



产品数据手册 Product Datasheet 版本 Ver 23.12

TH400AN10U3-S500

三电平 IGBT 模块 3-level IGBT Module

关键参数		Key Parameters	
V_{CES}		950	V
$V_{CE(sat)}$	Typ.	1.28	V
I_C	Max.	400	A
$I_{C(RM)}$	Max.	800	A

典型应用	Typical Applications
● 三电平应用	3-level-applications Converters
● 光伏应用	Solar applications
● UPS 系统	UPS Systems

特点	Features
● SiC 二极管	Ultra-fast SiC Diode
● 低开关损耗	Low Switching Losses
● 低感设计	Low Inductive Design
● 集成 NTC	Integrated NTC

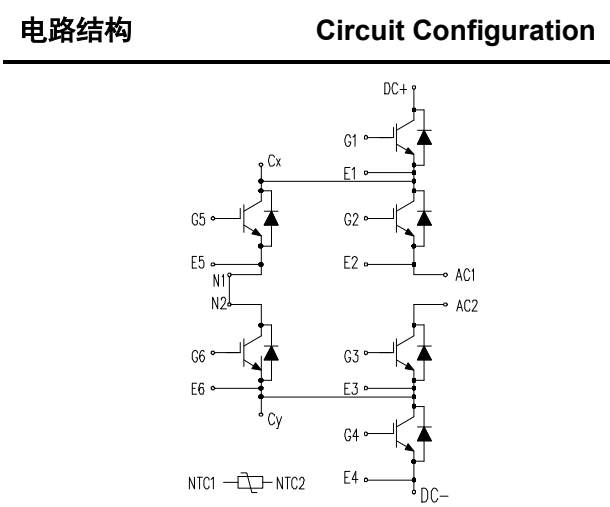


图 1. 电路结构
Fig. 1 Circuit configuration

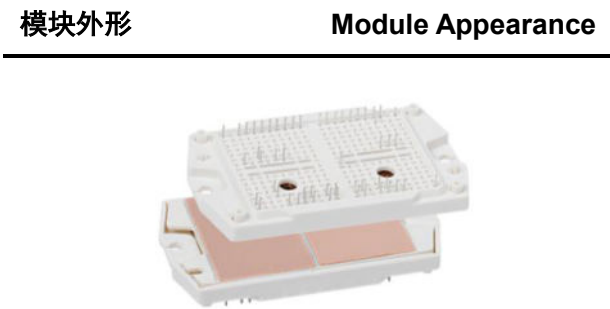


图 2. 模块外形
Fig. 2 Module appearance

模块标签说明	Module Label Code Instruction	
	数据位置 Data position	数据内容 Content of data
	1--8	模块批次号 Module batch number
	9--12	模块序列号 Module serial number

IGBT T1/T4, 二极管 D1/D4
IGBT T1/T4, Diode D1/D4
最大额定值
Absolute Maximum Ratings

符号 Symbol	参数名称 Parameter	测试条件 Test Conditions	数值 Value	单位 Unit
V_{CES}	集电极-发射极电压 Collector-emitter voltage	$V_{GE} = 0V, T_C = 25\text{ }^{\circ}\text{C}$	950	V
V_{GES}	栅极-发射极电压 Gate-emitter voltage	$T_C = 25\text{ }^{\circ}\text{C}$	± 20	V
I_C	集电极电流 Collector-emitter current	$T_C = 90\text{ }^{\circ}\text{C}, T_{vj\text{ max}}=175^{\circ}\text{C}$	220	A
	额定电流 Rating Current		400	A
$I_{C(RM)}$	集电极峰值电流 Peak collector current	$t_P=1\text{ms}$	800	A
P_{max}	晶体管部分最大损耗 Max. transistor power dissipation	$T_C = 25\text{ }^{\circ}\text{C}, T_{vj\text{ max}}=175^{\circ}\text{C}$	1.07	kW
ρ_t	二极管 ρ_t 值 Diode ρ_t	$V_R = 0V, t_P = 10\text{ms}, T_{vj} = 150\text{ }^{\circ}\text{C}$	2.05	kA^2s

热数据
Thermal Data

符号 Symbol	参数名称 Parameter	测试条件 Test Conditions	最小值 Min.	典型值 Typ.	最大值 Max.	单位 Unit
$R_{th(J-C)} \text{ IGBT}$	IGBT 结壳热阻 Thermal resistance – IGBT				140	K / kW
$R_{th(J-C)} \text{ Diode}$	二极管结壳热阻 Thermal resistance – Diode				290	K / kW
$R_{th(C-H)} \text{ IGBT}$	接触热阻(IGBT) Thermal resistance – case to heatsink (IGBT)	安装力矩 1.3Nm, 导热脂 3.3W/m·K Mounting torque 1.3Nm, with mounting grease 3.3W/m·K		100		K / kW
$R_{th(C-H)} \text{ Diode}$	接触热阻(Diode) Thermal resistance – case to heatsink (Diode)	安装力矩 1.3Nm, 导热脂 3.3W/m·K Mounting torque 1.3Nm, with mounting grease 3.3W/m·K		280		K / kW



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TH400AN10U3-S500

三电平 IGBT 模块 3-level IGBT Module

IGBT T1/T4, 二极管 D1/D4

IGBT T1/T4, Diode D1/D4

IGBT T1/T4，二极管 D1/D4
IGBT T1/T4, Diode D1/D4
电特性值
Electrical Characteristics

符号 Symbol	参数名称 Parameter	测试条件 Test Conditions		最小值 Min.	典型值 Typ.	最大值 Max.	单位 Unit
$t_{d(off)}$	关断延迟时间 Turn-off delay time	$I_C = 150A$, $V_{CE} = 500V$, $V_{GE} = -7.5/+15V$, $R_{G(OFF)} = 20\Omega$, $L_S = 25nH$, $dv/dt = 5500V/\mu s$ ($T_{vj} = 150\text{ }^{\circ}C$).	$T_{vj} = 25\text{ }^{\circ}C$		665		ns
			$T_{vj} = 125\text{ }^{\circ}C$		725		
			$T_{vj} = 150\text{ }^{\circ}C$		745		
t_f	下降时间 Fall time		$T_{vj} = 25\text{ }^{\circ}C$		75		ns
			$T_{vj} = 125\text{ }^{\circ}C$		95		
			$T_{vj} = 150\text{ }^{\circ}C$		105		
E_{OFF}	关断损耗 Turn-off energy loss		$T_{vj} = 25\text{ }^{\circ}C$		6.4		mJ
			$T_{vj} = 125\text{ }^{\circ}C$		7.7		
			$T_{vj} = 150\text{ }^{\circ}C$		8.3		
$t_{d(on)}$	开通延迟时间 Turn-on delay time	$T_{vj} = 25\text{ }^{\circ}C$		165		ns	
		$T_{vj} = 125\text{ }^{\circ}C$		160			
		$T_{vj} = 150\text{ }^{\circ}C$		160			
t_r	上升时间 Rise time	$T_{vj} = 25\text{ }^{\circ}C$		34		ns	
		$T_{vj} = 125\text{ }^{\circ}C$		38			
		$T_{vj} = 150\text{ }^{\circ}C$		39			
E_{ON}	开通损耗 Turn-on energy loss	$T_{vj} = 25\text{ }^{\circ}C$		3.4		mJ	
		$T_{vj} = 125\text{ }^{\circ}C$		3.6			
		$T_{vj} = 150\text{ }^{\circ}C$		3.8			
Q_{rr}	二极管反向恢复电荷 Diode reverse recovery charge	$T_{vj} = 25\text{ }^{\circ}C$		6		μC	
		$T_{vj} = 125\text{ }^{\circ}C$		11			
		$T_{vj} = 150\text{ }^{\circ}C$		12			
I_{rr}	二极管反向恢复电流 Diode reverse recovery current	$T_{vj} = 25\text{ }^{\circ}C$		65		A	
		$T_{vj} = 125\text{ }^{\circ}C$		84			
		$T_{vj} = 150\text{ }^{\circ}C$		85			
E_{rec}	二极管反向恢复损耗 Diode reverse recovery energy	$T_{vj} = 25\text{ }^{\circ}C$		1.6		mJ	
		$T_{vj} = 125\text{ }^{\circ}C$		3.7			
		$T_{vj} = 150\text{ }^{\circ}C$		3.9			

IGBT T2/T3, 二极管 D2/D3

IGBT T2/T3, Diode D2/D3

最大额定值

Absolute Maximum Ratings

符号 Symbol	参数名称 Parameter	测试条件 Test Conditions	数值 Value	单位 Unit
V_{CES}	集电极-发射极电压 Collector-emitter voltage	$V_{GE} = 0V, T_C = 25\text{ }^{\circ}\text{C}$	950	V
V_{GES}	栅极-发射极电压 Gate-emitter voltage	$T_C = 25\text{ }^{\circ}\text{C}$	± 20	V
I_C	集电极电流 Collector-emitter current	$T_C = 90\text{ }^{\circ}\text{C}, T_{vj\text{ max}}=175\text{ }^{\circ}\text{C}$	295	A
	额定电流 Rating Current		400	A
$I_{C(PK)}$	集电极峰值电流 Peak collector current	$t_P=1\text{ms}$	800	A
P_{max}	晶体管部分最大损耗 Max. transistor power dissipation	$T_C = 25\text{ }^{\circ}\text{C}, T_{vj\text{ max}}=175\text{ }^{\circ}\text{C}$	1.07	kW
I_t	二极管 I_t 值 Diode I_t	$V_R = 0V, t_P = 10\text{ms}, T_{vj} = 150\text{ }^{\circ}\text{C}$	2.05	kA^2s

热数据

Thermal Data

符号 Symbol	参数名称 Parameter	测试条件 Test Conditions	最小值 Min.	典型值 Typ.	最大值 Max.	单位 Unit
$R_{th(J-C)} \text{ IGBT}$	IGBT 结壳热阻 Thermal resistance – IGBT				140	K / kW
$R_{th(J-C)} \text{ Diode}$	二极管结壳热阻 Thermal resistance – Diode				290	K / kW
$R_{th(C-H)} \text{ IGBT}$	接触热阻(IGBT) Thermal resistance – case to heatsink (IGBT)	安装力矩 1.3Nm, 导热脂 3.3W/m·K Mounting torque 1.3Nm, with mounting grease 3.3W/m·K		100		K / kW
$R_{th(C-H)} \text{ Diode}$	接触热阻(Diode) Thermal resistance – case to heatsink (Diode)	安装力矩 1.3Nm, 导热脂 3.3W/m·K Mounting torque 1.3Nm, with mounting grease 3.3W/m·K		280		K / kW

IGBT T2/T3, 二极管 D2/D3
IGBT T2/T3, Diode D2/D3
电特性值
Electrical Characteristics

 除非特别声明, 否则 $T_C = 25\text{ }^{\circ}\text{C}$
 $T_C = 25\text{ }^{\circ}\text{C}$ unless otherwise stated

符号 Symbol	参数名称 Parameter	条件 Test Conditions	最小值 Min.	典型值 Typ.	最大值 Max.	单位 Unit
I_{CES}	集电极截止电流 Collector cut-off current	$V_{GE} = 0V, V_{CE} = V_{CES}$			1	mA
		$V_{GE} = 0V, V_{CE} = V_{CES}, T_{vj} = 125\text{ }^{\circ}\text{C}$			5	mA
		$V_{GE} = 0V, V_{CE} = V_{CES}, T_{vj} = 150\text{ }^{\circ}\text{C}$			10	mA
I_{GES}	栅极漏电流 Gate leakage current	$V_{GE} = \pm 20V, V_{CE} = 0V$			0.5	μA
$V_{GE(th)}$	栅极-发射极阈值电压 Gate threshold voltage	$I_C = 10\text{mA}, V_{GE} = V_{CE}$	4.70	5.30	5.90	V
$V_{CE(sat)}^{(*1)}$	集电极-发射极饱和电压 Collector-emitter saturation voltage	$V_{GE} = 15V, I_C = 150A$		1.05	1.35	V
		$V_{GE} = 15V, I_C = 150A, T_{vj} = 125\text{ }^{\circ}\text{C}$		1.05		V
		$V_{GE} = 15V, I_C = 150A, T_{vj} = 150\text{ }^{\circ}\text{C}$		1.05		V
I_F	二极管正向直流电流 Diode forward current	DC		150		A
	二极管额定正向电流 Diode rating forward current			200		A
I_{FRM}	二极管正向重复峰值电流 Diode peak forward current	$t_p = 1\text{ms}$		400		A
$V_F^{(*1)}$	二极管正向电压 Diode forward voltage	$I_F = 150A, V_{GE} = 0V$		2.05	2.45	V
		$I_F = 150A, V_{GE} = 0V, T_{vj} = 125\text{ }^{\circ}\text{C}$		2.25		V
		$I_F = 150A, V_{GE} = 0V, T_{vj} = 150\text{ }^{\circ}\text{C}$		2.20		V
C_{ies}	输入电容 Input capacitance	$V_{CE} = 25V, V_{GE} = 0V, f = 100\text{kHz}$		41		nF
Q_g	栅极电荷 Gate charge	-7.5/+15V		2.2		μC
C_{res}	反向传输电容 Reverse transfer capacitance	$V_{CE} = 25V, V_{GE} = 0V, f = 100\text{kHz}$		0.14		nF
R_{Gint}	内部栅极电阻 Internal gate resistor			3		Ω

注意: 1.(*1) 表示该参数基于芯片水平给出 (*1) indicates it is given at chip level),

Note: 2.(*2) 表示 L 是电路杂散电感加上 L_{sCE} (*2) indicates L is the circuit stray inductance plus L_{sCE}).

IGBT T2/T3, 二极管 D2/D3

IGBT T2/T3, Diode D2/D3

电特性值

Electrical Characteristics

符号 Symbol	参数名称 Parameter	测试条件 Test Conditions		最小值 Min.	典型值 Typ.	最大值 Max.	单位 Unit
$t_{d(off)}$	关断延迟时间 Turn-off delay time	$I_C = 150A$, $V_{CE} = 500V$, $V_{GE} = -7.5/+15V$, $R_{G(OFF)} = 5\Omega$, $L_S = 55nH$, $dv/dt = 2200V/\mu s$ ($T_{vj} = 150\text{ }^{\circ}C$).	$T_{vj} = 25\text{ }^{\circ}C$		765		ns
			$T_{vj} = 125\text{ }^{\circ}C$		850		
			$T_{vj} = 150\text{ }^{\circ}C$		870		
t_f	下降时间 Fall time		$T_{vj} = 25\text{ }^{\circ}C$		160		ns
			$T_{vj} = 125\text{ }^{\circ}C$		235		
			$T_{vj} = 150\text{ }^{\circ}C$		265		
E_{OFF}	关断损耗 Turn-off energy loss		$T_{vj} = 25\text{ }^{\circ}C$		15		mJ
			$T_{vj} = 125\text{ }^{\circ}C$		20		
			$T_{vj} = 150\text{ }^{\circ}C$		21		
$t_{d(on)}$	开通延迟时间 Turn-on delay time	$T_{vj} = 25\text{ }^{\circ}C$		290		ns	
		$T_{vj} = 125\text{ }^{\circ}C$		285			
		$T_{vj} = 150\text{ }^{\circ}C$		280			
t_r	上升时间 Rise time	$T_{vj} = 25\text{ }^{\circ}C$		34		ns	
		$T_{vj} = 125\text{ }^{\circ}C$		35			
		$T_{vj} = 150\text{ }^{\circ}C$		38			
E_{ON}	开通损耗 Turn-on energy loss	$T_{vj} = 25\text{ }^{\circ}C$		1.5		mJ	
		$T_{vj} = 125\text{ }^{\circ}C$		2.8			
		$T_{vj} = 150\text{ }^{\circ}C$		3.3			
Q_{rr}	二极管反向恢复电荷 Diode reverse recovery charge	$T_{vj} = 25\text{ }^{\circ}C$		6		μC	
		$T_{vj} = 125\text{ }^{\circ}C$		12			
		$T_{vj} = 150\text{ }^{\circ}C$		13			
I_{rr}	二极管反向恢复电流 Diode reverse recovery current	$T_{vj} = 25\text{ }^{\circ}C$		140		A	
		$T_{vj} = 125\text{ }^{\circ}C$		145			
		$T_{vj} = 150\text{ }^{\circ}C$		150			
E_{rec}	二极管反向恢复损耗 Diode reverse recovery energy	$T_{vj} = 25\text{ }^{\circ}C$		2.5		mJ	
		$T_{vj} = 125\text{ }^{\circ}C$		4.6			
		$T_{vj} = 150\text{ }^{\circ}C$		4.9			

IGBT T5/T6, 二极管 D5/D6
IGBT T5/T6, Diode D5/D6
最大额定值
Absolute Maximum Ratings

符号 Symbol	参数名称 Parameter	测试条件 Test Conditions	数值 Value	单位 Unit
V_{CES}	集电极-发射极电压 Collector-emitter voltage	$V_{GE} = 0V, T_C = 25\text{ }^{\circ}\text{C}$	950	V
V_{GES}	栅极-发射极电压 Gate-emitter voltage	$T_C = 25\text{ }^{\circ}\text{C}$	± 20	V
I_C	集电极电流 Collector-emitter current	$T_C = 90\text{ }^{\circ}\text{C}, T_{vj\text{ max}} = 175\text{ }^{\circ}\text{C}$	115	A
	额定电流 Rating Current		200	A
$I_{C(PK)}$	集电极峰值电流 Peak collector current	$t_P = 1\text{ms}$	400	A
P_{max}	晶体管部分最大损耗 Max. transistor power dissipation	$T_C = 25\text{ }^{\circ}\text{C}, T_{vj\text{ max}} = 175\text{ }^{\circ}\text{C}$	0.54	kW
I_{Tt}	二极管 I_{Tt} 值 Diode I_{Tt}	$V_R = 0V, t_P = 10\text{ms}, T_{vj} = 150\text{ }^{\circ}\text{C}$	2.3	kA^2s

热数据
Thermal Data

符号 Symbol	参数名称 Parameter	测试条件 Test Conditions	最小值 Min.	典型值 Typ.	最大值 Max.	单位 Unit
$R_{th(J-C)} \text{ IGBT}$	IGBT 结壳热阻 Thermal resistance – IGBT				280	K / kW
$R_{th(J-C)} \text{ Diode}$	二极管结壳热阻 Thermal resistance – Diode				260	K / kW
$R_{th(C-H)} \text{ IGBT}$	接触热阻(IGBT) Thermal resistance – case to heatsink (IGBT)	安装力矩 1.3Nm, 导热脂 3.3W/m·K Mounting torque 1.3Nm, with mounting grease 3.3W/m·K		171		K / kW
$R_{th(C-H)} \text{ Diode}$	接触热阻(Diode) Thermal resistance – case to heatsink (Diode)	安装力矩 1.3Nm, 导热脂 3.3W/m·K Mounting torque 1.3Nm, with mounting grease 3.3W/m·K		214		K / kW

IGBT T5/T6, 二极管 D5/D6

IGBT T5/T6, Diode D5/D6

电特性值

Electrical Characteristics

除非特别声明, 否则 $T_C = 25\text{ }^{\circ}\text{C}$ $T_C = 25\text{ }^{\circ}\text{C}$ unless otherwise stated

符号 Symbol	参数名称 Parameter	条件 Test Conditions	最小值 Min.	典型值 Typ.	最大值 Max.	单位 Unit
I_{CES}	集电极截止电流 Collector cut-off current	$V_{GE} = 0V, V_{CE} = V_{CES}$			1	mA
		$V_{GE} = 0V, V_{CE} = V_{CES}, T_{vj} = 125\text{ }^{\circ}\text{C}$			3	mA
		$V_{GE} = 0V, V_{CE} = V_{CES}, T_{vj} = 150\text{ }^{\circ}\text{C}$			5	mA
I_{GES}	栅极漏电流 Gate leakage current	$V_{GE} = \pm 20V, V_{CE} = 0V$			0.5	μA
$V_{GE(th)}$	栅极-发射极阈值电压 Gate threshold voltage	$I_C = 5\text{mA}, V_{GE} = V_{CE}$	5.00	5.60	6.20	V
$V_{CE(sat)}^{(*1)}$	集电极-发射极饱和电压 Collector-emitter saturation voltage	$V_{GE} = 15V, I_C = 150A$		1.60	2.00	V
		$V_{GE} = 15V, I_C = 150A, T_{vj} = 125\text{ }^{\circ}\text{C}$		1.95		V
		$V_{GE} = 15V, I_C = 150A, T_{vj} = 150\text{ }^{\circ}\text{C}$		2.05		V
I_F	二极管正向直流电流 Diode forward current	DC		100		A
I_{FRM}	二极管正向重复峰值电流 Diode peak forward current	$t_P = 1\text{ms}$		200		A
$V_F^{(*1)}$	二极管正向电压 Diode forward voltage	$I_F = 100A, V_{GE} = 0V$		1.55	1.85	V
		$I_F = 100A, V_{GE} = 0V, T_{vj} = 125\text{ }^{\circ}\text{C}$		2.05		V
		$I_F = 100A, V_{GE} = 0V, T_{vj} = 150\text{ }^{\circ}\text{C}$		2.15		V
C_{ies}	输入电容 Input capacitance	$V_{CE} = 25V, V_{GE} = 0V, f = 100\text{kHz}$		12		nF
Q_g	栅极电荷 Gate charge	-7.5/+15V		0.6		μC
C_{res}	反向传输电容 Reverse transfer capacitance	$V_{CE} = 25V, V_{GE} = 0V, f = 100\text{kHz}$		0.04		nF
R_{Gint}	内部栅极电阻 Internal gate resistor			2.2		Ω

注意: 1.(*1) 表示该参数基于芯片水平给出 (*1) indicates it is given at chip level),

Note: 2.(*2) 表示 L 是电路杂散电感加上 L_{sCE} (*2) indicates L is the circuit stray inductance plus L_{sCE}).

IGBT T5/T6，二极管 D5/D6

IGBT T5/T6, Diode D5/D6

电特性值

Electrical Characteristics

符号 Symbol	参数名称 Parameter	测试条件 Test Conditions		最小值 Min.	典型值 Typ.	最大值 Max.	单位 Unit
$t_{d(off)}$	关断延迟时间 Turn-off delay time	$I_C = 150A$, $V_{CE} = 500V$, $V_{GE} = -7.5/+15V$, $R_{G(OFF)} = 33\Omega$, $L_S = 25nH$, $dv/dt = 7200V/\mu s$ ($T_{vj} = 150\text{ }^{\circ}C$).	$T_{vj} = 25\text{ }^{\circ}C$		554		ns
			$T_{vj} = 125\text{ }^{\circ}C$		580		
			$T_{vj} = 150\text{ }^{\circ}C$		590		
t_f	下降时间 Fall time		$T_{vj} = 25\text{ }^{\circ}C$		70		ns
			$T_{vj} = 125\text{ }^{\circ}C$		85		
			$T_{vj} = 150\text{ }^{\circ}C$		100		
E_{OFF}	关断损耗 Turn-off energy loss		$T_{vj} = 25\text{ }^{\circ}C$		6.5		mJ
			$T_{vj} = 125\text{ }^{\circ}C$		7.7		
			$T_{vj} = 150\text{ }^{\circ}C$		8.6		
$t_{d(on)}$	开通延迟时间 Turn-on delay time	$T_{vj} = 25\text{ }^{\circ}C$		100		ns	
		$T_{vj} = 125\text{ }^{\circ}C$		95			
		$T_{vj} = 150\text{ }^{\circ}C$		95			
t_r	上升时间 Rise time	$T_{vj} = 25\text{ }^{\circ}C$		30		ns	
		$T_{vj} = 125\text{ }^{\circ}C$		35			
		$T_{vj} = 150\text{ }^{\circ}C$		40			
E_{ON}	开通损耗 Turn-on energy loss	$T_{vj} = 25\text{ }^{\circ}C$		6.0		mJ	
		$T_{vj} = 125\text{ }^{\circ}C$		7.6			
		$T_{vj} = 150\text{ }^{\circ}C$		8.3			
Q_{rr}	二极管反向恢复电荷 Diode reverse recovery charge	$T_{vj} = 25\text{ }^{\circ}C$		0.5		μC	
		$T_{vj} = 125\text{ }^{\circ}C$		1.0			
		$T_{vj} = 150\text{ }^{\circ}C$		1.2			
I_{rr}	二极管反向恢复电流 Diode reverse recovery current	$T_{vj} = 25\text{ }^{\circ}C$		30		A	
		$T_{vj} = 125\text{ }^{\circ}C$		31			
		$T_{vj} = 150\text{ }^{\circ}C$		32			
E_{rec}	二极管反向恢复损耗 Diode reverse recovery energy	$T_{vj} = 25\text{ }^{\circ}C$		0.10		mJ	
		$T_{vj} = 125\text{ }^{\circ}C$		0.11			
		$T_{vj} = 150\text{ }^{\circ}C$		0.12			

热敏电阻数据

NTC-Thermistor Data

符号 Symbol	参数名称 Parameter	测试条件 Test Conditions	最小值 Min.	典型值 Typ.	最大值 Max.	单位 Unit
R_{25}	额定电阻值 Rated resistance	$T_C = 25\text{ }^{\circ}\text{C}$		5		k Ω
$\Delta R/R$	R100 偏差 Deviation of R100	$T_C = 100\text{ }^{\circ}\text{C}$, $R_{100}=493\Omega$	-5		5	%
P_{25}	耗散功率 Power dissipation	$T_C = 25\text{ }^{\circ}\text{C}$			20	mW
$B_{25/50}$	B-值 B-value	$R_2 = R_{25}\exp [B_{25/50}(1/T_2 - 1/(298.15\text{ K}))]$		3375		K
$B_{25/80}$	B-值 B-value	$R_2 = R_{25}\exp [B_{25/80}(1/T_2 - 1/(298.15\text{ K}))]$		3411		K
$B_{25/100}$	B-值 B-value	$R_2 = R_{25}\exp [B_{25/100}(1/T_2 - 1/(298.15\text{ K}))]$		3433		K

模块

Module

参数 Symbol	说明 Explanation	值 Value	单位 Unit
爬电距离 Creepage distance	端子-散热器 Terminal to heatsink	11.5	mm
	端子-端子 Terminal to terminal	6.8	mm
绝缘间隙 Clearance	端子-散热器 Terminal to heatsink	9.4	mm
	端子-端子 Terminal to terminal	5.5	mm
相对漏电起痕指数 CTI (Comparative Tracking Index)		>400	
绝缘电压(模块) Isolation voltage – per module	短接所有端子，端子与基板间施加电压 (Connected terminals to base plate), AC RMS,1 min, 50Hz, $T_C = 25\text{ }^{\circ}\text{C}$	3200	V

模块

Module

符号 Symbol	参数名称 Parameter	测试条件 Test Conditions	最小值 Min.	典型值 Typ.	最大值 Max.	单位 Unit
L_{sCE}	模块电感 Module inductance			15		nH
$T_{vj\text{ op}}$	工作结温 Operating junction temperature	IGBT 芯片 (IGBT)	-40		150	$^{\circ}\text{C}$
		二极管芯片 (Diode)	-40		150	$^{\circ}\text{C}$
T_{stg}	存储温度 Storage temperature range		-40		125	$^{\circ}\text{C}$
M	安装力矩 Screw torque	安装紧固用 Mounting	1.3		1.5	Nm

IGBT T1/T4, 二极管 D1/D4

IGBT T1/T4, Diode D1/D4

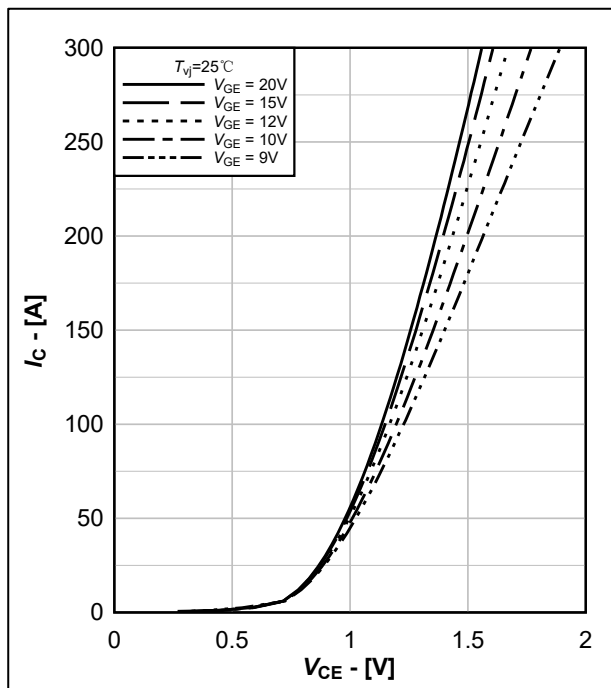


图 3. IGBT 输出特性典型曲线, $I_C = f(V_{CE})$

Fig.3 Typical IGBT output characteristic, $I_C = f(V_{CE})$

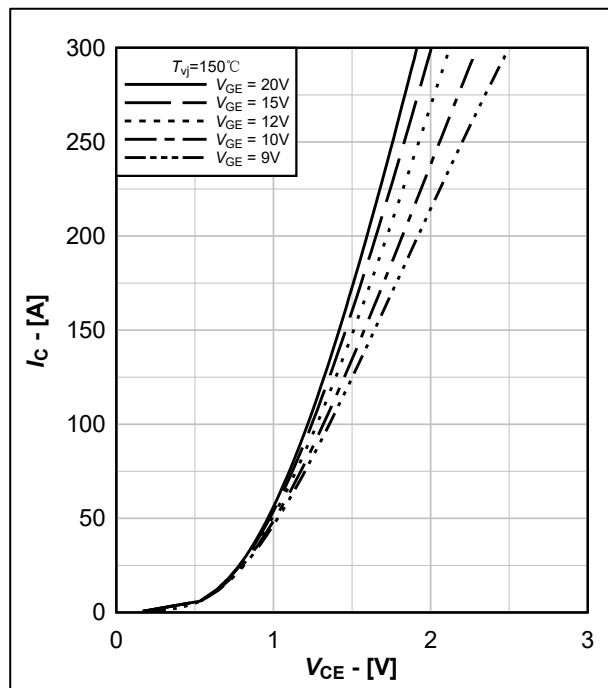


图 4. IGBT 输出特性典型曲线, $I_C = f(V_{CE})$

Fig.4 Typical IGBT output characteristic, $I_C = f(V_{CE})$

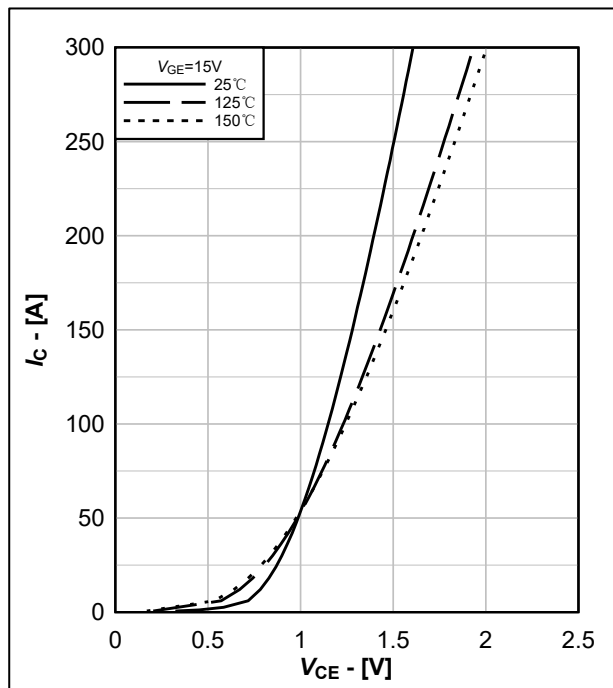


图 5. IGBT 输出特性典型曲线, $I_C = f(V_{CE})$

Fig.5 Typical IGBT output characteristic, $I_C = f(V_{CE})$

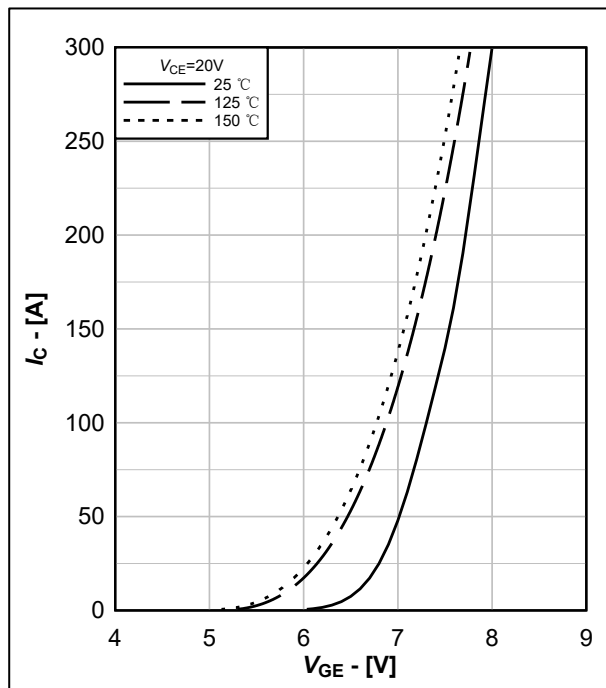
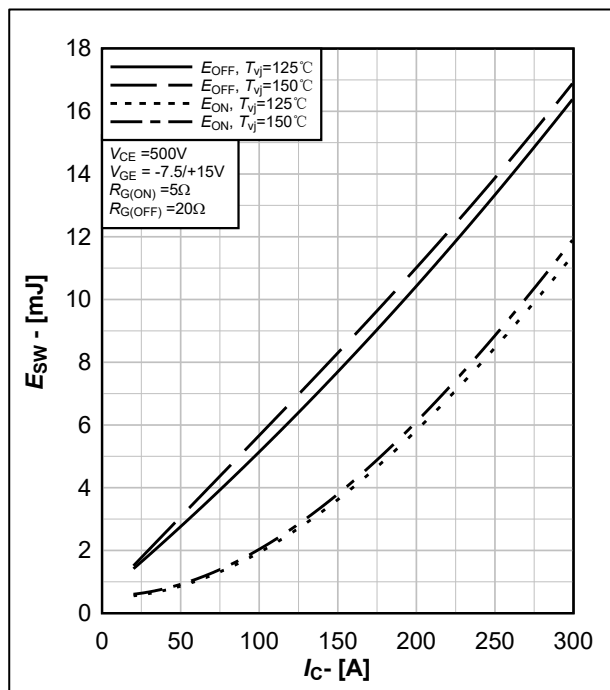
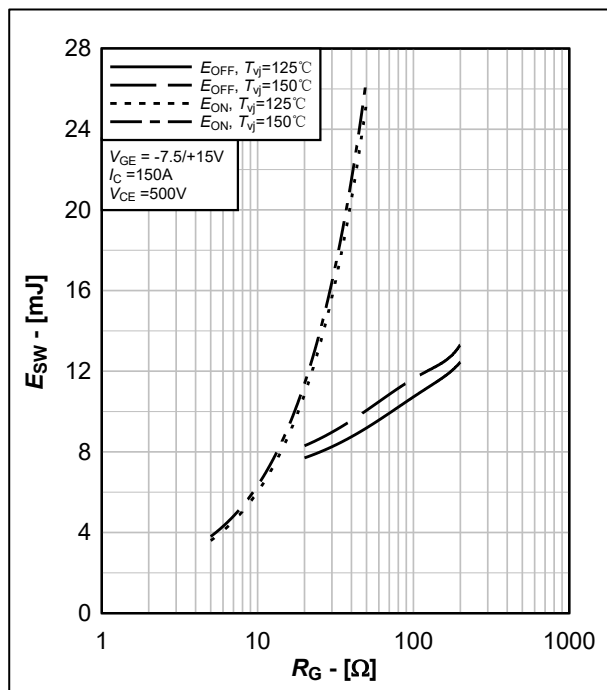
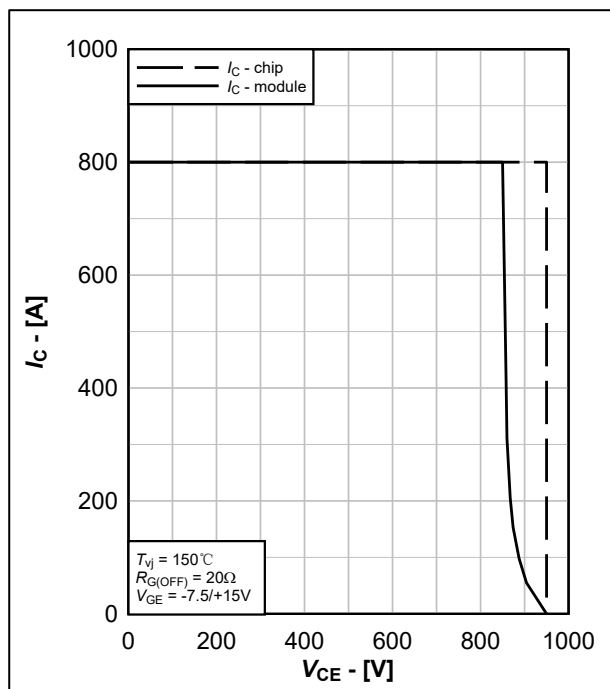
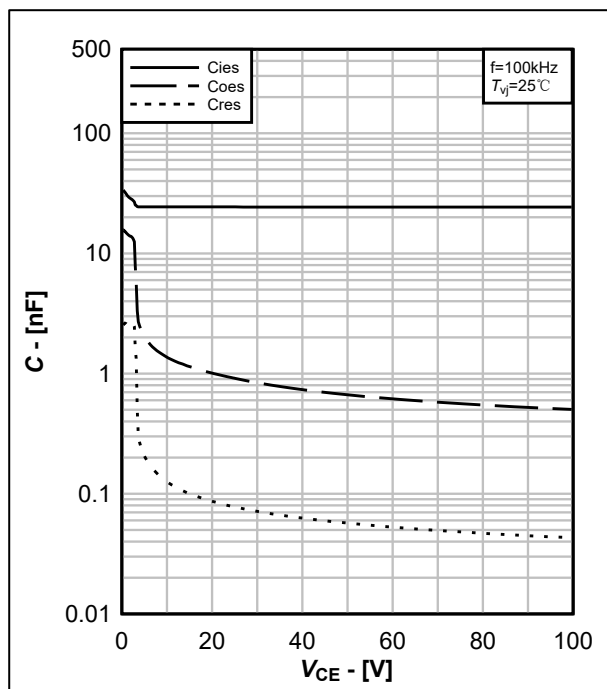


图 6. IGBT 传输特性典型曲线, $I_C = f(V_{GE})$

Fig.6 Typical IGBT transfer characteristic, $I_C = f(V_{GE})$

IGBT T1/T4, 二极管 D1/D4

IGBT T1/T4, Diode D1/D4

图 7. IGBT 开关损耗典型曲线, $E_{on}=f(I_c)$, $E_{off}=f(I_c)$ Fig.7 Typical IGBT switching energy, $E_{on}=f(I_c)$, $E_{off}=f(I_c)$ 图 8. IGBT 开关损耗典型曲线, $E_{on}=f(R_g)$, $E_{off}=f(R_g)$ Fig.8 Typical IGBT switching energy, $E_{on}=f(R_g)$, $E_{off}=f(R_g)$ 图 9. IGBT 反偏安全工作区, $I_c=f(V_{ce})$ Fig.9 Reverse bias safe operating area of IGBT, $I_c=f(V_{ce})$ 图 10. 电容特性典型曲线, $C=f(V_{ce})$ Fig.10 Typical capacity characteristic, $C=f(V_{ce})$

IGBT T1/T4, 二极管 D1/D4

IGBT T1/T4, Diode D1/D4

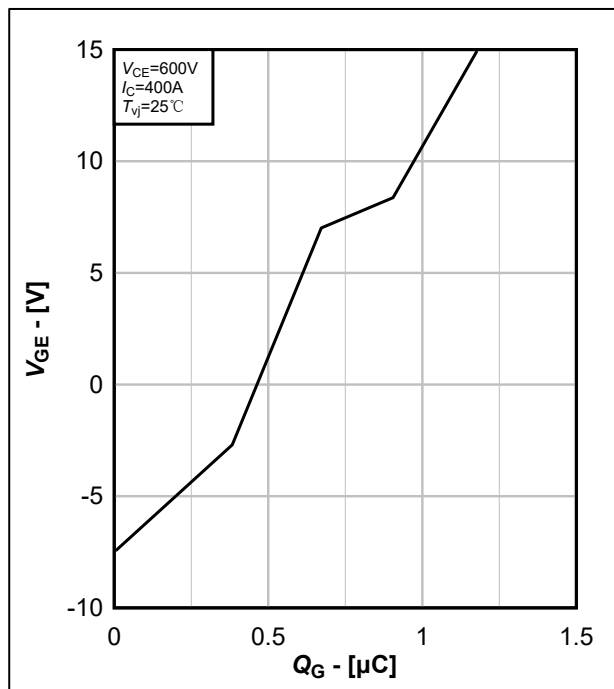

图 11. 栅极电荷特性典型曲线, $V_{GE} = f(Q_G)$

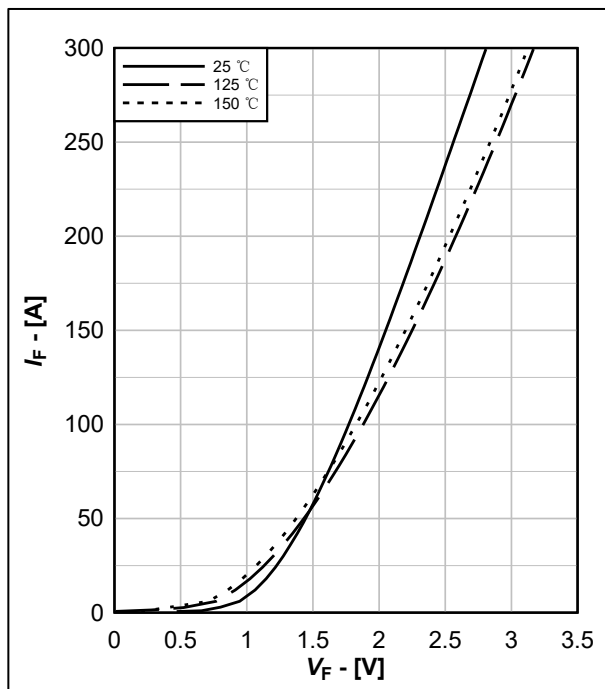
Fig.11 Typical gate charge characteristic, $V_{GE} = f(Q_G)$

图 12. FRD 输出特性典型曲线, $I_F = f(V_F)$

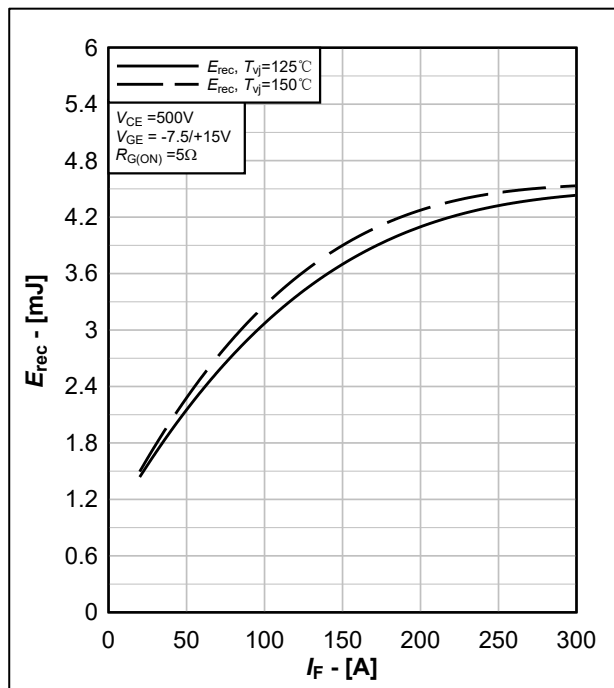
Fig.12 Typical FRD output characteristic, $I_F = f(V_F)$

图 13. FRD 反向恢复损耗典型曲线, $E_{rec} = f(I_F)$

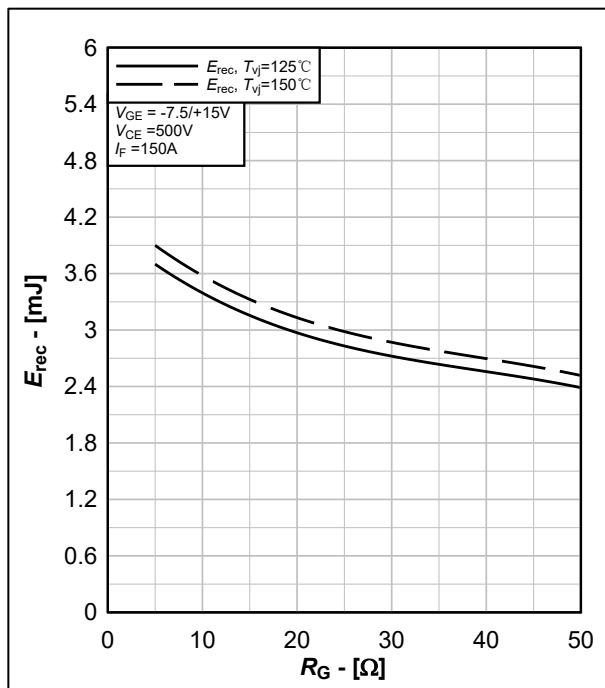
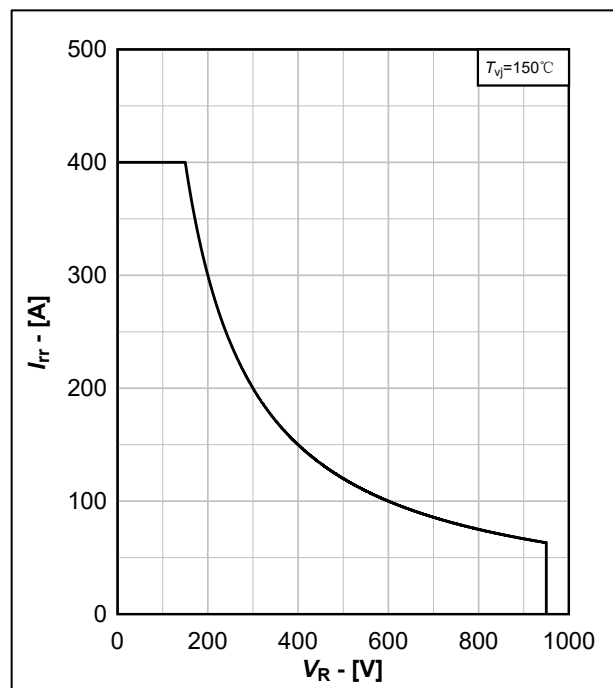
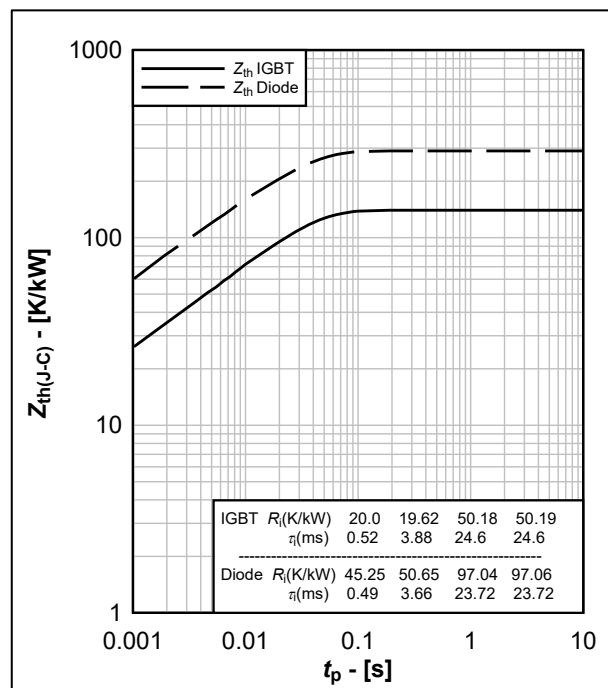
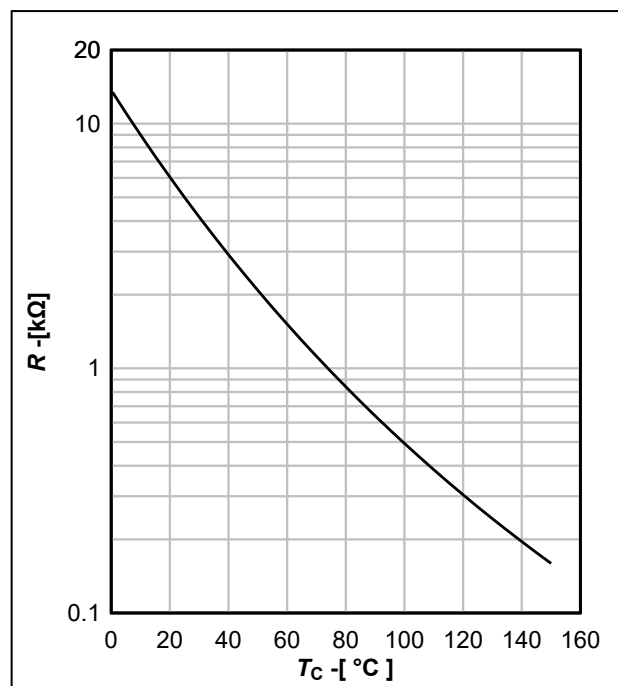
Fig.13 Typical FRD switching loss E_{rec} , $E_{rec} = f(I_F)$

图 14. FRD 反向恢复损耗典型曲线, $E_{rec} = f(R_G)$

Fig.14 Typical FRD switching loss E_{rec} , $E_{rec} = f(R_G)$

IGBT T1/T4, 二极管 D1/D4

图 15. FRD 反偏安全工作区, $I_{rr} = f(V_R)$ Fig.15 Reverse bias safe operating area of FRD, $I_{rr} = f(V_R)$ 图 16. 瞬态热阻抗曲线, $Z_{th(J-C)} = f(t_p)$ Fig.16 Transient thermal impedance, $Z_{th(J-C)} = f(t_p)$ 图 17. 热敏电阻典型特性曲线, $R = f(T_c)$ Fig.17 Typical NTC thermistor characteristic, $R = f(T_c)$

IGBT T2/T3, 二极管 D2/D3

IGBT T2/T3, Diode D2/D3

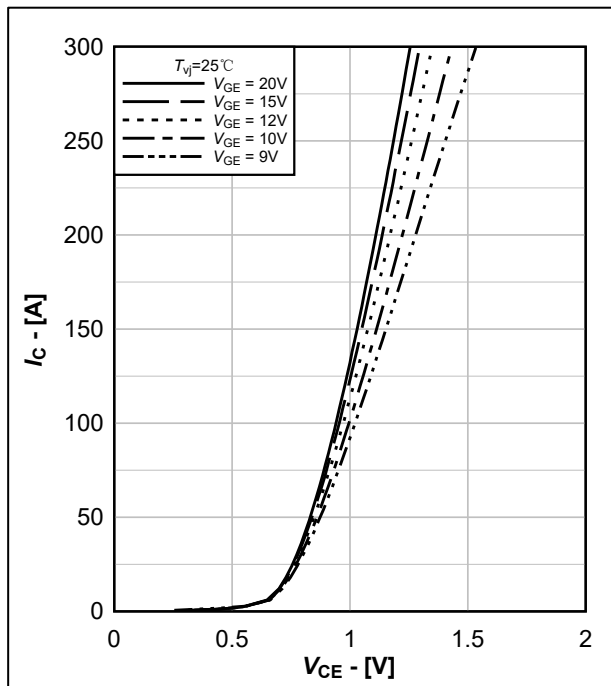


图 18. IGBT 输出特性典型曲线, $I_C = f(V_{CE})$

Fig.18 Typical IGBT output characteristic, $I_C = f(V_{CE})$

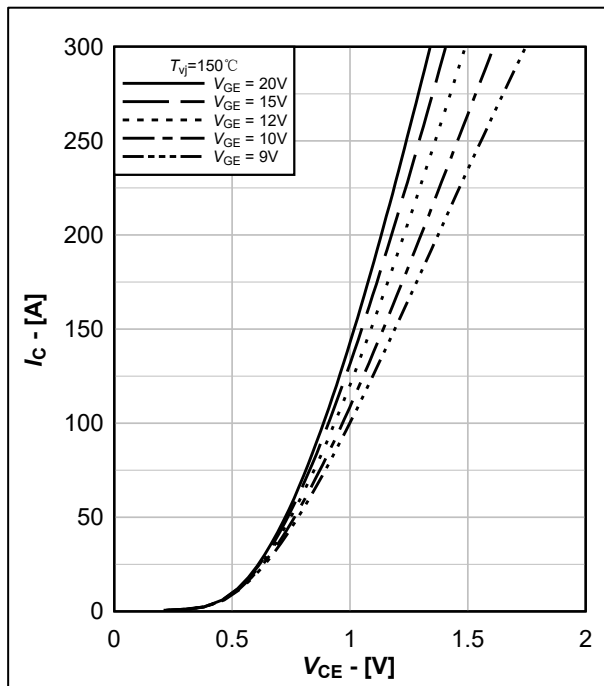


图 19. IGBT 输出特性典型曲线, $I_C = f(V_{CE})$

Fig.19 Typical IGBT output characteristic, $I_C = f(V_{CE})$

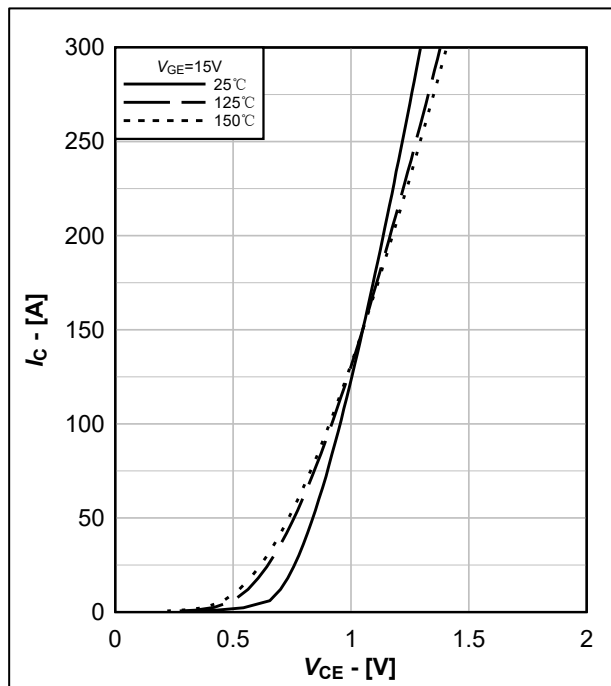


图 20. IGBT 输出特性典型曲线, $I_C = f(V_{CE})$

Fig.20 Typical IGBT output characteristic, $I_C = f(V_{CE})$

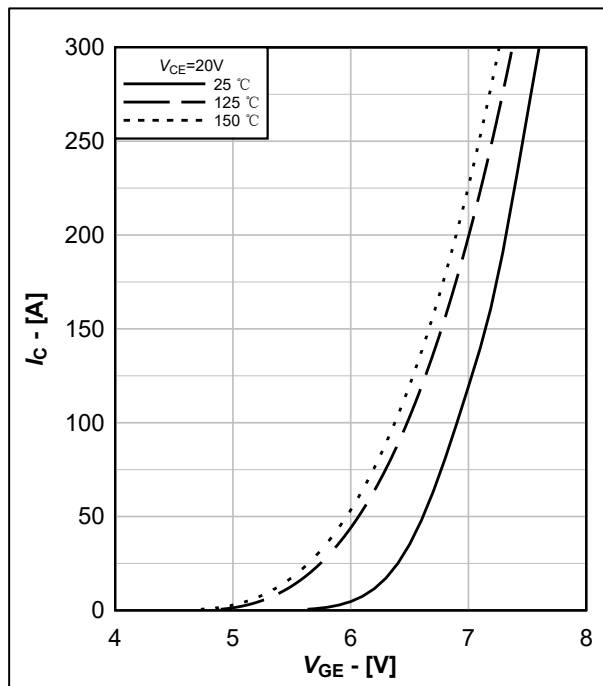
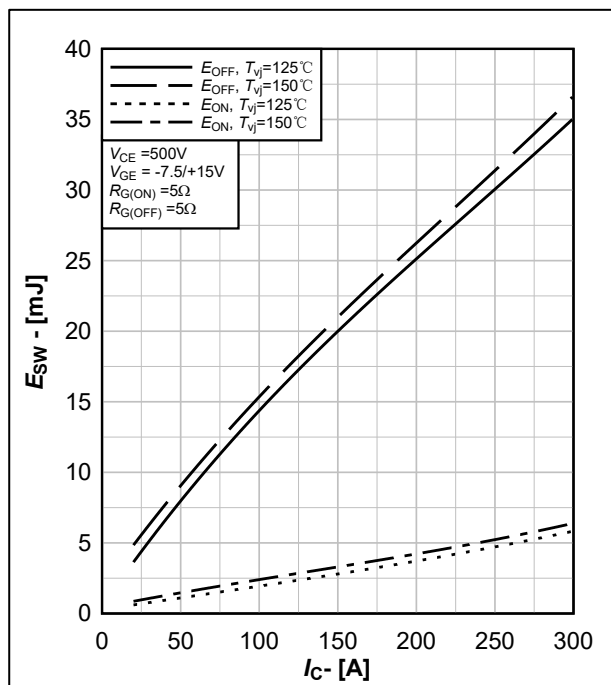
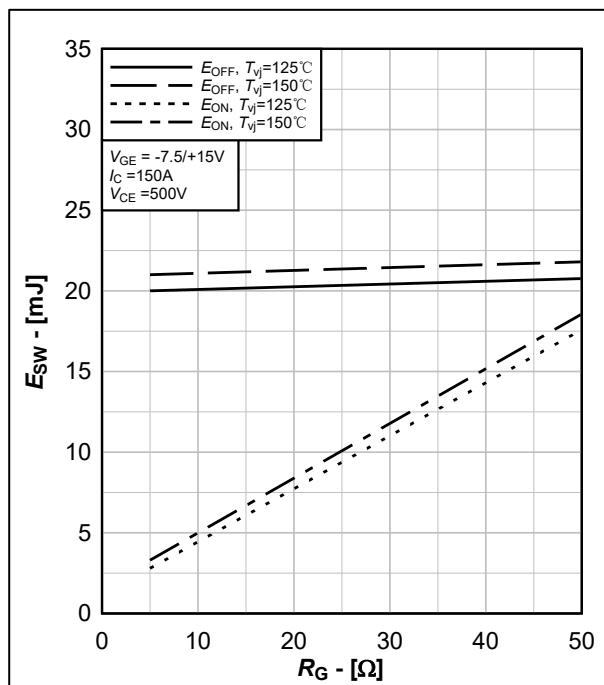
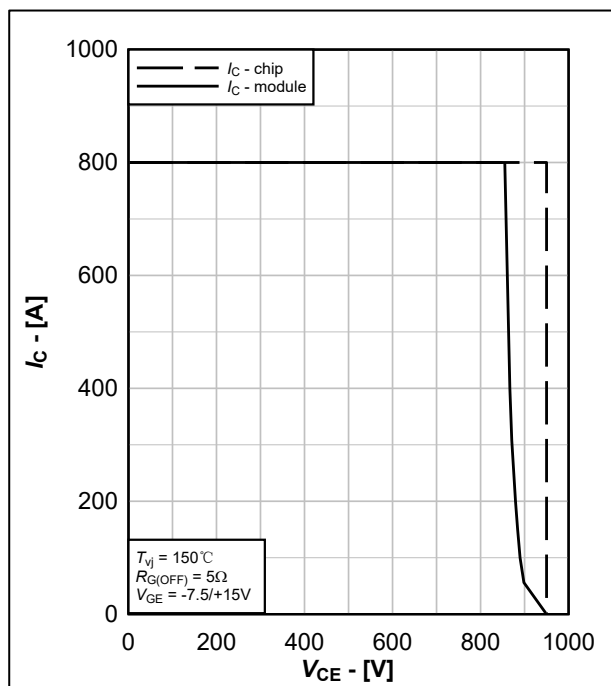
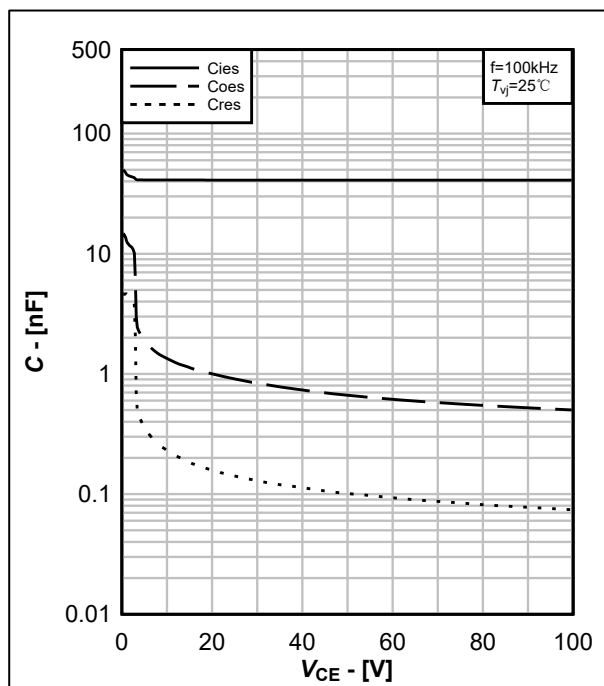


图 21. IGBT 传输特性典型曲线, $I_C = f(V_{GE})$

Fig.21 Typical IGBT transfer characteristic, $I_C = f(V_{GE})$

IGBT T2/T3, 二极管 D2/D3

IGBT T2/T3, Diode D2/D3

图 22. IGBT 开关损耗典型曲线, $E_{on}=f(I_C)$, $E_{off}=f(I_C)$ Fig.22 Typical IGBT switching energy, $E_{on}=f(I_C)$, $E_{off}=f(I_C)$ 图 23. IGBT 开关损耗典型曲线, $E_{on}=f(R_G)$, $E_{off}=f(R_G)$ Fig.23 Typical IGBT switching energy, $E_{on}=f(R_G)$, $E_{off}=f(R_G)$ 图 24. IGBT 反偏安全工作区, $I_C=f(V_{CE})$ Fig.24 Reverse bias safe operating area of IGBT, $I_C=f(V_{CE})$ 图 25. 电容特性典型曲线, $C=f(V_{CE})$ Fig.25 Typical capacity characteristic, $C=f(V_{CE})$

IGBT T2/T3, 二极管 D2/D3

IGBT T2/T3, Diode D2/D3

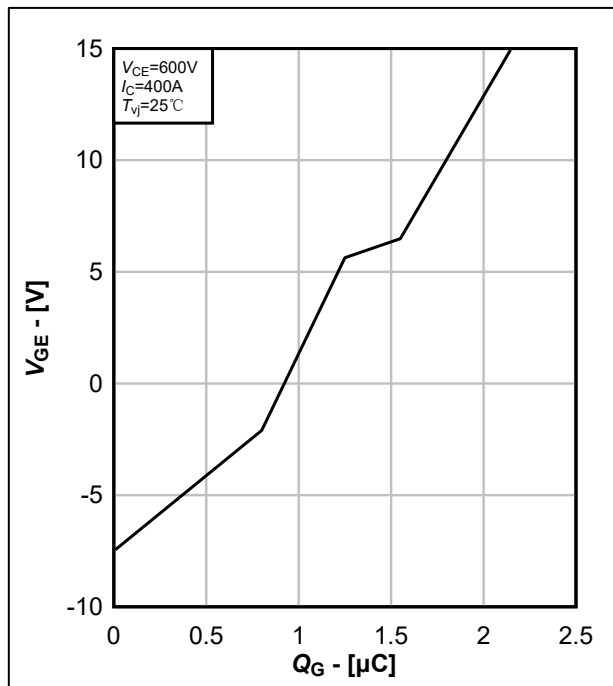

图 26. 栅极电荷特性典型曲线, $V_{GE} = f(Q_G)$

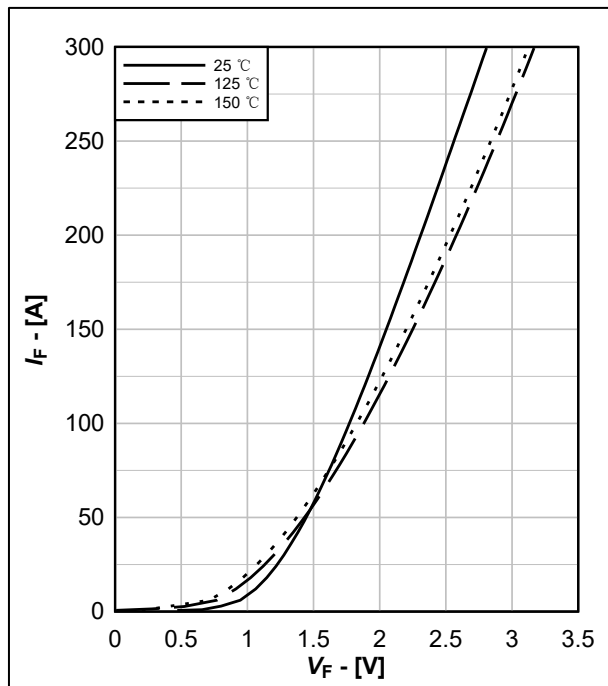
Fig.26 Typical gate charge characteristic, $V_{GE} = f(Q_G)$

图 27. FRD 输出特性典型曲线, $I_F = f(V_F)$

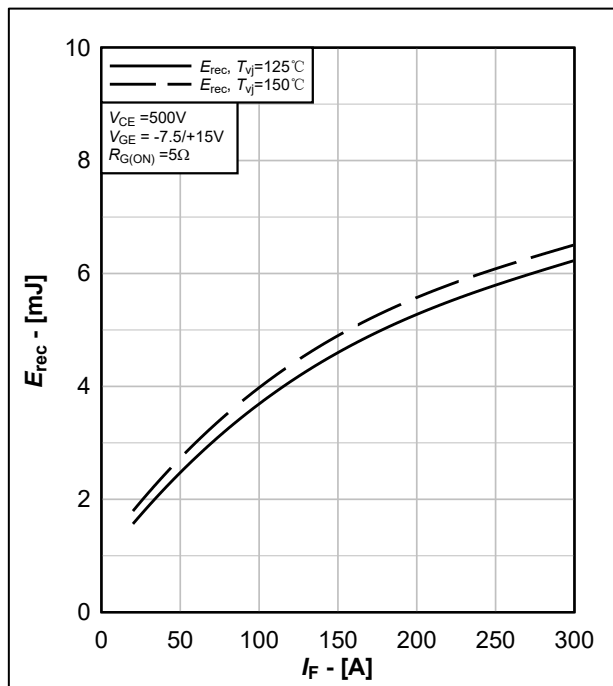
Fig.27 Typical FRD output characteristic, $I_F = f(V_F)$

图 28. FRD 反向恢复损耗典型曲线, $E_{rec} = f(I_F)$

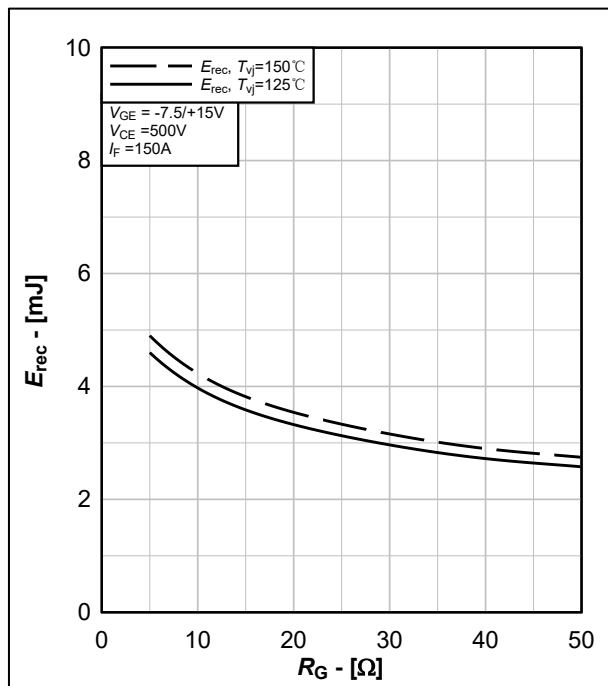
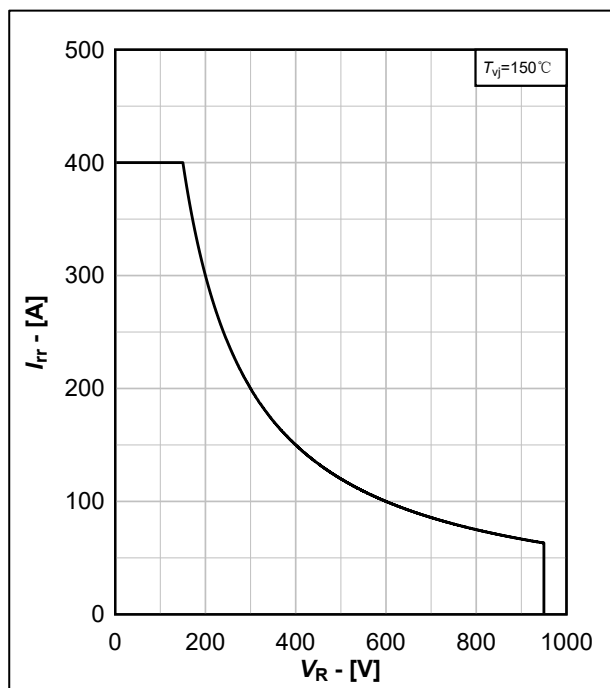
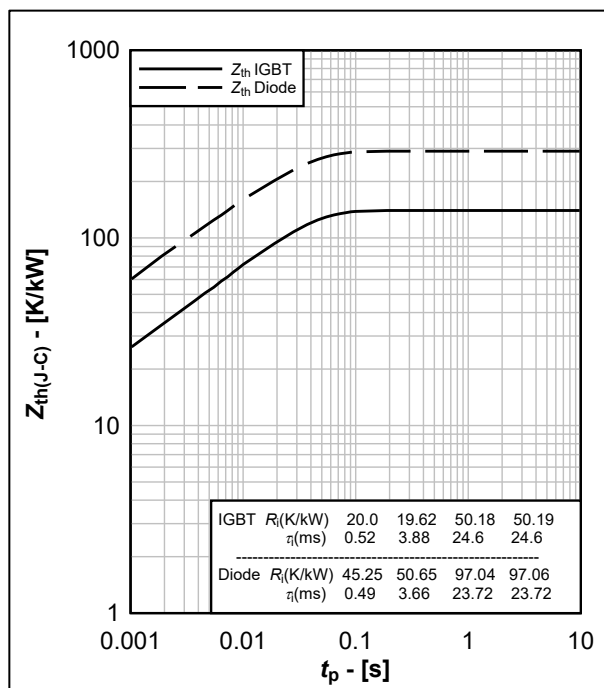
Fig.28 Typical FRD switching loss E_{rec} , $E_{rec} = f(I_F)$

图 29. FRD 反向恢复损耗典型曲线, $E_{rec} = f(R_G)$

Fig.29 Typical FRD switching loss E_{rec} , $E_{rec} = f(R_G)$

IGBT T2/T3, 二极管 D2/D3

图 30. FRD 反偏安全工作区, $I_{rr} = f(V_R)$ Fig.30 Reverse bias safe operating area of FRD, $I_{rr} = f(V_R)$ 图 31. 瞬态热阻抗曲线, $Z_{th(J-C)} = f(t_p)$ Fig.31 Transient thermal impedance, $Z_{th(J-C)} = f(t_p)$

IGBT T5/T6, 二极管 D5/D6

IGBT T5/T6, Diode D5/D6

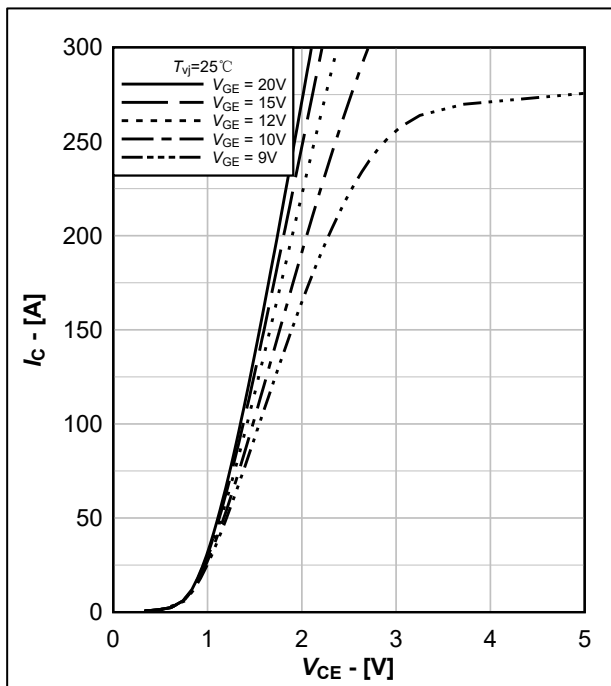

图 32. IGBT 输出特性典型曲线, $I_C = f(V_{CE})$

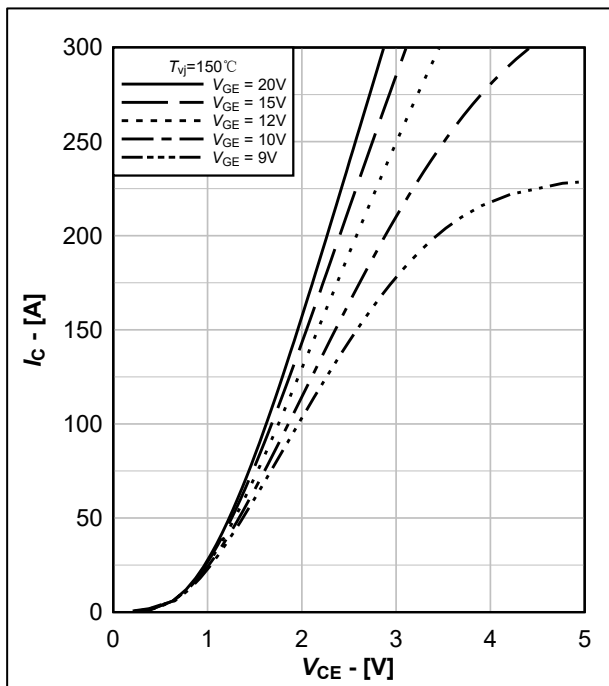
Fig.32 Typical IGBT output characteristic, $I_C = f(V_{CE})$

图 33. IGBT 输出特性典型曲线, $I_C = f(V_{CE})$

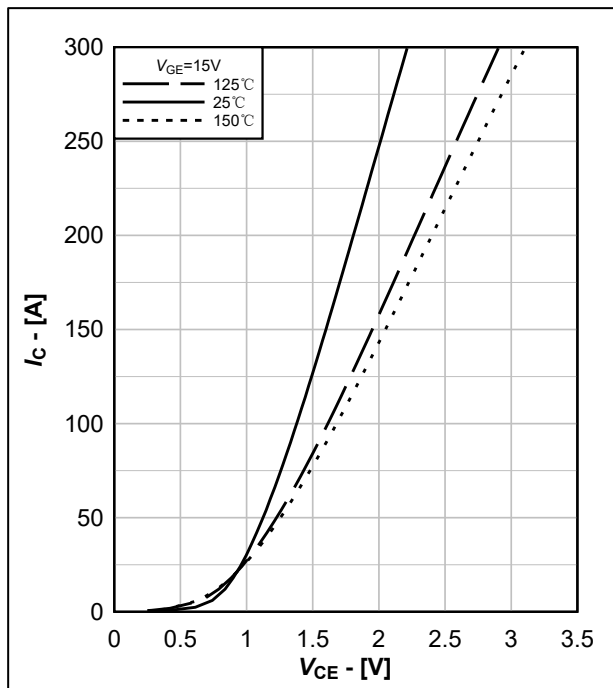
Fig.33 Typical IGBT output characteristic, $I_C = f(V_{CE})$

图 34. IGBT 输出特性典型曲线, $I_C = f(V_{CE})$

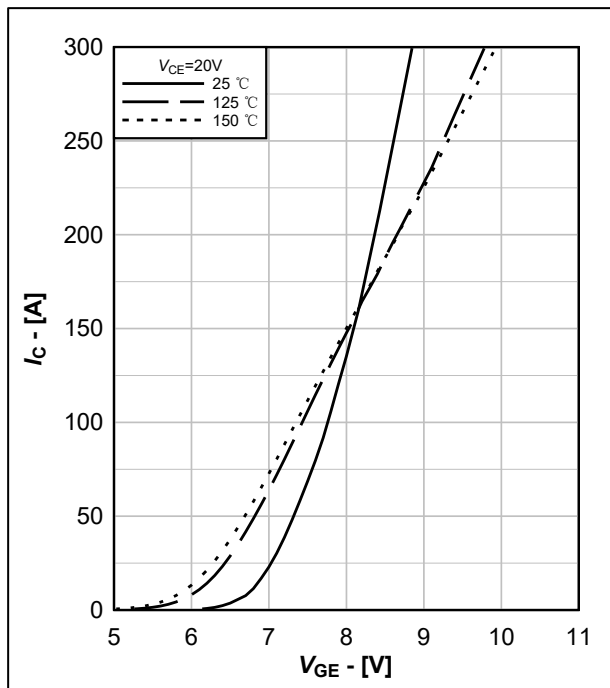
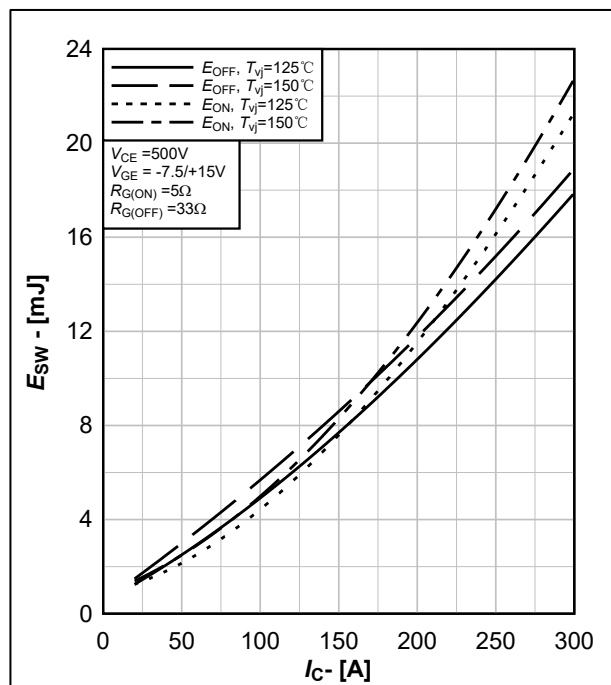
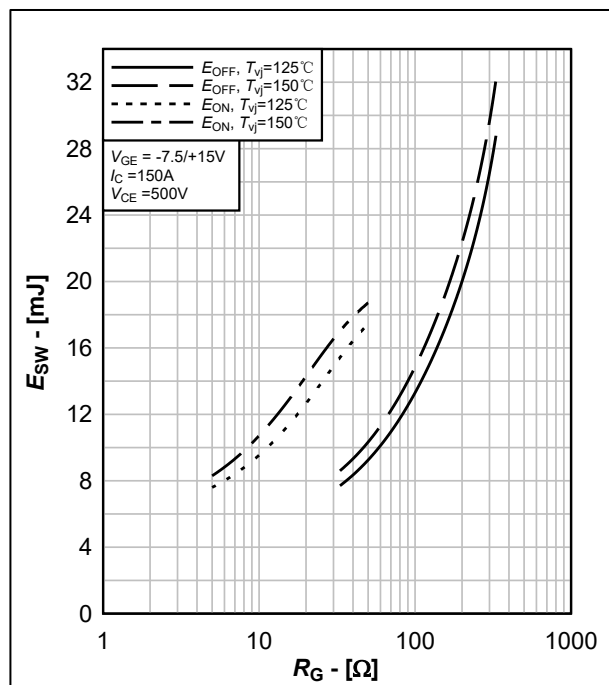
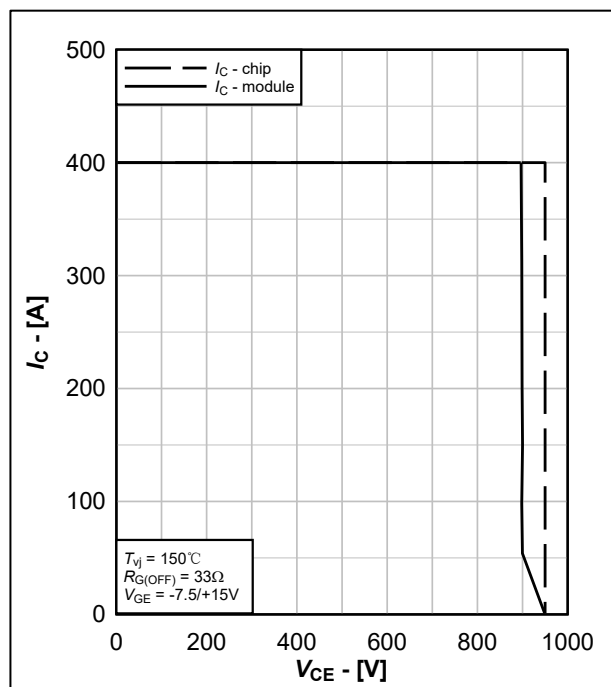
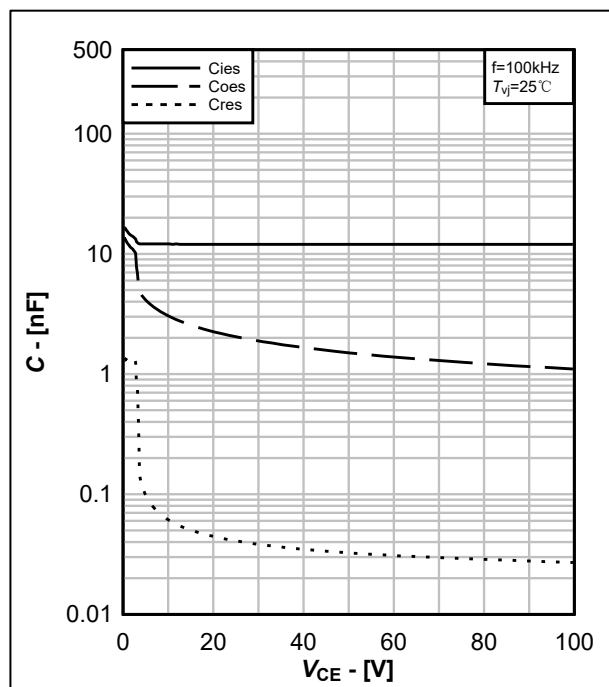
Fig.34 Typical IGBT output characteristic, $I_C = f(V_{CE})$

图 35. IGBT 传输特性典型曲线, $I_C = f(V_{GE})$

Fig.35 Typical IGBT transfer characteristic, $I_C = f(V_{GE})$

IGBT T5/T6, 二极管 D5/D6

IGBT T5/T6, Diode D5/D6

图 36. IGBT 开关损耗典型曲线, $E_{on}=f(I_C)$, $E_{off}=f(I_C)$ Fig.36 Typical IGBT switching energy, $E_{on}=f(I_C)$, $E_{off}=f(I_C)$ 图 37. IGBT 开关损耗典型曲线, $E_{on}=f(R_G)$, $E_{off}=f(R_G)$ Fig.37 Typical IGBT switching energy, $E_{on}=f(R_G)$, $E_{off}=f(R_G)$ 图 38. IGBT 反偏安全工作区, $I_C=f(V_{CE})$ Fig.38 Reverse bias safe operating area of IGBT, $I_C=f(V_{CE})$ 图 39. 电容特性典型曲线, $C=f(V_{CE})$ Fig.39 Typical capacity characteristic, $C=f(V_{CE})$

IGBT T5/T6, 二极管 D5/D6

IGBT T5/T6, Diode D5/D6

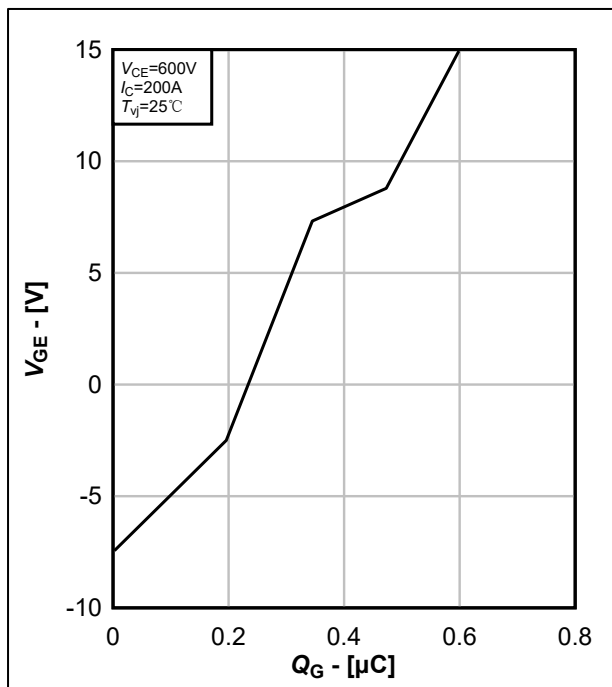

图 40. 栅极电荷特性典型曲线, $V_{GE} = f(Q_G)$

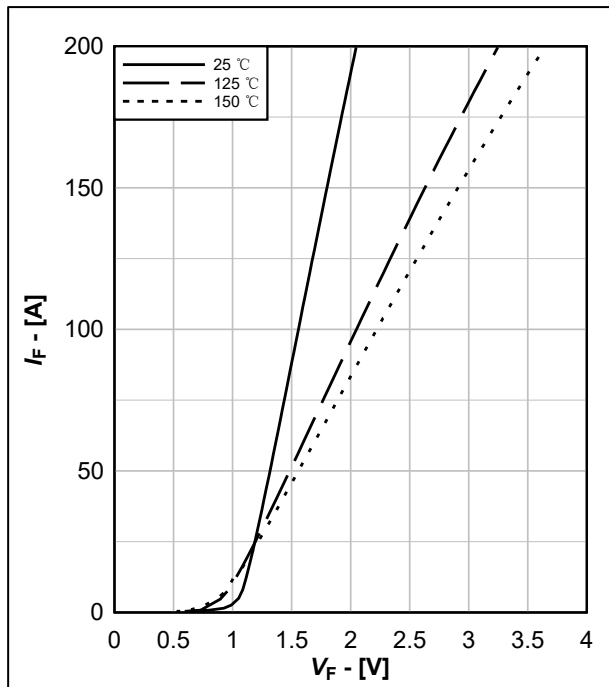
Fig.40 Typical gate charge characteristic, $V_{GE} = f(Q_G)$

图 41. FRD 输出特性典型曲线, $I_F = f(V_F)$

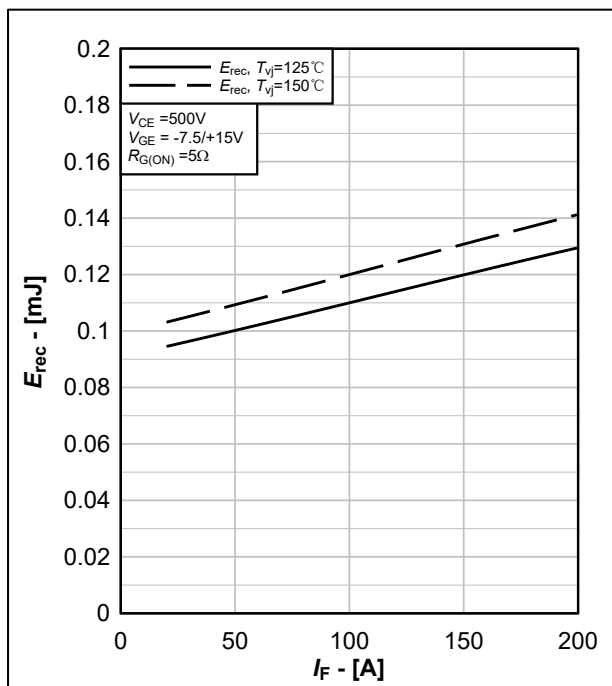
Fig.41 Typical FRD output characteristic, $I_F = f(V_F)$

图 42. FRD 反向恢复损耗典型曲线, $E_{rec}=f(I_F)$

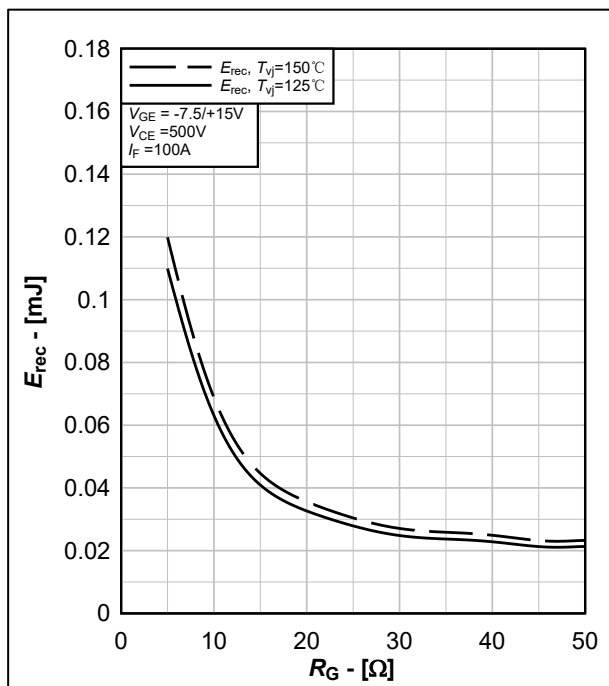
Fig.42 Typical FRD switching loss E_{rec} , $E_{rec}=f(I_F)$

图 43. FRD 反向恢复损耗典型曲线, $E_{rec}=f(R_G)$

Fig.43 Typical FRD switching loss E_{rec} , $E_{rec}=f(R_G)$

IGBT T5/T6，二极管 D5/D6

IGBT T5/T6, Diode D5/D6

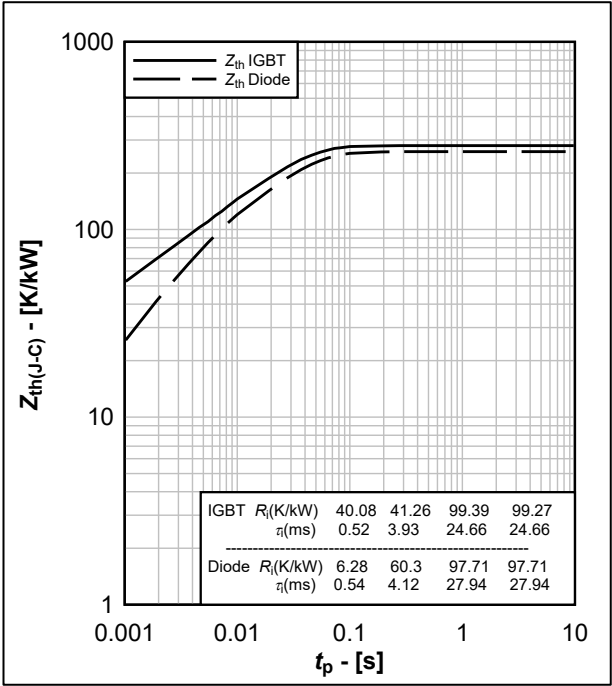
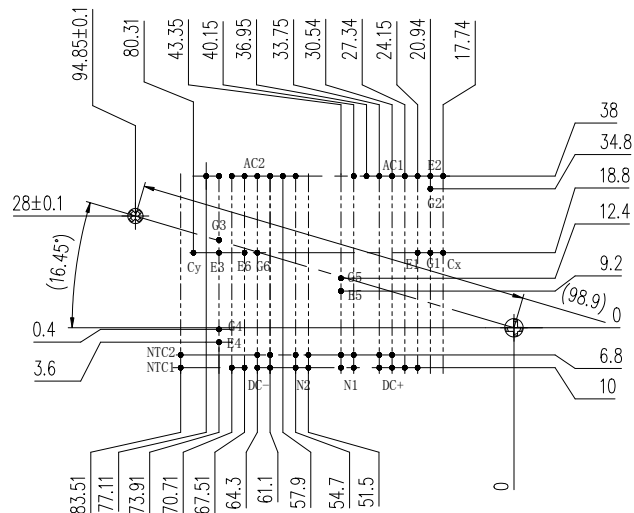
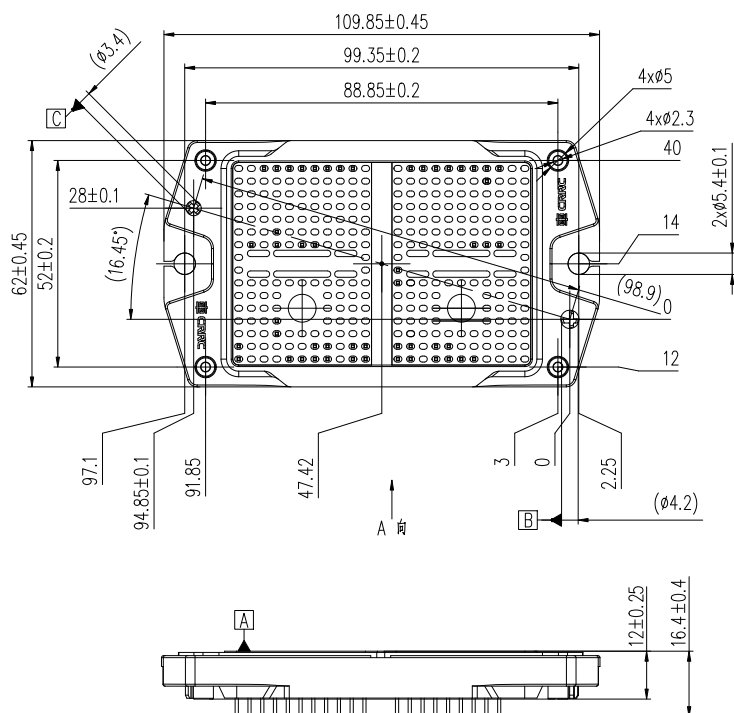


图 44. 瞬态热阻抗曲线, $Z_{th(J-C)} = f(t_p)$

Fig.44 Transient thermal impedance, $Z_{th(J-C)} = f(t_p)$



重量 Weight: 84g 模块外观类型 Module outline code: U3

图 45. 模块外观尺寸

Fig. 45 Module outlines

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电子邮箱 Email sbu@crzcic.cc

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产品数据手册 Product Datasheet 版本 Ver 23.12

TH400AN10U3-S500

三电平 IGBT 模块 3-level IGBT Module

使用条件和条款

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Terms and conditions of usage

(1) The product information in this datasheet are intended for use by technical personnel. Due to the diversity of product applications, the information contained in this document can only be used as a general guide, the application applicability cannot be guaranteed in some special applications. It is recommended that users do the assessment of the application applicability before applied. If users need additional product information and help, please contact our sales or technical support.

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(4) During the application, if the working conditions are beyond the limitation of temperature, voltage, current or safe operating area of the product defined in the product datasheet, our company cannot guarantee the reliability of the product.

(5) When the products are in use, it is strictly prohibited to touch. After power off, to ensure that there is no residual charge and the products have been cooled before they can be touched. And all operations must be under ESD protection measures.

(6) We annotate datasheet in the top right hand corner of the front page, to indicate product status. The annotation “Preliminary” indicates the product design is complete and final characterization for volume production is in progress, the product information in the datasheet is currently can be referenced, but some details may change in the future. There is no annotation indicates the product is capable to produce in batch quantity.

Caution: This device is sensitive to electrostatic discharge. Users should follow ESD handling procedures.

注意：该器件对静电敏感，用户须采取 ESD 防护措施。