

## FQA24N50F

### 500V N-Channel MOSFET

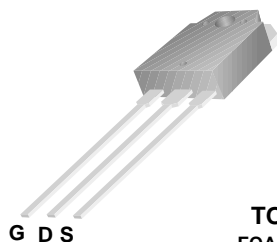
#### General Description

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

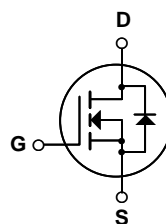
This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for high efficiency switch mode power supplies, where the body diode is used such as phase-shift ZVS, basic full-bridge topology.

#### 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
- Fast recovery body diode ( max, 250ns)



**TO-3PN**  
FQA Series



#### Absolute Maximum Ratings T<sub>C</sub> = 25°C unless otherwise noted

Symbol	Parameter	FQA24N50F	Units
V <sub>DSS</sub>	Drain-Source Voltage	500	V
I <sub>D</sub>	Drain Current - Continuous (T <sub>C</sub> = 25°C) - Continuous (T <sub>C</sub> = 100°C)	24	A
		15.2	A
I <sub>DM</sub>	Drain Current - Pulsed (Note 1)	96	A
V <sub>GSS</sub>	Gate-Source Voltage	± 30	V
E <sub>AS</sub>	Single Pulsed Avalanche Energy (Note 2)	1100	mJ
I <sub>AR</sub>	Avalanche Current (Note 1)	24	A
E <sub>AR</sub>	Repetitive Avalanche Energy (Note 1)	29	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	15	V/ns
P <sub>D</sub>	Power Dissipation (T <sub>C</sub> = 25°C) - Derate above 25°C	290	W
		2.33	W/°C
T <sub>J</sub> , T <sub>STG</sub>	Operating and Storage Temperature Range	-55 to +150	°C
T <sub>L</sub>	Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds	300	°C

#### Thermal Characteristics

Symbol	Parameter	Typ	Max	Units
R <sub>θJC</sub>	Thermal Resistance, Junction-to-Case	--	0.43	°C/W
R <sub>θCS</sub>	Thermal Resistance, Case-to-Sink	0.24	--	°C/W
R <sub>θJA</sub>	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
<b>Off Characteristics</b>						
$BV_{DSS}$	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	$V_{DS} = 500\text{ V}, V_{GS} = 0\text{ V}$	--	--	50	$\mu\text{A}$
		$V_{DS} = 400\text{ V}, T_C = 125^\circ\text{C}$	--	--	500	$\mu\text{A}$
$I_{GSSF}$	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	$V_{DS} = 50\text{ V}, I_D = 12\text{ A}$ (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		--	200	400	ns
$t_f$	Turn-Off Fall Time		(Note 4, 5)	--	155	320
$Q_g$	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		--	23	--	nC
$Q_{gd}$	Gate-Drain Charge		(Note 4, 5)	--	52	--

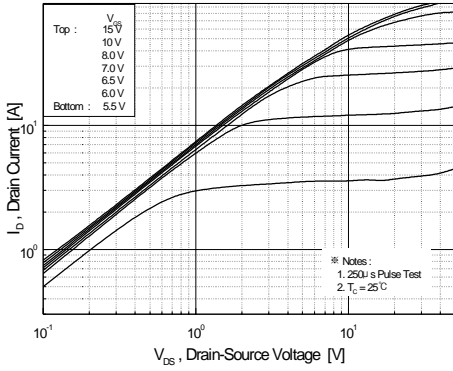
### Drain-Source Diode Characteristics and Maximum Ratings

$I_S$	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	$V_{GS} = 0\text{ V}, I_S = 24\text{ A},$	--	--	250	ns
$Q_{rr}$	Reverse Recovery Charge	$di_F / dt = 100\text{ A}/\mu\text{s}$ (Note 4)	--	1.1	--	$\mu\text{C}$

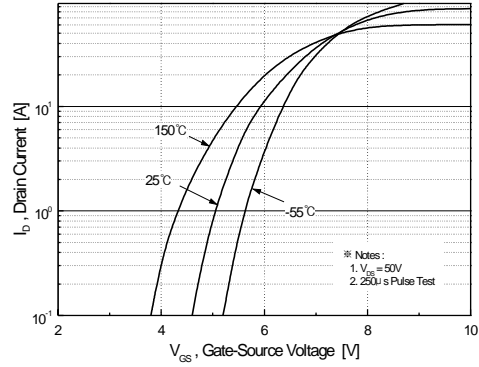
#### Notes:

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.  $I_{SD} \leq 24\text{ A}, di/dt \leq 350\text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$ , 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

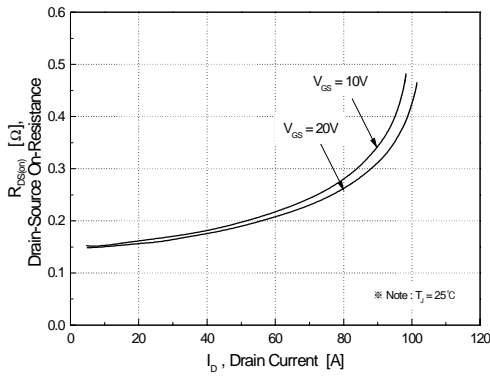
## Typical Characteristics



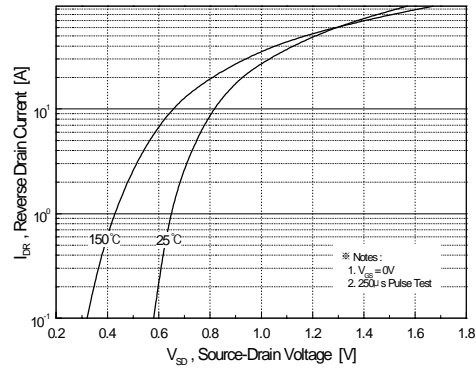
**Figure 1. On-Region Characteristics**



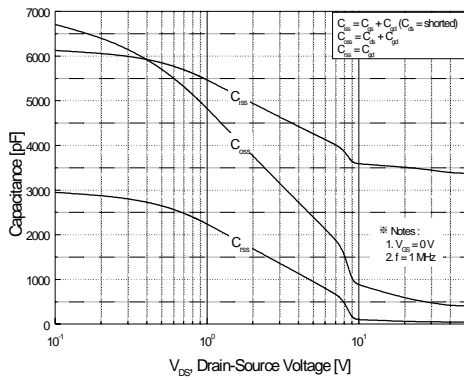
**Figure 2. Transfer Characteristics**



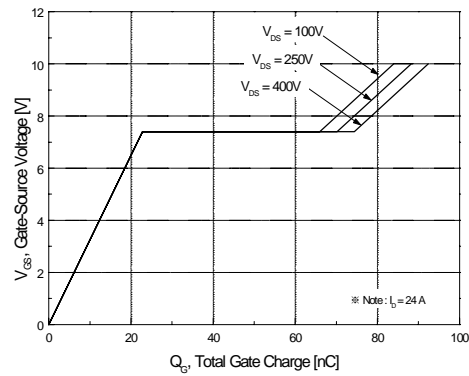
**Figure 3. On-Resistance Variation vs Drain Current and Gate Voltage**



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



**Figure 5. Capacitance Characteristics**



**Figure 6. Gate Charge Characteristics**

Typical Characteristics (Continued)

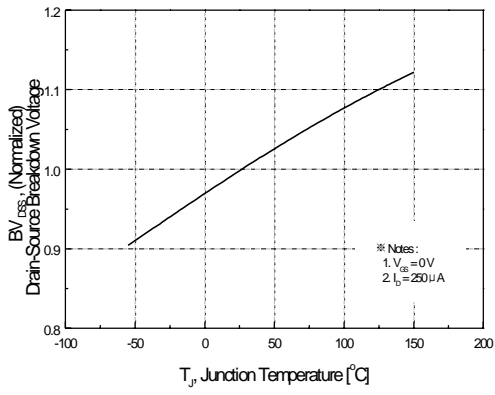


Figure 7. Breakdown Voltage Variation vs Temperature

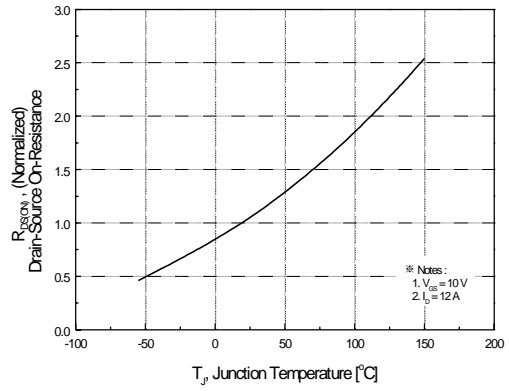


Figure 8. On-Resistance Variation vs Temperature

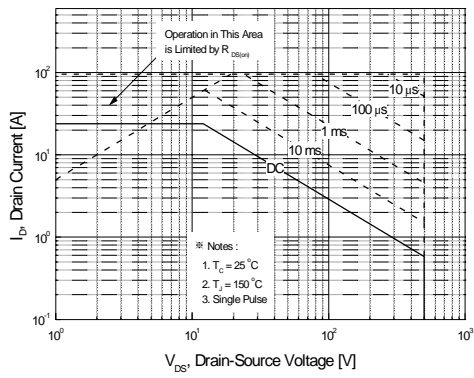


Figure 9. Maximum Safe Operating Area

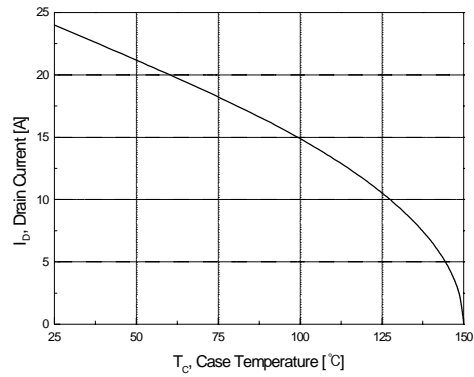


Figure 10. Maximum Drain Current vs Case Temperature

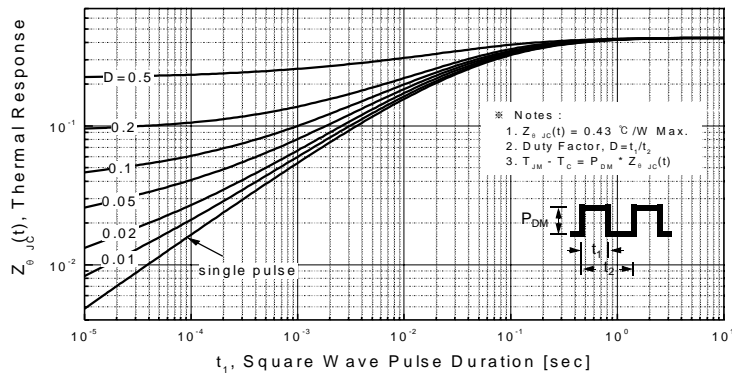
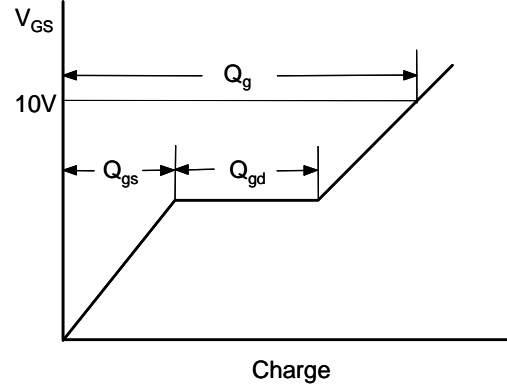
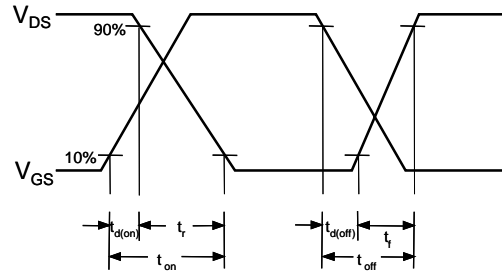
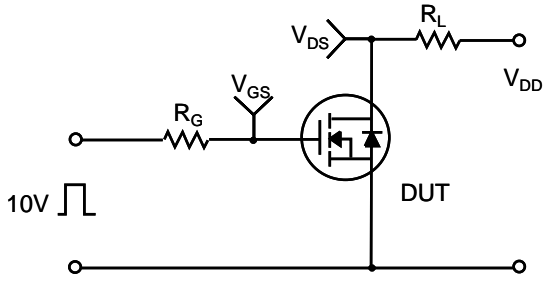


Figure 11. Transient Thermal Response Curve

**Gate Charge Test Circuit & Waveform**



**Resistive Switching Test Circuit & Waveforms**



**Unclamped Inductive Switching Test Circuit & Waveforms**

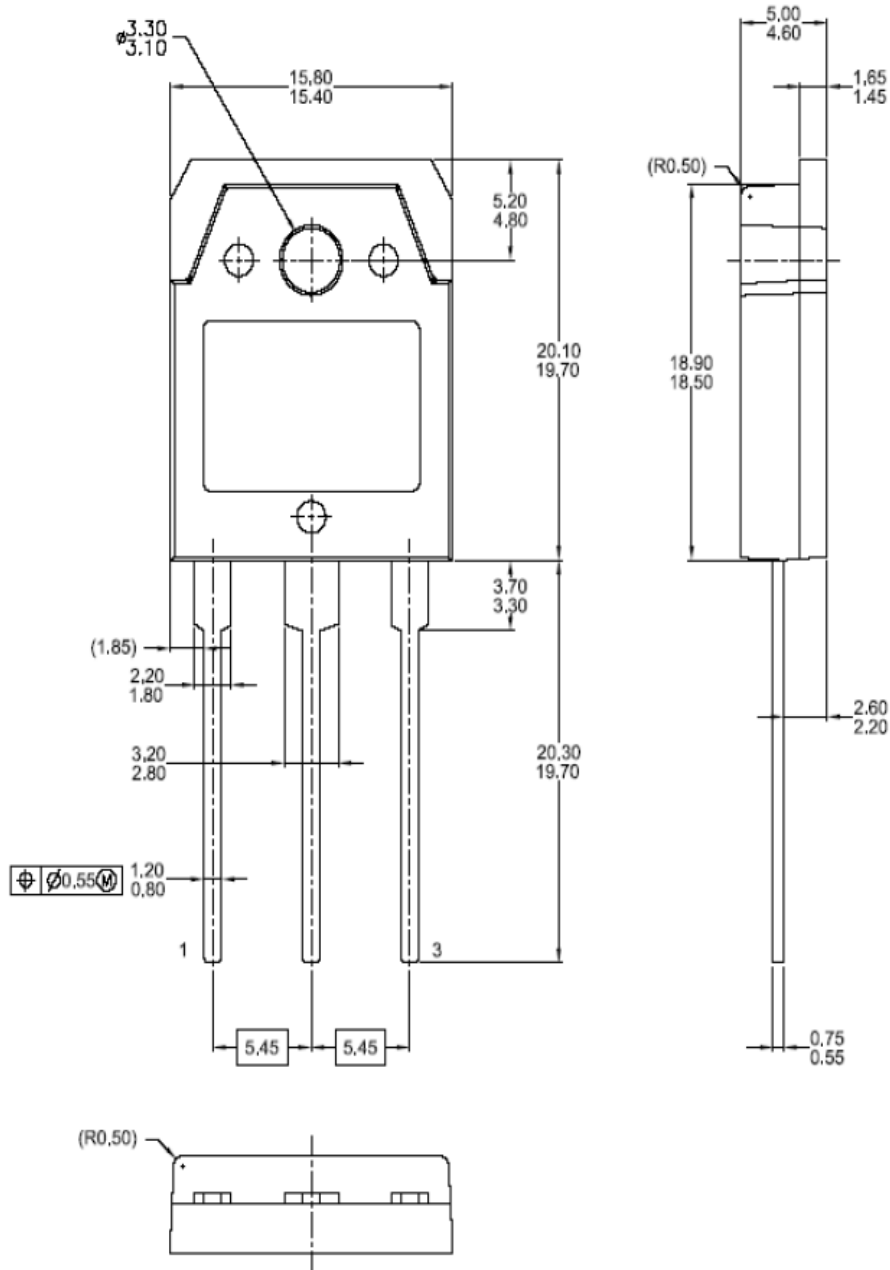


Peak Diode Recovery dv/dt Test Circuit & Waveforms



Mechanical Dimensions

TO-3PN



Dimensions in Millimeters

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