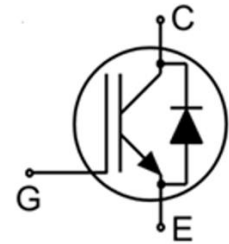


Trench Field-Stop Technology IGBT

Features

- 600V, 15A
- $V_{CE(sat)(typ.)} = 1.80V @ V_{GE} = 15V, I_C = 15A$
- Maximum Junction Temperature 175°C
- Pb-free Lead Plating; RoHS Compliant



Applications

- Solar Converters
- Uninterrupted Power Supply
- Welding Converters
- Mid to High Range Switching Frequency Converters

Key Performance and Package Parameters

Order codes	V_{CE}	I_C	$V_{CEsat}, T_{vj}=25^{\circ}C$	T_{vjmax}	Marking	Package
XD015H060CX1L3	600V	15A	1.80V	175°C	D15H60CX1L3	TO220-3L

Absolute Maximum Ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-Emitter Voltage	600	V
V_{GES}	Gate-Emitter Voltage	± 20	V
I_C	Continuous Collector Current ($T_C=25^{\circ}C$)	30	A
	Continuous Collector Current ($T_C=100^{\circ}C$)	15	A
I_{CM}	Pulsed Collector Current (Note 1)	45	A
P_D	Maximum Power Dissipation ($T_C=25^{\circ}C$) (Note 2)	125	W
	Maximum Power Dissipation ($T_C=100^{\circ}C$) (Note 2)	62.5	W
T_J	Operating Junction Temperature Range	-40 to 175	°C
T_{STG}	Storage Temperature Range	-55 to 150	°C

Thermal Data

Symbol	Parameter	Conditions	Max.	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case for IGBT	TO220-3L	1.2	°C/W
$R_{\theta JC}$	Thermal Resistance, Junction to Case for Diode	TO220-3L	2.4	°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	$V_{GE}=0V, I_C=200\mu A$	600	---	---	V
I_{CES}	Collector-Emitter Leakage Current	$V_{CE}=600V, V_{GE}=0V$	---	---	40	μA
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	$V_{GE}=V_{CE}, I_C=150\mu A$	3.0	3.9	4.8	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$V_{GE}=15V, I_C=15A, T_j=25^\circ\text{C}$	---	1.80	2.20	V
		$V_{GE}=15V, I_C=15A, T_j=125^\circ\text{C}$	---	2.20	---	V
Q_G	Total Gate Charge	$V_{CC}=480V$	---	24.38	---	nC
Q_{GE}	Gate-Emitter Charge	$V_{GE}=15V$	---	5.82	---	nC
Q_{GC}	Gate-Collector Charge	$I_C=15A$	---	6.59	---	nC
$t_{d(on)}$	Turn-on Delay Time	$V_{CC}=400V$ $V_{GE}=\pm 15V$ $I_C=15A$ $R_G=39\Omega$ Inductive Load $T_C=25^\circ\text{C}$	---	5	---	ns
t_r	Turn-on Rise Time		---	24	---	ns
$t_{d(off)}$	Turn-off Delay Time		---	70	---	ns
t_f	Turn-off Fall Time		---	144	---	ns
E_{on}	Turn-on Switching Loss		---	0.15	---	mJ
E_{off}	Turn-off Switching Loss		---	0.37	---	mJ
E_{ts}	Total Switching Loss		---	0.52	---	mJ
C_{ies}	Input Capacitance	$V_{CE}=25V$	---	703	---	pF
C_{oes}	Output Capacitance	$V_{GE}=0V$	---	91	---	pF
C_{res}	Reverse Transfer Capacitance	$f=1\text{MHz}$	---	6	---	pF
SCSOA	Short Circuit Safe Operation Area	$V_{GE}=15V, V_{CC}\leq 400V,$ $T_{J,start}\leq 25^\circ\text{C}$	10	---	---	μS

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

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_F	Diode Forward Voltage	$I_F=15\text{A}, T_j=25^{\circ}\text{C}$	---	1.45	2.20	V
		$I_F=15\text{A}, T_j=150^{\circ}\text{C}$	---	1.25	2.00	V
t_{rr}	Diode Reverse Recovery Time	$V_R=400\text{V}$	---	105	---	ns
I_{rr}	Diode peak Reverse Recovery Current	$I_F=15\text{A}$ $di_F/dt=300\text{A/us}$	---	5	---	A
Q_{rr}	Diode Reverse Recovery Charge	$T_C=25^{\circ}\text{C}$	---	317	---	nC

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

Note2: For TO-220

Typical Characteristics

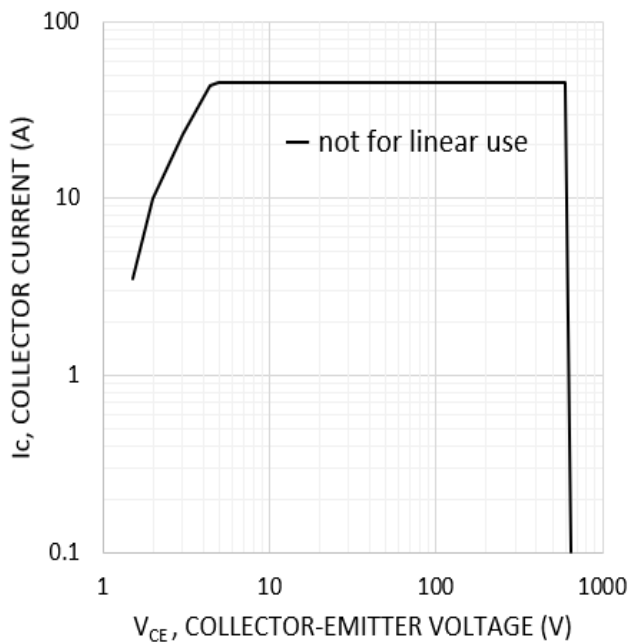


Fig. 1 Forward bias safe operating area (D=0, $T_c=25^\circ\text{C}$, $T_{vj}\leq 175^\circ\text{C}$; $V_{GE}=15\text{V}$. Recommended use at $V_{GE}\geq 7.5\text{V}$)

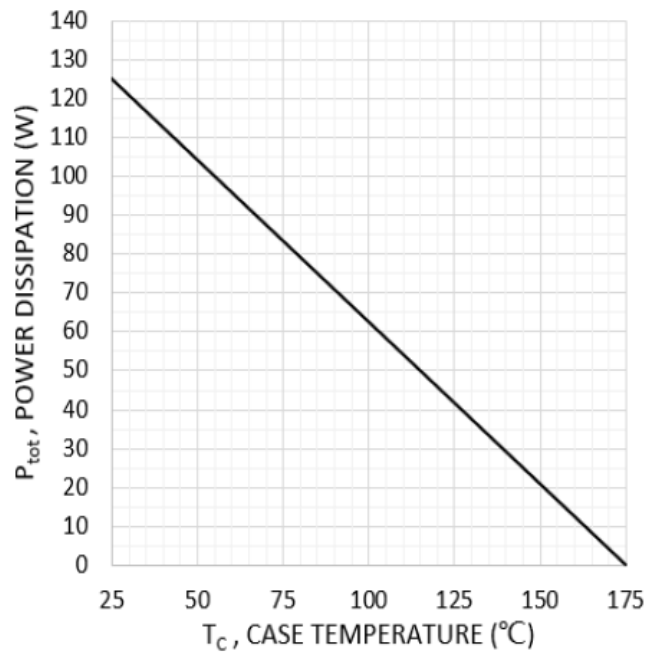


Fig. 2 Power dissipation as a function of case temperature ($T_{vj}\leq 175^\circ\text{C}$)

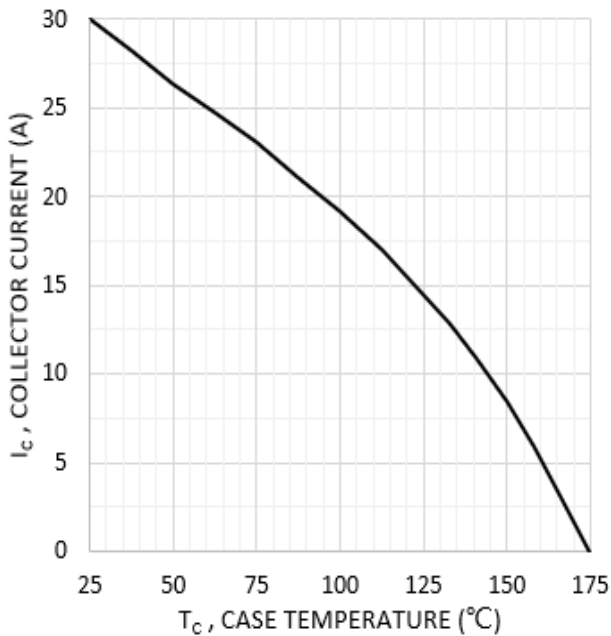


Fig. 3 Collector current as a function of case temperature ($V_{GE}\geq 15\text{V}$, $T_{vj}\leq 175^\circ\text{C}$)

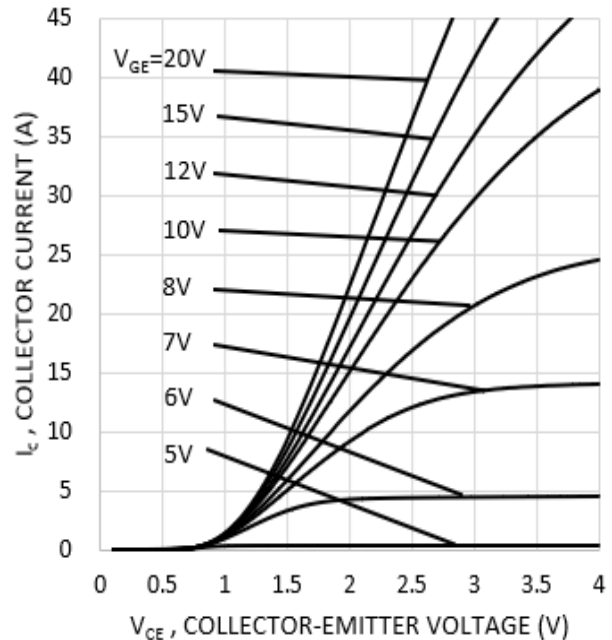


Fig. 4 Typical output characteristic ($T_{vj}=25^\circ\text{C}$)

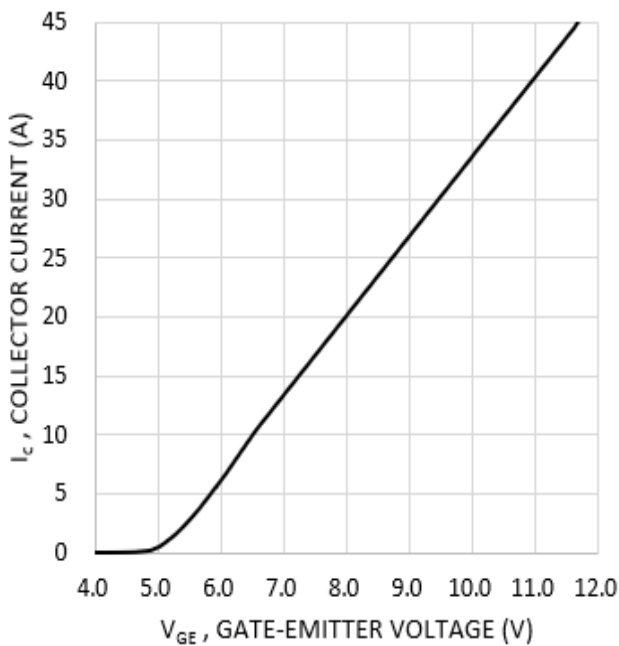


Fig. 5 Typical transfer characteristics ($V_{CE}=20V$)

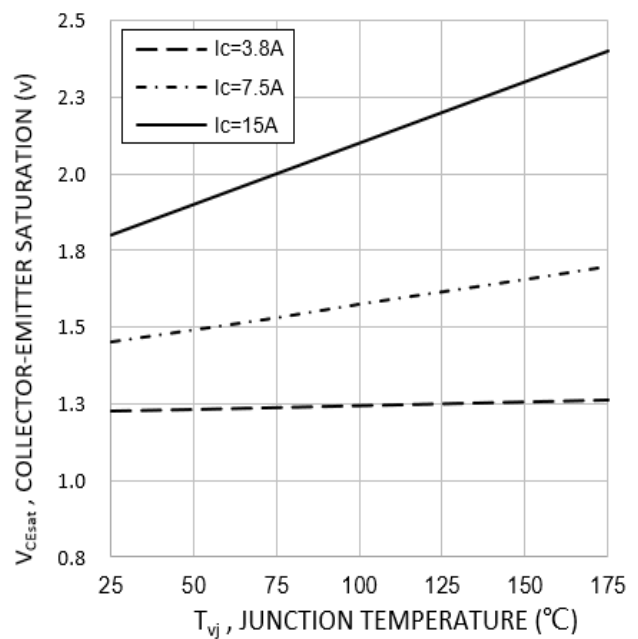


Fig. 6 Typical collector-emitter saturation voltage as a function of junction temperature ($V_{GE}=15V$)

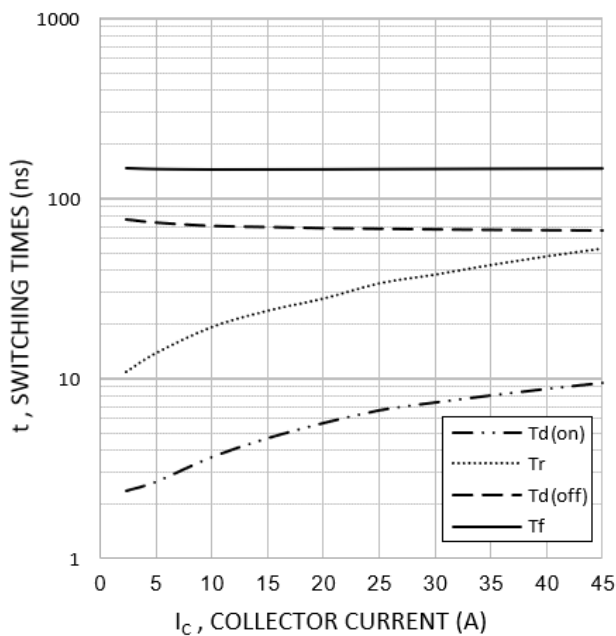


Fig. 7 Typical switching times as a function of collector current (inductive load, $T_{yj}=25^{\circ}C$, $V_{CE}=400V$, $V_{GE}=15/0V$, $r_G=39\Omega$)

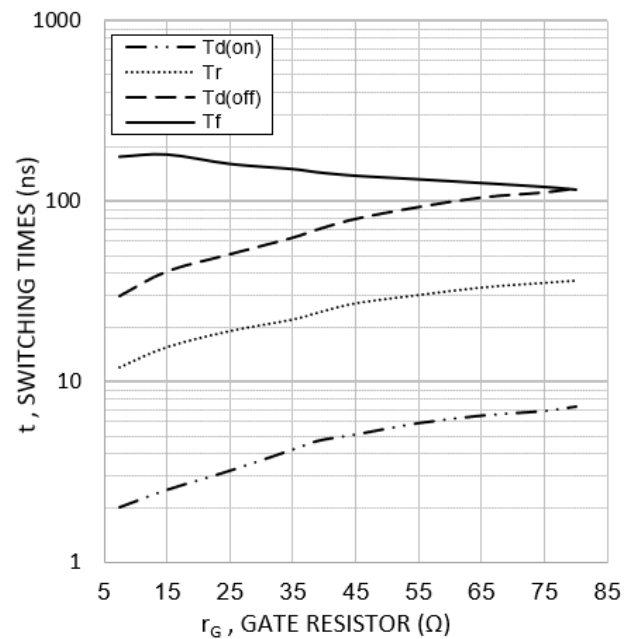


Fig. 8 Typical switching times as a function of gate resistor (inductive load, $T_{yj}=25^{\circ}C$, $V_{CE}=400V$, $V_{GE}=15/0V$, $I_c=15A$)

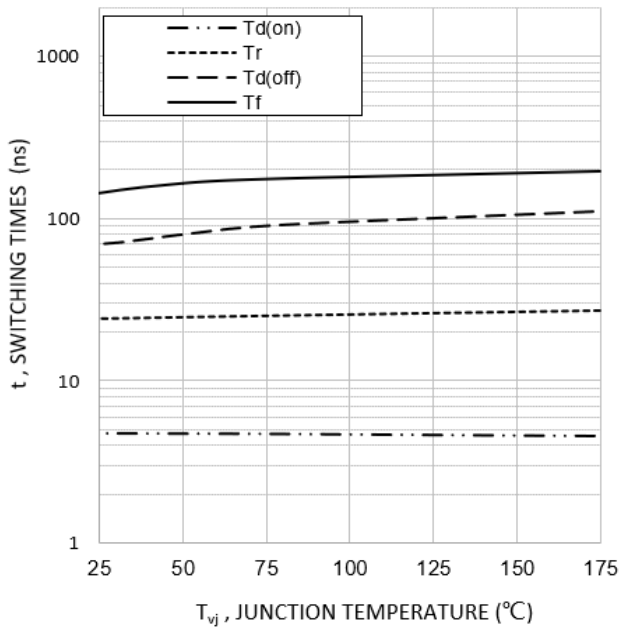


Fig. 9 Typical switching times as a function of junction temperature (inductive load, $V_{CE}=400V$, $V_{GE}=15/0V$, $I_C=15A$, $r_G=39\Omega$)

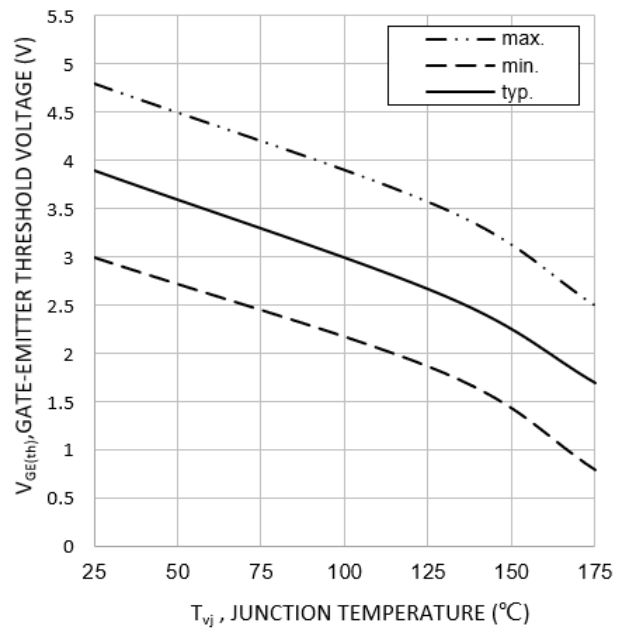


Fig. 10 Gate-emitter threshold voltage as a function of junction temperature ($I_C=0.15mA$)

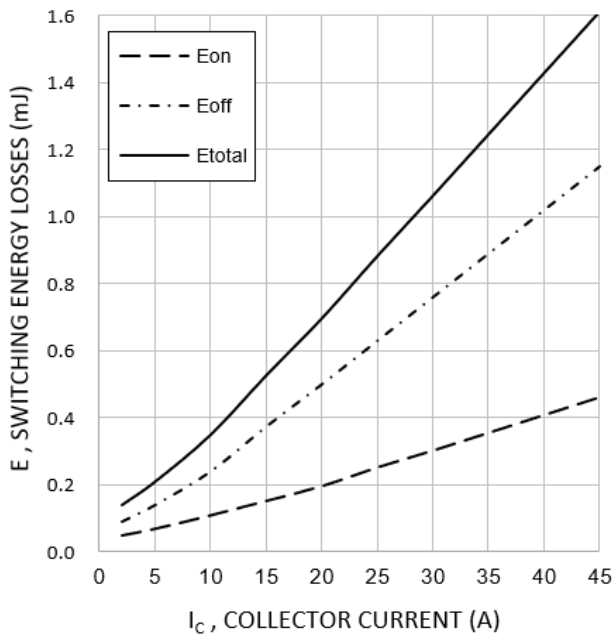


Fig. 11 Typical switching energy losses as a function of collector current (inductive load, $T_{j}=25^{\circ}C$, $V_{CE}=400V$, $V_{GE}=15/0V$, $r_G=39\Omega$)

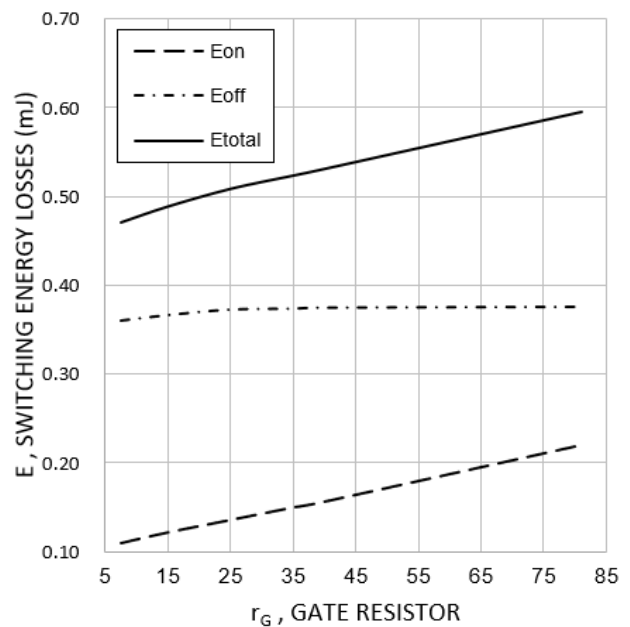


Fig. 12 Typical switching energy losses as a function of gate resistor (inductive load, $T_{j}=25^{\circ}C$, $V_{CE}=400V$, $V_{GE}=15/0V$, $I_C=15A$)

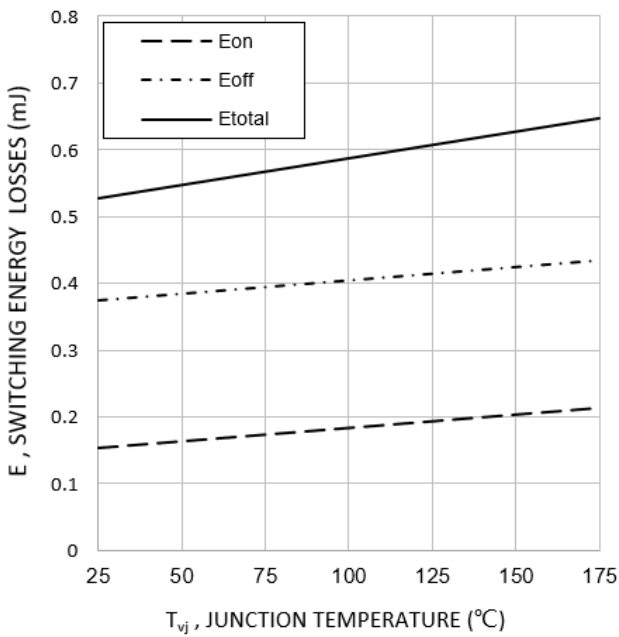


Fig. 13 Typical switching energy losses as a function of junction temperature (inductive load, $V_{CE}=400V$, $V_{GE}=15/0V$, $I_C=15A$, $r_G=39\Omega$)

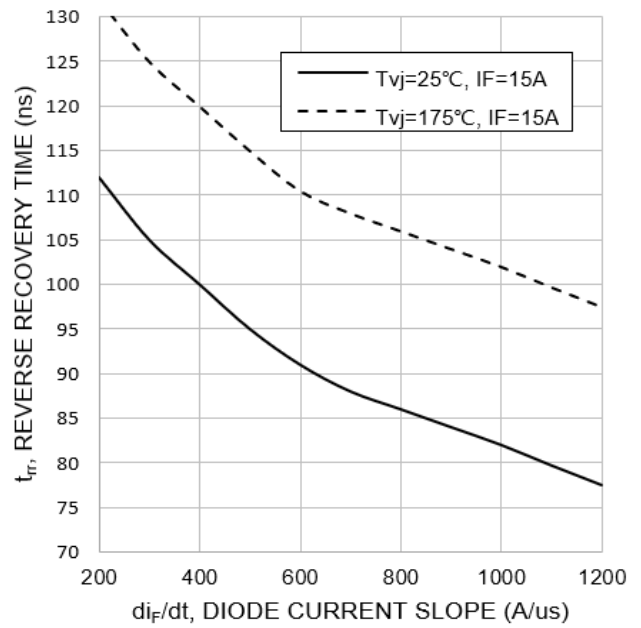


Fig. 14 Typical reverse recovery time as a function of diode current slope ($V_R=400V$)

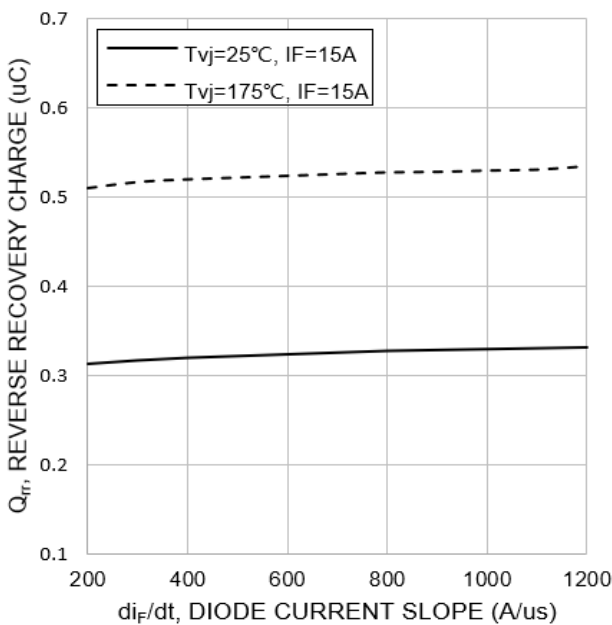


Fig. 15 Typical reverse recovery charge as a function of diode current slope ($V_R=400V$)

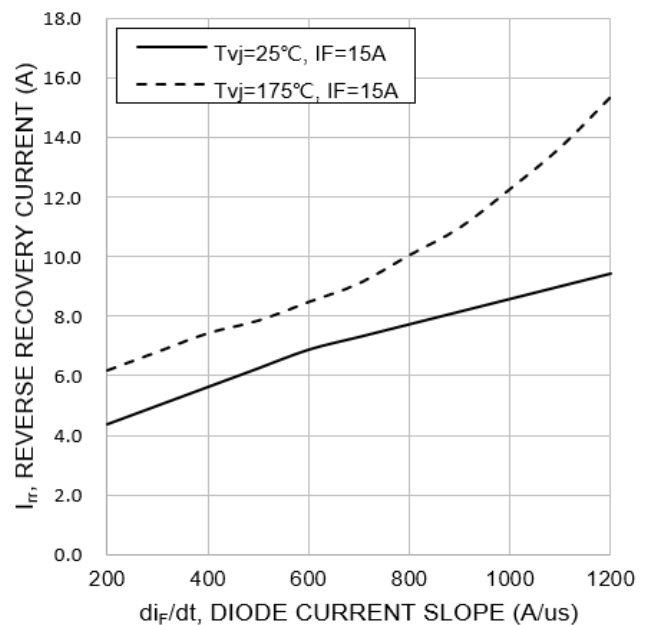


Fig. 16 Typical reverse recovery current as a function of diode current slope ($V_R=400V$)

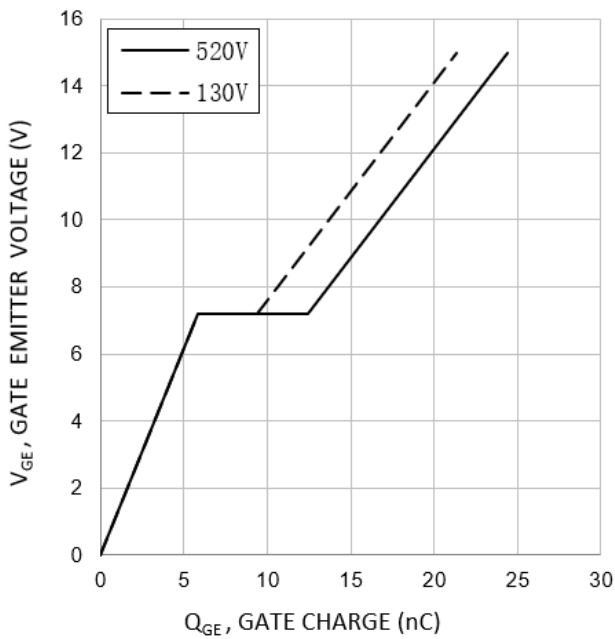


Fig. 17 Typical gate charge ($I_C=15A$)

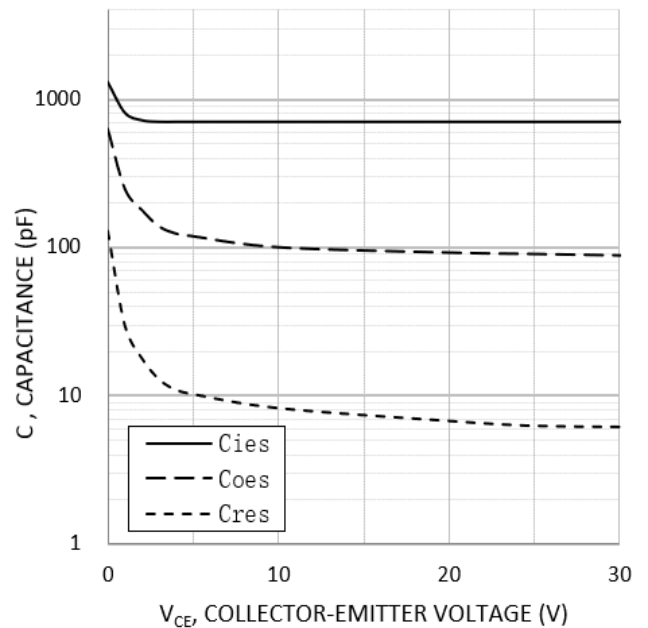


Fig. 18 Typical capacitance as a function of collector-emitter voltage ($V_{GE}=0V, f=1MHz$)

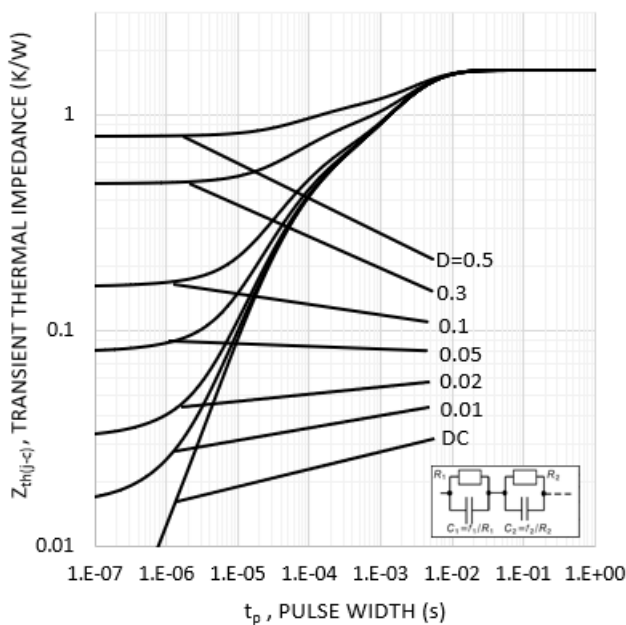


Fig. 19 IGBT transient thermal impedance ($D=t_p/T$) (TO-220)

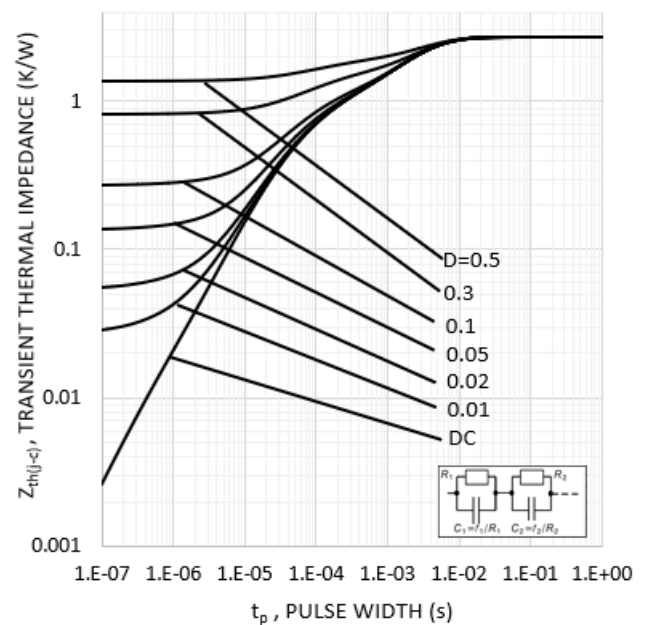
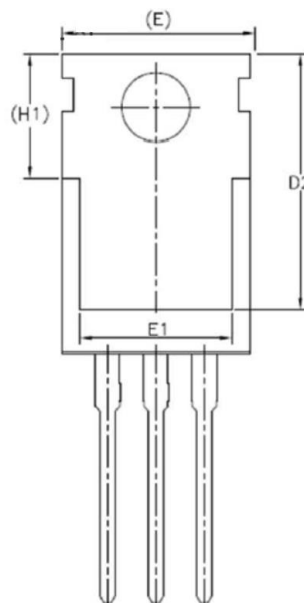
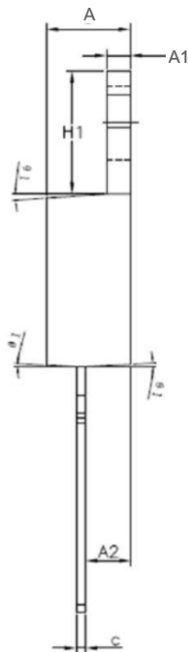
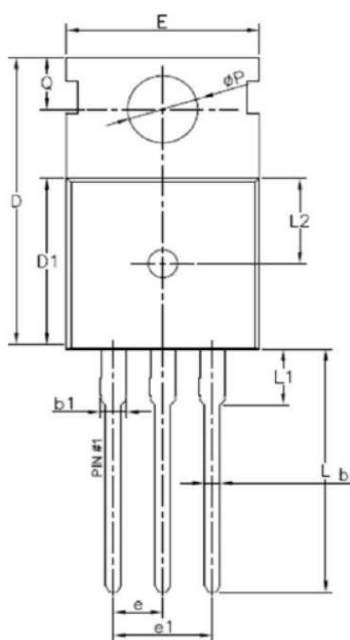


Fig. 20 Diode transient thermal impedance as a function of pulse width ($D=t_p/T$) (TO-220)

Package Information

TO-220-3L



SYMBOL	MIN	NOM	MAX
A	4.40	4.50	4.60
A1	1.27	1.30	1.33
A2	2.30	2.40	2.50
b	0.70	—	0.90
b1	1.27	—	1.40
c	0.45	0.50	0.60
D	15.30	15.70	16.10
D1	9.10	9.20	9.30
D2	13.10	—	13.70
E	9.70	9.90	10.20
E1	7.80	8.00	8.20
e	2.54BSC		
e1	5.08BSC		
H1	6.30	6.50	6.70
L	12.78	13.08	13.38
L1	—	—	3.50
L2	4.60REF		
øP	3.55	3.60	3.65
Q	2.73	—	2.87
#1	1°	3°	5°