

## 65V N-Ch Power MOSFET

### Feature

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

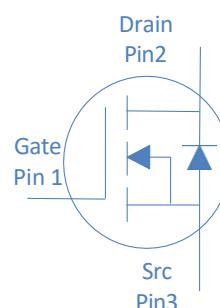
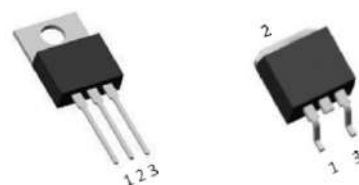
### Application

- ◇ Synchronous Rectification in SMPS
- ◇ Hard Switching and High Speed Circuit
- ◇ DC/DC in Telecoms and Industrial

|                         |        |     |    |
|-------------------------|--------|-----|----|
| $V_{DS}$                |        | 65  | V  |
| $R_{DS(on),typ}$        | TO-263 | 2.3 | mΩ |
| $R_{DS(on),typ}$        | TO-220 | 2.6 | mΩ |
| $I_D$ (Silicon Limited) |        | 181 | A  |

| Part Number | Package | Marking   |
|-------------|---------|-----------|
| KUGB028NE6A | TO-263  | GB028NE6A |
| KEGP028NE6A | TO-220  | GP028NE6A |

TO-220 TO-263



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

| Parameter                                  | Symbol            | Conditions                                  | Value      | Unit               |
|--------------------------------------------|-------------------|---------------------------------------------|------------|--------------------|
| Continuous Drain Current (Silicon Limited) | $I_D$             | $T_C=25^{\circ}\text{C}$                    | 181        | A                  |
|                                            |                   | $T_C=100^{\circ}\text{C}$                   | 128        |                    |
| Drain to Source Voltage                    | $V_{DS}$          | -                                           | 65         | V                  |
| Gate to Source Voltage                     | $V_{GS}$          | -                                           | $\pm 20$   | V                  |
| Pulsed Drain Current                       | $I_{DM}$          | -                                           | 400        | A                  |
| Avalanche Energy, Single Pulse             | $E_{AS}$          | $L=0.1\text{mH}$ , $T_C=25^{\circ}\text{C}$ | 80         | mJ                 |
| Power Dissipation                          | $P_D$             | $T_C=25^{\circ}\text{C}$                    | 172        | 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-Ambient | $R_{\theta JA}$ | 60   | $^{\circ}\text{C/W}$ |
| Thermal Resistance Junction-Case    | $R_{\theta JC}$ | 0.87 | $^{\circ}\text{C/W}$ |

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 | $V_{(BR)DSS}$ | $V_{GS}=0V, I_D=250\mu A$                        | 65    | -    | -         | V         |
| Gate Threshold Voltage            | $V_{GS(th)}$  | $V_{GS}=V_{DS}, I_D=250\mu A$                    | 2.0   | 2.6  | 4.0       |           |
| Zero Gate Voltage Drain Current   | $I_{DSS}$     | $V_{GS}=0V, V_{DS}=60V, T_j=25^{\circ}\text{C}$  | -     | -    | 1         | $\mu A$   |
|                                   |               | $V_{GS}=0V, V_{DS}=60V, T_j=100^{\circ}\text{C}$ | -     | -    | 100       |           |
| Gate to Source Leakage Current    | $I_{GSS}$     | $V_{GS}=\pm 20V, V_{DS}=0V$                      | -     | -    | $\pm 100$ | nA        |
| Drain to Source on Resistance     | $R_{DS(on)}$  | $V_{GS}=10V, I_D=20A$ TO-263                     | -     | 2.3  | 2.8       | $m\Omega$ |
| Drain to Source on Resistance     | $R_{DS(on)}$  | $V_{GS}=10V, I_D=20A$ TO-220                     | -     | 2.6  | 3.1       | $m\Omega$ |
| Transconductance                  | $g_{fs}$      | $V_{DS}=5V, I_D=20A$                             | -     | 66   | -         | S         |
| Gate Resistance                   | $R_G$         | $V_{GS}=0V, V_{DS}$ Open, $f=1\text{MHz}$        | -     | 1.25 | -         | $\Omega$  |

| Dynamic Characteristics       |              |                                                       |   |      |   |    |
|-------------------------------|--------------|-------------------------------------------------------|---|------|---|----|
| Input Capacitance             | $C_{iss}$    | $V_{GS}=0V, V_{DS}=30V, f=1\text{MHz}$                | - | 4348 | - | pF |
| Output Capacitance            | $C_{oss}$    |                                                       | - | 1501 | - |    |
| Reverse Transfer Capacitance  | $C_{rss}$    |                                                       | - | 92   | - |    |
| Total Gate Charge             | $Q_g(10V)$   | $V_{DD}=30V, I_D=20A, V_{GS}=10V$                     | - | 66   | - | nC |
| Gate to Source Charge         | $Q_{gs}$     |                                                       | - | 16   | - |    |
| Gate to Drain (Miller) Charge | $Q_{gd}$     |                                                       | - | 16   | - |    |
| Turn on Delay Time            | $t_{d(on)}$  | $V_{DD}=30V, I_D=20A, V_{GS}=10V,$<br>$R_G=10\Omega,$ | - | 15   | - | ns |
| Rise time                     | $t_r$        |                                                       | - | 12   | - |    |
| Turn off Delay Time           | $t_{d(off)}$ |                                                       | - | 52   | - |    |
| Fall Time                     | $t_f$        |                                                       | - | 19   | - |    |

| Reverse Diode Characteristics |          |                                        |   |     |     |    |
|-------------------------------|----------|----------------------------------------|---|-----|-----|----|
| Diode Forward Voltage         | $V_{SD}$ | $V_{GS}=0V, I_F=20A$                   | - | 0.9 | 1.2 | V  |
| Reverse Recovery Time         | $t_{rr}$ | $V_R=30V, I_F=20A, dI_F/dt=100A/\mu s$ | - | 50  | -   | ns |
| Reverse Recovery Charge       | $Q_{rr}$ |                                        | - | 50  | -   | nC |

Fig 1. Typical Output Characteristics

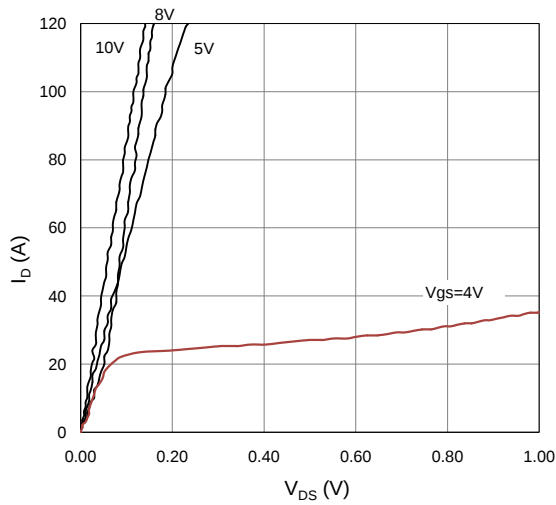


Figure 2. On-Resistance vs. Gate-Source Voltage

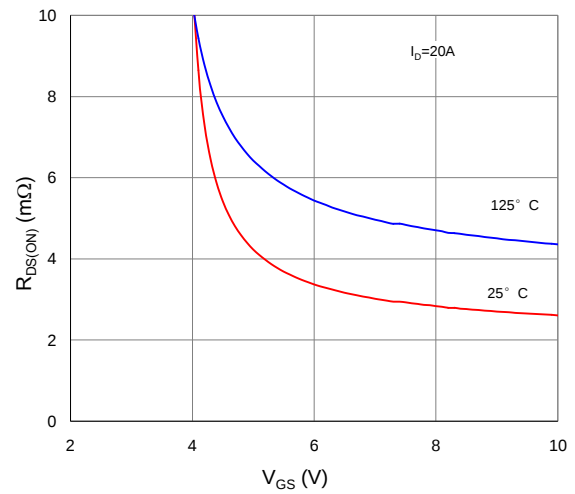


Figure 3. On-Resistance vs. Drain Current and Gate Voltage

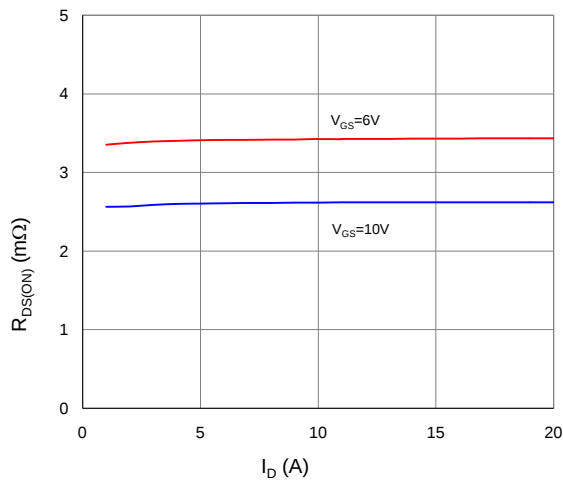


Figure 4. Normalized On-Resistance vs. Junction Temperature

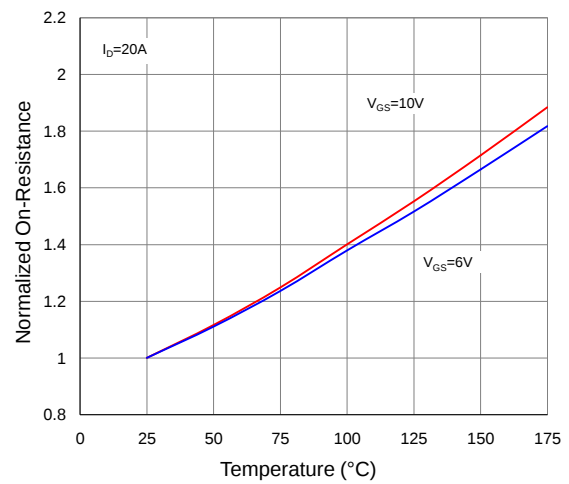


Figure 5. Typical Transfer Characteristics

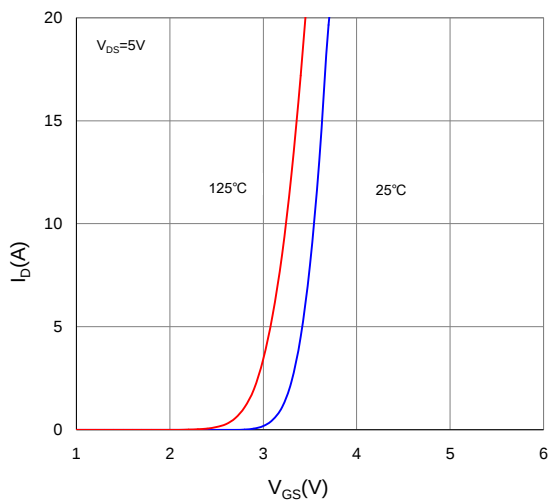


Figure 6. Typical Source-Drain Diode Forward Voltage

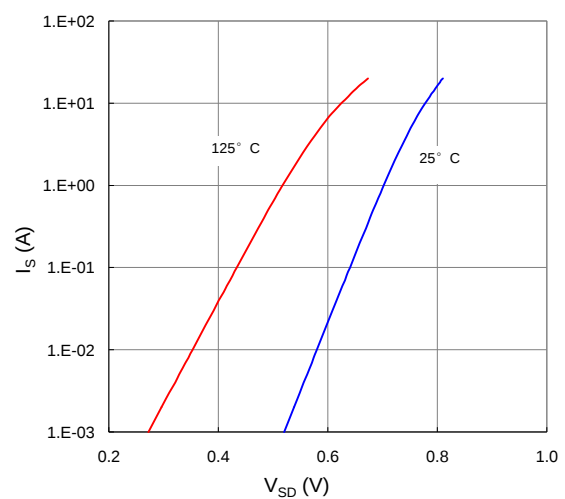


Figure 7. Typical Gate-Charge vs. Gate-to-Source Voltage

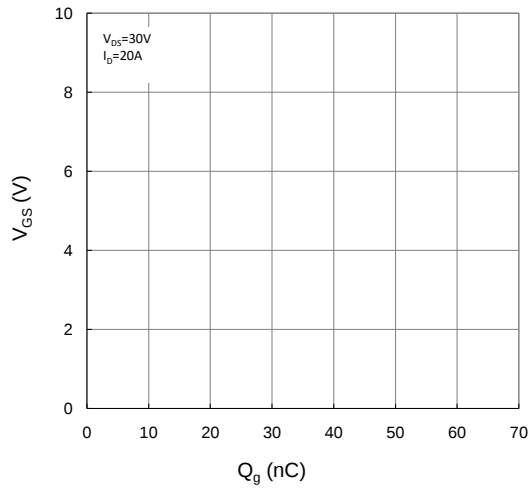


Figure 8. Typical Capacitance vs. Drain-to-Source Voltage

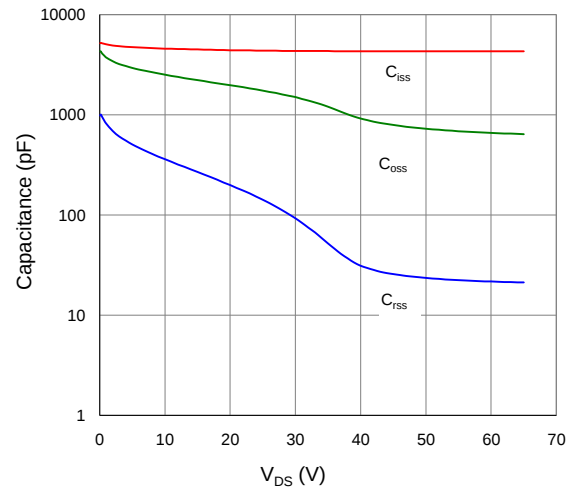


Figure 9. Maximum Safe Operating Area

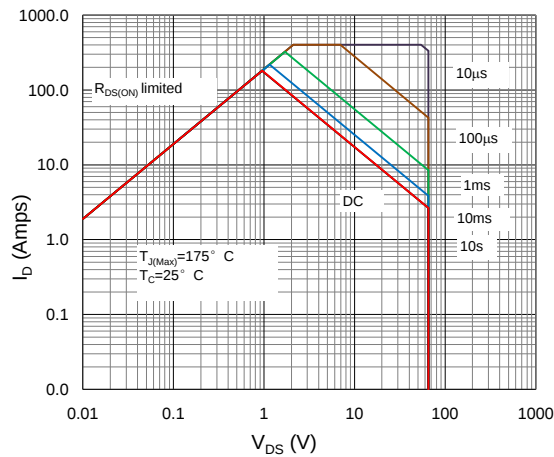


Figure 10. Maximum Drain Current vs. Case Temperature

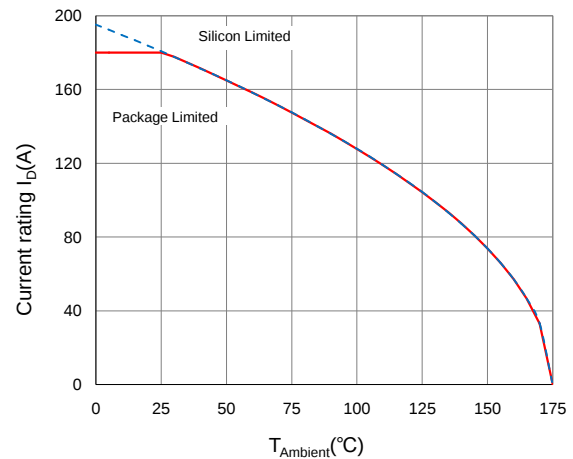
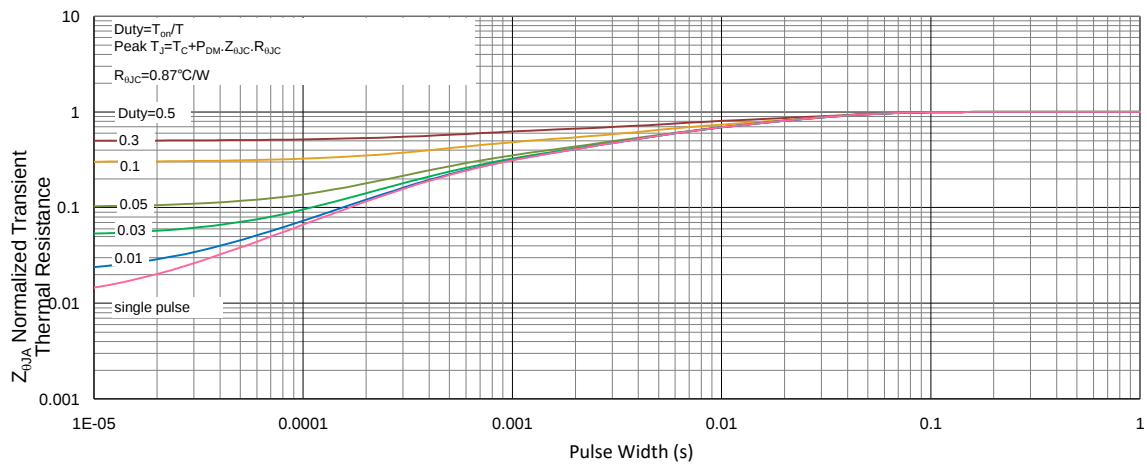
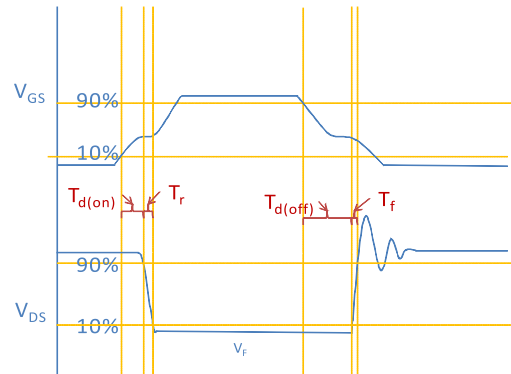
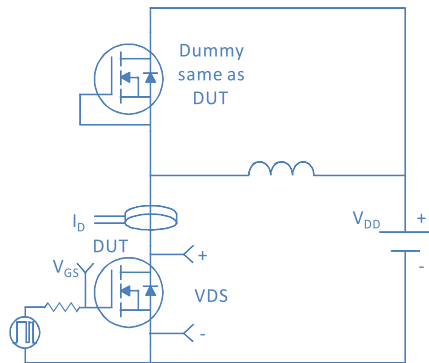


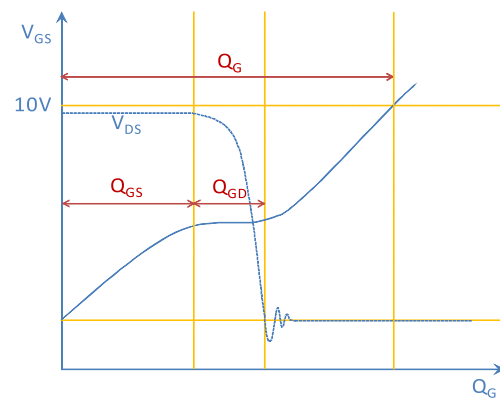
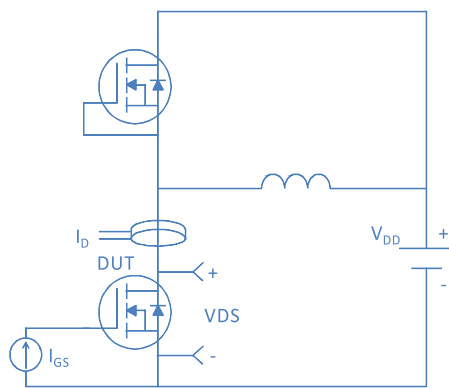
Figure 11. Normalized Maximum Transient Thermal Impedance, Junction-to-Ambient



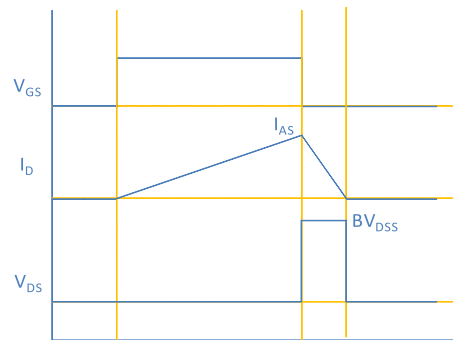
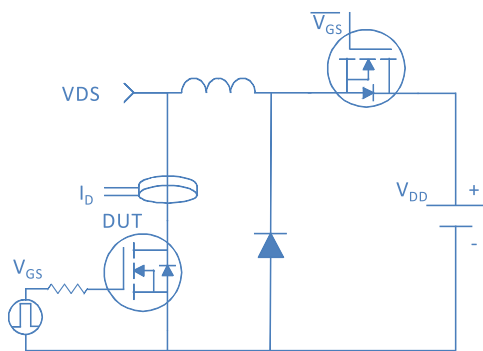
### Inductive switching Test



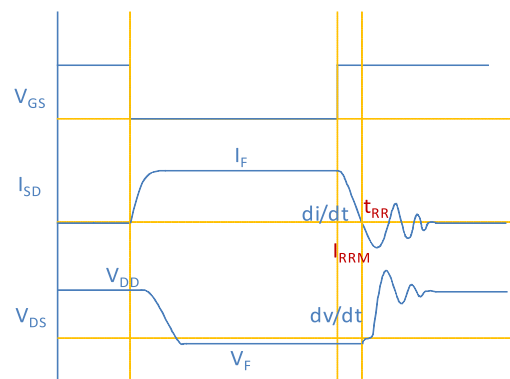
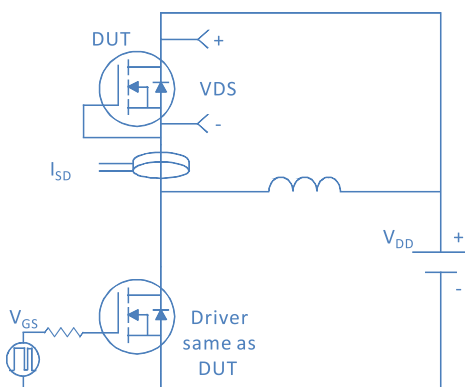
### Gate Charge Test



### Uclamped Inductive Switching (UIS) Test

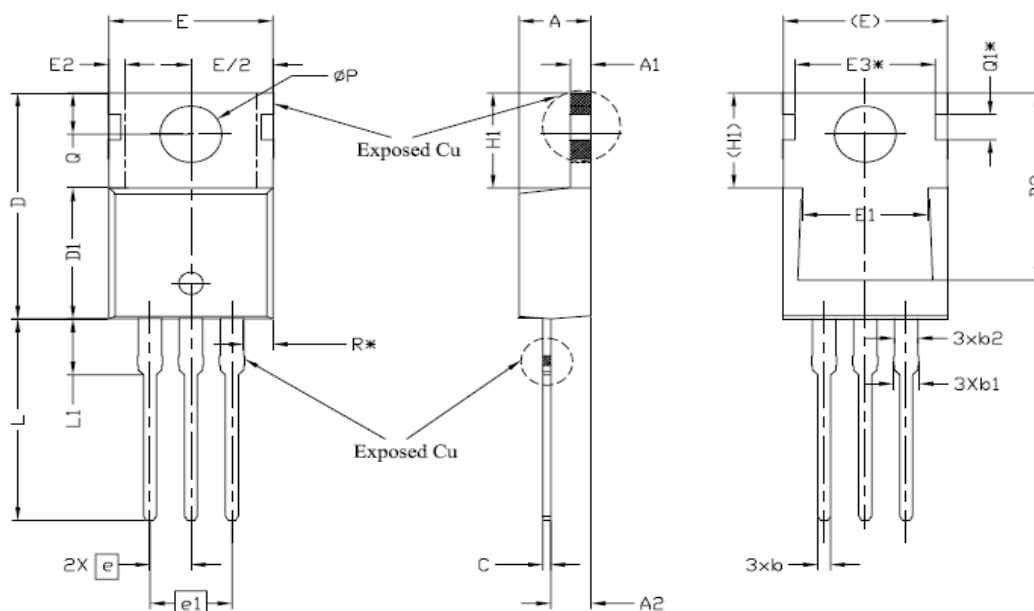


### Diode Recovery Test



## Package Outline

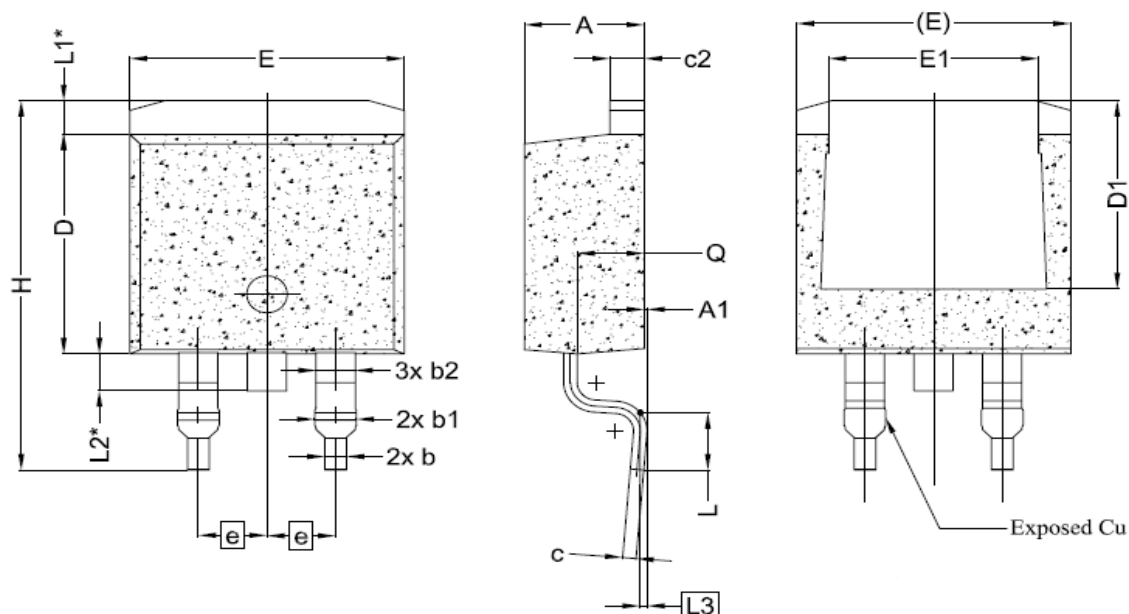
### TO-220, 3 leads



| 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.   |       |       |       |

## Package Outline

### TO-263, 3 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  |