

# FGH40N60UFD

## 600 V, 40 A Field Stop IGBT



### Features

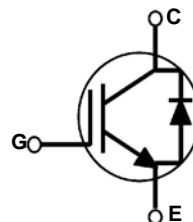
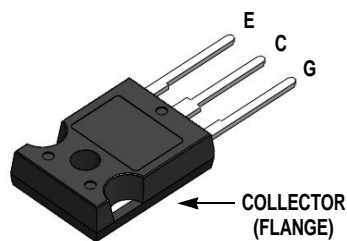
- High Current Capability
- Low Saturation Voltage:  $V_{CE(sat)} = 1.8\text{ V @ } I_C = 40\text{ A}$
- High Input Impedance
- Fast Switching
- RoHS Compliant

### General Description

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

### Applications

- Solar Inverter, UPS, Welder, PFC, Microwave Oven, Telecom, ESS



### 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 @ $T_C = 25^\circ\text{C}$	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
$R_{\theta JC}(\text{IGBT})$	Thermal Resistance, Junction to Case	-	0.43	$^\circ\text{C/W}$
$R_{\theta JC}(\text{Diode})$	Thermal Resistance, Junction to Case	-	1.45	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	-	40	$^\circ\text{C/W}$

## Package Marking and Ordering Information

Device Marking	Device	Package	Packaging Type	Qty per Tube	Max Qty per Box
FGH40N60UFD	FGH40N60UFDTU	TO-247	Tube	30ea	-

## 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>						
$V_{CES}$	Collector to Emitter Breakdown Voltage	$V_{GE} = 0V, I_C = 250\mu A$	600	-	-	V
$\Delta BV_{CES}$ $\Delta T_J$	Temperature Coefficient of Breakdown Voltage	$V_{GE} = 0V, I_C = 250\mu A$	-	0.6	-	V/°C
$I_{CES}$	Collector Cut-Off Current	$V_{CE} = V_{CES}, V_{GE} = 0V$	-	-	250	$\mu A$
$I_{GES}$	G-E Leakage Current	$V_{GE} = V_{GES}, V_{CE} = 0V$	-	-	$\pm 400$	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	$I_C = 40A, V_{GE} = 15V$	-	1.8	2.4	V
		$I_C = 40A, V_{GE} = 15V,$ $T_C = 125^\circ C$	-	2.0	-	V
<b>Dynamic Characteristics</b>						
$C_{ies}$	Input Capacitance	$V_{CE} = 30V, V_{GE} = 0V,$ $f = 1MHz$	-	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	$V_{CC} = 400V, I_C = 40A,$ $R_G = 10\Omega, V_{GE} = 15V,$ Inductive Load, $T_C = 25^\circ C$	-	24	-	ns
$t_r$	Rise Time		-	44	-	ns
$t_{d(off)}$	Turn-Off Delay Time		-	112	-	ns
$t_f$	Fall Time		-	30	60	ns
$E_{on}$	Turn-On Switching Loss		-	1.19	-	mJ
$E_{off}$	Turn-Off Switching Loss		-	0.46	-	mJ
$E_{ts}$	Total Switching Loss	-	1.65	-	mJ	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC} = 400V, I_C = 40A,$ $R_G = 10\Omega, V_{GE} = 15V,$ Inductive Load, $T_C = 125^\circ C$	-	24	-	ns
$t_r$	Rise Time		-	45	-	ns
$t_{d(off)}$	Turn-Off Delay Time		-	120	-	ns
$t_f$	Fall Time		-	40	-	ns
$E_{on}$	Turn-On Switching Loss		-	1.2	-	mJ
$E_{off}$	Turn-Off Switching Loss		-	0.69	-	mJ
$E_{ts}$	Total Switching Loss	-	1.89	-	mJ	
$Q_g$	Total Gate Charge	$V_{CE} = 400V, I_C = 40A,$ $V_{GE} = 15V$	-	120	-	nC
$Q_{ge}$	Gate to Emitter Charge		-	14	-	nC
$Q_{gc}$	Gate to Collector Charge		-	58	-	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	$I_F = 20\text{A}$	$T_C = 25^\circ\text{C}$	-	1.95	2.6	V
			$T_C = 125^\circ\text{C}$	-	1.85	-	
$t_{rr}$	Diode Reverse Recovery Time	$I_F = 20\text{A}, dI_{ES}/dt = 200\text{A}/\mu\text{s}$	$T_C = 25^\circ\text{C}$	-	45	-	ns
			$T_C = 125^\circ\text{C}$	-	140	-	
$Q_{rr}$	Diode Reverse Recovery Charge	$I_F = 20\text{A}, dI_{ES}/dt = 200\text{A}/\mu\text{s}$	$T_C = 25^\circ\text{C}$	-	75	-	nC
			$T_C = 125^\circ\text{C}$	-	375	-	

## Typical Performance Characteristics

Figure 1. Typical Output Characteristics

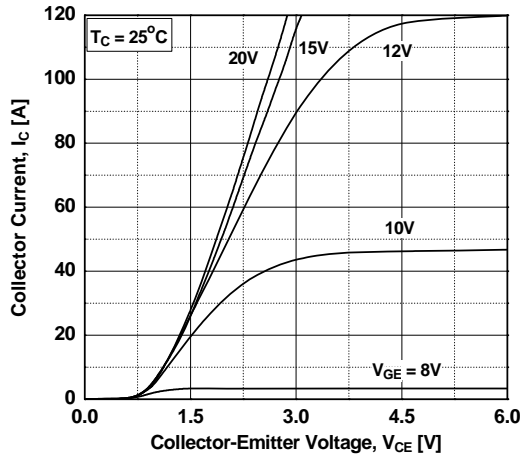


Figure 2. Typical Output Characteristics

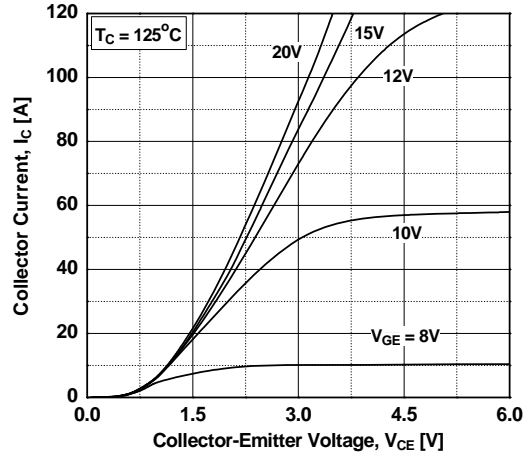


Figure 3. Typical Saturation Voltage Characteristics

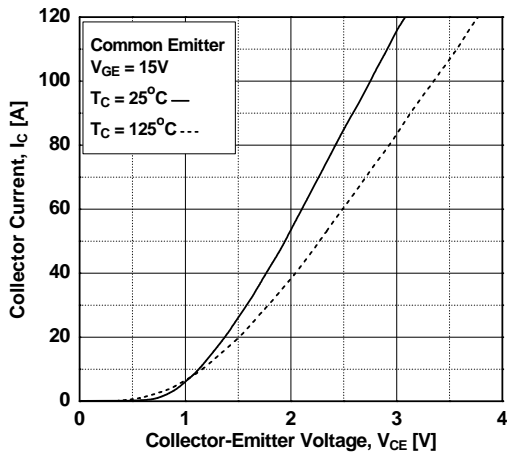


Figure 4. Transfer Characteristics

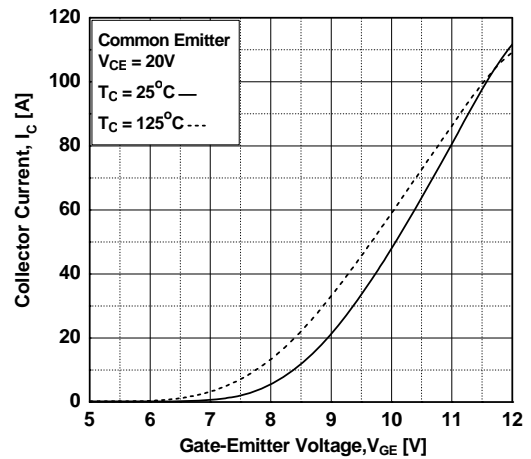


Figure 5. Saturation Voltage vs. Case Temperature at Variant Current Level

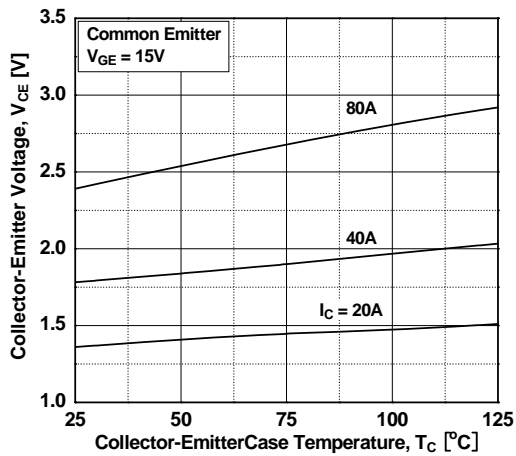
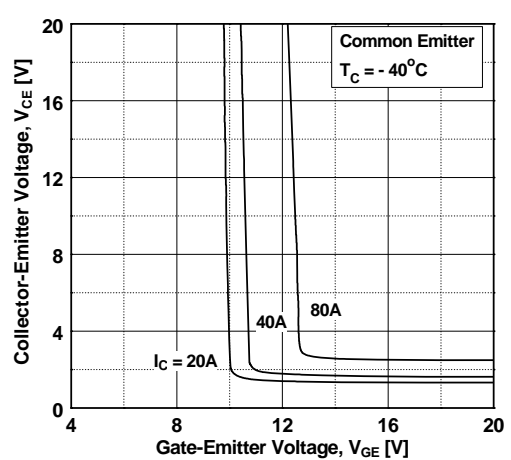


Figure 6. Saturation Voltage vs. Vge



## Typical Performance Characteristics

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

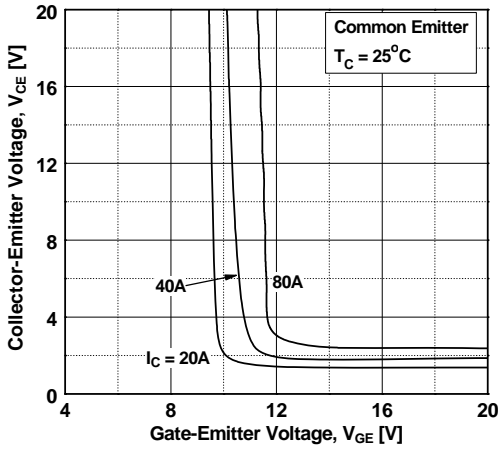


Figure 8. Saturation Voltage vs.  $V_{GE}$

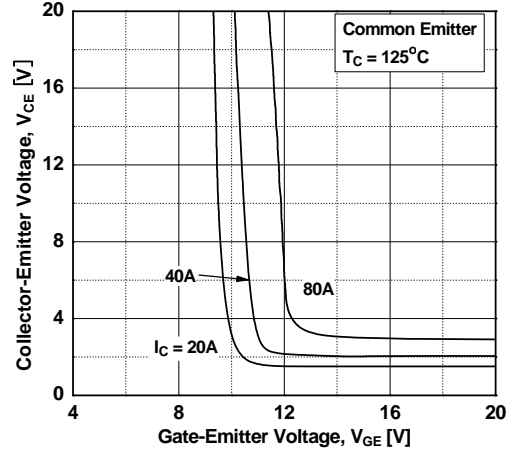


Figure 9. Capacitance Characteristics

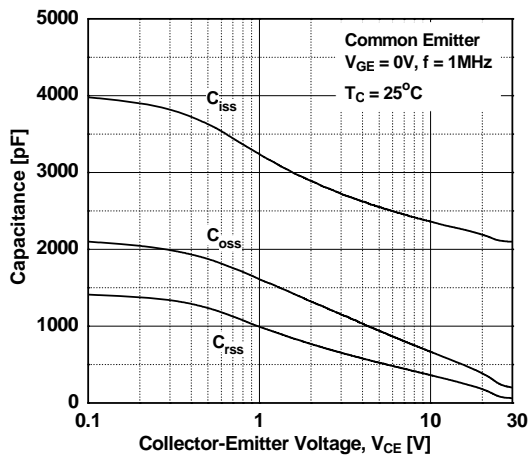


Figure 10. Gate charge Characteristics

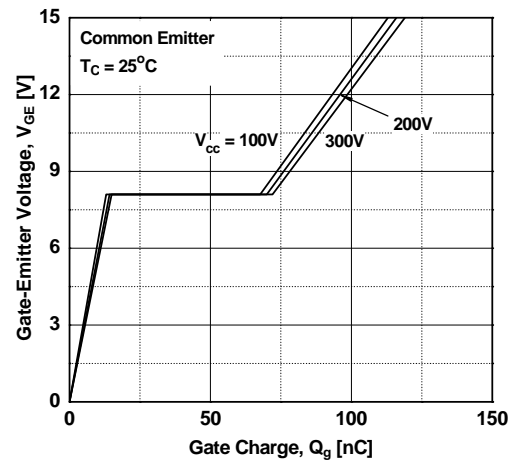


Figure 11. SOA Characteristics

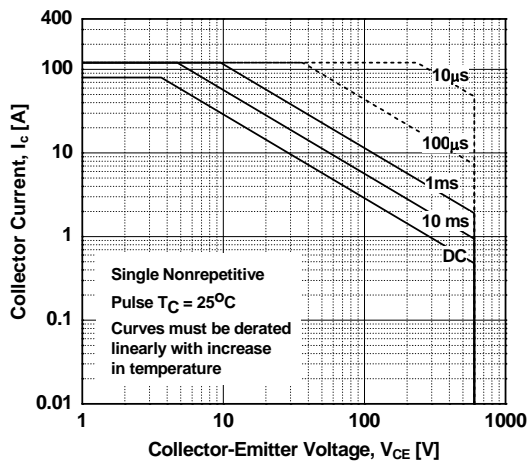
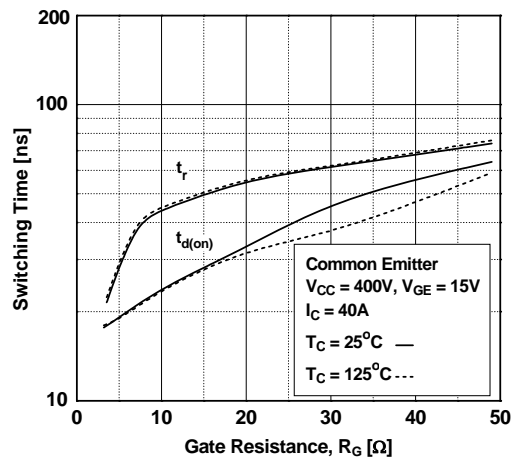
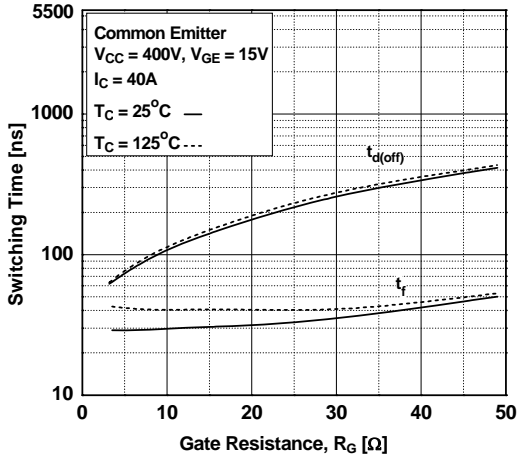


Figure 12. Turn-on Characteristics vs. Gate Resistance

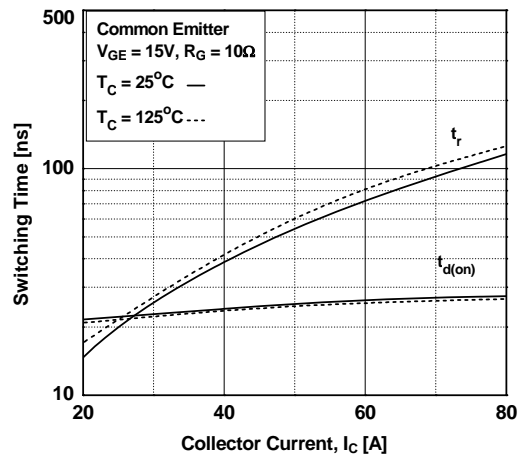


## Typical Performance Characteristics

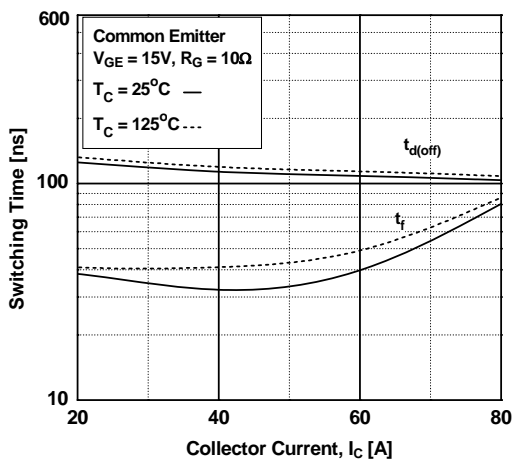
**Figure 13. Turn-off Characteristics vs. Gate Resistance**



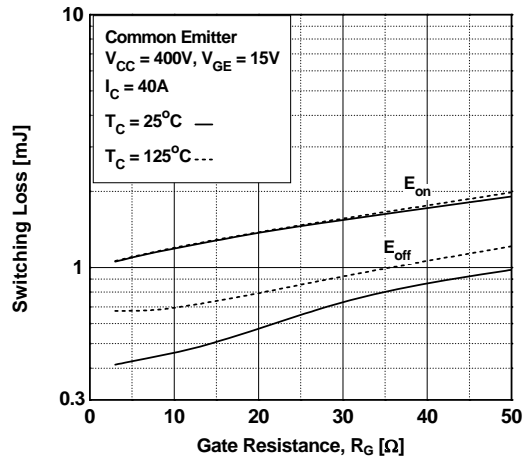
**Figure 14. Turn-on Characteristics vs. Collector Current**



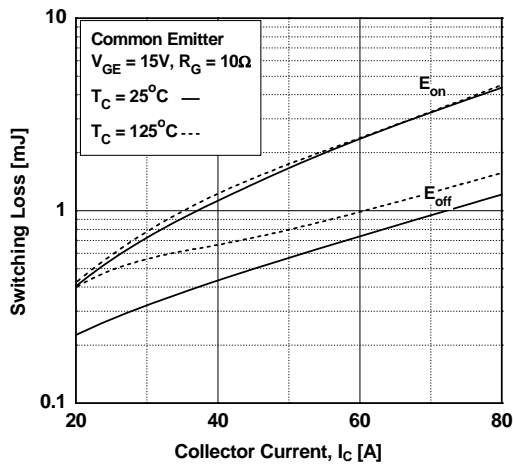
**Figure 15. Turn-off Characteristics vs. Collector Current**



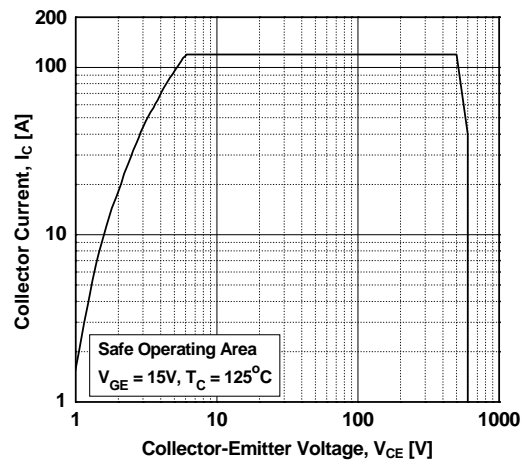
**Figure 16. Switching Loss vs. Gate Resistance**



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



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



## Typical Performance Characteristics

Figure 19. Forward Characteristics

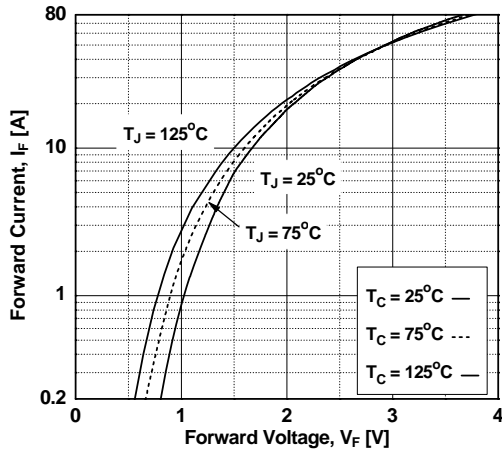


Figure 20. Typical Reverse Current vs. Reverse Voltage

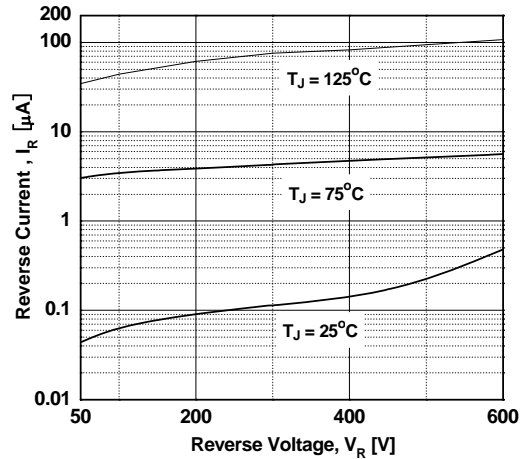


Figure 21. Stored Charge

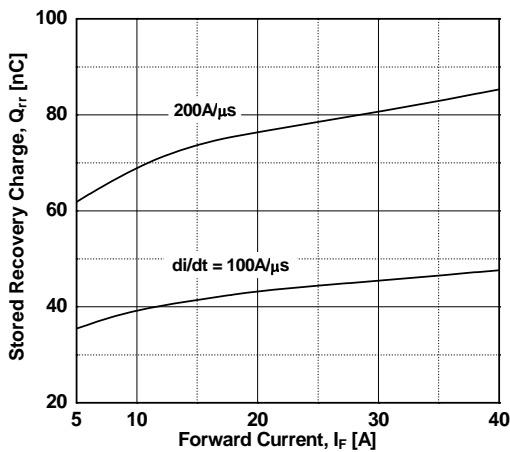


Figure 22. Reverse Recovery Time

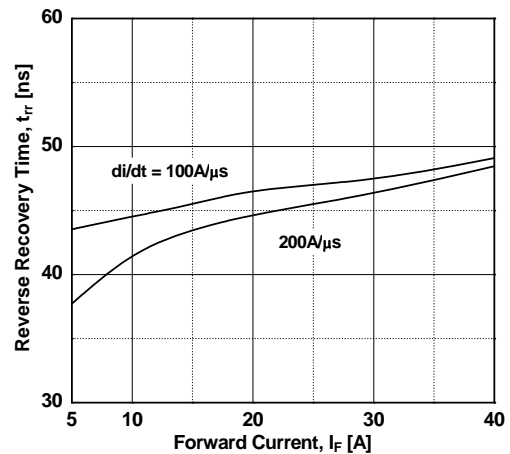
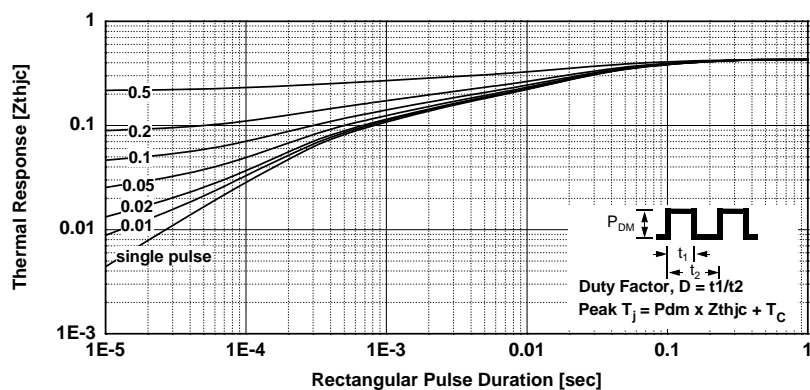
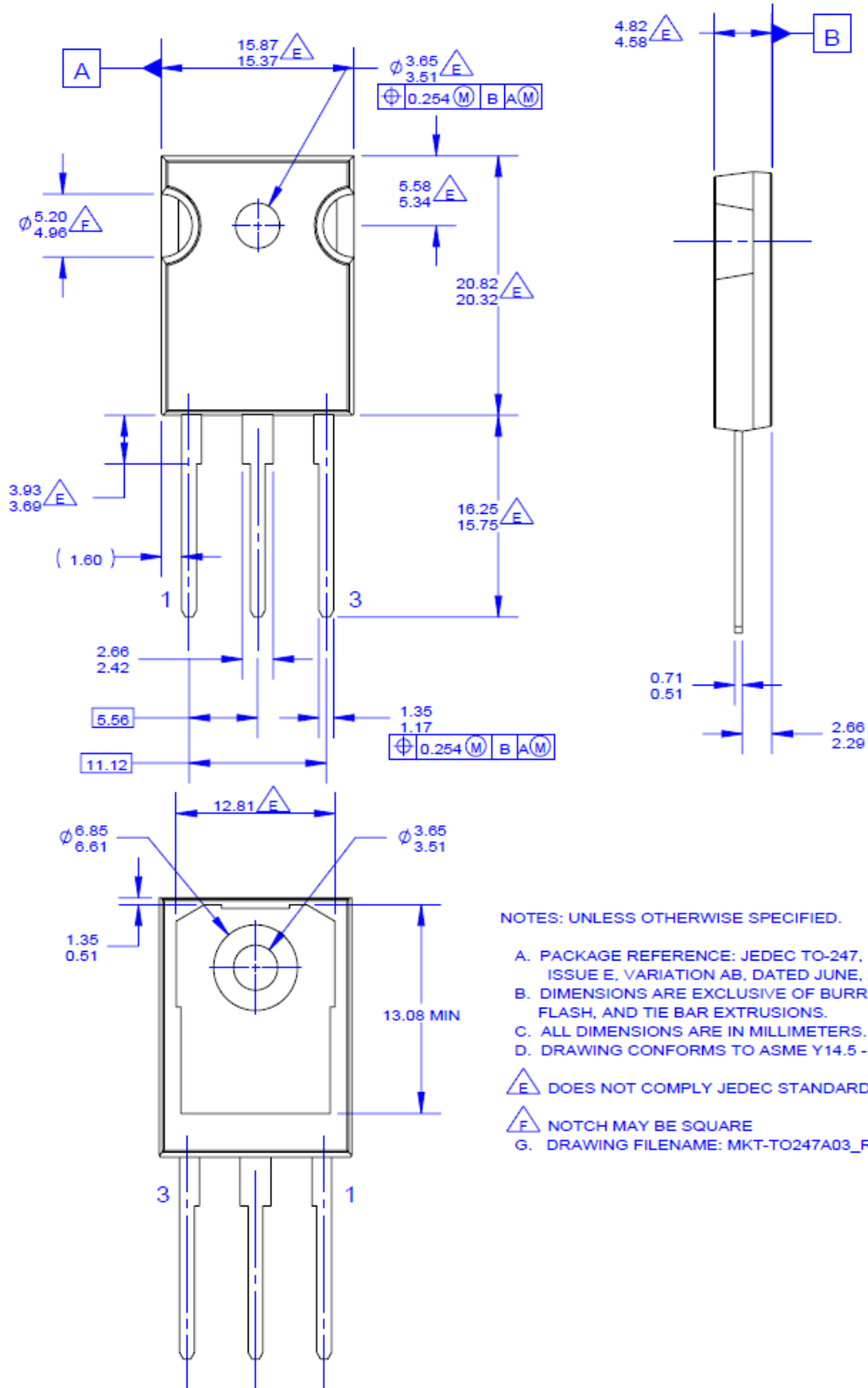


Figure 23. Transient Thermal Impedance of IGBT



Mechanical Dimensions

TO-247A03



NOTES: UNLESS OTHERWISE SPECIFIED.

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- B. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
- C. ALL DIMENSIONS ARE IN MILLIMETERS.
- D. DRAWING CONFORMS TO ASME Y14.5 - 1994
- (E) DOES NOT COMPLY JEDEC STANDARD VALUE
- (M) NOTCH MAY BE SQUARE
- G. DRAWING FILENAME: MKT-TO247A03\_REV03





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| AX-CAP®*                 | FRFET®                                          | TinyBoost™       |
| BitSIC™                  | Global Power Resource <sup>SM</sup>             | TinyBuck™        |
| Build it Now™            | Green Bridge™                                   | TinyCalc™        |
| CorePLUS™                | Green FPS™                                      | TinyLogic®       |
| CorePOWER™               | Green FPS™ e-Series™                            | TINYOPTO™        |
| CROSSVOLT™               | Gmax™                                           | TinyPower™       |
| CTL™                     | GTO™                                            | TinyPWM™         |
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| ESBC™                    | MicroFET™                                       | SerDes™          |
| Fairchild®               | MicroPak™                                       | UHC®             |
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| FACT Quiet Series™       | MillerDrive™                                    | UniFET™          |
| FACT®                    | MotionMax™                                      | VCX™             |
| FAST®                    | mWSaver™                                        | VisualMax™       |
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| FETBench™                | OPTOLOGIC®                                      | XST™             |
|                          | OPTOPLANAR®                                     |                  |
|                          | PowerTrench®                                    |                  |
|                          | PowerXS™                                        |                  |
|                          | Programmable Active Droop™                      |                  |
|                          | QFET®                                           |                  |
|                          | QS™                                             |                  |
|                          | Quiet Series™                                   |                  |
|                          | RapidConfigure™                                 |                  |
|                          | SignalWise™                                     |                  |
|                          | Saving our world, 1mW/W/kW at a time™           |                  |
|                          | SMARTMax™                                       |                  |
|                          | SMART START™                                    |                  |
|                          | Solutions for Your Success™                     |                  |
|                          | SPM®                                            |                  |
|                          | STEALTH™                                        |                  |
|                          | SuperFET®                                       |                  |
|                          | SuperSOT™-3                                     |                  |
|                          | SuperSOT™-6                                     |                  |
|                          | SuperSOT™-8                                     |                  |
|                          | SupreMOS®                                       |                  |
|                          | SyncFET™                                        |                  |

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