

## Description

The TM8958BGS uses advanced trench technology to provide excellent  $R_{DS(ON)}$  and low gate charge.

The complementary MOSFETs may be used to form a level shifted high side switch, and for a host of other applications.

## General Features

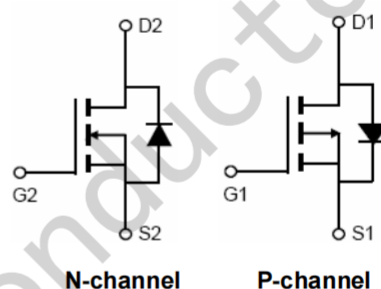
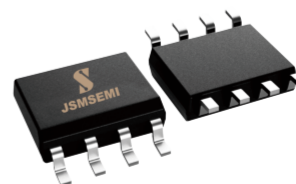
### ● N-Channel

$V_{DS} = 40V, I_D = 8.0A$   
 $R_{DS(ON)} < 22m\Omega @ V_{GS}=10V$   
 $R_{DS(ON)} < 31m\Omega @ V_{GS}=4.5V$

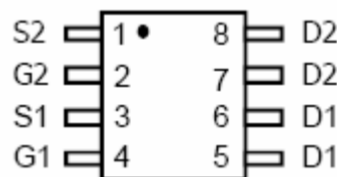
### ● P-Channel

$V_{DS} = -40V, I_D = -7.0A$   
 $R_{DS(ON)} < 35m\Omega @ V_{GS}=-10V$   
 $R_{DS(ON)} < 48m\Omega @ V_{GS}=-4.5V$

- High power and current handling capability
- Lead free product is acquired
- Surface mount package



**Schematic diagram**



**Marking and pin assignment**

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

| Parameter                                        |                  | Symbol         | N-Channel  | P-Channel  | Unit       |
|--------------------------------------------------|------------------|----------------|------------|------------|------------|
| Drain-Source Voltage                             |                  | $V_{DS}$       | 40         | -40        | V          |
| Gate-Source Voltage                              |                  | $V_{GS}$       | $\pm 20$   | $\pm 20$   | V          |
| Continuous Drain Current                         | $T_A=25^\circ C$ | $I_D$          | 8.0        | -7.0       | A          |
| Pulsed Drain Current <sup>(Note 1)</sup>         |                  | $I_{DM}$       | 40         | -30        | A          |
| Maximum Power Dissipation                        | $T_A=25^\circ C$ | $P_D$          | 2.0        | 2.0        | W          |
| Operating Junction and Storage Temperature Range |                  | $T_J, T_{STG}$ | -55 To 150 | -55 To 150 | $^\circ C$ |

## Thermal Characteristic

|                                                            |                 |      |      |              |
|------------------------------------------------------------|-----------------|------|------|--------------|
| Thermal Resistance, Junction-to-Ambient <sup>(Note2)</sup> | $R_{\theta JA}$ | N-Ch | 62.5 | $^\circ C/W$ |
| Thermal Resistance, Junction-to-Ambient <sup>(Note2)</sup> | $R_{\theta JA}$ | P-Ch | 62.5 | $^\circ C/W$ |

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

| Parameter                       | Symbol     | Condition                   | Min | Typ | Max       | Unit    |
|---------------------------------|------------|-----------------------------|-----|-----|-----------|---------|
| <b>Off Characteristics</b>      |            |                             |     |     |           |         |
| Drain-Source Breakdown Voltage  | $BV_{DSS}$ | $V_{GS}=0V, I_D=250\mu A$   | 40  | -   | -         | V       |
| Zero Gate Voltage Drain Current | $I_{DSS}$  | $V_{DS}=40V, V_{GS}=0V$     | -   | -   | 1         | $\mu A$ |
| Gate-Body Leakage Current       | $I_{GSS}$  | $V_{GS}=\pm 20V, V_{DS}=0V$ | -   | -   | $\pm 100$ | nA      |

**On Characteristics (Note 3)**

|                                  |              |                               |     |     |     |            |
|----------------------------------|--------------|-------------------------------|-----|-----|-----|------------|
| Gate Threshold Voltage           | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=250\mu A$ | 1.0 | 1.4 | 2.0 | V          |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $V_{GS}=10V, I_D=8A$          | -   | 17  | 22  | m $\Omega$ |
|                                  |              | $V_{GS}=4.5V, I_D=6A$         | -   | 21  | 31  | m $\Omega$ |
| Forward Transconductance         | $g_{FS}$     | $V_{DS}=5V, I_D=8A$           | 15  | -   | -   | S          |

**Dynamic Characteristics (Note4)**

|                              |           |                                        |   |     |   |    |
|------------------------------|-----------|----------------------------------------|---|-----|---|----|
| Input Capacitance            | $C_{iss}$ | $V_{DS}=20V, V_{GS}=0V,$<br>$F=1.0MHz$ | - | 415 | - | PF |
| Output Capacitance           | $C_{oss}$ |                                        | - | 112 | - | PF |
| Reverse Transfer Capacitance | $C_{rss}$ |                                        | - | 11  | - | PF |

**Switching Characteristics (Note 4)**

|                     |              |                                                              |   |     |   |    |
|---------------------|--------------|--------------------------------------------------------------|---|-----|---|----|
| Turn-on Delay Time  | $t_{d(on)}$  | $V_{DD}=20V, R_L=2.5\Omega$<br>$V_{GS}=10V, R_{GEN}=3\Omega$ | - | 4.0 | - | nS |
| Turn-on Rise Time   | $t_r$        |                                                              | - | 3.0 | - | nS |
| Turn-Off Delay Time | $t_{d(off)}$ |                                                              | - | 15  | - | nS |
| Turn-Off Fall Time  | $t_f$        |                                                              | - | 2.0 | - | nS |
| Total Gate Charge   | $Q_g$        | $V_{DS}=20V, I_D=8A,$<br>$V_{GS}=10V$                        | - | 12  | - | nC |
| Gate-Source Charge  | $Q_{gs}$     |                                                              | - | 3.5 | - | nC |
| Gate-Drain Charge   | $Q_{gd}$     |                                                              | - | 3.1 | - | nC |

**Drain-Source Diode Characteristics**

|                                |          |                     |   |      |     |   |
|--------------------------------|----------|---------------------|---|------|-----|---|
| Diode Forward Voltage (Note 3) | $V_{SD}$ | $V_{GS}=0V, I_S=8A$ | - | 0.75 | 1.0 | V |
|--------------------------------|----------|---------------------|---|------|-----|---|

**Notes:**

1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to production

## N- Channel Typical Electrical and Thermal Characteristics (Curves)

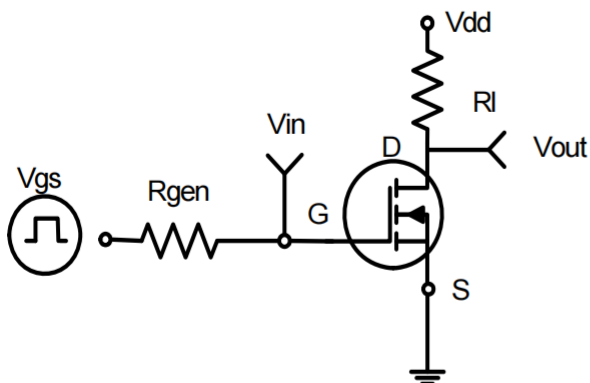


Figure 1: Switching Test Circuit

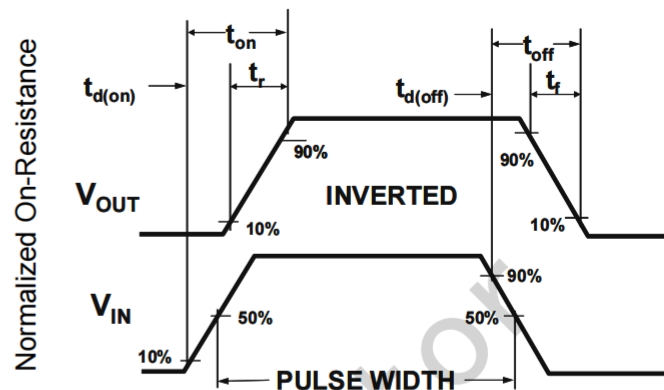


Figure 2: Switching Waveforms

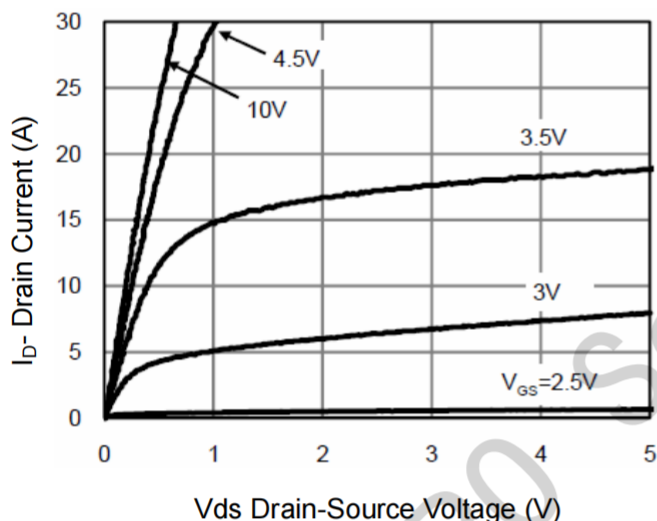


Figure 3 Output Characteristics

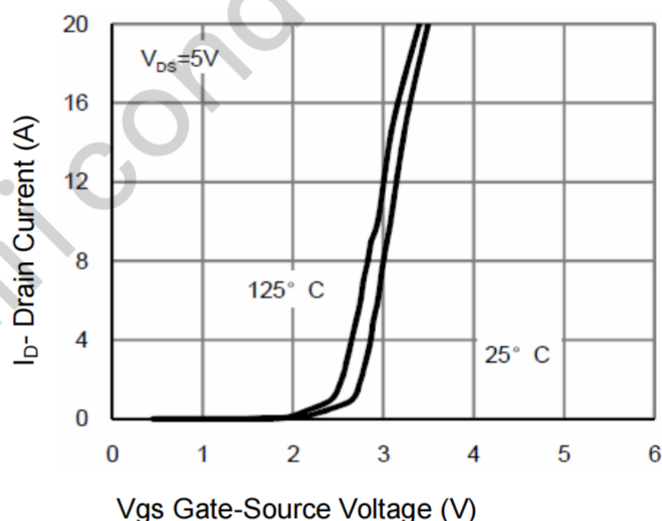


Figure 4 Transfer Characteristics

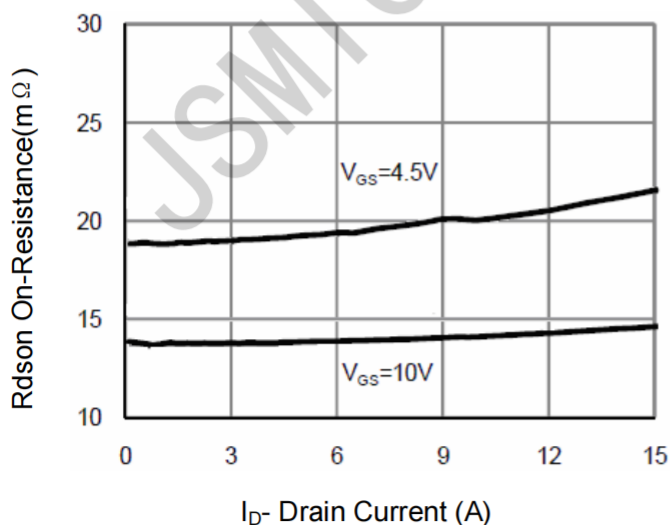


Figure 5 Drain-Source On-Resistance

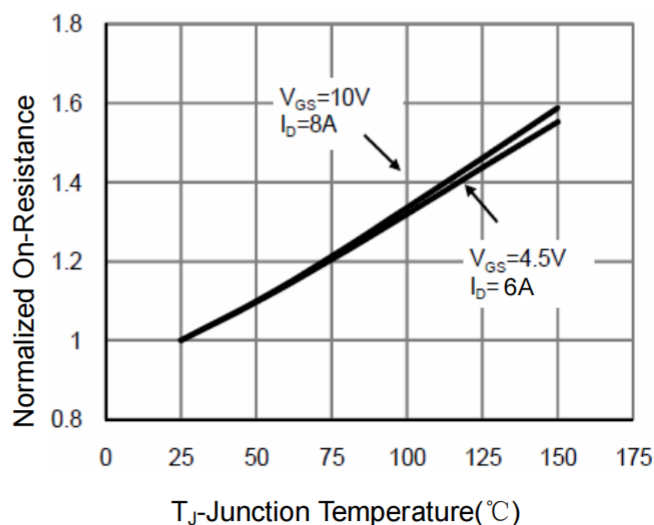
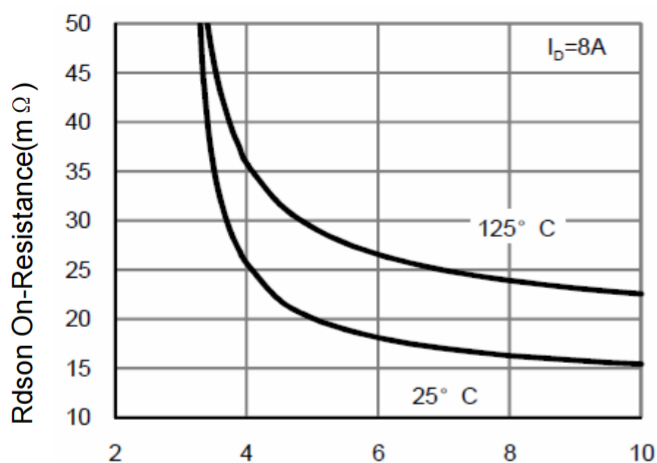
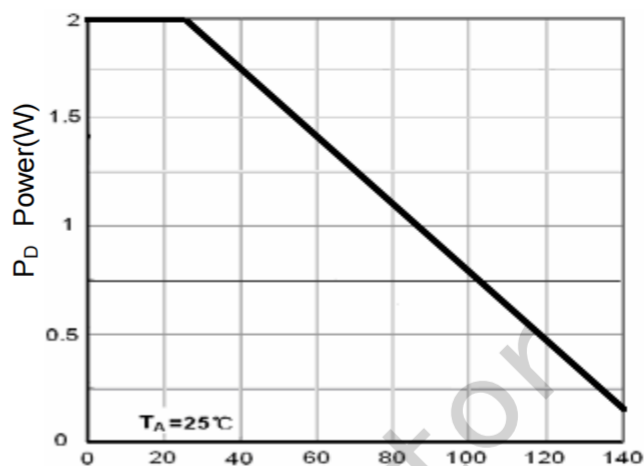


Figure 6 Drain-Source On-Resistance



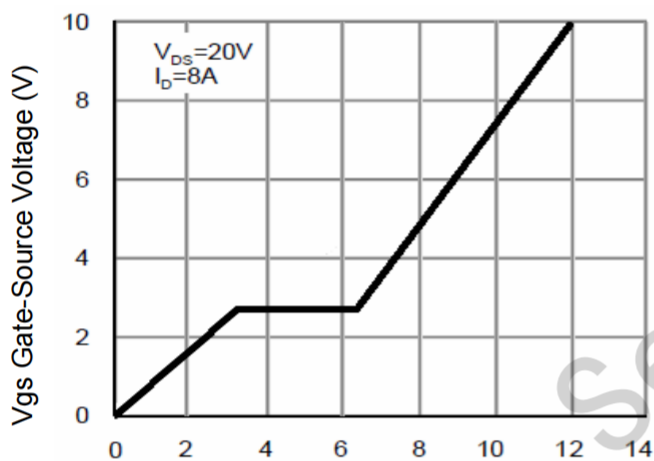
V<sub>GS</sub> Gate-Source Voltage (V)

**Figure 7 Rdson vs Vgs**



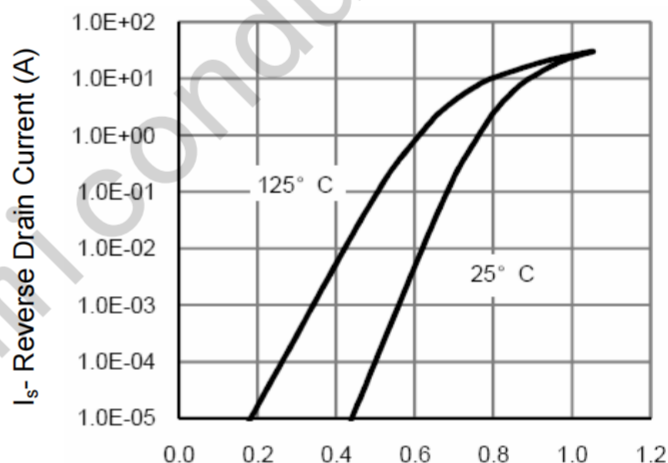
T<sub>J</sub>-Junction Temperature(°C)

**Figure 8 Power Dissipation**



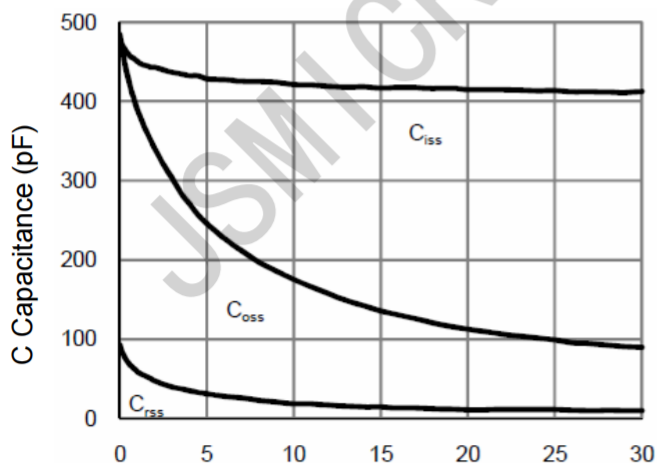
Q<sub>g</sub> Gate Charge (nC)

**Figure 9 Gate Charge**



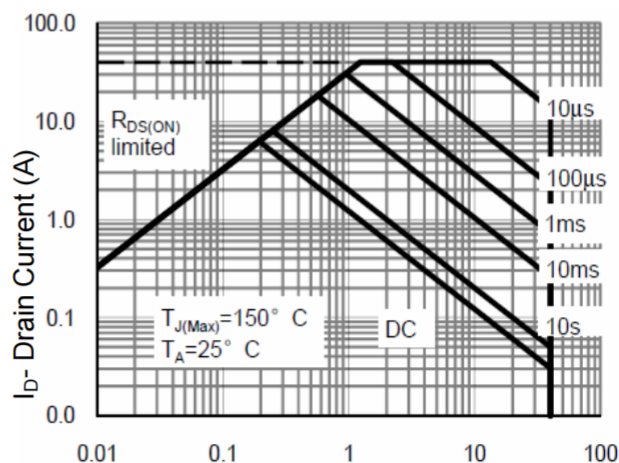
V<sub>DS</sub> Drain-Source Voltage (V)

**Figure 10 Source- Drain Diode Forward**



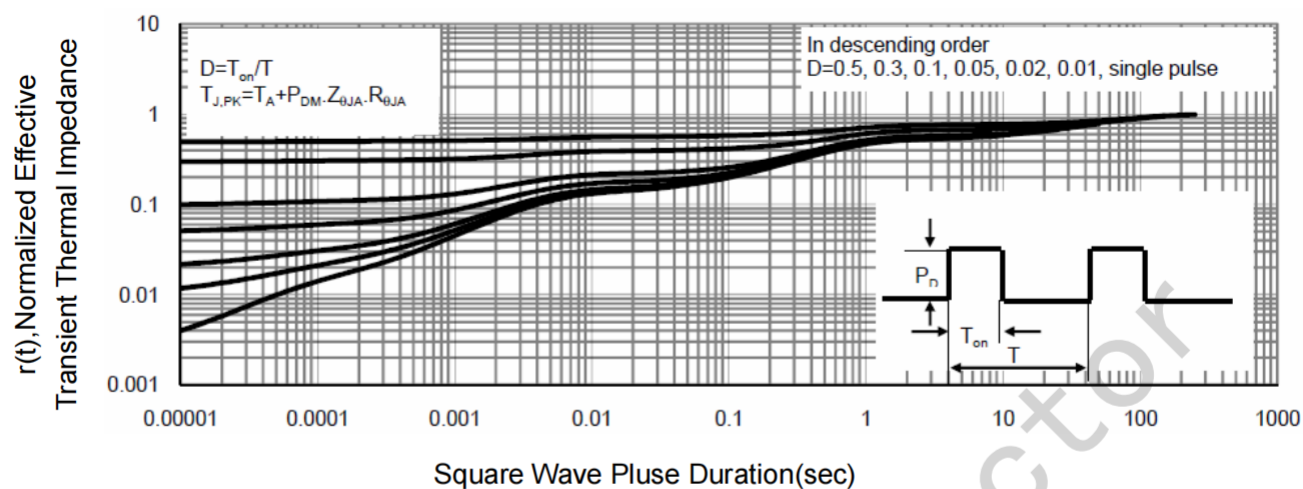
V<sub>DS</sub> Drain-Source Voltage (V)

**Figure 11 Capacitance vs Vds**



V<sub>DS</sub> Drain-Source Voltage (V)

**Figure 12 Safe Operation Area**



**Figure 13 Normalized Maximum Transient Thermal Impedance**

**P-CH Electrical Characteristics ( $T_A=25^{\circ}\text{C}$  unless otherwise noted)**

| Parameter                       | Symbol     | Condition                   | Min | Typ | Max       | Unit    |
|---------------------------------|------------|-----------------------------|-----|-----|-----------|---------|
| <b>Off Characteristics</b>      |            |                             |     |     |           |         |
| Drain-Source Breakdown Voltage  | $BV_{DSS}$ | $V_{GS}=0V, I_D=-250\mu A$  | -40 | -   | -         | V       |
| Zero Gate Voltage Drain Current | $I_{DSS}$  | $V_{DS}=-40V, V_{GS}=0V$    | -   | -   | -1        | $\mu A$ |
| Gate-Body Leakage Current       | $I_{GSS}$  | $V_{GS}=\pm 20V, V_{DS}=0V$ | -   | -   | $\pm 100$ | nA      |

**On Characteristics (Note 3)**

|                                  |              |                                |      |      |      |            |
|----------------------------------|--------------|--------------------------------|------|------|------|------------|
| Gate Threshold Voltage           | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=-250\mu A$ | -1.1 | -1.8 | -2.5 | V          |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $V_{GS}=-10V, I_D=-7.0A$       | -    | 30   | 35   | m $\Omega$ |
|                                  |              | $V_{GS}=-4.5V, I_D=-4.0A$      | -    | 43   | 48   | m $\Omega$ |
| Forward Transconductance         | $g_{FS}$     | $V_{DS}=-5V, I_D=-7.0A$        | 15   | -    | -    | S          |

**Dynamic Characteristics (Note4)**

|                              |           |                                         |   |     |   |    |
|------------------------------|-----------|-----------------------------------------|---|-----|---|----|
| Input Capacitance            | $C_{iss}$ | $V_{DS}=-20V, V_{GS}=0V,$<br>$F=1.0MHz$ | - | 520 | - | PF |
| Output Capacitance           | $C_{oss}$ |                                         | - | 100 | - | PF |
| Reverse Transfer Capacitance | $C_{rss}$ |                                         | - | 65  | - | PF |

**Switching Characteristics (Note 4)**

|                     |              |                                                                |   |     |   |    |
|---------------------|--------------|----------------------------------------------------------------|---|-----|---|----|
| Turn-on Delay Time  | $t_{d(on)}$  | $V_{DD}=-20V, R_L=2.3\Omega$<br>$V_{GS}=-10V, R_{GEN}=6\Omega$ | - | 7.5 | - | nS |
| Turn-on Rise Time   | $t_r$        |                                                                | - | 5.5 | - | nS |
| Turn-Off Delay Time | $t_{d(off)}$ |                                                                | - | 19  | - | nS |
| Turn-Off Fall Time  | $t_f$        |                                                                | - | 7   | - | nS |
| Total Gate Charge   | $Q_g$        | $V_{DS}=-20V, I_D=-7.0A$<br>$V_{GS}=-10V$                      | - | 13  | - | nC |
| Gate-Source Charge  | $Q_{gs}$     |                                                                | - | 3.8 | - | nC |
| Gate-Drain Charge   | $Q_{gd}$     |                                                                | - | 3.1 | - | nC |

**Drain-Source Diode Characteristics**

|                                |          |                        |   |      |      |   |
|--------------------------------|----------|------------------------|---|------|------|---|
| Diode Forward Voltage (Note 3) | $V_{SD}$ | $V_{GS}=0V, I_S=-7.0A$ | - | 0.75 | -1.0 | V |
|--------------------------------|----------|------------------------|---|------|------|---|

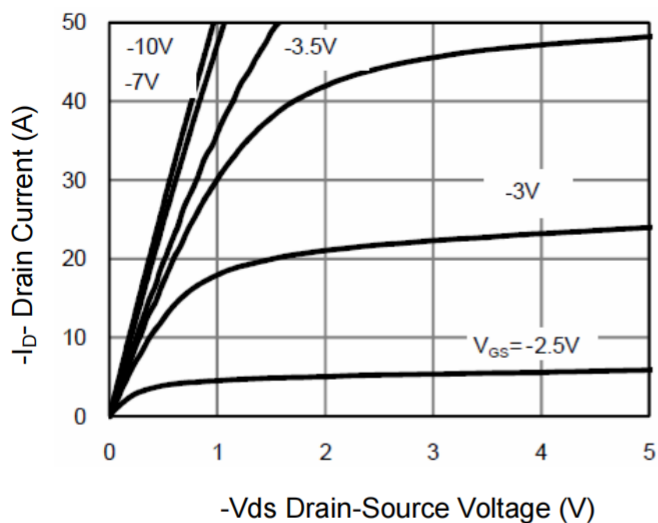
**Notes:**

1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to production

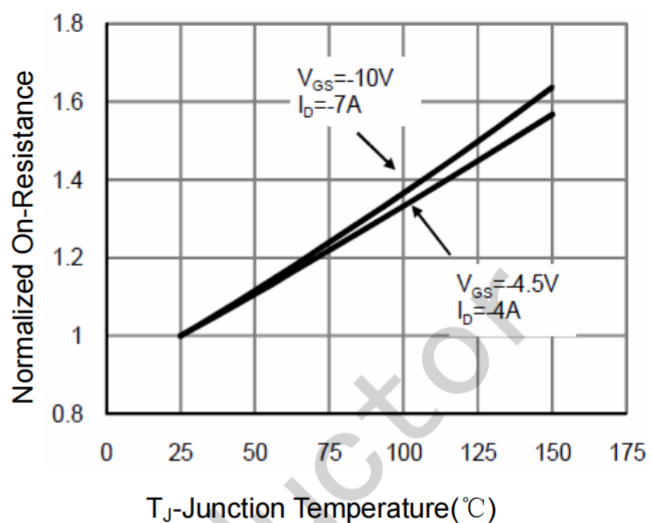




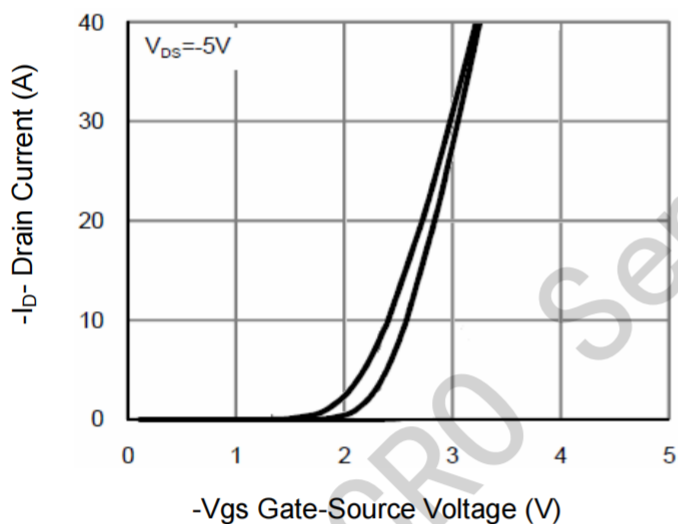
### P- Channel Typical Electrical and Thermal Characteristics (Curves)



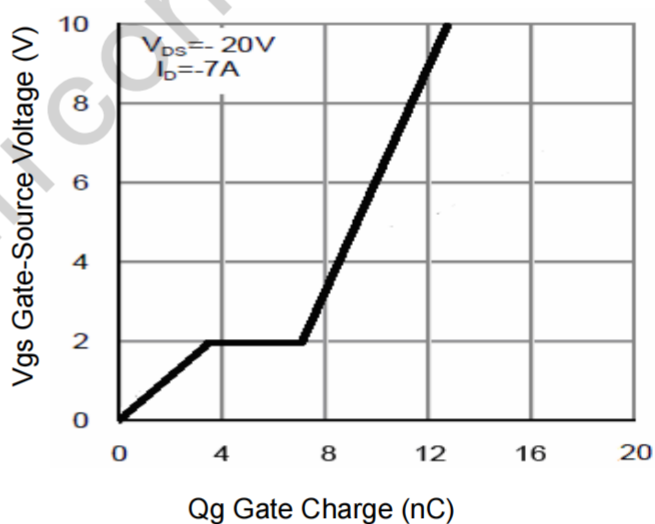
**Figure 1 Output Characteristics**



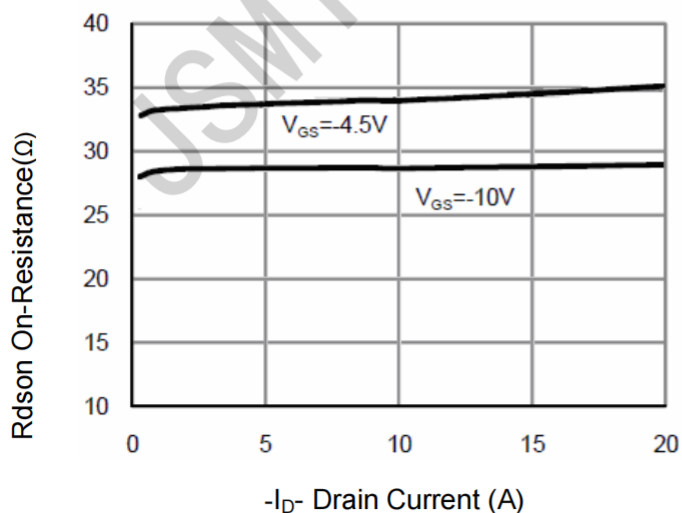
**Figure 4  $R_{DS(on)}$ -Junction Temperature**



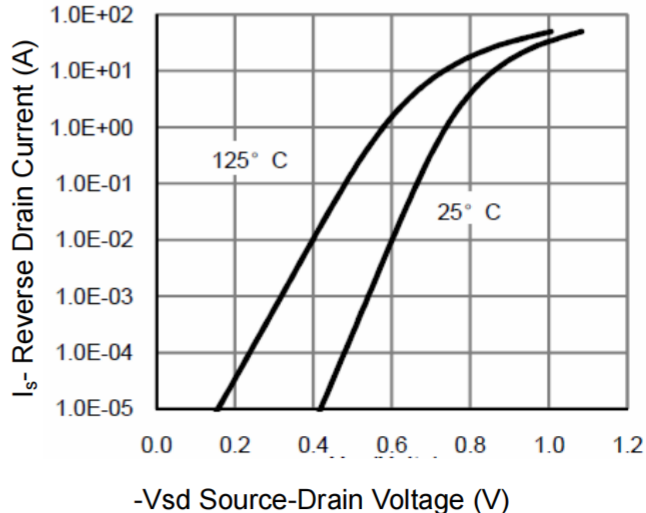
**Figure 2 Transfer Characteristics**



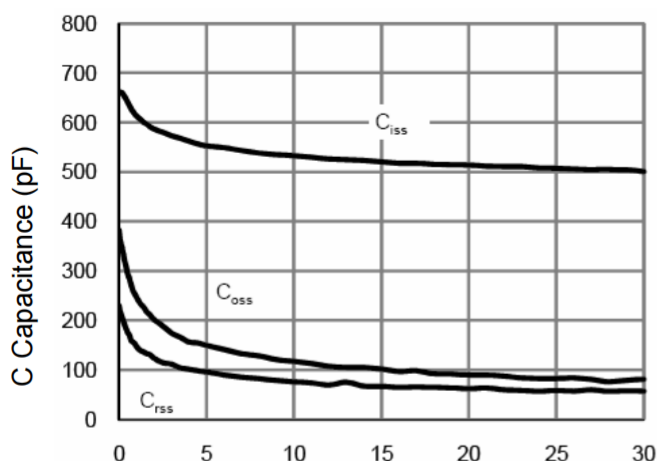
**Figure 5 Gate Charge**



**Figure 3  $R_{DS(on)}$ - Drain Current**



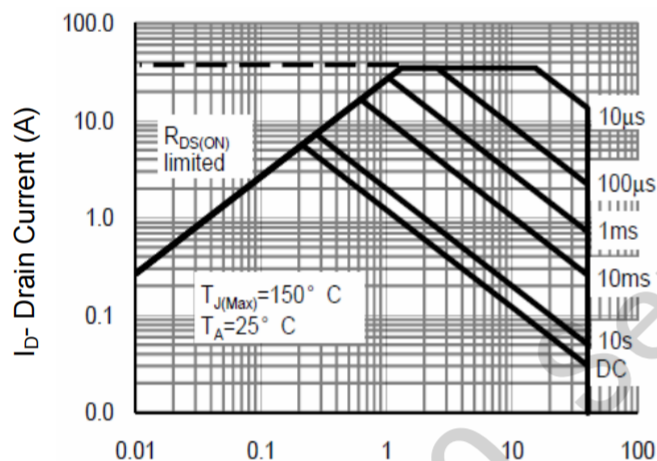
**Figure 6 Source- Drain Diode Forward**



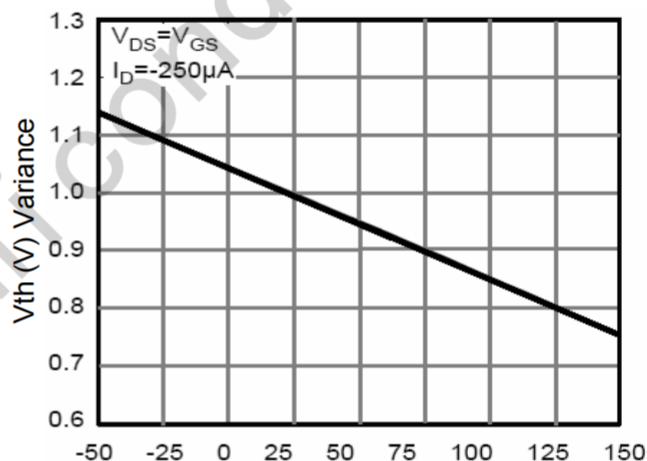
-Vds Drain-Source Voltage (V)  
**Figure 7 Capacitance vs Vds**



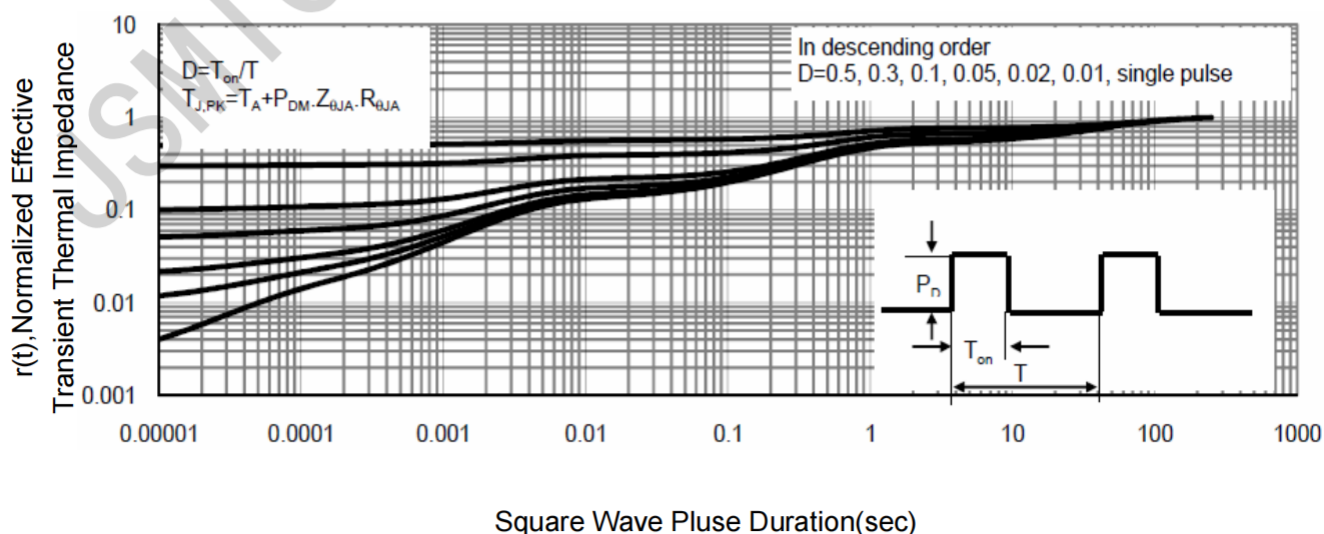
$T_J$ -Junction Temperature(°C)  
**Figure 9 Power Dissipation**



-Vds Drain-Source Voltage (V)  
**Figure 8 Safe Operation Area**



$T_J$ -Junction Temperature(°C)  
**Figure 10  $V_{GS(th)}$  vs Junction Temperature**

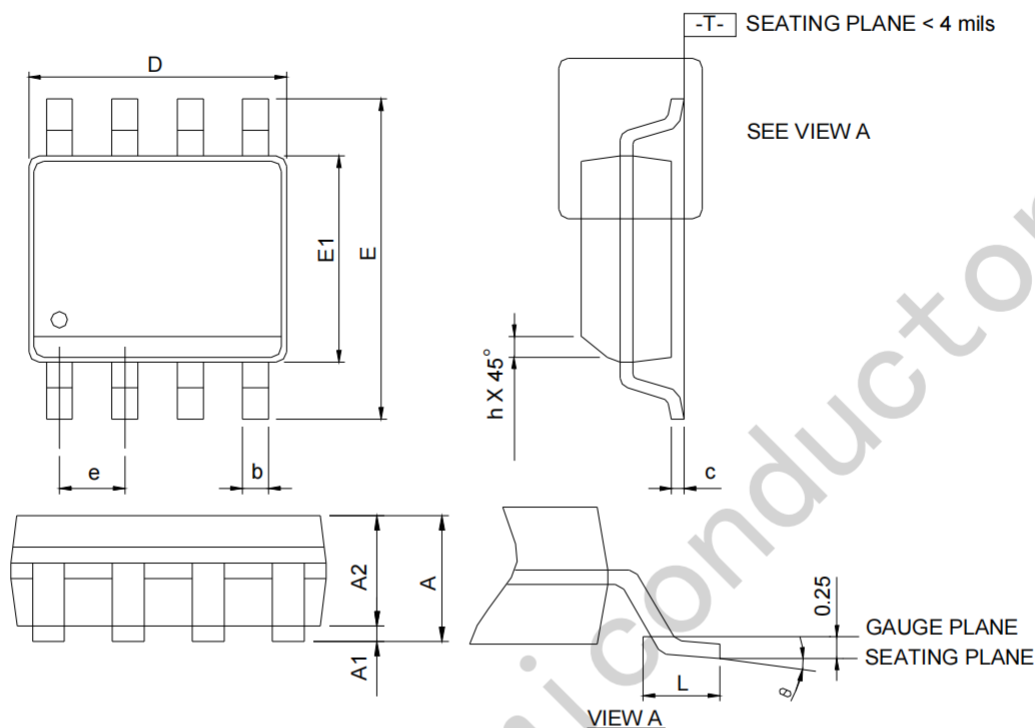


**Figure 11 Normalized Maximum Transient Thermal Impedance**



## Package Information

SOP-8



| SYMBOL | SOP-8       |      |           |       |
|--------|-------------|------|-----------|-------|
|        | MILLIMETERS |      | INCHES    |       |
|        | MIN.        | MAX. | MIN.      | MAX.  |
| A      | -           | 1.75 | -         | 0.069 |
| A1     | 0.10        | 0.25 | 0.004     | 0.010 |
| A2     | 1.25        | -    | 0.049     | -     |
| b      | 0.31        | 0.51 | 0.012     | 0.020 |
| c      | 0.17        | 0.25 | 0.007     | 0.010 |
| D      | 4.80        | 5.00 | 0.189     | 0.197 |
| E      | 5.80        | 6.20 | 0.228     | 0.244 |
| E1     | 3.80        | 4.00 | 0.150     | 0.157 |
| e      | 1.27 BSC    |      | 0.050 BSC |       |
| h      | 0.25        | 0.50 | 0.010     | 0.020 |
| L      | 0.40        | 1.27 | 0.016     | 0.050 |
| θ      | 0°          | 8°   | 0°        | 8°    |

Note: 1. Follow JEDEC MS-012 AA.

2. Dimension "D" does not include mold flash, protrusions or gate burrs. Mold flash, protrusion or gate burrs shall not exceed 6 mil per side.

3. Dimension "E" does not include inter-lead flash or protrusions. Inter-lead flash and protrusions shall not exceed 10 mil per side.

### RECOMMENDED LAND PATTERN

