Trench and Field Stop IGBT 650V 60A

Features

- Low Switching Losses
- Maximum Junction Temperature 175℃
- Positive Temperature Coefficient
- High Ruggedness, Temperature Stable
- High Short Circuit Capability(5us)
- Halogen Free. “Green” Device (Note 1)
- Epoxy Meets UL 94 V-0 Flammability Rating
- Lead Free Finish/RoHS Compliant (Note 2)("P" Suffix Designates RoHS Compliant. See Ordering Information)

Maximum Ratings

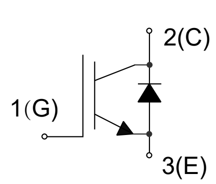
- Operating Junction Temperature Range : -40°C to +175°C
- Storage Temperature Range: -55°C to +150°C
- IGBT Thermal Resistance: 0.45°C/W Junction to Case
- Diode Thermal Resistance: 1.05°C/W Junction to Case
- Thermal Resistance: 40°C/W Junction to Ambient

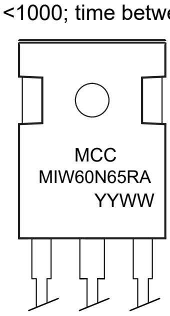
Parameter		Symbol	Rating	Unit
Collector-Emitter Voltage		V_{CE}	650	V
DC Collector Current[3]	T_C=25°C	I_C	120	A
	T_C=100°C		60	
Pulsed Collector Current [4] ,V_{GE}=15V		$I_{C,pluse}$	240	A
Diode Forward Current [3]	T_C=25°C	I_F	60	A
	T_C=100°C		30	
Diode Pulsed Current [4]		$I_{F,pluse}$	120	A
Continuous Gate-Emitter Voltage		V_{GE}	±20	V
Transient Gate-Emitter Voltage[5]			±30	
Short Circuit Withstand Time [6] V_{GE}=15V, V_{CC}=400V, V_{CEM}≤650V		t_{SC}	5	μs
Power Dissipation	T_C=25°C	P_D	333	W
	T_j=175°C			

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. High Temperature Solder Exemptions Applied, see EU Directive Annex 7a.
3. Limited by T_{Jmax}.
4. t_p limited by T_{Jmax}.
5. t_p≤10us, Duty Cycle<1%
6. Allowed number of short circuits: <1000; time between short circuits: >1s.

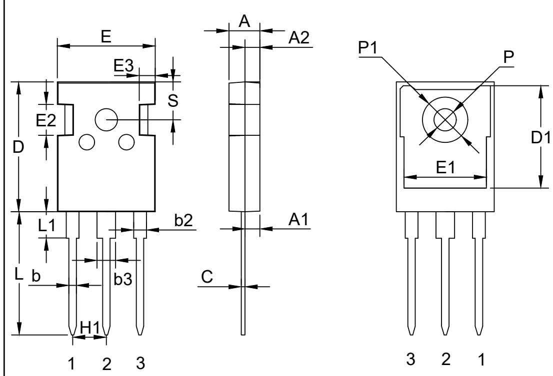
Internal Structure





Device Code:MIW60N65RA
Date Code:YYWW: (Year & Week)

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
IGBT Static Characteristics						
Collector-Emitter Breakdown Voltage	$V_{(BR)CES}$	V_{GE}=0V, I_C=250μA	650			V
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	V_{GE}=15V, I_C=60A, T_j=25°C		2.10	2.40	V
		V_{GE}=15V, I_C=60A, T_j=125°C		2.40		
		V_{GE}=15V, I_C=60A, T_j=150°C		2.50		
G-E Threshold Voltage	$V_{GE(th)}$	I_C=0.8mA, V_{CE}=V_{GE}	4.1	5.1	6.1	V
C-E Leakage Current	I_{CES}	V_{CE}=650V, V_{GE}=0V, T_j=25°C			0.25	mA
		V_{CE}=650V, V_{GE}=0V, T_j=150°C			4	
G-E Leakage Current	I_{GES}	V_{CE}=0V, V_{GE}=±20V			100	nA
Dynamic Characteristics						
Input Capacitance	C_{ies}	V_{CE}=25V,V_{GE}=0V,f=1MHz		2.04		nF
Reverse Transfer Capacitance	C_{res}			0.84		
Gate Charge	Q_G	V_{CC}=300V,I_C=60A,V_{GE}=15V		0.24		μC
Short Circuit Collector Current	I_{SC}	V_{GE}=15V, t_{sc}≤5μs, V_{CC}=400V, T_j≤150°C		280		A
IGBT Switching Characteristics						
Turn-On Delay Time	$td_{(on)}$	V_{CC}=400V, I_C=60A,L_s=60nH V_{GE}=0V~15V, R_G=10Ω,T_j=25°C		18		ns
Rise Time	t_r			75		
Turn-Off Delay Time	$td_{(off)}$			163		
Fall Time	t_f			62		
Turn-On Energy	E_{on}			2.84		mJ
Turn-Off Energy	E_{off}			1.21		
Turn-On Delay Time	$td_{(on)}$	V_{CC}=400V, I_C=60A,L_s=60nH V_{GE}=0V~15V, R_G=10Ω,T_j=125°C		17		ns
Rise Time	t_r			65		
Turn-Off Delay Time	$td_{(off)}$			176		
Fall Time	t_f			70		
Turn-On Energy	E_{on}			2.86		mJ
Turn-Off Energy	E_{off}			1.41		
Turn-On Delay Time	$td_{(on)}$	V_{CC}=400V, I_C=60A,L_s=60nH V_{GE}=0V~15V, R_G=10Ω,T_j=150°C		16		ns
Rise Time	t_r			59		
Turn-Off Delay Time	$td_{(off)}$			182		
Fall Time	t_f			82		
Turn-On Energy	E_{on}			2.98		mJ
Turn-Off Energy	E_{off}			1.51		

Electrical Characteristics @ 25°C (Unless Otherwise Specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Diode Characteristics						
Diode Forward Voltage	V_F	V_{GE}=0V, I_F=30A, T_j=25°C		1.9	2.6	V
		V_{GE}=0V, I_F=30A, T_j=125°C		1.85		
		V_{GE}=0V, I_F=30A, T_j=150°C		1.75		
Reverse Recovery Current	I_{rr}	V_R=400V, I_F=30A, di_F/dt=-350A/μs, T_j=25°C		7		A
Diode Reverse Recovery Time	t_{rr}			42		ns
Reverse Recovery Charge	Q_{rr}			0.14		μC
Reverse Recovery Energy	E_{rec}			0.09		mJ
Reverse Recovery Current	I_{rr}	V_R=400V, I_F=30A, di_F/dt=-350A/μs, T_j=125°C		13		A
Diode Reverse Recovery Time	t_{rr}			153		ns
Reverse Recovery Charge	Q_{rr}			0.94		μC
Reverse Recovery Energy	E_{rec}			0.22		mJ
Reverse Recovery Current	I_{rr}	V_R=400V, I_F=30A, di_F/dt=-350A/μs, T_j=150°C		15		A
Diode Reverse Recovery Time	t_{rr}			161		ns
Reverse Recovery Charge	Q_{rr}			1.26		μC
Reverse Recovery Energy	E_{rec}			0.26		mJ

Curve Characteristics

Fig1. Power dissipation as a function of case temperature ($T_j \leqslant 175℃$)

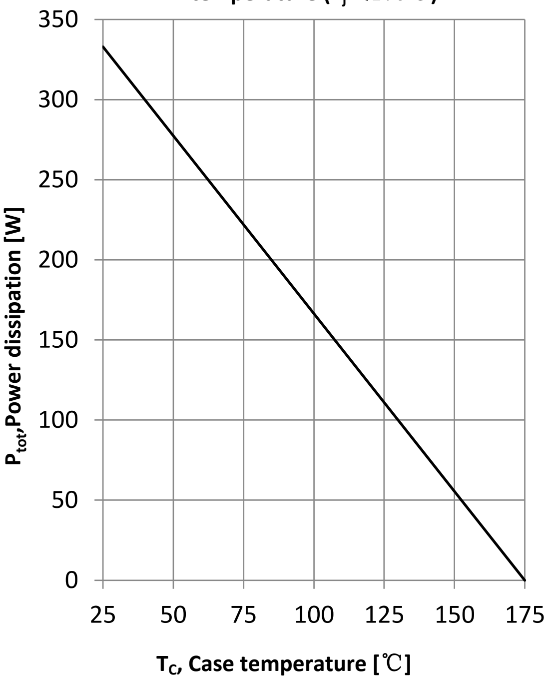


Fig2. Collector current as a function of case temperature($V_{GE} \geqslant 15V$, $T_j \leqslant 175℃$)

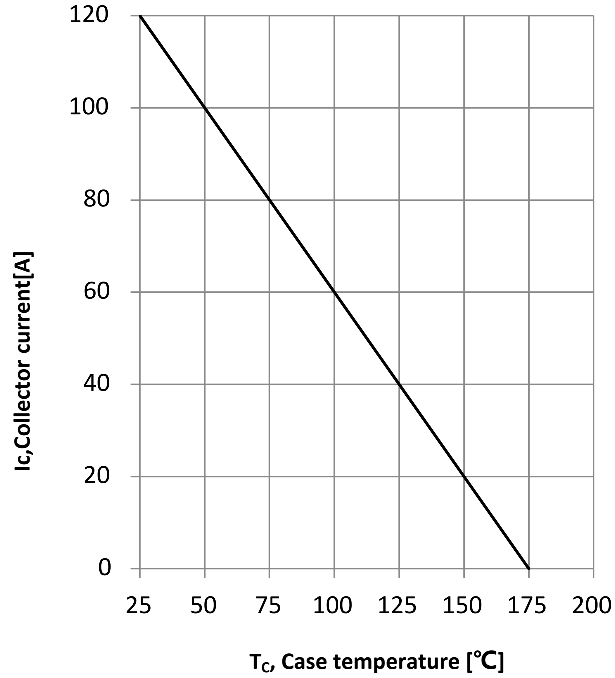


Fig3. Typical output characteristic (T_j=25℃)

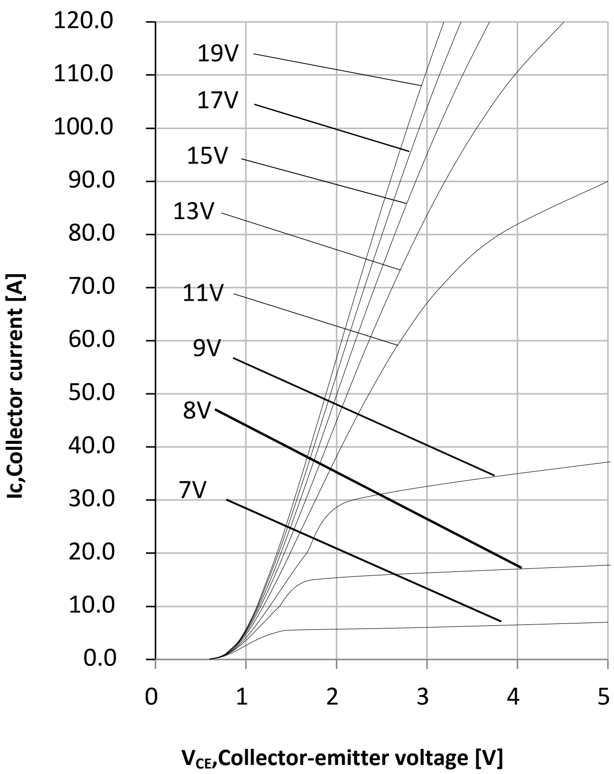
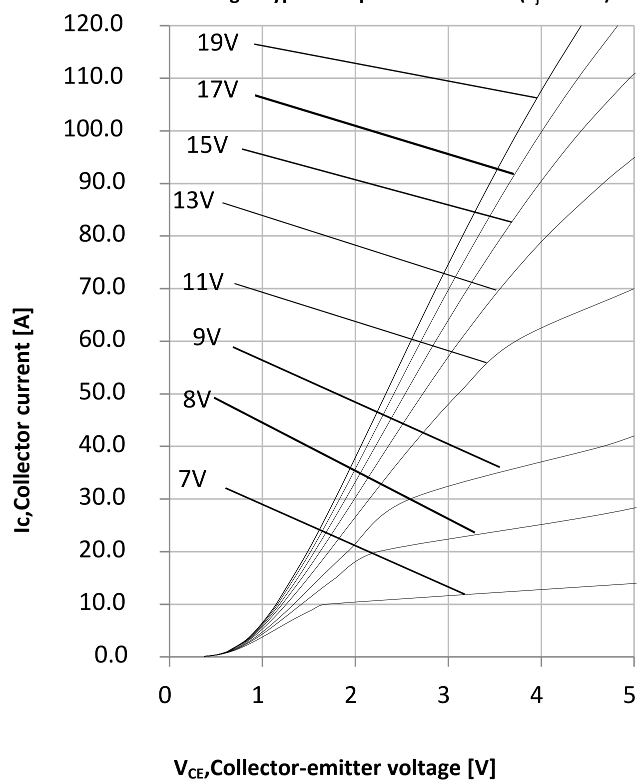


Fig4. Typical output characteristic (T_j=150℃)



Curve Characteristics

Fig5. Typical transfer characteristic (V_{CE}=20V)

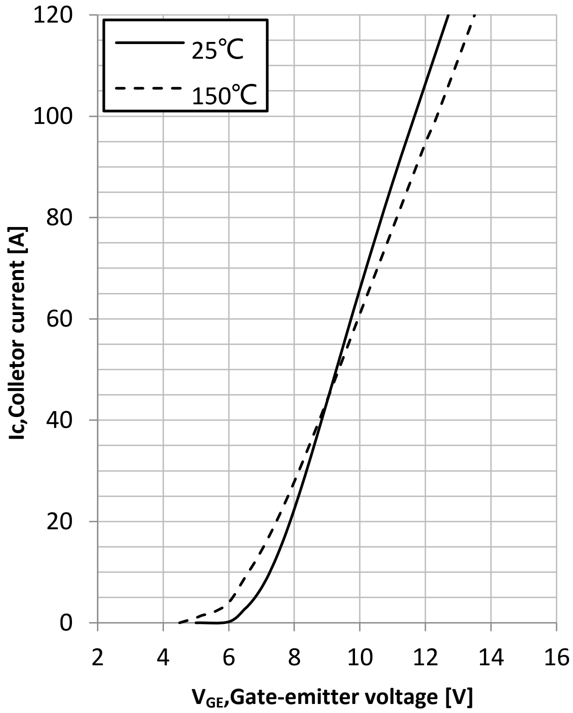


Fig6. Typical collector-emmiter saturation voltage as a function of junction temperature(V_{GE}=15V)

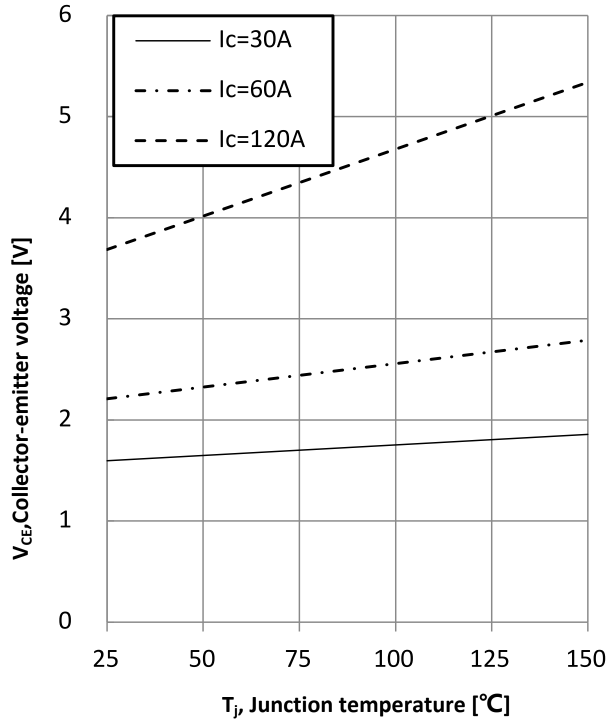


Fig7. Typical switching time as a function ofcollect current （inductive load,T_{vj}=150℃,V_{CE}=400V,V_{GE}=0/15V,Rg=10Ω）

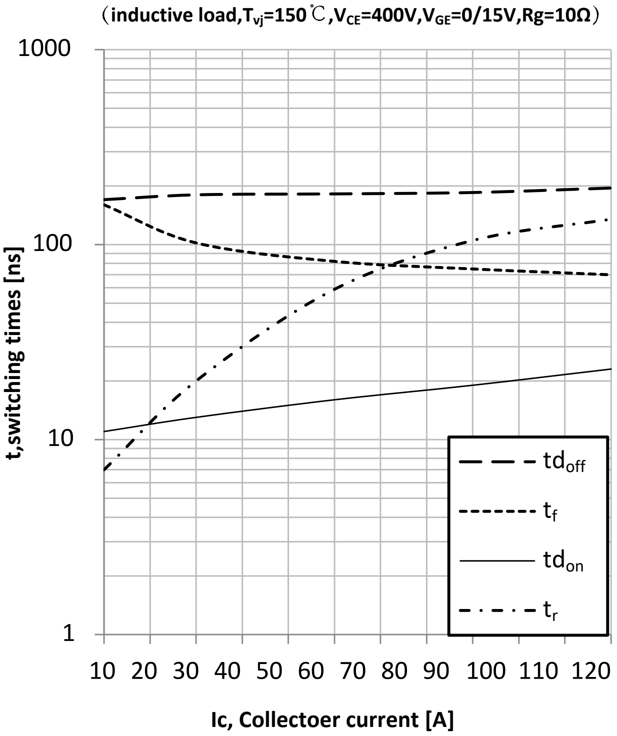
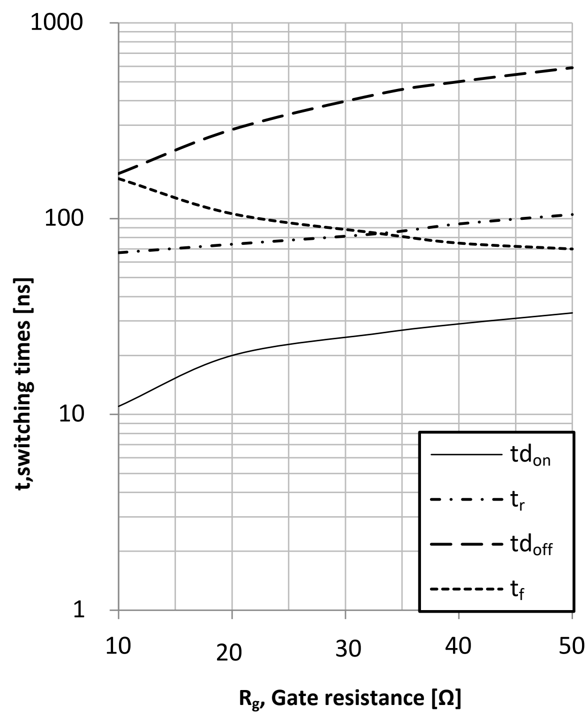
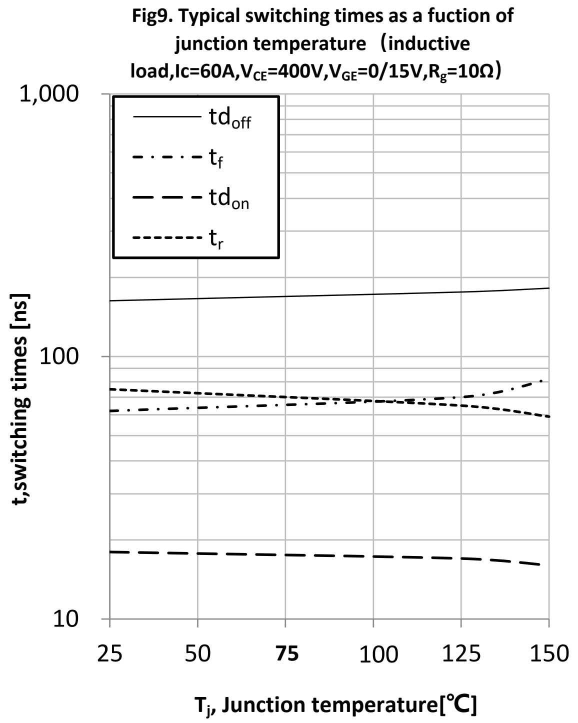
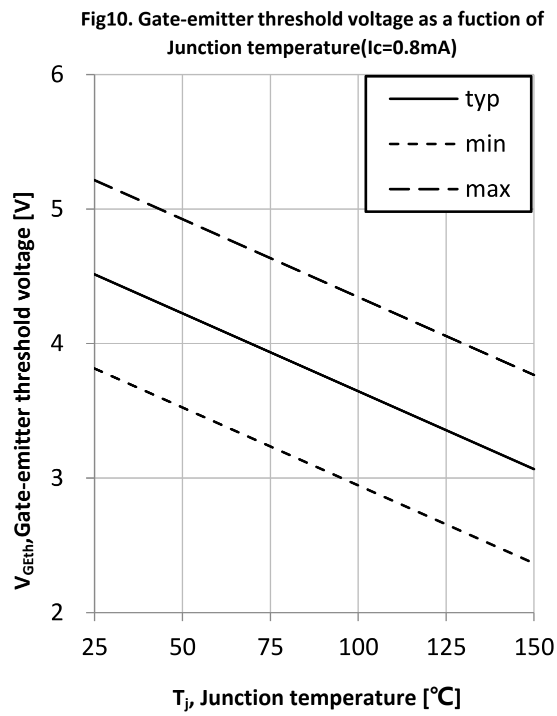


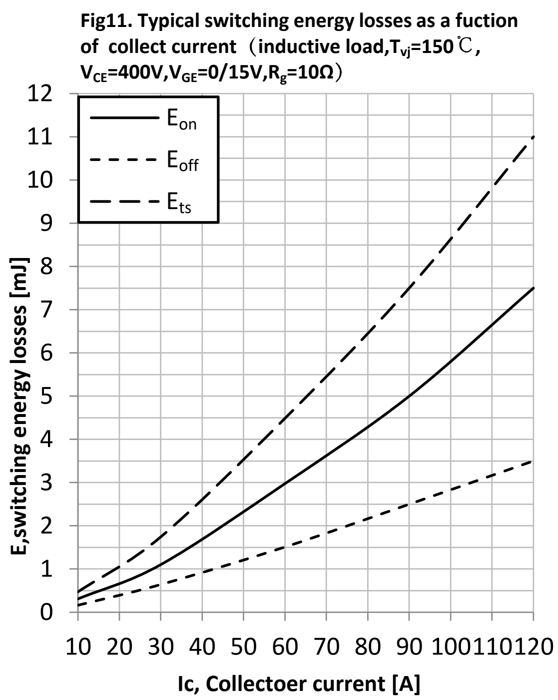
Fig8. Typical switching times as a fuction of gate resistance （inductive load,T_{vj}=150℃,V_{CE}=400V, V_{GE}=0/15V,Ic=60A）



Curve Characteristics







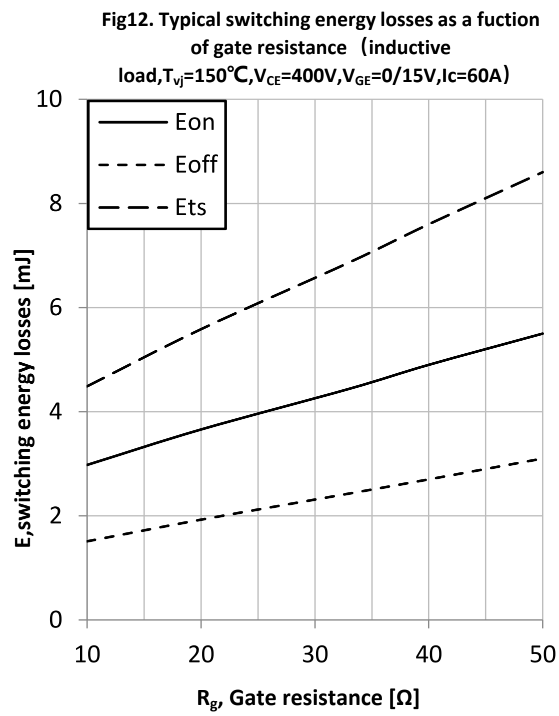


Fig13. Typical swltching energy losses as a fuction of Junction temperature（inductive load,Ic=60A,V_{CE}=400V,V_{GE}=0/15V,R_g=10Ω）

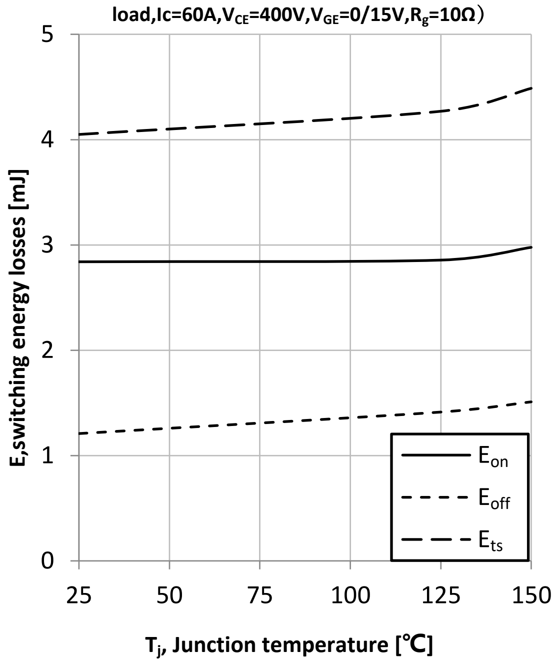


Fig14. Typical switching energy losses as a fuction of collector-emitter voltage（inductive load,T_{vj}=150℃, Ic=60A,V_{GE}=0/15V,Rg=10Ω）

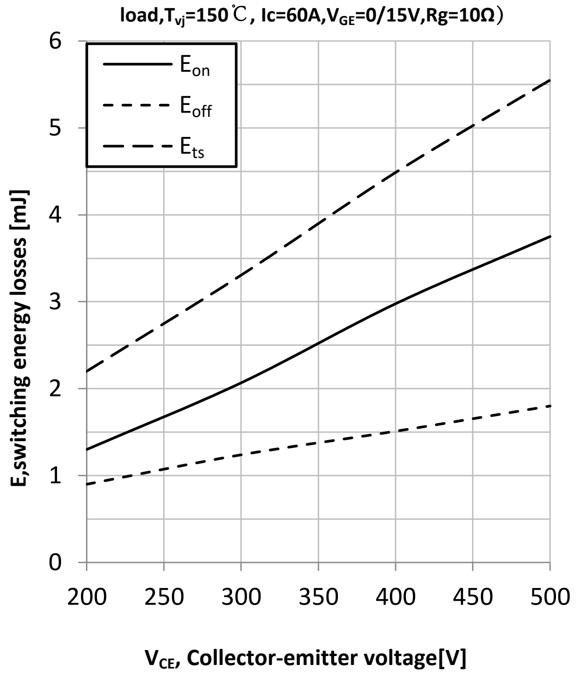


Fig15. Typical capacitance as a function of collector-emitter voltage

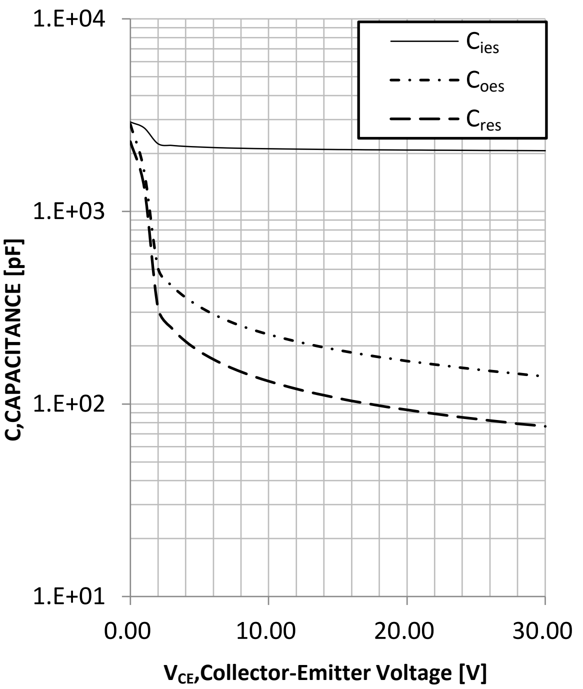


Fig 16. IGBT Transient Thermal Impedance

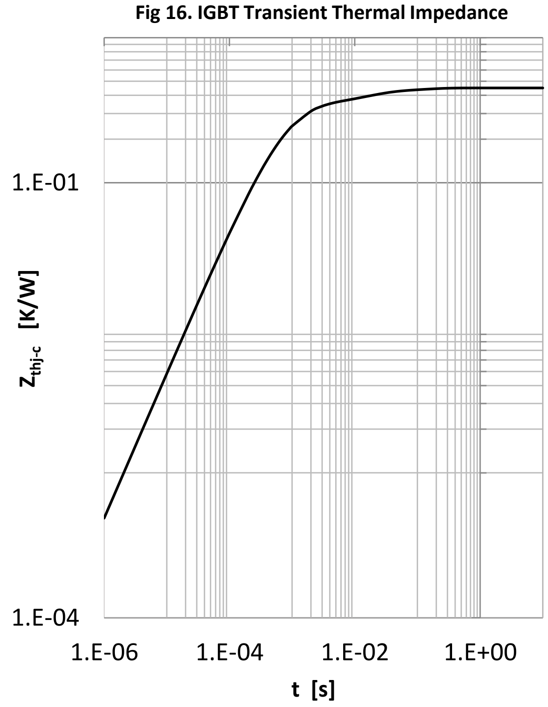


Fig 17. Diode Transient Thermal Impedance

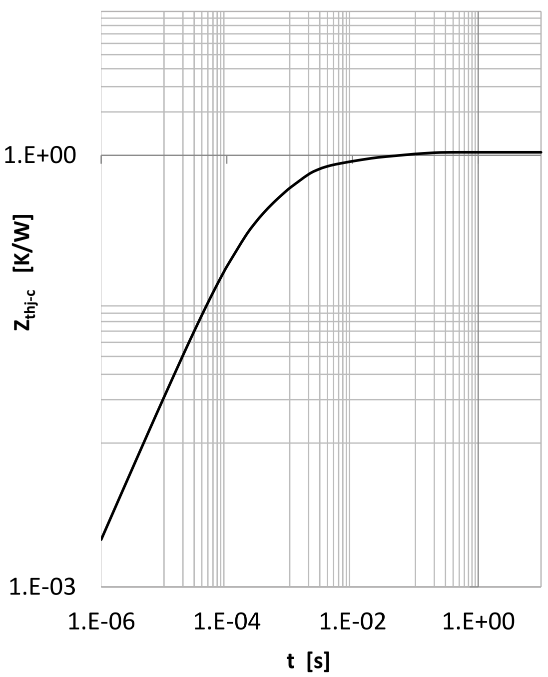


Fig18. Diode forawrd current as a function of foraward voltage

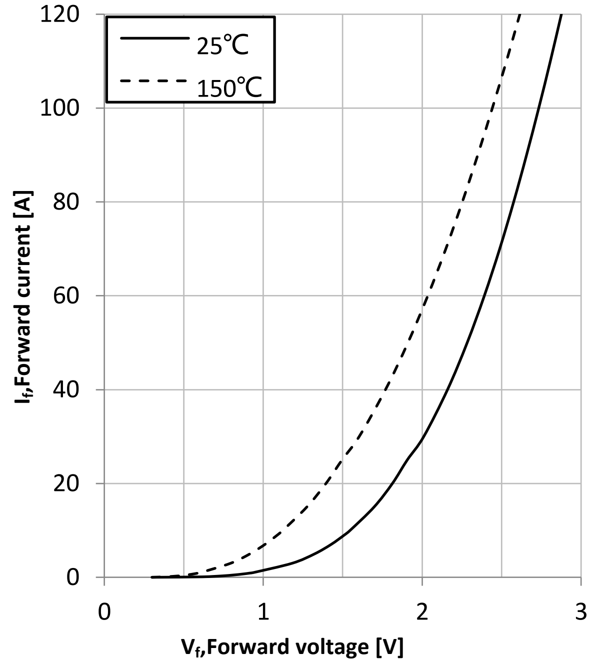


Fig19. Typical diode foraward voltageas a function of Junction temperature

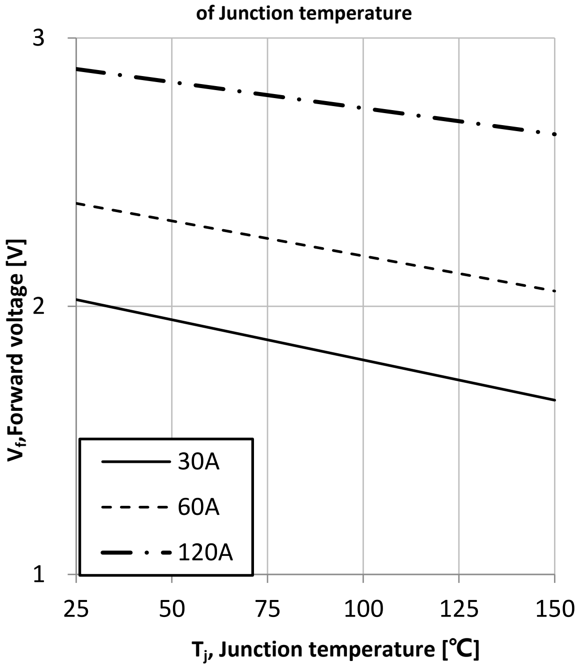
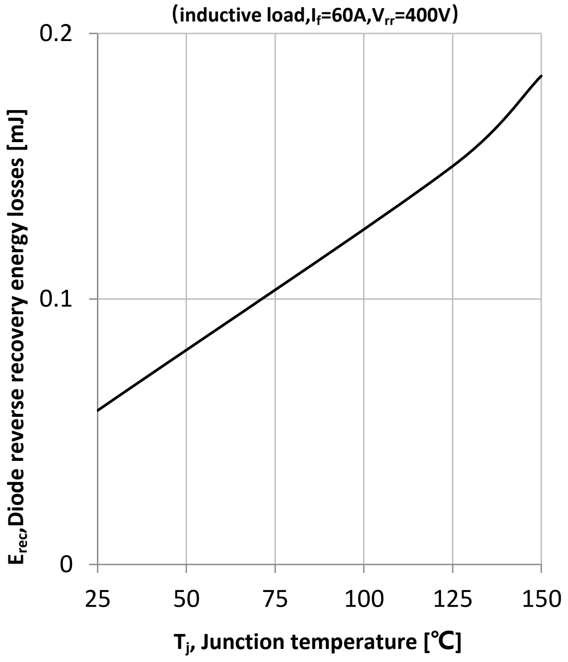


Fig20. Typical diode reverse recovery energy losses as a fuction of Junction temperature (inductive load,I_f=60A,V_{rr}=400V)



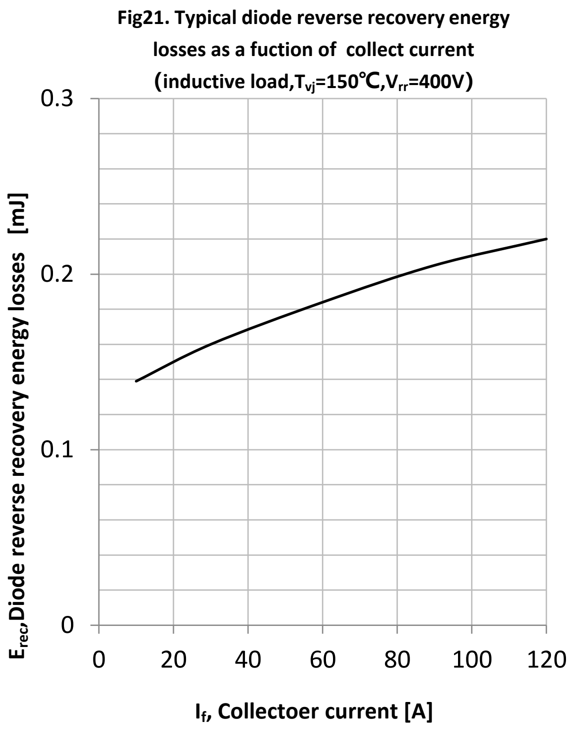


Fig21. Typical diode reverse recovery energy
losses as a fuction of collect current
(inductive load,Tvj=150℃,Vrr=400V)
0.3
0.2
0.1
0
0
20
40
60
80
100
120
Erec,Diode reverse recovery energy losses [mJ]
If, Collectoer current [A]

Ordering Information

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