

250V N-Ch Power MOSFET

Feature

- ◇ High Speed Power Smooth Switching
- ◇ Enhanced Body diode dv/dt capability
- ◇ Enhanced Avalanche Ruggedness
- ◇ 100% UIS Tested, 100% Rg Tested
- ◇ Lead Free

Application

- ◇ Synchronous Rectification in SMPS
- ◇ Hard Switching and High Speed Circuit
- ◇ Power Tools
- ◇ UPS
- ◇ Motor Control

| | | | |
|-------------------------|--------|------|----|
| V_{DS} | | 250 | V |
| $R_{DS(on),typ}$ | TO-263 | 16.3 | mΩ |
| $R_{DS(on),typ}$ | TO-247 | 15.5 | mΩ |
| $R_{DS(on),typ}$ | TO-220 | 16.6 | mΩ |
| I_D (Silicon Limited) | | 93 | A |
| I_D (Package Limited) | | 180 | A |

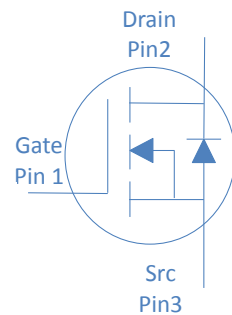
TO-263



TO-220



TO-247



| Part Number | Package | Marking |
|-------------|---------|-----------|
| HGB220N25S | TO-263 | GB220N25S |
| HGK220N25S | TO-247 | GK220N25S |
| HGP220N25S | TO-220 | GP220N25S |

Absolute Maximum Ratings at $T_j=25^\circ\text{C}$ (unless otherwise specified)

| Parameter | Symbol | Conditions | Value | Unit |
|--|----------------|--|------------|------------------|
| Continuous Drain Current (Silicon Limited) | I_D | $T_C=25^\circ\text{C}$ | 93 | A |
| | | $T_C=100^\circ\text{C}$ | 66 | |
| Drain to Source Voltage | V_{DS} | - | 250 | V |
| Gate to Source Voltage | V_{GS} | - | ± 20 | V |
| Pulsed Drain Current | I_{DM} | - | 290 | A |
| Avalanche Energy, Single Pulse | E_{AS} | $L=0.4\text{mH}, T_C=25^\circ\text{C}$ | 180 | mJ |
| Power Dissipation | P_D | $T_C=25^\circ\text{C}$ | 429 | W |
| Operating and Storage Temperature | T_J, T_{stg} | - | -55 to 175 | $^\circ\text{C}$ |

Absolute Maximum Ratings

| Parameter | Symbol | Max | Unit |
|-------------------------------------|-----------------|------|--------------------|
| Thermal Resistance Junction-Case | $R_{\theta JC}$ | 0.35 | $^\circ\text{C/W}$ |
| Thermal Resistance Junction-Ambient | $R_{\theta JA}$ | 60 | $^\circ\text{C/W}$ |

Electrical Characteristics at $T_J=25^{\circ}\text{C}$ (unless otherwise specified)
Static Characteristics

| Parameter | Symbol | Conditions | Value | | | Unit | |
|-----------------------------------|---------------|---|--------|-----|-----------|----------|------------|
| | | | min | typ | max | | |
| Drain to Source Breakdown Voltage | $V_{(BR)DSS}$ | $V_{GS}=0V, I_D=250\mu A$ | 250 | - | - | V | |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{GS}=V_{DS}, I_D=250\mu A$ | 2 | 3 | 4 | | |
| Zero Gate Voltage Drain Current | I_{DSS} | $V_{GS}=0V, V_{DS}=200V, T_J=25^{\circ}\text{C}$ | - | - | 1 | μA | |
| | | $V_{GS}=0V, V_{DS}=200V, T_J=100^{\circ}\text{C}$ | - | - | 100 | | |
| Gate to Source Leakage Current | I_{GSS} | $V_{GS}=\pm 20V, V_{DS}=0V$ | - | - | ± 100 | nA | |
| Drain to Source on Resistance | $R_{DS(on)}$ | $V_{GS}=10V, I_D=20A$ | TO-263 | - | 16.3 | 21.7 | m Ω |
| | | | TO-247 | - | 15.5 | 21.9 | |
| | | | TO-220 | - | 16.6 | 22 | |
| Transconductance | g_{fs} | $V_{DS}=5V, I_D=20A$ | - | 70 | - | S | |
| Gate Resistance | R_G | $V_{GS}=0V, V_{DS}$ Open, $f=1\text{MHz}$ | - | 3.7 | - | Ω | |

Dynamic Characteristics

| | | | | | | |
|-------------------------------|--------------|--|---|------|---|----|
| Input Capacitance | C_{iss} | $V_{GS}=0V, V_{DS}=100V, f=1\text{MHz}$ | - | 4950 | - | pF |
| Output Capacitance | C_{oss} | | - | 348 | - | |
| Reverse Transfer Capacitance | C_{rss} | | - | 7 | - | |
| Total Gate Charge | Q_g | $V_{DD}=125V, I_D=20A, V_{GS}=10V$ | - | 58 | - | nC |
| Gate to Source Charge | Q_{gs} | | - | 18 | - | |
| Gate to Drain (Miller) Charge | Q_{gd} | | - | 6 | - | |
| Turn on Delay Time | $t_{d(on)}$ | $V_{DD}=125V, I_D=20A, V_{GS}=10V,$ $R_G=10\Omega,$ | - | 17 | - | ns |
| Rise time | t_r | | - | 22 | - | |
| Turn off Delay Time | $t_{d(off)}$ | | - | 38 | - | |
| Fall Time | t_f | | - | 11 | - | |

Reverse Diode Characteristics

| | | | | | | |
|-------------------------|----------|---|---|-----|---|----|
| Diode Forward Voltage | V_{SD} | $V_{GS}=0V, I_F=20A$ | - | 0.9 | - | V |
| Reverse Recovery Time | t_{rr} | $V_R=125V, I_F=20A, dI_F/dt=100A/\mu s$ | - | 168 | - | ns |
| Reverse Recovery Charge | Q_{rr} | | - | 840 | - | nC |

Fig 1. Typical Output Characteristics

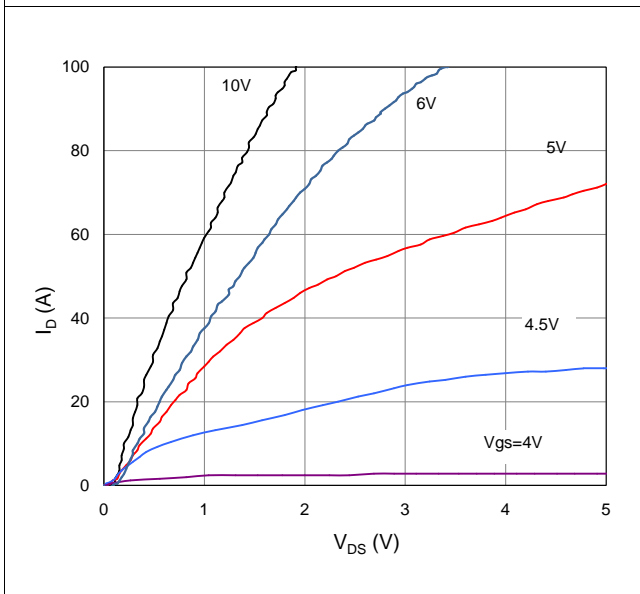


Figure 2. On-Resistance vs. Gate-Source Voltage

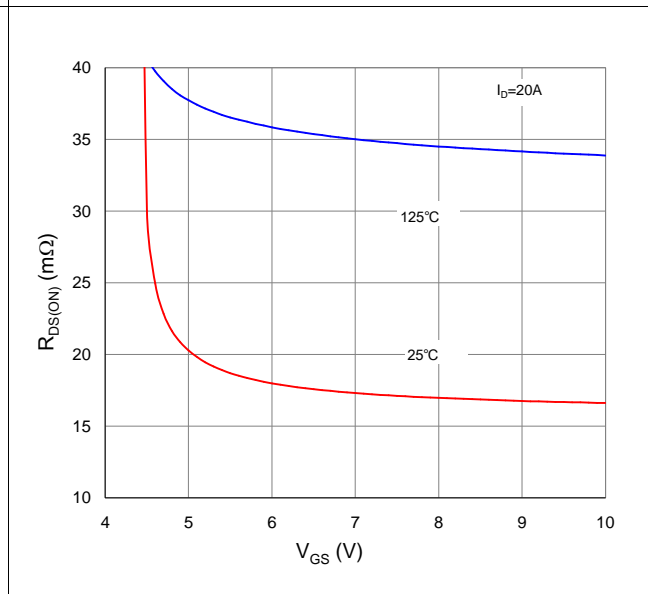


Figure 3. On-Resistance vs. Drain Current and Gate Voltage

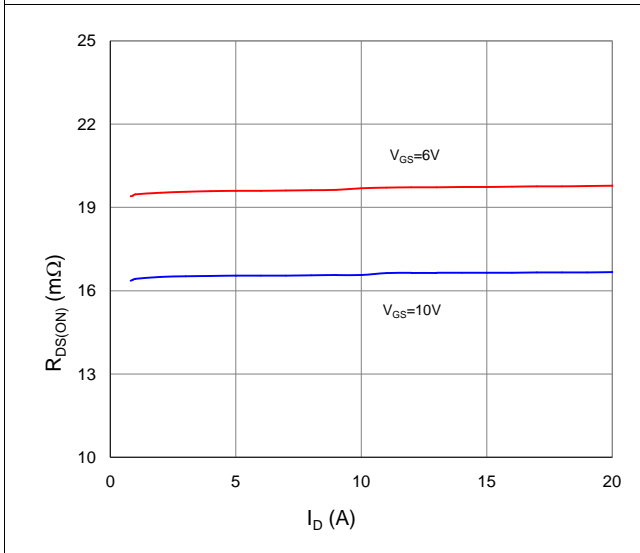


Figure 4. Normalized On-Resistance vs. Junction Temperature

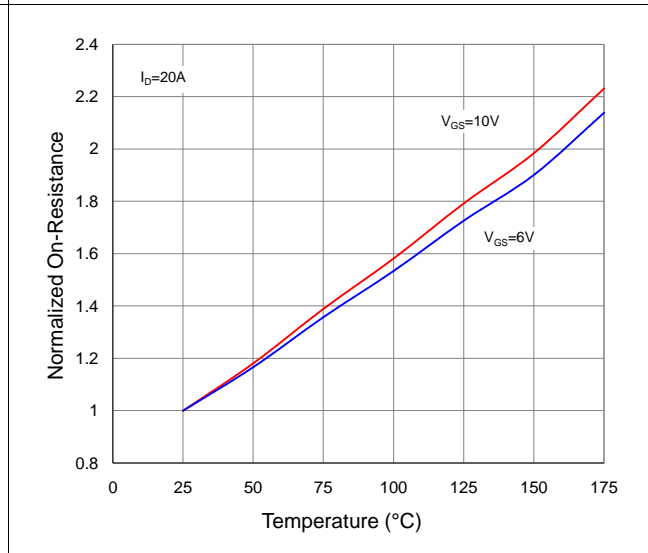


Figure 5. Typical Transfer Characteristics

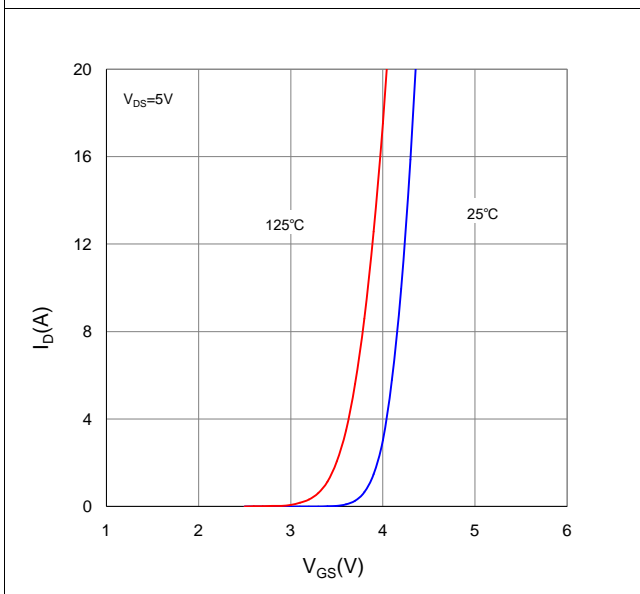


Figure 6. Typical Source-Drain Diode Forward Voltage

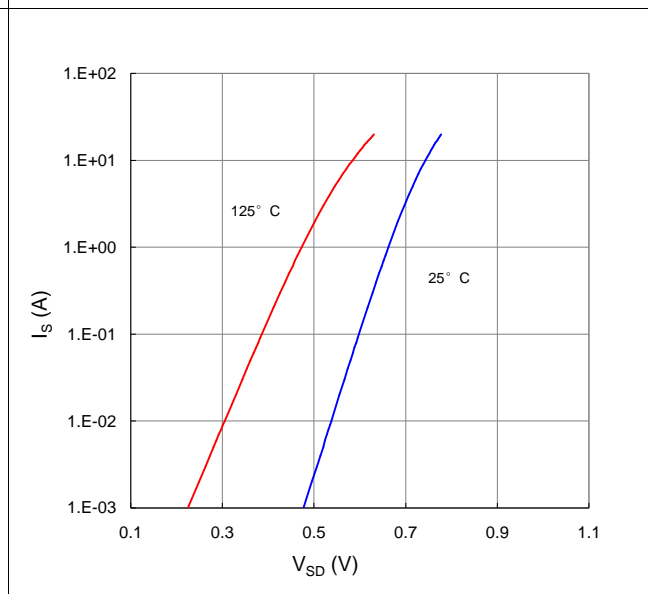


Figure 7. Typical Gate-Charge vs. Gate-to-Source Voltage

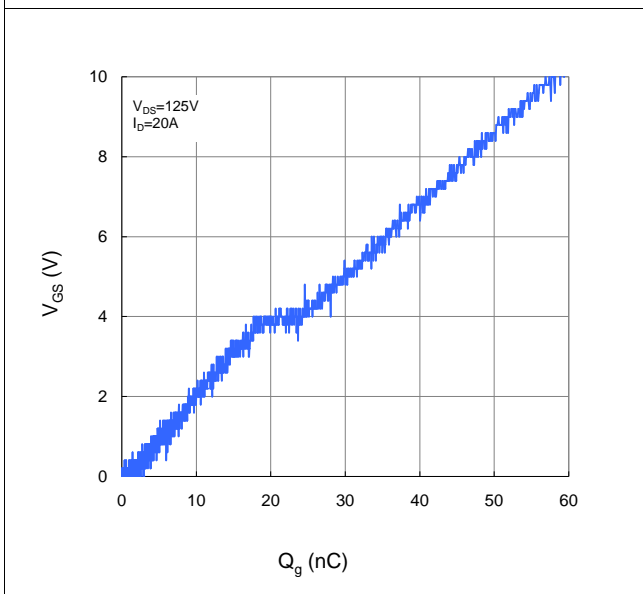


Figure 8. Typical Capacitance vs. Drain-to-Source Voltage

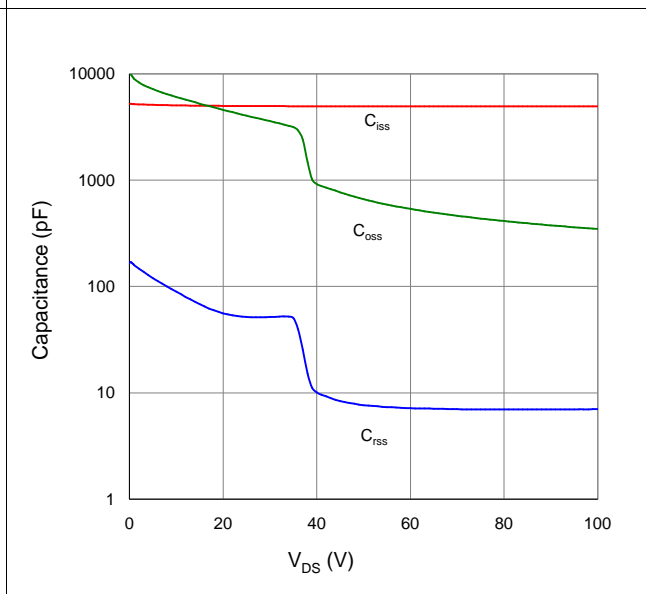


Figure 9. Maximum Safe Operating Area

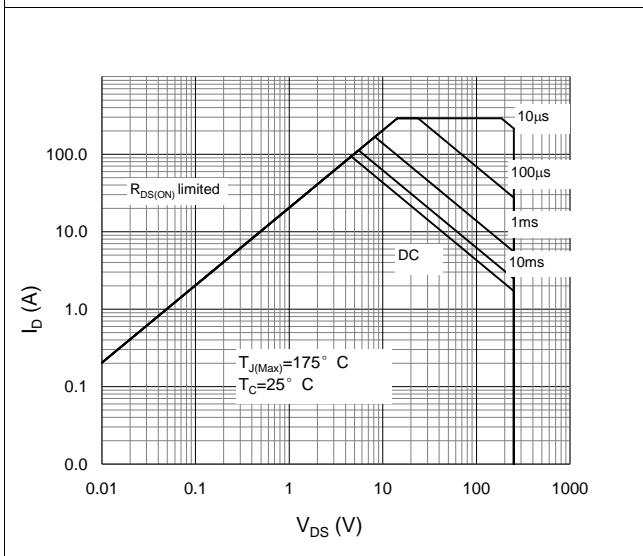


Figure 10. Maximum Drain Current vs. Case Temperature

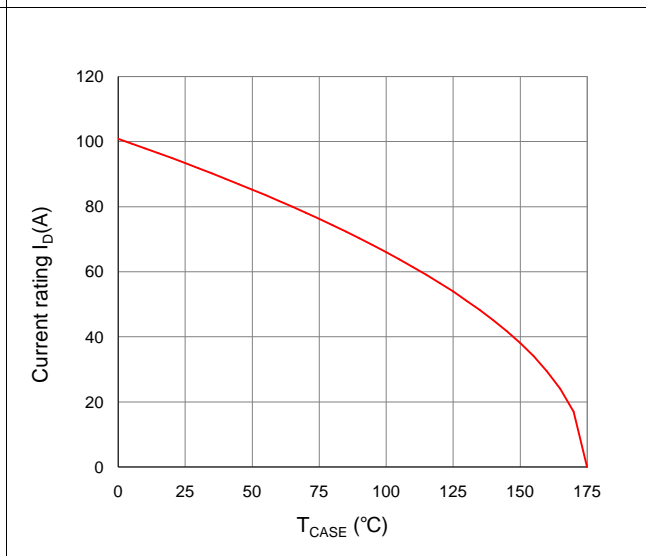
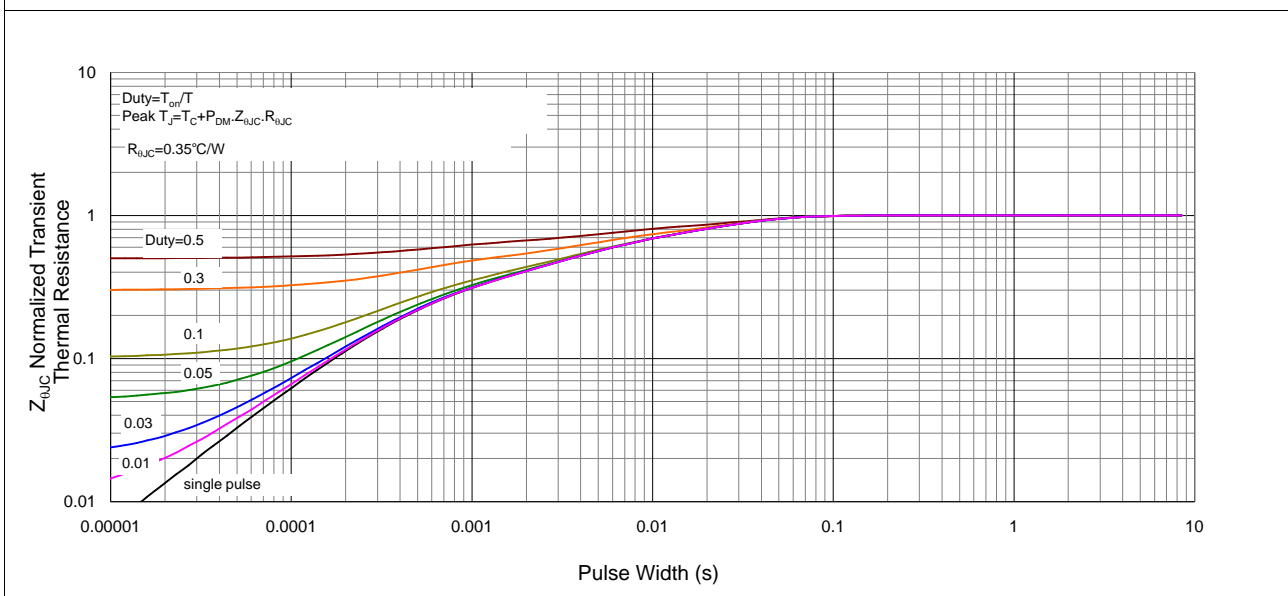
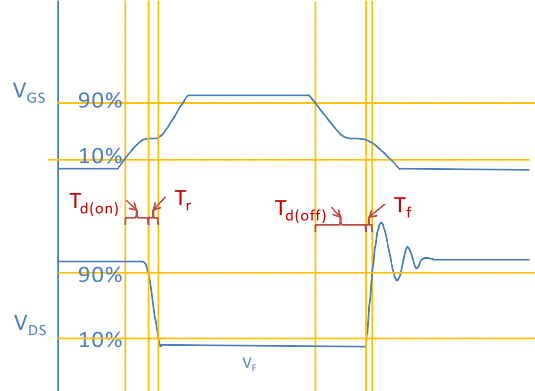
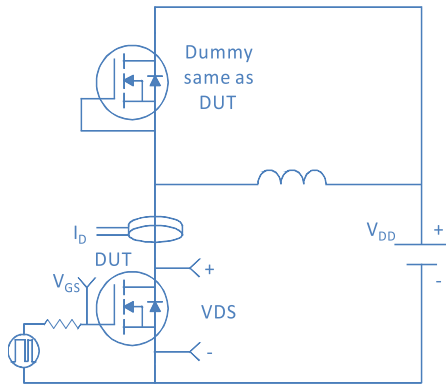


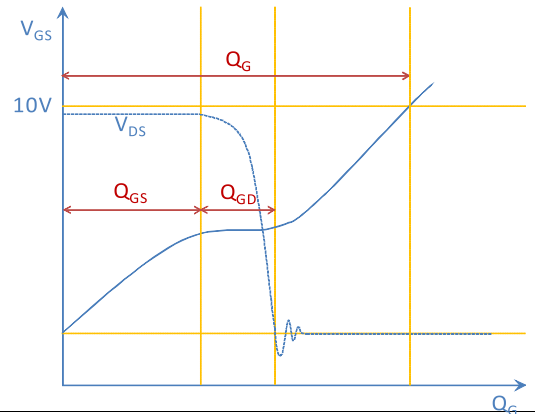
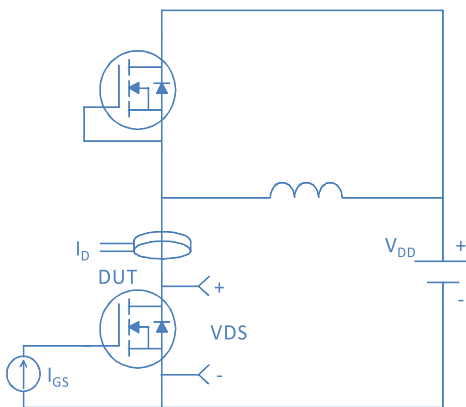
Figure 11. Normalized Maximum Transient Thermal Impedance, Junction-to-Case



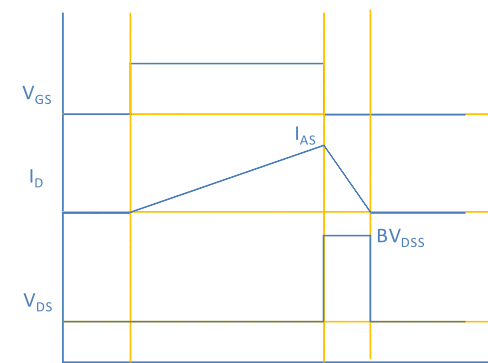
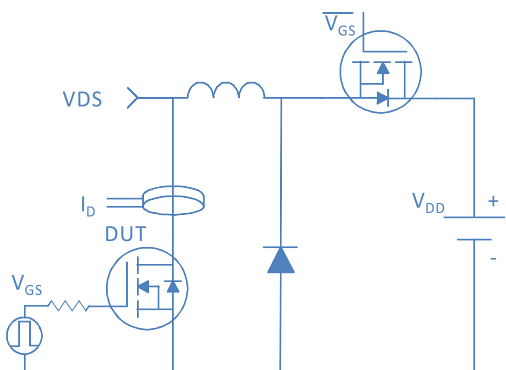
Inductive switching Test



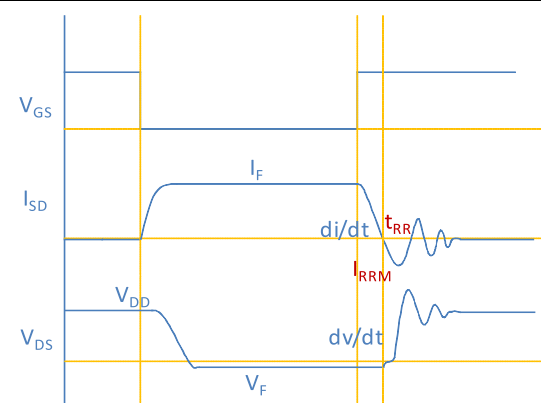
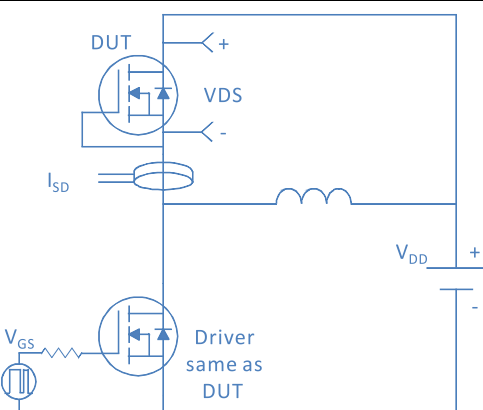
Gate Charge Test



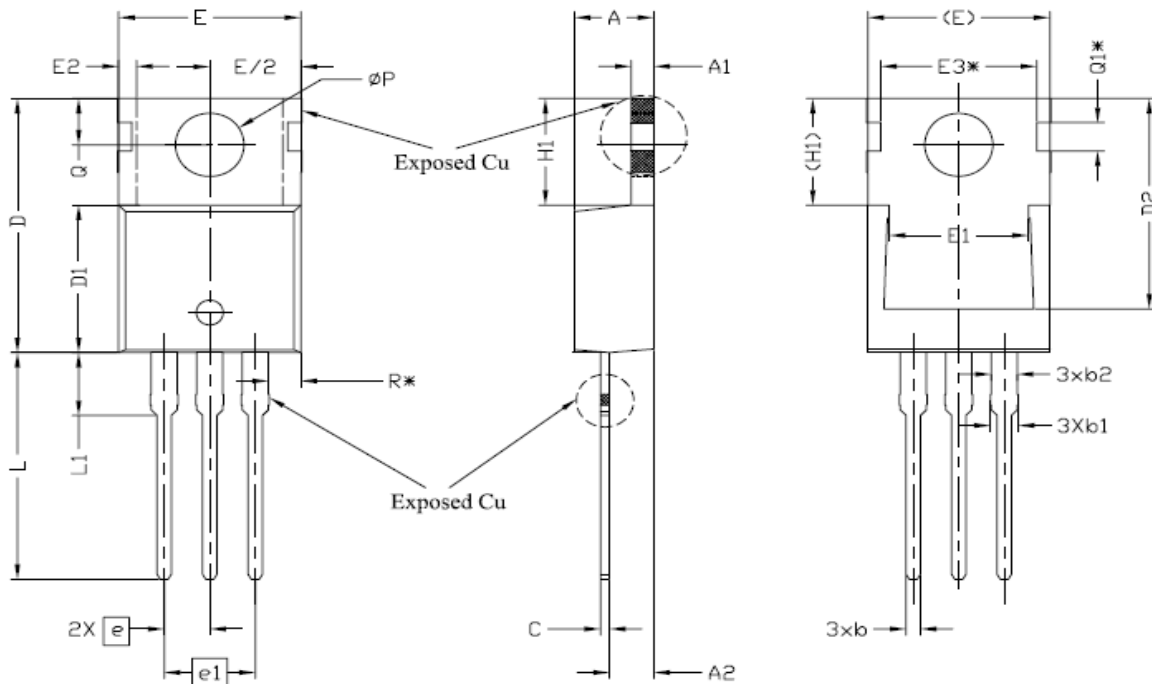
Uclamped Inductive Switching (UIS) Test



Diode Recovery Test

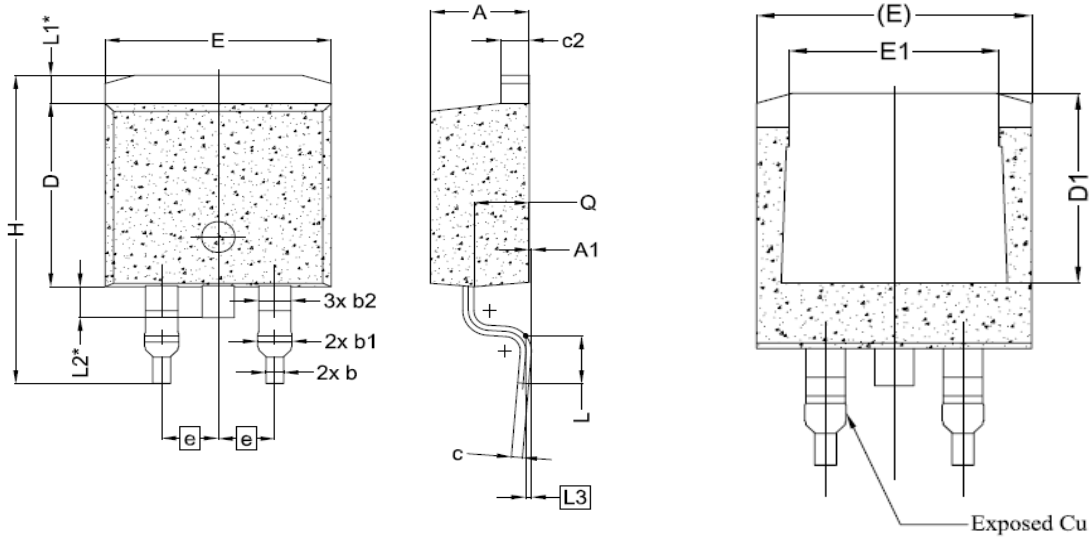


TO-220, 3 leads



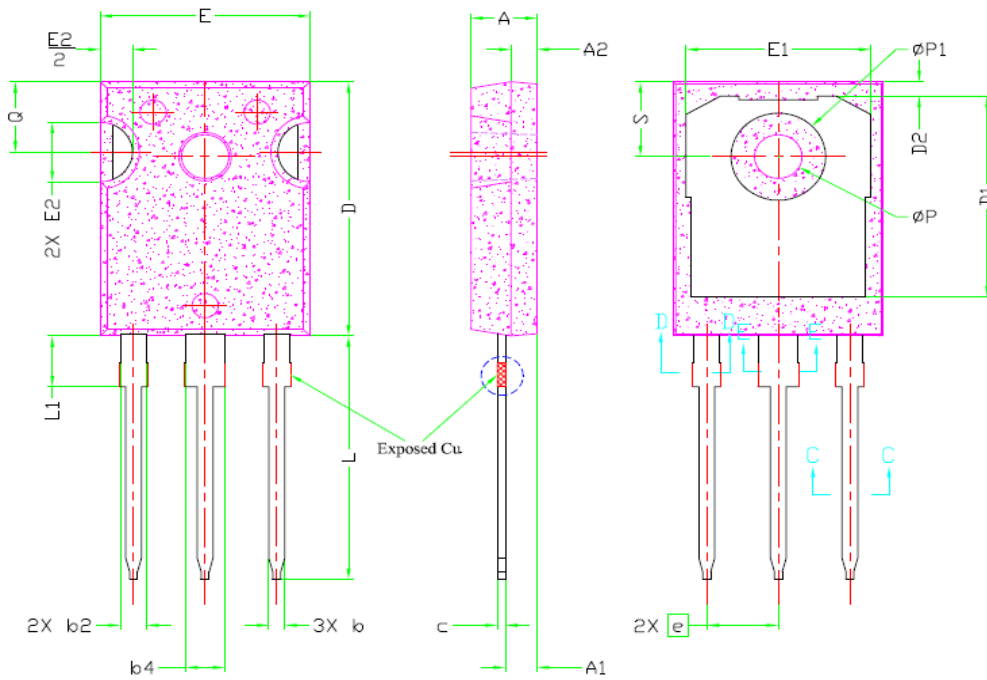
| SYMBOL | DIMENSIONS | | | NOTES |
|--------|------------|-------|-------|-------|
| | MIN. | NOM. | MAX. | |
| A | 4,24 | 4,44 | 4,64 | |
| A1 | 1,15 | 1,27 | 1,40 | |
| A2 | 2,30 | 2,48 | 2,70 | |
| b | 0,70 | 0,80 | 0,90 | |
| b1 | 1,20 | 1,55 | 1,75 | |
| b2 | 1,20 | 1,45 | 1,70 | |
| c | 0,40 | 0,50 | 0,60 | |
| D | 14,70 | 15,37 | 16,00 | 4 |
| D1 | 8,82 | 8,92 | 9,02 | |
| D2 | 12,63 | 12,73 | 12,83 | 5 |
| E | 9,96 | 10,16 | 10,36 | 4,5 |
| E1 | 6,86 | 7,77 | 8,89 | 5 |
| E2 | - | - | 0,76 | 6 |
| E3* | 8,70REF. | | | |
| e | 2,54BSC | | | |
| e1 | 5,08BSC | | | |
| H1 | 6,30 | 6,45 | 6,60 | 5,6 |
| L | 13,47 | 13,72 | 13,97 | |
| L1 | 3,60 | 3,80 | 4,00 | |
| ∅P | 3,75 | 3,84 | 3,93 | |
| Q | 2,60 | 2,80 | 3,00 | |
| Q1* | 1,73REF. | | | |
| R* | 1,82REF. | | | |

TO-263, 2 leads



| SYMBOL | DIMENSIONS | | |
|--------|------------|-------|-------|
| | MIN. | NOM. | MAX. |
| A | 4.24 | 4.44 | 4.64 |
| A1 | 0.00 | 0.10 | 0.25 |
| b | 0.70 | 0.80 | 0.90 |
| b1 | 1.20 | 1.55 | 1.75 |
| b2 | 1.20 | 1.45 | 1.70 |
| c | 0.40 | 0.50 | 0.60 |
| c2 | 1.15 | 1.27 | 1.40 |
| D | 8.82 | 8.92 | 9.02 |
| D1 | 6.86 | 7.65 | — |
| E | 9.96 | 10.16 | 10.36 |
| E1 | 6.89 | 7.77 | 7.89 |
| e | 2.54 BSC | | |
| H | 14.61 | 15.00 | 15.88 |
| L | 1.78 | 2.32 | 2.79 |
| L1 | 1.36 REF. | | |
| L2 | 1.50 REF. | | |
| L3 | 0.25 BSC | | |
| Q | 2.30 | 2.48 | 2.70 |

TO-247, 3 leads



| SYMBOL | DIMENSIONS | | | NOTES |
|--------|------------|-------|-------|-------|
| | MIN. | NOM. | MAX. | |
| A | 4.83 | 5.02 | 5.21 | |
| A1 | 2.29 | 2.41 | 2.55 | |
| A2 | 1.50 | 2.00 | 2.49 | |
| b | 1.12 | 1.20 | 1.33 | |
| b1 | 1.12 | 1.20 | 1.28 | |
| b2 | 1.91 | 2.00 | 2.39 | 6 |
| b3 | 1.91 | 2.00 | 2.34 | |
| b4 | 2.87 | 3.00 | 3.22 | 6, 8 |
| b5 | 2.87 | 3.00 | 3.18 | |
| c | 0.55 | 0.60 | 0.69 | 6 |
| c1 | 0.55 | 0.60 | 0.65 | |
| D | 20.80 | 20.95 | 21.10 | 4 |
| D1 | 16.25 | 16.55 | 17.65 | 5 |
| D2 | 0.51 | 1.19 | 1.35 | |
| E | 15.75 | 15.94 | 16.13 | 4 |
| E1 | 13.46 | 14.02 | 14.16 | 5 |
| E2 | 4.32 | 4.91 | 5.49 | 3 |
| e | 5.44BSC | | | |
| L | 19.81 | 20.07 | 20.32 | |
| L1 | 4.10 | 4.19 | 4.40 | 6 |
| ØP | 3.56 | 3.61 | 3.65 | 7 |
| ØP1 | 7.19REF. | | | |
| Q | 5.39 | 5.79 | 6.20 | |
| S | 6.04 | 6.17 | 6.30 | |