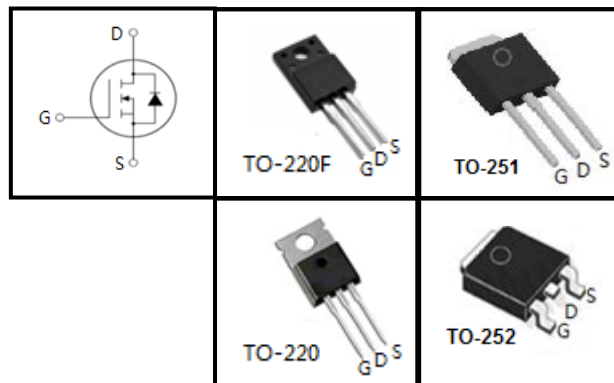


### FEATURES

- Very low FOM  $R_{DS(on)} \times Q_g$
- 100% avalanche tested
- RoHS compliant

### APPLICATIONS

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



| Device Marking and Package Information |           |           |           |           |
|----------------------------------------|-----------|-----------|-----------|-----------|
| Device                                 | SP65R750  |           |           |           |
| Package                                | TO-220    | TO-220F   | TO-251    | TO-252    |
| Marking                                | SP65R750F | SP65R750F | SP65R750U | SP65R750T |

| Absolute Maximum Ratings $T_C = 25^\circ\text{C}$ , unless otherwise noted |                |                        |         |                  |
|----------------------------------------------------------------------------|----------------|------------------------|---------|------------------|
| Parameter                                                                  | Symbol         | Value                  |         | Unit             |
|                                                                            |                | TO-220, TO-251, TO-252 | TO-220F |                  |
| Drain-Source Voltage ( $V_{GS} = 0\text{V}$ )                              | $V_{DSS}$      | 650                    |         | V                |
| Continuous Drain Current                                                   | $I_D$          | 6                      |         | A                |
| Pulsed Drain Current (note1)                                               | $I_{DM}$       | 18                     |         | A                |
| Gate-Source Voltage                                                        | $V_{GSS}$      | $\pm 30$               |         | V                |
| Single Pulse Avalanche Energy (note2)                                      | $E_{AS}$       | 192                    |         | mJ               |
| Avalanche Current (note1)                                                  | $I_{AR}$       | 1.6                    |         | A                |
| Repetitive Avalanche Energy (note1)                                        | $E_{AR}$       | 0.15                   |         | mJ               |
| Power Dissipation ( $T_C = 25^\circ\text{C}$ )                             | $P_D$          | 37                     | 25      | W                |
| Operating Junction and Storage Temperature Range                           | $T_J, T_{stg}$ | $-55 \sim +150$        |         | $^\circ\text{C}$ |

| Thermal Resistance                      |            |                        |         |                    |
|-----------------------------------------|------------|------------------------|---------|--------------------|
| Parameter                               | Symbol     | Value                  |         | Unit               |
|                                         |            | TO-220, TO-251, TO-252 | TO-220F |                    |
| Thermal Resistance, Junction-to-Case    | $R_{thJC}$ | 3.4                    | 5       | $^\circ\text{C/W}$ |
| Thermal Resistance, Junction-to-Ambient | $R_{thJA}$ | 62                     | 80      |                    |

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

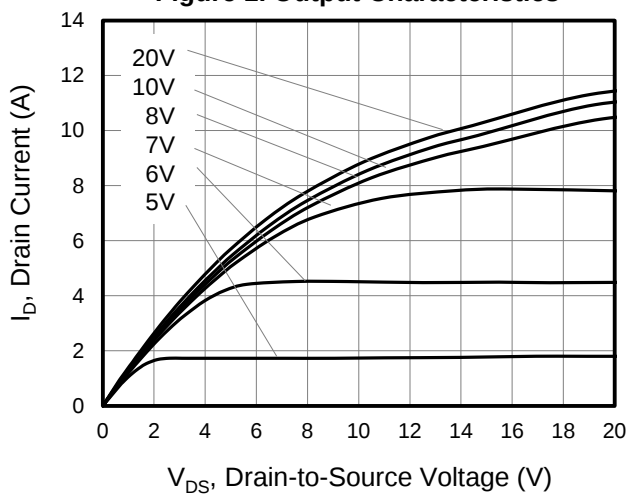
| Parameter                               | Symbol               | Test Conditions                                                                           | Value |      |      | Unit |
|-----------------------------------------|----------------------|-------------------------------------------------------------------------------------------|-------|------|------|------|
|                                         |                      |                                                                                           | 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   |
|                                         |                      | V <sub>DS</sub> = 650V, V <sub>GS</sub> = 0V, T <sub>J</sub> = 150°C                      | --    | --   | 100  |      |
| 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                                | 2.5   | --   | 4    | V    |
| Drain-Source On-Resistance (Note3)      | R <sub>DS(on)</sub>  | V <sub>GS</sub> = 10V, I <sub>D</sub> = 3A                                                | --    | 0.7  | 0.8  | Ω    |
| Forward Transconductance (Note3)        | g <sub>fs</sub>      | V <sub>DS</sub> = 10V, I <sub>D</sub> = 3A                                                | --    | 2.5  | --   | S    |
| Dynamic                                 |                      |                                                                                           |       |      |      |      |
| Input Capacitance                       | C <sub>iss</sub>     | V <sub>GS</sub> = 0V,<br>V <sub>DS</sub> = 50V,<br>f = 1.0MHz                             | --    | 475  | --   | pF   |
| Output Capacitance                      | C <sub>oss</sub>     |                                                                                           | --    | 24   | --   |      |
| Reverse Transfer Capacitance            | C <sub>rss</sub>     |                                                                                           | --    | 3    | --   |      |
| Total Gate Charge                       | Q <sub>g</sub>       | V <sub>DD</sub> = 520V, I <sub>D</sub> = 6A,<br>V <sub>GS</sub> = 10V                     | --    | 12   | --   | nC   |
| Gate-Source Charge                      | Q <sub>gs</sub>      |                                                                                           | --    | 2.5  | --   |      |
| Gate-Drain Charge                       | Q <sub>gd</sub>      |                                                                                           | --    | 4    | --   |      |
| Turn-on Delay Time                      | t <sub>d(on)</sub>   | V <sub>DD</sub> = 400V, I <sub>D</sub> = 6A,<br>R <sub>G</sub> = 25Ω                      | --    | 40   | --   | ns   |
| Turn-on Rise Time                       | t <sub>r</sub>       |                                                                                           | --    | 26   | --   |      |
| Turn-off Delay Time                     | t <sub>d(off)</sub>  |                                                                                           | --    | 95   | --   |      |
| Turn-off Fall Time                      | t <sub>f</sub>       |                                                                                           | --    | 18   | --   |      |
| Drain-Source Body Diode Characteristics |                      |                                                                                           |       |      |      |      |
| Continuous Body Diode Current           | I <sub>S</sub>       | T <sub>C</sub> = 25°C                                                                     | --    | --   | 3.9  | A    |
| Pulsed Diode Forward Current            | I <sub>SM</sub>      |                                                                                           | --    | --   | 12   |      |
| Body Diode Voltage                      | V <sub>SD</sub>      | T <sub>J</sub> = 25°C, I <sub>SD</sub> = 6A, V <sub>GS</sub> = 0V                         | --    | 0.9  | 1.2  | V    |
| Reverse Recovery Time                   | t <sub>rr</sub>      | V <sub>R</sub> = 520V, I <sub>F</sub> = I <sub>S</sub> ,<br>di <sub>F</sub> /dt = 100A/μs | --    | 226  | --   | ns   |
| Reverse Recovery Charge                 | Q <sub>rr</sub>      |                                                                                           | --    | 1.3  | --   | μC   |
| Peak Reverse Recovery Current           | I <sub>rrm</sub>     |                                                                                           | --    | 9.9  | --   | A    |

**Notes**

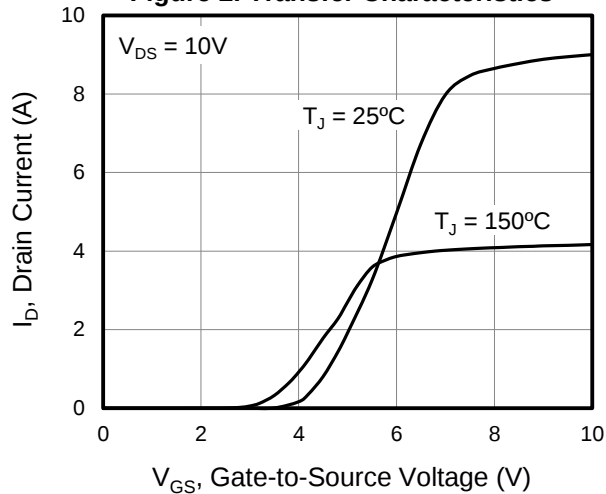
1. Repetitive Rating: Pulse Width limited by maximum junction temperature
2.  $I_{AS} = 1.6A, V_{DD} = 50V, R_G = 25\Omega$ , Starting  $T_J = 25^{\circ}\text{C}$
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 1\%$

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

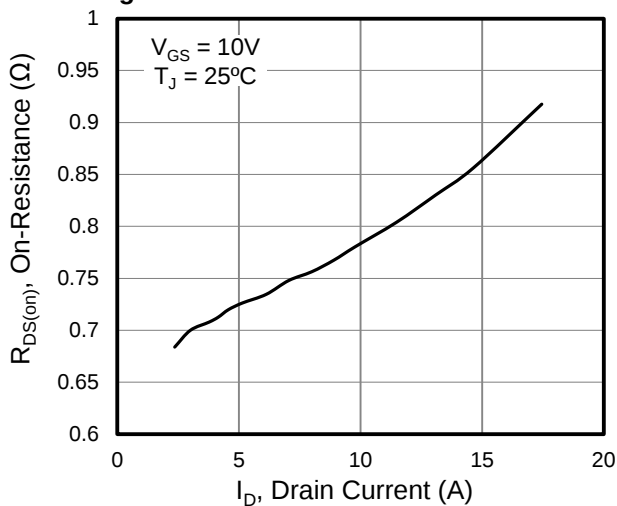
**Figure 1. Output Characteristics**



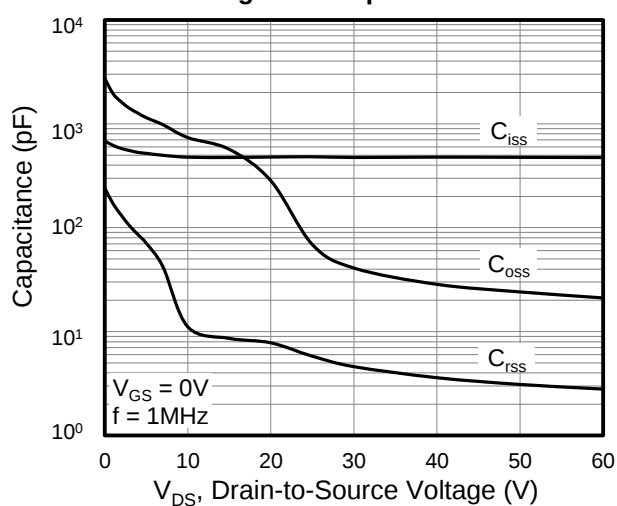
**Figure 2. Transfer Characteristics**



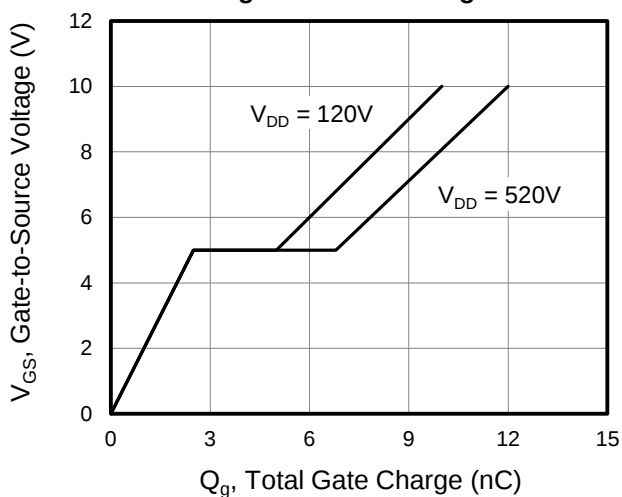
**Figure 3. On-Resistance vs. Drain Current**



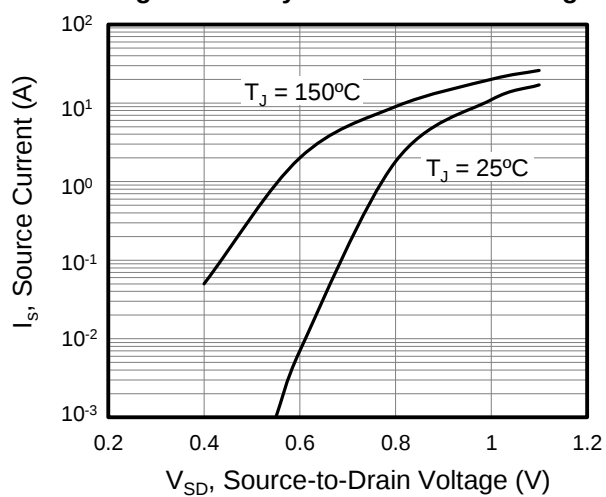
**Figure 4. Capacitance**



**Figure 5. Gate Charge**

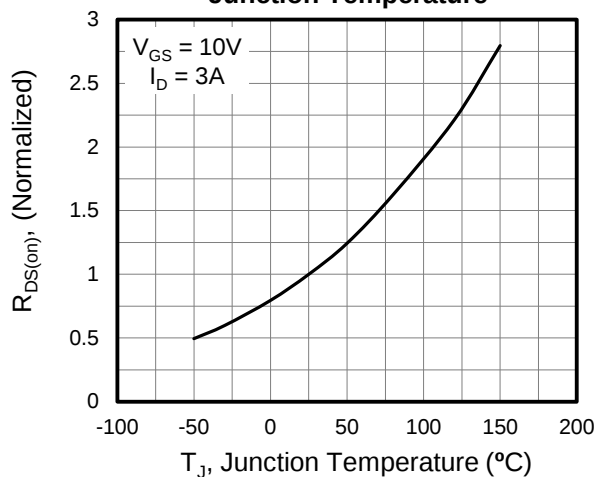


**Figure 6. Body Diode Forward Voltage**

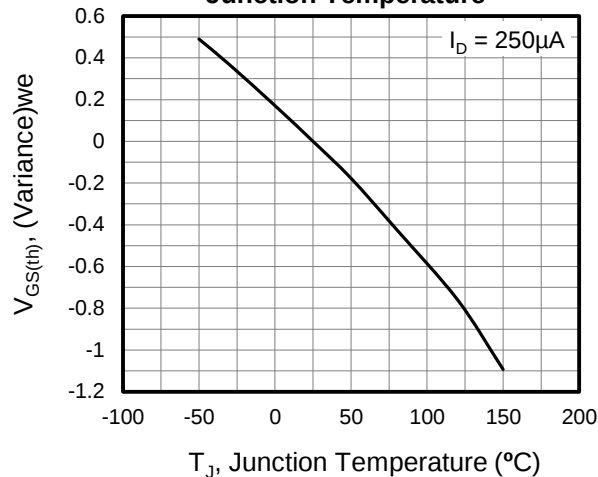


Typical Characteristics  $T_J = 25^\circ\text{C}$ , unless otherwise noted

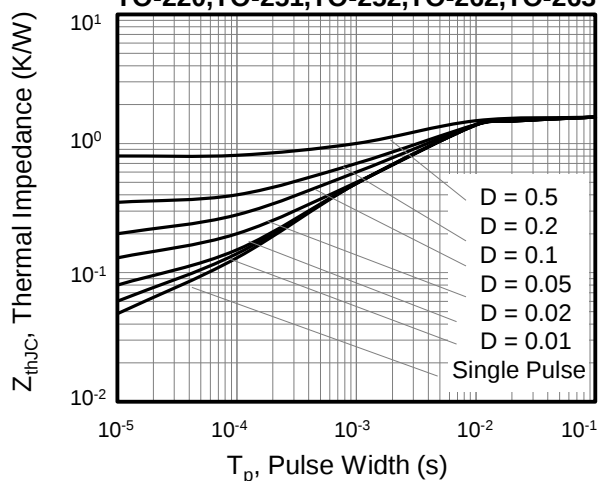
**Figure 7. On-Resistance vs. Junction Temperature**



**Figure 8. Threshold Voltage vs. Junction Temperature**



**Figure 9. Transient Thermal Impedance TO-220, TO-251, TO-252, TO-262, TO-263**



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

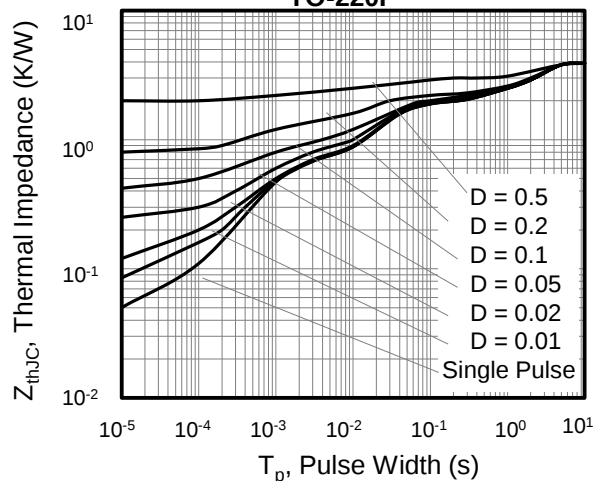


Figure A: Gate Charge Test Circuit and Waveform

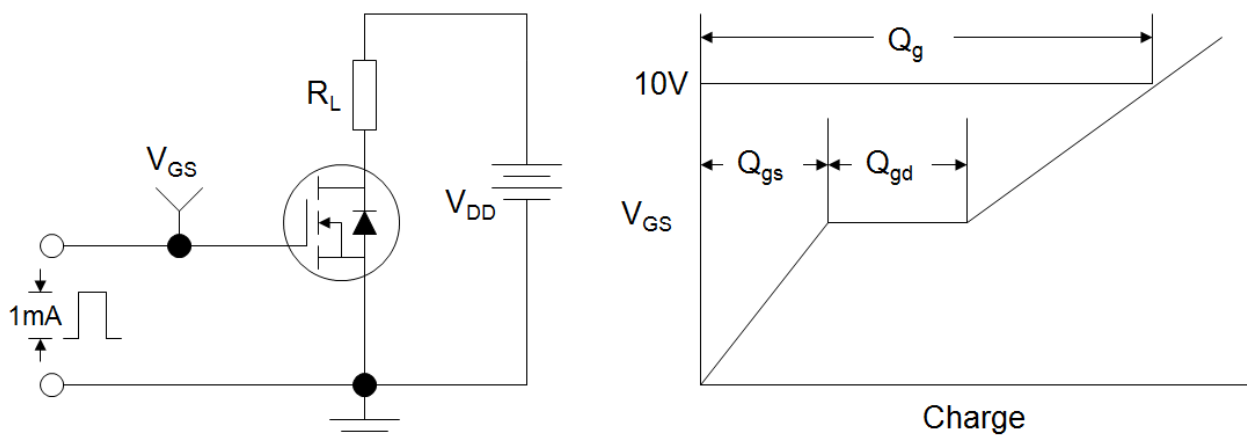


Figure B: Resistive Switching Test Circuit and Waveform

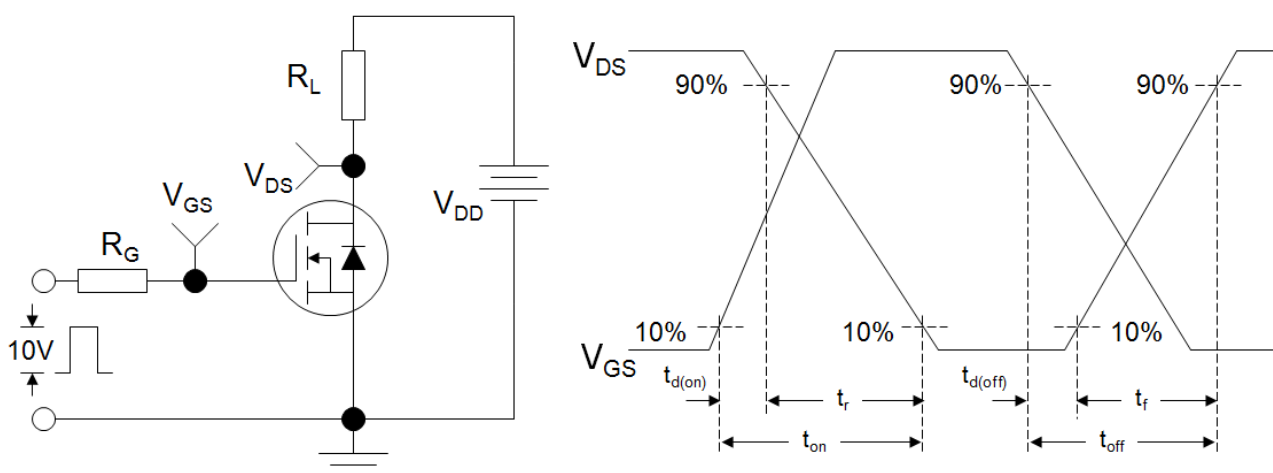
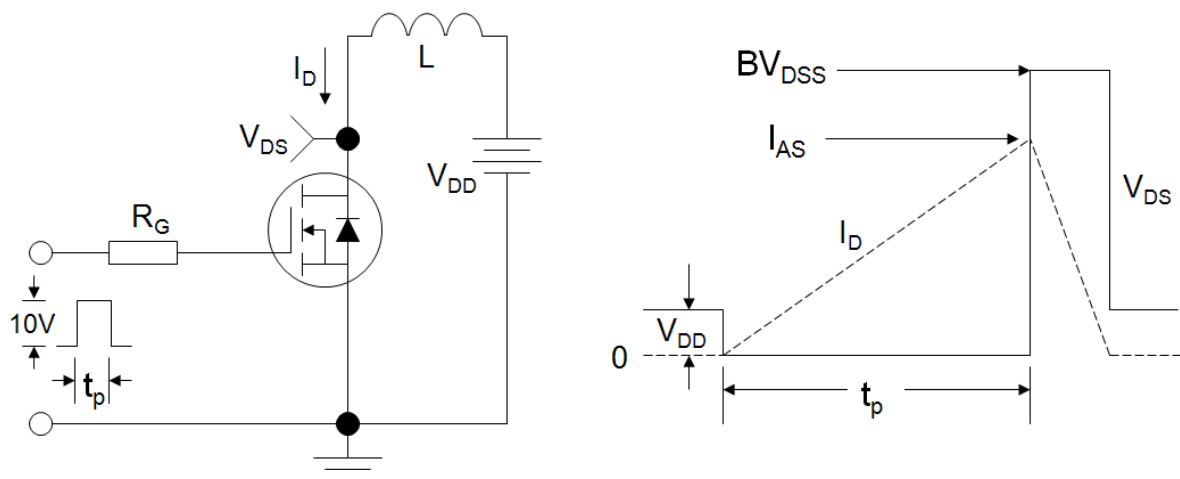
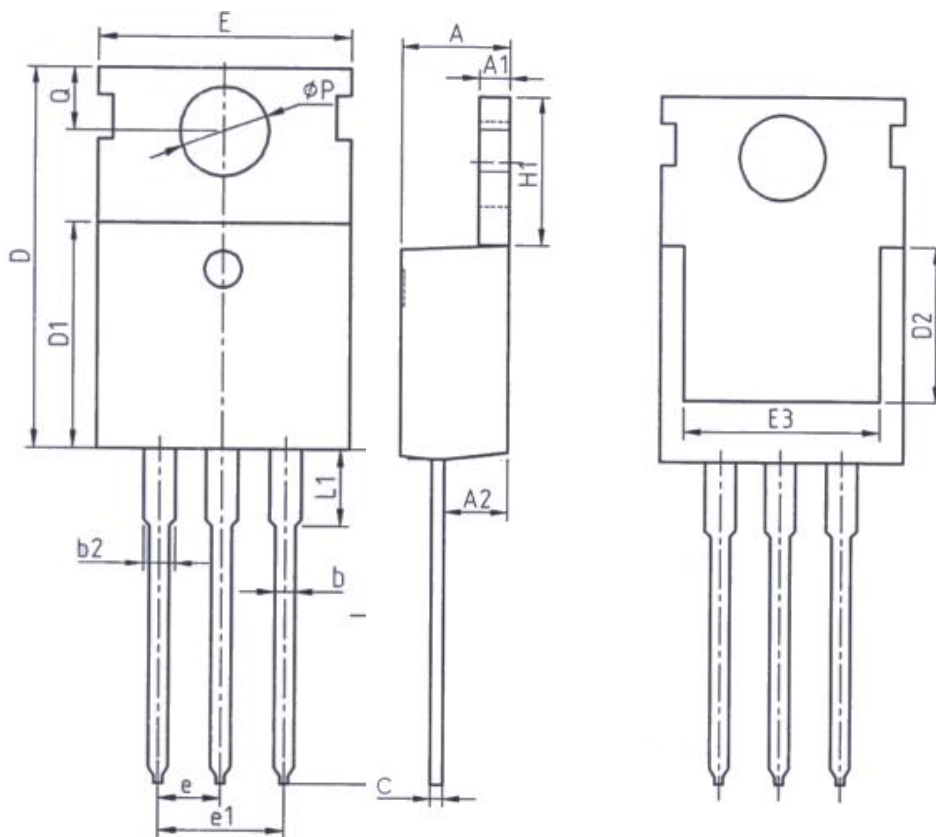


Figure C: Unclamped Inductive Switching Test Circuit and Waveform



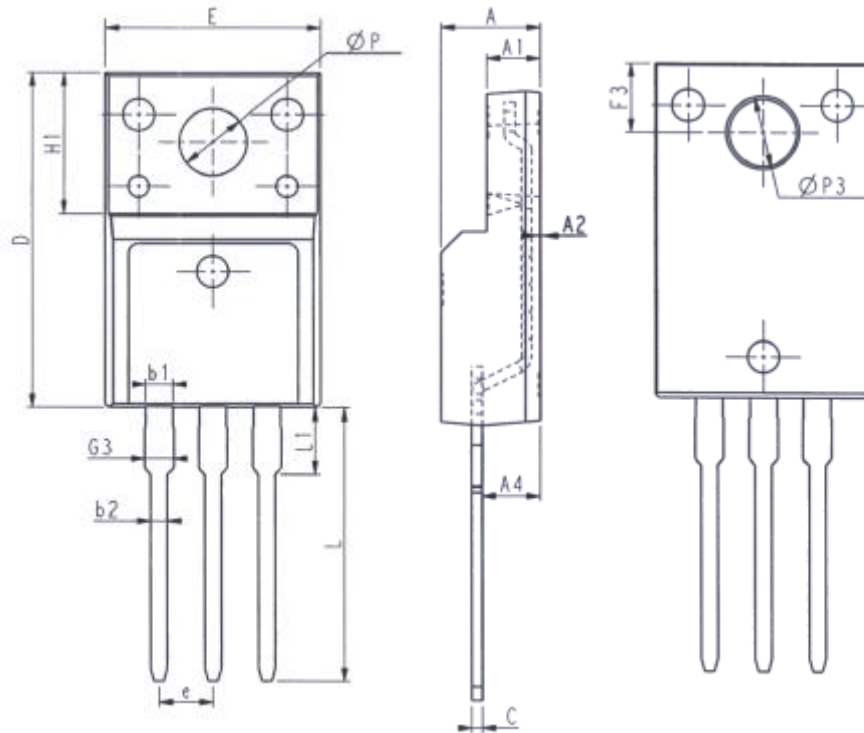
## TO-220



| Unit: mm |       |       |
|----------|-------|-------|
| Symbol   | Min.  | Max.  |
| A        | 4.37  | 4.77  |
| A1       | 1.25  | 1.45  |
| A2       | 2.20  | 2.60  |
| b        | 0.70  | 0.95  |
| b2       | 1.17  | 1.47  |
| c        | 0.40  | 0.65  |
| D        | 15.10 | 16.10 |
| D1       | 8.80  | 9.40  |
| D2       | 5.50  | —     |

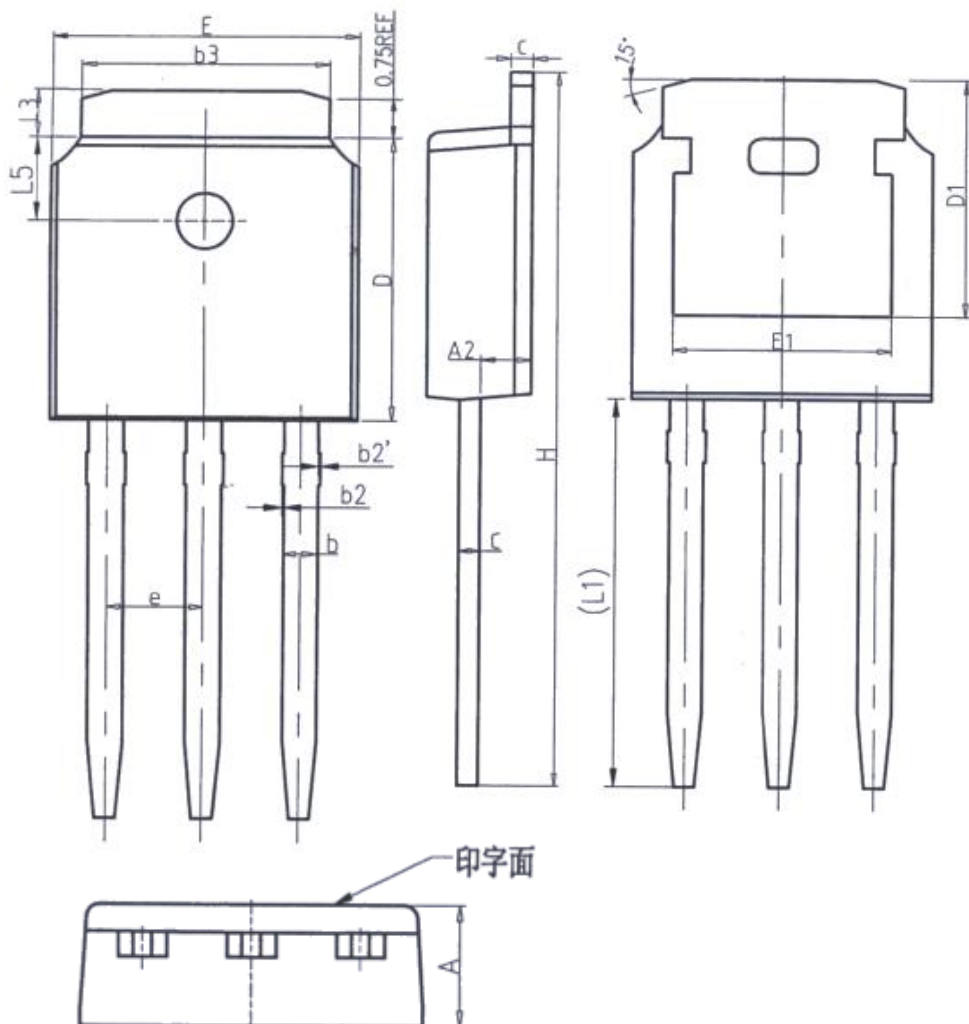
| Unit: mm |         |       |
|----------|---------|-------|
| Symbol   | Min.    | Max.  |
| E        | 9.70    | 10.30 |
| E3       | 7.00    | —     |
| e        | 2.54BSC |       |
| e1       | 5.08BSC |       |
| H1       | 6.25    | 6.85  |
| L        | 12.75   | 13.80 |
| L1       | —       | 3.40  |
| P        | 3.40    | 3.80  |
| Q        | 2.60    | 3.00  |

**TO-220F**



| Unit: mm |         |       | Unit: mm |       |       |
|----------|---------|-------|----------|-------|-------|
| Symbol   | Min.    | Max.  | Symbol   | Min.  | Max.  |
| E        | 9.96    | 10.36 | L        | 12.68 | 13.28 |
| A        | 4.50    | 4.90  | L1       | 2.93  | 3.13  |
| A1       | 2.34    | 2.74  | P        | 3.03  | 3.38  |
| A2       | 0.30    | 0.60  | P3       | 3.15  | 3.65  |
| A4       | 2.56    | 2.96  | F3       | 3.15  | 3.45  |
| c        | 0.40    | 0.65  | G3       | 1.25  | 1.55  |
| D        | 15.57   | 16.17 | b1       | 1.18  | 1.43  |
| H1       | 6.70REF |       | b2       | 0.70  | 0.95  |
| e        | 2.54BSC |       |          |       |       |

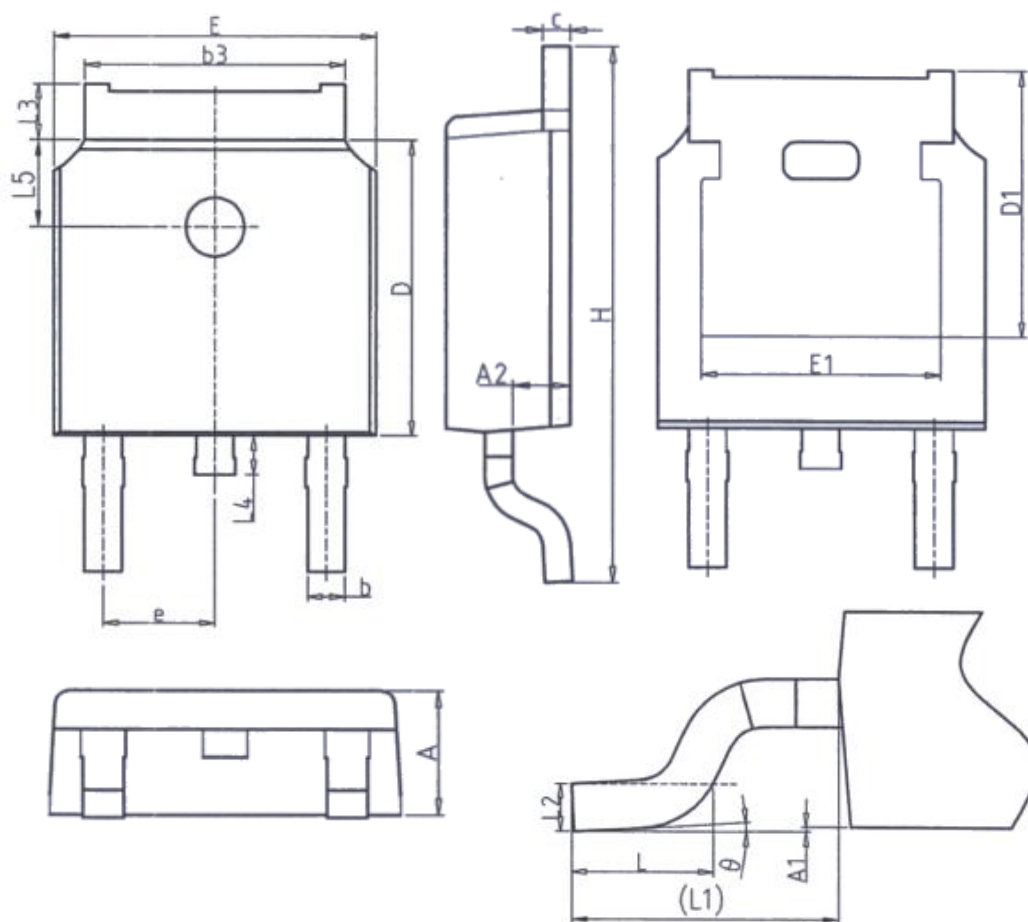
## TO-251



| Unit: mm |      |      |
|----------|------|------|
| Symbol   | Min. | Max. |
| A        | 2.20 | 2.40 |
| A2       | 0.97 | 1.17 |
| b        | 0.68 | 0.90 |
| b2       | 0.00 | 0.10 |
| b2'      | 0.00 | 0.10 |
| b3       | 5.20 | 5.50 |
| c        | 0.43 | 0.63 |
| D        | 5.98 | 6.22 |

| Unit: mm |          |       |
|----------|----------|-------|
| Symbol   | Min.     | Max.  |
| D1       | 5.30REF  |       |
| E        | 6.40     | 6.80  |
| E1       | 4.63     | -     |
| e        | 2.286BSC |       |
| H        | 16.22    | 16.82 |
| L1       | 9.15     | 9.65  |
| L3       | 0.88     | 1.28  |
| L5       | 1.65     | 1.95  |

## TO-252



| Unit: mm |         |      |
|----------|---------|------|
| Symbol   | Min.    | Max. |
| A        | 2.20    | 2.40 |
| A1       | 0.00    | 0.20 |
| A2       | 0.97    | 1.17 |
| b        | 0.68    | 0.90 |
| b3       | 5.20    | 5.50 |
| c        | 0.43    | 0.63 |
| D        | 5.98    | 6.22 |
| D1       | 5.30REF |      |
| E        | 6.40    | 6.80 |
| E1       | 4.63    | -    |

| Unit: mm |          |       |
|----------|----------|-------|
| Symbol   | Min.     | Max.  |
| e        | 2.286BSC |       |
| H        | 9.40     | 10.50 |
| L        | 1.38     | 1.75  |
| L1       | 2.90REF  |       |
| L2       | 0.51BSC  |       |
| L3       | 0.88     | 1.28  |
| L4       | -        | 1.00  |
| L5       | 1.65     | 1.95  |
| $\theta$ | 0°       | 8°    |