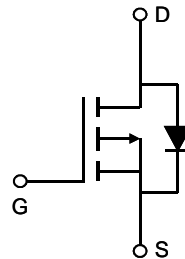
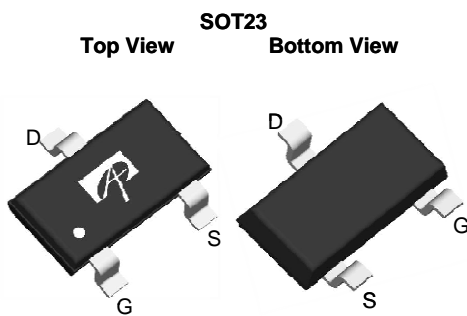


### General Description

The AO3413 uses advanced trench technology to provide excellent  $R_{DS(ON)}$ , low gate charge and operation with gate voltages as low as 1.8V. This device is suitable for use as a load switch or in PWM applications.

### Features

$V_{DS} = -20V$   
 $I_D = -3A$  ( $V_{GS} = -4.5V$ )  
 $R_{DS(ON)} < 80m\Omega$  ( $V_{GS} = -4.5V$ )  
 $R_{DS(ON)} < 100m\Omega$  ( $V_{GS} = -2.5V$ )  
 $R_{DS(ON)} < 130m\Omega$  ( $V_{GS} = -1.8V$ )



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

| Parameter                              | Symbol         | Maximum          | Units      |
|--|----------------|------------------|------------|
| Drain-Source Voltage                   | $V_{DS}$       | -20              | V          |
| Gate-Source Voltage                    | $V_{GS}$       | $\pm 8$          | V          |
| Continuous Drain Current <sup>A</sup>  | $I_D$          | $T_A=25^\circ C$ | -3         |
|  |                | $T_A=70^\circ C$ | -2.4       |
| Pulsed Drain Current <sup>B</sup>      | $I_{DM}$       | -15              | A          |
| Power Dissipation <sup>A</sup>         | $P_D$          | $T_A=25^\circ C$ | 1.4        |
|  |                | $T_A=70^\circ C$ | 0.9        |
| 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 <sup>A</sup> | $R_{\theta JA}$ | 70           | 90  | $^\circ C/W$ |
| Maximum Junction-to-Ambient <sup>A</sup> |                 | Steady-State | 100 | 125          |
| Maximum Junction-to-Lead <sup>C</sup>    | $R_{\theta JL}$ | 63           | 80  | $^\circ C/W$ |

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

| Symbol                      | Parameter                             | Conditions   | Min  | Typ      | Max       | Units |
|-----------------------------|---------------------------------------|--|------|----------|-----------|-------|
| BV <sub>DSS</sub>           | Drain-Source Breakdown Voltage        | I <sub>D</sub> =-250μA, V <sub>GS</sub> =0V  | -20  |          |           | V     |
| I <sub>DSS</sub>            | Zero Gate Voltage Drain Current       | V <sub>DS</sub> =-20V, 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> =±8V  |      |          | ±100      | nA    |
| V <sub>GS(th)</sub>         | Gate Threshold Voltage                | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =-250μA                                    | -0.4 | -0.65    | -1        | V     |
| I <sub>D(ON)</sub>          | On state drain current                | V <sub>GS</sub> =-4.5V, V <sub>DS</sub> =-5V   | -15  |          |           | A     |
| R <sub>DS(ON)</sub>         | Static Drain-Source On-Resistance     | V <sub>GS</sub> =-4.5V, I <sub>D</sub> =-3A<br>T <sub>J</sub> =125°C                         |      | 56<br>80 | 80<br>115 | mΩ    |
|                             |                                       | V <sub>GS</sub> =-2.5V, I <sub>D</sub> =-2.6A  |      | 70       | 100       | mΩ    |
|                             |                                       | V <sub>GS</sub> =-1.8V, I <sub>D</sub> =-1A  |      | 85       | 130       | mΩ    |
| g <sub>FS</sub>             | Forward Transconductance              | V <sub>DS</sub> =-5V, I <sub>D</sub> =-3A  |      | 12       |           | S     |
| V <sub>SD</sub>             | Diode Forward Voltage                 | I <sub>S</sub> =-1A, V <sub>GS</sub> =0V   |      | -0.7     | -1        | V     |
| I <sub>S</sub>              | Maximum Body-Diode Continuous Current |  |      |          | -1.4      | A     |
| <b>DYNAMIC PARAMETERS</b>   |                                       |  |      |          |           |       |
| C <sub>iss</sub>            | Input Capacitance                     | V <sub>GS</sub> =0V, V <sub>DS</sub> =-10V, f=1MHz   |      | 560      | 745       | pF    |
| C <sub>oss</sub>            | Output Capacitance                    |  |      | 80       |           | pF    |
| C <sub>rss</sub>            | Reverse Transfer Capacitance          |  |      | 70       |           | pF    |
| R <sub>g</sub>              | Gate resistance                       | V <sub>GS</sub> =0V, V <sub>DS</sub> =0V, f=1MHz   |      | 15       | 23        | Ω     |
| <b>SWITCHING PARAMETERS</b> |                                       |  |      |          |           |       |
| Q <sub>g</sub>              | Total Gate Charge                     | V <sub>GS</sub> =-4.5V, V <sub>DS</sub> =-10V, I <sub>D</sub> =-3A                           |      | 8.5      | 11        | nC    |
| Q <sub>gs</sub>             | Gate Source Charge                    |  |      | 1.2      |           | nC    |
| Q <sub>gd</sub>             | Gate Drain Charge                     |  |      | 2.1      |           | nC    |
| t <sub>D(on)</sub>          | Turn-On Delay Time                    | V <sub>GS</sub> =-4.5V, V <sub>DS</sub> =-10V, R <sub>L</sub> =3.3Ω,<br>R <sub>GEN</sub> =6Ω |      | 7.2      |           | ns    |
| t <sub>r</sub>              | Turn-On Rise Time                     |  |      | 36       |           | ns    |
| t <sub>D(off)</sub>         | Turn-Off Delay Time                   |  |      | 53       |           | ns    |
| t <sub>f</sub>              | Turn-Off Fall Time                    |  |      | 56       |           | ns    |
| t <sub>rr</sub>             | Body Diode Reverse Recovery Time      | I <sub>F</sub> =-3A, dI/dt=100A/μs   |      | 37       | 49        | ns    |
| Q <sub>rr</sub>             | Body Diode Reverse Recovery Charge    | I <sub>F</sub> =-3A, dI/dt=100A/μs   |      | 27       |           | nC    |

A: The value of R<sub>θJA</sub> 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<sub>A</sub>=25° C. The value in any given application depends on the user's specific board design. The current rating is based on the t ≤ 10s thermal resistance rating.

B: Repetitive rating, pulse width limited by junction temperature.

C: The R<sub>θJA</sub> is the sum of the thermal impedance from junction to lead R<sub>θJL</sub> and lead to ambient.

D: The static characteristics in Figures 1 to 6 are obtained using 300μs pulse width, duty cycle 0.5% max.

E: 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. The SOA curve provides a single pulse rating.

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TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

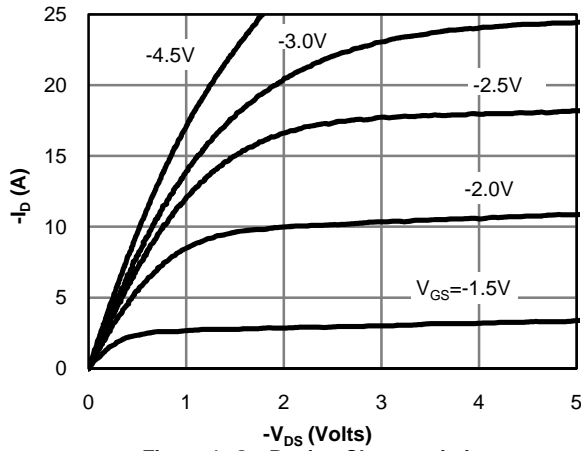


Figure 1: On-Region Characteristics

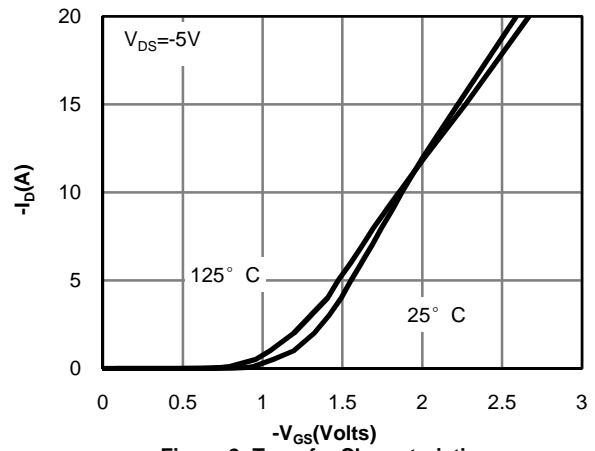


Figure 2: Transfer Characteristics

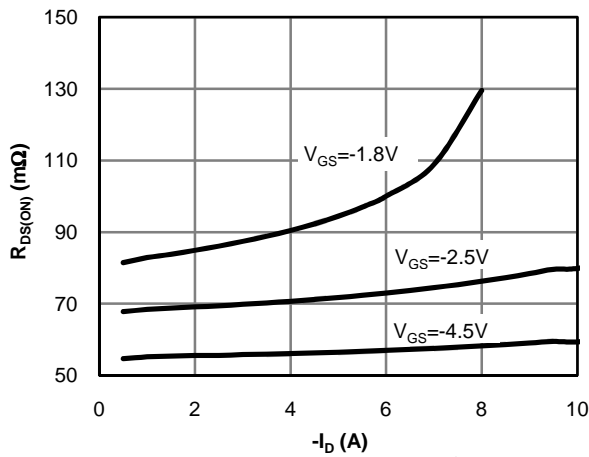


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

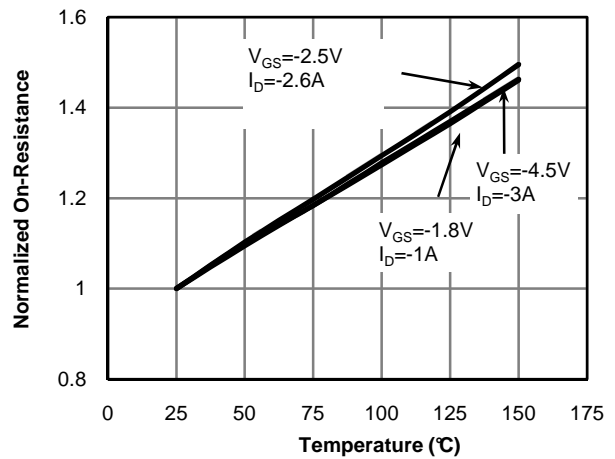


Figure 4: On-Resistance vs. Junction Temperature

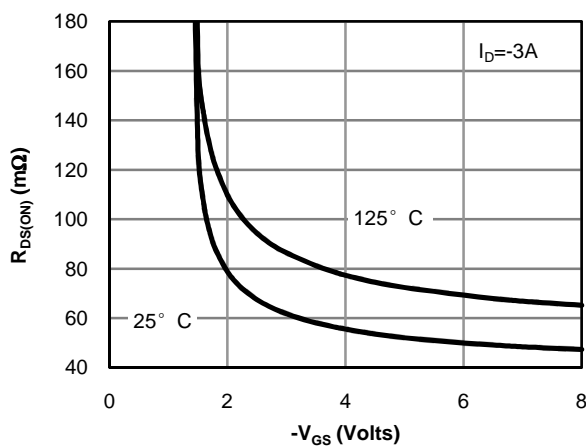


Figure 5: On-Resistance vs. Gate-Source Voltage

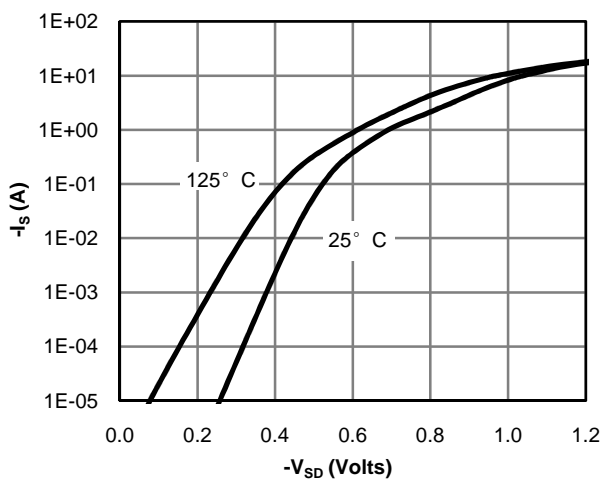


Figure 6: Body-Diode Characteristics



**TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS**

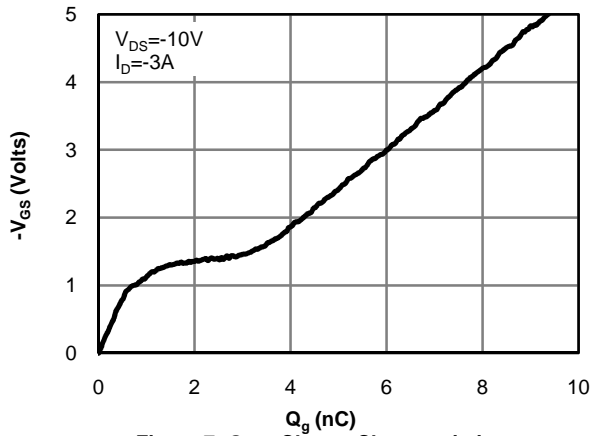


Figure 7: Gate-Charge Characteristics

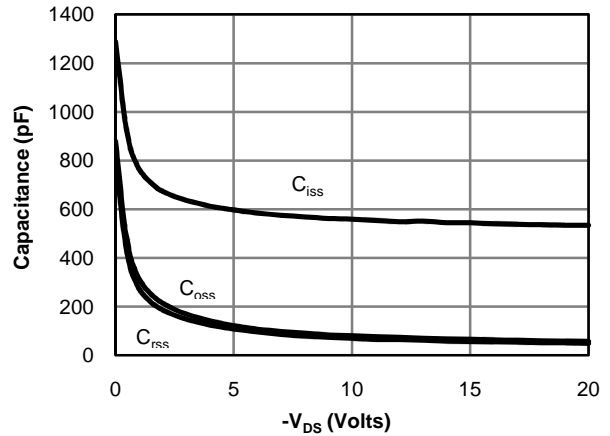


Figure 8: Capacitance Characteristics

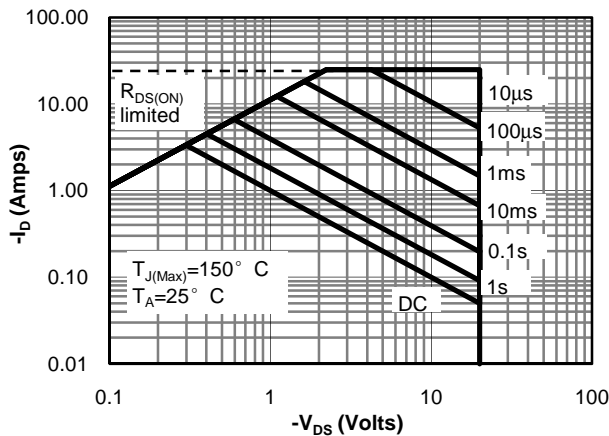


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

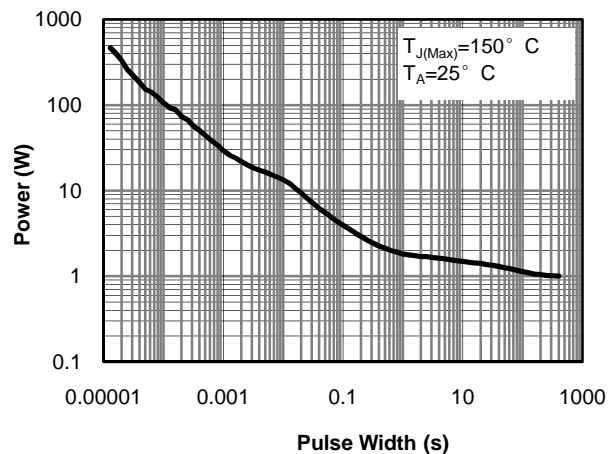


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

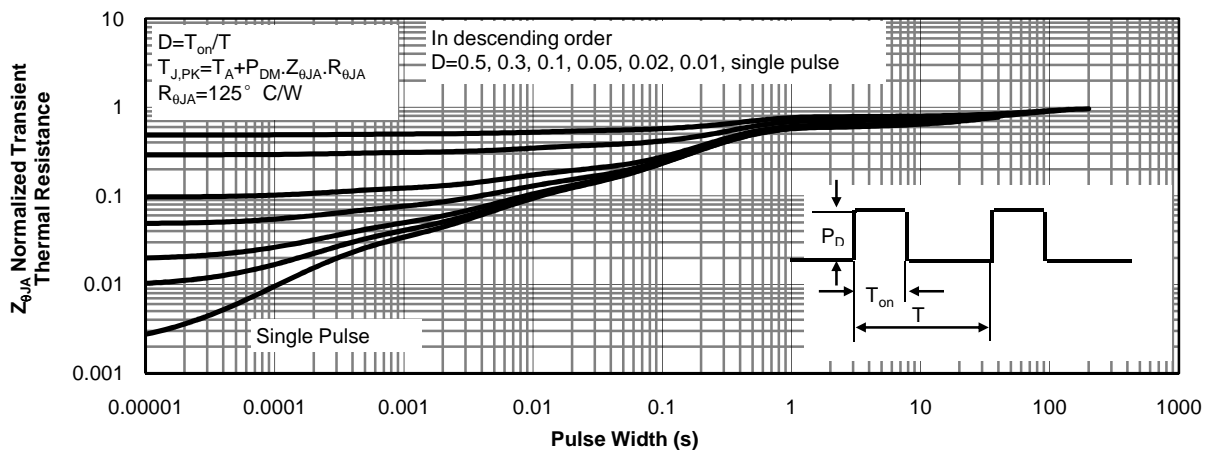
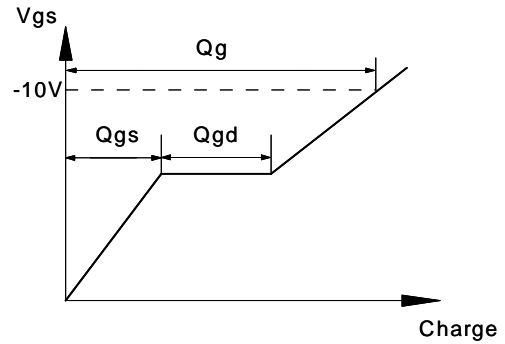
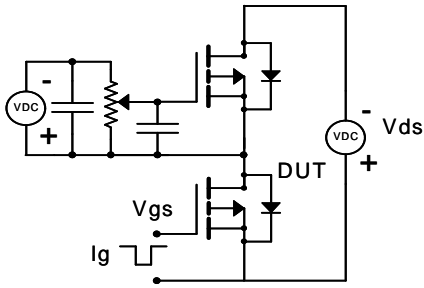
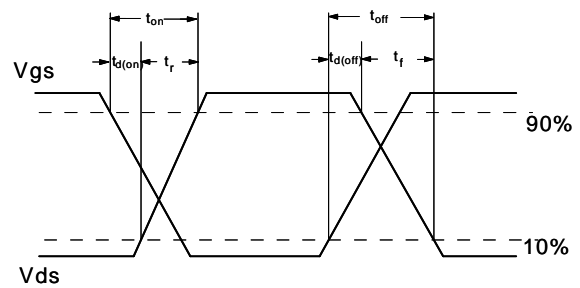
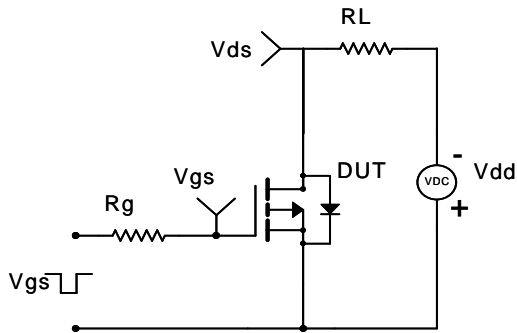


Figure 11: Normalized Maximum Transient Thermal Impedance (Note E)

Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms

