

# MOSFET – Power, P-Channel, SOT-223

**-5.2 A, -30 V**

**NTF5P03, NVF5P03**

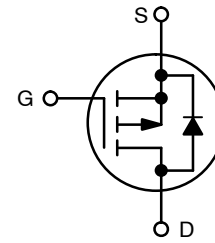
## Features

- Ultra Low  $R_{DS(on)}$
- Higher Efficiency Extending Battery Life
- Logic Level Gate Drive
- Miniature SOT-223 Surface Mount Package
- Avalanche Energy Specified
- AEC-Q101 Qualified and PPAP Capable – NVF5P03T3G
- These Devices are Pb-Free and are RoHS Compliant

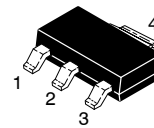
## Applications

- DC-DC Converters
- Power Management
- Motor Controls
- Inductive Loads
- Replaces MMFT5P03HD

**-5.2 AMPERES, -30 VOLTS**  
 $R_{DS(on)} = 100 \text{ m}\Omega$

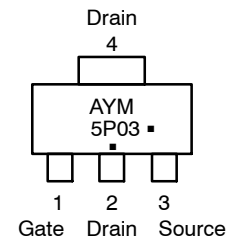


P-Channel MOSFET



SOT-223  
CASE 318E  
STYLE 3

## MARKING DIAGRAM & PIN ASSIGNMENT



A = Assembly Location  
Y = Year  
M = Date Code  
5P03 = Specific Device Code  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

## ORDERING INFORMATION

| Device     | Package           | Shipping <sup>†</sup> |
|------------|-------------------|-----------------------|
| NTF5P03T3G | SOT-223 (Pb-Free) | 4000 / Tape & Reel    |
| NVF5P03T3G | SOT-223 (Pb-Free) | 4000 / 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 Specification Brochure, [BRD8011/D](#).

# NTF5P03, NVF5P03

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

Negative sign for P-Channel devices omitted for clarity

| Rating                                                                                                                                                                                                     |                                                    | Symbol                            | Max         | Unit  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|-----------------------------------|-------------|-------|
| Drain-to-Source Voltage                                                                                                                                                                                    |                                                    | V <sub>DSS</sub>                  | -30         | V     |
| Drain-to-Gate Voltage (R <sub>GS</sub> = 1.0 MΩ)                                                                                                                                                           |                                                    | V <sub>DGR</sub>                  | -30         | V     |
| Gate-to-Source Voltage – Continuous                                                                                                                                                                        |                                                    | V <sub>GS</sub>                   | ± 20        | V     |
| 1 sq in<br>FR-4 or G-10 PCB<br><br>10 seconds                                                                                                                                                              | Thermal Resistance – Junction-to-Ambient           | R <sub>THJA</sub>                 | 40          | °C/W  |
|                                                                                                                                                                                                            | Total Power Dissipation @ T <sub>A</sub> = 25°C    | P <sub>D</sub>                    | 3.13        | Watts |
|                                                                                                                                                                                                            | Linear Derating Factor                             |                                   | 25          | mW/°C |
|                                                                                                                                                                                                            | Drain Current – Continuous @ T <sub>A</sub> = 25°C | I <sub>D</sub>                    | -5.2        | A     |
|                                                                                                                                                                                                            | Continuous @ T <sub>A</sub> = 70°C                 | I <sub>D</sub>                    | -4.1        | A     |
|                                                                                                                                                                                                            | Pulsed Drain Current (Note 1)                      | I <sub>DM</sub>                   | -26         | A     |
|                                                                                                                                                                                                            | Thermal Resistance – Junction-to-Ambient           | R <sub>THJA</sub>                 | 80          | °C/W  |
|                                                                                                                                                                                                            | Total Power Dissipation @ T <sub>A</sub> = 25°C    | P <sub>D</sub>                    | 1.56        | Watts |
|                                                                                                                                                                                                            | Linear Derating Factor                             |                                   | 12.5        | mW/°C |
|                                                                                                                                                                                                            | Drain Current – Continuous @ T <sub>A</sub> = 25°C | I <sub>D</sub>                    | -3.7        | A     |
|                                                                                                                                                                                                            | Continuous @ T <sub>A</sub> = 70°C                 | I <sub>D</sub>                    | -2.9        | A     |
|                                                                                                                                                                                                            | Pulsed Drain Current (Note 1)                      | I <sub>DM</sub>                   | -19         | A     |
| Operating and Storage Temperature Range                                                                                                                                                                    |                                                    | T <sub>J</sub> , T <sub>stg</sub> | - 55 to 150 | °C    |
| Single Pulse Drain-to-Source Avalanche Energy – Starting T <sub>J</sub> = 25°C<br>(V <sub>DD</sub> = -30 Vdc, V <sub>GS</sub> = -10 Vdc, Peak I <sub>L</sub> = -12 Apk, L = 3.5 mH, R <sub>G</sub> = 25 Ω) |                                                    | E <sub>AS</sub>                   | 250         | mJ    |

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. Repetitive rating; pulse width limited by maximum junction temperature.

## ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C unless otherwise noted)

| Characteristic                                                                                                                                                                                    | Symbol                                                             | Min              | Typ   | Max   | Unit  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|------------------|-------|-------|-------|
| <b>OFF CHARACTERISTICS</b>                                                                                                                                                                        |                                                                    |                  |       |       |       |
| Drain-to-Source Breakdown Voltage (C <sub>pk</sub> ≥ 2.0) (Notes 2 and 4)<br>(V <sub>GS</sub> = 0 Vdc, I <sub>D</sub> = -250 μAdc)                                                                | V <sub>(BR)DSS</sub>                                               | -30              | -     | -     | Vdc   |
| Temperature Coefficient (Positive)                                                                                                                                                                |                                                                    | -                | -28   | -     | mV/°C |
| Zero Gate Voltage Drain Current<br>(V <sub>DS</sub> = -24 Vdc, V <sub>GS</sub> = 0 Vdc)<br>(V <sub>DS</sub> = -24 Vdc, V <sub>GS</sub> = 0 Vdc, T <sub>J</sub> = 125°C)                           | I <sub>DSS</sub>                                                   | -                | -     | -1.0  | μAdc  |
|                                                                                                                                                                                                   |                                                                    | -                | -     | -25   |       |
| Gate-Body Leakage Current<br>(V <sub>GS</sub> = ± 20 Vdc, V <sub>DS</sub> = 0 Vdc)                                                                                                                | I <sub>GSS</sub>                                                   | -                | -     | ± 100 | nAdc  |
| <b>ON CHARACTERISTICS (Note 2)</b>                                                                                                                                                                |                                                                    |                  |       |       |       |
| Gate Threshold Voltage (C <sub>pk</sub> ≥ 2.0) (Notes 2 and 4)<br>(V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250 μAdc)                                                                | V <sub>GS(th)</sub>                                                | -1.0             | -1.75 | -3.0  | Vdc   |
| Threshold Temperature Coefficient (Negative)                                                                                                                                                      |                                                                    | -                | 3.5   | -     | mV/°C |
| Static Drain-to-Source On-Resistance (C <sub>pk</sub> ≥ 2.0) (Notes 2 and 4)<br>(V <sub>GS</sub> = -10 Vdc, I <sub>D</sub> = -5.2 Adc)<br>(V <sub>GS</sub> = -4.5 Vdc, I <sub>D</sub> = -2.6 Adc) | R <sub>DS(on)</sub>                                                | -                | 76    | 100   | mΩ    |
|                                                                                                                                                                                                   |                                                                    |                  | 107   | 150   |       |
| Forward Transconductance (Note 2)<br>(V <sub>DS</sub> = -15 Vdc, I <sub>D</sub> = -2.0 Adc)                                                                                                       | g <sub>fs</sub>                                                    | 2.0              | 3.9   | -     | Mhos  |
| <b>DYNAMIC CHARACTERISTICS</b>                                                                                                                                                                    |                                                                    |                  |       |       |       |
| Input Capacitance                                                                                                                                                                                 | (V <sub>DS</sub> = -25 Vdc, V <sub>GS</sub> = 0 V,<br>f = 1.0 MHz) | C <sub>iss</sub> | -     | 500   | pF    |
| Output Capacitance                                                                                                                                                                                |                                                                    | C <sub>oss</sub> | -     | 153   |       |
| Transfer Capacitance                                                                                                                                                                              |                                                                    | C <sub>rss</sub> | -     | 58    |       |

# NTF5P03, NVF5P03

## ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C unless otherwise noted)

| Characteristic                     |                                                                                                                          | Symbol              | Min | Typ | Max | Unit |
|------------------------------------|--------------------------------------------------------------------------------------------------------------------------|---------------------|-----|-----|-----|------|
| SWITCHING CHARACTERISTICS (Note 3) |                                                                                                                          |                     |     |     |     |      |
| Turn-On Delay Time                 | (V <sub>DD</sub> = -15 Vdc, I <sub>D</sub> = -4.0 Adc,<br>V <sub>GS</sub> = -10 Vdc,<br>R <sub>G</sub> = 6.0 Ω) (Note 2) | t <sub>d(on)</sub>  | –   | 10  | 24  | ns   |
| Rise Time                          |                                                                                                                          | t <sub>r</sub>      | –   | 33  | 48  |      |
| Turn-Off Delay Time                |                                                                                                                          | t <sub>d(off)</sub> | –   | 38  | 94  |      |
| Fall Time                          |                                                                                                                          | t <sub>f</sub>      | –   | 20  | 92  |      |
| Turn-On Delay Time                 | (V <sub>DD</sub> = -15 Vdc, I <sub>D</sub> = -2.0 Adc,<br>V <sub>GS</sub> = -10 Vdc,<br>R <sub>G</sub> = 6.0 Ω) (Note 2) | t <sub>d(on)</sub>  | –   | 16  | 38  | ns   |
| Rise Time                          |                                                                                                                          | t <sub>r</sub>      | –   | 45  | 110 |      |
| Turn-Off Delay Time                |                                                                                                                          | t <sub>d(off)</sub> | –   | 23  | 60  |      |
| Fall Time                          |                                                                                                                          | t <sub>f</sub>      | –   | 24  | 80  |      |
| Gate Charge                        | (V <sub>DS</sub> = -24 Vdc, I <sub>D</sub> = -4.0 Adc,<br>V <sub>GS</sub> = -10 Vdc) (Note 2)                            | Q <sub>T</sub>      | –   | 15  | 38  | nC   |
|                                    |                                                                                                                          | Q <sub>1</sub>      | –   | 1.6 | –   |      |
|                                    |                                                                                                                          | Q <sub>2</sub>      | –   | 3.5 | –   |      |
|                                    |                                                                                                                          | Q <sub>3</sub>      | –   | 2.6 | –   |      |

## SOURCE-DRAIN DIODE CHARACTERISTICS

|                                |                                                                                                                                                  |                 |        |               |           |     |
|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|--------|---------------|-----------|-----|
| Forward On-Voltage             | (I <sub>S</sub> = -4.0 Adc, V <sub>GS</sub> = 0 Vdc)<br>(I <sub>S</sub> = -4.0 Adc, V <sub>GS</sub> = 0 Vdc,<br>T <sub>J</sub> = 125°C) (Note 2) | V <sub>SD</sub> | –<br>– | -1.1<br>-0.89 | -1.5<br>– | Vdc |
| Reverse Recovery Time          | (I <sub>S</sub> = -4.0 Adc, V <sub>GS</sub> = 0 Vdc,<br>dI <sub>S</sub> /dt = 100 A/μs) (Note 2)                                                 | t <sub>rr</sub> | –      | 34            | –         | ns  |
|                                |                                                                                                                                                  | t <sub>a</sub>  | –      | 20            | –         |     |
|                                |                                                                                                                                                  | t <sub>b</sub>  | –      | 14            | –         |     |
| Reverse Recovery Stored Charge |                                                                                                                                                  | Q <sub>RR</sub> | –      | 0.036         | –         | μC  |

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.

- Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.
- Switching characteristics are independent of operating junction temperatures.
- Reflects typical values.

$$C_{pk} = \left| \frac{\text{Max limit} - \text{Typ}}{3 \times \text{SIGMA}} \right|$$



TYPICAL ELECTRICAL CHARACTERISTICS

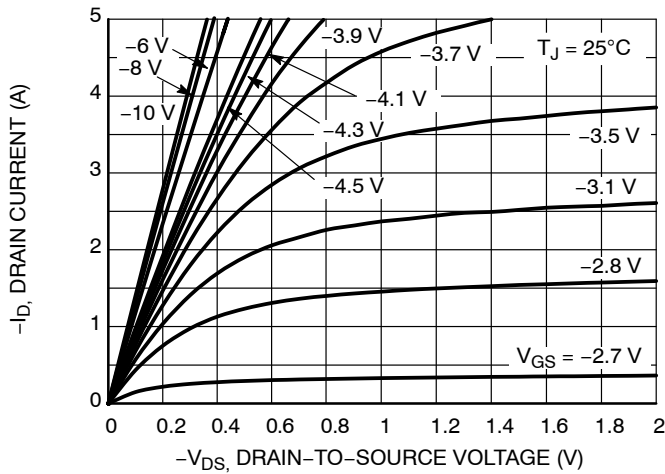


Figure 1. On-Region Characteristics

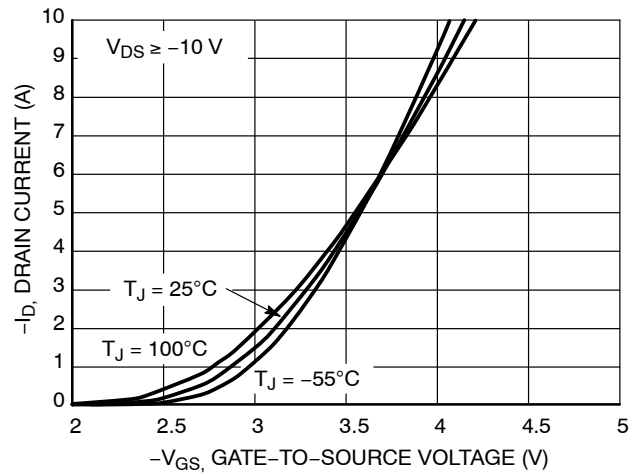


Figure 2. Transfer Characteristics

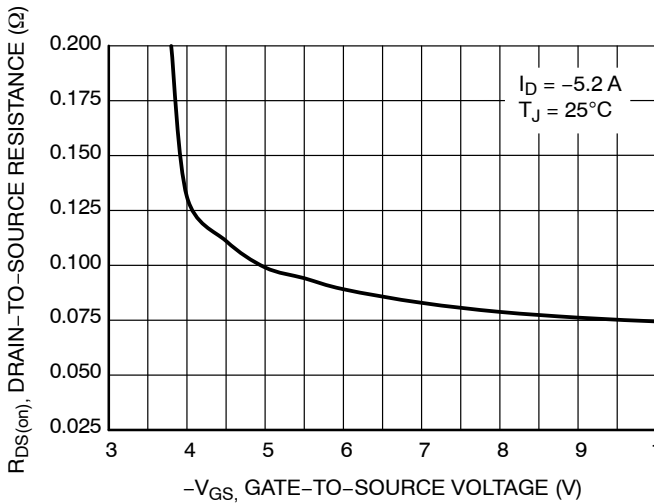


Figure 3. On-Resistance versus Gate-to-Source Voltage

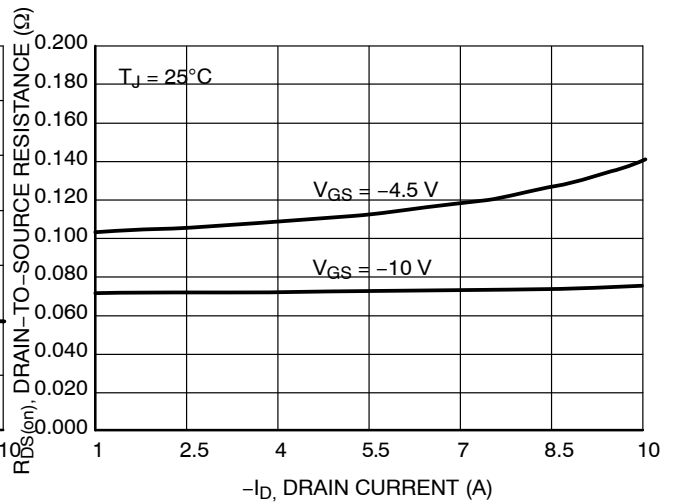


Figure 4. On-Resistance versus Drain Current and Gate Voltage

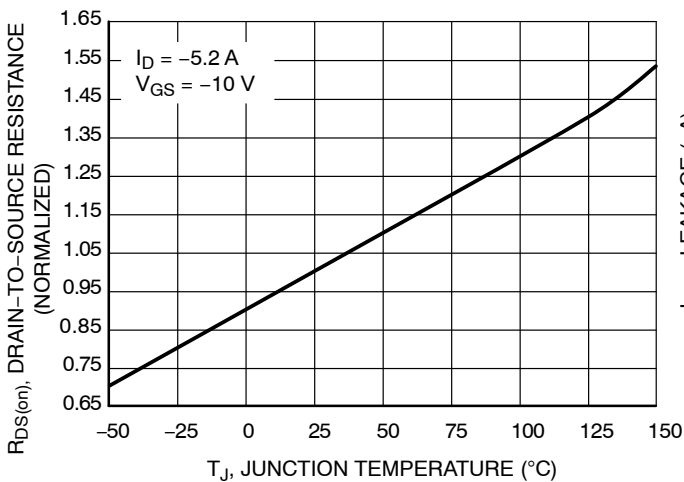


Figure 5. On-Resistance Variation with Temperature

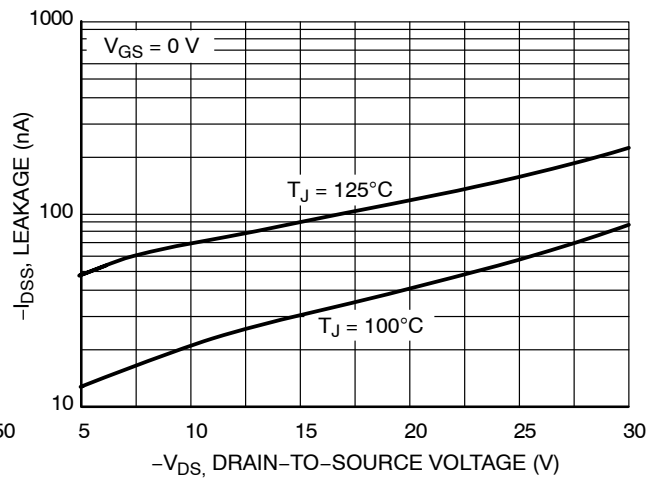


Figure 6. Drain-to-Source Leakage Current versus Voltage

TYPICAL ELECTRICAL CHARACTERISTICS

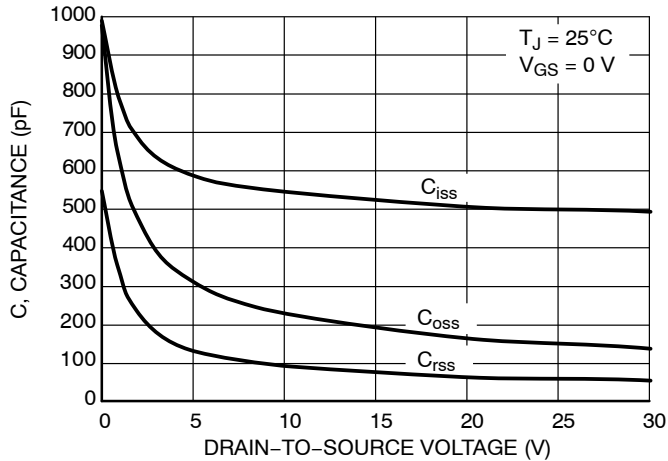


Figure 7. Capacitance Variation

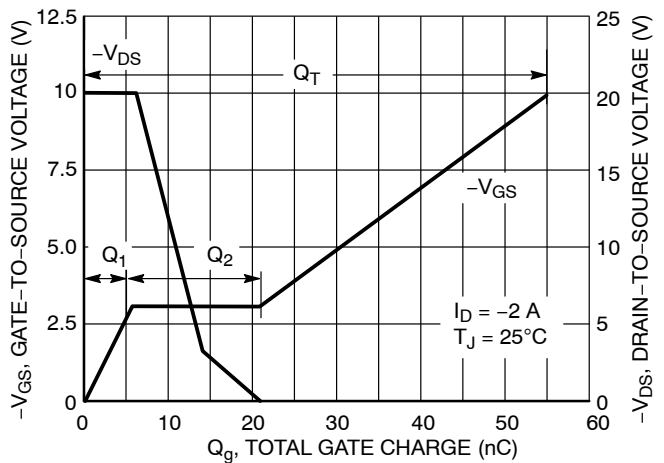


Figure 8. Gate-to-Source and Drain-to-Source Voltage versus Total Charge

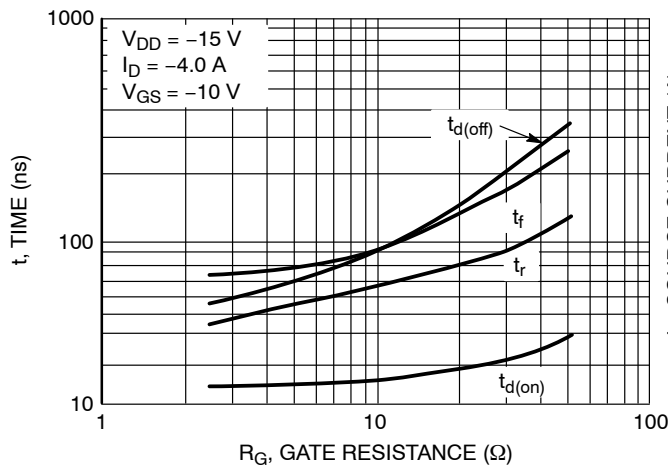


Figure 9. Resistive Switching Time Variation versus Gate Resistance

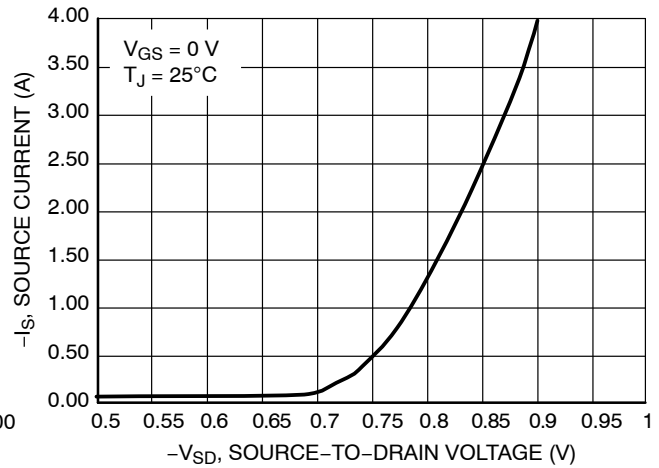
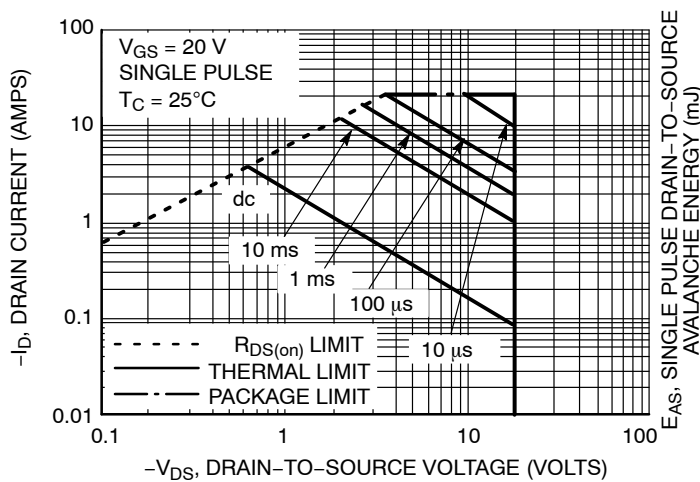


Figure 10. Diode Forward Voltage versus Current



Mounted on 2"sq. FR4 board (1"sq. 2 oz. Cu 0.06" thick single sided) with on die operating, 10 s max.

Figure 11. Maximum Rated Forward Biased Safe Operating Area

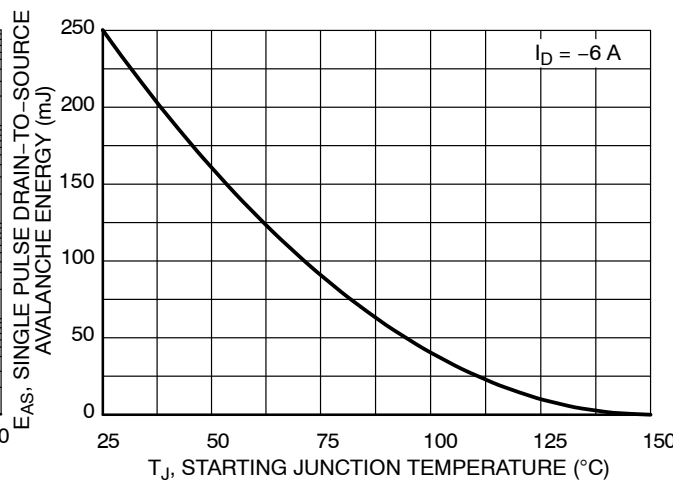


Figure 12. Maximum Avalanche Energy versus Starting Junction Temperature

TYPICAL ELECTRICAL CHARACTERISTICS

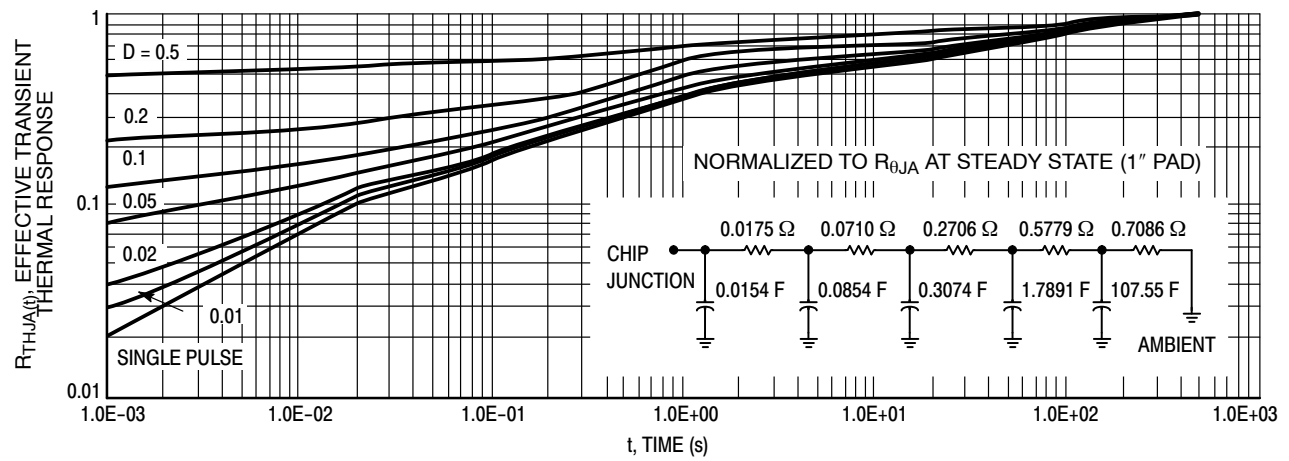


Figure 13. FET Thermal Response

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