## HBL5006 Series

## LED Shunt

The HBL5006 Series are electronic shunts which provide a current bypass in the case of LEDs going into open circuit. LEDs are by nature quite fragile when subjected to transients and surge conditions. There are also many cases where high reliability of the LED lighting must be maintained such as in headlights, lighthouses, bridges, aircraft, runways and so forth. In these cases the low cost addition of the shunt device will provide full assurance that an entire string of LEDs will not extinguish should one LED fail open. The shunt device is also applicable to other loads where circuit continuity is required. The devices are designed to be used with LED string currents from 50 to 350 mA .

## Features

- Protection for the Following IEC Standards:

IEC 61000-4-2 (Level 4)
ISO 10605

- Low ESD Clamping Voltage
- Automatically Resets Itself if the LED Heals Itself or is Replaced
- ON-State Voltage Typically 1.1 V
- OFF-State Current less than $1.0 \mu \mathrm{~A}$
- SZ Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable
- These Devices are Pb -Free and are RoHS Compliant


## Typical Applications

- LEDs where Preventive Maintenance is Impractical
- LED Headlights in Automobiles
- Automotive LED Applications
- LEDs with High Reliability Requirements
- Crowbar Protection for Open Circuit Conditions
- Overvoltage Protection for Sensitive Circuits



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## ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 5 of this data sheet.

MAXIMUM RATINGS

| Rating |  | Symbol | Value | Unit |
| :---: | :---: | :---: | :---: | :---: |
| On-State Current, ( $\left.\mathrm{T}_{\mathrm{A}}=25^{\circ} \mathrm{C}\right)($ Note 2) | SOD-323 (Note 1) SOD-323 (Note 2) SOD-523 (Note 1) SOD-523 (Note 2) SOD-923 (Note 1) SOD-923 (Note 2) | $I_{\text {T(AVG }}$ | $\begin{aligned} & 250 \\ & 200 \\ & 300 \\ & 250 \\ & 350 \\ & 300 \end{aligned}$ | mA |
| Thermal Resistance, Junction-to-Air (All Packages) | SOD-323 (Note 1) SOD-323 (Note 2) SOD-523 (Note 1) SOD-523 (Note 2) SOD-923 (Note 1) SOD-923 (Note 2) | $\theta_{\text {JA }}$ | $\begin{aligned} & 435 \\ & 550 \\ & \\ & 360 \\ & 435 \\ & 285 \\ & 360 \end{aligned}$ | ${ }^{\circ} \mathrm{C} / \mathrm{W}$ |
| Operating Temperature Range | (Note 3) | $\mathrm{T}_{\mathrm{J}}$ | -40 to 150 | ${ }^{\circ} \mathrm{C}$ |
| Non-Operating Temperature Range |  | $\mathrm{T}_{J}$ | 150 | ${ }^{\circ} \mathrm{C}$ |
| Lead Temperature, Soldering (10 Sec) |  | TL | 260 | ${ }^{\circ} \mathrm{C}$ |
| IEC 61000-4-2 Contact (ESD) IEC 61000-4-2 Air (ESD) |  | $\begin{aligned} & \text { ESD } \\ & \text { ESD } \end{aligned}$ | $\begin{aligned} & \pm 15 \\ & \pm 15 \end{aligned}$ | kV |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Mounted onto a 2-layer, $1000 \mathrm{~mm}^{2}$ per layer, 3 oz Cu, FR4 PCB with pin 2 connected to the heat sink and pin 1 only connected to a signal trace. The heat sinking must be connected to pin 2, which is the LED cathode connection.
Normally this device would be mounted on the same copper heat sink and adjacent to the LED(s). If the LED(s) were to go open, then the HBL shunt would now dissipate the power using the same copper heat sink. Since the shunt has a voltage that is nominally $30 \%$ of the LED, then the power dissipation would be much lower, and easily handled by the same heat sink as the LED.
2. Mounted onto a 2-layer, $50 \mathrm{~mm}^{2}$ per layer, $1 \mathrm{oz} \mathrm{Cu}, \mathrm{FR} 4$ PCB.
3. Max operating temperature for DC conditions is $150^{\circ} \mathrm{C}$, but not to exceed $175^{\circ} \mathrm{C}$ for pulsed conditions with low duty cycle or non-repetitive.

ELECTRICAL CHARACTERISTICS (Unless otherwise noted: $\mathrm{T}_{\mathrm{A}}=25^{\circ} \mathrm{C}$ )

| Symbol | Characteristics | Package | Min | Typ | Max | Unit |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $V_{B R}$ | Breakdown Voltage: The minimum voltage across the device in or at the breakdown region. Measured at $\mathrm{I}_{\mathrm{BR}}=1 \mathrm{~mA}$. | SOD-323 | 6.2 | 7.0 |  | V |
|  |  | SOD-523 | 6.2 | 7.0 |  |  |
|  |  | SOD-923 | 6.2 | 7.0 |  |  |
| $\mathrm{I}_{\mathrm{H}}$ | Holding Current: The minimum current required to maintain the device in the on-state. | SOD-323 |  | 25 | 40 | mA |
|  |  | SOD-523 |  | 25 | 40 |  |
|  |  | SOD-923 |  | 25 | 40 |  |
| IL | Latching Current: The minimum current required to turn from the off-state to the on-state. | SOD-323 |  | 9.0 |  | mA |
|  |  | SOD-523 |  | 9.0 |  |  |
|  |  | SOD-923 |  | 9.0 |  |  |
| $\mathrm{V}_{\mathrm{BO}}$ | Breakover Voltage: The voltage across the device in the breakover region. | SOD-323 | 6.5 | 7.2 | 8.0 | V |
|  |  | SOD-523 | 6.5 | 7.2 | 8.0 |  |
|  |  | SOD-923 | 6.5 | 7.2 | 8.0 |  |
| $I_{R}$ | Off-State Current: The dc value of current that results from the application of the off-state voltage. Measured at 3.3 V . | SOD-323 |  |  | 1.0 | $\mu \mathrm{A}$ |
|  |  | SOD-523 |  |  | 1.0 |  |
|  |  | SOD-923 |  |  | 1.0 |  |
| $\mathrm{V}_{\mathrm{T}}$ | On-State Voltage. Measured at 100 mA . | SOD-323 | 0.9 | 1.1 | 1.3 | V |
|  |  | SOD-523 | 0.9 | 1.1 | 1.3 |  |
|  |  | SOD-923 | 0.9 | 1.1 | 1.3 |  |
| $\mathrm{V}_{\mathrm{C}}$ | $\begin{aligned} & \left.\begin{array}{l} \text { Clamping Voltage } \\ \text { TLP (Note 4) } \end{array} \quad \begin{array}{l} \text { IEC 6100-4-2 Level } 2 \text { equivalent } \\ \qquad \begin{array}{l} \text { IPP }=8 \mathrm{~A} \\ ( \pm 4 \mathrm{kV} \text { Contact, } \pm 4 \mathrm{kV} \mathrm{Air)} \end{array} \\ \mathrm{I}_{\mathrm{PP}}=16 \mathrm{~A} \end{array}\right\} \begin{array}{l} \text { IEC } 6100-4-2 \text { Level } 4 \text { equivalent } \\ ( \pm 8 \mathrm{kV} \text { Contact, } \pm 15 \mathrm{kV} \text { Air }) \end{array} \end{aligned}$ | SOD-323 |  | $\begin{gathered} 6.5 \\ 11.2 \end{gathered}$ |  | V |
|  |  | SOD-523 |  | $\begin{gathered} \hline 6.5 \\ 11.2 \end{gathered}$ |  |  |
|  |  | SOD-923 |  | $\begin{gathered} \hline 6.5 \\ 11.2 \end{gathered}$ |  |  |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.
4. ANSI/ESD STM5.5.1 - Electrostatic Discharge Sensitivity Testing using Transmission Line Pulse (TLP) Model TLP conditions: $Z_{0}=50 \Omega$, $\mathrm{t}_{\mathrm{p}}=100 \mathrm{~ns}, \mathrm{t}_{\mathrm{r}}=4 \mathrm{~ns}$, averaging window; $\mathrm{t}_{1}=30 \mathrm{~ns}$ to $\mathrm{t}_{2}=60 \mathrm{~ns}$.


Figure 1. I-V Characteristics

## HBL5006 Series

TYPICAL APPLICATION CIRCUIT


Figure 2. Typical Application Circuit

DEVICE ORDERING INFORMATION

| Device | Marking | Package | Shipping ${ }^{\dagger}$ |
| :---: | :---: | :---: | :---: |
| HBL5006HT1G | HD | $\begin{aligned} & \text { SOD-323 } \\ & \text { (Pb-Free) } \end{aligned}$ | 3000 / Tape \& Reel |
| SZHBL5006HT1G* | HD |  |  |
| HBL5006XV2T1G | 56 | $\begin{aligned} & \text { SOD-523 } \\ & \text { (Pb-Free) } \end{aligned}$ | 3000 / Tape \& Reel |
| SZHBL5006XV2T1G* | 56 |  |  |
| HBL5006XV2T5G | 56 |  | 8000 / Tape \& Reel |
| SZHBL5006XV2T5G* | 56 |  |  |
| HBL5006P2T5G | LD | SOD-923 <br> ( $\mathrm{Pb}-\mathrm{Free}$ ) | 8000 / Tape \& Reel |
| SZHBL5006P2T5G* | LD |  |  |

$\dagger$ For additional information on our $\mathrm{Pb}-$ Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.
*SZ Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable.


SIDE VIEW


NDTES:

1. DIMENSIDNING AND TILERANCING AS PER ASME Y14.5M, 2018
2. CONTRaLLING DIMENSIDN: MILLIMETERS
3. LEAD THICKNESS SPECIFIED PER L/F DRAWING WITH SULDER PLATING.
4. DIMENSIIDNS A AND B DD NDT INCLUDE MDLD FLASH, pRITRUSIDNS aR GATE BURRS
5. DIMENSIIN L IS MEASURE FRDM END DF RADIUS



## RECDMMENDED MDUNTING FIDTPRINT

*For additional information on our $\mathrm{Pb}-$ Free strategy and soldering details, please download the ZN Semiconductor Soldering and Mounting Techniques Reference manual, SOLDERRM/D.


$$
\begin{aligned}
& X X=\text { Specific Device Code } \\
& M \text { = Date Code }
\end{aligned}
$$

*This information is generic. Please refer to device data sheet for actual part marking. $\mathrm{Pb}-\mathrm{Free}$ indicator, " G " or microdot " "", may or may not be present. Some products may not follow the Generic Marking.
STYLE 1:
PIN 1. CATHODE (POLARITY BAND) $\quad$ STYLE 2:
NO POLARITY

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| :---: | :---: | :---: |
| DESCRIPTION: | SOD-323 1.70x1.25x0.85 | PAGE 1 OF 1 |

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TロP VIEW


GENERIC
MARKING DIAGRAM*


XX = Specific Device Code M Date Code
*This information is generic. Please refer to device data sheet for actual part marking. $\mathrm{Pb}-\mathrm{Free}$ indicator, " G " or microdot " r ", may or may not be present. Some products may not follow the Generic Marking.

STYLE 1 :
PIN 1. CATHODE (POLARITY BAND) 2. ANODE

SOD-523 1.20×0.80x0.60
CASE 502
ISSUE F
DATE 08 FEB 2024
NDTES:

1. DIMENSIDNING AND TDLERANCING PER ASME Y14.5M, 2018.
2. CZNTROLLING DIMENSIDN: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH, MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS DF BASE MATERIAL.
4. DIMENSIDNS D AND E DD NDT INCLUDE MLLD FLASH, PRDTRUSIDNS, $\square R$ GATE BURRS,

| DIM | MILLIMETERS |  |  |
| :--- | :--- | :--- | :--- |
|  | MIN. | NDM. | MAX. |
| A | 0.50 | 0.60 | 0.70 |
| $b$ | 0.25 | 0.30 | 0.35 |
| $C$ | 0.07 | 0.14 | 0.20 |
| $D$ | 1.10 | 1.20 | 1.30 |
| $E$ | 0.70 | 0.80 | 0.90 |
| $H$ | 1.50 | 1.60 | 1.70 |
| $L$ | 0.30 REF |  |  |
| $L 2$ | 0.15 | 0.20 | 0.25 |



## RECDMMENDED MDUNTING F $\square \square$ TPRINT

*For additional information on our
Pb-Free strategy and soldering details, please download the $\square N$ Semiconductor Soldering and Mounting Techniques Reference manual, SDLDERRM/D.

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| ---: | :--- | :--- | :--- |
| DESCRIPTION: | SOD-523 1.20x0.80x0.60 | PAGE 1 OF 1 |  |



SOD-923 $0.80 \times 0.60 \times 0.37$
CASE 514AB
ISSUE E
DATE 08 FEB 2024


NDTES:

1. DIMENSIDNING AND TULERANCING PER ASME Y14.5M, 2018.
2. CDNTRDLLING DIMENSIDN: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS DF BASE MATERIAL
4. DIMENSIUNS D AND E DZ NDT INCLUDE MILD FLASH, PRITRUSIINS, GR GATE BURRS
5. DIMENSIUN L WILL NDT EXCEED 0.30 mm .

TロP VIEW


SEATING
PLANE

| MILLIMETERS |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
| DIM | MIN. | NDM. | MAX |  |
| A | 0.34 | 0.37 | 0.40 |  |
| b | 0.15 | 0.20 | 0.25 |  |
| $C$ | 0.07 | 0.12 | 0.17 |  |
| D | 0.75 | 0.80 | 0.85 |  |
| E | 0.55 | 0.60 | 0.65 |  |
| $H$ | 0.95 | 1.00 | 1.05 |  |
| $L$ | 0.19 REF |  |  |  |
| L2 | 0.05 | 0.10 | 0.15 |  |


*For additional information on our Pb-Free strategy and soldering details, please download the $\square N$
Semiconductor Soldering and Mounting Techniques Reference Manual,

SLLDERRM/D
*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "•", may or may not be present. Some products may not follow the Generic Marking.

STYLE 1:
PIN 1. CATHODE (POLARITY BAND) NO POLARITY 2. ANODE

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| ---: | :--- | :--- | :--- |
| DESCRIPTION: | SOD-923 0.80x0.60x0.37 | PAGE 1 OF 1 |  |

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