

### General Description

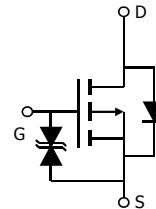
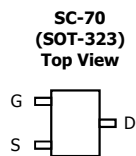
The AO7413 uses advanced trench technology to provide excellent  $R_{DS(ON)}$ , low gate charge and operation with gate voltages as low as 2.5V. This device is suitable for use as a load switch applications.

### Product Summary

|                                   |                 |
|-----------------------------------|-----------------|
| $V_{DS}$                          | -20V            |
| $I_D$ (at $V_{GS}=-10V$ )         | -1.4A           |
| $R_{DS(ON)}$ (at $V_{GS}=-10V$ )  | < 113m $\Omega$ |
| $R_{DS(ON)}$ (at $V_{GS}=-4.5V$ ) | < 135m $\Omega$ |
| $R_{DS(ON)}$ (at $V_{GS}=-2.5V$ ) | < 180m $\Omega$ |

### Typical ESD protection

**HBM Class 2**



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

| Parameter                              | Symbol         | Maximum                | Units            |
|--|----------------|------------------------|------------------|
| Drain-Source Voltage                   | $V_{DS}$       | -20                    | V                |
| Gate-Source Voltage                    | $V_{GS}$       | $\pm 12$               | V                |
| Continuous Drain Current               | $I_D$          | $T_A=25^\circ\text{C}$ | -1.4             |
|  |                | $T_A=70^\circ\text{C}$ | -1.2             |
| Pulsed Drain Current <sup>C</sup>      | $I_{DM}$       | -13                    | A                |
| Power Dissipation <sup>B</sup>         | $P_D$          | $T_A=25^\circ\text{C}$ | 0.35             |
|  |                | $T_A=70^\circ\text{C}$ | 0.22             |
| 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>   | $R_{\theta JA}$ | 300          | 360 | $^\circ\text{C}/\text{W}$ |
| Maximum Junction-to-Ambient <sup>A,D</sup> |                 | Steady-State | 350 | 425                       |
| Maximum Junction-to-Lead                   | $R_{\theta JL}$ | 280          | 320 | $^\circ\text{C}/\text{W}$ |

**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   | -20  |       |          | V     |
| I <sub>DSS</sub>            | Zero Gate Voltage Drain Current       | V <sub>DS</sub> =-20V, 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   |      |       | ±10      | μA    |
| V <sub>GS(th)</sub>         | Gate Threshold Voltage                | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =-250μA                                   | -0.5 | -0.85 | -1.2     | V     |
| I <sub>D(ON)</sub>          | On state drain current                | V <sub>GS</sub> =-4.5V, V <sub>DS</sub> =-5V  | -13  |       |          | A     |
| R <sub>DS(ON)</sub>         | Static Drain-Source On-Resistance     | V <sub>GS</sub> =-10V, I <sub>D</sub> =-1.4A<br>T <sub>J</sub> =125°C                       |      | 94    | 113      | mΩ    |
|                             |                                       | V <sub>GS</sub> =-4.5V, I <sub>D</sub> =-1.3A   |      | 111   | 135      |       |
|                             |                                       | V <sub>GS</sub> =-2.5V, I <sub>D</sub> =-1.1A   |      | 150   | 180      | mΩ    |
| g <sub>FS</sub>             | Forward Transconductance              | V <sub>DS</sub> =-5V, I <sub>D</sub> =-1.4A   |      | 5     |          | S     |
| V <sub>SD</sub>             | Diode Forward Voltage                 | I <sub>S</sub> =-1A, V <sub>GS</sub> =0V  |      | -0.76 | -1       | V     |
| I <sub>S</sub>              | Maximum Body-Diode Continuous Current |   |      |       | -1       | A     |
| <b>DYNAMIC PARAMETERS</b>   |                                       |   |      |       |          |       |
| C <sub>iss</sub>            | Input Capacitance                     | V <sub>GS</sub> =0V, V <sub>DS</sub> =-10V, f=1MHz  | 250  | 325   | 400      | pF    |
| C <sub>oss</sub>            | Output Capacitance                    |   | 40   | 63    | 85       | pF    |
| C <sub>rss</sub>            | Reverse Transfer Capacitance          |   | 22   | 37    | 52       | pF    |
| R <sub>g</sub>              | Gate resistance                       | V <sub>GS</sub> =0V, V <sub>DS</sub> =0V, f=1MHz  |      | 11.2  | 17       | Ω     |
| <b>SWITCHING PARAMETERS</b> |                                       |   |      |       |          |       |
| Q <sub>g</sub>              | Total Gate Charge                     | V <sub>GS</sub> =-4.5V, V <sub>DS</sub> =-10V, I <sub>D</sub> =-1.4A                        |      | 3.2   | 4.5      | nC    |
| Q <sub>gs</sub>             | Gate Source Charge                    |   |      | 0.6   |          | nC    |
| Q <sub>gd</sub>             | Gate Drain Charge                     |   |      | 0.9   |          | nC    |
| t <sub>D(on)</sub>          | Turn-On DelayTime                     | V <sub>GS</sub> =-10V, V <sub>DS</sub> =-10V, R <sub>L</sub> =7.1Ω,<br>R <sub>GEN</sub> =3Ω |      | 11    |          | ns    |
| t <sub>r</sub>              | Turn-On Rise Time                     |   |      | 5.5   |          | ns    |
| t <sub>D(off)</sub>         | Turn-Off DelayTime                    |   |      | 22    |          | ns    |
| t <sub>f</sub>              | Turn-Off Fall Time                    |   |      | 8     |          | ns    |
| t <sub>rr</sub>             | Body Diode Reverse Recovery Time      | I <sub>F</sub> =-1.4A, di/dt=100A/μs  |      | 6.1   |          | ns    |
| Q <sub>rr</sub>             | Body Diode Reverse Recovery Charge    | I <sub>F</sub> =-1.4A, di/dt=100A/μs  |      | 1.4   |          | 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

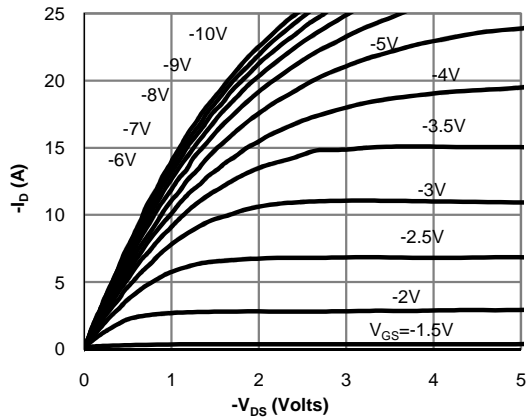


Fig 1: On-Region Characteristics (Note E)

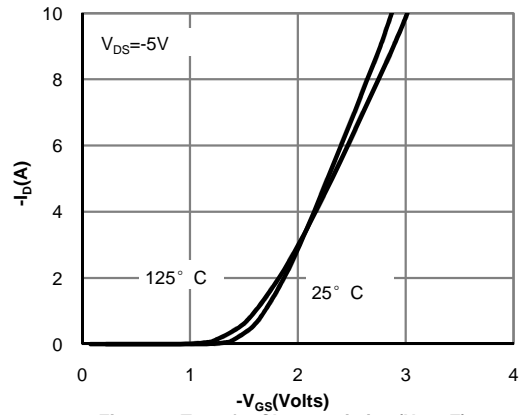


Figure 2: Transfer Characteristics (Note E)

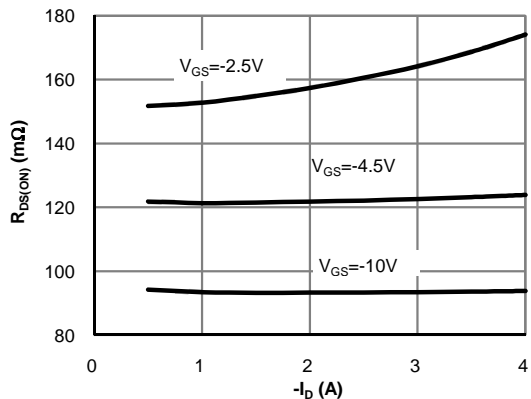


Figure 3: On-Resistance vs. Drain Current and Gate Voltage (Note E)

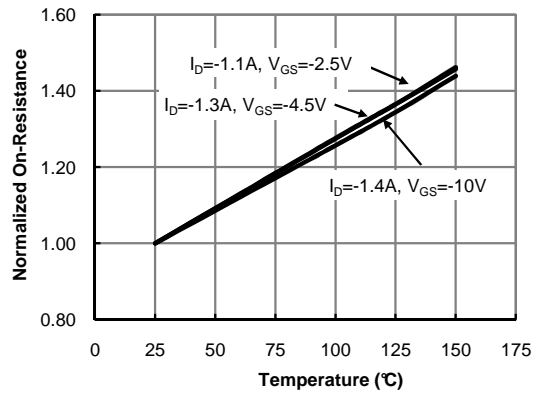


Figure 4: On-Resistance vs. Junction Temperature (Note E)

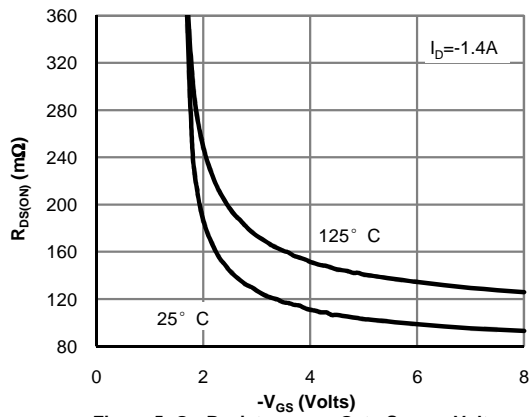


Figure 5: On-Resistance vs. Gate-Source Voltage (Note E)

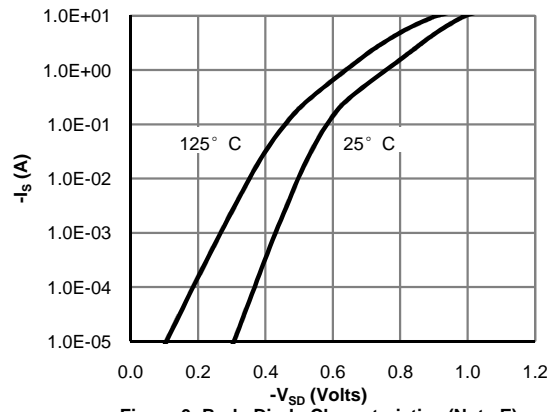


Figure 6: Body-Diode Characteristics (Note E)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

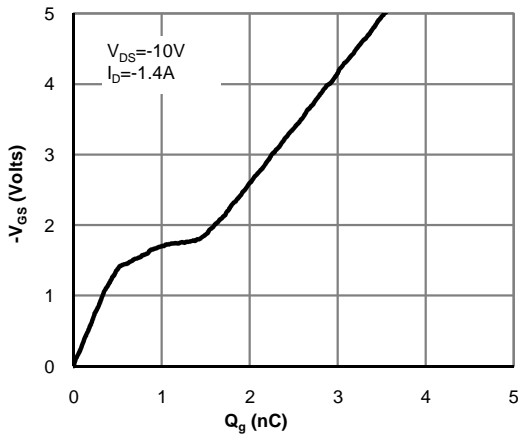


Figure 7: Gate-Charge Characteristics

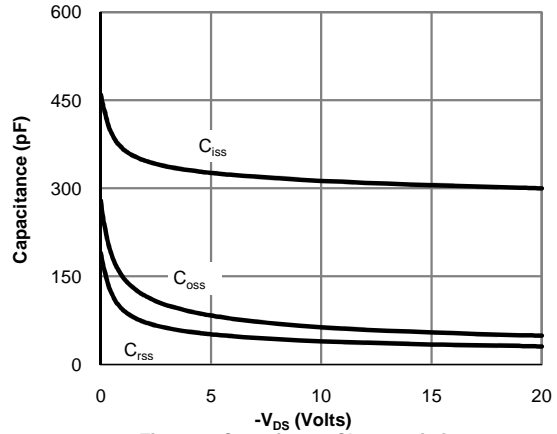


Figure 8: Capacitance Characteristics

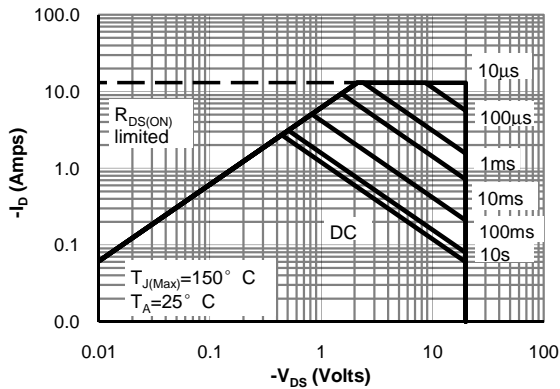


Figure 9: Maximum Forward Biased Safe Operating Area (Note F)

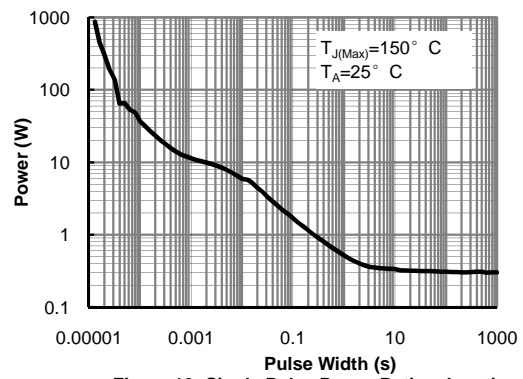


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note F)

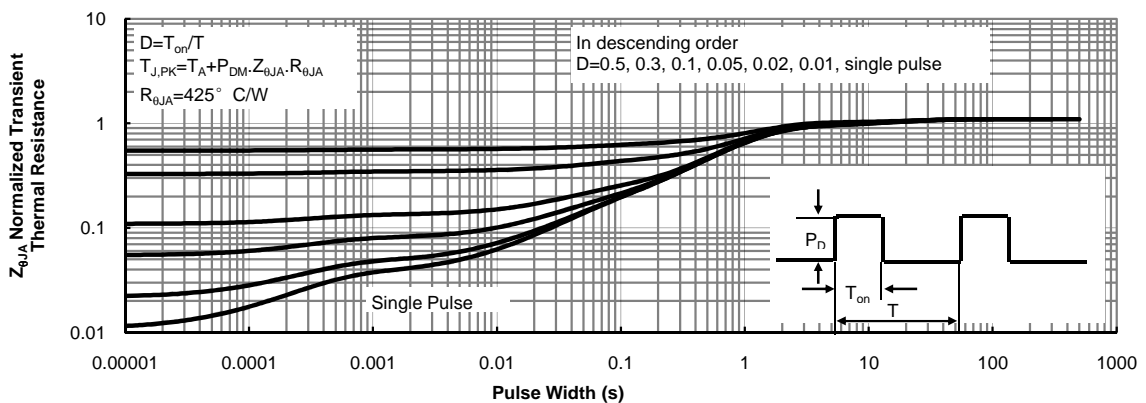
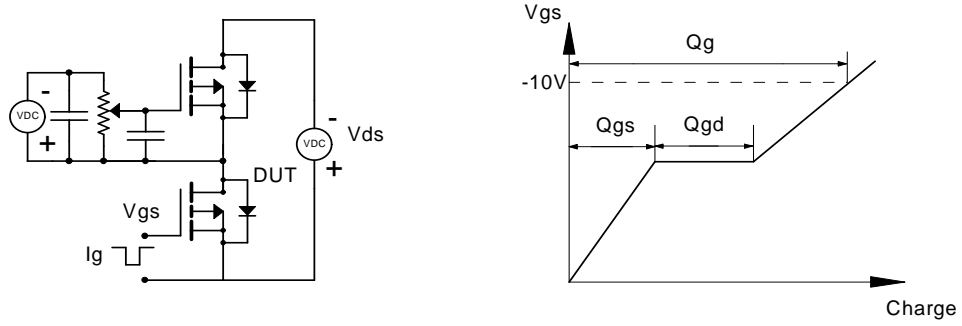
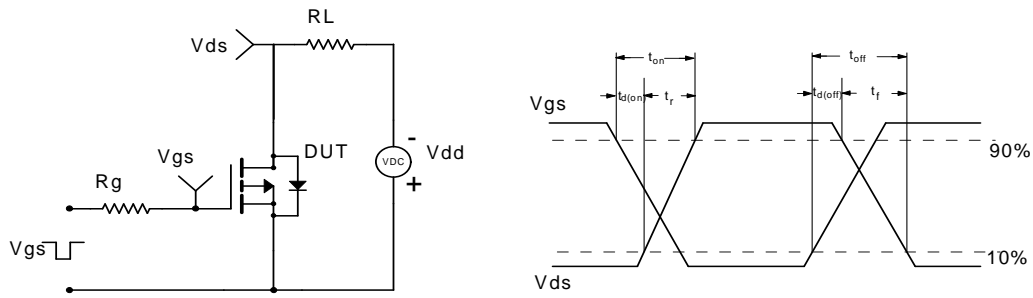


Figure 11: Normalized Maximum Transient Thermal Impedance (Note F)

**Gate Charge Test Circuit & Waveform**



**Resistive Switching Test Circuit & Waveforms**



**Diode Recovery Test Circuit & Waveforms**

