

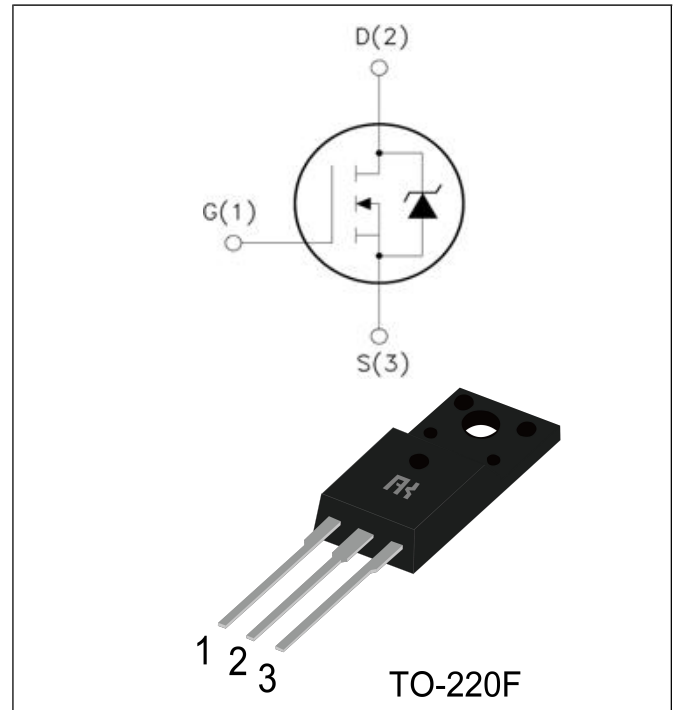
**650V,20A N-CHANNEL POWER MOSFET**

**GENERAL DESCRIPTION**

The AKF20N65P is a high voltage power MOSFET and is designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance and have a high rugged avalanche characteristics. It can be used in a wide variety applications.

**Features:**

- ◆ Low Intrinsic Capacitances.
- ◆ Excellent Switching Characteristics.
- ◆ Extended Safe Operating Area.
- ◆ Unrivalled Gate Charge :Qg=75 nC (Typ.).
- ◆  $V_{DSS}=650V, I_D=20A$
- ◆  $R_{DS(on)} : 0.42\Omega$  (Max) @ $V_G=10V$
- ◆ 100% Avalanche Tested



**Absolute Maximum Ratings** ( $T_a=25^\circ C$  unless otherwise noted)

| Symbol    | Parameter  | Value             | Unit       |
|-----------|--|-------------------|------------|
| $V_{DSS}$ | Drain-Source Voltage   | 650               | V          |
| $I_D$     | Drain Current  | $T_C=25^\circ C$  | 20         |
|           |  | $T_C=100^\circ C$ | 12.5       |
| $V_{GSS}$ | Gate-Source Voltage  | $\pm 30$          | V          |
| $E_{AS}$  | Single Pulse Avalanche Energy (note1)  | 580               | mJ         |
| $I_{AR}$  | Avalanche Current (note2)  | 20                | A          |
| $P_D$     | Power Dissipation ( $T_C=25^\circ C$ )                                       | 84                | W          |
| $T_j$     | Junction Temperature(Max)  | 150               | $^\circ C$ |
| $T_{stg}$ | Storage Temperature  | -55~+150          |            |
| TL        | Maximum lead temperature for soldering purpose, 1/8" from case for 5 seconds | 300               |            |

**Thermal Characteristics**

| Symbol          | Parameter                               | Typ. | Max. | Unit         |
|-----------------|---|------|------|--------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case    | -    | 1.48 | $^\circ C/W$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | -    | 62.5 |              |

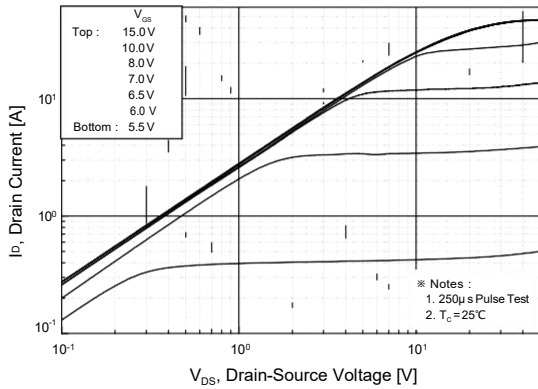
**Electrical Characteristics** (Ta=25°C unless otherwise noted)

| Symbol  | Parameter                                 | Test Condition   | Min. | Typ. | Max. | Unit |
|---|---|--|------|------|------|------|
| <b>Off Characteristics</b>                                    |   |  |      |      |      |      |
| BV <sub>DSS</sub>   | Drain-Source Breakdown Voltage            | I <sub>D</sub> =250μA, V <sub>GS</sub> =0                                      | 650  | -    | -    | V    |
| ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>                           | Breakdown Voltage Temperature Coefficient | I <sub>D</sub> =250μA, Reference to 25°C                                       | -    | 0.71 | -    | V/°C |
| I <sub>DSS</sub>  | Zero Gate Voltage Drain Current           | V <sub>DS</sub> =650V, V <sub>GS</sub> =0V                                     | -    | -    | 10   | μA   |
|   |   | V <sub>DS</sub> =520V, T <sub>c</sub> =125°C                                   | -    | -    | 100  |      |
| I <sub>GSSF</sub>   | Gate-body leakage Current, Forward        | V <sub>GS</sub> =+30V, V <sub>DS</sub> =0V                                     | -    | -    | 100  | nA   |
| I <sub>GSSR</sub>   | Gate-body leakage Current, Reverse        | V <sub>GS</sub> =-30V, V <sub>DS</sub> =0V                                     | -    | -    | -100 |      |
| <b>On Characteristics</b>                                     |   |  |      |      |      |      |
| V <sub>GS(TH)</sub>   | Gate Threshold Voltage                    | I <sub>D</sub> =250μA, V <sub>DS</sub> =V <sub>GS</sub>                        | 2    | -    | 4    | V    |
| R <sub>DS(ON)</sub>   | Static Drain-Source On-Resistance         | I <sub>D</sub> =10A, V <sub>GS</sub> =10V                                      | -    | 0.35 | 0.42 | Ω    |
| <b>Dynamic Characteristics</b>                                |   |  |      |      |      |      |
| C <sub>iss</sub>  | Input Capacitance                         | V <sub>DS</sub> =25V, V <sub>GS</sub> =0, f=1.0MHz                             | -    | 3420 | -    | pF   |
| C <sub>oss</sub>  | Output Capacitance                        |  | -    | 325  | -    |      |
| C <sub>rss</sub>  | Reverse Transfer Capacitance              |  | -    | 25   | -    |      |
| <b>Switching Characteristics</b>                              |   |  |      |      |      |      |
| T <sub>d(on)</sub>  | Turn-On Delay Time                        | V <sub>DD</sub> =325V, I <sub>D</sub> =20A<br>R <sub>G</sub> =25Ω (Note 3,4)   | -    | 62   | 135  | ns   |
| T <sub>r</sub>  | Turn-On Rise Time                         |  | -    | 140  | 290  |      |
| T <sub>d(off)</sub>   | Turn-Off Delay Time                       |  | -    | 230  | 470  |      |
| T <sub>f</sub>  | Turn-Off Rise Time                        |  | -    | 65   | 140  |      |
| Q <sub>g</sub>  | Total Gate Charge                         | V <sub>DS</sub> =520V, V <sub>GS</sub> =10V,<br>I <sub>D</sub> =20A (Note 3,4) | -    | 75   | 98   | nC   |
| Q <sub>gs</sub>   | Gate-Source Charge                        |  | -    | 13.5 | 18   |      |
| Q <sub>gd</sub>   | Gate-Drain Charge                         |  | -    | 36   | -    |      |
| <b>Drain-Source Diode Characteristics and Maximum Ratings</b> |   |  |      |      |      |      |
| I <sub>S</sub>  | Max. Diode Forward Current                | -  | -    | -    | 20   | A    |
| I <sub>SM</sub>   | Max. Pulsed Forward Current               | -  | -    | -    | 80   |      |
| V <sub>SD</sub>   | Diode Forward Voltage                     | I <sub>D</sub> =20A  | -    | -    | 1.4  | V    |
| T <sub>rr</sub>   | Reverse Recovery Time                     | I <sub>S</sub> =20A, V <sub>GS</sub> =0V<br>diF/dt=100A/μs<br>(Note3)          | -    | 530  | -    | nS   |
| Q <sub>rr</sub>   | Reverse Recovery Charge                   |  | -    | 10.5 | -    | μC   |

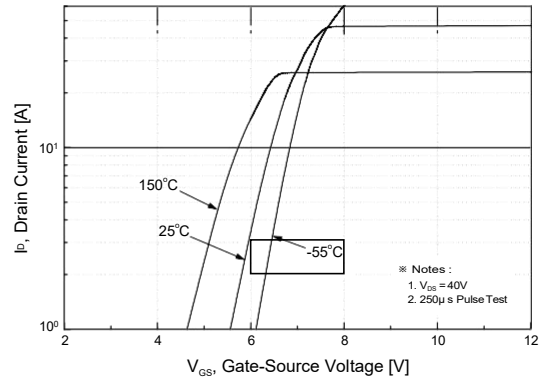
- Notes : 1, L=3.45mH, I<sub>AS</sub>=20A, V<sub>DD</sub>=50V, R<sub>G</sub>=25Ω, Starting T<sub>J</sub>=25°C  
 2, Repetitive Rating : Pulse width limited by maximum junction temperature  
 3, Pulse Test : Pulse Width ≤ 300μs, Duty Cycle ≤ 2%  
 4, Essentially Independent of Operating Temperature

Typical Characteristics

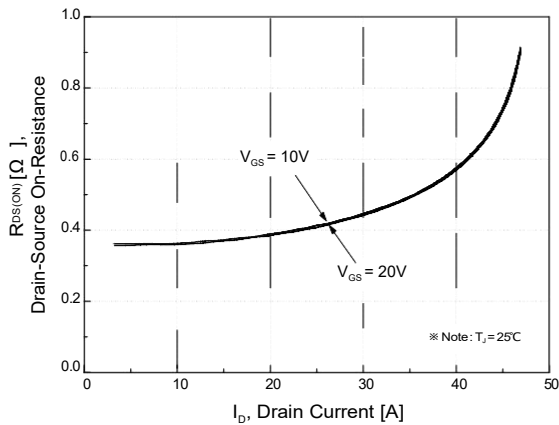
**Figure 1. On-Region Characteristics**



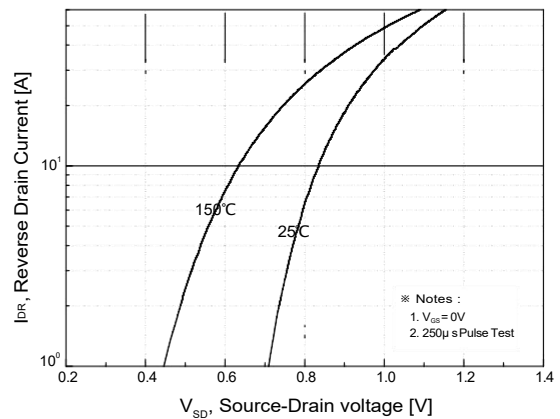
**Figure 2. Transfer Characteristics**



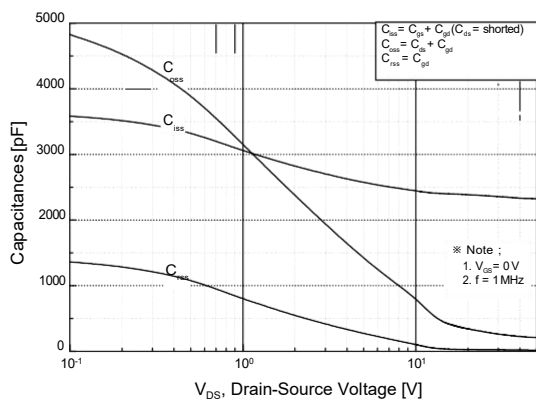
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



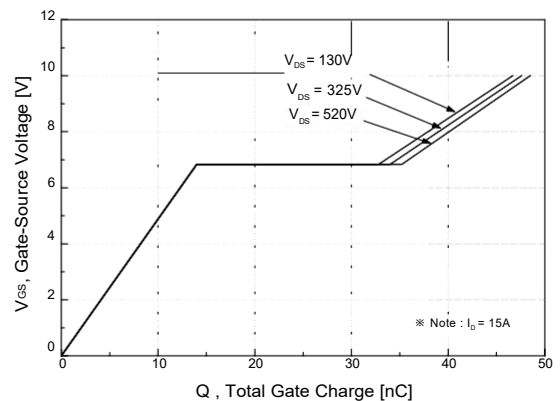
**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**



**Figure 5. Capacitance Characteristics**

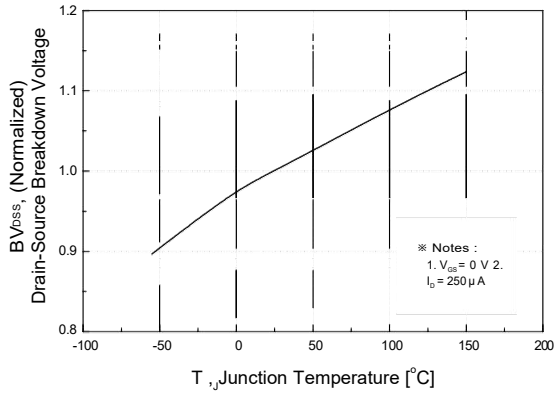


**Figure 6. Gate Charge Characteristics**

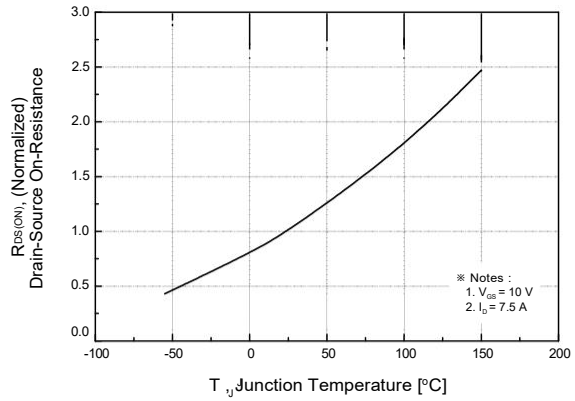


Typical Characteristics (Continued)

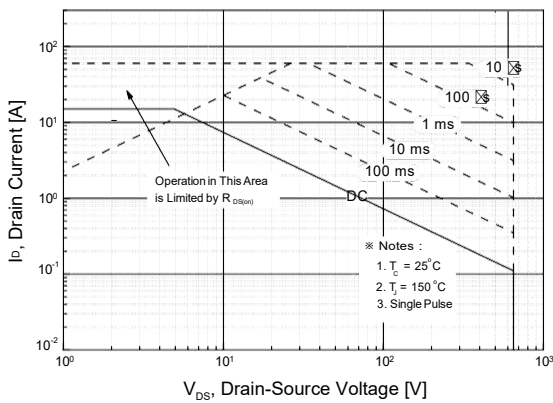
**Figure 7. Breakdown Voltage Variation vs. Temperature**



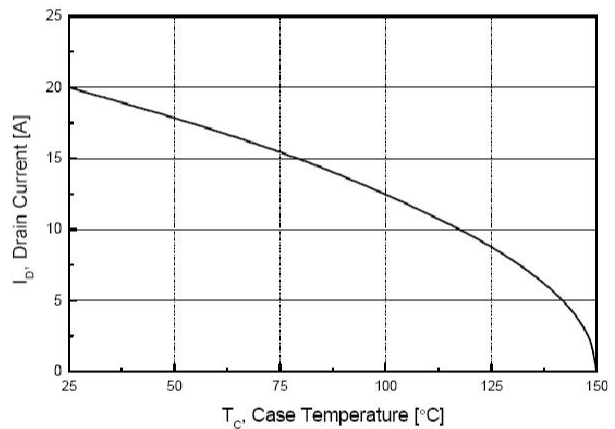
**Figure 8. On-Resistance Variation vs. Temperature**



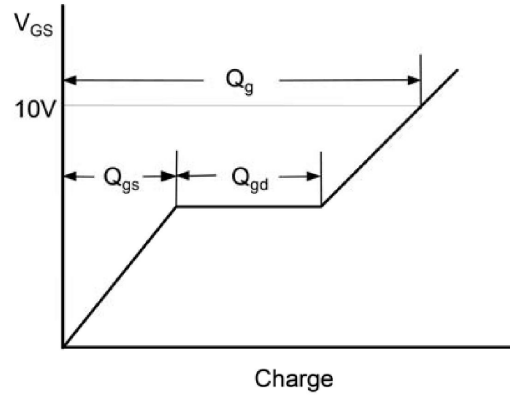
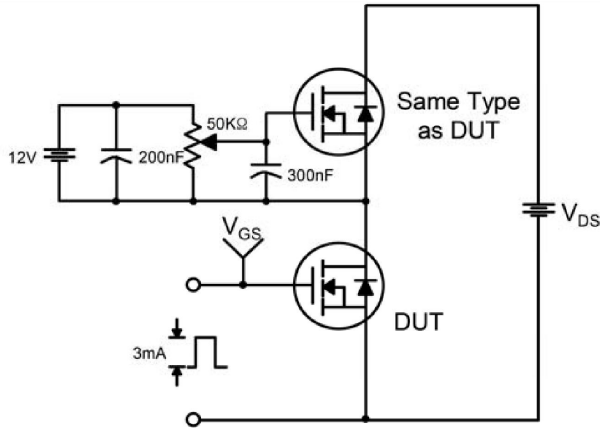
**Figure 9 Safe Operating Area**



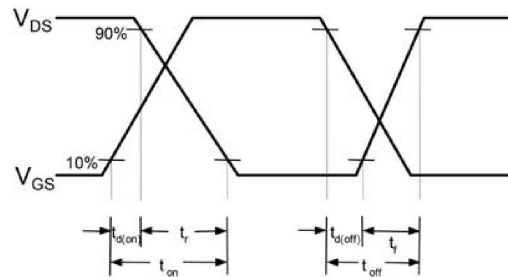
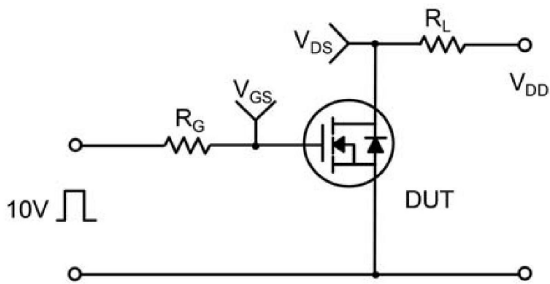
**Figure 10. Maximum Drain Current vs. Case Temperature**



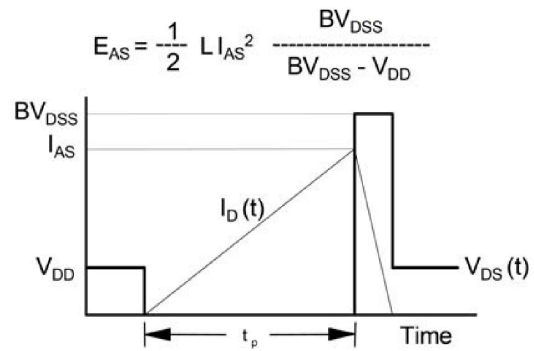
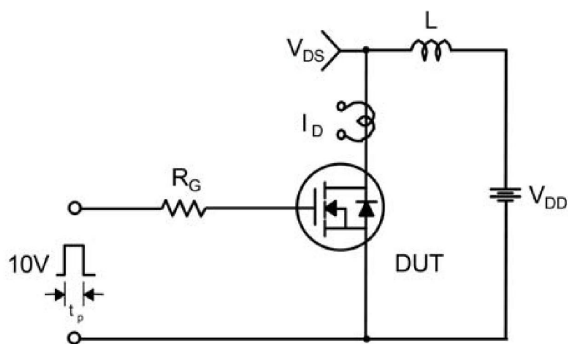
**Gate Charge Test Circuit & Waveform**



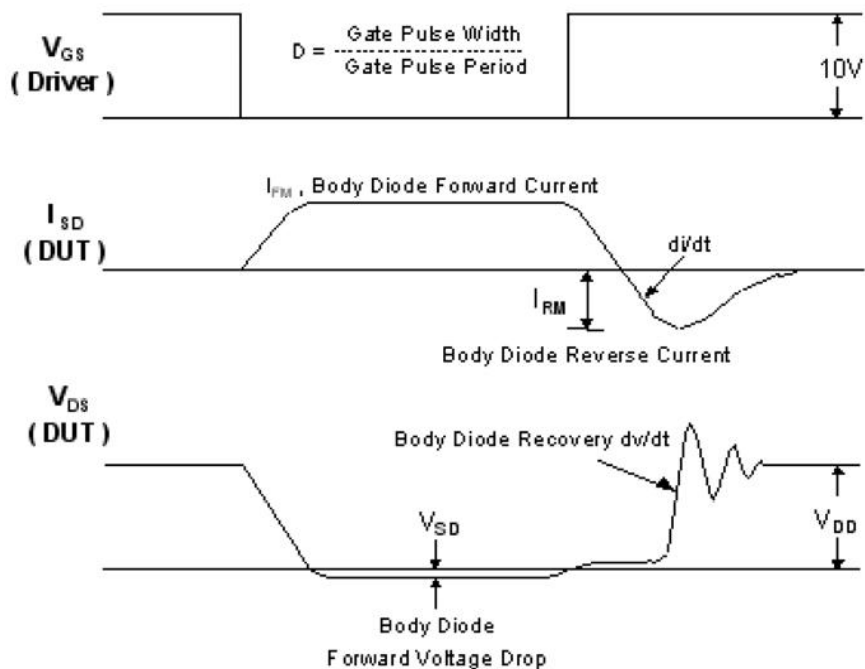
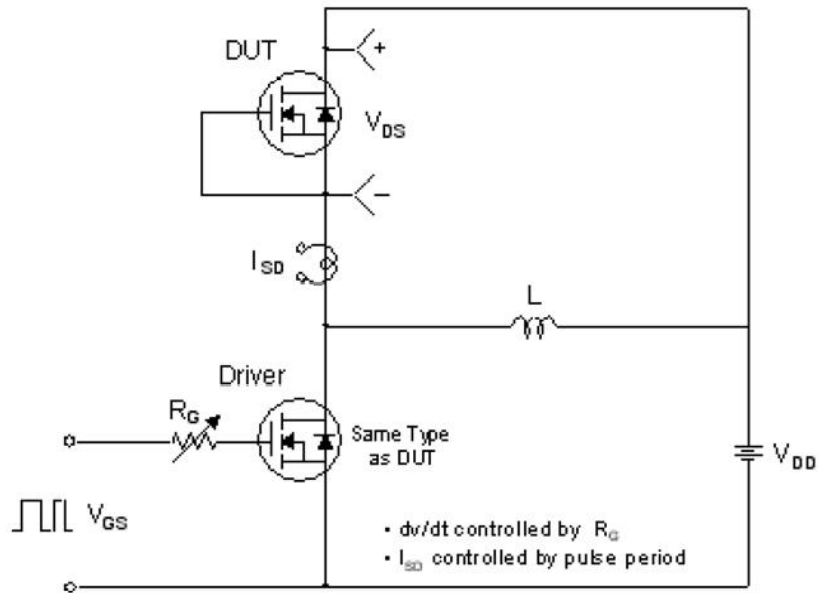
**Resistive Switching Test Circuit & Waveforms**



**Unclamped Inductive Switching Test Circuit & Waveforms**

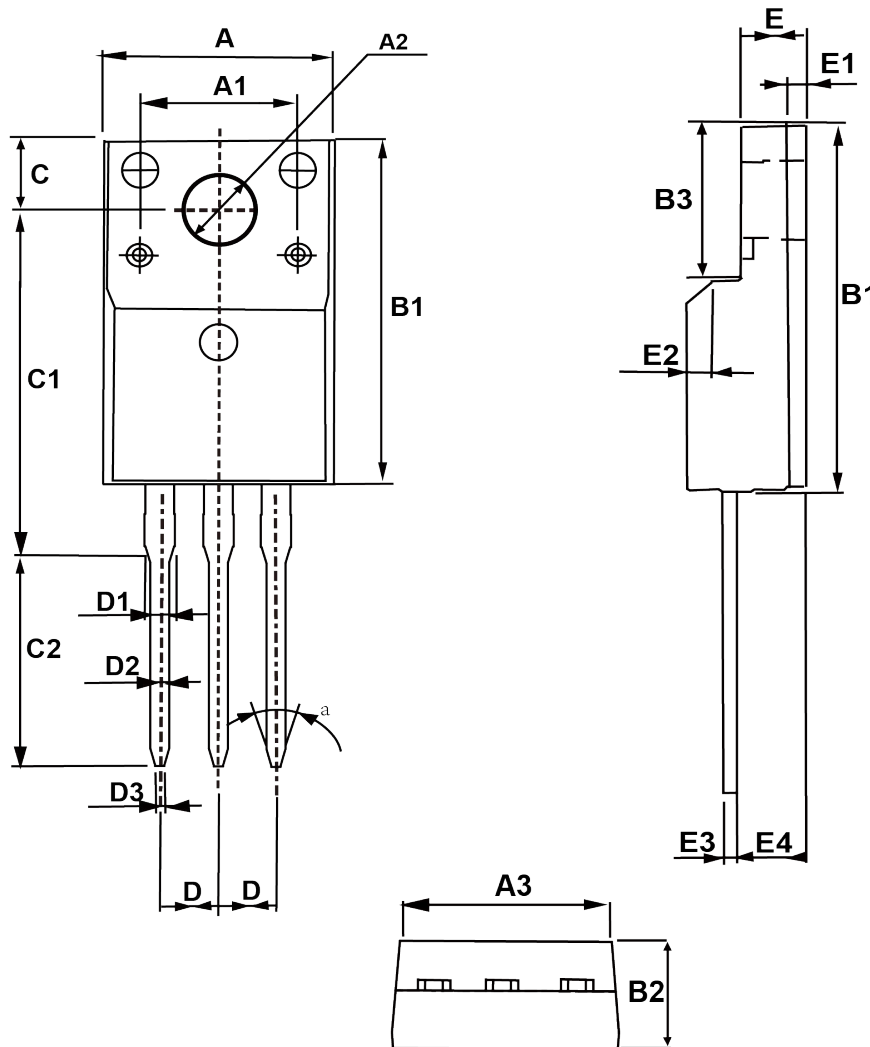


**Peak Diode Recovery dv/dt Test Circuit & Waveform**



**Package Dimension of TO-220F**

Unit: mm



| Symbol | Min   | Max   | Symbol    | Min     | Max  |
|--------|-------|-------|-----------|---------|------|
| A      | 9.96  | 10.36 | D         | 2.54    |      |
| A1     | 7.00  |       | D1        | 1.15    | 1.35 |
| A2     | 3.08  | 3.28  | D2        | 0.70    | 0.90 |
| A3     | 9.25  | 9.65  | D3        | 0.28    | 0.48 |
| B1     | 15.70 | 16.10 | E         | 2.34    | 2.74 |
| B2     | 4.50  | 4.90  | E1        | 0.70    |      |
| B3     | 6.20  | 6.80  | E2        | 1.0×45° |      |
| C      | 3.20  | 3.40  | E3        | 0.36    | 0.65 |
| C1     | 15.20 | 16.00 | E4        | 2.55    | 2.95 |
| C2     | 9.75  | 10.15 | a (angle) | 30°     |      |