

### 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 <a href="www.onsemi.com">www.onsemi.com</a>. Please email any questions regarding the system integration to Fairchild <a href="general-regarding-numbers-n

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 EDA 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 officer



December 2013

# FQPF9N50CF

# N-Channel QFET® FRFET® MOSFET

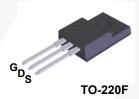
500 V, 9 A, 850 mΩ

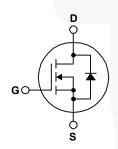
## **Description**

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 • Fast Recovery Body Diode (Typ. 100 ns) electronic lamp ballasts.

### **Features**

- 9 A, 500 V,  $R_{DS(on)}$  = 850 m $\Omega$  (Max.) @  $V_{GS}$  = 10 V,  $I_D$  = 4.5 A
- Low Gate Charge (Typ. 28 nC)
- Low Crss (Typ. 24 pF)
- 100% Avalanche Tested





### Absolute Maximum Ratings T<sub>C</sub> = 25°C unless otherwise noted.

Symbol	Parameter	FQPF9N50CF	Unit	
V <sub>DSS</sub>	Drain-Source Voltage	500	V	
I <sub>D</sub>	Drain Current - Continuous (T <sub>C</sub> = 25°C)	9*	Α	
	- Continuous (T <sub>C</sub> = 100°C)	5.4*	Α	
I <sub>DM</sub>	Drain Current - Pulsed (I	Note 1) 36*	Α	
V <sub>GSS</sub>	Gate-Source Voltage	± 30	V	
E <sub>AS</sub>	Single Pulsed Avalanche Energy (I	Note 2) 360	mJ	
I <sub>AR</sub>	Avalanche Current (I	Note 1) 9	Α	
E <sub>AR</sub>	Repetitive Avalanche Energy (I	Note 1) 4.4	mJ	
dv/dt	Peak Diode Recovery dv/dt (I	Note 3) 4.5	V/ns	
$P_{D}$	Power Dissipation (T <sub>C</sub> = 25°C)	44	W	
	- Derate above 25°C	0.35	W/°C	
T <sub>J</sub> , T <sub>STG</sub>	Operating and Storage Temperature Range	-55 to +150	°C	
T <sub>L</sub>	Maximum Lead Temperature for Soldering, 1/8 from Case for 5 Seconds.	300	°C	

<sup>\*</sup> Drain current limited by maximum junction temperature

### **Thermal Characteristics**

Symbol	Parameter	FQPF9N50CF	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	2.86	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	62.5	30/00

# **Package Marking and Ordering Information**

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FQPF9N50CF	FQPF9N50CF	TO-220F	Tube	N/A	N/A	50 units

# **Electrical Characteristics** $T_C = 25^{\circ}C$ unless otherwise noted.

Symbol	Parameter	Test Conditions		Тур.	Max.	Unit
Off Charac	teristics					
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	$V_{GS}$ = 0 V, $I_{D}$ = 250 $\mu$ A	500			V
$\Delta BV_{DSS}$ / $\Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D$ = 250 μA, Referenced to 25°C		0.57		V/°C
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 500 V, V <sub>GS</sub> = 0 V			10	μА
		V <sub>DS</sub> = 400 V, T <sub>C</sub> = 125°C			100	μА
I <sub>GSSF</sub>	Gate-Body Leakage Current, Forward	V <sub>GS</sub> = 30 V, V <sub>DS</sub> = 0 V			100	nA
I <sub>GSSR</sub>	Gate-Body Leakage Current, Reverse	V <sub>GS</sub> = -30 V, V <sub>DS</sub> = 0 V			-100	nA
On Charac	teristics					
V <sub>GS(th)</sub>	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_{D} = 250 \mu A$	2.0		4.0	
R <sub>DS(on)</sub>	Static Drain-Source On-Resistance	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 4.5 A		0.70	0.85	Ω
9 <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 40 V, I <sub>D</sub> = 4.5 A		6.5		S
Dynamic C	haracteristics					
C <sub>iss</sub>	Input Capacitance	$V_{DS} = 25 \text{ V}, V_{GS} = 0 \text{ V},$	-	790	1030	p <del>[</del>
C <sub>oss</sub>	Output Capacitance	f = 1.0 MHz		130	170	pF
C <sub>rss</sub>	Reverse Transfer Capacitance			24	30	pF
Switching (	Characteristics					
t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>DD</sub> = 250 V, I <sub>D</sub> = 9A,		18	45	ns
t <sub>r</sub>	Turn-On Rise Time	$R_G = 25 \Omega$		65	140	ns
t <sub>d(off)</sub>	Turn-Off Delay Time			93	195	ns
t <sub>f</sub>	Turn-Off Fall Time	(Note 4)	/	64	125	ns
Qg	Total Gate Charge	V <sub>DS</sub> = 400 V, I <sub>D</sub> = 9A,	/	28	35	nC
Q <sub>gs</sub>	Gate-Source Charge	V <sub>GS</sub> = 10 V	-	4		nC
Q <sub>gd</sub>	Gate-Drain Charge	(Note 4)	7-	15		nC
Drain-Sour	ce Diode Characteristics and Maximum Ratings				7	
I <sub>S</sub>	Maximum Continuous Drain-Source Diode Forward Current				9*	Α
I <sub>SM</sub>	Maximum Pulsed Drain-Source Diode Forward Current				36*	Α
V <sub>SD</sub>	Drain-Source Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 9 A		/	1.4	V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 9 A,		100		ns
Q <sub>rr</sub>	Reverse Recovery Charge	dI <sub>F</sub> / dt = 100 A/μs		0.3	/	μС

#### NOTES:

 $<sup>{\</sup>bf 1.} \ {\bf Repetitive} \ {\bf rating: pulse-width \ limited \ by \ maximum \ junction \ temperature.}$ 

<sup>2.</sup> L = 8 mH, I $_{AS}$  = 9 A, V $_{DD}$  = 50 V, R $_{G}$  = 25  $\Omega$ , starting T $_{J}$  = 25°C.

 $<sup>3.~</sup>I_{SD} \leq 11~A,~di/dt \leq 200~A/\mu s,~V_{DD} \leq BV_{DSS,}~Starting~~T_J = 25^{\circ}C.$ 

<sup>4.</sup> Essentially independent of operating temperature.

Notes : 1. V<sub>DS</sub> = 40V 2. 250µ s Pulse Test

# **Typical Performance Characteristics**

Figure 1. On-Region Characteristics

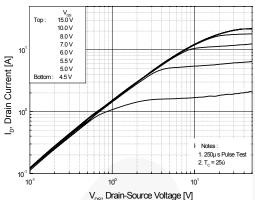


Figure 3. On-Resistance Variation vs. **Drain Current and Gate Voltage** 

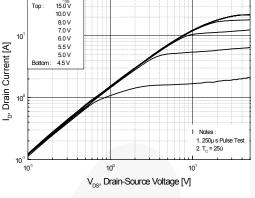


Figure 4. Body Diode Forward Voltage Variation vs. Source Current

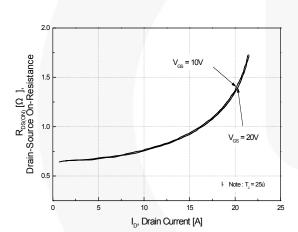
and Temperatue

V<sub>ss</sub>, Gate-Source Voltage [V]

Figure 2. Transfer Characteristics

150°C

Drain Current [A]



Reverse Drain Current [A] l- Notes : 1. V<sub>GS</sub> = 0V 2. 250µ s Pulse Test 10<sup>-1</sup> — 0.2 1.2 V<sub>SD</sub>, Source-Drain voltage [V]

**Figure 5. Capacitance Characteristics** 

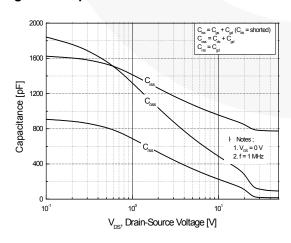
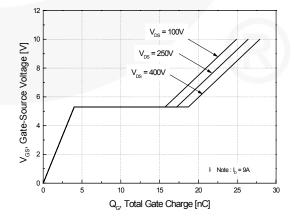


Figure 6. Gate Charge Characteristics



# Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

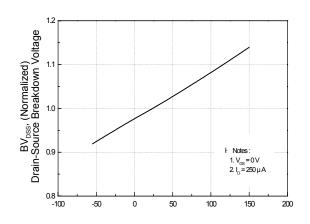


Figure 8. On-Resistance Variation vs. Temperature

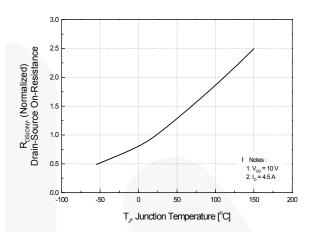


Figure 9. Maximum Safe Operating Area

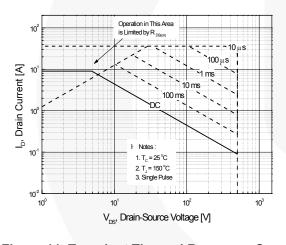
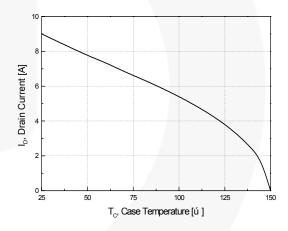
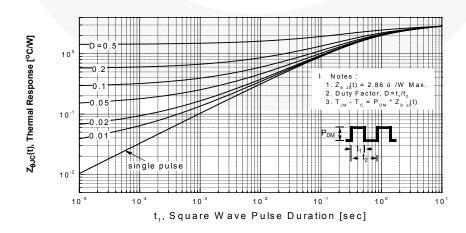


Figure 10. Maximum Drain Current vs. Case Temperature



**Figure 11. Transient Thermal Response Curve** 



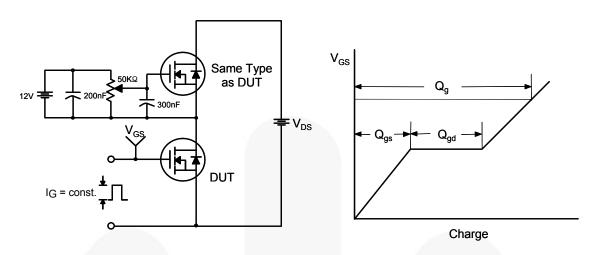


Figure 12. Gate Charge Test Circuit & Waveform

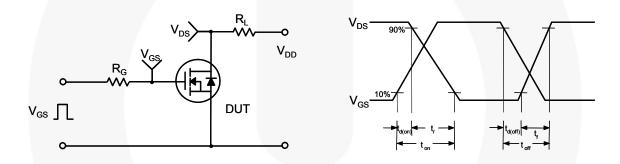


Figure 13. Resistive Switching Test Circuit & Waveforms

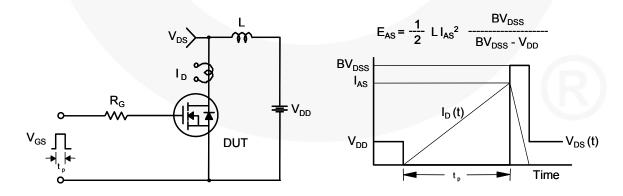


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

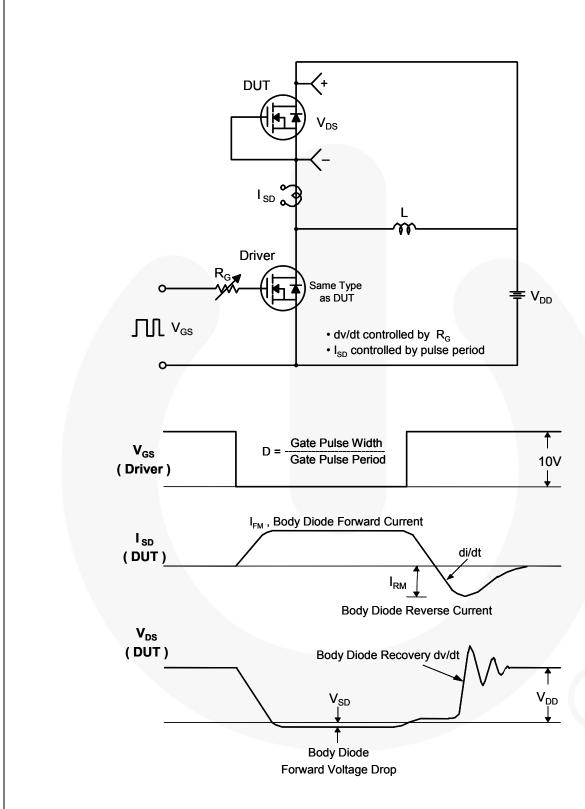


Figure 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms

### **Mechanical Dimensions**

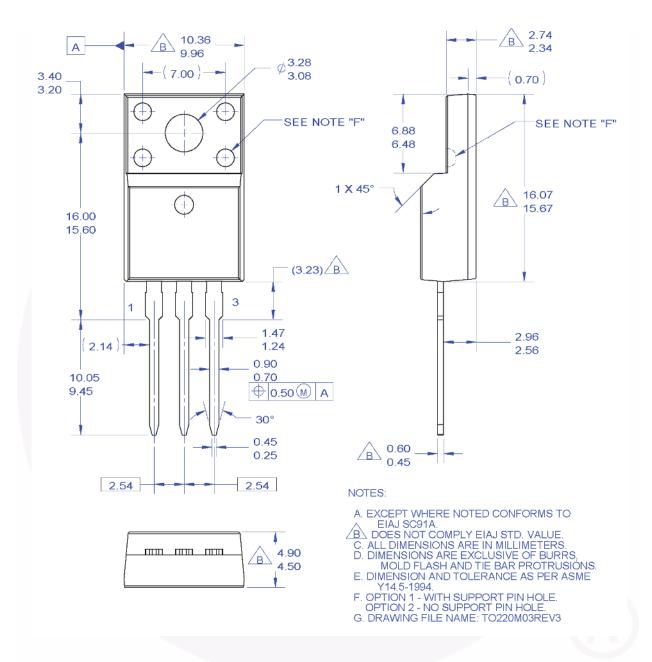


Figure 16. TO220, Molded, 3-Lead, Full Pack, EIAJ SC91, Straight Lead

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 TF220-003





#### **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™

 $CROSSVOLT^{\text{TM}}$ CTI ™ Current Transfer Logic™ DEUXPEED® Dual Cool™

EcoSPARK® EfficentMax™ ESBC™

Fairchild<sup>®</sup> Fairchild Semiconductor® FACT Quiet Series™ FACT® FAST® FastvCore™ FETBench™ FPS™

F-PFS™ FRFET® Global Power Resource<sup>SM</sup>

GreenBridge™ Green FPS™ Green FPS™ e-Series™

G*max*™ 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™

STEALTH™ SuperFET® SuperSOT™-3 SuperSOT™-6 SuperSOT™-8 SupreMOS® SvncFET™

Sync-Lock™ SYSTEM ®\* TinyBoost<sup>®</sup> TinyBuck<sup>®</sup> TinyCalc™ TinyLogic<sup>®</sup> TINYOPTO™ TinvPower™ TinyPWM™ TinyWire™ TranSiC™ TriFault Detect™ TRUECURRENT®\* uSerDes™

UHC® Ultra FRFET™ UniFFT™ VCX™ VisualMax™ VoltagePlus™ XSTM

\*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:

- 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 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. Specification 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 166

ON Semiconductor and in 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 <a href="www.onsemi.com/site/pdf/Patent-Marking.pdf">www.onsemi.com/site/pdf/Patent-Marking.pdf</a>. 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 hol

### **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