

IRFW644B / IRFI644B

250V N-Channel MOSFET

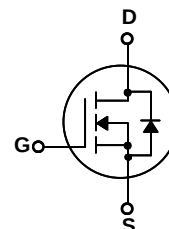
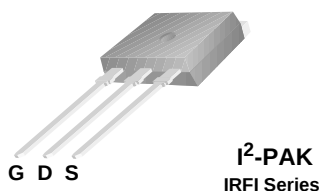
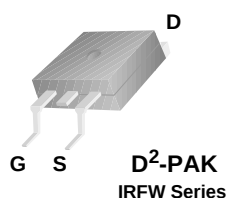
General Description

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 converter and switch mode power supplies.

Features

- 14A, 250V, $R_{DS(on)} = 0.28\Omega$ @ $V_{GS} = 10$ V
- Low gate charge (typical 47 nC)
- Low C_{rss} (typical 30 pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability



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

Symbol	Parameter	IRFW644B / IRFI644B	Units
V_{DSS}	Drain-Source Voltage	250	V
I_D	Drain Current - Continuous ($T_C = 25^\circ\text{C}$)	14	A
	- Continuous ($T_C = 100^\circ\text{C}$)	8.9	A
I_{DM}	Drain Current - Pulsed (Note 1)	56	A
V_{GSS}	Gate-Source Voltage	± 30	V
E_{AS}	Single Pulsed Avalanche Energy (Note 2)	480	mJ
I_{AR}	Avalanche Current (Note 1)	14	A
E_{AR}	Repetitive Avalanche Energy (Note 1)	13.9	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	5.5	V/ns
P_D	Power Dissipation ($T_A = 25^\circ\text{C}$) *	3.13	W
	Power Dissipation ($T_C = 25^\circ\text{C}$)	139	W
	- Derate above 25°C	1.11	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	--	0.9	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient *	--	40	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	--	62.5	$^\circ\text{C/W}$

* 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
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Off Characteristics

BV_{DSS}	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$	250	--	--	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250\text{ }\mu\text{A}$, Referenced to 25°C	--	0.24	--	V/ $^\circ\text{C}$
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 250\text{ V}, V_{GS} = 0\text{ V}$	--	--	10	μA
		$V_{DS} = 200\text{ V}, T_C = 125^\circ\text{C}$	--	--	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	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	2.0	--	4.0	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10\text{ V}, I_D = 7.0\text{ A}$	--	0.22	0.28	Ω
g_{FS}	Forward Transconductance	$V_{DS} = 40\text{ V}, I_D = 7.0\text{ A}$ (Note 4)	--	11.7	--	S

Dynamic Characteristics

C_{iss}	Input Capacitance	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$	--	1250	1600	pF
C_{oss}	Output Capacitance		--	150	195	pF
C_{rss}	Reverse Transfer Capacitance		--	30	40	pF

Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 125\text{ V}, I_D = 14\text{ A},$ $R_G = 25\text{ }\Omega$ (Note 4, 5)	--	20	50	ns
t_r	Turn-On Rise Time		--	115	240	ns
$t_{d(off)}$	Turn-Off Delay Time		--	150	310	ns
t_f	Turn-Off Fall Time		--	95	200	ns
Q_g	Total Gate Charge	$V_{DS} = 200\text{ V}, I_D = 14\text{ A},$ $V_{GS} = 10\text{ V}$ (Note 4, 5)	--	47	60	nC
Q_{gs}	Gate-Source Charge		--	6.2	--	nC
Q_{gd}	Gate-Drain Charge		--	23	--	nC

Drain-Source Diode Characteristics and Maximum Ratings

I _S	Maximum Continuous Drain-Source Diode Forward Current	--	--	14	A	
I _{SM}	Maximum Pulsed Drain-Source Diode Forward Current	--	--	56	A	
V _{SD}	Drain-Source Diode Forward Voltage	V _{GS} = 0 V, I _S = 14 A	--	--	1.5	V
t _{rr}	Reverse Recovery Time	V _{GS} = 0 V, I _S = 14 A,	--	240	--	ns
Q _{rr}	Reverse Recovery Charge	dI _F / dt = 100 A/μs (Note 4)	--	1.96	--	μC

Notes:

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. $L = 3.9\text{ mH}, I_{AS} = 14\text{ A}, V_{DD} = 50\text{ V}, R_G = 25\text{ }\Omega$, Starting $T_J = 25^\circ\text{C}$
3. $I_{SD} \leq 14\text{ A}, di/dt \leq 300\text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$, 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

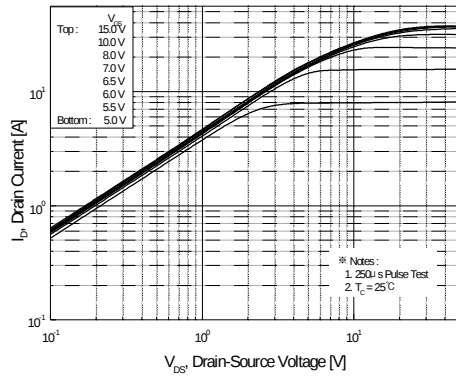


Figure 1. On-Region Characteristics

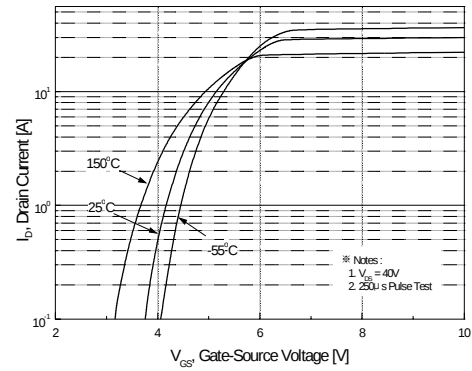


Figure 2. Transfer Characteristics

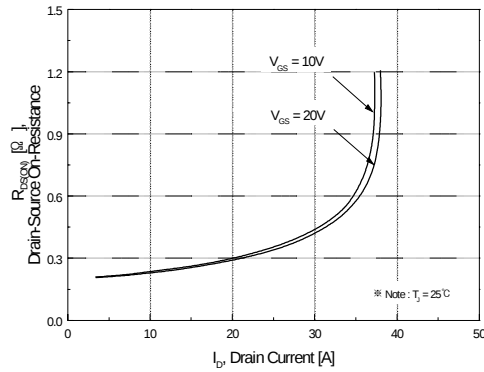


Figure 3. On-Resistance Variation vs Drain Current and Gate Voltage

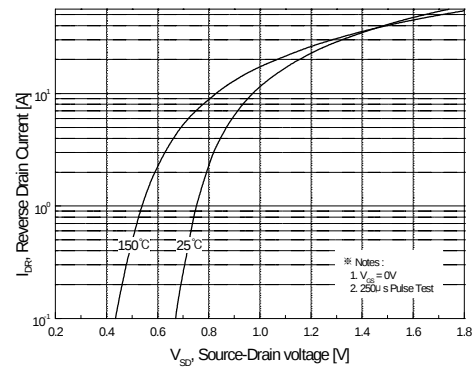


Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature

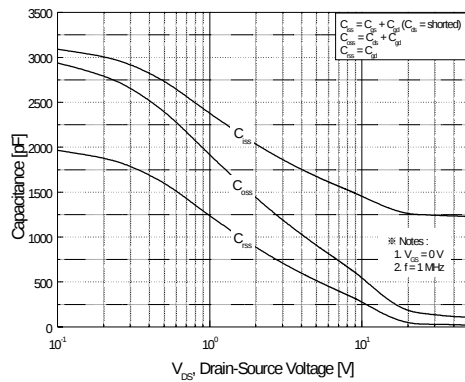


Figure 5. Capacitance Characteristics

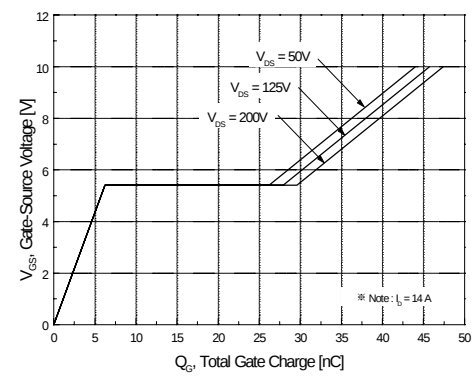


Figure 6. Gate Charge Characteristics

Typical Characteristics (Continued)

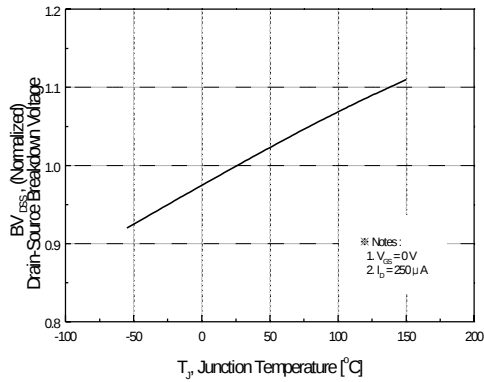


Figure 7. Breakdown Voltage Variation vs Temperature

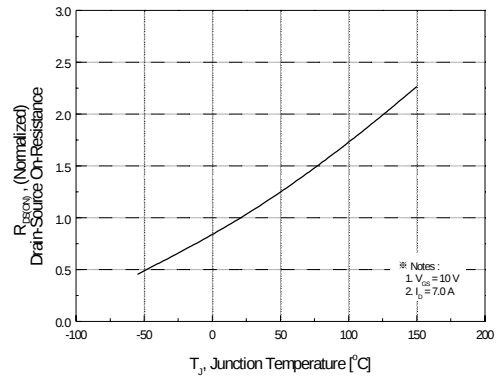


Figure 8. On-Resistance Variation vs Temperature

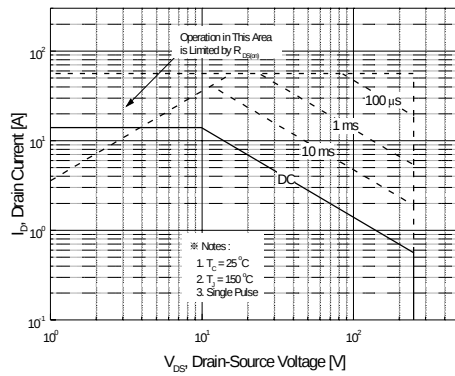


Figure 9. Maximum Safe Operating Area

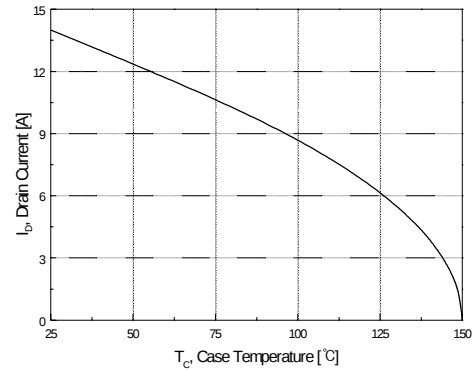


Figure 10. Maximum Drain Current vs Case Temperature

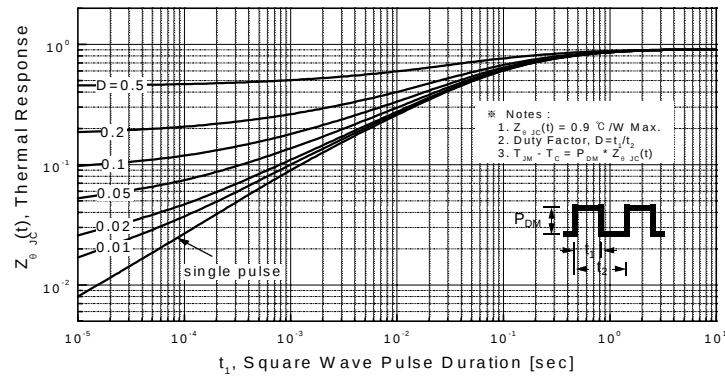


Figure 11. Transient Thermal Response Curve

Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching Test Circuit & Waveforms



The top diagram shows a circuit for testing the body diode of a MOSFET. A MOSFET (DUT) is connected with its source to ground and its drain to a load inductor L and a DC supply V_{DD} . The gate is driven by a pulse generator V_{GS} through a resistor R_G . A MOSFET (Driver) is used to drive the gate. The drain current I_{SD} is measured. The DUT and Driver are of the same type.

Key parameters and notes from the diagram:

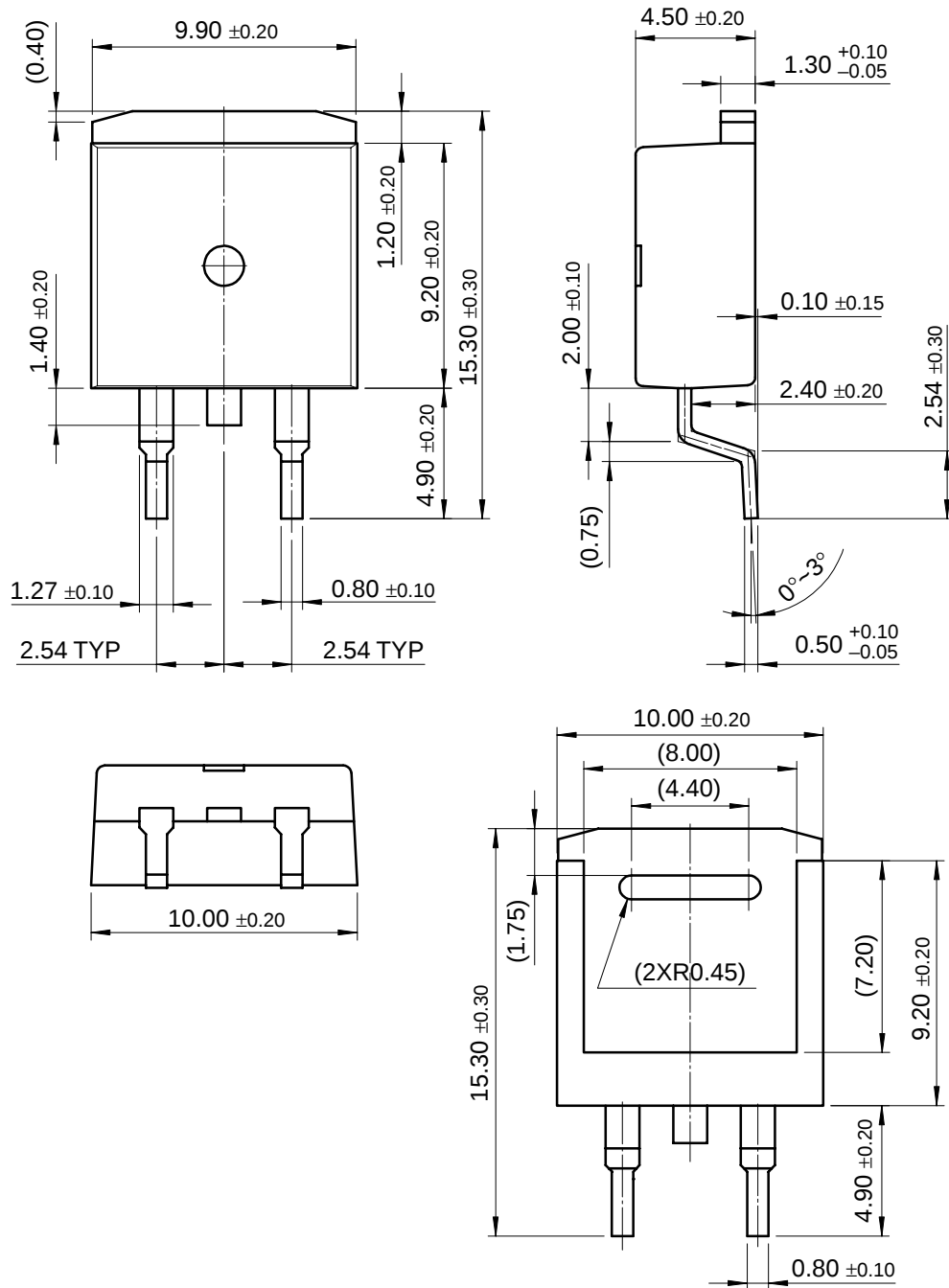
- V_{DS} : Drain-Source Voltage
- I_{SD} : Source-Drain Current
- L : Load Inductor
- V_{DD} : DC Supply Voltage
- R_G : Gate Resistor
- V_{GS} : Gate-Source Voltage (Pulse)
- Same Type as DUT: Refers to the Driver MOSFET.
- dv/dt controlled by R_G
- I_{SD} controlled by pulse period

The bottom part of the image shows three waveforms:

- V_{GS} (Driver)**: A square wave pulse. The duty cycle is defined as $D = \frac{\text{Gate Pulse Width}}{\text{Gate Pulse Period}}$. The pulse height is 10V.
- I_{SD} (DUT)**: The source-drain current. It shows a forward current I_{FM} during the gate pulse, followed by a reverse current I_{RM} during the off-time. The reverse current is labeled "Body Diode Reverse Current". The slope of the reverse current is labeled di/dt .
- V_{DS} (DUT)**: The drain-source voltage. It shows a forward voltage drop V_{SD} during the forward current, and a recovery voltage during the reverse current. The recovery is labeled "Body Diode Recovery dv/dt ". The peak reverse voltage is V_{DD} .

Package Dimensions

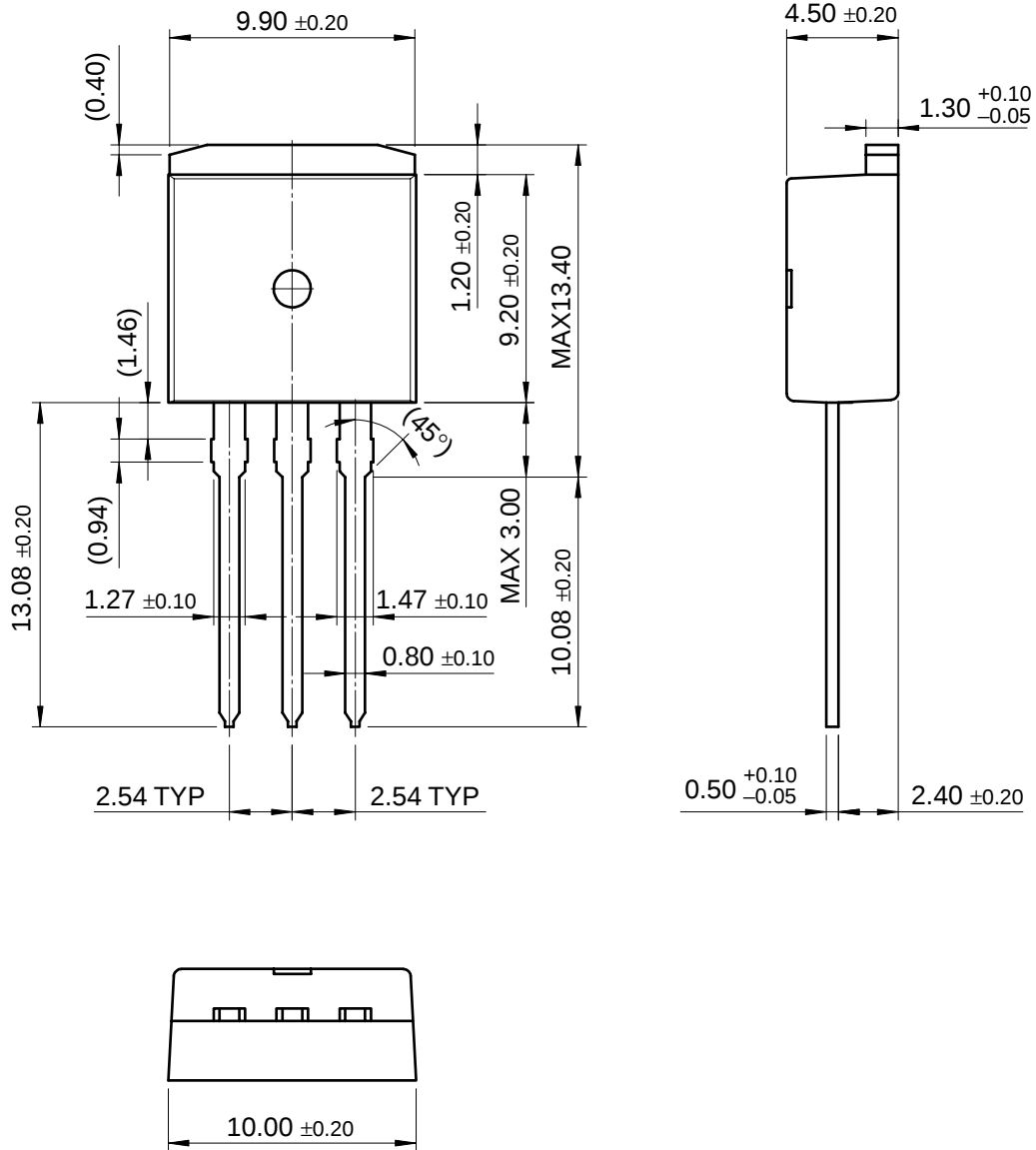
D²-PAK



Dimensions in Millimeters

Package Dimensions (Continued)

I²-PAK



Dimensions in Millimeters

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