

**AO5404E**
**N-Channel Enhancement Mode Field Effect Transistor**
**General Description**

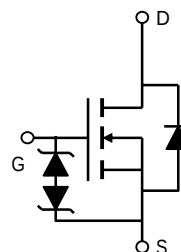
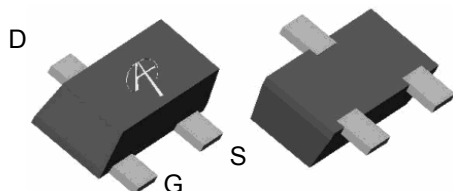
The AO5404E/L uses advanced trench technology to provide excellent  $R_{DS(ON)}$ , low gate charge and operation with gate voltages as low as 1.8V. This device is suitable for use as a load switch or in PWM applications. AO5404E and AO5404EL are electrically identical.

- RoHS compliant
- AO5404EL is Halogen Free

**Features**

$V_{DS} (V) = 20V$   
 $I_D = 0.5 A (V_{GS} = 4.5V)$   
 $R_{DS(ON)} < 0.55 \Omega (V_{GS} = 4.5V)$   
 $R_{DS(ON)} < 0.68 \Omega (V_{GS} = 2.5V)$   
 $R_{DS(ON)} < 0.80 \Omega (V_{GS} = 1.8V)$

**ESD PROTECTED!**

**SC89-3L**

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

| Parameter                                | Symbol           | 10 Sec     | Steady State | Units      |
|------------------------------------------|------------------|------------|--------------|------------|
| Drain-Source Voltage                     | $V_{DS}$         | 20         |              | V          |
| Gate-Source Voltage                      | $V_{GS}$         | $\pm 8$    |              | V          |
| Continuous Drain Current <sup>A, F</sup> | $T_A=25^\circ C$ | 0.5        | 0.5          | A          |
|                                          | $T_A=70^\circ C$ | 0.5        | 0.45         |            |
| Pulsed Drain Current <sup>B</sup>        | $I_{DM}$         | 3          |              |            |
| Power Dissipation <sup>A</sup>           | $T_A=25^\circ C$ | 0.38       | 0.28         | W          |
|                                          | $T_A=70^\circ C$ | 0.24       | 0.18         |            |
| 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> | $R_{\theta JA}$ | 275 | 330 | $^\circ C/W$ |
| Maximum Junction-to-Ambient <sup>A</sup> |                 | 360 | 450 | $^\circ C/W$ |
| Maximum Junction-to-Lead <sup>C</sup>    | $R_{\theta JL}$ | 300 | 350 | $^\circ C/W$ |

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

| Symbol               | Parameter                             | Conditions                                                                                                                                                         | Min  | Typ                            | Max                         | Units       |
|----------------------|---------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------------------------------|-----------------------------|-------------|
| STATIC PARAMETERS    |                                       |                                                                                                                                                                    |      |                                |                             |             |
| 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> =±4.5V<br>V <sub>DS</sub> =0V, V <sub>GS</sub> =±8V                                                                           |      |                                | ±1<br>±100                  | μA<br>μA    |
| V <sub>GS(th)</sub>  | Gate Threshold Voltage                | V <sub>DS</sub> =V <sub>GS</sub> I <sub>D</sub> =250μA                                                                                                             | 0.45 | 0.6                            | 1                           | V           |
| I <sub>D(ON)</sub>   | On state drain current                | V <sub>GS</sub> =4.5V, V <sub>DS</sub> =5V                                                                                                                         | 3    |                                |                             | A           |
| R <sub>DS(ON)</sub>  | Static Drain-Source On-Resistance     | V <sub>GS</sub> =4.5V, I <sub>D</sub> =0.5A<br>T <sub>J</sub> =125°C<br>V <sub>GS</sub> =2.5V, I <sub>D</sub> =0.5A<br>V <sub>GS</sub> =1.8V, I <sub>D</sub> =0.3A |      | 0.395<br>0.6<br>0.479<br>0.578 | 0.55<br>0.85<br>0.68<br>0.8 | Ω<br>Ω<br>Ω |
| g <sub>FS</sub>      | Forward Transconductance              | V <sub>DS</sub> =5V, I <sub>D</sub> =0.5A                                                                                                                          |      | 1.5                            |                             | S           |
| V <sub>SD</sub>      | Diode Forward Voltage                 | I <sub>S</sub> =0.1A,V <sub>GS</sub> =0V                                                                                                                           |      | 0.65                           | 1                           | V           |
| I <sub>S</sub>       | Maximum Body-Diode Continuous Current |                                                                                                                                                                    |      |                                | 0.4                         | A           |
| DYNAMIC PARAMETERS   |                                       |                                                                                                                                                                    |      |                                |                             |             |
| C <sub>iSS</sub>     | Input Capacitance                     | V <sub>GS</sub> =0V, V <sub>DS</sub> =10V, f=1MHz                                                                                                                  |      | 35                             | 45                          | pF          |
| C <sub>oSS</sub>     | Output Capacitance                    |                                                                                                                                                                    |      | 8                              |                             | pF          |
| C <sub>rSS</sub>     | Reverse Transfer Capacitance          |                                                                                                                                                                    |      | 6                              |                             | pF          |
| SWITCHING PARAMETERS |                                       |                                                                                                                                                                    |      |                                |                             |             |
| Q <sub>g</sub>       | Total Gate Charge                     | V <sub>GS</sub> =4.5V, V <sub>DS</sub> =10V, I <sub>D</sub> =0.5A                                                                                                  |      | 0.63                           | 1                           | nC          |
| Q <sub>gs</sub>      | Gate Source Charge                    |                                                                                                                                                                    |      | 0.08                           |                             | nC          |
| Q <sub>gd</sub>      | Gate Drain Charge                     |                                                                                                                                                                    |      | 0.16                           |                             | nC          |
| t <sub>D(on)</sub>   | Turn-On DelayTime                     | V <sub>GS</sub> =5V, V <sub>DS</sub> =10V, R <sub>L</sub> =50Ω,<br>R <sub>GEN</sub> =3Ω                                                                            |      | 4.5                            |                             | ns          |
| t <sub>r</sub>       | Turn-On Rise Time                     |                                                                                                                                                                    |      | 3.3                            |                             | ns          |
| t <sub>D(off)</sub>  | Turn-Off DelayTime                    |                                                                                                                                                                    |      | 78                             |                             | ns          |
| t <sub>f</sub>       | Turn-Off Fall Time                    |                                                                                                                                                                    |      | 32                             |                             | ns          |
| t <sub>rr</sub>      | Body Diode Reverse Recovery Time      | I <sub>F</sub> =0.5A, dI/dt=100A/μs                                                                                                                                |      | 8                              | 10                          | ns          |
| Q <sub>rr</sub>      | Body Diode Reverse Recovery Charge    | I <sub>F</sub> =0.5A, dI/dt=100A/μs                                                                                                                                |      | 2                              |                             | 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 6,12,14 are obtained using <300 μs pulses, 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.

F: The maximum current rating is limited by bond-wires

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## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

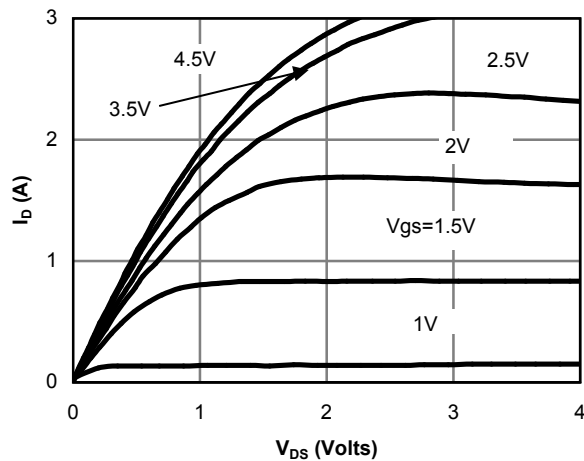


Figure 1: On-Region Characteristics

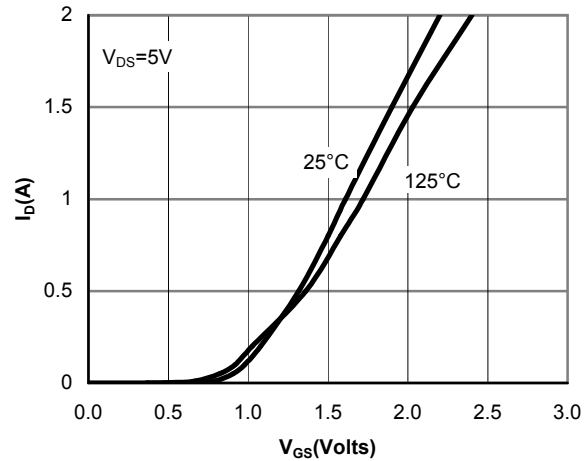


Figure 2: Transfer Characteristics

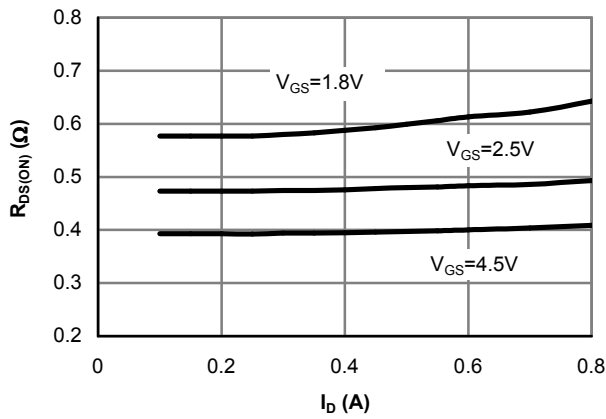


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

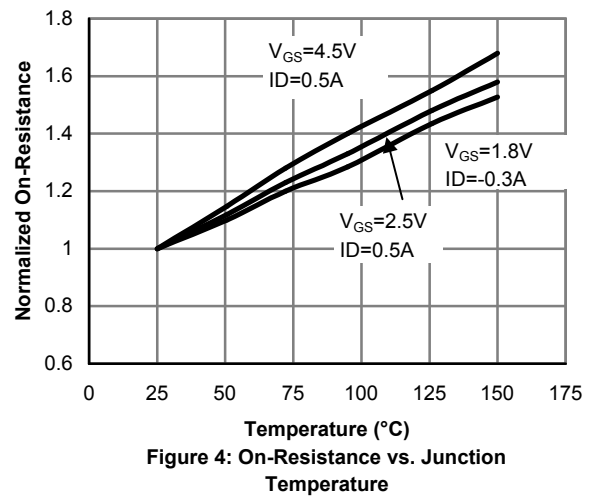


Figure 4: On-Resistance vs. Junction Temperature

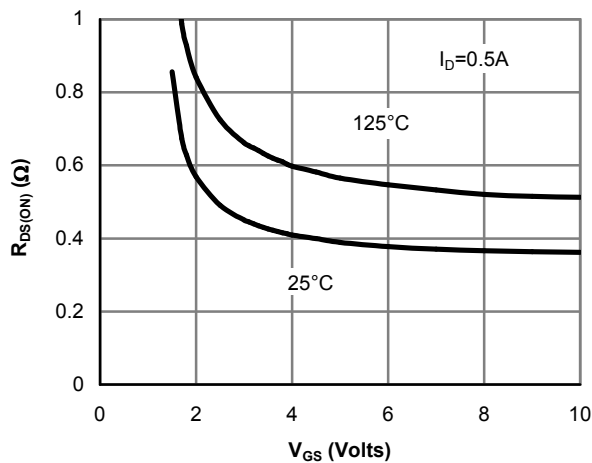


Figure 5: On-Resistance vs. Gate-Source Voltage

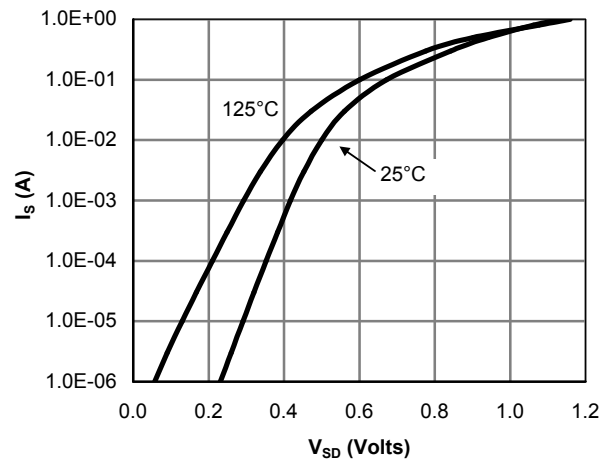


Figure 6: Body-Diode Characteristics

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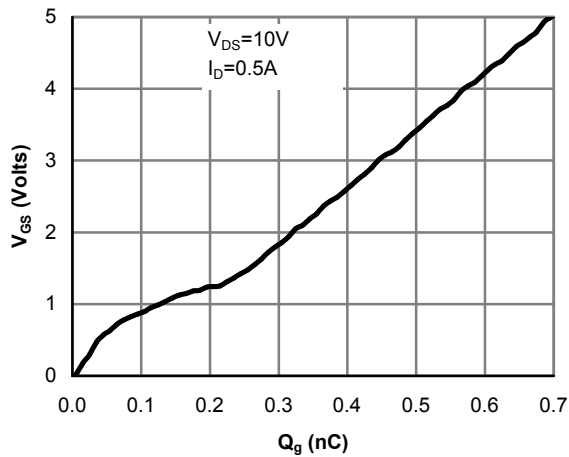


Figure 7: Gate-Charge Characteristics

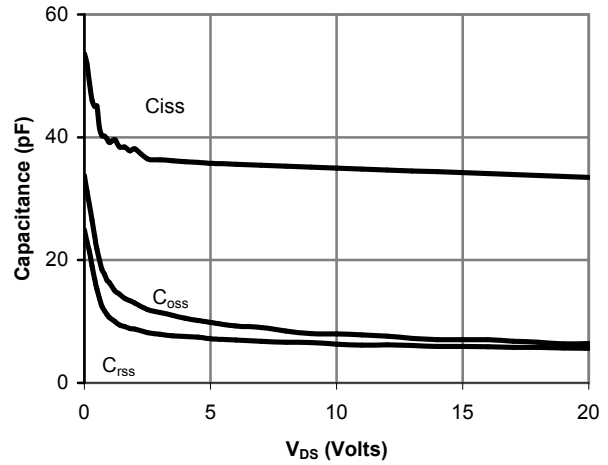


Figure 8: Capacitance Characteristics

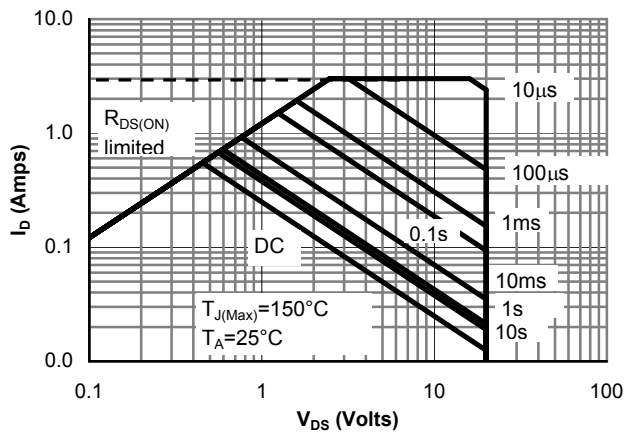


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

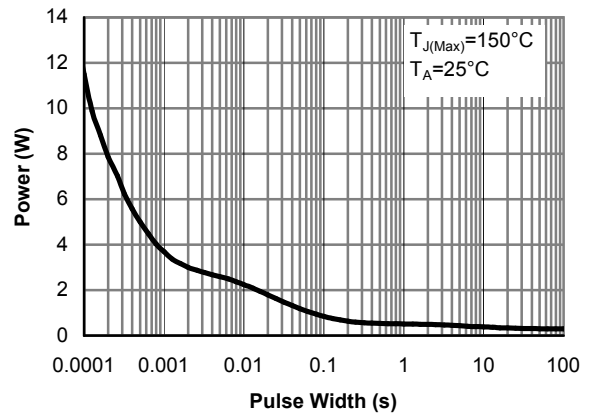


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

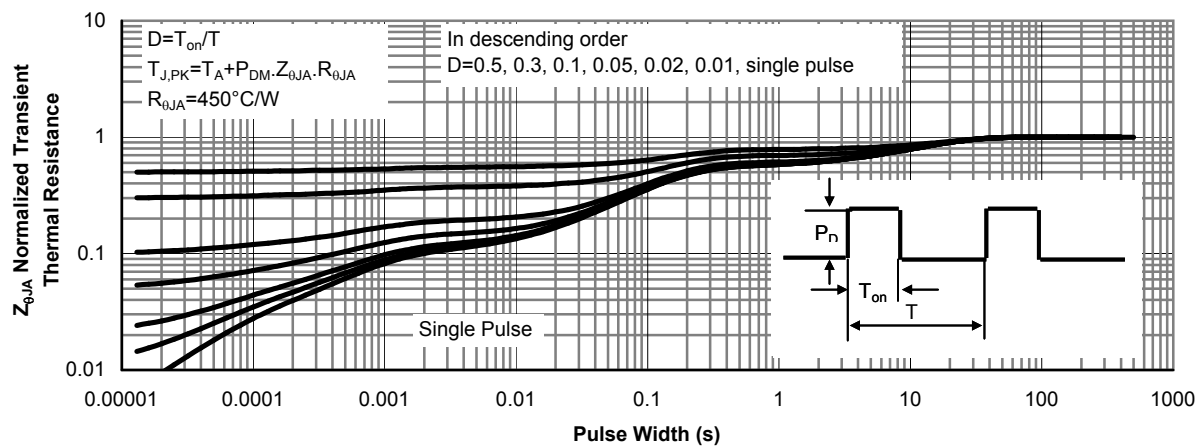
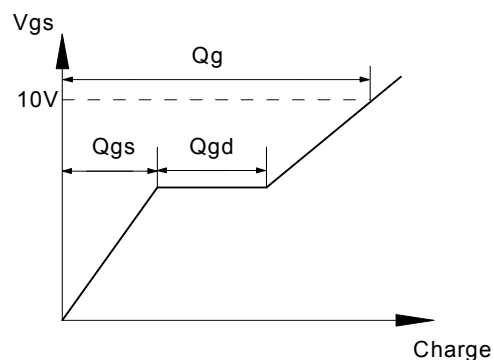
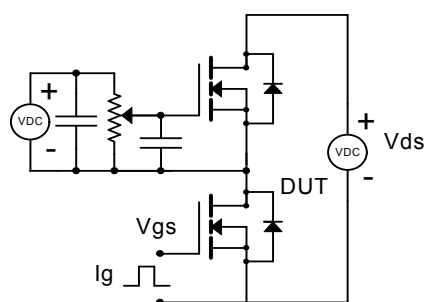
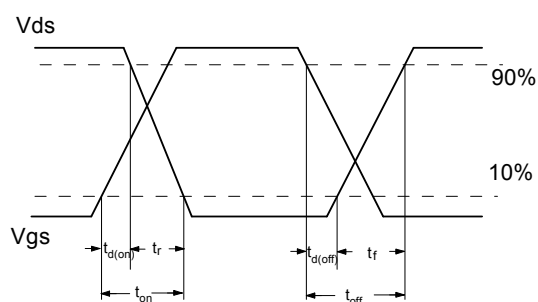
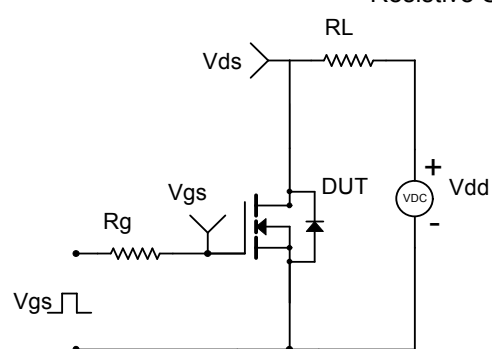


Figure 11: Normalized Maximum Transient Thermal Impedance

Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms

