

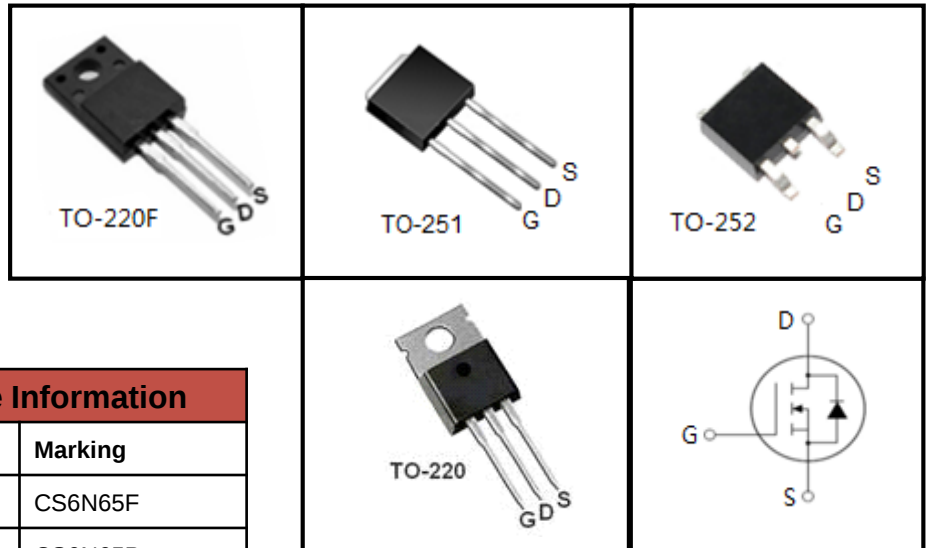
## 650V N-Channel MOSFET

### FEATURES

- Fast switching
- 100% avalanche tested
- Improved dv/dt capability

### APPLICATIONS

- Switch Mode Power Supply (SMPS)
- Uninterruptible Power Supply (UPS)
- Power Factor Correction (PFC)



| Device Marking and Package Information |         |         |
|----------------------------------------|---------|---------|
| Device                                 | Package | Marking |
| CS6N65F                                | TO-220F | CS6N65F |
| CS6N65P                                | TO-220  | CS6N65P |
| CS6N65U                                | TO-251  | CS6N65U |
| CS6N65D                                | TO-252  | CS6N65D |

| Absolute Maximum Ratings T <sub>C</sub> = 25°C, unless otherwise noted |                                   |          |        |        |        |      |
|------------------------------------------------------------------------|-----------------------------------|----------|--------|--------|--------|------|
| Parameter                                                              | Symbol                            | Value    |        |        |        | Unit |
|                                                                        |                                   | TO-220F  | TO-220 | TO-251 | TO-252 |      |
| Drain-Source Voltage (V <sub>GS</sub> = 0V)                            | V <sub>DSS</sub>                  | 650      |        |        |        | V    |
| Continuous Drain Current                                               | I <sub>D</sub>                    | 6        |        |        |        | A    |
| Pulsed Drain Current (note1)                                           | I <sub>DM</sub>                   | 24       |        |        |        | A    |
| Gate-Source Voltage                                                    | V <sub>GSS</sub>                  | ±30      |        |        |        | V    |
| Single Pulse Avalanche Energy (note2)                                  | E <sub>AS</sub>                   | 61       |        |        |        | mJ   |
| Avalanche Current (note1)                                              | I <sub>AR</sub>                   | 3.5      |        |        |        | A    |
| Repetitive Avalanche Energy (note1)                                    | E <sub>AR</sub>                   | 39       |        |        |        | mJ   |
| Power Dissipation (T <sub>C</sub> = 25°C)                              | P <sub>D</sub>                    | 54       | 83     |        |        | W    |
| Operating Junction and Storage Temperature Range                       | T <sub>J</sub> , T <sub>stg</sub> | -55~+150 |        |        |        | °C   |

| Thermal Resistance                      |                   |         |        |        |        |      |
|-----------------------------------------|-------------------|---------|--------|--------|--------|------|
| Parameter                               | Symbol            | Value   |        |        |        | Unit |
|                                         |                   | TO-220F | TO-251 | TO-252 | TO-220 |      |
| Thermal Resistance, Junction-to-Case    | R <sub>thJC</sub> | 2.3     | 1.5    |        |        | K/W  |
| Thermal Resistance, Junction-to-Ambient | R <sub>thJA</sub> | 62.5    | 60     |        |        |      |

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

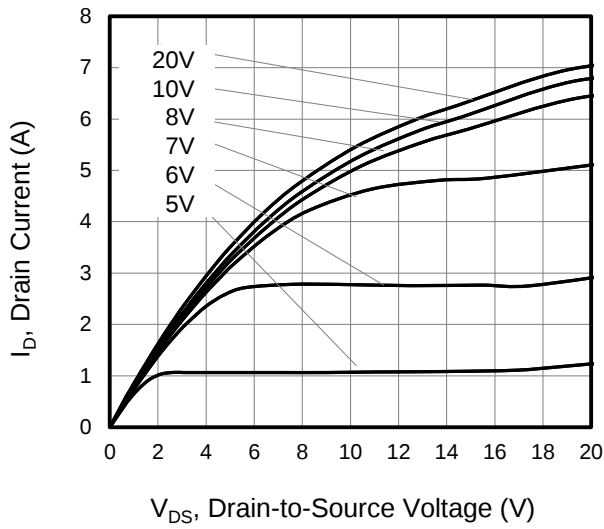
| Parameter                               | Symbol               | Test Conditions                                                               | Value |      |      | Unit |
|-----------------------------------------|----------------------|-------------------------------------------------------------------------------|-------|------|------|------|
|                                         |                      |                                                                               | Min.  | Typ. | Max. |      |
| Static                                  |                      |                                                                               |       |      |      |      |
| Drain-Source Breakdown Voltage          | V <sub>(BR)DSS</sub> | V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA                                  | 650   | --   | --   | V    |
| Zero Gate Voltage Drain Current         | I <sub>DSS</sub>     | V <sub>DS</sub> = 650V, V <sub>GS</sub> = 0V, T <sub>J</sub> = 25°C           | --    | --   | 1    | μA   |
| Gate-Source Leakage                     | I <sub>GSS</sub>     | V <sub>GS</sub> = ±30V                                                        | --    | --   | ±100 | nA   |
| Gate-Source Threshold Voltage           | V <sub>GS(th)</sub>  | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA                    | 3.0   | --   | 4.0  | V    |
| Drain-Source On-Resistance (Note3)      | R <sub>DS(on)</sub>  | V <sub>GS</sub> = 10V, I <sub>D</sub> = 3.0A                                  | --    | 1.65 | 1.9  | Ω    |
| Dynamic                                 |                      |                                                                               |       |      |      |      |
| Input Capacitance                       | C <sub>iss</sub>     | V <sub>GS</sub> = 0V,<br>V <sub>DS</sub> = 25V,<br>f = 1.0MHz                 | --    | 630  | --   | pF   |
| Output Capacitance                      | C <sub>oss</sub>     |                                                                               | --    | 65   | --   |      |
| Reverse Transfer Capacitance            | C <sub>rss</sub>     |                                                                               | --    | 7    | --   |      |
| Total Gate Charge                       | Q <sub>g</sub>       | V <sub>DD</sub> = 520V, I <sub>D</sub> = 6.0A,<br>V <sub>GS</sub> = 10V       | --    | 20   | --   | nC   |
| Gate-Source Charge                      | Q <sub>gs</sub>      |                                                                               | --    | 3    | --   |      |
| Gate-Drain Charge                       | Q <sub>gd</sub>      |                                                                               | --    | 10.5 | --   |      |
| Turn-on Delay Time                      | t <sub>d(on)</sub>   | V <sub>DD</sub> = 400V, I <sub>D</sub> =6.0A,<br>R <sub>G</sub> = 25 Ω        | --    | 37   | --   | ns   |
| Turn-on Rise Time                       | t <sub>r</sub>       |                                                                               | --    | 16   | --   |      |
| Turn-off Delay Time                     | t <sub>d(off)</sub>  |                                                                               | --    | 98   | --   |      |
| Turn-off Fall Time                      | t <sub>f</sub>       |                                                                               | --    | 28   | --   |      |
| Drain-Source Body Diode Characteristics |                      |                                                                               |       |      |      |      |
| Continuous Body Diode Current           | I <sub>S</sub>       | T <sub>C</sub> = 25 °C                                                        | --    | --   | 6    | A    |
| Pulsed Diode Forward Current            | I <sub>SM</sub>      |                                                                               | --    | --   | 24   |      |
| Body Diode Voltage                      | V <sub>SD</sub>      | T <sub>J</sub> = 25°C, I <sub>SD</sub> = 6.0A, V <sub>GS</sub> = 0V           | --    | --   | 1.4  | V    |
| Reverse Recovery Time                   | t <sub>rr</sub>      | V <sub>GS</sub> = 0V, I <sub>S</sub> = 6.0A,<br>di <sub>F</sub> /dt =100A /μs | --    | 630  | --   | ns   |
| Reverse Recovery Charge                 | Q <sub>rr</sub>      |                                                                               | --    | 1.52 | --   | μC   |

**Notes**

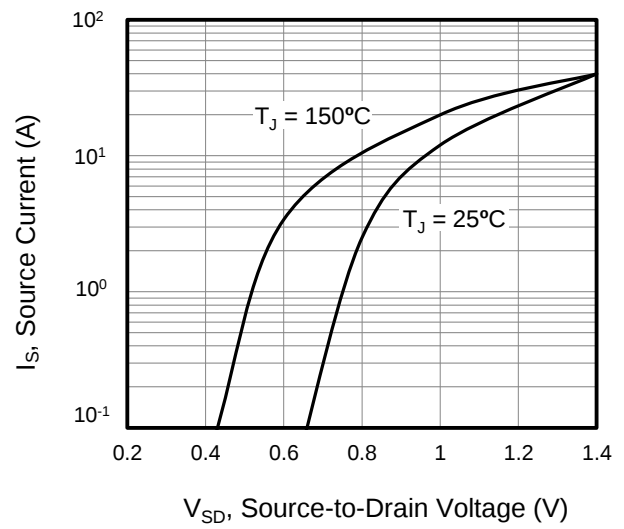
1. Repetitive Rating: Pulse width limited by maximum junction temperature
2.  $L = 10.0mH, V_{DD} = 50V, R_G = 25\Omega$ , Starting  $T_J = 25^{\circ}\text{C}$
3. Pulse Test: Pulse width  $\leq 300\mu s$ , Duty Cycle  $\leq 1\%$

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

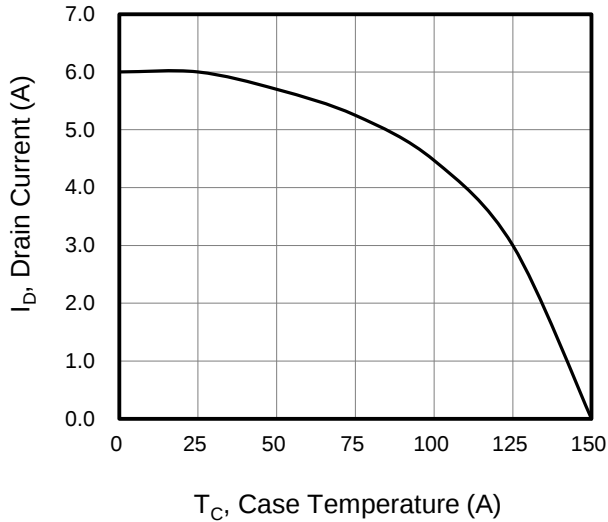
**Figure 1. Output Characteristics ( $T_J = 25^\circ\text{C}$ )**



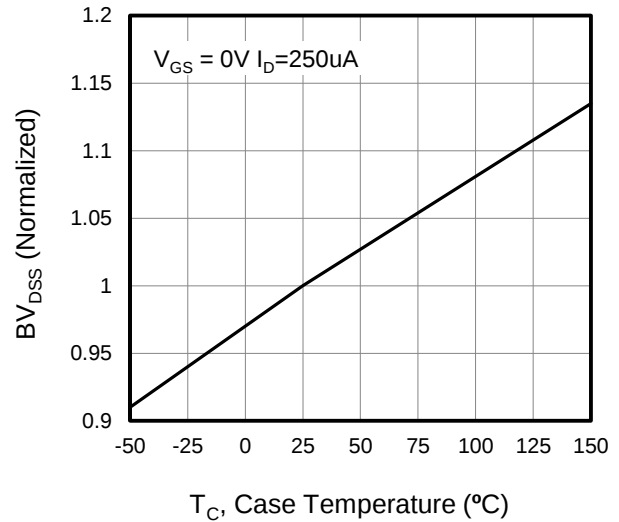
**Figure 2. Body Diode Forward Voltage**



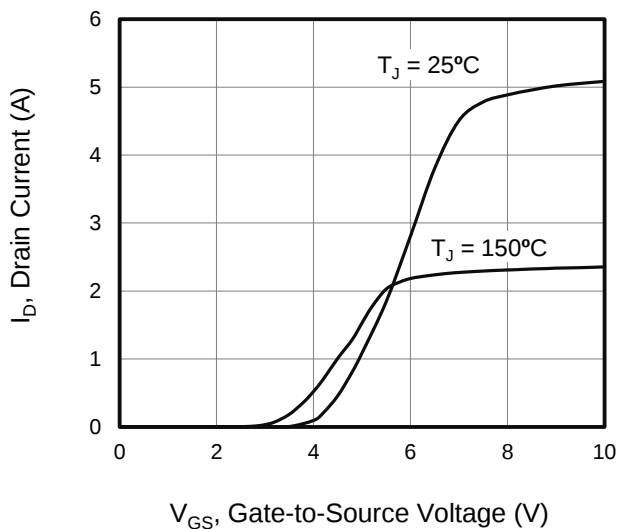
**Figure 3. Drain Current vs. Temperature**



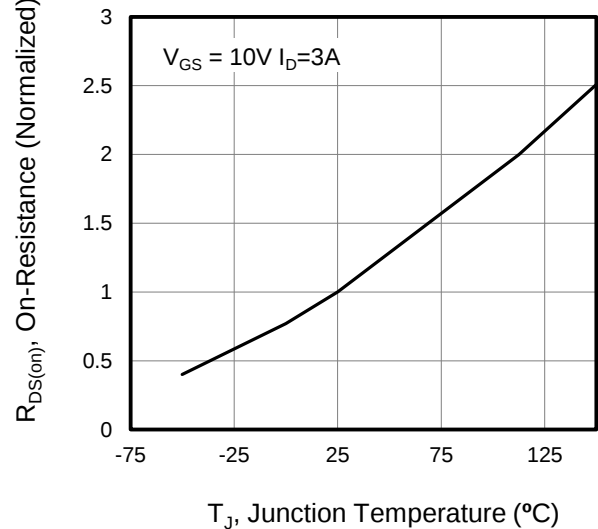
**Figure 4.  $BV_{DSS}$  Variation vs. Temperature**



**Figure 5. Transfer Characteristics**

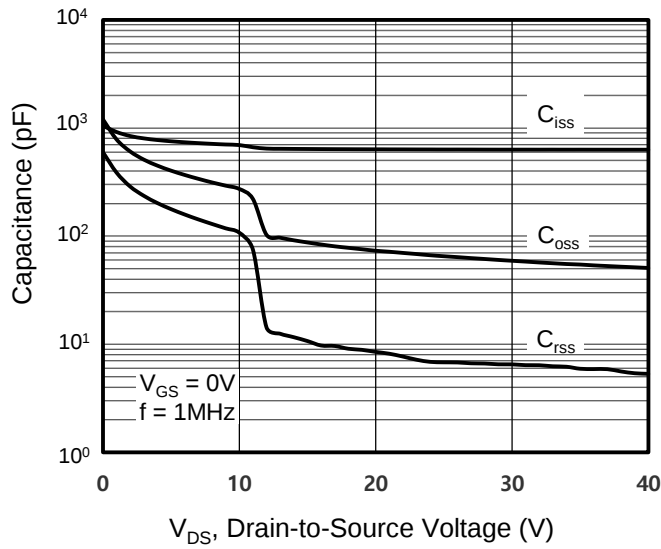


**Figure 6. On-Resistance vs. Temperature**

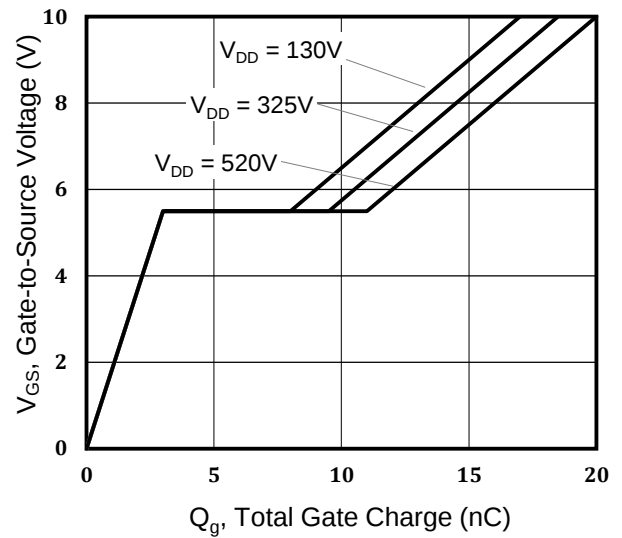


**Typical Characteristics**  $T_j = 25^\circ\text{C}$ , unless otherwise noted

**Figure 7. Capacitance**

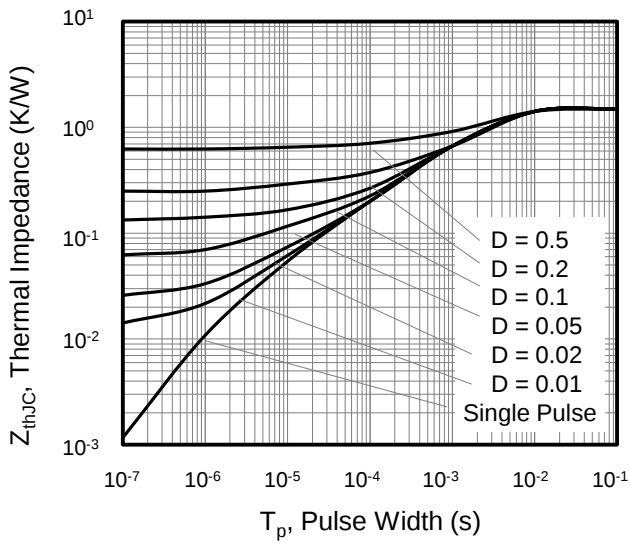


**Figure 8. Gate Charge**



**Figure 9. Transient Thermal Impedance**

**TO-262,TO-251,TO-252**



**Figure 10. Transient Thermal Impedance**

**TO-220F**

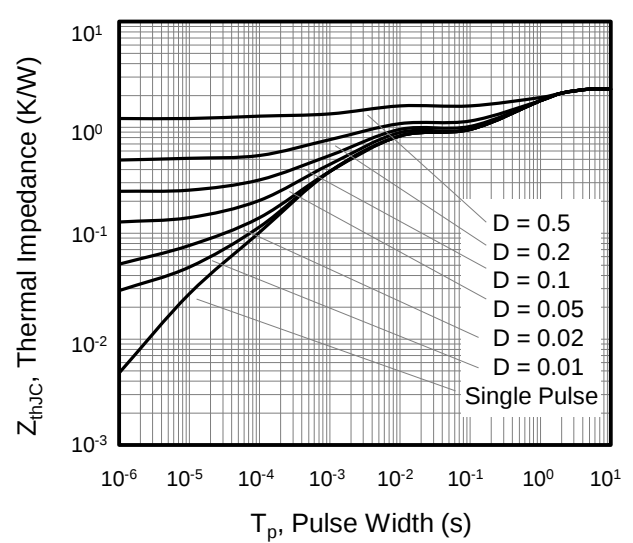


Figure A: Gate Charge Test Circuit and Waveform



Figure B: Resistive Switching Test Circuit and Waveform



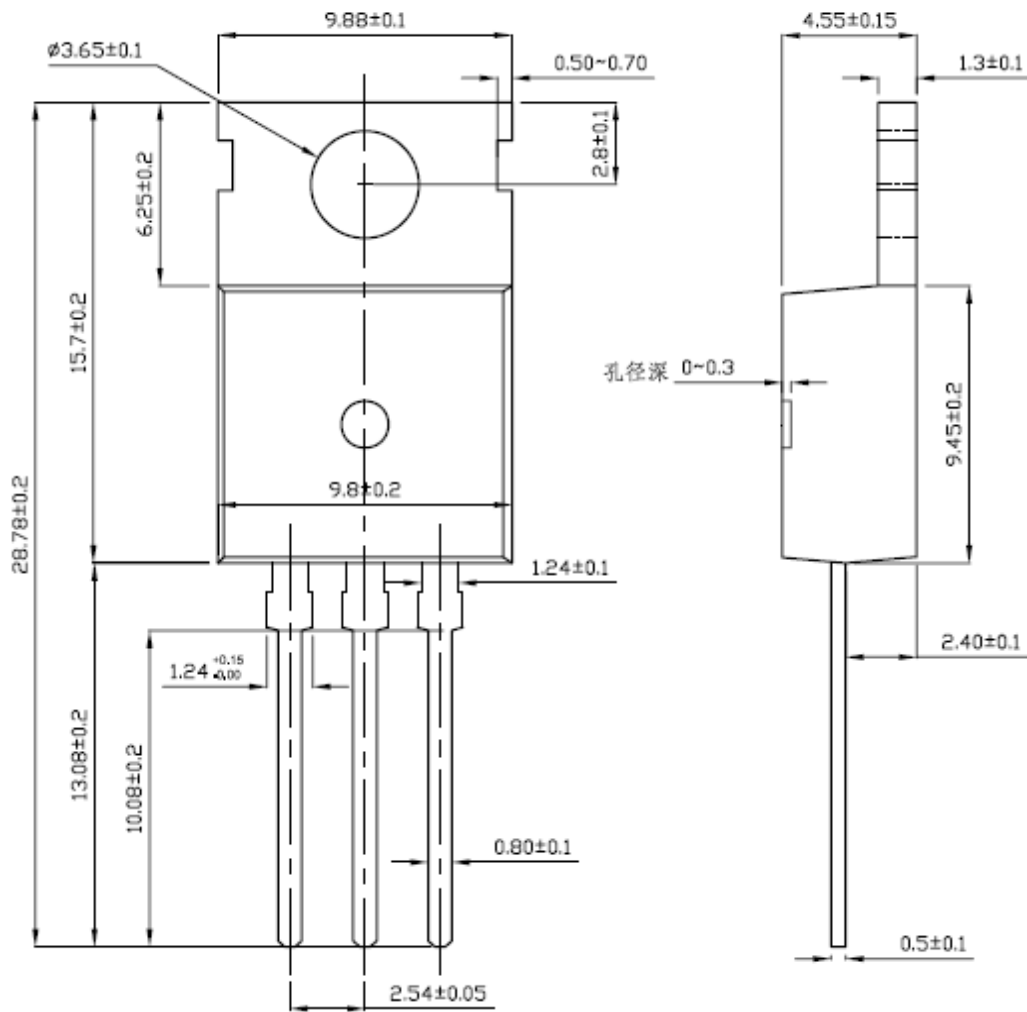
Figure C: Unclamped Inductive Switching Test Circuit and Waveform



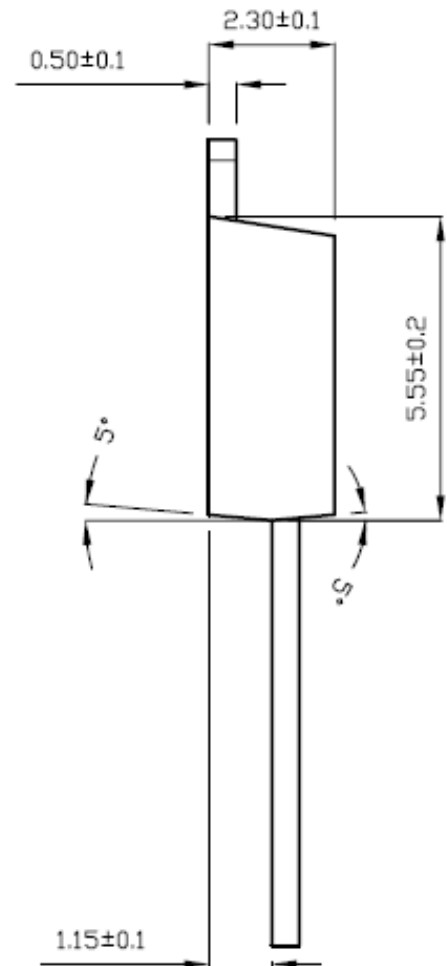
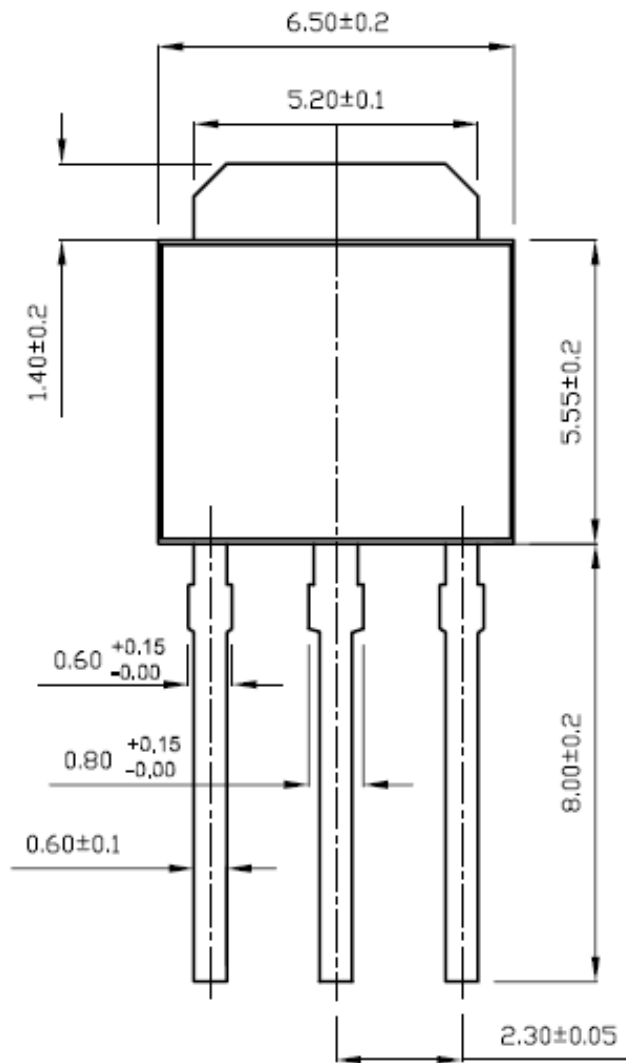
# TO-220F



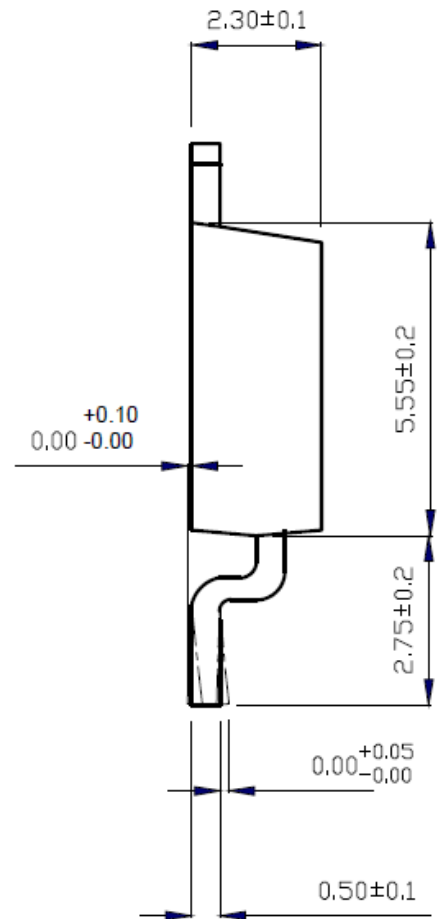
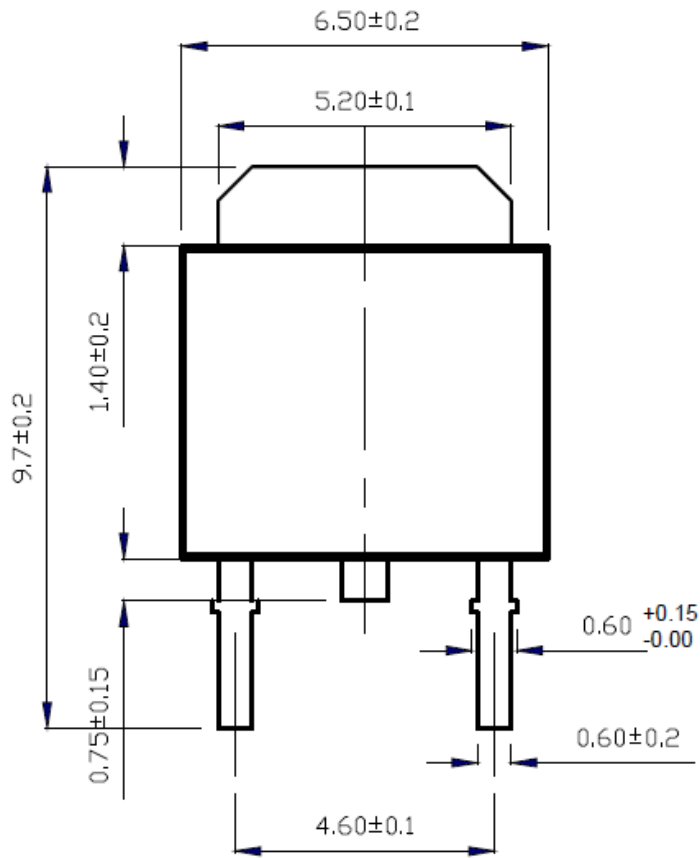
## TO-220



## TO-251



TO-252



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