



IRFW654B / IRFI654B

250V N-Channel MOSFET

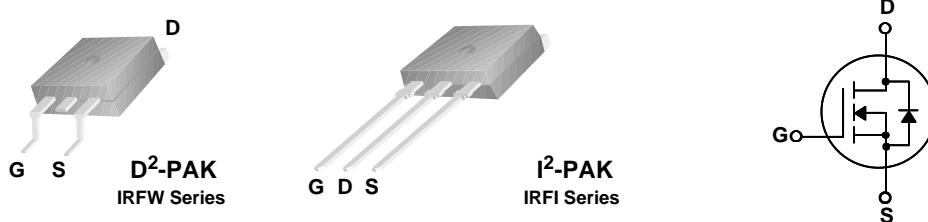
General Description

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 and switch mode power supplies.

Features

- 21A, 250V, $R_{DS(on)} = 0.14\Omega$ @ $V_{GS} = 10$ V
- Low gate charge (typical 95 nC)
- Low C_{RSS} (typical 60 pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability



Absolute Maximum Ratings

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

| Symbol | Parameter | IRFW654B / IRFI654B | Units |
|----------------|--|---------------------|---------------------|
| V_{DSS} | Drain-Source Voltage | 250 | V |
| I_D | Drain Current - Continuous ($T_C = 25^\circ\text{C}$) | 21 | A |
| | - Continuous ($T_C = 100^\circ\text{C}$) | 13.3 | A |
| I_{DM} | Drain Current - Pulsed | (Note 1) | A |
| V_{GSS} | Gate-Source Voltage | ± 30 | V |
| E_{AS} | Single Pulsed Avalanche Energy | (Note 2) | mJ |
| I_{AR} | Avalanche Current | (Note 1) | A |
| E_{AR} | Repetitive Avalanche Energy | (Note 1) | mJ |
| dv/dt | Peak Diode Recovery dv/dt | (Note 3) | V/ns |
| P_D | Power Dissipation ($T_A = 25^\circ\text{C}$) * | 3.13 | W |
| | Power Dissipation ($T_C = 25^\circ\text{C}$) | 156 | W |
| | - Derate above 25°C | 1.25 | 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 purposes, 1/8" from case for 5 seconds | 300 | $^\circ\text{C}$ |

Thermal Characteristics

| Symbol | Parameter | Typ | Max | Units |
|-----------------|---|-----|------|---------------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case | -- | 0.8 | $^\circ\text{C}/\text{W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient * | -- | 40 | $^\circ\text{C}/\text{W}$ |
| $R_{\theta CA}$ | Thermal Resistance, Case-to-Ambient | -- | 62.5 | $^\circ\text{C}/\text{W}$ |

* When mounted on the minimum pad size recommended (PCB Mount)

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 | $V_{\text{GS}} = 0 \text{ V}$, $I_D = 250 \mu\text{A}$ | 250 | -- | -- | V |
| $\Delta \text{BV}_{\text{DSS}} / \Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D = 250 \mu\text{A}$, Referenced to 25°C | -- | 0.26 | -- | $\text{V}/^\circ\text{C}$ |
| I_{DSS} | Zero Gate Voltage Drain Current | $V_{\text{DS}} = 250 \text{ V}$, $V_{\text{GS}} = 0 \text{ V}$ | -- | -- | 10 | μA |
| | | $V_{\text{DS}} = 200 \text{ V}$, $T_C = 125^\circ\text{C}$ | -- | -- | 100 | μA |
| I_{GSSF} | Gate-Body Leakage Current, Forward | $V_{\text{GS}} = 30 \text{ V}$, $V_{\text{DS}} = 0 \text{ V}$ | -- | -- | 100 | nA |
| I_{GSSR} | Gate-Body Leakage Current, Reverse | $V_{\text{GS}} = -30 \text{ V}$, $V_{\text{DS}} = 0 \text{ V}$ | -- | -- | -100 | nA |

On Characteristics

| | | | | | | |
|---------------------|-----------------------------------|--|-----|-----|------|----------|
| $V_{\text{GS(th)}}$ | Gate Threshold Voltage | $V_{\text{DS}} = V_{\text{GS}}$, $I_D = 250 \mu\text{A}$ | 2.0 | -- | 4.0 | V |
| $R_{\text{DS(on)}}$ | Static Drain-Source On-Resistance | $V_{\text{GS}} = 10 \text{ V}$, $I_D = 10.5 \text{ A}$ | -- | 0.1 | 0.14 | Ω |
| g_{FS} | Forward Transconductance | $V_{\text{DS}} = 40 \text{ V}$, $I_D = 10.5 \text{ A}$ (Note 4) | -- | 23 | -- | S |

Dynamic Characteristics

| | | | | | | |
|------------------|------------------------------|---|----|------|------|----|
| C_{iss} | Input Capacitance | $V_{\text{DS}} = 25 \text{ V}$, $V_{\text{GS}} = 0 \text{ V}$, $f = 1.0 \text{ MHz}$ | -- | 2600 | 3400 | pF |
| C_{oss} | Output Capacitance | | -- | 290 | 380 | pF |
| C_{rss} | Reverse Transfer Capacitance | | -- | 60 | 80 | pF |

Switching Characteristics

| | | | | | | |
|---------------------|---------------------|--|----|-----|-----|----|
| $t_{\text{d(on)}}$ | Turn-On Delay Time | $V_{\text{DD}} = 125 \text{ V}$, $I_D = 25 \text{ A}$, $R_G = 25 \Omega$ | -- | 35 | 80 | ns |
| t_r | Turn-On Rise Time | | -- | 195 | 400 | ns |
| $t_{\text{d(off)}}$ | Turn-Off Delay Time | | -- | 300 | 610 | ns |
| t_f | Turn-Off Fall Time | | -- | 180 | 370 | ns |
| Q_g | Total Gate Charge | $V_{\text{DS}} = 200 \text{ V}$, $I_D = 25 \text{ A}$, $V_{\text{GS}} = 10 \text{ V}$ | -- | 95 | 123 | nC |
| Q_{gs} | Gate-Source Charge | | -- | 12 | -- | nC |
| Q_{gd} | Gate-Drain Charge | | -- | 43 | -- | nC |

Drain-Source Diode Characteristics and Maximum Ratings

| | | | | | | |
|-----------------|---|---|----|------|-----|---------------|
| I_S | Maximum Continuous Drain-Source Diode Forward Current | -- | -- | 21 | A | |
| I_{SM} | Maximum Pulsed Drain-Source Diode Forward Current | -- | -- | 84 | A | |
| V_{SD} | Drain-Source Diode Forward Voltage | $V_{\text{GS}} = 0 \text{ V}$, $I_S = 21 \text{ A}$ | -- | -- | 1.5 | V |
| t_{rr} | Reverse Recovery Time | $V_{\text{GS}} = 0 \text{ V}$, $I_S = 25 \text{ A}$, $dI_F / dt = 100 \text{ A}/\mu\text{s}$ | -- | 300 | -- | ns |
| Q_{rr} | Reverse Recovery Charge | | -- | 3.23 | -- | μC |

Notes:

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. $L = 2.54\text{mH}$, $I_{AS} = 21\text{A}$, $V_{DD} = 50\text{V}$, $R_G = 25 \Omega$, Starting $T_J = 25^\circ\text{C}$
3. $I_{SD} \leq 25\text{A}$, $dI/dt \leq 300\text{A}/\mu\text{s}$, $V_{DD} \leq \text{BV}_{\text{DSS}}$, 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

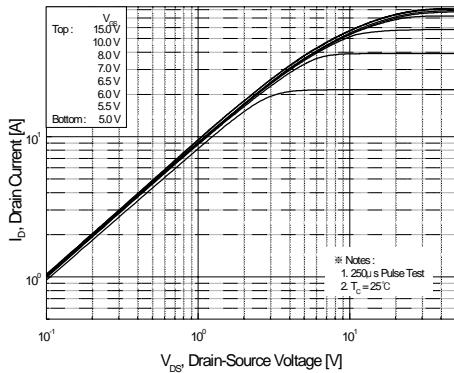


Figure 1. On-Region Characteristics

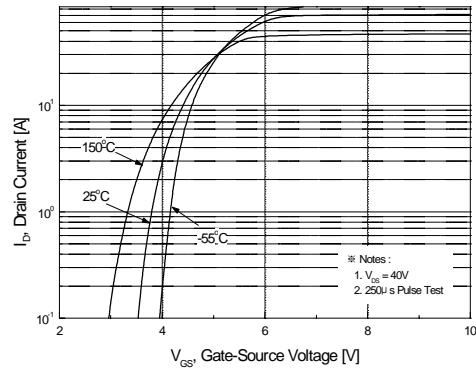


Figure 2. Transfer Characteristics

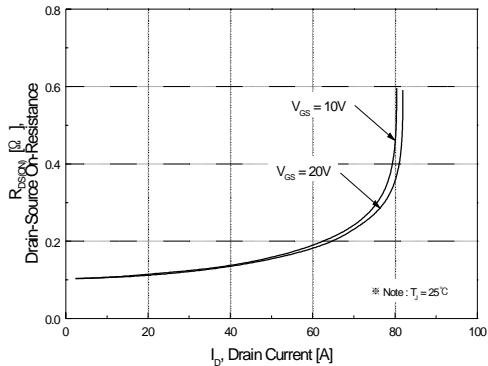


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

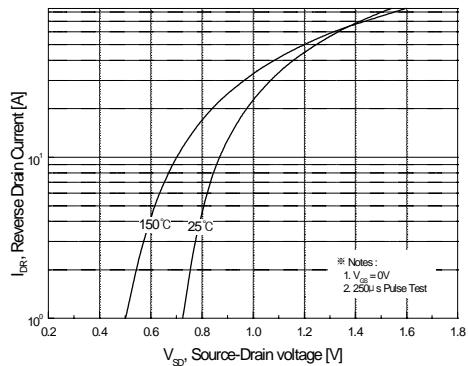


Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature

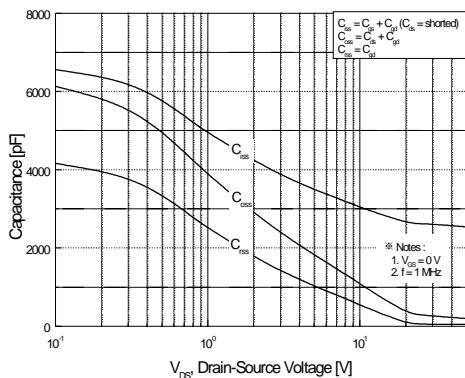


Figure 5. Capacitance Characteristics

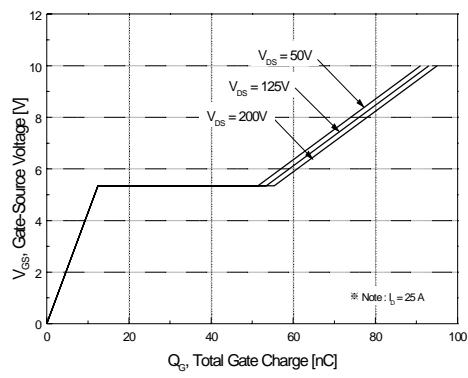


Figure 6. Gate Charge Characteristics