

LTC5597  
100MHz to 70GHz RMS Power Detector

**DESCRIPTION**

Demonstration circuit 2932A hosts a high accuracy RMS power detector featuring the LTC5597 IC. This ultrawide bandwidth device has a RMS response that measures RF and microwave signals from 100MHz to 70GHz. The input signal converts to a DC voltage that is logarithmically proportional to the input signal level. Moreover, the LTC5597 offers unprecedented sensitivity, capable of detecting signals of  $-37\text{dBm}$  typical. Additionally, it has outstanding input dynamic range up to 35dB, achieving 1dB accuracy, depending on frequency. The detector output voltage slope is normally 29mV/dB. The PCB layout employs the recommended microstrip transmission line structure, as well as the recommended endpoint transitions. Input impedance to LTC5597 is internally matched to  $50\Omega$ . It is suitable for RMS measurements of high crest factor waveforms up to 12dB peak/average ratio. No external coupling capacitor is necessary if DC voltage at  $\text{RF}_{\text{IN}}$  pin is kept below 1V. Contact applications support for more information.

[Design files for this circuit board are available.](#)

**ABSOLUTE MAXIMUM RATINGS**

(Note 1)

Supply Voltage ( $V_{\text{CC}}$ ):	.....	3.8V
DC Voltage at $\text{RF}_{\text{IN}}$ :	.....	$-0.3\text{V}$ to 1V
DC Voltage at FLTR:	.....	$-0.3\text{V}$ to 0.4V
DC Voltage at EN:	.....	$-0.3\text{V}$ to 3.8V
$\text{RF}_{\text{IN}}$ Input Power-Average:	.....	15dBm
$T_{\text{JMAX}}$ :	.....	150°C
Case Operating Temperature Range:	.....	$-40^{\circ}\text{C}$ to $105^{\circ}\text{C}$
Storage Temperature Range	.....	$-65^{\circ}\text{C}$ to $150^{\circ}\text{C}$

Note 1: Voltage on all pins must not exceed  $V_{\text{CC}} + 0.3\text{V}$  or be less than  $-0.3\text{V}$ .

**CAUTION: THIS PART IS SENSITIVE TO ELECTRO-STATIC DISCHARGE (ESD). OBSERVE PROPER ESD PRECAUTIONS WHEN HANDLING THE LTC5597.**

All registered trademarks and trademarks are the property of their respective owners.

**TEST SETUP**

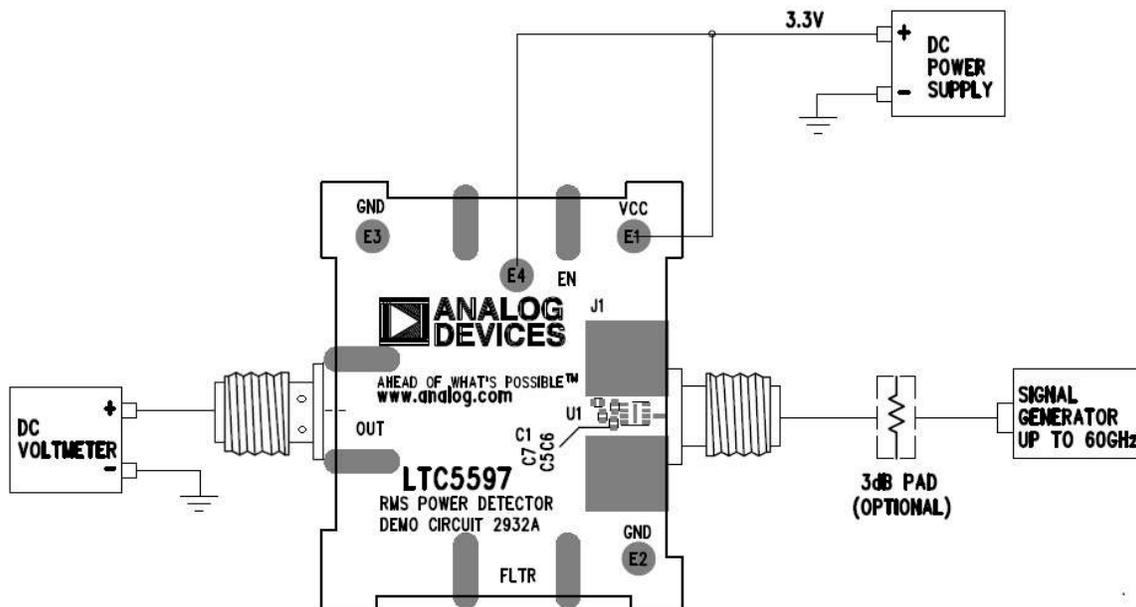


Figure 1. Test Setup for RF Performance Measurements

## NOTES ON TEST EQUIPMENT AND SETUP

- Use a high performance signal generator with accurate output power levels up to 70GHz, such as Agilent E8257D.
- Demo board 2932A includes the 1.85mm connector for best performance up to 70GHz.
- Connecting cable for RF signal should be rated up to 70GHz for the best performance.
- Optional input attenuation can be used to improve return loss, but also shifts the log intercept point accordingly.
- Use high quality power supply with low noise, able to support 3.3V with 40mA of current

---

## QUICK START PROCEDURE

1. Remove the DC2932A from its protective packaging in an ESD-safe working area (see Figure 1).
2. With power supply turned off, connect the  $V_{CC}$  and EN turrets to the supply positive output. Connect GND to the negative supply output. Keep the leads as short as possible to avoid voltage overshoot.
3. Slowly ramp up  $V_{CC}$  together with EN supply to 3.3V. Recommended ramp time is 1ms minimum. Do not float EN.
4. Connect the signal generator to the RF input at the 1.85mm connector.
5. Set the frequency and power level (less than +10dBm) of the signal generator.
6. Measure the output voltage with a DMM.
7. Sweep the power level to generate the transfer curve  $V_{OUT}$  vs Input Power.

## DEMO BOARD USAGE NOTES

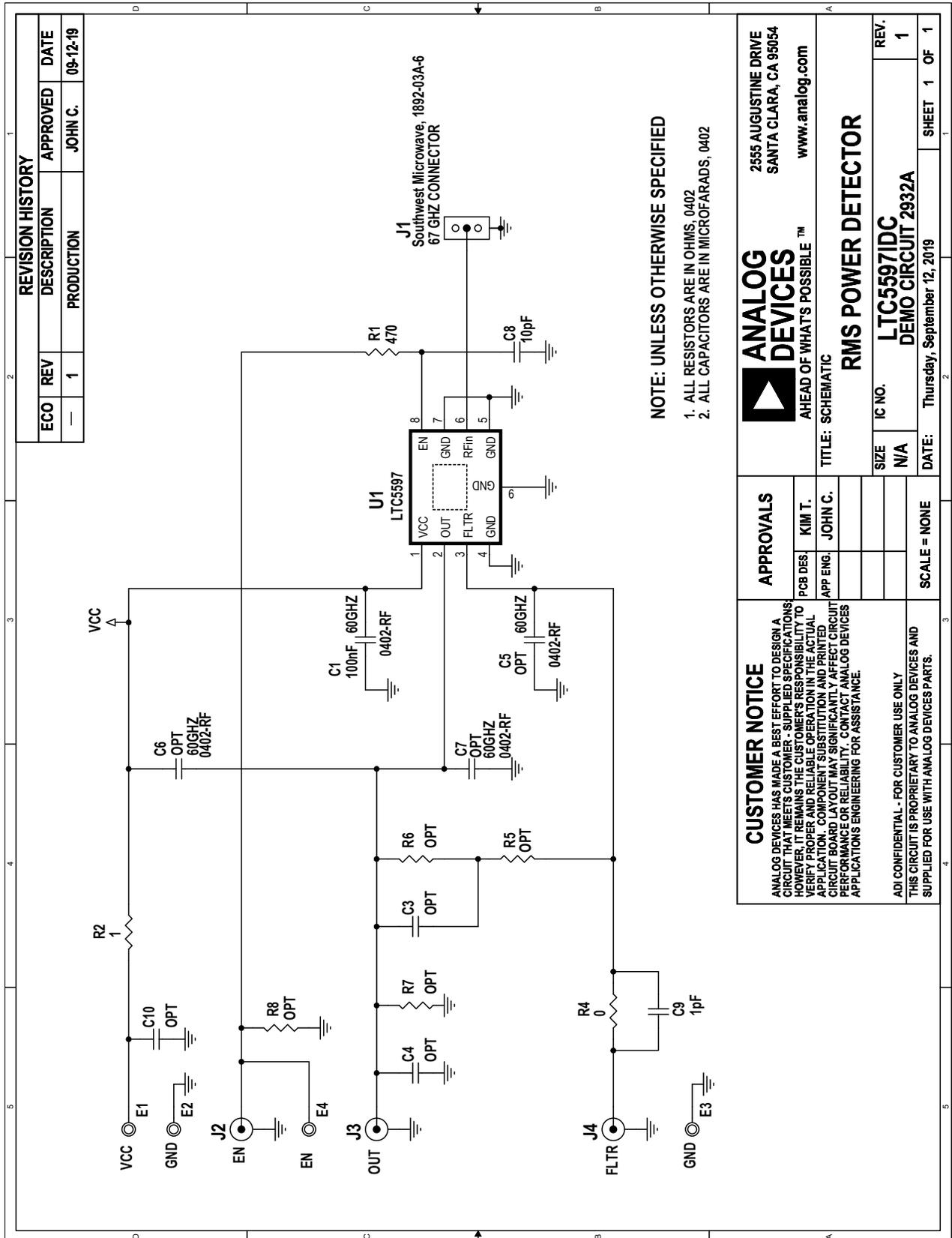
1. Demo board 2932A has provisions for adding an interstage filter cap. The capacitor (C3) can be inserted by shorting R5 and installing C3. Adding a filter has the benefit of reducing the output ripple, and hence, stabilizing the output reading. However, a trade off of adding the filter is that it slows the transient response. C3 can be in the range of 10pF to 1nF.
2. The detector output slope is approximately 29mV/dB.
3. Linear regression is used to generate the slope and intercept point from the best fit straight line.
4.  $\text{Linearity\_Error} = V_{\text{OUT}}/\text{Slope} + \text{Log\_Intercept} - \text{Input\_Power}$ .
5. A minimum two point calibration is necessary for most applications. Additional calibration points will improve the accuracy of the power detection.

# DEMO MANUAL DC2932A

## PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
<b>Required Circuit Components</b>				
1	1	C1	CAP, 100nF, 60GHz, 0402, 11V, UBSC SERIES (SILICON CAPACITORS)	MURATA, 935152424610-T3N
2	7	C3, C4, R5, R6, R7, R8, C10	NC, 0402	
3	3	C5, C6, C7	NC, 0402	
4	1	C8	CAP, NPO, 10pF, 5%, 50V, 0402	MURATA, GRM1555C1H100JA01D
5	1	C9	CAP, NPO, 1pF, $\pm 0.25$ pF, 50V, 0402	MURATA, GRM1555C1H1R0CZ01D
6	4	E1-E4	TURRET, PAD 0.061"	MILL-MAX, 2308-2-00-80-00-00-07-0
8	1	J1	CONN, 1.85mm JACK TO END-LAUNCH, DC - 67GHz	SOUTHWEST MICROWAVE, 1892-03A-6
9	3	J2-J4	CONN, SMA 50 $\Omega$ EDGE-LAUNCH	E. F. JOHNSON, 142-0701-851
10	1	R1	RES, CHIP, 470 $\Omega$ , 1%, 0402	VISHAY, CRCW0402470RFKED
11	1	R2	RES, CHIP, 1 $\Omega$ , 1%, 0402	VISHAY, CRCW04021R00FNED
12	1	R4	RES, CHIP, 0 $\Omega$ , 0402	VISHAY, CRCW04020000Z0ED
13	1	U1	IC, ANALOG DEVICES, LTC5597, DFN 2X2	ANALOG DEVICES., LTC5597

**SCHEMATIC DIAGRAM**



 <b>ANALOG DEVICES</b> AHEAD OF WHAT'S POSSIBLE™ www.analog.com		2555 AUGUSTINE DRIVE SANTA CLARA, CA 95054	
		TITLE: SCHEMATIC <b>RMS POWER DETECTOR</b>	
PCB DES	KIM T.	SIZE	IC NO.
APP ENG.	JOHN C.		LTC5597IDC
			DEMO CIRCUIT 2932A
		DATE:	Thursday, September 12, 2019
		SCALE =	NONE
<b>CUSTOMER NOTICE</b> ANALOG DEVICES HAS MADE A BEST EFFORT TO DESIGN A CIRCUIT THAT MEETS CUSTOMER-SUPPLIED SPECIFICATIONS; HOWEVER, IT REMAINS THE CUSTOMER'S RESPONSIBILITY TO VERIFY PROPER AND RELIABLE OPERATION IN THE ACTUAL APPLICATION. COMPONENT SUBSTITUTION AND PRINTED CIRCUIT BOARD LAYOUT MAY SIGNIFICANTLY AFFECT CIRCUIT PERFORMANCE OR RELIABILITY. CONTACT ANALOG DEVICES APPLICATIONS ENGINEERING FOR ASSISTANCE.		ADI CONFIDENTIAL - FOR CUSTOMER USE ONLY THIS CIRCUIT IS PROPRIETARY TO ANALOG DEVICES AND SUPPLIED FOR USE WITH ANALOG DEVICES PARTS.	
APPROVALS		SHEET 1 OF 1	



## ESD Caution

**ESD (electrostatic discharge) sensitive device.** Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

## Legal Terms and Conditions

By using the evaluation board discussed herein (together with any tools, components documentation or support materials, the "Evaluation Board"), you are agreeing to be bound by the terms and conditions set forth below ("Agreement") unless you have purchased the Evaluation Board, in which case the Analog Devices Standard Terms and Conditions of Sale shall govern. Do not use the Evaluation Board until you have read and agreed to the Agreement. Your use of the Evaluation Board shall signify your acceptance of the Agreement. This Agreement is made by and between you ("Customer") and Analog Devices, Inc. ("ADI"), with its principal place of business at One Technology Way, Norwood, MA 02062, USA. Subject to the terms and conditions of the Agreement, ADI hereby grants to Customer a free, limited, personal, temporary, non-exclusive, non-sublicensable, non-transferable license to use the Evaluation Board FOR EVALUATION PURPOSES ONLY. Customer understands and agrees that the Evaluation Board is provided for the sole and exclusive purpose referenced above, and agrees not to use the Evaluation Board for any other purpose. Furthermore, the license granted is expressly made subject to the following additional limitations: Customer shall not (i) rent, lease, display, sell, transfer, assign, sublicense, or distribute the Evaluation Board; and (ii) permit any Third Party to access the Evaluation Board. As used herein, the term "Third Party" includes any entity other than ADI, Customer, their employees, affiliates and in-house consultants. The Evaluation Board is NOT sold to Customer; all rights not expressly granted herein, including ownership of the Evaluation Board, are reserved by ADI. CONFIDENTIALITY. This Agreement and the Evaluation Board shall all be considered the confidential and proprietary information of ADI. Customer may not disclose or transfer any portion of the Evaluation Board to any other party for any reason. Upon discontinuation of use of the Evaluation Board or termination of this Agreement, Customer agrees to promptly return the Evaluation Board to ADI. ADDITIONAL RESTRICTIONS. Customer may not disassemble, decompile or reverse engineer chips on the Evaluation Board. Customer shall inform ADI of any occurred damages or any modifications or alterations it makes to the Evaluation Board, including but not limited to soldering or any other activity that affects the material content of the Evaluation Board. Modifications to the Evaluation Board must comply with applicable law, including but not limited to the RoHS Directive. TERMINATION. ADI may terminate this Agreement at any time upon giving written notice to Customer. Customer agrees to return to ADI the Evaluation Board at that time. LIMITATION OF LIABILITY. THE EVALUATION BOARD PROVIDED HEREUNDER IS PROVIDED "AS IS" AND ADI MAKES NO WARRANTIES OR REPRESENTATIONS OF ANY KIND WITH RESPECT TO IT. ADI SPECIFICALLY DISCLAIMS ANY REPRESENTATIONS, ENDORSEMENTS, GUARANTEES, OR WARRANTIES, EXPRESS OR IMPLIED, RELATED TO THE EVALUATION BOARD INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY, TITLE, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. IN NO EVENT WILL ADI AND ITS LICENSORS BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES RESULTING FROM CUSTOMER'S POSSESSION OR USE OF THE EVALUATION BOARD, INCLUDING BUT NOT LIMITED TO LOST PROFITS, DELAY COSTS, LABOR COSTS OR LOSS OF GOODWILL. ADI'S TOTAL LIABILITY FROM ANY AND ALL CAUSES SHALL BE LIMITED TO THE AMOUNT OF ONE HUNDRED US DOLLARS (\$100.00). EXPORT. Customer agrees that it will not directly or indirectly export the Evaluation Board to another country, and that it will comply with all applicable United States federal laws and regulations relating to exports. GOVERNING LAW. This Agreement shall be governed by and construed in accordance with the substantive laws of the Commonwealth of Massachusetts (excluding conflict of law rules). Any legal action regarding this Agreement will be heard in the state or federal courts having jurisdiction in Suffolk County, Massachusetts, and Customer hereby submits to the personal jurisdiction and venue of such courts. The United Nations Convention on Contracts for the International Sale of Goods shall not apply to this Agreement and is expressly disclaimed.