



**ALPHA & OMEGA**  
SEMICONDUCTOR

**AO3405**

**P-Channel Enhancement Mode Field Effect Transistor**

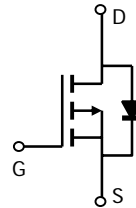
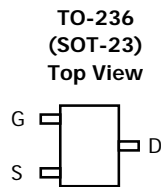


### General Description

The AO3405 uses advanced trench technology to provide excellent  $R_{DS(ON)}$  and low gate charge. This device is suitable for use as a load switch or in PWM applications. *Standard Product AO3405 is Pb-free (meets ROHS & Sony 259 specifications). AO3405L is a Green Product ordering option. AO3405 and AO3405L are electrically identical.*

### Features

$V_{DS}$  (V) = -30V  
 $I_D$  = -2.6 A ( $V_{GS}$  = -10V)  
 $R_{DS(ON)} < 130m\Omega$  ( $V_{GS}$  = -10V)  
 $R_{DS(ON)} < 180m\Omega$  ( $V_{GS}$  = -4.5V)



### 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                    | $V_{GS}$   | $\pm 12$   | V                |
| Continuous Drain Current <sup>A</sup>  | $T_A=25^\circ\text{C}$<br>$T_A=70^\circ\text{C}$ | $I_D$      | -2.6             |
|  |  |            | -2.2             |
| Pulsed Drain Current <sup>B</sup>      | $I_{DM}$   | -30        | A                |
| Power Dissipation <sup>A</sup>         | $T_A=25^\circ\text{C}$<br>$T_A=70^\circ\text{C}$ | $P_D$      | 1.4              |
|  |  |            | 1                |
| 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> | $R_{\theta JA}$ | 65  | 90  | $^\circ\text{C/W}$ |
| $t \leq 10\text{s}$                      |                 |     |     |                    |
| Maximum Junction-to-Ambient <sup>A</sup> | $R_{\theta JA}$ | 85  | 125 | $^\circ\text{C/W}$ |
| Steady-State                             |                 |     |     |                    |
| Maximum Junction-to-Lead <sup>C</sup>    | $R_{\theta JL}$ | 43  | 60  | $^\circ\text{C/W}$ |

Electrical Characteristics ( $T_J=25^\circ\text{C}$  unless otherwise noted)

| Symbol                      | Parameter                             | Conditions   | Min  | Typ   | Max       | Units            |
|-----------------------------|---------------------------------------|--|------|-------|-----------|------------------|
| <b>STATIC PARAMETERS</b>    |                                       |  |      |       |           |                  |
| $BV_{DSS}$                  | Drain-Source Breakdown Voltage        | $I_D=-250\mu\text{A}$ , $V_{GS}=0\text{V}$   | -30  |       |           | V                |
| $I_{DSS}$                   | Zero Gate Voltage Drain Current       | $V_{DS}=-24\text{V}$ , $V_{GS}=0\text{V}$<br>$T_J=55^\circ\text{C}$                |      |       | -1<br>-5  | $\mu\text{A}$    |
| $I_{GSS}$                   | Gate-Body leakage current             | $V_{DS}=0\text{V}$ , $V_{GS}=\pm 12\text{V}$                                       |      |       | $\pm 100$ | nA               |
| $V_{GS(th)}$                | Gate Threshold Voltage                | $V_{DS}=V_{GS}$ , $I_D=-250\mu\text{A}$  | -1.3 | -1.8  | -2.3      | V                |
| $I_{D(ON)}$                 | On state drain current                | $V_{GS}=-4.5\text{V}$ , $V_{DS}=-5\text{V}$  | -10  |       |           | A                |
| $R_{DS(ON)}$                | Static Drain-Source On-Resistance     | $V_{GS}=-10\text{V}$ , $I_D=-2.6\text{A}$<br>$T_J=125^\circ\text{C}$               |      | 102   | 130       | $\text{m}\Omega$ |
|                             |                                       | $V_{GS}=-4.5\text{V}$ , $I_D=-2\text{A}$   |      | 137   | 180       | $\text{m}\Omega$ |
|                             |                                       |  |      |       |           | $\text{m}\Omega$ |
| $g_{FS}$                    | Forward Transconductance              | $V_{DS}=-5\text{V}$ , $I_D=-2.5\text{A}$   | 7    | 11    |           | S                |
| $V_{SD}$                    | Diode Forward Voltage                 | $I_S=-1\text{A}$ , $V_{GS}=0\text{V}$  |      | -0.83 | -1        | V                |
| $I_S$                       | Maximum Body-Diode Continuous Current |  |      |       | -2.2      | A                |
| <b>DYNAMIC PARAMETERS</b>   |                                       |  |      |       |           |                  |
| $C_{iss}$                   | Input Capacitance                     | $V_{GS}=0\text{V}$ , $V_{DS}=-15\text{V}$ , $f=1\text{MHz}$                        |      | 481   |           | pF               |
| $C_{oss}$                   | Output Capacitance                    |  |      | 54    |           | pF               |
| $C_{riss}$                  | Reverse Transfer Capacitance          |  |      | 34    |           | pF               |
| $R_g$                       | Gate resistance                       | $V_{GS}=0\text{V}$ , $V_{DS}=0\text{V}$ , $f=1\text{MHz}$                          |      | 12    |           | $\Omega$         |
| <b>SWITCHING PARAMETERS</b> |                                       |  |      |       |           |                  |
| $Q_g$                       | Total Gate Charge                     | $V_{GS}=-4.5\text{V}$ , $V_{DS}=-15\text{V}$ , $I_D=-2.5\text{A}$                  |      | 1.25  |           | nC               |
| $Q_{gs}$                    | Gate Source Charge                    |  |      | 1.75  |           | nC               |
| $Q_{gd}$                    | Gate Drain Charge                     |  |      | 4.35  |           | nC               |
| $t_{D(on)}$                 | Turn-On Delay Time                    | $V_{GS}=-10\text{V}$ , $V_{DS}=-15\text{V}$ , $R_L=6\Omega$ ,<br>$R_{GEN}=6\Omega$ |      | 8.9   |           | ns               |
| $t_r$                       | Turn-On Rise Time                     |  |      | 8.8   |           | ns               |
| $t_{D(off)}$                | Turn-Off Delay Time                   |  |      | 23    |           | ns               |
| $t_f$                       | Turn-Off Fall Time                    |  |      | 6.9   |           | ns               |
| $t_{rr}$                    | Body Diode Reverse Recovery Time      | $I_F=-2.5\text{A}$ , $dI/dt=100\text{A}/\mu\text{s}$                               |      | 26    |           | ns               |
| $Q_{rr}$                    | Body Diode Reverse Recovery Charge    | $I_F=-2.5\text{A}$ , $dI/dt=100\text{A}/\mu\text{s}$                               |      | 15.6  |           | nC               |

A: The value of  $R_{\theta JA}$  is measured with the device mounted on 1 in<sup>2</sup> FR-4 board with 2oz. Copper, in a still air environment with  $T_A=25^\circ\text{C}$ . The value in any given application depends on the user's specific board design. The current rating is based on the  $t \leq 10\text{s}$  thermal resistance rating.

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

C. The  $R_{\theta JA}$  is the sum of the thermal impedance from junction to lead  $R_{\theta JL}$  and lead to ambient.

D. The static characteristics in Figures 1 to 6, 12, 14 are obtained using 80  $\mu\text{s}$  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  $T_A=25^\circ\text{C}$ . The SOA curve provides a single pulse rating.

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TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

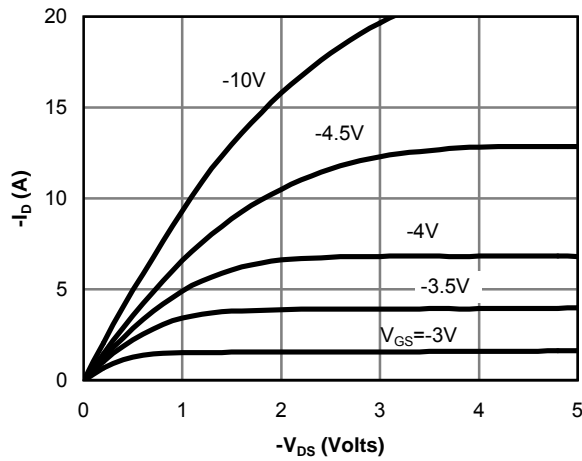


Fig 1: On-Region Characteristics

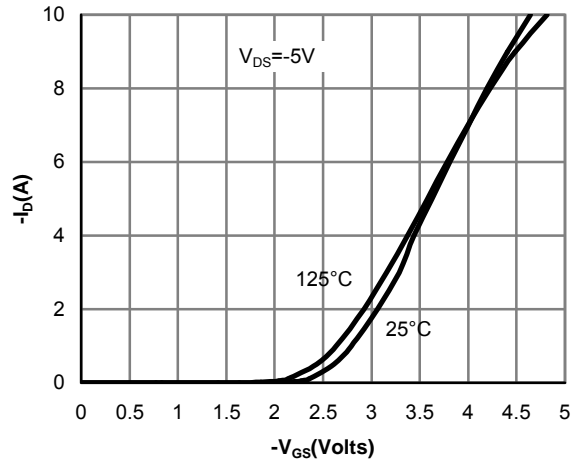


Figure 2: Transfer Characteristics

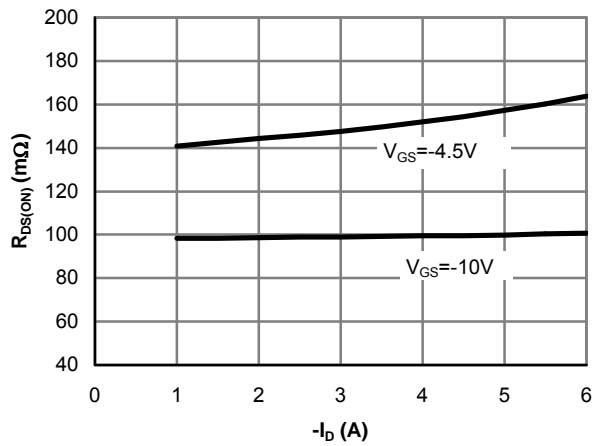


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

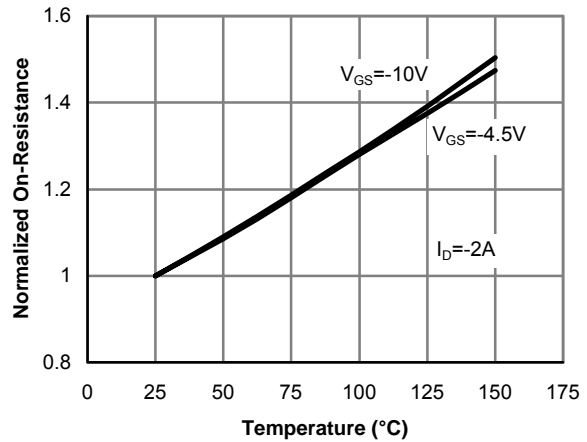


Figure 4: On-Resistance vs. Junction Temperature

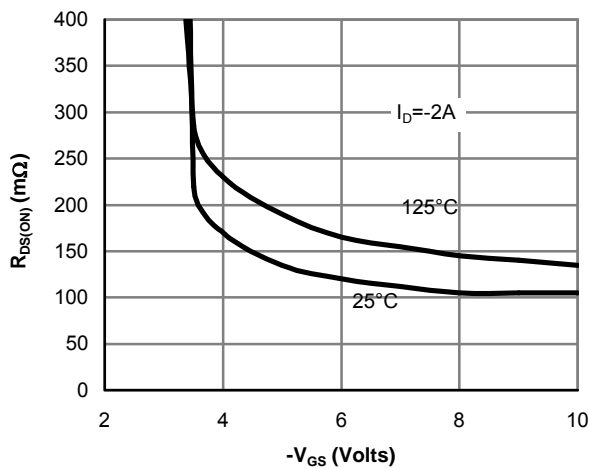


Figure 5: On-Resistance vs. Gate-Source Voltage

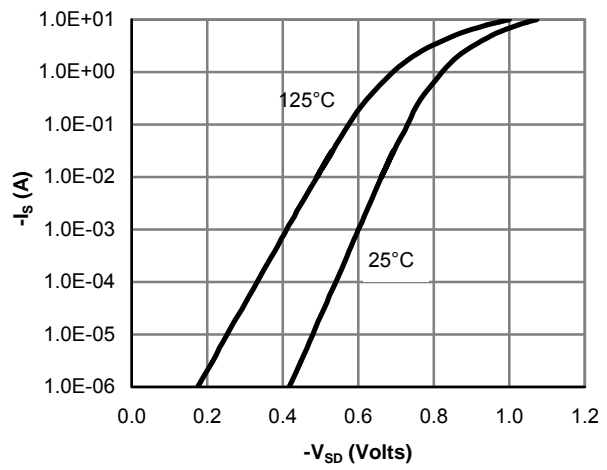


Figure 6: Body-Diode Characteristics

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

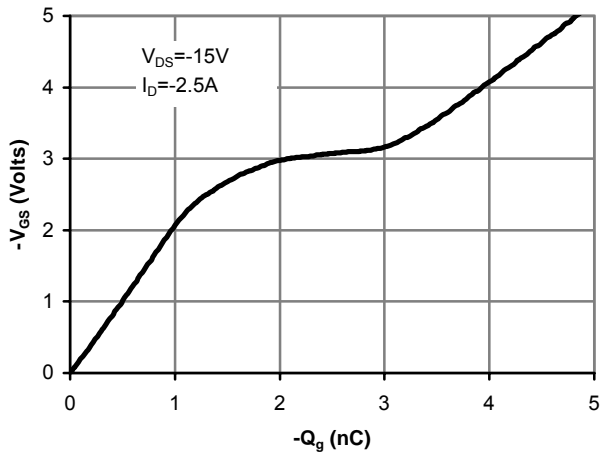


Figure 7: Gate-Charge Characteristics

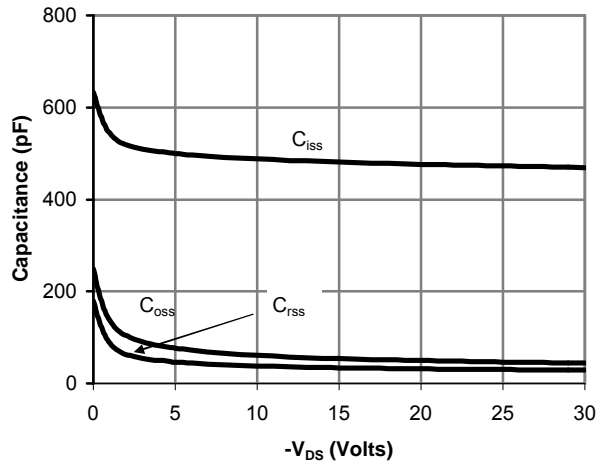


Figure 8: Capacitance Characteristics

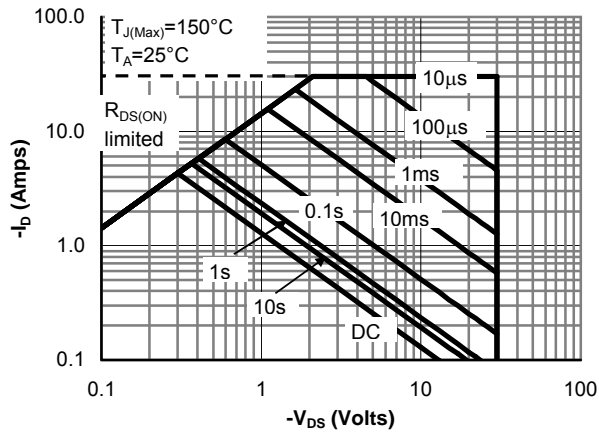


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

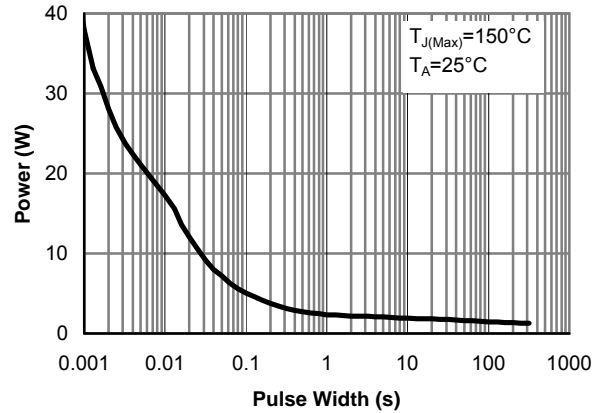


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

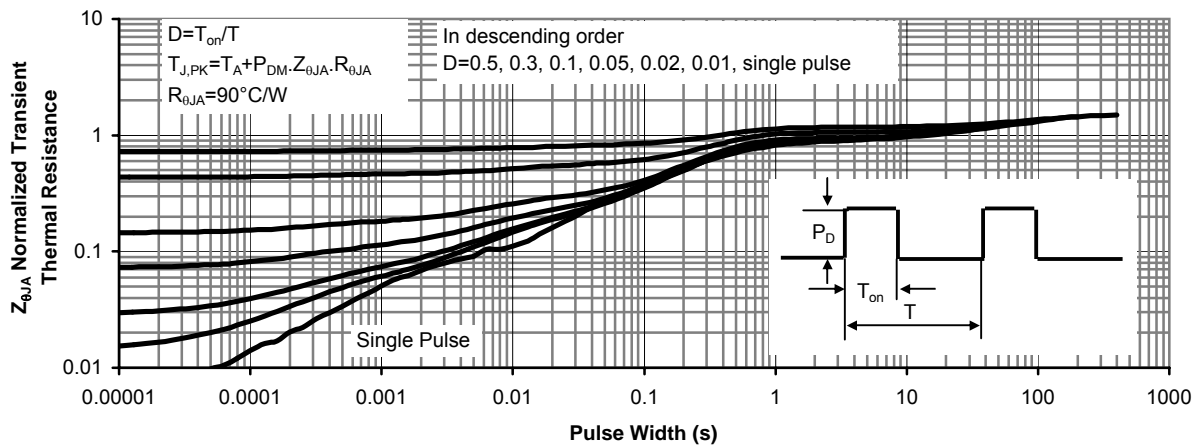


Figure 11: Normalized Maximum Transient Thermal Impedance