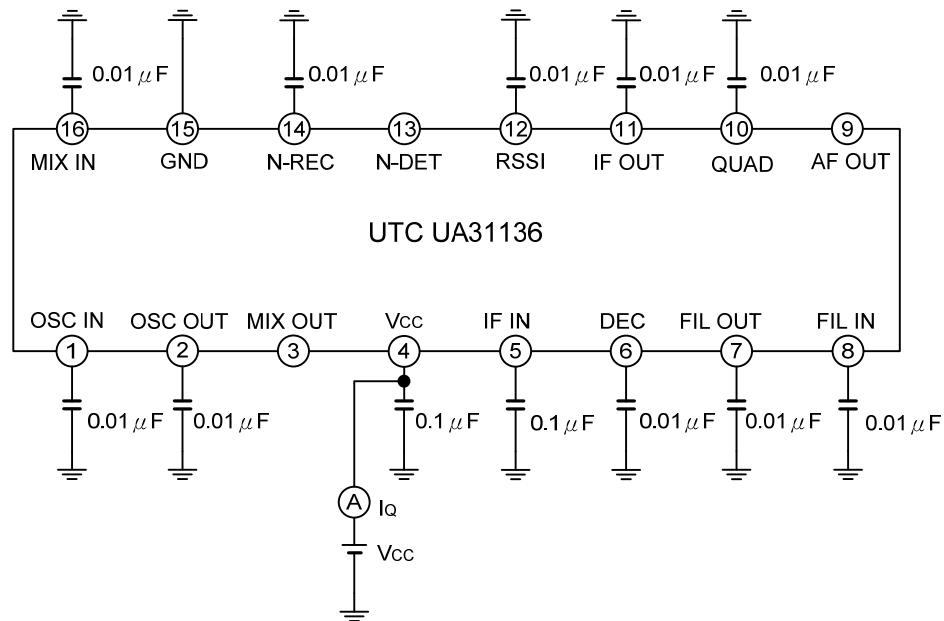


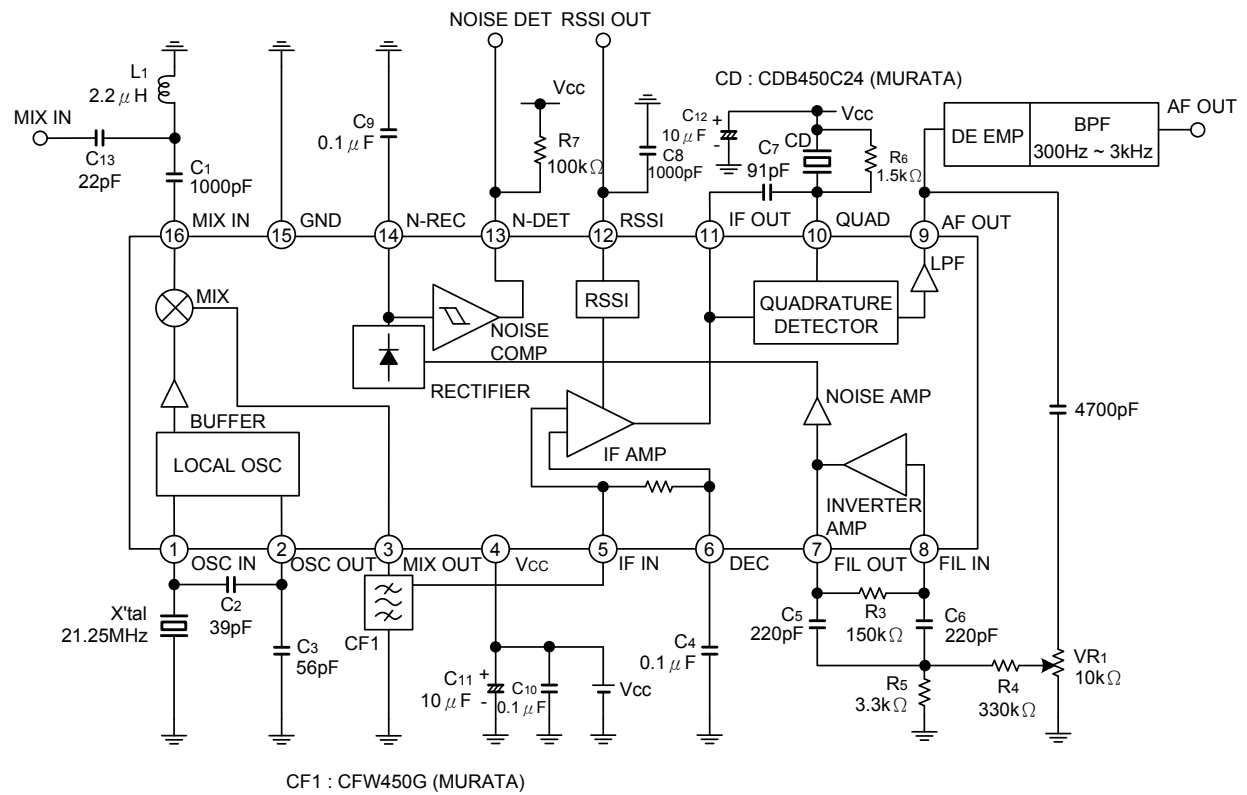
Figure 5

## ■ TEST CIRCUIT

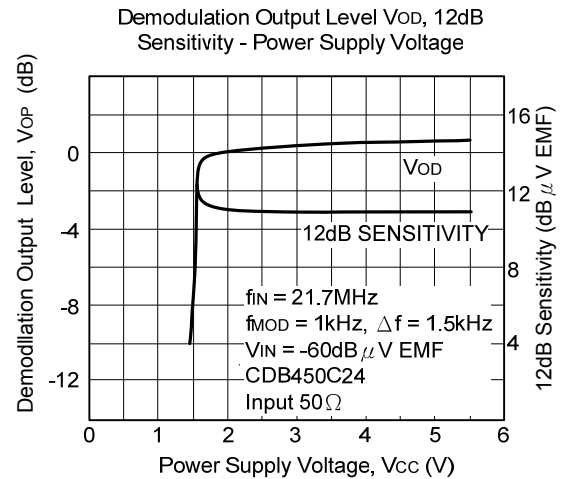
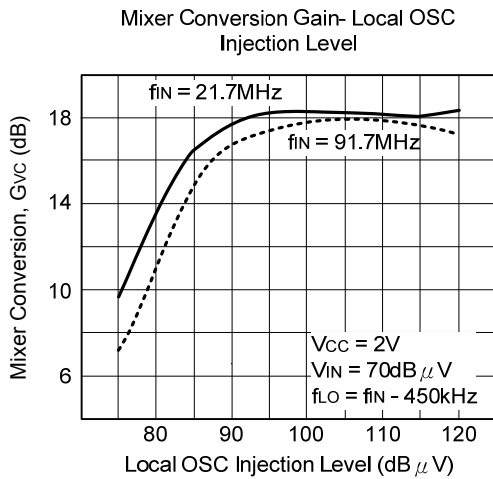
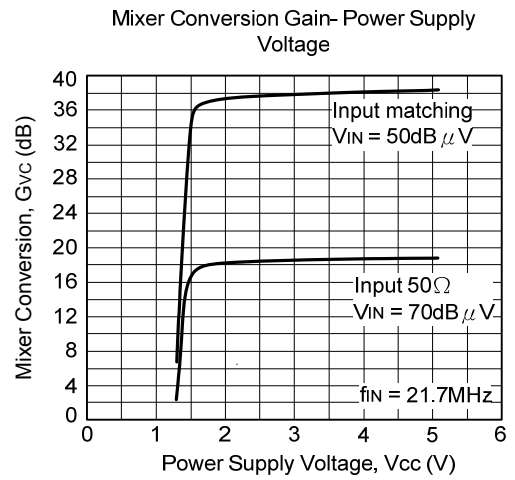
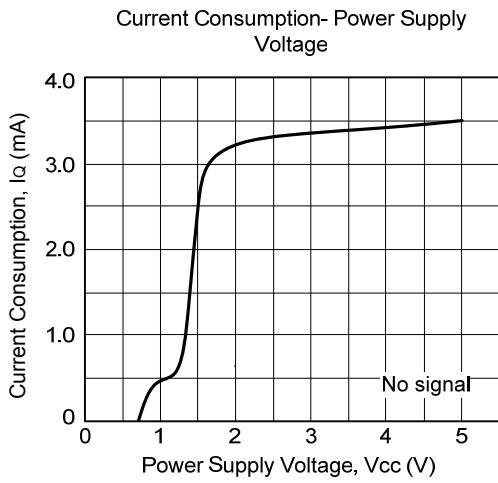




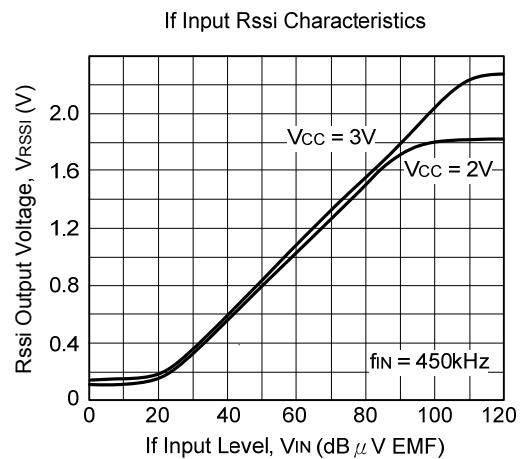
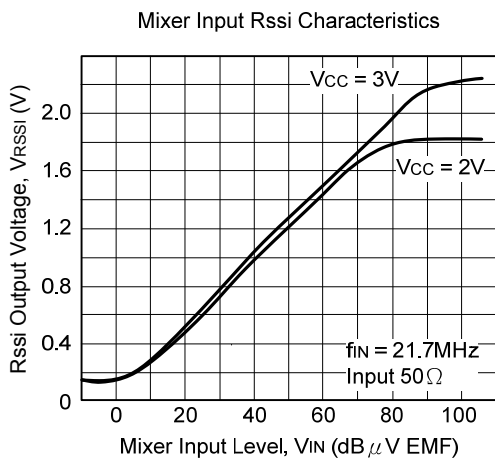
## ■ TYPICAL APPLICATION CIRCUIT



■ TYPICAL CHARACTERISTICS

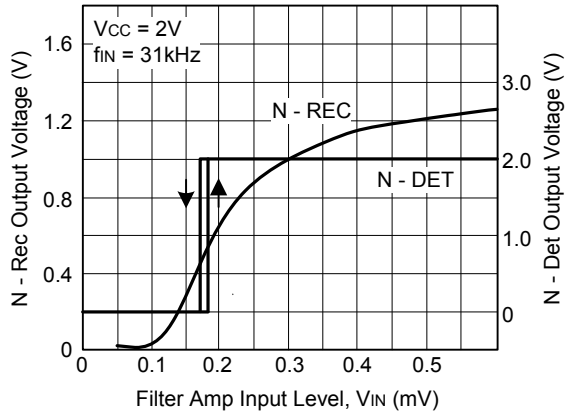


■ IN COIL DISCRIMINATER USED

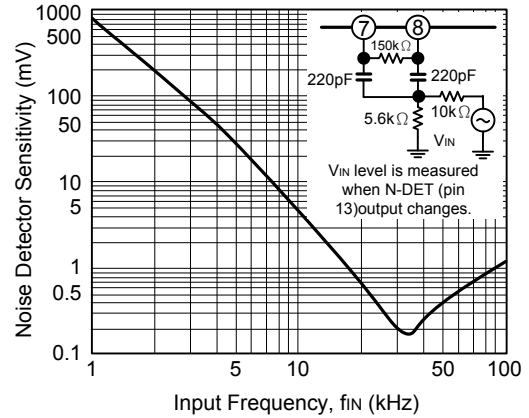


■ IN COIL DISCRIMINATER USED (Cont.)

Noise Detection Characteristics



Noise Detection Frequency Characteristics



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