

# FDA24N50F

## N-Channel UniFET™ FRFET® MOSFET

500 V, 24 A, 200 mΩ

### Features

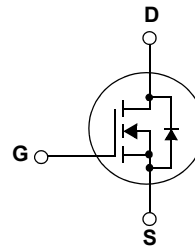
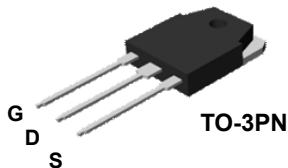
- $R_{DS(on)} = 166 \text{ m}\Omega$  (Typ.) @  $V_{GS} = 10 \text{ V}$ ,  $I_D = 12 \text{ A}$
- Low Gate Charge (Typ. 65 nC)
- Low  $C_{rss}$  (Typ. 32 pF)
- 100% Avalanche Tested
- Improved dv/dt Capability
- RoHS Compliant

### Applications

- PDP TV
- Uninterruptible Power Supply
- AC-DC Power Supply

### Description

UniFET™ MOSFET is Fairchild Semiconductor®'s high voltage MOSFET family based on planar stripe and DMOS technology. This MOSFET is tailored to reduce on-state resistance, and to provide better switching performance and higher avalanche energy strength. The body diode's reverse recovery performance of UniFET FRFET® MOSFET has been enhanced by lifetime control. Its  $t_{rr}$  is less than 100nsec and the reverse dv/dt immunity is 15V/ns while normal planar MOSFETs have over 200nsec and 4.5V/nsec respectively. Therefore, it can remove additional component and improve system reliability in certain applications in which the performance of MOSFET's body diode is significant. This device family is suitable for switching power converter applications such as power factor correction (PFC), flat panel display (FPD) TV power, ATX and electronic lamp ballasts.



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

Symbol	Parameter	FDA24N50F	Unit
$V_{DSS}$	Drain to Source Voltage	500	V
$V_{GSS}$	Gate to Source Voltage	$\pm 30$	V
$I_D$	Drain Current	- Continuous ( $T_C = 25^\circ\text{C}$ )	24
		- Continuous ( $T_C = 100^\circ\text{C}$ )	14
$I_{DM}$	Drain Current	- Pulsed (Note 1)	96
$E_{AS}$	Single Pulsed Avalanche Energy	(Note 2)	1872
$I_{AR}$	Avalanche Current	(Note 1)	24
$E_{AR}$	Repetitive Avalanche Energy	(Note 1)	27
dv/dt	Peak Diode Recovery dv/dt	(Note 3)	20
$P_D$	Power Dissipation	( $T_C = 25^\circ\text{C}$ )	270
		- Derate above $25^\circ\text{C}$	2.2
$T_J, T_{STG}$	Operating and Storage Temperature Range	-55 to +150	$^\circ\text{C}$
$T_L$	Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds	300	$^\circ\text{C}$

### Thermal Characteristics

Symbol	Parameter	FDA24N50F	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	0.46	$^\circ\text{C}/\text{W}$
$R_{\theta CS}$	Thermal Resistance, Case to Sink, Typ.	0.24	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	40	

## Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FDA24N50F	FDA24N50F	TO-3PN	-	-	30

## Electrical Characteristics $T_C = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
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### Off Characteristics

$BV_{DSS}$	Drain to Source Breakdown Voltage	$I_D = 250\mu\text{A}, V_{GS} = 0\text{V}, T_J = 25^\circ\text{C}$	500	-	-	V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250\mu\text{A}$ , Referenced to $25^\circ\text{C}$	-	0.6	-	$V/^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 500\text{V}, V_{GS} = 0\text{V}$	-	-	1	$\mu\text{A}$
		$V_{DS} = 400\text{V}, T_C = 125^\circ\text{C}$	-	-	10	
$I_{GSS}$	Gate to Body Leakage Current	$V_{GS} = \pm 30\text{V}, V_{DS} = 0\text{V}$	-	-	$\pm 100$	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	$V_{GS} = 10\text{V}, I_D = 12\text{A}$	-	0.166	0.2	$\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 20\text{V}, I_D = 12\text{A}$	-	30	-	S

### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = 25\text{V}, V_{GS} = 0\text{V}$ $f = 1\text{MHz}$	-	3240	4310	pF
$C_{oss}$	Output Capacitance		-	450	600	pF
$C_{rss}$	Reverse Transfer Capacitance		-	32	48	pF
$Q_{g(tot)}$	Total Gate Charge at 10V	$V_{DS} = 400\text{V}, I_D = 24\text{A}$ $V_{GS} = 10\text{V}$	-	65	85	nC
$Q_{gs}$	Gate to Source Gate Charge		-	18	-	nC
$Q_{gd}$	Gate to Drain "Miller" Charge		-	26	-	nC

(Note 4.)

### Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 250\text{V}, I_D = 24\text{A}$ $R_G = 25\Omega$	-	49	108	ns
$t_r$	Turn-On Rise Time		-	105	220	ns
$t_{d(off)}$	Turn-Off Delay Time		-	165	340	ns
$t_f$	Turn-Off Fall Time		-	87	185	ns

(Note 4)

### Drain-Source Diode Characteristics

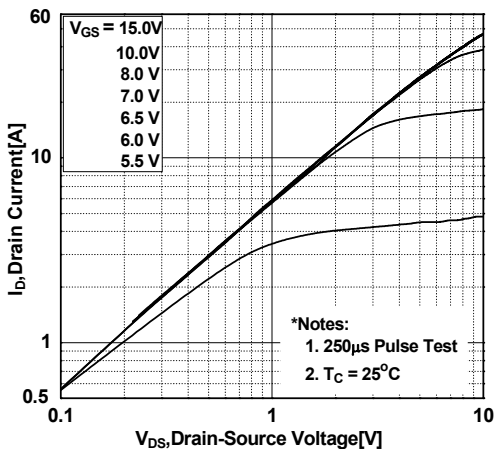
$I_S$	Maximum Continuous Drain to Source Diode Forward Current	-	-	24	A	
$I_{SM}$	Maximum Pulsed Drain to Source Diode Forward Current	-	-	96	A	
$V_{SD}$	Drain to Source Diode Forward Voltage	$V_{GS} = 0\text{V}, I_{SD} = 24\text{A}$	-	-	1.4	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0\text{V}, I_{SD} = 24\text{A}$	-	264	-	ns
$Q_{rr}$	Reverse Recovery Charge	$di_F/dt = 100\text{A}/\mu\text{s}$	-	1.4	-	$\mu\text{C}$

#### Notes:

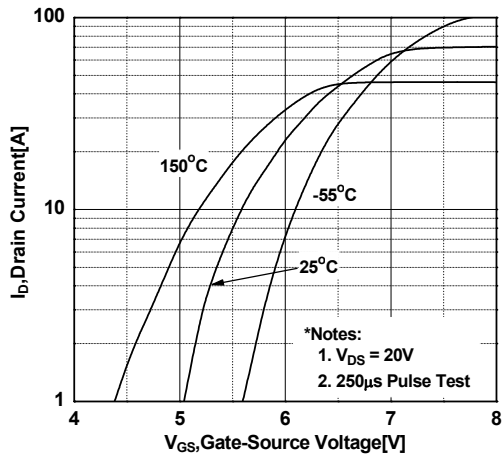
1. Repetitive Rating: Pulse width limited by maximum junction temperature
2.  $L = 6.5\text{mH}, I_{AS} = 24\text{A}, V_{DD} = 50\text{V}, R_G = 25\Omega$ , Starting  $T_J = 25^\circ\text{C}$
3.  $I_{SD} \leq 24\text{A}, di/dt \leq 200\text{A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$
4. Essentially Independent of Operating Temperature Typical Characteristics

## Typical Performance Characteristics

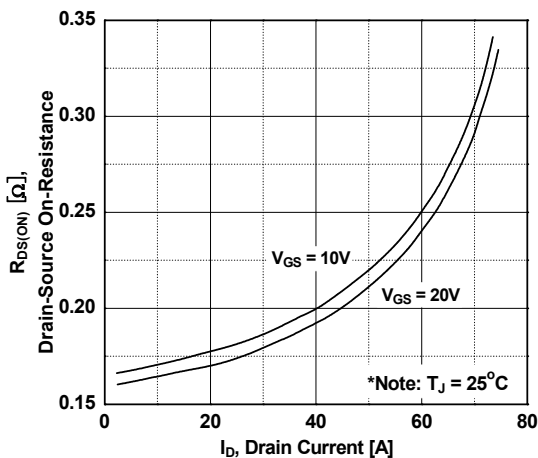
**Figure 1. On-Region Characteristics**



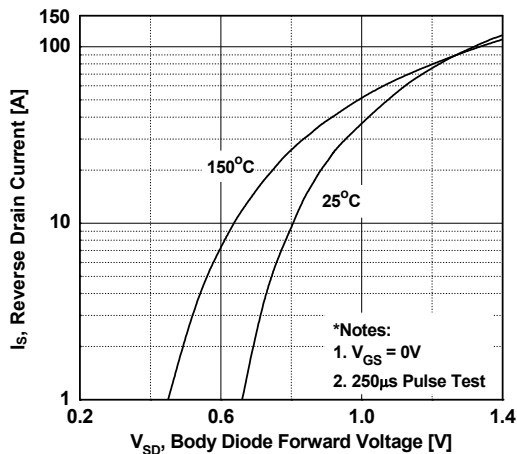
**Figure 2. Transfer Characteristics**



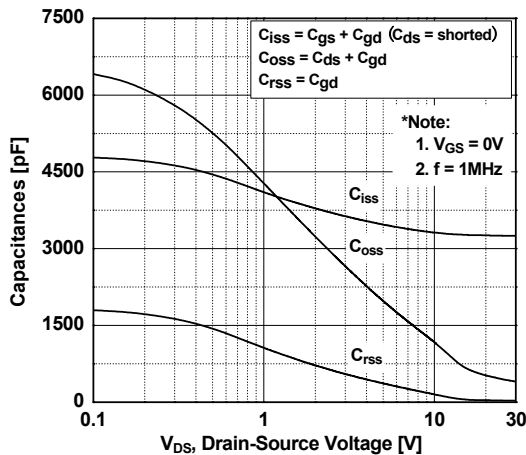
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



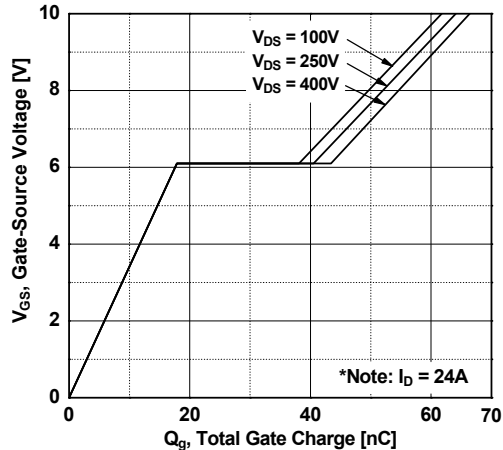
**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**



**Figure 5. Capacitance Characteristics**



**Figure 6. Gate Charge Characteristics**



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

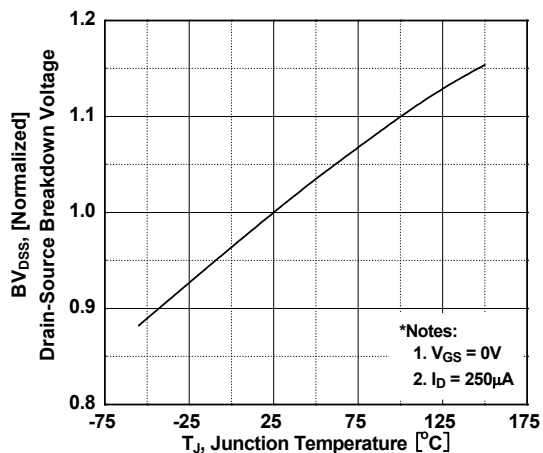


Figure 8. On-Resistance Variation vs. Temperature

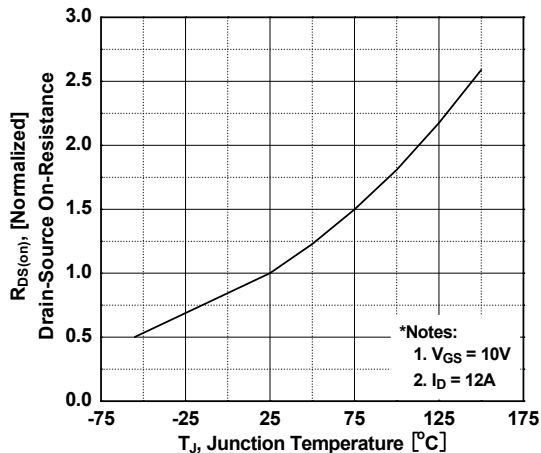


Figure 9. Maximum Safe Operating Area

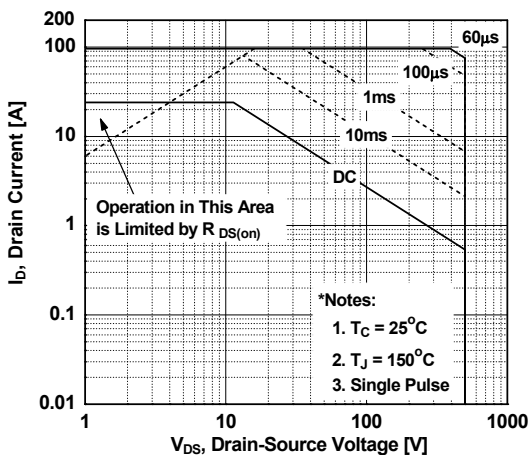


Figure 10. Maximum Drain Current vs. Case Temperature

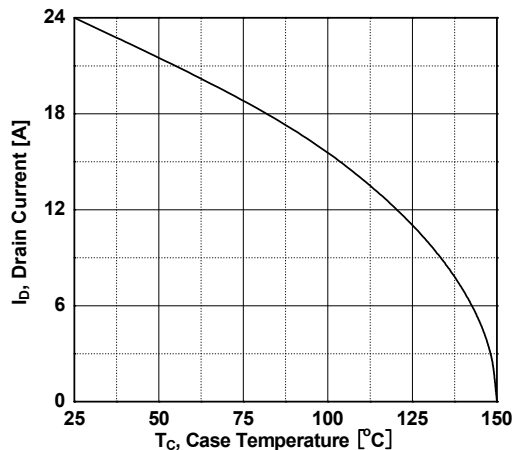
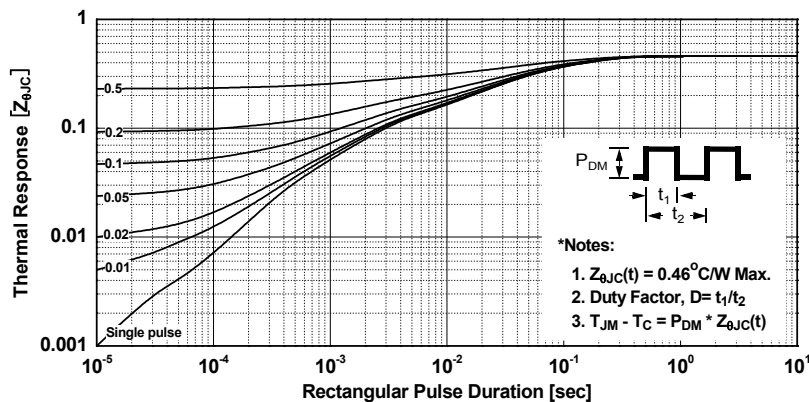
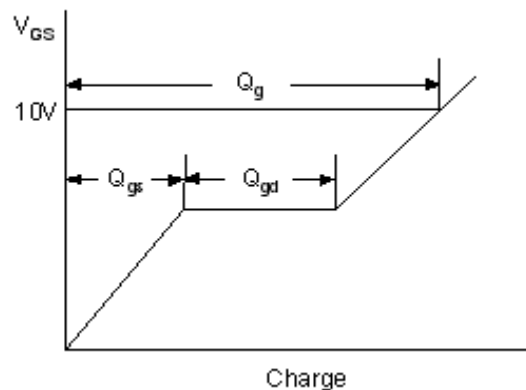
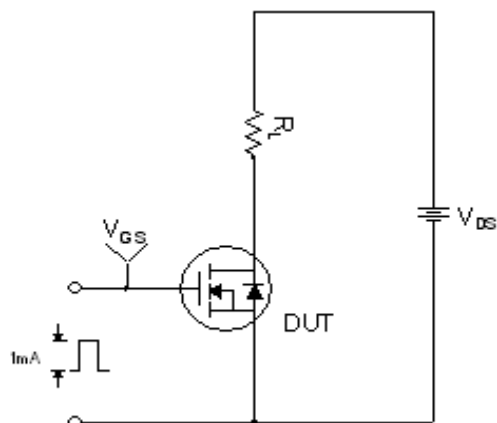


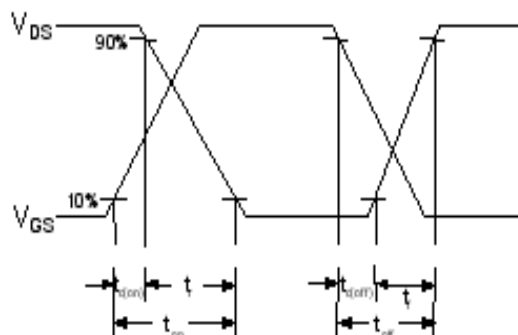
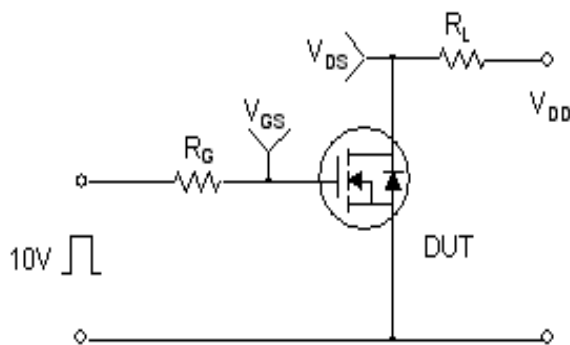
Figure 11. Transient Thermal Response Curve



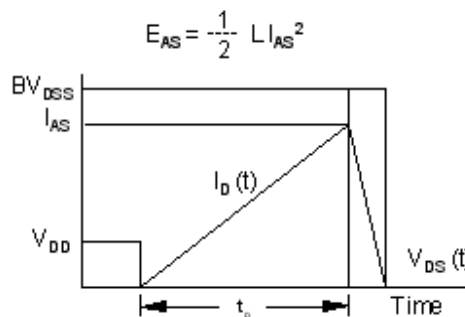
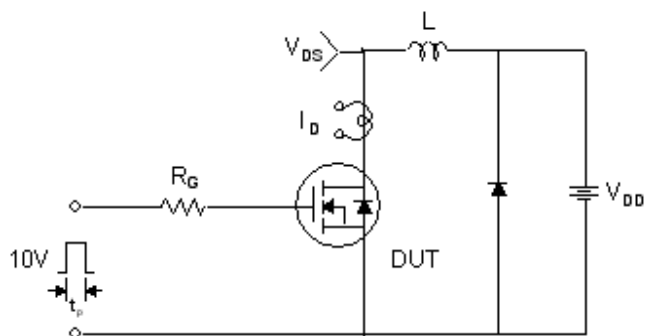
**Gate Charge Test Circuit & Waveform**



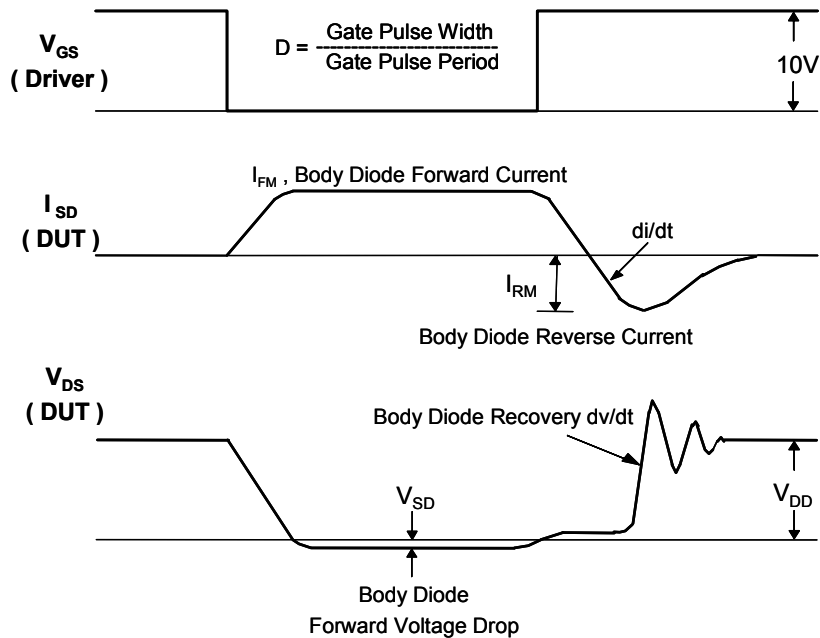
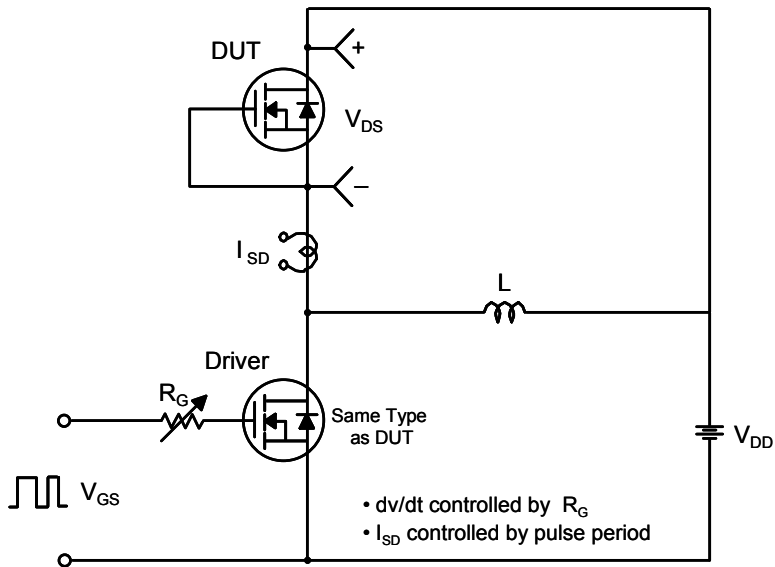
**Resistive Switching Test Circuit & Waveforms**



**Unclamped Inductive Switching Test Circuit & Waveforms**

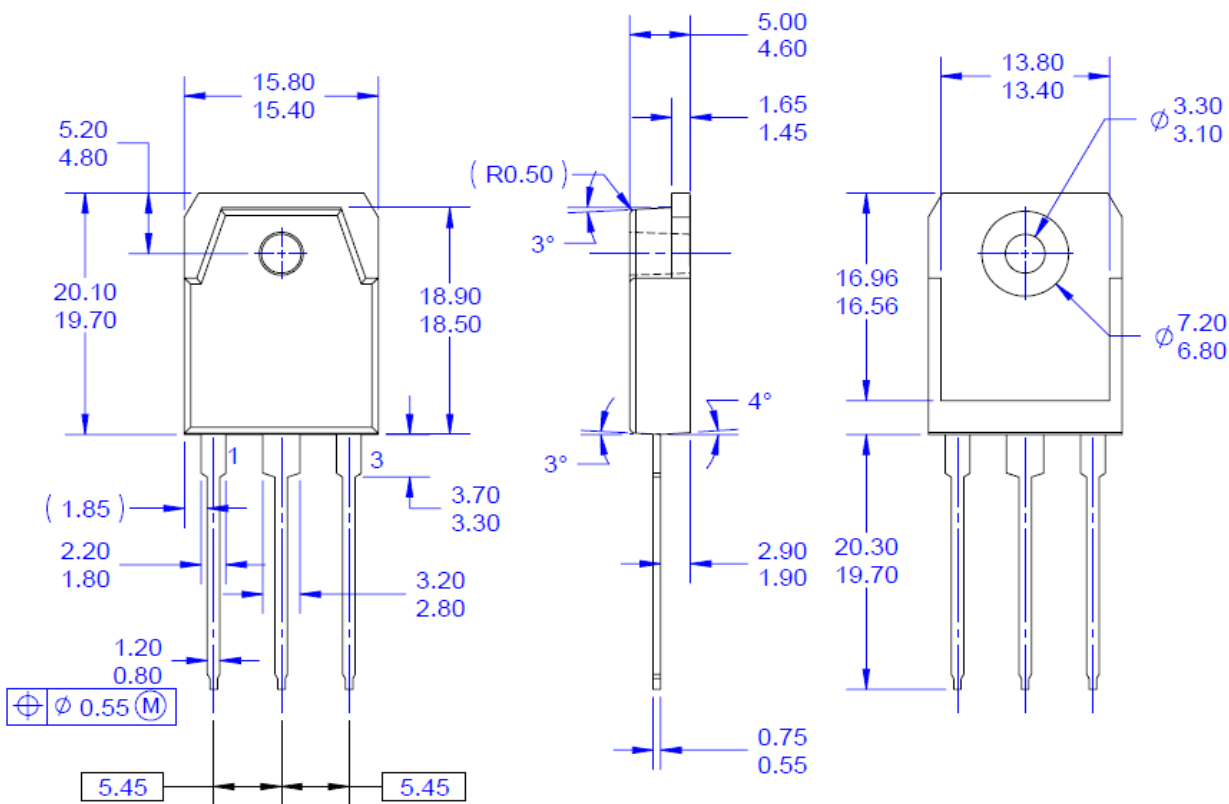


Peak Diode Recovery dv/dt Test Circuit & Waveforms



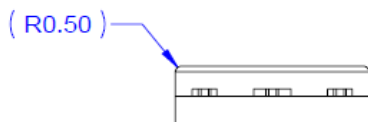
## Mechanical Dimensions

### TO-3PN



NOTES: UNLESS OTHERWISE SPECIFIED

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- C) DIMENSION AND TOLERANCING PER ASME14.5
- D) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
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Dimensions in Millimeters



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