

## SWITCHING REGULATOR APPLICATIONS

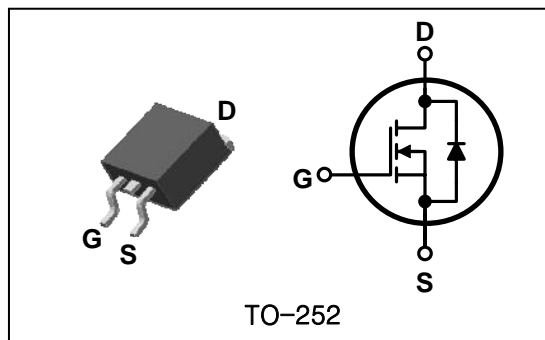
### Features

- High Voltage :  $BV_{DSS}=600V(\text{Min.})$
- Low  $C_{RSS}$  :  $C_{RSS}=3.4pF(\text{Typ.})$
- Low gate charge :  $Qg=3.9nC(\text{Typ.})$
- Low  $R_{DS(on)}$  :  $R_{DS(on)}=11.5\Omega(\text{Max.})$

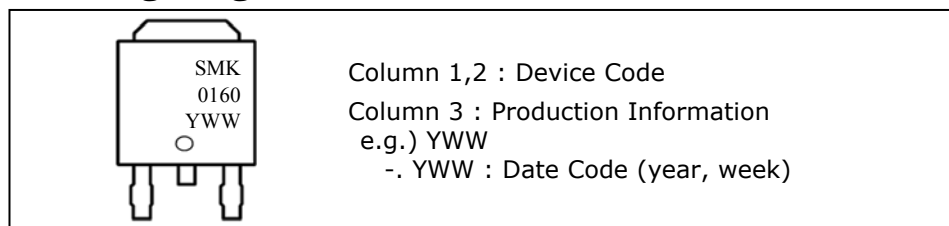
### Ordering Information

| Type No. | Marking | Package Code |
|----------|---------|--------------|
| SMK0160D | SMK0160 | TO-252       |

### PIN Connection



### Marking Diagram



### Absolute maximum ratings ( $T_C=25^\circ\text{C}$ unless otherwise noted)

| Characteristic                   | Symbol    | Rating                      | Unit             |
|----------------------------------|-----------|-----------------------------|------------------|
| Drain-source voltage             | $V_{DSS}$ | 600                         | V                |
| Gate-source voltage              | $V_{GSS}$ | $\pm 30$                    | V                |
| Drain current (DC) *             | $I_D$     | ( $T_C=25^\circ\text{C}$ )  | 1.0              |
|                                  |           | ( $T_C=100^\circ\text{C}$ ) | 0.77             |
| Drain current (Pulsed) *         | $I_{DM}$  | 4.0                         | A                |
| Power dissipation                | $P_D$     | 28                          | W                |
| Avalanche current (Single) ②     | $I_{AS}$  | 1.0                         | A                |
| Single pulsed avalanche energy ② | $E_{AS}$  | 22                          | mJ               |
| Avalanche current (Repetitive) ① | $I_{AR}$  | 1.0                         | A                |
| Repetitive avalanche energy ①    | $E_{AR}$  | 2.5                         | mJ               |
| Junction temperature             | $T_J$     | 150                         | $^\circ\text{C}$ |
| Storage temperature range        | $T_{stg}$ | -55~150                     |                  |

\* Limited by maximum junction temperature

| Characteristic     | Symbol           | Typ.          | Max. | Unit |
|--------------------|------------------|---------------|------|------|
| Thermal resistance | Junction-case    | $R_{th(J-C)}$ | -    | 4.46 |
|                    | Junction-ambient | $R_{th(J-A)}$ | -    | 62.5 |

## Electrical Characteristics (T<sub>C</sub>=25°C unless otherwise noted)

| Characteristic                 | Symbol              | Test Condition  | Min. | Typ. | Max. | Unit |   |
|--------------------------------|---------------------|---|------|------|------|------|---|
| Drain-source breakdown voltage | BV <sub>DSS</sub>   | I <sub>D</sub> =250μA, V <sub>GS</sub> =0                           | 600  | -    | -    | V    |   |
| Gate threshold voltage         | V <sub>GS(th)</sub> | I <sub>D</sub> =250μA, V <sub>DS</sub> =V <sub>GS</sub>             | 2.0  | -    | 4.0  | V    |   |
| Drain-source cut-off current   | I <sub>DSS</sub>    | V <sub>DS</sub> =600V, V <sub>GS</sub> =0V                          | -    | -    | 1    | μA   |   |
| Gate leakage current           | I <sub>GSS</sub>    | V <sub>DS</sub> =0V, V <sub>GS</sub> =±30V                          | -    | -    | ±100 | nA   |   |
| Drain-source on-resistance ④   | R <sub>DS(ON)</sub> | V <sub>GS</sub> =10V, I <sub>D</sub> =0.5A                          | -    | 9.3  | 11.5 | Ω    |   |
| Forward transfer conductance ④ | g <sub>fs</sub>     | V <sub>DS</sub> =10V, I <sub>D</sub> =0.5A                          | -    | 0.32 | -    | S    |   |
| Input capacitance              | C <sub>iss</sub>    | V <sub>GS</sub> =0V, V <sub>DS</sub> =25V,<br>f=1MHz                | -    | 131  | 164  | pF   |   |
| Output capacitance             | C <sub>oss</sub>    |   | -    | 19.4 | 24.3 |      |   |
| Reverse transfer capacitance   | C <sub>rss</sub>    |   | -    | 3.4  | 4.3  |      |   |
| Turn-on delay time             | t <sub>d(on)</sub>  | V <sub>DD</sub> =300V, I <sub>D</sub> =1.0A<br>R <sub>G</sub> =25Ω  | -    | 5.5  | -    | ns   |   |
| Rise time                      | t <sub>r</sub>      |   | -    | 5    | -    |      |   |
| Turn-off delay time            | t <sub>d(off)</sub> |   | ③④   | -    | 13   |      | - |
| Fall time                      | t <sub>f</sub>      |   | -    | -    | 28   |      | - |
| Total gate charge              | Q <sub>g</sub>      | V <sub>DS</sub> =480V, V <sub>GS</sub> =10V<br>I <sub>D</sub> =1.0A | -    | 3.9  | 4.9  | nC   |   |
| Gate-source charge             | Q <sub>gs</sub>     |   | -    | 1.7  | -    |      |   |
| Gate-drain charge              | Q <sub>gd</sub>     |   | ③④   | -    | 0.85 |      | - |

## Source-Drain Diode Ratings and Characteristics (T<sub>C</sub>=25°C unless otherwise noted)

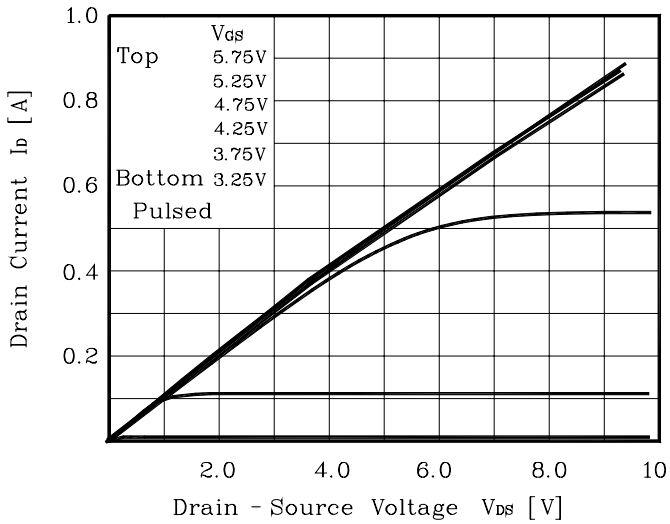
| Characteristic            | Symbol          | Test Condition   | Min. | Typ. | Max. | Unit |
|---------------------------|-----------------|--|------|------|------|------|
| Source current (DC)       | I <sub>S</sub>  | Integral reverse diode<br>in the MOSFET                                  | -    | -    | 1.0  | A    |
| Source current (Pulsed) ① | I <sub>SM</sub> |  | -    | -    | 4.0  |      |
| Forward voltage ④         | V <sub>SD</sub> | V <sub>GS</sub> =0V, I <sub>S</sub> =1.0A                                | -    | -    | 1.4  | V    |
| Reverse recovery time     | t <sub>rr</sub> | I <sub>S</sub> =1.0A, V <sub>GS</sub> =0V<br>dI <sub>F</sub> /dt=100A/μs | -    | 190  | -    | ns   |
| Reverse recovery charge   | Q <sub>rr</sub> |  | -    | 0.53 | -    | μC   |

Note ;

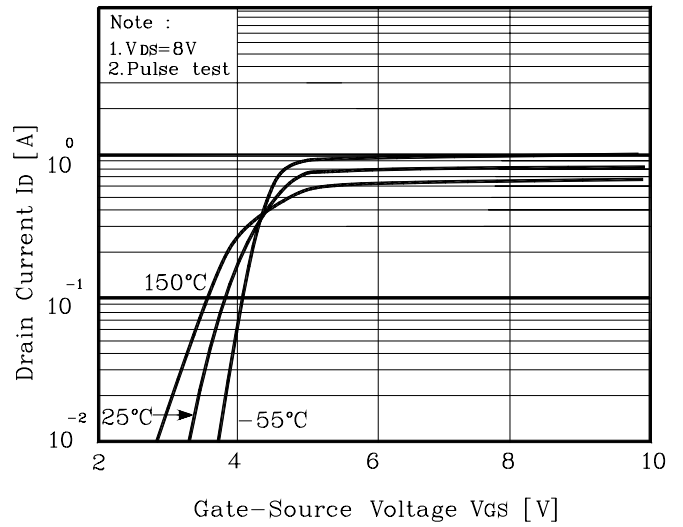
- ① Repetitive rating : Pulse width limited by maximum junction temperature
- ② L=1080mH, I<sub>AS</sub>=0.3A, V<sub>DD</sub>=50V, R<sub>G</sub>=25Ω, Starting T<sub>J</sub>=25°C
- ③ Pulse Test : Pulse width≤300μs, Duty cycle≤2%
- ④ Essentially independent of operating temperature

## Electrical Characteristic Curves

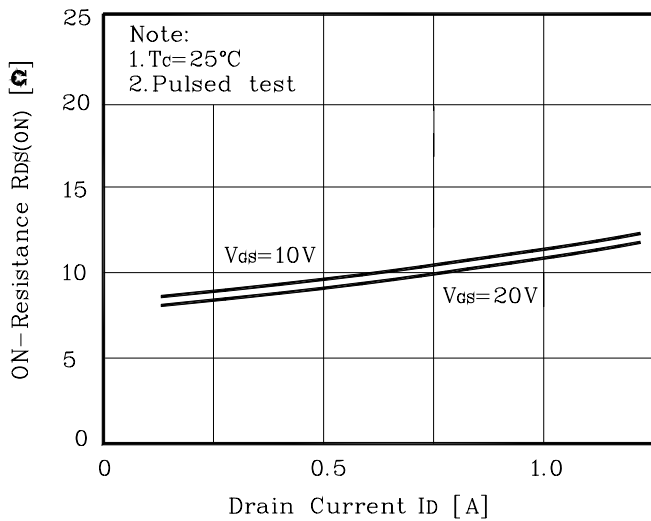
**Fig. 1  $I_D - V_{DS}$**



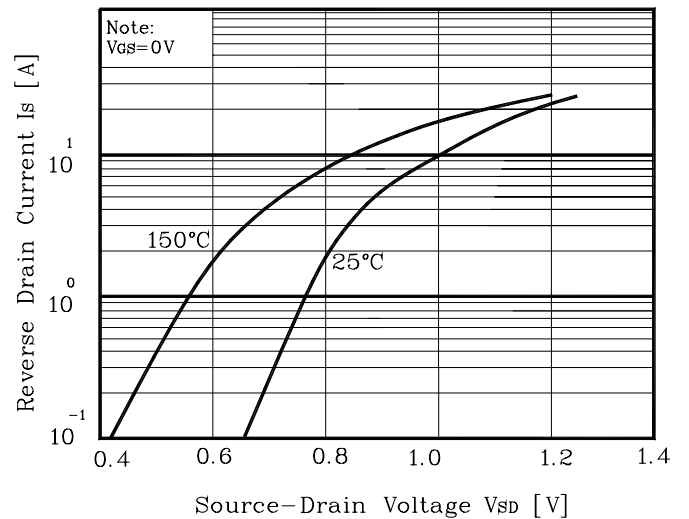
**Fig. 2  $I_D - V_{GS}$**



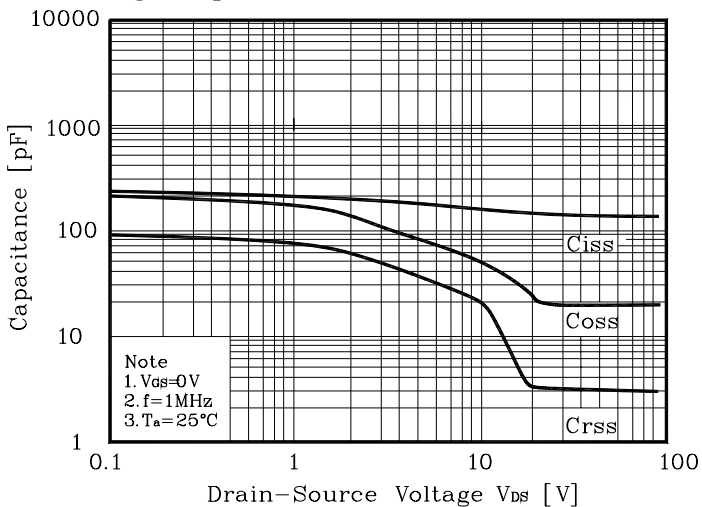
**Fig. 3  $R_{DS(on)} - I_D$**



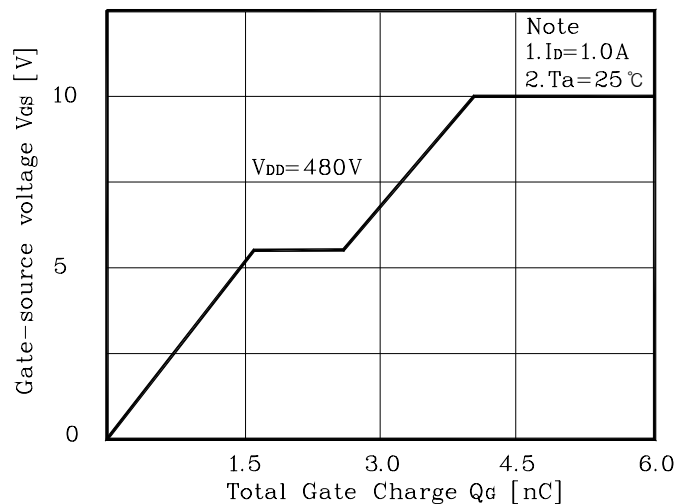
**Fig. 4  $I_S - V_{SD}$**



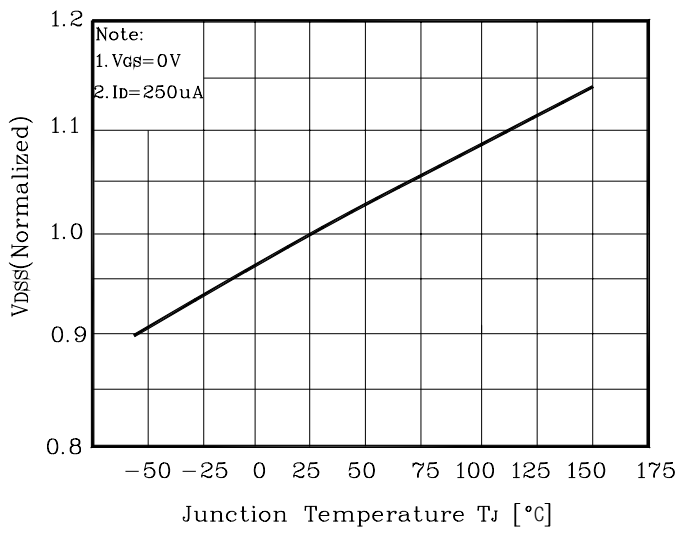
**Fig. 5 Capacitance -  $V_{DS}$**



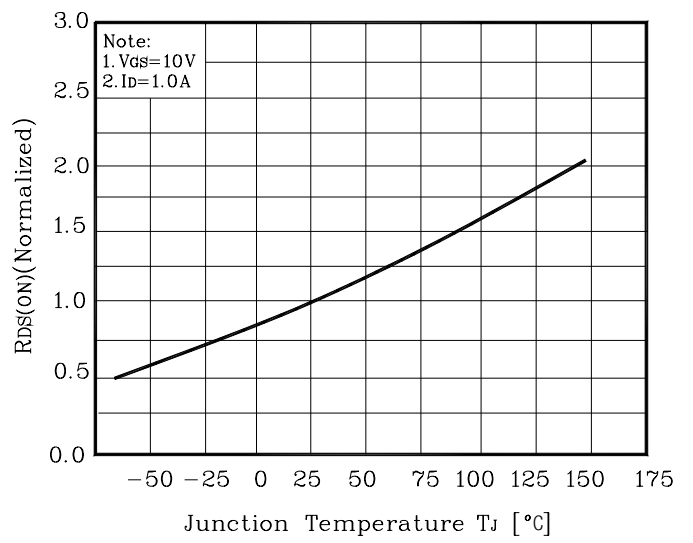
**Fig. 6  $V_{GS} - Q_G$**



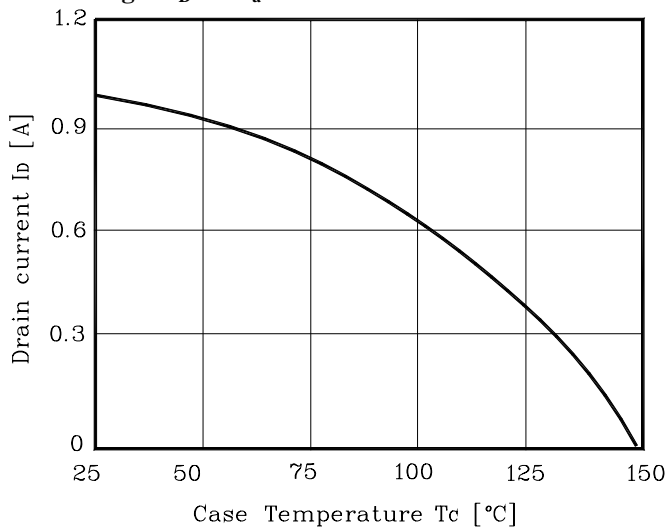
**Fig. 7  $V_{DSS} - T_J$**



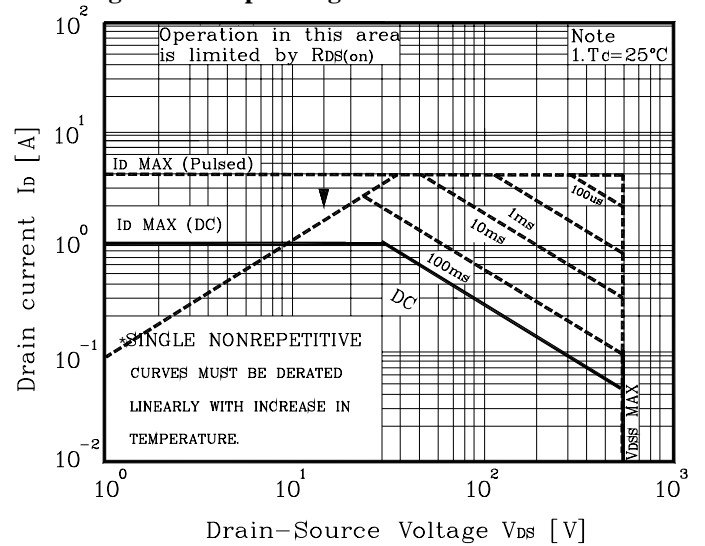
**Fig. 8  $R_{DS(on)} - T_J$**



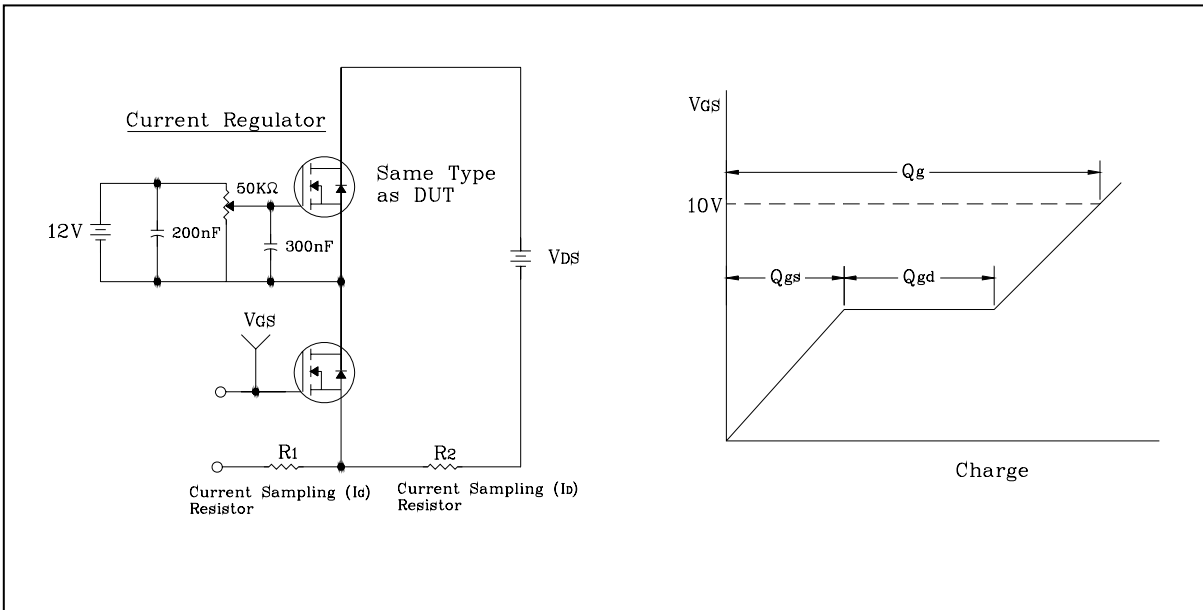
**Fig. 9  $I_D - T_c$**



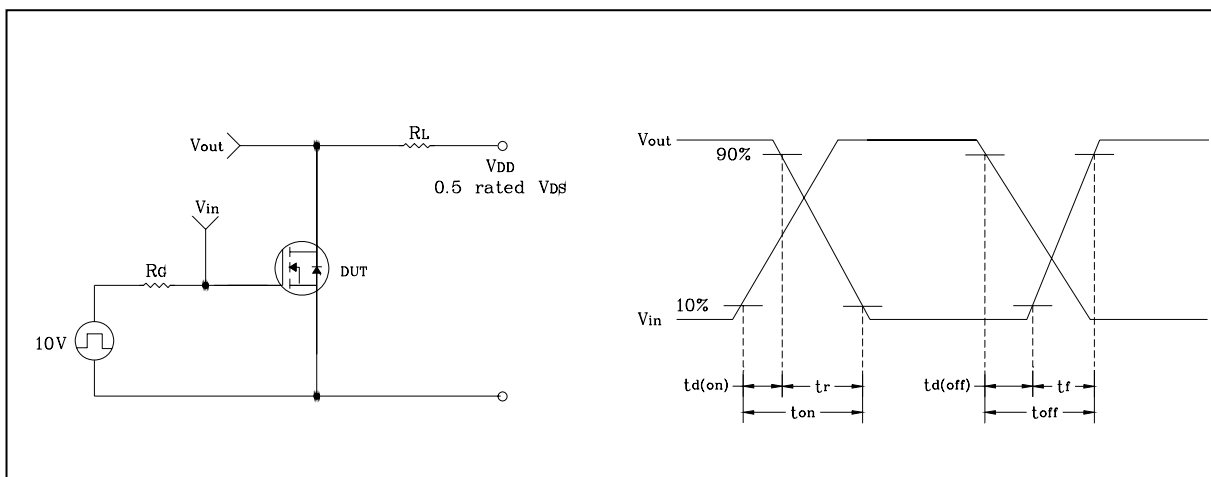
**Fig. 10 Safe Operating Area**



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



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



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

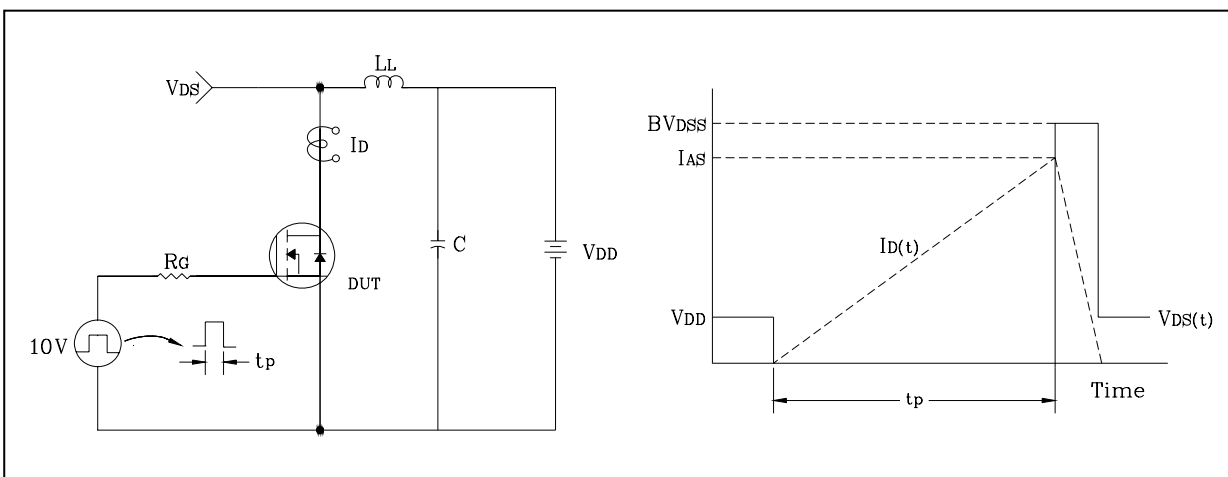
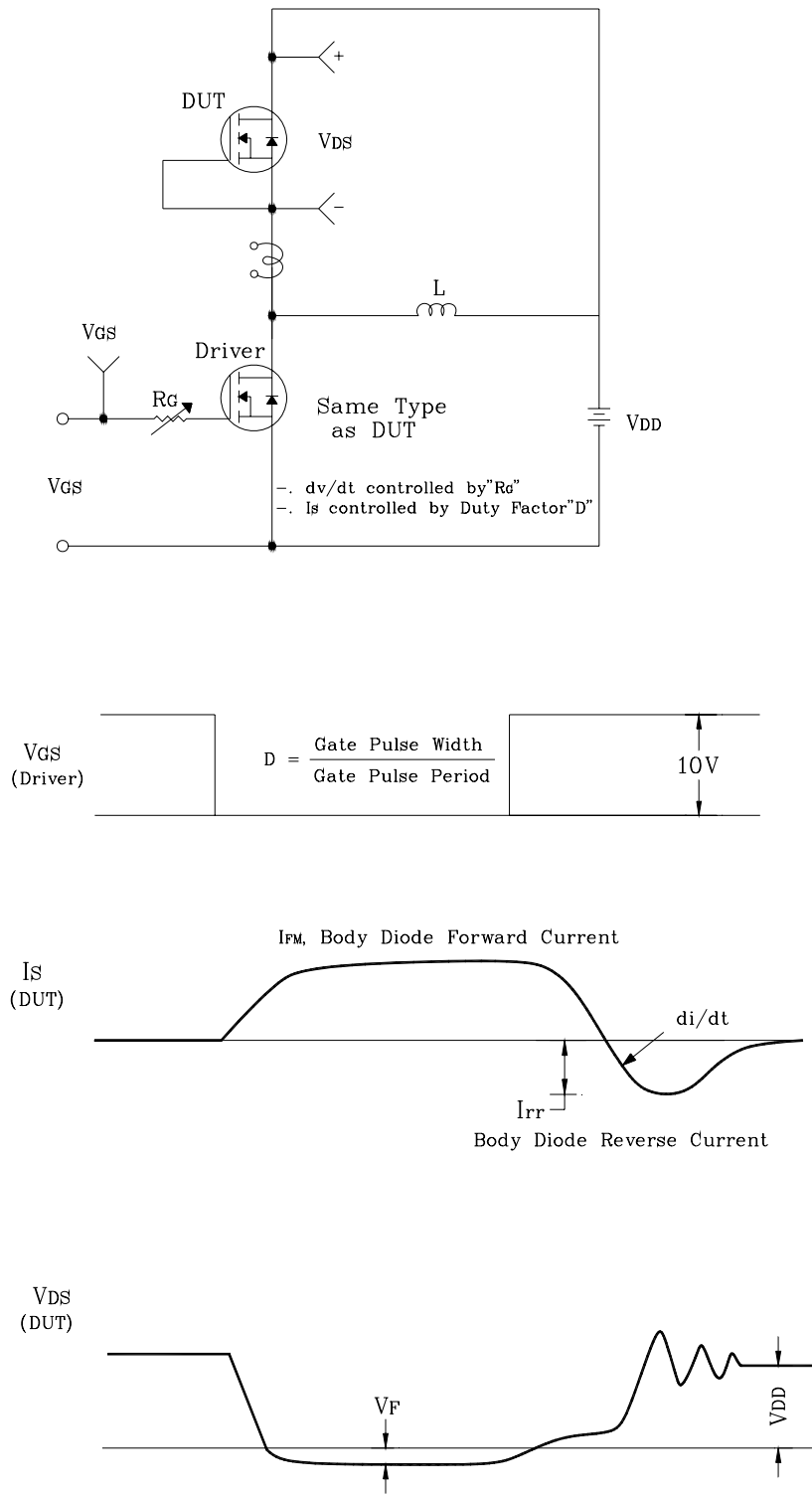
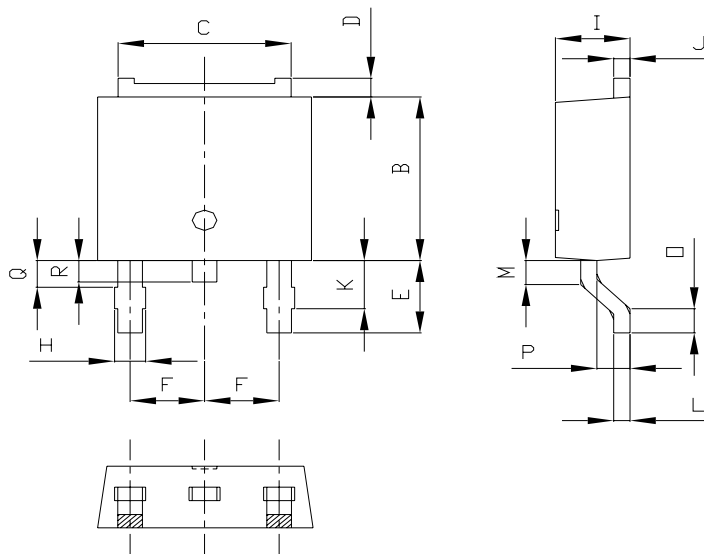


Fig. 14 Diode Reverse Recovery Time Test Circuit & Waveform



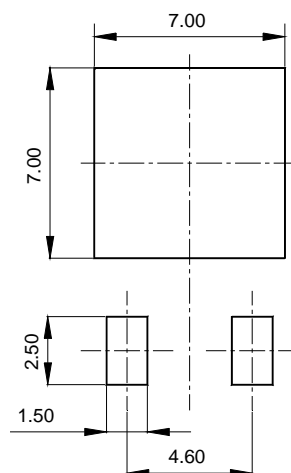
## Outline Dimension

unit: mm



| SYMBOL | MILLIMETERS |         |         | NOTE |
|--------|-------------|---------|---------|------|
|        | MINIMUM     | NOMINAL | MAXIMUM |      |
| A      | 6.40        | 6.60    | 6.80    |      |
| B      | 5.90        | 6.10    | 6.30    |      |
| C      | 5.04        | 5.34    | 5.64    |      |
| D      | 0.50        | 0.70    | 0.90    |      |
| E      | 2.50        | 2.70    | 2.90    |      |
| F      | 2.10        | 2.30    | 2.50    |      |
| H      | 0.96 MAX    |         |         |      |
| I      | 2.20        | 2.30    | 2.40    |      |
| J      | 0.40        | 0.50    | 0.60    |      |
| K      | 1.60        | 1.80    | 2.00    |      |
| L      | 0.40        | 0.50    | 0.60    |      |
| M      | 0.81        | 0.91    | 1.01    |      |
| O      | 0.80        | 0.90    | 1.00    |      |
| P      | 0.90        | 1.00    | 1.10    |      |
| Q      | 0.95 MAX    |         |         |      |
| R      | 0.60        | 0.80    | 1.00    |      |

## Recommended Land Pattern [unit: mm]



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