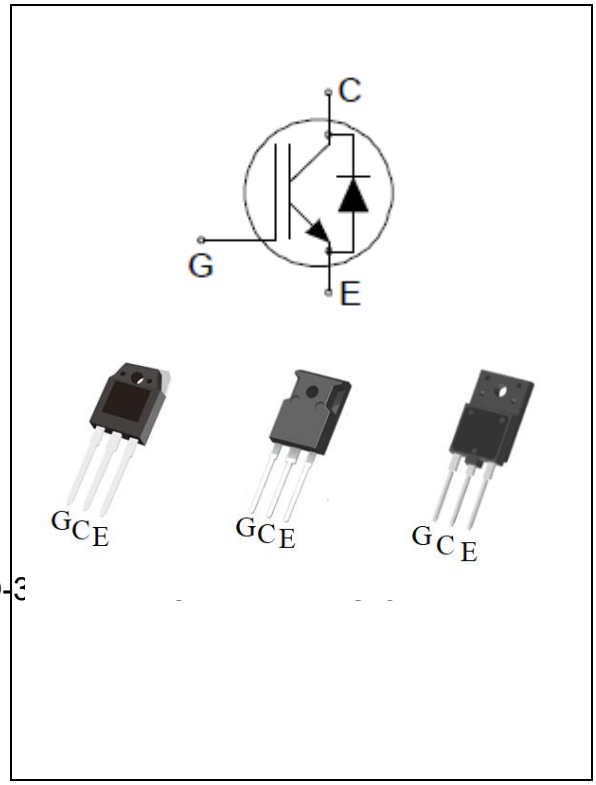
HMG40N65AT

1. Description

HMG40N65AT is obtained by advanced Trench Field Stop (T-FS) technology which is characteristic with low $V_{CE(sat)}$, optimized switching performance and low gate charge Qg. The IGBT is suitable device for Photovoltaic, UPS and high switching frequency applications.



TO-3

KEY CHARACTERISTICS

Parameter	Value	Unit
V_{CES}	650	V
I_C	40	A
$V_{CE(sat).typ}$	1.45	V

FEATURES

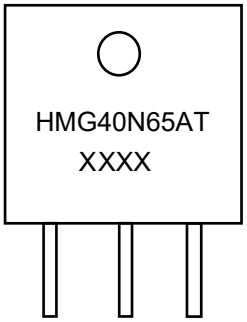
- Fast Switching
- Low $V_{CE(sat)}$
- Positive temperature coefficient
- Fast recovery anti-parallel diode
- RoHS product

APPLICATIONS

- Photovoltaic converters
- UPS

ORDERING INFORMATION

Device Marking	Ordering Codes	Package	Product Code	Packing
HMG40N65AT XXXX	HMG40N65AT	TO-247	HMG40N65AT	Tube



HMG40N65AT：Product Code
XXXX：Year & Week

2. ABSOLUTE RATINGS

Symbol	Parameter	TO-3PN/TO-247	TO-3PF	Units
V_{CES}	Collector-Emitter Voltage	650	650	V
I_C	Collector Current @T_C=25℃	80	80	A
	Collector Current @T_C=100°C	40	40	A
I_{CM}	Pulsed Collector Current, tp limited by T_{Jmax}	160	160	A
I_F	Diode Continuous Forward Current @T_C=25℃	80	80	A
	Diode Continuous Forward Current @T_C=100℃	40	40	A
I_{FM}	Diode Maximum Forward Current, limited by T_{Jmax}	160	160	A
V_{GES}	Gate-Emitter Voltage	±30	±30	V
t_{SC}	Short circuit withstand time V_{GE}=15V, V_{CC}≤400V, Allowed number of short circuits<1000,Times between short circuits: ≥ 1.0s,T_J ≤ 175℃	8		μs
P_D	Power Dissipation @T_C=25℃	300	50	W
T_{Jmax}, T_{stg}	Operating Junction and Storage Temperature Range	175, –55 to 175		℃
T_L	Maximum Temperature for Soldering	260		℃

3. Thermal characteristics

Symbol	Parameter	TO-3PN/TO-247	TO-3PF	Units
$R_{\theta JC}$	Junction-to-Case (IGBT)	0.5	3.0	℃/W
$R_{\theta JC}$	Junction-to-Case (Diode)	0.65	1.63	℃/W
$R_{\theta JA}$	Junction-to-Ambient	40	40	℃/W

4. Electrical Characteristics

at T_C = 25°C, unless otherwise specified

Static Characteristics

Symbol	Parameter	Test Conditions	Values			Units
			Min.	Typ.	Max.	
V_{CES}	Collector-Emitter Breakdown Voltage	V_{GE} = 0V, I_C = 250μA	650	--	--	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	V_{GE} = 15V,I_C = 40A T_J=25℃ T_J=125℃ T_J=175℃	 -- -- --	 1.45 1.65 1.75	 1.85 -- --	V

$V_{GE(TH)}$	Gate Threshold Voltage	V_{CE} = V_{GE},I_C = 1mA	4.7	5.5	6.2	V
V_F	Diode Forward Voltage	I_F=40A T_J=25℃ T_J=125℃ T_J=175℃	-- -- --	2.20 1.80 1.60	2.90 -- --	V
I_{CES}	Collector-Emitter Leakage Current	V_{CE} = 650V, V_{GE} = 0V	--	--	35	μA
$I_{GES(F)}$	Gate-Emitter Forward Leakage Current	V_{GE} = +30V	--	--	200	nA
$I_{GES(R)}$	Gate-Emitter Reverse Leakage Current	V_{GE} = -30V	--	--	-200	nA
Pulse width tp≤300μs, δ≤2%						

Dynamic Characteristics

Symbol	Parameter	Test Conditions	Values			Units
			Min.	Typ.	Max.	
C_{iss}	Input Capacitance	V_{GE}=0V V_{CE}=25V f =1.0MHz	--	2125	--	pF
C_{oss}	Output Capacitance		--	157	--	
C_{rss}	Reverse Transfer Capacitance		--	24	--	
Q_G	Gate charge	V_{CC}=520V I_{CE}=20A V_{GE}=15V	--	110	--	nC
Q_{GC}	Gate-emitter charge		--	55	--	
Q_{GE}	Gate-collector charge		--	22	--	
$I_{C(SC)}$	Short circuit collector current Max.1000 short circuits, Times between short circuits: ≥ 1.0s	V_{GE}=15.0V,V_{CC}≤400V， t_{SC}≤8us，T_J≤175℃		250		A

IGBT Switching Characteristics, at T_J=25℃

Symbol	Parameter	Test Conditions	Values			Units
			Min.	Typ.	Max.	
$t_{d(on)}$	Turn-on Delay Time	I_C =40A V_{CE} = 400V V_{GE} = 15V R_G =5Ω T_J=25℃ Inductive Load	--	20	--	ns
tr	Rise Time		--	33	--	
$t_{d(off)}$	Turn-Off Delay Time		--	112	--	
t_f	Fall Time		--	66	--	
E_{on}	Turn-On Switching Loss		--	0.65	--	mJ
E_{off}	Turn-Off Switching Loss		--	0.68	--	
E_{ts}	Total Switching Loss		--	1.33	--	

IGBT Switching Characteristics, at T_J=175℃

Symbol	Parameter	Test Conditions	Values			Units
			Min.	Typ.	Max.	
$t_{d(on)}$	Turn-on Delay Time	I_C =40A V_{CE} = 400V V_{GE} = 15V R_G =5Ω T_J=175℃ Inductive Load	--	19	--	ns
tr	Rise Time		--	34	--	
$t_{d(off)}$	Turn-Off Delay Time		--	148	--	
t_f	Fall Time		--	112	--	
E_{on}	Turn-On Switching Loss		--	0.87	--	mJ
E_{off}	Turn-Off Switching Loss		--	0.89	--	
E_{ts}	Total Switching Loss		--	1.76	--	

Diode Characteristics, at T_J=25℃

Symbol	Parameter	Test Conditions	Values			Units
			Min.	Typ.	Max.	
T_{rr}	Reverse Recovery Time	I_F=20A, di/dt=200A/μs, T_J=25°C	--	162	--	ns
Q_{rr}	Reverse Recovery Charge		--	148	--	nC
I_{rrm}	Reverse Recovery Current		--	2.0	--	A
T_{rr}	Reverse Recovery Time	I_F=40A, di/dt=200A/μs, T_J=25°C	--	180	--	ns
Q_{rr}	Reverse Recovery Charge		--	190	--	nC
I_{rrm}	Reverse Recovery Current		--	2.5	--	A

Diode Characteristics, at T_J=175℃

Symbol	Parameter	Test Conditions	Values			Units
			Min.	Typ.	Max.	
T_{rr}	Reverse Recovery Time	I_F=20A, di/dt=200A/μs, T_J=175°C	--	216	--	ns
Q_{rr}	Reverse Recovery Charge		--	156	--	nC
I_{rrm}	Reverse Recovery Current		--	4.2	--	A
T_{rr}	Reverse Recovery Time	I_F=40A, di/dt=200A/μs, T_J=175°C	--	251	--	ns
Q_{rr}	Reverse Recovery Charge		--	209	--	nC
I_{rrm}	Reverse Recovery Current		--	4.5	--	A

5. Characteristics Curves

Figure 1. Forward Bias Safe Operating Area for TO247TO3PN

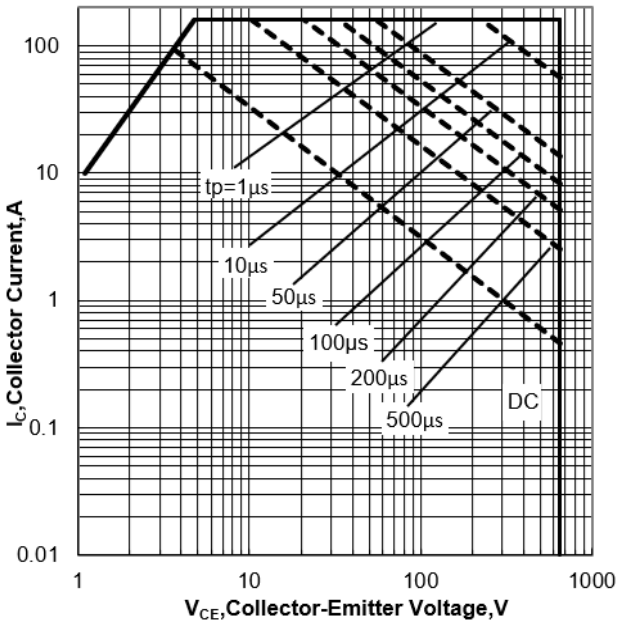


Figure 2. Forward Bias Safe Operating Area for TO3PF

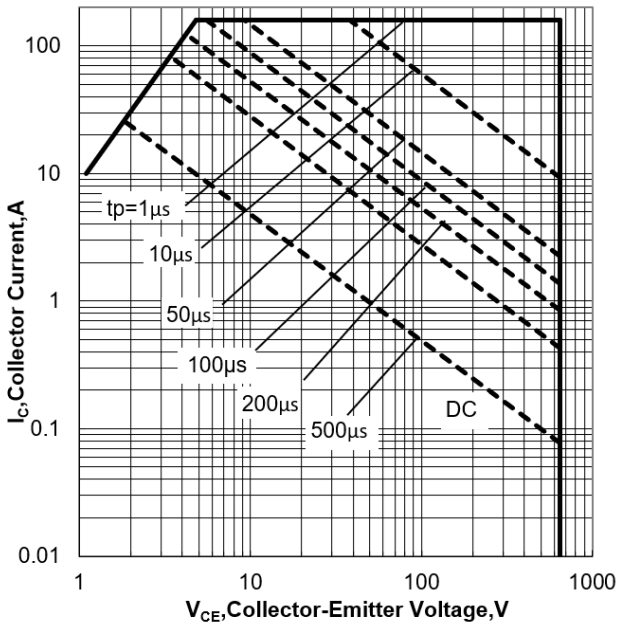


Figure 3. Power Dissipation vs Case Temperature for TO247/TO3PN

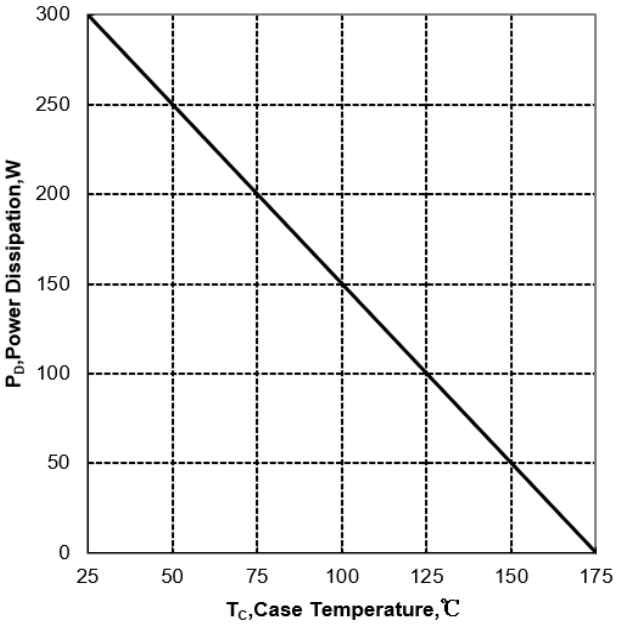


Figure 4. Power Dissipation vs Case Temperature for TO3PF

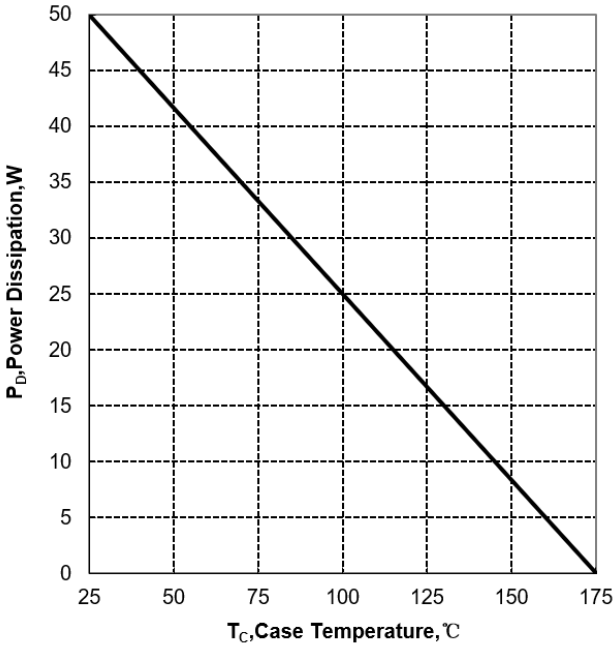


Figure 5. Collector Current vs Case Temperature

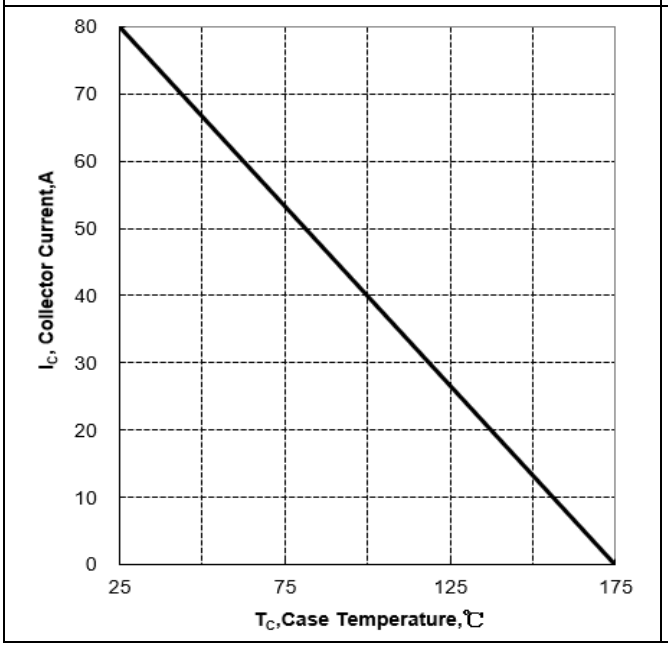


Figure 6. Typical Transfer Characteristics

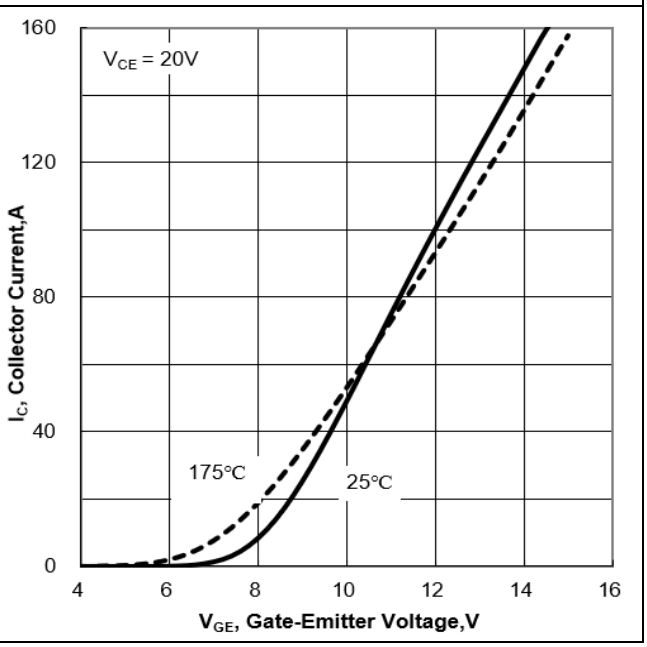


Figure 7. Typical Output Characteristics (T_J=25℃)

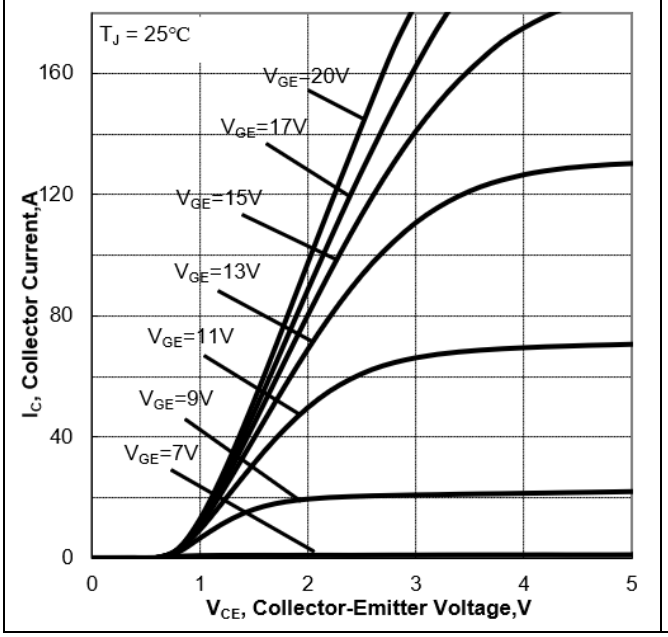


Figure 8. Typical Output Characteristics (T_J=175℃)

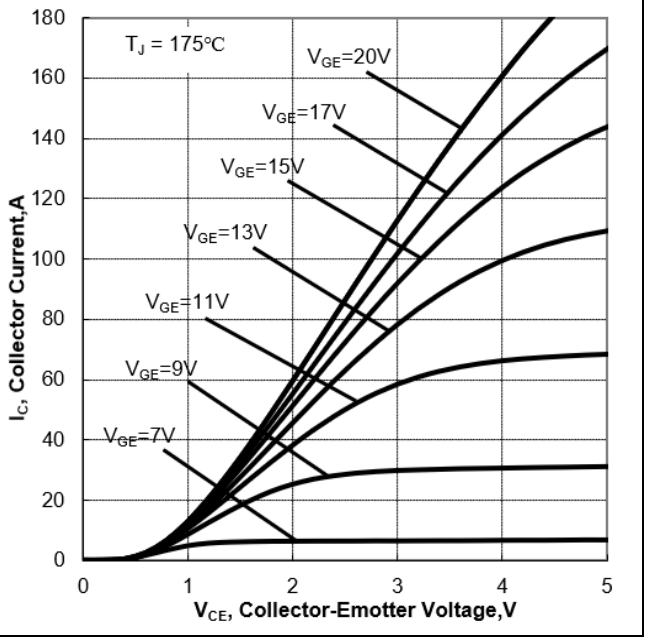


Figure 9. Typical Collector-Emitter Saturation Voltage vs Junction Temperature

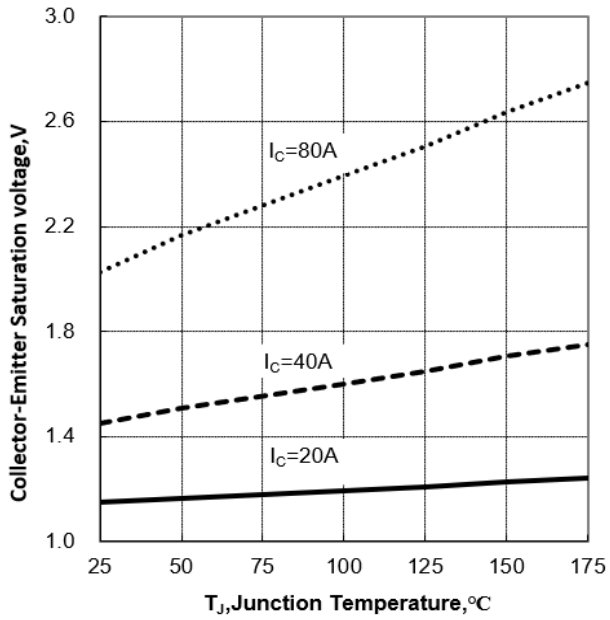


Figure 10. Typical Gate-Emitter Threshold Voltage vs Junction Temperature

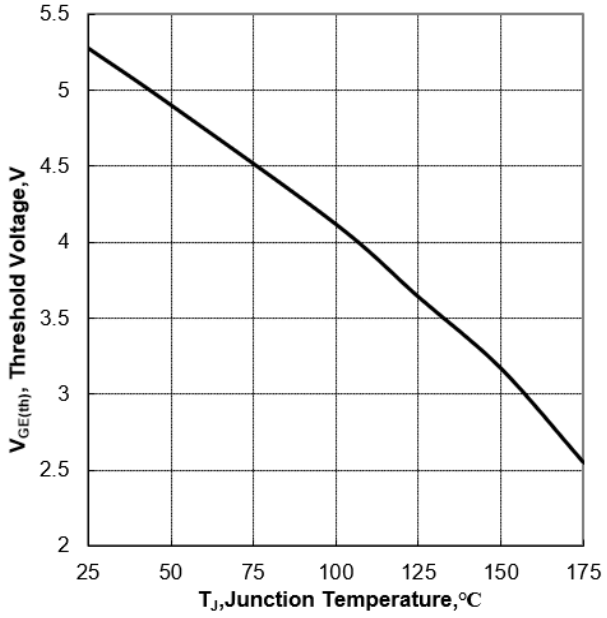


Figure 11. Typical Switching Times vs Gate Resistor (T_J=25℃, V_{CE}=400V, V_{GE}=15/0V, I_C=40A)

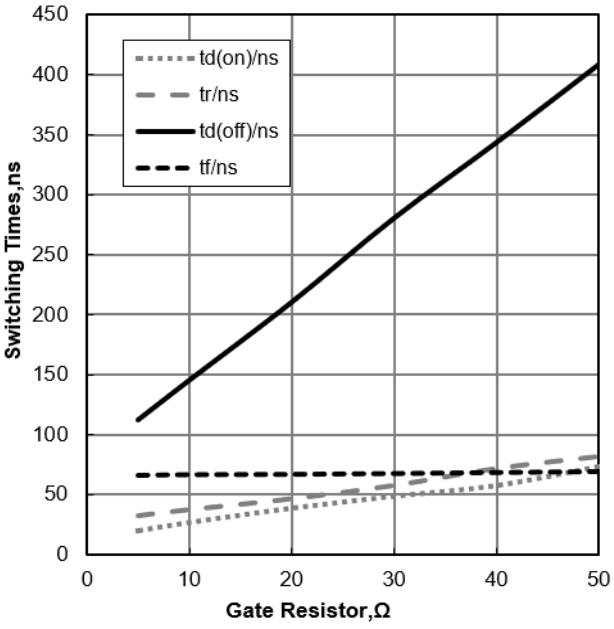


Figure 12. Typical Switching Energy vs Gate Resistor (T_J=25℃, V_{CE}=400V, V_{GE}=15/0V, I_C=40A)

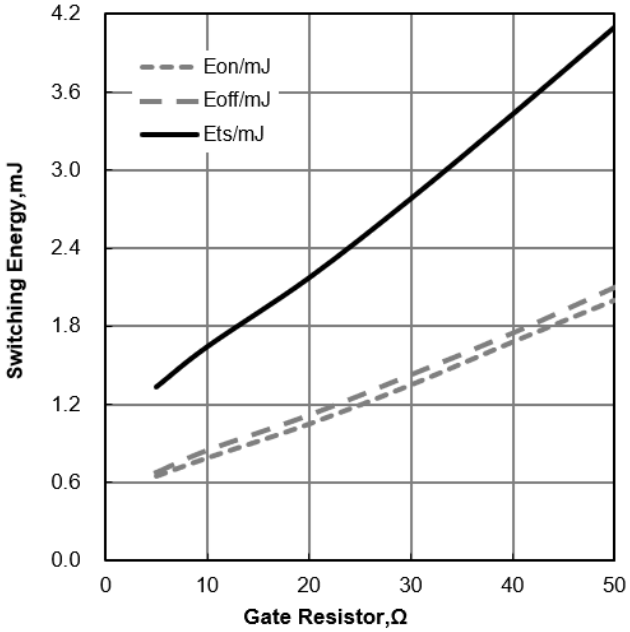


Figure 13. Typical Switching Times vs Junction Temperature (V_{CE}=400V, V_{GE}=15/0V, I_C=40A)

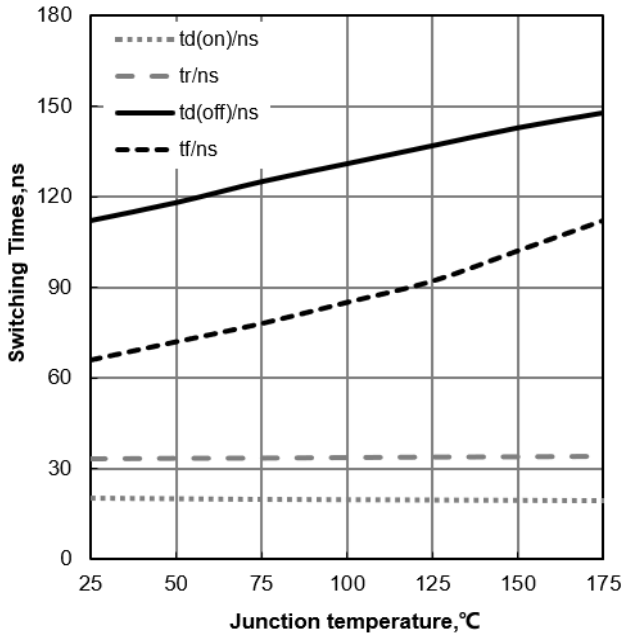


Figure 14. Typical Switching Energy vs Junction Temperature (V_{CE}=400V, V_{GE}=15/0V, I_C=40A)

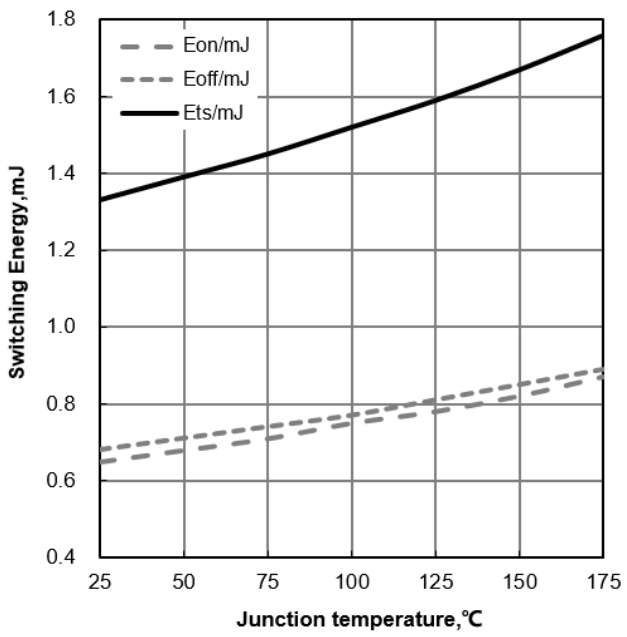


Figure 15. Typical Switching Times vs Collector Current (T_J=25℃, V_{CE}=400V, V_{GE}=15/0V)

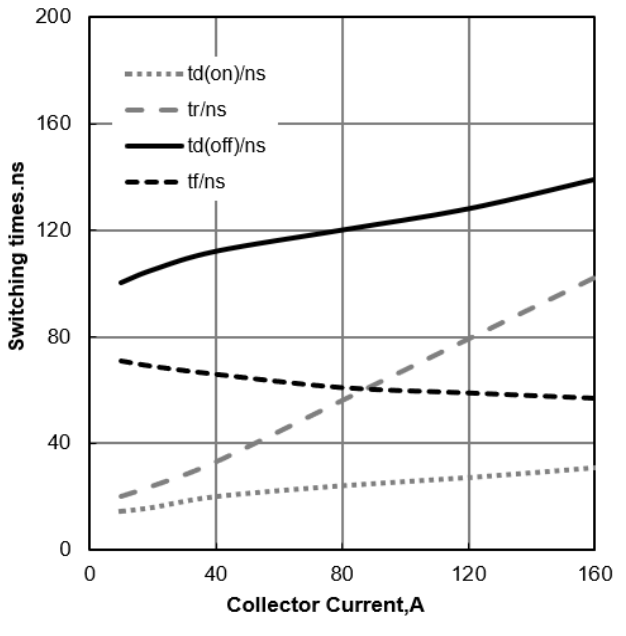


Figure 16. Typical Switching Energy vs Collector Current (T_J=25℃, V_{CE}=400V, V_{GE}=15/0V)

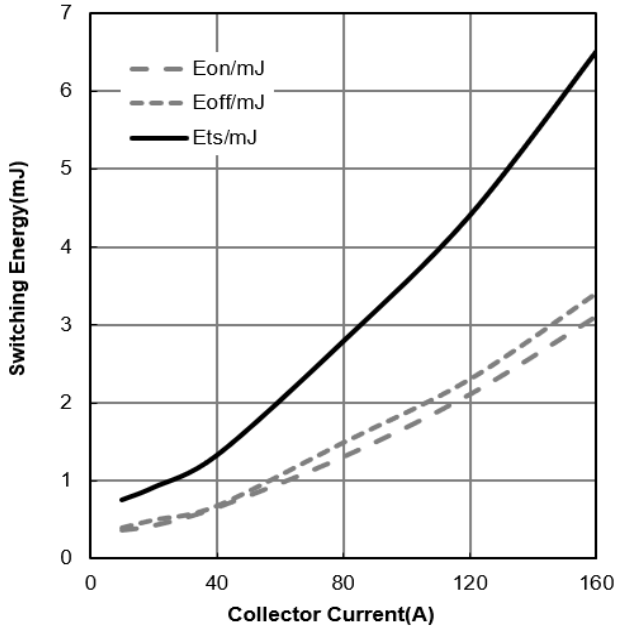


Figure 17. Typical Switching Times vs V_{CE} (T_J=25℃, V_{GE}=15/0V, I_C=40A)

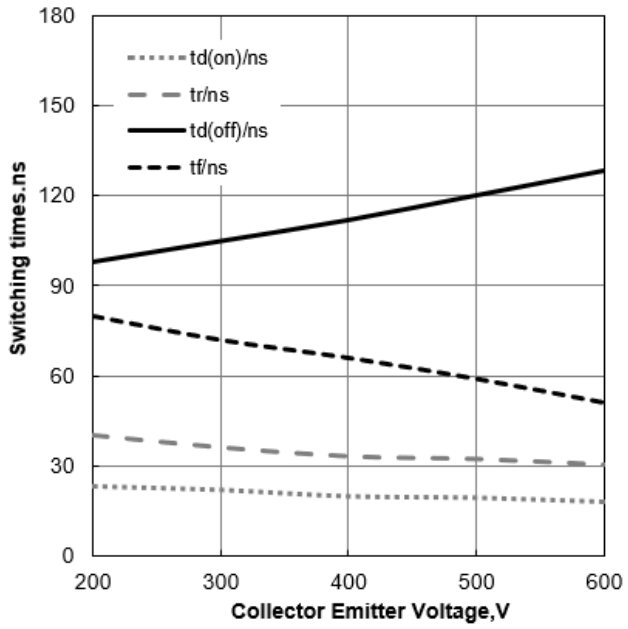


Figure 18. Typical Switching Energy vs V_{CE} (T_J=25℃, V_{GE}=15/0V, I_C=40A)

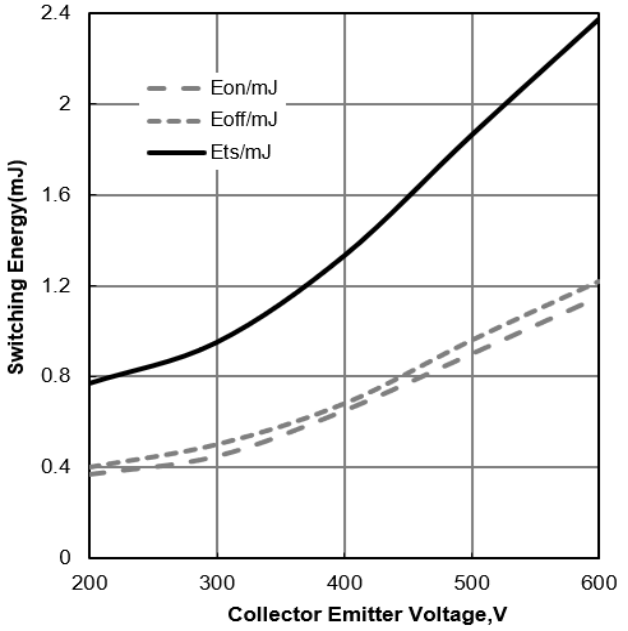


Figure 19. Typical Gate Charge

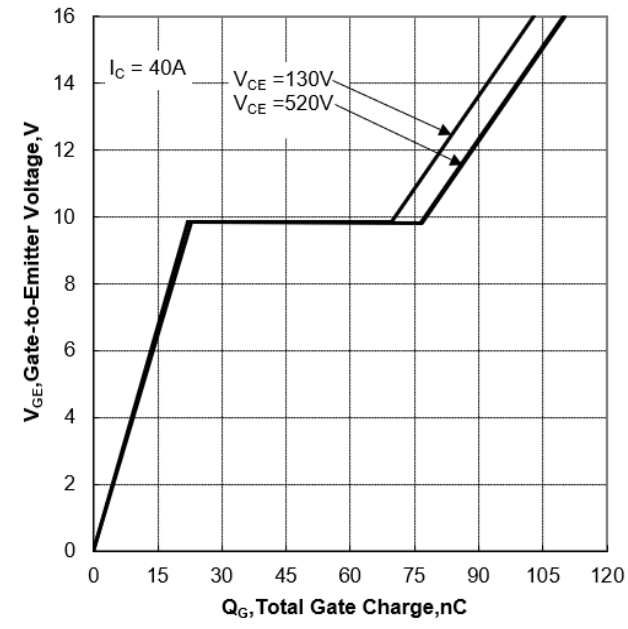


Figure 20. Typical Capacitance vs Collector-Emitter Voltage

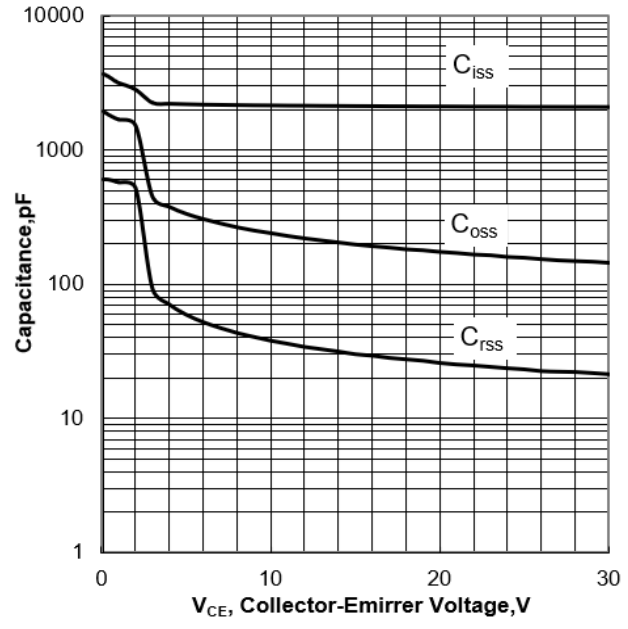


Figure 21. IGBT Transient Thermal Impedance vs Pulse Width(TO247/TO3PN)

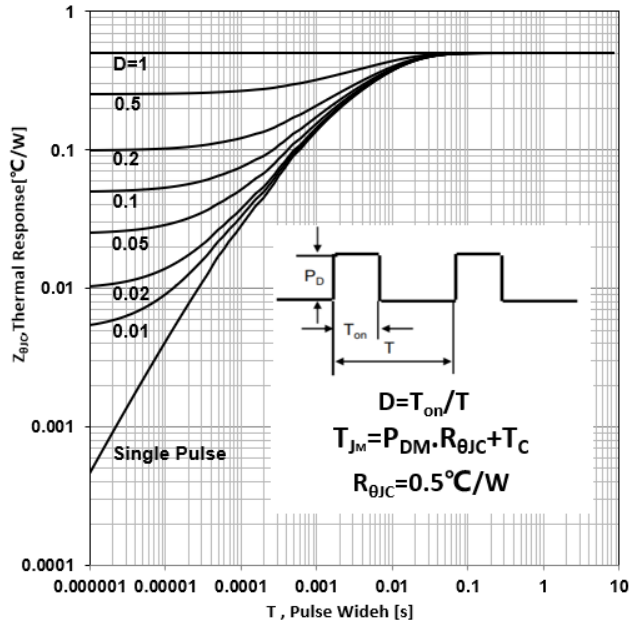


Figure 22. IGBT Transient Thermal Impedance vs Pulse Width(TO3PF)

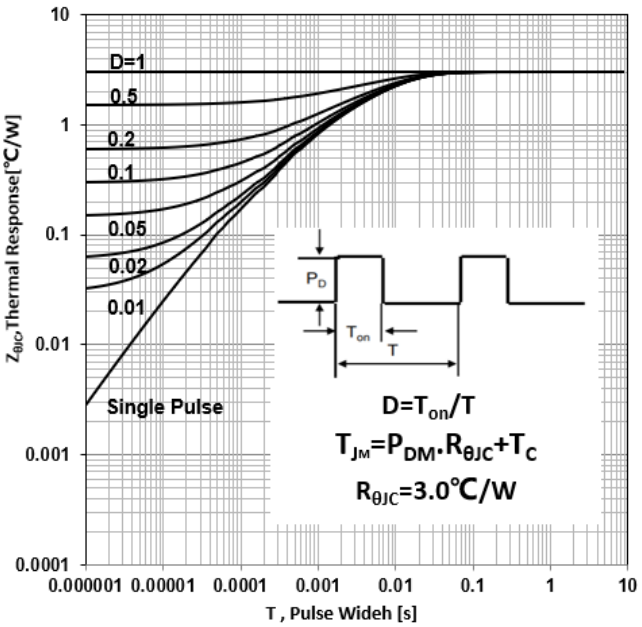


Figure 23. Diode Transient Thermal Impedance vs Pulse Width(TO247/TO3PN)

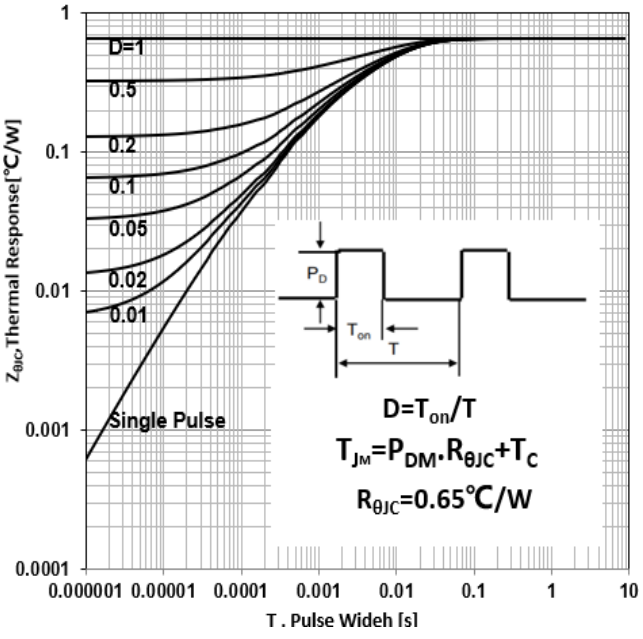


Figure 24. Diode Transient Thermal Impedance vs Pulse Width (TO3PF)

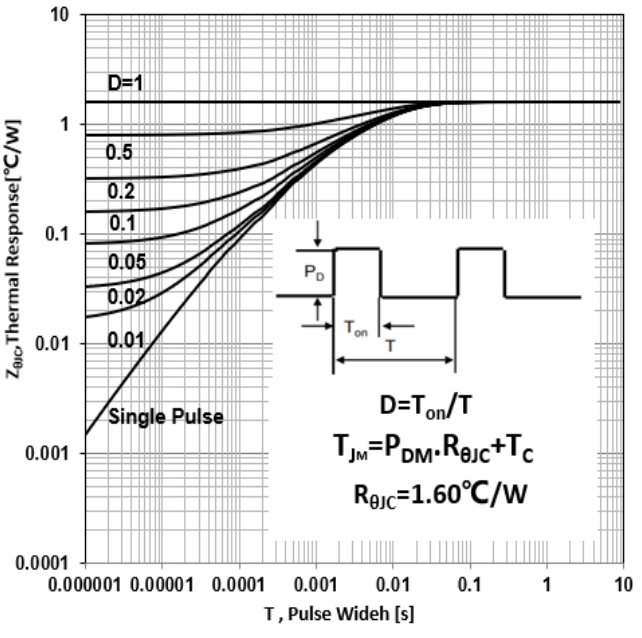
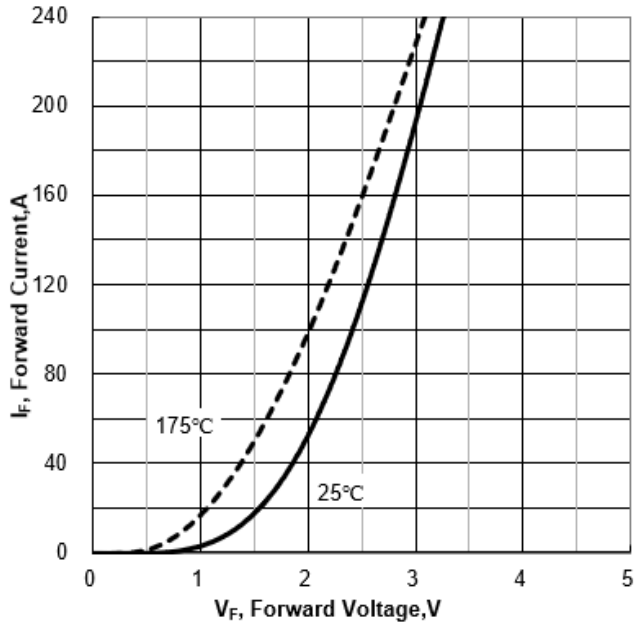


Figure 25. Typical Diode Forward Current vs Forward Voltage



6. Test Circuit and Waveform

Figure 22. Inductive Switching Test Circuit

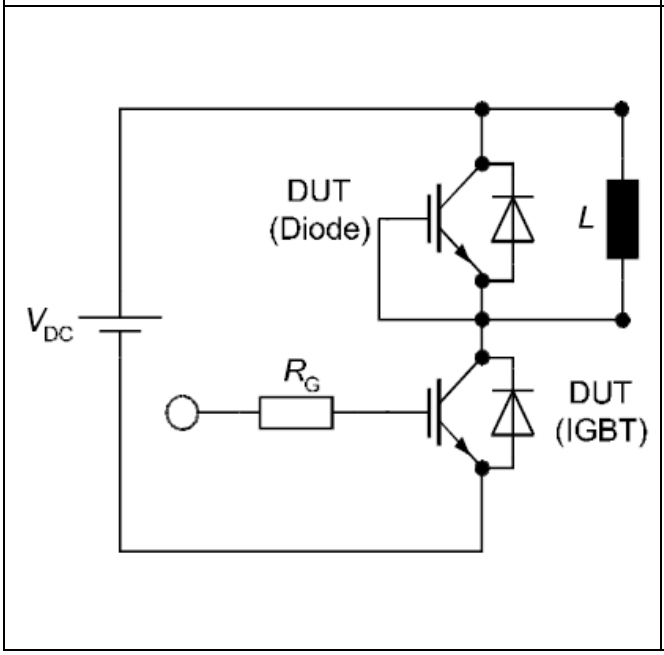


Figure 23. Definition of switching times

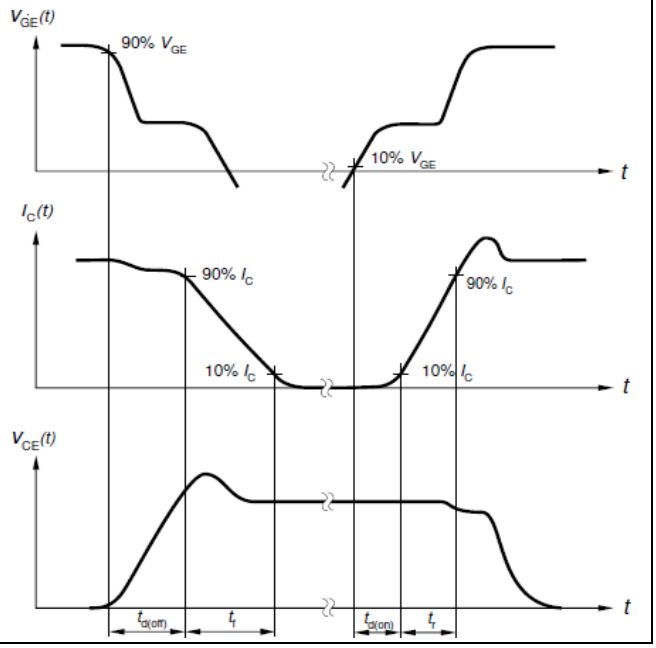


Figure 24. Definition of switching losses

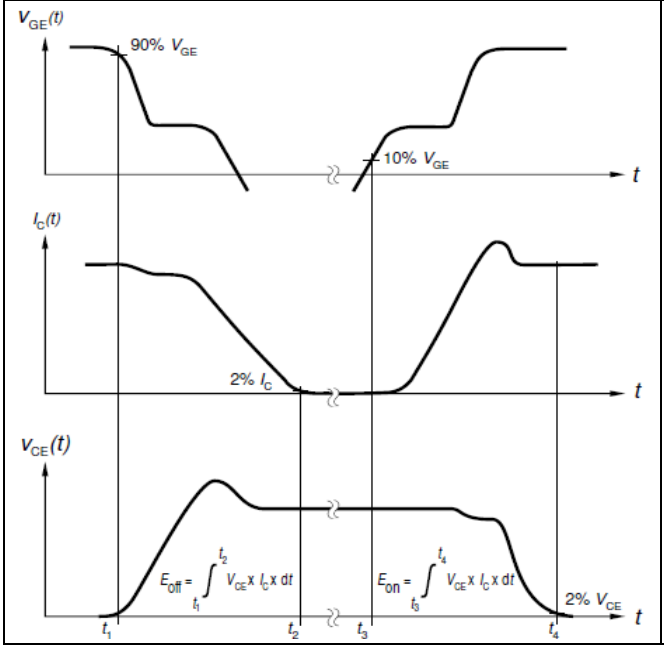
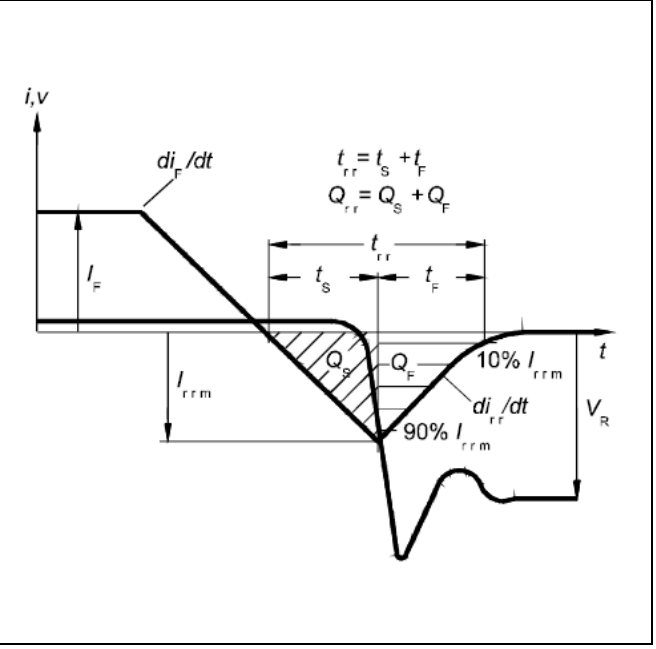
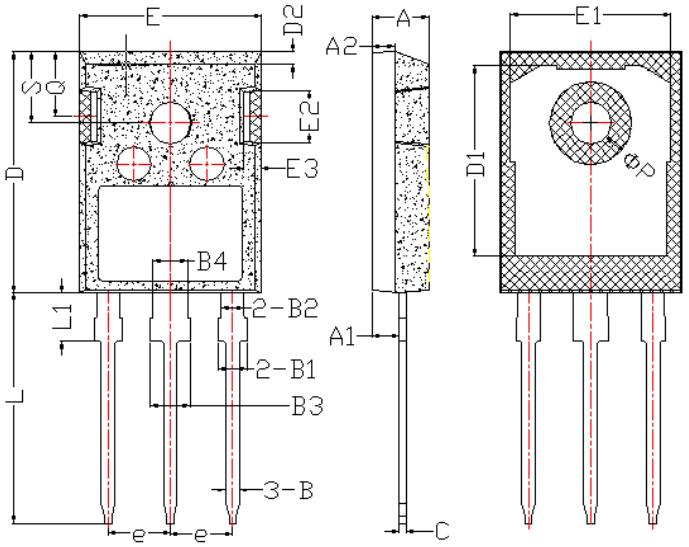


Figure 25. Definition of diode switching characteristics



7. Package Description



TO-247 Package

Items	Values(mm)	
	MIN	MAX
A	4.90	5.16
A1	2,27	2.53
A2	1.85	2.11
B	1.07	1.33
B1	1.90	2.41
B2	1.75	2.15
B3	2.87	3.38
B4	2.87	3.13
C	0.55	0.68
D	20.82	21.10
D1	16.25	17.65
D2	1.05	1.35
E	15.70	16.03
E1	13.10	14.15
E2	3.68	5.10
E3	1.68	2.60
e	5.44	
L	19.80	20.31
L1	4.17	4.47
ΦP	3.50	3.70
Q	5.49	6.00
S	6.04	6.30