



April 2000

QFET™

FQB4N20 / FQI4N20

200V N-Channel MOSFET

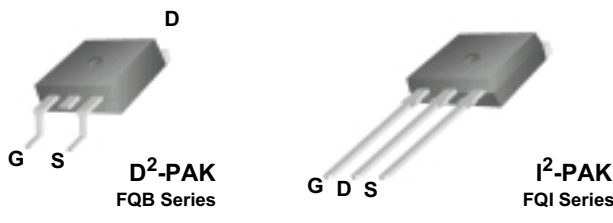
General Description

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 high efficiency switching DC/DC converters, switch mode power supply, DC-AC converters for uninterrupted power supply, motor control.

Features

- 3.6A, 200V, $R_{DS(on)} = 1.4\Omega @ V_{GS} = 10V$
- Low gate charge (typical 5.0 nC)
- Low Crss (typical 5.0 pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability



Absolute Maximum Ratings T_C = 25°C unless otherwise noted

Symbol	Parameter	FQB4N20 / FQI4N20	Units
V _{DSS}	Drain-Source Voltage	200	V
I _D	Drain Current - Continuous (T _C = 25°C)	3.6	A
	- Continuous (T _C = 100°C)	2.3	A
I _{DM}	Drain Current - Pulsed (Note 1)	14.4	A
V _{GSS}	Gate-Source Voltage	± 30	V
E _{AS}	Single Pulsed Avalanche Energy (Note 2)	52	mJ
I _{AR}	Avalanche Current (Note 1)	3.6	A
E _{AR}	Repetitive Avalanche Energy (Note 1)	4.5	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	5.5	V/ns
P _D	Power Dissipation (T _A = 25°C) *	3.13	W
	Power Dissipation (T _C = 25°C)	45	W
	- Derate above 25°C	0.36	W/°C
T _J , T _{STG}	Operating and Storage Temperature Range	-55 to +150	°C
T _L	Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds	300	°C

Thermal Characteristics

Symbol	Parameter	Typ	Max	Units
R _{θJC}	Thermal Resistance, Junction-to-Case	--	2.78	°C/W
R _{θJA}	Thermal Resistance, Junction-to-Ambient *	--	40	°C/W
R _{θJA}	Thermal Resistance, Junction-to-Ambient	--	62.5	°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
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	--	0.24	--	$\text{V}/^\circ\text{C}$
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 200\text{ V}, V_{GS} = 0\text{ V}$	--	--	1	μA
		$V_{DS} = 160\text{ V}, T_C = 125^\circ\text{C}$	--	--	10	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	$V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$	3.0	--	5.0	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10\text{ V}, I_D = 1.8\text{ A}$	--	1.12	1.4	Ω
g_{FS}	Forward Transconductance	$V_{DS} = 40\text{ V}, I_D = 1.8\text{ A}$ (Note 4)	--	2.0	--	S

Dynamic Characteristics

C_{iss}	Input Capacitance	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$	--	170	220	pF
C_{oss}	Output Capacitance		--	35	45	pF
C_{rss}	Reverse Transfer Capacitance		--	5	7	pF

Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 100\text{ V}, I_D = 3.6\text{ A},$ $R_G = 25\ \Omega$	--	7	25	ns	
t_r	Turn-On Rise Time		--	50	110	ns	
$t_{d(off)}$	Turn-Off Delay Time		(Note 4, 5)	--	7	25	ns
t_f	Turn-Off Fall Time		(Note 4, 5)	--	25	60	ns
Q_g	Total Gate Charge	$V_{DS} = 160\text{ V}, I_D = 3.6\text{ A},$ $V_{GS} = 10\text{ V}$	--	5.0	6.5	nC	
Q_{gs}	Gate-Source Charge		(Note 4, 5)	--	1.4	--	nC
Q_{gd}	Gate-Drain Charge		(Note 4, 5)	--	2.1	--	nC

Drain-Source Diode Characteristics and Maximum Ratings

I_S	Maximum Continuous Drain-Source Diode Forward Current	--	--	3.6	A	
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current	--	--	14.4	A	
V_{SD}	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = 3.6\text{ A}$	--	--	1.5	V
t_{rr}	Reverse Recovery Time	$V_{GS} = 0\text{ V}, I_S = 3.6\text{ A},$	--	90	--	ns
Q_{rr}	Reverse Recovery Charge	$di_F / dt = 100\text{ A}/\mu\text{s}$ (Note 4)	--	0.24	--	μC

Notes:

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. $L = 6.0\text{mH}, I_{AS} = 3.6\text{ A}, V_{DD} = 50\text{ V}, R_G = 25\ \Omega$, Starting $T_J = 25^\circ\text{C}$
3. $I_{SD} \leq 3.6\text{ A}, di/dt \leq 300\text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$, 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

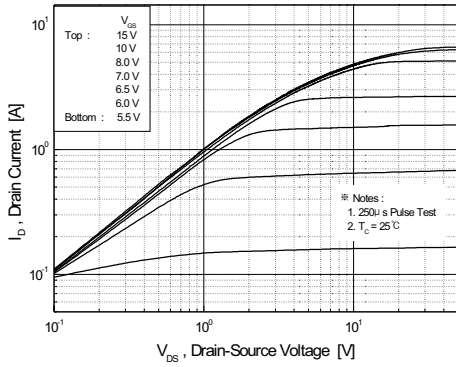


Figure 1. On-Region Characteristics

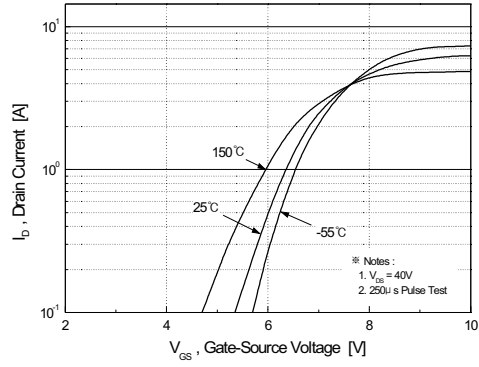


Figure 2. Transfer Characteristics

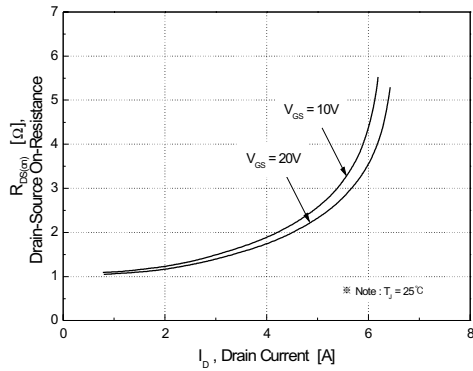


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

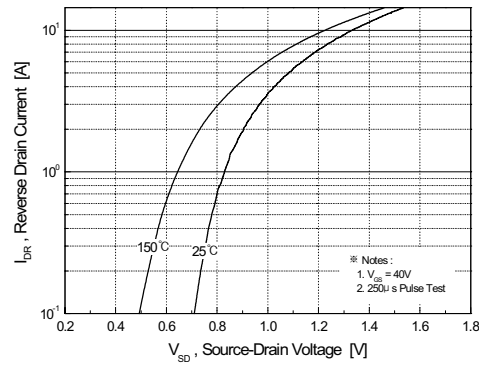


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

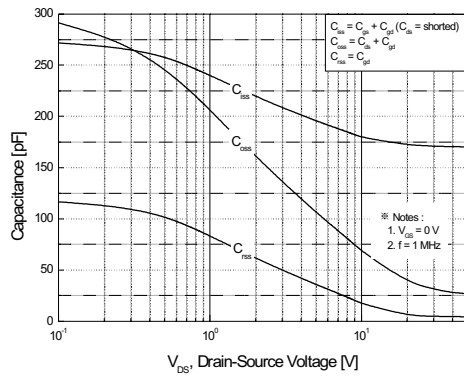


Figure 5. Capacitance Characteristics

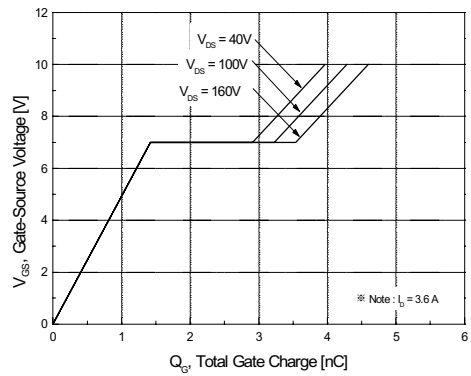


Figure 6. Gate Charge Characteristics

Typical Characteristics (Continued)

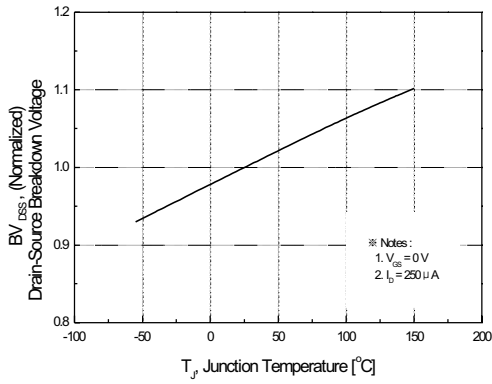


Figure 7. Breakdown Voltage Variation vs. Temperature

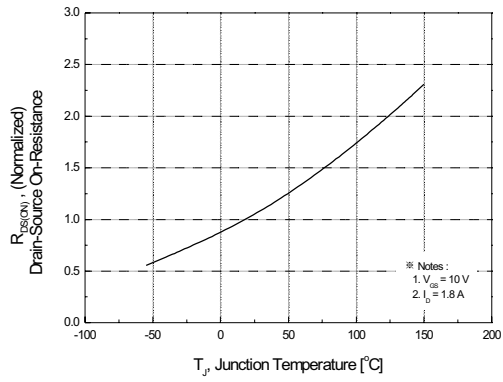


Figure 8. On-Resistance Variation vs. Temperature

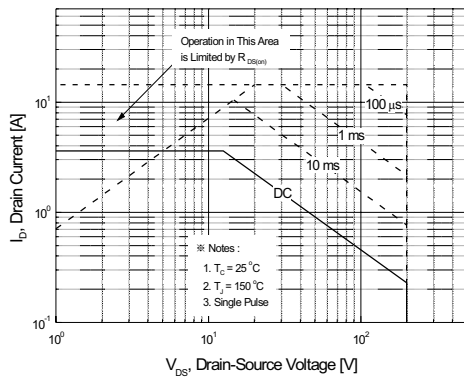


Figure 9. Maximum Safe Operating Area

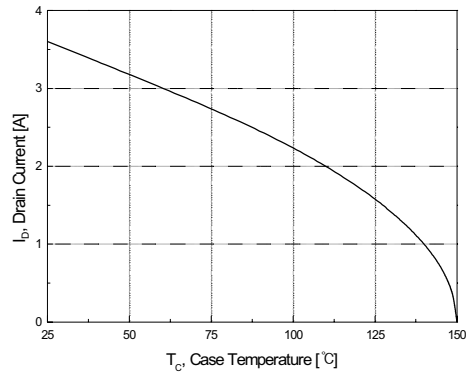


Figure 10. Maximum Drain Current vs. Case Temperature

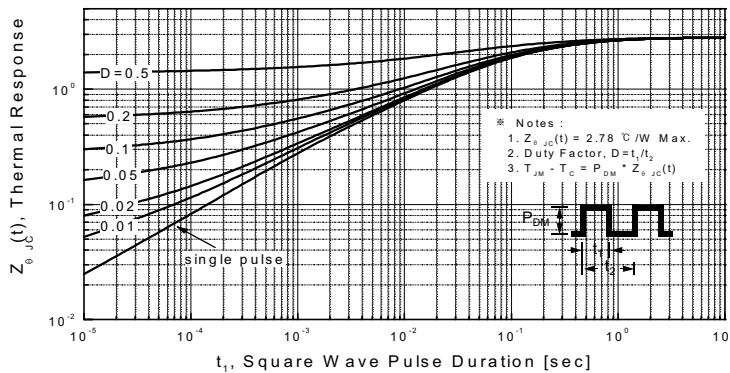
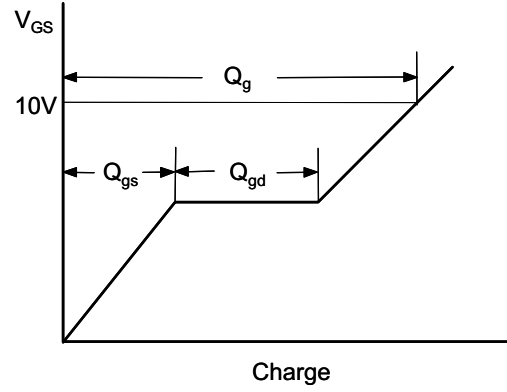
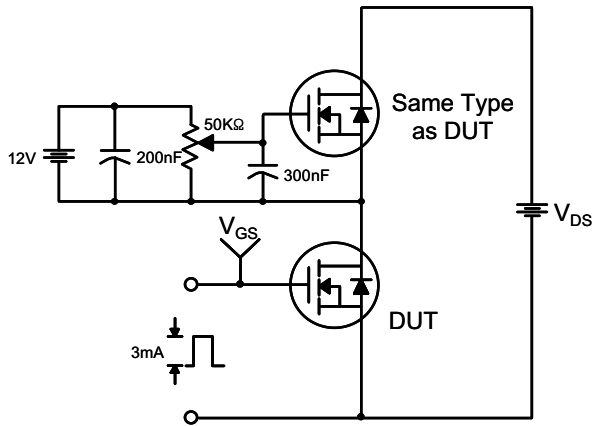
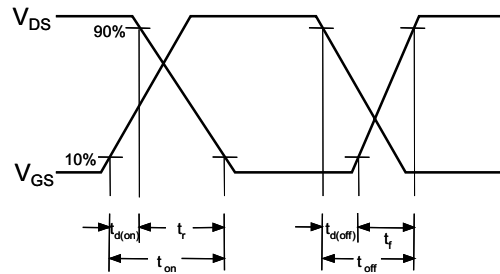
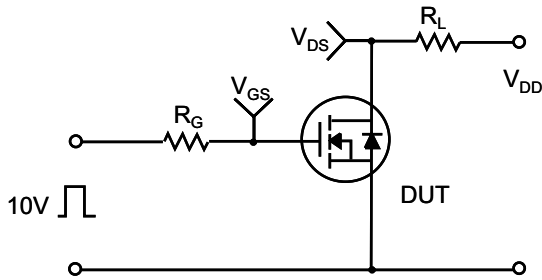


Figure 11. Transient Thermal Response Curve

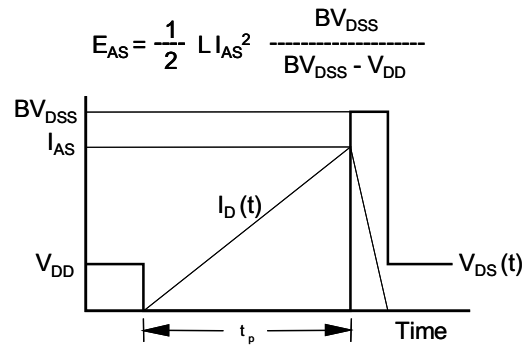
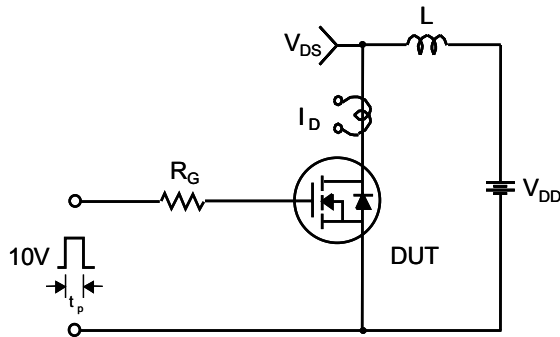
Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveforms

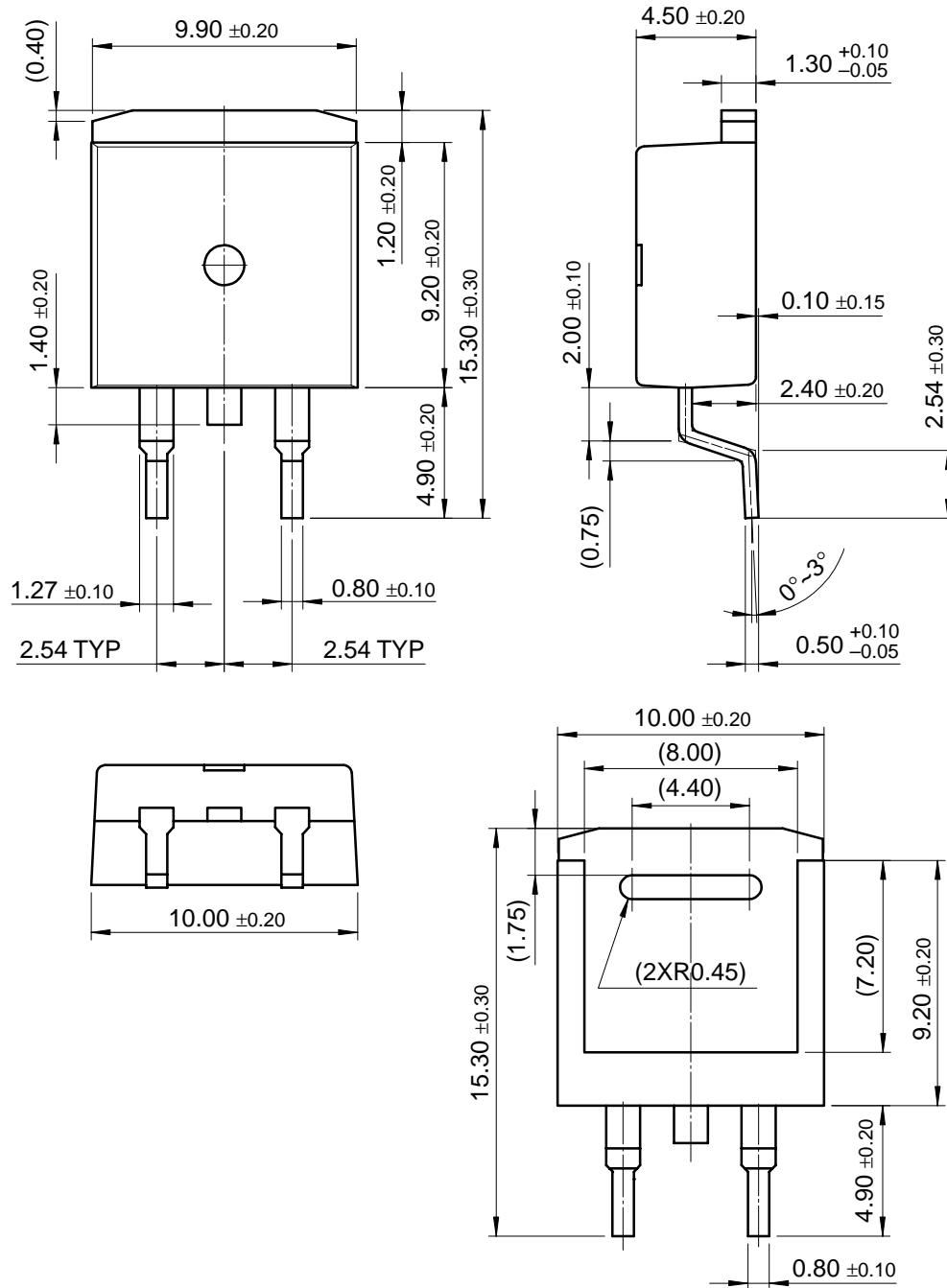


Unclamped Inductive Switching Test Circuit & Waveforms



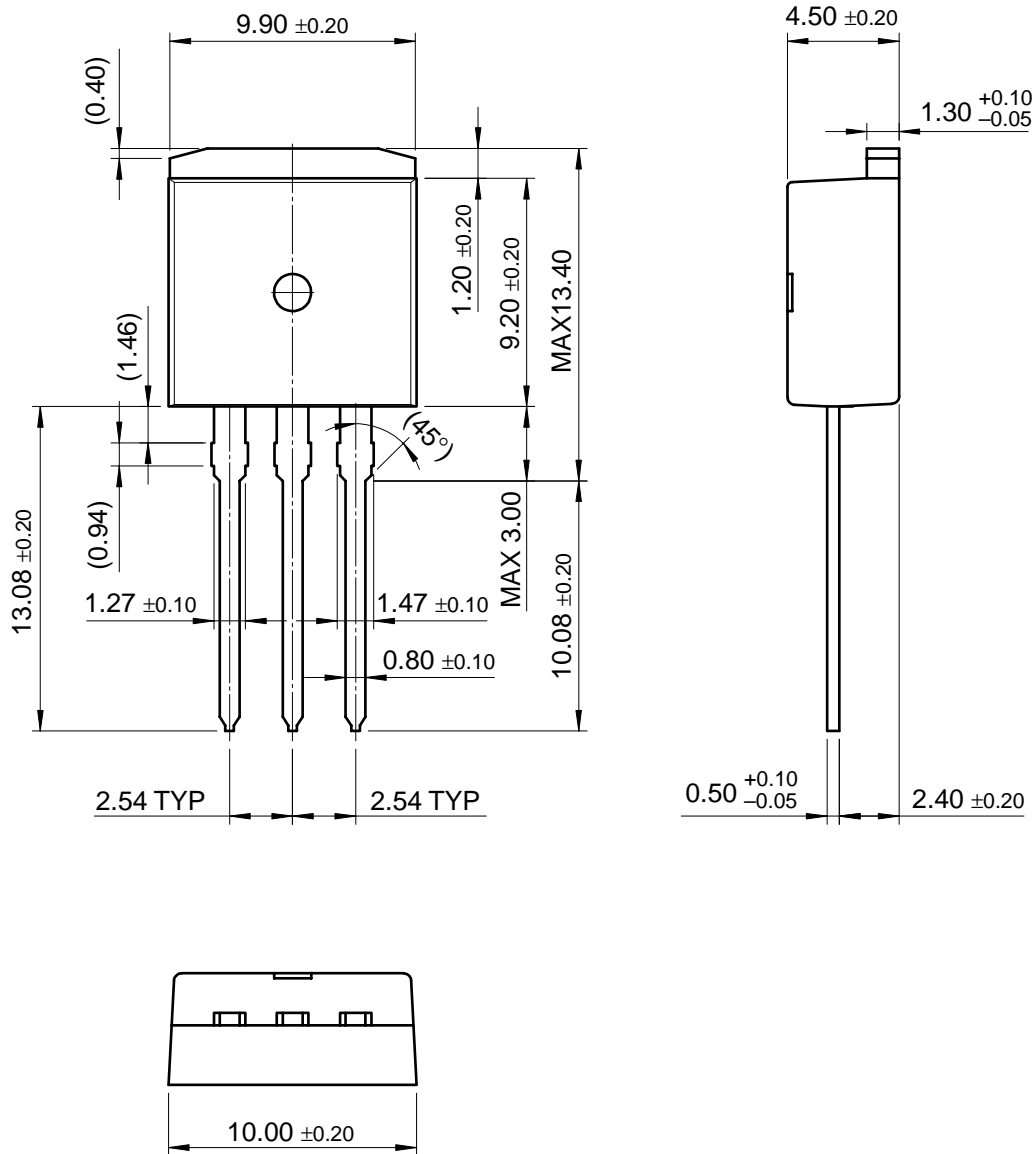
Package Dimensions

D²PAK



Package Dimensions (Continued)

I²PAK



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