



# LTC5507

## 100kHz to 1GHz RF Power Detector

### FEATURES

- Temperature Compensated Internal Schottky Diode RF Detector
- Wide Input Power Range: -34dBm to 14dBm
- Ultra Wide Input Frequency Range: 100kHz to 1000MHz
- Buffered Output
- Wide  $V_{CC}$  Range of 2.7V to 6V
- Low Operating Current: 550 $\mu$ A
- Low Shutdown Current: <2 $\mu$ A
- Low Profile (1mm) ThinSOT™ Package

### APPLICATIONS

- Wireless Transceivers
- Wireless and Cable Infrastructure
- RF Power Alarm
- Envelope Detector

### DESCRIPTION

The LTC®5507 is an RF power detector for applications operating from 100kHz to 1000MHz. The input frequency range is determined by an external capacitor. A temperature-compensated Schottky diode peak detector and buffer amplifier are combined in a small 6-pin ThinSOT package.

The RF input voltage is peak detected using an on-chip Schottky diode and external capacitor. The detected voltage is buffered and supplied to the  $V_{OUT}$  pin. A power saving shutdown mode reduces supply current to less than 2 $\mu$ A.

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ThinSOT is a trademark of Linear Technology Corporation

### TYPICAL APPLICATION

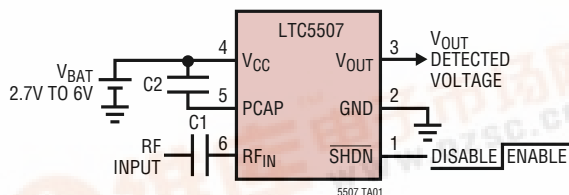
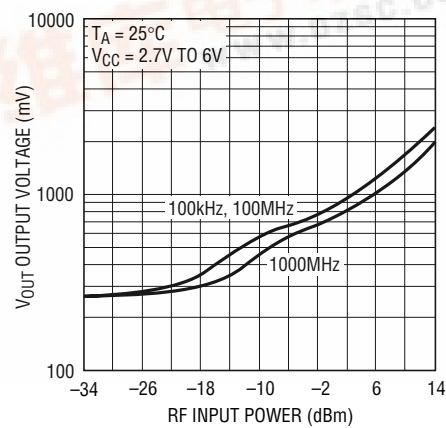


Figure 1. 100kHz to 1000MHz RF Power Detector

Typical Detector Characteristics  
at 100kHz, 100MHz and 1000MHz



5507 TA01b



## ABSOLUTE MAXIMUM RATINGS

(Note 1)

$V_{CC}$ , $V_{OUT}$ to GND .....	-0.3V to 6.5V
$RF_{IN}$ Voltage to GND .....	$(V_{CC} \pm 1.8V)$ to 7V
SHDN Voltage to GND .....	-0.3V to $(V_{CC} + 0.3V)$
PCAP Voltage to GND .....	$(V_{CC} - 1.8V)$ to 7V
$I_{VOUT}$ .....	5mA
Operating Temperature Range (Note 2) ..	-40°C to 85°C
Maximum Junction Temperature .....	125°C
Storage Temperature Range .....	-65°C to 150°C
Lead Temperature (Soldering, 10 sec).....	300°C

## PACKAGE/ORDER INFORMATION

	ORDER PART NUMBER
	LTC5507ES6
	S6 PART MARKING
	LTZX

Consult LTC Marketing for parts specified with wider operating temperature ranges.

## ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at  $T_A = 25^\circ\text{C}$ .  $V_{CC} = 3.6\text{V}$ , RF Input Signal is Off, unless otherwise noted.

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
$V_{CC}$ Operating Voltage		● 2.7		6	V
$I_{VCC}$ Shutdown Current	SHDN = 0V	●		2	$\mu\text{A}$
$I_{VCC}$ Operating Current	SHDN = $V_{CC}$ , $I_{VOUT} = 0\text{mA}$	●	0.55	0.85	mA
$V_{OUT}$ $V_{OL}$ (No RF Input)	$R_{LOAD} = 2\text{k}$ , SHDN = $V_{CC}$ , Enabled SHDN = 0V, Disabled	130	250 1	370	mV mV
$V_{OUT}$ Output Current	$V_{OUT} = 1.75\text{V}$ , $V_{CC} = 2.7\text{V}$ to 6V, $\Delta V_{OUT} = 10\text{mV}$	● 1	2		mA
$V_{OUT}$ Enable Time	SHDN = $V_{CC}$ , $C_{LOAD} = 33\text{pF}$ , $R_{LOAD} = 2\text{k}$	●	7	20	$\mu\text{s}$
$V_{OUT}$ Load Capacitance	(Note 4)	●		33	pF
$V_{OUT}$ Noise	$V_{CC} = 3\text{V}$ , Noise BW = 1.5MHz, 50 $\Omega$ RF Input Termination		2		mV <sub>P-P</sub>
SHDN Voltage, Chip Disabled	$V_{CC} = 2.7\text{V}$ to 6V	●		0.35	V
SHDN Voltage, Chip Enabled	$V_{CC} = 2.7\text{V}$ to 6V	●	1.4		V
SHDN Input Current	SHDN = 3.6V	●	24	40	$\mu\text{A}$
$RF_{IN}$ Input Frequency Range			0.1– 1000		MHz
Max $RF_{IN}$ Input Power	(Note 3)		14		dBm
$RF_{IN}$ AC Input Resistance	F = 10MHz, RF Input = -10dBm F = 1000MHz, RF Input = -10dBm		130 95		$\Omega$ $\Omega$
$RF_{IN}$ Input Shunt Capacitance			1.7		pF

**Note 1:** Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

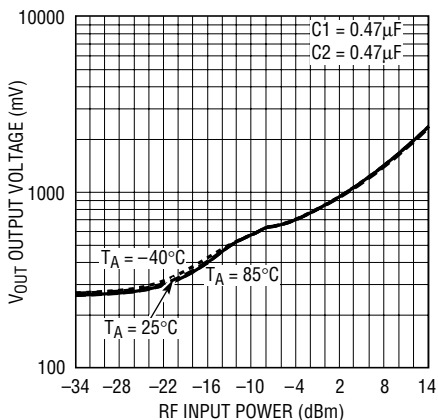
**Note 2:** Specifications over the -40°C to 85°C operating temperature range are assured by design, characterization and correlation with statistical process controls.

**Note 3:** RF performance is tested at: 80MHz, -4dBm

**Note 4:** Guaranteed by design.

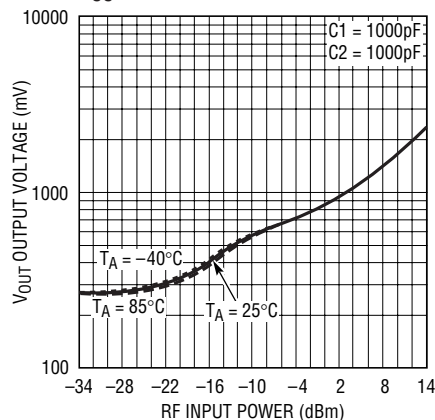
# TYPICAL PERFORMANCE CHARACTERISTICS

**LTC5507 Typical Detector Characteristics, 100kHz,  $V_{CC} = 2.7V$  TO  $6V$**



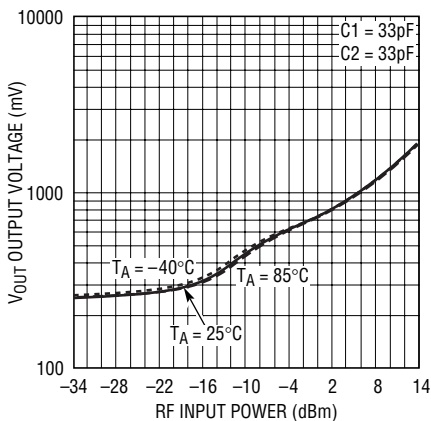
5507 G01

**LTC5507 Typical Detector Characteristics, 100MHz,  $V_{CC} = 2.7V$  TO  $6V$**



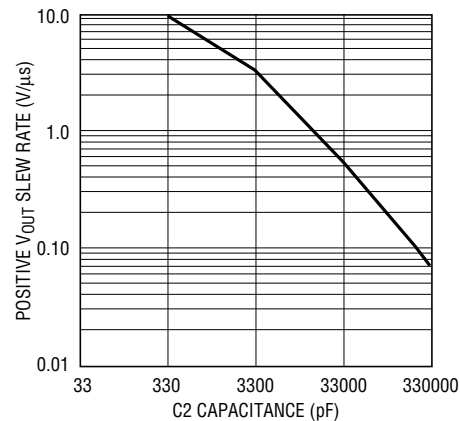
5507 G02

**LTC5507 Typical Detector Characteristics, 1000MHz,  $V_{CC} = 2.7V$  TO  $6V$**



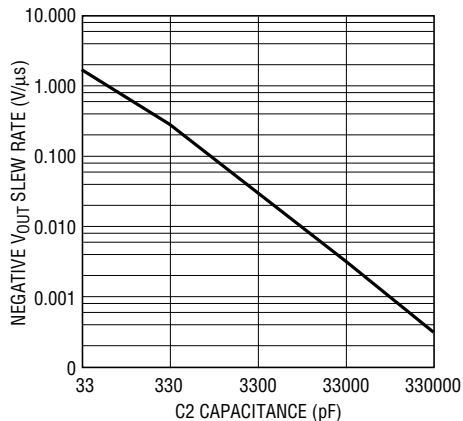
5507 G03

**Positive  $V_{OUT}$  Slew Rate vs  $C2$  Capacitance**



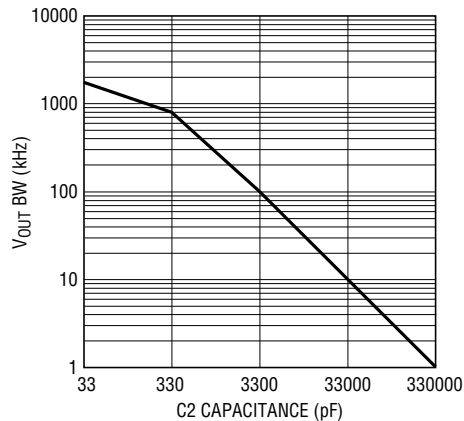
5507 G04

**Negative  $V_{OUT}$  Slew Rate vs  $C2$  Capacitance**



5507 G05

**$V_{OUT}$  BW vs  $C2$  Capacitance**



5507 G06

## PIN FUNCTIONS

**SHDN (Pin 1):** Shutdown Input. A logic low or no-connect on the SHDN pin places the part in shutdown mode. A logic high enables the part. SHDN has an internal 150k pull down resistor to ensure that the part is in shutdown when the enable driver is in a tri-state condition.

**GND (Pin 2):** System Ground.

**V<sub>OUT</sub> (Pin 3):** Buffered and Level Shifted Detector Output Voltage.

**V<sub>CC</sub> (Pin 4):** Power Supply Voltage, 2.7V to 6V. V<sub>CC</sub> should be bypassed with 0.1μF and 100pF ceramic capacitors.

**PCAP (Pin 5):** Peak Detector Hold Capacitor. Capacitor value is dependent on RF frequency. Capacitor must be connected between PCAP and V<sub>CC</sub>.

**RF<sub>IN</sub> (Pin 6):** RF Input Voltage. Referenced to V<sub>CC</sub>. A coupling capacitor must be used to connect to the RF signal source. This pin has an internal 250Ω termination and an internal Schottky diode detector.

## BLOCK DIAGRAM

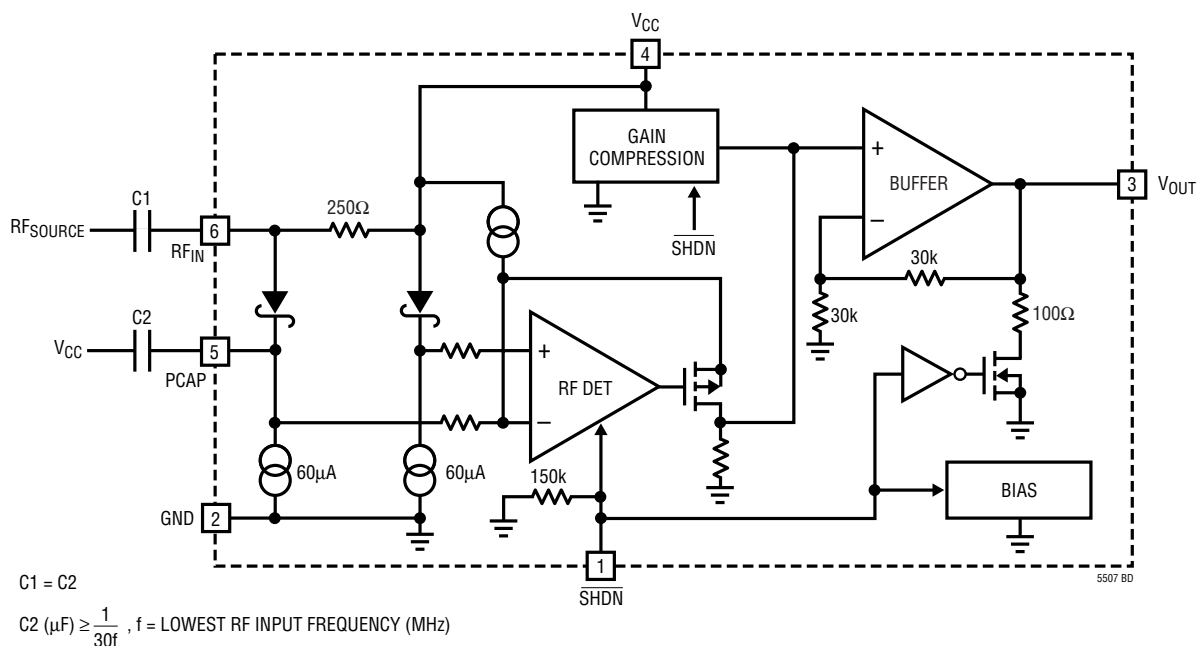


Figure 2.

## APPLICATIONS INFORMATION

### Operation

The LTC5507 integrates several functions to provide RF power detection over frequencies up to 1000MHz. These functions include an internally compensated buffer amplifier, an RF Schottky diode peak detector and level shift amplifier to convert the RF signal to DC, a delay circuit to avoid voltage transients at  $V_{OUT}$  when coming out of shutdown, and a gain compression circuit to extend the detector dynamic range.

### Buffer Amplifier

The buffer amplifier has a gain of two and is capable of driving a 2mA load. The buffer amplifier typically has an output voltage range of 0.25V to  $V_{CC} - 0.1V$ .

### RF Detector

The internal RF Schottky diode peak detector and level shift amplifier converts the RF input signal to a low frequency signal. The frequency range of the RF pin is typically up to 1000MHz. The detector demonstrates excellent operation over a wide range of input power. The Schottky detector is biased at about 70 $\mu$ A. The hold capacitor is external.

### Gain Compression

The gain compression circuit changes the feedback ratio as the RF peak-detected input voltage increases above 60mV. Below 60mV, the DC voltage gain from the peak detector to the buffer output is 4. Above 140mV, the DC voltage gain is reduced to 0.75. The compression expands the low power detector range due to higher gain.

### Modes of Operation

MODE	SHDN	OPERATION
Shutdown	Low	Disabled
Enable	High	Power Detect

### Applications

The LTC5507 can be used as a self-standing signal strength measuring receiver for a wide range of input signals from -34dBm to 14dBm for frequencies up to 1000MHz.

The LTC5507 can be used as a demodulator for AM and ASK modulated signals with data rates up to 1.5MHz. Depending on specific application needs, the RSSI output can be split into two branches, providing AC-coupled data (or audio) output and DC-coupled, RSSI output for signal strength measurements and AGC.

### C1, C2 Capacitor Selection (Refer to Figure 3)

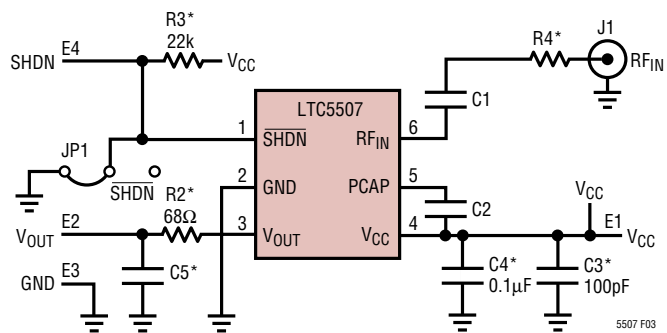
C1 couples the RF input signal to the detector input  $RF_{IN}$  which is referenced to  $V_{CC}$ . C2 is the peak detector capacitor connected between PCAP and  $V_{CC}$ . The value of C2 will affect the slew rate and bandwidth. Typically C1 can equal C2. Ceramic capacitors are recommended for C1 and C2. The values for C1 and C2 are dependent on the operating RF frequency. The capacitive reactance should be less than 5 $\Omega$  to minimize ripple on C2.

$$C2(\mu F) \geq 1/(30 \cdot f) \text{ where } f \text{ is the lowest RF input frequency (MHz)}$$

$$C1 = C2$$

In general, select C1 and C2 large enough to pass the lowest expected RF signal frequency, as described by the above formulas. But optimize C1 and C2, subject to this constraint, to improve output slew rate and bandwidth, and to enable good AC performance for the highest expected RF signal frequency.

## APPLICATIONS INFORMATION

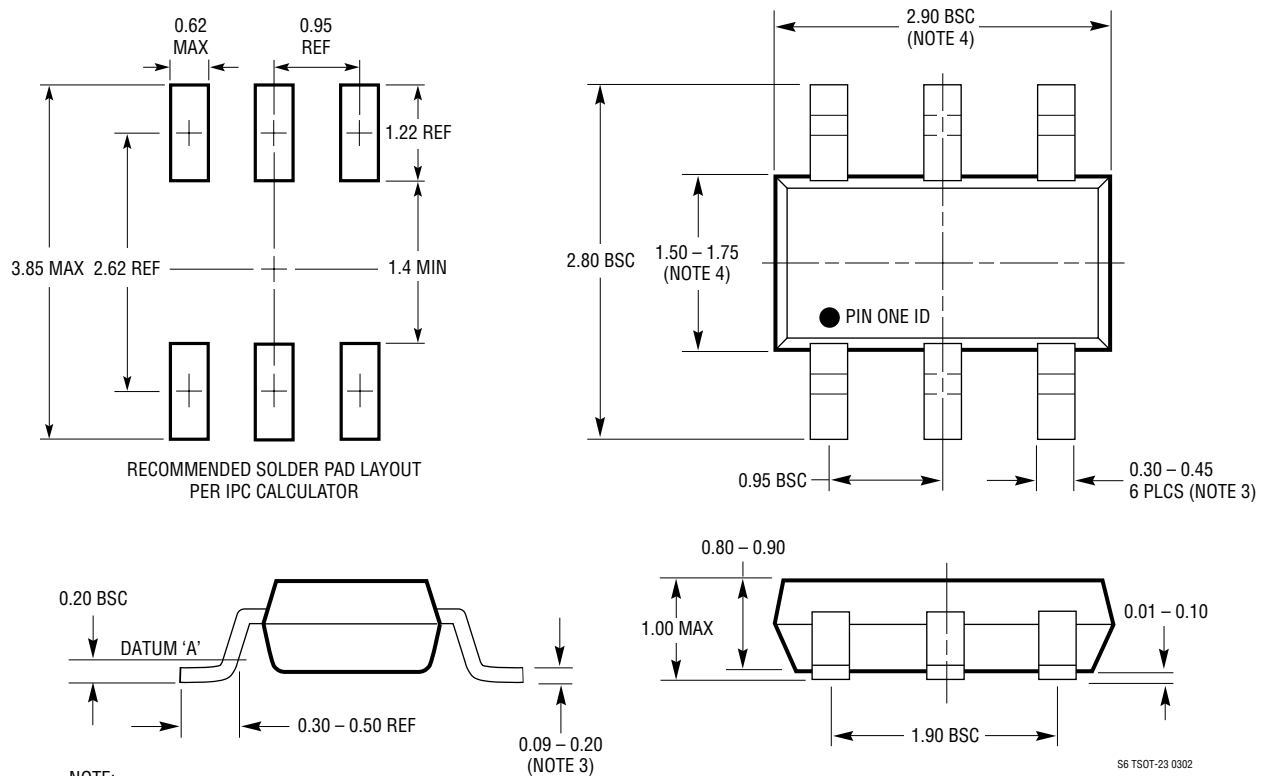


\* OPTIONAL COMPONENTS  
 R2 AND C5 FORM AN OPTIONAL OUTPUT LOWPASS FILTER.  
 R3 IS USED FOR DEMO PURPOSES ONLY, AND IS NOT USED IN ACTUAL PRODUCT IMPLEMENTATION.  
 R4 CAN BE USED FOR INPUT POWER LIMITING OR BROADBAND IMPEDANCE MATCHING.  
 C3 AND C4 ARE OPTIONAL POWER SUPPLY FILTERS.

**Figure 3. Evaluation Demo Board Schematic**

## PACKAGE DESCRIPTION

**S6 Package**  
**6-Lead Plastic TSOT-23**  
 (Reference LTC DWG # 05-08-1636)



# LTC5507

## RELATED PARTS

PART NUMBER	DESCRIPTION	COMMENTS
<b>RF Power Controllers</b>		
LTC1757A	RF Power Controller	Multiband GSM/DCS/GPRS Mobile Phones
LTC1758	RF Power Controller	Multiband GSM/DCS/GPRS Mobile Phones
LTC1957	RF Power Controller	Multiband GSM/DCS/GPRS Mobile Phones
LTC4400	ThinSOT RF PA Controller	Multiband GSM/DCS/GPRS Phones, 45dB Dynamic Range, 450kHz Loop BW
LTC4401	ThinSOT RF PA Controller	Multiband GSM/DCS/GPRS Phones, 45dB Dynamic Range, 250kHz Loop BW
LTC4403	Multiband RF Power Controllers for EDGE/TDMA	Supports EDGE/TDMA Applications
LT5504	800MHz to 2.7GHz RF Measuring Receivers	80dB Dynamic Range, Temperature Compensated, 2.7V to 5.5V Supply
LTC5505	300MHz to 3.5GHz RF Power Detector	>40dB Dynamic Range, Temperature Compensated, 2.7V to 6V Supply
LTC5508	300MHz to 7GHz RF Power Detector	>40dB Dynamic Range, SC-70 Package
<b>Other Related Parts</b>		
LT5500	1.8GHz to 2.7GHz, Receiver Front End	Dual LNA gain Setting +13.5dB/-14dB at 2.5GHz, Double-Balanced Mixer, 1.8V to 5.25V Supply
LT5502	400MHz Quadrature Demodulator with RSSI	1.8V to 5.25V Supply, 70MHz to 400MHz IF, 84dB Limiting Gain, 90dB RSSI Range
LT5503	1.2GHz to 2.7GHz Direct IQ Modulator and Up Converting Mixer	1.8V to 5.25V Supply, Four-Step RF Power Control, 120MHz Modulation Bandwidth
LT5506	500MHz Quadrature IF Demodulator with VGA	1.8V to 5.25V Supply, 40MHz to 500MHz IF, -4dB to 57dB Linear Power Gain
LT5511	High Signal Level Upconverting Mixer	10MHz to 3000MHz RF Output Range, Integrated LO Buffer, 17dBm IIP3
LT5512	High Signal Level Down Converting Mixer	DC-3GHz, 20dBm IIP3, Integrated LO Buffer