

## N-Channel Enhancement Mode Power MOSFET

## Description

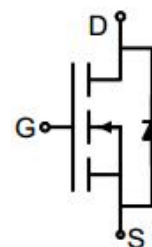
The G60N04K uses advanced trench technology to provide excellent  $R_{DS(ON)}$ , low gate charge. It can be used in a wide variety of applications.

## General Features

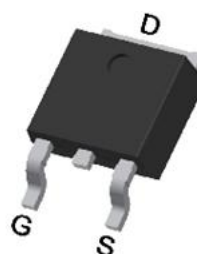
- $V_{DS}$  40V
- $I_D$  (at  $V_{GS} = 10V$ ) 60A
- $R_{DS(ON)}$  (at  $V_{GS} = 10V$ ) < 7m $\Omega$
- $R_{DS(ON)}$  (at  $V_{GS} = 4.5V$ ) < 9m $\Omega$
- 100% Avalanche Tested
- RoHS Compliant

## Application

- Power switch
- DC/DC converters



Schematic diagram



TO-252

## Ordering Information

| Device  | Package | Marking | Packaging    |
|---------|---------|---------|--------------|
| G60N04K | TO-252  | G60N04  | 2500pcs/Reel |

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

| Parameter                                        | Symbol         | Value      | Unit             |
|--------------------------------------------------|----------------|------------|------------------|
| Drain-Source Voltage                             | $V_{DS}$       | 40         | V                |
| Continuous Drain Current                         | $I_D$          | 60         | A                |
|                                                  |                | 38         |                  |
| Pulsed Drain Current (note1)                     | $I_{DM}$       | 240        | A                |
| Gate-Source Voltage                              | $V_{GS}$       | $\pm 20$   | V                |
| Power Dissipation                                | $P_D$          | 65         | W                |
| Single pulse avalanche energy (note2)            | $E_{AS}$       | 56         | mJ               |
| Operating Junction and Storage Temperature Range | $T_J, T_{stg}$ | -55 To 150 | $^\circ\text{C}$ |

## Thermal Resistance

| Parameter                               | Symbol     | Value | Unit               |
|-----------------------------------------|------------|-------|--------------------|
| Thermal Resistance, Junction-to-Ambient | $R_{thJA}$ | 60    | $^\circ\text{C/W}$ |
| Thermal Resistance, Junction-to-Case    | $R_{thJC}$ | 1.9   | $^\circ\text{C/W}$ |

| 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               | 1.1   | 1.7  | 2.5  | V    |
| Drain-Source On-Resistance                                   | R <sub>DS(on)</sub>  | V <sub>GS</sub> = 10V, I <sub>D</sub> = 30A                              | --    | 5.5  | 7.0  | mΩ   |
|                                                              |                      | V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 20A                             | --    | 7.5  | 9.0  |      |
| Forward Transconductance                                     | g <sub>FS</sub>      | V <sub>GS</sub> = 5V, I <sub>D</sub> = 30A                               | --    | 15   | --   | S    |
| Dynamic Parameters                                           |                      |                                                                          |       |      |      |      |
| Input Capacitance                                            | C <sub>iss</sub>     | V <sub>GS</sub> = 0V,<br>V <sub>DS</sub> = 20V,<br>f = 1.0MHz            | --    | 2350 | --   | pF   |
| Output Capacitance                                           | C <sub>oss</sub>     |                                                                          | --    | 170  | --   |      |
| Reverse Transfer Capacitance                                 | C <sub>rss</sub>     |                                                                          | --    | 153  | --   |      |
| Total Gate Charge                                            | Q <sub>g</sub>       | V <sub>DD</sub> = 20V,<br>I <sub>D</sub> = 30A,<br>V <sub>GS</sub> = 10V | --    | 42   | --   | nC   |
| Gate-Source Charge                                           | Q <sub>gs</sub>      |                                                                          | --    | 7    | --   |      |
| Gate-Drain Charge                                            | Q <sub>gd</sub>      |                                                                          | --    | 9    | --   |      |
| Turn-on Delay Time                                           | t <sub>d(on)</sub>   | V <sub>DD</sub> = 20V,<br>I <sub>D</sub> = 30A,<br>R <sub>G</sub> = 3Ω   | --    | 17   | --   | ns   |
| Turn-on Rise Time                                            | t <sub>r</sub>       |                                                                          | --    | 7    | --   |      |
| Turn-off Delay Time                                          | t <sub>d(off)</sub>  |                                                                          | --    | 30   | --   |      |
| Turn-off Fall Time                                           | t <sub>f</sub>       |                                                                          | --    | 17   | --   |      |
| Drain-Source Body Diode Characteristics                      |                      |                                                                          |       |      |      |      |
| Continuous Body Diode Current                                | I <sub>S</sub>       | T <sub>C</sub> = 25°C                                                    | --    | --   | 60   | A    |
| Body Diode Voltage                                           | V <sub>SD</sub>      | T <sub>J</sub> = 25°C, I <sub>SD</sub> = 30A, V <sub>GS</sub> = 0V       | --    | --   | 1.2  | V    |
| Reverse Recovery Charge                                      | Q <sub>rr</sub>      | I <sub>F</sub> = 30A, V <sub>GS</sub> = 0V<br>di/dt=100A/us              | --    | 29   | --   | nC   |
| Reverse Recovery Time                                        | T <sub>rr</sub>      |                                                                          | --    | 26   | --   | ns   |

## Notes

1. Repetitive Rating: Pulse width limited by maximum junction temperature

2. EAS condition :  $T_J = 25^{\circ}\text{C}$ ,  $V_{DD} = 40V$ ,  $V_{GS} = 10V$ ,  $L = 0.5mH$ ,  $R_G = 25\Omega$

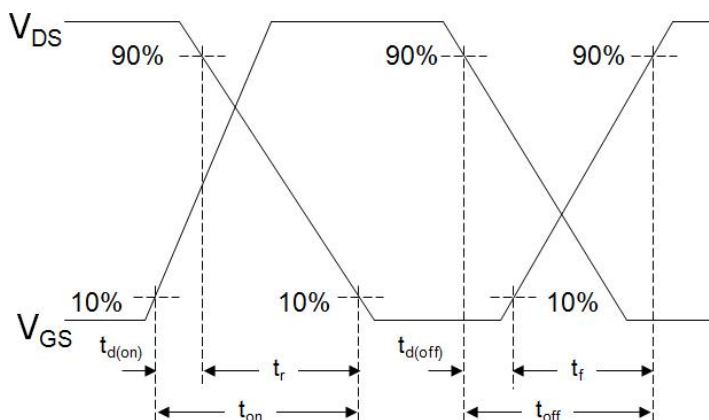
The table shows the minimum avalanche energy, which is 156mJ when the device is tested until failure

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

### Gate Charge Test Circuit



### Switch Time Test Circuit

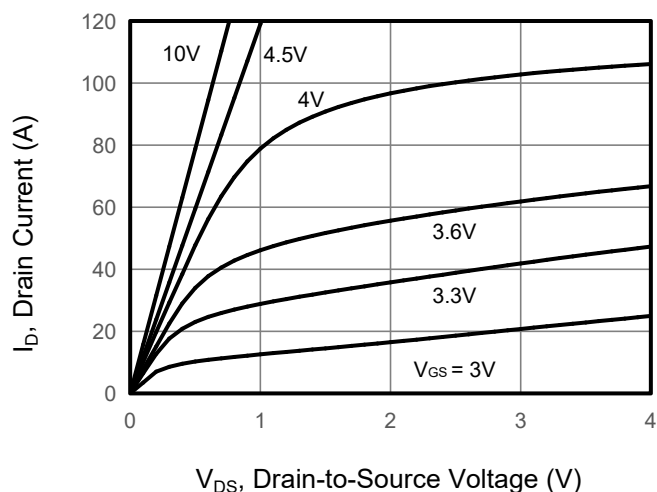


### EAS Test Circuit

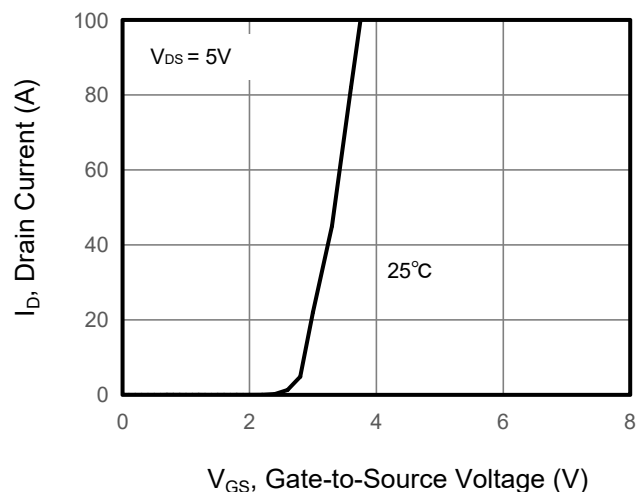


**Typical Characteristics**  $T_J = 25^\circ\text{C}$ , unless otherwise noted

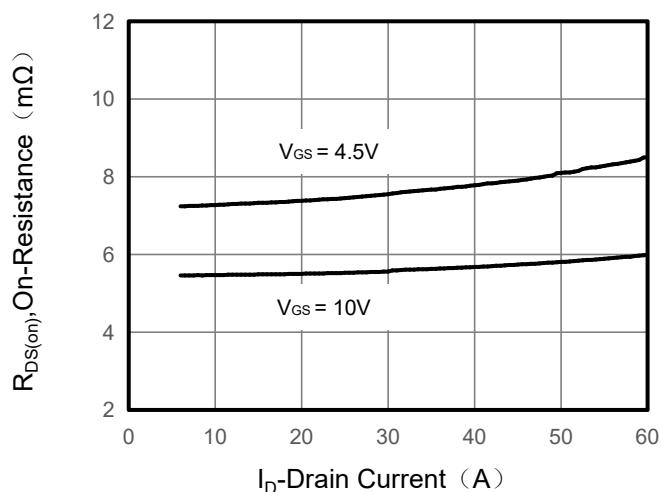
**Figure 1. Output Characteristics**



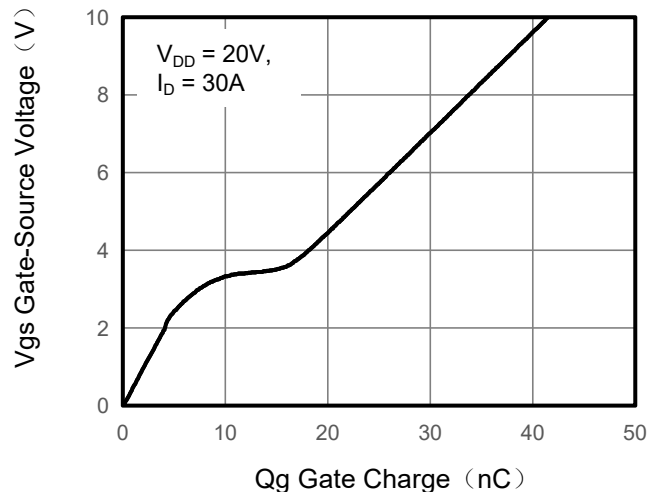
**Figure 2. Transfer Characteristics**



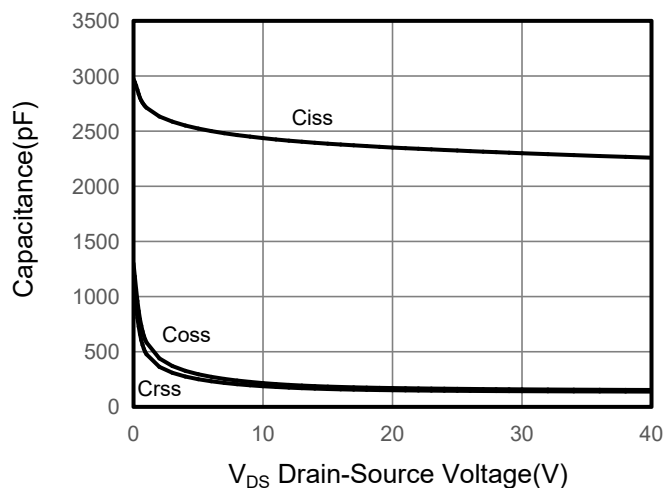
**Figure 3. Drain Source On Resistance**



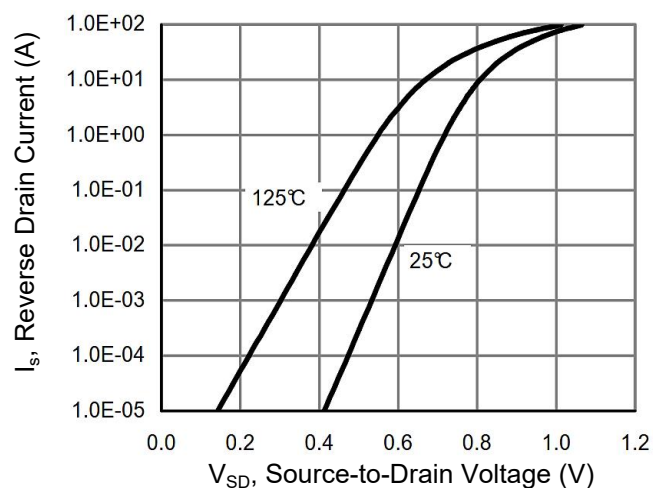
**Figure 4. Gate Charge**



**Figure 5. Capacitance**

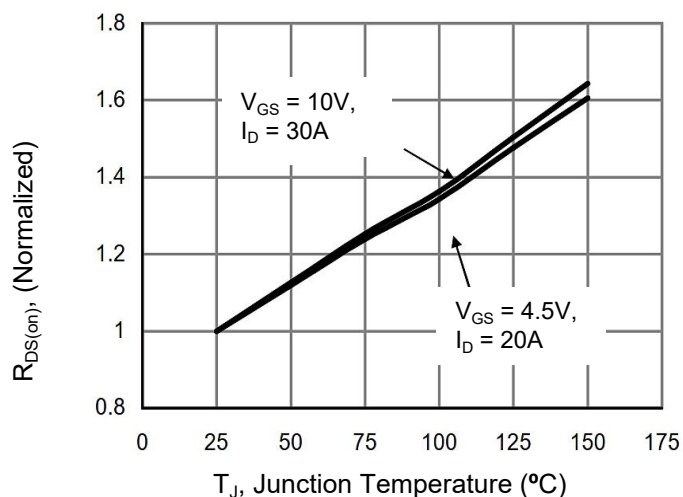


**Figure 6. Source-Drain Diode Forward**

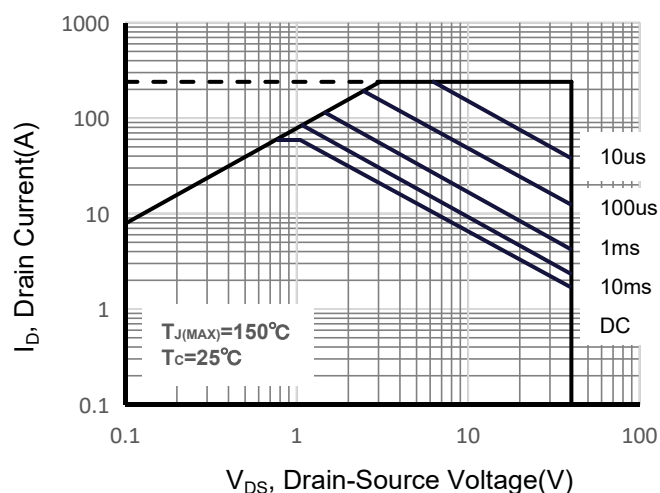


**Typical Characteristics**  $T_J = 25^\circ\text{C}$ , unless otherwise noted

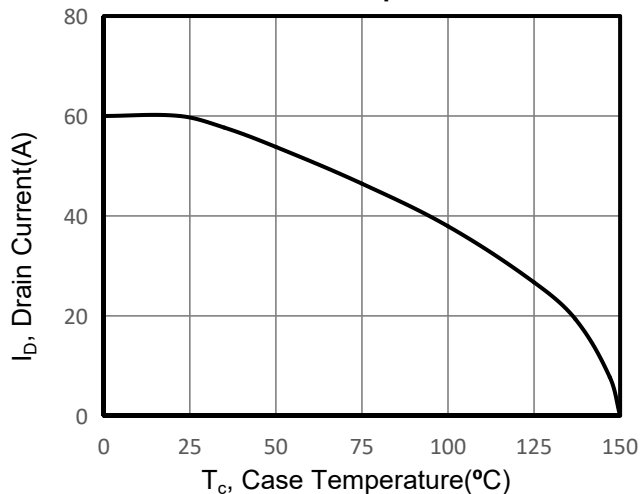
**Figure 7. Drain-Source On-Resistance**



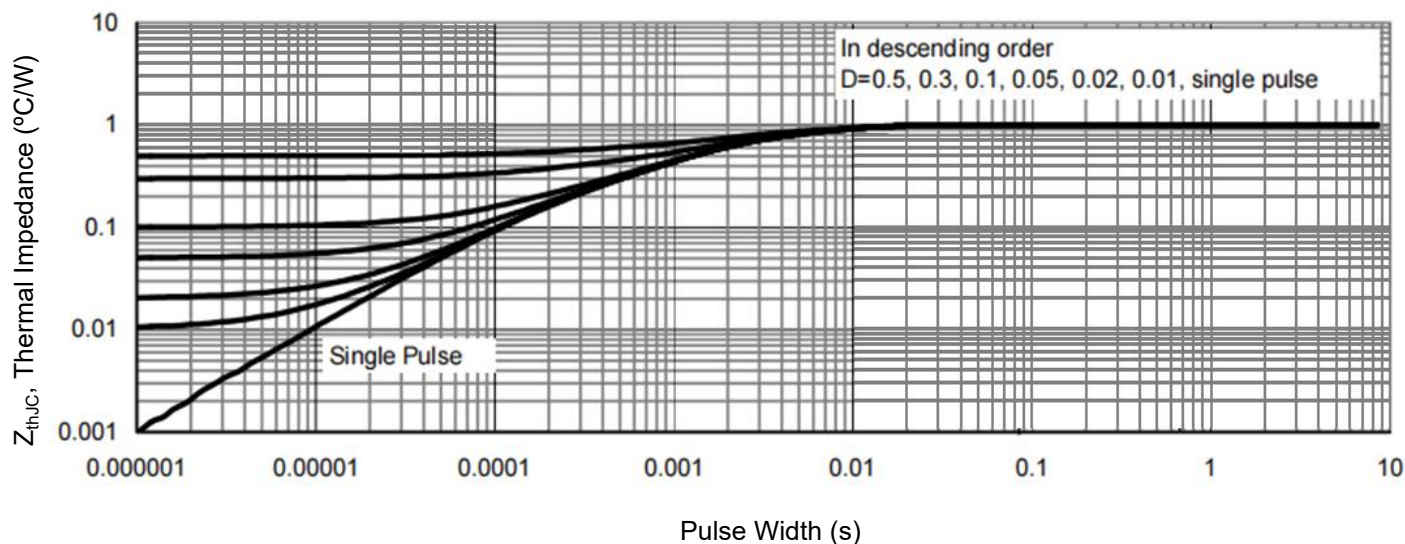
**Figure 8. Safe Operation Area**



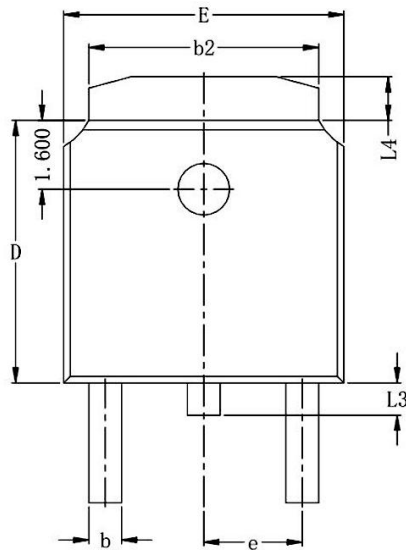
**Figure 9. Maximum Continuous Drain Current vs Case Temperature**



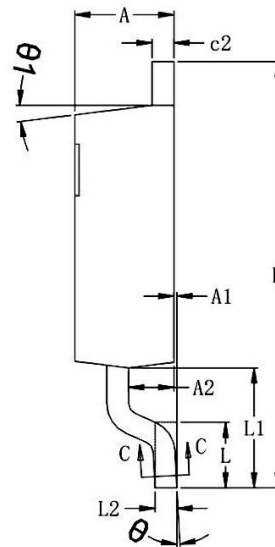
**Figure 10. Normalized Maximum**



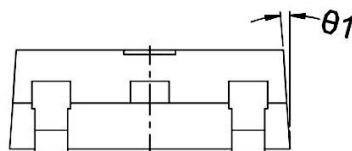
## TO-252 Package Information



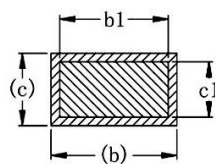
TOP VIEW



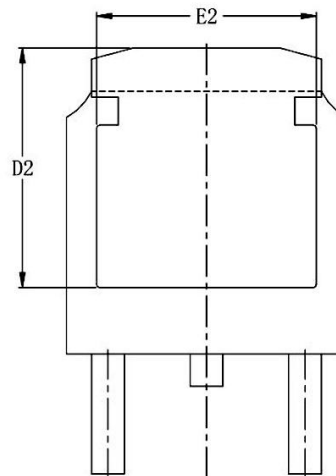
SIDE VIEW (Right)



SIDE VIEW (Front)



SECTION: C-C



OPTION 1  
BOTTOM VIEW

| DIM<br>SYMBOL | MIN.  | NOM.  | MAX.  | DIM<br>SYMBOL | MIN.       | NOM.  | MAX.   |
|---------------|-------|-------|-------|---------------|------------|-------|--------|
| A             | 2.200 | 2.300 | 2.400 | E             | 6.400      | 6.500 | 6.600  |
| A1            | 0.000 | 0.070 | 0.130 | E2            | 4.900      | 5.100 | 5.300  |
| A2            | 0.950 | 1.050 | 1.150 | e             | 2.286 BSC. |       |        |
| b             | 0.700 | 0.800 | 0.900 | H             | 9.700      | 9.900 | 10.100 |
| b1            | 0.660 | 0.760 | 0.860 | L             | 1.380      | 1.525 | 1.725  |
| b2            | 5.134 | 5.334 | 5.534 | L1            | 2.588      | 2.788 | 2.988  |
| c             | 0.448 | 0.548 | 0.648 | L2            | 0.508 BSC. |       |        |
| c1            | 0.458 | 0.508 | 0.558 | L3            | 0.600      | 0.750 | 0.950  |
| c2            | 0.448 | 0.548 | 0.648 | L4            | 0.812      | 1.012 | 1.212  |
| D             | 6.000 | 6.100 | 6.200 | $\theta$      | 1°         | 3°    | 5°     |
| D2            | 5.372 | 5.572 | 5.772 | $\theta_1$    | 6°         | 7°    | 8°     |