



# FGP5N60UFD

## 600V, 5A Field Stop IGBT

### Features

- High current capability
- Low saturation voltage:  $V_{CE(sat)} = 1.9V @ I_C = 5A$
- High input impedance
- Fast switching
- RoHS compliant

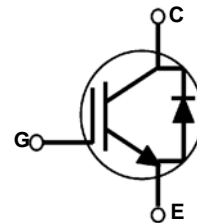
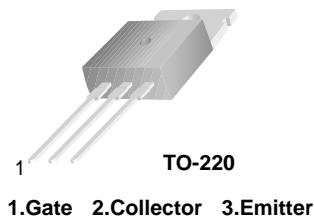
### Applications

- Induction Heating, UPS, SMPS, PFS



### General Description

Using Novel Field Stop IGBT Technology, Fairchild's new series of Field Stop IGBTs offer the optimum performance for Induction Heating, UPS, SMPS, and PFC 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 @ $T_C = 25^\circ C$	10	A
	Collector Current @ $T_C = 100^\circ C$	5	A
$I_{CM} (1)$	Pulsed Collector Current @ $T_C = 25^\circ C$	15	A
$P_D$	Maximum Power Dissipation @ $T_C = 25^\circ C$	81	W
	Maximum Power Dissipation @ $T_C = 100^\circ C$	32	W
$T_J$	Operating Junction Temperature	-55 to +150	$^\circ C$
$T_{stg}$	Storage Temperature Range	-55 to +150	$^\circ C$
$T_L$	Maximum Lead Temp. for soldering Purposes, 1/8" from case for 5 seconds	300	$^\circ C$

**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	-	1.55	$^\circ C/W$
$R_{\theta JC}(Diode)$	Thermal Resistance, Junction to Case	-	3.2	$^\circ C/W$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	-	62.5	$^\circ C/W$

## Package Marking and Ordering Information

Device Marking	Device	Package	Packaging Type	Qty per Tube	Max Qty per Box
FGP5N60UFD	FGP5N60UFDTU	TO-220	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>						
$V_{CES}$	Collector to Emitter Breakdown Voltage	$V_{GE} = 0V, I_C = 250\mu A$	600	-	-	V
$\frac{\Delta V_{CES}}{\Delta T_J}$	Temperature Coefficient of Breakdown Voltage	$V_{GE} = 0V, I_C = 250\mu A$	-	0.7	-	V/°C
$I_{CES}$	Collector Cut-Off Current	$V_{CE} = V_{CES}, V_{GE} = 0V, T_C = 25^\circ C$	-	-	250	$\mu A$
		$V_{CE} = V_{CES}, V_{GE} = 0V, T_C = 125^\circ C$	-	-	1	mA
$I_{GES}$	G-E Leakage Current	$V_{GE} = V_{GES}, V_{CE} = 0V$	-	-	±400	nA
<b>On Characteristics</b>						
$V_{GE(th)}$	G-E Threshold Voltage	$I_C = 250\mu A, V_{CE} = V_{GE}$	4.0	5.0	6.5	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C = 5A, V_{GE} = 15V$	-	1.9	2.4	V
		$I_C = 5A, V_{GE} = 15V, T_C = 125^\circ C$	-	2.1	-	V
<b>Dynamic Characteristics</b>						
$C_{ies}$	Input Capacitance	$V_{CE} = 30V, V_{GE} = 0V, f = 1MHz$	-	290	-	pF
$C_{oes}$	Output Capacitance		-	40	-	pF
$C_{res}$	Reverse Transfer Capacitance		-	10	-	pF
<b>Switching Characteristics</b>						
$t_{d(on)}$	Turn-On Delay Time	$V_{CC} = 400V, I_C = 5A, R_G = 20\Omega, V_{GE} = 15V, \text{Inductive Load}, T_C = 25^\circ C$	-	6	-	ns
$t_r$	Rise Time		-	8	-	ns
$t_{d(off)}$	Turn-Off Delay Time		-	44	-	ns
$t_f$	Fall Time		-	20	-	ns
$E_{on}$	Turn-On Switching Loss		-	0.075	-	mJ
$E_{off}$	Turn-Off Switching Loss		-	0.059	-	mJ
$E_{ts}$	Total Switching Loss	-	0.134	-	mJ	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC} = 400V, I_C = 5A, R_G = 20\Omega, V_{GE} = 15V, \text{Inductive Load}, T_C = 125^\circ C$	-	8	-	ns
$t_r$	Rise Time		-	11	-	ns
$t_{d(off)}$	Turn-Off Delay Time		-	48	-	ns
$t_f$	Fall Time		-	30	-	ns
$E_{on}$	Turn-On Switching Loss		-	0.077	-	mJ
$E_{off}$	Turn-Off Switching Loss		-	0.082	-	mJ
$E_{ts}$	Total Switching Loss	-	0.159	-	mJ	
$Q_g$	Total Gate Charge	$V_{CE} = 400V, I_C = 5A, V_{GE} = 15V$	-	19.5	-	nC
$Q_{ge}$	Gate to Emitter Charge		-	2.5	-	nC
$Q_{gc}$	Gate to Collector Charge		-	10.5	-	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	$I_F = 5\text{A}$	$T_C = 25^\circ\text{C}$	-	1.7	2.3	V
			$T_C = 125^\circ\text{C}$	-	1.5	-	
$t_{rr}$	Diode Reverse Recovery Time	$I_{ES} = 5\text{A}, dI_{ES}/dt = 200\text{A}/\mu\text{s}$	$T_C = 25^\circ\text{C}$	-	30	-	ns
			$T_C = 125^\circ\text{C}$	-	140	-	
$Q_{rr}$	Diode Reverse Recovery Charge	$I_{ES} = 5\text{A}, dI_{ES}/dt = 200\text{A}/\mu\text{s}$	$T_C = 25^\circ\text{C}$	-	25	-	nC
			$T_C = 125^\circ\text{C}$	-	173	-	

## Typical Performance Characteristics

Figure 1. Typical Output Characteristics

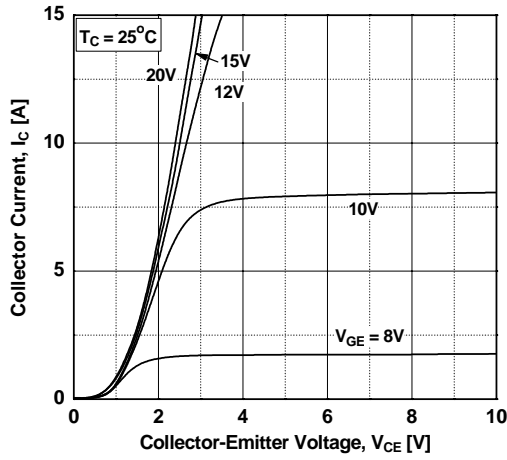


Figure 2. Typical Output Characteristics

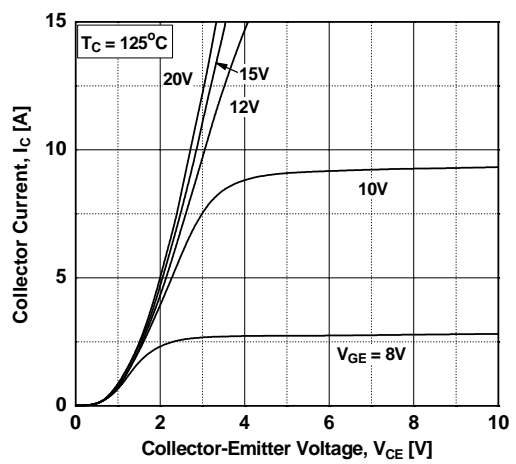


Figure 3. Typical Saturation Voltage Characteristics

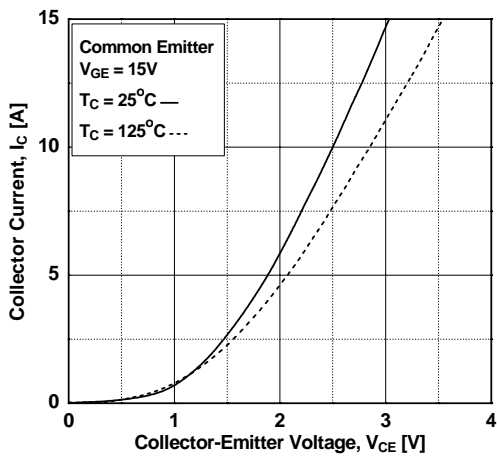


Figure 4. Transfer Characteristics

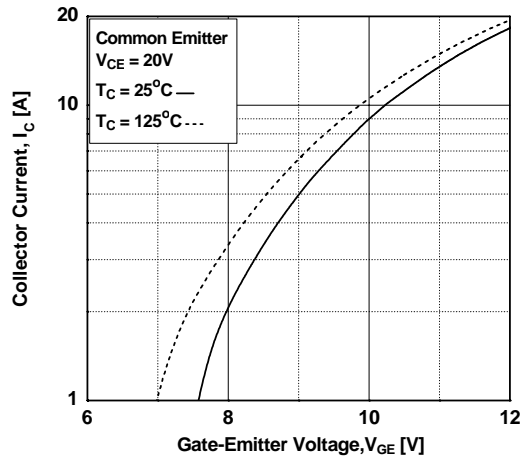


Figure 5. Saturation Voltage vs. Case Temperature at Variant Current Level

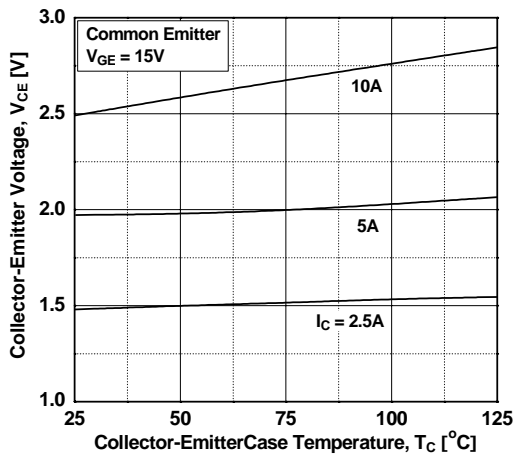
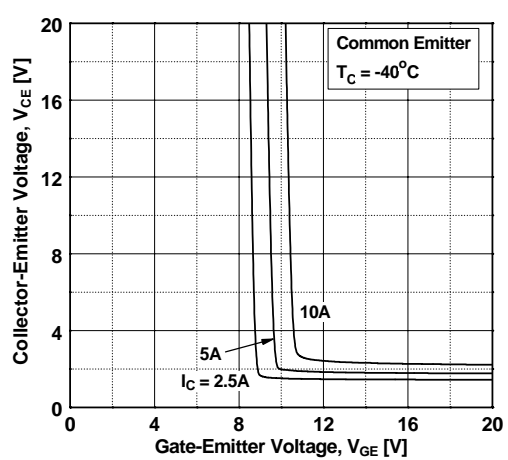


Figure 6. Saturation Voltage vs. Vge



## Typical Performance Characteristics

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

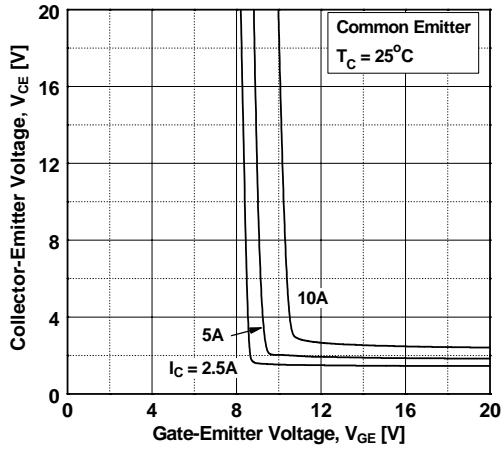


Figure 8. Saturation Voltage vs.  $V_{GE}$

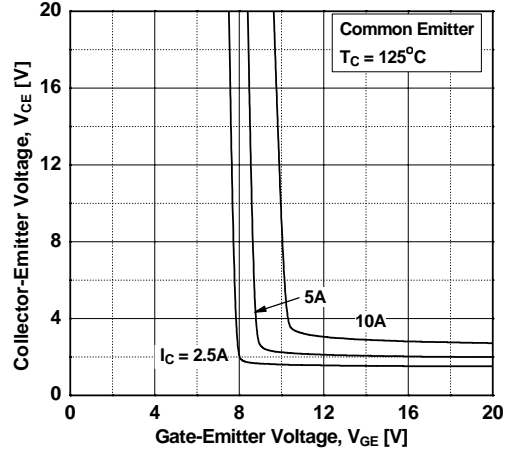


Figure 9. Capacitance Characteristics

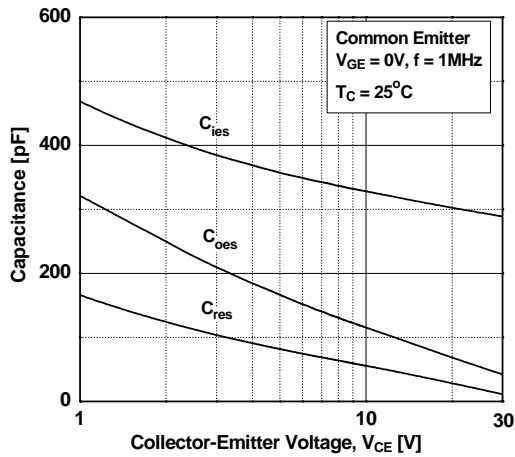


Figure 10. Gate charge Characteristics

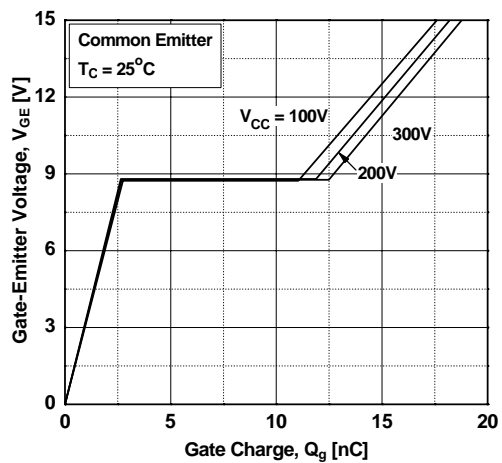


Figure 11. SOA Characteristics

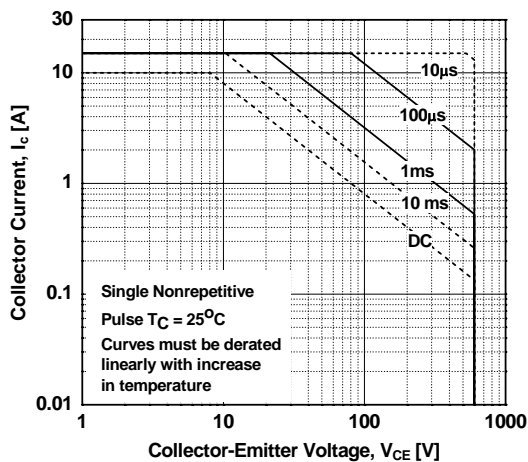
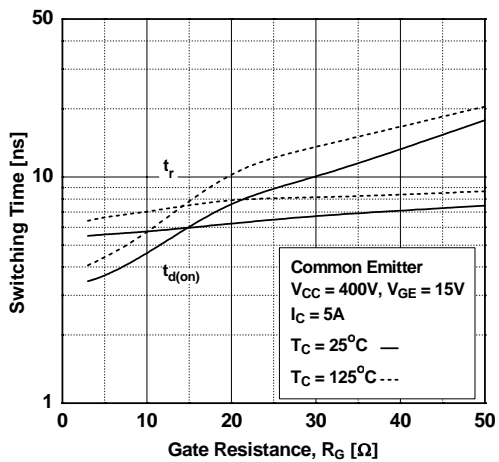
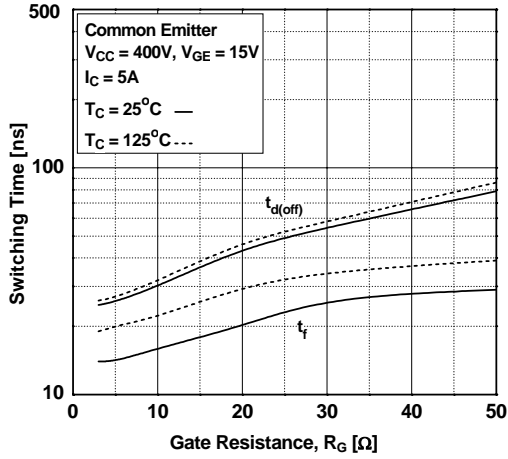


Figure 12. Turn-on Characteristics vs. Gate Resistance

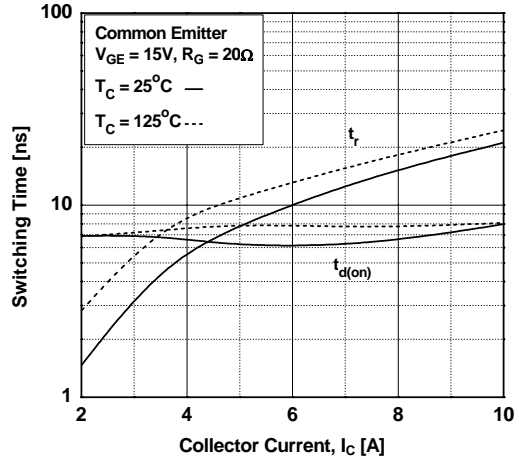


## Typical Performance Characteristics

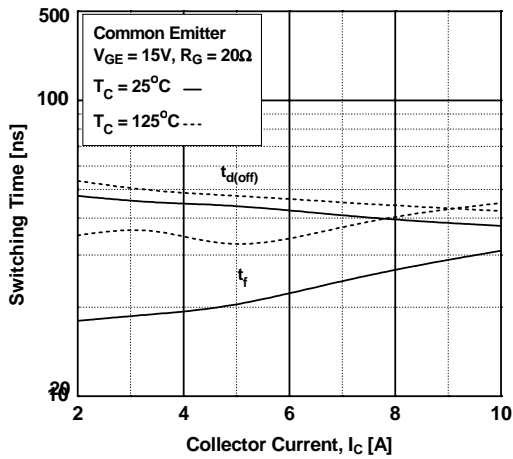
**Figure 13. Turn-off Characteristics vs. Gate Resistance**



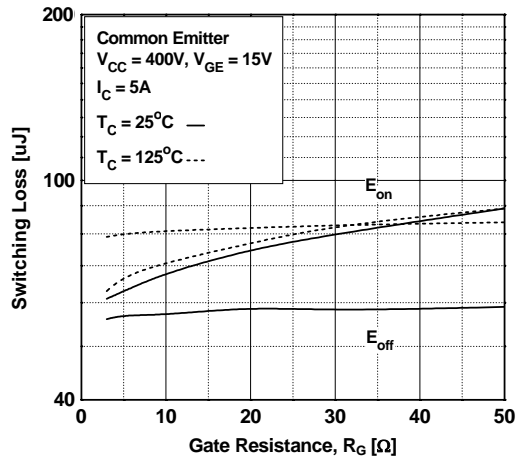
**Figure 14. Turn-on Characteristics vs. Collector Current**



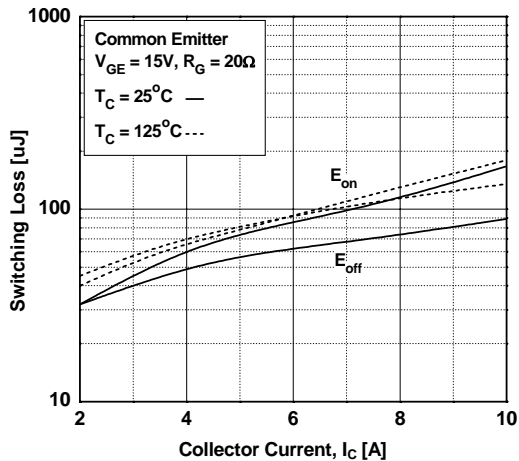
**Figure 15. Turn-off Characteristics vs. Collector Current**



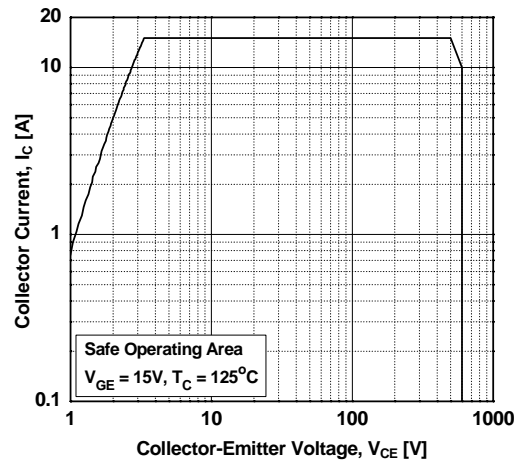
**Figure 16. Switching Loss vs Gate Resistance**



**Figure 17. Switching Loss vs Collector Current**



**Figure 18. Turn off Switching SOA Characteristics**



## Typical Performance Characteristics

Figure 19. Forward Characteristic

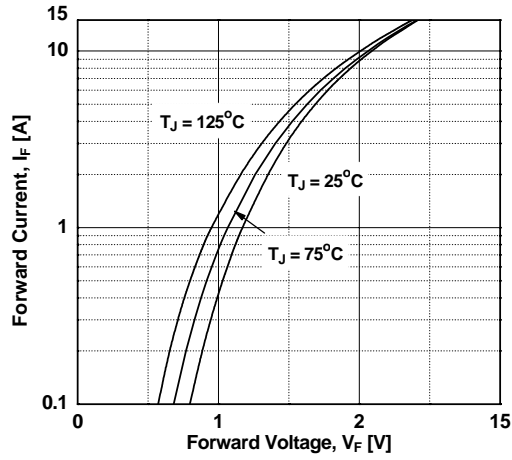


Figure 20. Reverse Current

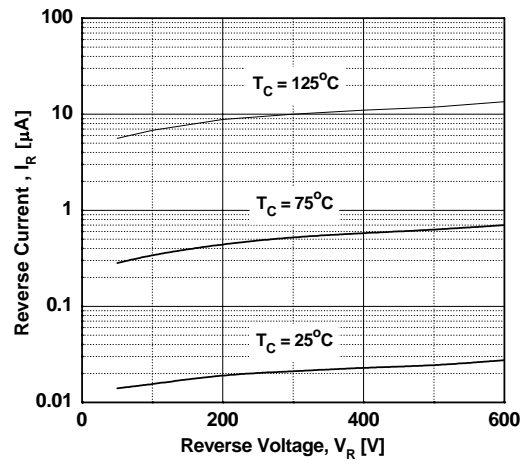


Figure 21. Reverse Recovery Current

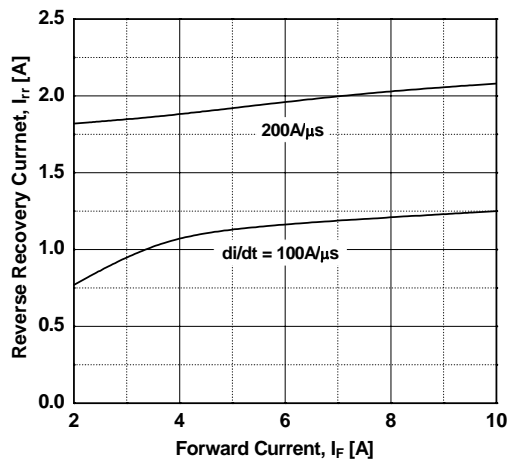


Figure 22. Stored Charge

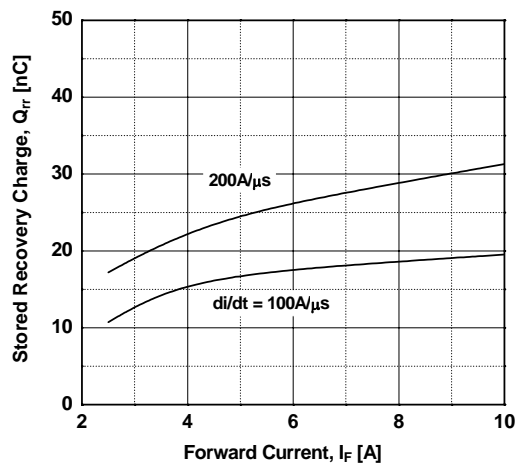
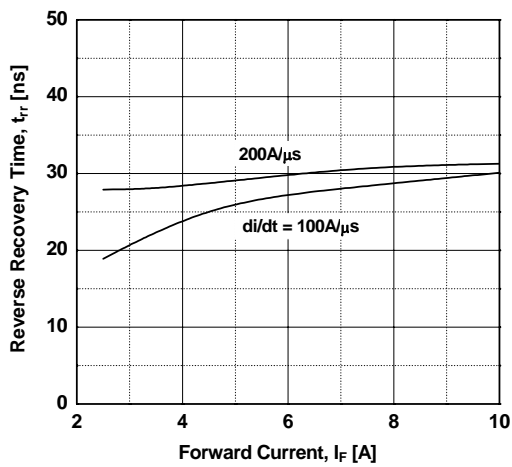
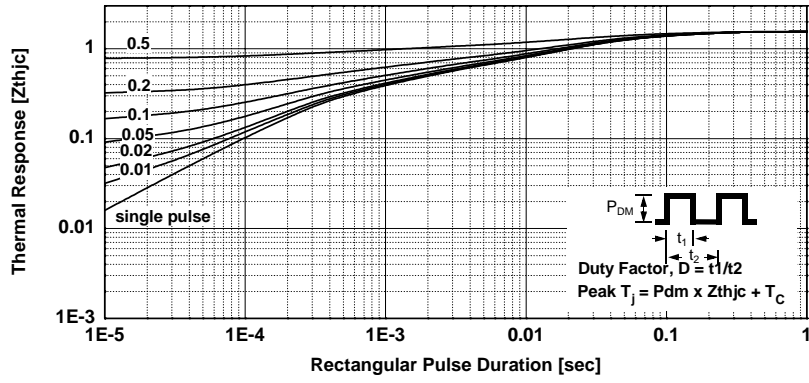


Figure 23. Reverse Recovery Time



## Typical Performance Characteristics

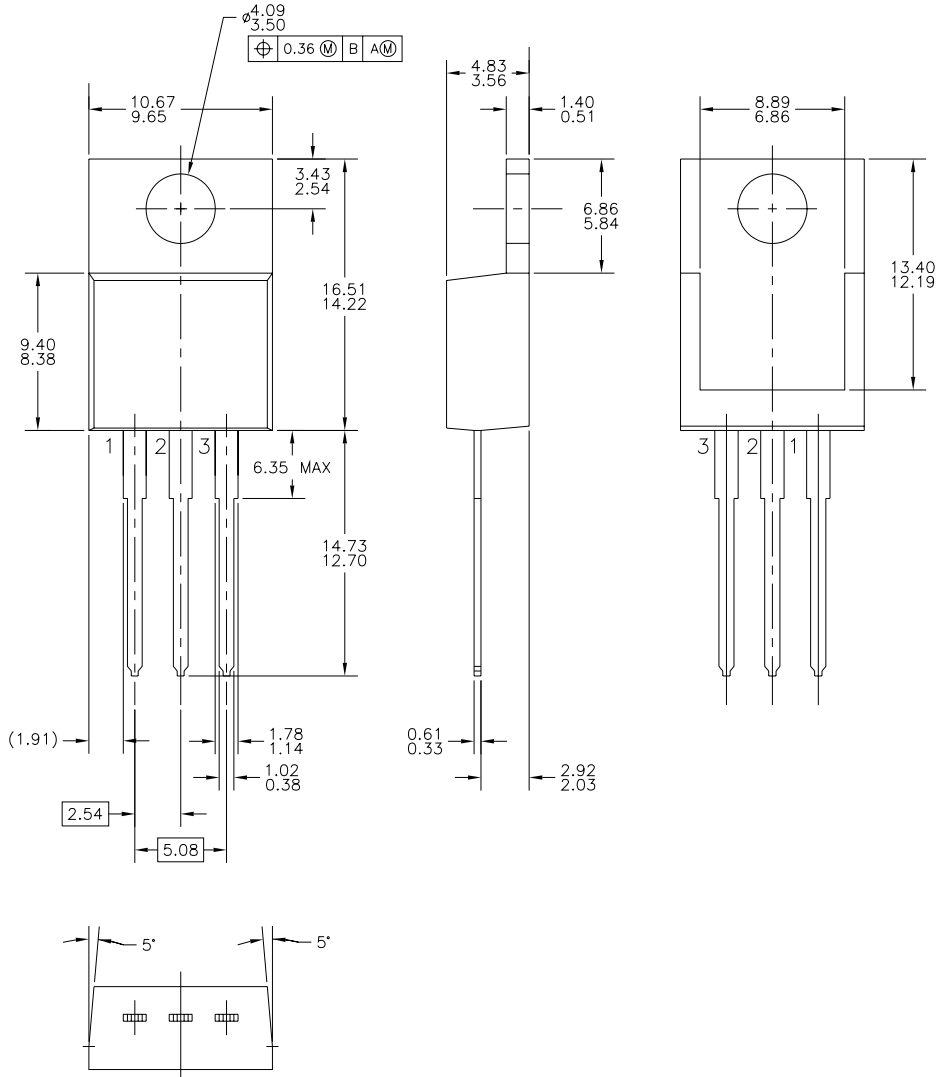
Figure 24. Transient Thermal Impedance of IGBT





Mechanical Dimensions






TO-220





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