Skyworks series of silicon limiter diode chips provide passive receiver protection over a wide range of frequencies from 100 MHz to beyond 30 GHz. These devices utilize Skyworks well established silicon technology for high resistivity and tightly controlled thin basewidth PIN limiter diodes. Limiter circuits employing these devices perform with strong limiting action and low loss. The CLA series consists of nine individual chip designs of different intrinsic region basewidths and capacitances designed to accommodate multistage limiter applications. The mesa constructed, thin basewidth, low capacitance CLA4601, CLA4602, CLA4604 and CLA4605 and SMP1330 are designed for low-level and cleanup applications. The CLA4603, and CLA4606 through CLA4609 are planar designs designed for mid-range and high-power applications.

Applications
- Receiver protection

Features
- High power, mid-range and clean-up designs
- Low insertion loss (0.1 dB at 10 GHz)
- Power handling to 70 dBm
- Tight control of basewidth

Skyworks Green™ products are compliant to all applicable materials legislation and are halogen-free. For additional information, refer to Skyworks Definition of Green™, document number SQ04-0074.
A Single-Stage Limiter

The PIN limiter diode can be described as an incident-power-controlled, variable resistor. In the case when no large input signal is present, the impedance of the limiter diode is at its maximum, thereby producing minimum insertion loss, typically less than 0.5 dB. The presence of a large input signal temporarily forces the impedance of the diode to a much lower value, producing an impedance mismatch which reflects the majority of the input signal power back towards its source.

Electrical Specifications at 25 °C

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Breakdown Voltage (V) Min. – Max.</th>
<th>I Region (μm) Nominal</th>
<th>$C_{\text{r}}$ @ 0 V (pF) Typ.</th>
<th>$C_{\text{r}}$ @ 6 V (pF) Max.</th>
<th>$R_s$ @ 10 mA (Ω) Max.</th>
<th>$T_L$ @ 10 mA (ns) Typ.</th>
<th>Thermal Impedance (°C/W)</th>
<th>Top Contact Diam. (mils/mm) Typ.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLA4601 Series</td>
<td>15–30</td>
<td>1.0</td>
<td>0.12</td>
<td>0.10</td>
<td>2.5</td>
<td>5</td>
<td>120</td>
<td>15</td>
</tr>
<tr>
<td>CLA4602 Series</td>
<td>15–30</td>
<td>1.0</td>
<td>0.20</td>
<td>0.15</td>
<td>2.0</td>
<td>5</td>
<td>80</td>
<td>10</td>
</tr>
<tr>
<td>SMP1330 Series</td>
<td>20–50</td>
<td>1.5</td>
<td>0.20</td>
<td>–</td>
<td>1.5</td>
<td>4</td>
<td>110</td>
<td>25</td>
</tr>
<tr>
<td>CLA4603 Series</td>
<td>20–45</td>
<td>1.5</td>
<td>0.20</td>
<td>0.15</td>
<td>2.0</td>
<td>5</td>
<td>100</td>
<td>10</td>
</tr>
<tr>
<td>CLA4604 Series</td>
<td>30–60</td>
<td>2.0</td>
<td>0.12</td>
<td>0.10</td>
<td>2.5</td>
<td>7</td>
<td>100</td>
<td>10</td>
</tr>
<tr>
<td>CLA4605 Series</td>
<td>30–60</td>
<td>2.0</td>
<td>0.20</td>
<td>0.15</td>
<td>2.0</td>
<td>7</td>
<td>70</td>
<td>7</td>
</tr>
<tr>
<td>CLA4606 Series</td>
<td>45–75</td>
<td>2.5</td>
<td>0.20</td>
<td>0.15</td>
<td>2.0</td>
<td>10</td>
<td>80</td>
<td>7</td>
</tr>
<tr>
<td>CLA4607 Series</td>
<td>120–180</td>
<td>7.0</td>
<td>0.20</td>
<td>0.15 @ 50 V</td>
<td>2.0</td>
<td>50</td>
<td>40</td>
<td>1.2</td>
</tr>
<tr>
<td>CLA4608 Series</td>
<td>120–180</td>
<td>7.0</td>
<td>0.80</td>
<td>0.5 @ 50 V</td>
<td>1.2</td>
<td>100</td>
<td>15</td>
<td>0.3</td>
</tr>
<tr>
<td>CLA4609 Series</td>
<td>&gt;250</td>
<td>28</td>
<td>0.26</td>
<td>0.14</td>
<td>1.5</td>
<td>1175</td>
<td>15</td>
<td>0.3</td>
</tr>
</tbody>
</table>

Capacitance, $C_r$, specified at 1 MHz. Resistance, $R_s$, measured at 500 MHz.

Typical Performance at 25 °C

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Insertion Loss @ -10 dBm (dB)</th>
<th>Input Power for 1 dB Loss (dBm)</th>
<th>Maximum Pulsed Input Power (dBm)</th>
<th>Output at Max. Pulsed Input (dBm)</th>
<th>Maximum CW Input Power (W)</th>
<th>Recovery Time (ns)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLA4601 Series</td>
<td>0.10</td>
<td>7</td>
<td>47</td>
<td>21</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>CLA4602 Series</td>
<td>0.10</td>
<td>7</td>
<td>50</td>
<td>24</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>SMP1330 Series</td>
<td>0.15</td>
<td>11</td>
<td>50</td>
<td>30</td>
<td>1</td>
<td>30</td>
</tr>
<tr>
<td>CLA4603 Series</td>
<td>0.10</td>
<td>10</td>
<td>50</td>
<td>22</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>CLA4604 Series</td>
<td>0.10</td>
<td>12</td>
<td>47</td>
<td>24</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>CLA4605 Series</td>
<td>0.10</td>
<td>12</td>
<td>50</td>
<td>27</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>CLA4606 Series</td>
<td>0.10</td>
<td>15</td>
<td>53</td>
<td>27</td>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td>CLA4607 Series</td>
<td>0.10</td>
<td>20</td>
<td>60</td>
<td>39</td>
<td>6</td>
<td>50</td>
</tr>
<tr>
<td>CLA4608 Series</td>
<td>0.20</td>
<td>20</td>
<td>66</td>
<td>44</td>
<td>15</td>
<td>100</td>
</tr>
<tr>
<td>CLA4609 Series</td>
<td>0.30</td>
<td>38</td>
<td>70</td>
<td>50</td>
<td>20</td>
<td>1000</td>
</tr>
</tbody>
</table>

Insertion loss for CLA4601 through CLA4607 at 10 GHz; insertion loss for CLA4608 at 5 GHz. Limiter power results at 1 GHz for shunt connected, single limiter diode and DC return in 50 Ω line.

Maximum pulsed power for 1 μs pulse and 0.1% duty factor with chip at 25 °C heat sink. Derate linearly to 0 W at 175 °C.

Maximum CW input power at 25 °C heat sink. Derate linearly to 0 W at 175 °C.

Recovery time to insertion loss from limiting state.
How to Select Limiter Diode Packages
Skyworks limiter diodes are available in several types of packages and as unpackaged dice. In most cases the requirements of the end application will determine the optimal physical diode configuration.

Plastic Surface Mount Technology Packages
Plastic surface mount technology (SMT) packages are inexpensive and are compatible with modern pick-and-place assembly techniques, so they are optimal choices for high-volume, low-cost final product assemblies.

While careful attention has been paid to minimizing package parasitic reactances they are always present in such diode configurations. These parasitics, package capacitance and package inductance, inherently reduce the bandwidth over which a diode may be used and can affect insertion loss and isolation. Plastic SMT packages also add thermal resistance to that of the die, thereby reducing the amount of power a diode can dissipate without exceeding its maximum rated operating junction temperature.

Ceramic-Metal Packages
Ceramic-metal packages offer several advantages over plastic packages: their parasitic inductances and capacitances are generally lower, sometimes by as much as 75%, than that of the plastic SMT packages described above. Their thermal resistances are also generally much lower than that of the large majority of plastic SMT packages. Most ceramic packages used for limiter diodes are capable of being hermetically sealed, thereby offering maximum protection to the die against environmental contaminants such as sodium (Na), water vapor, etc.

Ceramic-metal packages have two disadvantages compared to plastic SMT packages: they are typically more costly, and, they generally are not compatible with automated surface mount assembly.

(Packageless) Dice
Diode dice, sometimes known as chips, eliminate the parasitic reactances and thermal resistance of the package. This configuration produces the widest bandwidth of operation as well as maximal power dissipation capabilities.

Of course, the end user of unpackaged diode dice must be capable of handling these tiny devices as well as performing die attach and wire bonding assembly techniques. The assemblies which contain dice must be protected from mechanical damage, especially to the fragile bond wires.
Outline Drawings

149-815

150 Series

-210 Hermetic Pill

-203 Hermetic Pill
-240 Hermetic Stripline

-219 Hermetic Pill
Outline Drawings (Continued)

-085LF, -086LF

SOT-23 (-005LF) Plastic

Application Notes

For additional information, please refer to the following Application Notes.

Diode Chips, Beam-Lead Diodes, Capacitors: Bonding Methods and Packaging

PIN Diode Basics

PIN Limiter Diodes in Receiver Protectors

Through our Green Initiative,™ we are committed to manufacturing products that comply with global government directives and industry requirements.

Skyworks is continuously innovating RF, analog and mixed-signal ICs. For the latest product introductions and information about Skyworks, visit our Web site at www.skyworksinc.com

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