# TM7004S

## N+P-Channel Enhancement Mode Mosfet

### General Description

- Low $R_{DS(ON)}$
- RoHS and Halogen-Free Compliant

### Applications

- Load switch
- PWM

### Product Summary

**N Channel**

$V_{DS}$ = 40V,$I_D$ =7.3A

$R_{DS(ON)}$=26mΩ(typ.)@ $V_{GS}$=10V

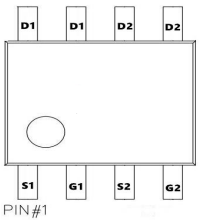
**P Channel**

$V_{DS}$ = -40V,$I_D$ = -6.1A

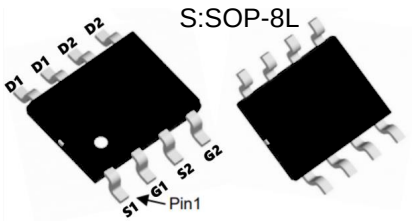
$R_{DS(ON)}$=56mΩ(typ.)@ $V_{GS}$=-10V

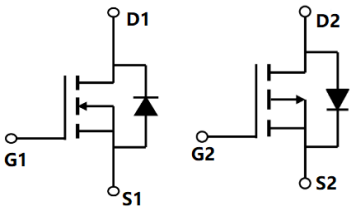
100% UIS Tested

100% $R_g$ Tested




Marking: 7004




### Absolute Maximum Ratings ($T_C$=25℃unless otherwise noted)

| Symbol | Parameter | Rating | | Units |
|---|---|---|---|---|
| | | N-Ch | P-Ch | |
| $V_{DS}$ | Drain-Source Voltage | 40 | -40 | V |
| $V_{GS}$ | Gate-Source Voltage | ±20 | ±20 | V |
| $I_D$@$T_A$=25℃ | Continuous Drain Current, $V_{GS}$ @ 10V[1] | 7.3 | -6.1 | A |
| $I_D$@$T_A$=70℃ | Continuous Drain Current, $V_{GS}$ @ 10V[1] | 4.9 | -3.8 | A |
| $I_{DM}$ | Pulsed Drain Current[2] | 26 | -22 | A |
| EAS | Single Pulse Avalanche Energy[3] | 16.2 | 39 | mJ |
| $I_{AS}$ | Avalanche Current | 6.8 | -6.8 | A |
| $P_D$@$T_A$=25℃ | Total Power Dissipation[4] | 1.67 | 1.67 | W |
| $T_{STG}$ | Storage Temperature Range | -55 to 150 | -55 to 150 | ℃ |
| $T_J$ | Operating Junction Temperature Range | -55 to 150 | -55 to 150 | ℃ |
| $R_{\theta JA}$ | Thermal Resistance Junction-Ambient [1] | 57 | | ℃/W |
| $R_{\theta JC}$ | Thermal Resistance Junction-Case[1] | 30 | | ℃/W |

## N-Channel Electrical Characteristics ($T_J$=25 ℃, unless otherwise noted)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| BVDSS | Drain-Source Breakdown Voltage | $V_{GS}$=0V , $I_D$=250uA | 40 | 44 | --- | V |
| △BVDSS/△TJ | BVDSS Temperature Coefficient | Reference to 25℃ , $I_D$=1mA | --- | 0.034 | --- | V/℃ |
| RDS(ON) | Static Drain-Source On-Resistance[2] | $V_{GS}$=10V , $I_D$=5A | --- | 26 | 36 | mΩ |
| | | $V_{GS}$=4.5V , $I_D$=4A | --- | 36 | 49 | |
| VGS(th) | Gate Threshold Voltage | $V_{GS}$=$V_{DS}$ , $I_D$ =250uA | 1.2 | 1.6 | 2.5 | V |
| △$V_{GS(th)}$ | $V_{GS(th)}$ Temperature Coefficient | | --- | -4.56 | --- | mV/℃ |
| IDSS | Drain-Source Leakage Current | $V_{DS}$=32V , $V_{GS}$=0V , $T_J$=25℃ | --- | --- | 1 | uA |
| | | $V_{DS}$=32V , $V_{GS}$=0V , $T_J$=55℃ | --- | --- | 5 | |
| IGSS | Gate-Source Leakage Current | $V_{GS}$=±20V , $V_{DS}$=0V | --- | --- | ±100 | nA |
| gfs | Forward Transconductance | $V_{DS}$=5V , $I_D$=5A | --- | 14 | --- | S |
| $R_g$ | Gate Resistance | $V_{DS}$=0V , $V_{GS}$=0V , f=1MHz | --- | 2.6 | --- | Ω |
| $Q_g$ | Total Gate Charge (4.5V) | $V_{DS}$=20V , $V_{GS}$=4.5V , $I_D$=5A | --- | 5.5 | --- | nC |
| $Q_{gs}$ | Gate-Source Charge | | --- | 1.25 | --- | |
| $Q_{gd}$ | Gate-Drain Charge | | --- | 2.5 | --- | |
| Td(on) | Turn-On Delay Time | $V_{DD}$=20V , $V_{GS}$=10V , $R_G$=3.3Ω $I_D$=1A | --- | 8.9 | --- | ns |
| $T_r$ | Rise Time | | --- | 2.2 | --- | |
| Td(off) | Turn-Off Delay Time | | --- | 41 | --- | |
| $T_f$ | Fall Time | | --- | 2.7 | --- | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$=15V , $V_{GS}$=0V , f=1MHz | --- | 593 | --- | pF |
| Coss | Output Capacitance | | --- | 76 | --- | |
| Crss | Reverse Transfer Capacitance | | --- | 56 | --- | |
| $I_S$ | Continuous Source Current[1,5] | $V_G$=$V_D$=0V , Force Current | --- | --- | 7.3 | A |
| ISM | Pulsed Source Current[2,5] | | --- | --- | 23 | A |
| VSD | Diode Forward Voltage[2] | $V_{GS}$=0V , $I_S$=1A , $T_J$=25℃ | --- | --- | 1.2 | V |

**Note :**

1、The data tested by surface mounted on a 1 inch$^2$ FR-4 board with 2OZ copper.

2、The data tested by pulsed , pulse width ≦ 300us , duty cycle ≦ 2%

3、The EAS data shows Max. rating . The test condition is $V_{DD}$=25V,$V_{GS}$=10V,L=0.1mH,$I_{AS}$=10A

4、The power dissipation is limited by 150℃ junction temperature

5 、The data is theoretically the same as $I_D$ and $I_{DM}$ , in real applications , should be limited by total power dissipation.

## P-Channel Electrical Characteristics ($T_J$=25 ℃, unless otherwise noted)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| BVDSS | Drain-Source Breakdown Voltage | $V_{GS}$=0V , $I_D$=-250uA | -40 | -44 | --- | V |
| △BVDSS/△TJ | $BV_{DSS}$ Temperature Coefficient | Reference to 25℃ , $I_D$=-1mA | --- | -0.018 | --- | V/℃ |
| RDS(ON) | Static Drain-Source On-Resistance[2] | $V_{GS}$=-10V , $I_D$=-3A | --- | 56 | 76 | mΩ |
| | | $V_{GS}$=-4.5V , $I_D$=-2A | --- | 76 | 85 | |
| VGS(th) | Gate Threshold Voltage | $V_{GS}$=$V_{DS}$ , $I_D$ =-250uA | -1.0 | -1.5 | -2.5 | V |
| △$V_{GS(th)}$ | $V_{GS(th)}$ Temperature Coefficient | | --- | 2.5 | --- | mV/℃ |
| IDSS | Drain-Source Leakage Current | $V_{DS}$=-40V , $V_{GS}$=0V , $T_J$=25℃ | --- | --- | -1 | uA |
| | | $V_{DS}$=-40V , $V_{GS}$=0V , $T_J$=55℃ | --- | --- | -5 | |
| IGSS | Gate-Source Leakage Current | $V_{GS}$=±20V , $V_{DS}$=0V | --- | --- | ±100 | nA |
| gfs | Forward Transconductance | $V_{DS}$=-5V , $I_D$=-3A | --- | 5.8 | --- | S |
| $Q_g$ | Total Gate Charge (-4.5V) | $V_{DS}$=-32V , $V_{GS}$=-4.5V , $I_D$=-3A | --- | 6.4 | --- | nC |
| Qgs | Gate-Source Charge | | --- | 2.1 | --- | |
| Qgd | Gate-Drain Charge | | --- | 2.5 | --- | |
| Td(on) | Turn-On Delay Time | $V_{DD}$=-20V , $V_{GS}$=-4.5V , $R_G$=3.3Ω, $I_D$=-3A | --- | 4.2 | --- | ns |
| $T_r$ | Rise Time | | --- | 23 | --- | |
| Td(off) | Turn-Off Delay Time | | --- | 26.8 | --- | |
| $T_f$ | Fall Time | | --- | 20.6 | --- | |
| Ciss | Input Capacitance | $V_{DS}$=-15V , $V_{GS}$=0V , f=1MHz | --- | 620 | --- | pF |
| Coss | Output Capacitance | | --- | 65 | --- | |
| Crss | Reverse Transfer Capacitance | | --- | 53 | --- | |
| IS | Continuous Source Current[1,4] | $V_G$=$V_D$=0V , Force Current | --- | --- | -6.1 | A |
| ISM | Pulsed Source Current[2,4] | | --- | --- | -16.1 | A |
| VSD | Diode Forward Voltage[2] | $V_{GS}$=0V , $I_S$=-1A , $T_J$=25℃ | --- | --- | -1 | V |

**Note :**

1、The data tested by surface mounted on a 1 inch$^2$ FR-4 board with 2OZ copper.
2、The data tested by pulsed , pulse width ≦ 300us , duty cycle ≦ 2%
3、The power dissipation is limited by 150℃ junction temperature
4、The data is theoretically the same as $I_D$ and $I_{DM}$ , in real applications , should be limited by total power dissipation.

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## N+P-Channel Enhancement Mode Mosfet

### N-Channel Typical Characteristics

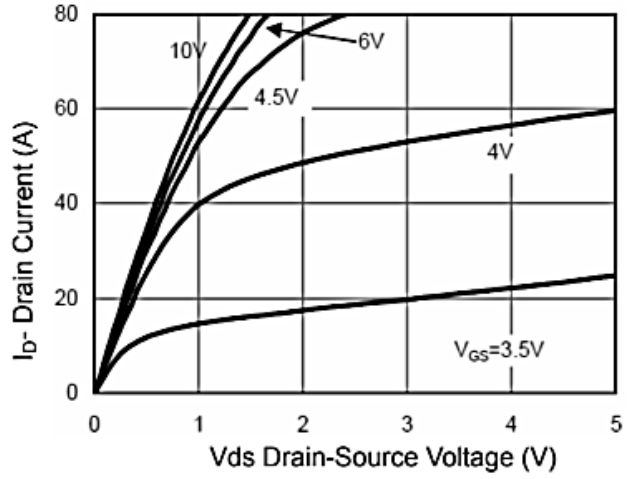


Figure 1 Output Characteristics

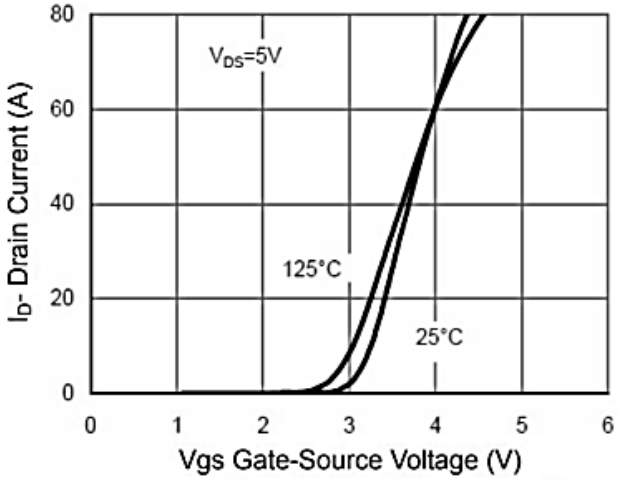


Figure 2 Transfer Characteristics

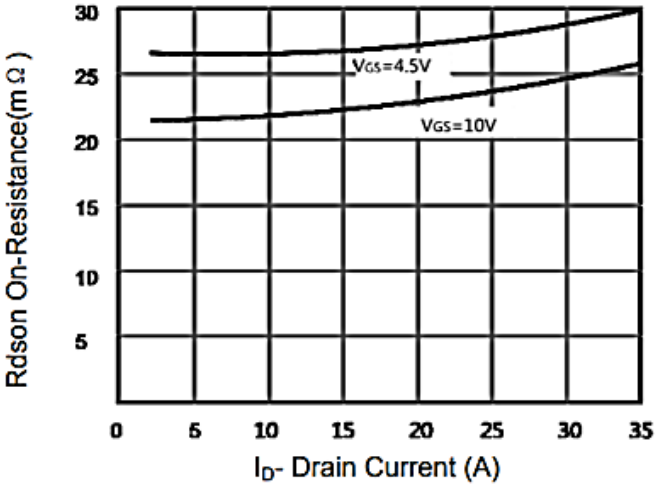


Figure 3 Rdson- Drain Current

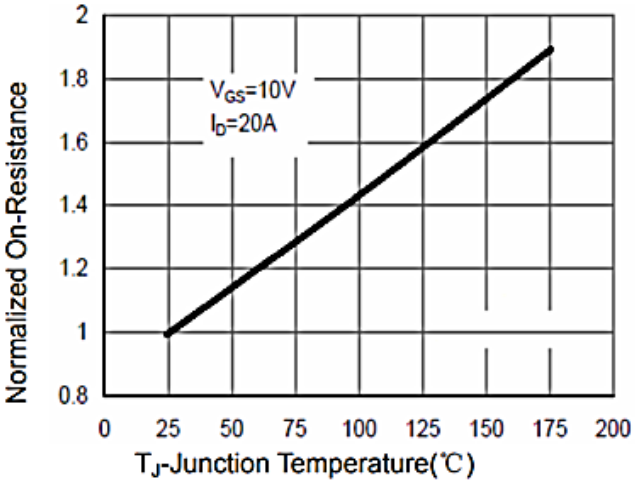


Figure 4 Rdson-JunctionTemperature

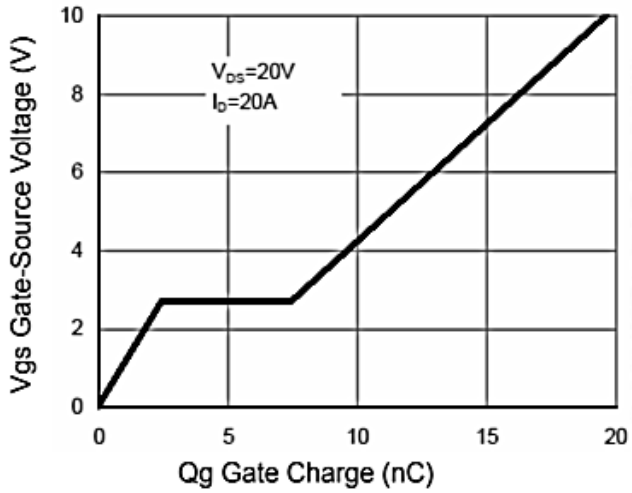


Figure 5 Gate Charge

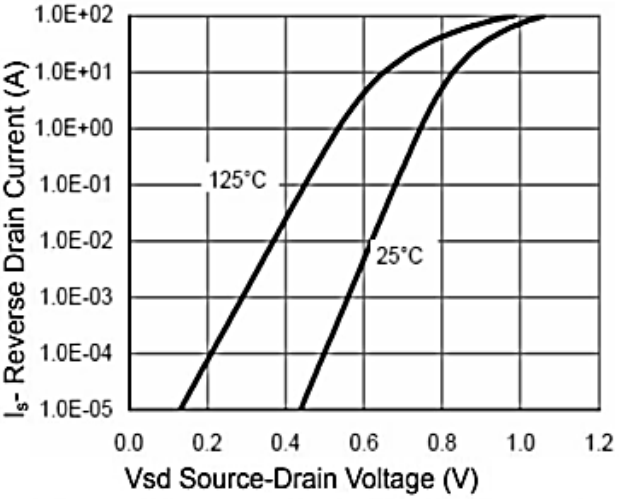


Figure 6 Source- Drain Diode Forward

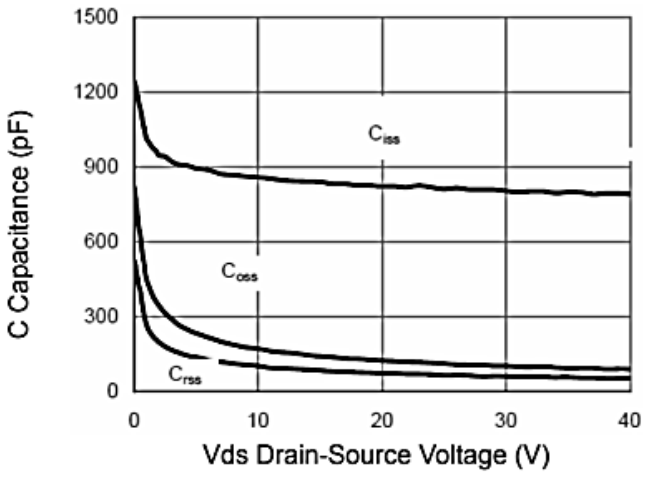


**Figure 7 Capacitance vs Vds**

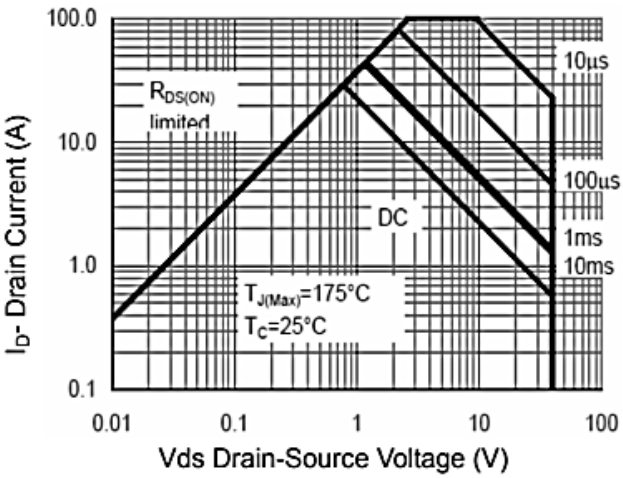


**Figure 8 Safe Operation Area**

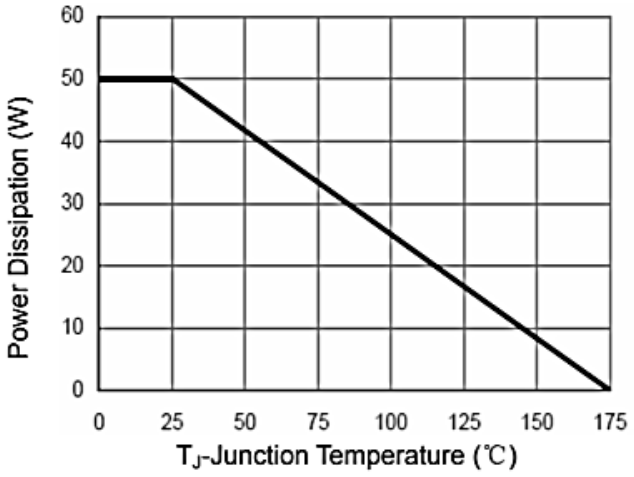


**Figure 9 Power De-rating**

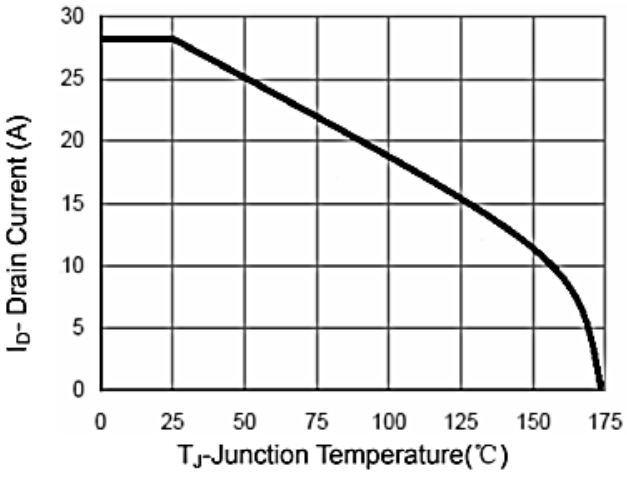


**Figure 10 $I_D$ Current De-rating**

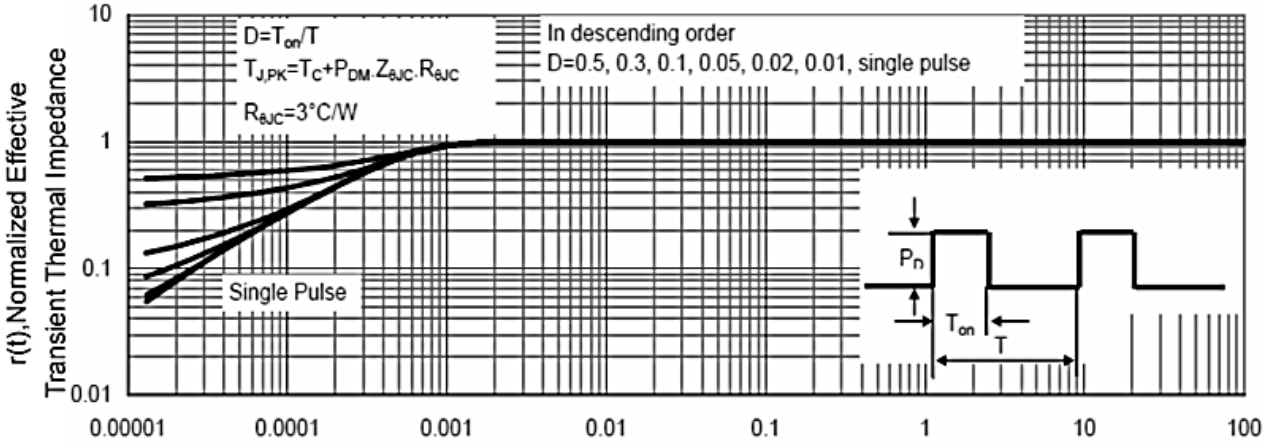


**Figure 11 Normalized Maximum Transient Thermal Impedance**

# TM7004S

## N+P-Channel Enhancement Mode Mosfet

### P-Typical Characteristics

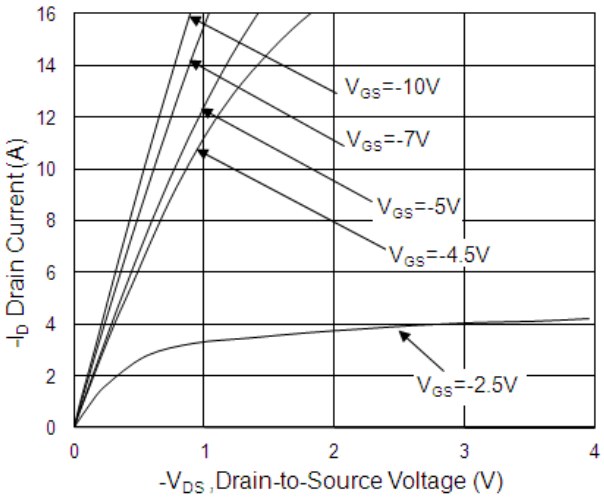


Fig.1 Typical Output Characteristics

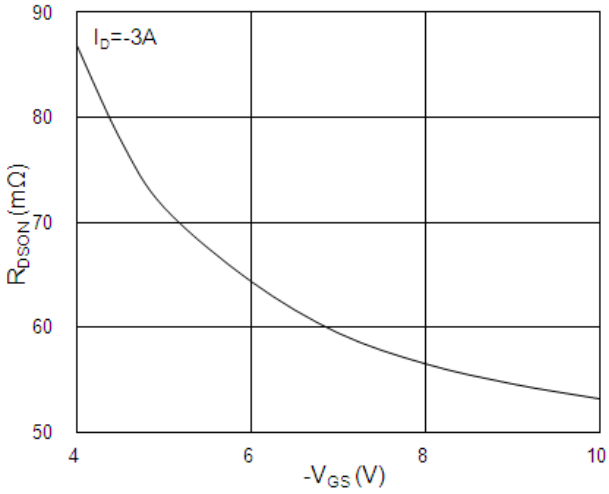


Fig.2 On-Resistance vs. G-S Voltage

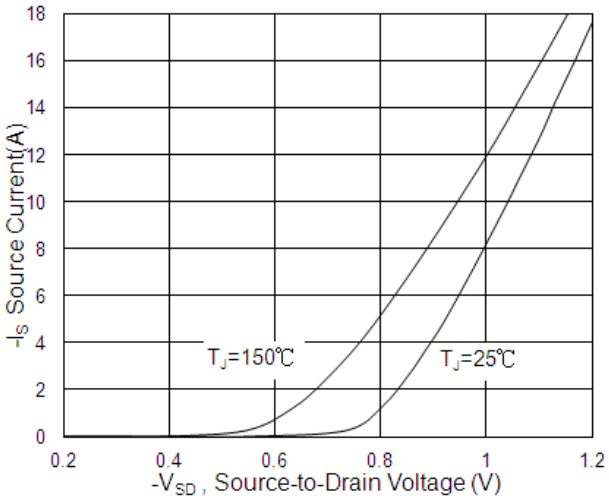


Fig.3 Forward Characteristics Of Reverse

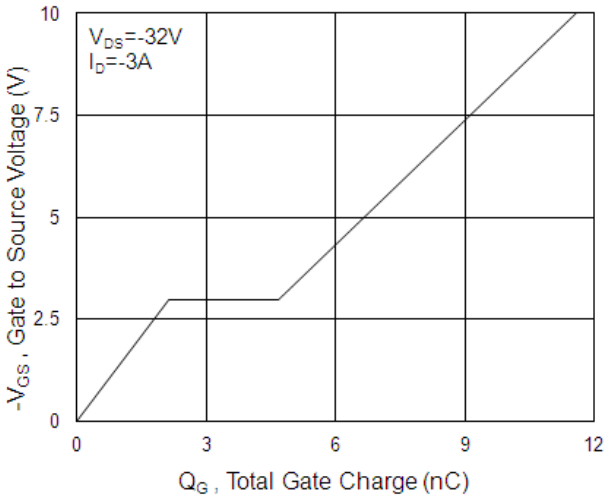


Fig.4 Gate-Charge Characteristics

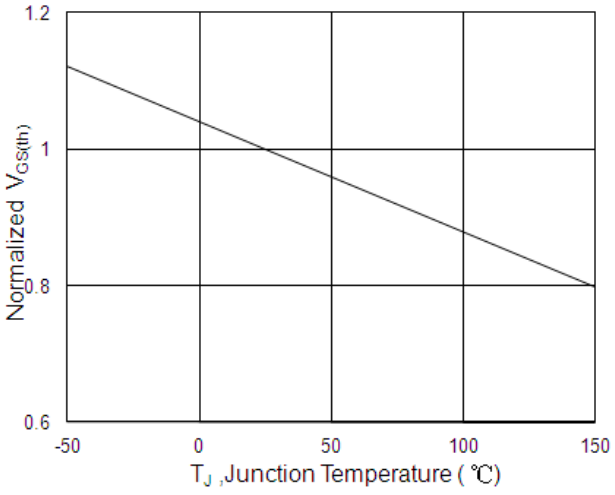


Fig.5 Normalized $V_{GS(th)}$ vs. $T_J$

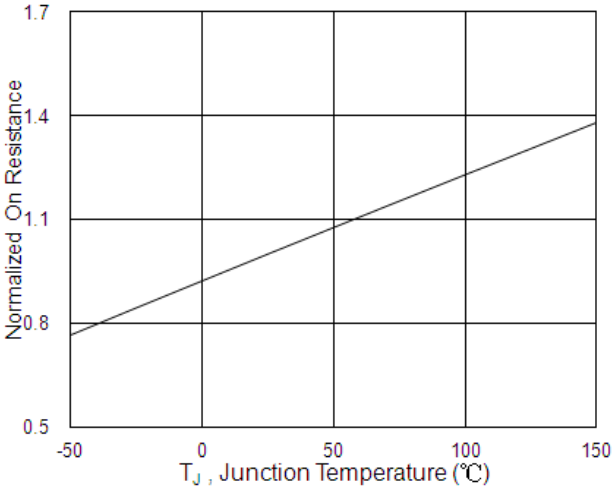


Fig.6 Normalized $R_{DSON}$ vs. $T_J$

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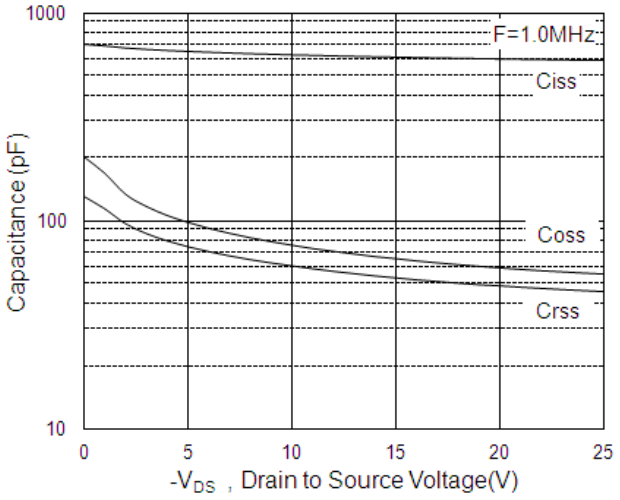



**Fig.7 Capacitance**

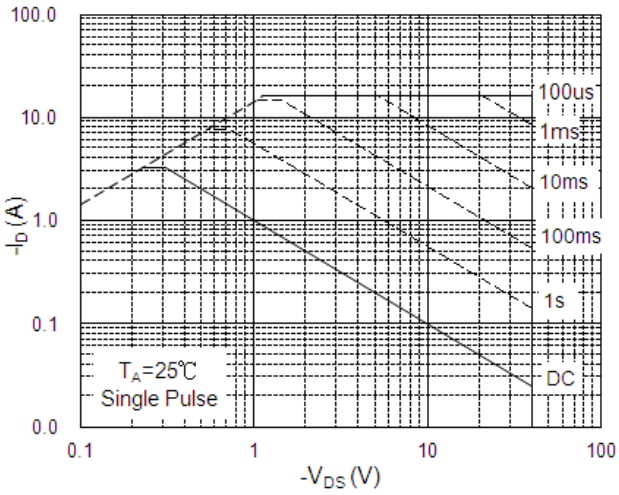



**Fig.8 Safe Operating Area**

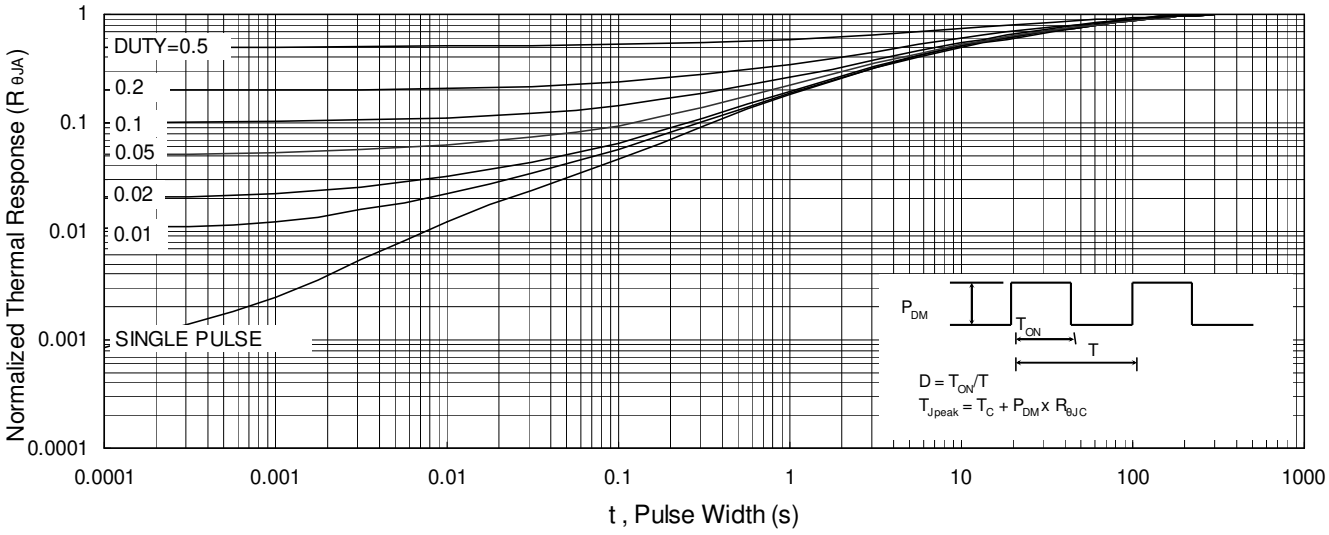



**Fig.9 Normalized Maximum Transient Thermal Impedance**

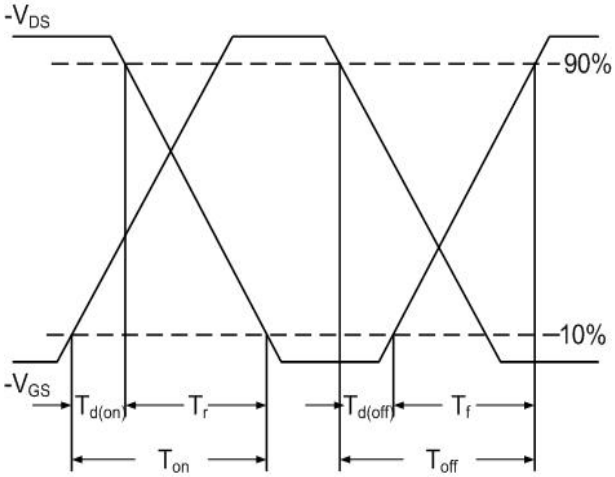



**Fig.10 Switching Time Waveform**

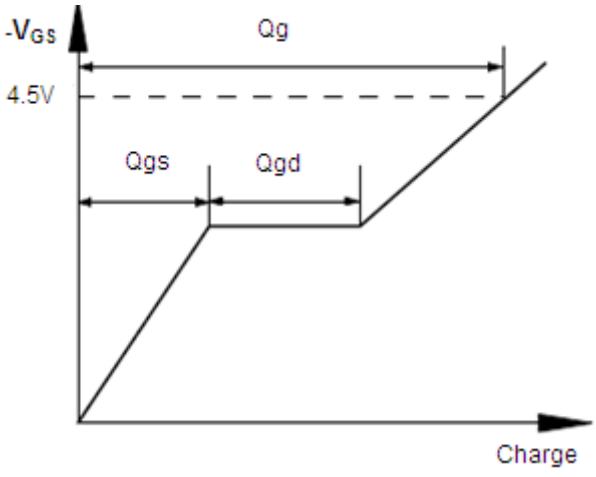
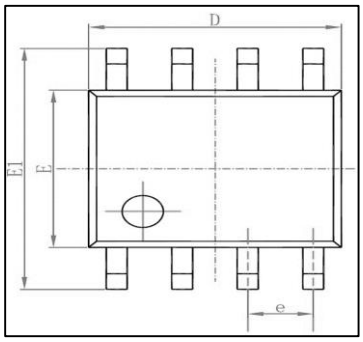
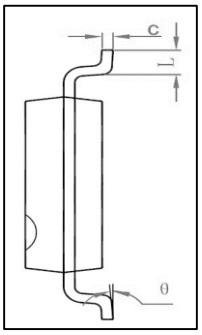


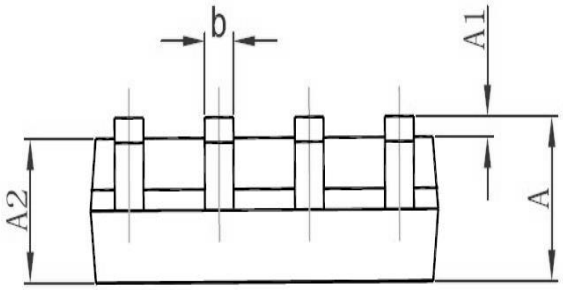

**Fig.11 Gate Charge Waveform**

Data and specifications subject to change without notice.

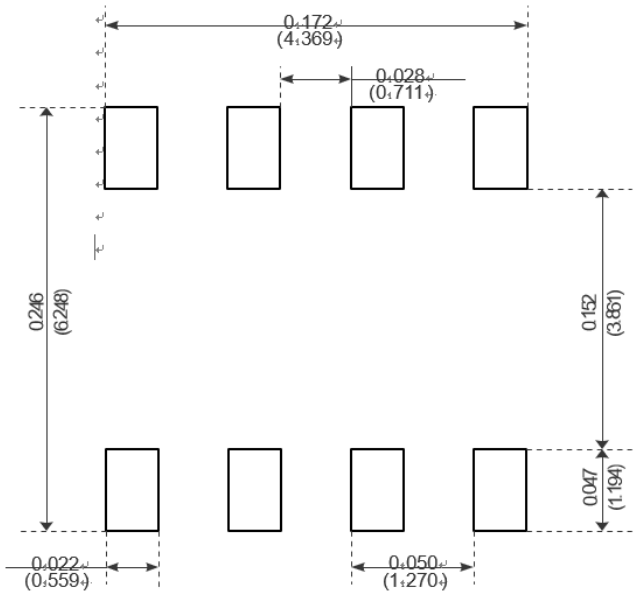
## Package Mechanical Data:SOP-8L




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 1.350 | 1.750 | 0.053 | 0.069 |
| A1 | 0.100 | 0.250 | 0.004 | 0.010 |
| A2 | 1.350 | 1.550 | 0.053 | 0.061 |
| b | 0.330 | 0.510 | 0.013 | 0.020 |
| c | 0.170 | 0.250 | 0.006 | 0.010 |
| D | 4.700 | 5.100 | 0.185 | 0.200 |
| E | 3.800 | 4.000 | 0.150 | 0.157 |
| E1 | 5.800 | 6.200 | 0.228 | 0.244 |
| e | 1.270 (BSC) | | 0.050 (BSC) | |
| L | 0.400 | 1.270 | 0.016 | 0.050 |
| θ | 0° | 8° | 0° | 8° |




Recommended Minimum Pads