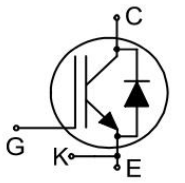
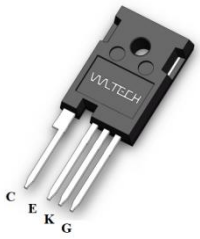
High-speed IGBT Power Transistor

(Integrated FRD)

HKZ75N65SHEB





Package: TO-247-4

1. Product Features:

- Ultra-low switching losses
- Benchmark efficiency in hard switching topologies
- Internal integrated fast&soft recovery anti-parallel FRD
- Maximum junction temperature 175℃
- Qualified according to JEDEC
- RoHS compliant

2. Product Applications

- Industrial Power Supplies
- Solar String Inverter
- Energy Storage Inverter
- UPS
- DC Charger for Electric Vehicles
- Welding Machines

3. Typical Performance Parameters

Tab.1. Typical Performance Parameters

Type	V_{CE}	I_C	V_{CEsat} T_{vj} = 25℃	T_{vjmax}	Marking	Package
HKW75N65SHEB	650V	75A	1.68V	175℃	HKZ75N65SHEB	TO-247-4

4. Maximum Ratings

Tab.2. Maximum Ratings

Parameters	Symbol	Value	Unit
Collector-emitter voltage, $Tvj \geq 25$℃	V_{CE}	650	V
DC collector current (limited by T_{vjmax})	I_C	90(T_c = 25℃) 75(T_c = 100℃)	A
Pulsed collector current (t_p limited by $T_{vjmax.}$)	I_{Cpuls}	300	A
Diode forward current (limited by T_{vjmax})	I_F	75 (T_c = 100℃)	A
Diode pulse current (t_p limited by $T_{vjmax.}$)	I_{Fpuls}	300(T_c = 25℃)	A
Gate-emitter voltage	V_{GE}	±20	V
Transient Gate-emitter voltage (tp ≤ 10μs, D < 0.0100)		±30	V
Power dissipation	P_{tot}	394(T_c = 25℃) 197(T_c = 100℃)	W
Operating junction temperature	T_{vj}	-40 to +175	℃
Storage temperature	T_{stg}	-55 to +150	℃
Soldering temperature, (wave soldering 1.6mm from case for 10s)		260	℃
Mounting torque (M3 screw) (Maximum of mounting processes: 3)	M	0.6	Nm

5. Thermal Properties

Tab.3. Thermal Properties

Parameters	Symbol	Max. value	Unit
IGBT thermal resistance (junction - case)	$R_{th(j-c)}$	0.38	℃/W
Diode thermal resistance (junction - case)	$R_{th(j-c)}$	0.55	℃/W
Thermal resistance (junction – ambient)	$R_{th(j-a)}$	40	℃/W

6. Electrical Characteristics

Tab.4. Static Characteristic (T_{vj} = 25℃, unless otherwise specified)

Parameters	Symbol	Conditions	Min. value	Typ. value	Max. value	Unit
Collector-emitter breakdown voltage	$V_{(BR)CES}$	V_{GE}= 0V, I_C= 1mA	650	-	-	V
Collector-emitter saturation voltage	V_{CEsat}	V_{GE}= 15V, I_C= 75A T_{vj}= 25℃ T_{vj}= 175℃	 - -	 1.68 2.26	 2.1 -	V
Diode forward voltage	V_F	V_{GE}= 0V, I_F= 75A T_{vj} = 25℃ T_{vj}= 175℃	 - -	 1.51 1.76	 2.8 -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C= 0.75mA, V_{CE}= V_{GE}	4.2	5.3	6.2	V
Zero gate voltage collector current	I_{CES}	V_{CE}= 650V, V_{GE}= 0V T_{vj}= 25℃ T_{vj}= 175℃	 - -	 1 2000	 75 -	μA
Gate-emitter leakage current	I_{GES}	V_{CE}= 0V, V_{GE}= 20V	-	-	100	nA
Transconductance	g_{fs}	V_{CE}= 20V, I_C= 75A	-	57	-	S
Internal Gate Resistance	$R_{G\ (int)}$	f = 1MHz, Vac=10mV	-	8.5	-	Ω

Tab.5. Dynamic Characteristic (T_{vj} = 25℃, unless otherwise specified)

Parameters	Symbol	Conditions	Min. value	Typ. value	Max. value	Unit
Input capacitance	C_{ies}	V_{CE}= 25V, V_{GE}= 0V f = 1MHz	-	2710	-	pF
Output capacitance	C_{oes}		-	265	-	
Reverse transfer capacitance	C_{res}		-	52	-	
Gate-charge	Q_g	V_{CE}= 520V, I_C= 75A, V_{GE}= 15V	-	103	-	nC

Tab.6. Switching Characteristic (Inductive load)

Parameters	Symbol	Conditions	Min. value	Typ. value	Max. value	Unit
IGBT Characteristic， at T_{vj} = 25°C						
Turn-on delay time	$t_{d(on)}$	T_{vj} = 25°C, V_{CC} = 400V, I_C = 75.0A, V_{GE} = 0.0/15.0V, $R_{G(int+ext)}$ =20.0Ω Inductive load Energy losses include "tail" and diode reverse recovery.	-	41	-	ns
Rise time	t_r		-	36	-	
Turn-off delay time	$t_{d(off)}$		-	180	-	
Fall time	t_f		-	28	-	
Turn-on energy	E_{on}		-	2.39	-	mJ
Turn-off energy	E_{off}		-	0.73	-	
Total switching energy	E_{ts}		-	3.12	-	
Turn-on delay time	$t_{d(on)}$	T_{vj} = 25°C, V_{CC} = 400V, I_C = 37.5A, V_{GE} = 0.0/15.0V, $R_{G(int+ext)}$ =20.0Ω Inductive load Energy losses include "tail" and diode reverse recovery.	-	36	-	ns
Rise time	t_r		-	27	-	
Turn-off delay time	$t_{d(off)}$		-	189	-	
Fall time	t_f		-	38	-	
Turn-on energy	E_{on}		-	1.0	-	mJ
Turn-off energy	E_{off}		-	0.24	-	
Total switching energy	E_{ts}		-	1.24	-	
Diode Characteristic， at T_{vj} = 25°C						
Diode reverse recovery time	t_{rr}	T_{vj} = 25°C, V_R =400V, I_F =75.0A, di_F/dt= 1000A/μs	-	83	-	ns
Diode reverse recovery charge	Q_{rr}		-	1.35	-	μC
Diode peak reverse recovery current	I_{rrm}		-	28	-	A
Diode peak rate of fall of reverse Recovery current during t_b	di_{rr}/dt		-	-600	-	A/μs

Diode reverse recovery time	t_{rr}	T_{vj} = 25°C, V_R =400V, I_F =37.5A, di_F/dt= 1000A/μs	-	71	-	ns
Diode reverse recovery charge	Q_{rr}		-	1.37	-	μC
Diode peak reverse recovery current	I_{rrm}		-	30	-	A
Diode peak rate of fall of reverse Recovery current during t_b	di_{rr}/dt		-	-875	-	A/μs

Tab.7. Switching Characteristic (Inductive load)

Parameters	**Symbol**	**Conditions**	**Min. value**	**Typ. value**	**Max. value**	**Unit**
IGBT Characteristic， at T_{vj} = 150°C						
Turn-on delay time	$t_{d(on)}$	T_{vj} = 150°C, V_{CC} = 400V, I_C = 75.0A, V_{GE} = 0.0/15.0V, $R_{G(int+ext)}$ =20.0Ω Inductive load	-	42	-	ns
Rise time	t_r		-	39	-	
Turn-off delay time	$t_{d(off)}$		-	218	-	
Fall time	t_f		-	33	-	
Turn-on energy	E_{on}	Energy losses include “tail” and diode reverse recovery.	-	2.86	-	mJ
Turn-off energy	E_{off}		-	1.05	-	
Total switching energy	E_{ts}		-	3.91	-	
Turn-on delay time	$t_{d(on)}$	T_{vj} = 150°C, V_{CC} = 400V, I_C = 37.5A, V_{GE} = 0.0/15.0V, $R_{G(int+ext)}$ =20.0Ω Inductive load	-	36	-	ns
Rise time	t_r		-	28	-	
Turn-off delay time	$t_{d(off)}$		-	238	-	
Fall time	t_f		-	55	-	
Turn-on energy	E_{on}	Energy losses include “tail” and diode reverse recovery.	-	1.18	-	mJ
Turn-off energy	E_{off}		-	0.46	-	
Total switching energy	E_{ts}		-	1.64	-	

Diode Characteristic， at T_{vj} = 150°C						
Diode reverse recovery time	t_{rr}	T_{vj} = 150°C, V_R =400V, I_F =75.0A, di_F/dt= 1000A/µs	-	153	-	ns
Diode reverse recovery charge	Q_{rr}		-	5.7	-	µC
Diode peak reverse recovery current	I_{rrm}		-	57	-	A
Diode peak rate of fall of reverse Recovery current during t_b	di_{rr}/dt		-	-730	-	A/µs
Diode reverse recovery time	t_{rr}	T_{vj} = 150°C, V_R =400V, I_F =37.5A, di_F/dt= 1000A/µs	-	116	-	ns
Diode reverse recovery charge	Q_{rr}		-	3.9	-	µC
Diode peak reverse recovery current	I_{rrm}		-	51	-	A
Diode peak rate of fall of reverse Recovery current during t_b	di_{rr}/dt		-	-1010	-	A/µs

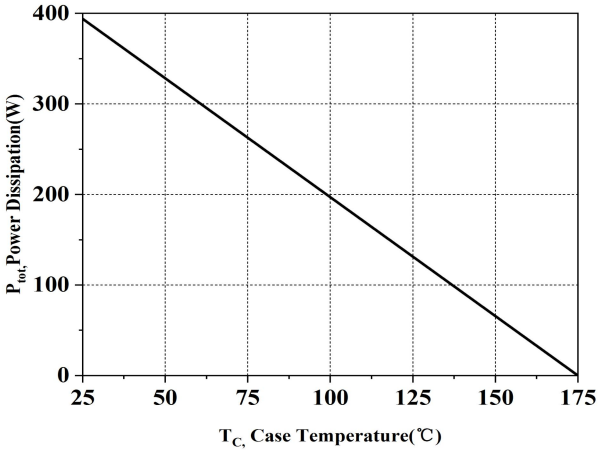


Fig.1. Power dissipation as a function of case temperature ($T_j \leq 175°C$)

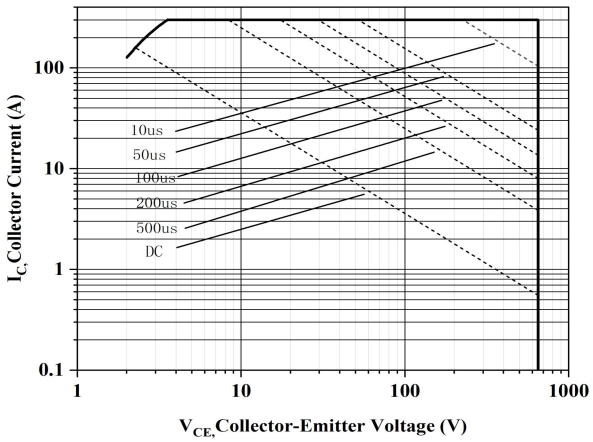


Fig.2. Forward bias safe operating area
($D = 0$, $T_C = 25°C$, $T_j \leq 175°C$, $V_{GE} = 15V$)

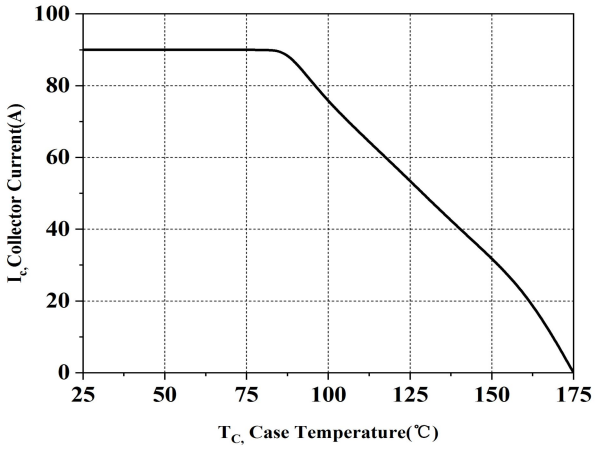


Fig.3. Collector current as a function of case temperature ($V_{GE} \geq 15V, T_j \leq 175°C$)

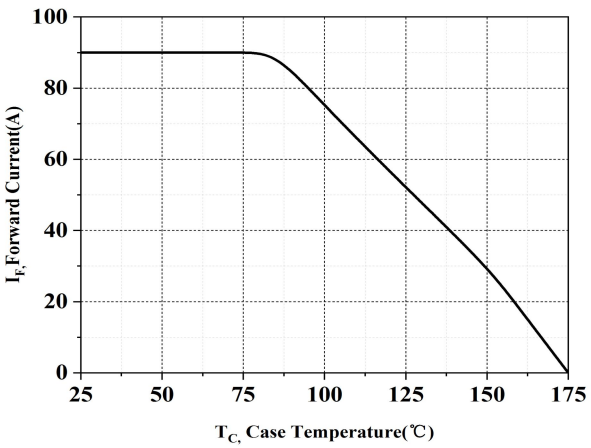


Fig.4. Diode Forward current as a function of case temperature

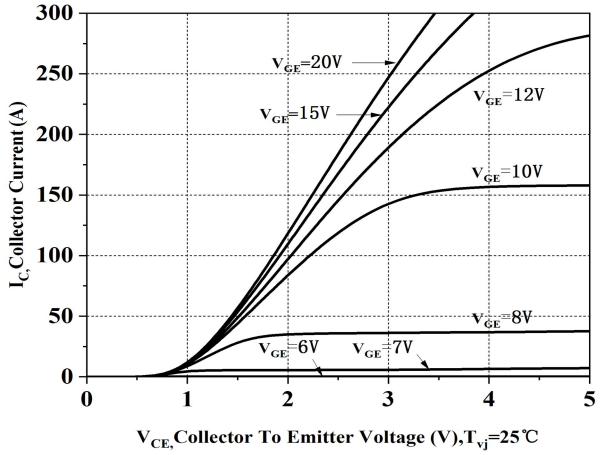


Fig.5. Typical output characteristics
($T_j = 25°C$)

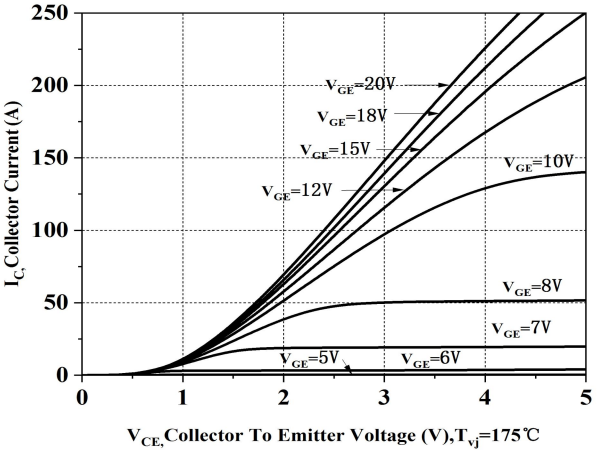


Fig.6. Typical output characteristics
($T_j = 150°C$)

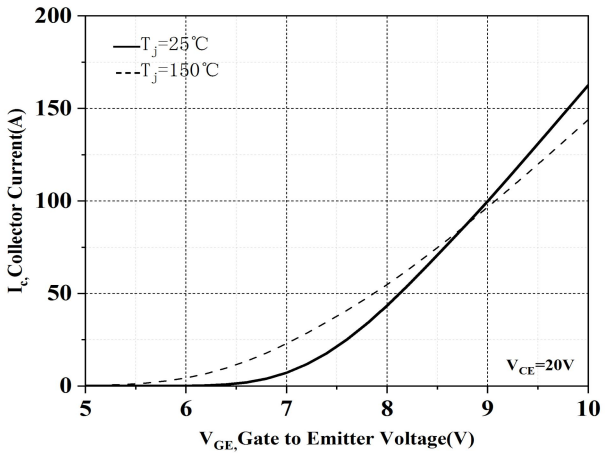


Fig.7. Typical transfer characteristic

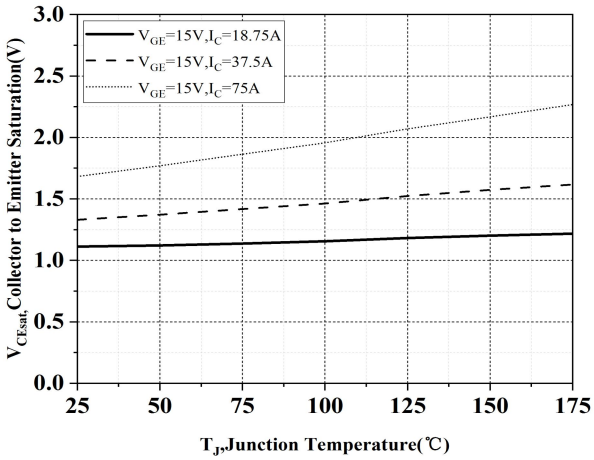


Fig.8. Typical collector-emitter saturation voltage vs. junction temperature (V_{GE}=15V)

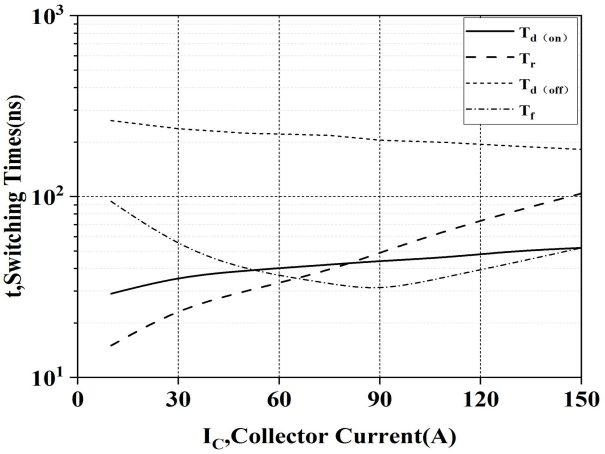


Fig.9. Typical switching times vs. collector current

(T_j= 150°C, V_{CE}= 400V, V_{GE}= 15/0V)

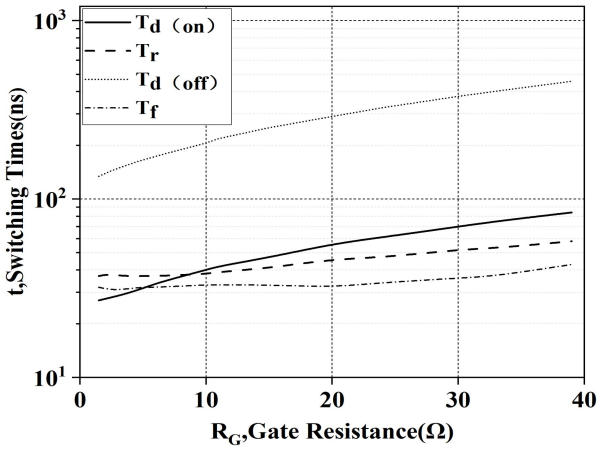


Fig.10. Typical switching times vs. gate Resistor

(Tj= 150°C, VCE=400V, VGE= 15/0V, IC = 75A)

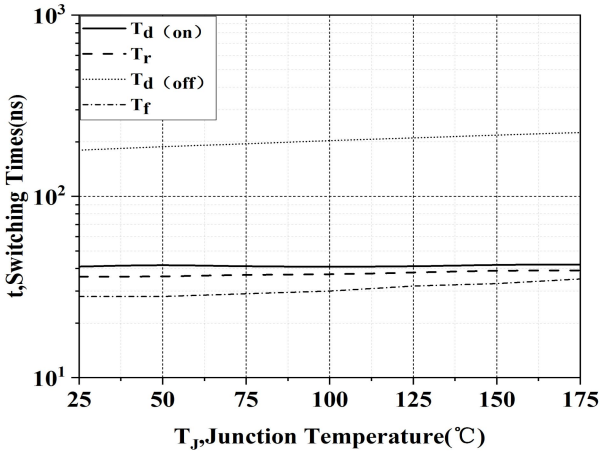


Fig.11. Typical switching times vs. junction temperature

(V_{CE}= 400V, V_{GE}= 15/0V, I_C = 75A）

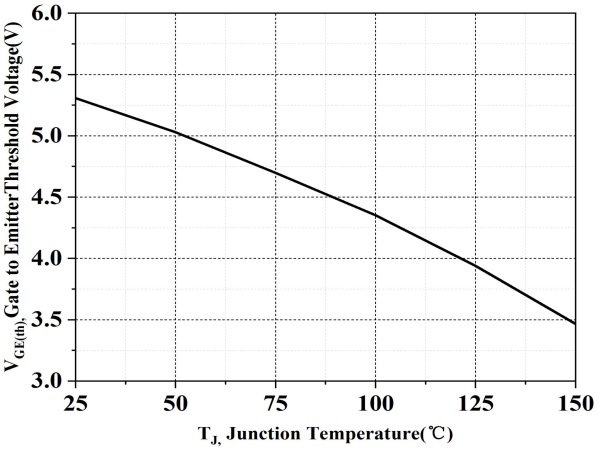


Fig.12. Gate-emitter threshold voltage vs. junction temperature

(I_C=0.75mA)

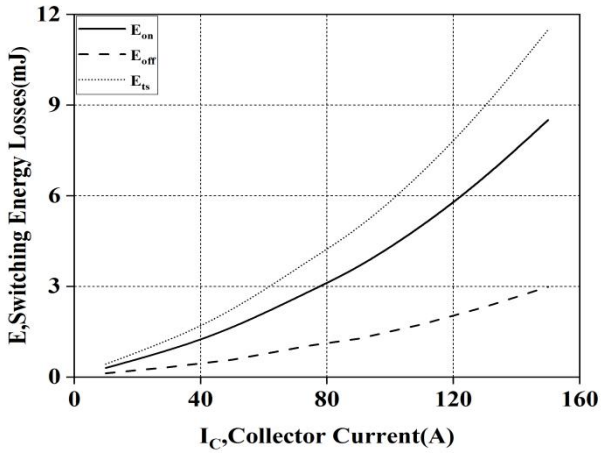


Fig.13. Typical switching energy losses as a function of collector current

(T_j= 150°C, V_{CE}= 400V, V_{GE}= 15/0V）

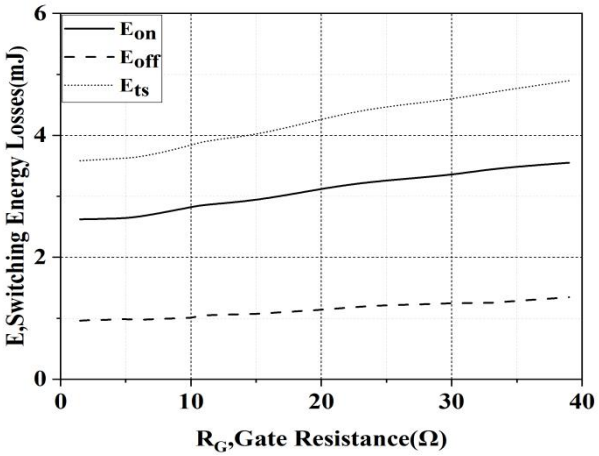


Fig.14. Typical switching energy losses as a function of gate resistor

(T_j= 150°C, V_{CE}= 400V, V_{GE}= 15/0V, I_C = 75A）

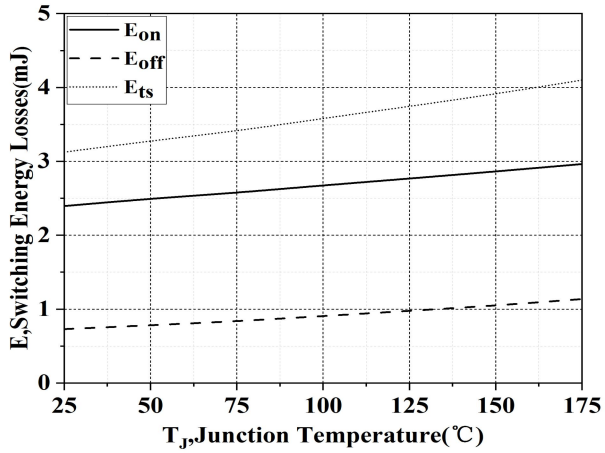


Fig.15. Typical switching energy losses as a function of junction temperature

(Inductive load, V_{CE}= 400V, V_{GE}= 15/0V, I_C = 75A）

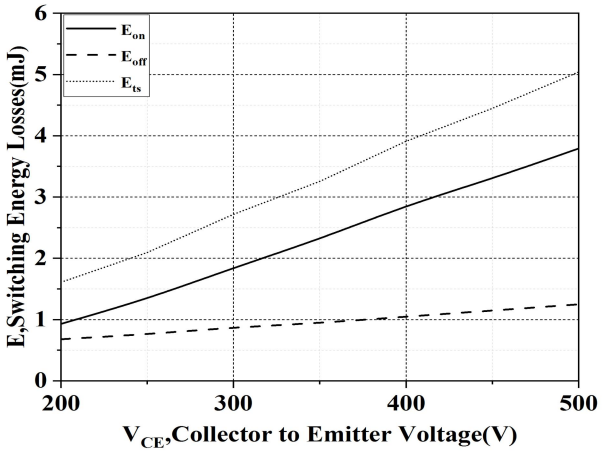


Fig.16. Typical switching energy losses as a function of collector emitter voltage

(Inductive load, T_j= 150°C, V_{GE}= 15/0V, I_C = 75A）

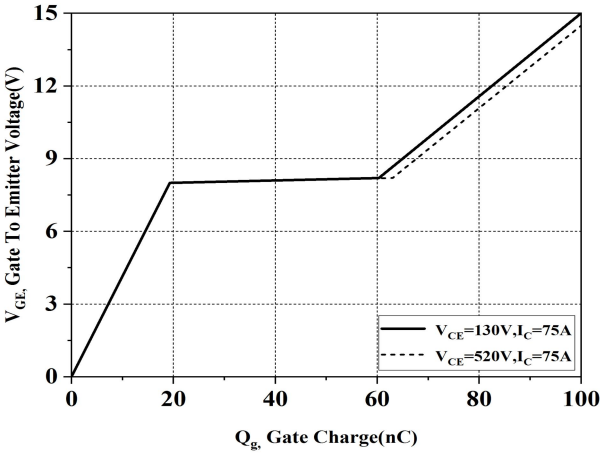


Fig.17. Typical gate charge

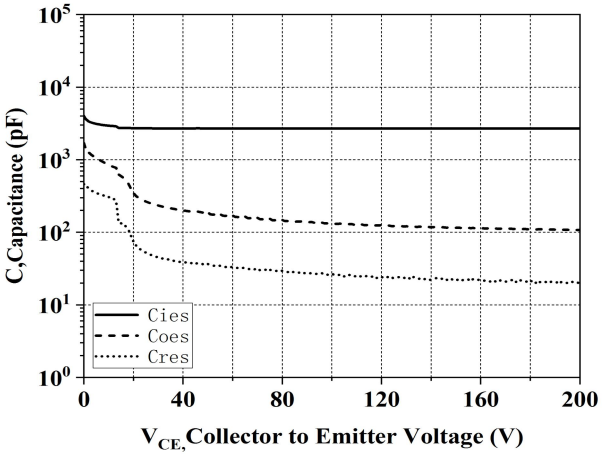


Fig.18. Typical capacitance as a function of collector-emitter voltage

(V_{GE} = 0V,f = 1MHz)

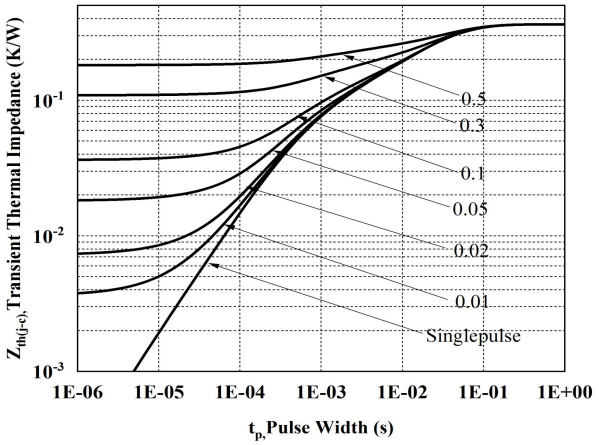


Fig.19. IGBT transient thermal impedance

(D = t_p/T)

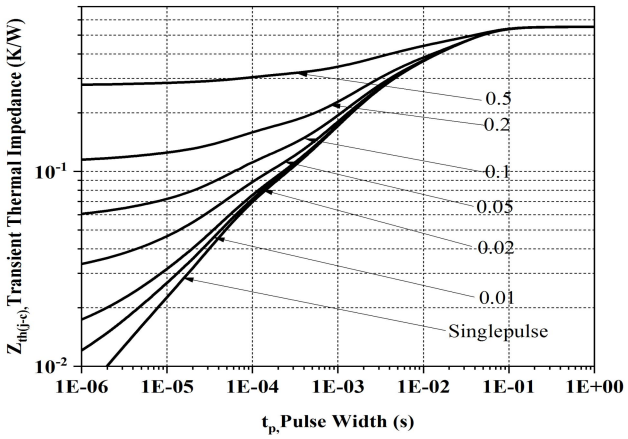


Fig.20. Transient thermal impedance of diode

(D = t_p/T)

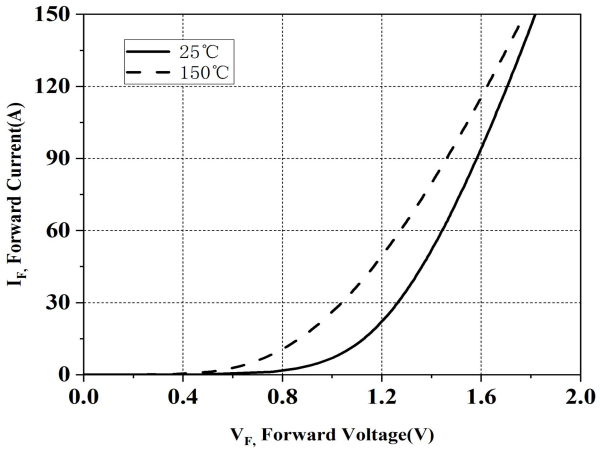


Fig.21. Typical diode forward current as a function of forward voltage

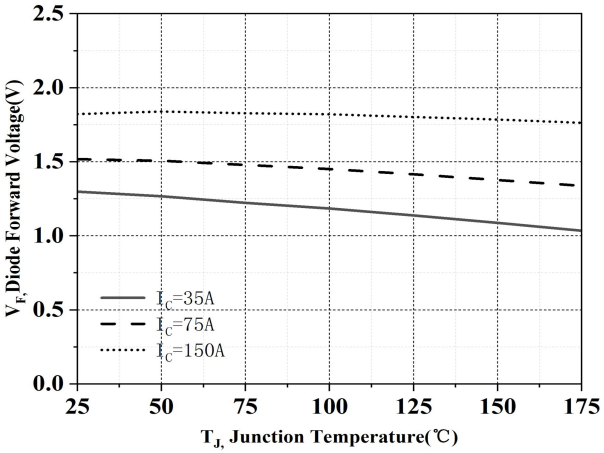


Fig.22. Typical diode forward voltage as a function of junction temperature

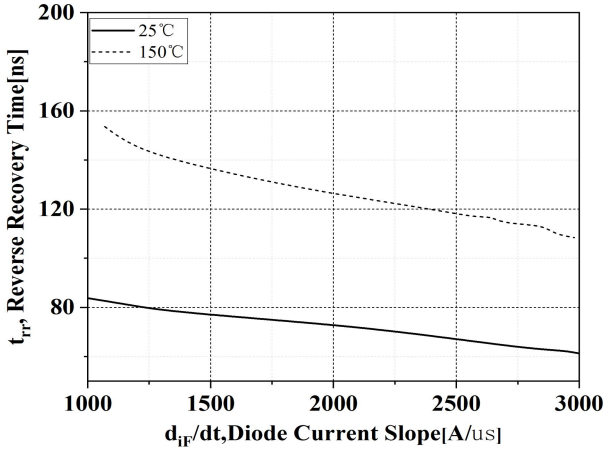


Fig.23.Typical reverse recovery time as a function of diode current slope

(VR=400V)

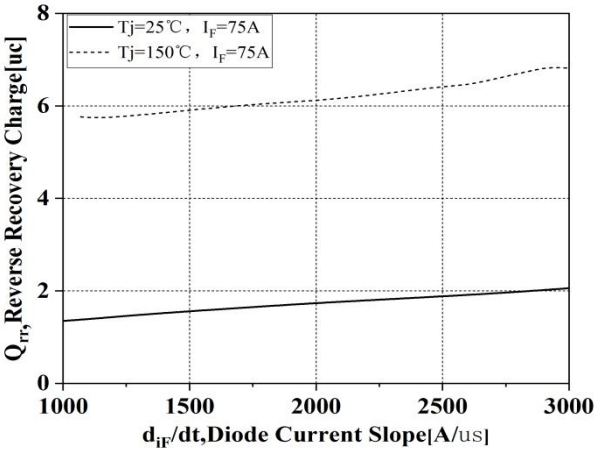


Fig.24. Typical reverse recovery charge as a function of diode current slope

(VR=400V)

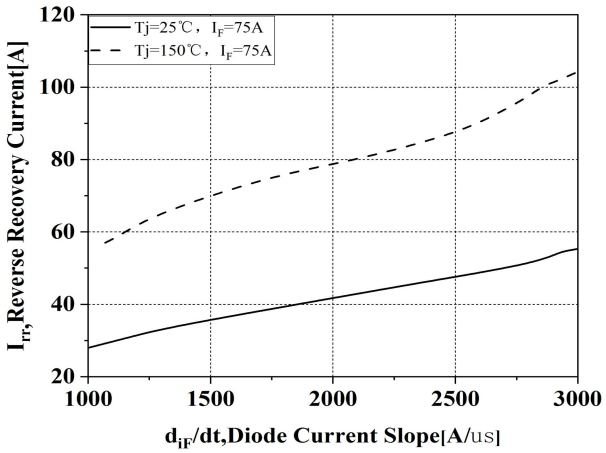


Fig.25.Typical reverse recovery current as a function of diode current slope

(VR=400V)

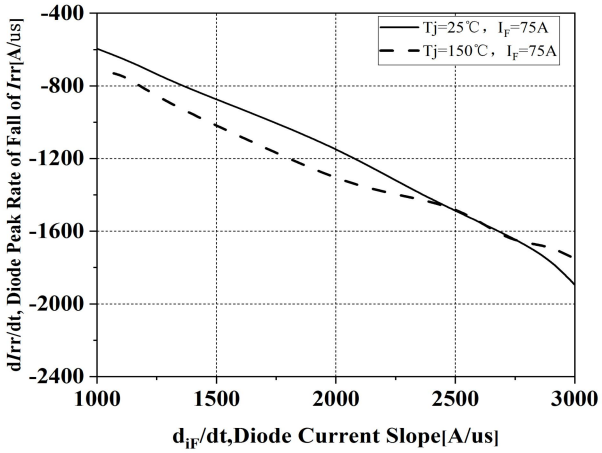
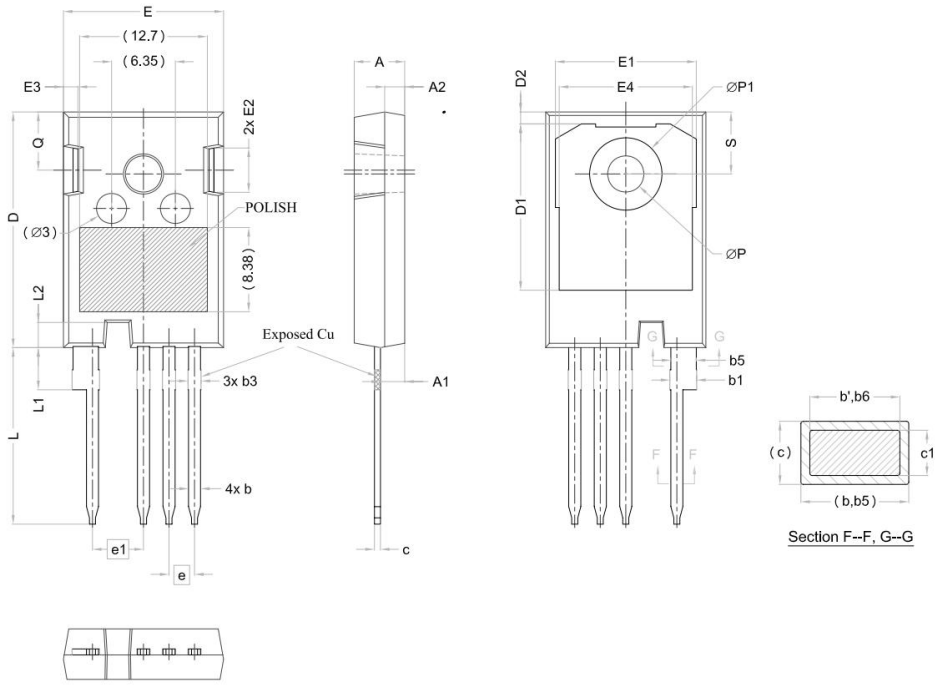


Fig.26.Typical diode peak rate of fall of reverse recovery current as a function of diode current slope

(VR=400V)

7. Package Dimensions



SYMBOL	DIMENSIONS		
	MIN.	NOM.	MAX.
A	4.83	5.02	5.21
A1	2.29	2.41	2.54
A2	1.91	2.00	2.16
b'	1.07	1.20	1.28
b	1.07	1.20	1.33
b1	2.39	2.67	2.94
b3	1.07	1.30	1.60
b5	2.39	2.53	2.69
b6	2.39	2.53	2.64
c	0.55	0.60	0.68
c1	0.55	0.60	0.65
D	23.30	23.45	23.60
D1	16.25	16.55	17.65
D2	0.95	1.19	1.25
E	15.75	15.94	16.13
E1	13.10	14.02	14.15
E2	3.68	4.40	5.10
E3	1.00	1.45	1.90
E4	12.38	13.26	13.43
e	2.54 BSC		
e1	5.08 BSC		
L	17.31	17.57	17.82
L1	3.97	4.19	4.37
L2	2.35	2.50	2.65
ØP	3.51	3.61	3.65
ØP1	7.19 REF.		
Q	5.49	5.79	6.00
S	6.04	6.17	6.30

8. Version Information

Version No.	Status	Date changed	Version revision record
V1.0	Initial version	2023/08	