

# FGH40N60SMDF

## 600 V, 40 A Field Stop IGBT

### Features

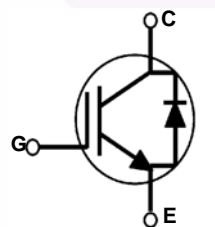
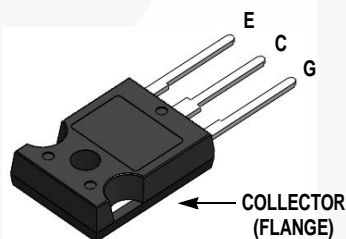
- Maximum Junction Temperature :  $T_J = 175^\circ\text{C}$
- Positive Temperature Co-efficient for Easy Parallel Operating
- High Current Capability
- Low Saturation Voltage:  $V_{CE(sat)} = 1.9\text{ V(Typ.)}$  @  $I_C = 40\text{ A}$
- High Input Impedance
- Fast Switching:  $E_{OFF} = 6.5\text{ uJ/A}$
- Tightened Parameter Distribution
- RoHS Compliant

### Applications

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

### General Description

Using Novel Field Stop IGBT Technology, Fairchild's new series of field stop 2<sup>nd</sup> generation IGBTs offer the optimum performance for solar inverter, UPS, welder, telecom, ESS and PFC applications where low conduction and switching losses 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 @ $T_C = 25^\circ\text{C}$	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 @ $T_C = 25^\circ\text{C}$	349	W
	Maximum Power Dissipation @ $T_C = 100^\circ\text{C}$	174	W
$T_J$	Operating Junction Temperature	-55 to +175	$^\circ\text{C}$
$T_{stg}$	Storage Temperature Range	-55 to +175	$^\circ\text{C}$
$T_L$	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

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FGH40N60SMDF	FGH40N60SMDF	TO-247	Tube	N/A	N/A	30

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Off Characteristics						
BV <sub>CES</sub>	Collector to Emitter Breakdown Voltage	V <sub>GE</sub> = 0 V, I <sub>C</sub> = 250 μA	600	-	-	V
$\frac{\Delta BV_{CES}}{\Delta T_J}$	Temperature Coefficient of Breakdown Voltage	V <sub>GE</sub> = 0 V, I <sub>C</sub> = 250 μA	-	0.6	-	V/°C
I <sub>CES</sub>	Collector Cut-Off Current	V <sub>CE</sub> = V <sub>CES</sub> , V <sub>GE</sub> = 0 V	-	-	250	μA
I <sub>GES</sub>	G-E Leakage Current	V <sub>GE</sub> = V <sub>GES</sub> , V <sub>CE</sub> = 0 V	-	-	±400	nA
On Characteristics						
V <sub>GE(th)</sub>	G-E Threshold Voltage	I <sub>C</sub> = 250 μA, V <sub>CE</sub> = V <sub>GE</sub>	3.5	4.6	6.0	V
V <sub>CE(sat)</sub>	Collector to Emitter Saturation Voltage	I <sub>C</sub> = 40 A, V <sub>GE</sub> = 15 V	-	1.9	2.5	V
		I <sub>C</sub> = 40 A, V <sub>GE</sub> = 15 V, T <sub>C</sub> = 150°C	-	2.1	-	V
Dynamic Characteristics						
C <sub>ies</sub>	Input Capacitance	V <sub>CE</sub> = 30 V, V <sub>GE</sub> = 0 V, f = 1 MHz	-	1880	-	pF
C <sub>oes</sub>	Output Capacitance		-	180	-	pF
C <sub>res</sub>	Reverse Transfer Capacitance		-	50	-	pF
Switching Characteristics						
t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>CC</sub> = 400 V, I <sub>C</sub> = 40 A, R <sub>G</sub> = 6 Ω, V <sub>GE</sub> = 15 V, Inductive Load, T <sub>C</sub> = 25°C	-	12	-	ns
t <sub>r</sub>	Rise Time		-	20	-	ns
t <sub>d(off)</sub>	Turn-Off Delay Time		-	92	-	ns
t <sub>f</sub>	Fall Time		-	13	20	ns
E <sub>on</sub>	Turn-On Switching Loss		-	1.3	-	mJ
E <sub>off</sub>	Turn-Off Switching Loss		-	0.26	-	mJ
E <sub>ts</sub>	Total Switching Loss	V <sub>CC</sub> = 400 V, I <sub>C</sub> = 40 A, R <sub>G</sub> = 6 Ω, V <sub>GE</sub> = 15 V, Inductive Load, T <sub>C</sub> = 150°C	-	1.56	-	mJ
t <sub>d(on)</sub>	Turn-On Delay Time		-	12	-	ns
t <sub>r</sub>	Rise Time		-	19	-	ns
t <sub>d(off)</sub>	Turn-Off Delay Time		-	97	-	ns
t <sub>f</sub>	Fall Time		-	14	21	ns
E <sub>on</sub>	Turn-On Switching Loss		-	2.09	-	mJ
E <sub>off</sub>	Turn-Off Switching Loss	V <sub>CE</sub> = 400 V, I <sub>C</sub> = 40 A, V <sub>GE</sub> = 15 V	-	0.44	-	mJ
E <sub>ts</sub>	Total Switching Loss		-	2.53	-	mJ
Q <sub>g</sub>	Total Gate Charge		-	119	-	nC
Q <sub>ge</sub>	Gate to Emitter Charge	V <sub>CE</sub> = 400 V, I <sub>C</sub> = 40 A, V <sub>GE</sub> = 15 V	-	13	-	nC
Q <sub>gc</sub>	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	$I_F = 20\text{ A}$	$T_C = 25^\circ\text{C}$	-	1.3	1.7	V
			$T_C = 150^\circ\text{C}$	-	1.2		
$t_{rr}$	Diode Reverse Recovery Time	$I_F = 20\text{ A}, di_F/dt = 200\text{ A}/\mu\text{s}$	$T_C = 25^\circ\text{C}$	-	70	90	ns
			$T_C = 150^\circ\text{C}$	-	126		
$Q_{rr}$	Diode Reverse Recovery Charge		$T_C = 25^\circ\text{C}$	-	207	290	nC
			$T_C = 150^\circ\text{C}$	-	638		

## Typical Performance Characteristics

Figure 1. Typical Output Characteristics

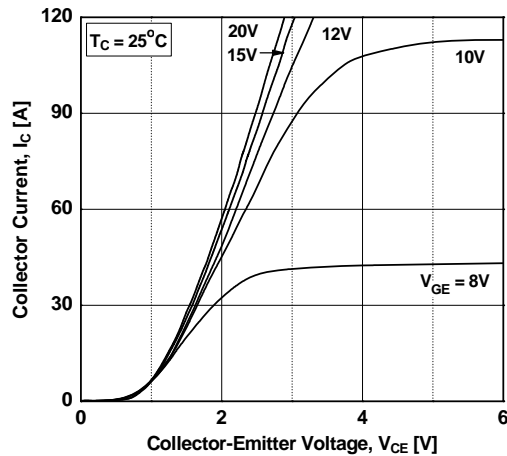


Figure 2. Typical Output Characteristics

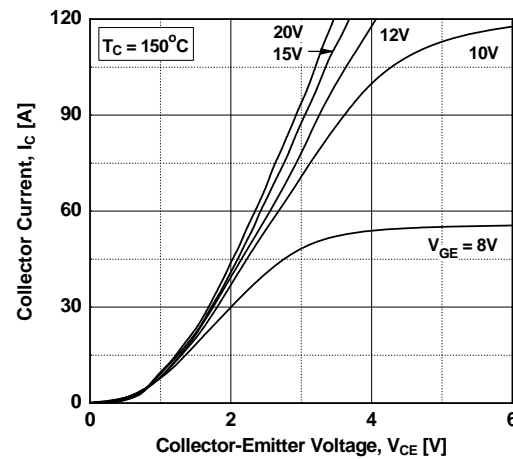


Figure 3. Typical Saturation Voltage Characteristics

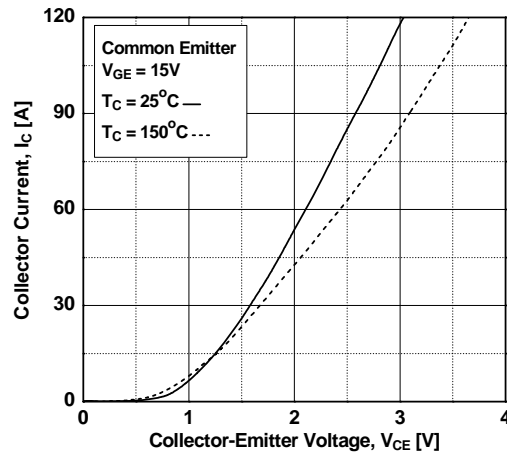


Figure 4. Transfer Characteristics

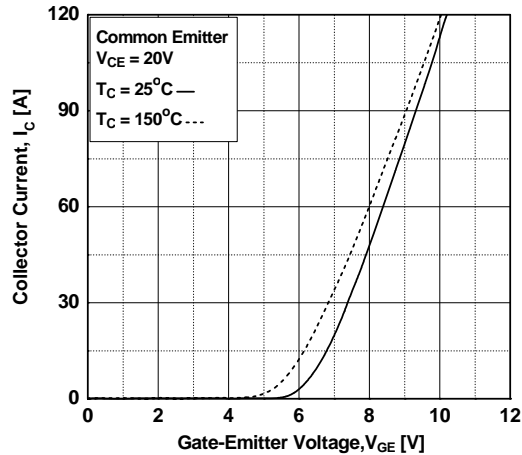


Figure 5. Saturation Voltage vs. Case Temperature at Variant Current Level

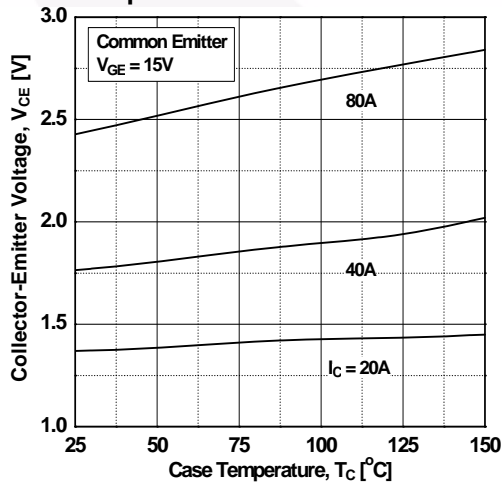
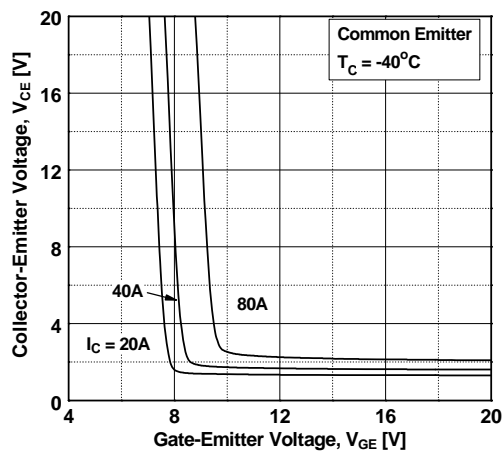


Figure 6. Saturation Voltage vs.  $V_{GE}$



## Typical Performance Characteristics

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

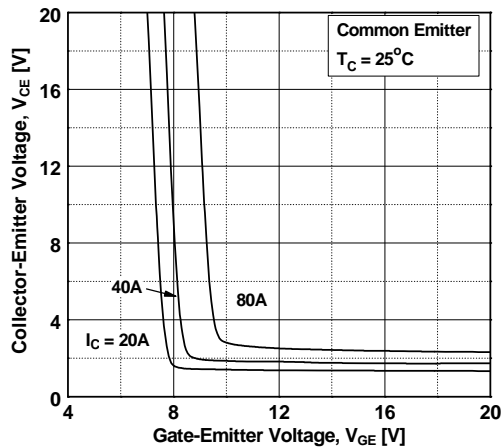


Figure 8. Saturation Voltage vs.  $V_{GE}$

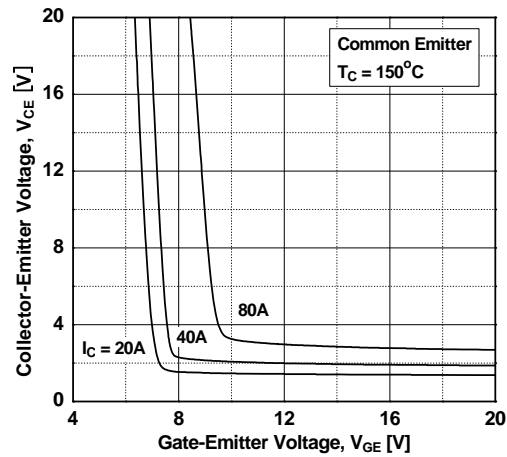


Figure 9. Capacitance Characteristics

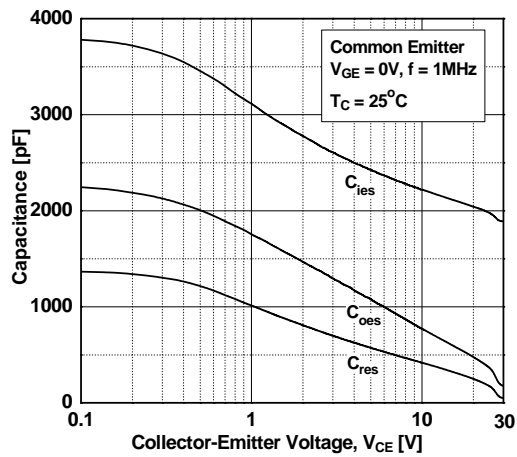


Figure 10. Gate charge Characteristics

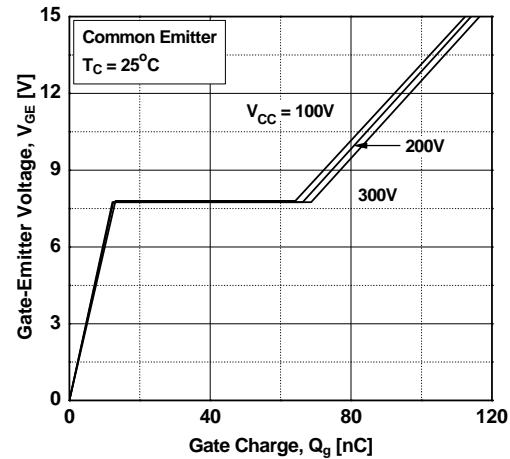


Figure 11. SOA Characteristics

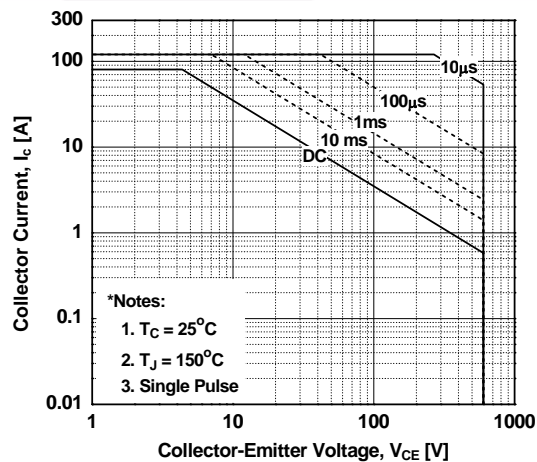
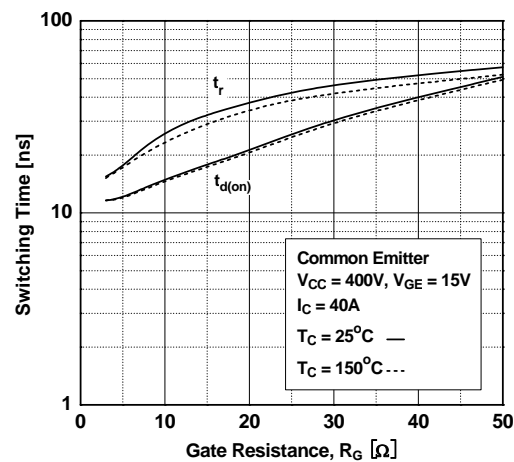


Figure 12. Turn-on Characteristics vs. Gate Resistance



## Typical Performance Characteristics

Figure 13. Turn-off Characteristics vs. Gate Resistance

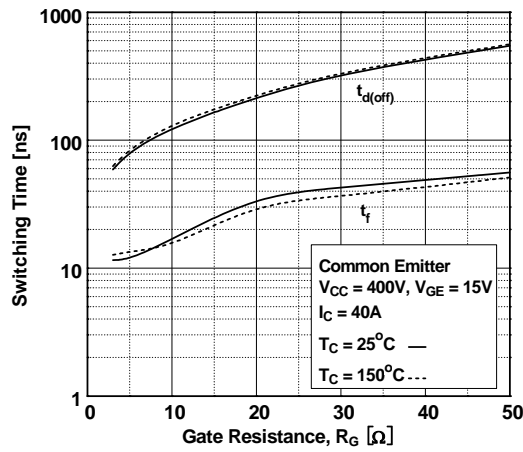


Figure 14. Turn-on Characteristics vs. Collector Current

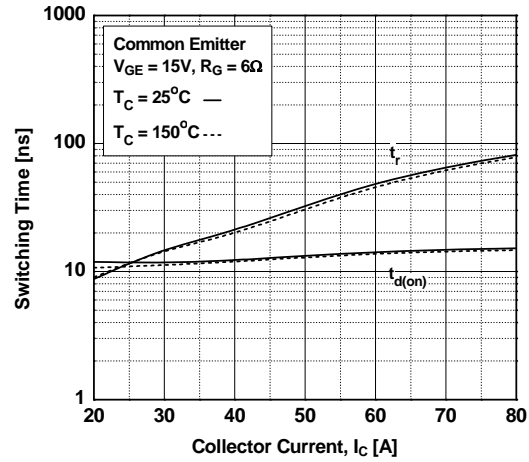


Figure 15. Turn-off Characteristics vs. Collector Current

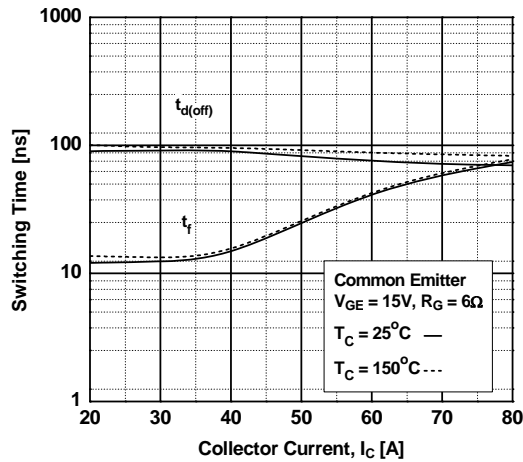


Figure 16. Switching Loss vs. Gate Resistance

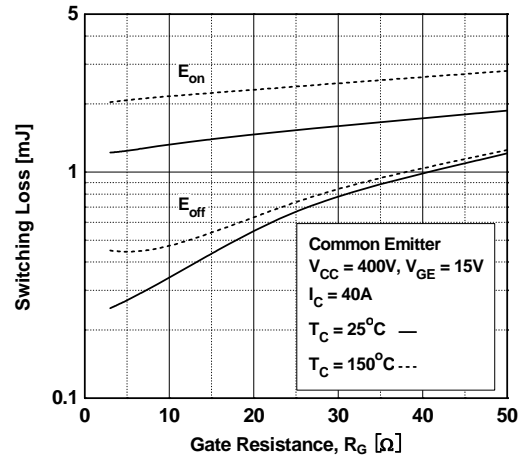


Figure 17. Switching Loss vs. Collector Current

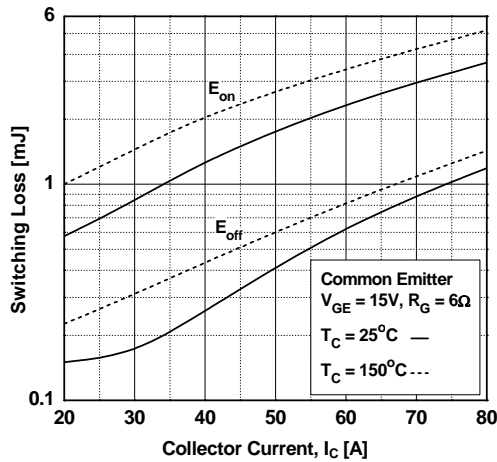
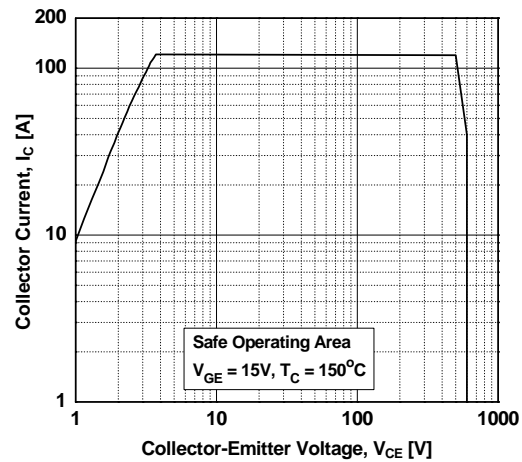


Figure 18. Turn off Switching SOA Characteristics



## Typical Performance Characteristics

Figure 19. Forward Characteristics

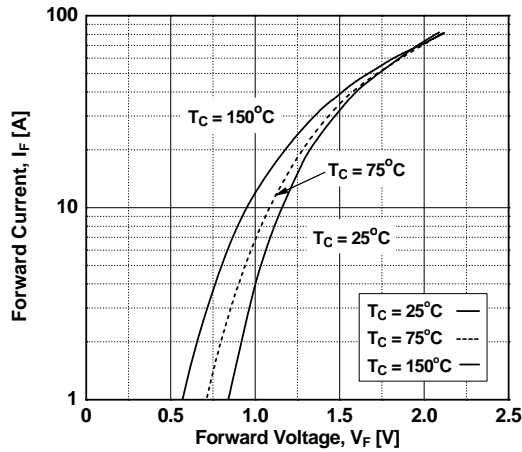


Figure 20. Reverse Current

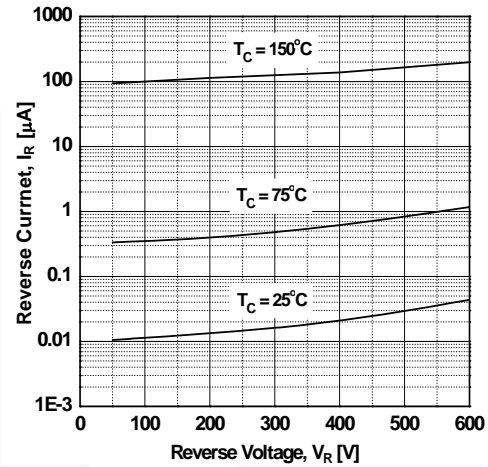


Figure 21. Stored Charge

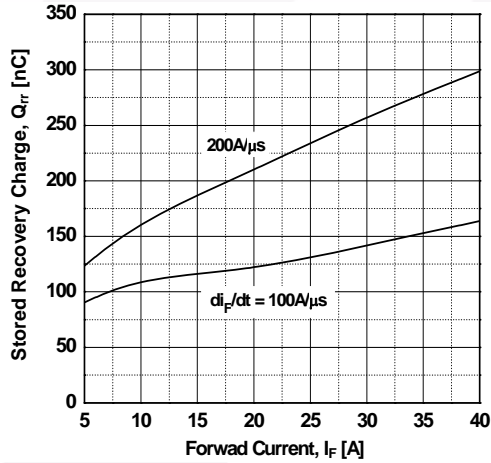


Figure 22. Reverse Recovery Time

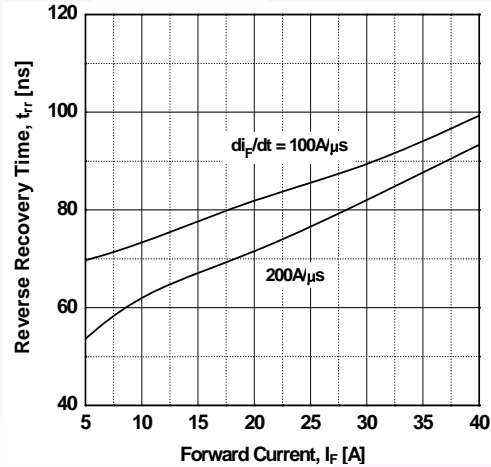
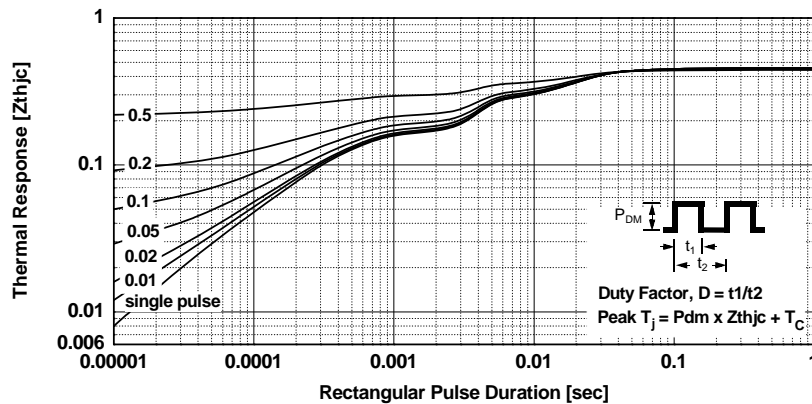


Figure 23. Transient Thermal Impedance of IGBT



Technical drawing of a 3-pin connector, showing three views: front, side, and top. The drawing includes dimensions and surface texture symbols (E).

**Front View Dimensions:**

- Top width: 15.87 (E), 15.37
- Central hole diameter:  $\phi 5.20$  (E), 4.96
- Pin diameter: 3.93 (E), 3.69
- Pin spacing (1.60)
- Pin 1 and Pin 3 labels
- Bottom width: 2.66, 2.42
- Bottom width (5.56)
- Bottom width (11.12)
- Bottom width (1.35, 1.17)
- Bottom width (0.254 (M), B A (M))

**Side View Dimensions:**

- Height: 4.82 (E), 4.58
- Pin diameter: 0.71, 0.51

**Top View Dimensions:**

- Top width: 12.81 (E)
- Central hole diameter:  $\phi 6.85$  (E), 6.61
- Pin diameter: 1.35 (E), 0.51
- Pin 3 and Pin 1 labels
- Bottom width: 13.08 MIN
- Bottom width (2.66, 2.29)

- A. PACKAGE REFERENCE: JEDEC TO-247, ISSUE E, VARIATION AB, DATED JUNE, 2004.
- B. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
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

G. DRAWING FILENAME: MKT-TO247A03\_REV03

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