KODENSHI AUK

# SMK0965FC

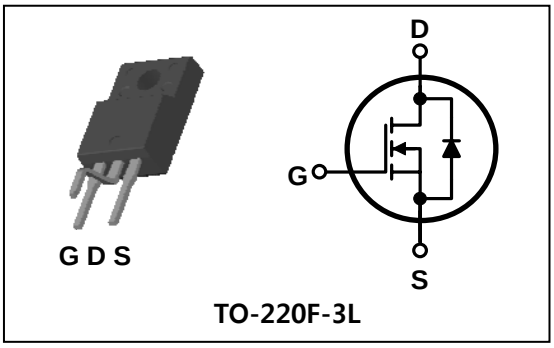
**Advanced N-Ch Power MOSFET**

SWITCHING REGULATOR APPLICATIONS

## Features

- High Voltage : $BV_{DSS}$=650V(Min.)
- Low $C_{rss}$ : $C_{rss}$=16pF(Typ.)
- Low gate charge : Qg=35nC(Typ.)
- Low $R_{DS(on)}$ : $R_{DS(on)}$=0.85Ω(Max.)

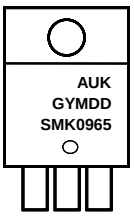
## PIN Connection




## Ordering Information

| Type No. | Marking | Package Code |
|---|---|---|
| SMK0965FC | SMK0965 | TO-220F-3L (C Forming) |

## Marking Diagram




Column 1 : Manufacturer

Column 2 : Production Information
e.g.) GYMDD
-. G : Factory management code
-. YMDD : Date Code (year, month, date)

Column 3 : Device Code

## Absolute maximum ratings ($T_C$=25°C unless otherwise noted)

| Characteristic | Symbol | | Rating | Unit |
|---|---|---|---|---|
| Drain-source voltage | $V_{DSS}$ | | 650 | V |
| Gate-source voltage | $V_{GSS}$ | | ±30 | V |
| Drain current (DC) * | $I_D$ | $T_C$=25℃ | 9 | A |
| | | $T_C$=100℃ | 5.5 | A |
| Drain current (Pulsed) * | $I_{DM}$ | | 36 | A |
| Power dissipation | $P_D$ | | 40 | W |
| Avalanche current (Single) ② | $I_{AS}$ | | 9 | A |
| Single pulsed avalanche energy ② | $E_{AS}$ | | 250 | mJ |
| Avalanche current (Repetitive) ① | $I_{AR}$ | | 9 | A |
| Repetitive avalanche energy ① | $E_{AR}$ | | 11.6 | mJ |
| Junction temperature | $T_J$ | | 150 | °C |
| Storage temperature range | $T_{stg}$ | | -55~150 | |

* Limited by maximum junction temperature

| Characteristic | | Symbol | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Thermal resistance | Junction-case | $R_{th(J-C)}$ | - | 3.1 | ℃/W |
| | Junction-ambient | $R_{th(J-A)}$ | - | 62.5 | |

## Electrical Characteristics ($T_C$=25°C unless otherwise noted)

| Characteristic | Symbol | Test Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Drain-source breakdown voltage | $BV_{DSS}$ | $I_D$=250uA, $V_{GS}$=0V | 650 | - | - | V |
| Gate threshold voltage | $V_{GS(th)}$ | $I_D$=250uA, $V_{DS}$=$V_{GS}$ | 2.0 | - | 4.0 | V |
| Drain-source cut-off current | $I_{DSS}$ | $V_{DS}$=650V, $V_{GS}$=0V | - | - | 1 | uA |
| Gate leakage current | $I_{GSS}$ | $V_{DS}$=0V, $V_{GS}$=±30V | - | - | ±100 | nA |
| Drain-source on-resistance ④ | $R_{DS(on)}$ | $V_{GS}$=10V, $I_D$=4.5A | - | 0.72 | 0.85 | Ω |
| Forward transfer conductance ④ | $g_{fs}$ | $V_{DS}$=10V, $I_D$=4.5A | - | 11 | - | S |
| Gate Resistance | $R_g$ | $V_{GS}$=0V, $V_{DS}$=0V, f=1MHz | 0.5 | 1.5 | 7 | Ω |
| Input capacitance | $C_{iss}$ | $V_{GS}$=0V, $V_{DS}$=25V<br>f=1 MHz | - | 2040 | 2550 | pF |
| Output capacitance | $C_{oss}$ | | - | 153 | 192 | |
| Reverse transfer capacitance | $C_{rss}$ | | - | 16 | 20 | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD}$=300V, $I_D$=9A<br>$R_G$=25Ω<br>③④ | - | 23 | - | ns |
| Rise time | $t_r$ | | - | 69 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 144 | - | |
| Fall time | $t_f$ | | - | 77 | - | |
| Total gate charge | $Q_g$ | $V_{DS}$=520V, $V_{GS}$=10V<br>$I_D$=9A<br>③④ | - | 35 | 57 | nC |
| Gate-source charge | $Q_{gs}$ | | - | 10 | - | |
| Gate-drain charge | $Q_{gd}$ | | - | 9 | - | |

## Source-Drain Diode Ratings and Characteristics ($T_C$=25°C unless otherwise noted)

| Characteristic | Symbol | Test Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Source current (DC) | $I_S$ | Integral reverse diode<br>in the MOSFET | - | - | 9 | A |
| Source current (Pulsed) ① | $I_{SM}$ | | - | - | 36 | |
| Forward voltage ④ | $V_{SD}$ | $V_{GS}$=0V, $I_S$=9A | - | - | 1.4 | V |
| Reverse recovery time | $t_{rr}$ | $I_S$=9A, $V_{GS}$=0V<br>$dI_F/dt$=100A/us | - | 420 | - | ns |
| Reverse recovery charge | $Q_{rr}$ | | - | 4.2 | - | uC |

Note ;

① Repetitive rating : Pulse width limited by maximum junction temperature

② L=5.7mH, $I_{AS}$=9A, $V_{DD}$=50V, $R_G$=25Ω, Starting $T_J$=25℃

③ Pulse Test : Pulse width≤300us, Duty cycle≤2%

④ Essentially independent of operating temperature

## Electrical Characteristic Curves

**Fig. 1 $I_D$ - $V_{DS}$**

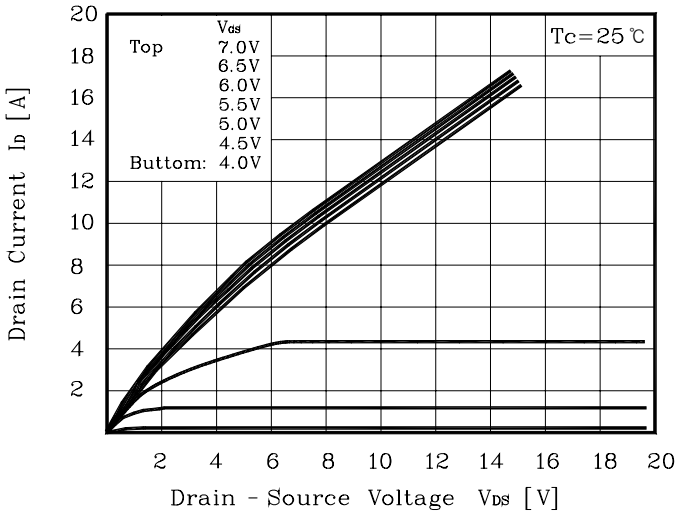



**Fig. 2 $I_D$ - $V_{GS}$**

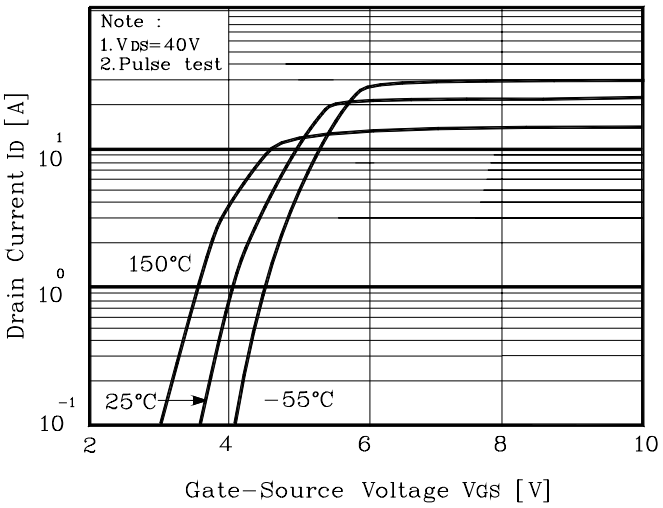



**Fig. 3 $R_{DS(on)}$ - $I_D$**

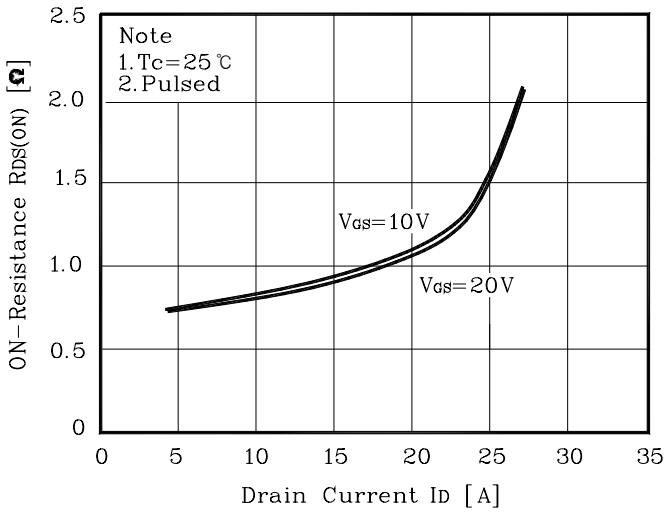



**Fig. 4 $I_S$ - $V_{SD}$**

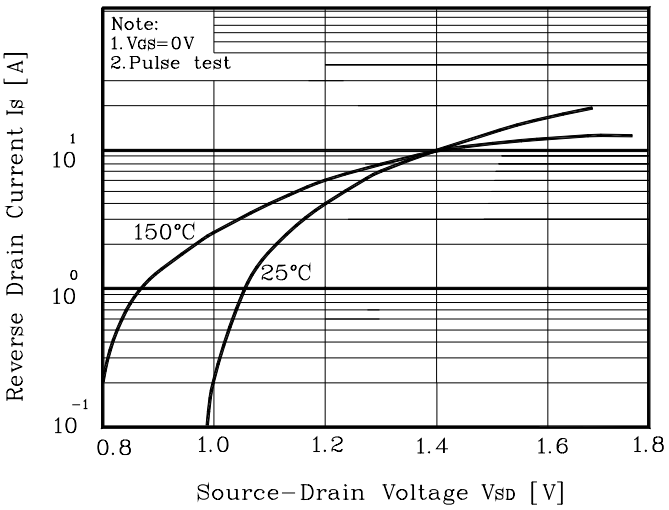



**Fig. 5 Capacitance - $V_{DS}$**

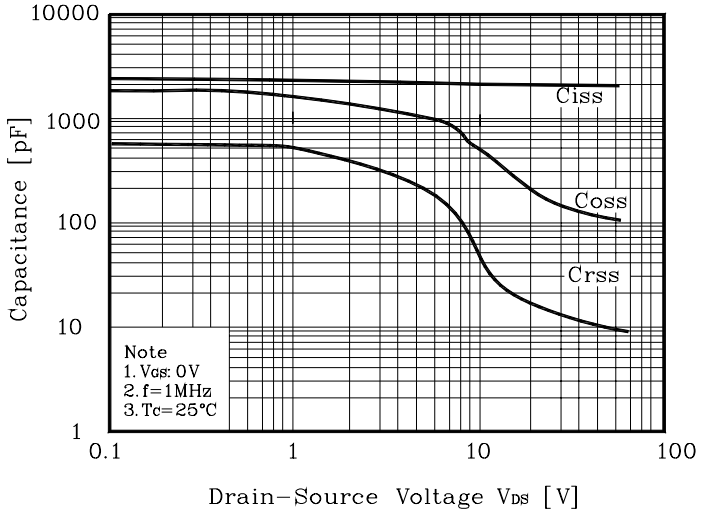
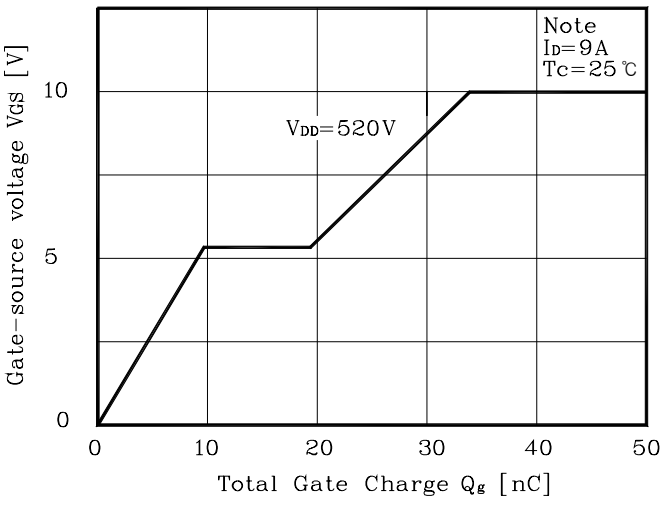



**Fig.6 $V_{GS}$ - $Q_G$**



## Electrical Characteristic Curves

**Fig. 7 $V_{DSS}$ - $T_J$**

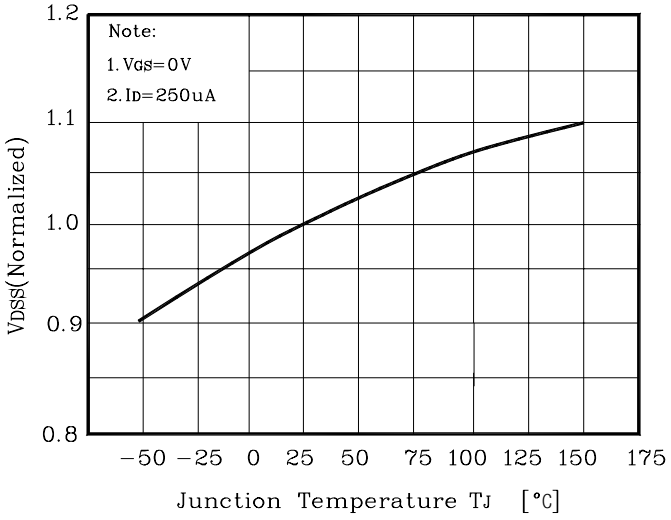



**Fig.8 $R_{DS(on)}$ - $T_J$**

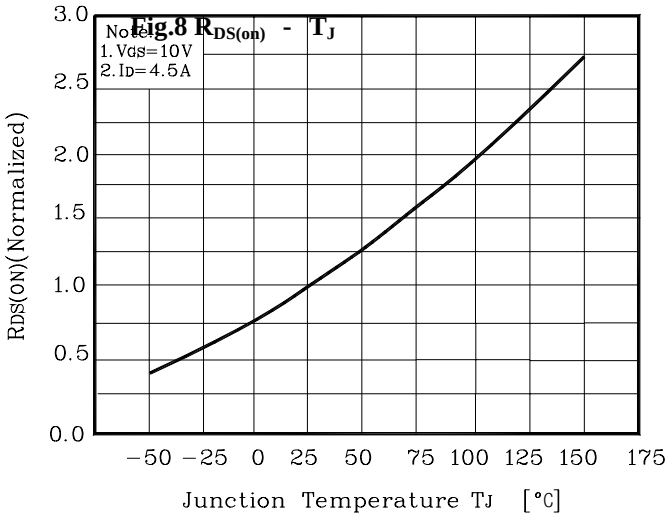



**Fig. 9 $I_D$ - $T_C$**

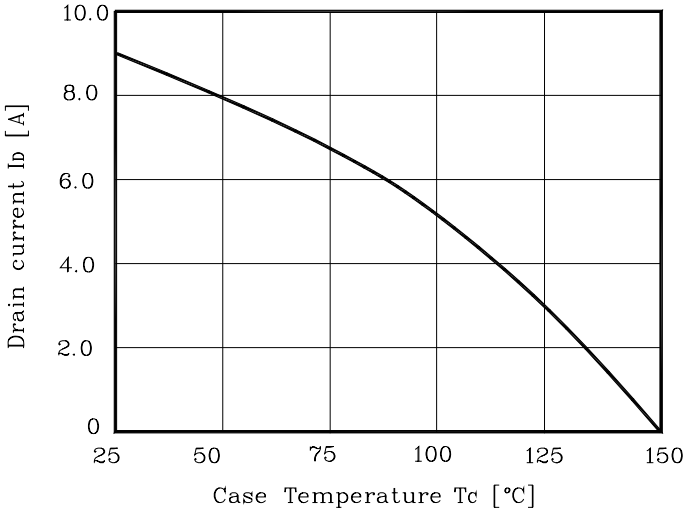



**Fig. 10 Safe Operating Area**

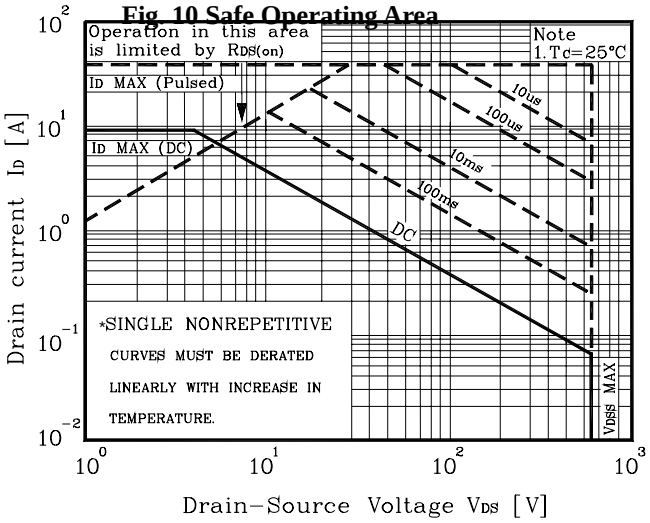


**Fig. 11 Gate Charge Test Circuit & Waveform**

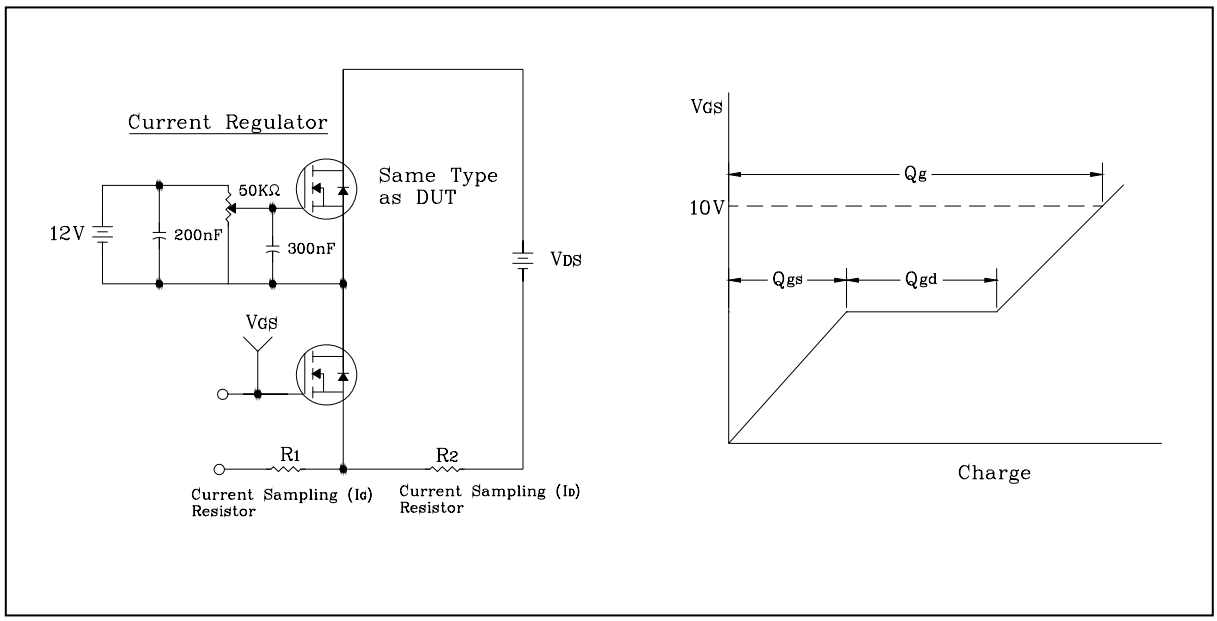



**Fig. 12 Resistive Switching Test Circuit & Waveform**

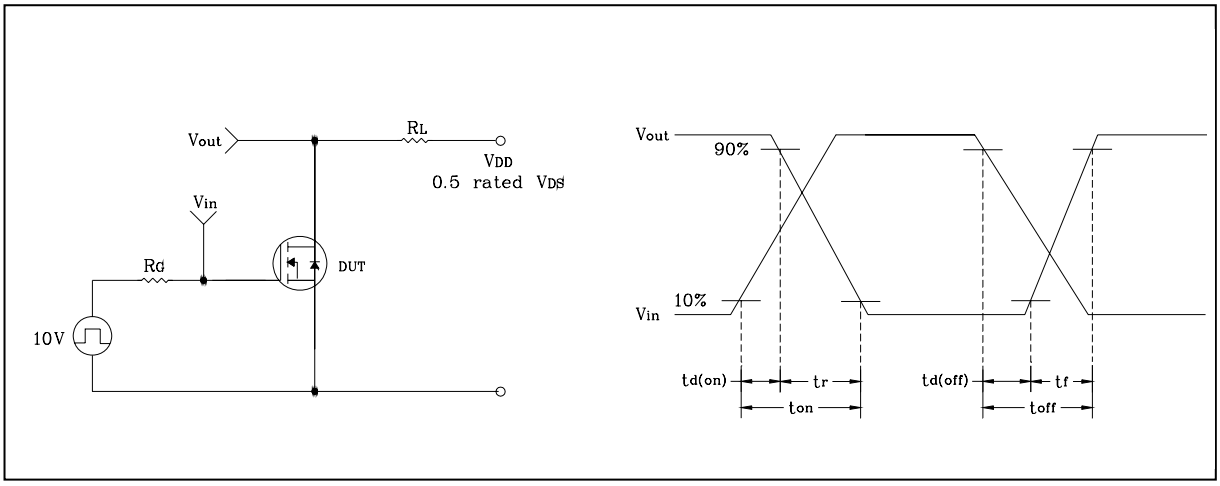



**Fig. 13 $E_{AS}$ Test Circuit & Waveform**

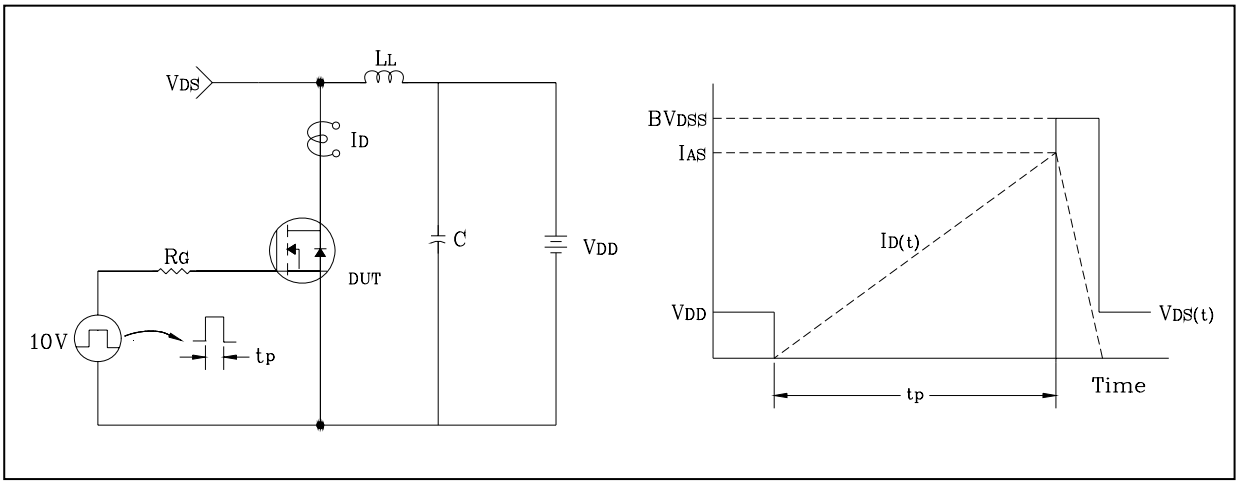
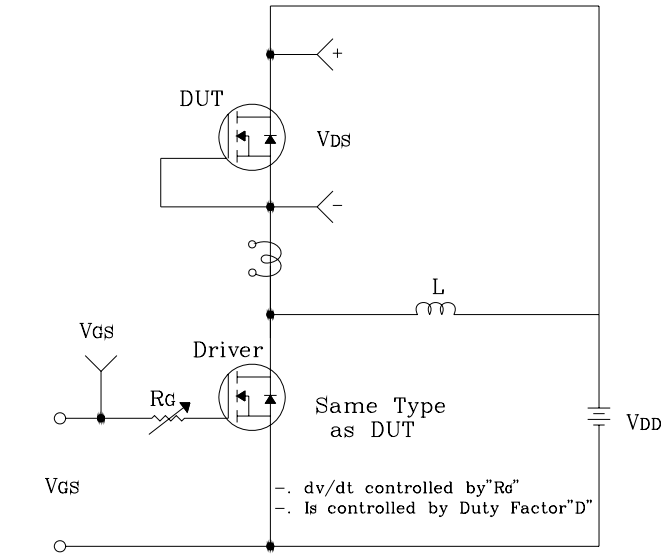
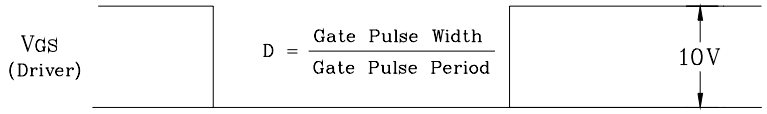
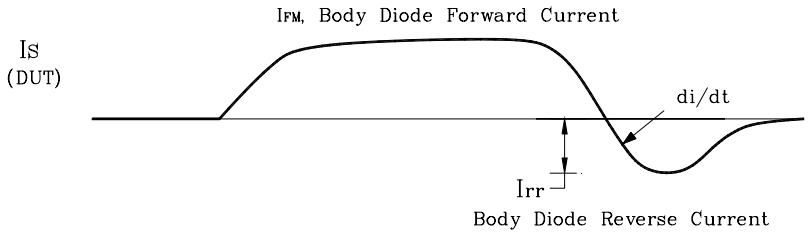
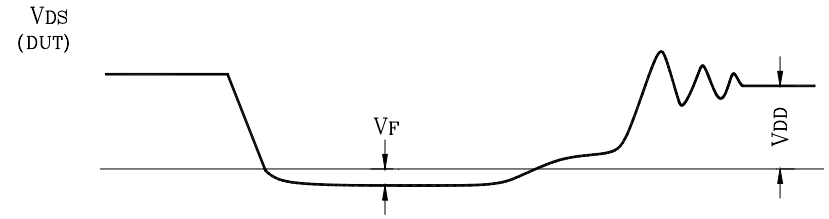


**Fig. 14 Diode Reverse Recovery Time Test Circuit & Waveform**



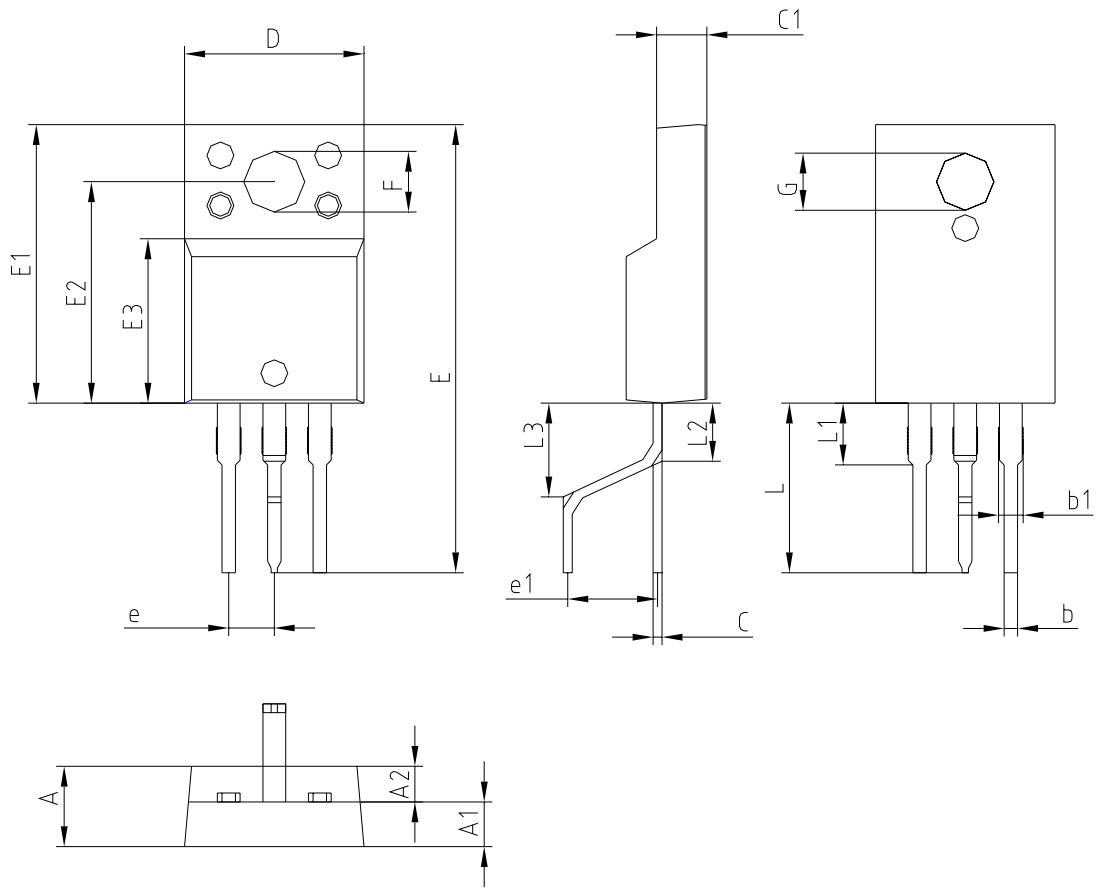



## Outline Dimension

**unit: mm**




| SYMBOL | MILLIMETERS | | | NOTE |
|---|---|---|---|---|
| | MINIMUM | NOMINAL | MAXIMUM | |
| A | – | – | 4.60 | |
| A1 | 2.45 | 2.50 | 2.55 | |
| A2 | 1.95 | 2.00 | 2.05 | |
| b | 0.65 | 0.75 | 0.85 | |
| b1 | 1.07 | 1.27 | 1.47 | |
| C | 0.40 | 0.50 | 0.60 | |
| C1 | 2.70 | 2.80 | 2.90 | |
| D | 9.90 | 10.00 | 10.10 | |
| E | 24.61 | – | 25.61 | |
| E1 | 15.50 | 15.60 | 15.70 | |
| E2 | 12.30 | 12.40 | 12.50 | |
| E3 | 9.15 | 9.20 | 9.25 | |
| F | 3.30 | 3.40 | 3.50 | |
| G | 3.10 | 3.20 | 3.30 | |
| e | 2.54 BSC | | | |
| e1 | 4.70 | 5.00 | 5.30 | |
| L | 9.01 | – | 10.01 | |
| L1 | 3.46 BSC | | | |
| L2 | 3.26 BSC | | | |
| L3 | 5.26 BSC | | | |

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