

Field Stop Trench IGBT

650 V, 40 A

FGA40T65SHD

General Description

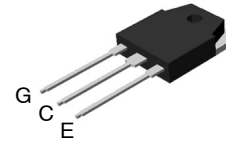
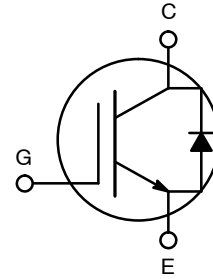
Using novel field stop IGBT technology, **onsemi**'s new series of field stop 3rd generation IGBTs offer the optimum performance for solar inverter, UPS, welder, telecom, ESS and PFC applications where low conduction and switching losses are essential.

Features

- Maximum Junction Temperature: $T_J = 175^{\circ}\text{C}$
- Positive Temperature Co-efficient for Easy Parallel Operating
- High Current Capability
- Low Saturation Voltage: $V_{CE(sat)} = 1.6\text{ V (Typ.) @ } I_C = 40\text{ A}$
- 100% of the Parts Tested for $I_{LM(1)}$
- High Input Impedance
- Fast Switching
- Tighten Parameter Distribution
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

Applications

- Solar Inverter, UPS, Welder, Telecom, ESS, PFC



**TO-3P-3LD
CASE 340BZ**

MARKING DIAGRAM



FGA40T65SHD = Specific Device Code
 A = Assembly Location
 YWW = Date Code (Year & Week)
 ZZ = Assembly Lot

ORDERING INFORMATION

Device	Package	Shipping
FGA40T65SHD	TO-3P-3LD (Pb-Free / Halide Free)	450 Units / Tube

FGA40T65SHD

ABSOLUTE MAXIMUM RATINGS (T_C = 25°C unless otherwise noted)

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
	Collector Current	@ T _C = 10°C	40
I _{LM} (Note 1)	Pulsed Collector Current	@ T _C = 25°C	120
I _{CM} (Note 2)	Pulsed Collector Current		120
I _F	Diode Forward Current	@ T _C = 25°C	40
	Diode Forward Current	@ T _C = 100°C	20
I _{FM} (Note 2)	Pulsed Diode Maximum Forward Current		120
P _D	Maximum Power Dissipation	@ T _C = 25°C	268
	Maximum Power Dissipation	@ T _C = 10°C	134
T _J	Operating Junction Temperature		-55 to +175
T _{stg}	Storage Temperature Range		-55 to +175
T _L	Maximum Lead Temp. for soldering Purposes, 1/8" from case for 5 seconds		300

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.

- V_{CC} = 400 V, V_{GE} = 15 V, I_C = 120 A, R_G = 30 Ω, Inductive Load.
- Repetitive rating: Pulse width limited by max. junction temperature.

THERMAL CHARACTERISTICS

Symbol	Parameter	Value	Unit
R _{θJC} (IGBT)	Thermal Resistance, Junction to Case, Max.	0.56	°C/W
R _{θJC} (Diode)	Thermal Resistance, Junction to Case, Max.	1.71	°C/W
R _{θJA}	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	-	2.2	2.8
			T _C = 175°C	-	1.94	-
E _{rec}	Reverse Recovery Energy	I _F = 20 A, di _F /dt = 200 A/μs	T _C = 175°C	-	50	-
t _{rr}	Diode Reverse Recovery Time		T _C = 25°C	-	31.8	-
			T _C = 175°C	-	192	-
Q _{rr}	Diode Reverse Recovery Charge		T _C = 25°C	-	50.6	-
		T _C = 175°C	-	699	-	

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.

FGA40T65SHD

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

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

OFF CHARACTERISTICS

BV_{CES}	Collector to Emitter Breakdown Voltage	$V_{GE} = 0\text{ V}, I_C = 1\text{ mA}$	650	–	–	V
$\Delta BV_{CES} / \Delta T_J$	Temperature Coefficient of Breakdown Voltage	$I_C = 1\text{ mA}$, Reference to 25°C	–	0.6	–	V/ $^\circ\text{C}$
I_{CES}	Collector Cut-Off Current	$V_{CE} = V_{CES}, V_{GE} = 0\text{ V}$	–	–	250	μA
I_{GES}	G-E Leakage Current	$V_{GE} = V_{GES}, V_{CE} = 0\text{ V}$	–	–	± 400	nA

ON CHARACTERISTICS

$V_{GE(th)}$	G-E Threshold Voltage	$I_C = 40\text{ mA}, V_{CE} = V_{GE}$	3.5	5.5	7.5	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C = 40\text{ A}, V_{GE} = 15\text{ V}$	–	1.6	2.1	V
		$I_C = 40\text{ A}, V_{GE} = 15\text{ V}, T_C = 175^\circ\text{C}$	–	2.14	–	V

DYNAMIC CHARACTERISTICS

C_{ies}	Input Capacitance	$V_{CE} = 30\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$	–	1995	–	pF
C_{oes}	Output Capacitance		–	70	–	pF
C_{res}	Reverse Transfer Capacitance		–	23	–	pF

SWITCHING CHARACTERISTICS

$t_{d(on)}$	Turn-On Delay Time	$V_{CC} = 400\text{ V}, I_C = 40\text{ A}, R_G = 6\ \Omega, V_{GE} = 15\text{ V},$ Inductive Load, $T_C = 25^\circ\text{C}$	–	19.2	–	ns
t_r	Rise Time		–	34.4	–	ns
$t_{d(off)}$	Turn-Off Delay Time		–	65.6	–	ns
t_f	Fall Time		–	9.6	–	ns
E_{on}	Turn-On Switching Loss		–	1010	–	μJ
E_{off}	Turn-Off Switching Loss		–	297	–	μJ
E_{ts}	Total Switching Loss		–	1307	–	μJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC} = 400\text{ V}, I_C = 40\text{ A}, R_G = 6\ \Omega, V_{GE} = 15\text{ V},$ Inductive Load, $T_C = 175^\circ\text{C}$	–	18.4	–	ns
t_r	Rise Time		–	32.8	–	ns
$t_{d(off)}$	Turn-Off Delay Time		–	71.2	–	ns
t_f	Fall Time		–	14.4	–	ns
E_{on}	Turn-On Switching Loss		–	1390	–	μJ
E_{off}	Turn-Off Switching Loss		–	541	–	μJ
E_{ts}	Total Switching Loss		–	1931	–	μJ
Q_g	Total Gate Charge	$V_{CE} = 400\text{ V}, I_C = 40\text{ A}, V_{GE} = 15\text{ V}$	–	72.2	–	nC
Q_{ge}	Gate to Emitter Charge		–	13.5	–	nC
Q_{gc}	Gate to Collector Charge		–	28.5	–	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

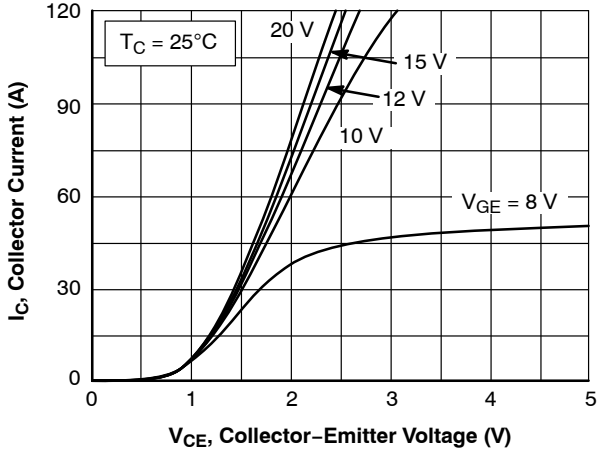


Figure 1. Typical Output Characteristics

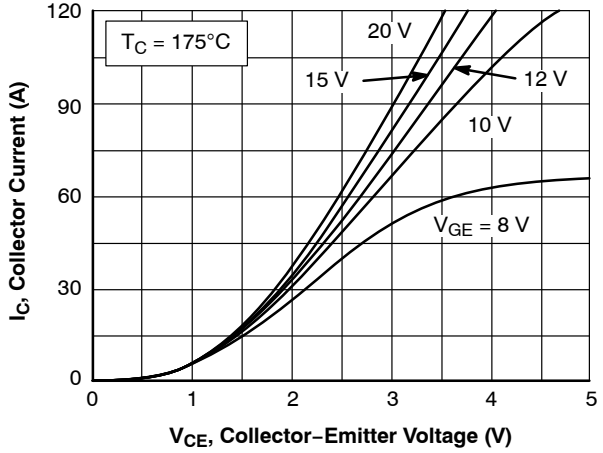


Figure 2. Typical Output Characteristics

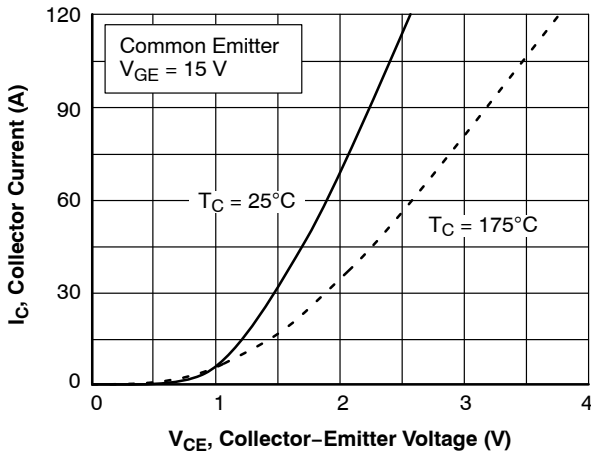


Figure 3. Typical Saturation Voltage Characteristics

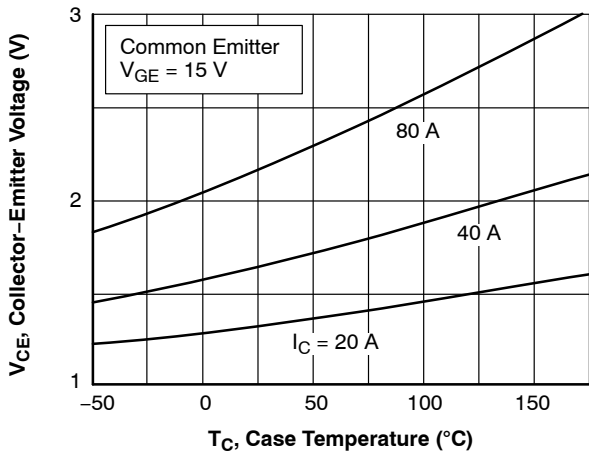


Figure 4. Saturation Voltage vs. Case Temperature at Variant Current Level

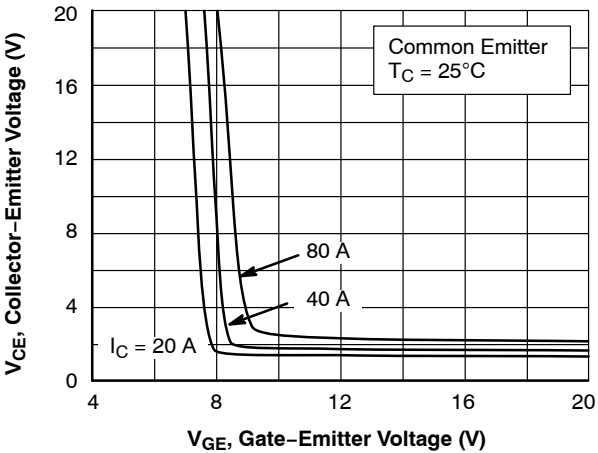


Figure 5. Saturation Voltage vs. V_{GE}

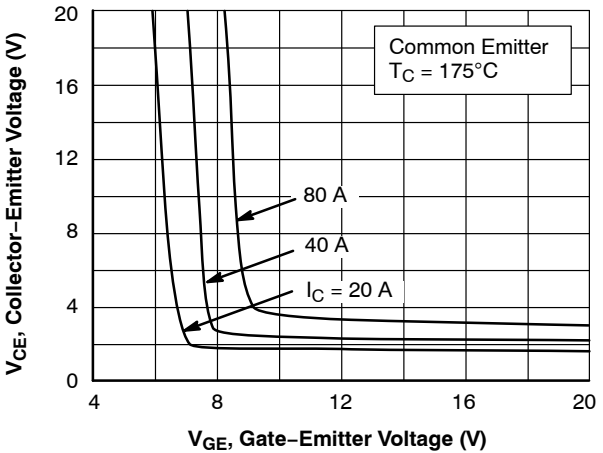


Figure 6. Saturation Voltage vs. V_{GE}

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

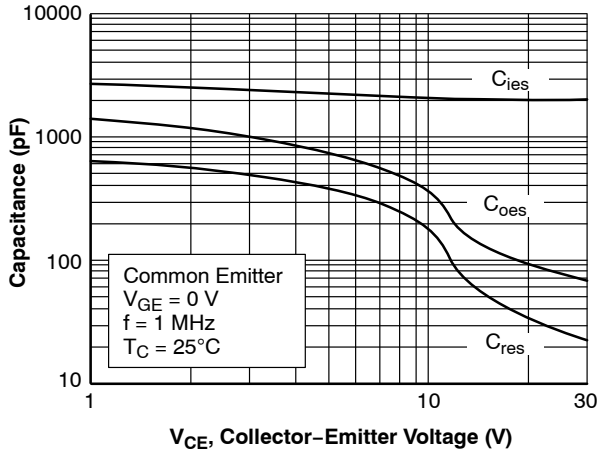


Figure 7. Capacitance Characteristics

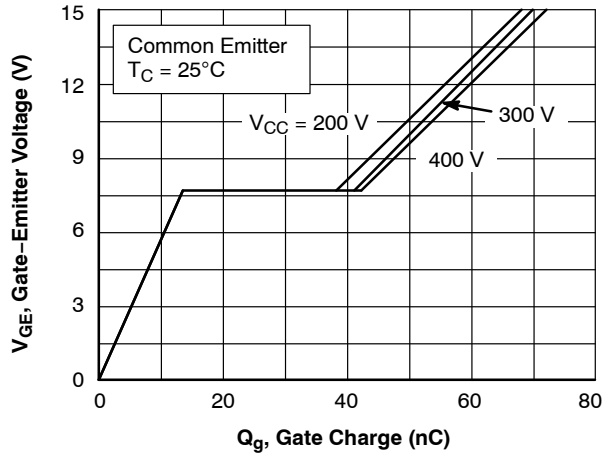


Figure 8. Gate Charge Characteristics

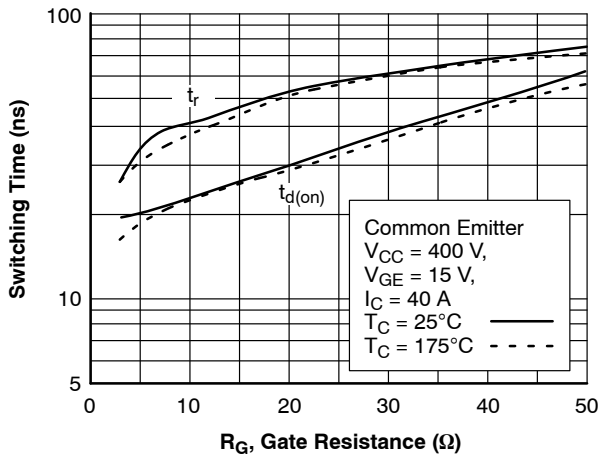


Figure 9. Turn-on Characteristics vs. Gate Resistance

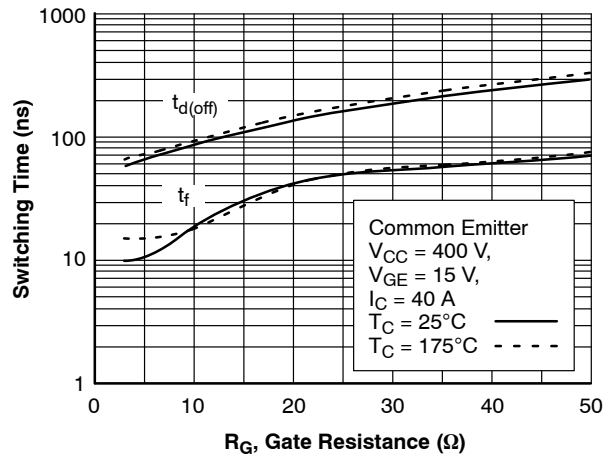


Figure 10. Turn-off Characteristics vs. Gate Resistance

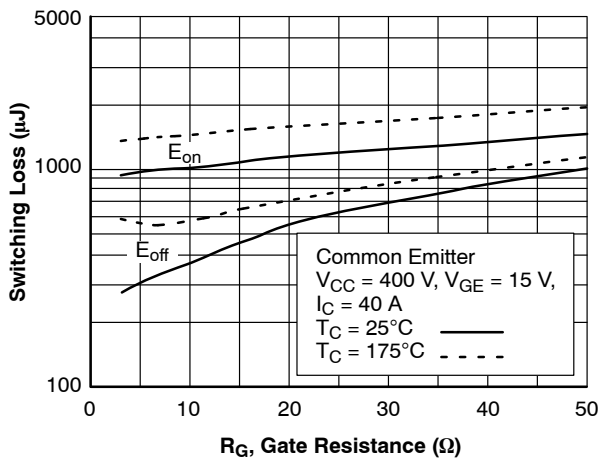


Figure 11. Switching Loss vs. Gate Resistance

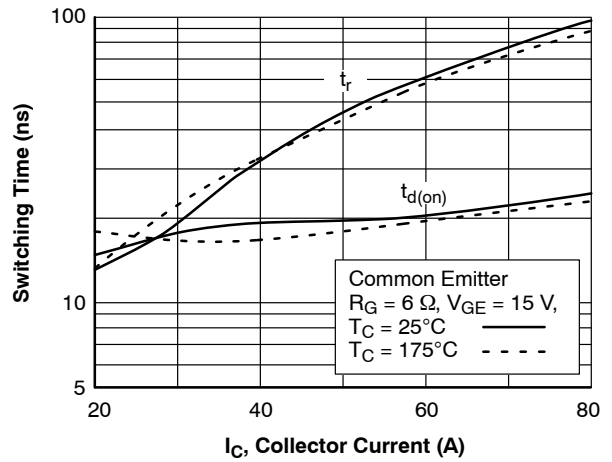


Figure 12. Turn-on Characteristics vs. Collector Current

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

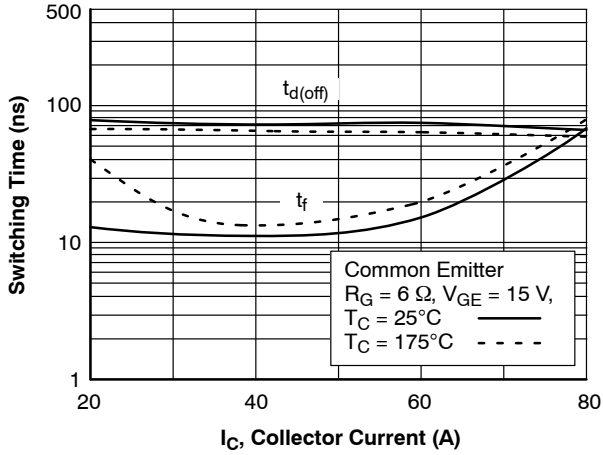


Figure 13. Turn-off Characteristics vs. Collector Current

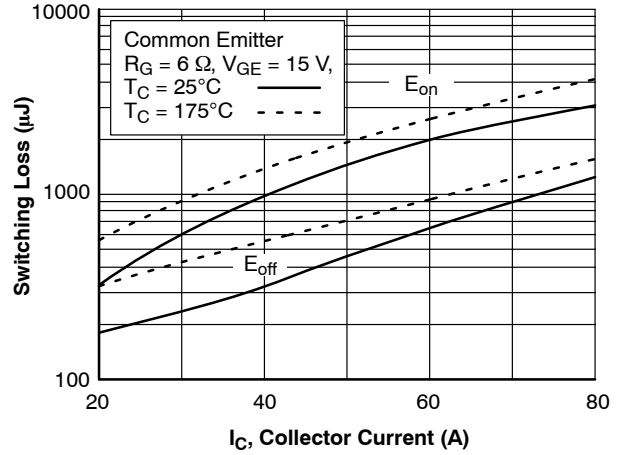


Figure 14. Switching Loss vs. Collector Current

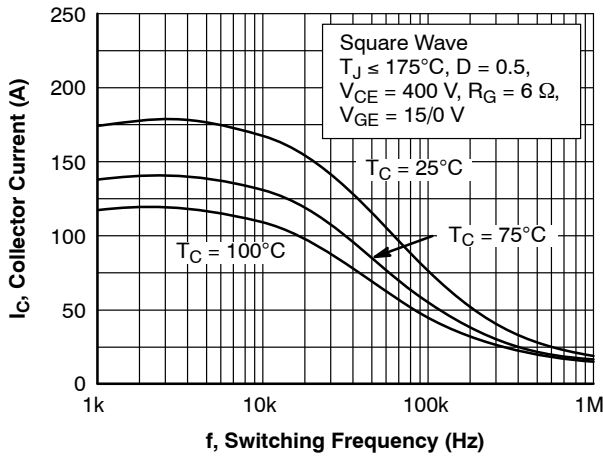


Figure 15. Load Current Vs. Frequency

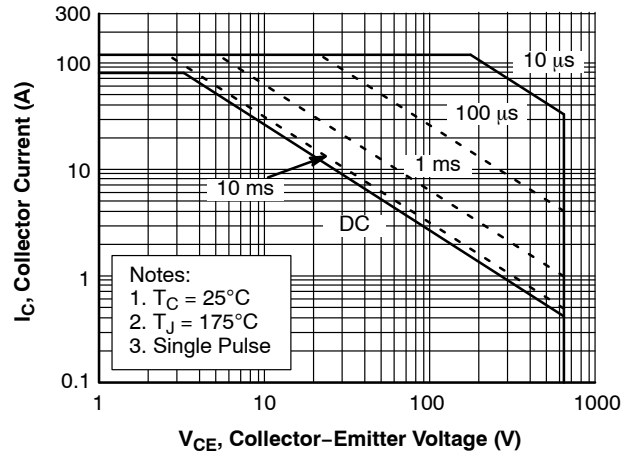


Figure 16. SOA Characteristics

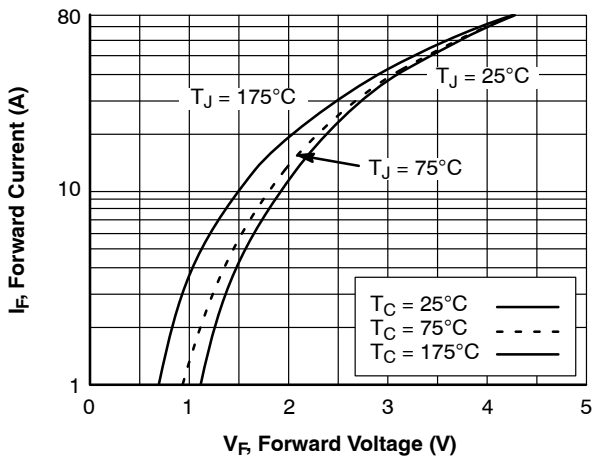


Figure 17. Forward Characteristics

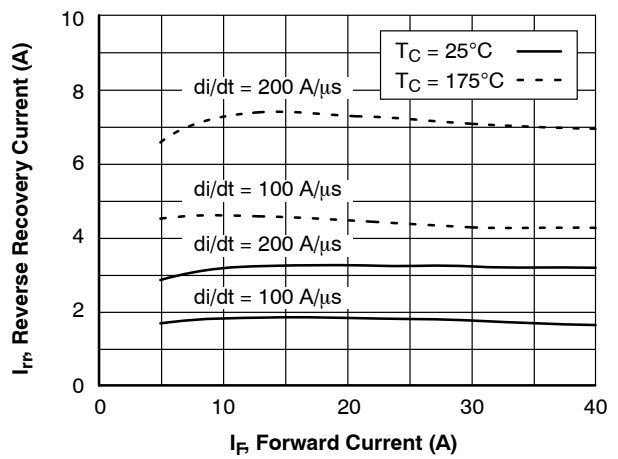


Figure 18. Reverse Recovery Current

FGA40T65SHD

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

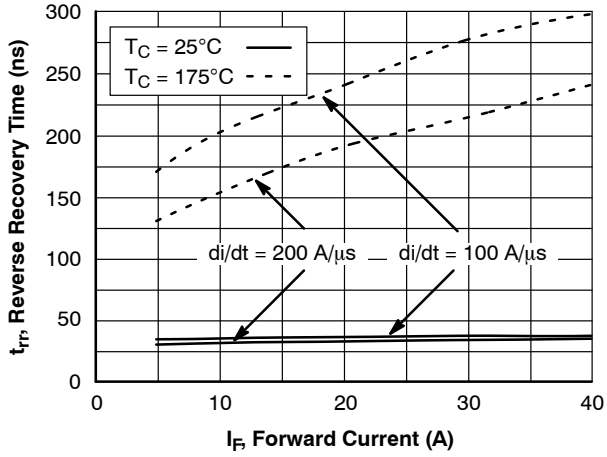


Figure 19. Reverse Recovery Time

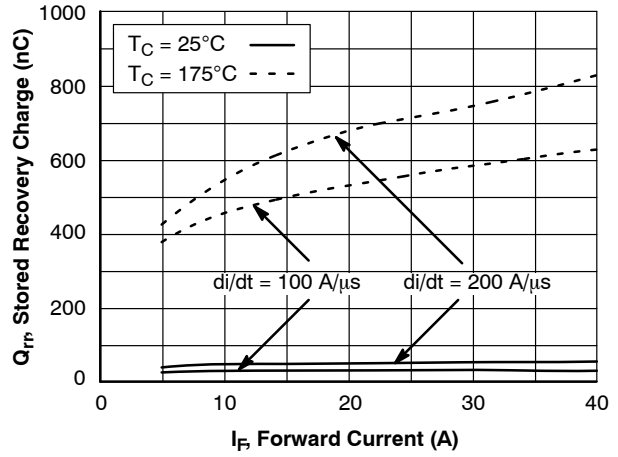


Figure 20. Stored Charge

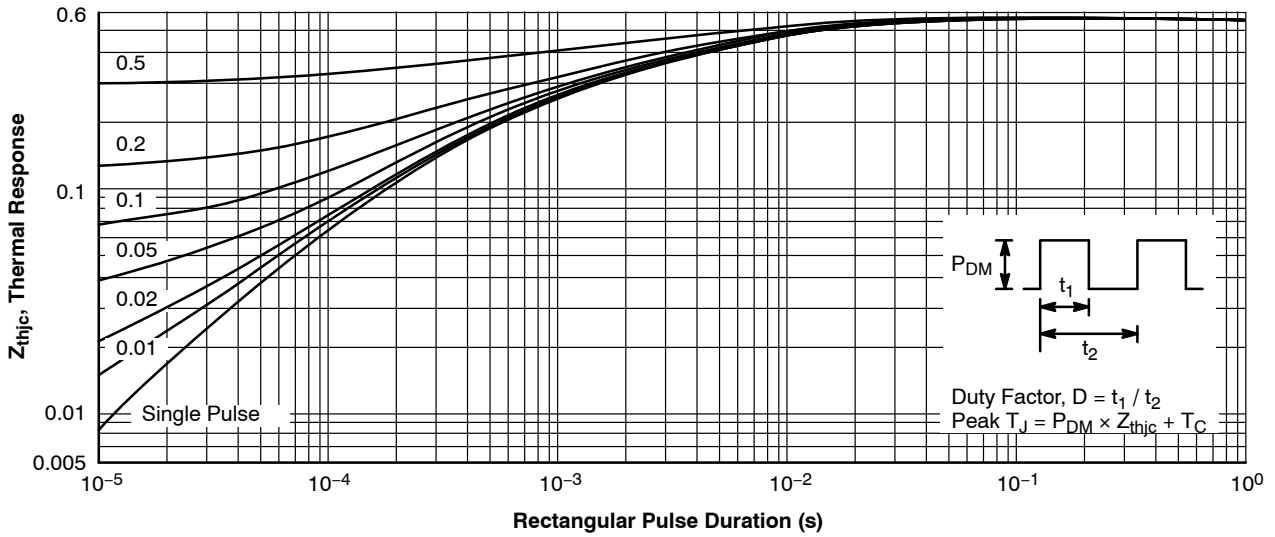


Figure 21. Transient Thermal Impedance of IGBT

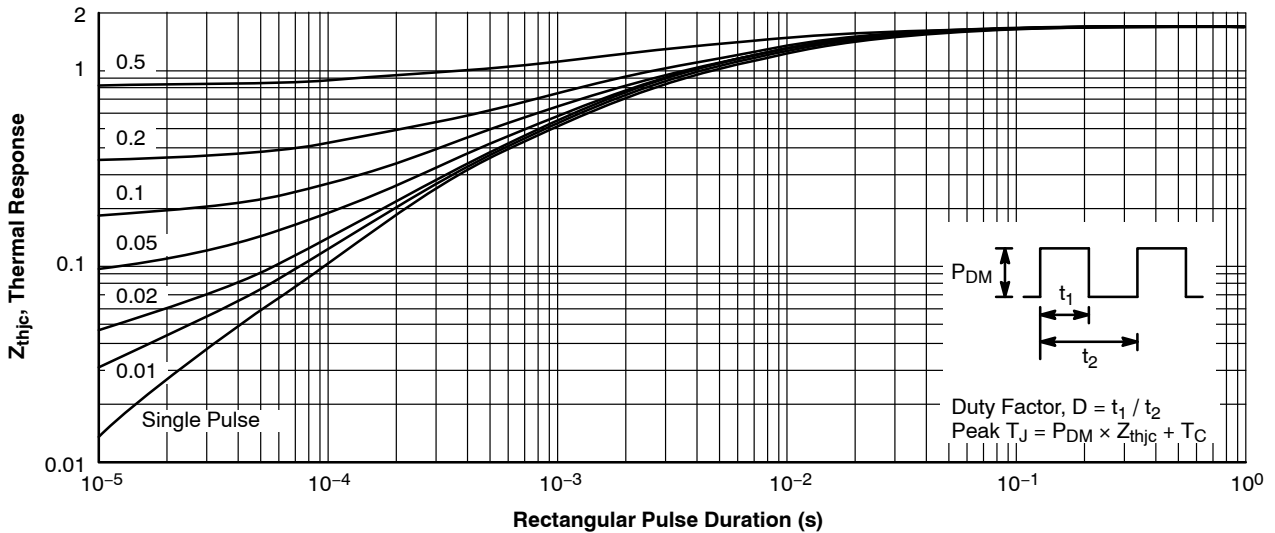


Figure 22. Transient Thermal Impedance of Diode

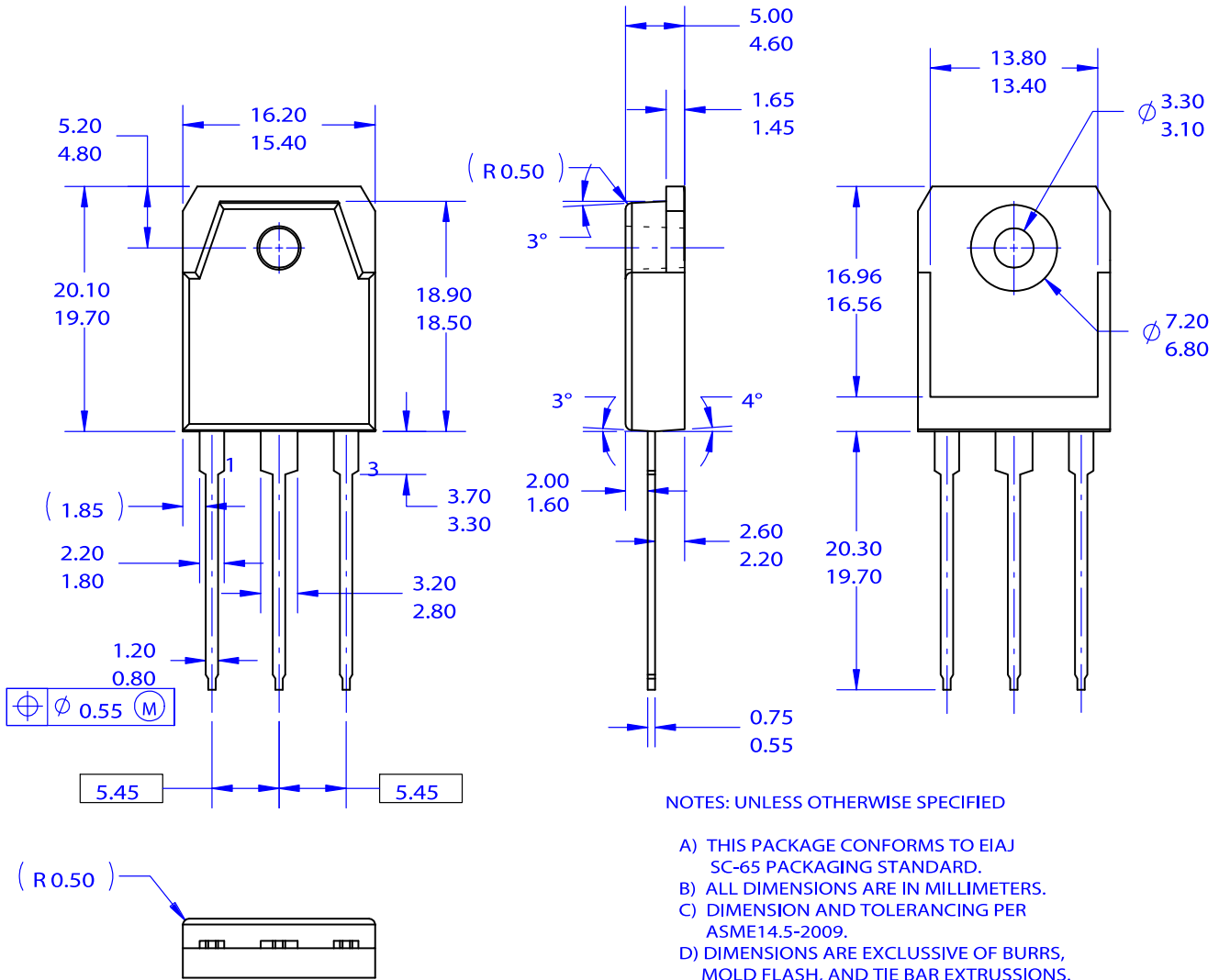
MECHANICAL CASE OUTLINE

PACKAGE DIMENSIONS



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 EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.

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 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.

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