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April 2015

# FGH40T120SMDL4

## 1200 V, 40 A FS Trench IGBT

### Features

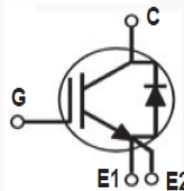
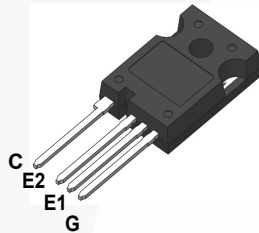
- FS Trench Technology, Positive Temperature Coefficient
- Excellent Switching Performance due to Kelvin Emitter Pin
- Low Saturation Voltage:  $V_{CE(sat)} = 1.8 \text{ V} @ I_C = 40 \text{ A}$
- 100% of the Parts tested for  $I_{LM}(1)$
- High Input Impedance
- RoHS Compliant

### General Description

Using innovative field stop trench IGBT technology, Fairchild®'s new series of field stop trench IGBTs offer the optimum performance for hard switching application such as solar inverter, UPS, welder and PFC applications.

### Applications

- Solar Inverter, Welder, UPS and PFC applications



E1: Kelvin Emitter  
E2: Power Emitter

### Absolute Maximum Ratings $T_C = 25^\circ\text{C}$ unless otherwise noted.

Symbol	Description	FGH40T120SMDL4	Unit
$V_{CES}$	Collector to Emitter Voltage	1200	V
$V_{GES}$	Gate to Emitter Voltage	$\pm 25$	V
	Transient Gate to Emitter Voltage	$\pm 30$	
$I_C$	Collector Current	@ $T_C = 25^\circ\text{C}$	A
	Collector Current	@ $T_C = 100^\circ\text{C}$	
$I_{LM}(1)$	Clamped Inductive Load Current	@ $T_C = 25^\circ\text{C}$	A
$I_{CM}(2)$	Pulsed Collector Current	160	A
$I_F$	Diode Continuous Forward Current	@ $T_C = 25^\circ\text{C}$	A
	Diode Continuous Forward Current	@ $T_C = 100^\circ\text{C}$	
$I_{FM}$	Diode Maximum Forward Current	240	A
$P_D$	Maximum Power Dissipation	@ $T_C = 25^\circ\text{C}$	W
	Maximum Power Dissipation	@ $T_C = 100^\circ\text{C}$	
$T_J$	Operating Junction Temperature	-55 to +175	$^\circ\text{C}$
$T_{stg}$	Storage Temperature Range	-55 to +175	$^\circ\text{C}$
$T_L$	Maximum Lead Temperature for Soldering, 1/8" from Case for 5 Seconds	300	$^\circ\text{C}$

### Thermal Characteristics

Symbol	Parameter	FGH40T120SMDL4	Unit
$R_{\theta JC}(\text{IGBT})$	Thermal Resistance, Junction to Case	0.27	$^\circ\text{C}/\text{W}$
$R_{\theta JC}(\text{Diode})$	Thermal Resistance, Junction to Case	0.89	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	40	$^\circ\text{C}/\text{W}$

#### Notes:

1.  $V_{CC} = 600 \text{ V}$ ,  $V_{GE} = 15 \text{ V}$ ,  $I_C = 160 \text{ A}$ ,  $R_G = 20 \Omega$ , inductive load.
2. Limited by  $T_{Jmax}$ .

## Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FGH40T120SMDL4	FGH40T120SMDL4	TO-247 A04	-	-	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 uA	1200	-	-	V
I <sub>CES</sub>	Collector Cut-Off Current	V <sub>CE</sub> = V <sub>CES</sub> , V <sub>GE</sub> = 0 V	-	-	250	uA
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> = 40 mA, V <sub>CE</sub> = V <sub>GE</sub>	4.9	6.2	7.5	V
V <sub>CE(sat)</sub>	Collector to Emitter Saturation Voltage	I <sub>C</sub> = 40 A, V <sub>GE</sub> = 15 V, T <sub>C</sub> = 25°C	-	1.8	2.4	V
		I <sub>C</sub> = 40 A, V <sub>GE</sub> = 15 V, T <sub>C</sub> = 175°C	-	2.0	-	V
Dynamic Characteristics						
C <sub>ies</sub>	Input Capacitance	V <sub>CE</sub> = 30 V, V <sub>GE</sub> = 0 V, f = 1MHz	-	4300	-	pF
C <sub>oes</sub>	Output Capacitance		-	180	-	pF
C <sub>res</sub>	Reverse Transfer Capacitance		-	100	-	pF
Switching Characcteristics						
t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>CC</sub> = 600 V, I <sub>C</sub> = 40 A, R <sub>G</sub> = 10 Ω, V <sub>GE</sub> = 15 V, Inductive Load, T <sub>C</sub> = 25°C	-	44	-	ns
t <sub>r</sub>	Rise Time		-	42	-	ns
t <sub>d(off)</sub>	Turn-Off Delay Time		-	464	-	ns
t <sub>f</sub>	Fall Time		-	24	-	ns
E <sub>on</sub>	Turn-On Switching Loss		-	2.24	-	mJ
E <sub>off</sub>	Turn-Off Switching Loss		-	1.02	-	mJ
E <sub>ts</sub>	Total Switching Loss		-	3.26	-	mJ
t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>CC</sub> = 600 V, I <sub>C</sub> = 40 A, R <sub>G</sub> = 10 Ω, V <sub>GE</sub> = 15 V, Inductive Load, T <sub>C</sub> = 175°C	-	42	-	ns
t <sub>r</sub>	Rise Time		-	48	-	ns
t <sub>d(off)</sub>	Turn-Off Delay Time		-	518	-	ns
t <sub>f</sub>	Fall Time		-	24	-	ns
E <sub>on</sub>	Turn-On Switching Loss		-	3.11	-	mJ
E <sub>off</sub>	Turn-Off Switching Loss		-	2.01	-	mJ
E <sub>ts</sub>	Total Switching Loss		-	5.12	-	mJ
Q <sub>g</sub>	Total Gate Charge	V <sub>CE</sub> = 600 V, I <sub>C</sub> = 40 A, V <sub>GE</sub> = 15 V	-	370	-	nC
Q <sub>ge</sub>	Gate to Emitter Charge		-	23	-	nC
Q <sub>gc</sub>	Gate to Collector Charge		-	210	-	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	$I_F = 40\text{ A}, T_C = 25^\circ\text{C}$	-	3.8	4.8	V
		$I_F = 40\text{ A}, T_C = 175^\circ\text{C}$	-	2.7	-	V
$t_{rr}$	Diode Reverse Recovery Time	$V_R = 600\text{ V}, I_F = 40\text{ A},$ $di_F/dt = 200\text{ A/us}, T_C = 25^\circ\text{C}$	-	65	-	ns
$I_{rr}$	Diode Peak Reverse Recovery Current		-	7.2	-	A
$Q_{rr}$	Diode Reverse Recovery Charge		-	234	-	nC
$t_{rr}$	Diode Reverse Recovery Time	$V_R = 600\text{ V}, I_F = 40\text{ A},$ $di_F/dt = 200\text{ A/us}, T_C = 175^\circ\text{C}$	-	200	-	ns
$I_{rr}$	Diode Peak Reverse Recovery Current		-	18.0	-	A
$Q_{rr}$	Diode Reverse Recovery Charge		-	1800	-	nC

## Typical Performance Characteristics

Figure 1. Typical Output Characteristics

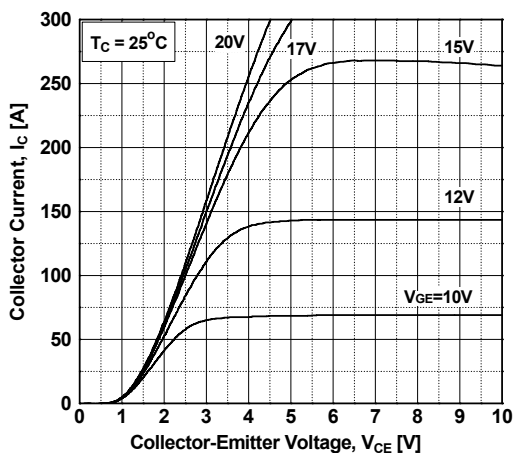


Figure 2. Typical Output Characteristics

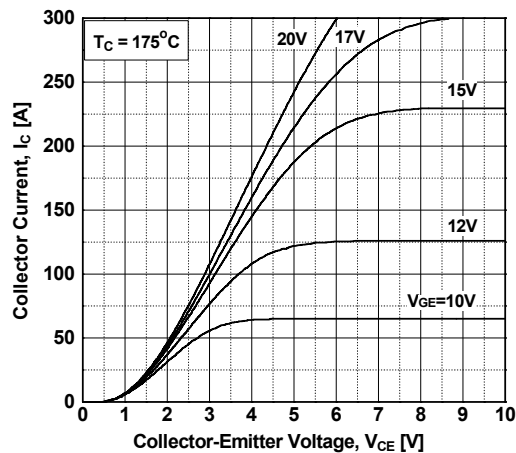


Figure 3. Typical Saturation Voltage Characteristics

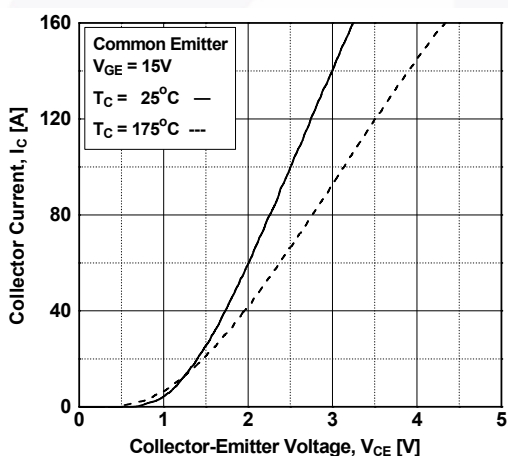


Figure 4. Saturation Voltage vs. Case Temperature at Variant Current Level

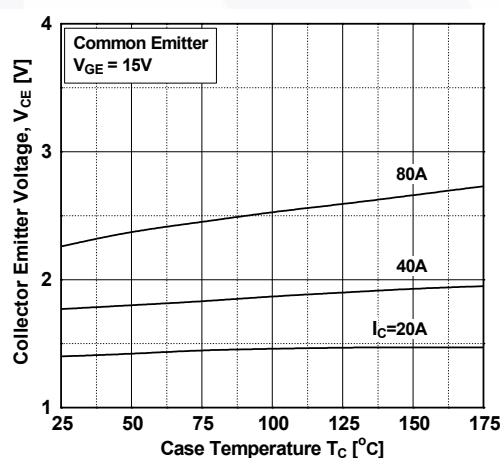


Figure 5. Saturation Voltage vs.  $V_{GE}$

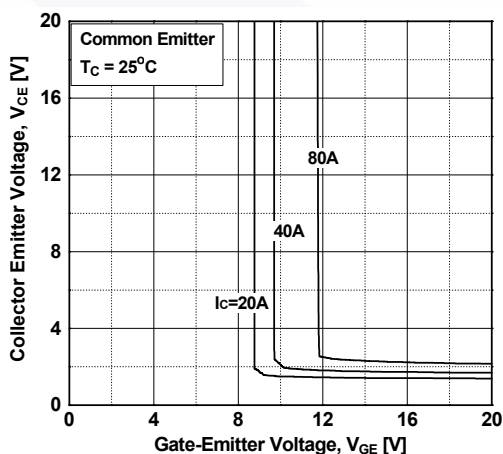
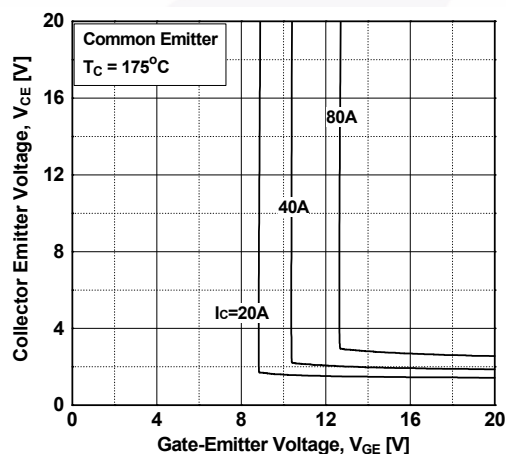


Figure 6. Saturation Voltage vs.  $V_{GE}$



## Typical Performance Characteristics

Figure 7. Capacitance Characteristics

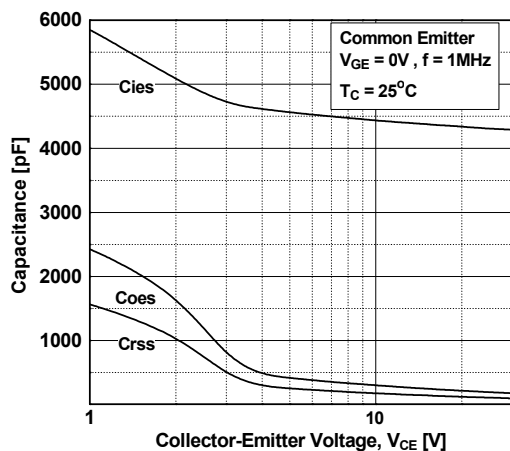


Figure 8. Gate Charge Characteristics

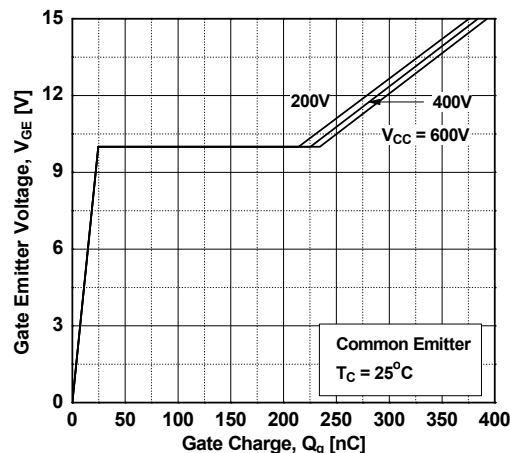


Figure 9. Turn-on Characteristics vs. Gate Resistance

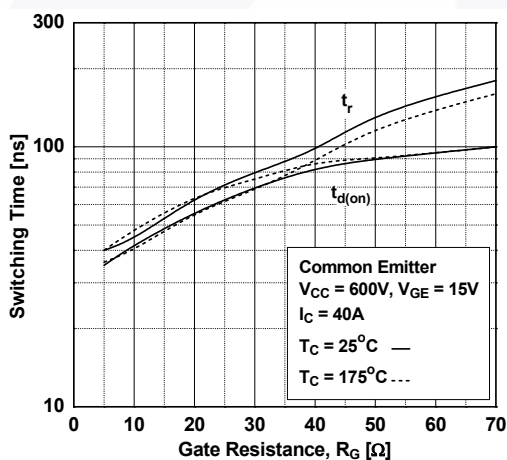


Figure 10. Turn-off Characteristics vs. Gate Resistance

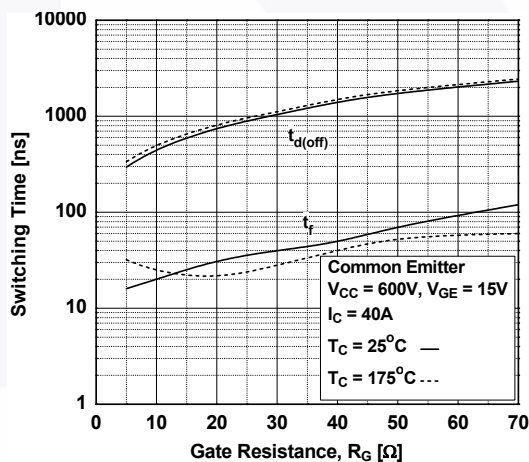


Figure 11. Switching Loss vs. Gate Resistance

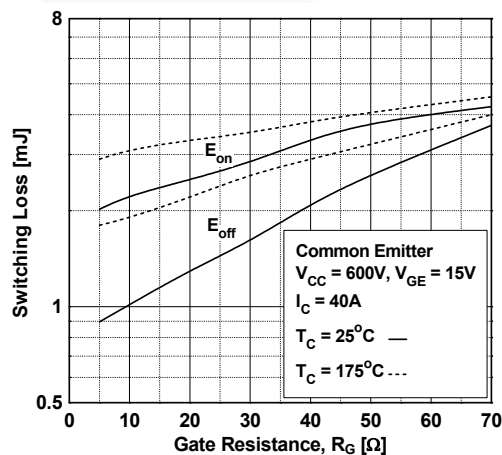
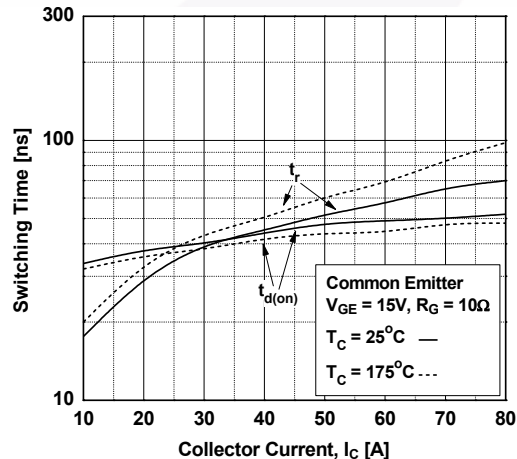


Figure 12. Turn-on Characteristics vs. Collector Current



## Typical Performance Characteristics

Figure 13. Turn-off Characteristics vs. Collector Current

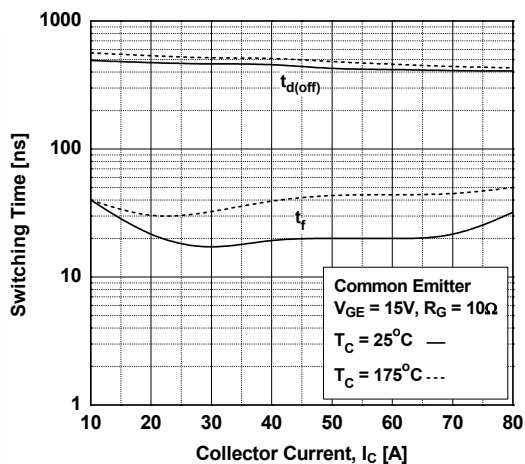


Figure 14. Switching Loss vs. Collector Current

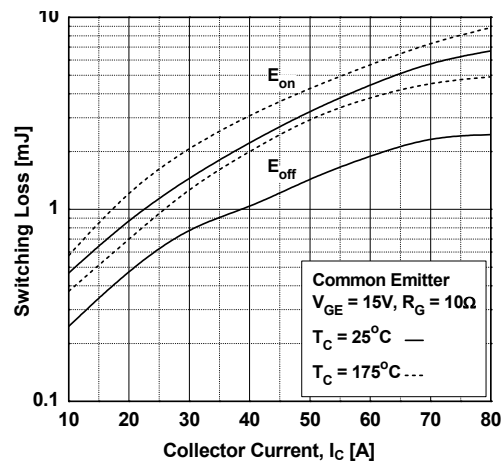


Figure 15. Load Current vs. Frequency

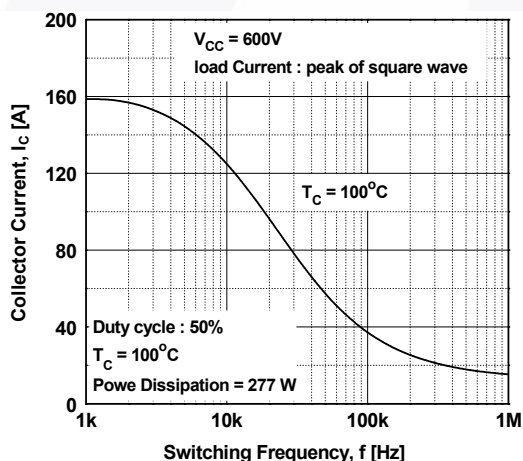


Figure 16. SOA Characteristics

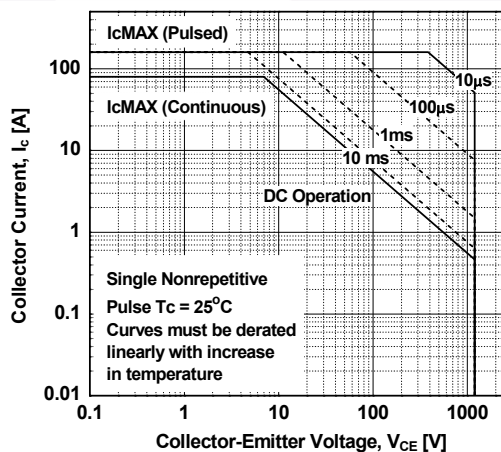


Figure 17. Forward Characteristics

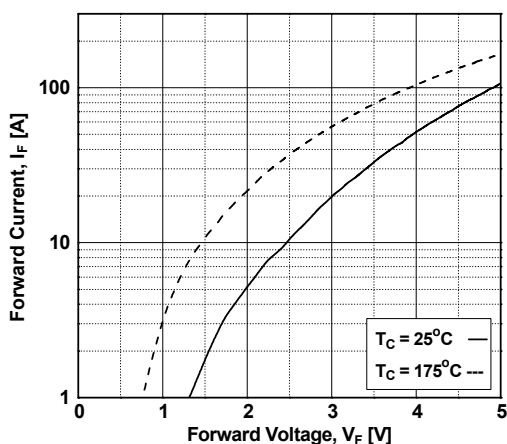
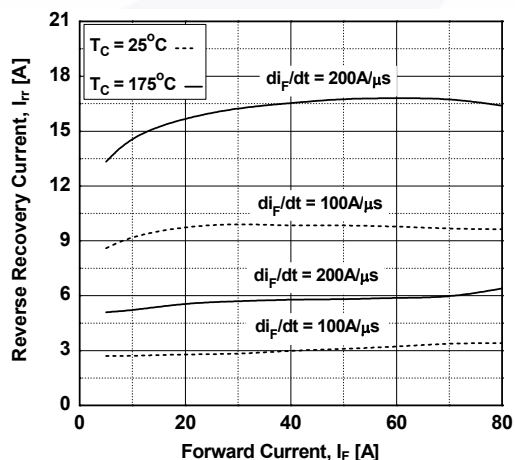


Figure 18. Reverse Recovery Current



## Typical Performance Characteristics

Figure 19. Reverse Recovery Time

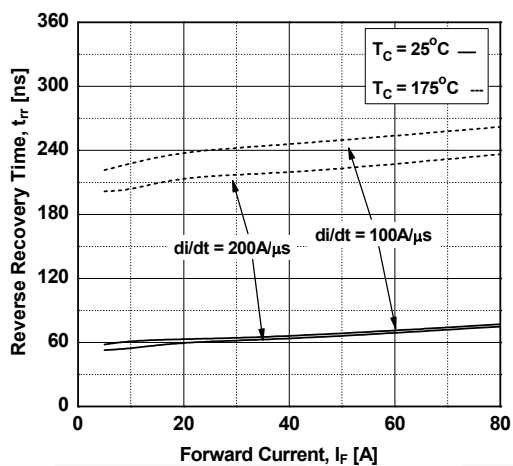


Figure 20. Stored Charge

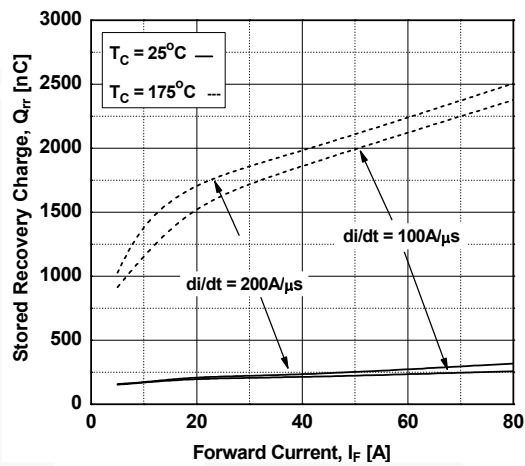


Figure 21. Transient Thermal Impedance of IGBT

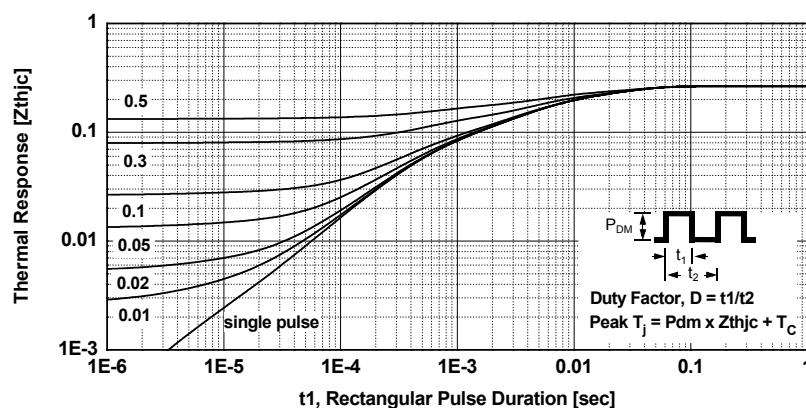
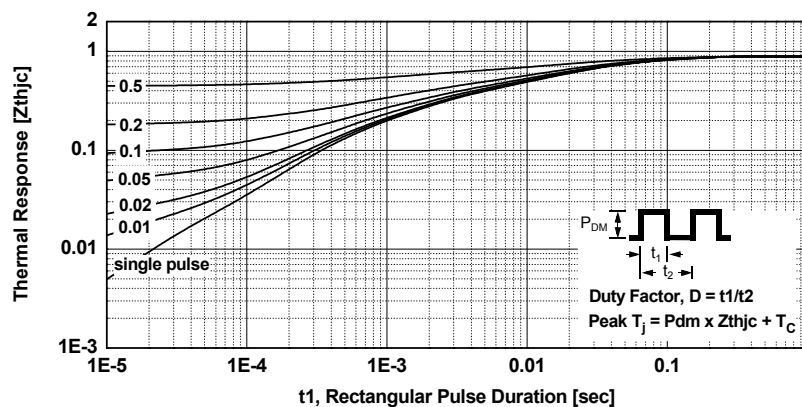
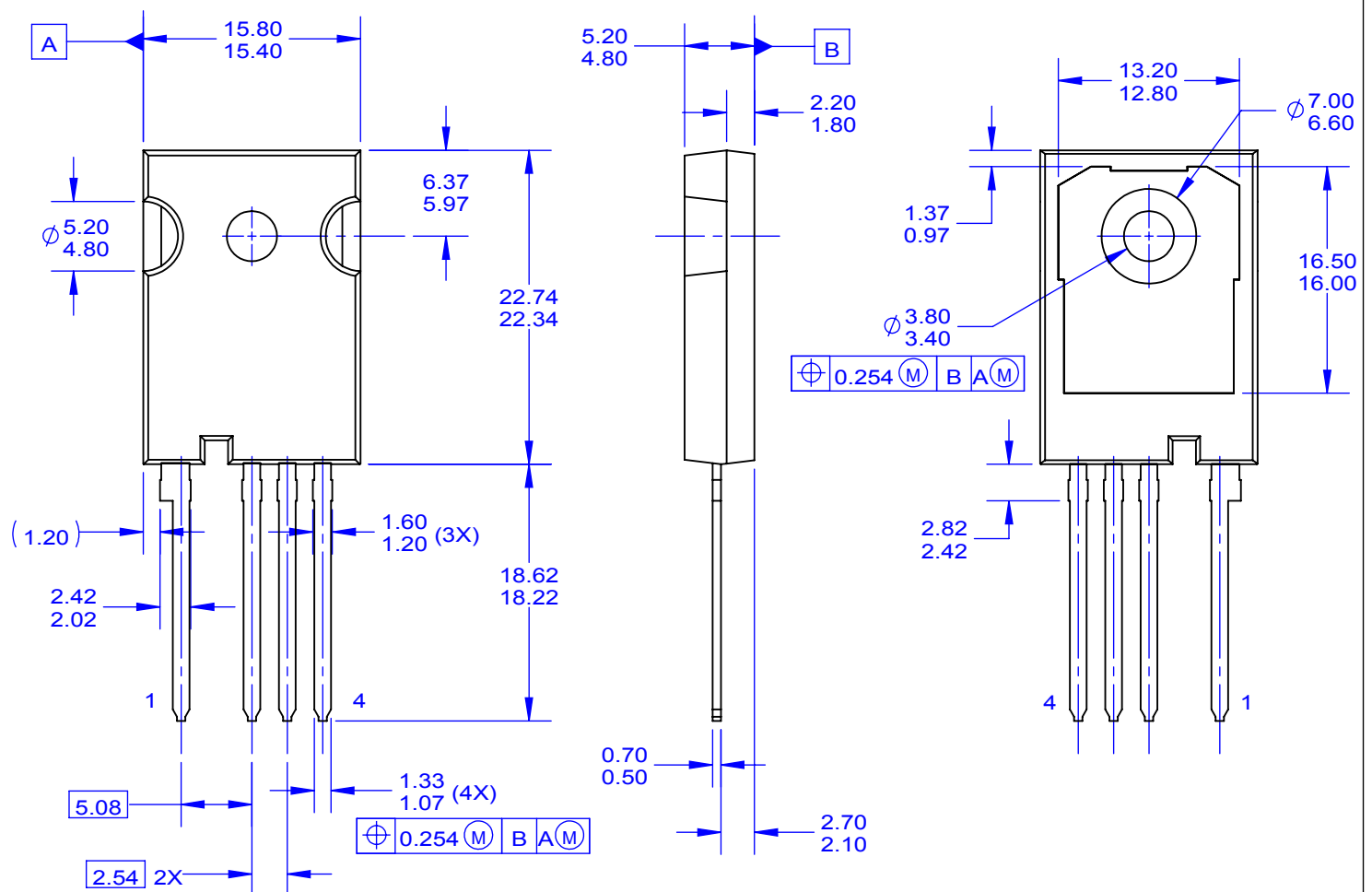


Figure 22. Transient Thermal Impedance of Diode







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