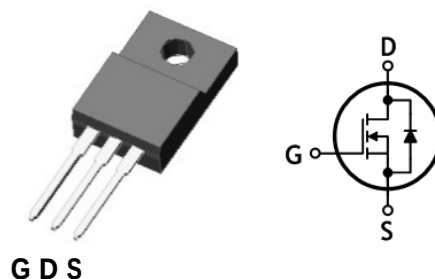


## HIGH SPEED SWITCHING APPLICATION

### Features

- Low drain-source On resistance:  $R_{DS(on)}=2.4\Omega$  (Typ.)
- Low gate charge:  $Q_g=12nC$  (Typ.)
- Low reverse transfer capacitance:  $C_{rss}=6pF$  (Typ.)
- Lower EMI noise
- RoHS compliant device
- 100% avalanche tested

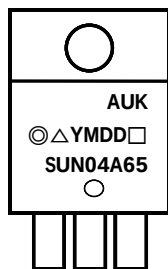


### Ordering Information

| Part Number | Marking  | Package    |
|-------------|----------|------------|
| SUN04A65F   | SUN04A65 | TO-220F-3L |

TO-220F-3L

### Marking Information



Column 1: Manufacturer  
Column 2: Production Information

e.g.) ◎△YMDD□

-. ◎: Option Code

-. △: Factory Management Code

-. YMDD: Date Code (Year, Month, Daily)

-. □: Package Option Code

Column 3: Device Code

### Absolute maximum ratings ( $T_c=25^\circ C$ unless otherwise noted)

| Characteristic                        | Symbol    | Rating            | Unit       |
|---------------------------------------|-----------|-------------------|------------|
| Drain-source voltage                  | $V_{DS}$  | 650               | V          |
| Gate-source voltage                   | $V_{GS}$  | $\pm 30$          | V          |
| Drain current (DC) *                  | $I_D$     | $T_c=25^\circ C$  | 4          |
|                                       |           | $T_c=100^\circ C$ | 2.53       |
| Drain current (Pulsed) *              | $I_{DM}$  | 16                | A          |
| Single avalanche energy (Note 2)      | $E_{AS}$  | 86.7              | mJ         |
| Repetitive avalanche current (Note 1) | $I_{AR}$  | 4                 | A          |
| Repetitive avalanche energy (Note 1)  | $E_{AR}$  | 3.2               | mJ         |
| Power dissipation                     | $P_D$     | 32                | W          |
| Junction temperature                  | $T_J$     | 150               | $^\circ C$ |
| Storage temperature range             | $T_{stg}$ | -55-150           | $^\circ C$ |

\* Limited only maximum junction temperature

## Thermal Characteristics

| Characteristic                          | Symbol        | Rating    | Unit |
|-----------------------------------------|---------------|-----------|------|
| Thermal resistance, junction to case    | $R_{th(j-c)}$ | Max. 3.9  | °C/W |
| Thermal resistance, junction to ambient | $R_{th(j-a)}$ | Max. 62.5 |      |

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

| Characteristic                        | Symbol       | Test Condition                                                  | Min. | Typ. | Max.      | Unit          |
|---------------------------------------|--------------|-----------------------------------------------------------------|------|------|-----------|---------------|
| Drain-source breakdown voltage        | $BV_{DSS}$   | $I_D=250\mu\text{A}$ , $V_{GS}=0$                               | 650  | -    | -         | V             |
| Gate threshold voltage                | $V_{GS(th)}$ | $I_D=250\mu\text{A}$ , $V_{DS}=V_{GS}$                          | 3    | -    | 5         | V             |
| Drain-source cut-off current          | $I_{DSS}$    | $V_{DS}=650\text{V}$ , $V_{GS}=0\text{V}$                       | -    | -    | 1         | $\mu\text{A}$ |
|                                       |              | $V_{DS}=650\text{V}$ , $T_c=150^\circ\text{C}$                  | -    | -    | 100       | $\mu\text{A}$ |
| Gate leakage current                  | $I_{GSS}$    | $V_{DS}=0\text{V}$ , $V_{GS}=\pm 30\text{V}$                    | -    | -    | $\pm 100$ | nA            |
| Drain-source on-resistance            | $R_{DS(ON)}$ | $V_{GS}=10\text{V}$ , $I_D=2\text{A}$                           | -    | 2.4  | 3         | $\Omega$      |
| Forward transfer conductance (Note 3) | $g_{fs}$     | $V_{DS}=10\text{V}$ , $I_D=2\text{A}$                           | -    | 4.4  | -         | S             |
| Input capacitance                     | $C_{iss}$    | $V_{DS}=25\text{V}$ , $V_{GS}=0\text{V}$ ,<br>$f=1.0\text{MHz}$ | -    | 725  | -         | pF            |
| Output capacitance                    | $C_{oss}$    |                                                                 | -    | 52   | -         |               |
| Reverse transfer capacitance          | $C_{rss}$    |                                                                 | -    | 6    | -         |               |
| Turn-on delay time (Note 3,4)         | $t_{d(on)}$  | $V_{DS}=325\text{V}$ , $I_D=4\text{A}$ ,<br>$R_G=25\Omega$      | -    | 48   | -         | ns            |
| Rise time (Note 3,4)                  | $t_r$        |                                                                 | -    | 32   | -         |               |
| Turn-off delay time (Note 3,4)        | $t_{d(off)}$ |                                                                 | -    | 79   | -         |               |
| Fall time (Note 3,4)                  | $t_f$        |                                                                 | -    | 25   | -         |               |
| Total gate charge (Note 3,4)          | $Q_g$        | $V_{DS}=520\text{V}$ , $V_{GS}=10\text{V}$ ,<br>$I_D=4\text{A}$ | -    | 12   | 16        | nC            |
| Gate-source charge (Note 3,4)         | $Q_{gs}$     |                                                                 | -    | 5    | -         |               |
| Gate-drain charge (Note 3,4)          | $Q_{gd}$     |                                                                 | -    | 2.5  | -         |               |

## Source-Drain Diode Ratings and Characteristics ( $T_c=25^\circ\text{C}$ unless otherwise noted)

| Characteristic                     | Symbol   | Test Condition                                                               | Min. | Typ. | Max. | Unit          |
|------------------------------------|----------|------------------------------------------------------------------------------|------|------|------|---------------|
| Source current (DC)                | $I_S$    | Integral reverse diode<br>in the MOSFET                                      | -    | -    | 4    | A             |
| Source current (Pulsed)            | $I_{SM}$ |                                                                              | -    | -    | 16   | A             |
| Forward voltage                    | $V_{SD}$ | $V_{GS}=0\text{V}$ , $I_{SD}=4\text{A}$                                      | -    | -    | 1.4  | V             |
| Reverse recovery time (Note 3,4)   | $t_{rr}$ | $I_{SD}=4\text{A}$ , $V_{GS}=0\text{V}$<br>$di_F/dt=100\text{A}/\mu\text{s}$ | -    | 498  | -    | ns            |
| Reverse recovery charge (Note 3,4) | $Q_{rr}$ |                                                                              | -    | 0.98 | -    | $\mu\text{C}$ |

Note:

1. Repeated rating: Pulse width limited by safe operating area
2.  $L=10\text{mH}$ ,  $I_{AS}=4\text{A}$ ,  $V_{DD}=50\text{V}$ ,  $R_G=25\Omega$ , Starting  $T_J=25^\circ\text{C}$
3. Pulse test: Pulse width  $\leq 300\mu\text{s}$ , Duty cycle  $\leq 2\%$
4. Essentially independent of operating temperature typical characteristics

## Typical Electrical Characteristics Curves

Fig. 1 Typical Output Characteristics

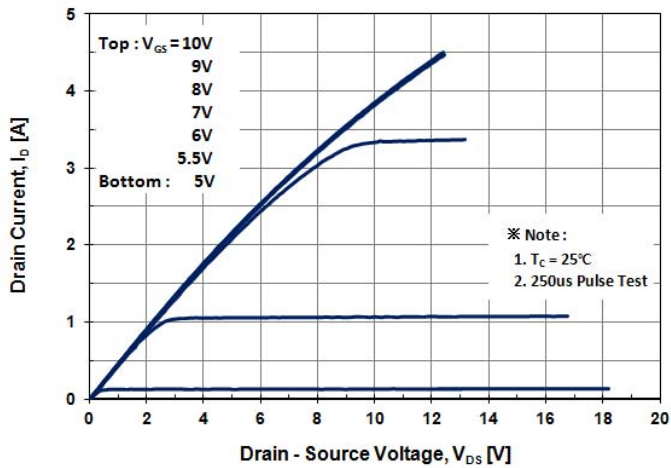


Fig. 2 Typical Output Characteristics

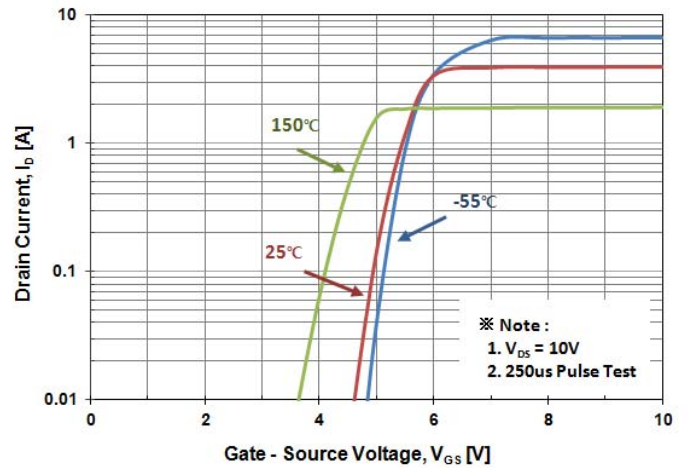


Fig.3 On-Resistance Variation with Drain Current and Gate Voltage

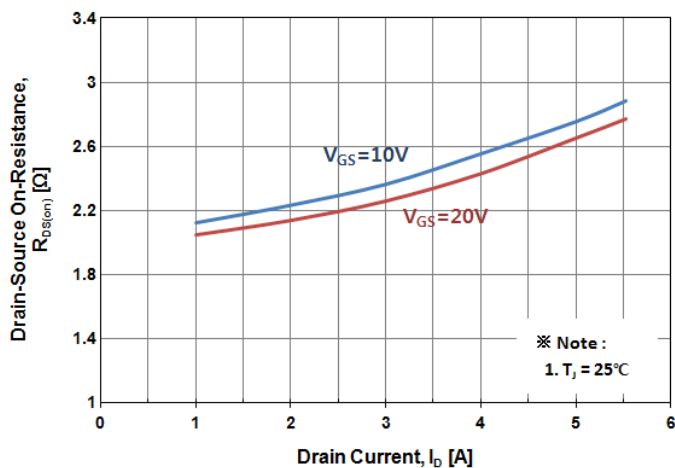


Fig. 4 Body Diode Forward Voltage Variation with Source Current

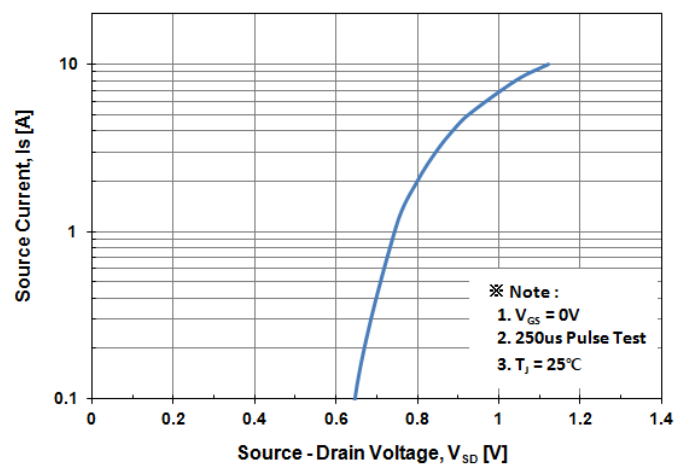


Fig. 5 Typical Capacitance Characteristics

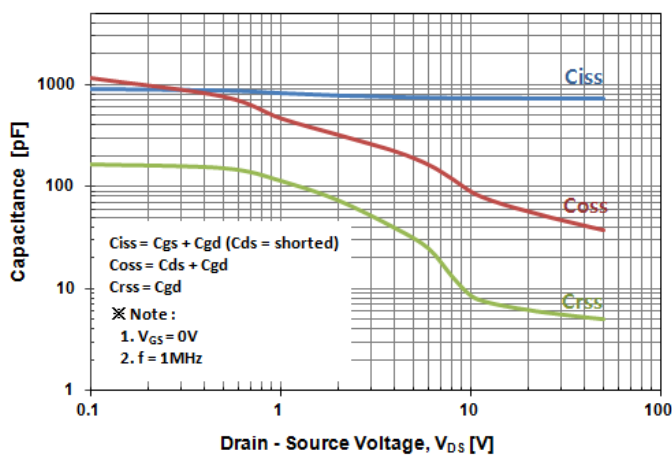


Fig. 6 Typical Total Gate Charge Characteristics

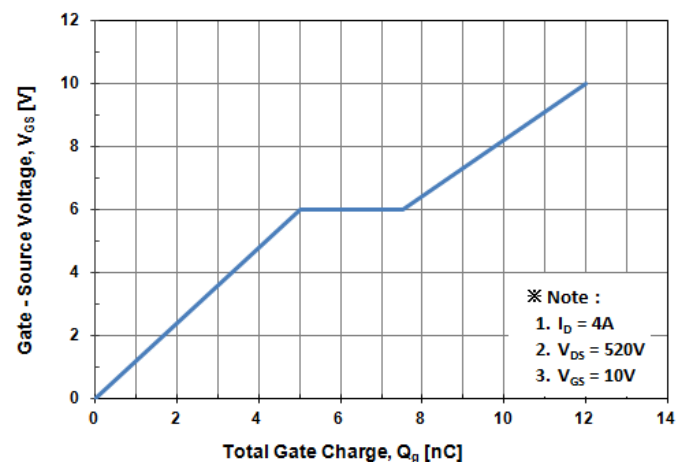


Fig. 7 Breakdown Voltage Variation vs. Temperature

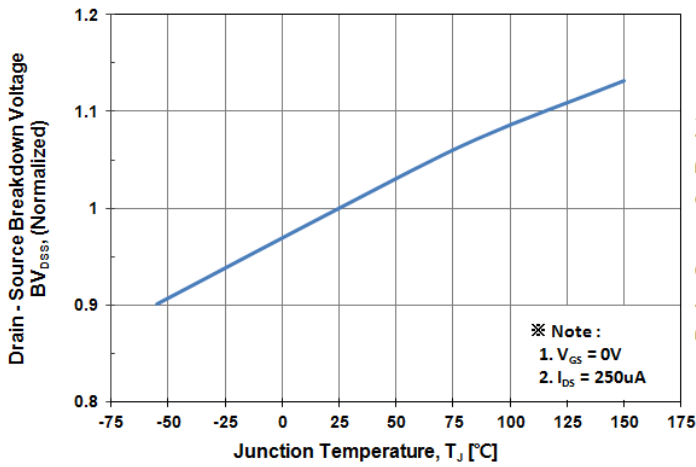


Fig. 8 On-Resistance Variation vs. Temperature

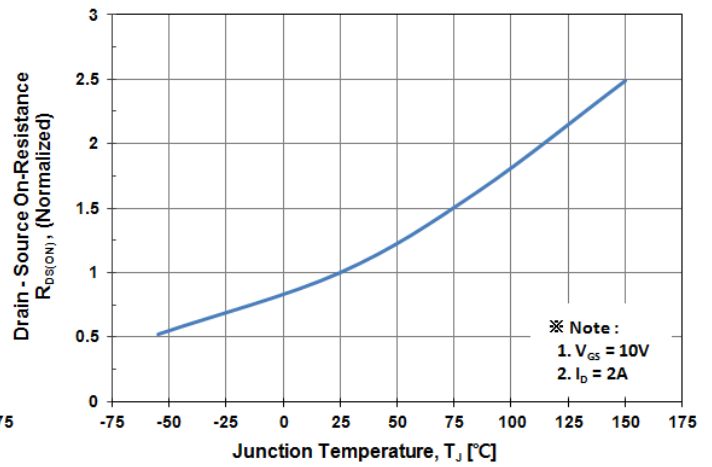


Fig. 9 Maximum Drain Current vs. Case Temperature

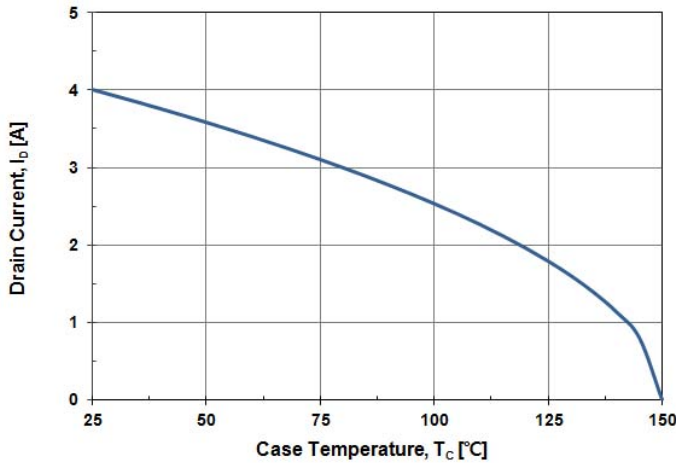


Fig. 10 Maximum Safe Operating Area

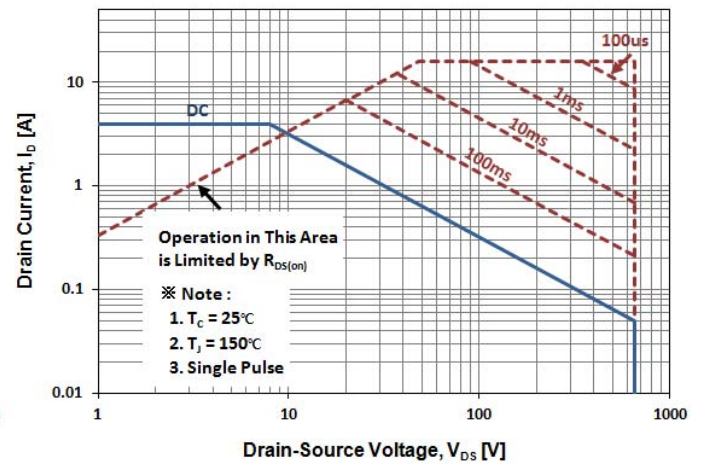


Fig. 11 Transient Thermal Impedance

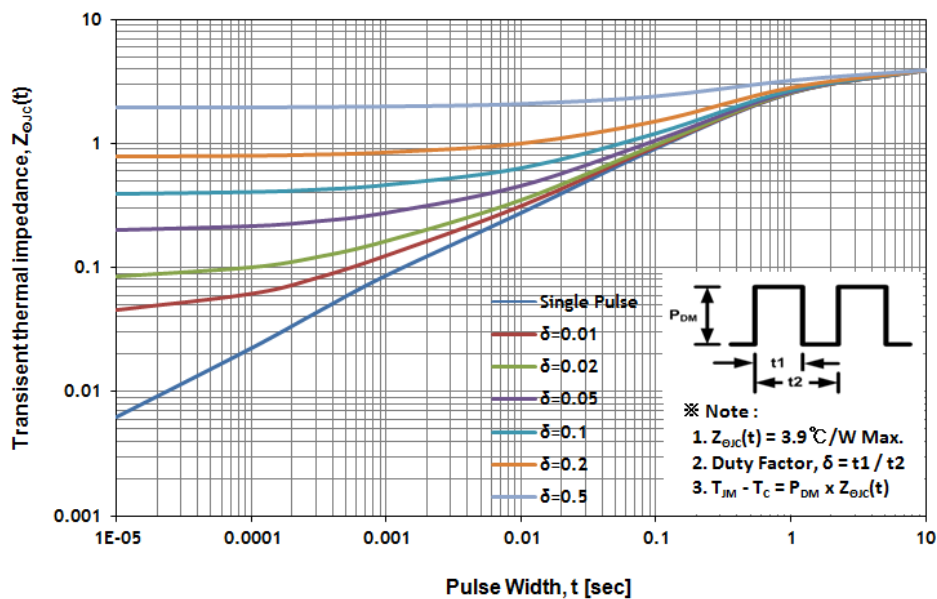


Fig. 12 Gate Charge Test Circuit & Waveform

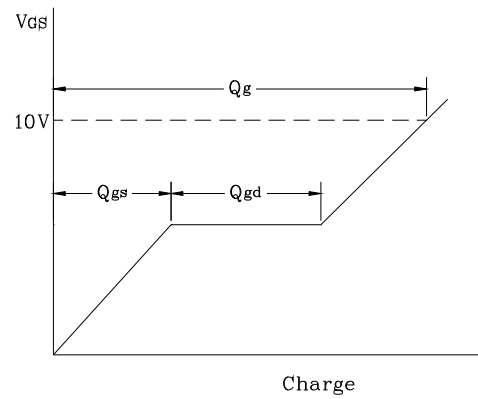
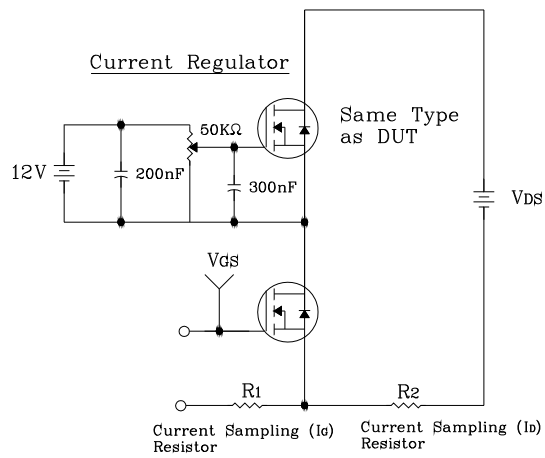


Fig. 13 Resistive Switching Test Circuit & Waveform

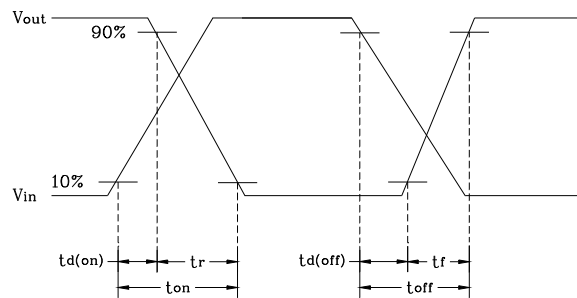
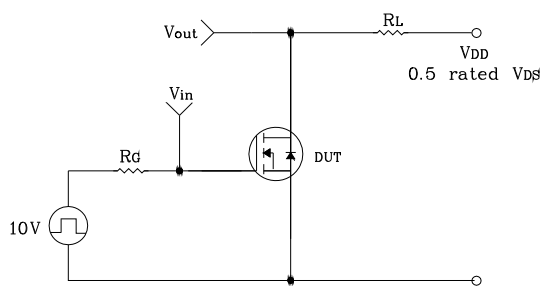


Fig. 14 E<sub>AS</sub> Test Circuit & Waveform

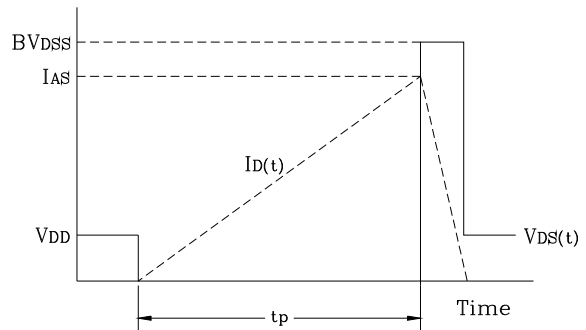
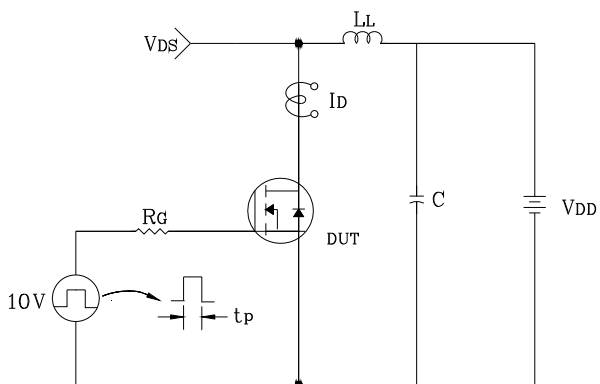
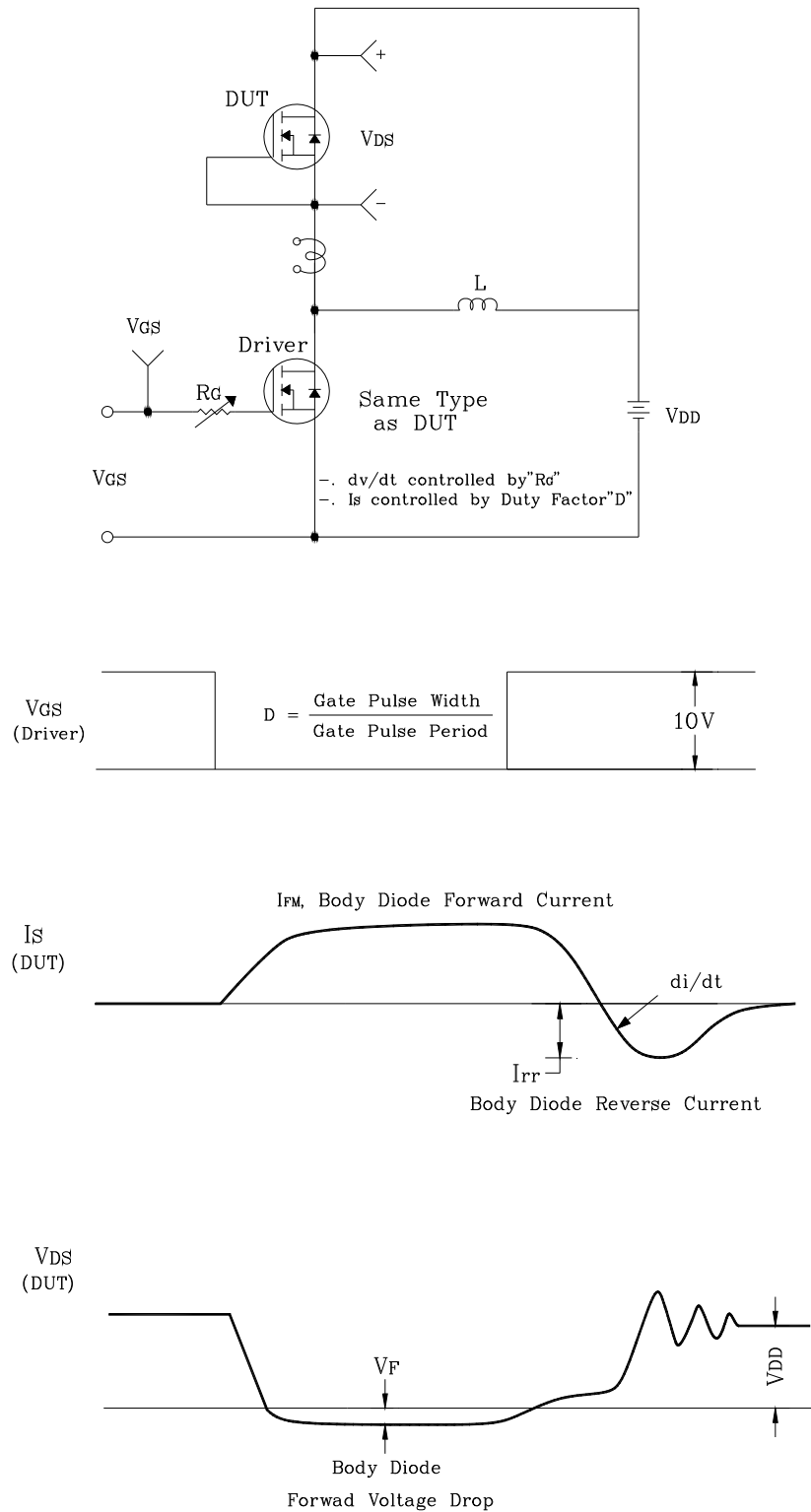
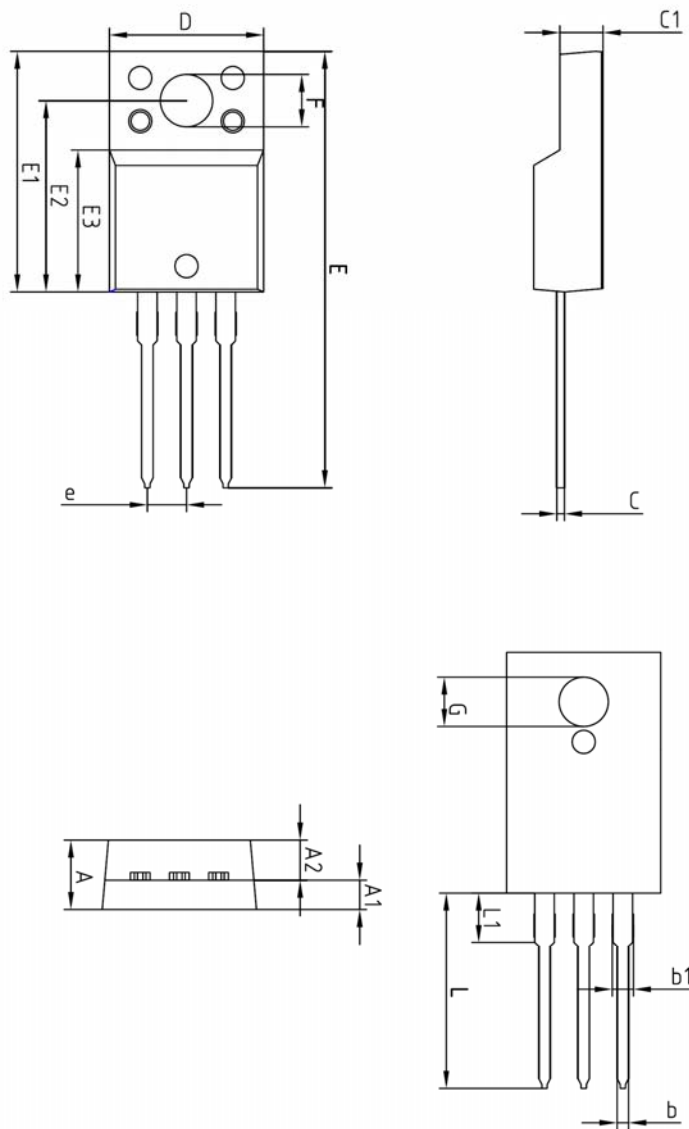


Fig. 15 Diode Reverse Recovery Time Test Circuit & Waveform



# Package Outline Dimensions



| 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      | 28.00       | —       | 28.60   |      |
| 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    |         |         |      |
| L      | 12.40       | —       | 13.00   |      |
| L1     | 3.46 BSC    |         |         |      |

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