

## N-Channel 600V (D-S) Super Junction Power MOSFET With Fast Diode

### PRODUCT SUMMARY

|                                    |                 |       |
|------------------------------------|-----------------|-------|
| $V_{DS}$ (V) at $T_J$ max.         | 600             |       |
| $R_{DS(on)}$ at 25 °C ( $\Omega$ ) | $V_{GS} = 10$ V | 0.062 |

### FEATURES

- Low figure-of-merit (FOM)  $R_{on} \times Q_g$
- Ultra-fast body diode
- Reduced switching and conduction losses
- Ultra low gate charge ( $Q_g$ )
- Avalanche energy rated (UIS)



RoHS

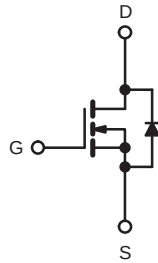
### APPLICATIONS

- Server and telecom power supplies
- Switch mode power supplies (SMPS)
- Power factor correction power supplies (PFC)
- Lighting
  - High-intensity discharge (HID)
  - Fluorescent ballast lighting
- Industrial

TO-263



Top View



N-Channel MOSFET

### ABSOLUTE MAXIMUM RATINGS ( $T_C = 25$ °C, unless otherwise noted)

| PARAMETER                                                        |                                     |                                     | SYMBOL         | LIMIT       | UNIT                  |
|------------------------------------------------------------------|-------------------------------------|-------------------------------------|----------------|-------------|-----------------------|
| Drain-Source Voltage                                             |                                     |                                     | $V_{DS}$       | 600         | V                     |
| Gate-Source Voltage                                              |                                     |                                     | $V_{GS}$       | $\pm 30$    |                       |
| Continuous Drain Current ( $T_J = 150\text{ }^{\circ}\text{C}$ ) | $V_{GS}$ at 10 V                    | $T_C = 25\text{ }^{\circ}\text{C}$  | $I_D$          | 41          | A                     |
|                                                                  |                                     | $T_C = 100\text{ }^{\circ}\text{C}$ |                | 26          |                       |
| Pulsed Drain Current <sup>a</sup>                                |                                     |                                     | $I_{DM}$       | 120         |                       |
| Linear Derating Factor                                           |                                     |                                     |                | 1.67        | W/ $^{\circ}\text{C}$ |
| Single Pulse Avalanche Energy <sup>b</sup>                       |                                     |                                     | $E_{AS}$       | 1600        | mJ                    |
| Maximum Power Dissipation                                        |                                     |                                     | $P_D$          | 180         | W                     |
| Operating Junction and Storage Temperature Range                 |                                     |                                     | $T_J, T_{stg}$ | -55 to +150 | $^{\circ}\text{C}$    |
| Drain-Source Voltage Slope                                       | $T_J = 125\text{ }^{\circ}\text{C}$ |                                     | $dV/dt$        | 50          | V/ns                  |
| Reverse Diode $dV/dt$ <sup>d</sup>                               |                                     | 15                                  |                |             |                       |
| Soldering Recommendations (Peak Temperature) <sup>c</sup>        | for 10 s                            |                                     |                | 260         | $^{\circ}\text{C}$    |

#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature.
- $V_{DD} = 100$  V, starting  $T_J = 25$  °C,  $L = 28.2$  mH,  $R_g = 25$   $\Omega$ ,  $I_{AS} = 8$  A.
- 1.6 mm from case.
- $I_{SD} \leq I_D$ ,  $dI/dt = 100$  A/ $\mu$ s, starting  $T_J = 25$  °C.

**THERMAL RESISTANCE RATINGS**

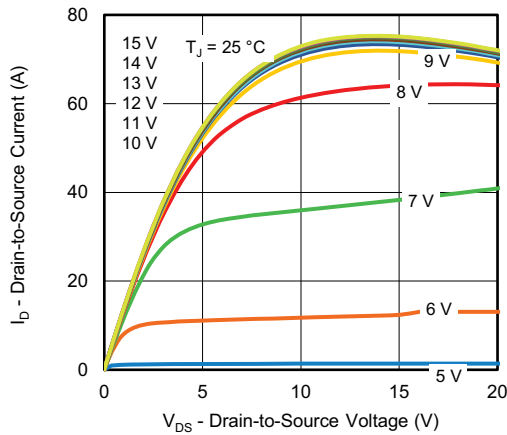
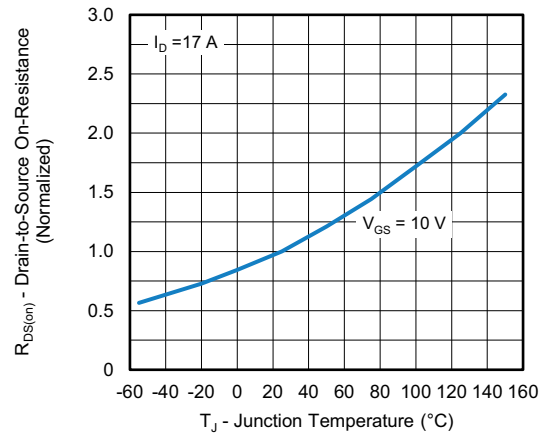
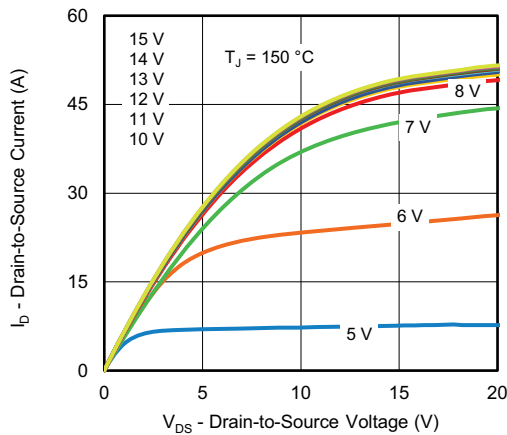
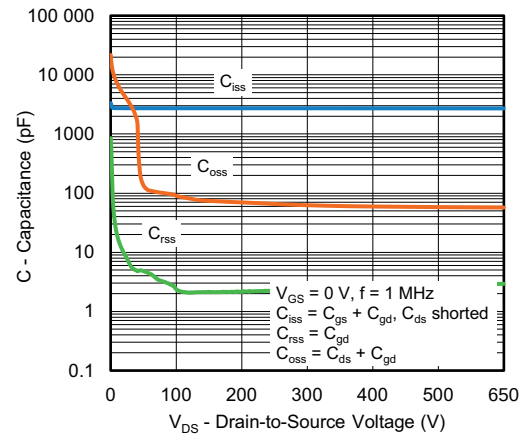
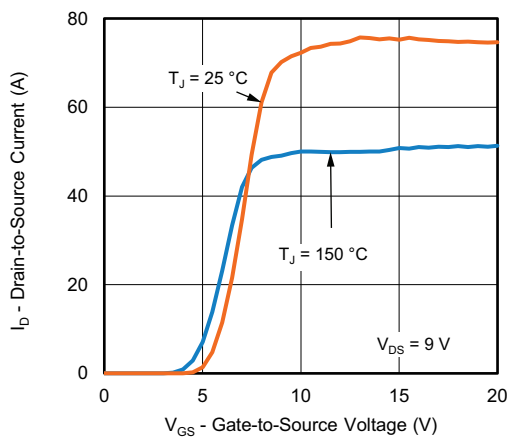
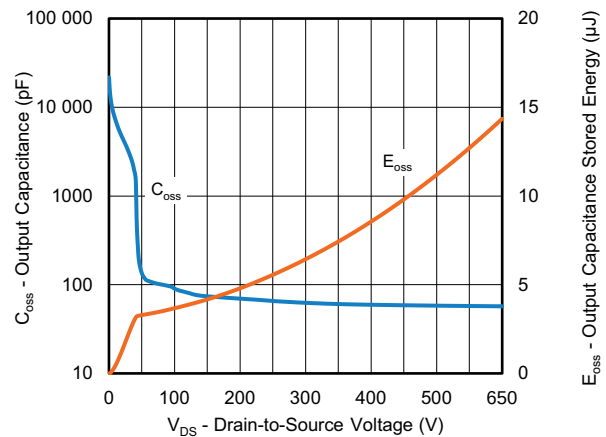
| PARAMETER                        | SYMBOL     | TYP. | MAX. | UNIT |
|----------------------------------|------------|------|------|------|
| Maximum Junction-to-Ambient      | $R_{thJA}$ | -    | 62   | °C/W |
| Maximum Junction-to-Case (Drain) | $R_{thJC}$ | -    | 0.57 |      |

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

| PARAMETER                                                 | SYMBOL              | TEST CONDITIONS                                                                                                                                          | MIN. | TYP.  | MAX.      | UNIT                  |
|-----------------------------------------------------------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------|-----------|-----------------------|
| <b>Static</b>                                             |                     |                                                                                                                                                          |      |       |           |                       |
| Drain-Source Breakdown Voltage                            | $V_{DS}$            | $V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$                                                                                                                 | 600  | -     | -         | V                     |
| $V_{DS}$ Temperature Coefficient                          | $\Delta V_{DS}/T_J$ | Reference to $25\text{ }^{\circ}\text{C}$ , $I_D = 1\text{ mA}$                                                                                          | -    | 0.70  | -         | V/ $^{\circ}\text{C}$ |
| Gate-Source Threshold Voltage (N)                         | $V_{GS(th)}$        | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$                                                                                                          | 2.5  | -     | 4.5       | V                     |
| Gate-Source Leakage                                       | $I_{GSS}$           | $V_{GS} = \pm 20\text{ V}$                                                                                                                               | -    | -     | $\pm 100$ | nA                    |
|                                                           |                     | $V_{GS} = \pm 30\text{ V}$                                                                                                                               | -    | -     | $\pm 1$   | $\mu\text{A}$         |
| Zero Gate Voltage Drain Current                           | $I_{DSS}$           | $V_{DS}=600\text{ V}, V_{GS}=0\text{ V}$                                                                                                                 | -    | -     | 1         | $\mu\text{A}$         |
|                                                           |                     | $V_{DS} = 480\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^{\circ}\text{C}$                                                                          | -    | -     | 100       |                       |
| Drain-Source On-State Resistance                          | $R_{DS(on)}$        | $V_{GS} = 10\text{ V}, I_D = 14\text{ A}$                                                                                                                | -    | 0.062 | -         | $\Omega$              |
| Forward Transconductance                                  | $g_{fs}$            | $V_{DS} = 30\text{ V}, I_D = 14\text{ A}$                                                                                                                | -    | 5.6   | -         | S                     |
| <b>Dynamic</b>                                            |                     |                                                                                                                                                          |      |       |           |                       |
| Input Capacitance                                         | $C_{iss}$           | $V_{GS} = 0\text{ V},$<br>$V_{DS} = 100\text{ V},$<br>$f = 1\text{ MHz}$                                                                                 | -    | 4500  | -         | pF                    |
| Output Capacitance                                        | $C_{oss}$           |                                                                                                                                                          | -    | 80    | -         |                       |
| Reverse Transfer Capacitance                              | $C_{rss}$           |                                                                                                                                                          | -    | 4     | -         |                       |
| Effective Output Capacitance, Energy Related <sup>a</sup> | $C_{o(er)}$         | $V_{DS} = 0\text{ V to } 520\text{ V}, V_{GS} = 0\text{ V}$                                                                                              | -    | 63    | -         | pF                    |
| Effective Output Capacitance, Time Related <sup>b</sup>   | $C_{o(tr)}$         |                                                                                                                                                          | -    | 213   | -         |                       |
| Total Gate Charge                                         | $Q_g$               | $V_{GS} = 10\text{ V}, I_D = 8\text{ A}, V_{DS} = 520\text{ V}$                                                                                          | -    | 102   | -         | nC                    |
| Gate-Source Charge                                        | $Q_{gs}$            |                                                                                                                                                          | -    | 15    | -         |                       |
| Gate-Drain Charge                                         | $Q_{gd}$            |                                                                                                                                                          | -    | 19    | -         |                       |
| Turn-On Delay Time                                        | $t_{d(on)}$         | $V_{DD} = 520\text{ V}, I_D = 8\text{ A},$<br>$V_{GS} = 10\text{ V}, R_g = 9.1\text{ }\Omega$                                                            | -    | 18    | 25        | ns                    |
| Rise Time                                                 | $t_r$               |                                                                                                                                                          | -    | 24    | 55        |                       |
| Turn-Off Delay Time                                       | $t_{d(off)}$        |                                                                                                                                                          | -    | 80    | -         |                       |
| Fall Time                                                 | $t_f$               |                                                                                                                                                          | -    | 12    | -         |                       |
| Gate Input Resistance                                     | $R_g$               | $f = 1\text{ MHz}, \text{open drain}$                                                                                                                    | -    | 0.8   | -         | $\Omega$              |
| <b>Drain-Source Body Diode Characteristics</b>            |                     |                                                                                                                                                          |      |       |           |                       |
| Continuous Source-Drain Diode Current                     | $I_S$               | MOSFET symbol showing the integral reverse p - n junction diode<br> | -    | -     | 41        | A                     |
| Pulsed Diode Forward Current                              | $I_{SM}$            |                                                                                                                                                          | -    | -     | 120       |                       |
| Diode Forward Voltage                                     | $V_{SD}$            | $T_J = 25\text{ }^{\circ}\text{C}, I_S = 8\text{ A}, V_{GS} = 0\text{ V}$                                                                                | -    | -     | 1.5       | V                     |
| Reverse Recovery Time                                     | $t_{rr}$            | $T_J = 25\text{ }^{\circ}\text{C}, I_F = I_S = 8\text{ A},$<br>$di/dt = 100\text{ A}/\mu\text{s}, V_R = 400\text{ V}$                                    | -    | 40    | -         | ns                    |
| Reverse Recovery Charge                                   | $Q_{rr}$            |                                                                                                                                                          | -    | 5.8   | -         | $\mu\text{C}$         |
| Reverse Recovery Current                                  | $I_{RRM}$           |                                                                                                                                                          | -    | 30    | -         | A                     |

**Notes**

- a.  $C_{oss(er)}$  is a fixed capacitance that gives the same energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 80 %  $V_{DSS}$ .  
 b.  $C_{oss(tr)}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 80 %  $V_{DSS}$ .

**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)

**Fig. 1 - Typical Output Characteristics**

**Fig. 4 - Normalized On-Resistance vs. Temperature**

**Fig. 2 - Typical Output Characteristics**

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

**Fig. 3 - Typical Transfer Characteristics**

**Fig. 6 -  $C_{oss}$  and  $E_{oss}$  vs.  $V_{DS}$**

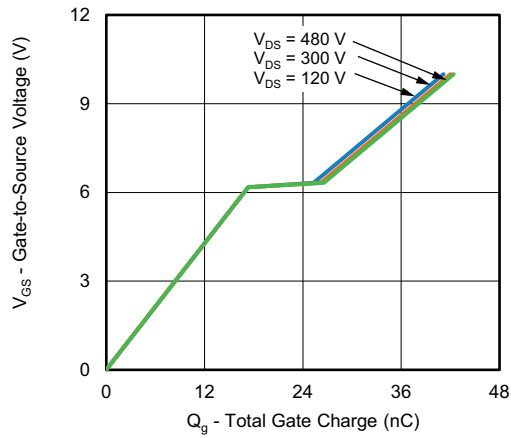


Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage

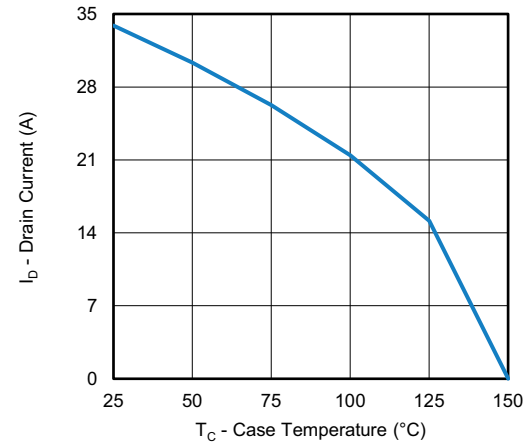


Fig. 10 - Maximum Drain Current vs. Case Temperature

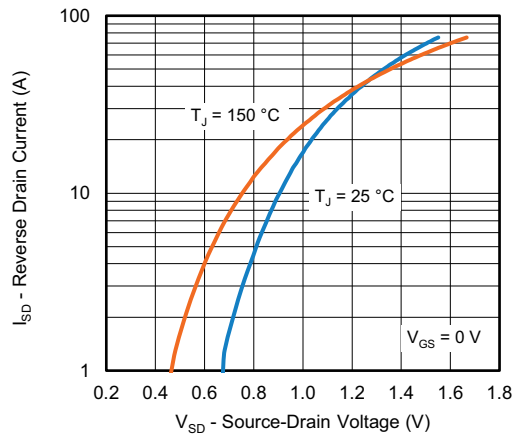


Fig. 8 - Typical Source-Drain Diode Forward Voltage

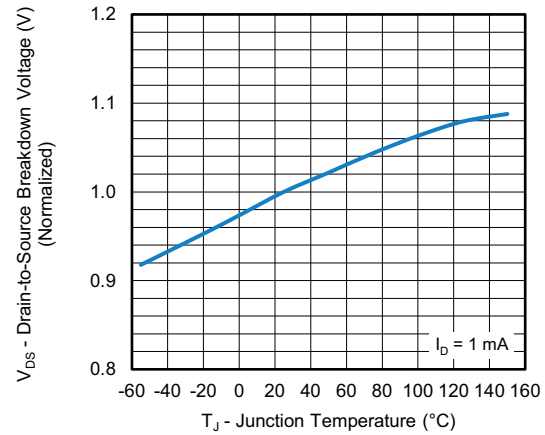


Fig. 11 - Temperature vs. Drain-to-Source Voltage

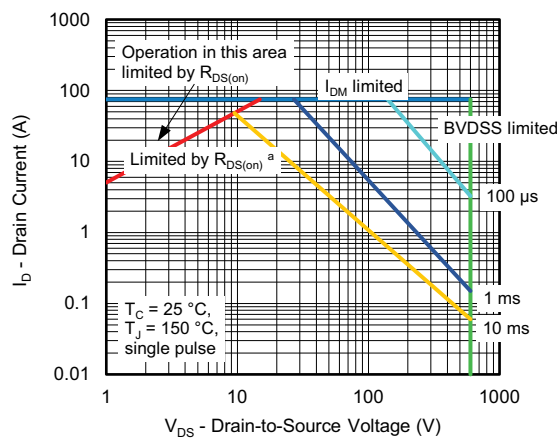
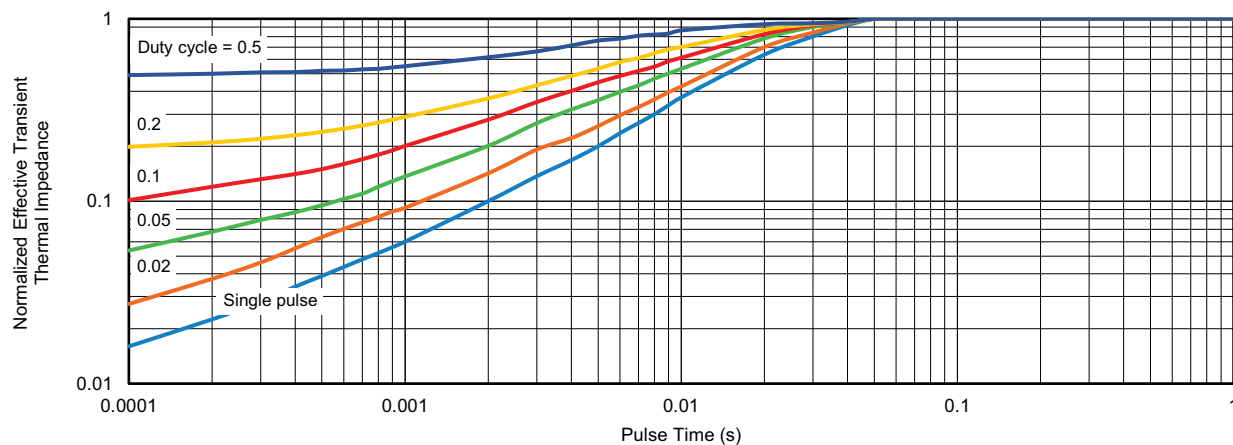


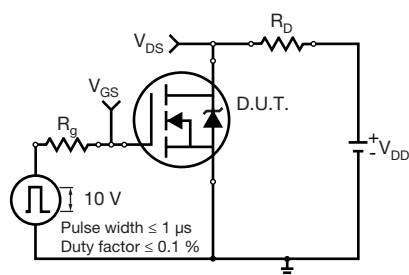
Fig. 9 - Maximum Safe Operating Area

**Note**

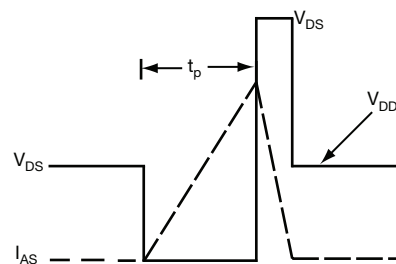
- a.  $V_{GS} >$  minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified



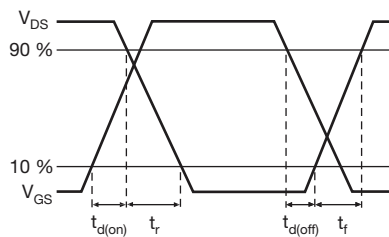
**Fig. 12 - Normalized Transient Thermal Impedance, Junction-to-Case**



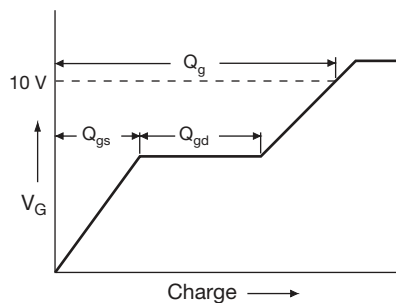
**Fig. 13 - Switching Time Test Circuit**



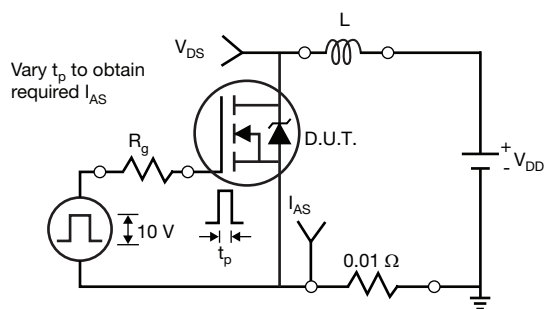
**Fig. 16 - Unclamped Inductive Waveforms**



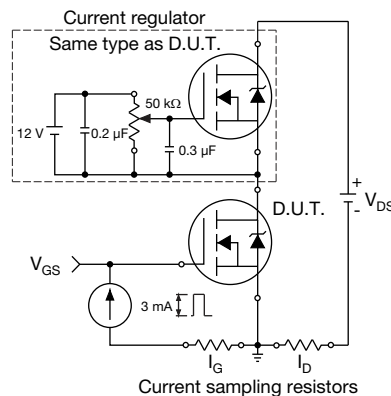
**Fig. 14 - Switching Time Waveforms**



**Fig. 17 - Basic Gate Charge Waveform**

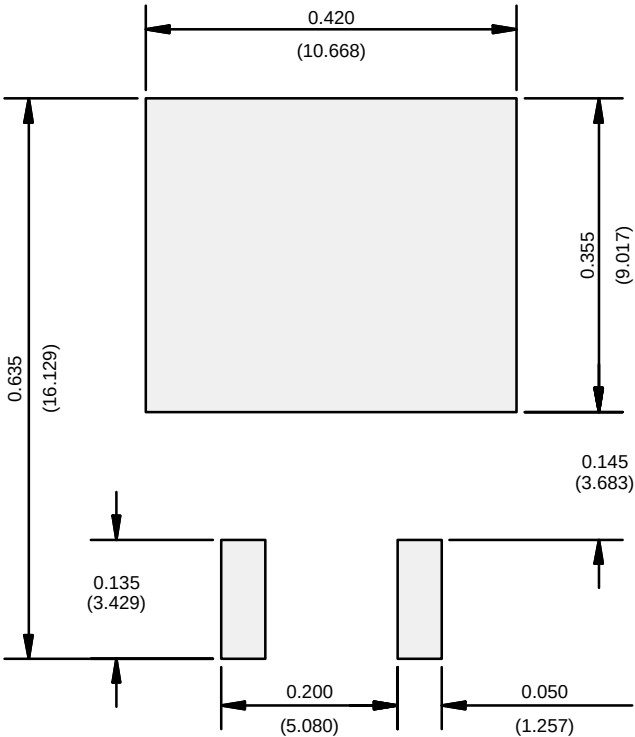


**Fig. 15 - Unclamped Inductive Test Circuit**



**Fig. 18 - Gate Charge Test Circuit**

**RECOMMENDED MINIMUM PADS FOR D<sup>2</sup>PAK: 3-Lead**



Recommended Minimum Pads  
Dimensions in Inches/(mm)

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