**AOD2610E/AOI2610E/AOY2610E**  
**60V N-Channel AlphaSGT™**

### General Description
- Trench Power AlphaSGT™ technology
- Low $R_{DSON}$
- Low Gate Charge
- Low Eoss
- ESD protected
- RoHS and Halogen-Free Compliant

### Applications
- High efficiency power supply
- Secondary synchronous rectifier

### Product Summary
- $V_{DS}$  60V
- $I_D$ (at $V_{GS}=10V$)  46A
- $R_{DSON}$ (at $V_{GS}=10V$)  $< 9.5mΩ$
- $R_{DSON}$ (at $V_{GS}=4.5V$)  $< 13.3mΩ$

### Typical ESD protection
- HBM Class 2
- 100% UIS Tested
- 100% Rg Tested

### Applications
- High efficiency power supply
- Secondary synchronous rectifier

### Absolute Maximum Ratings  $T_A=25°C$ unless otherwise noted

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Maximum</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain-Source Voltage</td>
<td>$V_{DS}$</td>
<td>60</td>
<td>V</td>
</tr>
<tr>
<td>Gate-Source Voltage</td>
<td>$V_{GS}$</td>
<td>±20</td>
<td>V</td>
</tr>
<tr>
<td>Continuous Drain Current a</td>
<td>$I_D$</td>
<td>46</td>
<td>A</td>
</tr>
<tr>
<td>$T_A=25°C$, $T_C=100°C$</td>
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<td></td>
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<tr>
<td>Pulsed Drain Current c</td>
<td>$I_{DM}$</td>
<td>110</td>
<td>A</td>
</tr>
<tr>
<td>Continuous Drain Current a</td>
<td>$I_{DSSM}$</td>
<td>19</td>
<td>A</td>
</tr>
<tr>
<td>$T_A=25°C$, $T_C=70°C$</td>
<td></td>
<td></td>
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<tr>
<td>Avalanche Current c</td>
<td>$I_{AS}$</td>
<td>17</td>
<td>A</td>
</tr>
<tr>
<td>Avalanche energy</td>
<td>$E_{AB}$</td>
<td>43</td>
<td>mJ</td>
</tr>
<tr>
<td>$V_{DS}$ Spike</td>
<td>$V_{SPIKE}$</td>
<td>10µs</td>
<td>V</td>
</tr>
<tr>
<td>Power Dissipation b</td>
<td>$P_D$</td>
<td>59.5</td>
<td>W</td>
</tr>
<tr>
<td>$T_A=25°C$, $T_C=100°C$</td>
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<td></td>
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<tr>
<td>Power Dissipation a</td>
<td>$P_{DSSM}$</td>
<td>6.2</td>
<td>W</td>
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<tr>
<td>$T_A=25°C$, $T_C=70°C$</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Junction and Storage Temperature Range</td>
<td>$T_J$, $T_{STG}$</td>
<td>-55 to 150</td>
<td>°C</td>
</tr>
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</table>

### Thermal Characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>Maximum Junction-to-Ambient a</td>
<td>$R_{UA}$</td>
<td>15</td>
<td>20</td>
<td>°C/W</td>
</tr>
<tr>
<td>Maximum Junction-to-Case a</td>
<td>$R_{UJC}$</td>
<td>1.7</td>
<td>2.1</td>
<td>°C/W</td>
</tr>
<tr>
<td>Maximum Junction-to-Ambient b Steady-State</td>
<td></td>
<td>40</td>
<td>50</td>
<td>°C/W</td>
</tr>
<tr>
<td>Maximum Junction-to-Case Steady-State</td>
<td></td>
<td>40</td>
<td>50</td>
<td>°C/W</td>
</tr>
</tbody>
</table>
### Electrical Characteristics (T<sub>J</sub>=25°C unless otherwise noted)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
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<tbody>
<tr>
<td><strong>STATIC PARAMETERS</strong></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>BV&lt;sub&gt;DSS&lt;/sub&gt;</td>
<td>Drain-Source Breakdown Voltage</td>
<td>I&lt;sub&gt;P&lt;/sub&gt;=250μA, V&lt;sub&gt;GS&lt;/sub&gt;=0V</td>
<td>60</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>IDS</td>
<td>Zero Gate Voltage Drain Current</td>
<td>V&lt;sub&gt;DS&lt;/sub&gt;=60V, V&lt;sub&gt;GS&lt;/sub&gt;=0V</td>
<td></td>
<td>1</td>
<td></td>
<td>μA</td>
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<tr>
<td>IDSS</td>
<td>Gate-Body leakage current</td>
<td>V&lt;sub&gt;DS&lt;/sub&gt;=0V, V&lt;sub&gt;GS&lt;/sub&gt;±20V</td>
<td></td>
<td>±10</td>
<td></td>
<td>μA</td>
</tr>
<tr>
<td>VGS(th)</td>
<td>Gate Threshold Voltage</td>
<td>V&lt;sub&gt;DS&lt;/sub&gt;=V&lt;sub&gt;GS&lt;/sub&gt;, I&lt;sub&gt;D&lt;/sub&gt;=250μA</td>
<td>1.4</td>
<td>1.8</td>
<td>2.4</td>
<td>V</td>
</tr>
<tr>
<td>RDS(ON)</td>
<td>Static Drain-Source On-Resistance</td>
<td>V&lt;sub&gt;GS&lt;/sub&gt;=10V, I&lt;sub&gt;D&lt;/sub&gt;=20A</td>
<td></td>
<td>7.7</td>
<td>9.5</td>
<td>mΩ</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V&lt;sub&gt;GS&lt;/sub&gt;=4.5V, I&lt;sub&gt;D&lt;/sub&gt;=20A</td>
<td></td>
<td>12.5</td>
<td>15.5</td>
<td>mΩ</td>
</tr>
<tr>
<td>gFS</td>
<td>Forward Transconductance</td>
<td>V&lt;sub&gt;DS&lt;/sub&gt;=5V, I&lt;sub&gt;D&lt;/sub&gt;=20A</td>
<td></td>
<td>52</td>
<td></td>
<td>S</td>
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<tr>
<td>VSD</td>
<td>Diode Forward Voltage</td>
<td>I&lt;sub&gt;DS&lt;/sub&gt;=1A, V&lt;sub&gt;GS&lt;/sub&gt;=0V</td>
<td></td>
<td>0.72</td>
<td>1</td>
<td>V</td>
</tr>
<tr>
<td>IS</td>
<td>Maximum Body-Diode Continuous Current</td>
<td></td>
<td></td>
<td>46</td>
<td></td>
<td>A</td>
</tr>
<tr>
<td></td>
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<td><strong>DYNAMIC PARAMETERS</strong></td>
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<td></td>
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<tr>
<td>Ciss</td>
<td>Input Capacitance</td>
<td>V&lt;sub&gt;GS&lt;/sub&gt;=0V, V&lt;sub&gt;DS&lt;/sub&gt;=30V, f=1MHz</td>
<td></td>
<td>1100</td>
<td></td>
<td>pF</td>
</tr>
<tr>
<td>COSS</td>
<td>Output Capacitance</td>
<td></td>
<td></td>
<td>300</td>
<td></td>
<td>pF</td>
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<tr>
<td>CGS</td>
<td>Reverse Transfer Capacitance</td>
<td></td>
<td></td>
<td>28</td>
<td></td>
<td>pF</td>
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<tr>
<td>R&lt;sub&gt;g&lt;/sub&gt;</td>
<td>Gate resistance</td>
<td>f=1MHz</td>
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<td>0.6</td>
<td>1.2</td>
<td>2.0</td>
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<tr>
<td><strong>SWITCHING PARAMETERS</strong></td>
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<tr>
<td>Qg(10V)</td>
<td>Total Gate Charge</td>
<td>V&lt;sub&gt;GS&lt;/sub&gt;=10V, V&lt;sub&gt;DS&lt;/sub&gt;=30V, I&lt;sub&gt;D&lt;/sub&gt;=20A</td>
<td></td>
<td>14.5</td>
<td>25</td>
<td>nC</td>
</tr>
<tr>
<td>Qg(4.5V)</td>
<td>Total Gate Charge</td>
<td>V&lt;sub&gt;GS&lt;/sub&gt;=10V, V&lt;sub&gt;DS&lt;/sub&gt;=30V, I&lt;sub&gt;D&lt;/sub&gt;=20A</td>
<td></td>
<td>7</td>
<td>13</td>
<td>nC</td>
</tr>
<tr>
<td>QGD</td>
<td>Gate Source Charge</td>
<td></td>
<td></td>
<td>2.5</td>
<td></td>
<td>nC</td>
</tr>
<tr>
<td>QGD</td>
<td>Gate Drain Charge</td>
<td></td>
<td></td>
<td>3.5</td>
<td></td>
<td>nC</td>
</tr>
<tr>
<td>t&lt;sub&gt;Q门槛&lt;/sub&gt;</td>
<td>Turn-On DelayTime</td>
<td></td>
<td></td>
<td>6.5</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>t&lt;sub&gt;QUT&lt;/sub&gt;</td>
<td>Turn-On Rise Time</td>
<td>V&lt;sub&gt;GS&lt;/sub&gt;=10V, V&lt;sub&gt;DS&lt;/sub&gt;=30V, R&lt;sub&gt;L&lt;/sub&gt;=1.5Ω</td>
<td></td>
<td>3.5</td>
<td></td>
<td>ns</td>
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<tr>
<td>t&lt;sub&gt;QDAT&lt;/sub&gt;</td>
<td>Turn-Off DelayTime</td>
<td>R&lt;sub&gt;GEN&lt;/sub&gt;=3Ω</td>
<td></td>
<td>22</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>t&lt;sub&gt;f&lt;/sub&gt;</td>
<td>Turn-Off Fall Time</td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>t&lt;sub&gt;QR&lt;/sub&gt;</td>
<td>Body Diode Reverse Recovery Time</td>
<td>I&lt;sub&gt;DS&lt;/sub&gt;=20A, di/dt=500A/μs</td>
<td></td>
<td>19</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Qf&lt;sub&gt;RR&lt;/sub&gt;</td>
<td>Body Diode Reverse Recovery Charge</td>
<td>I&lt;sub&gt;DS&lt;/sub&gt;=20A, di/dt=500A/μs</td>
<td></td>
<td>65</td>
<td></td>
<td>nC</td>
</tr>
</tbody>
</table>

A. The value of R<sub>qJA</sub> is measured with the device mounted on 1in<sup>2</sup> FR-4 board with 2oz. Copper, in a still air environment with T<sub>A</sub>=25°C. The Power dissipation P<sub>DSM</sub> is based on R<sub>qJA</sub> t≤ 10s and the maximum allowed junction temperature of 150°C. The value in any given application depends on the user's specific board design.

B. The power dissipation P<sub>D</sub> is based on T<sub>J(MAX)</sub>=150°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. Single pulse width limited by junction temperature T<sub>J(MAX)</sub>=150°C.

D. The maximum current rating is package limited.

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<sub>A</sub>=25°C.

I. The spike duty cycle 5% max, limited by junction temperature T<sub>J(MAX)</sub>=125°C.

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TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

Figure 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)
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 F)

Figure 11: Normalized Maximum Transient Thermal Impedance (Note F)
TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

Figure 12: Power De-rating (Note F)

Figure 13: Current De-rating (Note F)

Figure 14: Single Pulse Power Rating Junction-to-Ambient (Note H)

Figure 15: Normalized Maximum Transient Thermal Impedance (Note H)
Figure A: Gate Charge Test Circuit & Waveforms

Figure B: Resistive Switching Test Circuit & Waveforms

Figure C: Unclamped Inductive Switching (UIS) Test Circuit & Waveforms

Figure D: Diode Recovery Test Circuit & Waveforms