

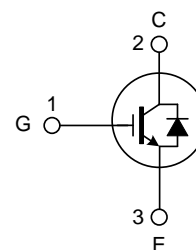
Features

- 650V,40A
- High speed switching
- Positive temperature coefficient in $V_{CE(sat)}$
- Very tight parameter distribution
- High ruggedness, temperature stable behavior
- 100% EAS Tested

Application

- Air Condition
- Inverters
- Motor drives

TO-247



Part ID	Package Type	Marking	Packing
ZT50TD65BT	TO-247	ZT50TD65BT	600pcs/Tape

Absolute Maximum Ratings $T_A = 25^\circ\text{C}$, unless otherwise specified

Symbol	Parameter	Rating	Unit	
Common Ratings ($T_c=25^\circ\text{C}$ Unless Otherwise Noted)				
V_{GES}	Gate- Emitter Voltage	± 20	V	
V_{CES}	Collector-Emitter Voltage	650	V	
T_J	Maximum Junction Temperature	150	$^\circ\text{C}$	
T_{STG}	Storage Temperature Range	-55 to 150	$^\circ\text{C}$	
I_{CM}	Drain Current-Continuous@ Current-Pulsed	$T_c=25^\circ\text{C}$ 150	A	
Mounted on Large Heat Sink				
I_C	Drain Current- Continuous	$T_c=25^\circ\text{C}$	100	A
		$T_c=100^\circ\text{C}$	40	A
I_F	Diode Continuous Forward Current	50	A	
P_D	Power Dissipation	235	W	
$R_{\theta JC}$	Thermal Resistance-Junction to Case (IGBT)	0.53	$^\circ\text{C}/\text{W}$	
$R_{\theta JC}$	Thermal Resistance-Junction to Case (FRD)	1.48	$^\circ\text{C}/\text{W}$	

Electrical Characteristics $T_J=25$ unless otherwise noted

Symbol	Parameter	Condition	Min	Typ	Max	Unit	
Static Electrical Characteristics @ $T_J=25^{\circ}\text{C}$ (unless otherwise stated)							
$V_{(BR)CES}$	Collector-Emitter Breakdown Voltage	$V_{GE}=0\text{V}, I_{CE}=250\mu\text{A}$	650	--	--	V	
I_{CES}	Collector-Emitter Leakage Current	$V_{GE}=0\text{V}, V_{CE}=600\text{V}$	--	--	200	μA	
$I_{GES(F)}$	Gate to Emitter Forward Leakage	$V_{GE}=+20\text{V}, V_{CE}=0\text{V}$	--	--	400	nA	
$I_{GES(R)}$	Gate to Emitter Reverse Leakage	$V_{GE}=-20\text{V}, V_{CE}=0\text{V}$	--	--	400	nA	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$I_C=50\text{A}$ $V_{GE}=15\text{V}$	$T_J=25^{\circ}\text{C}$	--	2.0	-	V
			$T_J=125^{\circ}\text{C}$	--	2.2	--	V
$V_{GE(th)}$	Gate Threshold Voltage	$I_C=250\mu\text{A}, V_{CE}=V_{GE}$	4.0	5.0	6.5	V	
Dynamic Electrical Characteristics @ $T_J = 25^{\circ}\text{C}$ (unless otherwise stated)							
C_{ies}	Input Capacitance	$V_{CE}=30\text{V}, V_{GE}=0\text{V},$ $f=1\text{MHz}$	--	4498	--	pF	
C_{oes}	Output Capacitance		--	99	--	pF	
C_{res}	Reverse Transfer Capacitance		--	41	--	pF	
Q_g	Total Gate Charge	$V_{CC}=400\text{V}, I_C=50\text{A},$ $V_{GE}=15\text{V}$	--	147	--	nC	
Q_{ge}	Gate to Emitter Charge		--	45	--	nC	
Q_{gc}	Gate to Collector Charge		--	43	--	nC	
Switching Characteristics							
$t_{d(ON)}$	Turn-on Delay Time	$V_{CE}=400\text{V}, I_C=50\text{A},$ $V_{GE}=15\text{V}, R_g=10\Omega,$ Inductive Load	--	45	--	ns	
t_r	Rise Time		--	145	--	ns	
$t_{d(OFF)}$	Turn-Off Delay Time		--	125	--	ns	
t_f	Fall Time		--	130	--	ns	
E_{on}	Turn-On Switching Loss		--	2.8	--	mJ	
E_{off}	Turn-Off Switching Loss		--	1.0	--	mJ	
E_{ts}	Total Switching Loss		--	3.8	--	mJ	
Source- Drain Diode Characteristics @ $T_J = 25^{\circ}\text{C}$ (unless otherwise stated)							
V_{FM}	Diode Forward Voltage	$I_F=25\text{A}$	$T_C=25^{\circ}\text{C}$	--	1.95	--	V
			$T_C=125^{\circ}\text{C}$	--	1.70	--	V
T_{rr}	Reverse Recovery Time	$I_{EC}=25\text{A},$ $di/dt=200\text{A}/\mu\text{s}$	--	33	--	ns	
Q_{rr}	Reverse Recovery Charge		--	65	--	μC	

Typical Electrical and Thermal Characteristics

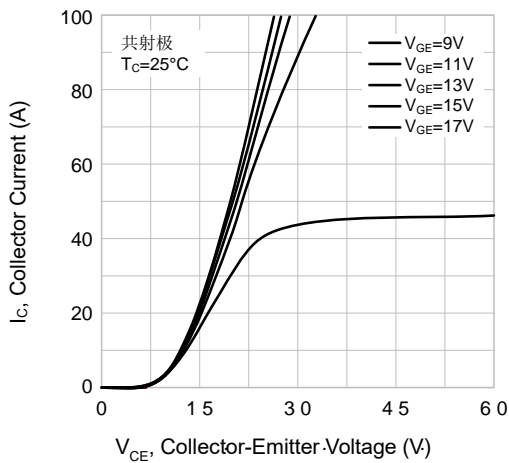


Figure 1 Output Characteristics

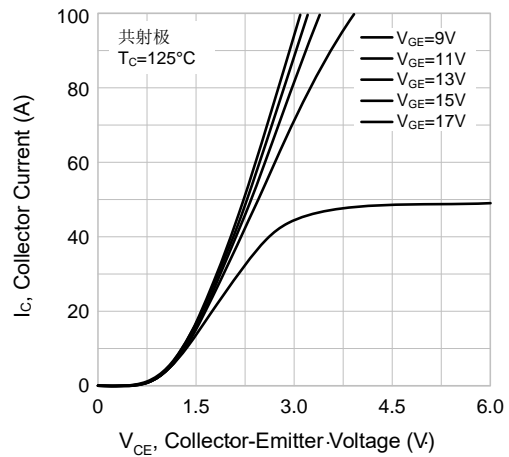


Figure 2 Output Characteristics

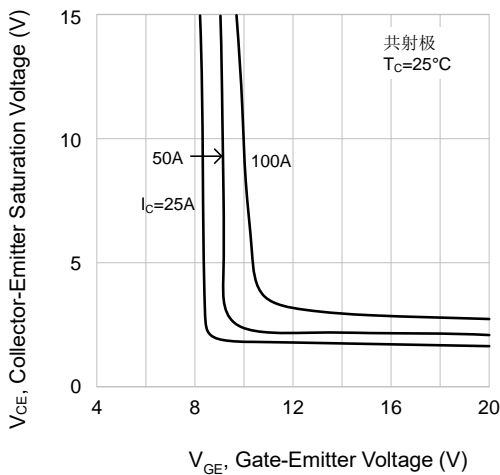


Figure 3 Saturation Voltage vs. V_{GE}

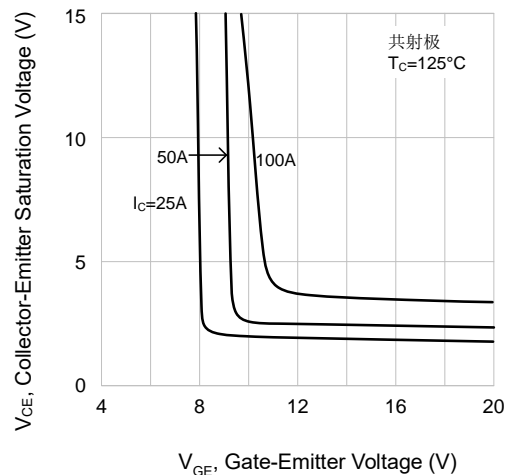


Figure 4 Saturation Voltage vs. V_{GE}

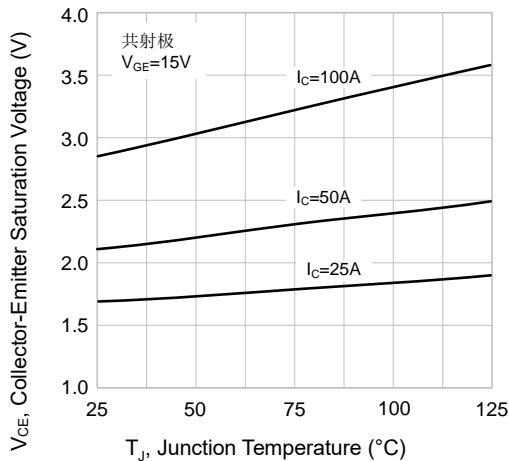


Figure 5 V_{CEsat} vs. Case Temperature

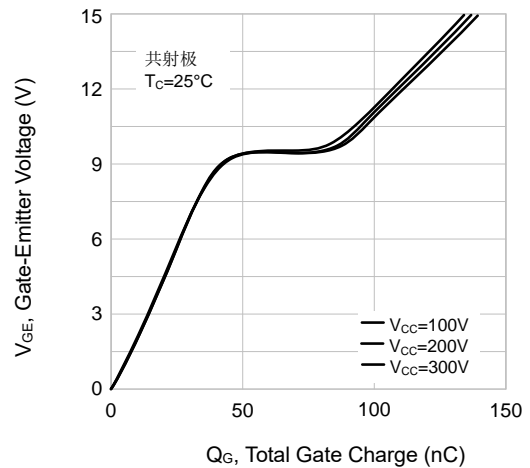


Figure 6 Gate Charge Wave Form

Typical Electrical and Thermal Characteristics

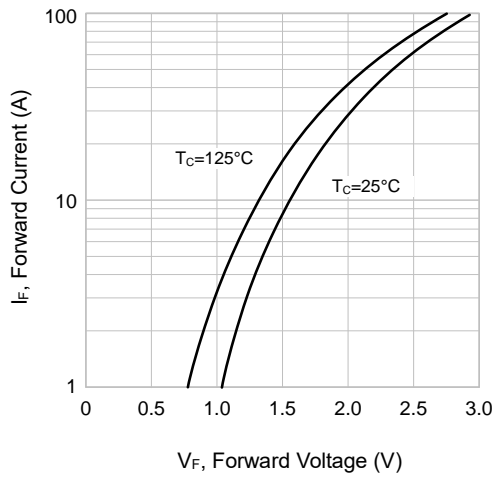


Figure 7 Forward Characteristics

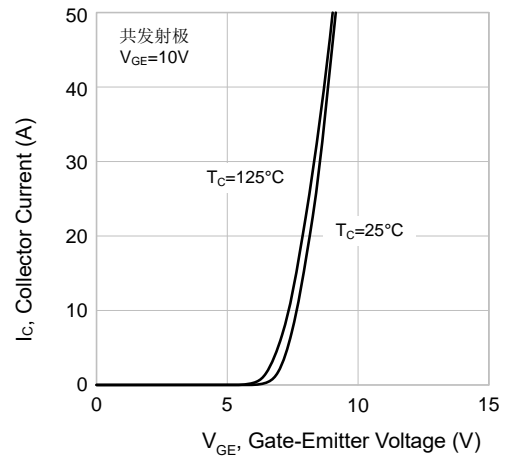


Figure 8 Transfer Characteristics

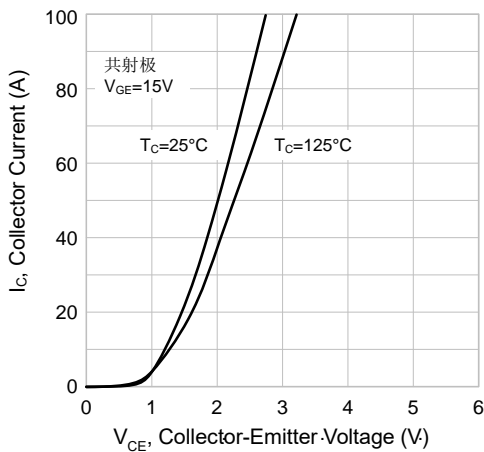


Figure 9 Typical saturation voltage characteristics

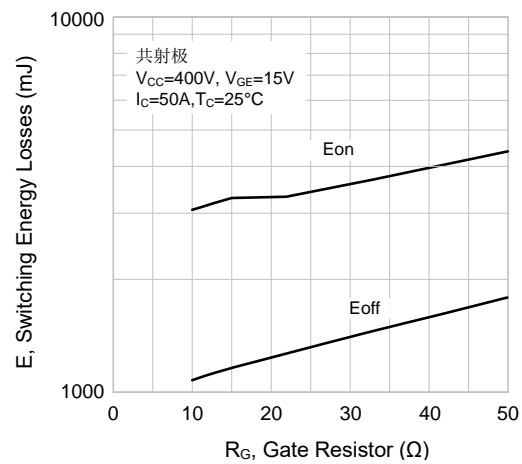


Figure 10 Switching Loss vs. R_G

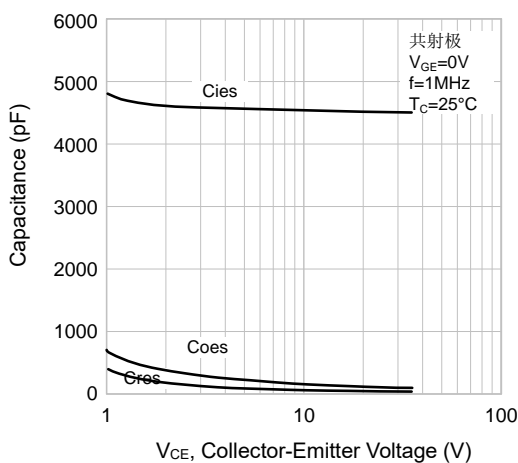


Figure 11 Capacitance Characteristics

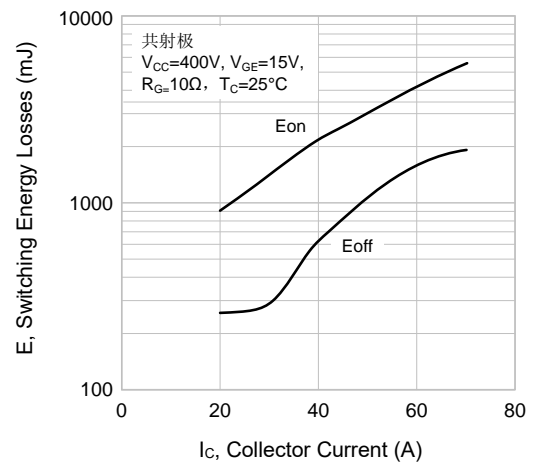


Figure 12 Switching Loss vs. Collector Current

Typical Electrical and Thermal Characteristics

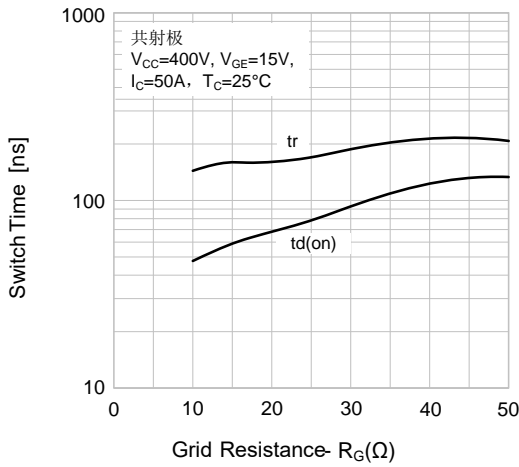


Figure 13 On-state Characteristic vs. R_G

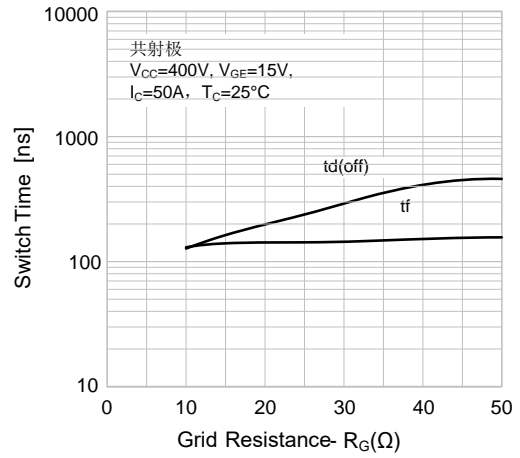


Figure 14 Turn-off Characteristic vs. R_G

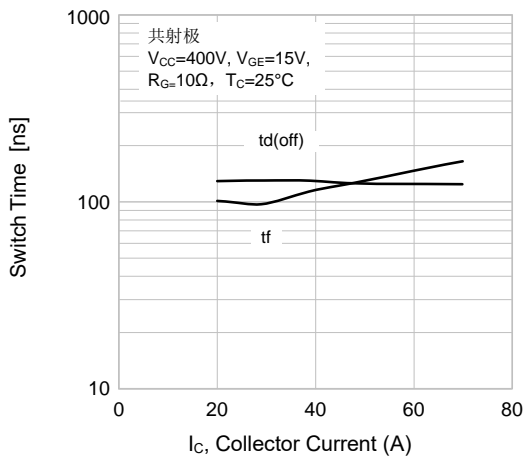


Figure 15 Turn-off Characteristic vs. Collector Current

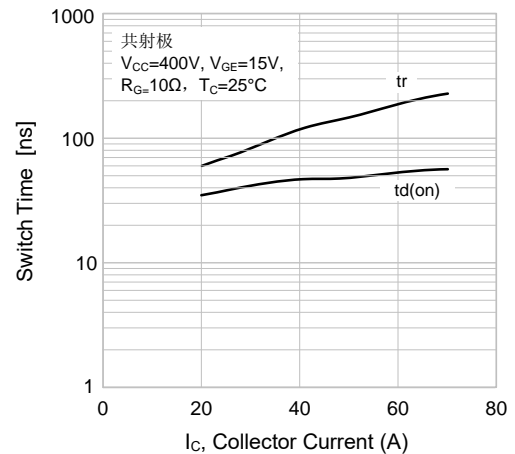


Figure 16 On-Region Characteristic vs. Collector Current

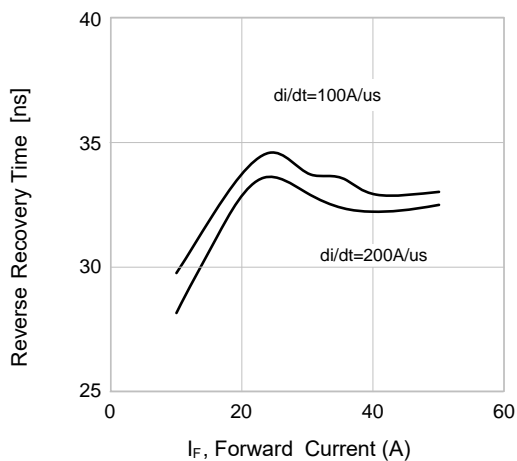


Figure 17 Reverse Recovery Time vs. I_F

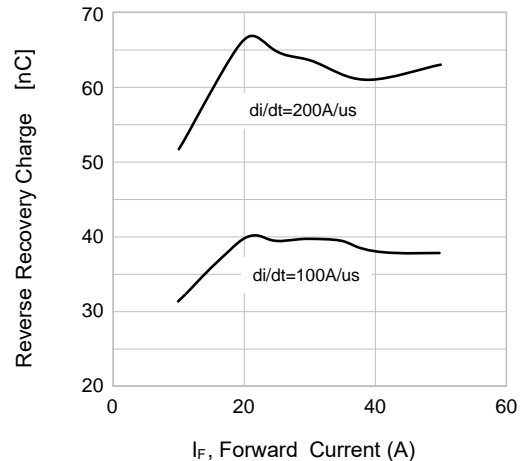


Figure 18 Reverse Recovery Charge vs. I_F

Typical Electrical and Thermal Characteristics

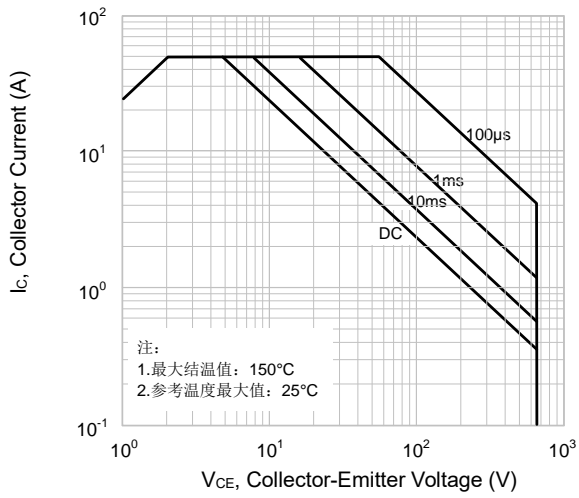
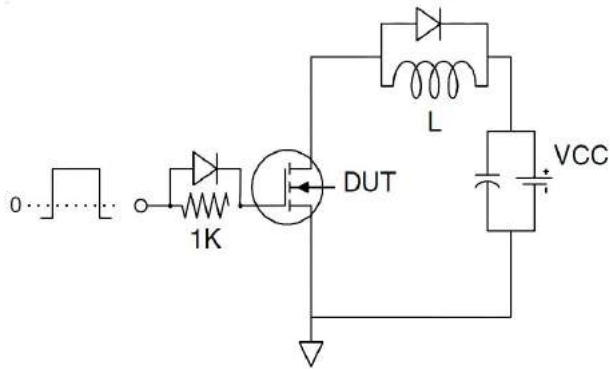


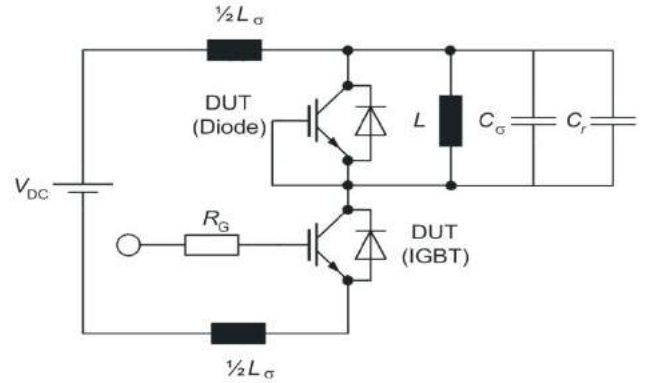
Figure 19 Forward Bias Safe Operating Area

Test Circuit

1) Gate Charge Test Circuit

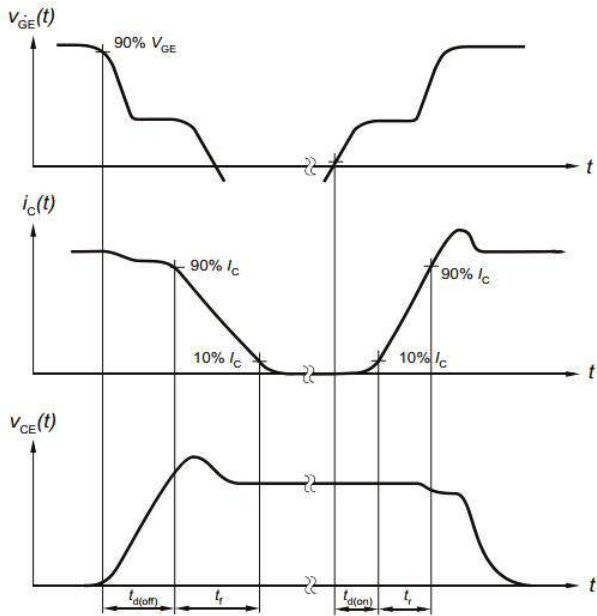


2) Switch Time Test Circuit

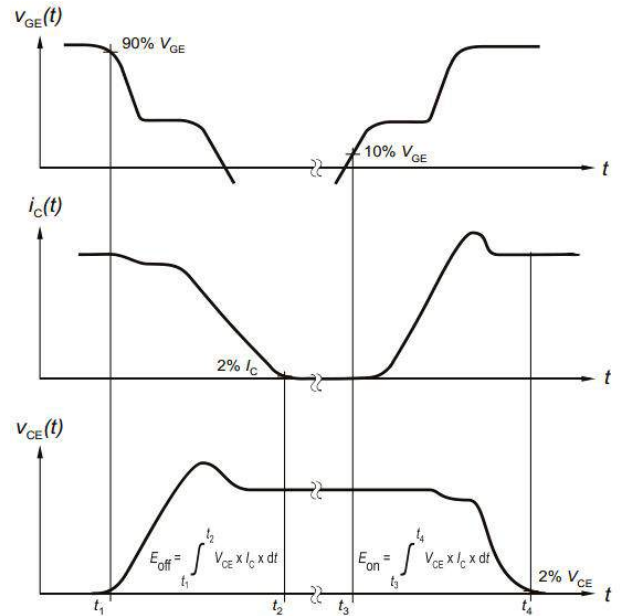


Switching characteristics

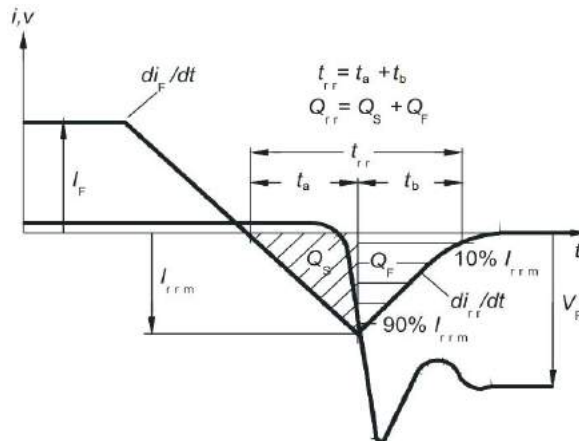
1) Definition of switching times



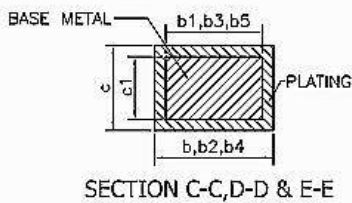
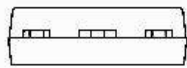
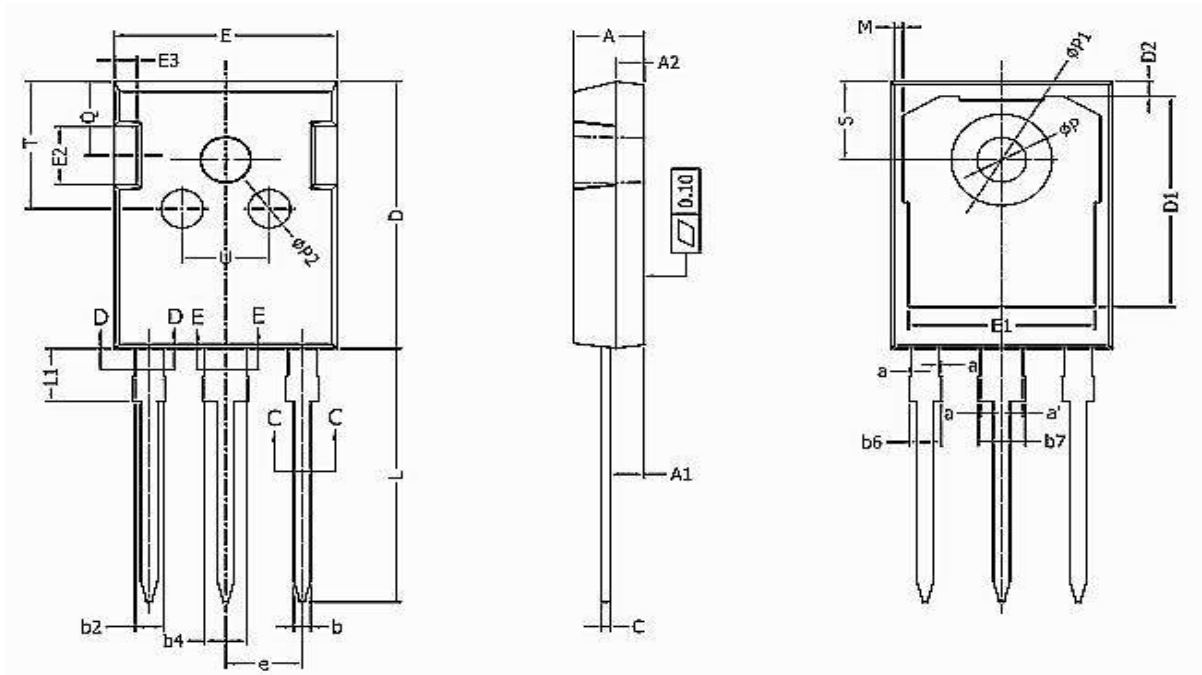
2) Definition of switching losses



3) Definition of diode switching characteristics



TO-247 Package Information



SYMBOL	MIN	NOM	MAX
A	4.90	5.00	5.10
A1	2.31	2.41	2.51
A2	1.90	2.00	2.10
a	0	---	0.15
a'	0	---	0.15
b	1.16	---	1.26
b1	1.15	1.2	1.22
b2	1.96	---	2.06
b3	1.95	2.00	2.02
b4	2.96	---	3.06
b5	2.96	3.00	3.02
b6	---	---	2.25
b7	---	---	3.25
c	0.59	---	0.66
c1	0.58	0.60	0.62
D	20.90	21.00	21.10
D1	16.25	16.55	16.85
D2	1.05	1.17	1.35
E	15.70	15.80	15.90
E1	13.10	13.30	13.50
E2	4.40	4.50	4.60
E3	1.50	1.60	1.70
e	5.436 BSC		
L	19.80	19.92	20.10
L1	---	---	4.30
M	0.35	---	0.95
P	3.40	3.50	3.60
P1	7.00	---	7.40
P2	2.40	2.50	2.60
Q	5.60	---	6.00
S	6.05	6.15	6.25
T	9.80	---	10.20
U	6.00	---	6.40

Customer Service

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