



**ALPHA & OMEGA**  
SEMICONDUCTOR



**AO4433**

## P-Channel Enhancement Mode Field Effect Transistor

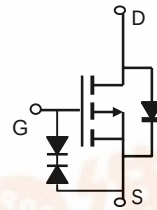
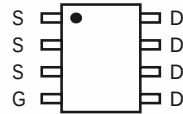
### General Description

The AO4433 uses advanced trench technology to provide excellent  $R_{DS(ON)}$ , and ultra-low low gate charge with a 25V gate rating. This device is suitable for use as a load switch or in PWM applications. The device is ESD protected. *Standard product AO4433 is Pb-free (meets ROHS & Sony 259 specifications). AO4433L is a Green Product ordering option. AO4433 and AO4433L are electrically identical.*

### Features

$V_{DS}$  (V) = -30V  
 $I_D$  = -11 A ( $V_{GS}$  = -20V)  
 $R_{DS(ON)}$  < 14m $\Omega$  ( $V_{GS}$  = -20V)  
 $R_{DS(ON)}$  < 18m $\Omega$  ( $V_{GS}$  = -10V)  
 ESD Rating: 1.5KV HBM

SOIC-8  
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                    | $V_{GS}$       | $\pm 25$   | V                |
| Continuous Drain Current <sup>A</sup>  | $I_D$          | -11        | A                |
|                                        |                | -9.7       |                  |
| Pulsed Drain Current <sup>B</sup>      | $I_{DM}$       | -50        |                  |
| Power Dissipation <sup>A</sup>         | $P_D$          | 3          | W                |
|                                        |                | 2.1        |                  |
| 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> | $R_{\theta JA}$ | 28  | 40  | $^\circ\text{C/W}$ |
| Maximum Junction-to-Ambient <sup>A</sup> |                 | 54  | 75  | $^\circ\text{C/W}$ |
| Maximum Junction-to-Lead <sup>C</sup>    | $R_{\theta JL}$ | 21  | 30  | $^\circ\text{C/W}$ |

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             | $V_{DS}=0\text{V}$ , $V_{GS}=\pm 25\text{V}$                                         |     |          | $\pm 1$  | $\mu\text{A}$    |
| $V_{GS(th)}$                | Gate Threshold Voltage                | $V_{DS}=V_{GS}$ , $I_D=-250\mu\text{A}$                                              | -2  | -2.8     | -4       | V                |
| $I_{D(ON)}$                 | On state drain current                | $V_{GS}=-10\text{V}$ , $V_{DS}=-5\text{V}$                                           | -50 |          |          | A                |
| $R_{DS(ON)}$                | Static Drain-Source On-Resistance     | $V_{GS}=-20\text{V}$ , $I_D=-11\text{A}$<br>$T_J=125^{\circ}\text{C}$                |     | 11<br>15 | 14<br>19 | $\text{m}\Omega$ |
|                             |                                       | $V_{GS}=-10\text{V}$ , $I_D=-10\text{A}$                                             |     | 13.8     | 18       | $\text{m}\Omega$ |
|                             |                                       | $V_{GS}=-4.5\text{V}$ , $I_D=-4\text{A}$                                             |     | 38.5     |          | $\text{m}\Omega$ |
|                             |                                       |                                                                                      |     |          |          |                  |
| $g_{FS}$                    | Forward Transconductance              | $V_{DS}=-5\text{V}$ , $I_D=-11\text{A}$                                              |     | 20       |          | S                |
| $V_{SD}$                    | Diode Forward Voltage                 | $I_S=-1\text{A}$ , $V_{GS}=0\text{V}$                                                |     | -0.72    | -1       | V                |
| $I_S$                       | Maximum Body-Diode Continuous Current |                                                                                      |     |          | -4.2     | A                |
| <b>DYNAMIC PARAMETERS</b>   |                                       |                                                                                      |     |          |          |                  |
| $C_{iss}$                   | Input Capacitance                     | $V_{GS}=0\text{V}$ , $V_{DS}=-15\text{V}$ , $f=1\text{MHz}$                          |     | 1760     | 2200     | pF               |
| $C_{oss}$                   | Output Capacitance                    |                                                                                      |     | 360      |          | pF               |
| $C_{rss}$                   | Reverse Transfer Capacitance          |                                                                                      |     | 255      |          | pF               |
| $R_g$                       | Gate resistance                       | $V_{GS}=0\text{V}$ , $V_{DS}=0\text{V}$ , $f=1\text{MHz}$                            |     | 6.4      | 8        | $\Omega$         |
| <b>SWITCHING PARAMETERS</b> |                                       |                                                                                      |     |          |          |                  |
| $Q_g$                       | Total Gate Charge                     | $V_{GS}=-10\text{V}$ , $V_{DS}=-15\text{V}$ , $I_D=-11\text{A}$                      |     | 30       | 38       | nC               |
| $Q_{gs}$                    | Gate Source Charge                    |                                                                                      |     | 7        |          | nC               |
| $Q_{gd}$                    | Gate Drain Charge                     |                                                                                      |     | 8        |          | nC               |
| $t_{D(on)}$                 | Turn-On DelayTime                     | $V_{GS}=-10\text{V}$ , $V_{DS}=-15\text{V}$ , $R_L=1.5\Omega$ ,<br>$R_{GEN}=3\Omega$ |     | 11.5     |          | ns               |
| $t_r$                       | Turn-On Rise Time                     |                                                                                      |     | 8        |          | ns               |
| $t_{D(off)}$                | Turn-Off DelayTime                    |                                                                                      |     | 35       |          | ns               |
| $t_f$                       | Turn-Off Fall Time                    |                                                                                      |     | 18.5     |          | ns               |
| $t_{rr}$                    | Body Diode Reverse Recovery Time      | $I_F=-11\text{A}$ , $dI/dt=100\text{A}/\mu\text{s}$                                  |     | 24       | 30       | ns               |
| $Q_{rr}$                    | Body Diode Reverse Recovery Charge    | $I_F=-11\text{A}$ , $dI/dt=100\text{A}/\mu\text{s}$                                  |     | 16       |          | nC               |

A: The value of  $R_{\theta JA}$  is measured with the device mounted on 1in<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  $\leq 10\text{s}$  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

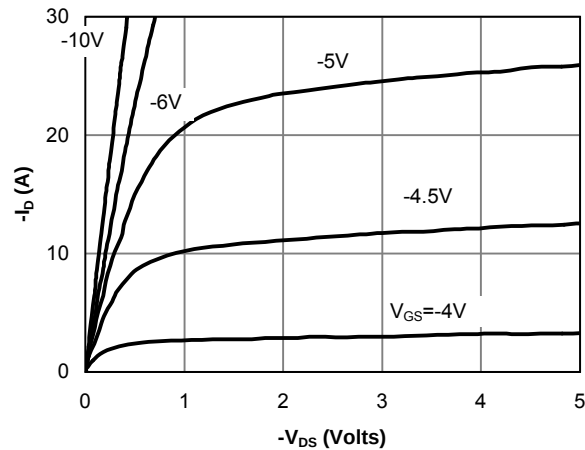


Fig 1: On-Region Characteristics

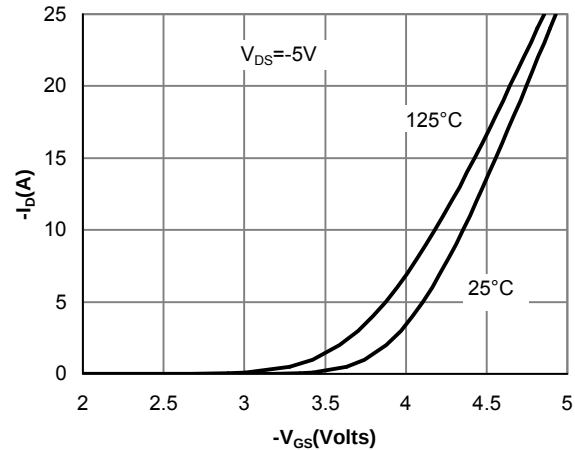


Figure 2: Transfer Characteristics

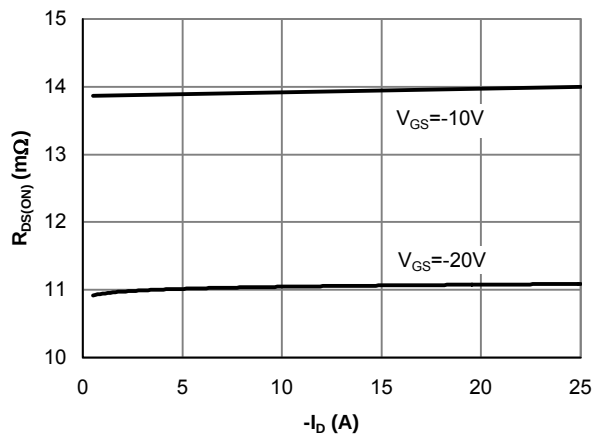


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

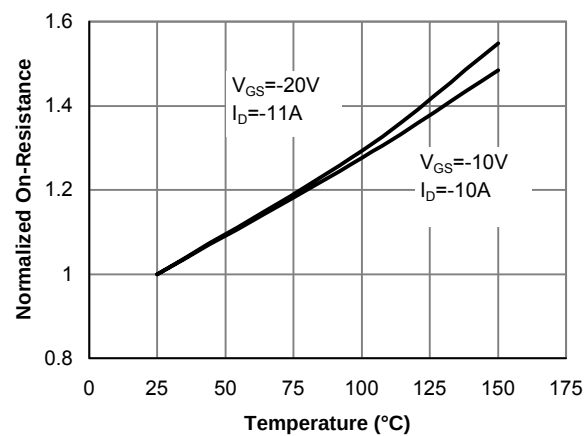


Figure 4: On-Resistance vs. Junction Temperature

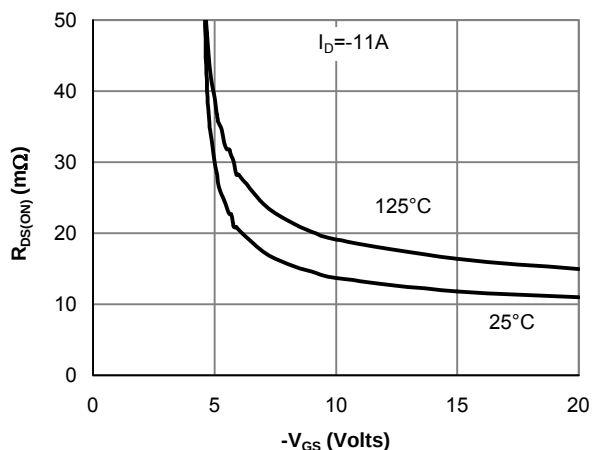


Figure 5: On-Resistance vs. Gate-Source Voltage

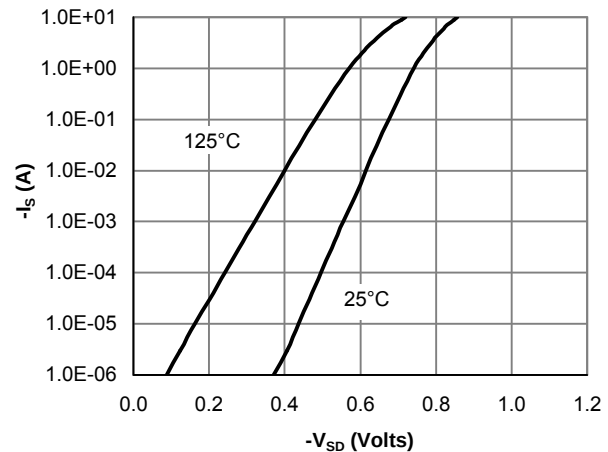


Figure 6: Body-Diode Characteristics

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

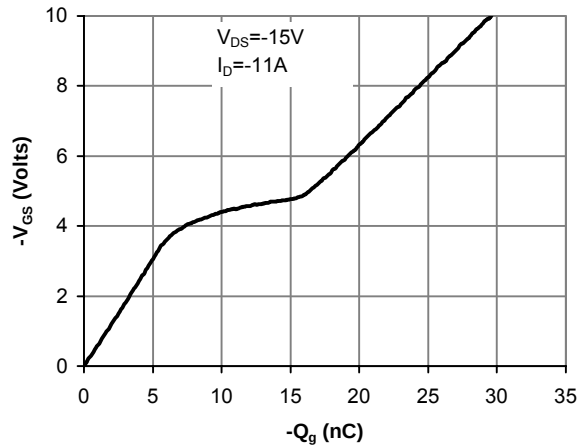


Figure 7: Gate-Charge Characteristics

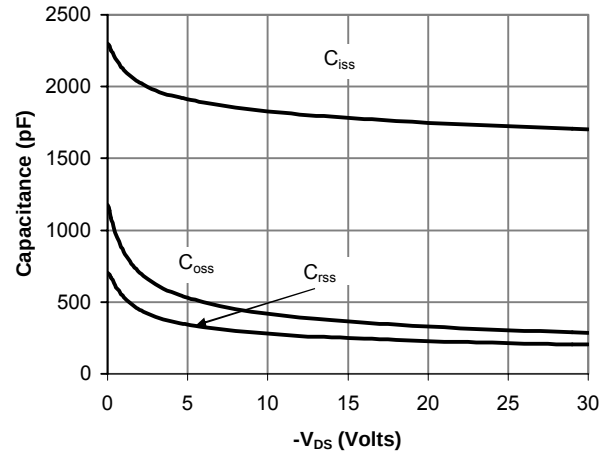


Figure 8: Capacitance Characteristics

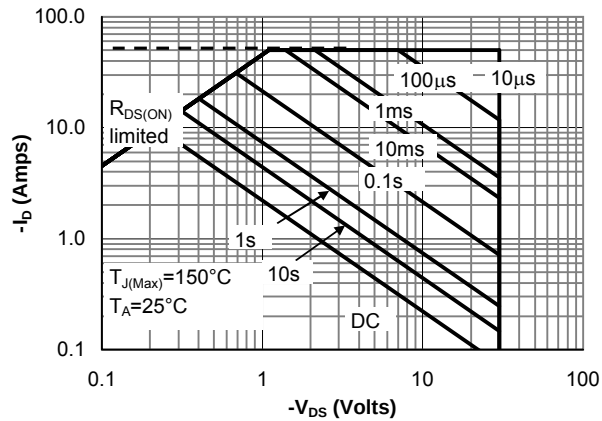


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

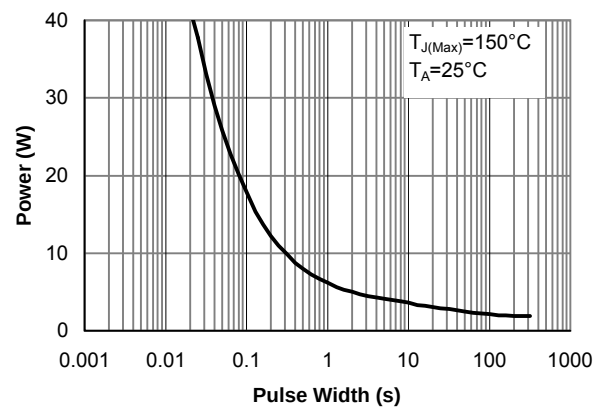


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

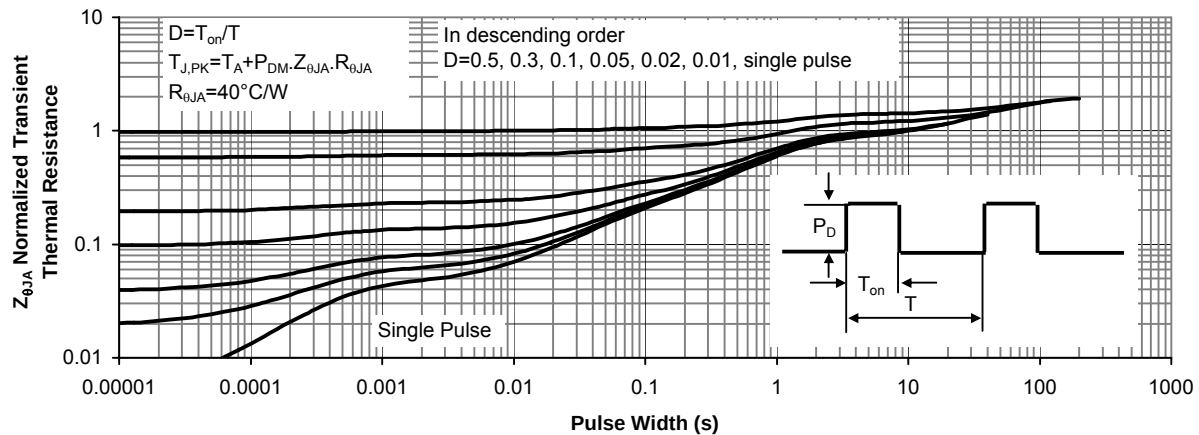


Figure 11: Normalized Maximum Transient Thermal Impedance