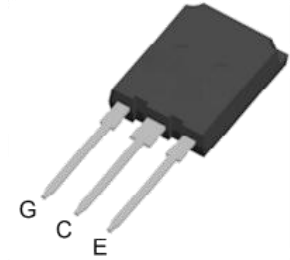


1200V 40A CoolFAST™ 7 Technology IGBT With Internal Isolation

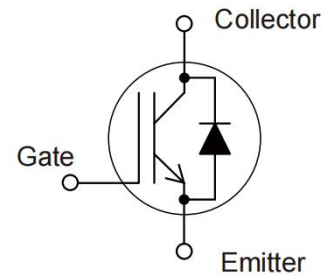
Features:

- Low Switching Power Loss
- Low Switching Surge And Noise
- Advanced Field Stop Technology
- Low EMI
- Maximum Junction Temperature 175°C
- Qualified According To JEDEC For Target Applications
- Pb-free Lead Plating, Halogen-free Mold Compound, RoHS Compliant



Applications:

- Industrial UPS
- Welding Machine
- Solar Converters
- Energy Storage
- EV Charger



Key Performance and Package Parameters

Type	V _{CE}	I _C	V _{CEsat} , T _{vj} =25°C	T _{vjmax}	Marking	Package
DKI40N120DF7	1200V	40A	1.75V	175°C	DKI40N120DF7	TO247iPS-3L

Maximum Ratings and Characteristics

Absolute Maximum Ratings at T_{vj}= 25°C (unless otherwise specified)

Items	Symbols	Value	Units
Collector-emitter voltage	V _{CEs}	1200	V
Gate-emitter voltage	V _{GES}	±20	V
Transient gate-emitter voltage (t _p ≤ 10μs, D < 0.010)		±30	V
DC collector current, limited by T _{vjmax}			
T _c = 25°C	I _C	65	A
T _c = 100°C		40	
Pulsed collector current, t _p limited by T _{vjmax}	I _{CP}	160	A
Turn-off safe operating area			
V _{ce} ≤ 1200V, T _j ≤ 175°C, t _p = 1μs	-	160	A
Diode forward current, limited by T _{vjmax}			
T _c = 25°C	I _F	65	A
T _c = 100°C		40	
IGBT max. power dissipation	P _{D_IGBT}	500	W
FWD max. power dissipation	P _{D_FWD}	395	°C
Operating junction temperature	T _{vj}	-40 ~ +175	°C
Storage temperature	T _{stg}	-55 ~ +150	°C

Electrical Characteristics at $T_{vj}= 25^{\circ}\text{C}$ (unless otherwise specified)

Description	Symbols	Conditions	Characteristics			Unit
			Min	Typ	Max	
Collector-emitter breakdown voltage	$V_{(BR)CES}$	$V_{GE}= 0\text{V}, I_C= 0.50\text{mA}$	1200	-	-	V
Zero gate voltage collector current	I_{CES}	$V_{CE}= 1200\text{V}, V_{GE}= 0\text{V}$	-	-	200	μA
Gate-emitter leakage current	I_{GES}	$V_{CE}= 0\text{V}, V_{GE}= \pm 20\text{V}$	-	-	± 200	nA
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{CE}= V_{GE}, I_C= 250\mu\text{A}$	5.1	5.9	6.7	V
Collector-emitter saturation voltage	$V_{CE(sat)}$	$V_{GE}= 15\text{V}, I_C= 40\text{A}$	-	1.75	2.20	V
		$T_{vj}= 25^{\circ}\text{C}$ $T_{vj}= 175^{\circ}\text{C}$	-	2.40	-	
Input capacitance	C_{ies}	$V_{CE}= 25\text{V}, V_{GE}= 0\text{V}$ $f= 1\text{MHz}$	-	9500	-	pF
Output capacitance	C_{oes}		-	150	-	pF
Reverse transfer capacitance	C_{res}		-	86	-	pF
Gate charge	Q_G	$V_{CC}= 960\text{V}, I_C= 40\text{A}, V_{GE}= 15\text{V}$	-	320	-	nC
Forward voltage drop	V_F	$I_F= 40\text{A}$	-	1.7	3.0	V
		$T_{vj}= 25^{\circ}\text{C}$ $T_{vj}= 175^{\circ}\text{C}$	-	1.5	-	

Switching Characteristics at $T_{vj}= 25^{\circ}\text{C}$

Description	Symbols	Conditions	Characteristics			Unit
			Min	Typ	Max	
IGBT Characteristics						
Turn-on delay time	$t_{d(on)}$	$V_{CC}= 600\text{V}$ $I_C= 40\text{A}$ $V_{GE}= 15\text{V}$ $R_G= 10\Omega$	-	65	-	ns
Rise time	t_r		-	110	-	ns
Turn-off delay time	$t_{d(off)}$		-	297	-	ns
Fall time	t_f		-	75	-	ns
Turn-on energy	E_{on}		-	3.3	-	mJ
Turn-off energy	E_{off}		-	1.2	-	mJ
Total switching energy	E_{ts}		-	4.5	-	mJ
Diode Characteristics						
Diode reverse recovery time	t_{rr}	$V_{CC}= 600\text{V}$	-	270	-	ns
Diode reverse recovery charge	Q_{rr}	$I_F= 40\text{A}$	-	2.8	-	μC
Diode peak reverse recovery current	I_{rrm}	$di_F/dt= 300\text{A}/\mu\text{s}$	-	19	-	A

Switching Characteristics at $T_{vj}= 175^{\circ}\text{C}$

Description	Symbols	Conditions	Characteristics			Unit
			Min	Typ	Max	
IGBT Characteristics						
Turn-on delay time	$t_{d(on)}$	$V_{CC}= 600\text{V}$ $I_C= 40\text{A}$ $V_{GE}= 15\text{V}$ $R_G= 10\Omega$	-	60	-	ns
Rise time	t_r		-	100	-	ns
Turn-off delay time	$t_{d(off)}$		-	360	-	ns
Fall time	t_f		-	150	-	ns
Turn-on energy	E_{on}		-	3.3	-	mJ
Turn-off energy	E_{off}		-	2.3	-	mJ
Total switching energy	E_{ts}		-	5.6	-	mJ
Diode Characteristics						
Diode reverse recovery time	t_{rr}	$V_{CC}= 600\text{V}$	-	440	-	ns
Diode reverse recovery charge	Q_{rr}	$I_F= 40\text{A}$	-	8.5	-	μC
Diode peak reverse recovery current	I_{rrm}	$di_F/dt= 300\text{A}/\mu\text{s}$	-	39	-	A

Thermal Resistance

Items	Symbols	Characteristics			Unit
		Min	Typ	Max	
Thermal Resistance, Junction-Ambient	R _{th(j-a)}	-	-	50	°C /W
Thermal Resistance, IGBT Junction to Case	R _{th(j-c)}	-	-	0.30	
Thermal Resistance, Diodes Junction to Case	R _{th(j-c)}	-	-	0.38	

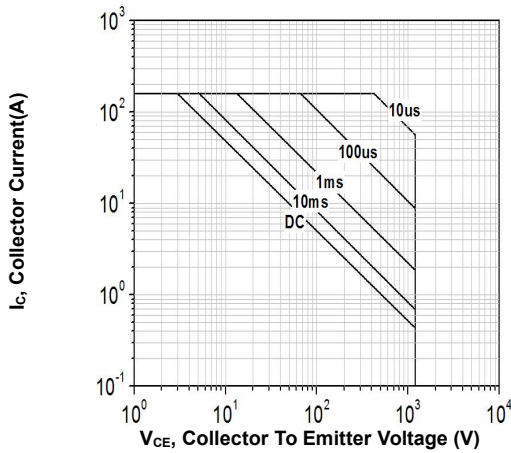


Figure 1. Forward bias safe operating area
($D=0$, $T_C=25^\circ\text{C}$, $T_{vj}\leq 175^\circ\text{C}$; $V_{GE}=15\text{V}$)

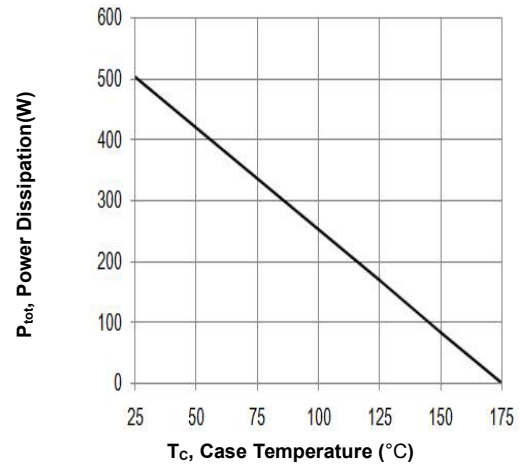


Figure 2. Power dissipation vs. case temperature
($T_{vj}\leq 175^\circ\text{C}$)

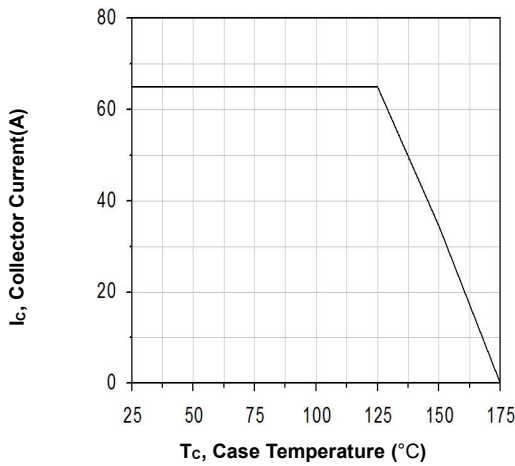


Figure 3. Collector current vs. case temperature
($V_{GE}\leq 15\text{V}$, $T_{vj}\leq 175^\circ\text{C}$)

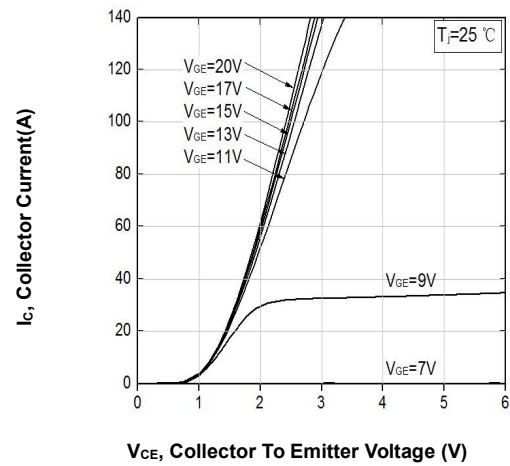


Figure 4. Typical output characteristic
($T_{vj}=25^\circ\text{C}$)

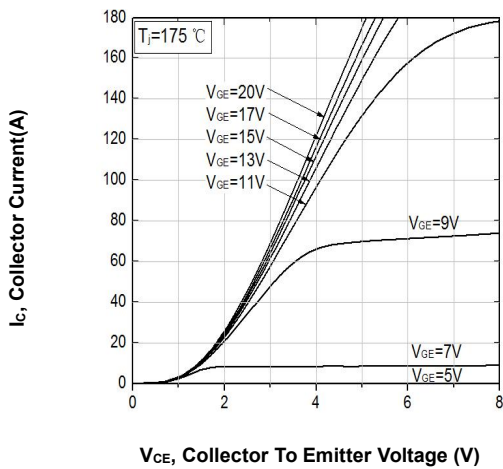


Figure 5. Typical output characteristic
($T_{vj}=175^\circ\text{C}$)

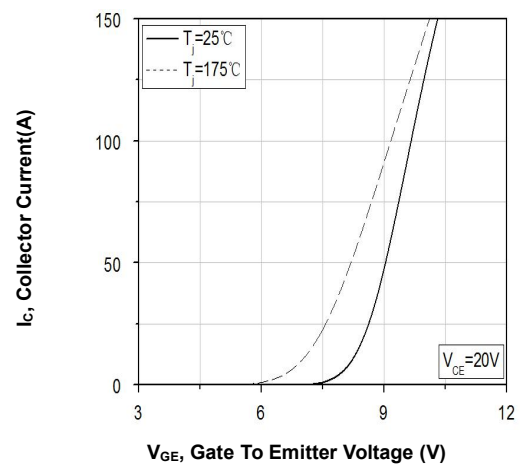


Figure 6. Typical transfer characteristic
($V_{CE}=20\text{V}$)

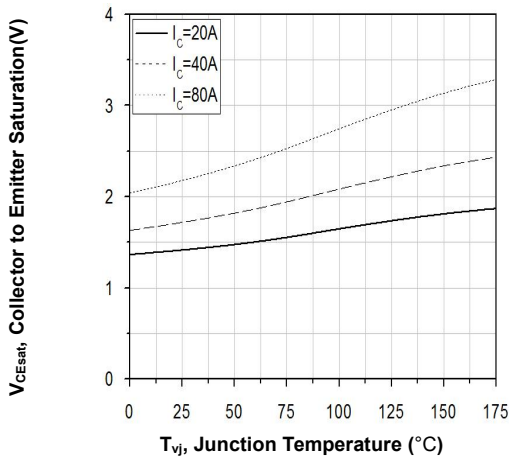


Figure 7. Typical collector-emitter saturation voltage vs. T_{vj} ($V_{GE} = 20V$)

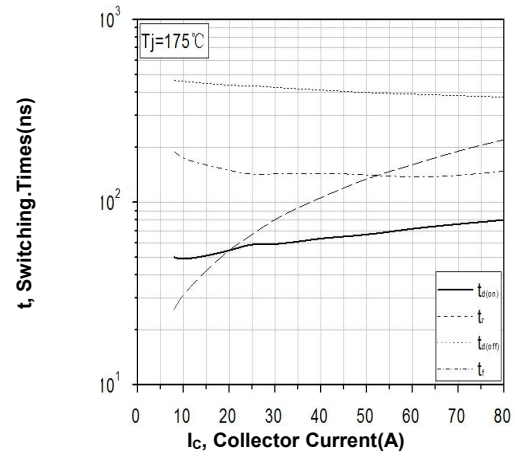


Figure 8. Typical switching times vs. collector current
(Ind. load, $T_{vj} = 175^{\circ}C$, $V_{CE} = 600V$, $V_{GE} = 15/0V$, $R_G = 12\Omega$)

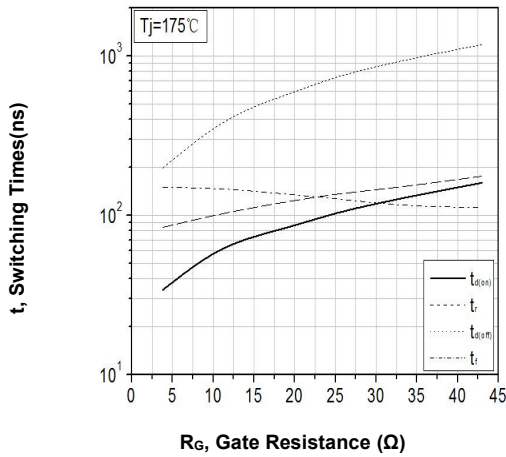


Figure 9. Typical switching times vs. gate resistor
(Ind. Load, $T_{vj} = 175^{\circ}C$, $V_{CE} = 600V$, $V_{GE} = 15/0V$, $I_C = 40A$)

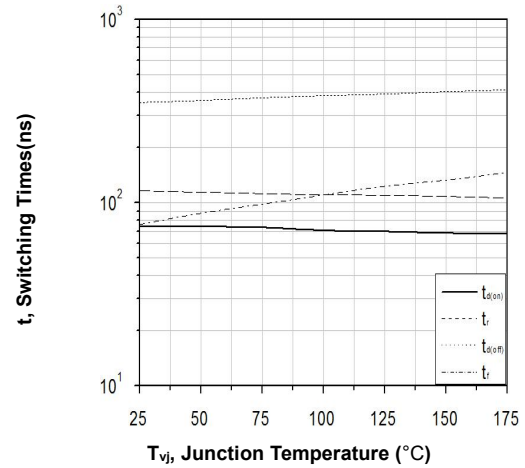


Figure 10. Typical switching times vs. T_{vj}
(Ind. Load, $V_{CE} = 600V$, $V_{GE} = 15/0V$, $I_C = 40A$, $R_G = 12\Omega$)

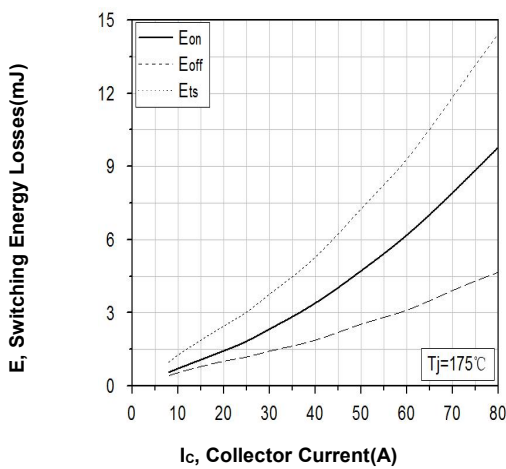


Figure 11. Typical switching energy losses vs. collector current (Ind. load, $T_{vj} = 175^{\circ}C$, $V_{CE} = 600V$, $V_{GE} = 15/0V$, $R_G = 12\Omega$)

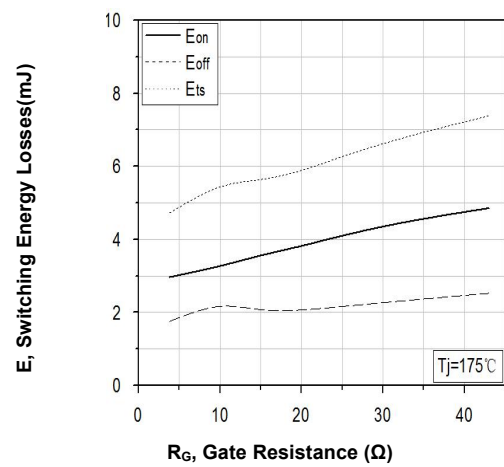


Figure 12. Typical switching energy losses vs. gate resistor (Ind. load, $T_{vj} = 175^{\circ}C$, $V_{CE} = 600V$, $V_{GE} = 15/0V$, $I_C = 40A$)

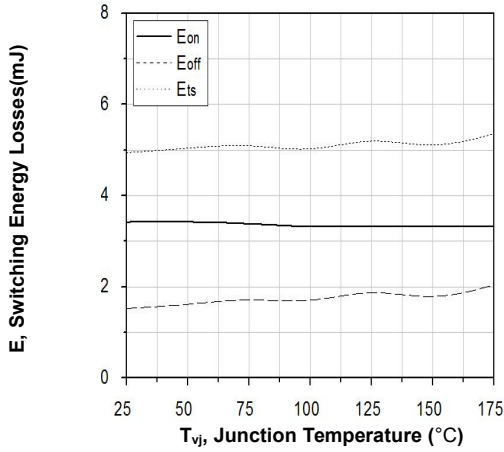


Figure 13. Typical switching energy losses vs. T_{vj}
(Ind load, $V_{CE} = 600V$, $V_{GE} = 15/0V$, $I_C = 40A$, $R_g = 12\Omega$)

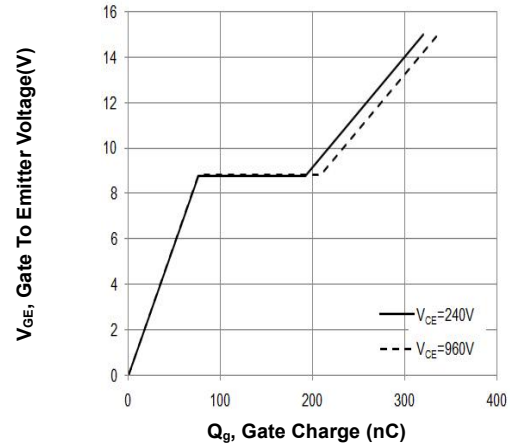


Figure 14. Typical gate charge
($I_C = 40A$)

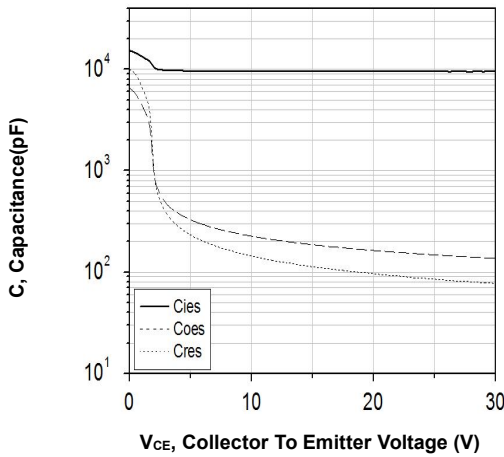


Figure 15. Typical capacitance vs. collector-emitter voltage ($V_{GE} = 0V$, $f = 1MHz$)

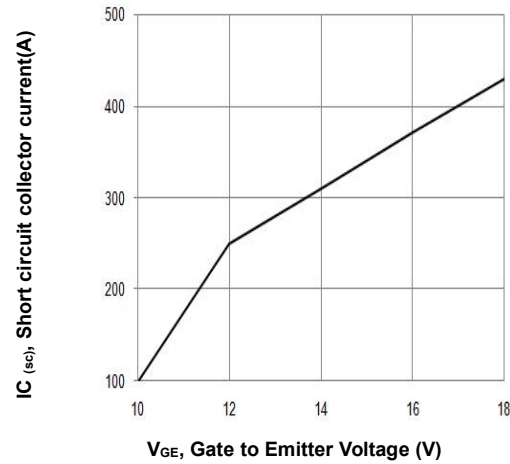


Figure 16. Typical short circuit collector current vs. gate-emitter voltage ($V_{CE} \leq 600V$ start at $T_{vj} = 25^\circ C$)

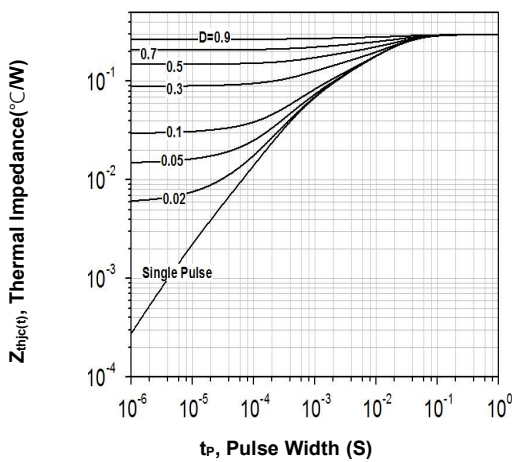


Figure 17. IGBT transient thermal impedance
($D = t_p/T$)

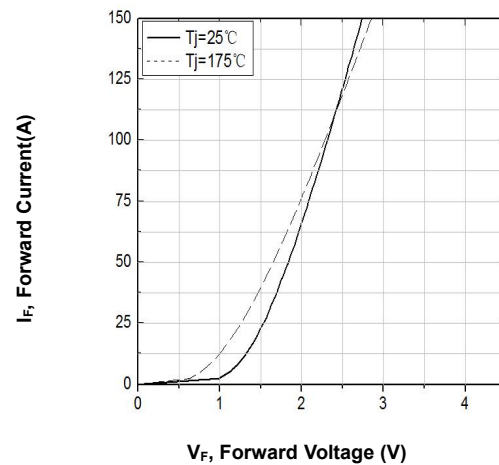


Figure 18. Typical diode forward current vs. forward voltage

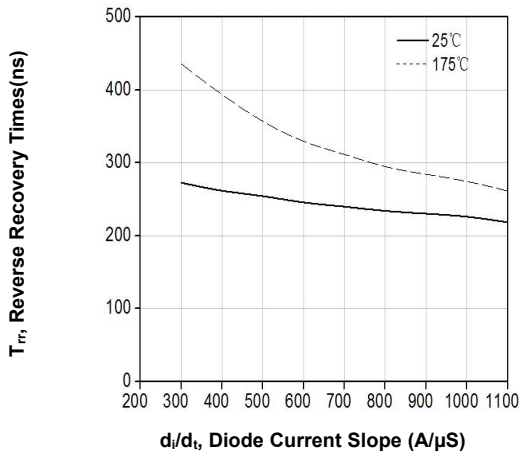


Figure 19. Typical reverse recovery time vs. diode current slope ($V_R=600V$)

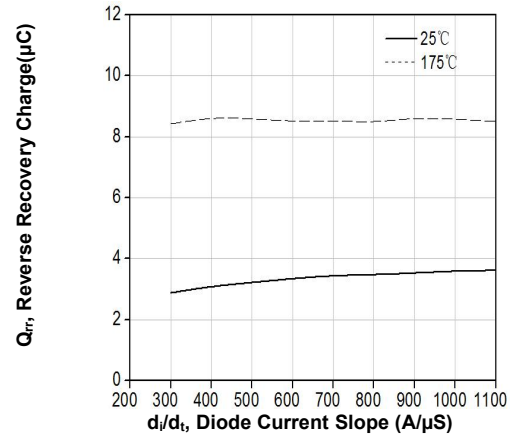


Figure 20. Typical reverse recovery charge vs. diode current slope ($V_R=600V$)

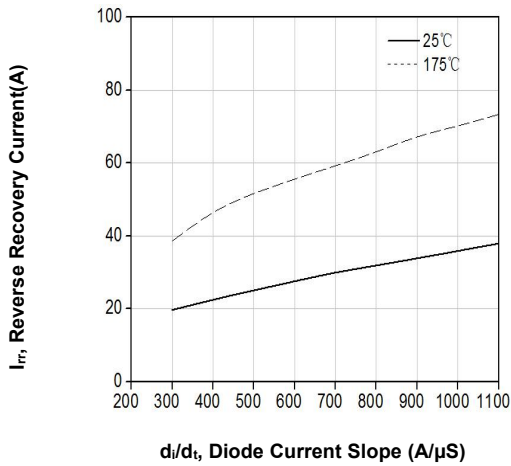
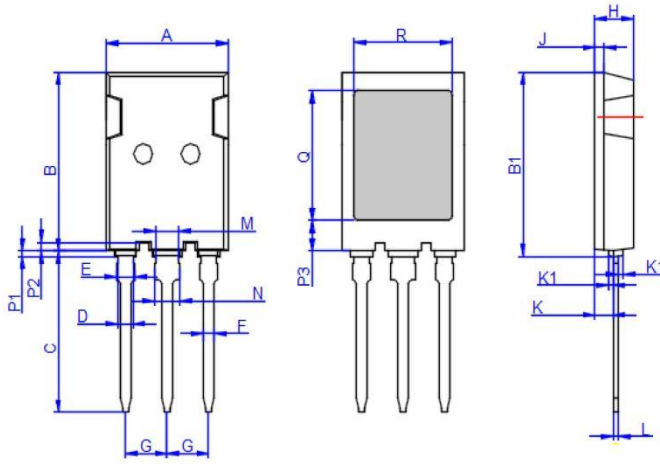


Figure 21. Typical reverse recovery current vs. diode current slope ($V_R=600V$)

TO247iPS-3L Package Outline



TO-247iPS-3L

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	15.70	16.00	16.30	0.618	0.630	0.642
B	21.80	22.00	22.20	0.858	0.866	0.874
B1	22.30	22.50	22.70	0.878	0.886	0.894
C	19.40	19.70	20.00	0.764	0.776	0.787
D	1.80	2.00	2.20	0.071	0.079	0.087
E	2.15	2.35	2.55	0.085	0.093	0.100
F	1.16	1.36	1.56	0.046	0.054	0.061
G	5.25	5.45	5.65	0.207	0.215	0.222
H	4.80	5.00	5.20	0.189	0.197	0.205
J	1.10	1.20	1.30	0.043	0.047	0.051
K	2.20	2.35	2.50	0.087	0.093	0.098
K1	0.45	0.60	0.75	0.018	0.024	0.030
L	0.51	0.70	0.89	0.020	0.028	0.035
M	2.80	3.00	3.20	0.110	0.118	0.126
N	3.15	3.35	3.55	0.124	0.132	0.140
P1	0.44	0.64	0.84	0.017	0.025	0.033
P2	0.80	1.00	1.20	0.031	0.039	0.047
P3	3.55	3.75	3.95	0.140	0.148	0.156
Q	12.60	12.90	13.20	0.496	0.508	0.520
R	15.55	15.85	16.15	0.612	0.624	0.636

Revision History

Revision	Date	Subjects (major changes since last revision)
0.1	2021-03-20	Target version
1.1	2022-11-11	Preliminary version
1.2	2023-07-18	MP version

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