



# AO3401A

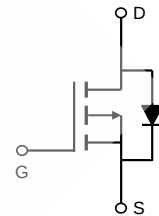
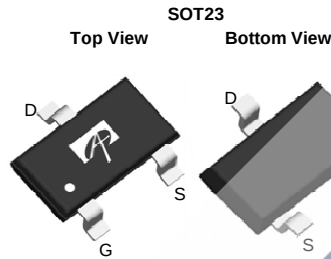
## 30V P-Channel MOSFET

### General Description

The AO3401A uses advanced trench technology to provide excellent  $R_{DS(ON)}$ , low gate charge and operation gate voltages as low as 2.5V. This device is suitable for use as a load switch or other general applications.

### Product Summary

|                                   |                |
|-----------------------------------|----------------|
| $V_{DS}$                          | -30V           |
| $I_D$ (at $V_{GS}=-10V$ )         | -4.0A          |
| $R_{DS(ON)}$ (at $V_{GS}=-10V$ )  | < 50m $\Omega$ |
| $R_{DS(ON)}$ (at $V_{GS}=-4.5V$ ) | < 60m $\Omega$ |
| $R_{DS(ON)}$ (at $V_{GS}=-2.5V$ ) | < 85m $\Omega$ |



### 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               | $I_D$          | -4         | A                |
| $T_A=25^\circ\text{C}$                 |                | -3.2       |                  |
| $T_A=70^\circ\text{C}$                 |                |            |                  |
| Pulsed Drain Current <sup>C</sup>      | $I_{DM}$       | -27        |                  |
| Power Dissipation <sup>B</sup>         | $P_D$          | 1.4        | W                |
| $T_A=25^\circ\text{C}$                 |                | 0.9        |                  |
| $T_A=70^\circ\text{C}$                 |                |            |                  |
| 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> $t \leq 10s$   | $R_{\theta JA}$ | 70  | 90  | $^\circ\text{C/W}$ |
| Maximum Junction-to-Ambient <sup>A,D</sup> Steady-State |                 | 100 | 125 | $^\circ\text{C/W}$ |
| Maximum Junction-to-Lead Steady-State                   | $R_{\theta JL}$ | 63  | 80  | $^\circ\text{C/W}$ |

**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> =-30V, 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> = ±12V                                                  |      |          | ±100     | nA    |
| V <sub>GS(th)</sub>         | Gate Threshold Voltage                | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =-250μA                                    | -0.5 | -0.9     | -1.3     | V     |
| I <sub>D(ON)</sub>          | On state drain current                | V <sub>GS</sub> =-10V, V <sub>DS</sub> =-5V                                                  | -27  |          |          | A     |
| R <sub>DS(ON)</sub>         | Static Drain-Source On-Resistance     | V <sub>GS</sub> =-10V, I <sub>D</sub> =-4.0A<br>T <sub>J</sub> =125°C                        |      | 41<br>62 | 50<br>75 | mΩ    |
|                             |                                       | V <sub>GS</sub> =-4.5V, I <sub>D</sub> =-3.5A                                                |      | 47       | 60       | mΩ    |
|                             |                                       | V <sub>GS</sub> =-2.5V, I <sub>D</sub> =-2.5A                                                |      | 60       | 85       | mΩ    |
| g <sub>FS</sub>             | Forward Transconductance              | V <sub>DS</sub> =-5V, I <sub>D</sub> =-4.0A                                                  |      | 17       |          | S     |
| V <sub>SD</sub>             | Diode Forward Voltage                 | I <sub>S</sub> =-1A, V <sub>GS</sub> =0V                                                     |      | -0.7     | -1       | V     |
| I <sub>S</sub>              | Maximum Body-Diode Continuous Current |                                                                                              |      |          | -2       | A     |
| <b>DYNAMIC PARAMETERS</b>   |                                       |                                                                                              |      |          |          |       |
| C <sub>iss</sub>            | Input Capacitance                     | V <sub>GS</sub> =0V, V <sub>DS</sub> =-15V, f=1MHz                                           |      | 645      |          | pF    |
| C <sub>oss</sub>            | Output Capacitance                    |                                                                                              |      | 80       |          | pF    |
| C <sub>rss</sub>            | Reverse Transfer Capacitance          |                                                                                              |      | 55       |          | pF    |
| R <sub>g</sub>              | Gate resistance                       | V <sub>GS</sub> =0V, V <sub>DS</sub> =0V, f=1MHz                                             | 4    | 7.8      | 12       | Ω     |
| <b>SWITCHING PARAMETERS</b> |                                       |                                                                                              |      |          |          |       |
| Q <sub>g(10V)</sub>         | Total Gate Charge                     | V <sub>GS</sub> =-10V, V <sub>DS</sub> =-15V, I <sub>D</sub> =-4.0A                          |      | 14       |          | nC    |
| Q <sub>g(4.5V)</sub>        | Total Gate Charge                     |                                                                                              |      | 7        |          | nC    |
| Q <sub>gs</sub>             | Gate Source Charge                    |                                                                                              |      | 1.5      |          | nC    |
| Q <sub>gd</sub>             | Gate Drain Charge                     |                                                                                              |      | 2.5      |          | nC    |
| t <sub>D(on)</sub>          | Turn-On DelayTime                     | V <sub>GS</sub> =-10V, V <sub>DS</sub> =-15V, R <sub>L</sub> =3.75Ω,<br>R <sub>GEN</sub> =3Ω |      | 6.5      |          | ns    |
| t <sub>r</sub>              | Turn-On Rise Time                     |                                                                                              |      | 3.5      |          | ns    |
| t <sub>D(off)</sub>         | Turn-Off DelayTime                    |                                                                                              |      | 41       |          | ns    |
| t <sub>f</sub>              | Turn-Off Fall Time                    |                                                                                              |      | 9        |          | ns    |
| t <sub>rr</sub>             | Body Diode Reverse Recovery Time      | I <sub>F</sub> =-4.0A, dI/dt=100A/μs                                                         |      | 11       |          | ns    |
| Q <sub>rr</sub>             | Body Diode Reverse Recovery Charge    | I <sub>F</sub> =-4.0A, dI/dt=100A/μs                                                         |      | 3.5      |          | 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 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 ≤ 10s junction-to-ambient thermal resistance.

C. Repetitive rating, pulse width limited by junction temperature T<sub>J(MAX)</sub>=150°C. Ratings are based on low frequency and duty cycles to keep initial T<sub>J</sub>=25°C.

D. The R<sub>θJA</sub> is the sum of the thermal impedance from junction to lead R<sub>θJL</sub> and lead to ambient.

E. The static characteristics in Figures 1 to 6 are obtained using <300μs pulses, duty cycle 0.5% max.

F. These curves are based on the junction-to-ambient thermal impedance which is measured with the device mounted on 1in<sup>2</sup> FR-4 board with 2oz. Copper, assuming a maximum junction temperature of T<sub>J(MAX)</sub>=150°C. The SOA curve provides a single pulse rating.

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# TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

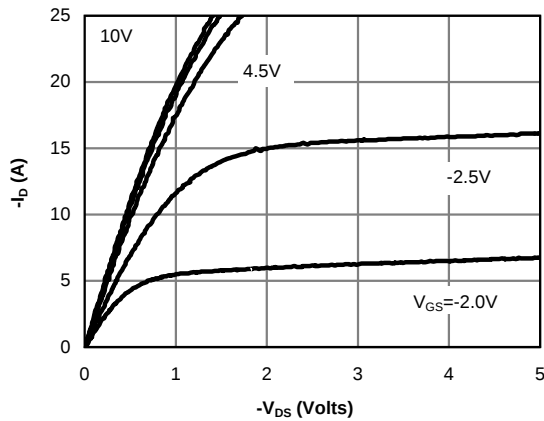


Figure 1: On-Region Characteristics (Note E)

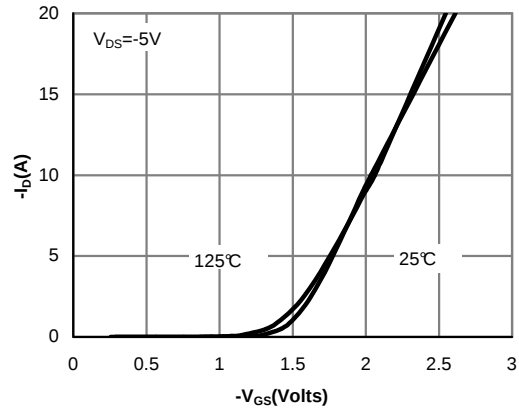


Figure 2: Transfer Characteristics (Note E)

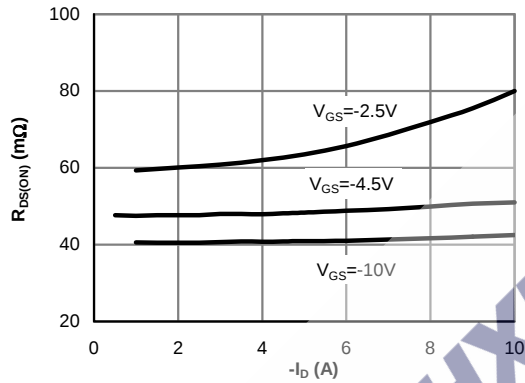


Figure 3: On-Resistance vs. Drain Current and Gate Voltage (Note E)

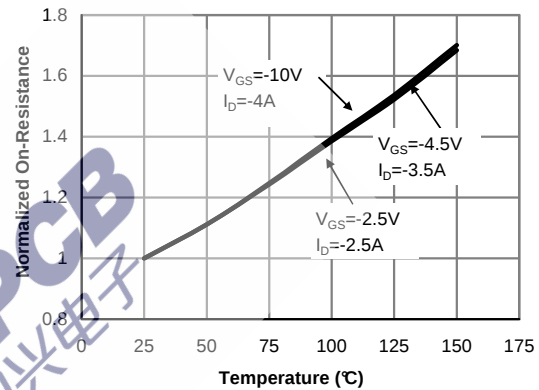


Figure 4: On-Resistance vs. Junction Temperature (Note E)

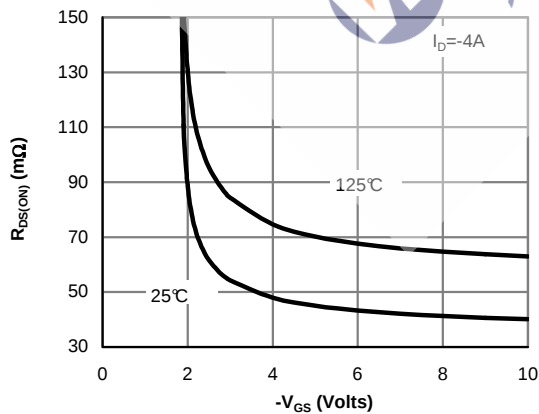


Figure 5: On-Resistance vs. Gate-Source Voltage (Note E)

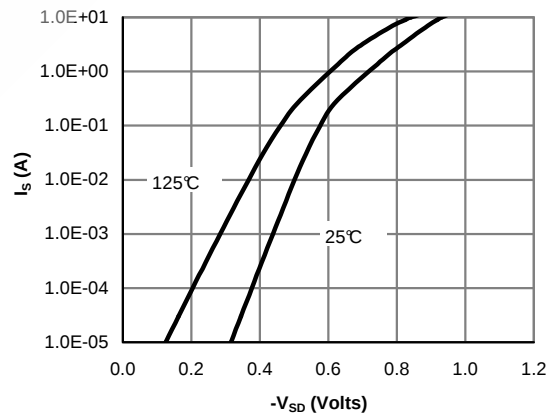


Figure 6: Body-Diode Characteristics (Note E)

**TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS**

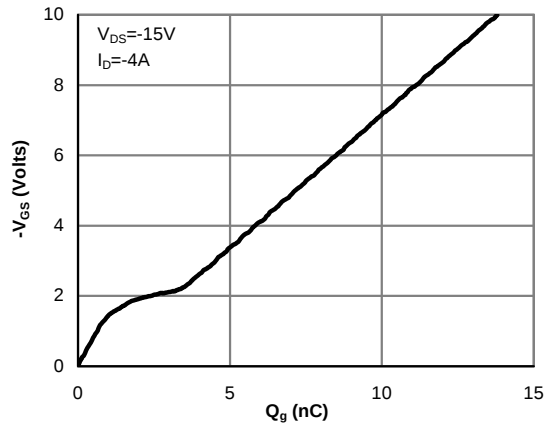


Figure 7: Gate-Charge Characteristics

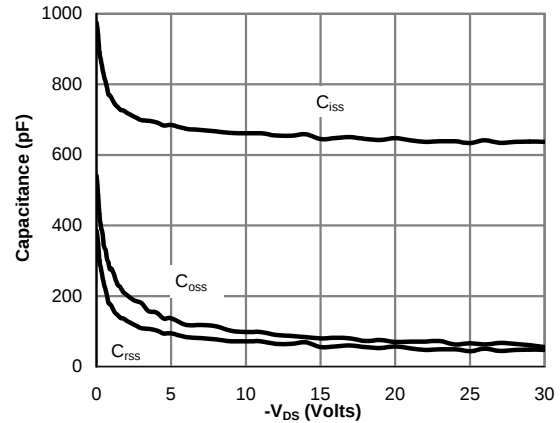


Figure 8: Capacitance Characteristics

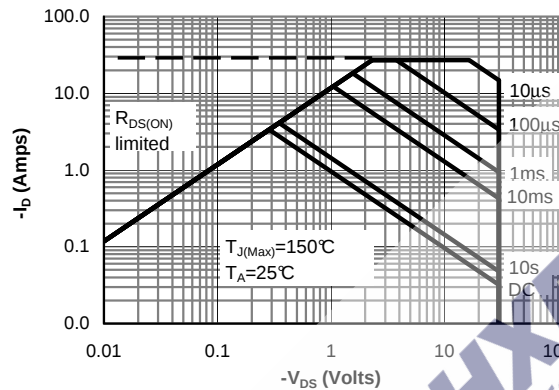


Figure 9: Maximum Forward Biased Safe Operating Area (Note F)

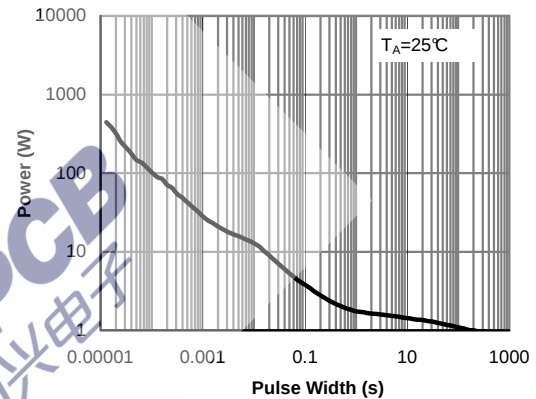


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note F)

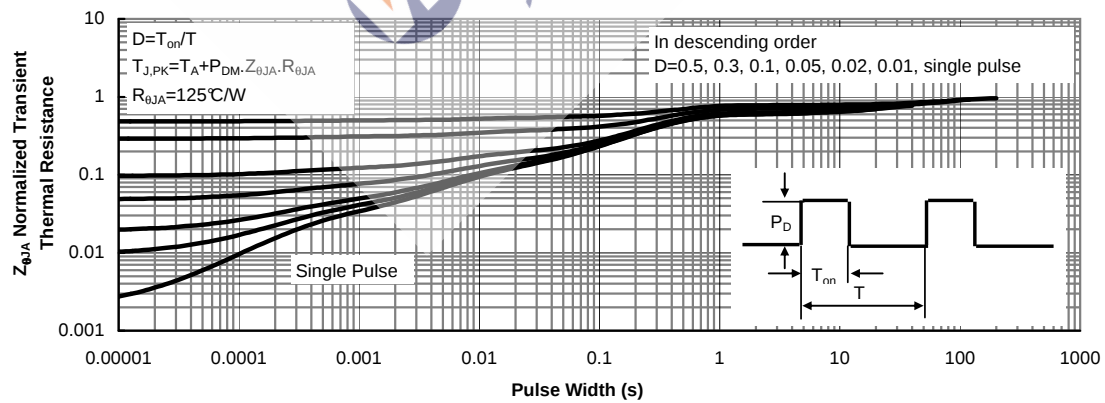
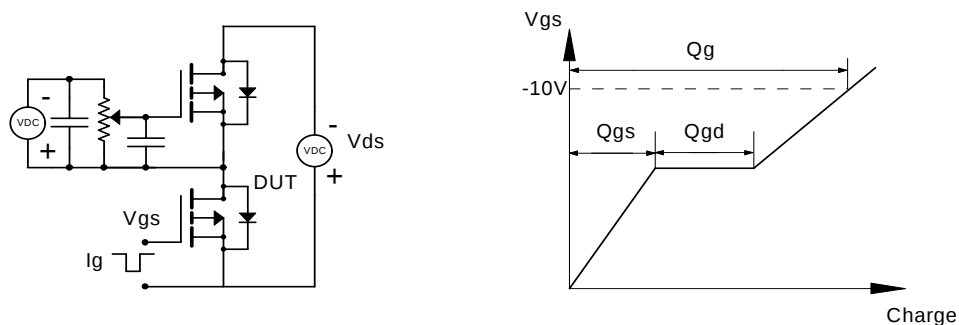
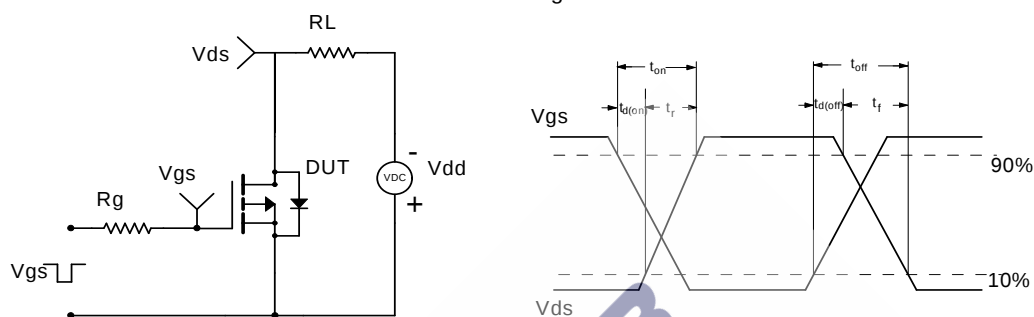


Figure 11: Normalized Maximum Transient Thermal Impedance (Note F)

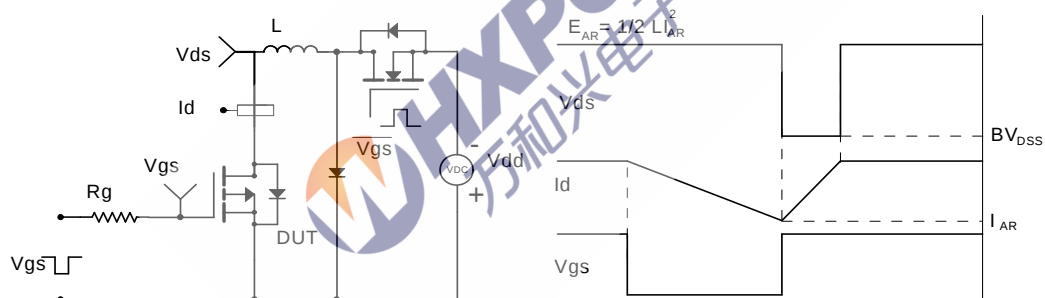
### Gate Charge Test Circuit & Waveform



### Resistive Switching Test Circuit & Waveforms



### Unclamped Inductive Switching (UIS) Test Circuit & Waveforms



### Diode Recovery Test Circuit & Waveforms

