

FAIRCHILD
SEMICONDUCTOR®

December 2007
UniFET™

FDA24N40F

N-Channel MOSFET, FRFET

400V, 23A, 0.19Ω

Features

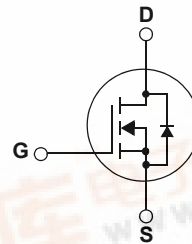
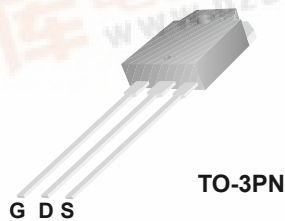
- $R_{DS(on)} = 0.15\Omega$ (Typ.) @ $V_{GS} = 10V, I_D = 11.5A$
- Low gate charge (Typ. 46nC)
- Low C_{rss} (Typ. 25pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability
- RoHS compliant



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 efficient switched mode power supplies and active power factor correction.



MOSFET Maximum Ratings $T_C = 25^\circ C$ unless otherwise noted*

Symbol	Parameter	Ratings	Units
V_{DSS}	Drain to Source Voltage	400	V
V_{GSS}	Gate to Source Voltage	± 30	V
I_D	Drain Current	-Continuous ($T_C = 25^\circ C$)	23
		-Continuous ($T_C = 100^\circ C$)	13.8
I_{DM}	Drain Current	- Pulsed (Note 1)	92
E_{AS}	Single Pulsed Avalanche Energy	(Note 2)	1190
I_{AR}	Avalanche Current	(Note 1)	23
E_{AR}	Repetitive Avalanche Energy	(Note 1)	23.5
dv/dt	Peak Diode Recovery dv/dt	(Note 3)	4.5
P_D	Power Dissipation	($T_C = 25^\circ C$)	235
		- Derate above $25^\circ C$	1.8
T_J, T_{STG}	Operating and Storage Temperature Range	-55 to +150	$^\circ C$
T_L	Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds	300	$^\circ C$

Thermal Characteristics

Symbol	Parameter	Min.	Max.	Units
$R_{\theta JC}$	Thermal Resistance, Junction to Case	-	0.53	$^\circ C/W$
$R_{\theta CS}$	Thermal Resistance, Case to Sink Typ.	0.24	-	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	-	40	

FDA24N40F N-Channel MOSFET



Package Marking and Ordering Information $T_C = 25^\circ\text{C}$ unless otherwise noted

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FDA24N40F	FDA24N40F	TO-3PN	-	-	30

Electrical Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
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Off Characteristics

BV_{DSS}	Drain to Source Breakdown Voltage	$I_D = 250\mu\text{A}, V_{GS} = 0\text{V}, T_J = 25^\circ\text{C}$	400	-	-	V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250\mu\text{A}$, Referenced to 25°C	-	0.5	-	V/ $^\circ\text{C}$
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 400\text{V}, V_{GS} = 0\text{V}$ $V_{DS} = 320\text{V}, T_C = 125^\circ\text{C}$	-	-	10 100	μA
I_{GSS}	Gate to Body Leakage Current	$V_{GS} = \pm 30\text{V}, V_{DS} = 0\text{V}$	-	-	± 100	nA

On Characteristics

$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 250\mu\text{A}$	3.0	-	5.0	V
$R_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10\text{V}, I_D = 11.5\text{A}$	-	0.15	0.19	Ω
g_{FS}	Forward Transconductance	$V_{DS} = 20\text{V}, I_D = 11.5\text{A}$ (Note 4)	-	29	-	S

Dynamic Characteristics

C_{iss}	Input Capacitance	$V_{DS} = 25\text{V}, V_{GS} = 0\text{V}$ $f = 1\text{MHz}$	-	2280	3030	pF
C_{oss}	Output Capacitance		-	370	490	pF
C_{rss}	Reverse Transfer Capacitance		-	25	38	pF
$Q_{g(tot)}$	Total Gate Charge at 10V	$V_{DS} = 320\text{V}$ $I_D = 23\text{A}$ (Note 4, 5)	-	46	60	nC
Q_{gs}	Gate to Source Gate Charge		-	13	-	nC
Q_{gd}	Gate to Drain "Miller" Charge		-	18	-	nC

Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DS} = 200\text{V}, I_D = 23\text{A}$ $R_G = 25\Omega$ (Note 4, 5)	-	40	90	ns
t_r	Turn-On Rise Time		-	92	195	ns
$t_{d(off)}$	Turn-Off Delay Time		-	120	250	ns
t_f	Turn-Off Fall Time		-	75	160	ns

Drain-Source Diode Characteristics

I_S	Maximum Continuous Drain to Source Diode Forward Current	-	-	23	A	
I_{SM}	Maximum Pulsed Drain to Source Diode Forward Current	-	-	92	A	
V_{SD}	Drain to Source Diode Forward Voltage	$V_{GS} = 0\text{V}, I_{SD} = 23\text{A}$	-	-	1.5	V
t_{rr}	Reverse Recovery Time	$V_{GS} = 0\text{V}, I_{SD} = 23\text{A}$	-	110	-	ns
Q_{rr}	Reverse Recovery Charge	$dI_F/dt = 100\text{A}/\mu\text{s}$ (Note 4)	-	0.3	-	μC

Notes:

- 1: Repetitive Rating: Pulse width limited by maximum junction temperature
- 2: $L = 4.5\text{mH}, I_{AS} = 23\text{A}, V_{DD} = 50\text{V}, R_G = 25\Omega$, Starting $T_J = 25^\circ\text{C}$
- 3: $I_{SD} \leq 23\text{A}, di/dt \leq 200\text{A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$, 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

Typical Performance Characteristics

Figure 1. On-Region Characteristics

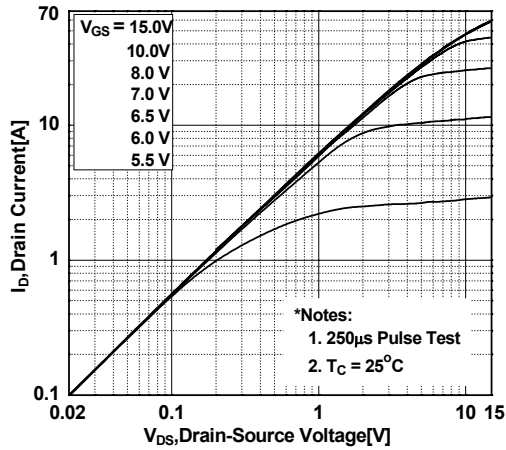


Figure 2. Transfer Characteristics

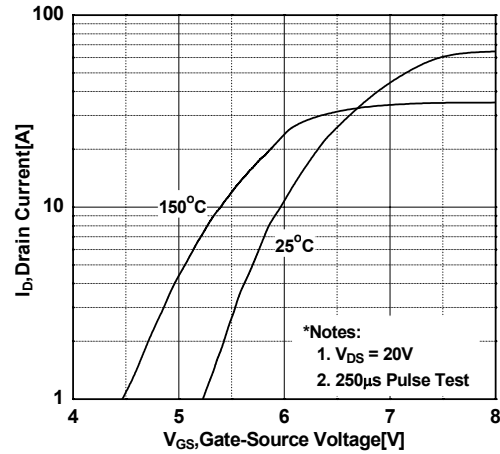


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

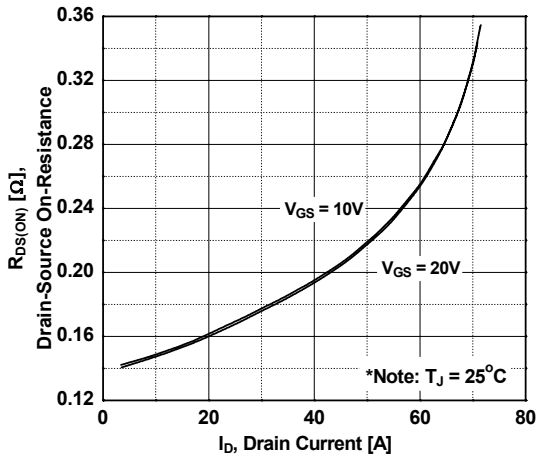


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

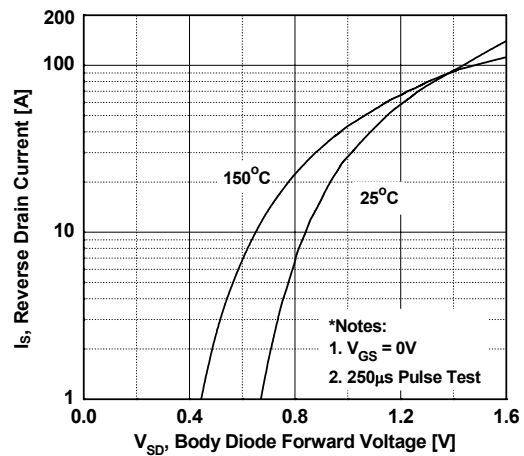


Figure 5. Capacitance Characteristics

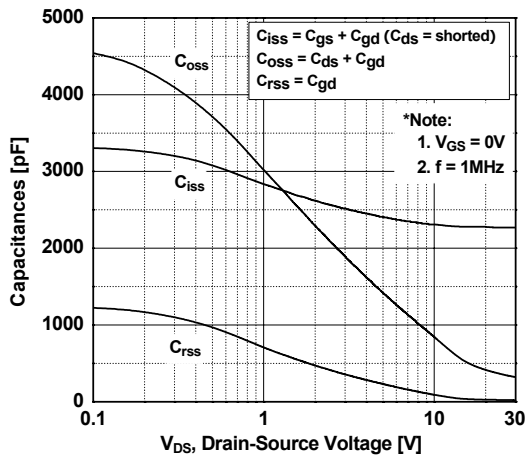
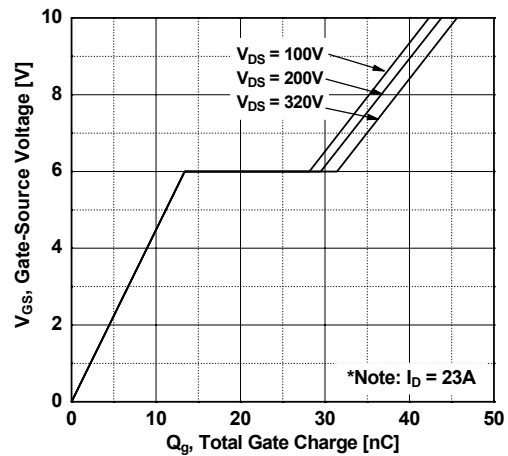


Figure 6. Gate Charge Characteristics



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

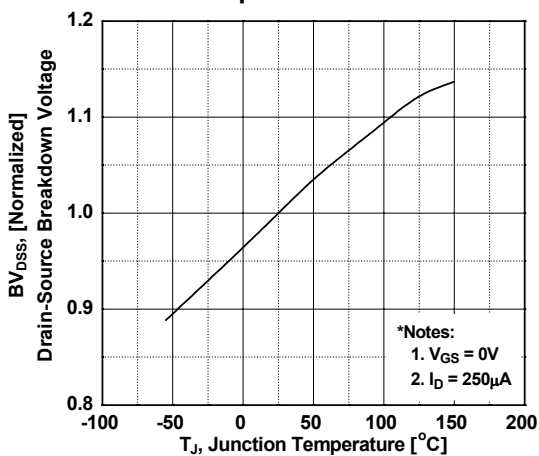


Figure 8. Maximum Safe Operating Area vs. Temperature

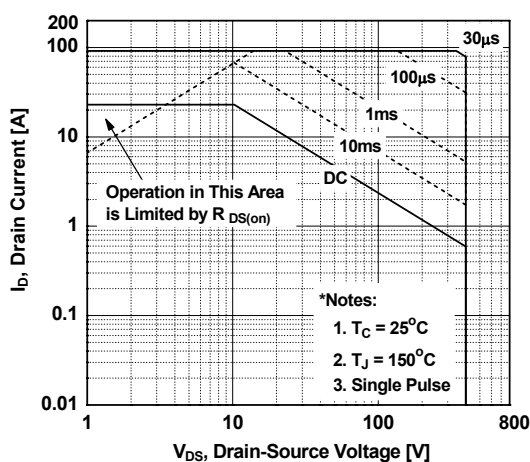


Figure 9. Maximum Drain Current vs. Case Temperature

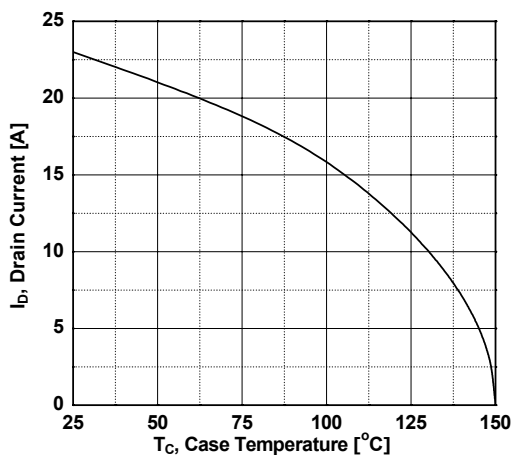
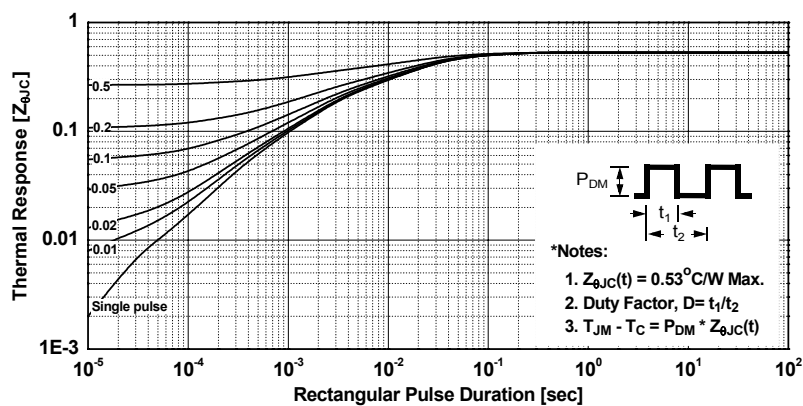
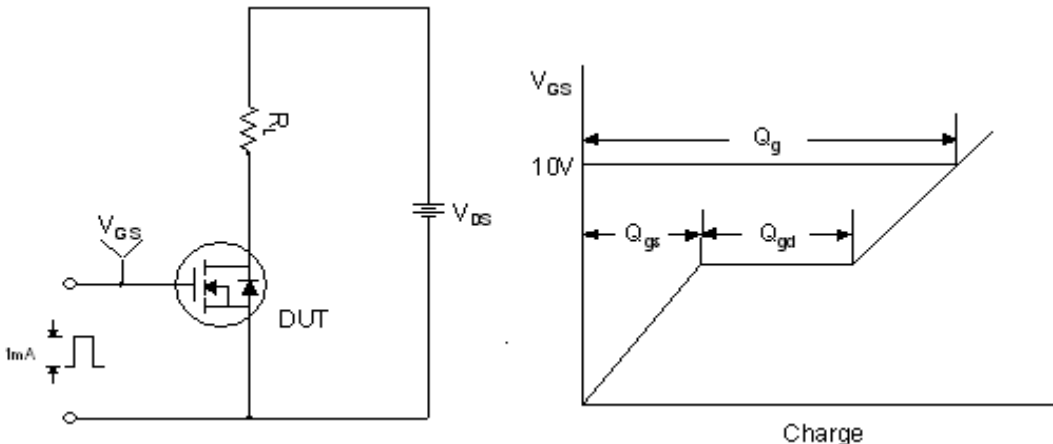


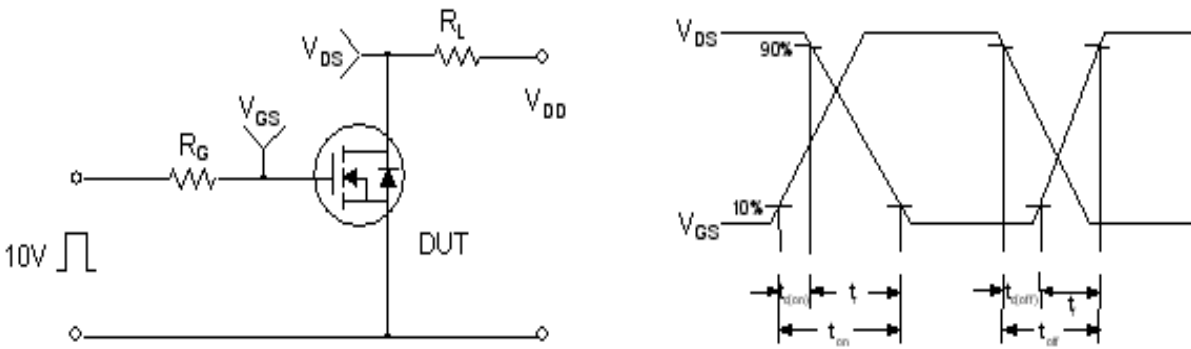
Figure 10. Transient Thermal Response Curve



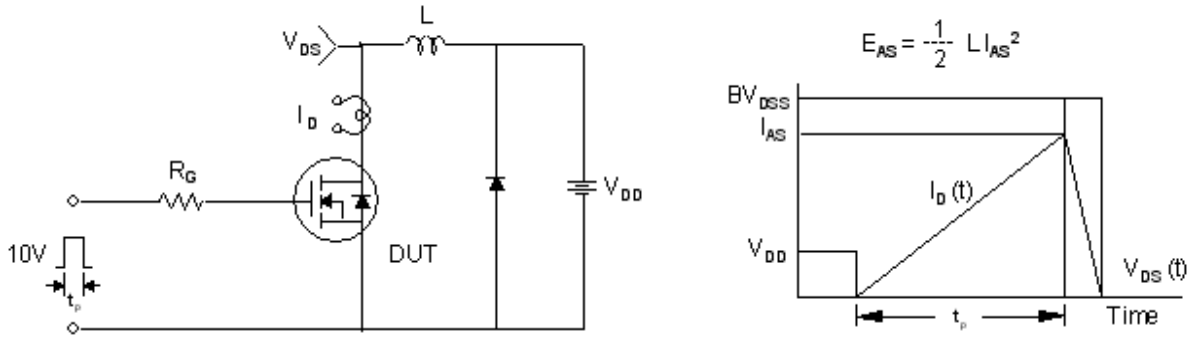
Gate Charge Test Circuit & Waveform



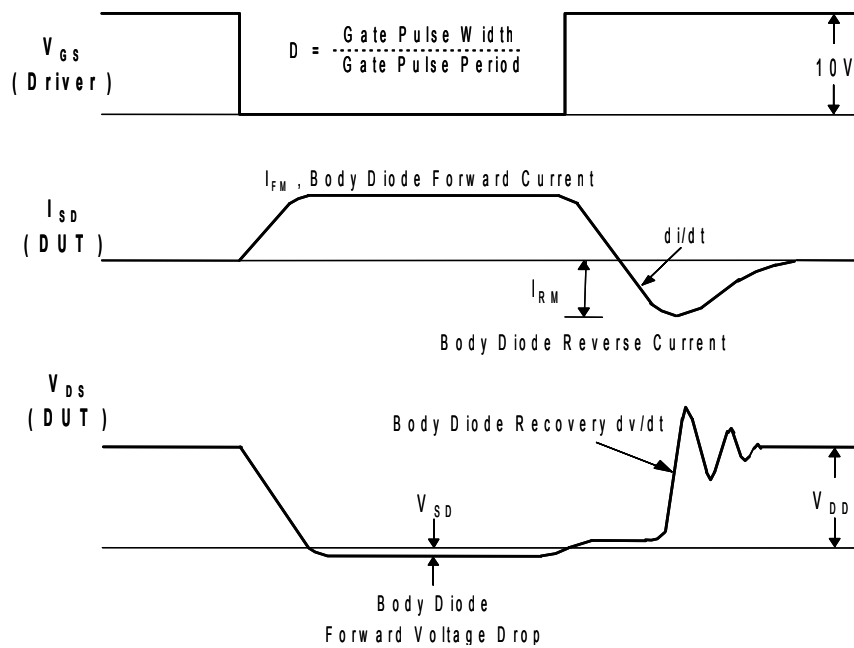
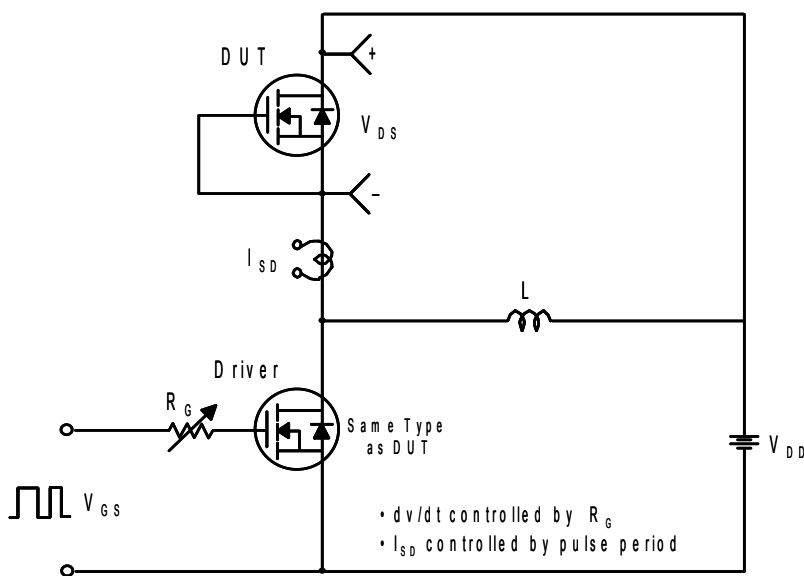
Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching Test Circuit & Waveforms

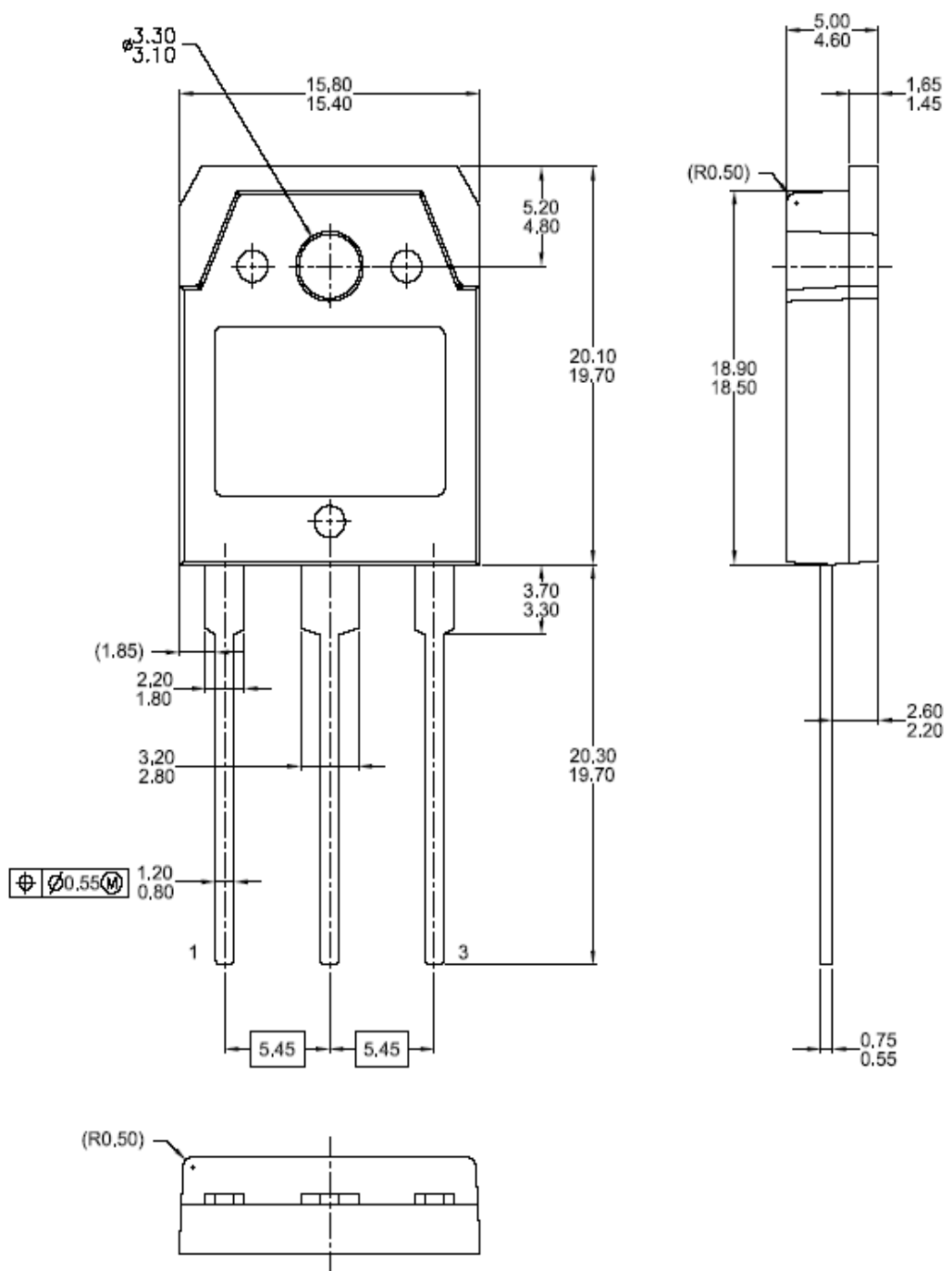


Peak Diode Recovery dv/dt Test Circuit & Waveforms



Mechanical Dimensions

TO-3PN






Dimensions in Millimeters



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