

**AOL1401**
**P-Channel Enhancement Mode Field Effect Transistor**
**General Description**

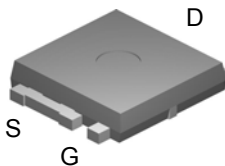
The AOL1401 uses advanced trench technology to provide excellent RDS(ON), and ultra-low low gate charge with a 25V gate rating. This device is suitable for use as a load switch or in PWM applications. It is ESD protected.

- RoHS Compliant
- Halogen and Antimony Free Green Device\*

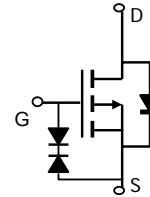
**Features**

$V_{DS} (V) = -38V$   
 $I_D = -85A$   
 $R_{DS(ON)} < 8.5m\Omega (V_{GS} = -20V)$   
 $R_{DS(ON)} < 10m\Omega (V_{GS} = -10V)$

ESD Rating: 3000V HBM  
 Rg,Ciss,Coss,Crss Tested

**Ultra SO-8™ Top View**


Bottom tab  
connected to  
drain


**Absolute Maximum Ratings  $T_A=25^\circ C$  unless otherwise noted**

| Parameter                              | Symbol         | Maximum           | Units      |
|--|----------------|-------------------|------------|
| Drain-Source Voltage                   | $V_{DS}$       | -38               | V          |
| Gate-Source Voltage                    | $V_{GS}$       | $\pm 25$          | V          |
| Continuous Drain Current <sup>G</sup>  | $I_D$          | $T_C=25^\circ C$  | A          |
|  |                | $T_C=100^\circ C$ |            |
| Pulsed Drain Current <sup>C</sup>      | $I_{DM}$       | -120              | A          |
| Continuous Drain Current <sup>G</sup>  | $I_{DSM}$      | $T_A=25^\circ C$  | W          |
|  |                | $T_A=70^\circ C$  |            |
| Power Dissipation <sup>B</sup>         | $P_D$          | $T_C=25^\circ C$  | W          |
|  |                | $T_C=100^\circ C$ |            |
| Power Dissipation <sup>A</sup>         | $P_{DSM}$      | $T_A=25^\circ C$  | W          |
|  |                | $T_A=70^\circ C$  |            |
| Junction and Storage Temperature Range | $T_J, T_{STG}$ | -55 to 175        | $^\circ C$ |

**Thermal Characteristics**

| Parameter                                | Symbol          | Typ | Max | Units        |
|--|-----------------|-----|-----|--------------|
| Maximum Junction-to-Ambient <sup>A</sup> | $R_{\theta JA}$ | 21  | 25  | $^\circ C/W$ |
| Maximum Junction-to-Ambient <sup>A</sup> |                 | 48  | 60  | $^\circ C/W$ |
| Maximum Junction-to-Case <sup>B</sup>    | $R_{\theta JC}$ | 1   | 1.5 | $^\circ C/W$ |

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

| Symbol                      | Parameter                             | Conditions   | Min   | Typ   | Max      | Units         |
|-----------------------------|---------------------------------------|--|---|-------|----------|---------------|
| <b>STATIC PARAMETERS</b>    |                                       |  |   |       |          |               |
| $BV_{DSS}$                  | Drain-Source Breakdown Voltage        | $I_D=-250\mu\text{A}$ , $V_{GS}=0\text{V}$   | -38   |       |          | V             |
| $I_{DSS}$                   | Zero Gate Voltage Drain Current       | $V_{DS}=-30\text{V}$ , $V_{GS}=0\text{V}$<br>$T_J=55^\circ\text{C}$                |   |       | -100     | nA            |
|                             |                                       |  |   |       | -500     |               |
| $I_{GSS}$                   | Gate-Body leakage current             | $V_{DS}=0\text{V}$ , $V_{GS}=\pm 20\text{V}$                                       |   |       | $\pm 1$  | $\mu\text{A}$ |
|                             |                                       | $V_{DS}=0\text{V}$ , $V_{GS}=\pm 25\text{V}$                                       |   |       | $\pm 10$ | $\mu\text{A}$ |
| $V_{GS(th)}$                | Gate Threshold Voltage                | $V_{DS}=V_{GS}$ , $I_D=-250\mu\text{A}$  | -1.5  | -2.2  | -3.5     | V             |
| $I_{D(ON)}$                 | On state drain current                | $V_{GS}=-10\text{V}$ , $V_{DS}=-5\text{V}$   | -120  |       |          | A             |
| $R_{DS(ON)}$                | Static Drain-Source On-Resistance     | $V_{GS}=-20\text{V}$ , $I_D=-20\text{A}$<br>$T_J=125^\circ\text{C}$                |   | 6.8   | 8.5      | m $\Omega$    |
|                             |                                       |  |   | 9.1   | 11       |               |
|                             |                                       | $V_{GS}=-10\text{V}$ , $I_D=-20\text{A}$   |   | 7.9   | 10       | m $\Omega$    |
| $g_{FS}$                    | Forward Transconductance              | $V_{DS}=-5\text{V}$ , $I_D=-20\text{A}$  |   | 50    |          | S             |
| $V_{SD}$                    | Diode Forward Voltage                 | $I_S=-1\text{A}$ , $V_{GS}=0\text{V}$  |   | 0.71  | -1       | V             |
| $I_S$                       | Maximum Body-Diode Continuous Current |  |   |       | 14.5     | A             |
| <b>DYNAMIC PARAMETERS</b>   |                                       |  |   |       |          |               |
| $C_{iss}$                   | Input Capacitance                     | $V_{GS}=0\text{V}$ , $V_{DS}=-20\text{V}$ , $f=1\text{MHz}$                        |   | 3800  | 4560     | pF            |
| $C_{oss}$                   | Output Capacitance                    |  |   | 560   |          | pF            |
| $C_{rss}$                   | Reverse Transfer Capacitance          |  |   | 350   |          | pF            |
| $R_g$                       | Gate resistance                       | $V_{GS}=0\text{V}$ , $V_{DS}=0\text{V}$ , $f=1\text{MHz}$                          |   | 7.5   | 9        | $\Omega$      |
| <b>SWITCHING PARAMETERS</b> |                                       |  |   |       |          |               |
| $Q_g(10\text{V})$           | Total Gate Charge (10V)               | $V_{GS}=-10\text{V}$ , $V_{DS}=-20\text{V}$ , $I_D=-20\text{A}$                    |   | 61.2  | 74       | nC            |
| $Q_{gs}$                    | Gate Source Charge                    |  |   | 11.88 |          | nC            |
| $Q_{gd}$                    | Gate Drain Charge                     |  |   | 15.4  |          | nC            |
| $t_{D(on)}$                 | Turn-On Delay Time                    | $V_{GS}=-10\text{V}$ , $V_{DS}=-20\text{V}$ , $R_L=1\Omega$ ,<br>$R_{GEN}=3\Omega$ |   | 13.5  |          | ns            |
| $t_r$                       | Turn-On Rise Time                     |  |   | 17    |          | ns            |
| $t_{D(off)}$                | Turn-Off Delay Time                   |  |   | 97    |          | ns            |
| $t_f$                       | Turn-Off Fall Time                    |  |   | 43    |          | ns            |
| $t_{rr}$                    | Body Diode Reverse Recovery Time      |  | $I_F=-20\text{A}$ , $dI/dt=100\text{A}/\mu\text{s}$ |       | 30       | 36            |
| $Q_{rr}$                    | Body Diode Reverse Recovery Charge    | $I_F=-20\text{A}$ , $dI/dt=100\text{A}/\mu\text{s}$                                |   | 29    |          | nC            |

A: The value of  $R_{\theta JA}$  is measured with the device mounted on 1 in<sup>2</sup> FR-4 board with 2oz. Copper, in a still air environment with  $T_A=25^\circ\text{C}$ . The Power dissipation  $P_{DSM}$  is based on  $R_{\theta JA}$  and the maximum allowed junction temperature of  $150^\circ\text{C}$ . The value in any given application depends on the user's specific board design, and the maximum temperature of  $175^\circ\text{C}$  may be used if the PCB allows it.

B: The power dissipation  $P_D$  is based on  $T_{J(MAX)}=175^\circ\text{C}$ , using junction-to-case thermal resistance, and is more useful in setting the upper dissipation limit for cases where additional heatsinking is used.

C: Repetitive rating, pulse width limited by junction temperature  $T_{J(MAX)}=175^\circ\text{C}$ .

D: The  $R_{\theta JA}$  is the sum of the thermal impedance from junction to case  $R_{\theta JC}$  and case to ambient.

E: The static characteristics in Figures 1 to 6 are obtained using  $<300\mu\text{s}$  pulses, duty cycle 0.5% max.

F: These curves are based on the junction-to-case thermal impedance which is measured with the device mounted to a large heatsink, assuming a maximum junction temperature of  $T_{J(MAX)}=175^\circ\text{C}$ .

G: The maximum current rating is limited by bond-wires.

H: These tests are performed with the device mounted on 1 in<sup>2</sup> FR-4 board with 2oz. Copper, in a still air environment with  $T_A=25^\circ\text{C}$ .

\* This device is guaranteed green after date code 8P11 (June 1<sup>ST</sup> 2008)

Rev 2: Dec 2008

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TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

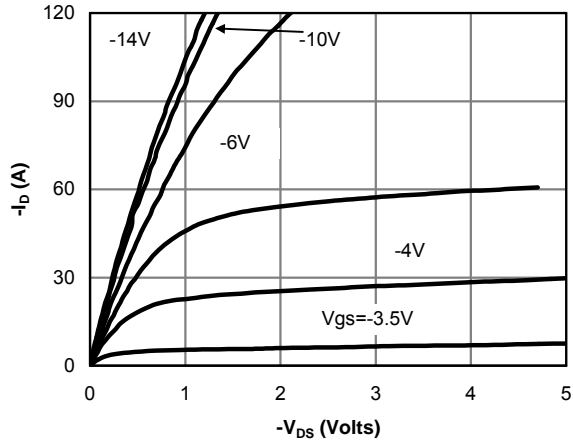


Fig 1: On-Region Characteristics

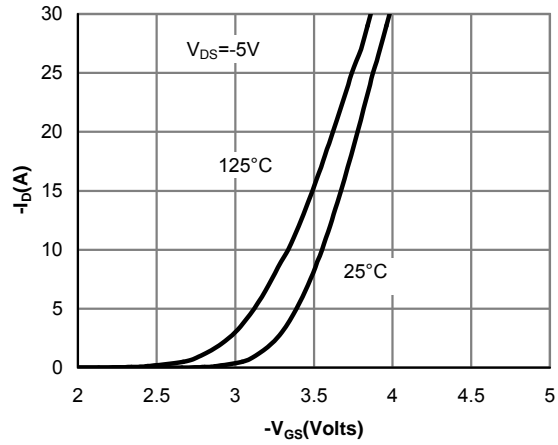


Figure 2: Transfer Characteristics

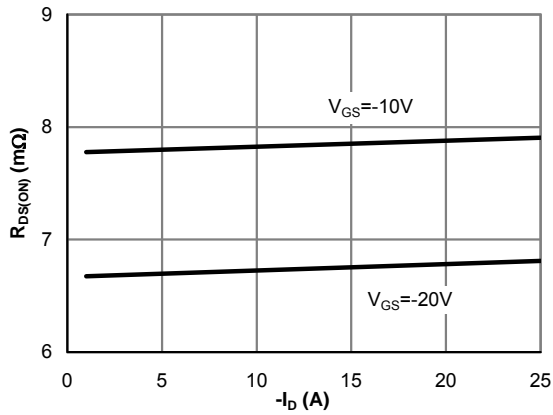


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

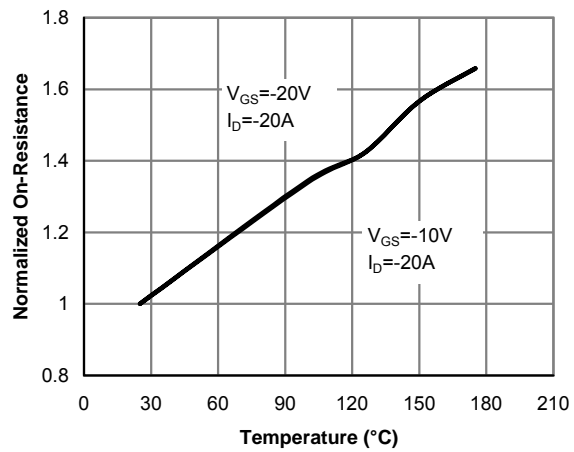


Figure 4: On-Resistance vs. Junction Temperature

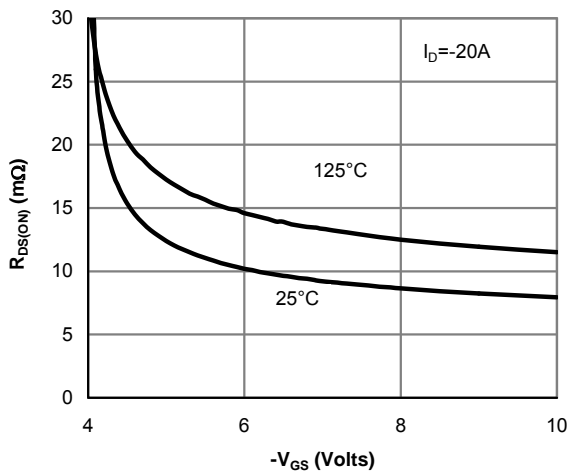


Figure 5: On-Resistance vs. Gate-Source Voltage

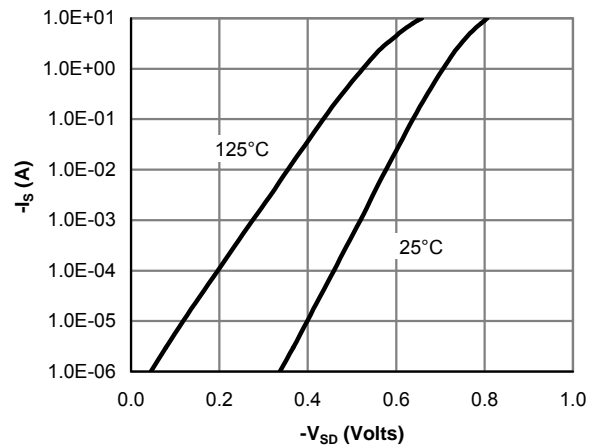


Figure 6: Body-Diode Characteristics

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

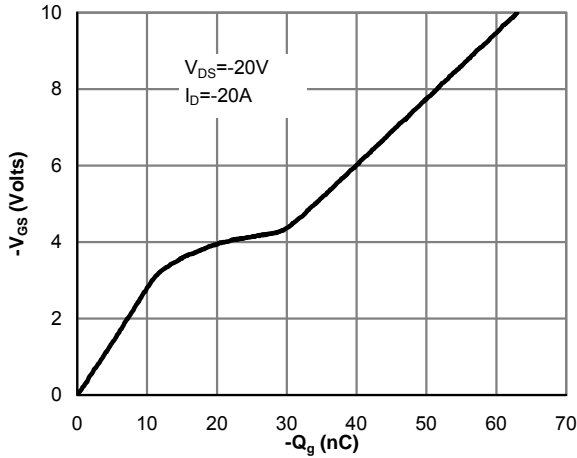


Figure 7: Gate-Charge Characteristics

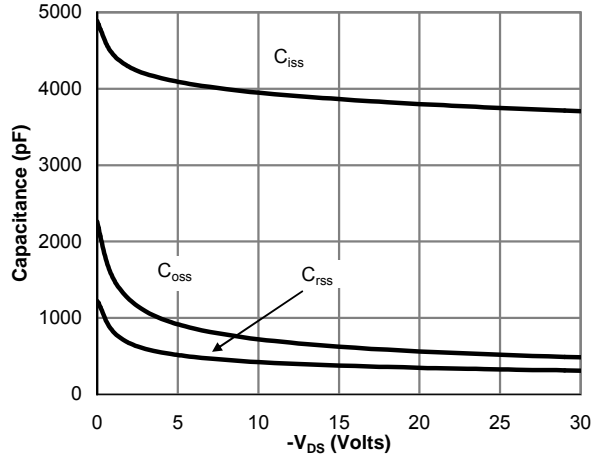


Figure 8: Capacitance Characteristics

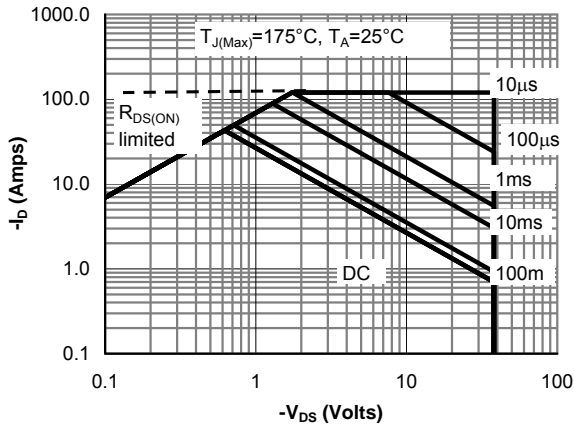


Figure 9: Maximum Forward Biased Safe Operating Area (Note F)

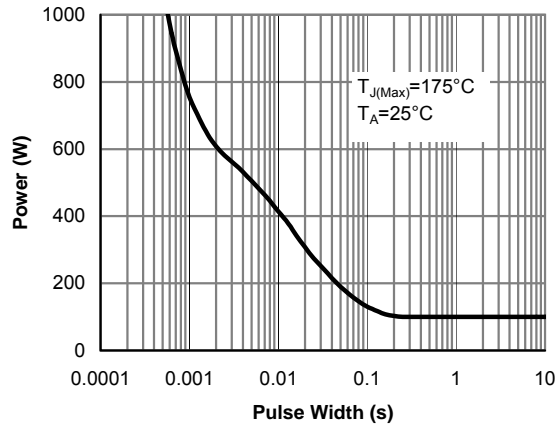


Figure 10: Single Pulse Power Rating Junction-to-Case (Note B)

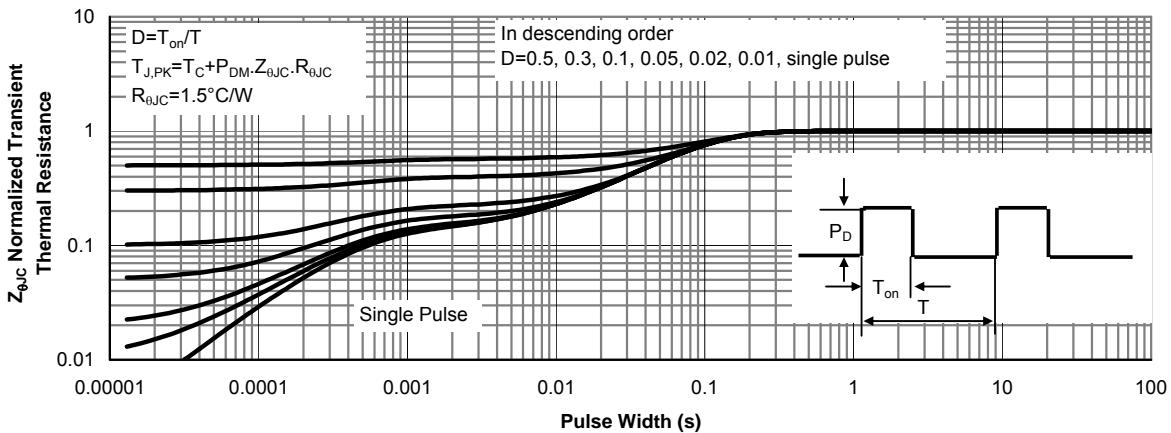


Figure 11: Normalized Maximum Transient Thermal Impedance (Note F)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

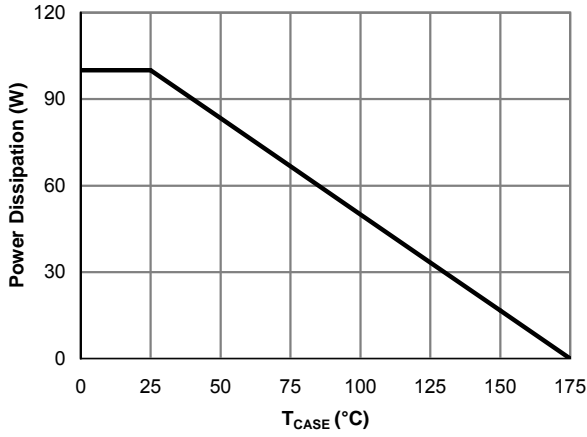


Figure 12: Power De-rating (Note B)

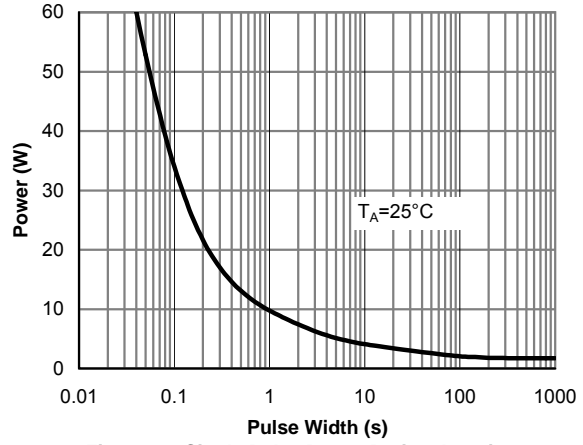


Figure 13: Single Pulse Power Rating Junction-to-Ambient (Note H)

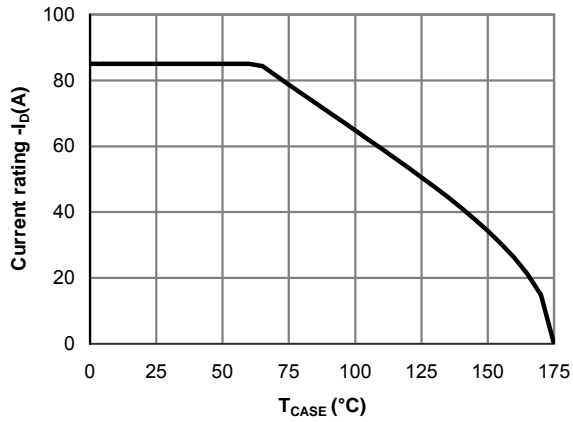


Figure 14: Current De-rating (Note B)

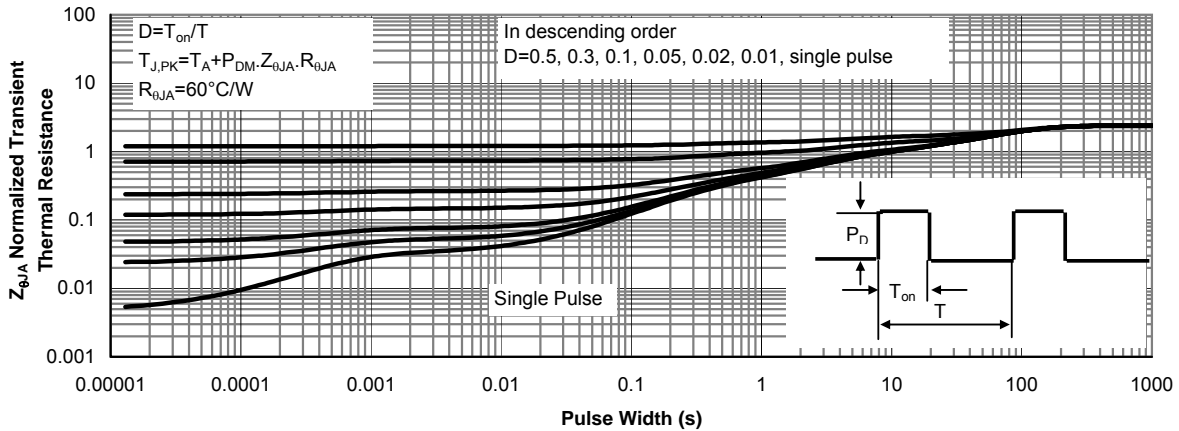
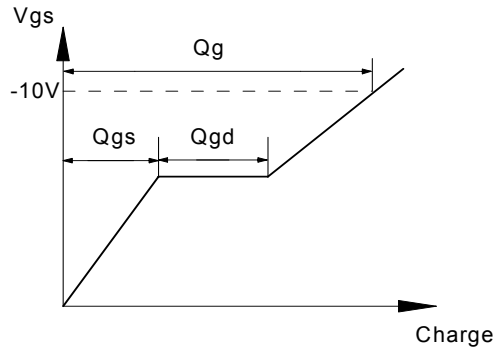
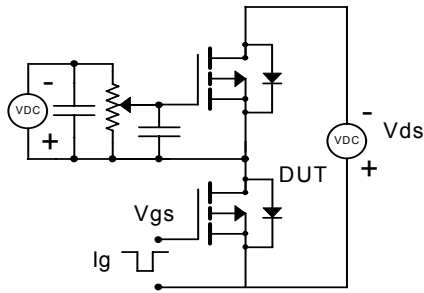
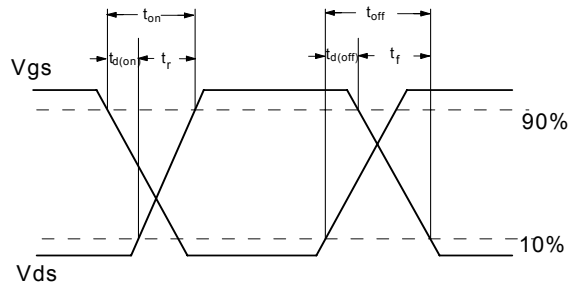
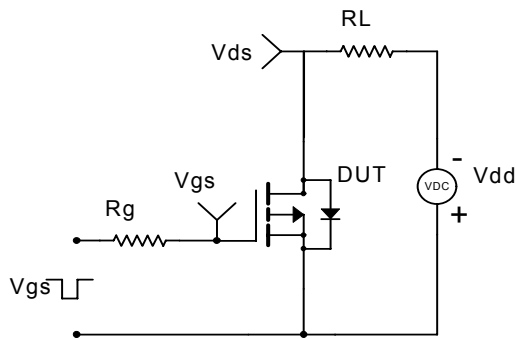


Figure 15: Normalized Maximum Transient Thermal Impedance (Note H)

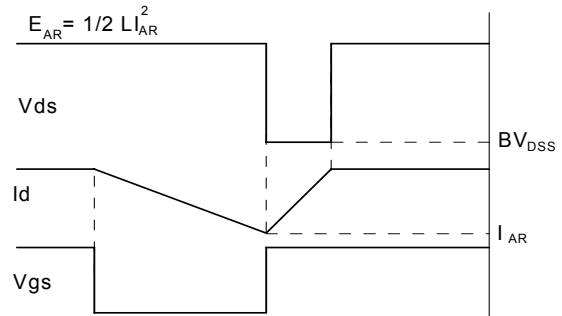
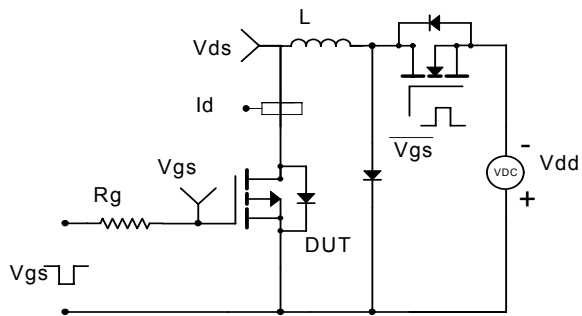
Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching (UIS) Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms

