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ON Semiconductor®

# FQA13N80-F109

## N-Channel QFET® MOSFET

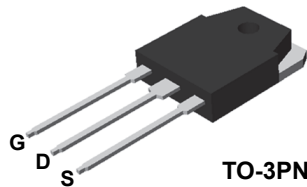
800 V, 12.6 A, 750 mΩ

### Description

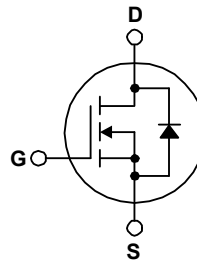
This N-Channel enhancement mode power MOSFET is produced using ON Semiconductor's proprietary planar stripe and DMOS technology. This advanced MOSFET technology has been especially tailored to reduce on-state resistance, and to provide superior switching performance and high avalanche energy strength. These devices are suitable for switched mode power supplies, active power factor correction (PFC), and electronic lamp ballasts.

### Features

- 12.6 A, 800 V,  $R_{DS(on)} = 750 \text{ m}\Omega$  (Max.) @  $V_{GS} = 10 \text{ V}$ ,  $I_D = 6.3 \text{ A}$
- Low Gate Charge (Typ. 68 nC)
- Low  $C_{rss}$  (Typ. 30 pF)
- 100% Avalanche Tested



TO-3PN



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

| Symbol         | Parameter   | FQA13N80-F109 | Unit                |
|----------------|---|---------------|---------------------|
| $V_{DSS}$      | Drain-Source Voltage  | 800           | V                   |
| $I_D$          | Drain Current - Continuous ( $T_C = 25^\circ\text{C}$ )                       | 12.6          | A                   |
|                | - Continuous ( $T_C = 100^\circ\text{C}$ )                                    | 8.0           | A                   |
| $I_{DM}$       | Drain Current - Pulsed (Note 1)   | 50.4          | A                   |
| $V_{GSS}$      | Gate-Source Voltage   | $\pm 30$      | V                   |
| $E_{AS}$       | Single Pulsed Avalanche Energy (Note 2)                                       | 1100          | mJ                  |
| $I_{AR}$       | Avalanche Current (Note 1)  | 12.6          | A                   |
| $E_{AR}$       | Repetitive Avalanche Energy (Note 1)  | 30            | mJ                  |
| $dv/dt$        | Peak Diode Recovery $dv/dt$ (Note 3)  | 4.0           | V/ns                |
| $P_D$          | Power Dissipation ( $T_C = 25^\circ\text{C}$ )                                | 300           | W                   |
|                | - Derate above $25^\circ\text{C}$   | 2.38          | W/ $^\circ\text{C}$ |
| $T_J, T_{STG}$ | Operating and Storage Temperature Range                                       | -55 to +150   | $^\circ\text{C}$    |
| $T_L$          | Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds | 300           | $^\circ\text{C}$    |

### Thermal Characteristics

| Symbol          | Parameter                                     | FQA13N80_F109 | Unit                      |
|-----------------|---|---------------|---------------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case, Max.    | 0.42          | $^\circ\text{C}/\text{W}$ |
| $R_{\theta CS}$ | Thermal Resistance, Case-to-Sink, Typ.        | 0.24          | $^\circ\text{C}/\text{W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient, Max. | 40            | $^\circ\text{C}/\text{W}$ |

## Package Marking and Ordering Information

| Part Number   | Top Mark | Package | Packing Method | Reel Size | Tape Width | Quantity |
|---------------|----------|---------|----------------|-----------|------------|----------|
| FQA13N80-F109 | FQA13N80 | TO-3PN  | Tube           | N/A       | N/A        | 30 units |

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

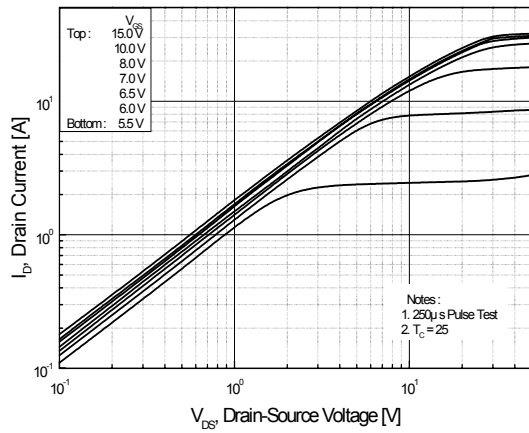
| Symbol  | Parameter   | Test Conditions   | Min | Typ  | Max  | Unit |
|---|---|---|-----|------|------|------|
| <b>Off Characteristics</b>                                    |   |   |     |      |      |      |
| BV <sub>DSS</sub>   | Drain-Source Breakdown Voltage                        | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA  | 800 | --   | --   | V    |
| ΔBV <sub>DSS</sub> / ΔT <sub>J</sub>                          | Breakdown Voltage Temperature Coefficient             | I <sub>D</sub> = 250 μA, Referenced to 25°C   | --  | 0.95 | --   | V/°C |
| I <sub>DSS</sub>  | Zero Gate Voltage Drain Current                       | V <sub>DS</sub> = 800 V, V <sub>GS</sub> = 0 V  | --  | --   | 10   | μA   |
|   |   | V <sub>DS</sub> = 640 V, T <sub>C</sub> = 125°C   | --  | --   | 100  | μA   |
| I <sub>GSSF</sub>   | Gate-Body Leakage Current, Forward                    | V <sub>GS</sub> = 30 V, V <sub>DS</sub> = 0 V   | --  | --   | 100  | nA   |
| I <sub>GSSR</sub>   | Gate-Body Leakage Current, Reverse                    | V <sub>GS</sub> = -30 V, V <sub>DS</sub> = 0 V  | --  | --   | -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> = 250 μA                             | 3.0 | --   | 5.0  | V    |
| R <sub>DS(on)</sub>   | Static Drain-Source On-Resistance                     | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 6.3A   | --  | 0.58 | 0.75 | Ω    |
| g <sub>FS</sub>   | Forward Transconductance                              | V <sub>DS</sub> = 50 V, I <sub>D</sub> = 6.3A   | --  | 13   | --   | S    |
| <b>Dynamic Characteristics</b>                                |   |   |     |      |      |      |
| C <sub>iss</sub>  | Input Capacitance                                     | V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V, f = 1.0 MHz                              | --  | 2700 | 3500 | pF   |
| C <sub>oss</sub>  | Output Capacitance                                    |   | --  | 275  | 360  | pF   |
| C <sub>rss</sub>  | Reverse Transfer Capacitance                          |   | --  | 30   | 39   | pF   |
| <b>Switching Characteristics</b>                              |   |   |     |      |      |      |
| t <sub>d(on)</sub>  | Turn-On Delay Time                                    | V <sub>DD</sub> = 400 V, I <sub>D</sub> = 12.6A, R <sub>G</sub> = 25 Ω<br><br>(Note 4)  | --  | 60   | 130  | ns   |
| t <sub>r</sub>  | Turn-On Rise Time                                     |   | --  | 150  | 310  | ns   |
| t <sub>d(off)</sub>   | Turn-Off Delay Time                                   |   | --  | 155  | 320  | ns   |
| t <sub>f</sub>  | Turn-Off Fall Time                                    |   | --  | 110  | 230  | ns   |
| Q <sub>g</sub>  | Total Gate Charge                                     | V <sub>DS</sub> = 640 V, I <sub>D</sub> = 12.6A, V <sub>GS</sub> = 10 V<br><br>(Note 4) | --  | 68   | 88   | nC   |
| Q <sub>gs</sub>   | Gate-Source Charge                                    |   | --  | 15   | --   | nC   |
| Q <sub>gd</sub>   | Gate-Drain Charge                                     |   | --  | 32   | --   | nC   |
| <b>Drain-Source Diode Characteristics and Maximum Ratings</b> |   |   |     |      |      |      |
| I <sub>S</sub>  | Maximum Continuous Drain-Source Diode Forward Current |   | --  | --   | 12.6 | A    |
| I <sub>SM</sub>   | Maximum Pulsed Drain-Source Diode Forward Current     |   | --  | --   | 50.4 | A    |
| V <sub>SD</sub>   | Drain-Source Diode Forward Voltage                    | V <sub>GS</sub> = 0 V, I <sub>S</sub> = 12.6A   | --  | --   | 1.4  | V    |
| t <sub>rr</sub>   | Reverse Recovery Time                                 | V <sub>GS</sub> = 0 V, I <sub>S</sub> = 12.6 A, di <sub>F</sub> / dt = 100 A/μs         | --  | 850  | --   | ns   |
| Q <sub>rr</sub>   | Reverse Recovery Charge                               |   | --  | 11.3 | --   | μC   |

**Notes:**

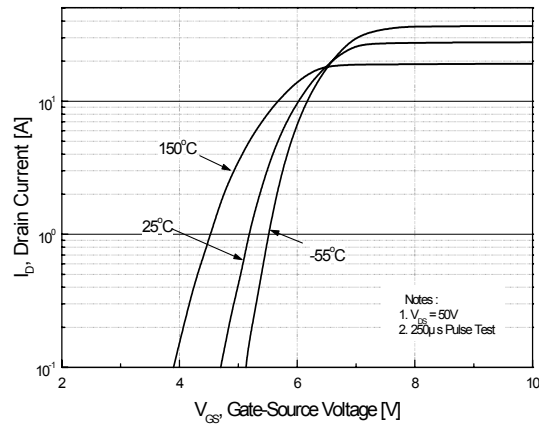
1. Repetitive Rating ; Pulse width limited by maximum junction temperature
2. L = 13 mH, I<sub>AS</sub> = 12.6 A, V<sub>DD</sub> = 50 V, R<sub>G</sub> = 25 Ω, Starting T<sub>J</sub> = 25°C
3. I<sub>SD</sub> ≤ 12.6 A, di/dt ≤ 200 A/μs, V<sub>DD</sub> ≤ BV<sub>DSS</sub>, Starting T<sub>J</sub> = 25°C
4. Essentially independent of operating temperature

## Typical Characteristics

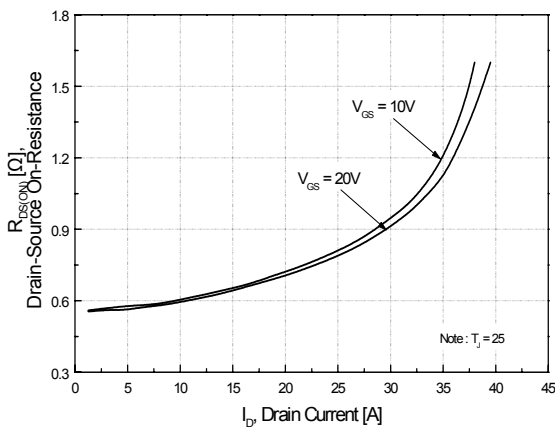
**Figure 1. On-Region Characteristics**



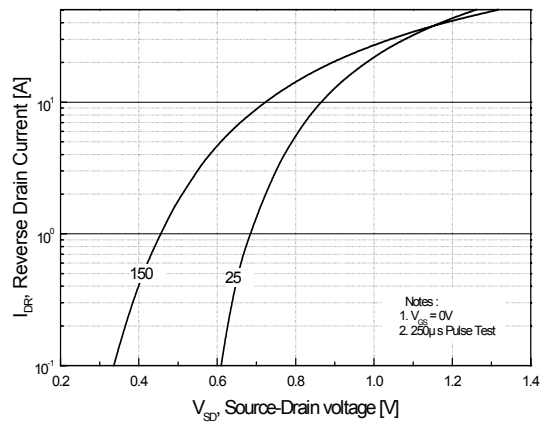
**Figure 2. Transfer Characteristics**



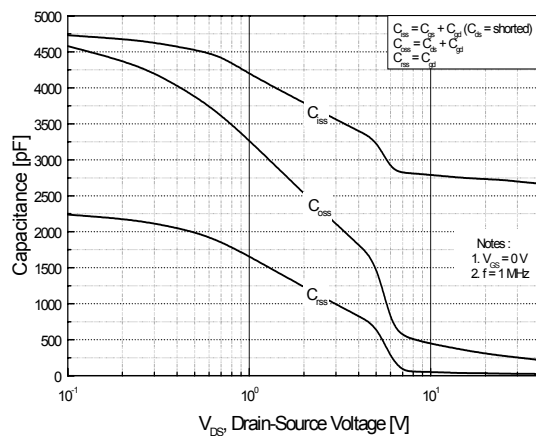
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



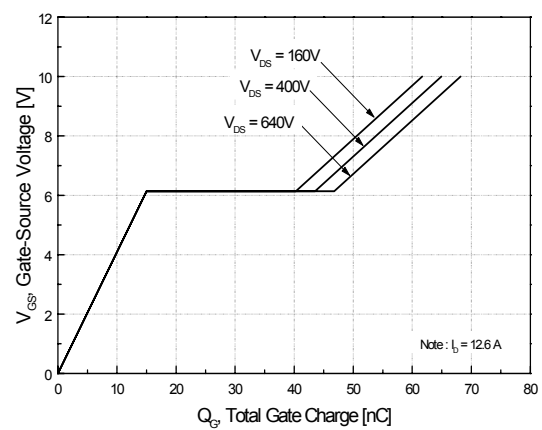
**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**



**Figure 5. Capacitance Characteristics**

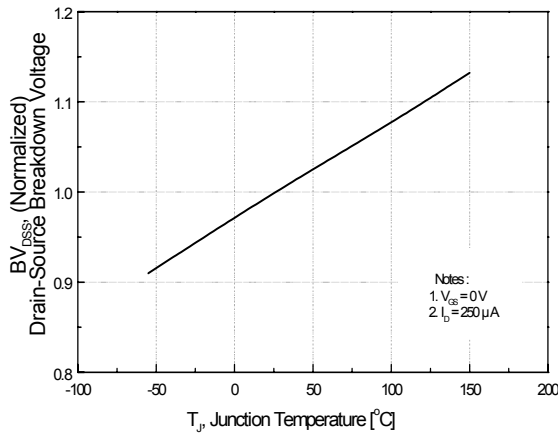


**Figure 6. Gate Charge Characteristics**

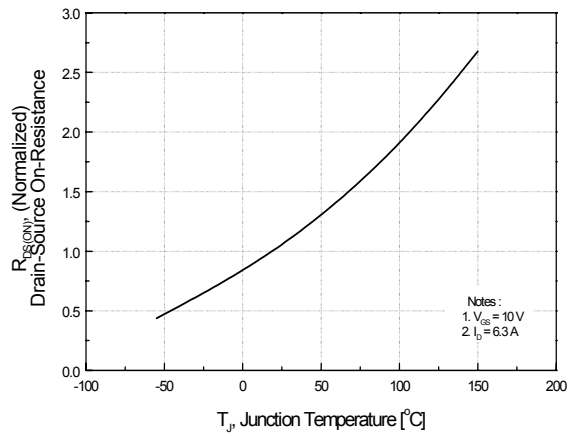


## Typical Characteristics (Continued)

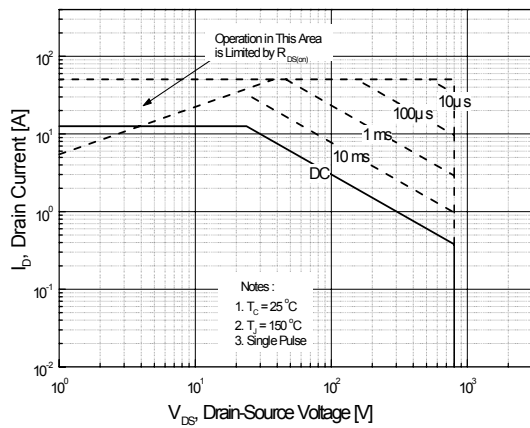
**Figure 7. Breakdown Voltage Variation vs. Temperature**



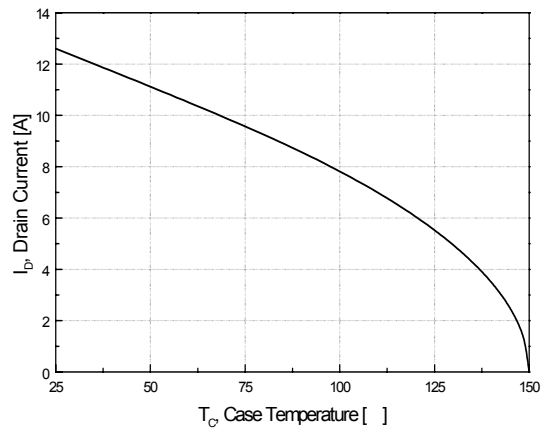
**Figure 8. On-Resistance Variation vs. Temperature**



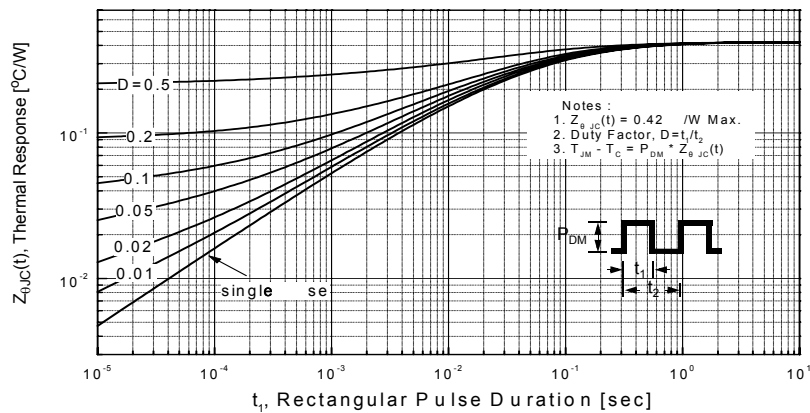
**Figure 9. Maximum Safe Operating Area**



**Figure 10. Maximum Drain Current vs. Case Temperature**



**Figure 11. Transient Thermal Response Curve**



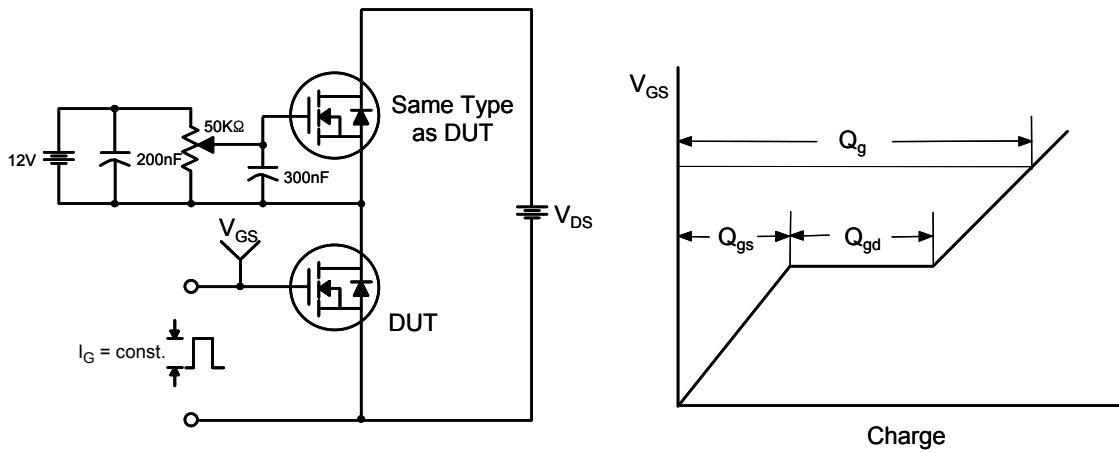


Figure 12. Gate Charge Test Circuit & Waveform

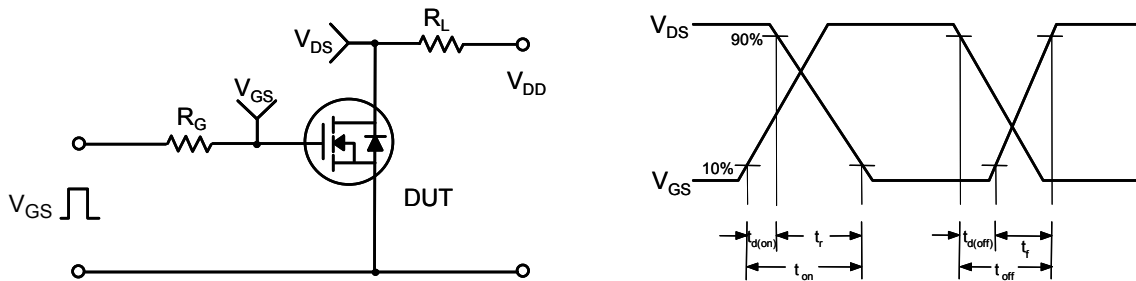


Figure 13. Resistive Switching Test Circuit & Waveforms

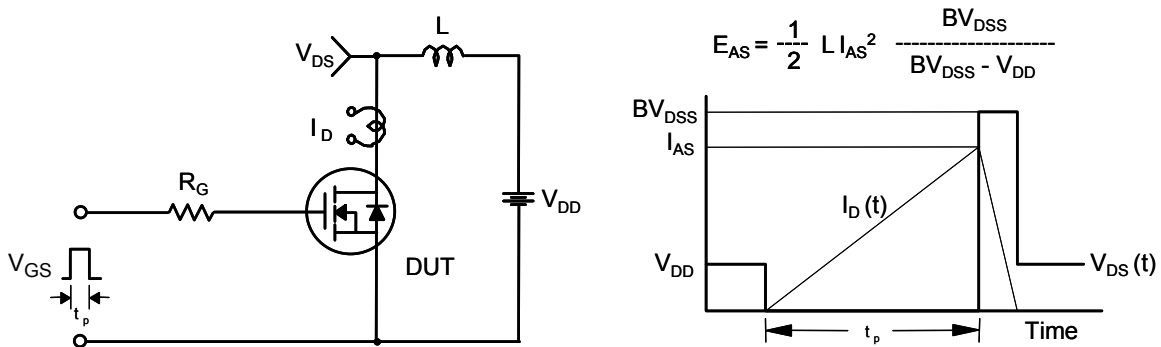


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

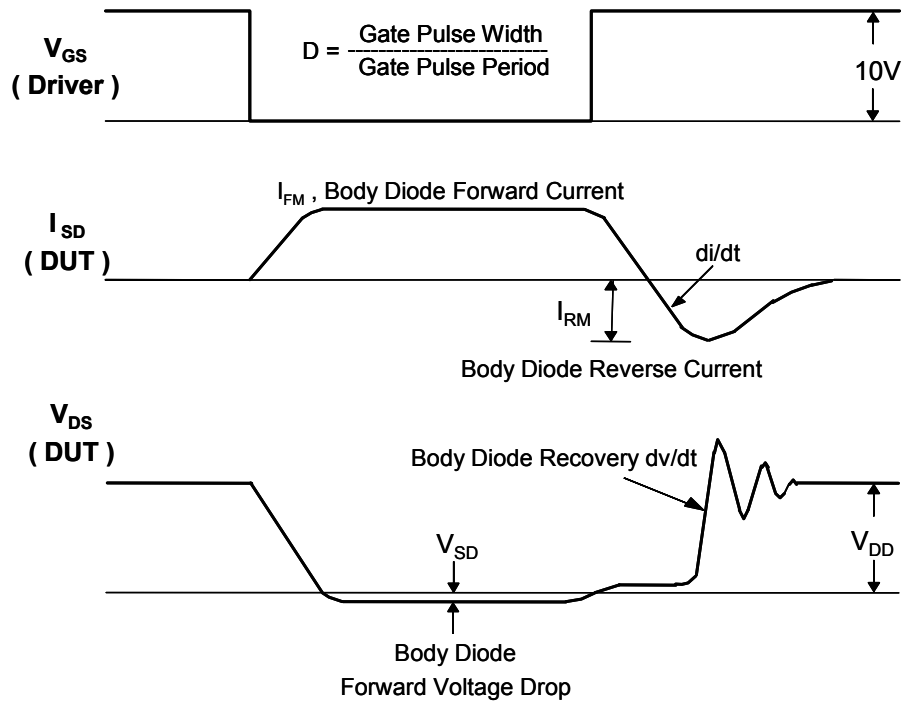
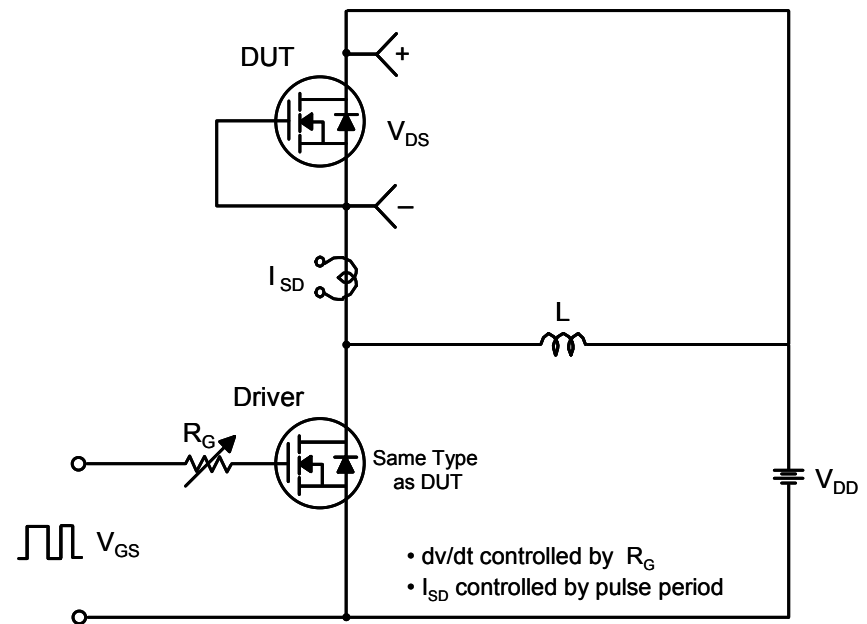
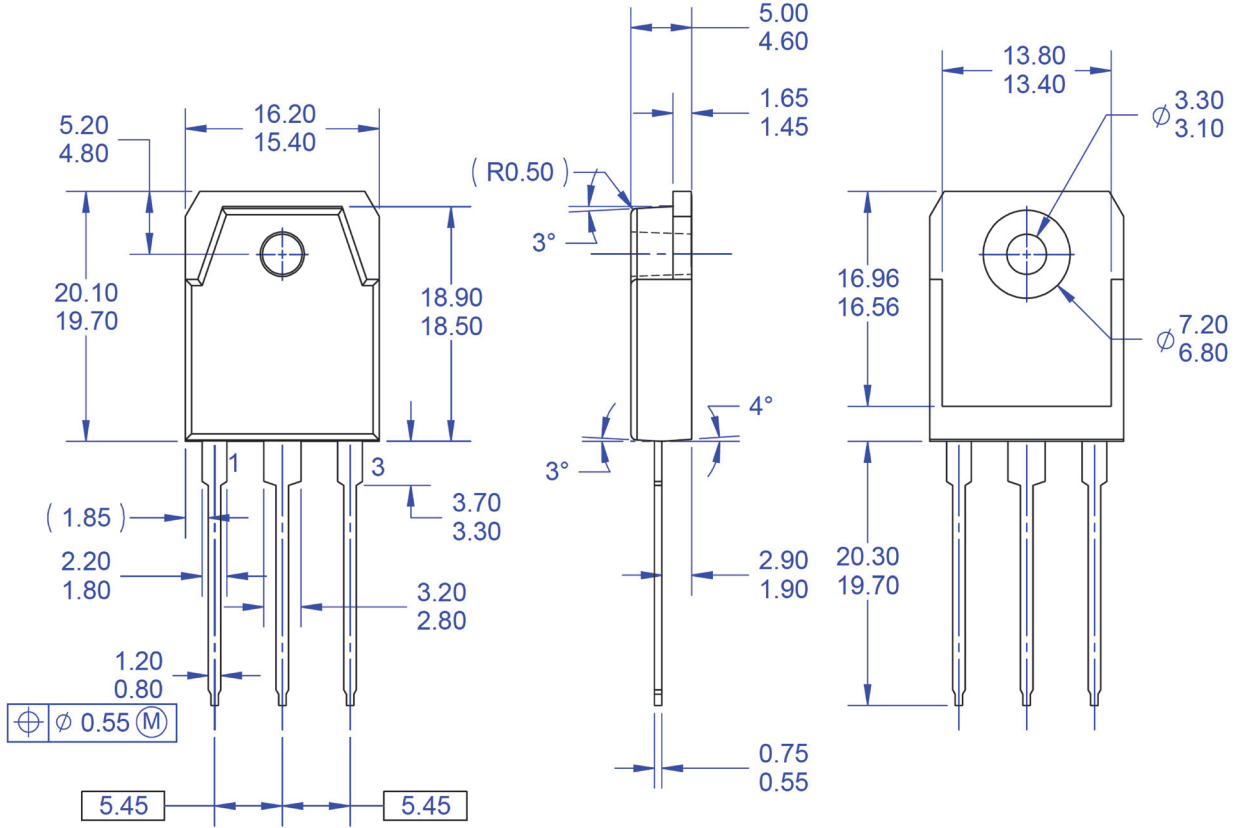


Figure 15. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms

### Mechanical Dimensions



NOTES: UNLESS OTHERWISE SPECIFIED

- A) THIS PACKAGE CONFORMS TO EIAJ SC-65 PACKAGING STANDARD.
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSION AND TOLERANCING PER ASME14.5-2009.
- D) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
- E) DRAWING FILE NAME: TO3PN03AREV1.
- F) FAIRCHILD SEMICONDUCTOR.

**Figure 16. TO3PN, 3-Lead, Plastic, EIAJ SC-65**

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