

## 40V Full-Bridge of MOSFET

### Description

The HM4924B uses advanced trench technology to provide excellent  $R_{DS(ON)}$  and low gate charge. The complementary MOSFETs may be used to form a H-Bridge, and for a host of other applications.

### General Features

- ◆ **N-channel:**  
 $V_{DS} = 40V, I_D = 10A$   
 $R_{DS(ON)} = 22m\Omega$  (typical) @  $V_{GS} = 4.5V$   
 $R_{DS(ON)} = 17m\Omega$  (typical) @  $V_{GS} = 10V$
- ◆ **P-Channel:**  
 $V_{DS} = -40V, I_D = -6A$   
 $R_{DS(ON)} = 65m\Omega$  (typical) @  $V_{GS} = -4.5V$   
 $R_{DS(ON)} = 45m\Omega$  (typical) @  $V_{GS} = -10V$
- ◆ Excellent gate charge x  $R_{DS(ON)}$  product(FOM)
- ◆ Very low on-resistance  $R_{DS(ON)}$
- ◆ 150 °C operating temperature
- ◆ Pb-free lead plating
- ◆ 100% UIS tested

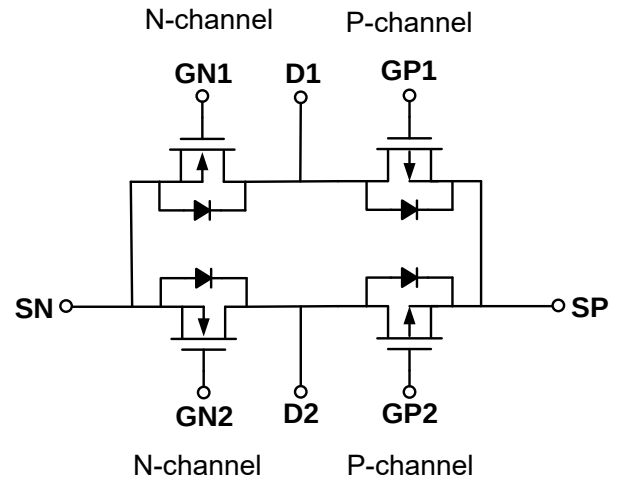
### Application

- ◆ Complementary MOSFET for DC FAN, Motor
- ◆ Wireless Charging

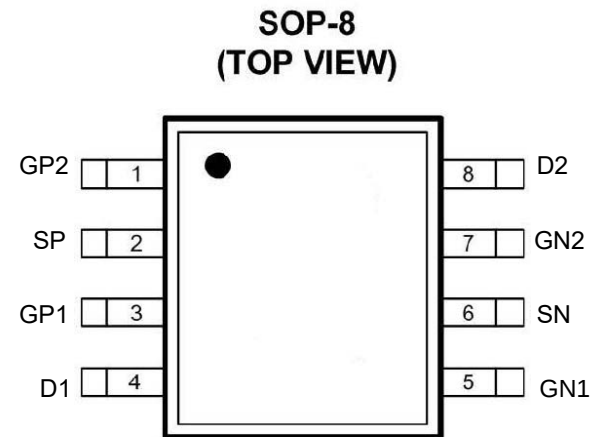
### Package

- ◆ SOP-8

### Schematic diagram



### Marking and pin assignment



### Ordering Information

| Part Number | Storage Temperature | Package | Devices Per Reel |
|-------------|---------------------|---------|------------------|
| HM4924BSR   | -55°C to +150°C     | SOP-8   | 3000             |
| HM4924SF    | -55°C to +150°C     | SOP-8   | 4000             |

### Absolute Maximum Ratings (TA=25°C unless otherwise noted)

| Parameter            | Symbol   | Limit |     | Unit |
|----------------------|----------|-------|-----|------|
|                      |          | N     | P   |      |
| Drain-source voltage | $V_{DS}$ | 40    | -40 | V    |

|                                               |                      |                                   |         |         |    |
|-----------------------------------------------|----------------------|-----------------------------------|---------|---------|----|
| Gate-source voltage                           |                      | V <sub>GS</sub>                   | ±12     | ±12     | V  |
| Maximum power dissipation                     |                      | P <sub>D</sub>                    | 2.0     | 2.0     | W  |
| Operating junction Temperature range          |                      | T <sub>J</sub>                    | -55—150 | -55—150 | °C |
| Drain Current-Continuous<br>(Silicon Limited) | T <sub>A</sub> =25°C | I <sub>D</sub>                    | 10      | -6      | A  |
|                                               | T <sub>A</sub> =75°C |                                   | 7       | -4.2    |    |
| Pulsed Drain Current (Package Limited)        |                      | I <sub>DM</sub>                   | 30      | -18     | A  |
| Power Dissipation <sup>B</sup>                | T <sub>A</sub> =25°C | P <sub>D</sub>                    | 2       | 2       | W  |
|                                               | T <sub>A</sub> =75°C |                                   | 1.3     | 1.3     |    |
| Junction and Storage Temperature Range        |                      | T <sub>J</sub> , T <sub>STG</sub> | -55—150 |         | °C |

### N-Channel Electrical Characteristics ( $T_J=25^{\circ}\text{C}$ 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                | $I_{GSS}$    | $V_{DS}=0V, V_{GS}=\pm 12V$                                                    | -   | -   | $\pm 100$ | nA         |
| <b>ON Characteristics</b>        |              |                                                                                |     |     |           |            |
| Gate threshold voltage           | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=250\mu A$                                                  | 1.0 |     | 2.5       | V          |
| Drain-source on-state resistance | $R_{DS(ON)}$ | $V_{GS}=4.5V, I_D=10A$                                                         | -   |     | 22        | m $\Omega$ |
|                                  |              | $V_{GS}=10V, I_D=2.8A$                                                         | -   |     | 17        |            |
| Forward transconductance         | $g_{fs}$     | $V_{GS}=5V, I_D=10A$                                                           | -   | 5   | -         | S          |
| <b>Dynamic Characteristics</b>   |              |                                                                                |     |     |           |            |
| Input capacitance                | $C_{ISS}$    | $V_{DS}=10V, V_{GS}=0V$<br>$f=1.0\text{MHz}$                                   | -   | 240 | -         | pF         |
| Output capacitance               | $C_{OSS}$    |                                                                                | -   | 45  | -         |            |
| Reverse transfer capacitance     | $C_{RSS}$    |                                                                                | -   | 23  | -         |            |
| Gate resistance                  | $R_g$        | $V_{GS}=0V, V_{DS}=0V,$<br>$f=1.0\text{MHz}$                                   | -   | 3.3 | 4.9       | $\Omega$   |
| <b>Switching Characteristics</b> |              |                                                                                |     |     |           |            |
| Turn-on delay time               | $t_{D(ON)}$  | $V_{DD}=10V$<br>$R_L=3.3\text{ohm}$<br>$V_{GEN}=4.5V$<br>$R_{GEN}=6\text{ohm}$ | -   | 2.3 | -         | ns         |
| Rise time                        | $t_r$        |                                                                                | -   | 3.1 | -         |            |
| Turn-off delay time              | $t_{D(OFF)}$ |                                                                                | -   | 21  | -         |            |
| Fall time                        | $t_f$        |                                                                                | -   | 2.6 | -         |            |
| Total gate charge                | $Q_g$        | $V_{DS}=10V$<br>$I_D=10A$<br>$V_{GS}=4.5V$                                     | -   | 2.7 | -         | nC         |
| Gate-source charge               | $Q_{gs}$     |                                                                                | -   | 0.4 | -         |            |
| Gate-drain charge                | $Q_{gd}$     |                                                                                | -   | 0.5 | -         |            |

### Thermal Characteristics

|                                        |             |     |      |
|----------------------------------------|-------------|-----|------|
| Thermal Resistance junction-to ambient | $R_{th JA}$ | 100 | °C/W |
|----------------------------------------|-------------|-----|------|

## N-Channel: Typical Electrical And Thermal Characteristics

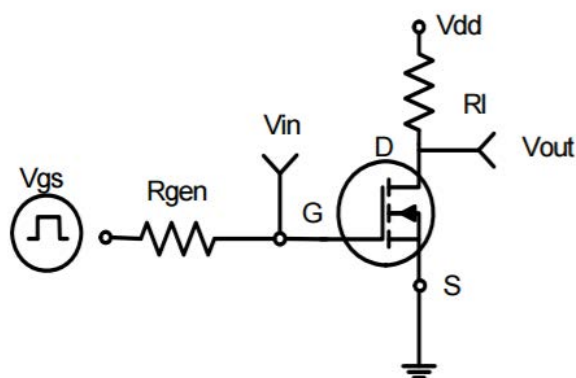


Figure 1: Switching Test Circuit

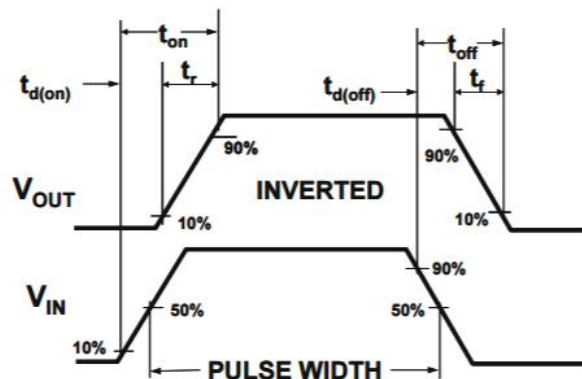
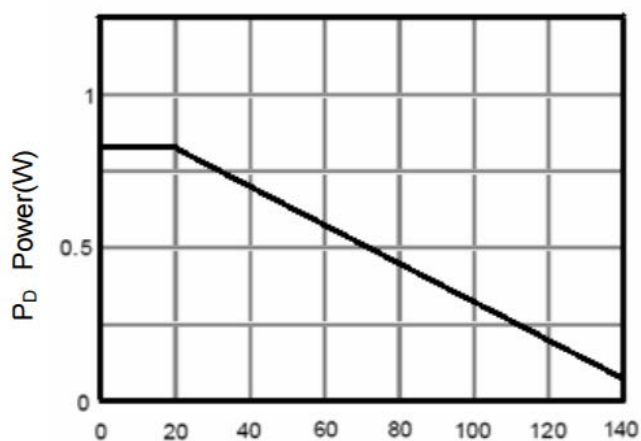
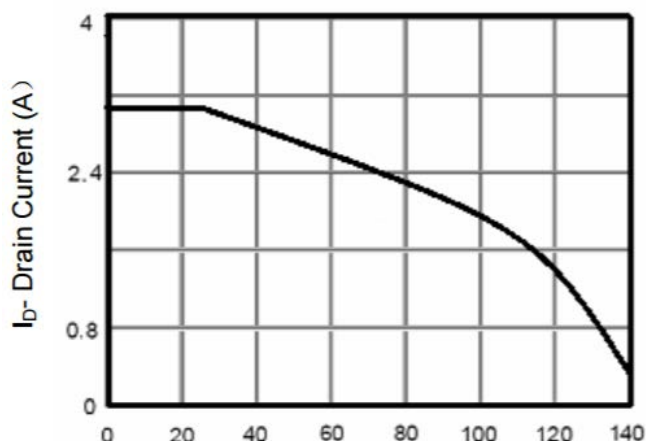


Figure 2: Switching Waveforms



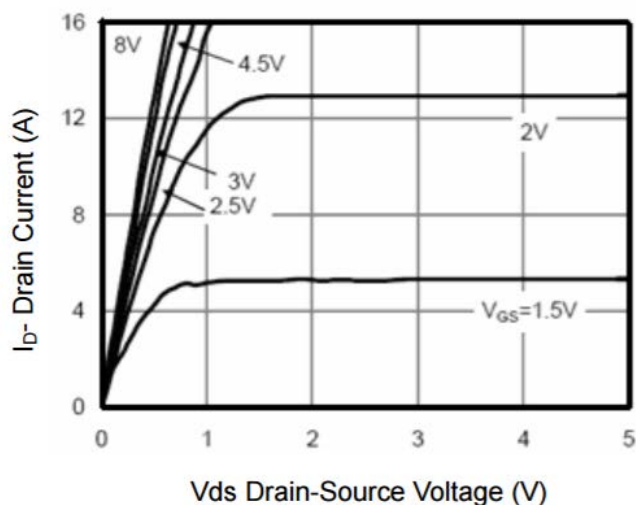
T<sub>J</sub>-Junction Temperature(°C)

Figure 3 Power Dissipation



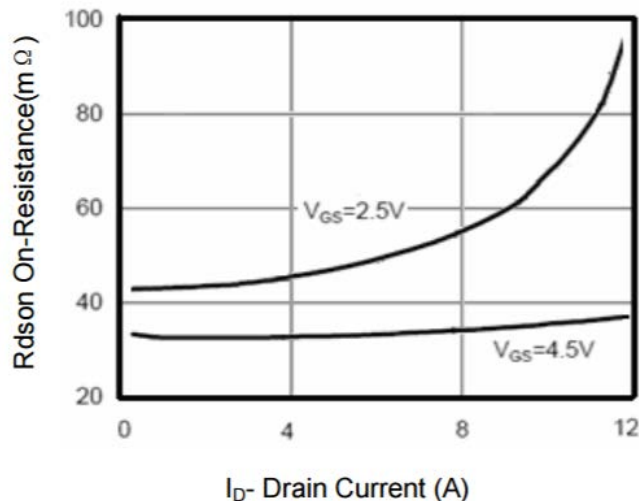
T<sub>J</sub>-Junction Temperature(°C)

Figure 4 Drain Current



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

Figure 5 Output Characteristics



I<sub>D</sub>- Drain Current (A)

Figure 6 Drain-Source On-Resistance

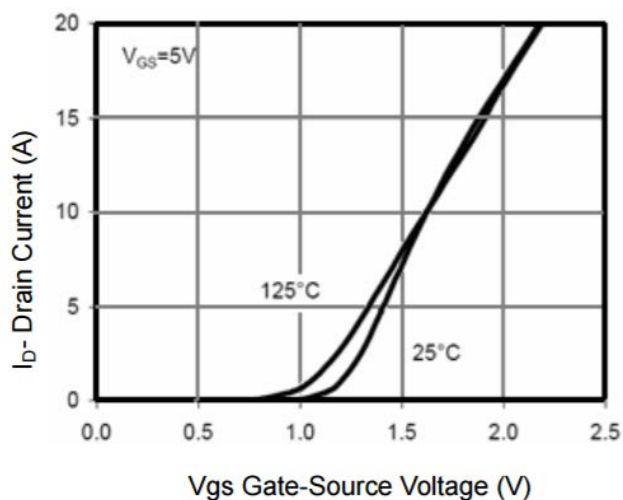


Figure 7 Transfer Characteristics

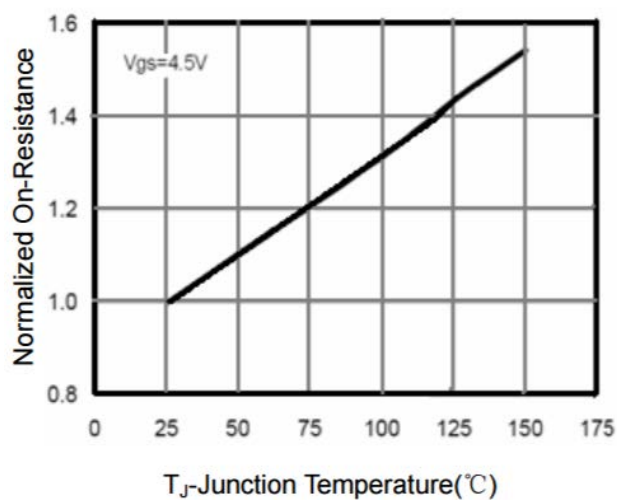


Figure 8 Drain-Source On-Resistance

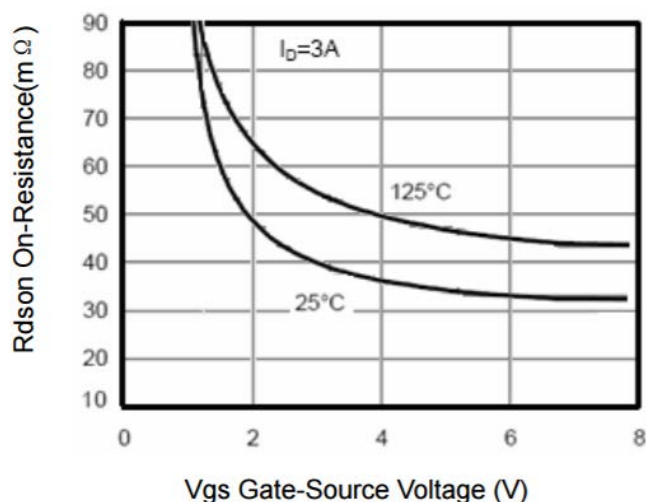


Figure 9  $R_{DS(on)}$  vs  $V_{GS}$

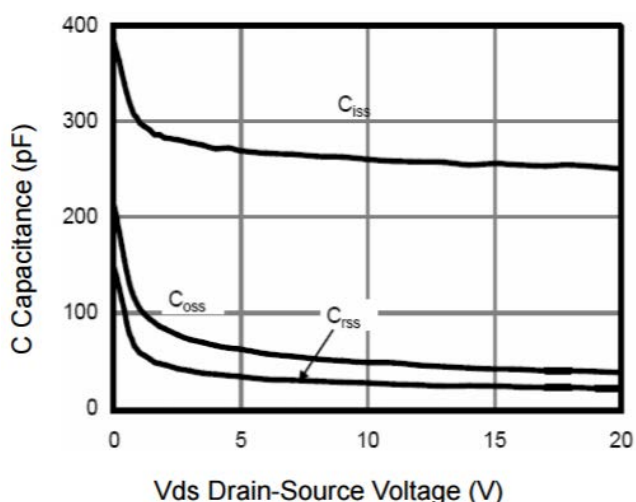


Figure 10 Capacitance vs  $V_{DS}$

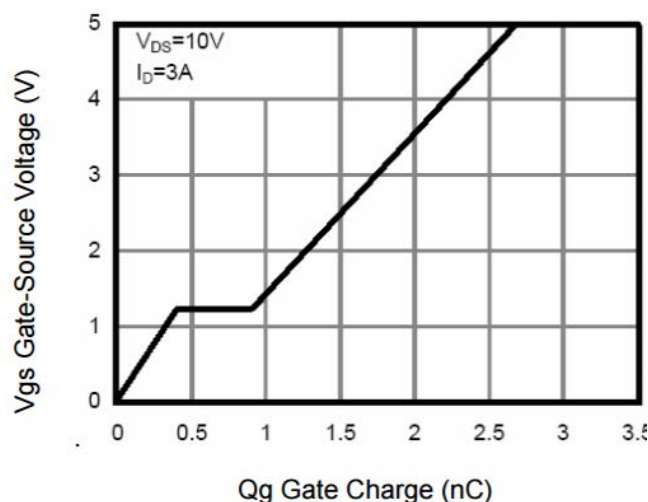


Figure 11 Gate Charge

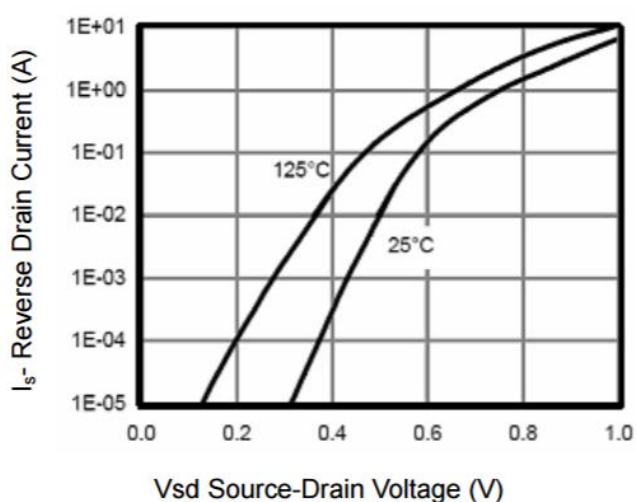


Figure 12 Source- Drain Diode Forward

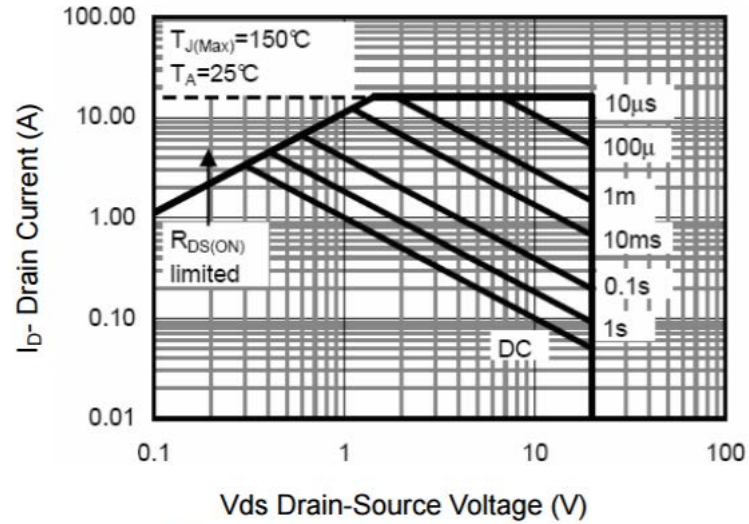


Figure 13 Safe Operation Area

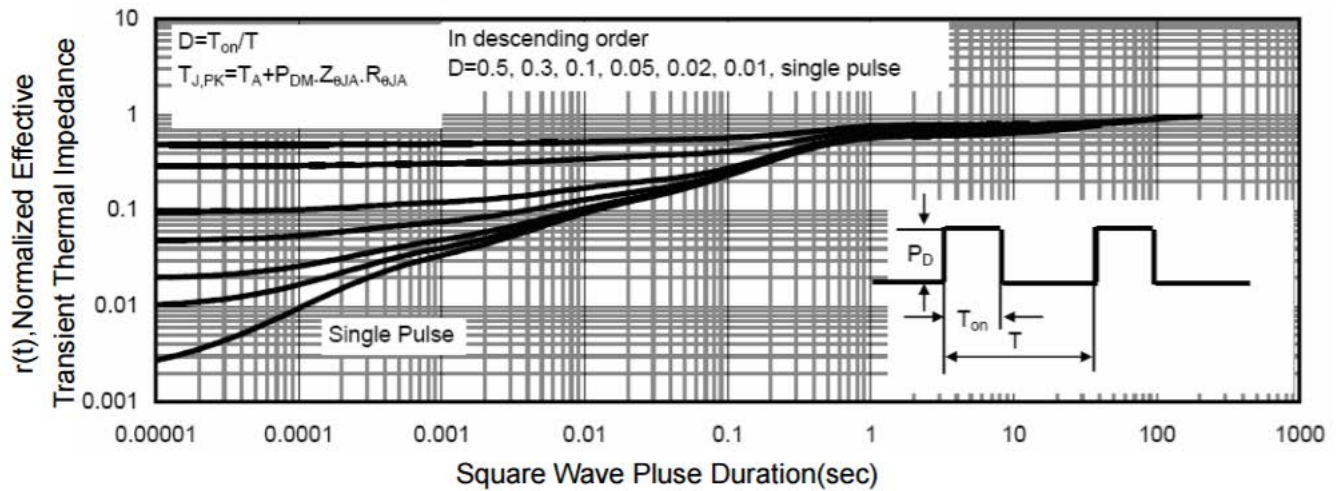
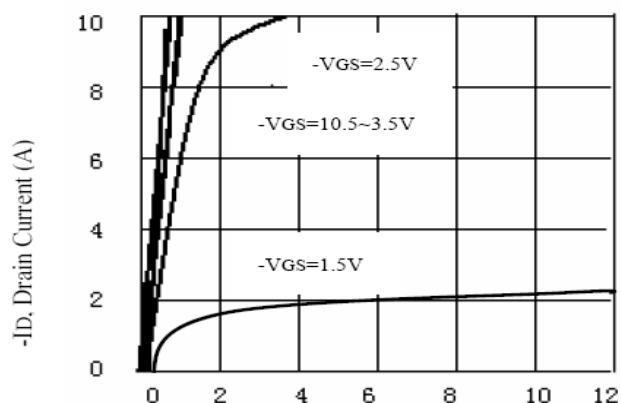


Figure 14 Normalized Maximum Transient Thermal Impedance

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

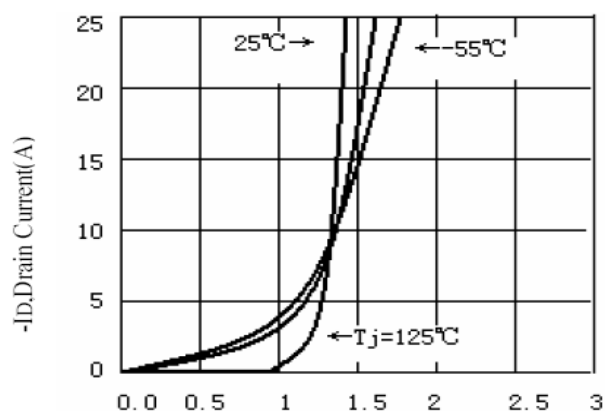
| Parameter                        | Symbol              | Condition                                                                                                                      | Min  | Typ  | Max  | Unit |
|----------------------------------|---------------------|--------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| OFF Characteristics              |                     |                                                                                                                                |      |      |      |      |
| Drain-source breakdown voltage   | BV <sub>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-body leakage                | I <sub>GSS</sub>    | V <sub>DS</sub> =0V, V <sub>GS</sub> =±12V                                                                                     | -    | -    | ±100 | nA   |
| ON Characteristics               |                     |                                                                                                                                |      |      |      |      |
| Gate threshold voltage           | V <sub>GS(th)</sub> | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =-250μA                                                                      | -1.3 |      | -2.5 | V    |
| Drain-source on-state resistance | R <sub>DS(ON)</sub> | V <sub>GS</sub> =-4.5V, I <sub>D</sub> =-2.8A                                                                                  | -    |      | 65   | mΩ   |
|                                  |                     | V <sub>GS</sub> =-10V, I <sub>D</sub> =-2.8A                                                                                   | -    |      | 45   |      |
| Forward transconductance         | g <sub>fs</sub>     | V <sub>GS</sub> =-5V, I <sub>D</sub> =-5A                                                                                      | -    | 5    | -    | S    |
| Dynamic Characteristics          |                     |                                                                                                                                |      |      |      |      |
| Input capacitance                | C <sub>ISS</sub>    | V <sub>DS</sub> =-10V ,V <sub>GS</sub> =0V<br>f=1.0MHz                                                                         | -    | 561  | -    | pF   |
| Output capacitance               | C <sub>OSS</sub>    |                                                                                                                                | -    | 61   | -    |      |
| Reverse transfer capacitance     | C <sub>RSS</sub>    |                                                                                                                                | -    | 52   | -    |      |
| Switching Characteristics        |                     |                                                                                                                                |      |      |      |      |
| Turn-on delay time               | t <sub>D(ON)</sub>  | V <sub>DD</sub> =-10V<br>I <sub>D</sub> =-2.8A<br>V <sub>GEN</sub> =-4.5V<br>R <sub>L</sub> =10ohm<br>R <sub>GEN</sub> =-60ohm | -    | 12.5 | -    | ns   |
| Rise time                        | tr                  |                                                                                                                                | -    | 6.6  | -    |      |
| Turn-off delay time              | t <sub>D(OFF)</sub> |                                                                                                                                | -    | 113  | -    |      |
| Fall time                        | tf                  |                                                                                                                                | -    | 46.6 | -    |      |
| Total gate charge                | Qg                  | V <sub>DS</sub> =-10V,I <sub>D</sub> =-6A<br>V <sub>GS</sub> =-4.5V                                                            | -    | 6.1  | -    | nC   |
| Gate-source charge               | Qgs                 |                                                                                                                                | -    | 1.7  | -    |      |
| Gate-drain charge                | Qgd                 |                                                                                                                                | -    | 1.2  | -    |      |

## P-Channel: Typical Electrical And Thermal Characteristics



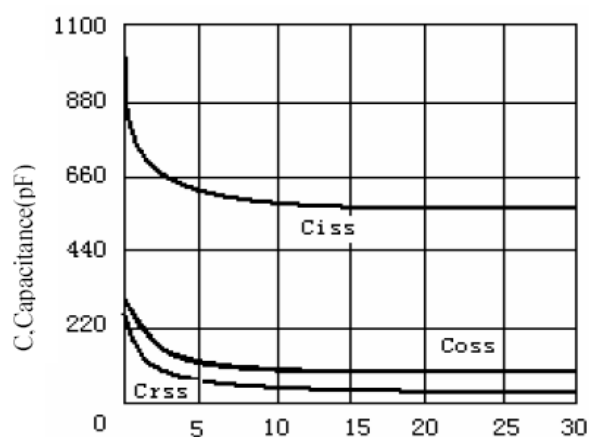
- VDS, Drain-to-Source Voltage (V)

Figure 1. Output Characteristics



-VGS, Gate-to-source Voltage (V)

Figure 2. Transfer Characteristics



- VGS, Drain-to Source Voltage

Figure3. Capacitance

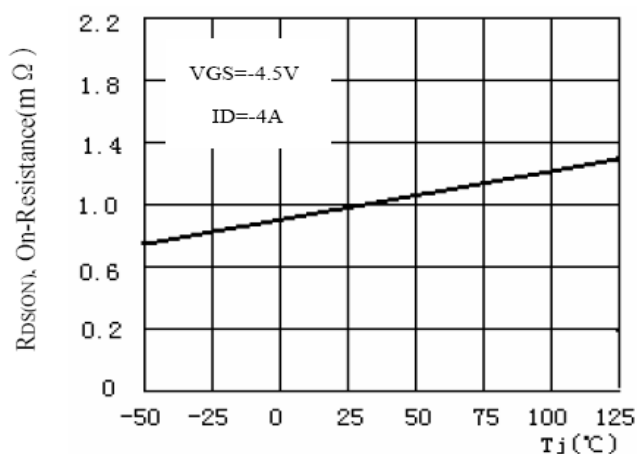


Figure4. On-Resistance Variation with Temperature

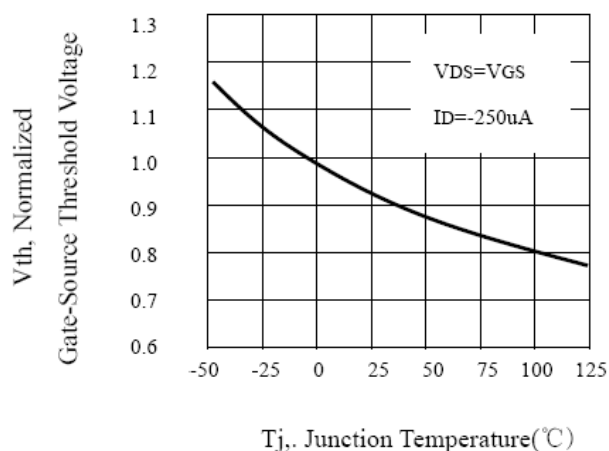


Figure5. Gate Threshold Variation With Temperature

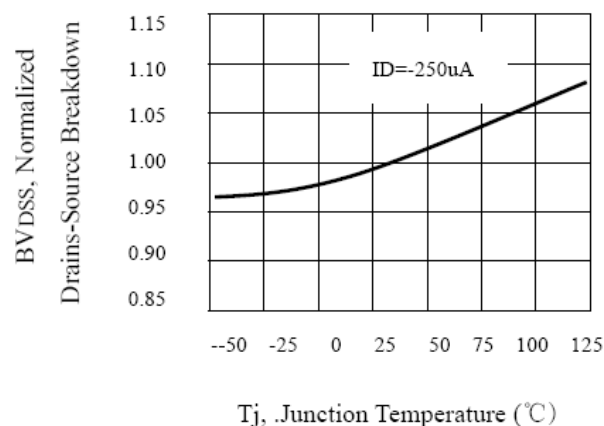


Figure6. Breakdown Voltage Variation With Temperature

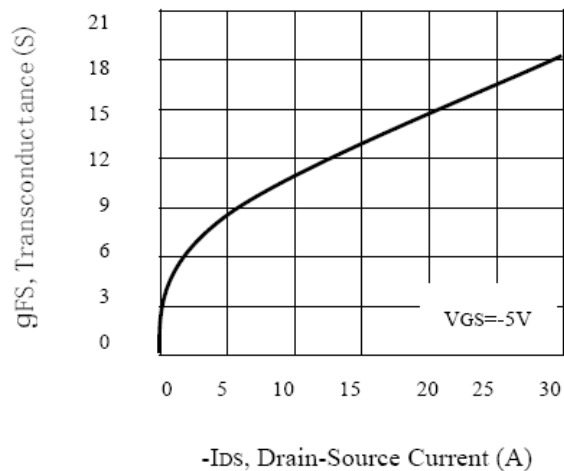


Figure7. Transconductance Variation  
With Drain Current

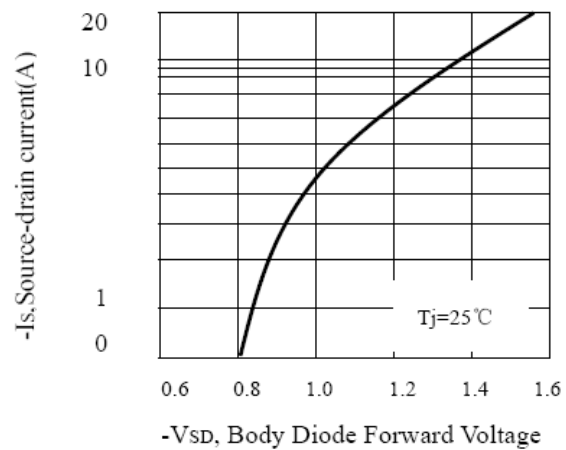


Figure8. Body Diode Forward Voltage  
Variation with Source Current

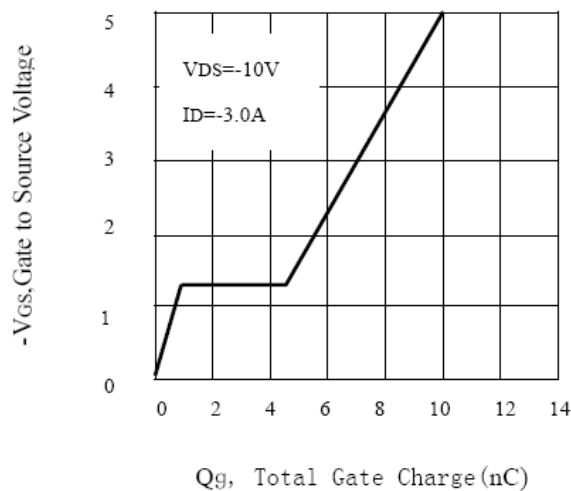


Figure9. Gate Charge

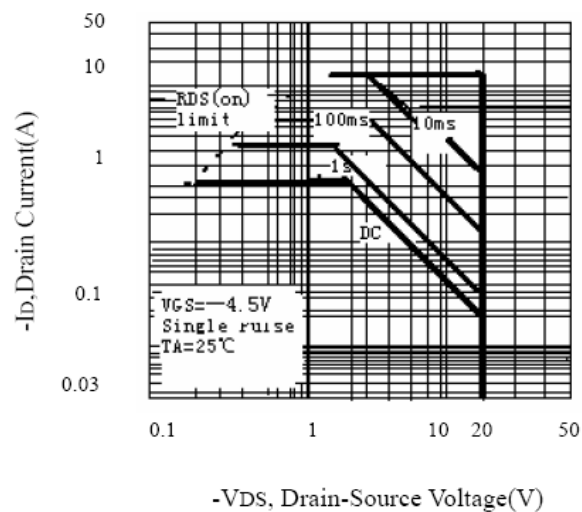
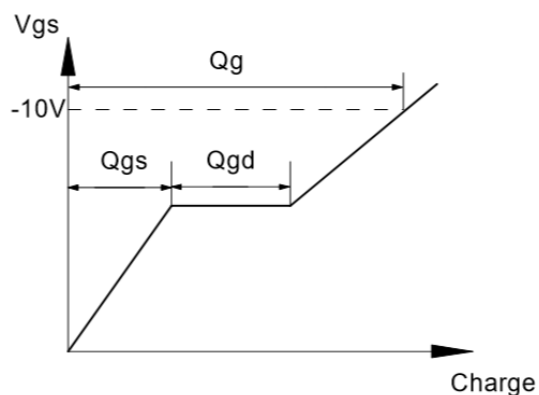
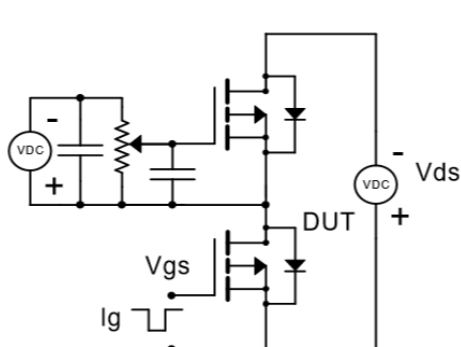
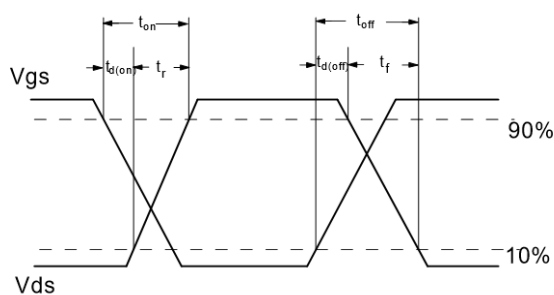
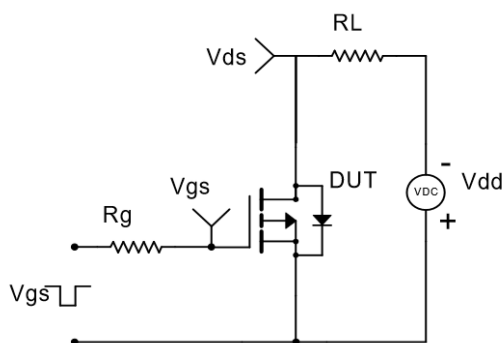


Figure10. Maximum Safe Operating Area

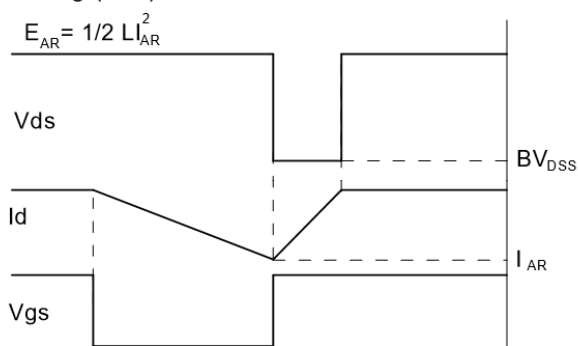
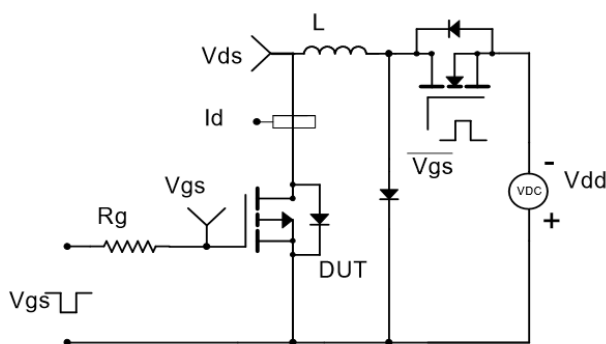
Gate Charge Test Circuit & Waveform



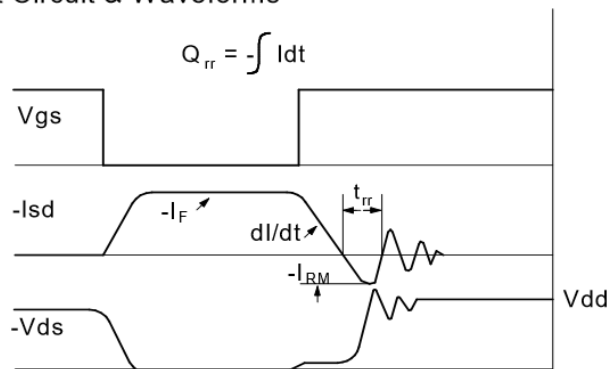
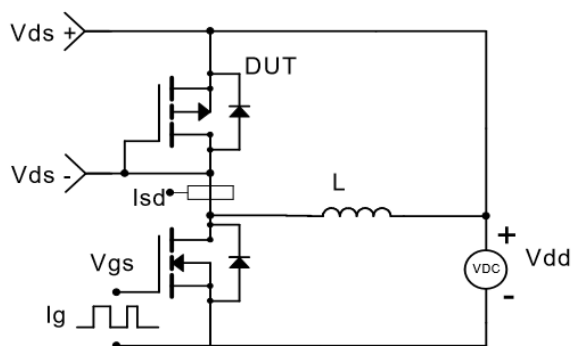
Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching (UIS) Test Circuit & Waveforms

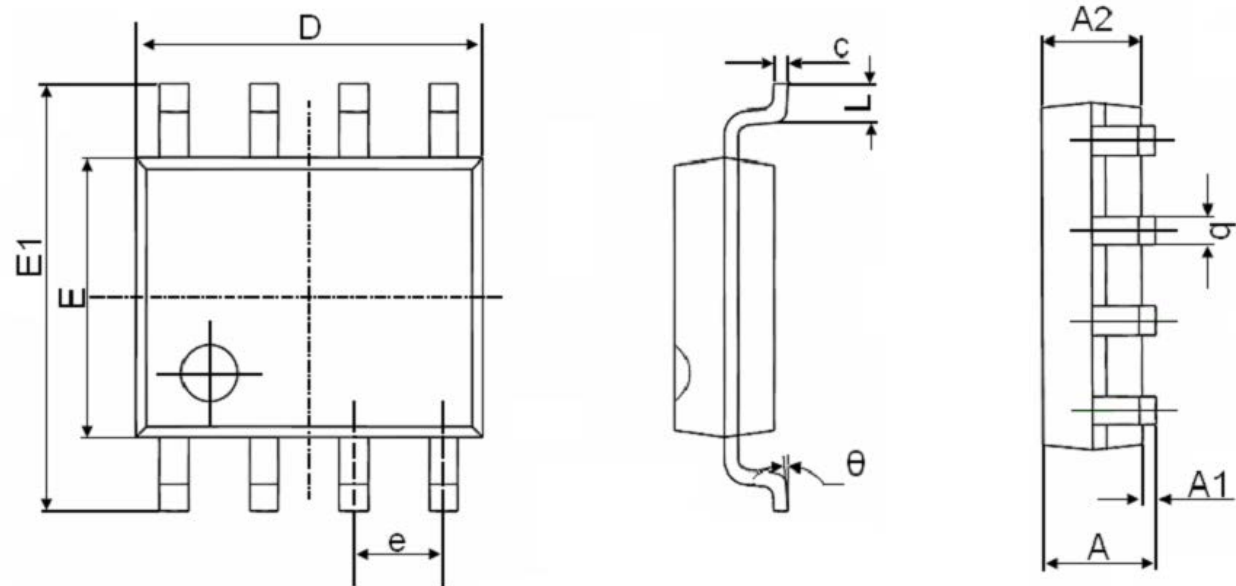


Diode Recovery Test Circuit & Waveforms



Package Information

- SOP-8



| 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 |
| $\theta$ | 0°                        | 8°    | 0°                   | 8°    |