



ON Semiconductor®

# FDPF7N50U

## N-Channel UniFET™ Ultra FRFET™ MOSFET

500 V, 5 A, 1.5 Ω

### Features

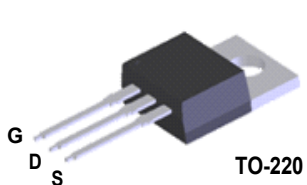
- $R_{DS(on)} = 1.5 \Omega$  (Max.) @  $V_{GS} = 10 V$ ,  $I_D = 2.5 A$
- Low Gate Charge (Typ. 12.8 nC)
- Low  $C_{rss}$  (Typ. 9 pF)
- 100% Avalanche Tested
- Improved dv/dt Capability

### Applications

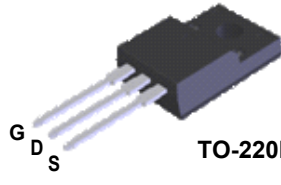
- LCD/LED TV
- Lighting
- Uninterruptible Power Supply
- AC-DC Power Supply

### Description

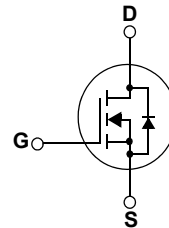
UniFET™ MOSFET is ON Semiconductor's high voltage MOSFET family based on planar stripe and DMOS technology. This MOSFET is tailored to reduce on-state resistance, and to provide better switching performance and higher avalanche energy strength. UniFET Ultra FRFET™ MOSFET has much superior body diode reverse recovery performance. Its  $t_{rr}$  is less than 50nsec and the reverse dv/dt immunity is 20V/nsec while normal planar MOSFETs have over 200nsec and 4.5V/nsec respectively. Therefore UniFET Ultra FRFET MOSFET can remove additional component and improve system reliability in certain applications that require performance improvement of the MOSFET's body diode. This device family is suitable for switching power converter applications such as power factor correction (PFC), flat panel display (FPD) TV power, ATX and electronic lamp ballasts.



TO-220



TO-220F



### Absolute Maximum Ratings

| Symbol         | Parameter  |                                      | FDPF7N50U   | Unit          |
|----------------|--|--------------------------------------|-------------|---------------|
| $V_{DSS}$      | Drain-Source Voltage   |                                      | 500         | V             |
| $I_D$          | Drain Current  | - Continuous ( $T_C = 25^\circ C$ )  | 5 *         | A             |
|                |  | - Continuous ( $T_C = 100^\circ C$ ) | 3.0 *       | A             |
| $I_{DM}$       | Drain Current  | - Pulsed (Note 1)                    | 20 *        | A             |
| $V_{GSS}$      | Gate-Source voltage  |                                      | $\pm 30$    | V             |
| $E_{AS}$       | Single Pulsed Avalanche Energy (Note 2)                                      |                                      | 125         | mJ            |
| $I_{AR}$       | Avalanche Current (Note 1)   |                                      | 5           | A             |
| $E_{AR}$       | Repetitive Avalanche Energy (Note 1)   |                                      | 8.9         | mJ            |
| dv/dt          | Peak Diode Recovery dv/dt (Note 3)   |                                      | 20          | V/ns          |
| $P_D$          | Power Dissipation  | ( $T_C = 25^\circ C$ )               | 31.3        | W             |
|                |  | - Derate above $25^\circ C$          | 0.25        | W/ $^\circ C$ |
| $T_J, T_{STG}$ | Operating and Storage Temperature Range                                      |                                      | -55 to +150 | $^\circ C$    |
| $T_L$          | Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds |                                      | 300         | $^\circ C$    |

\* Drain current limited by maximum junction temperature.

### Thermal Characteristics

| Symbol          | Parameter                                     | FDPF7N50U | Unit         |
|-----------------|---|-----------|--------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case, Max.    | 4.0       | $^\circ C/W$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient, Max. | 62.5      |              |

## Package Marking and Ordering Information

| Device Marking | Device    | Package | Reel Size | Tape Width | Quantity |
|----------------|-----------|---------|-----------|------------|----------|
| FDPF7N50U      | FDPF7N50U | TO-220F | --        | --         | 50       |

## Electrical Characteristics T<sub>C</sub> = 25°C unless otherwise noted

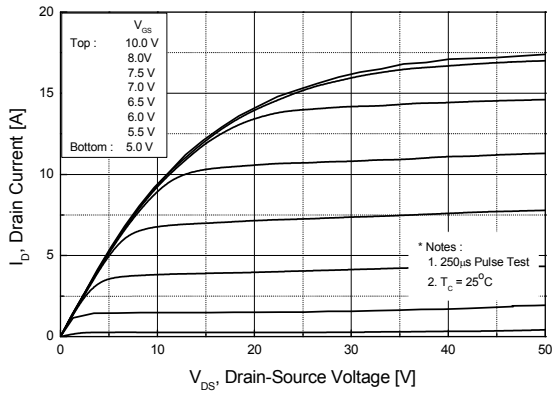
| Symbol  | Parameter   | Conditions   | Min. | Typ. | Max       | Unit     |
|---|---|--|------|------|-----------|----------|
| <b>Off Characteristics</b>                                    |   |  |      |      |           |          |
| BV <sub>DSS</sub>   | Drain-Source Breakdown Voltage                        | V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA   | 500  | --   | --        | V        |
| ΔBV <sub>DSS</sub><br>ΔT <sub>J</sub>                         | Breakdown Voltage Temperature Coefficient             | I <sub>D</sub> = 250μA, Referenced to 25°C   | --   | 0.5  | --        | V/°C     |
| I <sub>DSS</sub>  | Zero Gate Voltage Drain Current                       | V <sub>DS</sub> = 500V, V <sub>GS</sub> = 0V<br>V <sub>DS</sub> = 400V, T <sub>C</sub> = 125°C | --   | --   | 25<br>250 | μA<br>μA |
| I <sub>GSSF</sub>   | Gate-Body Leakage Current, Forward                    | V <sub>GS</sub> = 30V, V <sub>DS</sub> = 0V  | --   | --   | 100       | nA       |
| I <sub>GSSR</sub>   | Gate-Body Leakage Current, Reverse                    | V <sub>GS</sub> = -30V, V <sub>DS</sub> = 0V   | --   | --   | -100      | nA       |
| <b>On Characteristics</b>                                     |   |  |      |      |           |          |
| V <sub>GS(th)</sub>   | Gate Threshold Voltage                                | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA                                     | 3.0  | --   | 5.0       | V        |
| R <sub>DS(on)</sub>   | Static Drain-Source On-Resistance                     | V <sub>GS</sub> = 10V, I <sub>D</sub> = 2.5A   | --   | 1.2  | 1.5       | Ω        |
| g <sub>FS</sub>   | Forward Transconductance                              | V <sub>DS</sub> = 40V, I <sub>D</sub> = 2.5A   | --   | 2.5  | --        | S        |
| <b>Dynamic Characteristics</b>                                |   |  |      |      |           |          |
| C <sub>iss</sub>  | Input Capacitance                                     | V <sub>DS</sub> = 25V, V <sub>GS</sub> = 0V,<br>f = 1.0MHz                                     | --   | 720  | 940       | pF       |
| C <sub>oss</sub>  | Output Capacitance                                    |  | --   | 95   | 190       | pF       |
| C <sub>rss</sub>  | Reverse Transfer Capacitance                          |  | --   | 9    | 13.5      | pF       |
| <b>Switching Characteristics</b>                              |   |  |      |      |           |          |
| t <sub>d(on)</sub>  | Turn-On Delay Time                                    | V <sub>DD</sub> = 250V, I <sub>D</sub> = 5A<br>R <sub>G</sub> = 25Ω<br><br>(Note 4)            | --   | 6    | 20        | ns       |
| t <sub>r</sub>  | Turn-On Rise Time                                     |  | --   | 55   | 120       | ns       |
| t <sub>d(off)</sub>   | Turn-Off Delay Time                                   |  | --   | 25   | 60        | ns       |
| t <sub>f</sub>  | Turn-Off Fall Time                                    |  | --   | 35   | 80        | ns       |
| Q <sub>g</sub>  | Total Gate Charge                                     | V <sub>DS</sub> = 400V, I <sub>D</sub> = 5A<br>V <sub>GS</sub> = 10V<br><br>(Note 4)           | --   | 12.8 | 16.6      | nC       |
| Q <sub>gs</sub>   | Gate-Source Charge                                    |  | --   | 3.7  | --        | nC       |
| Q <sub>gd</sub>   | Gate-Drain Charge                                     |  | --   | 5.8  | --        | nC       |
| <b>Drain-Source Diode Characteristics and Maximum Ratings</b> |   |  |      |      |           |          |
| I <sub>S</sub>  | Maximum Continuous Drain-Source Diode Forward Current |  | --   | --   | 5         | A        |
| I <sub>SM</sub>   | Maximum Pulsed Drain-Source Diode Forward Current     |  | --   | --   | 20        | A        |
| V <sub>SD</sub>   | Drain-Source Diode Forward Voltage                    | V <sub>GS</sub> = 0V, I <sub>S</sub> = 5A  | --   | --   | 1.6       | V        |
| t <sub>rr</sub>   | Reverse Recovery Time                                 | V <sub>GS</sub> = 0V, I <sub>S</sub> = 5A<br>di <sub>F</sub> /dt = 100A/μs                     | --   | 40   | --        | ns       |
| Q <sub>rr</sub>   | Reverse Recovery Charge                               |  | --   | 0.04 | --        | μC       |

### NOTES:

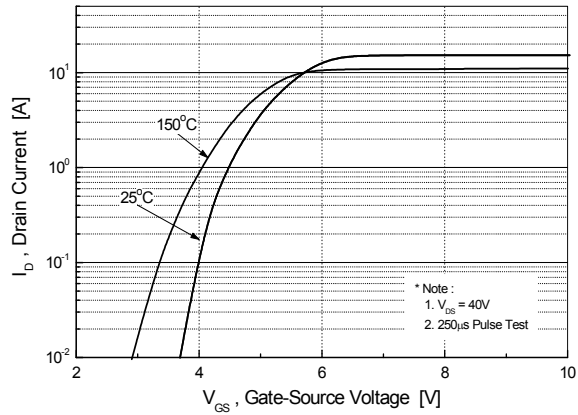
1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. I<sub>AS</sub> = 5A, V<sub>DD</sub> = 50V, L = 10mH, R<sub>G</sub> = 25Ω, Starting T<sub>J</sub> = 25°C
3. I<sub>SD</sub> ≤ 5A, di/dt ≤ 200A/μs, V<sub>DD</sub> ≤ BV<sub>DSS</sub>, Starting T<sub>J</sub> = 25°C
4. Essentially Independent of Operating Temperature Typical Characteristics

## Typical Performance Characteristics

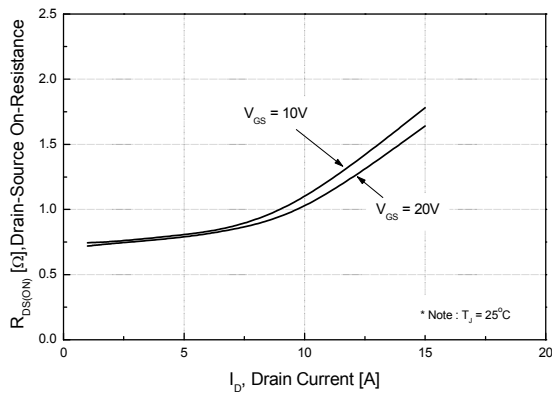
**Figure 1. On-Region Characteristics**



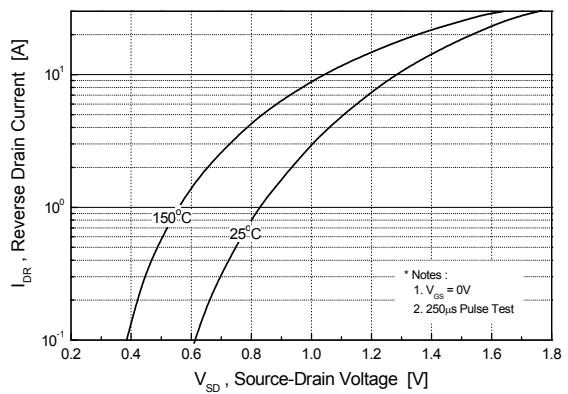
**Figure 2. Transfer Characteristics**



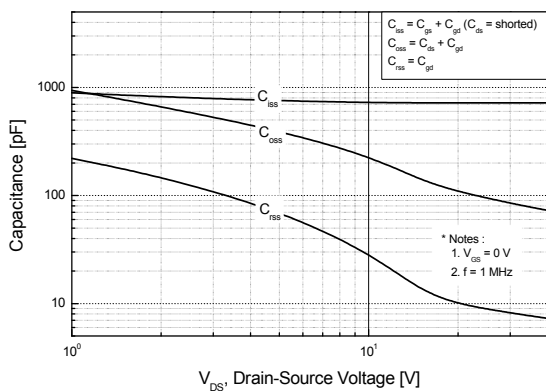
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



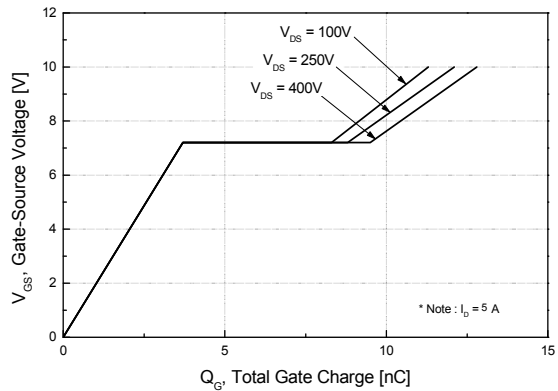
**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**



**Figure 5. Capacitance Characteristics**

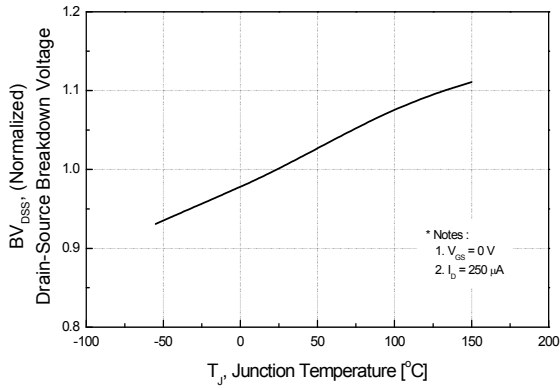


**Figure 6. Gate Charge Characteristics**

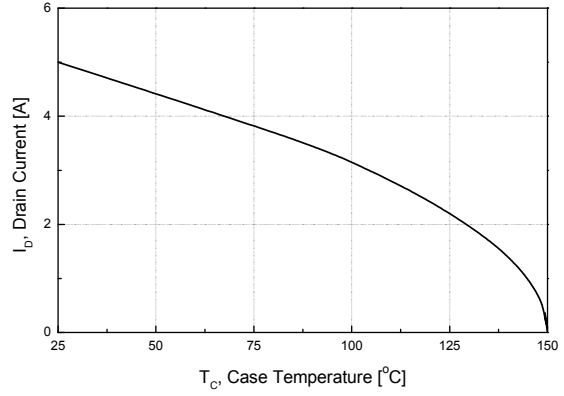


**Typical Performance Characteristics (Continued)**

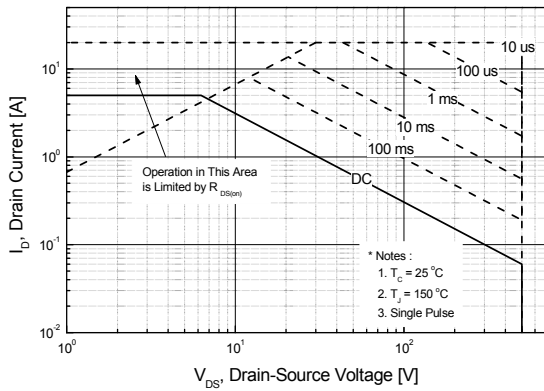
**Figure 7. Breakdown Voltage Variation vs. Temperature**



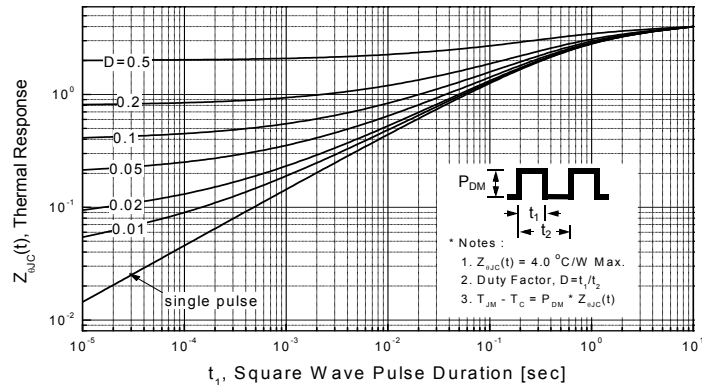
**Figure 8. Maximum Drain Current Vs. Case Temperature**



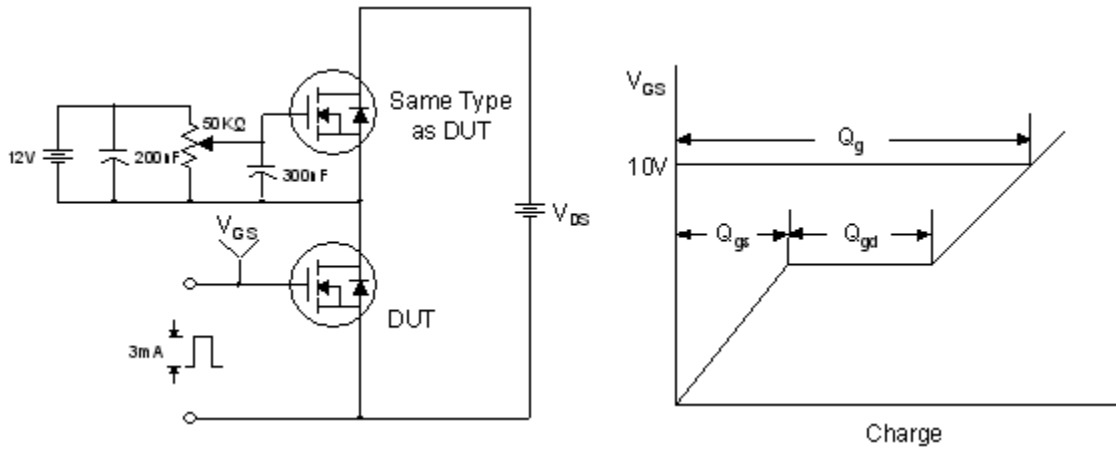
**Figure 9. Maximum Safe Operating Area - FDPF7N50U**



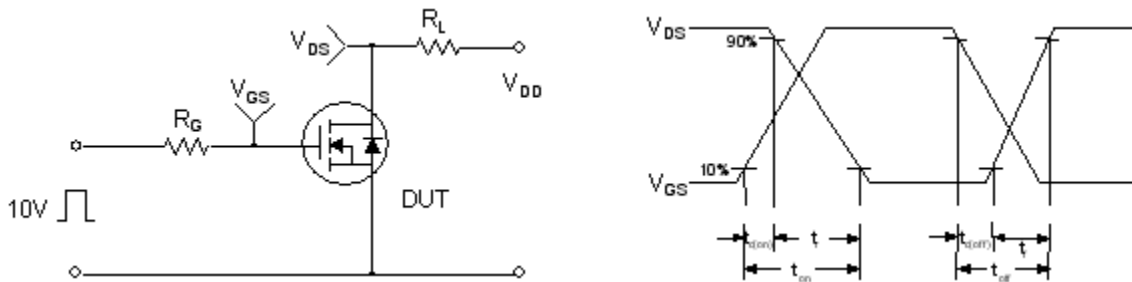
**Figure 10. Transient Thermal Response Curve**



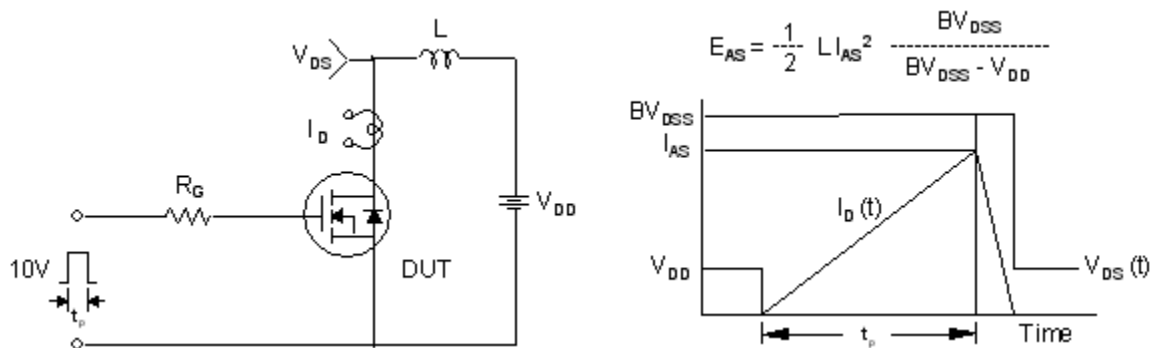
**Gate Charge Test Circuit & Waveform**



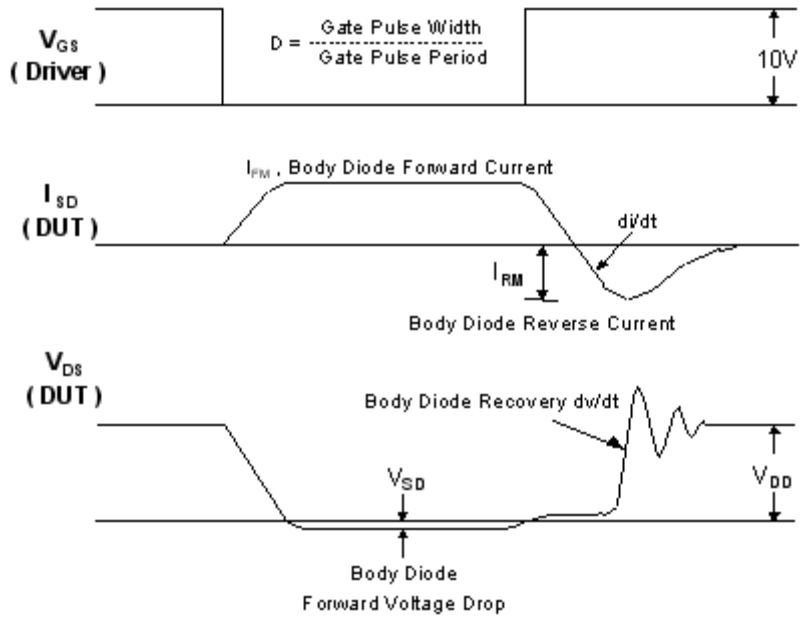
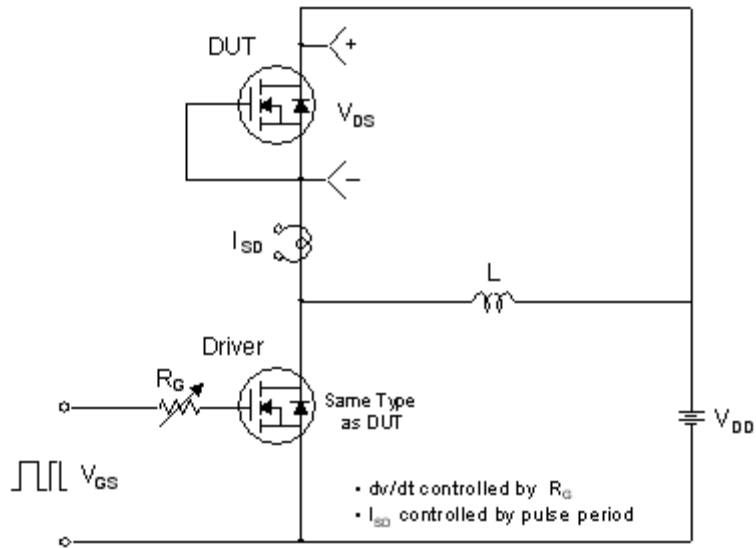
**Resistive Switching Test Circuit & Waveforms**



**Unclamped Inductive Switching Test Circuit & Waveforms**



**Peak Diode Recovery dv/dt Test Circuit & Waveforms**





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