

SA/NE602

Double Balanced Mixer And Oscillator

Product Specification

Linear Products

DESCRIPTION

The SA/NE602 is a low-power VHF monolithic double balanced mixer with input amplifier, on-board oscillator, and voltage regulator. It is intended for high performance, low power communication systems. The guaranteed parameters of the SA602 make this device particularly well suited for cellular radio applications. The mixer is a "Gilbert cell" multiplier configuration which typically provides 18dB of gain at 45MHz. The oscillator will operate to 200MHz. It can be configured as a crystal oscillator, a tuned tank oscillator, or a buffer for an external L.O. The noise figure at 45MHz is typically less than 5dB. The gain, intercept performance, low-power and noise characteristics make the SA/NE602 a superior choice for high-performance battery operated equipment. It is available in an 8-lead dual-in-line plastic package and an 8-lead SO (surface-mount miniature package).

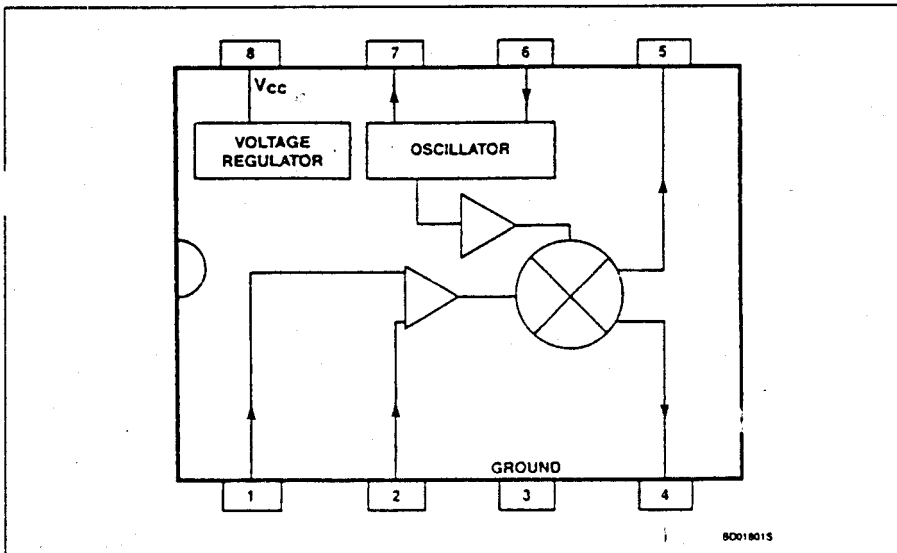
FEATURES

- Low current consumption: 2.4mA typical
- Excellent noise figure: < 5.0dB typical at 45MHz
- High operating frequency
- Excellent gain, intercept and sensitivity
- Low external parts count; suitable for crystal/ceramic filters
- SA602 meets cellular radio specifications

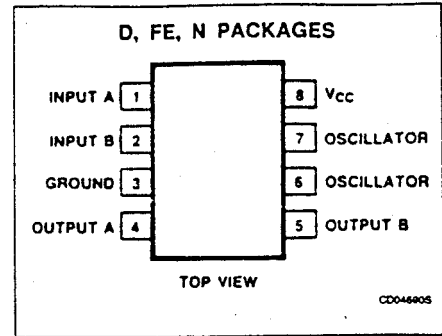
APPLICATIONS

- Cellular radio mixer/oscillator
- Portable radio
- VHF transceivers
- RF data links
- HF/VHF frequency conversion
- Instrumentation frequency conversion
- Broadband LAN's

BLOCK DIAGRAM



PIN CONFIGURATION



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ORDERING CODE

DESCRIPTION	ORDER CODE
Dual-in-Line, Plastic; 0 to +70°C	NE602N
Dual-in-Line, Small Outline; 0 to +70°C	NE602D
Cerdip; 0 to 70°C	NE602FE
Dual-in-Line, Plastic; -40 to +85°C	SA602N
Dual-in-Line, Small Outline; -40 to +85°C	SA602D
Cerdip; -40 to +85°C	SA602FE

ABSOLUTE MAXIMUM RATINGS

PARAMETER	RATING	UNIT
Maximum operating voltage	9	V
Storage temperature	-65 to +150	°C
Operating temperature NE602 SA602	0 to +70 -40 to +85	°C °C

AC/DC ELECTRICAL CHARACTERISTICS $T_A = 25^\circ\text{C}$, $V_{CC} = 6\text{V}$, Figure 1

PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNIT
Power supply voltage range		4.5		8.0	V
DC current drain			2.4	2.8	mA
Input signal frequency			500		MHz
Oscillator frequency			200		MHz
Noise figured at 45MHz			5.0	6.0	dB
Third order intercept point	$RF_{IN} = -45\text{dBm}$; $f_1 = 45.0$ $f_2 = 45.06$		-15	-17	dBm
Conversion gain at 45MHz		14			dB
RF input resistance		1.5			k Ω
RF input capacitance			3	3.5	pF
Mixer output resistance	(Pin 4 or 5)		1.5		k Ω

TEST CONFIGURATION

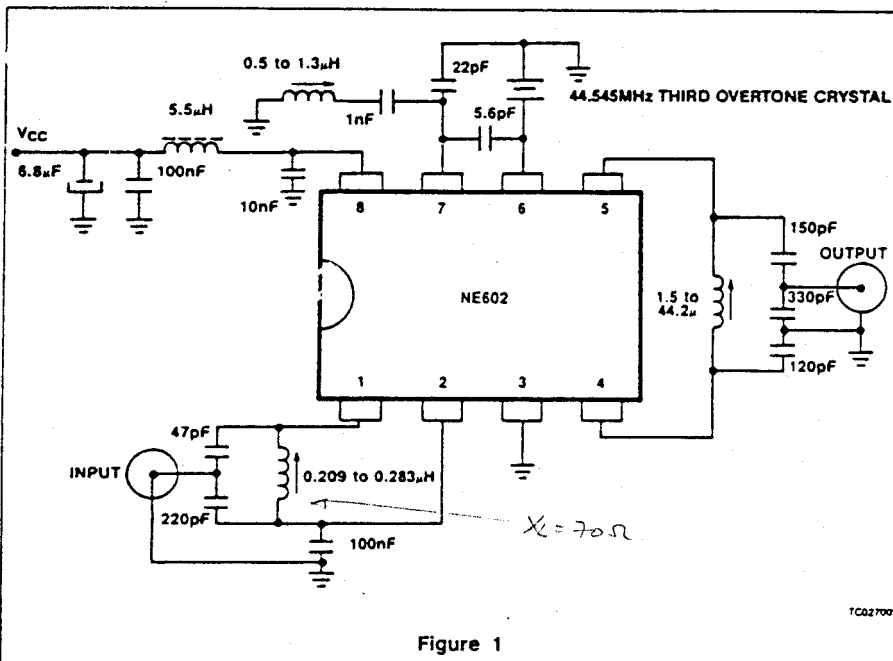


Figure 1

DESCRIPTION OF OPERATION

The SA/NE602 is a Gilbert cell, an oscillator/buffer, and a temperature compensated bias network as shown in the equivalent circuit. The Gilbert cell is a differential amplifier (Pins 1 and 2) which drives a balanced switching cell. The differential input stage provides gain and determines the noise figure and signal handling performance of the system.

The SA/NE602 is designed for optimum low power performance. When used with the SA604 as a 45MHz cellular radio 2nd IF and demodulator, the SA602 is capable of receiving -119dBm signals with a 12dB S/N ratio. Third order intercept is typically -15dBm (that's approximately +5dBm output intercept because of the RF gain). The system designer must be cognizant of this large signal limitation. When designing LAN's or other closed systems where transmission levels are high, and small signal or signal-to-noise issues not critical, the input to the NE602 should be appropriately scaled.

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Besides excellent low power performance well into VHF, the SA/NE602 is designed to be flexible. The input, output, and oscillator ports can support a variety of configurations provided the designer understands certain constraints, which will be explained here.

The RF inputs (Pins 1 and 2) are biased internally. They are symmetrical. The equivalent AC input impedance is approximately $1.5K \parallel 3pF$ through 50MHz. Pins 1 and 2 can be used interchangeably, but they should not be DC biased externally. Figure 3 shows three typical input configurations.

The mixer outputs (Pins 4 and 5) are also internally biased. Each output is connected to the internal positive supply by a $1.5k\Omega$ resistor. This permits direct output termination yet allows for balanced output as well. Figure 4 shows three single ended output configurations and a balanced output.

The oscillator is capable of sustaining oscillation beyond 200MHz in crystal or tuned tank configurations. The upper limit of operation is determined by tank "Q" and required drive levels. The higher the "Q" of the tank or the smaller the required drive, the higher the

permissible oscillation frequency. If the required L.O. is beyond oscillation limits, or the system calls for an external L.O., the external signal can be injected at Pin 6 through a DC blocking capacitor. External L.O. should be at least 200mVpp.

Figure 5 shows several proven oscillator circuits. Figure 5A is appropriate for cellular radio. As shown, an overtone mode of operation is utilized. Capacitor C3 and inductor L1 suppress oscillation at the crystal fundamental frequency. In the fundamental mode, the suppression network is omitted.

Figure 6 shows a Colpitts varactor tuned tank oscillator suitable for synthesizer controlled applications. It is important to buffer the output of this circuit to assure that switching spikes from the first counter or prescaler do not end up in the oscillator spectrum. The dual-gate MOSFET provides optimum isolation with low current. The FET offers good isolation, simplicity, and low current, while the bipolar transistors provide the simple solution for non-critical applications. The resistive divider in the emitter follower circuit should be chosen to provide the minimum input signal which will assure correct system operation.

When operated above 100MHz, the oscillator may not start if the Q of the tank is too low. A $22k\Omega$ resistor from Pin 7 to ground will increase the DC bias current of the oscillator transistor. This improves the AC operating characteristic of the transistor and should help the oscillator to start. $22k\Omega$ will not upset the other DC biasing internal to the device, but smaller resistance values should be avoided.

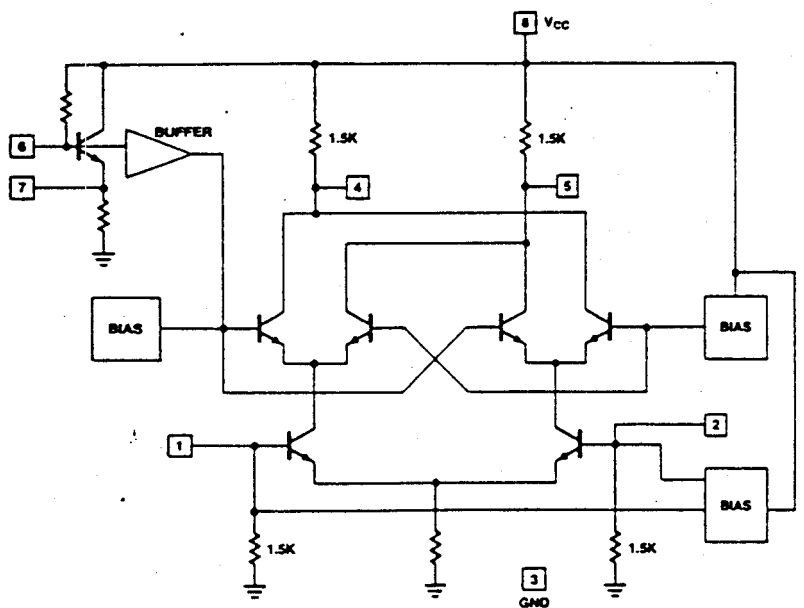
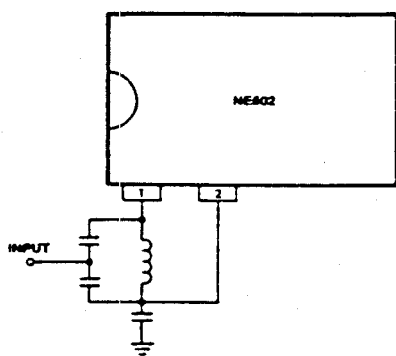
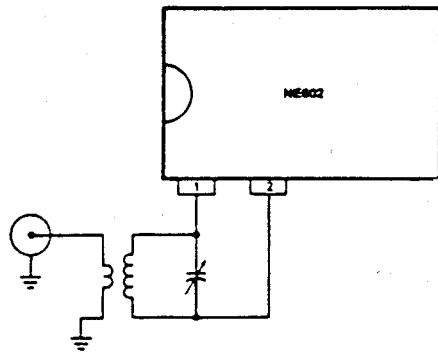


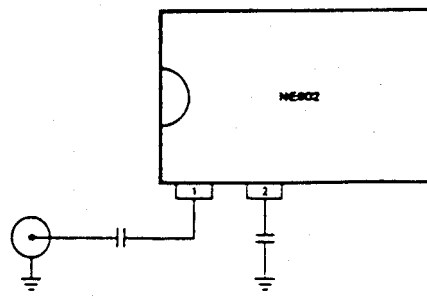
Figure 2. Equivalent Circuit



a. Single-Ended Tuned Input



b. Balanced Input (For Attenuation Of Second Order Products)



c. Single-Ended Untuned Input

Figure 3. Input Configuration

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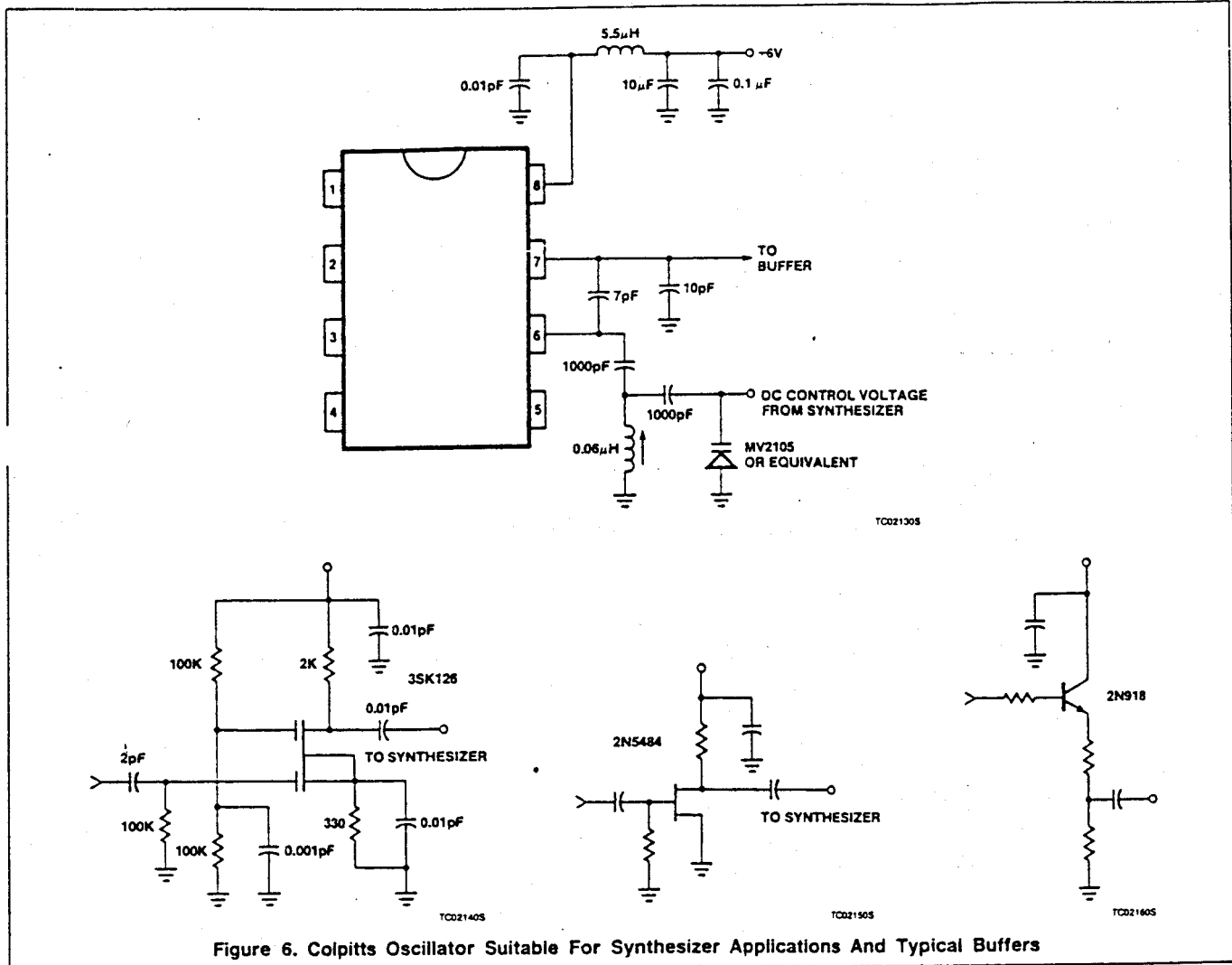


Figure 6. Colpitts Oscillator Suitable For Synthesizer Applications And Typical Buffers

BEST CONFIGURATION

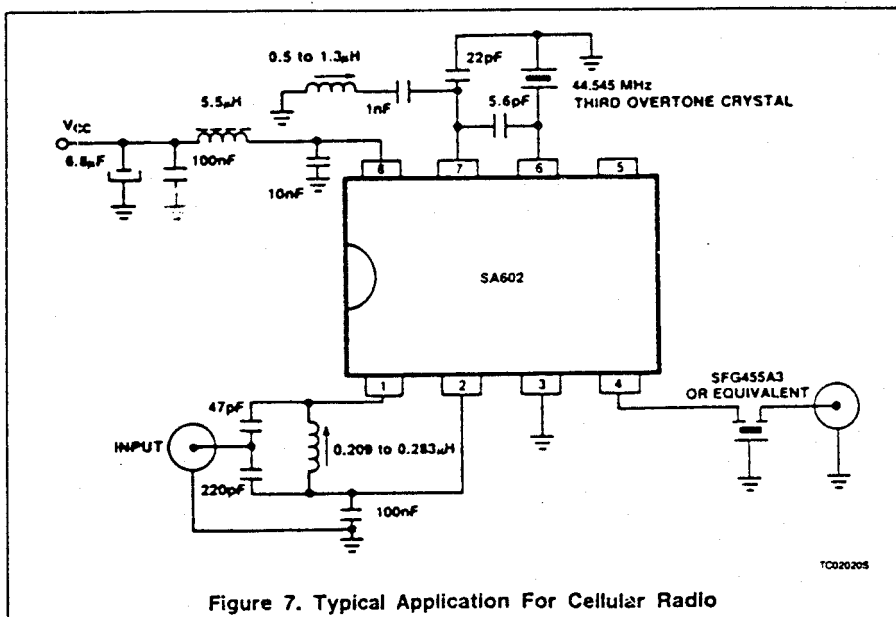


Figure 7. Typical Application For Cellular Radio

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