DATA SHEET
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## MOSFET－Power，Single N－Channel

40 V， $0.7 \mathrm{~m} \Omega, 378$ A

## NVMFS5C404N

## Features

－Small Footprint（ $5 \times 6 \mathrm{~mm}$ ）for Compact Design
－Low $\mathrm{R}_{\mathrm{DS}(\text { on })}$ to Minimize Conduction Losses
－Low $\mathrm{Q}_{\mathrm{G}}$ and Capacitance to Minimize Driver Losses
－NVMFS5C404NWF－Wettable Flank Option for Enhanced Optical Inspection
－AEC－Q101 Qualified and PPAP Capable
－These Devices are $\mathrm{Pb}-$ Free and are RoHS Compliant
MAXIMUM RATINGS $\left(T_{J}=25^{\circ} \mathrm{C}\right.$ unless otherwise noted）

| Parameter |  |  | Symbol | Value | Unit |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Drain－to－Source Voltage |  |  | $\mathrm{V}_{\text {DSS }}$ | 40 | V |
| Gate－to－Source Voltage |  |  | $\mathrm{V}_{\mathrm{GS}}$ | $\pm 20$ | V |
| Continuous Drain Current $\mathrm{R}_{\text {日JC }}$ （Notes 1，3） | Steady State | $\mathrm{T}_{\mathrm{C}}=25^{\circ} \mathrm{C}$ | ID | 378 | A |
|  |  | $\mathrm{T}_{\mathrm{C}}=100^{\circ} \mathrm{C}$ |  | 267 |  |
| Power Dissipation $\mathrm{R}_{\text {日JC }}$（Note 1） |  | $\mathrm{T}_{\mathrm{C}}=25^{\circ} \mathrm{C}$ | $\mathrm{P}_{\mathrm{D}}$ | 200 | W |
|  |  | $\mathrm{T}_{\mathrm{C}}=100^{\circ} \mathrm{C}$ |  | 100 |  |
| Continuous Drain <br> Current $\mathrm{R}_{\theta \mathrm{JA}}$ <br> （Notes 1，2，3） | Steady State | $\mathrm{T}_{\mathrm{A}}=25^{\circ} \mathrm{C}$ | $\mathrm{I}_{\mathrm{D}}$ | 53 | A |
|  |  | $\mathrm{T}_{\mathrm{A}}=100^{\circ} \mathrm{C}$ |  | 37 |  |
| Power Dissipation <br> $\mathrm{R}_{\text {өJA }}$（Notes 1，2） |  | $\mathrm{T}_{\mathrm{A}}=25^{\circ} \mathrm{C}$ | $\mathrm{P}_{\mathrm{D}}$ | 3.9 | W |
|  |  | $\mathrm{T}_{\mathrm{A}}=100^{\circ} \mathrm{C}$ |  | 1.9 |  |
| Pulsed Drain Current | $\mathrm{T}_{\mathrm{A}}=25$ | $\mathrm{C}, \mathrm{t}_{\mathrm{p}}=10 \mu \mathrm{~s}$ | IDM | 900 | A |
| Operating Junction and Storage Temperature Range |  |  | $\mathrm{T}_{\mathrm{J}}, \mathrm{T}_{\text {stg }}$ | $\begin{gathered} -55 \mathrm{to} \\ +175 \end{gathered}$ | ${ }^{\circ} \mathrm{C}$ |
| Source Current（Body Diode） |  |  | Is | 191 | A |
| Single Pulse Drain－to－Source Avalanche Energy（ $\mathrm{L}_{\mathrm{L}(\mathrm{pk})}=38 \mathrm{~A}$ ） |  |  | $\mathrm{E}_{\text {AS }}$ | 907 | mJ |
| Lead Temperature for Soldering Purposes （ $1 / 8^{\prime \prime}$ from case for 10 s ） |  |  | TL | 260 | ${ }^{\circ} \mathrm{C}$ |

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．

THERMAL RESISTANCE MAXIMUM RATINGS

| Parameter | Symbol | Value | Unit |
| :--- | :---: | :---: | :---: |
| Junction－to－Case－Steady State | $\mathrm{R}_{\text {日JC }}$ | 0.75 | ${ }^{\circ} \mathrm{C} / \mathrm{W}$ |
| Junction－to－Ambient－Steady State（Note 2） | $\mathrm{R}_{\text {日JA }}$ | 39 |  |

1．The entire application environment impacts the thermal resistance values shown， they are not constants and are only valid for the particular conditions noted．
2．Surface－mounted on FR4 board using a $650 \mathrm{~mm}^{2}, 2 \mathrm{oz}$ ．Cu pad．
3．Maximum current for pulses as long as 1 second is higher but is dependent on pulse duration and duty cycle．

| $\mathbf{V}_{\text {（BR）DSS }}$ | $\mathbf{R}_{\text {DS（ON）}}$ MAX | $\mathbf{I}_{\mathrm{D}}$ MAX |
| :---: | :---: | :---: |
| 40 V | $0.7 \mathrm{~m} \Omega @ 10 \mathrm{~V}$ | 378 A |



N－CHANNEL MOSFET


XXXXXX＝Specific Device Code
A＝Assembly Location
Y＝Year
W＝Work Week
ZZ＝Lot Traceability

## ORDERING INFORMATION

See detailed ordering，marking and shipping information on page 5 of this data sheet．

ELECTRICAL CHARACTERISTICS $\left(\mathrm{T}_{J}=25^{\circ} \mathrm{C}\right.$ unless otherwise specified)


ON CHARACTERISTICS (Note 4)

| Gate Threshold Voltage | $\mathrm{V}_{\mathrm{GS}(\mathrm{TH})}$ | $\mathrm{V}_{\mathrm{GS}}=\mathrm{V}_{\mathrm{DS}}, \mathrm{I}_{\mathrm{D}}=250 \mu \mathrm{~A}$ |  | 2.0 |  | 4.0 |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: |
| Threshold Temperature Coefficient | $\mathrm{V}_{\mathrm{GS}(\mathrm{TH})} / \mathrm{T}_{\mathrm{J}}$ |  |  | V |  |  |
| Drain-to-Source On Resistance | $\mathrm{R}_{\mathrm{DS}(\text { on })}$ | $\mathrm{V}_{\mathrm{GS}}=10 \mathrm{~V}$ | $\mathrm{I}_{\mathrm{D}}=50 \mathrm{~A}$ |  | 0.57 | 0.7 |
| Forward Transconductance | $\mathrm{g}_{\mathrm{FS}}$ | $\mathrm{V}_{\mathrm{DS}}=15 \mathrm{~V}, \mathrm{I}_{\mathrm{D}}=50 \mathrm{~A}$ |  | 210 | $\mathrm{mV} \Omega$ |  |

CHARGES, CAPACITANCES \& GATE RESISTANCE

| Input Capacitance | $\mathrm{Cl}_{\text {ISS }}$ | $\mathrm{V}_{\mathrm{GS}}=0 \mathrm{~V}, \mathrm{f}=1 \mathrm{MHz}, \mathrm{V}_{\mathrm{DS}}=25 \mathrm{~V}$ | 8400 | pF |
| :---: | :---: | :---: | :---: | :---: |
| Output Capacitance | Coss |  | 4600 |  |
| Reverse Transfer Capacitance | $\mathrm{C}_{\text {RSS }}$ |  | 120 |  |
| Total Gate Charge | $\mathrm{Q}_{\mathrm{G} \text { (TOT) }}$ | $\mathrm{V}_{\mathrm{GS}}=10 \mathrm{~V}, \mathrm{~V}_{\mathrm{DS}}=20 \mathrm{~V} ; \mathrm{I}_{\mathrm{D}}=50 \mathrm{~A}$ | 128 | nC |
| Threshold Gate Charge | $\mathrm{Q}_{\mathrm{G}(\mathrm{TH})}$ | $\mathrm{V}_{\mathrm{GS}}=10 \mathrm{~V}, \mathrm{~V}_{\mathrm{DS}}=20 \mathrm{~V} ; \mathrm{I}_{\mathrm{D}}=50 \mathrm{~A}$ | 22 |  |
| Gate-to-Source Charge | $Q_{G S}$ |  | 35 |  |
| Gate-to-Drain Charge | $Q_{G D}$ |  | 26 |  |
| Plateau Voltage | $V_{\text {GP }}$ |  | 4.3 | V |

SWITCHING CHARACTERISTICS (Note 5)

| Turn-On Delay Time | $\mathrm{t}_{\mathrm{d}(\mathrm{ON})}$ | $\begin{gathered} V_{G S}=10 \mathrm{~V}, \mathrm{~V}_{\mathrm{DS}}=20 \mathrm{~V}, \\ \mathrm{I}_{\mathrm{D}}=50 \mathrm{~A}, \mathrm{R}_{\mathrm{G}}=2.5 \Omega \end{gathered}$ | 16 | ns |
| :---: | :---: | :---: | :---: | :---: |
| Rise Time | $\mathrm{t}_{\mathrm{r}}$ |  | 113 |  |
| Turn-Off Delay Time | $\mathrm{t}_{\mathrm{d} \text { (OFF) }}$ |  | 77 |  |
| Fall Time | $\mathrm{t}_{\mathrm{f}}$ |  | 109 |  |

DRAIN-SOURCE DIODE CHARACTERISTICS

| Forward Diode Voltage | $\mathrm{V}_{\text {SD }}$ | $\begin{aligned} & V_{G S}=0 \mathrm{~V}, \\ & I_{S}=50 \mathrm{~A} \end{aligned}$ | $\mathrm{T}_{J}=25^{\circ} \mathrm{C}$ | 0.76 | 1.2 | V |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | $\mathrm{T}_{\mathrm{J}}=125^{\circ} \mathrm{C}$ | 0.63 |  |  |
| Reverse Recovery Time | $\mathrm{t}_{\mathrm{RR}}$ | $\begin{gathered} \mathrm{V}_{\mathrm{GS}}=0 \mathrm{~V}, \mathrm{dIS} / \mathrm{dt}=100 \mathrm{~A} / \mathrm{us}, \\ \mathrm{I}_{\mathrm{S}}=50 \mathrm{~A} \end{gathered}$ |  | 96 |  | ns |
| Charge Time | $\mathrm{ta}_{\mathrm{a}}$ |  |  | 49 |  |  |
| Discharge Time | $\mathrm{t}_{\mathrm{b}}$ |  |  | 47 |  |  |
| Reverse Recovery Charge | $\mathrm{Q}_{\mathrm{RR}}$ |  |  | 189 |  | 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.
4. Pulse Test: pulse width $\leq 300 \mu \mathrm{~s}$, duty cycle $\leq 2 \%$.
5. Switching characteristics are independent of operating junction temperatures.

## NVMFS5C404N

TYPICAL CHARACTERISTICS


Figure 1. On-Region Characteristics


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


Figure 5. On-Resistance Variation with Temperature


Figure 2. Transfer Characteristics


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


Figure 6. Drain-to-Source Leakage Current vs. Voltage

## NVMFS5C404N

TYPICAL CHARACTERISTICS


Figure 7. Capacitance Variation


Figure 9. Resistive Switching Time Variation vs. Gate Resistance


Figure 11. Maximum Rated Forward Biased Safe Operating Area


Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge


Figure 10. Diode Forward Voltage vs. Current


Figure 12. IPEAK vs. Time in Avalanche

## NVMFS5C404N



Figure 13. Thermal Characteristics

## DEVICE ORDERING INFORMATION

| Device | Case | Marking | Package | Shipping $^{\dagger}$ |
| :--- | :---: | :---: | :---: | :---: |
| NVMFS5C404NT1G | $506 E Z$ | 5 C404N | DFN5 <br> (Pb-Free) | $1500 /$ Tape \& Reel |
| NVMFS5C404NWFT1G | $507 B A$ | $404 N W F$ | DFNW5 <br> (Pb-Free) | $1500 /$ Tape \& Reel |
| NVMFS5C404NT3G | $506 E Z$ | 5 C404N | DFN5 <br> (Pb-Free) | $5000 /$ Tape \& Reel |
| NVMFS5C404NWFT3G | $507 B A$ | $404 N W F$ | DFNW5 <br> (Pb-Free) | $5000 /$ Tape \& Reel |
| NVMFS5C404NAFT1G | $506 E Z$ | $5 C 404 N$ | DFN5 <br> (Pb-Free) | $1500 /$ Tape \& Reel |
| NVMFS5C404NWFAFT1G | $507 B A$ | $404 N W F$ | DFNW5 <br> (Pb-Free) | $1500 /$ Tape \& Reel |
| NVMFS5C404NWFET1G | $507 B A$ | $404 N W F$ | DFNW5 <br> (Pb-Free) | $1500 /$ Tape \& Reel |
| NVMFS5C404NWFET3G | $507 B A$ | $404 N W F$ | DFNW5 <br> (Pb-Free) | $5000 /$ Tape \& Reel |

$\dagger$ 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.

DFN5 5x6, 1.27P (SO-8FL)
CASE 506EZ
ISSUE A
DATE 25 AUG 2021


TDP VIEW


DETAIL A
NOTES:

1. DIMENSIDNING AND TDLERANCING PER ASME Y14.5M, 2009.
2. CONTRDLLING DIMENSION: MILLIMETERS
3. DIMENSIDNS D1 AND E1 DD NDT INCLUDE MILD FLASH, PRDTRUSIDNS, DR GATE BURRS.

|  | MILLIMETERS |  |  |
| :--- | :--- | :--- | :--- |
| DIM | MIN. | NDM. | MAX. |
| A | 0.90 | 1.00 | 1.10 |
| A1 | 0.00 | --- | 0.05 |
| b | 0.33 | 0.41 | 0.51 |
| c | 0.23 | 0.28 | 0.33 |
| D | 5.00 | 5.15 | 5.30 |
| D1 | 4.70 | 4.90 | 5.10 |
| D2 | 3.80 | 4.00 | 4.20 |
| E | 6.00 | 6.15 | 6.30 |
| E1 | 5.70 | 5.90 | 6.10 |
| E2 | 3.45 | 3.80 | 3.85 |
| e | 1.27 BSC |  |  |
| G | 0.51 | 0.575 | 0.71 |
| k | 1.10 | 1.20 |  |
| L | 0.51 | 0.575 |  |
| L1 | 0.125 REF |  |  |
| M | 3.00 | 3.40 |  |
| $\theta$ | $0 \cdot$ | 3.80 |  |
|  | -- |  |  |

PIN 1
IDENTIFIER

## $\underset{\substack{\text { seativg } \\ \text { pLeane }}}{ }$



GENERIC


RECDMMENDED
XXXXXX = Specific Device Code
MLUNTING FODTPRINT
A = Assembly Location
Y = Year
W = Work Week ZZ = Lot Traceability
*This information is generic. Please refer to device data sheet for actual part marking. $\mathrm{Pb}-F r e e ~ i n d i c a t o r, ~ " ~ G " ~ o r ~ m i c r o d o t ~ " ~ " ", ~$ may or may not be present. Some products may not follow the Generic Marking.

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| ---: | :--- | :--- | :--- |
| DESCRIPTION: | DFN5 5x6, 1.27P (SO-8FL) | PAGE 1 OF 1 |

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NOTES:

1. DIMENSIDNING AND TQLERANCING PER ASME Y14.5M, 2009 .
2. CDNTRDLLING DIMENSIDN: MILLIMETERS
3. DIMENSIDNS D1 AND E1 DD NDT INCLUDE MDLD FLASH, PROTRUSIDNS, QR GATE BURRS.
4. THIS PACKAGE CUNTAINS WETTABLE FLANK DESIGN FEATURES TD AID IN FILLET FGRMATION DN THE LEADS DURING MDUNTING.


|  | MILLIMETERS |  |  |  |  |
| :--- | :--- | :--- | :--- | :---: | :---: |
| DIM | MIN. | NDM. | MAX. |  |  |
| A | 0.90 | 1.00 | 1.10 |  |  |
| A1 | 0.00 | --- | 0.05 |  |  |
| b | 0.33 | 0.41 | 0.51 |  |  |
| c | 0.23 | 0.28 | 0.33 |  |  |
| D | 5.00 | 5.15 | 5.30 |  |  |
| D1 | 4.70 | 4.90 | 5.10 |  |  |
| D2 | 3.80 | 4.00 | 4.20 |  |  |
| E | 6.00 | 6.15 | 6.30 |  |  |
| E1 | 5.70 | 5.90 | 6.10 |  |  |
| E2 | 3.45 | 3.65 | 3.85 |  |  |
| e | 1.27 BSC |  |  |  |  |
| G | 0.51 | 0.575 | 0.71 |  |  |
| K | 1.20 | 1.35 | 1.50 |  |  |
| L | 0.51 | 0.575 | 0.71 |  |  |
| L1 | 0.150 REF |  |  |  |  |
| M | 3.00 | 3.40 |  |  |  |
| O | $0^{\circ}$ | --- |  |  | 12.80 |



## MARKING DIAGRAM*



| XXXXXX | $=$ Specific Device Code |
| :--- | :--- |
| A | $=$ Assembly Location |
| Y | $=$ Year |
| W | $=$ Work Week |
| ZZ | $=$ Lot Traceability |

*This information is generic. Please refer to device data sheet for actual part marking. $\mathrm{Pb}-$ Free indicator, " G " or microdot " r ", may or may not be present. Some products may not follow the Generic Marking.

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| ---: | :--- | :--- | :--- |
| DESCRIPTION: | DFNW5 5x6 (FULL-CUT SO8FL WF) | PAGE 1 OF 1 |

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