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April 2015



FGH40N60SMDF_F085 600 V, 40 A Field Stop IGBT

Features

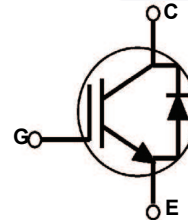
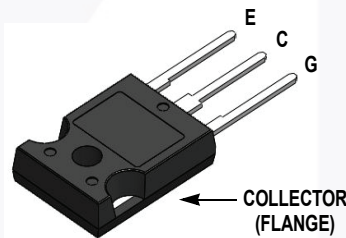
- Maximum Junction Temperature : $T_J = 175^{\circ}\text{C}$
- Positive Temperature Co-efficient for Easy Parallel Operating
- High Current Capability
- Low Saturation Voltage: $V_{CE(sat)} = 1.7\text{ V(Typ.) @ } I_C = 40\text{ A}$
- High Input Impedance
- Fast Switching: $E_{OFF} = 6.25\text{ uJ/A}$
- Tightened Parameter Distribution
- RoHS Compliant
- Qualified to Automotive Requirements of AEC-Q101

Applications

- Automotive chargers, Converters, High Voltage Auxiliaries
- Inverters, PFC, UPS

General Description

Using Novel Field Stop IGBT Technology, Fairchild's new series of Field Stop IGBTs offer the optimum performance for Automotive Chargers, Inverter, and other applications where low conduction and switching losses are essential.



Absolute Maximum Ratings

Symbol	Description	Ratings	Unit	
V_{CES}	Collector to Emitter Voltage	600	V	
V_{GES}	Gate to Emitter Voltage	± 20	V	
I_C	Collector Current	@ $T_C = 25^{\circ}\text{C}$	80	A
	Collector Current	@ $T_C = 100^{\circ}\text{C}$	40	A
$I_{CM(1)}$	Pulsed Collector Current	@ $T_C = 25^{\circ}\text{C}$	120	A
P_D	Maximum Power Dissipation	@ $T_C = 25^{\circ}\text{C}$	349	W
	Maximum Power Dissipation	@ $T_C = 100^{\circ}\text{C}$	174	W
T_J	Operating Junction Temperature	-55 to +175	$^{\circ}\text{C}$	
T_{stg}	Storage Temperature Range	-55 to +175	$^{\circ}\text{C}$	
T_L	Maximum Lead Temp. for soldering Purposes, 1/8" from case for 5 seconds	300	$^{\circ}\text{C}$	

Notes:

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

Thermal Characteristics

Symbol	Parameter	Typ.	Unit
$R_{\theta JC}(\text{IGBT})$	Thermal Resistance, Junction to Case	0.43	$^{\circ}\text{C/W}$
$R_{\theta JC}(\text{Diode})$	Thermal Resistance, Junction to Case	1.45	$^{\circ}\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	40	$^{\circ}\text{C/W}$

FGH40N60SMDF_F085 600 V, 40 A Field Stop IGBT

Package Marking and Ordering Information

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FGH40N60SMDF_F085	FGH40N60SMDF	TO-247	Tube	N/A	N/A	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	$V_{GE} = 0\text{ V}, I_C = 250\ \mu\text{A}$	600	-	-	V
$\frac{\Delta BV_{CES}}{\Delta T_J}$	Temperature Coefficient of Breakdown Voltage	$V_{GE} = 0\text{ V}, I_C = 250\ \mu\text{A}$	-	0.6	-	V/°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	$I_C = 250\ \mu\text{A}, V_{CE} = V_{GE}$	3.5	4.8	6.0	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C = 40\text{ A}, V_{GE} = 15\text{ V}$	-	1.7	2.5	V
		$I_C = 40\text{ A}, V_{GE} = 15\text{ V}, T_C = 150^\circ\text{C}$	-	2.0	-	V
Dynamic Characteristics						
C_{ies}	Input Capacitance	$V_{CE} = 30\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$	-	1840	-	pF
C_{oes}	Output Capacitance		-	180	-	pF
C_{res}	Reverse Transfer Capacitance		-	50	-	pF
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	$V_{CC} = 400\text{ V}, I_C = 40\text{ A}, R_G = 6\ \Omega, V_{GE} = 15\text{ V}, \text{Inductive Load}, T_C = 25^\circ\text{C}$	-	18	-	ns
t_r	Rise Time		-	22	-	ns
$t_{d(off)}$	Turn-Off Delay Time		-	110	-	ns
t_f	Fall Time		-	11	20	ns
E_{on}	Turn-On Switching Loss		-	1.3	-	mJ
E_{off}	Turn-Off Switching Loss		-	0.25	-	mJ
E_{ts}	Total Switching Loss		-	1.55	-	mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC} = 400\text{ V}, I_C = 40\text{ A}, R_G = 6\ \Omega, V_{GE} = 15\text{ V}, \text{Inductive Load}, T_C = 125^\circ\text{C}$	-	18	-	ns
t_r	Rise Time		-	32	-	ns
$t_{d(off)}$	Turn-Off Delay Time		-	112	-	ns
t_f	Fall Time		-	11	20	ns
E_{on}	Turn-On Switching Loss		-	2.05	-	mJ
E_{off}	Turn-Off Switching Loss		-	0.48	-	mJ
E_{ts}	Total Switching Loss		-	2.53	-	mJ
Q_g	Total Gate Charge	$V_{CE} = 400\text{ V}, I_C = 40\text{ A}, V_{GE} = 15\text{ V}$	-	122	-	nC
Q_{ge}	Gate to Emitter Charge		-	11	-	nC
Q_{gc}	Gate to Collector Charge		-	59	-	nC

Electrical Characteristics of the Diode $T_C = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max	Unit	
V_{FM}	Diode Forward Voltage	$I_F = 20\text{ A}$	$T_C = 25^\circ\text{C}$	-	1.3	1.7	V
			$T_C = 150^\circ\text{C}$	-	1.2		
t_{rr}	Diode Reverse Recovery Time	$I_F = 20\text{ A}, di_F/dt = 200\text{ A}/\mu\text{s}$	$T_C = 25^\circ\text{C}$	-	57	90	ns
			$T_C = 125^\circ\text{C}$	-	130		
Q_{rr}	Diode Reverse Recovery Charge	$I_F = 20\text{ A}, di_F/dt = 200\text{ A}/\mu\text{s}$	$T_C = 25^\circ\text{C}$	-	164	290	nC
			$T_C = 125^\circ\text{C}$	-	718		



Typical Performance Characteristics

Figure 1. Typical Output Characteristics

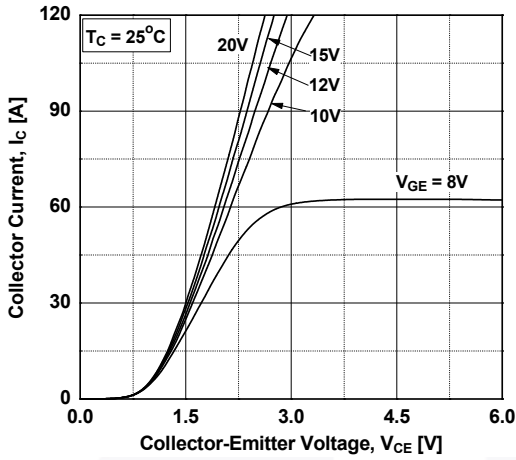


Figure 2. Typical Output Characteristics

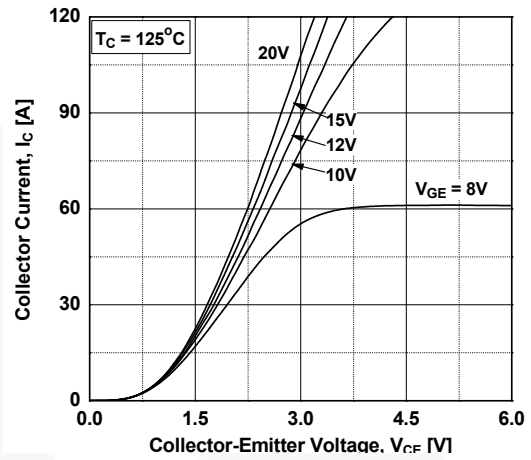


Figure 3. Typical Saturation Voltage Characteristics

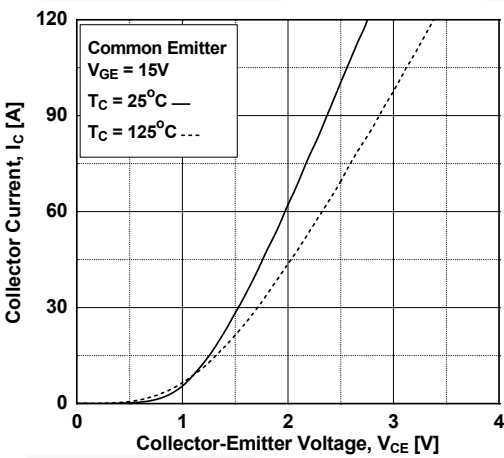


Figure 4. Transfer Characteristics

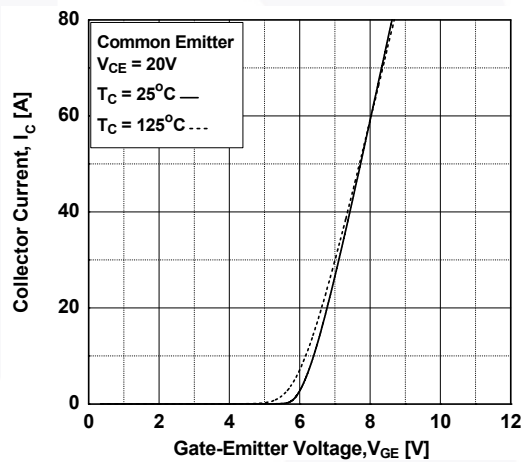


Figure 5. Saturation Voltage vs. Case Temperature at Variant Current Level

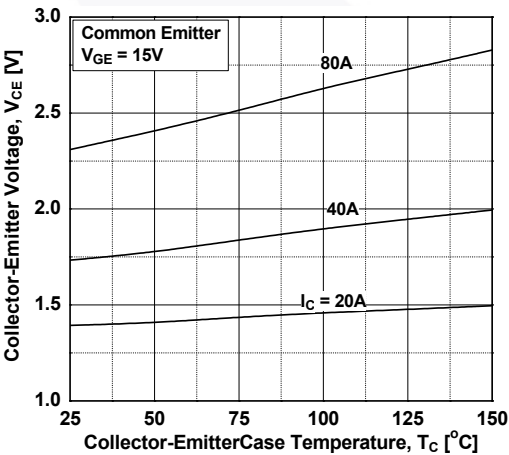
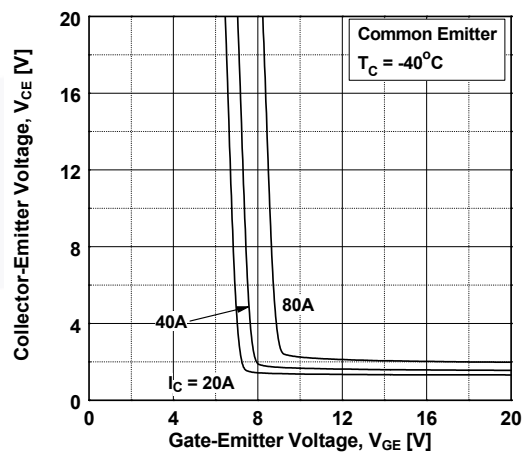


Figure 6. Saturation Voltage vs. Vge



Typical Performance Characteristics

Figure 7. Saturation Voltage vs. V_{GE}

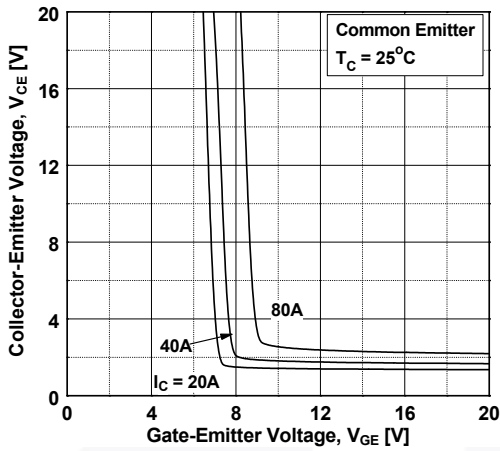


Figure 8. Saturation Voltage vs. V_{GE}

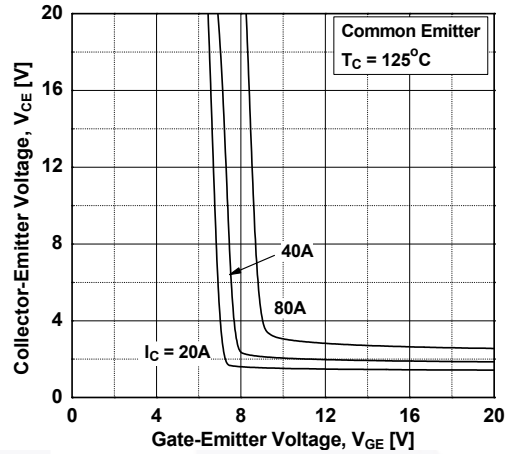


Figure 9. Capacitance Characteristics

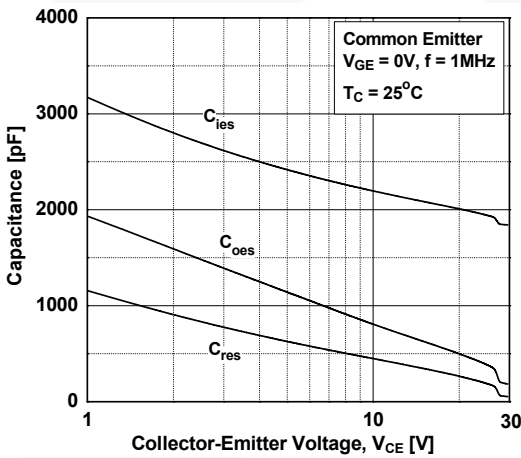


Figure 10. Gate charge Characteristics

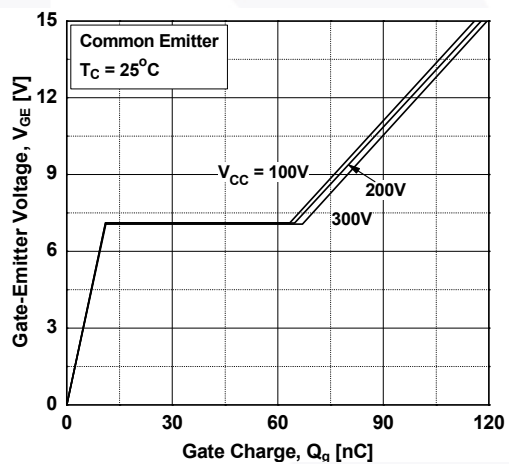


Figure 11. SOA Characteristics

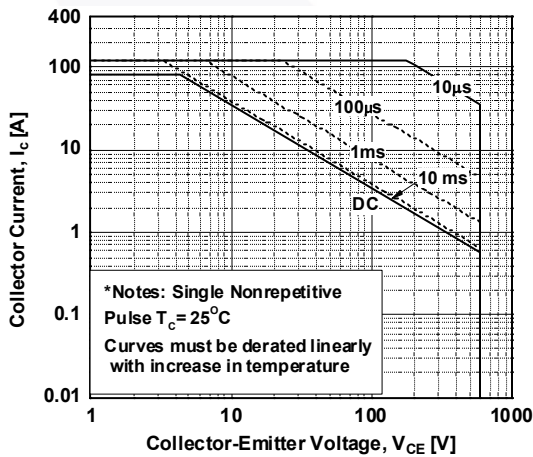
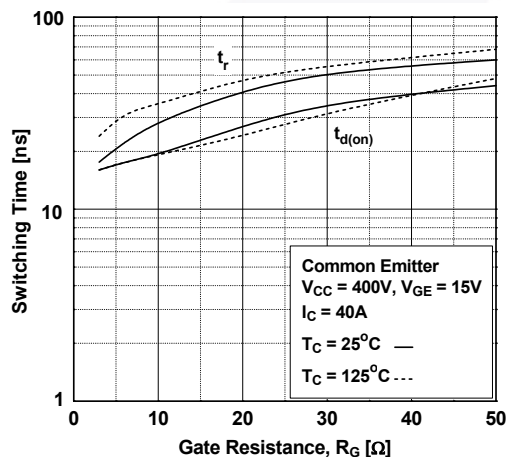


Figure 12. Turn-on Characteristics vs. Gate Resistance



Typical Performance Characteristics

Figure 13. Turn-off Characteristics vs. Gate Resistance

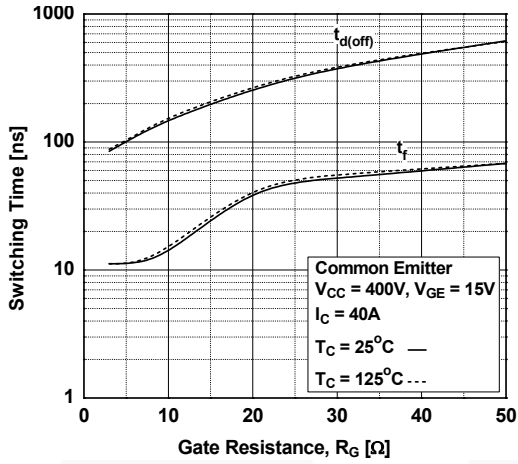


Figure 14. Turn-on Characteristics vs. Collector Current

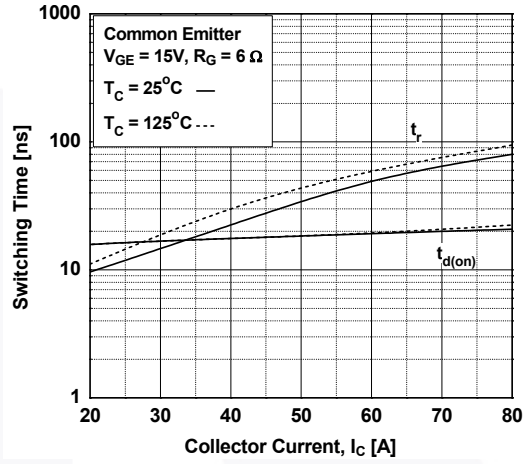


Figure 15. Turn-off Characteristics vs. Collector Current

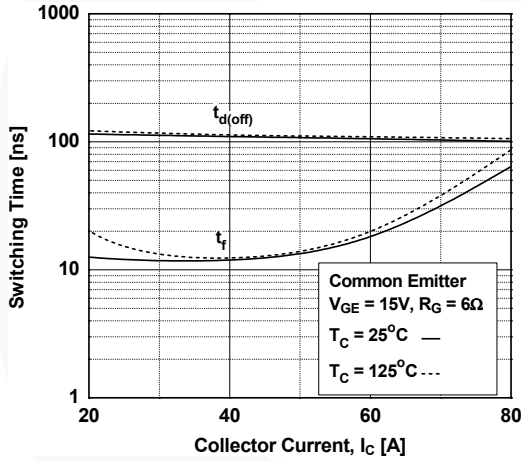


Figure 16. Switching Loss vs. Gate Resistance

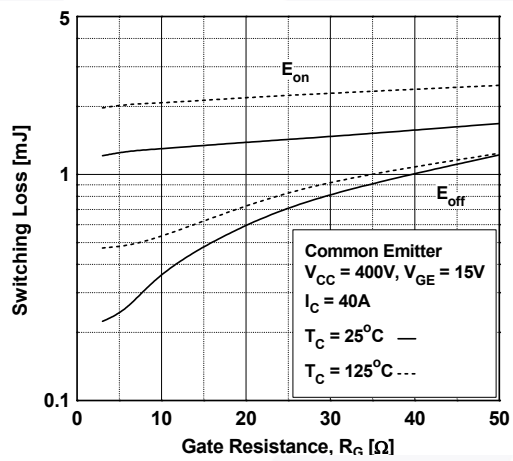


Figure 17. Switching Loss vs. Collector Current

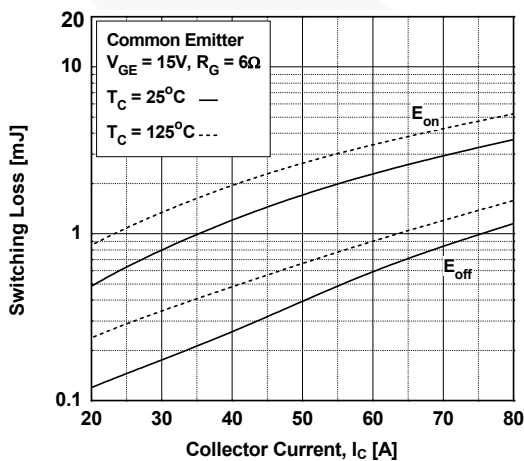
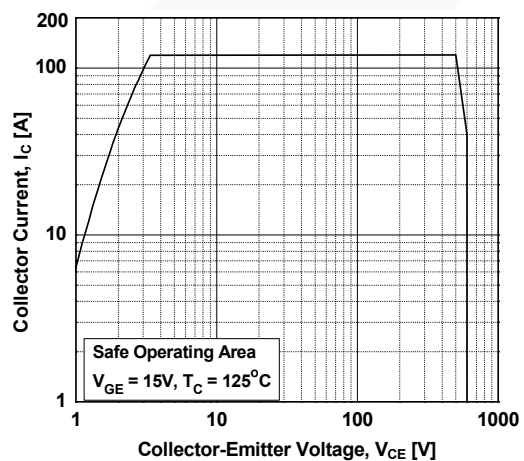


Figure 18. Turn off Switching SOA Characteristics



Typical Performance Characteristics

Figure 19. Forward Characteristics

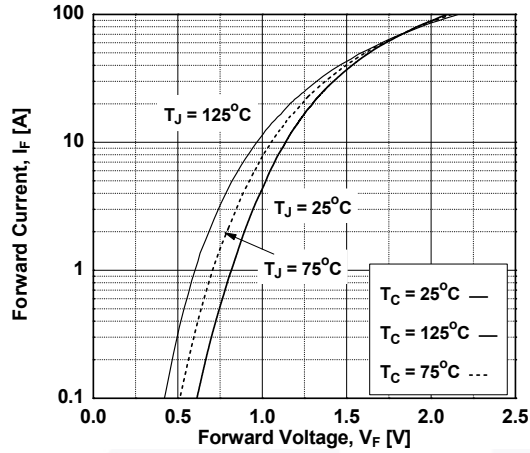


Figure 20. Reverse Current

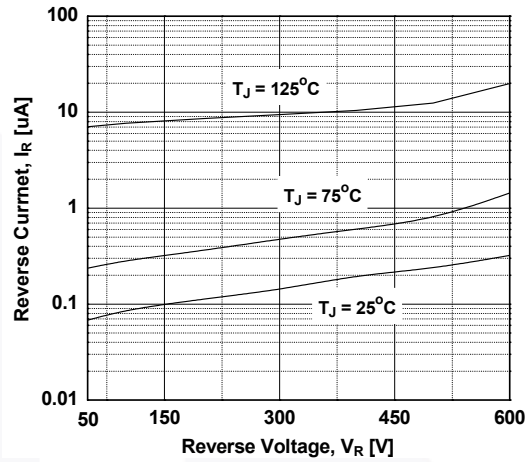


Figure 21. Stored Charge

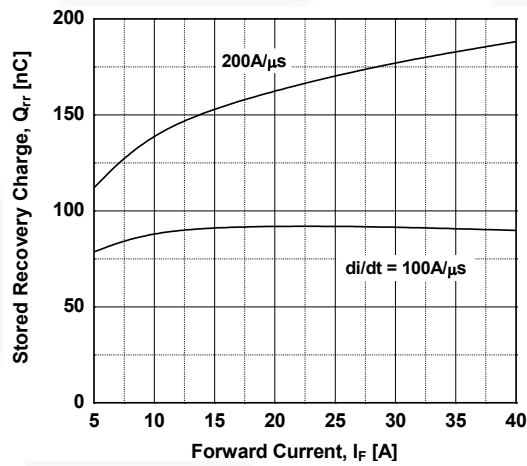


Figure 22. Reverse Recovery Time

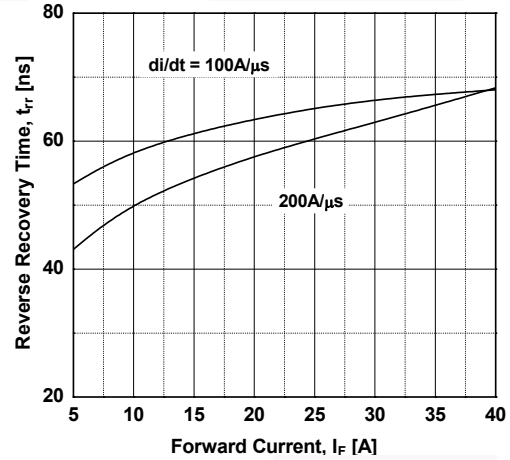
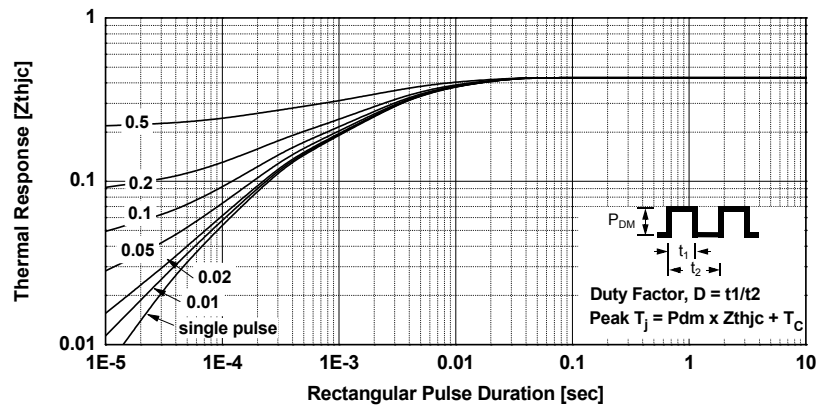
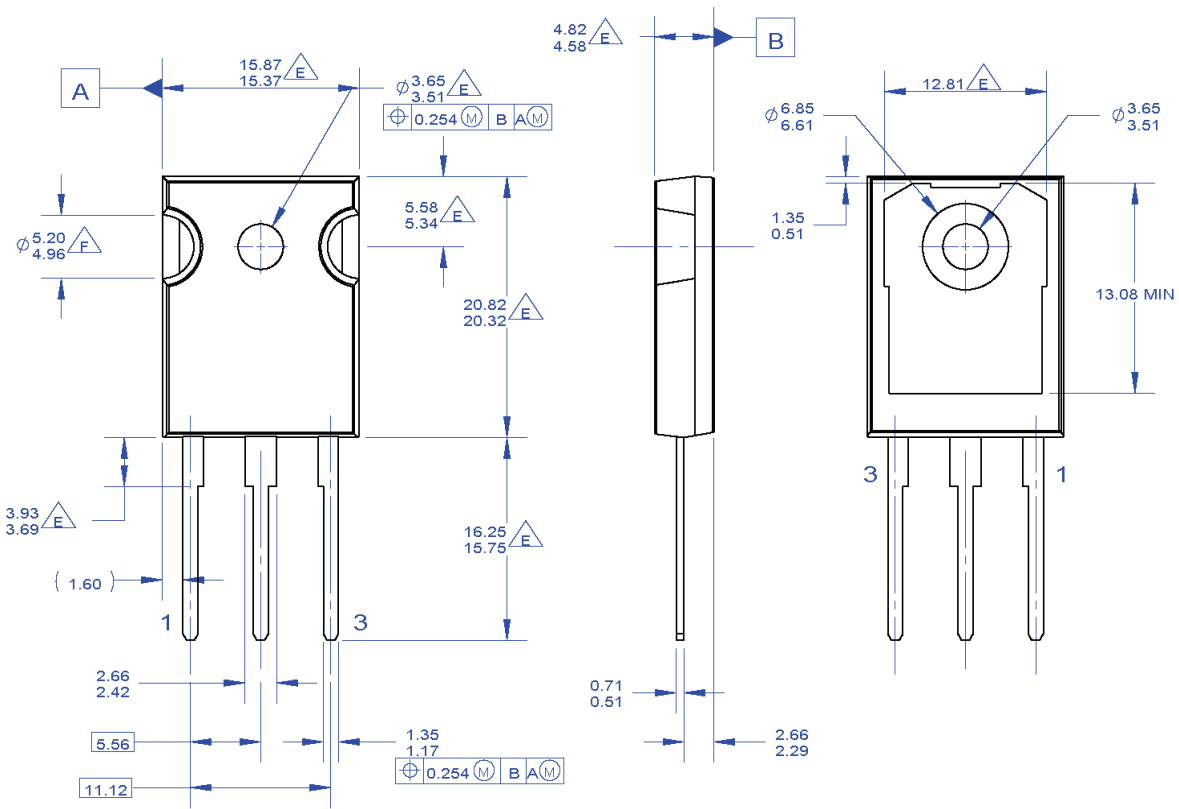


Figure 23. Transient Thermal Impedance of IGBT



Mechanical Dimensions



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Figure 24. TO-247 3L - TO-247,MOLDED,3 LEAD,JEDEC VARIATION AB

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