

FQB5N20L / FQI5N20L

200V LOGIC N-Channel MOSFET

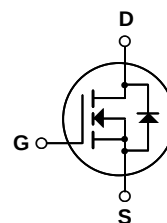
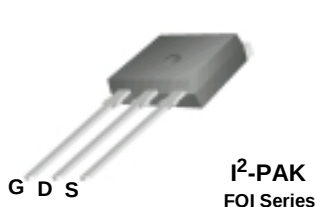
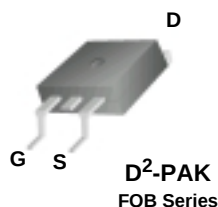
General Description

These N-Channel enhancement mode power field effect transistors are produced using Fairchild's proprietary, planar stripe, DMOS technology.

This advanced technology is especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation modes. These devices are well suited for high efficiency switching DC/DC converters, switch mode power supplies, and motor control.

Features

- 4.5A, 200V, $R_{DS(on)} = 1.2\Omega$ @ $V_{GS} = 10V$
- Low gate charge (typical 4.8 nC)
- Low C_{rss} (typical 6.0 pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability
- Low level gate drive requirement allowing direct operation from logic drivers



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

Symbol	Parameter	FQB5N20L / FQI5N20L	Units
V_{DSS}	Drain-Source Voltage	200	V
I_D	Drain Current - Continuous ($T_C = 25^\circ\text{C}$)	4.5	A
	- Continuous ($T_C = 100^\circ\text{C}$)	2.8	A
I_{DM}	Drain Current - Pulsed (Note 1)	18	A
V_{GSS}	Gate-Source Voltage	± 20	V
E_{AS}	Single Pulsed Avalanche Energy (Note 2)	60	mJ
I_{AR}	Avalanche Current (Note 1)	4.5	A
E_{AR}	Repetitive Avalanche Energy (Note 1)	5.2	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 ($T_C = 25^\circ\text{C}$)	52	W
	- Derate above 25°C	0.42	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	--	2.4	$^\circ\text{C/W}$
$R_{\theta JA}$	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	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$	200	--	--	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250\text{ }\mu\text{A}$, Referenced to 25°C	--	0.18	--	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	$V_{GS} = 20\text{ V}, V_{DS} = 0\text{ V}$	--	--	100	nA
I_{GSSR}	Gate-Body Leakage Current, Reverse	$V_{GS} = -20\text{ V}, V_{DS} = 0\text{ V}$	--	--	-100	nA

On Characteristics

$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	1.0	--	2.0	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10\text{ V}, I_D = 2.25\text{ A}$	--	0.94	1.2	Ω
		$V_{GS} = 5\text{ V}, I_D = 2.25\text{ A}$ (Note 4)	--	0.98	1.25	Ω
g_{FS}	Forward Transconductance	$V_{DS} = 30\text{ V}, I_D = 2.25\text{ A}$	--	3.6	--	S

Dynamic Characteristics

C_{iss}	Input Capacitance	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$	--	250	325	pF
C_{oss}	Output Capacitance		--	40	50	pF
C_{rss}	Reverse Transfer Capacitance		--	6	8	pF

Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 100\text{ V}, I_D = 4.5\text{ A},$ $R_G = 25\text{ }\Omega$ (Note 4, 5)	--	9	25	ns
t_r	Turn-On Rise Time		--	90	190	ns
$t_{d(off)}$	Turn-Off Delay Time		--	15	40	ns
t_f	Turn-Off Fall Time		--	50	110	ns
Q_g	Total Gate Charge	$V_{DS} = 160\text{ V}, I_D = 4.5\text{ A},$ $V_{GS} = 5\text{ V}$ (Note 4, 5)	--	4.8	6.2	nC
Q_{gs}	Gate-Source Charge		--	1.2	--	nC
Q_{gd}	Gate-Drain Charge		--	2.4	--	nC

Drain-Source Diode Characteristics and Maximum Ratings

I _S	Maximum Continuous Drain-Source Diode Forward Current		--	--	4.5	A
I _{SM}	Maximum Pulsed Drain-Source Diode Forward Current		--	--	18	A
V _{SD}	Drain-Source Diode Forward Voltage	V _{GS} = 0 V, I _S = 4.5 A	--	--	1.5	V
t _{rr}	Reverse Recovery Time	V _{GS} = 0 V, I _S = 4.5 A, (Note 4)	--	95	--	ns
Q _{rr}	Reverse Recovery Charge	dI _F / dt = 100 A/μs	--	0.3	--	μC

Notes:

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. $L = 4.44\text{ mH}, I_{AS} = 4.5\text{ A}, V_{DD} = 50\text{ V}, R_G = 25\text{ }\Omega$, Starting $T_J = 25^\circ\text{C}$
3. $I_{SD} \leq 4.5\text{ A}, di/dt \leq 300\text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$, 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

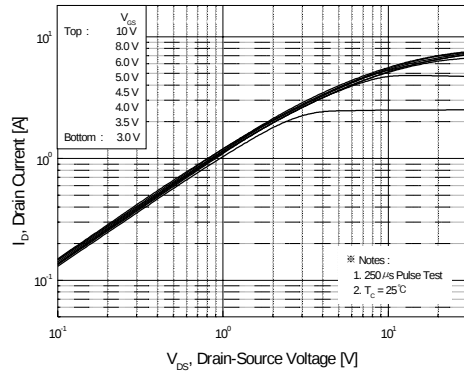


Figure 1. On-Region Characteristics

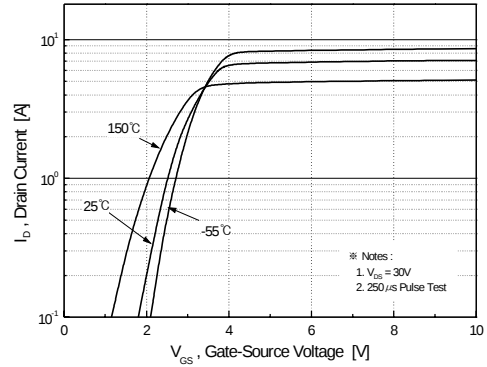


Figure 2. Transfer Characteristics

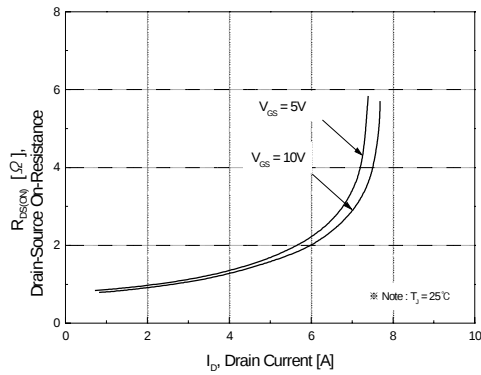


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

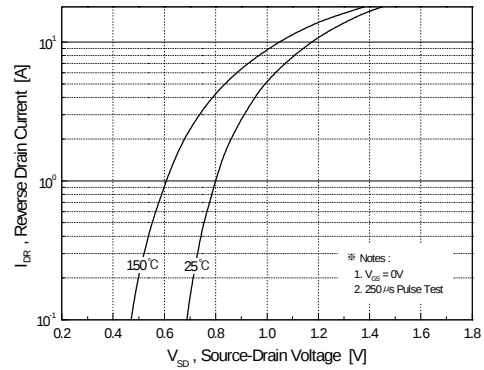


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

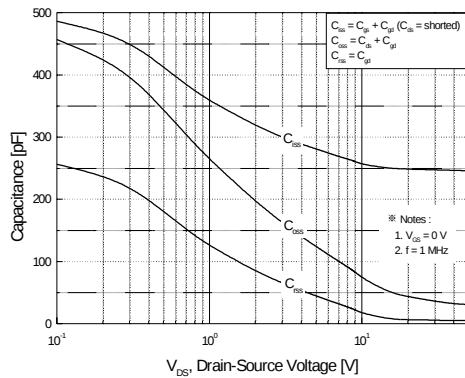


Figure 5. Capacitance Characteristics

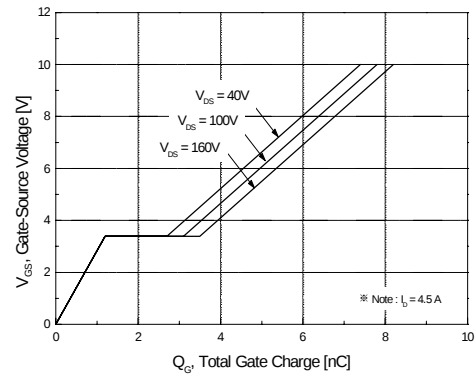


Figure 6. Gate Charge Characteristics

Typical Characteristics (Continued)

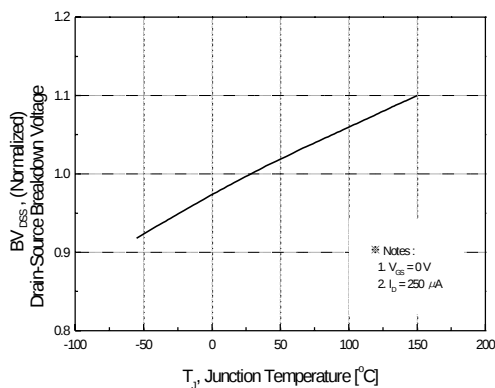


Figure 7. Breakdown Voltage Variation vs. Temperature

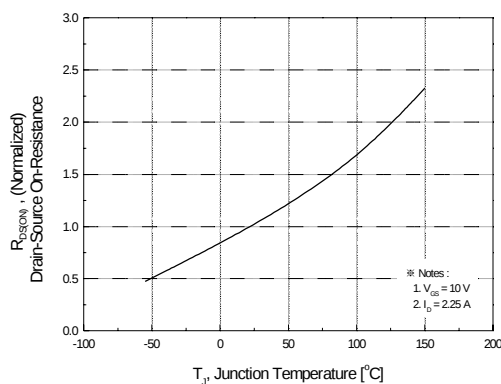


Figure 8. On-Resistance Variation vs. Temperature

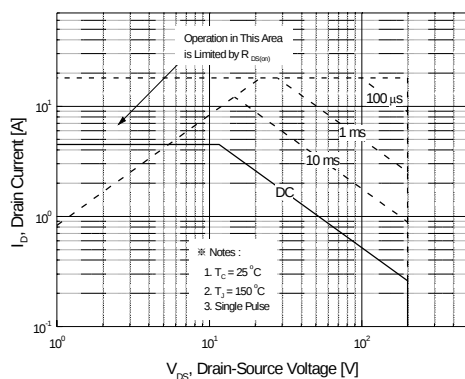


Figure 9. Maximum Safe Operating Area

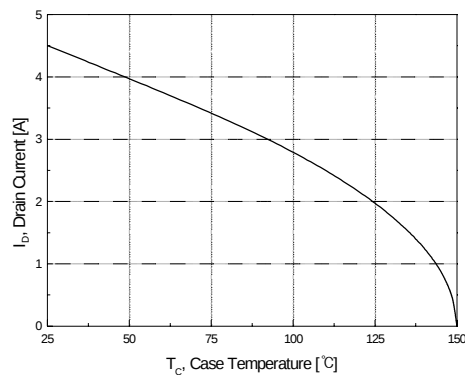


Figure 10. Maximum Drain Current vs. Case Temperature

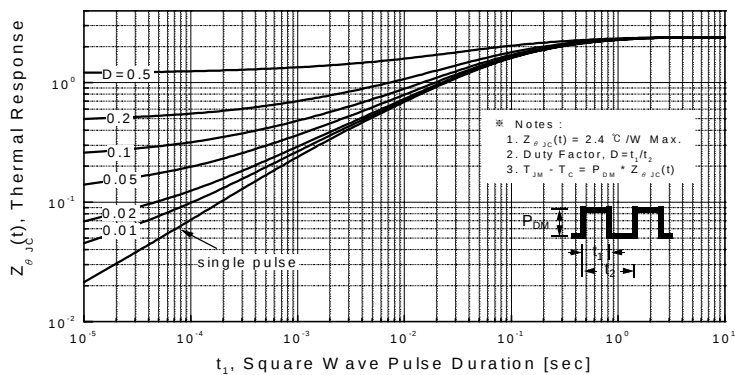
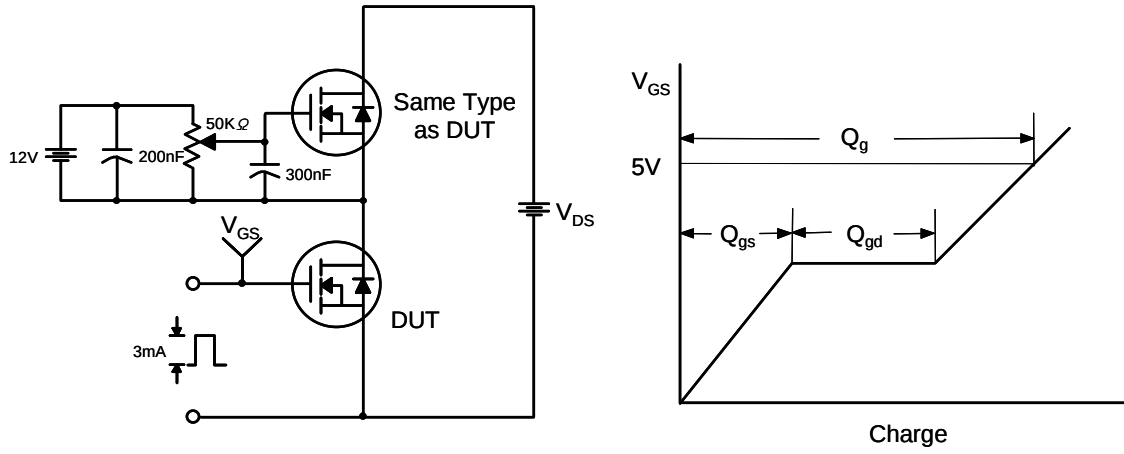
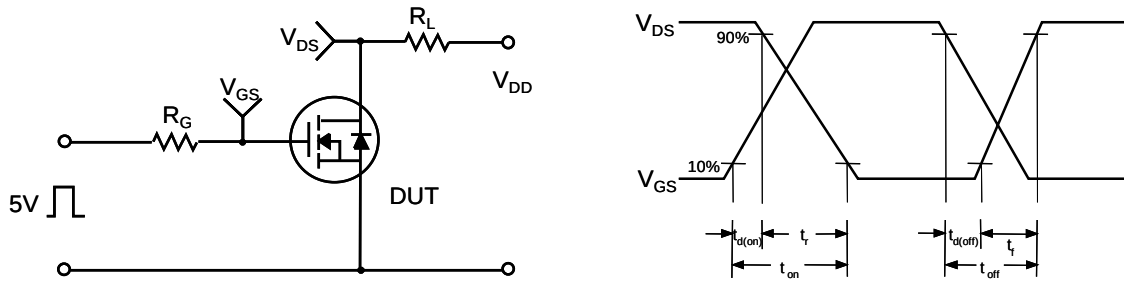


Figure 11. Transient Thermal Response Curve

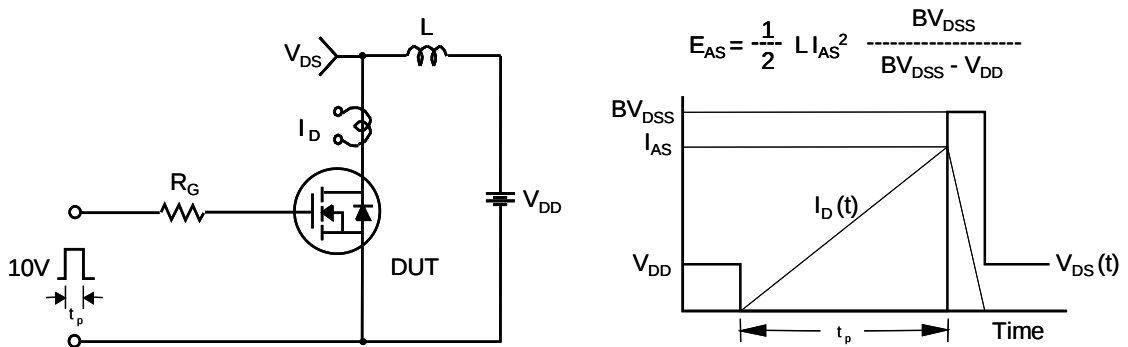
Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching Test Circuit & Waveforms



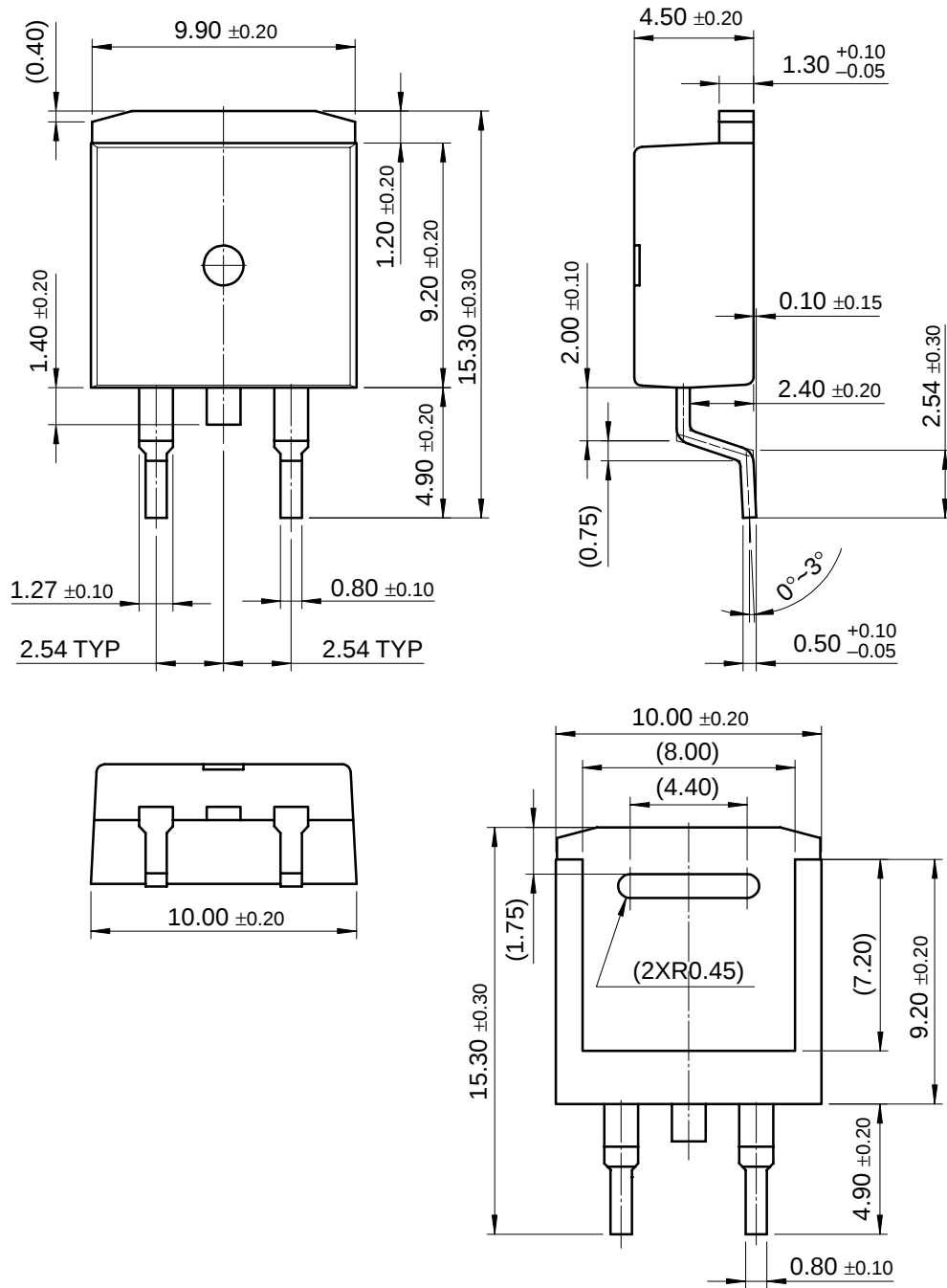
The top diagram shows a circuit for testing the body diode of a MOSFET. The DUT (Device Under Test) is a MOSFET with its gate connected to its drain. The source is connected to the source of a driver MOSFET. The driver's gate is driven by a square wave V_{GS} through a resistor R_G . The driver's drain is connected to the DUT's drain through an inductor L . The DUT's drain is connected to a DC supply V_{DD} . The DUT's source current is I_{SD} , and the drain-source voltage is V_{DS} . The driver is of the same type as the DUT.

Below the circuit, three waveforms are shown:

- 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 amplitude is 10V.
- I_{SD} (DUT):** The source current. 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 di/dt .
- V_{DS} (DUT):** The drain-source voltage. It shows a forward voltage drop V_{SD} during the pulse, followed by a recovery phase labeled dv/dt during which the voltage rises from V_{SD} to V_{DD} .

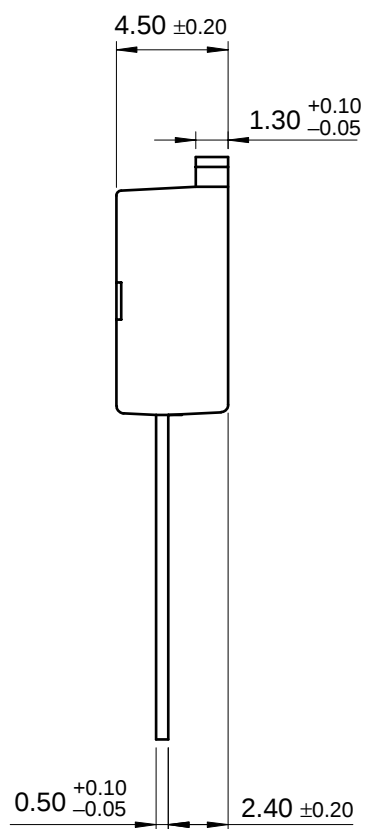
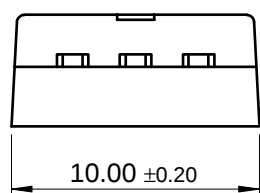
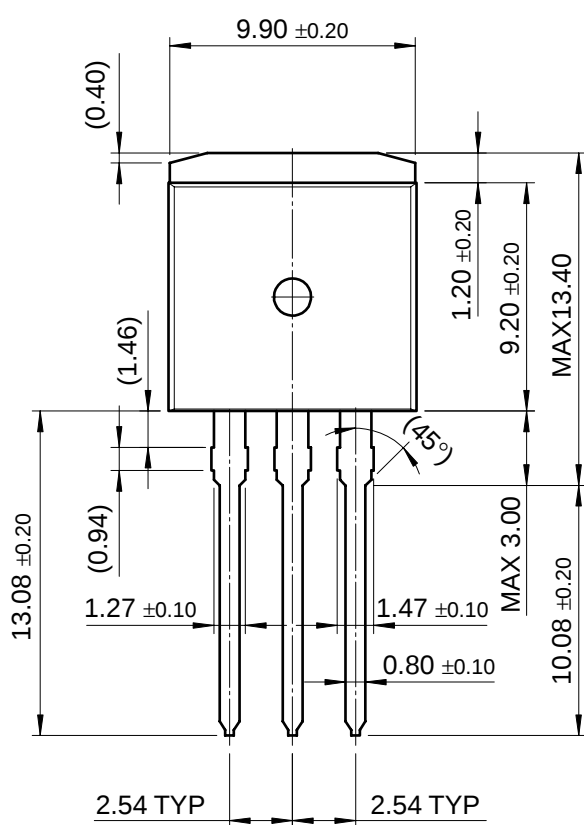
Package Dimensions

D²PAK



Package Dimensions (Continued)

I²PAK



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