100MHz to 40GHz Linear-in-dB RMS Power Detector Die

RH5596S

1.0 SCOPE

This specification documents the detail requirements for space qualified die per MIL-PRF-38534 class K except as modified herein.

The manufacturing flow described in the SPACE DIE BROCHURE is to be considered a part of this specification.

This datasheet specifically details the space grade version of this product. A more detailed operational description and a complete datasheet for commercial product grades can be found at www.analog.com/LTC5596.

2.0 Part Number. The complete part number(s) of this specification follow:

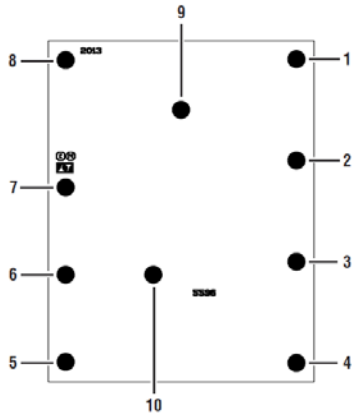
Part Number	Description
RH5596DICE	100MHz to 40GHz Linear-in-dB RMS Power Detector Die

3.0 Die Information

3.1 Die Specifics

Die Size	Die Thickness	Backside Potential	Backside Material/Finish	Bond Pad
47 mil x 59 mil (1193.8µm × 1498.6µm)	8 mils ± 0.6 mil (203.4µm, ±15µm)	Ground	Silicon with Backgrind	AlCu

3.2 Die Picture and Terminal Position

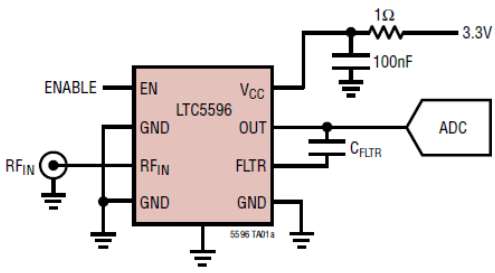


PAD FUNCTION

1. V_{CC}
2. OUT
3. FLTR
4. GND
5. GND
6. RF_{IN}
7. GND
8. EN
9. GND
10. GND

TYPICAL APPLICATION

100MHz to 40GHz RMS Power Detector



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3.3 Absolute Maximum Ratings 1/

Supply Voltage (VCC) 3.8V
RFIN Input Signal Power – Average 15dBm
RFIN Input Signal Power – Peak 20dBm 2/
DC Voltage at RFIN ..... –0.3V to 1V
DC Voltage at FLTR ..... –0.3V to 0.4V
DC Voltage at EN ..... –0.3V to 3.8V
Junction temperature maximum (T_J) ..... +150°C
Storage temperature range ..... -65°C to +150°C
Ambient operating temperature range (T_A)..... -40°C to +125°C

Absolute Maximum Ratings Notes:
1/ Stresses above the absolute maximum rating may cause permanent damage to the device. Extended operation at the maximum levels may degrade performance and affect reliability.
2/ The voltage on all pins should not exceed 3.8V, VCC + 0.3V or be less than –0.3V, otherwise damage to the ESD diodes may occur.

3.4 Radiation Features

Maximum total dose available (dose rate = 50 – 300 rads(Si)/s)….100 k rads(Si) 1/
No Single Event Latchup (SEL) occurs at Effective linear energy transfer (LET): ≤ 80 MeV-cm2/mg 2/

Radiation Features Notes:
1/ Guaranteed by device and process characterization. Contact ADI for data available up to 200Krads.
2/ Limits are characterized at initial qualification and after any design or process changes that may affect the SEL characteristics, but are not production lot tested unless specified by the customer through the purchase order or contract. For more information on single event effect (SEE) test results, contact ADI for further data beyond published report on the ADI website.

4.0 Die Qualification

In accordance with class-K version of MIL-PRF-38534, Appendix C, Table C-II, except as modified herein.

(a) Pre-screen test post assembly required prior to die qualification, to remove all assembly related rejects.
(b) Mechanical Shock or Constant Acceleration not performed; die qualification is performed in an open carrier.
(c) Interim and post burn-in electrical tests will include static tests screened at +25°C only.

TABLE I – PROBE TEST ELECTRICAL PERFORMANCE CHARACTERISTICS

Parameter	Symbol	**Conditions: T_A = 25°C. V_{CC} = EN = 3.3V. 1/ Unless otherwise specified**	Limit Min	Limit Max	Units
Output DC voltage	V_{OUT}	No RFin signal present, EN = 1.1V		5	mV
EN Input High Voltage (On)	EN_{ON}		1.1		V
EN Input Low Voltage (Off)	EN_{OFF}			0.6	V
EN Pin Input Current	I_{EN}			500	nA
Supply Voltage	V_{CC}		2.7	3.3	V
Active Supply Current	ICC	No RFin signal present, EN = 3.3V	25	35	mA
Shutdown Supply Current	ISD	EN = 0V		500	nA

1/ AC performance not production probe tested.

TABLE II – ELECTRICAL PERFORMANCE CHARACTERISTICS FOR QUALIFICATION SAMPLES

Parameter See notes at end of table	Symbol	Conditions 1/ Unless otherwise specified		Sub-Group	Limit Min	Limit Max	Units
OUT INTERFACE (OUT pin)							
Output DC voltage Min	V_{outMin}	RFin = off (No RF signal) EN = 1.1 V		1		5	mV
				2,3		7	
			R	1		5	
Output DC voltage Max	V_{outMax}	RFin = 10 dBm EN = 1.1 V		1	1.10	1.20	V
				2,3		1.22	
			R	1		1.22	
POWER SUPPLY (VCC pin)							
Active Supply current	I_{CC}	RFin = off (No RF signal) EN = 3.3 V		1	25	31	mA
				2,3	23	33	
			R	1	25	31	
ENABLE INPUT INTERFACE (EN pin)							
EN Input High Voltage (On)	EN_{ON}	Verify DC out		1,2,3	1.08		V
			R	1	1.08		
EN Input Low Voltage (Off)	EN_{OFF}	Verify no DC out		1,2,3		0.6	V
			R	1		0.6	
RF INPUT INTERFACE (RFin pin)							
Operating frequency	Fmax	2/		4,5,6	0.1	40	GHz
Frequency = 2140MHz Continuous Wave (CW) input							
Linear Dynamic Input Range for which the LOG-Linearity Error is within ±1dB	RFIN LIN	3/		4,5,6	27	32	dB
			R	4	27	32	
slope	slope	3/		4	26	34	mV/dB
				5,6	8	48	
			R	4	26	34	
intercept	intercept	3/		4	-41	-38	dBm
				5,6	-47	-33	
			R	4	-41	-37	
Frequency = 18 GHz Continuous Wave (CW) input							
Linear Dynamic Input Range for which the LOG-Linearity Error is within ±1dB	RFIN LIN	3/		4,5,6	27	32	dB
			R	4	27	32	
slope	slope	3/		4,5,6	15	45	mV/dB
			R	4	15	45	
intercept	intercept	3/		4,5,6	-45	-35	dBm
			R	4	-45	-35	

TABLE II – ELECTRICAL PERFORMANCE CHARACTERISTICS FOR QUALIFICATION SAMPLES - Continued

Parameter See notes at end of table	Symbol	Conditions 1/ Unless otherwise specified		Sub-Group	Limit Min	Limit Max	Units
Frequency = 40GHz Continuous Wave (CW) input							
Linear Dynamic Input Range for which the LOG-Linearity Error is within ±1dB	RFIN LIN	3/		4,5,6	21	26	dB
			R	4	21	26	
slope	slope	3/		4,5,6	24	34	mV/dB
			R	4	24	34	
intercept	intercept	3/		4,5,6	-38	-32	dBm
			R	4	-38	-32	

Table II Notes:

1/ VCC = EN = 3.3V. CW, 50Ω source at RFIN, f_{RF} = 2140MHz, T_A nom = 25ºC, T_A max = 85ºC, and T_A min = -40ºC, unless otherwise noted. Refer to section 3.4 for radiation features.

2/ Parameter is part of device initial characterization which is only repeated after major design and process changes or with subsequent wafer lots. Parameter is not production tested for Min Frequency.

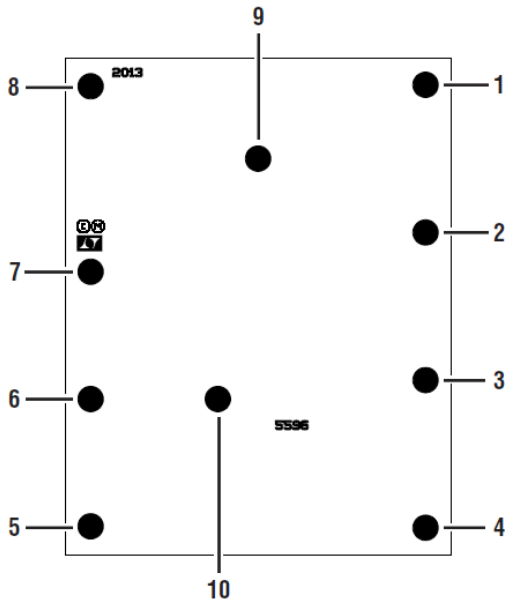
3/ LOG-Linearity Error is the input-referred power measurement error relative to the best fit straight line (VOUT vs pin in dBm) obtained by linear regression at T_A = 25°C. The input power range used for the linear regression is from –37dBm to –5dBm for 100MHz through 35GHz, from -32dBm to –5dBm for 40GHz. Refer to the applications notes in the LTC5596 commercial datasheet.

TABLE III – LIFE TEST/BURN-IN DELTA LIMITS

Parameter	Symbol	Delta	Units
Active Supply current	I_{CC}	±550	uA
Output DC voltage Max	V_{outMax}	±0.02	V

Table III Notes: Refer to Table II for conditions. T_A nom = 25ºC only.

5.0 Die Outline and Pad Functions



Bonding Recommendations
Bond Force: 20g
Ultrasonic Power: 85mW
Duration: 15ms
Bonding Temperature: 200°C

PAD NUMBER	PAD NAME	X-Coordinate (µm)	Y-Coordinate (µm)	X-Coordinate (Mil)	Y-Coordinate (Mil)
1	V_{CC}	460.79	609.00	18.14	23.98
2	OUT	460.79	203.00	18.14	7.99
3	FLTR	460.79	–203.00	18.14	–7.99
4	GND	460.79	–609.00	18.14	–23.98
5	GND	–460.79	–605.00	–18.14	–23.82
6	RF_{IN}	–460.79	–255.00	–18.14	–10.04
7	GND	–460.79	95	–18.14	3.74
8	EN	–460.79	605.00	–18.14	23.82
9	GND	0.00	406.00	0.00	15.98
10	GND	–110.79	–255.00	–4.36	–10.04

Pad opening: 2.756mils (70µm)

PAD FUNCTIONS

V_{CC} (Pad 1): Power Supply Pad. Typical current consumption is 30mA at room temperature. This pad should be externally bypassed with a 100nF capacitor.

OUT(Pad 2): Detector Output. The DC voltage at this pad varies linearly with the RF input power level in dBm. This output is able to drive a 50Ω load. To avoid permanent damage, do not short to V_{CC} or GND. In shutdown mode (EN = Low), this interface become high impedance, to avoid discharge of capacitors in an external ripple filter.

FLTR (Pad 3): An optional capacitor connected between FLTR and OUT (Pad 2) reduces the detector ripple averaging bandwidth. This will also increase the rise and fall times of the detector. To avoid permanent damage to the circuit, the DC voltage at this pad should not exceed 0.4V.

GND (Pads 4, 5, 7, 10): Circuit Ground. All ground pins are internally connected together. Pads 5 and 7 should be used as RF return ground and connected to the transmission line interfacing to RF_{IN} (Pad 6).

RF_{IN} (Pad 6): RF Input. This pad is internally DC-coupled to GND through a 50Ω termination resistor. To avoid damage to the internal circuit, the DC voltage applied to this pad should not exceed 1V. The ground-signal-ground arrangement of Pads 5 through 7 support termination of Pad 6 by a high frequency transmission line, such as a grounded co-planar waveguide (GCPW). No external decoupling capacitor is necessary as long as the DC voltage on Pad 6 is kept below 1V.

EN (Pad 8): Chip Enable. A voltage above 1.1V applied to this pad will bring the device into normal operating mode. A voltage below 0.6V will bring the device into a low power shutdown mode. Do not float this pad.

6.0 Die Packaging Information

Standard	Alternate
Gel Pack (with VR 76 mesh size)	(1)

Note:

1. For alternate packaging information, contact Analog Devices Inc.

Rev	Description of Change	Date
A	Initial Release	19-SEP-2019
B	Correct Post radiation limit VoutMax from 1.2 to 1.22 and 2140MHz Intercept from -38 to -37.	17-DEC-2019