



Is Now Part of



ON Semiconductor®

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

ON Semiconductor and the ON Semiconductor logo are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.



October 2014

FDD9410_F085

N-Channel Power Trench[®] MOSFET

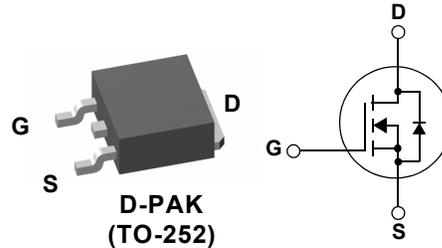
40 V, 50 A, 4.1 mΩ

Features

- Typ $r_{DS(on)} = 3.5\text{ m}\Omega$ at $V_{GS} = 10\text{V}$, $I_D = 50\text{ A}$
- Typ $Q_{g(tot)} = 23.5\text{ nC}$ at $V_{GS} = 10\text{V}$, $I_D = 50\text{ A}$
- UIS Capability
- RoHS Compliant
- Qualified to AEC Q101

Applications

- Automotive Engine Control
- Powertrain Management
- Solenoid and Motor Drivers
- Integrated Starter/alternator
- Primary Switch for 12V Systems



For current package drawing, please refer to the Fairchild website at <https://www.fairchildsemi.com/package-drawings/TO/T0252A03.pdf>

MOSFET Maximum Ratings $T_J = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Conditions	Rated	Units
V_{DSS}	Drain to Source Voltage		40	V
V_{GS}	Gate to Source Voltage		± 20	V
I_D	Drain Current - Continuous ($V_{GS}=10$) (Note 1)	$T_C = 25^\circ\text{C}$	50	A
	Pulsed Drain Current	$T_C = 25^\circ\text{C}$	See Figure4	
E_{AS}	Single Pulse Avalanche Energy	(Note 2)	40	mJ
P_D	Power Dissipation		75	W
	Derate Above 25°C		0.5	W/ $^\circ\text{C}$
T_J, T_{STG}	Operating and Storage Temperature		-55 to + 175	$^\circ\text{C}$
$R_{\theta JC}$	Thermal Resistance Junction to Case		2	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Maximum Thermal Resistance Junction to Ambient	(Note 3)	52	$^\circ\text{C}/\text{W}$

Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FDD9410	FDD9410_F085	D-PAK(TO-252)	13"	12mm	2500 units

Notes:

- 1: Current is limited by bondwire configuration.
- 2: Starting $T_J = 25^\circ\text{C}$, $L = 50\mu\text{H}$, $I_{AS} = 40\text{A}$, $V_{DD} = 40\text{V}$ during inductor charging and $V_{DD} = 0\text{V}$ during time in avalanche.
- 3: $R_{\theta JA}$ is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins. $R_{\theta JC}$ is guaranteed by design while $R_{\theta JA}$ is determined by the user's board design. The maximum rating presented here is based on mounting on a 1 in² pad of 2oz copper.

FDD9410_F085 N-Channel Power Trench[®] MOSFET

Electrical Characteristics $T_J = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
--------	-----------	-----------------	-----	-----	-----	-------

Off Characteristics

$B_{V_{DSS}}$	Drain to Source Breakdown Voltage	$I_D = 250\mu\text{A}, V_{GS} = 0\text{V}$	40	-	-	V
I_{DSS}	Drain to Source Leakage Current	$V_{DS} = 40\text{V}, T_J = 25^\circ\text{C}$	-	-	1	μA
		$V_{GS} = 0\text{V}, T_J = 175^\circ\text{C}(\text{Note 4})$	-	-	1	mA
I_{GSS}	Gate to Source Leakage Current	$V_{GS} = \pm 20\text{V}$	-	-	± 100	nA

On Characteristics

$V_{GS(th)}$	Gate to Source Threshold Voltage	$V_{GS} = V_{DS}, I_D = 250\mu\text{A}$	2.0	3.0	4.0	V
$r_{DS(on)}$	Drain to Source On Resistance	$I_D = 50\text{A}, T_J = 25^\circ\text{C}$	-	3.5	4.1	$\text{m}\Omega$
		$V_{GS} = 10\text{V}, T_J = 175^\circ\text{C}(\text{Note 4})$	-	6.1	7.1	$\text{m}\Omega$

Dynamic Characteristics

C_{iss}	Input Capacitance	$V_{DS} = 25\text{V}, V_{GS} = 0\text{V}, f = 1\text{MHz}$	-	1715	-	pF
C_{oss}	Output Capacitance		-	453	-	pF
C_{rss}	Reverse Transfer Capacitance		-	28	-	pF
R_g	Gate Resistance	$f = 1\text{MHz}$	-	2.3	-	Ω
$Q_{g(ToT)}$	Total Gate Charge at 10V	$V_{GS} = 0$ to 10V	-	23.5	34.5	nC
$Q_{g(th)}$	Threshold Gate Charge	$V_{GS} = 0$ to 2V				
Q_{gs}	Gate to Source Gate Charge	$V_{DD} = 20\text{V}, I_D = 50\text{A}$	-	9.6	-	nC
Q_{gd}	Gate to Drain "Miller" Charge		-	4.4	-	nC

Switching Characteristics

t_{on}	Turn-On Time	$V_{DD} = 20\text{V}, I_D = 50\text{A}, V_{GS} = 10\text{V}, R_{GEN} = 6\Omega$	-	-	38	ns
$t_{d(on)}$	Turn-On Delay Time		-	12	-	ns
t_r	Rise Time		-	12	-	ns
$t_{d(off)}$	Turn-Off Delay Time		-	20	-	ns
t_f	Fall Time		-	9	-	ns
t_{off}	Turn-Off Time		-	-	45	ns

Drain-Source Diode Characteristics

V_{SD}	Source to Drain Diode Voltage	$I_{SD} = 50\text{A}, V_{GS} = 0\text{V}$	-	-	1.25	V
		$I_{SD} = 25\text{A}, V_{GS} = 0\text{V}$	-	-	1.2	V
T_{rr}	Reverse Recovery Time	$I_F = 50\text{A}, dI_{SD}/dt = 100\text{A}/\mu\text{s}$	-	44	58	ns
Q_{rr}	Reverse Recovery Charge	$V_{DD} = 32\text{V}$	-	31.5	41	nC

Note:

4: The maximum value is specified by design at $T_J = 175^\circ\text{C}$. Product is not tested to this condition in production.

Typical Characteristics

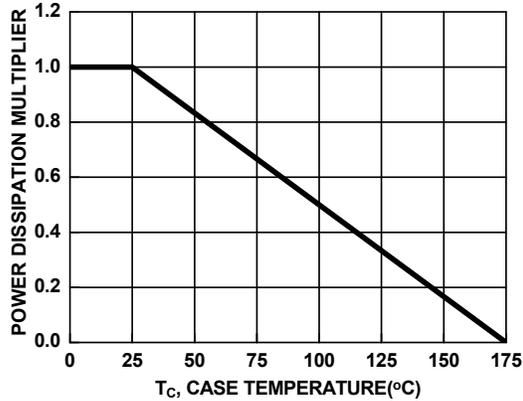


Figure 1. Normalized Power Dissipation vs. Case Temperature

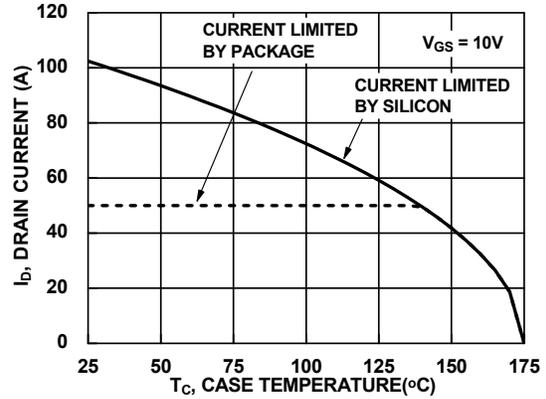


Figure 2. Maximum Continuous Drain Current vs. Case Temperature

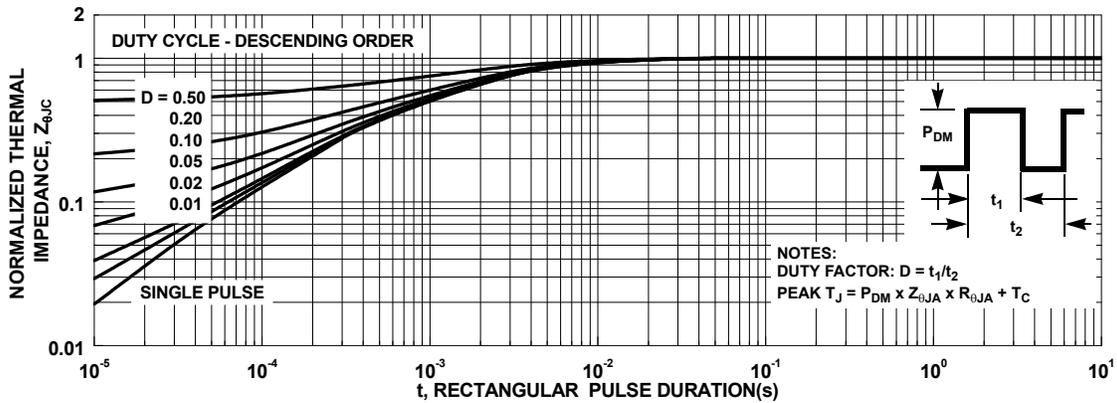


Figure 3. Normalized Maximum Transient Thermal Impedance

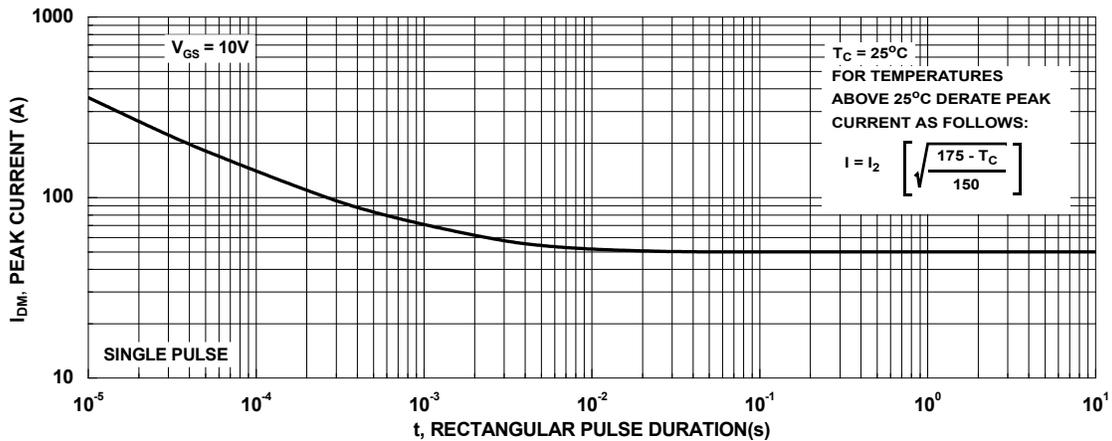


Figure 4. Peak Current Capability

Typical Characteristics

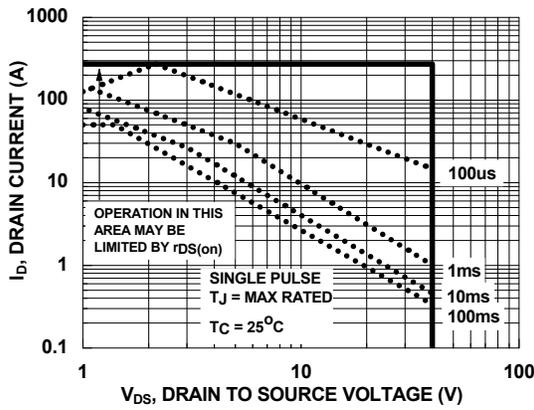
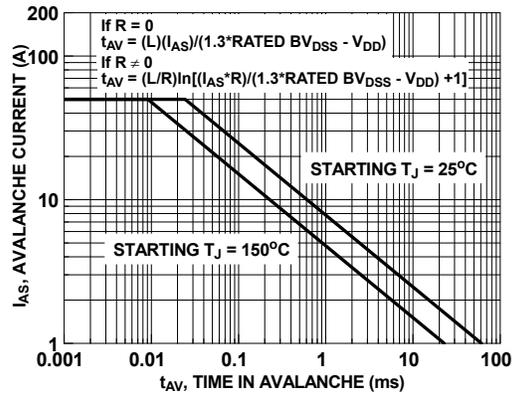


Figure 5. Forward Bias Safe Operating Area



NOTE: Refer to Fairchild Application Notes AN7514 and AN7515

Figure 6. Unclamped Inductive Switching Capability

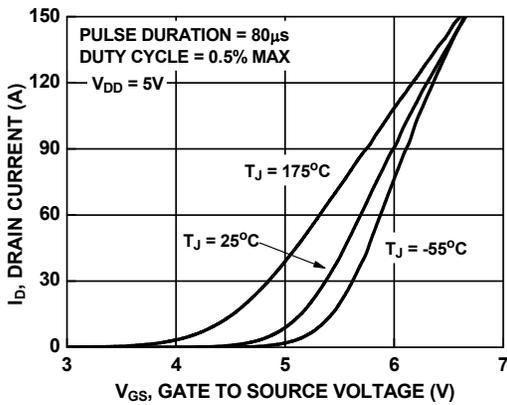


Figure 7. Transfer Characteristics

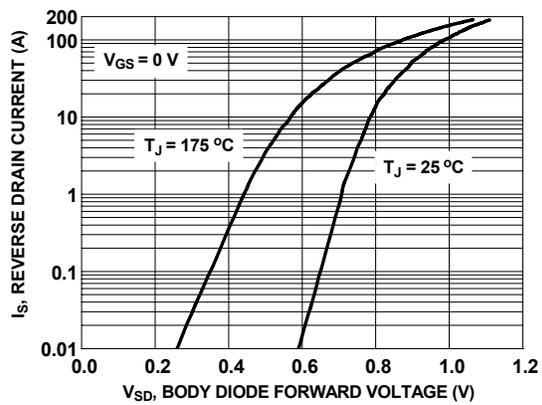


Figure 8. Forward Diode Characteristics

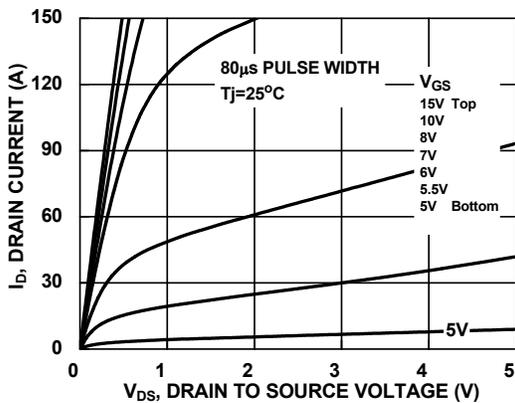


Figure 9. Saturation Characteristics

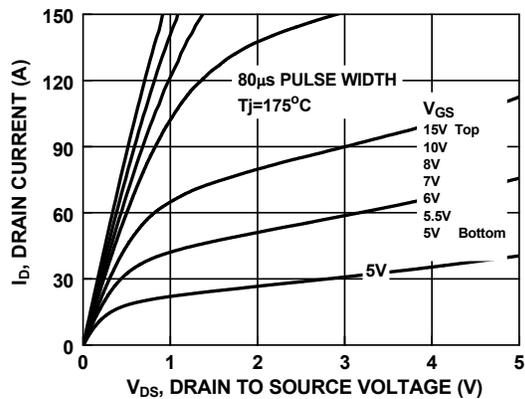


Figure 10. Saturation Characteristics

Typical Characteristics

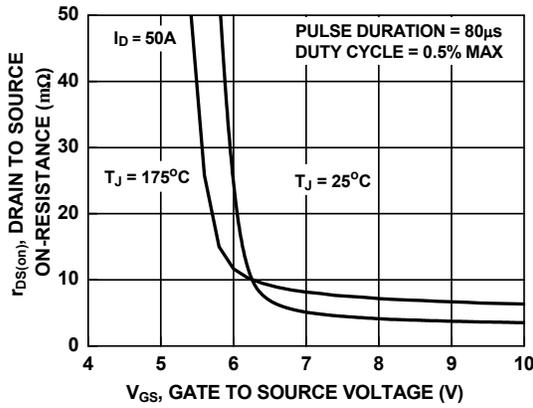


Figure 11. $R_{DS(on)}$ vs. Gate Voltage

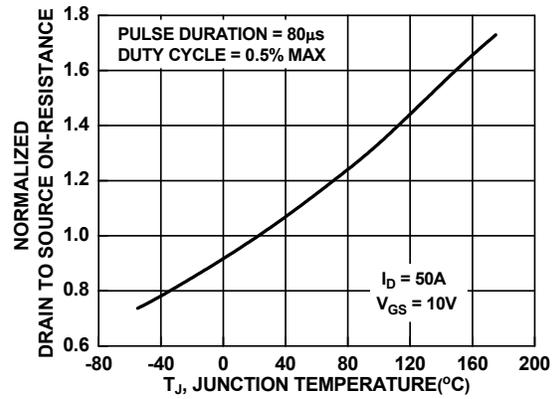


Figure 12. Normalized $R_{DS(on)}$ vs. Junction Temperature

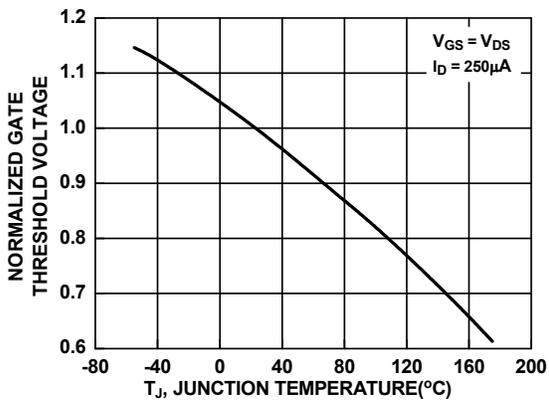


Figure 13. Normalized Gate Threshold Voltage vs. Temperature

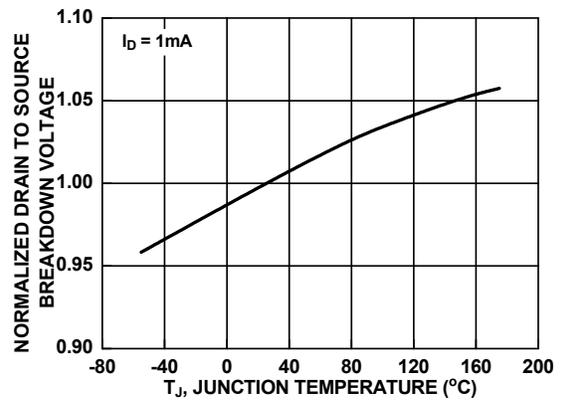


Figure 14. Normalized Drain to Source Breakdown Voltage vs. Junction Temperature

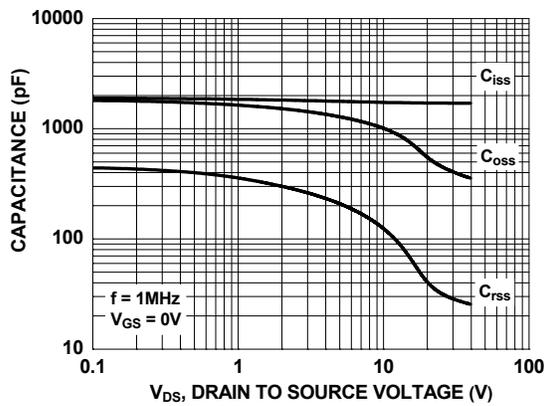


Figure 15. Capacitance vs. Drain to Source Voltage

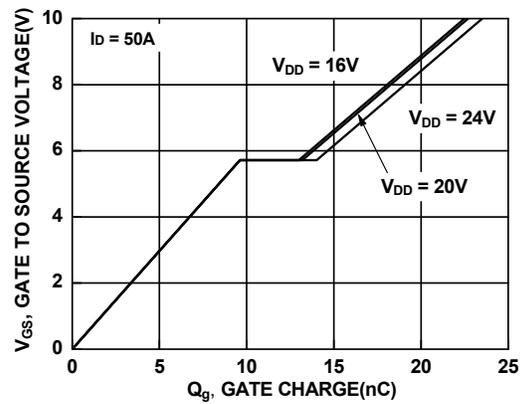


Figure 16. Gate Charge vs. Gate to Source Voltage



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™ | F-PFS™ |  ™ |  SYSTEM® |
| Awinda® | FRFET® | PowerTrench® | TinyBoost® |
| AX-CAP®* | Global Power ResourceSM | PowerXS™ | TinyBuck® |
| BitSiC™ | GreenBridge™ | Programmable Active Droop™ | TinyCalc™ |
| Build it Now™ | Green FPS™ | QFET® | TinyLogic® |
| CorePLUS™ | Green FPS™ e-Series™ | QS™ | TINYOPTO™ |
| CorePOWER™ | Gmax™ | Quiet Series™ | TinyPower™ |
| CROSSVOLT™ | GTO™ | RapidConfigure™ | TinyPWM™ |
| CTL™ | IntelliMAX™ |  ™ | TinyWire™ |
| Current Transfer Logic™ | ISOPLANAR™ | Saving our world, 1mW/W/kW at a time™ | TranSiC™ |
| DEUXPEED® | Marking Small Speakers Sound Louder and Better™ | SignalWise™ | TriFault Detect™ |
| Dual Cool™ | MegaBuck™ | SmartMax™ | TRUECURRENT®* |
| EcoSPARK® | MICROCOUPLER™ | SMART START™ | μSerDes™ |
| EfficientMax™ | MicroFET™ | Solutions for Your Success™ |  SerDes™ |
| ESBC™ | MicroPak™ | SPM® | UHC® |
|  Fairchild® | MicroPak2™ | STEALTH™ | Ultra FRFET™ |
| Fairchild Semiconductor® | MillerDrive™ | SuperFET® | UniFET™ |
| FACT Quiet Series™ | MotionMax™ | SuperSOT™-3 | VCX™ |
| FACT® | MotionGrid® | SuperSOT™-6 | VisualMax™ |
| FAST® | MTI® | SuperSOT™-8 | VoltagePlus™ |
| FastvCore™ | MTX® | SupreMOS® | XS™ |
| FETBench™ | MVN® | SyncFET™ | Xsens™ |
| FPS™ | mWSave® | Sync-Lock™ | 仙童™ |
| | OptoHiT™ | | |

*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. TO OBTAIN THE LATEST, MOST UP-TO-DATE DATASHEET AND PRODUCT INFORMATION, VISIT OUR WEBSITE AT [HTTP://WWW.FAIRCHILDSEMI.COM](http://www.fairchildsemi.com). 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.

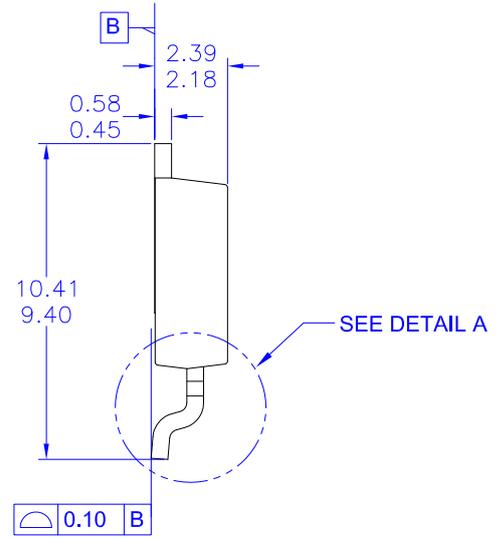
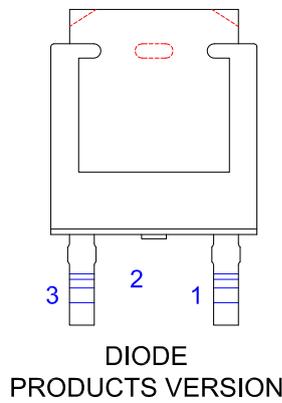
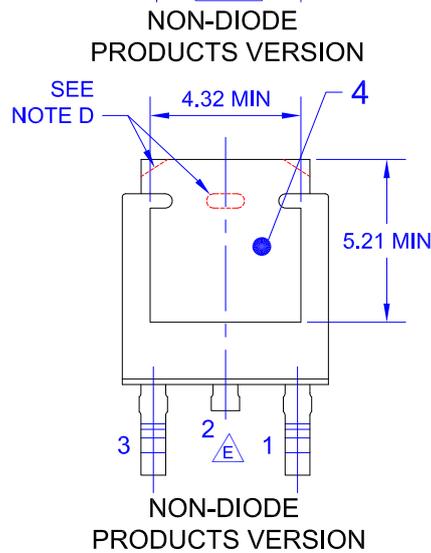
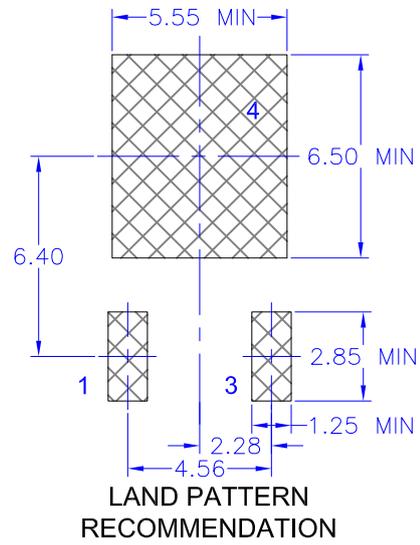
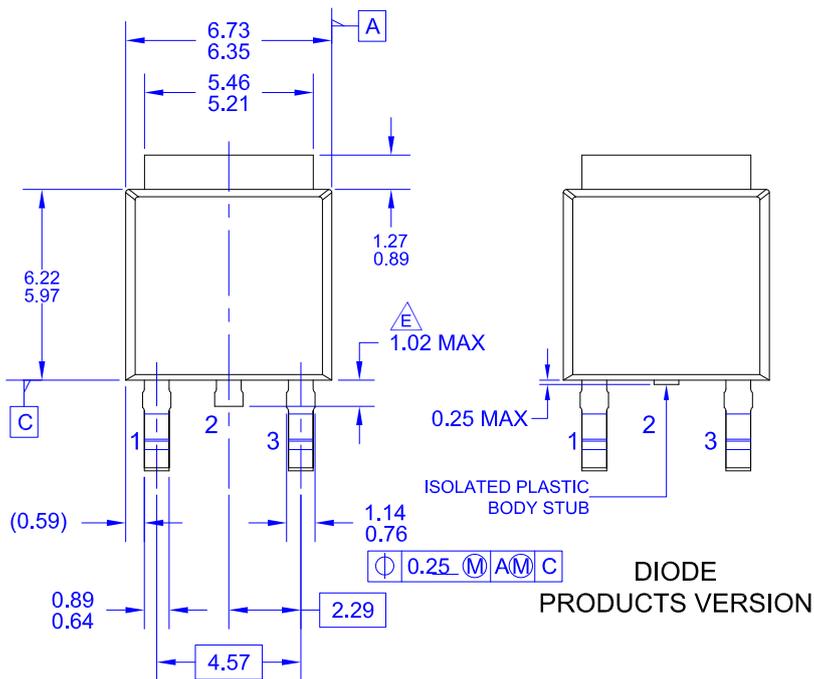
Counterfeiting of semiconductor parts is a growing problem in the industry. All manufactures of semiconductor products are experiencing counterfeiting of their parts. Customers who inadvertently purchase counterfeit parts experience many problems such as loss of brand reputation, substandard performance, 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 handling 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

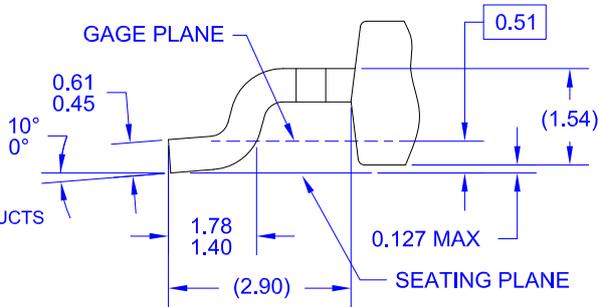
Definition of Terms

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. I71



- NOTES: UNLESS OTHERWISE SPECIFIED
- A) THIS PACKAGE CONFORMS TO JEDEC, TO-252, ISSUE C, VARIATION AA.
 - B) ALL DIMENSIONS ARE IN MILLIMETERS.
 - C) DIMENSIONING AND TOLERANCING PER ASME Y14.5M-2009.
 - D) SUPPLIER DEPENDENT MOLD LOCKING HOLES OR CHAMFERED CORNERS OR EDGE PROTRUSION.
 - E) TRIMMED METAL CENTER LEAD IS PRESENT ON FOR NON-DIODE PRODUCTS
 - F) DIMENSIONS ARE EXCLUSIVE OF BURS, MOLD FLASH AND TIE BAR EXTRUSIONS.
 - G) LAND PATTERN RECOMMENDATION IS BASED ON IPC7351A STD TO228P991X239-3N.
 - H) DRAWING NUMBER AND REVISION: MKT-TO252A03REV11



ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800-282-9855 Toll Free
USA/Canada
Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910
Japan Customer Focus Center
Phone: 81-3-5817-1050

ON Semiconductor Website: www.onsemi.com
Order Literature: <http://www.onsemi.com/orderlit>
For additional information, please contact your local
Sales Representative