

## Description:

This N-Channel and P-Channel MOSFET use advanced trench technology and design to provide excellent  $R_{DS(on)}$  with low gate charge.

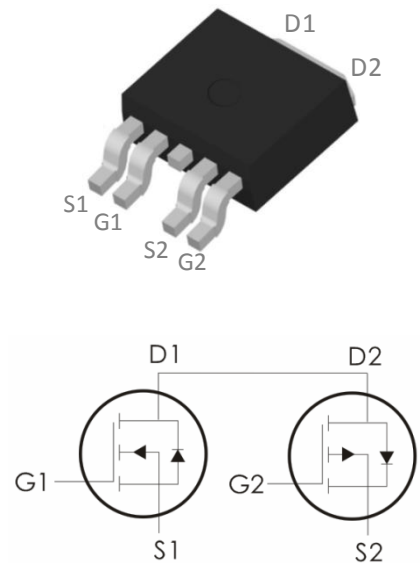
It can be used in a wide variety of applications.

## Features:

N-Channel:  $V_{DS}=40V, I_D=60A, R_{DS(ON)}<5.5m\Omega @V_{GS}=10V$

P-Channel:  $V_{DS}=-40V, I_D=-38A, R_{DS(ON)}<15m\Omega @V_{GS}=-10V$

- 1) Low gate charge.
- 2) Green device available.
- 3) Advanced high cell density trench technology for ultra low  $R_{DS(ON)}$ .
- 4) Excellent package for good heat dissipation.



## Absolute Maximum Ratings: ( $T_C=25^\circ C$ unless otherwise noted)

| Symbol         | Parameter                                        | N-Channel   | P-Channel | Units      |
|----------------|--------------------------------------------------|-------------|-----------|------------|
| $V_{DS}$       | Drain-Source Voltage                             | 40          | -40       | V          |
| $V_{GS}$       | Gate-Source Voltage                              | $\pm 20$    | $\pm 20$  | V          |
| $I_D$          | Continuous Drain Current $T_C=25^\circ C$        | 60          | -38       | A          |
|                | Continuous Drain Current- $T_C=100^\circ C$      | 35          | -20       |            |
|                | Pulsed Drain Current <sup>1</sup>                | 250         | -125      |            |
| $P_D$          | Power Dissipation $T_C=25^\circ C$               | 55          | 55        | W          |
| $T_J, T_{STG}$ | Operating and Storage Junction Temperature Range | -55 to +150 |           | $^\circ C$ |

## Thermal Characteristics:

| Symbol          | Parameter                               | Max | Units        |
|-----------------|-----------------------------------------|-----|--------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case    | 2.3 | $^\circ C/W$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | 62  |              |

## Package Marking and Ordering Information:

| Part NO. | Marking | Package  |
|----------|---------|----------|
| DOD639B  | D639B   | TO-252-4 |

## N-CH Electrical Characteristics: ( $T_C=25^{\circ}\text{C}$ unless otherwise noted)

| Symbol                             | Parameter                                | Conditions                                                                                  | Min | Typ  | Max   | Units |
|------------------------------------|------------------------------------------|---------------------------------------------------------------------------------------------|-----|------|-------|-------|
| Off Characteristics                |                                          |                                                                                             |     |      |       |       |
| BV <sub>DSS</sub>                  | Drain-Source Breakdown Voltage           | V <sub>GS</sub> =0V, I <sub>D</sub> =250 μ A                                                | 40  | ---  | ---   | V     |
| I <sub>DSS</sub>                   | Zero Gate Voltage Drain Current          | V <sub>GS</sub> =0V, V <sub>DS</sub> =-40V                                                  | --- | ---  | 1     | μ A   |
| I <sub>GSS</sub>                   | Gate-Source Leakage Current              | V <sub>GS</sub> =± 20V, V <sub>DS</sub> =0A                                                 | --- | ---  | ± 100 | nA    |
| On Characteristics                 |                                          |                                                                                             |     |      |       |       |
| V <sub>GS(th)</sub>                | GATE-Source Threshold Voltage            | V <sub>GS</sub> =V <sub>DS</sub> , I <sub>D</sub> =250 μ A                                  | 1   | 1.6  | 2.5   | V     |
| R <sub>DS(ON)</sub>                | Drain-Source On Resistance <sup>3</sup>  | V <sub>GS</sub> =10V, I <sub>D</sub> =20A                                                   | --- | 4.2  | 5.5   | m Ω   |
|                                    |                                          | V <sub>GS</sub> =4.5V, I <sub>D</sub> =10A                                                  | --- | 5.3  | 7     |       |
| G <sub>FS</sub>                    | Forward Transconductance                 | V <sub>DS</sub> =10V, I <sub>D</sub> =10A                                                   | --- | 16   | ---   | S     |
| Dynamic Characteristics            |                                          |                                                                                             |     |      |       |       |
| C <sub>iss</sub>                   | Input Capacitance                        | V <sub>DS</sub> =25V, V <sub>GS</sub> =0V, f=1MHz                                           | --- | 2380 | 3400  | pF    |
| C <sub>oss</sub>                   | Output Capacitance                       |                                                                                             | --- | 230  | 385   |       |
| C <sub>rss</sub>                   | Reverse Transfer Capacitance             |                                                                                             | --- | 148  | 210   |       |
| Switching Characteristics          |                                          |                                                                                             |     |      |       |       |
| t <sub>d(on)</sub>                 | Turn-On Delay Time <sup>2,3</sup>        | V <sub>DD</sub> =20V, I <sub>D</sub> =1A,<br>R <sub>GEN</sub> =3.3 Ω , V <sub>GS</sub> =10V | --- | 14.2 | 28    | ns    |
| t <sub>r</sub>                     | Rise Time <sup>2,3</sup>                 |                                                                                             | --- | 18.3 | 36    | ns    |
| t <sub>d(off)</sub>                | Turn-Off Delay Time <sup>2,3</sup>       |                                                                                             | --- | 38.8 | 76    | ns    |
| t <sub>f</sub>                     | Fall Time <sup>2,3</sup>                 |                                                                                             | --- | 13.9 | 28    | ns    |
| Q <sub>g</sub>                     | Total Gate Charge <sup>3</sup>           | V <sub>GS</sub> =4.5V, V <sub>DS</sub> =32V,<br>I <sub>D</sub> =10A                         | --- | 25   | 50    | nC    |
| Q <sub>gs</sub>                    | Gate-Source Charge                       |                                                                                             | --- | 6.5  | 13    | nC    |
| Q <sub>gd</sub>                    | Gate-Drain “Miller” Charge               |                                                                                             | --- | 12.1 | 24    | nC    |
| Drain-Source Diode Characteristics |                                          |                                                                                             |     |      |       |       |
| V <sub>SD</sub>                    | Drain Diode Forward Voltage <sup>3</sup> | V <sub>GS</sub> =0V, I <sub>S</sub> =1A                                                     | --- | ---  | 1     | V     |

|            |                           |                              |     |     |     |   |
|------------|---------------------------|------------------------------|-----|-----|-----|---|
| <b>LS</b>  | Continuous Source Current | $V_G=V_D=0V$ , Force Current | --- | --- | 60  | A |
| <b>Ism</b> | Pulsed Source Current     |                              | --- | --- | 250 | A |

**Typical Characteristics:** ( $T_C=25^\circ\text{C}$  unless otherwise noted)

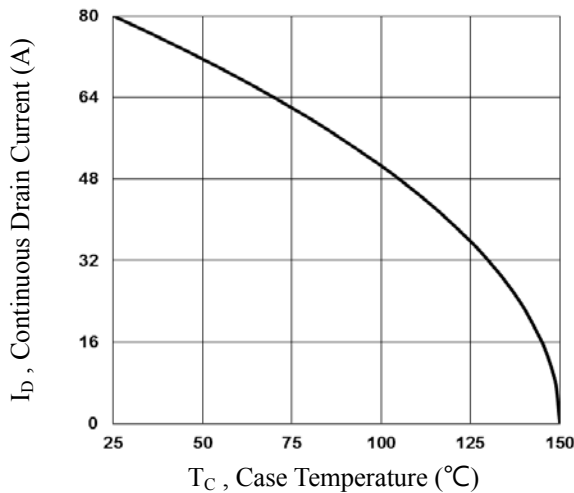


Fig.1 Continuous Drain Current vs.  $T_C$

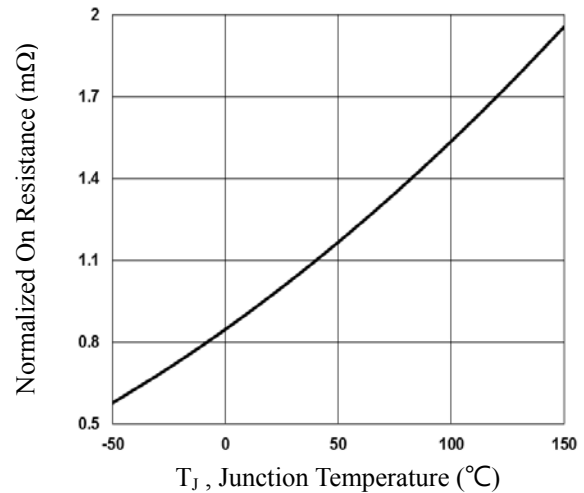


Fig.2 Normalized  $R_{DS(on)}$  vs.  $T_J$

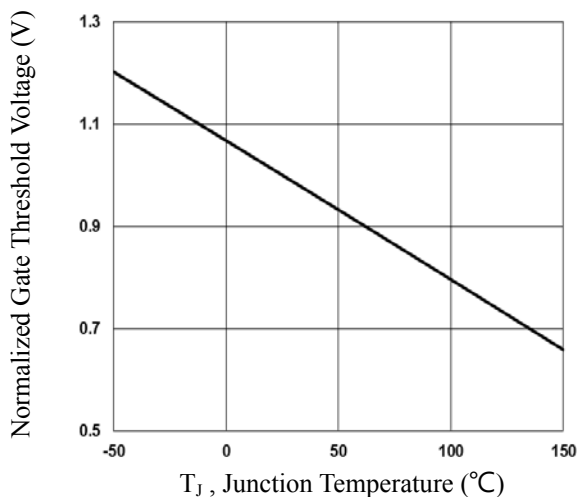


Fig.3 Normalized  $V_{th}$  vs.  $T_J$

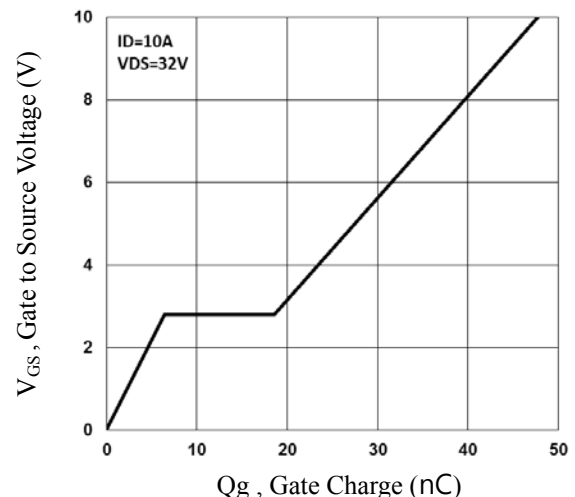


Fig.4 Gate Charge Waveform

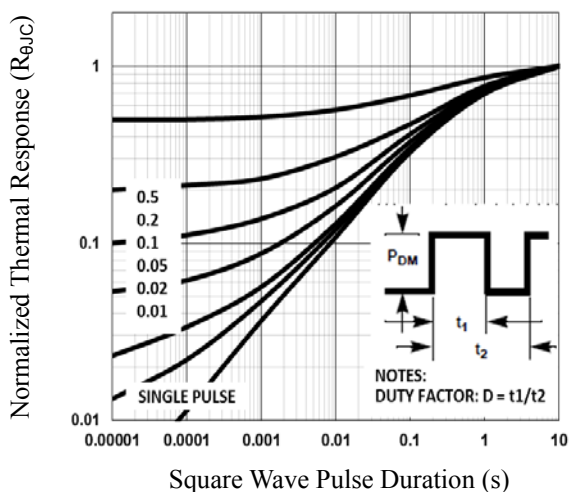


Fig.5 Normalized Transient Impedance

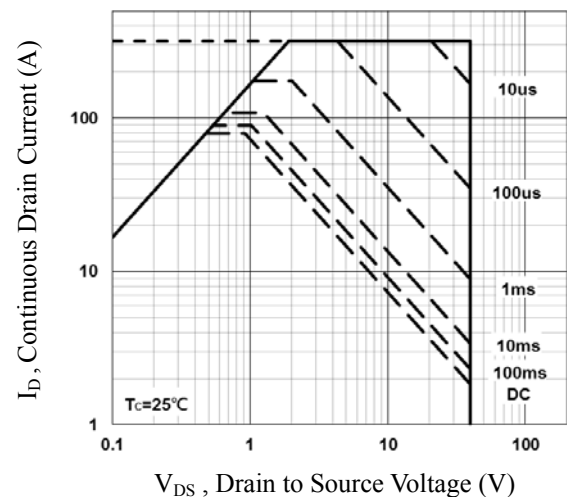


Fig.6 Maximum Safe Operation Area

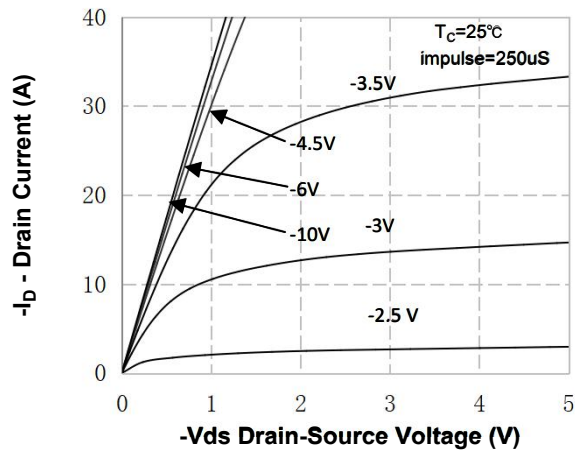
**Electrical Characteristics:** ( $T_C=25^{\circ}\text{C}$  unless otherwise noted)

| Symbol                             | Parameter                         | Conditions                                                                                 | Min | Typ  | Max   | Units |
|------------------------------------|-----------------------------------|--------------------------------------------------------------------------------------------|-----|------|-------|-------|
| Off Characteristics                |                                   |                                                                                            |     |      |       |       |
| BV <sub>DSS</sub>                  | Drain-Source Breakdown Voltage    | V <sub>GS</sub> =0V, I <sub>D</sub> =-250 μ A                                              | -40 | ---  | ---   | V     |
| I <sub>DSS</sub>                   | Zero Gate Voltage Drain Current   | V <sub>GS</sub> =0V, V <sub>DS</sub> =-40V                                                 | --- | ---  | -1    | μ A   |
| I <sub>GSS</sub>                   | Gate-Source Leakage Current       | V <sub>GS</sub> =± 20V, V <sub>DS</sub> =0A                                                | --- | ---  | ± 100 | nA    |
| On Characteristics                 |                                   |                                                                                            |     |      |       |       |
| V <sub>GS(th)</sub>                | GATE-Source Threshold Voltage     | V <sub>GS</sub> =V <sub>DS</sub> , I <sub>D</sub> =-250 μ A                                | -1  | ---  | -2.5  | V     |
| R <sub>DS(ON)</sub>                | Static Drain-Source On-Resistance | V <sub>GS</sub> =-10V, I <sub>D</sub> =210A                                                | --- | 10.2 | 15    | m Ω   |
|                                    |                                   | V <sub>GS</sub> =-4.5V, I <sub>D</sub> =-20A                                               | --- | 13.5 | 17    |       |
|                                    |                                   |                                                                                            |     |      |       |       |
| Dynamic Characteristics            |                                   |                                                                                            |     |      |       |       |
| C <sub>iss</sub>                   | Input Capacitance                 | V <sub>DS</sub> =-20V, V <sub>GS</sub> =0V, f=1MHz                                         | --- | 3119 | ---   | pF    |
| C <sub>oss</sub>                   | Output Capacitance                |                                                                                            | --- | 237  | ---   |       |
| C <sub>rss</sub>                   | Reverse Transfer Capacitance      |                                                                                            | --- | 225  | ---   |       |
| Switching Characteristics          |                                   |                                                                                            |     |      |       |       |
| t <sub>d(on)</sub>                 | Turn-On Delay Time                | V <sub>DD</sub> =-20V, I <sub>D</sub> =-20A,<br>V <sub>GS</sub> =-10V, R <sub>L</sub> =3 Ω | --- | 13   | ---   | ns    |
| t <sub>r</sub>                     | Rise Time                         |                                                                                            | --- | 15   | ---   | ns    |
| t <sub>d(off)</sub>                | Turn-Off Delay Time               |                                                                                            | --- | 35   | ---   | ns    |
| t <sub>f</sub>                     | Fall Time                         |                                                                                            | --- | 17   | ---   | ns    |
| Q <sub>g</sub>                     | Total Gate Charge                 | V <sub>GS</sub> =-10V, V <sub>DS</sub> =-20V,<br>I <sub>D</sub> =-20A                      | --- | 41   | ---   | nC    |
| Q <sub>gs</sub>                    | Gate-Source Charge                |                                                                                            | --- | 6    | ---   | nC    |
| Q <sub>gd</sub>                    | Gate-Drain “Miller” Charge        |                                                                                            | --- | 8.1  | ---   | nC    |
| Drain-Source Diode Characteristics |                                   |                                                                                            |     |      |       |       |
| V <sub>SD</sub>                    | Drain Diode Forward Voltage       | V <sub>GS</sub> =0V, I <sub>S</sub> =-20A                                                  | --- | ---  | -1.2  | V     |
| I <sub>S</sub>                     | Continuous Source Current         | V <sub>G</sub> =V <sub>D</sub> =0V ,                                                       | --- | ---  | -38   | A     |
| I <sub>SM</sub>                    | Pulsed Source Current             |                                                                                            | --- | ---  | -130  | A     |
| T <sub>rr</sub>                    | Reverse recovery time,            | IF =-20A dIF/dt=100A//μs                                                                   | --- | 42   | ---   | Ns    |
| Q <sub>rr</sub>                    | Reverse recovery charge           |                                                                                            | --- | 41   | ---   | Nc    |

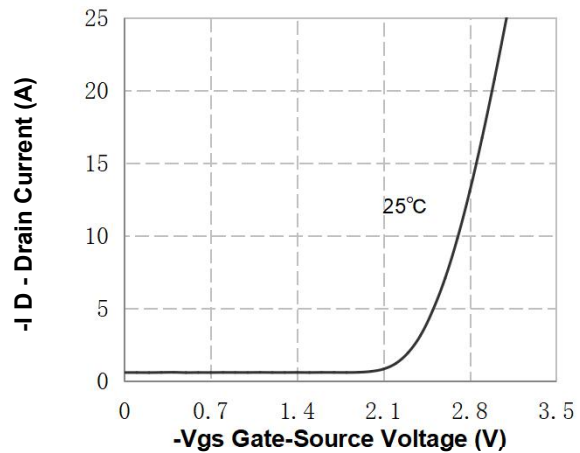
**Notes:**

1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature
2. EAS condition:  $T_J=25^{\circ}\text{C}$ ,  $V_{DD}=-20V$ ,  $V_G=-10V$ ,  $R_G=25\Omega$ ,  $L=0.5mH$ .
3. Pulse Test: Pulse Width $\leq 300\mu s$ , Duty Cycle $\leq 0.5\%$

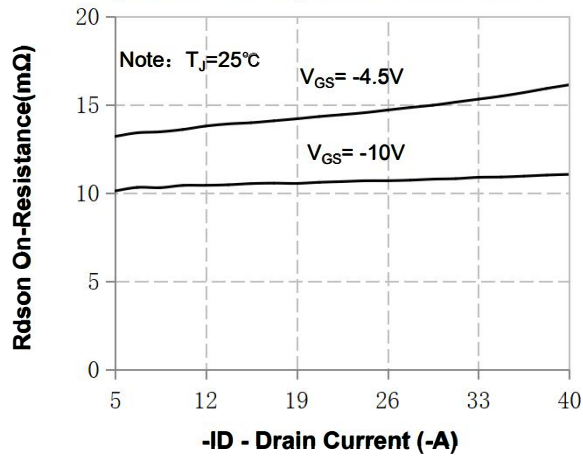
Typical Characteristics: ( $T_C=25^\circ\text{C}$  unless otherwise noted)



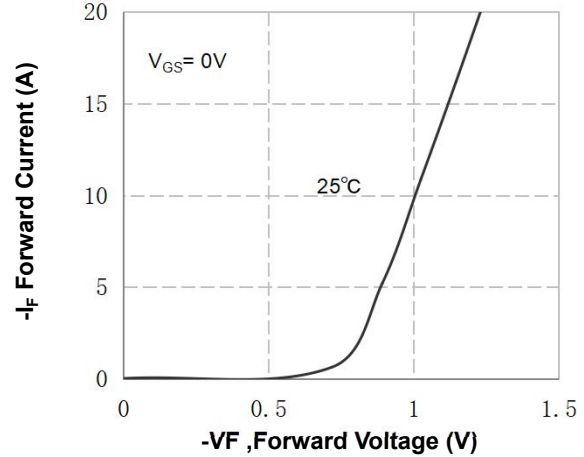
**Figure 1. On-Region Characteristics**



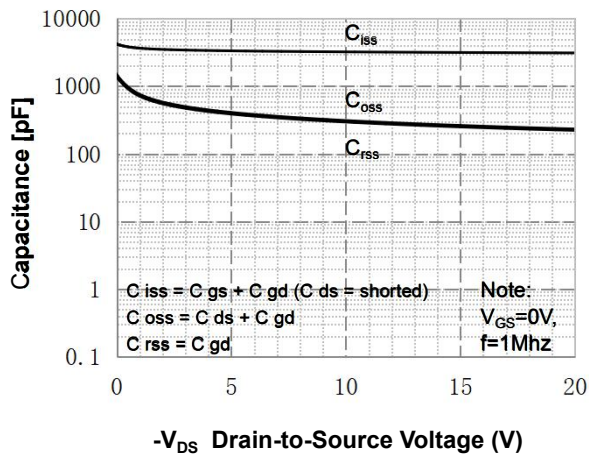
**Figure 2. Transfer Characteristics**



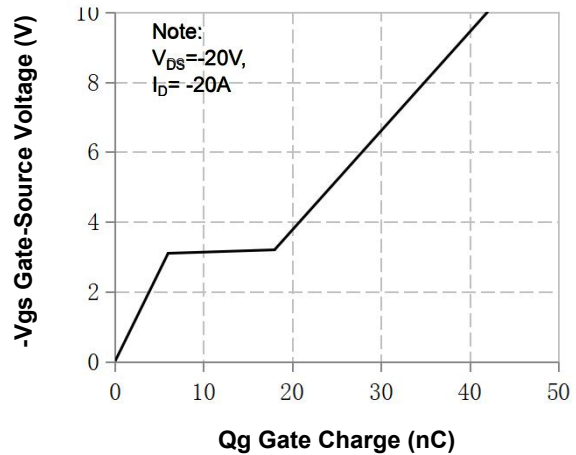
**Figure 3. On-Resistance Variation vs Drain Current and Gate Voltage**



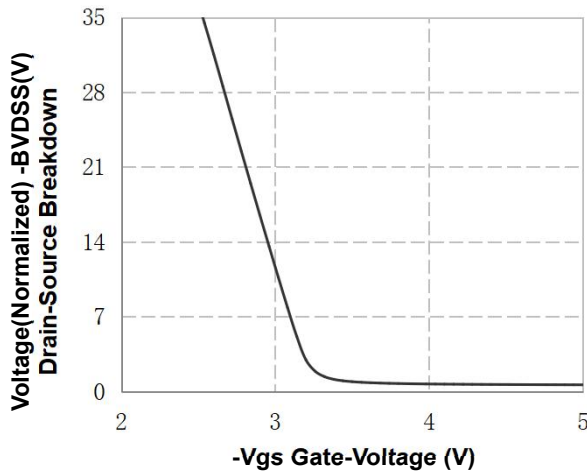
**Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature**



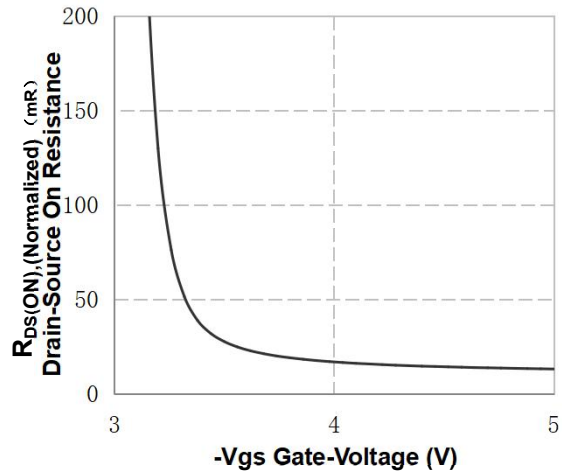
**Figure 5. Capacitance Characteristics**



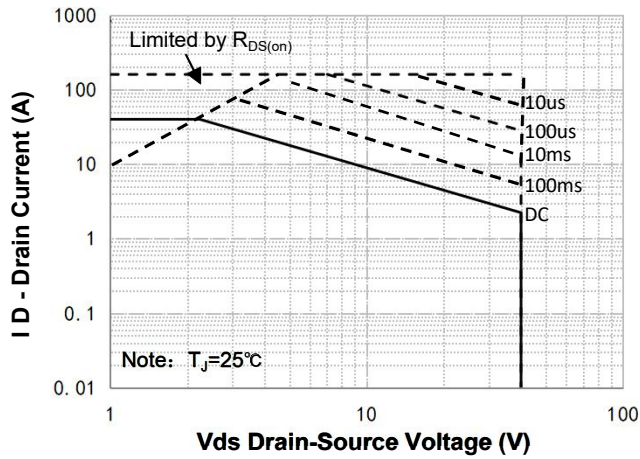
**Figure 6. Gate Charge Characteristics**



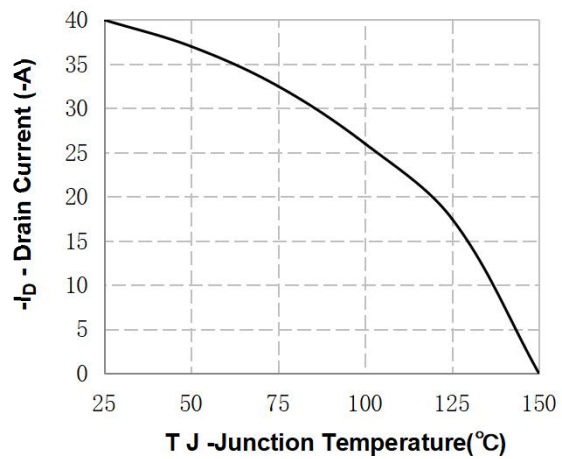
**Figure 7. Breakdown Voltage Variation vs Gate-Voltage**



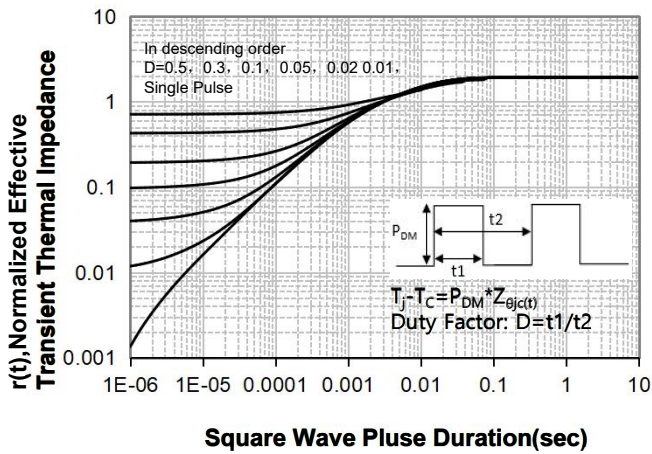
**Figure 8. On-Resistance Variation vs Gate Voltage**



**Figure 9. Maximum Safe Operating Area**



**Figure 10. Maximum PContinuous Drain Current vs Case Temperature**



**Figure 11. Transient Thermal Response Curve**