FAIRCHILD
SEMICONDUCTOR®

October 2007
UniFET™

FDA20N50F
N-Channel MOSFET
### 500V, 22A, 0.26Ω

Features

- $R_{DS(on)} = 0.22\Omega$ (Typ.) @ $V_{GS} = 10V$, $I_D = 11A$
- Low gate charge (Typ. 50nC)
- Low C_{rss} (Typ. 27pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability
- RoHS compliant

100% LEAD-FREE IMPLEMENTATION

Description

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

This advance 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 device are well suited for high efficient switched mode power supplies and active power factor correction.

TO-3PN

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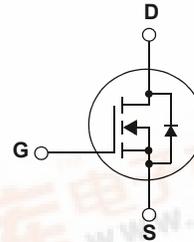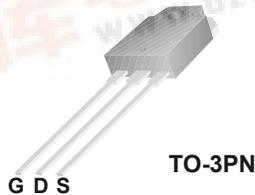
MOSFET Maximum Ratings $T_C = 25^oC$ unless otherwise noted*

Symbol	Parameter			Ratings	Units
V_{DSS}	Drain to Source Voltage			500	V
V_{GSS}	Gate to Source Voltage			±30	V
I_D	Drain Current	-Continuous ($T_C = 25^oC$)		22	A
		-Continuous ($T_C = 100^oC$)		13	
I_{DM}	Drain Current	- Pulsed	(Note 1)	88	A
E_{AS}	Single Pulsed Avalanche Energy		(Note 2)	1110	mJ
I_{AR}	Avalanche Current		(Note 1)	22	A
E_{AR}	Repetitive Avalanche Energy		(Note 1)	39	mJ
dv/dt	Peak Diode Recovery dv/dt		(Note 3)	4.5	V/ns
P_D	Power Dissipation	($T_C = 25^oC$)		388	W
		- Derate above 25^oC		3.1	W/^oC
T_J, T_{STG}	Operating and Storage Temperature Range			-55 to +150	^oC
T_L	Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds			300	^oC

Thermal Characteristics

Symbol	Parameter	Min.	Max.	Units
$R_{\theta JC}$	Thermal Resistance, Junction to Case	-	0.44	
$R_{\theta CS}$	Thermal Resistance, Case to Sink	0.24	-	$^oC/W$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	-	40	

Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FDA20N50F	FDA20N50F	TO-3PN	-	-	30

Electrical Characteristics T_C = 25°C unless otherwise noted

| Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
Off Characteristics						
BV_{DSS}	Drain to Source Breakdown Voltage	I_D = 250μA, V_{GS} = 0V, T_J = 25°C	500	-	-	V
ΔBV_{DSS} / ΔT_J	Breakdown Voltage Temperature Coefficient	I_D = 250μA, Referenced to 25°C	-	0.6	-	V/^{o}C
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 500V, V_{GS} = 0V	-	-	10	μA
		V_{DS} = 400V, T_C = 125°C	-	-	100	
I_{GSS}	Gate to Body Leakage Current	V_{GS} = ±30V, V_{DS} = 0V	-	-	±100	nA
On Characteristics						
$V_{GS(th)}$	Gate Threshold Voltage	V_{GS} = V_{DS}, I_D = 250μA	3.0	-	5.0	V
$R_{DS(on)}$	Static Drain to Source On Resistance	V_{GS} = 10V, I_D = 11A	-	0.22	0.26	Ω
g_{FS}	Forward Transconductance	V_{DS} = 40V, I_D = 11A (Note 4)	-	24	-	S
Dynamic Characteristics						
C_{iss}	Input Capacitance	V_{DS} = 25V, V_{GS} = 0V f = 1MHz	-	2550	3390	pF
C_{oss}	Output Capacitance		-	350	465	pF
C_{rss}	Reverse Transfer Capacitance		-	27	40	pF
$Q_{g(tot)}$	Total Gate Charge at 10V	V_{DS} = 400V, I_D = 20A V_{GS} = 10V	-	50	65	nC
Q_{gs}	Gate to Source Gate Charge		-	14	-	nC
Q_{gd}	Gate to Drain "Miller" Charge	(Note 4, 5)	-	20	-	nC
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	V_{DD} = 250V, I_D = 20A R_G = 25Ω	-	45	100	ns
t_r	Turn-On Rise Time		-	120	250	ns
$t_{d(off)}$	Turn-Off Delay Time		-	100	210	ns
t_f	Turn-Off Fall Time	(Note 4, 5)	-	60	130	ns
Drain-Source Diode Characteristics						
I_S	Maximum Continuous Drain to Source Diode Forward Current		-	-	22	A
I_{SM}	Maximum Pulsed Drain to Source Diode Forward Current		-	-	88	A
V_{SD}	Drain to Source Diode Forward Voltage	V_{GS} = 0V, I_{SD} = 22A	-	-	1.5	V
t_{rr}	Reverse Recovery Time	V_{GS} = 0V, I_{SD} = 20A	-	154	-	ns
Q_{rr}	Reverse Recovery Charge	dI_F/dt = 100A/μs (Note 4)	-	0.5	-	μC

Notes:
1: Repetitive Rating: Pulse width limited by maximum junction temperature
2: L = 5mH, I_{AS} = 20A, V_{DD} = 50V, R_G = 25Ω, Starting T_J = 25°C
3: $I_{SD} \le$ 22A, di/dt $\le$ 200A/μs, $V_{DD} \le BV_{DSS}$, Starting T_J = 25°C
4: Pulse Test: Pulse width $\le$ 300μs, Duty Cycle $\le$ 2%
5: Essentially Independent of Operating Temperature Typical Characteristics

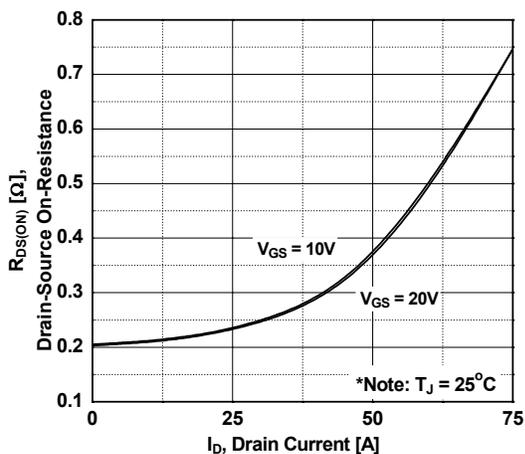FDA20N50F Rev. A

Typical Performance Characteristics
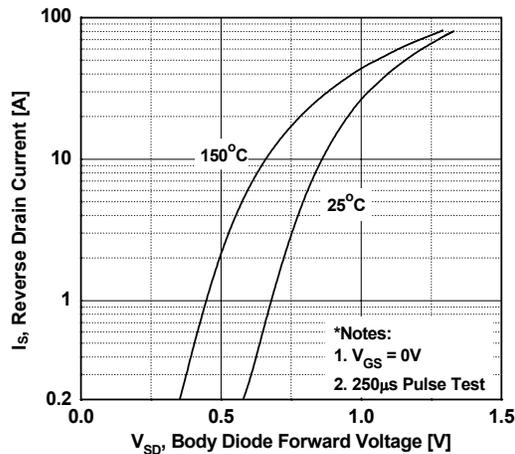
Figure 1. On-Region Characteristics
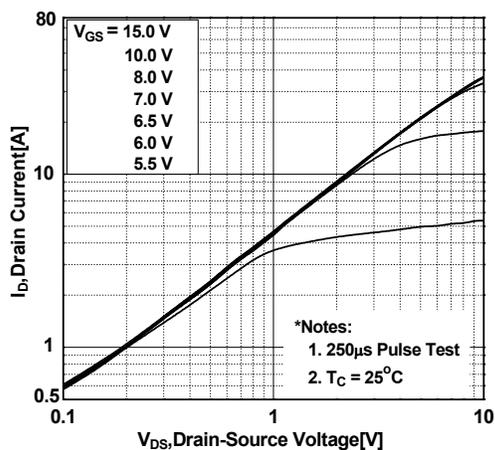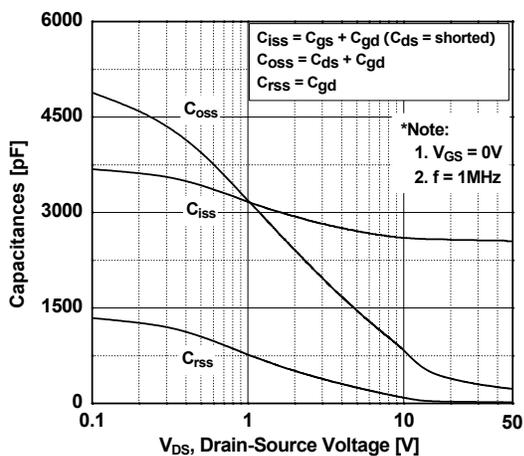

Figure 2. Transfer Characteristics
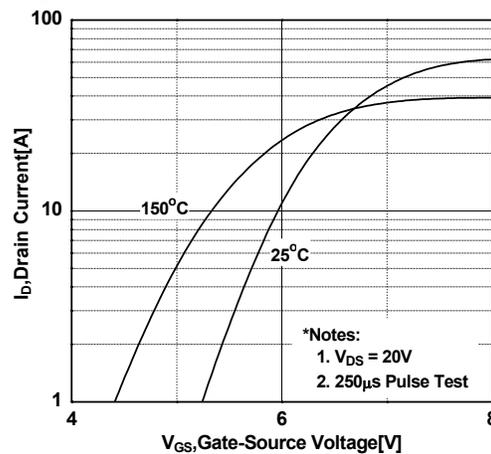
Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

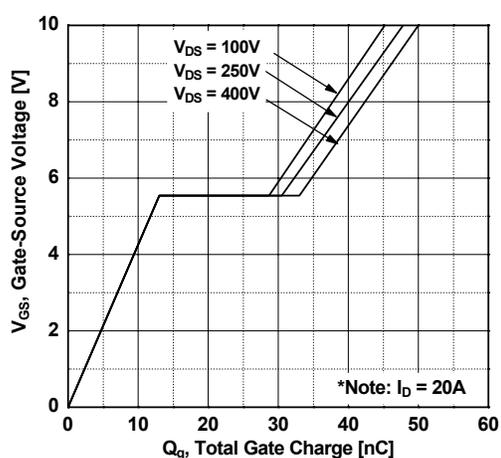### Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature
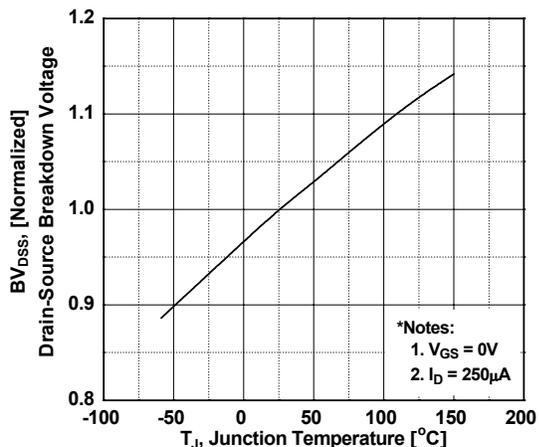

Figure 5. Capacitance Characteristics
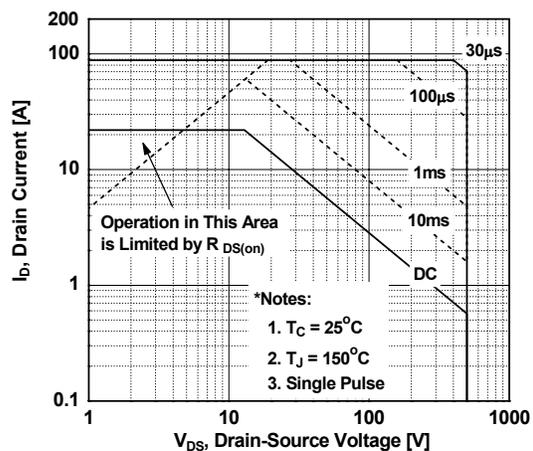

Figure 6. Gate Charge Characteristics
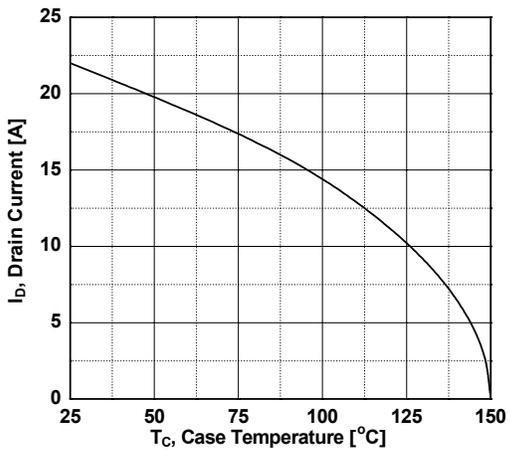
Typical Performance Characteristics (Continued)

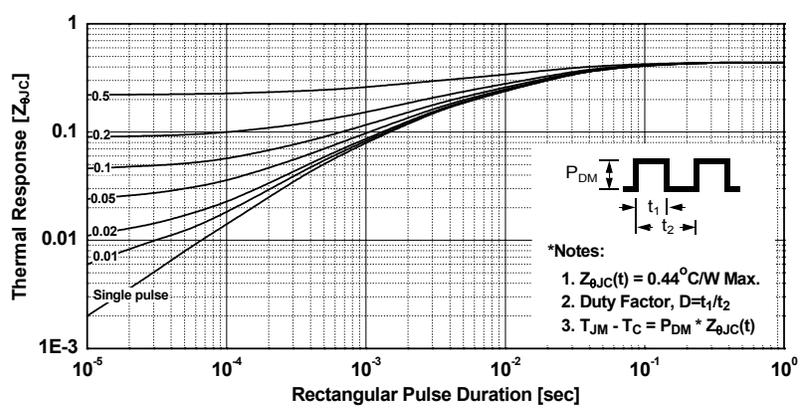### Figure 7. Breakdown Voltage Variation vs. Temperature

*Notes:
1. $V_{GS} = 0V$
2. $I_D = 250\mu A$

Figure 8. Maximum Safe Operating Area

Operation in This Area is Limited by $R_{DS(on)}$
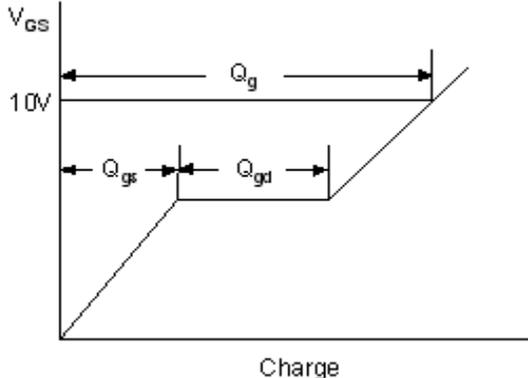
*Notes:
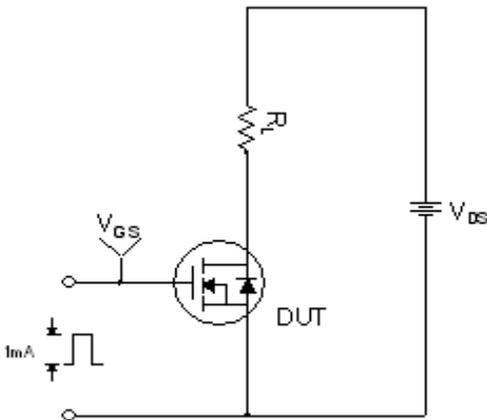1. $T_C = 25^oC$
2. $T_J = 150^oC$
3. Single Pulse

Figure 9. Maximum Drain Current vs. Case Temperature

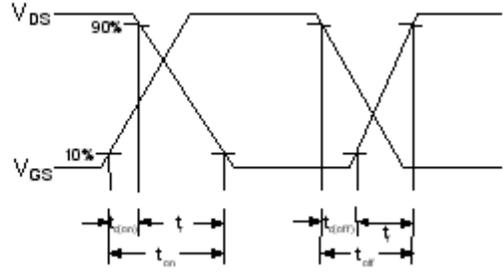### Figure 10. Transient Thermal Response Curve

*Notes:
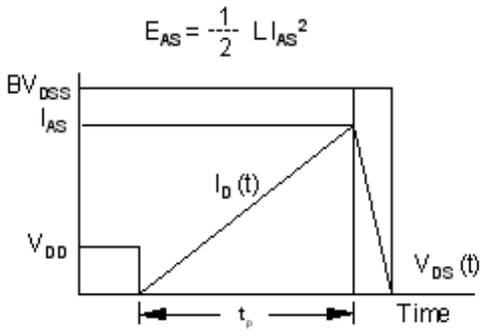1. $Z_{\theta JC}(t) = 0.44^oC/W$ Max.
2. Duty Factor, $D=t_1/t_2$
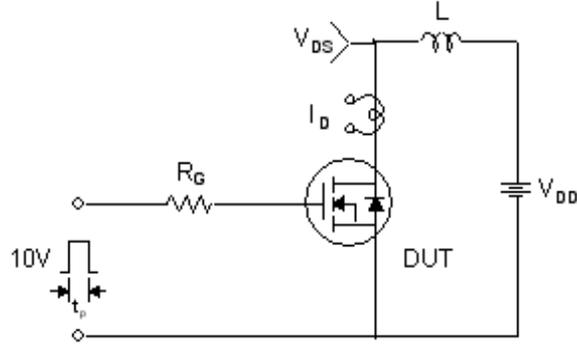3. $T_{JM} - T_C = P_{DM} * Z_{\theta JC}(t)$

Gate Charge Test Circuit & Waveform

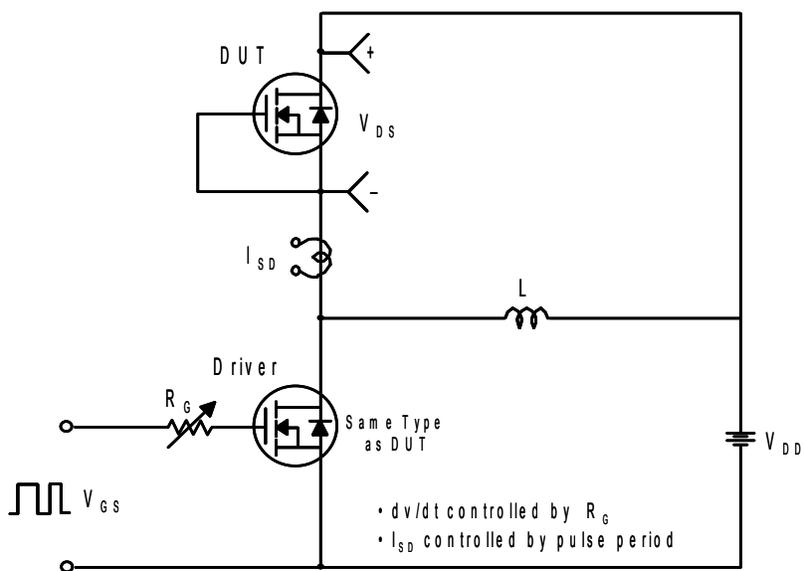## Resistive Switching Test Circuit & Waveforms
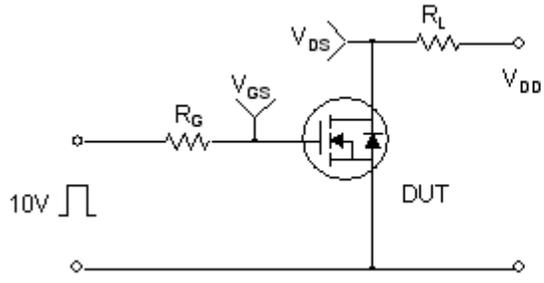
Unclamped Inductive Switching Test Circuit & Waveforms

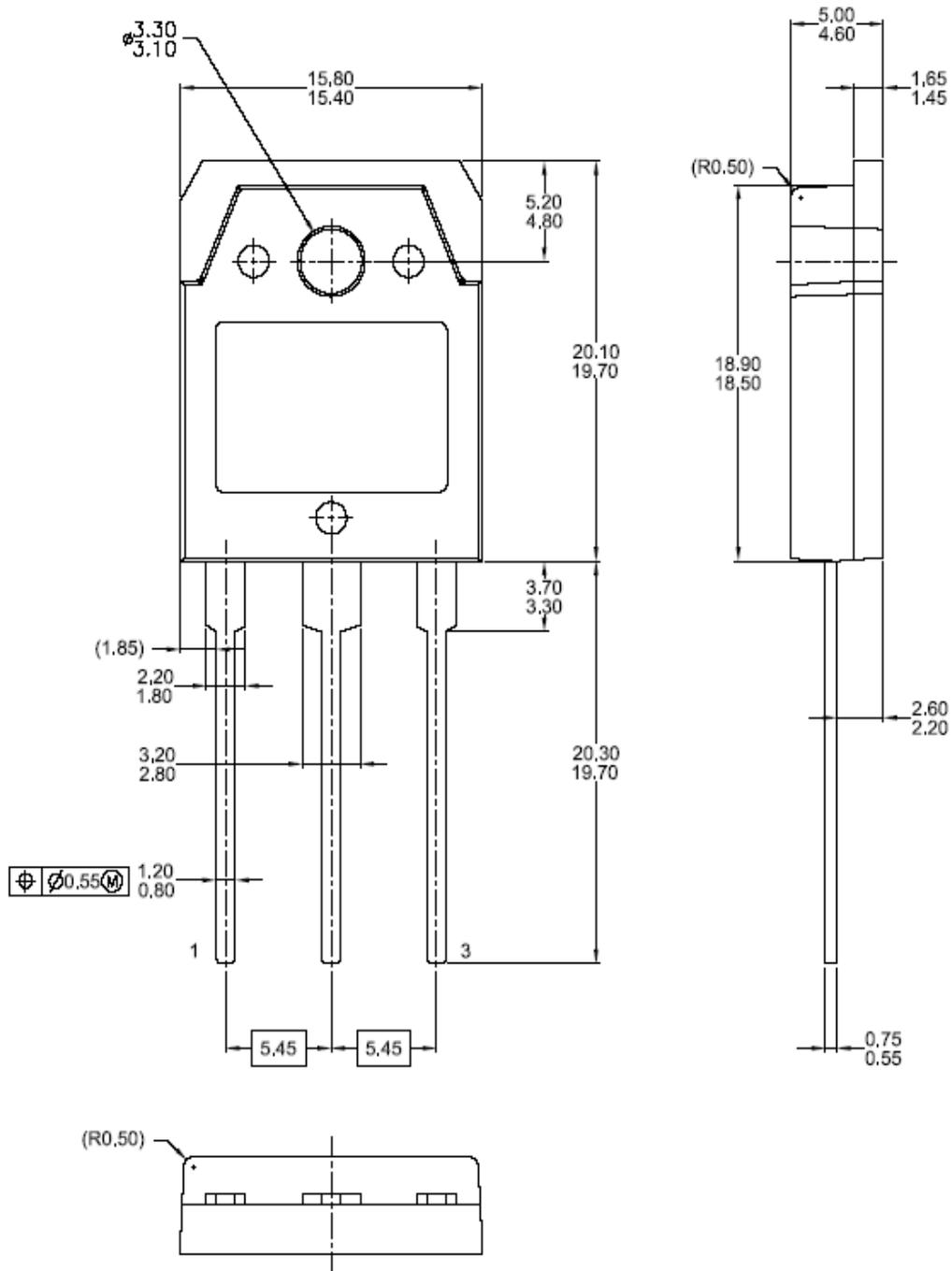$$E_{AS} = \frac{1}{2} L I_{AS}^2$$

Peak Diode Recovery dv/dt Test Circuit & Waveforms

$$D = \frac{Gate\ Pulse\ Width}{Gate\ Pulse\ Period}$$

- dv/dt controlled by R_G
- I_{SD} controlled by pulse period
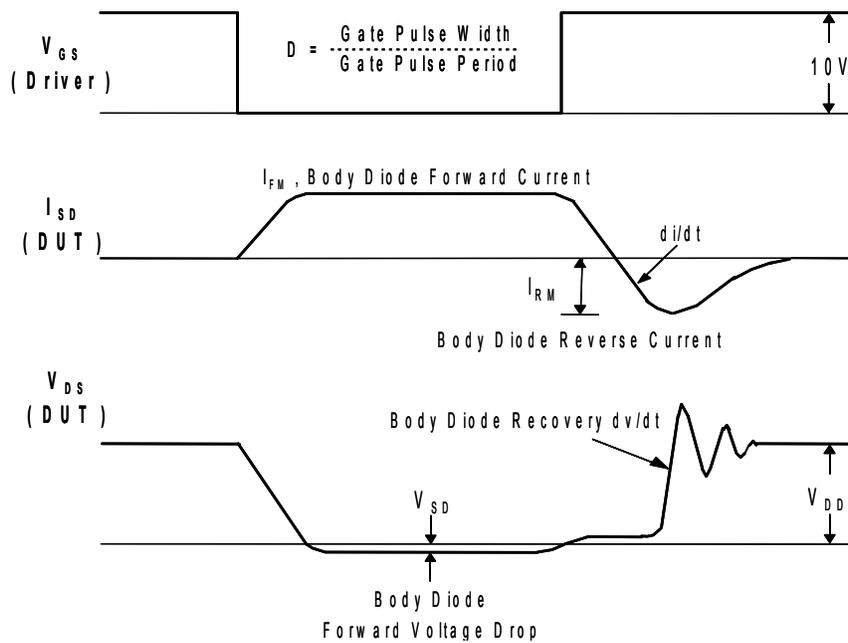
Mechanical Dimensions

TO-3PN

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