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July 2015

FGA4060ADF

600 V, 40 A Field Stop Trench IGBT

Features

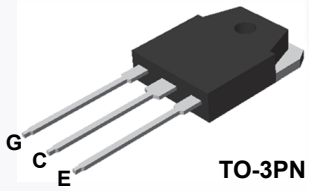
- Maximum Junction Temperature : T_J = 175°C
- Positive Temperaure Co-efficient for Easy Parallel Operating
- High Current Capability
- Low Saturation Voltage: $V_{CE(sat)}$ = 1.8 V(Typ.) @ I_C = 40 A
- 100% of the Parts Tested for I_{LM}(1)
- High Input Impedance
- Fast Switching
- Tighten Parameter Distribution
- RoHS Compliant

General Description

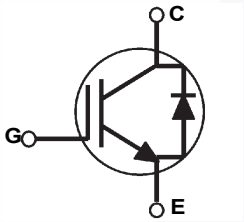
This ADF IGBT series adopted Field Stop Trench 3rd generation IGBT which offer extreme low Vce(sat) and much faster switching characteristics for outstanding efficiency. And this kind of technology is fully optimized to variety PFC (Power Factor Correction) topology ; Single boost, Multi channel interleaved etc with over 20KHz switching performance. TO3P package provide Super Low thermal resistance for much wider SOA for system stability.

Applications

- PFC topology for Home appliance : Single Boost , Multi channel Interleaved etc.



TO-3PN



Absolute Maximum Ratings T_C = 25°C unless otherwise noted

Symbol	Description		FGA4060ADF	Unit
V_{CES}	Collector to Emitter Voltage		600	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 (3)	Diode Forward Current	@ T_C = 25°C	3	A
	Diode Forward Current	@ T_C = 100°C	1.5	A
I_{FM} (2)	Pulsed Diode Maximum Forward Current		6	A
P_D	Maximum Power Dissipation	@ T_C = 25°C	238	W
	Maximum Power Dissipation	@ T_C = 100°C	119	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 = 120 Ω, Inductive Load.
2. Repetitive rating: Pulse width limited by max. junction temperature.
3. The purpose of diode is protection for negative voltage.

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Thermal Characteristics

Symbol	Parameter	FGA4060ADF	Unit
$R_{\theta JC}$(IGBT)	Thermal Resistance, Junction to Case, Max.	0.63	°C/W
$R_{\theta JC}$(Diode)	Thermal Resistance, Junction to Case, Max.	5	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	40	°C/W

Package Marking and Ordering Information

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Qty per Tube
FGA4060ADF	FGA4060ADF	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} = 0V, I_C = 1 mA	600	-	-	V
ΔBV_{CES} / ΔT_J	Temperature Coefficient of Breakdown Voltage	I_C = 1 mA, Reference to 25°C	-	0.6	-	V/°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}	4.1	5.6	7.6	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	I_C = 40 A, V_{GE} = 15 V	-	1.8	2.3	V
		I_C = 40 A, V_{GE} = 15 V, T_C = 175°C	-	2.31	-	V
Dynamic Characteristics						
C_{ies}	Input Capacitance	V_{CE} = 30 V, V_{GE} = 0 V, f = 1MHz	-	1525	-	pF
C_{oes}	Output Capacitance		-	60	-	pF
C_{res}	Reverse Transfer Capacitance		-	20	-	pF
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	V_{CC} = 400 V, I_C = 40 A, R_G = 6 Ω, V_{GE} = 15 V, Inductive Load, T_C = 25°C	-	16.8	-	ns
t_r	Rise Time		-	34.4	-	ns
$t_{d(off)}$	Turn-Off Delay Time		-	54.4	-	ns
t_f	Fall Time		-	10	-	ns
E_{on}	Turn-On Switching Loss		-	1.37	-	mJ
E_{off}	Turn-Off Switching Loss		-	0.25	-	mJ
E_{ts}	Total Switching Loss		-	1.62	-	mJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC} = 400 V, I_C = 40 A, R_G = 6 Ω, V_{GE} = 15 V, Inductive Load, T_C = 175°C	-	16	-	ns
t_r	Rise Time		-	35.2	-	ns
$t_{d(off)}$	Turn-Off Delay Time		-	57.6	-	ns
t_f	Fall Time		-	12.8	-	ns
E_{on}	Turn-On Switching Loss		-	1.89	-	mJ
E_{off}	Turn-Off Switching Loss		-	0.47	-	mJ
E_{ts}	Total Switching Loss		-	2.36	-	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	-	55.5	-	nC
Q_{ge}	Gate to Emitter Charge		-	9.8	-	nC
Q_{gc}	Gate to Collector Charge		-	21	-	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 = 3 A	T_C = 25°C	-	1.6	2.3	V
			T_C = 175°C	-	1.4	-	
E_{rec}	Reverse Recovery Energy	I_F = 3 A, dI_F/dt = 200 A/μs	T_C = 175°C	-	29.7	-	uJ
t_{rr}	Diode Reverse Recovery Time		T_C = 25°C	-	26	-	ns
			T_C = 175°C	-	153	-	
Q_{rr}	Diode Reverse Recovery Charge		T_C = 25°C	-	35	-	nC
			T_C = 175°C	-	305	-	

Typical Performance Characteristics

Figure 1. Typical Output Characteristics

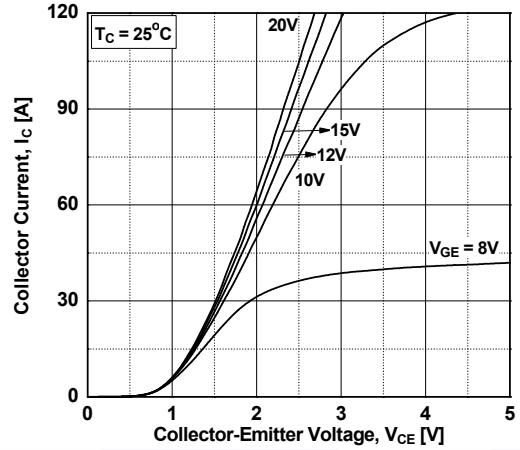


Figure 2. Typical Output Characteristics

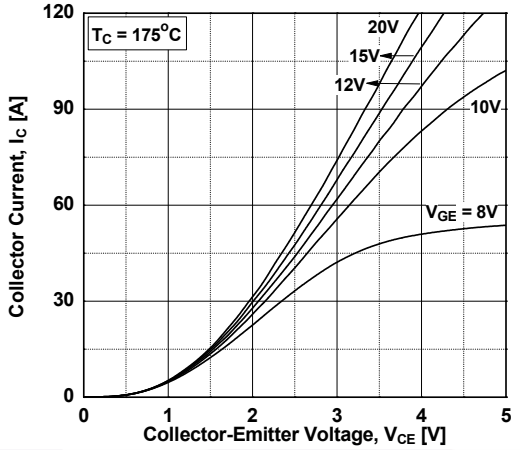


Figure 3. Typical Saturation Voltage Characteristics

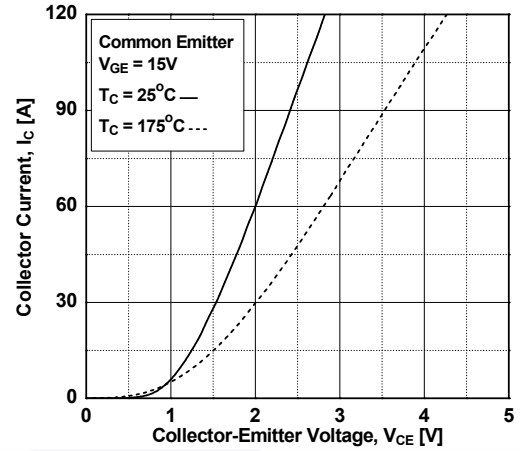


Figure 4. Saturation Voltage vs. Case Temperature at Variant Current Level

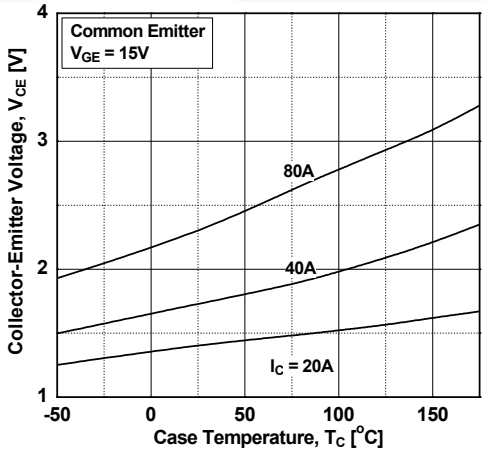


Figure 5. Saturation Voltage vs. V_{GE}

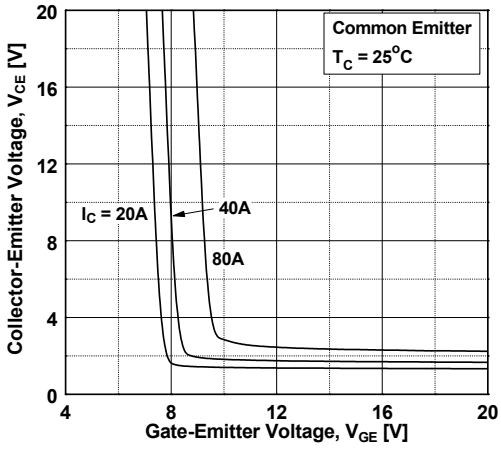
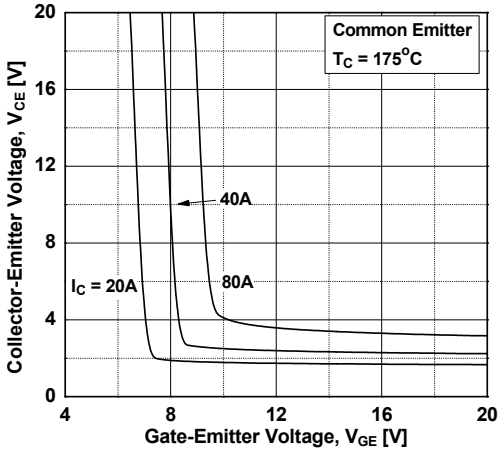


Figure 6. Saturation Voltage vs. V_{GE}



Typical Performance Characteristics

Figure 7. Capacitance Characteristics

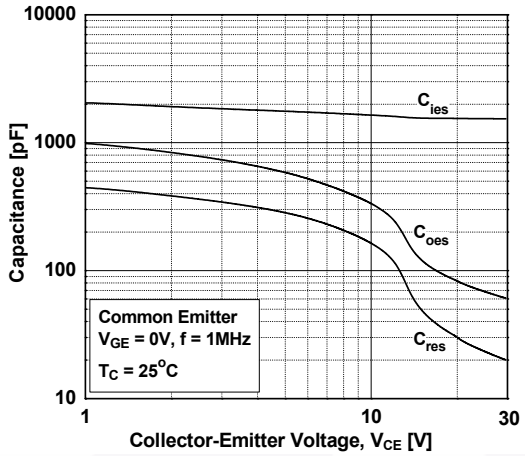


Figure 8. Gate charge Characteristics

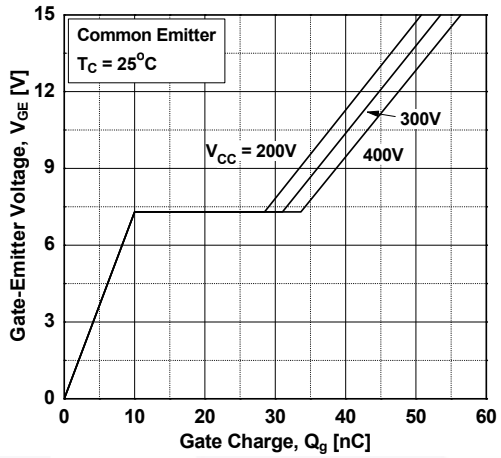


Figure 9. Turn-on Characteristics vs. Gate Resistance

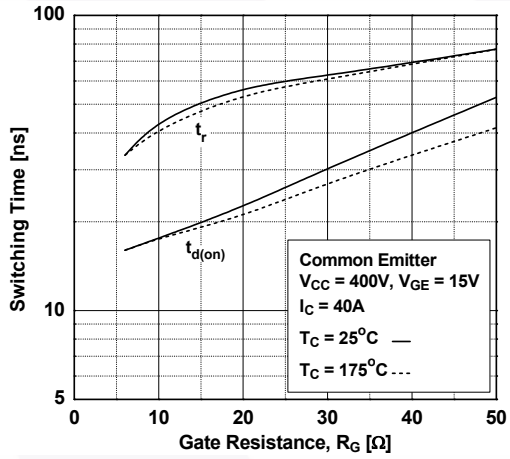


Figure 10. Turn-off Characteristics vs. Gate Resistance

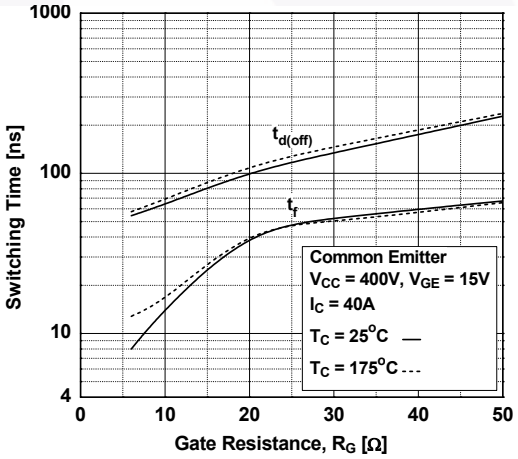


Figure 11. Switching Loss vs. Gate Resistance

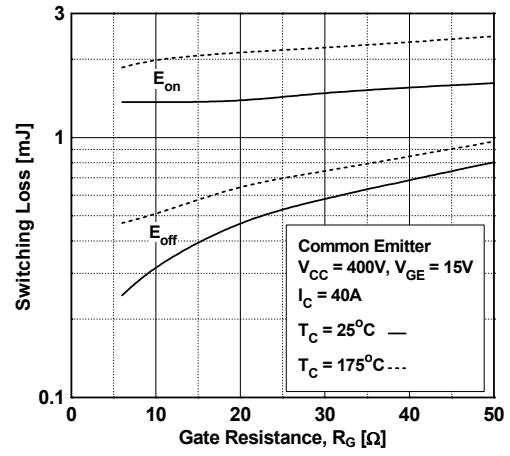
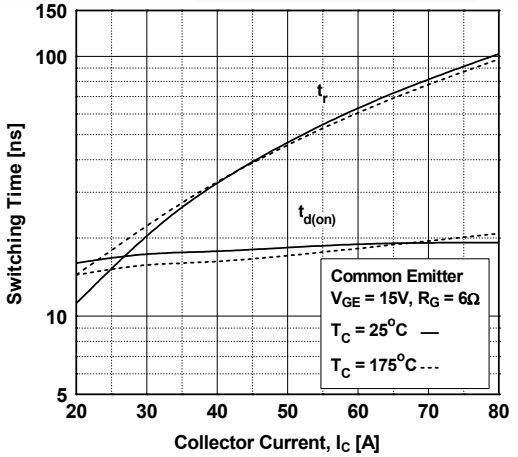


Figure 12. Turn-on Characteristics vs. Collector Current



Typical Performance Characteristics

Figure 13. Turn-off Characteristics vs. Collector Current

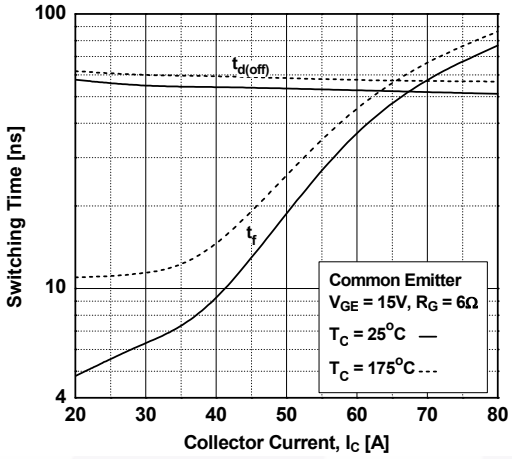


Figure 14. Switching Loss vs. Collector Current

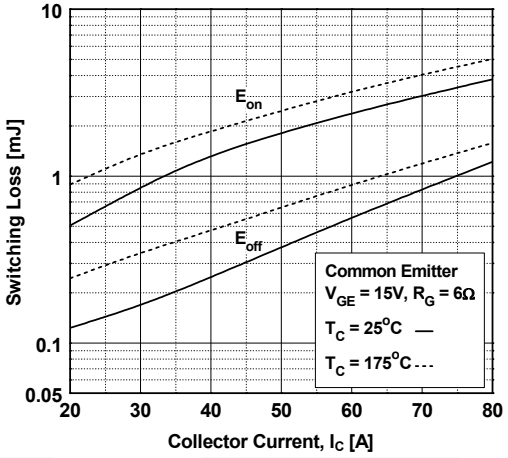


Figure 15. Load Current Vs. Frequency

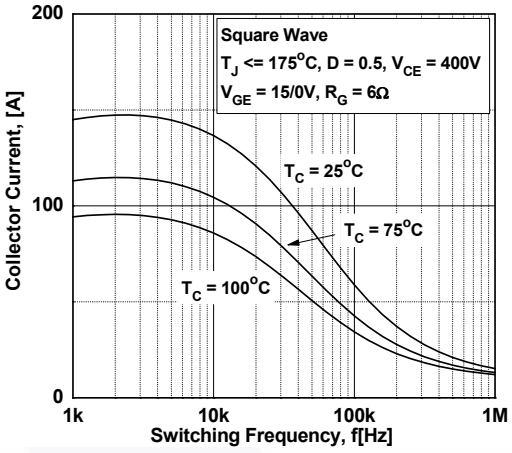


Figure 16. SOA Characteristics

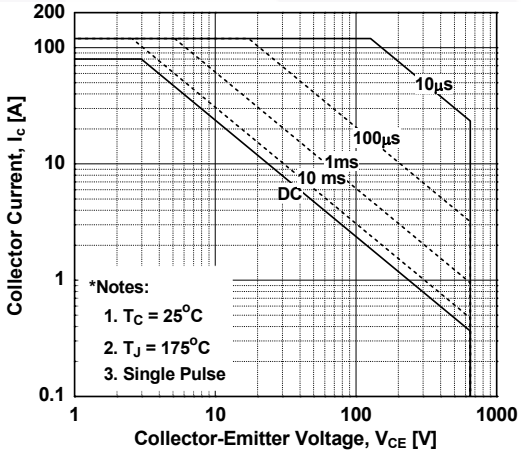


Figure 17. Forward Characteristics

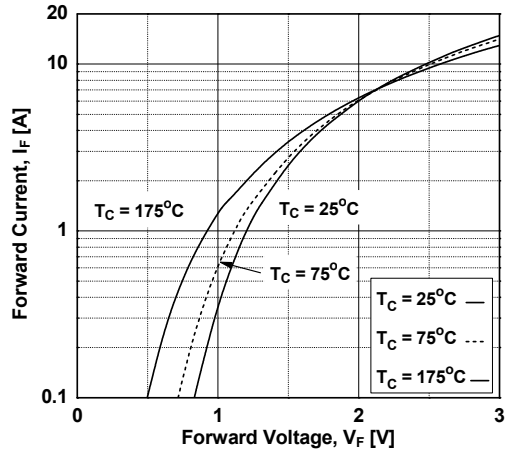
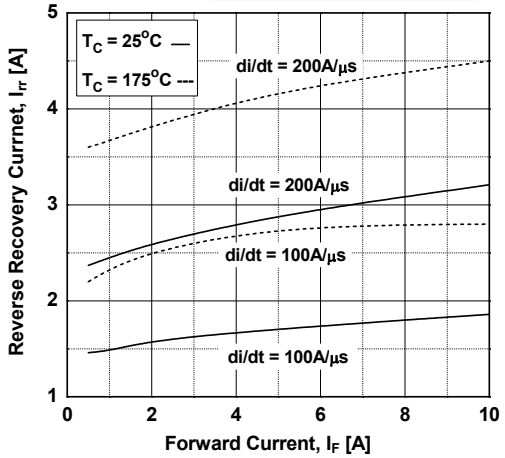


Figure 18. Reverse Recovery Current



Typical Performance Characteristics

Figure 19. Reverse Recovery Time

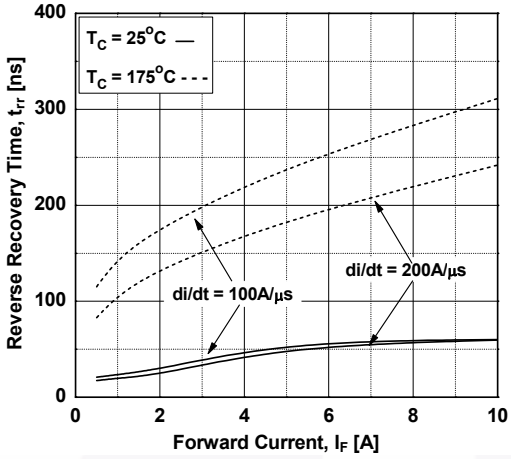


Figure 20. Stored Charge

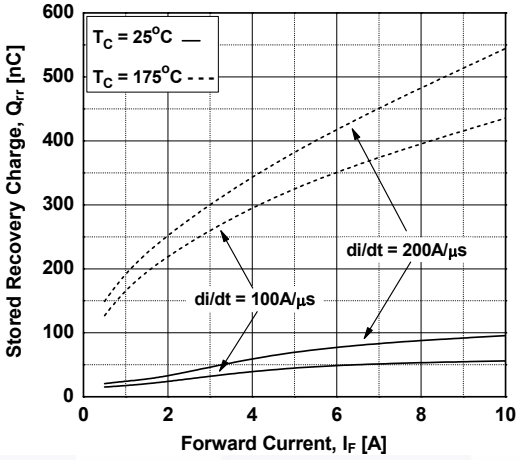


Figure 21.Transient Thermal Impedance of IGBT

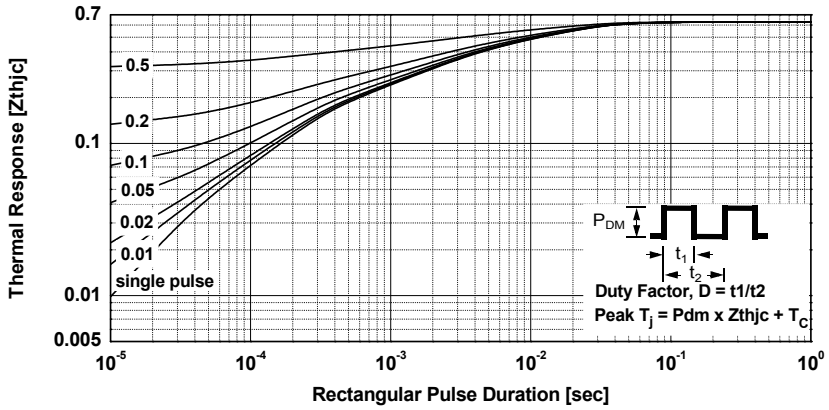
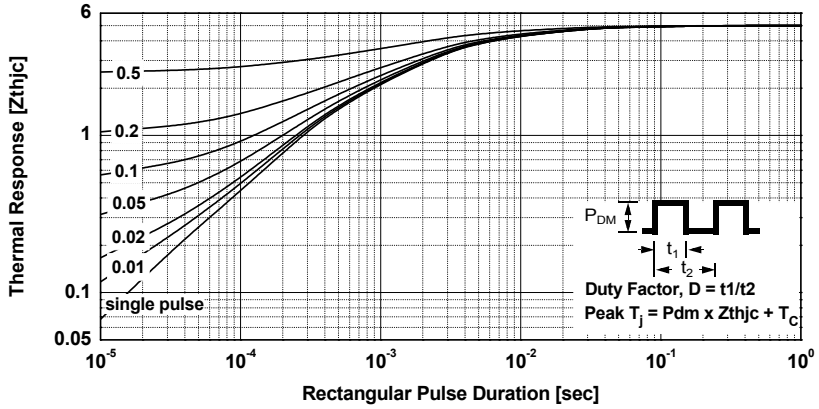
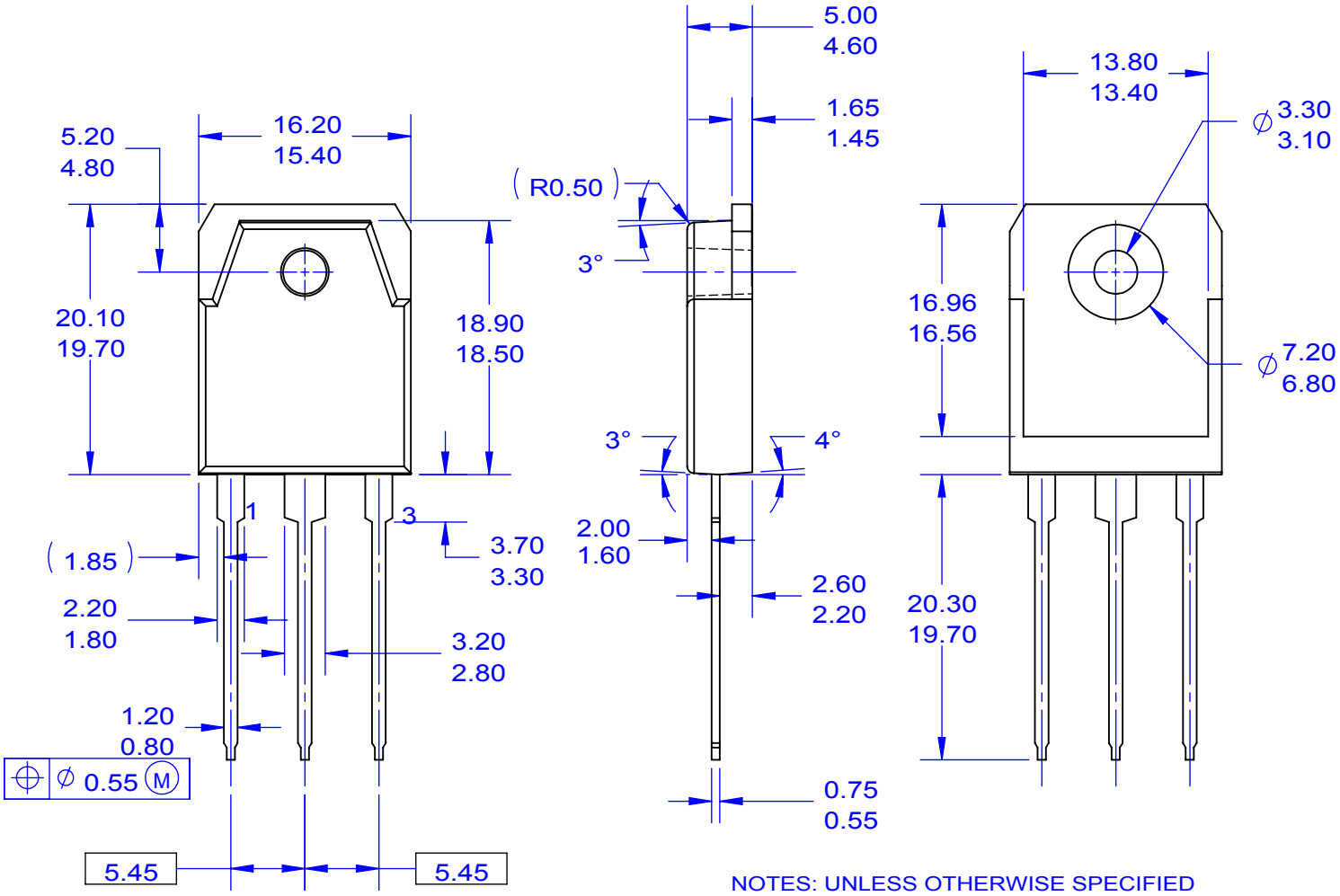
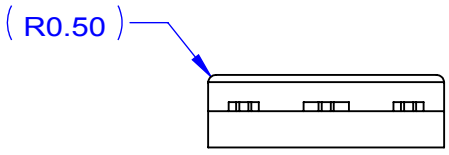


Figure 22.Transient Thermal Impedance of Diode







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