



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.

FDMC8651

N-Channel Power Trench® MOSFET

30 V, 20 A, 6.1 mΩ

Features

- Max $r_{DS(on)}$ = 6.1 mΩ at $V_{GS} = 4.5$ V, $I_D = 15$ A
- Max $r_{DS(on)}$ = 9.3 mΩ at $V_{GS} = 2.5$ V, $I_D = 12$ A
- Low Profile - 1 mm max in Power 33
- 100% UIL Tested
- RoHS Compliant

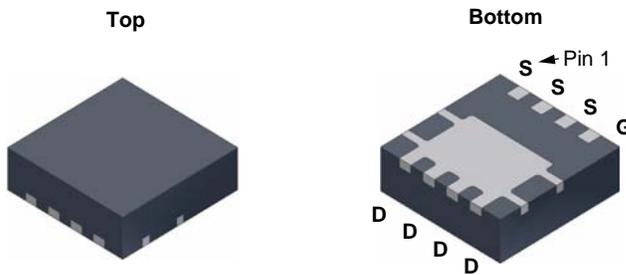


General Description

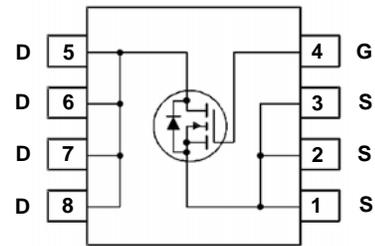
This device has been designed specifically to improve the efficiency of DC/DC converters. Using new techniques in MOSFET construction, the various components of gate charge and capacitance have been optimized to reduce switching losses. Low gate resistance and very low Miller charge enable excellent performance with both adaptive and fixed dead time gate drive circuits. Very low $r_{DS(on)}$ has been maintained to provide a sub logic-level device.

Applications

- Synchronous rectifier
- 3.3 V input synchronous buck switch



Power 33



MOSFET Maximum Ratings $T_A = 25$ °C unless otherwise noted

Symbol	Parameter	Rated	Units
V_{DS}	Drain to Source Voltage	30	V
V_{GS}	Gate to Source Voltage	±12	V
I_D	Drain Current -Continuous (Package limited) $T_C = 25$ °C	20	A
	-Continuous (Silicon limited) $T_C = 25$ °C	64	
	-Continuous $T_A = 25$ °C (Note 1a)	15	
	-Pulsed	60	
E_{AS}	Single Pulse Avalanche Energy (Note 3)	128	mJ
P_D	Power Dissipation $T_C = 25$ °C	41	W
	Power Dissipation $T_A = 25$ °C (Note 1a)	2.3	
T_J, T_{STG}	Operating and Storage Junction Temperature Range	-55 to +150	°C

Thermal Characteristics

$R_{\theta JC}$	Thermal Resistance, Junction to Case	3	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (Note 1a)	53	

Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FDMC8651	FDMC8651	Power 33	13 "	12 mm	3000 units

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

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

Off Characteristics

BV_{DSS}	Drain to Source Breakdown Voltage	$I_D = 250\ \mu\text{A}, V_{GS} = 0\ \text{V}$	30			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250\ \mu\text{A}$, referenced to $25\text{ }^\circ\text{C}$		27.5		mV/°C
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 24\ \text{V}, V_{GS} = 0\ \text{V}$			1	μA
I_{GSS}	Gate to Source Leakage Current	$V_{GS} = \pm 12\ \text{V}, V_{DS} = 0\ \text{V}$			± 100	nA

On Characteristics

$V_{GS(th)}$	Gate to Source Threshold Voltage	$V_{GS} = V_{DS}, I_D = 250\ \mu\text{A}$	0.8	1.1	1.5	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate to Source Threshold Voltage Temperature Coefficient	$I_D = 250\ \mu\text{A}$, referenced to $25\text{ }^\circ\text{C}$		-4.4		mV/°C
$r_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 4.5\ \text{V}, I_D = 15\ \text{A}$		4.3	6.1	m Ω
		$V_{GS} = 2.5\ \text{V}, I_D = 12\ \text{A}$		6.2	9.3	
		$V_{GS} = 4.5\ \text{V}, I_D = 15\ \text{A}, T_J = 125\text{ }^\circ\text{C}$		6.3	9.0	
g_{FS}	Forward Transconductance	$V_{DD} = 5\ \text{V}, I_D = 15\ \text{A}$		91		S

Dynamic Characteristics

C_{iss}	Input Capacitance	$V_{DS} = 15\ \text{V}, V_{GS} = 0\ \text{V}, f = 1\ \text{MHz}$		2530	3365	pF
C_{oss}	Output Capacitance			865	1150	pF
C_{rss}	Reverse Transfer Capacitance			140	205	pF
R_g	Gate Resistance			0.8		Ω

Switching Characteristics

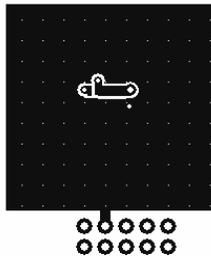
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 15\ \text{V}, I_D = 15\ \text{A}, V_{GS} = 4.5\ \text{V}, R_{GEN} = 6\ \Omega$		18	31	ns
t_r	Rise Time			9	18	ns
$t_{d(off)}$	Turn-Off Delay Time			35	56	ns
t_f	Fall Time			6	12	ns
$Q_{g(TOT)}$	Total Gate Charge at 4.5 V			19.4	27.2	nC
Q_{gs}	Total Gate Charge	$V_{DD} = 15\ \text{V}, I_D = 15\ \text{A}$		4.8		nC
Q_{gd}	Gate to Drain "Miller" Charge			4.2		nC

Drain-Source Diode Characteristics

V_{SD}	Source to Drain Diode Forward Voltage	$V_{GS} = 0\ \text{V}, I_S = 15\ \text{A}$ (Note 2)		0.8	1.3	V
		$V_{GS} = 0\ \text{V}, I_S = 1.7\ \text{A}$ (Note 2)		0.7	1.2	
t_{rr}	Reverse Recovery Time	$I_F = 15\ \text{A}, di/dt = 100\ \text{A}/\mu\text{s}$		35	55	ns
Q_{rr}	Reverse Recovery Charge			17	30	nC

NOTES:

1. $R_{\theta JA}$ is determined with the device mounted on a 1in² pad 2 oz copper pad on a 1.5 x 1.5 in. board of FR-4 material. $R_{\theta JC}$ is guaranteed by design while $R_{\theta CA}$ is determined by the user's board design.



a. 53 °C/W when mounted on a 1 in² pad of 2 oz copper



b. 125 °C/W when mounted on a minimum pad of 2 oz copper

2. Pulse Test: Pulse Width < 300 μs , Duty cycle < 2.0%.

3. Starting $T_J = 25\text{ }^\circ\text{C}$; N-ch: $L = 1\ \text{mH}, I_{AS} = 16\ \text{A}, V_{DD} = 27\ \text{V}, V_{GS} = 10\ \text{V}$.

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

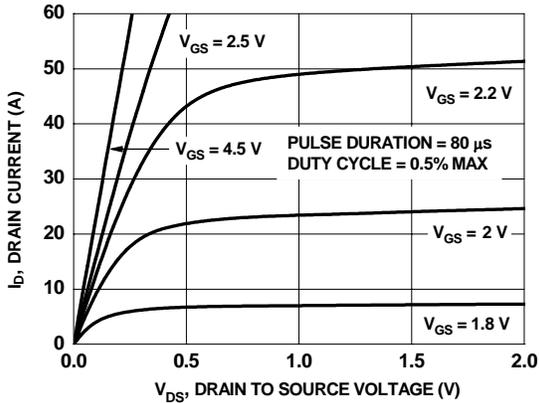


Figure 1. On-Region Characteristics

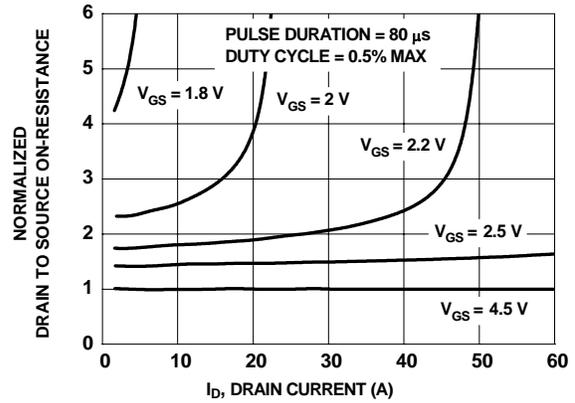


Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage

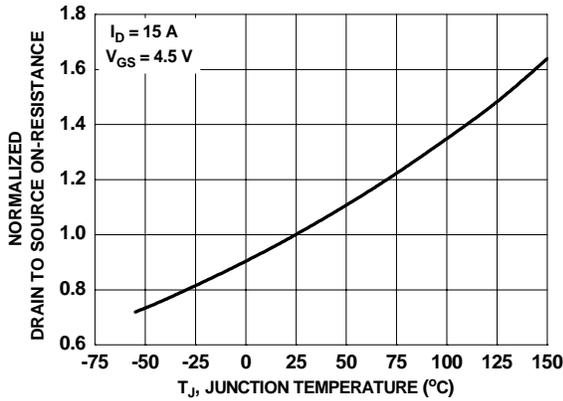


Figure 3. Normalized On-Resistance vs Junction Temperature

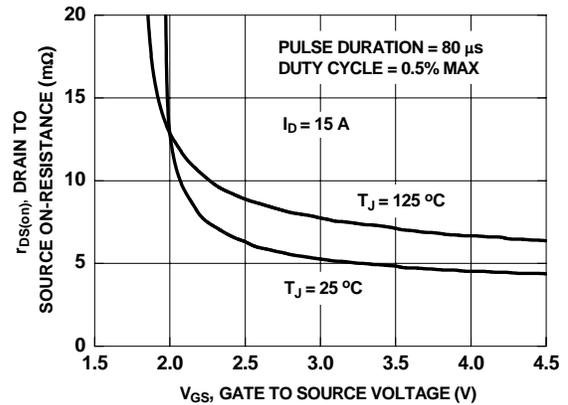


Figure 4. On-Resistance vs Gate to Source Voltage

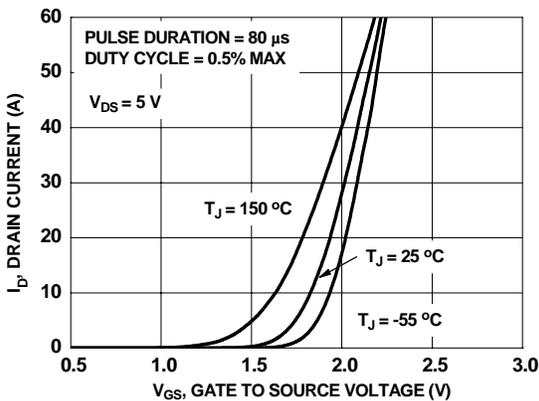


Figure 5. Transfer Characteristics

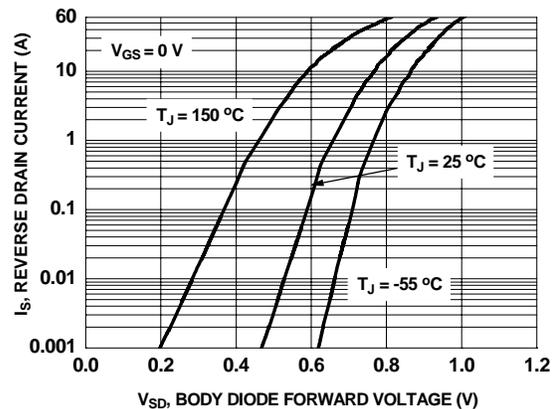


Figure 6. Source to Drain Diode Forward Voltage vs Source Current

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

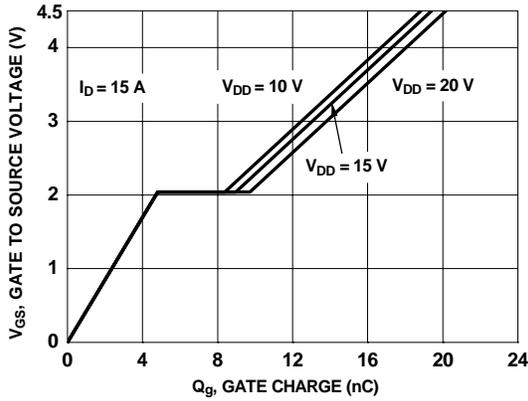


Figure 7. Gate Charge Characteristics

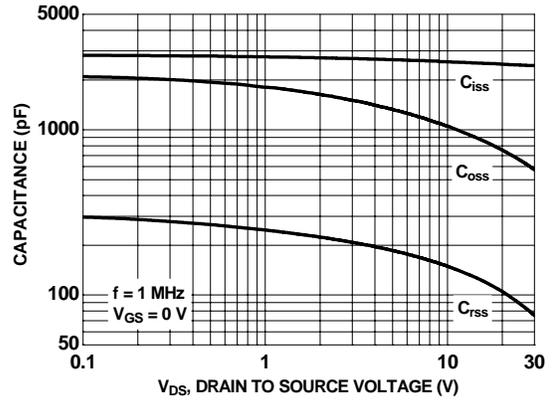


Figure 8. Capacitance vs Drain to Source Voltage

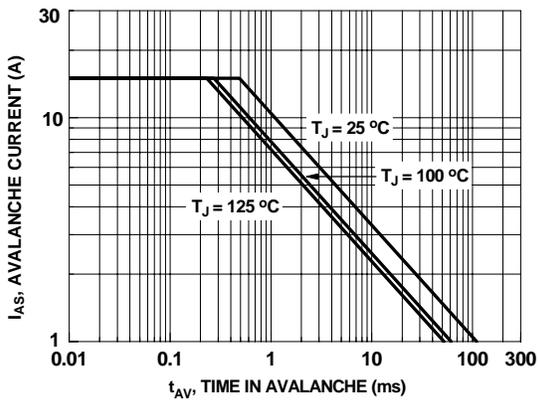


Figure 9. Unclamped Inductive Switching Capability

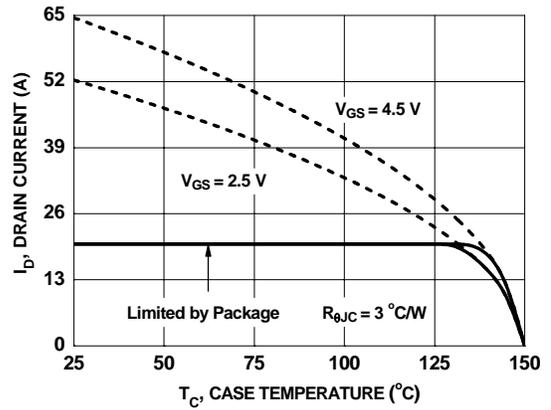


Figure 10. Maximum Continuous Drain Current vs Case Temperature

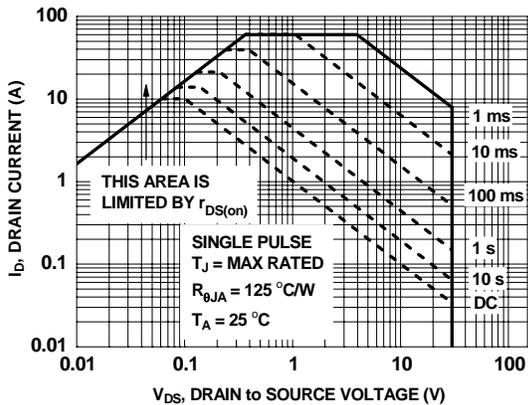


Figure 11. Forward Bias Safe Operating Area

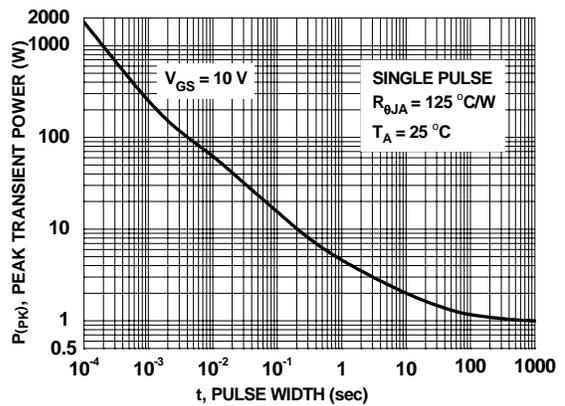


Figure 12. Single Pulse Maximum Power Dissipation

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

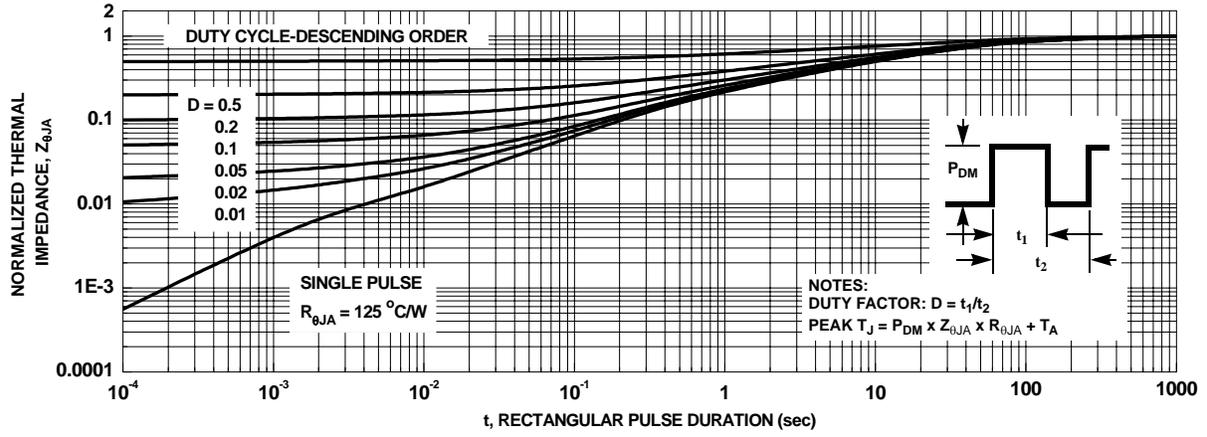
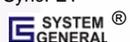


Figure 13. Junction-to-Ambient Transient Thermal Response Curve

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.

- | | | | |
|---|-------------------------------------|---|---|
| Build it Now™ | FPS™ | PDP SPM™ | The Power Franchise® |
| CorePLUS™ | F-PFS™ | Power-SPM™ | the power franchise |
| CorePOWER™ | FRFET® | PowerTrench® | TinyBoost™ |
| CROSSVOLT™ | Global Power Resource SM | Programmable Active Droop™ | TinyBuck™ |
| CTL™ | Green FPS™ | QFET® | TinyLogic® |
| Current Transfer Logic™ | Green FPS™ e-Series™ | QS™ | TINYOPTO™ |
| EcoSPARK® | GTO™ | Quiet Series™ | TinyPower™ |
| EfficientMax™ | IntelliMAX™ | RapidConfigure™ | TinyPWM™ |
| EZSWITCH™ * | ISOPLANAR™ | Saving our world, 1mW at a time™ | TinyWire™ |
|  | MegaBuck™ | SmartMax™ | |
|  | MICROCOUPLER™ | SMART START™ |  |
| Fairchild® | MicroFET™ | SPM® | Ultra FRFET™ |
| Fairchild Semiconductor® | MicroPak™ | STEALTH™ | UniFET™ |
| FACT Quiet Series™ | MillerDrive™ | SuperFET™ | VCX™ |
| FACT® | MotionMax™ | SuperSOT™-3 | VisualMax™ |
| FAST® | Motion-SPM™ | SuperSOT™-6 | |
| FastvCore™ | OPTOLOGIC® | SuperSOT™-8 | |
| FlashWriter® * | OPTOPLANAR® | SuperMOS™ | |
| | | SyncFET™ | |
| | |  | |

* EZSWITCH™ and FlashWriter® are 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 herein:

- 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.
- 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. 135

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