# HGB210N20S , HGK210N20S HGP210N20S

## 200V N-Ch Power MOSFET

| | | |
|---|---|---|
| $V_{DS}$ | 200 | V |
| $R_{DS(on),typ}$ | 16 | mΩ |
| $I_{D\ (Sillicon\ Limited)}$ | 70 | A |

### 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

TO-263     TO-220

TO-247

Drain
Pin2

Gate
Pin 1

Src
Pin3
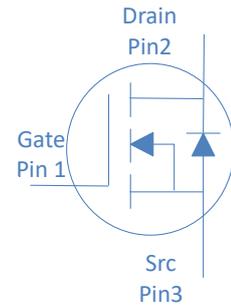
| Part Number | Package | Marking |
|---|---|---|
| HGB210N20S | TO-263 | GB210N20S |
| HGK210N20S | TO-247 | GK210N20S |
| HGP210N20S | TO-220 | GP210N20S |

### Absolute Maximum Ratings at $T_i$=25℃ (unless otherwise specified)

| Parameter | Symbol | Conditions | Value | Unit |
|---|---|---|---|---|
| Continuous Drain Current (Silicon Limited) | $I_D$ | $T_C$=25℃ | 70 | A |
| | | $T_C$=100℃ | 50 | |
| Drain to Source Voltage | $V_{DS}$ | - | 200 | V |
| Gate to Source Voltage | $V_{GS}$ | - | ±20 | V |
| Pulsed Drain Current | $I_{DM}$ | - | 260 | A |
| Avalanche Energy, Single Pulse | $E_{AS}$ | L=0.4mH, $T_C$=25℃ | 320 | mJ |
| Power Dissipation | $P_D$ | $T_C$=25℃ | 300 | W |
| Operating and Storage Temperature | $T_J$, $T_{stg}$ | - | -55 to175 | ℃ |

### Absolute Maximum Ratings

| Parameter | Symbol | Max | Unit |
|---|---|---|---|
| Thermal Resistance Junction-Case | $R_{\Theta JC}$ | 0.5 | ℃/W |
| Thermal Resistance Junction-Ambient | $R_{\Theta JA}$ | 60 | ℃/W |

## Electrical Characteristics at $T_j$=25℃ (unless otherwise specified)

### Static Characteristics

| Parameter | Symbol | Conditions | | Value | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | min | typ | max | |
| Drain to Source Breakdown Voltage | $V_{(BR)DSS}$ | $V_{GS}$=0V, $I_D$=250μA | | 200 | - | - | V |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{GS}$=$V_{DS}$, $I_D$=250μA | | 2 | 3 | 4 | |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{GS}$=0V, $V_{DS}$=200V, $T_j$=25℃ | | - | - | 1 | μA |
| | | $V_{GS}$=0V, $V_{DS}$=200V, $T_j$=100℃ | | - | - | 100 | |
| Gate to Source Leakage Current | $I_{GSS}$ | $V_{GS}$=±20V, $V_{DS}$=0V | | - | - | ±100 | nA |
| Drain to Source on Resistance | $R_{DS(on)}$ | $V_{GS}$=10V, $I_D$=20A | TO-263 | - | 16 | 21 | mΩ |
| | | | TO-247 | | 16 | 21 | |
| | | | TO-220 | - | 16 | 21 | |
| Transconductance | $g_{fs}$ | $V_{DS}$=5V, $I_D$=20A | | - | 60 | - | S |
| Gate Resistance | $R_G$ | $V_{GS}$=0V, $V_{DS}$ Open, f=1MHz | | - | 4.4 | - | Ω |

### Dynamic Characteristics

| Parameter | Symbol | Conditions | min | typ | max | Unit |
|---|---|---|---|---|---|---|
| Input Capacitance | $C_{iss}$ | $V_{GS}$=0V, $V_{DS}$=100V, f=1MHz | - | 2816 | - | pF |
| Output Capacitance | $C_{oss}$ | | - | 230 | - | |
| Reverse Transfer Capacitance | $C_{rss}$ | | - | 11 | - | |
| Total Gate Charge | $Q_g$ | $V_{DD}$=100V, $I_D$=20A, $V_{GS}$=10V | - | 35 | - | nC |
| Gate to Source Charge | $Q_{gs}$ | | - | 11 | - | |
| Gate to Drain (Miller) Charge | $Q_{gd}$ | | - | 6 | - | |
| Turn on Delay Time | $t_{d(on)}$ | $V_{DD}$=100V, $I_D$=20A, $V_{GS}$=10V, $R_G$=10Ω, | - | 10 | - | ns |
| Rise time | $t_r$ | | - | 20 | - | |
| Turn off Delay Time | $t_{d(off)}$ | | - | 21 | - | |
| Fall Time | $t_f$ | | - | 8 | - | |

### Reverse Diode Characteristics

| Parameter | Symbol | Conditions | min | typ | max | Unit |
|---|---|---|---|---|---|---|
| Diode Forward Voltage | $V_{SD}$ | $V_{GS}$=0V, $I_F$=20A | - | 0.9 | - | V |
| Reverse Recovery Time | $t_{rr}$ | $V_R$=100V, $I_F$=20A, $dI_F$/dt=100A/μs | - | 120 | - | ns |
| Reverse Recovery Charge | $Q_{rr}$ | | - | 420 | - | nC |

Fig 1. Typical Output Characteristics
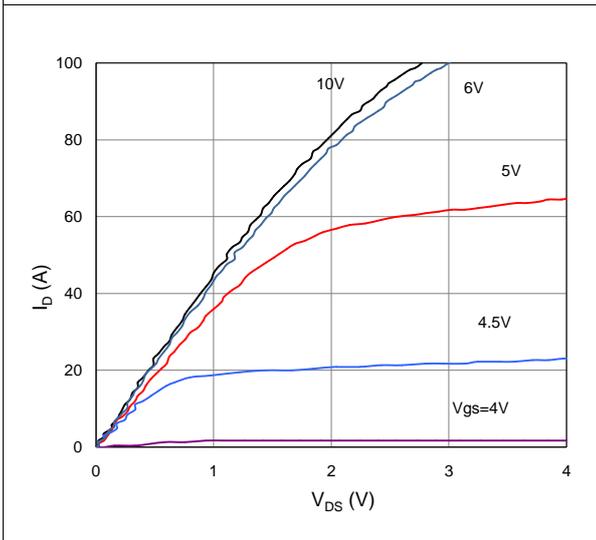


Figure 2. On-Resistance vs. Gate-Source Voltage
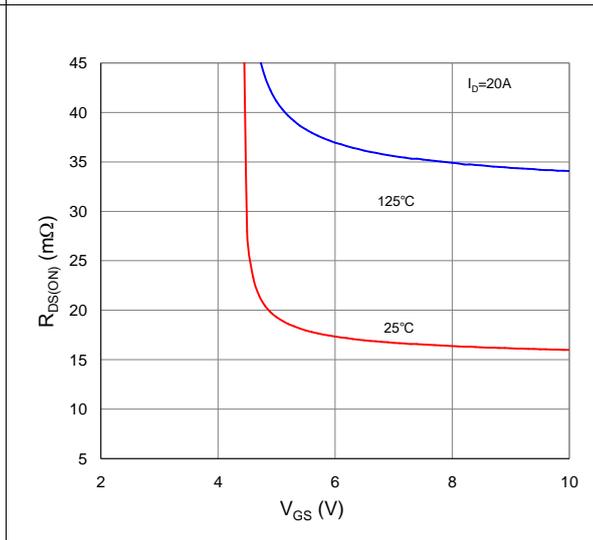


Figure 3. On-Resistance vs. Drain Current and Gate Voltage
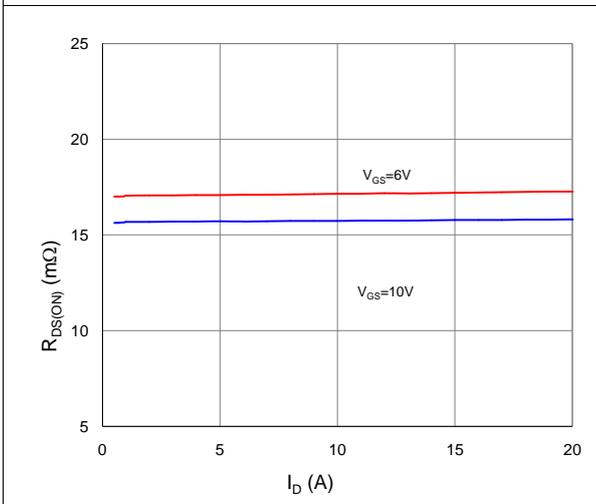


Figure 4. Normalized On-Resistance vs. Junction Temperature
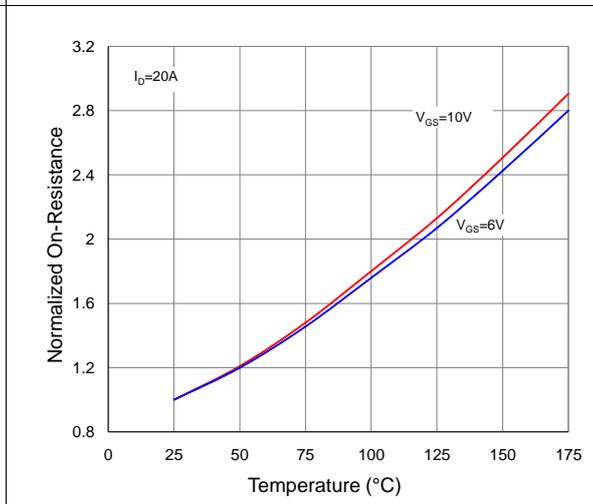


Figure 5. Typical Transfer Characteristics
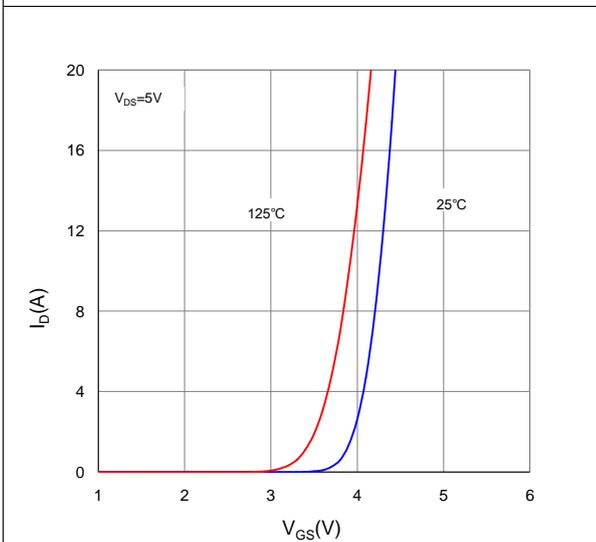


Figure 6. Typical Source-Drain Diode Forward Voltage



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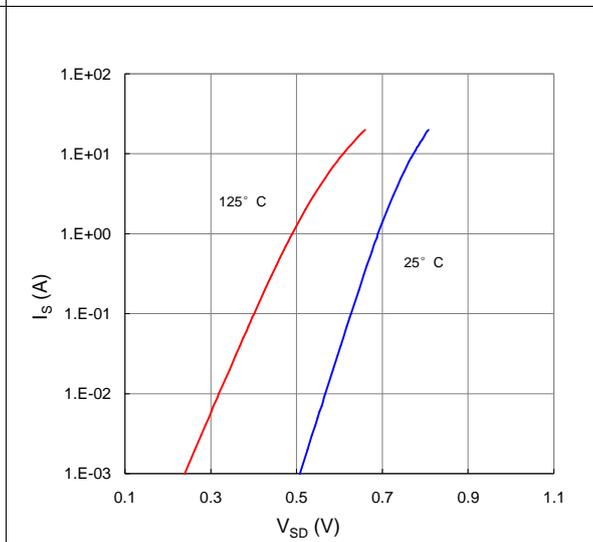
Figure 7. Typical Gate-Charge vs. Gate-to-Source Voltage



$V_{DS}=100V$
$I_D=20A$
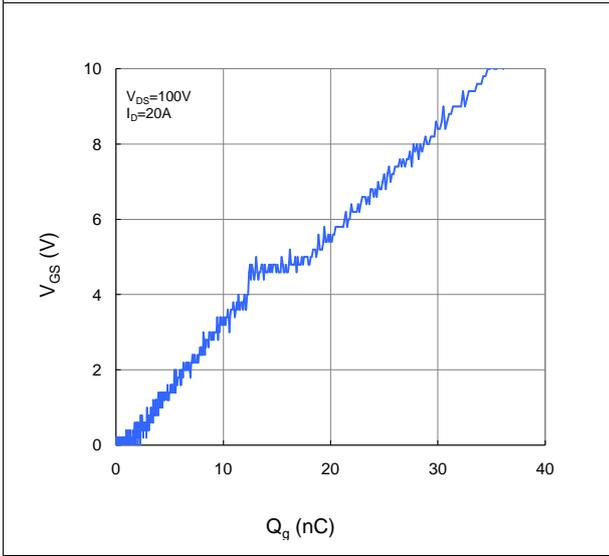
Figure 8. Typical Capacitance vs. Drain-to-Source Voltage



$C_{iss}$
$C_{oss}$
$C_{rss}$
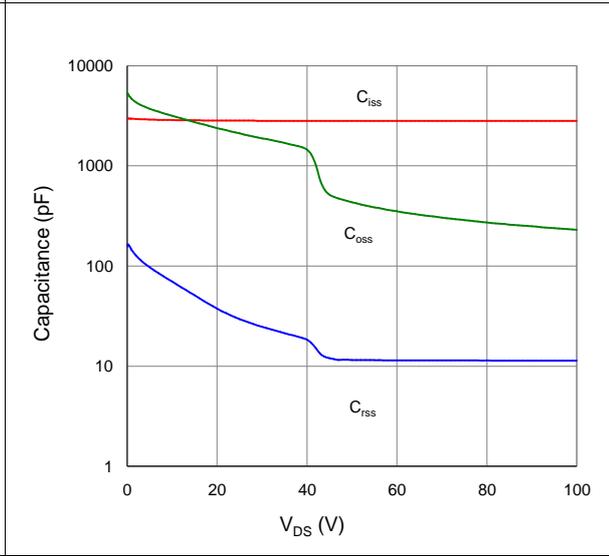
Figure 9. Maximum Safe Operating Area



$R_{DS(ON)}$ limited

10μs
100μs
1ms
10ms
DC

$T_{J(Max)}=175°C$
$T_C=25°C$
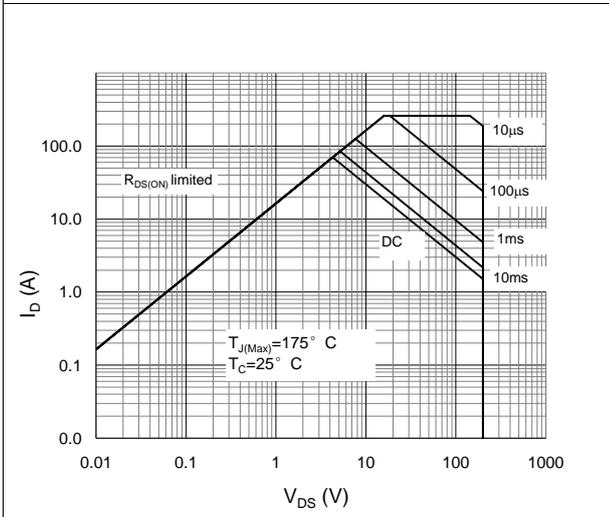
Figure 10. Maximun Drain Current vs. Case Temperature
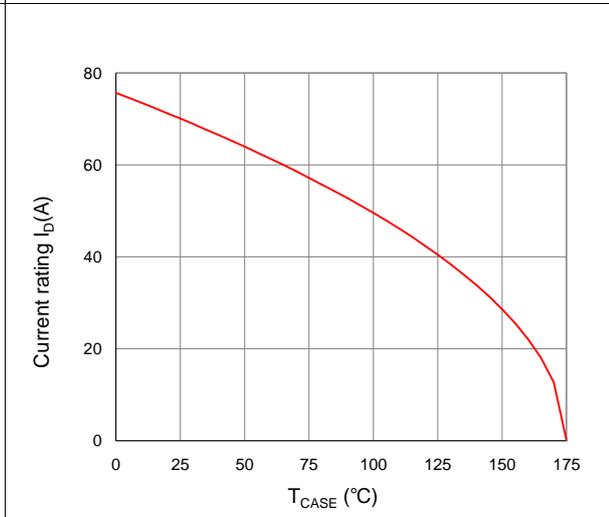


Figure 11. Normalized Maximum Transient Thermal Impedance, Junction-to-Case



Duty=$T_{on}$/T
Peak $T_J=T_C+P_{DM}\cdot Z_{\theta JC}\cdot R_{\theta JC}$
$R_{\theta JC}=0.5°C/W$

Duty=0.5
0.3
0.1
0.05
0.03
0.01
single pulse

## Inductive switching Test



$V_{GS}$
90%
10%
$T_{d(on)}$ — $T_r$  $T_{d(off)}$ — $T_f$
90%
$V_{DS}$
10%
$V_F$

## Gate Charge Test



$V_{GS}$
$Q_G$
10V
$V_{DS}$
$Q_{GS}$  $Q_{GD}$
$Q_G$
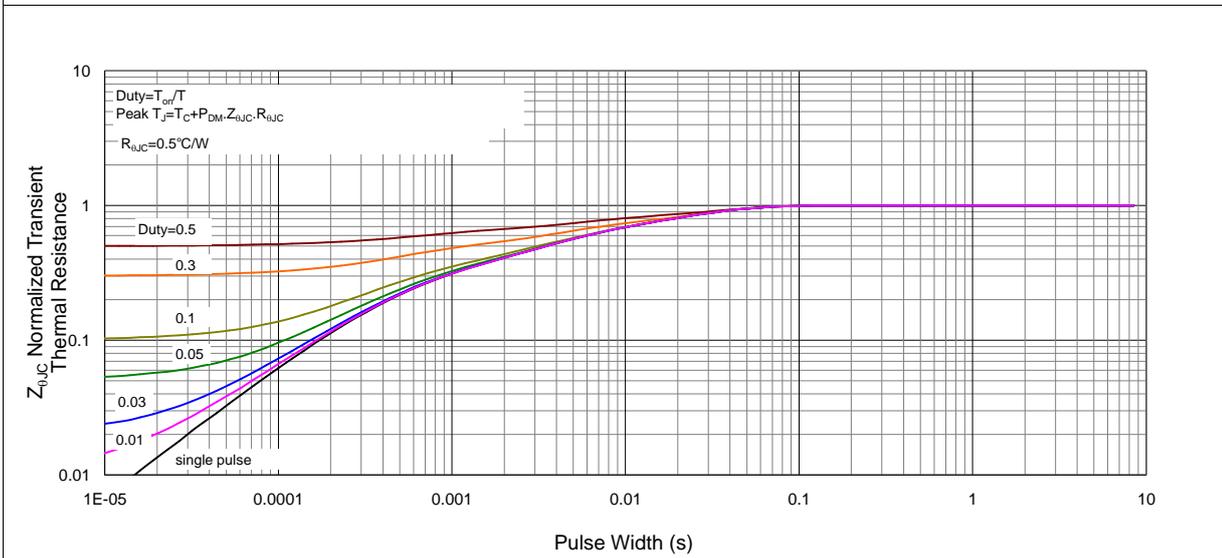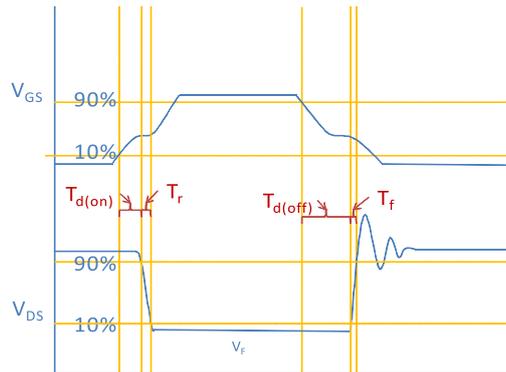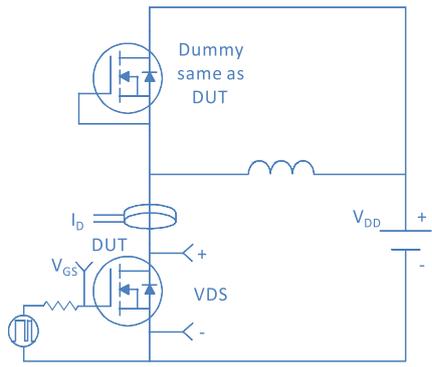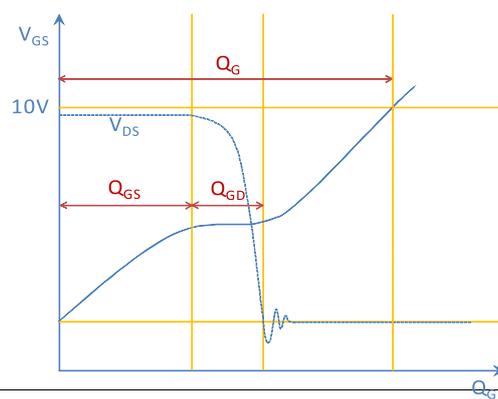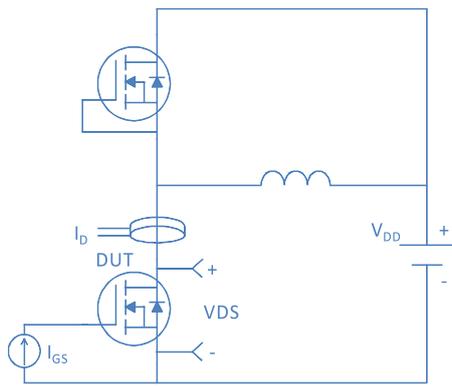
## Uclamped Inductive Switching (UIS) Test



$\overline{V_{GS}}$
VDS
$I_D$
DUT
$V_{DD}$
$V_{GS}$

$V_{GS}$
$I_{AS}$
$I_D$
$BV_{DSS}$
$V_{DS}$

## Diode Recovery Test



DUT
VDS
$I_{SD}$
$V_{DD}$
$V_{GS}$
Driver same as DUT

$V_{GS}$
$I_F$
$I_{SD}$
di/dt  $t_{RR}$
$I_{RRM}$
$V_{DD}$
$V_{DS}$
dv/dt
$V_F$
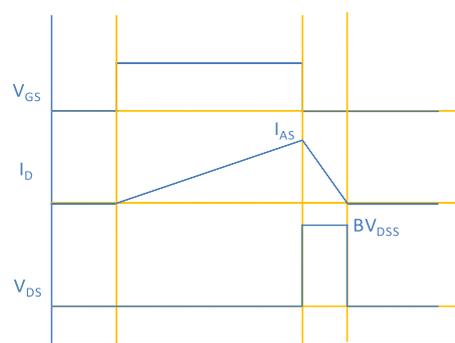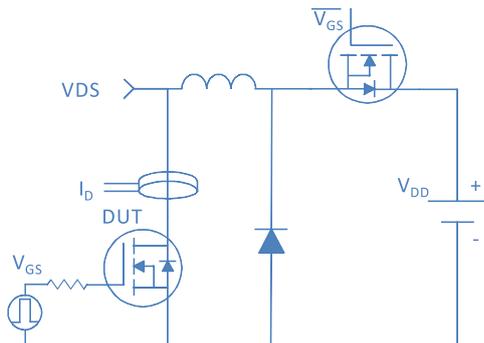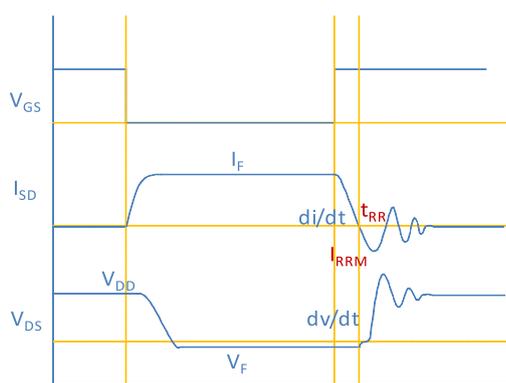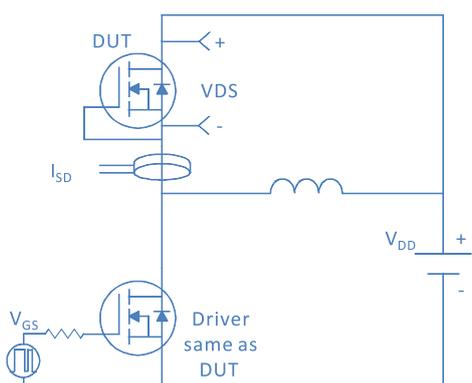
## TO-220, 3 leads
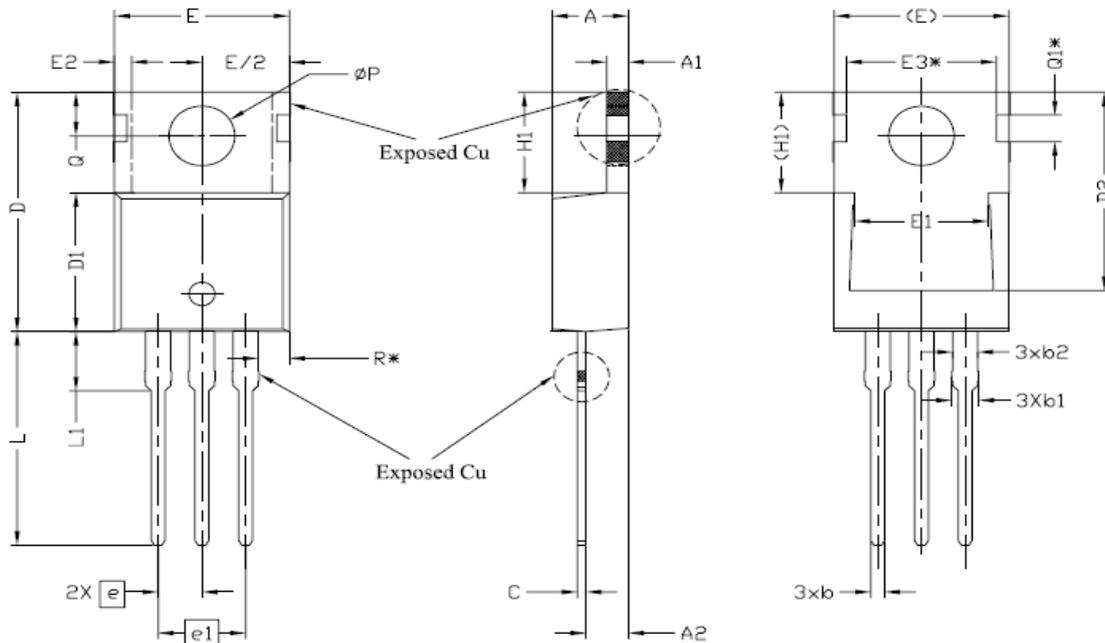


| SYMBOL | DIMENSIONS | | | NOTES |
|--------|------|------|------|-------|
| | MIN. | NOM. | MAX. | |
| A | 4.24 | 4.44 | 4.64 | |
| A1 | 1.15 | 1.27 | 1.40 | |
| A2 | 2.30 | 2.48 | 2.70 | |
| b | 0.70 | 0.80 | 0.90 | |
| b1 | 1.20 | 1.55 | 1.75 | |
| b2 | 1.20 | 1.45 | 1.70 | |
| c | 0.40 | 0.50 | 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 | |
| ØP | 3.75 | 3.84 | 3.93 | |
| Q | 2.60 | 2.80 | 3.00 | |
| Q1* | 1.73REF. | | | |
| R* | 1.82REF. | | | |

## TO-263, 2 leads



Exposed Cu
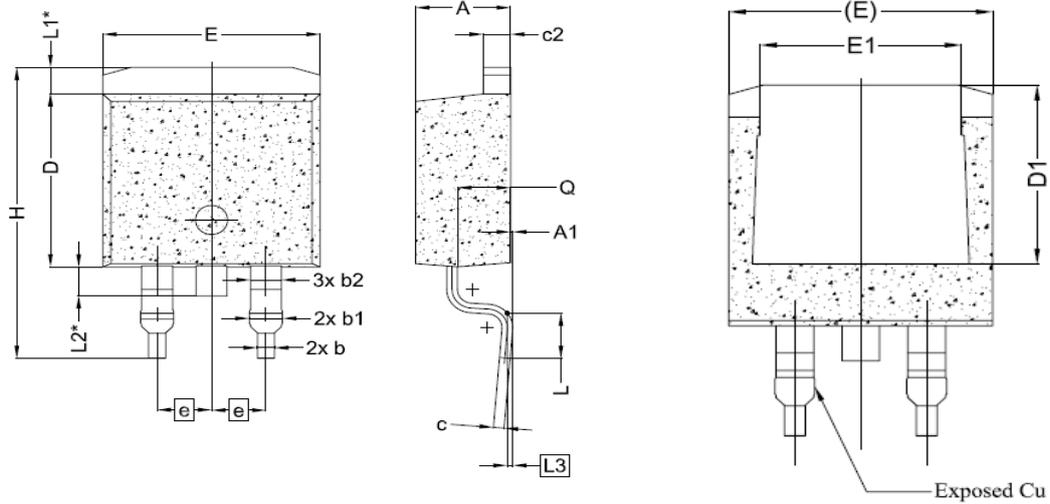
| SYMBOL | DIMENSIONS | | |
|---|---|---|---|
| | MIN. | NOM. | MAX. |
| A | 4.24 | 4.44 | 4.64 |
| A1 | 0.00 | 0.10 | 0.25 |
| b | 0.70 | 0.80 | 0.90 |
| b1 | 1.20 | 1.55 | 1.75 |
| b2 | 1.20 | 1.45 | 1.70 |
| c | 0.40 | 0.50 | 0.60 |
| c2 | 1.15 | 1.27 | 1.40 |
| D | 8.82 | 8.92 | 9.02 |
| D1 | 6.86 | 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
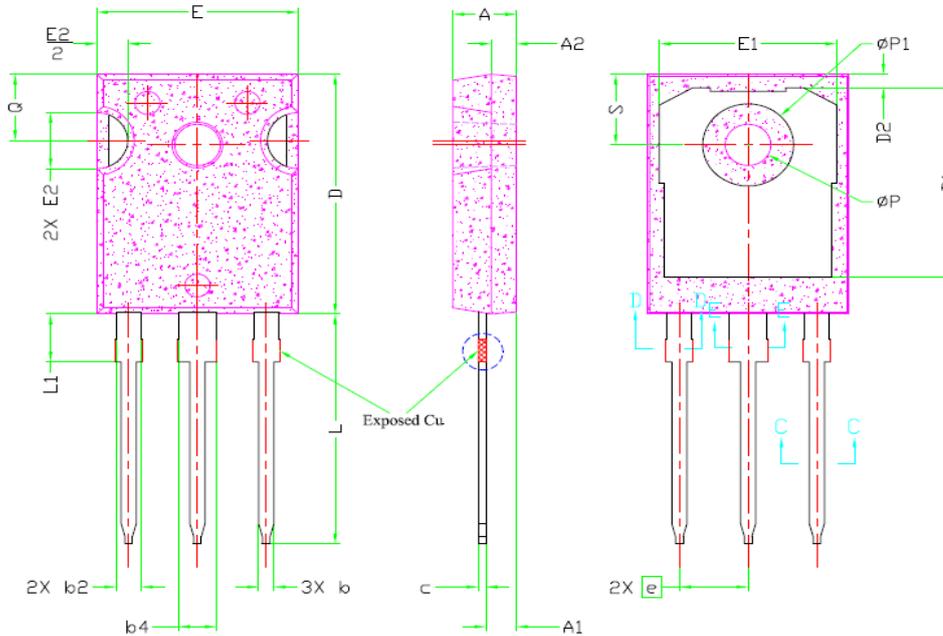


| SYMBOL | DIMENSIONS | | | NOTES |
|--------|------|------|------|-------|
| | MIN. | NOM. | MAX. | |
| A | 4.83 | 5.02 | 5.21 | |
| A1 | 2.29 | 2.41 | 2.55 | |
| A2 | 1.50 | 2.00 | 2.49 | |
| b | 1.12 | 1.20 | 1.33 | |
| b1 | 1.12 | 1.20 | 1.28 | |
| b2 | 1.91 | 2.00 | 2.39 | 6 |
| b3 | 1.91 | 2.00 | 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 | |