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# FGY160T65SPD\_F085

## 650V, 160A Field Stop Trench IGBT With Soft Fast Recovery Diode

### Features

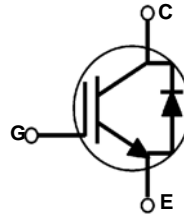
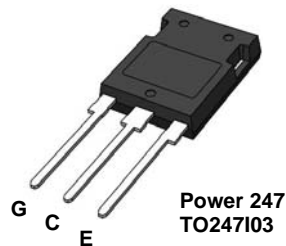
- Automotive Qualified
- Very low saturation voltage :  $V_{CE(sat)} = 1.6 \text{ V(Typ.)} @ I_C = 160 \text{ A}$
- Maximum junction temperature :  $T_J = 175 \text{ }^\circ\text{C}$
- Positive temperature Co-efficient
- Tight parameter distribution
- High input impedance
- 100% of the parts are dynamically tested
- Short circuit ruggedness  $> 6 \mu\text{s} @ 25 \text{ }^\circ\text{C}$
- Copacked with soft, fast recovery Extremerfast diode

### Benefits

- Very Low conduction and switching losses for a high efficiency operation in various applications
- Rugged transient reliability
- Outstanding parallel operation performance with balance current sharing
- Low EMI

### Applications

- Traction inverter for HEV/EV
- Auxiliary DC/AC converter
- Motor drives
- Other power-train applications requiring high power switch



### Absolute Maximum Ratings

Symbol	Description	Ratings	Units	
$V_{CES}$	Collector to Emitter Voltage	650	V	
$V_{GES}$	Gate to Emitter Voltage	$\pm 20$	V	
$I_C$	Collector Current (Note1)	@ $T_C = 25 \text{ }^\circ\text{C}$	240	A
	Collector Current	@ $T_C = 100 \text{ }^\circ\text{C}$	220	A
$I_{Nominal}$	Nominal Current	160	A	
$I_{CM}$	Pulsed Collector Current	480	A	
$I_F$	Diode Forward Current (Note1)	@ $T_C = 25 \text{ }^\circ\text{C}$	240	A
	Diode Forward Current	@ $T_C = 100 \text{ }^\circ\text{C}$	188	A
$P_D$	Maximum Power Dissipation	@ $T_C = 25 \text{ }^\circ\text{C}$	882	W
	Maximum Power Dissipation	@ $T_C = 100 \text{ }^\circ\text{C}$	441	W
SCWT	Short Circuit Withstand Time	@ $T_C = 25 \text{ }^\circ\text{C}$	6	$\mu\text{s}$
dV/dt	Voltage Transient Ruggedness (Note2)	10	V/ns	
$T_J$	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: Limited by bondwire
- 2:  $V_{CC} = 400 \text{ V}$ ,  $V_{GE} = 15 \text{ V}$ ,  $I_{CE} = 480 \text{ A}$ , Inductive Load

FGY160T65SPD\_F085 650V 160A Field Stop Trench IGBT With Soft Fast Recovery Diode

## Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$ (IGBT)	Thermal Resistance, Junction to Case	-	0.17	$^{\circ}\text{C}/\text{W}$
$R_{\theta JC}$ (Diode)	Thermal Resistance, Junction to Case	-	0.32	$^{\circ}\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	-	40	$^{\circ}\text{C}/\text{W}$

## Package Marking and Ordering Information

Device Marking	Device	Package	Packing Type	Qty per Tube
FGY160T65SPD	FGY160T65SPD_F085	TP-247	Tube	30ea

For Fairchild's definition of "green" Eco Status, please visit: [http://www.fairchildsemi.com/company/green/rohs\\_green.html](http://www.fairchildsemi.com/company/green/rohs_green.html).

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
<b>Off Characteristics</b>						
$BV_{CES}$	Collector to Emitter Breakdown Voltage	$V_{GE} = 0\text{V}, I_C = 1\text{mA}$	650	-	-	V
$\Delta BV_{CES} / \Delta T_J$	Temperature Coefficient of Breakdown Voltage	$V_{GE} = 0\text{V}, I_C = 1\text{mA}$	-	0.6	-	$\text{V}/^{\circ}\text{C}$
$I_{CES}$	Collector Cut-Off Current	$V_{CE} = V_{CES}, V_{GE} = 0\text{V}$	-	-	40	$\mu\text{A}$
$I_{GES}$	G-E Leakage Current	$V_{GE} = V_{GES}, V_{CE} = 0\text{V}$	-	-	$\pm 250$	nA
<b>On Characteristics</b>						
$V_{GE(th)}$	G-E Threshold Voltage	$I_C = 160\text{mA}, V_{CE} = V_{GE}$	4.3	5.3	6.3	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C = 160\text{A}, V_{GE} = 15\text{V}$	-	1.6	2.05	V
		$I_C = 160\text{A}, V_{GE} = 15\text{V}, T_J = 175^{\circ}\text{C}$	-	2.15	-	V
<b>Dynamic Characteristics</b>						
$C_{ies}$	Input Capacitance	$V_{CE} = 30\text{V}, V_{GE} = 0\text{V}, f = 1\text{MHz}$	-	6710	-	pF
$C_{oes}$	Output Capacitance		-	450	-	pF
$C_{res}$	Reverse Transfer Capacitance		-	55	-	pF
$R_G$	Internal Gate Resistance	$f = 1\text{MHz}$	-	3	-	$\Omega$
<b>Switching Characteristics</b>						
$T_{d(on)}$	Turn-On Delay Time	$V_{CC} = 400\text{V}, I_C = 160\text{A}, R_G = 5\Omega, V_{GE} = 15\text{V}, \text{Inductive Load}, T_J = 25^{\circ}\text{C}$	-	53	-	ns
$T_r$	Rise Time		-	197	-	ns
$T_{d(off)}$	Turn-Off Delay Time		-	98	-	ns
$T_f$	Fall Time		-	141	-	ns
$E_{on}$	Turn-On Switching Loss		-	12.4	-	mJ
$E_{off}$	Turn-Off Switching Loss		-	5.7	-	mJ
$E_{ts}$	Total Switching Loss		-	18.1	-	mJ
$T_{d(on)}$	Turn-On Delay Time	$V_{CC} = 400\text{V}, I_C = 160\text{A}, R_G = 5\Omega, V_{GE} = 15\text{V}, \text{Inductive Load}, T_J = 175^{\circ}\text{C}$	-	52	-	ns
$T_r$	Rise Time		-	236	-	ns
$T_{d(off)}$	Turn-Off Delay Time		-	104	-	ns
$T_f$	Fall Time		-	204	-	ns
$E_{on}$	Turn-On Switching Loss		-	21	-	mJ
$E_{off}$	Turn-Off Switching Loss		-	8.5	-	mJ
$E_{ts}$	Total Switching Loss		-	29.5	-	mJ

### Electrical Characteristics of the IGBT (Continued)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max	Units
$Q_g$	Total Gate Charge	$V_{CE} = 400V, I_C = 160A,$ $V_{GE} = 15V$	-	163	245	nC
$Q_{ge}$	Gate to Emitter Charge		-	50	-	nC
$Q_{gc}$	Gate to Collector Charge		-	49	-	nC

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max	Units	
$V_{FM}$	Diode Forward Voltage	$I_F = 160A$	$T_J = 25\text{ }^\circ\text{C}$	-	1.4	1.7	V
			$T_J = 175\text{ }^\circ\text{C}$	-	1.35	-	
$E_{rec}$	Reverse Recovery Energy	$V_{CE} = 400V, I_F = 160A,$ $di_F/dt = 1000A/\mu s$	$T_J = 25\text{ }^\circ\text{C}$	-	598	-	$\mu J$
			$T_J = 175\text{ }^\circ\text{C}$	-	4000	-	
$T_{rr}$	Diode Reverse Recovery Time	$V_{CE} = 400V, I_F = 160A,$ $di_F/dt = 1000A/\mu s$	$T_J = 25\text{ }^\circ\text{C}$	-	132	-	ns
			$T_J = 175\text{ }^\circ\text{C}$	-	245	-	
$Q_{rr}$	Diode Reverse Recovery Charge	$V_{CE} = 400V, I_F = 160A,$ $di_F/dt = 1000A/\mu s$	$T_J = 25\text{ }^\circ\text{C}$	-	3.3	-	$\mu C$
			$T_J = 175\text{ }^\circ\text{C}$	-	12.5	-	

## Typical Performance Characteristics

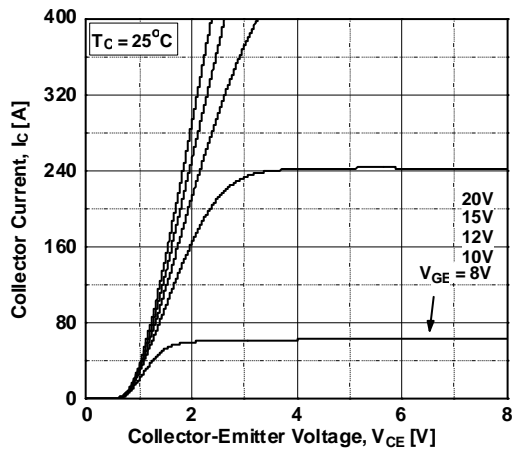


Figure 1. Typical Output Characteristics

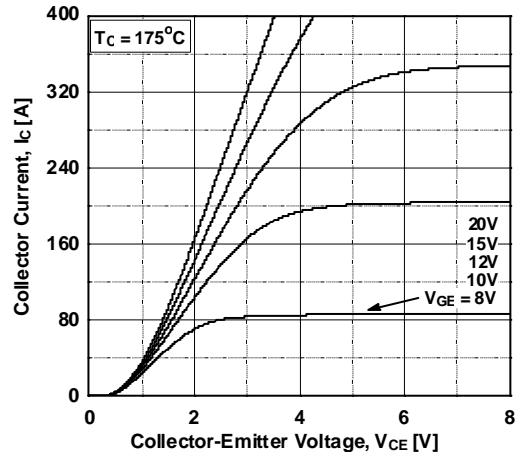


Figure 2. Typical Output Characteristics

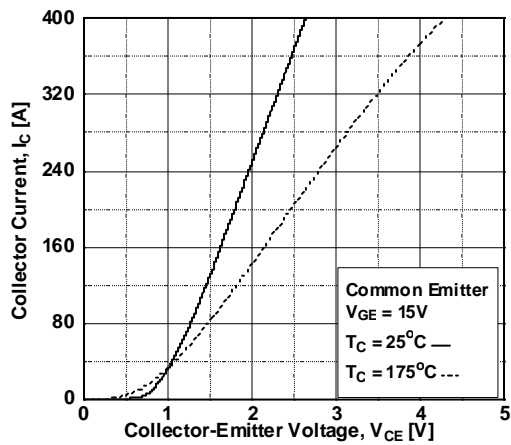


Figure 3. Typical Saturation Voltage

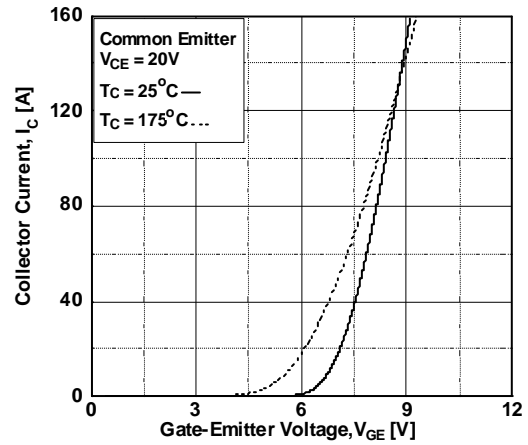


Figure 4. Transfer Characteristics

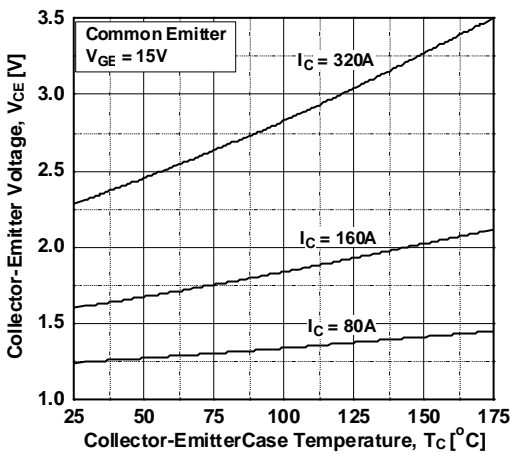


Figure 5. Saturation Voltage vs. Case Temperature at Variant Current Level

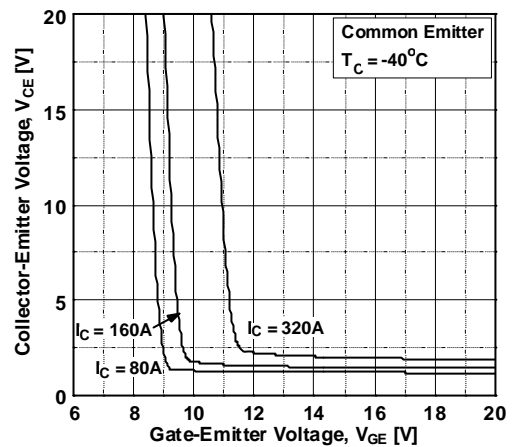


Figure 6. Saturation Voltage vs. VGE

### Typical Performance Characteristics

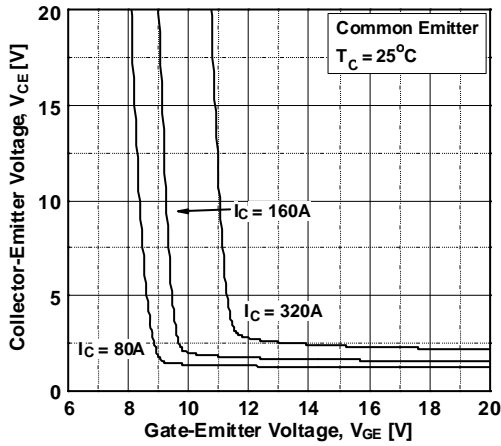


Figure 7. Saturation Voltage vs. VGE

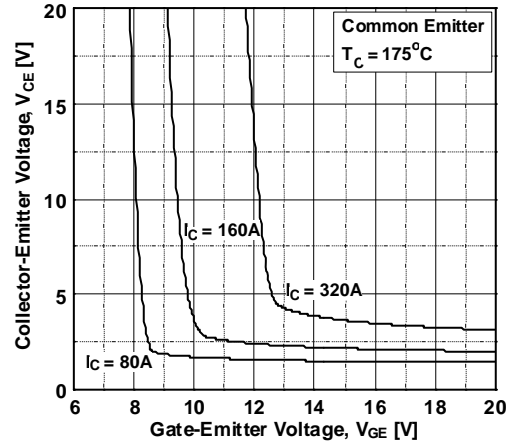


Figure 8. Saturation Voltage vs. VGE

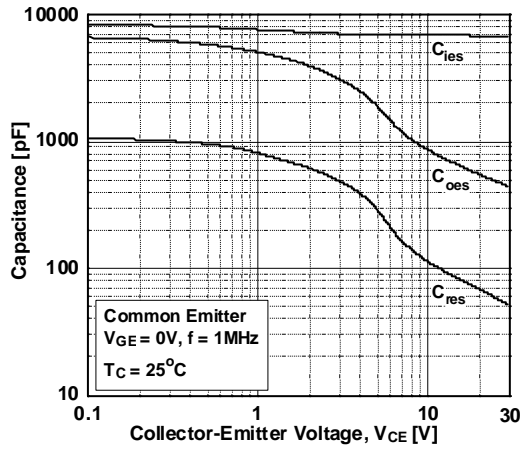


Figure 9. Capacitance Characteristics

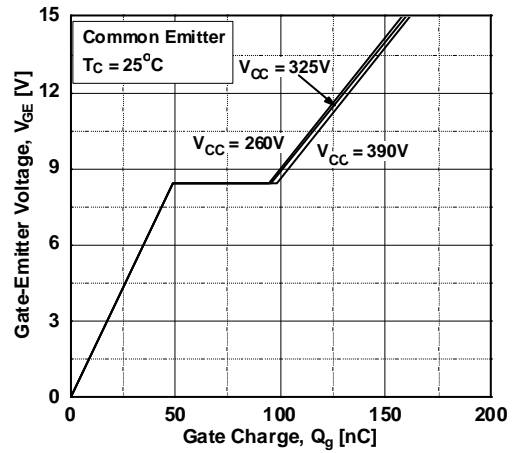


Figure 10. Gate Charge Characteristics

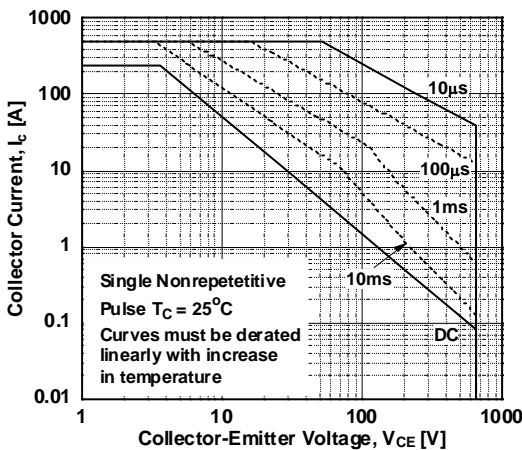


Figure 11. SOA Characteristics

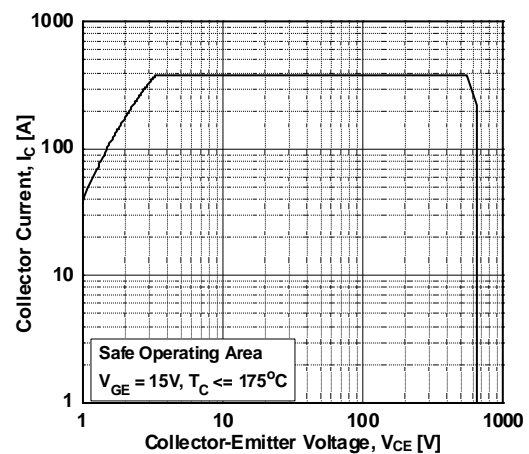


Figure 12. Turn off Switching SOA Characteristics

### Typical Performance Characteristics

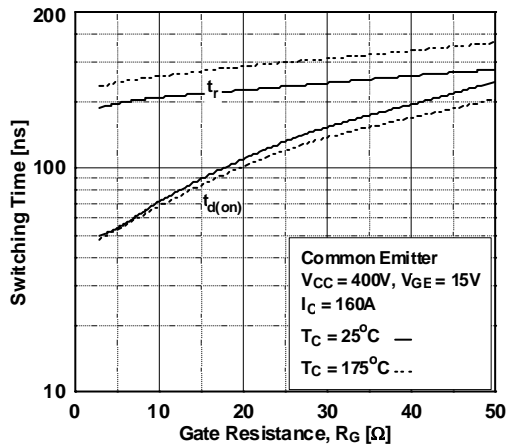


Figure 13. Turn-on Charateristics vs. Gate

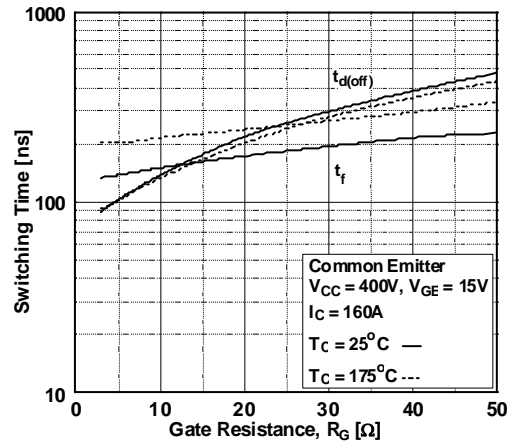


Figure 14. Turn-off Charateristics vs. Gate

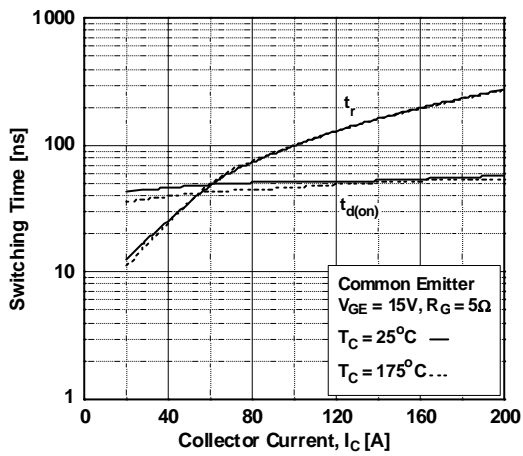


Figure 15. Turn-on Charateristics vs. Collector Current

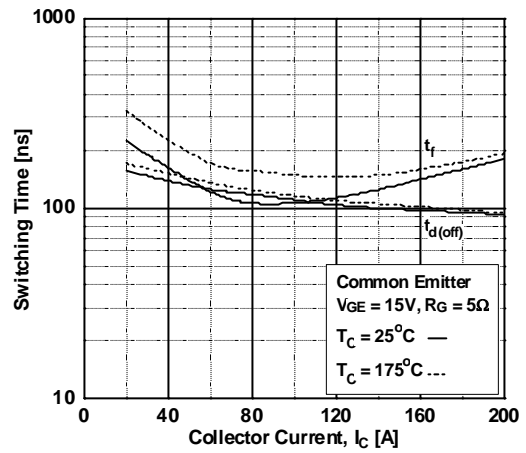


Figure 16. Turn-off Charateristics vs. Collector Current

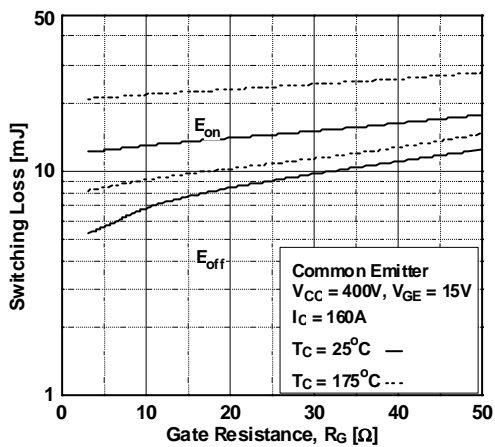


Figure 17. Switching Loss vs. Gate Resistance

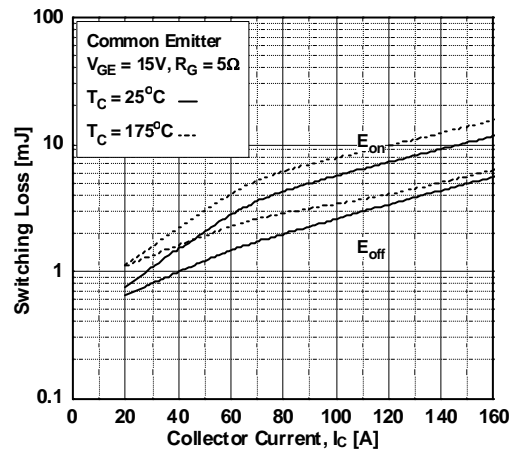


Figure 18. Switching Loss vs. Collector Current

### Typical Performance Characteristics

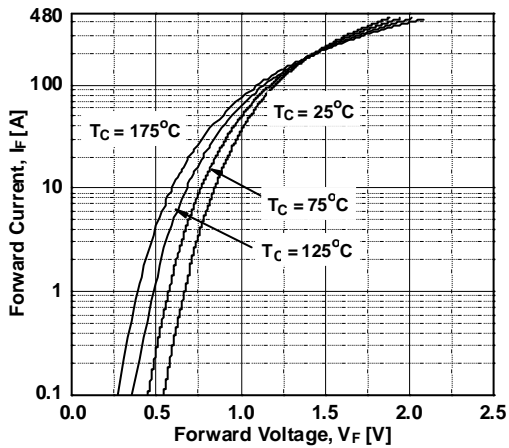


Figure 19. Forward Characteristics

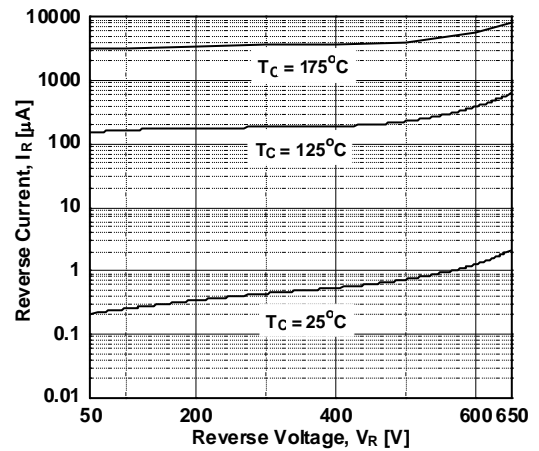


Figure 20. Reverse Current

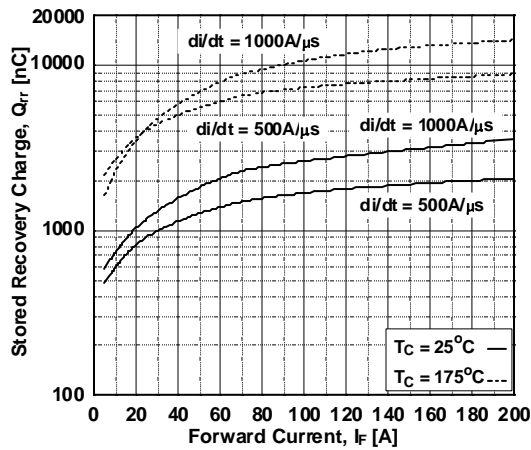


Figure 21. Stored Charge

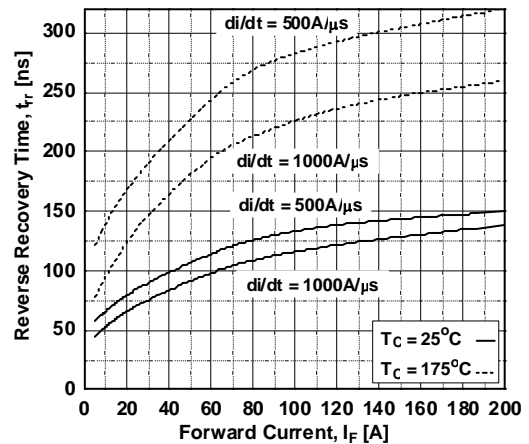


Figure 22. Reverse Recovery Time

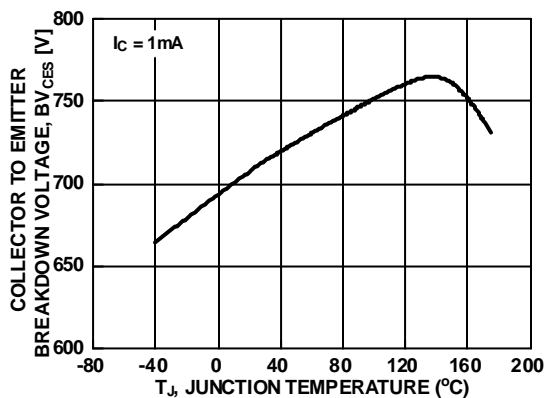


Figure 23. Collector to Emitter Breakdown Voltage vs. Junction Temperature



### Typical Performance Characteristics

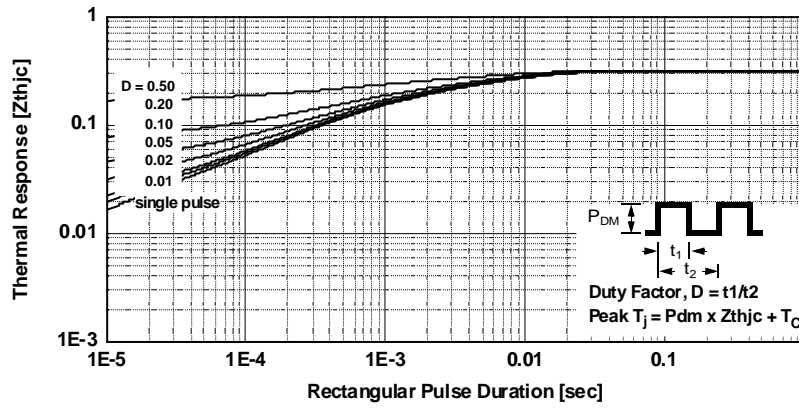


Figure 24. Transient Thermal Impedance of Diode

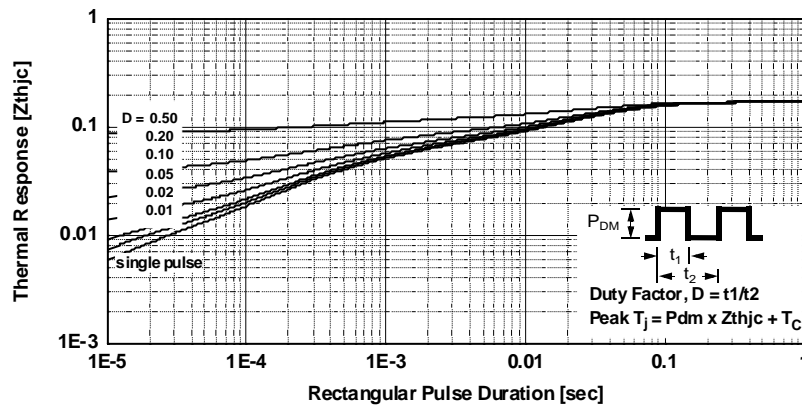
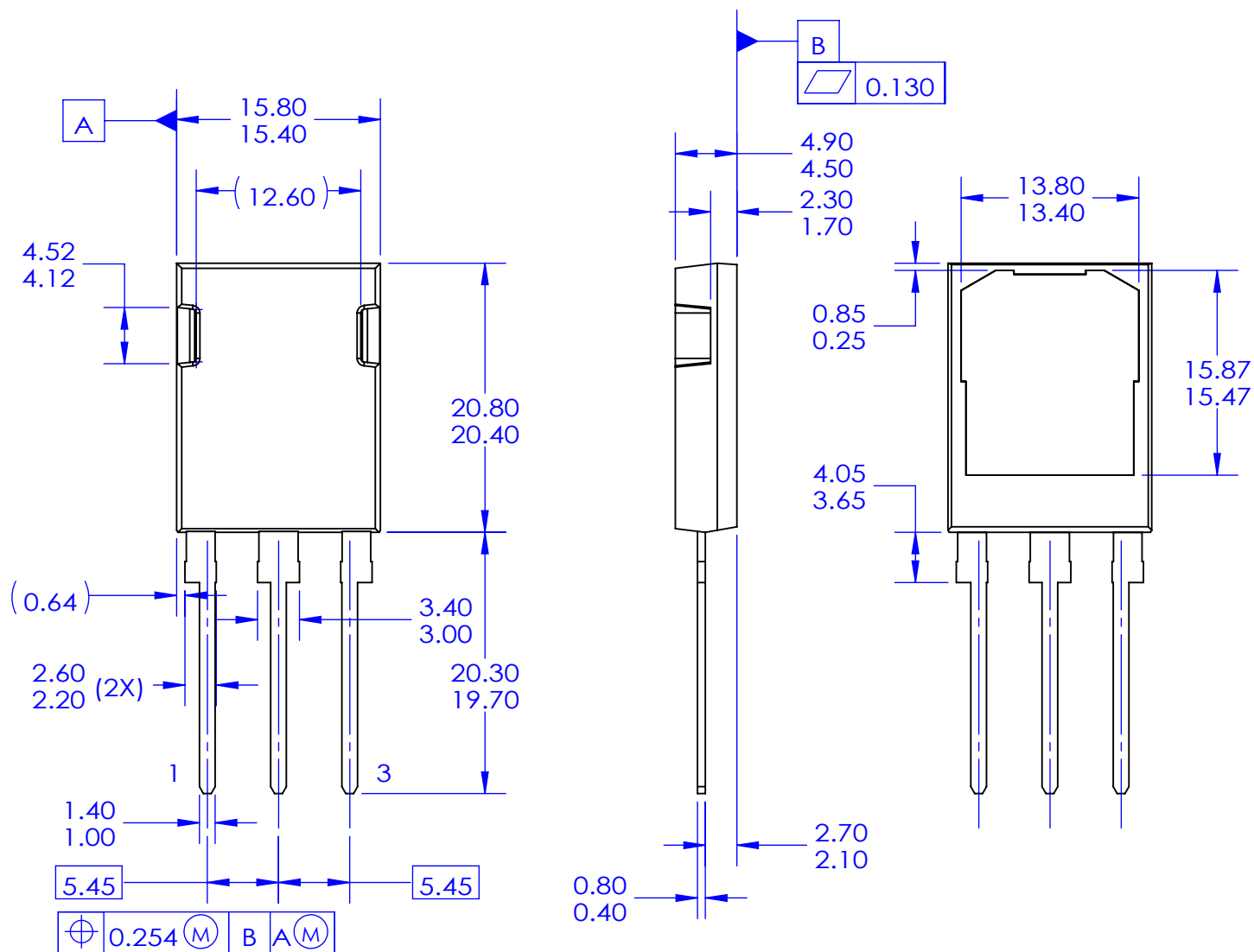


Figure 25. Transient Thermal Impedance of IGBT



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