

# IGBT - Field Stop 600 V, 20 A

## FGH20N60UFD

### Description

Using novel field stop IGBT Technology, ON Semiconductor's field stop IGBTs offer the optimum performance for solar inverter, UPS, welder and PFC applications where low conduction and switching losses are essential.

### Features

- High Current Capability
- Low Saturation Voltage:  $V_{CE(sat)} = 1.8 \text{ V @ } I_C = 20 \text{ A}$
- High Input Impedance
- Fast Switching
- This Device is Pb-Free and is RoHS Compliant

### Applications

- Solar Inverter, UPS, Welder, PFC

### ABSOLUTE MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector to Emitter Voltage	$V_{CES}$	600	V
Gate to Emitter Voltage	$V_{GES}$	$\pm 20$	V
Transient Gate to Emitter Voltage		$\pm 30$	
Collector Current @ $T_c = 25^\circ\text{C}$ @ $T_c = 100^\circ\text{C}$	$I_C$	40	A
		20	
Pulsed Collector Current @ $T_c = 25^\circ\text{C}$	$I_{CM}$ (Note 1)	60	A
Diode Forward Current @ $T_c = 25^\circ\text{C}$ @ $T_c = 100^\circ\text{C}$	$I_F$	20	A
		10	
Pulsed Diode Maximum Forward Current	$I_{FM}$ (Note 1)	60	A
Maximum Power Dissipation @ $T_c = 25^\circ\text{C}$ @ $T_c = 100^\circ\text{C}$	$P_D$	165	W
		66	
Operating Junction Temperature	$T_J$	-55 to + 150	$^\circ\text{C}$
Storage Temperature Range	$T_{stg}$	-55 to + 150	$^\circ\text{C}$
Maximum Lead Temperature for Soldering, 1/8" from Case for 5 Seconds	$T_L$	300	$^\circ\text{C}$

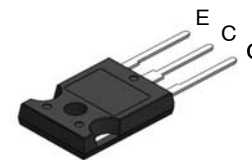
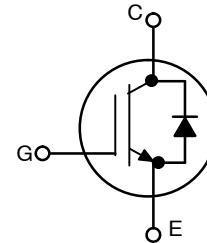
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

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



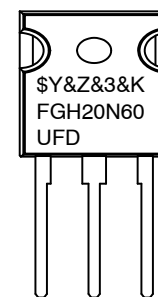
ON Semiconductor®

[www.onsemi.com](http://www.onsemi.com)



TO-247-3LD  
CASE 340CK

### MARKING DIAGRAM



\$Y	= ON Semiconductor Logo
&Z	= Assembly Plant Code
&3	= Numeric Date Code
&K	= Lot Code
FGH20N60UFD	= Specific Device Code

### ORDERING INFORMATION

See detailed ordering and shipping information on page 2 of this data sheet.

# FGH20N60UFD

## THERMAL CHARACTERISTICS

Parameter	Symbol	Typ.	Max.	Unit
Thermal Resistance Junction-to-Case, for IGBT	$R_{\theta JC}$	–	0.76	°C/W
Thermal Resistance Junction-to-Case, for Diode	$R_{\theta JC}$	–	2.51	°C/W
Thermal Resistance Junction-to-Ambient	$R_{\theta JA}$	–	40	°C/W

## PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FGH20N60UFDTU	FGH20N60UFD	TO-247	Tube	N/A	N/A	30 Units

## ELECTRICAL CHARACTERISTICS OF THE IGBT ( $T_C = 25^\circ\text{C}$ unless otherwise noted)

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

### OFF CHARACTERISTICS

Collector to Emitter Breakdown Voltage	$BV_{CES}$	$V_{GE} = 0\text{ V}, I_C = 250\ \mu\text{A}$	600	–	–	V
Temperature Coefficient of Breakdown Voltage	$\Delta BV_{CES}/\Delta T_J$	$V_{GE} = 0\text{ V}, I_C = 250\ \mu\text{A}$	–	0.6	–	V/°C
Collector Cut-Off Current	$I_{CES}$	$V_{CE} = V_{CES}, V_{GE} = 0\text{ V}$	–	–	250	$\mu\text{A}$
G-E Leakage Current	$I_{GES}$	$V_{GE} = V_{GES}, V_{CE} = 0\text{ V}$	–	–	±400	nA

### ON CHARACTERISTICS

G-E Threshold Voltage	$V_{GE(th)}$	$I_C = 250\ \mu\text{A}, V_{CE} = V_{GE}$	4.0	5.0	6.5	V
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C = 20\text{ A}, V_{GE} = 15\text{ V}$	–	1.8	2.4	V
		$I_C = 20\text{ A}, V_{GE} = 15\text{ V}, T_C = 125^\circ\text{C}$	–	2.0	–	V

### DYNAMIC CHARACTERISTICS

Input Capacitance	$C_{ies}$	$V_{CE} = 30\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$	–	940	–	pF
Output Capacitance	$C_{oes}$		–	110	–	pF
Reverse Transfer Capacitance	$C_{res}$		–	40	–	pF

### SWITCHING CHARACTERISTICS

Turn-On Delay Time	$t_{d(on)}$	$V_{CC} = 400\text{ V}, I_C = 20\text{ A}, R_G = 10\ \Omega, V_{GE} = 15\text{ V},$ Inductive Load, $T_C = 25^\circ\text{C}$	–	13	–	ns
Rise Time	$t_r$		–	17	–	ns
Turn-Off Delay Time	$t_{d(off)}$		–	87	–	ns
Fall Time	$t_f$		–	32	64	ns
Turn-On Switching Loss	$E_{on}$		–	0.38	–	mJ
Turn-Off Switching Loss	$E_{off}$		–	0.26	–	mJ
Total Switching Loss	$E_{ts}$		–	0.64	–	mJ
Turn-On Delay Time	$t_{d(on)}$	$V_{CC} = 400\text{ V}, I_C = 20\text{ A}, R_G = 10\ \Omega, V_{GE} = 15\text{ V},$ Inductive Load, $T_C = 125^\circ\text{C}$	–	13	–	ns
Rise Time	$t_r$		–	16	–	ns
Turn-Off Delay Time	$t_{d(off)}$		–	92	–	ns
Fall Time	$t_f$		–	63	–	ns
Turn-On Switching Loss	$E_{on}$		–	0.41	–	mJ
Turn-Off Switching Loss	$E_{off}$		–	0.36	–	mJ
Total Switching Loss	$E_{ts}$		–	0.77	–	mJ
Total Gate Charge	$Q_g$	$V_{CE} = 400\text{ V}, I_C = 20\text{ A}, V_{GE} = 15\text{ V}$	–	63	–	nC
Gate to Emitter Charge	$Q_{ge}$		–	7	–	nC
Gate to Collector Charge	$Q_{gc}$		–	32	–	nC

# FGH20N60UFD

## ELECTRICAL CHARACTERISTICS OF THE DIODE ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

Parametr	Symbol	Test Conditions	Min	Typ	Max	Unit	
Diode Forward Voltage	$V_{FM}$	$I_F = 10\text{ A}$	$T_C = 25^\circ\text{C}$	-	1.9	2.5	V
			$T_C = 125^\circ\text{C}$	-	1.7	-	
Diode Reverse Recovery Time	$t_{rr}$	$I_F = 10\text{ A}, di_F/dt = 200\text{ A}/\mu\text{s}$	$T_C = 25^\circ\text{C}$	-	34	-	ns
			$T_C = 125^\circ\text{C}$	-	57	-	
Diode Reverse Recovery Charge	$Q_{rr}$		$T_C = 25^\circ\text{C}$	-	41	-	nC
			$T_C = 125^\circ\text{C}$	-	96	-	

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

# FGH20N60UFD

## TYPICAL CHARACTERISTICS

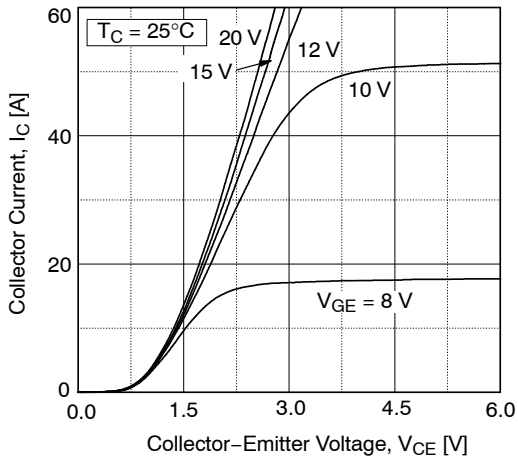


Figure 1. Typical Output Characteristics

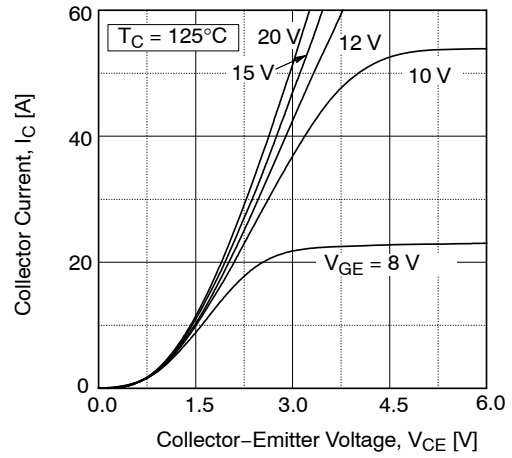


Figure 2. Typical Output Characteristics

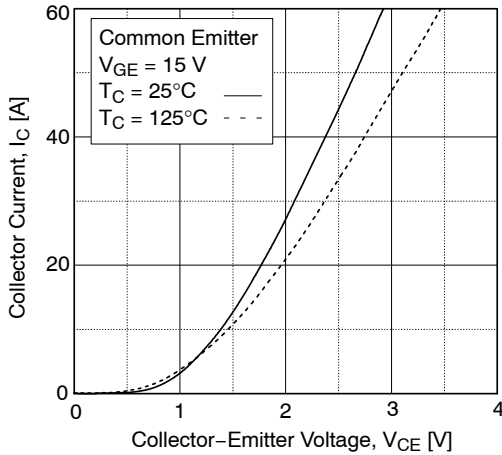


Figure 3. Typical Saturation Voltage Characteristics

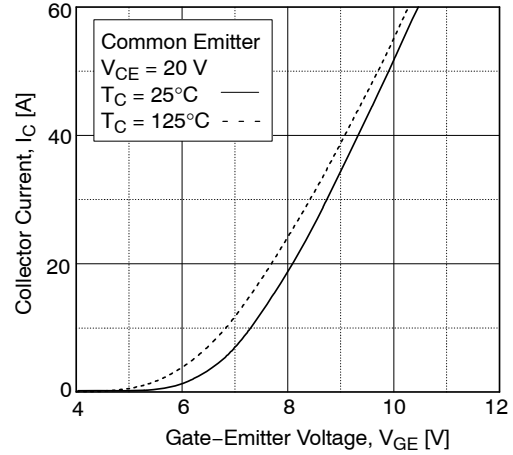


Figure 4. Transfer Characteristics

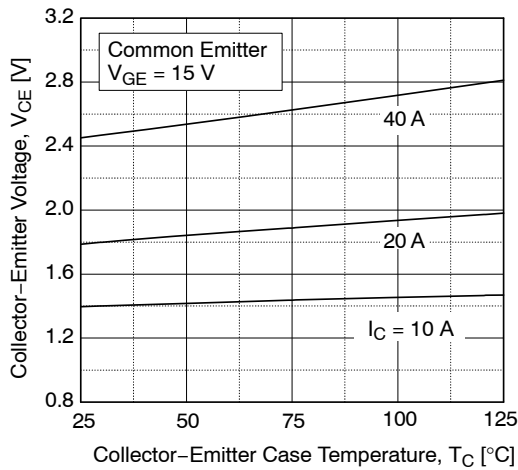


Figure 5. Saturation Voltage vs. Case Temperature at Variant Current Level

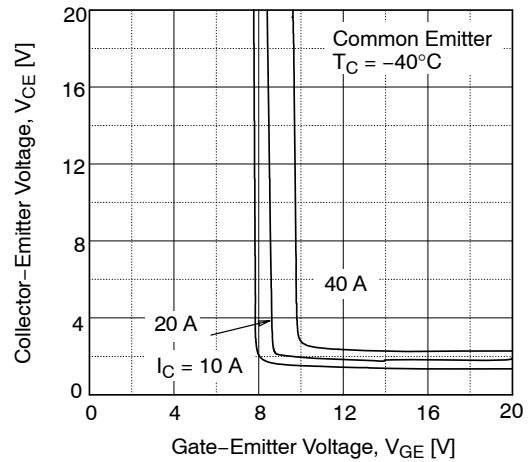


Figure 6. Saturation Voltage vs. Vge

# FGH20N60UFD

## TYPICAL CHARACTERISTICS

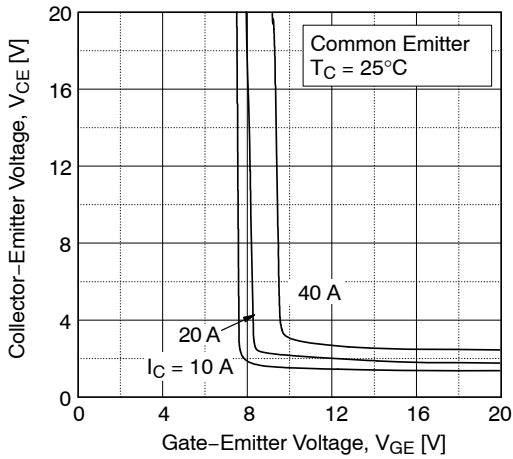


Figure 7. Saturation Voltage vs.  $V_{GE}$

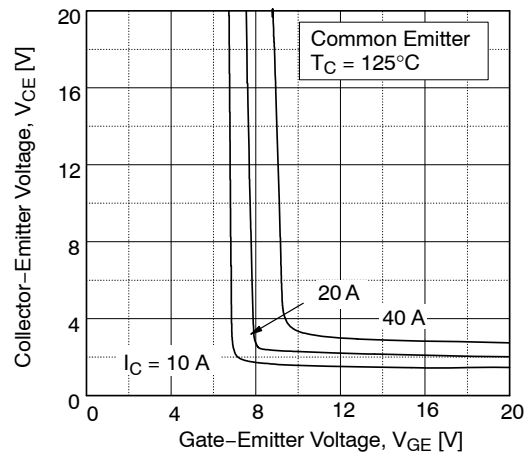


Figure 8. Saturation Voltage vs.  $V_{GE}$

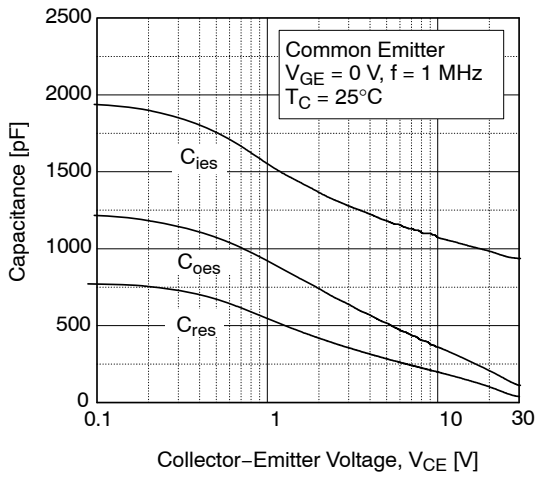


Figure 9. Capacitance Characteristics

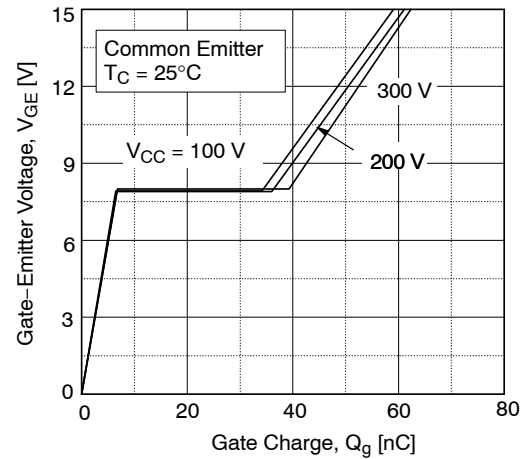


Figure 10. Gate Charge Characteristics

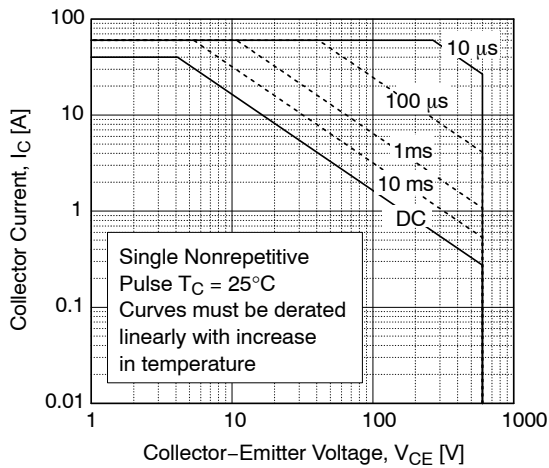


Figure 11. SOA Characteristics

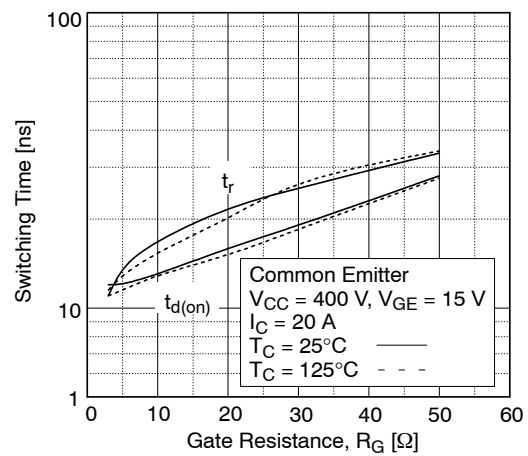
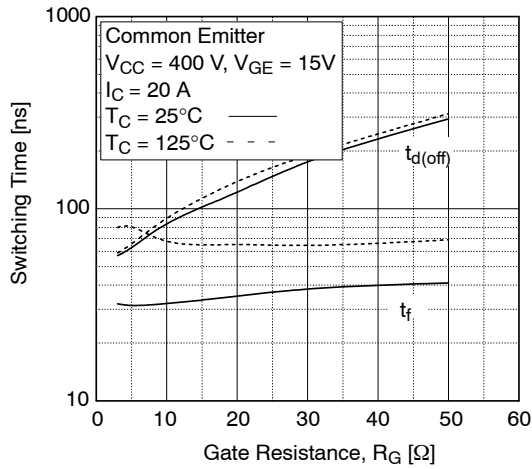


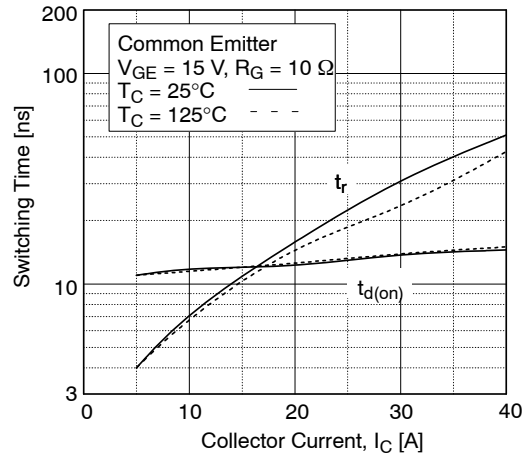
Figure 12. Turn-on Characteristics vs. Gate Resistance

# FGH20N60UFD

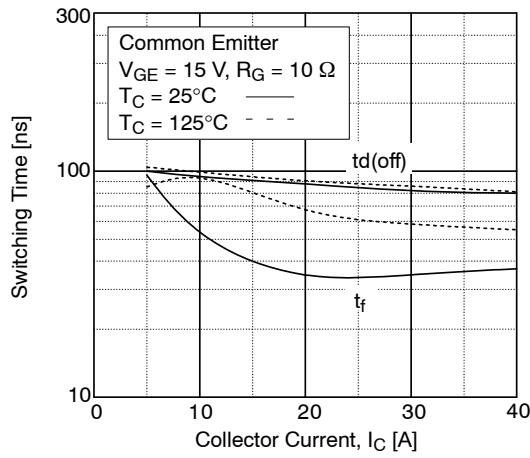
## TYPICAL CHARACTERISTICS



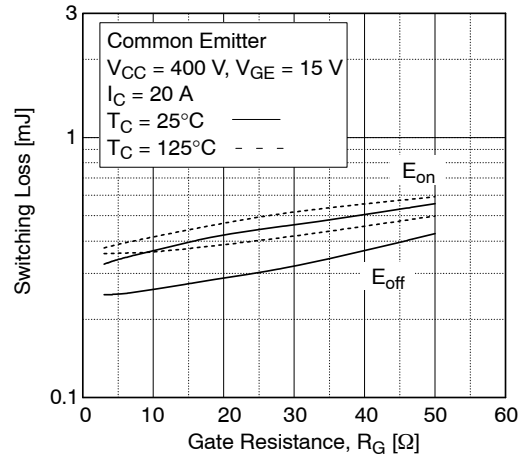
**Figure 13. Turn-off Characteristics vs. Gate Resistance**



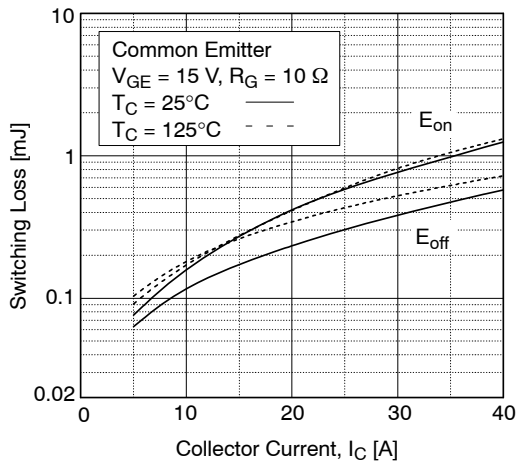
**Figure 14. Turn-on Characteristics vs. Collector Current**



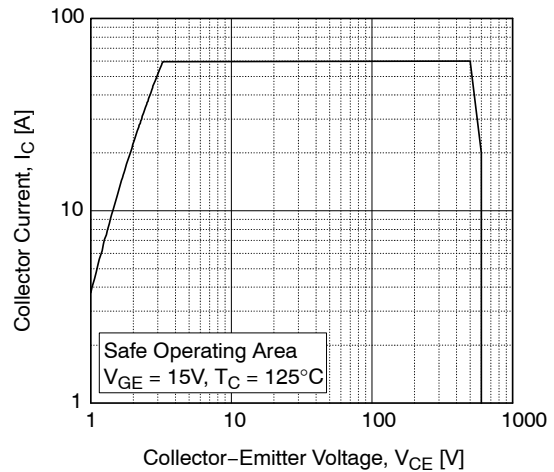
**Figure 15. Turn-off Characteristics vs. Collector Current**



**Figure 16. Switching Loss vs. Gate Resistance**



**Figure 17. Switching Loss vs. Collector Current**



**Figure 18. Turn-off Switching SOA Characteristics**

# FGH20N60UFD

## TYPICAL CHARACTERISTICS

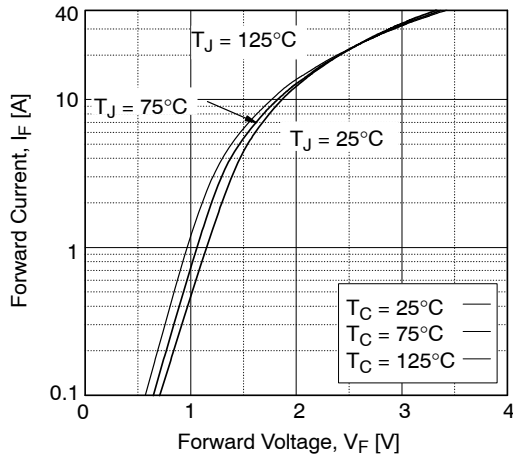


Figure 19. Forward Characteristics

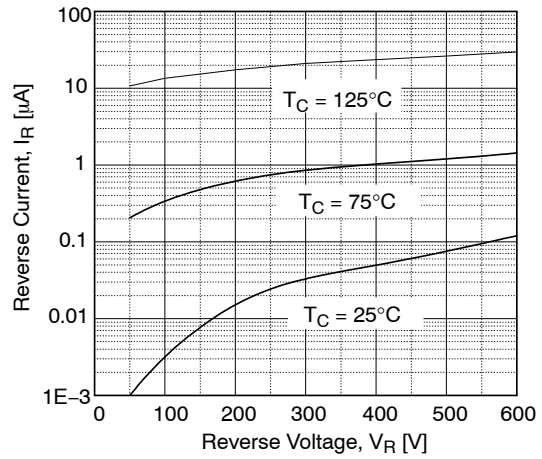


Figure 20. Reverse Current

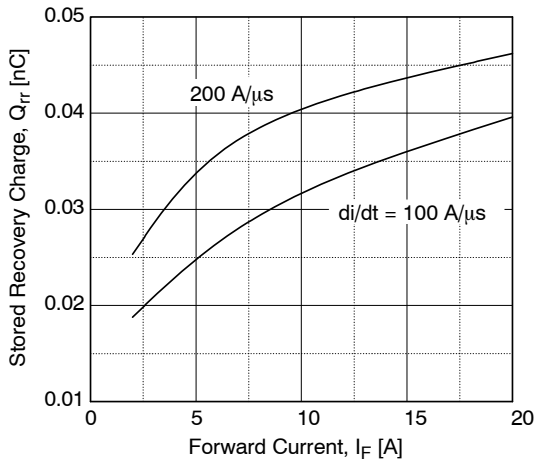


Figure 21. Stored Charge

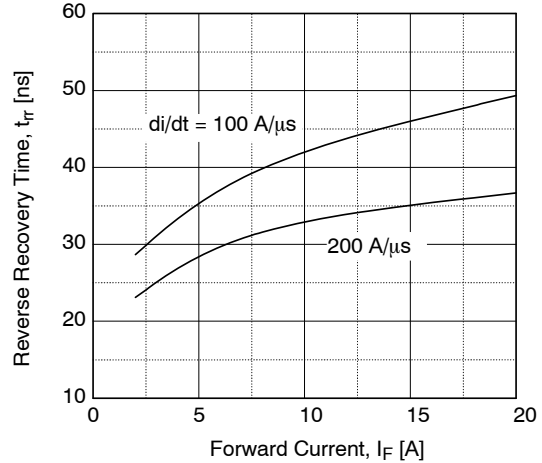


Figure 22. Reverse Recovery Time

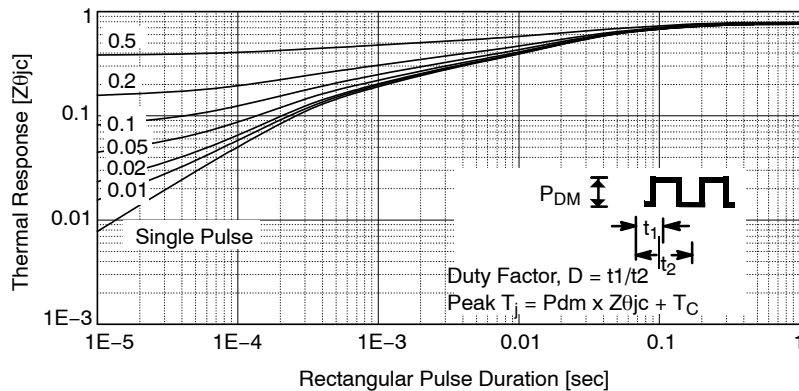
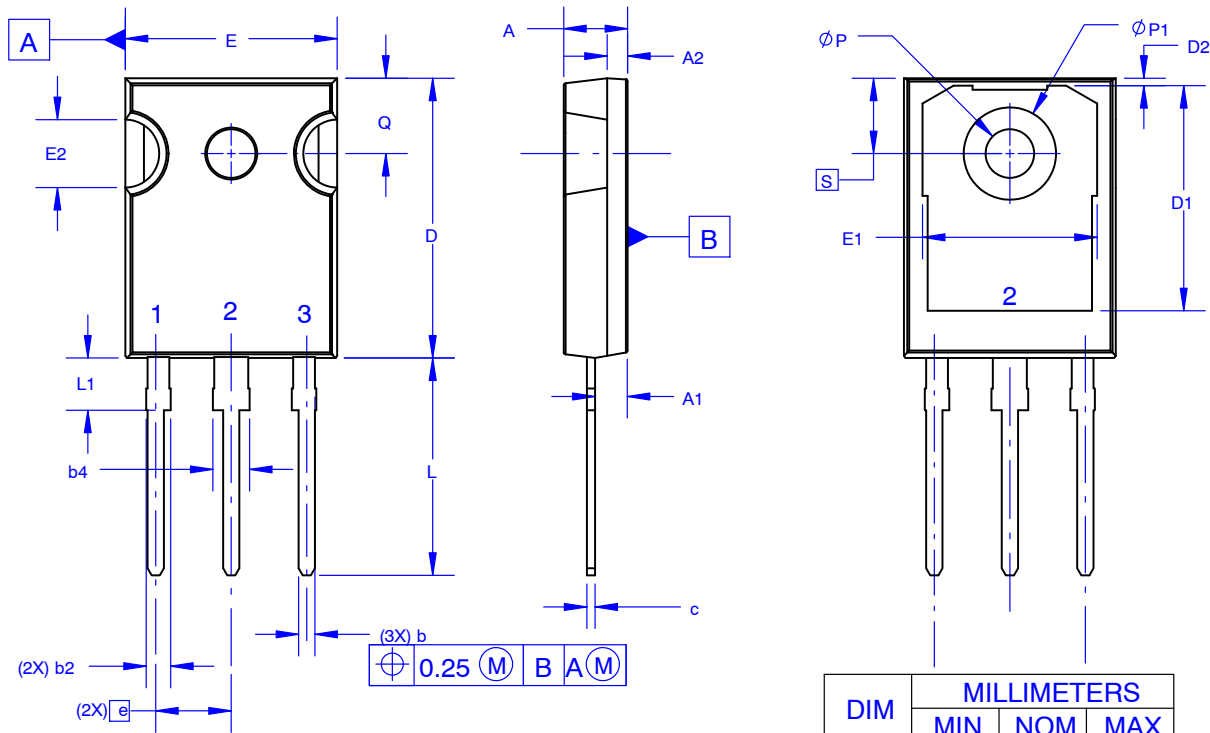


Figure 23. Transient Thermal Impedance of IGBT

**TO-247-3LD SHORT LEAD**  
**CASE 340CK**  
**ISSUE A**

DATE 31 JAN 2019



NOTES: UNLESS OTHERWISE SPECIFIED.

- A. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
- B. ALL DIMENSIONS ARE IN MILLIMETERS.
- C. DRAWING CONFORMS TO ASME Y14.5 - 2009.
- D. DIMENSION A1 TO BE MEASURED IN THE REGION DEFINED BY L1.
- E. LEAD FINISH IS UNCONTROLLED IN THE REGION DEFINED BY L1.

**GENERIC MARKING DIAGRAM\***



- XXXX = Specific Device Code
- A = Assembly Location
- Y = Year
- WW = Work Week
- ZZ = Assembly Lot Code

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "•", may or may not be present. Some products may not follow the Generic Marking.

DIM	MILLIMETERS		
	MIN	NOM	MAX
A	4.58	4.70	4.82
A1	2.20	2.40	2.60
A2	1.40	1.50	1.60
b	1.17	1.26	1.35
b2	1.53	1.65	1.77
b4	2.42	2.54	2.66
c	0.51	0.61	0.71
D	20.32	20.57	20.82
D1	13.08	~	~
D2	0.51	0.93	1.35
E	15.37	15.62	15.87
E1	12.81	~	~
E2	4.96	5.08	5.20
e	~	5.56	~
L	15.75	16.00	16.25
L1	3.69	3.81	3.93
ØP	3.51	3.58	3.65
ØP1	6.60	6.80	7.00
Q	5.34	5.46	5.58
S	5.34	5.46	5.58

<b>DOCUMENT NUMBER:</b>	<b>98AON13851G</b>	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
<b>DESCRIPTION:</b>	<b>TO-247-3LD SHORT LEAD</b>	<b>PAGE 1 OF 1</b>

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 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. ON Semiconductor does not convey any license under its patent rights nor the rights of others.



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](http://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:

Email Requests to: [orderlit@onsemi.com](mailto:orderlit@onsemi.com)

ON Semiconductor Website: [www.onsemi.com](http://www.onsemi.com)

### TECHNICAL SUPPORT

North American Technical Support:  
Voice Mail: 1 800-282-9855 Toll Free USA/Canada  
Phone: 011 421 33 790 2910

Europe, Middle East and Africa Technical Support:

Phone: 00421 33 790 2910

For additional information, please contact your local Sales Representative