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# FGD3N60UNDF

## 600 V, 3 A

### Short Circuit Rated IGBT



#### Features

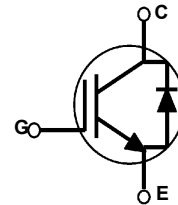
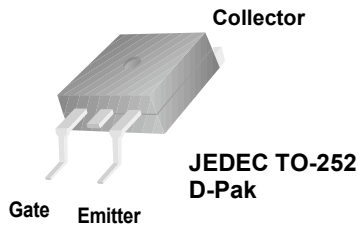
- Short Circuit Rated 10us
- High Current Capability
- High Input Impedance
- Fast Switching
- RoHS Compliant

#### Applications

- Sewing Machine, CNC, Home Appliances, Motor Control

#### General Description

Using advanced NPT IGBT technology, Fairchild®'s the NPT IGBTs offer the optimum performance for low-power inverter-driven applications where low-losses and short-circuit ruggedness features are essential.



#### Absolute Maximum Ratings

Symbol	Description	Ratings	Unit
$V_{CES}$	Collector to Emitter Voltage	600	V
$V_{GES}$	Gate to Emitter Voltage	$\pm 20$	V
$I_C$	Collector Current @ $T_C = 25^\circ\text{C}$	6	A
	Collector Current @ $T_C = 100^\circ\text{C}$	3	A
$I_{CM(1)}$	Pulsed Collector Current @ $T_C = 25^\circ\text{C}$	9	A
$I_F$	Diode Forward Current @ $T_C = 25^\circ\text{C}$	3	A
$P_D$	Maximum Power Dissipation @ $T_C = 25^\circ\text{C}$	60	W
	Maximum Power Dissipation @ $T_C = 100^\circ\text{C}$	24	W
$T_J$	Operating Junction Temperature	-55 to +150	$^\circ\text{C}$
$T_{stg}$	Storage Temperature Range	-55 to +150	$^\circ\text{C}$
$T_L$	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.	Unit
$R_{\theta JC}(\text{IGBT})$	Thermal Resistance, Junction to Case		2.08	$^\circ\text{C/W}$
$R_{\theta JC}(\text{Diode})$	Thermal Resistance, Junction to Case		5.0	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (PCB Mount)(2)		150	$^\circ\text{C/W}$

**Notes:**

2: Mounted on 1" square PCB (FR4 or G-10 material)

## Package Marking and Ordering Information

Device Marking	Device	Package	Rel Size	Tape Width	Quantity
FGD3N60UNDF	FGD3N60UNDF	TO252	330mm	16mm	2500 units

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
<b>Off Characteristics</b>						
$BV_{CES}$	Collector to Emitter Breakdown Voltage	$V_{GE} = 0V, I_C = 250\mu A$	600	-	-	V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250\mu A$ , Referenced to 25°C	-	0.3	-	V/°C
$I_{CES}$	Collector Cut-Off Current	$V_{CE} = V_{CES}, V_{GE} = 0V$	-	-	1	mA
$I_{GES}$	G-E Leakage Current	$V_{GE} = V_{GES}, V_{CE} = 0V$	-	-	±10	uA
<b>On Characteristics</b>						
$V_{GE(th)}$	G-E Threshold Voltage	$I_C = 3mA, V_{CE} = V_{GE}$	5.5	6.8	8.5	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C = 3A, V_{GE} = 15V$	-	2.0	2.52	V
		$I_C = 3A, V_{GE} = 15V, T_C = 125^\circ C$	-	2.4	-	V
<b>Dynamic Characteristics</b>						
$C_{ies}$	Input Capacitance	$V_{CE} = 30V, V_{GE} = 0V, f = 1MHz$	-	165		pF
$C_{oes}$	Output Capacitance		-	28		pF
$C_{res}$	Reverse Transfer Capacitance		-	8.5		pF
<b>Switching Characteristics</b>						
$t_{d(on)}$	Turn-On Delay Time	$V_{CC} = 400V, I_C = 3A, R_G = 10\Omega, V_{GE} = 15V, \text{Inductive Load}, T_C = 25^\circ C$	-	5.5		ns
$t_r$	Rise Time		-	1.8		ns
$t_{d(off)}$	Turn-Off Delay Time		-	22		ns
$t_f$	Fall Time		-	91		ns
$E_{on}$	Turn-On Switching Loss		-	52		uJ
$E_{off}$	Turn-Off Switching Loss		-	30		uJ
$E_{ts}$	Total Switching Loss	-	82		uJ	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC} = 400V, I_C = 3A, R_G = 10\Omega, V_{GE} = 15V, \text{Inductive Load}, T_C = 125^\circ C$	-	4.8		ns
$t_r$	Rise Time		-	2.6		ns
$t_{d(off)}$	Turn-Off Delay Time		-	24		ns
$t_f$	Fall Time		-	122		ns
$E_{on}$	Turn-On Switching Loss		-	65		uJ
$E_{off}$	Turn-Off Switching Loss		-	44		uJ
$E_{ts}$	Total Switching Loss	-	109		uJ	
$T_{sc}$	Short Circuit Withstand Time	$V_{CC} = 350V, R_G = 100\Omega, V_{GE} = 15V, T_C = 150^\circ C$	10			us

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

$Q_g$	Total Gate Charge	$V_{CE} = 400\text{V}, I_C = 3\text{A},$ $V_{GE} = 15\text{V}$	-	1.6	-	nC
$Q_{ge}$	Gate to Emitter Charge		-	6.6	-	nC
$Q_{gc}$	Gate to Collector Charge		-	11.3	-	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	$I_F = 3\text{A}$	$T_C = 25^\circ\text{C}$	-	1.7	2.2	V
			$T_C = 125^\circ\text{C}$	-	1.6	-	
$t_{rr}$	Diode Reverse Recovery Time	$I_F = 3\text{A}, di_F/dt = 200\text{A}/\mu\text{s}$	$T_C = 25^\circ\text{C}$	-	21	-	ns
			$T_C = 125^\circ\text{C}$	-	31	-	
$Q_{rr}$	Diode Reverse Recovery Charge		$T_C = 25^\circ\text{C}$	-	23	-	nC
			$T_C = 125^\circ\text{C}$	-	49	-	

## Typical Performance Characteristics

Figure 1. Typical Output Characteristics

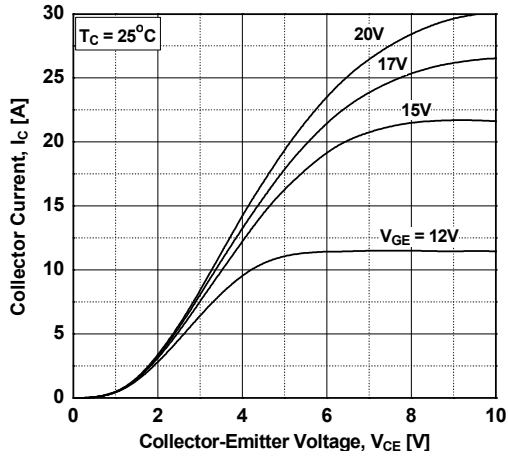


Figure 2. Typical Output Characteristics

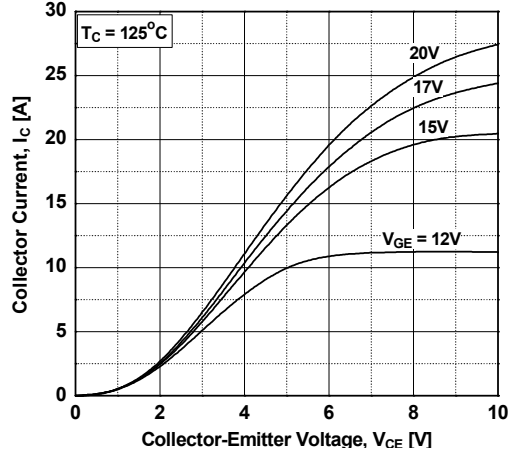


Figure 3. Typical Saturation Voltage Characteristics

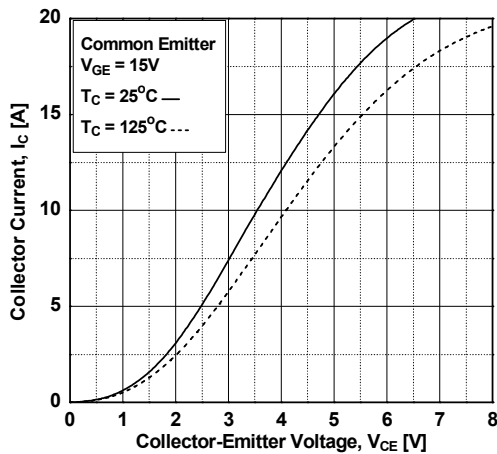


Figure 4. Transfer Characteristics

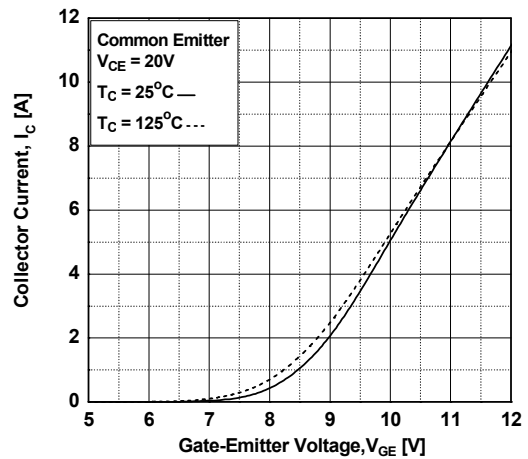


Figure 5. Saturation Voltage vs. Case Temperature at Variant Current Level

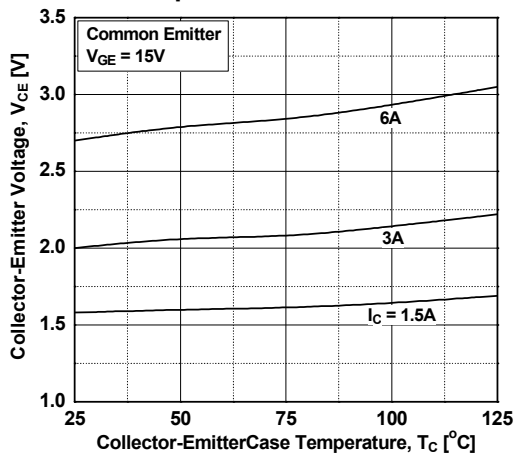
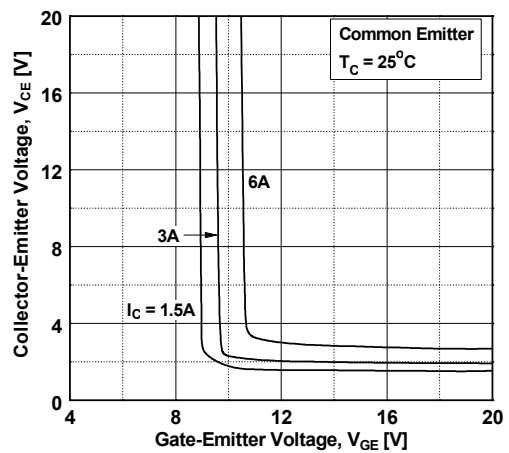
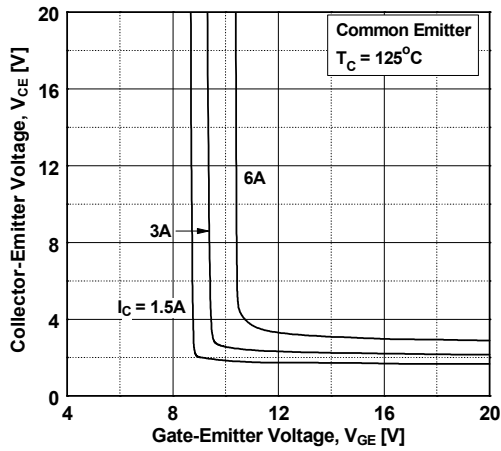


Figure 6. Saturation Voltage vs. Vge

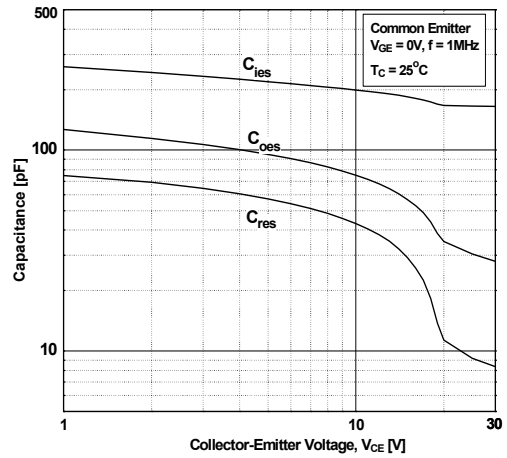


## Typical Performance Characteristics

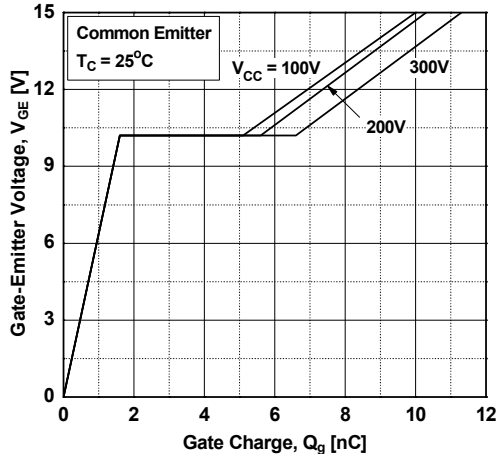
**Figure 7. Saturation Voltage vs.  $V_{GE}$**



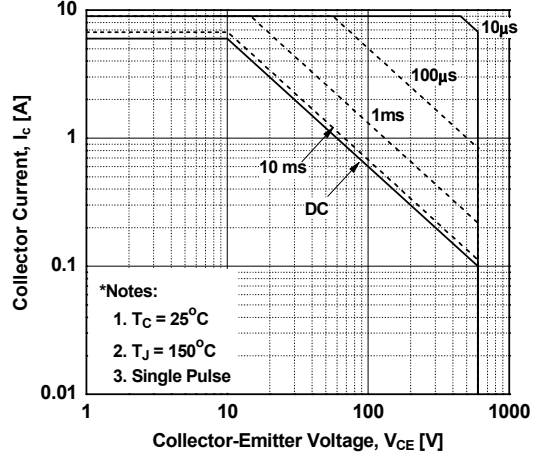
**Figure 8. Capacitance Characteristics**



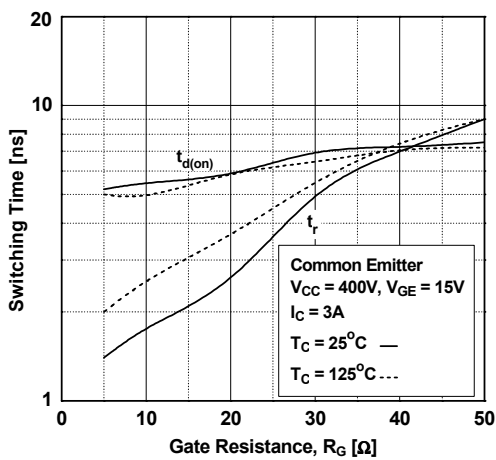
**Figure 9. Gate charge Characteristics**



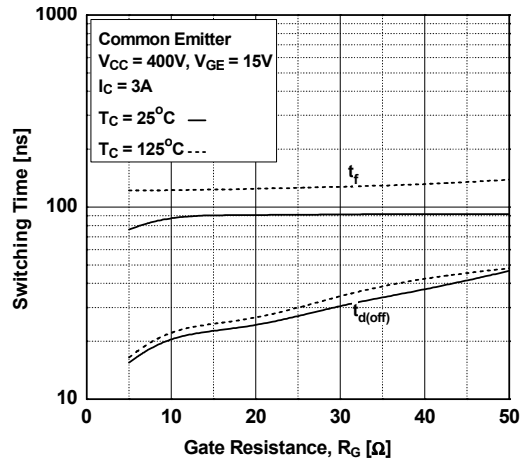
**Figure 10. SOA Characteristics**



**Figure 11. Turn-on Characteristics vs. Gate Resistance**

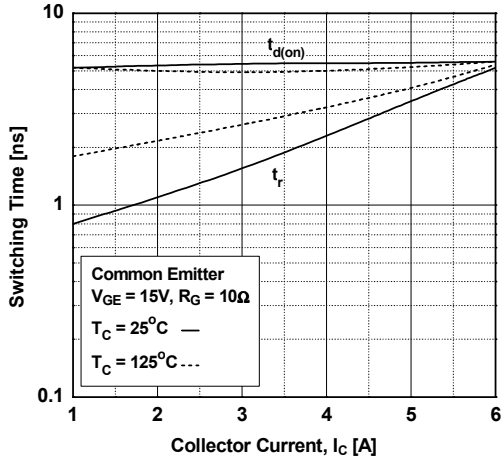


**Figure 12. Turn-off Characteristics vs. Gate Resistance**

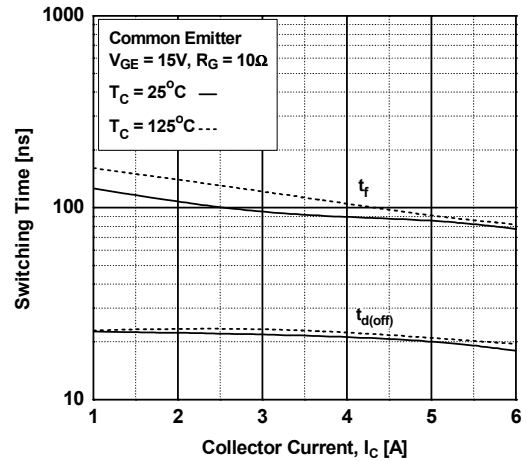


### Typical Performance Characteristics

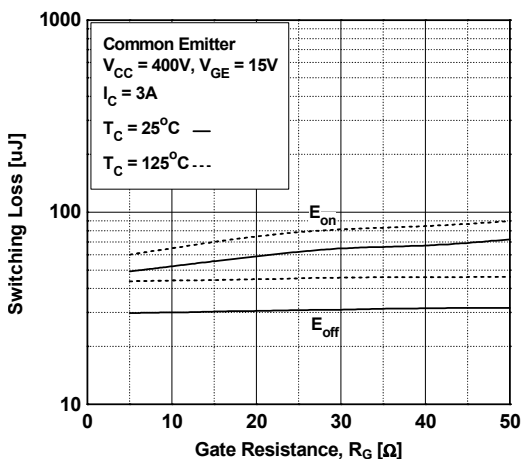
**Figure 13. Turn-on Characteristics vs. Collector Current**



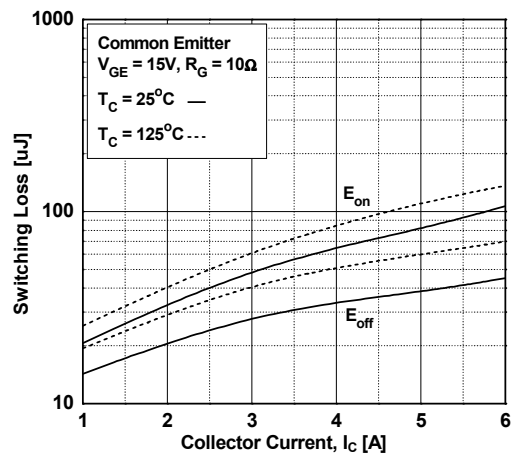
**Figure 14. Turn-off Characteristics vs. Collector Current**



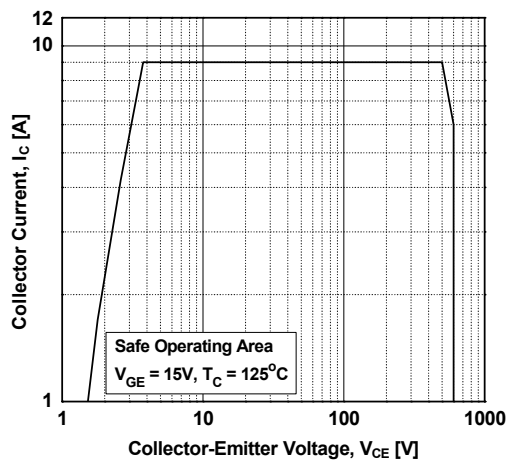
**Figure 15. Switching Loss vs. Gate Resistance**



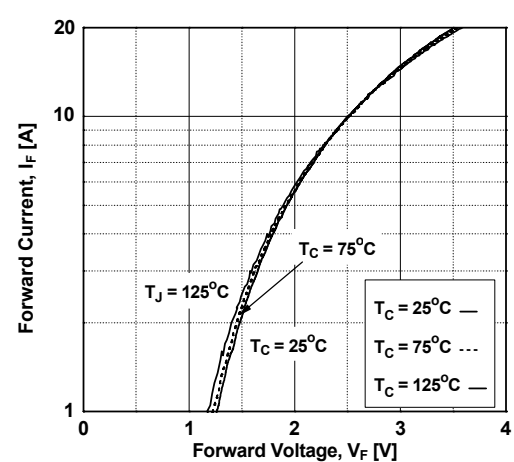
**Figure 16. Switching Loss vs. Collector Current**



**Figure 17. Turn off Switching SOA Characteristics**

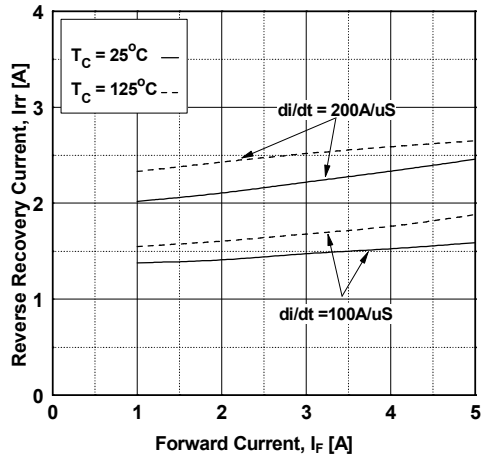


**Figure 18. Forward Characteristics**

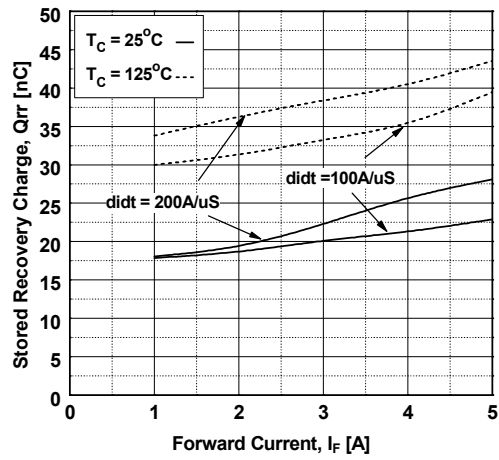


### Typical Performance Characteristics

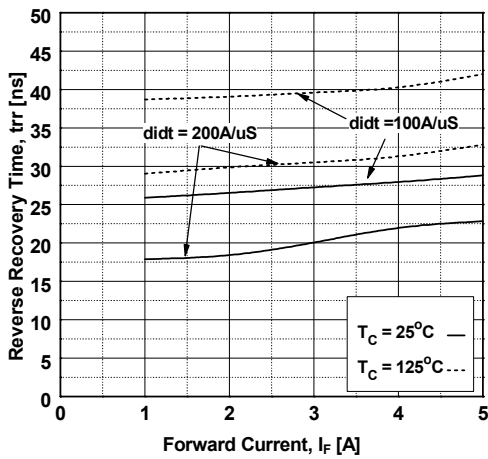
**Figure 19. Reverse Recovery Current**



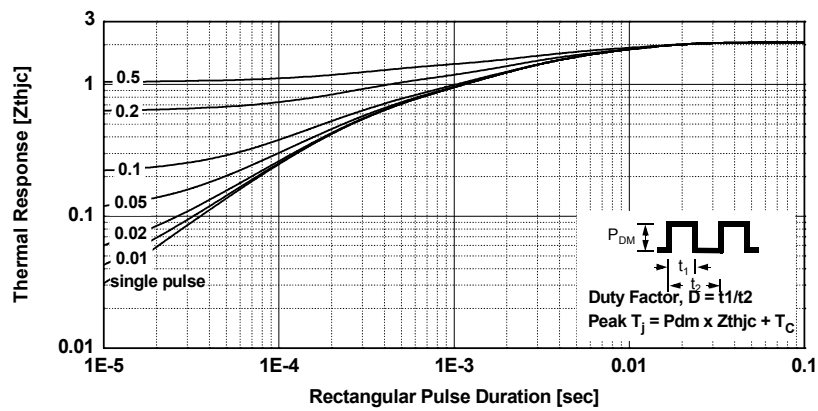
**Figure 20. Stored Charge**



**Figure 21. Reverse Recovery Time**



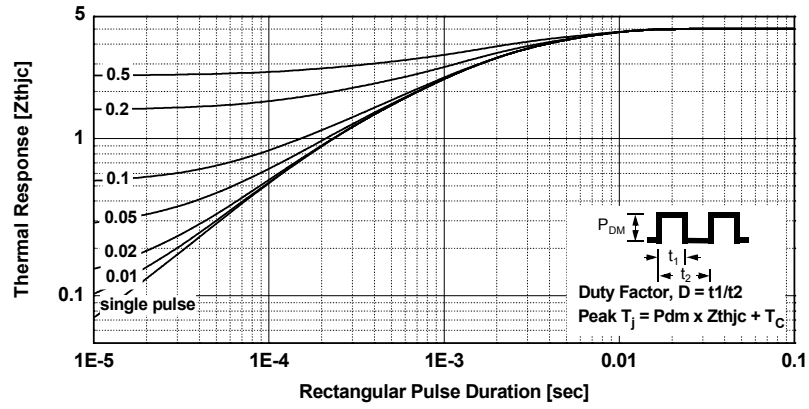
**Figure 22. Transient Thermal Impedance of IGBT**





Typical Performance Characteristics

Figure 23. Transient Thermal Impedance of FRD

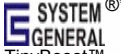









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