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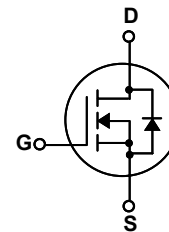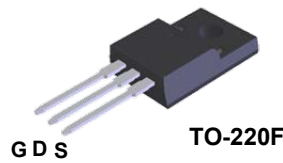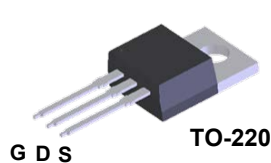# FQP16N25C / FQPF16N25C

N-Channel QFET® MOSFET

250 V, 15.6 A, 270 mΩ

Description

This N-Channel enhancement mode power MOSFET is produced using Fairchild Semiconductor®'s proprietary planar stripe and DMOS technology. This advanced MOSFET technology has been especially tailored to reduce on-state resistance, and to provide superior switching performance and high avalanche energy strength. These devices are suitable for switched mode power supplies, active power factor correction (PFC), and electronic lamp ballasts.

Features

- 15.6 A, 250 V, $R_{DS(on)}$=270 mΩ(Max.)@V_{GS}=10 V, I_D=7.8 A
- Low Gate Charge (Typ. 41 nC)
- Low C_{rss} (Typ. 68 pF)
- 100% Avalanche Tested

G D S **TO-220**

G D S **TO-220F**

Absolute Maximum Ratings T_C = 25°C unless otherwise noted

Symbol	Parameter			FQP16N25C	FQPF16N25C	Unit
V_{DSS}	Drain-Source Voltage			250		V
I_D	Drain Current	- Continuous (T_C = 25°C)		15.6	15.6 *	A
		- Continuous (T_C = 100°C)		9.8	9.8 *	A
I_{DM}	Drain Current	- Pulsed	(Note 1)	62.4	62.4 *	A
V_{GSS}	Gate-Source Voltage			± 30		V
E_{AS}	Single Pulsed Avalanche Energy	(Note 2)		410		mJ
I_{AR}	Avalanche Current	(Note 1)		15.6		A
E_{AR}	Repetitive Avalanche Energy	(Note 1)		13.9		mJ
dv/dt	Peak Diode Recovery dv/dt	(Note 3)		5.5		V/ns
P_D	Power Dissipation (T_C = 25°C)			139	43	W
	- Derate above 25°C			1.11	0.34	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

* Drain current limited by maximum junction temperature.

Thermal Characteristics

Symbol	Parameter	FQP16N25C	FQPF16N25C	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	0.9	2.89	°C/W
$R_{\theta JS}$	Thermal Resistance, Case-to-Sink Typ.	0.5	--	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	62.5	62.5	°C/W

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Electrical Characteristics T_C = 25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
Off Characteristics						
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} = 0 V, I_D = 250 μA	250	--	--	V
ΔBV_{DSS} / ΔT_J	Breakdown Voltage Temperature Coefficient	I_D = 250 μA, Referenced to 25°C	--	0.31	--	V/°C
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 250 V, V_{GS} = 0 V	--	--	10	μA
		V_{DS} = 200 V, T_C = 125°C	--	--	100	μA
I_{GSSF}	Gate-Body Leakage Current, Forward	V_{GS} = 30 V, V_{DS} = 0 V	--	--	100	nA
I_{GSSR}	Gate-Body Leakage Current, Reverse	V_{GS} = -30 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 = 7.8 A	--	0.22	0.27	Ω
g_{FS}	Forward Transconductance	V_{DS} = 40 V, I_D = 7.8 A (Note 4)	--	10.5	--	S
Dynamic Characteristics						
C_{iss}	Input Capacitance	V_{DS} = 25 V, V_{GS} = 0 V, f = 1.0 MHz	--	830	1080	pF
C_{oss}	Output Capacitance		--	170	220	pF
C_{rss}	Reverse Transfer Capacitance		--	68	89	pF
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	V_{DD} = 125 V, I_D = 15.6 A, R_G = 25 Ω	--	15	40	ns
t_r	Turn-On Rise Time		--	130	270	ns
$t_{d(off)}$	Turn-Off Delay Time		--	135	280	ns
t_f	Turn-Off Fall Time	(Note 4, 5)	--	105	220	ns
Q_g	Total Gate Charge	V_{DS} = 200 V, I_D = 15.6 A, V_{GS} = 10 V	--	41	53.5	nC
Q_{gs}	Gate-Source Charge		--	5.6	--	nC
Q_{gd}	Gate-Drain Charge	(Note 4, 5)	--	22.7	--	nC
Drain-Source Diode Characteristics and Maximum Ratings						
I_S	Maximum Continuous Drain-Source Diode Forward Current		--	--	15.6	A
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current		--	--	62.4	A
V_{SD}	Drain-Source Diode Forward Voltage	V_{GS} = 0 V, I_S = 15.6 A	--	--	1.5	V
t_{rr}	Reverse Recovery Time	V_{GS} = 0 V, I_S = 15.6 A,	--	260	--	ns
Q_{rr}	Reverse Recovery Charge	dI_F / dt = 100 A/μs (Note 4)	--	2.47	--	μC

Notes:
1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. L = 2.7mH, I_{AS} = 15.6A, V_{DD} = 50V, R_G = 25 Ω, Starting T_J = 25°C
3. I_{SD} ≤ 15.6A, di/dt ≤ 300A/μs, V_{DD} ≤ BV_{DSS}, Starting T_J = 25°C
4. Pulse Test : Pulse width ≤ 300μs, Duty cycle ≤ 2%
5. Essentially independent of operating temperature
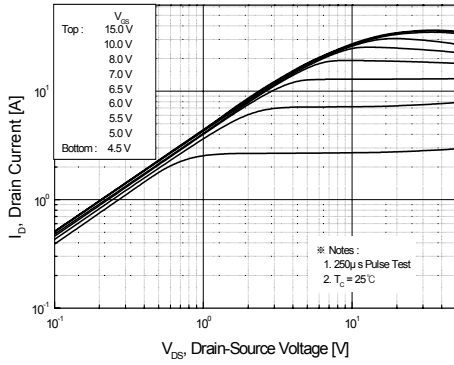
Typical Characteristics

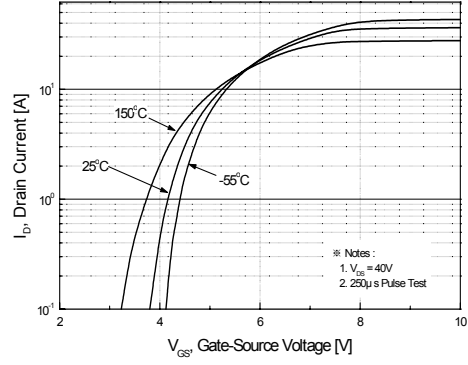**Figure 1. On-Region Characteristics**
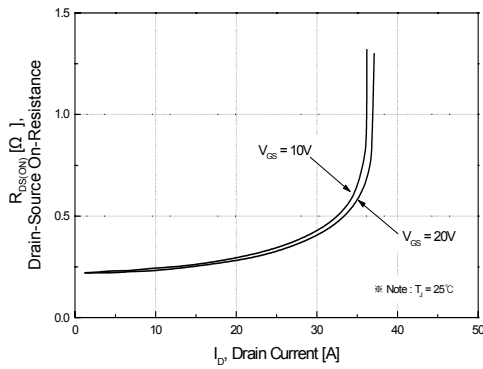
Figure 2. Transfer Characteristics

Figure 3. On-Resistance Variation vs Drain Current and Gate Voltage
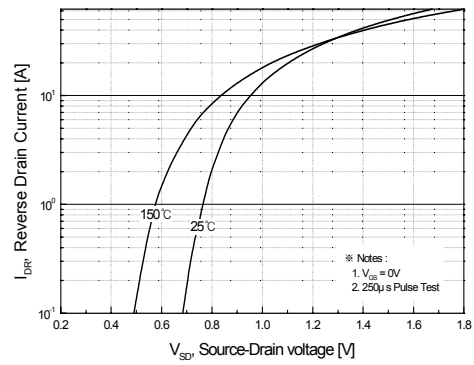
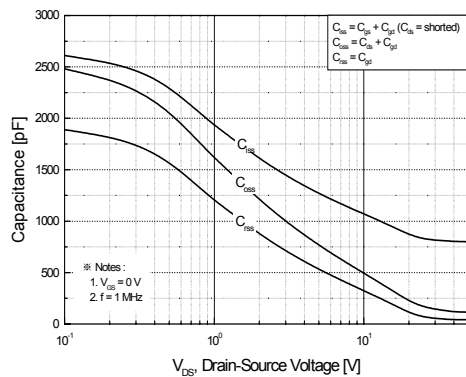**Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature**
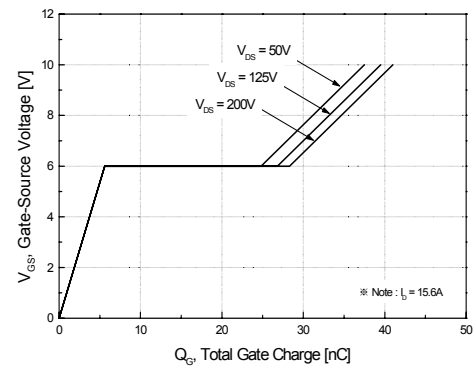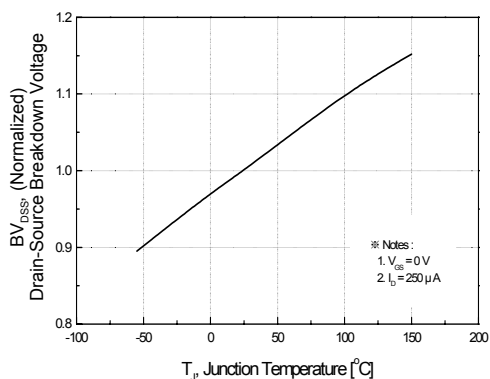
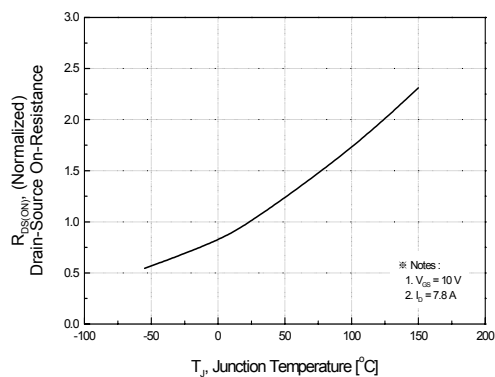**Figure 5. Capacitance Characteristics**

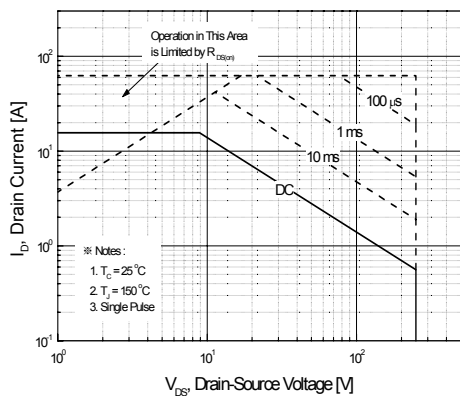**Figure 6. Gate Charge Characteristics**

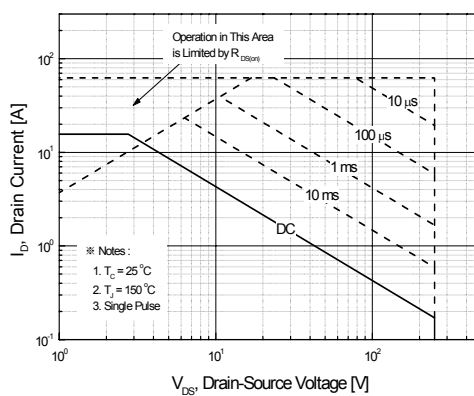## Typical Characteristics (Continued)

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

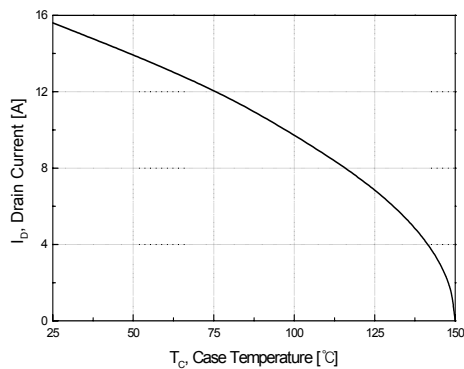**Figure 8. On-Resistance Variation
vs Temperature**

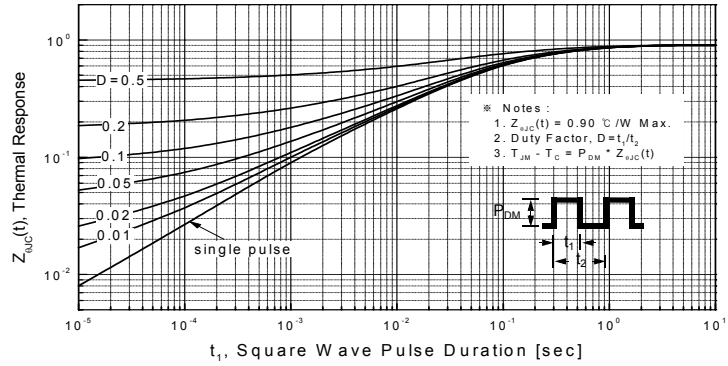**Figure 9-1. Maximum Safe Operating Area
for FQP16N25C**

**Figure 9-2. Maximum Safe Operating Area
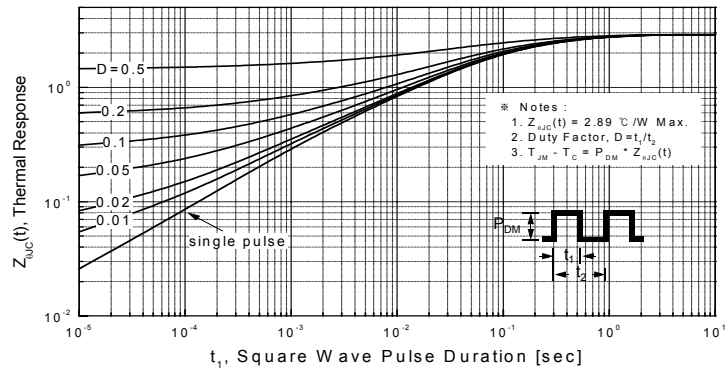for FQPF16N25C**

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

Typical Characteristics (Continued)

Figure 11-1. Transient Thermal Response Curve for FQP16N25C

Figure 11-2. Transient Thermal Response Curve for FQPF16N25C

Gate Charge Test Circuit & Waveform

Same Type
as DUT

12V   200nF   50KΩ   300nF

V_{GS}

3mA

DUT

V_{DS}

V_{GS}

10V

Q_g

Q_{gs} Q_{gd}

Charge

Resistive Switching Test Circuit & Waveforms

V_{DS} R_L

V_{GS} V_{DD}

R_G

10V   DUT

V_{DS} 90%

V_{GS} 10%

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

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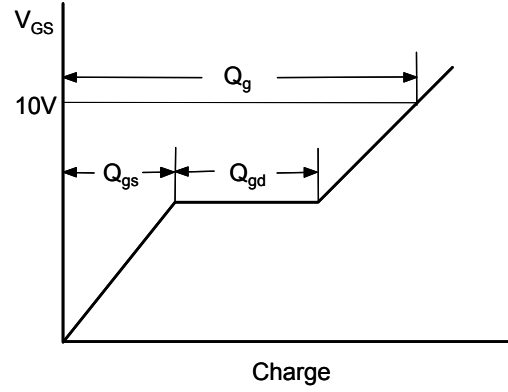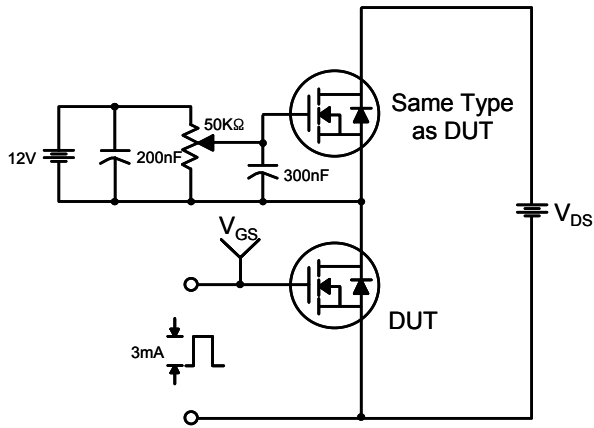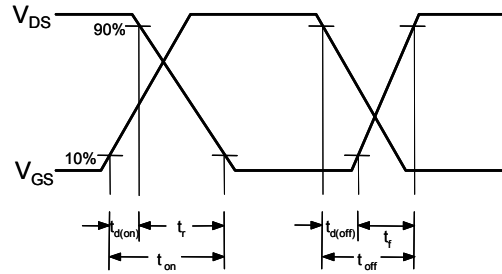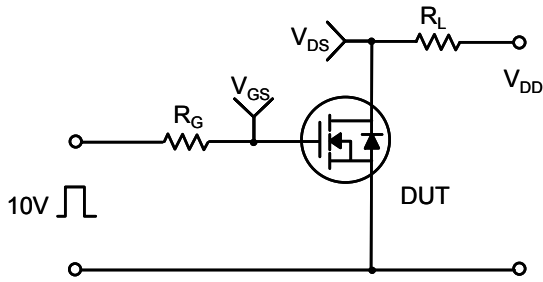
Unclamped Inductive Switching Test Circuit & Waveforms

V_{DS} L

I_D

R_G V_{DD}

10V   DUT

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
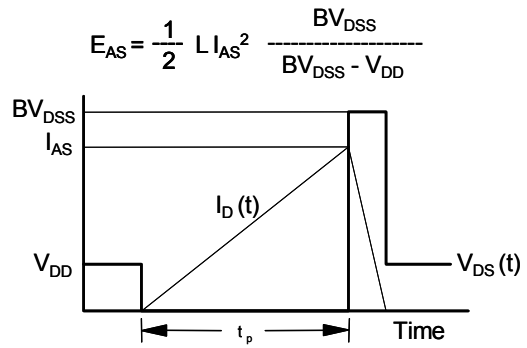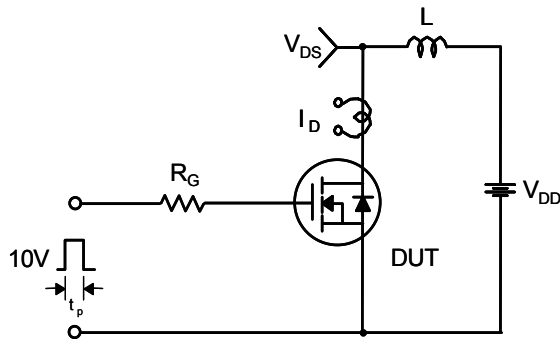
Peak Diode Recovery dv/dt Test Circuit & Waveforms

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)

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

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

Mechanical Dimensions

TO-220

Ø4.09
3.50

⊕ | 0.36 (M) | B | A(M)

A ▸ 10.67
9.65

3.43
2.54

B ▸ 4.83
3.56

"A1"

8.89
6.86

16.51
14.22

6.86
5.84

7°
3°

△13.40
12.19

△9.40
8.38

1 2 3

C

6.35 MAX

5°
3°

5°
3°

3 2 1

14.73
12.70

(1.91)

1.78
1.14

1.02
0.38

0.61
△0.33

2.54

⊕ | 0.36 (M) | B | A(M)

5.08

2.92
2.03

NOTES: UNLESS OTHERWISE SPECIFIED
 A) REFERENCE JEDEC, TO-220, ISSUE K,
      VARIATION AB, DATED APRIL, 2002.
 B) ALL DIMENSIONS ARE IN MILLIMETERS.
 C) DIMENSIONING AND TOLERANCING PER
      ANSI Y14,5 - 1973
 D) LOCATION OF THE PIN HOLE MAY VARY
      (LOWER LEFT CORNER, LOWER CENTER
      AND CENTER OF THE PACKAGE)
 E) DOES NOT COMPLY JEDEC STANDARD VALUE,
 F) "A1" DIMENSIONS REPRESENT LIKE BELOW:
      SINGLE GAUGE = 0.51 - 0.61
      DUAL GAUGE   = 1,14 - 1,40
 G) DRAWING FILE NAME: TO220B03REV6

5°
3°

5°
3°

Dimensions in
Millimeters

Mechanical Dimensions

TO-220F

A

B 10.36
9.96

(7.00)

⌀ 3.28
3.08

SEE NOTE "F"

3.40
3.20

16.00
15.60

(3.23) B

1   3

1.47
1.24

(2.14)

0.90
0.70

10.05
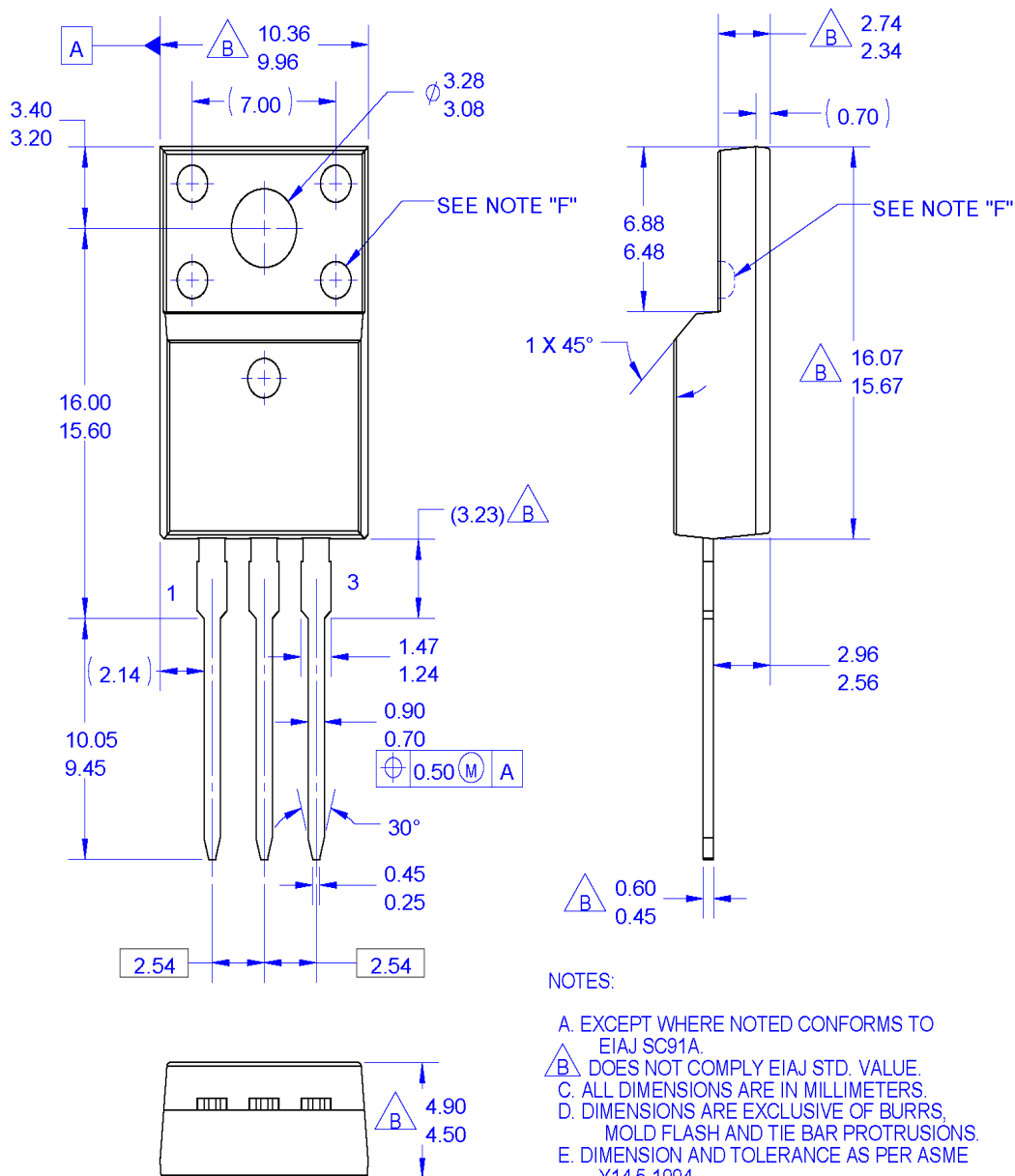9.45

⊕ 0.50 Ⓜ A

30°

0.45
0.25

2.54   2.54

B 2.74
2.34

(0.70)

6.88
6.48

SEE NOTE "F"

1 X 45°

B 16.07
15.67

2.96
2.56

B 0.60
0.45

B 4.90
4.50

NOTES:

A. EXCEPT WHERE NOTED CONFORMS TO
   EIAJ SC91A.
B. DOES NOT COMPLY EIAJ STD. VALUE.
C. ALL DIMENSIONS ARE IN MILLIMETERS.
D. DIMENSIONS ARE EXCLUSIVE OF BURRS,
   MOLD FLASH AND TIE BAR PROTRUSIONS.
E. DIMENSION AND TOLERANCE AS PER ASME
   Y14.5-1994.
F. OPTION 1 - WITH SUPPORT PIN HOLE.
   OPTION 2 - NO SUPPORT PIN HOLE.
G. DRAWING FILE NAME: TO220M03REV3

Dimensions in Millimeters

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Preliminary	First Production	Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
No Identification Needed	Full Production	Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.
Obsolete	Not In Production	Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only.

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