

# FGH40N60SMD

## 600V, 40A Field Stop IGBT

### Features

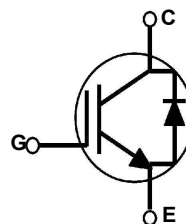
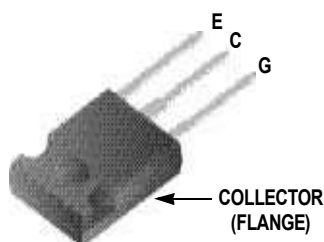
- Maximum Junction Temperature :  $T_J = 175^{\circ}\text{C}$
- Positive Temperature Co-efficient for easy parallel operating
- High current capability
- Low saturation voltage:  $V_{CE(sat)} = 1.9\text{V(Typ.)}$  @  $I_C = 40\text{A}$
- High input impedance
- Fast switching
- Tighten Parameter Distribution
- RoHS compliant

### Applications

- Solar Inverter
- UPS, Welder, SMPS

### General Description

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



### Absolute Maximum Ratings

Symbol	Description	Ratings	Units
$V_{CES}$	Collector to Emitter Voltage	600	V
$V_{GES}$	Gate to Emitter Voltage	$\pm 20$	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	120	A
$I_F$	Diode Forward Current @ $T_C = 25^{\circ}\text{C}$	40	A
	Diode Forward Current @ $T_C = 100^{\circ}\text{C}$	20	A
$I_{FM(1)}$	Pulsed Diode Maximum Forward Current	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.	Max.	Units
$R_{\theta JC}$ (IGBT)	Thermal Resistance, Junction to Case	-	0.43	$^{\circ}\text{C}/\text{W}$
$R_{\theta JC}$ (Diode)	Thermal Resistance, Junction to Case	-	1.5	$^{\circ}\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	-	40	$^{\circ}\text{C}/\text{W}$

## Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FGH40N60SMD	FGH40N60SMD	TO-247	-	-	30

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
Off Characteristics						
BV <sub>CES</sub>	Collector to Emitter Breakdown Voltage	V <sub>GE</sub> = 0V, I <sub>C</sub> = 250μA	600	-	-	V
$\frac{\Delta BV_{CES}}{\Delta T_J}$	Temperature Coefficient of Breakdown Voltage	V <sub>GE</sub> = 0V, I <sub>C</sub> = 250μA	-	0.6	-	V/°C
I <sub>CES</sub>	Collector Cut-Off Current	V <sub>CE</sub> = V <sub>CES</sub> , V <sub>GE</sub> = 0V	-	-	250	μA
I <sub>GES</sub>	G-E Leakage Current	V <sub>GE</sub> = V <sub>GES</sub> , V <sub>CE</sub> = 0V	-	-	±400	nA
On Characteristics						
V <sub>GE(th)</sub>	G-E Threshold Voltage	I <sub>C</sub> = 250μA, V <sub>CE</sub> = V <sub>GE</sub>	3.5	4.5	6.0	V
V <sub>CE(sat)</sub>	Collector to Emitter Saturation Voltage	I <sub>C</sub> = 40A, V <sub>GE</sub> = 15V	-	1.9	2.5	V
		I <sub>C</sub> = 40A, V <sub>GE</sub> = 15V, T <sub>C</sub> = 175°C	-	2.1	-	V
Dynamic Characteristics						
C <sub>ies</sub>	Input Capacitance	V <sub>CE</sub> = 30V, V <sub>GE</sub> = 0V, f = 1MHz	-	1880	-	pF
C <sub>oes</sub>	Output Capacitance		-	180	-	pF
C <sub>res</sub>	Reverse Transfer Capacitance		-	50	-	pF
Switching Characteristics						
t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>CC</sub> = 400V, I <sub>C</sub> = 40A, R <sub>G</sub> = 6Ω, V <sub>GE</sub> = 15V, Inductive Load, T <sub>C</sub> = 25°C	-	12	16	ns
t <sub>r</sub>	Rise Time		-	20	28	ns
t <sub>d(off)</sub>	Turn-Off Delay Time		-	92	120	ns
t <sub>f</sub>	Fall Time		-	13	17	ns
E <sub>on</sub>	Turn-On Switching Loss		-	0.87	1.30	mJ
E <sub>off</sub>	Turn-Off Switching Loss		-	0.26	0.34	mJ
E <sub>ts</sub>	Total Switching Loss		-	1.13	1.64	mJ
t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>CC</sub> = 400V, I <sub>C</sub> = 40A, R <sub>G</sub> = 6Ω, V <sub>GE</sub> = 15V, Inductive Load, T <sub>C</sub> = 175°C	-	15	-	ns
t <sub>r</sub>	Rise Time		-	22	-	ns
t <sub>d(off)</sub>	Turn-Off Delay Time		-	116	-	ns
t <sub>f</sub>	Fall Time		-	16	-	ns
E <sub>on</sub>	Turn-On Switching Loss		-	0.97	-	mJ
E <sub>off</sub>	Turn-Off Switching Loss		-	0.60	-	mJ
E <sub>ts</sub>	Total Switching Loss		-	1.57	-	mJ

**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**  $T_C = 25^\circ C$  unless otherwise noted

Symbol	Parameter	Test Conditions		Min.	Typ.	Max	Units
V <sub>FM</sub>	Diode Forward Voltage	I <sub>F</sub> = 20A	T <sub>C</sub> = 25°C	-	2.3	2.8	V
			T <sub>C</sub> = 175°C	-	1.67	-	
E <sub>rec</sub>	Reverse Recovery Energy	I <sub>F</sub> =20A, dI <sub>F</sub> /dt = 200A/μs	T <sub>C</sub> = 175°C	-	48.9	-	μJ
t <sub>rr</sub>	Diode Reverse Recovery Time		T <sub>C</sub> = 25°C	-	36	-	ns
			T <sub>C</sub> = 175°C	-	110	-	
Q <sub>rr</sub>	Diode Reverse Recovery Charge		T <sub>C</sub> = 25°C	-	46.8	-	nC
			T <sub>C</sub> = 175°C	-	445	-	

## Typical Performance Characteristics

Figure 1. Typical Output Characteristics

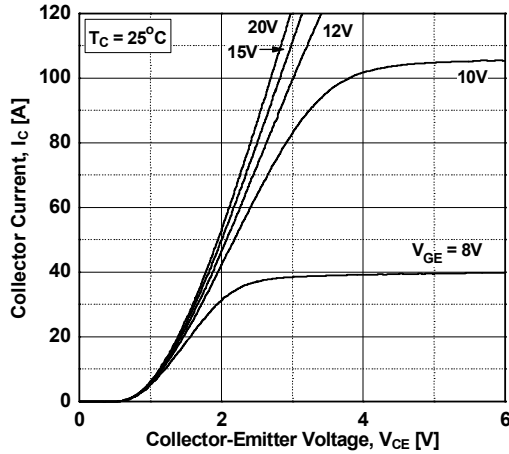


Figure 2. Typical Output Characteristics

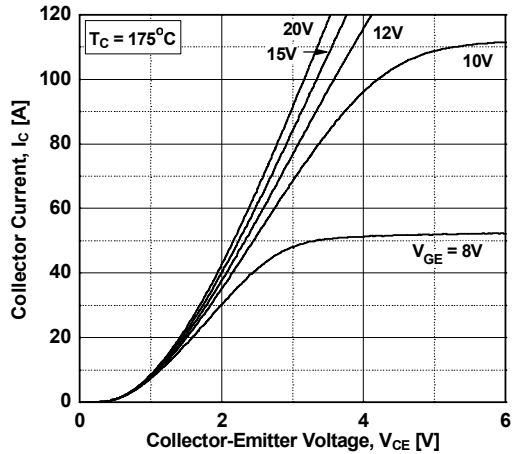


Figure 3. Typical Saturation Voltage Characteristics

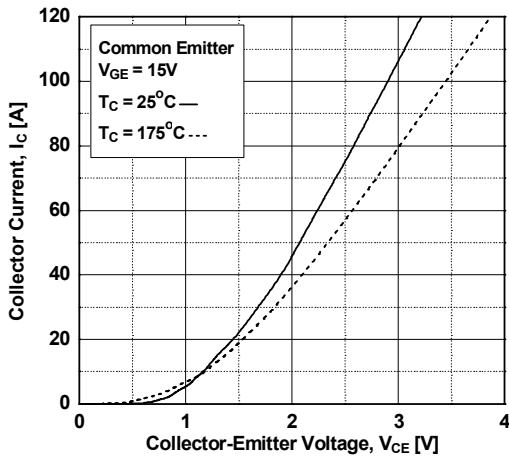


Figure 4. Transfer Characteristics

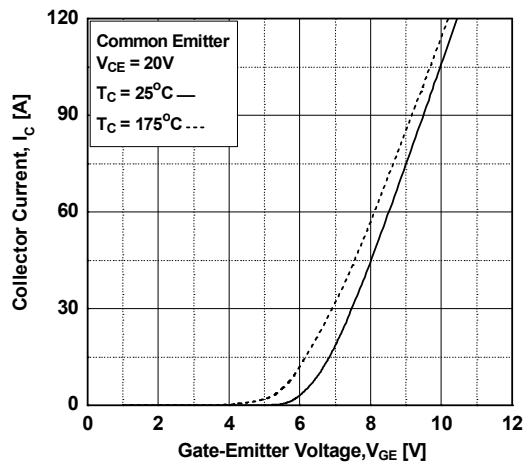


Figure 5. Saturation Voltage vs. Case Temperature at Variant Current Level

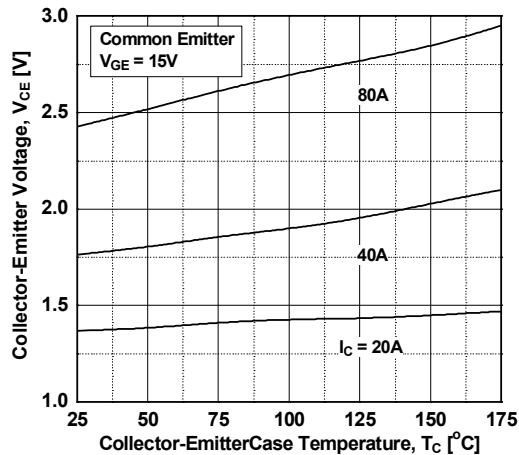
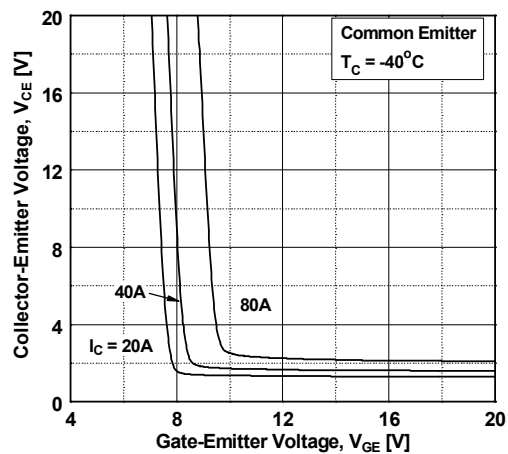


Figure 6. Saturation Voltage vs. Vge



## Typical Performance Characteristics

Figure 7. Saturation Voltage vs.  $V_{GE}$

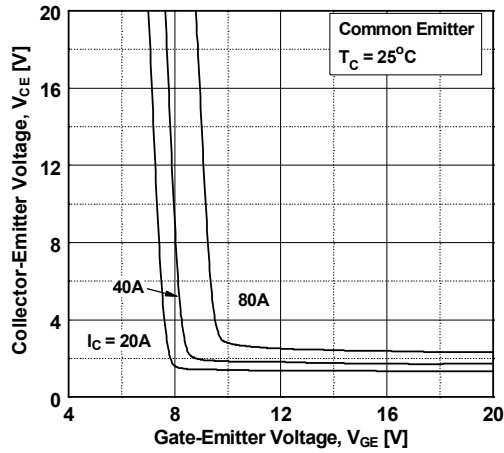


Figure 8. Saturation Voltage vs.  $V_{GE}$

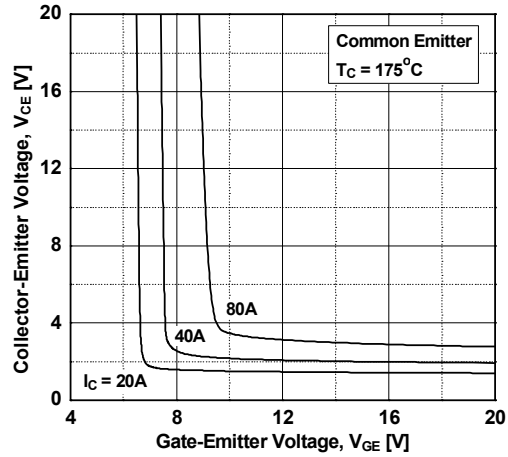


Figure 9. Capacitance Characteristics

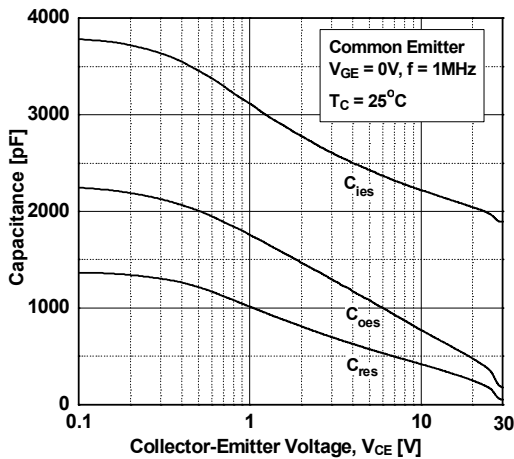


Figure 10. Gate charge Characteristics

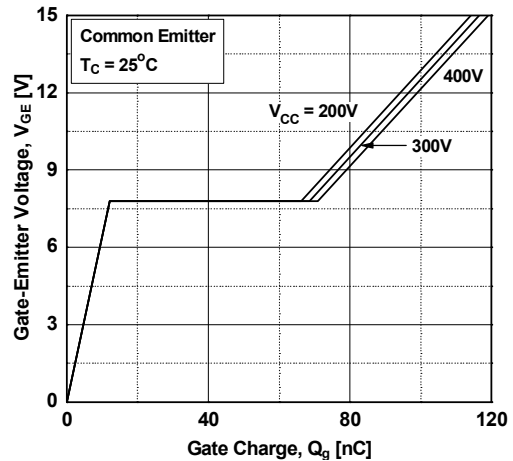


Figure 11. SOA Characteristics

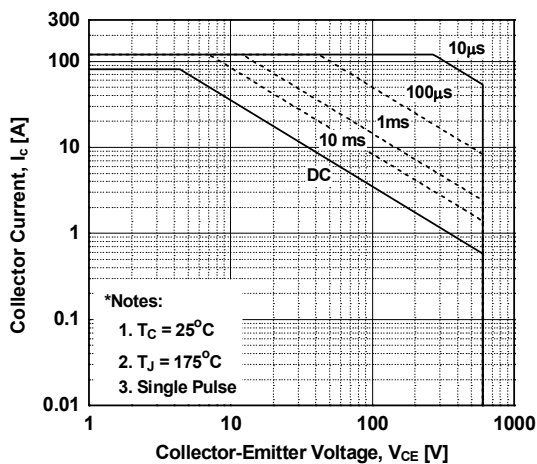
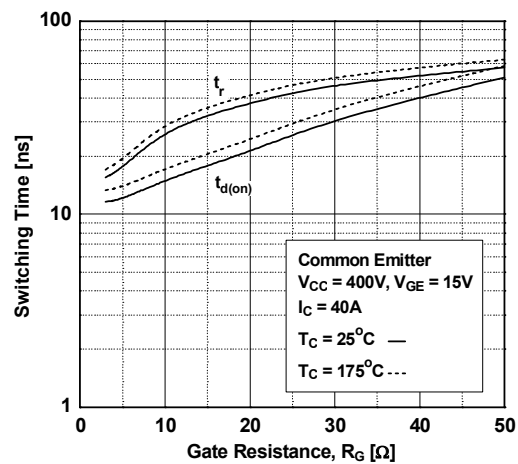


Figure 12. Turn-on Characteristics vs. Gate Resistance



## Typical Performance Characteristics

Figure 13. Turn-off Characteristics vs. Gate Resistance

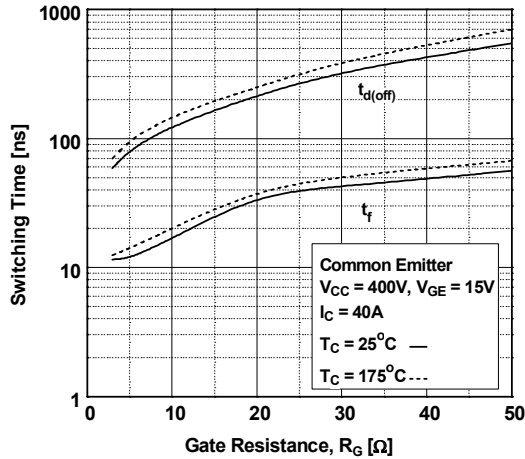


Figure 14. Turn-on Characteristics vs. Collector Current

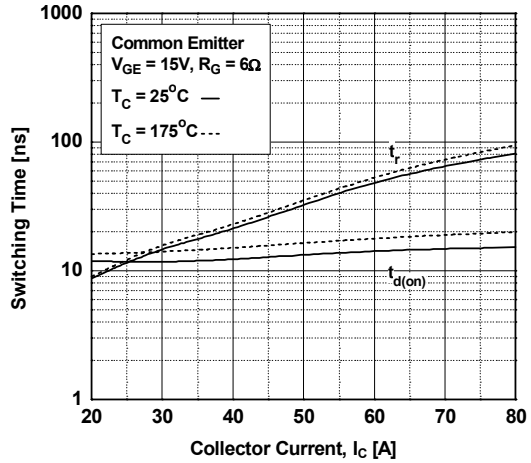


Figure 15. Turn-off Characteristics vs. Collector Current

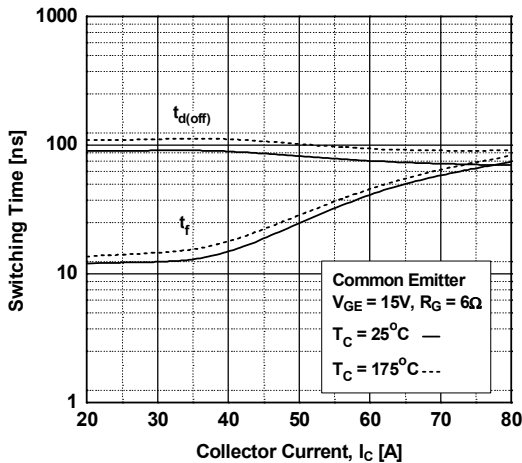


Figure 16. Switching Loss vs. Gate Resistance

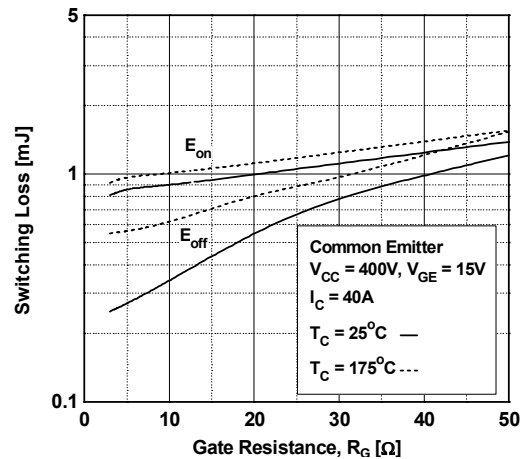


Figure 17. Switching Loss vs. Collector Current

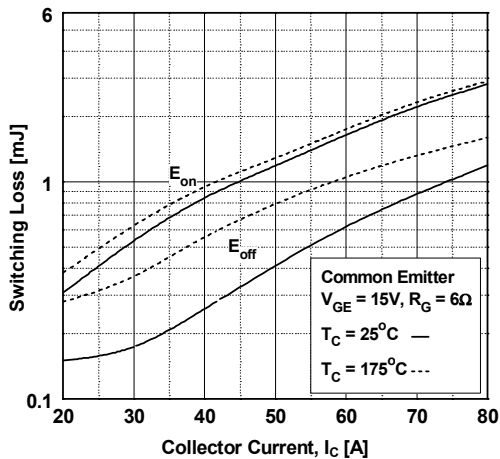
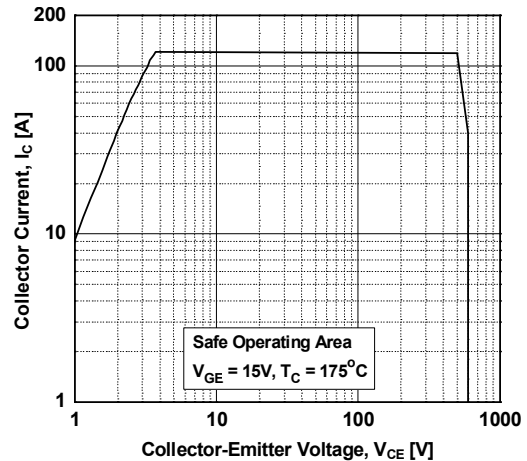


Figure 18. Turn off Switching SOA Characteristics



## Typical Performance Characteristics

Figure 19. Current Derating

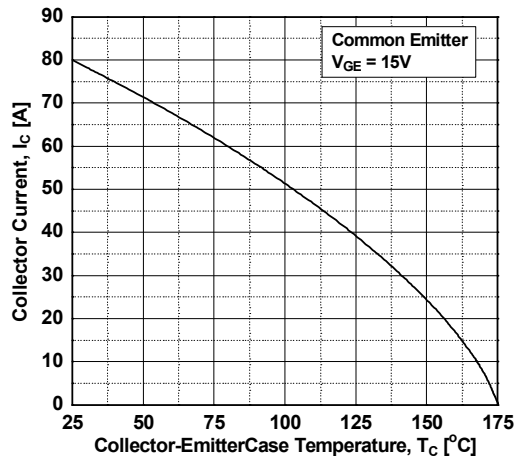


Figure 20. Load Current Vs. Frequency

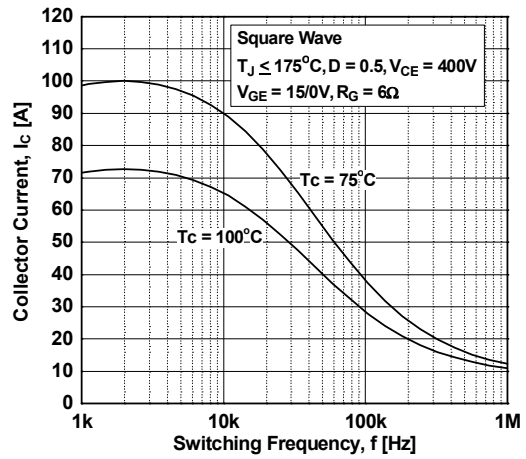


Figure 21. Forward Characteristics

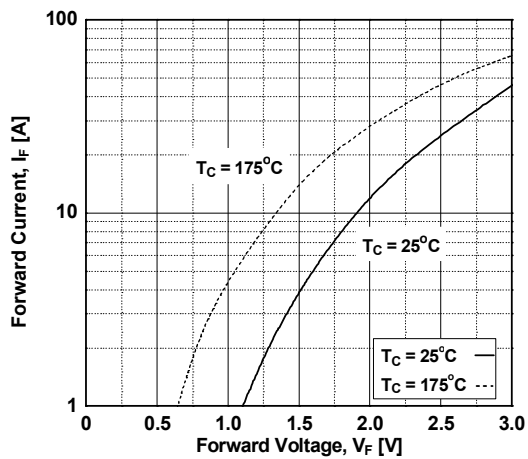


Figure 22. Reverse Current

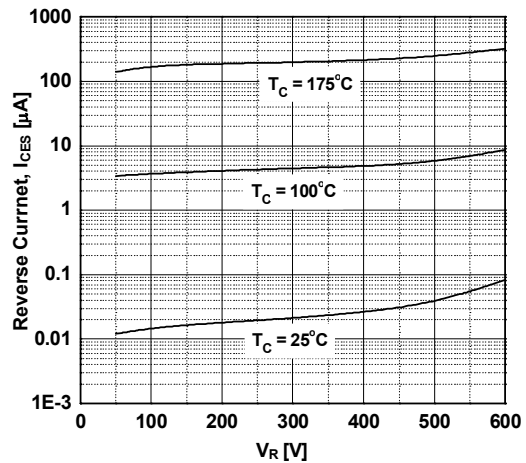


Figure 23. Stored Charge

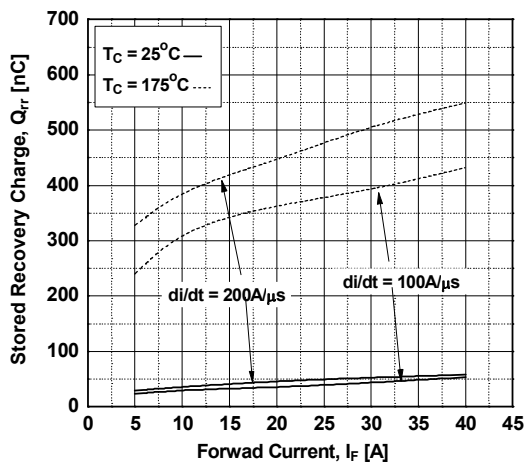
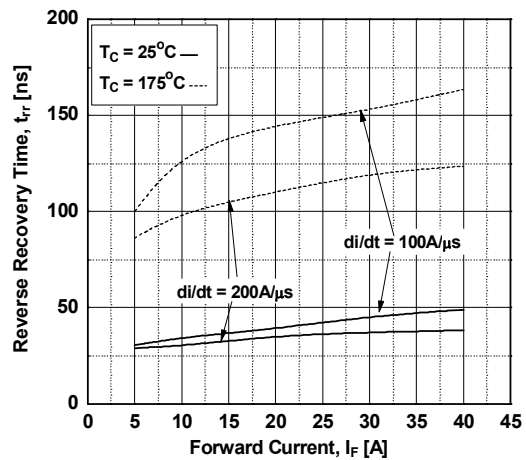


Figure 24. Reverse Recovery Time



## Typical Performance Characteristics

Figure 25. Transient Thermal Impedance of IGBT

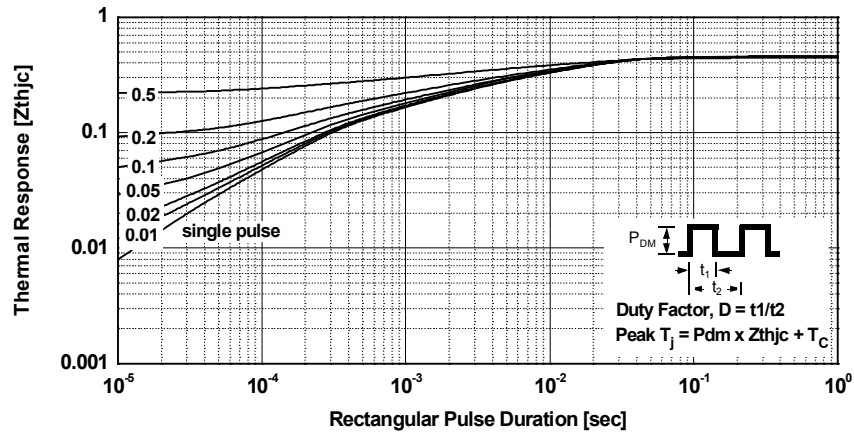
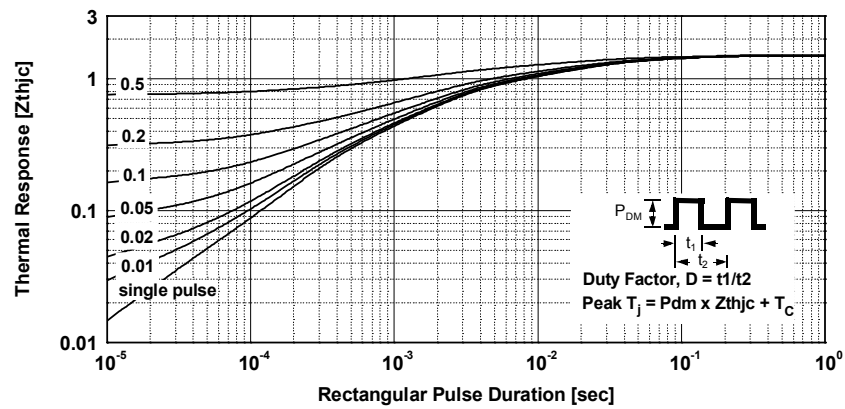


Figure 26. Transient Thermal Impedance of Diode













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