FAST RESPONDING, 45 dB RANGE, 0.5 GHz TO 43.5 GHz ENVELOPE DETECTOR DIE

ADL6010S

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/ADL6010.

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

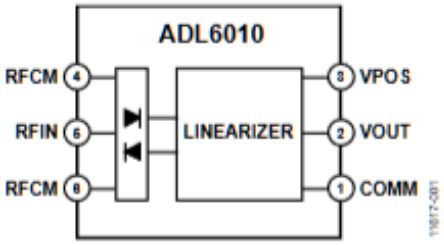
Part Number	Description
ADL6010R000C	Fast Responding, 45 dB Range, 0.5 GHz to 43.5 GHz Envelope Detector Die

3.0 Die Information

3.1 Die Specifics

Die Size	Die Thickness	Backside Potential	Backside Material / Finish	Bond Pad
33 mil x 48 mil	12 mils ± 1 mil	Ground	Silicon with Backgrind	AlCu

3.2 Die Picture and Terminal Position



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3.3 Absolute Maximum Ratings 1/

Supply voltage (VS) 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
Ambient operating temperature range (T_A)…….. -55°C to +125°C
ESD Sensitivity (FICDM) ..... 750 V (Class III) 3/
ESD Sensitivity (HBM) ..... 500 V (Class 1B) 3/

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/ Driven from a 50 Ω source.
3/ 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.

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/ 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.
2/ 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.

4.0 Die Qualification

In accordance with class-K version of MIL-PRF-38534, Appendix C, Table C-II, except as modified herein.
(a) Qual Sample Size and Qual Acceptance Criteria – 10/0
(b) Pre-screen test post assembly required prior to die qualification, to remove all assembly related rejects.
(c) Pre-240 hour Burn-in Test was performed prior to die qualification

Table I – Probe Test Electrical Performance Characteristics

Parameter	Symbol	Conditions: V_{pos} = +5V unless otherwise specified	Limits		Unit
			Min	Max	
Output Offset Voltage	V_{OUT}	RFin = off	-10	10	mV
Supply Current	I_{SY}		1.3	2	mA

Table II – Electrical Performance Characteristics						
Parameter see notes at end of table	**Symbol**	**Conditions 1/ unless otherwise specified**	**Subgroup**	**Limits**		**Unit**
				Min	**Max**	
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 II – Electrical Performance Characteristics – Continued						
Parameter see notes at end of table	**Symbol**	**Conditions 1/ unless otherwise specified**	**Subgroup**	**Limits**		**Unit**
				Min	**Max**	
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 II – Electrical Performance Characteristics – Continued						
Parameter see notes at end of table	**Symbol**	**Conditions 1/ unless otherwise specified**	**Subgroup**	**Limits**		**Unit**
				Min	**Max**	
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 II – Electrical Performance Characteristics – Continued						
Parameter see notes at end of table	Symbol	Conditions 1/ unless otherwise specified	Subgroup	Limits		Unit
				Min	Max	
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 II 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 III – Life Test / Burn-in Delta Limits				
Parameter	**Symbol**	**Condition**	**Delta**	**Unit**
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 Die Outline

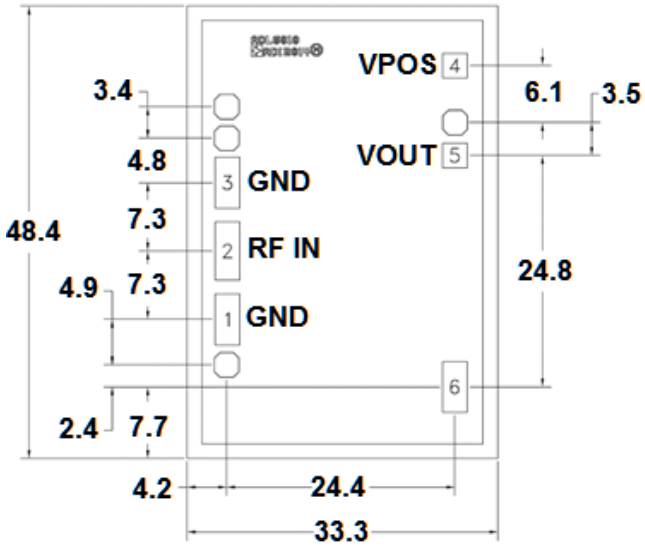

Table IV – Pad Identification		
Pad	**Description**	**Pad Size (mils)**
1	RFCM	2.6 x 5.4
2	RFIN	2.6 x 6.2
3	RFCM	2.6 x 5.4
4	VPOS	2.6 x 2.6
5	VOUT	2.7 x 2.6
6	COMM	2.6 x 5.4

Notes:

1. All dimensions are in mils.
2. Die Thickness is 12 mils.
3. Bond metallization: Aluminum Copper
4. Overall Die Size +/- 2 mils.
5. No connection required for unlabeled bond pads.

6.0 Die Packaging Information

Table V – Packaging Information	
Standard	**Alternate**
GELPACK GP-5: VR-103CC-02-XL 50pcs per pack	(1)

Note:

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

Rev	Description of Change	Date
A	Initial Release	4-24-2018
B	Specify ESD rating. Corrected die dimension and identify bond pad designation at Die Outline. Correct formatting.	2-12-2019
C	Update Table IV Pad Size	3-20-2019
D	Change Qual Sample Size and Qual Acceptance Criteria and Add Die Qualification exception note	7-27-2020
E	Update Die Packaging Information	10-14-2020