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Please note: As part of the Fairchild Semiconductor integration, some of the Fairchild orderable part numbers will need to change in order to meet ON Semiconductor's system requirements. Since the ON Semiconductor product management systems do not have the ability to manage part nomenclature that utilizes an underscore (_), the underscore (_) in the Fairchild part numbers will be changed to a dash (-). This document may contain device numbers with an underscore (_). Please check the ON Semiconductor website to verify the updated device numbers. The most current and up-to-date ordering information can be found at www.onsemi.com. Please email any questions regarding the system integration to Fairchild_questions@onsemi.com.

ON Semiconductor®

June 2017

FGH40T65SQD

650 V, 40 A Field Stop Trench IGBT

Features

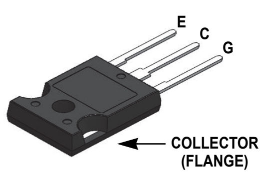
- Maximum Junction Temperature: T_J = 175°C
- Positive Temperature Co-efficient for Easy Parallel Operating
- High Current Capability
- Low Saturation Voltage: $V_{CE(sat)}$ = 1.6 V (Typ.) @ I_C = 40 A
- 100% of the Parts tested for I_{LM}(1)
- High Input Impedance
- Fast Switching
- Tighten Parameter Distribution
- RoHS Compliant

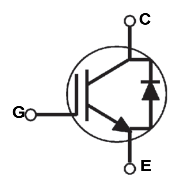
General Description

Using novel field stop IGBT technology, ON semiconductor's new series of field stop 4th generation IGBTs offer the optimum performance for solar inverter, UPS, welder, telecom, ESS and PFC applications where low conduction and switching losses are essential.

Applications

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





Absolute Maximum Ratings

Symbol	Description		FGH40T65SQD_F155 (1)	Unit
V_{CES}	Collector to Emitter Voltage		650	V
V_{GES}	Gate to Emitter Voltage		± 20	V
	Transient Gate to Emitter Voltage		± 30	V
I_C	Collector Current	@ T_C = 25°C	80	A
	Collector Current	@ T_C = 100°C	40	A
I_{LM} (2)	Pulsed Collector Current	@ T_C = 25°C	160	A
I_{CM} (3)	Pulsed Collector Current		160	A
I_F	Diode Forward Current	@ T_C = 25°C	40	A
	Diode Forward Current	@ T_C = 100°C	20	A
I_{FM} (3)	Pulsed Diode Maximum Forward Current		160	A
P_D	Maximum Power Dissipation	@ T_C = 25°C	238	W
	Maximum Power Dissipation	@ T_C = 100°C	119	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

Notes:
1. Due to system integration constraints between Fairchild and ON semiconductor, as of November 1, 2017 any product part number with a underscore will be replaced with a dash. This is a notification.
2. V_{CC} = 400 V, V_{GE} = 15 V, I_C = 160 A, R_G = 22 Ω , Inductive Load
3. Repetitive rating: Pulse width limited by max. junction temperature

Thermal Characteristics

Symbol	Parameter	FGH40T65SQD_F155	Unit
$R_{\theta JC}$ (IGBT)	Thermal Resistance, Junction to Case, Max.	0.63	$^oC/W$
$R_{\theta JC}$ (Diode)	Thermal Resistance, Junction to Case, Max.	1.71	$^oC/W$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	40	$^oC/W$

Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Qty per Tube
FGH40T65SQD	FGH40T65SQD_F155	TO-247 G03	-	-	30

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	V_{GE} = 0 V, I_C = 1 mA	-	0.6	-	V/^oC
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, $V_{CE} = V_{GE}$	2.6	4.5	6.4	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^oC	-	1.92	-	V
Dynamic Characteristics						
C_{ies}	Input Capacitance	V_{CE} = 30 V, V_{GE} = 0 V, f = 1 MHz	-	2620	-	pF
C_{oes}	Output Capacitance		-	60	-	pF
C_{res}	Reverse Transfer Capacitance		-	9	-	pF
Switching Characteristics						
$T_{d(on)}$	Turn-On Delay Time	V_{CC} = 400 V, I_C = 10 A, R_G = 6 Ω, V_{GE} = 15 V, Inductive Load, T_C = 25^oC	-	16.4	-	ns
T_r	Rise Time		-	4.8	-	ns
$T_{d(off)}$	Turn-Off Delay Time		-	86.4	-	ns
T_f	Fall Time		-	8.8	-	ns
E_{on}	Turn-On Switching Loss		-	138	-	μJ
E_{off}	Turn-Off Switching Loss		-	52	-	μJ
E_{ts}	Total Switching Loss		-	190	-	μJ
$T_{d(on)}$	Turn-On Delay Time	V_{CC} = 400 V, I_C = 20 A, R_G = 6 Ω, V_{GE} = 15 V, Inductive Load, T_C = 25^oC	-	17.6	-	ns
T_r	Rise Time		-	9.6	-	ns
$T_{d(off)}$	Turn-Off Delay Time		-	80	-	ns
T_f	Fall Time		-	8.8	-	ns
E_{on}	Turn-On Switching Loss		-	329	-	μJ
E_{off}	Turn-Off Switching Loss		-	84	-	μJ
E_{ts}	Total Switching Loss		-	413	-	μJ

Electrical Characteristics of the IGBT (Continued)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$T_{d(on)}$	Turn-On Delay Time	V_{CC} = 400 V, I_C = 10 A, R_G = 6 Ω, V_{GE} = 15 V, Inductive Load, T_C = 175°C	-	14.4	-	ns
T_r	Rise Time		-	6.4	-	ns
$T_{d(off)}$	Turn-Off Delay Time		-	99.2	-	ns
T_f	Fall Time		-	8	-	ns
E_{on}	Turn-On Switching Loss		-	269	-	μJ
E_{off}	Turn-Off Switching Loss		-	132	-	μJ
E_{ts}	Total Switching Loss		-	401	-	μJ
$T_{d(on)}$	Turn-On Delay Time	V_{CC} = 400 V, I_C = 20 A, R_G = 6 Ω, V_{GE} = 15 V, Inductive Load, T_C = 175°C	-	16	-	ns
T_r	Rise Time		-	11.2	-	ns
$T_{d(off)}$	Turn-Off Delay Time		-	91.2	-	ns
T_f	Fall Time		-	8	-	ns
E_{on}	Turn-On Switching Loss		-	581	-	μJ
E_{off}	Turn-Off Switching Loss		-	237	-	μJ
E_{ts}	Total Switching Loss		-	818	-	μJ
Q_g	Total Gate Charge	V_{CE} = 400 V, I_C = 40 A, V_{GE} = 15 V	-	80	-	nC
Q_{ge}	Gate to Emitter Charge		-	15	-	nC
Q_{gc}	Gate to Collector Charge		-	20	-	nC

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	-	

Typical Performance Characteristics

Figure 1. Typical Output Characteristics

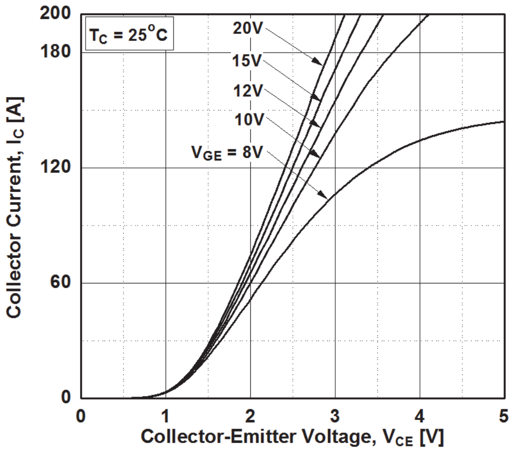


Figure 2. Typical Output Characteristics

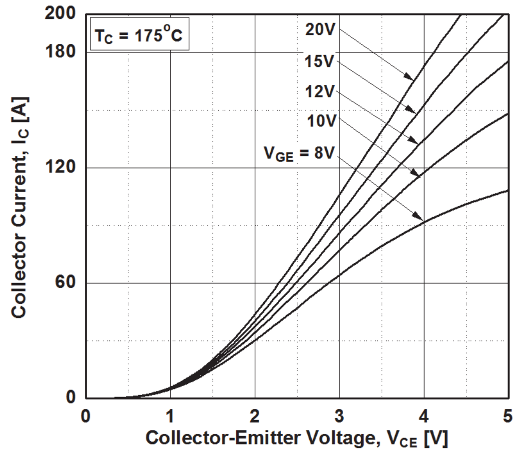


Figure 3. Typical Saturation Voltage Characteristics

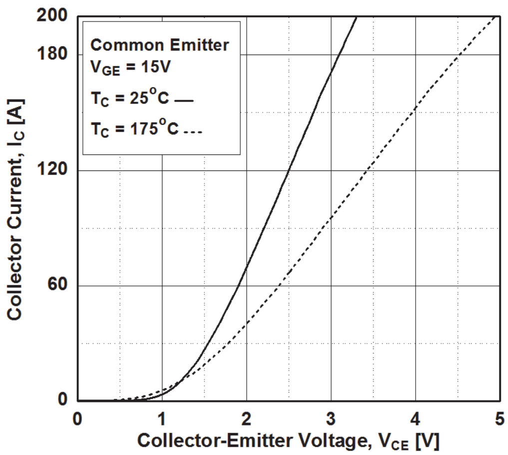


Figure 4. Saturation Voltage vs. Case Temperature at Variant Current Level

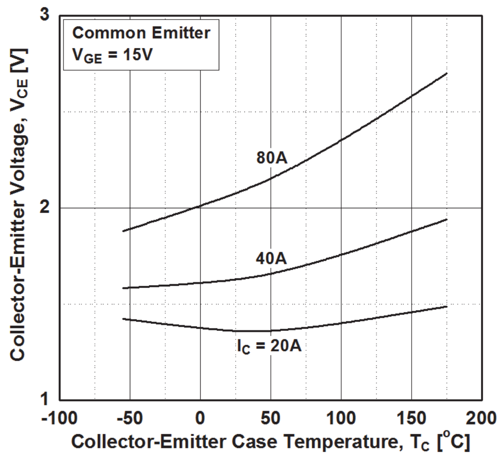


Figure 5. Saturation Voltage vs. V_{GE}

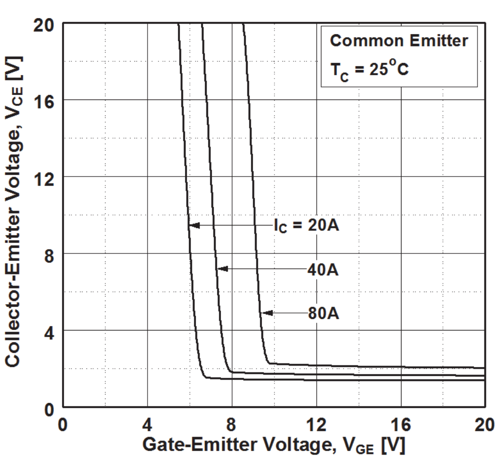
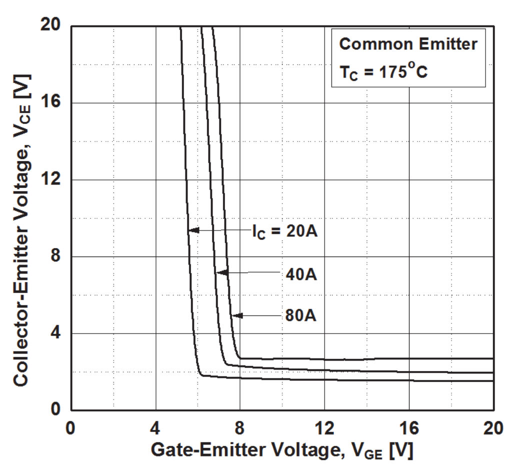


Figure 6. Saturation Voltage vs. V_{GE}



Typical Performance Characteristics

Figure 7. Capacitance Characteristics

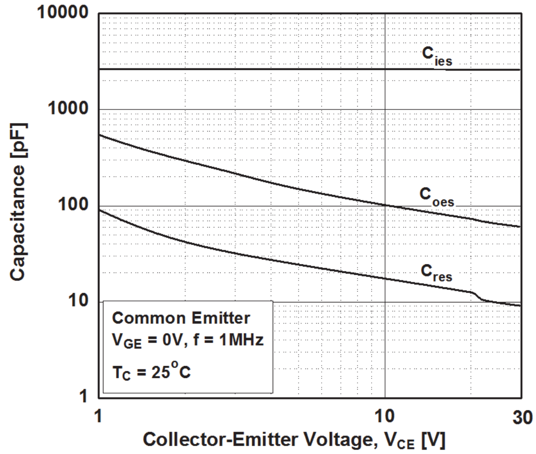


Figure 8. Gate charge Characteristics

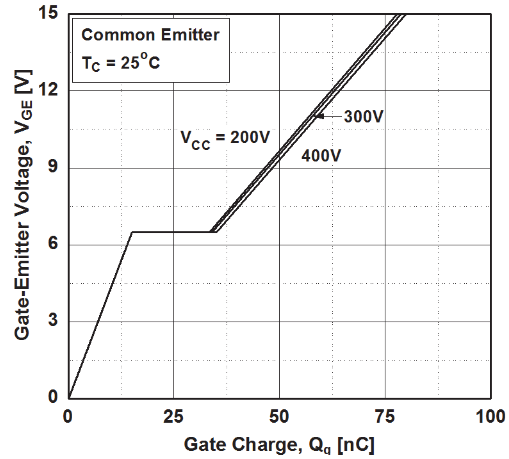


Figure 9. Turn-on Characteristics vs. Gate Resistance

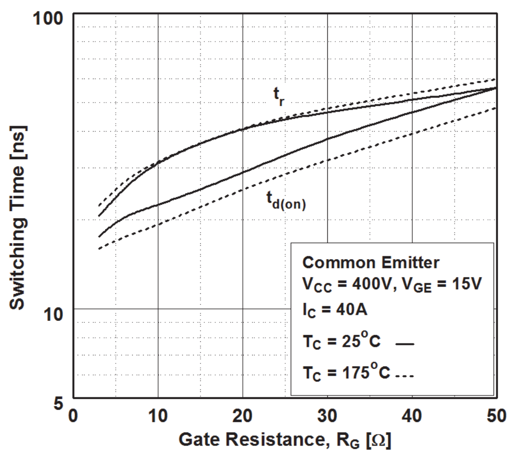


Figure 10. Turn-off Characteristics vs. Gate Resistance

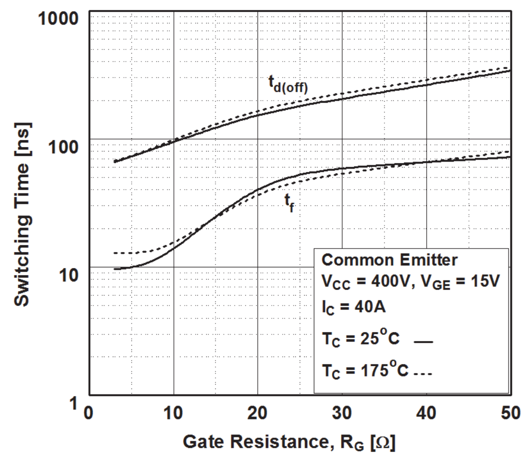


Figure 11. Switching Loss vs. Gate Resistance

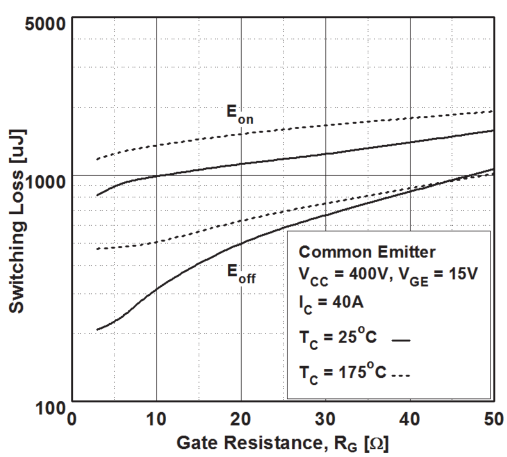
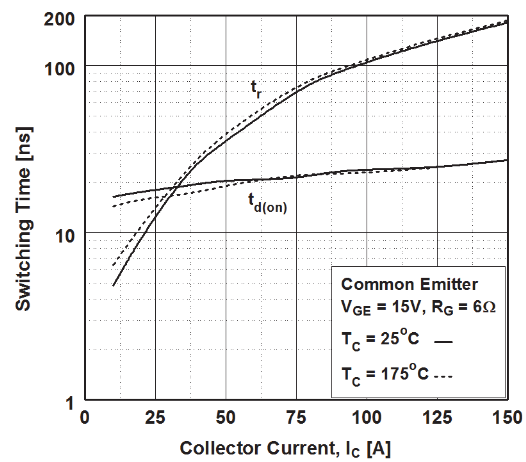


Figure 12. Turn-on Characteristics vs. Collector Current



Typical Performance Characteristics

Figure 13. Turn-off Characteristics vs. Collector Current

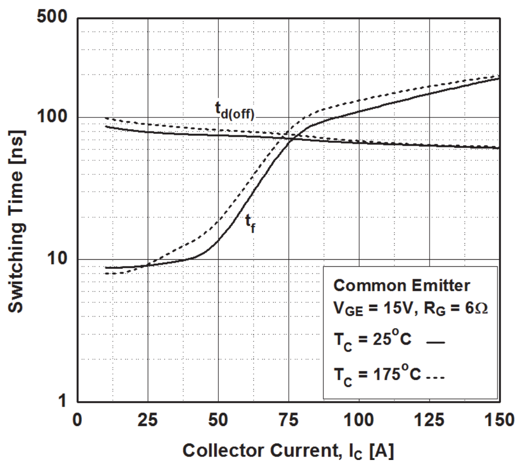


Figure 14. Switching Loss vs. Collector Current

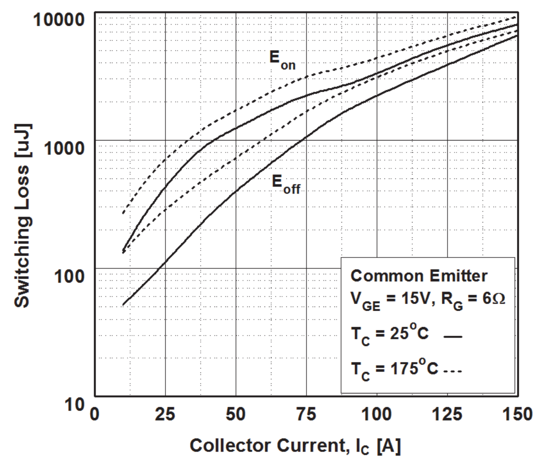


Figure 15. Load Current Vs. Frequency

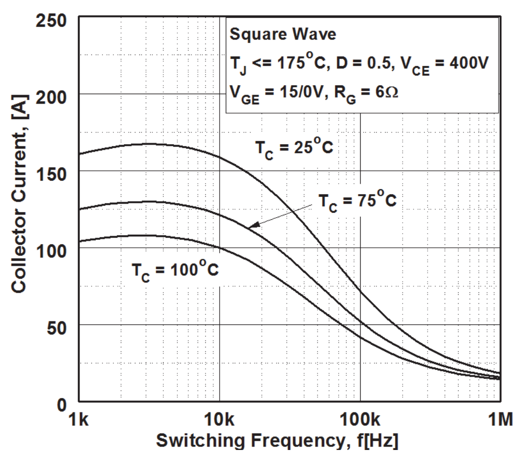


Figure 16. SOA Characteristics

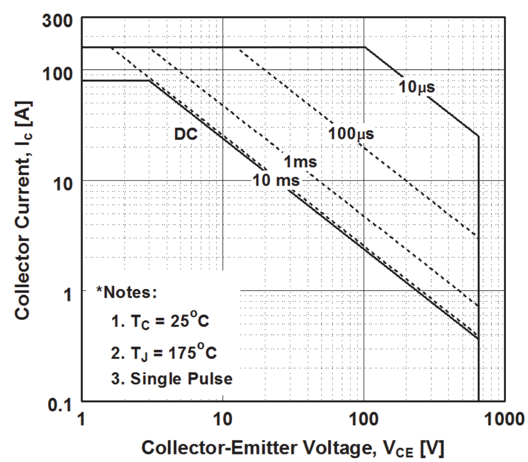


Figure 17. Forward Characteristics

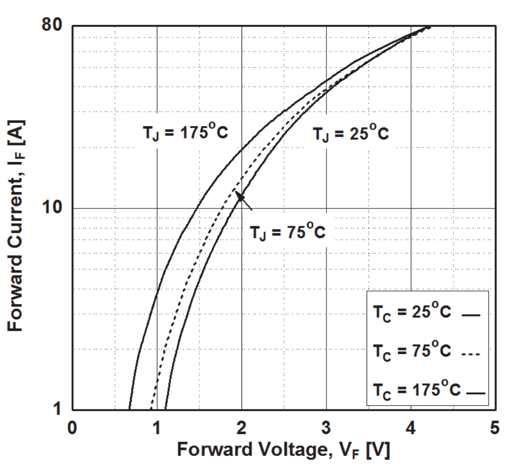
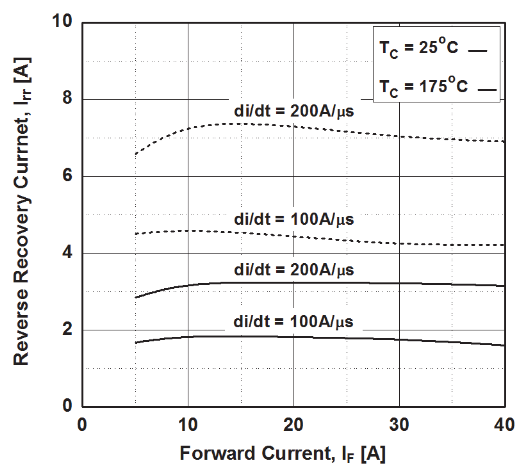


Figure 18. Reverse Recovery Current



Typical Performance Characteristics

Figure 19. Reverse Recovery Time

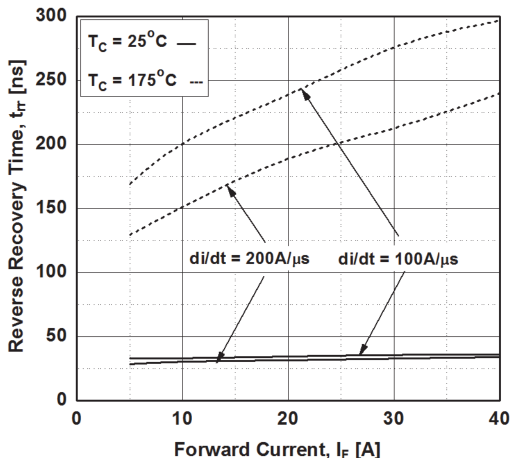


Figure 20. Stored Charge

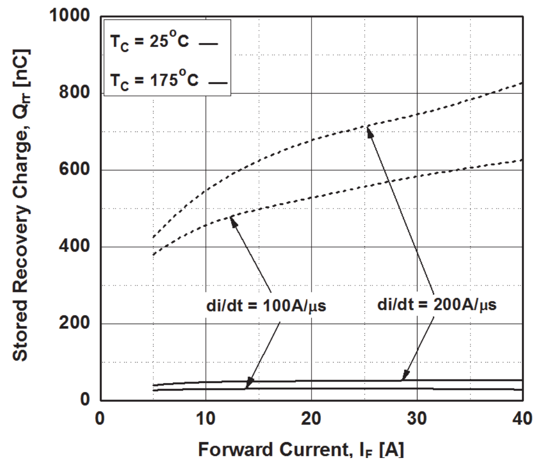


Figure 21.Transient Thermal Impedance of IGBT

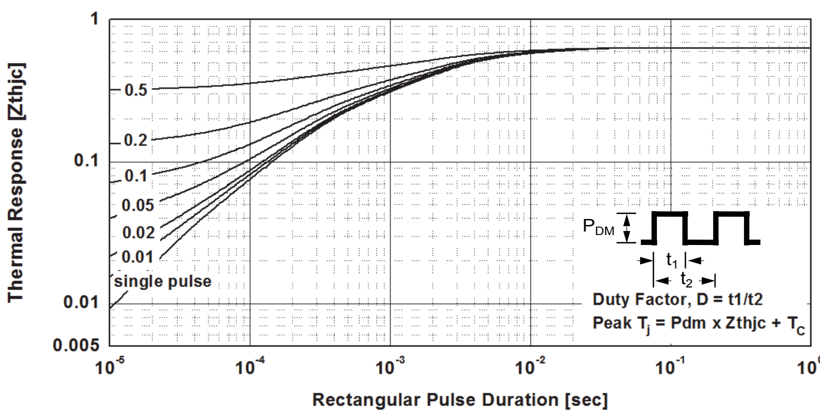
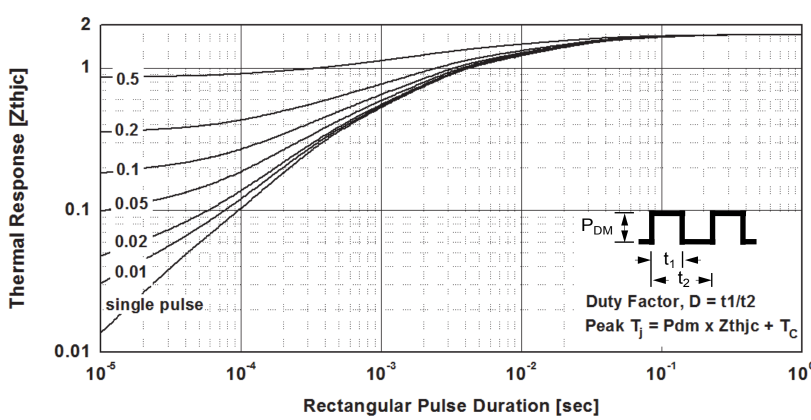
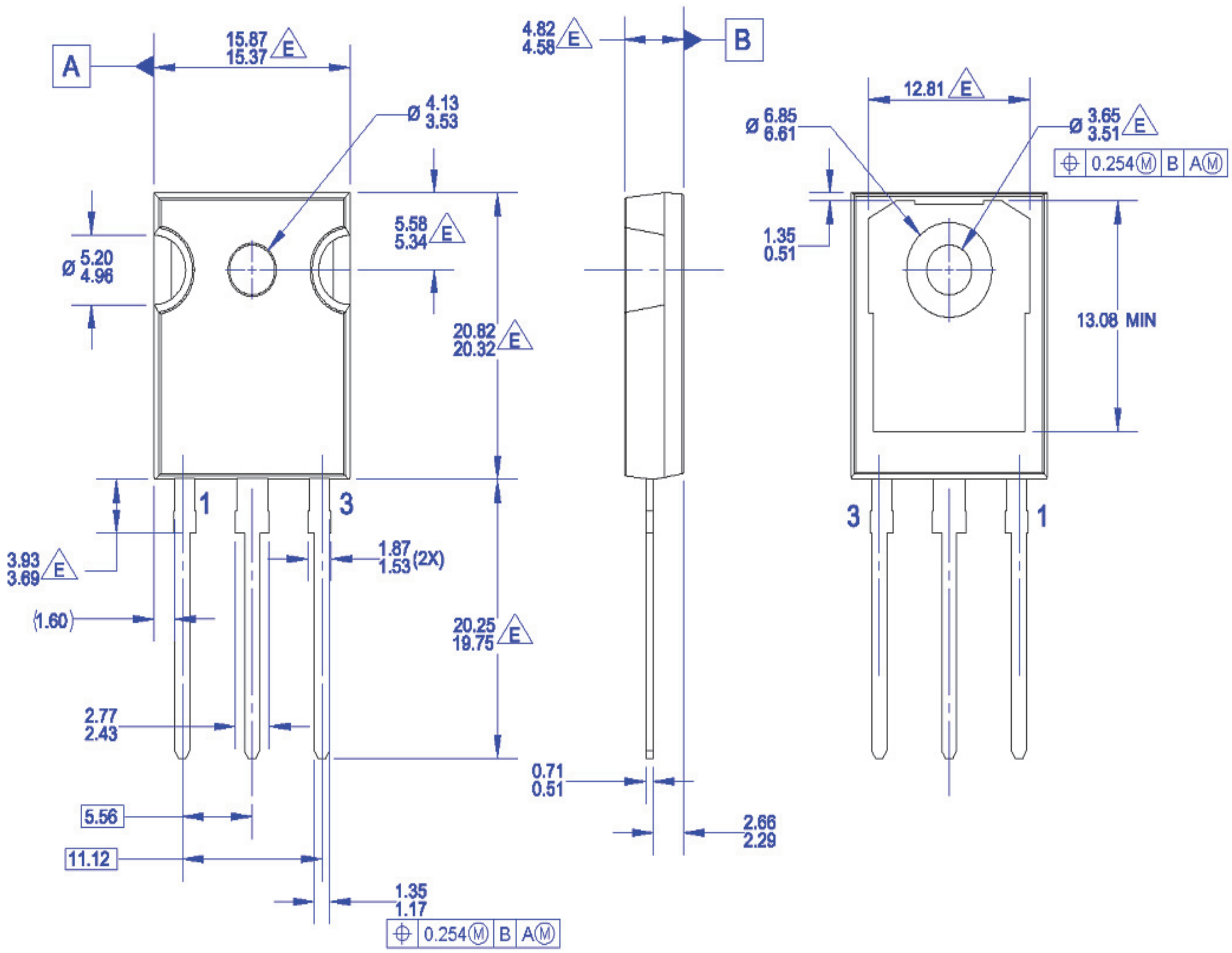


Figure 22.Transient Thermal Impedance of Diode



Mechanical Dimensions



NOTES: UNLESS OTHERWISE SPECIFIED.

A. PACKAGE REFERENCE: JEDEC TO-247, ISSUE E, VARIATION AB, DATED JUNE, 2004.
B. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
C. ALL DIMENSIONS ARE IN MILLIMETERS.
D. DRAWING CONFORMS TO ASME Y14.5 - 1994

E DOES NOT COMPLY JEDEC STANDARD VALUE
F. DRAWING FILENAME: MKT-TO247G03_REV02

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