FAIRCHILD

SEMICONDUCTOR ™

April 2000

$QFET^{TM}$

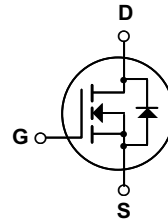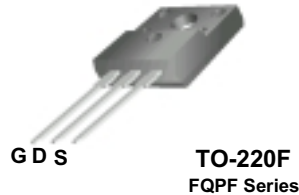# FQPF16N15

150V 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 low voltage applications such as audio amplifire, high efficiency switching for DC/DC converters, and DC motor control, uninterrupted power supply.

Features

- 11.6A, 150V, $R_{DS(on)}$ = 0.16Ω @V_{GS} = 10 V
- Low gate charge (typical 23 nC)
- Low Crss (typical 30 pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability
- 175°C maximum junction temperature rating

G D S **TO-220F**
FQPF Series

D

G

S

Absolute Maximum Ratings T_C = 25°C unless otherwise noted

Symbol	Parameter			FQPF16N15	Units
V_{DSS}	Drain-Source Voltage			150	V
I_D	Drain Current	- Continuous (T_C = 25°C)		11.6	A
		- Continuous (T_C = 100°C)		8.2	A
I_{DM}	Drain Current	- Pulsed	(Note 1)	46.4	A
V_{GSS}	Gate-Source Voltage			± 25	V
E_{AS}	Single Pulsed Avalanche Energy		(Note 2)	230	mJ
I_{AR}	Avalanche Current		(Note 1)	11.6	A
E_{AR}	Repetitive Avalanche Energy		(Note 1)	5.3	mJ
dv/dt	Peak Diode Recovery dv/dt		(Note 3)	6.0	V/ns
P_D	Power Dissipation (T_C = 25°C)			53	W
	- Derate above 25°C			0.36	W/°C
T_J, T_{STG}	Operating and Storage Temperature Range			-55 to +175	°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
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	--	2.78	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	--	62.5	°C/W

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Electrical Characteristics T_C = 25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
Off Characteristics						
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} = 0 V, I_D = 250 µA	150	--	--	V
ΔBV_{DSS} / ΔT_J	Breakdown Voltage Temperature Coefficient	I_D = 250 µA, Referenced to 25°C	--	0.17	--	V/°C
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 150 V, V_{GS} = 0 V	--	--	1	µA
		V_{DS} = 120 V, T_C = 150°C	--	--	10	µA
I_{GSSF}	Gate-Body Leakage Current, Forward	V_{GS} = 25 V, V_{DS} = 0 V	--	--	100	nA
I_{GSSR}	Gate-Body Leakage Current, Reverse	V_{GS} = -25 V, V_{DS} = 0 V	--	--	-100	nA
On Characteristics						
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS} = V_{GS}, I_D = 250 µA	2.0	--	4.0	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	V_{GS} = 10 V, I_D = 5.8 A	--	0.123	0.16	Ω
g_{FS}	Forward Transconductance	V_{DS} = 40 V, I_D = 5.8 A (Note 4)	--	8.3	--	S
Dynamic Characteristics						
C_{iss}	Input Capacitance	V_{DS} = 25 V, V_{GS} = 0 V, f = 1.0 MHz	--	700	910	pF
C_{oss}	Output Capacitance		--	145	190	pF
C_{rss}	Reverse Transfer Capacitance		--	30	40	pF
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	V_{DD} = 75 V, I_D = 16.4 A, R_G = 25 Ω	--	11	30	ns
t_r	Turn-On Rise Time		--	115	240	ns
$t_{d(off)}$	Turn-Off Delay Time		--	50	110	ns
t_f	Turn-Off Fall Time	(Note 4, 5)	--	80	170	ns
Q_g	Total Gate Charge	V_{DS} = 120 V, I_D = 16.4 A, V_{GS} = 10 V	--	23	30	nC
Q_{gs}	Gate-Source Charge		--	4.5	--	nC
Q_{gd}	Gate-Drain Charge	(Note 4, 5)	--	11	--	nC
Drain-Source Diode Characteristics and Maximum Ratings						
I_S	Maximum Continuous Drain-Source Diode Forward Current		--	--	11.6	A
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current		--	--	46.4	A
V_{SD}	Drain-Source Diode Forward Voltage	V_{GS} = 0 V, I_S = 11.6 A	--	--	1.5	V
t_{rr}	Reverse Recovery Time	V_{GS} = 0 V, I_S = 16.4 A,	--	85	--	ns
Q_{rr}	Reverse Recovery Charge	dI_F / dt = 100 A/µs (Note 4)	--	0.35	--	µC

Notes:
1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. L = 2.85mH, I_{AS} = 11.6A, V_{DD} = 25V, R_G = 25 Ω, Starting T_J = 25°C
3. $I_{SD} \leq$ 11.6A, di/dt $\leq$ 300A/µs, $V_{DD} \leq BV_{DSS}$, Starting T_J = 25°C
4. Pulse Test : Pulse width $\leq$ 300µs, Duty cycle $\leq$ 2%
5. Essentially independent of operating temperature
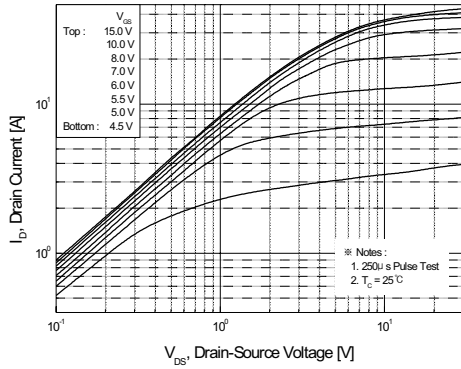
Typical Characteristics

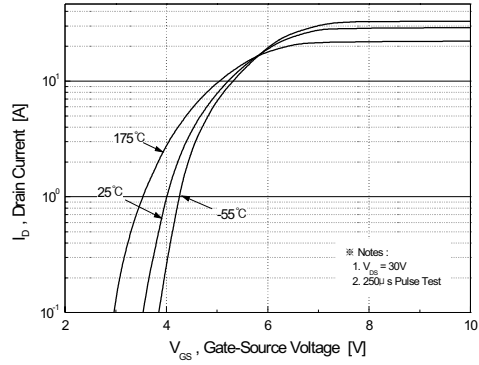**Figure 1. On-Region Characteristics**

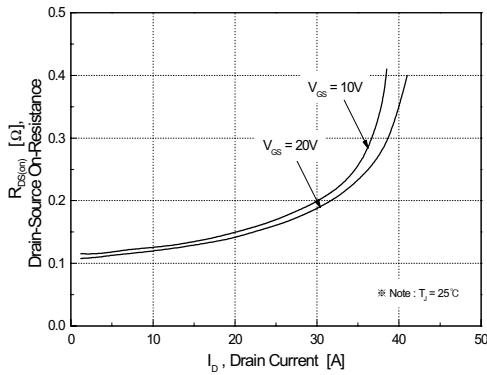**Figure 2. Transfer Characteristics**

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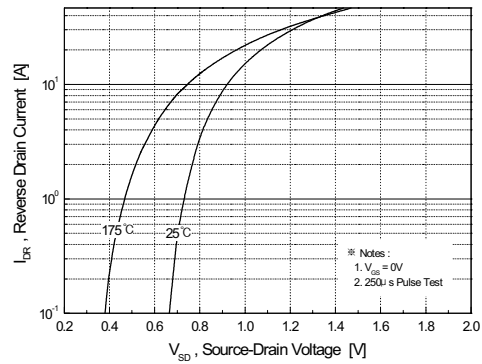Drain Current and Gate Voltage**

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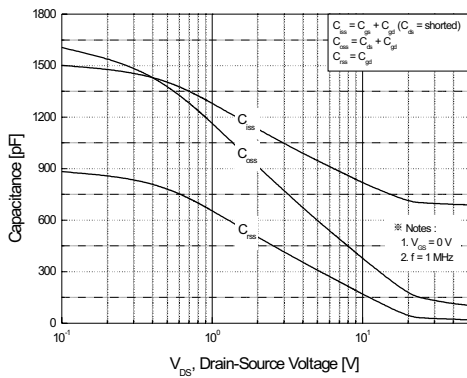Variation vs. Source Current
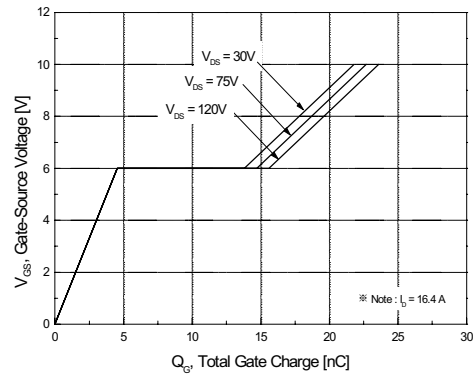and Temperature**

Figure 5. Capacitance Characteristics

Figure 6. Gate Charge Characteristics

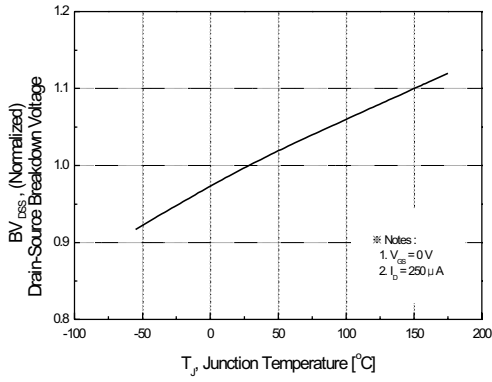# Typical Characteristics (Continued)

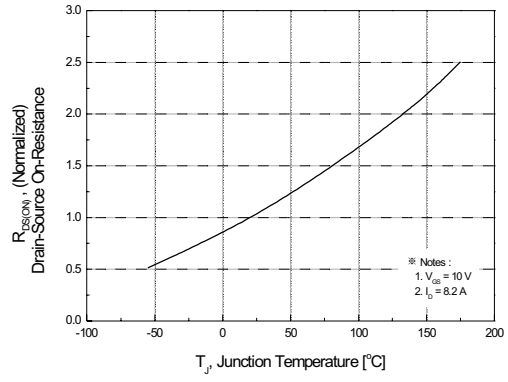**Figure 7. Breakdown Voltage Variation vs. Temperature**

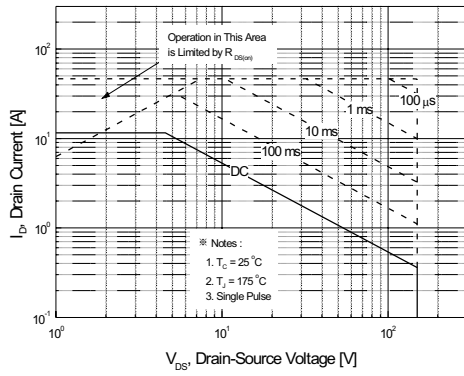**Figure 8. On-Resistance Variation vs. Temperature**
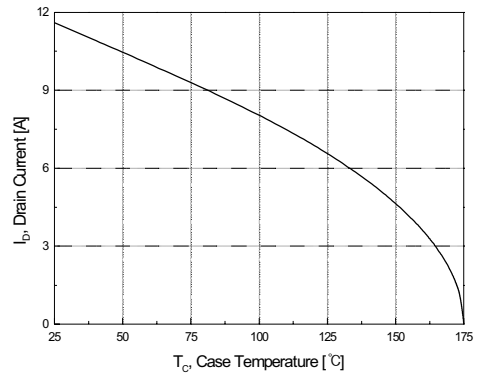

Figure 9. Maximum Safe Operating Area
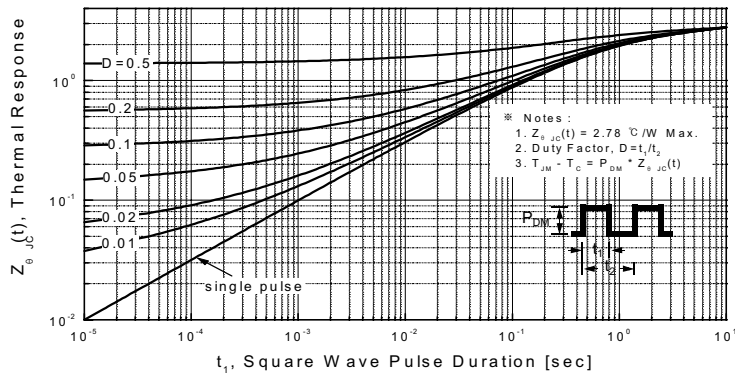

Figure 10. Maximum Drain Current vs. Case Temperature

Figure 11. Transient Thermal Response Curve

Gate Charge Test Circuit & Waveform

Same Type as DUT

12V 200nF 50KΩ 300nF

V_{GS}

DUT

3mA

V_{DS}

V_{GS}

10V

Q_g

Q_{gs} Q_{gd}

Charge

Resistive Switching Test Circuit & Waveforms

V_{DS} R_L

V_{GS}

R_G

V_{DD}

DUT

10V

V_{DS} 90%

V_{GS} 10%

$t_{d(on)}$ t_r $t_{d(off)}$ t_f

t_{on} t_{off}
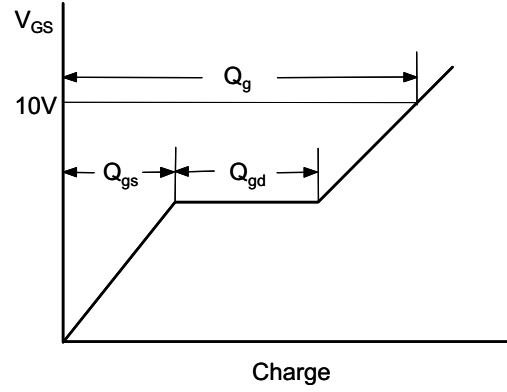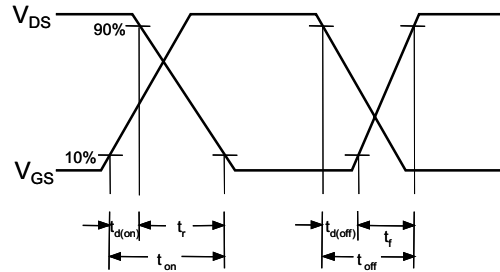
Unclamped Inductive Switching Test Circuit & Waveforms

V_{DS} L

I_D

R_G

V_{DD}

DUT

10V

t_p

$$E_{AS} = \frac{1}{2} \, L\, I_{AS}^2 \; \frac{BV_{DSS}}{BV_{DSS} - V_{DD}}$$

BV_{DSS}

I_{AS}

$I_D(t)$

V_{DD} $V_{DS}(t)$

t_p Time

Peak Diode Recovery dv/dt Test Circuit & Waveforms

DUT

+

V_{DS}

−

I_{SD}

L

Driver

R_G

Same Type
as DUT

V_{DD}

V_{GS}

• dv/dt controlled by R_G
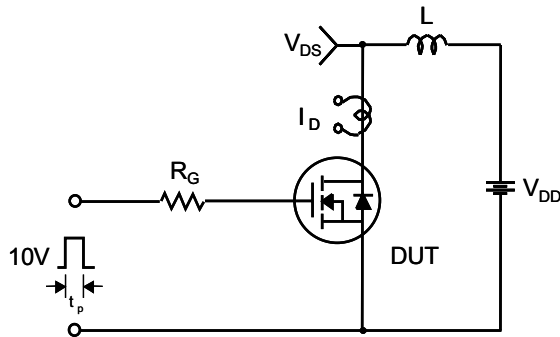• I_{SD} controlled by pulse period

V_{GS}
(Driver)

$$D = \frac{\text{Gate Pulse Width}}{\text{Gate Pulse Period}}$$

10V

I_{SD}
(DUT)

I_{FM} , Body Diode Forward Current

di/dt

I_{RM}

Body Diode Reverse Current

V_{DS}
(DUT)

Body Diode Recovery dv/dt

V_{SD}

V_{DD}

Body Diode
Forward Voltage Drop

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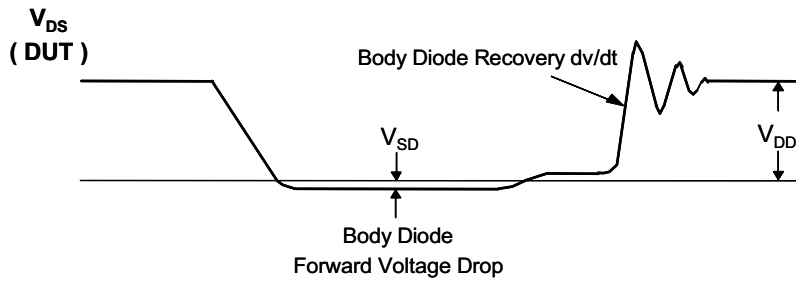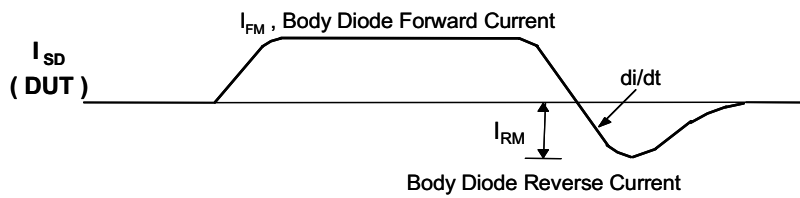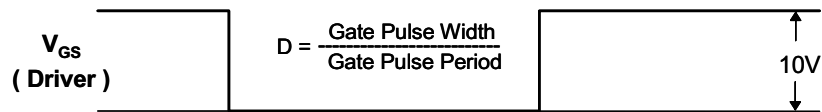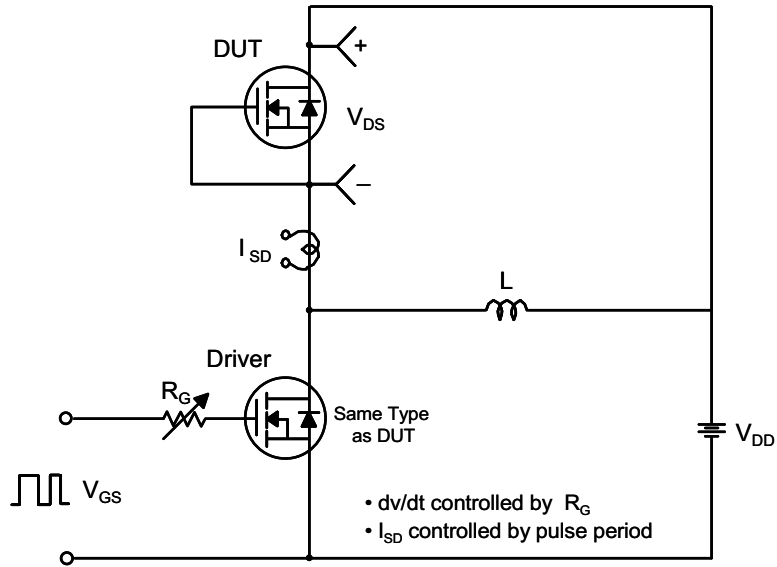
Package Dimensions

TO-220F

10.16 ±0.20

(7.00)

ø3.18 ±0.10

3.30 ±0.10

2.54 ±0.20

(0.70)

6.68 ±0.20

15.87 ±0.20

15.80 ±0.20

(1.00x45°)

MAX1.47

0.80 ±0.10

(30°)

9.75 ±0.30

0.35 ±0.10

#1

0.50 $^{+0.10}_{-0.05}$

2.76 ±0.20

2.54TYP
[2.54 ±0.20]

2.54TYP
[2.54 ±0.20]

9.40 ±0.20

4.70 ±0.20

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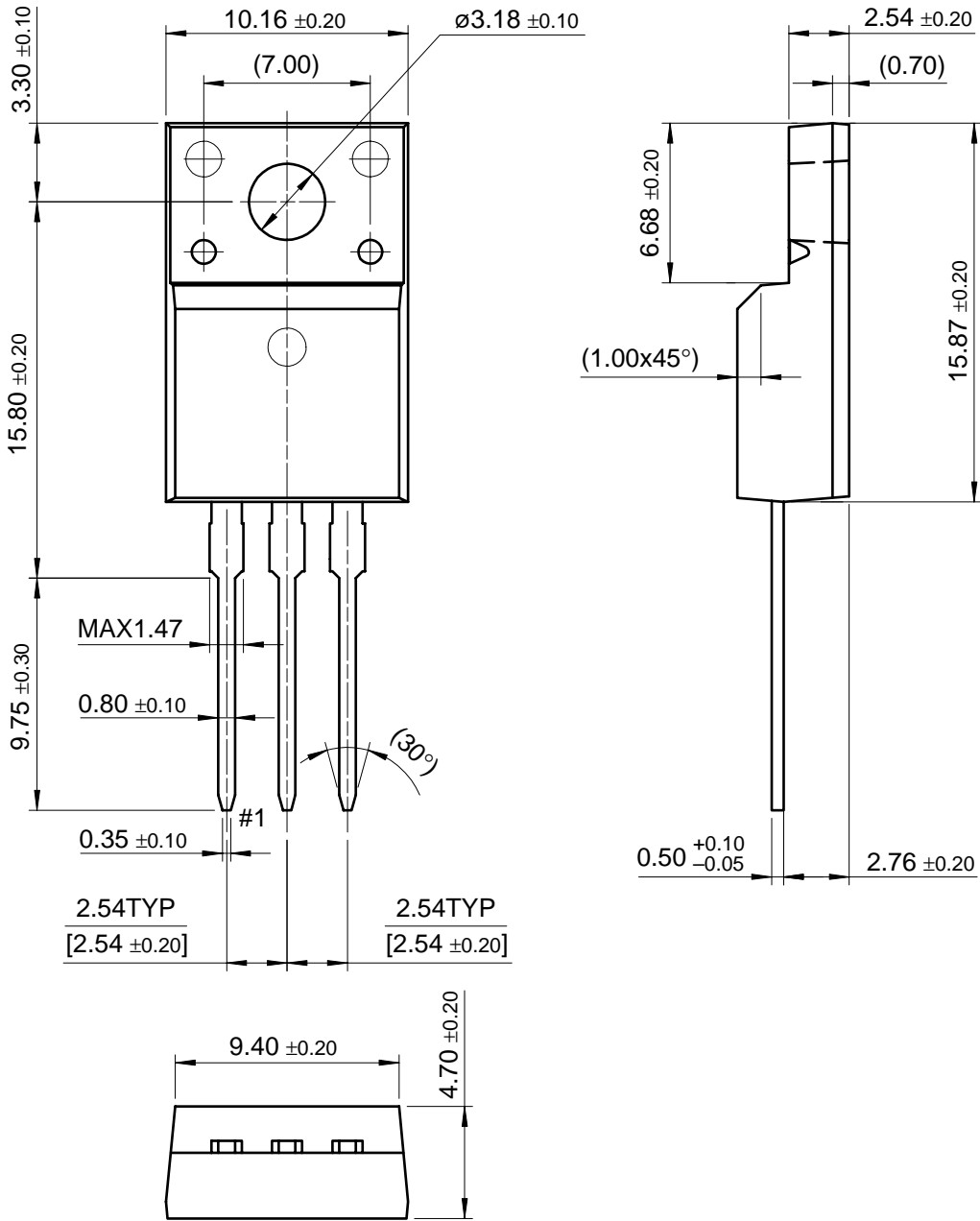
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E^{2}CMOS™	PowerTrench$^®$	VCX™
FACT™	QFET™	
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FAST$^®$	Quiet Series™	
FASTr™	SuperSOT™-3	
GTO™	SuperSOT™-6	

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No Identification Needed	Full Production	This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design.
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