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June 2014

# FQA24N50

## N-Channel QFET<sup>®</sup> MOSFET

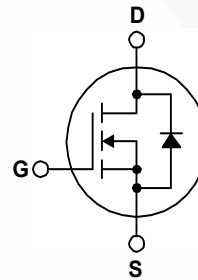
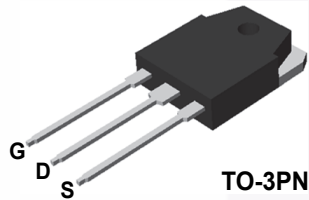
500 V, 24 A, 200 mΩ

### Features

- 24 A, 500 V,  $R_{DS(on)} = 200\text{ m}\Omega$  (Max.) @  $V_{GS} = 10\text{ V}$ ,  $I_D = 12\text{ A}$
- Low Gate Charge (Typ. 90 nC)
- Low  $C_{rss}$  (Typ. 55 pF)
- 100% Avalanche Tested
- 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 efficiency switch mode power supply, power factor correction, electronic lamp ballast based on half bridge.



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

Symbol	Parameter	FQA24N50	Unit
$V_{DSS}$	Drain-Source Voltage	500	V
$I_D$	Drain Current - Continuous ( $T_C = 25^\circ\text{C}$ ) - Continuous ( $T_C = 100^\circ\text{C}$ )	24	A
		15.2	A
$I_{DM}$	Drain Current - Pulsed (Note 1)	96	A
$V_{GSS}$	Gate-Source Voltage	$\pm 30$	V
$E_{AS}$	Single Pulsed Avalanche Energy (Note 2)	1100	mJ
$I_{AR}$	Avalanche Current (Note 1)	24	A
$E_{AR}$	Repetitive Avalanche Energy (Note 1)	29	mJ
$dv/dt$	Peak Diode Recovery $dv/dt$ (Note 3)	4.5	V/ns
$P_D$	Power Dissipation ( $T_C = 25^\circ\text{C}$ ) - Derate above $25^\circ\text{C}$	290	W
		2.33	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, 1/8" from Case for 5 Seconds	300	$^\circ\text{C}$

### Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	--	0.43	$^\circ\text{C}/\text{W}$
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink	0.24	--	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	--	40	$^\circ\text{C}/\text{W}$

## Package Marking and Ordering Information

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FQA24N50	FQA24N50	TO-3PN	Tube	N/A	N/A	30 units

## 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-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	500	--	--	V
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250\ \mu\text{A}$ , Referenced to $25^\circ\text{C}$	--	0.53	--	$\text{V}/^\circ\text{C}$
$I_{DSS}$	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	$\mu\text{A}$
$I_{GSSF}$	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	$V_{GS} = 10\text{ V}, I_D = 12\text{ A}$	--	0.156	0.2	$\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 50\text{ V}, I_D = 12\text{ A}$	--	22	--	S

### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$	--	3500	4500	pF
$C_{oss}$	Output Capacitance		--	520	670	pF
$C_{rss}$	Reverse Transfer Capacitance		--	55	70	pF

### Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 250\text{ V}, I_D = 24\text{ A},$ $R_G = 25\ \Omega$	--	80	170	ns	
$t_r$	Turn-On Rise Time		--	250	500	ns	
$t_{d(off)}$	Turn-Off Delay Time		(Note 4)	--	200	400	ns
$t_f$	Turn-Off Fall Time		(Note 4)	--	155	320	ns
$Q_g$	Total Gate Charge	$V_{DS} = 400\text{ V}, I_D = 24\text{ A},$ $V_{GS} = 10\text{ V}$	--	90	120	nC	
$Q_{gs}$	Gate-Source Charge		(Note 4)	--	23	--	nC
$Q_{gd}$	Gate-Drain Charge		(Note 4)	--	44	--	nC

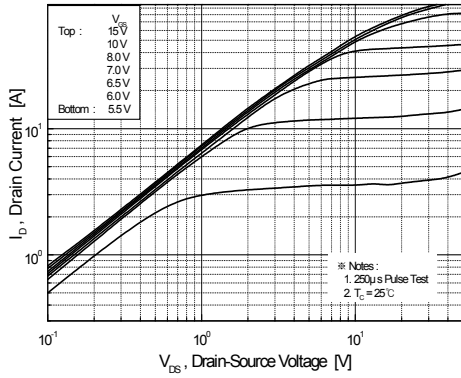
### Drain-Source Diode Characteristics and Maximum Ratings

$I_S$	Maximum Continuous Drain-Source Diode Forward Current	--	--	24	A	
$I_{SM}$	Maximum Pulsed Drain-Source Diode Forward Current	--	--	96	A	
$V_{SD}$	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = 24\text{ A}$	--	--	1.4	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0\text{ V}, I_S = 24\text{ A},$ $di_F / dt = 100\text{ A}/\mu\text{s}$	--	400	--	ns
$Q_{rr}$	Reverse Recovery Charge		--	4.3	--	$\mu\text{C}$

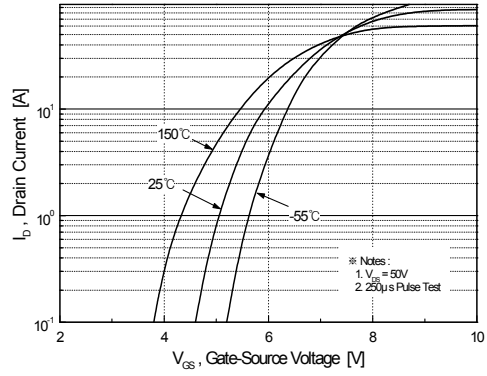
#### Notes :

1. Repetitive rating : pulse width limited by maximum junction temperature.
2.  $L = 3.4\text{ mH}, I_{AS} = 24\text{ A}, V_{DD} = 50\text{ V}, R_G = 25\ \Omega$ , 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.

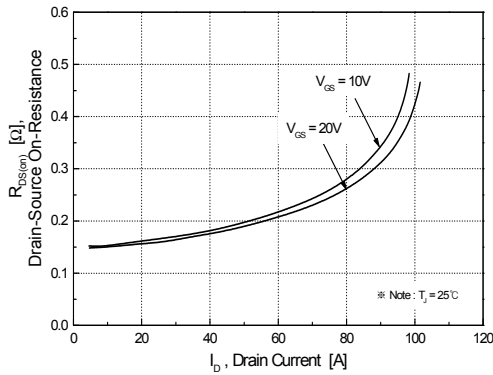
## Typical Characteristics



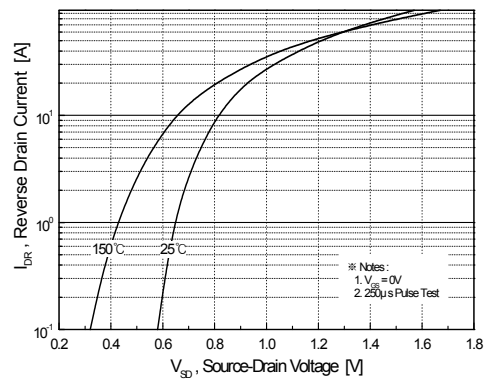
**Figure 1. On-Region Characteristics**



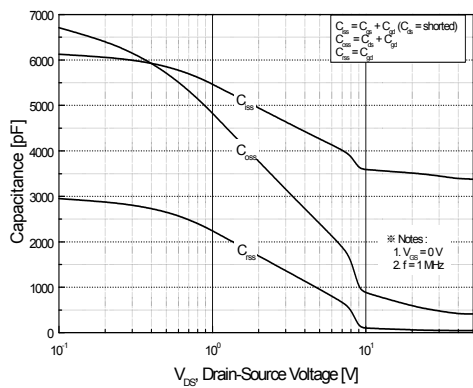
**Figure 2. Transfer Characteristics**



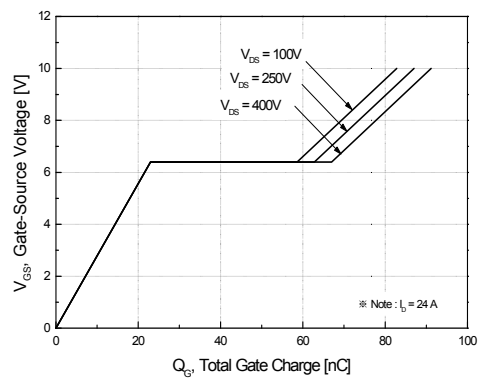
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



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

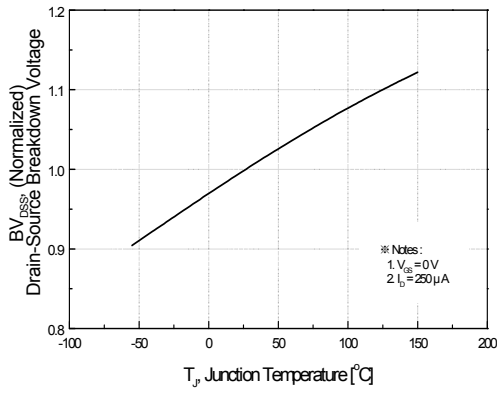


**Figure 5. Capacitance Characteristics**

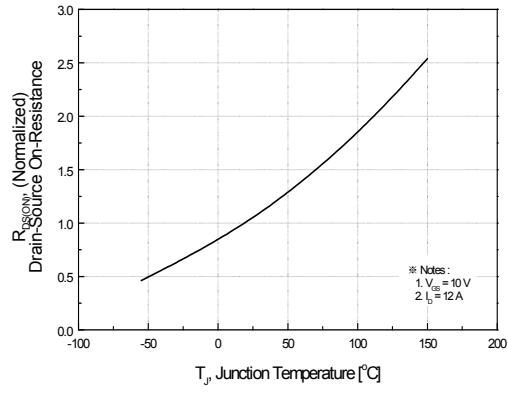


**Figure 6. Gate Charge Characteristics**

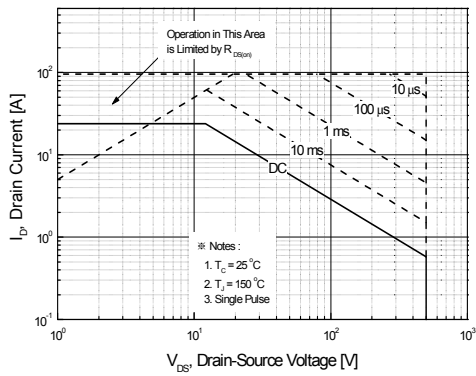
**Typical Characteristics** (Continued)



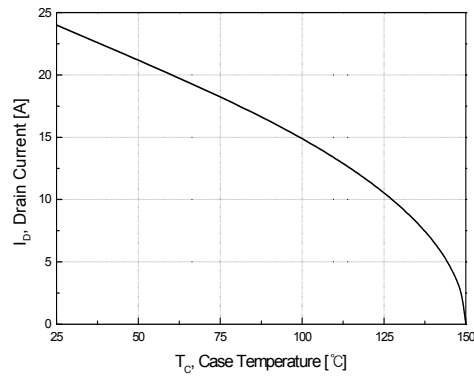
**Figure 7. Breakdown Voltage Variation vs. Temperature**



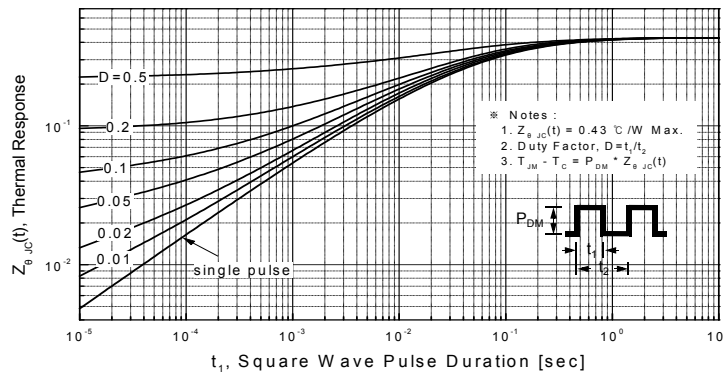
**Figure 8. On-Resistance Variation vs. Temperature**



**Figure 9. Maximum Safe Operating Area**

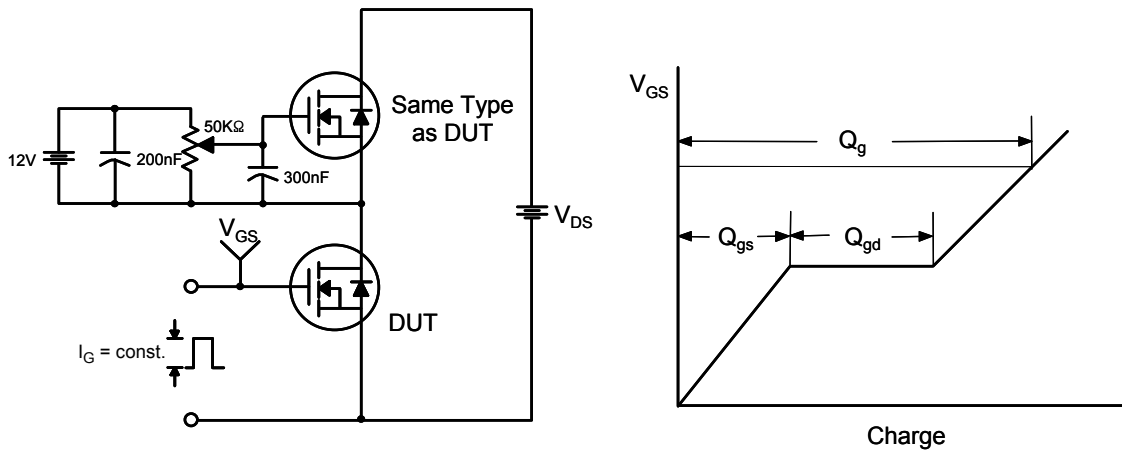


**Figure 10. Maximum Drain Current vs. Case Temperature**

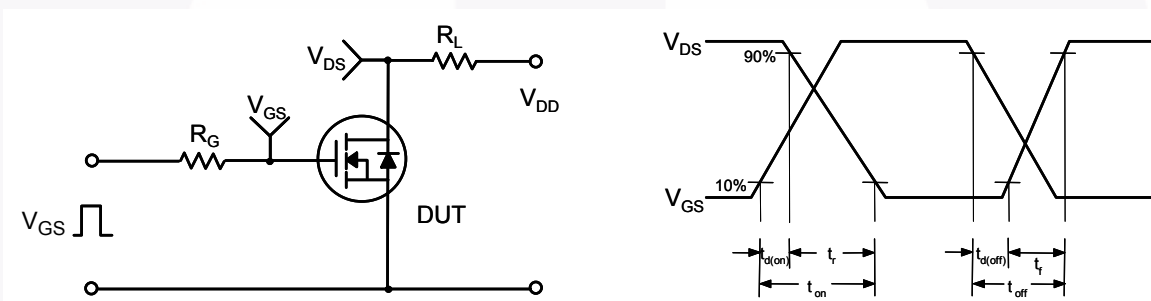


**Figure 11. Transient Thermal Response Curve**

**Figure 12. Gate Charge Test Circuit & Waveform**



**Figure 13. Resistive Switching Test Circuit & Waveforms**



**Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms**

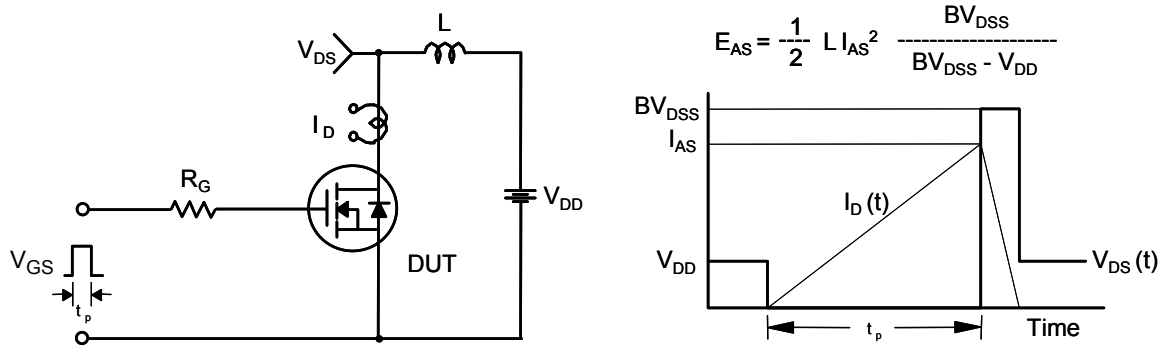
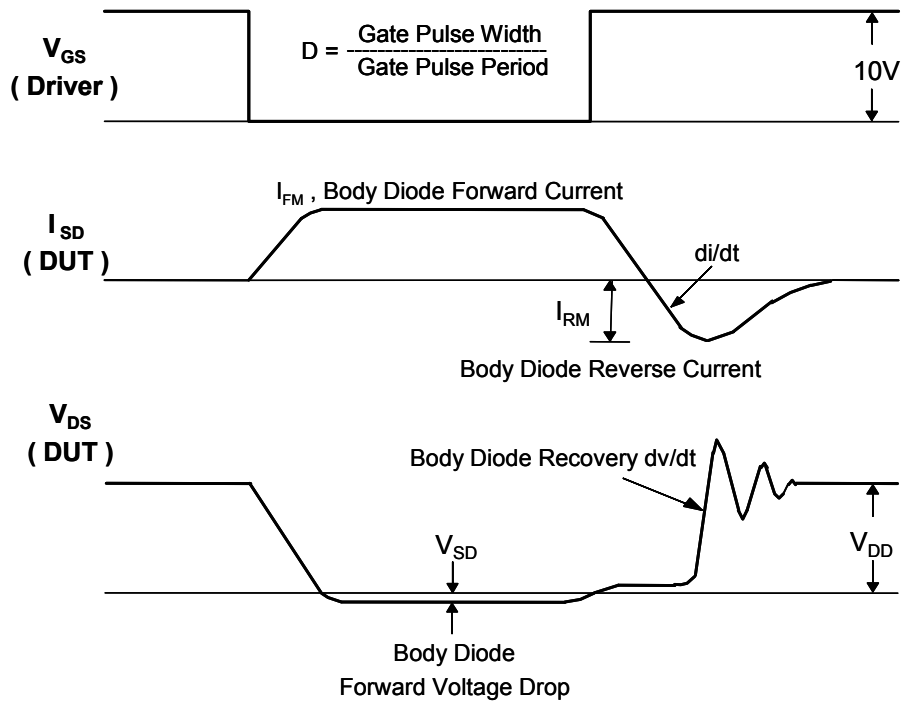
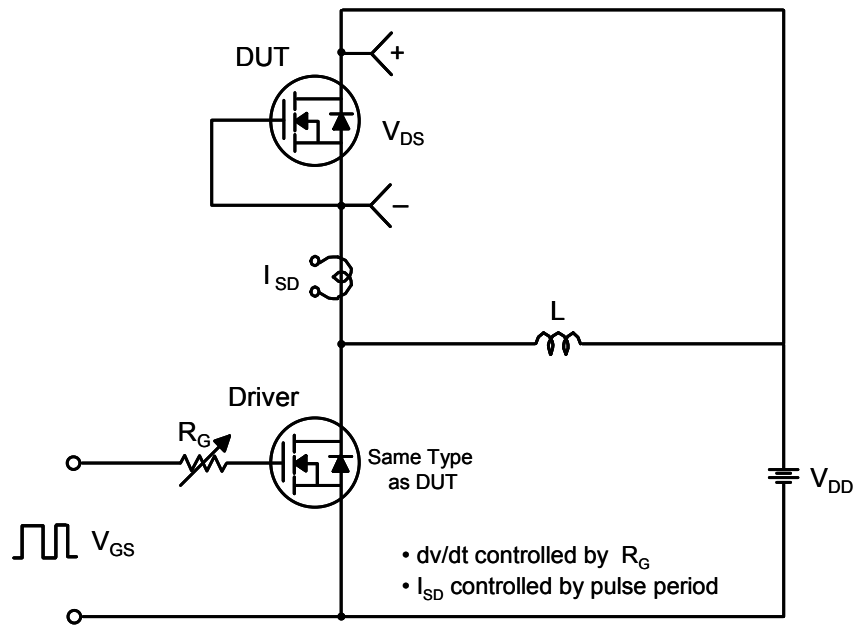
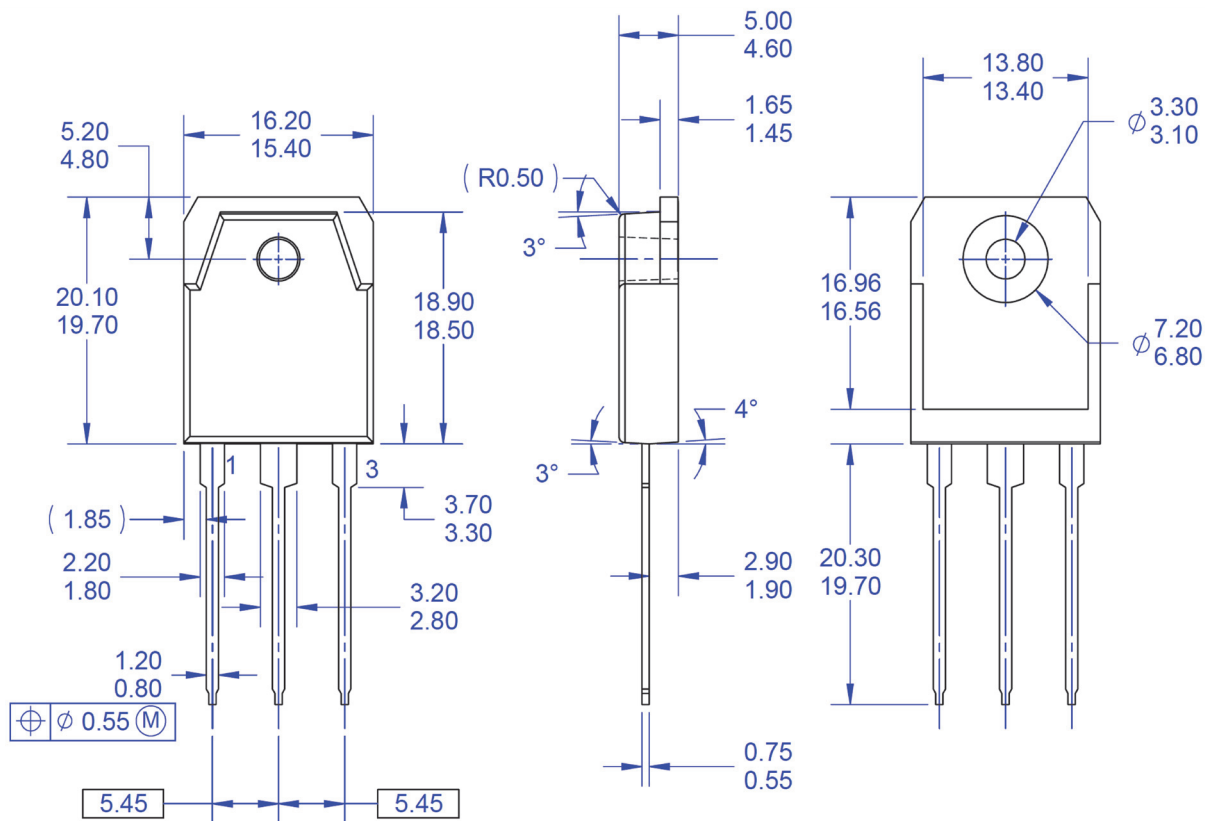


Figure 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms

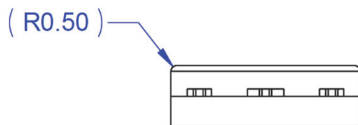


## Mechanical Dimensions



NOTES: UNLESS OTHERWISE SPECIFIED

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- ALL DIMENSIONS ARE IN MILLIMETERS.
- DIMENSION AND TOLERANCING PER ASME14.5-2009.
- DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
- DRAWING FILE NAME: TO3PN03AREV1.
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**Figure 16. TO3PN, 3-Lead, Plastic, EIAJ SC-65**

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