

IRF650B / IRFS650B

200V N-Channel MOSFET

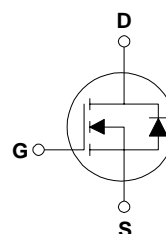
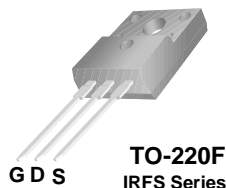
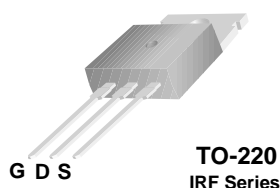
General Description

These N-Channel enhancement mode power field effect transistors are produced using Fairchild's proprietary, planar, 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 high efficiency switching DC/DC converters, switch mode power supplies, DC-AC converters for uninterrupted power supply and motor control.

Features

- 28A, 200V, $R_{DS(on)} = 0.085\Omega @ V_{GS} = 10V$
- Low gate charge (typical 95 nC)
- Low C_{rss} (typical 75 pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability



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

| Symbol | Parameter | IRF650B | IRFS650B | Units |
|----------------|---|-------------|----------|---------------------|
| V_{DSS} | Drain-Source Voltage | 200 | | V |
| I_D | Drain Current - Continuous ($T_C = 25^\circ\text{C}$) - Continuous ($T_C = 100^\circ\text{C}$) | 28 | 28 * | A |
| | | 17.7 | 17.7 * | A |
| I_{DM} | Drain Current - Pulsed (Note 1) | 112 | 112 | A |
| V_{GSS} | Gate-Source Voltage | ± 30 | | V |
| E_{AS} | Single Pulsed Avalanche Energy (Note 2) | 600 | | mJ |
| I_{AR} | Avalanche Current (Note 1) | 28 | | A |
| E_{AR} | Repetitive Avalanche Energy (Note 1) | 15.6 | | mJ |
| dv/dt | Peak Diode Recovery dv/dt (Note 3) | 5.5 | | V/ns |
| P_D | Power Dissipation ($T_C = 25^\circ\text{C}$) - Derate above 25°C | 156 | 50 | W |
| | | 1.25 | 0.4 | 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 | | $^\circ\text{C}$ |

* Drain current limited by maximum junction temperature.

Thermal Characteristics

| Symbol | Parameter | IRF650B | IRFS650B | Units |
|-----------------|---|---------|----------|---------------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case Max. | 0.8 | 2.51 | $^\circ\text{C}/\text{W}$ |
| $R_{\theta CS}$ | Thermal Resistance, Case-to-Sink Typ. | 0.5 | -- | $^\circ\text{C}/\text{W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient Max | 62.5 | 62.5 | $^\circ\text{C}/\text{W}$ |

Electrical Characteristics

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

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|--------------------------------|---|---|-----|-----|------|---------------------|
| Off Characteristics | | | | | | |
| BV_{DSS} | Drain-Source Breakdown Voltage | $V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$ | 200 | -- | -- | V |
| $\Delta BV_{DSS} / \Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D = 250\ \mu\text{A}$, Referenced to 25°C | -- | 0.2 | -- | V/ $^\circ\text{C}$ |
| I_{DSS} | Zero Gate Voltage Drain Current | $V_{DS} = 200\text{ V}, V_{GS} = 0\text{ V}$ | -- | -- | 10 | μA |
| | | $V_{DS} = 160\text{ V}, T_C = 125^\circ\text{C}$ | -- | -- | 100 | μA |
| 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 | $V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$ | 2.0 | -- | 4.0 | V |
| $R_{DS(on)}$ | Static Drain-Source On-Resistance | $V_{GS} = 10\text{ V}, I_D = 14\text{ A}$ | -- | 0.071 | 0.085 | Ω |
| g_{FS} | Forward Transconductance | $V_{DS} = 40\text{ V}, I_D = 14\text{ A}$ (Note 4) | -- | 25 | -- | S |

Dynamic Characteristics

| | | | | | | |
|------------|------------------------------|--|----|------|------|----|
| C_{iss} | Input Capacitance | $V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$ | -- | 2600 | 3400 | pF |
| C_{oss} | Output Capacitance | | -- | 330 | 430 | pF |
| C_{riss} | Reverse Transfer Capacitance | | -- | 75 | 100 | pF |

Switching Characteristics

| | | | | | | |
|--------------|---------------------|---|-------------|-----|-----|-----|
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD} = 100\text{ V}, I_D = 32\text{ A},$ $R_G = 25\ \Omega$ | -- | 30 | 70 | ns |
| t_r | Turn-On Rise Time | | -- | 240 | 490 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | -- | 295 | 600 | ns |
| t_f | Turn-Off Fall Time | | (Note 4, 5) | -- | 195 | 400 |
| Q_g | Total Gate Charge | $V_{DS} = 160\text{ V}, I_D = 32\text{ A},$ $V_{GS} = 10\text{ V}$ | -- | 95 | 123 | nC |
| Q_{gs} | Gate-Source Charge | | -- | 13 | -- | nC |
| Q_{gd} | Gate-Drain Charge | | (Note 4, 5) | -- | 43 | -- |

Drain-Source Diode Characteristics and Maximum Ratings

| | | | | | | |
|----------|---|---|----|------|-----|---------------|
| I_S | Maximum Continuous Drain-Source Diode Forward Current | -- | -- | 28 | A | |
| I_{SM} | Maximum Pulsed Drain-Source Diode Forward Current | -- | -- | 112 | A | |
| V_{SD} | Drain-Source Diode Forward Voltage | $V_{GS} = 0\text{ V}, I_S = 28\text{ A}$ | -- | -- | 1.5 | V |
| t_{rr} | Reverse Recovery Time | $V_{GS} = 0\text{ V}, I_S = 32\text{ A},$ | -- | 220 | -- | ns |
| Q_{rr} | Reverse Recovery Charge | $di_F / dt = 100\text{ A}/\mu\text{s}$ (Note 4) | -- | 1.89 | -- | μC |

Notes:

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. $L = 1.15\text{ mH}, I_{AS} = 28\text{ A}, V_{DD} = 50\text{ V}, R_G = 25\ \Omega$, Starting $T_J = 25^\circ\text{C}$
3. $I_{SD} \leq 32\text{ A}, di/dt \leq 300\text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$, 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

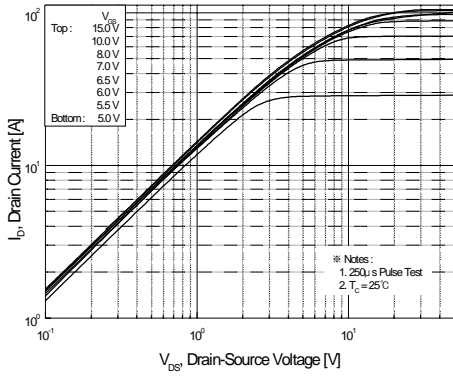


Figure 1. On-Region Characteristics

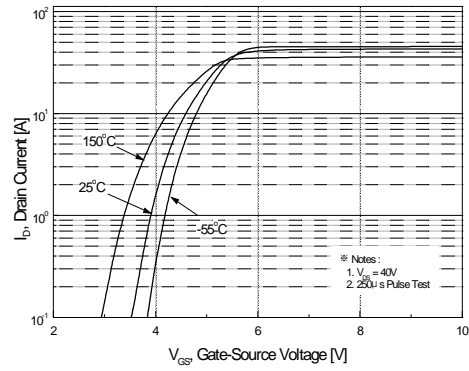


Figure 2. Transfer Characteristics

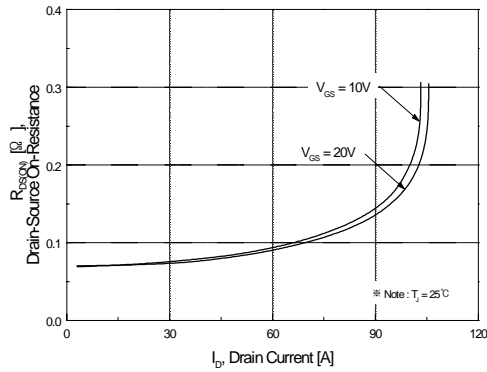


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

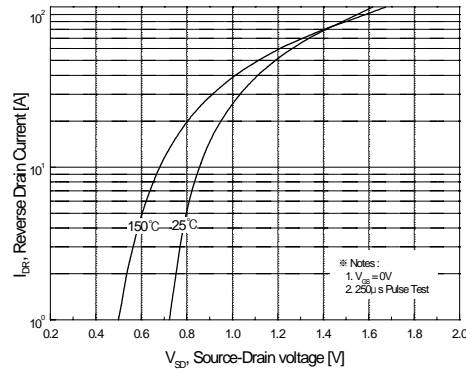


Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature

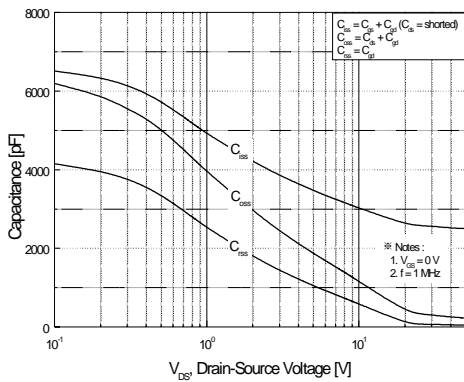


Figure 5. Capacitance Characteristics

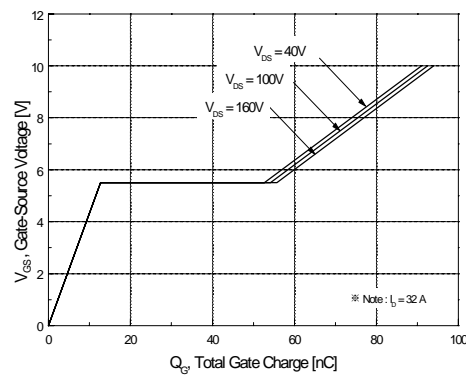


Figure 6. Gate Charge Characteristics

Typical Characteristics (Continued)

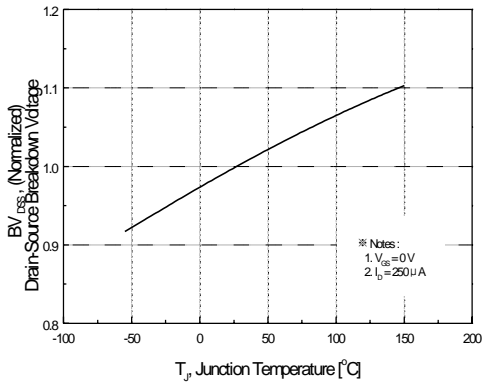


Figure 7. Breakdown Voltage Variation vs Temperature

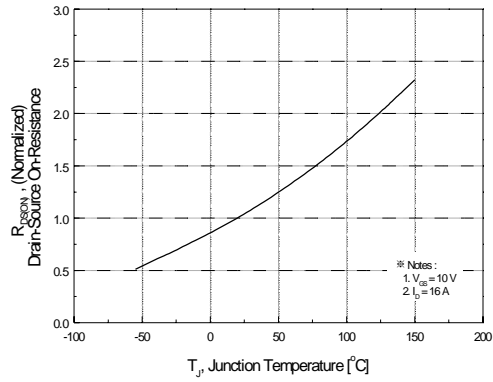


Figure 8. On-Resistance Variation vs Temperature

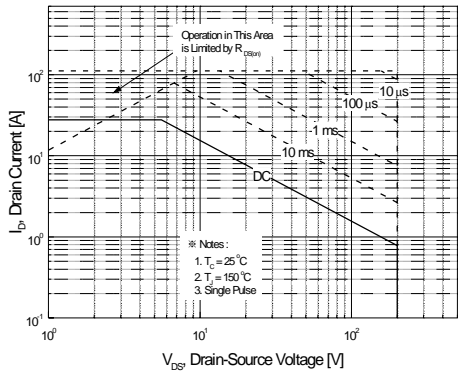


Figure 9-1. Maximum Safe Operating Area for IRF650B

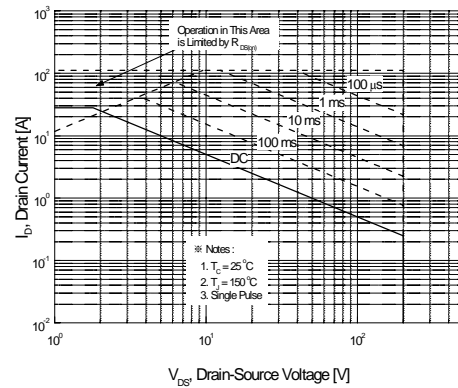


Figure 9-2. Maximum Safe Operating Area for IRFS650B

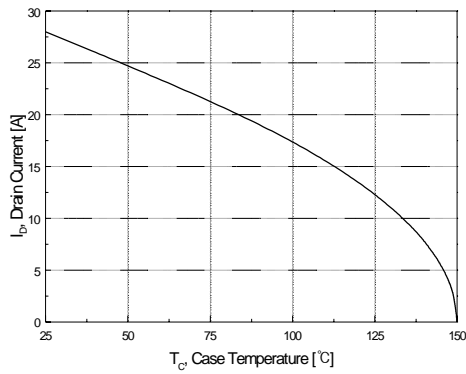


Figure 10. Maximum Drain Current vs Case Temperature

Typical Characteristics (Continued)

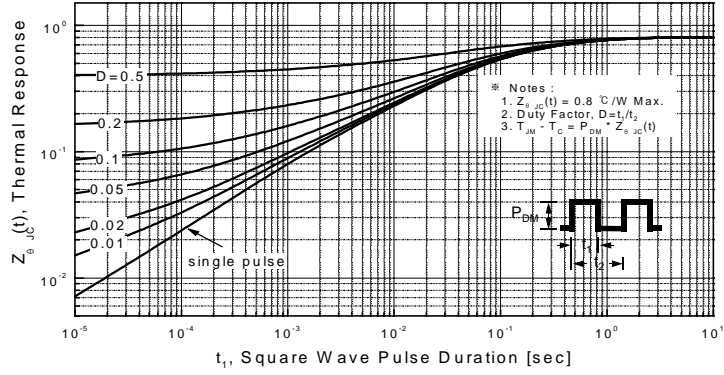


Figure 11. Transient Thermal Response Curve for IRF650B

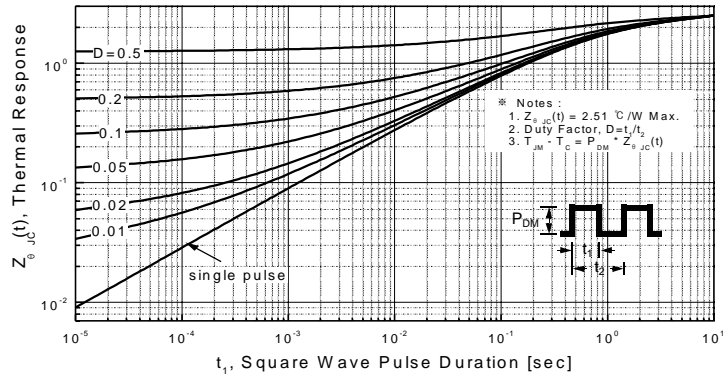
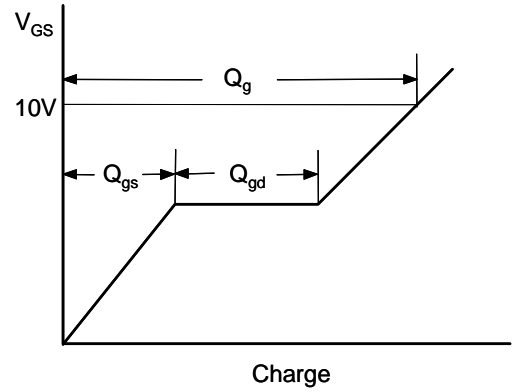


Figure 11. Transient Thermal Response Curve for IRFS650B

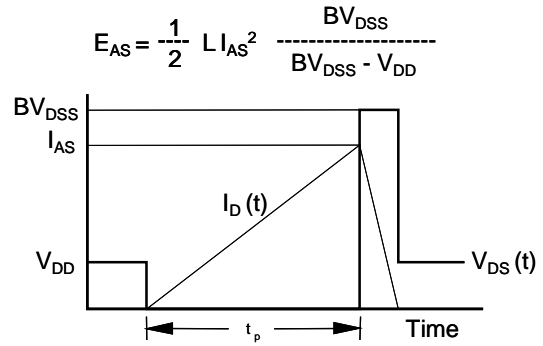
Gate Charge Test Circuit & Waveform



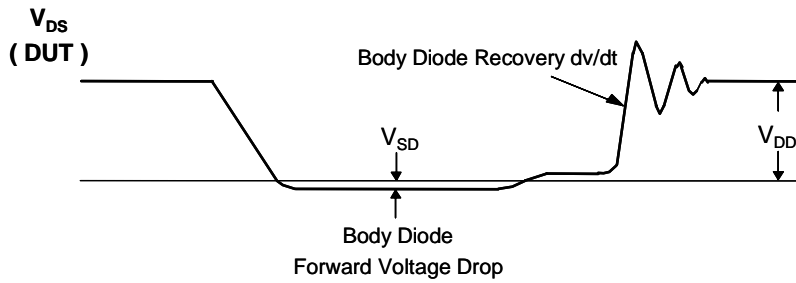
Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching Test Circuit & Waveforms



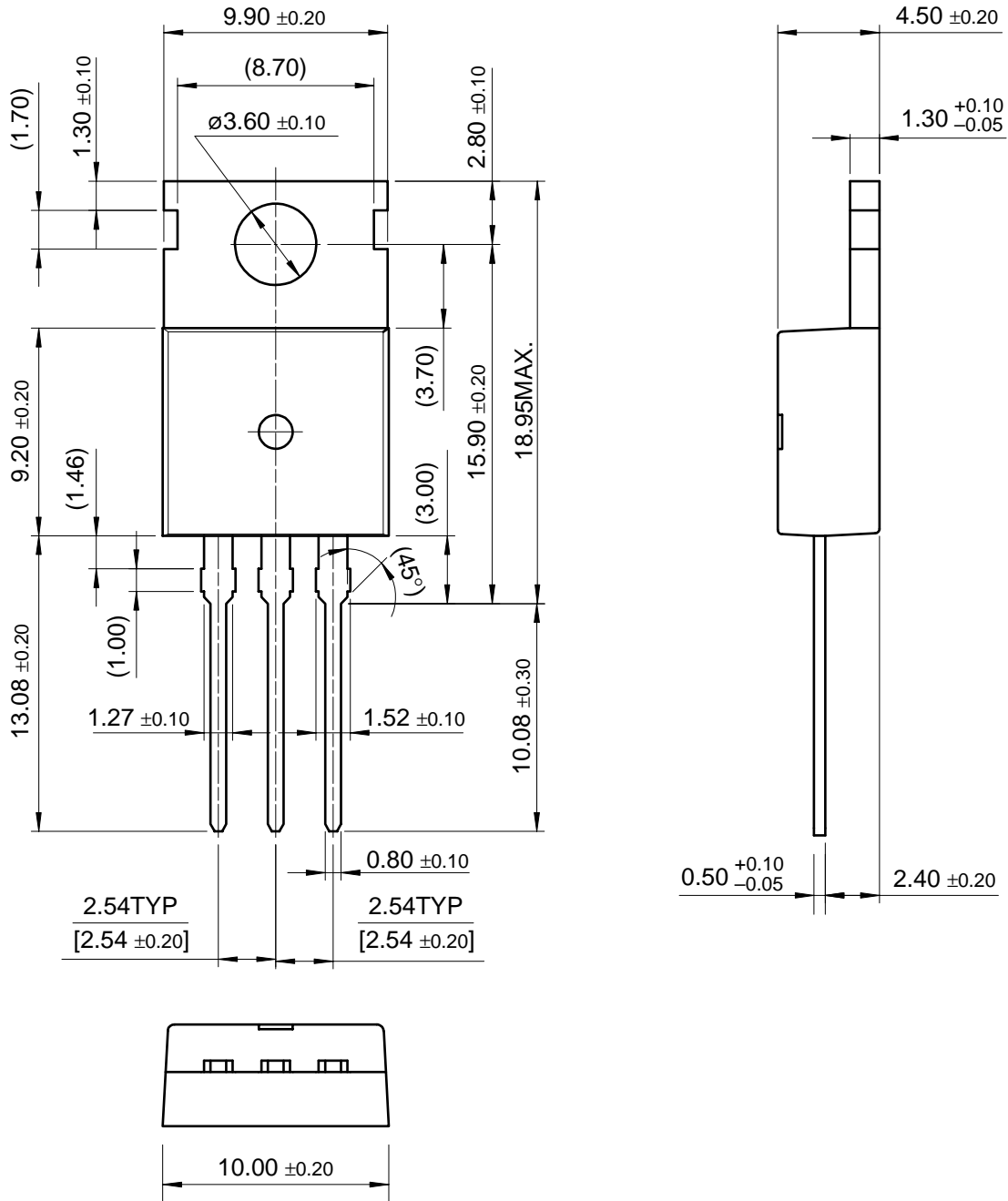
Peak Diode Recovery dv/dt Test Circuit & Waveforms



Package Dimensions

TO-220

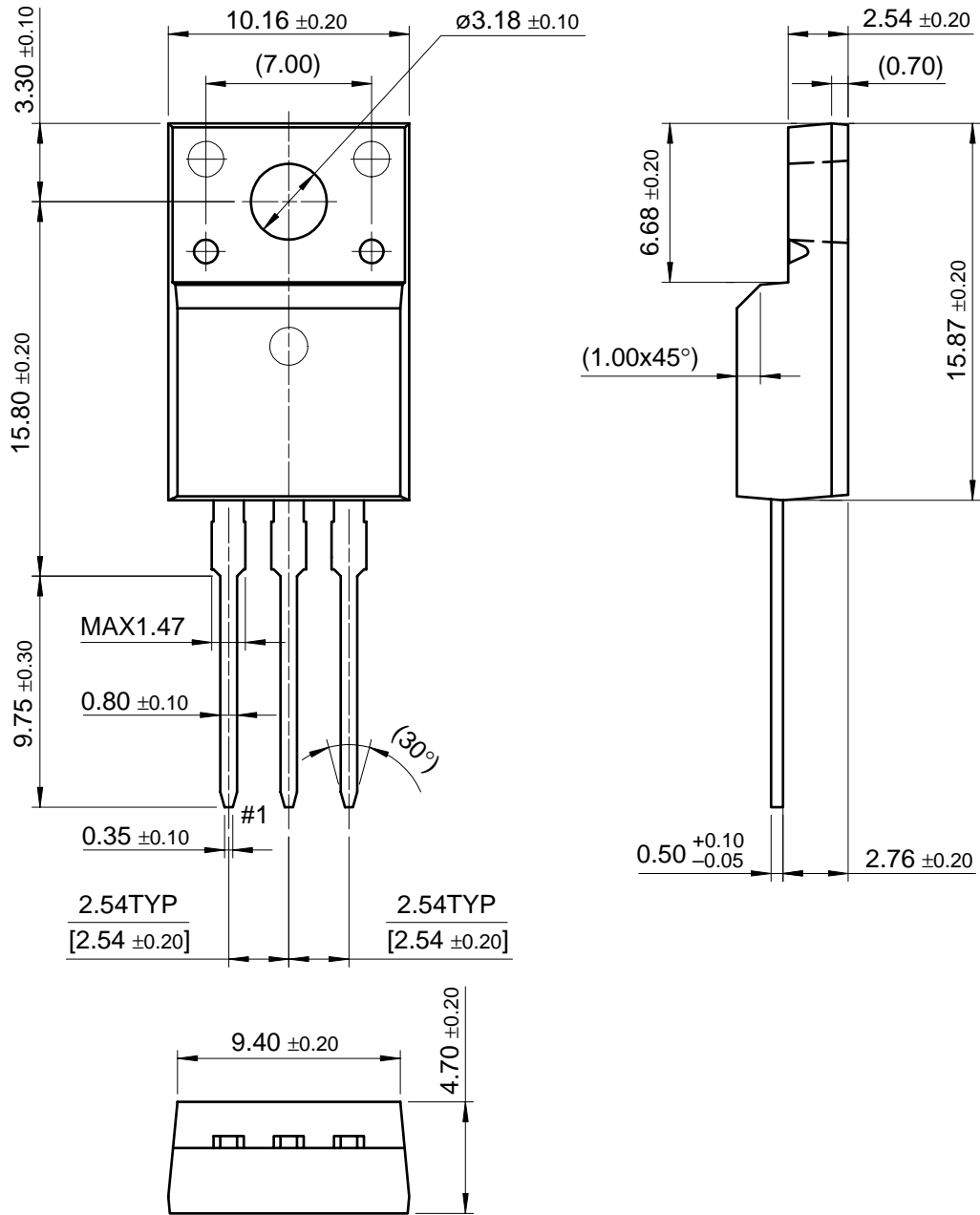
IRF650B / IRFS650B



Dimensions in Millimeters

Package Dimensions (Continued)

TO-220F



IRF650B / IRFS650B

Dimensions in Millimeters

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