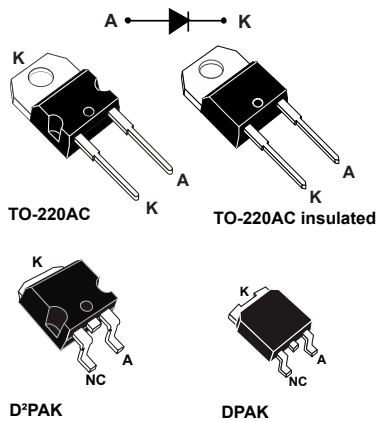


650 V, 10 A high surge silicon carbide power Schottky diode



Features

- No reverse recovery charge in application current range
- Switching behavior independent of temperature
- High forward surge capability
- Insulated package TO-220AC Ins:
 - Insulated voltage: 2500 V_{RMS}
 - Typical package capacitance: 7 pF
- Power efficient product
- ECOPACK®2 compliant component


Applications

- Switch mode power supply
- PFC
- DCDC converters
- LLC topologies
- Boost diode

Description

This 10 A, 650 V SiC diode is an ultrahigh performance power Schottky diode. It is manufactured using a silicon carbide substrate. The wide band gap material allows the design of a Schottky diode structure with a 650 V rating. Due to the Schottky construction, no recovery is shown at turn-off and ringing patterns are negligible. The minimal capacitive turn-off behavior is independent of temperature.

This **STPSC10H065** is especially suited for use in PFC applications. This ST SiC diode will boost the performance in hard switching conditions. Its high forward surge capability ensures a good robustness during transient phases.

| Product status | |
|---|--------|
| STPSC10H065 | |
| Product summary | |
| Symbol | Value |
| I _{F(AV)} | 10 A |
| V _{RRM} | 650 V |
| T _{j(max.)} | 175 °C |
| Product label | |
|  | |

1 Characteristics

Table 1. Absolute ratings (limiting values at 25 °C, unless otherwise specified)

| Symbol | Parameter | | Value | Unit |
|--------------|---|---|-------------|------|
| V_{RRM} | Repetitive peak reverse voltage | | 650 | V |
| $I_{F(RMS)}$ | Forward rms current | | 22 | A |
| $I_{F(AV)}$ | Average forward current | TO-220AC, DPAK, D ² PAK, $T_C = 135\text{ °C}$, DC ⁽¹⁾ | 10 | A |
| | | TO-220AC Ins, $T_C = 85\text{ °C}$, DC ⁽¹⁾ | | |
| I_{FRM} | Repetitive peak forward current | TO-220AC, DPAK, D ² PAK, $T_C = 135\text{ °C}$, $T_j = 175\text{ °C}$, $\delta = 0.1$ ⁽¹⁾ | 41 | A |
| | | TO-220AC Ins, $T_C = 85\text{ °C}$, $T_j = 175\text{ °C}$, $\delta = 0.1$ ⁽¹⁾ | | |
| I_{FSM} | Surge non repetitive forward current | $t_p = 10\text{ ms}$ sinusoidal, $T_C = 25\text{ °C}$ | 90 | A |
| | | $t_p = 10\text{ ms}$ sinusoidal, $T_C = 125\text{ °C}$ | 80 | |
| | | $t_p = 10\text{ }\mu\text{s}$ square, $T_C = 25\text{ °C}$ | 470 | |
| T_{stg} | Storage temperature range | | -55 to +175 | °C |
| T_j | Operating junction temperature range ⁽²⁾ | | -40 to +175 | °C |

1. Value based on $R_{th(j-c)}$ max.

2. $(dP_{tot}/dT_j) < (1/R_{th(j-a)})$ condition to avoid thermal runaway for a diode on its own heatsink.

Table 2. Thermal resistance parameters

| Symbol | Parameter | | Typ. value | Max. value | Unit |
|---------------|------------------|------------------------------------|------------|------------|------|
| $R_{th(j-c)}$ | Junction to case | TO-220AC, DPAK, D ² PAK | 1.25 | 1.5 | °C/W |
| | | TO-220AC Ins. | 2.1 | 3.5 | |

Table 3. Static electrical characteristics

| Symbol | Parameter | Test conditions | | Min. | Typ. | Max. | Unit |
|----------------------|-------------------------|-----------------------|---------------------|------|------|------|---------------|
| I_R ⁽¹⁾ | Reverse leakage current | $T_j = 25\text{ °C}$ | $V_R = V_{RRM}$ | - | 9 | 100 | μA |
| | | $T_j = 150\text{ °C}$ | | - | 85 | 425 | |
| V_F ⁽²⁾ | Forward voltage drop | $T_j = 25\text{ °C}$ | $I_F = 10\text{ A}$ | - | 1.56 | 1.75 | V |
| | | $T_j = 150\text{ °C}$ | | - | 1.98 | 2.5 | |

1. Pulse test: $t_p = 10\text{ ms}$, $\delta < 2\%$

2. Pulse test: $t_p = 500\text{ }\mu\text{s}$, $\delta < 2\%$

To evaluate the conduction losses, use the following equation:

$$P = 1.35 \times I_{F(AV)} + 0.115 \times I_F^2 (RMS)$$

For more information, please refer to the following application notes related to the power losses :

- AN604: Calculation of conduction losses in a power rectifier
- AN4021: Calculation of reverse losses on a power diode

Table 4. Dynamic electrical characteristics

| Symbol | Parameter | Test conditions | Typ. | Unit |
|----------------|-------------------------|---|------|------|
| $Q_{Cj}^{(1)}$ | Total capacitive charge | $V_R = 400 \text{ V}$ | 28.5 | nC |
| C_j | Total capacitance | $V_R = 0 \text{ V}, T_c = 25 \text{ }^\circ\text{C}, F = 1 \text{ MHz}$ | 480 | pF |
| | | $V_R = 400 \text{ V}, T_c = 25 \text{ }^\circ\text{C}, F = 1 \text{ MHz}$ | 48 | |

1. Most accurate value for the capacitive charge:

$$Q_{Cj} = \int_0^{V_{OUT}} C_J(V_R) \cdot dV_R \quad (1)$$

1.1 Characteristics (curves)

Figure 1. Forward voltage drop versus forward current (typical values, low level)

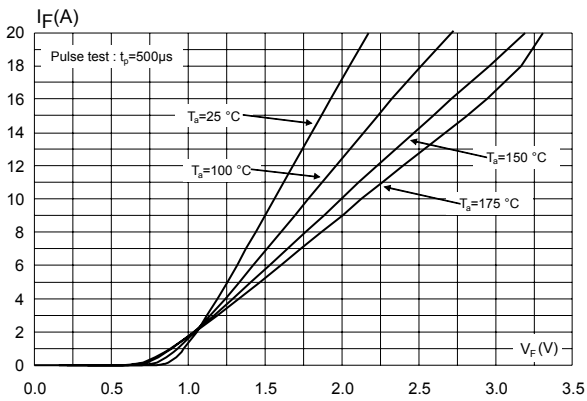


Figure 2. Forward voltage drop versus forward current (typical values, high level)

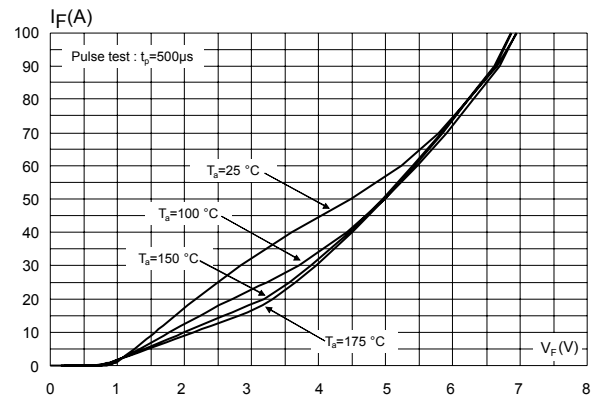


Figure 3. Reverse leakage current versus reverse voltage applied (typical values)

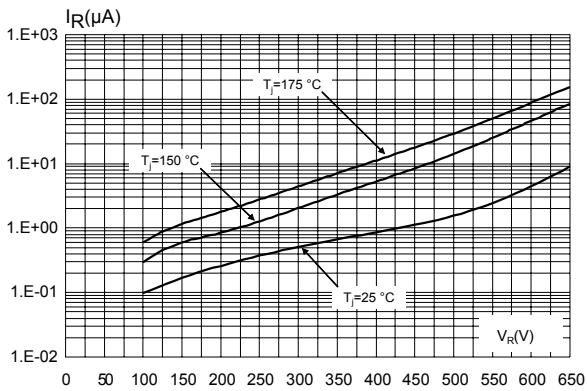


Figure 4. Peak forward current versus case temperature (TO-220AC, DPAK, D²PAK)

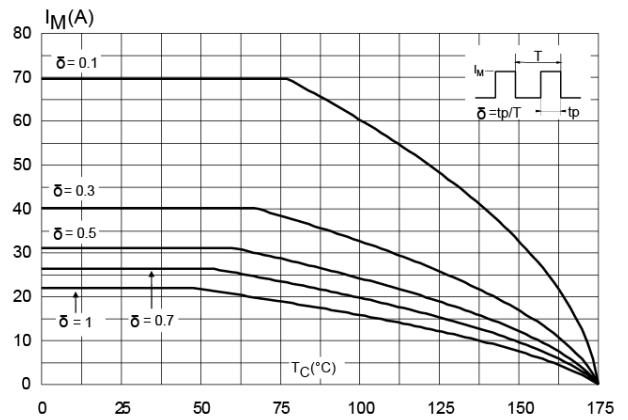


Figure 5. Peak forward current versus case temperature (TO-220AC Ins)

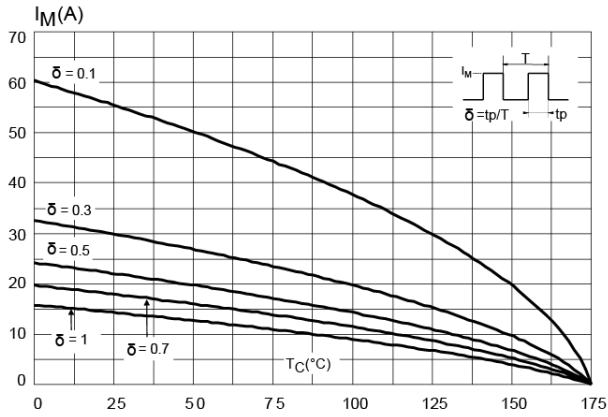


Figure 6. Junction capacitance versus reverse voltage applied (typical values)

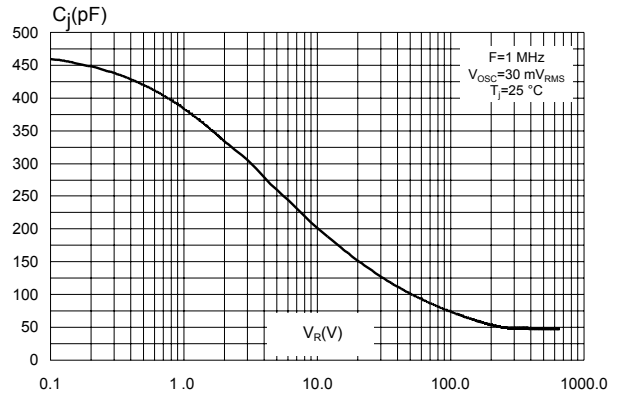


Figure 7. Relative variation of thermal impedance junction to case versus pulse duration (TO-220AC, DPAK and D²PAK)

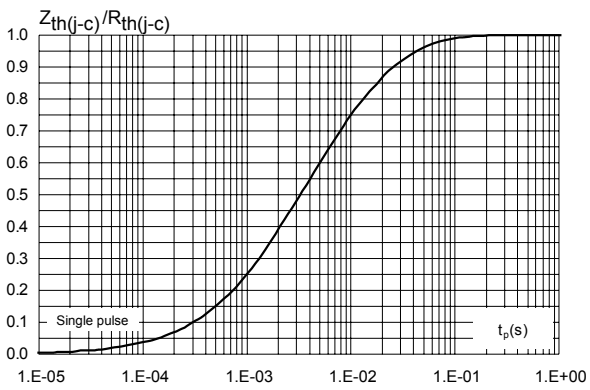


Figure 8. Relative variation of thermal impedance junction to case versus pulse duration (TO-220AC Ins)

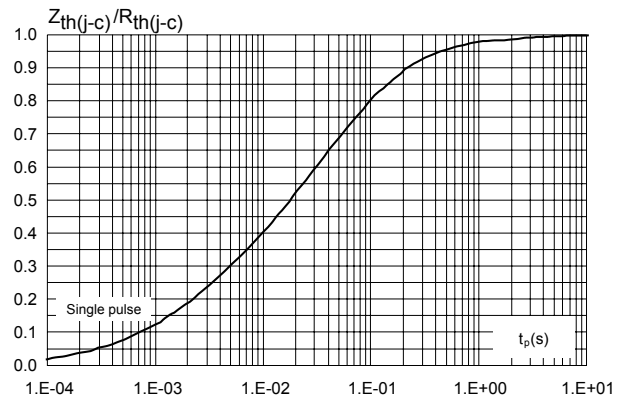


Figure 9. Non-repetitive peak surge forward current versus pulse duration (sinusoidal waveform)

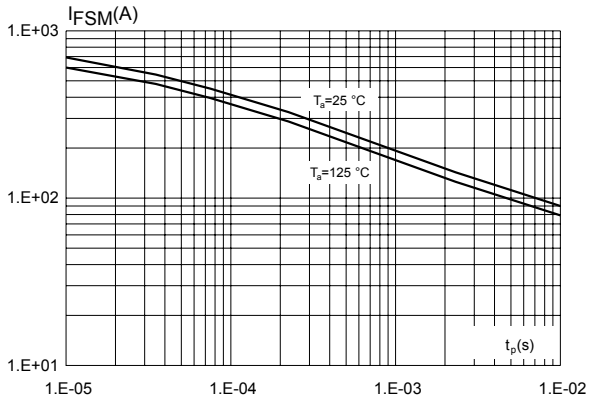


Figure 10. Total capacitive charges versus reverse voltage applied (typical values)

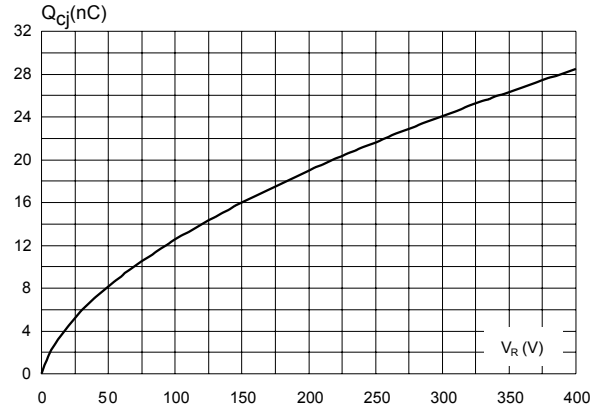
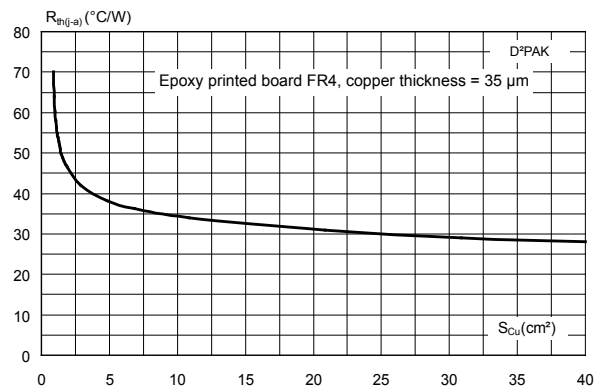


Figure 11. Thermal resistance junction to ambient versus copper surface under tab for D²PAK package (typical values)



2 Package information

In order to meet environmental requirements, ST offers these devices in different grades of **ECOPACK** packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions and product status are available at: www.st.com. ECOPACK is an ST trademark.

2.1 DPAK package information

- Epoxy meets UL94, V0

Figure 12. DPAK package outline

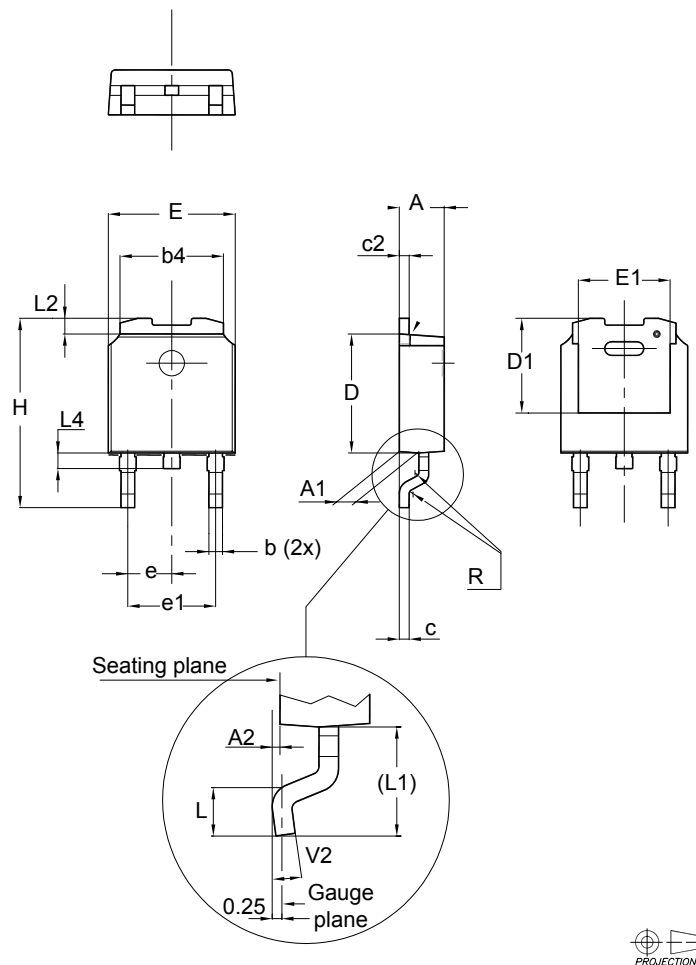
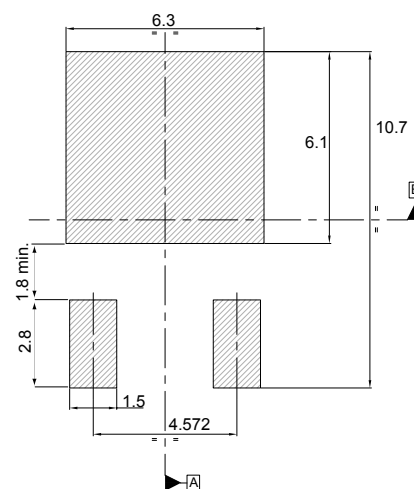


Table 5. DPAK mechanical data

| Dim. | Dimensions | | | | | |
|------|-------------|-------|-------|-----------------------|-------|-------|
| | Millimeters | | | Inches ⁽¹⁾ | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | 2.20 | | 2.40 | 0.087 | | 0.094 |
| A1 | 0.90 | | 1.10 | 0.035 | | 0.043 |
| A2 | 0.03 | | 0.23 | 0.001 | | 0.009 |
| b | 0.64 | | 0.90 | 0.025 | | 0.035 |
| b4 | 5.20 | | 5.40 | 0.205 | | 0.213 |
| c | 0.45 | | 0.60 | 0.018 | | 0.024 |
| c2 | 0.48 | | 0.60 | 0.019 | | 0.024 |
| D | 6.00 | | 6.20 | 0.236 | | 0.244 |
| D1 | 4.95 | 5.10 | 5.25 | 0.195 | 0.201 | 0.207 |
| E | 6.40 | | 6.60 | 0.252 | | 0.260 |
| E1 | 4.60 | 4.70 | 4.80 | 0.181 | 0.185 | 0.189 |
| e | 2.159 | 2.286 | 2.413 | 0.085 | 0.090 | 0.095 |
| e1 | 4.445 | 4.572 | 4.699 | 0.175 | 0.180 | 0.185 |
| H | 9.35 | | 10.10 | 0.368 | | 0.398 |
| L | 1.00 | | 1.50 | 0.039 | | 0.059 |
| (L1) | 2.60 | 2.80 | 3.00 | 0.102 | 0.110 | 0.118 |
| L2 | 0.65 | 0.80 | 0.95 | 0.026 | 0.031 | 0.037 |
| L4 | 0.60 | | 1.00 | 0.024 | | 0.039 |
| R | | 0.20 | | | 0.008 | |
| V2 | 0° | | 8° | 0° | | 8° |

1. Inches dimensions given for reference only

Figure 13. DPAK recommended footprint (dimensions are in mm)

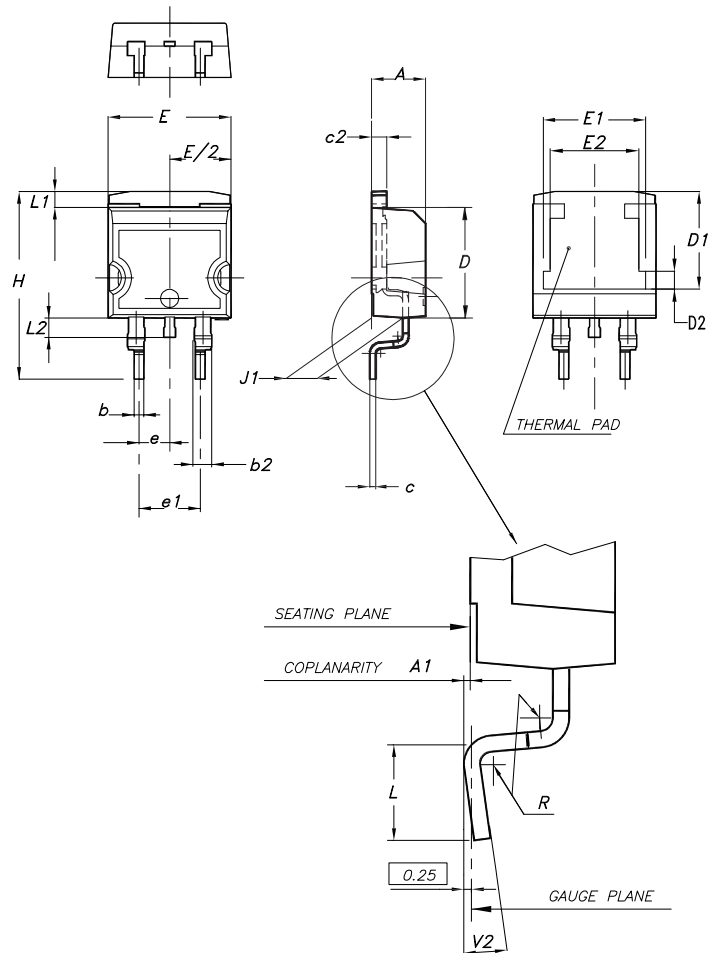


The device must be positioned within $\oplus 0.05$ A B

2.2 D²PAK package information

- Epoxy meets UL94, V0.
- Cooling method: by conduction (C)

Figure 14. D²PAK package outline

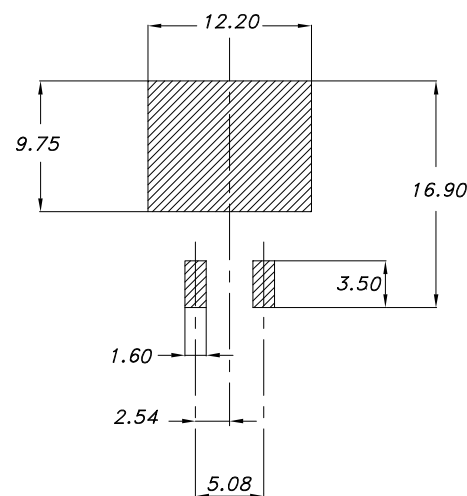


Note: This package drawing may slightly differ from the physical package. However, all the specified dimensions are guaranteed.

Table 6. D²PAK package mechanical data

| Ref. | Dimensions | | | | | |
|------|-------------|------|-------|-----------------------------|-------|-------|
| | Millimeters | | | Inches (for reference only) | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | 4.40 | | 4.60 | 0.173 | | 0.181 |
| A1 | 0.03 | | 0.23 | 0.001 | | 0.009 |
| b | 0.70 | | 0.93 | 0.028 | | 0.037 |
| b2 | 1.14 | | 1.70 | 0.045 | | 0.067 |
| c | 0.45 | | 0.60 | 0.018 | | 0.024 |
| c2 | 1.23 | | 1.36 | 0.048 | | 0.053 |
| D | 8.95 | | 9.35 | 0.352 | | 0.368 |
| D1 | 7.50 | 7.75 | 8.00 | 0.295 | 0.305 | 0.315 |
| D2 | 1.10 | 1.30 | 1.50 | 0.043 | 0.051 | 0.060 |
| E | 10.00 | | 10.40 | 0.394 | | 0.409 |
| E1 | 8.30 | 8.50 | 8.70 | 0.335 | 0.343 | 0.346 |
| E2 | 6.85 | 7.05 | 7.25 | 0.266 | 0.278 | 0.282 |
| e | | 2.54 | | | 0.100 | |
| e1 | 4.88 | | 5.28 | 0.190 | | 0.205 |
| H | 15.00 | | 15.85 | 0.591 | | 0.624 |
| J1 | 2.49 | | 2.69 | 0.097 | | 0.106 |
| L | 2.29 | | 2.79 | 0.090 | | 0.110 |
| L1 | 1.27 | | 1.40 | 0.049 | | 0.055 |
| L2 | 1.30 | | 1.75 | 0.050 | | 0.069 |
| R | | 0.40 | | | 0.015 | |
| V2 | 0° | | 8° | 0° | | 8° |

Figure 15. D²PAK recommended footprint (dimensions are in mm)

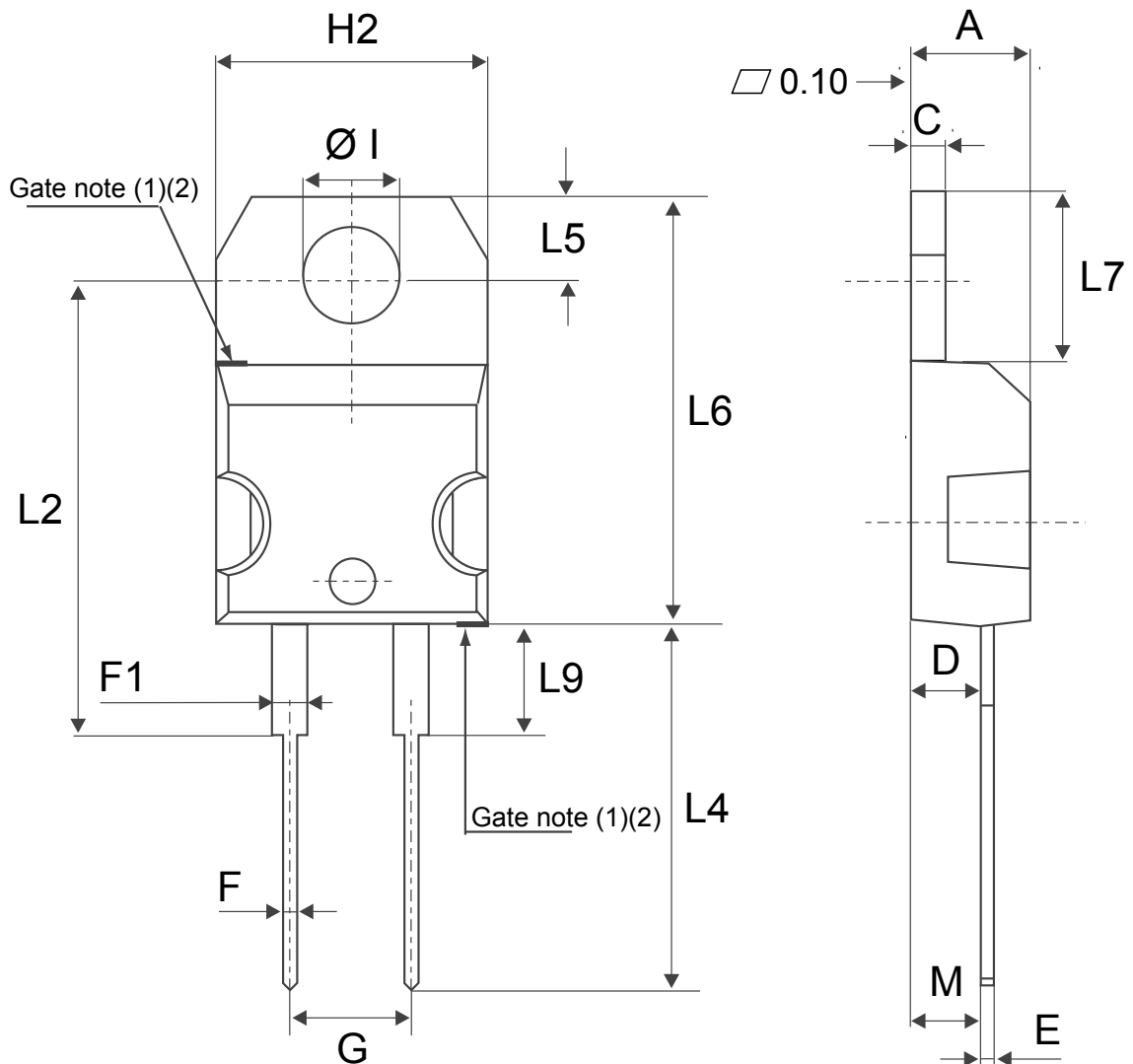


Footprint_26

2.3 TO-220AC package information

- Epoxy meets UL 94,V0
- Cooling method: by conduction (C)
- Recommended torque value: 0.55 N·m
- Maximum torque value: 0.70 N·m

Figure 16. TO-220AC package outline



(1) :Max resin gate protusion 0.5 mm

(2) :Resin gate position is accepted in each of the two positions shown on the drawings or their symmetrical

Table 7. TO-220AC package mechanical data

| Ref. | Dimensions | | | |
|------|-------------|-------|-----------------------------|-------|
| | Millimeters | | Inches (for reference only) | |
| | Min. | Max. | Min. | Max. |
| A | 4.40 | 4.60 | 0.173 | 0.181 |
| C | 1.23 | 1.32 | 0.048 | 0.051 |
| D | 2.40 | 2.72 | 0.094 | 0.107 |
| E | 0.49 | 0.70 | 0.019 | 0.027 |
| F | 0.61 | 0.88 | 0.024 | 0.034 |
| F1 | 1.14 | 1.70 | 0.044 | 0.066 |
| G | 4.95 | 5.15 | 0.194 | 0.202 |
| H2 | 10.00 | 10.40 | 0.393 | 0.409 |
| L2 | 16.40 typ. | | 0.645 typ. | |
| L4 | 13.00 | 14.00 | 0.511 | 0.551 |
| L5 | 2.65 | 2.95 | 0.104 | 0.116 |
| L6 | 15.25 | 15.75 | 0.600 | 0.620 |
| L7 | 6.20 | 6.60 | 0.244 | 0.259 |
| L9 | 3.50 | 3.93 | 0.137 | 0.154 |
| M | 2.60 typ. | | 0.102 typ. | |
| Diam | 3.75 | 3.85 | 0.147 | 0.151 |

2.4 TO-220AC Ins. package information

- Epoxy meets UL 94,V0
- Cooling method: by conduction (C)
- Recommended torque value: 0.55 N·m
- Maximum torque value: 0.70 N·m

Figure 17. TO-220AC Ins. package outline

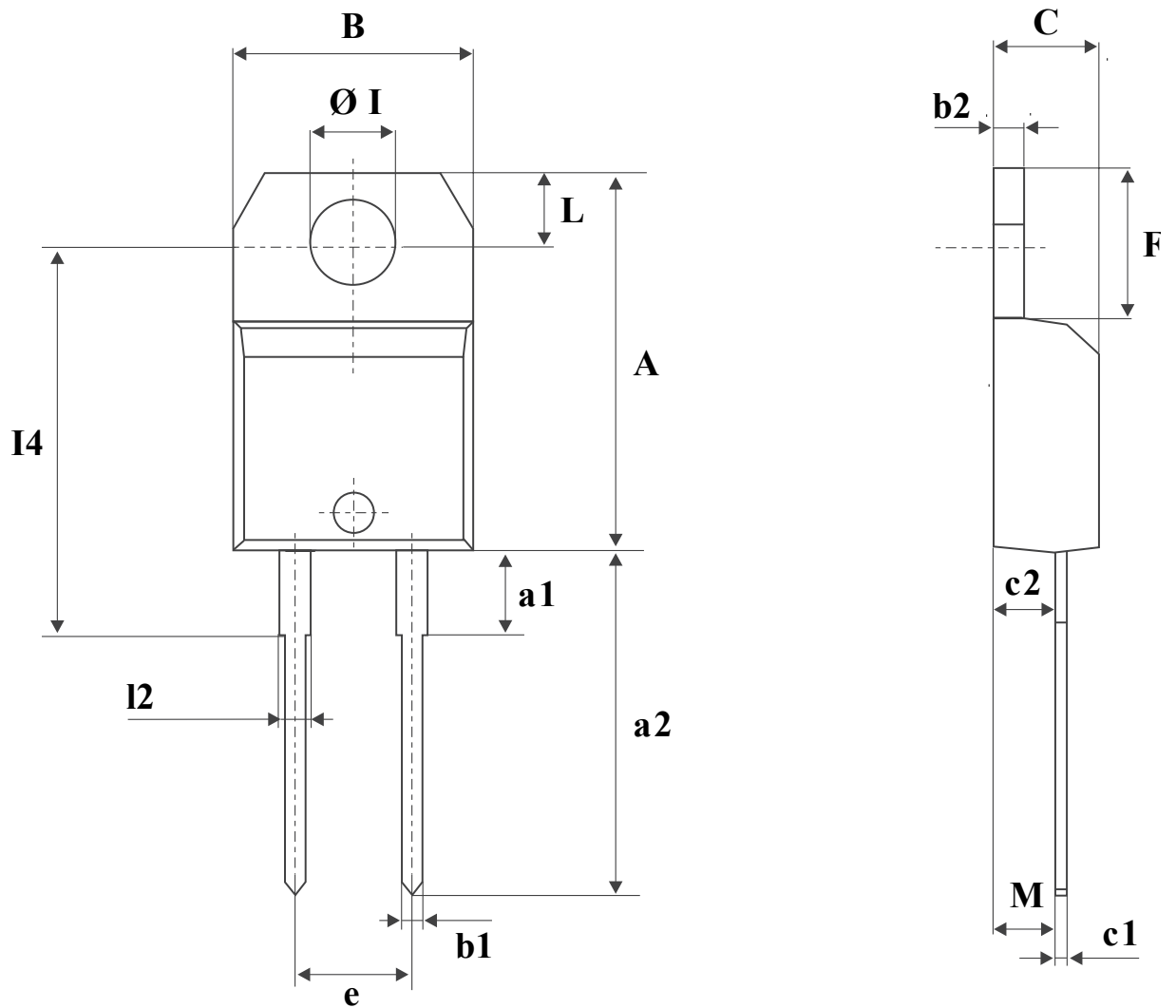


Table 8. TO-220AC Ins. package mechanical data

| Ref. | Dimensions | | | | | |
|------|-------------|-------|-------|-----------------------------|-------|-------|
| | Millimeters | | | Inches (for reference only) | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | 15.20 | | 15.90 | 0.598 | | 0.625 |
| a1 | | 3.75 | | | 0.147 | |
| a2 | 13.00 | | 14.00 | 0.511 | | 0.551 |
| B | 10.00 | | 10.40 | 0.393 | | 0.409 |
| b1 | 0.61 | | 0.88 | 0.024 | | 0.034 |
| b2 | 1.23 | | 1.32 | 0.048 | | 0.051 |
| C | 4.40 | | 4.60 | 0.173 | | 0.181 |
| c1 | 0.49 | | 0.70 | 0.019 | | 0.027 |
| c2 | 2.40 | | 2.72 | 0.094 | | 0.107 |
| e | 4.80 | | 5.40 | 0.189 | | 0.212 |
| F | 6.20 | | 6.60 | 0.244 | | 0.259 |
| L | 2.65 | | 2.95 | 0.104 | | 0.116 |
| l2 | 1.14 | | 1.70 | 0.044 | | 0.066 |
| l4 | 15.80 | 16.40 | 16.80 | 0.622 | 0.645 | 0.661 |
| M | | 2.60 | | | 0.102 | |
| Øl | 3.75 | | 3.85 | 0.147 | | 0.151 |

3 Ordering information

Table 9. Ordering information

| Order code | Marking | Package | Weight | Base qty. | Delivery mode |
|-----------------|----------------|--------------------|--------|-----------|---------------|
| STPSC10H065G-TR | STPSC10H065G | D ² PAK | 1.48 g | 1000 | Tape and reel |
| STPSC10H065D | STPSC10H065D | TO-220AC | 1.86 g | 50 | Tube |
| STPSC10H065DI | STPSC 10H065DI | TO-220AC Ins. | 2.12 g | 50 | Tube |
| STPSC10H065B-TR | PSC10 H065 | DPAK | 0.32 g | 2500 | Tape and reel |

Revision history

Table 10. Document revision history

| Date | Revision | Changes |
|-------------|----------|---|
| 31-Aug-2012 | 1 | First issue. |
| 10-Oct-2012 | 2 | Added Max. value to Table 3. |
| 07-Nov-2013 | 3 | Updated Figure 1, Figure 2, Figure 13, Figure 14 and Table 8. |
| 07-Jan-2014 | 4 | Added TO-220AC Ins package. |
| 22-Jul-2015 | 5 | Updated Table 10 and reformatted to current standard. |
| 10-Dec-2015 | 6 | Inserted package name on cover page. |
| 26-Jan-2017 | 7 | Updated D ² PAK package information. |
| 09-Jan-2020 | 8 | Updated Features. |

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