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ON Semiconductor®

# FGH40T120SMD / FGH40T120SMD-F155

## 1200 V, 40 A FS Trench IGBT

### Features

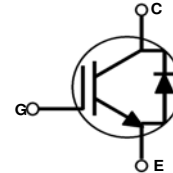
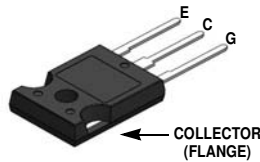
- FS Trench Technology, Positive Temperature Coefficient
- High Speed Switching
- Low Saturation Voltage:  $V_{CE(sat)} = 1.8 \text{ V @ } I_C = 40 \text{ A}$
- 100% of the Parts tested for  $I_{LM}(1)$
- High Input Impedance
- RoHS Compliant

### General Description

Using innovative field stop trench IGBT technology, ON Semiconductor'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 & PFC applications.



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

Symbol	Description	Ratings	Unit
$V_{CES}$	Collector to Emitter Voltage	1200	V
$V_{GES}$	Gate to Emitter Voltage	$\pm 25$	V
	Transient Gate to Emitter Voltage	$\pm 30$	V
$I_C$	Collector Current @ $T_C = 25^\circ\text{C}$	80	A
	Collector Current @ $T_C = 100^\circ\text{C}$	40	A
$I_{LM}(1)$	Clamped Inductive Load Current @ $T_C = 25^\circ\text{C}$	160	A
$I_{CM}(2)$	Pulsed Collector Current	160	A
$I_F$	Diode Continuous Forward Current @ $T_C = 25^\circ\text{C}$	80	A
	Diode Continuous Forward Current @ $T_C = 100^\circ\text{C}$	40	A
$I_{FM}$	Diode Maximum Forward Current	240	A
$P_D$	Maximum Power Dissipation @ $T_C = 25^\circ\text{C}$	555	W
	Maximum Power Dissipation @ $T_C = 100^\circ\text{C}$	277	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	$^\circ\text{C}$

### Thermal Characteristics

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

**Notes:**

1.  $V_{CC} = 600 \text{ V}, V_{GE} = 15 \text{ V}, I_C = 160 \text{ A}, R_G = 10 \Omega$ . Inductive Load
2. Limited by  $T_{jmax}$

### Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FGH40T120SMD	FGH40T120SMD	TO-247 A03	-	-	30
FGH40T120SMD	FGH40T120SMD-F155	TO-247G03	-	-	30

### 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	$V_{GE} = 0\text{ V}, I_C = 250\text{ }\mu\text{A}$	1200	-	-	V
$I_{CES}$	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	$I_C = 40\text{ mA}, V_{CE} = V_{GE}$	4.9	6.2	7.5	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C = 40\text{ A}, V_{GE} = 15\text{ V}$ $T_C = 25^\circ\text{C}$	-	1.8	2.4	V
		$I_C = 40\text{ A}, V_{GE} = 15\text{ V},$ $T_C = 175^\circ\text{C}$	-	2.0	-	V
<b>Dynamic Characteristics</b>						
$C_{ies}$	Input Capacitance	$V_{CE} = 30\text{ V}, V_{GE} = 0\text{ V},$ $f = 1\text{ MHz}$	-	4300	-	pF
$C_{oes}$	Output Capacitance		-	180	-	pF
$C_{res}$	Reverse Transfer Capacitance		-	100	-	pF
<b>Switching Characteristics</b>						
$t_{d(on)}$	Turn-On Delay Time	$V_{CC} = 600\text{ V}, I_C = 40\text{ A},$ $R_G = 10\text{ }\Omega, V_{GE} = 15\text{ V},$ Inductive Load, $T_C = 25^\circ\text{C}$	-	40	-	ns
$t_r$	Rise Time		-	47	-	ns
$t_{d(off)}$	Turn-Off Delay Time		-	475	-	ns
$t_f$	Fall Time		-	10	-	ns
$E_{on}$	Turn-On Switching Loss		-	2.7	-	mJ
$E_{off}$	Turn-Off Switching Loss		-	1.1	-	mJ
$E_{ts}$	Total Switching Loss	-	3.8	-	mJ	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC} = 600\text{ V}, I_C = 40\text{ A},$ $R_G = 10\text{ }\Omega, V_{GE} = 15\text{ V},$ Inductive Load, $T_C = 175^\circ\text{C}$	-	40	-	ns
$t_r$	Rise Time		-	55	-	ns
$t_{d(off)}$	Turn-Off Delay Time		-	520	-	ns
$t_f$	Fall Time		-	50	-	ns
$E_{on}$	Turn-On Switching Loss		-	3.4	-	mJ
$E_{off}$	Turn-Off Switching Loss		-	2.5	-	mJ
$E_{ts}$	Total Switching Loss	-	5.9	-	mJ	
$Q_g$	Total Gate Charge	$V_{CE} = 600\text{ V}, I_C = 40\text{ A},$ $V_{GE} = 15\text{ V}$	-	370	-	nC
$Q_{ge}$	Gate to Emitter Charge		-	23	-	nC
$Q_{gc}$	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

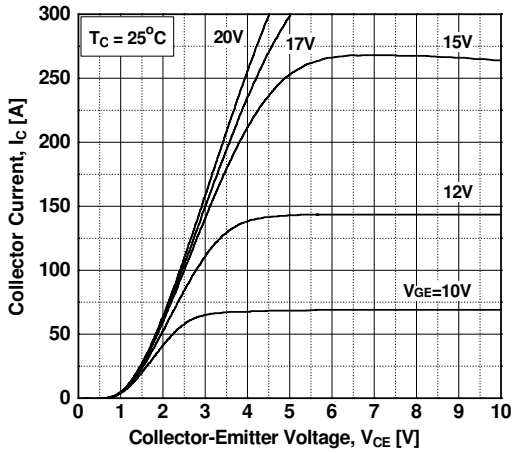


Figure 2. Typical Output Characteristics

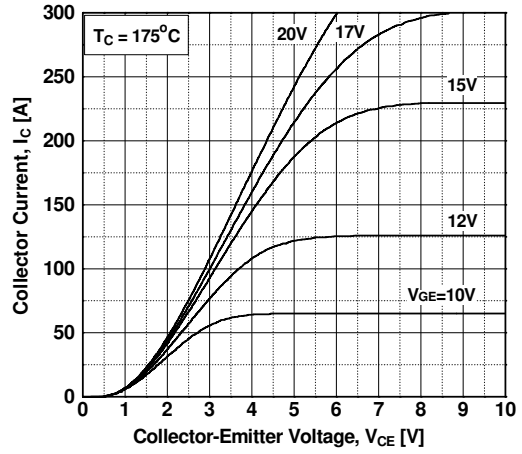


Figure 3. Typical Saturation Voltage Characteristics

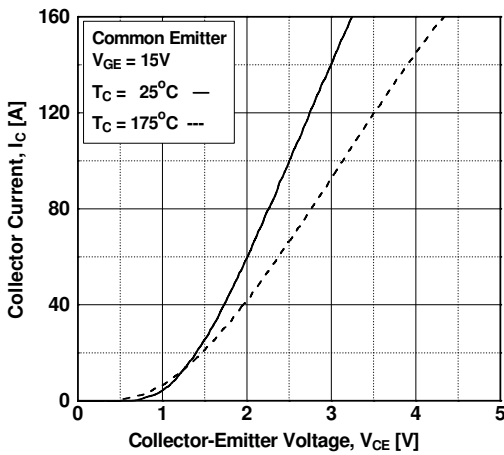


Figure 4. Saturation Voltage vs. Case Temperature at Variant Current Level

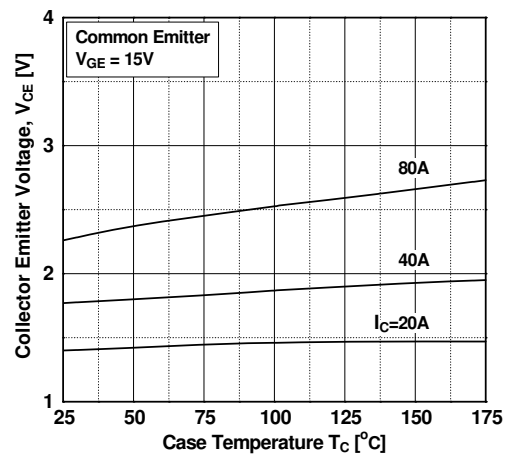


Figure 5. Saturation Voltage vs. Vge

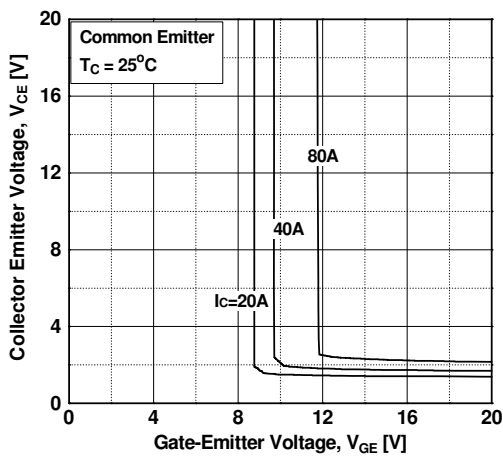
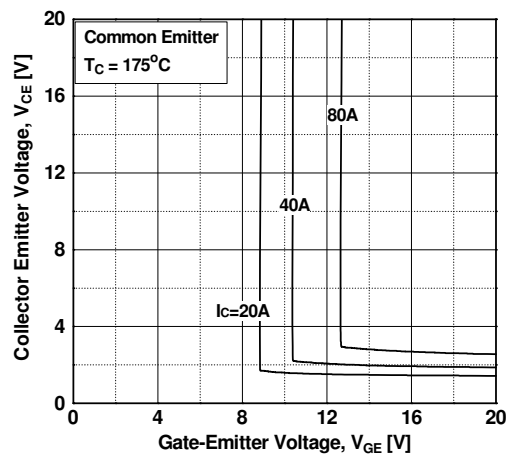
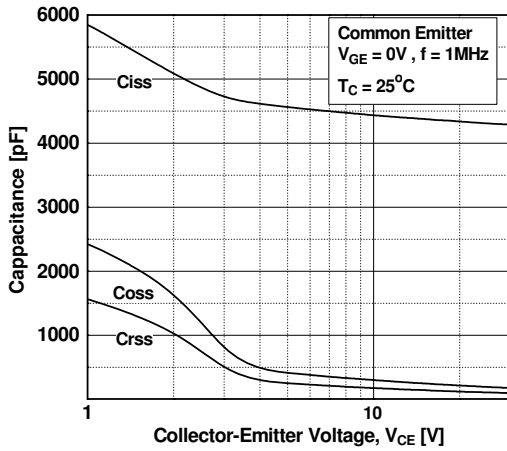


Figure 6. Saturation Voltage vs. Vge

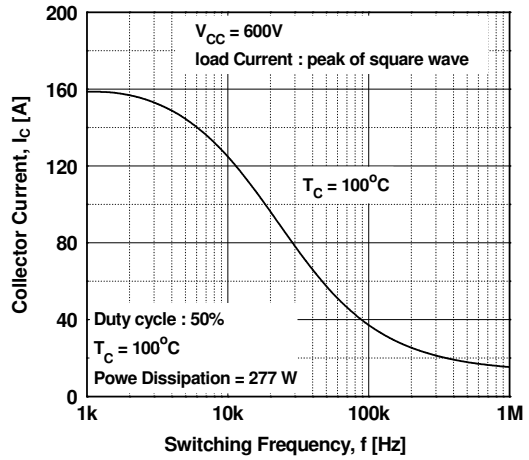


## Typical Performance Characteristics

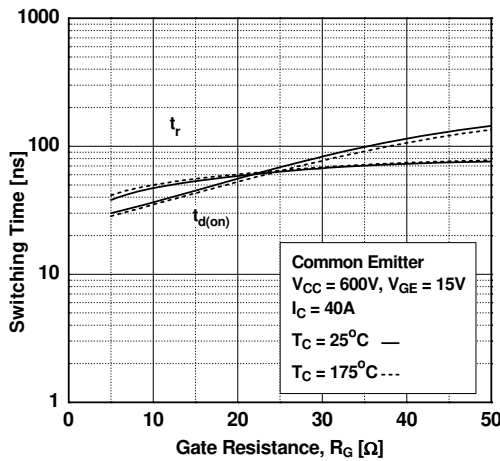
**Figure 7. Capacitance Characteristics**



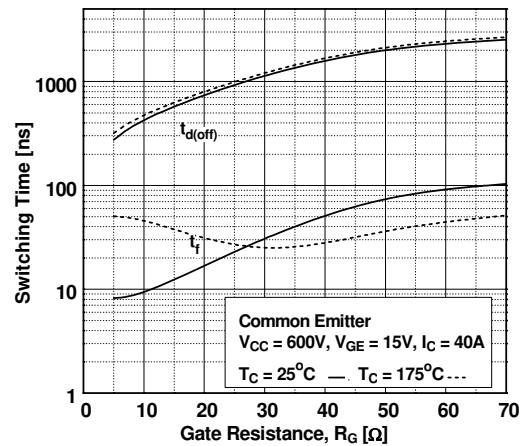
**Figure 8. Load Current vs. Frequency**



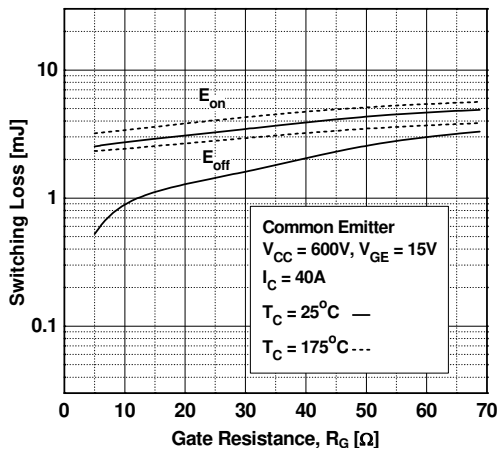
**Figure 9. Turn-on Characteristics vs. Gate Resistance**



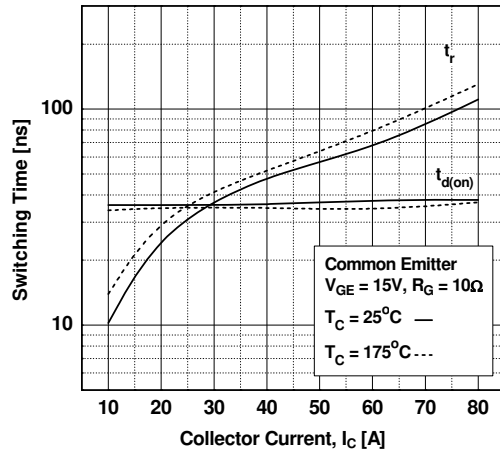
**Figure 10. Turn-off Characteristics vs. Gate Resistance**



**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

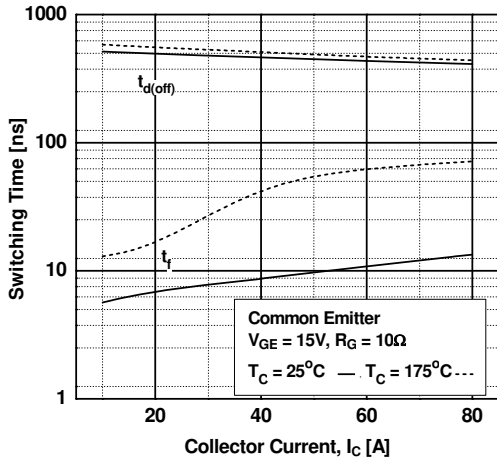


Figure 15. Gate Charge Characteristics

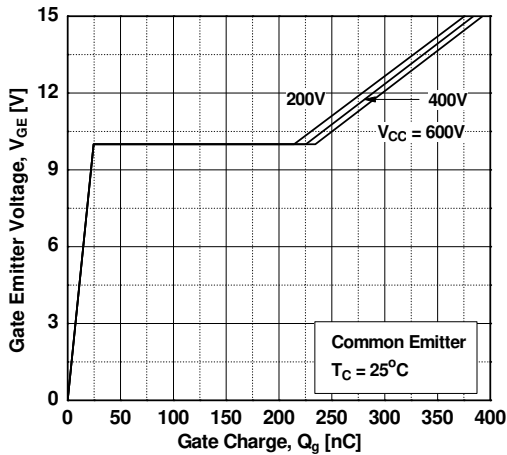


Figure 17. Forward Characteristics

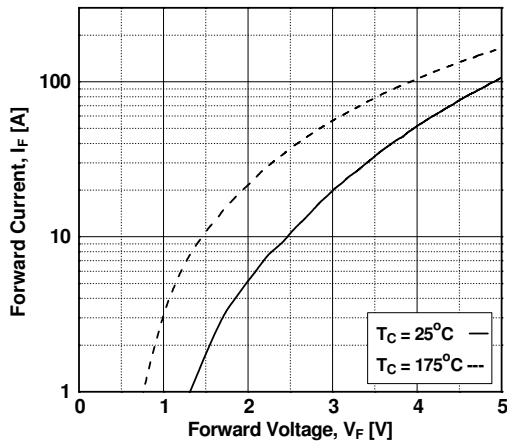


Figure 14. Switching Loss vs. Collector Current

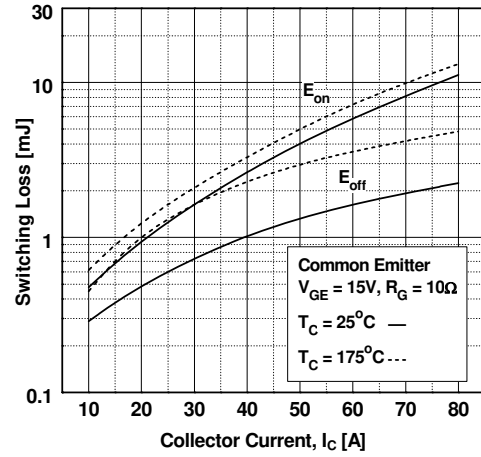


Figure 16. SOA Characteristics

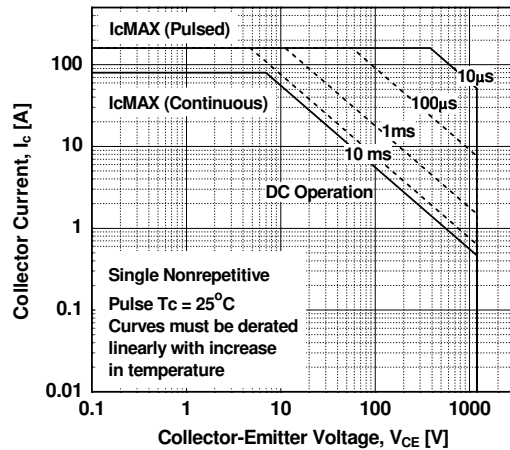
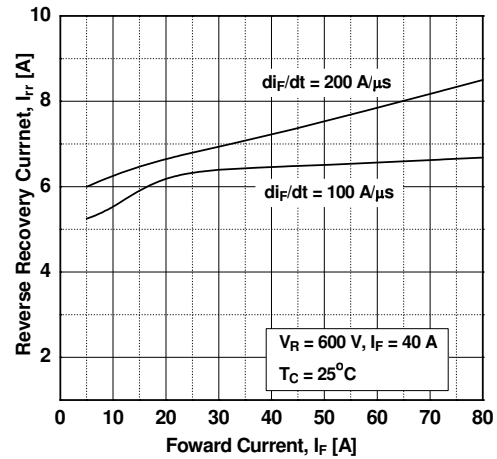


Figure 18. Reverse Recovery Current



## Typical Performance Characteristics

Figure 19. Reverse Recovery Time

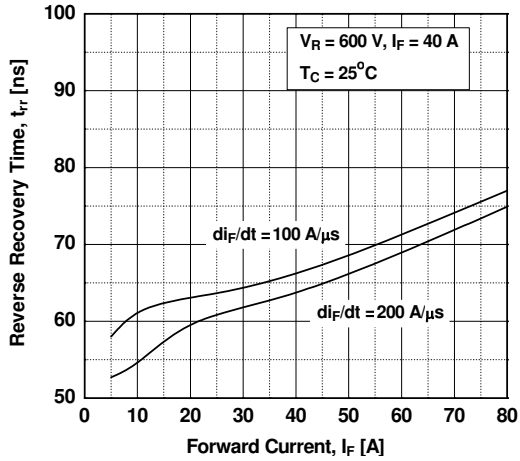


Figure 20. Stored Charge

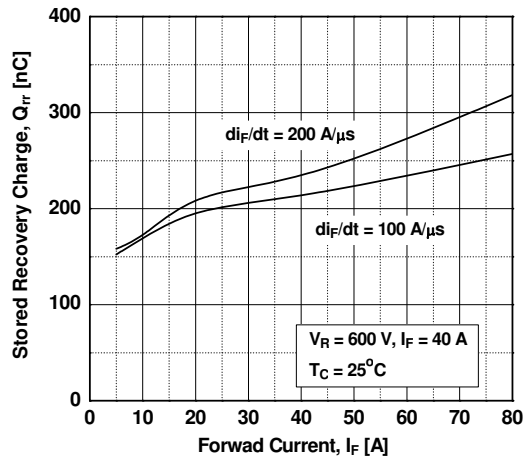
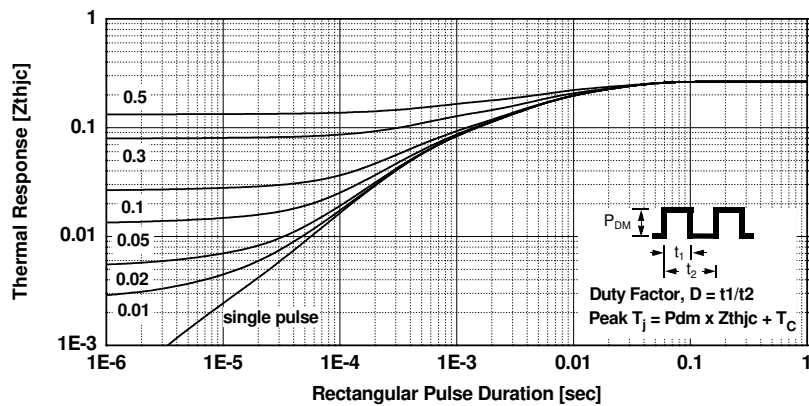


Figure 21. Transient Thermal Impedance of IGBT

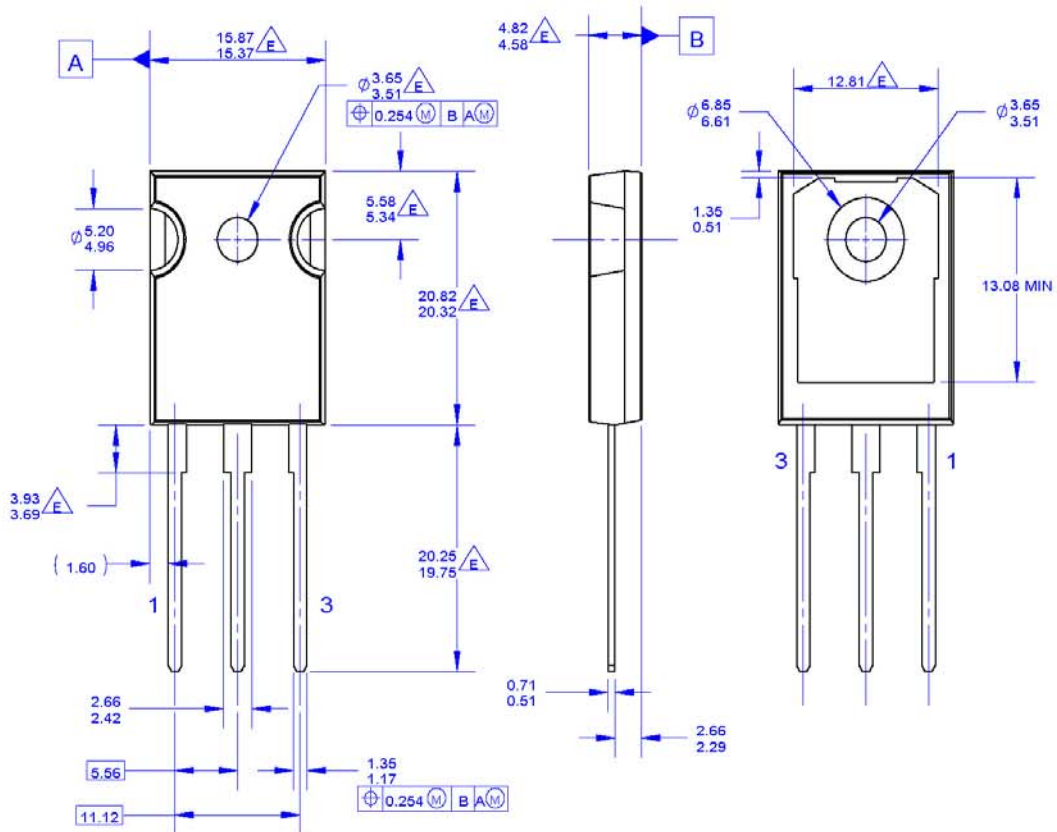






Mechanical Dimensions


TO-247G03



NOTES: UNLESS OTHERWISE SPECIFIED.

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