LTC5505-1/LTC5505-2

RF Power Detector with Buffered Output and >40dB Dynamic Range

FEATURES

- **Internal Schottky Diode RF Detector with Two Input Power Ranges:**
  LTC5505-1, –28dBm to 18dBm
  LTC5505-2, –32dBm to 12dBm
- **Wide Input Frequency Range: 300MHz to 3GHz (LTC5505-1); 300MHz to 3.5GHz (LTC5505-2)**
- **Temperature Compensated**
- **Buffered Detector Output**
- **Wide V_{CC} Range of 2.7V to 6V**
- Low Operating Current: 0.5mA
- Low Shutdown Current: <2μA
- Low Profile (1mm) ThinSOT™ Package

APPLICATIONS

- Multimode Mobile Phone Products
- PCS Devices
- Wireless Data Modems
- Wireless and Cable Infrastructure
- RF Power Alarm
- Envelope Detector

DESCRIPTION

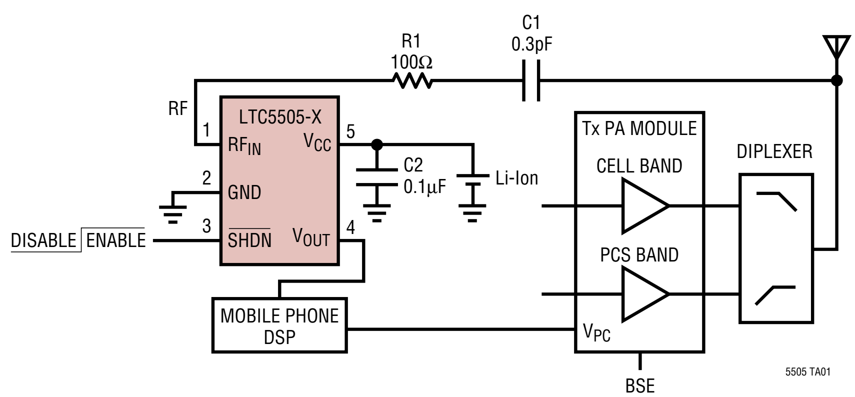
The LTC®5505-X is an RF power detector for RF applications operating in the 300MHz to 3.5GHz range. A temperature compensated Schottky diode peak detector and buffer amplifier are combined in a small 5-pin ThinSOT package. The supply voltage range is optimized for operation from a single lithium-ion cell or 3xNiMH.

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

The LTC5505-1 operates with input power levels from –28dBm to 18dBm. The LTC5505-2 operates with input power levels from –32dBm to 12dBm.

TYPICAL APPLICATION

Dual Band Mobile Phone Tx Power Control

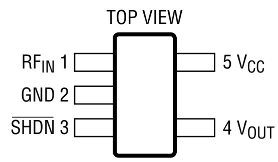


ABSOLUTE MAXIMUM RATINGS

(Note 1)

V_{CC}, V_{OUT} to GND .... –0.3V to 6.5V
RF Voltage
LTC5505-1 .... (V_{CC} – 2.6V) to 7V
LTC5505-2 .... (V_{CC} – 1.4V) to 7V
$\overline{SHDN}$ Voltage to GND .... –0.3V to (V_{CC} + 0.3V)
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



S5 PACKAGE
5-LEAD PLASTIC SOT-23

T_{JMAX} = 125°C, θ_{JA} = 250°C/W

ORDER PART NUMBER	S5 PART MARKING
LTC5505-1ES5	LTXV
LTC5505-2ES5	LTRW

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, $\overline{SHDN}$ = V_{CC} = HI, $\overline{SHDN}$ = 0V = LO, 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	$\overline{SHDN}$ = LO	●			2	µA
I_{VCC} Operating Current	$\overline{SHDN}$ = HI, I_{VOUT} = 0mA	●		0.5	0.75	mA
V_{OUT} V_{OL} (No RF Input)	R_{LOAD} = 2k, $\overline{SHDN}$ = HI, Enabled $\overline{SHDN}$ = LOW, Disabled		170	260 1	350	mV mV
V_{OUT} Output Current	V_{OUT} = 1.75V, V_{CC} = 2.7V, ΔV_{OUT} = 10mV	●	1	2		mA
V_{OUT} Enable Time	$\overline{SHDN}$ = HI, C_{LOAD} = 33pF, R_{LOAD} = 2k	●		8	20	µs
V_{OUT} Bandwidth	C_{LOAD} = 33pF, R_{LOAD} = 2k (Note 4)			4		MHz
V_{OUT} Load Capacitance	(Note 7)	●			33	pF
V_{OUT} Slew Rate	V_{RFIN} = 2V Step, C_{LOAD} = 33pF, R_{LOAD} = 2k (Note 3)			10		V/µs
V_{OUT} Noise	V_{CC} = 3V, Noise BW = 1.5MHz, 50Ω RF Input Termination			1.4		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

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, $\overline{SHDN}$ = V_{CC} = HI, $\overline{SHDN}$ = 0V = LO, RF Input Signal is Off, unless otherwise noted.

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
RF_{IN} Input Frequency Range (LTC5505-1) (LTC5505-2)				300 to 3000 300 to 3500		MHz MHz
RF_{IN} Input Power Range (LTC5505-1)	RF Frequency = 900MHz (Note 5, 6, 7) V_{CC} = 2.7V to 6V RF Frequency = 1800MHz (Note 5, 6, 7)V_{CC} = 2.7V to 6V RF Frequency = 2400MHz (Note 5, 7)V_{CC} = 2.7V to 6V RF Frequency = 2700MHz (Note 5, 7)V_{CC} = 2.7V to 6V			–28 to 18 –26 to 18 –24 to 16 –22 to 16		dBm dBm dBm dBm
RF_{IN} Input Power Range (LTC5505-2)	RF Frequency = 900MHz (Note 5) RF Frequency = 1800MHz (Note 5) RF Frequency = 2400MHz (Note 5) RF Frequency = 2700MHz (Note 5)			–32 to 12 –32 to 12 –32 to 12 –30 to 12		dBm dBm dBm dBm
RF_{IN} AC Input Resistance (LTC5505-1)	F = 850MHz F = 1850MHz			165 20		Ω Ω
RF_{IN} Input Shunt Capacitance (LTC5505-1)				2		pF
RF_{IN} AC Input Resistance (LTC5505-2)	F = 850MHz F = 1850MHz			165 59		Ω Ω
RF_{IN} Input Shunt Capacitance (LTC5505-2)				1.3		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: The rise time at V_{OUT} is measured between 0.5V and 1.5V.

Note 4: Bandwidth is calculated using the 10% to 90% rise time equation: BW = 0.35/rise time.

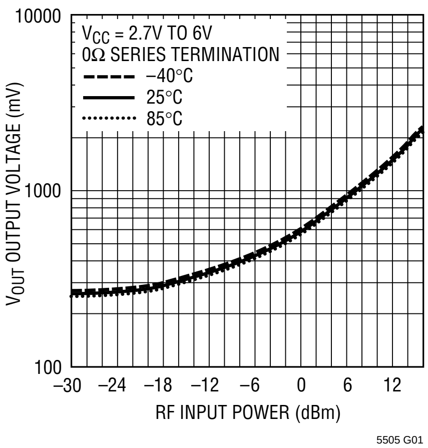
Note 5: RF performance is tested at:
1800MHz, 14dBm, –14dBm (LTC5505-1)
1800MHz, 12dBm, –14dBm (LTC5505-2)

Note 6: For input RF power levels >16dBm, V_{CC} minimum is 3V and an RF input series resistor of 20Ω is required to limit the input current.

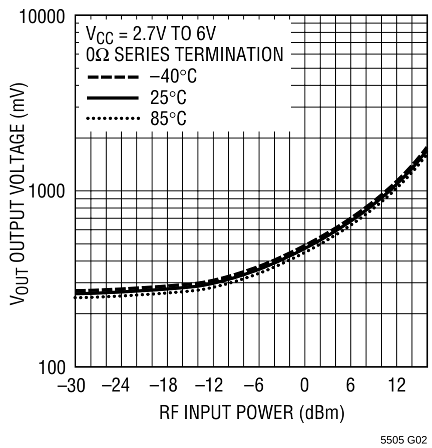
Note 7: Guaranteed by design.

TYPICAL PERFORMANCE CHARACTERISTICS

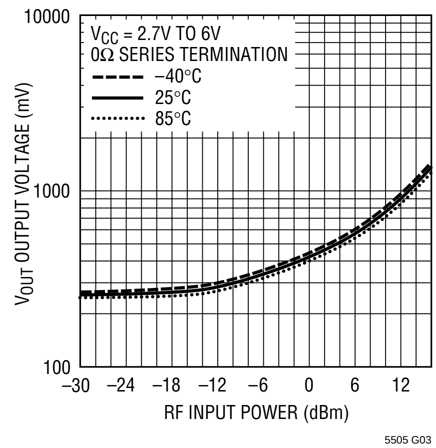
LTC5505-1 Typical Detector Characteristics, 0.85GHz



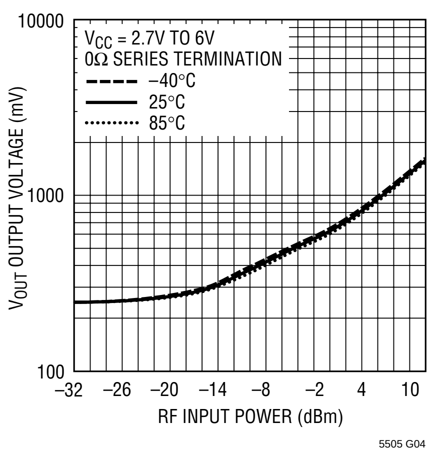
LTC5505-1 Typical Detector Characteristics, 1.85GHz



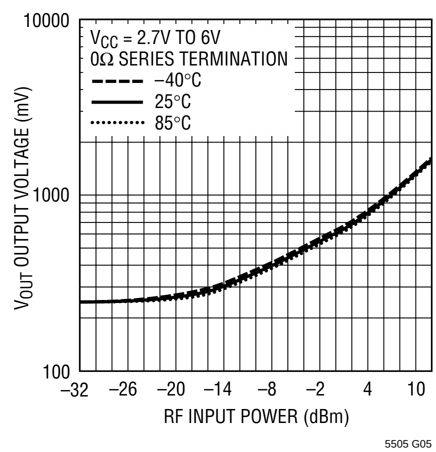
LTC5505-1 Typical Detector Characteristics, 2.45GHz



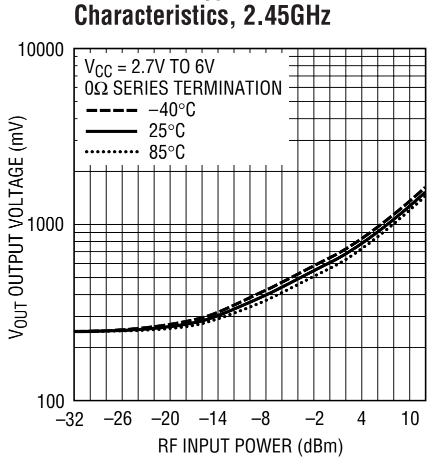
LTC5505-2 Typical Detector Characteristics, 0.85GHz



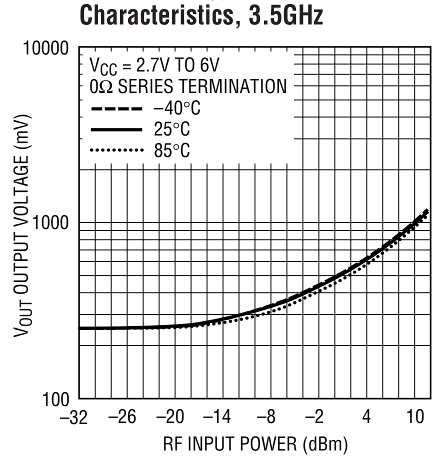
LTC5505-2 Typical Detector Characteristics, 1.85GHz



LTC5505-2 Typical Detector Characteristics, 2.45GHz



LTC5505-2 Typical Detector Characteristics, 3.5GHz



PIN FUNCTIONS

RF_{IN} (Pin 1): RF Input Voltage. Referenced to V_{CC}. An external coupling capacitor to the RF source is required. The frequency range is 300MHz to 3GHz. This pin has an internal 250Ω termination, an internal Schottky diode detector and peak detector capacitor. (See Note 6 in the Electrical Characteristics.)

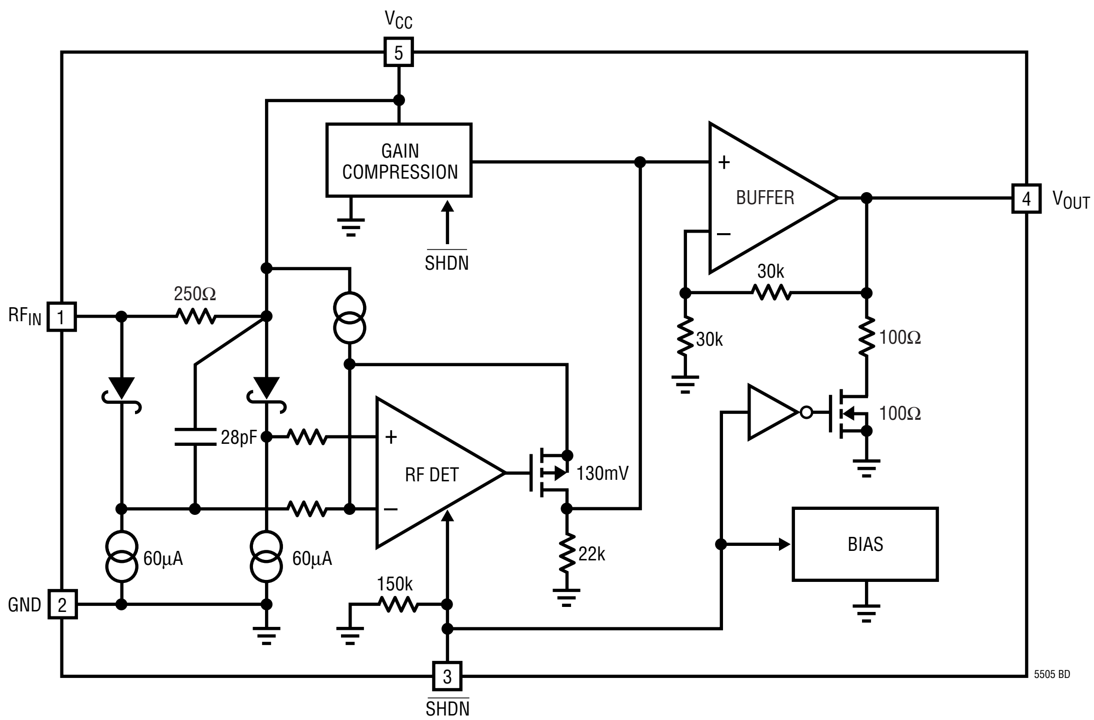
GND (Pin 2): System Ground.

$\overline{SHDN}$ (Pin 3): Shutdown Input. A logic low 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 drivers are in a tri-state condition.

V_{OUT} (Pin 4): Buffered and Level Shifted Detector Output Voltage.

V_{CC} (Pin 5): Power Supply Voltage, 2.7V to 6V. V_{CC} should be bypassed appropriately with ceramic capacitors.

BLOCK DIAGRAM



APPLICATIONS INFORMATION

Operation

The LTC5505-X RF detector integrates several functions to provide RF power detection over frequencies ranging from 300MHz to 3.5GHz. These functions include an internally compensated buffer amplifier, an RF Schottky diode peak detector and level shift amplifier to convert the RF feedback 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 1.75V.

RF Detector

The internal RF Schottky diode peak detector and level shift amplifier converts the RF input signal to a low frequency signal. The detector demonstrates excellent efficiency and linearity over a wide range of input power. The Schottky detector is biased at about 60µA and drives a peak detector capacitor of 28pF.

Gain Compression

The gain compression circuit changes the feedback ratio as the RF peak-detected input voltage increases above 100mV. Below 100mV, the voltage gain from the peak detector to the buffer output is 1.5. Above 200mV, the voltage gain is reduced to 0.7. 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

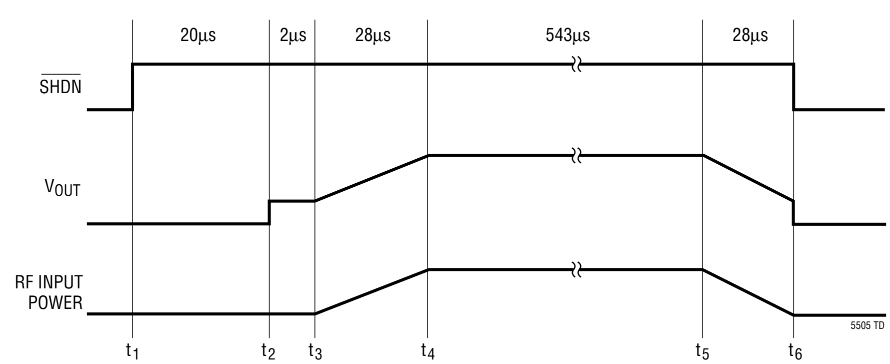
Applications

The LTC5505-1 and LTC5505-2 can be used as self-standing signal strength measuring receivers for a wide range of input signals from –32dBm to 18dBm for frequencies from 300MHz to 3.5GHz.

The LTC5505-1 and LTC5505-2 can be used as demodulators for AM and ASK modulated signals with data rates up to 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.

The LTC5505-1 and LTC5505-2 can be used for dual band mobile phone transmitter power control (refer to Typical Application schematic on first page). The circuit uses a capacitive tap at the Tx PA outputs. For example, a 0.3pF capacitor (C1) followed by a 100Ω resistor (R1) forms a coupling circuit with about a 20dB loss at the cellular band and 18dB loss at the PCS band, referenced to the LTC5505-2 IC RF input pin. For improved coupling accuracy, the C1 capacitor should be a high tolerance component (±0.05pF.)

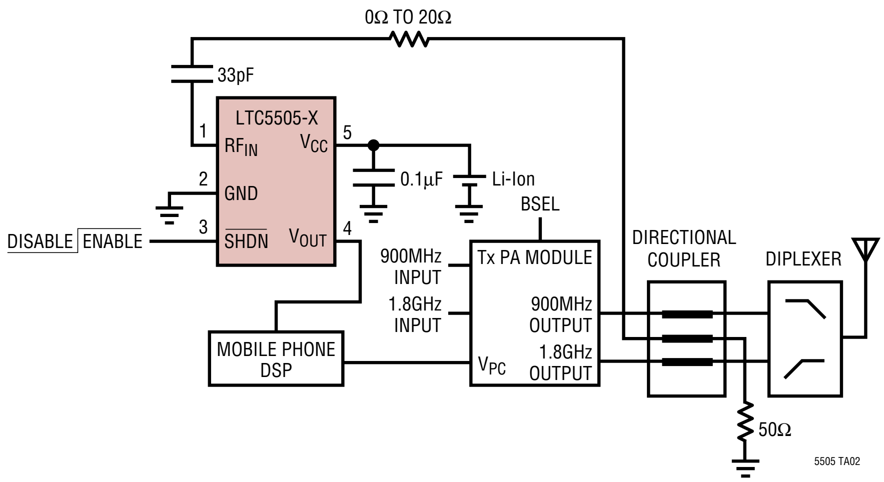
Example of LTC5505-X GSM/DCS Power Control Timing Diagram



t_1: PART COMES OUT OF SHUTDOWN 20µs MAXIMUM PRIOR TO BURST.
t_2: CIRCUITS POWER UP AND SETTLE.
t_3: BASEBAND CONTROLLER STARTS RF POWER RAMP UP AT 22µs AFTER $\overline{SHDN}$ IS ASSERTED HIGH.
t_4: BASEBAND CONTROLLER COMPLETES RAMP UP.
t_5: BASEBAND CONTROLLER STARTS RF POWER RAMP DOWN AT END OF BURST.
t_6: LTC5505-X RETURNS TO SHUTDOWN MODE BETWEEN BURSTS

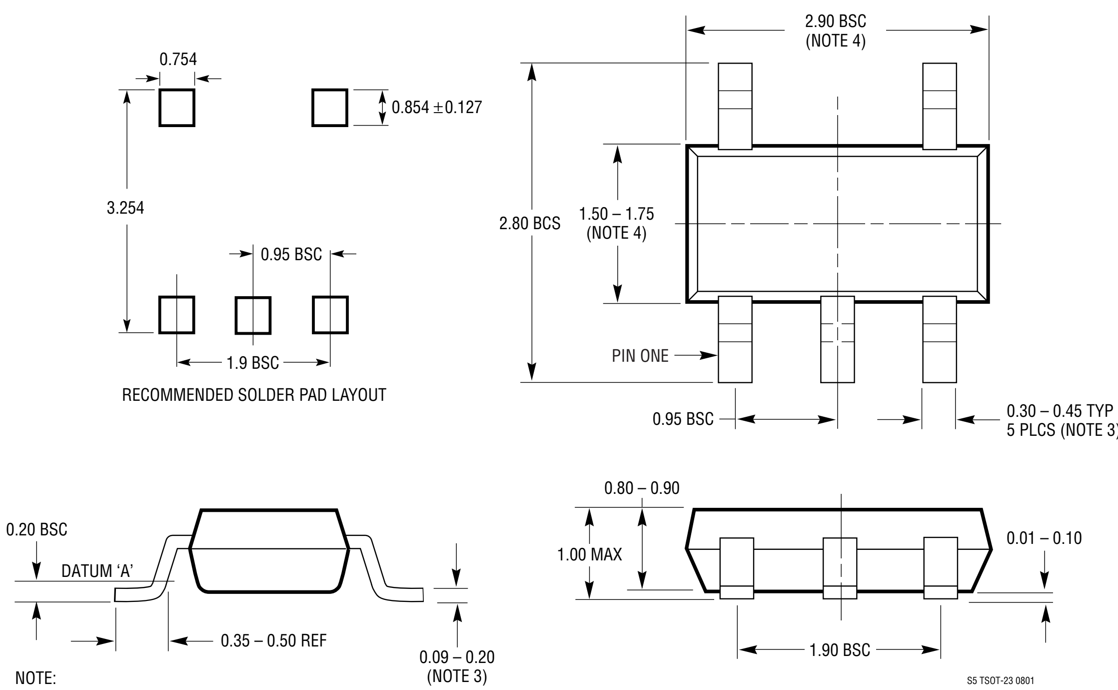
TYPICAL APPLICATION

Dual Band Mobile Phone Tx Power Control with Directional Coupler



PACKAGE DESCRIPTION

S5 Package
5-Lead Plastic TSOT-23
(Reference LTC DWG # 05-08-1635)



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

RELATED PARTS

PART NUMBER	DESCRIPTION	COMMENTS
LT1618	Constant Current/Constant Voltage, 1.4MHz, High Efficiency Boost Regulator	Up to 16 White LEDs, V_{IN} = 1.6V to 18V, V_{OUT} Max = 34V, I_Q = 1.8mA, I_{SD} = <1µA, MS10
LTC1733	Standalone Li-Ion Linear Battery Charger	Monolithic Charger, Thermal Rejection Prevents Overheating, Small Design, Up to 1.5A Charge Current
LTC1734/ LTC1734L	Li-Ion Linear Battery Charger in ThinSOT	50mA to 700mA Charge Current, Only Three Components for Complete Solution
LTC1878	600mA I_{OUT}, 550kHz, Synchronous Step-Down DC/DC Converter	95% Efficiency, V_{IN} = 2.7V to 6V, V_{OUT} Min = 0.8V, I_Q = 10µA, I_{SD} = <1µA, MS8
LT1932	Constant Current, 1.2MHz, High Efficiency White LED Boost Regulator	Up to 8 White LEDs, V_{IN} = 1V to 10V, V_{OUT} Max = 34V, I_Q = 1.2mA, I_{SD} = <1µA, ThinSOT
LT1937	Constant Current, 1.2MHz, High Efficiency White LED Boost Regulator	Up to 4 White LEDs, V_{IN} = 2.5V to 10V, V_{OUT} Max = 34V, I_Q = 1.9mA, I_{SD} = <1µA, ThinSOT, SC70
LTC3200	Low Noise, 2MHz, Regulated Charge Pump White LED Driver	Up to 6 White LEDs, V_{IN} = 2.7V to 4.5V, I_Q = 8mA, I_{SD} = <1µA, MS10
LTC3200-5	Low Noise, 2MHz, Regulated Charge Pump White LED Driver	Up to 6 White LEDs, V_{IN} = 2.7V to 4.5V, I_Q = 6.5mA, I_{SD} = <1µA, ThinSOT
LTC3201	Low Noise, 1.7MHz, Regulated Charge Pump White LED Driver	Up to 6 White LEDs, V_{IN} = 2.7V to 4.5V, I_Q = 6.5mA, I_{SD} = <1µA, MS10
LTC3202	Low Noise, 1.5MHz, Regulated Charge Pump White LED Driver	Up to 8 White LEDs, V_{IN} = 2.7V to 4.5V, I_Q = 5mA, I_{SD} = <1µA, MS10
LTC3404	600mA I_{OUT}, 1.4MHz, Synchronous Step-Down DC/DC Converter	95% Efficiency, V_{IN} = 2.7V to 6V, V_{OUT} Min = 0.8V, I_Q = 10µA, I_{SD} = <1µA, MS8
LTC3405/ LTC3405A	300mA I_{OUT}, 1.5MHz, Synchronous Step-Down DC/DC Converter	95% Efficiency, V_{IN} = 2.7V to 6V, V_{OUT} Min = 0.8V, I_Q = 20µA, I_{SD} = <1µA, ThinSOT
LTC3406/ LTC3406B	600mA I_{OUT}, 1.5MHz, Synchronous Step-Down DC/DC Converter	95% Efficiency, V_{IN} = 2.5V to 5.5V, V_{OUT} Min = 0.6V, I_Q = 20µA, I_{SD} = <1µA, ThinSOT
LTC3412	2.5A I_{OUT}, 4MHz, Synchronous Step-Down DC/DC Converter	95% Efficiency, V_{IN} = 2.5V to 5.5V, V_{OUT} Min = 0.8V, I_Q = 60µA, I_{SD} = <1µA, TSSOP-16E
LTC3411	1.25A I_{OUT}, 4MHz, Synchronous Step-Down DC/DC Converter	95% Efficiency, V_{IN} = 2.5V to 5.5V, V_{OUT} Min = 0.8V, I_Q = 60µA, I_{SD} = <1µA, MS10
LTC3440	600mA I_{OUT}, 2MHz, Synchronous Buck-Boost DC/DC Converter	95% Efficiency, V_{IN} = 2.5V to 5.5V, V_{OUT} Min = 2.5V, I_Q = 25µA, I_{SD} = <1µA, MS10
LTC4052	Li-Ion Battery Pulse Charger	Minimum Heat Dissipation, Current Limit for Safety, Standalone Charger, Monolithic
LTC4053	USB Compatible Li-Ion Charger	Standalone, Monolithic, 100mA/500mA or Up to 2A from Wall Adapter
LTC4412	Low Loss PowerPath™ Controller	Replaces Power Supply ORing Diodes, High Efficiency

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