

### 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="guestions@onsemi.com">guestions@onsemi.com</a>.

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



September 2013

### FGB5N60UNDF 600 V, 5 A **Short Circuit Rated IGBT**

### **Features**

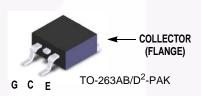
- · Short Circuit Rated 10 us
- High Current Capability
- High Input Impedance
- Fast Switching
- RoHS Compliant

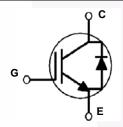
### **Applications**

· Sewing Machine, CNC, Home Appliances, Motor Control

### **General Description**

Using advanced NPT IGBT technology, Fairchild's the NPT IGBTs offer the optimum performance for low-power inverterdriven applications where low-losses and short-circuit ruggedness features are essential, such as sewing machine, CNC, motor control and home appliances.





### **Absolute Maximum Ratings**

Symbol	Description		Ratings	Unit
V <sub>CES</sub>	Collector to Emitter Voltage		600	V
$V_{GES}$	Gate to Emitter Voltage		± 20	V
Ic	Collector Current	$@ T_C = 25^{\circ}C$	10	A
	Collector Current	$@ T_C = 100^{\circ}C$	5	А
I <sub>CM (1)</sub>	Pulsed Collector Current @ T <sub>C</sub> = 25°C		15	А
I <sub>F</sub>	Diode Forward Current	$@ T_C = 25^{\circ}C$	5	A
'F	Diode Forward Current	$@ T_C = 100^{\circ}C$	2.5	А
P <sub>D</sub>	Maximum Power Dissipation	@ $T_C = 25^{\circ}C$	73.5	W
' D	Maximum Power Dissipation	$@ T_C = 100^{\circ}C$	29.4	W
TJ	Operating Junction Temperature		-55 to +150	°C
T <sub>stg</sub>	Storage Temperature Range		-55 to +150	°C
T <sub>L</sub>	Maximum Lead Temp. for soldering Purposes, 1/8" from case for 5 seconds		300	°C

1: Repetitive rating: Pulse width limited by max. junction temperature

### **Thermal Characteristics**

Symbol	Parameter	Тур.	Max.	Unit
$R_{\theta JC}(IGBT)$	Thermal Resistance, Junction to Case		1.7	°C/W
$R_{\theta JC}$ (Diode)	Thermal Resistance, Junction to Case		4.5	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (PCB Mount)(2)		40	°C/W

2: Mounted on 1" square PCB (FR4 or G-10 material)

## **Package Marking and Ordering Information**

<b>Device Marking</b>	Device	Package	Rel Size	Tape Width	Quantity
FGB5N60UNDF	FGB5N60UNDF	TO-263AB(D <sup>2</sup> -PAK)		-	50

### Electrical Characteristics of the IGBT $T_C = 25$ °C unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Тур.	Max.	Unit
Off Charac	teristics					
BV <sub>CES</sub>	Collector to Emitter Breakdown Voltage	$V_{GE} = 0V, I_{C} = 250\mu A$	600	-	-	V
I <sub>CES</sub>	Collector Cut-Off Current	$V_{CE} = V_{CES}, V_{GE} = 0V$	-	-	1	mA
I <sub>GES</sub>	G-E Leakage Current	$V_{GE} = V_{GES}, V_{CE} = 0V$	-	-	±10	uA
On Charac	teristics					
V <sub>GE(th)</sub>	G-E Threshold Voltage	$I_C = 5mA$ , $V_{CE} = V_{GE}$	5.5	6.8	8.5	V
		I <sub>C</sub> = 5A, V <sub>GE</sub> = 15V	/ -	1.9	2.4	V
V <sub>CE(sat)</sub>	Collector to Emitter Saturation Voltage	I <sub>C</sub> = 5A, V <sub>GE</sub> = 15V, T <sub>C</sub> = 125°C	-	2.3	-	V
Dynamic C	haracteristics			!		
C <sub>ies</sub>	Input Capacitance		-	181		pF
C <sub>oes</sub>	Output Capacitance	$V_{CE} = 30V_{,} V_{GE} = 0V_{,}$ f = 1MHz	-	28		pF
C <sub>res</sub>	Reverse Transfer Capacitance	I = IIVIMZ	-	7		pF
Switching	Characteristics					
t <sub>d(on)</sub>	Turn-On Delay Time		-	5.4		ns
t <sub>r</sub>	Rise Time		-	1.9		ns
t <sub>d(off)</sub>	Turn-Off Delay Time	$V_{CC} = 400 \text{V}, I_{C} = 5 \text{A},$	-	25.4		ns
t <sub>f</sub>	Fall Time	$R_G = 10\Omega$ , $V_{GE} = 15V$ , Inductive Load, $T_C = 25^{\circ}C$	-	101	202	ns
E <sub>on</sub>	Turn-On Switching Loss	111dddivo 25dd, 16 = 25 G	-	0.08		mJ
E <sub>off</sub>	Turn-Off Switching Loss		-	0.07		mJ
E <sub>ts</sub>	Total Switching Loss		-	0.15		mJ
t <sub>d(on)</sub>	Turn-On Delay Time		- /	5.2		ns
t <sub>r</sub>	Rise Time		-	2.3		ns
t <sub>d(off)</sub>	Turn-Off Delay Time	$V_{CC} = 400V, I_{C} = 5A,$	-	26.6		ns
t <sub>f</sub>	Fall Time	$R_G = 10\Omega$ , $V_{GE} = 15V$ ,	-	125		ns
E <sub>on</sub>	Turn-On Switching Loss	Inductive Load, T <sub>C</sub> = 125°C	-	0.15		mJ
E <sub>off</sub>	Turn-Off Switching Loss		-	0.09		mJ
E <sub>ts</sub>	Total Switching Loss		-	0.24		mJ
T <sub>sc</sub>	Short Circuit Withstand Time	$V_{CC} = 350V,$ $R_G = 100\Omega, V_{GE} = 15V,$ $T_C = 150^{\circ}C$	10		- \	μs

## Electrical Characteristics of the IGBT $T_C = 25^{\circ}\text{C}$ unless otherwise noted

$Q_g$	Total Gate Charge		-	12.1	nC
Q <sub>ge</sub>	Gate to Emitter Charge	$V_{CE} = 400V, I_{C} = 5A,$ $V_{GE} = 15V$	ı	1.7	nC
Q <sub>qc</sub>	Gate to Collector Charge	VGE = 10V	-	7.2	nC

## Electrical Characteristics of the Diode $T_C = 25^{\circ}C$ unless otherwise noted

Symbol	Parameter	Test Condition	ns	Min.	Тур.	Max	Unit
V <sub>FM</sub>	Diode Forward Voltage	I <sub>F</sub> = 5A	$T_C = 25^{\circ}C$	-	1.7	2.2	V
Plode i siwara voltage	1 <sub>F</sub> = 0/1	$T_{\rm C} = 125^{\rm o}{\rm C}$	-	1.6	-		
t <sub>rr</sub>	Diode Reverse Recovery Time	$I_{F} = 5A$ , $dI_{F}/dt = 200A/\mu s$	$T_C = 25^{\circ}C$	-	35		ns
ना			$T_{\rm C} = 125^{\rm o}{\rm C}$	-	87		
Q <sub>rr</sub>	Diode Reverse Recovery Charge		$T_C = 25^{\circ}C$	-	71		nC
<b>∠</b> II			$T_{\rm C} = 125^{\rm o}{\rm C}$	-	240	-	"

Figure 1. Typical Output Characteristics

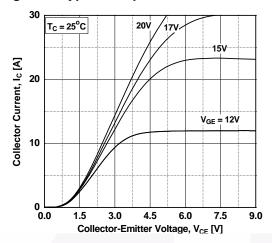


Figure 3. Typical Saturation Voltage Characteristics

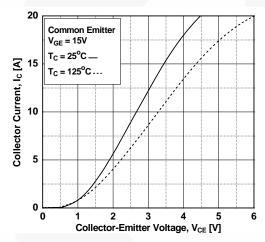
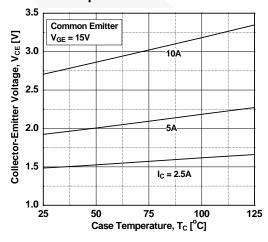


Figure 5. Saturation Voltage vs. Case
Temperature at Variant Current Level



**Figure 2. Typical Output Characteristics** 

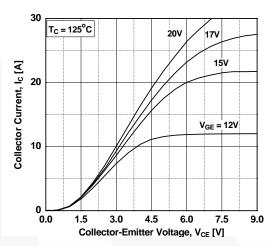


Figure 4. Transfer Characteristics

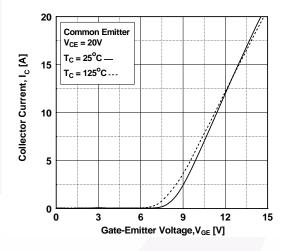


Figure 6. Saturation Voltage vs. V<sub>GE</sub>

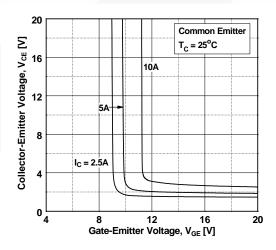


Figure 7. Saturation Voltage vs. V<sub>GE</sub>

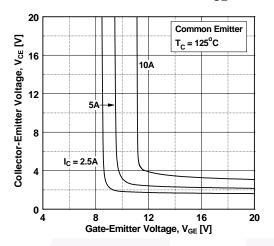


Figure 9. Gate charge Characteristics

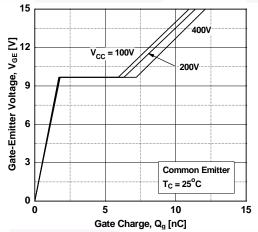


Figure 11. Turn-on Characteristics vs.
Gate Resistance

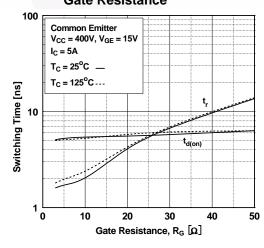


Figure 8. Capacitance Characteristics

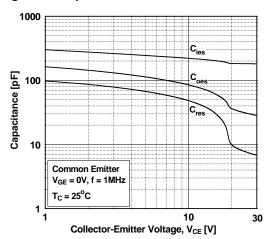


Figure 10. SOA Characteristics

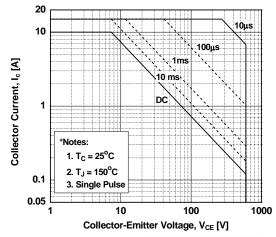


Figure 12. Turn-off Characteristics vs.
Gate Resistance

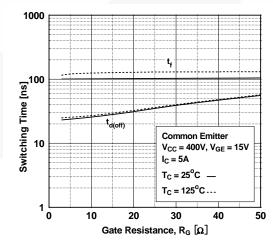


Figure 13. Turn-on Characteristics vs. Collector Current

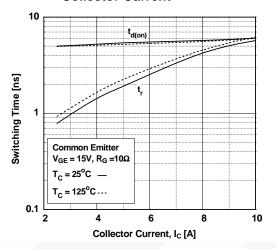


Figure 15. Switching Loss vs.

Gate Resistance

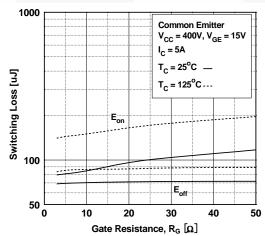


Figure 17. Turn off Switching SOA Characteristics

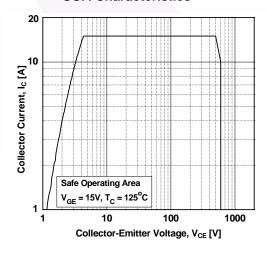


Figure 14. Turn-off Characteristics vs.
Collector Current

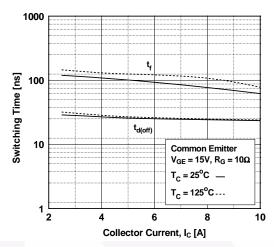


Figure 16. Switching Loss vs Collector Current

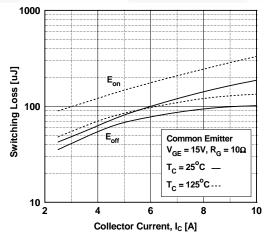
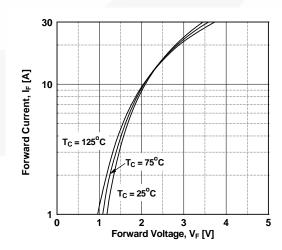


Figure 18. Forward Characteristics



### Figure 19. Reverse Current

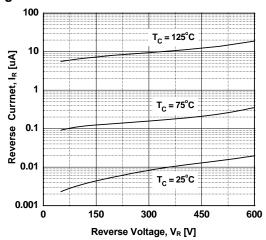


Figure 20. Stored Charge

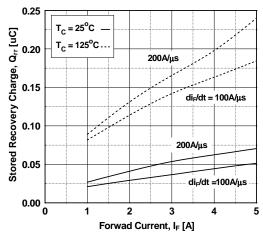


Figure 21. Reverse Recovery Time

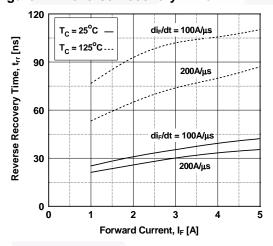
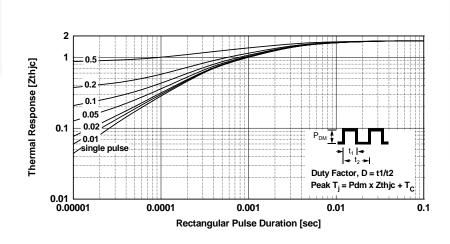


Figure 22. Transient Thermal Impedance of IGBT



### **Mechanical Dimensions** 9.45 10.00 (6.40)1.78 MAX 3.80 1,05 (2.12) -5.08 LAND PATTERN RECOMMENDATION UNLESS NOTED, ALL DIMS TYPICAL → 0.25 M B AM 5,08 6.22 MIN -6.86 MIN 15.88 14.61 SEE DETA**|**L A 2 NOTES; UNLESS OTHERWISE SPECIFIED A) ALL DIMENSIONS ARE IN MILLIMETERS. B) REFERENCE JEDEC, TO-263, VARIATION AB. C) DIMENSIONING AND TOLERANCING PER ANS| Y14,5M - 1994, D) LOCATION OF THE PIN HOLE MAY VARY GAGE PLANE (LOWER LEFT CORNER, LOWER CENTER AND CENTER OF THE PACKAGE). LANDPATTERN RECOMMENDATION PER IPC TO254P1524X482-3N 0.25 FILENAME: TO263A02REV6 ○ 0.10 B 2.79 0,25 MAX (5.38)SEATING PLANE

Figure 23. TO-263 2L (D2PAK) - 2LD,TO263, SURFACE MOUNT

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:

DETAIL A, ROTATED 90°

http://www.fairchildsemi.com/package/packageDetails.html?id=PN TT263-002

Dimensions in Millimeters





#### **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-CAF BitSiC™ Build it Now™ CorePLUS™ CorePOWER™

 $CROSSVOLT^{rm}$ CTL™ Current Transfer Logic™ DEUXPEED® Dual Cool™ EcoSPARK® EfficentMax™ **ESBC™** 

Fairchild® Fairchild Semiconductor® FACT Quiet Series™

FACT® FAST® FastvCore™ FETBench™ **FPS™** 

F-PFSTM FRFET®

Global Power Resource<sup>SM</sup> GreenBridge™

Green FPS™ Green FPS™ e-Series™

G*max*™ GTO™ IntelliMAX™ ISOPLANAR™

Marking Small Speakers Sound Louder

MegaBuck™ MICROCOUPLER™ MicroFET<sup>T</sup> MicroPak™ MicroPak2™ MillerDrive™ MotionMax™ mWSaver<sup>®</sup> OptoHiT™ OPTOLOGIC® OPTOPLANAR®

PowerTrench® PowerXS™

Programmable Active Droop™ **OFET**®

QS<sup>TM</sup> 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<sup>®</sup> SyncFET™

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

**UHC®** Ultra FRFET™ UniFET™  $VCX^{TM}$ VisualMax™ VoltagePlus™ XS™

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

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.

- 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

#### 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. 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/pdt/Patent-Marking.pdf">www.onsemi.com/site/pdt/Patent-Marking.pdf</a>. ON Semiconductor reserves the right to make changes without further notice to any products herein. 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 exp

#### **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