

## Advanced Power MOSFET

## IRFR/U120A

### FEATURES

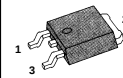
- Avalanche Rugged Technology
- Rugged Gate Oxide Technology
- Lower Input Capacitance
- Improved Gate Charge
- Extended Safe Operating Area
- Lower Leakage Current : 10  $\mu$ A (Max.) @  $V_{DS} = 100V$
- Lower  $R_{DS(ON)}$  : 0.155  $\Omega$  (Typ.)

$$BV_{DSS} = 100 V$$

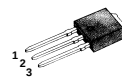
$$R_{DS(on)} = 0.2 \Omega$$

$$I_D = 8.4 A$$

**D-PAK**



**I-PAK**



1. Gate 2. Drain 3. Source

### Absolute Maximum Ratings

| Symbol         | Characteristic                                                          | Value        | Units         |
|----------------|-------------------------------------------------------------------------|--------------|---------------|
| $V_{DSS}$      | Drain-to-Source Voltage                                                 | 100          | V             |
| $I_D$          | Continuous Drain Current ( $T_C=25^\circ C$ )                           | 8.4          | A             |
|                | Continuous Drain Current ( $T_C=100^\circ C$ )                          | 5.3          |               |
| $I_{DM}$       | Drain Current-Pulsed ①                                                  | 34           | A             |
| $V_{GS}$       | Gate-to-Source Voltage                                                  | $\pm 20$     | V             |
| $E_{AS}$       | Single Pulsed Avalanche Energy ②                                        | 141          | mJ            |
| $I_{AR}$       | Avalanche Current ①                                                     | 8.4          | A             |
| $E_{AR}$       | Repetitive Avalanche Energy ①                                           | 3.2          | mJ            |
| $dv/dt$        | Peak Diode Recovery $dv/dt$ ③                                           | 6.5          | V/ns          |
| $P_D$          | Total Power Dissipation ( $T_A=25^\circ C$ ) *                          | 2.5          | W             |
|                | Total Power Dissipation ( $T_C=25^\circ C$ )                            | 32           | W             |
|                | Linear Derating Factor                                                  | 0.26         | W/ $^\circ C$ |
| $T_J, T_{STG}$ | Operating Junction and Storage Temperature Range                        | - 55 to +150 | $^\circ C$    |
| $T_L$          | Maximum Lead Temp. for Soldering Purposes, 1/8" from case for 5-seconds | 300          |               |

### Thermal Resistance

| Symbol          | Characteristic        | Typ. | Max. | Units        |
|-----------------|-----------------------|------|------|--------------|
| $R_{\theta JC}$ | Junction-to-Case      | --   | 3.9  | $^\circ C/W$ |
| $R_{\theta JA}$ | Junction-to-Ambient * | --   | 50   |              |
| $R_{\theta JA}$ | Junction-to-Ambient   | --   | 110  |              |

\* When mounted on the minimum pad size recommended (PCB Mount).

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

| Symbol              | Characteristic                          | Min. | Typ. | Max. | Units | Test Condition                                                                                          |
|---------------------|-----------------------------------------|------|------|------|-------|---------------------------------------------------------------------------------------------------------|
| BV <sub>DSS</sub>   | Drain-Source Breakdown Voltage          | 100  | --   | --   | V     | V <sub>GS</sub> =0V, I <sub>D</sub> =250 μA                                                             |
| ΔBV/ΔT <sub>J</sub> | Breakdown Voltage Temp. Coeff.          | --   | 0.12 | --   | V/°C  | I <sub>D</sub> =250 μA <b>See Fig 7</b>                                                                 |
| V <sub>GS(th)</sub> | Gate Threshold Voltage                  | 2.0  | --   | 4.0  | V     | V <sub>DS</sub> =5V, I <sub>D</sub> =250 μA                                                             |
| I <sub>GSS</sub>    | Gate-Source Leakage , Forward           | --   | --   | 100  | nA    | V <sub>GS</sub> =20V                                                                                    |
|                     | Gate-Source Leakage , Reverse           | --   | --   | -100 |       | V <sub>GS</sub> =-20V                                                                                   |
| I <sub>DSS</sub>    | Drain-to-Source Leakage Current         | --   | --   | 10   | μA    | V <sub>DS</sub> =100V                                                                                   |
|                     |                                         | --   | --   | 100  |       | V <sub>DS</sub> =80V, T <sub>C</sub> =125°C                                                             |
| R <sub>DS(on)</sub> | Static Drain-Source On-State Resistance | --   | --   | 0.2  | Ω     | V <sub>GS</sub> =10V, I <sub>D</sub> =4.2A ④                                                            |
| g <sub>fs</sub>     | Forward Transconductance                | --   | 6.29 | --   | Ω     | V <sub>DS</sub> =40V, I <sub>D</sub> =4.2A ④                                                            |
| C <sub>iss</sub>    | Input Capacitance                       | --   | 370  | 480  | pF    | V <sub>GS</sub> =0V, V <sub>DS</sub> =25V, f=1MHz<br><b>See Fig 5</b>                                   |
| C <sub>oss</sub>    | Output Capacitance                      | --   | 95   | 110  |       |                                                                                                         |
| C <sub>rss</sub>    | Reverse Transfer Capacitance            | --   | 38   | 45   |       |                                                                                                         |
| t <sub>d(on)</sub>  | Turn-On Delay Time                      | --   | 14   | 40   | ns    | V <sub>DD</sub> =50V, I <sub>D</sub> =9.2A,<br>R <sub>G</sub> =18Ω<br><b>See Fig 13</b> ④⑤              |
| t <sub>r</sub>      | Rise Time                               | --   | 14   | 40   |       |                                                                                                         |
| t <sub>d(off)</sub> | Turn-Off Delay Time                     | --   | 36   | 90   |       |                                                                                                         |
| t <sub>f</sub>      | Fall Time                               | --   | 28   | 70   |       |                                                                                                         |
| Q <sub>g</sub>      | Total Gate Charge                       | --   | 16   | 22   | nC    | V <sub>DS</sub> =80V, V <sub>GS</sub> =10V,<br>I <sub>D</sub> =9.2A<br><b>See Fig 6 &amp; Fig 12</b> ④⑤ |
| Q <sub>gs</sub>     | Gate-Source Charge                      | --   | 2.7  | --   |       |                                                                                                         |
| Q <sub>gd</sub>     | Gate-Drain(" Miller" ) Charge           | --   | 7.8  | --   |       |                                                                                                         |

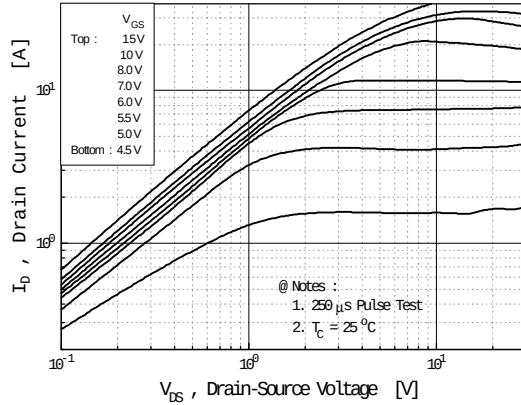
### Source-Drain Diode Ratings and Characteristics

| Symbol          | Characteristic            | Min. | Typ. | Max. | Units | Test Condition                                                  |
|-----------------|---------------------------|------|------|------|-------|-----------------------------------------------------------------|
| I <sub>S</sub>  | Continuous Source Current | --   | --   | 8.4  | A     | Integral reverse pn-diode in the MOSFET                         |
| I <sub>SM</sub> | Pulsed-Source Current ①   | --   | --   | 34   |       |                                                                 |
| V <sub>SD</sub> | Diode Forward Voltage ④   | --   | --   | 1.5  | V     | T <sub>J</sub> =25°C, I <sub>S</sub> =8.4A, V <sub>GS</sub> =0V |
| t <sub>rr</sub> | Reverse Recovery Time     | --   | 98   | --   | ns    | T <sub>J</sub> =25°C, I <sub>F</sub> =9.2A                      |
| Q <sub>rr</sub> | Reverse Recovery Charge   | --   | 0.34 | --   | μC    | di <sub>F</sub> /dt=100A/μs ④                                   |

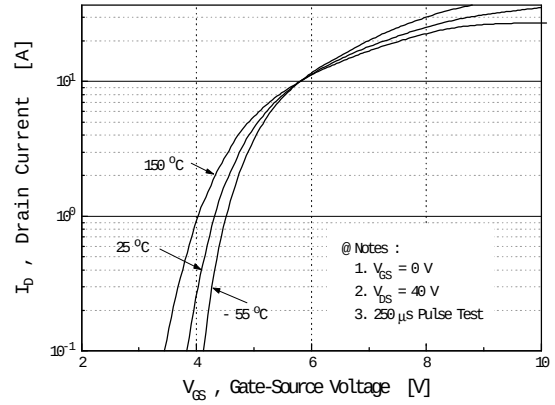
#### Notes ;

- ① Repetitive Rating : Pulse Width Limited by Maximum Junction Temperature
- ② L=3mH, I<sub>AS</sub>=8.4A, V<sub>DD</sub>=25V, R<sub>G</sub>=27Ω, Starting T<sub>J</sub>=25°C
- ③ I<sub>SD</sub> ≤ 9.2A, di/dt ≤ 300A/μs, V<sub>DD</sub> ≤ BV<sub>DSS</sub>, Starting T<sub>J</sub>=25°C
- ④ Pulse Test : Pulse Width = 250 μs, Duty Cycle ≤ 2%
- ⑤ Essentially Independent of Operating Temperature

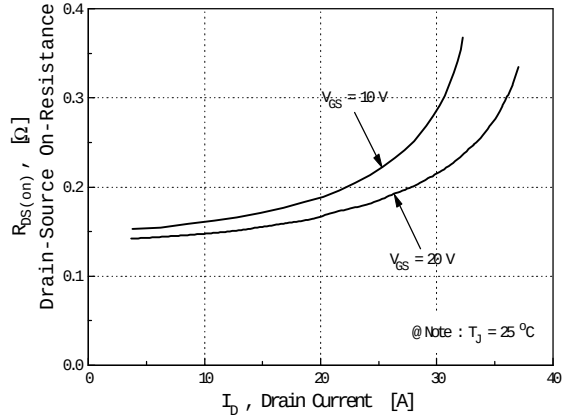
**Fig 1. Output Characteristics**



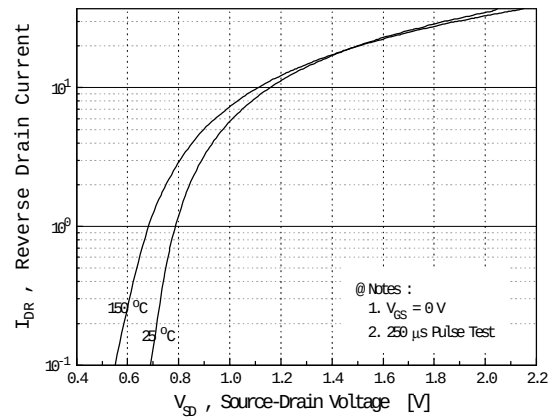
**Fig 2. Transfer Characteristics**



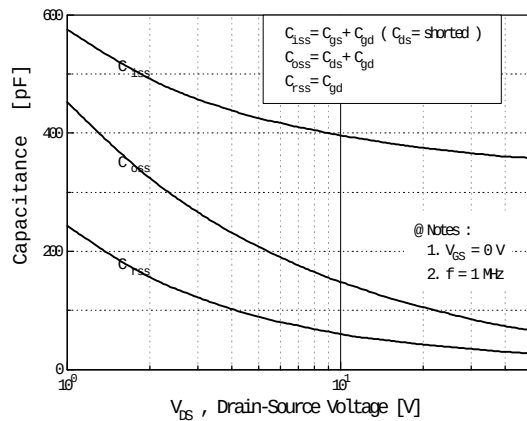
**Fig 3. On-Resistance vs. Drain Current**



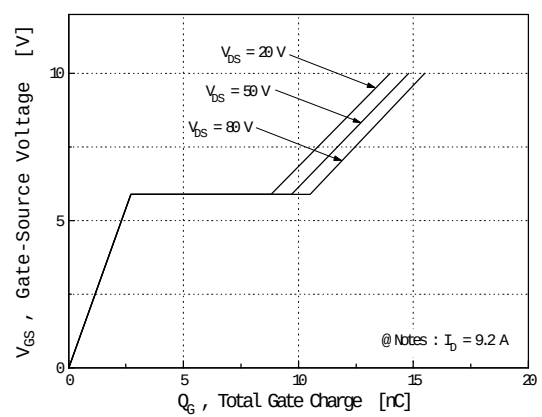
**Fig 4. Source-Drain Diode Forward Voltage**



**Fig 5. Capacitance vs. Drain-Source Voltage**

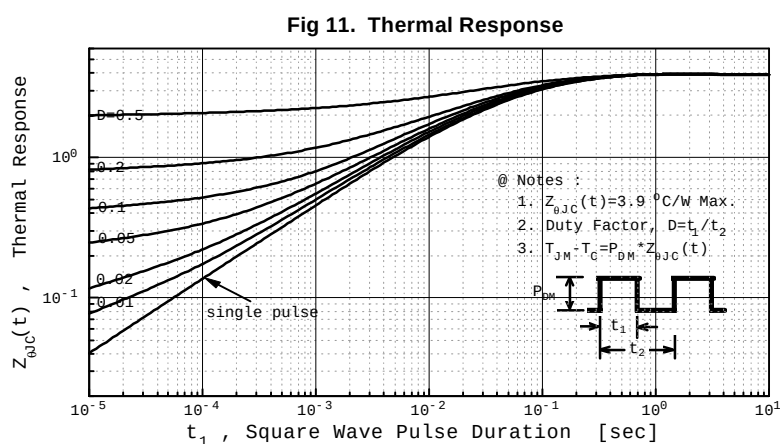
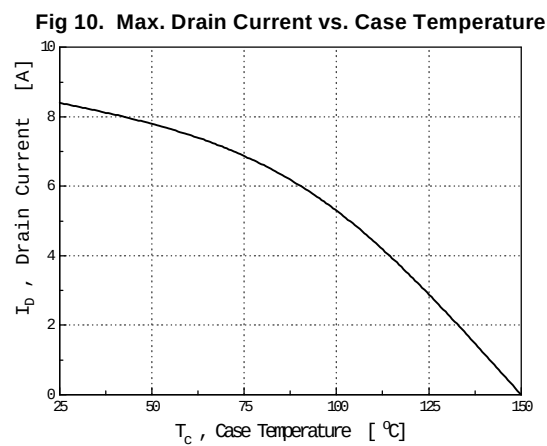
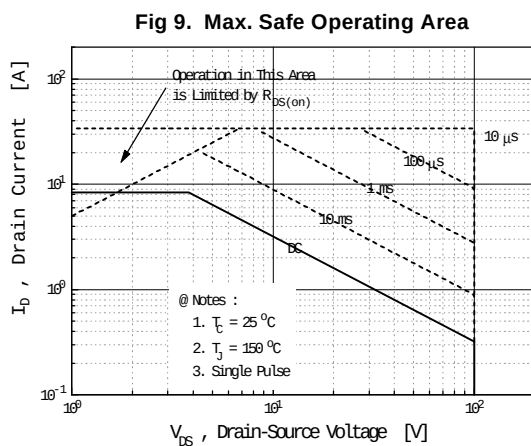
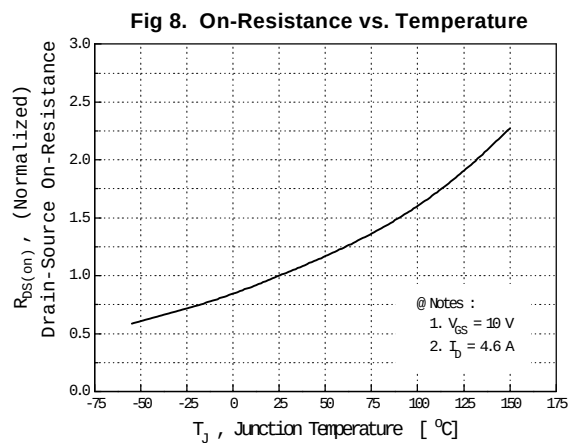
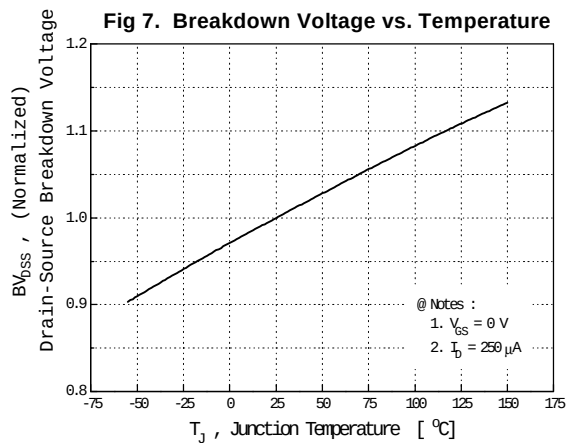


**Fig 6. Gate Charge vs. Gate-Source Voltage**

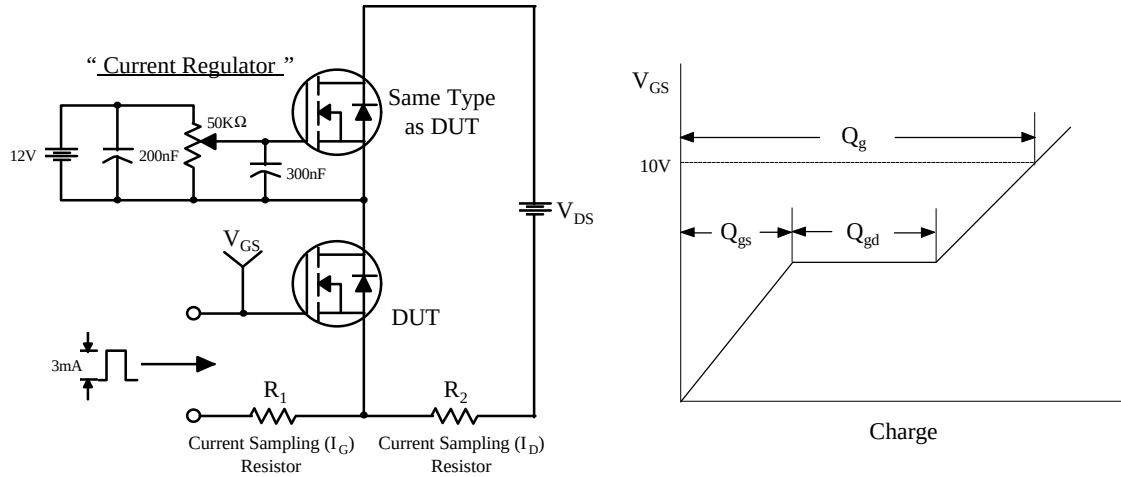


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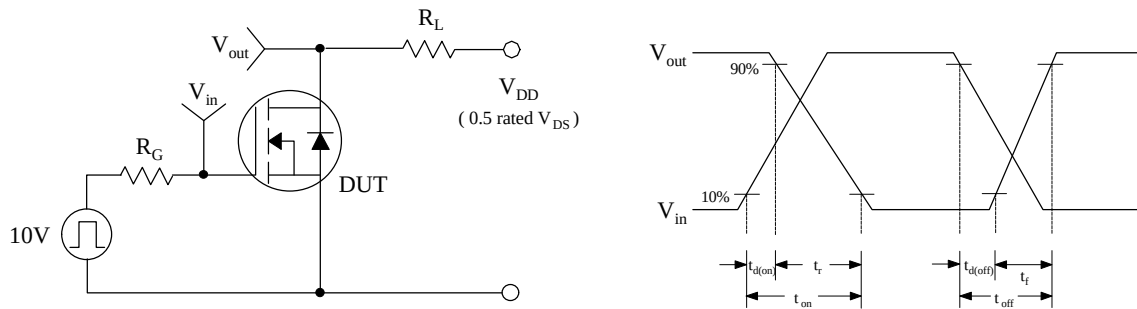
## N-CHANNEL POWER MOSFET



**Fig 12. Gate Charge Test Circuit & Waveform**



**Fig 13. Resistive Switching Test Circuit & Waveforms**



**Fig 14. Unclamped Inductive Switching Test Circuit & Waveforms**

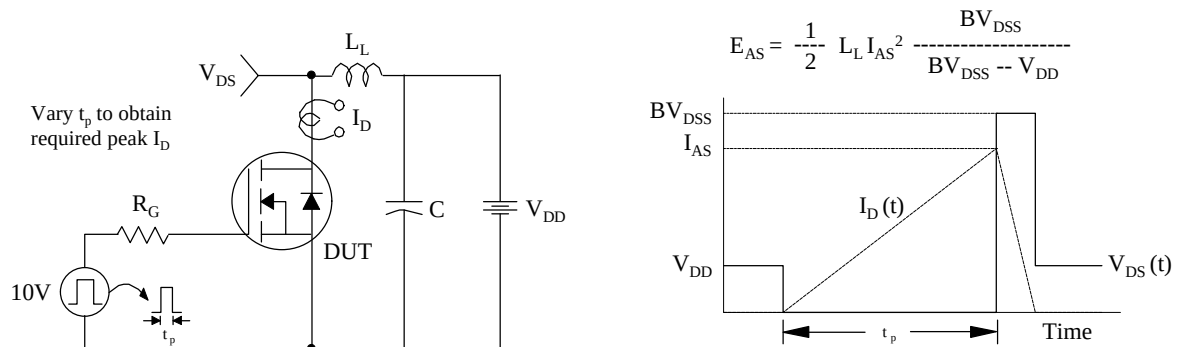
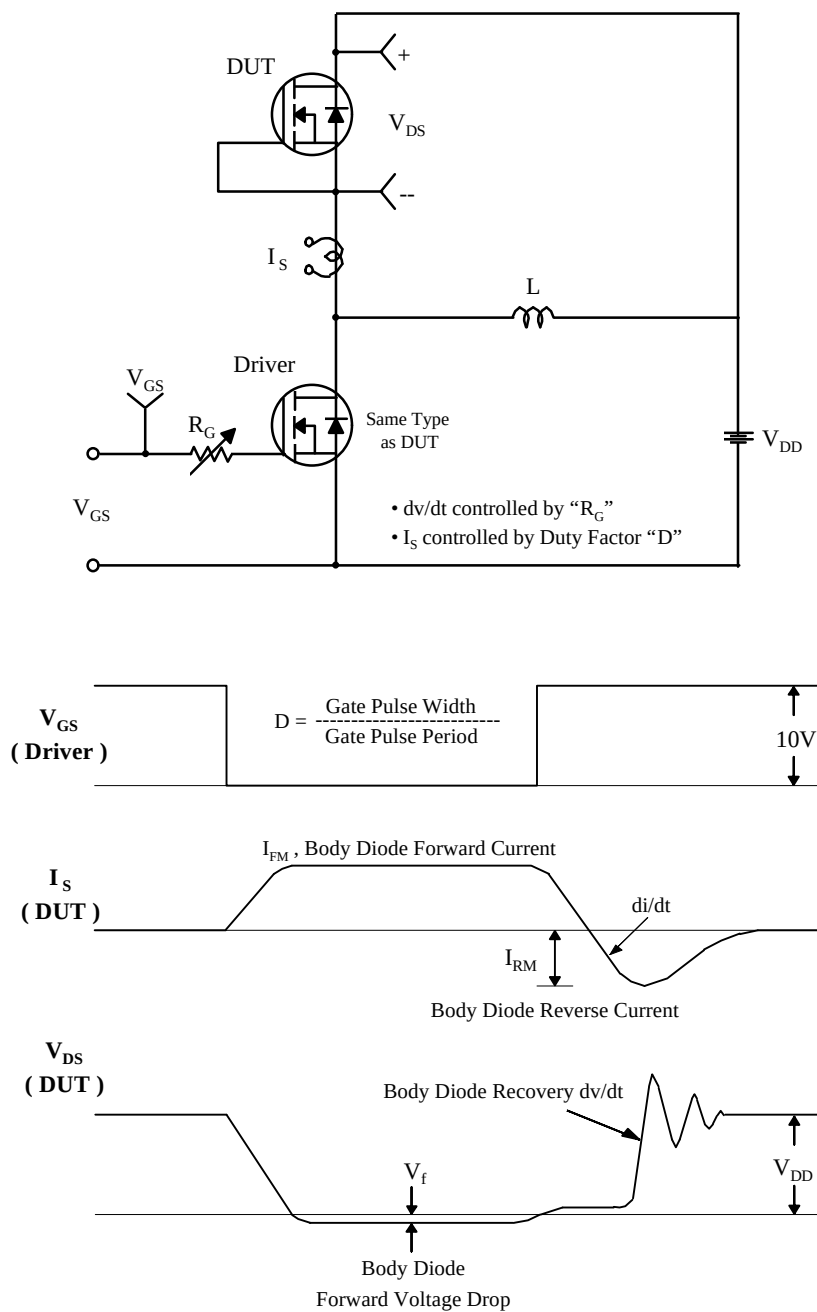


Fig 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms



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