



THE DATASHEET OF FQA24N50





April 2000

QFET™

FQA24N50

500V N-Channel MOSFET

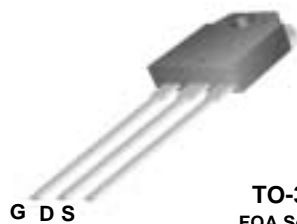
General Description

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

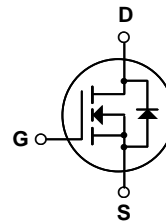
This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for high efficiency switch mode power supply, power factor correction, motor drive, and welding machine.

Features

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



TO-3PN
FQA Series



Absolute Maximum Ratings T_C = 25°C unless otherwise noted

Symbol	Parameter	FQA24N50	Units
V _{DSS}	Drain-Source Voltage	500	V
I _D	Drain Current - Continuous (T _C = 25°C)	24	A
	- Continuous (T _C = 100°C)	15.2	A
I _{DM}	Drain Current - Pulsed (Note 1)	96	A
V _{GSS}	Gate-Source Voltage	± 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°C)	290	W
	- Derate above 25°C	2.33	W/°C
T _J , T _{STG}	Operating and Storage Temperature Range	-55 to +150	°C
T _L	Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds	300	°C

Thermal Characteristics

Symbol	Parameter	Typ	Max	Units
R _{θJC}	Thermal Resistance, Junction-to-Case	--	0.43	°C/W
R _{θCS}	Thermal Resistance, Case-to-Sink	0.24	--	°C/W
R _{θJA}	Thermal Resistance, Junction-to-Ambient	--	40	°C/W

Electrical Characteristics

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
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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
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250\ \mu\text{A}$, Referenced to 25°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	μA
		$V_{DS} = 400\text{ V}, T_C = 125^\circ\text{C}$	--	--	10	μA
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	Ω
g_{FS}	Forward Transconductance	$V_{DS} = 50\text{ V}, I_D = 12\text{ A}$ (Note 4)	--	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, 5)	--	200	400	ns
t_f	Turn-Off Fall Time		(Note 4, 5)	--	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, 5)	--	23	--	nC
Q_{gd}	Gate-Drain Charge		(Note 4, 5)	--	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	$V_{GS} = 0\text{ V}, I_S = 24\text{ A},$ $dI_F / dt = 100\text{ A}/\mu\text{s}$ (Note 4)	--	400	--	ns
Q_{rr}	Reverse Recovery Charge		--	4.3	--	μC

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. Pulse Test : Pulse width $\leq 300\ \mu\text{s}$, Duty cycle $\leq 2\%$
5. Essentially independent of operating temperature

Typical Characteristics

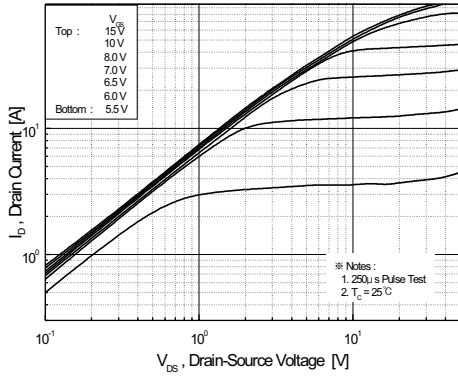


Figure 1. On-Region Characteristics

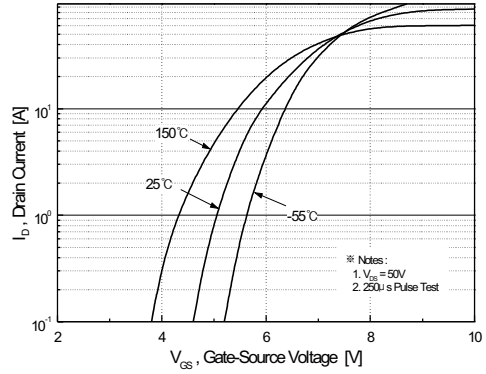


Figure 2. Transfer Characteristics

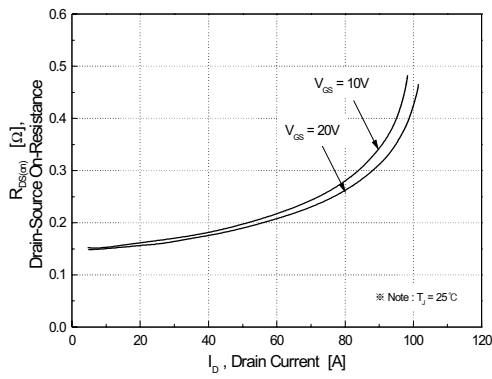


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

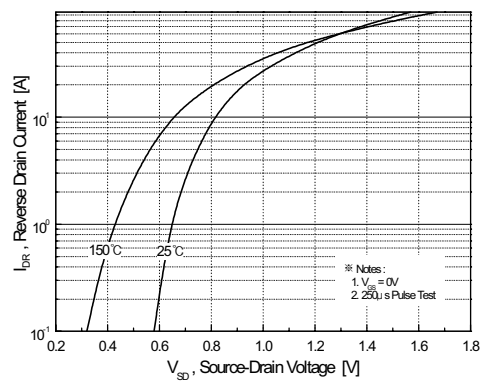


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

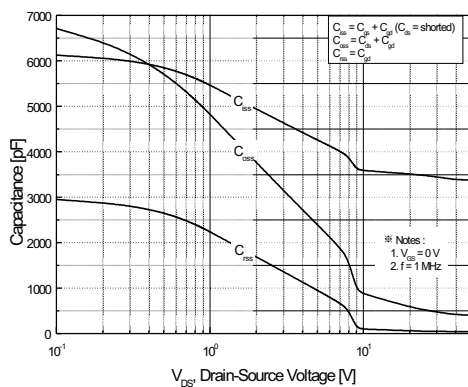


Figure 5. Capacitance Characteristics

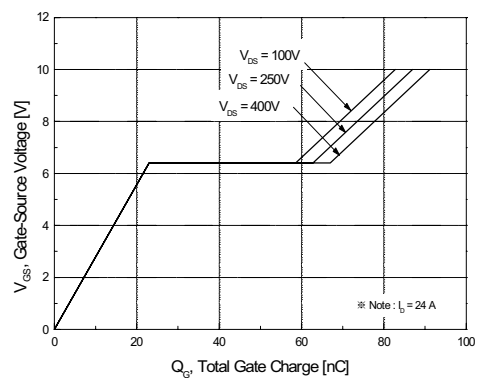


Figure 6. Gate Charge Characteristics

Typical Characteristics (Continued)

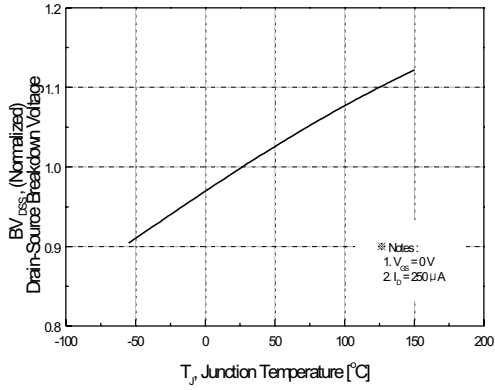


Figure 7. Breakdown Voltage Variation vs. Temperature

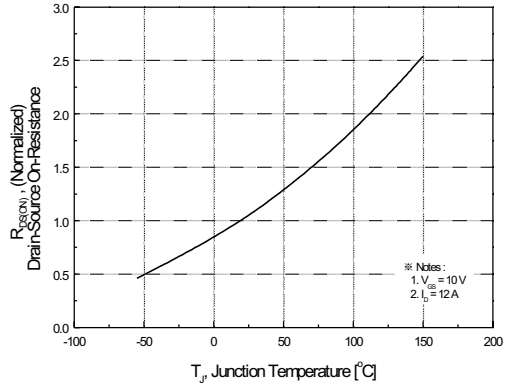


Figure 8. On-Resistance Variation vs. Temperature

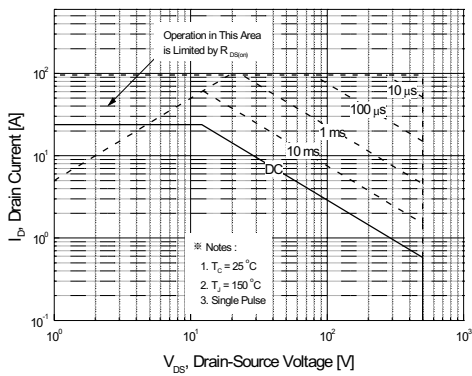


Figure 9. Maximum Safe Operating Area

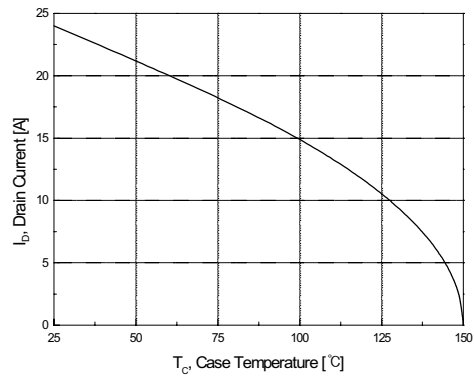


Figure 10. Maximum Drain Current vs. Case Temperature

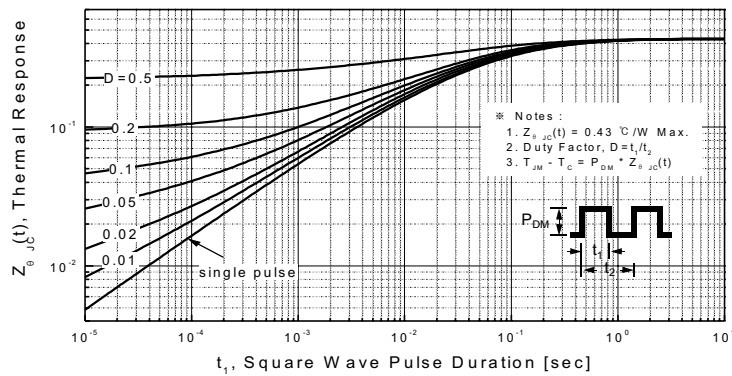


Figure 11. Transient Thermal Response Curve

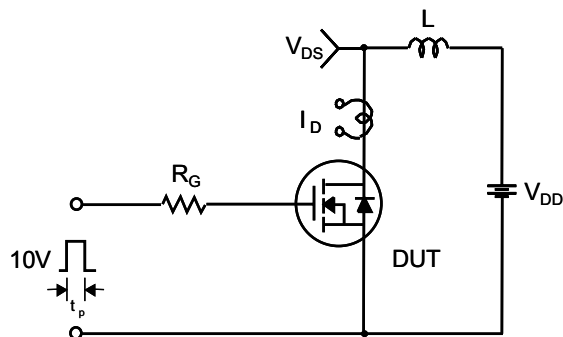
Gate Charge Test Circuit & Waveform



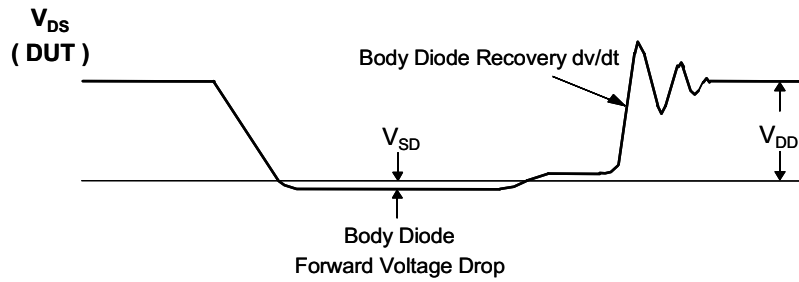
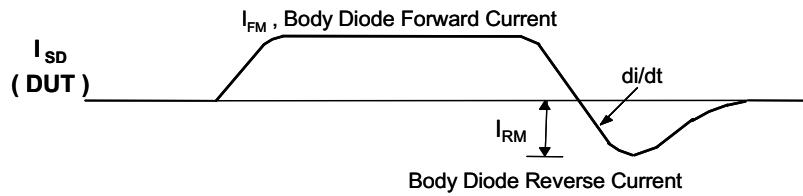
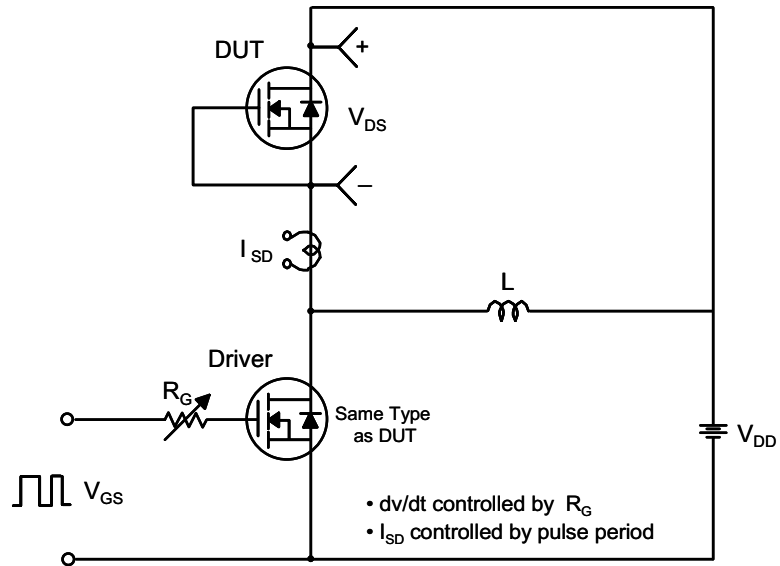
Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching Test Circuit & Waveforms

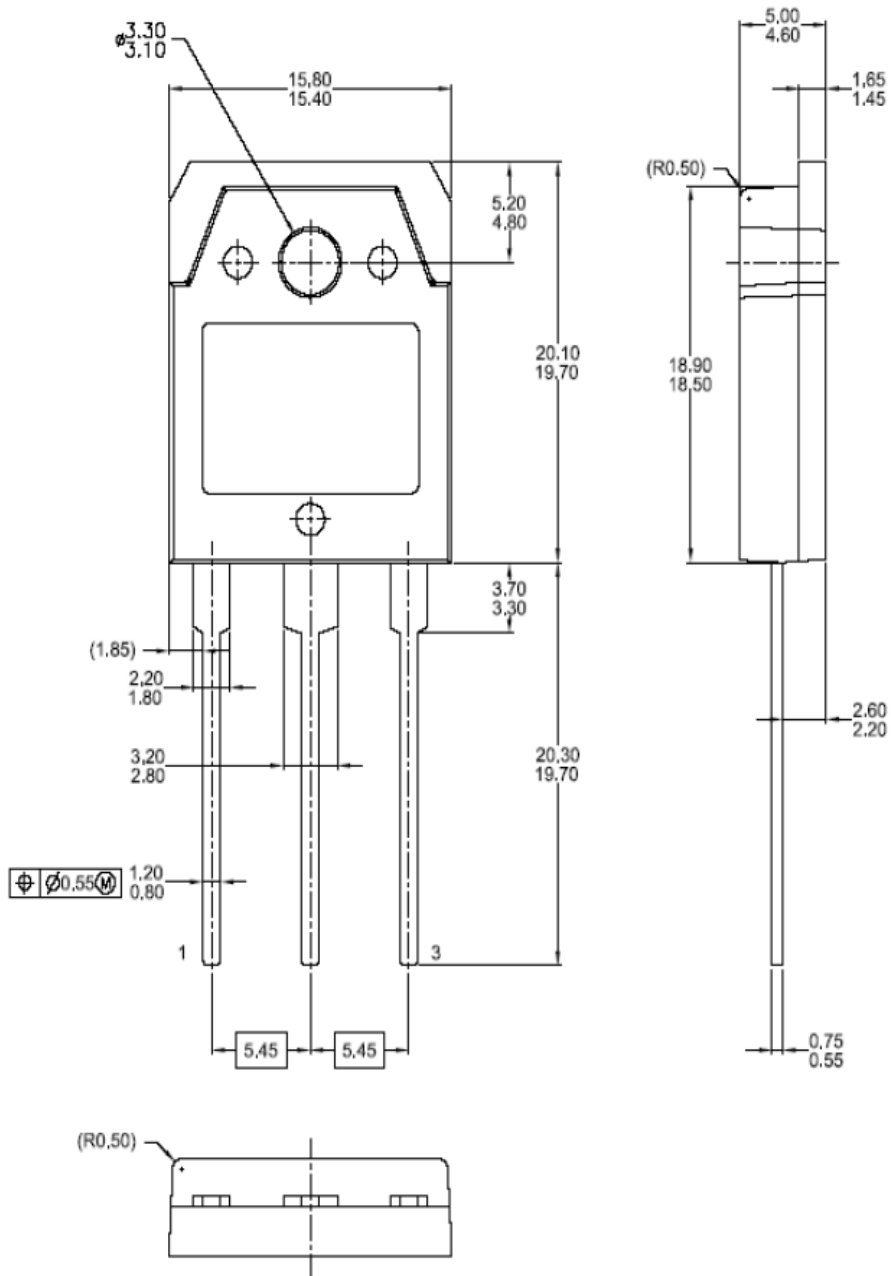


Peak Diode Recovery dv/dt Test Circuit & Waveforms



Mechanical Dimensions

TO-3PN



Dimensions in Millimeters

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