RF MICRO·DEVICES

RF2103

MEDIUM POWER LINEAR AMPLIFIER

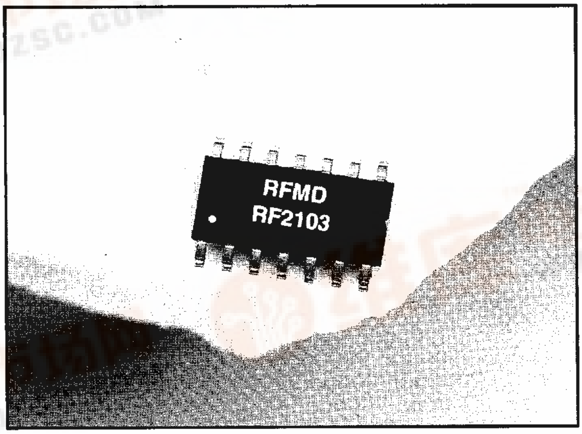
Typical Applications

- Digital Communications Systems
- Spread Spectrum Communications Systems
- Driver for Higher Power Linear Applications
- Portable Battery Powered Equipment
- Commercial and Consumer Systems
- Base Station Equipment

Product Description

The RF2103 is a medium power linear amplifier IC. The device is manufactured on an advanced Gallium Arsenide Heterojunction Bipolar Transistor (HBT) process, and has been designed for use as the final linear RF amplifier in UHF radio transmitters operating between 450 MHz and 1 GHz. It may also be used as a driver amplifier in higher power applications. The device is packaged in a 14-lead plastic or ceramic SOIC package. The device is self-contained with the exception of the output matching network, power supply feed line, and bypass capacitors, and it produces an output power level of 750 mW (CW). **The device can be used in 3 cell battery applications**. The maximum CW output at 3.6 V is 175 mW. The unit has a total gain of 31 dB, depending upon the output matching network.

Handle with care: ESD sensitive.



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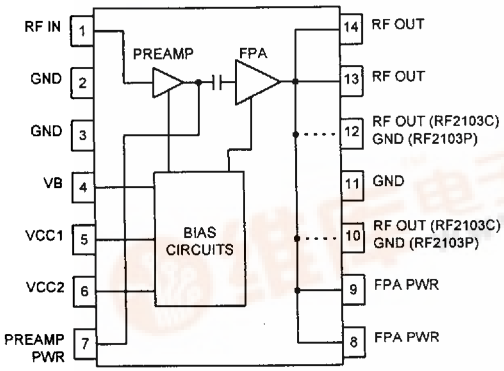
POWER AMPLIFIERS



Functional Block Diagram

Features

- *450 MHz to 1000 MHz Operation*
- *Up to 750 mW CW Output Power*
- *31 dB Small Signal Gain*
- *Single 2.7 to 7.5 V Supply*
- *42% Efficiency*
- *Digitally Controlled Power Down Mode*

RF2103

Parameter: Specified at T=25°C, Vcc=5.8 V, Vb=5.0 V, Z_{LOAD}=18Ω, Pin=0 dBm, 915 MHz, unless indicated otherwise.	Specification			Units
	Min	Typ	Max	
Overall:				
Frequency Range		450 - 1000		MHz
Maximum Output Power (at Vcc = 7.5 V)		750		mW
Maximum Output Power (at Vcc = 5.8 V)		450		mW
Second Harmonic (without external second harmonic trap)		-24		dBc
Third Harmonic		-30		dBc
Output Noise Power		< -125		dBm/Hz
Zin (with external matching network; see application schematic)		50		Ω
Input VSWR (with external matching network; see application schematic)		< 2:1		
Z_L (Load Impedance for Optimal Match)		18+j0		Ω
Power Supply Voltage		2.7 - 6.5		V
Power Supply Idle Current		45	80	mA
Total "OFF" Current Drain (Vb < 0.1 Vdc)		1	10	µA
Turn-on Time (from Vb = 0 to +4 Vdc)		< 100		ns
Nominal 5.8 V Configuration: (Conditions: Vcc = 5.8 Vdc, Vb = 4.0 Vdc, Freq. = 830 MHz, Zload = 18Ω, T = 25°C)				
Power Gain		31		dB
CW Output Power	24	26.5		dBm
IM3 (at Pout = 18.5 dBm for each tone)		-40	-25	dBc
IM5 (at Pout = 18.5 dBm for each tone)		-45	-30	dBc
VCC1&VCC2 (Pins 5 & 6) Current (at 26.5 dBm output power)		175	250	mA
Vb (Pin 4) Current		< 3.5		mA
CW Total Efficiency		47		%
Two Tone Total Efficiency (at Pout = 18.5 dBm for each tone)		26		%
Operating Temperature Range	-40		+85	°C
Package Style:	14 lead SOIC (SO-14)			

Absolute Maximum Ratings

	Value	Units
Supply Voltage (Vcc)	+7.5	Vdc
FPA DC Input Current	300	mA
Bias Voltage (Vb)	+5	V
Input RF Power	+6	dBm
Case Temperature	+100	°C

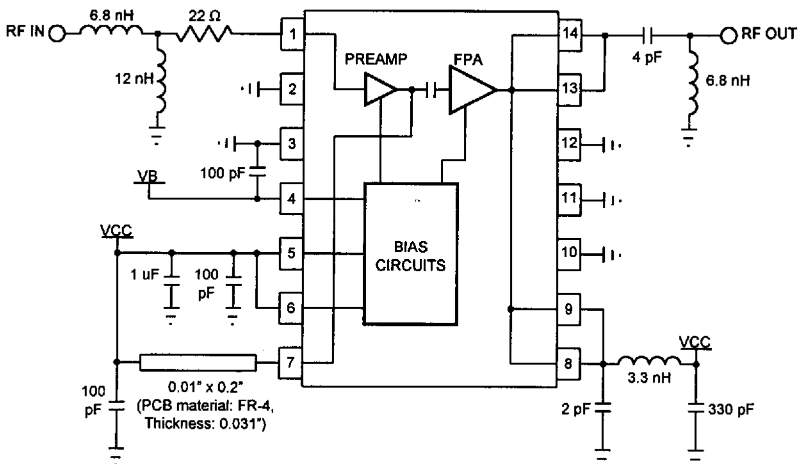
Ordering Information

Part No.	Description
RF2103C	Linear Amplifier (ceramic)
RF2103P	Linear Amplifier (plastic)
RF2103PCBA	Fully Assembled Evaluation PCB (plastic)
RF2103PCB	Evaluation PCB Only

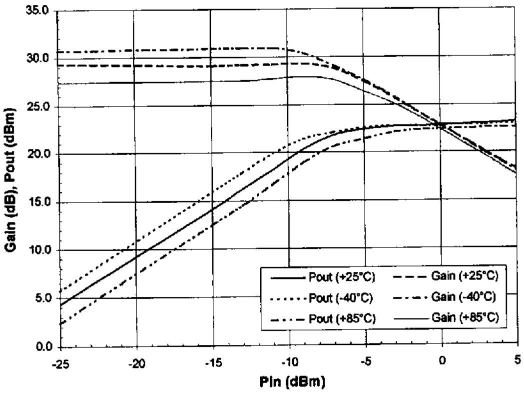
For:	Contact:
• Pricing Information • Application Assistance • Samples	RF Micro Devices, Inc. (910) 855-8085

Pin	Function	Description
1	RF Input	RF input pin. There is an internal blocking capacitor between this pin and the preamp input, but not between the pin and an internal 2kΩ resistor to ground.
2	Ground	Ground connection. Keep traces physically short and connect immediately to ground plane for best performance.
3	Ground	Same as Pin 2.
4	VB	Power down control voltage. When this pin is at 0 V, the device will be in power down mode, dissipating minimum DC power. When this pin is at VCC (3 V to 6.5 V), the device will be in full power mode delivering maximum available gain and output power capability. This pin may also be used to perform some degree of gain control or power control when set to voltages between 0 V and VCC. It is not optimized for this function so the transfer function is not linear over a wide range as with other devices specifically designed for analog gain control, however, it may be useable for course adjustment or in some closed loop AGC systems. This pin should not, in any circumstance, be higher in voltage than VCC. This pin should also have an external bypassing capacitor.
5	VCC1	Positive supply for the active bias circuits. This pin can be externally combined with pin 6 (VCC2) and the pair bypassed with a single capacitor, placed as close as possible to the package. Additional bypassing of 1μF is also recommended, but proximity to the package is not as critical. In most applications, pins 5, 6, and 7 can share a single 1μF bypass capacitor.
6	VCC2	Same as pin 5.
7	PREAMP PWR	Positive supply for the preamplifier. This is an unmatched transistor collector output. This pin should see an inductive path to AC ground (Vcc with bypass capacitor). This inductance can be achieved with a short, thin microstrip line or with a low value chip inductor (~1.8 nH). At lower frequencies, the inductance value should be larger (longer microstrip line) and Vcc should be bypassed with a larger bypass capacitor. This inductance forms a matching network with the internal series capacitor between the two amplifier stages, setting the amplifier's frequency of maximum gain. An additional 1μF bypass capacitor in parallel with the 22 pF bypass capacitor is also recommended, but placement of this component is not as critical. In most applications, pins 5, 6, and 7 can share a single 1μF bypass capacitor.
8	FPA PWR	See Pin 14.
9	FPA PWR	See Pin 14.
10	RF Output (2103C)	See Pin 14.
10	Ground (2103P)	Same as Pin 2.
11	Ground	Same as Pin 2.
12	Ground (2103P)	Same as Pin 2.
12	RF Output (2103C)	See Pin 14.
13	RF Output	See Pin 14.
14	RF Output	Amplifier RF output. This is an unmatched collector output of the final amplifier transistor. It is internally connected to pins 8, 9, 13 and 14 to provide low series inductance and flexibility in output matching. Bias for the final power amplifier output transistor must also be provided through two of these four pins. Typically, pins 8 and 9 are connected to a network that provides the DC bias and also creates a second harmonic trap. For 915 MHz operation, this harmonic trap network is simply a single 2 pF capacitor from both pins to ground. This capacitor series resonates with internal bond wires at two times the operating frequency, effectively shorting out the 2nd-harmonic. Shorting out this harmonic serves to increase the amplifier's maximum output power and efficiency, as well as to lower the level of the 2nd harmonic output. Typically, pins 13 and 14 are externally connected very close to the package and used as the RF output with a matching network that presents the optimum load impedance to the PA for maximum power and efficiency, as well as providing DC blocking at the output. Shunt protection diodes are included to clip peak voltage excursions above ~15 V to prevent voltage breakdown in worst case conditions.

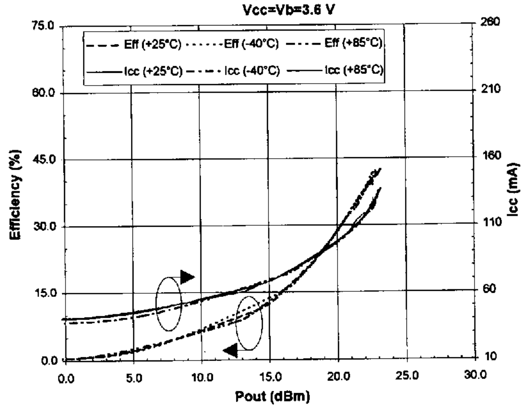
RF2103P Application Schematic: 915 MHz Operation



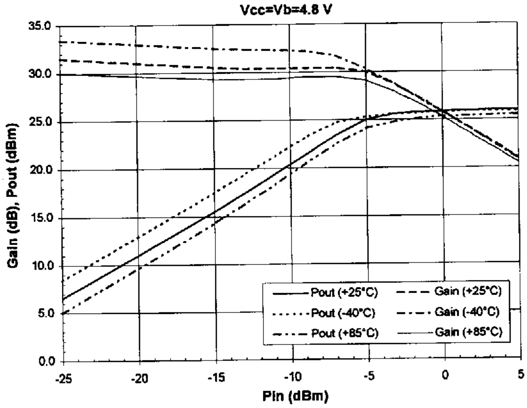
Gain and Pout vs. Pin
Vcc=Vb=3.6 V



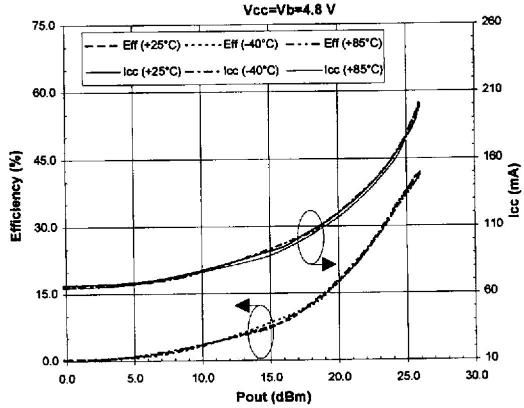
Efficiency and Icc vs. Pout
Vcc=Vb=3.6 V



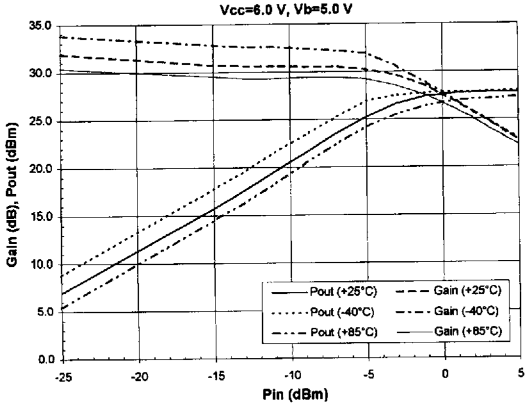
Gain and Pout vs. Pin
Vcc=Vb=4.8 V



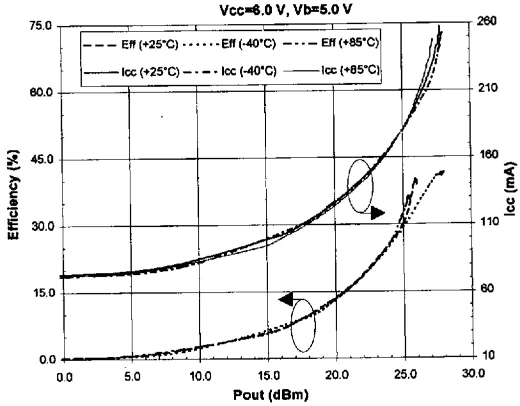
Efficiency and Icc vs. Pout
Vcc=Vb=4.8 V



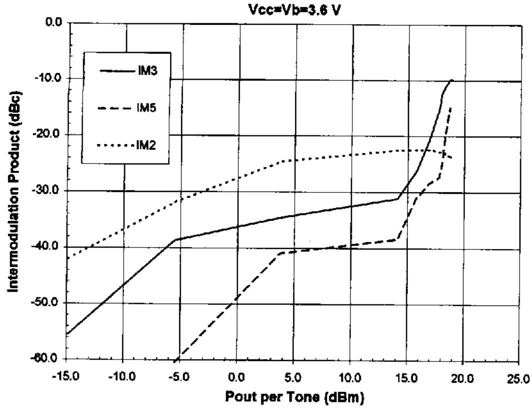
Gain and Pout vs. Pin
Vcc=6.0 V, Vb=5.0 V



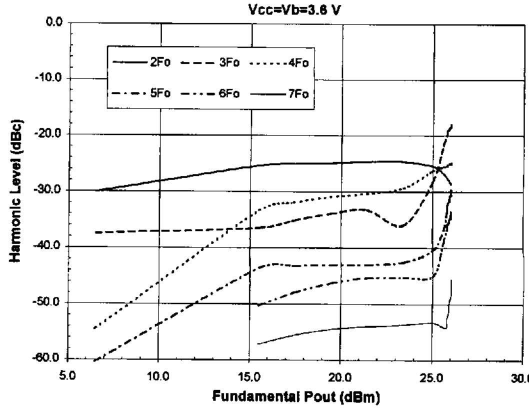
Efficiency and Icc vs. Pout
Vcc=6.0 V, Vb=5.0 V



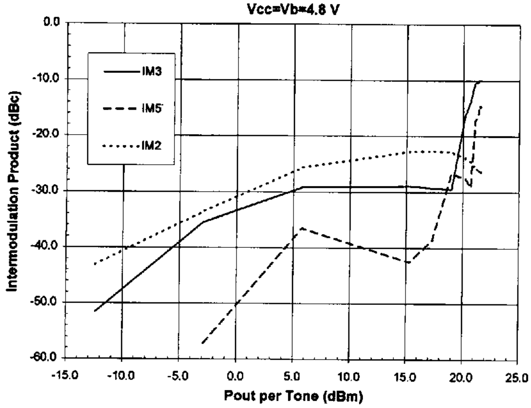
IM3, IM5, and IM2 vs. Pout
Vcc=Vb=3.6 V



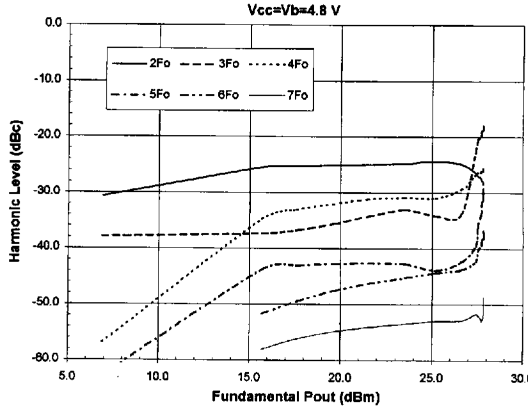
Harmonics vs. Pout
Vcc=Vb=3.6 V



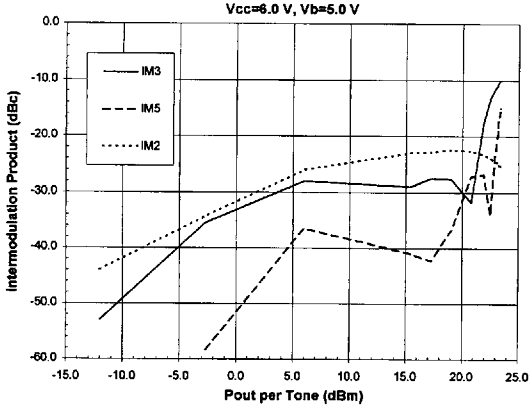
IM3, IM5, and IM2 vs. Pout
Vcc=Vb=4.8 V



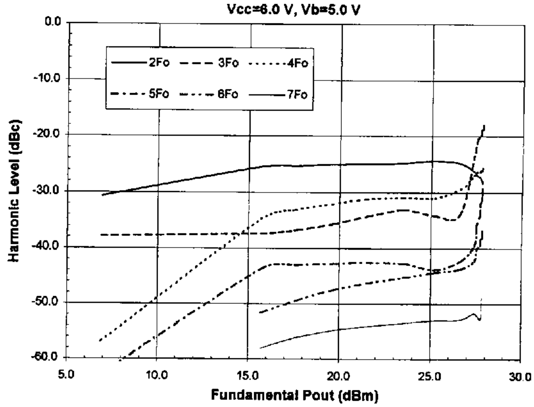
Harmonics vs. Pout
Vcc=Vb=4.8 V



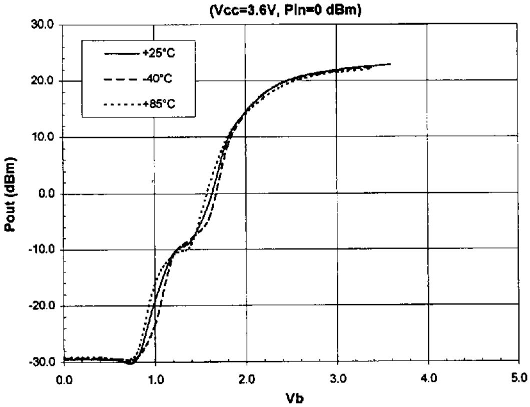
IM3, IM5, and IM2 vs. Pout
Vcc=6.0 V, Vb=5.0 V



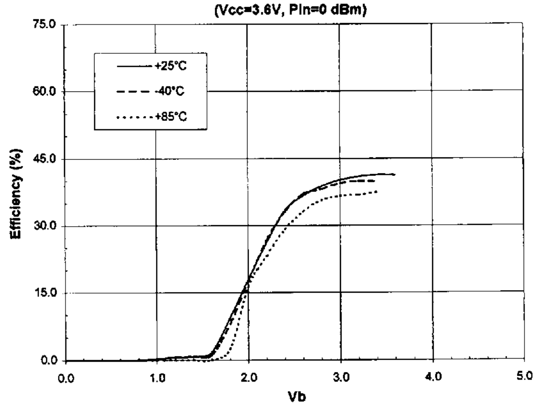
Harmonics vs. Pout
Vcc=6.0 V, Vb=5.0 V



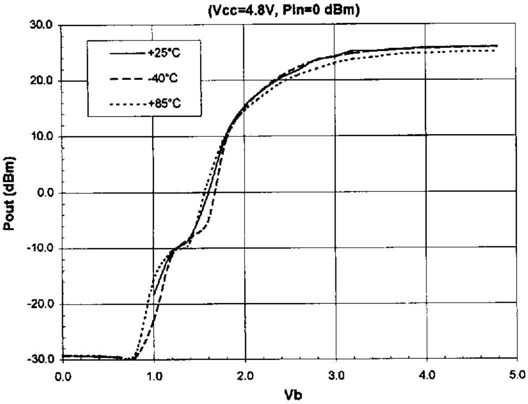
Pout vs. Vb
(Vcc=3.6V, Pin=0 dBm)



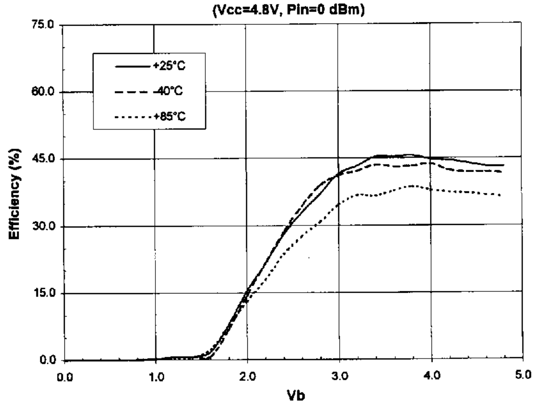
Efficiency vs. Vb
(Vcc=3.6V, Pin=0 dBm)



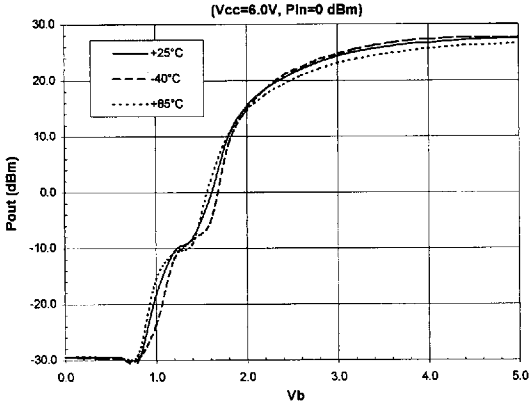
Pout vs. Vb
(Vcc=4.8V, Pin=0 dBm)



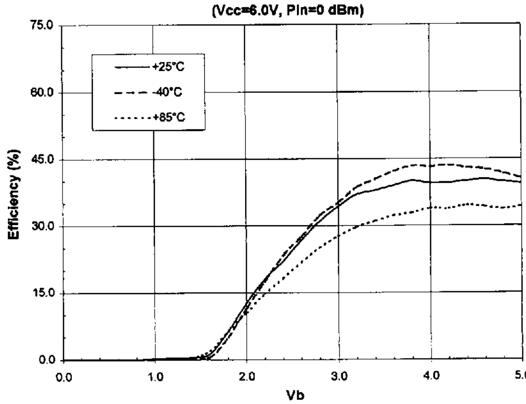
Efficiency vs. Vb
(Vcc=4.8V, Pin=0 dBm)

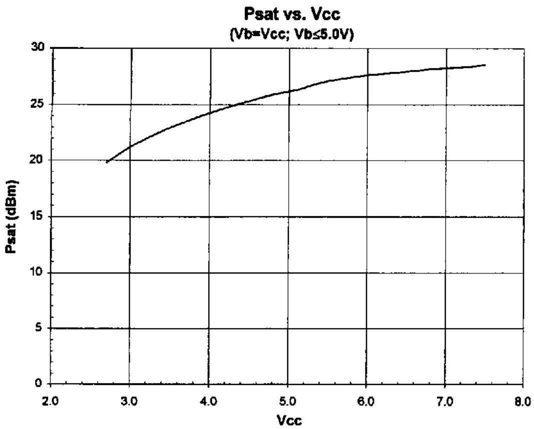


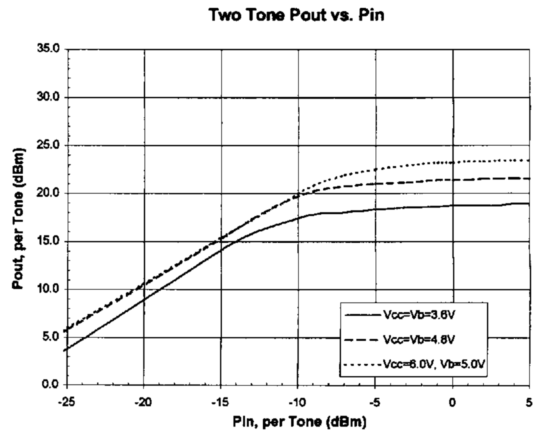
Pout vs. Vb
(Vcc=6.0V, Pin=0 dBm)

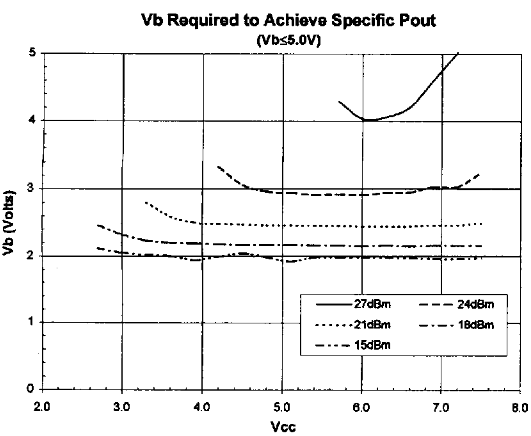


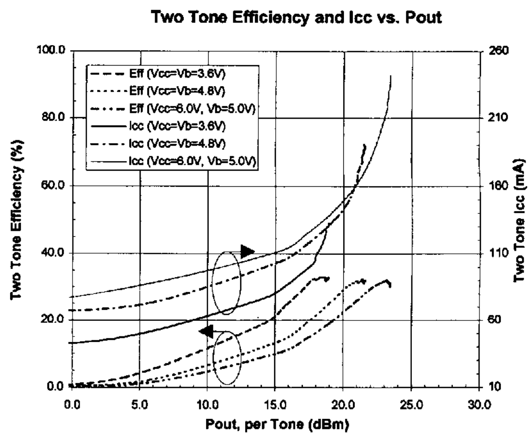
Efficiency vs. Vb
(Vcc=6.0V, Pin=0 dBm)



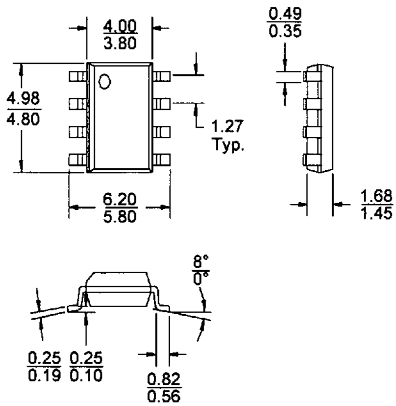

Psat vs. Vcc
(Vb=Vcc; Vb≤5.0V)
Psat (dBm)
Vcc
30
25
20
15
10
5
0
2.0
3.0
4.0
5.0
6.0
7.0
8.0


Two Tone Pout vs. Pin
Pout, per Tone (dBm)
Pin, per Tone (dBm)
Vcc=Vb=3.6V
Vcc=Vb=4.8V
Vcc=6.0V, Vb=5.0V
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
-25
-20
-15
-10
-5
0
5

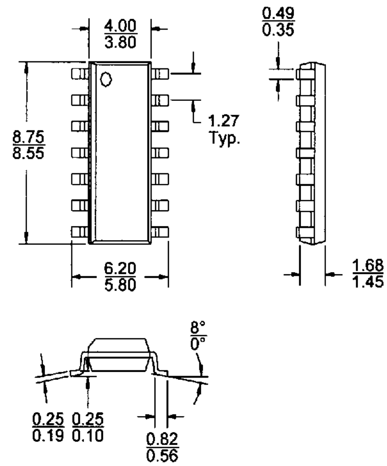

Vb Required to Achieve Specific Pout
(Vb≤5.0V)
Vb (Volts)
Vcc
27dBm
24dBm
21dBm
18dBm
15dBm
5
4
3
2
1
0
2.0
3.0
4.0
5.0
6.0
7.0
8.0


Two Tone Efficiency and Icc vs. Pout
Two Tone Efficiency (%)
Two Tone Icc (mA)
Pout, per Tone (dBm)
Eff (Vcc=Vb=3.6V)
Eff (Vcc=Vb=4.8V)
Eff (Vcc=6.0V, Vb=5.0V)
Icc (Vcc=Vb=3.6V)
Icc (Vcc=Vb=4.8V)
Icc (Vcc=6.0V, Vb=5.0V)
100.0
80.0
60.0
40.0
20.0
0.0
260
210
160
110
60
10
0.0
5.0
10.0
15.0
20.0
25.0
30.0

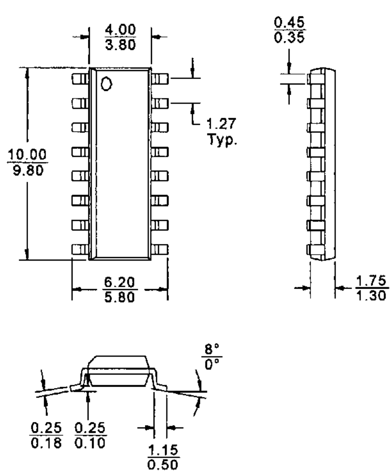
Max. / Min.	All dimensions in millimeters



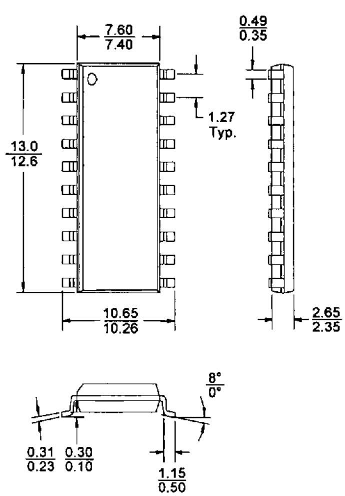
SOIC-8



SOIC-14

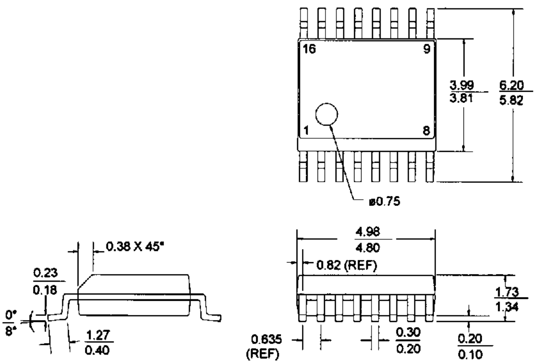


SOIC-16

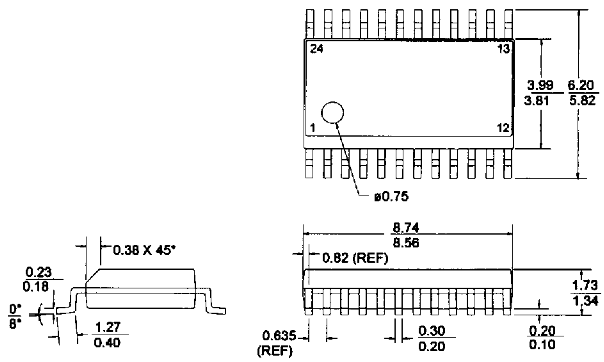


SOIC-20

Outline Drawings



QSOP-16



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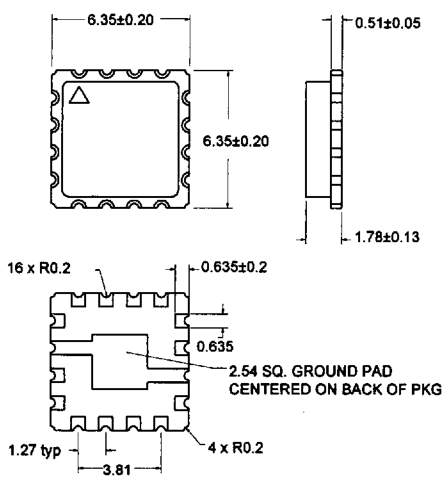
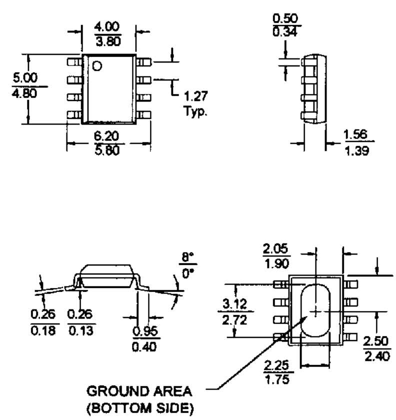


QLCC-16



PSOP2-8