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: 550µA
- Low Shutdown Current: <2µA
- 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 2µA.

TYPICAL APPLICATION

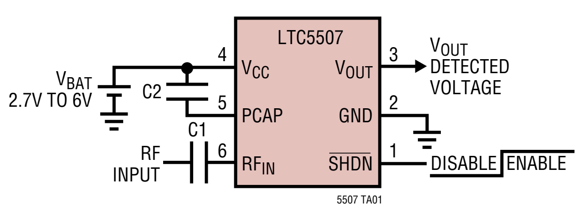
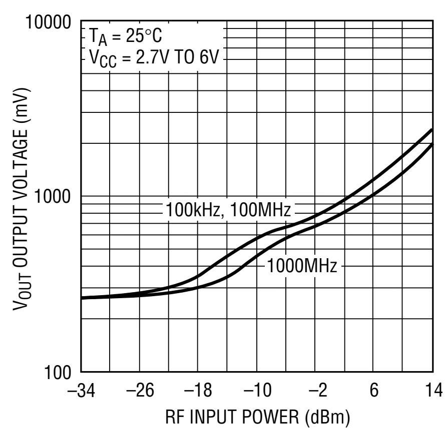


Figure 1. 100kHz to 1000MHz RF Power Detector

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

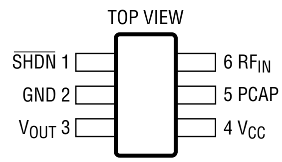


ABSOLUTE MAXIMUM RATINGS

(Note 1)

V_{CC}, V_{OUT} to GND .... −0.3V to 6.5V
RF_{IN} Voltage to GND .... (V_{CC} ± 1.8V) to 7V
$\overline{SHDN}$ 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



S6 PACKAGE
6-LEAD PLASTIC SOT-23

T_{JMAX} = 125°C, θ_{JA} = 250°C/W

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°C. V_{CC} = 3.6V, 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	$\overline{SHDN}$ = 0V	●			2	µA
I_{VCC} Operating Current	$\overline{SHDN}$ = V_{CC}, I_{VOUT} = 0mA	●		0.55	0.85	mA
V_{OUT} V_{OL} (No RF Input)	R_{LOAD} = 2k, $\overline{SHDN}$ = V_{CC}, Enabled $\overline{SHDN}$ = 0V, Disabled		130	250 1	370	mV mV
V_{OUT} Output Current	V_{OUT} = 1.75V, V_{CC} = 2.7V to 6V, ΔV_{OUT} = 10mV	●	1	2		mA
V_{OUT} Enable Time	$\overline{SHDN}$ = V_{CC}, C_{LOAD} = 33pF, R_{LOAD} = 2k	●		7	20	µs
V_{OUT} Load Capacitance	(Note 4)	●			33	pF
V_{OUT} Noise	V_{CC} = 3V, Noise BW = 1.5MHz, 50Ω RF Input Termination			2		mV_{P-P}
$\overline{SHDN}$ Voltage, Chip Disabled	V_{CC} = 2.7V to 6V	●			0.35	V
$\overline{SHDN}$ Voltage, Chip Enabled	V_{CC} = 2.7V to 6V	●	1.4			V
$\overline{SHDN}$ Input Current	$\overline{SHDN}$ = 3.6V	●		24	40	µA
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		Ω Ω
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.

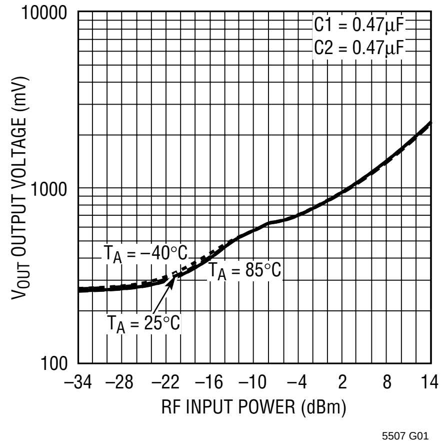
Note 2: Specifications over the –40°C to 85°C operating temperature range are assured by design, characterization and correlation with statistical process controls.

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

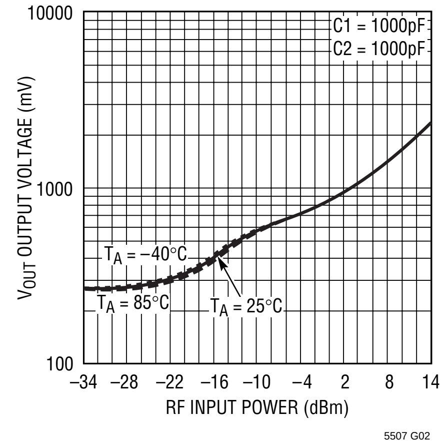
Note 4: Guaranteed by design.

TYPICAL PERFORMANCE CHARACTERISTICS

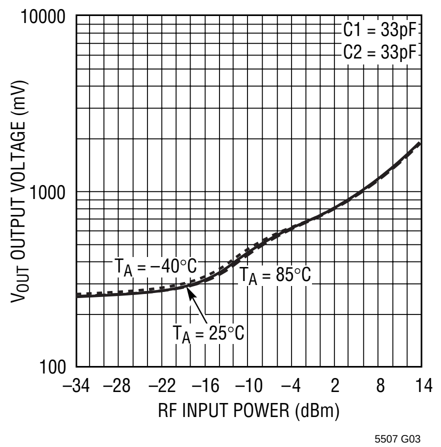
LTC5507 Typical Detector Characteristics, 100kHz, V_{CC} = 2.7V TO 6V



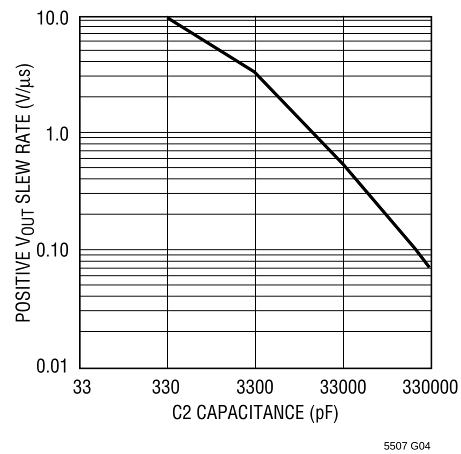
LTC5507 Typical Detector Characteristics, 100MHz, V_{CC} = 2.7V TO 6V



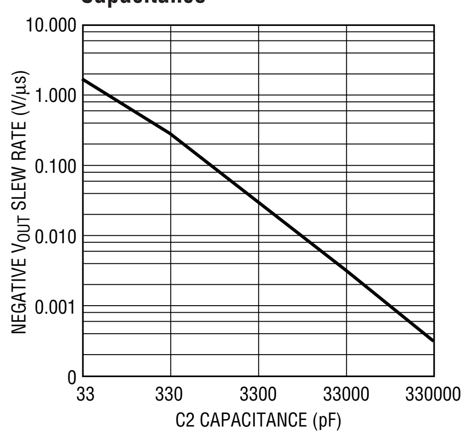
LTC5507 Typical Detector Characteristics, 1000MHz, V_{CC} = 2.7V TO 6V



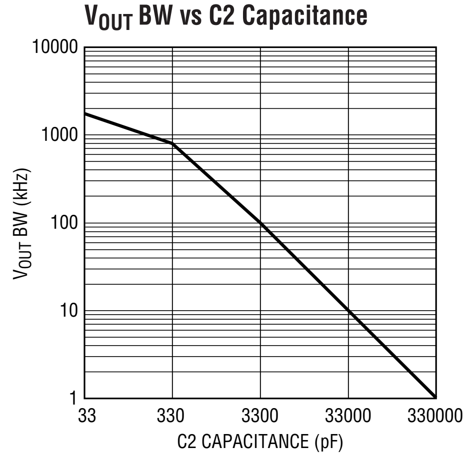
Positive V_{OUT} Slew Rate vs C2 Capacitance



Negative V_{OUT} Slew Rate vs C2 Capacitance



V_{OUT} BW vs C2 Capacitance



PIN FUNCTIONS

$\overline{SHDN}$ (Pin 1): Shutdown Input. A logic low or no-connect on the $\overline{SHDN}$ pin places the part in shutdown mode. A logic high enables the part. $\overline{SHDN}$ 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.

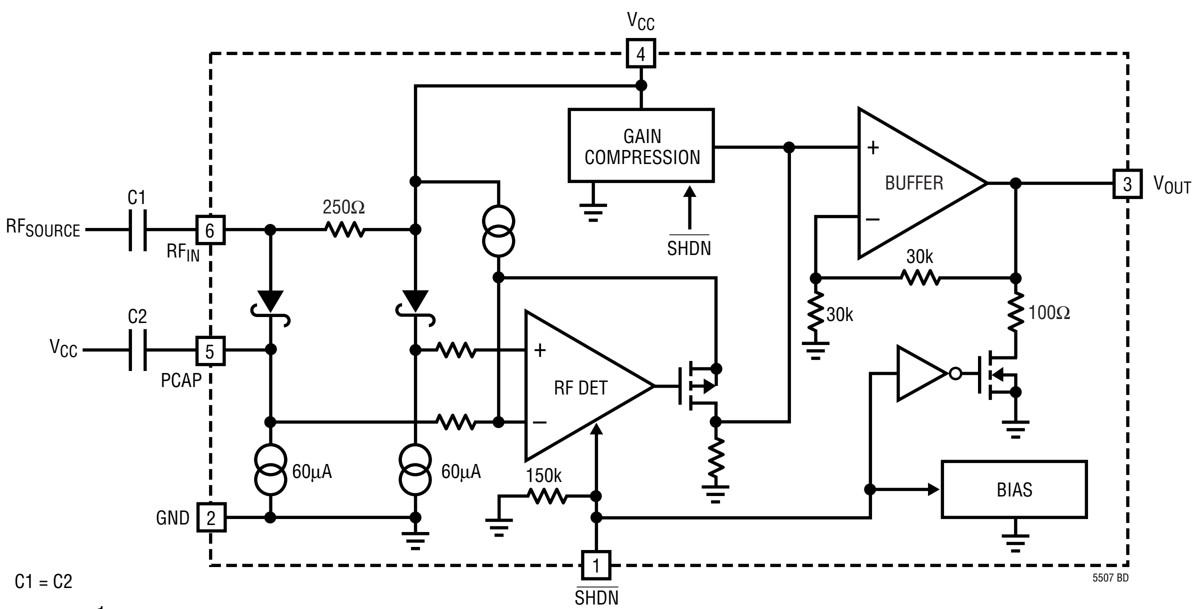
V_{OUT} (Pin 3): Buffered and Level Shifted Detector Output Voltage.

V_{CC} (Pin 4): Power Supply Voltage, 2.7V to 6V. V_{CC} 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_{CC}.

RF_{IN} (Pin 6): RF Input Voltage. Referenced to V_{CC}. 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



C1 = C2

C2 (μF) ≥ $\frac{1}{30f}$, f = LOWEST RF INPUT FREQUENCY (MHz)

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 70μA. 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	$\overline{SHDN}$	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)

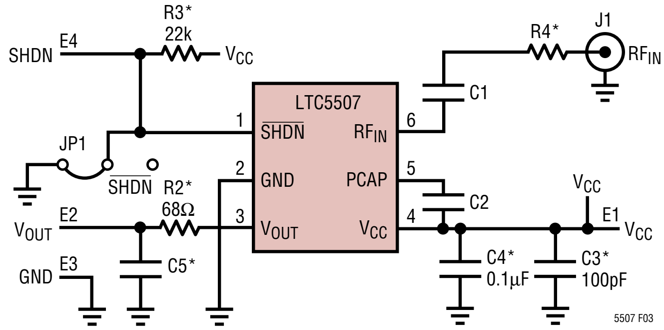
C1 couples the RF input signal to the detector input RF_{IN} which is referenced to V_{CC}. C2 is the peak detector capacitor connected between PCAP and V_{CC}. The value of C2 will affect the slew rate and bandwidth. Typically C1 can equal C2. Ceramic capacitors are recommended for C1 and C2. The values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

$C2(\mu F) \geq 1/(30 \bullet f)$ where f 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

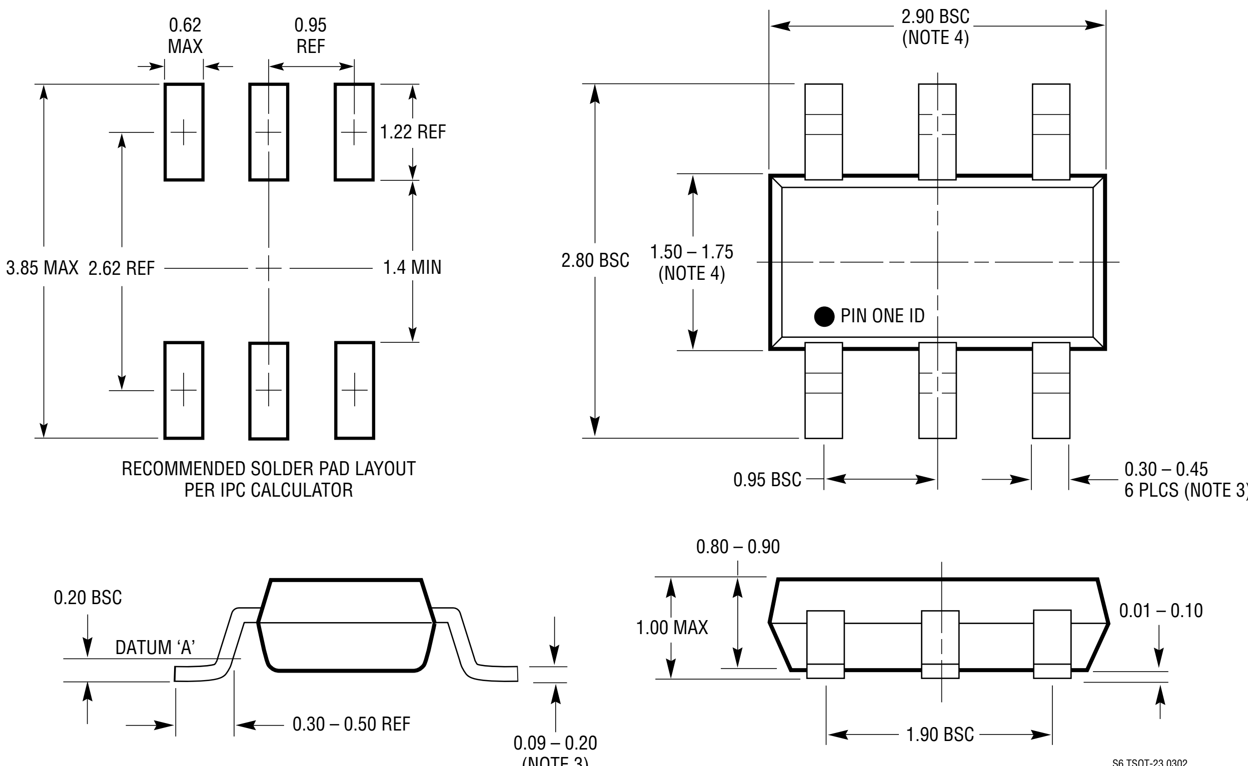


* OPTIONAL COMPONENTS
R2 AND C5 FORM AN OPTIONAL OUTPUT LOWPASS FILTER.
R3 IS USED FOR DEMO PURPOSES ONLY, AND IS NOT USED IN ACTUAL PRODUCT IMPLEMENTATION.
R4 CAN BE USED FOR INPUT POWER LIMITING OR BROADBAND IMPEDANCE MATCHING.
C3 AND C4 ARE OPTIONAL POWER SUPPLY FILTERS.

Figure 3. Evaluation Demo Board Schematic

PACKAGE DESCRIPTION

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



NOTE:
1. DIMENSIONS ARE IN MILLIMETERS
2. DRAWING NOT TO SCALE
3. DIMENSIONS ARE INCLUSIVE OF PLATING
4. DIMENSIONS ARE EXCLUSIVE OF MOLD FLASH AND METAL BURR
5. MOLD FLASH SHALL NOT EXCEED 0.254mm
6. JEDEC PACKAGE REFERENCE IS MO-193