

IRFR420B / IRFU420B

500V N-Channel MOSFET

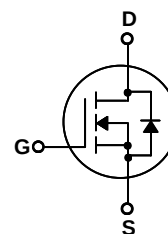
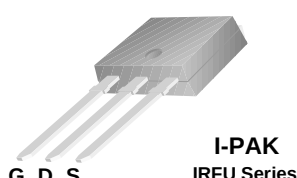
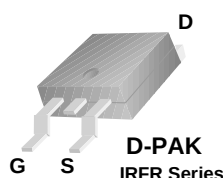
General Description

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 switch mode power supplies, power factor correction and electronic lamp ballasts based on half bridge.

Features

- 2.3A, 500V, $R_{DS(on)} = 2.6\Omega$ @ $V_{GS} = 10V$
- Low gate charge (typical 14 nC)
- Low C_{rss} (typical 10 pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability



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

Symbol	Parameter	IRFR420B / IRFU420B	Units
V_{DSS}	Drain-Source Voltage	500	V
I_D	Drain Current - Continuous ($T_C = 25^\circ\text{C}$)	2.3	A
	- Continuous ($T_C = 100^\circ\text{C}$)	1.5	A
I_{DM}	Drain Current - Pulsed (Note 1)	8.0	A
V_{GSS}	Gate-Source Voltage	± 30	V
E_{AS}	Single Pulsed Avalanche Energy (Note 2)	200	mJ
I_{AR}	Avalanche Current (Note 1)	2.3	A
E_{AR}	Repetitive Avalanche Energy (Note 1)	4.1	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	5.5	V/ns
P_D	Power Dissipation ($T_A = 25^\circ\text{C}$) *	2.5	W
	Power Dissipation ($T_C = 25^\circ\text{C}$)	41	W
	- Derate above 25°C	0.33	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	--	3.05	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient *	--	50	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	--	110	$^\circ\text{C/W}$

* 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	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$	500	--	--	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250\text{ }\mu\text{A}$, Referenced to 25°C	--	0.54	--	V/ $^\circ\text{C}$
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 500\text{ V}, V_{GS} = 0\text{ V}$	--	--	10	μA
		$V_{DS} = 400\text{ V}, T_C = 125^\circ\text{C}$	--	--	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	$V_{GS} = 10\text{ V}, I_D = 1.15\text{ A}$	--	2.1	2.6	Ω
g_{FS}	Forward Transconductance	$V_{DS} = 40\text{ V}, I_D = 1.15\text{ A}$ (Note 4)	--	2.7	--	S

Dynamic Characteristics

C_{iss}	Input Capacitance	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$	--	470	610	pF
C_{oss}	Output Capacitance		--	45	60	pF
C_{rss}	Reverse Transfer Capacitance		--	10	15	pF

Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 250\text{ V}, I_D = 2.5\text{ A},$ $R_G = 25\text{ }\Omega$ (Note 4, 5)	--	10	30	ns
t_r	Turn-On Rise Time		--	30	70	ns
$t_{d(off)}$	Turn-Off Delay Time		--	40	90	ns
t_f	Turn-Off Fall Time		--	35	80	ns
Q_g	Total Gate Charge	$V_{DS} = 400\text{ V}, I_D = 2.5\text{ A},$ $V_{GS} = 10\text{ V}$ (Note 4, 5)	--	14	18	nC
Q_{gs}	Gate-Source Charge		--	2.4	--	nC
Q_{gd}	Gate-Drain Charge		--	5.8	--	nC

Drain-Source Diode Characteristics and Maximum Ratings

I _S	Maximum Continuous Drain-Source Diode Forward Current		--	--	2.3	A
I _{SM}	Maximum Pulsed Drain-Source Diode Forward Current		--	--	8.0	A
V _{SD}	Drain-Source Diode Forward Voltage	V _{GS} = 0 V, I _S = 2.3 A	--	--	1.4	V
t _{rr}	Reverse Recovery Time	V _{GS} = 0 V, I _S = 2.5 A,	--	260	--	ns
Q _{rr}	Reverse Recovery Charge	dI _F / dt = 100 A/μs (Note 4)	--	1.56	--	μC

Notes:

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. $L = 68\text{ mH}, I_{AS} = 2.3\text{ A}, V_{DD} = 50\text{ V}, R_G = 25\text{ }\Omega$, Starting $T_J = 25^\circ\text{C}$
3. $I_{SD} \leq 2.5\text{ A}, dI/dt \leq 300\text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$, Starting $T_J = 25^\circ\text{C}$
4. Pulse Test : Pulse width $\leq 300\mu\text{s}$, Duty cycle $\leq 2\%$
5. Essentially independent of operating temperature

Typical Characteristics

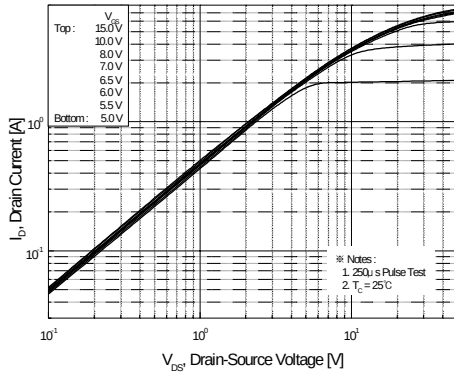


Figure 1. On-Region Characteristics

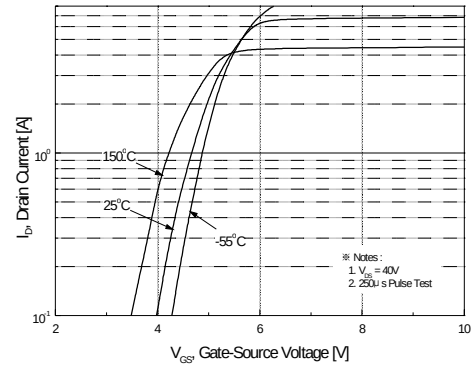


Figure 2. Transfer Characteristics

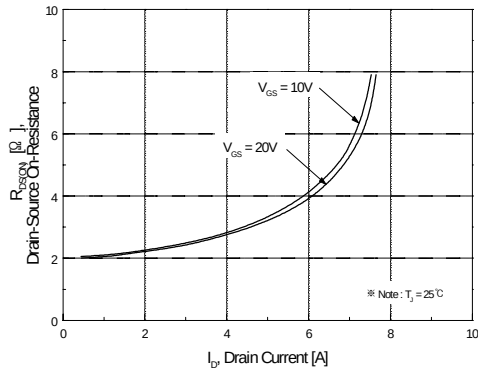


Figure 3. On-Resistance Variation vs Drain Current and Gate Voltage

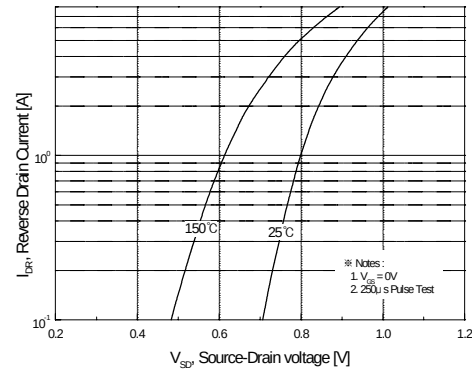


Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature

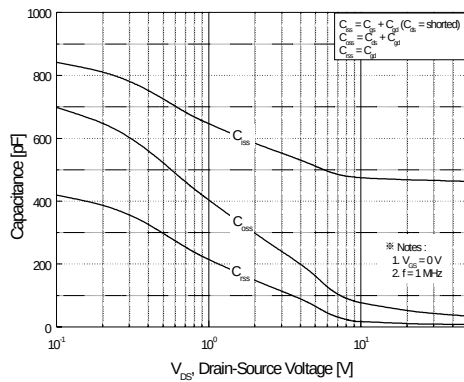


Figure 5. Capacitance Characteristics

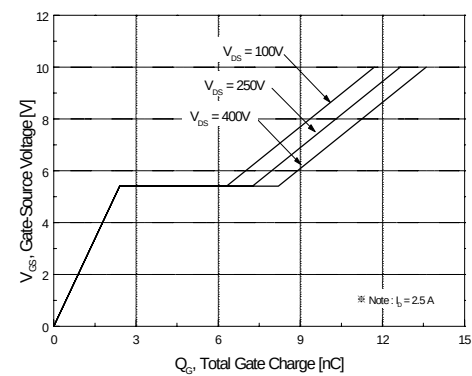


Figure 6. Gate Charge Characteristics

Typical Characteristics (Continued)

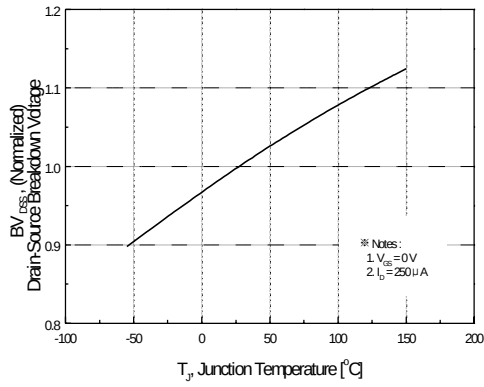


Figure 7. Breakdown Voltage Variation vs Temperature

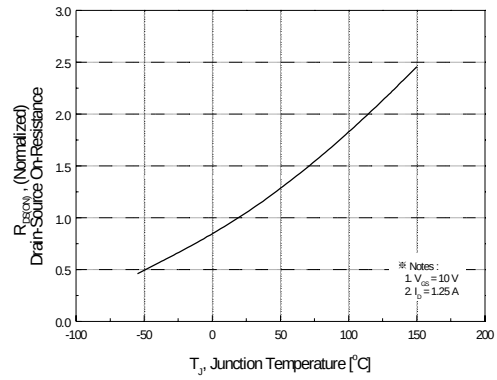


Figure 8. On-Resistance Variation vs Temperature

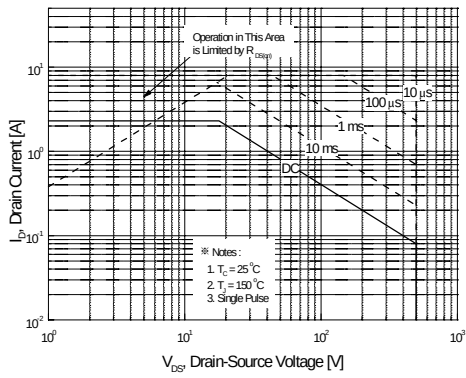


Figure 9. Maximum Safe Operating Area

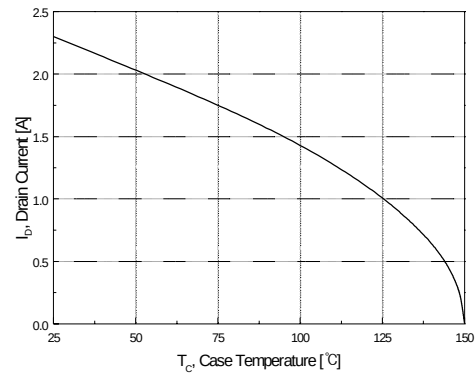


Figure 10. Maximum Drain Current vs Case Temperature

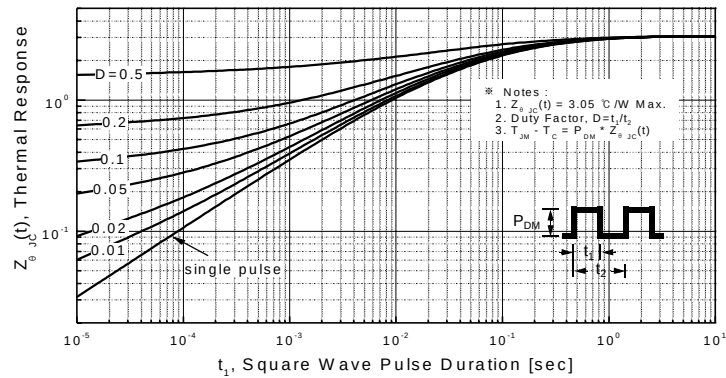
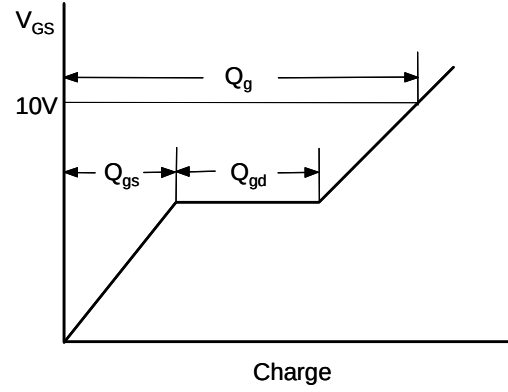
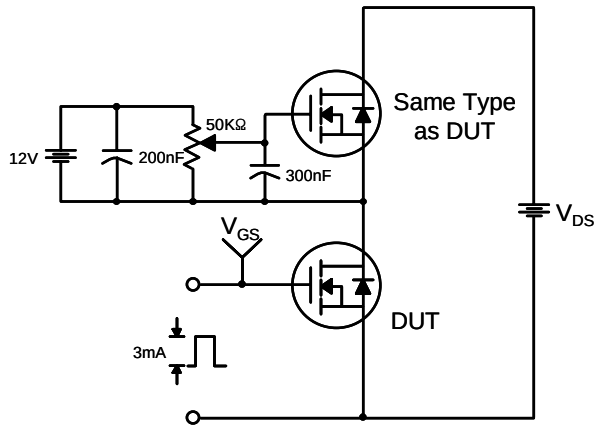
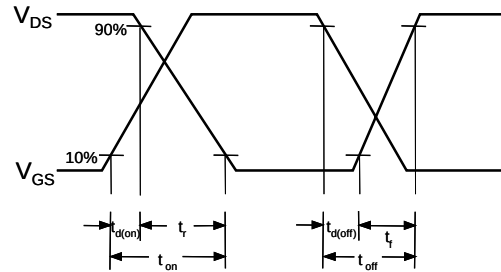
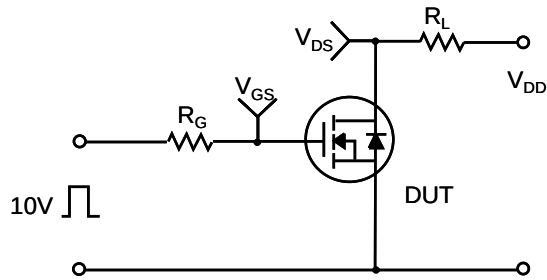


Figure 11. Transient Thermal Response Curve

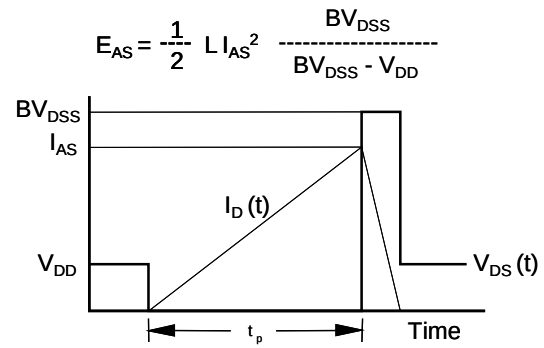
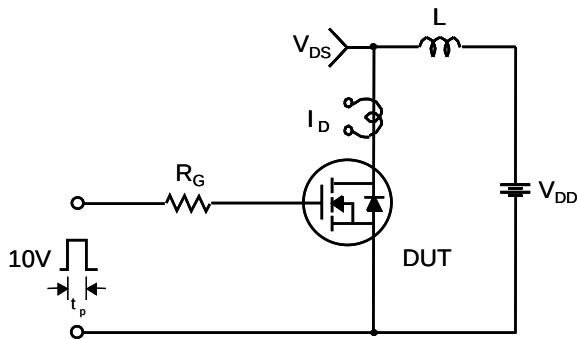
Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching Test Circuit & Waveforms



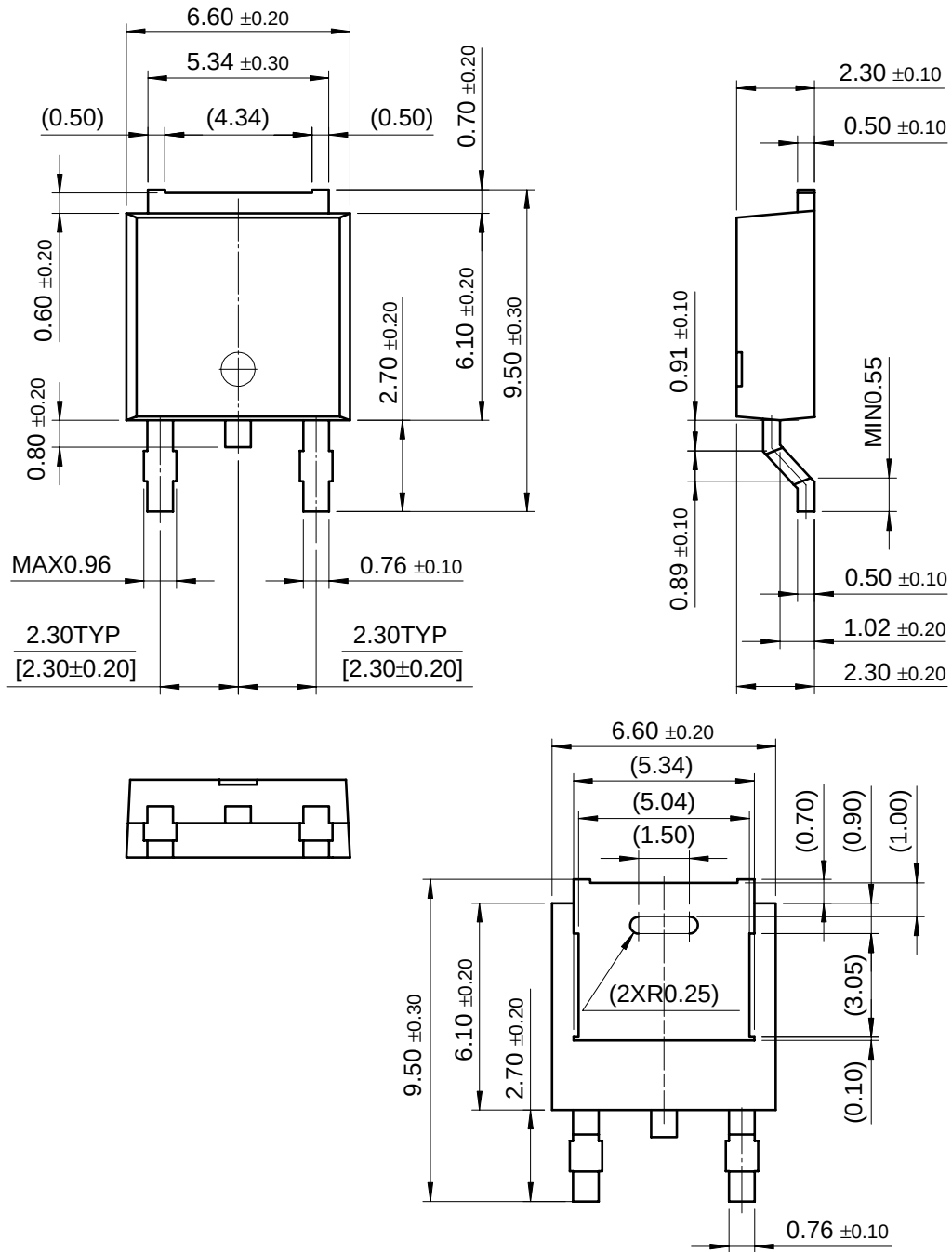
The top diagram shows a circuit for testing the body diode of a MOSFET. The DUT (Device Under Test) is a MOSFET with its gate connected to its drain. The source is connected to the source of a driver MOSFET. The driver's gate is driven by a square wave V_{GS} through a resistor R_G . The driver's drain is connected to the DUT's drain through an inductor L . The DUT's source is connected to ground. The DUT's drain is also connected to ground through a current source I_{SD} . The DUT's body is connected to its source. The driver is labeled "Same Type as DUT".

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 of the DUT. It shows a forward current I_{FM} during the pulse, followed by a reverse current I_{RM} during the recovery phase. The recovery phase is labeled "Body Diode Reverse Current".
- V_{DS} (DUT):** The drain-source voltage of the DUT. It shows a forward voltage drop V_{SD} during the pulse, followed by a recovery voltage V_{DD} during the recovery phase. The recovery phase is labeled "Body Diode Recovery dv/dt".

Package Dimensions

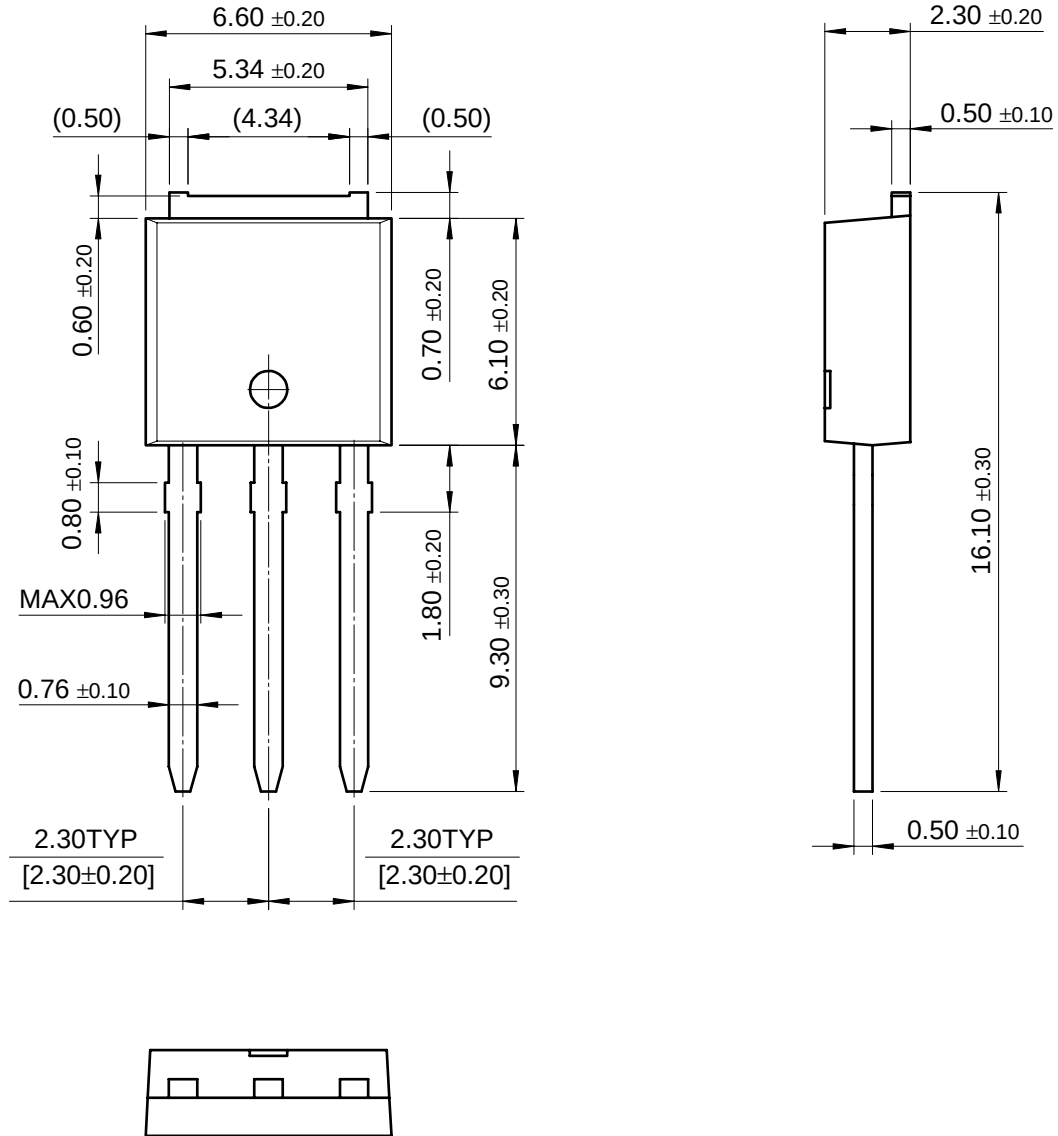
D-PAK



Dimensions in Millimeters

Package Dimensions (Continued)

I-PAK



Dimensions in Millimeters

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