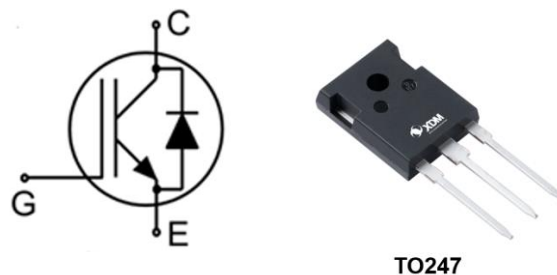


Trench Field-Stop Technology IGBT

Features

- 650V, 20A
- $V_{CE(sat)(typ.)} = 2.0V @ V_{GE} = 15V, I_C = 20A$
- 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
XD020H065CX1L3	650V	20A	2.0V	175°C	D20H65CX1	TO220-3L
XD020H065CX1H3	650V	20A	2.0V	175°C	D20H65CX1	TO220F-3L
XD020H065CX1S3	650V	20A	2.0V	175°C	D20H65CX1	TO247-3L
XD020H065CX1R3	650V	20A	2.0V	175°C	D20H65CX1	TO263-2L

Absolute Maximum Ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-Emitter Voltage	650	V
V_{GES}	Gate-Emitter Voltage	±20	V
I_C	Continuous Collector Current ($T_C=25^{\circ}C$)	40	A
	Continuous Collector Current ($T_C=100^{\circ}C$)	20	A
I_{CM}	Pulsed Collector Current (Note 1)	60	A
I_F	Diode Continuous Forward Current ($T_C=25^{\circ}C$)	40	A
	Diode Continuous Forward Current ($T_C=100^{\circ}C$)	20	A
I_{FM}	Diode Maximum Forward Current (Note 1)	60	A
t_{sc}	Short Circuit Withstand Time	5	us
P_D	Maximum Power Dissipation ($T_C=25^{\circ}C$) (Note 2)	94	W
	Maximum Power Dissipation ($T_C=100^{\circ}C$) (Note 2)	47	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 _{θJC}	Thermal Resistance, Junction to Case for IGBT	TO220-3L	1.6	°C/W
		TO220F-3L	1.9	°C/W
		TO247-3L	1.2	°C/W
		TO263	1.6	°C/W
R _{θJC}	Thermal Resistance, Junction to Case for Diode	TO220-3L	2.7	°C/W
		TO220F-3L	2.9	°C/W
		TO247-3L	2.4	°C/W
		TO263	2.7	°C/W

Electrical Characteristics (T_c=25°C unless otherwise noted.)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
BV _{CES}	Collector-Emitter Breakdown Voltage	V _{GE} =0V, I _C =200uA	650	---	---	V
I _{CES}	Collector-Emitter Leakage Current	V _{CE} =650V, V _{GE} =0V	---	---	40	uA
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 =150uA	3.0	3.9	4.8	V
V _{CE(sat)}	Collector-Emitter Saturation Voltage	V _{GE} =15V, I _C =20A, T _j =25°C	---	2.0	2.40	V
		V _{GE} =15V, I _C =20A, T _j =125°C	---	2.40	---	V
Q _G	Total Gate Charge	V _{CC} =520V	---	24.38	---	nC
Q _{GE}	Gate-Emitter Charge	V _{GE} =15V	---	5.82	---	nC
Q _{GC}	Gate-Collector Charge	I _C =20A	---	6.59	---	nC
t _{d(on)}	Turn-on Delay Time	V _{CC} =400V V _{GE} =±15V I _C =20A R _G =39Ω Inductive Load T _C =25°C	---	5	---	ns
t _r	Turn-on Rise Time		---	28	---	ns
t _{d(off)}	Turn-off Delay Time		---	70	---	ns
t _f	Turn-off Fall Time		---	144	---	ns
E _{on}	Turn-on Switching Loss		---	0.2	---	mJ
E _{off}	Turn-off Switching Loss		---	0.45	---	mJ
E _{ts}	Total Switching Loss		---	0.65	---	mJ
C _{ies}	Input Capacitance		V _{CE} =25V	---	703	---
C _{oes}	Output Capacitance	V _{GE} =0V	---	91	---	pF
C _{res}	Reverse Transfer Capacitance	f=1MHz	---	6	---	pF

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

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_F	Diode Forward Voltage	$I_F=20A, T_j=25^{\circ}C$	---	1.5	2.25	V
		$I_F=20A, T_j=150^{\circ}C$	---	1.3	2.00	V
t_{rr}	Diode Reverse Recovery Time	$V_R=400V$	---	105	---	ns
I_{rr}	Diode peak Reverse Recovery Current	$I_F=20A$ $di_F/dt=300A/us$	---	5	---	A
Q_{rr}	Diode Reverse Recovery Charge	$T_C=25^{\circ}C$	---	317	---	nC

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

Note2: For TO-220

Typical Characteristics

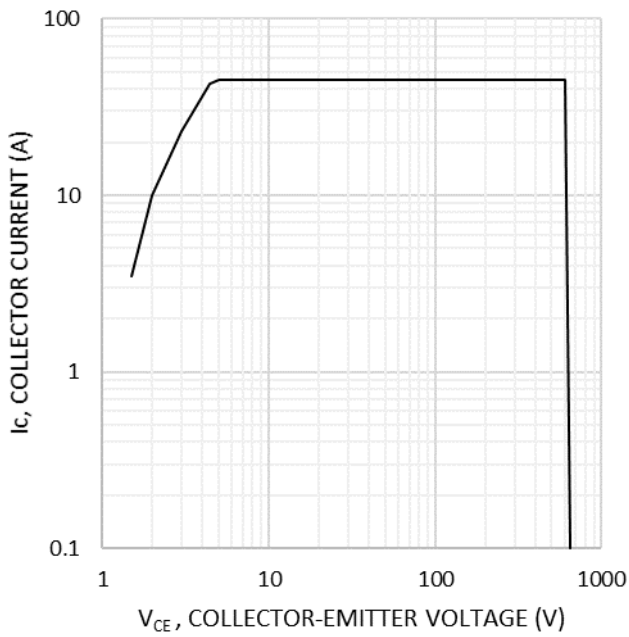


Fig. 1 Forward bias safe operating area (D=0, $T_c=25^\circ\text{C}$, $T_{vj}\leq 175^\circ\text{C}$; $V_{GE}=15\text{V}$. Recommended use at $V_{GE}\geq 7.5\text{V}$)

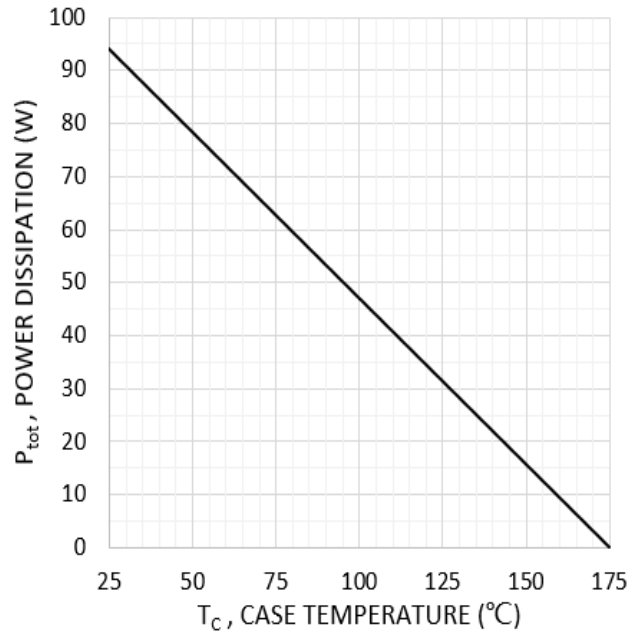


Fig. 2 Power dissipation as a function of case temperature ($T_{vj}\leq 175^\circ\text{C}$)

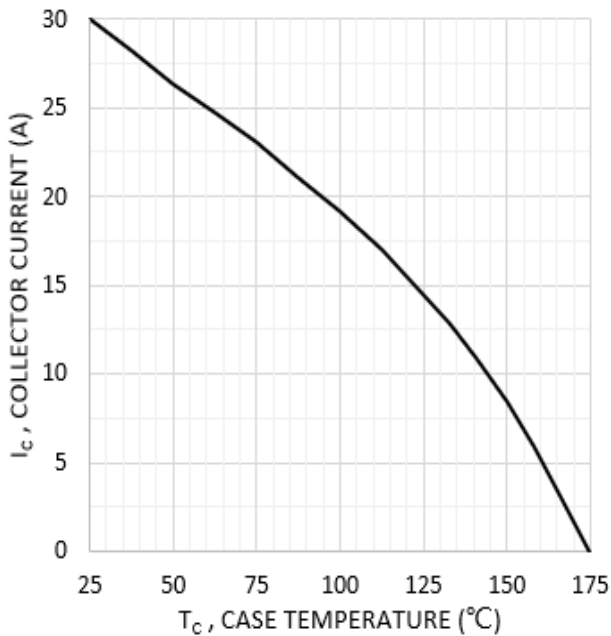


Fig. 3 Collector current as a function of case temperature ($V_{GE}\geq 15\text{V}$, $T_{vj}\leq 175^\circ\text{C}$)

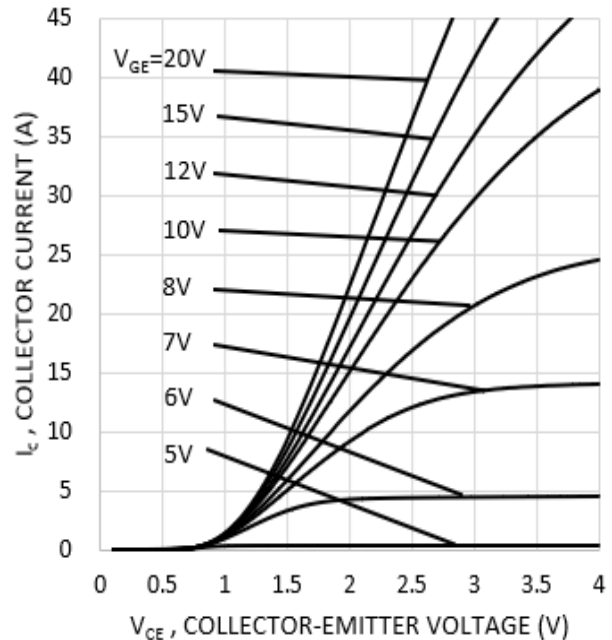


Fig. 4 Typical output characteristic ($T_{vj}=25^\circ\text{C}$)

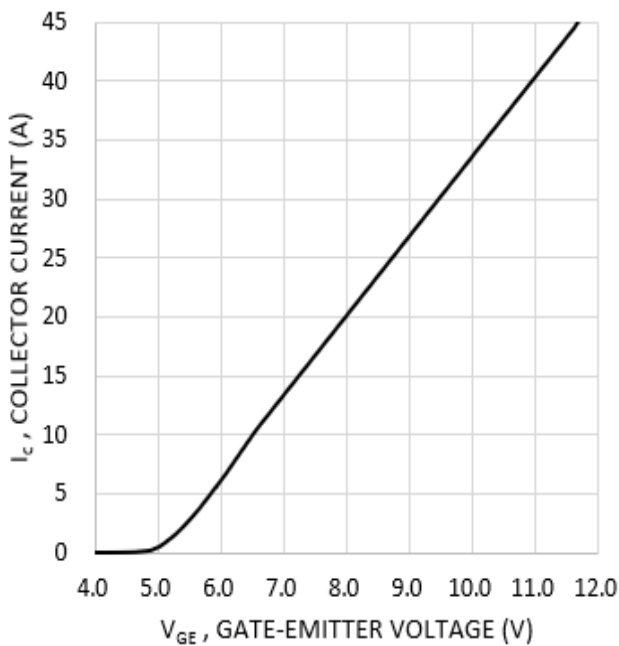


Fig. 5 Typical transfer characteristics ($V_{CE}=20V$)

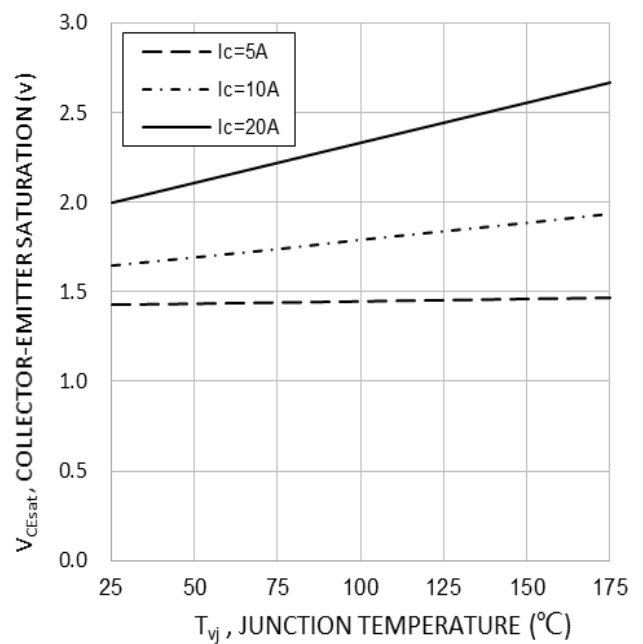


Fig. 6 Typical collector-emitter saturation voltage as a function of junction temperature ($V_{GE}=15V$)

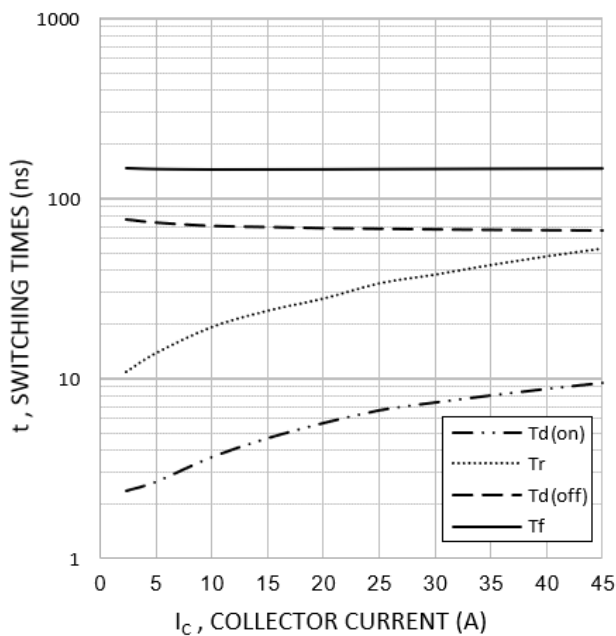


Fig. 7 Typical switching times as a function of collector current (inductive load, $T_{yj}=25^{\circ}C$, $V_{CE}=400V$, $V_{GE}=15/0V$, $r_G=39\Omega$)

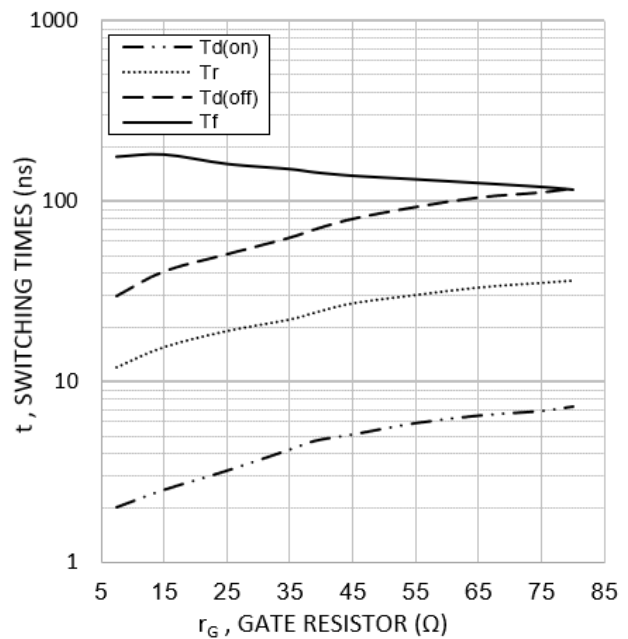


Fig. 8 Typical switching times as a function of gate resistor (inductive load, $T_{yj}=25^{\circ}C$, $V_{CE}=400V$, $V_{GE}=15/0V$, $I_c=20A$)

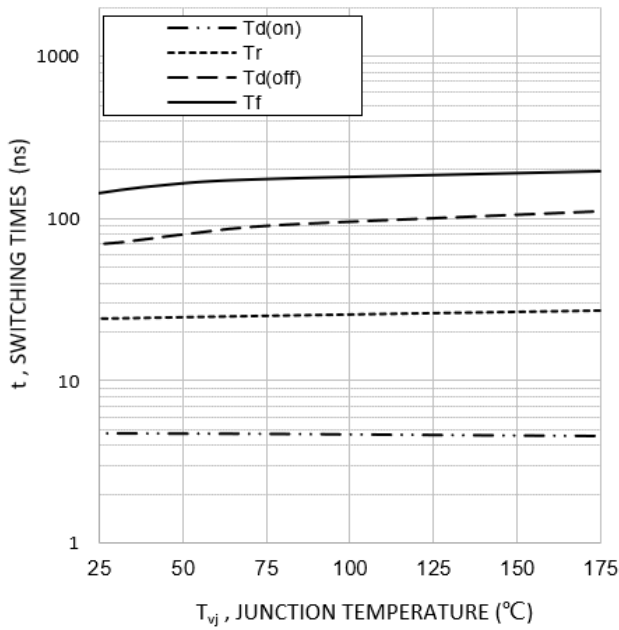


Fig. 9 Typical switching times as a function of junction temperature (inductive load, $V_{CE}=400V$, $V_{GE}=15/0V$, $I_C=20A$, $r_G=39\Omega$)

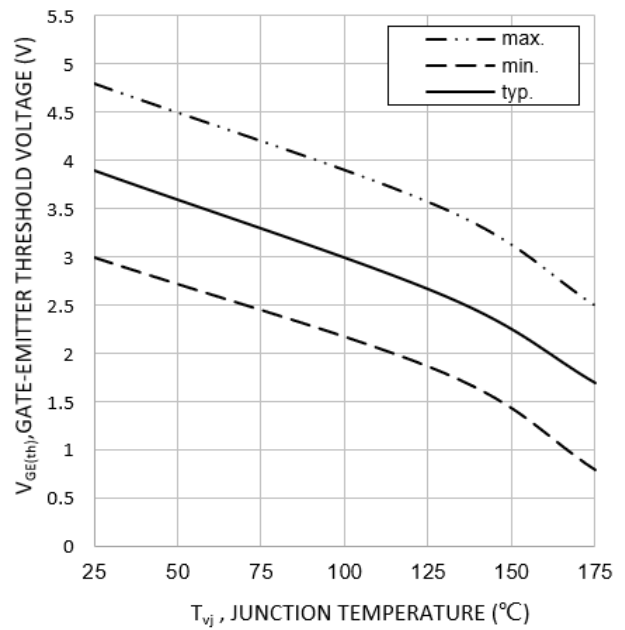


Fig. 10 Gate-emitter threshold voltage as a function of junction temperature ($I_C=0.15mA$)

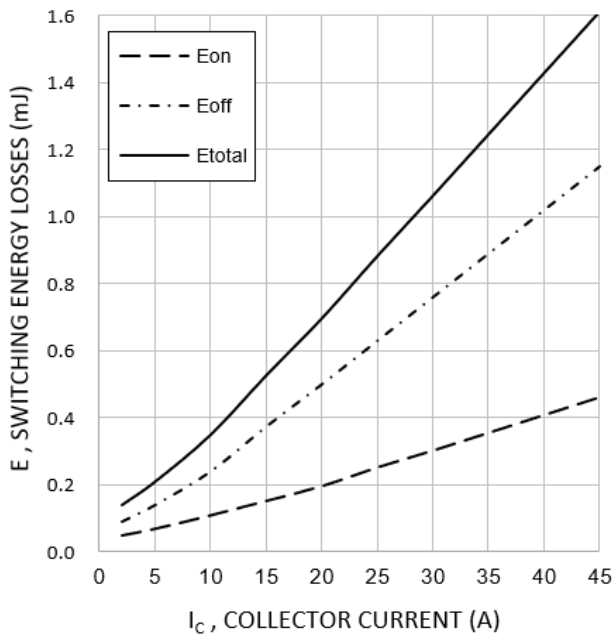


Fig. 11 Typical switching energy losses as a function of collector current (inductive load, $T_{j}=25^{\circ}C$, $V_{CE}=400V$, $V_{GE}=15/0V$, $r_G=39\Omega$)

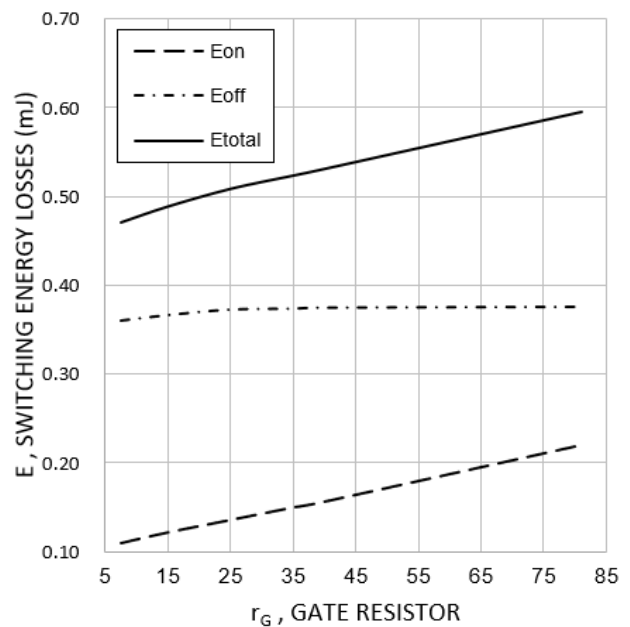


Fig. 12 Typical switching energy losses as a function of gate resistor (inductive load, $T_{j}=25^{\circ}C$, $V_{CE}=400V$, $V_{GE}=15/0V$, $I_C=20A$)

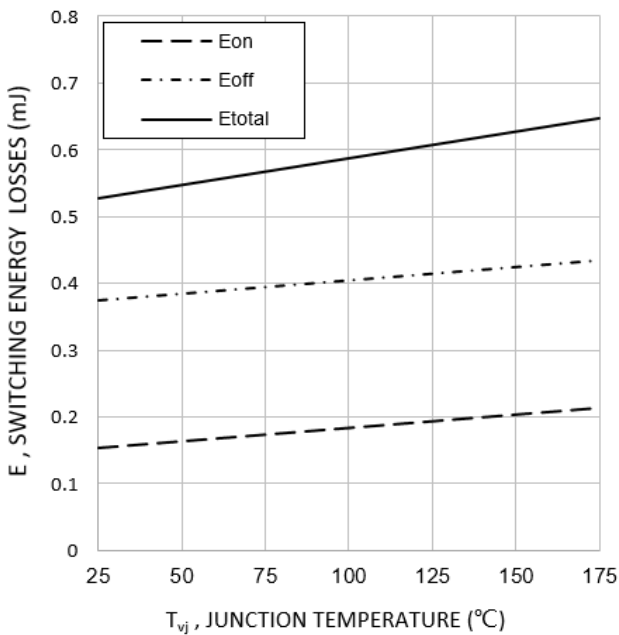


Fig. 13 Typical switching energy losses as a function of junction temperature (inductive load, $V_{CE}=400V$, $V_{GE}=15/0V$, $I_C=20A$, $r_G=39\Omega$)

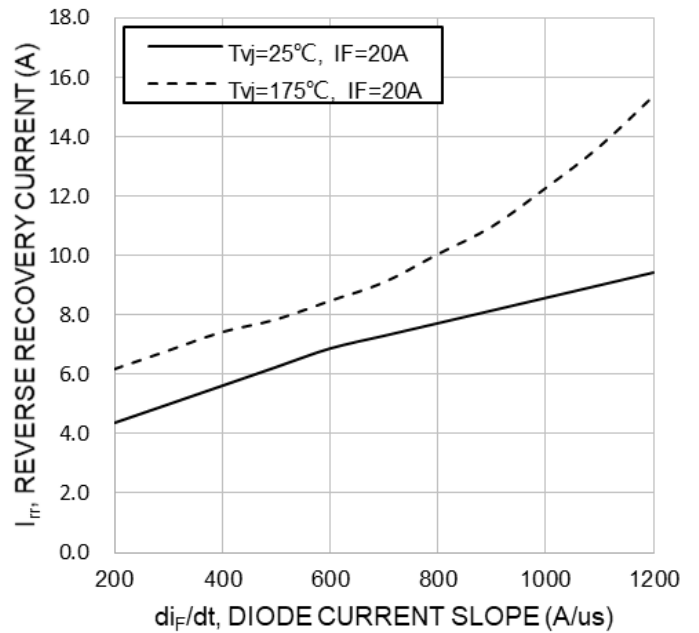


Fig. 14 Typical reverse recovery time as a function of diode current slope ($V_R=400V$)

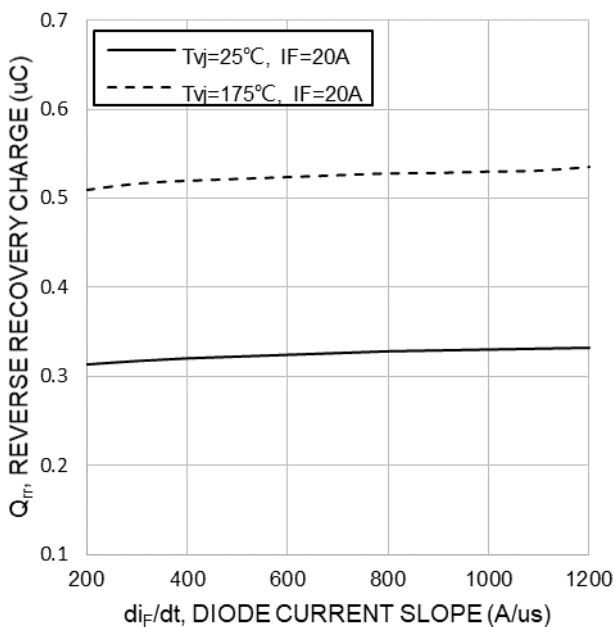


Fig. 15 Typical reverse recovery charge as a function of diode current slope ($V_R=400V$)

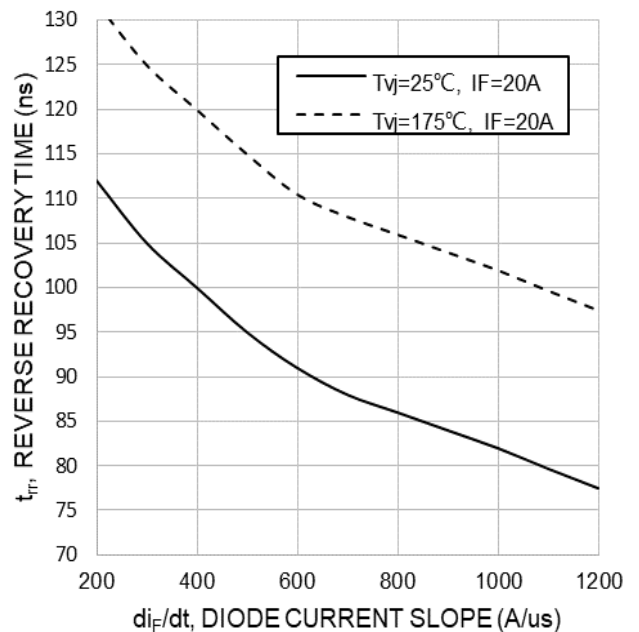


Fig. 16 Typical reverse recovery current as a function of diode current slope ($V_R=400V$)

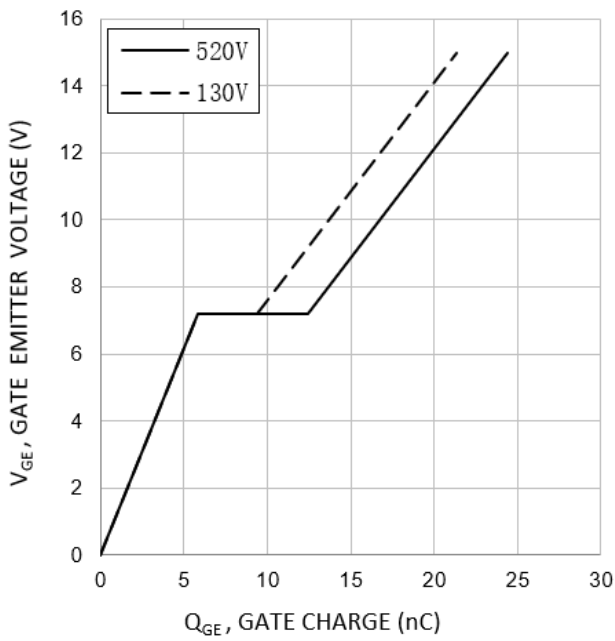


Fig. 17 Typical gate charge ($I_C=20A$)

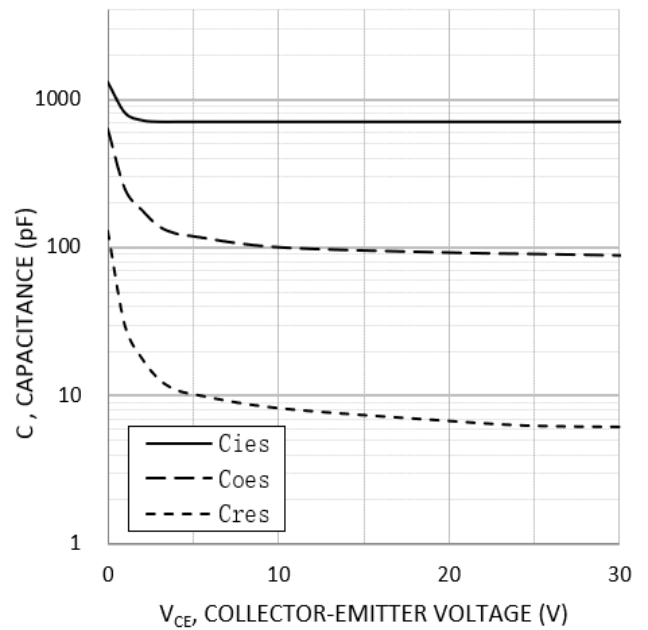


Fig. 18 Typical capacitance as a function of collector-emitter voltage ($V_{GE}=0V, f=1MHz$)

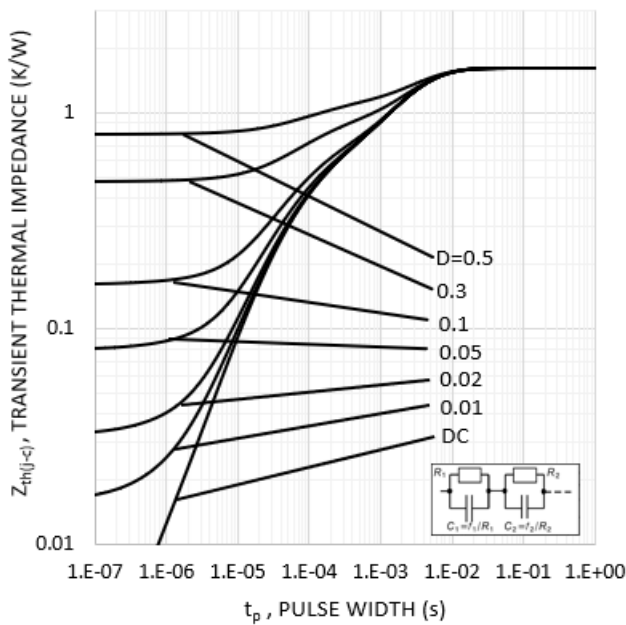


Fig. 19 IGBT transient thermal impedance ($D=t_p/T$) (TO-220)

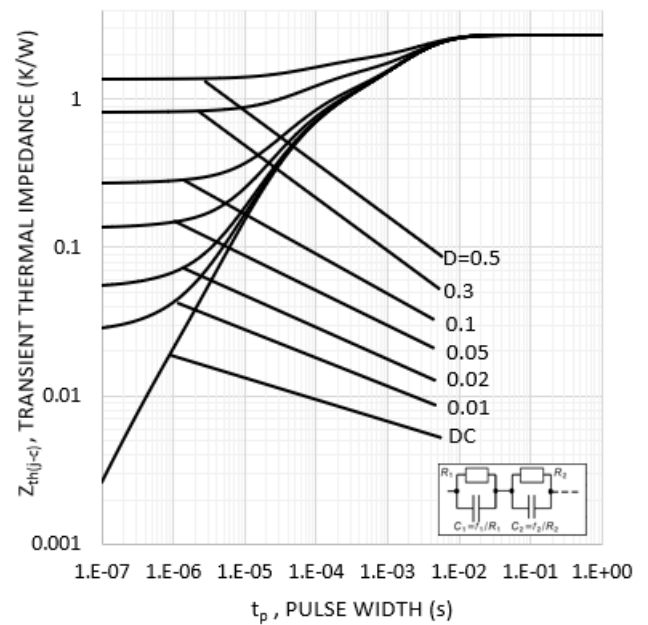
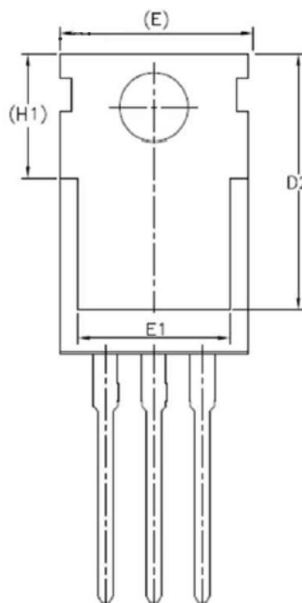
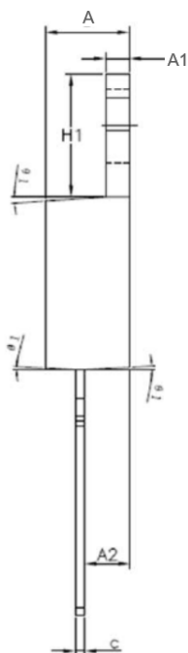
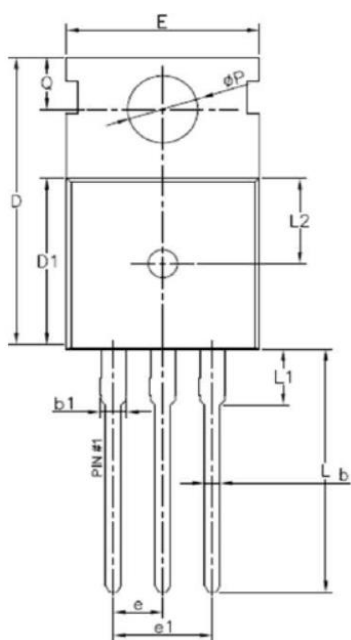


Fig. 20 Diode transient thermal impedance as a function of pulse width ($D=t_p/T$) (TO-220)

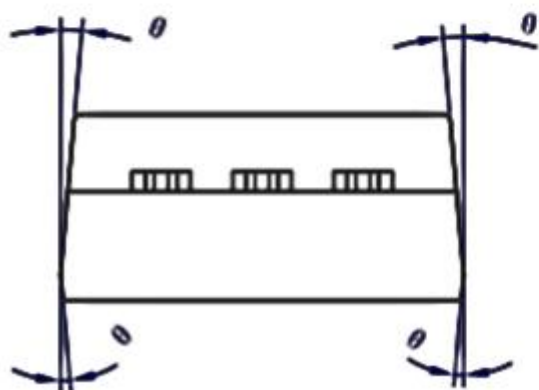
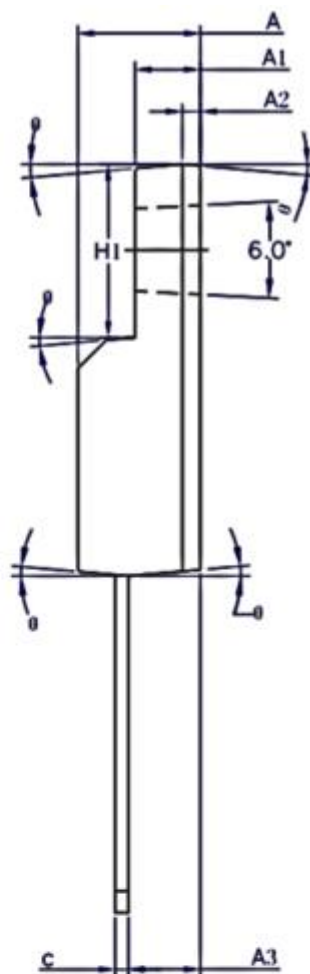
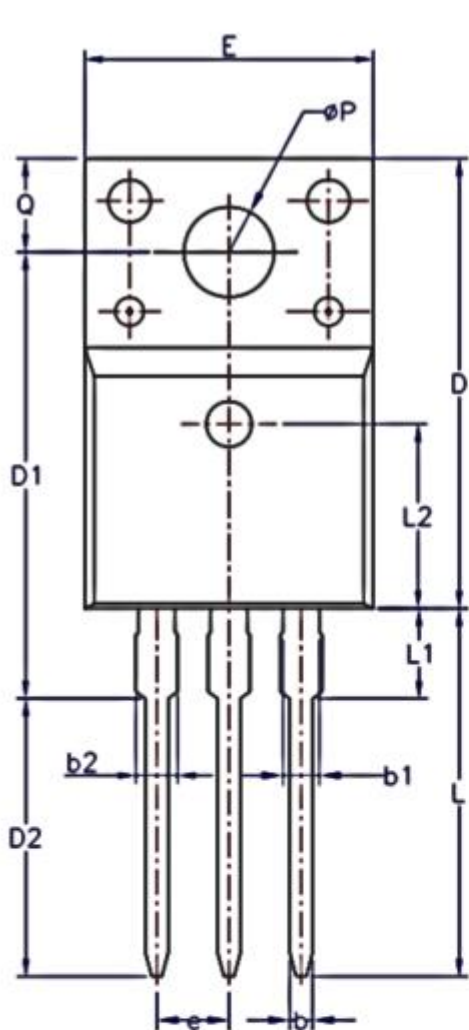
Package Information

TO-220-3L



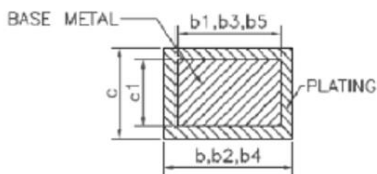
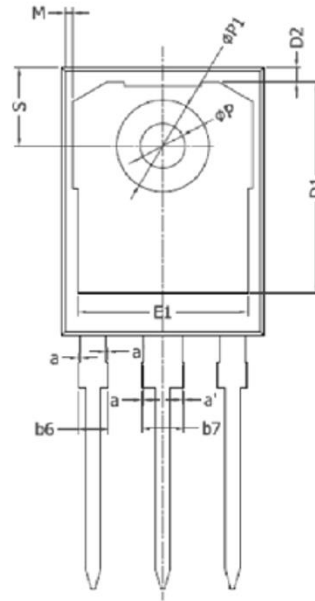
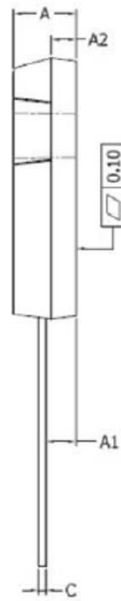
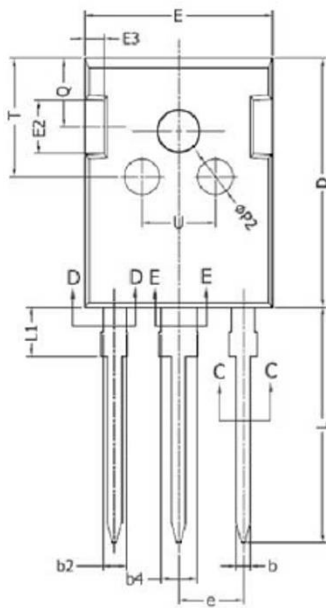
SYMBOL	MIN	NOM	MAX
A	4.40	4.50	4.60
A1	1.27	1.30	1.33
A2	2.30	2.40	2.50
b	0.70	—	0.90
b1	1.27	—	1.40
c	0.45	0.50	0.60
D	15.30	15.70	16.10
D1	9.10	9.20	9.30
D2	13.10	—	13.70
E	9.70	9.90	10.20
E1	7.80	8.00	8.20
e	2.54BSC		
e1	5.08BSC		
H1	6.30	6.50	6.70
L	12.78	13.08	13.38
L1	—	—	3.50
L2	4.60REF		
øP	3.55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

TO220F-3L



SYMBOL	MIN	NOM	MAX
A	4.50	4.70	4.83
A1	2.34	2.54	2.74
A2	0.70 REF		
A3	2.56	2.76	2.93
b	0.70	-	0.90
b1	1.18	-	1.38
b2	-	-	1.47
c	0.45	0.50	0.60
D	15.67	15.87	16.07
D1	15.55	15.75	15.95
D2	9.60	9.80	10.0
E	9.96	10.16	10.36
e	2.54BSC		
H1	6.48	6.68	6.88
L	12.68	12.98	13.28
L1	-	-	3.50
L2	6.50REF		
øP	3.08	3.18	3.28
Q	3.20	-	3.40
θ1	1°	3°	5°

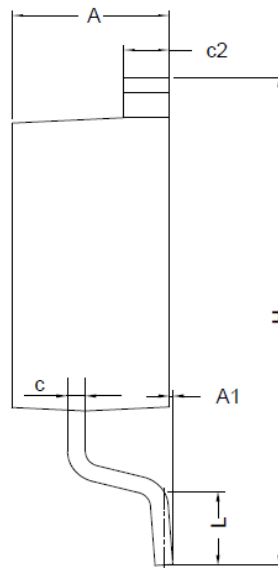
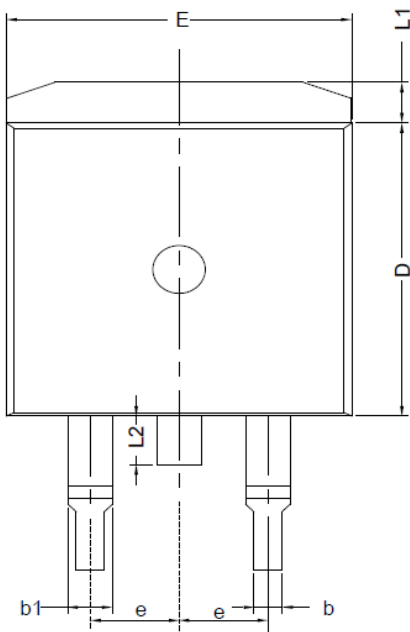
TO-247-3L



SECTION C-C, D-D & E-E

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	0.58	0.60	0.62
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	13.30	13.50
E2	4.40	4.50	4.60
E3	1.50	1.60	1.70
e	5.436 BSC		
L	19.80	19.92	20.10
L1	---	---	4.30
M	0.35	---	0.95
P	3.40	3.50	3.60
P1	7.00	---	7.40
P2	2.40	2.50	2.60
Q	5.60	---	6.00
S	6.05	6.15	6.25
T	9.80	---	10.20
U	6.00	---	6.40

TO-263



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	4.30	4.57	4.72
A1	0	0.10	0.25
b	0.71	0.81	0.91
b1	1.17	—	1.50
c	0.30	—	0.60
c2	1.17	1.27	1.37
D	8.50	—	9.35
E	9.80	—	10.45
e	2.54BSC		
H	14.70	—	15.75
L	2.00	2.30	2.74
L1	1.12	1.27	1.42
L2	—	—	1.75