

# 1SMC5348 THRU 1SMC5388

## SURFACE MOUNT SILICON ZENER DIODE

VOLTAGE - 11 TO 200 Volts      Power - 5.0 Watts

### FEATURES

- For surface mounted applications in order to optimize board space
- Low profile package
- Built-in strain relief
- Glass passivated junction
- Low inductance
- Typical  $I_D$  less than 1 EgA above 13V
- High temperature soldering :  
260 °C/10 seconds at terminals
- Plastic package has Underwriters Laboratory  
Flammability Classification 94V-O

### MECHANICAL DATA

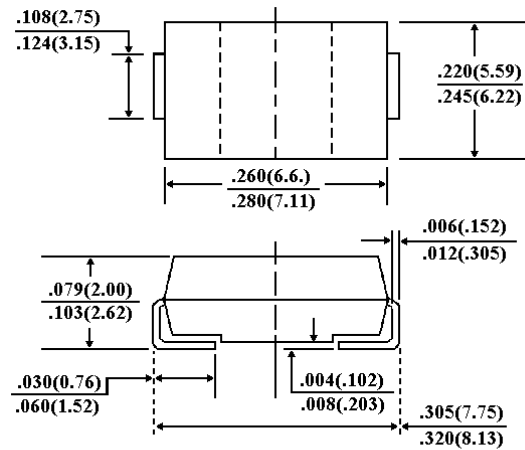
Case: JEDEC DO-214AB Molded plastic  
over passivated junction

Terminals: Solder plated, solderable per  
MIL-STD-750, method 2026

Standard Packaging: 16mm tape(EIA-481)

Weight: 0.007 ounce, 0.21 gram

### DO-214AB



Dimensions in inches and (millimeters)

### MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Ratings at 25 °C ambient temperature unless otherwise specified.

|   | SYMBOL         | VALUE       | UNITS          |
|---|----------------|-------------|----------------|
| DC Power Dissipation @ $T_L=75$ °C, Measure at Zero Lead Length(Fig. 1)<br>Derate above 75 °C(Note 1)         | $P_D$          | 5.0<br>40.0 | Watts<br>mW/°C |
| Peak forward Surge Current 8.3ms single half sine-wave superimposed on rated<br>load(JEDEC Method) (Note 1,2) | $I_{FSM}$      | See Fig. 5  | Amps           |
| Operating Junction and Storage Temperature Range  | $T_J, T_{STG}$ | -55 to +150 | °C             |

### NOTES:

1. Mounted on 8.0mm<sup>2</sup> copper pads to each terminal.
2. 8.3ms single half sine-wave, or equivalent square wave, duty cycle = 4 pulses per minute maximum.

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ELECTRICAL CHARACTERISTICS ( $T_A=25\text{ }^\circ\text{C}$  unless otherwise noted,  $V_F=1.2\text{ Max @ }I_F=1\text{A}$  for all types.

| Type No.<br>(Note 1.) | Nominal Zener Voltage $V_Z @ I_{ZT}$ volts<br>(Note 2.) | Test current $I_{ZT}$ mA | Maximum Zener Impedance                |  | Max reverse Leakage Current |                |          | Max Surge Current $I_r$ Amps<br>(Note 3.) | Max Voltage Regulation $\Delta V_Z$ , Volts<br>(Note 4.) | Maximum Regulator Current $I_{ZM}$ mA<br>(Note 5.) | Device Marking Code |
|-----------------------|---|--------------------------|--|--|-----------------------------|----------------|----------|---|--|--|---------------------|
|                       |   |                          | $Z_{ZT} @ I_{ZT}$<br>Ohms<br>(Note 2.) | $Z_{ZK} @ I_{ZK} = 1$<br>mA<br>Ohms<br>(Note 2.) | $I_R$<br>Eg A               | @ $V_R$ Volts  |          |   |  |  |                     |
|                       |   |                          |  |  |                             | Non & A Suffix | B-Suffix |   |  |  |                     |
| 1SMC5348              | 11  | 125                      | 2.5                                    | 125  | 5                           | 8              | 8.4      | 8   | 0.25   | 430  | 348B                |
| 1SMC5349              | 12  | 100                      | 2.5                                    | 125  | 2                           | 8.6            | 9.1      | 7.5                                       | 0.25   | 395  | 349B                |
| 1SMC5350              | 13  | 100                      | 2.5                                    | 100  | 1                           | 9.4            | 9.9      | 7   | 0.25   | 365  | 350B                |
| 1SMC5351              | 14  | 100                      | 2.5                                    | 75   | 1                           | 10.1           | 10.6     | 6.7                                       | 0.25   | 340  | 351B                |
| 1SMC5352              | 15  | 75                       | 2.5                                    | 75   | 1                           | 10.8           | 11.5     | 6.3                                       | 0.25   | 315  | 352B                |
| 1SMC5353              | 16  | 75                       | 2.5                                    | 75   | 1                           | 11.5           | 12.2     | 6   | 0.3  | 295  | 353B                |
| 1SMC5354              | 17  | 70                       | 2.5                                    | 75   | 0.5                         | 12.2           | 12.9     | 5.8                                       | 0.35   | 280  | 354B                |
| 1SMC5355              | 18  | 65                       | 2.5                                    | 75   | 0.5                         | 13             | 13.7     | 5.5                                       | 0.4  | 265  | 355B                |
| 1SMC5356              | 19  | 65                       | 3                                      | 75   | 0.5                         | 13.7           | 14.4     | 5.3                                       | 0.4  | 250  | 356B                |
| 1SMC5357              | 20  | 65                       | 3                                      | 75   | 0.5                         | 14.4           | 15.2     | 5.1                                       | 0.4  | 237  | 357B                |
| 1SMC5358              | 22  | 50                       | 3.5                                    | 75   | 0.5                         | 15.8           | 16.7     | 4.7                                       | 0.45   | 216  | 358B                |
| 1SMC5359              | 24  | 50                       | 3.5                                    | 100  | 0.5                         | 17.3           | 18.2     | 4.4                                       | 0.55   | 198  | 359B                |
| 1SMC5360              | 25  | 50                       | 4                                      | 110  | 0.5                         | 18             | 19       | 4.3                                       | 0.55   | 190  | 360B                |
| 1SMC5361              | 27  | 50                       | 5                                      | 120  | 0.5                         | 19.4           | 20.6     | 4.1                                       | 0.6  | 176  | 361B                |
| 1SMC5362              | 28  | 50                       | 6                                      | 130  | 0.5                         | 20.1           | 21.2     | 3.9                                       | 0.6  | 170  | 362B                |
| 1SMC5363              | 30  | 40                       | 8                                      | 140  | 0.5                         | 21.6           | 22.8     | 3.7                                       | 0.6  | 158  | 363B                |
| 1SMC5364              | 33  | 40                       | 10                                     | 150  | 0.5                         | 23.8           | 25.1     | 3.5                                       | 0.6  | 144  | 364B                |
| 1SMC5365              | 36  | 30                       | 11                                     | 160  | 0.5                         | 25.9           | 27.4     | 3.3                                       | 0.65   | 132  | 365B                |
| 1SMC5366              | 39  | 30                       | 14                                     | 170  | 0.5                         | 28.1           | 29.7     | 3.1                                       | 0.65   | 122  | 366B                |
| 1SMC5367              | 43  | 30                       | 20                                     | 190  | 0.5                         | 31             | 32.7     | 2.8                                       | 0.7  | 110  | 367B                |
| 1SMC5368              | 47  | 25                       | 25                                     | 210  | 0.5                         | 33.8           | 35.8     | 2.7                                       | 0.8  | 100  | 368B                |
| 1SMC5369              | 51  | 25                       | 27                                     | 230  | 0.5                         | 36.7           | 38.8     | 2.5                                       | 0.9  | 93   | 369B                |
| 1SMC5370              | 56  | 20                       | 35                                     | 280  | 0.5                         | 40.3           | 42.6     | 2.3                                       | 1  | 86   | 370B                |
| 1SMC5371              | 60  | 20                       | 40                                     | 350  | 0.5                         | 43             | 45.5     | 2.2                                       | 1.2  | 79   | 371B                |
| 1SMC5372              | 62  | 20                       | 42                                     | 400  | 0.5                         | 44.6           | 47.1     | 2.1                                       | 1.35   | 76   | 372B                |
| 1SMC5373              | 68  | 20                       | 44                                     | 500  | 0.5                         | 49             | 51.7     | 2   | 1.5  | 70   | 373B                |
| 1SMC5374              | 75  | 20                       | 45                                     | 620  | 0.5                         | 54             | 56       | 1.9                                       | 1.6  | 63   | 374B                |
| 1SMC5375              | 82  | 15                       | 65                                     | 720  | 0.5                         | 59             | 62.2     | 1.8                                       | 1.8  | 58   | 375B                |
| 1SMC5376              | 87  | 15                       | 75                                     | 760  | 0.5                         | 63             | 66       | 1.7                                       | 2  | 54.5   | 376B                |
| 1SMC5377              | 91  | 15                       | 75                                     | 760  | 0.5                         | 65.5           | 69.2     | 1.6                                       | 2.2  | 52.5   | 377B                |
| 1SMC5378              | 100   | 12                       | 90                                     | 800  | 0.5                         | 72             | 76       | 1.5                                       | 2.5  | 47.5   | 378B                |
| 1SMC5379              | 110   | 12                       | 125                                    | 1000   | 0.5                         | 79.2           | 83.6     | 1.4                                       | 2.5  | 43   | 379B                |
| 1SMC5380              | 120   | 10                       | 170                                    | 1150   | 0.5                         | 86.4           | 91.2     | 1.3                                       | 2.5  | 39.5   | 380B                |
| 1SMC5381              | 130   | 10                       | 190                                    | 1250   | 0.5                         | 93.6           | 98.8     | 1.2                                       | 2.5  | 36.6   | 381B                |
| 1SMC5382              | 140   | 8                        | 230                                    | 1500   | 0.5                         | 101            | 106      | 1.2                                       | 2.5  | 34   | 382B                |
| 1SMC5383              | 150   | 8                        | 330                                    | 1500   | 0.5                         | 108            | 114      | 1.1                                       | 3  | 31.6   | 383B                |
| 1SMC5384              | 160   | 8                        | 350                                    | 1650   | 0.5                         | 115            | 122      | 1.1                                       | 3  | 29.4   | 384B                |
| 1SMC5385              | 170   | 8                        | 380                                    | 1750   | 0.5                         | 122            | 129      | 1   | 3  | 28   | 385B                |
| 1SMC5386              | 180   | 5                        | 430                                    | 1750   | 0.5                         | 130            | 137      | 1   | 4  | 26.4   | 386B                |
| 1SMC5387              | 190   | 5                        | 450                                    | 1850   | 0.5                         | 137            | 144      | 0.9                                       | 5  | 25   | 387B                |
| 1SMC5388              | 200   | 5                        | 480                                    | 1850   | 0.5                         | 144            | 152      | 0.9                                       | 5  | 23.6   | 388B                |

## NOTE:

1. TOLERANCE AND VOLTAGE DESIGNATION - The JEDEC type numbers shown indicate a tolerance of  $\pm 10\%$  with guaranteed limits on only  $V_Z$ ,  $I_R$ ,  $I_r$ , and  $V_F$  as shown in the electrical characteristics table. Units with guaranteed limits on all seven parameters are indicated by suffix "B" for  $\pm 5\%$  tolerance.
2. ZENER VOLTAGE ( $V_Z$ ) AND IMPEDANCE ( $Z_{ZT}$  &  $Z_{ZK}$ ) - Test conditions for Zener voltage and impedance are as follows;  $I_Z$  is applied 40  $\pm 10$  ms prior to reading. Mounting contacts are located from the inside edge of mounting clips to the body of the diode. ( $T_A=25\text{ }^\circ\text{C}$   $\pm 1\text{ }^\circ\text{C}$   $\pm 1\text{ }^\circ\text{C}$ ).

3. SURGE CURRENT ( $I_r$ ) - Surge current is specified as the maximum allowable peak, non-recurrent square-wave current with a pulse width, PW, of 8.3 ms. The data given in Figure 5 may be used to find the maximum surge current for a square wave of any pulse width between 1 ms and 1000ms by plotting the applicable points on logarithmic paper. Examples of this, using the 6.8v and 200V zeners, are shown in Figure 6. Mounting contact located as specified in Note 3. ( $T_A=25 \text{ }^\circ\text{C}$  at  $T_J$ ).
4. VOLTAGE REGULATION ( $\Delta V_z$ ) - Test conditions for voltage regulation are as follows:  $V_z$  measurements are made at 10% and then at 50% of the  $I_z$  max value listed in the electrical characteristics table. The test currents are the same for the 5% and 10% tolerance devices. The test current time duration for each  $V_z$  measurement is 40  $\pm$  10 ms. ( $T_A=25 \text{ }^\circ\text{C}$  at  $T_J$ ). Mounting contact located as specified in Note 2.
5. MAXIMUM REGULATOR CURRENT ( $I_{ZM}$ ) - The maximum current shown is based on the maximum voltage of a 5% type unit. Therefore, it applies only to the B-suffix device. The actual  $I_{ZM}$  for any device may not exceed the value of 5 watts divided by the actual  $V_z$  of the device.  $T_L=75 \text{ }^\circ\text{C}$  at maximum from the device body.

#### APPLICATION NOTE:

Since the actual voltage available from a given zener diode is temperature dependent, it is necessary to determine junction temperature under any set of operating conditions in order to calculate its value. The following procedure is recommended:

Lead Temperature,  $T_L$ , should be determined from:

$$T_L = \theta_{LA} P_D + T_A$$

$\theta_{LA}$  is the lead-to-ambient thermal resistance ( $^\circ\text{C}/\text{W}$ ) and  $P_D$  is the power dissipation.

Junction Temperature,  $T_J$ , may be found from:

$$T_J = T_L + \theta_{JT} \Delta T_{JL}$$

$\theta_{JT}$  is the increase in junction temperature above the lead temperature and may be found from Figure 3 for a train of power pulses or from Figure 4 for dc power.

$$\theta_{JT} = \theta_{JL} P_D$$

For worst-case design, using expected limits of  $I_z$ , limits

of  $P_D$  and the extremes of  $T_J(\theta_{JT})$  may be estimated.

Changes in voltage,  $V_z$ , can then be found from:

$$\Delta V_z = \theta_{VZ} \Delta T_J$$

$\theta_{VZ}$ , the zener voltage temperature coefficient, is found from Figures 2.

Under high power-pulse operation, the zener voltage will vary with time and may also be affected significantly by the zener resistance. For best regulation, keep current excursions as low as possible.

Data of Figure 3 should not be used to compute surge capability. Surge limitations are given in Figure 5. They are lower than would be expected by considering only junction temperature, as current crowding effects cause temperatures to be extremely high in small spots resulting in device degradation should the limits of Figure 5 be exceeded.

RATING AND CHARACTERISTICS CURVES  
1N5348B THRU 1N5388B

TEMPERATURE COEFFICIENTS

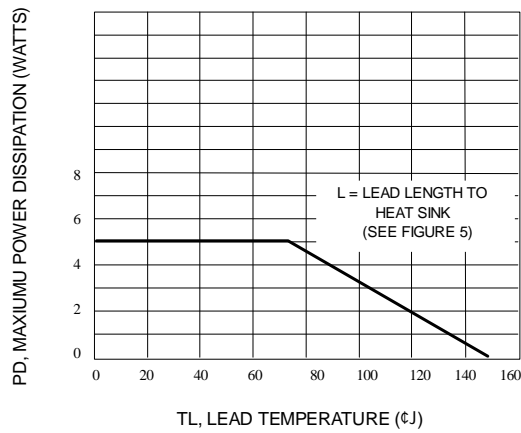


Fig. 1-POWER TEMPERATURE DERATING CURVE

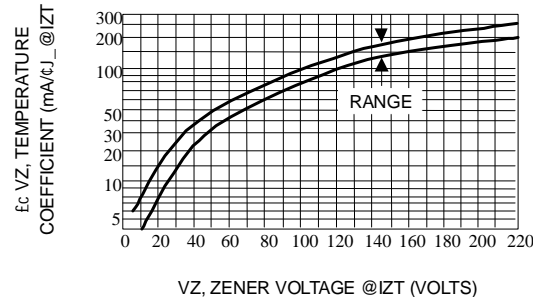


Fig. 2-TEMPERATURE COEFFICIENT-RANGE FOR UNITS 6 TO 220 VOLTS

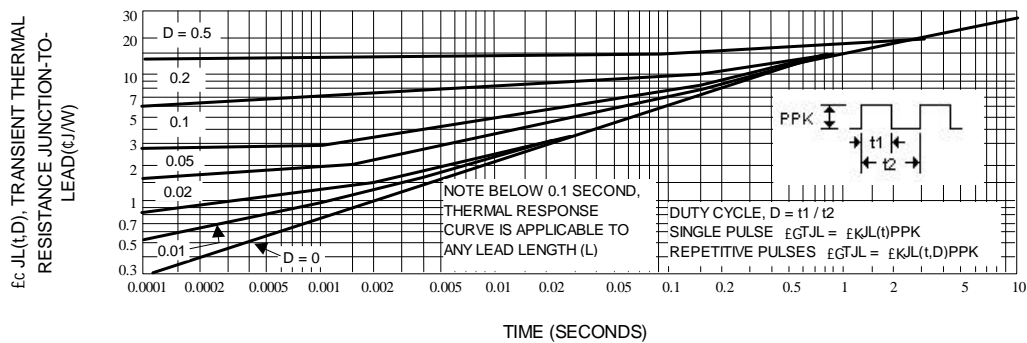


Fig. 3-TYPICAL THERMAL RESPONSE

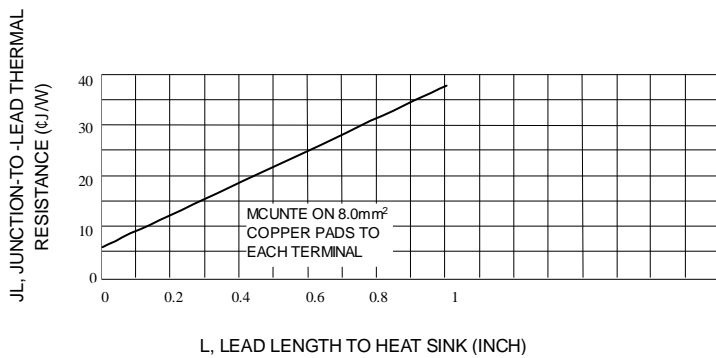


Fig. 4-TYPICAL THERMAL RESISTANCE

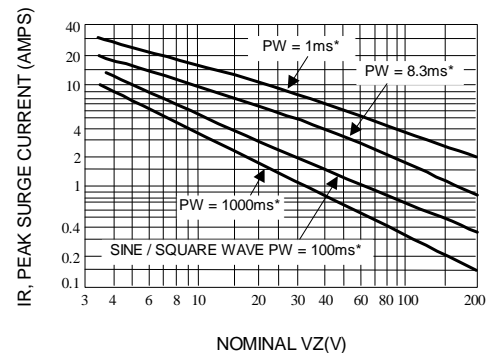


Fig. 5-MAXIMUM NON-REPETITIVE SURGE CURRENT VERSUS NOMINAL ZENER VOLTAGE (SEE NOTE 3)

RATING AND CHARACTERISTICS CURVES

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ZENER VOLTAGE VERSUS ZENER CURRENT  
(FIGURES 7,8, AND 9)

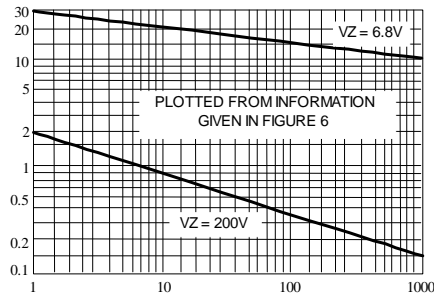


Fig. 6-PEAK SURGE CURRENT VERSUS PULSE WIDTH(SEE NOTE 3)

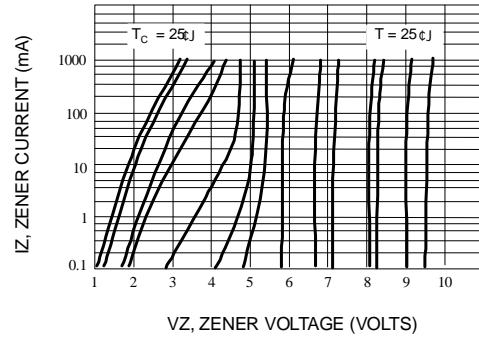


Fig. 7-ZENER VOLTAGE VERSUS ZENER CURRENT  
V<sub>Z</sub> = 6.8 THRU 10 VOLTS

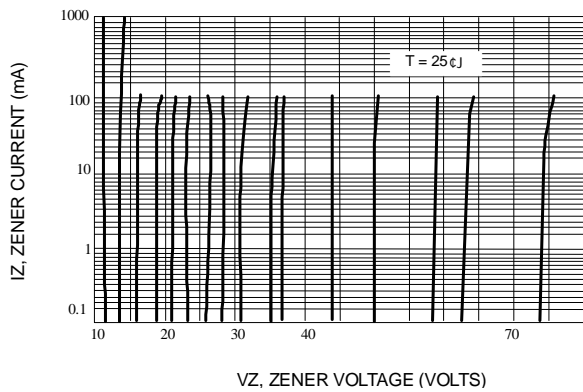


Fig. 8-ZENER VOLTAGE VERSUS ZENER CURRENT  
V<sub>Z</sub> = 11 THRU 75 VOLTS

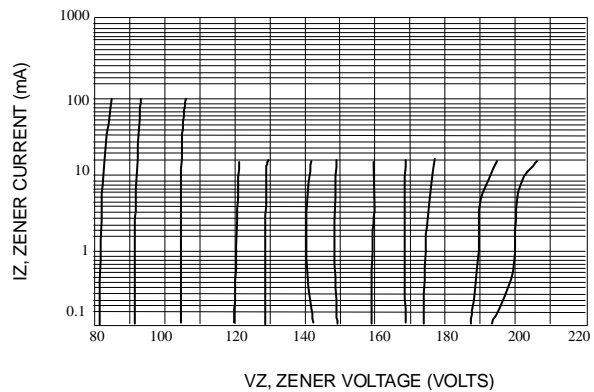


Fig. 9-ZENER VOLTAGE VERSUS ZENER CURRENT  
V<sub>Z</sub> = 82 THRU 200 VOLTS

\*\*\* Data of Figure 3 should not be used to compute surge capability. Surge limitations are given in Figure 5. They are lower than would be expected by considering only junction temperature, as current crowding effects cause temperatures to be extremely high in small spots resulting in device degradation should the limits of Figure. 5 be exceeded