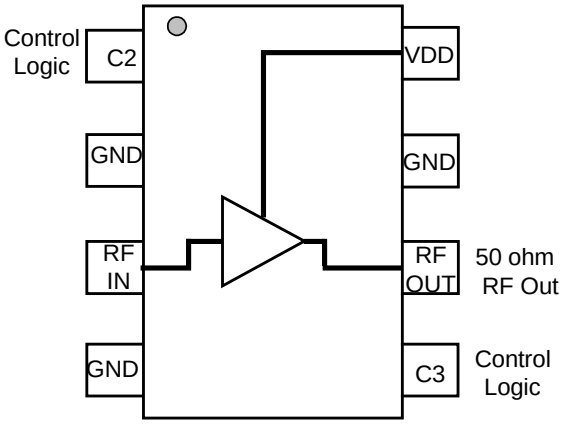
TriQuint SEMICONDUCTOR

WIRELESS COMMUNICATIONS DIVISION



TQ3132

DATA SHEET

Low Current, 3V Cellular Band CDMA/AMPS LNA IC

Features

- *Small size: SOT23-8*
- *Single 3V operation*
- *Low-current operation*
- *Gain Select*
- *Mode Select*
- *High IP3 performance*
- *Few external components*
- *50Ω Output*

Applications

- *IS-95 CDMA Mobile Phones*
- *AMPS Mobile Phones*
- *Dual Mode CDMA Cellular applications*
- *832-870MHz CDMA applications*

Product Description

The TQ3132 is a low current, 3V, RF LNA IC designed specifically for Cellular band CDMA/AMPS applications. It's RF performance meets the requirements of products designed to the IS-95 and AMPS standards. The TQ3132 is designed to be used with the TQ5131 or TQ5132 (CDMA/AMPS mixer) which provides a complete CDMA receiver for 800MHz dual-mode phones.

The LNA incorporates on-chip switches which determine CDMA, AMPS, and bypass mode select. When used with the TQ5131 or TQ5132 (CDMA RFA/mixer), four gain states are available. The RF output port is internally matched to 50 Ω, greatly simplifying the design and keeping the number of external components to a minimum. The TQ3132 achieves good RF performance with low current consumption, supporting long standby times in portable applications. Coupled with the very small SOT23-8 package, the part is ideally suited for Cellular band mobile phones.

Electrical Specifications[1]

Parameter	Min	Typ	Max	Units
Frequency	832		894	MHz
Gain		13.0		dB
Noise Figure		1.4		dB
Input 3rd Order Intercept		8.0		dBm
DC supply Current		7.5		mA

Note 1: Test Conditions: Vdd=2.8V, Tc=25C, RF frequency=881MHz, CDMA High Gain state.

Electrical Characteristics

Parameter	Conditions	Min.	Typ/Nom	Max.	Units
RF Frequency		832	881	894	MHz
CDMA Mode-High Gain					
Gain		10.5	13.0		dB
Noise Figure			1.4	1.7	dB
Input IP3		6.0	8.0		dBm
LNA IN Return Loss (with external matching)		10			dB
LNA OUT Return Loss		10			dB
Supply Current			7.5	9.5	mA
Bypass Mode					
Gain		-3.0	-2.0		dB
Noise Figure			2.0	3.0	dB
Input IP3		20.0	25.0		dBm
LNA IN Return Loss (with external matching)		10			dB
LNA OUT Return Loss		10			dB
Supply Current			1.0	2.5	mA
AMPS Mode					
Gain		8.5	11.0		dB
Noise Figure			1.6	2.4	dB
Input IP3		2.0	4.0		dBm
LNA IN Return Loss (with external matching)		10			dB
LNA OUT Return Loss		10			dB
Supply Current			4.5	5.5	mA
Supply Voltage		2.7	2.8	3.3	V

Note 1: Test Conditions: Vdd=2.8V, RF=881MHz, T_C = 25° C, unless otherwise specified.

Note 2: Min/Max limits are at +25°C case temperature, unless otherwise specified.

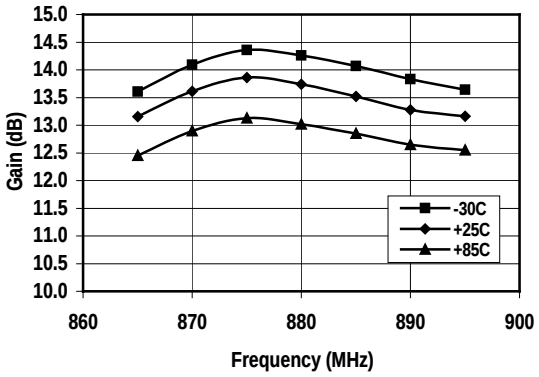
Absolute Maximum Ratings

Parameter	Value	Units
DC Power Supply	5.0	V
Power Dissipation	500	mW
Operating Temperature	-30 to 85	C
Storage Temperature	-60 to 150	C
Signal level on inputs/outputs	+20	dBm
Voltage to any non supply pin	+0.3	V

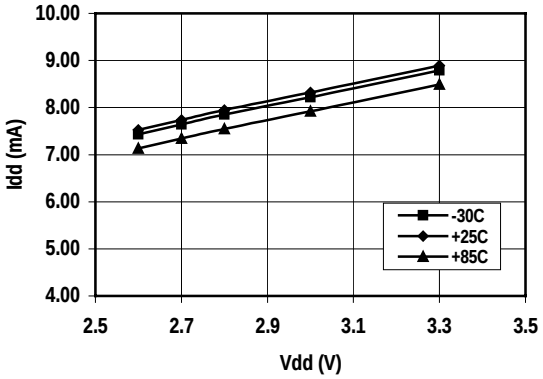
Typical Performance

Test Conditions, unless Otherwise Specified: Vdd=2.8V, Tc=+25C, RF=881MHz

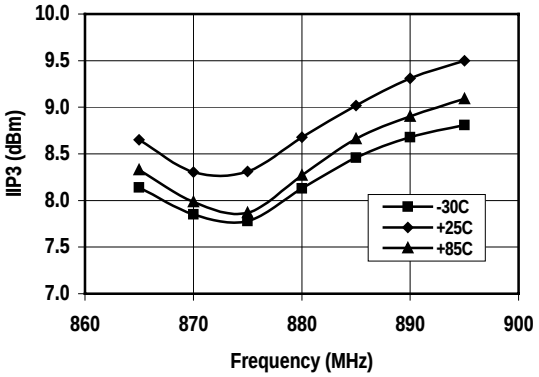
CDMA High Gain Mode
Gain v Freq v Temp



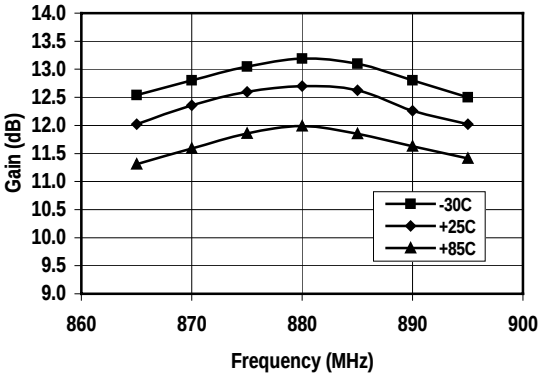
CDMA High Gain Mode
Idd v Vdd v Temp



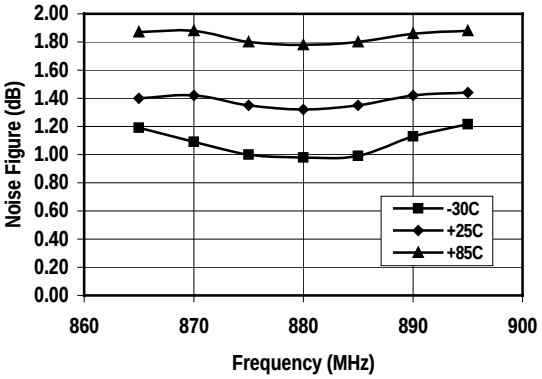
CDMA High Gain Mode
IIP3 v Freq v Temp



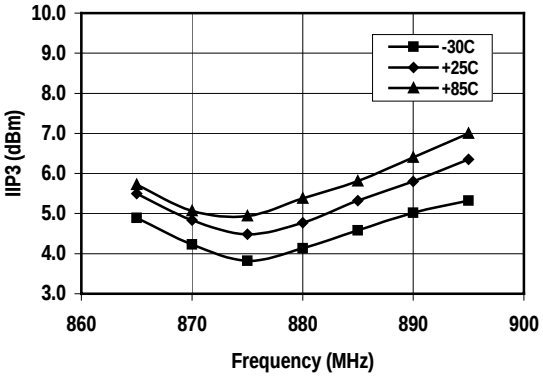
AMPS Mode
Gain v Freq v Temp



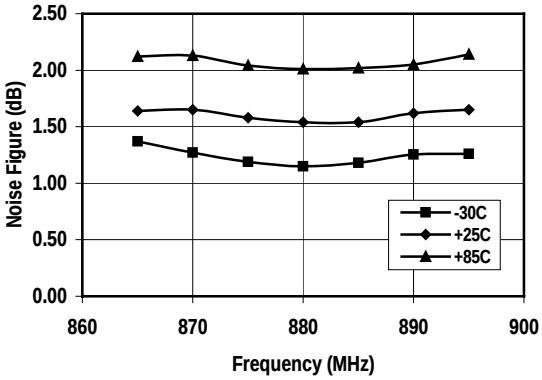
CDMA High Gain Mode
Noise Figure v Freq v Temp



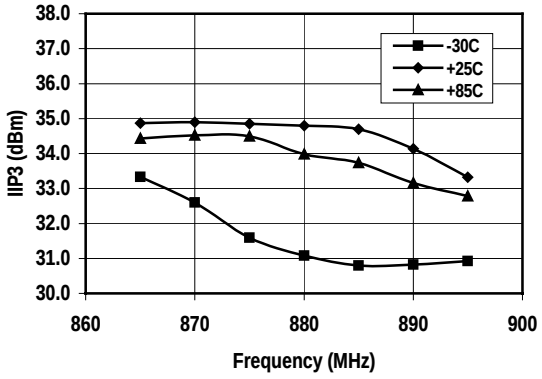
AMPS Mode
IIP3 v Freq v Temp



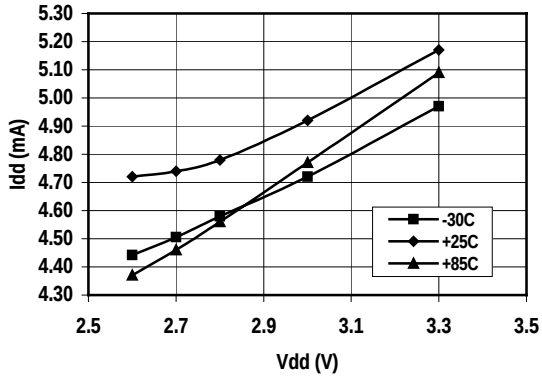
AMPS Mode
Noise Figure v Freq v Temp



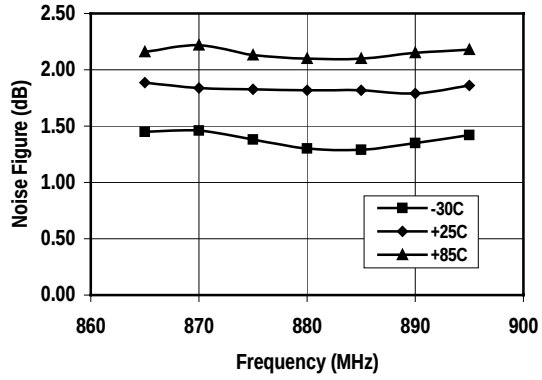
BYPASS Mode
IIP3 v Freq v Temp



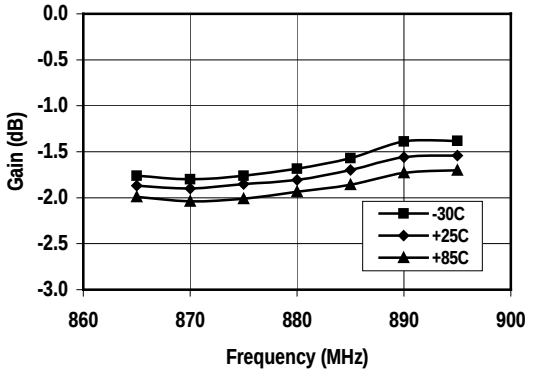
AMPS Mode
Idd v Vdd v Temp



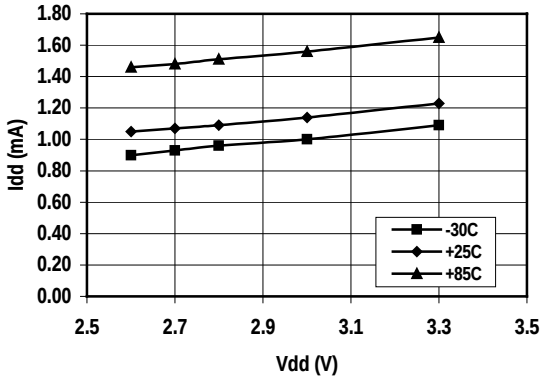
BYPASS Mode
Noise Figure v Freq v Temp



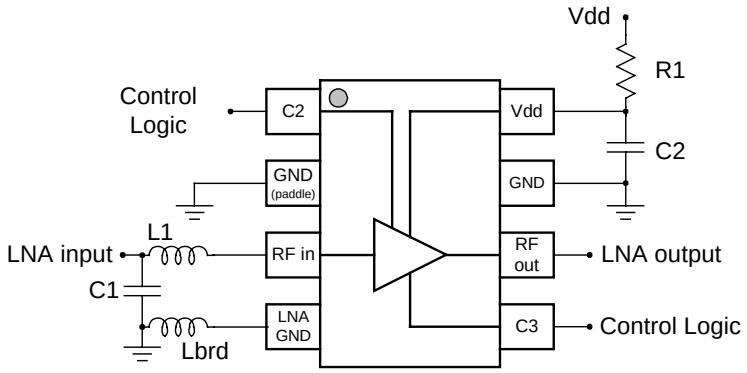
BYPASS Mode
Gain v Freq v Temp



BYPASS Mode
Idd v Vdd v Temp



Application/Test Circuit



Bill of Material for TQ3132 LNA Application/Test Circuit

Component	Reference Designator	Part Number	Value	Size	Manufacturer
Receiver IC	U1	TQ3132		SOT23-8	TriQuint Semiconductor
Capacitor	C1		3pF	0402	
Capacitor	C2		15pF	0402	
Resistor	R1		3.3Ω	0402	
Inductor	L1		15nH	0402	
Inductor	Lbrd		See application note		

TQ3132 Product Description

The TQ3132 is a miniature low noise amplifier in a small SOT-23-8 package (2.9X2.8X1.14 mm) with operation at 2.8v. The LNA specs are designed to be compatible with IS-98 Interim Standard for Dual-Mode CDMA cellular systems. The LNA features excellent linearity with small current consumption in all modes. TQ3132 is configured in a cascode topology with switching circuitry for the various CDMA output levels. A bias control circuit sets the quiescent current for each mode and ensures peak performance over process and temperature.

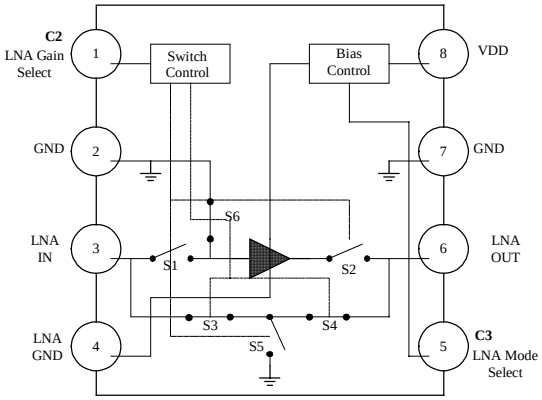


Figure 1. TQ3132 Functional Block Diagram

LNA Input Matching Network

Only three external components are needed to tune the LNA (see Figure 2). The chip uses an external capacitor and inductor for the input match to pin 3. The output is internally matched to 50 ohms at pin 6. In the TQ3132 the matching network is in the signal path for all three modes: High Gain, AMPS, and Bypass. Therefore, some experimentation is required to find the matching network that provides a compromise between noise figure and gain for all 3 modes. One could take the values used on TriQuint's evaluation board as a starting point (see Figure 2). The input match will affect the output match to some degree as well, so S22 should be monitored.

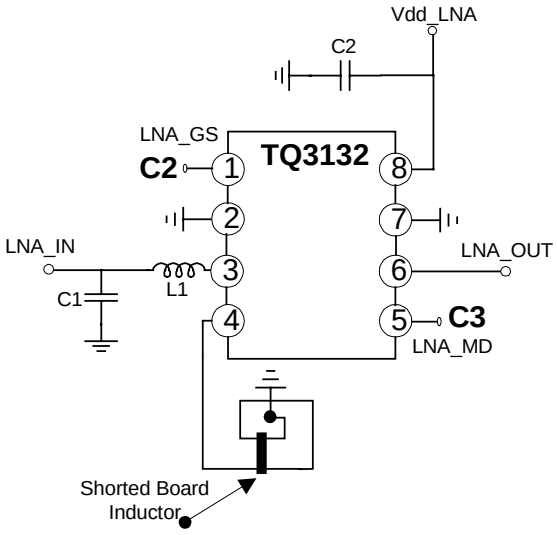


Figure 2. TQ3132 Applications Circuit

Selecting the LNA Vdd Bypass Capacitor

A Vdd bypass capacitor is recommended close to pin 8. The Vdd bypass capacitor has the largest effect on the LNA output match. Because the input match affects the output match to some degree as well, the process of picking the bypass capacitor value involves some iteration. First, an input match is selected to give adequate gain and noise figure. Then the bypass capacitor is varied to give the best output match. TriQuint's evaluation board achieves a 2:1 VSWR with the selected tuning components which allows direct connection to the input of a SAW filter.

Logic Control Functions

The control lines can be toggled between high and low levels using CMOS logic circuitry. A logic level high (C3) is applied to pin 5 to change bias state from CDMA to Amps modes. Similarly, a logic level high (C2) at pin 1 selects the gain step for the amplifier. In the high gain mode, switches S1, S2, and S5 are closed, with switches S3 and S4 open. In the bypass mode, switches S1, S2, and S5 are open, with switches S3 and S4 closed (see figure 1).

Table 1. TQ3132 Control lines C2, C3

TQ3132 LNA Mode	C2	C3
CDMA High Gain (HG)	0 1	0 0
Bypassed	1	1
AMPS	0	1

Gain Control via Pin 4 Inductance

The source connection of the LNA cascode is brought out separately through pin 4. This allows external degeneration of the cascode by adding a small amount of PC board trace inductance to pin 4. Thus some increase in IIP3 can be made while reducing LNA gain. The total amount of inductance present at the source of the cascode is equal to the bond wire plus package plus external inductances. One should generally use an external inductance such that gain in the High Gain mode = 13.5dB. On the evaluation board the total PCB trace inductance at pin 4 is approximately 2.57nH. In order to achieve the desire gain, this board inductor should be shorted half way of its total length which is equivalent to about 1.55nH.

Board Layout Recommendations

All ground pins should be kept close to the IC and have its own via to the ground plane to minimize inductance. Most PC boards for portable applications have thin dielectric layers and very narrow line width which increase the board parasitic capacitance and inductance. To minimize these effects when implementing a matching network, it is recommended to relieve the ground underneath pads carrying RF signals whenever possible.

RF input power levels for accurate test results

Because the CDMA devices have a number of gain states, it important to make sure that IP3 measurements are not taken in a state of compression. Additionally, using too low of a power puts the IMD products too close to the noise floor for accurate results. Additionally, the LNA in the bypass mode have OIP3 of around 30dBm, which is higher than the IIP3 of common spectrum analyzers in their preset configuration. We have found that setting the spectrum analyzer attenuator to 20dB allows for accurate measurement in that mode, and in all the other modes.

TQ3132 Noise and S-Parameters Data

The following noise and S-parameter data was obtained using TriQuint's evaluation board. This information is intended to be used as a guide to synthesize the LNA tuning network and find a compromise between noise figure and gain for all modes.

Table 2. Gamma Opt analysis for TQ3132 High Gain Mode

Freq (MHz)	Γ Opt	< Angle	Fmin (dB)	R noise
700	0.53	32.8	1.1	24.15
880	0.52	41.5	1.0	19.03
1000	0.49	42.6	1.1	17.98

Table 3. Gamma Opt analysis for TQ3132 AMPS Mode

Freq (MHz)	Γ Opt	< Angle	Fmin (dB)	R noise
700	0.62	33.5	1.3	33.5
880	0.56	40.2	1.2	26.4
1000	0.53	41.9	1.3	25.1

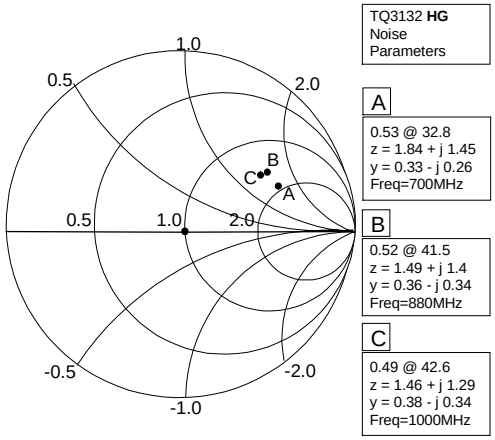


Figure 3. TQ3132 CDMA High Gain Noise Parameters

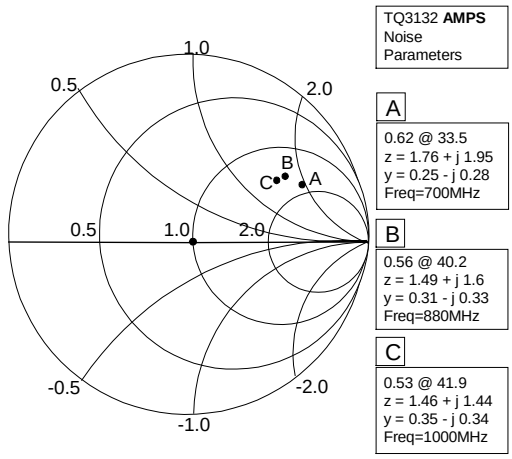
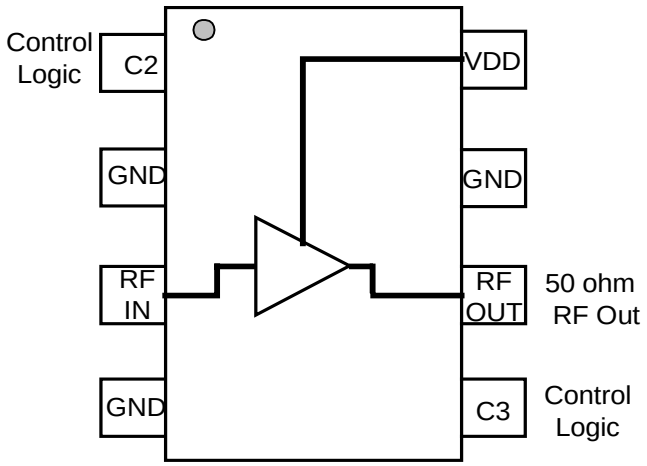


Figure 4. TQ3132 CDMA AMPS Noise Parameters

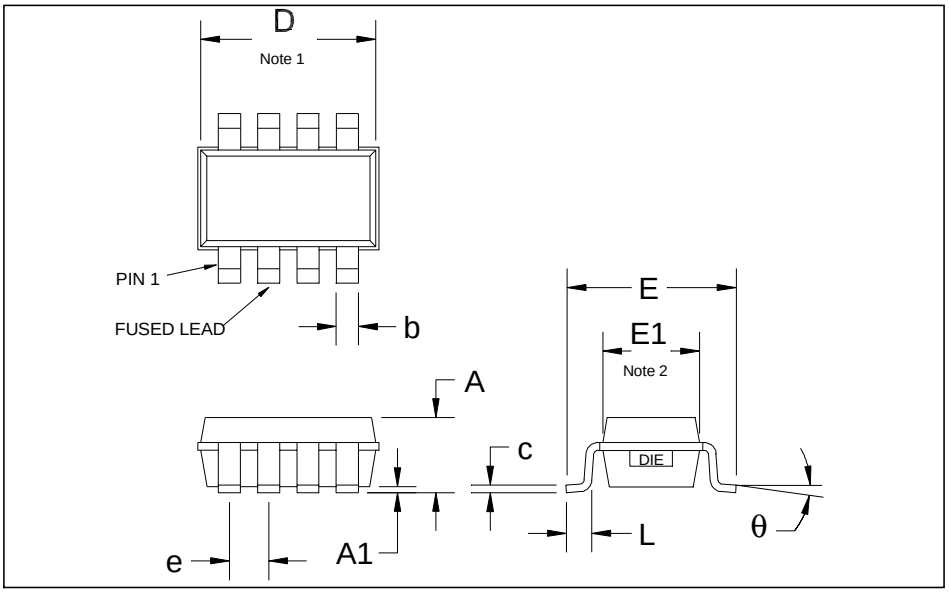
Package Pinout



Pin Descriptions

Pin Name	Pin #	Description and Usage
C2	1	Control logic 2
GND	2	Ground, paddle
RF IN	3	RF input, off-chip matching required
LNA GND	4	Ground, LNA Source ground
C3	5	Control logic 3
RF OUT	6	RF output, no matching required
LNA GND	7	Ground
Vdd	8	LNA Vdd, typical 2.8V, C2 capacitor required

Package Type: SOT23-8 Plastic Package



DESIGNATION	DESCRIPTION	METRIC		ENGLISH		NOTE
A	OVERALL HEIGHT	1.20	+/-.25 mm	0.05	+/-.250 in	3
A1	STANDOFF	.100	+/-.05 mm	.004	+/-.002 in	3
b	LEAD WIDTH	.365	mm TYP	.014	in	3
c	LEAD THICKNESS	.127	mm TYP	.005	in	3
D	PACKAGE LENGTH	2.90	+/-.10 mm	.114	+/-.004 in	1,3
e	LEAD PITCH	.65	mm TYP	.026	in	3
E	LEAD TIP SPAN	2.80	+/-.20 mm	.110	+/-.008 in	3
E1	PACKAGE WIDTH	1.60	+/-.10 mm	.063	+/-.004 in	2,3
L	FOOT LENGTH	.45	+/-.10 mm	.018	+/-.004 in	3
Theta	FOOT ANGLE	1.5	+/-1.5 DEG	1.5	+/-1.5 DEG	

Notes
1. The package length dimension includes allowance for mold mismatch and flashing.
2. The package width dimension includes allowance for mold mismatch and flashing.
3. Primary dimensions are in metric millimeters. The English equivalents are calculated and subject to rounding error.

Additional Information

For latest specifications, additional product information, worldwide sales and distribution locations, and information about TriQuint:

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