

# FGPF10N60UNDF

## 600V, 10A Short Circuit Rated IGBT

### Features

- Short circuit rated 10us
- High current capability
- High input impedance
- Fast switching
- RoHS compliant

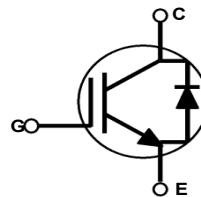
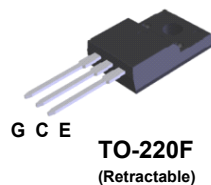


### Applications

- Home appliance inverter-driven application  
- Air Conditioner, Washing Machine, Refrigerator, Dish Washer
- Industrial Inverter - Sewing Machine, CNC

### 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 feature 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 @ $T_C = 25^\circ\text{C}$	20	A
	Collector Current @ $T_C = 100^\circ\text{C}$	10	A
$I_{CM(1)}$	Pulsed Collector Current @ $T_C = 25^\circ\text{C}$	30	A
$I_F$	Diode Forward Current @ $T_C = 25^\circ\text{C}$	10	A
$P_D$	Maximum Power Dissipation @ $T_C = 25^\circ\text{C}$	42	W
	Maximum Power Dissipation @ $T_C = 100^\circ\text{C}$	17	W
$T_J$	Operating Junction Temperature	-55 to +150	$^\circ\text{C}$
$T_{stg}$	Storage Temperature Range	-55 to +150	$^\circ\text{C}$

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

### Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}(\text{IGBT})$	Thermal Resistance, Junction to Case	-	3.0	$^\circ\text{C}/\text{W}$
$R_{\theta JC}(\text{Diode})$	Thermal Resistance, Junction to Case	-	5.6	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (PCB Mount)(2)	-	62.5	$^\circ\text{C}/\text{W}$

**Notes:**  
2: Mountde on 1" square PCB (FR4 or G-10 material)

## Package Marking and Ordering Information

Device Marking	Device	Package	Packaging Type	Qty per Tube	Max Qty per Box
FGPF10N60UNDF	FGPF10N60UNDF	TO-220F	Tube	50ea	-

## 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 <sub>CES</sub>	Collector to Emitter Breakdown Voltage	V <sub>GE</sub> = 0V, I <sub>C</sub> = 250μA	600	-	-	V
I <sub>CES</sub>	Collector Cut-Off Current	V <sub>CE</sub> = V <sub>CES</sub> , V <sub>GE</sub> = 0V	-	-	1	mA
I <sub>GES</sub>	G-E Leakage Current	V <sub>GE</sub> = V <sub>GES</sub> , V <sub>CE</sub> = 0V	-	-	±10	μA
<b>On Characteristics</b>						
V <sub>GE(th)</sub>	G-E Threshold Voltage	I <sub>C</sub> = 10mA, V <sub>CE</sub> = V <sub>GE</sub>	5.5	6.8	8.5	V
V <sub>CE(sat)</sub>	Collector to Emitter Saturation Voltage	I <sub>C</sub> = 10A, V <sub>GE</sub> = 15V	-	2	2.45	V
		I <sub>C</sub> = 10A, V <sub>GE</sub> = 15V, T <sub>C</sub> = 125°C	-	2.3	-	V
<b>Dynamic Characteristics</b>						
C <sub>ies</sub>	Input Capacitance	V <sub>CE</sub> = 30V, V <sub>GE</sub> = 0V, f = 1MHz	-	517		pF
C <sub>oes</sub>	Output Capacitance		-	65		pF
C <sub>res</sub>	Reverse Transfer Capacitance		-	20		pF
<b>Switching Characteristics</b>						
t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>CC</sub> = 400V, I <sub>C</sub> = 10A, R <sub>G</sub> = 10Ω, V <sub>GE</sub> = 15V, Inductive Load, T <sub>C</sub> = 25°C	-	8.0		ns
t <sub>r</sub>	Rise Time		-	6.3		ns
t <sub>d(off)</sub>	Turn-Off Delay Time		-	52.2		ns
t <sub>f</sub>	Fall Time		-	19.1	24.8	ns
E <sub>on</sub>	Turn-On Switching Loss		-	0.15		mJ
E <sub>off</sub>	Turn-Off Switching Loss		-	0.05		mJ
E <sub>ts</sub>	Total Switching Loss		-	0.2		mJ
t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>CC</sub> = 400V, I <sub>C</sub> = 10A, R <sub>G</sub> = 10Ω, V <sub>GE</sub> = 15V, Inductive Load, T <sub>C</sub> = 125°C	-	8.1		ns
t <sub>r</sub>	Rise Time		-	7.3		ns
t <sub>d(off)</sub>	Turn-Off Delay Time		-	55.1		ns
t <sub>f</sub>	Fall Time		-	34.2		ns
E <sub>on</sub>	Turn-On Switching Loss		-	0.22		mJ
E <sub>off</sub>	Turn-Off Switching Loss		-	0.08		mJ
E <sub>ts</sub>	Total Switching Loss		-	0.3		mJ
T <sub>sc</sub>	Short Circuit Withstand Time	V <sub>CC</sub> = 350V, R <sub>G</sub> = 100Ω, V <sub>GE</sub> = 15V, T <sub>C</sub> = 150°C	10	-	-	μs

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

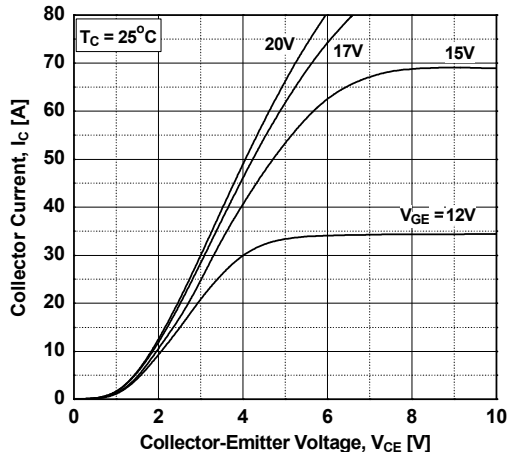
Symbol	Parameter	Test Conditions	Min.	Typ.	Max	Units
$Q_g$	Total Gate Charge	$V_{CE} = 400\text{V}, I_C = 10\text{A},$ $V_{GE} = 15\text{V}$	-	37		nC
$Q_{ge}$	Gate to Emitter Charge		-	5		nC
$Q_{gc}$	Gate to Collector Charge		-	21		nC

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

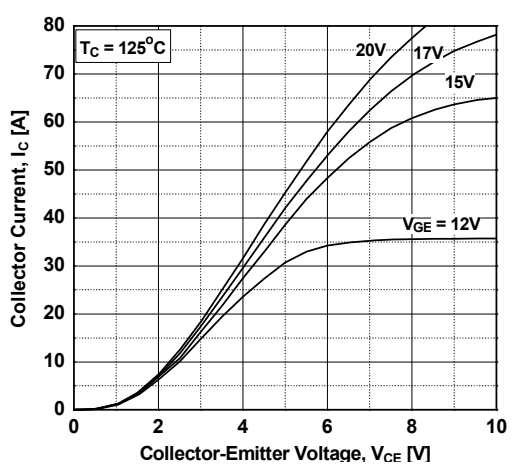
Symbol	Parameter	Test Conditions	Min.	Typ.	Max	Units	
$V_{FM}$	Diode Forward Voltage	$I_F = 10\text{A}$	$T_C = 25^\circ\text{C}$	-	1.8	2.2	V
			$T_C = 125^\circ\text{C}$	-	1.7		
$t_{rr}$	Diode Reverse Recovery Time	$I_F = 10\text{A}, di_F/dt = 200\text{A}/\mu\text{s}$	$T_C = 25^\circ\text{C}$	-	37.7		ns
			$T_C = 125^\circ\text{C}$	-	78.9		
$Q_{rr}$	Diode Reverse Recovery Charge	$I_F = 10\text{A}, di_F/dt = 200\text{A}/\mu\text{s}$	$T_C = 25^\circ\text{C}$	-	75		nC
			$T_C = 125^\circ\text{C}$	-	221		

## Typical Performance Characteristics

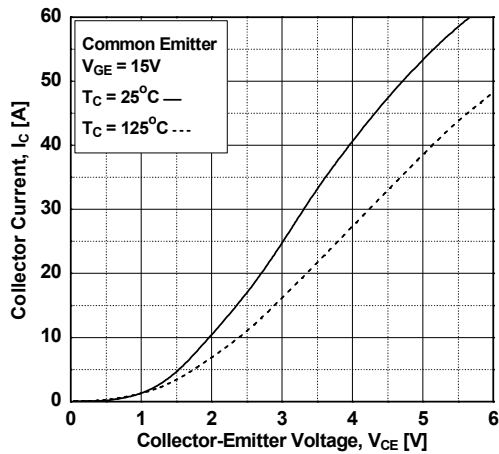
**Figure 1. Typical Output Characteristics**



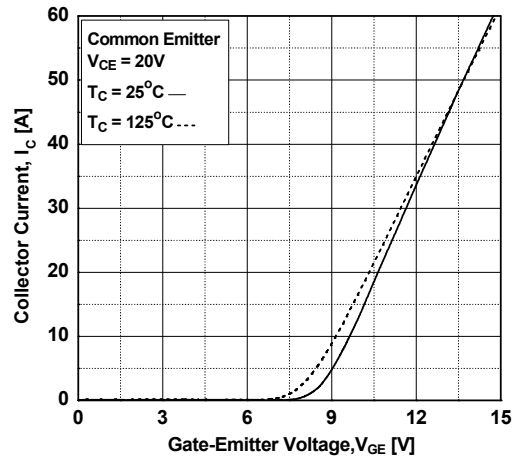
**Figure 2. Typical Output Characteristics**



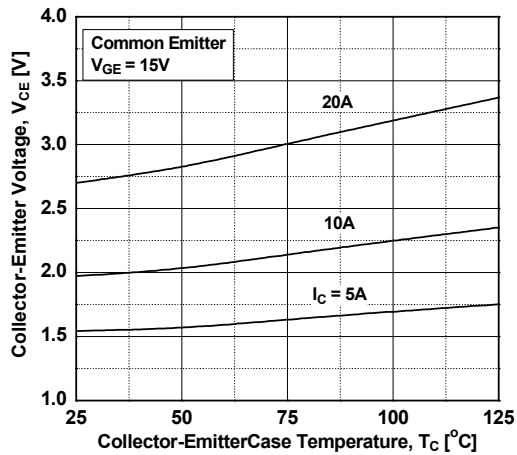
**Figure 3. Typical Saturation Voltage Characteristics**



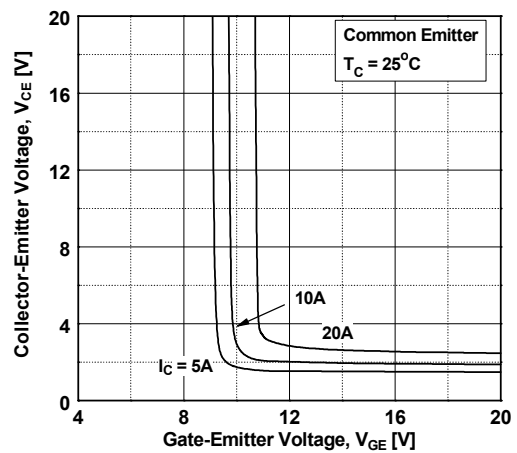
**Figure 4. Transfer Characteristics**



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



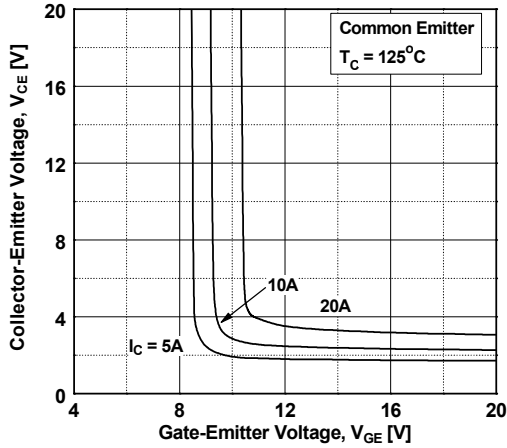
**Figure 6. Saturation Voltage vs. Vge**



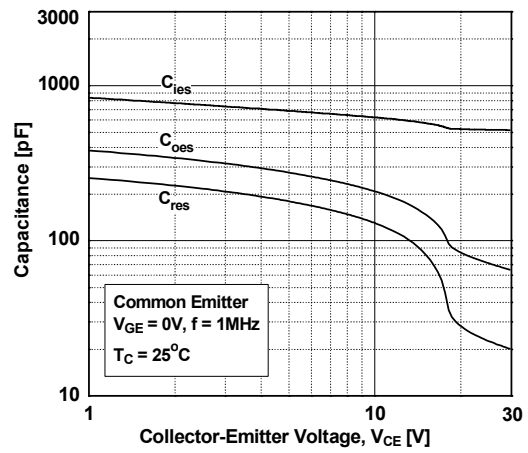
**Typical Performance Characteristics**

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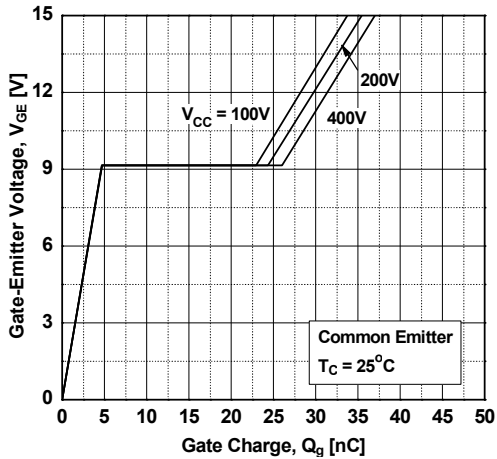
**Figure 7. Saturation Voltage vs.  $V_{GE}$**



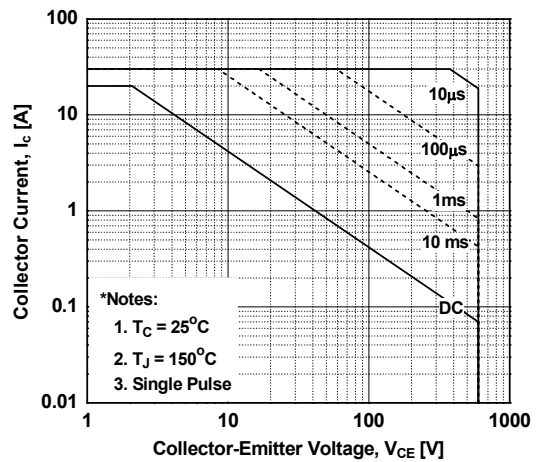
**Figure 8. Capacitance Characteristics**



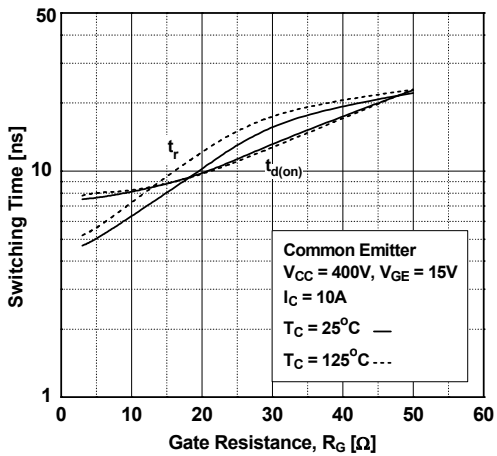
**Figure 9. Gate charge Characteristics**



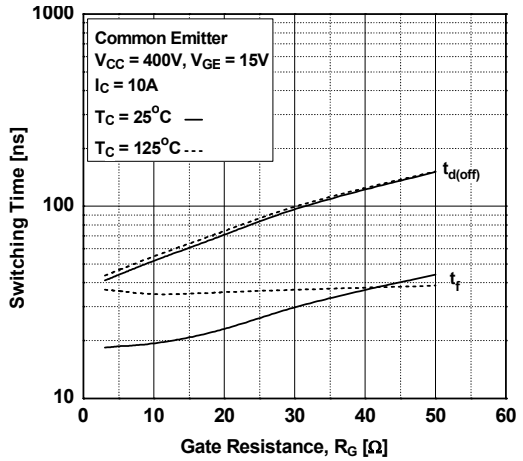
**Figure 10. SOA Characteristics**



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

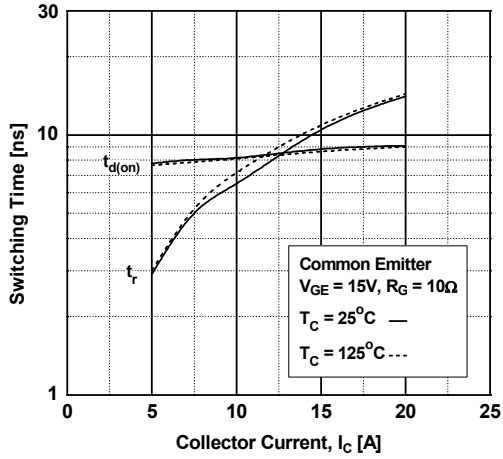


**Figure 12. Turn-off Characteristics vs. Gate Resistance**

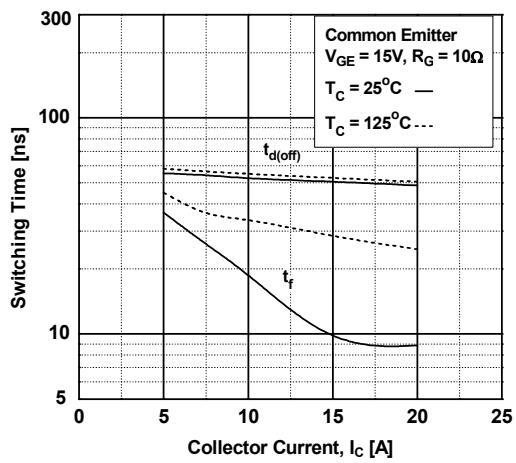


### Typical Performance Characteristics

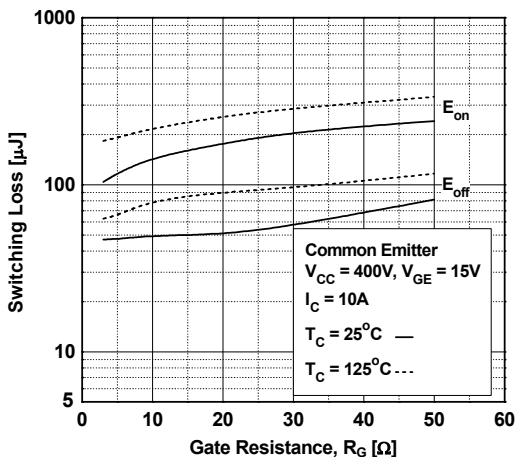
**Figure 13. Turn-on Characteristics vs. Collector Current**



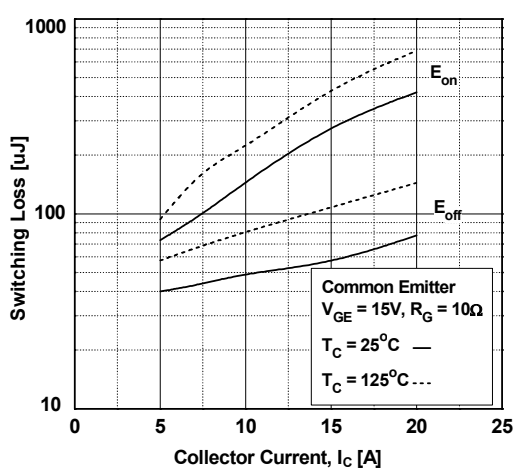
**Figure 14. Turn-off Characteristics vs. Collector Current**



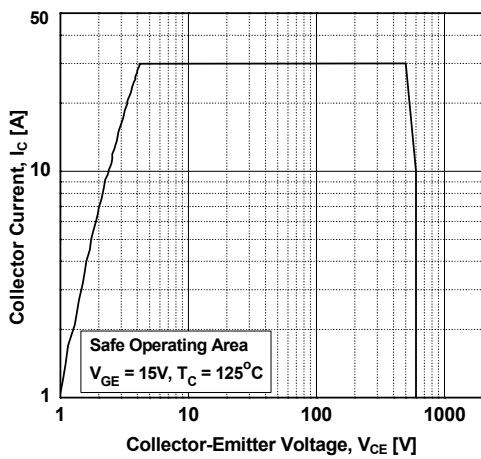
**Figure 15. Switching Loss vs. Gate Resistance**



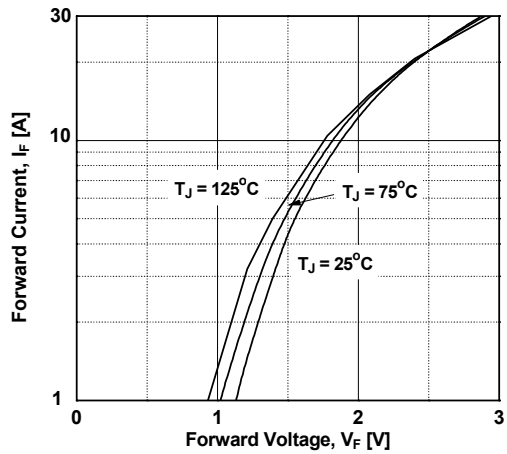
**Figure 16. Switching Loss vs Collector Current**



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



**Figure 18. Forward Characteristics**



## Typical Performance Characteristics

Figure 19. Reverse Recovery Current

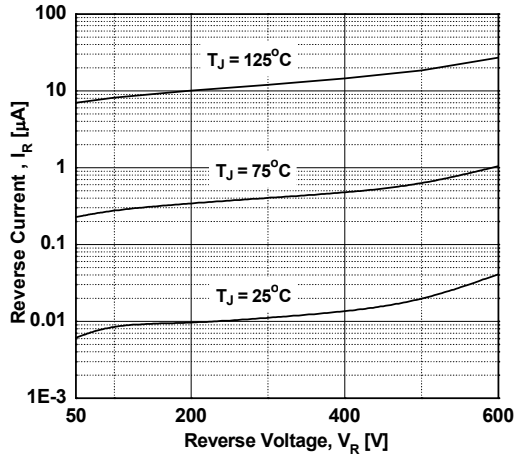


Figure 20. Stored Charge

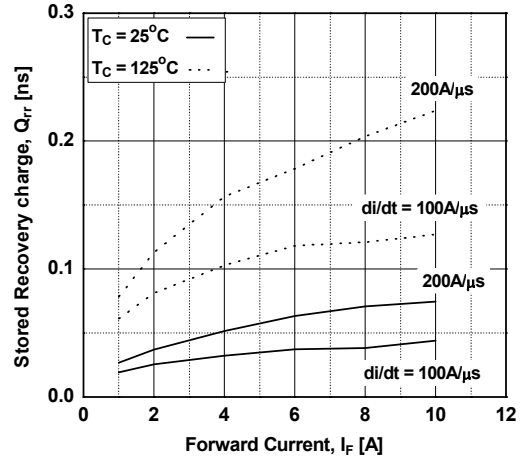


Figure 21. Reverse Recovery Time

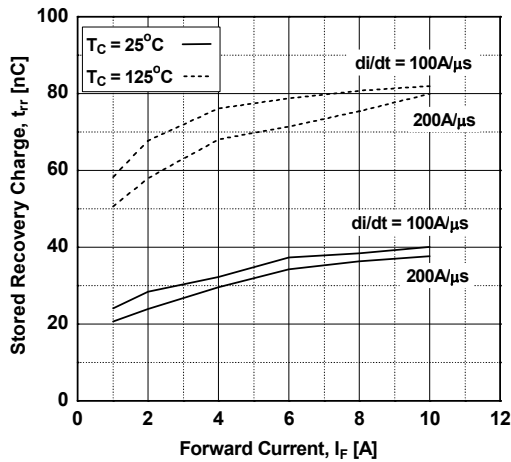
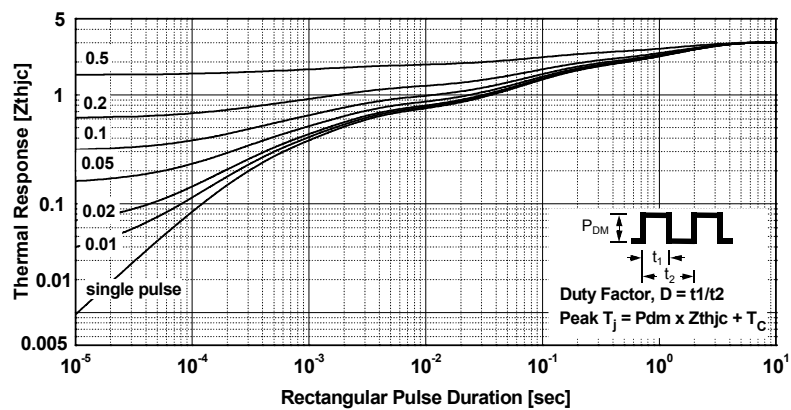
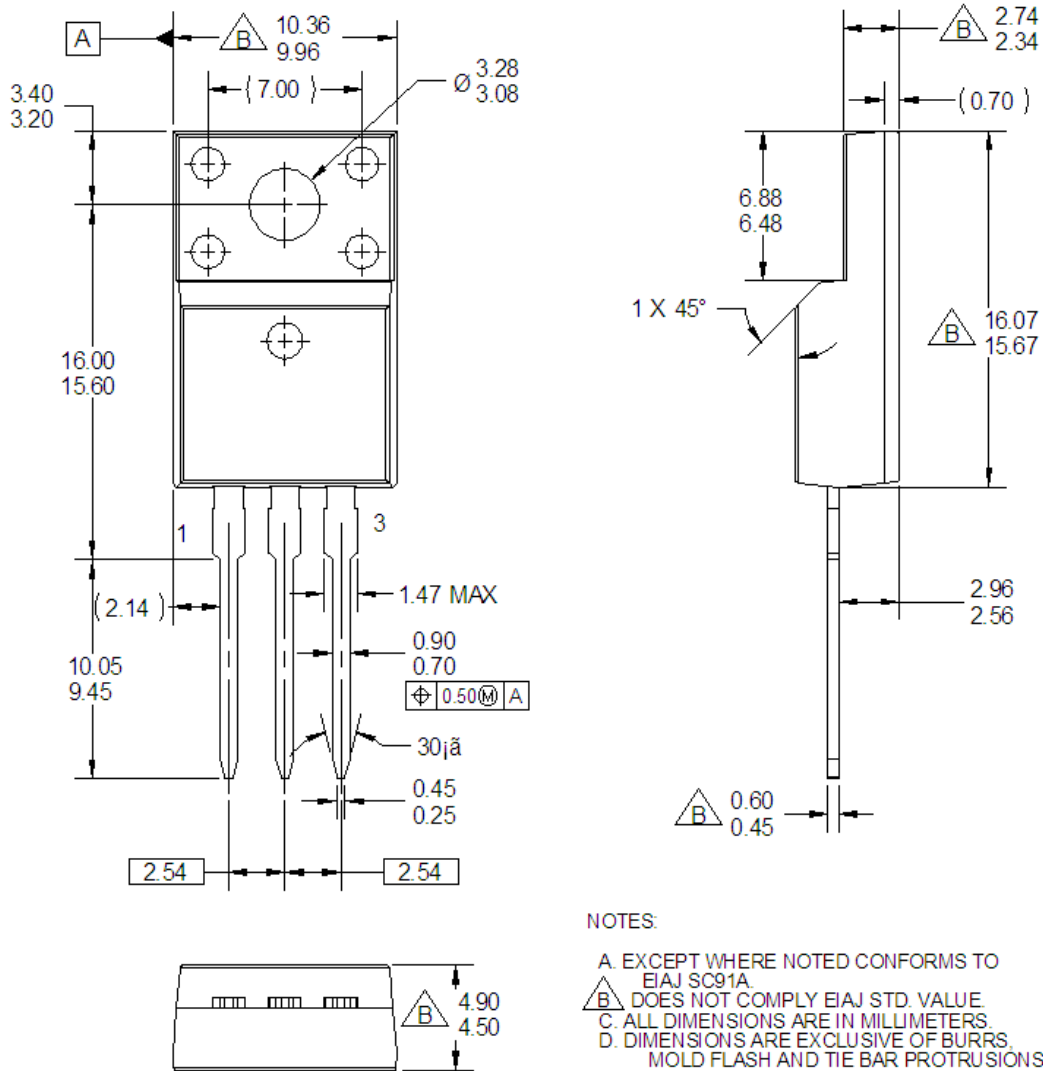


Figure 22. Transient Thermal Impedance of IGBT



**Mechanical Dimensions**

**TO-220F (Retractable)**



**NOTES:**

- A. EXCEPT WHERE NOTED CONFORMS TO EIAJ SC91A.
- B. DOES NOT COMPLY EIAJ STD. VALUE.
- C. ALL DIMENSIONS ARE IN MILLIMETERS.
- D. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUSIONS.
- E. DIMENSION AND TOLERANCE AS PER ASME Y14.5-1994.
- F. DRAWING FILE NAME: TO220M03REV1

**\* Front/Back Side Isolation Voltage : AC 2700V**



