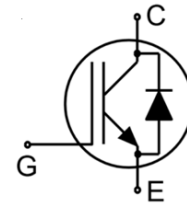


## Trench Field-Stop Technology IGBT

### Features

- 1200V, 50A
- $V_{CE(sat)(typ.)} = 1.85V @ V_{GE}=15V, I_C=50A$
- Low Switching Losses
- $V_{CE(sat)}$  with Positive Temperature Coefficient
- Pb-free Lead Plating; RoHS Compliant



### Applications

- Frequency Converters
- Uninterrupted Power Supply
- Air Conditioning
- Motor Drives

### Key Performance and Package Parameters

Order codes	$V_{CE}$	$I_C$	$V_{CEsat}, T_{vj}=25^{\circ}C$	$T_{vjmax}$	Marking	Package
XD050H120CX1S4	1200V	50A	1.85V	175 $^{\circ}C$	D50H120CX1	TO-247-PLUS

### Absolute Maximum Ratings

Symbol	Parameter	Value	Unit
$V_{CES}$	Collector-Emitter Voltage	1200	V
$V_{GES}$	Gate-Emitter Voltage	$\pm 20$	V
$I_C$	Continuous Collector Current ( $T_C=25^{\circ}C$ )	100	A
	Continuous Collector Current ( $T_C=100^{\circ}C$ )	50	A
$I_{CM}$	Pulsed Collector Current (Note 1)	200	A
$I_F$	Diode Forward Current ( $T_C=25^{\circ}C$ )	100	A
	Diode Forward Current ( $T_C=100^{\circ}C$ )	50	A
$P_D$	Maximum Power Dissipation ( $T_C=25^{\circ}C$ )	714	W
	Maximum Power Dissipation ( $T_C=100^{\circ}C$ )	357	W
$T_J$	Operating Junction Temperature Range	-40 to 175	$^{\circ}C$
$T_{STG}$	Storage Temperature Range	-55 to 150	$^{\circ}C$

### Thermal Data

Symbol	Parameter	Max.	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case for IGBT	0.21	$^{\circ}C/W$
$R_{\theta JC}$	Thermal Resistance, Junction to Case for Diode	0.39	$^{\circ}C/W$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	40	$^{\circ}C/W$

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

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$BV_{CES}$	Collector-Emitter Breakdown Voltage	$V_{GE}=0V, I_C=500\mu A$	1200	---	---	V
$I_{CES}$	Collector-Emitter Leakage Current	$V_{CE}=1200V, V_{GE}=0V$	---	---	350	$\mu A$
$I_{GES}$	Gate Leakage Current, Forward	$V_{GE}=20V, V_{CE}=0V$	---	---	100	nA
	Gate Leakage Current, Reverse	$V_{GE}=-20V, V_{CE}=0V$	---	---	-100	nA
$V_{GE(th)}$	Gate Threshold Voltage	$V_{GE}=V_{CE}, I_C=1.70mA$	5.2	6.0	6.8	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$V_{GE}=15V, I_C=50A, T_j=25^\circ\text{C}$	---	1.85	2.15	V
		$V_{GE}=15V, I_C=50A, T_j=125^\circ\text{C}$	---	2.40	---	V
$Q_G$	Total Gate Charge	$V_{CC}=960V$	---	290	---	nC
$Q_{GE}$	Gate-Emitter Charge	$V_{GE}=15V$	---	42	---	nC
$Q_{GC}$	Gate-Collector Charge	$I_C=50A$	---	215	---	nC
$t_{d(on)}$	Turn-on Delay Time	$V_{CC}=600V$ $V_{GE}=\pm 15V$ $I_C=50A$ $R_G=10\Omega$ Inductive Load $T_C=25^\circ\text{C}$	---	46	---	ns
$t_r$	Turn-on Rise Time		---	50	---	ns
$t_{d(off)}$	Turn-off Delay Time		---	304	---	ns
$t_f$	Turn-off Fall Time		---	215	---	ns
$E_{on}$	Turn-on Switching Loss		---	6.10	---	mJ
$E_{off}$	Turn-off Switching Loss		---	3.90	---	mJ
$E_{ts}$	Total Switching Loss		---	10.00	---	mJ
$C_{ies}$	Input Capacitance	$V_{CE}=25V$	---	3600	---	pF
$C_{oes}$	Output Capacitance	$V_{GE}=0V$	---	331	---	pF
$C_{res}$	Reverse Transfer Capacitance	$f=1MHz$	---	166	---	pF
$I_{sc}$	Short circuit collector current Max. 1000 short circuits Time between short circuits: $\geq 1.0s$	$V_{GE}=15V, V_{CC}\leq 600V$ $t_{sc}\leq 10\mu s, T_j\leq 150^\circ\text{C}$	---	140	---	A

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

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$V_F$	Diode Forward Voltage	$I_F=50\text{A}, T_j=25^{\circ}\text{C}$	---	1.80	2.3	V
		$I_F=50\text{A}, T_j=125^{\circ}\text{C}$	---	1.60	2.0	V
$t_{rr}$	Diode Reverse Recovery Time	$V_R=600\text{V}$ $I_F=50\text{A}$ $dI_F/dt=200\text{A}/\mu\text{s}$	---	418	---	ns
$I_{rr}$	Diode peak Reverse Recovery Current		---	9.15	---	A
$Q_{rr}$	Diode Reverse Recovery Charge		---	2.14	---	$\mu\text{C}$

Note1: Repetitive rating, pulse width limited by maximum junction temperature

### Typical Characteristics

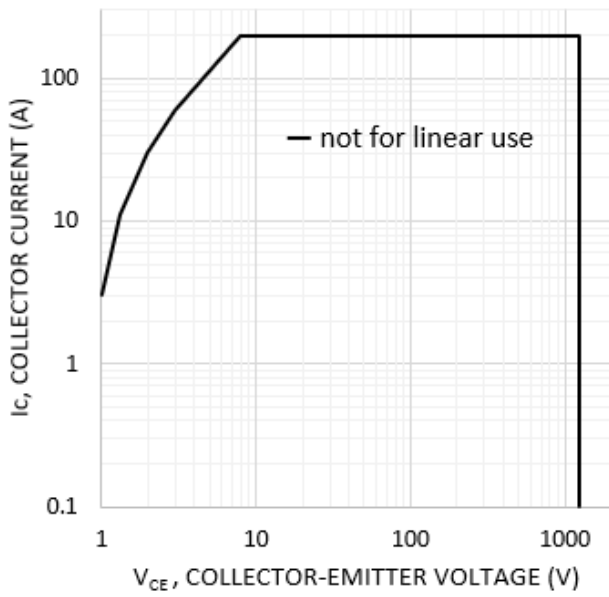


Fig. 1 Forward bias safe operating area (D=0,  $T_c=25^\circ\text{C}$ ,  $T_{vj}\leq 175^\circ\text{C}$ ;  $V_{GE}=15\text{V}$ )

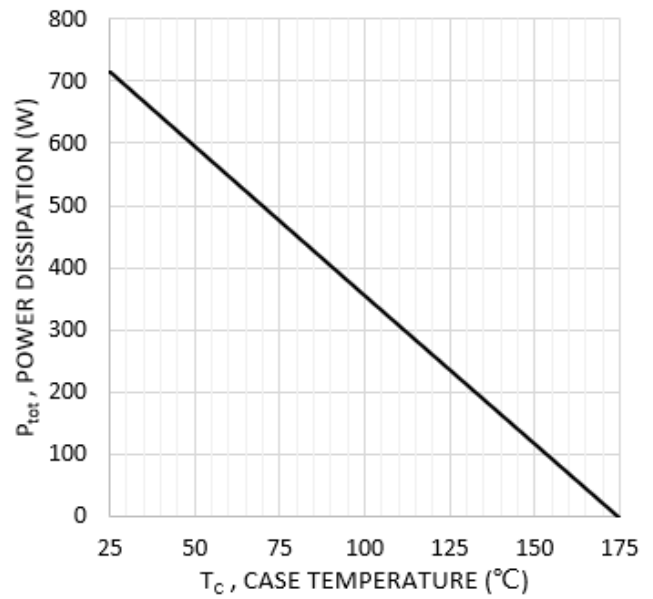


Fig. 2 Power dissipation as a function of case temperature ( $T_{vj}\leq 175^\circ\text{C}$ )

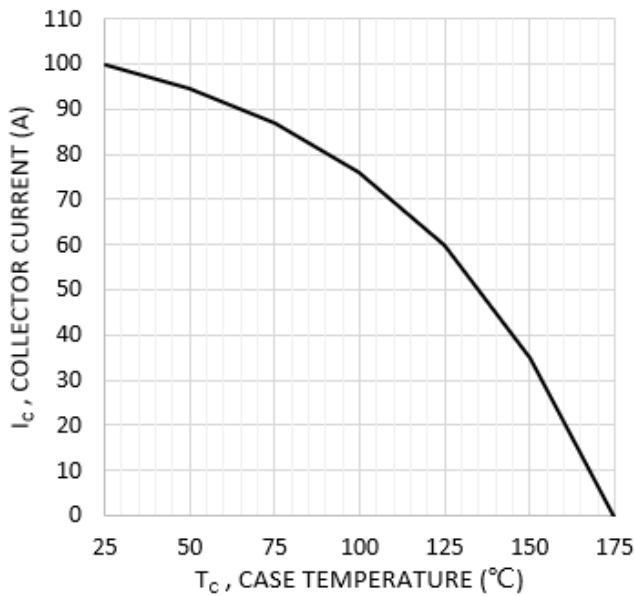


Fig. 3 Collector current as a function of case temperature ( $V_{GE}\geq 15\text{V}$ ,  $T_{vj}\leq 175^\circ\text{C}$ )

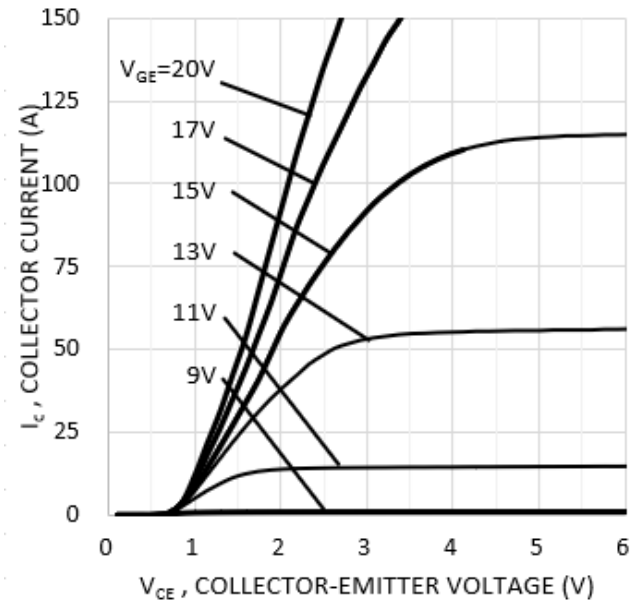


Fig. 4 Typical output characteristic ( $T_{vj}=25^\circ\text{C}$ )

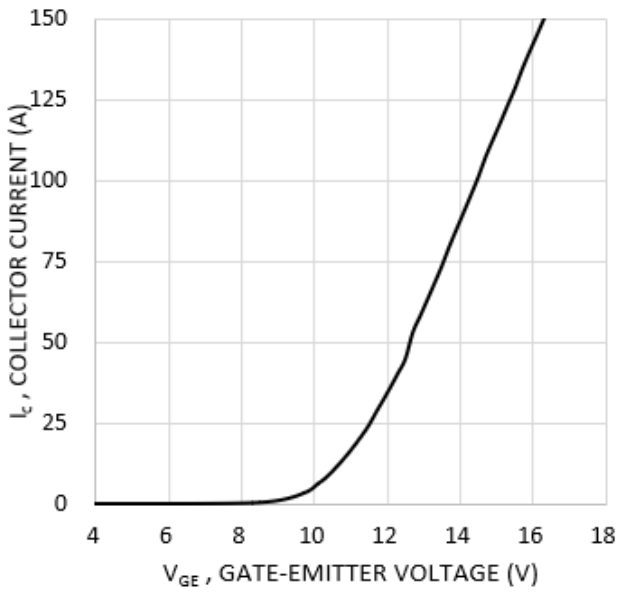


Fig. 5 Typical transfer characteristics ( $V_{CE}=20V$ )

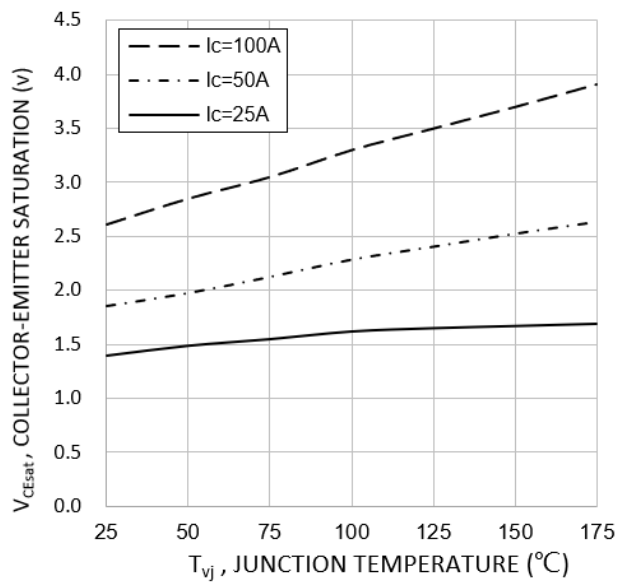


Fig. 6 Typical collector-emitter saturation voltage as a function of junction temperature ( $V_{GE}=15V$ )

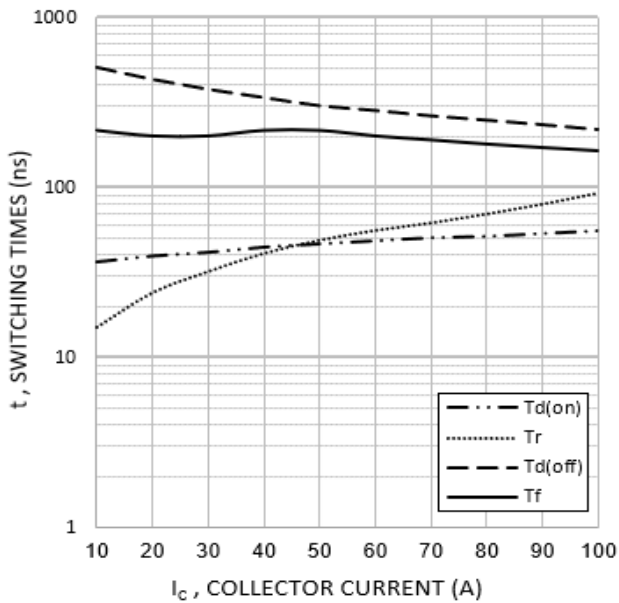


Fig. 7 Typical switching times as a function of collector current (inductive load,  $T_{j}=25^{\circ}C$ ,  $V_{CE}=600V$ ,  $V_{GE}=15/0V$ ,  $r_G=10\Omega$ )

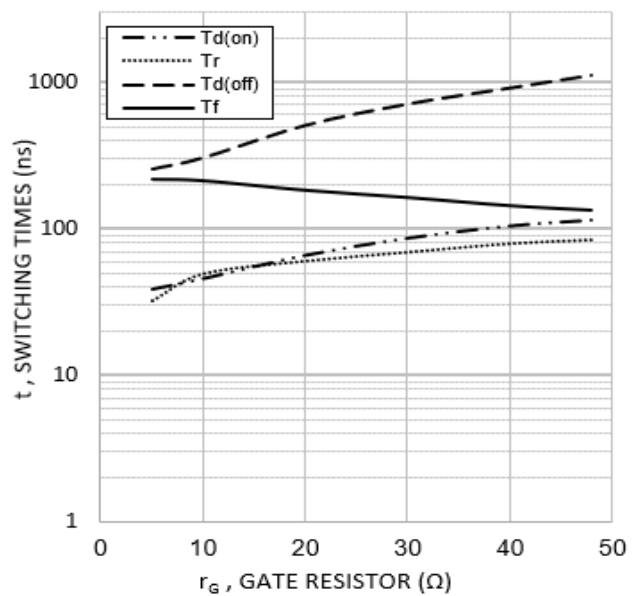
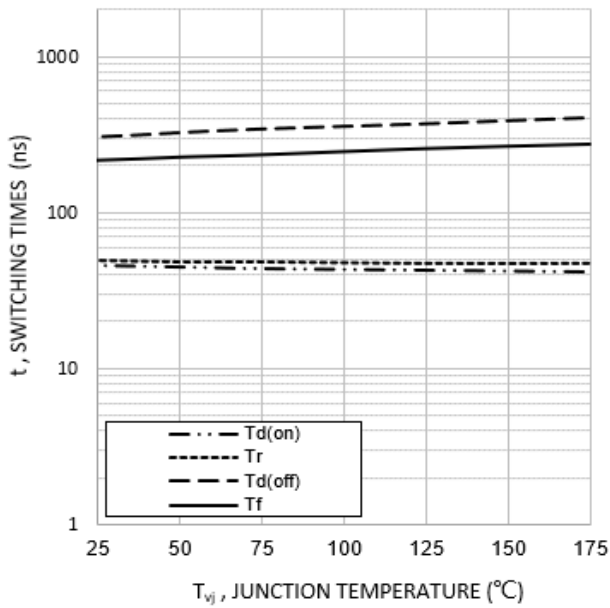
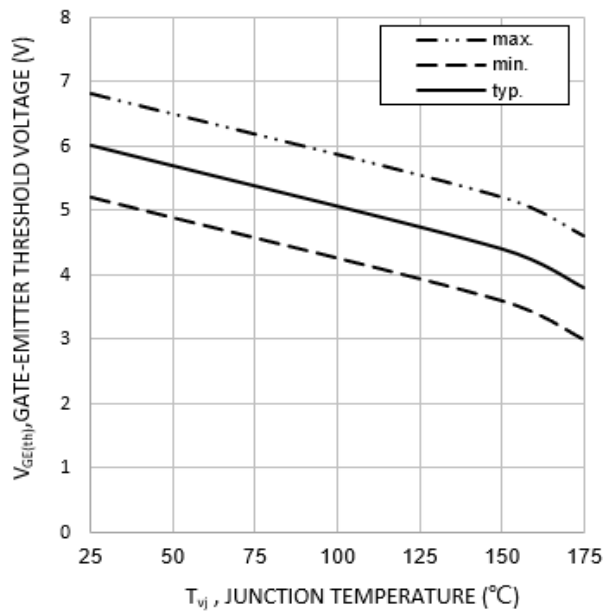


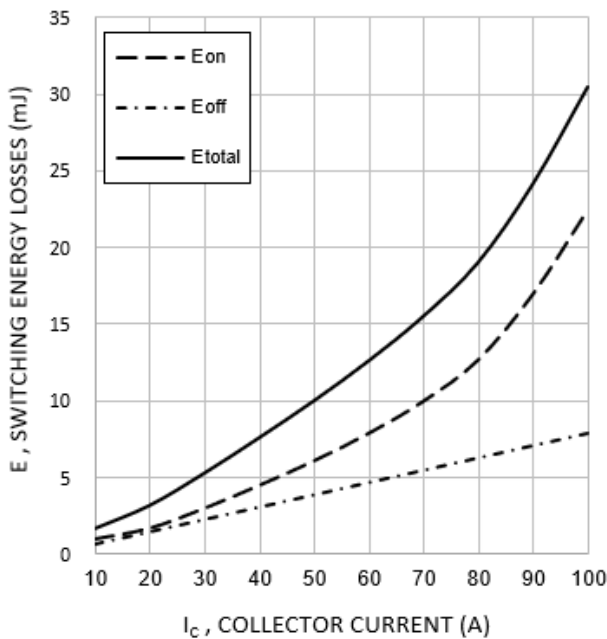
Fig. 8 Typical switching times as a function of gate resistor (inductive load,  $T_{j}=25^{\circ}C$ ,  $V_{CE}=600V$ ,  $V_{GE}=15/0V$ ,  $I_C=50A$ )



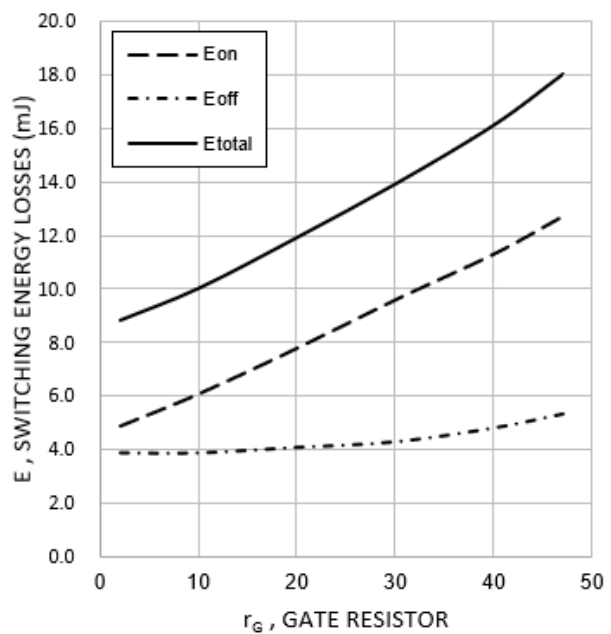
**Fig. 9 Typical switching times as a function of junction temperature (inductive load,  $V_{CE}=600V$ ,  $V_{GE}=15/0V$ ,  $I_C=50A$ ,  $r_G=10\Omega$ )**



**Fig. 10 Gate-emitter threshold voltage as a function of junction temperature ( $I_C=1.7mA$ )**



**Fig. 11 Typical switching energy losses as a function of collector current (inductive load,  $T_{j}=25^{\circ}C$ ,  $V_{CE}=600V$ ,  $V_{GE}=15/0V$ ,  $r_G=10\Omega$ )**



**Fig. 12 Typical switching energy losses as a function of gate resistor (inductive load,  $T_{j}=25^{\circ}C$ ,  $V_{CE}=600V$ ,  $V_{GE}=15/0V$ ,  $I_C=50A$ )**

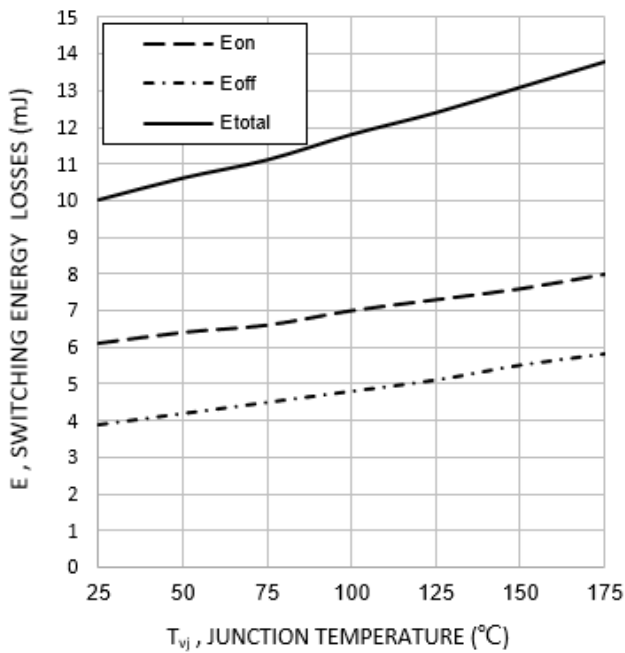


Fig. 13 Typical switching energy losses as a function of junction temperature (inductive load, V<sub>CE</sub>=600V, V<sub>GE</sub>=15/0V, I<sub>C</sub>=50A, r<sub>G</sub>=10Ω)

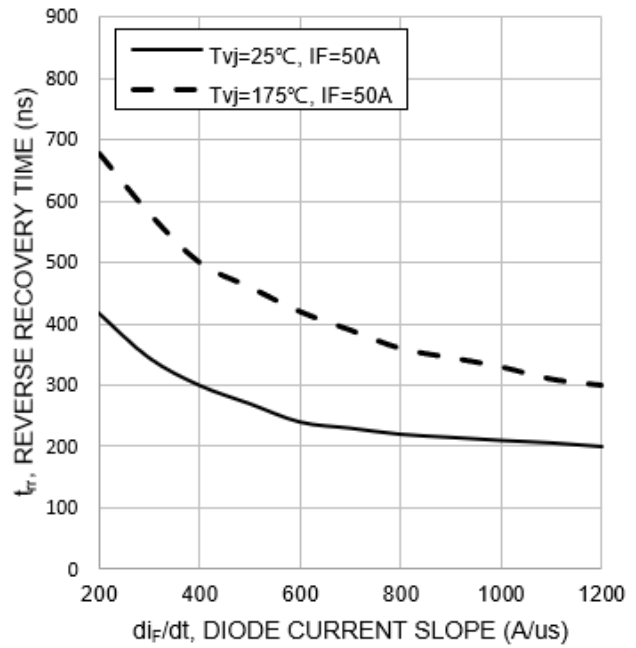


Fig. 14 Typical reverse recovery time as a function of diode current slope (V<sub>R</sub>=600V)

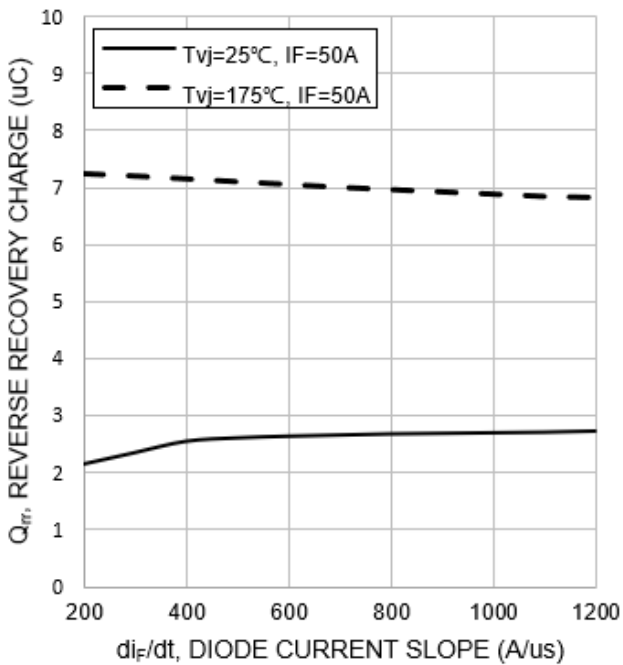


Fig. 15 Typical peak reverse recovery charge as a function of diode current slope (V<sub>R</sub>=400V)

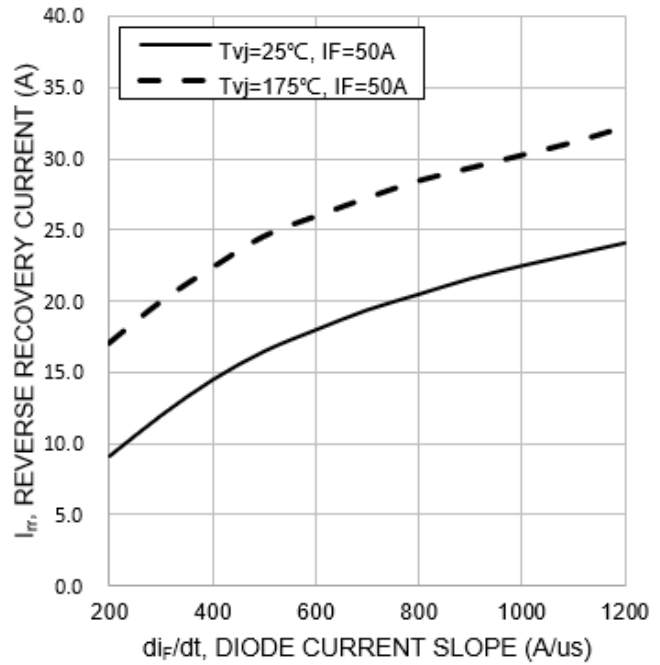


Fig. 16 Typical peak reverse recovery current as a function of diode current slope (V<sub>R</sub>=400V)

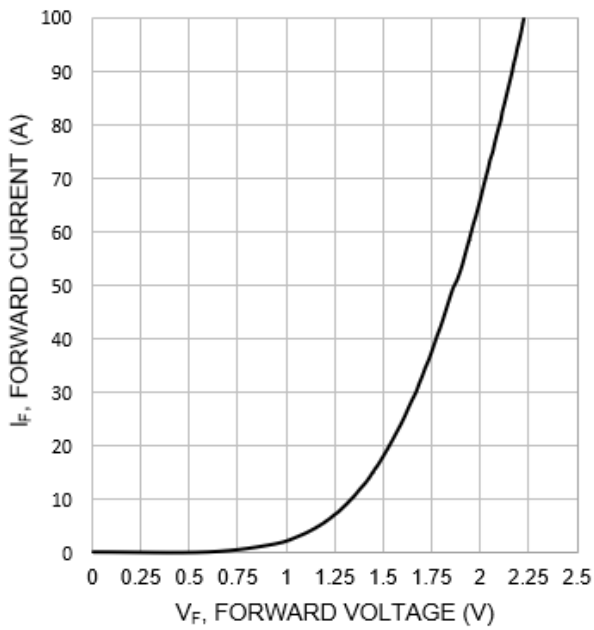


Fig. 17 Typical diode forward current as a function of forward voltage

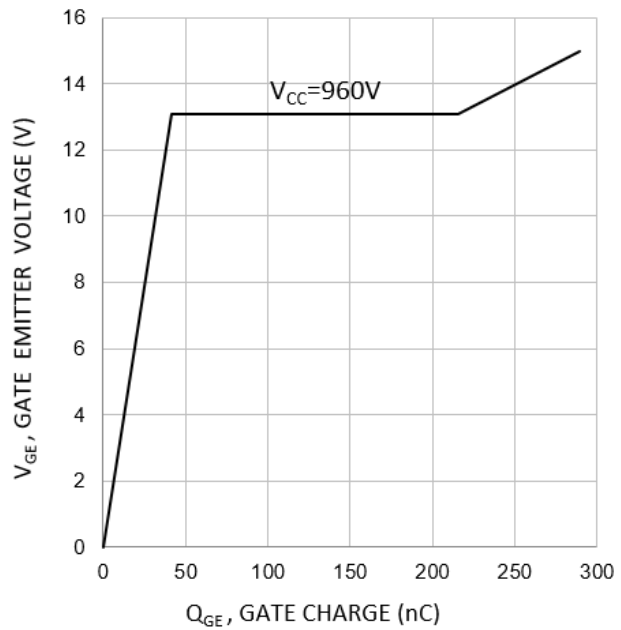


Fig. 18 Typical gate charge ( $I_C=50A$ )

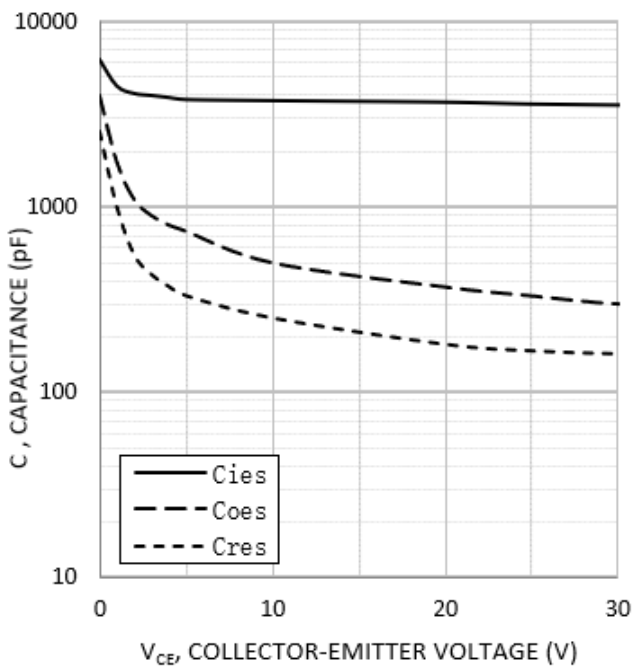


Fig. 19 Typical capacitance as a function of collector-emitter voltage ( $V_{GE}=0V$ ,  $f=1MHz$ )

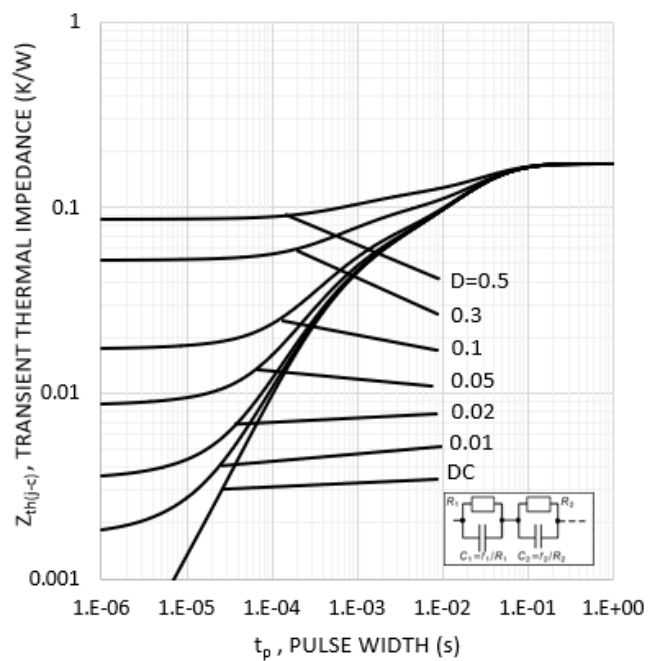


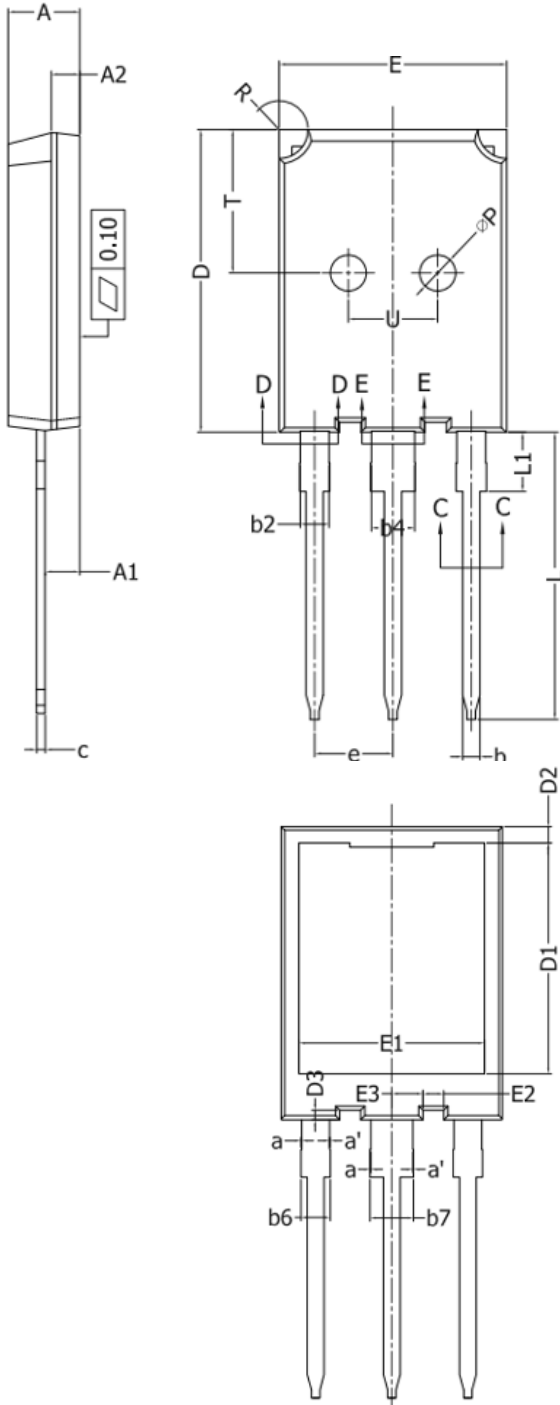
Fig. 20 IGBT transient thermal impedance ( $D=t_p/T$ )



# Package Information

## TO-247-PLUS

### 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	2.96	3.00	3.02
b6	---	---	2.25
b7	---	---	3.25
c	0.59	---	0.66
c1	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
D3	0.58	---	0.78
E	15.70	15.80	15.90
E1	13.10	13.30	13.50
E2	1.40	1.50	1.60
E3	2.12	2.22	2.32
e	5.436 BSC		
L	19.80	19.95	20.10
L1	---	---	4.30
P	2.40	2.50	2.60
R	1.90	---	2.10
T	9.80	---	10.20
U	6.00	---	6.40

