ANALOG DEVICES

0.5GHz to 43.5GHz Envelope Detector

ADL6010S

1.0 Scope

This specification documents the detail requirements for space qualified product manufacturing on Analog Devices, Inc.'s QML certified line per MIL-PRF-38535 Level V except as modified herein.

The manufacturing flow described in the STANDARD SPACE LEVEL PRODUCTS PROGRAM brochure is to be considered a part of this specification. http:www.analog.com/aeroinfo

This data specifically details the space grade version of this product. A more detailed operational description and a complete data sheet for commercial product grades can be found at http:www.analog.com/ADL6010

2.0 Part Number

Specific Part Number	Description
ADL6010R703LSH6	0.5 GHZ to 43.5 GHz envelope detector

3.0 Case Outline

Outline Letter	Descriptive Designator	Terminals	Lead Finish	Package style
X	See figure 2	16 lead	Gold	Square Leadless RF Via Chip Carrier

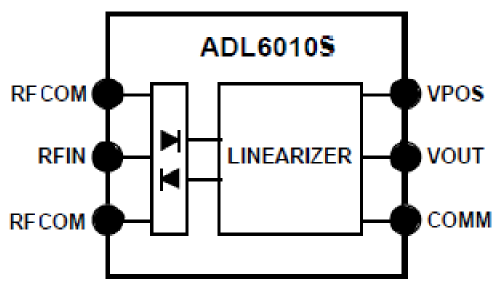

FIGURE 1. Functional Block Diagram

ASD0016564 Rev. B

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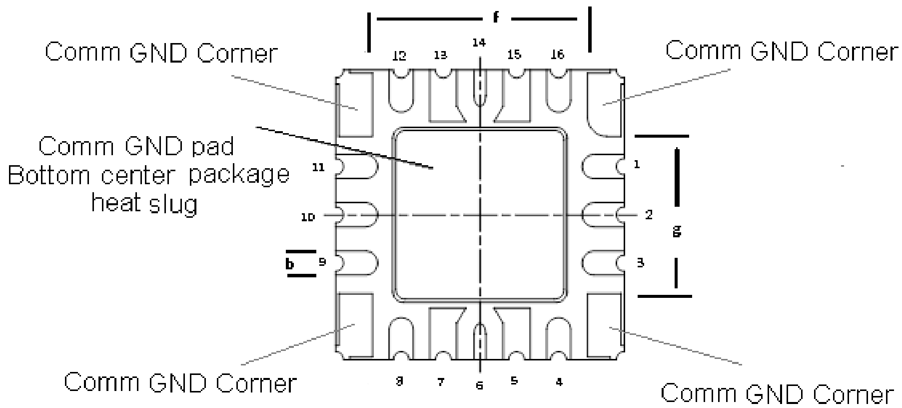


Bottom View

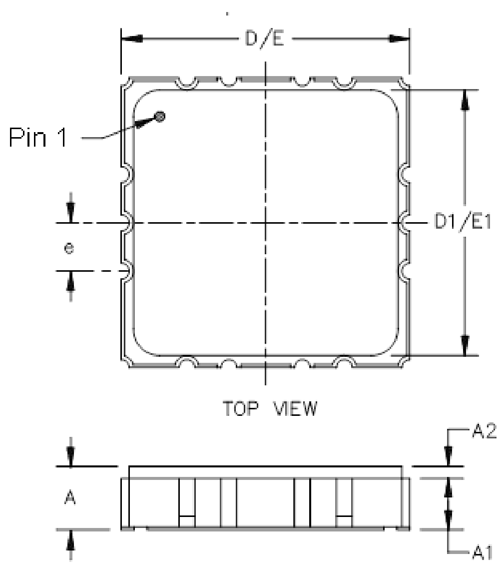


FIGURE 2A. Case outline

Symbol	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
A	0.047	0.063	1.194	1.600
A1	0.039	0.055	0.991	1.397
A2	0.008	0.012	0.203	0.305
b	0.018	0.022	0.457	0.560
D/E	0.230	0.242	5.842	6.147
e	0.033	0.045	0.838	1.143
f	0.177	0.189	4.50	4.80
g	0.129	0.141	3.277	3.581

FIGURE 2B. Case outline - Dimensions

NOTES:

1. Controlling dimensions are inch, millimeter dimensions are given for reference only.

Package: X			
Pin Number	Terminal Symbol	Pin Type	Pin Description
	Comm	Power	Common ground pad, Corner
1	Comm	Power	Comm for Vout 1/
2	NC		No Connection 2/
3	NC		No Connection 2/
	Comm	Power	Common ground pad, Corner
4	NC		No Connection 2/
5	Comm	Power	Comm for RF input
6	NC		No Connection 2/
7	Comm	Power	Comm for RF input
8	NC		No Connection 2/
	Comm	Power	Common ground pad, Corner
9	NC		No Connection 2/
10	Vout	Output	Low Frequency Output
11	Vpos	Power	Supply Voltage
	Comm	Power	Common ground pad, Corner
12	NC		No Connection 2/
13	RFcom	Power	Comm for RF input
14	RFin	Input	RF input
15	RFcom	Power	Comm for RF input
16	NC		No Connection 2/
	Comm	Power	Common ground pad, Bottom Center package heat slug

Figure 3 – Terminal Connections

1/ This COMM is the ground for VOUT circuits (dc). All other commons are RF input (ac).

2/ Pin 6 RF port is unused. No internal connection on these pins so they may be connected to COMM

4.0 Specifications

4.1. Absolute Maximum Ratings 1/

Supply voltage (VPOS) .... -0.5V to 5.5V
Input radio frequency (RF) power .... 20 dBm 2/
Equivalent voltage, sine wave input .... 3.16 V
Internal power dissipation (PD) .... 20 mW
Junction temperature maximum (T_J) .... +150°C
Storage temperature range .... -65°C to +150°C
Lead temperature (soldering, 10 seconds) .... +300°C
Thermal resistance, junction-to-case (θ_{JC}) .... 10 °C/W 3/
Thermal resistance, junction-to-ambient (θ_{JA}) .... 20 °C/W 3/
Thermal resistance, termination resistance-to- junction (θ_{termJ}) .... 1850 °C/W 4/

4.2. Recommended Operating Conditions

Supply voltage (VPOS) .... +5.0 V
Ambient operating temperature range (T_A)…………………………. -55°C to +125°C

4.3. Nominal Operating Performance Characteristic s

(VPOS = 5.0V, TA nom = ambient, RFin = 50 Ω source impedance, unless otherwise noted)

DC output resistance (Rout) .... < 5.0 Ω
Input Impedance .... 50 Ω
Maximum output voltage (max Vout) .... +5.0 V
Available output sourcing current (max pos Iout) .... 5.0 mA
Available output sinking current (max neg Iout) .... 0.3 mA
Rise time (tRise) .... 4 nS
RFin = off to 0dBm; Vout = 10% to 90%;
Cload = 10pF, Rseries = 100 Ω
Fall time (tFall) .... 30 nS
RFin = 0dBm to off; Vout = 90% to 10%;
Cload = 10pF, Rseries = 100 Ω
Envelope bandwidth (BW)... 40 MHz
3 dB bandwidth

Maximum input level, ±1 dB error (max Pin)
Continuous Wave (CW) input, +25°C; Three point calibration at:
For 500MHz: -26 dBm, -14 dBm, and +5 dBm RFin …………………. 16 dBm
For 1GHz: -25 dBm, -10 dBm, and +8 dBm RFin ……………………. 15 dBm
For 5GHz: -25 dBm, -10 dBm, and +8 dBm RFin ……………………. 16 dBm
For 10GHz: -28 dBm, -10 dBm, and +10 dBm RFin ……..…….……. 16 dBm
For 15GHz: -28 dBm, -10 dBm, and +10 dBm RFin …………….…… 16 dBm
For 20GHz: -28 dBm, -10 dBm, and +8 dBm RFin ………………..…. 15 dBm
For 25GHz: -28 dBm, 0 dBm, and +10 dBm RFin …………………… 15 dBm
For 30GHz: -26 dBm, -14 dBm, and +5 dBm RFin ………………….. 16 dBm
For 35GHz: -25 dBm, 0 dBm, and +10 dBm RFin …………………… 15 dBm
For 40GHz: -20 dBm, 0 dBm, and +10 dBm RFin …………………… 17 dBm
For 43.5GHz: -20 dBm, 0 dBm, and +10 dBm RFin ……………….…. 17 dBm

Nominal Operating Performance Characteristics - Continued

Minimum input level, ±1 dB error (min Pin)

Continuous Wave (CW) input, +25°C; Three point calibration at:

For 500MHz: -26 dBm, -14 dBm, and +5 dBm RFin ………………..... ……… -28 dBm
For 1GHz: -25 dBm, -10 dBm, and +8 dBm RFin …………………………… -30 dBm
For 5GHz: -25 dBm, -10 dBm, and +8 dBm RFin …………………………… -30 dBm
For 10GHz: -28 dBm, -10 dBm, and +10 dBm RFin ……………………….. -30 dBm
For 15GHz: -28 dBm, -10 dBm, and +10 dBm RFin ……………………….. -30 dBm
For 20GHz: -28 dBm, -10 dBm, and +8 dBm RFin ……………................ -30 dBm
For 25GHz: -28 dBm, 0 dBm, and +10 dBm RFin …………………………. -30 dBm
For 30GHz: -26 dBm, -14 dBm, and +5 dBm RFin ……………................ -29 dBm
For 35GHz: -25 dBm, 0 dBm, and +10 dBm RFin …………………………. -29 dBm
For 40GHz: -20 dBm, 0 dBm, and +10 dBm RFin …………………………. -25 dBm
For 43.5GHz: -20 dBm, 0 dBm, and +10 dBm RFin ………………………. -24 dBm

Detection range, ±1 dB error (Range)

Continuous Wave (CW) input, +25°C; Three point calibration at:

For 500MHz: -26 dBm, -14 dBm, and +5 dBm RFin …………….…………. 44 dB
For 1GHz: -25 dBm, -10 dBm, and +8 dBm RFin ………………..………… 45 dB
For 5GHz: -25 dBm, -10 dBm, and +8 dBm RFin …………………..……… 46 dB
For 10GHz: -28 dBm, -10 dBm, and +10 dBm RFin …………….………… 46dB
For 15GHz: -28 dBm, -10 dBm, and +10 dBm RFin ……………….……… 46 dB
For 20GHz: -28 dBm, -10 dBm, and +8 dBm RFin ……………...………… 46 dB
For 25GHz: -28 dBm, 0 dBm, and +10 dBm RFin ………………………… 45 dB
For 30GHz: -26 dBm, -14 dBm, and +5 dBm RFin ……………..……. …. 45 dB
For 35GHz: -25 dBm, 0 dBm, and +10 dBm RFin ………………………… 44 dB
For 40GHz: -20 dBm, 0 dBm, and +10 dBm RFin ………………………… 42 dB
For 43.5GHz: -20 dBm, 0 dBm, and +10 dBm RFin ………….………... 41 dB

4.4. Radiation Features

Maximum total dose available (dose rate = 50 – 300 rads(Si)/s)….100 k rads(Si) 5/
No Single Event latchup (SEL) occurs at Effective linear energy transfer (LET): ≤ 80 MeV-cm^2/mg 6/

1/ Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions outside of those indicated in the operation sections of this specification is not implied. Exposure to absolute maximum ratings for extended periods may affect device reliability.
2/ Driven from a 50 Ω source
3/ Measurement taken under absolute worst case condition and represents data taken with thermal camera for highest power density location.
4/ RF signal power is terminated to and dissipated by two resistor on the die. Calculate junction temperature using Vpos power and θJA, then Calculate termination resistor temperature using RF power and θtermJ. The temperature of these termination resistors on the die must not exceed junction temperature maximum: Applied input power must be derated to keep termination resistor temperature below maximum.
5/ These parts may be dose rate sensitive in a space environment and may demonstrate enhanced low dose rate effects Radiation end point limits for the noted parameters are guaranteed only for the conditions specified in MIL-STD-883, method 1019, condition A
6/ Limits are characterized at initial qualification and after any design or process changes that may affect the SEP 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, customers are requested to contact the manufacturer.

TABLE I – ELECTRICAL PERFORMANCE CHARACTERISTICS

Parameter See notes at end of table	Symbol	Conditions 1/ Unless otherwise specified		Sub-Group	Limit Min	Limit Max	Units
OUTPUT INTERFACE (Vout pin)							
Output offset voltage	V_{noRF}	RFin = off		1	-50	50	mV
				2,3	-80	80	
			M,D,P,L,R	1	-50	50	
Maximum output voltage	V_{outMax}	2/ RFin = 19 dBm		4,5,6	4.0		V
POWER SUPPLY (VPOS pin)							
Supply current	I_{pos}	RFin = +10dBm, 1GHz		1,2,3		3.0	mA
			M,D,P,L,R	1		3.0	
RF INPUT INTERFACE (RFin pin)							
Operating frequency	F_{max}	2/		4,5,6	0.5	43.5	GHz
Frequency = 500MHz Continuous Wave (CW) input							
Deviation vs. Temperature (Deviation from output at 25°C) 55°C < TA <+125°C	Dev_T	2/ RFin = +10dBm		4,5,6	-1.0	1.0	dB
		2/ RFin = -10dBm		4,5,6	-1.8	1.2	
Slope	slope	3/ 4/ LSqR of 7 points		4,5,6	2.0	2.5	V/ Vpeak
			M,D,P,L,R	4	2.0	2.5	
Intercept	intercept	3/ 4/ LSqR of 7 points		4,5,6	-0.15	0.15	V
			M,D,P,L,R	4	-0.15	0.15	
Output Voltage	Vout	RFin = +10 dBm		4,5,6	2.0	2.5	V
			M,D,P,L,R	4	2.0	2.5	
		RFin = -10 dBm		4,5,6	0	0.35	
			M,D,P,L,R	4	0	0.35	
Frequency = 1GHz Continuous Wave (CW) input							
Deviation vs. Temperature (Deviation from output at 25°C) 55°C < TA <+125°C	Dev_T	2/ RFin = +10dBm		4,5,6	-1.0	1.0	dB
		2/ RFin = -10dBm		4,5,6	-1.0	1.0	
Slope	slope	3/ 4/ LSqR of 7 points		4,5,6	2.0	2.5	V/ Vpeak
			M,D,P,L,R	4	2.0	2.5	
Intercept	intercept	3/ 4/ LSqR of 7 points		4,5,6	-0.15	0.15	V
			M,D,P,L,R	4	-0.15	0.15	
Output Voltage	Vout	2/ RFin = +10dBm		4,5,6	2.0	2.5	V
			M,D,P,L,R	4	2.0	2.5	
		2/ RFin = -10dBm		4,5,6	0	0.35	
			M,D,P,L,R	4	0	0.35	

See footnotes at end of table.

TABLE I – ELECTRICAL PERFORMANCE CHARACTERISTICS - Continued

Parameter See notes at end of table	Symbol	Conditions 1/ Unless otherwise specified	Sub-Group	Limit Min	Limit Max	Units
Frequency = 5GHz Continuous Wave (CW) input						
Deviation vs. Temperature (Deviation from output at 25°C) 55°C < TA <+125°C	Dev_T	2/ RFin = +10dBm	4,5,6	-1.0	1.0	dB
		2/ RFin = -10dBm	4,5,6	-1.0	1.0	
Slope	slope	3/ 4/ LSqR of 7 points	4,5,6	1.8	2.65	V/ Vpeak
		M,D,P,L,R	4	1.8	2.65	
Intercept	intercept	3/ 4/ LSqR of 7 points	4,5,6	-0.1	0.1	V
		M,D,P,L,R	4	-0.1	0.1	
Output Voltage	Vout	RFin = +10 dBm	4,5,6	1.8	2.7	V
		M,D,P,L,R	2.0	1.8	2.7	
		RFin = -10 dBm	4,5,6	0	0.35	
		M,D,P,L,R	4	0	0.35	
Frequency = 10GHz Continuous Wave (CW) input						
Deviation vs. Temperature (Deviation from output at 25°C) 55°C < TA <+125°C	Dev_T	2/ RFin = +10dBm	4,5,6	-1.0	1.0	dB
		2/ RFin = -10dBm	4,5,6	-1.5	1.0	
Slope	slope	3/ 4/ LSqR of 7 points	4,5,6	1.8	2.5	V/ Vpeak
		M,D,P,L,R	4	1.8	2.5	
Intercept	intercept	3/ 4/ LSqR of 7 points	4,5,6	-0.1	0.1	V
		M,D,P,L,R	4	-0.1	0.1	
Output Voltage	Vout	RFin = +10 dBm	4,5,6	1.8	2.6	V
		M,D,P,L,R	4	1.8	2.6	
		RFin = -10 dBm	4,5,6	0	0.35	
		M,D,P,L,R	4	0	0.35	
Frequency = 15GHz Continuous Wave (CW) input						
Deviation vs. Temperature (Deviation from output at 25°C) 55°C < TA <+125°C	Dev_T	2/ RFin = +10dBm	4,5,6	-1.0	1.0	dB
		2/ RFin = -10dBm	4,5,6	-1.0	1.0	dB
Slope	slope	3/ 4/ LSqR of 7 points	4,5,6	1.8	3	V/ Vpeak
		M,D,P,L,R	4	1.8	3	
Intercept	intercept	3/ 4/ LSqR of 7 points	4,5,6	-0.1	0.1	V
		M,D,P,L,R	4	-0.1	0.1	
Output Voltage	Vout	RFin = +10 dBm	4,5,6	1.8	3	V
		M,D,P,L,R	4	1.8	3	
		RFin = -10 dBm	4,5,6	0	0.35	
		M,D,P,L,R	4	0	0.35	

See footnotes at end of table.

TABLE I – ELECTRICAL PERFORMANCE CHARACTERISTICS - Continued

Parameter See notes at end of table	Symbol	Conditions 1/ Unless otherwise specified		Sub-Group	Limit Min	Limit Max	Units
Frequency = 20GHz Continuous Wave (CW) input							
Deviation vs. Temperature (Deviation from output at 25°C) 55°C < TA <+125°C	Dev_T	2/ RFin = +10dBm		4,5,6	-1.0	1.0	dB
		2/ RFin = -10dBm		4,5,6	-1.0	1.0	
Slope	slope	3/ 4/ LSqR of 7 points		4,5,6	1.7	3	V/ Vpeak
			M,D,P,L,R	4	1.7	3	
Intercept	intercept	3/ 4/ LSqR of 7 points		4,5,6	-0.15	0.15	V
			M,D,P,L,R	4	-0.15	0.15	
Output Voltage	Vout	RFin = +10 dBm		4,5,6	1.7	3	V
			M,D,P,L,R	4	1.7	3	
		RFin = -10 dBm		4,5,6	0	0.35	
			M,D,P,L,R	4	0	0.35	
Frequency = 25GHz Continuous Wave (CW) input							
Deviation vs. Temperature (Deviation from output at 25°C) 55°C < TA <+125°C	Dev_T	2/ RFin = +10dBm		4,5,6	-1.0	1.0	dB
		2/ RFin = -10dBm		4,5,6	-1.5	1.0	dB
Slope	slope	3/ 4/ LSqR of 7 points M,D,P,L,R		4,5,6	1.7	3	V/ Vpeak
Intercept	intercept	3/ 4/ LSqR of 7 points M,D,P,L,R		4,5,6	-0.1	0.1	V
Output Voltage	Vout	RFin = +10 dBm M,D,P,L,R		4,5,6	1.7	3	V
		RFin = -10 dBm M,D,P,L,R		4,5,6	0	0.35	
Frequency = 30GHz Continuous Wave (CW) input							
Deviation vs. Temperature (Deviation from output at 25°C) 55°C < TA <+125°C	Dev_T	2/ RFin = +10dBm		4,5,6	-1.2	1.2	dB
		2/ RFin = -10dBm		4,5,6	-1.6	1.2	
Slope	slope	3/ 4/ LSqR of 7 points		4,5,6	1.7	3	V/ Vpeak
Intercept	intercept	3/ 4/ LSqR of 7 points		4,5,6	-0.1	0.1	V
Output Voltage	Vout	RFin = +10 dBm		4,5,6	1.8	3	V
		RFin = -10 dBm		4,5,6	0	0.35	

See footnotes at end of table.

TABLE I – ELECTRICAL PERFORMANCE CHARACTERISTICS - Continued

Parameter See notes at end of table	Symbol	Conditions 1/ Unless otherwise specified	Sub-Group	Limit Min	Limit Max	Units
Frequency = 35GHz Continuous Wave (CW) input						
Deviation vs. Temperature (Deviation from output at 25°C) 55°C < TA <+125°C	Dev_T	2/ RFin = +10dBm	4,5,6	-1.2	1.2	dB
		2/ RFin = -10dBm	4,5,6	-2.2	1.2	
Slope	slope	2/ 3/ 4/ LSqR of 7 points	4,5,6	1.7	3	V/ Vpeak
Intercept	intercept	2/ 3/ 4/ LSqR of 7 points	4,5,6	-0.1	0.1	V
Output Voltage	Vout	2/ RFin = +10 dB	4,5,6	1.9	3	V
		2/ RFin = -10 dB	4,5,6	0	0.35	
Frequency = 40GHz Continuous Wave (CW) input						
Deviation vs. Temperature (Deviation from output at 25°C) 55°C < TA <+125°C	Dev_T	2/ RFin = +10dBm	4,5,6	-1.2	1.2	dB
		2/ RFin = -10dBm	4,5,6	-2.0	1.2	
Slope	slope	2/ 3/ 4/ LSqR of 7 points	4,5,6	1.6	3	V/ Vpeak
Intercept	intercept	2/ 3/ 4/ LSqR of 7 points	4,5,6	-0.1	0.1	V
Output Voltage	Vout	2/ RFin = +10 dBm	4,5,6	1.6	3	V
		2/ RFin = -10 dBm	4,5,6	0	0.35	
Frequency = 43.5GHz Continuous Wave (CW) input						
Deviation vs. Temperature (Deviation from output at 25°C) 55°C < TA <+125°C	Dev_T	2/ RFin = +10dBm	4,5,6	-1.2	1.2	dB
		2/ RFin = -10dBm	4,5,6	-2.2	1.6	
Slope	Slope	2/ 3/ 4/ LSqR of 7 points	4,5,6	1.5	2.6	V/ Vpeak
Intercept	intercept	2/ 3/ 4/ LSqR of 7 points	4,5,6	-0.1	0.1	V
Output Voltage	Vout	2/ RFin = +10 dBm	4,5,6	1.5	2.6	V
		2/ RFin = -10 dBm	4,5,6	0	0.25	

TABLE I NOTES:

1/ VPOS = 5.0 V, T_A nom = 25ºC, T_A max = 125ºC, and T_A min = -55ºC, RFin = 50 Ω source impedance, unless otherwise noted.

2/ Parameter is part of device initial characterization which is only repeated after design and process changes or with subsequent wafer lots. Parameter is not tested post irradiation

3/ The Intercept specification is defined as the calculated crossing point of the RFin = 0.0Vpk axis of a line defined by the calibration points plotted as Vout (in volts) verses RFin (in volts peak), not the 0 dBm axis crossing. The Slope specification is defined as the calculated slope of a line defined by the calibration points plotted as Vout (in volts) verses RFin (in volts peak). The measured Vout due to RFin = 0.0V peak being applied defined is a specification called Offset.

4/ Slope and intercept calculated using LSqR (Least Squared Regression) of seven test points: Inputs levels are 10dBm, 8dbm, 6.5dBm, 5dBm, 2dBm, -2dBm and -10dBm; which is equivalent to 1.0Vpk, 0.79Vpk, 0.67Vpk, 0.56Vpk, 0.40Vpk, 0.25Vpk and 0.10Vpk.

TABLE IIA – ELECTRICAL TEST REQUIREMENTS:

Table IIA	
Test Requirements	Subgroups (in accordance with MIL-PRF-38535, Table III)
Interim Electrical Parameters	1
Final Electrical Parameters	1, 2, 3, 4, 5, 6 1/ 2/ 3/
Group A Test Requirements	1, 2, 3, 4, 5, 6
Group C end-point electrical parameters	1, 2, 3, 4, 5, 6, 2/
Group D end-point electrical parameters	1, 2, 3, 4, 5, 6
Group E end-point electrical parameters	1, 4 2/ 3/

Table IIA Notes:
1/ PDA applies to Table I subgroup 1 and Table IIB delta parameters.
2/ See Table IIB for delta parameters
3/ Parameters noted in Table I are not tested post irradiation.

TABLE IIB – LIFE TEST/BURN-IN DELTA LIMITS

Table IIB				
Parameter	Symbol	Condition	Delta	Units
Dynamic Supply Current VPOS	I_{POS}	RFin = +10dBm, 1GHz	±300	uA
Output Voltages	Vout	Frequency = 500MHz, RFin = +10dBm	±0.2	V
		Frequency = 500MHz, RFin = -10dBm	±0.08	V

5.0 Burn-In Life Test, and Radiation

5.1. Burn-In Test Circuit, Life Test Circuit

5.1.1. The test conditions and circuit shall be maintained by the manufacturer under document revision level control and shall be made available to the preparing or acquiring activity upon request. The test circuit shall specify the inputs, outputs, biases, and power dissipation, as applicable, in accordance with the intent specified in method 1015 test condition D of MIL –STD-883.

5.1.2. HTRB is not applicable for this drawing.

5.2. Radiation Exposure Circuit

5.2.1. The radiation exposure circuit shall be maintained by the manufacturer under document revision level control and shall be made available to the preparing and acquiring activity upon request. Total dose irradiation testing shall be performed in accordance with MIL-STD-883 method 1019, condition A.

6.0 MIL-PRF-38535 QMLV Exceptions

6.1. Device Assembly

Device assembly occurs at ADI's Chelmsford, MA site. Device contains bi-metallic wire bonds (Gold bond wires on Aluminum die pads).

6.2. X-Ray Inspection

MIL-STD-883 Test Method 2012 X-ray inspection acceptance requirements may include solder fillet as part of design seal width.

6.3. Group D

Group D-5 Salt Atmosphere testing may not be performed.

7.0 Application Notes

Theory of Operation

The ADL6010S uses eight Schottky diodes in a novel two path detector topology. One path responds during the positive half cycles of the input, and the second responds during the negative half cycles of the input, thus achieving full wave rectification. This arrangement presents a constant input impedance throughout the full RF cycle, thereby preventing the reflection of even-order distortion components back toward the source, which is a well-known limitation of the widely used traditional single Schottky diode detectors.

Eight diodes are arranged on the chip in such a way as to minimize the effect of chip stresses and temperature variations. They are biased by small keep alive currents chosen in a trade-off between the inherently low sensitivity of a diode detector and the need to preserve envelope bandwidth. Thus, the corner frequency of the front-end low-pass filtering is a weak function of the input level. At low input levels, the −3 dB corner frequency is at approximately 0.5 GHz. The overall envelope bandwidth is limited mainly by the subsequent linearizing and output circuitry.

At small input levels, all Schottky diode detectors exhibit an extremely weak response which approximates a square law characteristic (having zero slope at the origin). For large inputs, the response approaches a linear transfer function. In the ADL6010S, this nonlinearity and variations in the response are corrected using proprietary circuitry having an equally shaped but inverse amplitude function, resulting in an overall envelope response that is linear across the whole span of input levels.

The composite signal is buffered and presented at the output pin (VOUT). The transfer function relating the instantaneous RF voltage amplitude to the quasi-dc output is a scalar constant of a little over ×2. This scalar constant is mainly determined by ratios of resistors, which are independent of temperature and process variations. Errors associated with the minuscule voltages generated by the Schottky front-end under low level conditions, and other errors in the nonlinear signal processing circuitry, are minimized by laser trimming, permitting accurate measurement of RF input voltages down to the millivolts level. An aspect of the linear in volts response is that the minimum VOUT is limited by the ability of the output stage to reach down to absolute zero (the potential on the COMM pin) when using a single positive supply.

DC voltages at the input are blocked by an on-chip capacitor. The two ground pins (RFCM) on either side of RFIN form part of an RF coplanar waveguide (CPW) launch into the detector. The RFCM pins must be connected to the signal ground. Give careful attention to the design of the PCB in this area.

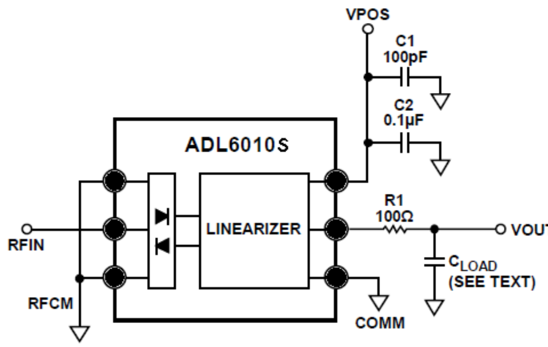
The envelope voltage gain of the ADL6010S is nominally ×2.2 V/VPEAK from 1 GHz to 35 GHz. This factor becomes 3.2 V/V when the input signal is specified as the rms voltage of a CW carrier. For example, a steady −30 dBm input generates a dc output voltage of 22.5 mV, at which level the output buffer is able to track the envelope. In fact, the sensitivity at ambient temperatures typically extends below −30 dBm. However, over the specified temperature range, the measurement error tends to increase at the bottom of the specified range.

For large inputs, the voltage headroom in the signal processing stages limits the measurement range. Using a 5 V supply, the maximum signal is approximately 3.6 V p-p, corresponding to a power of 15 dBm, referenced to 50 Ω. Therefore, the ADL6010S achieves a 45 dB dynamic range of high accuracy measurement. Note that, above 43.5 GHz, accuracy is limited by the package, PCB, and instrumentation. The RF input interface provides a broadband (flat) 50 Ω termination without the need for external components. Although the input return loss inevitably degrades at very high frequencies, the slope of the transfer function holds near 2.2 V/VPEAK up to 35 GHz, owing to the voltage responding behavior of the ADL6010S.

Basic Connections

The basic connections are shown in Figure 37. A dc supply of nominally 5 V is required. The bypass capacitors (C1 and C2) provide supply decoupling for the output buffer. Place these capacitors as close as possible to the VPOS pin. The exposed pad is internally connected to the IC ground and must be soldered down to a low impedance ground on the PCB. A filter capacitor (CLOAD) and series resistor (R1) may be inserted to form a low-pass filter for the output envelope. Small CLOAD values allow a quicker response to an RF burst waveform, and high CLOAD values provide signal averaging and noise reduction.

Figure 4: Basic connections



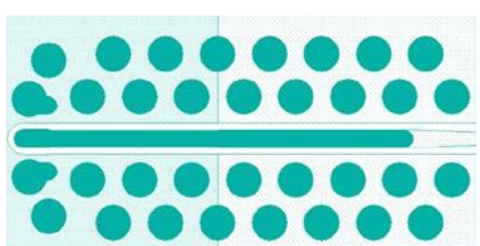
PCB Layout Recommendations

Parasitic elements of the PCB such as coupling and radiation limit accuracy at very high frequencies. Ensure faithful power transmission from the connector to the internal circuit of the ADL6010S. Microstrip and CPW are popular forms of transmission lines because of their ease of fabrication and low cost. In the ADL6010S evaluation board, a grounded coplanar waveguide (GCPW) minimizes radiation effects and provides the maximum bandwidth by using two rows of grounding vias on both sides of the signal trace.

Figure 2 shows the PCB layout of a GCPW. Minimize air gaps between the vias to ensure reliable transmission. Because a certain minimum distance between two adjacent grounding vias in a single row is needed, adding a second row of grounding vias on both sides of the GCPW is recommended. In this way, a much smaller equivalent air gap between grounding vias is achieved, and better transmission is accomplished.

Contact factory for reference PCB layout support.

Figure 5: GCPW



System Calibration and Error Calculation

To achieve the highest measurement accuracy, perform calibration at the board level, as the IC scaling varies from device to device. Calibration begins by applying two or more known signal levels, VIN1 and VIN2, within the operating range of the IC, and noting the corresponding outputs, VOUT1 and VOUT2. From these measurements, the slope and intercept of the scaling is extracted.

For a two point calibration, the calculations are as follows:

Slope = (VOUT2 − VOUT1)/(VIN2 − VIN1)

Intercept = VOUT1 − (Slope × VIN1)

Where each VIN is the equivalent peak input voltage to RFIN, at a 50 Ω input impedance.
Once the slope and intercept are calculated and stored, use the following simple equations to calculate the unknown input power:

VIN_CALCULATED = (VOUT (MEASURED) − Intercept)/Slope

PIN_CALCULATED (dBm) = 10log10(1000 × (VIN_CALCULATED/√2)2/50)

The conformance error is

Error (dB) = PIN_CALCULATED (dBm) − PIN_IDEAL (dBm)

The relative error at these two calibration points is equal to 0 dB by definition.

ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option
ADL6010R703LSH6	−55°C to +125°C	16 Lead Square RF Via	LSH6

Revision History		
Rev	Description of Change	Date
A	Initial Released	4/20/18
B	Correct typo in part number	5/1/18