

## N and P Channel Enhancement Mode Power MOSFET

### Description

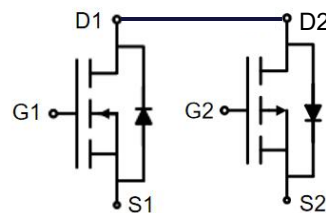
The G160C04Y uses advanced trench technology to provide excellent  $R_{DS(ON)}$ , low gate charge. It can be used in a wide variety of applications.

### General Features

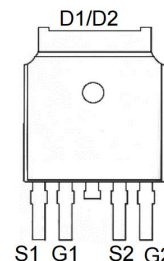
- NMOS
- $V_{DS}$  40V
- $I_D$  (at  $V_{GS} = 10V$ ) 25A
- $R_{DS(ON)}$  (at  $V_{GS} = 10V$ ) < 14m $\Omega$
- $R_{DS(ON)}$  (at  $V_{GS} = 4.5V$ ) < 19m $\Omega$
- 100% Avalanche Tested
- RoHS Compliant
- PMOS
- $V_{DS}$  -40V
- $I_D$  (at  $V_{GS} = -10V$ ) -12A
- $R_{DS(ON)}$  (at  $V_{GS} = -10V$ ) < 35m $\Omega$
- $R_{DS(ON)}$  (at  $V_{GS} = -4.5V$ ) < 45m $\Omega$
- 100% Avalanche Tested
- RoHS Compliant

### Application

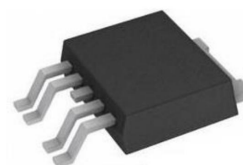
- Power switch
- DC/DC converters



Schematic diagram



pin assignment



TO-252-4 Dual

### Ordering Information

| Device   | Package       | Marking | Packaging    |
|----------|---------------|---------|--------------|
| G160C04Y | TO-252-4 Dual | G160C04 | 2500pcs/Reel |

### Absolute Maximum Ratings $T_C = 25^\circ\text{C}$ , unless otherwise noted

| Parameter                                        | Symbol                    | NMOS       | PMOS       | Unit             |
|--------------------------------------------------|---------------------------|------------|------------|------------------|
| Drain-Source Voltage                             | $V_{DS}$                  | 40         | -40        | V                |
| Continuous Drain Current                         | $T_C = 25^\circ\text{C}$  | 25         | -12        | A                |
|                                                  | $T_C = 100^\circ\text{C}$ | 16         | -7.5       |                  |
| Pulsed Drain Current (note1)                     | $I_{DM}$                  | 100        | -48        | A                |
| Gate-Source Voltage                              | $V_{GS}$                  | $\pm 20$   | $\pm 20$   | V                |
| Power Dissipation                                | $P_D$                     | 43         | 40         | W                |
| Single pulse avalanche energy (note2)            | $E_{AS}$                  | 18         | 30         | mJ               |
| Operating Junction and Storage Temperature Range | $T_J, T_{stg}$            | -55 To 150 | -55 To 150 | $^\circ\text{C}$ |

### Thermal Resistance

| Parameter                               | Symbol     | NMOS | PMOS | Unit               |
|-----------------------------------------|------------|------|------|--------------------|
| Thermal Resistance, Junction-to-Ambient | $R_{thJA}$ | 50   | 50   | $^\circ\text{C/W}$ |
| Thermal Resistance, Junction-to-Case    | $R_{thJC}$ | 2.9  | 3.1  | $^\circ\text{C/W}$ |

| NMOS Specifications T <sub>J</sub> = 25°C, unless otherwise noted |                      |                                                                          |       |      |      |      |
|-------------------------------------------------------------------|----------------------|--------------------------------------------------------------------------|-------|------|------|------|
| Parameter                                                         | Symbol               | Test Conditions                                                          | Value |      |      | Unit |
|                                                                   |                      |                                                                          | Min.  | Typ. | Max. |      |
| Static Parameters                                                 |                      |                                                                          |       |      |      |      |
| Drain-Source Breakdown Voltage                                    | V <sub>(BR)DSS</sub> | V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA                             | 40    | --   | --   | V    |
| Zero Gate Voltage Drain Current                                   | I <sub>DSS</sub>     | V <sub>DS</sub> = 40V, V <sub>GS</sub> = 0V                              | --    | --   | 1    | μA   |
| Gate-Source Leakage                                               | I <sub>GSS</sub>     | V <sub>GS</sub> = ±20V                                                   | --    | --   | ±100 | nA   |
| Gate-Source Threshold Voltage                                     | V <sub>GS(th)</sub>  | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA               | 1.0   | 1.6  | 2.0  | V    |
| Drain-Source On-Resistance                                        | R <sub>DS(on)</sub>  | V <sub>GS</sub> = 10V, I <sub>D</sub> = 10A                              | --    | 11   | 14   | mΩ   |
|                                                                   |                      | V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 10A                             | --    | 15   | 19   |      |
| Forward Transconductance                                          | g <sub>FS</sub>      | V <sub>GS</sub> = 5V, I <sub>D</sub> = 10A                               | --    | 12   | --   | S    |
| Dynamic Parameters                                                |                      |                                                                          |       |      |      |      |
| Input Capacitance                                                 | C <sub>iss</sub>     | V <sub>GS</sub> = 0V,<br>V <sub>DS</sub> = 20V,<br>f = 1.0MHz            | --    | 1000 | --   | pF   |
| Output Capacitance                                                | C <sub>oss</sub>     |                                                                          | --    | 90   | --   |      |
| Reverse Transfer Capacitance                                      | C <sub>rss</sub>     |                                                                          | --    | 80   | --   |      |
| Total Gate Charge                                                 | Q <sub>g</sub>       | V <sub>DD</sub> = 20V,<br>I <sub>D</sub> = 10A,<br>V <sub>GS</sub> = 10V | --    | 24   | --   | nC   |
| Gate-Source Charge                                                | Q <sub>gs</sub>      |                                                                          | --    | 3    | --   |      |
| Gate-Drain Charge                                                 | Q <sub>gd</sub>      |                                                                          | --    | 5    | --   |      |
| Turn-on Delay Time                                                | t <sub>d(on)</sub>   | V <sub>DD</sub> = 20V,<br>I <sub>D</sub> = 10A,<br>R <sub>G</sub> = 3Ω   | --    | 5    | --   | ns   |
| Turn-on Rise Time                                                 | t <sub>r</sub>       |                                                                          | --    | 13   | --   |      |
| Turn-off Delay Time                                               | t <sub>d(off)</sub>  |                                                                          | --    | 22   | --   |      |
| Turn-off Fall Time                                                | t <sub>f</sub>       |                                                                          | --    | 11   | --   |      |
| Drain-Source Body Diode Characteristics                           |                      |                                                                          |       |      |      |      |
| Continuous Body Diode Current                                     | I <sub>S</sub>       | T <sub>C</sub> = 25°C                                                    | --    | --   | 25   | A    |
| Body Diode Voltage                                                | V <sub>SD</sub>      | T <sub>J</sub> = 25°C, I <sub>SD</sub> = 10A, V <sub>GS</sub> = 0V       | --    | --   | 1.2  | V    |
| Reverse Recovery Charge                                           | Q <sub>rr</sub>      | I <sub>F</sub> = 10A, V <sub>GS</sub> = 0V<br>di/dt=100A/us              | --    | 35   | --   | nC   |
| Reverse Recovery Time                                             | T <sub>rr</sub>      |                                                                          | --    | 31   | --   | ns   |

## Notes

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. EAS condition :  $T_J = 25^\circ\text{C}$ ,  $V_{DD} = 40V$ ,  $V_{GS} = 10V$ ,  $L = 0.5mH$ ,  $R_G = 25\Omega$

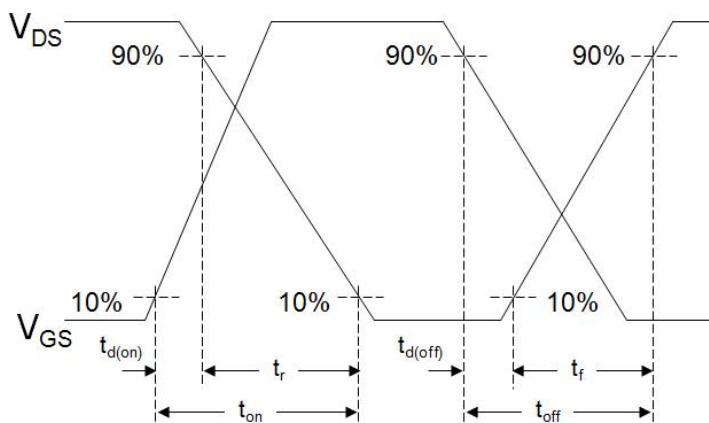
The table shows the minimum avalanche energy, which is 49mJ when the device is tested until failure

3. Identical low side and high side switch with identical  $R_G$

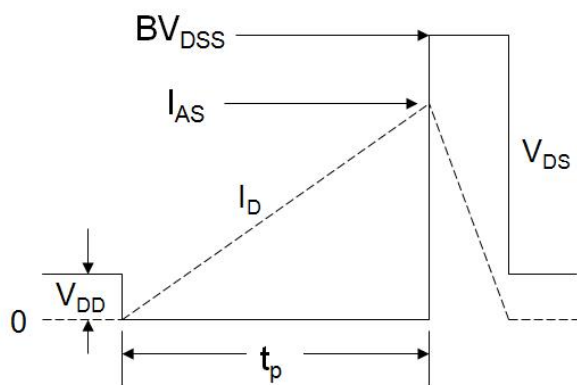
### Gate Charge Test Circuit



### Switch Time Test Circuit



### EAS Test Circuit



## NMOS Typical Characteristics $T_J = 25^\circ\text{C}$ , unless otherwise noted

Figure 1. Output Characteristics

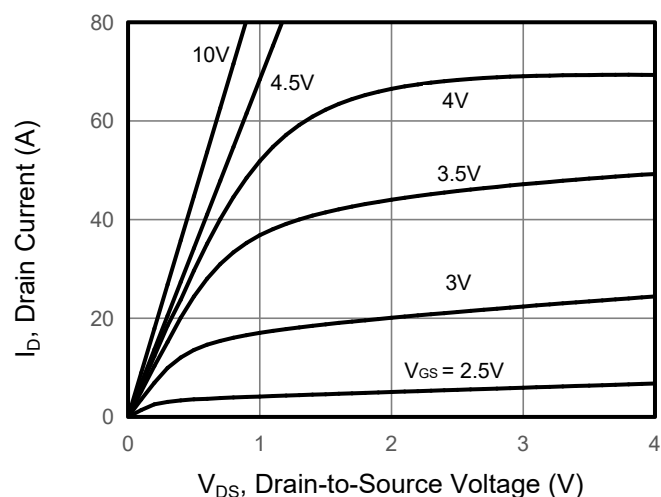


Figure 2. Transfer Characteristics

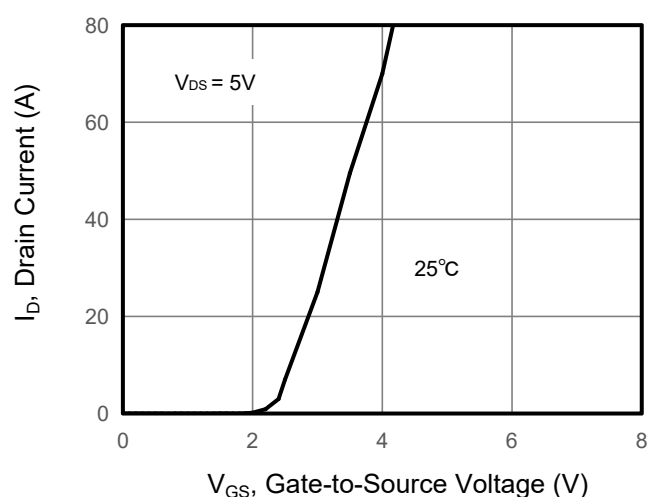


Figure 3. Drain Source On Resistance

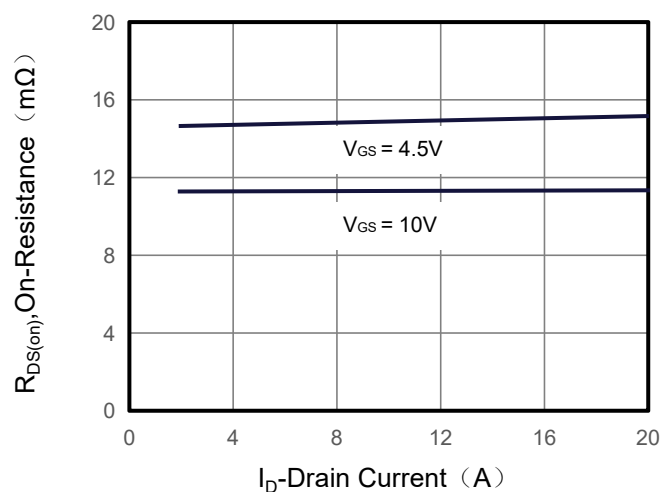


Figure 4. Gate Charge

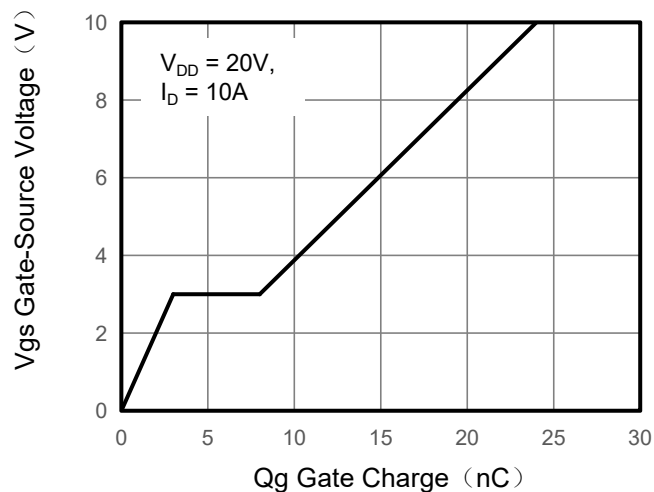


Figure 5. Capacitance

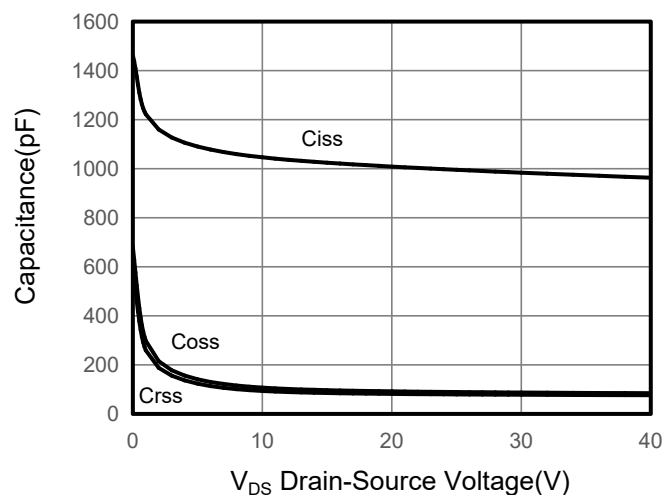
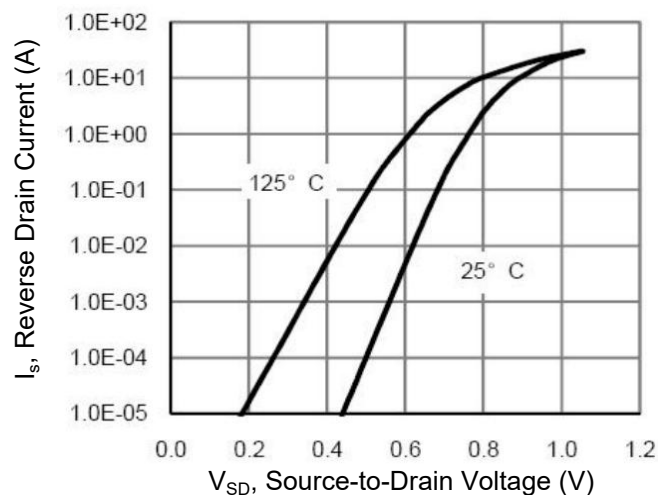


Figure 6. Source-Drain Diode Forward



## NMOS Typical Characteristics $T_J = 25^\circ\text{C}$ , unless otherwise noted

Figure 7. Drain-Source On-Resistance

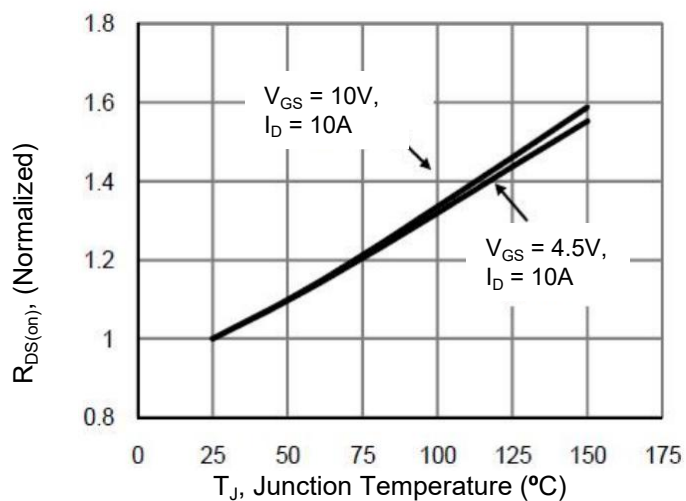


Figure 8. Safe Operation Area

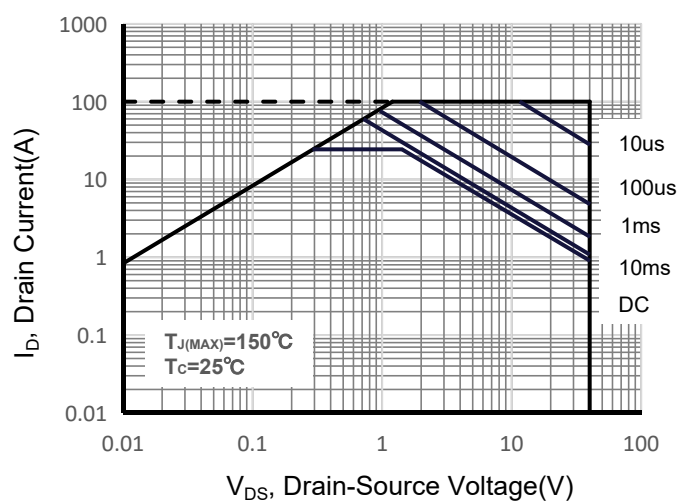


Figure 9. Maximum Continuous Drain Current vs Case Temperature

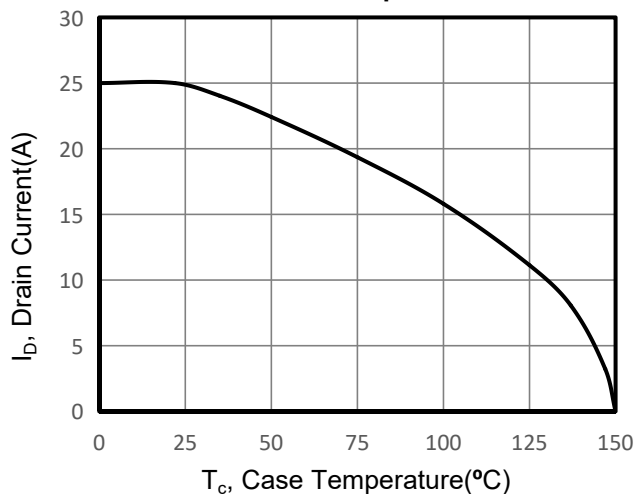
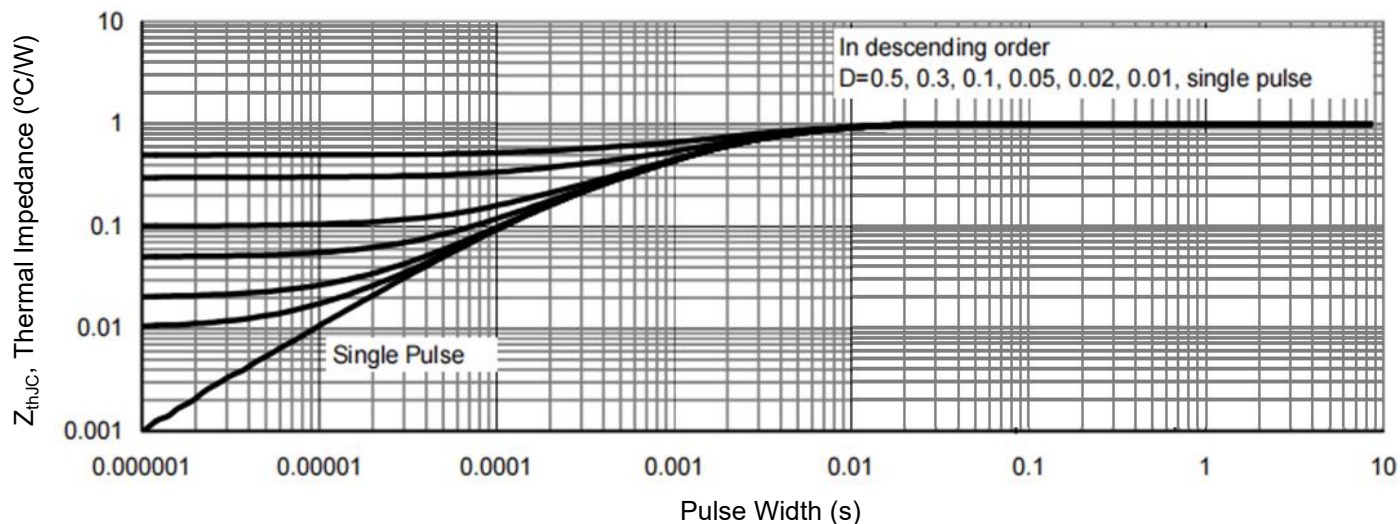


Figure 10. Normalized Maximum Transient Thermal Impedance



| PMOS Specifications T <sub>J</sub> = 25°C, unless otherwise noted |                      |                                                                            |       |      |      |      |
|-------------------------------------------------------------------|----------------------|----------------------------------------------------------------------------|-------|------|------|------|
| Parameter                                                         | Symbol               | Test Conditions                                                            | Value |      |      | Unit |
|                                                                   |                      |                                                                            | Min.  | Typ. | Max. |      |
| Static Parameters                                                 |                      |                                                                            |       |      |      |      |
| Drain-Source Breakdown Voltage                                    | V <sub>(BR)DSS</sub> | V <sub>GS</sub> = 0V, I <sub>D</sub> = -250μA                              | -40   | --   | --   | V    |
| Zero Gate Voltage Drain Current                                   | I <sub>DSS</sub>     | V <sub>DS</sub> = -40V, V <sub>GS</sub> = 0V                               | --    | --   | -1   | μA   |
| Gate-Source Leakage                                               | I <sub>GSS</sub>     | V <sub>GS</sub> = ±20V                                                     | --    | --   | ±100 | nA   |
| Gate-Source Threshold Voltage                                     | V <sub>GS(th)</sub>  | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250μA                | -1.0  | -1.5 | -2.5 | V    |
| Drain-Source On-Resistance                                        | R <sub>DS(on)</sub>  | V <sub>GS</sub> = -10V, I <sub>D</sub> = -9A                               | --    | 28   | 35   | mΩ   |
|                                                                   |                      | V <sub>GS</sub> = -4.5V, I <sub>D</sub> = -9A                              | --    | 35   | 45   |      |
| Forward Transconductance                                          | g <sub>FS</sub>      | V <sub>DS</sub> = -5V, I <sub>b</sub> = -9A                                | --    | 10   | --   | S    |
| Dynamic Parameters                                                |                      |                                                                            |       |      |      |      |
| Input Capacitance                                                 | C <sub>iss</sub>     | V <sub>GS</sub> = 0V,<br>V <sub>DS</sub> = -20V,<br>f = 1.0MHz             | --    | 1200 | --   | pF   |
| Output Capacitance                                                | C <sub>oss</sub>     |                                                                            | --    | 110  | --   |      |
| Reverse Transfer Capacitance                                      | C <sub>rss</sub>     |                                                                            | --    | 100  | --   |      |
| Total Gate Charge                                                 | Q <sub>g</sub>       | V <sub>DD</sub> = -20V,<br>I <sub>D</sub> = -9A,<br>V <sub>GS</sub> = -10V | --    | 25   | --   | nC   |
| Gate-Source Charge                                                | Q <sub>gs</sub>      |                                                                            | --    | 3    | --   |      |
| Gate-Drain Charge                                                 | Q <sub>gd</sub>      |                                                                            | --    | 7    | --   |      |
| Turn-on Delay Time                                                | t <sub>d(on)</sub>   | V <sub>DD</sub> = -20V,<br>I <sub>D</sub> = -9A,<br>R <sub>G</sub> = 3Ω    | --    | 8    | --   | ns   |
| Turn-on Rise Time                                                 | t <sub>r</sub>       |                                                                            | --    | 4    | --   |      |
| Turn-off Delay Time                                               | t <sub>d(off)</sub>  |                                                                            | --    | 32   | --   |      |
| Turn-off Fall Time                                                | t <sub>f</sub>       |                                                                            | --    | 7    | --   |      |
| Drain-Source Body Diode Characteristics                           |                      |                                                                            |       |      |      |      |
| Continuous Body Diode Current                                     | I <sub>S</sub>       | T <sub>C</sub> = 25°C                                                      | --    | --   | -12  | A    |
| Body Diode Voltage                                                | V <sub>SD</sub>      | T <sub>J</sub> = 25°C, I <sub>SD</sub> = -9A, V <sub>GS</sub> = 0V         | --    | --   | -1.2 | V    |
| Reverse Recovery Charge                                           | Q <sub>rr</sub>      | I <sub>F</sub> = -9A, V <sub>GS</sub> = 0V<br>di/dt=-100A/us               | --    | 25   | --   | nC   |
| Reverse Recovery Time                                             | T <sub>rr</sub>      |                                                                            | --    | 31   | --   | ns   |

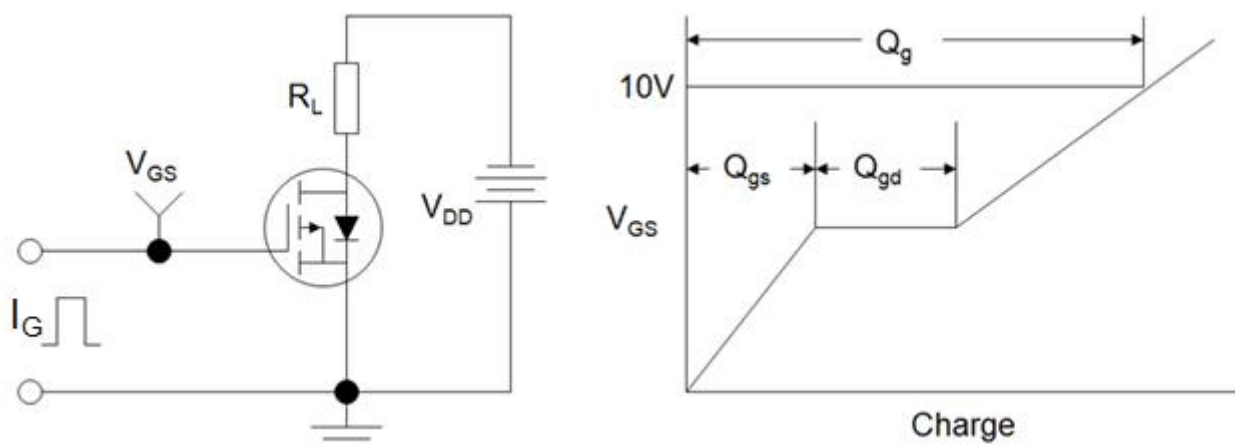
**Notes**

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. EAS condition :  $T_J = 25^\circ\text{C}$ ,  $V_{DD} = -40V$ ,  $V_{GS} = -10V$ ,  $L = 0.5\text{mH}$ ,  $R_g = 25\Omega$

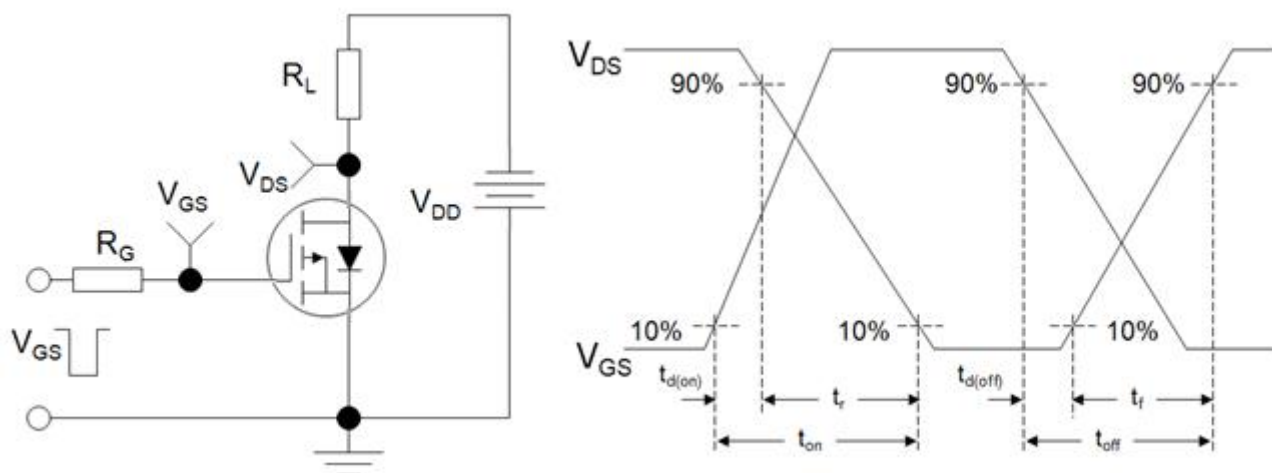
The table shows the minimum avalanche energy, which is 81mJ when the device is tested until failure

3. Identical low side and high side switch with identical  $R_G$

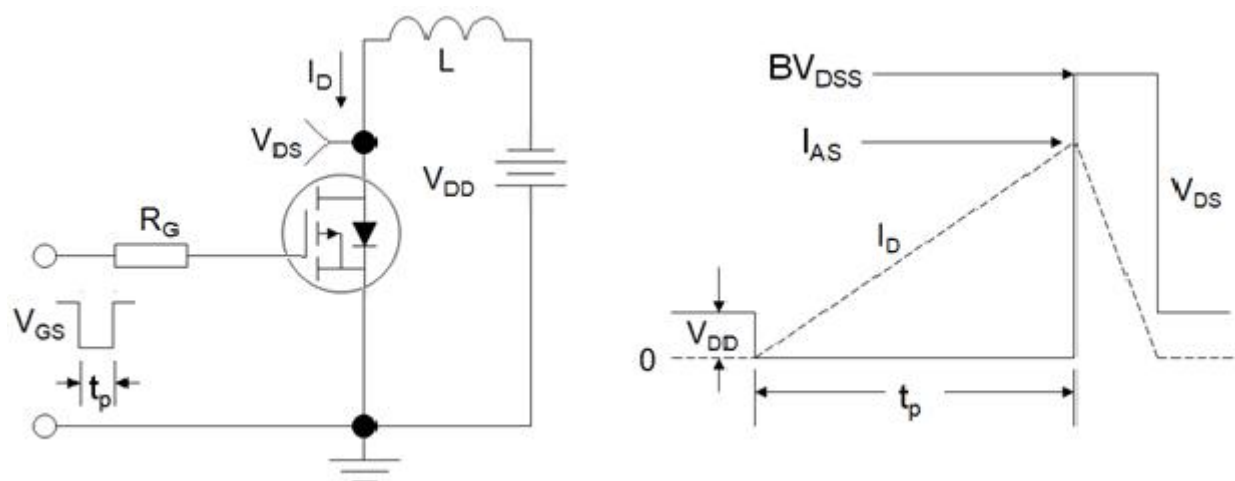
### Gate Charge Test Circuit



### Switch Time Test Circuit



### EAS Test Circuit



## PMOS Typical Characteristics $T_J = 25^\circ\text{C}$ , unless otherwise noted

Figure 1. Output Characteristics

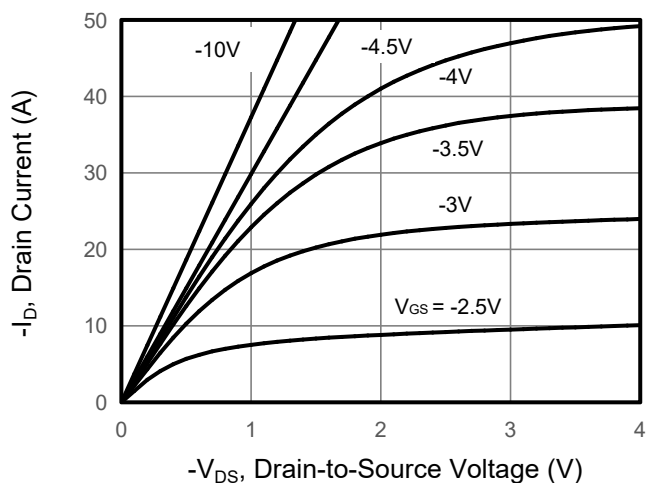


Figure 2. Transfer Characteristics

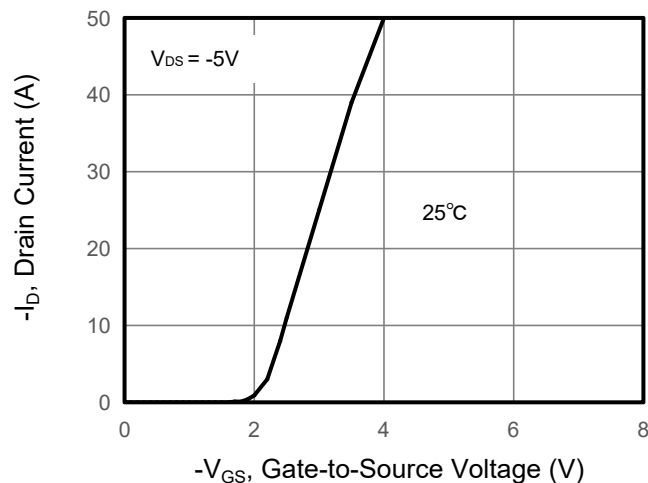


Figure 3. Drain Source On Resistance

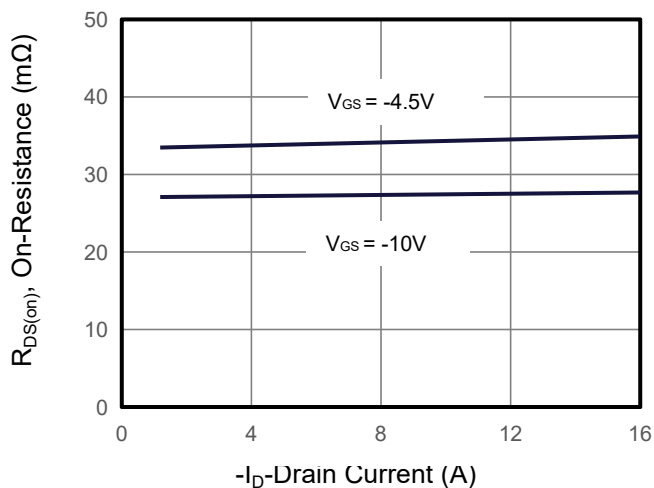


Figure 4. Gate Charge

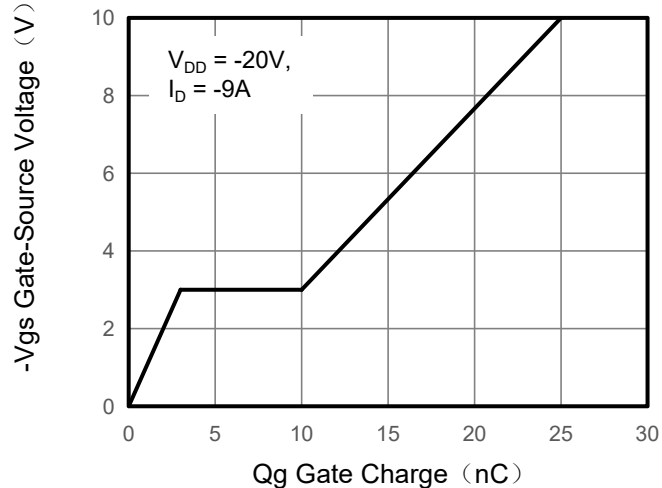


Figure 5. Capacitance

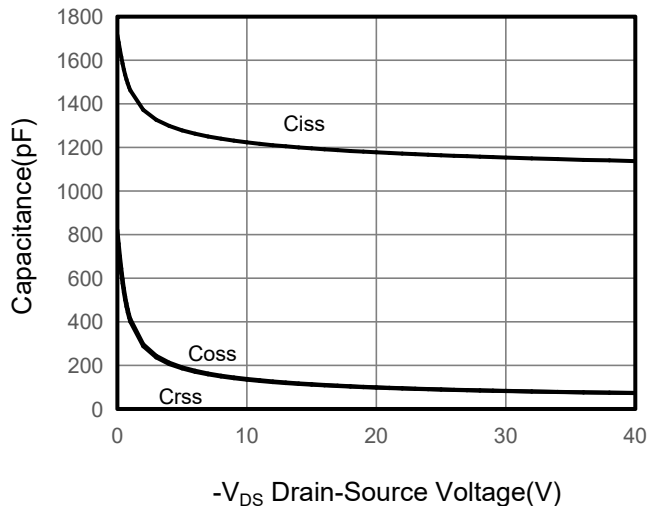
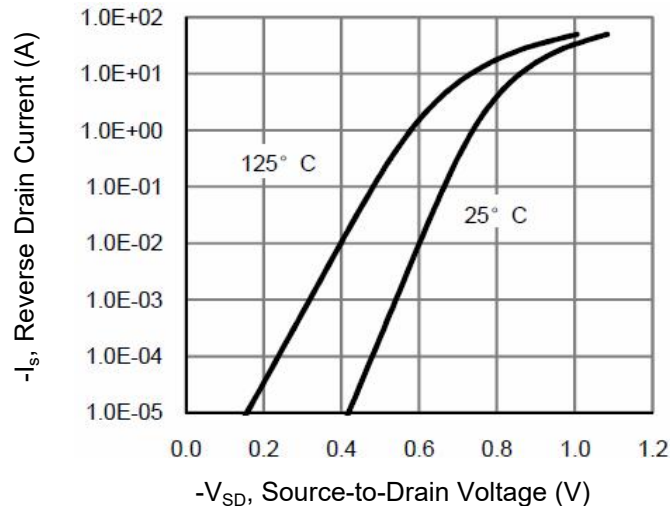


Figure 6. Source-Drain Diode Forward



## PMOS Typical Characteristics $T_J = 25^\circ\text{C}$ , unless otherwise noted

Figure 7. Drain-Source On-Resistance

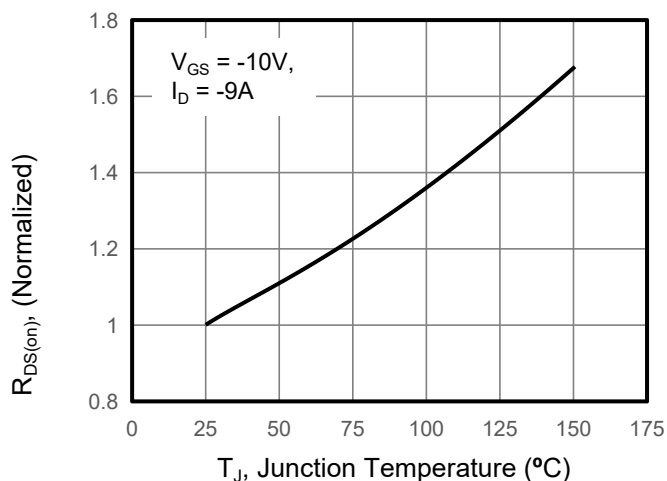


Figure 8. Safe Operation Area

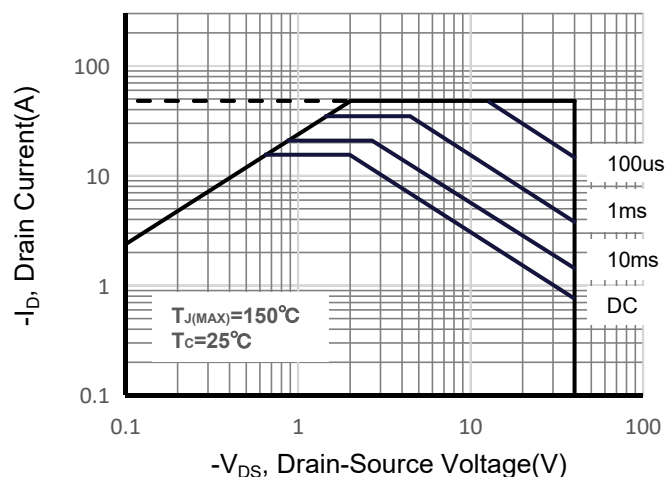


Figure 9. Maximum Continuous Drain Current vs Case Temperature

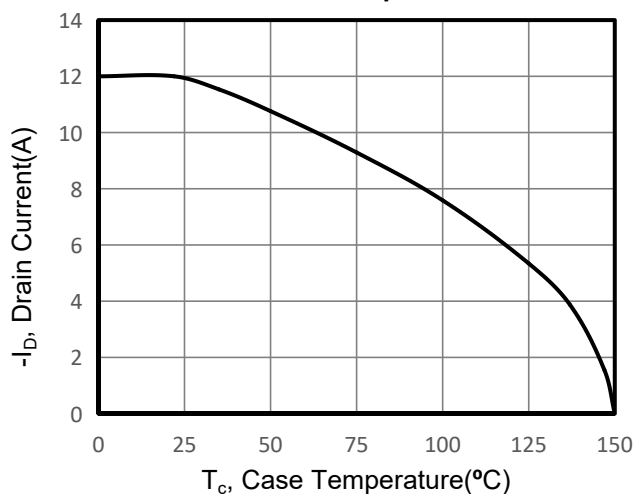
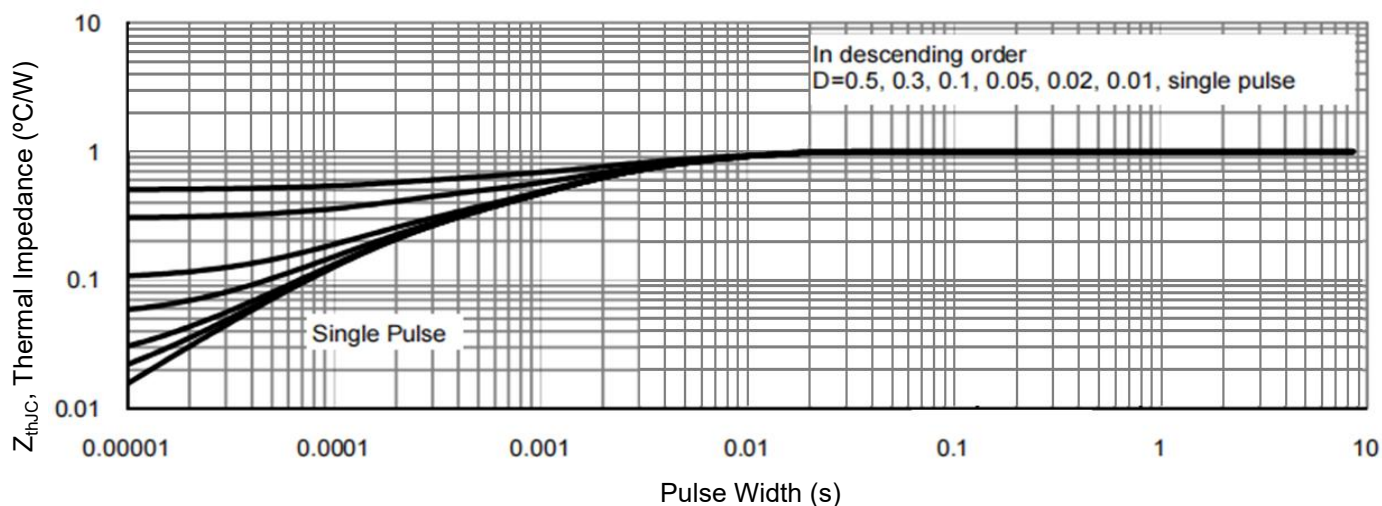
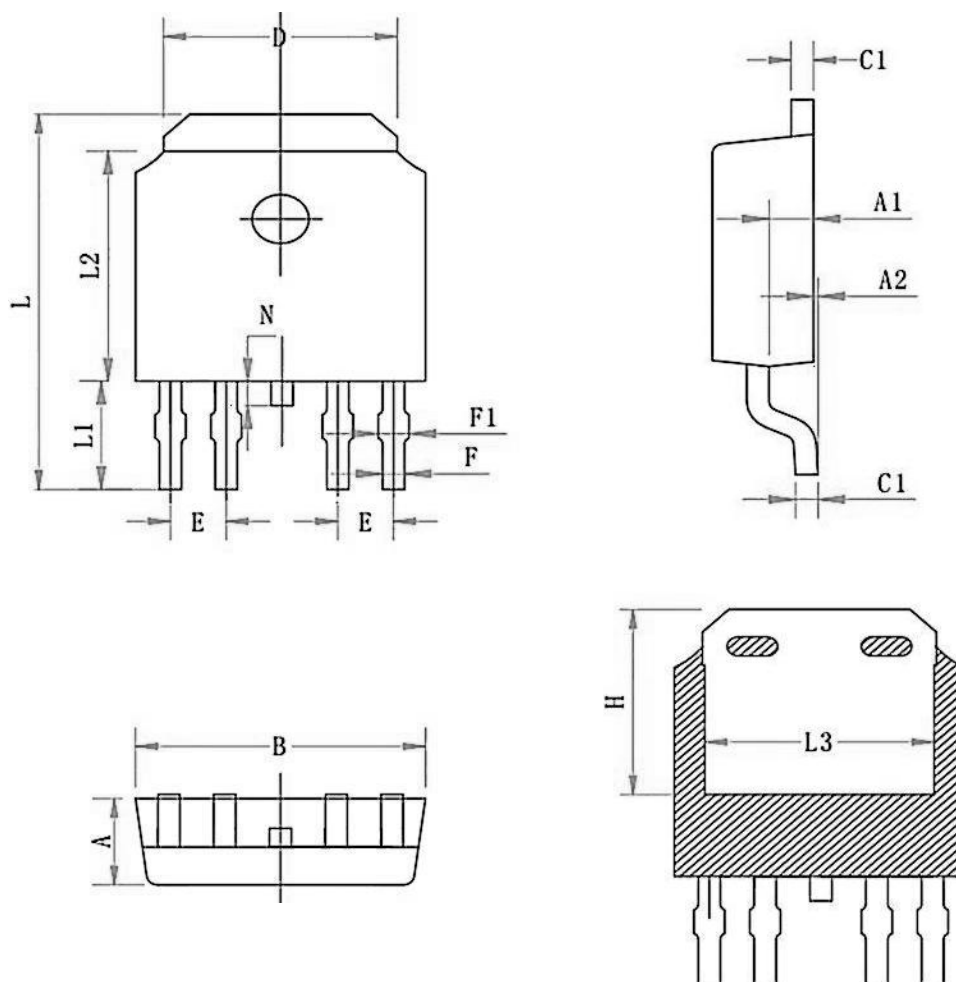


Figure 10. Normalized Maximum Transient Thermal Impedance



## TO-252-4 Dual Package Information



| Symbol | Min      | Typ   | Max   |
|--------|----------|-------|-------|
| A      | 2.20     | 2.30  | 2.40  |
| A1     | 0.91     | 1.01  | 1.11  |
| A2     | 0.05     | 0.15  | 0.25  |
| B      | 6.45     | 6.60  | 6.75  |
| C      | 0.45     | 0.50  | 0.58  |
| C1     | 0.45     | 0.50  | 0.58  |
| D      | 5.12     | 5.32  | 5.52  |
| E      | 1.27 TYP |       |       |
| F1     | 0.45     | 0.60  | 0.75  |
| F      | 0.40     | 0.50  | 0.60  |
| H      | 4.70     | 4.90  | 5.10  |
| L      | 9.70     | 10.00 | 10.20 |
| L1     | 2.6      | 2.8   | 3.0   |
| L2     | 5.95     | 6.10  | 6.25  |
| L3     | 5.00     | 5.20  | 5.40  |
| N      | 0.45     | 0.65  | 0.85  |