

Features

- Low switching losses
- Maximum junction temperature 175°C
- Positive temperature coefficient
- High ruggedness, temperature stable
- High short circuit capability(5μs)
- Halogen Free. "Green" Device (Note 1)
- Epoxy Meets UL 94 V-0 Flammability Rating
- Lead Free Finish/RoHS Compliant ("P" Suffix Designates RoHS Compliant. See Ordering Information)

Applications

- High frequency switching application
- Medical applications
- Uninterruptible power supply
- Motion/servo control

Maximum Ratings

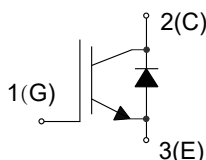
- Operating Junction Temperature Range : -40°C to +175°C
- Storage Temperature Range: -55°C to +150°C
- IGBT Thermal Resistance: 0.49°C/W Junction to Case
- Diode Thermal Resistance: 1.05°C/W Junction to Case
- Thermal Resistance: 40°C/W Junction to Ambient

Parameter	Symbol	Rating	Unit	
Collector-Emitter Voltage	V_{CE}	650	V	
DC Collector Current ⁽²⁾	I_C	$T_C=25^\circ\text{C}$	80	
		$T_C=100^\circ\text{C}$	40	
Pulsed Collector Current ⁽³⁾ $V_{GE}=15\text{V}$	I_{CM}	160	A	
Diode Forward Current ⁽²⁾	I_F	$T_C=25^\circ\text{C}$	60	
		$T_C=100^\circ\text{C}$	30	
Diode Pulsed Current ⁽³⁾	$I_{F,pulse}$	120	A	
Gate-Emitter Voltage	V_{GE}	± 20	V	
Transient Gate-Emitter Voltage		± 30		
Short Circuit Withstand Time $V_{GE}=15\text{V}, V_{CC}=400\text{V}, V_{CEM} \leq 650\text{V}$	t_{SC}	5	μs	
Power Dissipation	$T_j=25^\circ\text{C}$	P_D	306	W

Note:

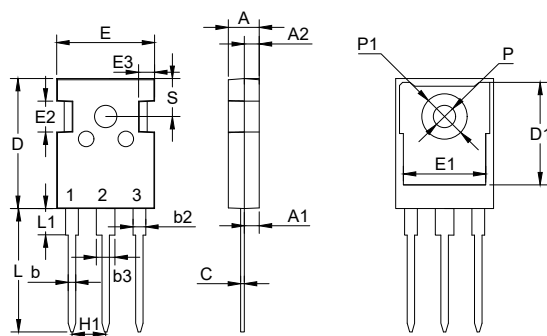
1. Halogen free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
2. Limited by T_{Jmax} .
3. T_p limited by T_{Jmax} .

Internal Structure



Trench and Field Stop IGBT 650V 40A

TO-247AB



DIMENSIONS

DIM	INCHES		MM		NOTE
	MIN	MAX	MIN	MAX	
A	0.189	0.205	4.80	5.20	
A1	0.087	0.103	2.21	2.61	
A2	0.073	0.085	1.85	2.15	
b	0.039	0.055	1.00	1.40	
b2	0.075	0.087	1.91	2.21	
C	0.020	0.028	0.50	0.70	
D	0.815	0.839	20.70	21.30	
D1	0.640	0.663	16.25	16.85	
E	0.610	0.634	15.50	16.10	
E1	0.512	0.535	13.00	13.60	
E2	0.189	0.205	4.80	5.20	
E3	0.091	0.106	2.30	2.70	
L	0.772	0.796	19.62	20.22	
L1	-	0.169	-	4.30	
P	0.134	0.150	3.40	3.80	Φ
P1		0.287	-	7.30	Φ
S		0.242		6.15	TYP
H1		0.214		5.44	TYP
b3	0.110	0.126	2.80	3.20	

Electrical Characteristics @ 25°C (Unless Otherwise Specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Static Characteristics						
Collector-Emitter Breakdown Voltage	$V_{(BR)CES}$	$V_{GE}=0V, I_C=250\mu A$	650			V
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$V_{GE}=15V, I_C=40A, T_J=25^\circ C$		1.95	2.40	V
		$V_{GE}=15V, I_C=40A, T_J=125^\circ C$		2.30		
		$V_{GE}=15V, I_C=40A, T_J=150^\circ C$		2.40		
G-E Threshold Voltage	$V_{GE(th)}$	$I_C=430\mu A, V_{GE}=V_{CE}$	4.1	5.1	6.1	V
C-E Leakage Current	I_{CES}	$V_{CE}=650V, V_{GE}=0V, T_J=25^\circ C$			0.25	mA
		$V_{CE}=650V, V_{GE}=0V, T_J=150^\circ C$			4.00	
G-E Leakage Current	I_{GES}	$V_{CE}=0V, V_{GE}=\pm 20V$			100	nA
Dynamic Characteristics						
Input Capacitance	C_{ies}	$V_{CE}=25V, V_{GE}=0V, f=1MHz$		1.56		nF
Reverse Transfer Capacitance	C_{res}			0.06		
Gate Charge	Q_g	$V_{CC}=300V, I_C=40A, V_{GE}=15V$		0.16		μC
Short Circuit Collector Current	I_{sc}	$V_{GE}=15V, t_{sc}\leq 5\mu s, V_{CC}=300V, T_J\leq 150^\circ C$		200		A
IGBT Switching Characteristics						
Turn-On Delay Time	$t_{d(on)}$	$V_{CC}=400V, I_C=40A, V_{GE}=0\sim 15V, R_G=10\Omega, L_s=60nH, T_J=25^\circ C$		12		ns
Rise Time	t_r			31		
Turn-Off Delay Time	$t_{d(off)}$			124		
Fall Time	t_f			54		
Turn-On Energy	E_{on}			1.55		mJ
Turn-Off Energy	E_{off}			0.59		
Turn-On Delay Time	$t_{d(on)}$	$V_{CC}=400V, I_C=40A, V_{GE}=0\sim 15V, R_G=10\Omega, L_s=60nH, T_J=125$		11		ns
Rise Time	t_r			30		
Turn-Off Delay Time	$t_{d(off)}$			132		
Fall Time	t_f			84		
Turn-On Energy	E_{on}			1.57		mJ
Turn-Off Energy	E_{off}			0.83		
Turn-On Delay Time	$t_{d(on)}$	$V_{CC}=400V, I_C=40A, V_{GE}=0\sim 15V, R_G=10\Omega, L_s=60nH, T_J=150$		11		ns
Rise Time	t_r			30		
Turn-Off Delay Time	$t_{d(off)}$			137		
Fall Time	t_f			102		
Turn-On Energy	E_{on}			1.6		mJ
Turn-Off Energy	E_{off}			0.88		

Electrical Characteristics @ 25°C (Unless Otherwise Specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Diode Static Characteristics						
Diode Forward Voltage	V_F	$I_F=30A, T_J=25^\circ C$		2.00	2.50	V
		$I_F=30A, T_J=125^\circ C$		1.95		
		$I_F=30A, T_J=150^\circ C$		1.95		
Diode Dynamic Characteristics						
Reverse Recovery Current	I_{rr}	$V_R=400V, I_F=40A,$ $di/dt=-410A/\mu s, T_J=25^\circ C$		9		A
Reverse Recovery Charge	Q_{rr}			0.155		μC
Diode Reverse Recovery Time	t_{rr}			29		ns
Reverse Recovery Energy	E_{rec}			0.09		mJ
Reverse Recovery Current	I_{rr}	$V_R=400V, I_F=40A,$ $di/dt=-410A/\mu s, T_J=125^\circ C$		13		A
Reverse Recovery Charge	Q_{rr}			0.824		μC
Diode Reverse Recovery Time	t_{rr}			112		ns
Reverse Recovery Energy	E_{rec}			0.15		mJ
Reverse Recovery Current	I_{rr}	$V_R=400V, I_F=40A,$ $di/dt=-410A/\mu s, T_J=150^\circ C$		13		A
Reverse Recovery Charge	Q_{rr}			1.16		μC
Diode Reverse Recovery Time	t_{rr}			140		ns
Reverse Recovery Energy	E_{rec}			0.23		mJ

Curve Characteristics

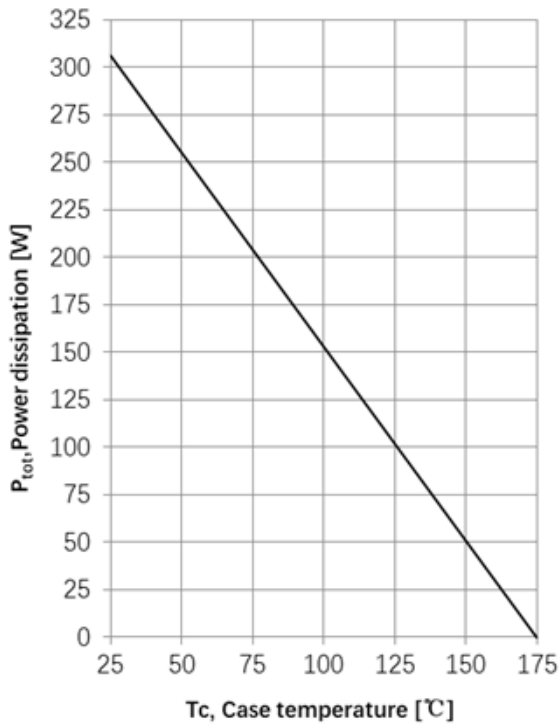


Fig1. Power dissipation as a function of case temperature ($T_j \leq 175^\circ\text{C}$)

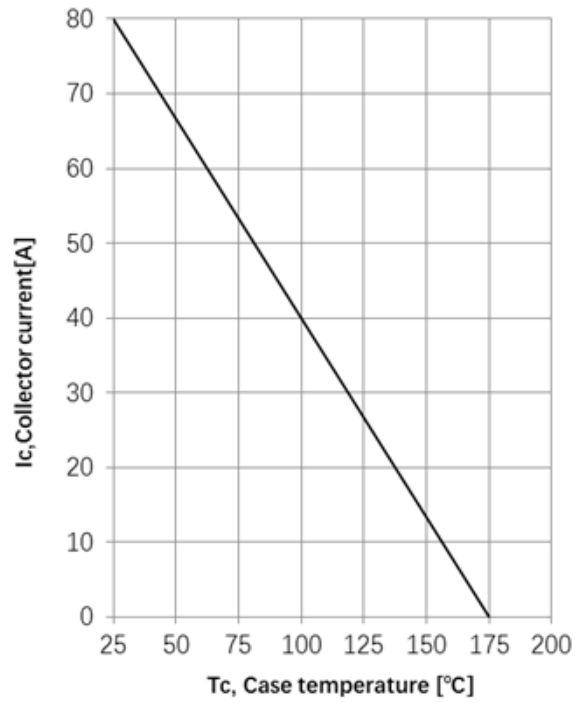


Fig2. Collector current as a function of case temperature ($V_{ge} \geq 15\text{V}$, $T_j \leq 175^\circ\text{C}$)

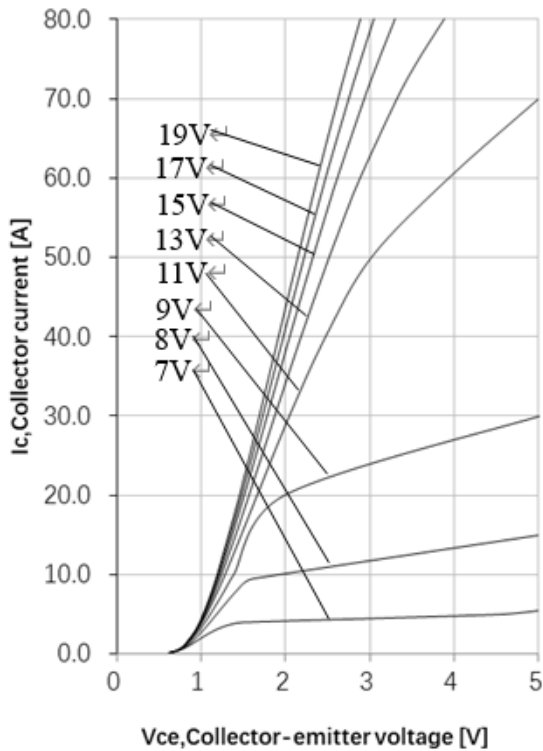


Fig3. Typical output characteristic ($T_j = 25^\circ\text{C}$)

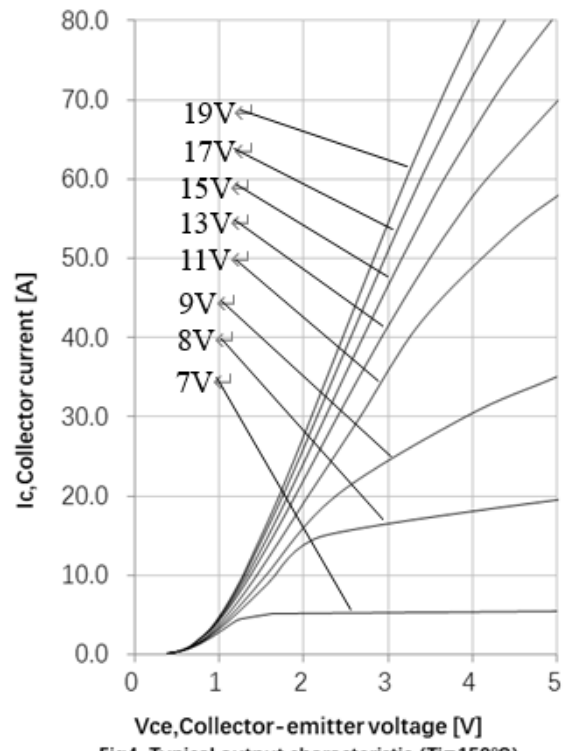


Fig4. Typical output characteristic ($T_j = 150^\circ\text{C}$)

Curve Characteristics

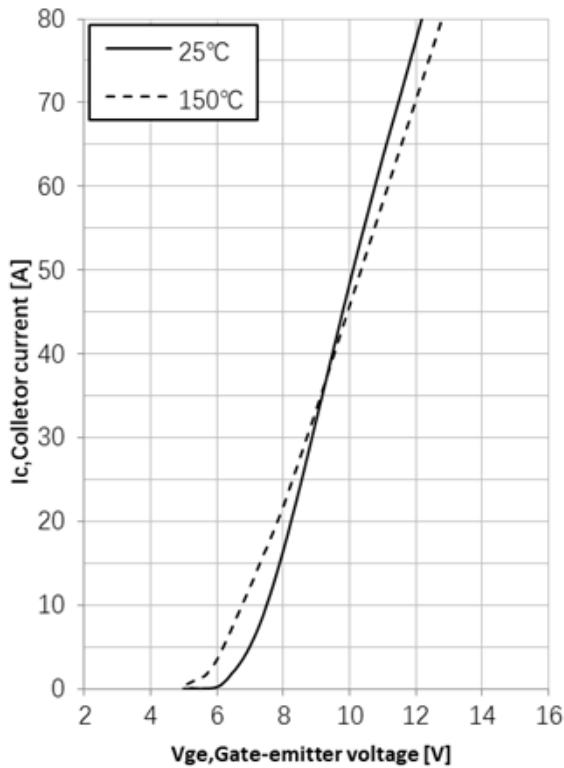


Fig5. Typical transfer characteristic (Vce=20V)

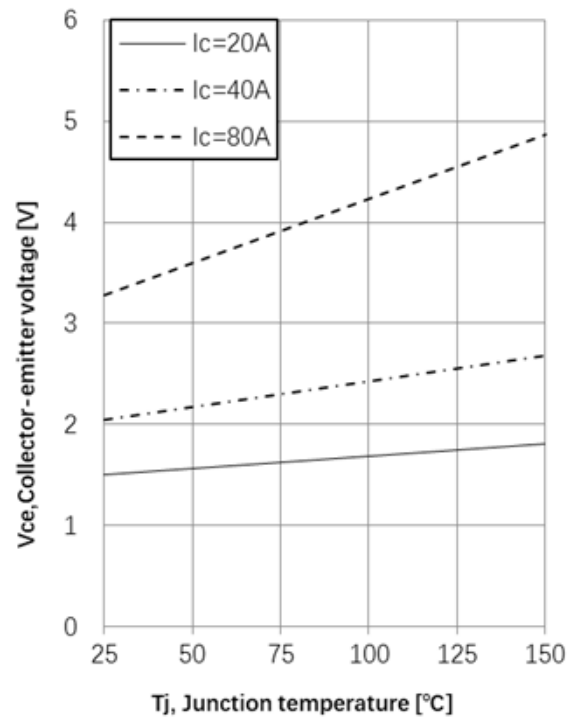


Fig6. Typical collector-emitter saturation voltage as a function of junction temperature (Vge=15V)

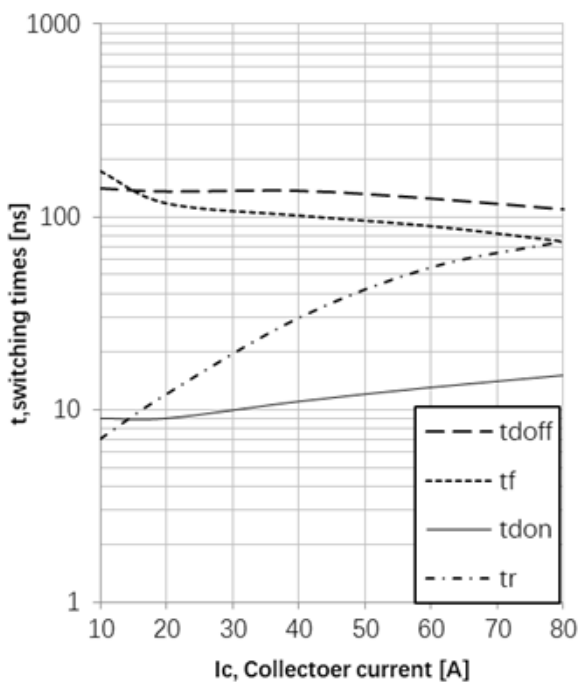


Fig7. Typical switching time as a function of collector current (inductive load, Tvj=150°C, Vce=400V, Vge=0/15V, Rg=10Ω)

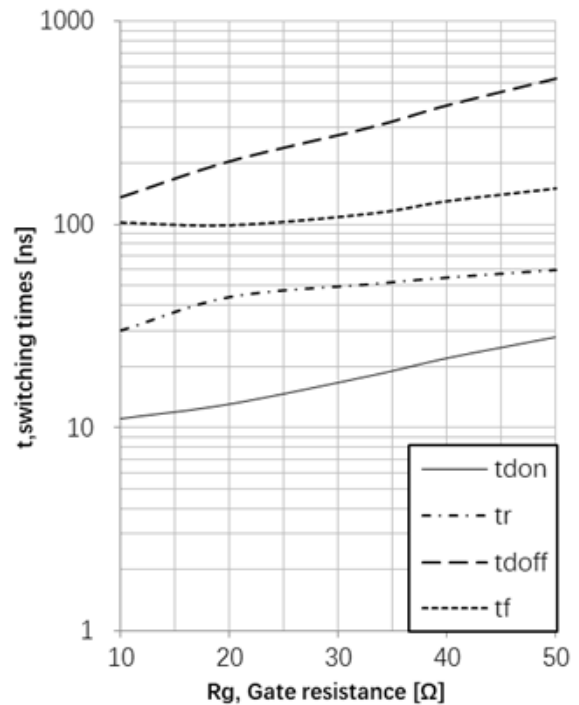


Fig8. Typical switching times as a function of gate resistance (inductive load, Tvj=150°C, Vce=400V, Vge=0/15V, Ic=40A)

Curve Characteristics

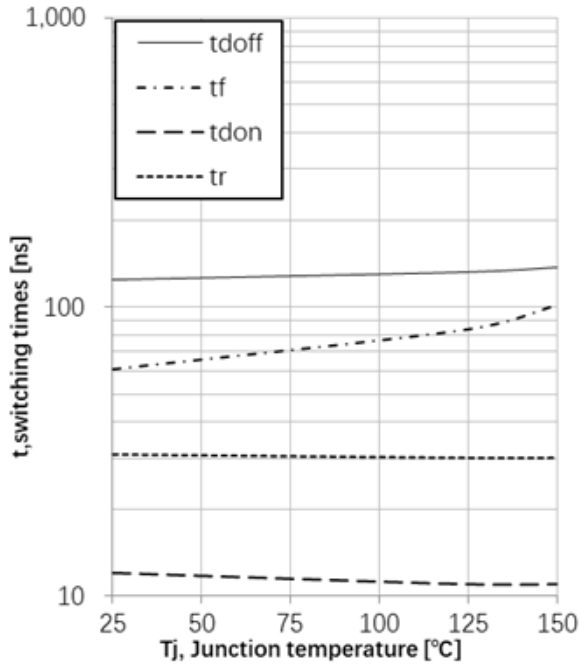


Fig9. Typical switching times as a function of junction temperature (inductive load, I_c=40A, V_{ce}=400V, V_{ge}=0/15V, R_g=10Ω)

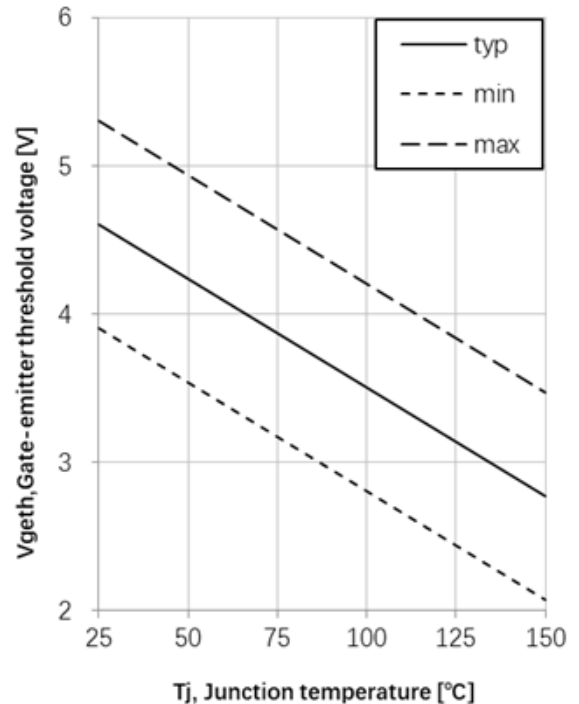


Fig10. Gate-emitter threshold voltage as a function of Junction temperature (I_c=0.75mA)

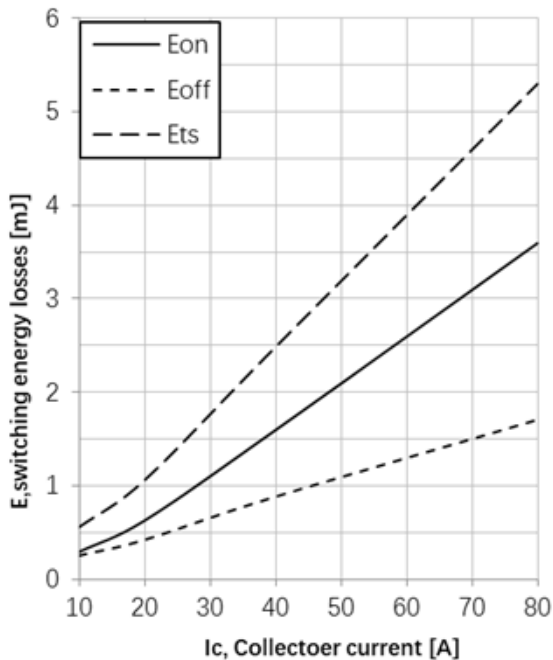


Fig11. Typical switching energy losses as a function of collect current (inductive load, T_{vj}=150°C, V_{ce}=400V, V_{ge}=0/15V, R_g=10Ω)

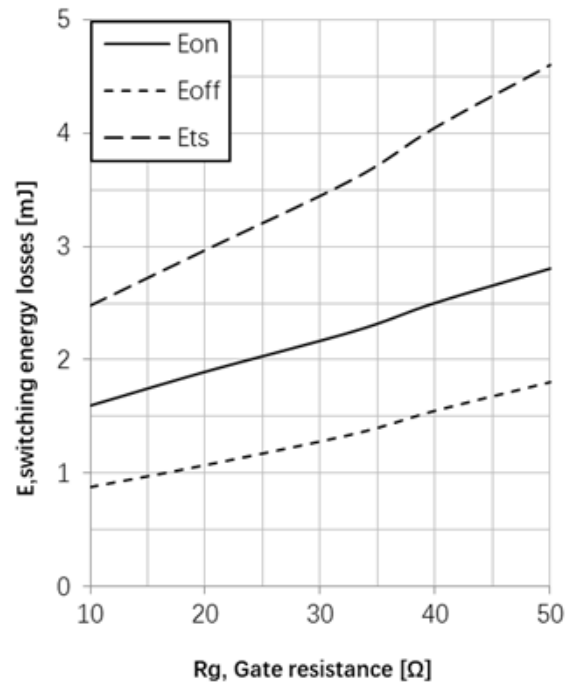


Fig12. Typical switching energy losses as a function of gate resistance (inductive load, T_{vj}=150°C, V_{ce}=400V, V_{ge}=0/15V, I_c=40A)

Curve Characteristics

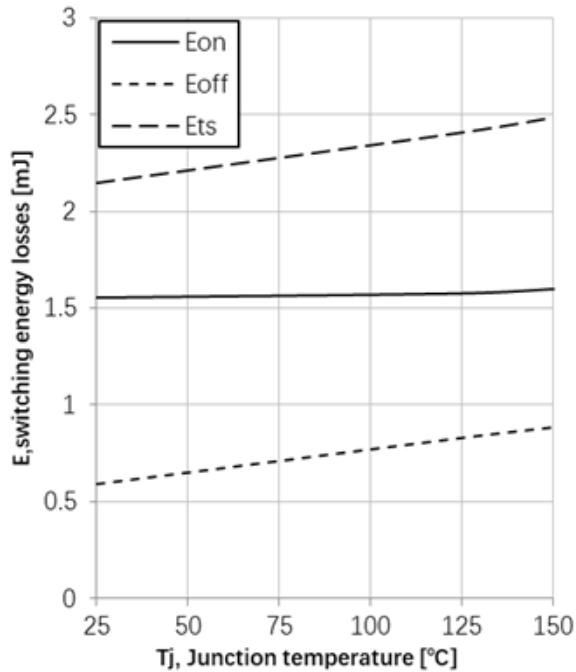


Fig13. Typical switching energy losses as a function of Junction temperature (inductive)
load, I_c=40A, V_{ce}=400V, V_{ge}=0/15V, R_g=10Ω

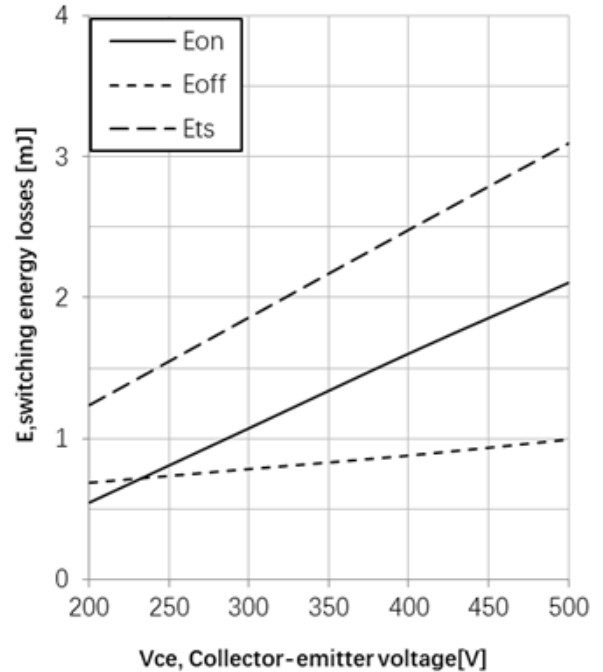


Fig14. Typical switching energy losses as a function of collector-emitter voltage (inductive)
load, T_{vj}=150°C, I_c=40A, V_{ge}=0/15V, R_g=10Ω

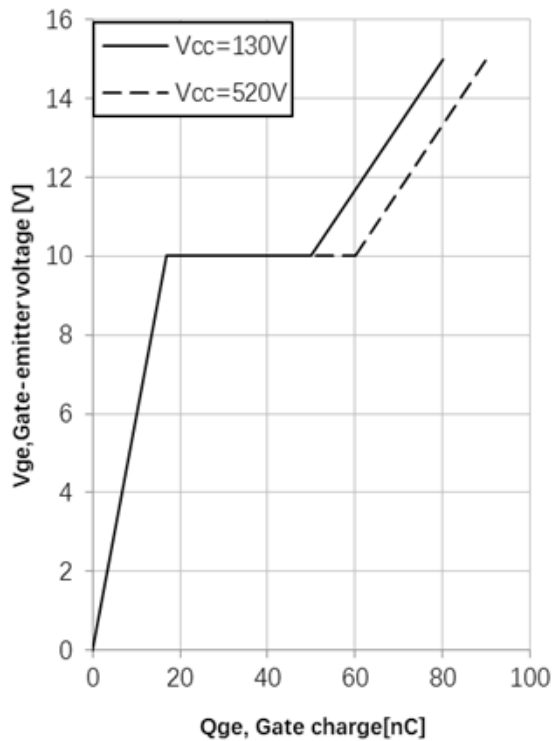


Fig15. Typical gate charge (I_c=40A)

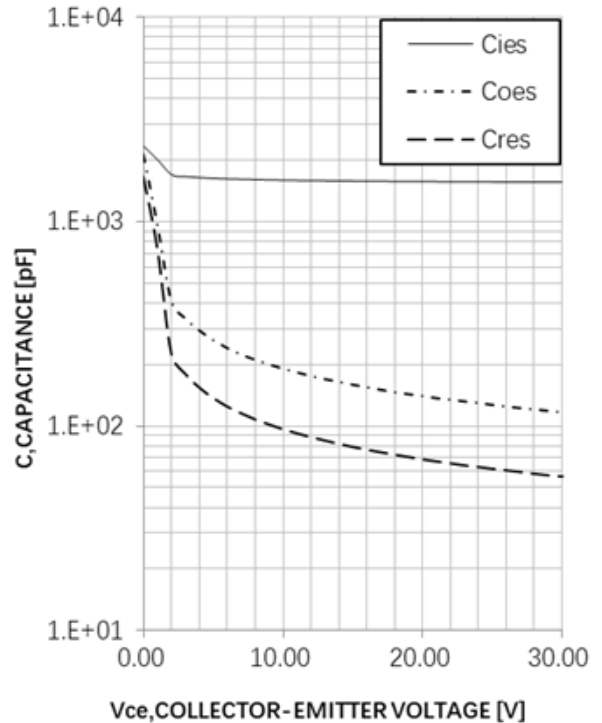


Fig16. Typical capacitance as a function of collector-emitter voltage

Curve Characteristics

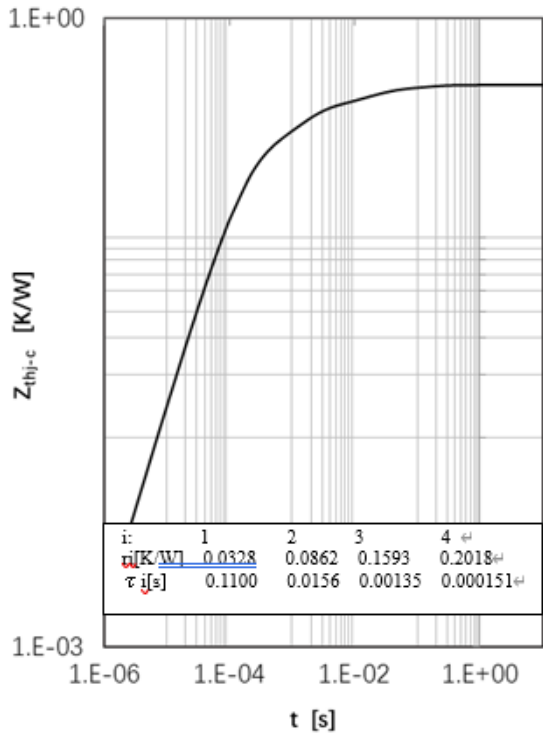


Fig 17. IGBT Transient Thermal Impedance

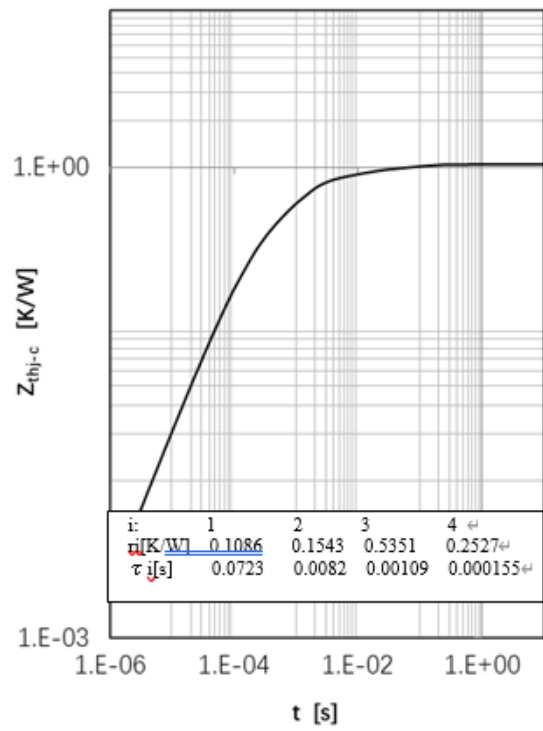


Fig 18. Diode Transient Thermal Impedance

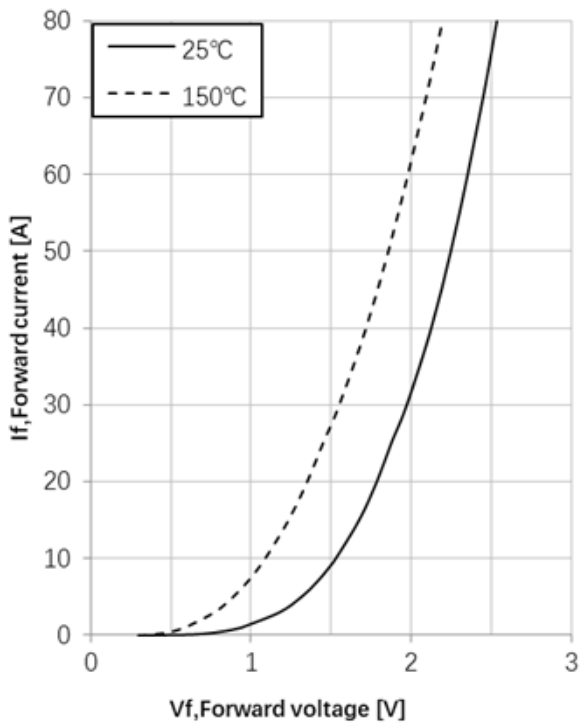


Fig19. Diode forward current as a function of forward voltage

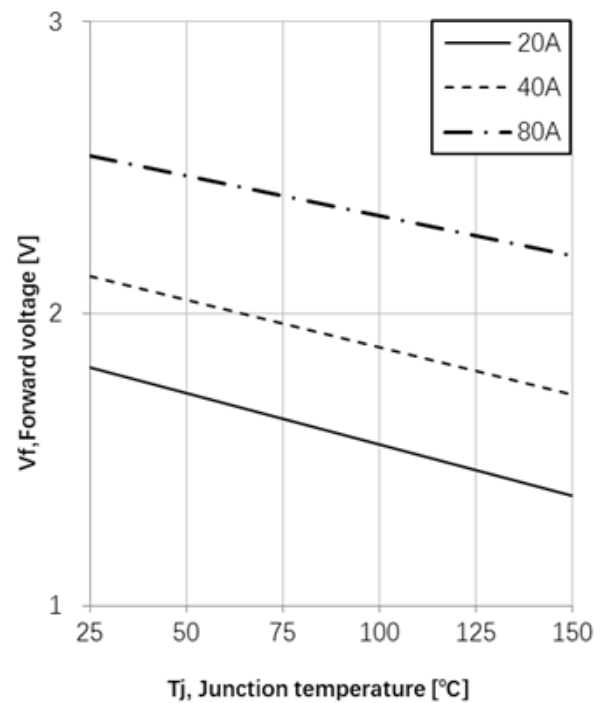
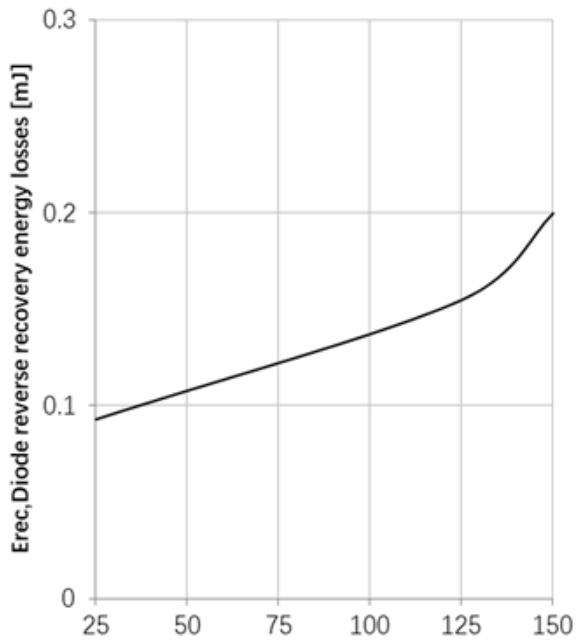
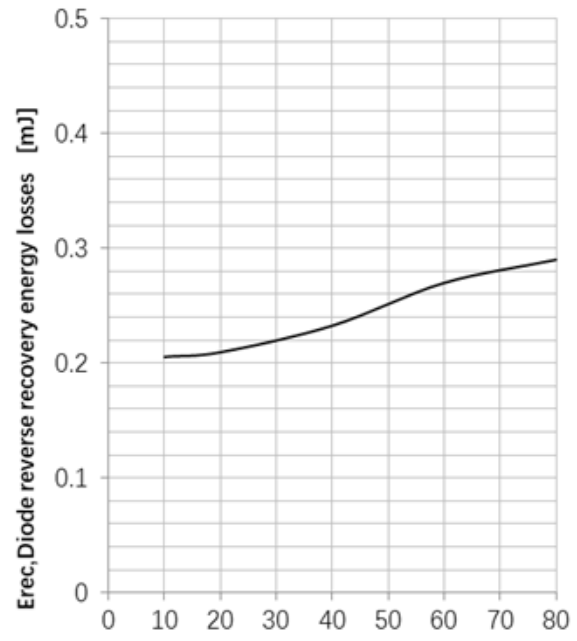


Fig20. Typical diode forward voltage as a function of Junction temperature

Curve Characteristics



Tj, Junction temperature [°C]
Fig21. Typical diode reverse recovery energy losses as a fuction of Junction temperature (inductive load, If=40A, Vrr=400V)



If, Collectoer current [A]
Fig22. Typical diode reverse recovery energy losses as a fuction of collect current (inductive load, Tvj=150°C, Vrr=400V)

Ordering Information

Device	Packing
Part Number-BP	Tube: 30pcs/Tube, 1800pcs/Ctn

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