

主要参数 MAIN CHARACTERISTICS

I_c (100°C)	20 A
V_{CES}	600 V
$V_{cesat-typ}$ (@ $I_c=20A$)	1.49 V

用途 APPLICATIONS

逆变电源	Inverter power supply
电机驱动	Motor drive
空调	Air condition
功率因数校正	Power factor correction
变频器	Variable-frequency drive

产品特性 FEATURES

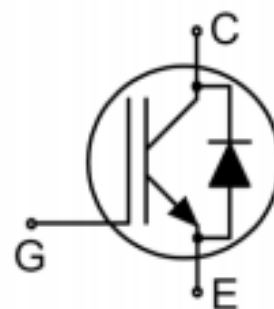
Trench-FS 技术	Trench Field Stop technology
低栅极电荷	Low gate charge
低开关损耗	Low Switching losses
低 V_{CEsat}	Low V_{CEsat}
RoHS 产品	RoHS product
带有反向并行快回复二极管	With anti-parallel fast recovery diode
正温度系数	Positive temperature coefficient
高可靠性	High reliability

封装形式 Package



TO-220F
FHF series

等效电路 Equivalent Circuit



绝对最大额定值 ABSOLUTE RATINGS ($T_c=25^\circ C$)

项目 parameter	符号 Symbol	数值 Value	单位 Unit
最高集电极-发射极直流电压 Collector-Emmitter Voltage	V_{CE}	600	V
连续集电极极电流 Collector Current-continuous	I_c	($T_c=25^\circ C$)	A
		($T_c=100^\circ C$)	
最大脉冲集电极极电流 (注1) Collector Current – pulse (note 1)	I_{CM}	60	A
二极管连续正向电流 Diode Continuous Forward Current	I_F	($T_c=25^\circ C$)	A
		($T_c=100^\circ C$)	
二极管最大正向电流 Diode Maximum Forward Current	I_{FM}	40	A
最高栅极发射极电压 Gate-Emmitter Voltage	V_{GE}	± 20	V
短路耐受时间 Short circuit withstand time $V_{GE}=15V, V_{CC}\leq 400V,$ Allowed number of short circuits<1000, Times between short circuits: $\geq 1.0s, T_J \leq 175^\circ C$	t_{sc}	3.0	us
耗散功率 Power Dissipation ($T_c=25^\circ C$)	P_D	30	W
最高结温及存储温度 Operating and Storage Temperature Range	T_J, T_{STG}	150,-55~+150	$^\circ C$
引线最高焊接温度 Maximum Lead Temperature for Soldering Purposes	T_L	270	$^\circ C$

注1: 集极电流由最高结温限制

Note1: Collector current limited by maximum junction temperature

电特性 ELECTRICAL CHARACTERISTICS(at T_C= 25°C, unless otherwise specified)

项目 Parameter	符号 Symbol	测试条件 Tests conditions	最小 Min	典型 Typ	最大 Max	单位 Units	
关态特性 Off –Characteristics							
集电极-发射极击穿电压 Collector-Emmitter Voltage	BV _{CES}	V _{GE} =0V, I _C =250uA	600	-	-	V	
击穿电压温度特性 Breakdown Voltage Temperature Coefficient	ΔBV _{CES} /ΔT _J	I _C =1mA, referenced to 25°C	-	0.60	-	V/°C	
零栅压下集电极漏电流 Zero Gate Voltage Collector Current	I _{CES}	V _{CE} =600V, V _{GE} =0V	-	-	600	nA	
栅极体漏电流 Gate-Emitter leakage current	I _{GES(F/R)}	V _{CE} =0V, V _{GE} =±30V	-	-	±200	nA	
通态特性 On-Characteristics							
阈值电压 Gate-Emmitter Threshold Voltage	V _{GE(th)}	V _{CE} = V _{GE} , I _C =1mA	4.9	5.4	6.4	V	
饱和压降 Collector-Emmitter saturation Voltage	V _{CESAT}	V _{GE} =15V, I _C =20A,	-	1.49	1.70	V	
动态特性 Dynamic Characteristics							
开启延迟时间 Turn-On delay time	td(on)	V _{GE} =15V, V _{CC} =400V, I _C =20A, R _G =7Ω, T _J =25°C, Inductive Load	-	35.2	-	ns	
上升时间 Turn-On rise time	tr		-	36.2	-	ns	
关断延迟时间 Turn-Off delay time	td(off)		-	125.6	-	ns	
下降时间 Turn-Off Fall time	tf		-	37.8	-	ns	
开启损耗 Turn-on energy	Eon		-	0.72	-	mJ	
关断损耗 Turn-off energy	Eoff		-	0.28	-		
总的开关损耗 Total switching energy	Ets		-	1.0	-		
开启延迟时间 Turn-On delay time	td(on)		V _{GE} =15V, V _{CC} =400V, I _C =20A, R _G =7Ω, T _J =150°C, Inductive Load	-	32.3	-	ns
上升时间 Turn-On rise time	tr			-	37.7	-	ns
关断延迟时间 Turn-Off delay time	td(off)	-		142.7	-	ns	
下降时间 Turn-Off Fall time	tf	-		43.5	-	ns	
开启损耗 Turn-on energy	Eon	-		0.75	-	mJ	
关断损耗 Turn-off energy	Eoff	-		0.34	-		
总的开关损耗 Total switching energy	Ets	-		1.09	-		
栅极电荷总量 Total Gate Charge	Qg	V _{CE} =480V, I _C =20A, V _{GE} =15V		-	73	-	nC
栅极-发射极电荷 Gate-emitter charge	Qge			-	37	-	
栅极-集电极电荷 Gate-collector charge	Qgc		-	13	-		
集电极短路电流 Short circuit collector current (最大值100sc; 短路时间间隔: ≥1.0s)	I _{C(sc)}	V _{GE} =15V, V _{CC} ≤400V, t _{sc} ≤3us, T _J ≤175°C		320		A	
栅极电阻 Gate Resistance	Rg	f=1.0MHz, V _{CE} OPEN	-	2.1	-	Ω	
输入电容 Input capacitance	Cies	V _{CE} =30V, V _{GE} =0V, f=1.0MHz	-	1481	-	pF	
输出电容 Output capacitance	Coes		-	74.7	-		
反向传输电容 Reverse transfer capacitance	Cres		-	43.5	-		

二极管特性 Diode characteristics						
项目 Parameter	符号 Symbol	测试条件 Tests conditions	最小 Min	典型 Typ	最大 Max	单位 Units
正向压降 Diode Forward Voltage	V_{FM}	$I_F=20A$	-	1.47	1.70	V
反向恢复时间 Reverse recovery time	trr	$I_F=10A,$ $di/dt=100A/\mu s,$	-	47	-	ns
反向恢复电流 Reverse recovery current	Irr		-	7.5	-	A
反向恢复电荷 Reverse recovery charge	Qrr		-	176	-	nC

热特性 THERMAL CHARACTERISTIC

项目 Parameter	符号 Symbol	数值 Value	单位 Unit
结到管壳的热阻 (IGBT) Thermal Resistance, Junction to Case (IGBT)	Rth(j-c)	4.16	°C/W
结到管壳的热阻 (Diode) Thermal Resistance, Junction to Case (Diode)	Rth(j-c)	6.9	°C/W
结到环境的热阻 Thermal Resistance, Junction to Ambient	Rth(j-A)	62.5	°C/W

特性曲线

(ELECTRICAL CHARACTERISTICS (curves))

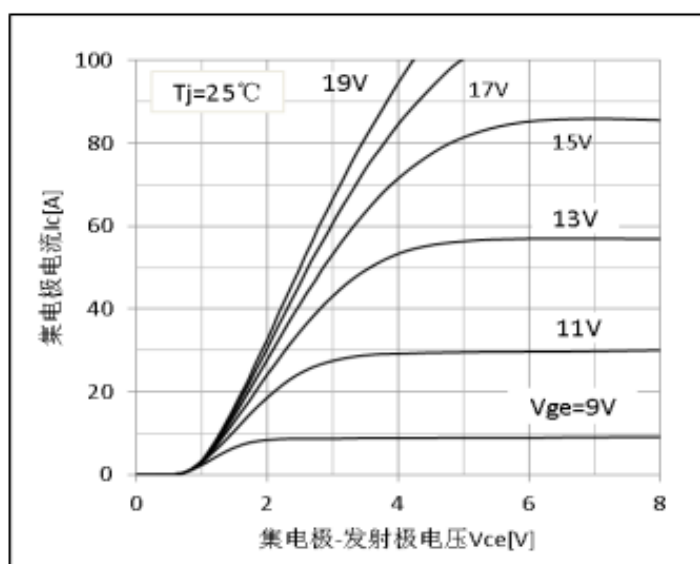


图 1 输出特性曲线

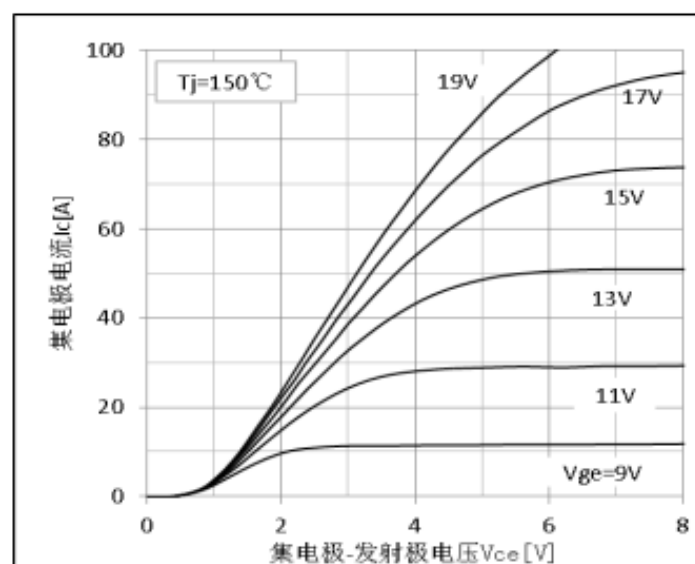


图 2 输出特性曲线

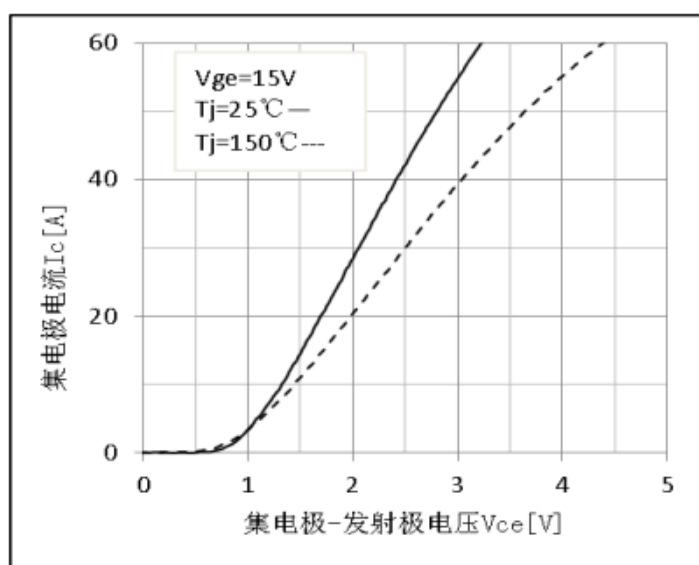


图 3 饱和压降特性

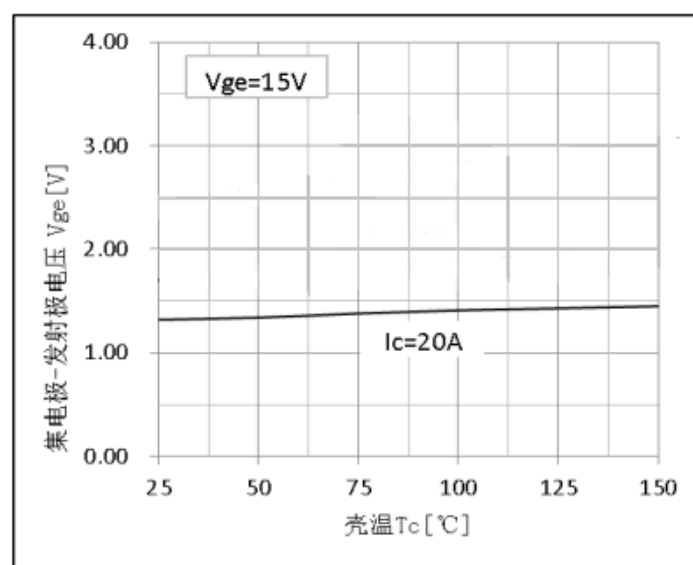


图 4 饱和压降温度特性

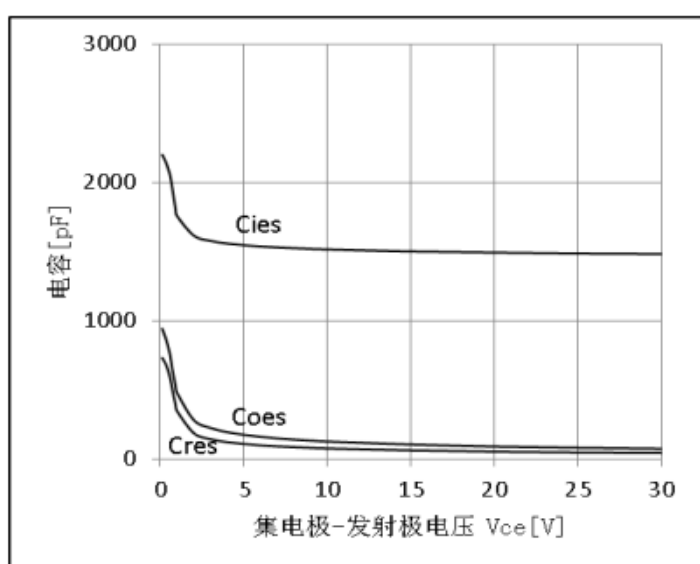


图 5 电容特性

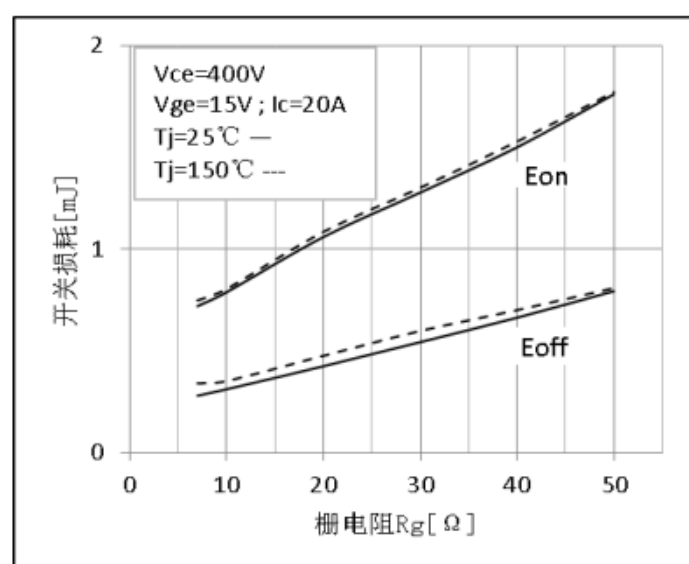


图 6 开关损耗-栅电阻特性曲线

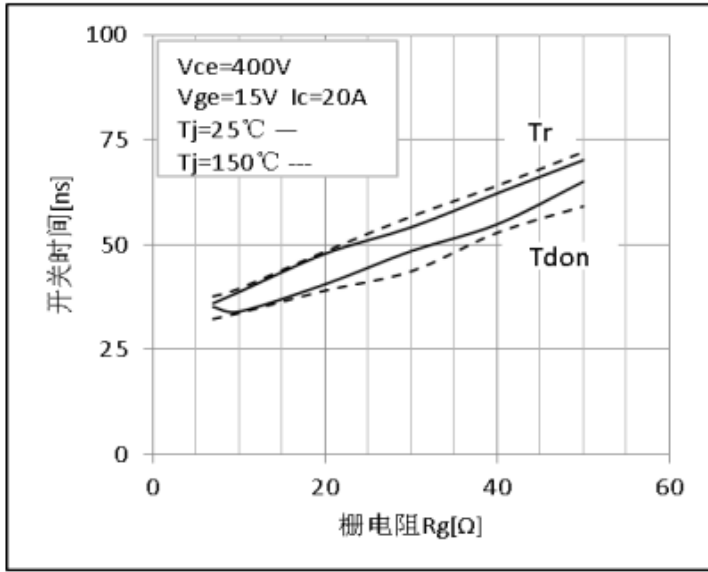


图 7 开通-栅电阻特性曲线

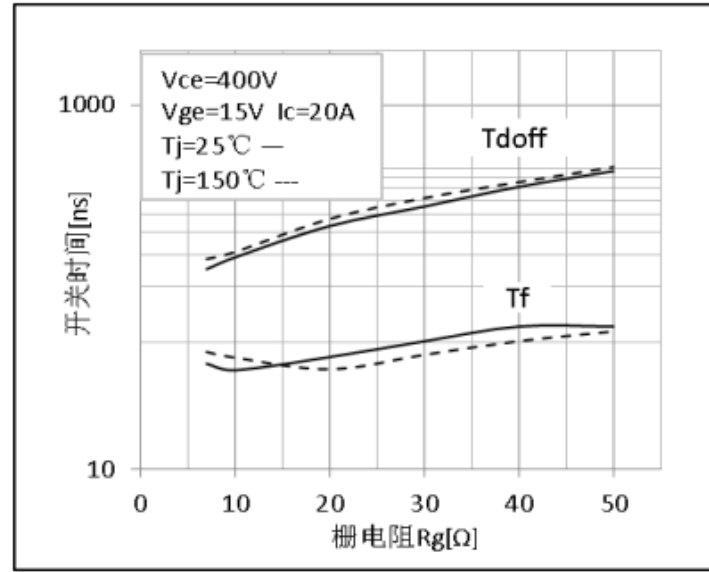


图 8 关断-栅电阻特性曲线

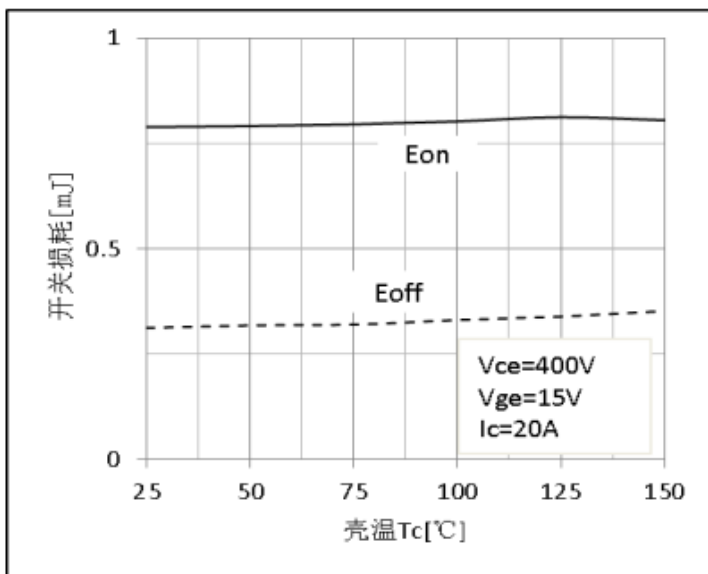


图 9 开关损耗温度特性

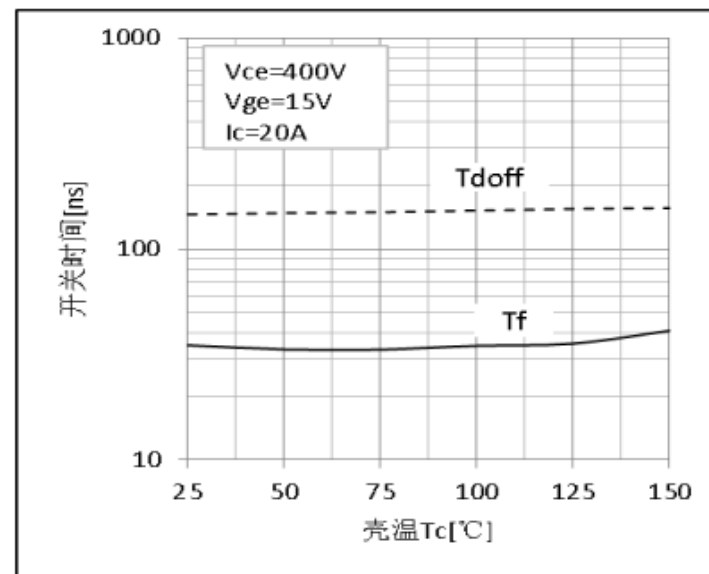


图 10 关断温度特性

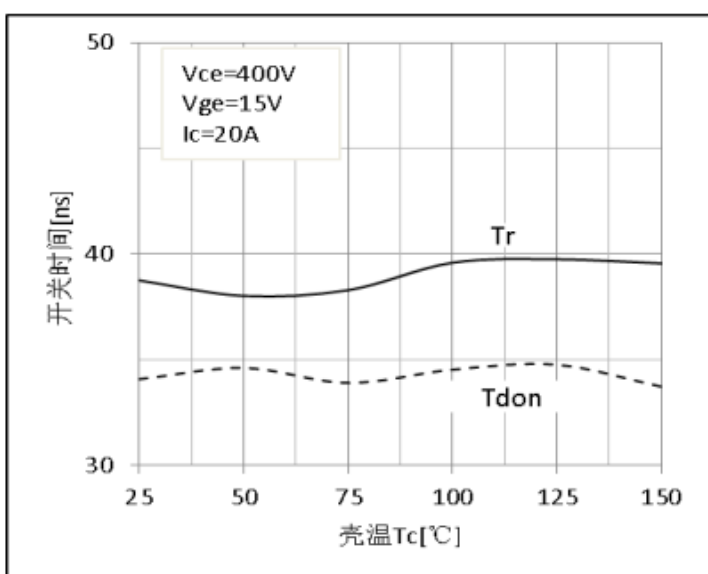


图 11 开通的温度特性

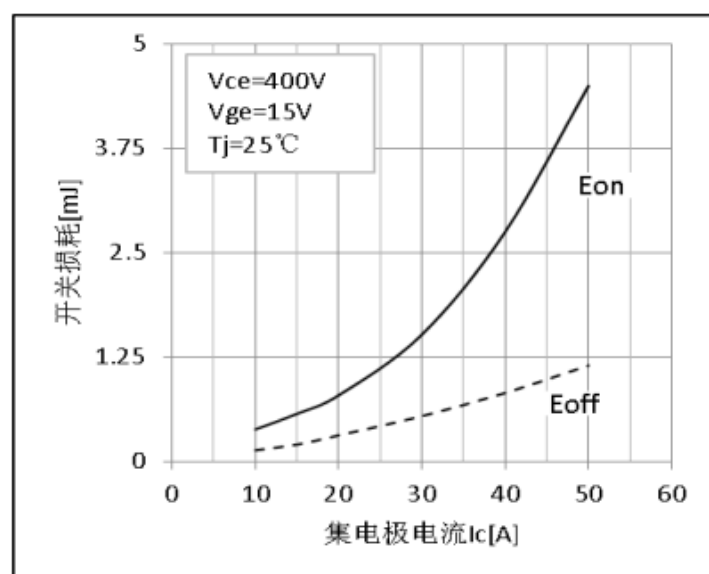


图 12 开关损耗的电流特性

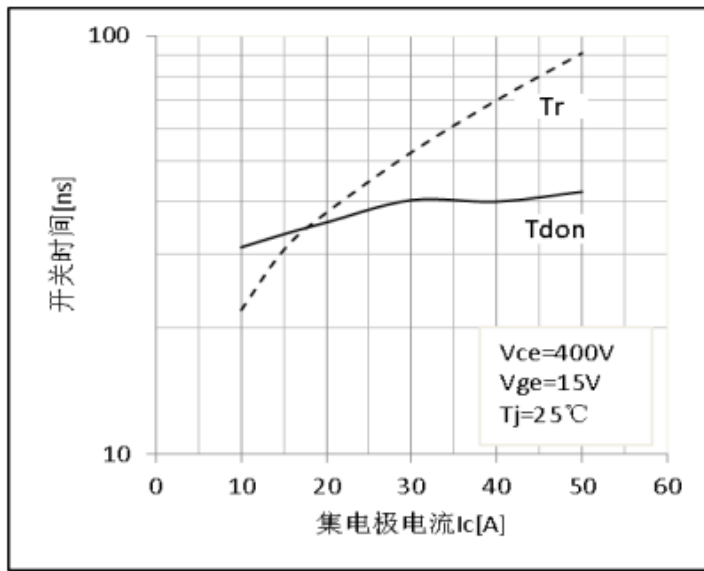


图 13 开通的电流特性

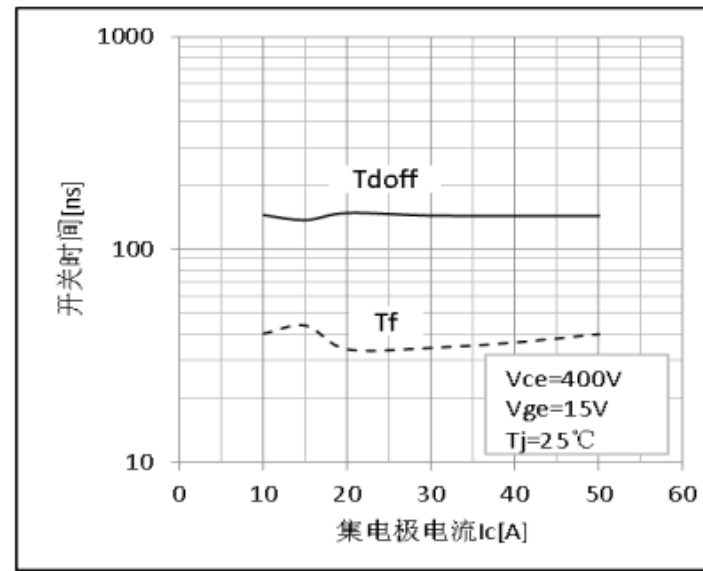


图 14 关断的电流特性

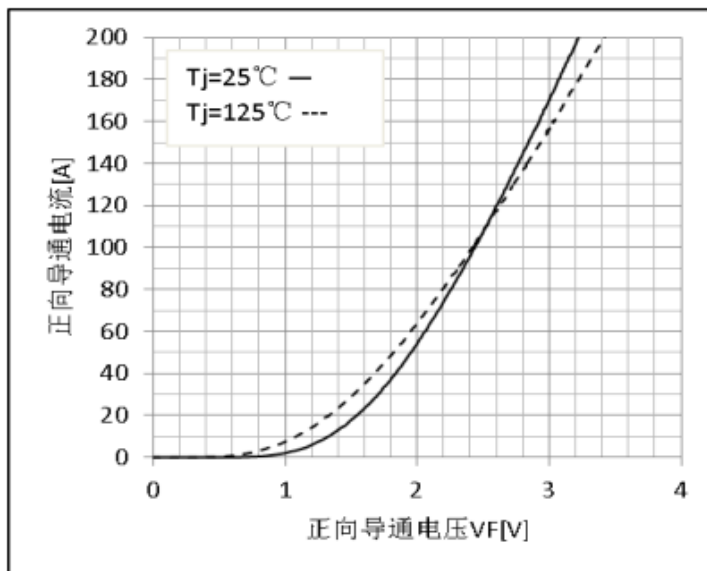


图 15 二极管正向特性

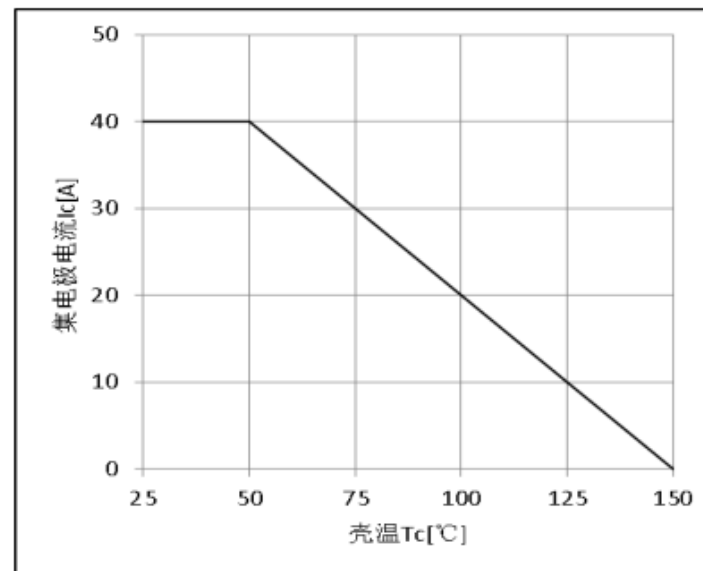


图 16 集电极电流温度特性

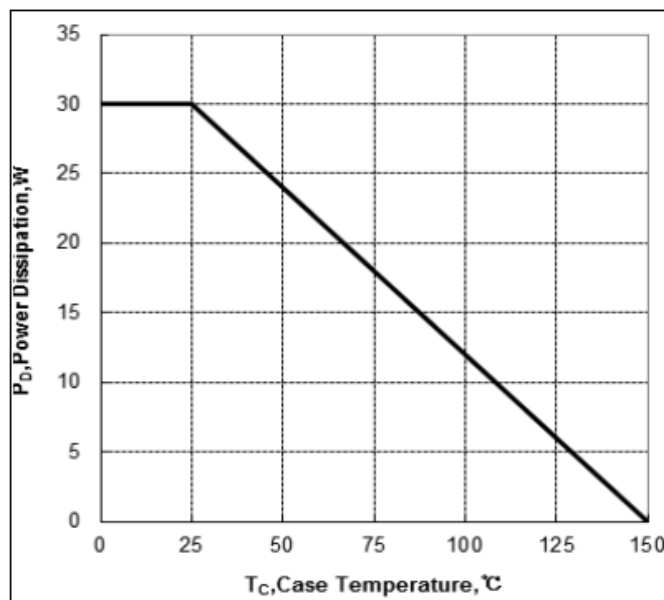


图 17 耗散功率-壳温 Tc 特性

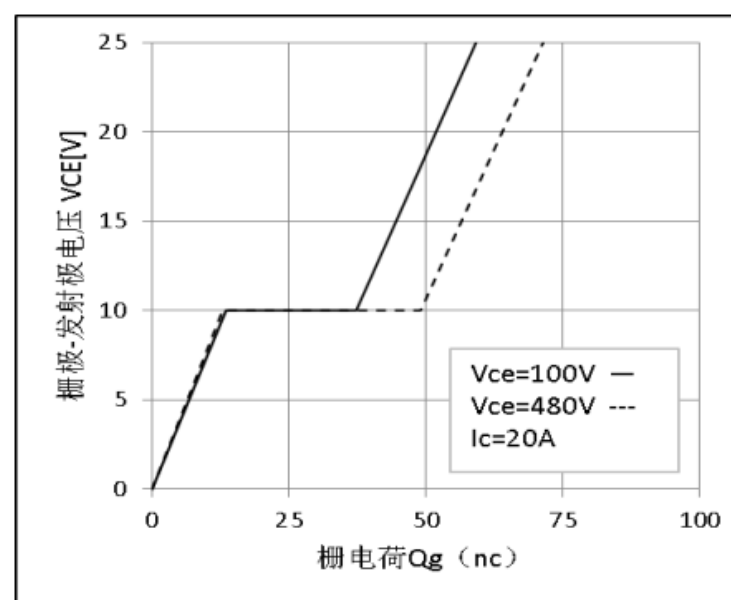


图 18 栅电荷特性

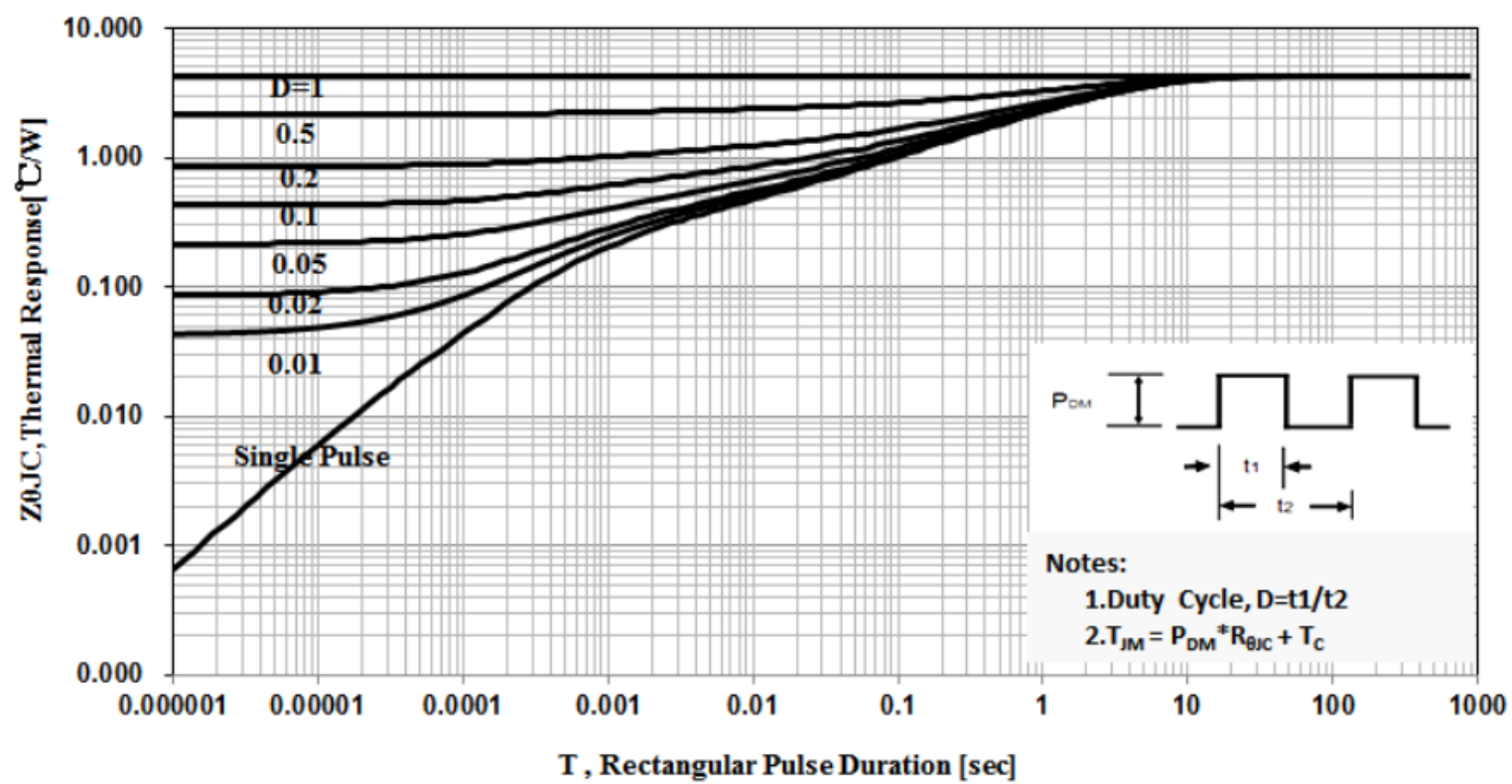


图 19 瞬态热阻特性

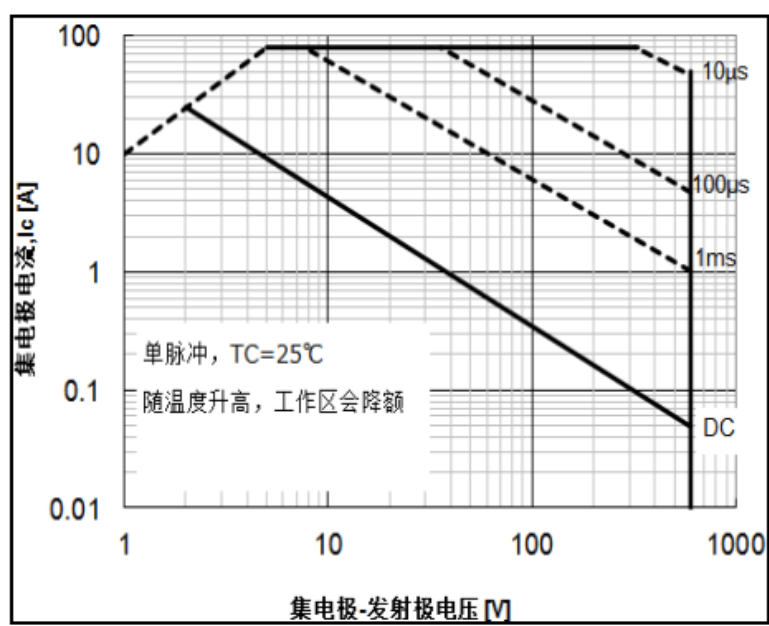
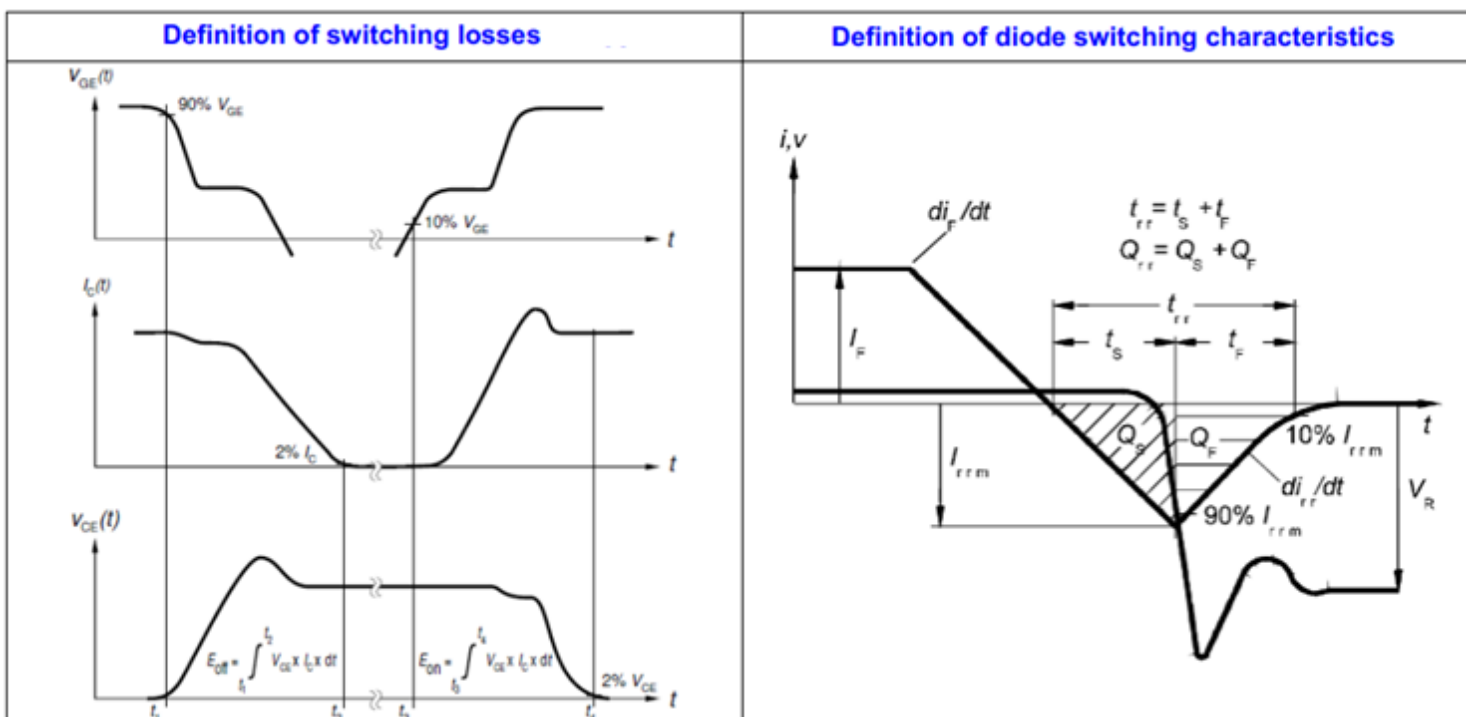
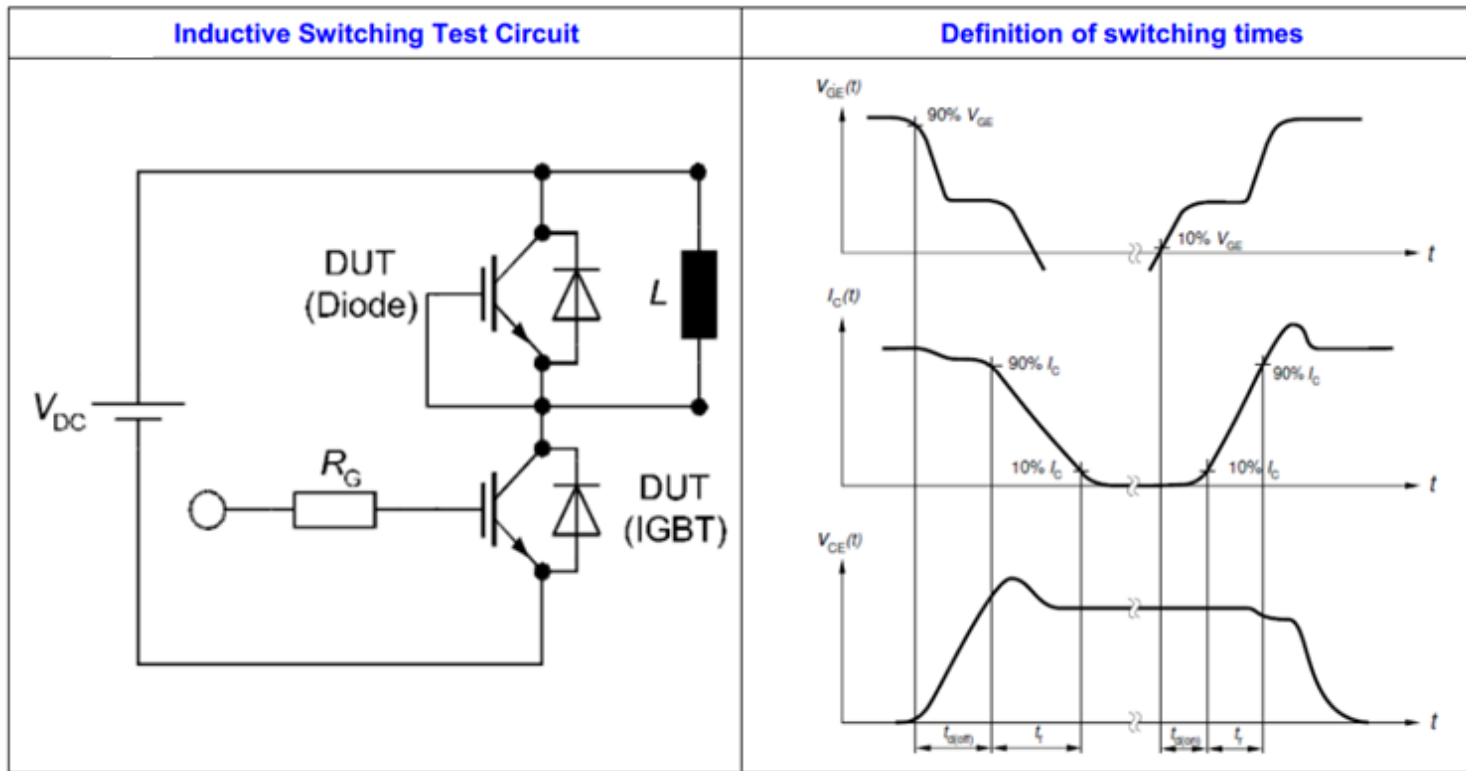
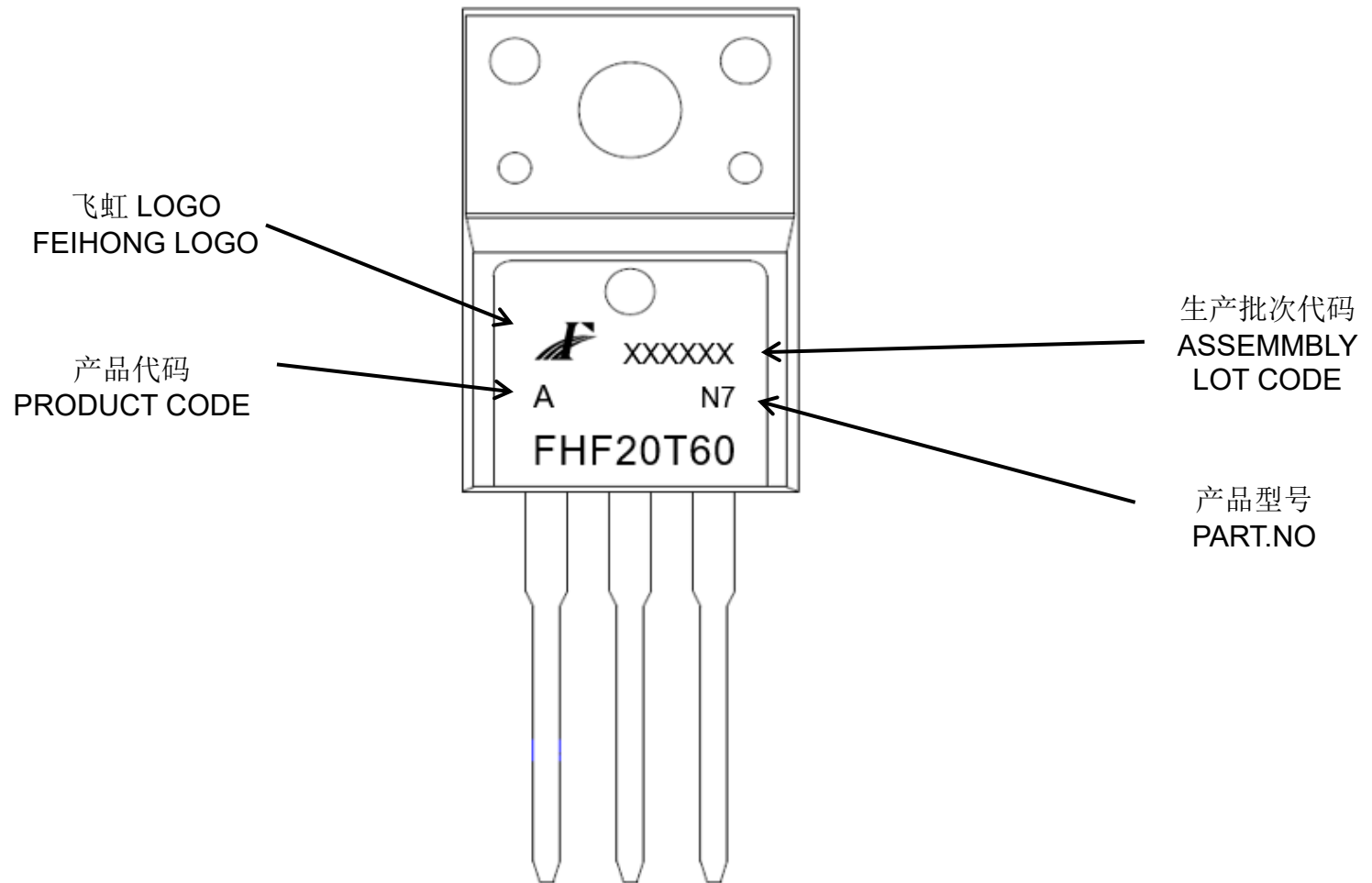


图 20 正向安全工作区

Test Circuit and Waveform



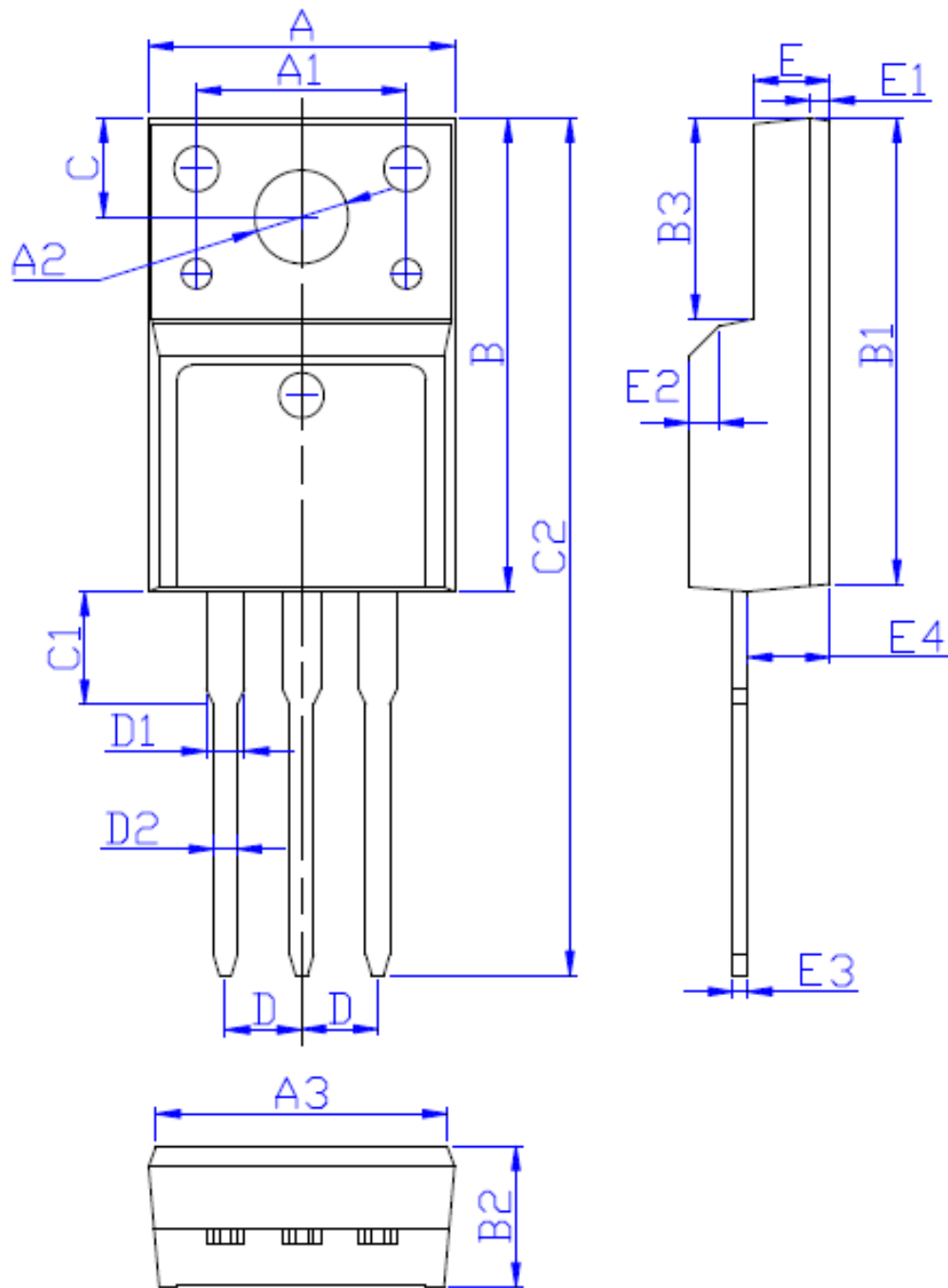
印记 Marking:



外形尺寸:

Package Dimension:

TO-220F



DIM	MILLIMETERS
A	10.16±0.30
A1	7.00±0.20
A2	3.12±0.20
A3	9.70±0.30
B	15.90±0.50
B1	15.60±0.50
B2	4.70±0.30
B3	6.70±0.30
C	3.30±0.25
C1	3.25±0.30
C2	28.70±0.50
D	Typical 2.54
D1	1.47 (MAX)
D2	0.80±0.20
E	2.55±0.25
E1	0.70±0.25
E2	1.0×45°
E3	0.50±0.20
E4	2.75±0.30

(Unit: mm)