

## AOD609G

### Complementary Enhancement Mode Field Effect Transistor

#### General Description

The AOD609G uses advanced trench technology MOSFETs to provide excellent  $R_{DS(ON)}$  and low gate charge. The complementary MOSFETs may be used in H-bridge, Inverters and other applications.

- RoHS Compliant
- Halogen Free\*

#### Features

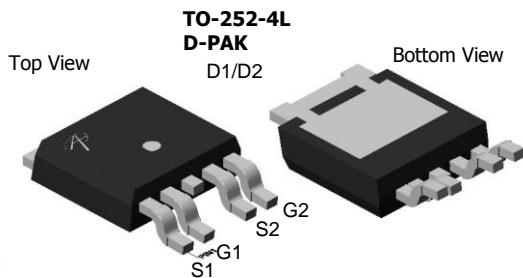
##### n-channel

$V_{DS}$  (V) = 40V,  $I_D$  = 12A ( $V_{GS}=10V$ )  
 $R_{DS(ON)} < 30m\Omega$  ( $V_{GS}=10V$ )  
 $R_{DS(ON)} < 40m\Omega$  ( $V_{GS}=4.5V$ )

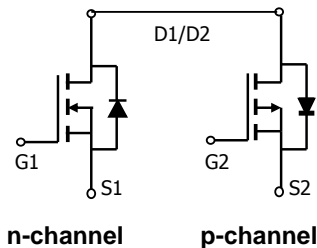
##### p-channel

$V_{DS}$  (V) = -40V,  $I_D$  = -12A ( $V_{GS}=-10V$ )  
 $R_{DS(ON)} < 45m\Omega$  ( $V_{GS}= -10V$ )  
 $R_{DS(ON)} < 66m\Omega$  ( $V_{GS}= -4.5V$ )

**100% UIS Tested!**  
**100% Rg Tested!**



Top View  
 Drain Connected  
 to Tab



n-channel

p-channel

#### Absolute Maximum Ratings $T_A=25^\circ\text{C}$ unless otherwise noted

| Parameter   | Symbol         | Max n-channel           | Max p-channel | Units            |
|---|----------------|-------------------------|---------------|------------------|
| Drain-Source Voltage                                      | $V_{DS}$       | 40                      | -40           | V                |
| Gate-Source Voltage                                       | $V_{GS}$       | $\pm 20$                | $\pm 20$      | V                |
| Continuous Drain Current <sup>B,H</sup>                   | $I_D$          | $T_C=25^\circ\text{C}$  | -12           | A                |
|   |                | $T_C=100^\circ\text{C}$ | 12            |                  |
| Pulsed Drain Current <sup>B</sup>                         | $I_{DM}$       | 30                      | -30           |                  |
| Avalanche Current <sup>C</sup>                            | $I_{AR}$       | 14                      | -20           |                  |
| Repetitive avalanche energy $L=0.1\text{mH}$ <sup>C</sup> | $E_{AR}$       | 9.8                     | 20            | mJ               |
| Power Dissipation   | $P_D$          | $T_C=25^\circ\text{C}$  | 30            | W                |
|   |                | $T_C=100^\circ\text{C}$ | 15            |                  |
| Power Dissipation   | $P_{DSM}$      | $T_A=25^\circ\text{C}$  | 2             | W                |
|   |                | $T_A=70^\circ\text{C}$  | 1.3           |                  |
| Junction and Storage Temperature Range                    | $T_J, T_{STG}$ | -55 to 175              | -55 to 175    | $^\circ\text{C}$ |

#### Thermal Characteristics: n-channel and p-channel

| Parameter                                  | Symbol          | Device | Typ                 | Max  | Units              |
|--|-----------------|--------|---------------------|------|--------------------|
| Maximum Junction-to-Ambient <sup>A,D</sup> | $R_{\theta JA}$ | n-ch   | $t \leq 10\text{s}$ | 17.4 | 25                 |
| Maximum Junction-to-Ambient <sup>A,D</sup> |                 |        | Steady-State        | 50   | 60                 |
| Maximum Junction-to-Lead <sup>C</sup>      | $R_{\theta JC}$ | n-ch   | 4                   | 5.5  | $^\circ\text{C/W}$ |
| Maximum Junction-to-Ambient <sup>A,D</sup> | $R_{\theta JA}$ | p-ch   | $t \leq 10\text{s}$ | 16.7 | 25                 |
| Maximum Junction-to-Ambient <sup>A,D</sup> |                 |        | Steady-State        | 50   | 60                 |
| Maximum Junction-to-Lead <sup>C</sup>      | $R_{\theta JC}$ | p-ch   | 3.5                 | 5    | $^\circ\text{C/W}$ |

**N Channel Electrical Characteristics (T<sub>J</sub>=25°C unless otherwise noted)**

| Symbol                      | Parameter                             | Conditions  | Min | Typ      | Max      | Units |
|-----------------------------|---------------------------------------|---|-----|----------|----------|-------|
| <b>STATIC PARAMETERS</b>    |                                       |   |     |          |          |       |
| BV <sub>DSS</sub>           | Drain-Source Breakdown Voltage        | I <sub>D</sub> =250μA, V <sub>GS</sub> =0V  | 40  |          |          | V     |
| I <sub>DSS</sub>            | Zero Gate Voltage Drain Current       | V <sub>DS</sub> =40V, V <sub>GS</sub> =0V<br>T <sub>J</sub> =55°C                         |     |          | 1<br>5   | μA    |
| I <sub>GSS</sub>            | Gate-Body leakage current             | V <sub>DS</sub> =0V, V <sub>GS</sub> = ±20V   |     |          | ±100     | nA    |
| V <sub>GS(th)</sub>         | Gate Threshold Voltage                | V <sub>DS</sub> =V <sub>GS</sub> I <sub>D</sub> =250μA                                    | 1.7 | 2.5      | 3        | V     |
| I <sub>D(ON)</sub>          | On state drain current                | V <sub>GS</sub> =10V, V <sub>DS</sub> =5V   | 30  |          |          | A     |
| R <sub>DS(ON)</sub>         | Static Drain-Source On-Resistance     | V <sub>GS</sub> =10V, I <sub>D</sub> =12A<br>T <sub>J</sub> =125°C                        |     | 24<br>37 | 30<br>46 | mΩ    |
|                             |                                       | V <sub>GS</sub> =4.5V, I <sub>D</sub> =8A   |     | 31       | 40       |       |
| g <sub>FS</sub>             | Forward Transconductance              | V <sub>DS</sub> =5V, I <sub>D</sub> =12A  |     | 25       |          | S     |
| V <sub>SD</sub>             | Diode Forward Voltage                 | I <sub>S</sub> =1A, V <sub>GS</sub> =0V   |     | 0.76     | 1        | V     |
| I <sub>S</sub>              | Maximum Body-Diode Continuous Current |   |     |          | 2        | A     |
| <b>DYNAMIC PARAMETERS</b>   |                                       |   |     |          |          |       |
| C <sub>iss</sub>            | Input Capacitance                     |   |     | 545      |          | pF    |
| C <sub>oss</sub>            | Output Capacitance                    | V <sub>GS</sub> =0V, V <sub>DS</sub> =20V, f=1MHz   |     | 65       |          | pF    |
| C <sub>rss</sub>            | Reverse Transfer Capacitance          |   |     | 40       |          | pF    |
| R <sub>g</sub>              | Gate resistance                       | V <sub>GS</sub> =0V, V <sub>DS</sub> =0V, f=1MHz  | 1.6 | 3.2      | 4.8      | Ω     |
| <b>SWITCHING PARAMETERS</b> |                                       |   |     |          |          |       |
| Q <sub>g</sub> (10V)        | Total Gate Charge                     | V <sub>GS</sub> =10V, V <sub>DS</sub> =20V,<br>I <sub>D</sub> =12A                        |     | 10       | 13       | nC    |
| Q <sub>gs</sub>             | Gate Source Charge                    |   |     | 2        |          | nC    |
| Q <sub>gd</sub>             | Gate Drain Charge                     |   |     | 2.2      |          | nC    |
| t <sub>D(on)</sub>          | Turn-On DelayTime                     |   |     | 5.5      |          | ns    |
| t <sub>r</sub>              | Turn-On Rise Time                     | V <sub>GS</sub> =10V, V <sub>DS</sub> =20V, R <sub>L</sub> =1.4Ω,<br>R <sub>GEN</sub> =3Ω |     | 3        |          | ns    |
| t <sub>D(off)</sub>         | Turn-Off DelayTime                    |   |     | 19       |          | ns    |
| t <sub>f</sub>              | Turn-Off Fall Time                    |   |     | 4        |          | ns    |
| t <sub>rr</sub>             | Body Diode Reverse Recovery Time      | I <sub>F</sub> =12A, di/dt=100A/μs  |     | 13       |          | ns    |
| Q <sub>rr</sub>             | Body Diode Reverse Recovery Charge    | I <sub>F</sub> =12A, di/dt=100A/μs  |     | 6.5      |          | nC    |

A: The value of R<sub>θJA</sub> is measured with the device in a still air environment with T<sub>A</sub>=25° C. The power dissipation P<sub>DSM</sub> and current rating I<sub>DSM</sub> are based on T<sub>J(MAX)</sub>=150° C, using the steady state junction-to-ambient thermal resistance.

B. The power dissipation P<sub>D</sub> is based on T<sub>J(MAX)</sub>=175° 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<sub>J(MAX)</sub>=175° C.

D. The R<sub>θJA</sub> is the sum of the thermal impedance from junction to case R<sub>θJC</sub> and case to ambient.

E. The static characteristics in Figures 1 to 6 are obtained using <300 μs 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<sub>J(MAX)</sub>=175° C. The SOA curve provides a single pulse rating.

G. 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<sub>A</sub>=25° C.

H. The maximum current rating is limited by bond-wires.

\*This device is guaranteed green after data code 8X11 (Sep 1<sup>ST</sup> 2008).

Rev4: Aug 2009

THIS PRODUCT HAS BEEN DESIGNED AND QUALIFIED FOR THE CONSUMER MARKET. APPLICATIONS OR USES AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS ARE NOT AUTHORIZED. AOS DOES NOT ASSUME ANY LIABILITY ARISING OUT OF SUCH APPLICATIONS OR USES OF ITS PRODUCTS. AOS RESERVES THE RIGHT TO IMPROVE PRODUCT DESIGN, FUNCTIONS AND RELIABILITY WITHOUT NOTICE.

**P-Channel Electrical Characteristics (T<sub>J</sub>=25°C unless otherwise noted)**

| Symbol                      | Parameter                             | Conditions  | Min  | Typ      | Max      | Units |
|-----------------------------|---------------------------------------|---|------|----------|----------|-------|
| <b>STATIC PARAMETERS</b>    |                                       |   |      |          |          |       |
| B <sub>V</sub> DSS          | Drain-Source Breakdown Voltage        | I <sub>D</sub> = -250μA, V <sub>GS</sub> =0V  | -40  |          |          | V     |
| I <sub>DSS</sub>            | Zero Gate Voltage Drain Current       | V <sub>DS</sub> = -40V, V <sub>GS</sub> =0V<br>T <sub>J</sub> =55°C                           |      |          | -1<br>-5 | μA    |
| I <sub>GSS</sub>            | Gate-Body leakage current             | V <sub>DS</sub> =0V, V <sub>GS</sub> = ±20V   |      |          | ±100     | nA    |
| V <sub>GS(th)</sub>         | Gate Threshold Voltage                | V <sub>DS</sub> =V <sub>GS</sub> I <sub>D</sub> = -250μA                                      | -1.7 | -2       | -3       | V     |
| I <sub>D(ON)</sub>          | On state drain current                | V <sub>GS</sub> = -10V, V <sub>DS</sub> = -5V   | -30  |          |          | A     |
| R <sub>DS(ON)</sub>         | Static Drain-Source On-Resistance     | V <sub>GS</sub> = -10V, I <sub>D</sub> = -12A<br>T <sub>J</sub> =125°C                        |      | 36<br>52 | 45<br>65 | mΩ    |
|                             |                                       | V <sub>GS</sub> = -4.5V, I <sub>D</sub> = -8A   |      | 51       | 66       |       |
| g <sub>FS</sub>             | Forward Transconductance              | V <sub>DS</sub> = -5V, I <sub>D</sub> = -12A  |      | 22       |          | S     |
| V <sub>SD</sub>             | Diode Forward Voltage                 | I <sub>S</sub> = -1A, V <sub>GS</sub> =0V   |      | -0.76    | -1       | V     |
| I <sub>S</sub>              | Maximum Body-Diode Continuous Current |   |      |          | -2       | A     |
| <b>DYNAMIC PARAMETERS</b>   |                                       |   |      |          |          |       |
| C <sub>ISS</sub>            | Input Capacitance                     |   |      | 890      |          | pF    |
| C <sub>OSS</sub>            | Output Capacitance                    | V <sub>GS</sub> =0V, V <sub>DS</sub> = -20V, f=1MHz   |      | 90       |          | pF    |
| C <sub>rSS</sub>            | Reverse Transfer Capacitance          |   |      | 60       |          | pF    |
| R <sub>g</sub>              | Gate resistance                       | V <sub>GS</sub> =0V, V <sub>DS</sub> =0V, f=1MHz  | 6.5  | 13       | 19.5     | Ω     |
| <b>SWITCHING PARAMETERS</b> |                                       |   |      |          |          |       |
| Q <sub>g</sub> (-10V)       | Total Gate Charge                     |   |      | 15.5     | 21       | nC    |
| Q <sub>g</sub> (-4.5V)      | Total Gate Charge                     | V <sub>GS</sub> = -10V, V <sub>DS</sub> = -20V,<br>I <sub>D</sub> = -12A                      |      | 7        | 9        | nC    |
| Q <sub>gs</sub>             | Gate Source Charge                    |   |      | 3.2      |          | nC    |
| Q <sub>gd</sub>             | Gate Drain Charge                     |   |      | 3.5      |          | nC    |
| t <sub>D(on)</sub>          | Turn-On DelayTime                     |   |      | 10       |          | ns    |
| t <sub>r</sub>              | Turn-On Rise Time                     | V <sub>GS</sub> = -10V, V <sub>DS</sub> = -20V,<br>R <sub>L</sub> =1.4Ω, R <sub>GEN</sub> =3Ω |      | 15.5     |          | ns    |
| t <sub>D(off)</sub>         | Turn-Off DelayTime                    |   |      | 35       |          | ns    |
| t <sub>f</sub>              | Turn-Off Fall Time                    |   |      | 50       |          | ns    |
| t <sub>rr</sub>             | Body Diode Reverse Recovery Time      | I <sub>F</sub> = -12A, dI/dt=100A/μs  |      | 20       |          | ns    |
| Q <sub>rr</sub>             | Body Diode Reverse Recovery Charge    | I <sub>F</sub> = -12A, dI/dt=100A/μs  |      | 11       |          | nC    |

A: The value of R<sub>θJA</sub> is measured with the device in a still air environment with T<sub>A</sub>=25° C. The power dissipation P<sub>DSM</sub> and current rating I<sub>DSM</sub> are based on T<sub>J(MAX)</sub>=150° C, using t ≤ 10s junction-to-ambient thermal resistance.

B: The power dissipation P<sub>D</sub> is based on T<sub>J(MAX)</sub>=175° 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<sub>J(MAX)</sub>=175° C.

D: The R<sub>θJA</sub> is the sum of the thermal impedance from junction to case R<sub>θJC</sub> and case to ambient.

E: The static characteristics in Figures 1 to 6 are obtained using <300 μs 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<sub>J(MAX)</sub>=175° C. The SOA curve provides a single pulse rating.

G: 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<sub>A</sub>=25° C.

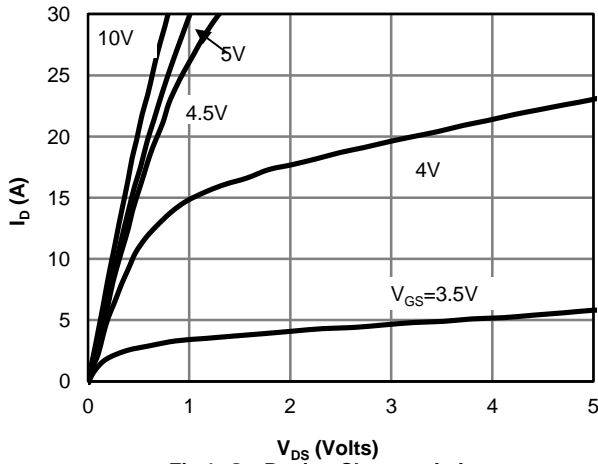
H: The maximum current rating is limited by bond-wires.

\*This device is guaranteed green after data code 8X11 (Sep 1<sup>ST</sup> 2008).

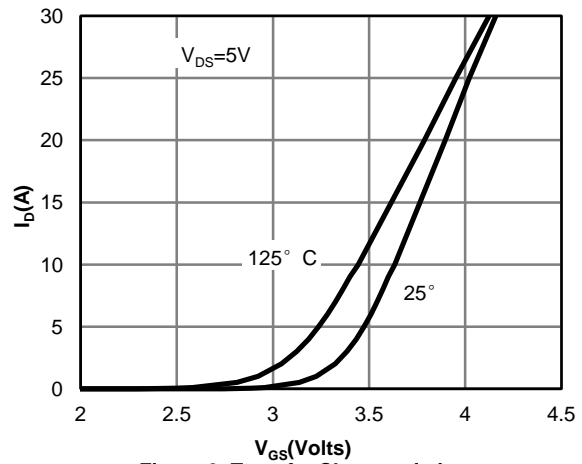
Rev4: Aug 2009

THIS PRODUCT HAS BEEN DESIGNED AND QUALIFIED FOR THE CONSUMER MARKET. APPLICATIONS OR USES AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS ARE NOT AUTHORIZED. AOS DOES NOT ASSUME ANY LIABILITY ARISING OUT OF SUCH APPLICATIONS OR USES OF ITS PRODUCTS. AOS RESERVES THE RIGHT TO IMPROVE PRODUCT DESIGN, FUNCTIONS AND RELIABILITY WITHOUT NOTICE.

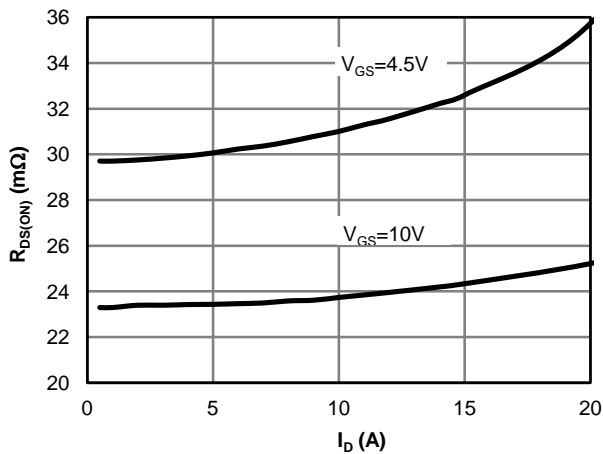
**TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS: N-CANNEL**



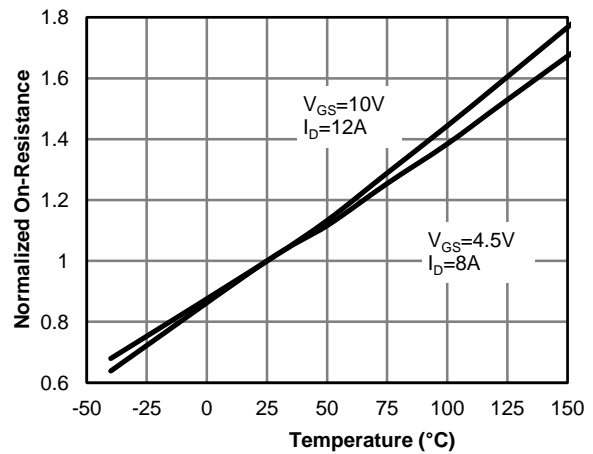
**Fig 1: On-Region Characteristics**



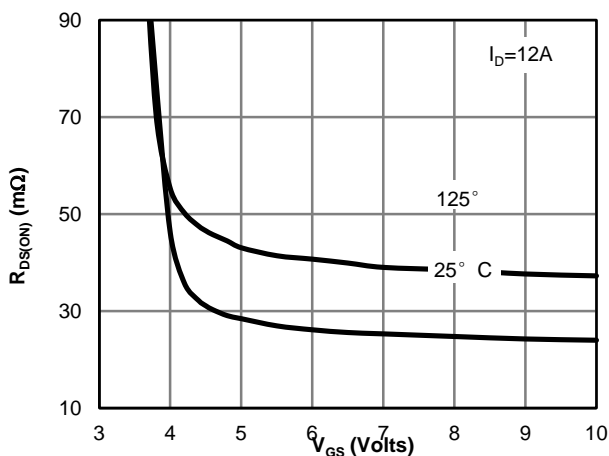
**Figure 2: Transfer Characteristics**



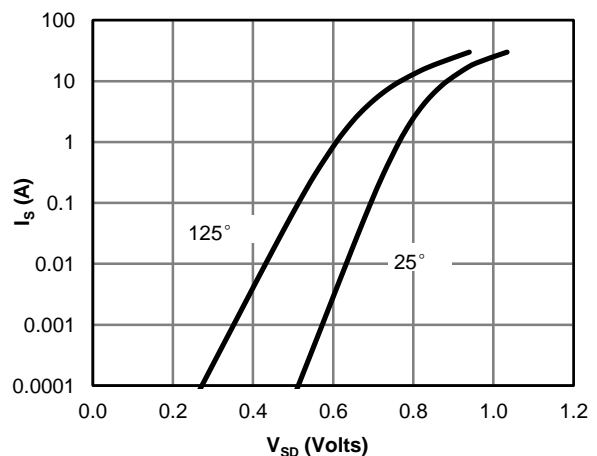
**Figure 3: On-Resistance vs. Drain Current and Gate Voltage**



**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: N-CANNEL**

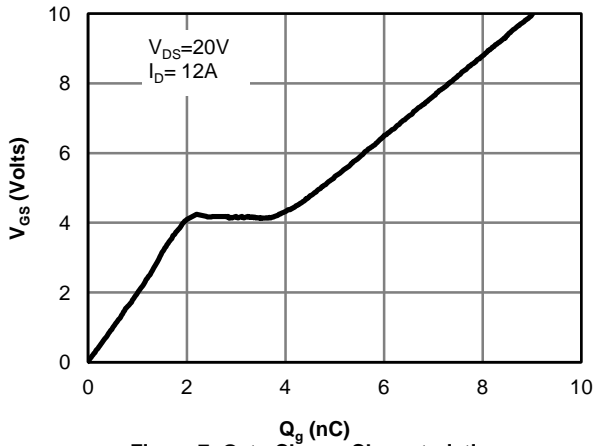


Figure 7: Gate-Charge Characteristics

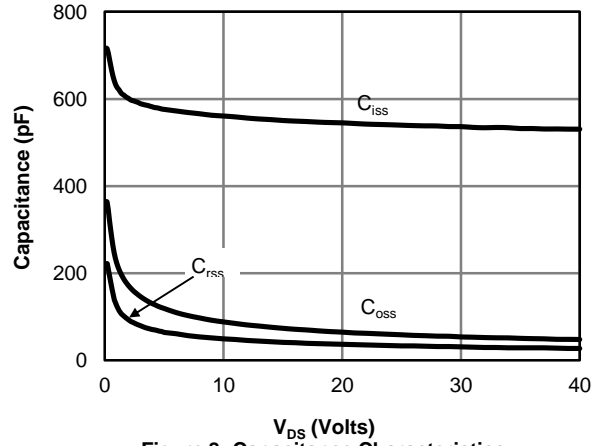


Figure 8: Capacitance Characteristics

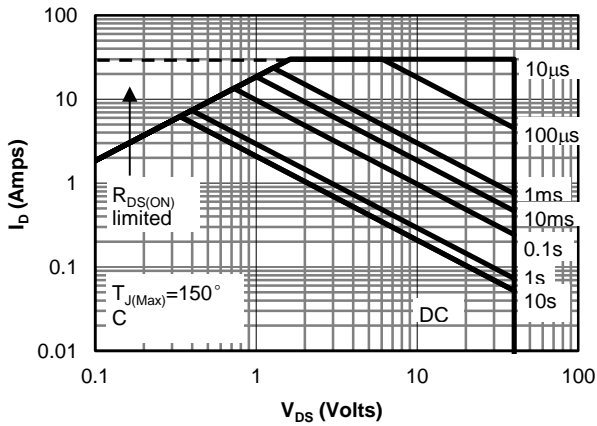


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

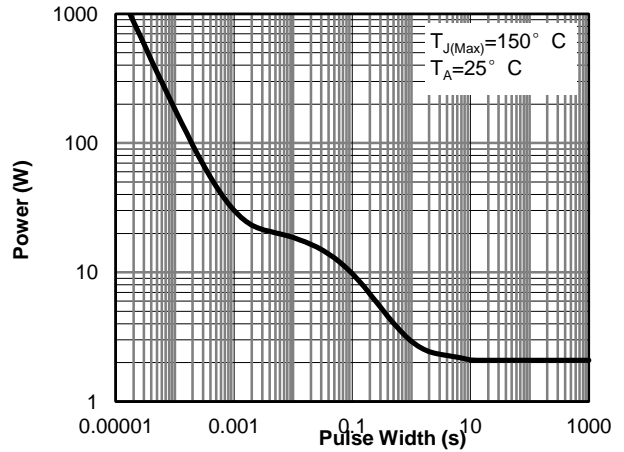


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

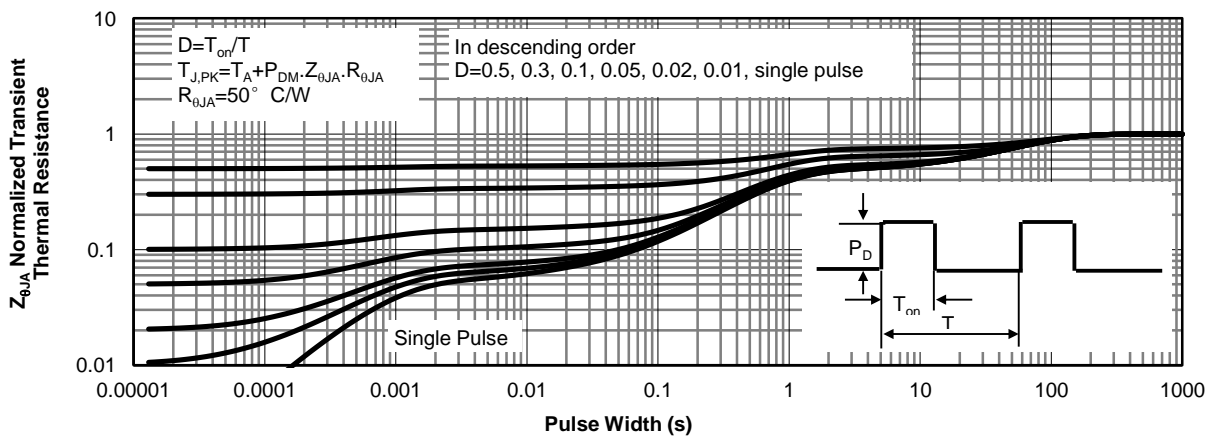
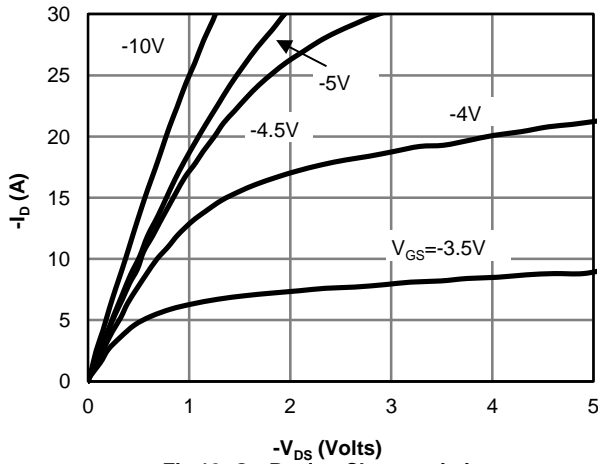
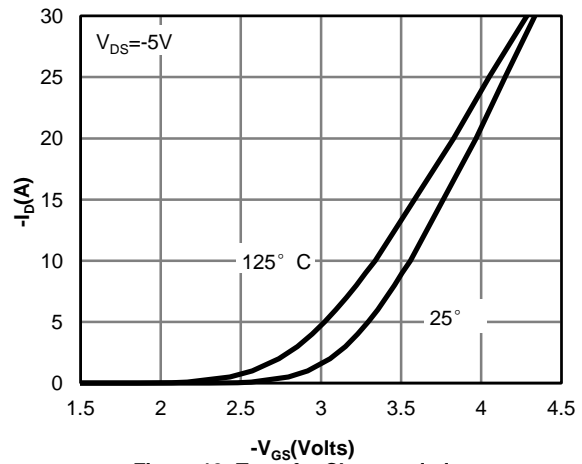


Figure 11: Normalized Maximum Transient Thermal Impedance

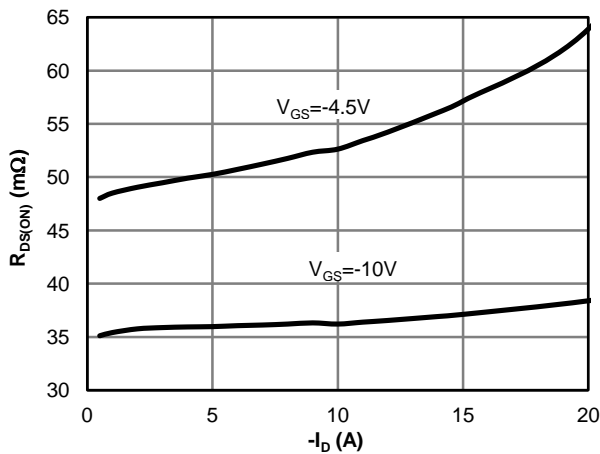
**TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS: P-CHANNEL**



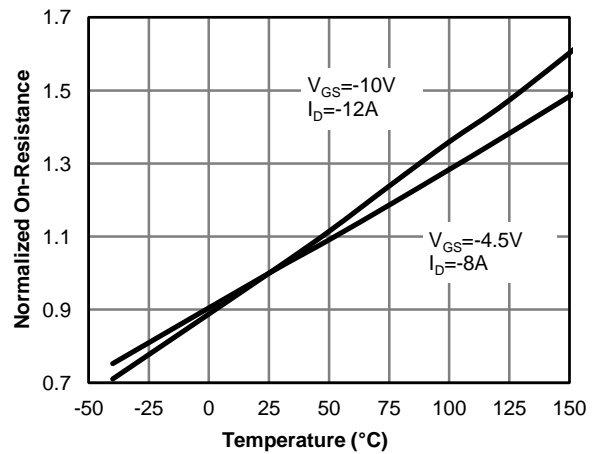
**Fig 12: On-Region Characteristics**



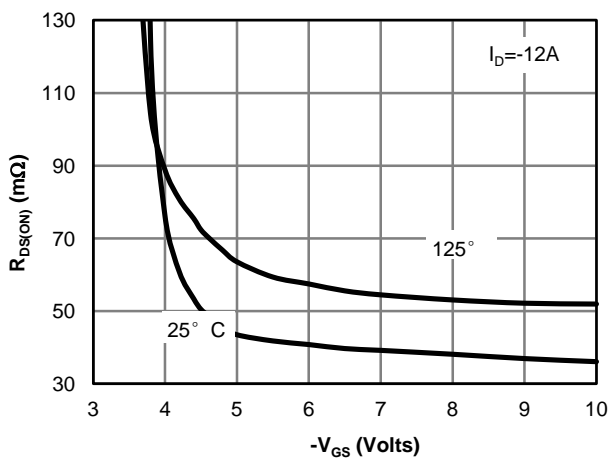
**Figure 13: Transfer Characteristics**



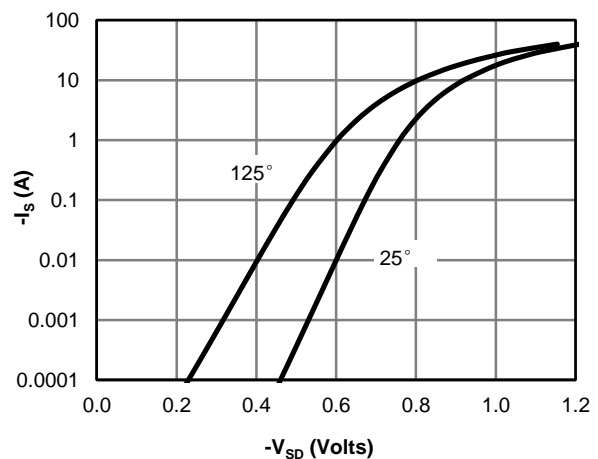
**Figure 14: On-Resistance vs. Drain Current and Gate Voltage**



**Figure 15: On-Resistance vs. Junction Temperature**



**Figure 16: On-Resistance vs. Gate-Source Voltage**



**Figure 17: Body-Diode Characteristics**

**TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS: P-CHANNEL**

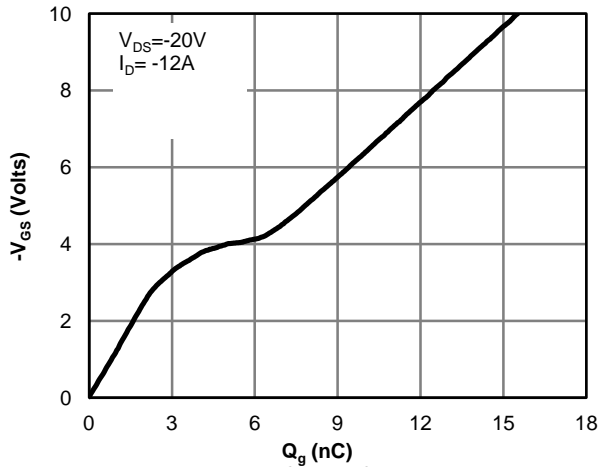


Figure 18: Gate-Charge Characteristics

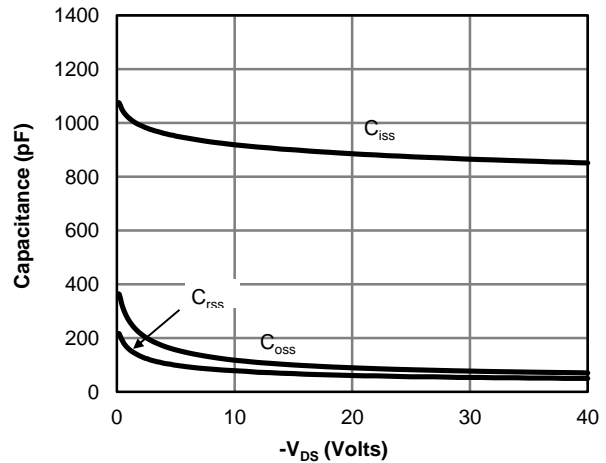


Figure 19: Capacitance Characteristics

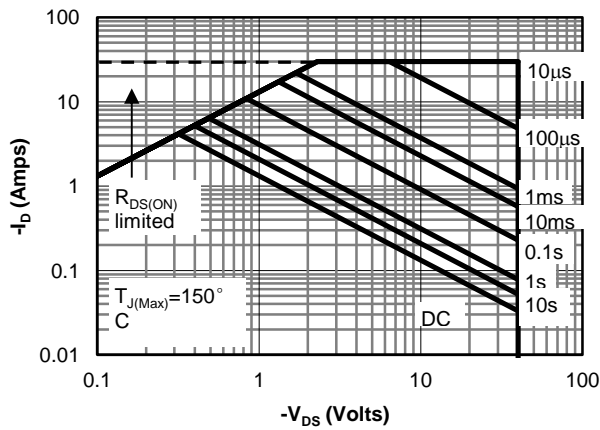


Figure 20: Maximum Forward Biased Safe Operating Area (Note E)

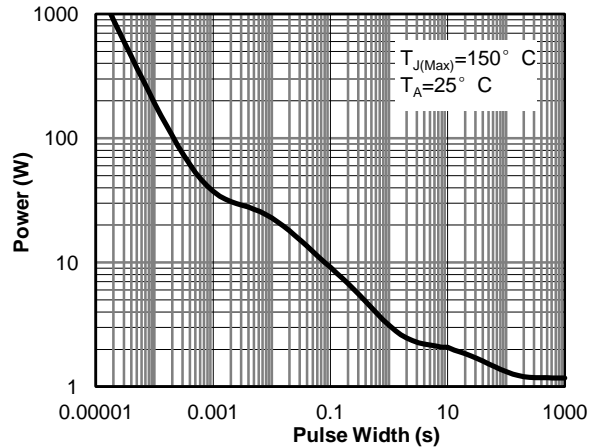


Figure 21: Single Pulse Power Rating Junction-to-Ambient (Note E)

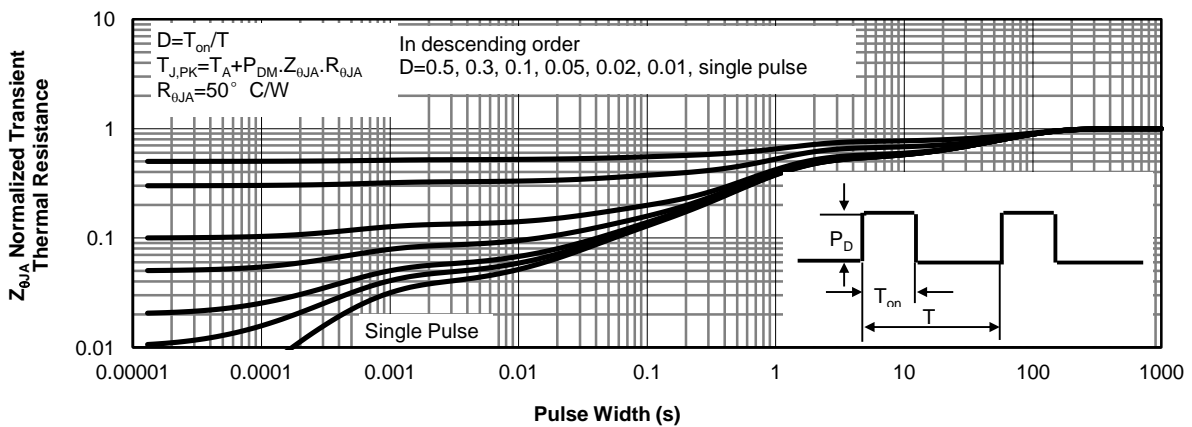
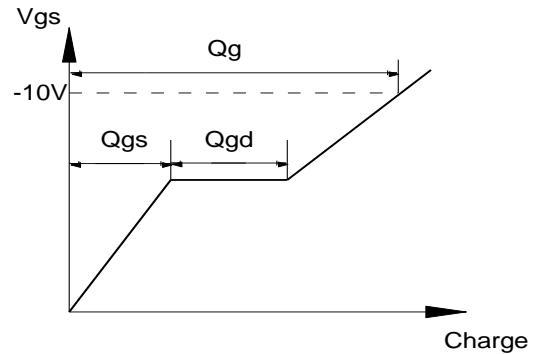
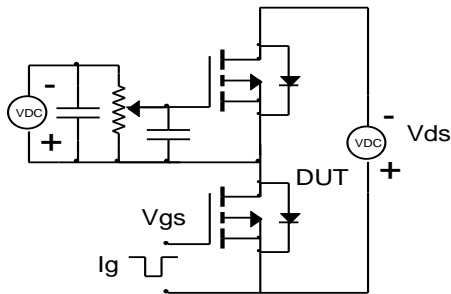
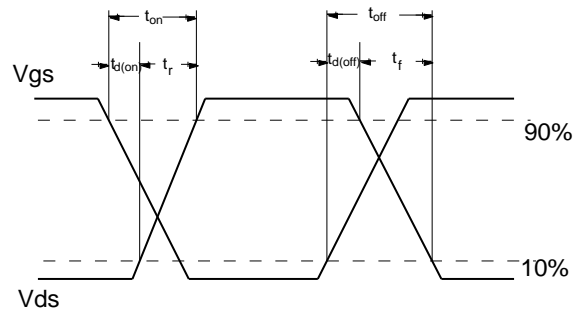
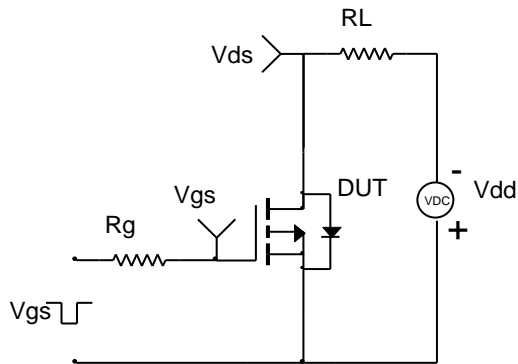


Figure 22: Normalized Maximum Transient Thermal Impedance

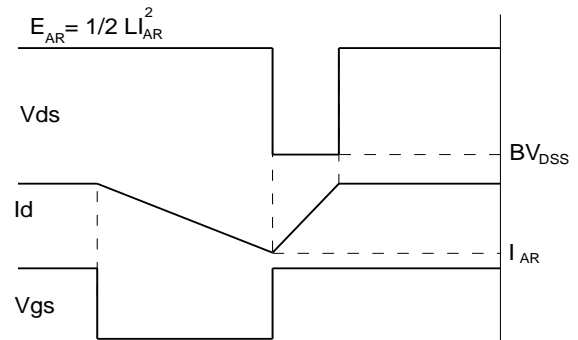
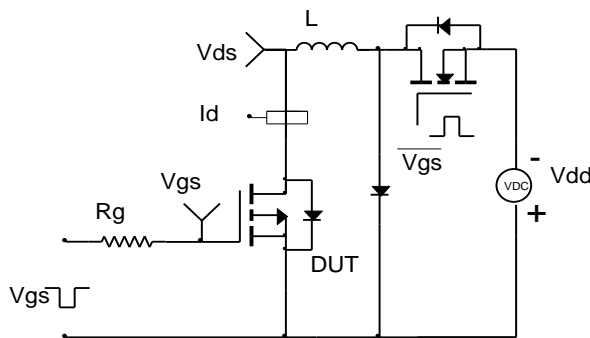
**Gate Charge Test Circuit & Waveform**



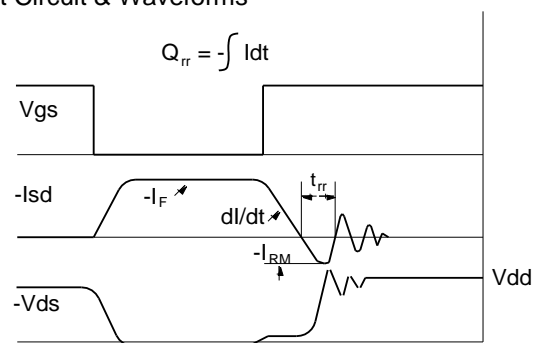
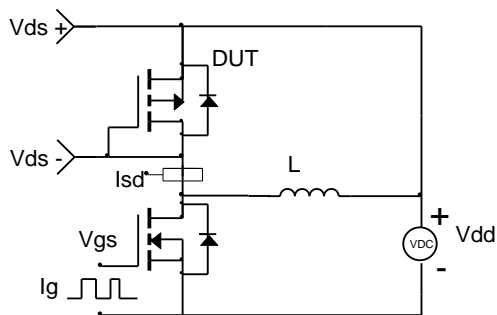
**Resistive Switching Test Circuit & Waveforms**



**Unclamped Inductive Switching (UIS) Test Circuit & Waveforms**

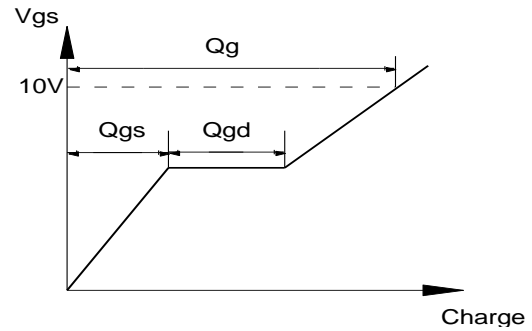
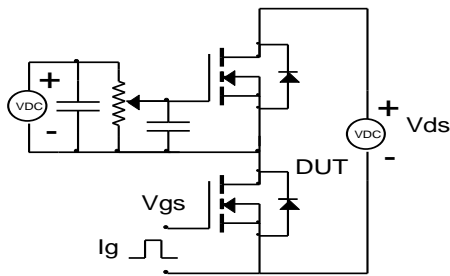


**Diode Recovery Test Circuit & Waveforms**

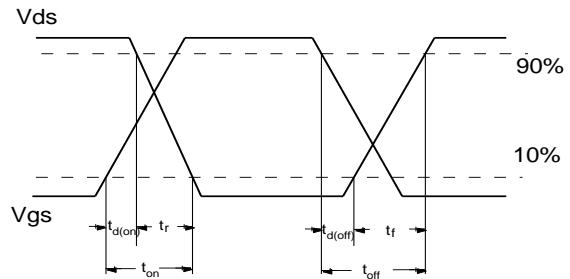
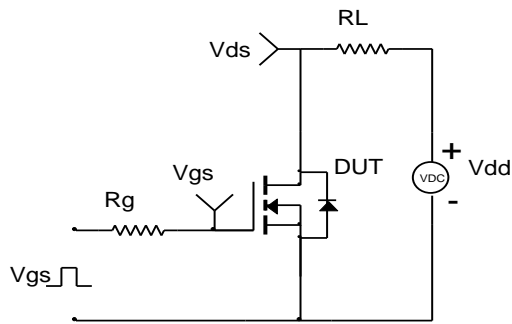




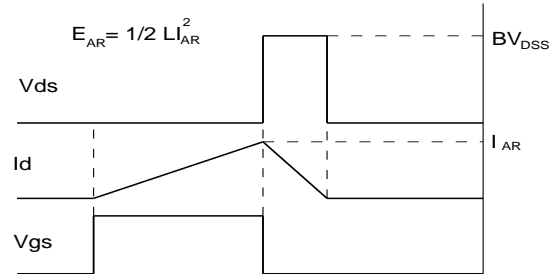
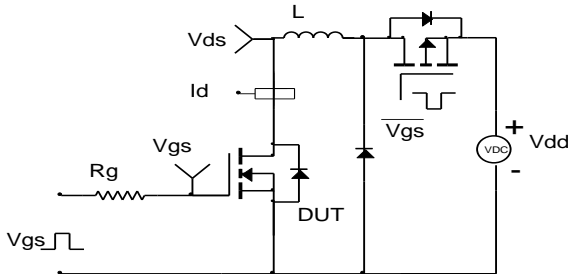
**Gate Charge Test Circuit & Waveform**



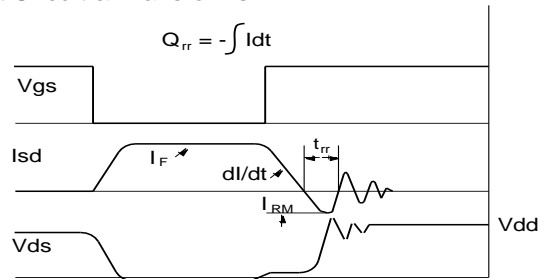
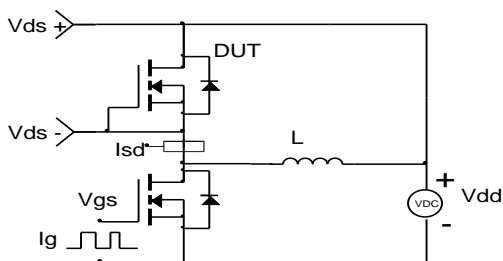
**Resistive Switching Test Circuit & Waveforms**



**Unclamped Inductive Switching (UIS) Test Circuit & Waveforms**



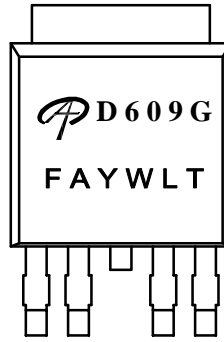
**Diode Recovery Test Circuit & Waveforms**





|              |                             |
|--------------|-----------------------------|
| Document No. | PD-02982                    |
| Version      | A                           |
| Title        | AOD609G Marking Description |

TO252-4L PACKAGE MARKING DESCRIPTION



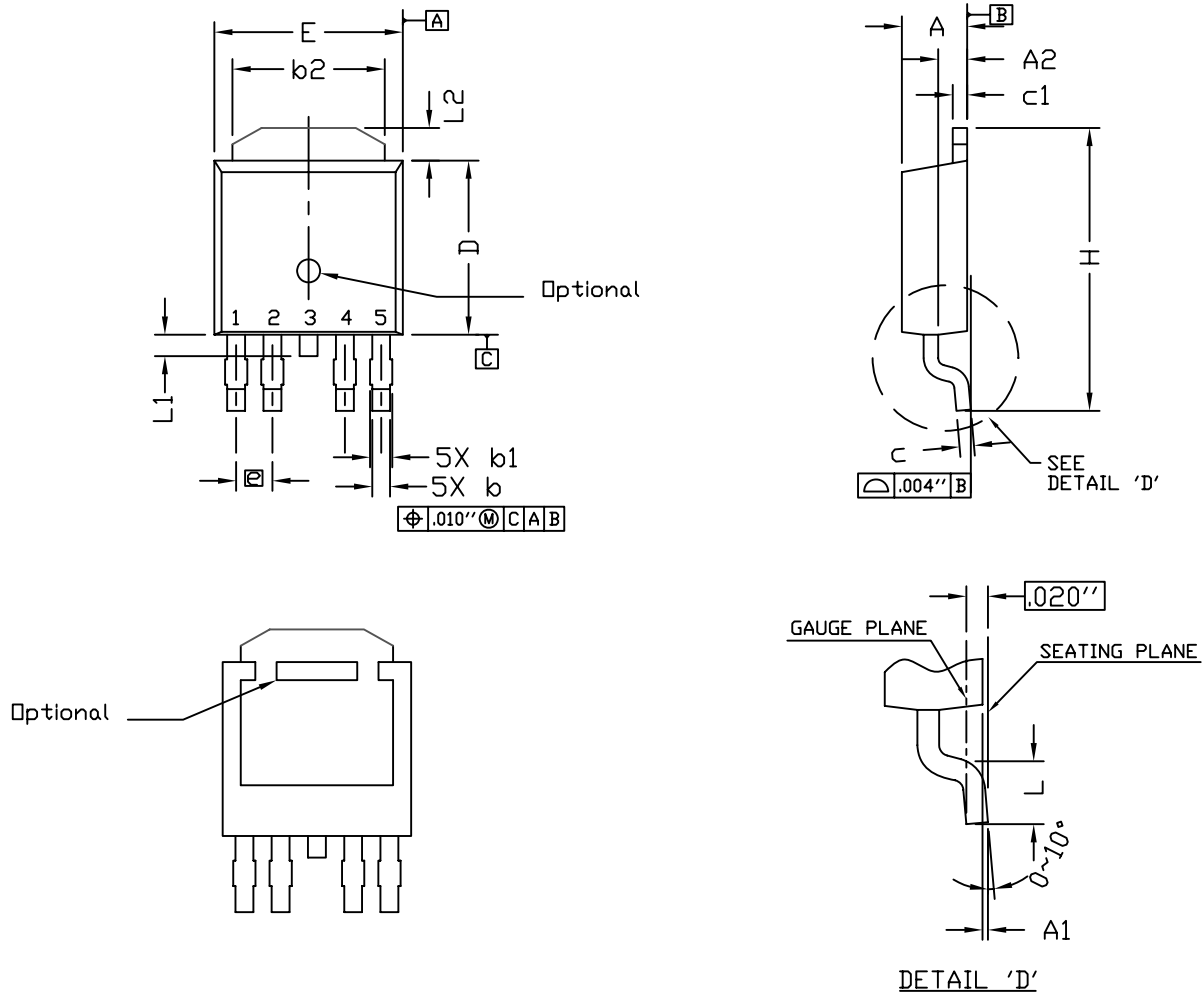
Green product

NOTE:

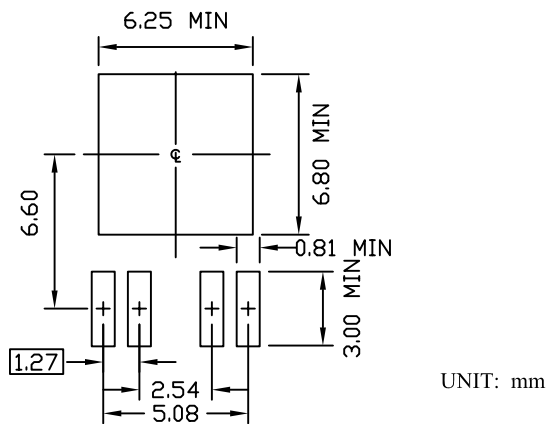
- LOGO - AOS Logo
- D609G - Part number code
- F - Fab code
- A - Assembly location code
- Y - Year code
- W - Week code
- L&T - Assembly lot code

| PART NO. | DESCRIPTION   | CODE  |
|----------|---------------|-------|
| AOD609G  | Green product | D609G |

### TO252\_4L PACKAGE OUTLINE



#### RECOMMENDED LAND PATTERN



UNIT: mm

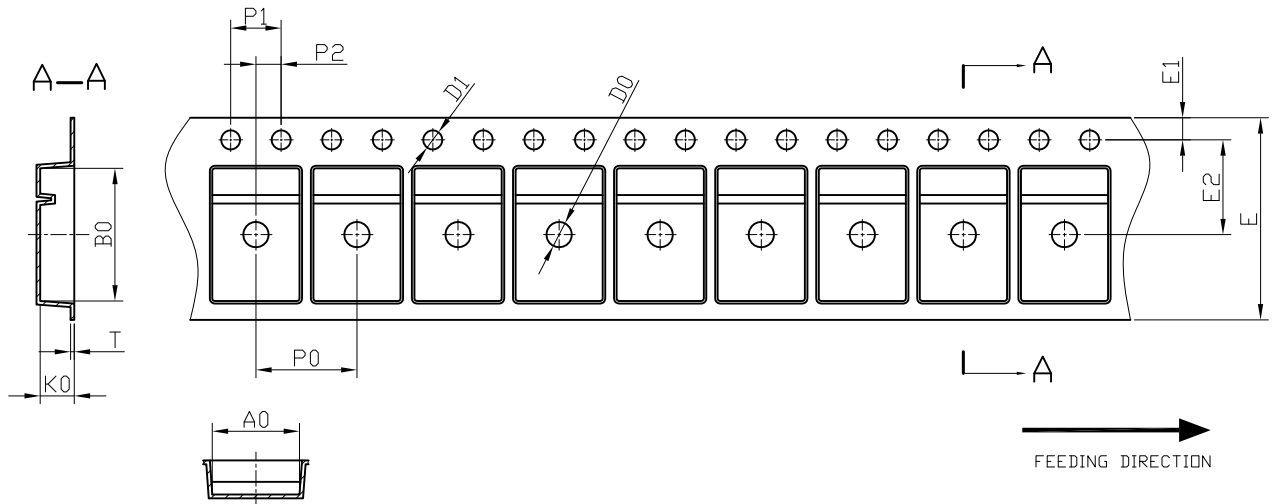
#### NOTE

1. PACKAGE BODY SIZES EXCLUDE MOLD FLASH AND GATE BURRS. MOLD FLASH SHOULD BE LESS THAN 6 MIL.
2. DIMENSION L IS MEASURED IN GAUGE PLANE.
3. TOLERANCE 0.10 mm UNLESS OTHERWISE SPECIFIED.
4. CONTROLLING DIMENSION IS MILLIMETER. CONVERTED INCH DIMENSIONS ARE NOT NECESSARILY EXACT.
5. REFER TO JEDEC TO-252 (AD).

| SYMBOL | DIMENSION IN MILLIMETERS |       |        | DIMENSIONS IN INCHES |       |       |
|--------|--------------------------|-------|--------|----------------------|-------|-------|
|        | MIN.                     | NOM.  | MAX.   | MIN.                 | NOM.  | MAX.  |
| A      | 2.184                    | 2.286 | 2.388  | 0.086                | 0.090 | 0.094 |
| A1     | 0.000                    | ----  | 0.127  | 0.000                | ----  | 0.005 |
| A2     | 0.889                    | ----  | 1.143  | 0.035                | ----  | 0.045 |
| b      | 0.508                    | ----  | 0.711  | 0.020                | ----  | 0.028 |
| b1     | 0.584                    | ----  | 0.787  | 0.023                | ----  | 0.031 |
| b2     | 4.953                    | ----  | 5.461  | 0.195                | ----  | 0.215 |
| c      | 0.457                    | 0.508 | 0.610  | 0.018                | 0.020 | 0.024 |
| c1     | 0.457                    | ----  | 0.610  | 0.018                | ----  | 0.024 |
| D      | 5.969                    | 6.096 | 6.223  | 0.235                | 0.240 | 0.245 |
| E      | 6.350                    | 6.604 | 6.731  | 0.250                | 0.260 | 0.265 |
| e      | 1.270 BSC.               |       |        | 0.050 BSC.           |       |       |
| H      | 9.398                    | ----  | 10.414 | 0.370                | ----  | 0.410 |
| L      | 1.270                    | ----  | 2.032  | 0.050                | ----  | 0.080 |
| L1     | ----                     | ----  | 1.016  | ----                 | ----  | 0.040 |
| L2     | 0.889                    | ----  | 1.270  | 0.035                | ----  | 0.050 |



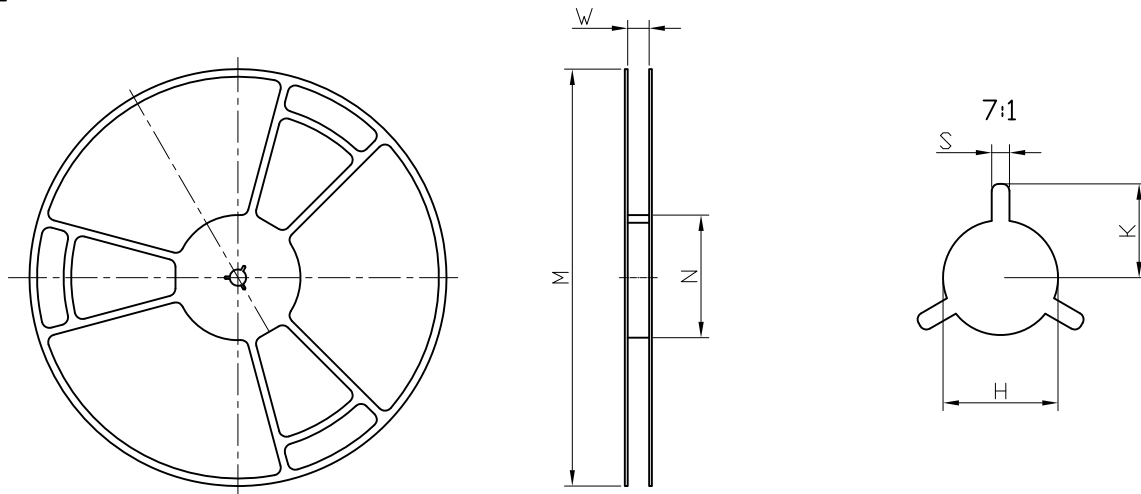
**TO-252-4L**  
**Carrier Tape**



UNIT: MM

| PACKAGE              | A0            | B0             | K0            | D0            | D1                 | E              | E1            | E2            | P0            | P1            | P2            | T             |
|----------------------|---------------|----------------|---------------|---------------|--------------------|----------------|---------------|---------------|---------------|---------------|---------------|---------------|
| TO-252-4L<br>(16 mm) | 6.90<br>±0.10 | 10.50<br>±0.10 | 2.70<br>±0.10 | 2.00<br>±0.25 | 1.50<br>+0.1<br>-0 | 16.00<br>±0.30 | 1.75<br>±0.10 | 7.50<br>±0.10 | 8.00<br>±0.10 | 4.00<br>±0.10 | 2.00<br>±0.10 | 0.30<br>±0.05 |

**TO-252-4L**  
**Reel**



UNIT: MM

| TAPE SIZE | REEL SIZE | M               | N              | W                  | H                        | K             | S           |
|-----------|-----------|-----------------|----------------|--------------------|--------------------------|---------------|-------------|
| 16 mm     | ø330      | ø330.00<br>±0.5 | ø97.00<br>±1.0 | 17.0<br>+1.5<br>-0 | ø13.00<br>+0.50<br>-0.20 | 10.6<br>±0.25 | 2.0<br>±0.5 |

**TO-252-4L Tape**

**Leader / Trailer**  
**& Orientation**

Unit Per Reel:  
2500pcs

