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## FQP50N06

### 60V N-Channel MOSFET

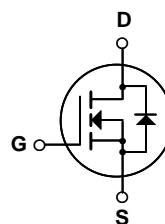
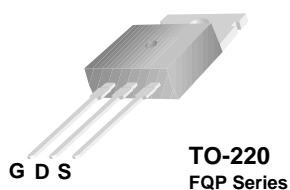
#### General Description

These N-Channel enhancement mode power field effect transistors are produced using Fairchild's proprietary, planar stripe, DMOS technology.

This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for low voltage applications such as automotive, DC/DC converters, and high efficiency switching for power management in portable and battery operated products.

#### Features

- 50A, 60V,  $R_{DS(on)} = 0.022\Omega @ V_{GS} = 10V$
- Low gate charge ( typical 31 nC)
- Low Crss ( typical 65 pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability
- 175°C maximum junction temperature rating



#### Absolute Maximum Ratings T<sub>C</sub> = 25°C unless otherwise noted

| Symbol                            | Parameter   | FQP50N06    | Units |
|-----------------------------------|---|-------------|-------|
| V <sub>DSS</sub>                  | Drain-Source Voltage  | 60          | V     |
| I <sub>D</sub>                    | Drain Current - Continuous (T <sub>C</sub> = 25°C)<br>- Continuous (T <sub>C</sub> = 100°C) | 50          | A     |
|                                   |   | 35.4        | A     |
| I <sub>DM</sub>                   | Drain Current - Pulsed (Note 1)   | 200         | A     |
| V <sub>GSS</sub>                  | Gate-Source Voltage   | ± 25        | V     |
| E <sub>AS</sub>                   | Single Pulsed Avalanche Energy (Note 2)   | 490         | mJ    |
| I <sub>AR</sub>                   | Avalanche Current (Note 1)  | 50          | A     |
| E <sub>AR</sub>                   | Repetitive Avalanche Energy (Note 1)  | 12          | mJ    |
| dv/dt                             | Peak Diode Recovery dv/dt (Note 3)  | 7.0         | V/ns  |
| P <sub>D</sub>                    | Power Dissipation (T <sub>C</sub> = 25°C)<br>- Derate above 25°C                            | 120         | W     |
|                                   |   | 0.8         | W/°C  |
| T <sub>J</sub> , T <sub>STG</sub> | Operating and Storage Temperature Range   | -55 to +175 | °C    |
| T <sub>L</sub>                    | Maximum lead temperature for soldering purposes,<br>1/8" from case for 5 seconds            | 300         | °C    |

#### Thermal Characteristics

| Symbol           | Parameter                               | Typ | Max  | Units |
|------------------|---|-----|------|-------|
| R <sub>θJC</sub> | Thermal Resistance, Junction-to-Case    | --  | 1.24 | °C/W  |
| R <sub>θCS</sub> | Thermal Resistance, Case-to-Sink        | 0.5 | --   | °C/W  |
| R <sub>θJA</sub> | Thermal Resistance, Junction-to-Ambient | --  | 62.5 | °C/W  |

## Electrical Characteristics

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

| Symbol                         | Parameter                                 | Test Conditions   | Min | Typ  | Max  | Units               |
|--------------------------------|---|---|-----|------|------|---------------------|
| <b>Off Characteristics</b>     |   |   |     |      |      |                     |
| $BV_{DSS}$                     | Drain-Source Breakdown Voltage            | $V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$               | 60  | --   | --   | V                   |
| $\Delta BV_{DSS} / \Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D = 250\ \mu\text{A}$ , Referenced to $25^\circ\text{C}$ | --  | 0.06 | --   | V/ $^\circ\text{C}$ |
| $I_{DSS}$                      | Zero Gate Voltage Drain Current           | $V_{DS} = 60\text{ V}, V_{GS} = 0\text{ V}$                 | --  | --   | 1    | $\mu\text{A}$       |
|                                |   | $V_{DS} = 48\text{ V}, T_C = 150^\circ\text{C}$             | --  | --   | 10   | $\mu\text{A}$       |
| $I_{GSSF}$                     | Gate-Body Leakage Current, Forward        | $V_{GS} = 25\text{ V}, V_{DS} = 0\text{ V}$                 | --  | --   | 100  | nA                  |
| $I_{GSSR}$                     | Gate-Body Leakage Current, Reverse        | $V_{GS} = -25\text{ V}, V_{DS} = 0\text{ V}$                | --  | --   | -100 | nA                  |

### On Characteristics

|              |                                   |  |     |       |       |          |
|--------------|-----------------------------------|--|-----|-------|-------|----------|
| $V_{GS(th)}$ | Gate Threshold Voltage            | $V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$          | 2.0 | --    | 4.0   | V        |
| $R_{DS(on)}$ | Static Drain-Source On-Resistance | $V_{GS} = 10\text{ V}, I_D = 25\text{ A}$          | --  | 0.018 | 0.022 | $\Omega$ |
| $g_{FS}$     | Forward Transconductance          | $V_{DS} = 25\text{ V}, I_D = 25\text{ A}$ (Note 4) | --  | 22    | --    | S        |

### Dynamic Characteristics

|            |                              |  |    |      |      |    |
|------------|------------------------------|--|----|------|------|----|
| $C_{iss}$  | Input Capacitance            | $V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$<br>$f = 1.0\text{ MHz}$ | -- | 1180 | 1540 | pF |
| $C_{oss}$  | Output Capacitance           |  | -- | 440  | 580  | pF |
| $C_{riss}$ | Reverse Transfer Capacitance |  | -- | 65   | 90   | pF |

### Switching Characteristics

|              |                     |  |             |     |     |     |
|--------------|---------------------|--|-------------|-----|-----|-----|
| $t_{d(on)}$  | Turn-On Delay Time  | $V_{DD} = 30\text{ V}, I_D = 25\text{ A},$<br>$R_G = 25\ \Omega$     | --          | 15  | 40  | ns  |
| $t_r$        | Turn-On Rise Time   |  | --          | 105 | 220 | ns  |
| $t_{d(off)}$ | Turn-Off Delay Time |  | --          | 60  | 130 | ns  |
| $t_f$        | Turn-Off Fall Time  |  | (Note 4, 5) | --  | 65  | 140 |
| $Q_g$        | Total Gate Charge   | $V_{DS} = 48\text{ V}, I_D = 50\text{ A},$<br>$V_{GS} = 10\text{ V}$ | --          | 31  | 41  | nC  |
| $Q_{gs}$     | Gate-Source Charge  |  | --          | 8   | --  | nC  |
| $Q_{gd}$     | Gate-Drain Charge   |  | (Note 4, 5) | --  | 13  | --  |

### Drain-Source Diode Characteristics and Maximum Ratings

|          |   |   |    |     |     |    |
|----------|---|---|----|-----|-----|----|
| $I_S$    | Maximum Continuous Drain-Source Diode Forward Current | --  | -- | 50  | A   |    |
| $I_{SM}$ | Maximum Pulsed Drain-Source Diode Forward Current     | --  | -- | 200 | A   |    |
| $V_{SD}$ | Drain-Source Diode Forward Voltage                    | $V_{GS} = 0\text{ V}, I_S = 50\text{ A}$        | -- | --  | 1.5 | V  |
| $t_{rr}$ | Reverse Recovery Time                                 | $V_{GS} = 0\text{ V}, I_S = 50\text{ A},$       | -- | 52  | --  | ns |
| $Q_{rr}$ | Reverse Recovery Charge                               | $di_F / dt = 100\text{ A}/\mu\text{s}$ (Note 4) | -- | 75  | --  | nC |

**Notes:**

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2.  $L = 230\ \mu\text{H}, I_{AS} = 50\text{ A}, V_{DD} = 25\text{ V}, R_G = 25\ \Omega$ , Starting  $T_J = 25^\circ\text{C}$
3.  $I_{SD} \leq 50\text{ A}, di/dt \leq 300\text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$
4. Pulse Test : Pulse width  $\leq 300\ \mu\text{s}$ , Duty cycle  $\leq 2\%$
5. Essentially independent of operating temperature

## Typical Characteristics

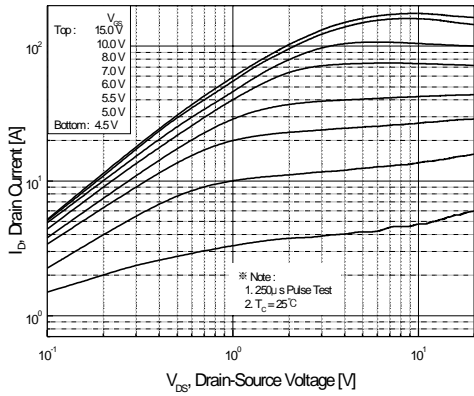


Figure 1. On-Region Characteristics

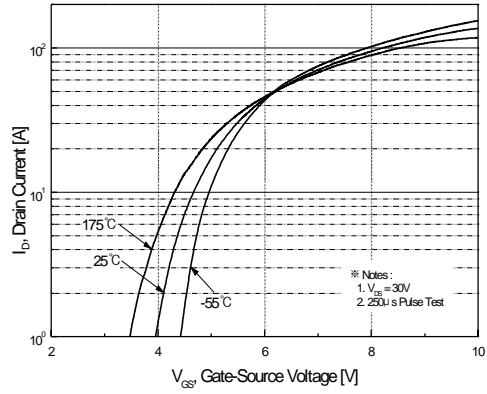


Figure 2. Transfer Characteristics

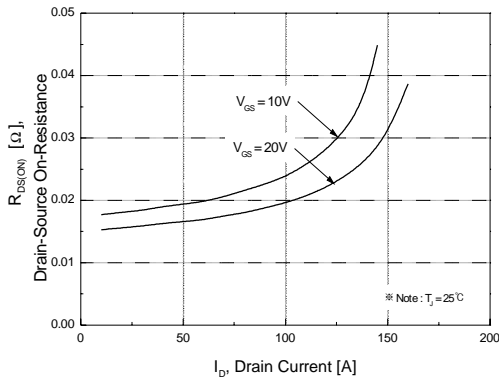


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

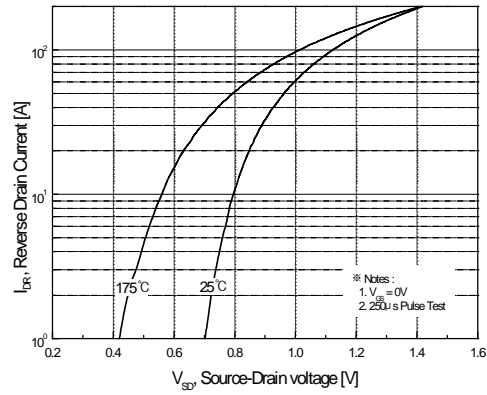


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

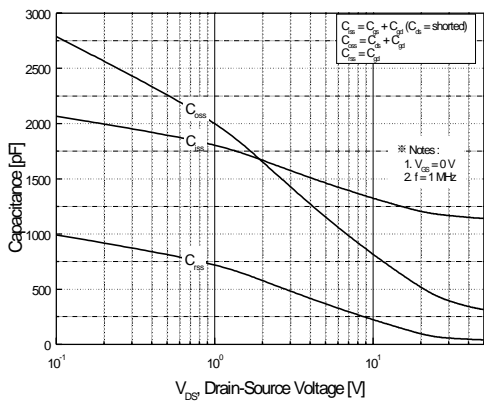


Figure 5. Capacitance Characteristics

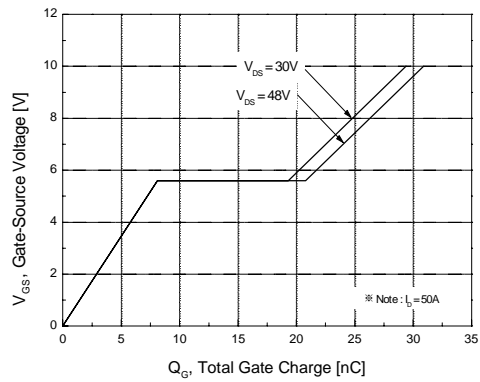
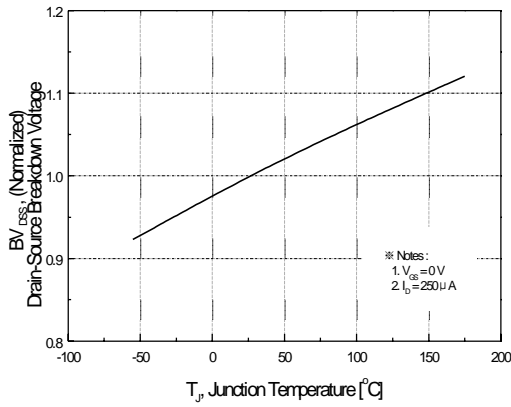
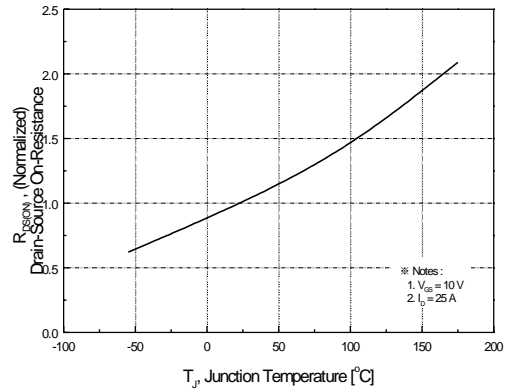


Figure 6. Gate Charge Characteristics

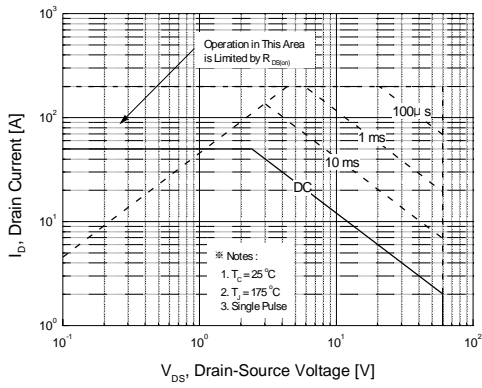
**Typical Characteristics** (Continued)



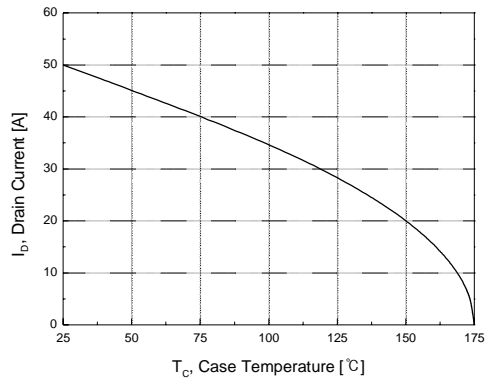
**Figure 7. Breakdown Voltage Variation vs. Temperature**



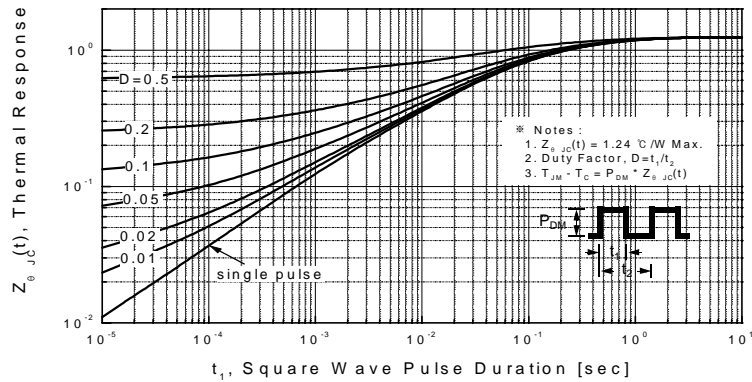
**Figure 8. On-Resistance Variation vs. Temperature**



**Figure 9. Maximum Safe Operating Area**

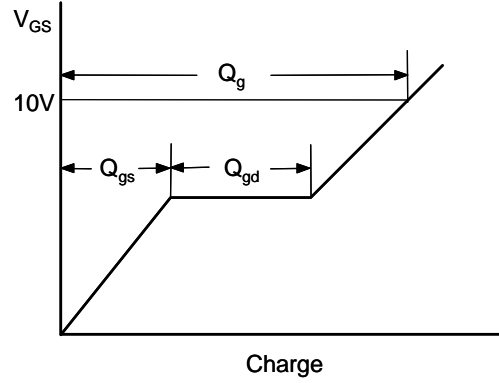
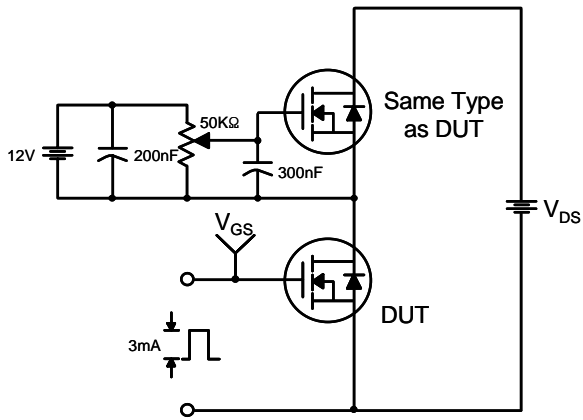


**Figure 10. Maximum Drain Current vs. Case Temperature**

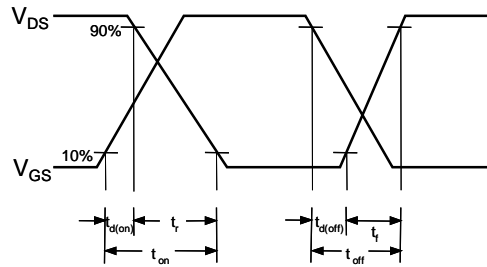
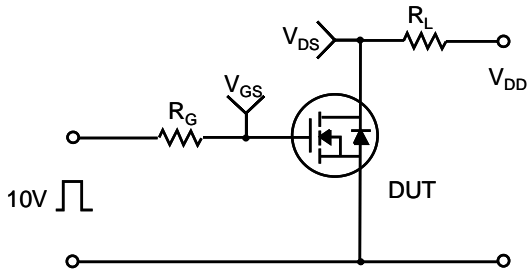


**Figure 11. Transient Thermal Response Curve**

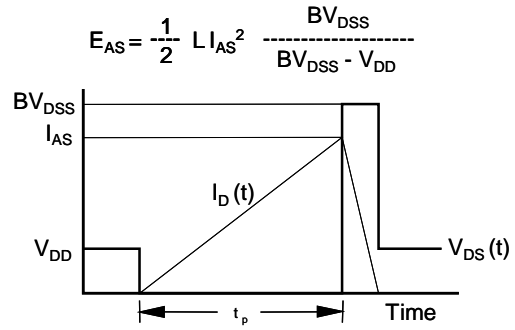
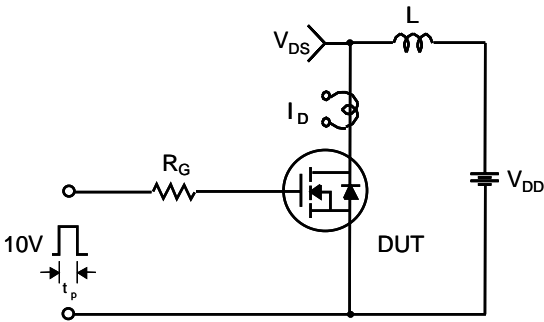
**Gate Charge Test Circuit & Waveform**



**Resistive Switching Test Circuit & Waveforms**



**Unclamped Inductive Switching Test Circuit & Waveforms**

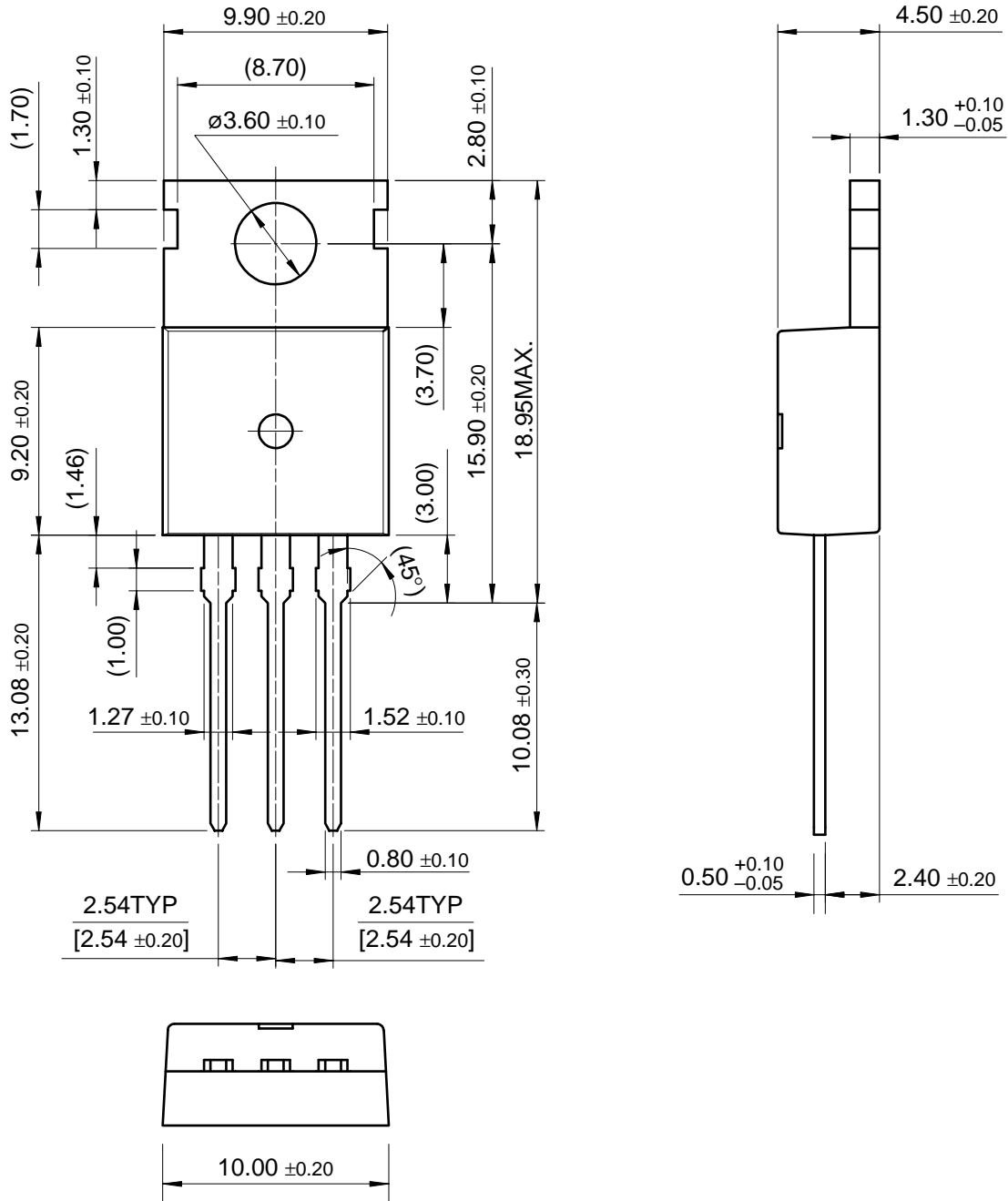




# Package Dimensions

## TO-220

FQP50N06



Dimensions in Millimeters



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