

# MOSFET – N-Channel, QFET

**900 V, 7.0 A, 1.1  $\Omega$**

## FQAF11N90C

### Description

This N-Channel enhancement mode power MOSFET is produced using onsemi'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

- 7.0 A, 900 V,  $R_{DS(on)} = 1.1 \Omega$  (Max.) @  $V_{GS} = 10$  V,  $I_D = 3.5$  A
- Low Gate Charge (Typ. 60 nC)
- Low  $C_{RSS}$  (Typ. 23 pF)
- 100% Avalanche Tested
- This is a Pb-Free Device

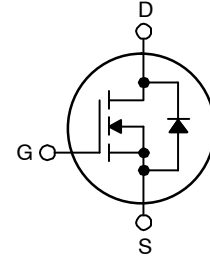
### ABSOLUTE MAXIMUM RATINGS ( $T_C = 25^\circ\text{C}$ unless otherwise noted)

| Symbol         | Parameter                                                                     | Value           | Unit                |
|----------------|-------------------------------------------------------------------------------|-----------------|---------------------|
| $V_{DSS}$      | Drain-Source Voltage                                                          | 900             | V                   |
| $I_D$          | Drain Current – Continuous ( $T_C = 25^\circ\text{C}$ )                       | 7.0             | A                   |
|                | – Continuous ( $T_C = 100^\circ\text{C}$ )                                    | 4.4             | A                   |
| $I_{DM}$       | Drain Current – Pulsed (Note 1)                                               | 28.0            | A                   |
| $V_{GSS}$      | Gate-Source Voltage                                                           | $\pm 30$        | V                   |
| $E_{AS}$       | Single Pulsed Avalanche Energy (Note 2)                                       | 960             | mJ                  |
| $I_{AR}$       | Avalanche Current (Note 1)                                                    | 7.0             | A                   |
| $E_{AR}$       | Repetitive Avalanche Energy (Note 1)                                          | 12              | mJ                  |
| $dv/dt$        | Peak Diode Recovery $dv/dt$ (Note 3)                                          | 4.0             | V/ns                |
| $P_D$          | Power Dissipation ( $T_C = 25^\circ\text{C}$ )                                | 120             | W                   |
|                | – Derate Above $25^\circ\text{C}$                                             | 0.96            | 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             | $^\circ\text{C}$    |

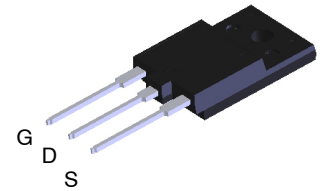
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2.  $L = 37$  mH,  $I_{AS} = 7.0$  A,  $V_{DD} = 50$  V,  $R_G = 25 \Omega$ , Starting  $T_J = 25^\circ\text{C}$ .
3.  $I_{SD} \leq 11.0$  A,  $di/dt \leq 200$  A/ $\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$ .

| $V_{DSS}$ | $R_{DS(on)}$ MAX    | $I_D$ MAX |
|-----------|---------------------|-----------|
| 900 V     | 1.1 $\Omega$ @ 10 V | 7.0 A     |



N-CHANNEL MOSFET



TO-3PF-L  
CASE 340AH

### MARKING DIAGRAM

FQAF  
11N90C  
AYWWZZ

FQAF11N90 = Specific Device Code  
A = Assembly Plant Code  
YWW = Date Code (Year & Week)  
ZZ = Lot Code

### ORDERING INFORMATION

| Device     | Package             | Shipping           |
|------------|---------------------|--------------------|
| FQAF11N90C | TO-3PF<br>(Pb-Free) | 30 Units /<br>Tube |

# FQAF11N90C

## THERMAL CHARACTERISTICS

| Symbol          | Parameter                                     | Value | Unit |
|-----------------|-----------------------------------------------|-------|------|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case, Max.    | 1.04  | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient, Max. | 40    | °C/W |

## ELECTRICAL CHARACTERISTICS ( $T_C = 25^\circ\text{C}$ unless otherwise noted)

| Symbol | Parameter | Test Condition | Min | Typ | Max | Unit |
|--------|-----------|----------------|-----|-----|-----|------|
|--------|-----------|----------------|-----|-----|-----|------|

### OFF CHARACTERISTICS

|                                |                                           |                                                                   |     |      |      |               |
|--------------------------------|-------------------------------------------|-------------------------------------------------------------------|-----|------|------|---------------|
| $BV_{DSS}$                     | Drain-Source Breakdown Voltage            | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$               | 900 | –    | –    | V             |
| $\Delta BV_{DSS} / \Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D = 250\text{ }\mu\text{A}$ , Referenced to $25^\circ\text{C}$ | –   | 1.00 | –    | V/°C          |
| $I_{DSS}$                      | Zero Gate Voltage Drain Current           | $V_{DS} = 900\text{ V}, V_{GS} = 0\text{ V}$                      | –   | –    | 10   | $\mu\text{A}$ |
|                                |                                           | $V_{DS} = 720\text{ V}, T_C = 125^\circ\text{C}$                  | –   | –    | 100  | $\mu\text{A}$ |
| $I_{GSSF}$                     | Gate-Body Leakage Current, Forward        | $V_{GS} = 30\text{ V}, V_{DS} = 0\text{ V}$                       | –   | –    | 100  | nA            |
| $I_{GSSR}$                     | Gate-Body Leakage Current, Reverse        | $V_{GS} = -30\text{ V}, V_{DS} = 0\text{ V}$                      | –   | –    | -100 | nA            |

### ON CHARACTERISTICS

|              |                                   |                                                 |     |      |     |          |
|--------------|-----------------------------------|-------------------------------------------------|-----|------|-----|----------|
| $V_{GS(th)}$ | Gate Threshold Voltage            | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$ | 3.0 | –    | 5.0 | V        |
| $R_{DS(on)}$ | Static Drain-Source On-Resistance | $V_{GS} = 10\text{ V}, I_D = 3.5\text{ A}$      | –   | 0.91 | 1.1 | $\Omega$ |
| $g_{FS}$     | Forward Transconductance          | $V_{DS} = 50\text{ V}, I_D = 3.5\text{ A}$      | –   | –    | –   | S        |

### DYNAMIC CHARACTERISTICS

|           |                              |                                                               |   |      |      |    |
|-----------|------------------------------|---------------------------------------------------------------|---|------|------|----|
| $C_{iss}$ | Input Capacitance            | $V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$ | – | 2530 | 3290 | pF |
| $C_{oss}$ | Output Capacitance           |                                                               | – | 215  | 280  | pF |
| $C_{rss}$ | Reverse Transfer Capacitance |                                                               | – | 23   | 30   | pF |

### SWITCHING CHARACTERISTICS

|              |                     |                                                                               |   |     |     |    |
|--------------|---------------------|-------------------------------------------------------------------------------|---|-----|-----|----|
| $t_{d(on)}$  | Turn-On Delay Time  | $V_{DD} = 450\text{ V}, I_D = 11.0\text{ A}, R_G = 25\text{ }\Omega$ (Note 4) | – | 60  | 130 | ns |
| $t_r$        | Turn-On Rise Time   |                                                                               | – | 130 | 270 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time |                                                                               | – | 130 | 270 | ns |
| $t_f$        | Turn-Off Fall Time  |                                                                               | – | 85  | 180 | ns |
| $Q_g$        | Total Gate Charge   | $V_{DS} = 720\text{ V}, I_D = 11.0\text{ A}, V_{GS} = 10\text{ V}$ (Note 4)   | – | 60  | 80  | nC |
| $Q_{gs}$     | Gate-Source Charge  |                                                                               | – | 13  | –   | nC |
| $Q_{gd}$     | Gate-Drain Charge   |                                                                               | – | 25  | –   | nC |

### DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS

|                 |                                                       |                                                                                   |   |      |      |    |
|-----------------|-------------------------------------------------------|-----------------------------------------------------------------------------------|---|------|------|----|
| I <sub>S</sub>  | Maximum Continuous Drain–Source Diode Forward Current |                                                                                   | – | –    | 7.0  | A  |
| I <sub>SM</sub> | Maximum Pulsed Drain–Source Diode Forward Current     |                                                                                   | – | –    | 28.0 | A  |
| V <sub>SD</sub> | Drain–Source Diode Forward Voltage                    | V <sub>GS</sub> = 0 V, I <sub>S</sub> = 7.0 A                                     | – | –    | 1.4  | V  |
| t <sub>rr</sub> | Reverse Recovery Time                                 | V <sub>GS</sub> = 0 V, I <sub>S</sub> = 11.0 A,<br>dI <sub>F</sub> /dt = 100 A/μs | – | 1000 | –    | ns |
| Q <sub>rr</sub> | Reverse Recovery Charge                               |                                                                                   | – | 17.0 | –    | 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.

4. Essentially Independent of Operating Temperature.

## TYPICAL CHARACTERISTICS

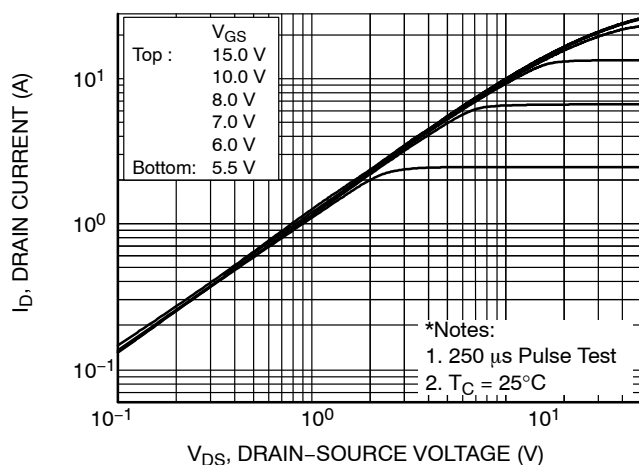


Figure 1. On-Region Characteristics

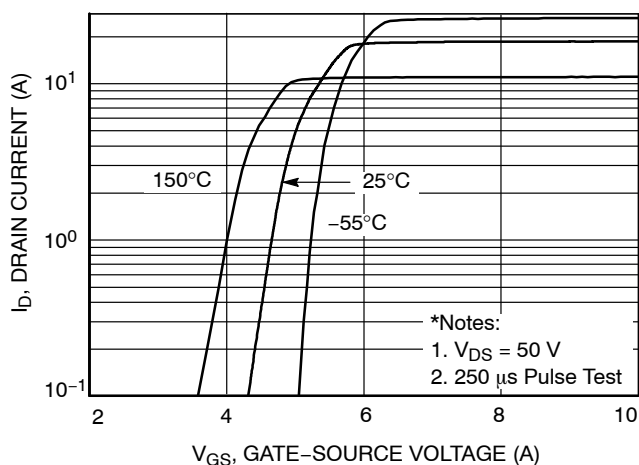


Figure 2. Transfer Characteristics

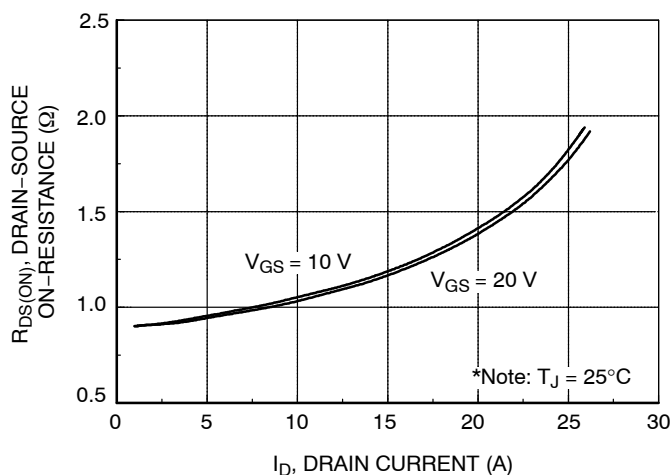


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

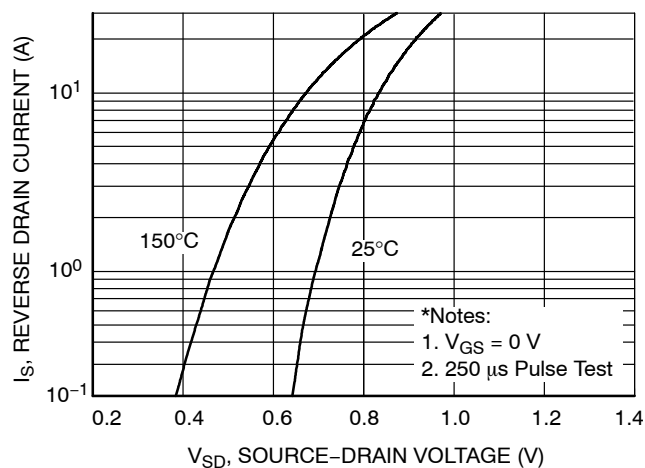


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

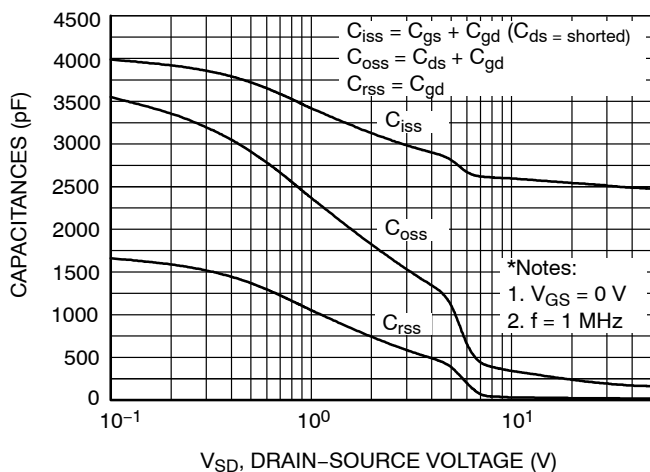


Figure 5. Capacitance Characteristics

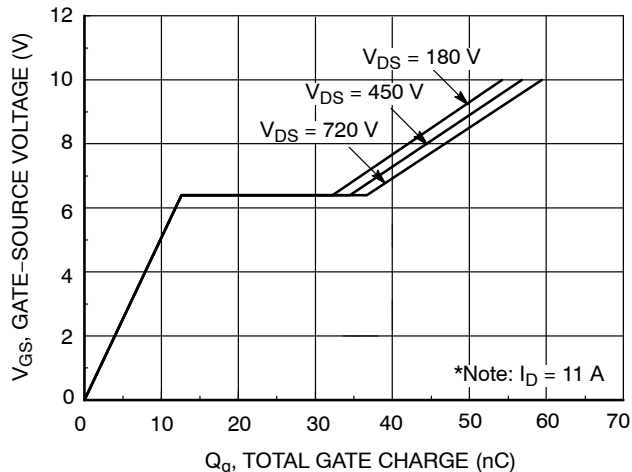


Figure 6. Gate Charge Characteristics

## TYPICAL CHARACTERISTICS (CONTINUED)

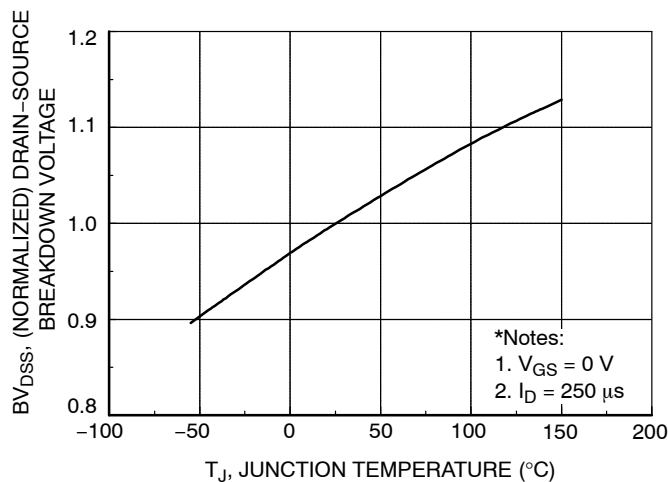


Figure 8. Breakdown Voltage Variation vs. Temperature

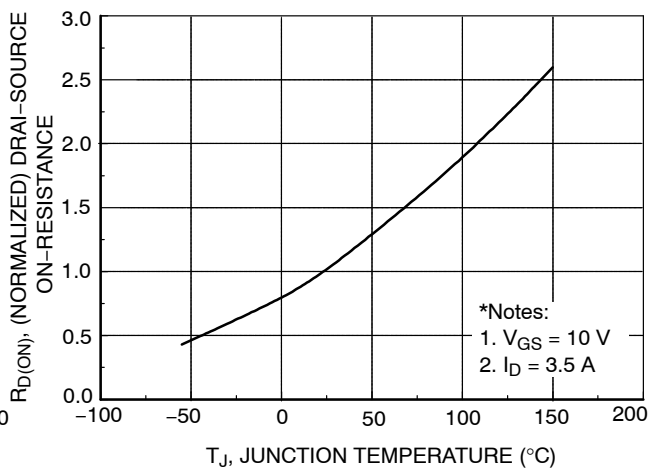


Figure 9. On-Resistance Variation vs. Temperature

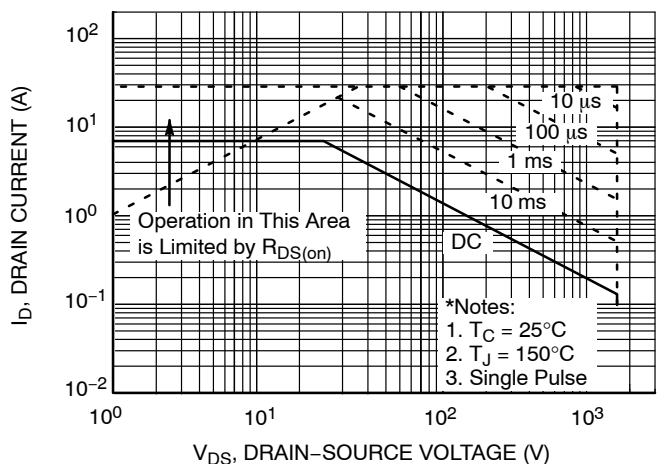


Figure 10. Maximum Safe Operating Area

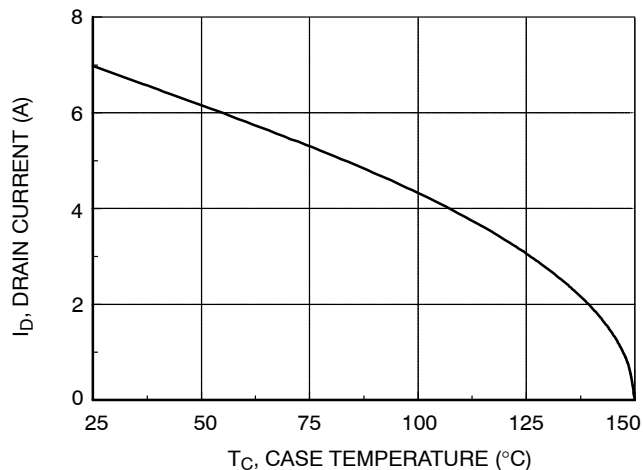


Figure 11. Maximum Drain Current vs. Case Temperature

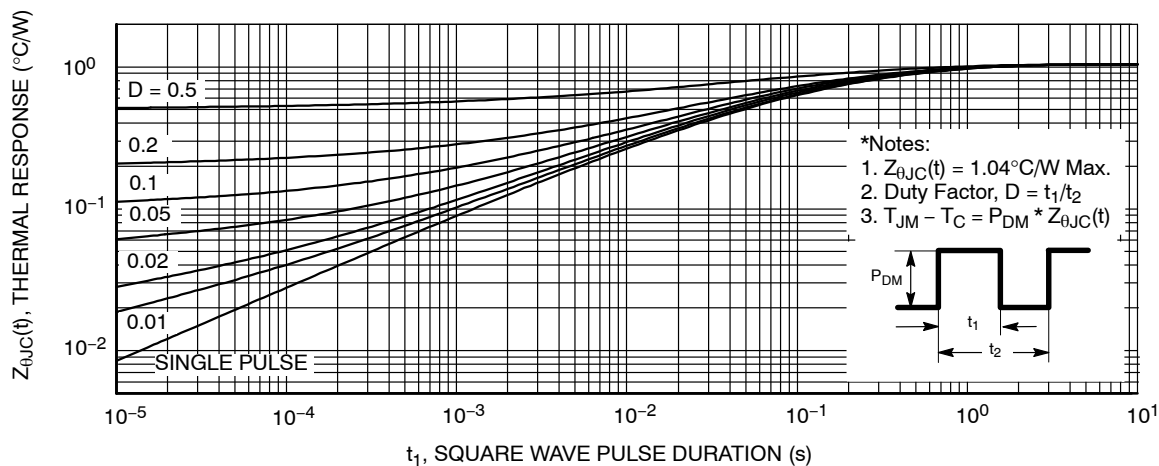


Figure 7. Transient Thermal Response Curve

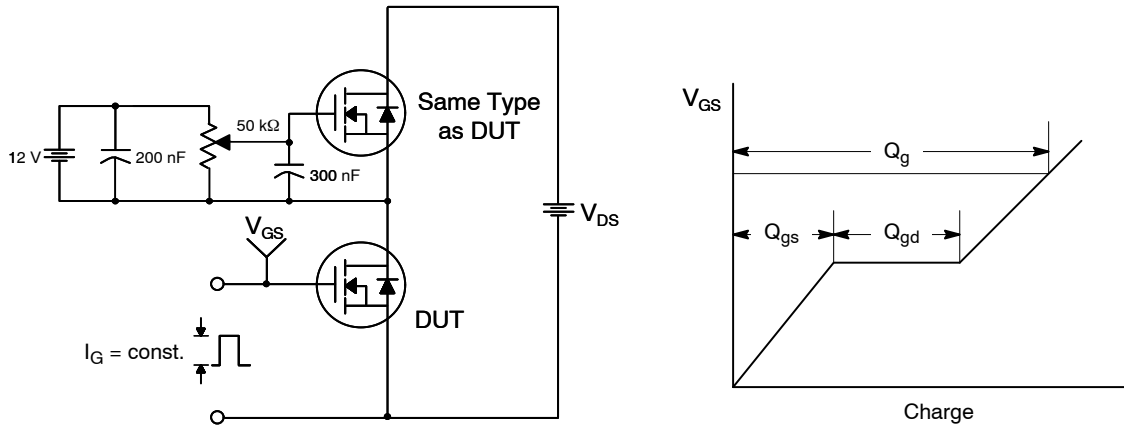


Figure 12. Gate Charge Test Circuit & Waveform

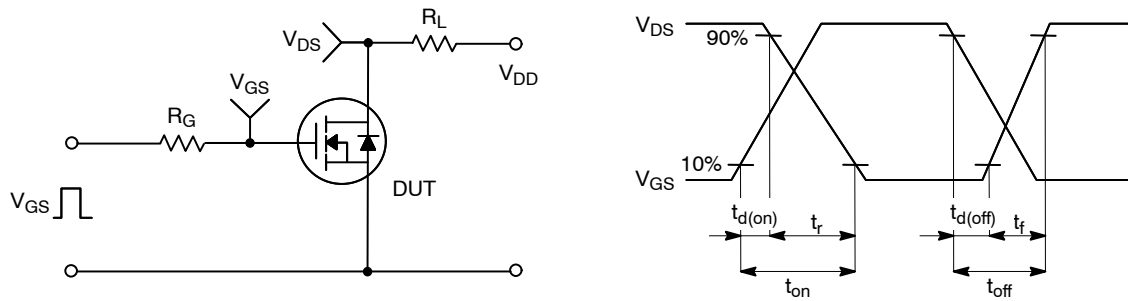


Figure 13. Resistive Switching Test Circuit & Waveforms

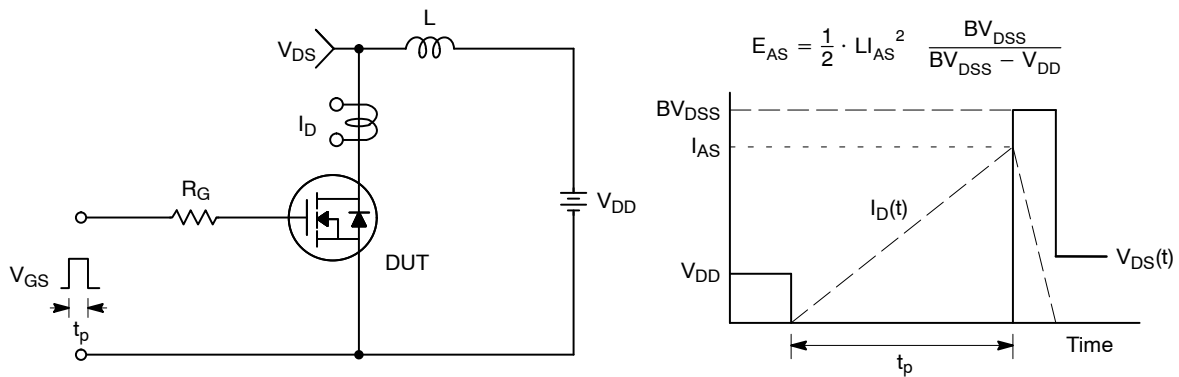
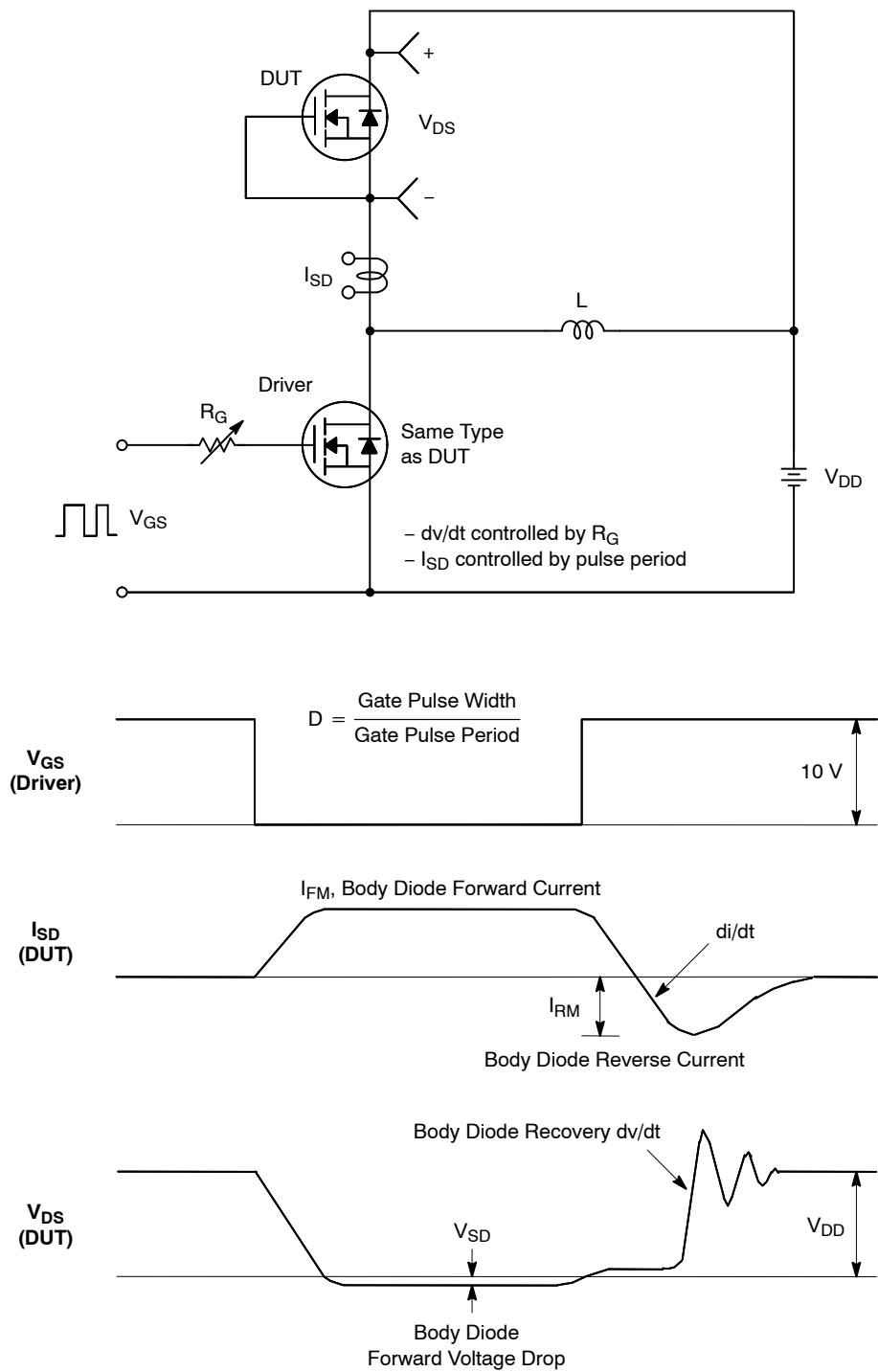


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

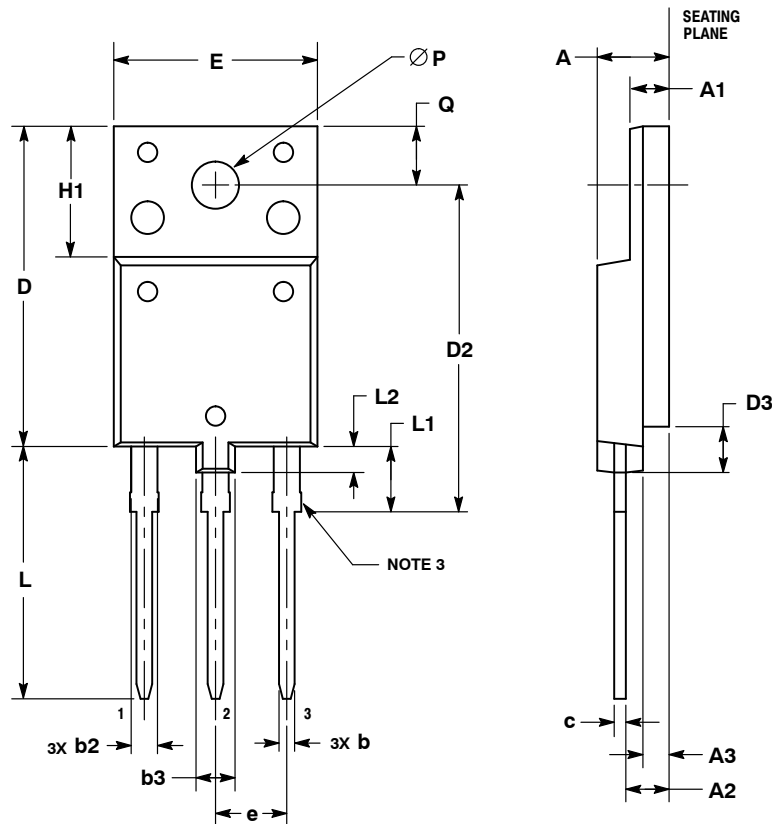
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**Figure 15. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms**

**TO-3PF-3L**  
**CASE 340AH**  
**ISSUE A**

DATE 09 JAN 2015



## NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. CONTOUR UNCONTROLLED IN THIS AREA (6 PLACES).
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH OR GATE PROTRUSIONS. MOLD FLASH AND GATE PROTRUSIONS NOT TO EXCEED 0.13 PER SIDE. THESE DIMENSIONS ARE TO BE MEASURED AT THE OUTERMOST EXTREME OF THE PLASTIC BODY.
5. DIMENSION b2 DOES NOT INCLUDE DAMBAR PROTRUSION. LEAD WIDTH INCLUDING PROTRUSION SHALL NOT EXCEED 2.20.

| DIM | MILLIMETERS |       |
|-----|-------------|-------|
|     | MIN         | MAX   |
| A   | 5.30        | 5.70  |
| A1  | 2.80        | 3.20  |
| A2  | 3.10        | 3.50  |
| A3  | 1.80        | 2.20  |
| b   | 0.65        | 0.95  |
| b2  | 1.90        | 2.15  |
| b3  | 3.80        | 4.20  |
| c   | 0.80        | 1.10  |
| D   | 24.30       | 24.70 |
| D2  | 24.70       | 25.30 |
| D3  | 3.30        | 3.70  |
| E   | 15.30       | 15.70 |
| e   | 5.35        | 5.55  |
| H1  | 9.80        | 10.20 |
| L   | 19.10       | 19.50 |
| L1  | 4.80        | 5.20  |
| L2  | 1.90        | 2.20  |
| P   | 3.40        | 3.80  |
| Q   | 4.30        | 4.70  |

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