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# FCP7N60 / FCPF7N60

## N-Channel SuperFET® MOSFET

600 V, 7 A, 600 mΩ

### Features

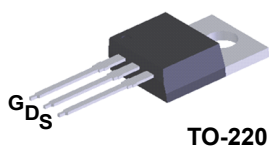
- 650 V @  $T_J = 150^\circ\text{C}$
- Typ.  $R_{DS(on)} = 530\text{ m}\Omega$
- Ultra Low Gate Charge (Typ.  $Q_g = 23\text{ nC}$ )
- Low Effective Output Capacitance (Typ.  $C_{oss(eff.)} = 60\text{ pF}$ )
- 100% Avalanche Tested
- RoHS Compliant

### Application

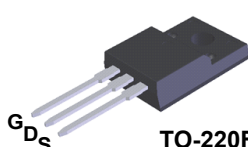
- LCD/LED/PDP TV
- Solar Inverter
- AC-DC Power Supply

### Description

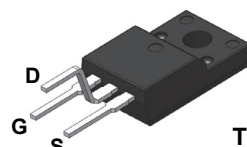
SuperFET® MOSFET is Fairchild Semiconductor's first generation of high voltage super-junction (SJ) MOSFET family that is utilizing charge balance technology for outstanding low on-resistance and lower gate charge performance. This technology is tailored to minimize conduction loss, provide superior switching performance,  $dv/dt$  rate and higher avalanche energy. Consequently, SuperFET MOSFET is very suitable for the switching power applications such as PFC, server/telecom power, FPD TV power, ATX power and industrial power applications.



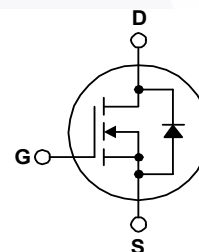
TO-220



TO-220F



TO-220F  
Y-formed



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

| Symbol         | Parameter                                                            |                                            | FCP7N60         | FCPF7N60 / FCPF7N60YDTU | Unit                |
|----------------|----------------------------------------------------------------------|--------------------------------------------|-----------------|-------------------------|---------------------|
| $V_{DSS}$      | Drain-Source Voltage                                                 |                                            | 600             |                         | V                   |
| $I_D$          | Drain Current                                                        | - Continuous ( $T_C = 25^\circ\text{C}$ )  | 7               | 7*                      | A                   |
|                |                                                                      | - Continuous ( $T_C = 100^\circ\text{C}$ ) | 4.4             | 4.4*                    | A                   |
| $I_{DM}$       | Drain Current                                                        | - Pulsed (Note 1)                          | 21              | 21*                     | A                   |
| $V_{GSS}$      | Gate-Source voltage                                                  |                                            | $\pm 30$        |                         | V                   |
| $E_{AS}$       | Single Pulsed Avalanche Energy                                       | (Note 2)                                   | 230             |                         | mJ                  |
| $I_{AR}$       | Avalanche Current                                                    | (Note 1)                                   | 7               |                         | A                   |
| $E_{AR}$       | Repetitive Avalanche Energy                                          | (Note 1)                                   | 8.3             |                         | mJ                  |
| $dv/dt$        | Peak Diode Recovery $dv/dt$                                          | (Note 3)                                   | 4.5             |                         | V/ns                |
| $P_D$          | Power Dissipation                                                    | ( $T_C = 25^\circ\text{C}$ )               | 83              | 31                      | W                   |
|                |                                                                      | - Derate Above $25^\circ\text{C}$          | 0.67            | 0.25                    | 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, 1/8" from Case for 5 Seconds |                                            | 300             |                         | $^\circ\text{C}$    |

\*Drain current limited by maximum junction temperature.

### Thermal Characteristics

| Symbol          | Parameter                                     | FCP7N60 | FCPF7N60 / FCPF7N60YDTU | Unit               |
|-----------------|-----------------------------------------------|---------|-------------------------|--------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case, Max.    | 1.5     | 4.0                     | $^\circ\text{C/W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient, Max. | 62.5    | 62.5                    |                    |

## Package Marking and Ordering Information

| Part Number  | Top Mark | Package               | Packing Method | Reel Size | Tape Width | Quantity |
|--------------|----------|-----------------------|----------------|-----------|------------|----------|
| FCP7N60      | FCP7N60  | TO220                 | Tube           | N/A       | N/A        | 50 units |
| FCPF7N60     | FCPF7N60 | TO220F                | Tube           | N/A       | N/A        | 50 units |
| FCPF7N60YDTU | FCPF7N60 | TO-220F<br>(Y-formed) | Tube           | N/A       | N/A        | 50 units |

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

| Symbol                                                 | Parameter                                             | Conditions                                                                                                   | Min. | Typ. | Max. | Unit |
|--------------------------------------------------------|-------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|------|------|------|------|
| Off Characteristics                                    |                                                       |                                                                                                              |      |      |      |      |
| BV <sub>DSS</sub>                                      | Drain-Source Breakdown Voltage                        | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA, T <sub>J</sub> = 25°C                                        | 600  | --   | --   | V    |
|                                                        |                                                       | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA, T <sub>J</sub> = 150°C                                       | --   | 650  | --   | V    |
| ΔBV <sub>DSS</sub> / ΔT <sub>J</sub>                   | Breakdown Voltage Temperature Coefficient             | I <sub>D</sub> = 250 μA, Referenced to 25°C                                                                  | --   | 0.6  | --   | V/°C |
| BV <sub>DS</sub>                                       | Drain-Source Avalanche Breakdown Voltage              | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 7 A                                                                  | --   | 700  | --   | V    |
| I <sub>DSS</sub>                                       | Zero Gate Voltage Drain Current                       | V <sub>DS</sub> = 600 V, V <sub>GS</sub> = 0 V                                                               | --   | --   | 1    | μA   |
|                                                        |                                                       | V <sub>DS</sub> = 480 V, T <sub>C</sub> = 125°C                                                              | --   | --   | 10   | 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   |
| On Characteristics                                     |                                                       |                                                                                                              |      |      |      |      |
| 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> = 3.5 A                                                               | --   | 0.53 | 0.6  | Ω    |
| g <sub>FS</sub>                                        | Forward Transconductance                              | V <sub>DS</sub> = 40 V, I <sub>D</sub> = 3.5 A                                                               | --   | 6    | --   | S    |
| Dynamic Characteristics                                |                                                       |                                                                                                              |      |      |      |      |
| C <sub>iss</sub>                                       | Input Capacitance                                     | V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V, f = 1 MHz                                                     | --   | 710  | 920  | pF   |
| C <sub>oss</sub>                                       | Output Capacitance                                    |                                                                                                              | --   | 380  | 500  | pF   |
| C <sub>rss</sub>                                       | Reverse Transfer Capacitance                          |                                                                                                              | --   | 34   | --   | pF   |
| C <sub>oss</sub>                                       | Output Capacitance                                    | V <sub>DS</sub> = 480 V, V <sub>GS</sub> = 0 V, f = 1 MHz                                                    | --   | 22   | 29   | pF   |
| C <sub>oss(eff.)</sub>                                 | Effective Output Capacitance                          | V <sub>DS</sub> = 0 V to 400 V, V <sub>GS</sub> = 0 V                                                        | --   | 60   | --   | pF   |
| Switching Characteristics                              |                                                       |                                                                                                              |      |      |      |      |
| t <sub>d(on)</sub>                                     | Turn-On Delay Time                                    | V <sub>DD</sub> = 300 V, I <sub>D</sub> = 7 A, V <sub>GS</sub> = 10 V, R <sub>G</sub> = 25 Ω<br><br>(Note 4) | --   | 35   | 80   | ns   |
| t <sub>r</sub>                                         | Turn-On Rise Time                                     |                                                                                                              | --   | 55   | 120  | ns   |
| t <sub>d(off)</sub>                                    | Turn-Off Delay Time                                   |                                                                                                              | --   | 75   | 160  | ns   |
| t <sub>f</sub>                                         | Turn-Off Fall Time                                    |                                                                                                              | --   | 32   | 75   | ns   |
| Q <sub>g</sub>                                         | Total Gate Charge                                     | V <sub>DS</sub> = 480 V, I <sub>D</sub> = 7 A, V <sub>GS</sub> = 10 V<br><br>(Note 4)                        | --   | 23   | 30   | nC   |
| Q <sub>gs</sub>                                        | Gate-Source Charge                                    |                                                                                                              | --   | 4.2  | 5.5  | nC   |
| Q <sub>gd</sub>                                        | Gate-Drain Charge                                     |                                                                                                              | --   | 11.5 | --   | nC   |
| Drain-Source Diode Characteristics and Maximum Ratings |                                                       |                                                                                                              |      |      |      |      |
| I <sub>S</sub>                                         | Maximum Continuous Drain-Source Diode Forward Current |                                                                                                              | --   | --   | 7    | A    |
| I <sub>SM</sub>                                        | Maximum Pulsed Drain-Source Diode Forward Current     |                                                                                                              | --   | --   | 21   | A    |
| V <sub>SD</sub>                                        | Drain-Source Diode Forward Voltage                    | V <sub>GS</sub> = 0 V, I <sub>S</sub> = 7 A                                                                  | --   | --   | 1.4  | V    |
| t <sub>rr</sub>                                        | Reverse Recovery Time                                 | V <sub>GS</sub> = 0 V, I <sub>S</sub> = 7 A, dI <sub>F</sub> /dt =100 A/μs                                   | --   | 360  | --   | ns   |
| Q <sub>rr</sub>                                        | Reverse Recovery Charge                               |                                                                                                              | --   | 4.5  | --   | μC   |

### Notes:

1. Repetitive rating: pulse-width limited by maximum junction temperature.
2.  $I_{AS} = 3.5\text{ A}, V_{DD} = 50\text{ V}, R_G = 25\text{ }\Omega$ , starting  $T_J = 25^\circ\text{C}$ .
3.  $I_{SD} \leq 7\text{ A}, di/dt \leq 200\text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$ , starting  $T_J = 25^\circ\text{C}$ .
4. Essentially independent of operating temperature typical characteristics.

## Typical Performance Characteristics

Figure 1. On-Region Characteristics

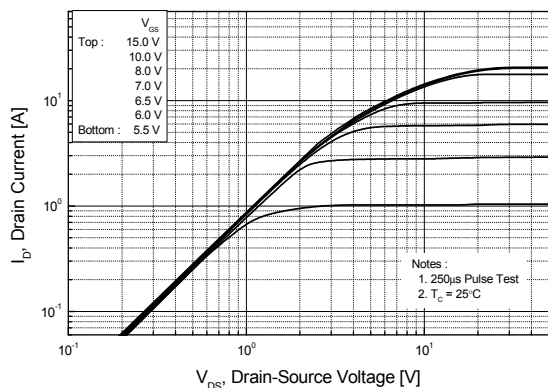


Figure 2. Transfer Characteristics

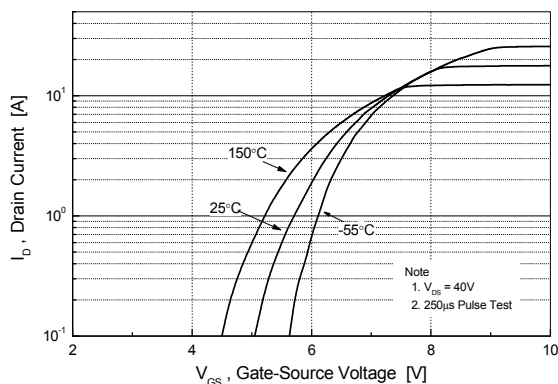


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

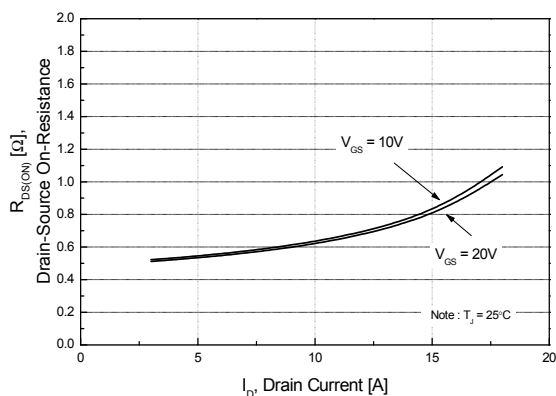


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

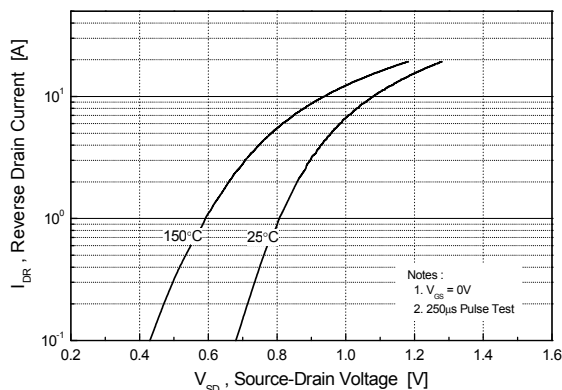


Figure 5. Capacitance Characteristics

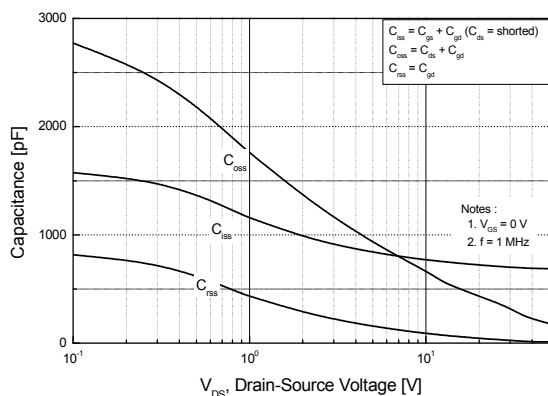
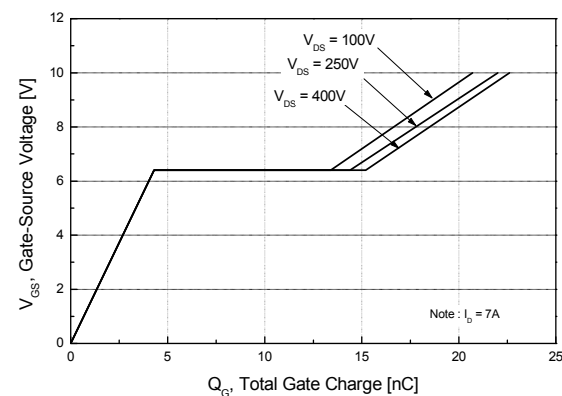
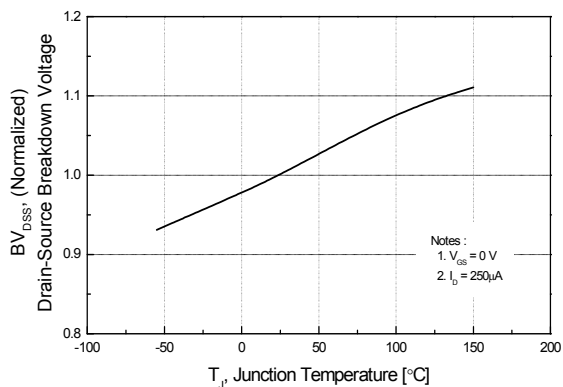


Figure 6. Gate Charge Characteristics

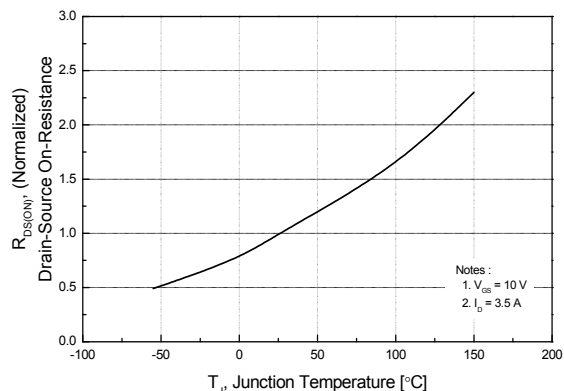


## Typical Performance Characteristics (Continued)

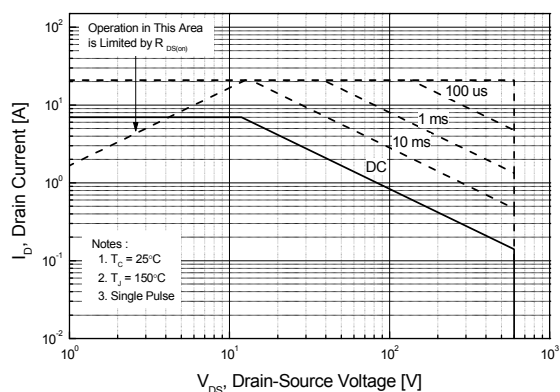
**Figure 7. Breakdown Voltage Variation vs. Temperature**



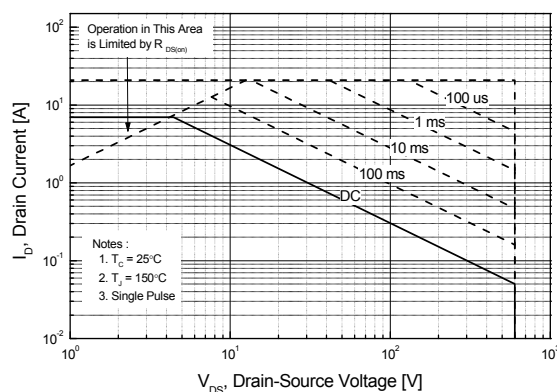
**Figure 8. On-Resistance Variation vs. Temperature**



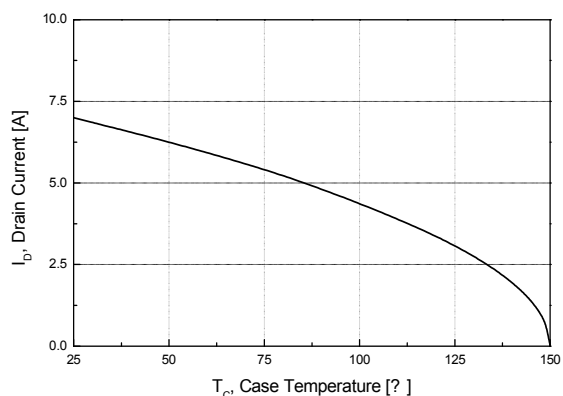
**Figure 9-1. Maximum Safe Operating Area for FCP7N60**



**Figure 9-2. Maximum Safe Operating Area for FCPF7N60**



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



# Typical Performance Characteristics (Continued)

Figure 11-1. Transient Thermal Response Curve for FCP7N60

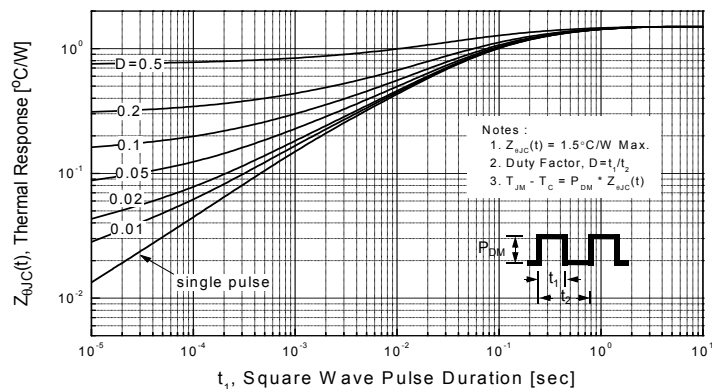
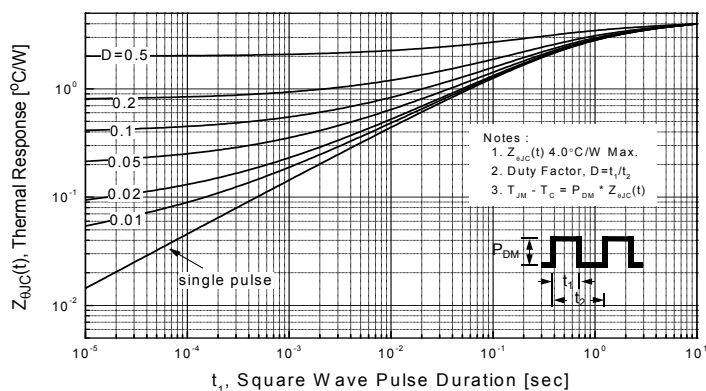


Figure 11-2. Transient Thermal Response Curve for FCPF7N60



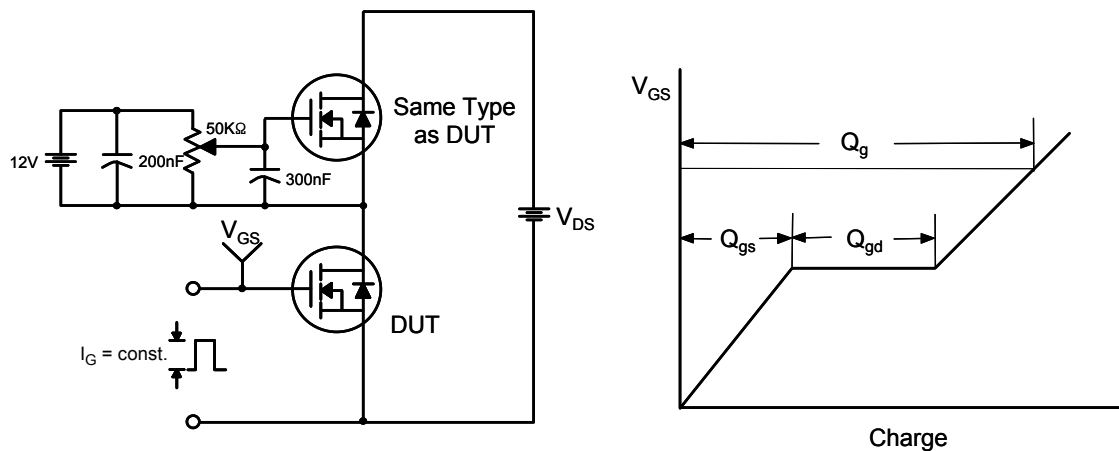


Figure 12. Gate Charge Test Circuit & Waveform



Figure 13. Resistive Switching Test Circuit & Waveforms

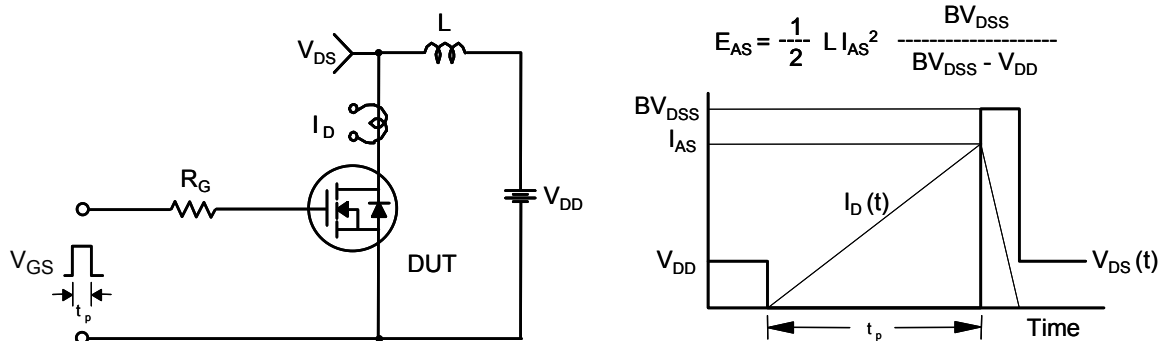
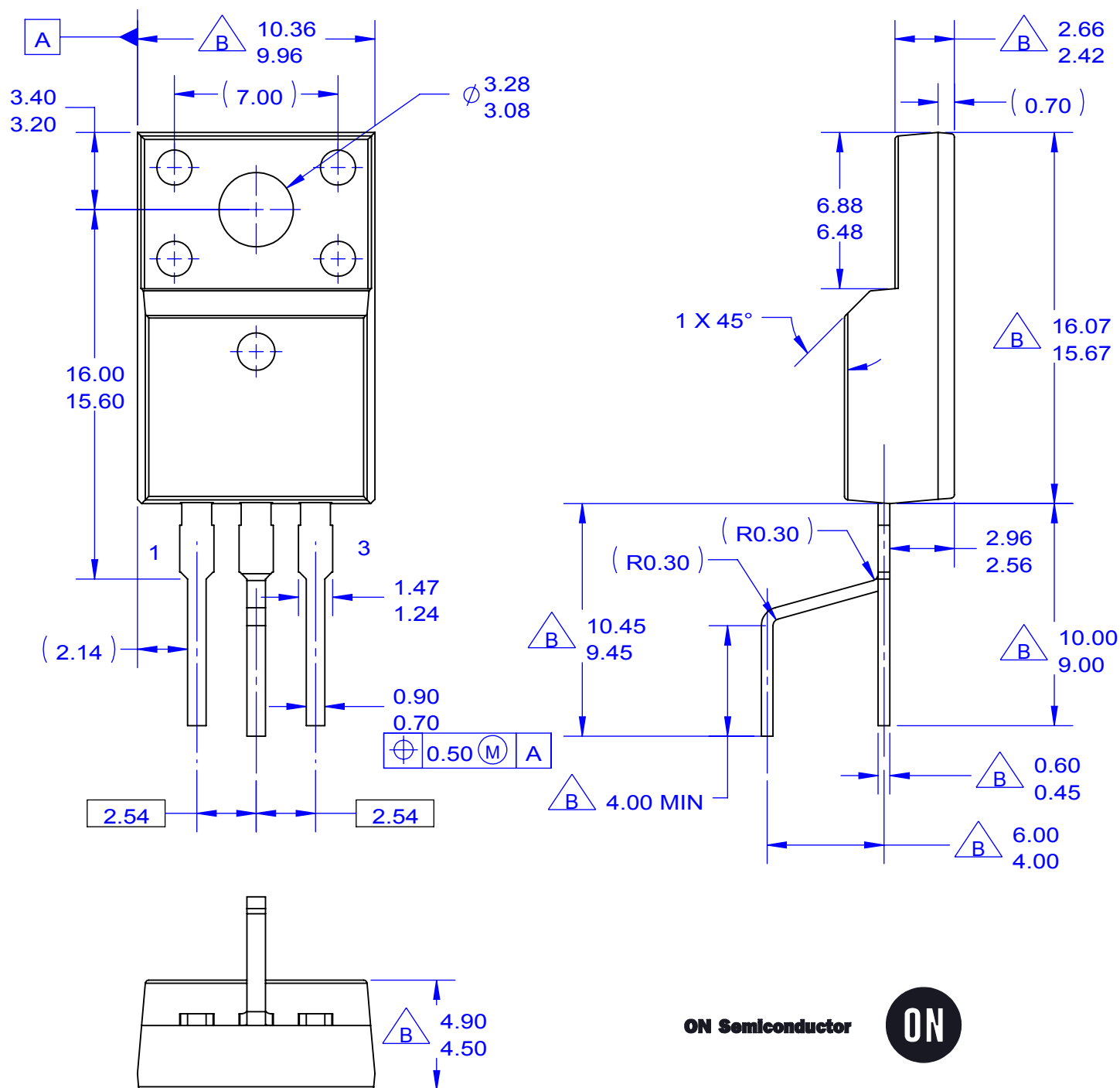


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms



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



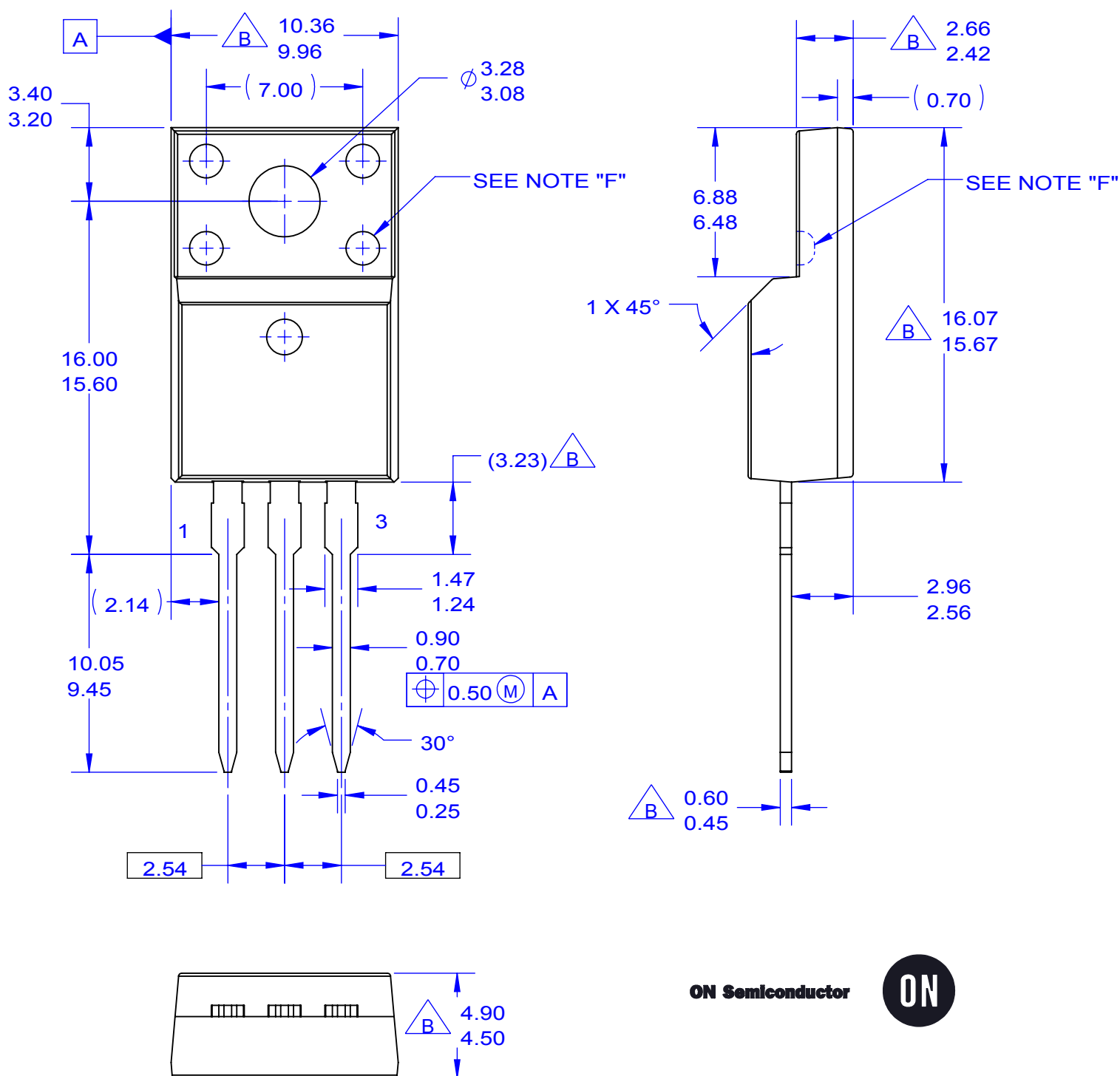
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- E. DIMENSION AND TOLERANCE AS PER ASME Y14.5-1994.
- F. OPTION 1 - WITH SUPPORT PIN HOLE.  
OPTION 2 - NO SUPPORT PIN HOLE.
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