



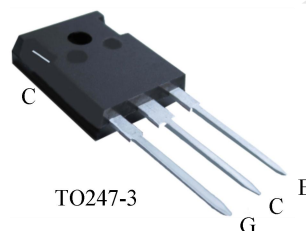
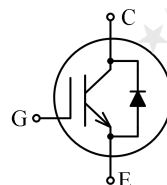
IGBT in advanced Trench FS Technology with soft and fast recovery anti-parallel diode

具有先进 Trench FS 技术的 IGBT 且反并联软快恢复二极管

Features

特性

- 650V trench field-stop technology
650V沟槽场终止技术
- Low saturation voltage
低饱和压降
- Negative temperature coefficient of forward voltage
正向电压负温度系数
- Low gate charge
低栅极电荷



Applications

应用

- Electric Automotive Air-Condition Compressor
电动汽车空调压缩机
- Electric Automotive PTC Heater
汽车PTC加热器
- Inverter
变频器

Ordering Information

订货信息

Type 型号	$V_{CE}[V]$ 集电极-发射极电压	$I_c[A]$ 集电极电流	$V_{CEsat}[V]$ 饱和电压	$T_{jmax}[^{\circ}C]$ 最高结温	Marking 标记	Package 封装
BGNE60V65SD	650	60	1.5	175	60V65SD	TO-247-3L



Maximum Rated Values

最大额定参数

Parameter 参数	Symbol 符号	Value 值	Unit 单位
Collector-emitter voltage, $T_j \geq 25^\circ\text{C}$ 集电极-发射极电压, $T_j \geq 25^\circ\text{C}$	V_{CE}	650	V
Collector current, $T_c = 25^\circ\text{C}$ 集电极电流, $T_c = 25^\circ\text{C}$	I_C	120	A
Collector current, $T_c = 100^\circ\text{C}$ 集电极电流, $T_c = 100^\circ\text{C}$	I_C	60	A
Pulsed collector current, t_p limited by T_{jmax} 集电极脉冲电流, 脉宽时间受 T_{jmax} 限制	I_{Cpuls}	240	A
Diode forward current, $T_c = 25^\circ\text{C}$ 二极管正向电流, $T_c = 25^\circ\text{C}$	I_F	120	A
Diode forward current, $T_c = 100^\circ\text{C}$ 二极管正向电流, $T_c = 100^\circ\text{C}$	I_F	60	A
Diode pulsed current 二极管脉冲电流	I_{Fpuls}	240	A
Gate-emitter voltage 栅极-发射极电压	V_{GE}	± 20	V
Total power dissipation, $T_c = 25^\circ\text{C}$ 总耗散功率, $T_c = 25^\circ\text{C}$	P_{tot}	364	W
Operating junction temperature 最高结温	T_{jmax}	175	$^\circ\text{C}$
Operating junction temperature 工作结温	T_{jop}	$-40 \dots +150$	$^\circ\text{C}$
Storage temperature 储存温度	T_{stg}	$-55 \dots +150$	$^\circ\text{C}$
Soldering temperature, 1.6mm from case for 10s 焊接温度	T_{st}	260	$^\circ\text{C}$

Thermal Resistance

热阻

Parameter 参数	Symbol 符号	Value 值	Unit 单位
IGBT Thermal resistance junction to case IGBT 结-管壳热阻	$R_{th(j-c)}$	0.34	$^\circ\text{C/W}$
Diode Thermal resistance junction to case 二极管结-管壳热阻	$R_{th(j-c)}$	0.40	$^\circ\text{C/W}$
Thermal resistance junction to ambient 结-环境热阻	$R_{th(j-a)}$	40	$^\circ\text{C/W}$



Electrical Characteristic at $T_j=25^\circ\text{C}$ (unless otherwise specified)

$T_j=25^\circ\text{C}$ 时电学特性（除非特别声明）

Parameter 参数	Symbol 符号	Conditions 条件	Value 值			Unit 单位
			Min. 最小值	Typ. 典型值	Max. 最大值	

Static Characteristic

静态特性

Collector-emitter breakdown voltage 集电极-发射极击穿电压	$V_{(BR)CES}$	$V_{GE}=0V, I_C=100\mu A$		650	-	-	V
Collector-emitter saturation voltage 集电极-发射极饱和电压	V_{CEsat}	$V_{GE}=15V,$ $I_C=60A$	$T_j=25^{\circ}C$	-	1.5	2.0	V
			$T_j=150^{\circ}C$	-	1.8	-	V
Diode forward voltage 二极管正向电压	V_F	$V_{GE}=0V,$ $I_F=60A$	$T_j=25^{\circ}C$	-	1.7	2.3	V
			$T_j=150^{\circ}C$	-	1.4	-	V
Gate-emitter threshold voltage 栅极-发射极阈值电压	$V_{GE(th)}$	$I_C=300\mu A, V_{CE}=V_{GE}$		4	4.9	6	V
Collector-emitter cut-off current 集电极-发射极截止电流	I_{CES}	$V_{CE}=650V, V_{GE}=0V$		-	-	100	μA
Gate-emitter leakage current 栅极-发射极漏电流	I_{GES}	$V_{CE}=0V, V_{GE}=\pm 20V$		-100	-	100	nA

Dynamic Characteristic

动态特性

Input capacitance 输入电容	C_{ies}	$V_{CE}=25V,$ $V_{GE}=0V,$ $f=1\text{MHz}$	-	2743	-	pF
Output capacitance 输出电容	C_{oes}		-	212	-	pF
Reverse transfer capacitance 反向传输电容	C_{res}		-	22	-	pF
Gate charge 门极电阻	R_G	$V_{GE}=0V,$ $V_{CE}=0V,$ $f=1\text{MHz}$	-	0.8	-	Ω

Notes:

a: FRD features negative temperature coefficient. Parallel connection is forbidden.

注:

a: FRD 负温度系数，禁止并联使用。



Switching Characteristic at $T_j=25^\circ\text{C}$ (Inductive Load)

$T_j=25^\circ\text{C}$ 时开关特性（感性负载）

Parameter 参数	Symbol 符号	Conditions 条件	Value 值			Unit 单位
			Min. 最小值	Typ. 典型值	Max. 最大值	

IGBT Characteristic

IGBT 特性

Turn-on delay time 开通延迟时间	$t_{d(on)}$	$V_{CE}=400V$, $I_C=60A$, $V_{GE}=15V$, $R_G=10\Omega$, $T_j=25^\circ\text{C}$, Energy losses include “tail” and diode reverse recovery.	-	59	-	ns
Rise time 上升时间	t_r		-	110	-	ns
Turn-off delay time 关断延迟时间	$t_{d(off)}$		-	124	-	ns
Fall time 下降时间	t_f		-	74	-	ns
Turn-on energy 开通损耗	E_{on}		-	2.5	-	mJ
Turn-off energy 关断损耗	E_{off}		-	1.5	-	mJ
Total switching energy 总开关损耗	E_{ts}		-	4.0	-	mJ

Anti-Parallel Diode Characteristic

反并联二极管特性

Reverse recovery time 反向恢复时间	t_{rr}	$V_R=400V$, $I_F=60A$, $R_G=10\Omega$, $T_j=25^\circ\text{C}$	-	147	-	ns
Reverse recovery charge 反向恢复电荷	Q_{rr}		-	1.7	-	μC
Peak reverse recovery current 反向恢复峰值电流	I_{rrm}		-	16.3	-	A
Reverse recovered energy 反向恢复损耗	E_{rec}		-	0.5	-	mJ



Switching Characteristic at $T_j=150^{\circ}\text{C}$ (Inductive Load)

$T_j=150^{\circ}\text{C}$ 时开关特性（感性负载）

Parameter 参数	Symbol 符号	Conditions 条件	Value 值			Unit 单位
			Min. 最小值	Typ. 典型值	Max. 最大值	

IGBT Characteristic

IGBT 特性

Turn-on delay time 开通延迟时间	$t_{d(on)}$	$V_{CE}=400V,$ $I_C=60A,$ $V_{GE}=15V,$ $R_G=10\Omega,$ $T_j=150^{\circ}\text{C},$ Energy losses include “tail” and diode reverse recovery.	-	55	-	ns
Rise time 上升时间	t_r		-	111	-	ns
Turn-off delay time 关断延迟时间	$t_{d(off)}$		-	143	-	ns
Fall time 下降时间	t_f		-	90	-	ns
Turn-on energy 开通损耗	E_{on}		-	3.5	-	mJ
Turn-off energy 关断损耗	E_{off}		-	1.8	-	mJ
Total switching energy 总开关损耗	E_{ts}		-	5.3	-	mJ

Anti-Parallel Diode Characteristic

反并联二极管特性

Reverse recovery time 反向恢复时间	t_{rr}	$V_R=400V,$ $I_F=60A,$ $R_G=10\Omega,$ $T_j=150^{\circ}\text{C}$	-	228	-	ns
Reverse recovery charge 反向恢复电荷	Q_{rr}		-	4.5	-	μC
Peak reverse recovery current 反向恢复峰值电流	I_{rrm}		-	31.7	-	A
Reverse recovered energy 反向恢复损耗	E_{rec}		-	1.3	-	mJ



Typical Characteristics Diagrams

特性曲线

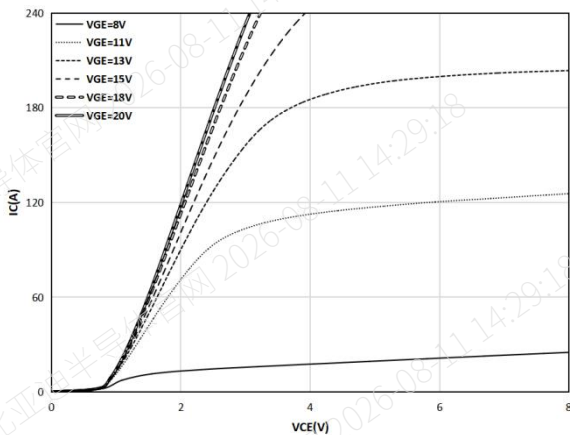


Figure 1. Typical output characteristic ($T_j=25^{\circ}\text{C}$)

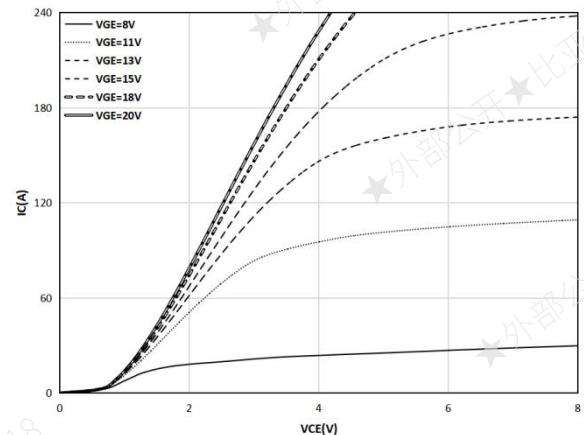


Figure 2. Typical output characteristic ($T_j=150^{\circ}\text{C}$)

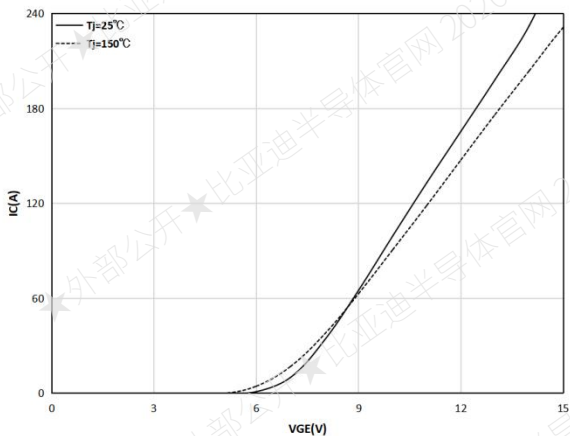


Figure 3. Typical transfer characteristic ($V_{ce}=20\text{V}$)

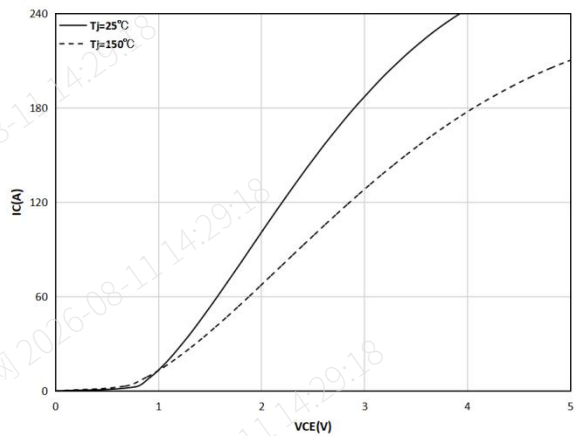


Figure 4. Typical collector current as a function of collector-emitter saturation voltage ($V_{ge}=15\text{V}$)

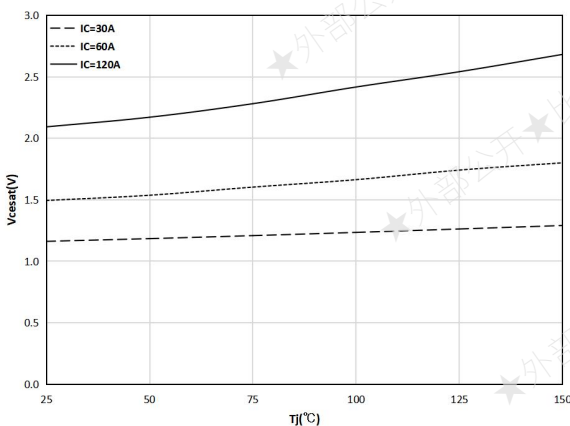


Figure 5. Typical collector-emitter saturation voltage as a function of junction temperature ($V_{ge}=15\text{V}$)

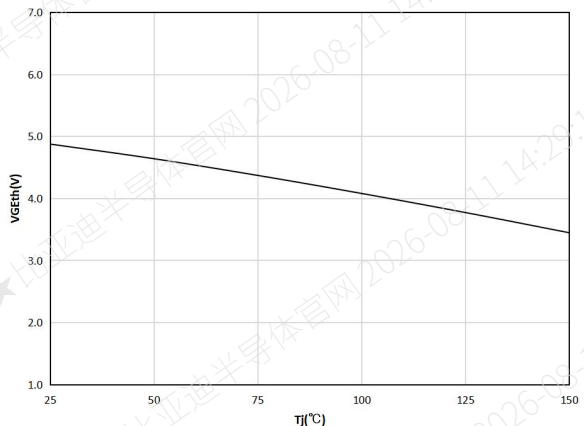


Figure 6. Gate-emitter threshold voltage as a function of junction temperature ($I_c=300\mu\text{A}$)

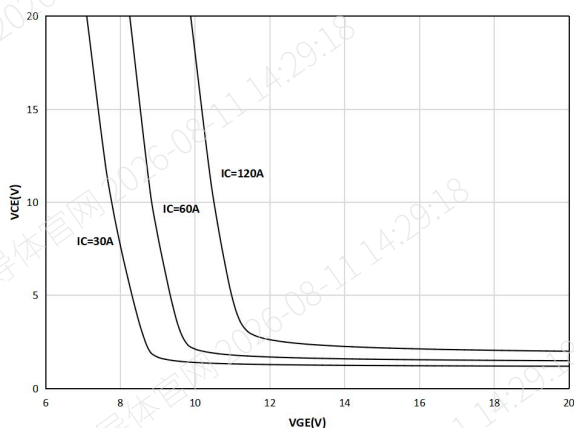


Figure 7. Typical collector-emitter saturation voltage as a function of gate-emitter voltage ($T_j=25^\circ\text{C}$)

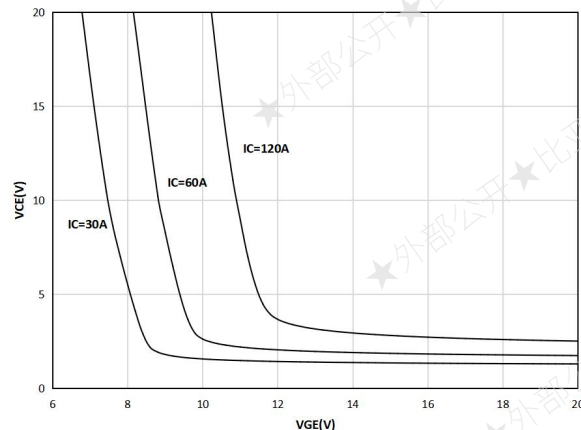


Figure 8. Typical collector-emitter saturation voltage as a function of gate-emitter voltage ($T_j=150^\circ\text{C}$)

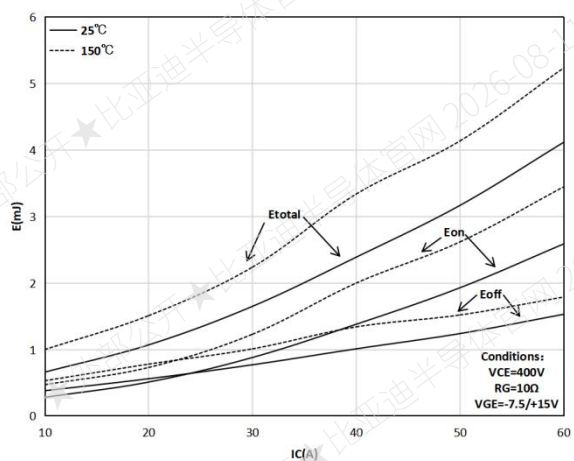


Figure 9. Typical switching energy losses as a function of collector current

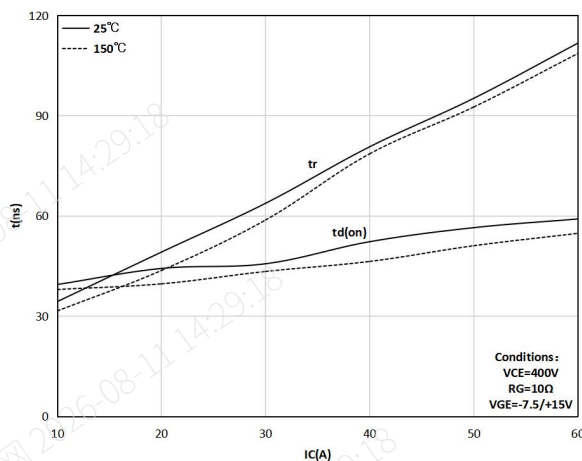


Figure 10. Typical turn-on characteristic as a function of collector current

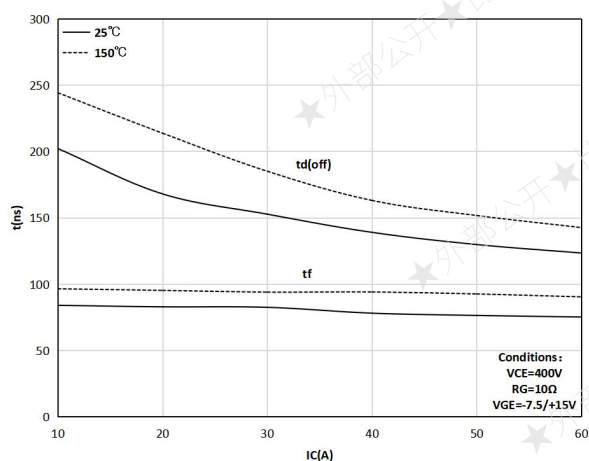


Figure 11. Typical turn-off characteristic as a function of collector current

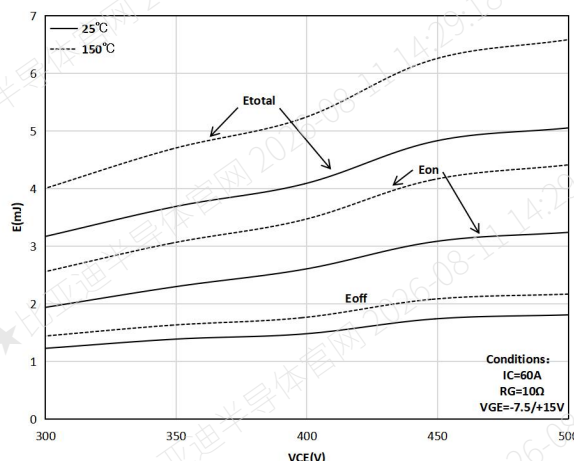


Figure 12. Typical switching energy losses as a function of collector emitter voltage

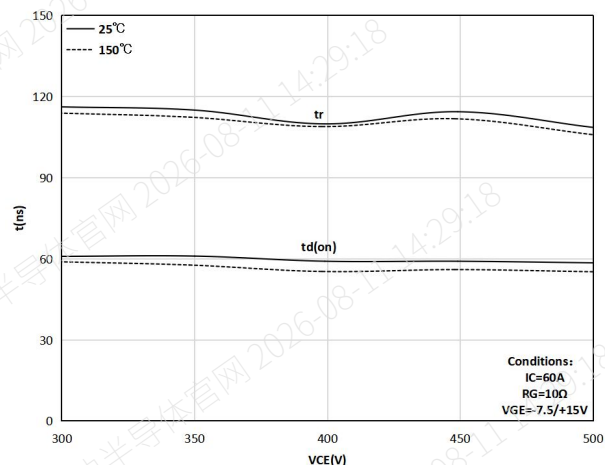


Figure 13. Typical turn-on characteristic as a function of collector emitter voltage

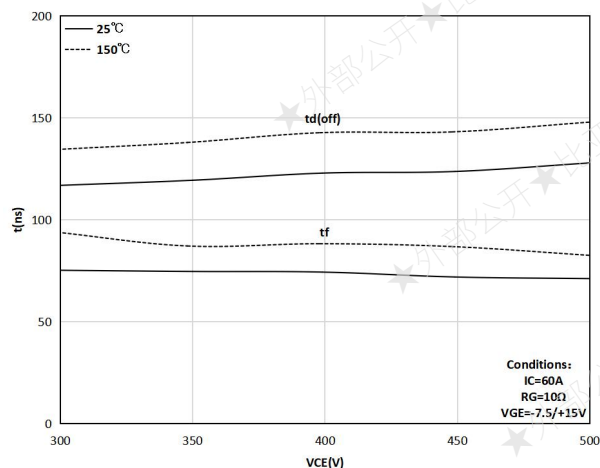


Figure 14. Typical turn-off characteristic as a function of collector emitter voltage

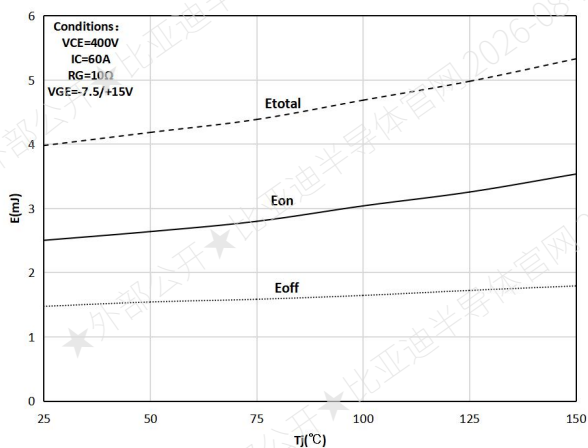


Figure 15. Typical switching energy losses as a function of junction temperature

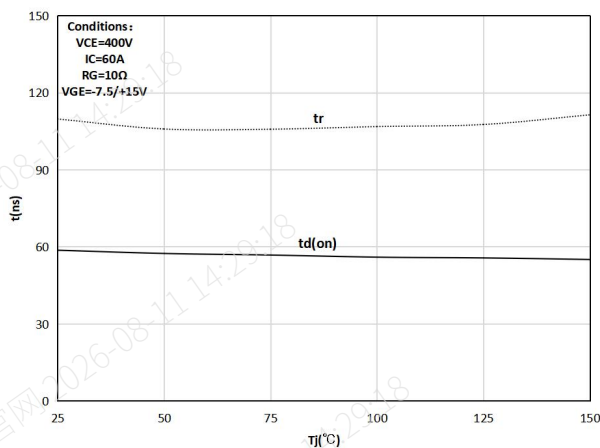


Figure 16. Typical turn-on characteristic as a function of junction temperature

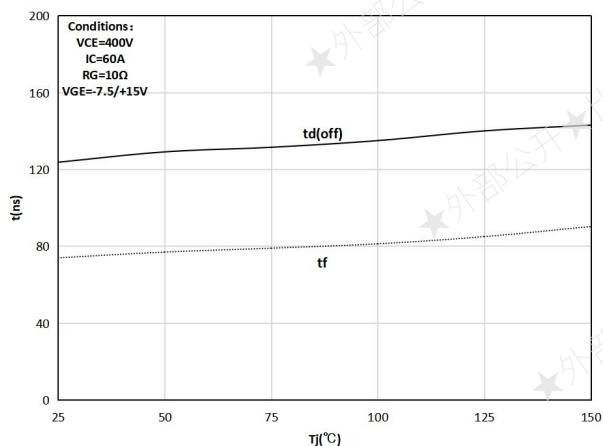


Figure 17. Typical turn-off characteristic as a function of junction temperature

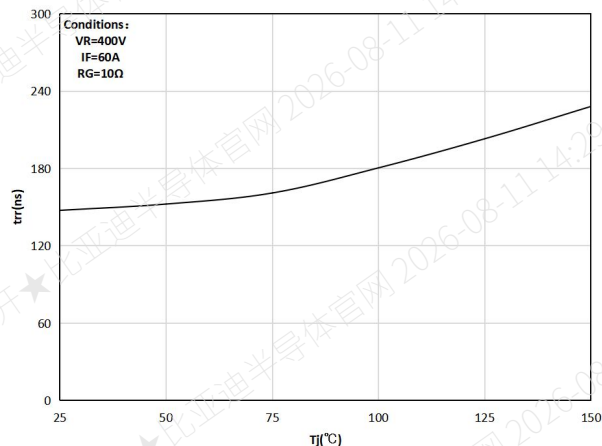


Figure 18. Typical reverse recovery time as a function of junction temperature

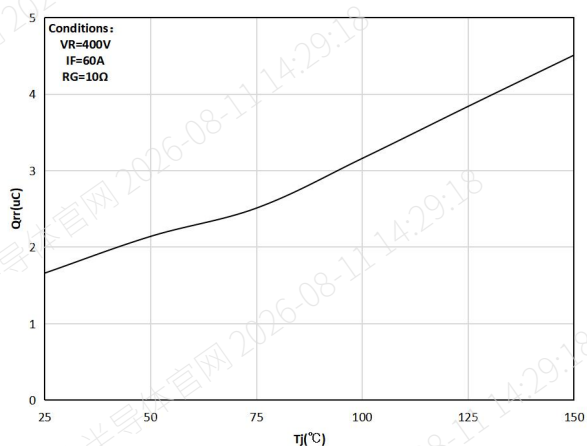


Figure 19. Typical reverse recovery charge as a function of junction temperature

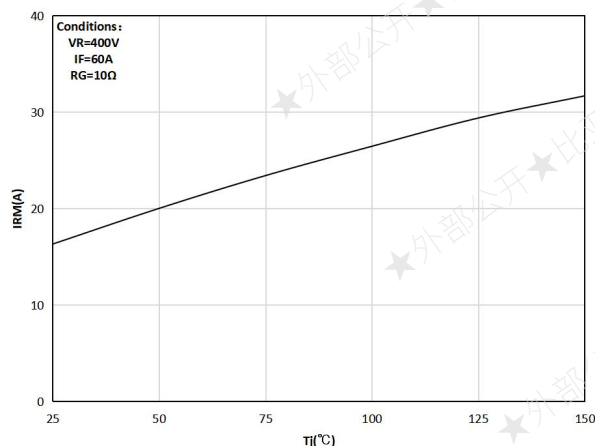


Figure 20. Typical reverse recovery current as a function of junction temperature

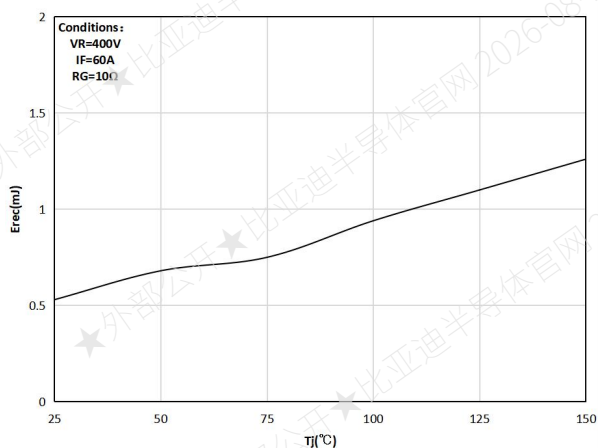


Figure 21. Typical reverse energy losses as a function of junction temperature

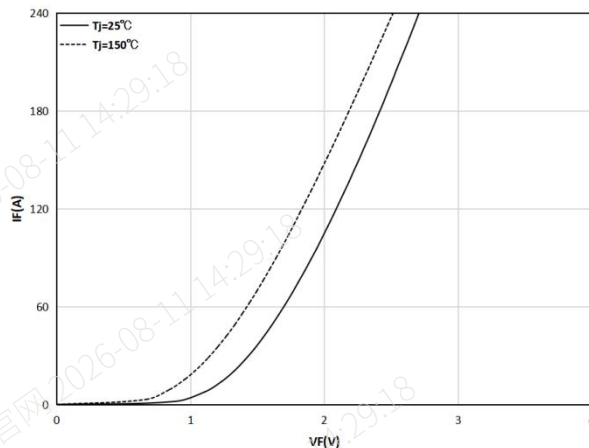


Figure 22. Typical diode forward current as a function of forward voltage

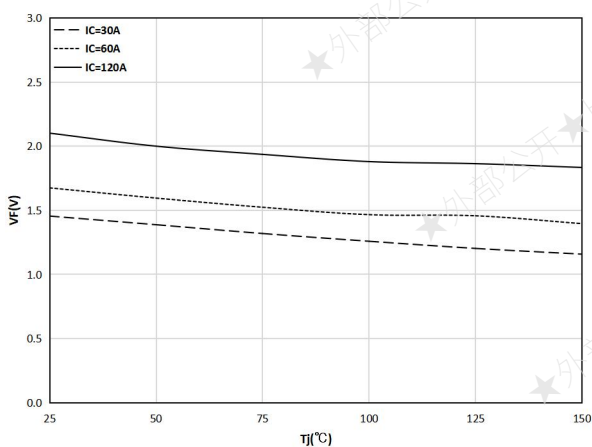


Figure 23. Typical diode forward current as a function of junction temperature

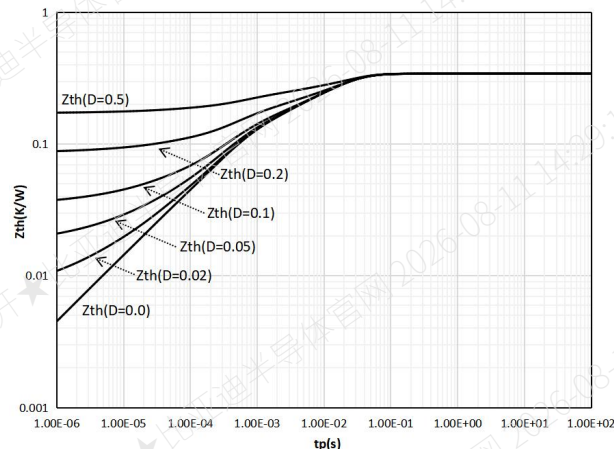


Figure 24. IGBT Transient thermal impedance as a function of pulse width ($D=t_p/T$)

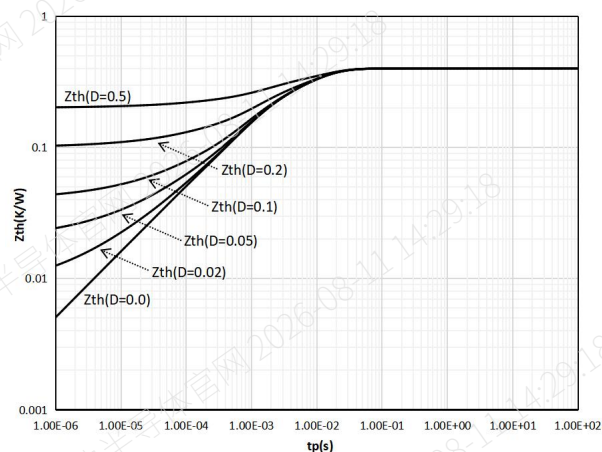


Figure 25. Diode Transient thermal impedance as a function of pulse width ($D = t_p / T$)

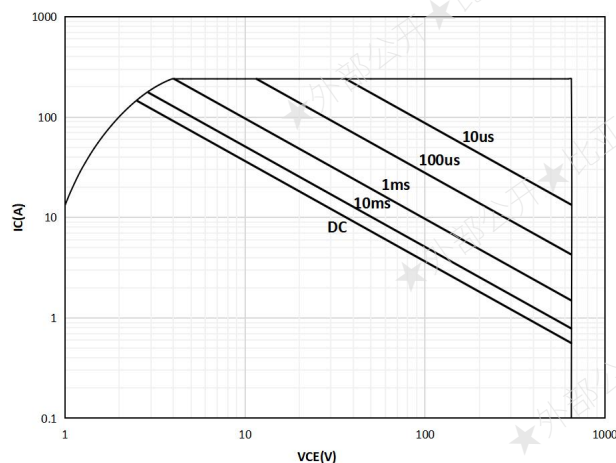


Figure 26. Forward bias safe operating area
($D=0, T_c=25^\circ\text{C}, T_j \leq 150^\circ\text{C}, V_{GE}=15\text{V}, I_{cmax}$ defined by design - not subject to production test)

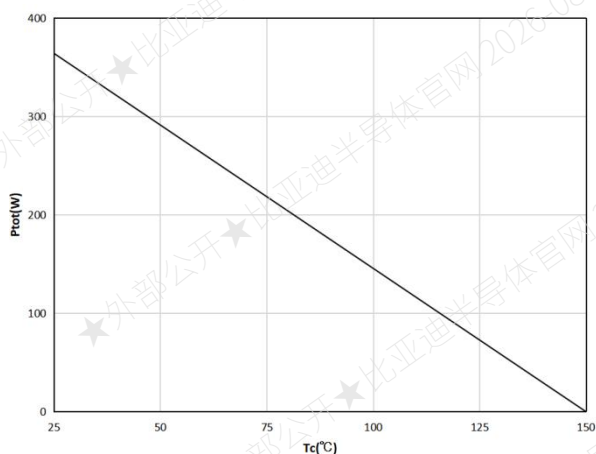
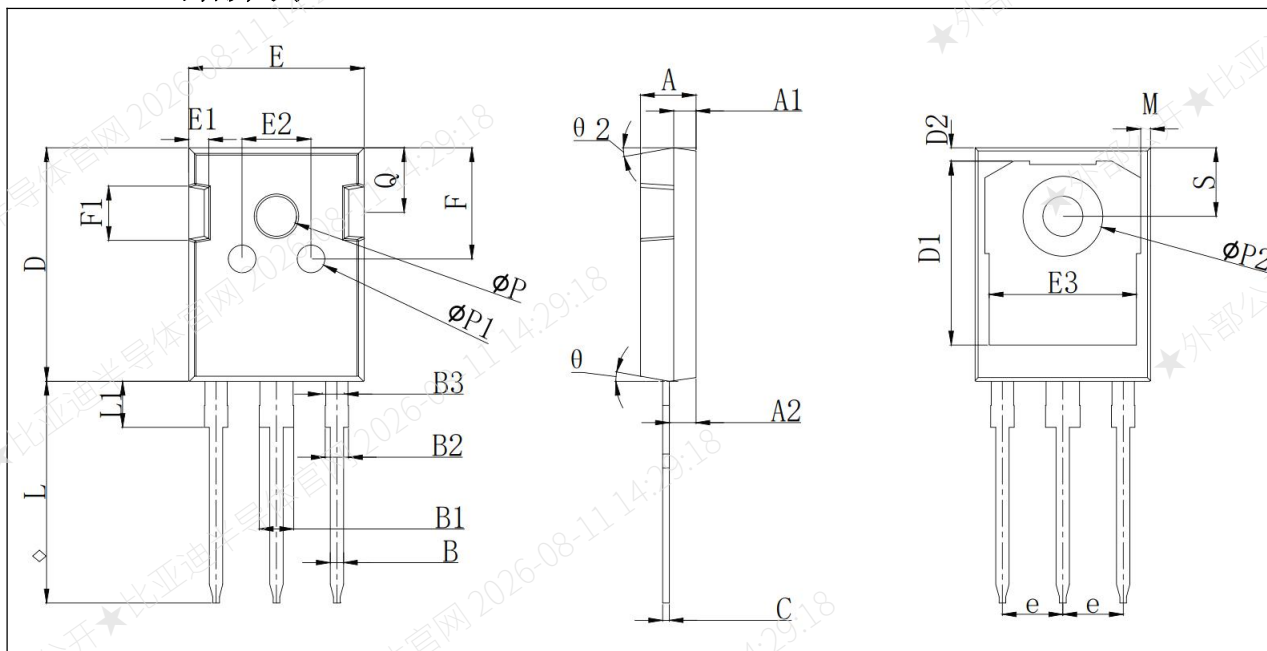


Figure 27. Power dissipation as a function of case temperature ($T_j \leq 150^\circ\text{C}$)



TO-247-3L Outline Dimensions:

TO-247-3L 外形尺寸



Common Dimensions (Units:Millimeter)

Symbol	Min.	Max.	Symbol	Min.	Max.
A	4.85	5.15	E3	13.06	14.22
A1	1.90	2.10	F	8.76	10.20
A2	2.20	2.60	F1	4.00	5.30
B	1.00	1.40	e	5.39	5.49
B1	2.80	3.25	L	19.72	21.00
B2	1.80	2.20	L1	3.90	4.80
B3	1.80	2.10	phi P	3.50	3.70
C	0.50	0.70	phi P1	2.40	3.10
D	20.30	21.10	phi P2	7.10	7.30
D1	16.35	16.75	Q	5.40	5.98
D2	0.85	1.32	S	5.98	6.27
E	15.45	15.90	theta	1°	11°
E1	1.20	2.60	theta 2	9°	23°
E2	6.10	8.20			

Note: Please note that molds can vary between packaging plants. For definitive specifications, please refer to the physical product.

备注：因各封装厂的模具存在细微差异，请以实物的尺寸为准。

Packing

包装

Packing 包装	pcs/tube 个/料管	tube/inner box 料管/内盒	inner box/carton 内盒/箱	pcs/carton 个/箱
Tube	30	12	6	2160



DISCLAIMER 免责声明

- **Warranty Period:** Unless otherwise agreed in the COOPERATION AGREEMENT or other WRITTEN DOCUMENTS, the Warranty Period for products specified in this specification shall be one year from the date of purchase if the products are properly preserved.
Special instructions: Storage Temperature: $20\pm 5^{\circ}\text{C}$; Relative Humidity: 30%-60%; The product should be stored in a place away from direct light and vibration.
质保期: 除双方在合作协议或其他书面文件中另行约定外, 产品妥当保存的情况下自购买之日起, 本规格书所述产品质保期为一年。
特殊说明: 储存温度: $20\pm 5^{\circ}\text{C}$; 相对湿度: 30%-60%; 产品应放置于避光地方, 避免震动。
- Our Company is committed to enhancing product quality and stability. This specification serves solely to delineate technical product details.
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- **Notwithstanding the Company's reasonable efforts and due diligence, the sensitive nature of the products and variations in testing environments and systems may result in a certain failure rate, including potential malfunctions or failures under specific conditions. Consequently, the Company does not warrant the accuracy of the information contained in this specification, nor the fitness for a particular purpose or merchantability of the products. The information in this specification shall not be construed as a guarantee or commitment regarding product functionality, condition, or quality.**
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- **The Company shall not be held liable for any product damage or consequential incidents resulting from usage beyond the recommended storage conditions, operating parameters, or absolute maximum ratings (or other explicitly stated limits) specified in this specification. Customers must strictly adhere to the operational procedures and conditions outlined in the latest version of the**



specification when utilizing or testing the product. Customers are responsible for complying with safety standards, including but not limited to redundant design, fire prevention measures, and fault prevention, to design and maintain a safe and stable system environment. Customers must verify all functionalities described in this specification before or during actual application to ensure product suitability, safety (preventing potential accidents, fires, or public harm etc.), and reliability. It is recommended that Customers consult our company prior to testing to confirm whether the product information adequately covers the application requirements.

任何超出本文件中建议存储条件、使用条件及绝对最大额定参数条件（或部分明确值）使用，造成的产品损坏或连带事故发生，本公司不承担相关责任。当客户在使用产品时，应根据最新版本文件上规定的操作步骤或示明条件进行使用或测试。客户有责任遵从安全规则（包括冗余设计、防火措施、故障预防等）设计安全及稳定的系统环境，在实际应用前、或实际应用中验证本文件所述的任何功能，以确保适用性、安全性（预防可能发生的任何事故、火灾或社会伤害等）及可靠性。建议客户在测试前可咨询本公司，以验证产品信息是否可以涵盖应用需求。

- This product shall not be used in any equipment or applications requiring higher reliability or quality standards where failure could result in personal injury, death, or catastrophic events, including but not limited to nuclear control systems, aircraft/aviation components, maritime/rail transport equipment, traffic signaling devices, combustion control systems, medical equipment, or other safety-critical applications. Customers must procure genuine products exclusively through the Company or authorized channels, and utilize them strictly within legally permitted boundaries and under conditions expressly defined in this specification. The Company disclaims all liability for losses, damages, or injuries arising from non-compliance with these requirements.

本产品不能且禁止应用在一些需要更高稳定性及质量的特殊设备上，以免导致人员伤亡等意外发生，包括原子能控制设备，飞机及航空器件，船舶、轨道等运输设备，交通信号设备，燃烧控制设备，医药设备以及所有安全性设备等。客户应通过本公司或经本公司授权的渠道购买正品，并应在法律约束范围内及本文件明确条件下合法、合理使用，否则造成损失与伤害的，本公司概不负责。

- The information presented in this specification constitutes the latest product details compiled and recorded by our Company with reasonable efforts at the time of publication. To ensure greater accuracy, our Company reserves the right to make periodic corrections, modifications, and version updates to this specification without prior notice. Customers should always refer to the latest version when using or consulting this document.

本文件示明信息，均为发布时本公司尽合理努力整理并记录的产品最新信息。为提供更加准确的信息，本公司保留对本文件不定期勘误修改及版本更新的权利。客户在使用或参阅时，请使用最新版本。

- This specification is written in both Chinese and English, and in case of any conflict between the Chinese and English versions, the Chinese version shall prevail.

本文件以中英文双语书就，如有不同之处，以中文内容为准。