

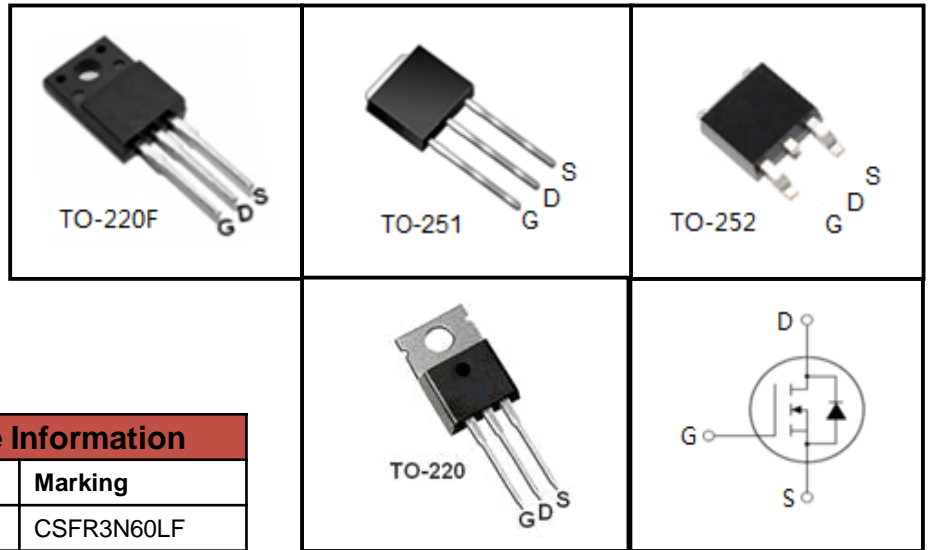
## 600V N-Channel MOSFET

### FEATURES

- Fast switching
- Integrate fast recovery diode
- Fast switching speed
- 100% avalanche tested
- Improved dv/dt capability

### APPLICATIONS

- Switch Mode Power Supply (SMPS)
- Motor Controls
- Power Factor Correction (PFC)



| Device Marking and Package Information |         |            |
|--|---------|------------|
| Device                                 | Package | Marking    |
| CSFR3N60LF                             | TO-220F | CSFR3N60LF |
| CSFR3N60LP                             | TO-220  | CSFR3N60LP |
| CSFR3N60LU                             | TO-251  | CSFR3N60LU |
| CSFR3N60LD                             | TO-252  | CSFR3N60LD |

| Absolute Maximum Ratings $T_C = 25^\circ\text{C}$ , unless otherwise noted |                |          |        |        |        |                  |
|--|----------------|----------|--------|--------|--------|------------------|
| Parameter  | Symbol         | Value    |        |        |        | Unit             |
|  |                | TO-220F  | TO-220 | TO-251 | TO-252 |                  |
| Drain-Source Voltage ( $V_{GS} = 0V$ )                                     | $V_{DSS}$      | 600      |        |        |        | V                |
| Continuous Drain Current   | $I_D$          | 3        |        |        |        | A                |
| Pulsed Drain Current (note1)   | $I_{DM}$       | 12       |        |        |        | A                |
| Gate-Source Voltage  | $V_{GSS}$      | $\pm 30$ |        |        |        | V                |
| Single Pulse Avalanche Energy (note2)                                      | $E_{AS}$       | 192.2    |        |        |        | mJ               |
| Avalanche Current (note1)  | $I_{AS}$       | 3        |        |        |        | A                |
| Repetitive Avalanche Energy (note1)  | $E_{AR}$       | 115.3    |        |        |        | mJ               |
| Power Dissipation ( $T_C = 25^\circ\text{C}$ )                             | $P_D$          | 25       | 30     |        |        | W                |
| Operating Junction and Storage Temperature Range                           | $T_J, T_{stg}$ | -55~+150 |        |        |        | $^\circ\text{C}$ |

| Thermal Resistance                      |            |         |        |        |        |      |
|---|------------|---------|--------|--------|--------|------|
| Parameter                               | Symbol     | Value   |        |        |        | Unit |
|   |            | TO-220F | TO-251 | TO-252 | TO-220 |      |
| Thermal Resistance, Junction-to-Case    | $R_{thJC}$ | 5       | 4.2    |        |        | K/W  |
| Thermal Resistance, Junction-to-Ambient | $R_{thJA}$ | 62.5    | 60     |        |        |      |

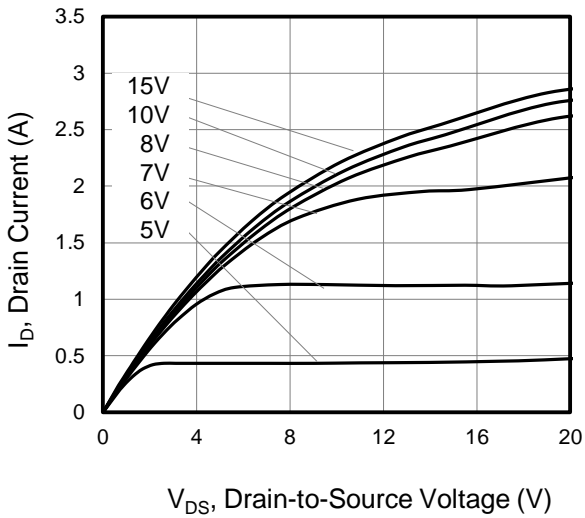
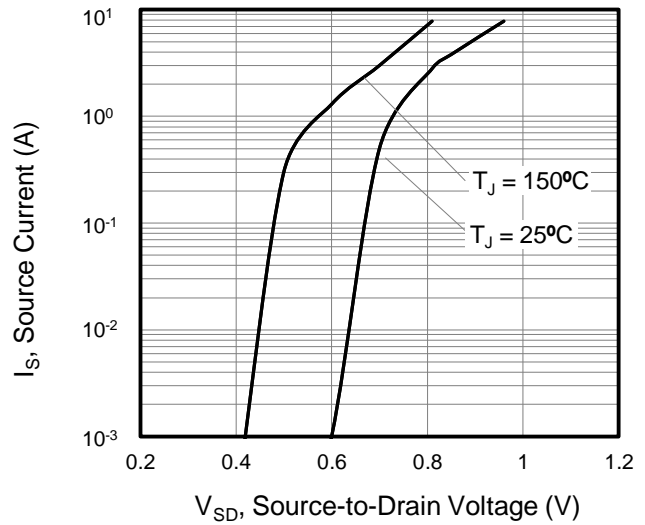
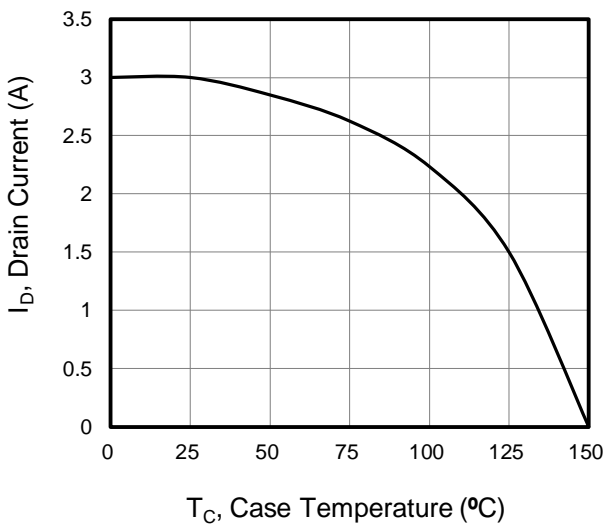
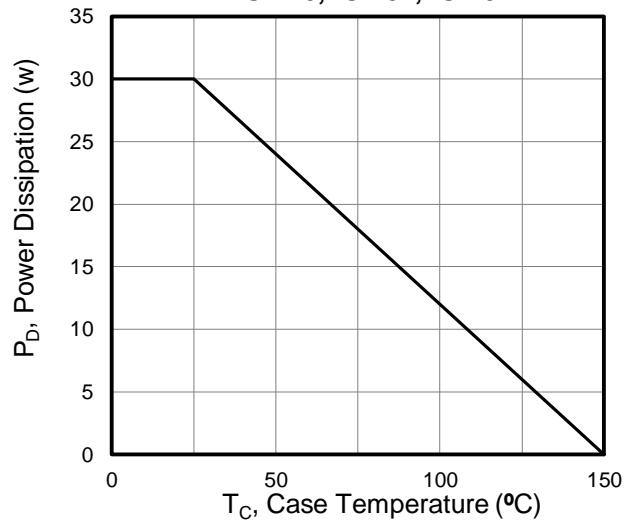
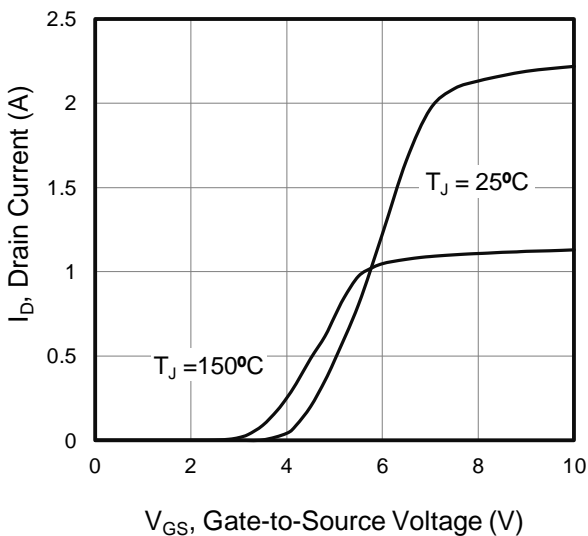
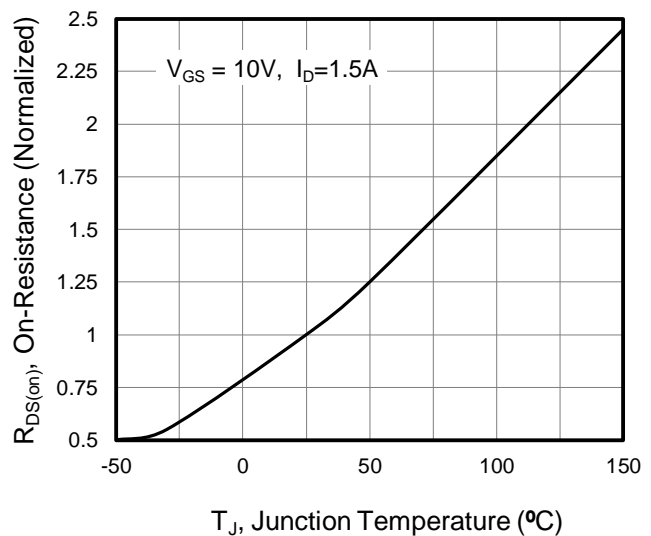
**Specifications**  $T_J = 25^{\circ}\text{C}$ , unless otherwise noted

| Parameter                                      | Symbol        | Test Conditions  | Value |      |           | Unit     |
|--|---------------|--|-------|------|-----------|----------|
|  |               |  | Min.  | Typ. | Max.      |          |
| <b>Static</b>                                  |               |  |       |      |           |          |
| Drain-Source Breakdown Voltage                 | $V_{(BR)DSS}$ | $V_{GS} = 0V, I_D = 250\mu A$                            | 600   | --   | --        | V        |
| Zero Gate Voltage Drain Current                | $I_{DSS}$     | $V_{DS} = 600V, V_{GS} = 0V, T_J = 25^{\circ}\text{C}$   | --    | --   | 1         | $\mu A$  |
| Gate-Source Leakage                            | $I_{GSS}$     | $V_{GS} = \pm 20V$                                       | --    | --   | $\pm 100$ | nA       |
| Gate-Source Threshold Voltage                  | $V_{GS(th)}$  | $V_{DS} = V_{GS}, I_D = 250\mu A$                        | 3.0   | --   | 4.0       | V        |
| Drain-Source On-Resistance (Note3)             | $R_{DS(on)}$  | $V_{GS} = 10V, I_D = 1.25A$                              | --    | 3.2  | 3.8       | $\Omega$ |
| <b>Dynamic</b>                                 |               |  |       |      |           |          |
| Input Capacitance                              | $C_{iss}$     | $V_{GS} = 0V,$<br>$V_{DS} = 25V,$<br>$f = 1.0\text{MHz}$ | --    | 333  | --        | pF       |
| Output Capacitance                             | $C_{oss}$     |  | --    | 36   | --        |          |
| Reverse Transfer Capacitance                   | $C_{rss}$     |  | --    | 5    | --        |          |
| Total Gate Charge                              | $Q_g$         | $V_{DD} = 480V, I_D = 2.5A,$<br>$V_{GS} = 10V$           | --    | 12   | --        | nC       |
| Gate-Source Charge                             | $Q_{gs}$      |  | --    | 1.9  | --        |          |
| Gate-Drain Charge                              | $Q_{gd}$      |  | --    | 6.4  | --        |          |
| Turn-on Delay Time                             | $t_{d(on)}$   | $V_{DD} = 300V, I_D = 2.5A,$<br>$R_G = 25\Omega$         | --    | 34   | --        | ns       |
| Turn-on Rise Time                              | $t_r$         |  | --    | 7    | --        |          |
| Turn-off Delay Time                            | $t_{d(off)}$  |  | --    | 65   | --        |          |
| Turn-off Fall Time                             | $t_f$         |  | --    | 25   | --        |          |
| <b>Drain-Source Body Diode Characteristics</b> |               |  |       |      |           |          |
| Continuous Body Diode Current                  | $I_S$         | $T_C = 25^{\circ}\text{C}$                               | --    | --   | 3         | A        |
| Pulsed Diode Forward Current                   | $I_{SM}$      |  | --    | --   | 10        |          |
| Body Diode Voltage                             | $V_{SD}$      | $T_J = 25^{\circ}\text{C}, I_{SD} = 1.5A, V_{GS} = 0V$   | --    | --   | 1.4       | V        |
| Reverse Recovery Time                          | $t_{rr}$      | $V_{GS} = 0V, I_S = 3A,$<br>$di_F/dt = 100A/\mu s$       | --    | 59   | --        | ns       |
| Reverse Recovery Charge                        | $Q_{rr}$      |  | --    | 0.05 | --        | $\mu C$  |

**Notes**

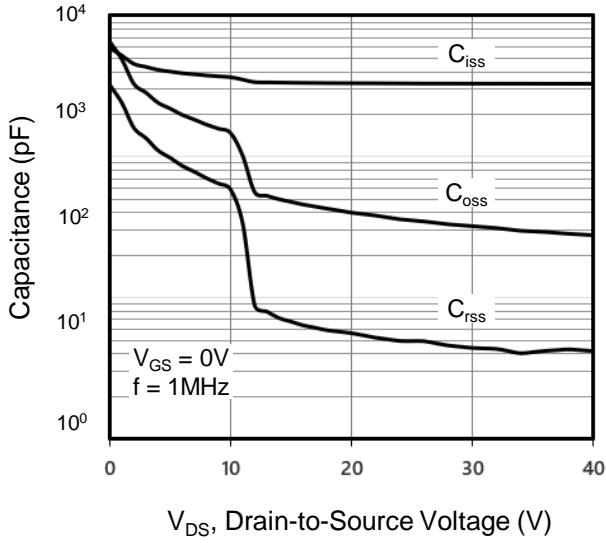
1. Repetitive Rating: Pulse width limited by maximum junction temperature
2.  $L=10\text{mH}, V_{DD} = 50V, R_G = 25\Omega$ , Starting  $T_J = 25^{\circ}\text{C}$
3. Pulse Test: Pulse width  $\leq 300\mu s$ , Duty Cycle  $\leq 1\%$

**Typical Characteristics**  $T_J = 25^\circ\text{C}$ , unless otherwise noted

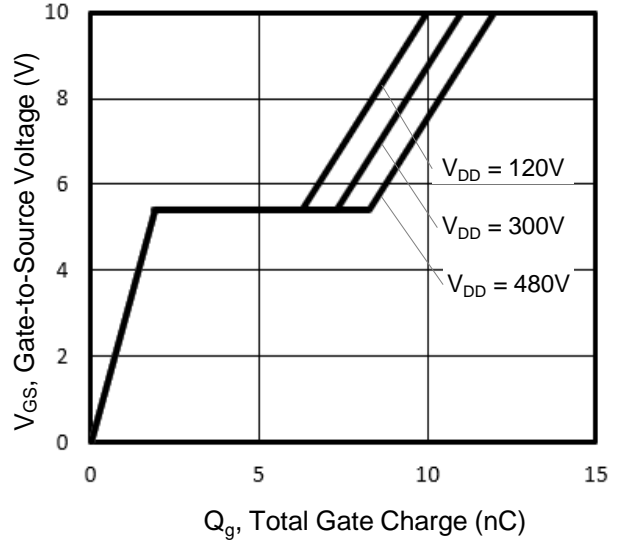
**Figure 1. Output Characteristics ( $T_J = 25^\circ\text{C}$ )**

**Figure 2. Body Diode Forward Voltage**

**Figure 3. Drain Current vs. Temperature**

**Figure 4. Power Dissipation vs. Temperature**  
**TO-220, TO-251, TO-252**

**Figure 5. Transfer Characteristics**

**Figure 6. On-Resistance vs. Temperature**


**Typical Characteristics**  $T_J = 25^{\circ}\text{C}$ , unless otherwise noted

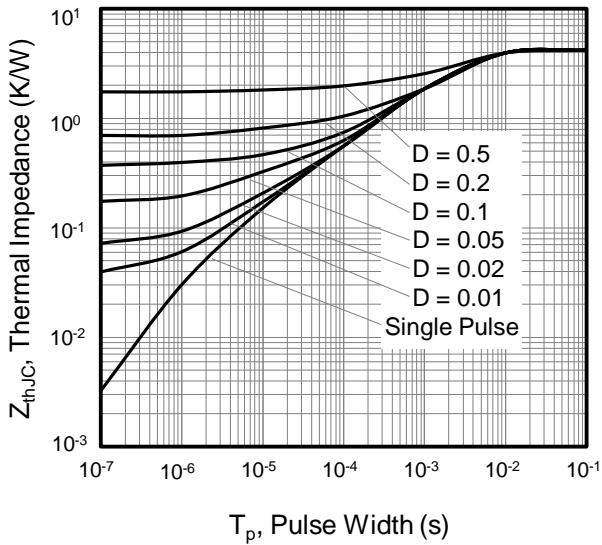
**Figure 7. Capacitance**



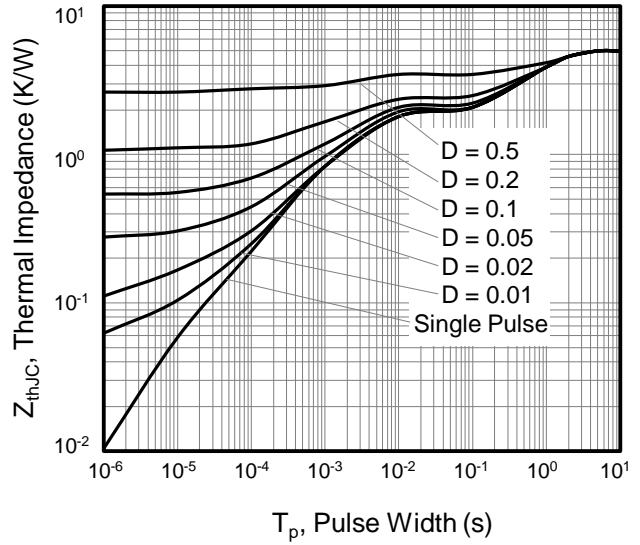
**Figure 8. Gate Charge**

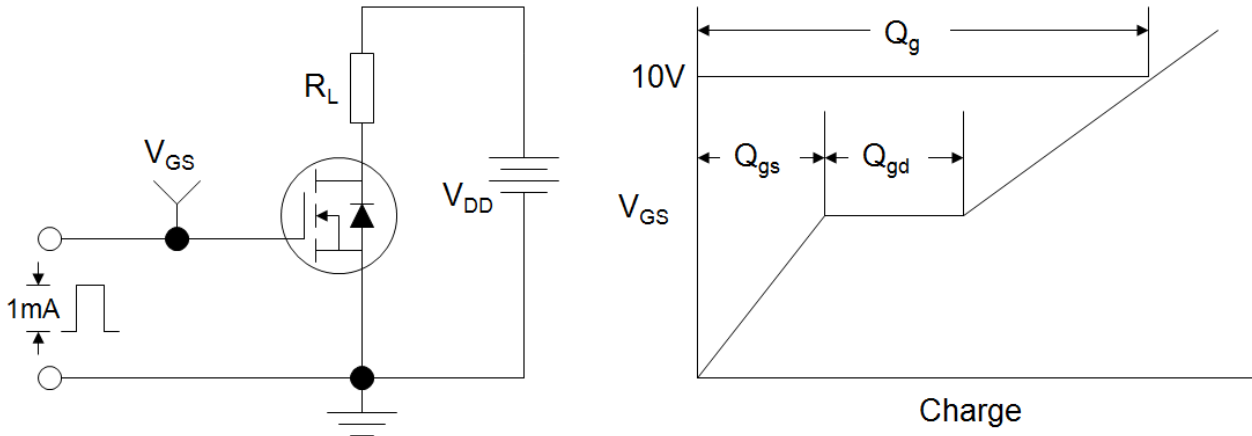
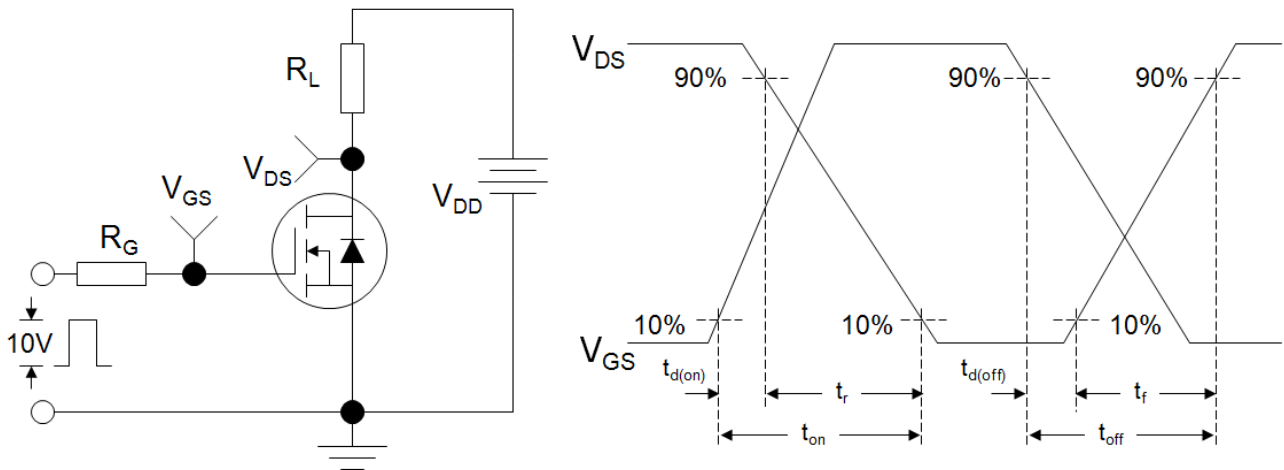
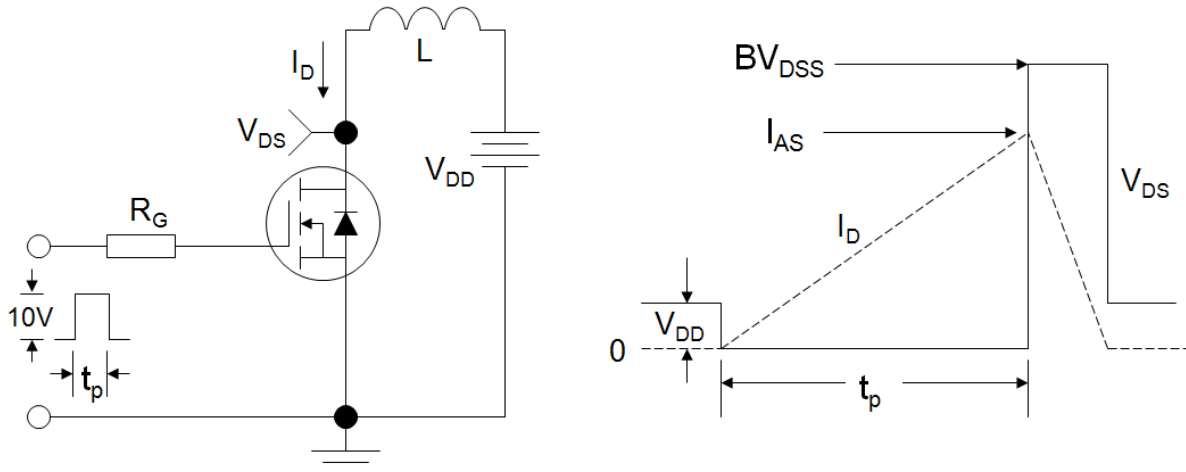


**Figure 9. Transient Thermal Impedance  
TO-252,TO-251,TO-220**



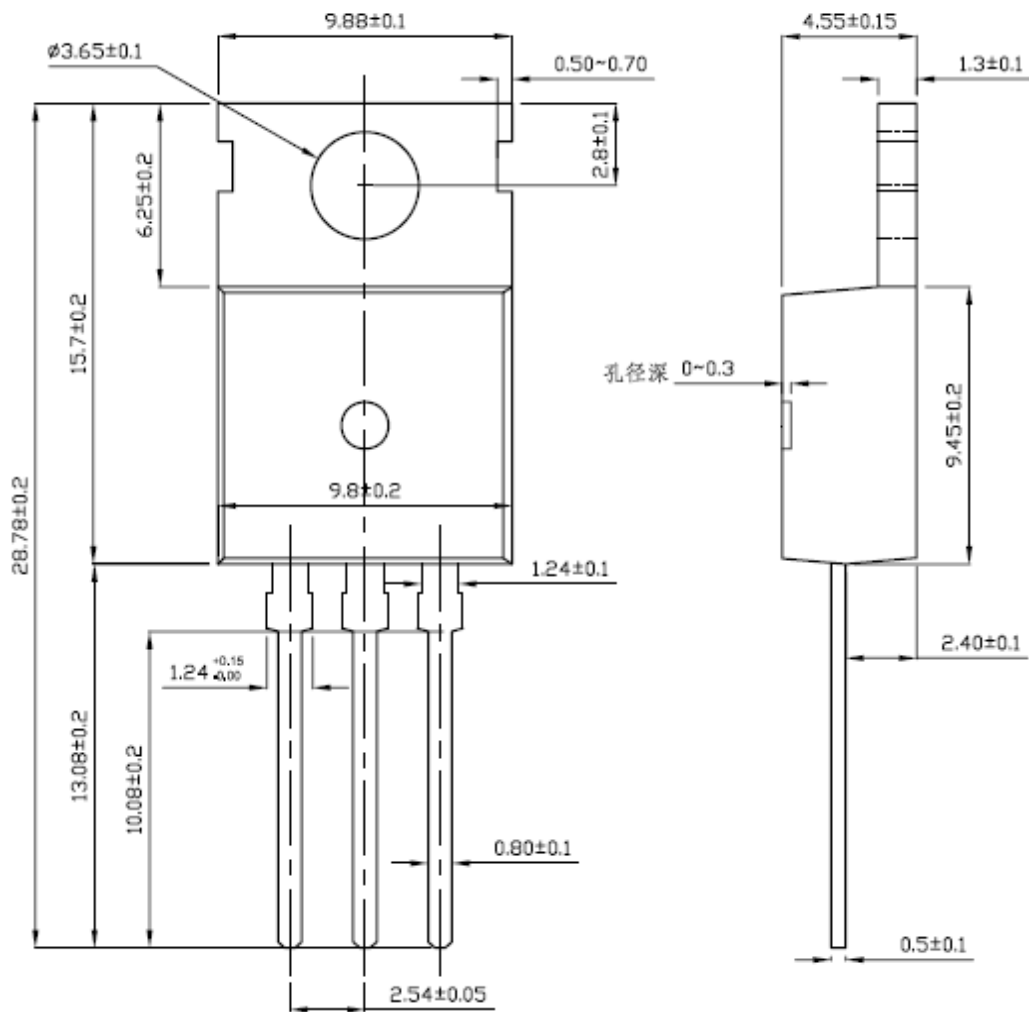
**Figure 10. Transient Thermal Impedance  
TO-220F**



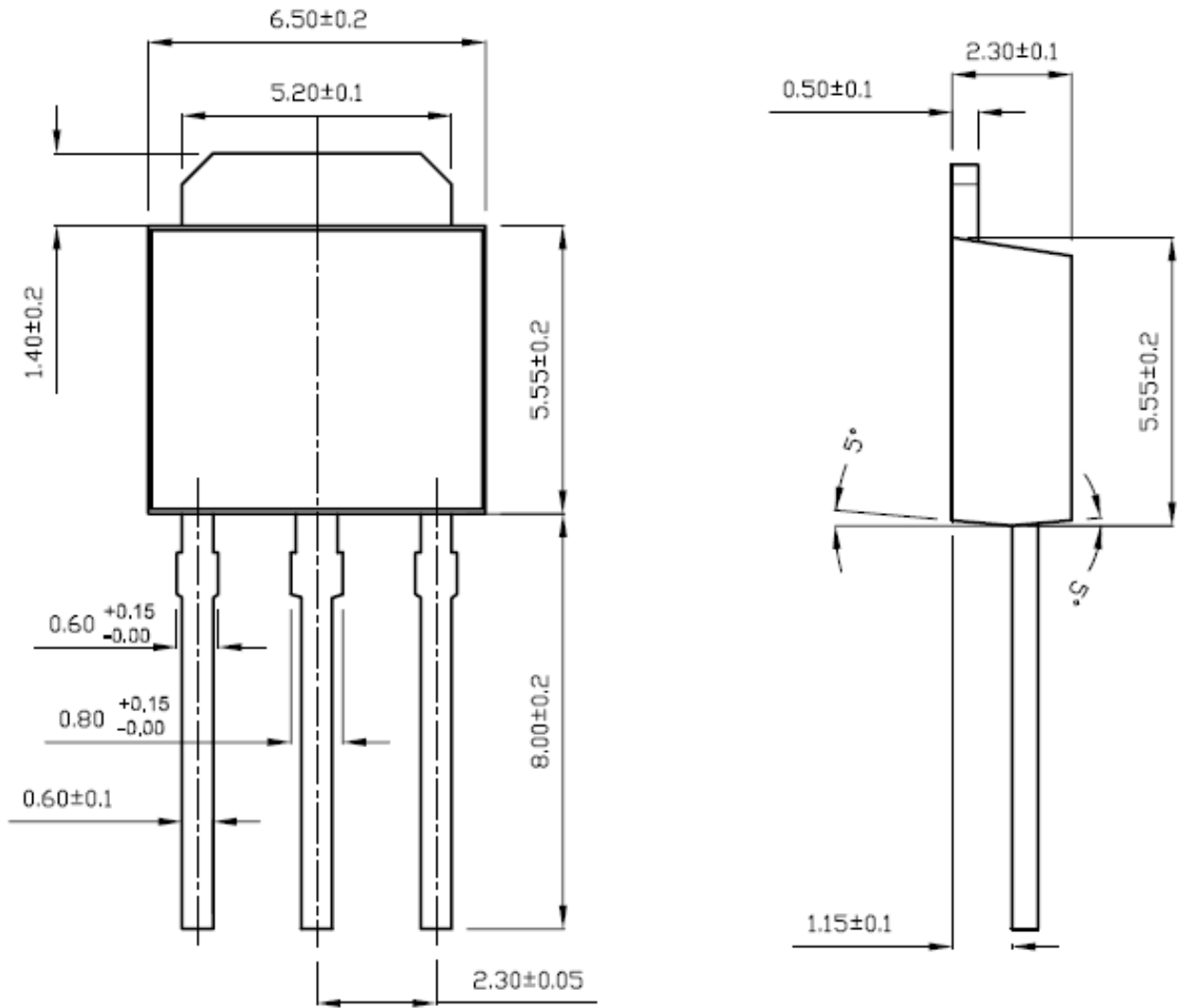
**Figure A: Gate Charge Test Circuit and Waveform**

**Figure B: Resistive Switching Test Circuit and Waveform**

**Figure C: Unclamped Inductive Switching Test Circuit and Waveform**




## TO-220

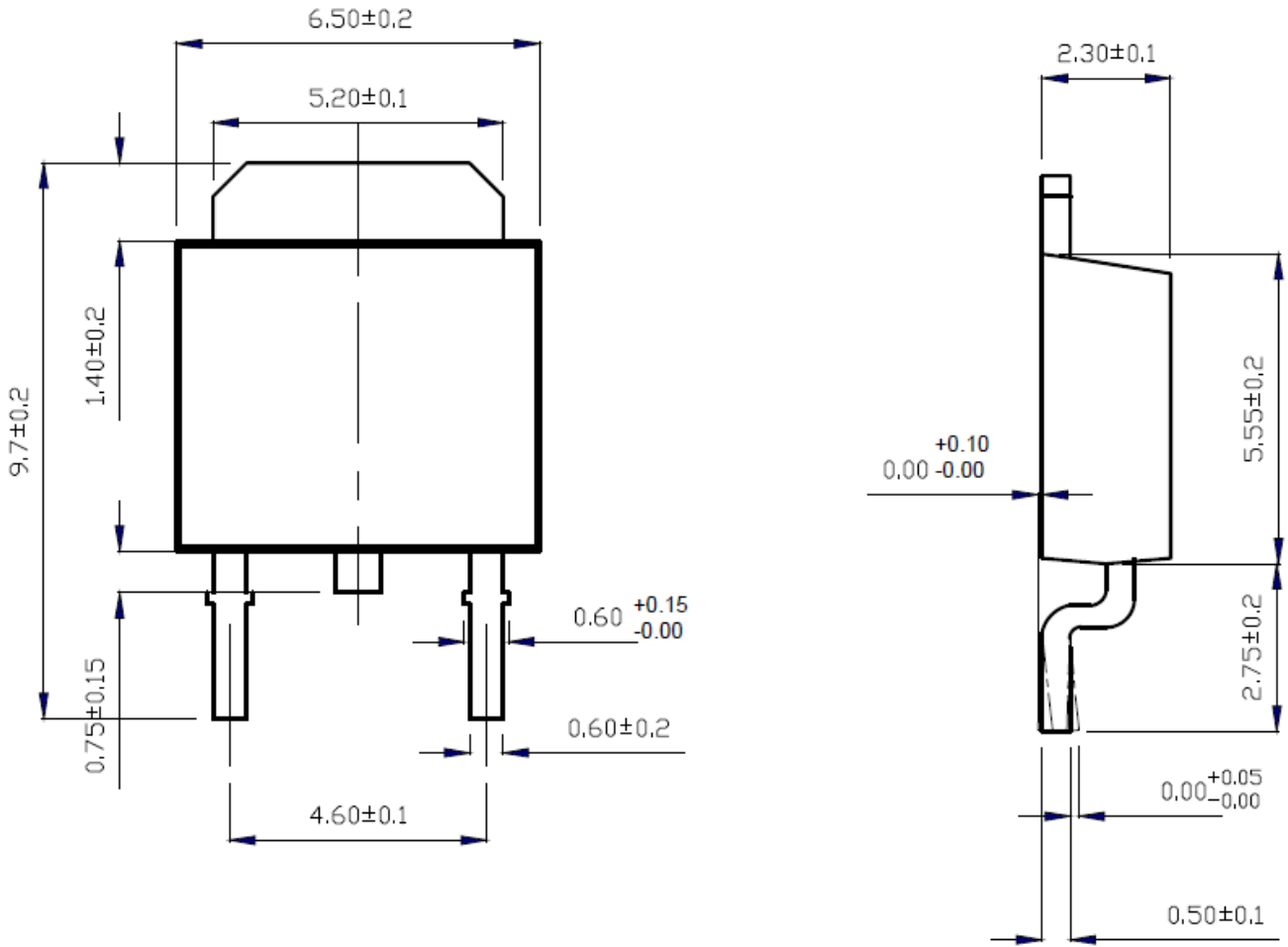


**TO-251**





**TO-252**



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