Field Stop Trench IGBT

650 V, 40 A

FGA40T65SHD

General Description

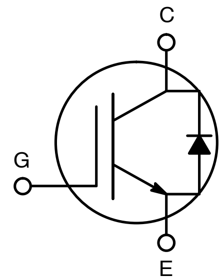
Using novel field stop IGBT technology, **onsemi**'s new series of field stop 3rd generation IGBTs offer the optimum performance for solar inverter, UPS, welder, telecom, ESS and PFC applications where low conduction and switching losses are essential.

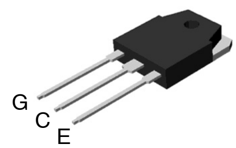
Features

- Maximum Junction Temperature: $T_J = 175°C$
- Positive Temperature Co−efficient for Easy Parallel Operating
- High Current Capability
- Low Saturation Voltage: $V_{CE(sat)} = 1.6$ V (Typ.) @ $I_C = 40$ 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

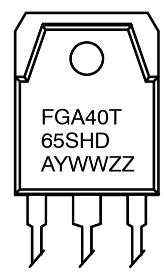
- Solar Inverter, UPS, Welder, Telecom, ESS, PFC





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

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	A
	Collector Current	@ T_C = 10°C	40	A
I_{LM} (Note 1)	Pulsed Collector Current	@ T_C = 25°C	120	A
I_{CM} (Note 2)	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 2)	Pulsed Diode Maximum Forward Current		120	A
P_D	Maximum Power Dissipation	@ T_C = 25°C	268	W
	Maximum Power Dissipation	@ T_C = 10°C	134	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. V_{CC} = 400 V, V_{GE} = 15 V, I_C = 120 A, R_G = 30 Ω, Inductive Load.
2. 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.	0.56	°C/W
$R_{\theta JC}$(Diode)	Thermal Resistance, Junction to Case, Max.	1.71	°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	–	2.2	2.8	V
			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	–	μJ
t_{rr}	Diode Reverse Recovery Time		T_C = 25°C	–	31.8	–	ns
			T_C = 175°C	–	192	–	
Q_{rr}	Diode Reverse Recovery Charge		T_C = 25°C	–	50.6	–	nC
			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.

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 = 1 mA	650	–	–	V
ΔBV_{CES} / ΔT_J	Temperature Coefficient of Breakdown Voltage	I_C = 1 mA, Reference to 25°C	–	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 = 40 mA, V_{CE} = V_{GE}	3.5	5.5	7.5	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	I_C = 40 A, V_{GE} = 15 V	–	1.6	2.1	V
		I_C = 40 A, V_{GE} = 15 V, T_C = 175°C	–	2.14	–	V
DYNAMIC CHARACTERISTICS						
C_{ies}	Input Capacitance	V_{CE} = 30 V, V_{GE} = 0 V, f = 1 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 V, I_C = 40 A, R_G = 6 Ω, V_{GE} = 15 V, Inductive Load, T_C = 25°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 V, I_C = 40 A, R_G = 6 Ω, V_{GE} = 15 V, Inductive Load, T_C = 175°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 V, I_C = 40 A, V_{GE} = 15 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

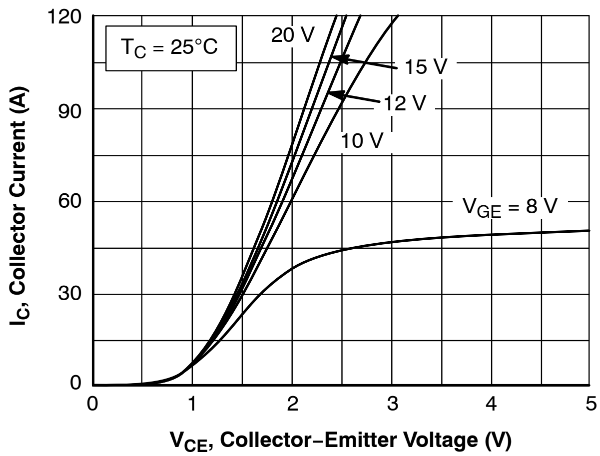


Figure 1. Typical Output Characteristics

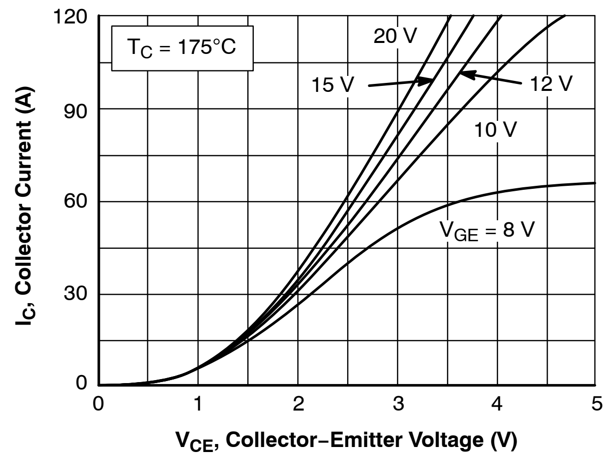


Figure 2. Typical Output Characteristics

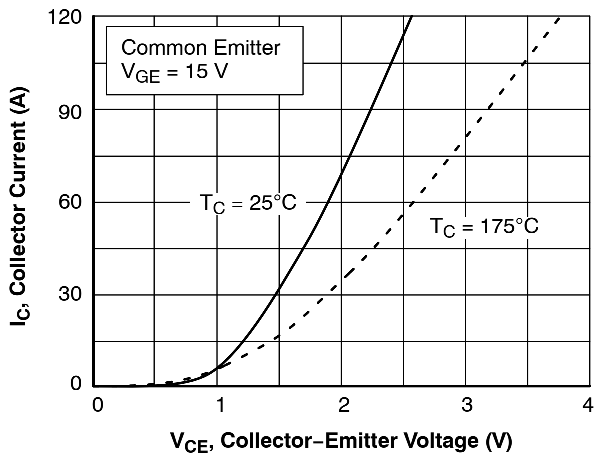


Figure 3. Typical Saturation Voltage Characteristics

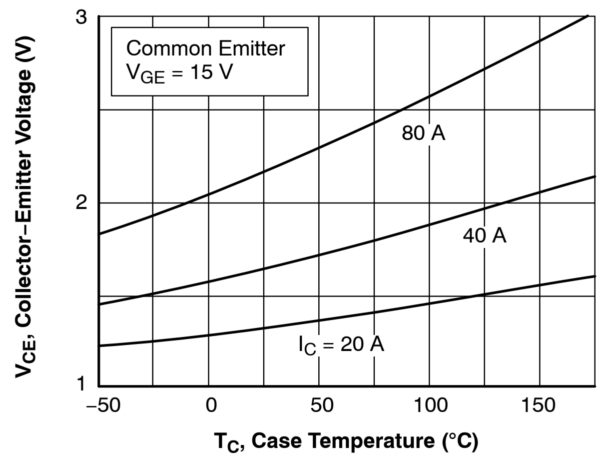


Figure 4. Saturation Voltage vs. Case Temperature at Variant Current Level

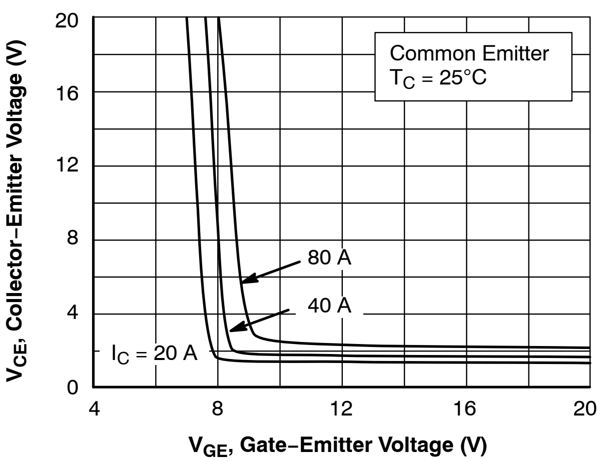


Figure 5. Saturation Voltage vs. V_{GE}

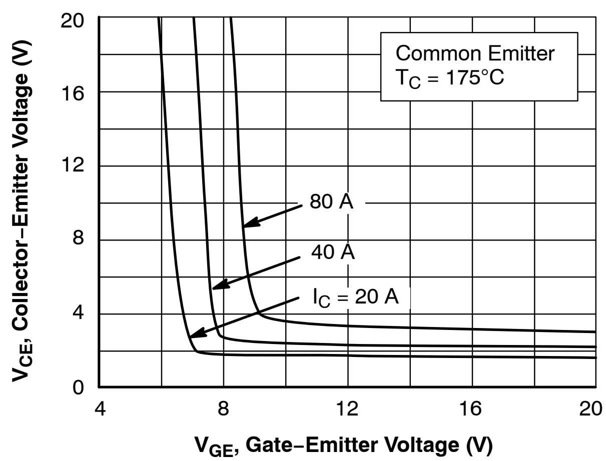


Figure 6. Saturation Voltage vs. V_{GE}

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

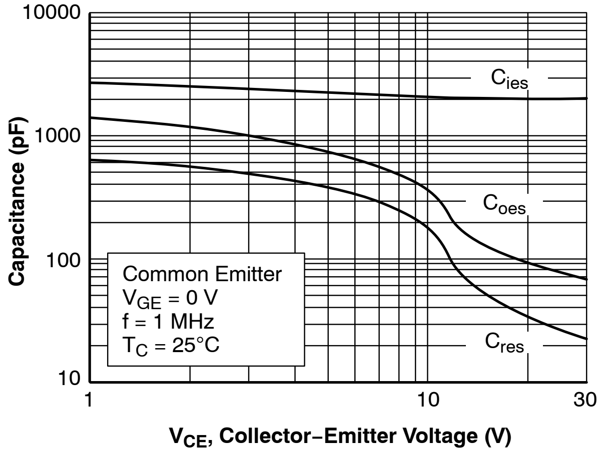


Figure 7. Capacitance Characteristics

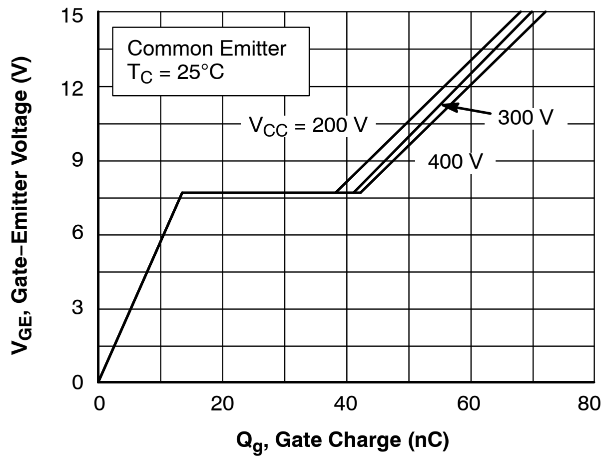


Figure 8. Gate Charge Characteristics

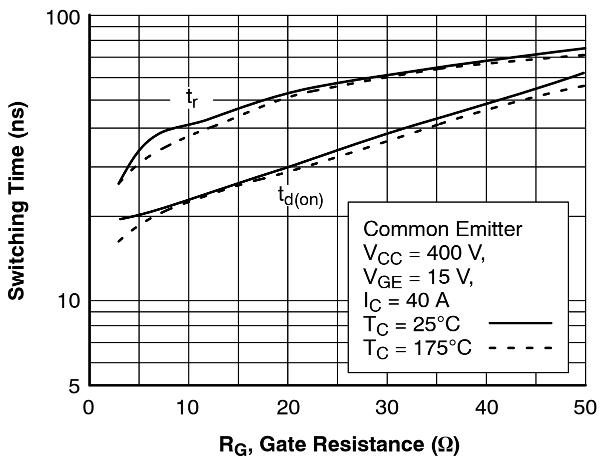


Figure 9. Turn−on Characteristics vs. Gate Resistance

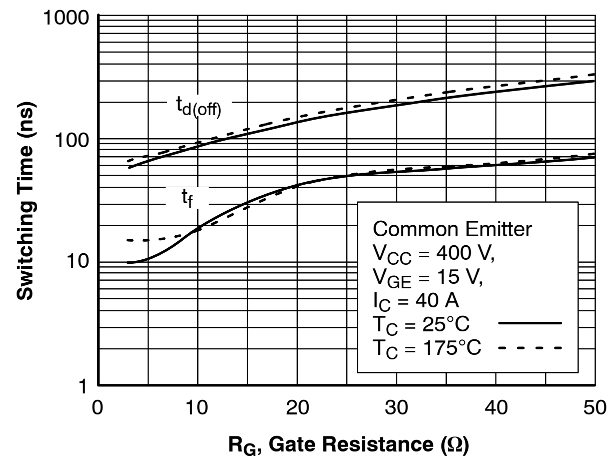


Figure 10. Turn−off Characteristics vs. Gate Resistance

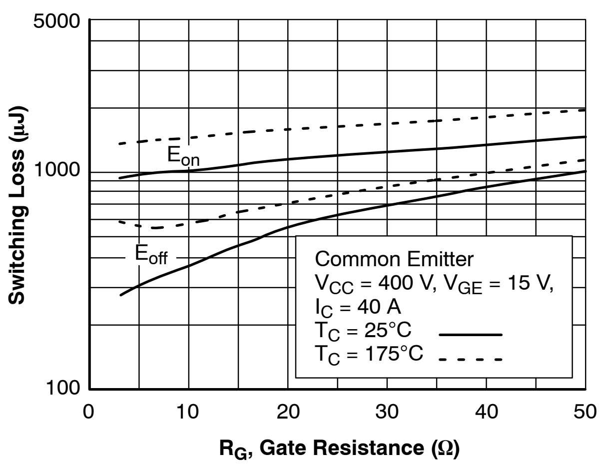


Figure 11. Switching Loss vs. Gate Resistance

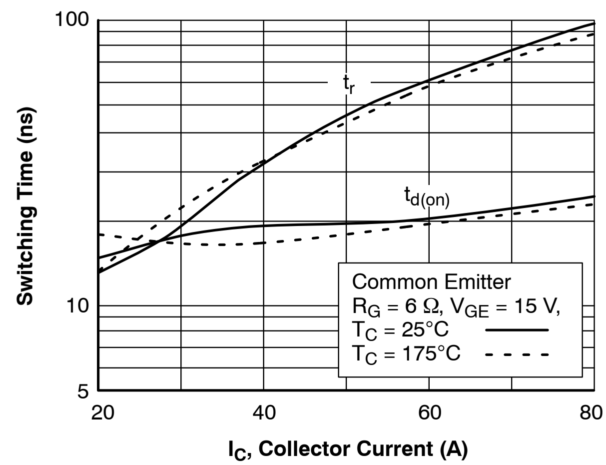


Figure 12. Turn−on Characteristics vs. Collector Current

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

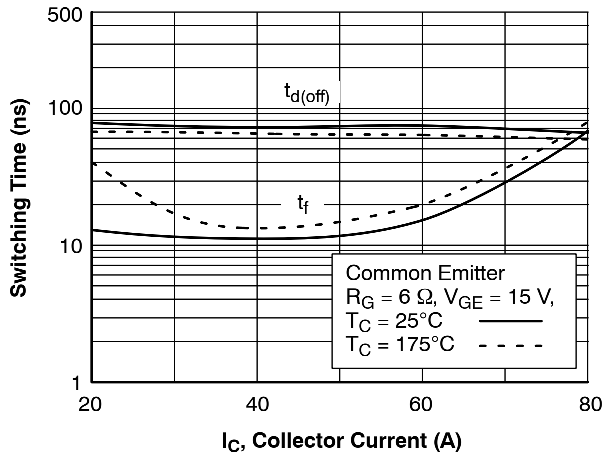


Figure 13. Turn−off Characteristics vs. Collector Current

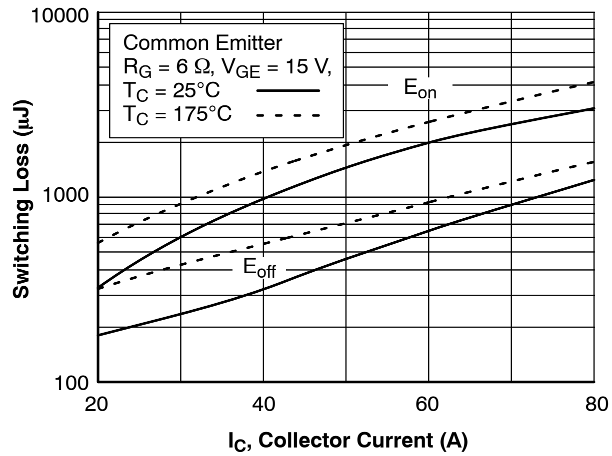


Figure 14. Switching Loss vs. Collector Current

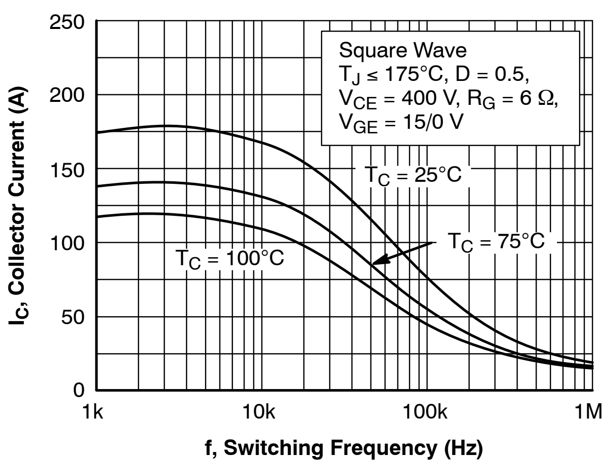


Figure 15. Load Current Vs. Frequency

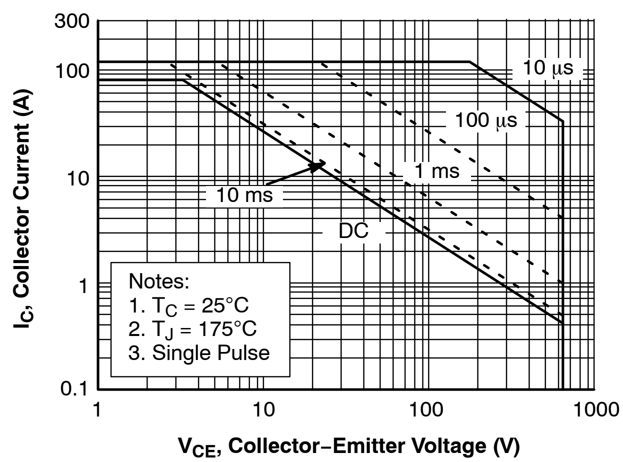


Figure 16. SOA Characteristics

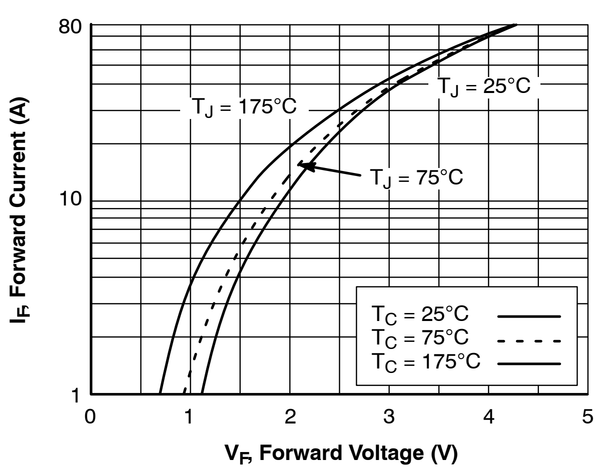


Figure 17. Forward Characteristics

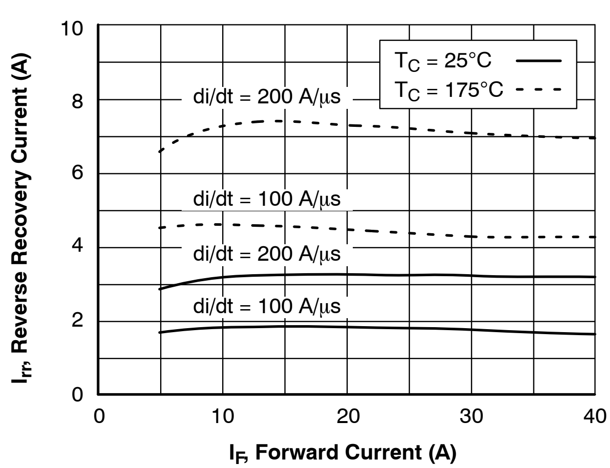


Figure 18. Reverse Recovery Current

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

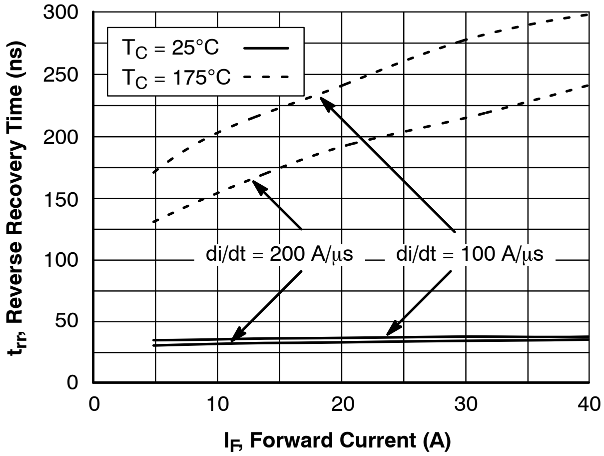


Figure 19. Reverse Recovery Time

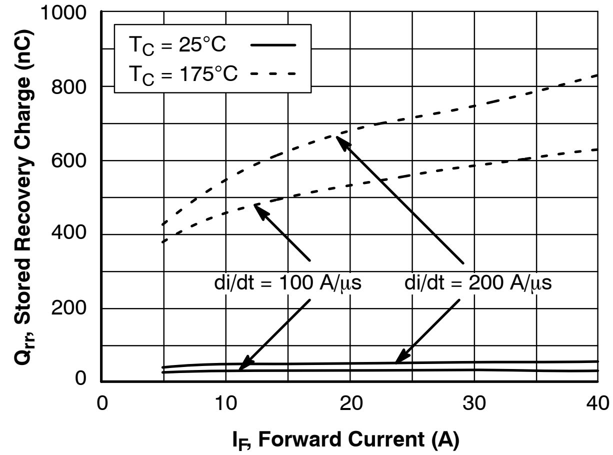


Figure 20. Stored Charge

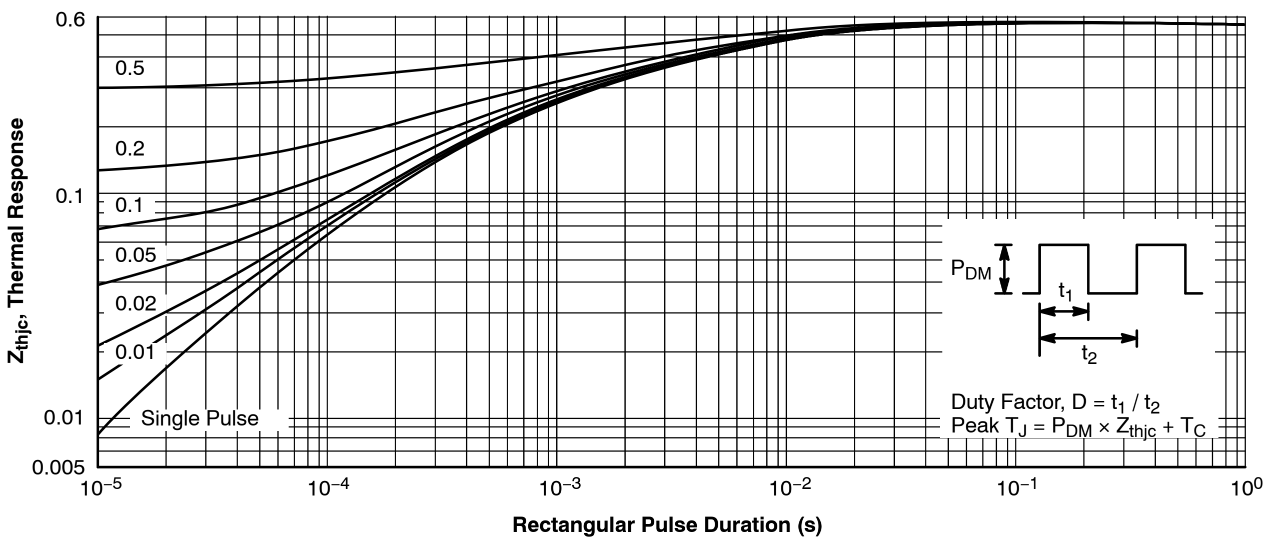


Figure 21. Transient Thermal Impedance of IGBT

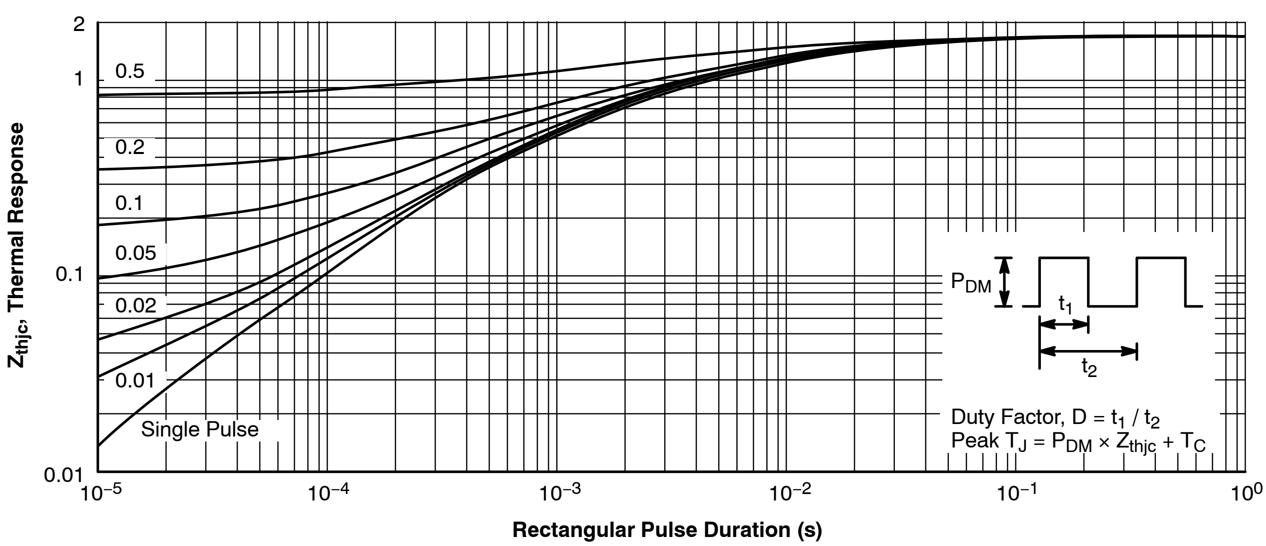
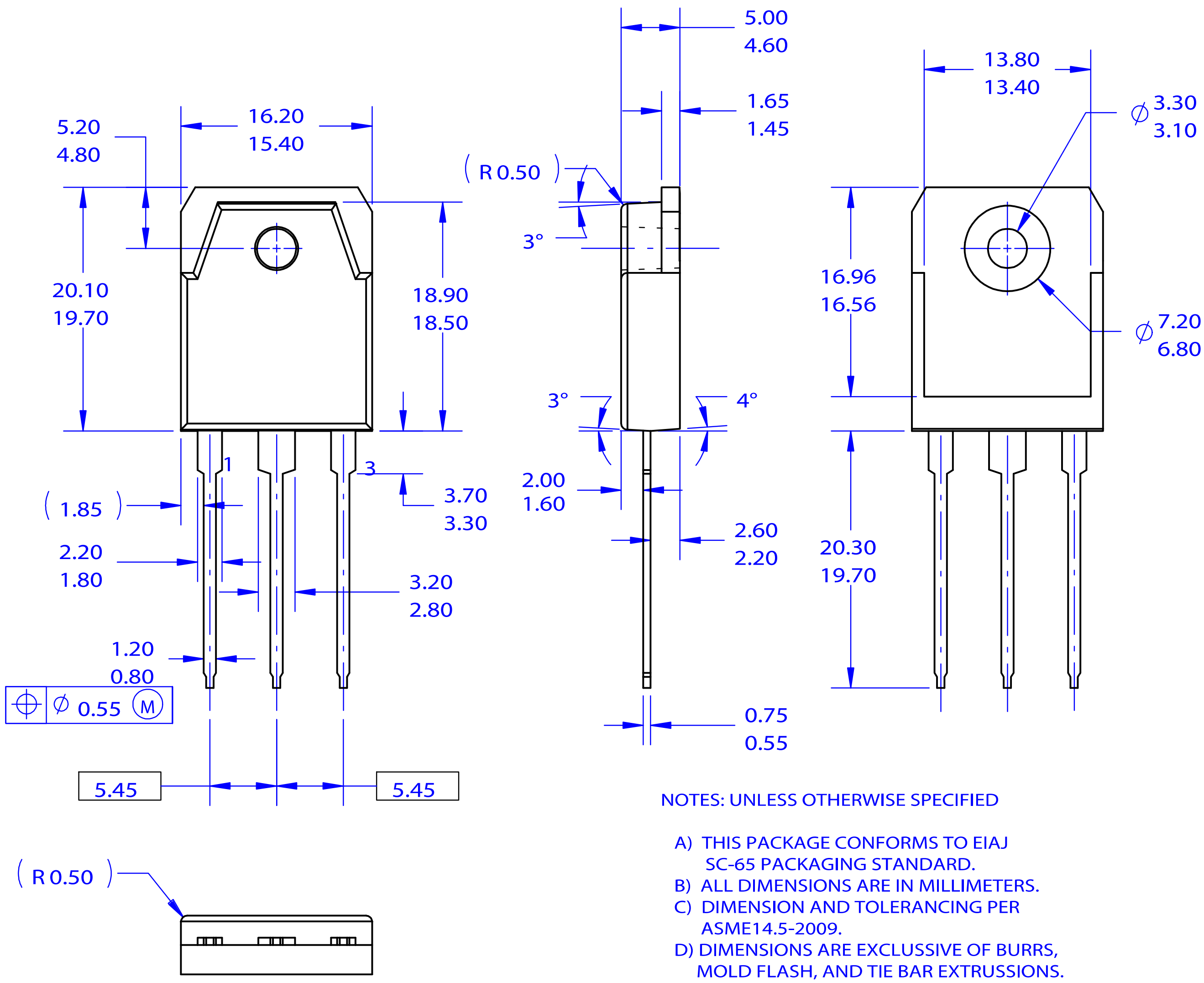


Figure 22. Transient Thermal Impedance of Diode

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.

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