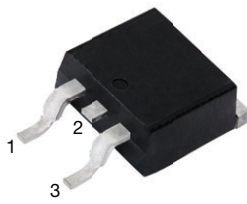
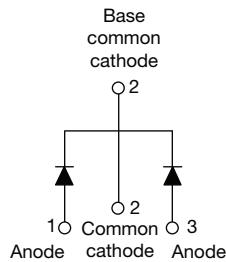
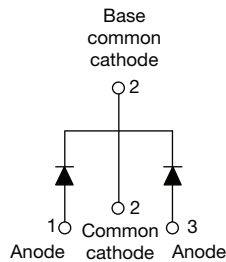


## High Performance Schottky Rectifier, 2 x 20 A


**D<sup>2</sup>PAK (TO-263AB)**

**VS-40CTQ045S-M3**

**TO-262AA**

**VS-40CTQ045-1-M3**

### FEATURES

- 150 °C T<sub>J</sub> operation
- Center tap configuration
- Very low forward voltage drop
- High frequency operation
- High purity, high temperature epoxy encapsulation for enhanced mechanical strength and moisture resistance
- Guard ring for enhanced ruggedness and long term reliability
- Meets MSL level 1, per J-STD-020, LF maximum peak of 245 °C
- Designed and qualified according to JEDEC®-JESD 47
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

### DESCRIPTION

This center tap Schottky rectifier has been optimized for very low forward voltage drop, with moderate leakage. The proprietary barrier technology allows for reliable operation up to 150 °C junction temperature. Typical applications are in switching power supplies, converters, freewheeling diodes, and reverse battery protection.

#### PRIMARY CHARACTERISTICS

|                                  |                                         |
|----------------------------------|-----------------------------------------|
| I <sub>F(AV)</sub>               | 2 x 20 A                                |
| V <sub>R</sub>                   | 45 V                                    |
| V <sub>F</sub> at I <sub>F</sub> | 0.48 V                                  |
| I <sub>RM</sub> max.             | 115 mA at 125 °C                        |
| T <sub>J</sub> max.              | 150 °C                                  |
| E <sub>AS</sub>                  | 20 mJ                                   |
| Package                          | D <sup>2</sup> PAK (TO-263AB), TO-262AA |
| Circuit configuration            | Common cathode                          |

#### MAJOR RATINGS AND CHARACTERISTICS

| SYMBOL             | CHARACTERISTICS                                        | VALUES      | UNITS |
|--------------------|--------------------------------------------------------|-------------|-------|
| I <sub>F(AV)</sub> | Rectangular waveform                                   | 40          | A     |
| V <sub>RRM</sub>   |                                                        | 45          | V     |
| I <sub>FSM</sub>   | t <sub>p</sub> = 5 μs sine                             | 1240        | A     |
| V <sub>F</sub>     | 20 A <sub>pk</sub> , T <sub>J</sub> = 125 °C (per leg) | 0.48        | V     |
| T <sub>J</sub>     | Range                                                  | -55 to +150 | °C    |

#### VOLTAGE RATINGS

| PARAMETER                            | SYMBOL           | VS-40CTQ045S-M3<br>VS-40CTQ045-1-M3 | UNITS |
|--------------------------------------|------------------|-------------------------------------|-------|
| Maximum DC reverse voltage           | V <sub>R</sub>   | 45                                  | V     |
| Maximum working peak reverse voltage | V <sub>RWM</sub> |                                     |       |

**ABSOLUTE MAXIMUM RATINGS**

| PARAMETER                                                                 | SYMBOL      | TEST CONDITIONS                                                                                                           | VALUES | UNITS |
|---------------------------------------------------------------------------|-------------|---------------------------------------------------------------------------------------------------------------------------|--------|-------|
| Maximum average forward current<br>per leg<br>See fig. 5                  | $I_{F(AV)}$ | 50 % duty cycle at $T_C = 116\text{ }^{\circ}\text{C}$ , rectangular waveform                                             | 20     | A     |
| per device                                                                |             |                                                                                                                           | 40     |       |
| Maximum peak one cycle non-repetitive surge current per leg<br>See fig. 7 | $I_{FSM}$   | 5 $\mu\text{s}$ sine or 3 $\mu\text{s}$ rect. pulse                                                                       | 1240   |       |
|                                                                           |             | 10 ms sine or 6 ms rect. pulse                                                                                            | 350    |       |
| Non-repetitive avalanche energy per leg                                   | $E_{AS}$    | $T_J = 25\text{ }^{\circ}\text{C}$ , $I_{AS} = 3\text{ A}$ , $L = 4.40\text{ mH}$                                         | 20     | mJ    |
| Repetitive avalanche current per leg                                      | $I_{AR}$    | Current decaying linearly to zero in 1 $\mu\text{s}$<br>Frequency limited by $T_J$ maximum $V_A = 1.5 \times V_R$ typical | 3      | A     |

**ELECTRICAL SPECIFICATIONS**

| PARAMETER                                             | SYMBOL         | TEST CONDITIONS                                                                            | VALUES | UNITS            |
|-------------------------------------------------------|----------------|--------------------------------------------------------------------------------------------|--------|------------------|
| Maximum forward voltage drop per leg<br>See fig. 1    | $V_{FM}^{(1)}$ | 20 A                                                                                       | 0.53   | V                |
|                                                       |                | 40 A                                                                                       | 0.68   |                  |
|                                                       |                | 20 A                                                                                       | 0.48   |                  |
|                                                       |                | 40 A                                                                                       | 0.67   |                  |
| Maximum reverse leakage current per leg<br>See fig. 2 | $I_{RM}^{(1)}$ | $T_J = 25\text{ }^{\circ}\text{C}$                                                         | 3      | mA               |
|                                                       |                | $T_J = 125\text{ }^{\circ}\text{C}$                                                        | 115    |                  |
| Threshold voltage                                     | $V_{F(TO)}$    | $T_J = T_J$ maximum                                                                        | 0.27   | V                |
| Forward slope resistance                              | $r_t$          |                                                                                            | 8.72   | m $\Omega$       |
| Maximum junction capacitance per leg                  | $C_T$          | $V_R = 5\text{ V}_{DC}$ (test signal range 100 kHz to 1 MHz), $25\text{ }^{\circ}\text{C}$ | 2800   | pF               |
| Typical series inductance per leg                     | $L_S$          | Measured lead to lead 5 mm from package body                                               | 8.0    | nH               |
| Maximum voltage rate of change                        | $dV/dt$        | Rated $V_R$                                                                                | 10 000 | V/ $\mu\text{s}$ |

**Note**(1) Pulse width < 300  $\mu\text{s}$ , duty cycle < 2 %**THERMAL - MECHANICAL SPECIFICATIONS**

| PARAMETER                                                | SYMBOL                            | TEST CONDITIONS                          | VALUES     | UNITS                  |
|----------------------------------------------------------|-----------------------------------|------------------------------------------|------------|------------------------|
| Maximum junction and storage temperature range           | T <sub>J</sub> , T <sub>Stg</sub> |                                          | -55 to 150 | °C                     |
| Maximum thermal resistance, junction to case per leg     | R <sub>thJC</sub>                 | DC operation                             | 2.0        | °C/W                   |
| Maximum thermal resistance, junction to case per package |                                   |                                          | 1.0        |                        |
| Typical thermal resistance, case to heatsink             | R <sub>thCS</sub>                 | Mounting surface, smooth and greased     | 0.50       |                        |
| Approximate weight                                       |                                   |                                          | 2          | g                      |
|                                                          |                                   |                                          | 0.07       | oz.                    |
| Mounting torque                                          | minimum                           |                                          | 6 (5)      | kgf · cm<br>(lbf · in) |
|                                                          | maximum                           |                                          | 12 (10)    |                        |
| Marking device                                           |                                   | Case style D <sup>2</sup> PAK (TO-263AB) | 40CTQ045S  |                        |
|                                                          |                                   | Case style TO-262AA                      | 40CTQ045-1 |                        |

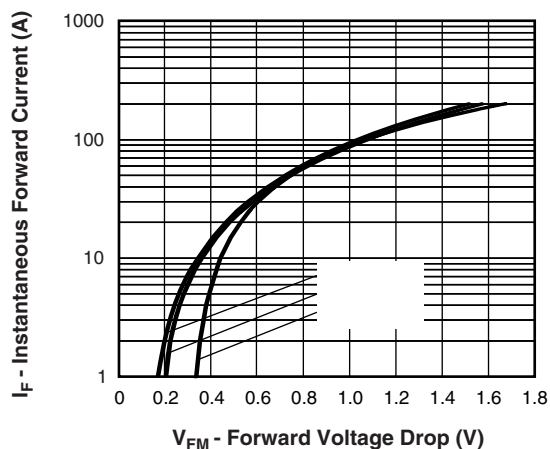


Fig. 1 - Maximum Forward Voltage Drop Characteristics (Per Leg)

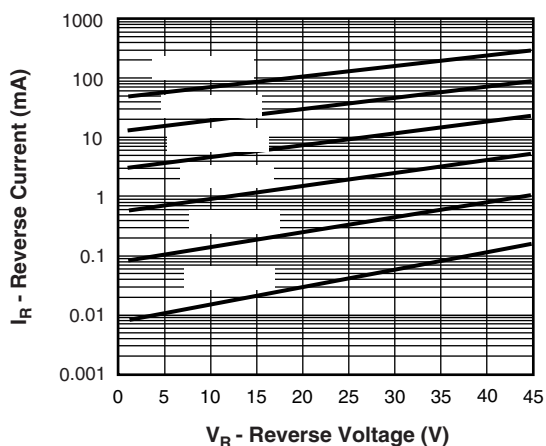


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage (Per Leg)

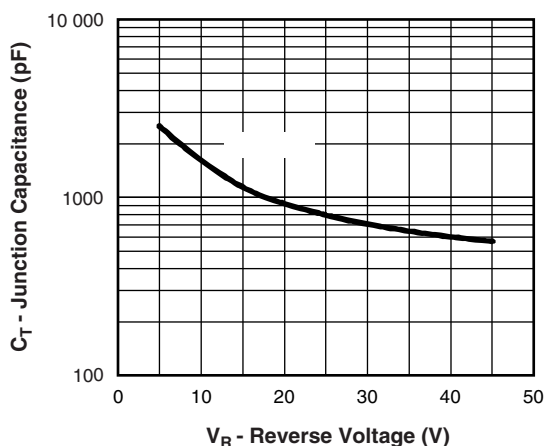


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage (Per Leg)

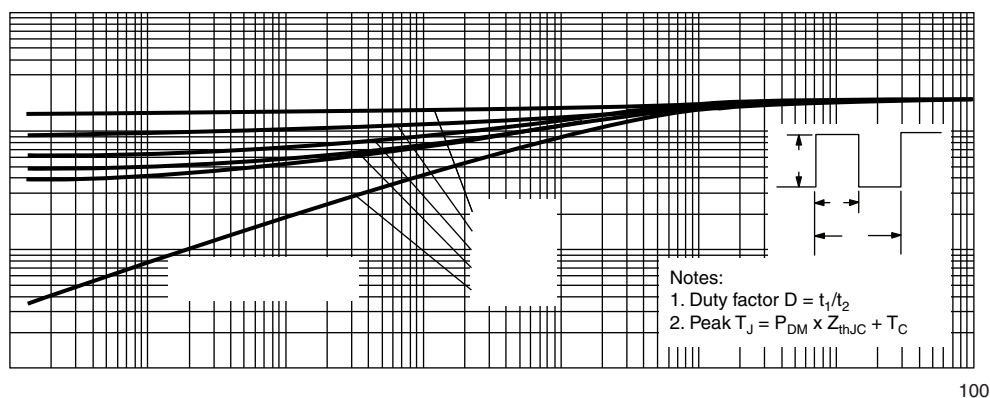


Fig. 4 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics (Per Leg)

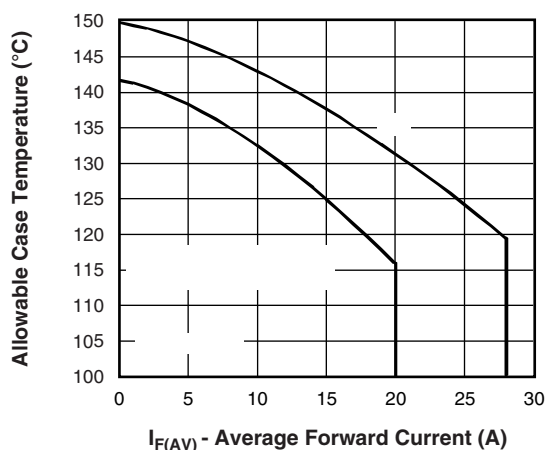


Fig. 5 - Maximum Allowable Case Temperature vs. Average Forward Current (Per Leg)

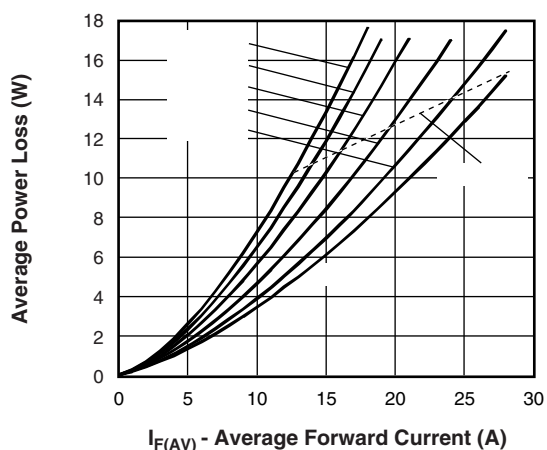


Fig. 6 - Forward Power Loss Characteristics (Per Leg)

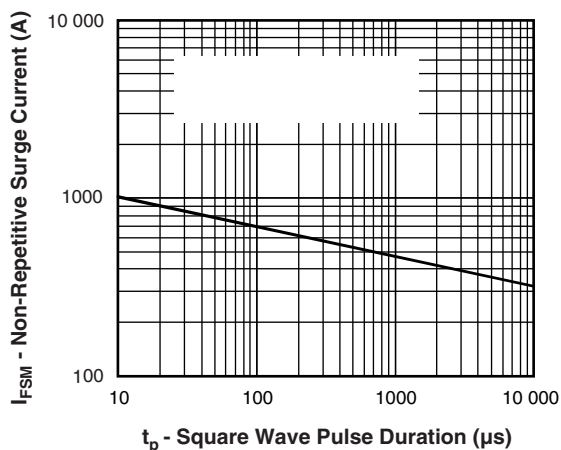


Fig. 7 - Maximum Non-Repetitive Surge Current (Per Leg)

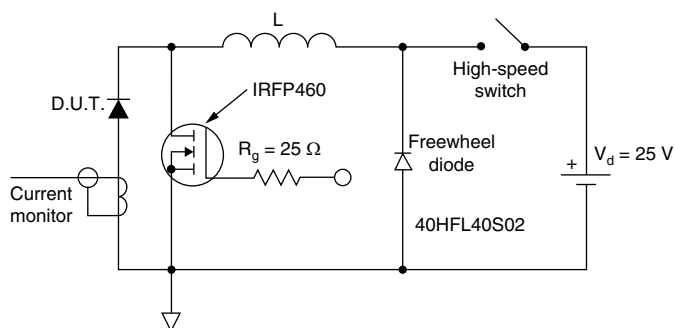


Fig. 8 - Unclamped Inductive Test Circuit

#### Note

- (1) Formula used:  $T_C = T_J - (P_d + P_{dREV}) \times R_{thJC}$ ;  
 $P_d$  = forward power loss =  $I_{F(AV)} \times V_{FM}$  at  $(I_{F(AV)}/D)$  (see fig. 6);  
 $P_{dREV}$  = inverse power loss =  $V_{R1} \times I_R (1 - D)$ ;  $I_R$  at  $V_{R1} = 10\text{ V}$

**ORDERING INFORMATION TABLE**

|             |            |           |          |          |          |            |          |            |            |
|-------------|------------|-----------|----------|----------|----------|------------|----------|------------|------------|
| Device code | <b>VS-</b> | <b>40</b> | <b>C</b> | <b>T</b> | <b>Q</b> | <b>045</b> | <b>S</b> | <b>TRL</b> | <b>-M3</b> |
|             | 1          | 2         | 3        | 4        | 5        | 6          | 7        | 8          | 9          |

- |          |   |                                                                                                                                                                                    |
|----------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1</b> | - | Vishay Semiconductors product                                                                                                                                                      |
| <b>2</b> | - | Current rating (40 A)                                                                                                                                                              |
| <b>3</b> | - | Circuit configuration: C = common cathode                                                                                                                                          |
| <b>4</b> | - | T = TO-220                                                                                                                                                                         |
| <b>5</b> | - | Schottky "Q" series                                                                                                                                                                |
| <b>6</b> | - | Voltage rating (045 = 45 V)                                                                                                                                                        |
| <b>7</b> | - | • S = D <sup>2</sup> PAK (TO-263AB)<br>• -1 = TO-262AA                                                                                                                             |
| <b>8</b> | - | • None = tube<br>• TRL = tape and reel (left oriented - for D <sup>2</sup> PAK (TO-263AB) only)<br>• TRR = tape and reel (right oriented - for D <sup>2</sup> PAK (TO-263AB) only) |
| <b>9</b> | - | -M3 = halogen-free, RoHS-compliant, and termination lead (Pb)-free                                                                                                                 |

**ORDERING INFORMATION**

| PREFERRED P/N      | QUANTITY PER T/R | MINIMUM ORDER QUANTITY | PACKAGING DESCRIPTION    |
|--------------------|------------------|------------------------|--------------------------|
| VS-40CTQ045S-M3    | 50               | 1000                   | Antistatic plastic tubes |
| VS-40CTQ045STRR-M3 | 800              | 800                    | 13" diameter reel        |
| VS-40CTQ045STRL-M3 | 800              | 800                    | 13" diameter reel        |
| VS-40CTQ045-1-M3   | 50               | 1000                   | Antistatic plastic tubes |

**LINKS TO RELATED DOCUMENTS**

|                          |                               |                                                                        |
|--------------------------|-------------------------------|------------------------------------------------------------------------|
| Dimensions               | D <sup>2</sup> PAK (TO-263AB) | <a href="http://www.vishay.com/doc?96164">www.vishay.com/doc?96164</a> |
|                          | TO-262AA                      | <a href="http://www.vishay.com/doc?96165">www.vishay.com/doc?96165</a> |
| Part marking information | D <sup>2</sup> PAK (TO-263AB) | <a href="http://www.vishay.com/doc?95444">www.vishay.com/doc?95444</a> |
|                          | TO-262AA                      | <a href="http://www.vishay.com/doc?95443">www.vishay.com/doc?95443</a> |
| Packaging information    |                               | <a href="http://www.vishay.com/doc?96424">www.vishay.com/doc?96424</a> |



## D<sup>2</sup>PAK

### DIMENSIONS in millimeters and inches

Conforms to JEDEC® outline D<sup>2</sup>PAK (SMD-220)



| SYMBOL | MILLIMETERS |       | INCHES |       | NOTES |
|--------|-------------|-------|--------|-------|-------|
|        | MIN.        | MAX.  | MIN.   | MAX.  |       |
| A      | 4.06        | 4.83  | 0.160  | 0.190 |       |
| A1     | 0.00        | 0.254 | 0.000  | 0.010 |       |
| b      | 0.51        | 0.99  | 0.020  | 0.039 |       |
| b1     | 0.51        | 0.89  | 0.020  | 0.035 | 4     |
| b2     | 1.14        | 1.78  | 0.045  | 0.070 |       |
| b3     | 1.14        | 1.73  | 0.045  | 0.068 | 4     |
| c      | 0.38        | 0.74  | 0.015  | 0.029 |       |
| c1     | 0.38        | 0.58  | 0.015  | 0.023 | 4     |
| c2     | 1.14        | 1.65  | 0.045  | 0.065 |       |
| D      | 8.51        | 9.65  | 0.335  | 0.380 | 2     |

| SYMBOL | MILLIMETERS |       | INCHES    |       | NOTES |
|--------|-------------|-------|-----------|-------|-------|
|        | MIN.        | MAX.  | MIN.      | MAX.  |       |
| D1     | 6.86        | 8.00  | 0.270     | 0.315 | 3     |
| E      | 9.65        | 10.67 | 0.380     | 0.420 | 2, 3  |
| E1     | 7.90        | 8.80  | 0.311     | 0.346 | 3     |
| e      | 2.54 BSC    |       | 0.100 BSC |       |       |
| H      | 14.61       | 15.88 | 0.575     | 0.625 |       |
| L      | 1.78        | 2.79  | 0.070     | 0.110 |       |
| L1     | -           | 1.65  | -         | 0.066 | 3     |
| L2     | 1.27        | 1.78  | 0.050     | 0.070 |       |
| L3     | 0.25 BSC    |       | 0.010 BSC |       |       |
| L4     | 4.78        | 5.28  | 0.188     | 0.208 |       |

#### Notes

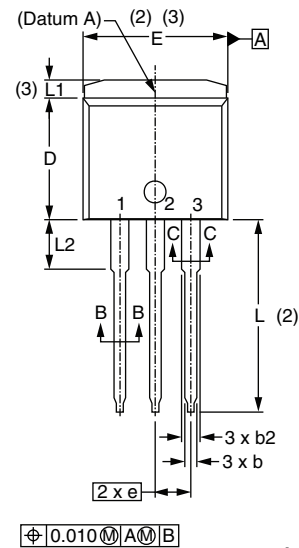
- (1) Dimensioning and tolerancing per ASME Y14.5 M-1994
- (2) Dimension D and E do not include mold flash. Mold flash shall not exceed 0.127 mm (0.005") per side. These dimensions are measured at the outmost extremes of the plastic body
- (3) Thermal pad contour optional within dimension E, L1, D1 and E1
- (4) Dimension b1 and c1 apply to base metal only
- (5) Datum A and B to be determined at datum plane H
- (6) Controlling dimension: inch
- (7) Outline conforms to JEDEC® outline TO-263AB



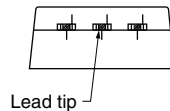
### TO-262

#### DIMENSIONS in millimeters and inches

##### Modified JEDEC outline TO-262



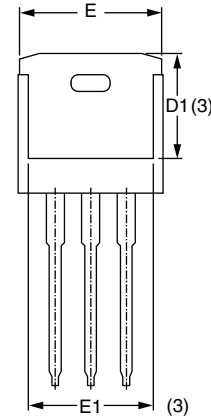
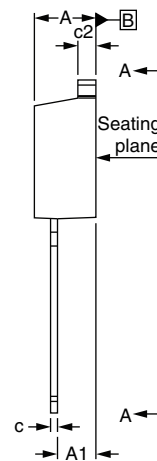
$\pm 0.010$  (A) (B)



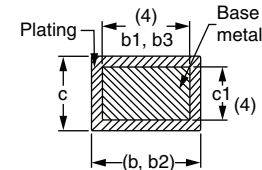
##### Lead assignments

##### Diodes

1. - Anode (two die)/open (one die)
2. - Cathode
3. - Anode



##### Section A - A



##### Section B - B and C - C

Scale: None

| SYMBOL | MILLIMETERS |       | INCHES    |       | NOTES |
|--------|-------------|-------|-----------|-------|-------|
|        | MIN.        | MAX.  | MIN.      | MAX.  |       |
| A      | 4.06        | 4.83  | 0.160     | 0.190 |       |
| A1     | 2.03        | 3.02  | 0.080     | 0.119 |       |
| b      | 0.51        | 0.99  | 0.020     | 0.039 |       |
| b1     | 0.51        | 0.89  | 0.020     | 0.035 | 4     |
| b2     | 1.14        | 1.78  | 0.045     | 0.070 |       |
| b3     | 1.14        | 1.73  | 0.045     | 0.068 | 4     |
| c      | 0.38        | 0.74  | 0.015     | 0.029 |       |
| c1     | 0.38        | 0.58  | 0.015     | 0.023 | 4     |
| c2     | 1.14        | 1.65  | 0.045     | 0.065 |       |
| D      | 8.51        | 9.65  | 0.335     | 0.380 | 2     |
| D1     | 6.86        | 8.00  | 0.270     | 0.315 | 3     |
| E      | 9.65        | 10.67 | 0.380     | 0.420 | 2, 3  |
| E1     | 7.90        | 8.80  | 0.311     | 0.346 | 3     |
| e      | 2.54 BSC    |       | 0.100 BSC |       |       |
| L      | 13.46       | 14.10 | 0.530     | 0.555 |       |
| L1     | -           | 1.65  | -         | 0.065 | 3     |
| L2     | 3.56        | 3.71  | 0.140     | 0.146 |       |

##### Notes

- (1) Dimensioning and tolerancing as per ASME Y14.5M-1994
- (2) Dimension D and E do not include mold flash. Mold flash shall not exceed 0.127 mm (0.005") per side. These dimensions are measured at the outmost extremes of the plastic body
- (3) Thermal pad contour optional within dimension E, L1, D1 and E1
- (4) Dimension b1 and c1 apply to base metal only
- (5) Controlling dimension: inches
- (6) Outline conform to JEDEC TO-262 except A1 (maximum), b (minimum) and D1 (minimum) where dimensions derived the actual package outline

## TO-262



Example: This is a xxxxxx-1 <sup>(1)</sup> with assembly lot code AC, assembled on WW 19, 2001 in the assembly line "X"

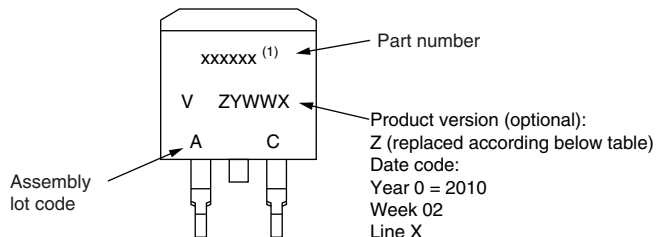
### Note

<sup>(1)</sup> If part number contain "H" as last digit, product is AEC-Q101 qualified

| ENVIRONMENTAL NAMING CODE (Z) | PRODUCT DEFINITION                                          |
|-------------------------------|-------------------------------------------------------------|
| A                             | Termination lead (Pb)-free                                  |
| B                             | Totally lead (Pb)-free                                      |
| E                             | RoHS-compliant and termination lead (Pb)-free               |
| F                             | RoHS-compliant and totally lead (Pb)-free                   |
| M                             | Halogen-free, RoHS-compliant and termination lead (Pb)-free |
| N                             | Halogen-free, RoHS-compliant and totally lead (Pb)-free     |
| G                             | Green                                                       |



## D<sup>2</sup>PAK



Example: This is a xxxxxx <sup>(1)</sup> with assembly lot code AC, assembled on WW 02, 2010

### Note

<sup>(1)</sup> If part number contain "H" as last digit, product is AEC-Q101 qualified

| ENVIRONMENTAL NAMING CODE (Z) | PRODUCT DEFINITION                                           |
|-------------------------------|--------------------------------------------------------------|
| A                             | Termination lead (Pb)-free                                   |
| B                             | Totally lead (Pb)-free                                       |
| E                             | RoHS-compliant and termination lead (Pb)-free                |
| F                             | RoHS-compliant and totally lead (Pb)-free                    |
| M                             | Halogen-free, RoHS-compliant, and termination lead (Pb)-free |
| N                             | Halogen-free, RoHS-compliant, and totally lead (Pb)-free     |
| G                             | Green                                                        |



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