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FAIRCHILD SEMICONDUCTOR®

December 2013

FGH40N60SMD_F085
600V, 40A Field Stop IGBT

Features

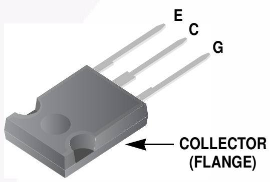
- Maximum Junction Temperature : $T_J = 175^oC$
- Positive Temperaure Co-efficient for easy parallel operating
- High current capability
- Low saturation voltage: $V_{CE(sat)} = 1.9V(Typ.) @ I_C = 40A$
- High input impedance
- Tightened Parameter Distribution
- RoHS compliant
- Qualified to Automotive Requirements of AEC-Q101

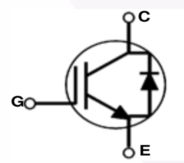
General Description

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.

Applications

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





Absolute Maximum Ratings

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

Thermal Characteristics

Symbol	Parameter	Ratings	Units
$R_{\theta JC}$(IGBT)(2)	Thermal Resistance, Junction to Case	0.43	$^oC/W$
$R_{\theta JC}$(Diode)	Thermal Resistance, Junction to Case	1.8	$^oC/W$

Symbol	Parameter	Typ.	Units
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (PCB Mount)(2)	45	$^oC/W$

Package Marking and Ordering Information

Device Marking	Device	Package	Packing Type	Qty per Tube
FGH40N60SMD	FGH40N60SMD_F085	TO-247	Tube	30ea

For Fairchild's definition of "green" Eco Status, please visit: http://www.fairchildsemi.com/company/green/rohs_green.html.

Electrical Characteristics of the IGBT T_C = 25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
Off Characteristics						
BV_{CES}	Collector to Emitter Breakdown Voltage	V_{GE} = 0V, I_C = 250uA	600	-	-	V
$\frac{\Delta BV_{CES}}{\Delta T_J}$	Temperature Coefficient of Breakdown Voltage	V_{GE} = 0V, I_C = 250uA	-	0.6	-	V/°C
I_{CES}	Collector Cut-Off Current	V_{CE} = V_{CES}, V_{GE} = 0V	-	-	250	μA
		I_{CES} at 80%*B_{VCES}, 175°C	-	-	800	
I_{GES}	G-E Leakage Current	V_{GE} = V_{GES}, V_{CE} = 0V	-	-	±400	nA
On Characteristics						
$V_{GE(th)}$	G-E Threshold Voltage	I_C = 250uA, V_{CE} = V_{GE}	3.5	4.5	6.0	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	I_C = 40A, V_{GE} = 15V	-	1.9	2.5	V
		I_C = 40A, V_{GE} = 15V, T_C = 175°C	-	2.1	-	V
Dynamic Characteristics						
C_{ies}	Input Capacitance	V_{CE} = 30V, V_{GE} = 0V, f = 1MHz	-	1880	2500	pF
C_{oes}	Output Capacitance		-	180	240	pF
C_{res}	Reverse Transfer Capacitance		-	50	65	pF
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	V_{CC} = 400V, I_C = 40A, R_G = 6Ω, V_{GE} = 15V, Inductive Load, T_C = 25°C	-	18	24	ns
t_r	Rise Time		-	28	36.4	ns
$t_{d(off)}$	Turn-Off Delay Time		-	110	143	ns
t_f	Fall Time		-	13.2	18.5	ns
E_{on}	Turn-On Switching Loss		-	0.92	1.2	mJ
E_{off}	Turn-Off Switching Loss		-	0.3	0.39	mJ
E_{ts}	Total Switching Loss		-	1.22	1.59	mJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC} = 400V, I_C = 40A, R_G = 6Ω, V_{GE} = 15V, Inductive Load, T_C = 175°C	-	16.7	23.8	ns
t_r	Rise Time		-	27	35.1	ns
$t_{d(off)}$	Turn-Off Delay Time		-	116	151	ns
t_f	Fall Time		-	56.5	81	ns
E_{on}	Turn-On Switching Loss		-	1.47	1.91	mJ
E_{off}	Turn-Off Switching Loss		-	0.73	0.95	mJ
E_{ts}	Total Switching Loss		-	2.20	2.86	mJ

Notes:

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

2:Rthjc for TO-247 : according to Mil standard 883-1012 test method. Rthja for TO-247 : according to JESD51-2, test method environmental condition and JESD51-10, test boards for through hole perimeter leaded package thermal measurements.
JESD51-3 : Low Effective Thermal Conductivity Test Board for Leaded Surface Mount Package.

Electrical Characteristics of the IGBT (Continued)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max	Units
Q_g	Total Gate Charge	V_{CE} = 400V, I_C = 40A, V_{GE} = 15V	-	119	180	nC
Q_{ge}	Gate to Emitter Charge		-	13	20	nC
Q_{gc}	Gate to Collector Charge		-	58	90	nC

Electrical Characteristics of the Diode T_C = 25°C unless otherwise noted

Symbol	Parameter	Test Conditions		Min.	Typ.	Max	Units
V_{FM}	Diode Forward Voltage	I_F = 20A	T_C = 25°C	-	2.3	2.8	V
			T_C = 175°C	-	1.67	-	
E_{rec}	Reverse Recovery Energy	I_F =20A, dI_F/dt = 200A/µs	T_C = 175°C	-	48.9	-	uJ
t_{rr}	Diode Reverse Recovery Time		T_C = 25°C	-	36	47	ns
			T_C = 175°C	-	110	-	
Q_{rr}	Diode Reverse Recovery Charge		T_C = 25°C	-	46.8	61	nC
			T_C = 175°C	-	470	-	

Typical Performance Characteristics

Figure 1. Typical Output Characteristics

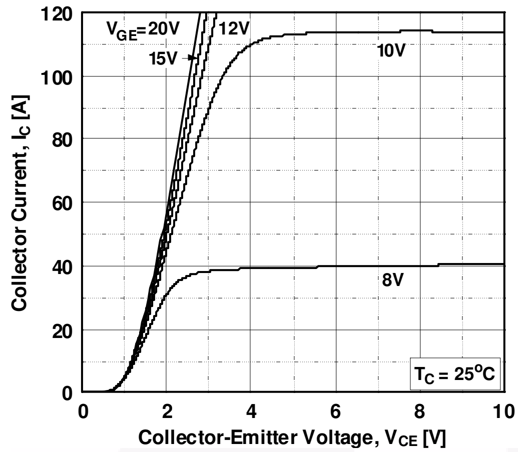


Figure 2. Typical Output Characteristics

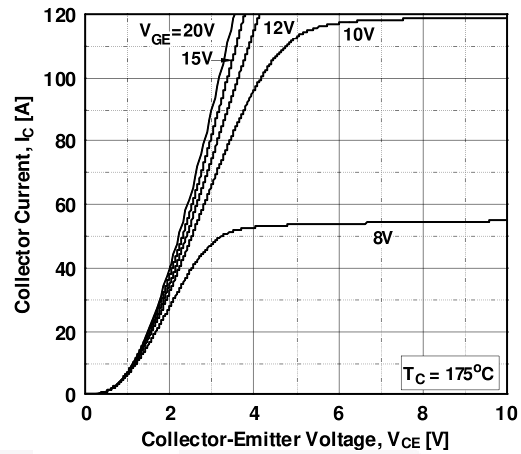


Figure 3. Typical Saturation Voltage Characteristics

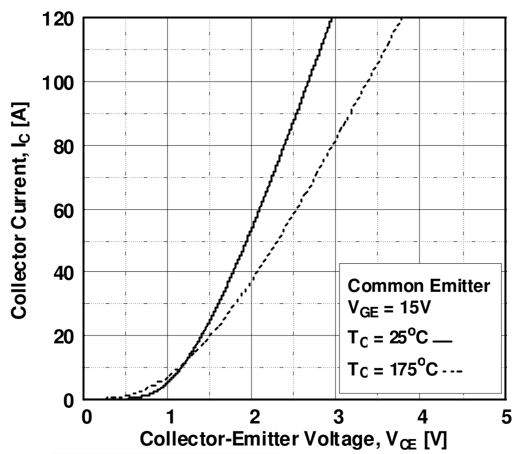


Figure 4. Transfer Characteristics

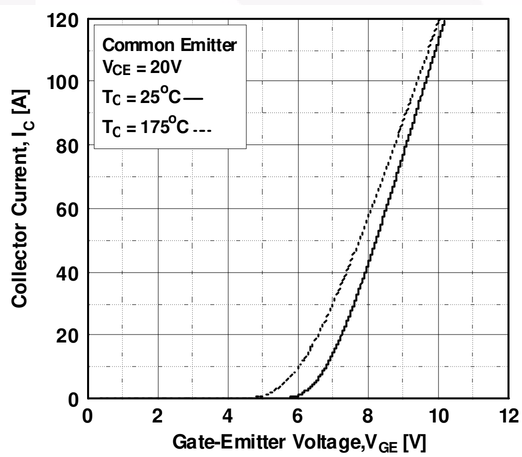


Figure 5. Saturation Voltage vs. Case Temperature at Variant Current Level

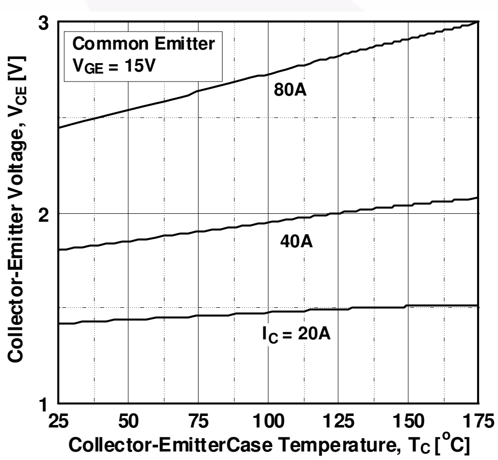
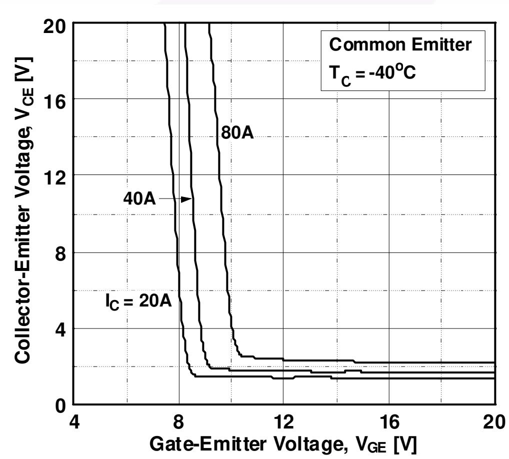


Figure 6. Saturation Voltage vs. V_{GE}



Typical Performance Characteristics

Figure 7. Saturation Voltage vs. V_{GE}

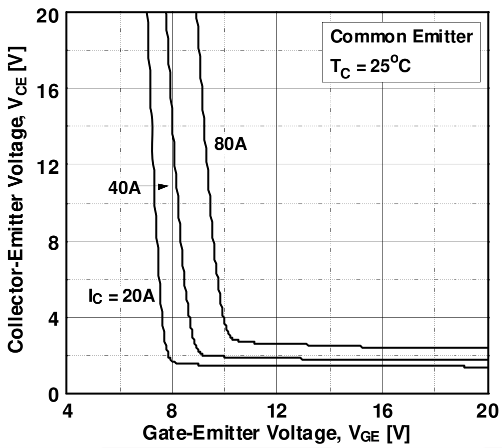


Figure 8. Saturation Voltage vs. V_{GE}

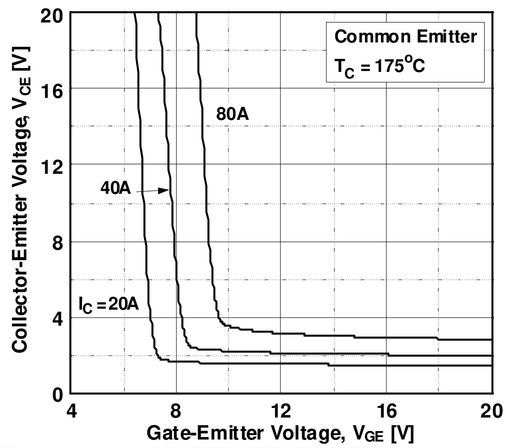


Figure 9. Capacitance Characteristics

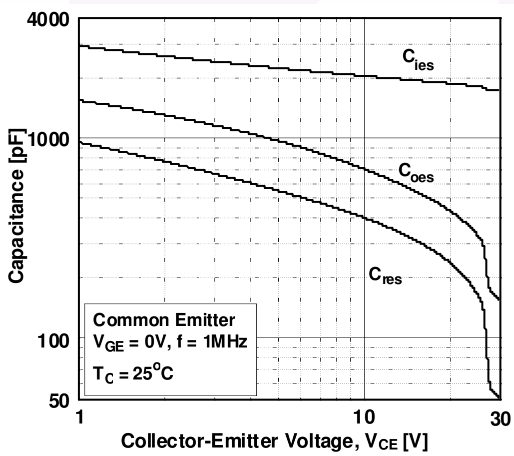


Figure 10. Gate charge Characteristics

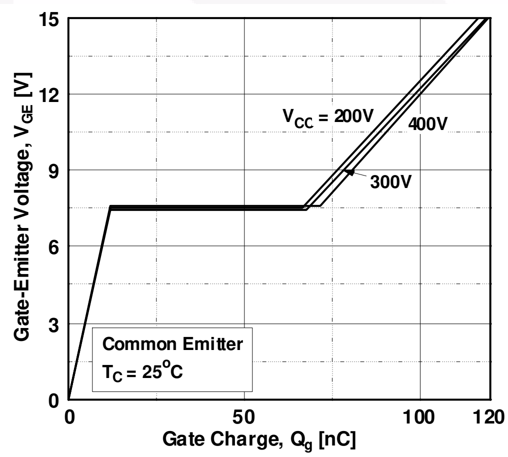


Figure 11. SOA Characteristics

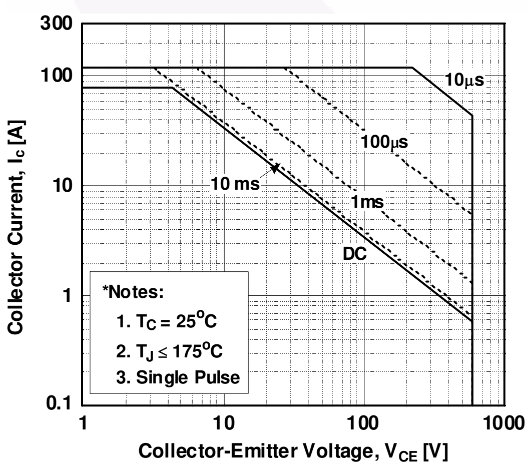
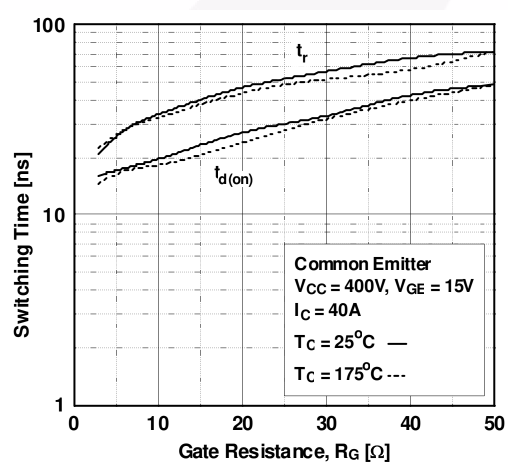


Figure 12. Turn-on Characteristics vs. Gate Resistance



Typical Performance Characteristics

Figure 13. Turn-off Characteristics vs. Gate Resistance

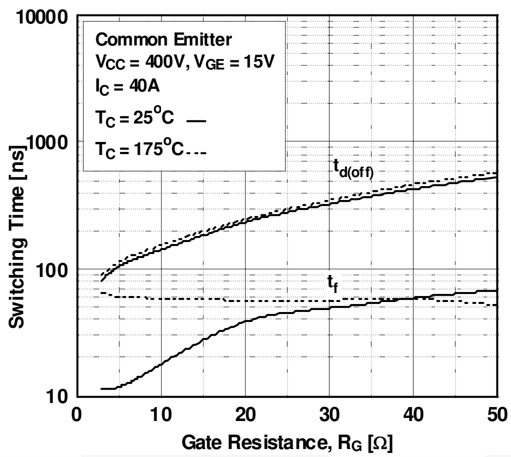


Figure 14. Turn-on Characteristics vs. Collector Current

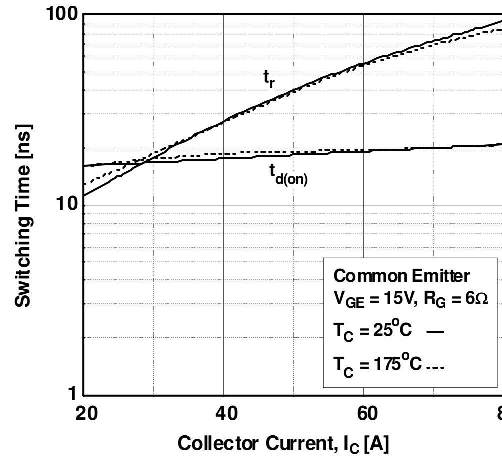


Figure 15. Turn-off Characteristics vs. Collector Current

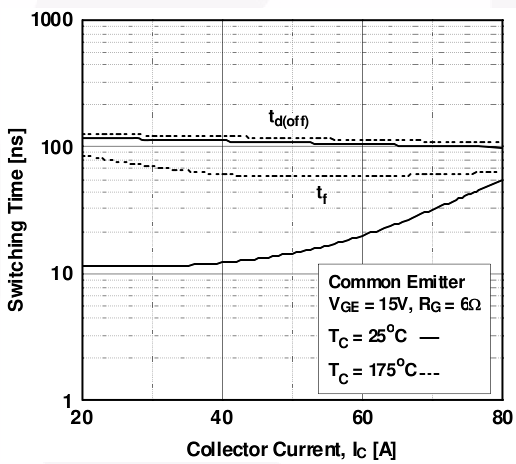


Figure 16. Switching Loss vs. Gate Resistance

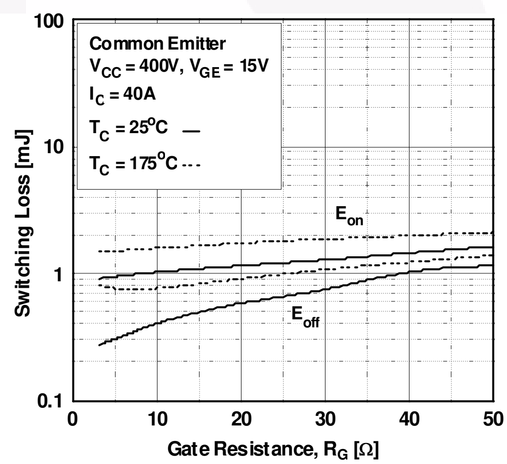


Figure 17. Switching Loss vs. Collector Current

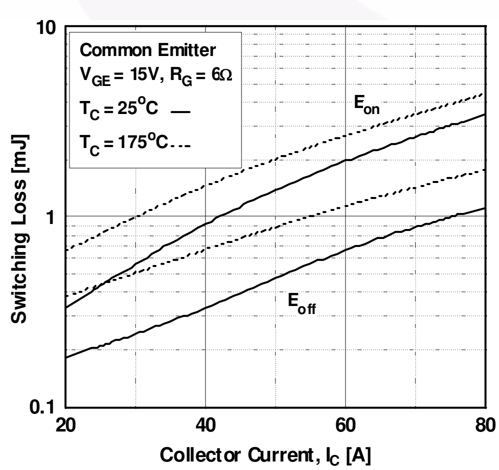
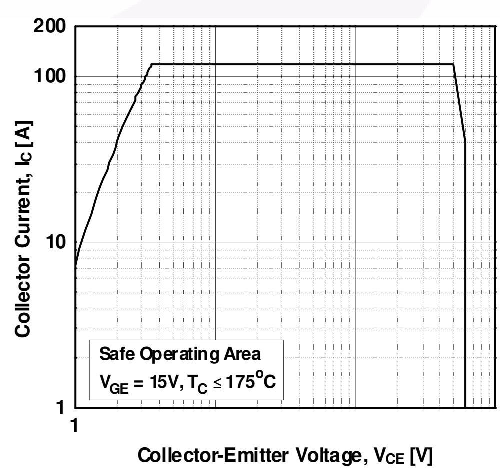


Figure 18. Turn off Switching SOA Characteristics



Typical Performance Characteristics

Figure 19. Current Derating

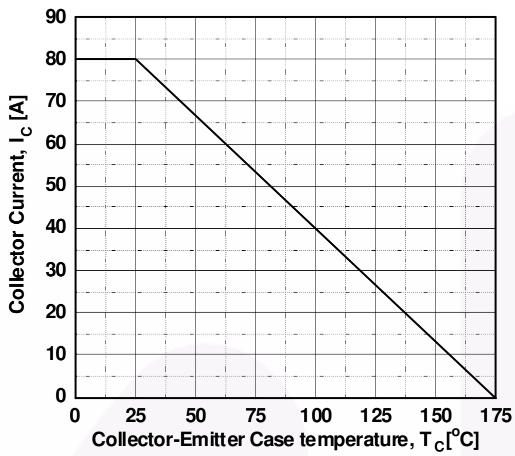


Figure 20. Load Current Vs. Frequency

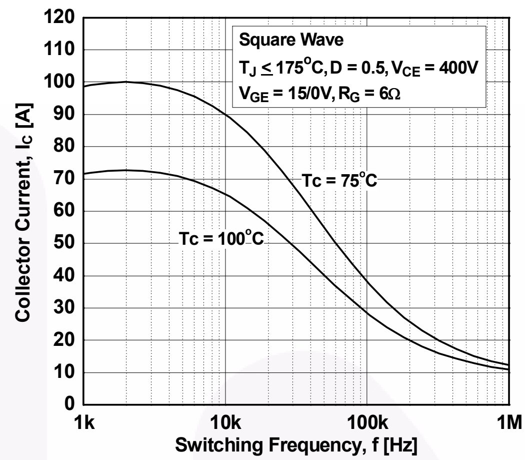


Figure 21. Forward Characteristics

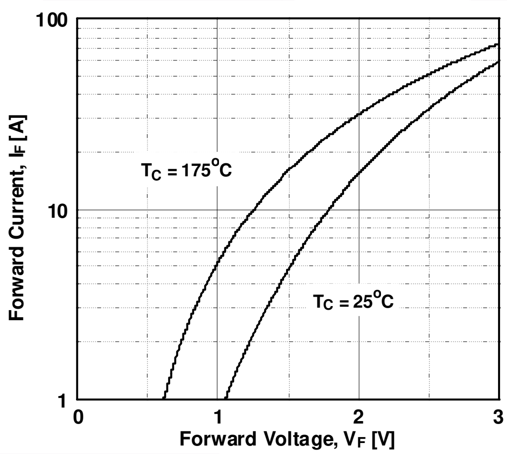


Figure 22. Reverse Current

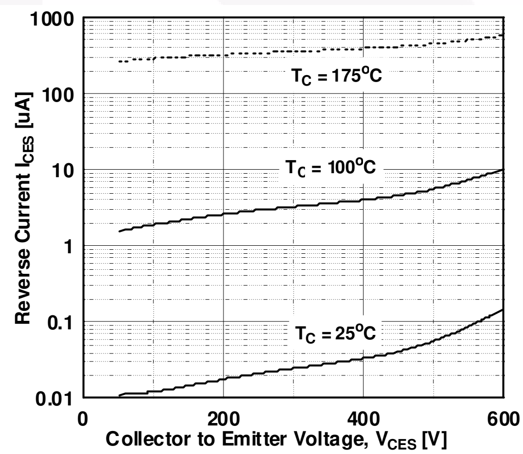


Figure 23. Stored Charge

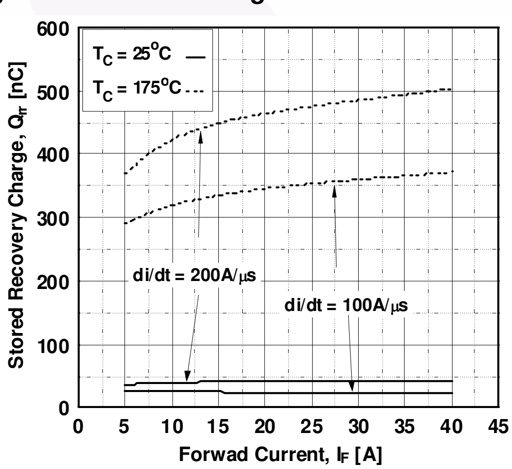


Figure 24. Reverse Recovery Time

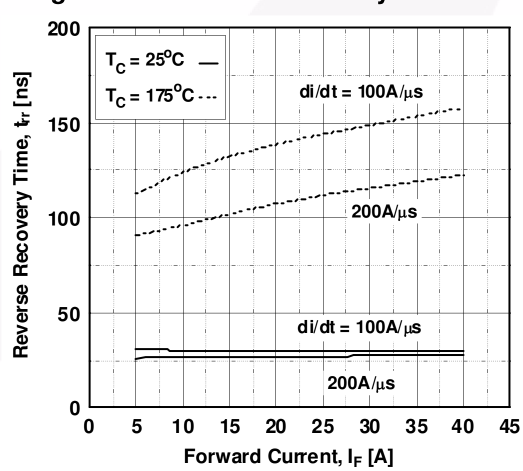


Figure 25. Transient Thermal Impedance of IGBT

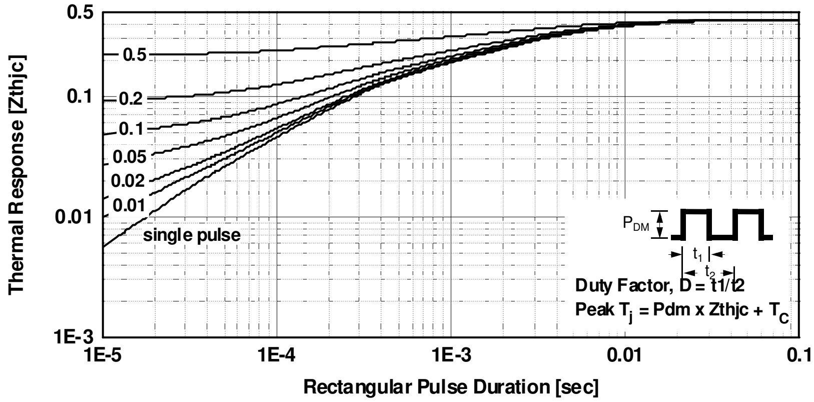
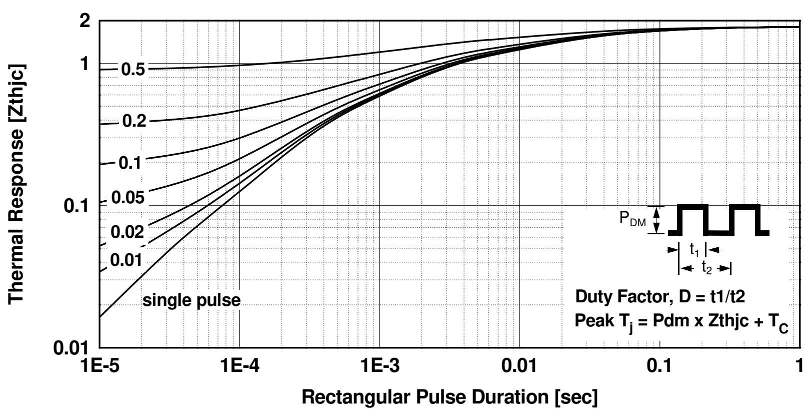
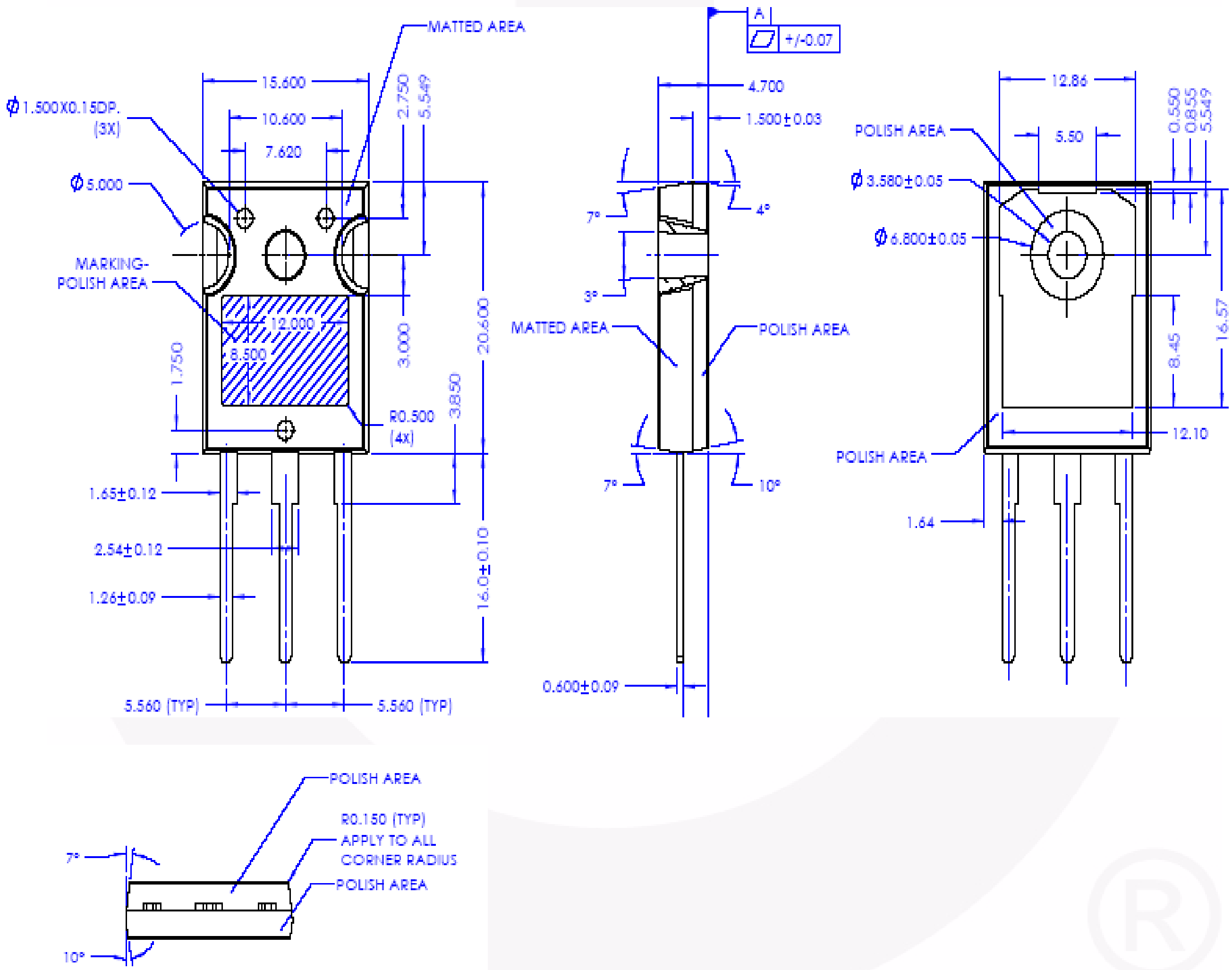


Figure 26.Transient Thermal Impedance of Diode



Mechanical Dimensions

TO - 247AB (FKS PKG CODE 001)



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Definition of Terms

Datasheet Identification	Product Status	Definition
Advance Information	Formative / In Design	Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
No Identification Needed	Full Production	Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.
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