

ON Semiconductor

Is Now



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

onsemi and onsemi. and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "onsemi" or its affiliates and/or subsidiaries in the United States and/or other countries. onsemi owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of onsemi product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. onsemi reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and onsemi makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does onsemi 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 onsemi products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by onsemi. "Typical" parameters which may be provided in onsemi 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. onsemi does not convey any license under any of its intellectual property rights nor the rights of others. onsemi 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 onsemi products for any such unintended or unauthorized application, Buyer shall indemnify and hold onsemi 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 onsemi was negligent regarding the design or manufacture of the part. onsemi is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner. Other names and brands may be claimed as the property of others.



ON Semiconductor®

FGBS3040E1-F085

Integrated Smart Ignition Coil Driver

Features

- 400V 300mJ N Channel Ignition IGBT
- Control Input buffering
- Input spike filter of typical 13us
- Operation from Ignition or Battery line
- Ground shift tolerance +/- 1.5V
- Programmable maximum dwell time
- Current programmable bidirectional Input/Diagnostic pin
- Collector Current limit typical 16.5A
- Soft Shutdown of Collector Current after Max Dwell

Applications

- Coil on Plug Ignition systems
- General ignition systems

Description

The FGBS3040E1-F085 is designed to directly drive an ignition coil and control the current and spark event of the coil. The coil current is controlled via the input/diagnostic pin. When the input is driven high, the IGBT is enabled to start charging the coil. The FGBS3040E1-F085 will sink a current (IIN1) into the input to denote this condition. When the collector current increases to Icthr the input current into the FGBS3040E1-F085 is reduced to IIN2 indicating the collector current has reached this level. An input filter suppresses input signals of less than 13 µsec in duration. A Max Dwell timer is included in the FGBS3040E1-F085 which will turn off the IGBT if the input stays active for longer than the programmed time. This time interval can be modified through an external capacitor. When the Max Dwell timer is exceeded, the FGBS3040E1-F085 will enter a Soft-Shut-Down mode (SSD) slowly dropping the collector current thereby discharging the coil such as to inhibit a spark event. Once the soft shutdown operation has started, any transitions on the input signal are ignored until after completion of the soft shutdown function. The FGBS3040E1-F085 will also limit the collector current of the IGBT to Iclim during charging.

Block Diagram

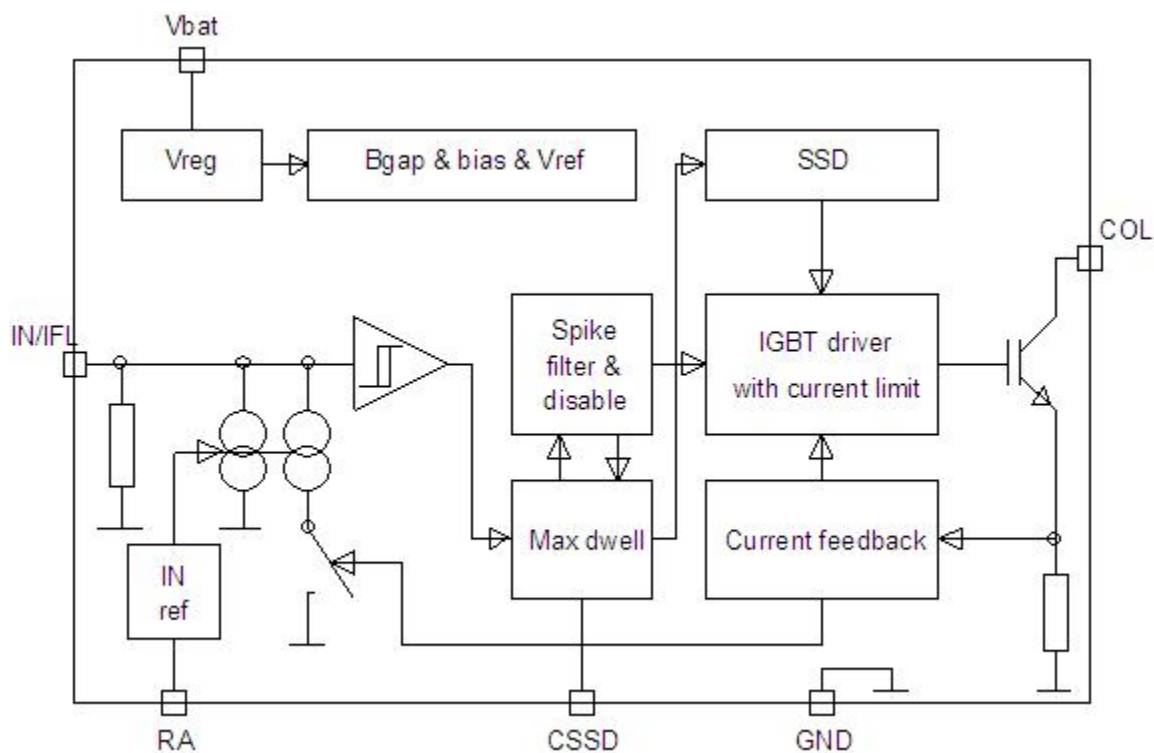
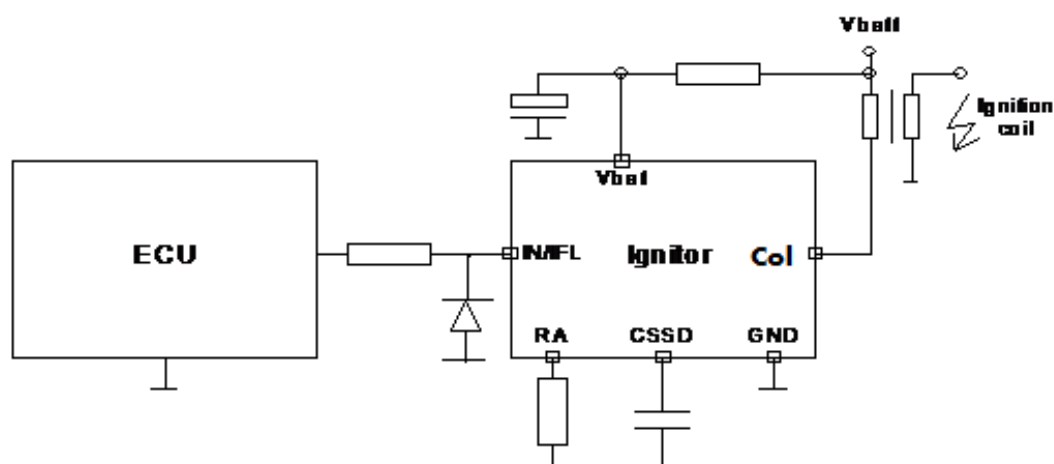


Figure 1. Block Diagram of FGBS3040E1-F085

Typical Application

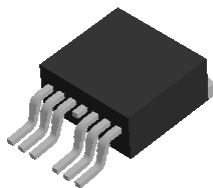
Figure 2. Typical Ignition Coil Driver Application



Pin Configuration

The FGBS3040E1-F085 is assembled in a 7 lead TO263 package

TO263-7L



Pin Assignment (Top Through View)

Pin1	GND	Emitter and control IC ground
Pin2	V _{bat}	Supply voltage
Pin3	IN/IFL	Input and diagnostic (bidirectional)
Pin4/Tab	COL	IGBT collector output
Pin5	NC	NC
Pin6	CSSD	Maximum dwell time and Soft-Shut-Down current output (to external capacitor)
Pin7	RA	Input reference current output (to external resistor)

Absolute Maximum Ratings¹

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Parameter	Symbol	Values	Unit
Voltage at V _{bat} pin (excl. EMC transients)	V _{bat}	-0.3... 28	V
Voltage at IN/IFL pin	V _{IN1}	- 1... 16	V
Voltage at A & C _{SSD} pins	V _{IN2}	- 0.3... 6	V
Collector Emitter Voltage (V _{IN} = 0V) I _c =10mA	V _{C-GND(CL)}	450	V
Operating Temperature Range	T _J	-40... +175	°C
Storage Temperature Range	T _{STG}	-40... +175	°C
Output Current	I _{c(lim)}	I _{c(lim) max}	A
Self Clamped Inductive Switched Energy @T _J = 25°C	E _{AS}	300	mJ
Self Clamped Inductive Switched Energy @T _J = 150°C	E _{AS}	170	mJ
Maximum power dissipation (continuous) from TC = 25°C	P _{max}	150	W
Thermal Resistance junction–case (typical)	R _{θJC}	1	°C /W
Electrostatic Discharge Voltage (Human Body Model) according to MIL STD 883D, method 3015.7 and EOS/ESD assn. standard S5.1 - 1993	V _{ESD} (pin to pin)	2	kV
	V _{ESD} (CE)	4	kV

Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance. ON Semiconductor does not recommend exceeding them or designing to Absolute Maximum Ratings.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{INL}	Input low voltage	$V_{bat} = 5$ to 28 V; $T_J = -40$ °C to $+175$ °C (unless otherwise specified)	-0.3		2.05	V
V_{INH}	Input high voltage	$V_{bat} = 5$ to 28 V; $T_J = -40$ °C to $+175$ °C (unless otherwise specified)	2.85			V
V_{INHys}	Input voltage hysteresis	$V_{bat} = 5$ to 28 V; $T_J = -40$ °C to $+175$ °C (unless otherwise specified)	0.25			V
I_{IN1}	Input current ($I_C < I_{CTHR}$)	See fig 8 for typical values vs R_a (Measured with $11.5k_{\Omega}$, $\pm 1\%$ resistor on A pin)	16	18	20	mA
I_{IN2}	Input current ($I_C > I_{CTHR}$)	See fig 8 for typical values vs R_a (Measured with $11.5k_{\Omega}$, $\pm 1\%$ resistor on A pin)	6	7.1	10	mA
I_{IN1}	Input current ($I_C < I_{CTHR}$)	(Note 1)		4.2		mA
I_{IN2}	Input current ($I_C > I_{CTHR}$)	(Note 1)		1.8		mA
C_{OSS}	Output capacitance	$V_{C-GND} = 25$ V, $V_{IN} = 0$ V, $f = 1$ MHz		70		pF
I_{CTHR}	Collector current feedback (IFL) threshold 25 °C to 175 °C	(Measured with $11.5k_{\Omega}$, $\pm 1\%$ resistor on A pin)	4.3	5.3	6.8	A
I_{CTHR} Note 3	Collector current feedback (IFL) threshold -40 °C	(Measured with $11.5k_{\Omega}$, $\pm 1\%$ resistor on A pin)	4.3		7.3	A
R_A	Resistor for input reference current		5.2		200	k Ω
$CSSD_{MIN}$	Minimum dwell time capacitor			2.2		nF
T_{DMAX}	Maximum dwell time	($CSSD_{EXT} = 10$ nF)	19	23	28	ms
I_{SLEW}	Soft-Shut-Down slew rate	(I_C : 90% -20% I_L)	0.7	1.5	2.5	A/ms
I_{CSSD1}	CSSD Pin current for T_{DMAX}		1.0	1.25	1.5	μ A

Electrical Characteristics

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{bat1}	Operating voltage	Coil switching	4		28	V
V_{bat2}	Operating voltage	All functions	5		28	V
I_{bat}	Supply current	($T_J=175^{\circ}\text{C}$, $V_{bat} = 28\text{V}$, RA open, $I_{N/IFL} = 5\text{V}$)			5	mA
$V_{C-GND(CL)}$	Collector emitter clamping voltage	($I_C = 10\text{ mA}$)	390		450	V
$I_{C(leak)}$	Collector leakage current	($T_J=175^{\circ}\text{C}$, $V_{C-GND}=300\text{ V}$)			30	μA
$V_{C-GND(SA T)}$	Collector emitter saturation voltage ($I_C=10\text{A}$, $T_J=175^{\circ}\text{C}$)	Collector emitter saturation voltage ($I_C=10\text{A}$, $T_J=175^{\circ}\text{C}$)			1.8	V
$I_{C(lim)}$	Current Limit	(Note 2)	14		19	A
T_{fall}	Current fall time	Current fall time			15	μs
T_{spike}	Input spike filter delay on rising and falling edge of IN/IFL	Input spike filter delay on rising and falling edge of IN/IFL		13		μs
T_{D1}	Turn on delay time (Time from $V_{IN/IFL}=4.0\text{ V}$ to $V_{C-gnd}=V_{bat}/2$)	Turn on delay time (Time from $V_{IN/IFL}=4.0\text{ V}$ to $V_{C-gnd}=V_{bat}/2$)	10	13	26	μs
T_{D2}	Turn off delay time (Time from $V_{IN/IFL}=0.5\text{ V}$ to $V_{C-gnd}=V_{bat}/2$)	Turn off delay time (Time from $V_{IN/IFL}=0.5\text{ V}$ to $V_{C-gnd}=V_{bat}/2$)	10	17	28	μs

Notes:

1. Measured with open or shorted RA pin
2. Range can be varied between typ. 8-16.5A or can be eliminated with metal mask options
3. $I_{Cth\text{ max}} < 7.3\text{A} - 0.0077 \cdot (T + 40\text{C})$ for T_J from -40 to 25C

Functional Description

Input and spike filter

When the input signal voltage reaches V_{INH} , the coil current will be switched on through the IGBT. When the input voltage goes below V_{INL} , the coil current through the IGBT will be turned off. If the ignitor is in SSD mode, the input signal control is disabled. After a SSD sequence input control will be re-enabled after the input has reached a valid low. Positive and negative spikes of $< T_{spike}$ duration at the input line will be filtered out and will not turn on/off the IGBT.

Bidirectional input / diagnosis pin

The pin IN/IFL has a double function. It is used as input pin to control the power stage (on/off) and as output pin that delivers diagnostic information about the collector current level (current flag).

- If the input voltage reaches V_{INH} , the power stage is turned on. If the input voltage is below V_{INL} , the power stage is turned off.
- The IN/IFL pin sinks constantly a current of I_{IN1} . When the input voltage is above V_{INH} and the collector current exceeds the I_{cTHR} threshold, the current flag is set by switching a current sink at the bidirectional IN/IFL pin to I_{IN2} (see Fig.4)
- If resistor R_A has a value $< 5.2k$ or $> 200k$, I_{IN1} and I_{IN2} will be set to their default values.

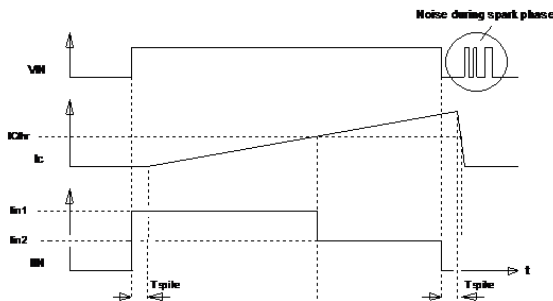


Figure 4: Bidirectional IN/IFL Diagnostic Pin

Maximum dwell time and soft-shutdown (SSD)

When the IGBT is turned on, a delay timer, dependent on the value of the external CSSD capacitor (see Fig.6), is started. If a valid falling edge has not been received after the time T_{DMAX} , the IGBT will be turned off slowly as shown in Fig.5. The coil current will not exceed a slow rate of typical 1.2A/ms. If a valid falling edge is received after the time T_{DMAX} , the edge will be ignored and the soft shutdown will be completed. The IGBT cannot be subsequently turned on until a valid rising edge is detected.

If the CSSD capacitor has a value of $< 2.2nF$ or the CSSD pin is shorted to ground, the maximum dwell time and SSD functions will be disabled.

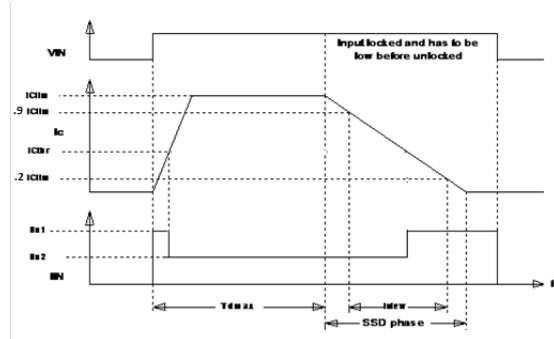


Figure 5: Dwell time and Soft-Shut-Down

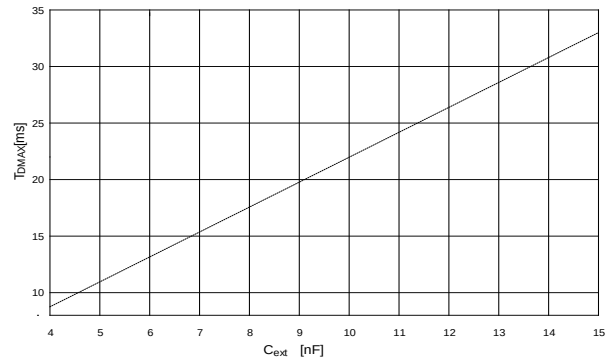


Figure 6: T_{DMAX} as function of external CSSD capacitor

Figure 7 shows the IN1 and IN2 currents in dependency of the IRA current.

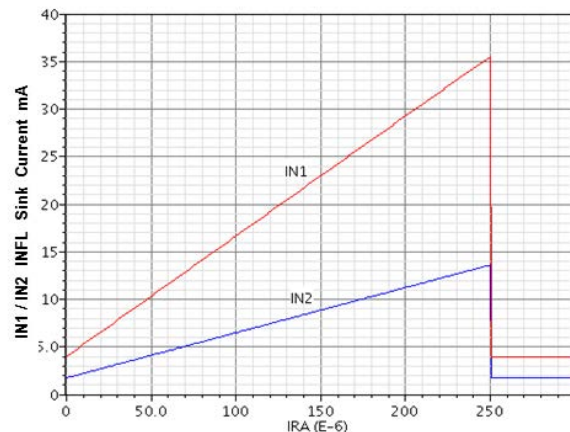


Figure 7: Typical IN1 and IN2 Currents vs R_A
The value for R_A can be determined by the formula:
 $R_A = (1.24/IRA) - 750$.

Physical Dimensions

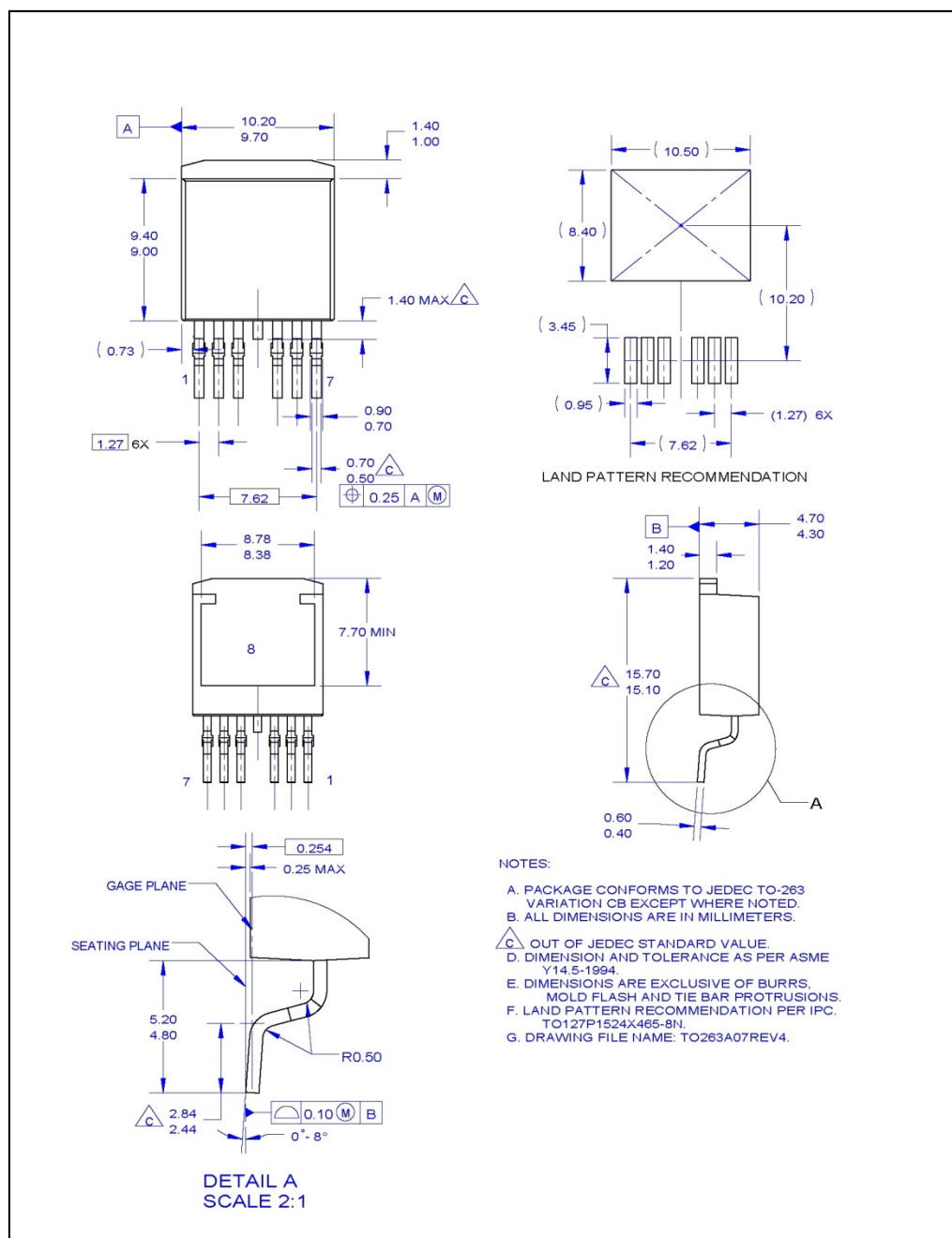


Figure 3. Packaging Outline and Dimensions (TO263A07 Rev4)

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

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.

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