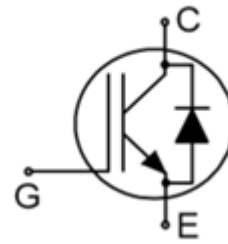


Trench Field-Stop Technology IGBT

Features

- 1200V, 40A
- $V_{CE(sat)(typ.)} = 1.7V @ V_{GE} = 20V, I_C = 40A$
- Low Switching Losses
- Low switching surge and noise
- Low EMI



Applications

- Solar Converters
- Uninterrupted Power Supply
- Energy Storage
- Welding machine
- EV Charger

Order codes	V_{CE}	I_C	$V_{CEsat}, T_{vj}=25^{\circ}C$	T_{vjmax}	Marking	Package
XD040H120A1S3-A	1200V	40A	1.7V	175 $^{\circ}C$	D40H120A1A	TO247-3

Absolute Maximum Ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-Emitter Voltage	1200	V
V_{GES}	Gate-Emitter Voltage	± 20	V
I_C	Continuous Collector Current ($T_C=25^{\circ}C$)	65	A
	Continuous Collector Current ($T_C=100^{\circ}C$)	40	A
I_{CM}	Pulsed Collector Current (Note 1)	160	A
I_F	Diode Continuous Forward Current ($T_C=25^{\circ}C$)	65	A
	Diode Continuous Forward Current ($T_C=100^{\circ}C$)	40	A
P_D	Maximum Power Dissipation (IGBT)	420	W
	Maximum Power Dissipation (FWD)	300	W
T_J	Operating Junction Temperature Range	-40 to 175	$^{\circ}C$
T_{STG}	Storage Temperature Range	-55 to 175	$^{\circ}C$

Thermal Data

Symbol	Parameter	Max.	Unit
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	50	$^{\circ}\text{C}/\text{W}$
$R_{\theta JC}$	Thermal Resistance, Junction to Case for IGBT	0.35	$^{\circ}\text{C}/\text{W}$
$R_{\theta JC}$	Thermal Resistance, Junction to Case for Diodes	0.5	$^{\circ}\text{C}/\text{W}$

Electrical Characteristics ($T_c=25^{\circ}\text{C}$ unless otherwise noted)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
BV_{CES}	Collector-Emitter Breakdown Voltage	$V_{GE}=0\text{V}, I_C=500\mu\text{A}$	1200	---	---	V
I_{CES}	Collector-Emitter Leakage Current	$V_{CE}=1200\text{V}, V_{GE}=0\text{V}$	---	---	200	μA
I_{GES}	Gate Leakage Current, Forward	$V_{GE}=20\text{V}, V_{CE}=0\text{V}$	---	---	200	nA
	Gate Leakage Current, Reverse	$V_{GE}=-20\text{V}, V_{CE}=0\text{V}$	---	---	-200	nA
$V_{GE(th)}$	Gate Threshold Voltage	$V_{GE}=V_{CE}, I_C=250\mu\text{A}$	5.1	5.9	6.7	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$V_{GE}=20\text{V}, I_C=40\text{A}$	---	1.7	2.0	V
Q_G	Total Gate Charge	$V_{CC}=600\text{V}, V_{GE}=15\text{V}$ $I_C=40\text{A}$	---	320	---	nC
$t_{d(on)}$	Turn-on Delay Time	$V_{CC}=600\text{V}$ $V_{GE}=\pm 15\text{V}$ $I_C=40\text{A}$ $R_G=10\Omega$ Inductive Load $T_c=25^{\circ}\text{C}$	---	65	---	ns
t_r	Turn-on Rise Time		---	110	---	ns
$t_{d(off)}$	Turn-off Delay Time		---	250	---	ns
t_f	Turn-off Fall Time		---	75	---	ns
E_{on}	Turn-on Switching Loss		---	2.1	---	mJ
E_{off}	Turn-off Switching Loss		---	1.2	---	mJ
E_{ts}	Total Switching Loss		---	3.3	---	mJ
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}$	---	9500	---	pF
C_{oes}	Output Capacitance	$V_{GE}=0\text{V}$	---	150	---	pF
C_{res}	Reverse Transfer Capacitance	$f=1\text{MHz}$	---	86	---	pF

Diode Characteristics ($T_C=25^{\circ}\text{C}$ unless otherwise noted)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_F	Diode Forward Voltage	$I_F=40\text{A}$	---	1.7	3.0	V
t_{rr}	Diode Reverse Recovery Time	$V_{CE}=600\text{V}$ $I_F=40\text{A}$ $di_F/dt=300\text{A}/\mu\text{s}$	---	440	---	ns
I_{rr}	Diode Peak Reverse Recovery Current		---	39	---	A
Q_{rr}	Diode Reverse Recovery Charge		---	8.5	---	μC

Note 1: Repetitive Rating; Pulse width limited by maximum junction temperature

Typical Characteristics

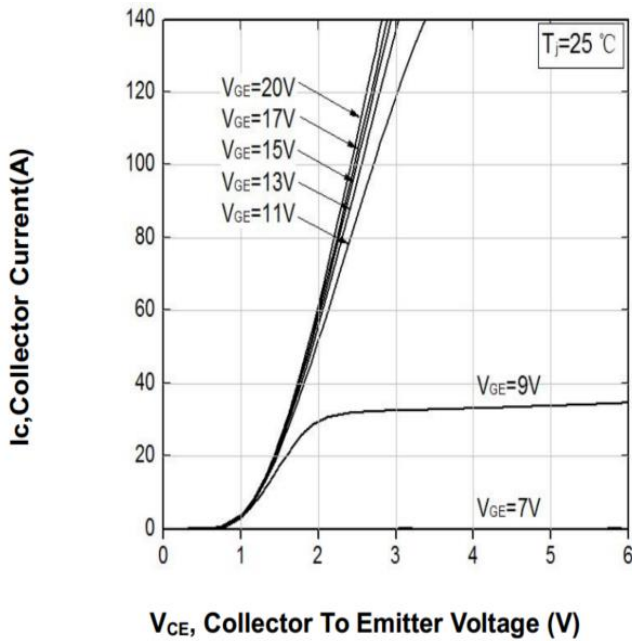


Fig. 1 Typical IGBT Output Characteristics at $T_J=25^\circ\text{C}$

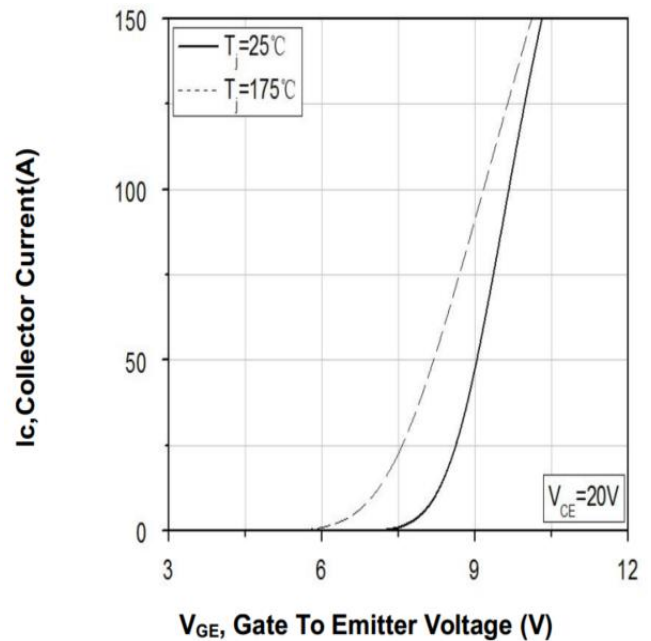


Fig. 2 Typical Transfer Characteristics at $V_{CE}=20\text{V}$

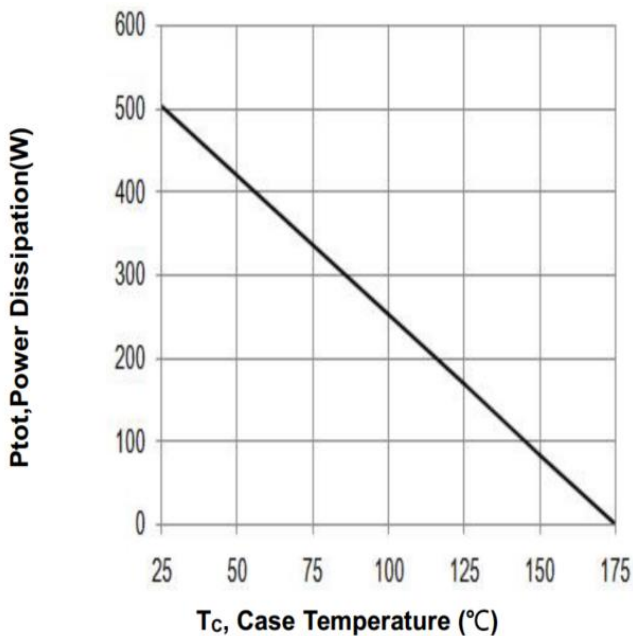


Fig. 3 Power dissipation vs. case temperature ($T_{vj} \leq 175^\circ\text{C}$)

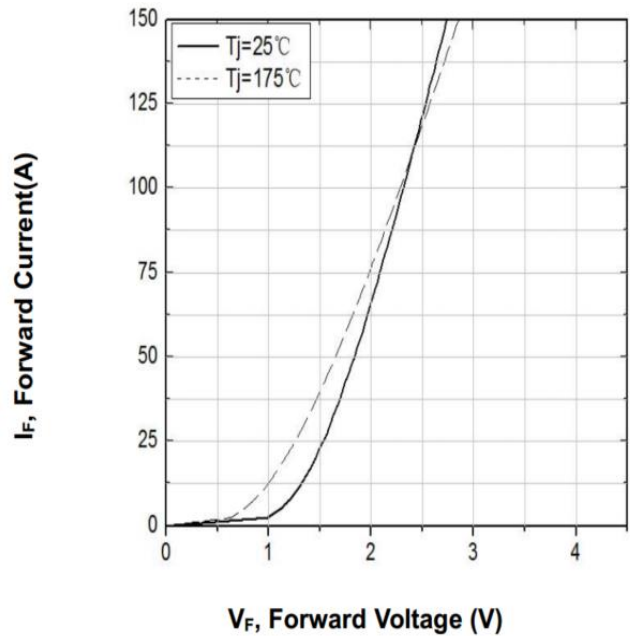


Fig. 4 Forward characteristic of Diode-Inverter

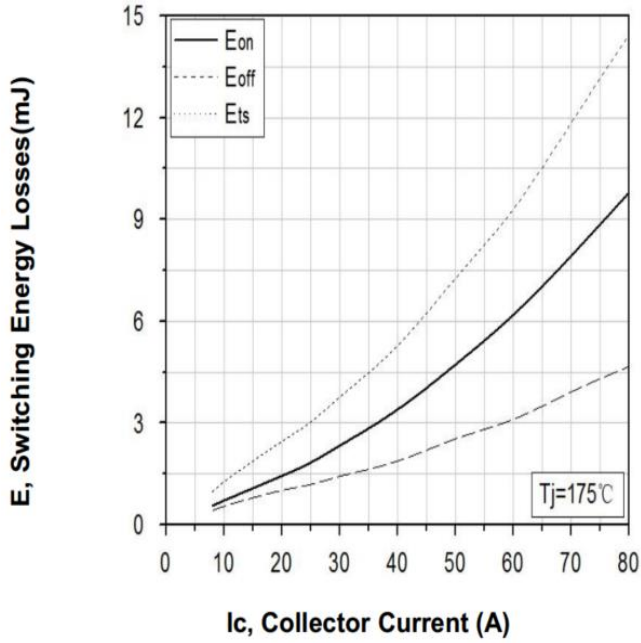


Fig. 5 Typical Energy Loss vs. I_c at $T_c=175^\circ\text{C}$,
 $V_{CE}=600\text{V}$, $V_{GE}=15\text{V}$, $R_g=12\Omega$

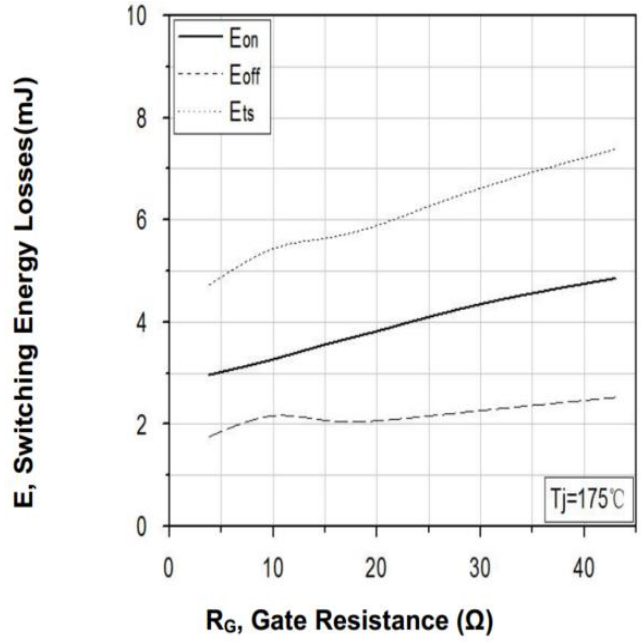


Fig. 6 Typical Switching Time vs. R_g at
 $T_c=25^\circ\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=15\text{V}$, $I_c=40\text{A}$

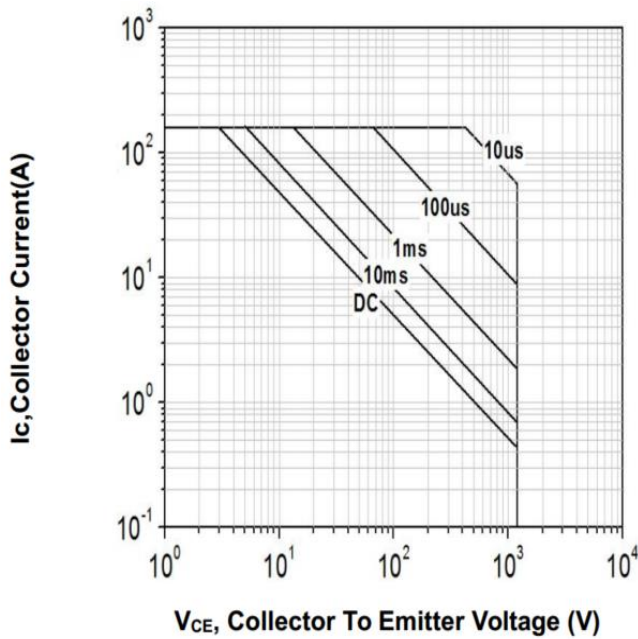


Fig. 7 Forward bias safe operating area
 $(D=0, T_c=25^\circ\text{C}, T_{vj} \leq 175^\circ\text{C}; V_{GE}=15\text{V})$

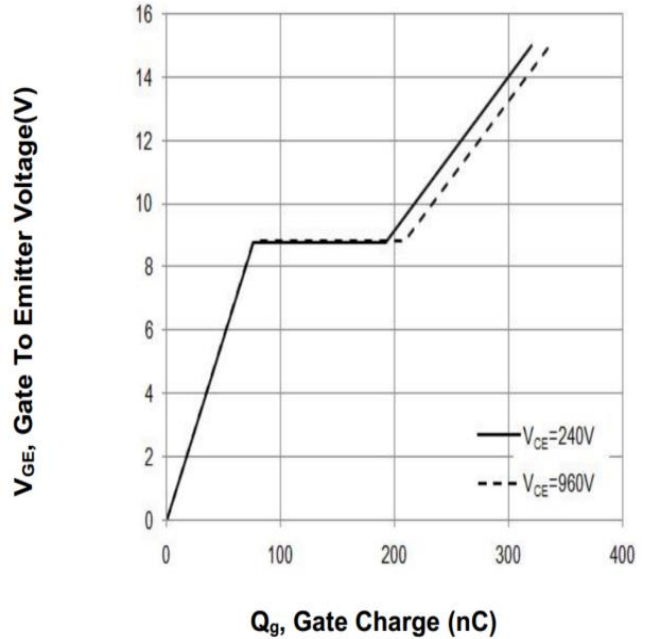


Fig. 8 Typical gate charge ($I_c=40\text{A}$)

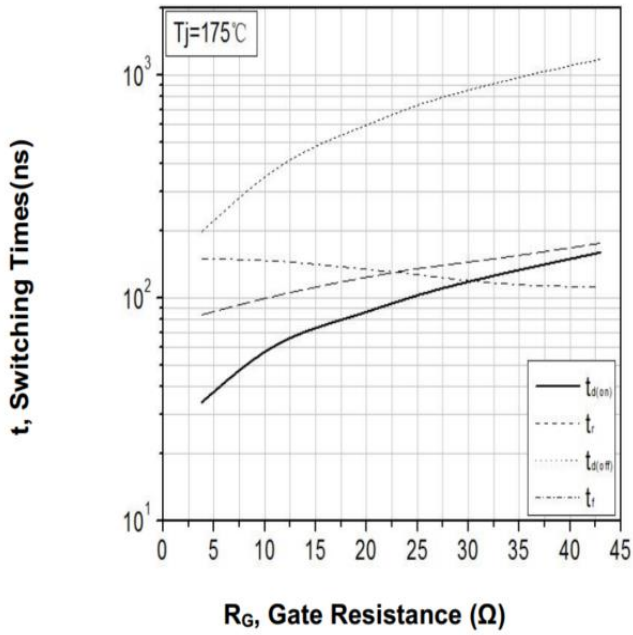


Fig. 9 Typical switching times vs. gate resistor
 (Ind. Load, $T_{vj}=175^{\circ}\text{C}$, $V_{CE}=600\text{V}$,
 $V_{GE}=15/0\text{V}$, $I_C=40\text{A}$)

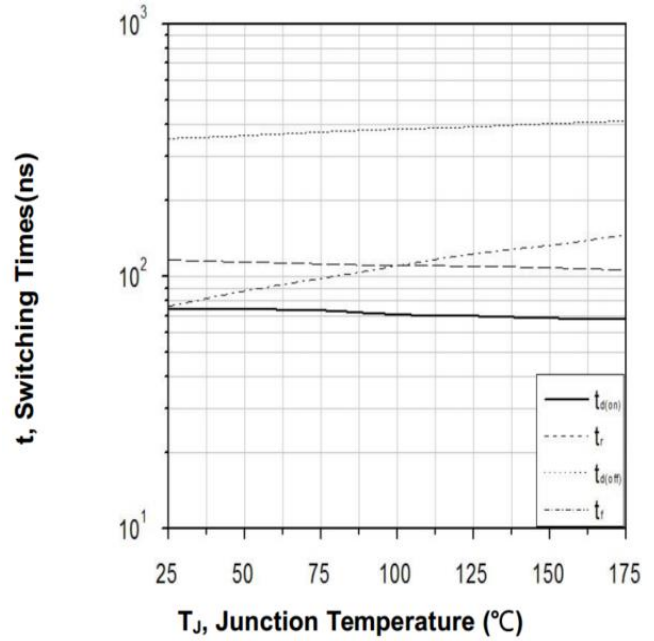


Fig. 10 Typical switching times vs. T_{vj}
 (Ind. Load, $V_{CE}=600\text{V}$, $V_{GE}=15/0\text{V}$,
 $I_C=40\text{A}$, $R_g=12\Omega$)

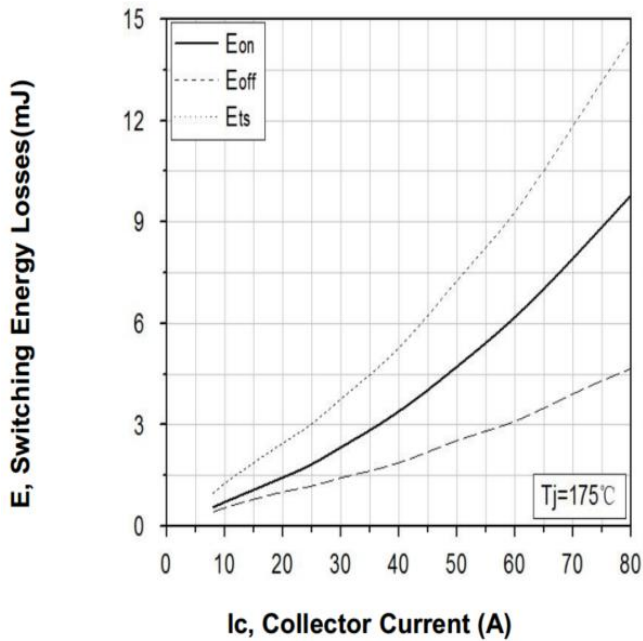


Fig. 11 Typical switching energy losses vs. collector current (Ind. load, $T_{vj}=175^{\circ}\text{C}$,
 $V_{CE}=600\text{V}$, $V_{GE}=15/0\text{V}$, $R_g=12\Omega$)

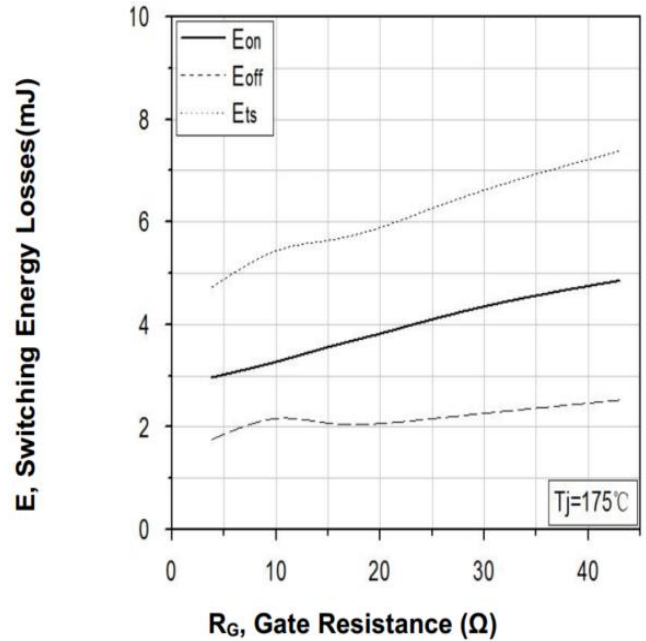


Fig. 12 Typical switching energy losses vs. gate resistor (Ind. load, $T_{vj}=175^{\circ}\text{C}$,
 $V_{CE}=600\text{V}$, $V_{GE}=15/0\text{V}$, $I_C=40\text{A}$)

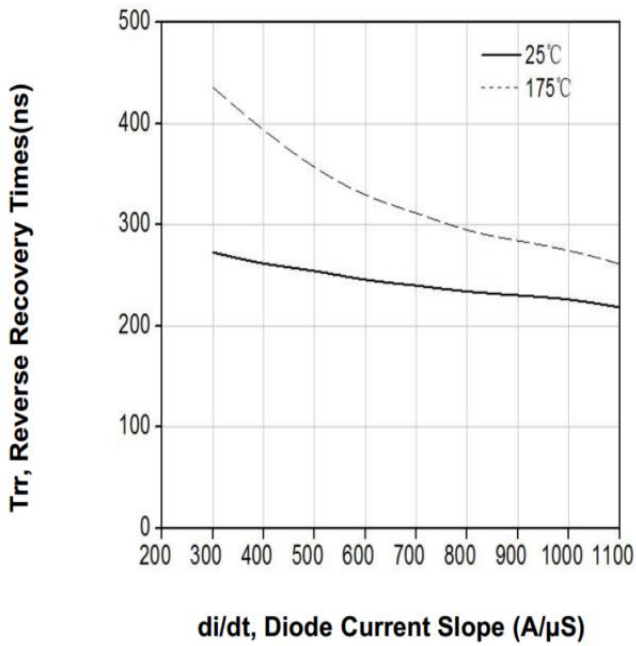


Fig. 13 Typical reverse recovery time vs. diode current slope (VR=600V)

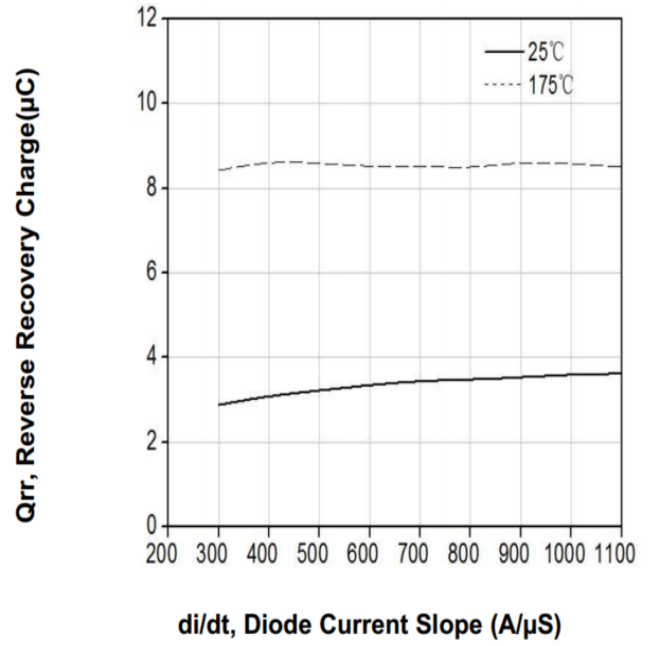


Fig. 14 Typical reverse recovery charge vs. diode current slope (VR=600V)

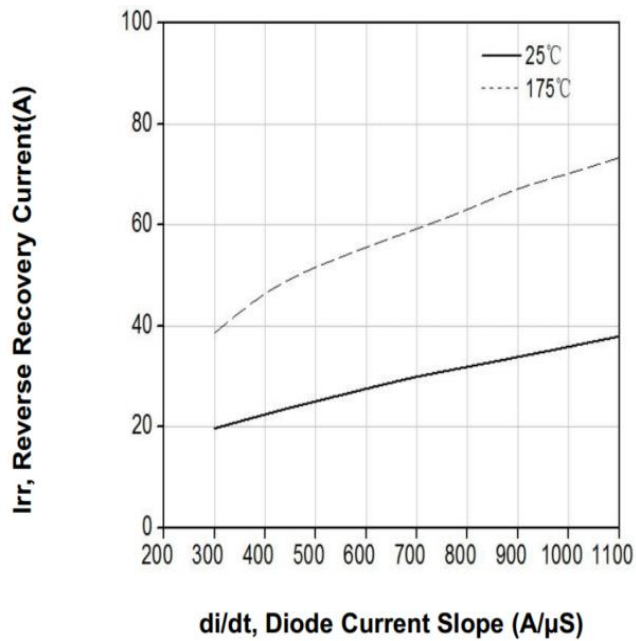
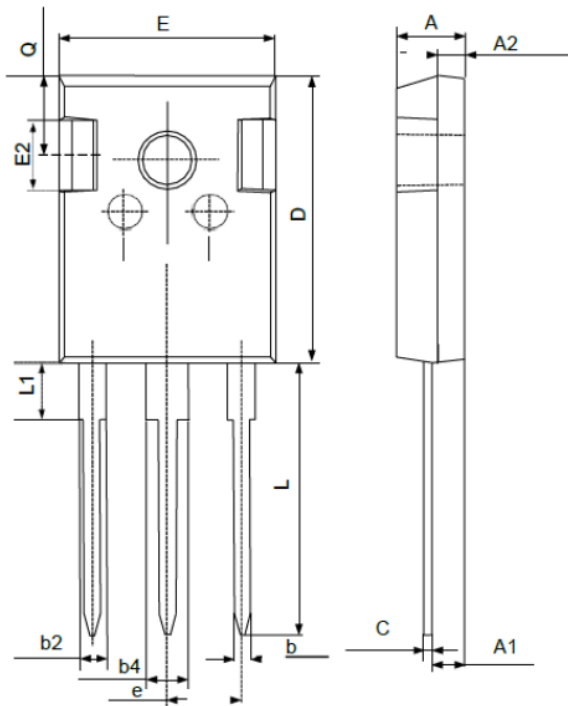


Fig. 15 Typical switching energy losses vs. collector current (Ind. load, Tvj=175°C, VCE=600V, VGE=15/0V, Rg=12Ω)

Package Information

TO-247



SYMBOL	MIN	NOM	MAX
A	4.80	5.00	5.20
A1	2.21	2.41	2.59
A2	1.85	2.00	2.15
b	1.11	----	1.36
b2	1.91	----	2.25
b4	2.91	----	3.25
c	0.51	----	0.75
D	20.80	21.00	21.30
E	15.50	15.80	16.10
E2	4.40	5.00	5.20
e	5.44 BSC		
L	19.72	19.92	20.22
L1	----	----	4.30
Q	5.60	5.80	6.00