

# FQP10N20C / FQPF10N20C

## N-Channel QFET® MOSFET

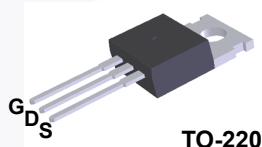
200 V, 9.5 A, 360 mΩ

### Features

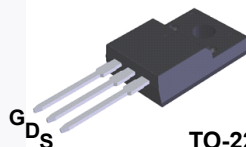
- 9.5 A, 200 V,  $R_{DS(on)} = 360 \text{ m}\Omega$  (Max.) @  $V_{GS} = 10 \text{ V}$ ,  $I_D = 4.75 \text{ A}$
- Low Gate Charge (Typ. 20 nC)
- Low  $C_{rss}$  (Typ. 40.5 pF)
- 100% Avalanche Tested

### Description

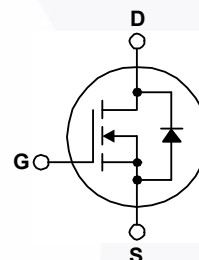
This N-Channel enhancement mode power MOSFET is produced using Fairchild Semiconductor's proprietary planar stripe and DMOS technology. This advanced MOSFET technology has been especially tailored to reduce on-state resistance, and to provide superior switching performance and high avalanche energy strength.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



TO-220



TO-220F



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

| Symbol         | Parameter                                                                    | FQP10N20C   | FQPF10N20C | Unit                |
|----------------|------------------------------------------------------------------------------|-------------|------------|---------------------|
| $V_{DSS}$      | Drain to Source Voltage                                                      | 200         |            | V                   |
| $I_D$          | Drain Current - Continuous ( $T_C = 25^\circ\text{C}$ )                      | 9.5         | 9.5 *      | A                   |
|                | - Continuous ( $T_C = 100^\circ\text{C}$ )                                   | 6.0         | 6.0 *      | A                   |
| $I_{DM}$       | Drain Current - Pulsed (Note 1)                                              | 38          | 38 *       | A                   |
| $V_{GSS}$      | Gate to Source Voltage                                                       | $\pm 30$    |            | V                   |
| $E_{AS}$       | Single Pulsed Avalanche Energy (Note 2)                                      | 210         |            | mJ                  |
| $I_{AR}$       | Avalanche Current (Note 1)                                                   | 9.5         |            | A                   |
| $E_{AR}$       | Repetitive Avalanche Energy (Note 1)                                         | 7.2         |            | mJ                  |
| $dv/dt$        | Peak Diode Recovery $dv/dt$ (Note 3)                                         | 5.5         |            | V/ns                |
| $P_D$          | Power Dissipation ( $T_C = 25^\circ\text{C}$ )                               | 72          | 38         | W                   |
|                | - Derate above $25^\circ\text{C}$                                            | 0.57        | 0.3        | 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 Purpose, 1/8" from Case for 5 Seconds | 300         |            | $^\circ\text{C}$    |

\*Drain current limited by maximum junction temperature

### Thermal Characteristics

| Symbol          | Parameter                                    | FQP10N20C | FQPF10N20C | Unit               |
|-----------------|----------------------------------------------|-----------|------------|--------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case, Max    | 1.74      | 3.33       | $^\circ\text{C/W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient, Max | 62.5      | 62.5       | $^\circ\text{C/W}$ |

## Package Marking and Ordering Information

| Device Marking | Device     | Package | Reel Size | Tape Width | Quantity |
|----------------|------------|---------|-----------|------------|----------|
| FQP10N20C      | FQP10N20C  | TO-220  | Tube      | N/A        | 50 units |
| FQPF10N20C     | FQPF10N20C | TO-220F | Tube      | N/A        | 50 units |

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

| Symbol                                                 | Parameter                                             | Test 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                                 | 200 | --   | --   | V    |
| ΔBV <sub>DSS</sub> / ΔT <sub>J</sub>                   | Breakdown Voltage Temperature Coefficient             | I <sub>D</sub> = 250 μA, Referenced to 25°C                                    | --  | 0.28 | --   | V/°C |
| I <sub>DSS</sub>                                       | Zero Gate Voltage Drain Current                       | V <sub>DS</sub> = 200 V, V <sub>GS</sub> = 0 V                                 | --  | --   | 10   | μA   |
|                                                        |                                                       | V <sub>DS</sub> = 160 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   |
| On Characteristics                                     |                                                       |                                                                                |     |      |      |      |
| V <sub>GS(th)</sub>                                    | Gate Threshold Voltage                                | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA                    | 2.0 | --   | 4.0  | V    |
| R <sub>DS(on)</sub>                                    | Static Drain-Source On-Resistance                     | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 4.75 A                                | --  | 0.29 | 0.36 | Ω    |
| g <sub>FS</sub>                                        | Forward Transconductance                              | V <sub>DS</sub> = 40 V, I <sub>D</sub> = 4.75 A                                | --  | 5.5  | --   | S    |
| Dynamic Characteristics                                |                                                       |                                                                                |     |      |      |      |
| C <sub>iss</sub>                                       | Input Capacitance                                     | V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V, f = 1.0 MHz                     | --  | 395  | 510  | pF   |
| C <sub>oss</sub>                                       | Output Capacitance                                    |                                                                                | --  | 97   | 125  | pF   |
| C <sub>rss</sub>                                       | Reverse Transfer Capacitance                          |                                                                                | --  | 40.5 | 53   | pF   |
| Switching Characteristics                              |                                                       |                                                                                |     |      |      |      |
| t <sub>d(on)</sub>                                     | Turn-On Delay Time                                    | V <sub>DD</sub> = 100 V, I <sub>D</sub> = 9.5 A, R <sub>G</sub> = 25 Ω         | --  | 11   | 30   | ns   |
| t <sub>r</sub>                                         | Turn-On Rise Time                                     |                                                                                | --  | 92   | 190  | ns   |
| t <sub>d(off)</sub>                                    | Turn-Off Delay Time                                   |                                                                                | --  | 70   | 150  | ns   |
| t <sub>f</sub>                                         | Turn-Off Fall Time                                    |                                                                                | --  | 72   | 160  | ns   |
| Q <sub>g</sub>                                         | Total Gate Charge                                     | V <sub>DS</sub> = 160 V, I <sub>D</sub> = 9.5 A, V <sub>GS</sub> = 10 V        | --  | 20   | 26   | nC   |
| Q <sub>gs</sub>                                        | Gate-Source Charge                                    |                                                                                | --  | 3.1  | --   | nC   |
| Q <sub>gd</sub>                                        | Gate-Drain Charge                                     |                                                                                | --  | 10.5 | --   | nC   |
| Drain-Source Diode Characteristics and Maximum Ratings |                                                       |                                                                                |     |      |      |      |
| I <sub>S</sub>                                         | Maximum Continuous Drain-Source Diode Forward Current |                                                                                | --  | --   | 9.5  | A    |
| I <sub>SM</sub>                                        | Maximum Pulsed Drain-Source Diode Forward Current     |                                                                                | --  | --   | 38   | A    |
| V <sub>SD</sub>                                        | Drain-Source Diode Forward Voltage                    | V <sub>GS</sub> = 0 V, I <sub>S</sub> = 9.5 A                                  | --  | --   | 1.5  | V    |
| t <sub>rr</sub>                                        | Reverse Recovery Time                                 | V <sub>GS</sub> = 0 V, I <sub>S</sub> = 9.5 A, dI <sub>F</sub> / dt = 100 A/μs | --  | 158  | --   | ns   |
| Q <sub>rr</sub>                                        | Reverse Recovery Charge                               |                                                                                | --  | 0.97 | --   | μC   |

### Notes:

1. Repetitive Rating : Pulse width limited by maximum junction temperature.
2.  $L = 3.5\text{ mH}$ ,  $I_{AS} = 9.5\text{ A}$ ,  $V_{DD} = 50\text{ V}$ ,  $R_G = 25\text{ }\Omega$ , starting  $T_J = 25^\circ\text{C}$ .
3.  $I_{SD} \leq 9.5\text{ A}$ ,  $dI/dt \leq 300\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , starting  $T_J = 25^\circ\text{C}$ .
4. Essentially independent of operating temperature.

## Typical Characteristics

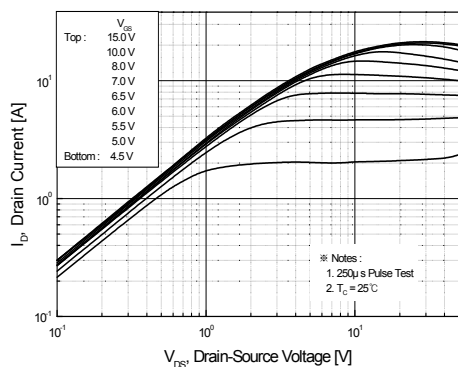


Figure 1. On-Region Characteristics

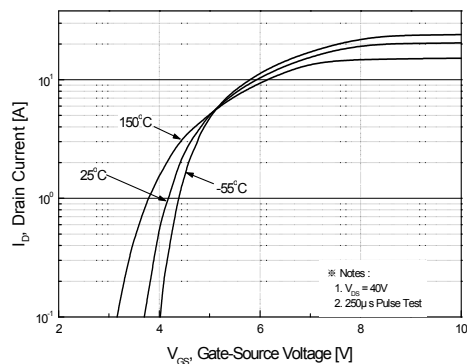


Figure 2. Transfer Characteristics

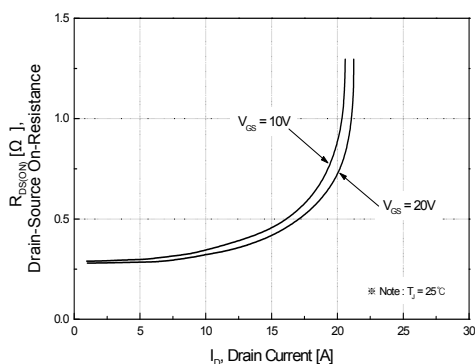


Figure 3. On-Resistance Variation vs Drain Current and Gate Voltage

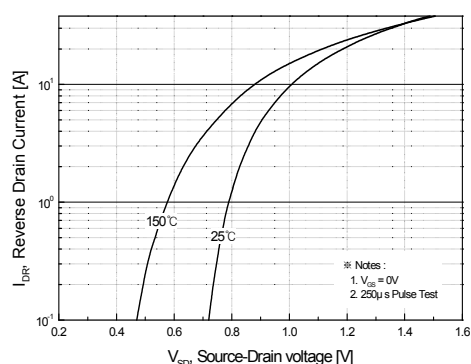


Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature

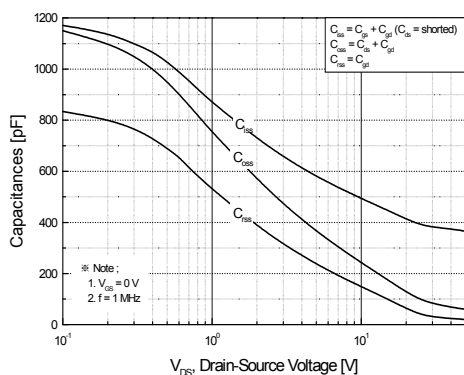


Figure 5. Capacitance Characteristics

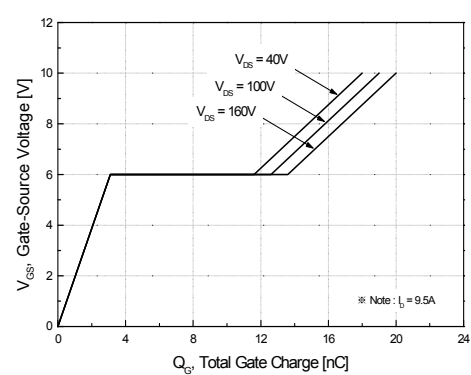


Figure 6. Gate Charge Characteristics

## Typical Characteristics (Continued)

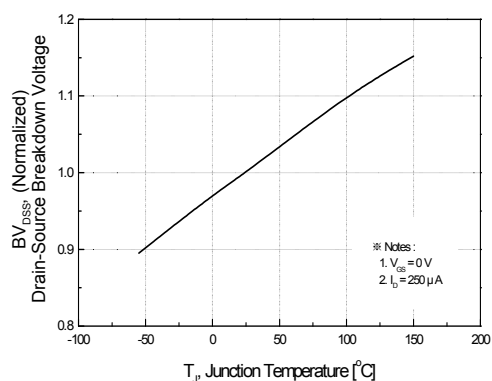


Figure 7. Breakdown Voltage Variation vs Temperature

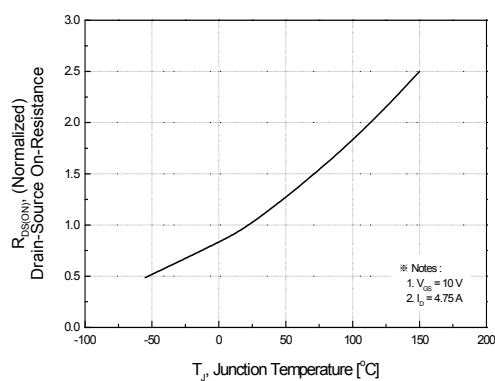


Figure 8. On-Resistance Variation vs Temperature

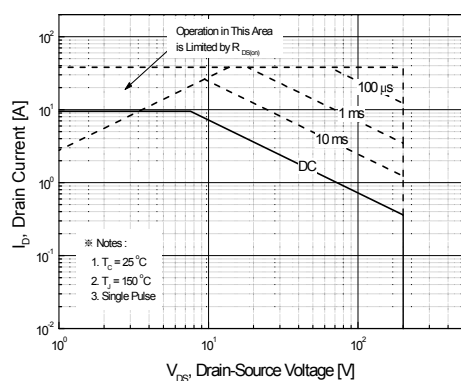


Figure 9-1. Maximum Safe Operating Area for FQP10N20C

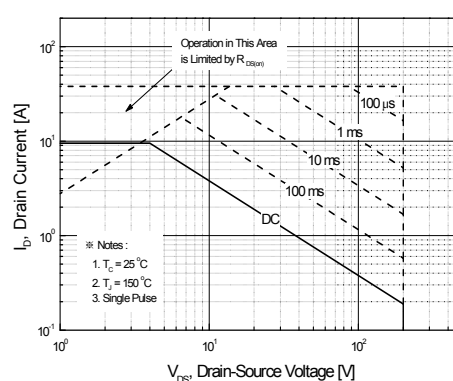


Figure 9-2. Maximum Safe Operating Area for FQPF10N20C

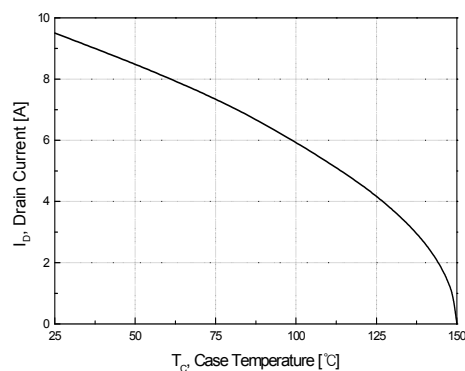


Figure 10. Maximum Drain Current vs Case Temperature

# Typical Characteristics (Continued)

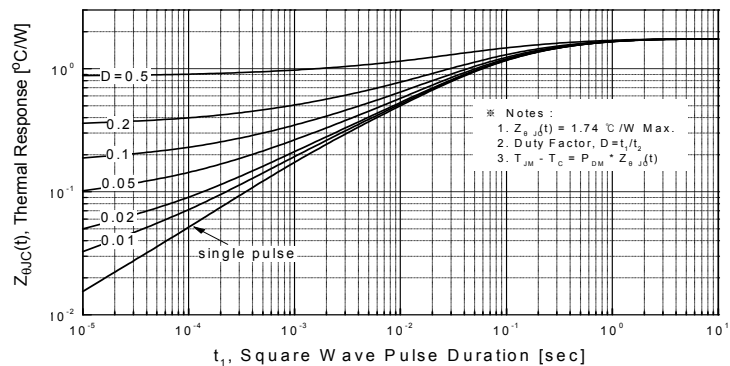


Figure 11-1. Transient Thermal Response Curve for FQP10N20C

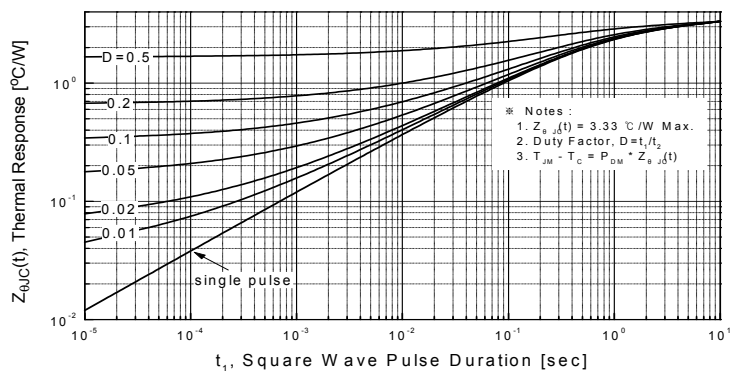


Figure 11-2. Transient Thermal Response Curve for FQPF10N20C

Figure 12. Gate Charge Test Circuit & Waveform

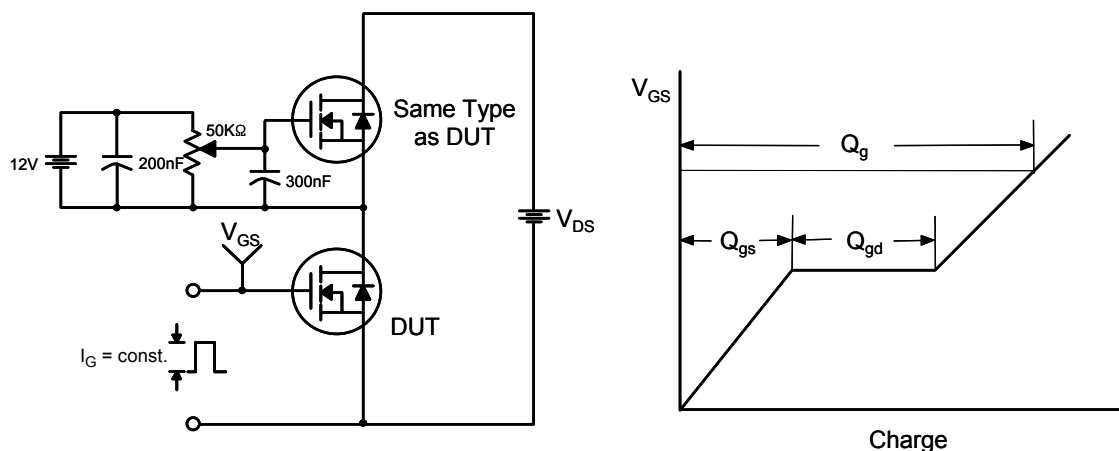


Figure 13. Resistive Switching Test Circuit & Waveforms

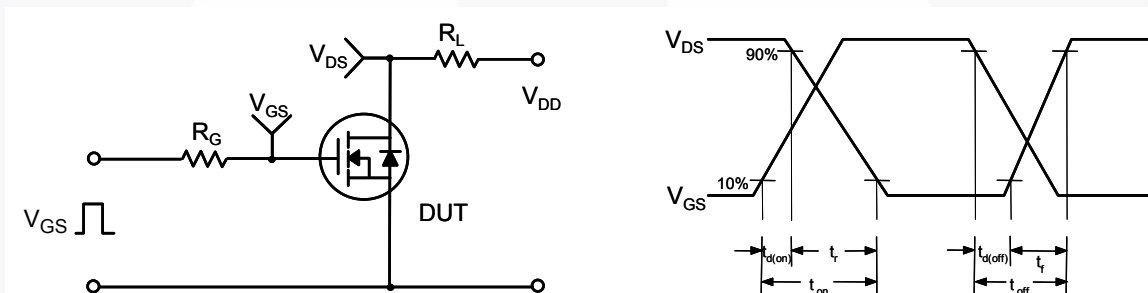
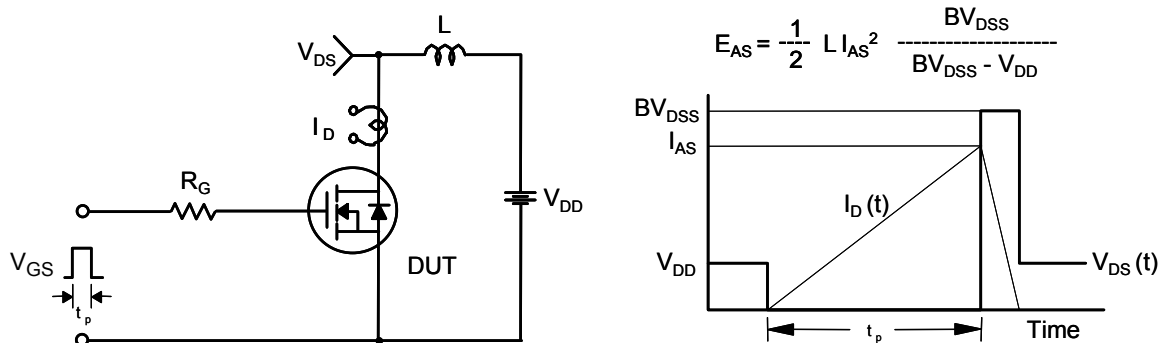
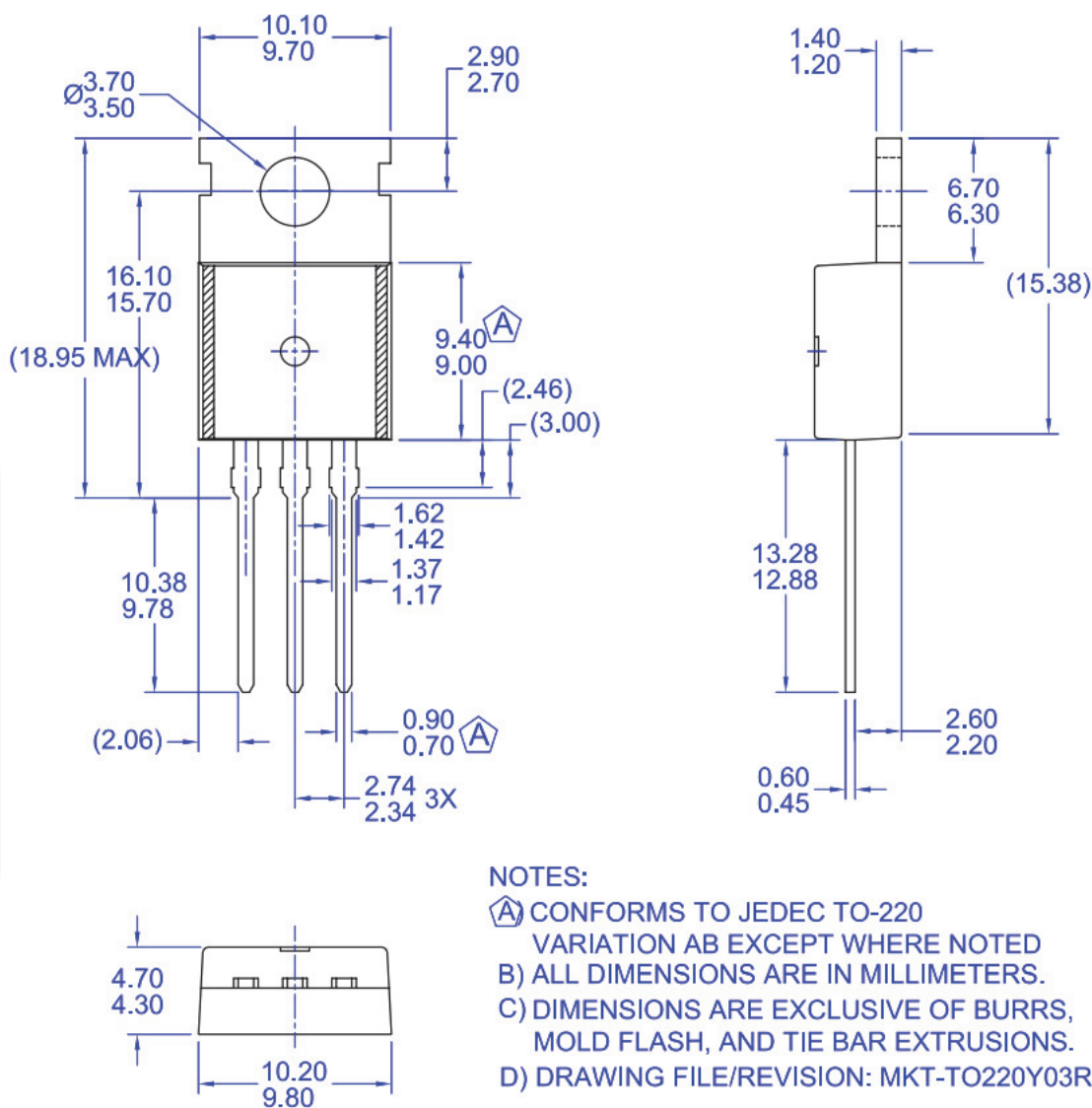


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms





## Mechanical Dimensions



**Figure 16. TO220, Molded, 3-Lead, Jedec Variation AB**

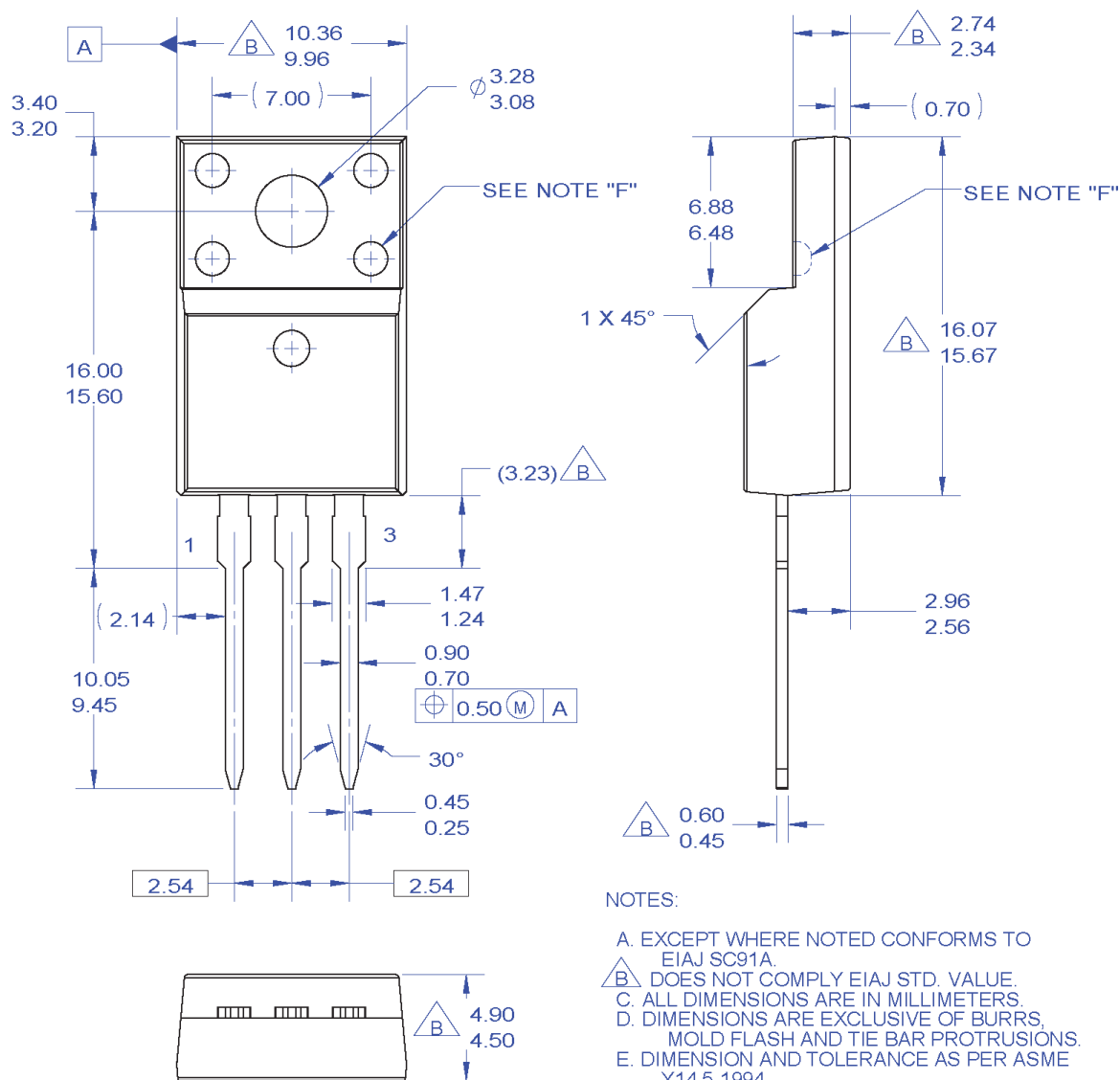
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# Mechanical Dimensions



**Figure 17. TO220, Molded, 3-Lead, Full Pack, EIAJ SC91, Straight Lead**

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