Double-balanced mixer and oscillator 602A

DESCRIPTION

The 602A 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 602A make this device particularly well suited for cellular radio applications. The mixer is a "Gilbert cell" multiplier configuration which typically provides 14dB of grain 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 602A a superior choice for high-performance batter operated equipment.

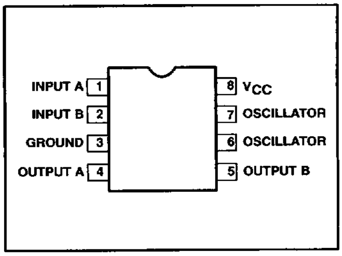
FEATURES

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

APPLICATIONS

- Cellular radio mixer/oscillator portable radio
- VHF transceivers
- RF data links
- HF/VHF frequency conversion
- Instrumentation frequency conversion
- Broadband LANs

PIN CONFIGURATION



ORDERING INFORMATION

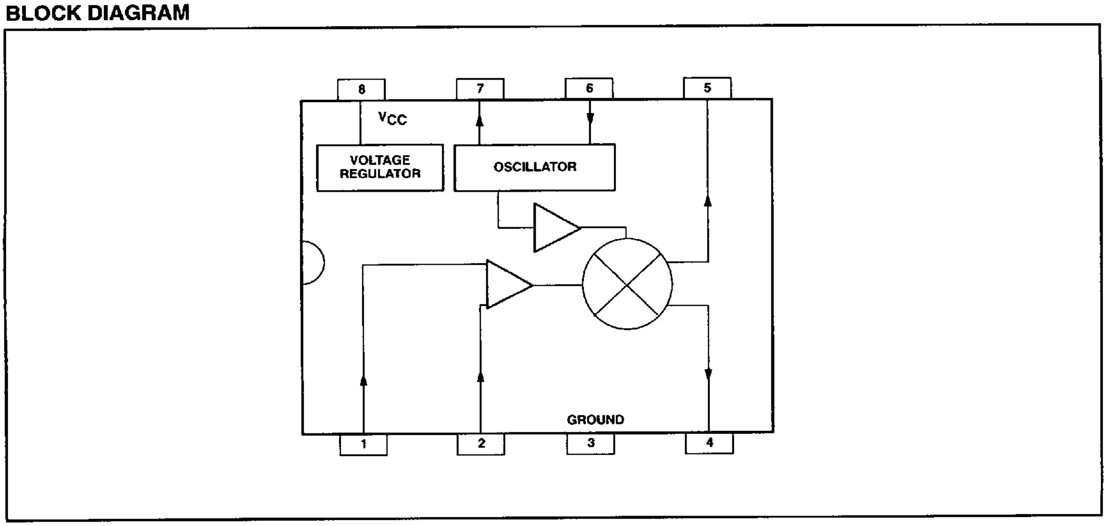
DESCRIPTION	ORDER CODE	PACKAGE DESIGNATOR*
8-Pin Ceramic DIP	602A/BPA	GDIP1-T8

* MIL-STD 1835 or Appendix A of 1995 Military Data Handbook

ABSOLUTE MAXIMUM RATINGS[3]

SYMBOL	PARAMETER	RATING	UNIT
V_{CC}	Maximum operating voltage	8	V
T_{STG}	Storage temperature	-65 to +150	°C
T_{amb}	Operating ambient temperature range	-55 to +125	°C

BLOCK DIAGRAM



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AC/DC ELECTRICAL CHARACTERISTICS

V_{CC} = 6V, -55°C ≤ T_{amb} ≤ +125°C, Figure 1

SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS			UNIT
			MIN	TYP[1]	MAX	
V_{CC}	Power supply voltage range		4.5		7.0	V
I_{CC}	DC current drain			2.5	4.0	mA
f_{IN}	Input signal frequency			500		MHz
f_{OSC}	Oscillator frequency			500		MHz
NF	Noise figured at 45MHz			5.0		dB
	Third-order intercept point	RF_{IN} = -45dBm, f_1 = 45.0 MHz, f_2 = 45.06 MHz		-14	-19	dBm
A	Conversion gain at 45MHz		8	14		dB
R_{IN}	RF input resistance[2]		1.5	3.5		kΩ
C_{IN}	RF input capacitance[2]			3	3.5	pF
R_O	Mixer output resistance	(Pin 4 or 5)		1.5		kΩ

NOTES:
1. All typical values are at +25°C only and V_{CC} = 6.0V
2. This parameter is guaranteed, but not tested.
3. Stresses above those listed under 'Absolute Maximum Ratings' may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operations section or this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

DESCRIPTION OF OPERATION

The 602A 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 602A is designed for optimum low power performance. When used with the 604A as a 45MHz cellular radio 2nd IF and demodulator, the 602A 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 LANs or other closed systems where transmission levels are high, and small-signal or signal-to-noise issues not critical, the input to the 602A should be appropriately scaled.

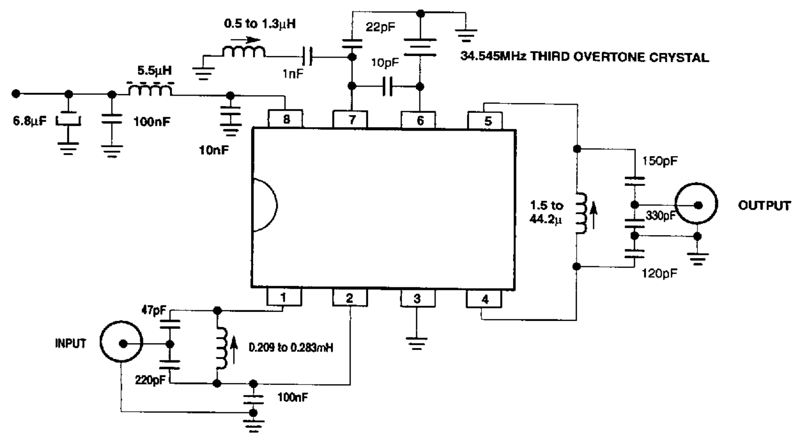


Figure 1. Test Configuration

Double-balanced mixer and oscillator

602A

Besides excellent low power performance well into VHF, the 602A 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 ll 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 1.5kΩ 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 $200mV_{p-p}$.

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 varacter 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 22kΩ 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. 22kΩ will not upset the other DC biasing internal to the device, but smaller resistance values should be avoided.

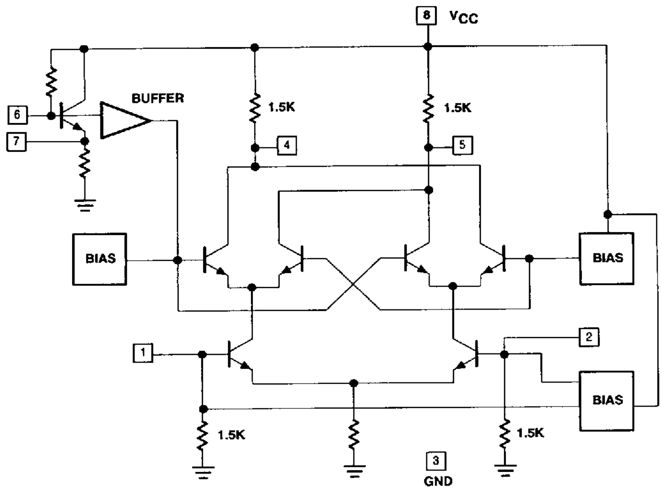
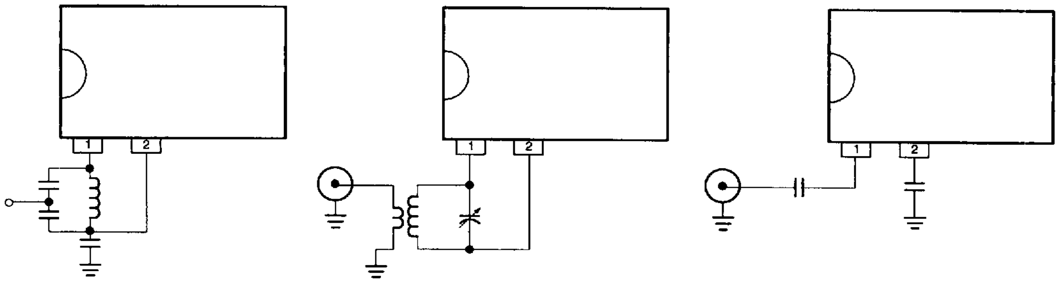


Figure 2. Equivalent Circuit

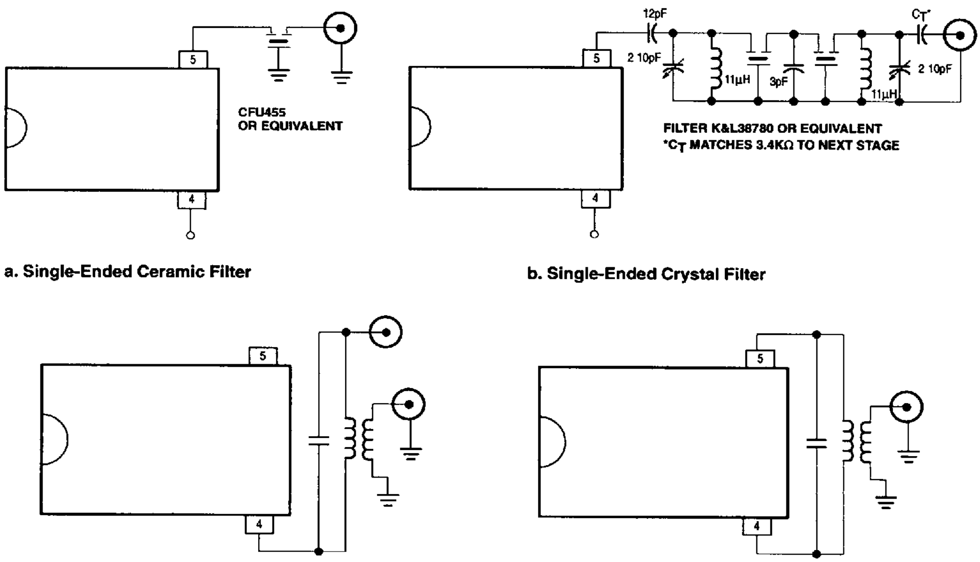


a. Single-Ended Tuned Input

b. Balanced Input (For Attenuation of Second-Order Products)

c. Single-Ended Untuned Input

Figure 3. Input Configuration



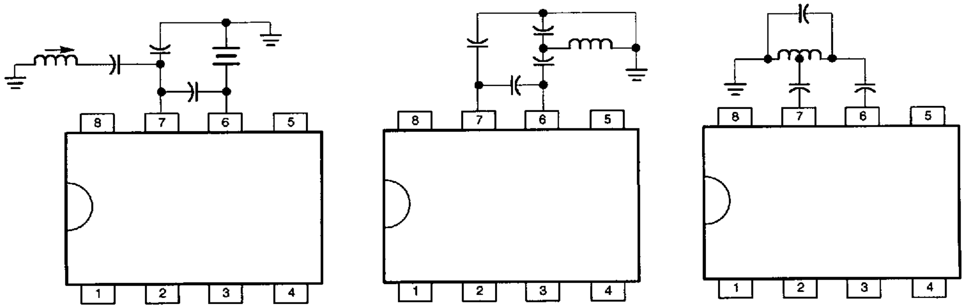
a. Single-Ended Ceramic Filter

b. Single-Ended Crystal Filter

c. Single-Ended IFT

d. Balanced Output

Figure 4. Output Configuration



a. Colpitts Crystal Oscillator (Overtone Mode)

b. Colpitts L/C Tank Oscillator

c. Hartley L/C Tank Oscillator

Figure 5. Oscillator Circuits

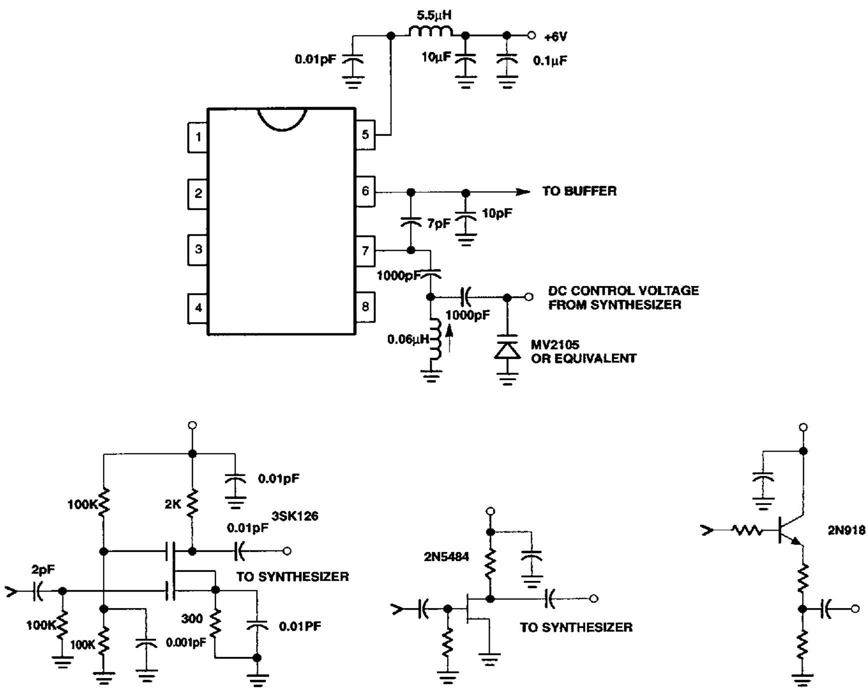


Figure 6. Colpitts Oscillator Suitable for Synthesizer Applications and Typical Buffers

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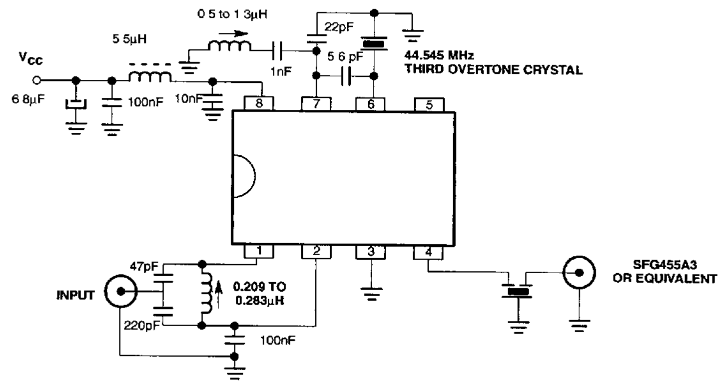


Figure 7. Typical Application for Cellular Radio

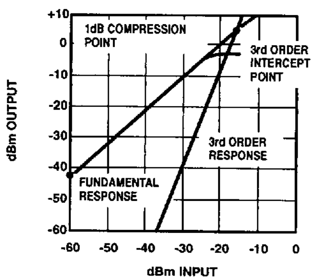


Figure 8. Third-Order Intermod and 1dB Compression Point Performance

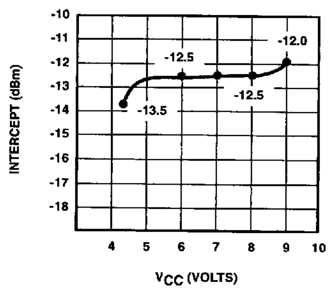


Figure 9. Input Third-Order Intercept Point vs V_{CC}

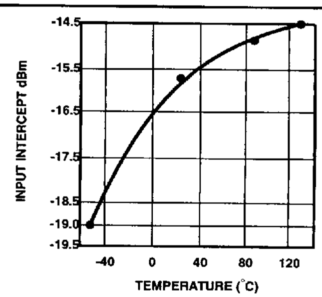
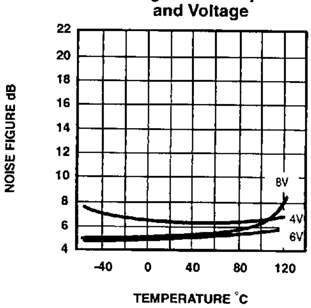


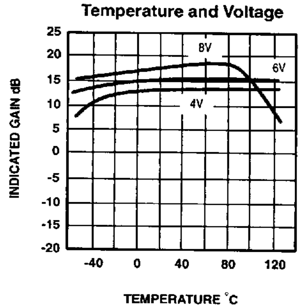
Figure 10. Third-Order Intercept Point vs Temperature

TYPICAL PERFORMANCE CHARACTERISTICS

Noise Figure vs Temperature and Voltage



Indicated Gain vs Temperature and Voltage



I_{CC} vs Temperature and Voltage