



ON Semiconductor®

# FGH12040WD 1200 V, 40 A Field Stop Trench IGBT

## Features

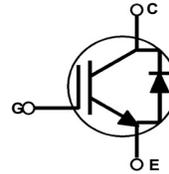
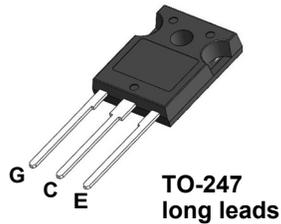
- Maximum Junction Temperature :  $T_J = 175^\circ\text{C}$
- Positive Temperature Co-efficient for Easy Parallel Operating
- Low Saturation Voltage:  $V_{CE(sat)} = 2.3\text{ V}$  (Typ.) @  $I_C = 40\text{ A}$
- 100% of The Parts Tested for  $I_{LM}^{(1)}$
- Short Circuit Ruggedness  $> 5\text{ us}$  @  $150^\circ\text{C}$
- High Input Impedance
- RoHS Compliant

## General Description

Using novel field stop IGBT technology, ON Semiconductor's new series of field stop 2<sup>nd</sup> generation IGBTs offer the optimum performance for welder applications where low conduction and switching losses are essential.

## Applications

- Only for Welder



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

Symbol	Description	FGH12040WD-F155	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 @ $T_C = 25^\circ\text{C}$	100	A
$I_{CM}^{(2)}$	Pulsed Collector Current	100	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
$I_{FM}^{(2)}$	Diode Maximum Forward Current	100	A
$SCWT^{(3)}$	Short Circuit Withstand Time, @ $T_C = 150^\circ\text{C}$	5	us
	Maximum Power Dissipation @ $T_C = 25^\circ\text{C}$	428	W
$P_D$	Maximum Power Dissipation @ $T_C = 100^\circ\text{C}$	214	W
	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.  $V_{CC} = 600\text{ V}$ ,  $V_{GE} = 15\text{ V}$ ,  $I_C = 100\text{ A}$ ,  $R_G = 23\ \Omega$ . Inductive Load
2. Repetitive rating : Pulse width limited by max. junction temperature
3.  $V_{CC} = 600\text{ V}$ ,  $V_{GE} = 12\text{ V}$

## Thermal Characteristics

Symbol	Parameter	FGH12040WD-F155	Unit
$R_{\theta JC}(IGBT)$	Thermal Resistance, Junction to Case	0.35	$^{\circ}C/W$
$R_{\theta JC}(Diode)$	Thermal Resistance, Junction to Case	1.4	$^{\circ}C/W$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	40	$^{\circ}C/W$

## Package Marking and Ordering Information

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FGH12040WD-F155	FGH12040WD	TO-247 G03	Tube	-	-	30

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
<b>Off Characteristics</b>						
$BV_{CES}$	Collector to Emitter Breakdown Voltage	$V_{GE} = 0 V, I_C = 250 \mu A$	1200	-	-	V
$\Delta BV_{CES} / \Delta T_J$	Temperature Coefficient of Breakdown Voltage	$V_{GE} = 0 V, I_C = 250 \mu A$	-	1.2	-	$V/^{\circ}C$
$I_{CES}$	Collector Cut-Off Current	$V_{CE} = V_{CES}, V_{GE} = 0 V$	-	-	250	$\mu A$
$I_{GES}$	G-E Leakage Current	$V_{GE} = V_{GES}, V_{CE} = 0 V$	-	-	$\pm 400$	nA
<b>On Characteristics</b>						
$V_{GE(th)}$	G-E Threshold Voltage	$I_C = 40 mA, V_{CE} = V_{GE}$	4.8	6.4	8.0	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C = 40 A, V_{GE} = 15 V$ $T_C = 25^{\circ}C$	-	2.3	2.9	V
		$I_C = 40 A, V_{GE} = 15 V,$ $T_C = 175^{\circ}C$	-	2.7	-	V
<b>Dynamic Characteristics</b>						
$C_{ies}$	Input Capacitance	$V_{CE} = 30 V, V_{GE} = 0 V,$ $f = 1MHz$	-	2800	-	pF
$C_{oes}$	Output Capacitance		-	105	-	pF
$C_{res}$	Reverse Transfer Capacitance		-	60	-	pF
<b>Switching Characteristics</b>						
$t_{d(on)}$	Turn-On Delay Time	$V_{CC} = 600 V, I_C = 40 A,$ $R_G = 23 \Omega, V_{GE} = 15 V,$ Inductive Load, $T_C = 25^{\circ}C$	-	45	-	ns
$t_r$	Rise Time		-	70	-	ns
$t_{d(off)}$	Turn-Off Delay Time		-	560	-	ns
$t_f$	Fall Time		-	15	-	ns
$E_{on}$	Turn-On Switching Loss		-	4.1	-	mJ
$E_{off}$	Turn-Off Switching Loss		-	1.0	-	mJ
$E_{ts}$	Total Switching Loss		-	5.1	-	mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC} = 600 V, I_C = 40 A,$ $R_G = 23 \Omega, V_{GE} = 15 V,$ Inductive Load, $T_C = 175^{\circ}C$	-	43	-	ns
$t_r$	Rise Time		-	73	-	ns
$t_{d(off)}$	Turn-Off Delay Time		-	572	-	ns
$t_f$	Fall Time		-	58	-	ns
$E_{on}$	Turn-On Switching Loss		-	6.9	-	mJ
$E_{off}$	Turn-Off Switching Loss		-	1.9	-	mJ
$E_{ts}$	Total Switching Loss		-	8.8	-	mJ

**Electrical Characteristics of the IGBT** (continued)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$Q_g$	Total Gate Charge	$V_{CE} = 600\text{ V}, I_C = 40\text{ A},$ $V_{GE} = 15\text{ V}$	-	226	-	nC
$Q_{ge}$	Gate to Emitter Charge		-	18	-	nC
$Q_{gc}$	Gate to Collector Charge		-	155	-	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	$I_F = 40\text{ A}, T_C = 25^\circ\text{C}$	-	3.6	4.7	V
		$I_F = 40\text{ A}, T_C = 175^\circ\text{C}$	-	2.9	-	V
$t_{rr}$	Diode Reverse Recovery Time	$V_R = 600\text{ V}, I_F = 40\text{ A},$ $di_F/dt = 200\text{ A/us}, T_C = 25^\circ\text{C}$	-	71	-	ns
$I_{rr}$	Diode Peak Reverse Recovery Current		-	6.8	-	A
$Q_{rr}$	Diode Reverse Recovery Charge		-	242	-	nC
$E_{rec}$	Reverse Recovery Energy	$V_R = 600\text{ V}, I_F = 40\text{ A},$ $di_F/dt = 200\text{ A/us}, T_C = 175^\circ\text{C}$	-	690	-	uJ
$t_{rr}$	Diode Reverse Recovery Time		-	500	-	ns
$I_{rr}$	Diode Peak Reverse Recovery Current		-	17	-	A
$Q_{rr}$	Diode Reverse Recovery Charge		-	4250	-	nC

## Typical Performance Characteristics

Figure 1. Typical Output Characteristics

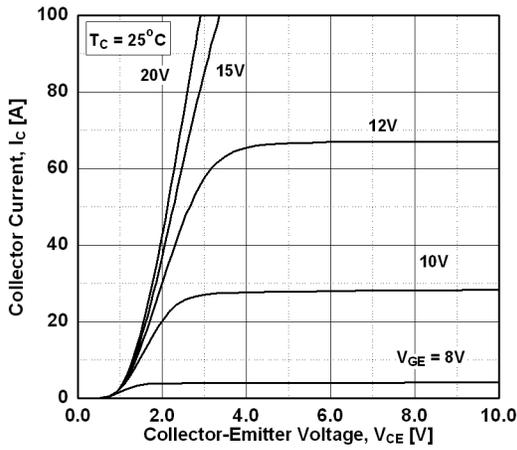


Figure 2. Typical Output Characteristics

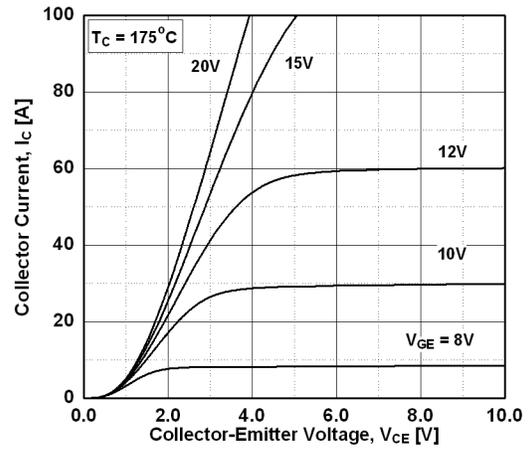


Figure 3. Typical Saturation Voltage Characteristics

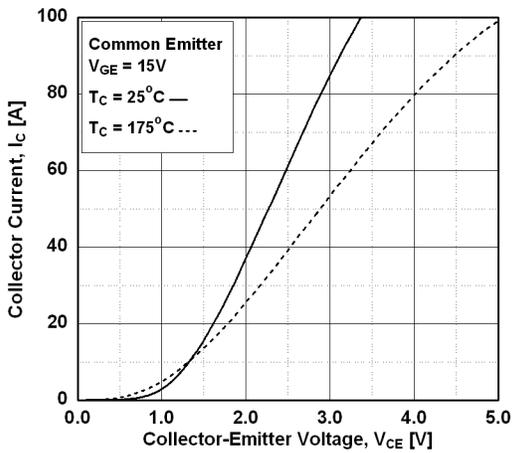


Figure 4. Saturation Voltage vs. Case Temperature at Variant Current Level

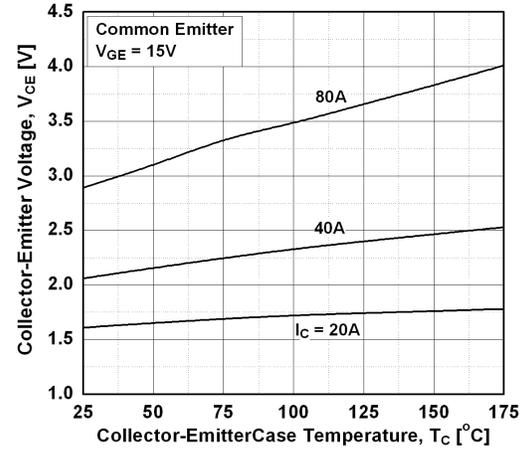


Figure 5. Saturation Voltage vs. Vge

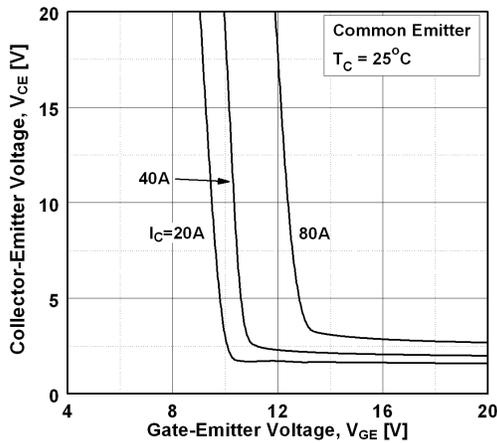
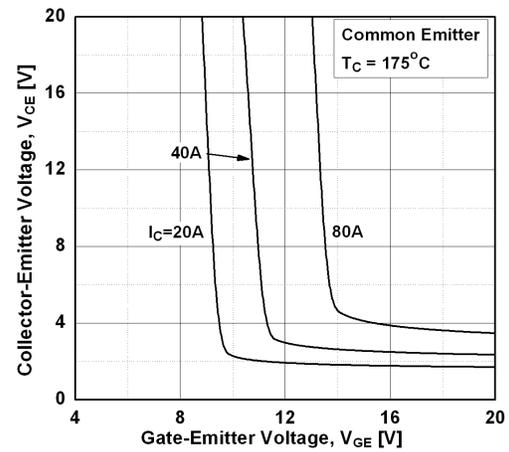
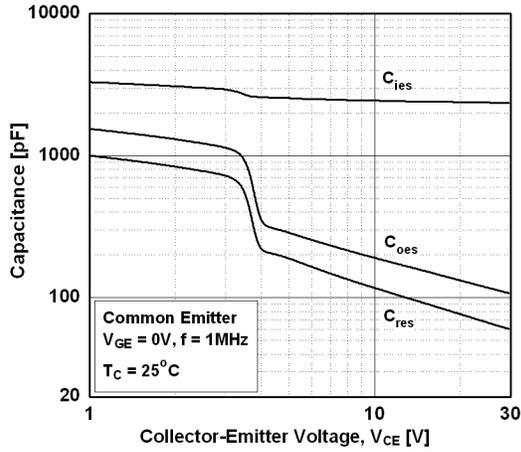


Figure 6. Saturation Voltage vs. Vge

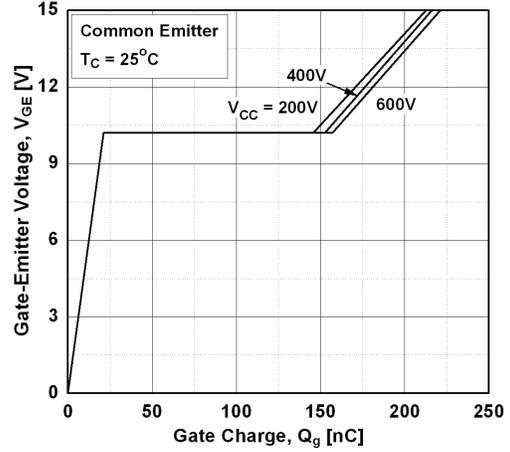


## Typical Performance Characteristics

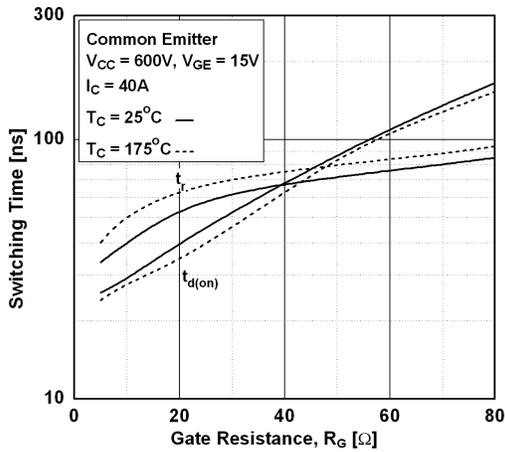
**Figure 7. Capacitance Characteristics**



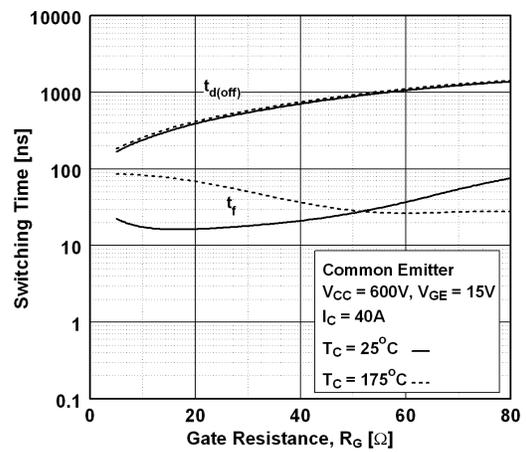
**Figure 8. Gate Charge Characteristics**



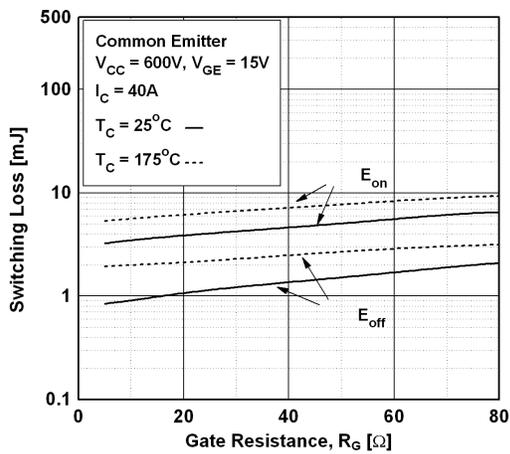
**Figure 9. Turn-on Characteristics vs. Gate Resistance**



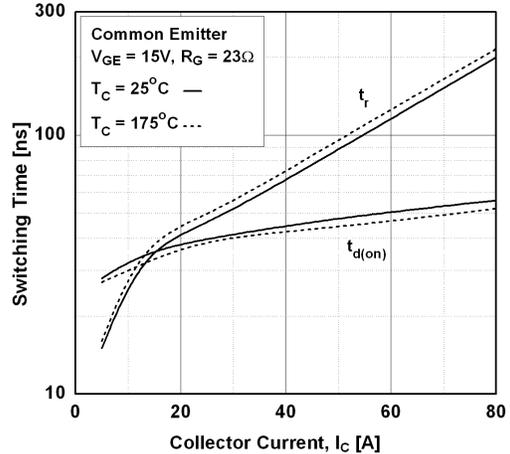
**Figure 10. Turn-off Characteristics vs. Gate Resistance**



**Figure 11. Switching Loss vs. Gate Resistance**

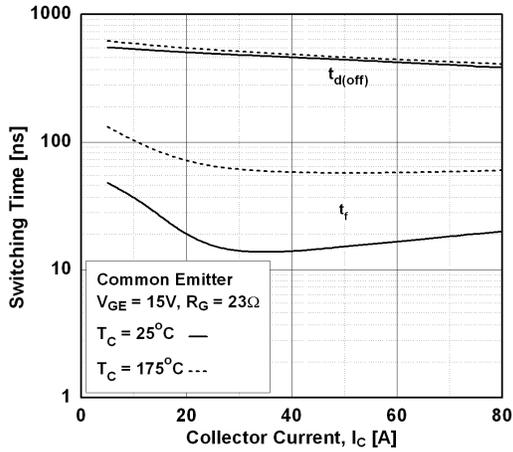


**Figure 12. Turn-on Characteristics vs. Collector Current**

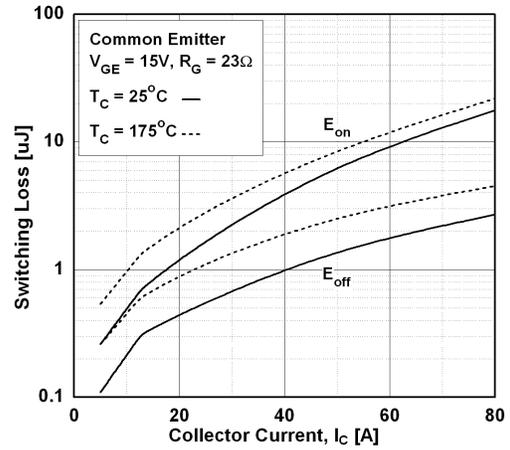


## Typical Performance Characteristics

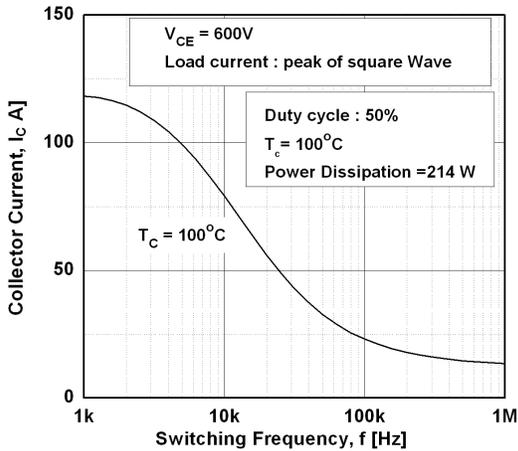
**Figure 13. Turn-off Characteristics vs. Collector Current**



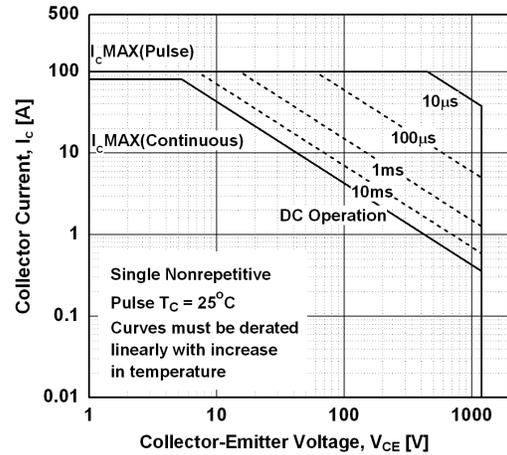
**Figure 14. Switching Loss vs. Collector Current**



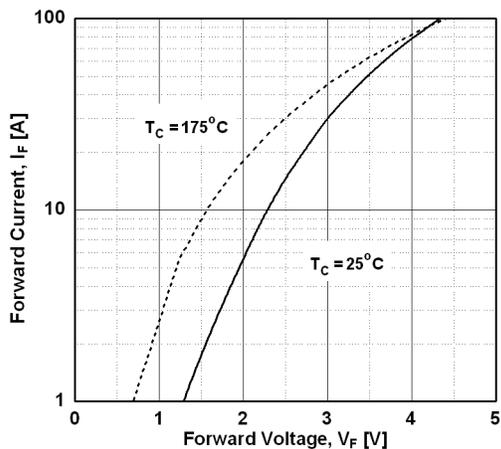
**Figure 15. Load Current vs. Frequency**



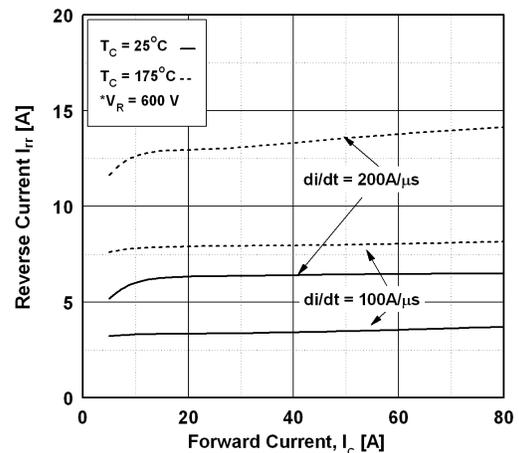
**Figure 16. SOA Characteristics**



**Figure 17. Forward Characteristics**



**Figure 18. Reverse Recovery Current**



## Typical Performance Characteristics

Figure 19. Reverse Recovery Time

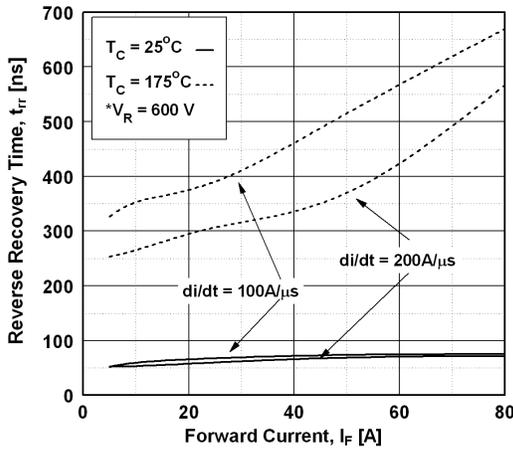


Figure 20. Stored Charge

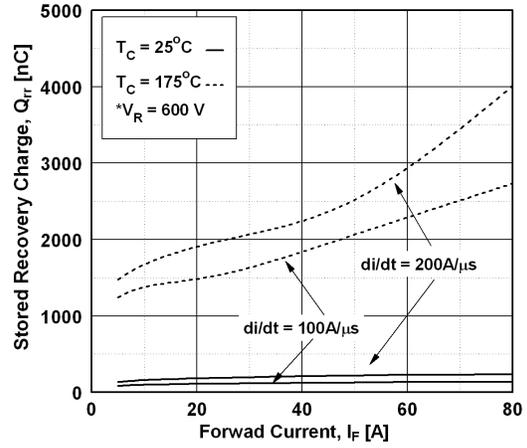


Figure 21. Transient Thermal Impedance of IGBT

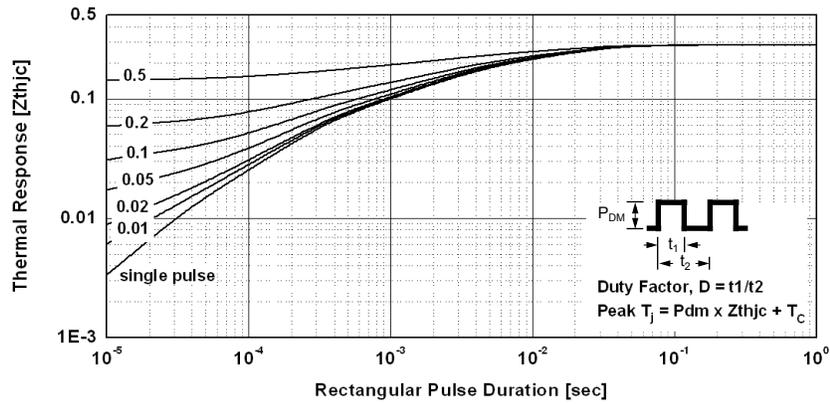
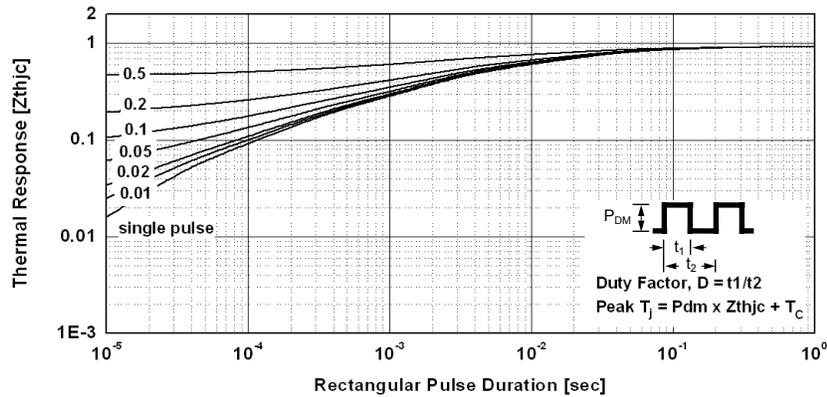


Figure 22. Transient Thermal Impedance of Diode



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