

## 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.) @  $V_{DS} = -60V$
- Lower  $R_{DS(ON)}$  : 0.106  $\Omega$  (Typ.)

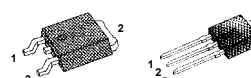
$$BV_{DSS} = -60 V$$

$$R_{DS(on)} = 0.14 \Omega$$

$$I_D = -14 A$$

D-PAK

I-PAK



1. Gate 2. Drain 3. Source

## Absolute Maximum Ratings

| Symbol         | Characteristic                                                          | Value        | Units         |
|----------------|-------------------------------------------------------------------------|--------------|---------------|
| $V_{DSS}$      | Drain-to-Source Voltage                                                 | -60          | V             |
| $I_D$          | Continuous Drain Current ( $T_C=25^\circ C$ )                           | -14          | A             |
|                | Continuous Drain Current ( $T_C=100^\circ C$ )                          | -9.8         |               |
| $I_{DM}$       | Drain Current-Pulsed ①                                                  | 56           | A             |
| $V_{GS}$       | Gate-to-Source Voltage                                                  | $\pm 20$     | V             |
| $E_{AS}$       | Single Pulsed Avalanche Energy ②                                        | 336          | mJ            |
| $I_{AR}$       | Avalanche Current ①                                                     | -14          | A             |
| $E_{AR}$       | Repetitive Avalanche Energy ①                                           | 4.9          | mJ            |
| dv/dt          | Peak Diode Recovery dv/dt ③                                             | -5.5         | V/ns          |
| $P_D$          | Total Power Dissipation ( $T_A=25^\circ C$ ) *                          | 2.5          | W             |
|                | Total Power Dissipation ( $T_C=25^\circ C$ )                            | 49           | W             |
|                | Linear Derating Factor                                                  | 0.39         | 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      | --   | 2.55 | $^\circ C/W$ |
| $R_{\theta JA}$ | Junction-to-Ambient * | --   | 50   |              |
| $R_{\theta JA}$ | Junction-to-Ambient   | --   | 110  |              |

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

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

| Symbol                 | Characteristic                          | Min. | Typ.  | Max. | Units              | Test Condition                                                                |
|------------------------|-----------------------------------------|------|-------|------|--------------------|-------------------------------------------------------------------------------|
| $BV_{DSS}$             | Drain-Source Breakdown Voltage          | -60  | --    | --   | V                  | $V_{GS}=0V, I_D=-250\mu A$                                                    |
| $\Delta BV/\Delta T_J$ | Breakdown Voltage Temp. Coeff.          | --   | -0.05 | --   | $V/^\circ\text{C}$ | $I_D=-250\mu A$ <b>See Fig 7</b>                                              |
| $V_{GS(th)}$           | Gate Threshold Voltage                  | -2.0 | --    | -4.0 | V                  | $V_{DS}=-5V, I_D=-250\mu A$                                                   |
| $I_{GSS}$              | Gate-Source Leakage, Forward            | --   | --    | -100 | nA                 | $V_{GS}=-20V$                                                                 |
|                        | Gate-Source Leakage, Reverse            | --   | --    | 100  |                    | $V_{GS}=20V$                                                                  |
| $I_{DSS}$              | Drain-to-Source Leakage Current         | --   | --    | -10  | $\mu A$            | $V_{DS}=-60V$                                                                 |
|                        |                                         | --   | --    | -100 |                    | $V_{DS}=-48V, T_C=125^\circ\text{C}$                                          |
| $R_{DS(on)}$           | Static Drain-Source On-State Resistance | --   | --    | 0.14 | $\Omega$           | $V_{GS}=-10V, I_D=-7.0A$ ④                                                    |
| $g_{fs}$               | Forward Transconductance                | --   | 8.1   | --   | $\text{S}$         | $V_{DS}=-30V, I_D=-7.0A$ ④                                                    |
| $C_{iss}$              | Input Capacitance                       | --   | 890   | 1155 | pF                 | $V_{GS}=0V, V_{DS}=-25V, f=1\text{MHz}$<br><b>See Fig 5</b>                   |
| $C_{oss}$              | Output Capacitance                      | --   | 265   | 400  |                    |                                                                               |
| $C_{rss}$              | Reverse Transfer Capacitance            | --   | 84    | 125  |                    |                                                                               |
| $t_{d(on)}$            | Turn-On Delay Time                      | --   | 14    | 40   | ns                 | $V_{DD}=-30V, I_D=-18A,$<br>$R_G=12\Omega$<br><b>See Fig 13</b> ④⑤            |
| $t_r$                  | Rise Time                               | --   | 24    | 60   |                    |                                                                               |
| $t_{d(off)}$           | Turn-Off Delay Time                     | --   | 43    | 95   |                    |                                                                               |
| $t_f$                  | Fall Time                               | --   | 28    | 65   |                    |                                                                               |
| $Q_g$                  | Total Gate Charge                       | --   | 30    | 38   | nC                 | $V_{DS}=-48V, V_{GS}=-10V,$<br>$I_D=-18A$<br><b>See Fig 6 &amp; Fig 12</b> ④⑤ |
| $Q_{gs}$               | Gate-Source Charge                      | --   | 5.3   | --   |                    |                                                                               |
| $Q_{gd}$               | Gate-Drain("Miller") Charge             | --   | 12    | --   |                    |                                                                               |

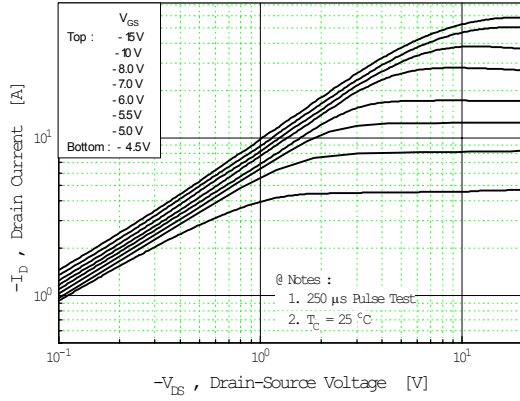
**Source-Drain Diode Ratings and Characteristics**

| Symbol   | Characteristic            | Min. | Typ. | Max. | Units         | Test Condition                              |
|----------|---------------------------|------|------|------|---------------|---------------------------------------------|
| $I_S$    | Continuous Source Current | --   | --   | -14  | A             | Integral reverse pn-diode in the MOSFET     |
| $I_{SM}$ | Pulsed-Source Current ①   | --   | --   | -56  |               |                                             |
| $V_{SD}$ | Diode Forward Voltage ④   | --   | --   | -3.9 | V             | $T_J=25^\circ\text{C}, I_S=-14A, V_{GS}=0V$ |
| $t_{rr}$ | Reverse Recovery Time     | --   | 85   | --   | ns            | $T_J=25^\circ\text{C}, I_F=-18A$            |
| $Q_{rr}$ | Reverse Recovery Charge   | --   | 0.25 | --   | $\mu\text{C}$ | $di_F/dt=100A/\mu\text{s}$ ④                |

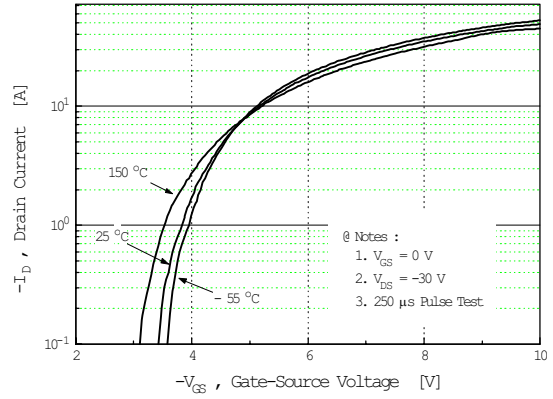
**Notes ;**

- ① Repetitive Rating : Pulse Width Limited by Maximum Junction Temperature  
 ②  $L=2.0\text{mH}, I_{AS}=-14A, V_{DD}=-25V, R_G=27\Omega^*,$  Starting  $T_J=25^\circ\text{C}$   
 ③  $I_{SD}\leq -18A, di/dt\leq 300A/\mu\text{s}, V_{DD}\leq BV_{DSS},$  Starting  $T_J=25^\circ\text{C}$   
 ④ Pulse Test : Pulse Width =  $250\mu\text{s},$  Duty Cycle  $\leq 2\%$   
 ⑤ Essentially Independent of Operating Temperature

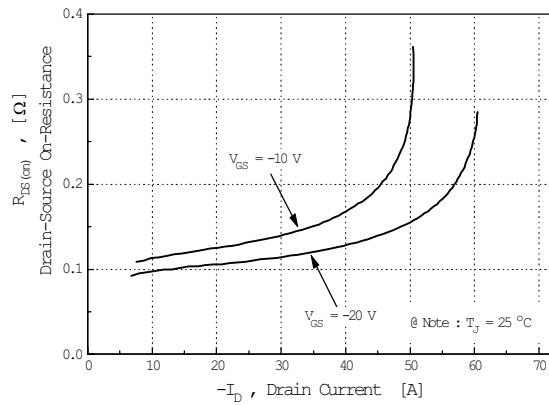
**Fig 1. Output Characteristics**



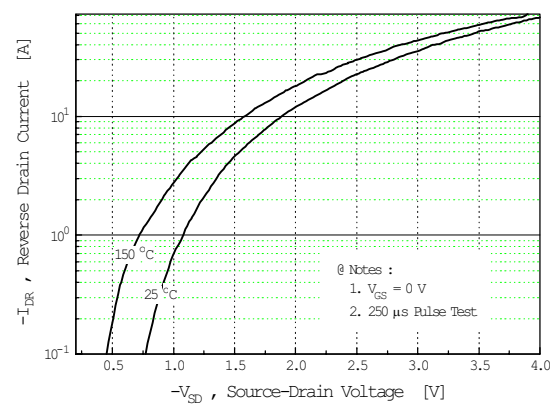
**Fig 2. Transfer Characteristics**



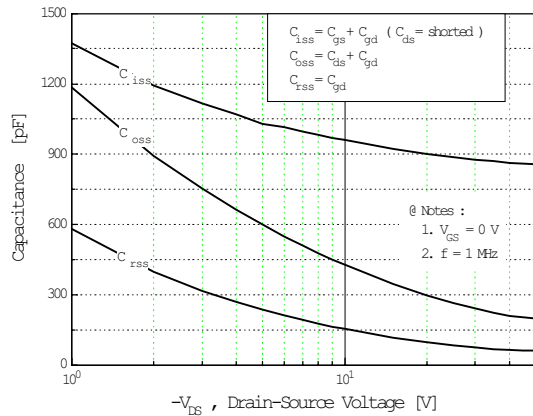
**Fig 3. On-Resistance vs. Drain Current**



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



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



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

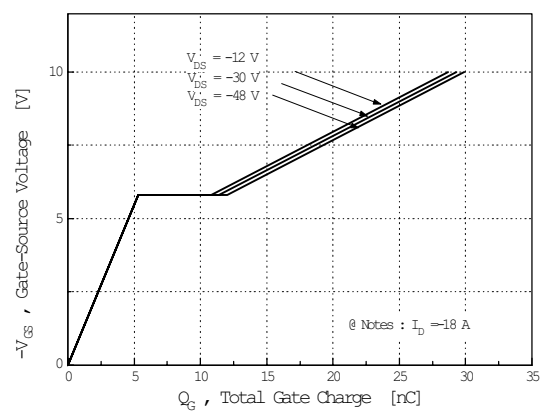


Fig 7. Breakdown Voltage vs. Temperature

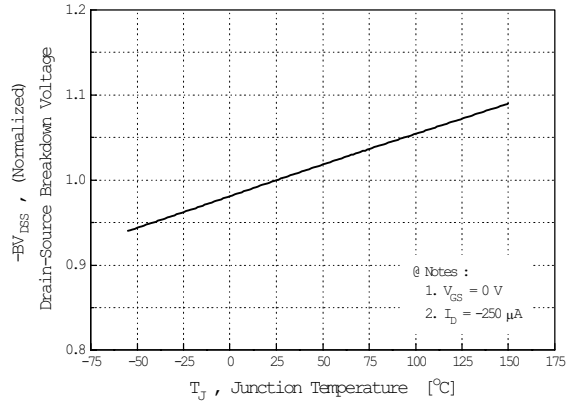


Fig 8. On-Resistance vs. Temperature

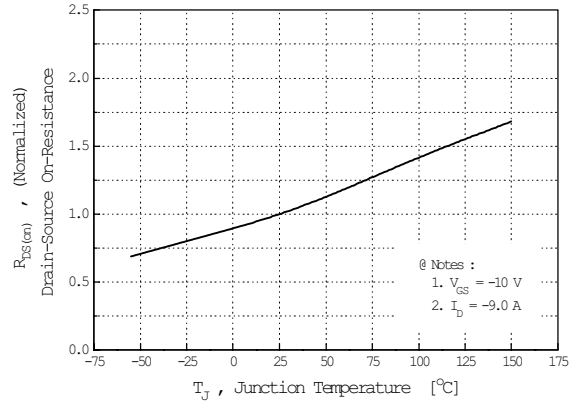


Fig 9. Max. Safe Operating Area

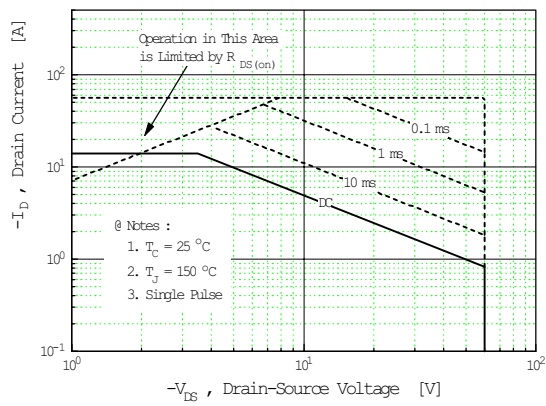


Fig 10. Max. Drain Current vs. Case Temperature

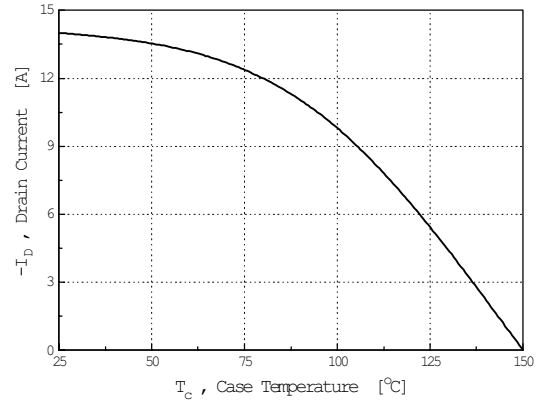
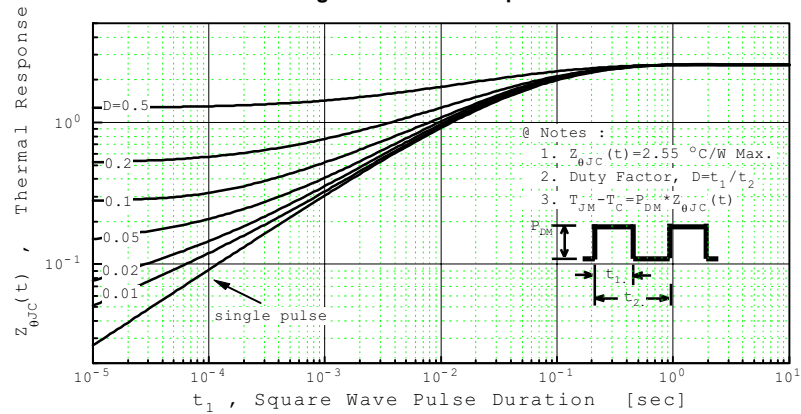
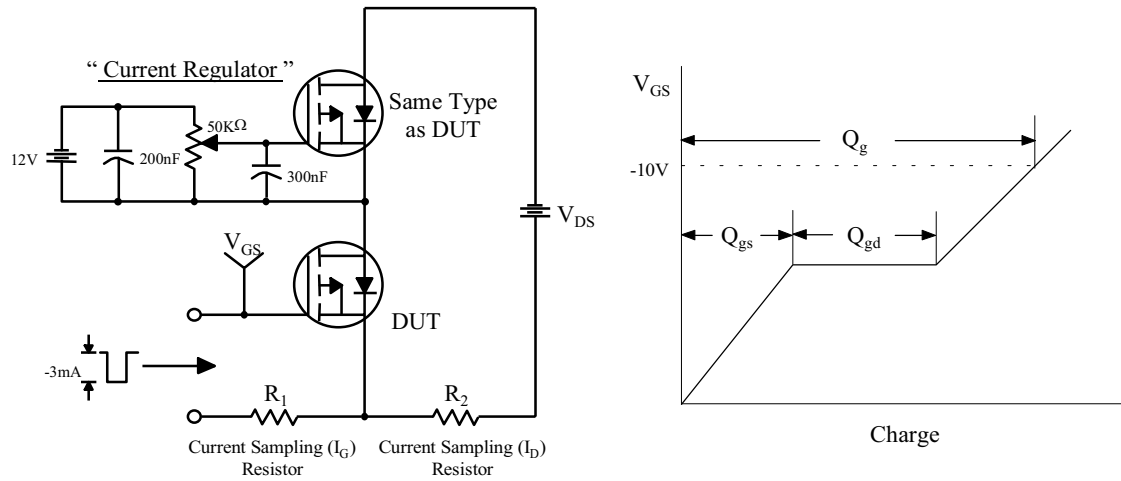


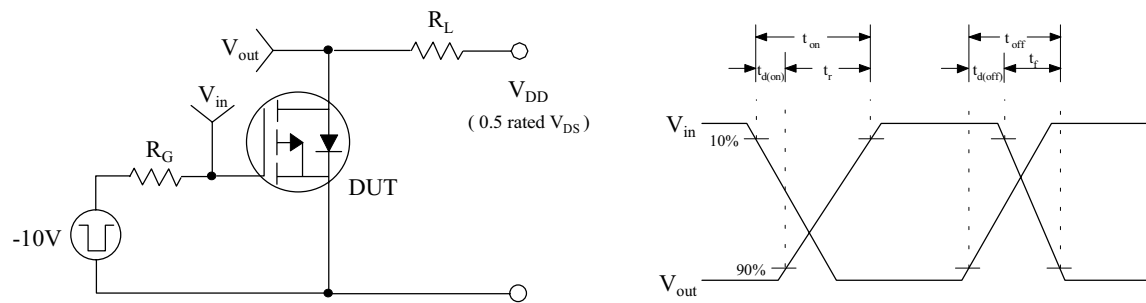
Fig 11. Thermal Response



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



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



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

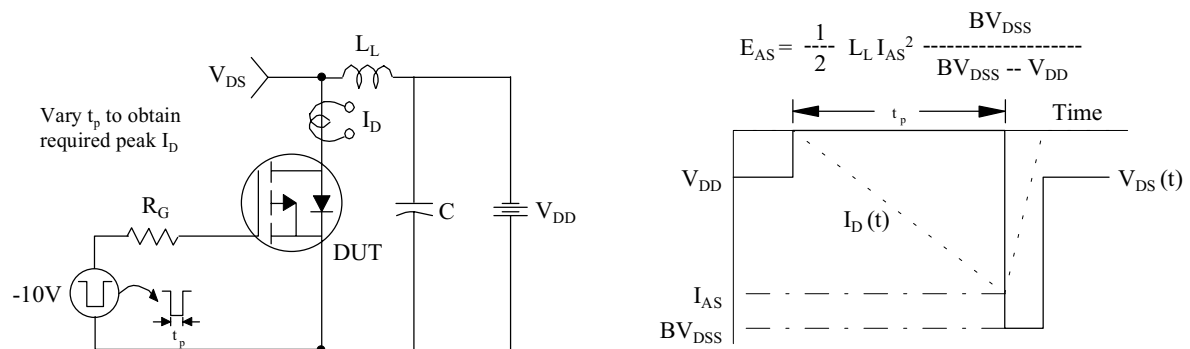


Fig 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms

