



THE DATASHEET OF
AO6604L_001





General Description

The AO6604 combines advanced trench MOSFET technology with a low resistance package to provide extremely low $R_{DS(ON)}$. This device is ideal for load switch and battery protection applications.

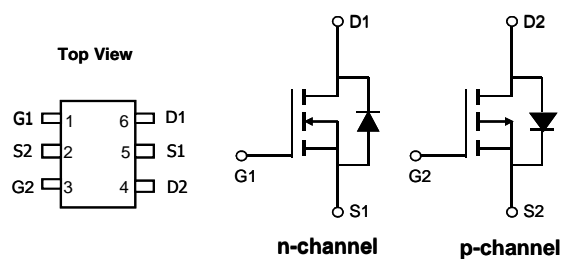
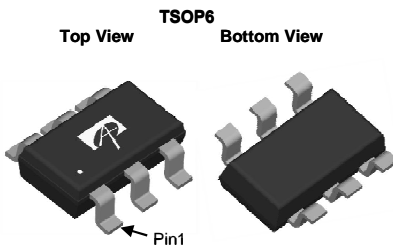
Product Summary

N-Channel

$V_{DS} = 20V$
 $I_D = 3.4A$ ($V_{GS} = 4.5V$)
 $R_{DS(ON)} < 65m\Omega$ ($V_{GS} = 4.5V$)
 $< 75m\Omega$ ($V_{GS} = 2.5V$)
 $< 100m\Omega$ ($V_{GS} = 1.8V$)

P-Channel

$-20V$
 $-2.5A$ ($V_{GS} = -4.5V$)
 $R_{DS(ON)} < 75m\Omega$ ($V_{GS} = -4.5V$)
 $< 95m\Omega$ ($V_{GS} = -2.5V$)
 $< 115m\Omega$ ($V_{GS} = -1.8V$)



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

| Parameter | Symbol | Max n-channel | Max p-channel | Units |
|--|----------------|--------------------|---------------|------------|
| Drain-Source Voltage | V_{DS} | 20 | -20 | V |
| Gate-Source Voltage | V_{GS} | ± 8 | ± 8 | V |
| Continuous Drain Current | I_D | $T_A = 25^\circ C$ | 3.4 | -2.5 |
| | | $T_A = 70^\circ C$ | 2.5 | -2 |
| Pulsed Drain Current ^C | I_{DM} | 13 | -13 | A |
| Power Dissipation ^B | P_D | $T_A = 25^\circ C$ | 1.1 | 1.1 |
| | | $T_A = 70^\circ C$ | 0.7 | 0.7 |
| Junction and Storage Temperature Range | T_J, T_{STG} | -55 to 150 | | $^\circ C$ |

Thermal Characteristics

| Parameter | Symbol | Typ | Max | Units |
|--|-----------------|-----|-----|--------------|
| Maximum Junction-to-Ambient ^A | $R_{\theta JA}$ | 78 | 110 | $^\circ C/W$ |
| Maximum Junction-to-Ambient ^{A,D} | | 106 | 150 | $^\circ C/W$ |
| Maximum Junction-to-Lead | $R_{\theta JL}$ | 64 | 80 | $^\circ C/W$ |

N-Channel Electrical Characteristics (T_J=25°C unless otherwise noted)

| Symbol | Parameter | Conditions | Min | Typ | Max | Units |
|-----------------------------|---------------------------------------|---|-----|----------|----------|-------|
| STATIC PARAMETERS | | | | | | |
| BV _{DSS} | Drain-Source Breakdown Voltage | I _D =250μA, V _{GS} =0V | 20 | | | V |
| I _{DSS} | Zero Gate Voltage Drain Current | V _{DS} =20V, V _{GS} =0V T _J =55°C | | | 1 5 | μA |
| I _{GSS} | Gate-Body leakage current | V _{DS} =0V, V _{GS} = ±8V | | | ±100 | nA |
| V _{GS(th)} | Gate Threshold Voltage | V _{DS} =V _{GS} I _D =250μA | 0.4 | 0.7 | 1 | V |
| I _{D(ON)} | On state drain current | V _{GS} =4.5V, V _{DS} =5V | 13 | | | A |
| R _{DS(ON)} | Static Drain-Source On-Resistance | V _{GS} =4.5V, I _D =3.4A T _J =125°C | | 51 68 | 65 85 | mΩ |
| | | V _{GS} =2.5V, I _D =3A | | 58 | 75 | mΩ |
| | | V _{GS} =1.8V, I _D =2A | | 68 | 100 | mΩ |
| g _{FS} | Forward Transconductance | V _{DS} =5V, I _D =3.4A | | 16 | | S |
| V _{SD} | Diode Forward Voltage | I _S =1A, V _{GS} =0V | | 0.7 | 1 | V |
| I _S | Maximum Body-Diode Continuous Current | | | | 1.5 | A |
| DYNAMIC PARAMETERS | | | | | | |
| C _{iss} | Input Capacitance | V _{GS} =0V, V _{DS} =10V, f=1MHz | 205 | 260 | 320 | pF |
| C _{oss} | Output Capacitance | | 33 | 48 | 63 | pF |
| C _{riss} | Reverse Transfer Capacitance | | 16 | 27 | 38 | pF |
| R _g | Gate resistance | V _{GS} =0V, V _{DS} =0V, f=1MHz | 1.5 | 3 | 4.5 | Ω |
| SWITCHING PARAMETERS | | | | | | |
| Q _{g(4.5V)} | Total Gate Charge | V _{GS} =4.5V, V _{DS} =10V, I _D =3.4A | | 2.9 | 3.8 | nC |
| Q _{gs} | Gate Source Charge | | 0.4 | | nC | |
| Q _{gd} | Gate Drain Charge | | 0.6 | | nC | |
| t _{D(on)} | Turn-On DelayTime | V _{GS} =5V, V _{DS} =10V, R _L =2.95Ω, R _{GEN} =3Ω | | 2.5 | | ns |
| t _r | Turn-On Rise Time | | 3.2 | | ns | |
| t _{D(off)} | Turn-Off DelayTime | | 21 | | ns | |
| t _f | Turn-Off Fall Time | | 3 | | ns | |
| t _{rr} | Body Diode Reverse Recovery Time | I _F =3.4A, dI/dt=100A/μs | | 14 | 19 | ns |
| Q _{rr} | Body Diode Reverse Recovery Charge | I _F =3.4A, dI/dt=100A/μs | | 3.8 | | nC |

A. The value of R_{θJA} is measured with the device mounted on 1in² FR-4 board with 2oz. Copper, in a still air environment with T_A=25° C. The value in any given application depends on the user's specific board design.

B. The power dissipation P_D is based on T_{J(MAX)}=150° C, using ≤ 10s junction-to-ambient thermal resistance.

C. Repetitive rating, pulse width limited by junction temperature T_{J(MAX)}=150° C. Ratings are based on low frequency and duty cycles to keep initial T_J=25° C.

D. The R_{θJA} is the sum of the thermal impedance from junction to lead R_{θJL} and lead to ambient.

E. The static characteristics in Figures 1 to 6 are obtained using <300μs pulses, duty cycle 0.5% max.

F. These curves are based on the junction-to-ambient thermal impedance which is measured with the device mounted on 1in² FR-4 board with 2oz. Copper, assuming a maximum junction temperature of T_{J(MAX)}=150° C. The SOA curve provides a single pulse rating.

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N-Channel: TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

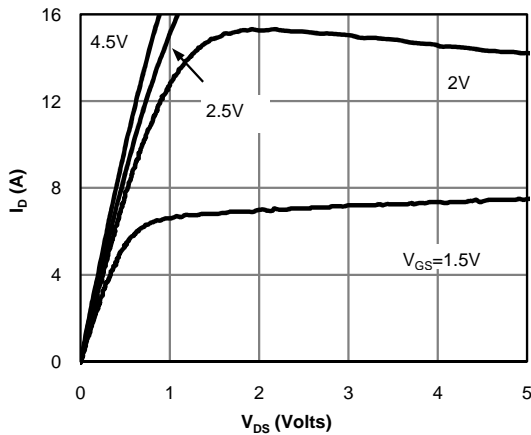


Fig 1: On-Region Characteristics (Note E)

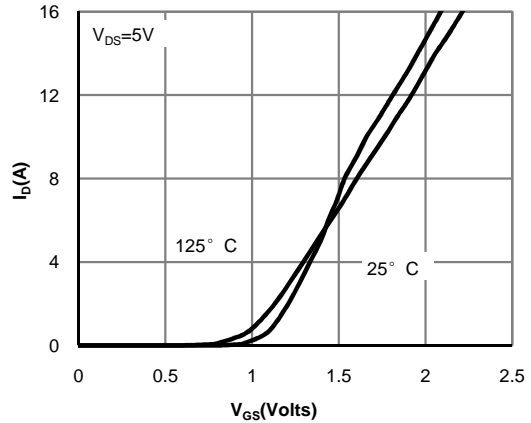


Figure 2: Transfer Characteristics (Note E)

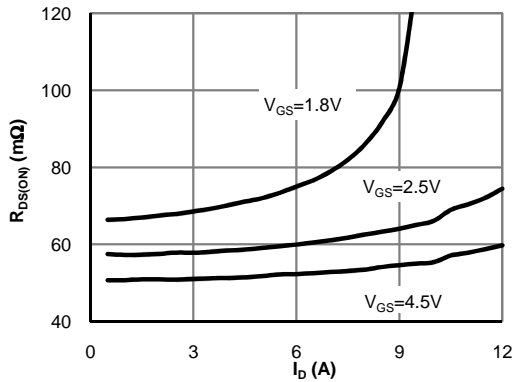


Figure 3: On-Resistance vs. Drain Current and Gate Voltage (Note E)

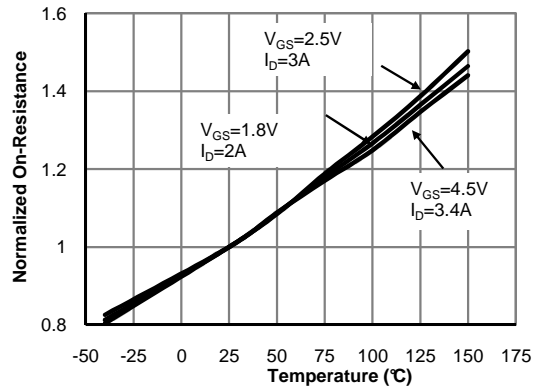


Figure 4: On-Resistance vs. Junction Temperature (Note E)

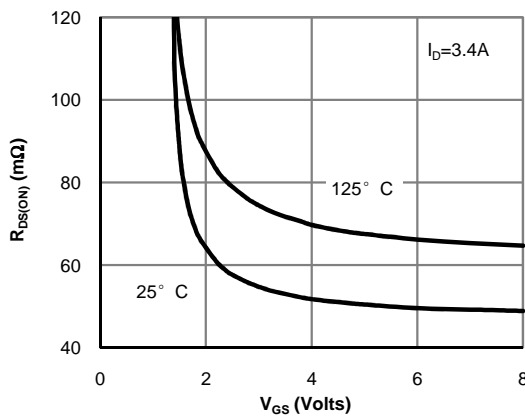


Figure 5: On-Resistance vs. Gate-Source Voltage (Note E)

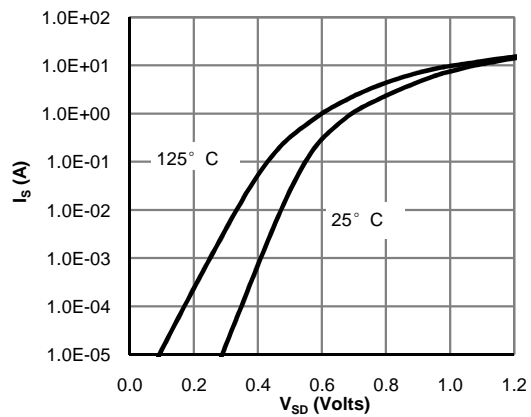


Figure 6: Body-Diode Characteristics (Note E)

N-Channel: TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

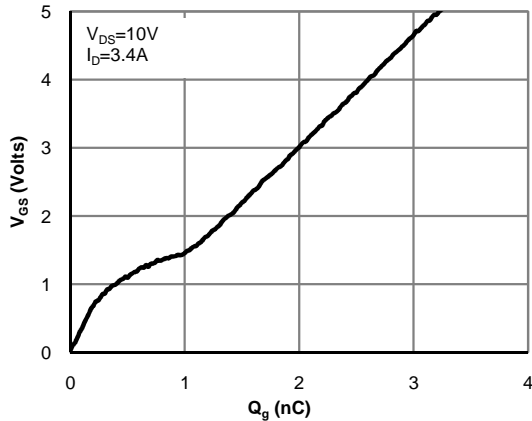


Figure 7: Gate-Charge Characteristics

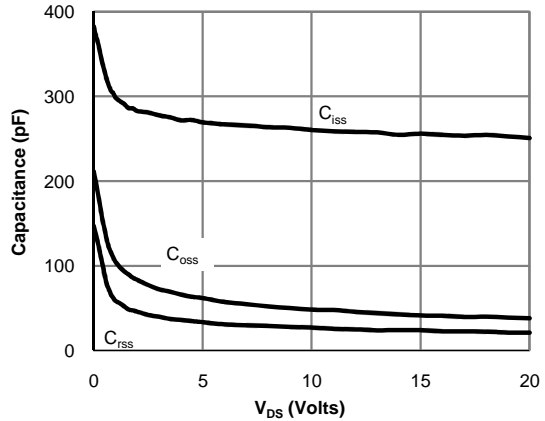


Figure 8: Capacitance Characteristics

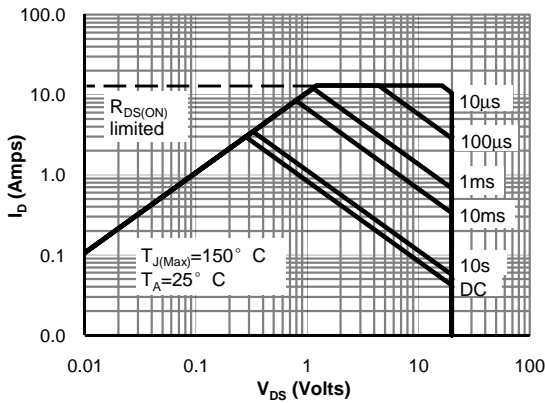


Figure 9: Maximum Forward Biased Safe Operating Area (Note F)

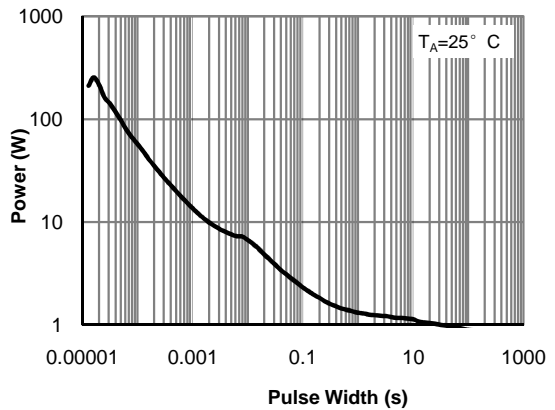


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note F)

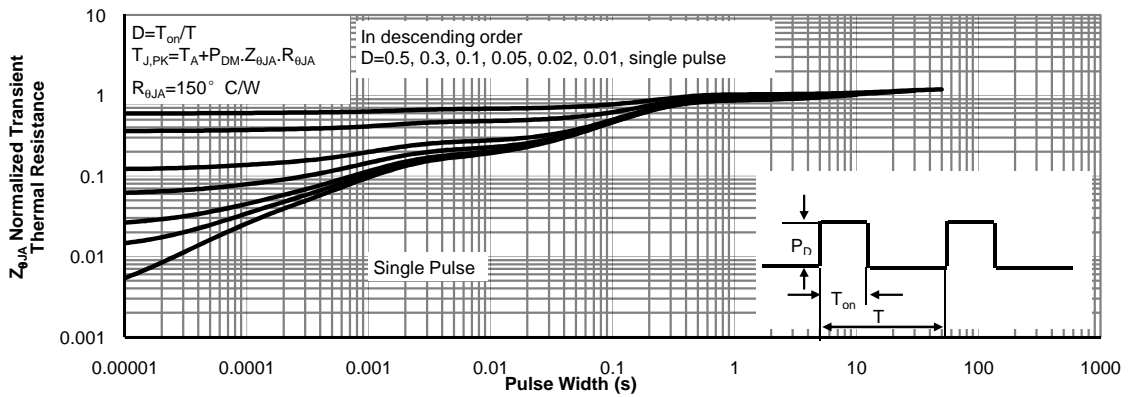
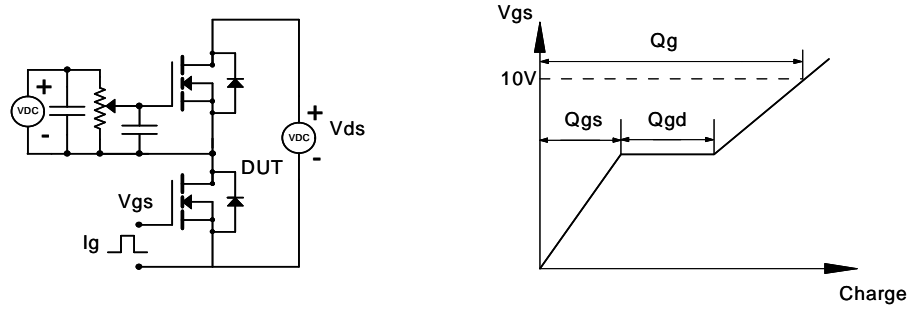
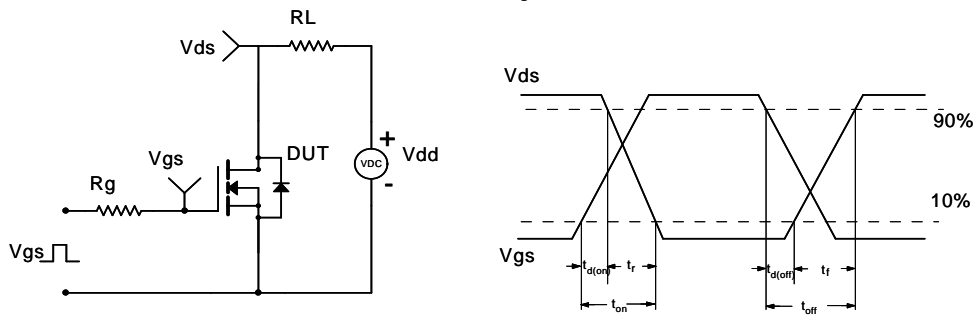


Figure 11: Normalized Maximum Transient Thermal Impedance (Note F)

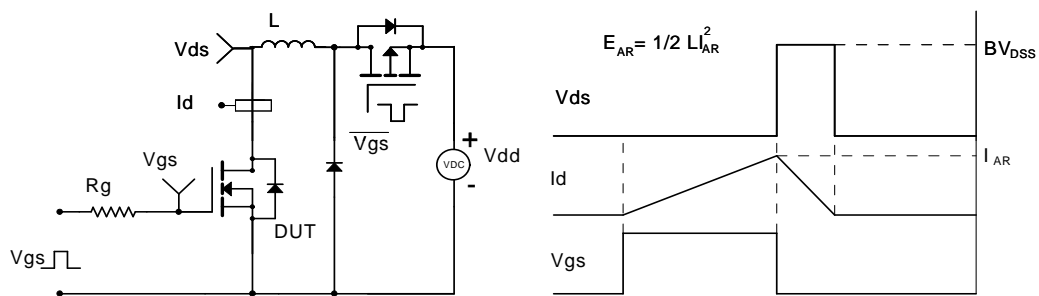
Gate Charge Test Circuit & Waveform



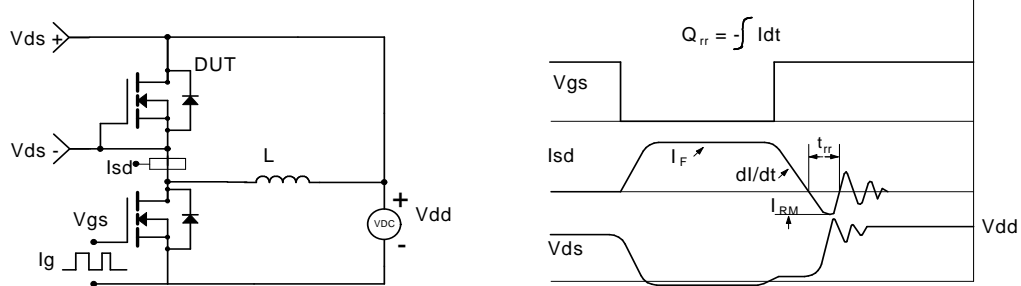
Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching (UIS) Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms



P-Channel Electrical Characteristics (T_J=25°C unless otherwise noted)

| Symbol | Parameter | Conditions | Min | Typ | Max | Units |
|-----------------------------|---------------------------------------|--|------|----------|-----------|-------|
| STATIC PARAMETERS | | | | | | |
| BV _{DSS} | Drain-Source Breakdown Voltage | I _D =-250μA, V _{GS} =0V | -20 | | | V |
| I _{DSS} | Zero Gate Voltage Drain Current | V _{DS} =-20V, V _{GS} =0V T _J =55°C | | | -1 -5 | μA |
| I _{GSS} | Gate-Body leakage current | V _{DS} =0V, V _{GS} = ±8V | | | ±100 | nA |
| V _{GS(th)} | Gate Threshold Voltage | V _{DS} =V _{GS} , I _D =-250μA | -0.4 | -0.65 | -1 | V |
| I _{D(ON)} | On state drain current | V _{GS} =-4.5V, V _{DS} =-5V | -13 | | | A |
| R _{DS(ON)} | Static Drain-Source On-Resistance | V _{GS} =-4.5V, I _D =-2.5A T _J =125°C | | 56 80 | 75 105 | mΩ |
| | | V _{GS} =-2.5V, I _D =-2A | | 70 | 95 | mΩ |
| | | V _{GS} =-1.8V, I _D =-1A | | 85 | 115 | mΩ |
| g _{FS} | Forward Transconductance | V _{DS} =-5V, I _D =-2.5A | | 13 | | S |
| V _{SD} | Diode Forward Voltage | I _S =-1A, V _{GS} =0V | | -0.7 | -1 | V |
| I _S | Maximum Body-Diode Continuous Current | | | | -1.5 | A |
| DYNAMIC PARAMETERS | | | | | | |
| C _{iss} | Input Capacitance | V _{GS} =0V, V _{DS} =-10V, f=1MHz | | 560 | 745 | pF |
| C _{oss} | Output Capacitance | | | 80 | | pF |
| C _{riss} | Reverse Transfer Capacitance | | | 70 | | pF |
| R _g | Gate resistance | V _{GS} =0V, V _{DS} =0V, f=1MHz | | 15 | 23 | Ω |
| SWITCHING PARAMETERS | | | | | | |
| Q _{g(4.5V)} | Total Gate Charge | V _{GS} =-4.5V, V _{DS} =-10V, I _D =-2.5A | | 8.5 | 11 | nC |
| Q _{gs} | Gate Source Charge | | | 1.2 | | nC |
| Q _{gd} | Gate Drain Charge | | | 2.1 | | nC |
| t _{D(on)} | Turn-On DelayTime | V _{GS} =-4.5V, V _{DS} =-10V, R _L =4Ω, R _{GEN} =6Ω | | 7.2 | | ns |
| t _r | Turn-On Rise Time | | | 36 | | ns |
| t _{D(off)} | Turn-Off DelayTime | | | 53 | | ns |
| t _f | Turn-Off Fall Time | | | 56 | | ns |
| t _{rr} | Body Diode Reverse Recovery Time | I _F =-2.5A, dI/dt=100A/μs | | 37 | 49 | ns |
| Q _{rr} | Body Diode Reverse Recovery Charge | I _F =-2.5A, dI/dt=100A/μs | | 27 | | nC |

A. The value of R_{θJA} is measured with the device mounted on 1in² FR-4 board with 2oz. Copper, in a still air environment with T_A =25° C. The value in any given application depends on the user's specific board design.

B. The power dissipation P_D is based on T_{J(MAX)}=150° C, using ≤ 10s junction-to-ambient thermal resistance.

C. Repetitive rating, pulse width limited by junction temperature T_{J(MAX)}=150° C. Ratings are based on low frequency and duty cycles to keep initial T_J=25° C.

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P-Channel: TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

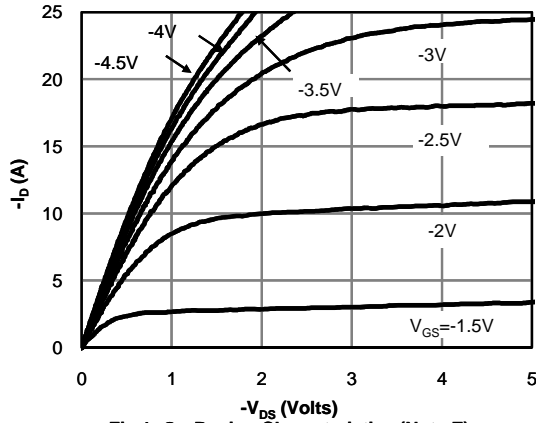


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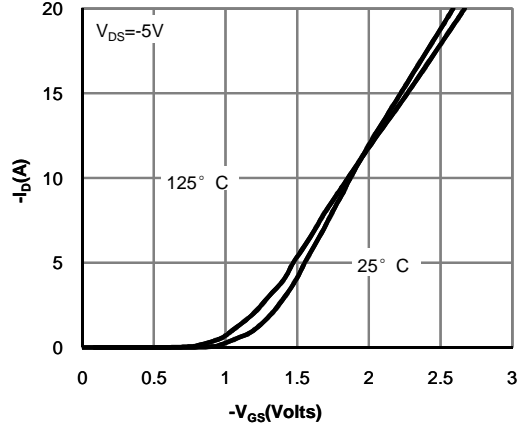


Figure 2: Transfer Characteristics (Note E)

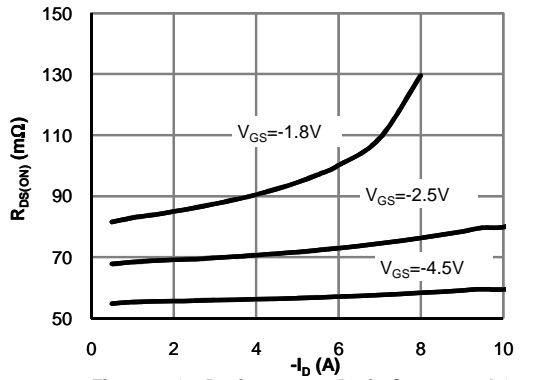


Figure 3: On-Resistance vs. Drain Current and Gate Voltage (Note E)

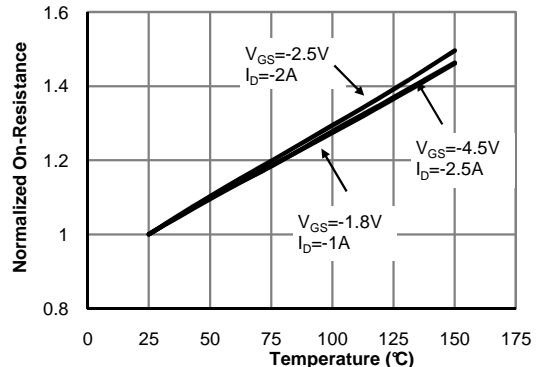


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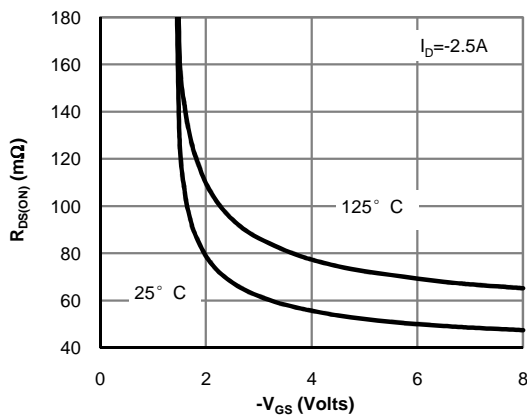


Figure 5: On-Resistance vs. Gate-Source Voltage (Note E)

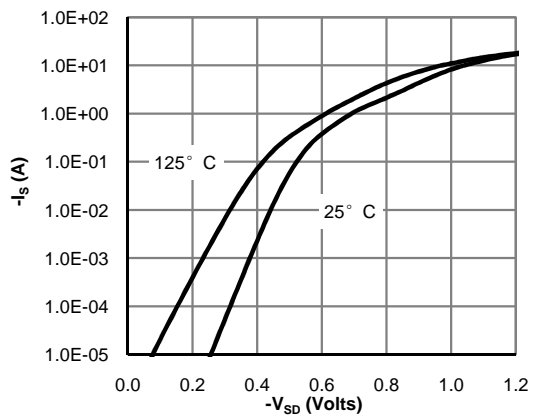


Figure 6: Body-Diode Characteristics (Note E)

P-Channel: TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

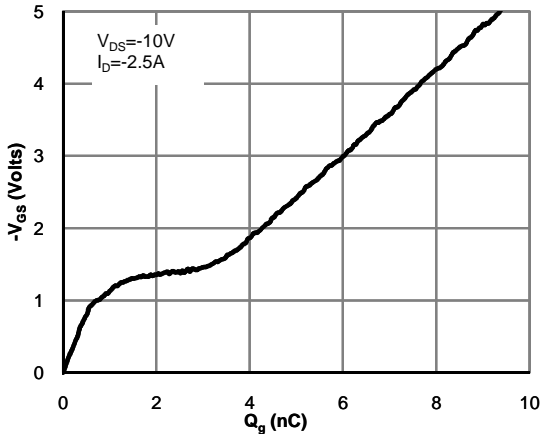


Figure 7: Gate-Charge Characteristics

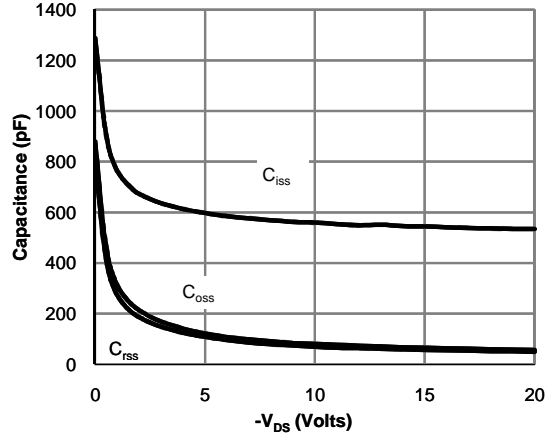


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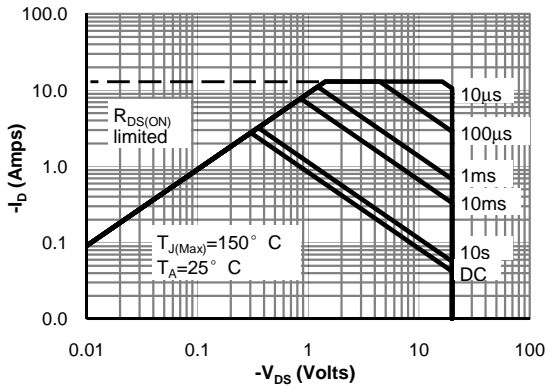


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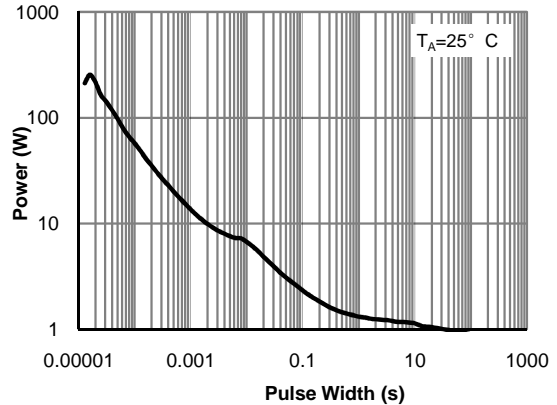


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note F)

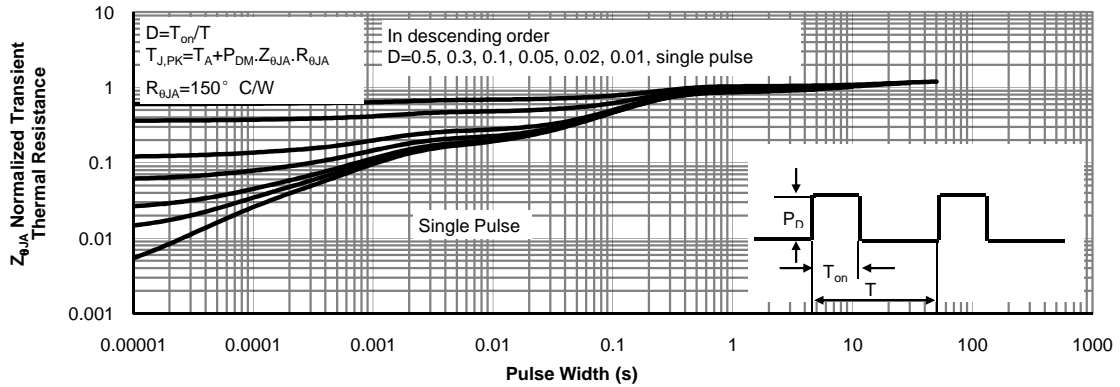
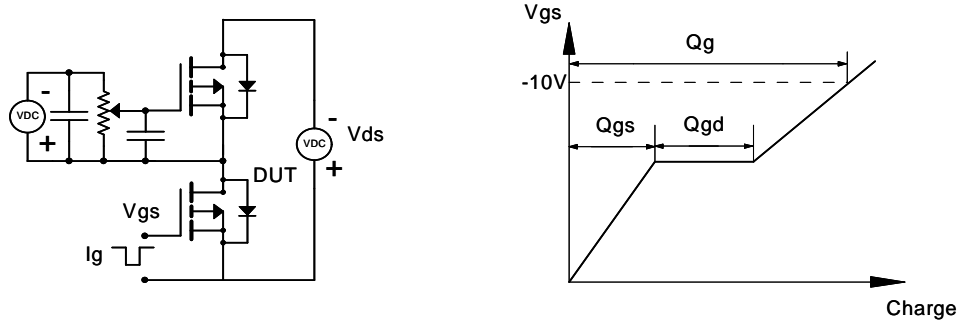
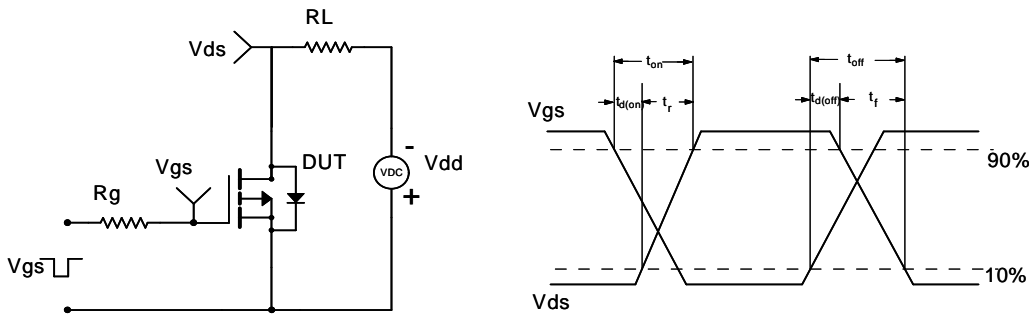


Figure 11: Normalized Maximum Transient Thermal Impedance (Note F)

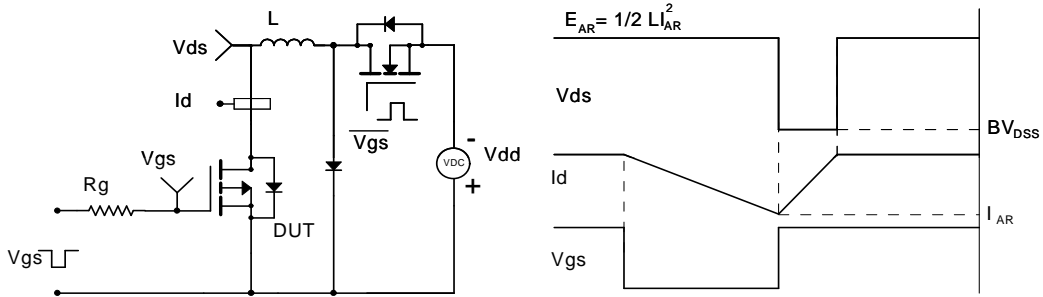
Gate Charge Test Circuit & Waveform



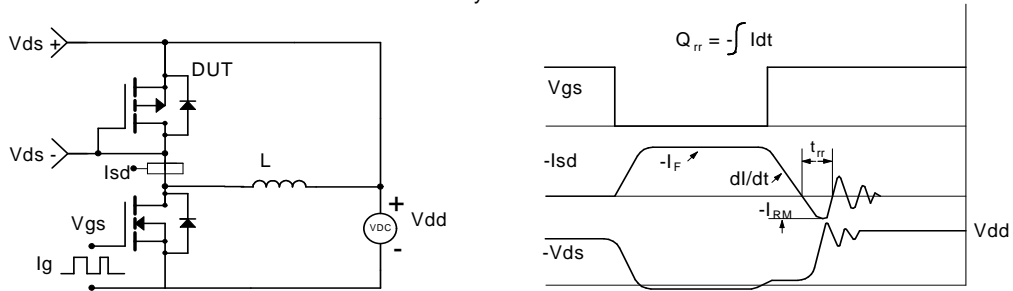
Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching (UIS) Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms



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