

DATA SHEET

## CLA Series: Silicon Limiter Diodes and Ceramic Hermetic Packaged Devices

### Applications

- LNA receiver protection
- Commercial and defense radar

### Features

- Established 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



### Description

The Isolink CLA series of silicon limiter diodes provides passive receiver protection over a wide range of frequencies from 100 MHz to over 20 GHz. These devices use a 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 series, CLA4602 series, CLA4604 series, and CLA4605 series are designed for low-level and cleanup applications. The CLA4603 series, CLA4606 series, CLA4607 series, CLA4608 series and CLA4610 series are planar designs designated for high-power and mid-range applications.

The CLA4609 series 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 1. CLA Series Absolute Maximum Ratings<sup>1</sup>**

| Parameter                           | Symbol           | Minimum | Typical | Maximum  | Units |
|-------------------------------------|------------------|---------|---------|--|-------|
| Power dissipation                   | P <sub>DIS</sub> |         |         | $\frac{\text{Maximum } T_J - \text{Case Temp}}{\text{Thermal Resistance}_{\text{junction-to-case}}}$ | W     |
| Reverse voltage                     | V <sub>R</sub>   |         |         | Minimum rated breakdown voltage  | V     |
| Forward current                     | I <sub>F</sub>   |         |         | 200  | mA    |
| Junction temperature                | T <sub>J</sub>   | -65     |         | +175   | °C    |
| Storage temperature                 | T <sub>STG</sub> | -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     |

<sup>1</sup> 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.

**ESD HANDLING:** 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 when handling or transporting. Static charges may easily produce potentials of several kilovolts on the human body or equipment, which can discharge without detection. Industry-standard ESD handling precautions should be used at all times.

**Table 2. CLA Series Electrical Specifications<sup>1,2</sup> (1 of 2)**

| Part Number | Breakdown Voltage (V) | I Region (µm) | Total Capacitance (C <sub>T</sub> ) @ 0 V (pF) | Total Capacitance (C <sub>T</sub> ) @ 6 V (pF) | Series Resistance (R <sub>S</sub> ) @ 10 mA (Ω) | Minority Carrier Lifetime (TL) @ 10 mA (ns) | Thermal Resistance (θ) <sup>3</sup> Average (°C/W) |
|-------------|-----------------------|---------------|--|--|---|---|--|
|             | Min to Max            | Nominal       | Typical  | Maximum  | Typical   | Typical                                     | Maximum  |
| CLA4601-203 | 15 to 30              | 1.0           | 0.37   | 0.35   | 2.0   | 5   | 150  |
| CLA4601-210 | 15 to 30              | 1.0           | 0.37   | 0.35   | 2.0   | 5   | 140  |
| CLA4601-219 | 15 to 30              | 1.0           | 0.37   | 0.35   | 2.0   | 5   | 200  |
| CLA4601-240 | 15 to 30              | 1.0           | 0.37   | 0.35   | 2.0   | 5   | 200  |
| CLA4602-203 | 15 to 30              | 1.0           | 0.45   | 0.40   | 1.5   | 5   | 110  |
| CLA4602-210 | 15 to 30              | 1.0           | 0.45   | 0.40   | 1.5   | 5   | 100  |
| CLA4602-219 | 15 to 30              | 1.0           | 0.45   | 0.35   | 1.5   | 5   | 160  |
| CLA4602-240 | 15 to 30              | 1.0           | 0.45   | 0.40   | 1.5   | 5   | 160  |
| CLA4603-203 | 20 to 45              | 1.5           | 0.45   | 0.35   | 1.5   | 5   | 130  |
| CLA4603-210 | 20 to 45              | 1.5           | 0.45   | 0.40   | 1.5   | 5   | 120  |
| CLA4603-219 | 20 to 45              | 1.5           | 0.45   | 0.40   | 1.5   | 5   | 180  |
| CLA4603-240 | 20 to 45              | 1.5           | 0.45   | 0.35   | 1.5   | 5   | 180  |
| CLA4604-203 | 30 to 60              | 2.0           | 0.37   | 0.30   | 2.0   | 7   | 130  |
| CLA4604-210 | 30 to 60              | 2.0           | 0.37   | 0.35   | 2.0   | 7   | 120  |
| CLA4604-219 | 30 to 60              | 2.0           | 0.37   | 0.30   | 2.0   | 7   | 160  |
| CLA4604-240 | 30 to 60              | 2.0           | 0.37   | 0.30   | 2.0   | 7   | 180  |

Table 2. CLA Series Electrical Specifications<sup>1,2</sup> (2 of 2)

| Part Number | Breakdown Voltage (V) | I Region (μm) | Total Capacitance (C <sub>T</sub> ) @ 0 V (pF) | Total Capacitance (C <sub>T</sub> ) @ 6 V (pF) | Series Resistance (RS) @ 10 mA (Ω) | Minority Carrier Lifetime (TL) @ 10 mA (ns) | Thermal Resistance (θ) <sup>3</sup> Average (°C/W) |
|-------------|-----------------------|---------------|--|--|------------------------------------|---|--|
|             | Min to Max            | Nominal       | Typical  | Maximum  | Typical                            | Typical                                     | Maximum  |
| CLA4605-203 | 30 to 60              | 2.0           | 0.45   | 0.30   | 1.5                                | 7   | 100  |
| CLA4605-210 | 30 to 60              | 2.0           | 0.45   | 0.40   | 1.5                                | 7   | 90   |
| CLA4605-219 | 30 to 60              | 2.0           | 0.45   | 0.40   | 1.5                                | 7   | 150  |
| CLA4605-240 | 30 to 60              | 2.0           | 0.45   | 0.35   | 1.5                                | 7   | 150  |
| CLA4606-203 | 45 to 75              | 2.5           | 0.45   | 0.35   | 1.5                                | 10  | 110  |
| CLA4606-210 | 45 to 75              | 2.5           | 0.45   | 0.40   | 1.5                                | 10  | 100  |
| CLA4606-219 | 45 to 75              | 2.5           | 0.45   | 0.40   | 1.5                                | 10  | 160  |
| CLA4606-240 | 45 to 75              | 2.5           | 0.45   | 0.35   | 1.5                                | 10  | 106  |
| CLA4607-203 | 120 to 180            | 7.0           | 0.45   | 0.35 @ 38 V                                    | 1.5                                | 50  | 70   |
| CLA4607-210 | 120 to 180            | 7.0           | 0.45   | 0.40 @ 38 V                                    | 1.5                                | 50  | 60   |
| CLA4607-219 | 120 to 180            | 7.0           | 0.45   | 0.40 @ 38 V                                    | 1.5                                | 50  | 120  |
| CLA4607-240 | 120 to 180            | 7.0           | 0.45   | 0.35 @ 38 V                                    | 1.5                                | 50  | 120  |
| CLA4608-203 | 120 to 180            | 7.0           | 0.85   | 0.75 @ 38 V                                    | 0.5                                | 100   | 45   |
| CLA4608-210 | 120 to 180            | 7.0           | 0.85   | 0.75 @ 38 V                                    | 0.5                                | 100   | 35   |
| CLA4608-219 | 120 to 180            | 7.0           | 0.85   | 0.70 @ 38 V                                    | 0.5                                | 100   | 100  |
| CLA4608-240 | 120 to 180            | 7.0           | 0.85   | 0.70 @ 38 V                                    | 0.5                                | 100   | 100  |
| CLA4609-203 | 250 (Min)             | 20.0          | 0.51   | 0.40   | 1.0                                | 1175  | 45   |
| CLA4609-210 | 250 (Min)             | 20.0          | 0.51   | 0.45   | 1.0                                | 1175  | 35   |
| CLA4609-219 | 250 (Min)             | 20.0          | 0.51   | 0.40   | 1.0                                | 1175  | 100  |
| CLA4609-240 | 250 (Min)             | 20.0          | 0.51   | 0.40   | 1.0                                | 1175  | 100  |
| CLA4610-203 | 80 to 120             | 4.5           | 0.38   | 0.40   | 1.7                                | 20  | 182  |
| CLA4610-210 | 80 to 120             | 4.5           | 0.38   | 0.45   | 1.7                                | 20  | 81   |
| CLA4610-219 | 80 to 120             | 4.5           | 0.38   | 0.40   | 1.7                                | 20  | 152  |
| CLA4610-240 | 80 to 120             | 4.5           | 0.38   | 0.40   | 1.7                                | 20  | 163  |

<sup>1</sup> 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.

<sup>2</sup> TOP = +25 °C, C<sub>J</sub> measured at 1 MHz, R<sub>S</sub> measured at 500 MHz, C<sub>W</sub> thermal resistance for infinite heat sink, unless otherwise noted.

<sup>3</sup> 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<sub>0</sub> = 50 Ω<sup>1</sup>**

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

<sup>1</sup> 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.

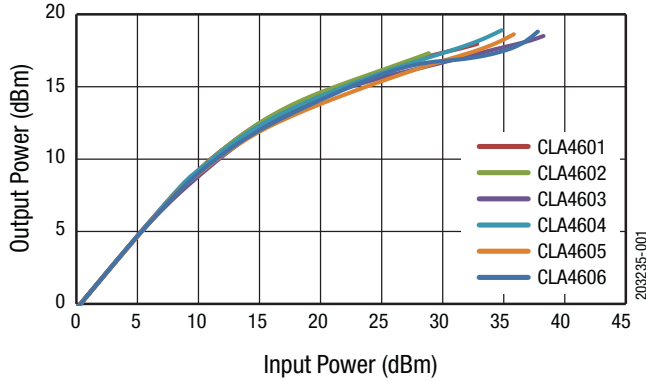
<sup>2</sup> Pulsed power measurements taken at 1 μs pulse width, @ f = 10 KHz, and 0.1% duty cycle.

<sup>3</sup> 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.

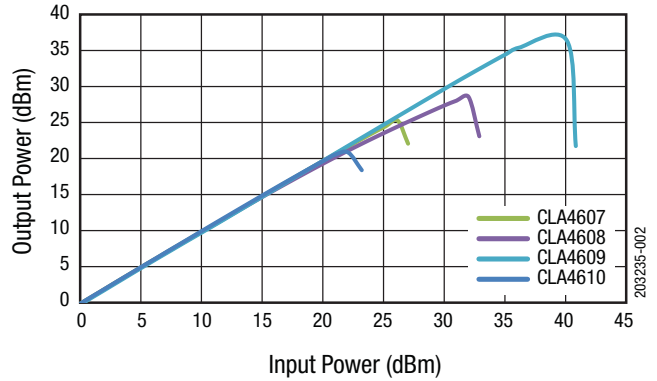
<sup>4</sup> Spike Leakage (ergs) = t<sub>s</sub> x P<sub>s</sub> x 10<sup>7</sup> where t<sub>s</sub> is the spike width at the half-power point (in seconds) and P<sub>s</sub> is the maximum spike amplitude in watts.

<sup>5</sup> Not detectable under current test conditions described in Note 2.

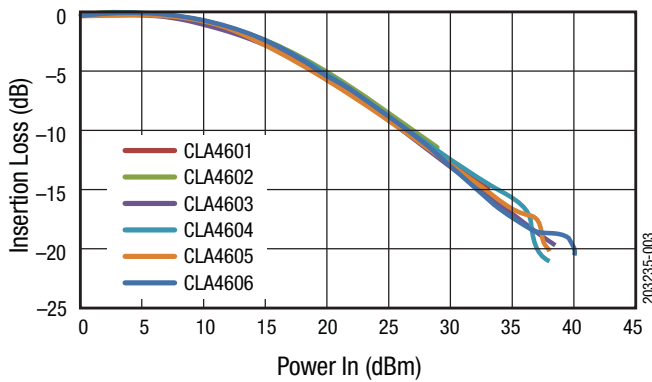
**Typical Performance Characteristics**  
**(Tested at 25 °C, Board and Connector Loss Are Not De-Embedded)**



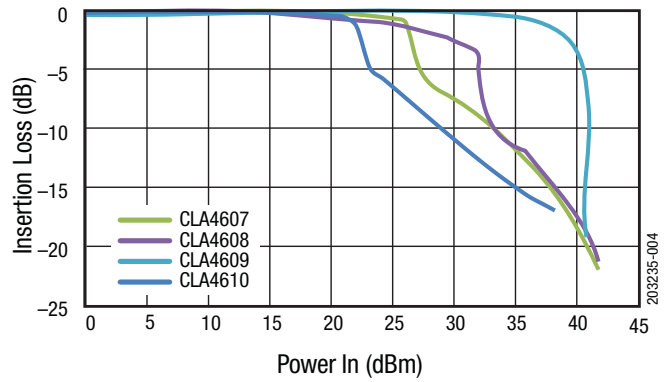
**Figure 1. CLA4601 to CLA4606 CW Output vs Input Power**



**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 limiter can be used in various configurations to meet different application requirements. For example, in low-to-medium power applications, a single-stage limiter can be used. In this case, an inductor must be used in parallel with the limiter to create a DC return choke.

A dual-stage limiter design can handle much higher power. The first stage works as the coarse stage (CLA4607 through

CLA4610), and the second stage works as the cleanup stage (CLA4601 through CLA4606).

Package dimension drawings are provided in Figures 5 through 8.

For detailed application information, refer to the Skyworks Application Note: *PIN Limiter Diodes in Receiver Protectors* at [www.skyworksinc.com](http://www.skyworksinc.com).

### Package Outline Drawings

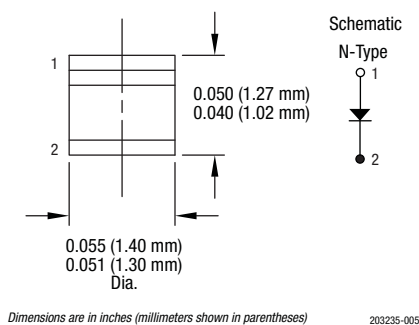


Figure 5. -203 Package

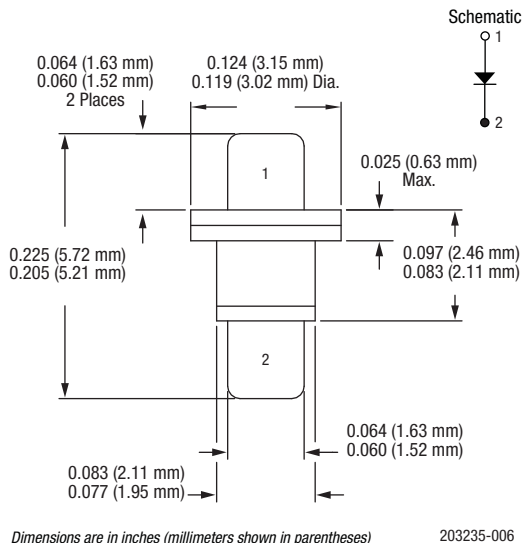
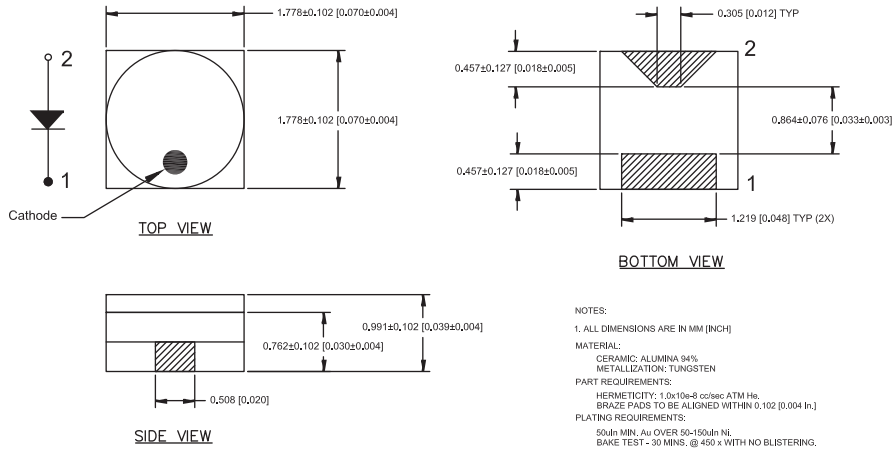
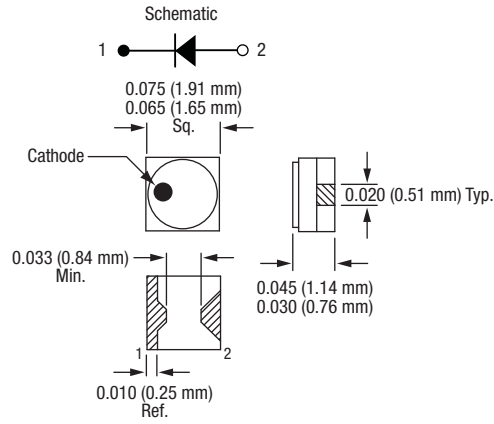


Figure 6. -210 Package



Version A

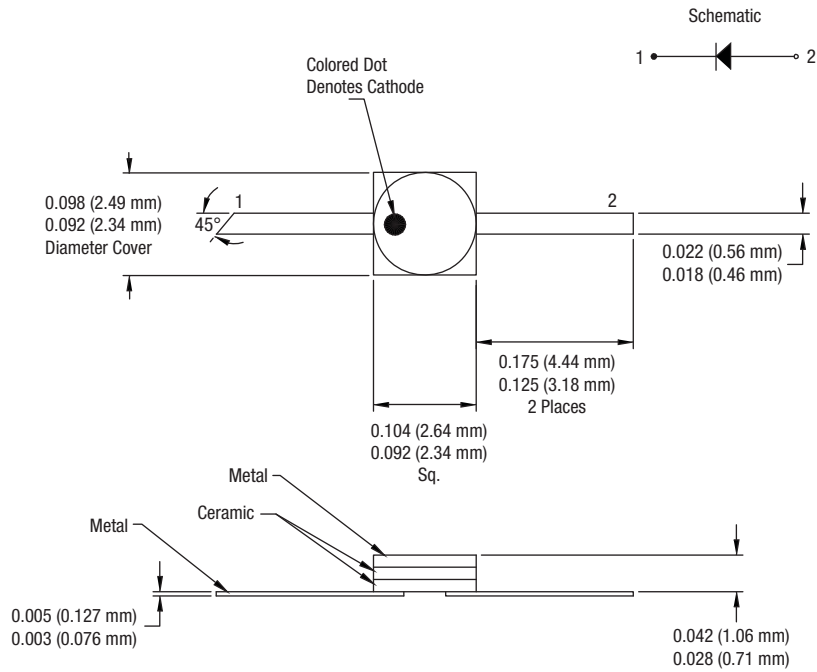


Dimensions are in inches (millimeters shown in parentheses)

Version B

203235-007

Figure 7. -219 Package



Dimensions are in inches (millimeters shown in parentheses)

203235-008

**Figure 8. -240 Package**



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