



April 2000

QFET™

## FQA24N50

### 500V N-Channel MOSFET

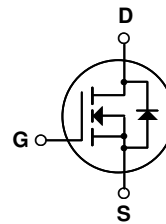
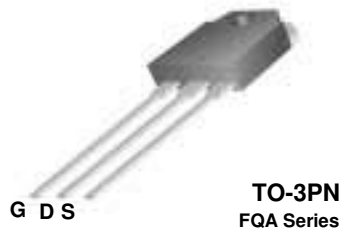
#### General Description

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

This advanced technology 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, motor drive, and welding machine.

#### Features

- 24A, 500V,  $R_{DS(on)} = 0.2\Omega @ V_{GS} = 10V$
- Low gate charge ( typical 90 nC)
- Low  $C_{rss}$  ( typical 55 pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability



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

Symbol	Parameter	FQA24N50	Units
$V_{DSS}$	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 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	--	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	$^\circ\text{C}/\text{W}$

## Electrical Characteristics T<sub>C</sub> = 25°C unless otherwise noted

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

BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA	500	--	--	V
ΔBV <sub>DSS</sub> / ΔT <sub>J</sub>	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = 250 μA, Referenced to 25°C	--	0.53	--	V/°C
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 500 V, V <sub>GS</sub> = 0 V	--	--	1	μA
		V <sub>DS</sub> = 400 V, T <sub>C</sub> = 125°C	--	--	10	μA
I <sub>GSSF</sub>	Gate-Body Leakage Current, Forward	V <sub>GS</sub> = 30 V, V <sub>DS</sub> = 0 V	--	--	100	nA
I <sub>GSSR</sub>	Gate-Body Leakage Current, Reverse	V <sub>GS</sub> = -30 V, V <sub>DS</sub> = 0 V	--	--	-100	nA

### On Characteristics

V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA	3.0	--	5.0	V
R <sub>DS(on)</sub>	Static Drain-Source On-Resistance	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 12 A	--	0.156	0.2	Ω
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 50 V, I <sub>D</sub> = 12 A (Note 4)	--	22	--	S

### Dynamic Characteristics

C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V, f = 1.0 MHz	--	3500	4500	pF
C <sub>oss</sub>	Output Capacitance		--	520	670	pF
C <sub>rss</sub>	Reverse Transfer Capacitance		--	55	70	pF

### Switching Characteristics

t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>DD</sub> = 250 V, I <sub>D</sub> = 24 A, R <sub>G</sub> = 25 Ω  (Note 4, 5)	--	80	170	ns
t <sub>r</sub>	Turn-On Rise Time		--	250	500	ns
t <sub>d(off)</sub>	Turn-Off Delay Time		--	200	400	ns
t <sub>f</sub>	Turn-Off Fall Time		--	155	320	ns
Q <sub>g</sub>	Total Gate Charge		V <sub>DS</sub> = 400 V, I <sub>D</sub> = 24 A, V <sub>GS</sub> = 10 V  (Note 4, 5)	--	90	120
Q <sub>gs</sub>	Gate-Source Charge		--	23	--	nC
Q <sub>gd</sub>	Gate-Drain Charge		--	44	--	nC

### Drain-Source Diode Characteristics and Maximum Ratings

I <sub>S</sub>	Maximum Continuous Drain-Source Diode Forward Current	--	--	24	A	
I <sub>SM</sub>	Maximum Pulsed Drain-Source Diode Forward Current	--	--	96	A	
V <sub>SD</sub>	Drain-Source Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 24 A	--	--	1.4	V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 24 A, di <sub>F</sub> / dt = 100 A/μs  (Note 4)	--	400	--	ns
Q <sub>rr</sub>	Reverse Recovery Charge		--	4.3	--	μC

#### Notes:

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. L = 3.4mH, I<sub>AS</sub> = 24A, V<sub>DD</sub> = 50V, R<sub>G</sub> = 25 Ω, Starting T<sub>J</sub> = 25°C
3. I<sub>SD</sub> ≤ 24A, di/dt ≤ 200A/μs, V<sub>DD</sub> ≤ BV<sub>DSS</sub>, Starting T<sub>J</sub> = 25°C
4. Pulse Test : Pulse width ≤ 300μs, Duty cycle ≤ 2%
5. Essentially independent of operating temperature

## Typical Characteristics

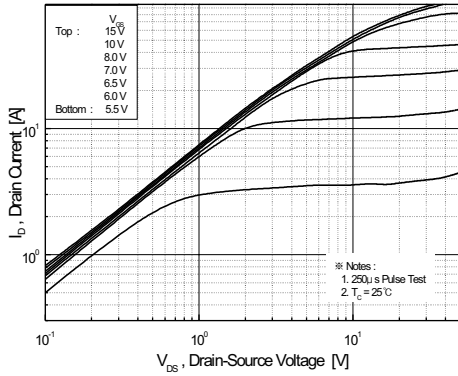


Figure 1. On-Region Characteristics

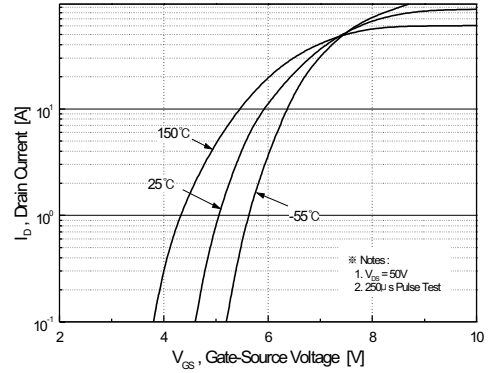


Figure 2. Transfer Characteristics

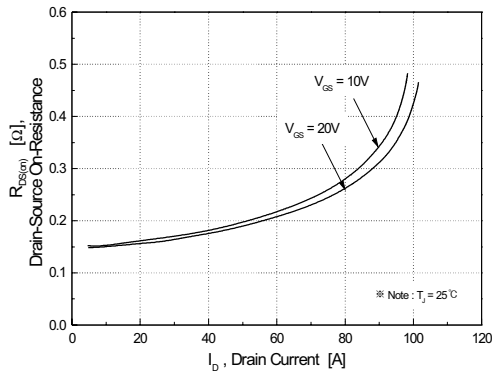


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

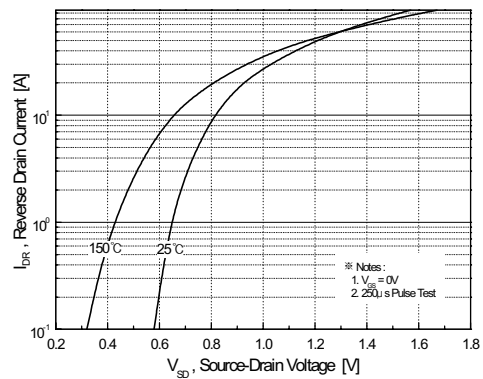


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

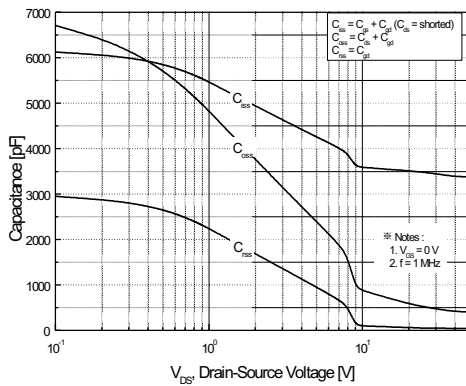


Figure 5. Capacitance Characteristics

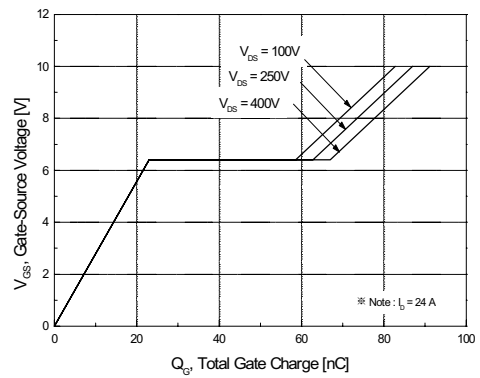


Figure 6. Gate Charge Characteristics

Typical Characteristics (Continued)

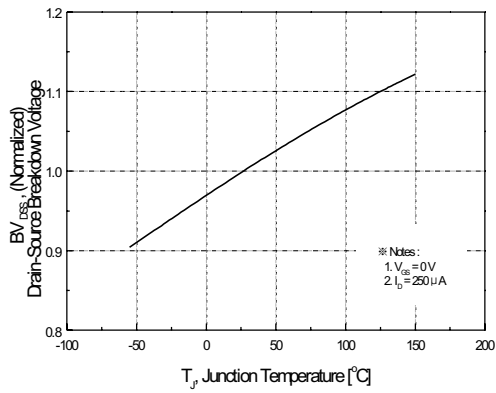


Figure 7. Breakdown Voltage Variation vs. Temperature

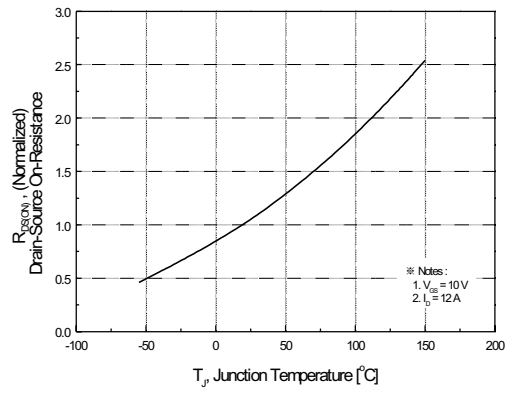


Figure 8. On-Resistance Variation vs. Temperature

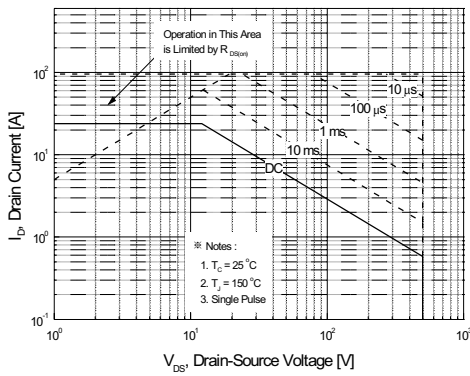


Figure 9. Maximum Safe Operating Area

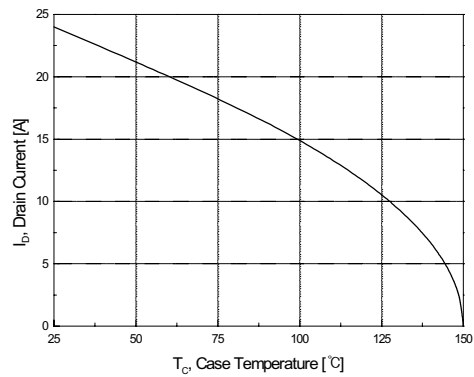


Figure 10. Maximum Drain Current vs. Case Temperature

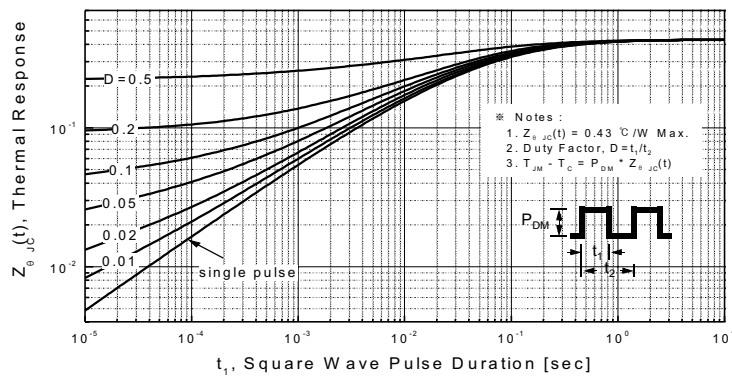
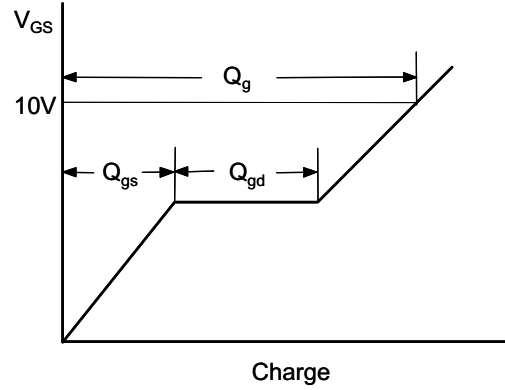
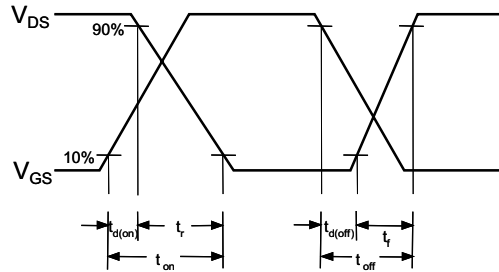
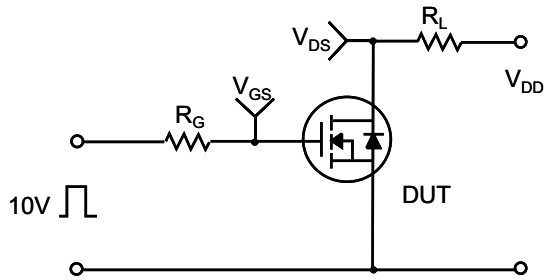


Figure 11. Transient Thermal Response Curve

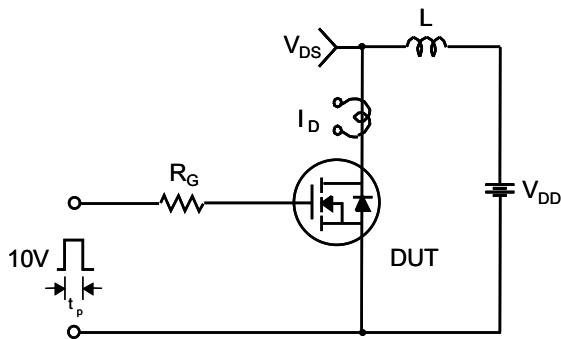
Gate Charge Test Circuit & Waveform



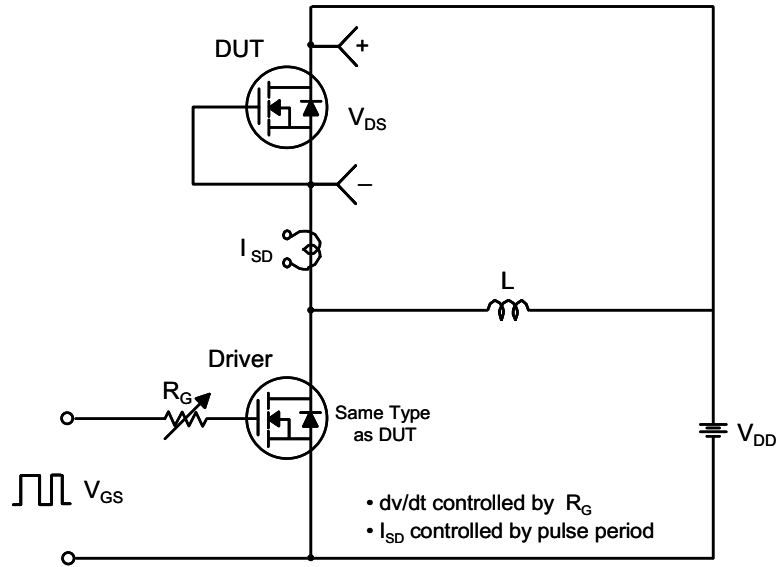
Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching Test Circuit & Waveforms

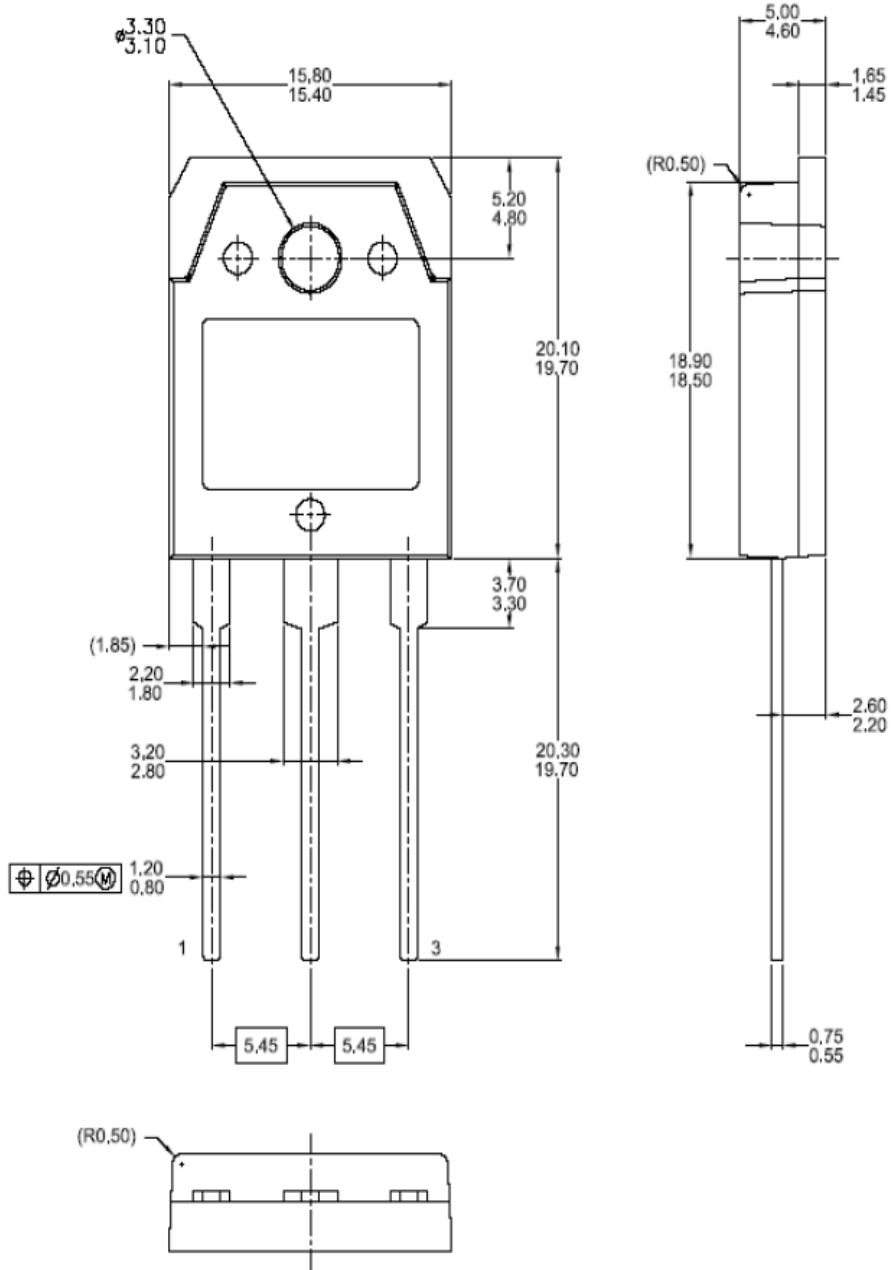


Peak Diode Recovery dv/dt Test Circuit & Waveforms



Mechanical Dimensions

TO-3PN



Dimensions in Millimeters

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