IGBT Discrete with Anti-Parallel Diode

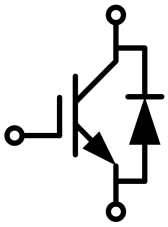
电气特性/ Features And Benefits:

- 1200V 沟槽栅/场终止工艺

  1200V trench gate/field termination process
- 低开关损耗

  Low switching losses
- Vcesat 正温度系数

  Vcesat has a positive temperature coefficient



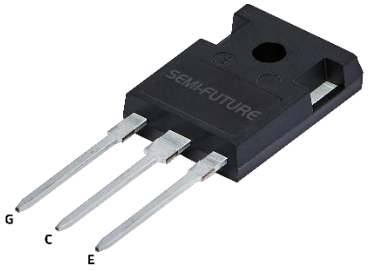
典型应用/Applications:

- 充电桩

  Charging station
- 不间断电源

  Uninterruptible power supplies
- 逆变器

  Inverters



关键性能和程序参数 / Key Performance And Package Parameters

Type	V_{CE}	I_C	VCEsat, T_{vj}=25°C	T_{vjmax}	Package
SD40R12A6HS	1200V	40A	1.90V	175°C	TO-247-3L

双极晶体管/IGBT

最大额定值 / Maximum Ratings

Parameter	Conditions	Symbol	Value	Unit
集电极-发射极电压 Collector-Emitter Voltage	T_{vj}=25°C	V_{CES}	1200	V
连续集电极直流电流 Continuous DC collector current	T_C=100°C, $T_{vj\ max}$=175°C	I_C	40	A
集电极重复峰值电流 Repetitive peak collector current	t_P=1 ms	I_{CRM}	120	A
总功率损耗 Total power dissipation	T_C =25°C, $T_{vj\ max}$ =175°C T_C =100°C, $T_{vj\ max}$ =175°C	P_{tot}	900 500	W

栅极-发射极电压 Gate emitter voltage		V_{GE}	±20	V
瞬变栅极-发射极电压 Transient Gate-emitter voltage	tp ≤10μs, D<0.010	V_{GE}	±25	V
在开关状态下温度 Temperature under switching conditions		$T_{vj\ op}$	-40…+175	℃
储存温度 Storage temperature		T_{stg}	-40…+150	℃

热特性 / Thermal Characteristics

Parameter	Conditions	Symbol	Value			Unit
			Min.	Typ.	Max.	
IGBT 热阻，结-壳 IGBT thermal resistance, junction - case		$R_{th(j-C)}$		0.138		K/W
二极管热阻，结-壳 Diode thermal resistance, junction - case		$R_{th(j-C)}$		0.393		K/W

特征值 / Characteristic Values

Parameter	Conditions		Symbol	Value			Unit
				Min.	Typ.	Max.	
击穿电压 Collector-emitter breakdown voltage	VGE=0V, Ic=0.25mA		$V_{(BR)CES}$	1200			V
集电极-发射极饱和电压 Collector-Emitter saturation Voltage	V_{GE}=15V, I_C=40A V_{GE}=15V, I_C=40A V_{GE}=15V, I_C=40A	T_{vj}=25°C T_{vj}=150°C T_{vj}=175°C	V_{CEsat}		1.90 2.47 2.57	2.40	
栅极-发射极阈值电压 Gate-Emitter threshold Voltage	I_C=0.4mA, V_{GE}=V_{CE}	T_{vj}=25°C	$V_{GE(th)}$	4.9	5.5	6.1	
跨导 Transconductance	V_{CE}=20V，I_C=40A		G_{fs}		28		S
内部栅极电阻 Internal gate resistor	T_{vj} = 25 °C		R_{Gint}		2.3		Ω
输入电容 Input capacitance	f=1 00KHZ, V_{CE}=25V, V_{GE}=0V	T_{vj}=25°C	C_{ies}		3.12		nF
输出电容 Output capacitance			C_{oes}		0.24		
反向传输电容 Reverse transfer capacitance			C_{res}		0.12		
门极电荷 Gate charge	I_C =40A, V_{GE} =15V, V_{CE} =960V	T_{vj}=25°C	Q_G		255		μC
集电极-发射极截止电流 Collector-emitter cut-off current	V_{CE}=1200V, V_{GE}=0V	T_{vj}=25°C T_{vj}=175°C	I_{CES}		 3000	10	μA
栅极-发射极漏电流 Gate-emitter leakage current	V_{CE}=0V, V_{GE}=20V	T_{vj}=25°C	I_{GES}			100	nA

开通延迟时间 Turn-on delay time	I_C=40A, V_{CE}=600V V_{GE}=±15V, R_G=10Ω (电感负载) / (inductive load)	T_{vj}=25°C T_{vj}=175°C	$t_{d\,on}$		49 50		ns
上升时间 Rise time	I_C=40A, V_{CE}=600V V_{GE}=±15V, R_G=10Ω (电感负载) / (inductive load)	T_{vj}=25°C T_{vj}=175°C	t_r		74 69		
关断延迟时间 Turn-off delay time	I_C=40A, V_{CE}=600V V_{GE}=±15V, R_G=10Ω (电感负载) / (inductive load)	T_{vj}=25°C T_{vj}=175°C	$t_{d\,off}$		162 237		
下降时间 Fall time	I_C=40A, V_{CE}=600V V_{GE}=±15V, R_G=10Ω (电感负载) / (inductive load)	T_{vj}=25°C T_{vj}=175°C	t_f		136 160		
开通损耗能量（每脉冲） Turn-on energy loss per pulse	I_C=40A, V_{CE}=600V V_{GE}=±15V, R_G=10Ω (电感负载) / (inductive load)	T_{vj}=25°C T_{vj}=175°C	E_{on}		3.51 6.78		mJ
关断损耗能量（每脉冲） Turn-off energy loss per pulse	I_C=40A, V_{CE}=600V V_{GE}=±15V, R_G=10Ω di/dt = 450 A/µs (T_{vj} = 175 °C)	T_{vj}=25°C T_{vj}=175°C	E_{off}		1.61 2.66		mJ
开关损耗能量（每脉冲） Total switching energy	I_C=40A, V_{CE}=600V V_{GE}=±15V, R_G=10Ω dv/dt = 5500 V/µs (T_{vj} = 175 °C)	T_{vj}=25°C T_{vj}=175°C	E_{ts}		5.12 9.44		

二极管/Diode

最大额定值 / Maximum Ratings

Parameter	Conditions	Symbol	Value	Unit
反向重复峰值电压 Repetitive peak reverse Voltage	T_{vj}=25°C	V_{RRM}	1200	V
连续正向直流电流 Continuous DC forward current	T_C=100°C, $T_{vj\,max}$=175°C	I_F	40	A
正向重复峰值电流 Repetitive peak forward current	t_p=1ms	I_{FRM}	120	A
I^2t 值 I^2t-value	t_p=10ms，sin180°，T_j=125°C	I^2t	310	A

特征值 / Characteristic Values

Parameter	Conditions		Symbol	Value			Unit
				Min.	Typ.	Max.	
正向电压 Forward Voltage	I_F=40A, V_{GE}=0V I_F=40A, V_{GE}=0V I_F=40A, V_{GE}=0V	T_{vj}=25°C T_{vj}=150°C T_{vj}=175°C	V_F		1.82 1.60 1.54	2.40	V

反向恢复峰值电流 Peak reverse recovery current	I_F=40A, $-di_F/dt$=350A/μs(T_{vj}=175°C) V_R=600V, V_{GE}=-15V	T_{vj}=25°C T_{vj}=175°C	I_{RM}		12 29		A
反向恢复电荷 Reverse Recovered charge	I_F=40A, $-di_F/dt$=350A/μs(T_{vj}=175°C) V_R=600V, V_{GE}=-15V	T_{vj}=25°C T_{vj}=175°C	Q_{rr}		3.29 10.5		μC
反向恢复时间 Reverse Recovery Time	I_F=40A, $-di_F/dt$=350A/μs(T_{vj}=175°C) V_R=600V, V_{GE}=-15V	T_{vj}=25°C T_{vj}=175°C	t_{rr}		558 870		ns
反向恢复损耗（每脉冲） Reverse recovered energy	I_F=40A, $-di_F/dt$=350A/μs(T_{vj}=175°C) V_R=600V, V_{GE}=-15V	T_{vj}=25°C T_{vj}=175°C	E_{rec}		1.40 4.21		mJ

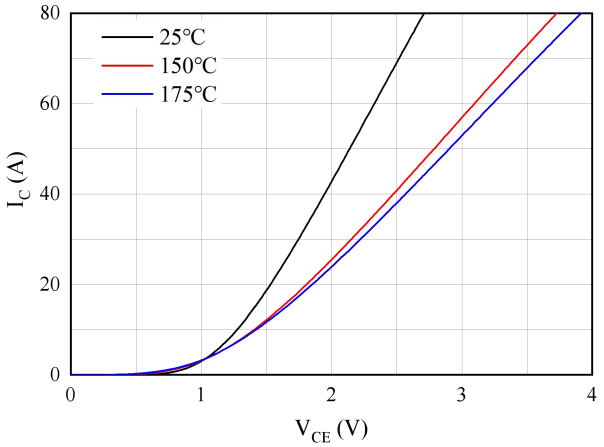


图 1. 典型输出特性 (V_{GE}=15V)
Figure 1. Typical output characteristics (V_{GE}=15V)

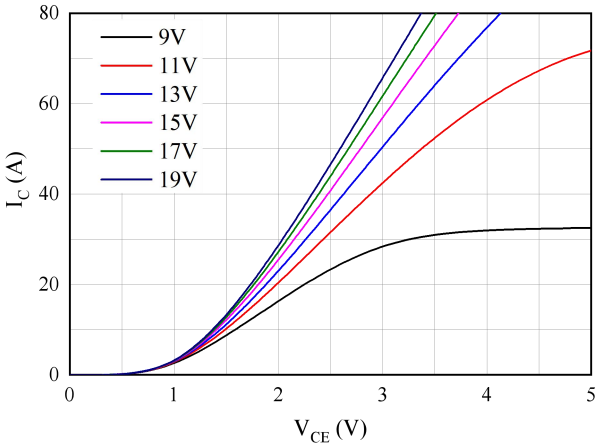


图 2. 典型输出特性 (T_{vj}=150℃)
Figure 2. Typical output characteristics (T_{vj}=150℃)

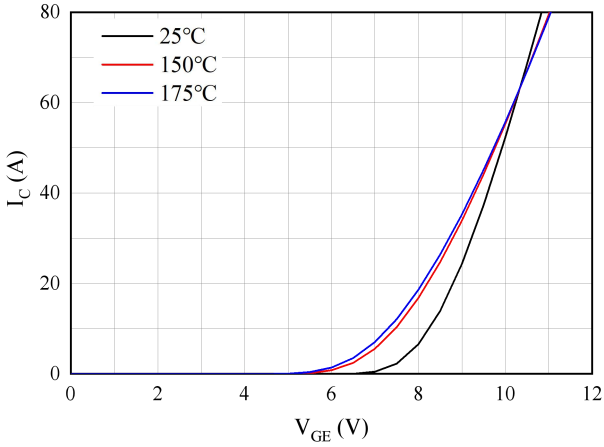


图 3. 典型传输特性(V_{CE}=20V)
Figure 3. Typical transfer characteristic(V_{CE}=20V)

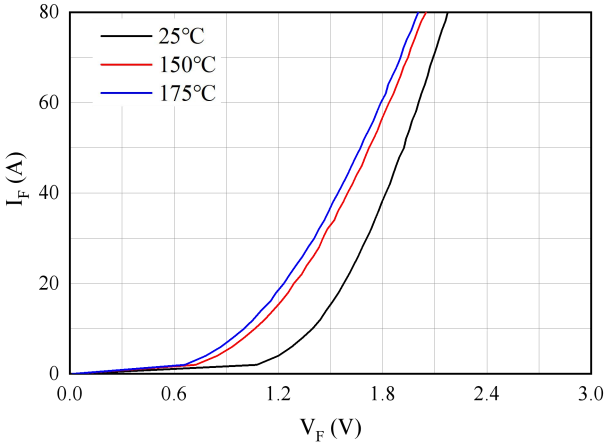


图 4. 正向偏压特性 二极管
Figure 4. Forward characteristic of Diode

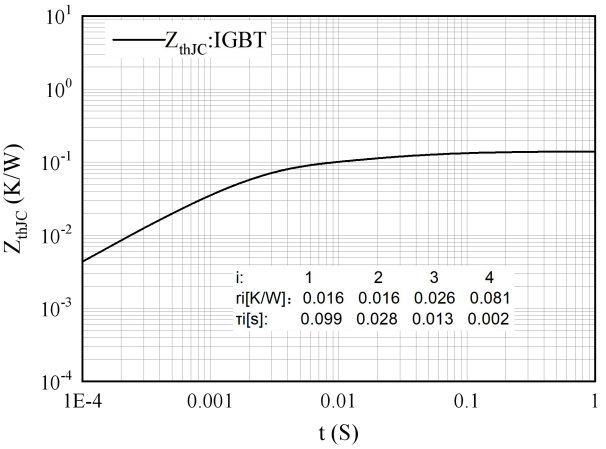


图 5. 瞬态热阻抗 IGBT
Figure 5. Transient thermal impedance IGBT, Z_{thJC}=f(t)

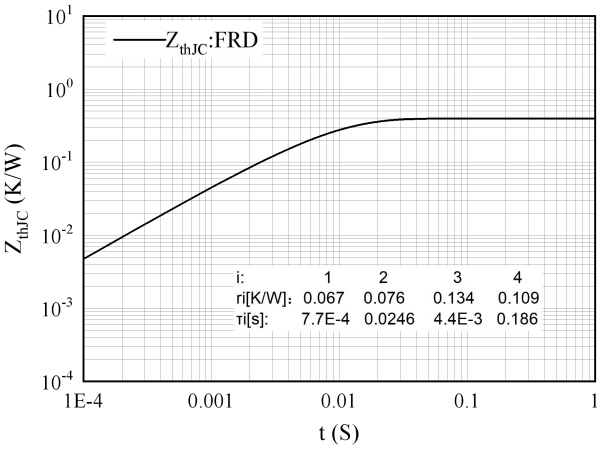


图 6. 瞬态热阻抗 FRD
Figure 6. Transient thermal impedance FRD, Z_{thJC}=f(t)

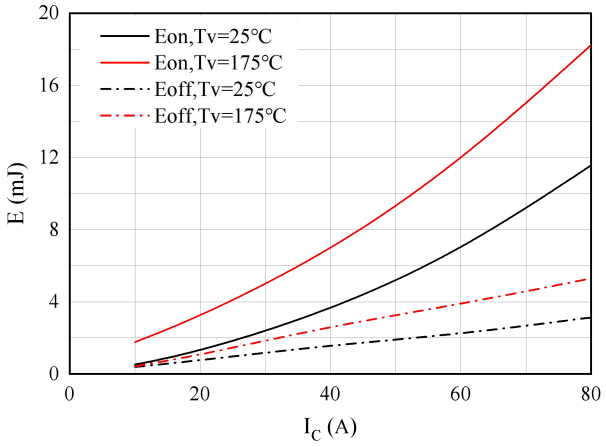


图 7. 开关损耗

Figure 7. Switching losses of IGBT

VGE=±15V, RGon=10Ω, Rgoff=10Ω,VCE=600V

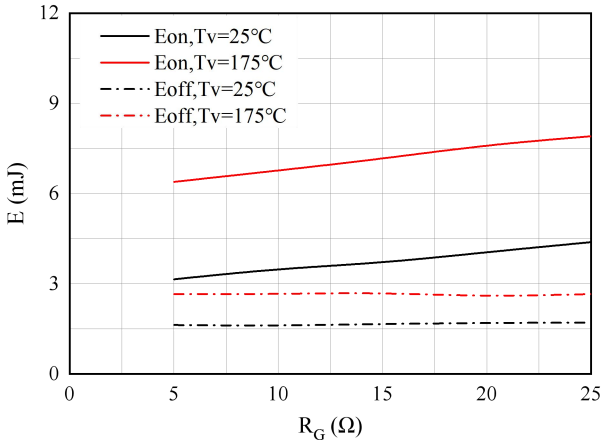


图 8. 开关损耗

Figure 8. Switching losses of IGBT

VGE=±15V, IC=40A,VCE=600V

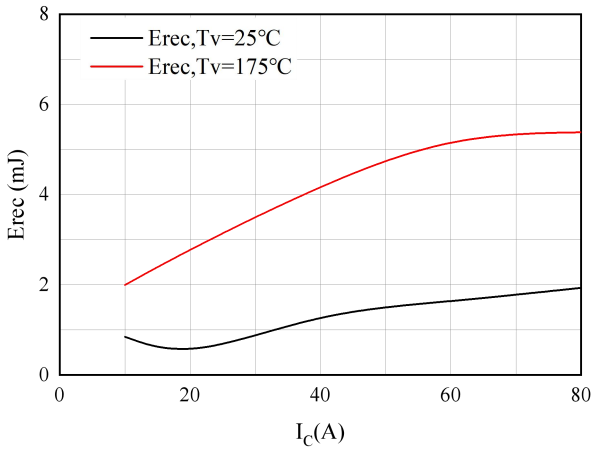


图 9. 开关损耗 二极管

Figure 9. Switching losses of Diode

Rgon=10Ω,VCE=600V

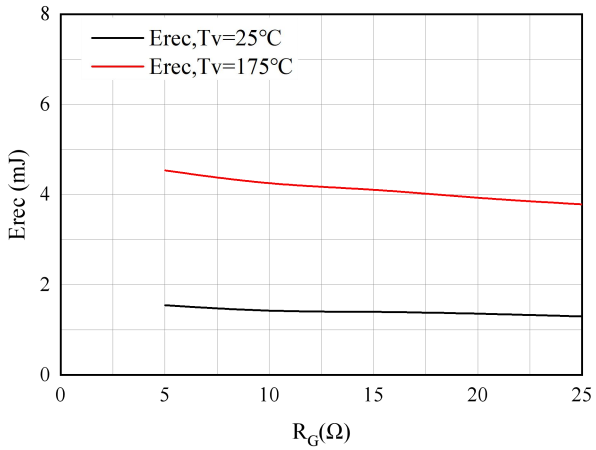


图 10. 开关损耗 二极管

Figure 10. Switching losses of Diode

IF=40A,VCE=600V

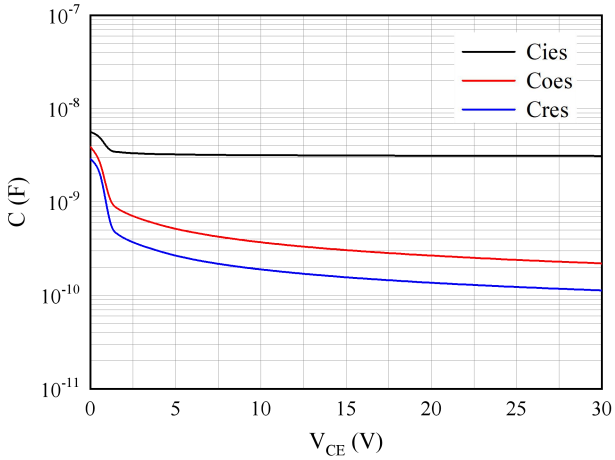
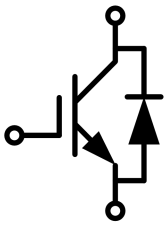


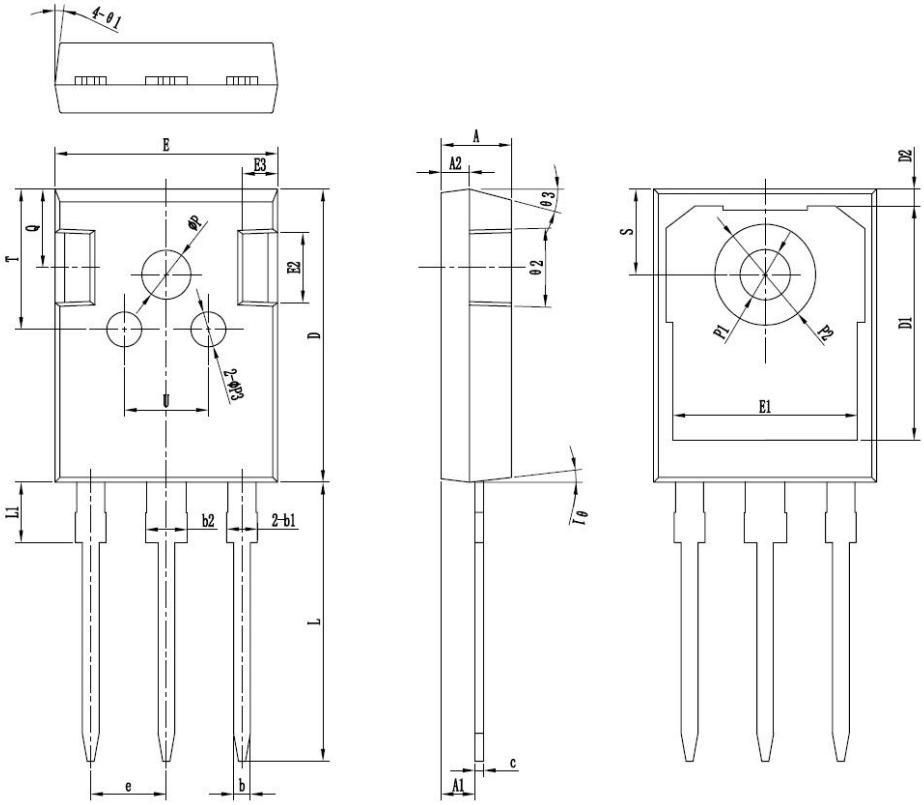
图 11. 电容特性

Figure 11. Capacitance characteristic

接线图 / Circuit diagram



封装尺寸 / Package outlines



符号	单位:mm		
	MIN	NOM	MAX
*A	4.90	5.00	5.10
*A1	2.31	2.41	2.51
A2	1.90	2.00	2.10
*b	1.15	1.20	1.25
*b1	1.95	2.10	2.25
*b2	2.95	3.10	3.25
*c	0.55	0.60	0.65
*D	20.90	21.00	21.10
D1	16.35	16.55	16.75
D2	1.05	1.20	1.35
*E	15.70	15.80	15.90
E1	13.10	13.25	13.40
E2	4.90	5.00	5.10
E3	2.40	2.50	2.60
*e	5.40	5.44	5.48
*L	19.80	19.92	20.10
*L1	-	-	4.30
*φP	3.70	3.80	3.90
*φP1	3.50	3.60	3.70
φP2	7.00	7.20	7.40
φP3	2.40	2.50	2.60
Q	5.60	5.80	6.00
*S	6.05	6.15	6.25
T	9.80	10.00	10.20
U	6.00	6.20	6.40
θ1	5°	7°	9°
θ2	1°	3°	5°
θ3	13°	15°	17°

*为关键管控尺寸