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August 2014

# FQP15P12 / FQPF15P12

## P-Channel QFET® MOSFET

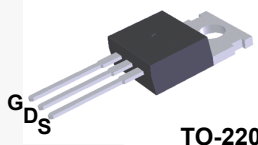
-120 V, -15 A, 0.2  $\Omega$

### Description

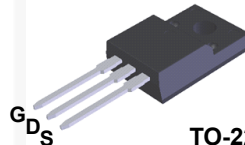
This P-Channel enhancement mode power MOSFET is produced using Fairchild Semiconductor's proprietary planar stripe and DMOS technology. This advanced MOSFET technology has been especially tailored to reduce on-state resistance, and to provide superior switching performance and high avalanche energy strength. These devices are suitable for switched mode power supplies, audio amplifier, DC motor control, and variable switching power applications.

### Features

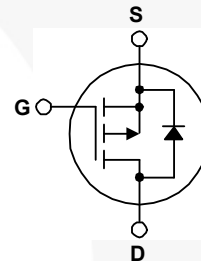
- 15 A, -120 V,  $R_{DS(on)} = 0.2 \Omega$  (Max.) @  $V_{GS} = -10$  V,  $I_D = -7.5$  A
- Low Gate Charge (Typ. 29 nC)
- Low  $C_{rss}$  (Typ. 110 pF)
- 100% Avalanche Tested
- 175°C Maximum Junction Temperature Rating



TO-220



TO-220F



### Absolute Maximum Ratings

$T_C = 25^\circ\text{C}$  unless otherwise noted.

| Symbol         | Parameter  | FQP15P12    | FQPF15P12 | Unit                |
|----------------|--|-------------|-----------|---------------------|
| $V_{DSS}$      | Drain-Source Voltage   | -120        |           | V                   |
| $I_D$          | Drain Current - Continuous ( $T_C = 25^\circ\text{C}$ )              | -15         | -15 *     | A                   |
|                | - Continuous ( $T_C = 100^\circ\text{C}$ )                           | -10.6       | -10.6 *   | A                   |
| $I_{DM}$       | Drain Current - Pulsed (Note 1)                                      | -60         | -60 *     | A                   |
| $V_{GSS}$      | Gate-Source Voltage  | $\pm 30$    |           | V                   |
| $E_{AS}$       | Single Pulsed Avalanche Energy (Note 2)                              | 1157        |           | mJ                  |
| $I_{AR}$       | Avalanche Current (Note 1)   | -15         |           | A                   |
| $E_{AR}$       | Repetitive Avalanche Energy (Note 1)                                 | 10          |           | mJ                  |
| $dv/dt$        | Peak Diode Recovery $dv/dt$ (Note 3)                                 | -5.0        |           | V/ns                |
| $P_D$          | Power Dissipation ( $T_C = 25^\circ\text{C}$ )                       | 100         | 41        | W                   |
|                | - Derate above $25^\circ\text{C}$                                    | 0.67        | 0.27      | W/ $^\circ\text{C}$ |
| $T_J, T_{STG}$ | Operating and Storage Temperature Range                              | -55 to +175 |           | $^\circ\text{C}$    |
| $T_L$          | Maximum Lead Temperature for Soldering, 1/8" from Case for 5 Seconds | 300         |           | $^\circ\text{C}$    |

\* Drain current limited by maximum junction temperature.

### Thermal Characteristics

| Symbol          | Parameter                               | FQP15P12 | FQPF15P12 | Unit               |
|-----------------|---|----------|-----------|--------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case    | 1.5      | 3.66      | $^\circ\text{C/W}$ |
| $R_{\theta JS}$ | Thermal Resistance, Case-to-Sink Typ.   | 40       | --        | $^\circ\text{C/W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | 62.5     | 62.5      | $^\circ\text{C/W}$ |

FQP15P12 / FQPF15P12 P-Channel QFET® MOSFET

**Electrical Characteristics** $T_C = 25^\circ\text{C}$  unless otherwise noted

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

**Off Characteristics**

|                                |   |  |      |       |      |                     |
|--------------------------------|---|--|------|-------|------|---------------------|
| $BV_{DSS}$                     | Drain-Source Breakdown Voltage            | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$                | -120 | --    | --   | V                   |
| $\Delta BV_{DSS} / \Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D = -250\text{ }\mu\text{A}$ , Referenced to $25^\circ\text{C}$ | --   | -0.13 | --   | V/ $^\circ\text{C}$ |
| $I_{DSS}$                      | Zero Gate Voltage Drain Current           | $V_{DS} = -120\text{ V}, V_{GS} = 0\text{ V}$                      | --   | --    | -1   | $\mu\text{A}$       |
|                                |   | $V_{DS} = -96\text{ V}, T_C = 150^\circ\text{C}$                   | --   | --    | -10  | $\mu\text{A}$       |
| $I_{GSSF}$                     | 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            | $V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$ | -2.0 | --   | -4.0 | V        |
| $R_{DS(on)}$ | Static Drain-Source On-Resistance | $V_{GS} = -10\text{ V}, I_D = -7.5\text{ A}$     | --   | 0.17 | 0.2  | $\Omega$ |
| $g_{FS}$     | Forward Transconductance          | $V_{DS} = -40\text{ V}, I_D = -7.5\text{ A}$     | --   | 9.5  | --   | S        |

**Dynamic Characteristics**

|           |                              |   |    |     |      |    |
|-----------|------------------------------|---|----|-----|------|----|
| $C_{iss}$ | Input Capacitance            | $V_{DS} = -25\text{ V}, V_{GS} = 0\text{ V},$<br>$f = 1.0\text{ MHz}$ | -- | 850 | 1100 | pF |
| $C_{oss}$ | Output Capacitance           |   | -- | 310 | 400  | pF |
| $C_{rss}$ | Reverse Transfer Capacitance |   | -- | 110 | 140  | pF |

**Switching Characteristics**

|              |                     |  |    |     |     |    |
|--------------|---------------------|--|----|-----|-----|----|
| $t_{d(on)}$  | Turn-On Delay Time  | $V_{DD} = -60\text{ V}, I_D = -15\text{ A},$<br>$R_G = 25\text{ }\Omega$<br><br>(Note 4) | -- | 15  | 40  | ns |
| $t_r$        | Turn-On Rise Time   |  | -- | 100 | 210 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time |  | -- | 80  | 170 | ns |
| $t_f$        | Turn-Off Fall Time  |  | -- | 80  | 170 | ns |
| $Q_g$        | Total Gate Charge   | $V_{DS} = -96\text{ V}, I_D = -15\text{ A},$<br>$V_{GS} = -10\text{ V}$<br><br>(Note 4)  | -- | 29  | 38  | nC |
| $Q_{gs}$     | Gate-Source Charge  |  | -- | 5.1 | --  | nC |
| $Q_{gd}$     | Gate-Drain Charge   |  | -- | 15  | --  | nC |

**Drain-Source Diode Characteristics and Maximum Ratings**

|                 |   |  |    |      |      |    |
|-----------------|---|--|----|------|------|----|
| I <sub>S</sub>  | Maximum Continuous Drain-Source Diode Forward Current |  | -- | --   | -15  | A  |
| I <sub>SM</sub> | Maximum Pulsed Drain-Source Diode Forward Current     |  | -- | --   | -60  | A  |
| V <sub>SD</sub> | Drain-Source Diode Forward Voltage                    | V <sub>GS</sub> = 0 V, I <sub>S</sub> = -15 A  | -- | --   | -4.0 | V  |
| t <sub>rr</sub> | Reverse Recovery Time                                 | V <sub>GS</sub> = 0 V, I <sub>S</sub> = -15 A, | -- | 126  | --   | ns |
| Q <sub>rr</sub> | Reverse Recovery Charge                               | dI <sub>F</sub> / dt = 100 A/μs                | -- | 0.61 | --   | μC |

**Notes:**

1. Repetitive rating : pulse width limited by maximum junction temperature.
2.  $L = 6.0\text{ mH}$ ,  $I_{AS} = -15\text{ A}$ ,  $V_{DD} = -50\text{ V}$ ,  $R_G = 25\text{ }\Omega$ , starting  $T_J = 25^\circ\text{C}$ .
3.  $I_{SD} \leq -15\text{ A}$ ,  $di/dt \leq 300\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , starting  $T_J = 25^\circ\text{C}$ .
4. Essentially independent of operating temperature.

## Typical Characteristics

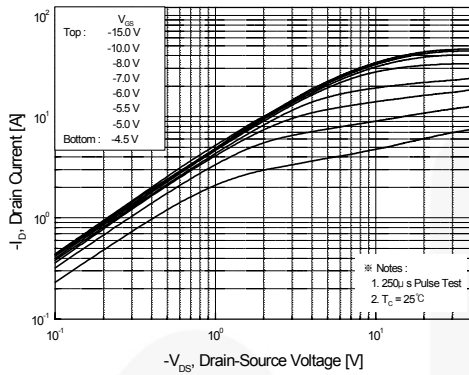


Figure 1. On-Region Characteristics

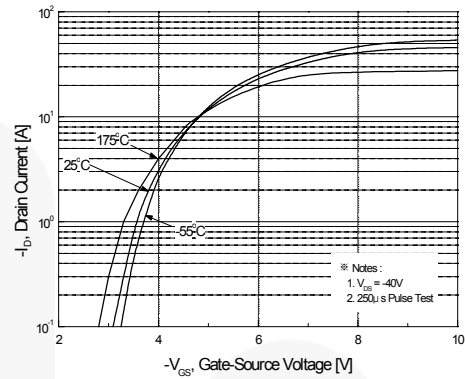


Figure 2. Transfer Characteristics

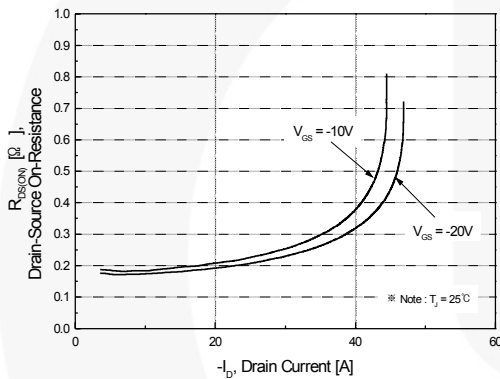


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

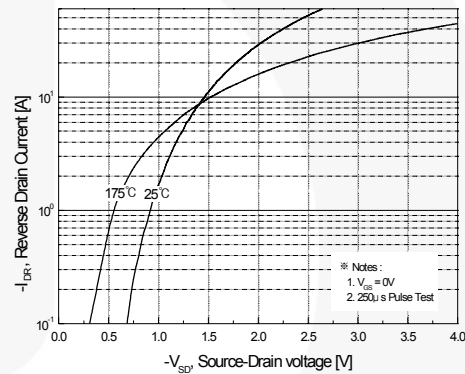


Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature

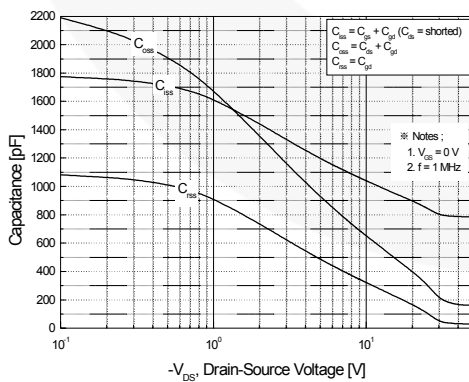


Figure 5. Capacitance Characteristics

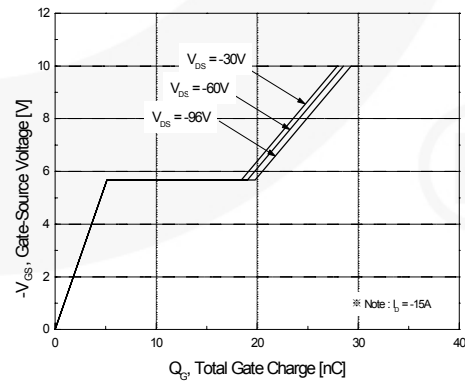
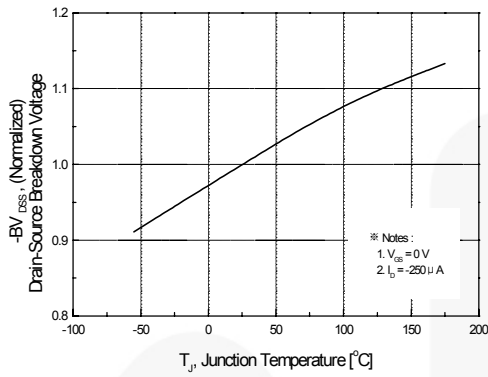
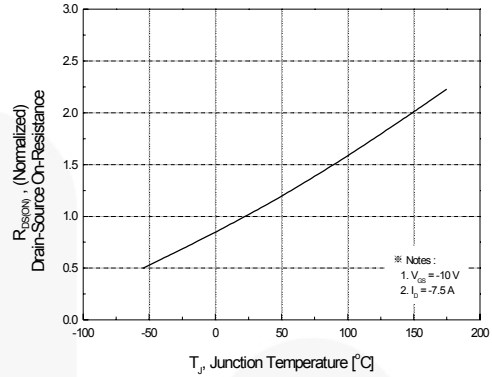


Figure 6. Gate Charge Characteristics

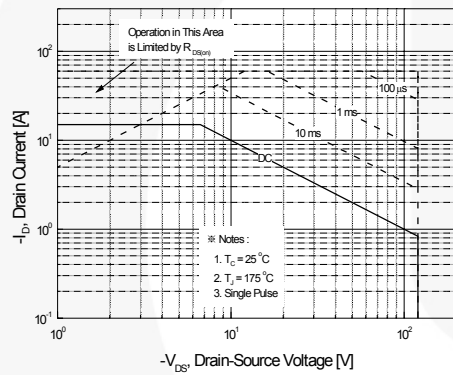
## Typical Characteristics (Continued)



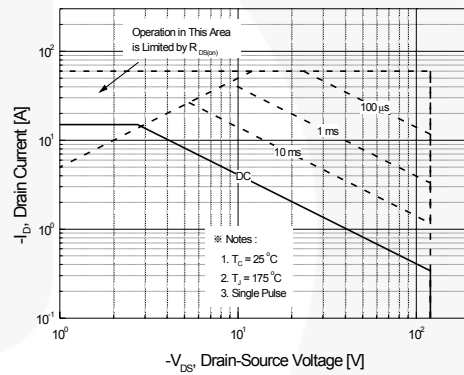
**Figure 7. Breakdown Voltage Variation vs Temperature**



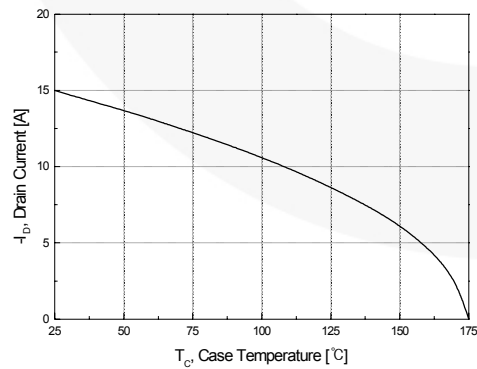
**Figure 8. On-Resistance Variation vs Temperature**



**Figure 9-1. Maximum Safe Operating Area for FQP15P12**



**Figure 9-2. Maximum Safe Operating Area for FQPF15P12**



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

# Typical Characteristics (Continued)

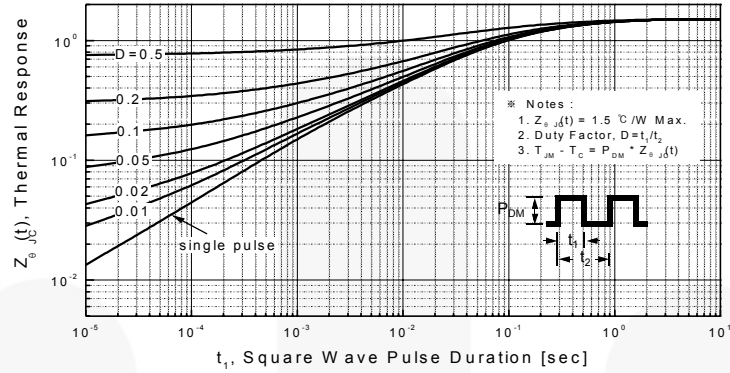


Figure 11-1. Transient Thermal Response Curve for FQP15P12

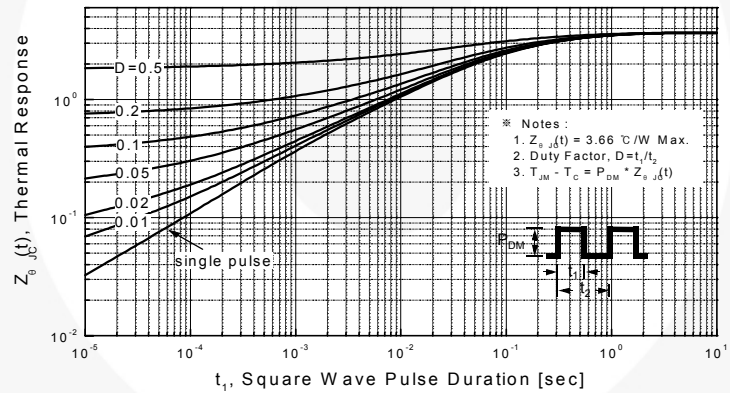


Figure 11-2. Transient Thermal Response Curve for FQPF15P12

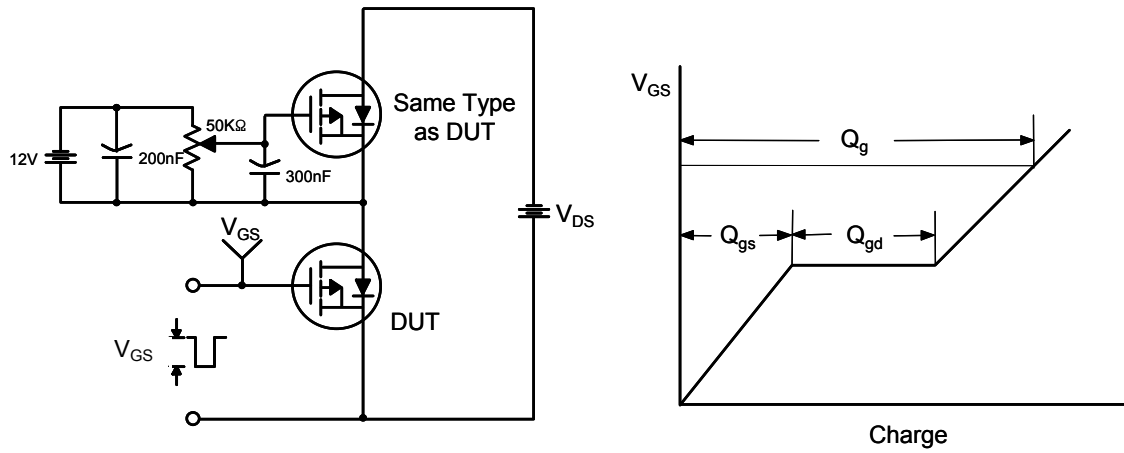


Figure 12. Gate Charge Test Circuit & Waveform

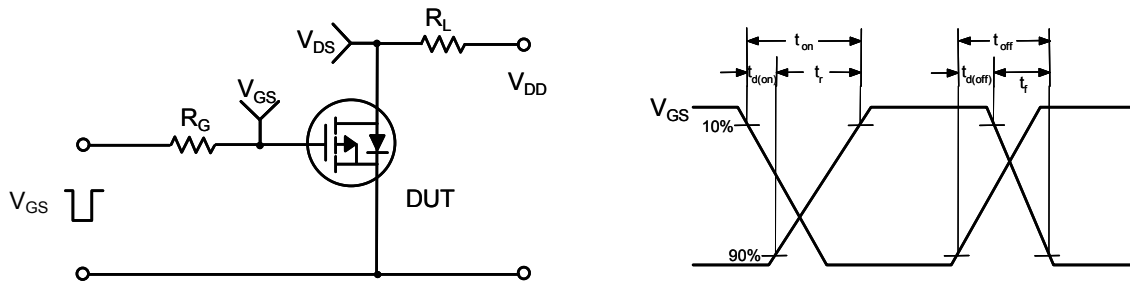


Figure 13. Resistive Switching Test Circuit & Waveforms

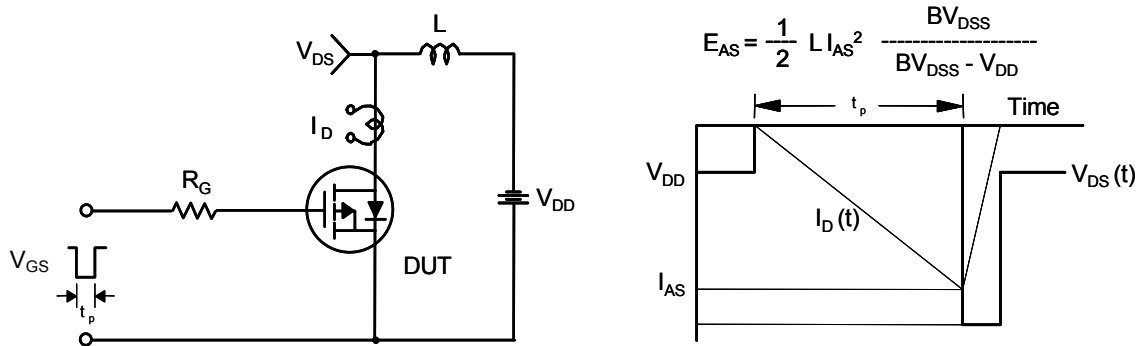
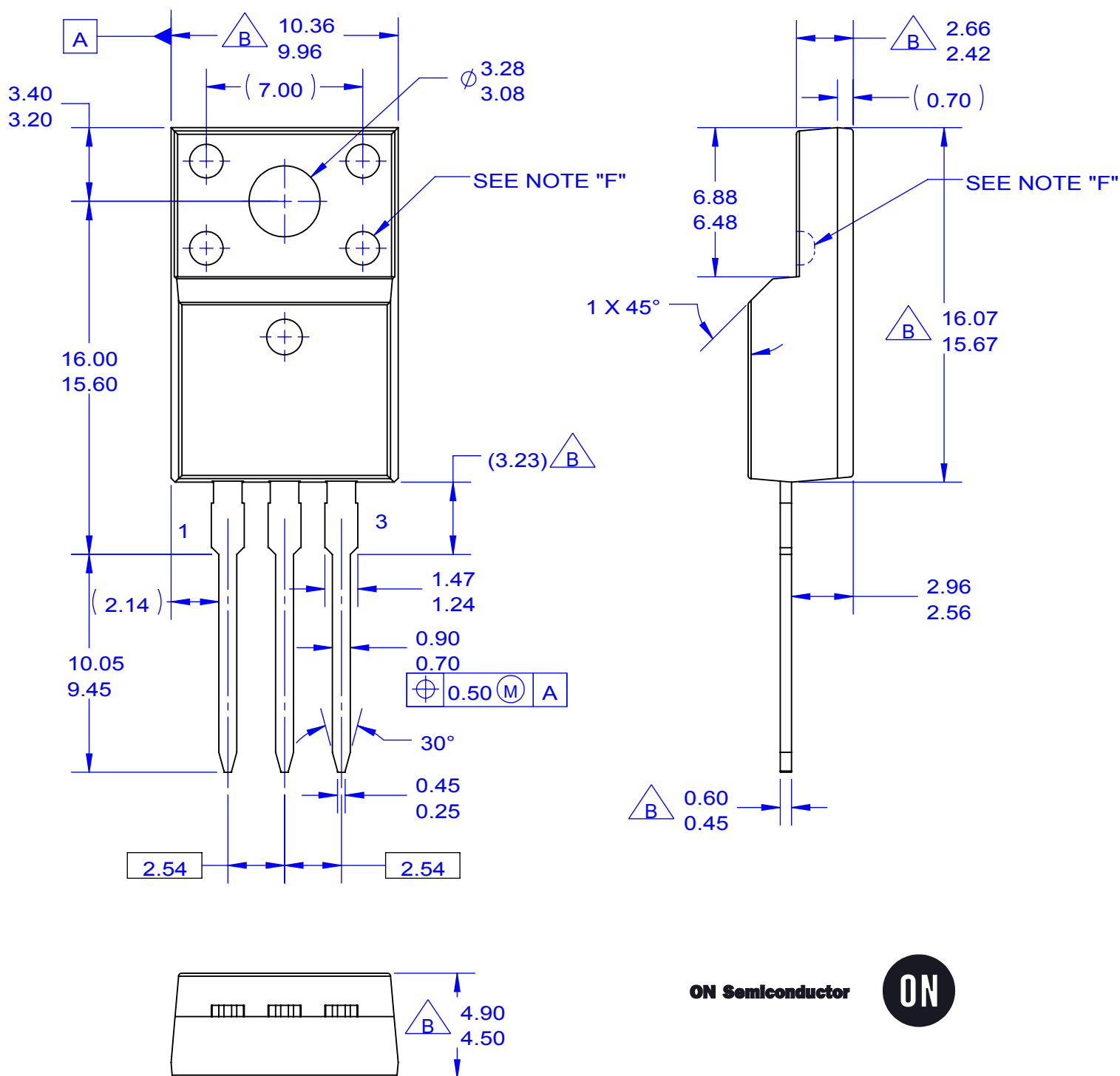


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms









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#### NOTES:

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- B. DOES NOT COMPLY EIAJ STD. VALUE.
- C. ALL DIMENSIONS ARE IN MILLIMETERS.
- D. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUSIONS.
- E. DIMENSION AND TOLERANCE AS PER ASME Y14.5-1994.
- F. OPTION 1 - WITH SUPPORT PIN HOLE.  
OPTION 2 - NO SUPPORT PIN HOLE.
- G. DRAWING FILE NAME: TO220M03REV5

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