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# MOSFET - Power, Single N-Channel, SO-8 FL 30 V, 3.4 m $\Omega$ , 71 A

## **NVMFS4C306N**

#### **Features**

- Low R<sub>DS(on)</sub> to Minimize Conduction Losses
- Low Capacitance to Minimize Driver Losses
- Optimized Gate Charge to Minimize Switching Losses
- AEC-Q101 Qualified and PPAP Capable
- NVMFS4C306NWF Wettable Flanks Option for Enhanced Optical Inspection
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

#### **Applications**

- Reverse Battery Protection
- DC-DC Converters Output Driver

#### MAXIMUM RATINGS (T<sub>J</sub> = 25°C unless otherwise stated)

| Parameter  |                                     |                        | Symbol                            | Value          | Unit |
|--|-------------------------------------|------------------------|-----------------------------------|----------------|------|
| Drain-to-Source Voltage  |                                     |                        | $V_{DSS}$                         | 30             | ٧    |
| Gate-to-Source Volta   | Gate-to-Source Voltage              |                        |                                   | ±20            | ٧    |
| Continuous Drain<br>Current R <sub>B.IA</sub>  |                                     | T <sub>A</sub> = 25°C  | I <sub>D</sub>                    | 20.6           | Α    |
| (Notes 1, 2)   |                                     | T <sub>A</sub> = 100°C |                                   | 14.5           |      |
| Power Dissipation R <sub>θJA</sub> (Notes 1, 2)  |                                     | T <sub>A</sub> = 25°C  | P <sub>D</sub>                    | 3              | W    |
| Continuous Drain<br>Current R <sub>0</sub> JC<br>(Notes 1, 2, 3)   | Steady<br>State                     | T <sub>C</sub> = 25°C  | I <sub>D</sub>                    | 71             | Α    |
| Continuous Drain<br>Current R <sub>θJC</sub><br>(Notes 1, 2, 3)  |                                     | T <sub>C</sub> = 100°C |                                   | 50             |      |
| Power Dissipation R <sub>θJC</sub> (Notes 1, 2, 3)   |                                     | T <sub>C</sub> = 25°C  | P <sub>D</sub>                    | 36.5           | W    |
| Pulsed Drain Current   | $T_A = 25^{\circ}C, t_p = 10 \mu s$ |                        | I <sub>DM</sub>                   | 166            | Α    |
| Operating Junction and Storage Temperature Range   |                                     |                        | T <sub>J</sub> , T <sub>STG</sub> | -55 to<br>+175 | °C   |
| Source Current (Body Diode)  |                                     |                        | Is                                | 28             | Α    |
| Single Pulse Drain–to–Source Avalanche Energy ( $T_J$ = 25°C, $V_{GS}$ = 10 V, $I_L$ = 37 $A_{pk}$ , $L$ = 0.1 mH, $R_{GS}$ = 25 $\Omega$ ) (Note 3) |                                     |                        | E <sub>AS</sub>                   | 68             | mJ   |
| Lead Temperature for Soldering Purposes (1/8" from case for 10 s)  |                                     |                        | TL                                | 260            | °C   |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

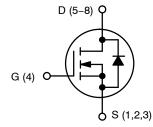
- 1. Surface-mounted on FR4 board using 1 sq-in pad, 1 oz Cu.
- 2. Surface-mounted on FR4 board using the minimum recommended pad size.
- 3. Parts are 100% tested at  $T_J = 25^{\circ}C$ ,  $V_{GS} = 10$  V,  $I_L = 27$  Apk,  $E_{AS} = 36$  mJ.



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| V <sub>(BR)DSS</sub> | R <sub>DS(ON)</sub> MAX | I <sub>D</sub> MAX |
|----------------------|-------------------------|--------------------|
| 30 V                 | 3.4 mΩ @ 10 V           | 71 A               |
| 30 V                 | 4.8 mΩ @ 4.5 V          | 71 A               |



**N-CHANNEL MOSFET** 



# S XXXXXXX S AYWZZ

MARKING DIAGRAM

4C06N = Specific Device Code for NVMFS4C306N

4C06WF= Specific Device Code of NVMFS4C306NWF

A = Assembly Location

Y = Year
W = Work Week
ZZ = Lot Traceability

#### ORDERING INFORMATION

| Device           | Package              | Shipping <sup>†</sup> |
|------------------|----------------------|-----------------------|
| NVMFS4C306NT1G   | SO-8 FL<br>(Pb-Free) | 1500 /<br>Tape & Reel |
| NVMFS4C306NWFT1G | SO-8 FL<br>(Pb-Free) | 1500 /<br>Tape & Reel |

<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

#### THERMAL RESISTANCE MAXIMUM RATINGS

| Parameter                          | Symbol         | Value | Unit |
|------------------------------------|----------------|-------|------|
| Junction-to-Case (Drain)           | $R_{	heta JC}$ | 4.1   | °C/W |
| Junction-to-Ambient - Steady State | $R_{	heta JA}$ | 49    | C/VV |

| Parameter  | Symbol                              | Test Condition   |                       | Min | Тур   | Max  | Unit       |
|--|-------------------------------------|--|-----------------------|-----|-------|------|------------|
| OFF CHARACTERISTICS  |                                     |  |                       |     |       | •    |            |
| Drain-to-Source Breakdown Voltage                            | V <sub>(BR)DSS</sub>                | $V_{GS} = 0 \text{ V}, I_D = 250 \mu\text{A}$  |                       | 30  |       |      | V          |
| Drain-to-Source Breakdown Voltage (transient)                | V <sub>(BR)DSSt</sub>               | $V_{GS}$ = 0 V, $I_{D(aval)}$ = 12.6 A, $T_{case}$ = 25°C, $t_{transient}$ = 100 ns                    |                       | 34  |       |      | ٧          |
| Drain-to-Source Breakdown Voltage<br>Temperature Coefficient | V <sub>(BR)DSS</sub> /              |  |                       |     | 14.4  |      | mV/°C      |
| Zero Gate Voltage Drain Current                              | I <sub>DSS</sub>                    | $V_{GS} = 0 \text{ V}, \ V_{DS} = 24 \text{ V}$ $T_J = 25^{\circ}\text{C}$ $T_J = 125^{\circ}\text{C}$ |                       |     |       | 1.0  | μΑ         |
|  |                                     |  |                       |     |       | 10   |            |
| Gate-to-Source Leakage Current                               | I <sub>GSS</sub>                    | $V_{DS} = 0 V, V_{GS}$   | = ±20 V               |     |       | ±100 | nA         |
| ON CHARACTERISTICS (Note 4)                                  |                                     |  |                       |     |       |      |            |
| Gate Threshold Voltage                                       | V <sub>GS(TH)</sub>                 | $V_{GS} = V_{DS}, I_D$   | = 250 μΑ              | 1.3 |       | 2.1  | V          |
| Negative Threshold Temperature Coefficient                   | V <sub>GS(TH)</sub> /T <sub>J</sub> |  |                       |     | 3.8   |      | mV/°C      |
| Drain-to-Source On Resistance                                | R <sub>DS(on)</sub>                 | V <sub>GS</sub> = 10 V   | I <sub>D</sub> = 30 A |     | 2.8   | 3.4  | <b>~</b> 0 |
|  |                                     | V <sub>GS</sub> = 4.5 V  | I <sub>D</sub> = 30 A |     | 4.0   | 4.8  | mΩ         |
| Forward Transconductance                                     | 9FS                                 | V <sub>DS</sub> = 1.5 V, I <sub>D</sub> = 15 A   |                       |     | 58    |      | S          |
| Gate Resistance  | $R_{G}$                             | T <sub>A</sub> = 25°C  |                       | 0.3 | 1.0   | 2.0  | Ω          |
| CHARGES AND CAPACITANCES                                     |                                     |  |                       |     |       |      |            |
| Input Capacitance  | C <sub>ISS</sub>                    | V <sub>GS</sub> = 0 V, f = 1 MHz, V <sub>DS</sub> = 15 V   |                       |     | 1683  |      | pF         |
| Output Capacitance   | C <sub>OSS</sub>                    |  |                       |     | 841   |      |            |
| Reverse Transfer Capacitance                                 | C <sub>RSS</sub>                    |  |                       |     | 40    |      |            |
| Capacitance Ratio  | C <sub>RSS</sub> /C <sub>ISS</sub>  | V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 15 V, f = 1 MHz   |                       |     | 0.023 |      |            |
| Total Gate Charge  | Q <sub>G(TOT)</sub>                 |  |                       |     | 11.6  |      |            |
| Threshold Gate Charge  | Q <sub>G(TH)</sub>                  |  |                       |     | 2.6   |      | 1          |
| Gate-to-Source Charge  | $Q_{GS}$                            | $V_{GS} = 4.5 \text{ V}, V_{DS} = 15 \text{ V}; I_D = 30 \text{ A}$                                    |                       |     | 4.7   |      | nC         |
| Gate-to-Drain Charge   | $Q_{GD}$                            |  |                       |     | 4.0   |      |            |
| Gate Plateau Voltage   | $V_{GP}$                            |  |                       |     | 3.1   |      | V          |
| Total Gate Charge  | Q <sub>G(TOT)</sub>                 | V <sub>GS</sub> = 10 V, V <sub>DS</sub> = 15 V; I <sub>D</sub> = 30 A                                  |                       |     | 26    |      | nC         |
| SWITCHING CHARACTERISTICS (Note 5)                           |                                     |  |                       |     |       | •    |            |
| Turn-On Delay Time   | t <sub>d(ON)</sub>                  | $V_{GS}$ = 4.5 V, $V_{DS}$ = 15 V, $I_{D}$ = 15 A, $R_{G}$ = 3.0 $\Omega$                              |                       |     | 10    |      |            |
| Rise Time  | t <sub>r</sub>                      |  |                       |     | 32    |      | ns         |
| Turn-Off Delay Time  | t <sub>d(OFF)</sub>                 |  |                       |     | 18    |      |            |
| Fall Time  | t <sub>f</sub>                      |  |                       |     | 5.0   |      |            |
| Turn-On Delay Time   | t <sub>d(ON)</sub>                  |  |                       |     | 8.0   |      |            |
| Rise Time  | t <sub>r</sub>                      | VG9 = 10 V. Vn   | e = 15 V              |     | 28    |      |            |
| Turn-Off Delay Time  | t <sub>d(OFF)</sub>                 | $V_{GS}$ = 10 V, $V_{DS}$ = 15 V, $I_{D}$ = 15 A, $R_{G}$ = 3.0 $\Omega$                               |                       |     | 24    |      | ns         |
| Fall Time  | t <sub>f</sub>                      |  |                       |     | 3.0   |      |            |

- 4. Pulse Test: pulse width  $\leq 300~\mu s$ , duty cycle  $\leq 2\%$ . 5. Switching characteristics are independent of operating junction temperatures.

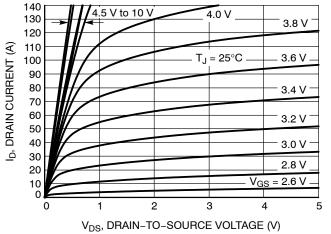
#### **ELECTRICAL CHARACTERISTICS** (T<sub>J</sub> = 25°C unless otherwise specified)

| Parameter                          | Symbol          | Test Condition   |                        | Min | Тур  | Max | Unit |  |  |
|------------------------------------|-----------------|--|------------------------|-----|------|-----|------|--|--|
| DRAIN-SOURCE DIODE CHARACTERISTICS |                 |  |                        |     |      |     |      |  |  |
| Forward Diode Voltage              | $V_{SD}$        | V <sub>GS</sub> = 0 V,<br>I <sub>S</sub> = 10 A                | T <sub>J</sub> = 25°C  |     | 0.8  | 1.1 | V    |  |  |
|                                    |                 |  | T <sub>J</sub> = 125°C |     | 0.63 |     |      |  |  |
| Reverse Recovery Time              | t <sub>RR</sub> | $V_{GS}$ = 0 V, dIS/dt = 100 A/ $\mu$ s, I <sub>S</sub> = 30 A |                        |     | 34   |     |      |  |  |
| Charge Time                        | t <sub>a</sub>  |  |                        |     | 17   |     | ns   |  |  |
| Discharge Time                     | t <sub>b</sub>  |  |                        |     | 17   |     |      |  |  |
| Reverse Recovery Charge            | $Q_{RR}$        |  |                        |     | 22   |     | nC   |  |  |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

<sup>4.</sup> Pulse Test: pulse width  $\leq$  300  $\mu$ s, duty cycle  $\leq$  2%. 5. Switching characteristics are independent of operating junction temperatures.

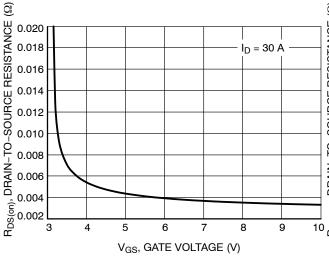
#### **TYPICAL CHARACTERISTICS**



80 70  $V_{DS} = 5 V$ ID, DRAIN CURRENT (A) 60 50 40 30  $T_J = 25^{\circ}C$ 20  $T_J = 125^{\circ}C$ 10  $T_J = -55^{\circ}C$ 0 0.5 1.0 1.5 2.5 3.0 3.5 2.0 V<sub>GS</sub>, GATE-TO-SOURCE VOLTAGE (V)

Figure 1. On-Region Characteristics

Figure 2. Transfer Characteristics



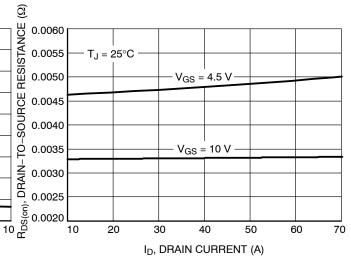
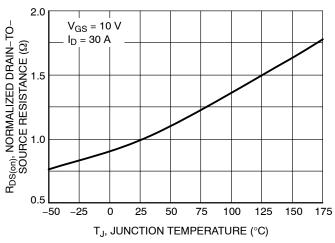


Figure 3. On-Resistance vs. Gate-to-Source Voltage

Figure 4. On-Resistance vs. Drain Current and Gate Voltage



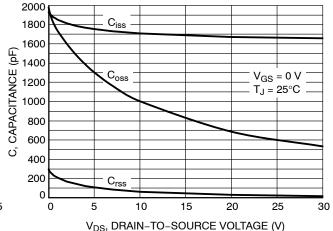


Figure 5. On–Resistance Variation with Temperature

Figure 6. Capacitance Variation

#### **TYPICAL CHARACTERISTICS**

1000

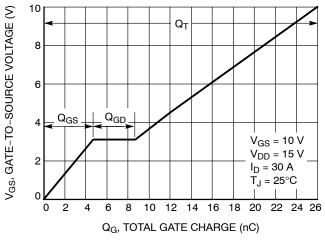
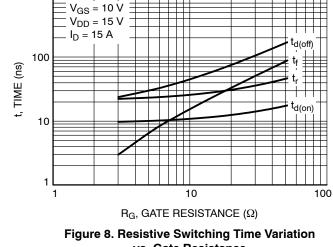


Figure 7. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge



vs. Gate Resistance

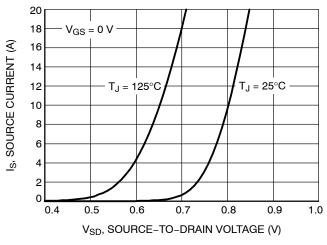


Figure 9. Diode Forward Voltage vs. Current

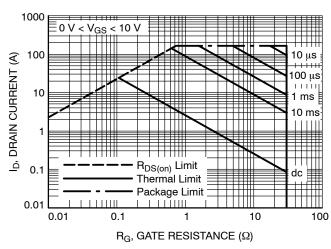


Figure 10. Maximum Rated Forward Biased Safe Operating Area

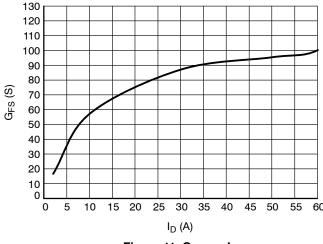


Figure 11. G<sub>FS</sub> vs. I<sub>D</sub>

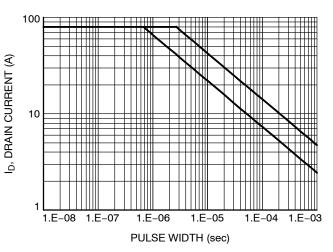


Figure 12. Avalanche Characteristics

#### **TYPICAL CHARACTERISTICS**

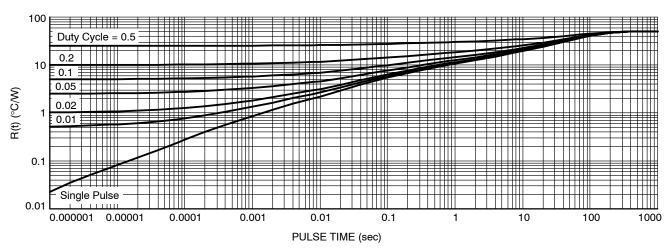
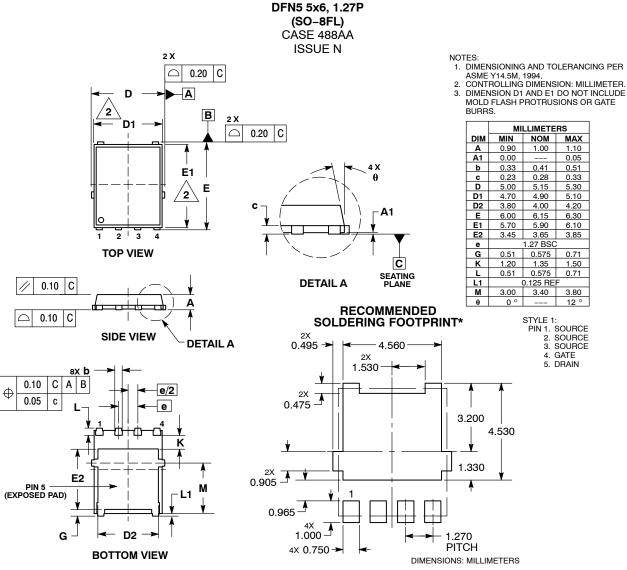


Figure 13. Thermal Response

#### PACKAGE DIMENSIONS



\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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