FAIRCHILD™

Is Now Part of

ON Semiconductor®

To learn more about ON Semiconductor, please visit our website at
www.onsemi.com

Please note: As part of the Fairchild Semiconductor integration, some of the Fairchild orderable part numbers will need to change in order to meet ON Semiconductor's system requirements. Since the ON Semiconductor product management systems do not have the ability to manage part nomenclature that utilizes an underscore (_), the underscore (_) in the Fairchild part numbers will be changed to a dash (-). This document may contain device numbers with an underscore (_). Please check the ON Semiconductor website to verify the updated device numbers. The most current and up-to-date ordering information can be found at www.onsemi.com. Please email any questions regarding the system integration to Fairchild_questions@onsemi.com.

December 2013

FQP2P40

P-Channel QFET® MOSFET
**-400 V, -2.0 A, 6.5 Ω**

Description

These P-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 electronic lamp ballast based on complimentary half bridge.

Features

- -2.0 A, -400 V, $R_{DS(on)}$ = 6.5 Ω (Max.) @ V_{GS} = -10 V
- Low Gate Charge (Typ. 10 nC)
- Low Crss (Typ. 6.5 pF)
- Fast Switching
- 100% Avalanche Tested
- Improved dv/dt Capability

TO-220
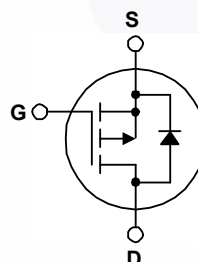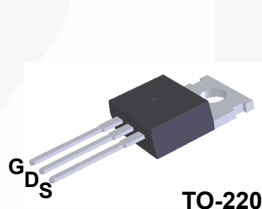
Absolute Maximum Ratings
T_C = 25°C unless otherwise noted.

Symbol	Parameter			FQP2P40_F080	Unit
V_{DSS}	Drain-Source Voltage			-400	V
I_D	Drain Current	- Continuous (T_C = 25°C)		-2.0	A
		- Continuous (T_C = 100°C)		-1.27	A
I_{DM}	Drain Current	- Pulsed	(Note 1)	-8.0	A
V_{GSS}	Gate-Source Voltage			± 30	V
E_{AS}	Single Pulsed Avalanche Energy		(Note 2)	120	mJ
I_{AR}	Avalanche Current		(Note 1)	-2.0	A
E_{AR}	Repetitive Avalanche Energy		(Note 1)	6.3	mJ
dv/dt	Peak Diode Recovery dv/dt		(Note 3)	-4.5	V/ns
P_D	Power Dissipation (T_C = 25°C)			63	W
		- Derate Above 25°C		0.51	W/°C
T_J, T_{STG}	Operating and Storage Temperature Range			-55 to +150	°C
T_L	Maximum Lead Temperature for Soldering, 1/8" from Case for 5 Seconds			300	°C

Thermal Characteristics

Symbol	Parameter	FQP2P40_F080	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case, Max.	1.98	°C/W
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink, Typ.	0.5	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient, Max.	62.5	°C/W

Package Marking and Ordering Information

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FQP2P40_F080	FQP2P40	TO-220	Tube	N/A	N/A	50 units

Elerical 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	-400	--	--	V
ΔBV_{DSS} / ΔT_J	Breakdown Voltage Temperature Coefficient	$I_D = -250$ μA, Referenced to 25°C	--	-	--	V/°C
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = -400$ V, $V_{GS} = 0$ V	--	--	-1	μA
		$V_{DS} = -320$ V, $T_C = 125°C$	--	--	-10	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	-3.0	--	-5.0	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = -10$ V, $I_D = -1.0$ A	--	5.0	6.5	Ω
g_{FS}	Forward Transconductance	$V_{DS} = -50$ V, $I_D = -1.0$ A	--	1.42	--	S
Dynamic Characteristics						
C_{iss}	Input Capacitance	$V_{DS} = -25$ V, $V_{GS} = 0$ V, f = 1.0 MHz	--	270	350	pF
C_{oss}	Output Capacitance		--	45	60	pF
C_{rss}	Reverse Transfer Capacitance		--	6.5	8.5	pF
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = -200$ V, $I_D = -2.0$ A, $V_{GS} = -10$ V, $R_G = 25$ Ω	--	9	30	ns
t_r	Turn-On Rise Time		--	33	75	ns
$t_{d(off)}$	Turn-Off Delay Time		--	22	55	ns
t_f	Turn-Off Fall Time	(Note 4)	--	25	60	ns
Q_g	Total Gate Charge	$V_{DS} = -320$ V, $I_D = -2.0$ A, $V_{GS} = -10$ V	--	10	13	nC
Q_{gs}	Gate-Source Charge		--	2.1	--	nC
Q_{gd}	Gate-Drain Charge	(Note 4)	--	5.5	--	nC
Drain-Source Diode Characteristics and Maximum Ratings						
I_S	Maximum Continuous Drain-Source Diode Forward Current		--	--	-2.0	A
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current		--	--	-8.0	A
V_{SD}	Drain-Source Diode Forward Voltage	$V_{GS} = 0$ V, $I_S = -2.0$ A	--	--	-5.0	V
t_{rr}	Reverse Recovery Time	$V_{GS} = 0$ V, $I_S = -2.0$ A, $dI_F / dt = 100$ A/μs	--	250	--	ns
Q_{rr}	Reverse Recovery Charge		--	0.85	--	μC

Notes:

1. Repetitive rating : pulse-width limited by maximum junction temperature.
2. L = 52.5 mH, $I_{AS} = -2.0$ A, $V_{DD} = -50$ V, $R_G = 25$ Ω, Starting $T_J = 25°C$.
3. $I_{SD} \leq -2.0$ A, di/dt ≤ 200 A/μs, $V_{DD} \leq BV_{DSS}$, Starting $T_J = 25°C$.
4. Essentially independent of operating temperature.
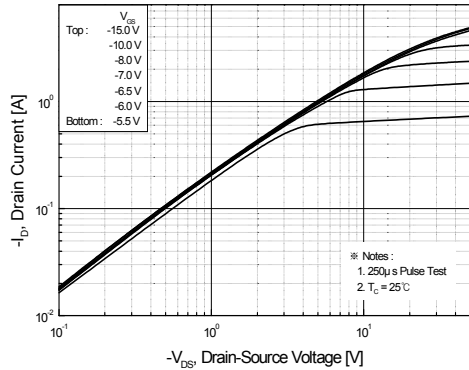
Typical Performance Characteristics
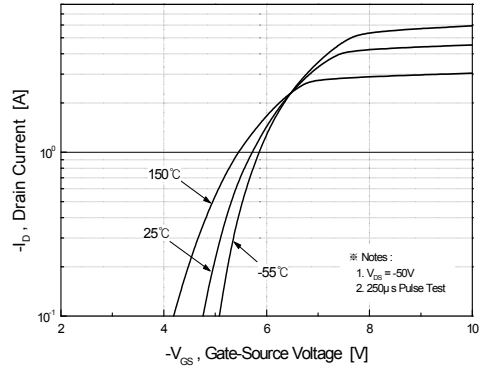
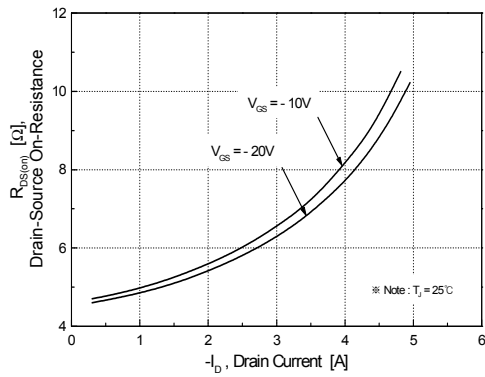Figure 1. On-Region Characteristics

Figure 2. Transfer Characteristics

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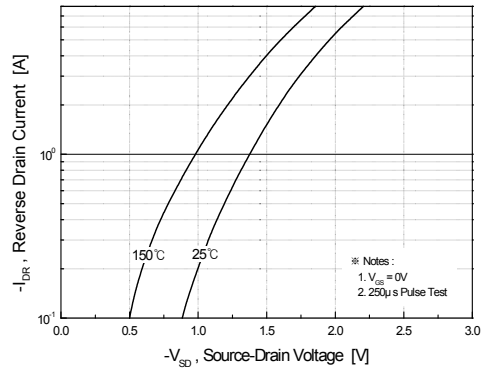Drain Current and Gate Voltage

Figure 4. Body Diode Forward Voltage
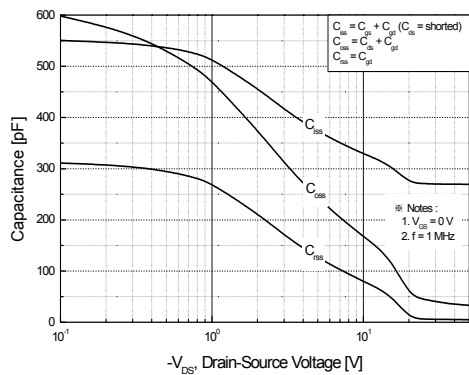Variation vs. Source Current
and Temperature
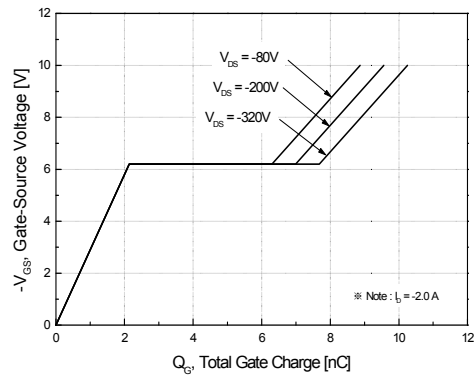
Figure 5. Capacitance Characteristics

Figure 6. Gate Charge Characteristics

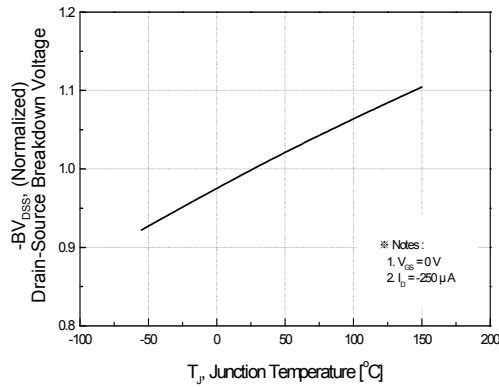## Typical Performance Characteristics (Continued)

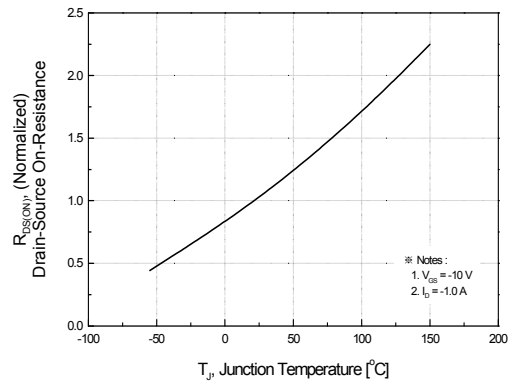Figure 7. Breakdown Voltage Variation vs. Temperature

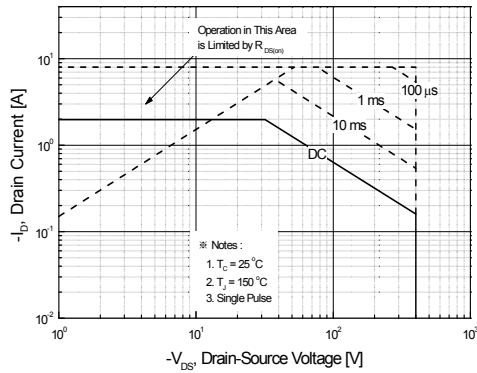Figure 8. On-Resistance Variation vs. Temperature
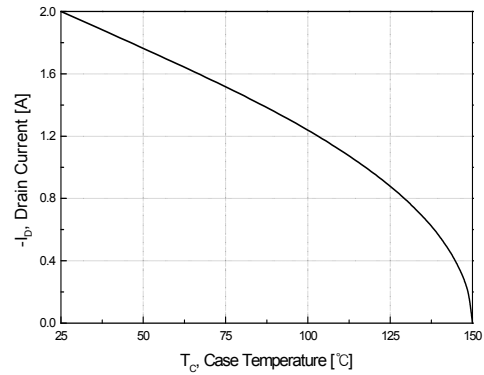

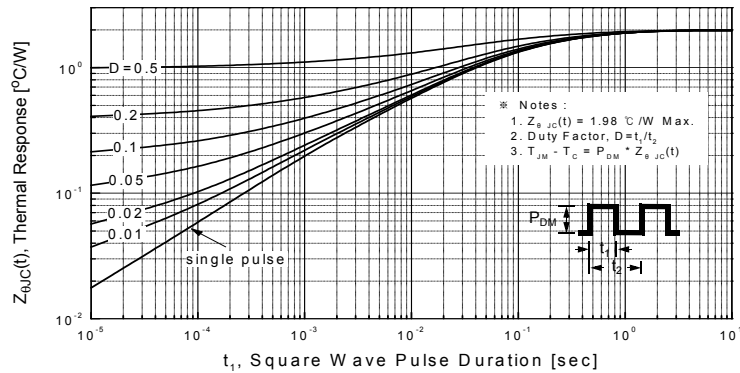Figure 9. Maximum Safe Operating Area

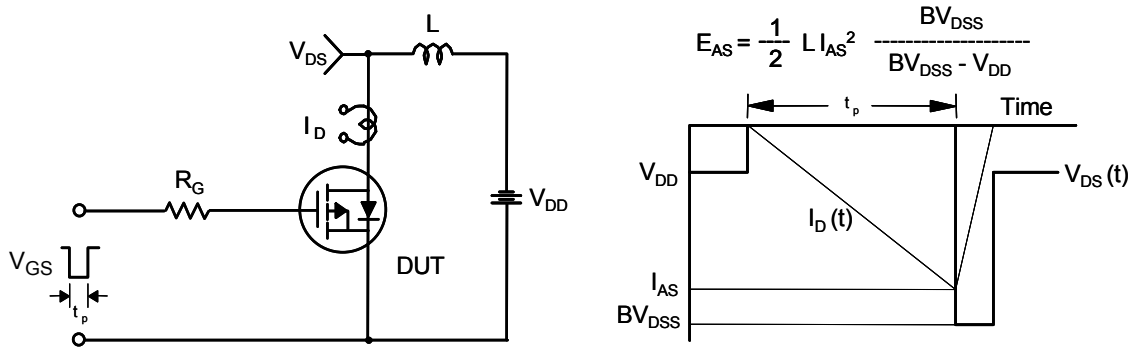Figure 10. Maximum Drain Current vs. Case Temperature

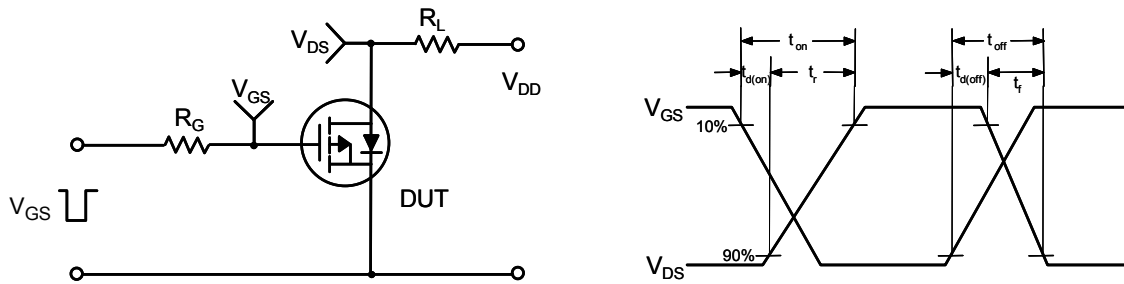Figure 11. Transient Thermal Response Curve

Figure 12. Gate Charge Test Circuit & Waveform

Figure 13. Resistive Switching Test Circuit & Waveforms

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

Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

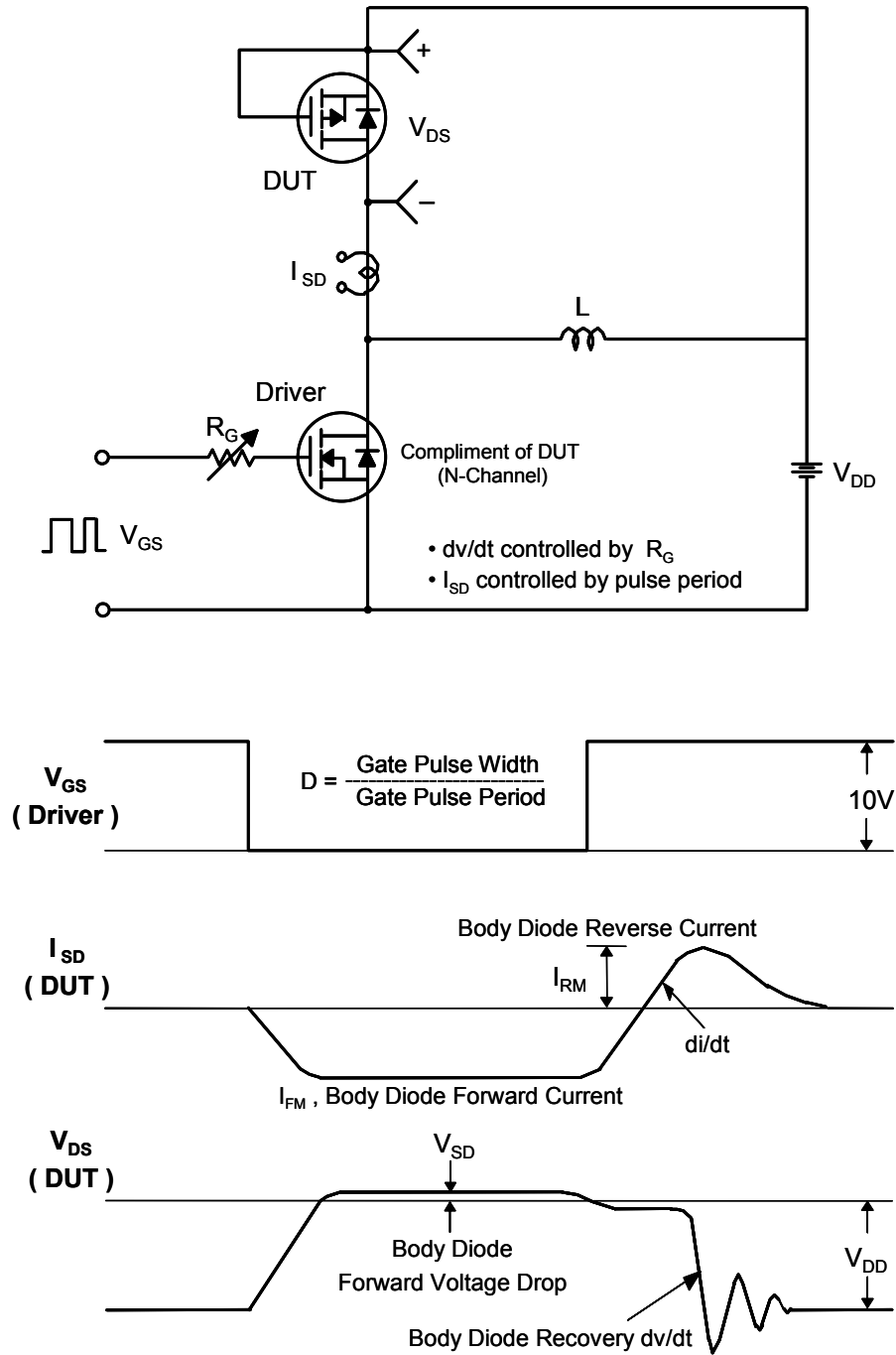$$D = \frac{\text{Gate Pulse Width}}{\text{Gate Pulse Period}}$$
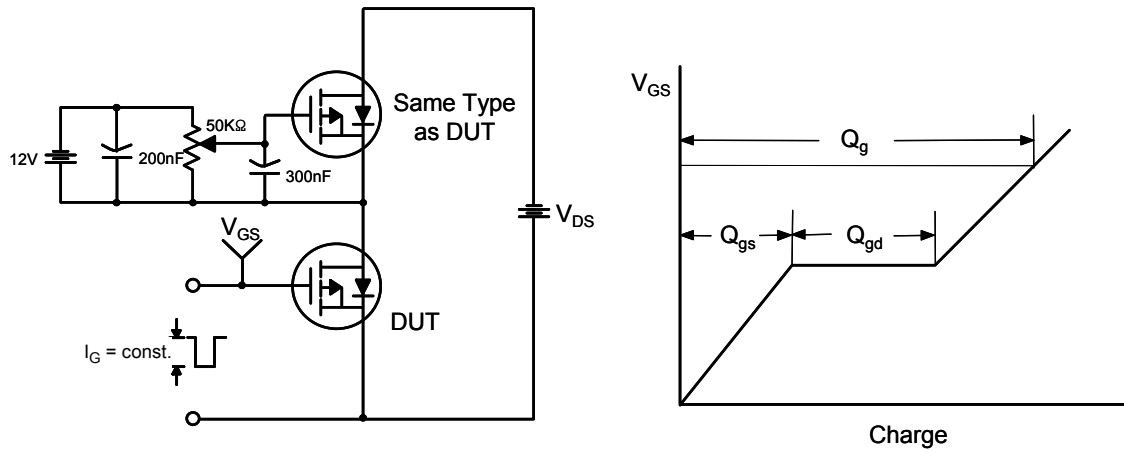
Figure 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms

Mechanical Dimensions
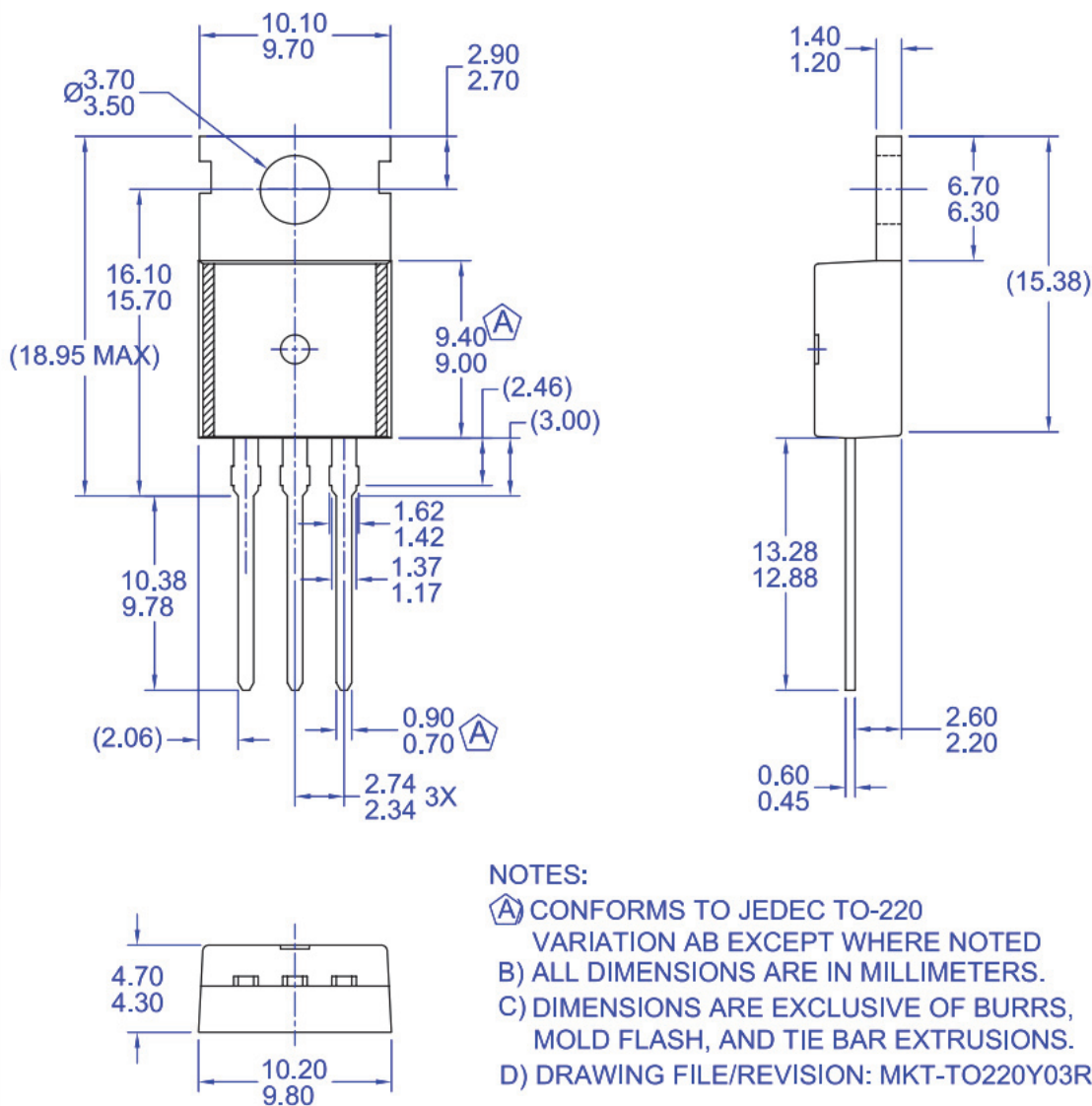
Figure 16. TO220, Molded, 3-Lead, Jedec Variation AB

NOTES:

A) CONFORMS TO JEDEC TO-220 VARIATION AB EXCEPT WHERE NOTED
B) ALL DIMENSIONS ARE IN MILLIMETERS.
C) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
D) DRAWING FILE/REVISION: MKT-TO220Y03REV1

Package drawings are provided as a service to customers considering Fairchild components. Drawings may change in any manner without notice. Please note the revision and/or date on the drawing and contact a Fairchild Semiconductor representative to verify or obtain the most recent revision. Package specifications do not expand the terms of Fairchild's worldwide terms and conditions, specifically the warranty therein, which covers Fairchild products.

Always visit Fairchild Semiconductor's online packaging area for the most recent package drawings:

http://www.fairchildsemi.com/package/packageDetails.html?id=PN_TO220-003

TRADEMARKS

The following includes registered and unregistered trademarks and service marks, owned by Fairchild Semiconductor and/or its global subsidiaries, and is not intended to be an exhaustive list of all such trademarks.

AccuPower™
AX-CAP®*
BitSiC™
Build it Now™
CorePLUS™
CorePOWER™
CROSSVOLT™
CTL™
Current Transfer Logic™
DEUXPEED®
Dual Cool™
EcoSPARK®
EffcientMax™
ESBC™

Fairchild®
Fairchild Semiconductor®
FACT Quiet Series™
FACT®
FAST®
FastvCore™
FETBench™
FPS™

F-PFS™
FRFET®
Global Power Resource℠
GreenBridge™
Green FPS™
Green FPS™ e-Series™
Gmax™
GTO™
IntelliMAX™
ISOPLANAR™
Marking Small Speakers Sound Louder and Better™
MegaBuck™
MICROCOUPLER™
MicroFET™
MicroPak™
MicroPak2™
MillerDrive™
MotionMax™
mWSaver®
OptoHiT™
OPTOLOGIC®
OPTOPLANAR®

®
PowerTrench®
PowerXS™
Programmable Active Droop™
QFET®
QS™
Quiet Series™
RapidConfigure™

™
Saving our world, 1mW/W/kW at a time™
SignalWise™
SmartMax™
SMART START™
Solutions for Your Success™
SPM®
STEALTH™
SuperFET®
SuperSOT™-3
SuperSOT™-6
SuperSOT™-8
SupreMOS®
SyncFET™

Sync-Lock™

SYSTEM GENERAL ®*
TinyBoost®
TinyBuck®
TinyCalc™
TinyLogic®
TINYOPTO™
TinyPower™
TinyPWM™
TinyWire™
TranSiC™
TriFault Detect™
TRUECURRENT®*
µSerDes™

μSerDes™
UHC®
Ultra FRFET™
UniFET™
VCX™
VisualMax™
VoltagePlus™
XS™

*Trademarks of System General Corporation, used under license by Fairchild Semiconductor.

DISCLAIMER
FAIRCHILD SEMICONDUCTOR RESERVES THE RIGHT TO MAKE CHANGES WITHOUT FURTHER NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION, OR DESIGN. FAIRCHILD DOES NOT ASSUME ANY LIABILITY ARISING OUT OF THE APPLICATION OR USE OF ANY PRODUCT OR CIRCUIT DESCRIBED HEREIN; NEITHER DOES IT CONVEY ANY LICENSE UNDER ITS PATENT RIGHTS, NOR THE RIGHTS OF OTHERS. THESE SPECIFICATIONS DO NOT EXPAND THE TERMS OF FAIRCHILD'S WORLDWIDE TERMS AND CONDITIONS, SPECIFICALLY THE WARRANTY THEREIN, WHICH COVERS THESE PRODUCTS.

LIFE SUPPORT POLICY
FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF FAIRCHILD SEMICONDUCTOR CORPORATION.

As used here in:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury of the user.

2. A critical component in any component of a life support, device, or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

ANTI-COUNTERFEITING POLICY
Fairchild Semiconductor Corporation's Anti-Counterfeiting Policy. Fairchild's Anti-Counterfeiting Policy is also stated on our external website, www.Fairchildsemi.com, under Sales Support.

Counterfeiting of semiconductor parts is a growing problem in the industry. All manufactures of semiconductor products are experiencing counterfeiting of their parts. Customers who inadvertently purchase counterfeit parts experience many problems such as loss of brand reputation, substandard performance, failed application, and increased cost of production and manufacturing delays. Fairchild is taking strong measures to protect ourselves and our customers from the proliferation of counterfeit parts. Fairchild strongly encourages customers to purchase Fairchild parts either directly from Fairchild or from Authorized Fairchild Distributors who are listed by country on our web page cited above. Products customers buy either from Fairchild directly or from Authorized Fairchild Distributors are genuine parts, have full traceability, meet Fairchild's quality standards for handing and storage and provide access to Fairchild's full range of up-to-date technical and product information. Fairchild and our Authorized Distributors will stand behind all warranties and will appropriately address and warranty issues that may arise. Fairchild will not provide any warranty coverage or other assistance for parts bought from Unauthorized Sources. Fairchild is committed to combat this global problem and encourage our customers to do their part in stopping this practice by buying direct or from authorized distributors.

PRODUCT STATUS DEFINITIONS
Definition of Terms

Datasheet Identification	Product Status	Definition
Advance Information	Formative / In Design	Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
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.

Rev. I66

PUBLICATION ORDERING INFORMATION

© Semiconductor Components Industries, LLC

www.onsemi.com