

## N and P-channel Enhancement Mode Power MOSFET

### Features

- Advanced
- Excellent  $R_{DS(ON)}$  and Low Gate Charge
- Pb-free Lead Plating
- Halogen-free and RoHS-compliant
- 100% UIS TESTED!, 100% Rg TESTED!

### Applications

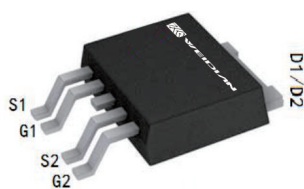
- Load Switch
- PWM Application
- Power Management

### N-Channel

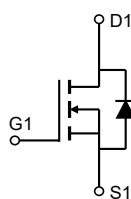
| Parameters                      | Value | Unit      |
|---------------------------------|-------|-----------|
| $V_{DSS}$                       | 30    | V         |
| $V_{GS(th\_Typ)}$               | 1.65  | V         |
| $I_D(@V_{GS}=10V)$              | 40    | A         |
| $R_{DS(ON\_Typ)}(@V_{GS}=10V)$  | 7.6   | $m\Omega$ |
| $R_{DS(ON\_Typ)}(@V_{GS}=4.5V)$ | 11.5  | $m\Omega$ |

### P-Channel

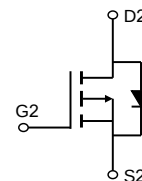
| Parameters                       | Value | Unit      |
|----------------------------------|-------|-----------|
| $V_{DSS}$                        | -30   | V         |
| $V_{GS(th\_Typ)}$                | -1.5  | V         |
| $I_D(@V_{GS}=-10V)$              | -12   | A         |
| $R_{DS(ON\_Typ)}(@V_{GS}=-10V)$  | 13    | $m\Omega$ |
| $R_{DS(ON\_Typ)}(@V_{GS}=-4.5V)$ | 17.5  | $m\Omega$ |



TO-252-4L Top View



N-channel



P-channel

### Ordering Information

| Device   | Marking | Package | Packing | Reel Size | Tape Width | Reel (pcs) |
|----------|---------|---------|---------|-----------|------------|------------|
| ZK3020DL | 3020D   | TO-252  | Reel    | N/A       | N/A        | 2500       |

### MAXIMUM RATINGS ( $T_a=25^{\circ}C$ unless otherwise noted )

| Parameter                                        |                     | Symbol         | N-Channel  | P-Channel  | Unit        |
|--------------------------------------------------|---------------------|----------------|------------|------------|-------------|
| Drain-Source Voltage                             |                     | $V_{DS}$       | 30         | -30        | V           |
| Gate-Source Voltage                              |                     | $V_{GS}$       | $\pm 12$   | $\pm 12$   | V           |
| Continuous Drain Current                         | $T_C = 25^{\circ}C$ | $I_D$          | 40         | -12        | A           |
|                                                  | $T_C = 70^{\circ}C$ |                | 25         | -7         |             |
| Pulsed Drain Current (Note 1)                    |                     | $I_{DM}$       | 55         | -43        | A           |
| Maximum Power Dissipation                        | $T_A=25^{\circ}C$   | $P_D$          | 3.5        | 3.5        | W           |
| Operating Junction and Storage Temperature Range |                     | $T_J, T_{STG}$ | -55 To 150 | -55 To 150 | $^{\circ}C$ |

## N-CH ELECTRICAL CHARACTERISTICS

$T_a = 25^\circ\text{C}$  unless otherwise specified

| Parameter                                     | Symbol                | Test Condition                                                                         | Min | Typ  | Max  | Unit |
|-----------------------------------------------|-----------------------|----------------------------------------------------------------------------------------|-----|------|------|------|
| Off characteristics                           |                       |                                                                                        |     |      |      |      |
| Drain-source breakdown voltage                | V <sub>(BR) DSS</sub> | V <sub>GS</sub> = 0V, I <sub>D</sub> = 250uA                                           | 30  |      |      | V    |
| Zero gate voltage drain current               | I <sub>DSS</sub>      | V <sub>DS</sub> = 40V, V <sub>GS</sub> =0V                                             |     |      | 100  | nA   |
| Gate-body leakage current                     | I <sub>GSS</sub>      | V <sub>DS</sub> = 0V, V <sub>GS</sub> =±20V                                            |     |      | ±100 | nA   |
|                                               |                       |                                                                                        |     |      |      |      |
| On characteristics                            |                       |                                                                                        |     |      |      |      |
| Gate-threshold voltage                        | V <sub>GS(th)</sub>   | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250uA                               | 1.0 | 1.65 | 2.5  | V    |
| Static drain-source on-sate resistance        | R <sub>DS(on)</sub>   | V <sub>GS</sub> =10V, I <sub>D</sub> =20A                                              |     | 7.6  | 10   | mΩ   |
|                                               |                       | V <sub>GS</sub> =4.5V, I <sub>D</sub> =10A                                             |     | 11.5 | 17   | mΩ   |
| Dynamic characteristics                       |                       |                                                                                        |     |      |      |      |
| Input capacitance                             | C <sub>iss</sub>      | V <sub>DS</sub> =15V,V <sub>GS</sub> =0V<br>f =1MHz                                    |     | 1850 |      | pF   |
| Output capacitance                            | C <sub>oss</sub>      |                                                                                        |     | 150  |      |      |
| Reverse transfer capacitance                  | C <sub>rss</sub>      |                                                                                        |     | 124  |      |      |
| Gate Resistance                               | R <sub>g</sub>        | f =1MHz                                                                                |     | 3.2  |      | Ω    |
| Switching characteristics                     |                       |                                                                                        |     |      |      |      |
| Total gate charge                             | Q <sub>g</sub>        | V <sub>GS</sub> =0 to 4,5V<br>V <sub>DS</sub> =15V, I <sub>D</sub> =10A                |     | 10   |      | nC   |
| Gate-source charge                            | Q <sub>gs</sub>       |                                                                                        |     | 3.5  |      |      |
| Gate-drain charge                             | Q <sub>gd</sub>       |                                                                                        |     | 2.2  |      |      |
| Turn-on delay time                            | t <sub>d(on)</sub>    | V <sub>DD</sub> =15V,I <sub>D</sub> =10A<br>V <sub>GS</sub> =4.5V,R <sub>GEN</sub> =3Ω |     | 8    |      | ns   |
| Turn-on rise time                             | t <sub>r</sub>        |                                                                                        |     | 28   |      |      |
| Turn-off delay time                           | t <sub>d(off)</sub>   |                                                                                        |     | 15   |      |      |
| Turn-off fall time                            | t <sub>f</sub>        |                                                                                        |     | 7    |      |      |
| Drain-Source Diode Characteristics            |                       |                                                                                        |     |      |      |      |
| Drain-source diode forward voltage            | V <sub>SD</sub> ④     | V <sub>GS</sub> =0V, I <sub>S</sub> =1A                                                |     |      | 1.2  | V    |
| Continuous drain-source diode forward current | I <sub>S</sub> ①      | T <sub>C</sub> =25℃                                                                    |     |      | 12.5 | A    |

Notes:

1. The data tested by surface mounted on a 1 inch<sup>2</sup> FR-4 board with 20Z copper.
2. The data tested by pulsed, pulse width  $\leq 300\mu s$ , duty cycle  $\leq 2\%$
3. The power dissipation is limited by  $150^\circ\text{C}$  junction temperature
4. The EAS data shows Max. rating. The test condition is  $V_{DD} = 18V, R_G = 25\Omega, V_{GS} = 4.5V, L = 0.1mH, I_{AS} = 11A$
5. The data is theoretically the same as  $I_D$  and  $I_{DM}$ , in real applications, should be limited by total power dissipation.

## P-CH ELECTRICAL CHARACTERISTICS

$T_a = 25^\circ\text{C}$  unless otherwise specified

| Parameter                                     | Symbol                | Test Condition                                                                          | Min  | Typ  | Max  | Unit |
|-----------------------------------------------|-----------------------|-----------------------------------------------------------------------------------------|------|------|------|------|
| Off characteristics                           |                       |                                                                                         |      |      |      |      |
| Drain-source breakdown voltage                | V <sub>(BR) DSS</sub> | V <sub>GS</sub> = 0V, I <sub>D</sub> = -250uA                                           | -30  |      |      | V    |
| Zero gate voltage drain current               | I <sub>DSS</sub>      | V <sub>DS</sub> = -30V, V <sub>GS</sub> =0V                                             |      |      | -1   | μA   |
| Gate-body leakage current                     | I <sub>GSS</sub>      | V <sub>DS</sub> = 0V, V <sub>GS</sub> =±20V                                             |      |      | ±100 | nA   |
|                                               |                       |                                                                                         |      |      |      |      |
| On characteristics                            |                       |                                                                                         |      |      |      |      |
| Gate-threshold voltage                        | V <sub>GS(th)</sub>   | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =-250uA                               | -1.0 | -1.5 | -2.5 | V    |
| Static drain-source on-sate resistance        | R <sub>DS(on)</sub>   | V <sub>GS</sub> =-10V, I <sub>D</sub> =-10A                                             |      | 13   | 17   | mΩ   |
|                                               |                       | V <sub>GS</sub> =-4.5V, I <sub>D</sub> =-5A                                             |      | 17.5 | 22   | mΩ   |
| Dynamic characteristics                       |                       |                                                                                         |      |      |      |      |
| Input capacitance                             | C <sub>iss</sub>      | V <sub>DS</sub> =-15V,V <sub>GS</sub> =0V<br>f =1MHz                                    |      | 1267 |      | pF   |
| Output capacitance                            | C <sub>oss</sub>      |                                                                                         |      | 166  |      |      |
| Reverse transfer capacitance                  | C <sub>rss</sub>      |                                                                                         |      | 126  |      |      |
| Gate Resistance                               | R <sub>g</sub>        | f =1MHz                                                                                 |      | 12   |      | Ω    |
| Switching characteristics                     |                       |                                                                                         |      |      |      |      |
| Total gate charge                             | Q <sub>g</sub>        | V <sub>GS</sub> =0 to -10V<br>V <sub>DS</sub> =-15V, I <sub>D</sub> =-5A                |      | 20   |      | nC   |
| Gate-source charge                            | Q <sub>gs</sub>       |                                                                                         |      | 3    |      |      |
| Gate-drain charge                             | Q <sub>gd</sub>       |                                                                                         |      | 5.5  |      |      |
| Turn-on delay time                            | t <sub>d(on)</sub>    | V <sub>DD</sub> =-15V,I <sub>D</sub> =-5A<br>V <sub>GS</sub> =-10V,R <sub>GEN</sub> =3Ω |      | 7.5  |      | ns   |
| Turn-on rise time                             | t <sub>r</sub>        |                                                                                         |      | 16   |      |      |
| Turn-off delay time                           | t <sub>d(off)</sub>   |                                                                                         |      | 49   |      |      |
| Turn-off fall time                            | t <sub>f</sub>        |                                                                                         |      | 32   |      |      |
| Drain-Source Diode Characteristics            |                       |                                                                                         |      |      |      |      |
| Drain-source diode forward voltage            | V <sub>SD</sub>       | V <sub>GS</sub> =0V, I <sub>S</sub> =-5A                                                |      |      | -1.2 | V    |
| Continuous drain-source diode forward current | I <sub>S</sub>        | T <sub>c</sub> =25 C                                                                    |      |      | -7   | A    |
|                                               |                       |                                                                                         |      |      |      |      |
| Reverse recovery time                         | trr                   | di/dt = 100A/μs, I <sub>F</sub> = -20A                                                  |      | 10   |      | ns   |
| Reverse recovery charge                       | Qrr                   |                                                                                         |      | 3.5  |      | nC   |

Notes:

- 1、The data tested by surface mounted on a 1 inch<sup>2</sup> FR-4 board with 20Z copper.
- 2、The data tested by pulsed , pulse width  $\leq 300\mu s$  , duty cycle  $\leq 2\%$
- 3、The power dissipation is limited by  $150^\circ\text{C}$  junction temperature
- 4、The EAS data shows Max. rating . The test condition is  $V_{DD} = 18V, R_G = 25\Omega, V_{GS} = 4.5V, L = 0.1mH, I_{AS} = 18A$
- 5、The data is theoretically the same as  $I_D$  and  $I_{DM}$  , in real applications , should be limited by total power dissipation.

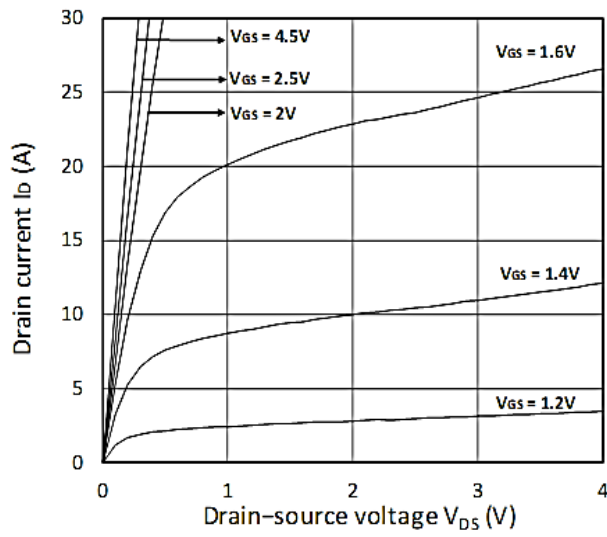


Figure 1. Output Characteristics

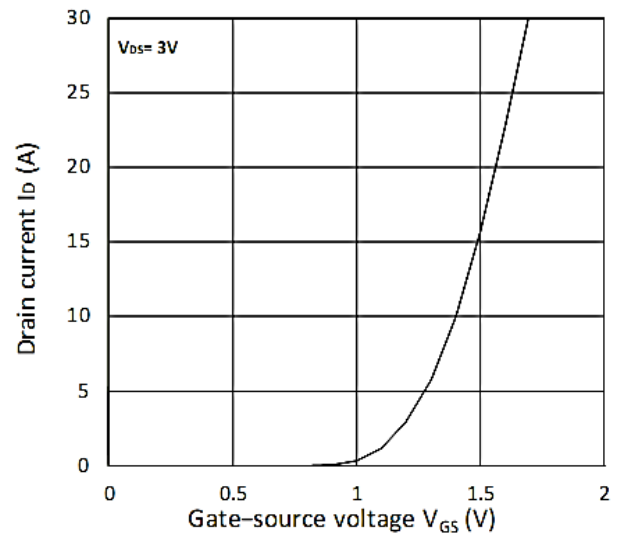


Figure 2. Transfer Characteristics

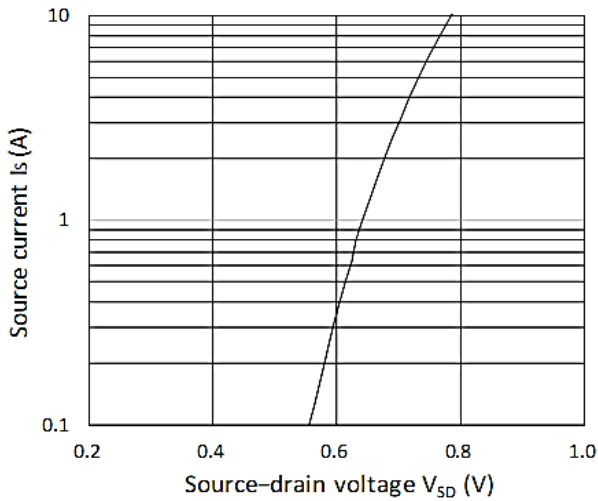


Figure 3. Forward Characteristics of Reverse

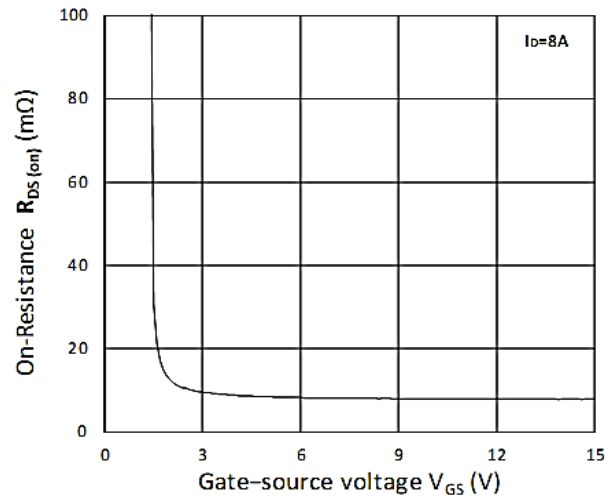


Figure 4.  $R_{DS(ON)}$  vs.  $V_{GS}$

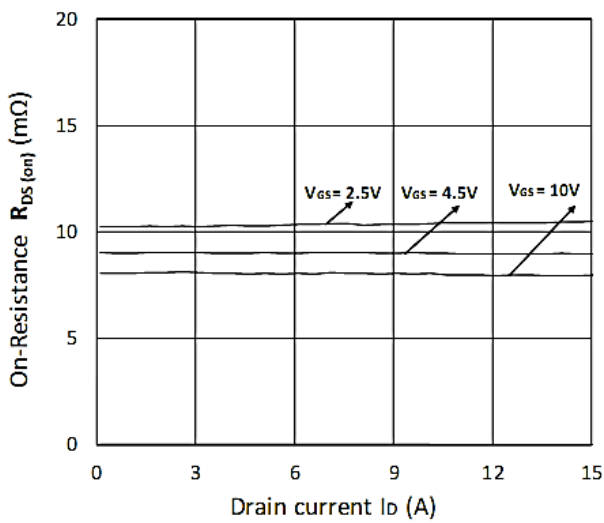


Figure 5.  $R_{DS(ON)}$  vs.  $I_D$

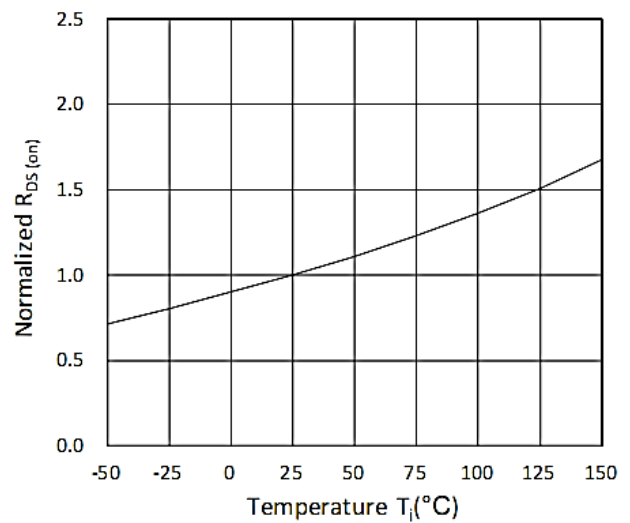


Figure 6. Normalized  $R_{DS(on)}$  vs. Temperature

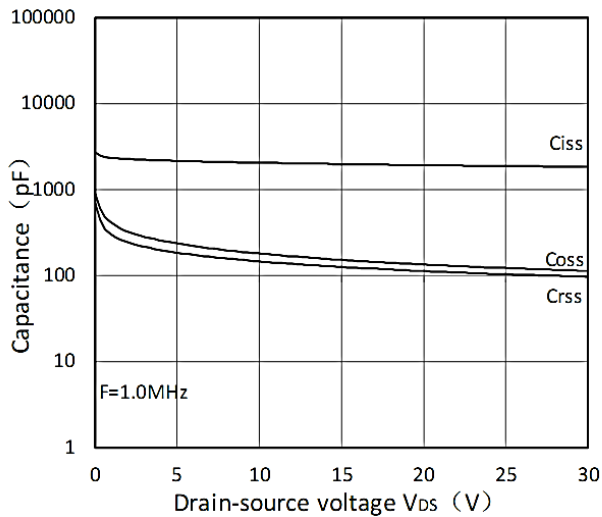


Figure 7. Capacitance Characteristics

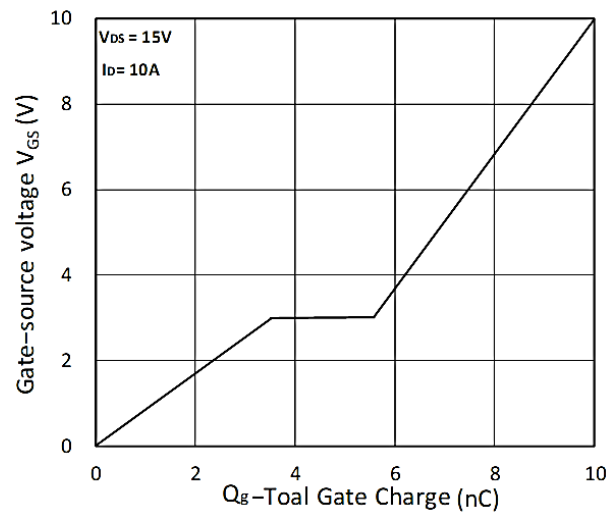


Figure 8. Gate Charge Characteristics

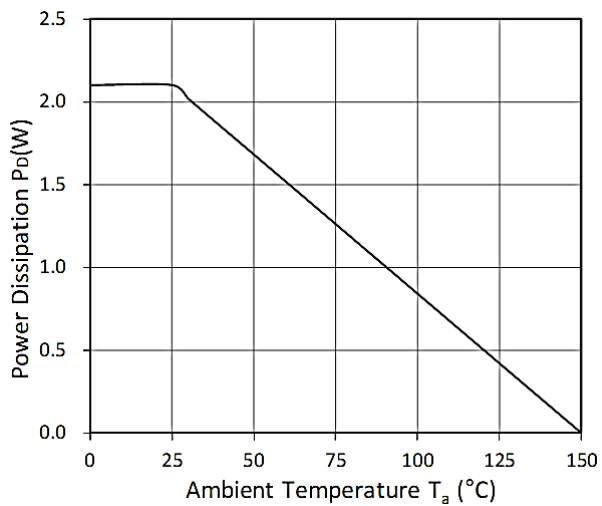


Figure 9. Power Dissipation

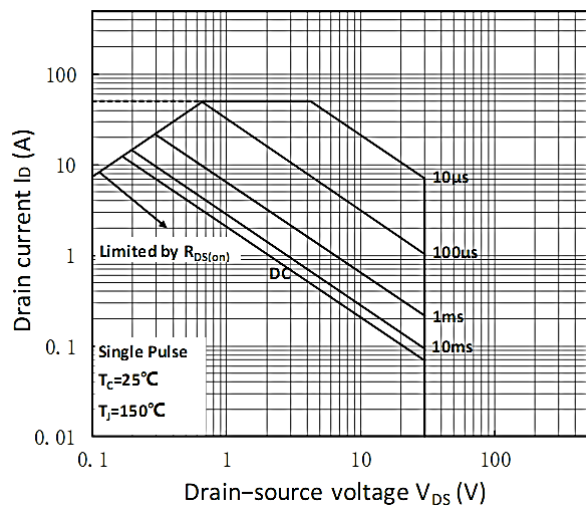


Figure 10. Safe Operating Area

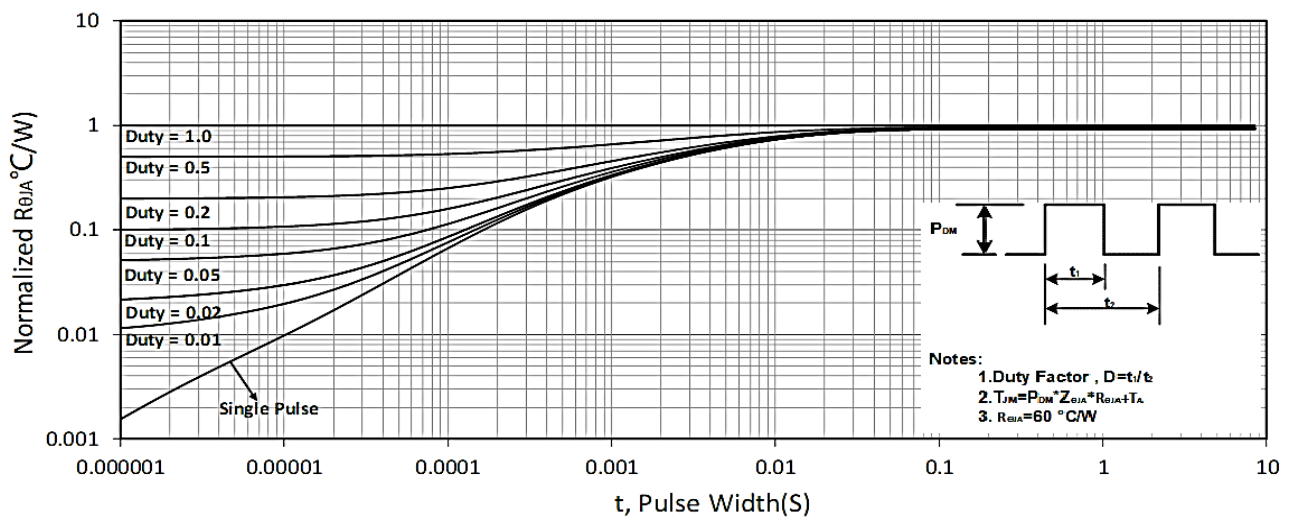
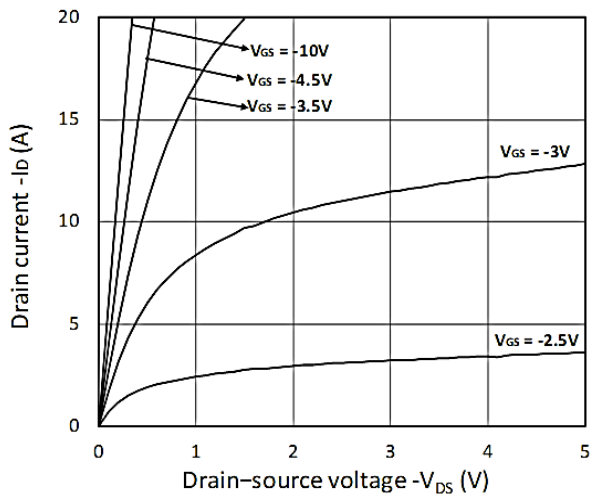
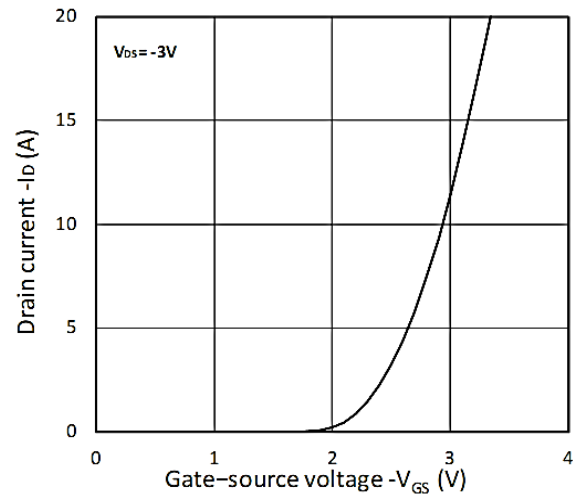


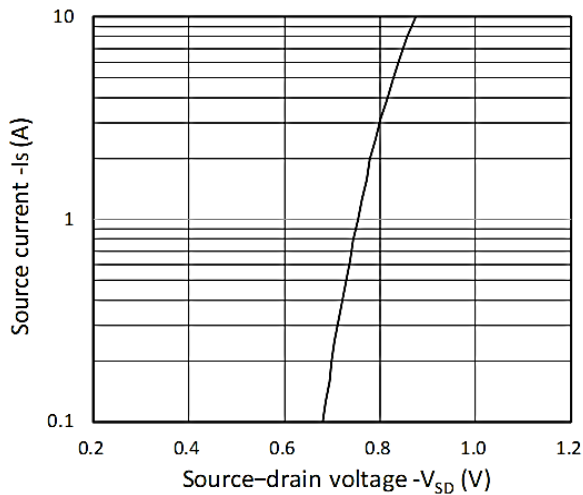
Figure 11. Normalized Maximum Transient Thermal Impedance



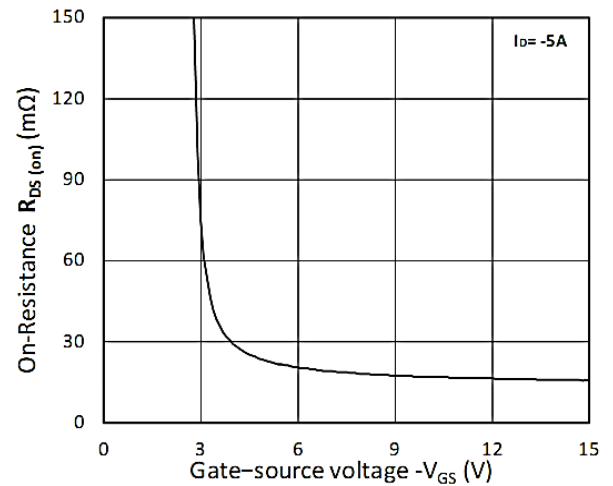
**Figure 1. Output Characteristics**



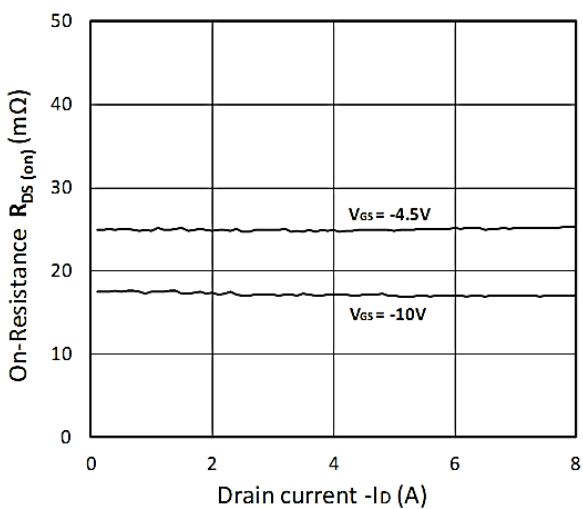
**Figure 2. Transfer Characteristics**



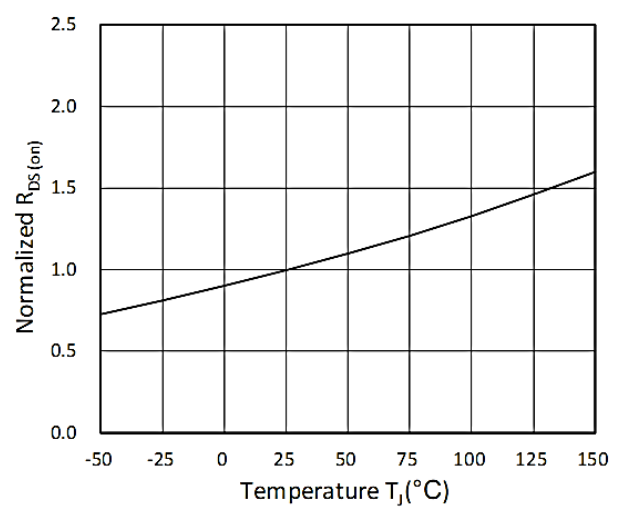
**Figure 3. Forward Characteristics of Reverse**



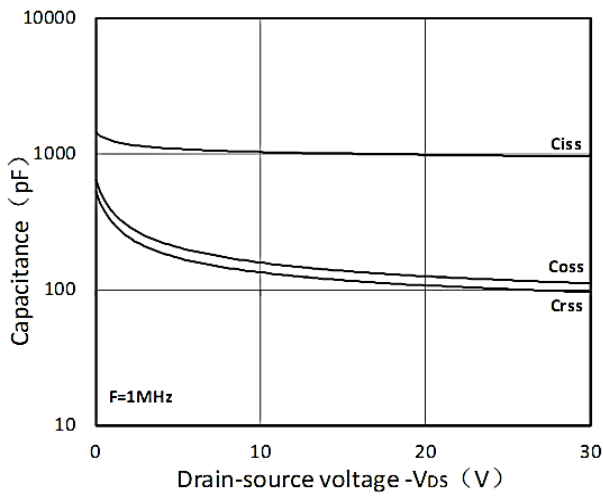
**Figure 4. R\_DS(ON) vs. V\_GS**



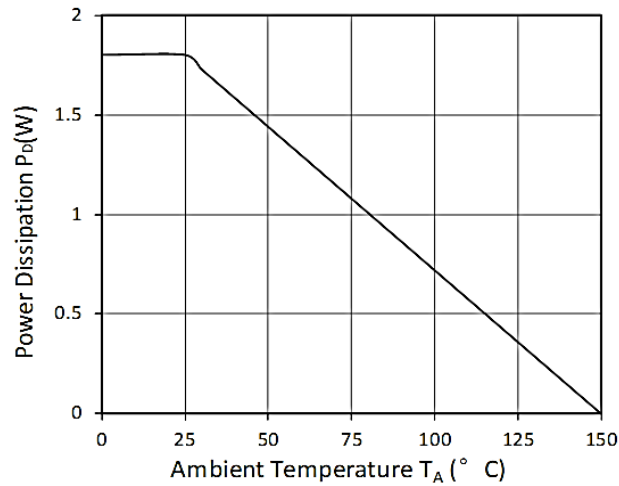
**Figure 5. R\_DS(ON) vs. I\_D**



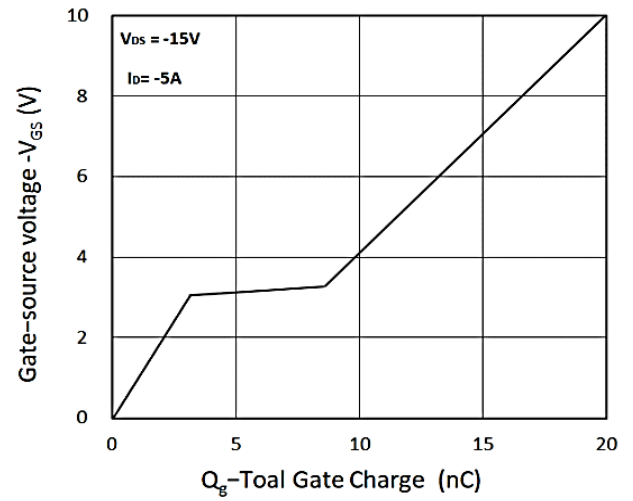
**Figure 6. Normalized R\_DS(on) vs. Temperature**



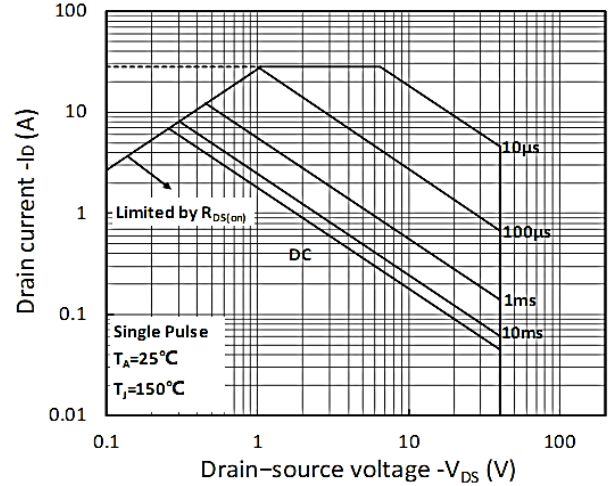
**Figure 7. Capacitance Characteristics**



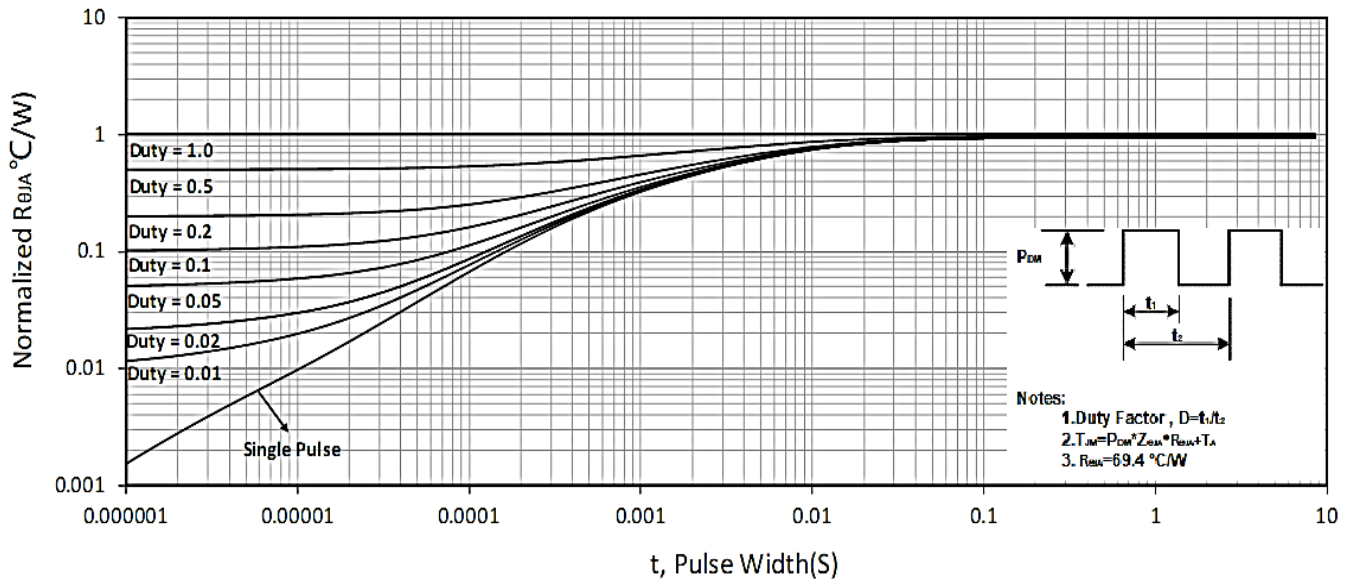
**Figure 9. Power Dissipation**



**Figure 8. Gate Charge Characteristics**

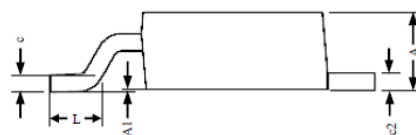
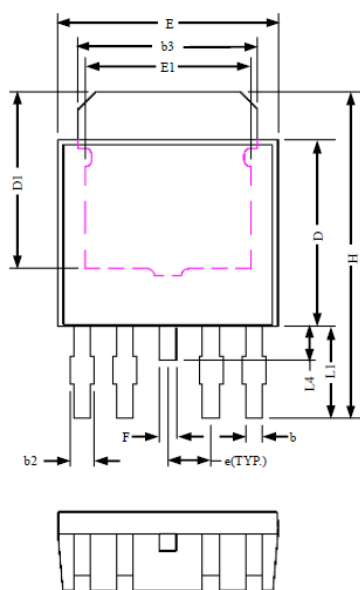


**Figure10. Safe Operating Area**



**Figure11, Normalized Maximum Transient Thermal Impedance**

## TO-252-4L Package Information



| Symbol | Dimensions In Millimeters |       | Dimensions In Inches |       |
|--------|---------------------------|-------|----------------------|-------|
|        | MAX                       | MIN   | MAX                  | MIN   |
| A      | 2.400                     | 2.200 | 0.094                | 0.087 |
| A1     | 0.150                     | 0.000 | 0.006                | 0.000 |
| B      | 0.600                     | 0.400 | 0.024                | 0.016 |
| b2     | 0.800                     | 0.500 | 0.031                | 0.020 |
| b3     | 5.500                     | 5.200 | 0.217                | 0.205 |
| C      | 0.508typ.                 |       | 0.02typ.             |       |
| c2     | 0.550                     | 0.450 | 0.022                | 0.018 |
| D      | 5.800                     | 5.400 | 0.228                | 0.213 |
| D1     | ---                       | 4.570 | ---                  | 0.180 |
| E      | 6.800                     | 6.400 | 0.268                | 0.252 |
| E1     | ---                       | 3.810 | ---                  | 0.150 |
| E      | 1.27ref.                  |       | 0.05ref.             |       |
| F      | 0.600                     | 0.400 | 0.024                | 0.016 |
| H      | 10.200                    | 9.400 | 0.402                | 0.370 |
| L      | 1.770                     | 1.400 | 0.070                | 0.055 |
| L1     | 3.000                     | 2.400 | 0.118                | 0.094 |
| L4     | 1.200                     | 0.800 | 0.047                | 0.031 |