

ing

|  | Top Marking | Package | Packing Method | MOQ  | QTY  |
|--|-------------|---------|----------------|------|------|
|  |             | TO-220F | Tube           | 1000 | 5000 |

## Electrical Characteristics

$T_C = 25^{\circ}\text{C}$  unless otherwise noted

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|--------|-----------|-----------------|-----|-----|-----|-------|
|--------|-----------|-----------------|-----|-----|-----|-------|

### Off Characteristics

|            |                                    |                                                     |      |    |     |               |
|------------|------------------------------------|-----------------------------------------------------|------|----|-----|---------------|
| $BV_{DSS}$ | Drain-Source Breakdown Voltage     | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$ | 800  | -- | --  | V             |
| $I_{DSS}$  | Zero Gate Voltage Drain Current    | $V_{DS} = 800\text{ V}, V_{GS} = 0\text{ V}$        | --   | -- | 1   | $\mu\text{A}$ |
| $I_{GSSF}$ | Gate-Body Leakage Current, Forward | $V_{GS} = 30\text{ V}, V_{DS} = 0\text{ V}$         | --   | -- | 100 | nA            |
| $I_{GSSR}$ | Gate-Body Leakage Current, Reverse | $V_{GS} = -30\text{ V}, V_{DS} = 0\text{ V}$        | -100 | -- | --  | nA            |

### On Characteristics

|              |                                   |                                                 |     |     |     |            |
|--------------|-----------------------------------|-------------------------------------------------|-----|-----|-----|------------|
| $V_{GS(th)}$ | Gate Threshold Voltage            | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$ | 2.5 | --  | 4.5 | V          |
| $R_{DS(on)}$ | Static Drain-Source On-Resistance | $V_{GS} = 10\text{ V}, I_D = 5\text{ A}$        | --  | 410 | 500 | m $\Omega$ |

### Dynamic Characteristics

|           |                              |                                                                       |    |      |    |    |
|-----------|------------------------------|-----------------------------------------------------------------------|----|------|----|----|
| $C_{iss}$ | Input Capacitance            | $V_{DS} = 100\text{ V}, V_{GS} = 0\text{ V},$<br>$f = 100\text{ KHz}$ | -- | 1030 | -- | pF |
| $C_{oss}$ | Output Capacitance           |                                                                       | -- | 31   | -- | pF |
| $C_{rss}$ | Reverse Transfer Capacitance |                                                                       | -- | 0.6  | -- | pF |

### Switching Characteristics

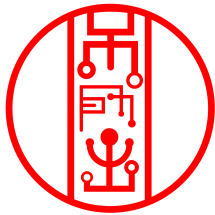
|              |                     |                                                                                                           |    |      |    |          |
|--------------|---------------------|-----------------------------------------------------------------------------------------------------------|----|------|----|----------|
| $t_{d(on)}$  | Turn-On Delay Time  | $V_{DS} = 400\text{ V}, I_D = 10\text{ A},$<br>$R_G = 4.7\text{ }\Omega, V_{GS} = 10\text{ V}$<br>(Note3) | -- | 46   | -- | ns       |
| $t_r$        | Turn-On Rise Time   |                                                                                                           | -- | 34   | -- | ns       |
| $t_{d(off)}$ | Turn-Off Delay Time |                                                                                                           | -- | 61   | -- | ns       |
| $t_f$        | Turn-Off Fall Time  |                                                                                                           | -- | 20   | -- | ns       |
| $Q_g$        | Total Gate Charge   | $V_{DS} = 400\text{ V}, I_D = 10\text{ A},$<br>$V_{GS} = 10\text{ V}$<br>(Note3)                          | -- | 24.2 | -- | nC       |
| $Q_{gs}$     | Gate-Source Charge  |                                                                                                           | -- | 6.8  | -- | nC       |
| $Q_{gd}$     | Gate-Drain Charge   |                                                                                                           | -- | 10.8 | -- | nC       |
| $R_G$        | Gate Resistance     | $f = 1\text{ MHz}$                                                                                        | -- | 4.0  | -- | $\Omega$ |

### Drain-Source Diode Characteristics and Maximum Ratings

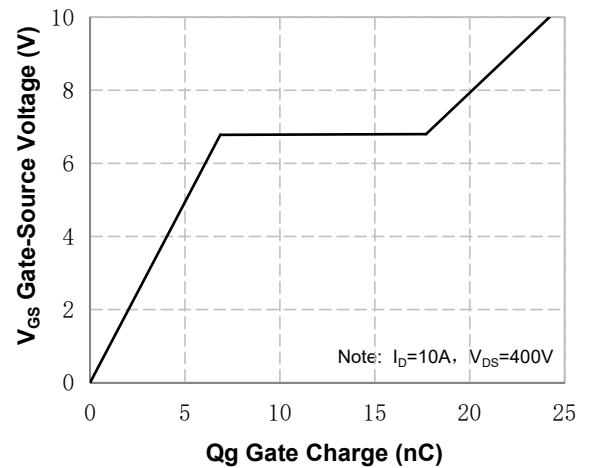
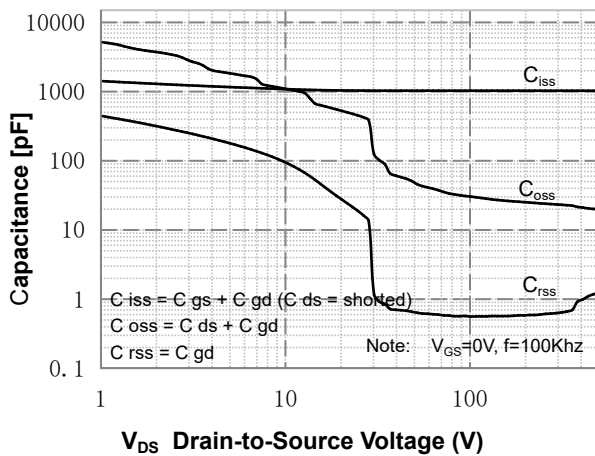
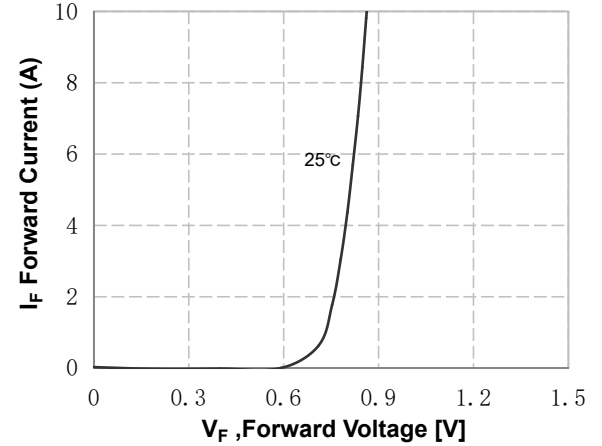
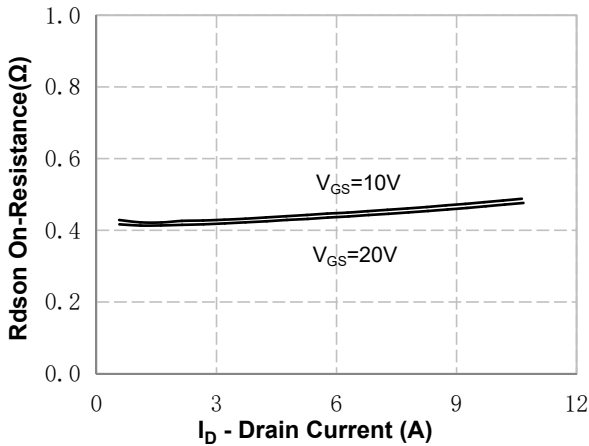
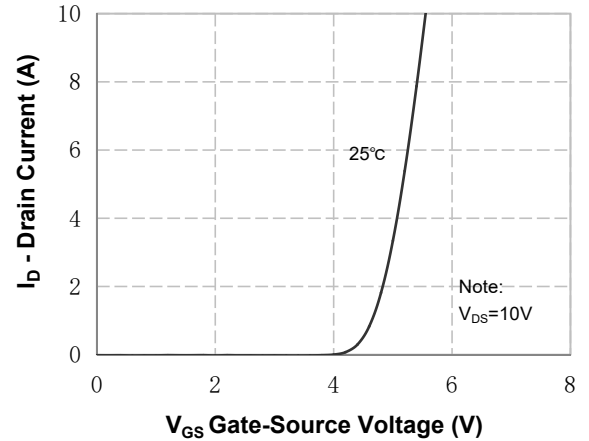
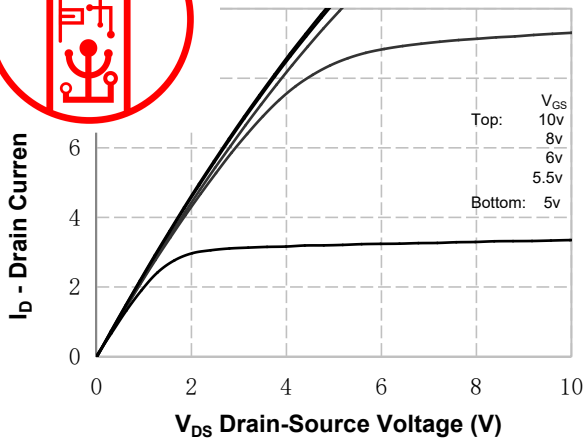
|                 |                                                       |                                                                                 |    |     |     |    |
|-----------------|-------------------------------------------------------|---------------------------------------------------------------------------------|----|-----|-----|----|
| I <sub>S</sub>  | Maximum Continuous Drain-Source Diode Forward Current |                                                                                 | -- | --  | 10  | A  |
| I <sub>SM</sub> | Maximum Pulsed Drain-Source Diode Forward Current     |                                                                                 | -- | --  | 30  | A  |
| V <sub>SD</sub> | Drain-Source Diode Forward Voltage                    | V <sub>GS</sub> = 0 V, I <sub>S</sub> = 6A                                      | -- | --  | 1.4 | V  |
| t <sub>rr</sub> | Reverse Recovery Time                                 | V <sub>DS</sub> =400 V, I <sub>S</sub> = 10A,<br>dI <sub>F</sub> / dt = 120A/us | -- | 288 | --  | ns |
| Q <sub>rr</sub> | Reverse Recovery Charge                               |                                                                                 | -- | 3.9 | --  | uC |

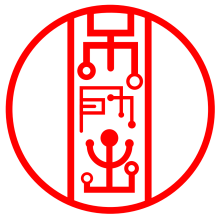
#### Notes:

1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature
2. EAS condition:  $T_J = 25^{\circ}\text{C}, V_{DS} = 50\text{ V}, V_G = 10\text{ V}, L = 10\text{ mH},$
3. Pulse Test: Pulse Widths  $\leq 300\text{ }\mu\text{s}$ , Duty Cycles  $\leq 0.5\%$



## acteristics





## acteristics (Continued)

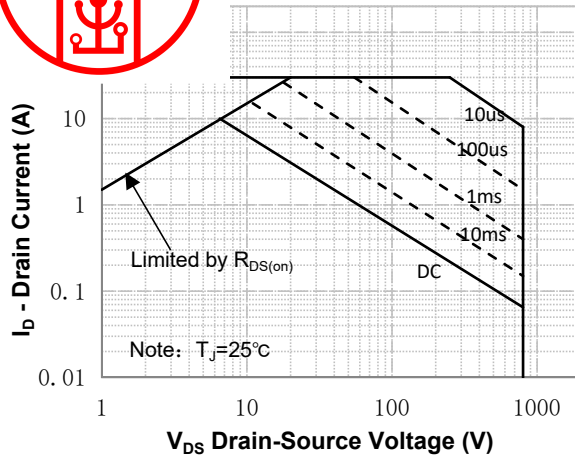


Figure 7. Maximum Safe Operating Area

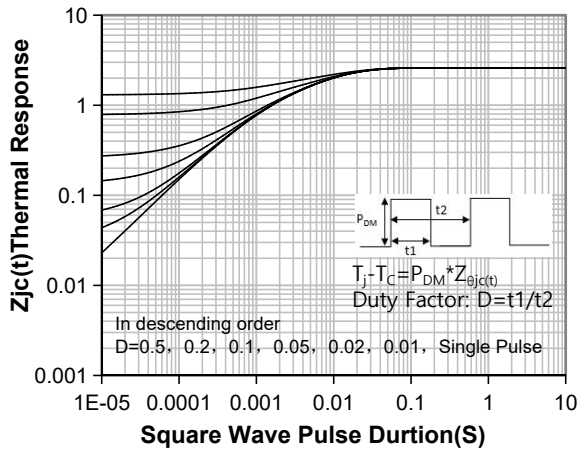


Figure 9. Transient Thermal Response Curve

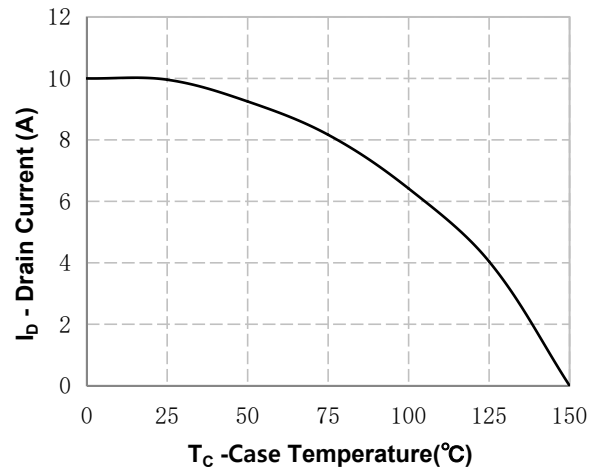
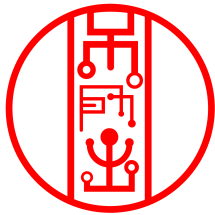
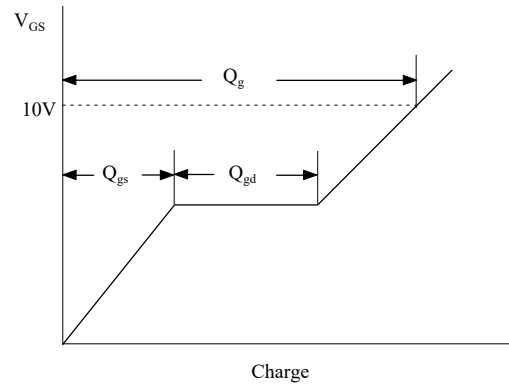
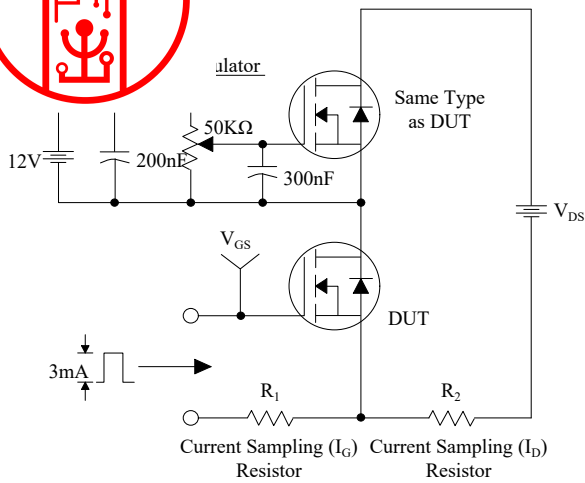


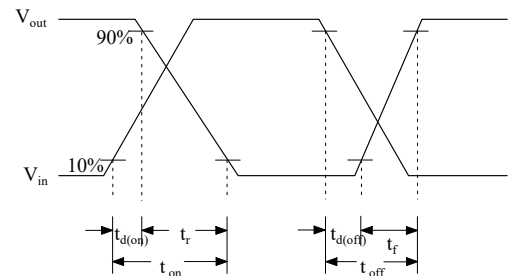
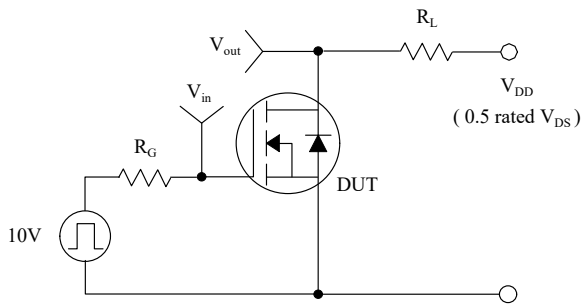
Figure 8. Maximum Drain Current vs Case Temperature



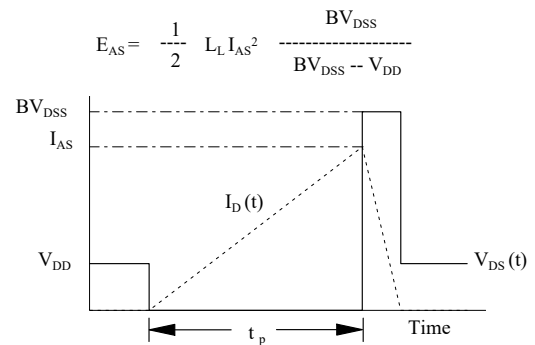
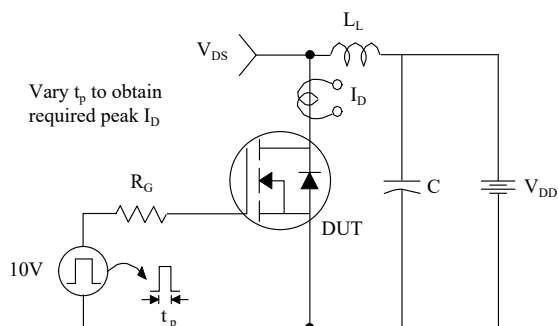
## Gate Charge Test Circuit & Waveform

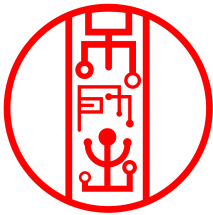


## Resistive Switching Test Circuit & Waveforms

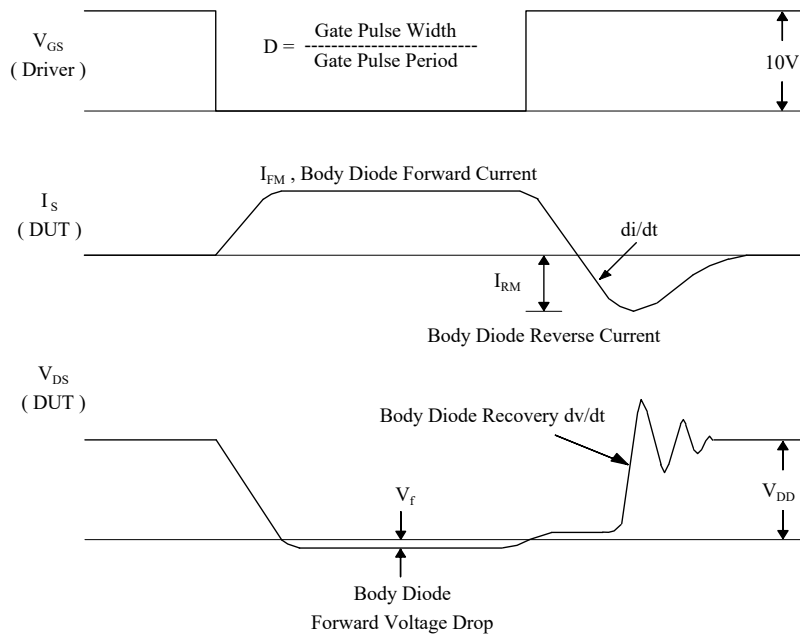
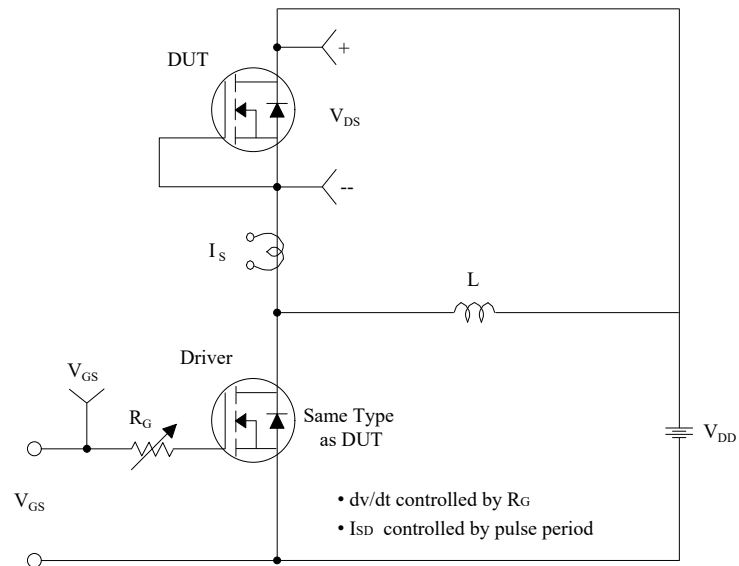


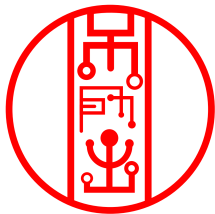
## Unclamped Inductive Switching Test Circuit & Waveforms



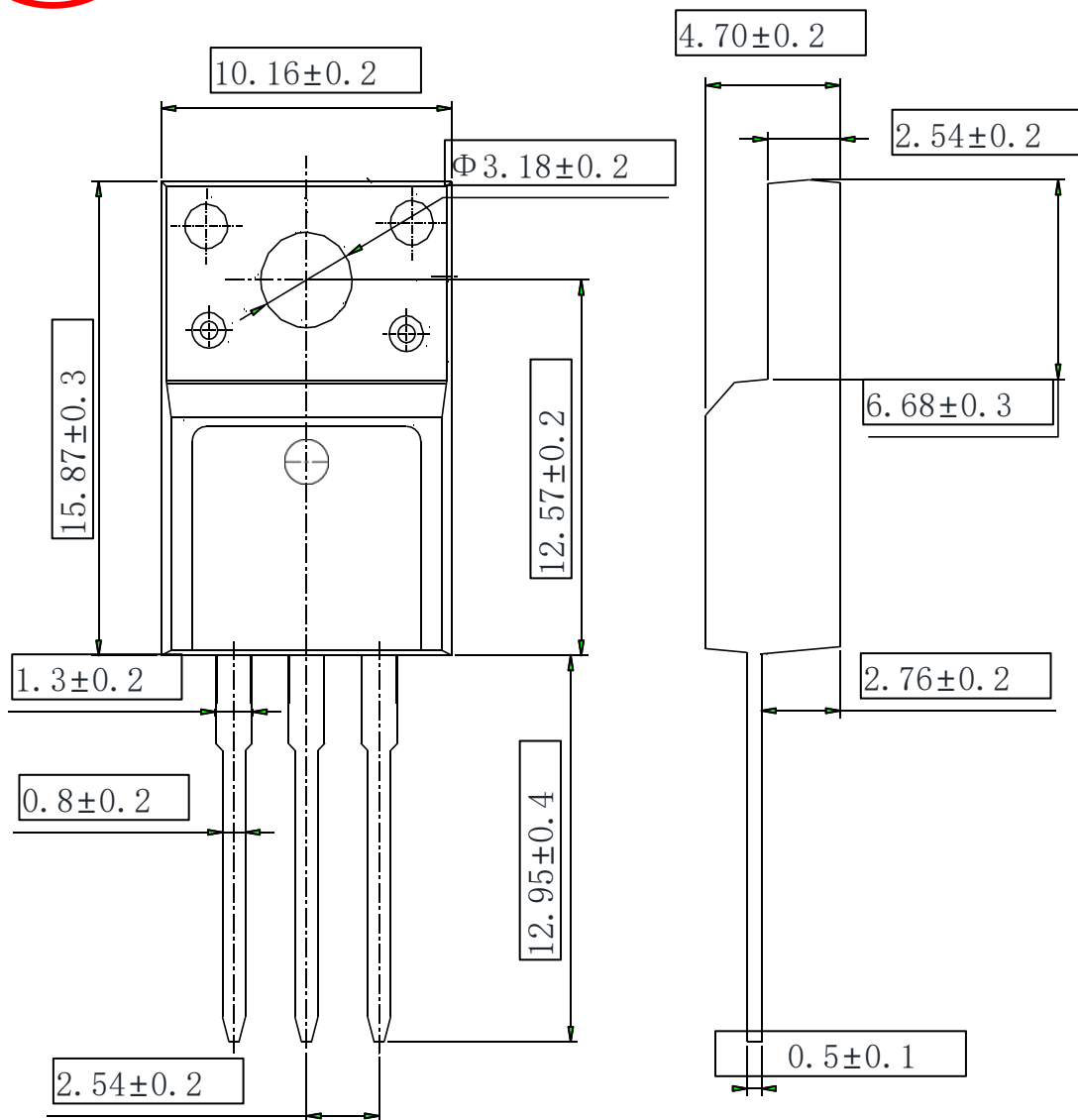


## ak Diode Recovery dv/dt Test Circuit & Waveforms





## TO-220F OUTLINE



### NOTE:

- 1The plastic package is not marked as smooth surface  $Ra=0.1$ ; Subglossy surface  $Ra=0.8$
- 2.Undeclared tolerance  $\pm 0.15$ , Unmarked fillet  $R_{max}=0.25$