

Power MOSFET

D²PAK (TO-263)


N-Channel MOSFET

PRODUCT SUMMARY

| | |
|---------------------------|-----------------------------|
| V_{DS} (V) | 250 |
| $R_{DS(on)}$ (Ω) | $V_{GS} = 10\text{ V}$ 0.28 |
| Q_g max. (nC) | 68 |
| Q_{gs} (nC) | 11 |
| Q_{gd} (nC) | 35 |
| Configuration | Single |

FEATURES

- Surface-mount
- Available in tape and reel
- Dynamic dv/dt rating
- Repetitive avalanche rated
- Fast switching
- Ease of paralleling
- Simple drive requirements
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912



RoHS*
Available
HALOGEN
FREE
Available

Note

* This datasheet provides information about parts that are RoHS-compliant and / or parts that are non RoHS-compliant. For example, parts with lead (Pb) terminations are not RoHS-compliant. Please see the information / tables in this datasheet for details

DESCRIPTION

Third generation power MOSFETs from Vishay provide the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost-effectiveness.

The D²PAK (TO-263) is a surface-mount power package capable of accommodating die size up to HEX-4. It provides the highest power capability and the lowest possible on-resistance in any existing surface-mount package. The D²PAK (TO-263) is suitable for high current applications because of its low internal connection resistance and can dissipate up to 2.0 W in a typical surface-mount application.

ORDERING INFORMATION

| Package | D ² PAK (TO-263) | D ² PAK (TO-263) | D ² PAK (TO-263) |
|---------------------------------|-----------------------------|------------------------------|------------------------------|
| Lead (Pb)-free and halogen-free | SiHF644S-GE3 | SiHF644STRL-GE3 ^a | SiHF644STRR-GE3 ^a |
| Lead (Pb)-free | IRF644SPbF | IRF644STRLPbF ^a | IRF644STRRPbF ^a |

Note

a. See device orientation

ABSOLUTE MAXIMUM RATINGS ($T_C = 25\text{ }^{\circ}\text{C}$, unless otherwise noted)

| PARAMETER | SYMBOL | LIMIT | UNIT |
|---|----------------|-------------|-----------------------|
| Drain-source voltage | V_{DS} | 250 | V |
| Gate-source voltage | V_{GS} | ± 20 | |
| Continuous drain current | I_D | 14 | A |
| | | 8.5 | |
| Pulsed drain current ^a | I_{DM} | 56 | |
| Linear derating factor | | 1.0 | W/ $^{\circ}\text{C}$ |
| Linear derating factor (PCB mount) ^e | | 0.025 | |
| Single pulse avalanche energy ^b | E_{AS} | 550 | mJ |
| Avalanche current ^a | I_{AR} | 14 | A |
| Repetitive avalanche energy ^a | E_{AR} | 13 | mJ |
| Maximum power dissipation | P_D | 125 | W |
| Maximum power dissipation (PCB mount) ^e | | 3.1 | |
| Peak diode recovery dv/dt ^c | dv/dt | 4.8 | V/ns |
| Operating junction and storage temperature range | T_J, T_{stg} | -55 to +150 | $^{\circ}\text{C}$ |
| Soldering recommendations (peak temperature) ^d | for 10 s | 300 | |

Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)
- $V_{DD} = 50\text{ V}$, starting $T_J = 25\text{ }^{\circ}\text{C}$, $L = 4.5\text{ mH}$, $R_g = 25\text{ }\Omega$, $I_{AS} = 14\text{ A}$ (see fig. 12)
- $I_{SD} \leq 14\text{ A}$, $di/dt \leq 150\text{ A}/\mu\text{s}$, $V_{DD} \leq V_{DS}$, $T_J \leq 150\text{ }^{\circ}\text{C}$
- 1.6 mm from case
- When mounted on 1" square PCB (FR-4 or G-10 material)

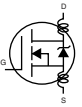
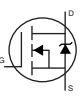
**THERMAL RESISTANCE RATINGS**

| PARAMETER | SYMBOL | TYP. | MAX. | UNIT |
|--|------------|------|------|------|
| Maximum junction-to-ambient | R_{thJA} | - | 62 | °C/W |
| Maximum junction-to-ambient (PCB mount) ^a | R_{thJA} | - | 40 | |
| Maximum junction-to-case (drain) | R_{thJC} | - | 1.0 | |

Note

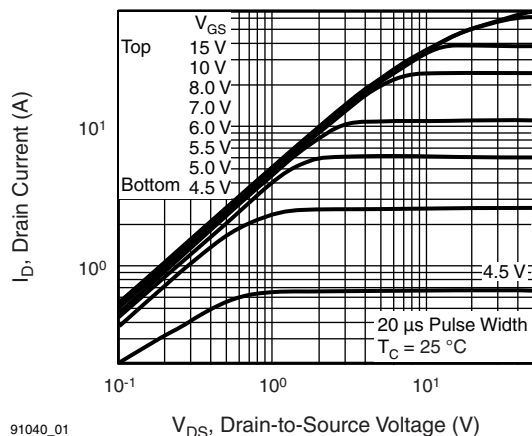
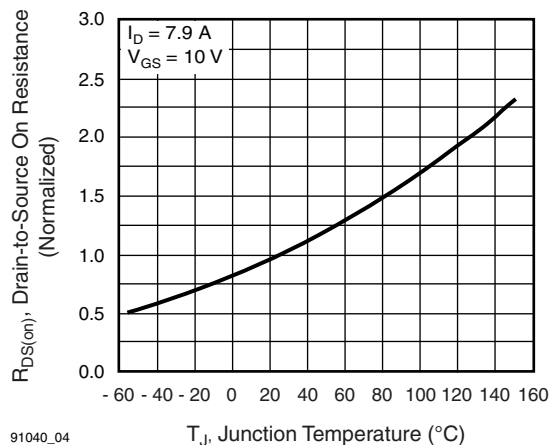
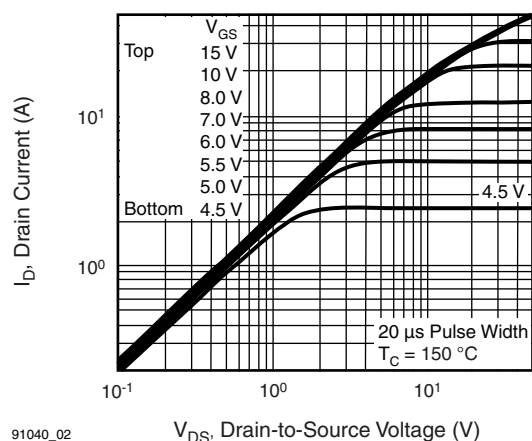
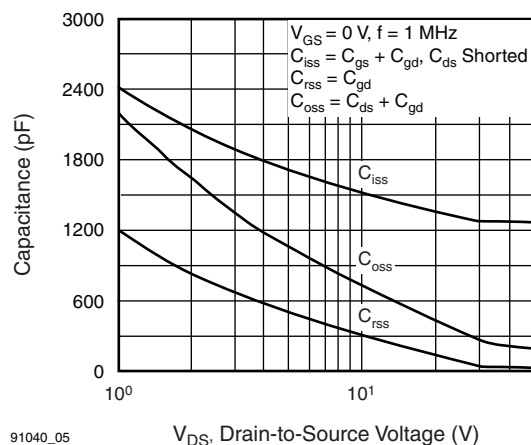
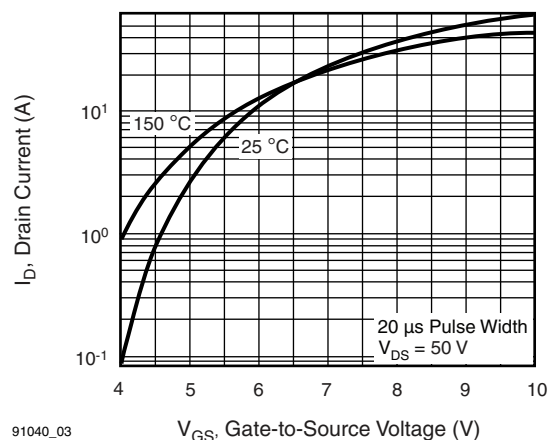
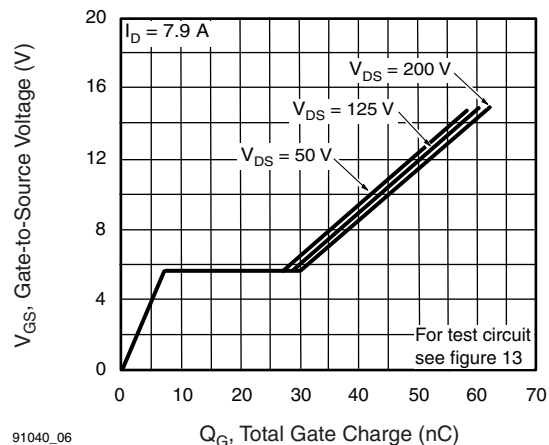
a. When mounted on 1" square PCB (FR-4 or G-10 material)

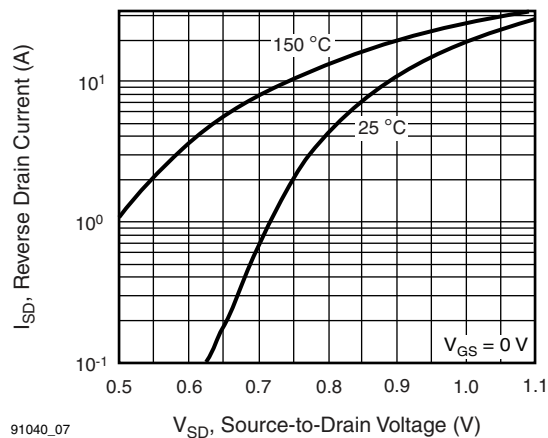
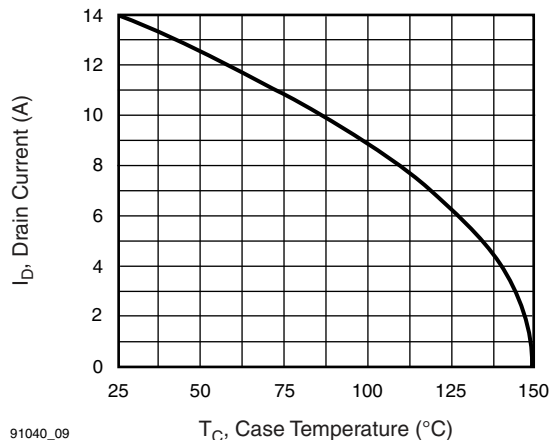
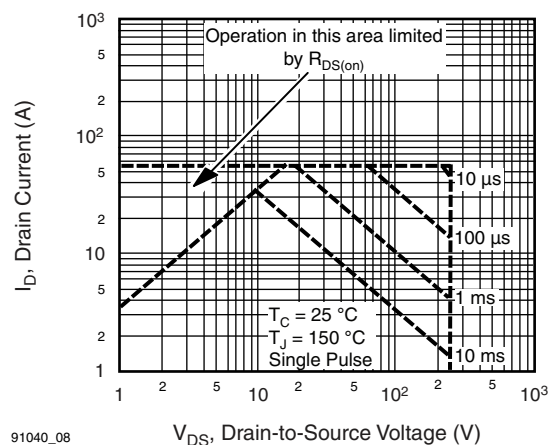
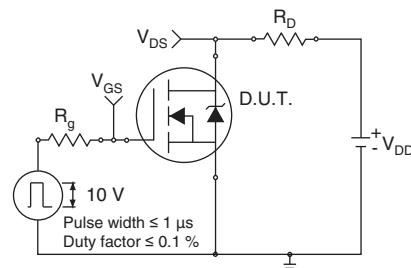
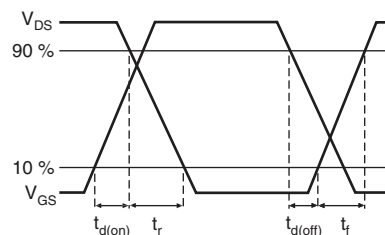
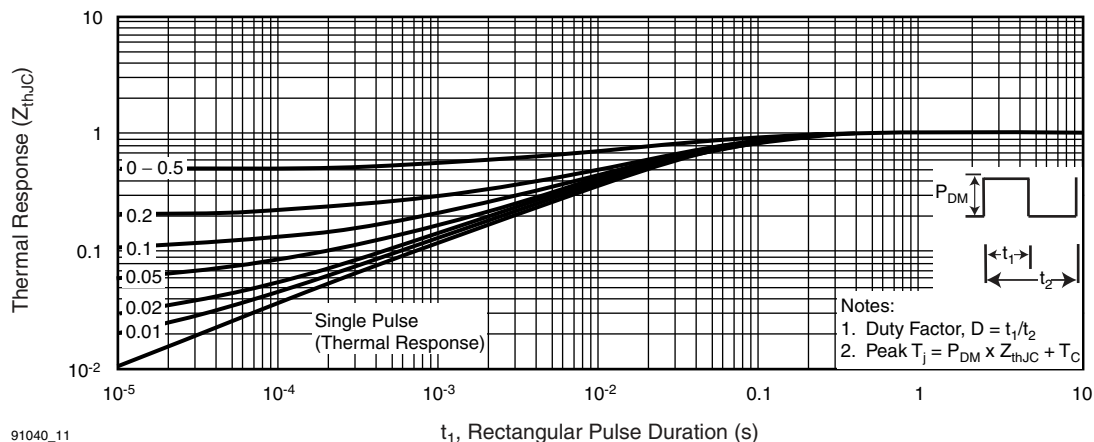
SPECIFICATIONS ($T_J = 25\text{ °C}$, unless otherwise noted)

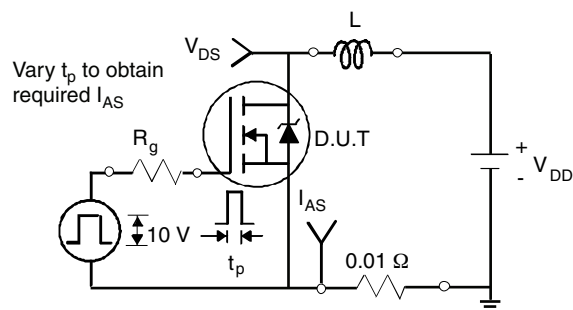
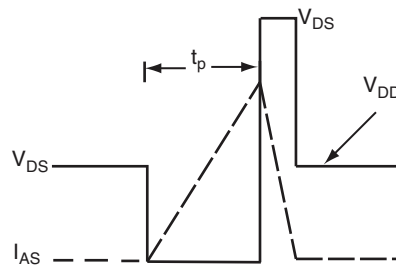
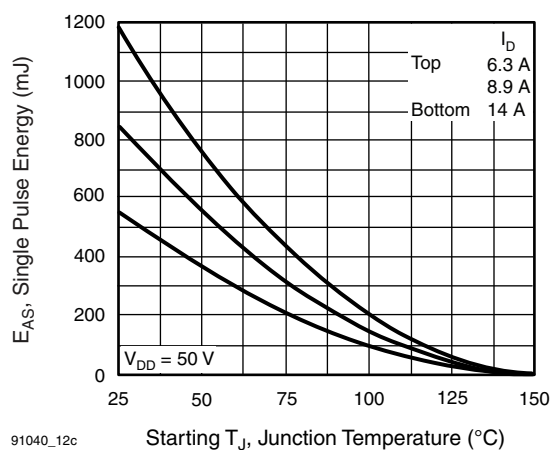
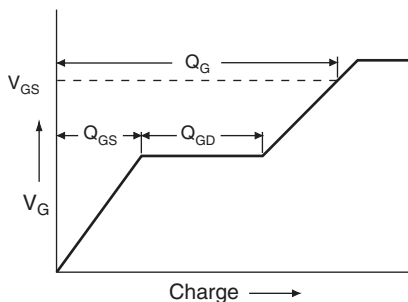
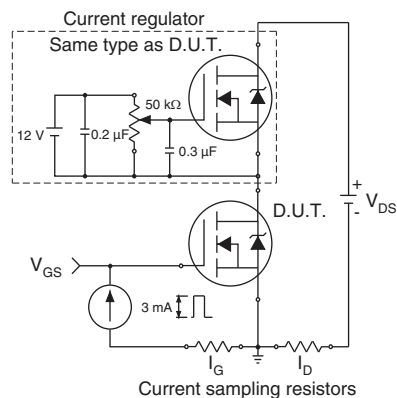
| PARAMETER | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|--|---------------------|--|------|------|-----------|---------------|
| Static | | | | | | |
| Drain-source breakdown voltage | V_{DS} | $V_{GS} = 0$, $I_D = 250\text{ }\mu\text{A}$ | 250 | - | - | V |
| V_{DS} temperature coefficient | $\Delta V_{DS}/T_J$ | Reference to 25 °C , $I_D = 1\text{ mA}$ | - | 0.34 | - | V/°C |
| Gate-source threshold voltage | $V_{GS(th)}$ | $V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$ | 2.0 | - | 4.0 | V |
| Gate-source leakage | I_{GSS} | $V_{GS} = \pm 20\text{ V}$ | - | - | ± 100 | nA |
| Zero gate voltage drain current | I_{DSS} | $V_{DS} = 250\text{ V}$, $V_{GS} = 0\text{ V}$ | - | - | 25 | μA |
| | | $V_{DS} = 200\text{ V}$, $V_{GS} = 0\text{ V}$, $T_J = 125\text{ °C}$ | - | - | 250 | |
| Drain-source on-state resistance | $R_{DS(on)}$ | $V_{GS} = 10\text{ V}$, $I_D = 8.4\text{ A}^b$ | - | - | 0.28 | Ω |
| Forward transconductance | g_{fs} | $V_{DS} = 50\text{ V}$, $I_D = 8.4\text{ A}^b$ | 6.7 | - | - | S |
| Dynamic | | | | | | |
| Input capacitance | C_{iss} | $V_{GS} = 0\text{ V}$, $V_{DS} = 25\text{ V}$, $f = 1.0\text{ MHz}$, see fig. 5 | - | 1300 | - | pF |
| Output capacitance | C_{oss} | | - | 330 | - | |
| Reverse transfer capacitance | C_{rss} | | - | 85 | - | |
| Total gate charge | Q_g | $V_{GS} = 10\text{ V}$, $I_D = 7.9\text{ A}$, $V_{DS} = 200\text{ V}$, see fig. 6 and 13 ^b | - | - | 68 | nC |
| Gate-source charge | Q_{gs} | | - | - | 11 | |
| Gate-drain charge | Q_{gd} | | - | - | 35 | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD} = 125\text{ V}$, $I_D = 7.9\text{ A}$, $R_g = 9.1\text{ }\Omega$, $R_D = 8.7\text{ }\Omega$, see fig. 10 ^b | - | 11 | - | ns |
| Rise time | t_r | | - | 24 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 53 | - | |
| Fall time | t_f | | - | 49 | - | |
| Gate input resistance | L_D | Between lead, 6 mm (0.25") from package and center of die contact  | - | 4.5 | - | nH |
| Internal drain inductance | L_S | | - | 7.5 | - | |
| Internal source inductance | R_g | $f = 1\text{ MHz}$, open drain | 0.3 | - | 1.2 | Ω |
| Drain-Source Body Diode Characteristics | | | | | | |
| Continuous source-drain diode current | I_S | MOSFET symbol showing the integral reverse p - n junction diode  | - | - | 14 | A |
| Pulsed diode forward current ^a | I_{SM} | | - | - | 56 | |
| Body diode voltage | V_{SD} | $T_J = 25\text{ °C}$, $I_S = 14\text{ A}$, $V_{GS} = 0\text{ V}^b$ | - | - | 1.8 | V |
| Body diode reverse recovery time | t_{rr} | $T_J = 25\text{ °C}$, $I_F = 7.9\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}^b$ | - | 250 | 500 | ns |
| Body diode reverse recovery charge | Q_{rr} | | - | 2.3 | 4.6 | μC |
| Forward turn-on time | t_{on} | Intrinsic turn-on time is negligible (turn-on is dominated by L_S and L_D) | | | | |

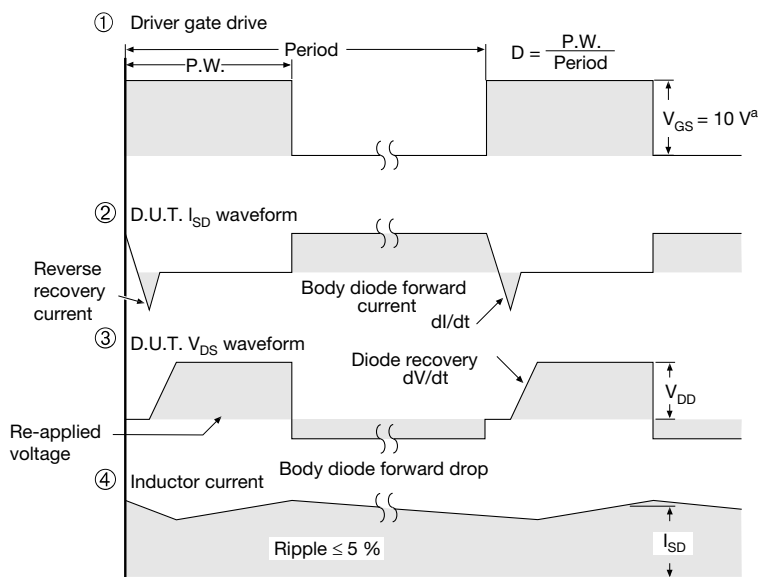
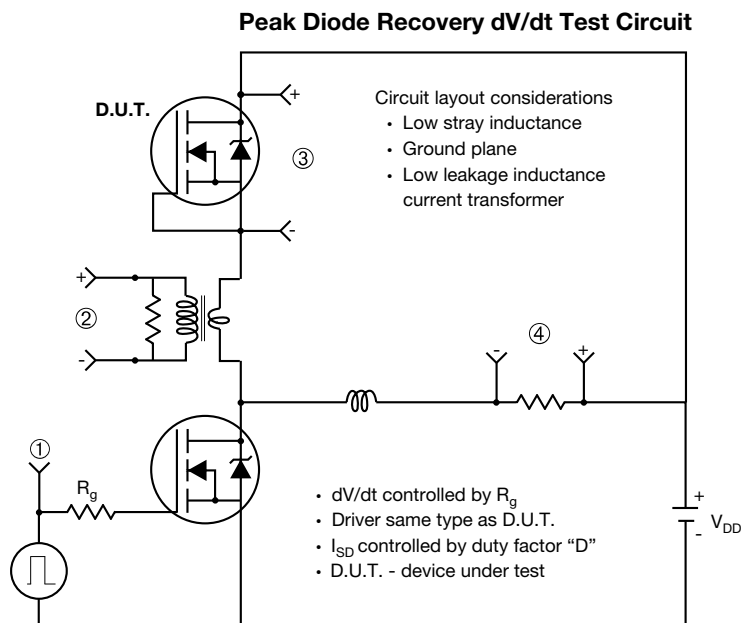
Notes

- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)
b. Pulse width $\leq 300\text{ }\mu\text{s}$; duty cycle $\leq 2\%$

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

Fig. 1 - Typical Output Characteristics, $T_C = 25\text{ °C}$

Fig. 4 - Normalized On-Resistance vs. Temperature

Fig. 2 - Typical Output Characteristics, $T_C = 150\text{ °C}$

Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

Fig. 3 - Typical Transfer Characteristics

Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage


Fig. 7 - Typical Source-Drain Diode Forward Voltage

Fig. 9 - Maximum Drain Current vs. Case Temperature

Fig. 8 - Maximum Safe Operating Area

Fig. 10a - Switching Time Test Circuit

Fig. 10b - Switching Time Waveforms

Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case


Fig. 12a - Unclamped Inductive Test Circuit

Fig. 12b - Unclamped Inductive Waveforms

Fig. 12c - Maximum Avalanche Energy vs. Drain Current

Fig. 13a - Basic Gate Charge Waveform

Fig. 13b - Gate Charge Test Circuit


Note

a. $V_{GS} = 5\text{ V}$ for logic level devices

Fig. 14 - For N-Channel

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TO-263AB (HIGH VOLTAGE)



| DIM. | MILLIMETERS | | INCHES | |
|------|-------------|------|--------|-------|
| | MIN. | MAX. | MIN. | MAX. |
| A | 4.06 | 4.83 | 0.160 | 0.190 |
| A1 | 0.00 | 0.25 | 0.000 | 0.010 |
| b | 0.51 | 0.99 | 0.020 | 0.039 |
| b1 | 0.51 | 0.89 | 0.020 | 0.035 |
| b2 | 1.14 | 1.78 | 0.045 | 0.070 |
| b3 | 1.14 | 1.73 | 0.045 | 0.068 |
| c | 0.38 | 0.74 | 0.015 | 0.029 |
| c1 | 0.38 | 0.58 | 0.015 | 0.023 |
| c2 | 1.14 | 1.65 | 0.045 | 0.065 |
| D | 8.38 | 9.65 | 0.330 | 0.380 |

| DIM. | MILLIMETERS | | INCHES | |
|------|-------------|-------|-----------|-------|
| | MIN. | MAX. | MIN. | MAX. |
| D1 | 6.86 | - | 0.270 | - |
| E | 9.65 | 10.67 | 0.380 | 0.420 |
| E1 | 6.22 | - | 0.245 | - |
| 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 |
| L2 | - | 1.78 | - | 0.070 |
| L3 | 0.25 BSC | | 0.010 BSC | |
| L4 | 4.78 | 5.28 | 0.188 | 0.208 |

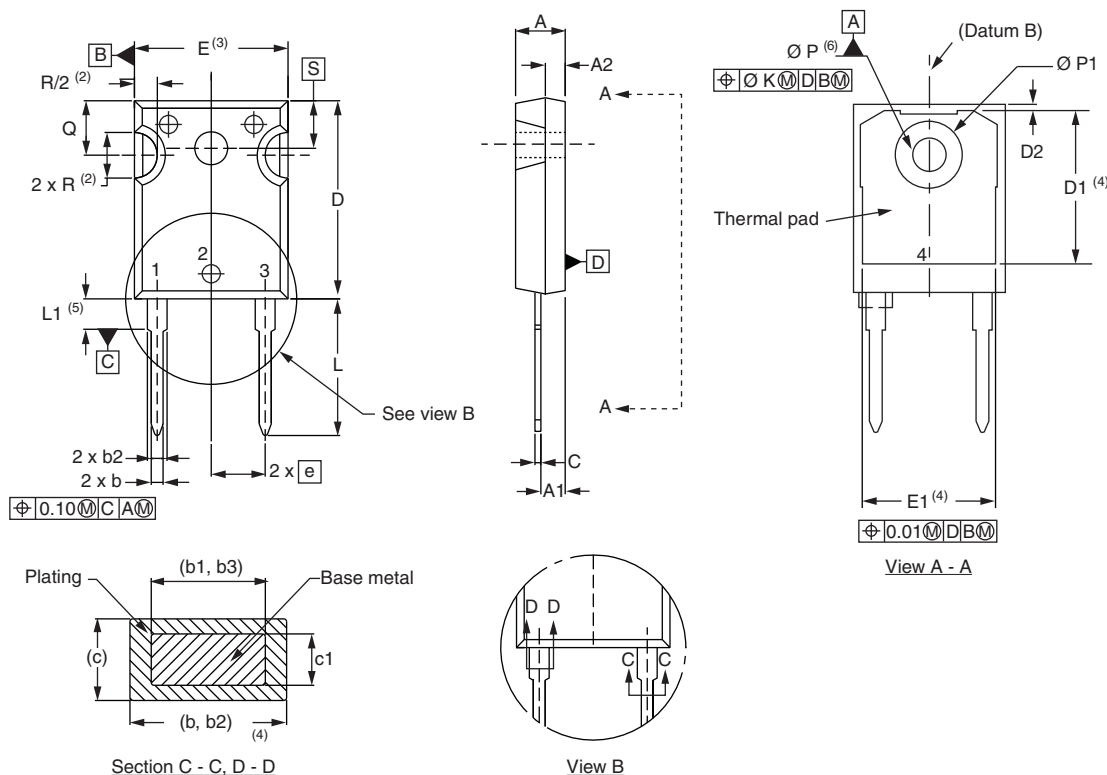
ECN: S-82110-Rev. A, 15-Sep-08
DWG: 5970

Notes

1. Dimensioning and tolerancing per ASME Y14.5M-1994.
2. Dimensions are shown in millimeters (inches).
3. 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 at datum A.
4. Thermal PAD contour optional within dimension E, L1, D1 and E1.
5. Dimension b1 and c1 apply to base metal only.
6. Datum A and B to be determined at datum plane H.
7. Outline conforms to JEDEC outline to TO-263AB.



TO-247AC 2L

DIMENSIONS in millimeters and inches

| SYMBOL | MILLIMETERS | | INCHES | | NOTES |
|--------|-------------|-------|--------|-------|-------|
| | MIN. | MAX. | MIN. | MAX. | |
| A | 4.65 | 5.31 | 0.183 | 0.209 | |
| A1 | 2.21 | 2.59 | 0.087 | 0.102 | |
| A2 | 1.17 | 1.37 | 0.046 | 0.054 | |
| b | 0.99 | 1.40 | 0.039 | 0.055 | |
| b1 | 0.99 | 1.35 | 0.039 | 0.053 | |
| b2 | 1.65 | 2.39 | 0.065 | 0.094 | |
| b3 | 1.65 | 2.34 | 0.065 | 0.092 | |
| c | 0.38 | 0.89 | 0.015 | 0.035 | |
| c1 | 0.38 | 0.84 | 0.015 | 0.033 | |
| D | 19.71 | 20.70 | 0.776 | 0.815 | 3 |
| D1 | 13.08 | - | 0.515 | - | 4 |
| D2 | 0.51 | 1.35 | 0.020 | 0.053 | |

| SYMBOL | MILLIMETERS | | INCHES | | NOTES |
|-----------|-------------|-------|-----------|-------|-------|
| | MIN. | MAX. | MIN. | MAX. | |
| E | 15.29 | 15.87 | 0.602 | 0.625 | 3 |
| E1 | 13.46 | - | 0.53 | - | |
| e | 5.46 BSC | | 0.215 BSC | | |
| ϕK | 0.254 | | 0.010 | | |
| L | 14.20 | 16.10 | 0.559 | 0.634 | |
| L1 | 3.71 | 4.29 | 0.146 | 0.169 | |
| ϕP | 3.56 | 3.66 | 0.14 | 0.144 | |
| $\phi P1$ | - | 7.39 | - | 0.291 | |
| Q | 5.31 | 5.69 | 0.209 | 0.224 | |
| R | 4.52 | 5.49 | 0.178 | 0.216 | |
| S | 5.51 BSC | | 0.217 BSC | | |

Notes

- (1) Dimensioning and tolerancing per ASME Y14.5M-1994
- (2) Contour of slot optional
- (3) 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 outermost extremes of the plastic body
- (4) Thermal pad contour optional with dimensions D1 and E1
- (5) Lead finish uncontrolled in L1
- (6) ϕP to have a maximum draft angle of 1.5 to the top of the part with a maximum hole diameter of 3.91 mm (0.154")
- (7) Outline conforms to JEDEC® outline TO-247 with exception of dimension Q

RECOMMENDED MINIMUM PADS FOR D²PAK: 3-Lead



Recommended Minimum Pads
Dimensions in Inches/(mm)

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