



ON Semiconductor®

# FGB40T65SPD-F085

## 650V, 40A Field Stop Trench IGBT

### Features

- AEC-Q101 Qualified
- Low Saturation Voltage :  $V_{CE(sat)} = 2.0\text{ V(Typ.) @ } I_C = 40\text{ A}$
- 100% of the parts are dynamically tested (Note 1)
- Short Circuit Ruggedness  $> 5\ \mu\text{s @ } 25\text{ °C}$
- Maximum Junction Temperature :  $T_J = 175\text{ °C}$
- Fast Switching
- Tight Parameter Distribution
- Positive Temperature Coefficient for Easy Parallel Operation
- Copacked with soft, fast recovery diode
- RoHS Compliant

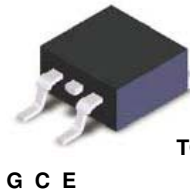


### General Description

Using the novel field stop 3rd generation IGBT technology, FGH40T65SPD-F085 offers the optimum performance with both low conduction loss and switching loss for a high efficiency operation in various applications, while provides 50V higher blocking voltage and rugged high current switching reliability. Meanwhile, this part also offers an advantage of outstanding performance in parallel operation.

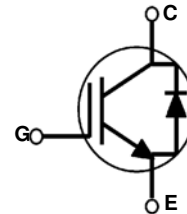
### Applications

- Onboard Charger
- AirCon Compressor
- PTC Heater
- Motor Drivers
- Other automotive power-train and auxiliary applications



TO-263AB/D<sup>2</sup>-PAK

← COLLECTOR (FLANGE)



### Absolute Maximum Ratings

Symbol	Description	Ratings	Units
$V_{CES}$	Collector to Emitter Voltage	650	V
$V_{GES}$	Gate to Emitter Voltage	$\pm 20$	V
	Transient Gate to Emitter Voltage	$\pm 30$	V
$I_C$	Collector Current @ $T_C = 25\text{ °C}$	80	A
	Collector Current @ $T_C = 100\text{ °C}$	40	A
$I_{CM}$	Pulsed Collector Current (Note 2)	120	A
$I_F$	Diode Forward Current @ $T_C = 25\text{ °C}$	40	A
	Diode Forward Current @ $T_C = 100\text{ °C}$	20	A
$I_{FM}$	Pulsed Diode Maximum Forward Current (Note 2)	120	A
$P_D$	Maximum Power Dissipation @ $T_C = 25\text{ °C}$	267	W
	Maximum Power Dissipation @ $T_C = 100\text{ °C}$	134	W
SCWT	Short Circuit Withstand Time @ $T_C = 25\text{ °C}$	5	$\mu\text{s}$
$T_J$	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:  $V_{CC} = 400\text{ V}$ ,  $V_{GE} = 15\text{ V}$ ,  $I_C = 120\text{ A}$ ,  $R_G = 20\ \Omega$ , Inductive Load
- 2: Repetitive rating; pulse width limited by max. junction temperature

## Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Qty per Reel
FGB40T65SPD	FGB40T65SPD-F085	TO-263AB/D2-PAK	-	-	800ea

## Electrical Characteristics of the IGBT T<sub>C</sub> = 25 °C unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
<b>Off Characteristics</b>						
$BV_{CES}$	Collector to Emitter Breakdown Voltage	$V_{GE} = 0V, I_C = 1mA$	650	-	-	V
$\frac{\Delta BV_{CES}}{\Delta T_J}$	Temperature Coefficient of Breakdown Voltage	$V_{GE} = 0V, I_C = 1mA$	-	0.6	-	V/°C
$I_{CES}$	Collector Cut-Off Current	$V_{CE} = V_{CES}, V_{GE} = 0V$	-	-	250	μA
$I_{GES}$	G-E Leakage Current	$V_{GE} = V_{GES}, V_{CE} = 0V$	-	-	± 400	nA
<b>On Characteristics</b>						
$V_{GE(th)}$	G-E Threshold Voltage	$I_C = 40mA, V_{CE} = V_{GE}$	4.0	5.8	7.5	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C = 40A, V_{GE} = 15V$	-	2.0	2.4	V
		$I_C = 40A, V_{GE} = 15V, T_C = 175 °C$	-	2.9	-	V
<b>Dynamic Characteristics</b>						
$C_{ies}$	Input Capacitance	$V_{CE} = 30V, V_{GE} = 0V, f = 1MHz$	-	1520	-	pF
$C_{oes}$	Output Capacitance		-	92	-	pF
$C_{res}$	Reverse Transfer Capacitance		-	15	-	pF
<b>Switching Characteristics</b>						
$T_{d(on)}$	Turn-On Delay Time	$V_{CC} = 400V, I_C = 40A, R_G = 6\Omega, V_{GE} = 15V, \text{Inductive Load}, T_C = 25 °C$	-	18	-	ns
$T_r$	Rise Time		-	26	-	ns
$T_{d(off)}$	Turn-Off Delay Time		-	35	-	ns
$T_f$	Fall Time		-	10	-	ns
$E_{on}$	Turn-On Switching Loss		-	0.97	-	mJ
$E_{off}$	Turn-Off Switching Loss		-	0.28	-	mJ
$E_{ts}$	Total Switching Loss		-	1.25	-	mJ
$T_{d(on)}$	Turn-On Delay Time	$V_{CC} = 400V, I_C = 40A, R_G = 6\Omega, V_{GE} = 15V, \text{Inductive Load}, T_C = 175 °C$	-	14	-	ns
$T_r$	Rise Time		-	35	-	ns
$T_{d(off)}$	Turn-Off Delay Time		-	38	-	ns
$T_f$	Fall Time		-	13	-	ns
$E_{on}$	Turn-On Switching Loss		-	1.61	-	mJ
$E_{off}$	Turn-Off Switching Loss		-	0.47	-	mJ
$E_{ts}$	Total Switching Loss		-	2.08	-	mJ
$T_{SC}$	Short Circuit Withstand Time	$V_{CC} = 400V, V_{GE} = 15V, R_G = 10\Omega$	5	-	-	μs

### Electrical Characteristics of the IGBT (Continued)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max	Units
$Q_g$	Total Gate Charge	$V_{CE} = 400V, I_C = 40A,$ $V_{GE} = 15V$	-	36	-	nC
$Q_{ge}$	Gate to Emitter Charge		-	12	-	nC
$Q_{gc}$	Gate to Collector Charge		-	11	-	nC

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max	Units	
$V_{FM}$	Diode Forward Voltage	$I_F = 20A$	$T_C = 25^\circ C$	-	2.0	2.7	V
			$T_C = 175^\circ C$	-	1.8	-	
$E_{rec}$	Reverse Recovery Energy	$I_F = 20A,$ $dI_F/dt = 200A/\mu s$	$T_C = 175^\circ C$	-	51	-	$\mu J$
$T_{rr}$	Diode Reverse Recovery Time		$T_C = 25^\circ C$	-	34	-	ns
			$T_C = 175^\circ C$	-	206	-	
$Q_{rr}$	Diode Reverse Recovery Charge		$T_C = 25^\circ C$	-	56	-	nC
		$T_C = 175^\circ C$	-	731	-		

### Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}(IGBT)$	Thermal Resistance, Junction to Case	-	0.56	$^\circ C/W$
$R_{\theta JC}(Diode)$	Thermal Resistance, Junction to Case	-	1.71	$^\circ C/W$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	-	40	$^\circ C/W$

## Typical Performance Characteristics

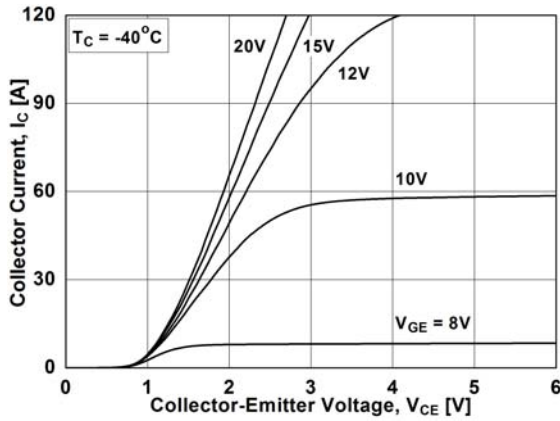


Figure 1. Typical Output Characteristics

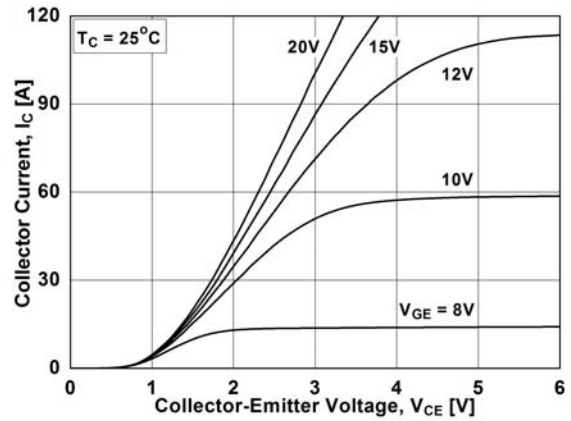


Figure 2. Typical Output Characteristics

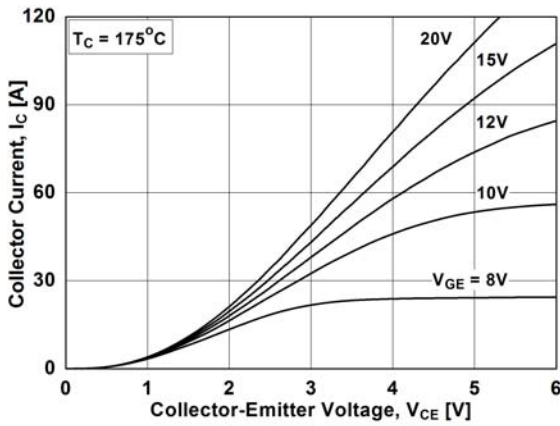


Figure 3. Typical Output Characteristics

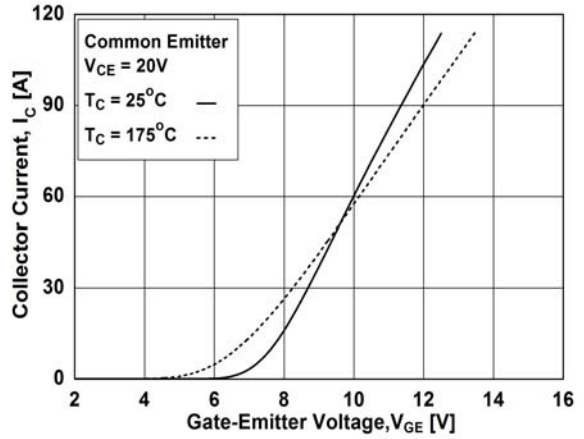


Figure 4. Transfer Characteristic

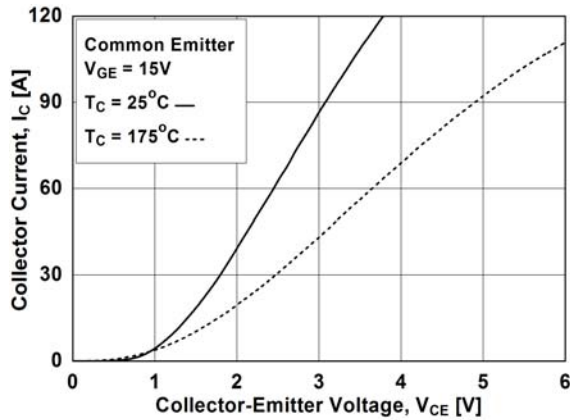


Figure 5. Typical Saturation Voltage

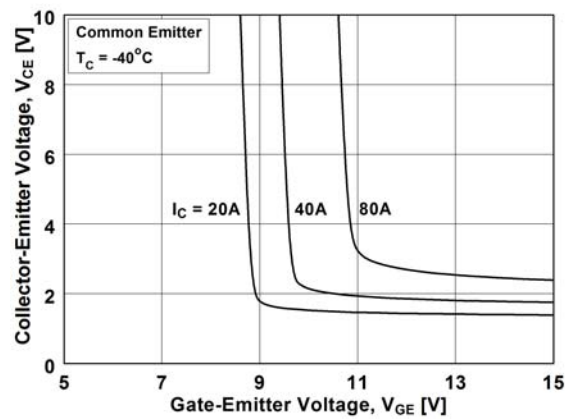
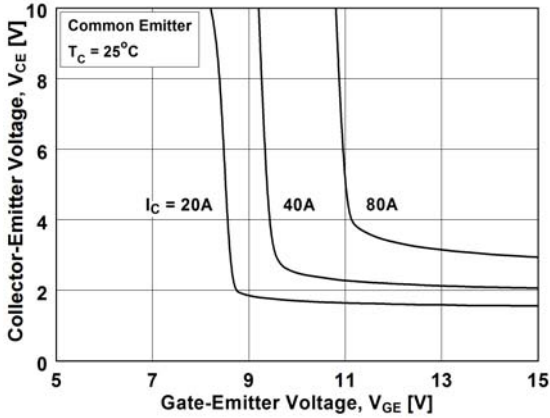
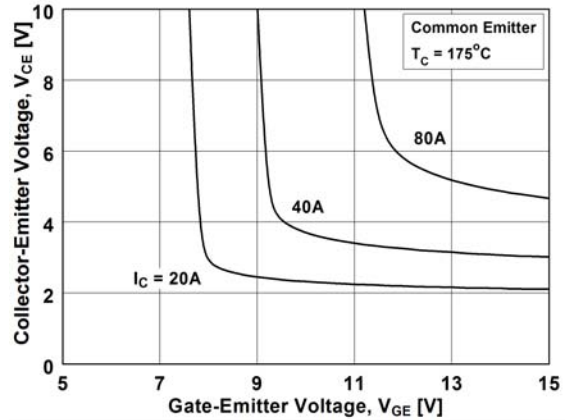


Figure 6. Saturation Voltage vs.  $V_{GE}$  Characteristics

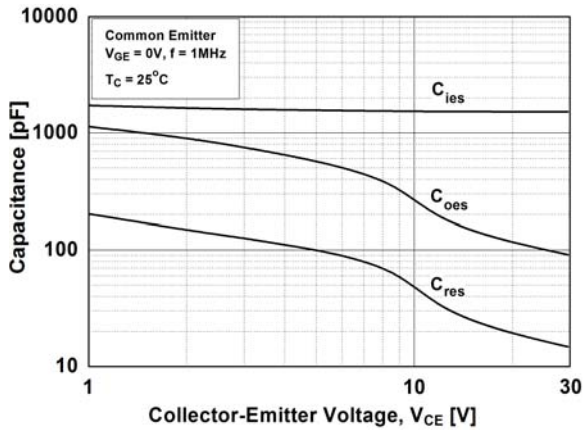
**Typical Performance Characteristics**



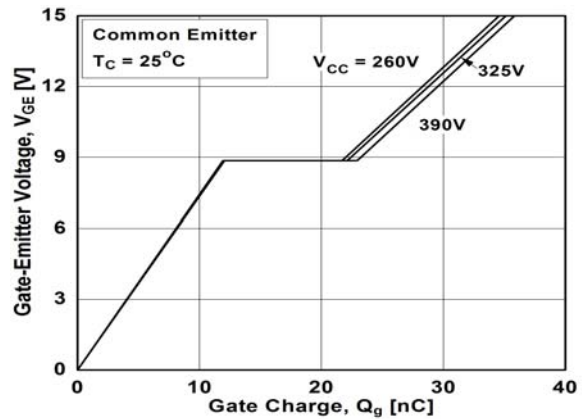
**Figure 7. Saturation Voltage vs.  $V_{GE}$**



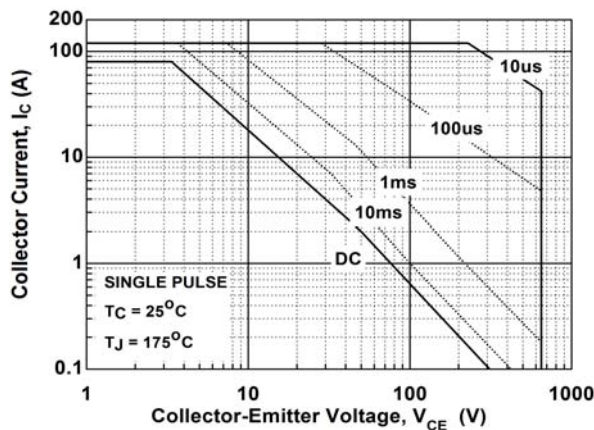
**Figure 8. Saturation Voltage vs.  $V_{GE}$**



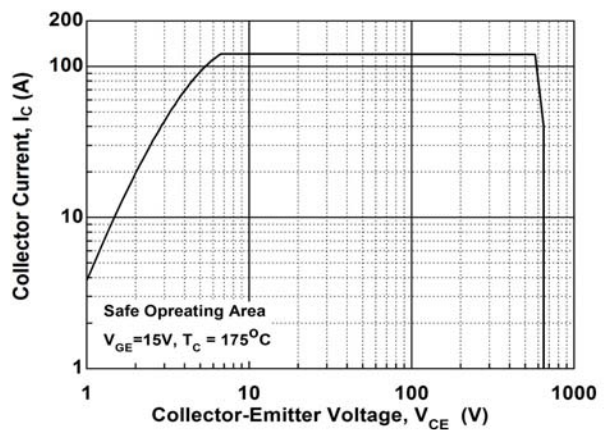
**Figure 9. Capacitance Characteristics**



**Figure 10. Gate charge Characteristics**



**Figure 11. SOA Characteristics**



**Figure 12. Turn off Switching SOA Characteristics**

## Typical Performance Characteristics

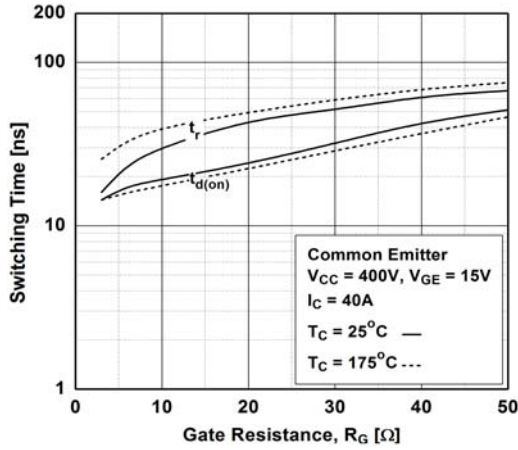


Figure 13. Turn-on Characteristics vs. Gate Resistance

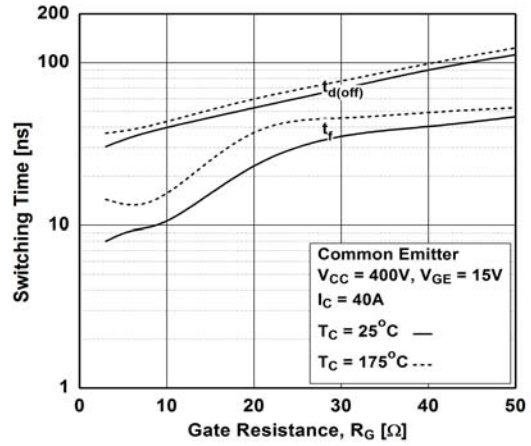


Figure 14. Turn-off Characteristics vs. Gate Resistance

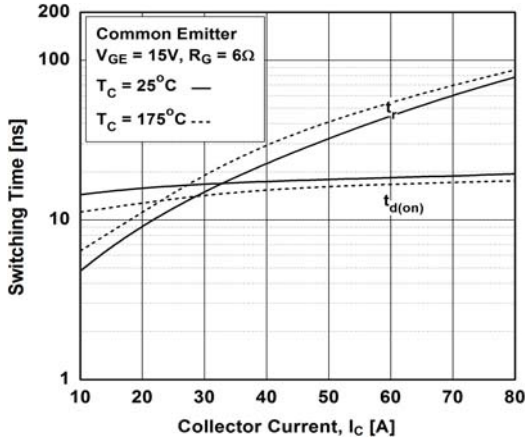


Figure 15. Turn-on Characteristics vs. Collector Current

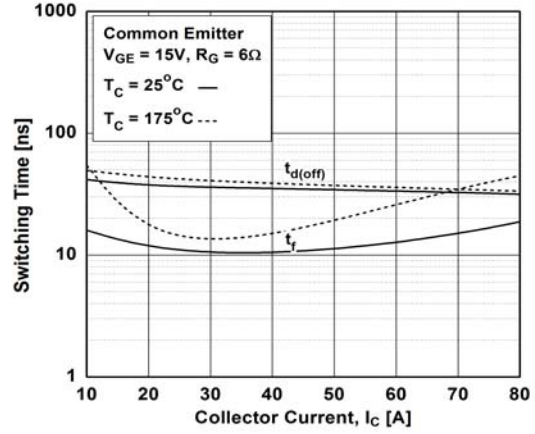


Figure 16. Turn-off Characteristics vs. Collector Current

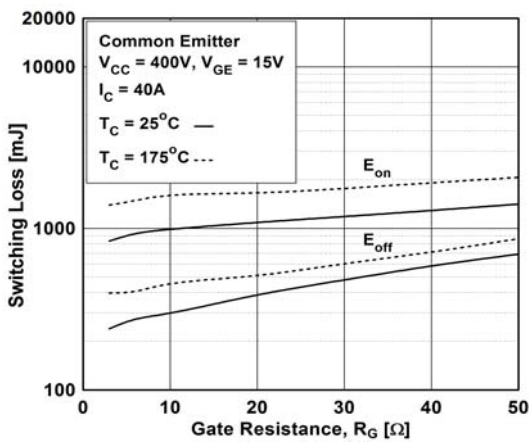


Figure 17. Switching Loss vs Gate Resistance

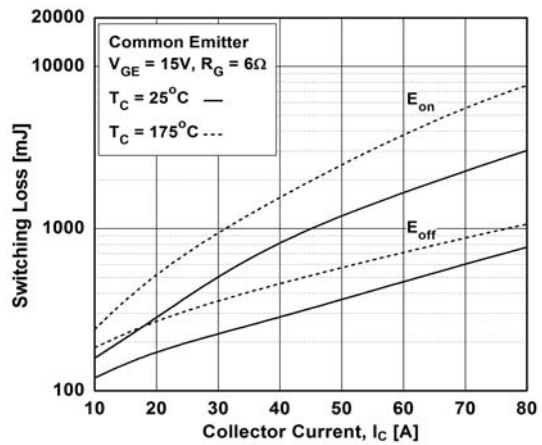


Figure 18. Switching Loss vs Collector Current

## Typical Performance Characteristics

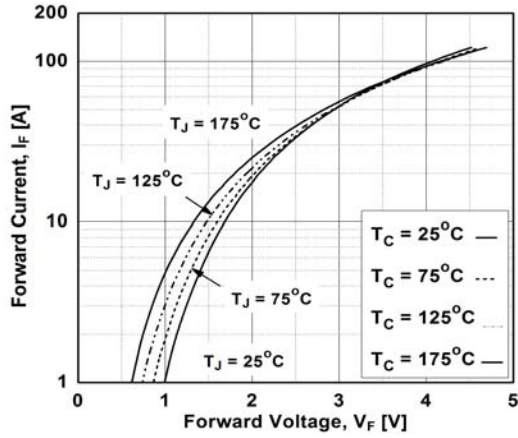


Figure 19. Forward Characteristics

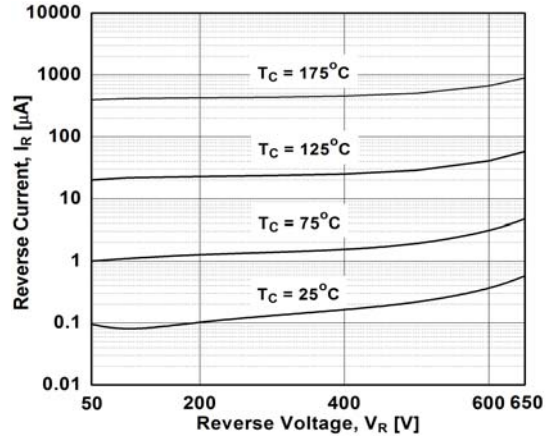


Figure 20. Reverse Current

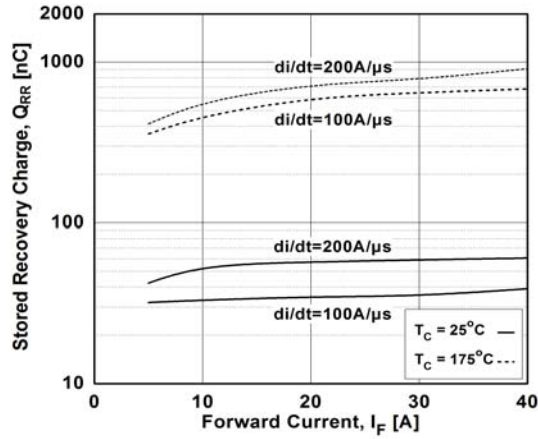


Figure 21. Stored Charge

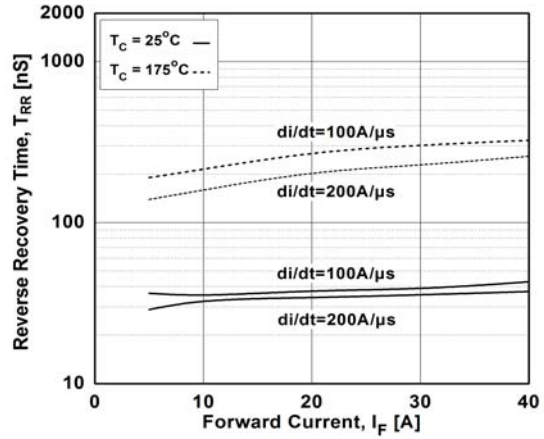


Figure 22. Reverse Recovery Time

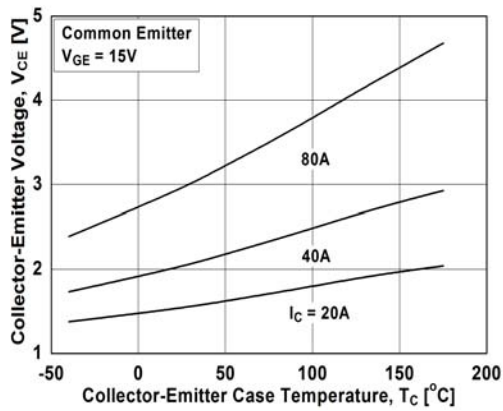


Figure 23. Saturation Voltage vs. Case Temperature at Variant Current Level

Typical Performance Characteristics

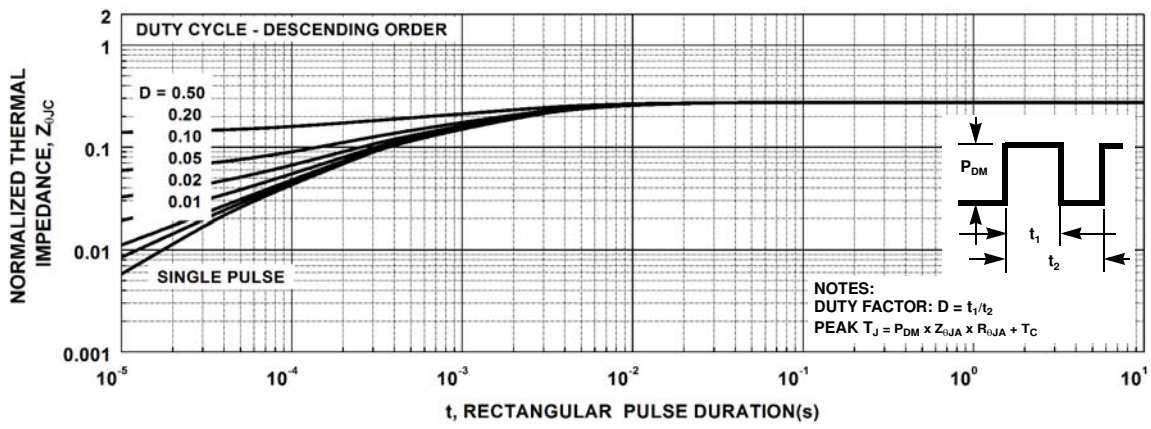


Figure 24. Transient Thermal Impedance of IGBT

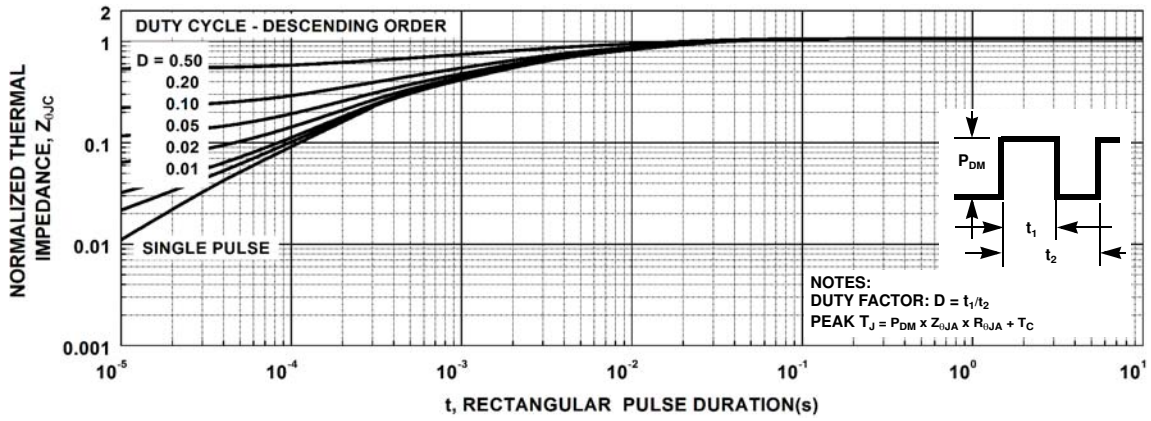



Figure 25. Transient Thermal Impedance of Diode



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