1200V 40A CoolFAST™ 7 Technology IGBT

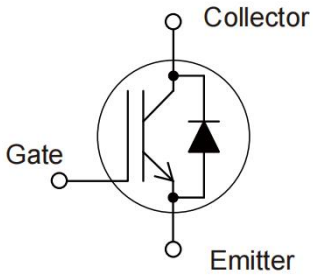
Features:

- 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

G C E

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
DKW40N120DF7	1200V	40A	1.75V	175°C	DKW40N120DF7	TO247-3

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 Transient gate-emitter voltage (t_p≤ 10µs, D< 0.010)	V_{GES}	±20 ±30	V
DC collector current, limited by T_{vjmax} Tc= 25°C Tc= 100°C	I_C	 65 40	A
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} Tc= 25°C Tc= 100°C	I_F	 65 40	A
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°C (unless otherwise specified)

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

Switching Characteristics at T_{vj}= 25°C

Description	Symbols	Conditions	Characteristics			Unit
			Min	Typ	Max	
IGBT Characteristics						
Turn-on delay time	$t_{d(on)}$	V_{CC}= 600V I_C= 40A V_{GE}= 15V R_G= 10Ω	-	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}= 600V I_F= 40A di_F/dt= 300A/μs	-	270	-	ns
Diode reverse recovery charge	Q_{rr}		-	2.8	-	μC
Diode peak reverse recovery current	I_{rrm}		-	19	-	A

Switching Characteristics at T_{vj}= 175°C

Description	Symbols	Conditions	Characteristics			Unit
			Min	Typ	Max	
IGBT Characteristics						
Turn-on delay time	$t_{d(on)}$	V_{CC}= 600V I_C= 40A V_{GE}= 15V R_G= 10Ω	-	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}= 600V I_F= 40A di_F/dt= 300A/μs	-	440	-	ns
Diode reverse recovery charge	Q_{rr}		-	8.5	-	μC
Diode peak reverse recovery current	I_{rrm}		-	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	

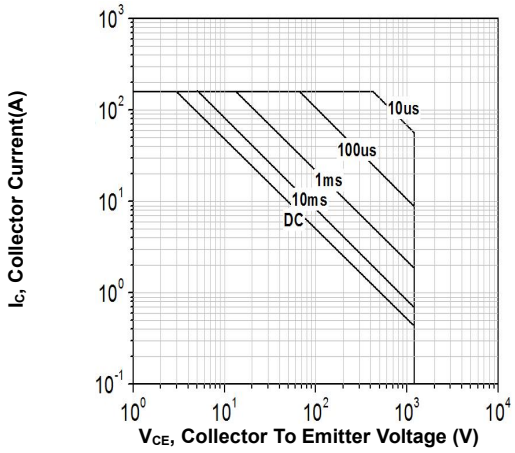


Figure 1. Forward bias safe operating area
(D= 0, T_C= 25°C, T_{vj}≤ 175°C; V_{GE}= 15V)

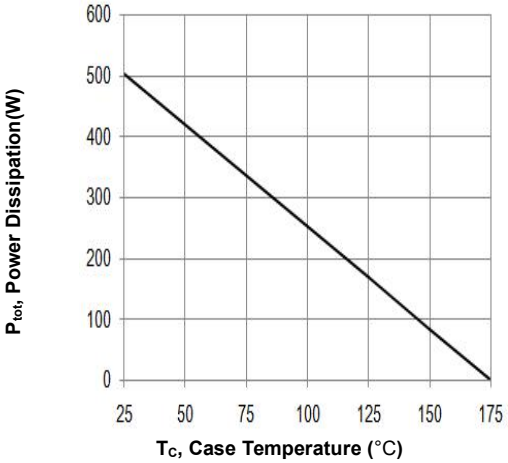


Figure 2. Power dissipation vs. case temperature
(T_{vj}≤ 175°C)

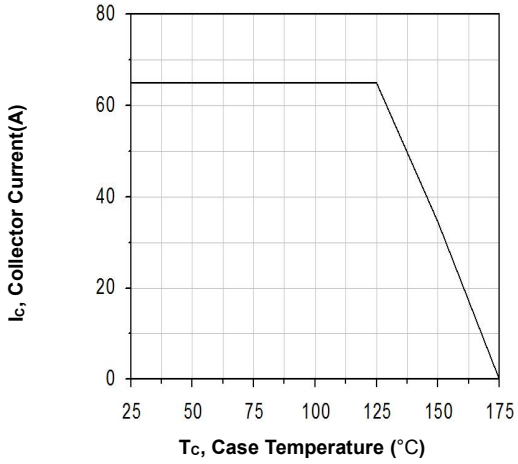


Figure 3. Collector current vs. case temperature
(V_{GE}≤ 15V, T_{vj}≤ 175℃)

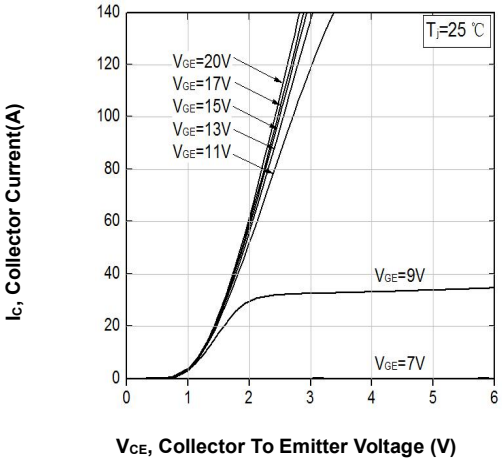


Figure 4. Typical output characteristic
(T_{vj}= 25°C)

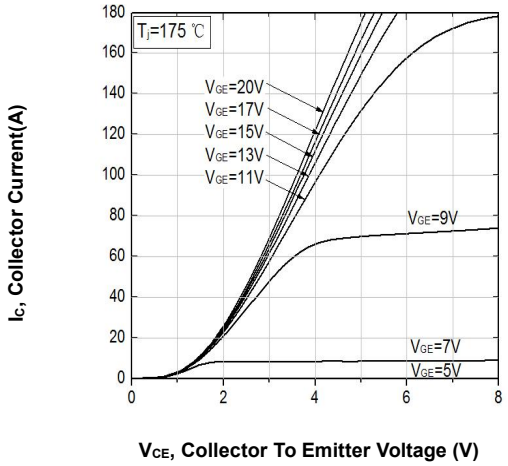


Figure 5. Typical output characteristic
(T_{vj}= 175°C)

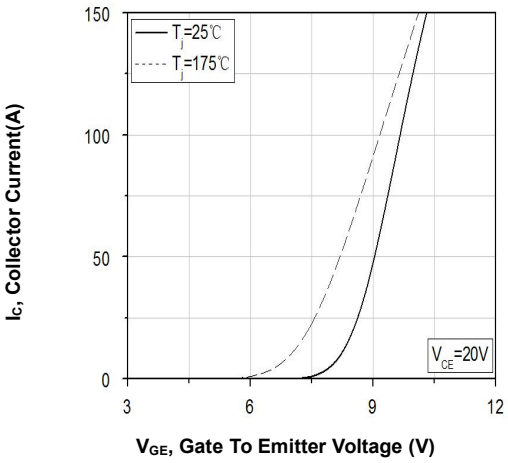


Figure 6. Typical transfer characteristic
(V_{CE}= 20V)

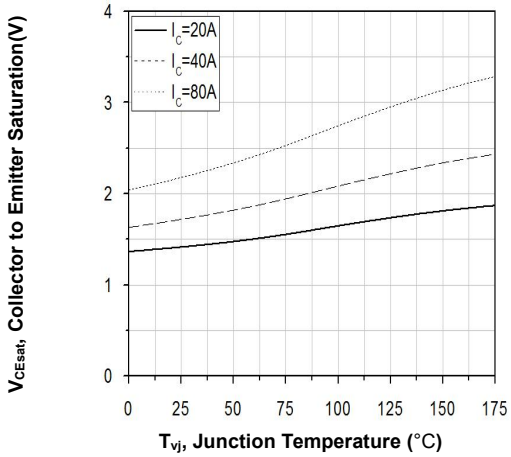


Figure 7. Typical collector-emitter saturation voltage vs. T_{vj} (V_{GE}= 20V)

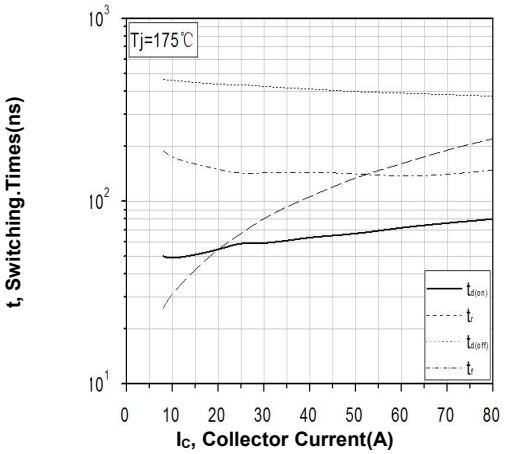


Figure 8. Typical switching times vs. collector current
(Ind. load, T_{vj}= 175°C, V_{CE}= 600V, V_{GE}= 15/0V, R_G=12Ω)

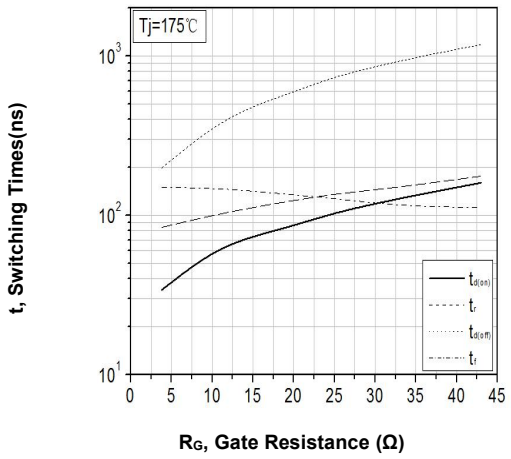


Figure 9. Typical switching times vs. gate resistor
(Ind. Load, T_{vj}= 175°C, V_{CE}= 600V, V_{GE}= 15/0V, I_C= 40A)

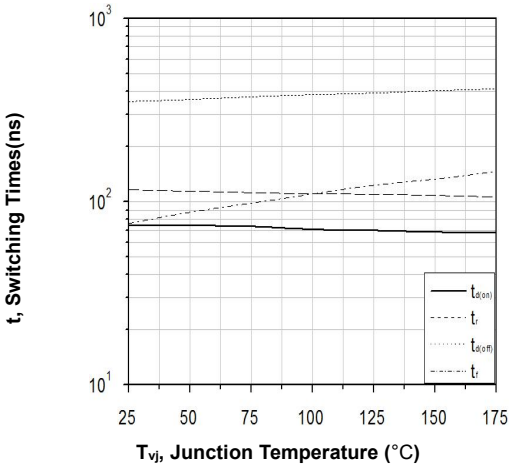


Figure 10. Typical switching times vs. T_{vj}
(Ind. Load, V_{CE}= 600V, V_{GE}= 15/0V, I_C= 40A, R_G= 12Ω)

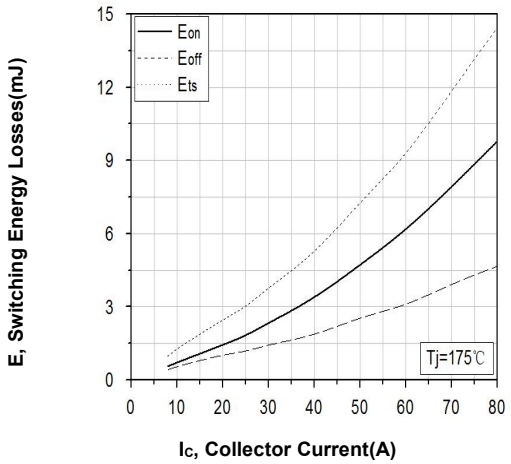


Figure 11. Typical switching energy losses vs. collector current (Ind. load, T_{vj}= 175°C, V_{CE}= 600V, V_{GE}=15/0V, R_g= 12Ω)

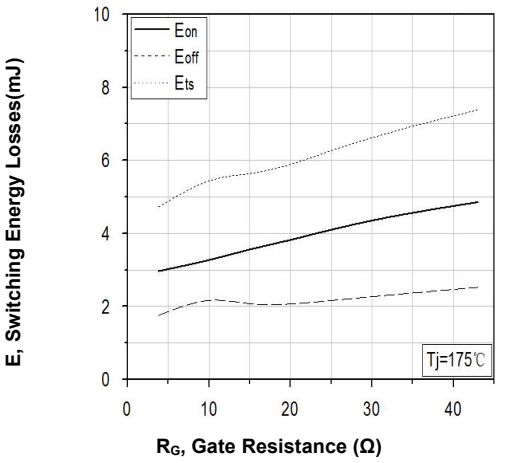


Figure 12. Typical switching energy losses vs. gate resistor (Ind. load, T_{vj}= 175°C, V_{CE}= 600V, V_{GE}=15/0V, I_C= 40A)

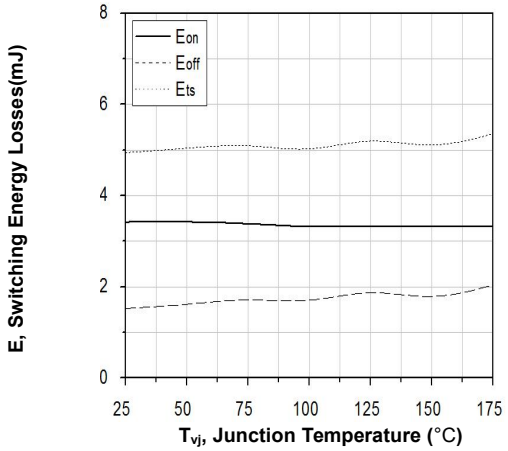


Figure 13. Typical switching energy losses vs. T_{vj}
(Ind load, V_{CE}= 600V, V_{GE}= 15/0V, I_C= 40A, R_g= 12Ω)

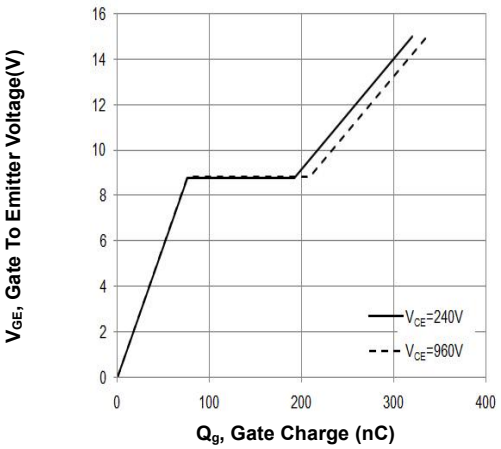


Figure 14. Typical gate charge
(I_C= 40A)

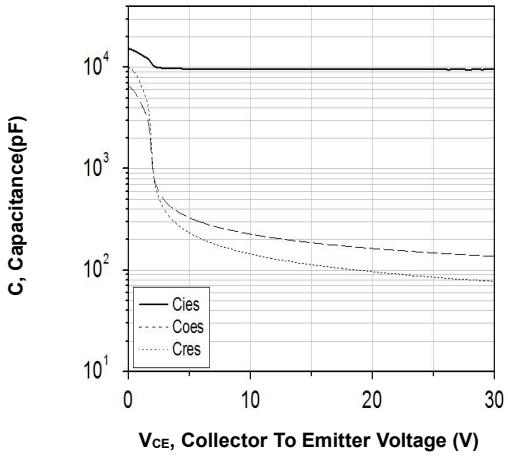


Figure 15. Typical capacitance vs. collector-emitter voltage (V_{GE}= 0V, f= 1MHz)

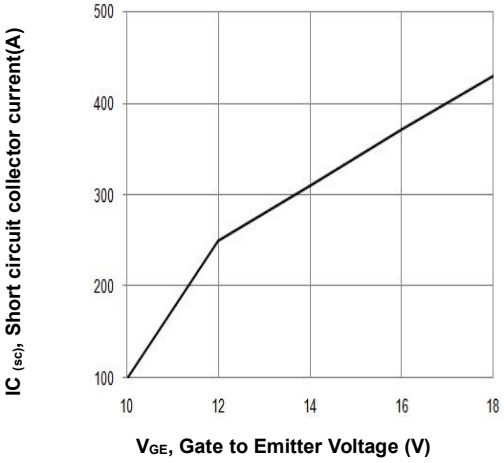


Figure 16. Typical short circuit collector current vs. gate-emitter voltage ($V_{CE}\leq$ 600V start at T_{vj}= 25°C)

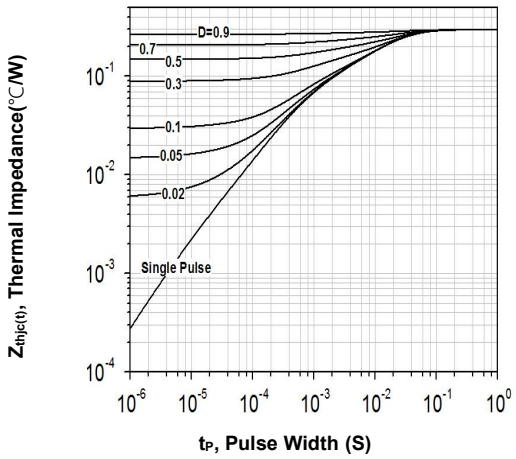


Figure 17.IGBT transient thermal impedance
(D= t_p/T)

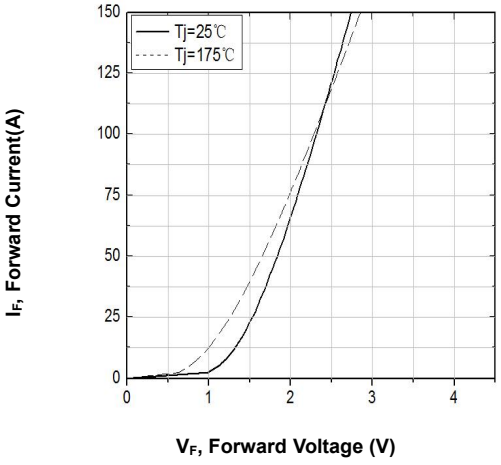


Figure 18. Typical diode forward current vs. forward voltage

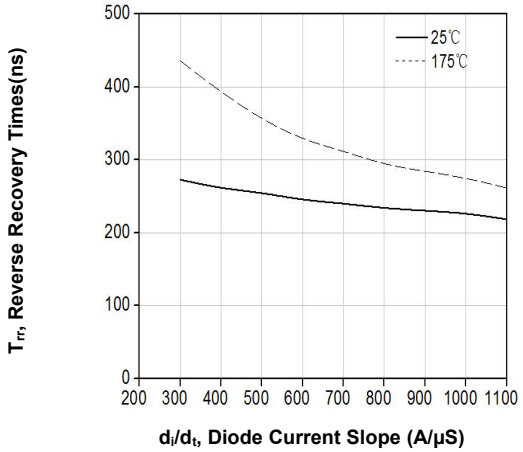


Figure 19. Typical reverse recovery time vs. diode current slope (V_R= 600V)

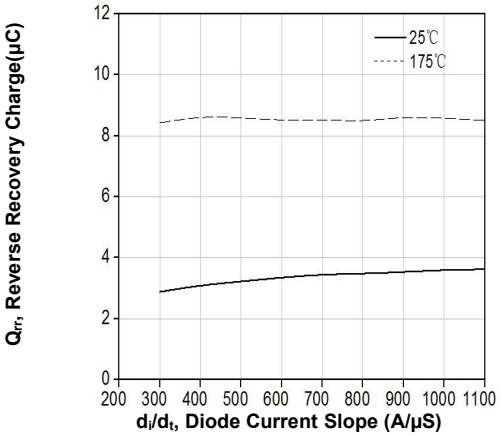


Figure 20. Typical reverse recovery charge vs. diode current slope (V_R= 600V)

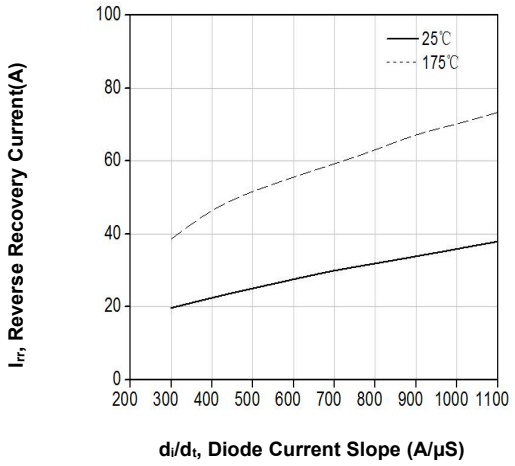
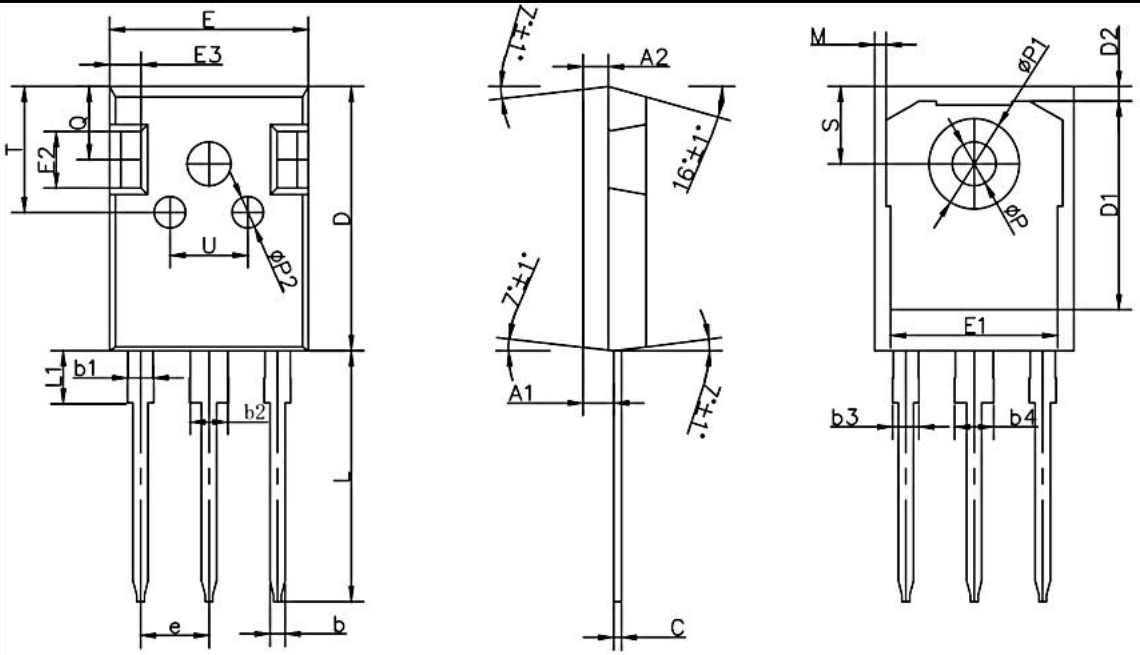


Figure 21. Typical reverse recovery current vs. diode current slope (V_R= 600V)

TO247-3 Package Outline



TO247-3L			
DIM.	MIN.	NOM.	MAX.
A	4.90	5.00	5.10
A1	2.25	2.36	2.51
A2	1.90	2.00	2.10
b	1.16	1.20	1.26
b1	1.96	2.00	2.06
b2	2.96	3.00	3.06
b3	–	–	2.25
b4	–	–	3.25
c	0.59	0.60	0.66
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	13.26	13.50
E2	4.40	4.50	4.60
E3	2.40	2.50	2.60
e	5.436BSC		
L	19.80	19.90	20.10
L1	–	–	4.30
M	0.35	0.89	0.95
P	3.40	3.50	3.60
P1	7.00	7.20	7.40
P2	2.40	2.50	2.60
Q	5.60	5.80	6.00
S	6.05	6.15	6.25
T	9.80	10.00	10.20
U	6.00	6.20	6.40
All dimensions in millimeters			

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	2023-05-18	MP version

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