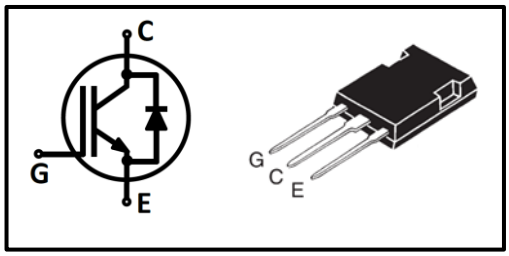
Features

- Easy parallel switching capability due to positive temperature coefficient in V_{CEsat}
- Low V_{CEsat}, fast switching
- High ruggedness, good thermal stability
- Very tight parameter distribution

Applications

- Motor drives
- Main inverter
- PTC heater
- Climate Compressor

Type	Marking	Package Code
MPBQ120N65GSF	MP120N65GSF	TO-247-3L Plus



Maximum Rated Values [1]

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CE}	650	V
DC collector current[2]			A
T_C=25℃	I_C	220	
T_C=126℃		120	
Pulsed collector current[3]	I_{Cpuls}	360	
Diode forward current[2]			
T_C=25℃	I_F	220	
T_C=100℃		120	
Diode pulsed current[3]	I_{Fpuls}	360	
Gate-emitter voltage	V_{GE}	±20	V
Transient Gate-emitter voltage（t_p≤10us)		±30	
Short circuit withstand time V_{GE}=15.0V, V_{CE}=400V	t_{SC}	5	μs
Power dissipation			W
T_C=25℃	P_{tot}	834	
T_C=100℃		417	
Operating junction temperature	T_{vj}	-55~175	℃
Storage temperature	T_{stg}	-55~150	

1:Reference standard: JESD-022 2: limited by T_{vjmax} 3: T_p limited by T_{vjmax} ;

Thermal Characteristics

Parameter	Symbol	Min	Typ	Max	Unit
IGBT thermal resistance, junction-case	R_{thJC}	-	-	0.18	K/W
Diode thermal resistance, junction-case	R_{thJCD}	-	-	0.32	
Thermal Resistance, junction-ambient	R_{thJA}	-	-	40	

Electrical Characteristics（at T_{vj}=25℃, unless otherwise specified）

Static Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Collector-emitter breakdown voltage	$V_{(BR)CES}$	V_{GE}=0V, I_C=0.25mA	650	-	-	V
Collector-emitter saturation voltage	$V_{CE(sat)}$	V_{GE}=15V, I_C=120A T_{vj}=25℃	-	1.30	1.60	
		T_{vj}=125℃	-	1.44	-	
		T_{vj}=175℃	-	1.52	-	
Diode forward voltage	V_F	V_{GE}=0V， I_F=120A T_{vj}=25℃	1.35	1.70	2.10	
		T_{vj}=125℃	-	1.60	-	
		T_{vj}=175℃	-	1.52	-	
G-E threshold voltage	$V_{GE(th)}$	I_C=1.6mA, V_{CE}=V_{GE}	4.7	5.7	6.7	
C-E leakage current	I_{CES}	V_{CE}=650V, V_{GE}=0V T_{vj}=25℃	-	-	0.1	mA
		T_{vj}=175℃	-	4.0	-	
G-E leakage current	I_{GES}	V_{CE}=0V, V_{GE}=20V	-	-	250	nA

Dynamic Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Input capacitance	C_{iss}	V_{CE}=25V, V_{GE}=0V, f=1MHz	-	10963	-	pF
Output capacitance	C_{oss}		-	473	-	
Reverse transfer capacitance	C_{rss}		-	94	-	
Gate charge	Q_G	V_{CC}=300V, I_C=120A, V_{GE}=15V	-	404	-	nC

IGBT Switching Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Turn-on delay time	$t_{d(on)}$	T_{vj}=25℃, V_{CC}=400V, I_C=120A, V_{GE}=0/15V, R_G=10Ω, Inductive load	-	142	-	ns
Rise time	t_r		-	70	-	
Turn-off delay time	$t_{d(off)}$		-	484	-	
Fall time	t_f		-	158	-	
Turn-on energy	E_{on}		-	7.80	-	mJ
Turn-off energy	E_{off}		-	6.02	-	
Total switching energy	E_{ts}		-	13.82	-	
Turn-on delay time	$t_{d(on)}$	T_{vj}=175℃, V_{CC}=400V, I_C=120A, V_{GE}=0/15V, R_G=10Ω, Inductive load	-	128	-	ns
Rise time	t_r		-	84.4	-	
Turn-off delay time	$t_{d(off)}$		-	565.8	-	
Fall time	t_f		-	150.4	-	
Turn-on energy	E_{on}		-	12.75	-	mJ
Turn-off energy	E_{off}		-	6.44	-	
Total switching energy	E_{ts}		-	19.19	-	

Diode Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Diode reverse recovery time	t_{rr}	T_{vj}=25℃, V_R=400V, I_F=120A, di_F/dt=1000A/μs	-	159	-	ns
Diode reverse recovery charge	Q_{rr}		-	2.154	-	μC
Diode peak reverse recovery current	I_{rrm}		-	31.2	-	A
Diode reverse recovery time	t_{rr}	T_{vj}=175℃, V_R=400V, I_F=120A, di_F/dt=1000A/μs		255		ns
Diode reverse recovery charge	Q_{rr}			6.962		μC
Diode peak reverse recovery current	I_{rrm}			40.8		A

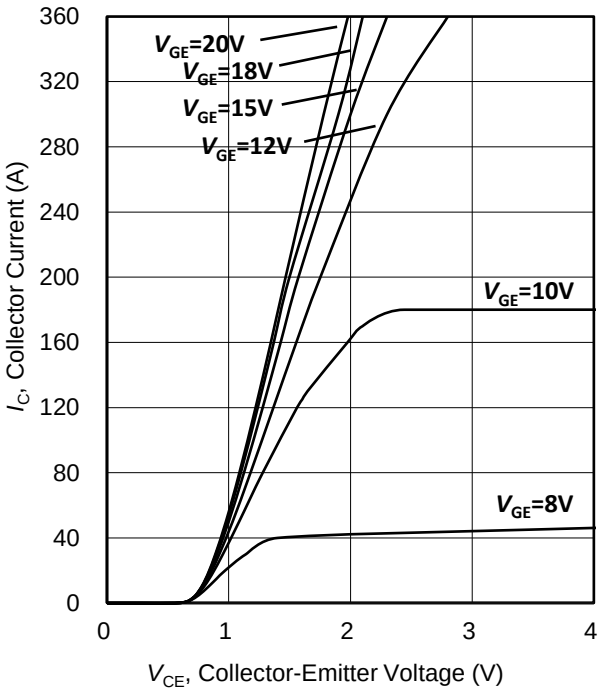


Figure 1. Typical output characteristic
(T_{vj}=25℃)

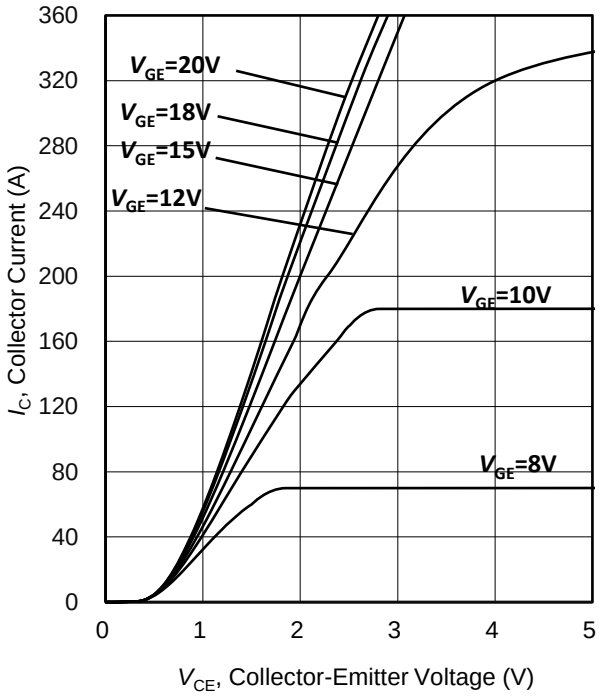


Figure 2. Typical output characteristic
(T_{vj} =175℃)

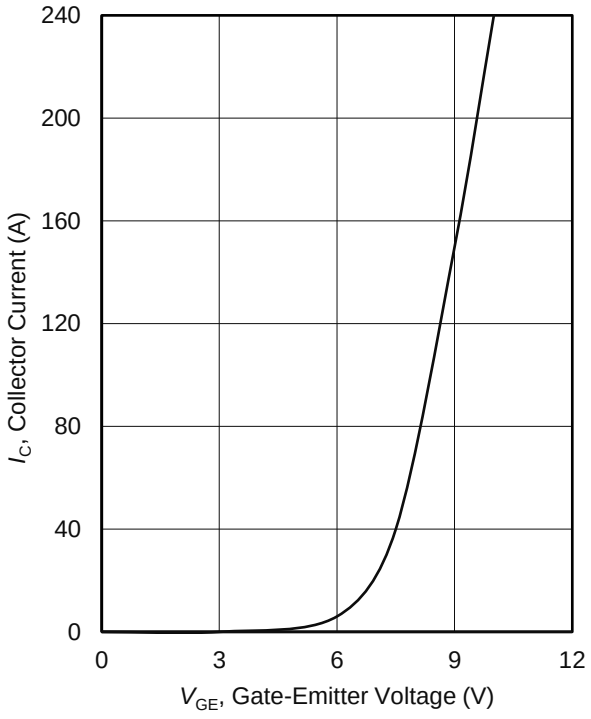


Figure 3. Typical transfer characteristic
(V_{CE}=20V)

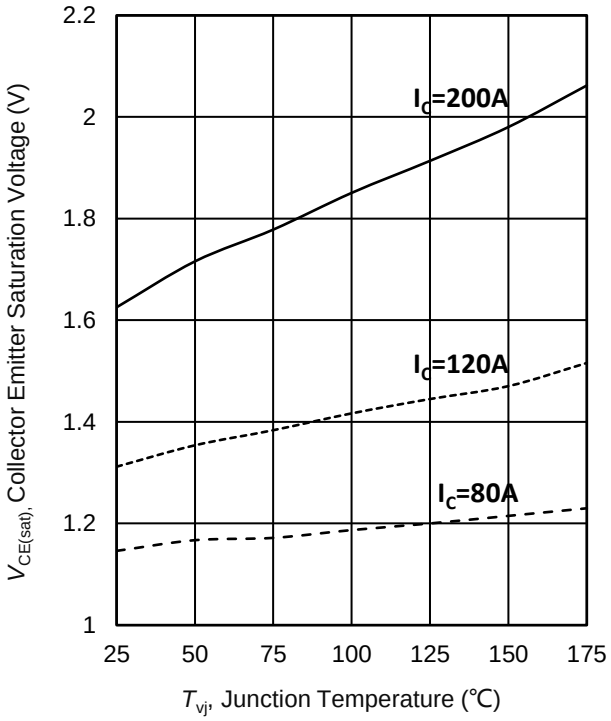


Figure 4. Typical collector-emitter saturation voltage as a function of junction temperature
(V_{GE}=15V)

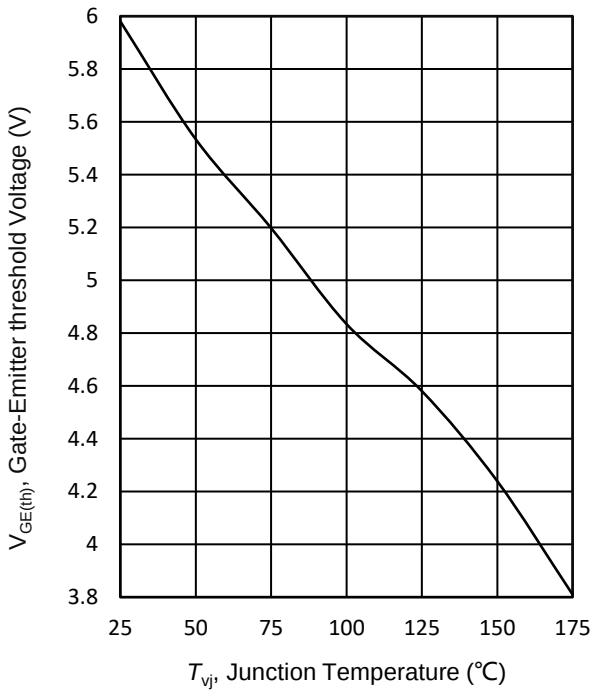


Figure 5. Gate-emitter threshold voltage as a function of junction temperature
(I_{CE}=0.25mA)

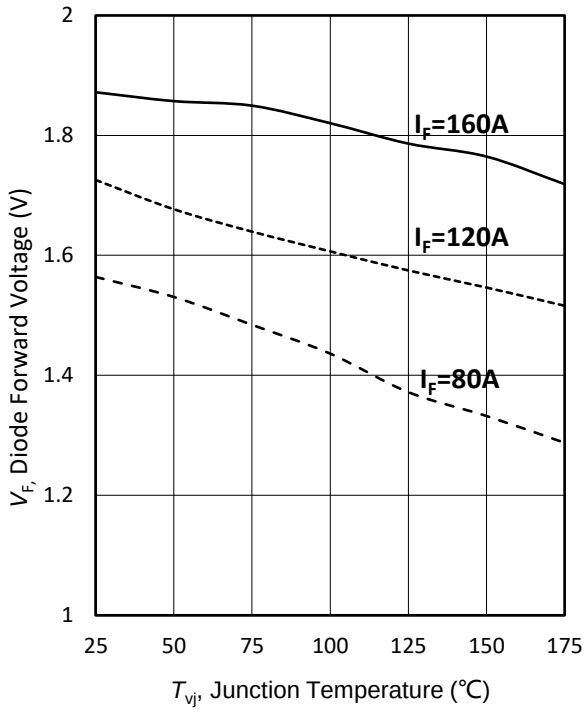


Figure 6. Typical diode forward voltage as a function of junction temperature

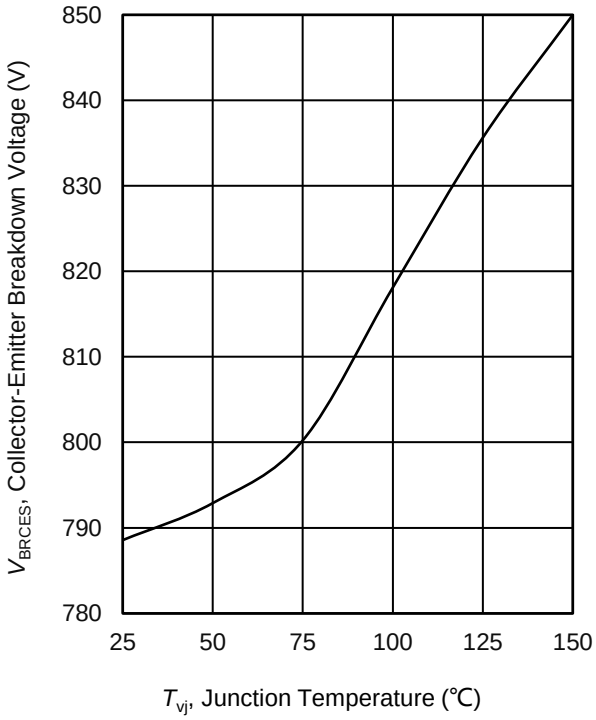


Figure 7. Collector-emitter breakdown voltage as a function of junction temperature
(I_{CE}=0.25mA)

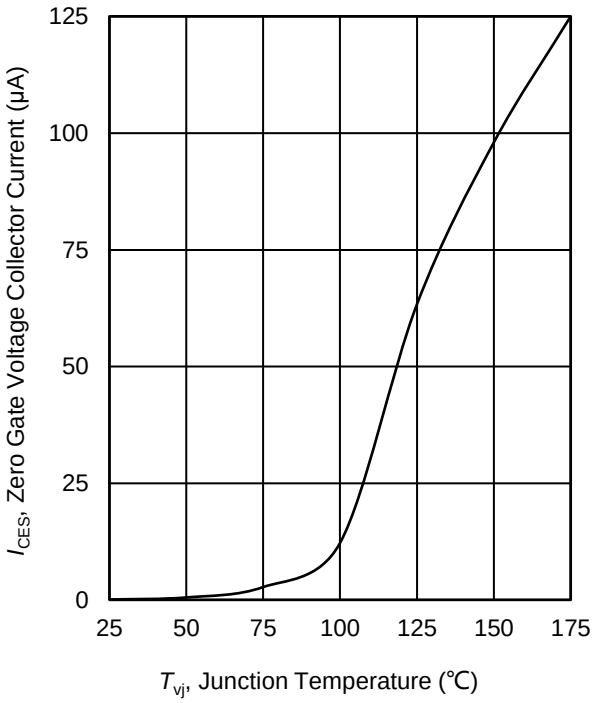


Figure 8. Zero gate voltage collector current as a function of junction temperature
(V_{CE}=650V)

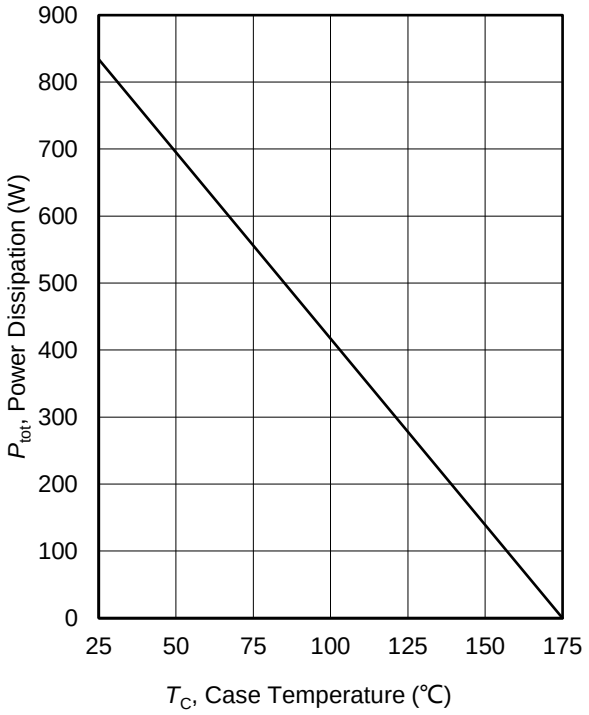


Figure 9. Power dissipation as a function of case temperature
(T_{vj}≤175 ℃)

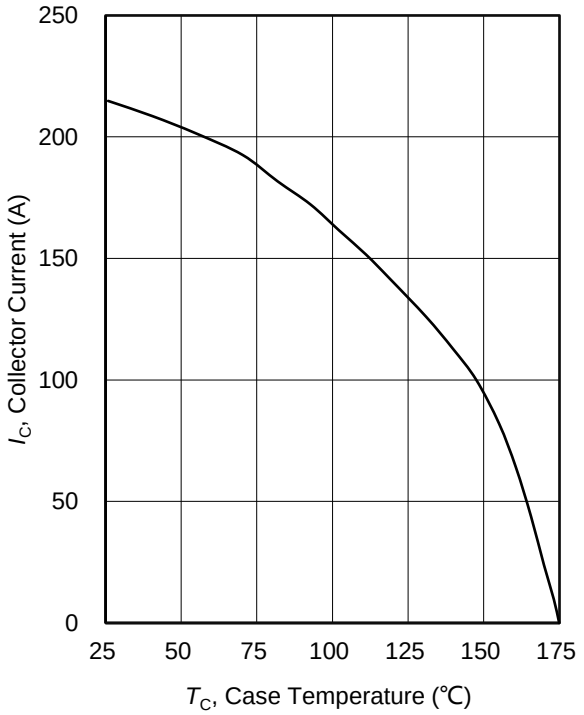


Figure 10. Collector current as a function of case temperature
(V_{GE}≥15V, T_{vj}≤175 ℃)

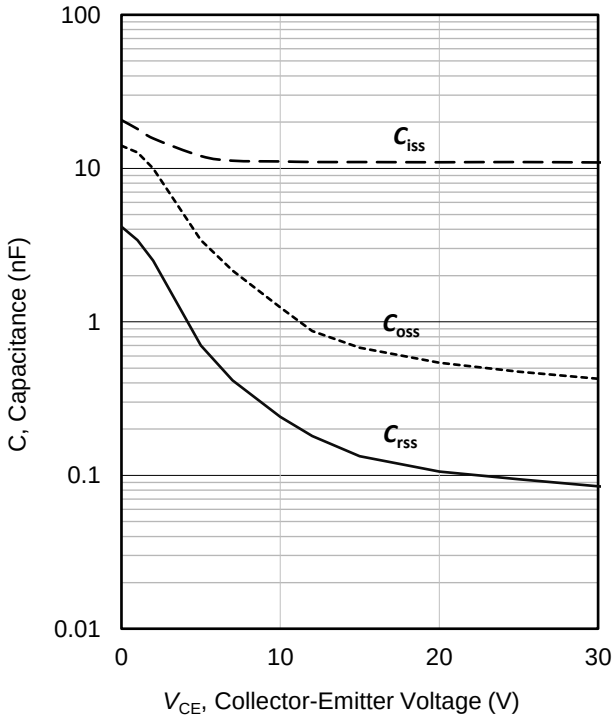


Figure 11. Capacitance characteristic
(V_{GE}=0V, f=1MHz)

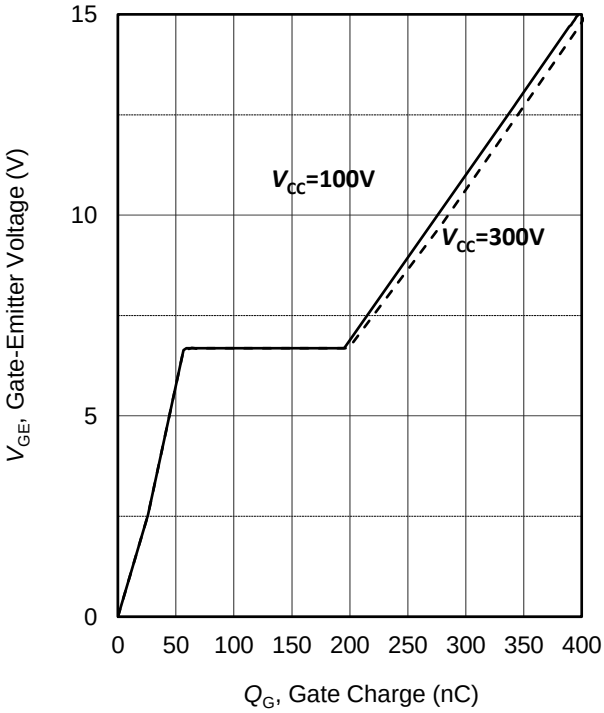


Figure 12. Typical gate charge
(I_C=120A)

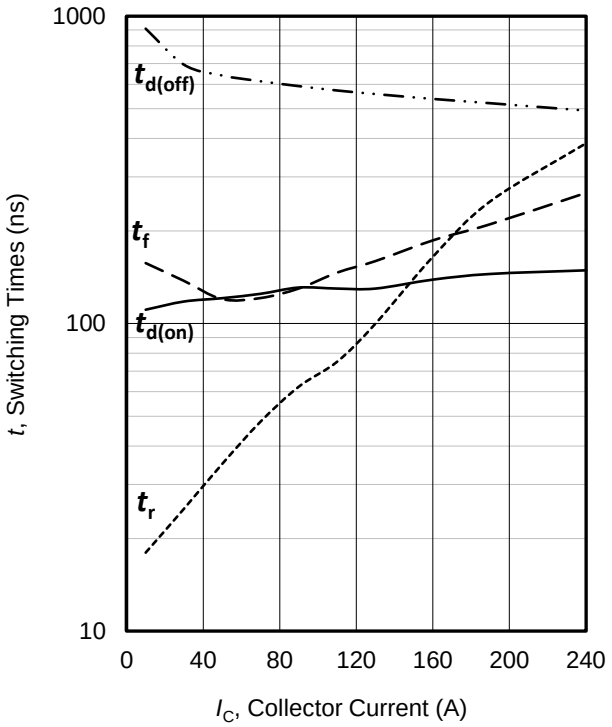


Figure 13. Typical switching times as a function of collector current
(T_{vj}=175 ℃, V_{CE}=400V, $R_{G(on)}$=$R_{G(off)}$=10Ω)

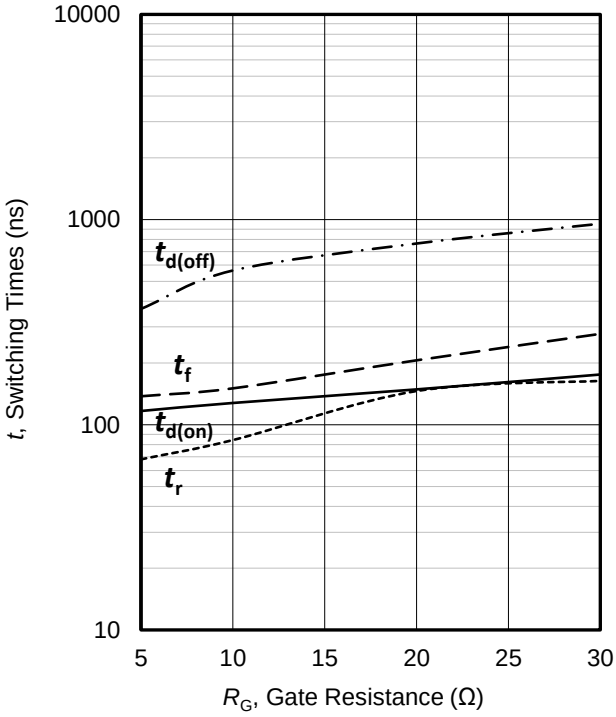


Figure 14. Typical switching times as a function of gate resistance
(T_{vj}=175 ℃, V_{CE}=400V, I_C=120A)

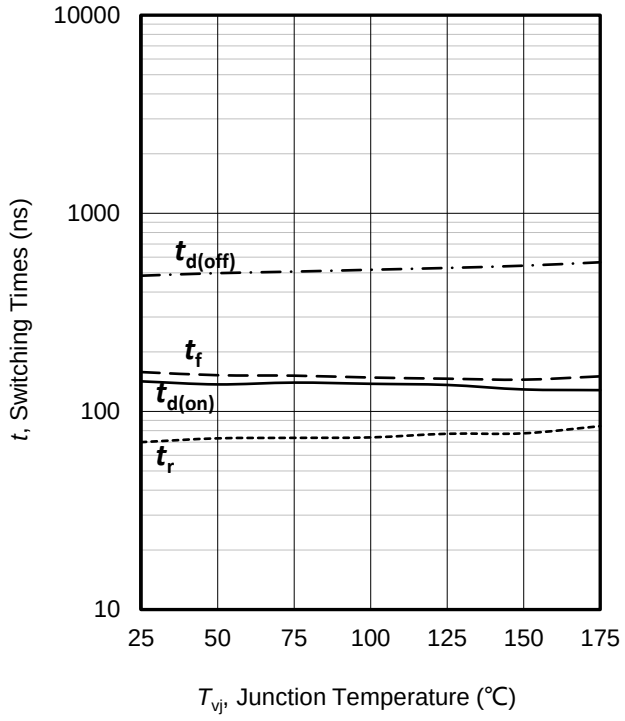


Figure 15. Typical switching times as a function of junction temperature
(V_{CE}=400V, I_C=120A, $R_{G(on)}$=$R_{G(off)}$=10Ω)

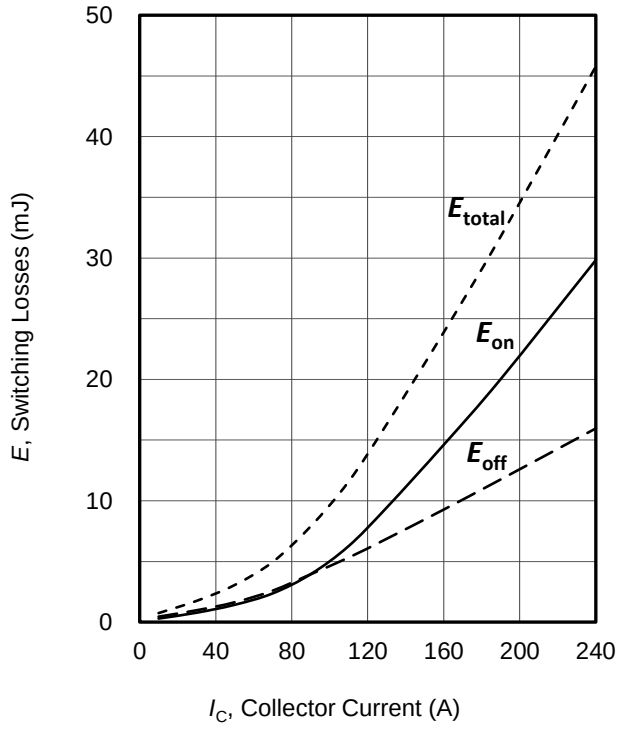


Figure 16. Typical switching energy losses as a function of collector current
(T_{vj}=25 ℃, V_{CE}=400V, $R_{G(on)}$=$R_{G(off)}$=10Ω)

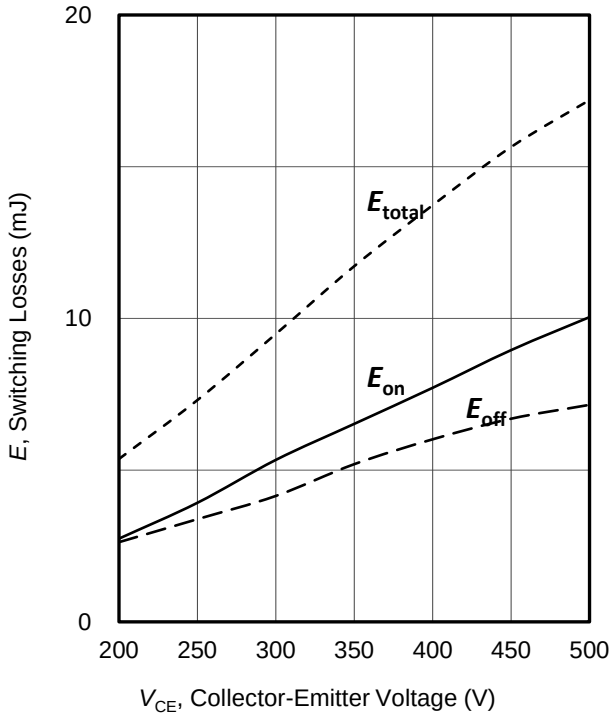


Figure 17. Typical switching energy losses as a function of V_{CE}
(T_{vj}=25 ℃, I_C=120A, R_G=10Ω, V_{GE}=15/0V)

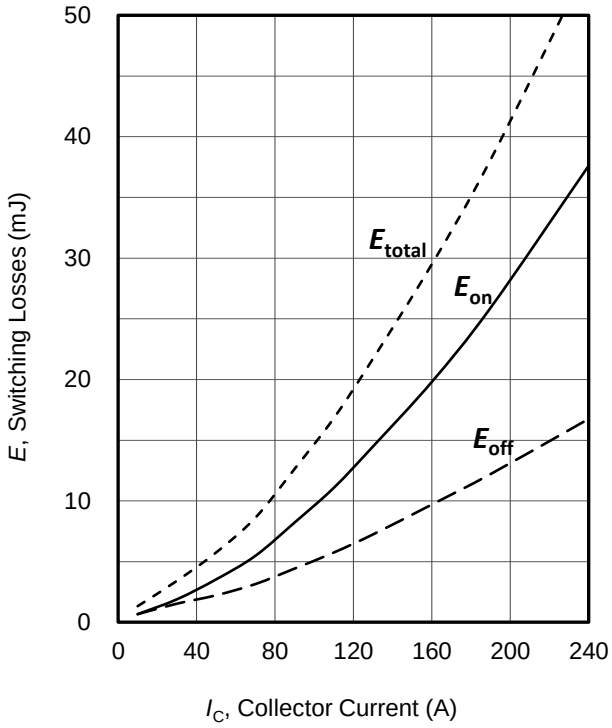


Figure 18. Typical switching energy losses as a function of I_C
(T_{vj}=175 ℃, V_{CE}=400V, $R_{G(on)}$=$R_{G(off)}$=10Ω)

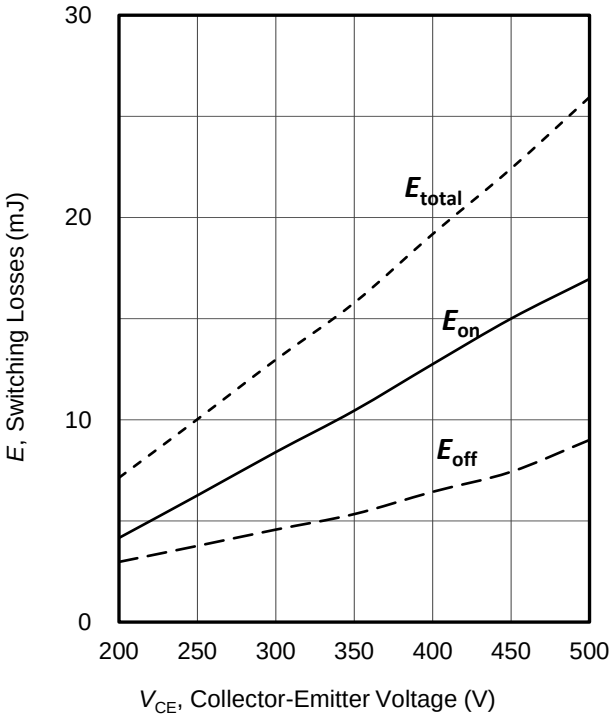


Figure 19. Typical switching energy losses as a function of V_{CE}
(T_{vj}=175 ℃, I_C=120A, R_G=10Ω, V_{GE}=15/0V)

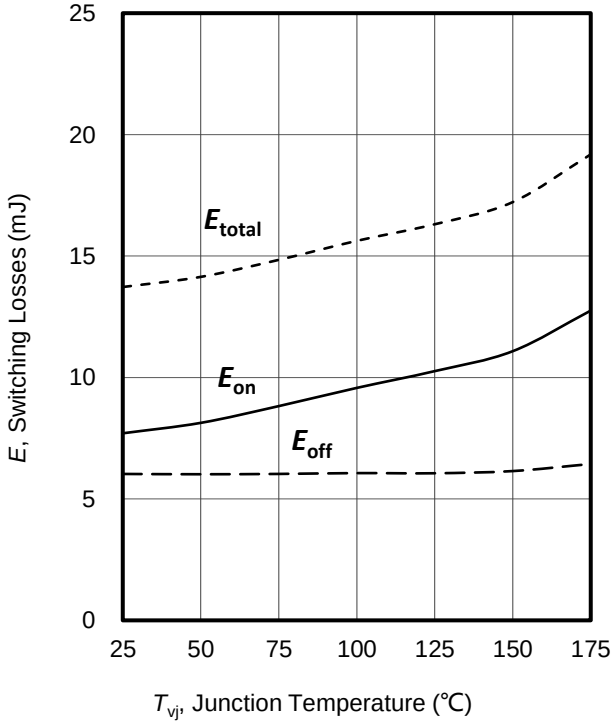


Figure 20. Typical switching energy losses as a function of junction temperature
(V_{CE}=400V, I_C=120A, R_G=10Ω, V_{GE}=15/0V)

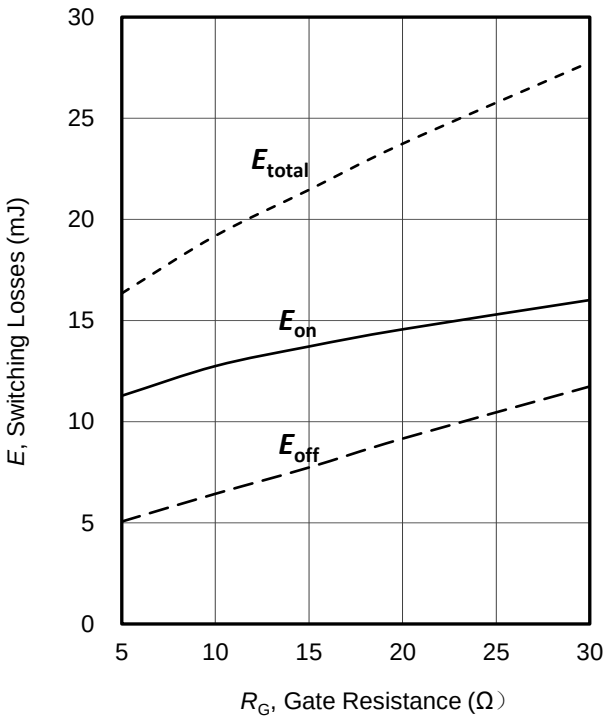


Figure 21. Typical switching energy losses as a function of gate resistance
(T_{vj}=175 ℃)

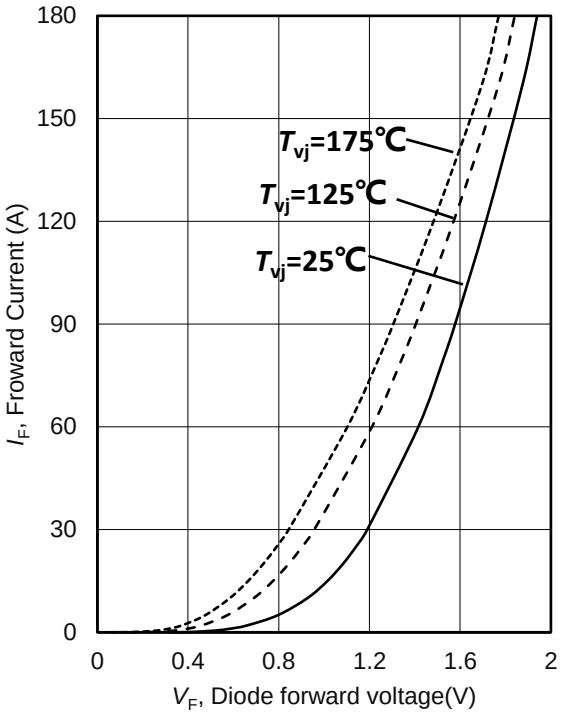


Figure 22. Typical diode forward current as a function of forward voltage

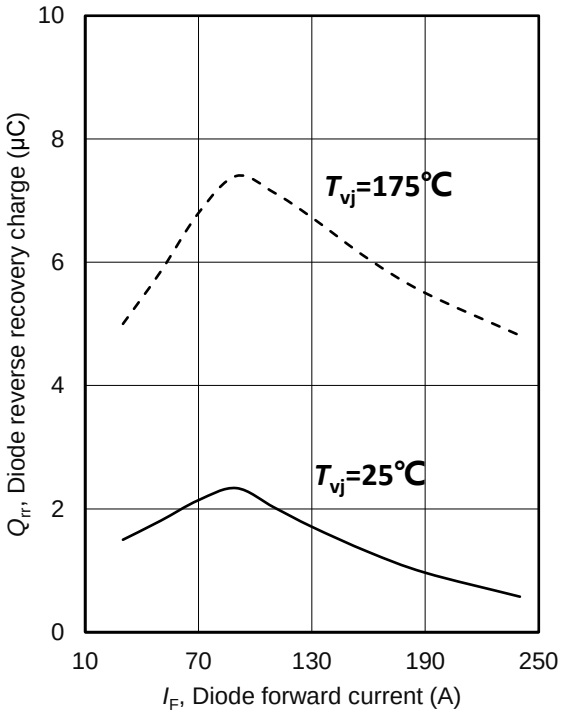


Figure 23. Typical diode reverse recovery charge as a function of diode forward current
(V_{CE}=400V, $R_{G(on)}$=$R_{G(off)}$=10Ω)

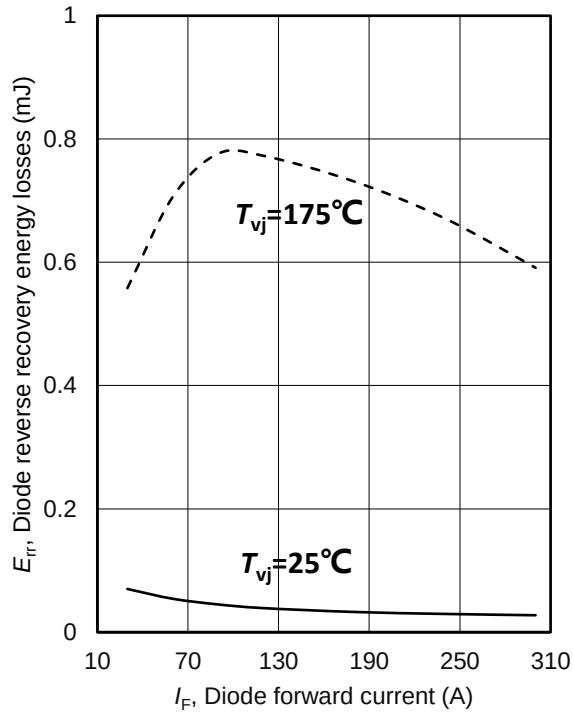
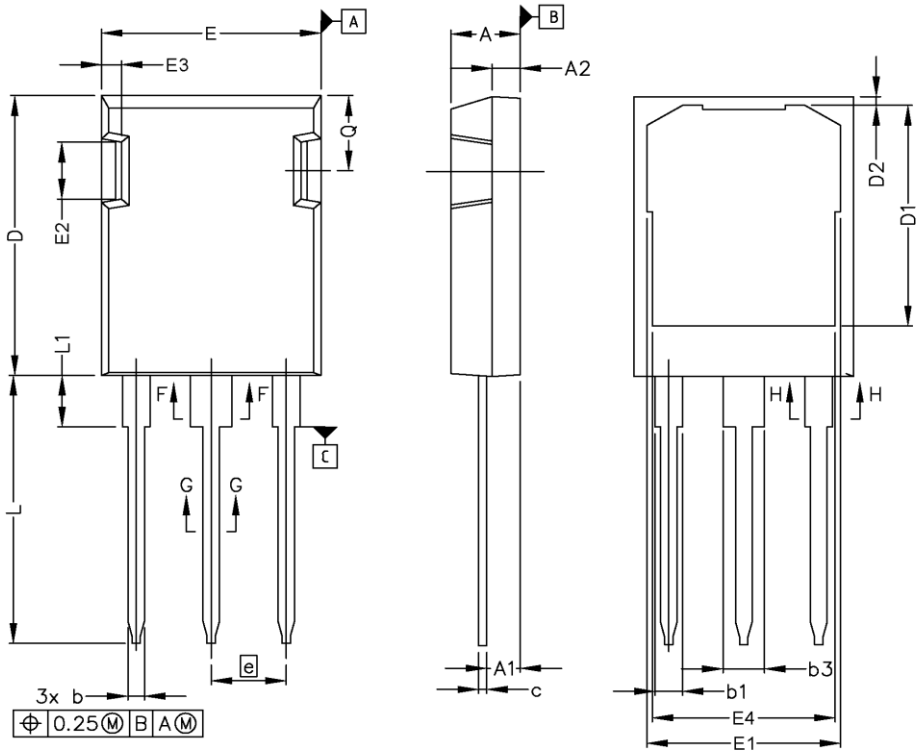


Figure 24. Typical diode reverse recovery energy losses as a function of diode forward current

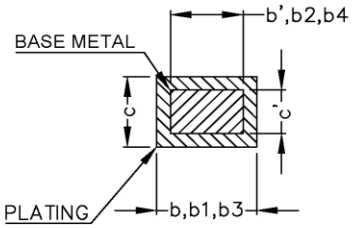
TO-247-3L Plus



SYMBOL	MIN	MAX
A	4.83	5.21
A1	2.29	2.54
A2	1.91	2.16
b'	1.07	1.28
b	1.07	1.33
b1	1.91	2.41
b2	1.91	2.16
b3	2.87	3.38
b4	2.87	3.13
c'	0.55	0.65
c	0.55	0.68
D	20.80	21.10
D1	16.25	17.65
D2	0.50	0.80
E	15.75	16.13
E1	13.10	14.15
E2	3.68	5.10
E3	1.00	1.90
E4	12.38	13.43
e	5.44 BSC	
N	3	
L	19.81	20.32
L1	3.70	4.00
Q	5.49	6.00

NOTE ;
1. ALL METAL SURFACES: TIN PLATED,EXCEPT AREA OF CUT
2. DIMENSIONING & TOLERANCEING CONFIRM TO ASME Y14.5M-1994.
3. ALL DIMENSIONS ARE IN MILLIMETERS. ANGLES ARE IN DEGREES.
4. THIS DRAWING WILL MEET ALL DIMENSIONS REQUIREMENT OF JEDEC outlines TO-247 AD.

1 - GATE
2 - DRAIN (COLLECTOR)
3 - SOURCE (EMITTER)
4 - DRAIN (COLLECTOR)



SECTION "F-F", "G-G" AND "H-H"
SCALE: NONE

Revision History：

Revision	Date	Subjects (major changes since last revision)
1.0	2022-10	Initial Version
1.1	2023-03	Add the graphs
1.2	2023-06	Add E_{on}, E_{off}-R_G
1.3	2023-07	Add t-R_G/I_C/T_{vj}
1.4	2023-08	Add FRD related graphs

Terms & Conditions of usage

1. The product specifications, characteristics, data, materials and structures given in this datasheet are subject to change without notice.

2. The information given in this datasheet shall in no event be regarded as a guarantee of conditions or characteristics. Marching-Power Technology Co., Ltd. does not warrant or assume any legal liability or responsibility for the accuracy and completeness of any examples, hints or any typical values stated herein and/or any information regarding the application of the product.

3. This datasheet is only used as a reference for customers to apply our products, Marching-Power Technology Co., Ltd. does not undertake to permit the use of intellectual property rights or any third-party property rights related to the product information described in this datasheet.

4. Although Marching-Power Technology Co., Ltd. is committed to enhancing product quality and reliability, all semiconductor products still have a probability of failure. When using Marching-Power semiconductor products in your equipment, you are requested to take adequate safety measures to prevent the equipment from causing accidents or events including but not limited to physical injury, fire or damage to other property if any of the products become faulty.

5. The products introduced in this datasheet are electrostatic sensitive devices and must be protected against static electricity during device installation, testing, packaging, storage and transportation.

6. Do not use the products introduced in this datasheet in equipment or systems that requiring strict reliability or/and may directly endanger human life such as medical, life-saving, life-sustaining, space equipment, aeronautic equipment, nuclear equipment submarine repeater equipment and equivalents to strategic equipment (without limitation).

7. No part of this datasheet may be disseminated and reproduced in any form or by any means without prior written permission from Marching-Power Technology Co., Ltd.

8. The data contained in this datasheet is exclusively intended for use by professional technicians only. It is the responsibility of the customer's own technical departments to evaluate the suitability of the product for the intended application and the completeness of the product information given in this document with respect to corresponding application. If you have any question about any portion in this datasheet, contact Marching-Power Technology Co., Ltd. before using the product. Marching-Power Technology Co., Ltd. shall not be liable for any injury caused by any use of the products not in accordance with instructions set forth herein.