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March 2015



# FGH40N60SF 600 V, 40 A Field Stop IGBT

## Features

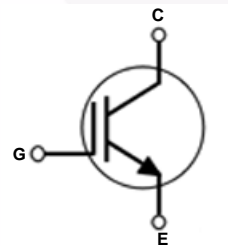
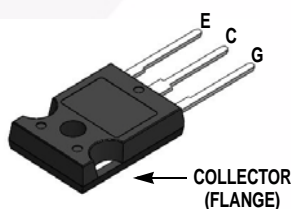
- High Current Capability
- Low Saturation Voltage:  $V_{CE(sat)} = 2.3\text{ V @ } I_C = 40\text{ A}$
- High Input Impedance
- Fast Switching:  $E_{OFF} = 8\text{ uJ/A}$
- RoHS Compliant

## General Description

Using novel field stop IGBT technology, Fairchild's field stop IGBTs offer the optimum performance for solar inverter, UPS, welder and PFC applications where low conduction and switching losses are essential.

## Applications

- Solar Inverter, UPS, Welder, PFC



## Absolute Maximum Ratings

Symbol	Description	Ratings	Unit
$V_{CES}$	Collector to Emitter Voltage	600	V
$V_{GES}$	Gate to Emitter Voltage	$\pm 20$	V
	Transient Gate-to-Emitter Voltage	$\pm 30$	
$I_C$	Collector Current @ $T_C = 25^\circ\text{C}$	80	A
	Collector Current @ $T_C = 100^\circ\text{C}$	40	A
$I_{CM(1)}$	Pulsed Collector Current @ $T_C = 25^\circ\text{C}$	120	A
$P_D$	Maximum Power Dissipation @ $T_C = 25^\circ\text{C}$	290	W
	Maximum Power Dissipation @ $T_C = 100^\circ\text{C}$	116	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
$R_{\theta JC(IGBT)}$	Thermal Resistance, Junction to Case	-	0.43	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	-	40	$^\circ\text{C/W}$

**Package Marking and Ordering Information**

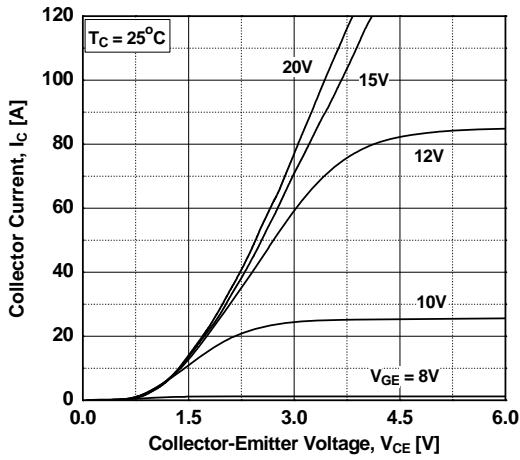
Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FGH40N60SFTU	FGH40N60SF	TO-247	Tube	N/A	N/A	30

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

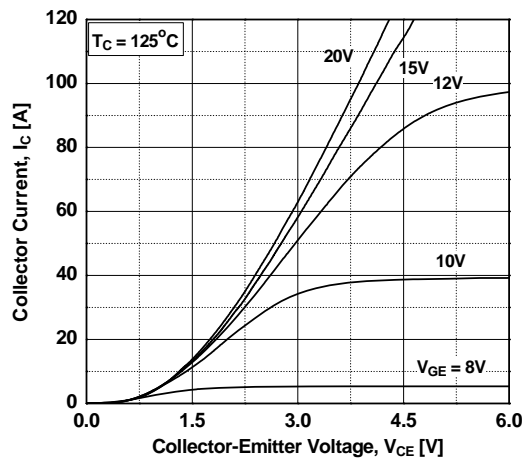
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
<b>Off Characteristics</b>						
$BV_{CES}$	Collector to Emitter Breakdown Voltage	$V_{GE} = 0\text{ V}, I_C = 250\ \mu\text{A}$	600	-	-	V
$\Delta BV_{CES} / \Delta T_J$	Temperature Coefficient of Breakdown Voltage	$V_{GE} = 0\text{ V}, I_C = 250\ \mu\text{A}$	-	0.6	-	V/ $^\circ\text{C}$
$I_{CES}$	Collector Cut-Off Current	$V_{CE} = V_{CES}, V_{GE} = 0\text{ V}$	-	-	250	$\mu\text{A}$
$I_{GES}$	G-E Leakage Current	$V_{GE} = V_{GES}, V_{CE} = 0\text{ V}$	-	-	$\pm 400$	nA
<b>On Characteristics</b>						
$V_{GE(th)}$	G-E Threshold Voltage	$I_C = 250\ \mu\text{A}, V_{CE} = V_{GE}$	4.0	5.0	6.5	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C = 40\text{ A}, V_{GE} = 15\text{ V}$	-	2.3	2.9	V
		$I_C = 40\text{ A}, V_{GE} = 15\text{ V}, T_C = 125^\circ\text{C}$	-	2.5	-	V
<b>Dynamic Characteristics</b>						
$C_{ies}$	Input Capacitance	$V_{CE} = 30\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$	-	2110	-	pF
$C_{oes}$	Output Capacitance		-	200	-	pF
$C_{res}$	Reverse Transfer Capacitance		-	60	-	pF
<b>Switching Characteristics</b>						
$t_{d(on)}$	Turn-On Delay Time	$V_{CC} = 400\text{ V}, I_C = 40\text{ A}, R_G = 10\ \Omega, V_{GE} = 15\text{ V},$ Inductive Load, $T_C = 25^\circ\text{C}$	-	25	-	ns
$t_r$	Rise Time		-	42	-	ns
$t_{d(off)}$	Turn-Off Delay Time		-	115	-	ns
$t_f$	Fall Time		-	27	54	ns
$E_{on}$	Turn-On Switching Loss		-	1.13	-	mJ
$E_{off}$	Turn-Off Switching Loss		-	0.31	-	mJ
$E_{ts}$	Total Switching Loss	-	1.44	-	mJ	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC} = 400\text{ V}, I_C = 40\text{ A}, R_G = 10\ \Omega, V_{GE} = 15\text{ V},$ Inductive Load, $T_C = 125^\circ\text{C}$	-	24	-	ns
$t_r$	Rise Time		-	43	-	ns
$t_{d(off)}$	Turn-Off Delay Time		-	120	-	ns
$t_f$	Fall Time		-	30	-	ns
$E_{on}$	Turn-On Switching Loss		-	1.14	-	mJ
$E_{off}$	Turn-Off Switching Loss		-	0.48	-	mJ
$E_{ts}$	Total Switching Loss	-	1.62	-	mJ	
$Q_g$	Total Gate Charge	$V_{CE} = 400\text{ V}, I_C = 40\text{ A}, V_{GE} = 15\text{ V}$	-	120	-	nC
$Q_{ge}$	Gate to Emitter Charge		-	14	-	nC
$Q_{gc}$	Gate to Collector Charge		-	58	-	nC

## Typical Performance Characteristics

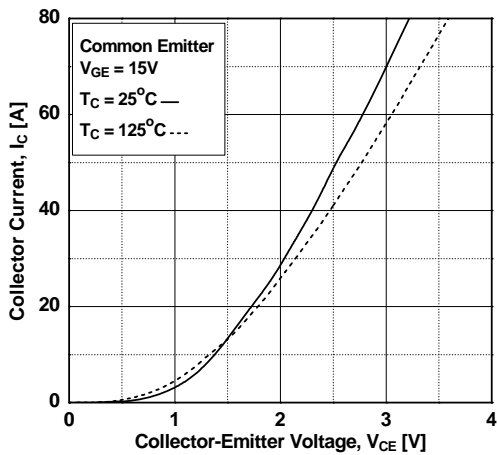
**Figure 1. Typical Output Characteristics**



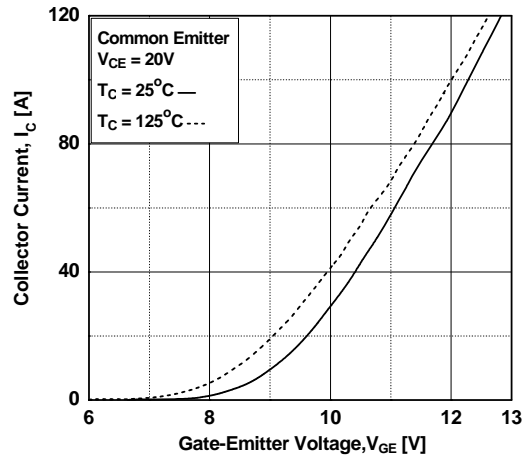
**Figure 2. Typical Output Characteristics**



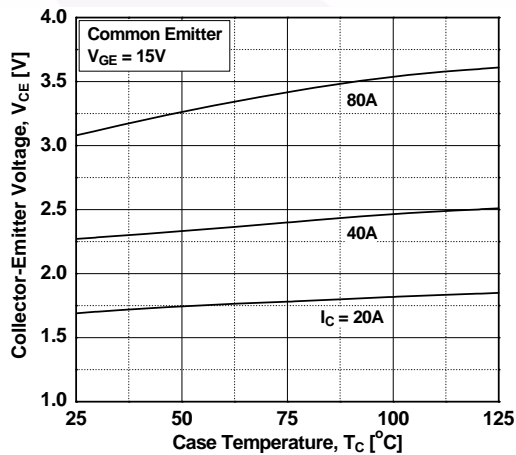
**Figure 3. Typical Saturation Voltage Characteristics**



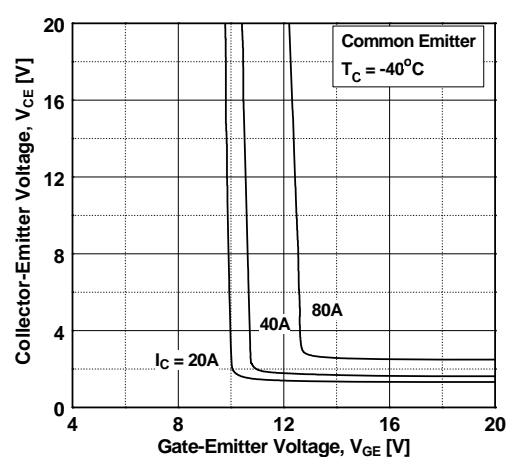
**Figure 4. Transfer Characteristics**



**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.  $V_{GE}$

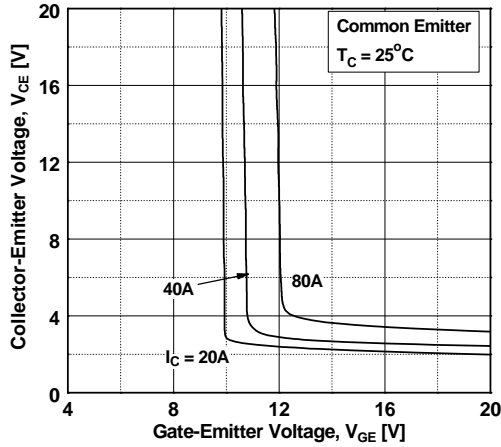


Figure 8. Saturation Voltage vs.  $V_{GE}$

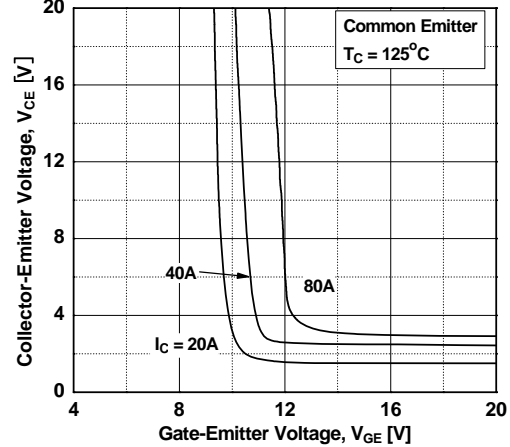


Figure 9. Capacitance Characteristics

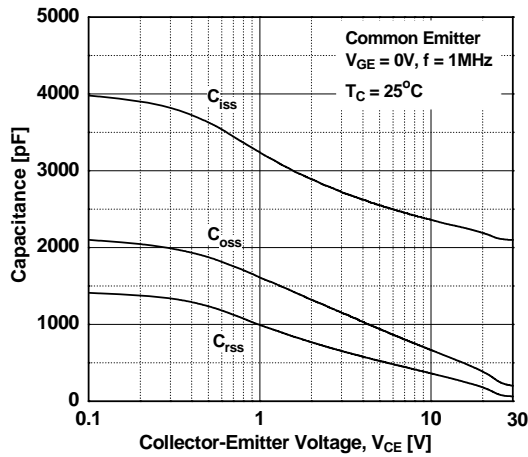


Figure 10. Gate charge Characteristics

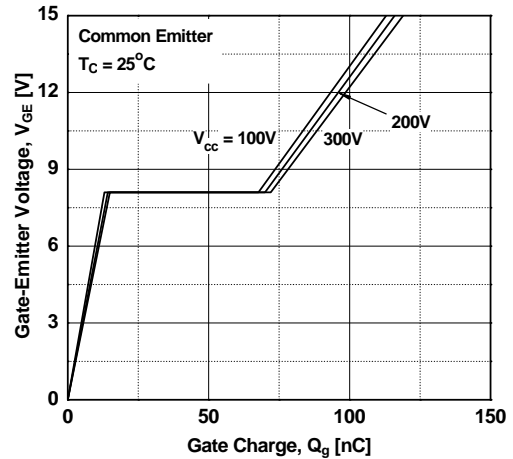


Figure 11. SOA Characteristics

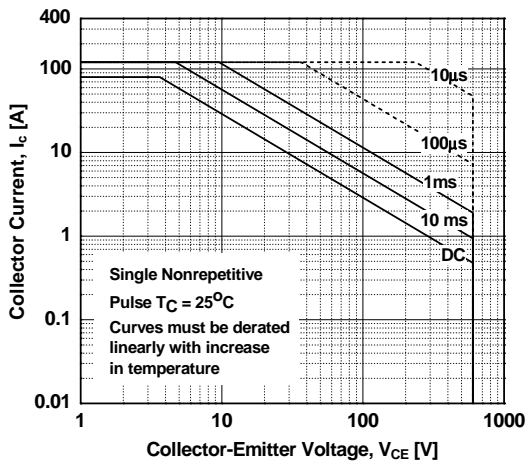
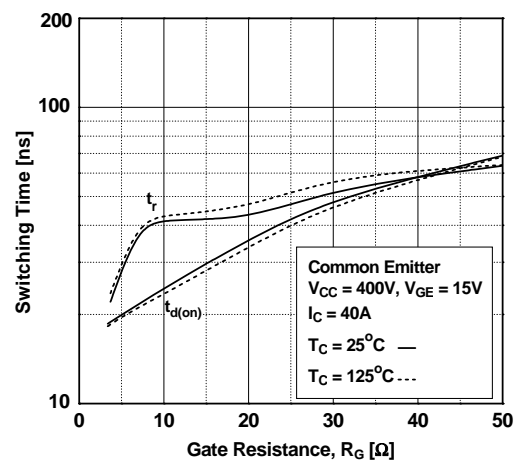
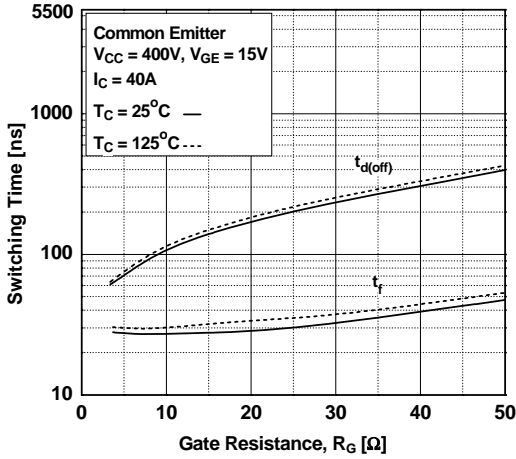


Figure 12. Turn-on Characteristics vs. Gate Resistance

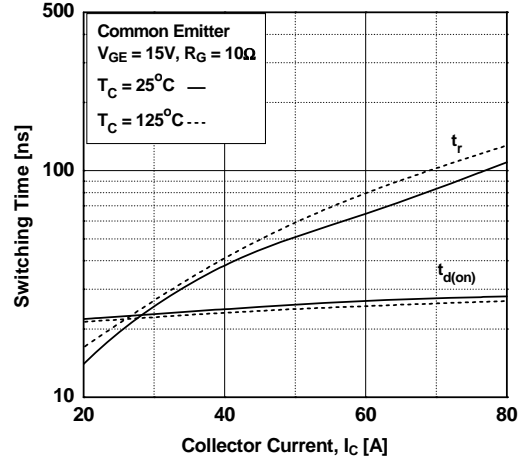


## Typical Performance Characteristics

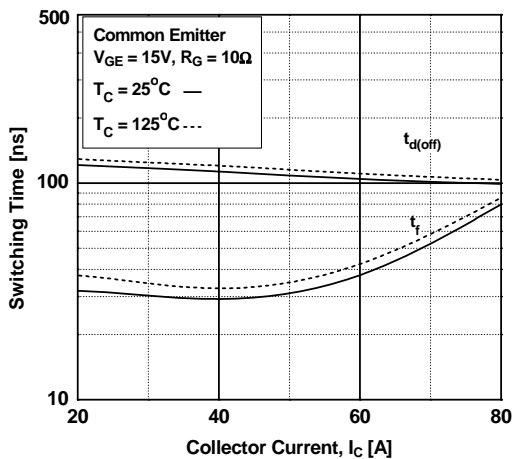
**Figure 13. Turn-off Characteristics vs. Gate Resistance**



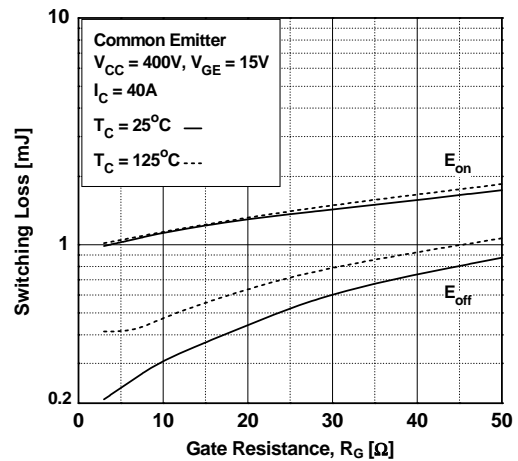
**Figure 14. Turn-on Characteristics vs. Collector Current**



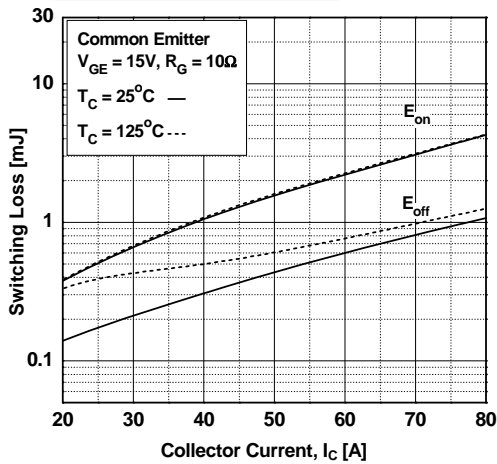
**Figure 15. Turn-off Characteristics vs. Collector Current**



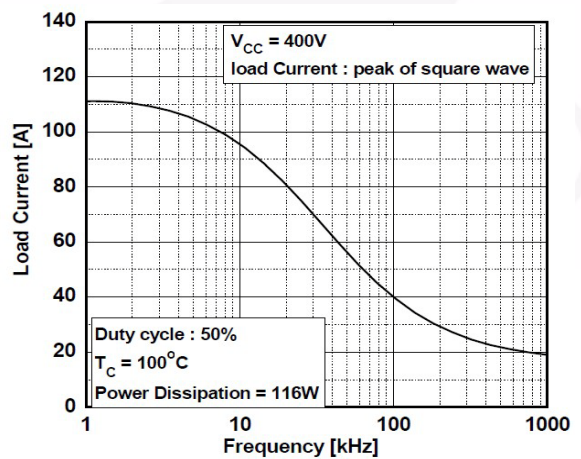
**Figure 16. Switching Loss vs. Gate Resistance**



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



**Figure 18. Load Current vs. Frequency**



### Typical Performance Characteristics

Figure 19. Turn off Switching SOA Characteristics

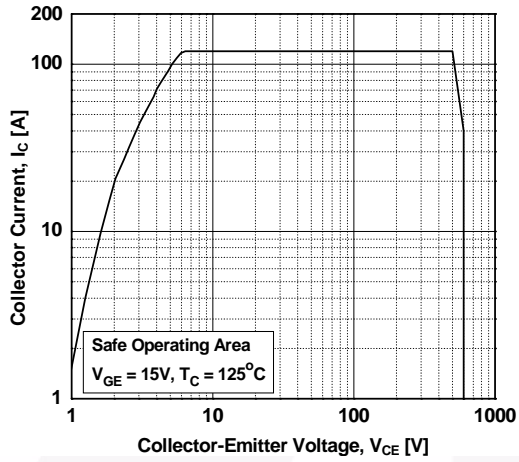
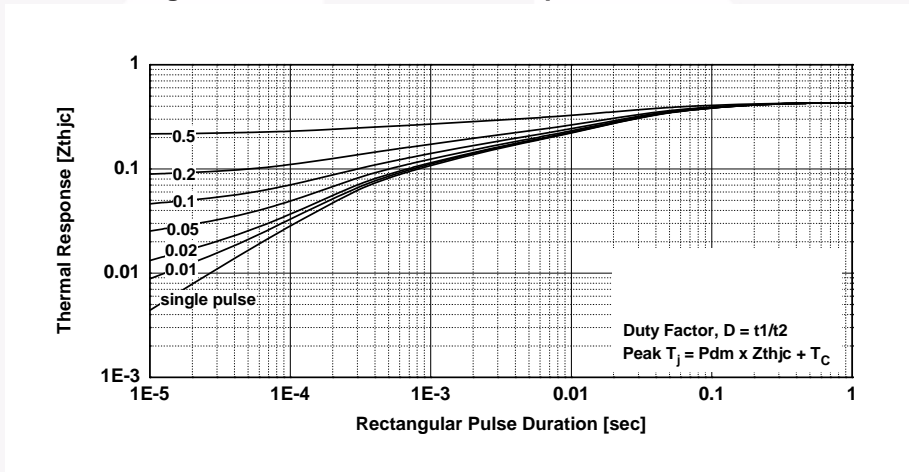
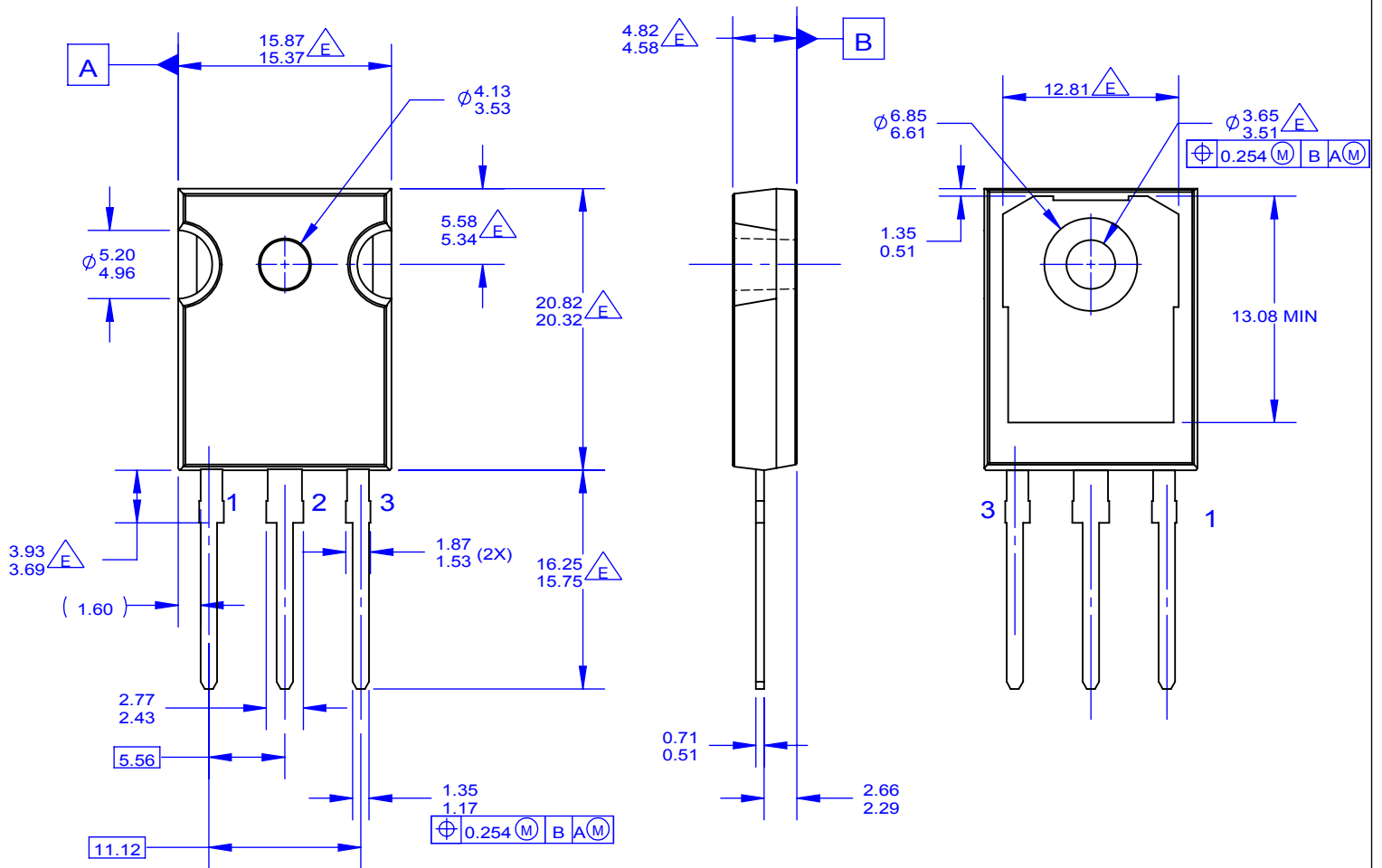


Figure 20. Transient Thermal Impedance of IGBT





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