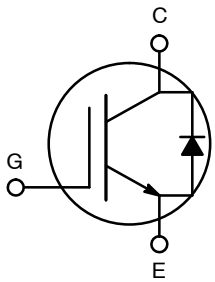
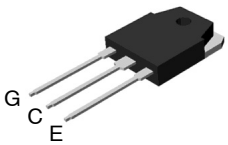
Field Stop IGBT

650 V, 40 A

FGA40N65SMD





TO−3P−3LD
CASE 340BZ

General Description

Using novel field stop IGBT technology, **onsemi**'s new series of field stop 2nd generation IGBTs offer the optimum performance for solar inverter, UPS, welder, induction heating, telecom, ESS and PFC applications where low conduction and switching losses are essential.

Features

- Maximum Junction Temperature: T_J = 175°C
- Positive Temperature Co−efficient for Easy Parallel Operating
- High Current Capability
- Low Saturation Voltage: $V_{CE(sat)}$ = 1.9 V (Typ.) @ I_C = 40 A
- Fast Switching: E_{OFF} = 6.5 μJ/A
- Tighten Parameter Distribution
- These Devices are Pb−Free and are RoHS Compliant

Applications

- Solar Inverter, UPS, Welder, Induction Heating
- Telecom, ESS

MARKING DIAGRAM

FGA40N65SMD	= Specific Device Code
A	= Assembly Location
YWW	= Date Code (Year & Week)
ZZ	= Assembly Lot

ORDERING INFORMATION

Device	Package	Shipping
FGA40N65SMD	TO−3P−3LD (Pb−Free)	450 Units / Tube

© Semiconductor Components Industries, LLC, 2014

ABSOLUTE MAXIMUM RATINGS

Symbol	Description		Value	Unit
V_{CES}	Collector to Emitter Voltage		650	V
V_{GES}	Gate to Emitter Voltage		±20	A
	Transient Gate to Emitter Voltage		±30	A
I_C	Collector Current	@ T_C = 25°C	80	A
	Collector Current	@ T_C = 100°C	40	A
I_{CM} (Note 1)	Pulsed Collector Current		120	A
I_F	Diode Forward Current	@ T_C = 25°C	40	A
	Diode Forward Current	@ T_C = 100°C	20	A
I_{FM} (Note 1)	Pulsed Diode Maximum Forward Current		120	A
P_D	Maximum Power Dissipation	@ T_C = 25°C	349	W
	Maximum Power Dissipation	@ T_C = 100°C	174	W
T_J	Operating Junction Temperature		−55 to +175	°C
T_{stg}	Storage Temperature Range		−55 to +175	°C
T_L	Maximum Lead Temp. for Soldering Purposes, 1/8″ from case for 5 seconds		300	°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.

THERMAL CHARACTERISTICS

Symbol	Parameter	Value	Unit
$R_{\theta JC}$(IGBT)	Thermal Resistance, Junction to Case, Max.	0.43	°C/W
$R_{\theta JC}$(Diode)	Thermal Resistance, Junction to Case, Max.	1.5	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	40	°C/W

ELECTRICAL CHARACTERISTICS OF THE DIODE (T_C = 25°C unless otherwise noted)

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
V_{FM}	Diode Forward Voltage	I_F = 20 A	T_C = 25°C	–	2.1	2.6	V
			T_C = 175°C	–	1.7	–	
E_{rec}	Reverse Recovery Energy	I_F = 20 A, dI_F/dt = 200 A/μs	T_C = 175°C	–	96	–	μJ
t_{rr}	Diode Reverse Recovery Time		T_C = 25°C	–	42	–	ns
			T_C = 175°C	–	200	–	
I_{rr}	Diode Peak Reverse Recovery Current		T_C = 25°C	–	3.6	–	A
			T_C = 175°C	–	8.0	–	
Q_{rr}	Diode Reverse Recovery Charge		T_C = 25°C	–	76	–	nC
			T_C = 175°C	–	800	–	

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.

ELECTRICAL CHARACTERISTICS OF THE IGBT (T_C = 25°C unless otherwise noted)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
OFF CHARACTERISTICS						
BV_{CES}	Collector to Emitter Breakdown Voltage	V_{GE} = 0 V, I_C = 250 μA	650	–	–	V
$\Delta BV_{CES} / \Delta T_J$	Temperature Coefficient of Breakdown Voltage	V_{GE} = 0 V, I_C = 250 μA	–	0.6	–	V/°C
I_{CES}	Collector Cut−Off Current	$V_{CE} = V_{CES}$, V_{GE} = 0 V	–	–	250	μA
I_{GES}	G−E Leakage Current	$V_{GE} = V_{GES}$, V_{CE} = 0 V	–	–	±400	nA
ON CHARACTERISTICS						
$V_{GE(th)}$	G−E Threshold Voltage	I_C = 250 μA, $V_{CE} = V_{GE}$	3.5	4.5	6.0	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	I_C = 40 A, V_{GE} = 15 V	–	1.9	2.5	V
		I_C = 40 A, V_{GE} = 15 V, T_C = 175°C	–	2.1	–	V
DYNAMIC CHARACTERISTICS						
C_{ies}	Input Capacitance	V_{CE} = 30 V, V_{GE} = 0 V, f = 1 MHz	–	1880	–	pF
C_{oes}	Output Capacitance		–	180	–	pF
C_{res}	Reverse Transfer Capacitance		–	50	–	pF
SWITCHING CHARACTERISTICS						
$t_{d(on)}$	Turn−On Delay Time	V_{CC} = 400 V, I_C = 40 A, R_G = 6 Ω, V_{GE} = 15 V, Inductive Load, T_C = 25°C	–	12	16	ns
t_r	Rise Time		–	20	28	ns
$t_{d(off)}$	Turn−Off Delay Time		–	92	120	ns
t_f	Fall Time		–	13	17	ns
E_{on}	Turn−On Switching Loss		–	0.82	1.23	mJ
E_{off}	Turn−Off Switching Loss		–	0.26	0.34	mJ
E_{ts}	Total Switching Loss		–	1.08	1.57	mJ
$t_{d(on)}$	Turn−On Delay Time	V_{CC} = 400 V, I_C = 40 A, R_G = 6 Ω, V_{GE} = 15 V, Inductive Load, T_C = 175°C	–	15	–	ns
t_r	Rise Time		–	22	–	ns
$t_{d(off)}$	Turn−Off Delay Time		–	116	–	ns
t_f	Fall Time		–	16	–	ns
E_{on}	Turn−On Switching Loss		–	1.08	–	mJ
E_{off}	Turn−Off Switching Loss		–	0.60	–	mJ
E_{ts}	Total Switching Loss		–	1.68	–	mJ
Q_g	Total Gate Charge	V_{CE} = 400 V, I_C = 40 A, V_{GE} = 15 V	–	119	180	nC
Q_{ge}	Gate to Emitter Charge		–	13	20	nC
Q_{gc}	Gate to Collector Charge		–	58	90	nC

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.

TYPICAL PERFORMANCE CHARACTERISTICS

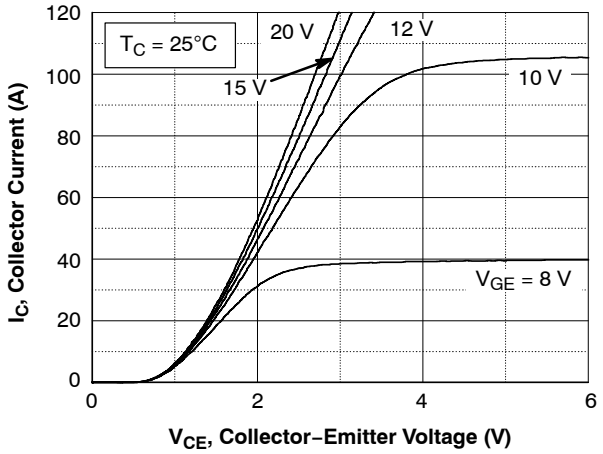


Figure 1. Typical Output Characteristics

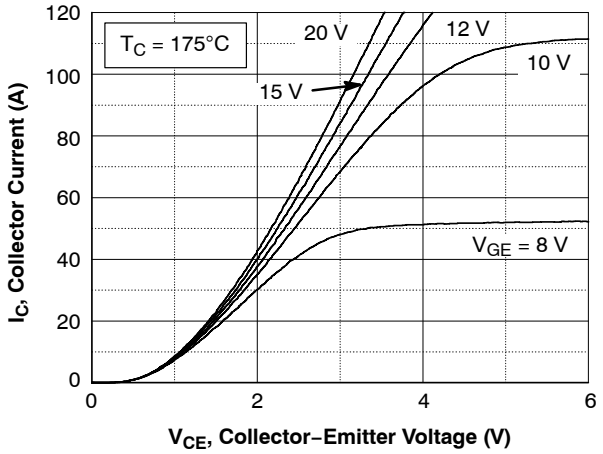


Figure 2. Typical Output Characteristics

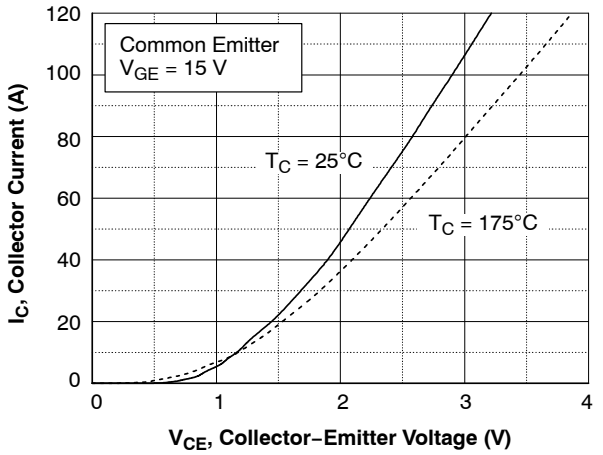


Figure 3. Typical Saturation Voltage Characteristics

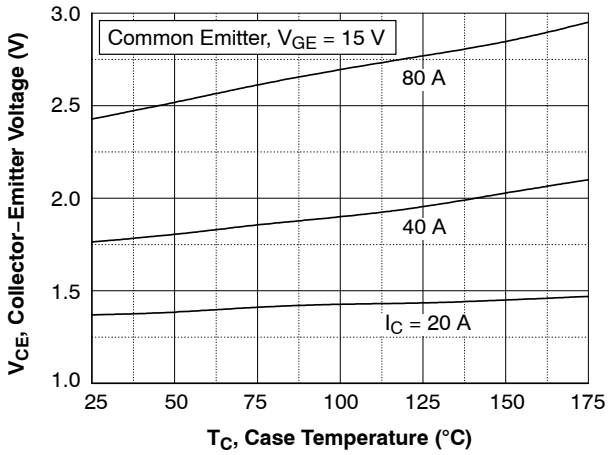


Figure 4. Saturation Voltage vs. Case Temperature at Variant Current Level

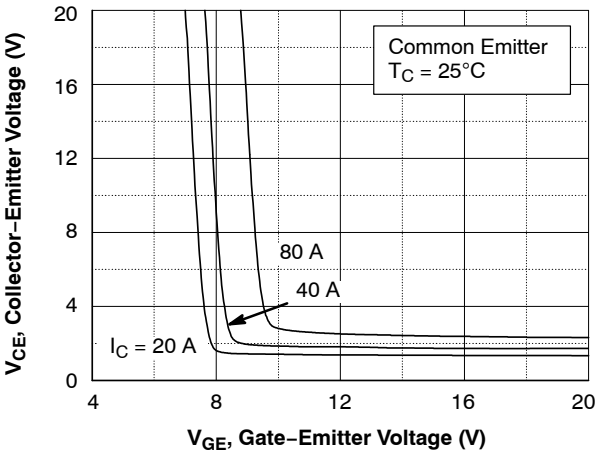


Figure 5. Saturation Voltage vs. V_{GE}

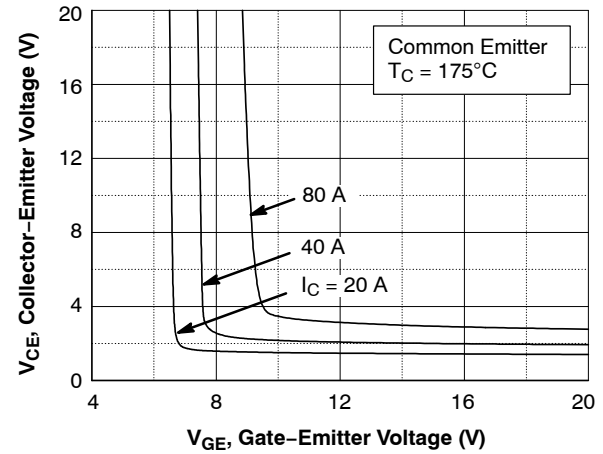


Figure 6. Saturation Voltage vs. V_{GE}

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

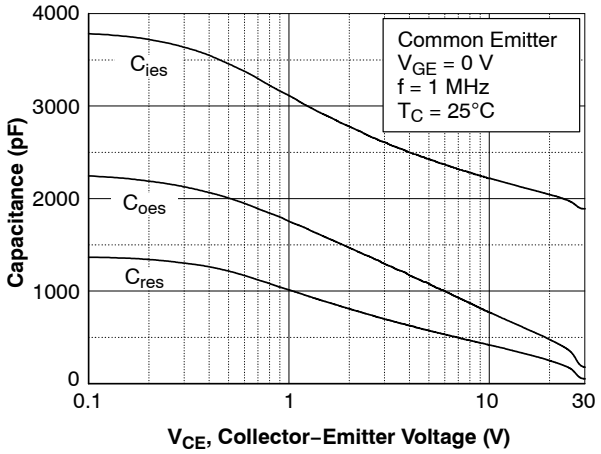


Figure 7. Capacitance Characteristics

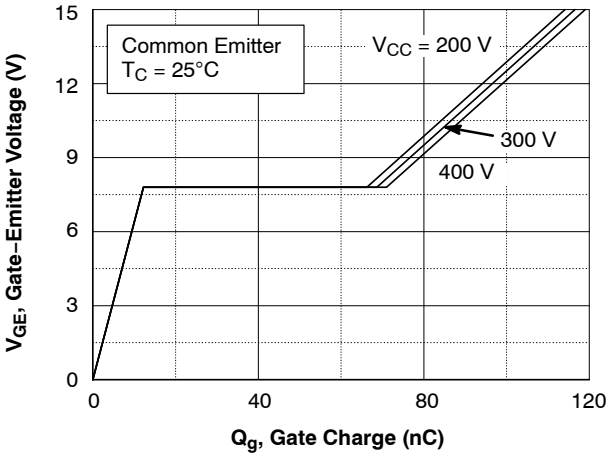


Figure 8. Gate Charge Characteristics

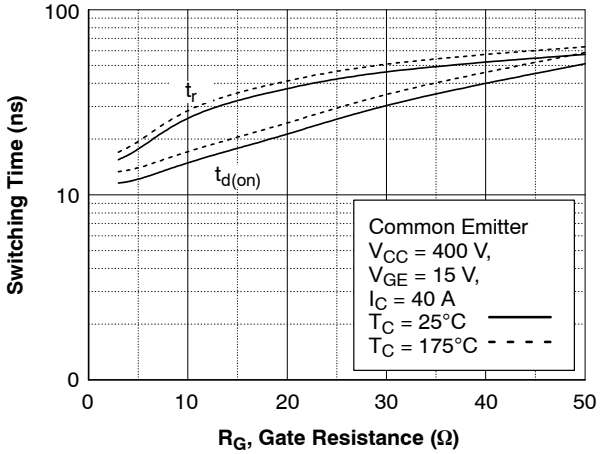


Figure 9. Turn−on Characteristics vs. Gate Resistance

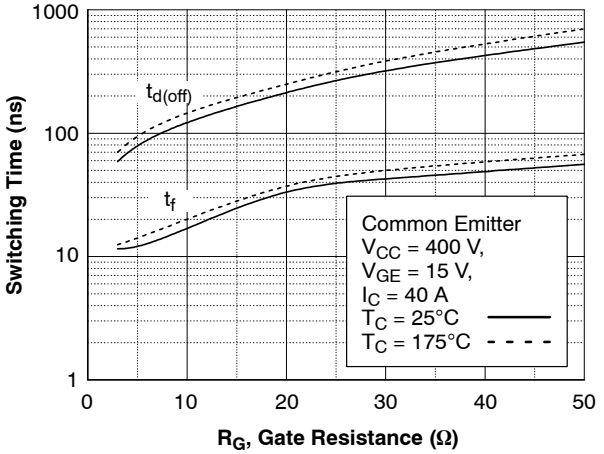


Figure 10. Turn−off Characteristics vs. Gate Resistance

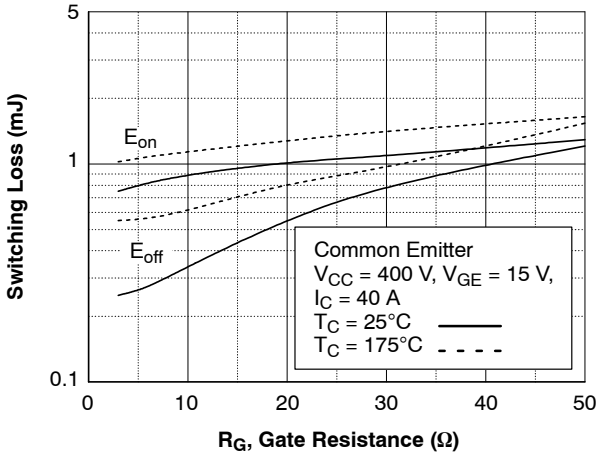


Figure 11. Switching Loss vs. Gate Resistance

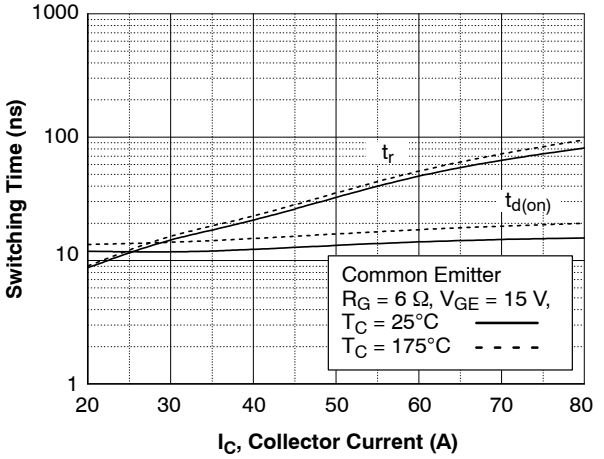


Figure 12. Turn−on Characteristics vs. Collector Current

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

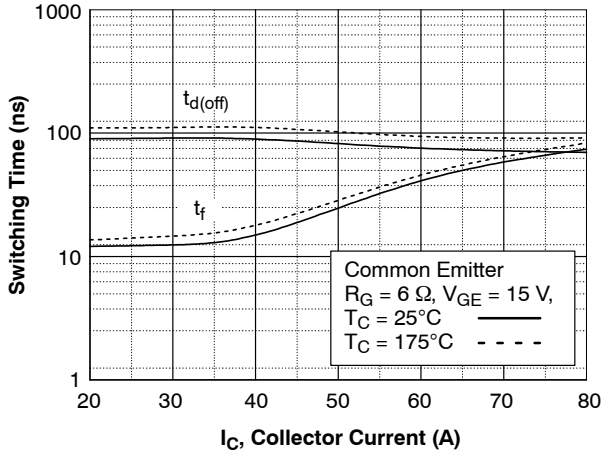


Figure 13. Turn−off Characteristics vs. Collector Current

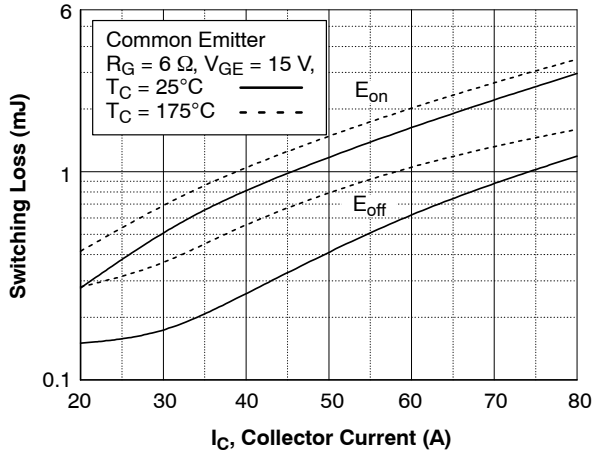


Figure 14. Switching Loss vs. Collector Current

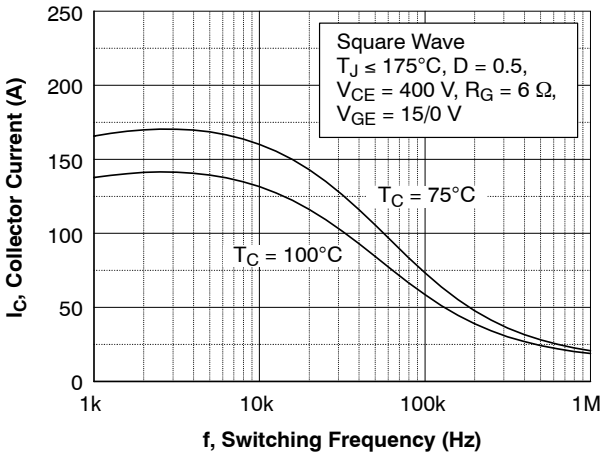


Figure 15. Load Current Vs. Frequency

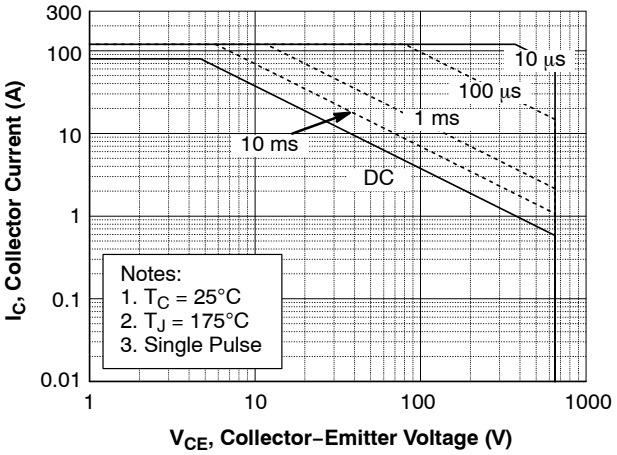


Figure 16. SOA Characteristics

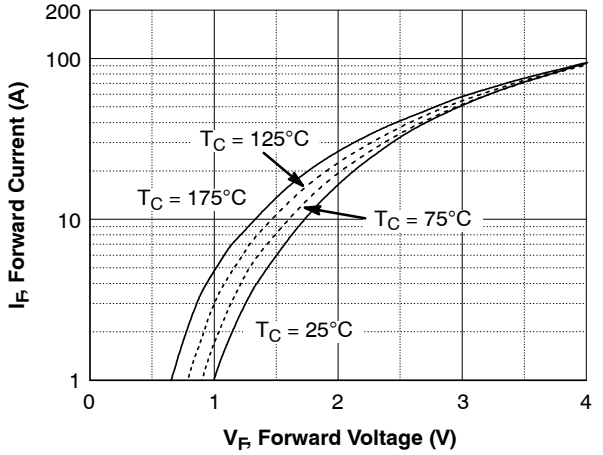


Figure 17. Forward Characteristics

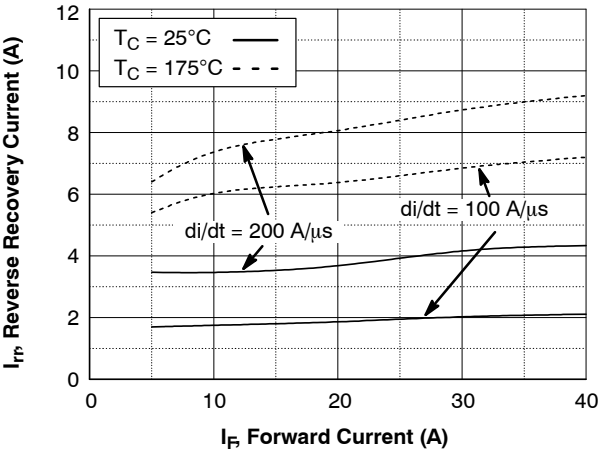


Figure 18. Reverse Recovery Current

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

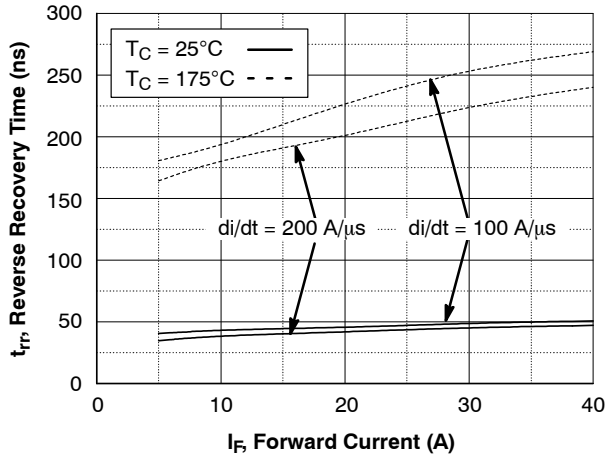


Figure 19. Reverse Recovery Time

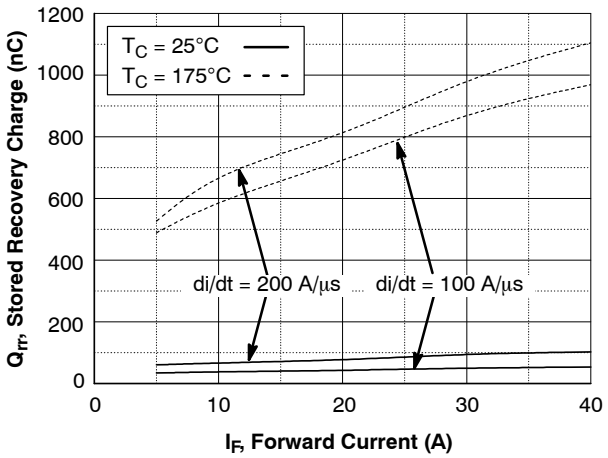


Figure 20. Stored Charge

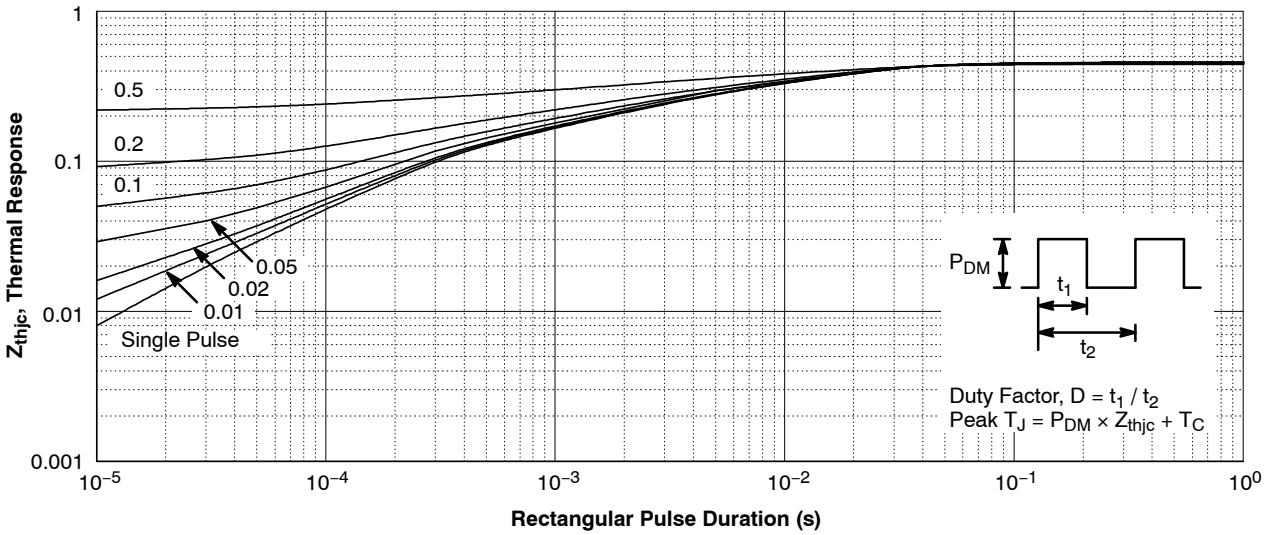


Figure 21. Transient Thermal Impedance of IGBT

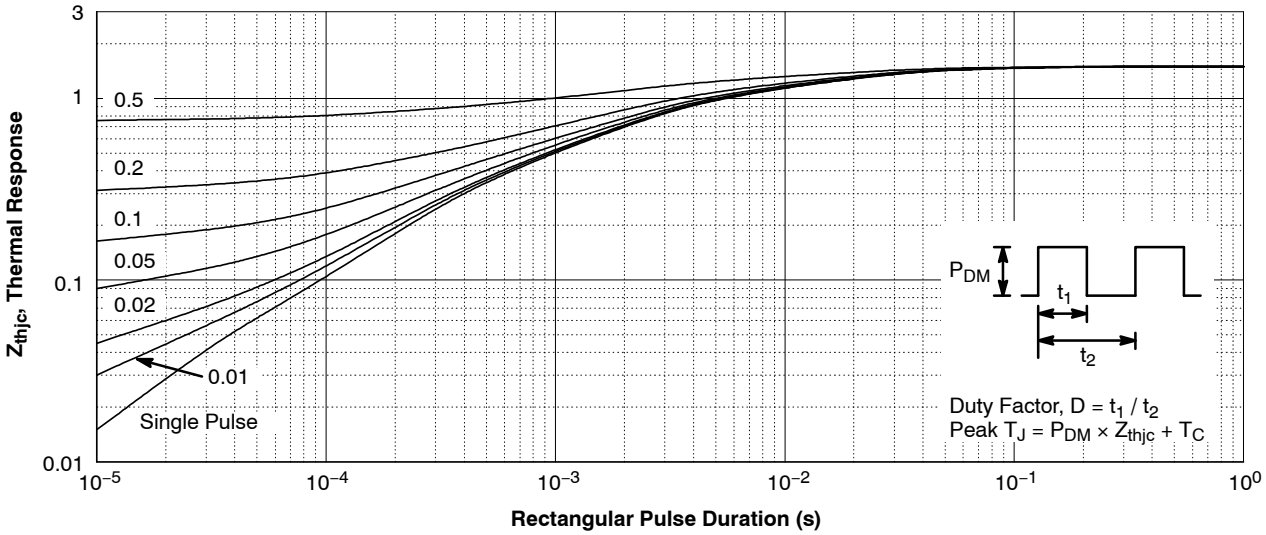
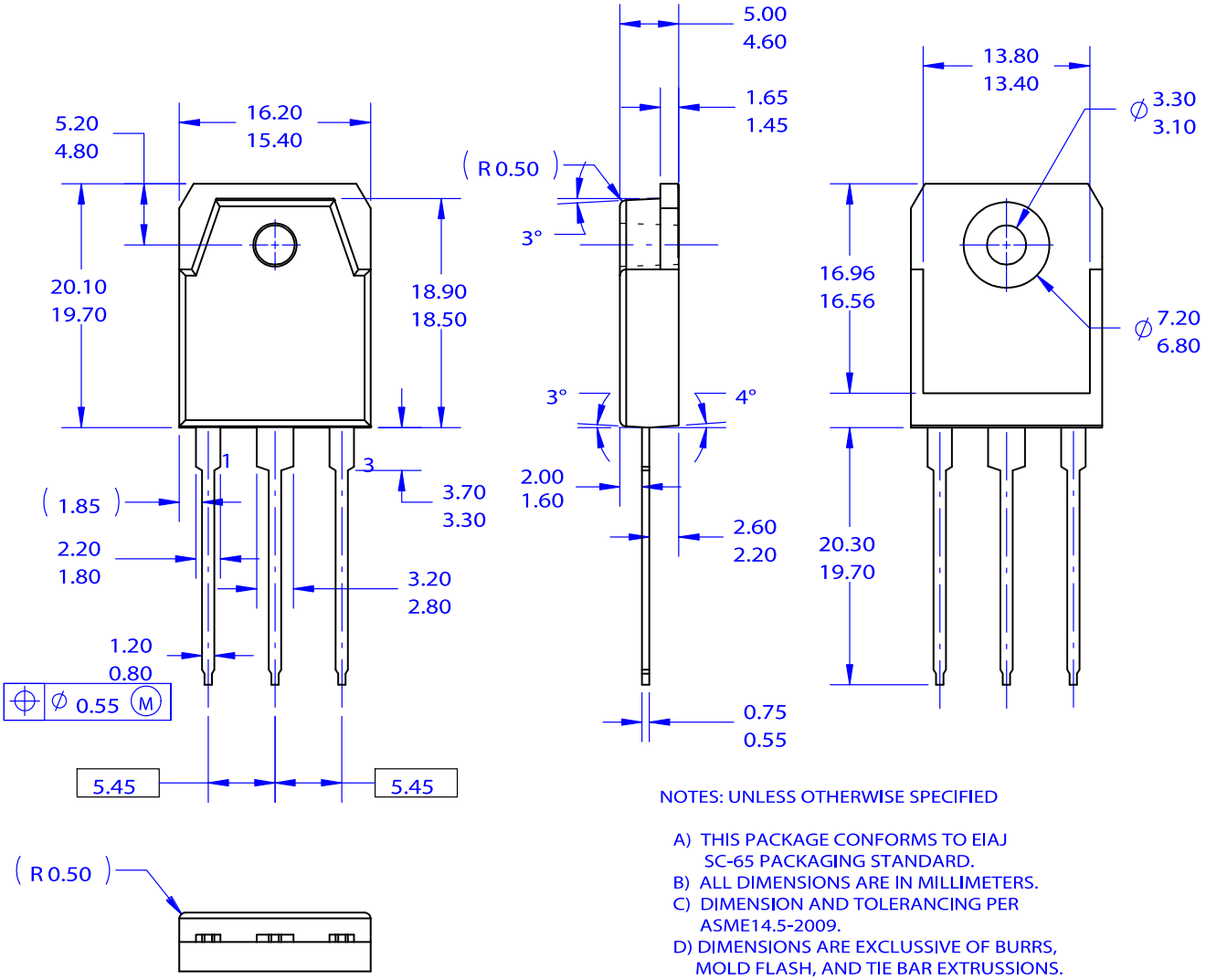


Figure 22. Transient Thermal Impedance of Diode

TO−3P−3LD / EIAJ SC−65, ISOLATED
CASE 340BZ
ISSUE O

DATE 31 OCT 2016



NOTES: UNLESS OTHERWISE SPECIFIED

A) THIS PACKAGE CONFORMS TO EIAJ SC-65 PACKAGING STANDARD.
B) ALL DIMENSIONS ARE IN MILLIMETERS.
C) DIMENSION AND TOLERANCING PER ASME14.5-2009.
D) DIMENSIONS ARE EXCLUSSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSSIONS.

DOCUMENT NUMBER:	**98AON13862G**	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	**TO−3P−3LD / EIAJ SC−65, ISOLATED**	**PAGE 1 OF 1**

ON Semiconductor and ON 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.

© Semiconductor Components Industries, LLC, 2019

onsemi, 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**'s 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.

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:
Technical Library: www.onsemi.com/design/resources/technical−documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support
For additional information, please contact your local Sales Representative at
www.onsemi.com/support/sales