



**ALPHA & OMEGA**  
SEMICONDUCTOR, LTD.

Rev 3:Nov 2004

## AO6402, AO6402L ( Green Product ) N-Channel Enhancement Mode Field Effect Transistor

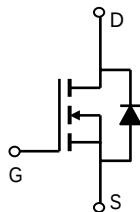
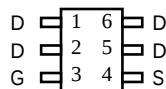
### General Description

The AO6402 uses advanced trench technology to provide excellent  $R_{DS(ON)}$  and low gate charge. This device may be used as a load switch or in PWM applications. AO6402L ( Green Product ) is offered in a lead-free package.

### Features

$V_{DS}$  (V) = 30V  
 $I_D$  = 6.9A  
 $R_{DS(ON)} < 28m\Omega$  ( $V_{GS} = 10V$ )  
 $R_{DS(ON)} < 42m\Omega$  ( $V_{GS} = 4.5V$ )

TSOP-6  
Top View



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

| Parameter                              | Symbol                 | Maximum    | Units            |
|----------------------------------------|------------------------|------------|------------------|
| Drain-Source Voltage                   | $V_{DS}$               | 30         | V                |
| Gate-Source Voltage                    | $V_{GS}$               | $\pm 20$   | V                |
| Continuous Drain Current <sup>A</sup>  | $T_A=25^\circ\text{C}$ | 6.9        | A                |
|                                        | $T_A=70^\circ\text{C}$ | 5.8        |                  |
| Pulsed Drain Current <sup>B</sup>      | $I_{DM}$               | 20         |                  |
| Power Dissipation                      | $T_A=25^\circ\text{C}$ | 2          | W                |
|                                        | $T_A=70^\circ\text{C}$ | 1.44       |                  |
| Junction and Storage Temperature Range | $T_J, T_{STG}$         | -55 to 150 | $^\circ\text{C}$ |

### Thermal Characteristics

| Parameter                                | Symbol          | Typ | Max  | Units              |
|------------------------------------------|-----------------|-----|------|--------------------|
| Maximum Junction-to-Ambient <sup>A</sup> | $R_{\theta JA}$ | 48  | 62.5 | $^\circ\text{C/W}$ |
| Maximum Junction-to-Ambient <sup>A</sup> |                 | 74  | 110  | $^\circ\text{C/W}$ |
| Maximum Junction-to-Lead <sup>C</sup>    | $R_{\theta JL}$ | 35  | 40   | $^\circ\text{C/W}$ |

**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                                                | 30  |              |          | V     |
| I <sub>DSS</sub>            | Zero Gate Voltage Drain Current       | V <sub>DS</sub> =24V, 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   | 1.9          | 3        | V     |
| I <sub>D(ON)</sub>          | On state drain current                | V <sub>GS</sub> =4.5V, V <sub>DS</sub> =5V                                                | 20  |              |          | A     |
| R <sub>DS(ON)</sub>         | Static Drain-Source On-Resistance     | V <sub>GS</sub> =10V, I <sub>D</sub> =6.9A<br>T <sub>J</sub> =125°C                       |     | 22.5<br>31.3 | 28<br>38 | mΩ    |
|                             |                                       | V <sub>GS</sub> =4.5V, I <sub>D</sub> =5.0A                                               |     | 34.5         | 42       | mΩ    |
|                             |                                       |                                                                                           |     |              |          |       |
| g <sub>FS</sub>             | Forward Transconductance              | V <sub>DS</sub> =5V, I <sub>D</sub> =6.9A                                                 | 10  | 15.4         |          | S     |
| V <sub>SD</sub>             | Diode Forward Voltage                 | I <sub>S</sub> =1A                                                                        |     | 0.76         | 1        | V     |
| I <sub>S</sub>              | Maximum Body-Diode Continuous Current |                                                                                           |     |              | 3        | A     |
| <b>DYNAMIC PARAMETERS</b>   |                                       |                                                                                           |     |              |          |       |
| C <sub>iss</sub>            | Input Capacitance                     | V <sub>GS</sub> =0V, V <sub>DS</sub> =15V, f=1MHz                                         |     | 680          | 820      | pF    |
| C <sub>oss</sub>            | Output Capacitance                    |                                                                                           |     | 102          |          | pF    |
| C <sub>rss</sub>            | Reverse Transfer Capacitance          |                                                                                           |     | 77           |          | pF    |
| R <sub>g</sub>              | Gate resistance                       | V <sub>GS</sub> =0V, V <sub>DS</sub> =0V, f=1MHz                                          |     | 3            | 3.6      | Ω     |
| <b>SWITCHING PARAMETERS</b> |                                       |                                                                                           |     |              |          |       |
| Q <sub>g</sub> (10V)        | Total Gate Charge                     | V <sub>GS</sub> =10V, V <sub>DS</sub> =15V, I <sub>D</sub> =6.9A                          |     | 13.84        | 16.7     | nC    |
| Q <sub>g</sub> (4.5V)       | Total Gate Charge                     |                                                                                           |     | 6.74         | 8.1      | nC    |
| Q <sub>gs</sub>             | Gate Source Charge                    |                                                                                           |     | 1.82         |          | nC    |
| Q <sub>gd</sub>             | Gate Drain Charge                     |                                                                                           |     | 3.2          |          | nC    |
| t <sub>D(on)</sub>          | Turn-On DelayTime                     | V <sub>GS</sub> =10V, V <sub>DS</sub> =15V, R <sub>L</sub> =2.2Ω,<br>R <sub>GEN</sub> =3Ω |     | 4.6          |          | ns    |
| t <sub>r</sub>              | Turn-On Rise Time                     |                                                                                           |     | 4.1          |          | ns    |
| t <sub>D(off)</sub>         | Turn-Off DelayTime                    |                                                                                           |     | 20.6         |          | ns    |
| t <sub>f</sub>              | Turn-Off Fall Time                    |                                                                                           |     | 5.2          |          | ns    |
| t <sub>rr</sub>             | Body Diode Reverse Recovery Time      | I <sub>F</sub> =6.9A, dI/dt=100A/μs                                                       |     | 16.5         | 20       | ns    |
| Q <sub>rr</sub>             | Body Diode Reverse Recovery Charge    | I <sub>F</sub> =6.9A, dI/dt=100A/μs                                                       |     | 7.8          |          | nC    |

A: The value of R<sub>θJA</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 value in any a 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 80μs 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.

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TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

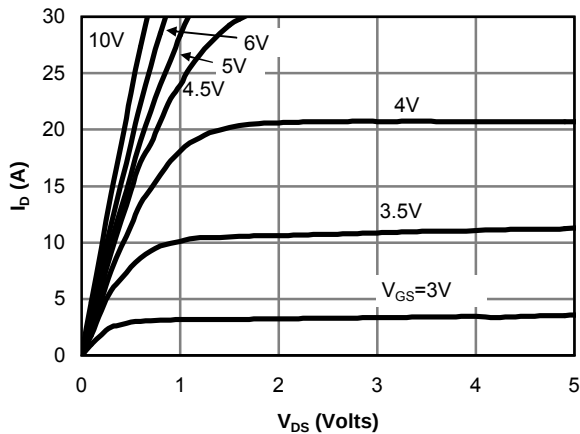


Fig 1: On-Region Characteristics

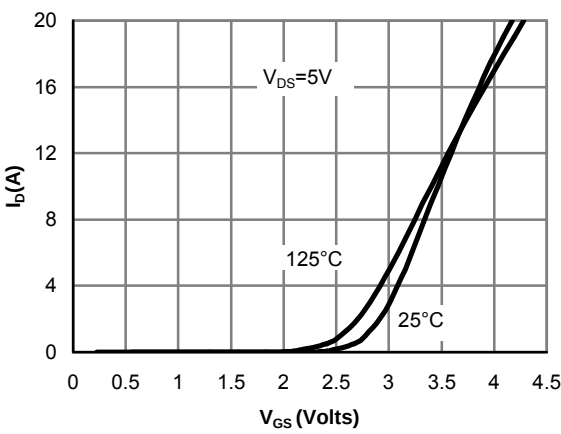


Figure 2: Transfer Characteristics

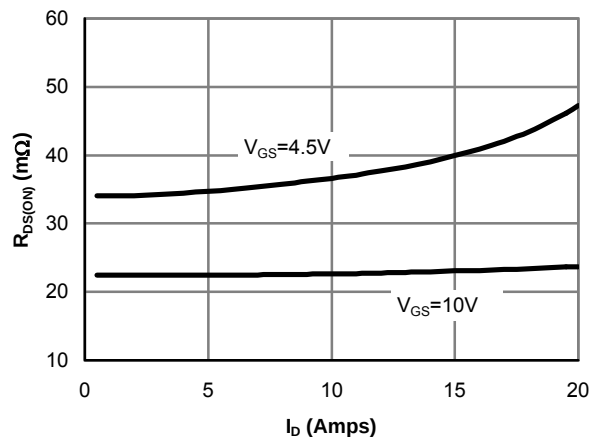


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

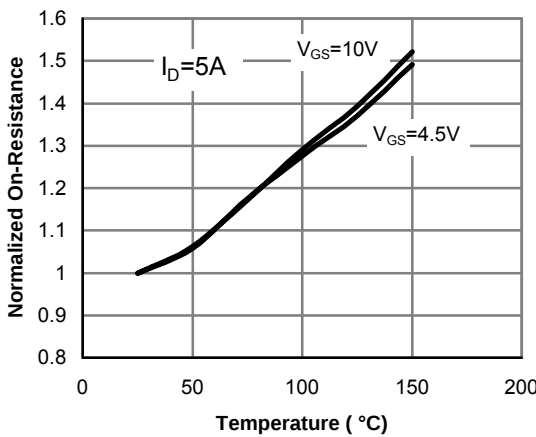


Figure 4: On-Resistance vs. Junction Temperature

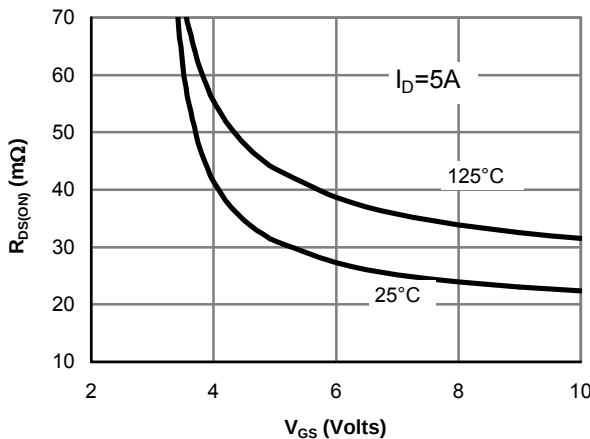


Figure 5: On-Resistance vs. Gate-Source Voltage

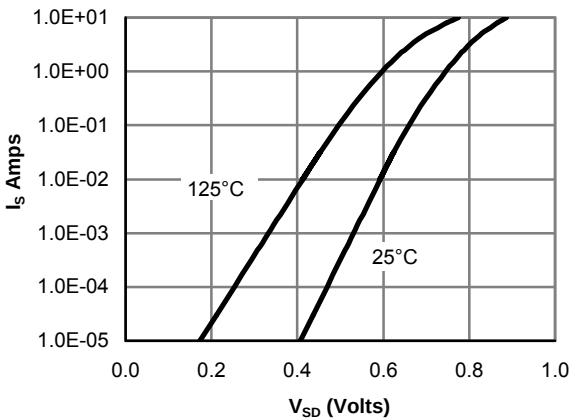


Figure 6: Body diode characteristics

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

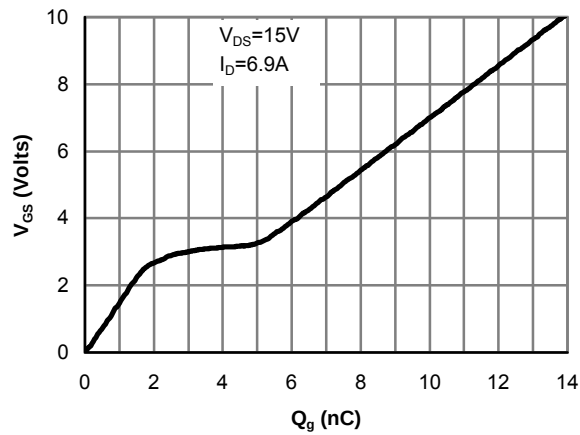


Figure 7: Gate-Charge characteristics

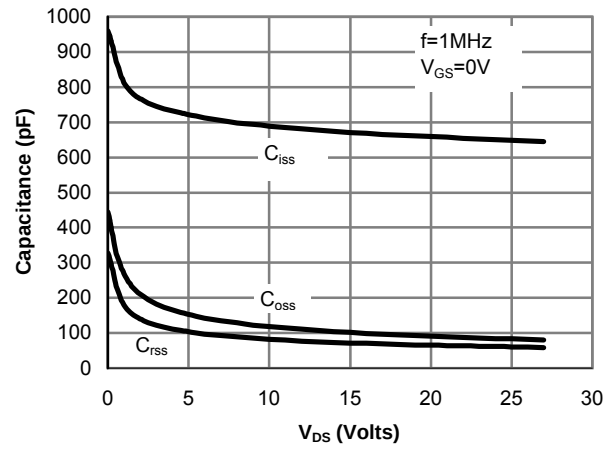


Figure 8: Capacitance Characteristics

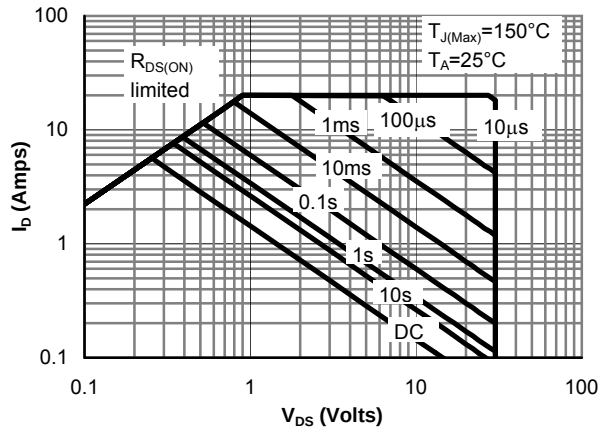


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

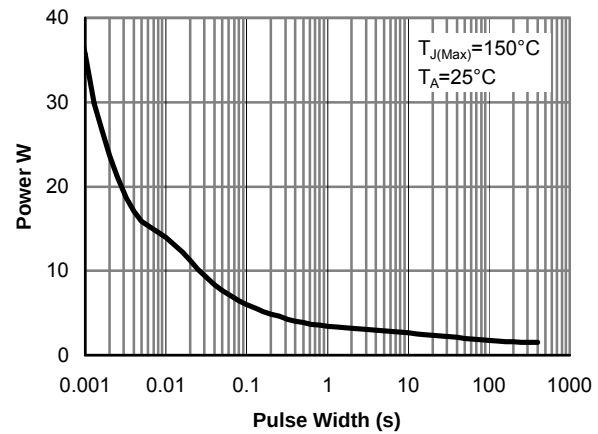


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

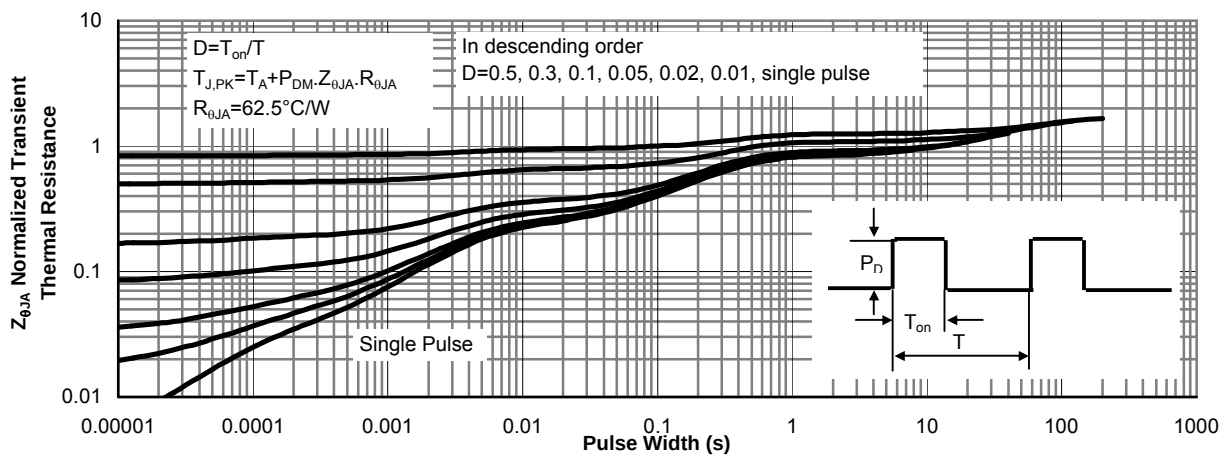


Figure 11: Normalized Maximum Transient Thermal Impedance