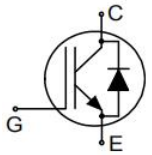
RoHS

1200V 15A Field Stop Fast IGBT

(Integrated FRD)

HKW15N120FPTA1



Package: TO-247-3

1. Product Features:

- Ultra-low static losses
- Internal integrated fast&soft recovery anti-parallel FRD
- Maximum junction temperature 175℃
- 10μs short circuit Capability
- Qualified according to JEDEC
- RoHS compliant: Pb-Free including Lead plating and solder

2. Product Applications

- Solar String Inverter
- Uninterruptible Power Inverter Supplies (UPS)
- Welding

3. Typical Performance Parameters

Tab.1. Typical Performance Parameters

Type	V_{CE}	I_C	V_{CEsat} T_{vj} = 25℃	T_{vjmax}	Marking	Package
HKW15N120FPTA1	1200V	15A	1.56V	175℃	HKW15N120FPTA1	TO-247-3

4. Maximum Ratings

Tab.2. Maximum Ratings

Parameters	Symbol	Value	Unit
Collector-emitter voltage	V_{CE}	1200	V
DC collector current (limited by T_{vjmax} and bond wire)	I_C	30.0 (T_c = 25℃) 15.0 (T_c = 110℃)	A
Pulsed collector current (t_p limited by $T_{vjmax.}$)	I_{Cpuls}	60	A
Turn off safe operating area (V_{CE} ≤1200V, T_{vj} ≤175℃)	-	60	A
Diode forward current (limited by T_{vjmax})	I_F	15.0 (T_c = 110℃)	A
Diode pulse current (t_p limited by $T_{vjmax.}$)	I_{Fpuls}	60.0(T_c = 25℃)	A
Gate-emitter voltage	V_{GE}	±20	V
Power dissipation	P_{tot}	333.0 (T_c = 25℃) 122.0 (T_c = 120℃)	W
Operating junction temperature	T_{vj}	-40 to +175	℃
Storage temperature	T_{stg}	-55 to +150	℃
Short circuit withstand time[1] V_{GE} = 15V, V_{CC} ≤ 600V, $T_{j,start}$ ≤ 150°C	t_{sc}	10	μs
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)	$R_{th(j-c)}$	0.45	°C/W
Diode thermal resistance (junction - case)	$R_{th(j-c)}$	1.01	°C/W
Thermal resistance (junction – ambient)	$R_{th(j-a)}$	40	°C/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	1200	-	-	V
Collector-emitter saturation voltage	V_{CEsat}	V_{GE}= 15V, I_C= 15A T_{vj}= 25℃ T_{vj}= 175℃	 - -	 1.56 2.05	 2.15 -	V
Diode forward voltage	V_F	V_{GE}= 0V, I_F= 15A T_{vj} = 25℃ T_{vj}= 175℃	 - -	 1.95 1.5	 2.5 -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C= 0.375mA, V_{CE}= V_{GE}	5.1	6.03	6.8	V
Zero gate voltage collector current	I_{CES}	V_{CE}= 1200V, V_{GE}= 0V T_{vj}= 25℃ T_{vj}= 175℃	 - -	 - -	 250 2500	μA
Gate-emitter leakage current	I_{GES}	V_{CE}= 0V, V_{GE}= 20V	-	-	200	nA
Transconductance	g_{fs}	V_{CE}= 20V, I_C= 15.0A	-	10.0	-	S

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	-	3500	-	pF
Output capacitance	C_{oes}		-	98	-	
Reverse transfer capacitance	C_{res}		-	24	-	
Gate-charge	Q_g	V_{CE}= 960V, I_C= 15.0A, V_{GE}= 15V	-	120	-	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} = 600V, I_C = 15.0A, V_{GE} = 0.0/15.0V, R_G =30.0Ω Inductive load	-	72	-	ns
Rise time	t_r		-	40	-	
Turn-off delay time	$t_{d(off)}$		-	296	-	
Fall time	t_f		-	268	-	
Turn-on energy	E_{on}	Energy losses include “tail” and diode reverse recovery.	-	1.174	-	mJ
Turn-off energy	E_{off}		-	1.092	-	
Total switching energy	E_{ts}		-	2.267	-	
Diode Characteristic，at T_{vj} = 25°C						
Diode reverse recovery time	t_{rr}	T_{vj} = 25°C, V_R =600V, I_F =15.0A, di_F/dt = 600A/μs	-	234	-	ns
Diode reverse recovery charge	Q_{rr}		-	0.984	-	μC
Diode peak reverse recovery current	I_{rrm}		-	14.4	-	A
Diode peak rate of fall of reverse Recovery current during tb	di_{rr}/dt		-	-756	-	A/μs

Tab.7. Switching Characteristic (Inductive load)

Parameters	Symbol	Conditions	Min. value	Typ. value	Max. value	Unit
IGBT Characteristic， at T_{vj} = 175°C						
Turn-on delay time	$t_{d(on)}$	T_{vj} = 175°C, V_{CC} = 600V, I_C = 15.0A, V_{GE} = 0.0/15.0V, R_G =30.0Ω, Inductive load	-	65	-	ns
Rise time	t_r		-	50	-	
Turn-off delay time	$t_{d(off)}$		-	322	-	
Fall time	t_f		-	444	-	
Turn-on energy	E_{on}	Energy losses include “tail” and diode reverse recovery.	-	1.614	-	mJ
Turn-off energy	E_{off}		-	1.646	-	
Total switching energy	E_{ts}		-	3.26	-	
Diode Characteristic， at T_{vj} = 175°C						
Diode reverse recovery time	t_{rr}	T_{vj} = 175°C, V_R =600V, I_F =15.0A, di_F/dt = 600A/μs	-	405	-	ns
Diode reverse recovery charge	Q_{rr}		-	3.6	-	μC
Diode peak reverse recovery current	I_{rrm}		-	26.6	-	A
Diode peak rate of fall of reverse Recovery current during tb	di_{rr}/dt		-	-481	-	A/μs

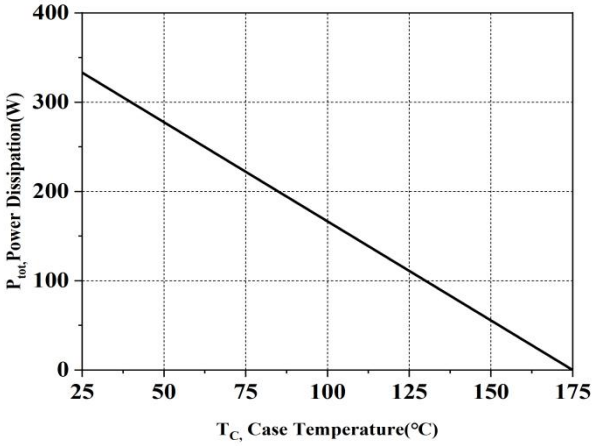


Fig.1. Power dissipation as a function of case temperature ($T_j \leq 175°C$)

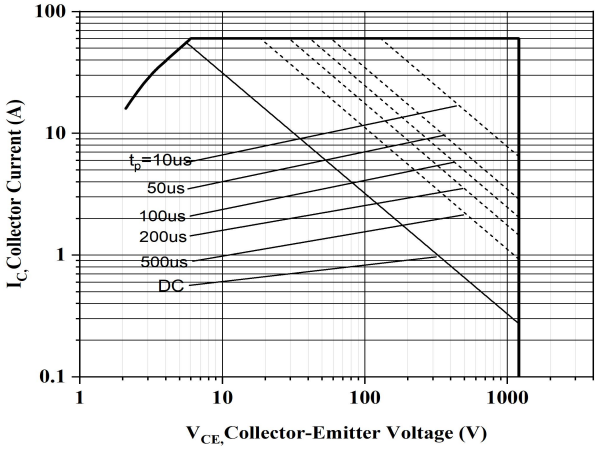


Fig.2. Forward bias safe operating area
($D = 0$, $T_C = 25°C$, $T_j \leq 175°C$, $V_{GE} = 15V$)

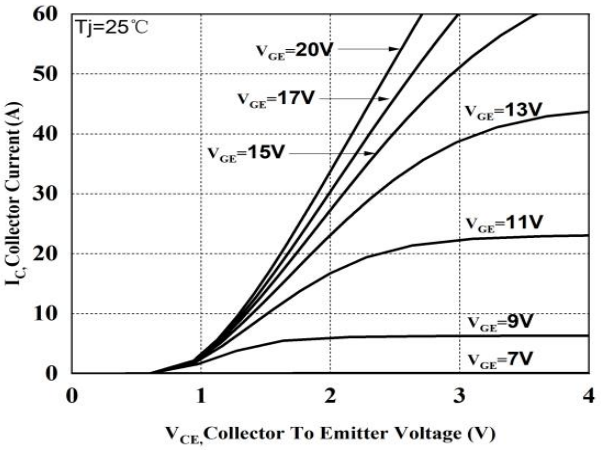


Fig.3. Typical output characteristics
($T_j = 25°C$)

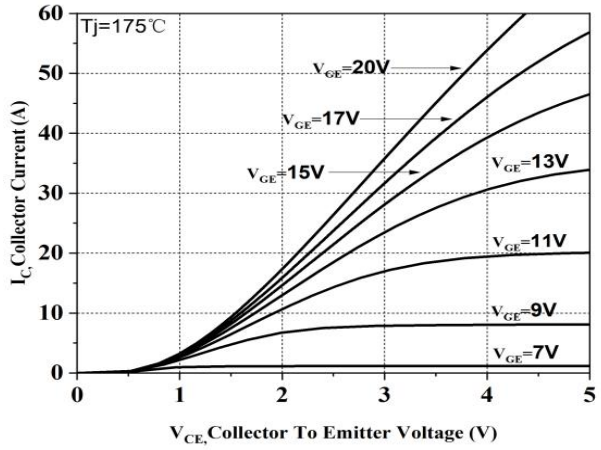


Fig.4. Typical output characteristics
($T_j = 175°C$)

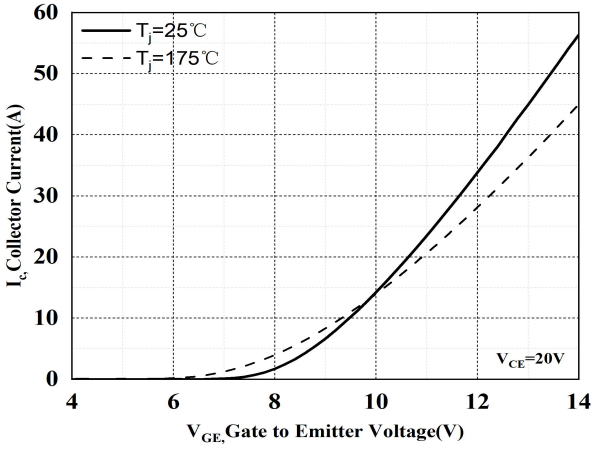


Fig.5. Typical transfer characteristic

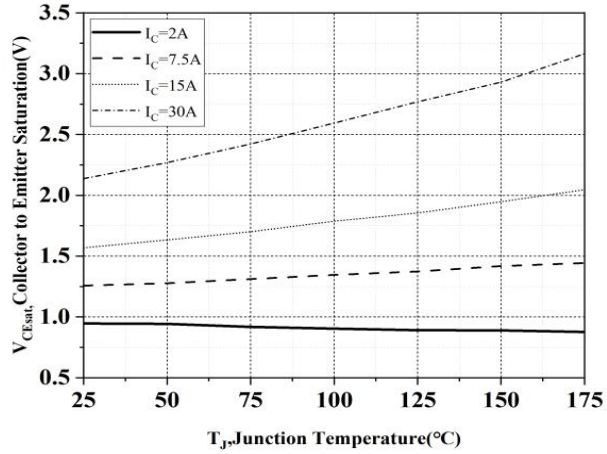


Fig.6. Typical collector-emitter saturation voltage vs. junction temperature（$V_{GE} = 15V$）

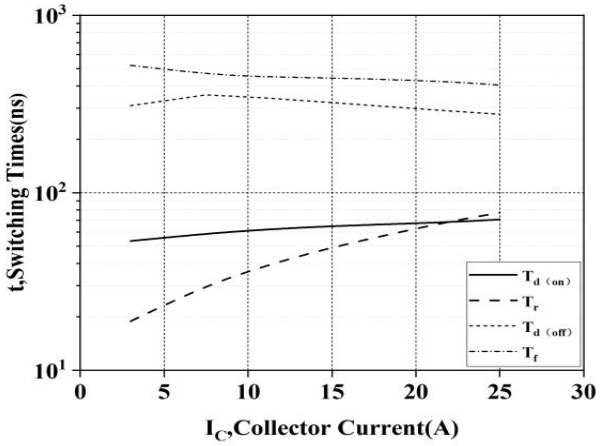


Fig.7. Typical switching times vs. collector current
(T_j= 175°C, V_{CE}= 600V, V_{GE}= 15/0V)

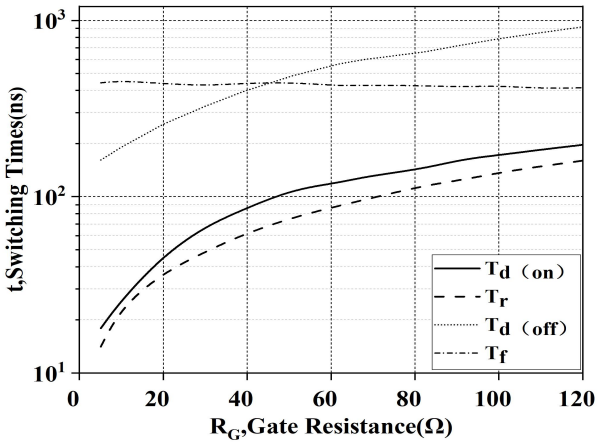


Fig.8. Typical switching times vs. gate Resistor (Tj= 175°C, VCE= 600V, VGE= 15/0V, IC = 15A)

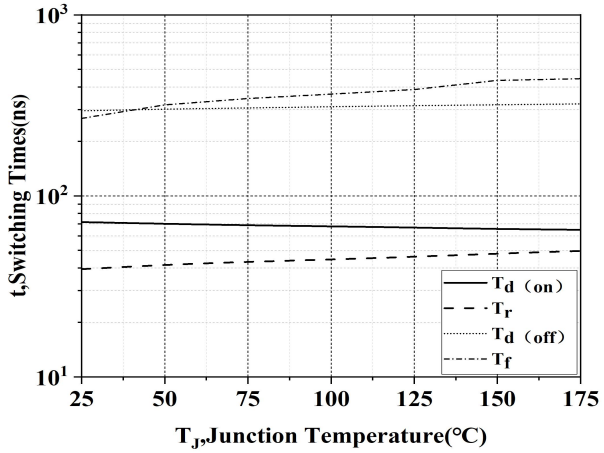


Fig.9. Typical switching times vs. junction temperature
(V_{CE}= 600V, V_{GE}= 15/0V, I_C = 15A）

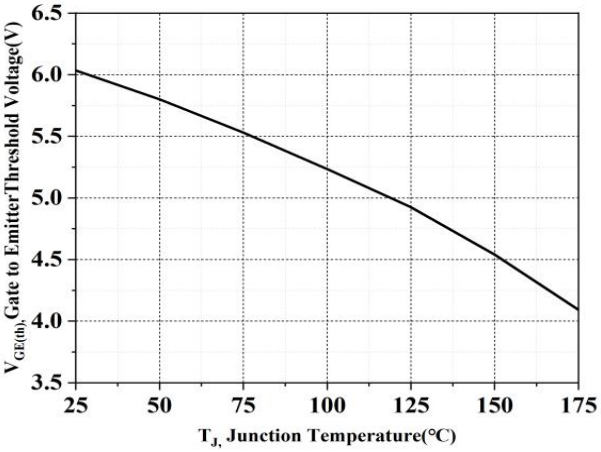


Fig.10. Gate-emitter threshold voltage vs. junction temperature（I_C = 0.375mA）

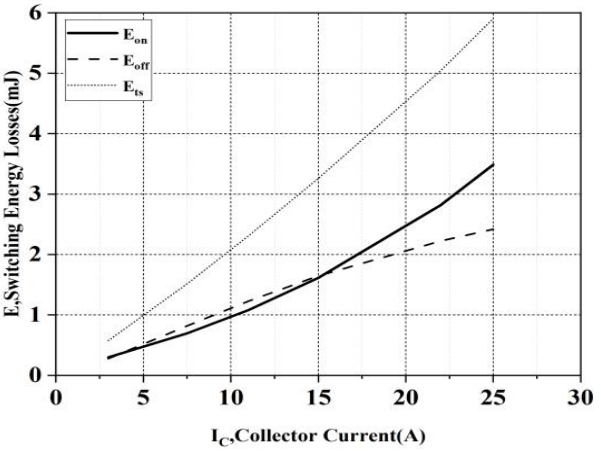


Fig.11. Typical switching energy losses as a function of collector current
(T_j= 175°C, V_{CE}= 600V, V_{GE}= 15/0V）

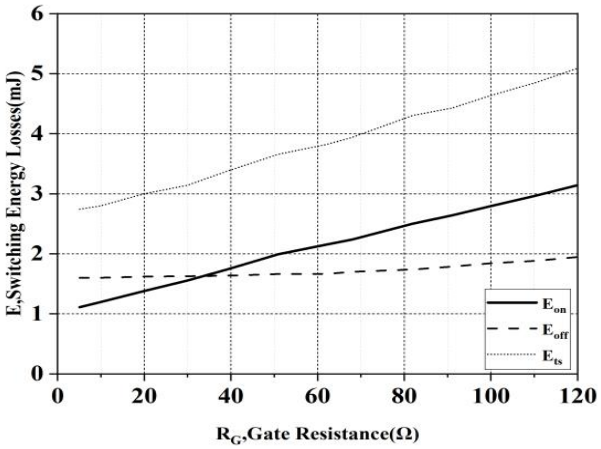


Fig.12. Typical switching energy losses as a function of gate resistor
(T_j= 175°C, V_{CE}= 600V, V_{GE}= 15/0V, I_C = 15A）

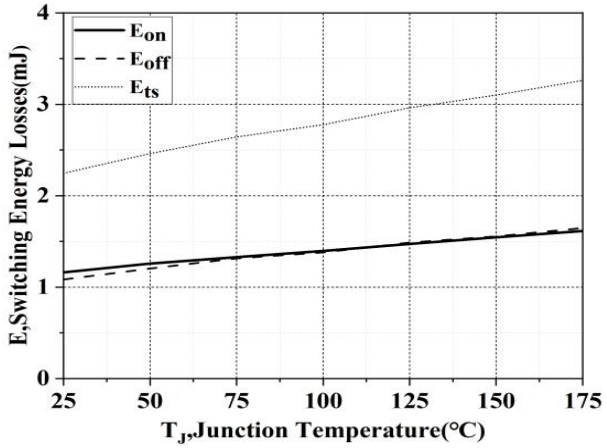


Fig.13. Typical switching energy losses as a function of junction temperature

(Inductive load, V_{CE}= 600V, V_{GE}= 15/0V, I_C = 15A）

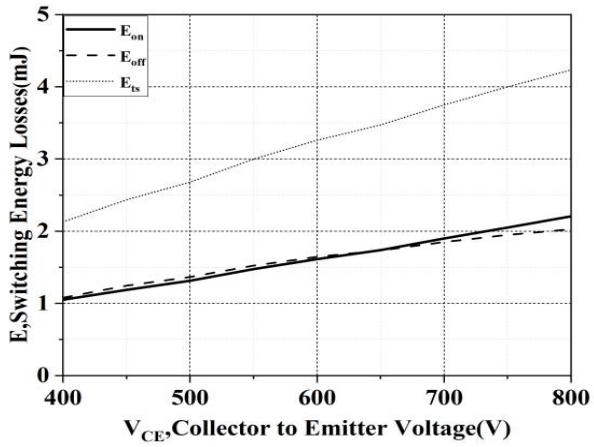


Fig.14. Typical switching energy losses as a function of collector emitter voltage

(Inductive load, T_J= 175°C, V_{GE}= 15/0V, I_C = 15A）

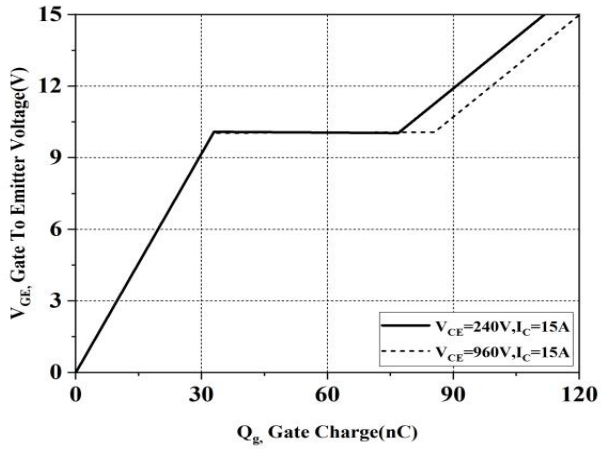


Fig.15. Typical gate charge

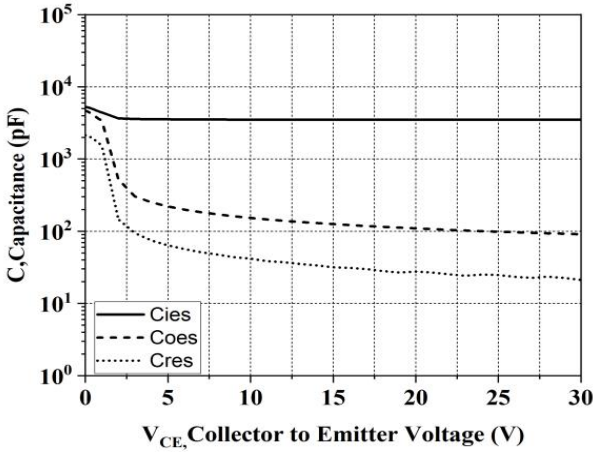


Fig.16. Typical capacitance as a function of collector-emitter voltage

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

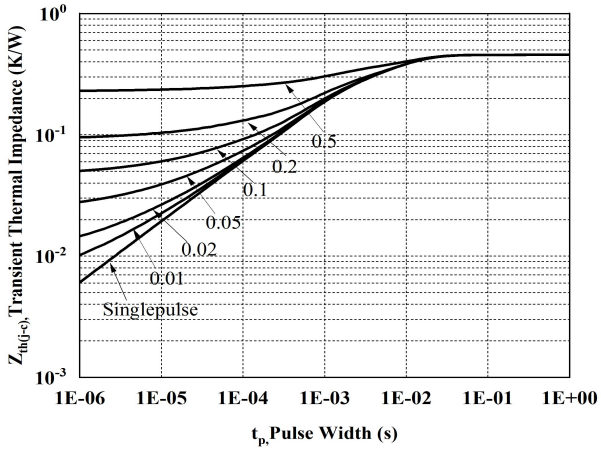


Fig.17. IGBT transient thermal impedance

(D = t_p/T)

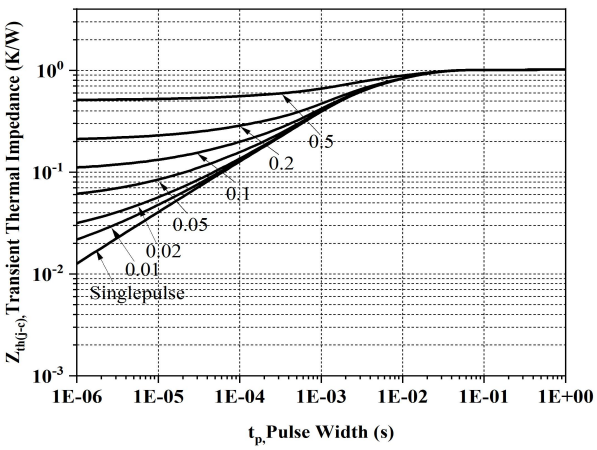


Fig.18. Transient thermal impedance of diode

(D = t_p/T)

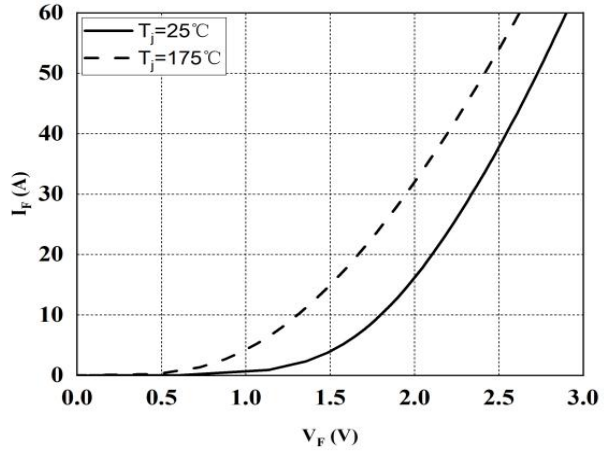


Fig.19. Typical diode forward current as a function of forward voltage

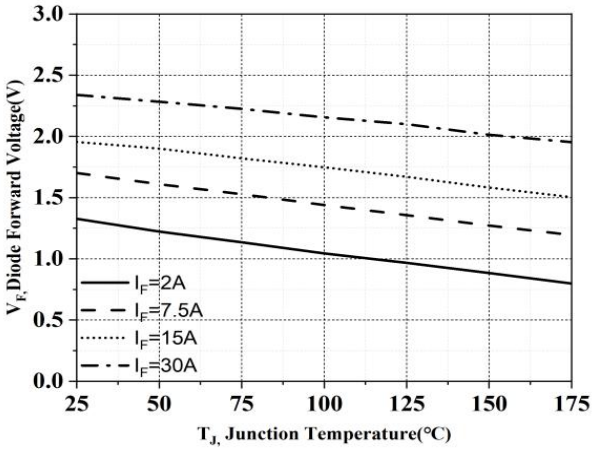


Fig.20. Typical diode forward voltage as a function of junction temperature

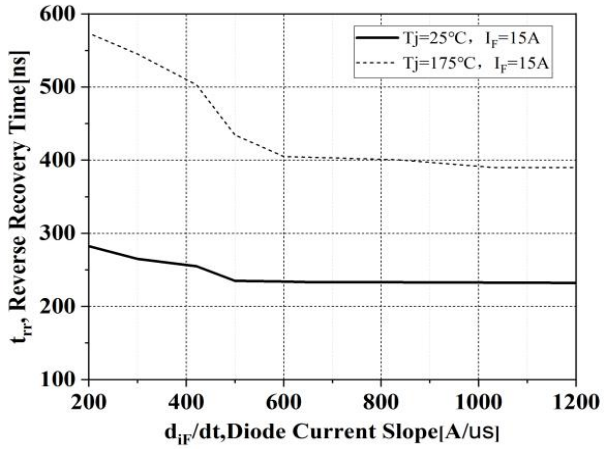


Fig.21.Typical reverse recovery time as a function of diode current slope

(VR=600V)

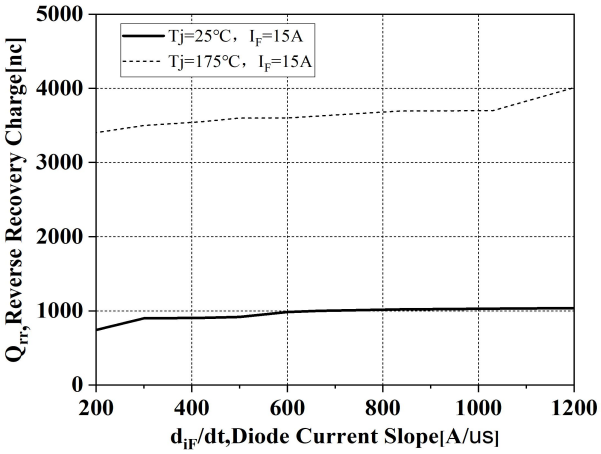


Fig.22. Typical reverse recovery charge as a function of diode current slope

(VR=600V)

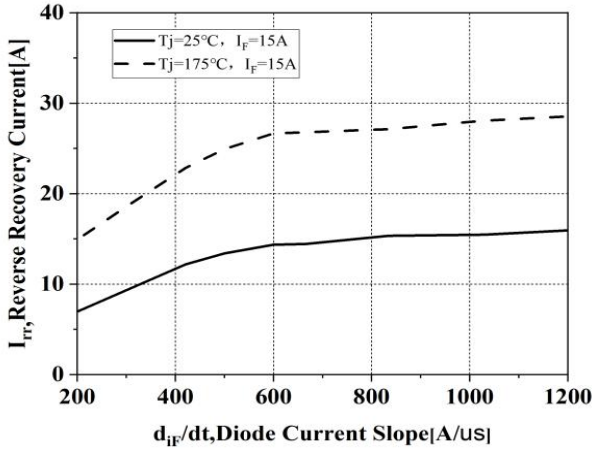


Fig.23.Typical reverse recovery current as a function of diode current slope

(VR=600V)

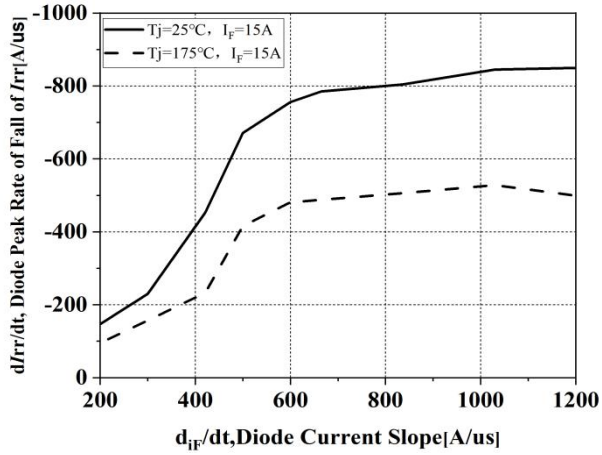
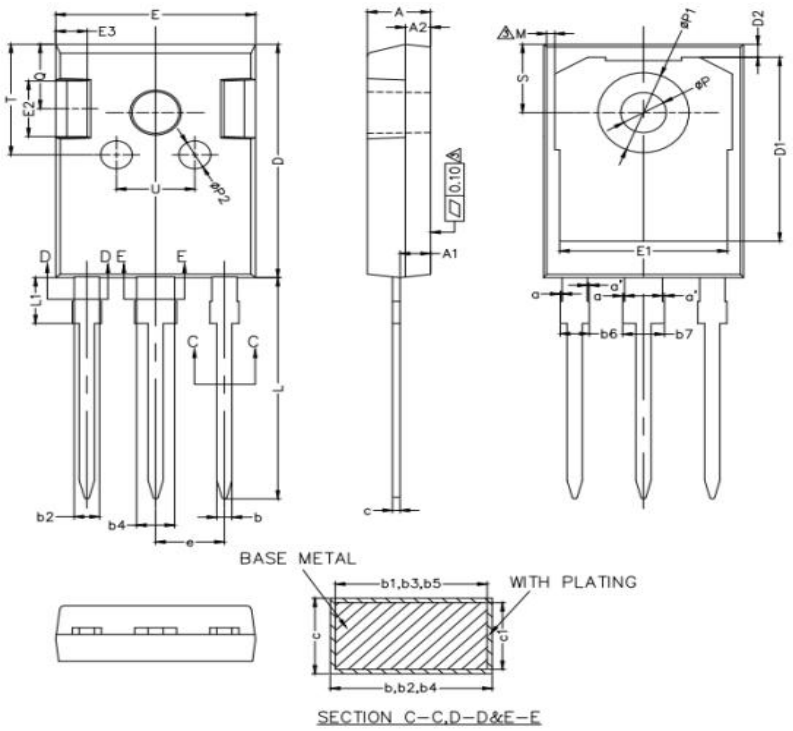


Fig.24.Typical diode peak rate of fall of reverse recovery current as a function of diode current slope

(VR=600V)

7. Package Dimensions



COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

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	2.95	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	1.20	1.35
E	15.70	15.80	15.90
E1	13.10	13.30	13.50
E2	4.90	5.00	5.10
E3	2.40	2.50	2.60
⚠ e	5.34	5.44	5.54
L	19.80	19.92	20.10
⚠ L1	3.95	4.13	4.30
⚠ M	0.35	–	0.95
P	3.50	3.60	3.70
⚠ 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

NOTES:
1.ALL DIMENSIONS REFER TO JEDEC STANDARD TO-247 AD DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
2.EJECTION MARK DEPTH $0.10^{+0.15}_{-0.05}$

8. Version Information

Version No.	Date changed	Version revision record
V1.0	2024/03	Release version