

## 650V Super Junction Power MOSFET

- ★ Super Low Gate Charge
- ★ 100% EAS Guaranteed
- ★ Green Device Available
- ★ Excellent CdV/dt effect decline
- ★ Advanced trench gate super junction technology

## Product Summary

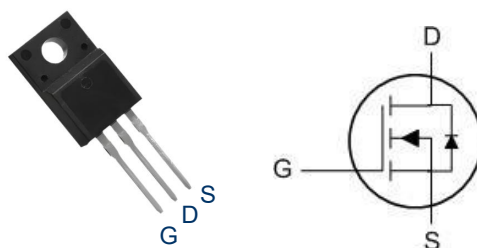


| BVDSS | RDS(on) | ID  |
|-------|---------|-----|
| 650 V | 241mΩ   | 13A |

## Description

The XR65R250FTg2 use super junction technology and design to provide excellent RDS(ON) with low gate charge. This super junction MOSFET fits the industry's AC-DC SMPS requirements for PFC, AC/DC power conversion, and industrial power applications. The XR65R250FTg2 meet the RoHS and Green Product requirement, 100% EAS guaranteed with full function reliability approved.

## TO220F Pin Configuration



## Absolute Maximum Ratings

| Symbol                      | Parameter                                      | Rating     | Units            |
|-----------------------------|------------------------------------------------|------------|------------------|
| $V_{DS}$                    | Drain-Source Voltage                           | 650        | V                |
| $V_{GS}$                    | Gate-Source Voltage                            | $\pm 30$   | V                |
| $I_D@T_C=25^\circ\text{C}$  | Continuous Drain Current, $V_{GS} @ 10V^{1,6}$ | 13         | A                |
| $I_D@T_C=100^\circ\text{C}$ | Continuous Drain Current, $V_{GS} @ 10V^{1,6}$ | 8          | A                |
| $I_{DM}$                    | Pulsed Drain Current <sup>2</sup>              | 53         | A                |
| EAS                         | Single Pulse Avalanche Energy <sup>3</sup>     | 120        | mJ               |
| $I_{AS}$                    | Avalanche Current                              | ---        | A                |
| $P_D@T_C=25^\circ\text{C}$  | Total Power Dissipation <sup>4</sup>           | 21         | W                |
| $T_{STG}$                   | Storage Temperature Range                      | -55 to 150 | $^\circ\text{C}$ |
| $T_J$                       | Operating Junction Temperature Range           | -55 to 150 | $^\circ\text{C}$ |

## Thermal Data

| Symbol          | Parameter                                        | Typ. | Max. | Unit               |
|-----------------|--------------------------------------------------|------|------|--------------------|
| $R_{\theta JA}$ | Thermal Resistance Junction-Ambient <sup>1</sup> | ---  | 64   | $^\circ\text{C/W}$ |
| $R_{\theta JC}$ | Thermal Resistance Junction-Case <sup>1</sup>    | ---  | 5.84 | $^\circ\text{C/W}$ |

## 650V Super Junction Power MOSFET

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

| Symbol                       | Parameter                                      | Conditions                                                    | Min. | Typ. | Max.      | Unit                |
|------------------------------|------------------------------------------------|---------------------------------------------------------------|------|------|-----------|---------------------|
| $BV_{DSS}$                   | Drain-Source Breakdown Voltage                 | $V_{GS}=0V$ , $I_D=250\mu A$                                  | 650  | ---  | ---       | V                   |
| $\Delta BV_{DSS}/\Delta T_J$ | $BV_{DSS}$ Temperature Coefficient             | Reference to $25^\circ\text{C}$ , $I_D=1mA$                   | ---  | ---  | ---       | $V/^\circ\text{C}$  |
| $R_{DS(ON)}$                 | Static Drain-Source On-Resistance <sup>2</sup> | $V_{GS}=10V$ , $I_D=7.5A$                                     | ---  | 241  | 300       | $m\Omega$           |
|                              |                                                | $V_{GS}=4.5V$ , $I_D=7.5A$                                    | ---  | ---  | ---       |                     |
| $V_{GS(th)}$                 | Gate Threshold Voltage                         | $V_{GS}=V_{DS}$ , $I_D=250\mu A$                              | 2.8  | ---  | 3.8       | V                   |
| $\Delta V_{GS(th)}$          | $V_{GS(th)}$ Temperature Coefficient           |                                                               | ---  | ---  | ---       | $mV/^\circ\text{C}$ |
| $I_{DSS}$                    | Drain-Source Leakage Current                   | $V_{DS}=650V$ , $V_{GS}=0V$ , $T_J=25^\circ\text{C}$          | ---  | ---  | 1         | $\mu A$             |
|                              |                                                | $V_{DS}=650V$ , $V_{GS}=0V$ , $T_J=150^\circ\text{C}$         | ---  | 5    | ---       |                     |
| $I_{GSS}$                    | Gate-Source Leakage Current                    | $V_{GS}=\pm 30V$ , $V_{DS}=0V$                                | ---  | ---  | $\pm 100$ | nA                  |
| $g_{fs}$                     | Forward Transconductance                       | $V_{DS}=20V$ , $I_D=7.5A$                                     | ---  | 11   | ---       | S                   |
| $R_g$                        | Gate Resistance                                | $V_{DS}=0V$ , $V_{GS}=0V$ , $f=1MHz$                          | ---  | 6.5  | ---       | $\Omega$            |
| $Q_g$                        | Total Gate Charge                              | $V_{DS}=480V$ , $V_{GS}=10V$ , $I_D=7.5A$                     | ---  | 23.5 | ---       | nC                  |
| $Q_{gs}$                     | Gate-Source Charge                             |                                                               | ---  | 5    | ---       |                     |
| $Q_{gd}$                     | Gate-Drain Charge                              |                                                               | ---  | 10   | ---       |                     |
| $T_{d(on)}$                  | Turn-On Delay Time                             | $V_{GS}=10V$ , $V_{DS}=400V$ ,<br>$R_G=25\Omega$ , $I_D=7.5A$ | ---  | 14   | ---       | ns                  |
| $T_r$                        | Rise Time                                      |                                                               | ---  | 24   | ---       |                     |
| $T_{d(off)}$                 | Turn-Off Delay Time                            |                                                               | ---  | 97   | ---       |                     |
| $T_f$                        | Fall Time                                      |                                                               | ---  | 22   | ---       |                     |
| $C_{iss}$                    | Input Capacitance                              | $V_{DS}=100V$ , $V_{GS}=0V$ , $f=1MHz$                        | ---  | 750  | ---       | pF                  |
| $C_{oss}$                    | Output Capacitance                             |                                                               | ---  | 40   | ---       |                     |
| $C_{rss}$                    | Reverse Transfer Capacitance                   |                                                               | ---  | 1.4  | ---       |                     |

## Diode Characteristics

| Symbol   | Parameter                                | Conditions                                                | Min. | Typ. | Max. | Unit |
|----------|------------------------------------------|-----------------------------------------------------------|------|------|------|------|
| $I_S$    | Continuous Source Current <sup>1,4</sup> | $V_G=V_D=0V$ , Force Current                              | ---  | ---  | 13   | A    |
| $V_{SD}$ | Diode Forward Voltage <sup>2</sup>       | $V_{GS}=0V$ , $I_S=7.5A$ , $T_J=25^\circ\text{C}$         | 0.6  | 0.86 | 1.1  | V    |
| $t_{rr}$ | Reverse Recovery Time                    | $I_F=11$ , $di/dt=100A/\mu s$ ,<br>$T_J=25^\circ\text{C}$ | ---  | 250  | ---  | nS   |
| $Q_{rr}$ | Reverse Recovery Charge                  |                                                           | ---  | 2.94 | ---  | nC   |

Note :

1.The data tested by surface mounted on a 1 inch<sup>2</sup> FR-4 board with 2OZ copper.2.The data tested by pulsed , pulse width  $\leq 300\mu s$ , duty cycle  $\leq 2\%$ 3.The EAS data shows Max. rating . The test condition is  $T_J=25^\circ\text{C}$ ,  $V_{DD}=200V$ ,  $V_{GS}=10V$ ,  $L=30mH$ 4.The power dissipation is limited by  $150^\circ\text{C}$  junction temperature5.The data is theoretically the same as  $I_D$  and  $I_{DM}$ , in real applications , should be limited by total power

dissipation.

### Typical Performance Characteristics

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

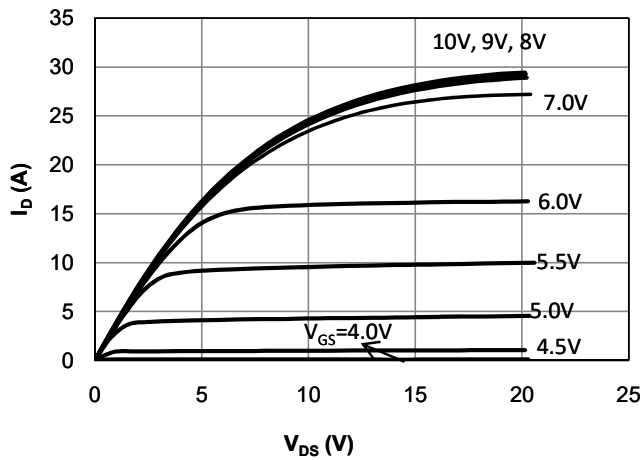


Fig 2. Output Characteristics ( $T_J=150^\circ\text{C}$ )

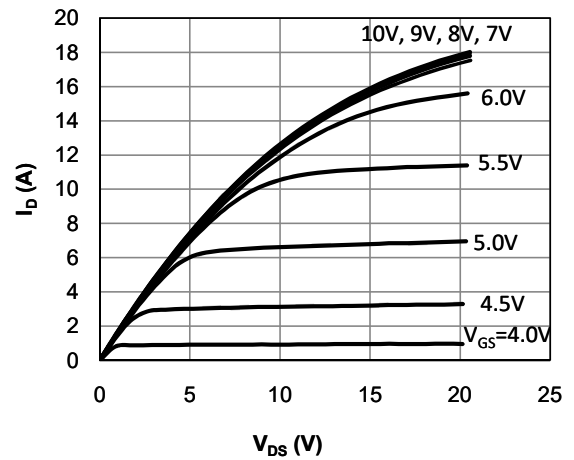


Fig 3: Transfer Characteristics

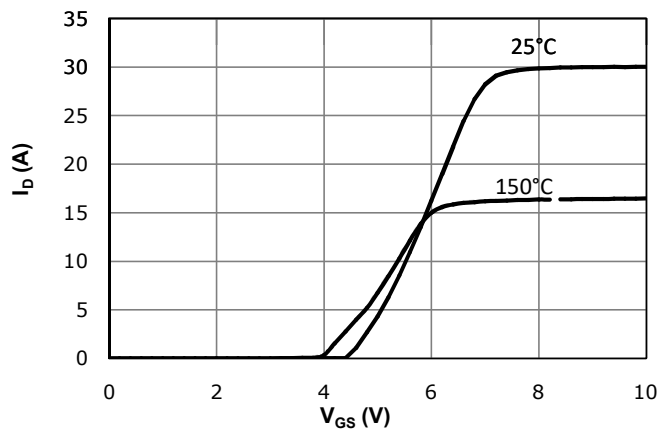


Fig 4:  $V_{TH}$  vs.  $T_J$  Temperature Characteristics

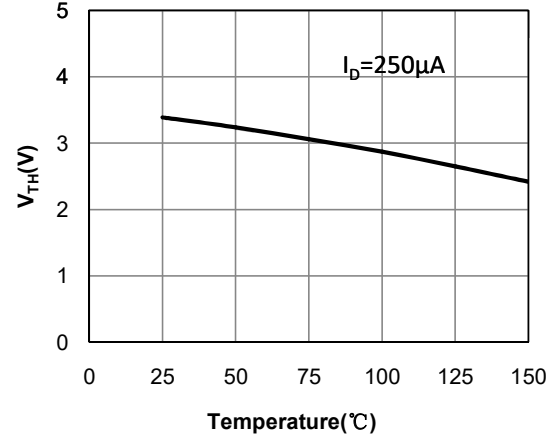


Fig 5:  $R_{DS(on)}$  vs.  $I_{DS}$  Characteristics ( $T_J=25^\circ\text{C}$ )

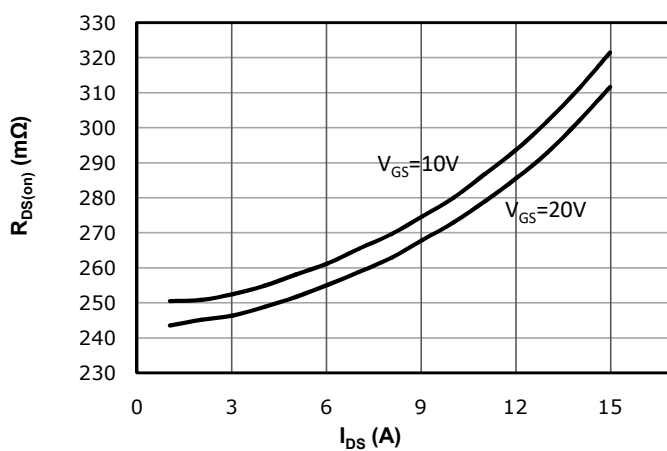


Fig 6:  $R_{DS(on)}$  vs. Temperature

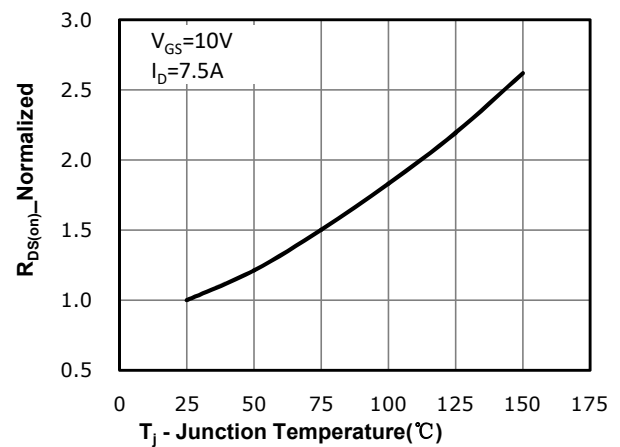


Fig 7:  $BV_{DSS}$  vs. Temperature

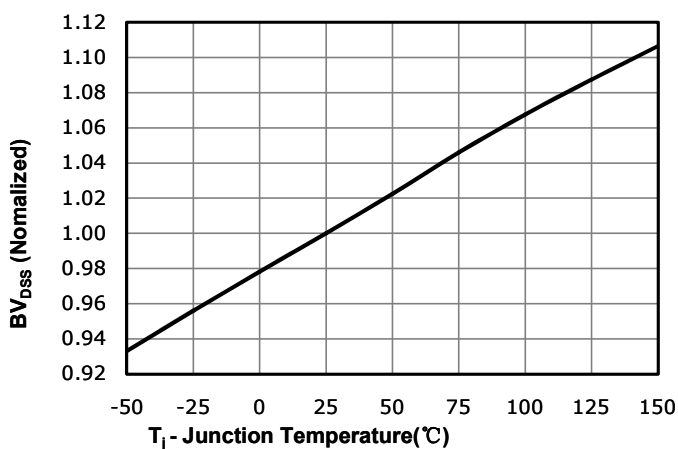


Fig 8:  $R_{DS(on)}$  vs. Gate Voltage

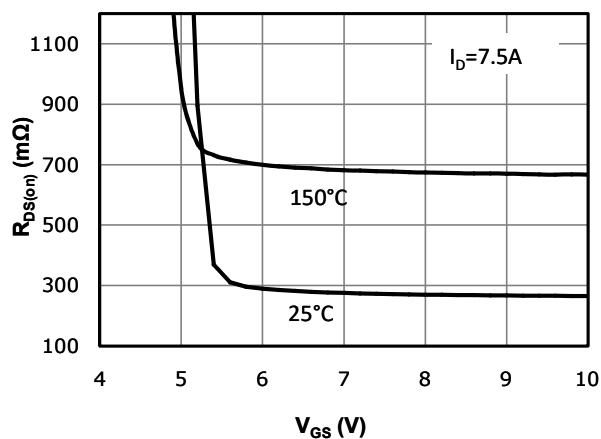


Fig 9: Body-diode Forward Characteristics

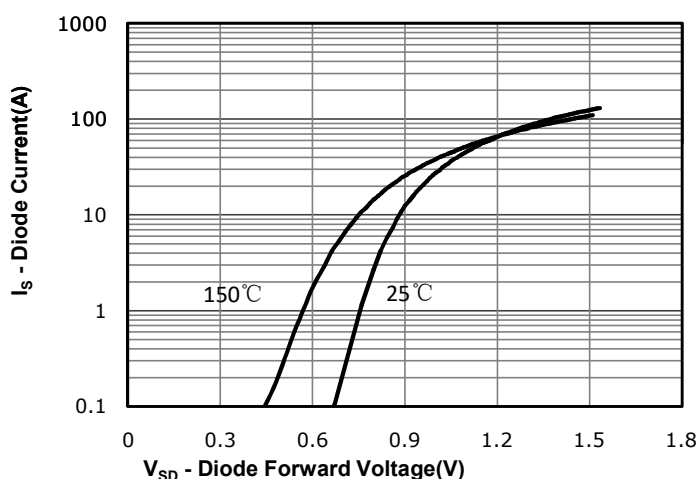


Fig 10: Gate Charge Characteristics

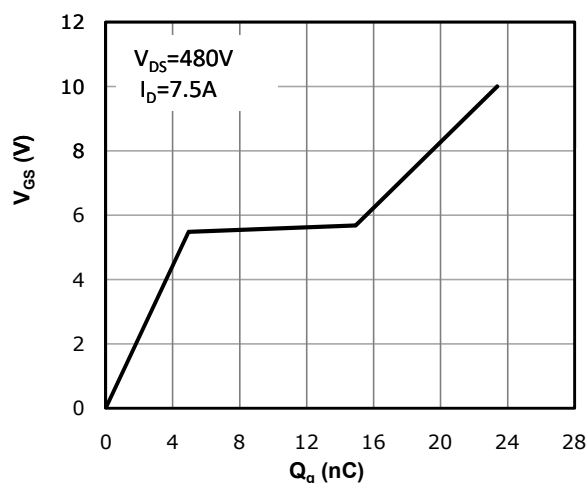


Fig 11: Capacitance Characteristics

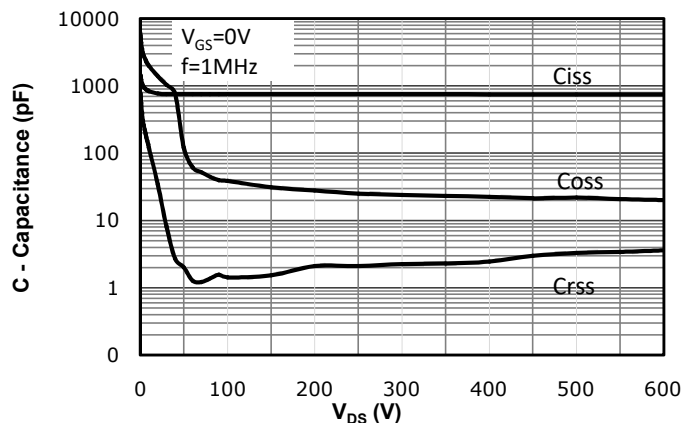


Fig 12: Safe Operating Area

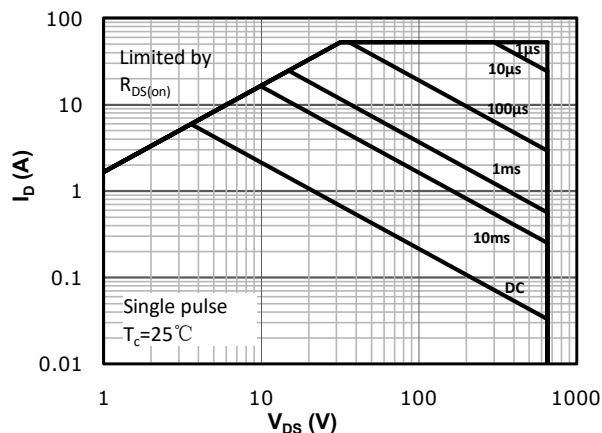
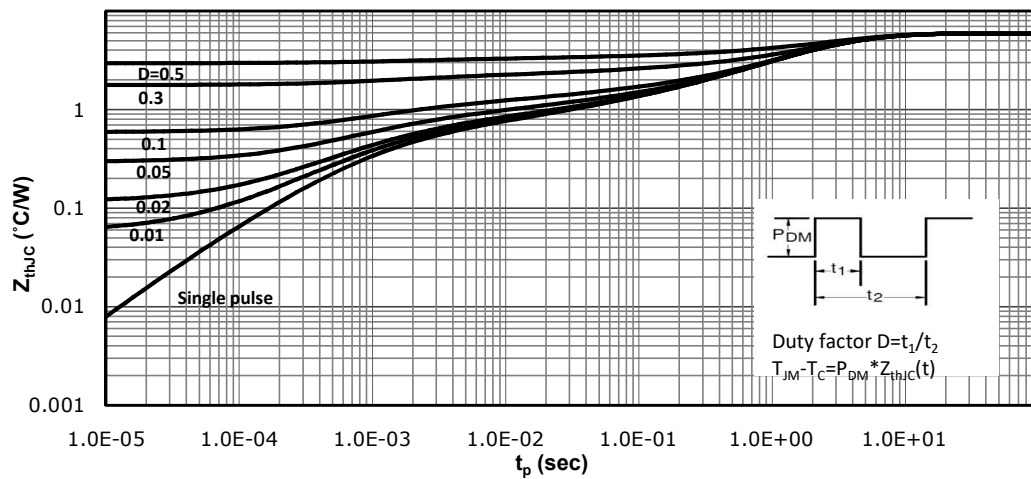
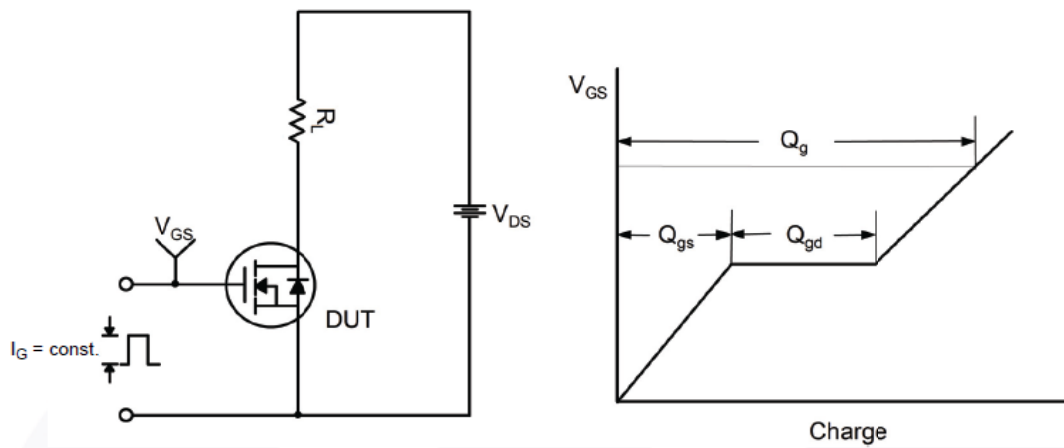


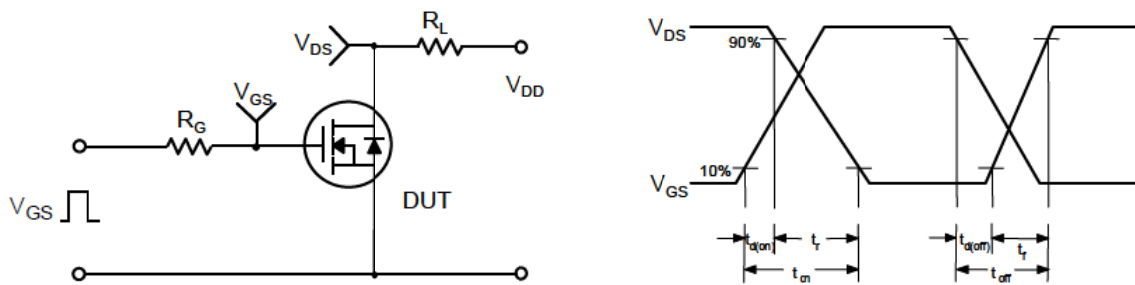
Fig 13: Max. Transient Thermal Impedance



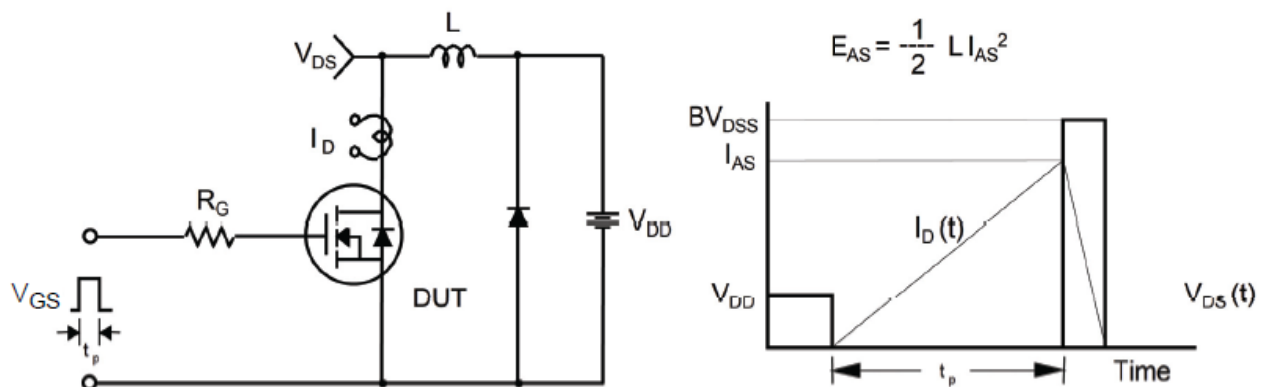
### Gate Charge Test Circuit & Waveform



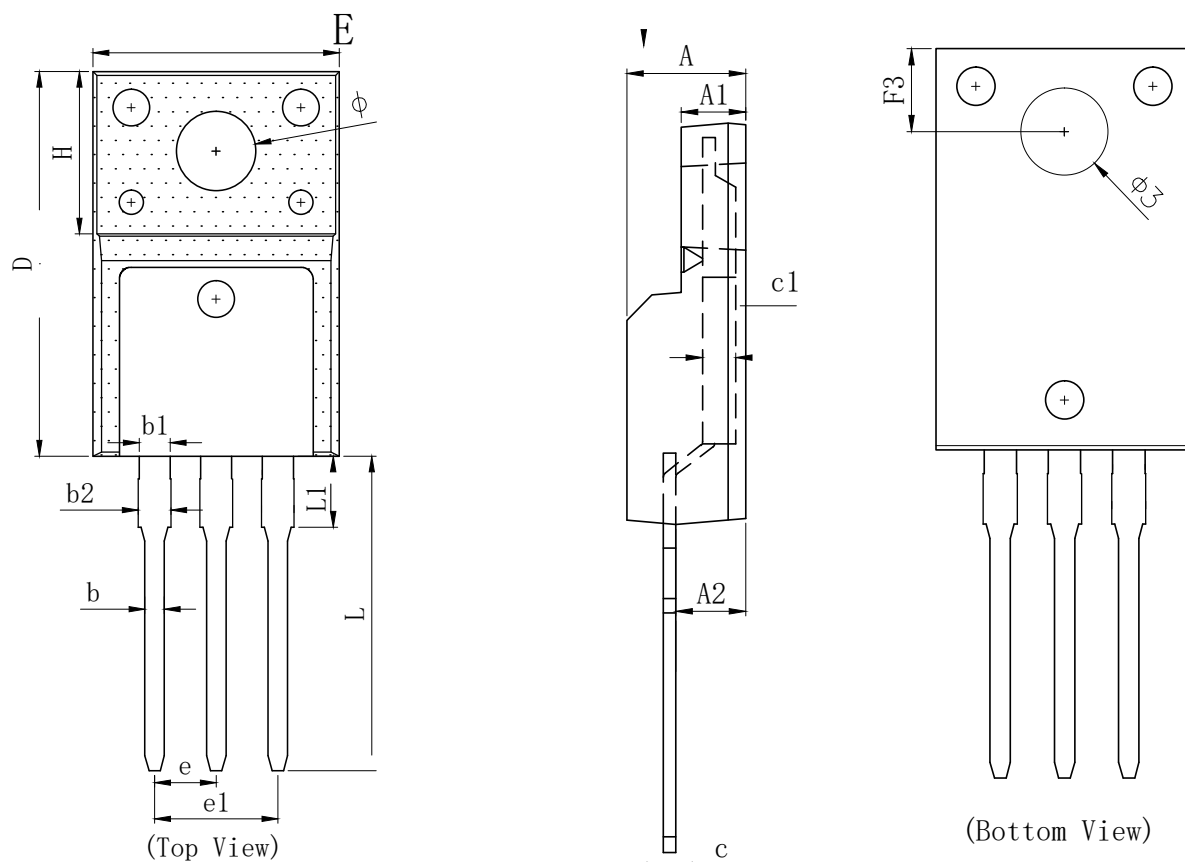
### Switching Test Circuit & Waveforms



### Unclamped Inductive Switching Test Circuit & Waveforms



### Mechanical Dimensions for TO-220F



| SYMBOL | MILLIMETER |        |        |
|--------|------------|--------|--------|
|        | MIN        | Typ.   | MAX    |
| A      | 4.500      | 4.700  | 4.900  |
| A1     | 2.340      | 2.540  | 2.740  |
| A2     | 2.560      | 2.760  | 2.960  |
| b      | 0.700      | 0.800  | 0.950  |
| b1     | 1.180      | 1.280  | 1.430  |
| b2     | 1.250      | 1.350  | 1.550  |
| c      | 0.400      | 0.500  | 0.650  |
| c1     | 1.200      | 1.300  | 1.350  |
| D      | 15.570     | 15.870 | 16.170 |
| H      | 6.700 REF  |        |        |
| E      | 9.960      | 10.160 | 10.360 |
| e      | 2.540 BSC  |        |        |
| e1     | 5.080 BSC  |        |        |
| L      | 12.680     | 12.980 | 13.280 |
| L1     | 2.780      | 2.930  | 3.080  |
| F3     | 3.150      | 3.300  | 3.450  |
| Φ      | 3.030      | 3.180  | 3.450  |
| Φ3     | 3.150      | 3.450  | 3.650  |