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April 2015

FGA40T65SHDF

650 V, 40 A Field Stop Trench IGBT

Features

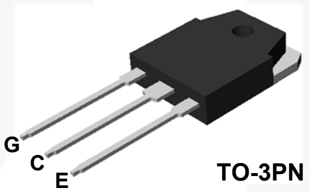
- Maximum Junction Temperature : T_J = 175°C
- Positive Temperature Co-efficient for Easy Parallel Operating
- High Current Capability
- Low Saturation Voltage: $V_{CE(sat)}$ = 1.45 V (Typ.) @ I_C = 40 A
- 100% of the Parts tested for I_{LM}(1)
- High Input Impedance
- Fast Switching
- Tighten Parameter Distribution
- RoHS Compliant

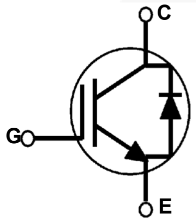
General Description

Using novel field stop IGBT technology, Fairchild's new series of field stop 3rd generation IGBTs offer superior conduction and switching performance and easy parallel operation. This device is well suited for the resonant or soft switching application such as induction heating and MWO.

Applications

- Induction Heating, MWO





Absolute Maximum Ratings

T_C = 25°C unless otherwise noted

Symbol	Description		FGA40T65SHDF	Unit
V_{CES}	Collector to Emitter Voltage		650	V
V_{GES}	Gate to Emitter Voltage		± 20	V
	Transient Gate to Emitter Voltage		± 30	V
I_C	Collector Current	@ T_C = 25°C	80	A
	Collector Current	@ T_C = 100°C	40	A
I_{LM} (1)	Pulsed Collector Current	@ T_C = 25°C	120	A
I_{CM} (2)	Pulsed Collector Current		120	A
I_F	Diode Forward Current	@ T_C = 25°C	40	A
	Diode Forward Current	@ T_C = 100°C	20	A
I_{FM}	Pulsed Diode Maximum Forward Current		60	A
P_D	Maximum Power Dissipation	@ T_C = 25°C	268	W
	Maximum Power Dissipation	@ T_C = 100°C	134	W
T_J	Operating Junction Temperature		-55 to +175	°C
T_{stg}	Storage Temperature Range		-55 to +175	°C
T_L	Maximum Lead Temp. for soldering Purposes, 1/8" from case for 5 seconds		300	°C

Notes:

1. V_{CC} = 400 V, V_{GE} = 15 V, I_C = 120 A, R_G = 30 Ω, Inductive Load
2. Repetitive rating: Pulse width limited by max. junction temperature

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Thermal Characteristics

Symbol	Parameter	FGA40T65SHDF	Unit
$R_{\theta JC}$ (IGBT)	Thermal Resistance, Junction to Case, Max.	0.56	$^{o}C/W$
$R_{\theta JC}$ (Diode)	Thermal Resistance, Junction to Case, Max.	1.75	$^{o}C/W$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	40	$^{o}C/W$

Package Marking and Ordering Information

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FGA40T65SHDF	FGA40T65SHDF	TO-3PN	Tube	-	-	30

Electrical Characteristics of the IGBT

$T_C = 25°C$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Off Characteristics						
BV_{CES}	Collector to Emitter Breakdown Voltage	$V_{GE} = 0$ V, $I_C = 1$ mA	650	-	-	V
$\Delta BV_{CES}/\Delta T_J$	Temperature Coefficient of Breakdown Voltage	$V_{GE} = 0$ V, $I_C = 1$ mA	-	0.6	-	$V/^{o}C$
I_{CES}	Collector Cut-Off Current	$V_{CE} = V_{CES}$, $V_{GE} = 0$ V	-	-	250	μA
I_{GES}	G-E Leakage Current	$V_{GE} = V_{GES}$, $V_{CE} = 0$ V	-	-	± 400	nA
On Characteristics						
$V_{GE(th)}$	G-E Threshold Voltage	$I_C = 40$ mA, $V_{CE} = V_{GE}$	4.0	5.5	7.5	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C = 40$ A, $V_{GE} = 15$ V	-	1.45	1.81	V
		$I_C = 40$ A, $V_{GE} = 15$ V, $T_C = 175^{o}C$	-	1.8	-	V
Dynamic Characteristics						
C_{ies}	Input Capacitance	$V_{CE} = 30$ V, $V_{GE} = 0$ V, f = 1 MHz	-	1982	-	pF
C_{oes}	Output Capacitance		-	70	-	pF
C_{res}	Reverse Transfer Capacitance		-	25	-	pF
Switching Characteristics						
$T_{d(on)}$	Turn-On Delay Time	$V_{CC} = 400$ V, $I_C = 40$ A, $R_G = 6\ \Omega$, $V_{GE} = 15$ V, Inductive Load, $T_C = 25^{o}C$	-	18	-	ns
T_r	Rise Time		-	27	-	ns
$T_{d(off)}$	Turn-Off Delay Time		-	64	-	ns
T_f	Fall Time		-	3	-	ns
E_{on}	Turn-On Switching Loss		-	1.22	-	mJ
E_{off}	Turn-Off Switching Loss		-	0.44	-	mJ
E_{ts}	Total Switching Loss		-	1.66	-	mJ
$T_{d(on)}$	Turn-On Delay Time	$V_{CC} = 400$ V, $I_C = 40$ A, $R_G = 6\ \Omega$, $V_{GE} = 15$ V, Inductive Load, $T_C = 175^{o}C$	-	18	-	ns
T_r	Rise Time		-	31	-	ns
$T_{d(off)}$	Turn-Off Delay Time		-	70	-	ns
T_f	Fall Time		-	56	-	ns
E_{on}	Turn-On Switching Loss		-	1.78	-	mJ
E_{off}	Turn-Off Switching Loss		-	0.78	-	mJ
E_{ts}	Total Switching Loss		-	2.56	-	mJ

Electrical Characteristics of the IGBT (Continued)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Q_g	Total Gate Charge	V_{CE} = 400 V, I_C = 40 A, V_{GE} = 15 V	-	68	-	nC
Q_{ge}	Gate to Emitter Charge		-	12	-	nC
Q_{gc}	Gate to Collector Charge		-	25	-	nC

Electrical Characteristics of the Diode T_C = 25°C unless otherwise noted

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
V_{FM}	Diode Forward Voltage	I_F = 20 A	T_C = 25°C	-	1.5	1.95	V
			T_C = 175°C	-	1.37	-	
E_{rec}	Reverse Recovery Energy	I_F = 20 A, dI_F/dt = 200 A/μs	T_C = 175°C	-	153	-	μJ
T_{rr}	Diode Reverse Recovery Time		T_C = 25°C	-	101	-	ns
			T_C = 175°C	-	238	-	
Q_{rr}	Diode Reverse Recovery Charge		T_C = 25°C	-	343	-	nC
			T_C = 175°C	-	1493	-	

Typical Performance Characteristics

Figure 1. Typical Output Characteristics

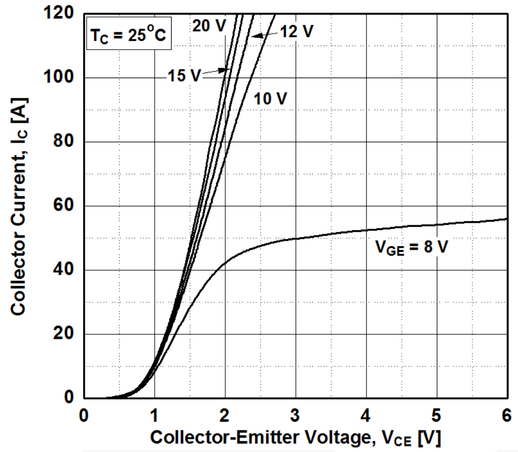


Figure 2. Typical Output Characteristics

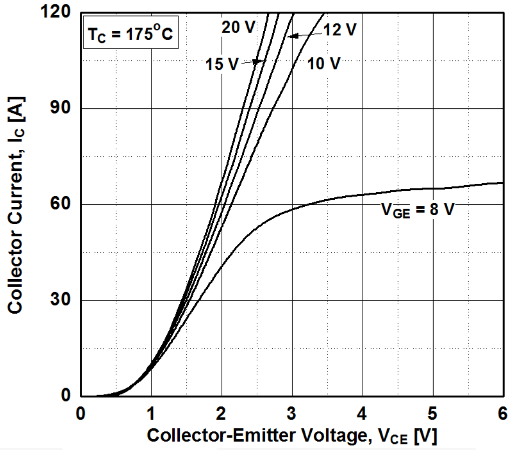


Figure 3. Typical Saturation Voltage Characteristics

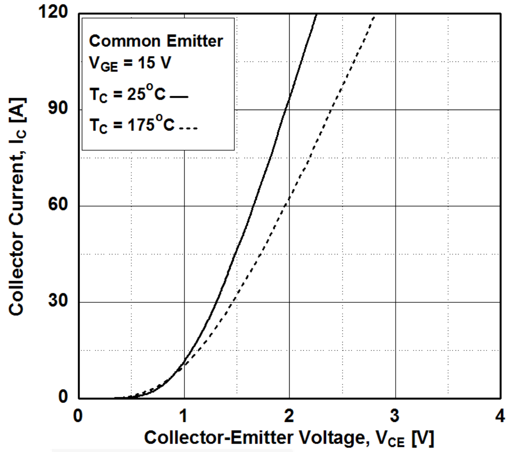


Figure 4. Saturation Voltage vs. Case Temperature at Variant Current Level

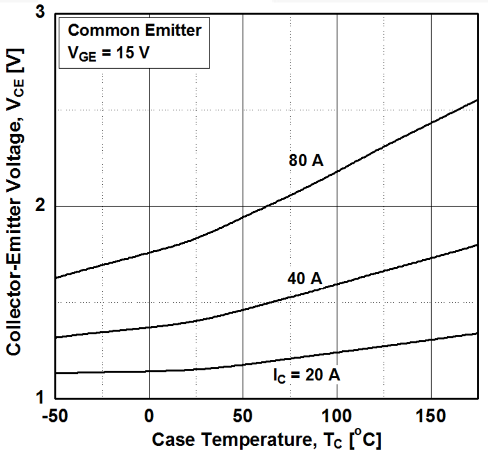


Figure 5. Saturation Voltage vs. V_{GE}

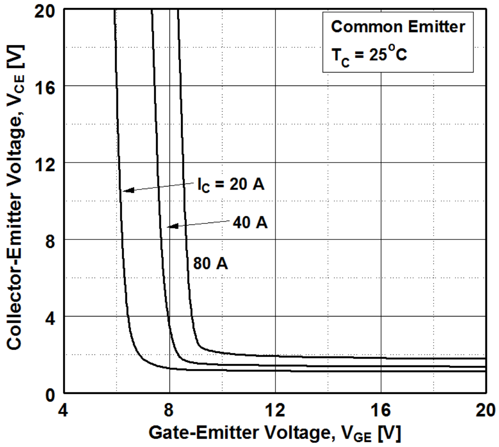
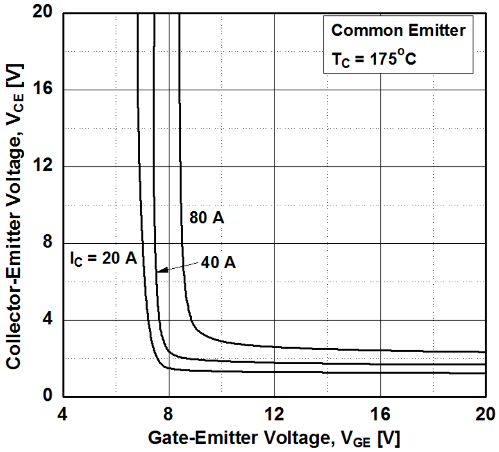


Figure 6. Saturation Voltage vs. V_{GE}



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Typical Performance Characteristics

Figure 7. Capacitance Characteristics

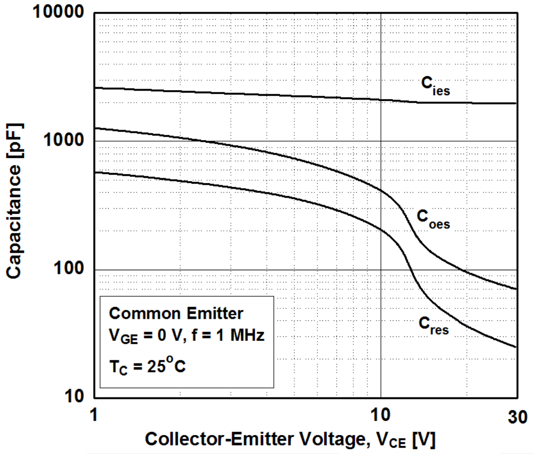


Figure 8. Gate charge Characteristics

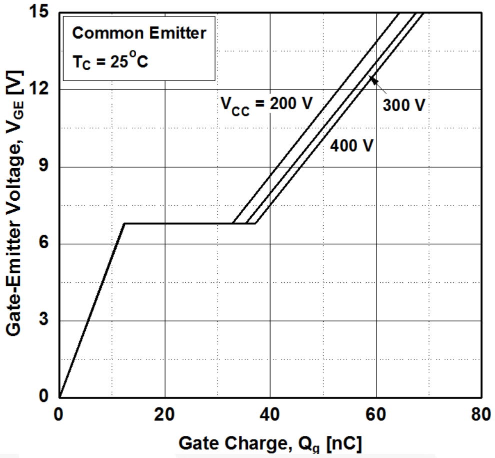


Figure 9. Turn-on Characteristics vs. Gate Resistance

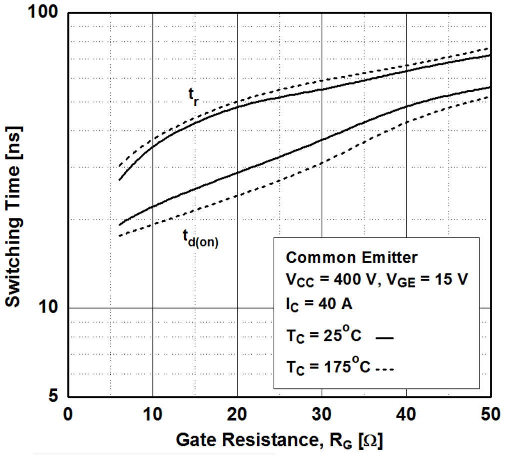


Figure 10. Turn-off Characteristics vs. Gate Resistance

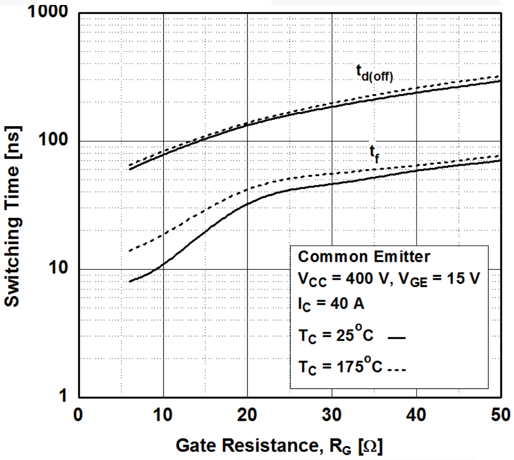


Figure 11. Switching Loss vs. Gate Resistance

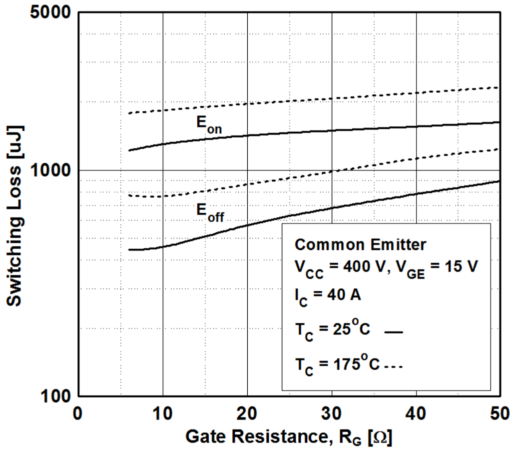
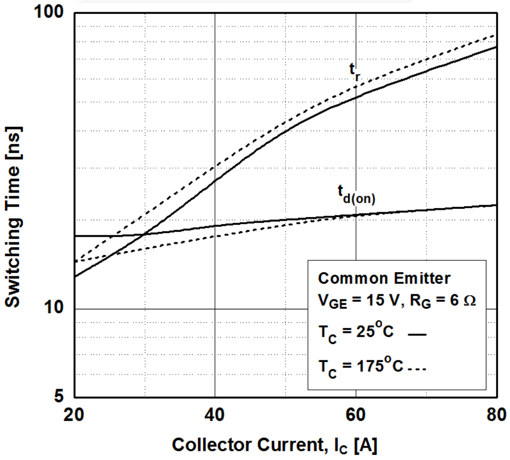


Figure 12. Turn-on Characteristics vs. Collector Current



Typical Performance Characteristics

Figure 13. Turn-off Characteristics vs. Collector Current

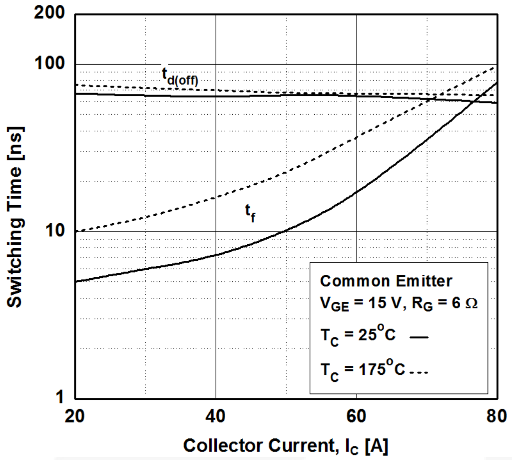


Figure 14. Switching Loss vs. Collector Current

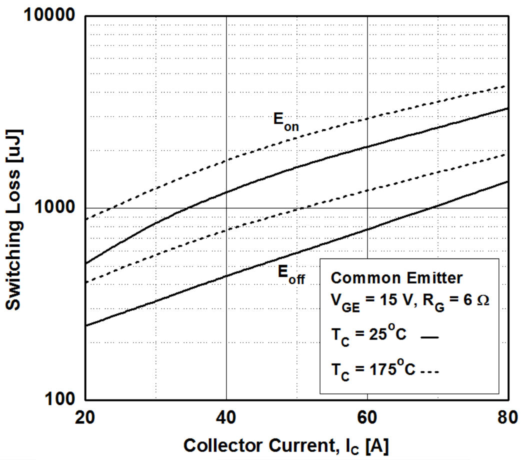


Figure 15. Load Current Vs. Frequency

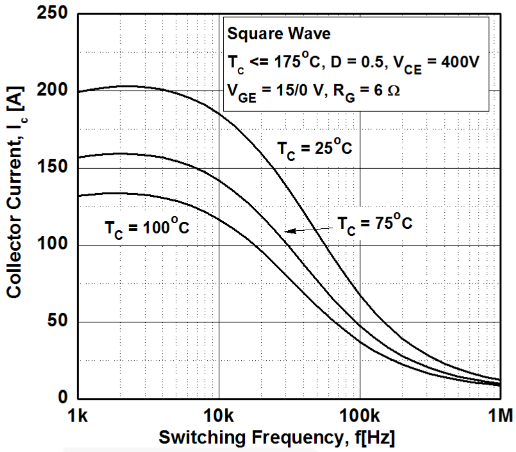


Figure 16. SOA Characteristics

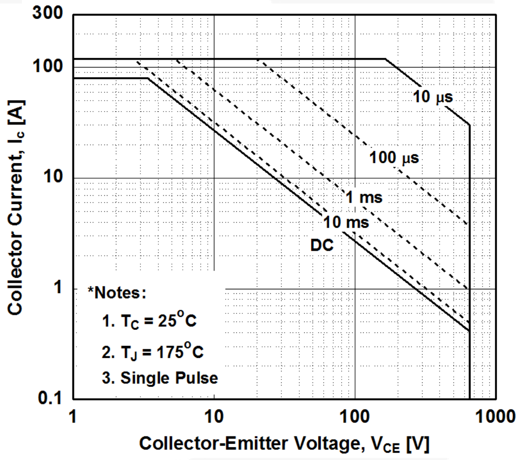


Figure 17. Forward Characteristics

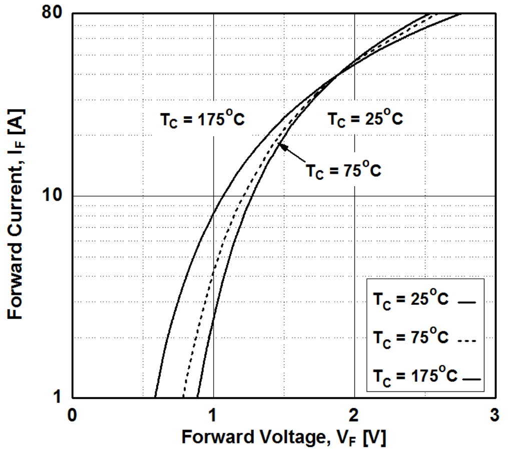
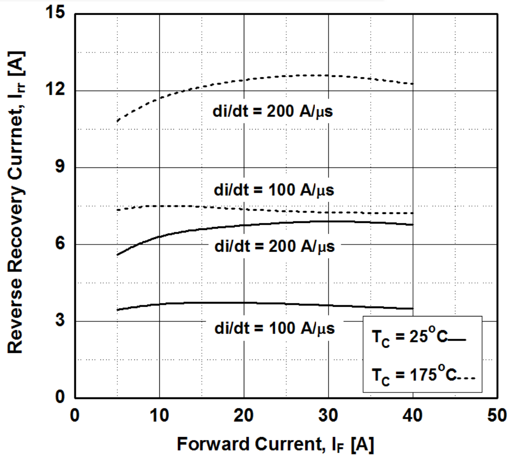


Figure 18. Reverse Recovery Current



Typical Performance Characteristics

Figure 19. Reverse Recovery Time

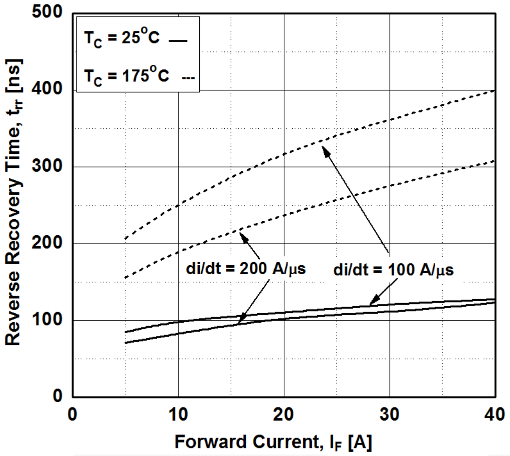


Figure 20. Stored Charge

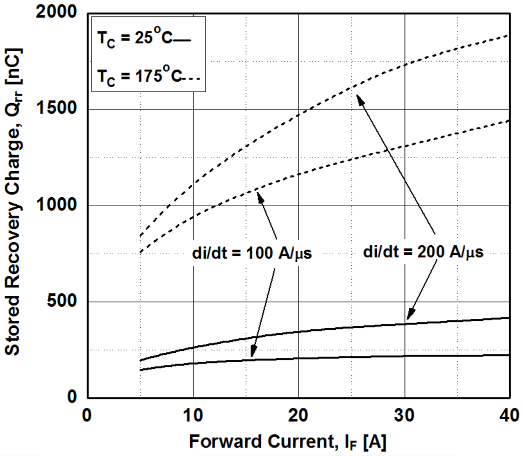


Figure 21. Transient Thermal Impedance of IGBT

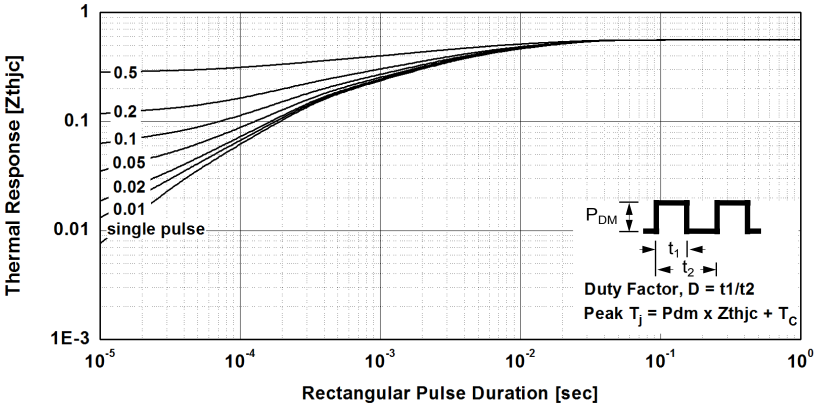
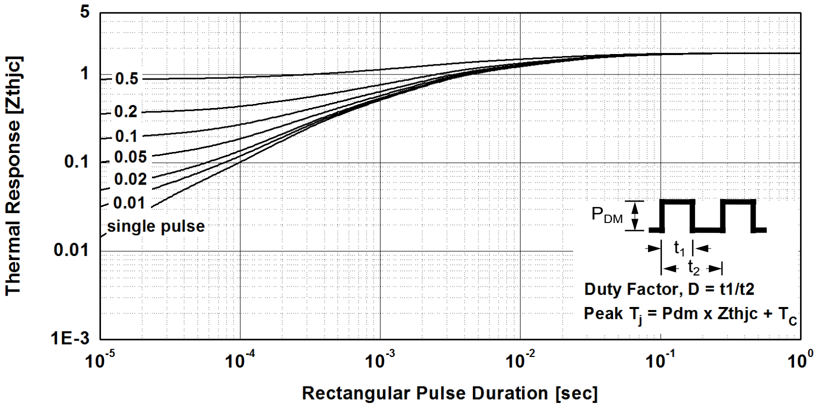
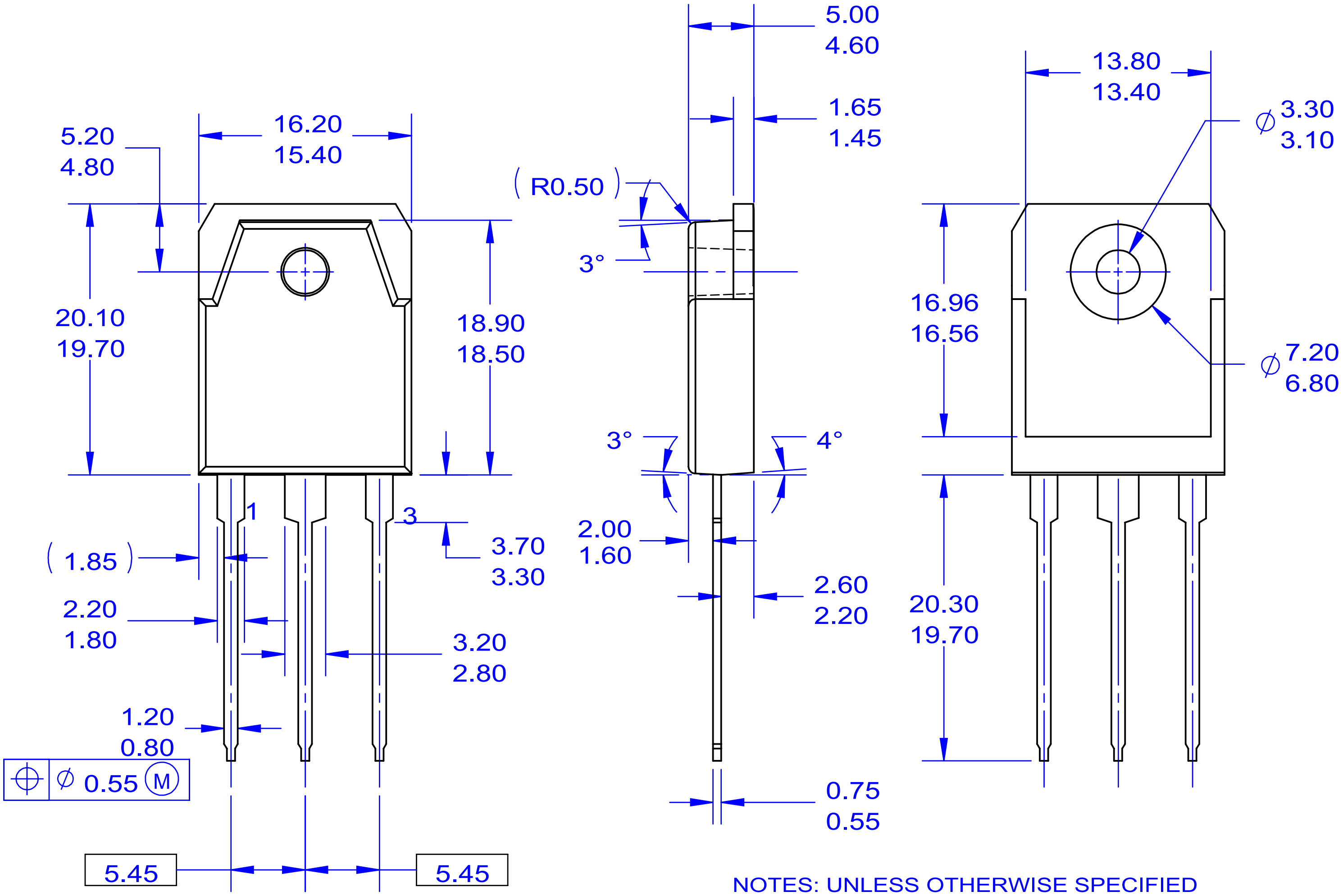
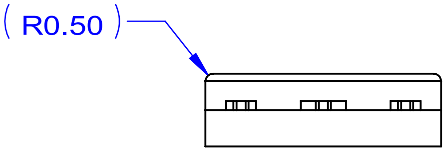


Figure 22. Transient Thermal Impedance of Diode







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