

DATA SHEET

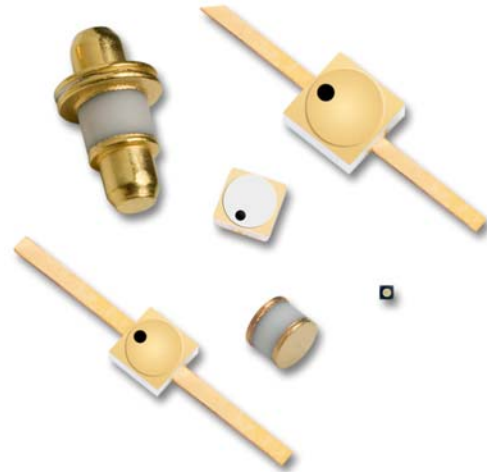
# CLA Series: Silicon Limiter Diodes, Packaged Devices and Bondable Chips

## Applications

- LNA receiver protection
- Commercial and defense radar

## Features

- Established Skyworks limiter diode process
- High power, mid-range, and cleanup designs
- Low insertion loss: 0.1 dB @ 10 GHz
- Peak power handling to +74 dBm
- Ultra low spike leakage power
- Tight control of I layer base width
- Mesa and planar chip designs



Skyworks Green™ products are compliant with all applicable legislation and are halogen-free. For additional information, refer to *Skyworks Definition of Green™*, document number SQ04-0074.

## Description

Skyworks CLA series of silicon limiter diodes provides passive receiver protection over a wide range of frequencies from 100 MHz to over 30 GHz. These devices use Skyworks well-established silicon technology resulting in high resistivity and tightly controlled base width PIN limiter diodes. Limiter circuits using these devices perform with strong limiting action and low loss.

The CLA series consists of ten individual chip designs of different intrinsic region base widths and capacitances designed to accommodate multi-stage limiter applications. The mesa-constructed, thin base width, low capacitance CLA4601-000, CLA4602-000, CLA4604-000, and CLA4605-000 are designed for low-level and cleanup applications. The CLA4603-000, CLA4606-000 through CLA4608-000, and CLA4610-000 are planar designs designated for high-power and mid-range applications.

The CLA4609-000 thick base width mesa diode is designed for coarse limiter-stage applications.

The absolute maximum ratings of the CLA diode series are provided in Table 1. Electrical specifications are specified in Table 2. Typical performance characteristics are provided in Table 3 and Figures 1 through 4. Table 4 identifies the die part numbers with their corresponding top contact diameters and die outline drawings. Table 5 identifies the hermetic part numbers together with their thermal resistance specifications and hermetic outline drawings.

**Table 1. CLA Series Absolute Maximum Ratings**

Parameter	Symbol	Minimum	Typical	Maximum	Units
Power dissipation	$P_{DIS}$			$\frac{\text{Maximum } T_J - \text{Case Temp}}{\text{Thermal Resistance junction-to-case}}$	W
Reverse voltage	$V_R$			Minimum rated breakdown voltage	V
Forward current	$I_F$			200	mA
Junction temperature	$T_J$	-65		+175	°C
Storage temperature	$T_{STG}$	-65		+200	°C
Electrostatic discharge:					
Charged Device Model (CDM), Class 4				1000	V
Human Body Model (HBM), Class 1C				1000	V
Machine Model (MM), Class A				150	V

**Note:** Exposure to maximum rating conditions for extended periods may reduce device reliability. There is no damage to device with only one parameter set at the limit and all other parameters set at or below their nominal value. Exceeding any of the limits listed here may result in permanent damage to the device.

**CAUTION:** Although this device is designed to be as robust as possible, Electrostatic Discharge (ESD) can damage this device. This device must be protected at all times from ESD. Static charges may easily produce potentials of several kilovolts on the human body or equipment, which can discharge without detection. Industry-standard ESD precautions should be used at all times.

**Table 2. CLA Series Electrical Specifications (Notes 1 and 2)**

Part Number	Breakdown Voltage (V)	I Region (μm)	Junction Capacitance (C <sub>J</sub> ) @ 0 V (pF)	Junction Capacitance (C <sub>J</sub> ) @ 6 V (pF)	Series Resistance (R <sub>S</sub> ) @ 10 mA (Ω)	Minority Carrier Lifetime (T <sub>L</sub> ) @ 10 mA (ns)	Thermal Resistance (θ) (Note 3)		
							Average (°C/W)	1 μs Pulse 0.1% Duty Cycle (°C/W)	Input Power (W)
	Min to Max	Nominal	Typical	Maximum	Maximum	Typical	Maximum	Typical	Typical
CLA4601-000	15 to 30	1	0.12	0.10	2.5	5	47	47	2.0
CLA4602-000	15 to 30	1	0.20	0.15	2.0	5	59	59	1.7
CLA4603-000	20 to 45	1.5	0.20	0.15	2.0	5	45	45	2.1
CLA4604-000	30 to 60	2.0	0.12	0.10	2.5	7	64	64	1.7
CLA4605-000	30 to 60	2.0	0.20	0.15	2.0	7	53	53	1.6
CLA4606-000	45 to 75	2.5	0.20	0.15	2.0	10	54	54	1.6
CLA4607-000	120 to 180	7.0	0.20	0.15 @ 50 V	2.0	50	91	91	1.0
CLA4608-000	120 to 180	7.0	0.60	0.50 @ 50 V	1.2	100	123	123	1.1
CLA4609-000	250 (Min.)	20	0.26	0.14	1.5	1175	52	52	2.9
CLA4610-000	80 to 120	4.5	0.13	0.12	2.2	20	72	72	1.3

**Note 1:** Performance is guaranteed only under the conditions listed in this Table and is not guaranteed over the full operating or storage temperature ranges. Operation at elevated temperatures may reduce reliability of the device.

**Note 2:** T<sub>OP</sub> = +25 °C, C<sub>J</sub> measured at 1 MHz, R<sub>S</sub> measured at 500 MHz, CW thermal resistance for infinite heat sink, unless otherwise noted.

**Note 3:** Thermal resistance is calculated from the measured power dissipation @ f = 2.6 GHz, T<sub>J</sub> max = 175 °C and T<sub>CASE</sub> = 85 °C.

**Table 3. Typical Performance @ 25 °C @ 2.6 GHz,  $Z_0 = 50 \Omega$  (Note 1)**

Part Number	Insertion Loss @ -10 dBm (dB)	CW Input Power for 1 dB Insertion Loss (dBm)	Maximum CW Input Power (dBm)	Maximum Pulsed Input Power (dBm) (Note 2)	Output @ Maximum Pulsed Input (dBm) (Note 2)	Recovery Time (ns) (Note 3)	Spike Leakage (ergs) (Note 4)
CLA4601-000	0.1	12	36	65	21	5	Note 5
CLA4602-000	0.1	12	36	65	24	5	Note 5
CLA4603-000	0.1	10	38	67	22	5	Note 5
CLA4604-000	0.1	11	40	70	24	5	Note 5
CLA4605-000	0.1	12	40	70	27	5	0.08
CLA4606-000	0.1	14	41	71	27	5	0.03
CLA4607-000	0.1	26	43	73	39	5	0.21
CLA4608-000	0.2	26	43	73	44	5	0.15
CLA4609-000	0.3	37	44	74	50	5	25.77
CLA4610-000	0.1	24	40	57	32	5	Note 5

**Note 1:** Diode chip is mounted on a 0.5 oz Cu PC board using 1 to 2 mils of conductive epoxy. Bond wire connections are made with 0.8 mil Au wire. Limiter configured with shunt connected diode and 22 nH ground return and 100 pF DC blocking capacitors.

**Note 2:** Pulsed power measurements taken at 1  $\mu$ s pulse width, @ f = 10 KHz, and 0.1% duty cycle.

**Note 3:** Recovery time represents the transition time from the high-loss state to the low-loss state following the removal of a high-power input. It is defined as the time from the end of the high-power pulse to the time when insertion loss has returned to within 3 dB of the quiescent (low-power) state.

**Note 4:** Spike Leakage (ergs) =  $t_s \times P_s \times 10^7$  where  $t_s$  is the spike width at the half-power point (in seconds) and  $P_s$  is the maximum spike amplitude in watts.

**Note 5:** Not detectable under current test conditions described in Note 2.

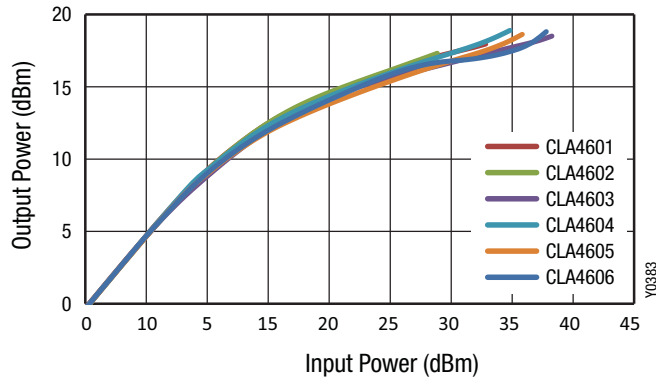
**Table 4. CLA Series Parts – Die Packages**

Part Number	Typical Top Contact Diameter (mils/mm)	Die Drawing
CLA4601-000	1.10/0.028	150–806
CLA4602-000	1.25/0.032	150–806
CLA4603-000	2.00/0.051	149–815
CLA4604-000	1.65/0.042	150–806
CLA4605-000	2.05/0.052	150–813
CLA4606-000	2.25/0.057	149–815
CLA4607-000	3.50/0.089	149–815
CLA4608-000	7.50/0.190	149–815
CLA4609-000	6.50/0.165	150–813
CLA4610-000	2.85/0.072	149–815

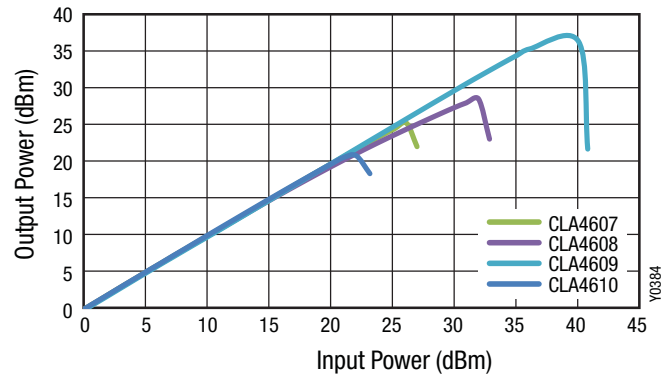
**Table 5. Hermetic Packages**

Hermetic Stripline Drawing	Typical $\theta_{JC}$ (°C/W)	Hermetic Pill Drawing	Typical $\theta_{JC}$ (°C/W)	Hermetic Pill Drawing	Typical $\theta_{JC}$ (°C/W)	Hermetic Pill Drawing	Typical $\theta_{JC}$ (°C/W)
CLA4601-240	200	CLA4601-203	150	CLA4601-219	200	CLA4601-210	140
CLA4602-240	160	CLA4602-203	110	CLA4602-219	160	CLA4602-210	100
CLA4603-240	180	CLA4603-203	130	CLA4603-219	180	CLA4603-210	120
CLA4604-240	160	CLA4604-203	130	CLA4604-219	180	CLA4604-210	120
CLA4605-240	150	CLA4605-203	100	CLA4605-219	150	CLA4605-210	90
CLA4606-240	160	CLA4606-203	110	CLA4606-219	160	CLA4606-210	100
CLA4607-240	120	CLA4607-203	70	CLA4607-219	120	CLA4607-210	60
CLA4608-240	100	CLA4608-203	45	CLA4608-219	100	CLA4608-210	35
CLA4609-240	100	CLA4609-203	45	CLA4609-219	100	CLA4609-210	35
CLA4610-240	163	CLA4609-203	182	CLA4609-219	152	CLA4609-210	81

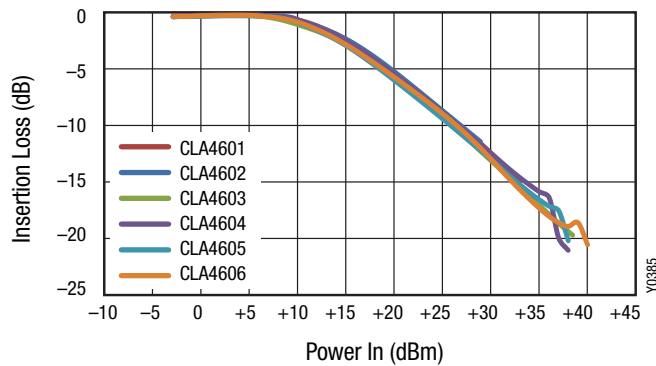
### Typical Performance Characteristics (Tested at 25 °C, Board and Connector Loss Are Not De-Embedded)



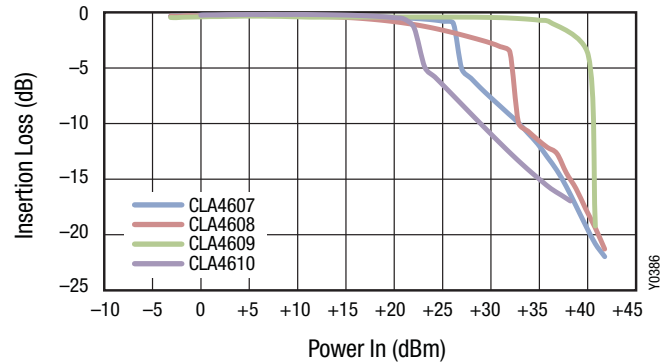
**Figure 1. CLA4601 to CLA4606 CW Output vs Input Power**



**Figure 2. CLA4607 to CLA4610 CW Output vs Input Power**



**Figure 3. CLA4601 to CLA4606 Insertion Loss vs CW Input Power**



**Figure 4. CLA4607 to CLA4610 Insertion Loss vs CW Input Power**

## Technical Description

The CLA4601, CLA4602, CLA4604, and CLA4605 limiter diodes are constructed in a passivated flat-chip configuration and are available in a basic chip form or encapsulated in several Skyworks hermetic ceramic packages.

Limiter diodes with lower capacitance values to 0.08 pF and constructed with a passivated mesa configuration are available in the CLA4603, CLA4606 through CLA4608, and CLA4610 series. The mesa devices offer low capacitance and, therefore, broader bandwidth, lower loss, and faster response at reduced power.

These diodes are also available in chip package form and represent the ultimate in limiter performance not approached by other manufacturers.

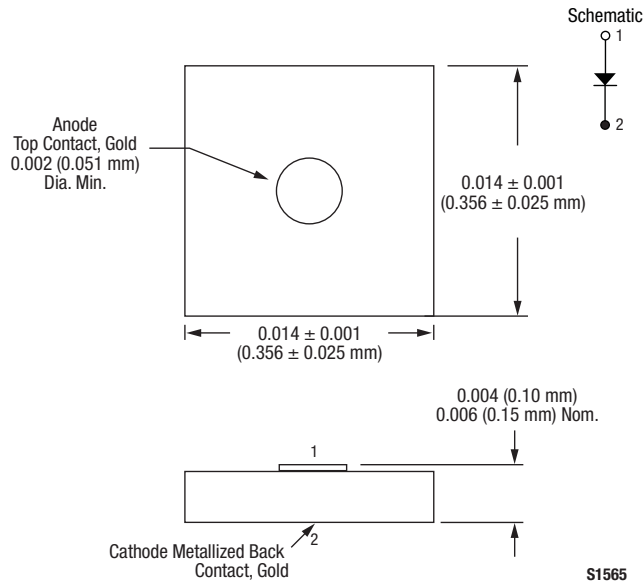
The highest power CLA4609 diodes use a mesa construction.

Additional bonding and handling methods are contained in the Skyworks Application Notes, *Waffle Pack Chip Carrier Handling/Opening Procedure* (document #200146) and *Diode Chips, Beam-Lead Diodes, Capacitors: Bonding Methods and Packaging* (document #200146).

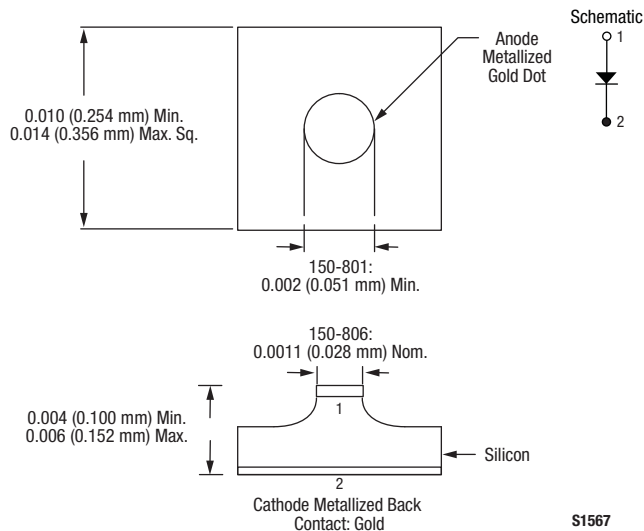
## Package Outline Drawings

Package outline die drawings for the CLA diode series are shown in Figures 5, 6, and 7. Hermetic package outlines are shown in Figures 8 through 11.

### Die Packages

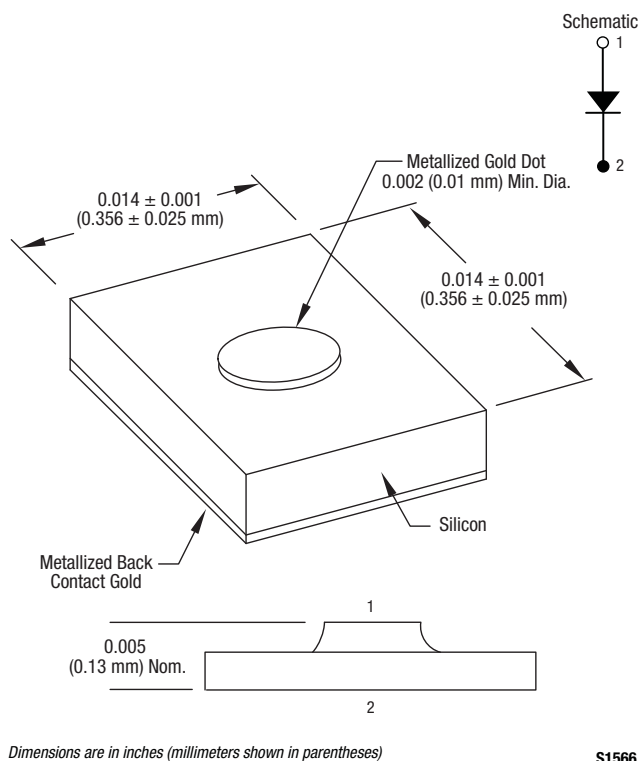


**Figure 5. 149-815 Package**



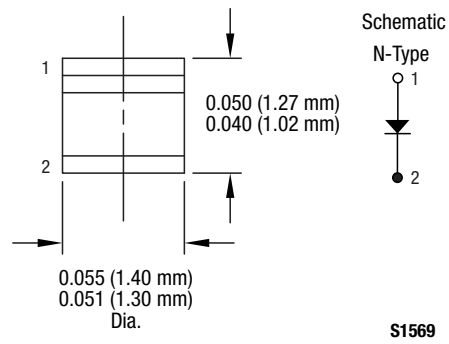
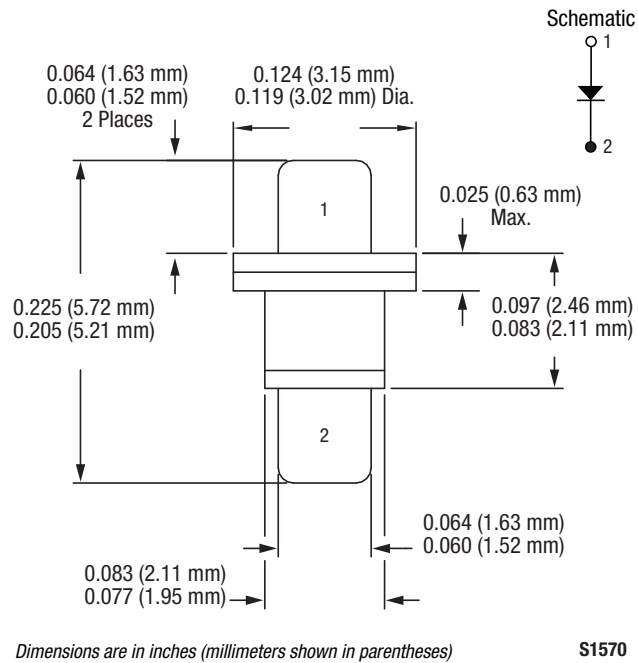
**Figure 6. 150 Series Package**

**Die Packages (Continued)**

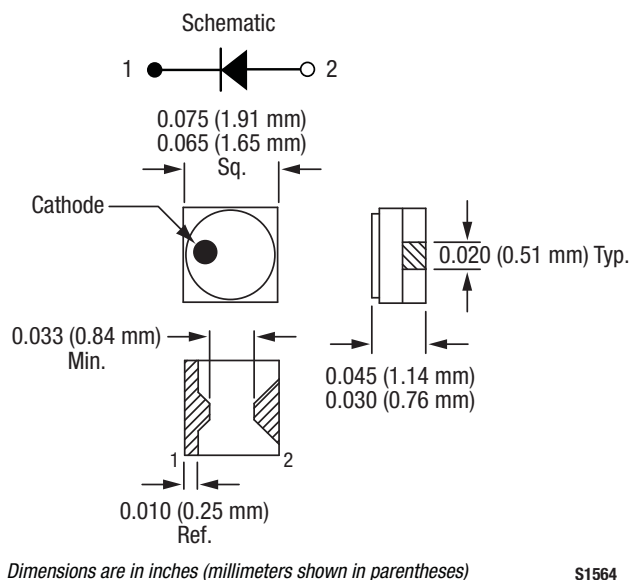


**Figure 7. 150-813 Package**

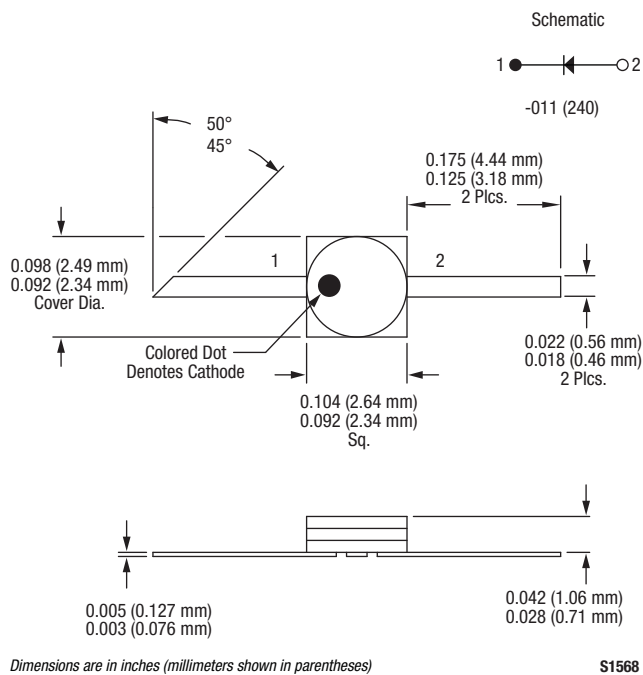


**Hermetic Packages****Figure 8. -203 Package****Figure 9. -210 Package**

**Hermetic Packages (Continued)**



**Figure 10. -219 Package**



**Figure 11. -240 Package**

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