

### General Description

- Trench Power MOSFET technology
- Low  $R_{DS(ON)}$
- With ESD protection to improve battery performance and safety
- Common drain configuration for design simplicity
- RoHS and Halogen-Free Compliant

### Applications

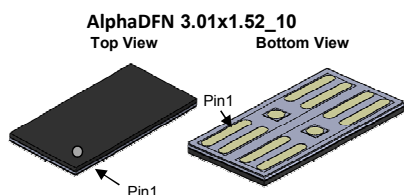
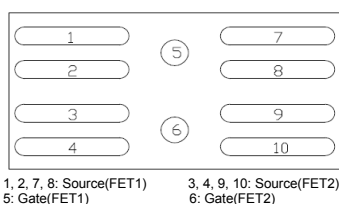
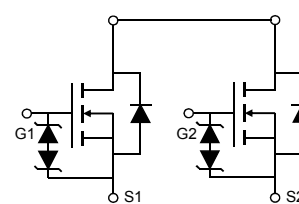
- Battery protection switch
- Mobile device battery charging and discharging

### Product Summary

|                                  |                 |
|----------------------------------|-----------------|
| $V_{SS}$                         | 12V             |
| $R_{DS(ON)}$ (at $V_{GS}=4.5V$ ) | < 2.8m $\Omega$ |
| $R_{DS(ON)}$ (at $V_{GS}=4.0V$ ) | < 3m $\Omega$   |
| $R_{DS(ON)}$ (at $V_{GS}=3.8V$ ) | < 3.2m $\Omega$ |
| $R_{DS(ON)}$ (at $V_{GS}=3.1V$ ) | < 3.7m $\Omega$ |
| $R_{DS(ON)}$ (at $V_{GS}=2.5V$ ) | < 4.7m $\Omega$ |

### Typical ESD protection

HBM Class 2



| Orderable Part Number | Package Type          | Form        | Minimum Order Quantity |
|-----------------------|-----------------------|-------------|------------------------|
| AOC3870               | AlphaDFN 3.01x1.52_10 | Tape & Reel | 8000                   |

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

| Parameter                              | Symbol         | Rating     | Units            |
|----------------------------------------|----------------|------------|------------------|
| Source-Source Voltage                  | $V_{SS}$       | 12         | V                |
| Gate-Source Voltage                    | $V_{GS}$       | $\pm 8$    | V                |
| Source Current(DC) <sup>Note1</sup>    | $I_S$          | 25         | A                |
| Source Current(Pulse) <sup>Note2</sup> | $I_{SM}$       | 130        | A                |
| Power Dissipation <sup>Note1</sup>     | $P_D$          | 2.2        | W                |
| Junction and Storage Temperature Range | $T_J, T_{STG}$ | -55 to 150 | $^\circ\text{C}$ |

### Thermal Characteristics

| Parameter                                | Symbol          | Typical | Units              |
|------------------------------------------|-----------------|---------|--------------------|
| Maximum Junction-to-Ambient $t \leq 10s$ | $R_{\theta JA}$ | 45      | $^\circ\text{C/W}$ |
| Maximum Junction-to-Ambient Steady-State |                 | 55      | $^\circ\text{C/W}$ |

**Note 1.**  $I_S$  rated value is based on bare silicon. Mounted on 70mmx70mm FR-4 board.

**Note 2.** PW < 10  $\mu s$  pulses, duty cycle 1% max.

**Electrical Characteristics (T<sub>J</sub>=25°C unless otherwise noted)**

| Symbol                      | Parameter                             | Conditions                                                                                                | Min        | Typ        | Max        | Units |
|-----------------------------|---------------------------------------|-----------------------------------------------------------------------------------------------------------|------------|------------|------------|-------|
| <b>STATIC PARAMETERS</b>    |                                       |                                                                                                           |            |            |            |       |
| BV <sub>SSS</sub>           | Source-Source Breakdown Voltage       | I <sub>S</sub> =250μA, V <sub>GS</sub> =0V Test Circuit 6                                                 | 12         |            |            | V     |
| I <sub>SSS</sub>            | Zero Gate Voltage Source Current      | V <sub>SS</sub> =12V, V <sub>GS</sub> =0V Test Circuit 1<br>T <sub>J</sub> =55°C                          |            |            | 1<br>5     | μA    |
| I <sub>GSS</sub>            | Gate leakage current                  | V <sub>SS</sub> =0V, V <sub>GS</sub> =±8V Test Circuit 2                                                  |            |            | ±10        | μA    |
| V <sub>GS(th)</sub>         | Gate Threshold Voltage                | V <sub>SS</sub> =V <sub>GS</sub> , I <sub>S</sub> =250μA Test Circuit 3                                   | 0.4        | 0.7        | 1.1        | V     |
| R <sub>SS(ON)</sub>         | Static Source to Source On-Resistance | V <sub>GS</sub> =4.5V, I <sub>S</sub> =5A Test Circuit 4<br>T <sub>J</sub> =125°C                         | 1.6<br>2.2 | 2.3<br>3.2 | 2.8<br>3.9 | mΩ    |
|                             |                                       | V <sub>GS</sub> =4.0V, I <sub>S</sub> =5A Test Circuit 4                                                  | 1.7        | 2.4        | 3.0        | mΩ    |
|                             |                                       | V <sub>GS</sub> =3.8V, I <sub>S</sub> =5A Test Circuit 4                                                  | 1.75       | 2.45       | 3.2        | mΩ    |
|                             |                                       | V <sub>GS</sub> =3.1V, I <sub>S</sub> =5A Test Circuit 4                                                  | 1.9        | 2.75       | 3.7        | mΩ    |
|                             |                                       | V <sub>GS</sub> =2.5V, I <sub>S</sub> =5A Test Circuit 4                                                  | 2.2        | 3.2        | 4.7        | mΩ    |
| g <sub>FS</sub>             | Forward Transconductance              | V <sub>SS</sub> =5V, I <sub>S</sub> =5A Test Circuit 3                                                    |            | 50         |            | S     |
| V <sub>FSS</sub>            | Forward Source to Source Voltage      | I <sub>S</sub> =1A, V <sub>GS</sub> =0V Test Circuit 5                                                    |            | 0.57       | 1          | V     |
| <b>DYNAMIC PARAMETERS</b>   |                                       |                                                                                                           |            |            |            |       |
| R <sub>g</sub>              | Gate resistance                       | f=1MHz                                                                                                    |            | 1.2        |            | KΩ    |
| <b>SWITCHING PARAMETERS</b> |                                       |                                                                                                           |            |            |            |       |
| Q <sub>g</sub>              | Total Gate Charge                     | V <sub>G1S1</sub> =4.5V, V <sub>SS</sub> =6V, I <sub>S</sub> =5A                                          |            | 32         |            | nC    |
| t <sub>D(on)</sub>          | Turn-On DelayTime                     | V <sub>G1S1</sub> =4.5V, V <sub>SS</sub> =6V, R <sub>L</sub> =1.2Ω,<br>R <sub>GEN</sub> =3Ω Test Circuit8 |            | 1.2        |            | μs    |
| t <sub>r</sub>              | Turn-On Rise Time                     |                                                                                                           |            | 3.0        |            | μs    |
| t <sub>D(off)</sub>         | Turn-Off DelayTime                    |                                                                                                           |            | 3.1        |            | μs    |
| t <sub>f</sub>              | Turn-Off Fall Time                    |                                                                                                           |            | 8.2        |            | μs    |

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TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

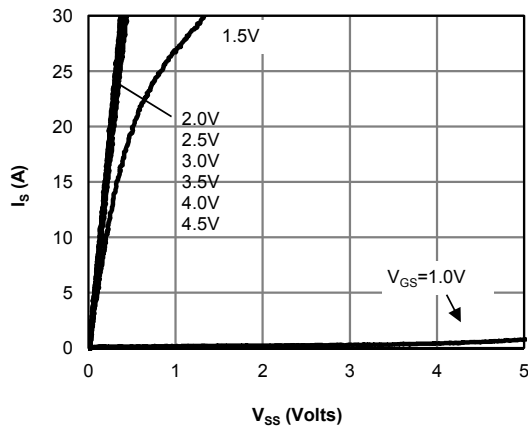


Figure 1: On-Region Characteristics

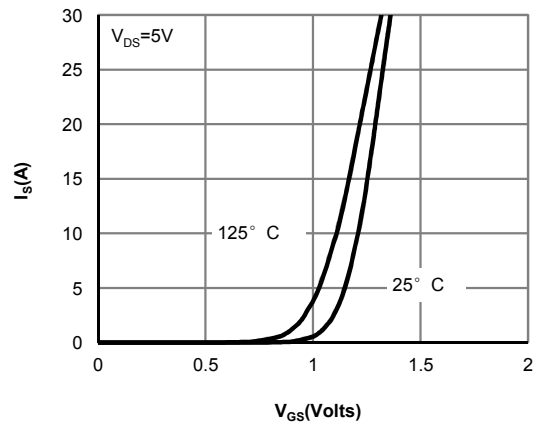


Figure 2: Transfer Characteristics

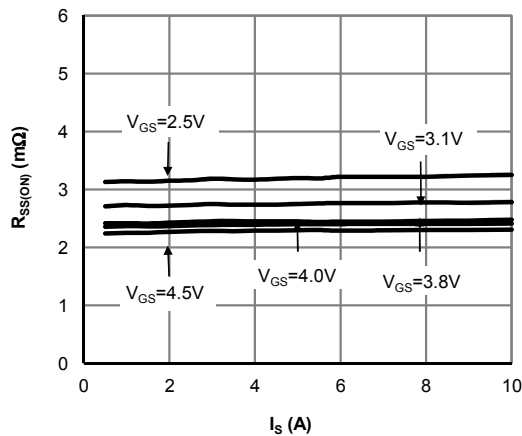


Figure 3: On-Resistance vs. Source Current and Gate Voltage

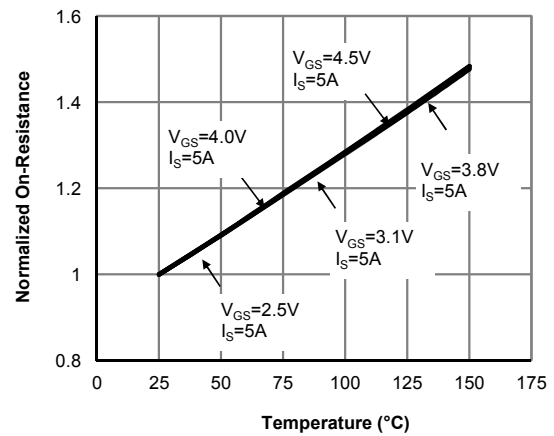


Figure 4: On-Resistance vs. Junction Temperature

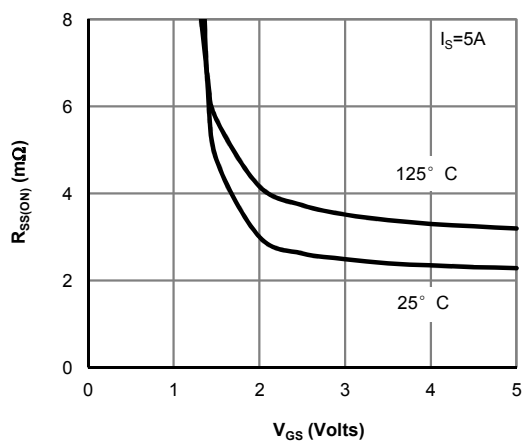


Figure 5: On-Resistance vs. Gate-Source Voltage

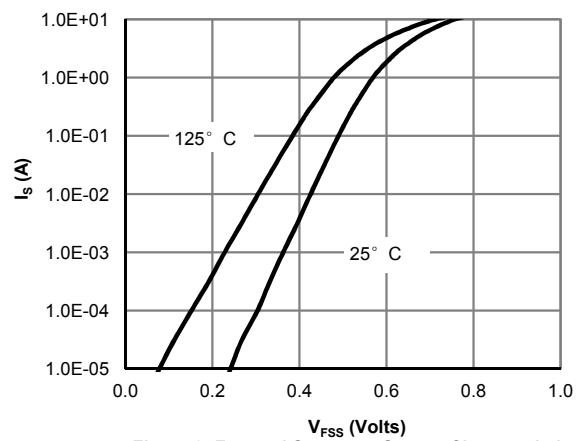


Figure 6: Forward Source to Source Characteristics



## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

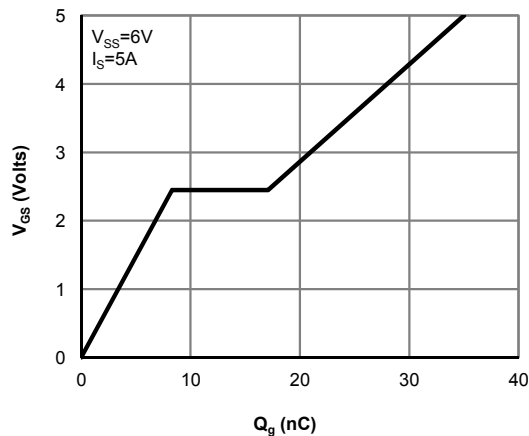


Figure 7: Gate-Charge Characteristics

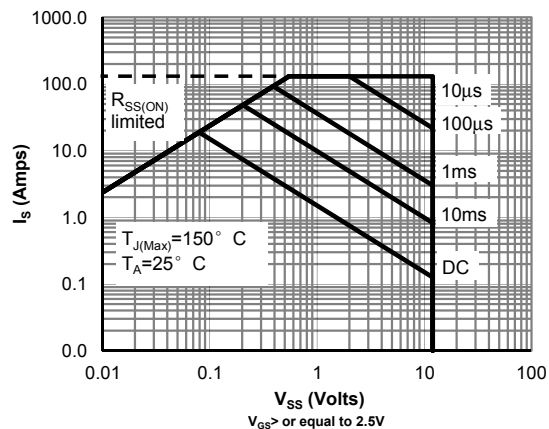


Figure 8: Maximum Forward Biased Safe Operating Area (Note1)

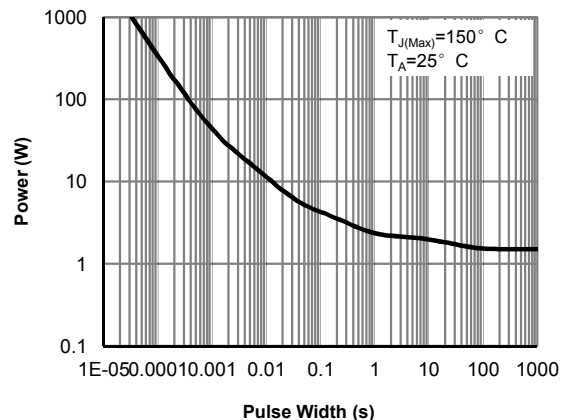


Figure 9: Single Pulse Power Rating Junction-to-Ambient (Note1)

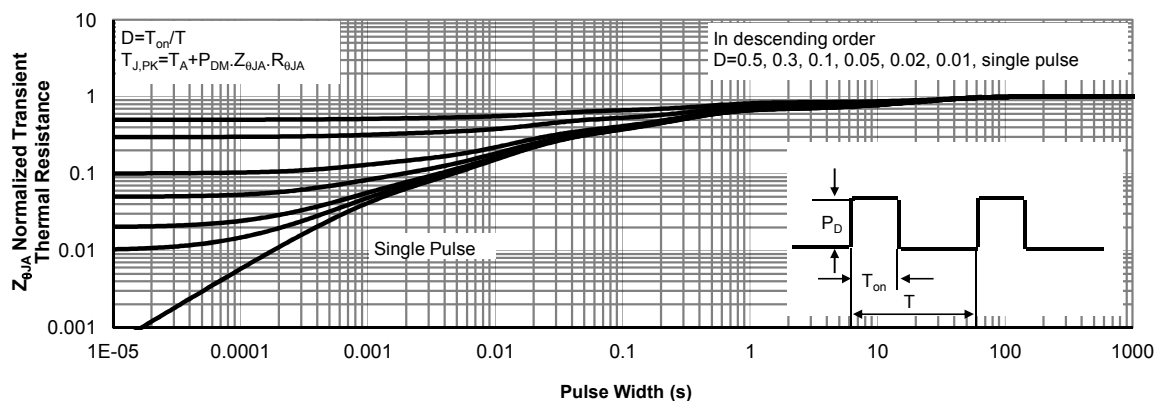
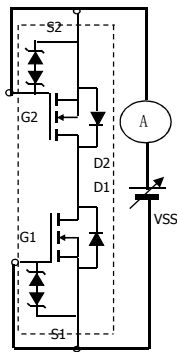


Figure 10: Normalized Maximum Transient Thermal Impedance (Note1)

**TEST CIRCUIT 1  $I_{SSS}$**

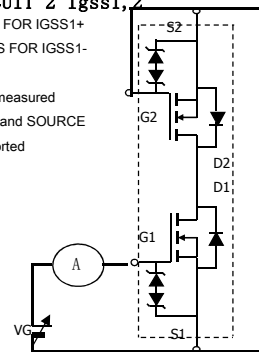
POSITIVE VSS FOR ISSS+  
NEGATIVE VSS FOR ISSS-



**TEST CIRCUIT 2  $I_{gss1,2}$**

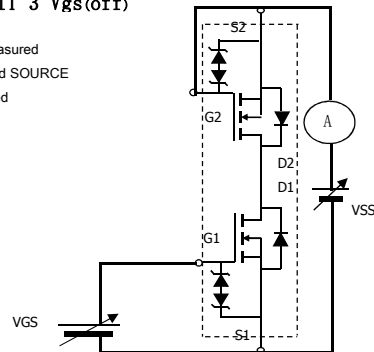
POSITIVE VGS FOR IGSS1+  
NEGATIVE VGS FOR IGSS1-

When FET1 is measured  
between GATE and SOURCE  
of FET2 are shorted



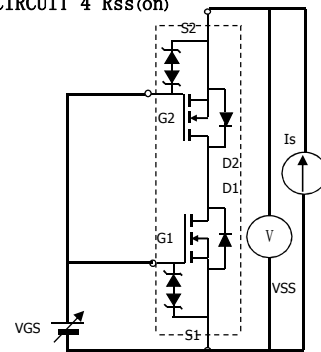
**TEST CIRCUIT 3  $V_{gs(off)}$**

When FET1 is measured  
between GATE and SOURCE  
of FET2 are shorted



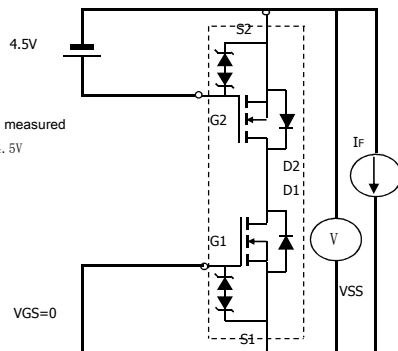
**TEST CIRCUIT 4  $R_{ss(on)}$**

Vss/Is



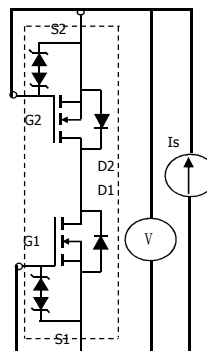
**TEST CIRCUIT 5  $V_{F(ss)1,2}$**

When FET1 measured  
FET2  $V_{GS}=4.5V$



**TEST CIRCUIT 6  $BV_{DSS}$**

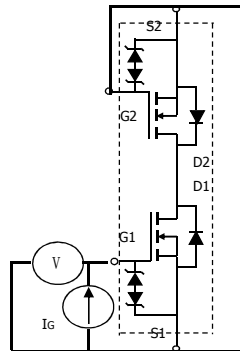
POSITIVE VSS FOR ISSS+  
NEGATIVE VSS FOR ISSS-



**TEST CIRCUIT 7  $BV_{GS01,2}$**

POSITIVE VSS FOR ISSS+  
NEGATIVE VSS FOR ISSS-

When FET1 is measured  
between GATE and SOURCE  
of FET2 are shorted



**TEST CIRCUIT 8**

Switching time

