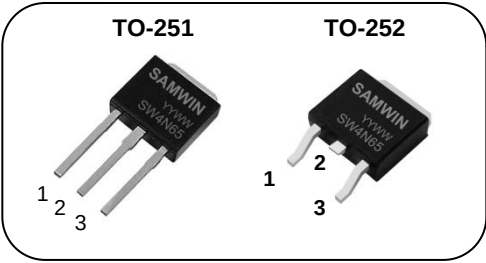


N-channel MOSFET

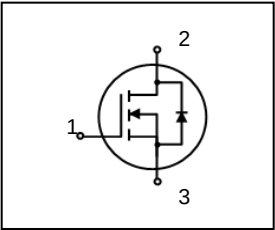
Features

- High ruggedness
- $R_{DS(ON)}$  (Max 2.6  $\Omega$ )@ $V_{GS}=10V$
- Gate Charge (Typ 19nC)
- Improved dv/dt Capability
- 100% Avalanche Tested



1. Gate 2. Drain 3. Source

|              |          |
|--------------|----------|
| $BV_{DSS}$   | : 650V   |
| $I_D$        | : 4.0A   |
| $R_{DS(ON)}$ | : 2.6ohm |



General Description

This power MOSFET is produced with advanced VDMOS technology of SAMWIN. This technology enable power MOSFET to have better characteristics, such as fast switching time, low on resistance, low gate charge and especially excellent avalanche characteristics. This power MOSFET is usually used at high efficient DC to DC converter block and switch mode power supply.

Order Codes

| Item | Sales Type | Marking | Package | Packaging |
|------|------------|---------|---------|-----------|
| 1    | SW I 4N65  | SW4N65  | TO-251  | TUBE      |
| 2    | SW D 4N65  | SW4N65  | TO-252  | REEL      |

Absolute maximum ratings

| Symbol         | Parameter                                                                    | Value       | Unit           |
|----------------|------------------------------------------------------------------------------|-------------|----------------|
|                |                                                                              | TO-251      |                |
| $V_{DSS}$      | Drain to Source Voltage                                                      | 650         | V              |
| $I_D$          | Continuous Drain Current (@ $T_C=25^{\circ}C$ )                              | 4.0         | A              |
|                | Continuous Drain Current (@ $T_C=100^{\circ}C$ )                             | 2.6         | A              |
| $I_{DM}$       | Drain current pulsed (note 1)                                                | 16          | A              |
| $V_{GS}$       | Gate to Source Voltage                                                       | $\pm 30$    | V              |
| $E_{AS}$       | Single pulsed Avalanche Energy (note 2)                                      | 143         | mJ             |
| $E_{AR}$       | Repetitive Avalanche Energy (note 1)                                         | 10.6        | mJ             |
| dv/dt          | Peak diode Recovery dv/dt (note 3)                                           | 4.5         | V/ns           |
| $P_D$          | Total power dissipation (@ $T_C=25^{\circ}C$ )                               | 54          | W              |
|                | Derating Factor above 25 $^{\circ}C$                                         | 0.43        | W/ $^{\circ}C$ |
| $T_{STG}, T_J$ | Operating Junction Temperature & Storage Temperature                         | -55 ~ + 150 | $^{\circ}C$    |
| $T_L$          | Maximum Lead Temperature for soldering purpose, 1/8 from Case for 5 seconds. | 300         | $^{\circ}C$    |

Thermal characteristics

| Symbol     | Parameter                               | Value |      |      | Unit          |
|------------|-----------------------------------------|-------|------|------|---------------|
|            |                                         | Min.  | Typ. | Max. |               |
| $R_{thjc}$ | Thermal resistance, Junction to case    |       |      | 2.3  | $^{\circ}C/W$ |
| $R_{thja}$ | Thermal resistance, Junction to ambient |       |      | 83   | $^{\circ}C/W$ |

Electrical characteristic (  $T_C = 25^\circ\text{C}$  unless otherwise specified )

| Symbol                         | Parameter                                 | Test conditions                                   | Min. | Typ. | Max. | Unit               |
|--------------------------------|-------------------------------------------|---------------------------------------------------|------|------|------|--------------------|
| <b>Off characteristics</b>     |                                           |                                                   |      |      |      |                    |
| $BV_{DSS}$                     | Drain to source breakdown voltage         | $V_{GS}=0V, I_D=250\mu A$                         | 650  | -    | -    | V                  |
| $\Delta BV_{DSS} / \Delta T_J$ | Breakdown voltage temperature coefficient | $I_D=250\mu A$ , referenced to $25^\circ\text{C}$ | -    | 0.53 | -    | $V/^\circ\text{C}$ |
| $I_{DSS}$                      | Drain to source leakage current           | $V_{DS}=650V, V_{GS}=0V$                          | -    | -    | 1    | $\mu A$            |
|                                |                                           | $V_{DS}=520V, T_C=125^\circ\text{C}$              | -    | -    | 10   | $\mu A$            |
| $I_{GSS}$                      | Gate to source leakage current, forward   | $V_{GS}=30V, V_{DS}=0V$                           | -    | -    | 100  | nA                 |
|                                | Gate to source leakage current, reverse   | $V_{GS}=-30V, V_{DS}=0V$                          | -    | -    | -100 | nA                 |
| <b>On characteristics</b>      |                                           |                                                   |      |      |      |                    |
| $V_{GS(TH)}$                   | Gate threshold voltage                    | $V_{DS}=V_{GS}, I_D=250\mu A$                     | 2.0  | -    | 4.0  | V                  |
| $R_{DS(ON)}$                   | Drain to source on state resistance       | $V_{GS}=10V, I_D = 2.0A$                          |      |      | 2.6  | $\Omega$           |
| <b>Dynamic characteristics</b> |                                           |                                                   |      |      |      |                    |
| $C_{ISS}$                      | Input capacitance                         | $V_{GS}=0V, V_{DS}=25V, f=1\text{MHz}$            |      | 570  | 740  | pF                 |
| $C_{OSS}$                      | Output capacitance                        |                                                   |      | 70   | 90   |                    |
| $C_{RSS}$                      | Reverse transfer capacitance              |                                                   |      | 20   | 24   |                    |
| $t_{d(on)}$                    | Turn on delay time                        | $V_{DS}=320V, I_D=4.0A, R_G=25\Omega$             |      | 21   | 52   | ns                 |
| $t_r$                          | Rising time                               |                                                   |      | 46   | 102  |                    |
| $t_{d(off)}$                   | Turn off delay time                       |                                                   |      | 102  | 214  |                    |
| $t_f$                          | Fall time                                 |                                                   |      | 34   | 78   |                    |
| $Q_g$                          | Total gate charge                         | $V_{DS}=520V, V_{GS}=10V, I_D=4.0A$               |      | 18.6 | 28   | nC                 |
| $Q_{gs}$                       | Gate-source charge                        |                                                   |      | 3.0  | -    |                    |
| $Q_{gd}$                       | Gate-drain charge                         |                                                   |      | 6.0  | -    |                    |

## Source to drain diode ratings characteristics

| Symbol   | Parameter                     | Test conditions                                   | Min. | Typ. | Max. | Unit    |
|----------|-------------------------------|---------------------------------------------------|------|------|------|---------|
| $I_S$    | Continuous source current     | Integral reverse p-n Junction diode in the MOSFET | -    | -    | 4    | A       |
| $I_{SM}$ | Pulsed source current         |                                                   | -    | -    | 16   | A       |
| $V_{SD}$ | Diode forward voltage drop.   | $I_S=4.0A, V_{GS}=0V$                             | -    | -    | 1.4  | V       |
| $T_{rr}$ | Reverse recovery time         | $I_S=4.0A, V_{GS}=0V,$                            | -    | 390  | -    | ns      |
| $Q_{rr}$ | Breakdown voltage temperature | $dI_F/dt=100A/\mu s$                              | -    | 1.6  | -    | $\mu C$ |

※. Notes

1. Repeattive rating : pulse width limited by junction temperature.
2.  $L = 19\text{mH}, I_{AS} = 4.0A, V_{DD} = 50V, R_G=25\Omega$ , Starting  $T_J = 25^\circ\text{C}$
3.  $I_{SD} \leq 4.0A, di/dt = 100A/\mu s, V_{DD} \leq BV_{DSS}$ , Staring  $T_J = 25^\circ\text{C}$
4. Pulse Test : Pulse Width  $\leq 300\mu s$ , duty cycle  $\leq 2\%$
5. Essentially independent of operating temperature.

Fig. 1. On-state characteristics

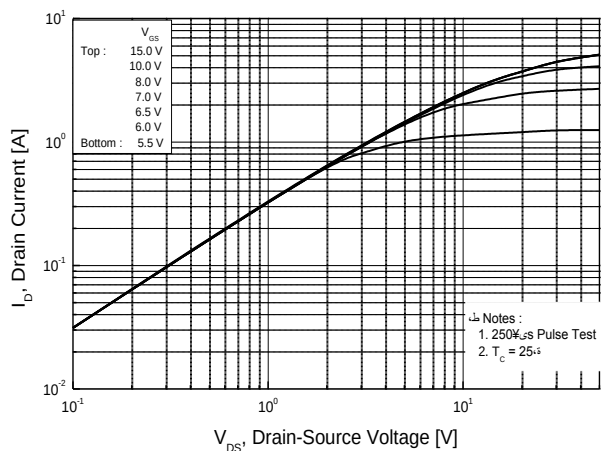


Fig. 2. Transfer characteristics

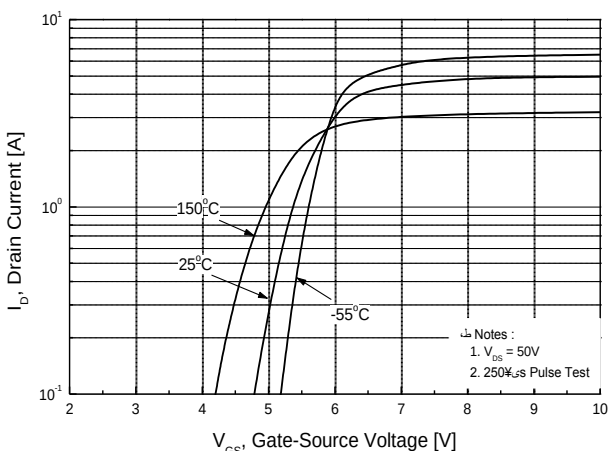


Fig. 3. On-resistance variation vs. drain current and gate voltage

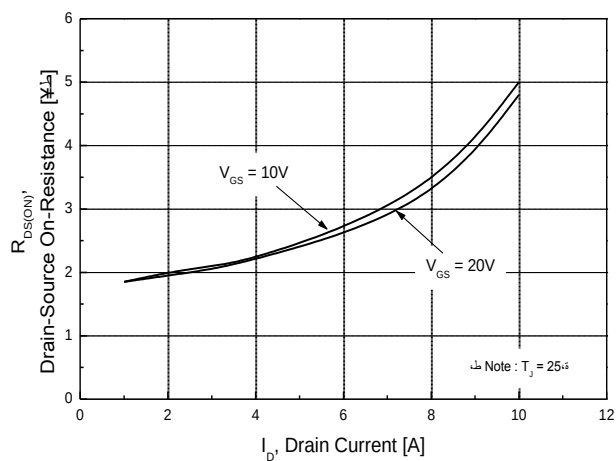


Fig. 4. On state current vs. diode forward voltage

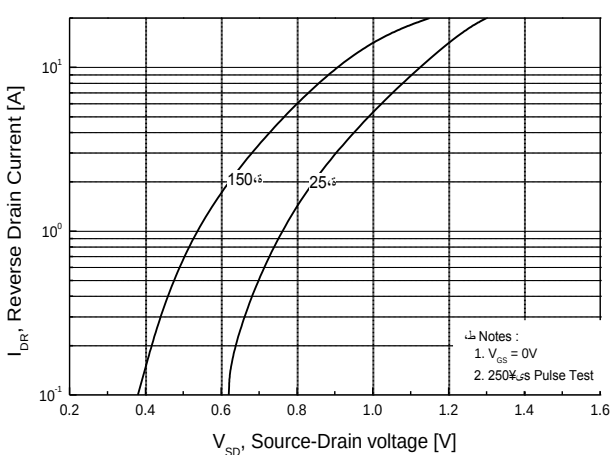


Fig. 5. Capacitance characteristics (Non-Repetitive)

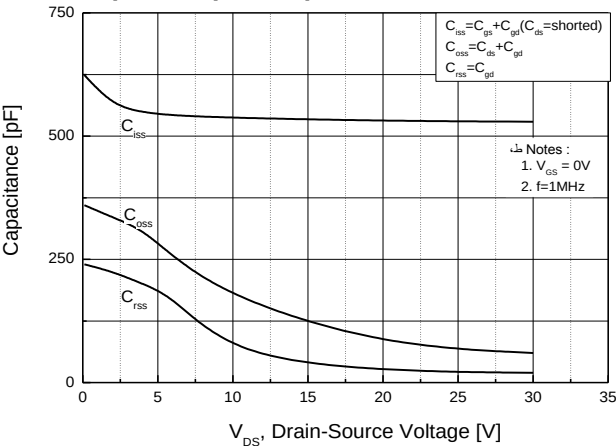


Fig. 6. Gate charge characteristics

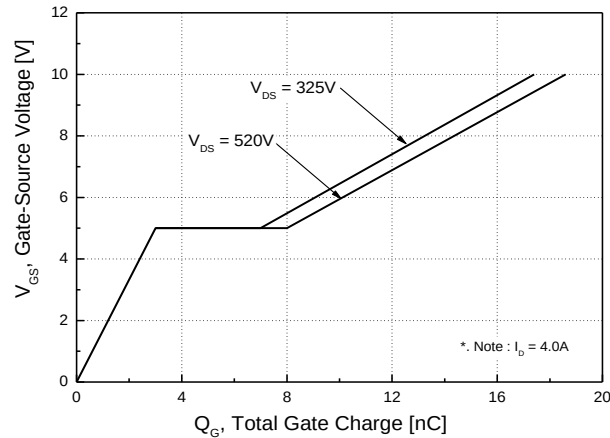


Fig 7. Breakdown Voltage Variation vs. Junction Temperature

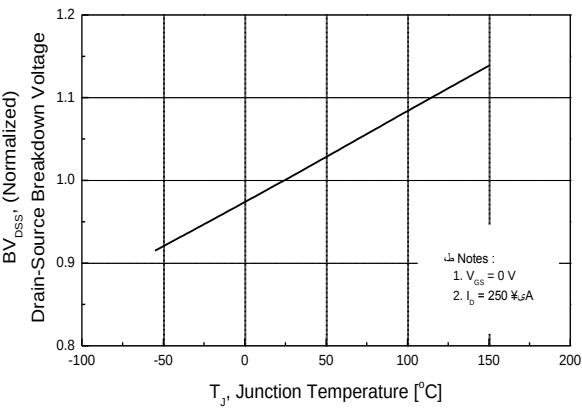


Fig. 8. On resistance variation vs. junction temperature

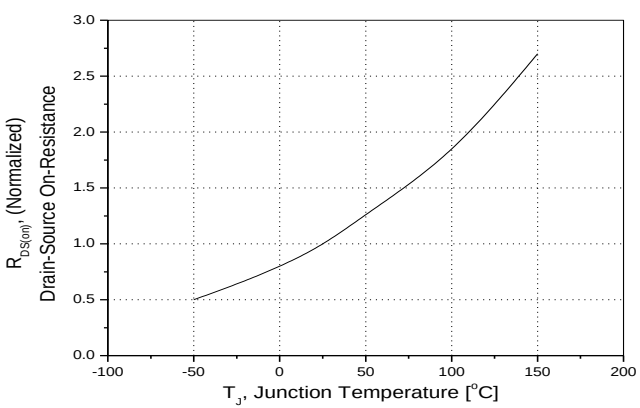


Fig. 9. Maximum drain current vs. case temperature.

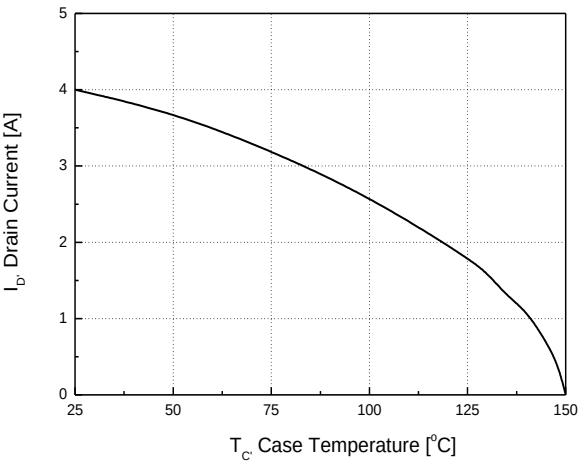


Fig. 10. Maximum safe operating area

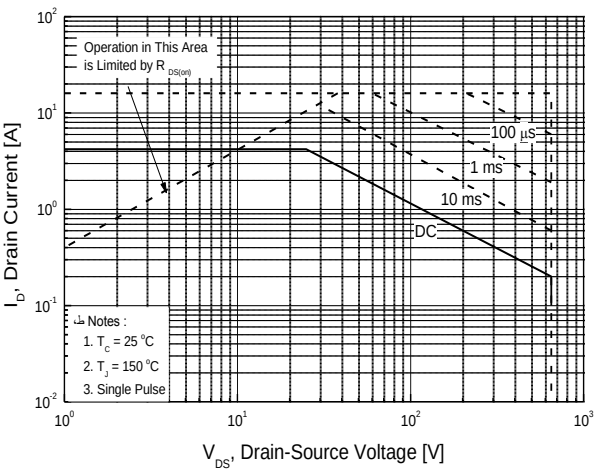


Fig. 11. Transient thermal response curve

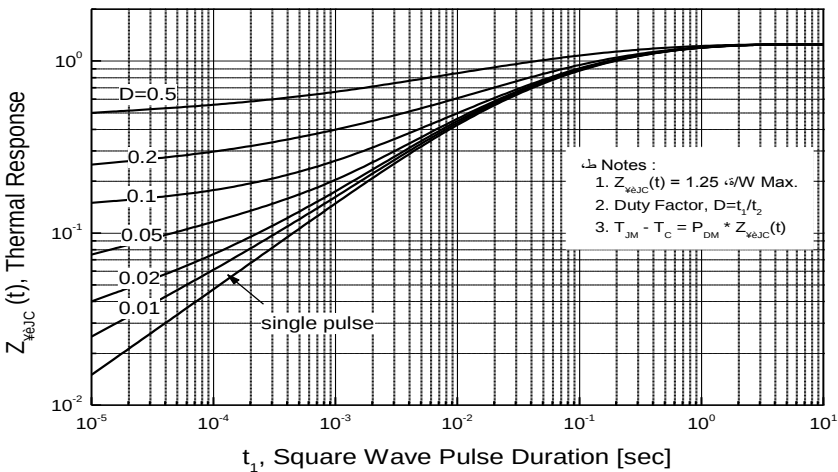


Fig. 12. Gate charge test circuit & waveform

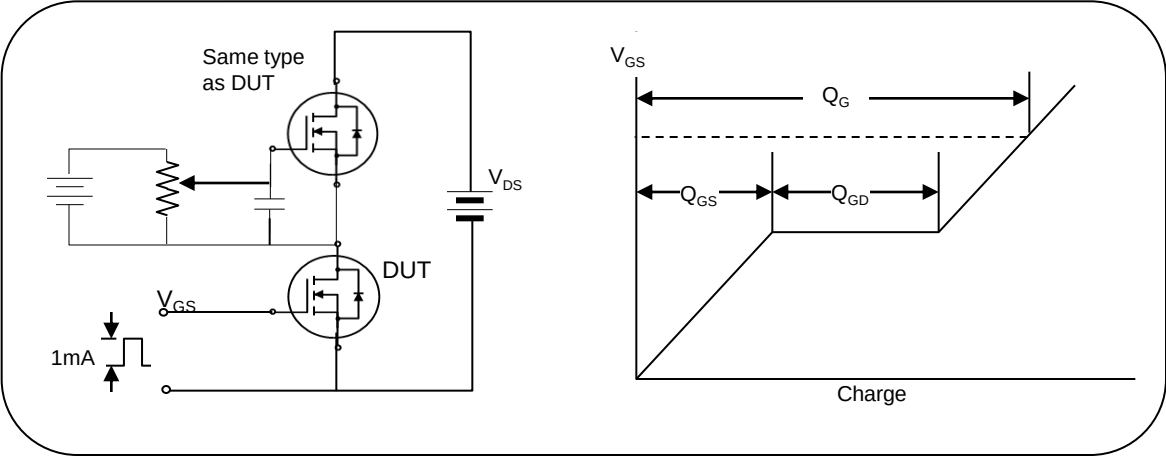


Fig. 13. Switching time test circuit & waveform

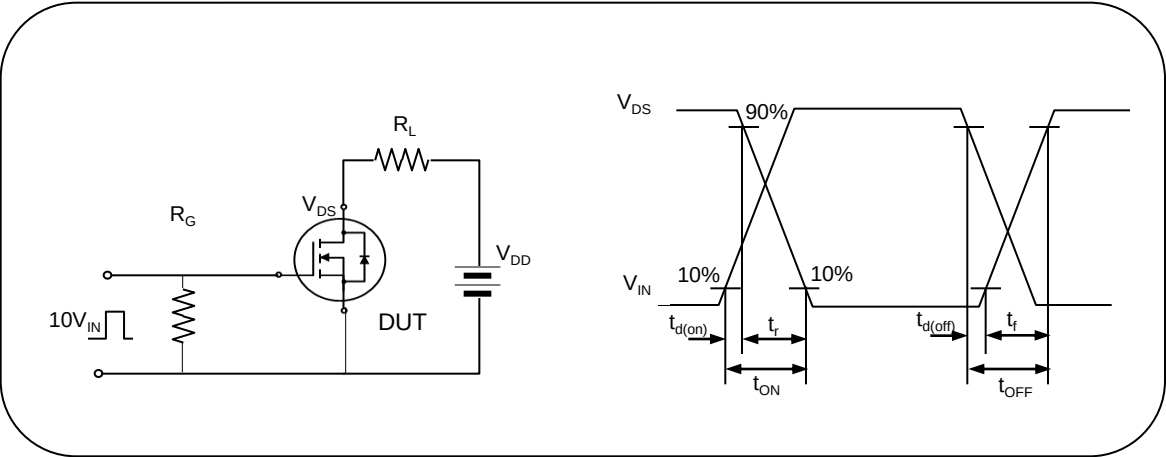


Fig. 14. Unclamped Inductive switching test circuit & waveform

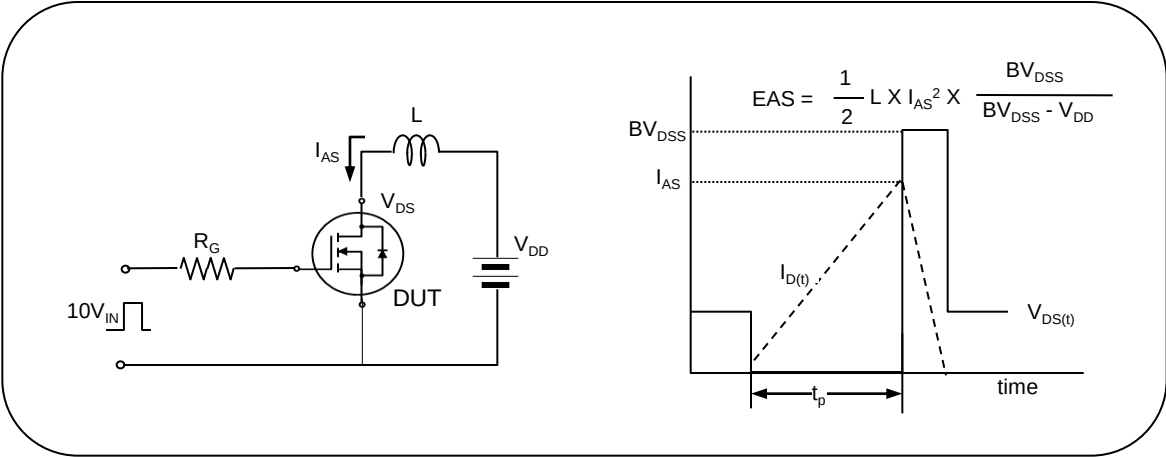
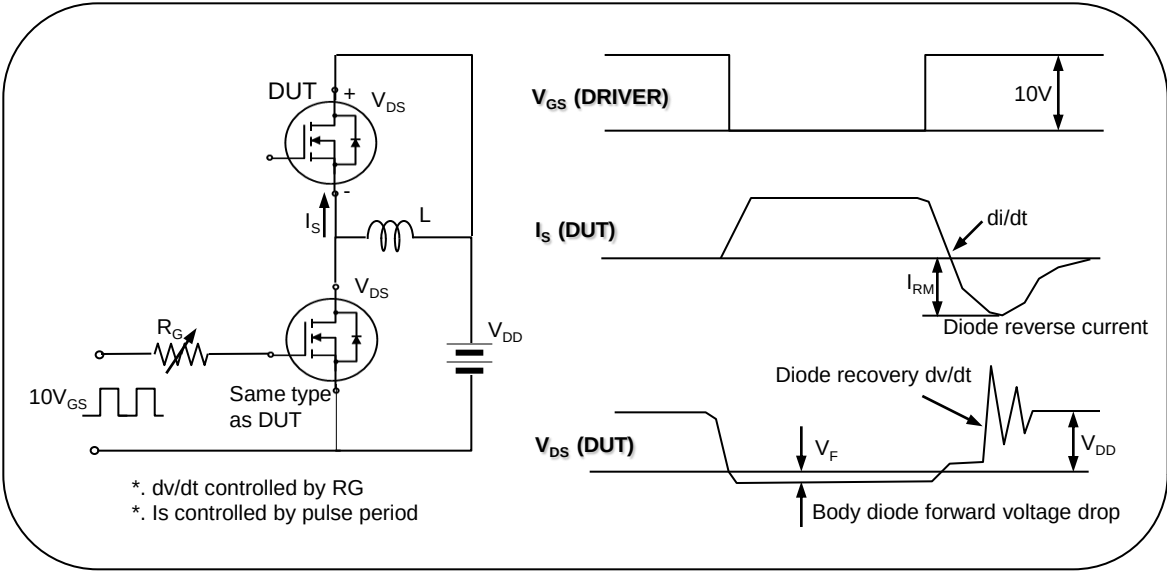


Fig. 15. Peak diode recovery dv/dt test circuit & waveform



REVISION HISTORY

| Revision No. | Changed Characteristics                                | Responsible | Date       | Issuer |
|--------------|--------------------------------------------------------|-------------|------------|--------|
| REV 1.0      | Origination, First Release                             | Alice Nie   | 2007.12.05 | XZQ    |
| REV 2.0      | Updated the format of datasheet and added Order Codes. | Alice Nie   | 2011.03.24 | XZQ    |

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