

APT5024BVR-VB Datasheet

N-Channel 500 V (D-S) Super Junction Power MOSFET

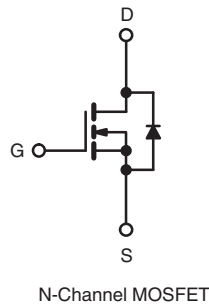
| PRODUCT SUMMARY | | |
|---------------------------|------------------------|-------|
| V_{DS} (V) | 500 | |
| $R_{DS(on)}$ (Ω) | $V_{GS} = 10\text{ V}$ | 0.080 |
| Q_g (Max.) (nC) | 350 | |
| Q_{gs} (nC) | 85 | |
| Q_{gd} (nC) | 180 | |
| Configuration | Single | |

FEATURES

- Low Gate Charge Q_g Results in Simple Drive Requirement
- Improved Gate, Avalanche and Dynamic dV/dt Ruggedness
- Fully Characterized Capacitance and Avalanche Voltage and Current
- Low $R_{DS(on)}$
- Compliant to RoHS Directive 2002/95/EC



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APPLICATIONS


- Switch Mode Power Supply (SMPS)
- Uninterruptible Power Supply
- High Speed Power Switching
- Hard Switched and High Frequency Circuits

| ABSOLUTE MAXIMUM RATINGS ($T_C = 25\text{ }^\circ\text{C}$, unless otherwise noted) | | | | | |
|---|----------------------------------|----------------|-----------------------------------|---------------------|---|
| PARAMETER | | SYMBOL | LIMIT | UNIT | |
| Drain-Source Voltage | | V_{DS} | 500 | V | |
| Gate-Source Voltage | | V_{GS} | ± 30 | | |
| Continuous Drain Current | V_{GS} at 10 V | I_D | $T_C = 25\text{ }^\circ\text{C}$ | 40 | A |
| | | | $T_C = 100\text{ }^\circ\text{C}$ | 25 | |
| Pulsed Drain Current ^a | | I_{DM} | 180 | | |
| Linear Derating Factor | | | 4.3 | W/ $^\circ\text{C}$ | |
| Single Pulse Avalanche Energy ^b | | E_{AS} | 910 | mJ | |
| Repetitive Avalanche Current ^a | | I_{AR} | 40 | A | |
| Repetitive Avalanche Energy ^a | | E_{AR} | 51 | mJ | |
| Maximum Power Dissipation | $T_C = 25\text{ }^\circ\text{C}$ | P_D | 530 | W | |
| Peak Diode Recovery dV/dt^c | | dV/dt | 9.0 | V/ns | |
| Operating Junction and Storage Temperature Range | | T_J, T_{stg} | - 55 to + 150 | $^\circ\text{C}$ | |
| Soldering Recommendations (Peak Temperature) | for 10 s | | 300 ^d | | |

Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- Starting $T_J = 25\text{ }^\circ\text{C}$, $L = 0.82\text{ mH}$, $R_g = 25\text{ }\Omega$, $I_{AS} = 47\text{ A}$ (see fig. 12c).
- $I_{SD} \leq 47\text{ A}$, $dI/dt \leq 230\text{ A}/\mu\text{s}$, $V_{DD} \leq V_{DS}$, $T_J \leq 150\text{ }^\circ\text{C}$.
- 1.6 mm from case.

| THERMAL RESISTANCE RATINGS | | | | |
|-------------------------------------|------------|------|------|------|
| PARAMETER | SYMBOL | TYP. | MAX. | UNIT |
| Maximum Junction-to-Ambient | R_{thJA} | - | 40 | °C/W |
| Case-to-Sink, Flat, Greased Surface | R_{thCS} | 0.24 | - | |
| Maximum Junction-to-Case (Drain) | R_{thJC} | - | 0.23 | |

| SPECIFICATIONS ($T_J = 25\text{ }^\circ\text{C}$, unless otherwise noted) | | | | | | | |
|---|-----------------------|--|--|-------|-----------|---------------|----|
| PARAMETER | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNIT | |
| Static | | | | | | | |
| Drain-Source Breakdown Voltage | V_{DS} | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$ | 500 | - | - | V | |
| V_{DS} Temperature Coefficient | $\Delta V_{DS}/T_J$ | Reference to $25\text{ }^\circ\text{C}, I_D = 1\text{ mA}$ | - | 0.60 | - | V/°C | |
| Gate-Source Threshold Voltage | $V_{GS(th)}$ | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$ | 3.0 | - | 5.0 | V | |
| Gate-Source Leakage | I_{GSS} | $V_{GS} = \pm 30\text{ V}$ | - | - | ± 100 | nA | |
| Zero Gate Voltage Drain Current | I_{DSS} | $V_{DS} = 500\text{ V}, V_{GS} = 0\text{ V}$ | - | - | 50 | μA | |
| | | $V_{DS} = 400\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$ | - | - | 250 | | |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $V_{GS} = 10\text{ V}, I_D = 28\text{ A}^b$ | - | 0.080 | - | Ω | |
| Forward Transconductance | g_{fs} | $V_{DS} = 50\text{ V}, I_D = 28\text{ A}$ | 23 | - | - | S | |
| Dynamic | | | | | | | |
| Input Capacitance | C_{iss} | $V_{GS} = 0\text{ V}, V_{DS} = 25\text{ V}, f = 1.0\text{ MHz}, \text{ see fig. 5}$ | - | 8310 | - | pF | |
| Output Capacitance | C_{oss} | | - | 960 | - | | |
| Reverse Transfer Capacitance | C_{riss} | | - | 120 | - | | |
| Output Capacitance | C_{oss} | $V_{GS} = 0\text{ V}$ | $V_{DS} = 1.0\text{ V}, f = 1.0\text{ MHz}$ | - | 10170 | - | |
| Effective Output Capacitance | $C_{oss\text{ eff.}}$ | | $V_{DS} = 400\text{ V}, f = 1.0\text{ MHz}$ | - | 240 | - | |
| Total Gate Charge | Q_g | | $V_{DS} = 0\text{ V to } 400\text{ V}^c$ | - | 440 | - | |
| Gate-Source Charge | Q_{gs} | $V_{GS} = 10\text{ V}$ | $I_D = 47\text{ A}, V_{DS} = 400\text{ V}, \text{ see fig. 6 and 13}^b$ | - | - | 350 | nC |
| Gate-Drain Charge | Q_{gd} | | | - | - | 85 | |
| Turn-On Delay Time | $t_{d(on)}$ | | | - | - | 180 | |
| Rise Time | t_r | $V_{GS} = 10\text{ V}$ | $V_{DD} = 250\text{ V}, I_D = 47\text{ A}, R_G = 1.0\text{ }\Omega, \text{ see fig. 10}^b$ | - | 25 | - | ns |
| Turn-Off Delay Time | $t_{d(off)}$ | | | - | 140 | - | |
| Fall Time | t_f | | | - | 55 | - | |
| Drain-Source Body Diode Characteristics | | | | | | | |
| Continuous Source-Drain Diode Current | I_S | MOSFET symbol showing the integral reverse p - n junction diode  | - | - | 47 | A | |
| Pulsed Diode Forward Current ^a | I_{SM} | | - | - | 190 | | |
| Body Diode Voltage | V_{SD} | $T_J = 25\text{ }^\circ\text{C}, I_S = 47\text{ A}, V_{GS} = 0\text{ V}^b$ | - | - | 1.5 | V | |
| Body Diode Reverse Recovery Time | t_{rr} | $T_J = 25\text{ }^\circ\text{C}, I_F = 47\text{ A}, di/dt = 100\text{ A}/\mu\text{s}^b$ | - | 150 | - | ns | |
| Body Diode Reverse Recovery Charge | Q_{rr} | | - | 14 | 21 | μC | |
| Body Diode Recovery Current | I_{RRM} | | - | 38 | - | A | |
| 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 $\leq 400\text{ }\mu\text{s}$; duty cycle $\leq 2\%$.
- c. $C_{oss\text{ eff.}}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 % to 80 % V_{DS} .

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

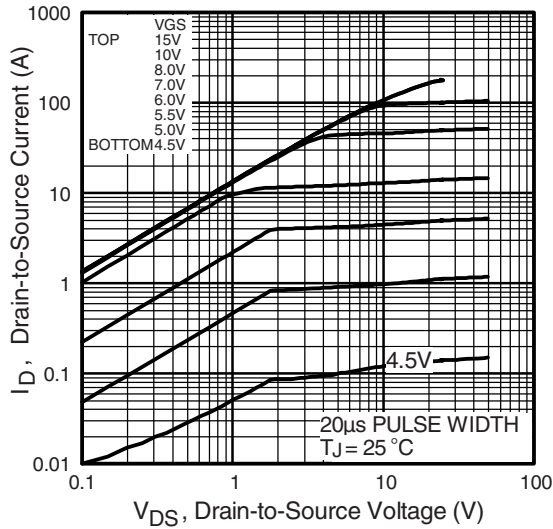


Fig. 1 - Typical Output Characteristics

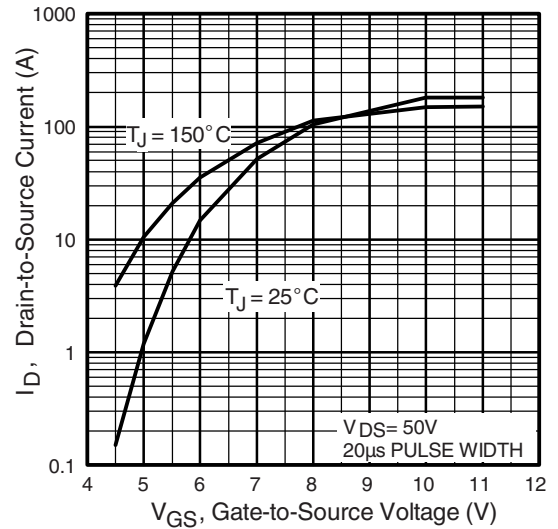


Fig. 3 - Typical Transfer Characteristics

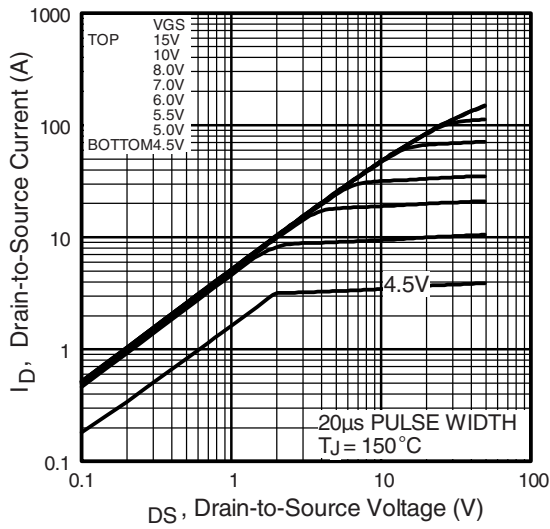


Fig. 2 - Typical Output Characteristics

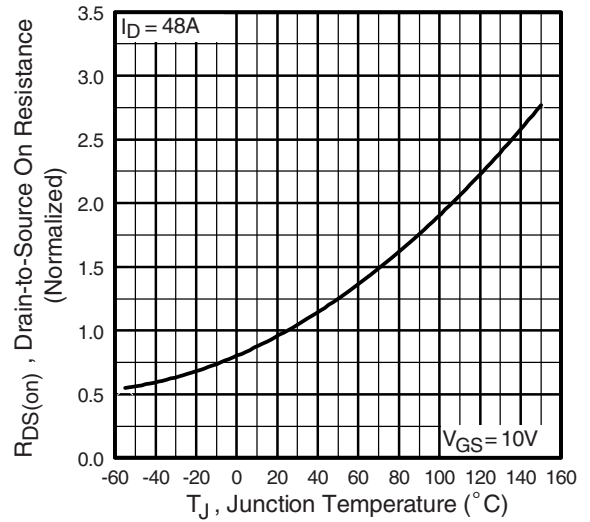


Fig. 4 - Normalized On-Resistance vs. Temperature

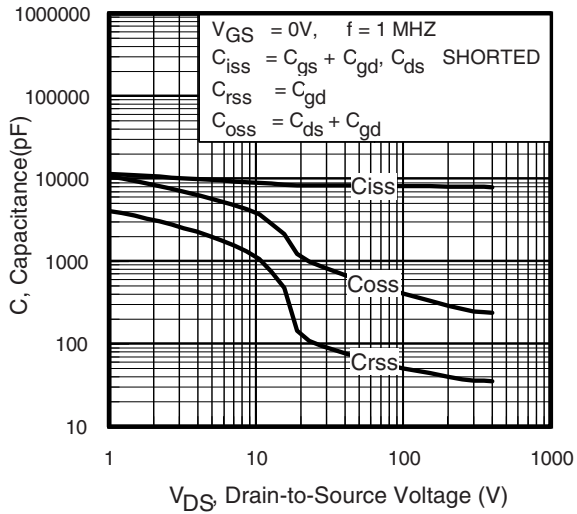


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

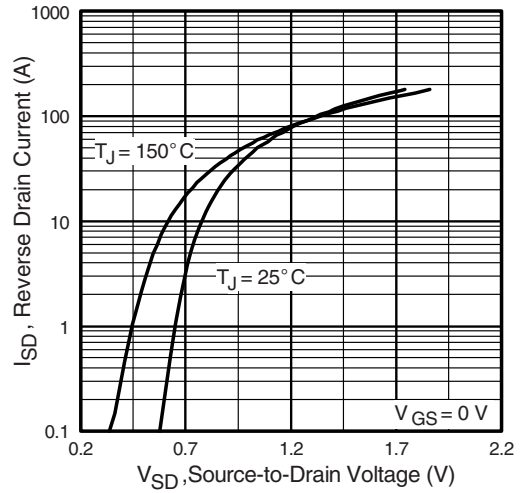


Fig. 7 - Typical Source-Drain Diode Forward Voltage

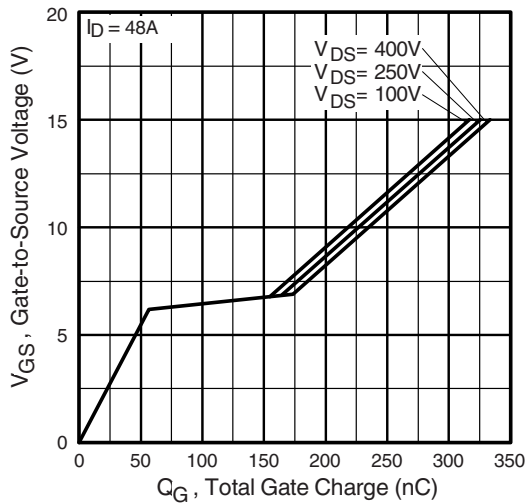


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

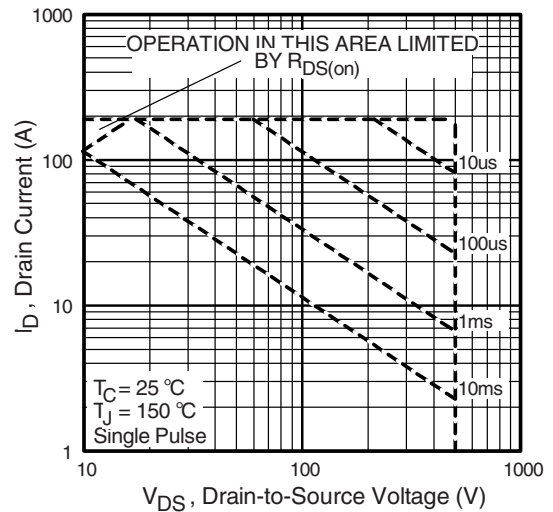


Fig. 8 - Maximum Safe Operating Area

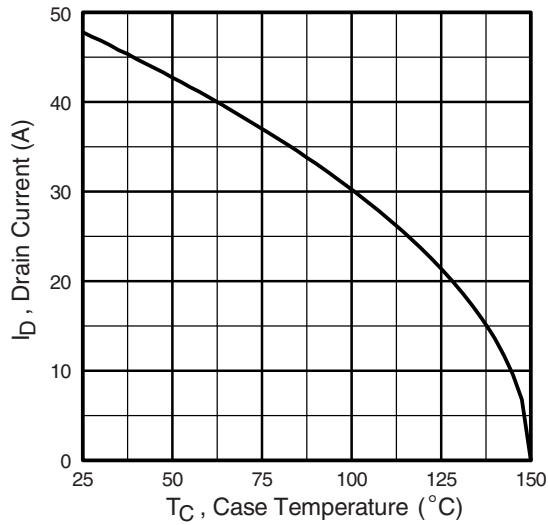


Fig. 9 - Maximum Drain Current vs. Case Temperature

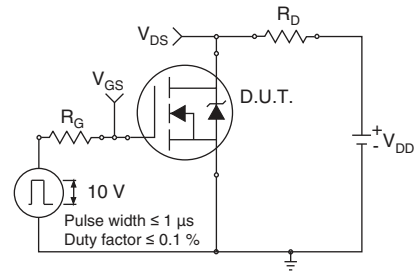


Fig. 10a - Switching Time Test Circuit

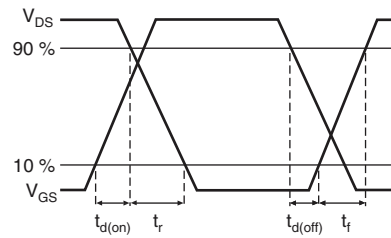


Fig. 10b - Switching Time Waveforms

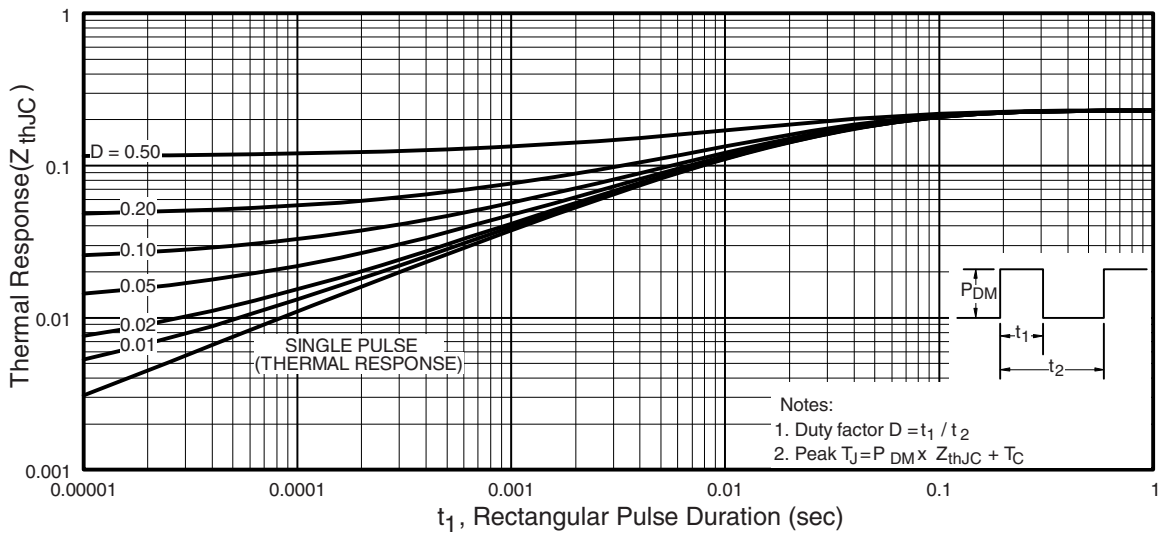


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

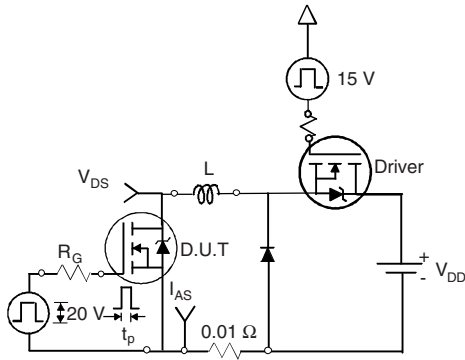


Fig. 12a - Unclamped Inductive Test Circuit

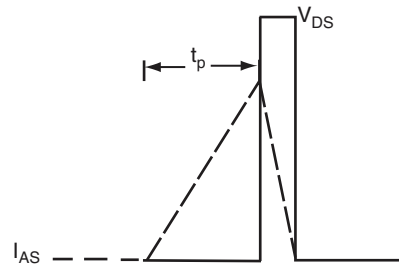


Fig. 12b - Unclamped Inductive Waveforms

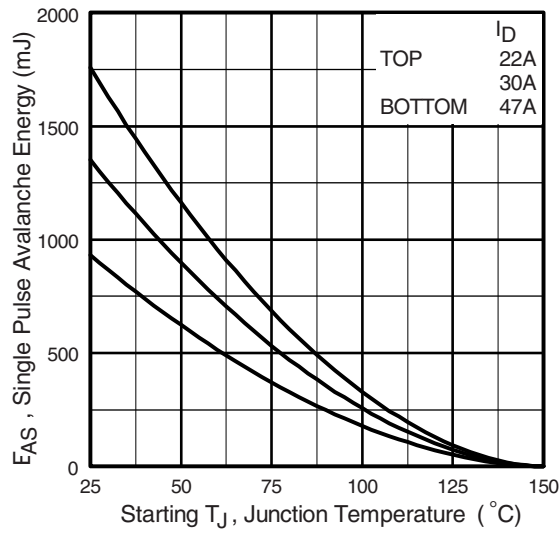


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

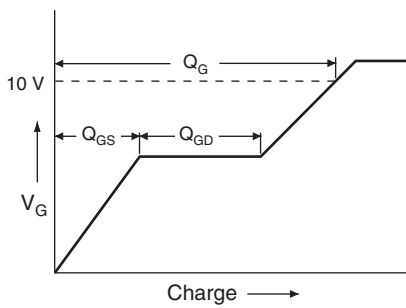


Fig. 13a - Basic Gate Charge Waveform

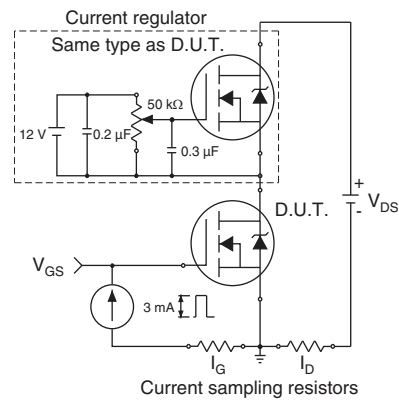
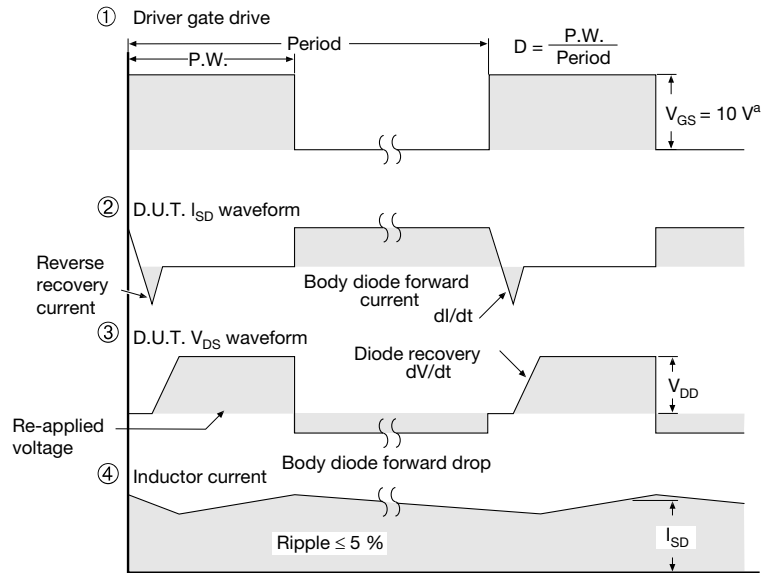
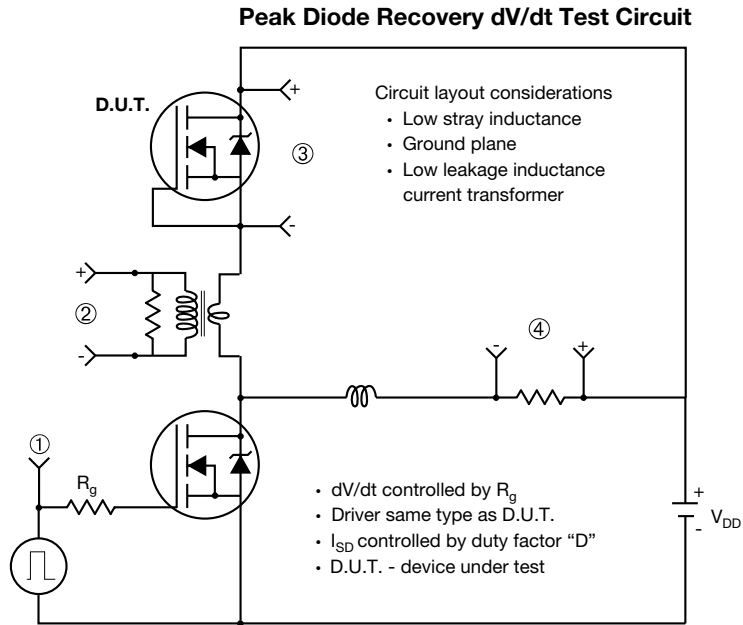


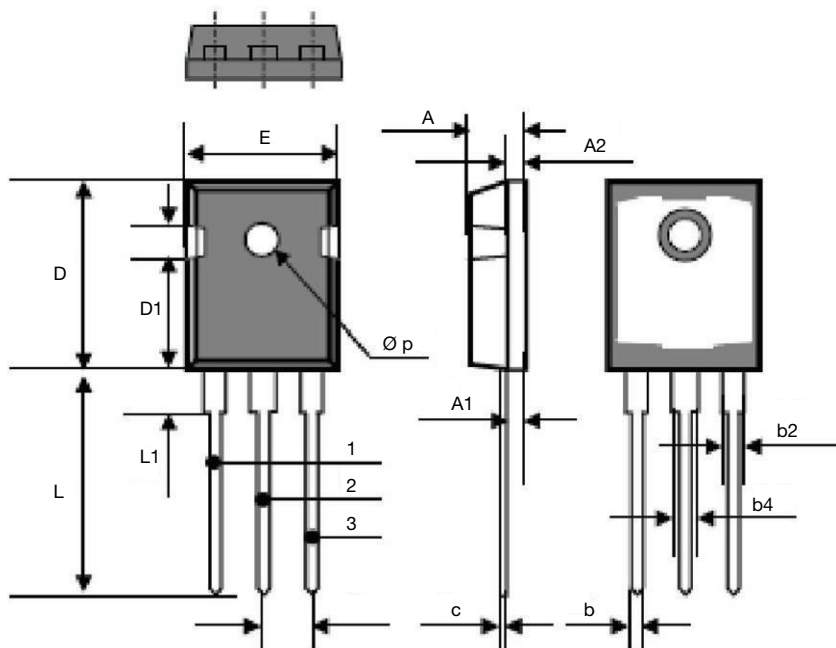
Fig. 13b - Gate Charge Test Circuit



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

Fig. 14 - For N-Channel

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| DIM. | MILLIMETERS | | INCHES | |
|------|-------------|-------|-----------|-------|
| | MIN. | MAX. | MIN. | MAX. |
| A | 4.70 | 5.31 | 0.185 | 0.209 |
| A1 | 2.21 | 2.59 | 0.087 | 0.102 |
| A2 | 1.50 | 2.49 | 0.059 | 0.098 |
| b | 0.99 | 1.40 | 0.039 | 0.055 |
| b2 | 1.65 | 2.41 | 0.065 | 0.095 |
| b4 | 2.59 | 3.43 | 0.102 | 0.135 |
| c | 0.61 BSC | | 0.024 BSC | |
| D | 20.80 | 21.46 | 0.819 | 0.845 |
| D1 | 3.68 | 5.49 | 0.145 | 0.216 |
| (e) | 5.46 BSC | | 0.215 BSC | |
| E | 15.49 | 16.26 | 0.610 | 0.640 |
| L | 19.81 | 20.32 | 0.780 | 0.800 |
| L1 | 4.06 | 4.50 | 0.160 | 0.177 |
| Ø p | 3.51 | 3.66 | 0.138 | 0.144 |

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