

## 主要参数 MAIN CHARACTERISTICS

$I_c$ (100°C)	60 A
$V_{CES}$	650 V
$V_{cesat-typ}$ (@ $I_c=60A$ )	1.75 V

## 用途 APPLICATIONS

逆变电源	Inverter power supply
不间断电源	UPS
电机驱动	Motor drive
电焊机	Welding Machines
PFC电路	PFC Circuits
中高开关频率变频器	Medium-high switching frequency converter

## 封装形式 Package

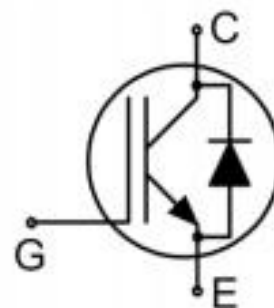


TO-247  
FHA series

## 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 $V_{CEsat}$
符合 RoHS 标准	RoHS compliant
带有反向并联快恢复二极管	With anti-parallel fast recovery diode
正温度系数	Positive temperature coefficient
高可靠性	High reliability

## 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	$V_{CE}$	650	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)	$I_{CM}$	180	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	$I_{FM}$	90	A
最高栅极发射极电压 Gate-Emmitter Voltage	$V_{GE}$	$\pm 30$	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 ( $T_c=25^\circ C$ )	$P_D$	465	W
最高结温及存储温度 Operating and Storage Temperature Range	$T_J, T_{STG}$	-55~+175	$^\circ C$
引线最高焊接温度 Maximum Lead Temperature for Soldering Purposes	TL	260	$^\circ C$

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<sub>C</sub>= 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
<b>关态特性 Off –Characteristics</b>						
集电极-发射极击穿电压 Collector-Emmitter Voltage	BV <sub>CES</sub>	V <sub>GE</sub> =0V, I <sub>C</sub> =250uA	650	-	-	V
击穿电压温度特性 Breakdown Voltage Temperature Coefficient	ΔBV <sub>CES</sub> /ΔT <sub>J</sub>	I <sub>C</sub> =1mA, referenced to 25°C	-	0.65	-	V/°C
零栅压下集电极漏电流 Zero Gate Voltage Collector Current	I <sub>CES</sub>	V <sub>CE</sub> =650V, V <sub>GE</sub> =0V	-	-	600	nA
栅极体漏电流 Gate-Emitter leakage current	I <sub>GES(F/R)</sub>	V <sub>CE</sub> =0V, V <sub>GE</sub> =±30V	-	-	±200	nA
<b>通态特性 On-Characteristics</b>						
阈值电压 Gate-Emmitter Threshold Voltage	V <sub>GE(th)</sub>	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> =1mA	4.7	5.3	5.8	V
饱和压降 Collector-Emmitter saturation Voltage	V <sub>CESAT</sub>	V <sub>GE</sub> =15V, I <sub>C</sub> =40A, T <sub>J</sub> =25°C T <sub>J</sub> =150°C	- -	1.75 2.35	2.0 -	V
<b>动态特性 Dynamic Characteristics</b>						
开启延迟时间 Turn-On delay time	td(on)	V <sub>GE</sub> =15V, V <sub>CC</sub> =400V, I <sub>C</sub> =60A, R <sub>G</sub> =20Ω, T <sub>J</sub> =25°C, Inductive Load L=100uH	-	125	-	ns
上升时间 Turn-On rise time	tr		-	136	-	ns
关断延迟时间 Turn-Off delay time	td(off)		-	540	-	ns
下降时间 Turn-Off Fall time	tf		-	71	-	ns
开启损耗 Turn-on energy	Eon		-	2.38	-	mJ
关断损耗 Turn-off energy	Eoff		-	2.13	-	
总的开关损耗 Total switching energy	Etotal		-	4.51	-	
开启延迟时间 Turn-On delay time	td(on)	V <sub>GE</sub> =15V, V <sub>CC</sub> =400V, I <sub>C</sub> =60A, R <sub>G</sub> =20Ω, T <sub>J</sub> =175°C, Inductive Load L=100uH	-	113	-	ns
上升时间 Turn-On rise time	tr		-	135	-	ns
关断延迟时间 Turn-Off delay time	td(off)		-	612	-	ns
下降时间 Turn-Off Fall time	tf		-	86	-	ns
开启损耗 Turn-on energy	Eon		-	3.1	-	mJ
关断损耗 Turn-off energy	Eoff		-	2.64	-	
总的开关损耗 Total switching energy	Etotal		-	5.74	-	
栅极电荷总量 Total Gate Charge	Qg	V <sub>CE</sub> =520V, I <sub>C</sub> =60A, V <sub>GE</sub> =15V	-	254	-	nC
栅极-发射极电荷 Gate-emitter charge	Qge		-	40	-	
栅极-集电极电荷 Gate-collector charge	Qgc		-	132	-	
集电极短路电流 Short circuit collector current Max.1000 short circuits Time between short circuits: ≥1.0s	I <sub>C(sc)</sub>	V <sub>GE</sub> =15V, V <sub>CC</sub> ≤400V, t <sub>SC</sub> ≤3us, T <sub>J</sub> ≤150°C		300		A
栅极电阻 Gate Resistance	Rg	f=1.0MHz, V <sub>CE</sub> OPEN	-	1.1	-	Ω
输入电容 Input capacitance	Cies	V <sub>CE</sub> =30V, V <sub>GE</sub> =0V, f=1.0MHz	-	5500	-	pF
输出电容 Output capacitance	Coes		-	190	-	
反向传输电容 Reverse transfer capacitance	Cres		-	88	-	

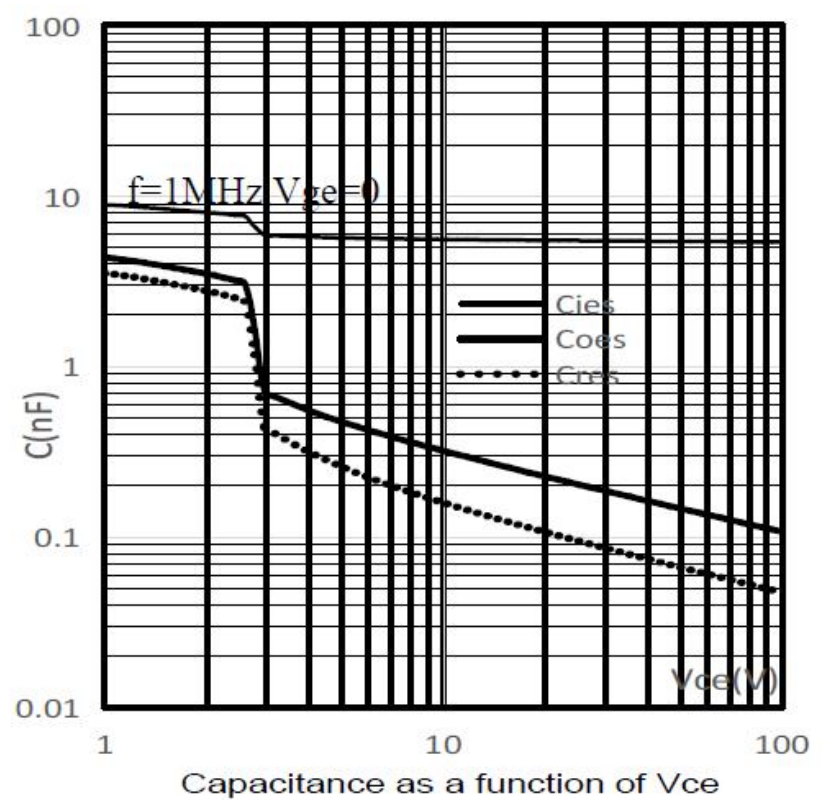
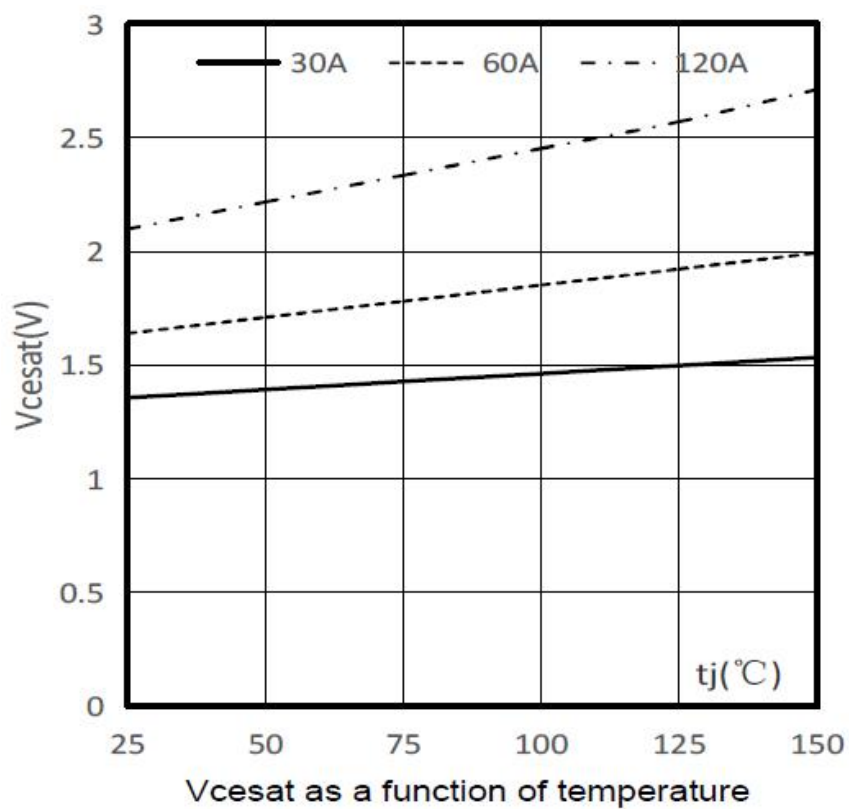
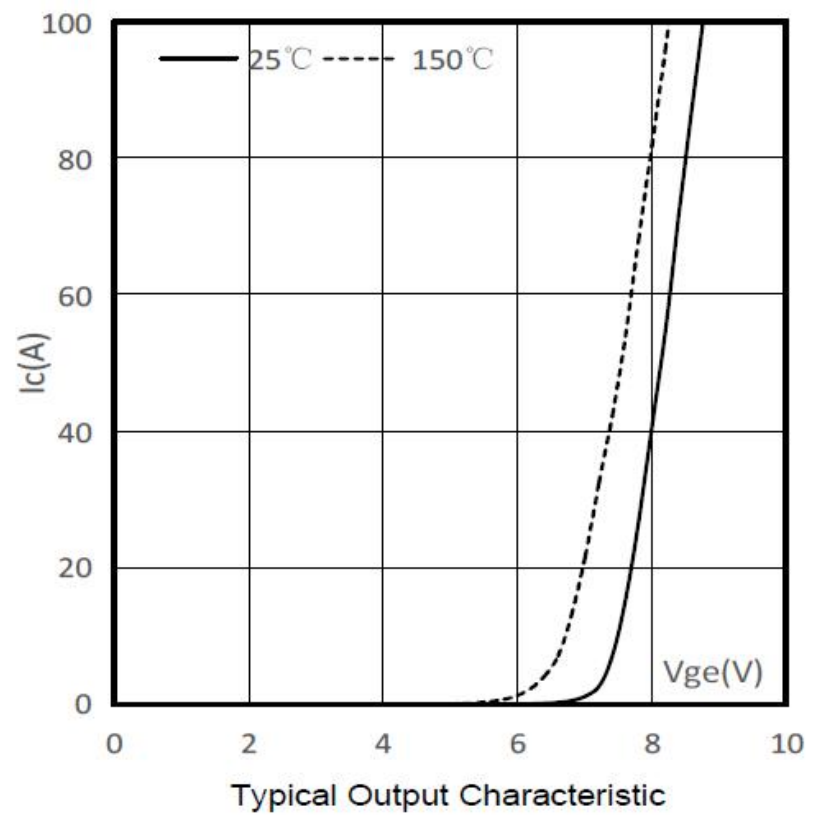
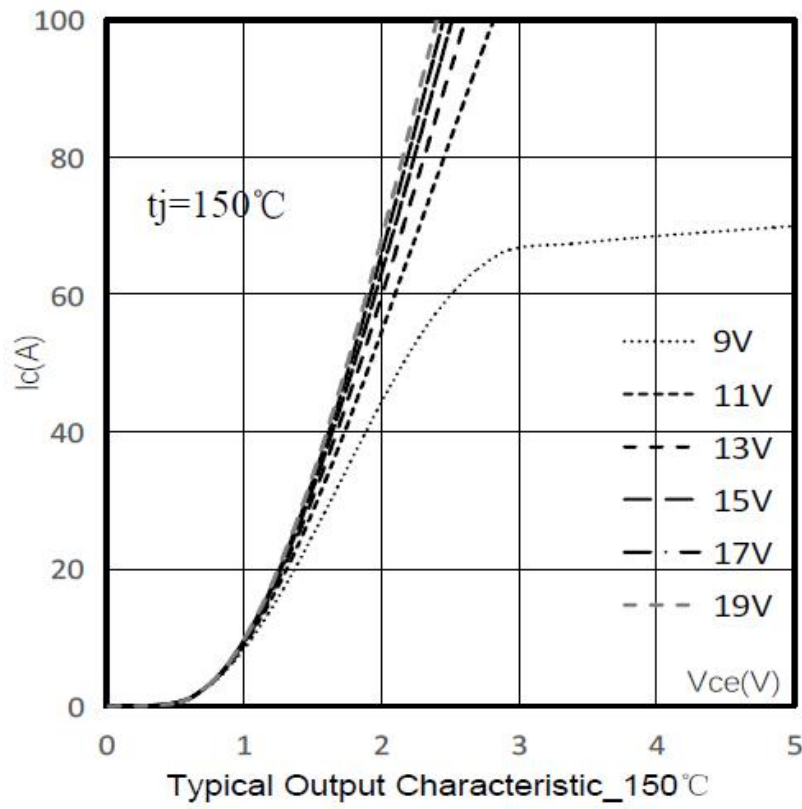
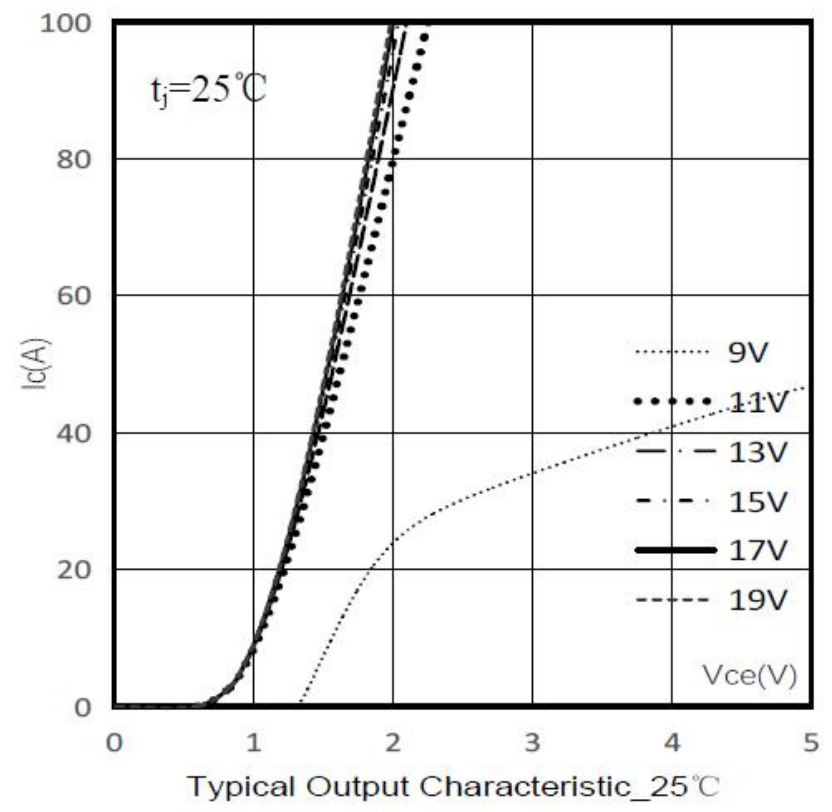
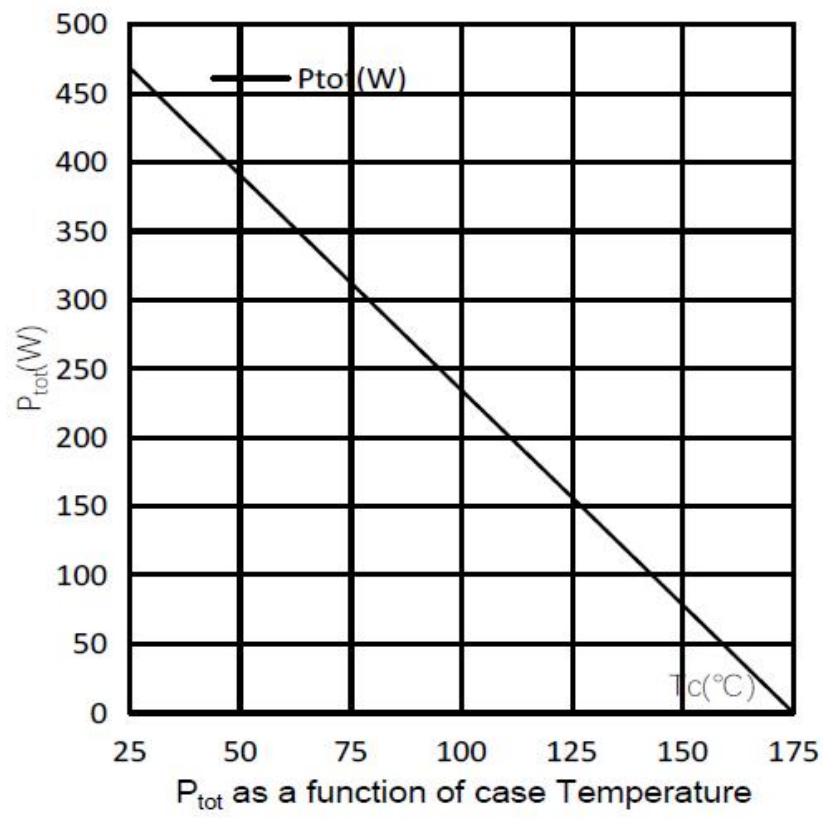
二极管特性 Diode characteristics						
项目 Parameter	符号 Symbol	测试条件 Tests conditions	最小 Min	典型 Typ	最大 Max	单位 Units
正向压降 Diode Forward Voltage	$V_F$	$I_F=60A$	-	1.85	2.1	V
反向恢复时间 Reverse recovery time	trr	$I_F=30A$ , $di/dt=200A/\mu s$ , $T_J=25^\circ C$	-	96	-	ns
反向恢复电流 Reverse recovery current	Irrm		-	4	-	A
反向恢复电荷 Reverse recovery charge	Qrr		-	562	-	nC
反向恢复时间 Reverse recovery time	trr	$I_F=30A$ , $di/dt=200A/\mu s$ , $T_J=150^\circ C$	-	121	-	ns
反向恢复电流 Reverse recovery current	Irr		-	4.7	-	A
反向恢复电荷 Reverse recovery charge	Qrr		-	1567	-	nC

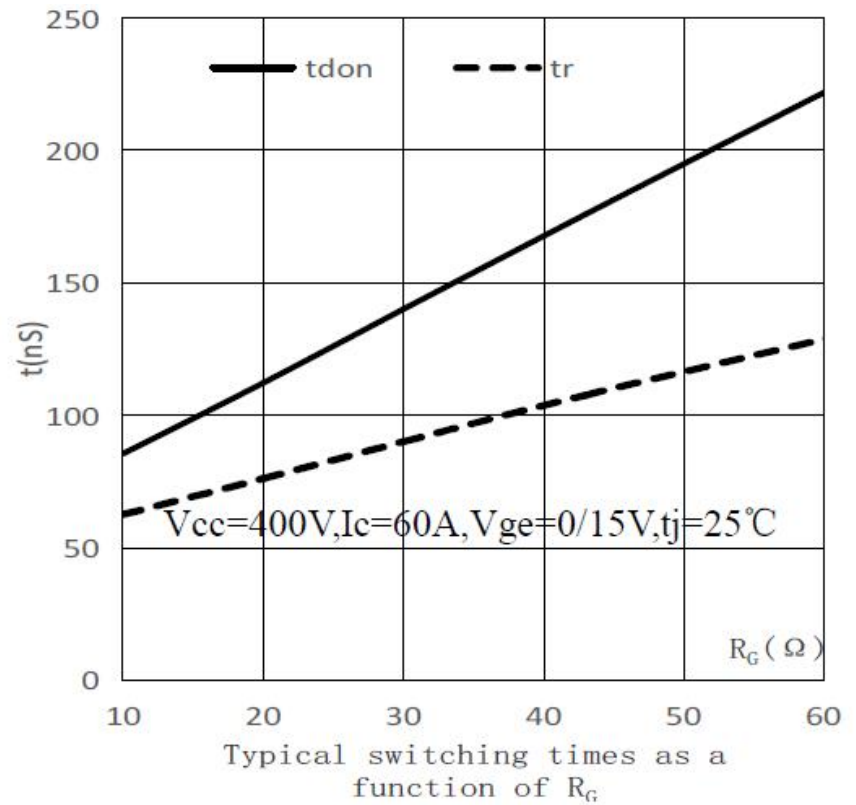
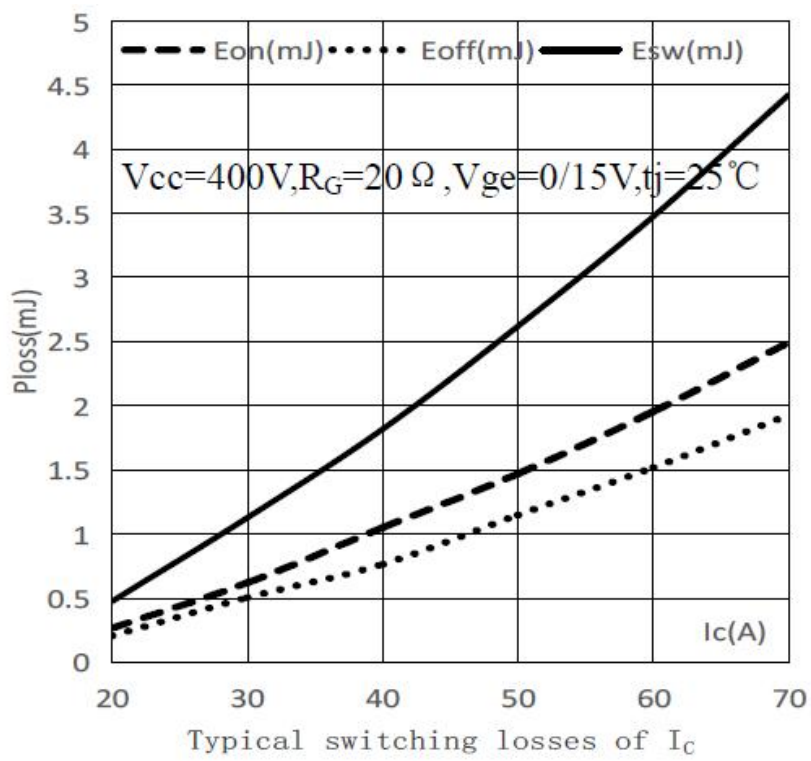
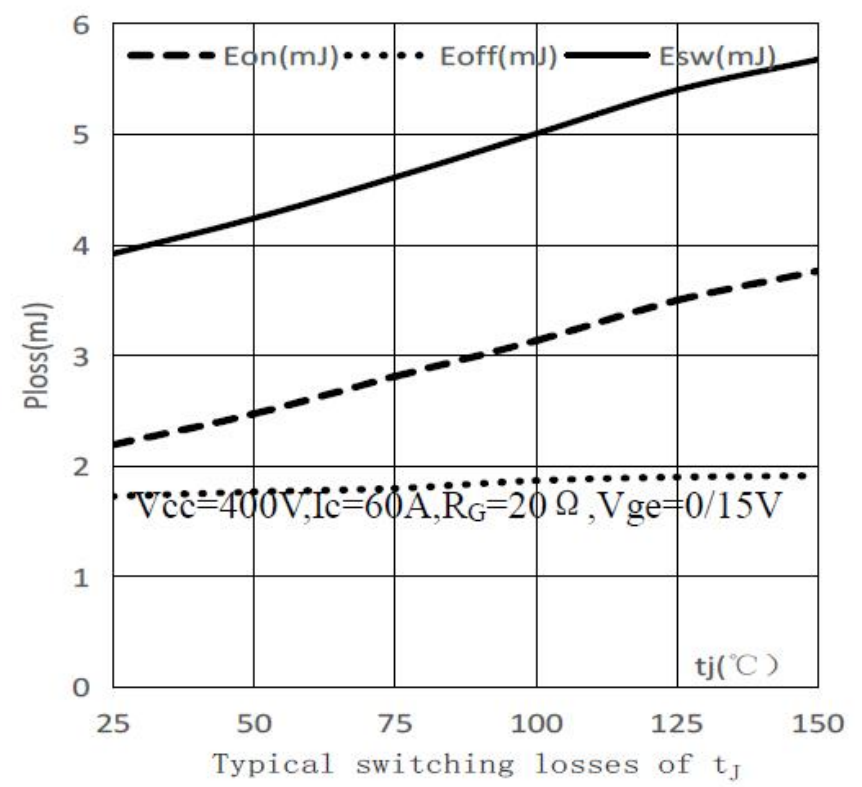
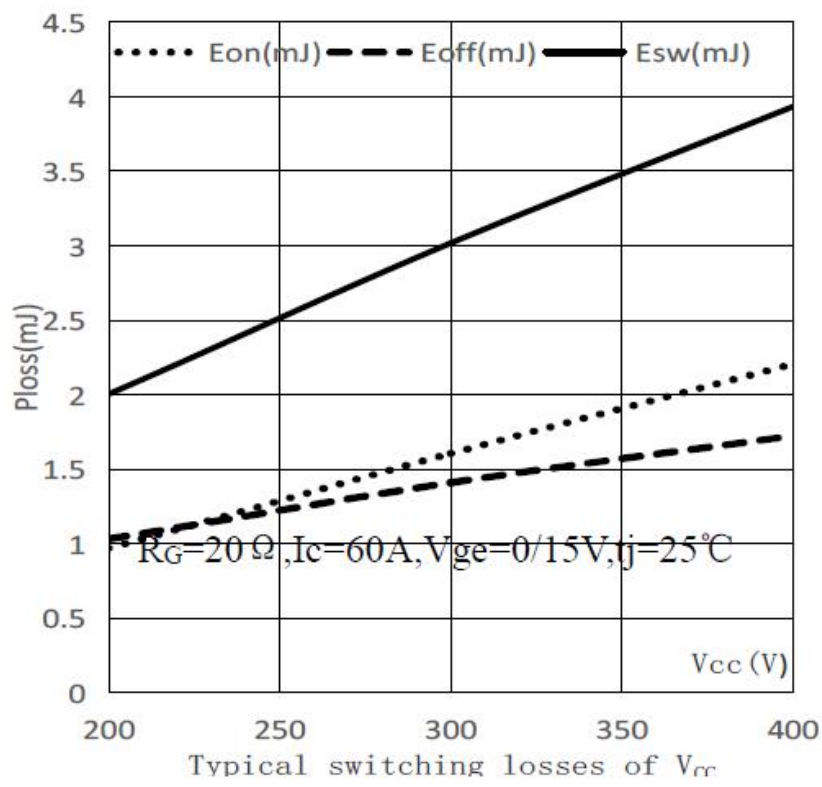
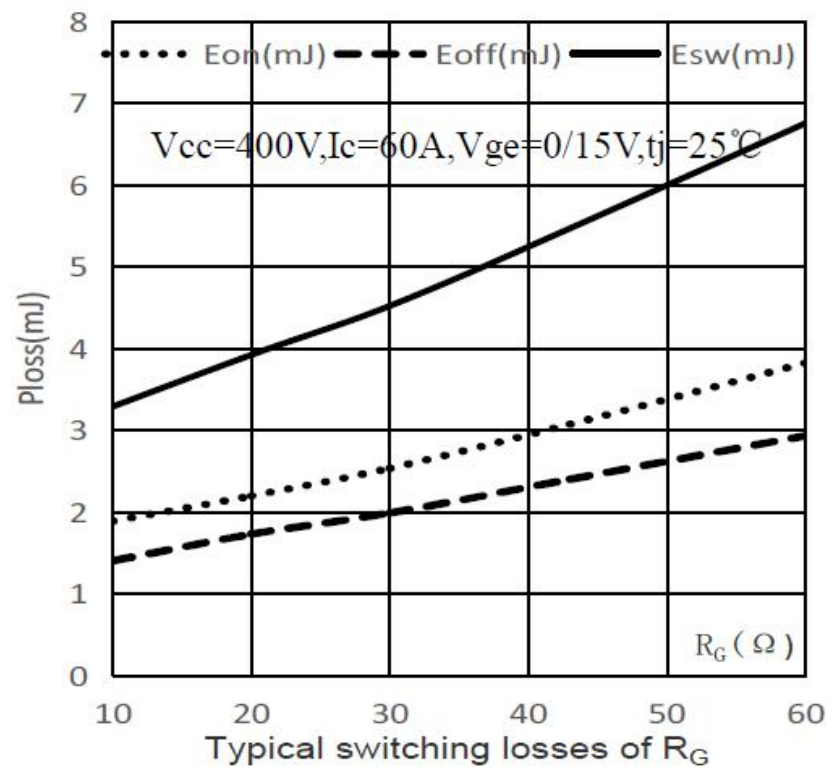
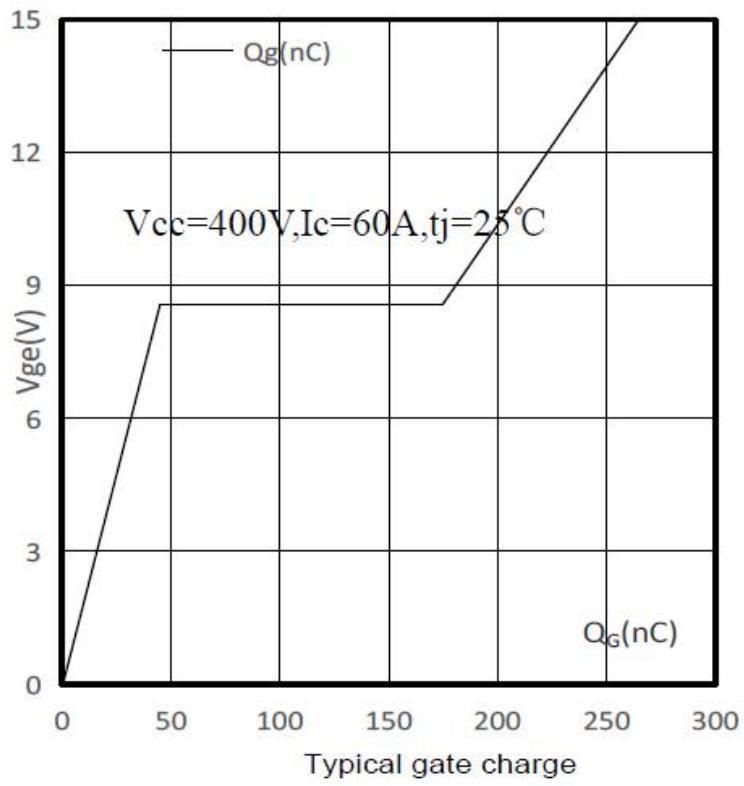
### 热特性 THERMAL CHARACTERISTIC

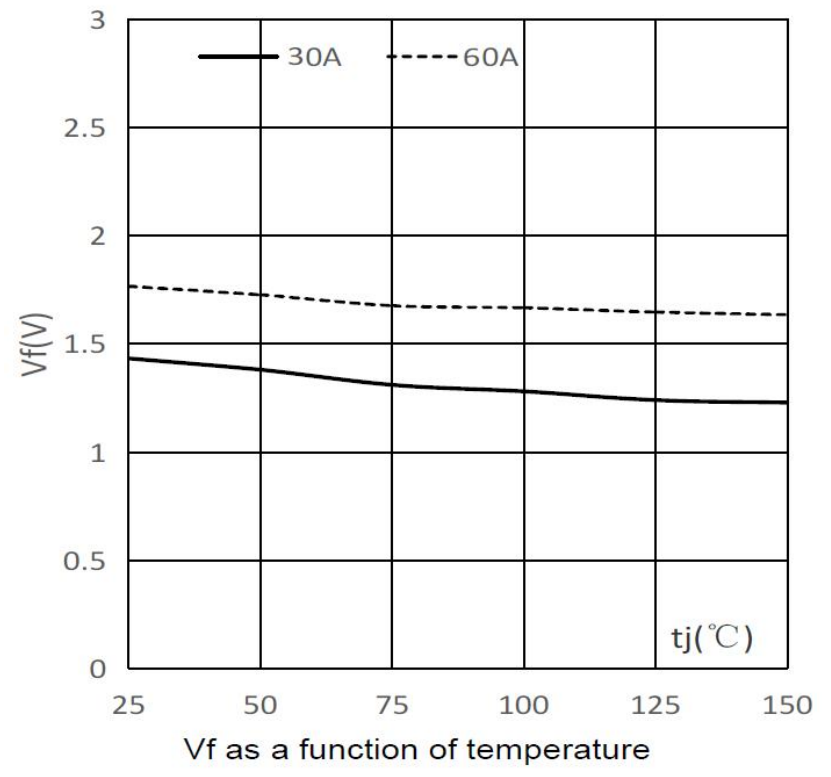
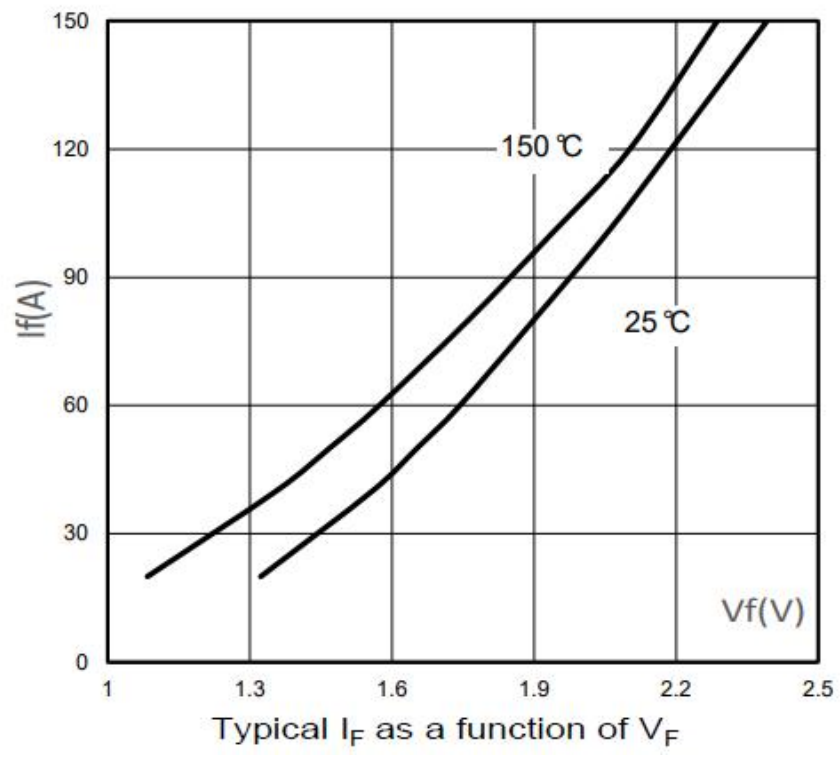
项目 Parameter	符号 Symbol	数值 Value	单位 Unit
结到管壳的热阻 (IGBT) Thermal Resistance, Junction to Case (IGBT)	Rth(j-c)	0.4	$^\circ C/W$
结到管壳的热阻 (Diode) Thermal Resistance, Junction to Case (Diode)	Rth(j-c)	0.8	$^\circ C/W$
结到环境的热阻 Thermal Resistance, Junction to Ambient	Rth(j-A)	40	$^\circ C/W$

# 特性曲线

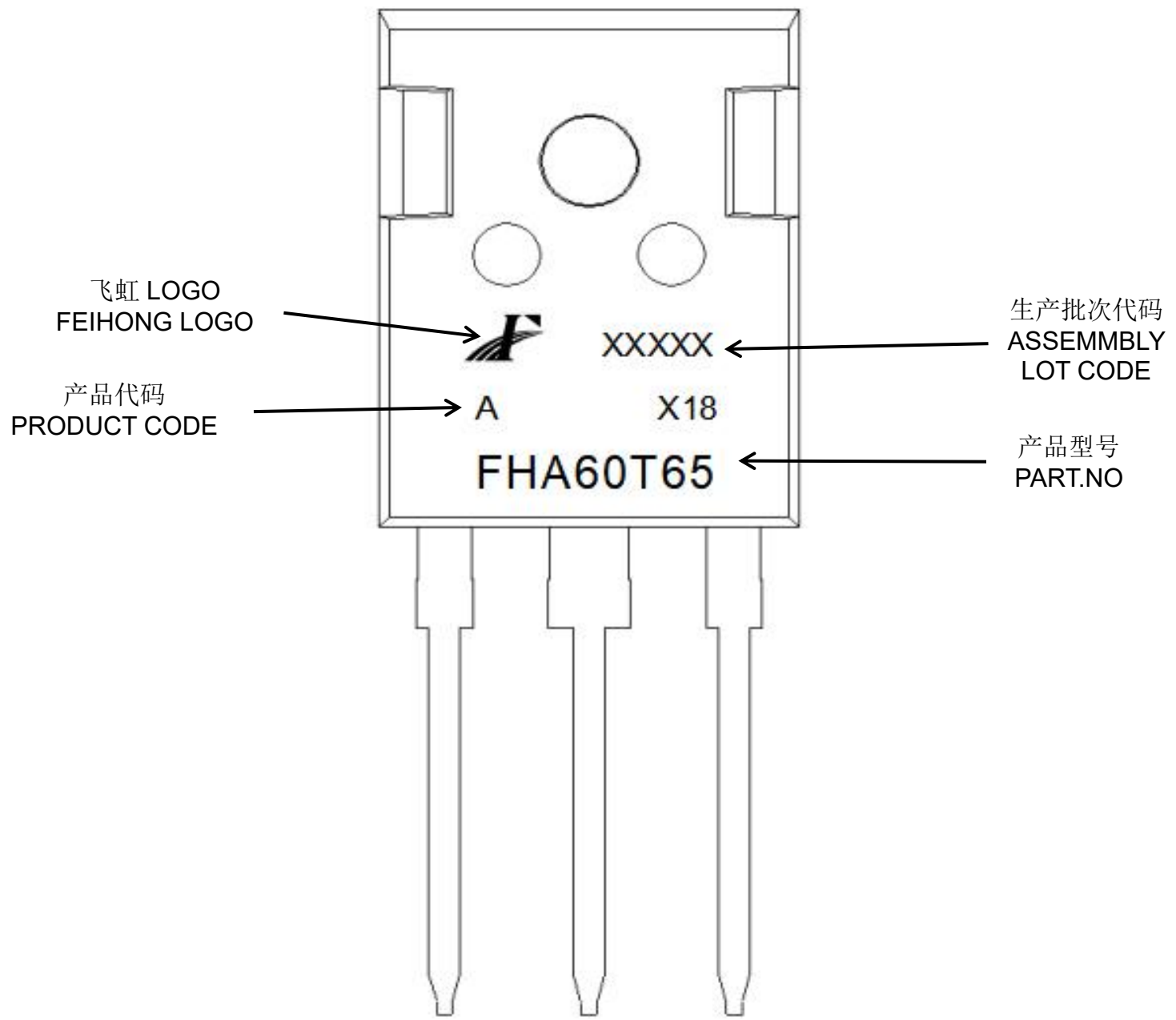
## (ELECTRICAL CHARACTERISTICS (curves))







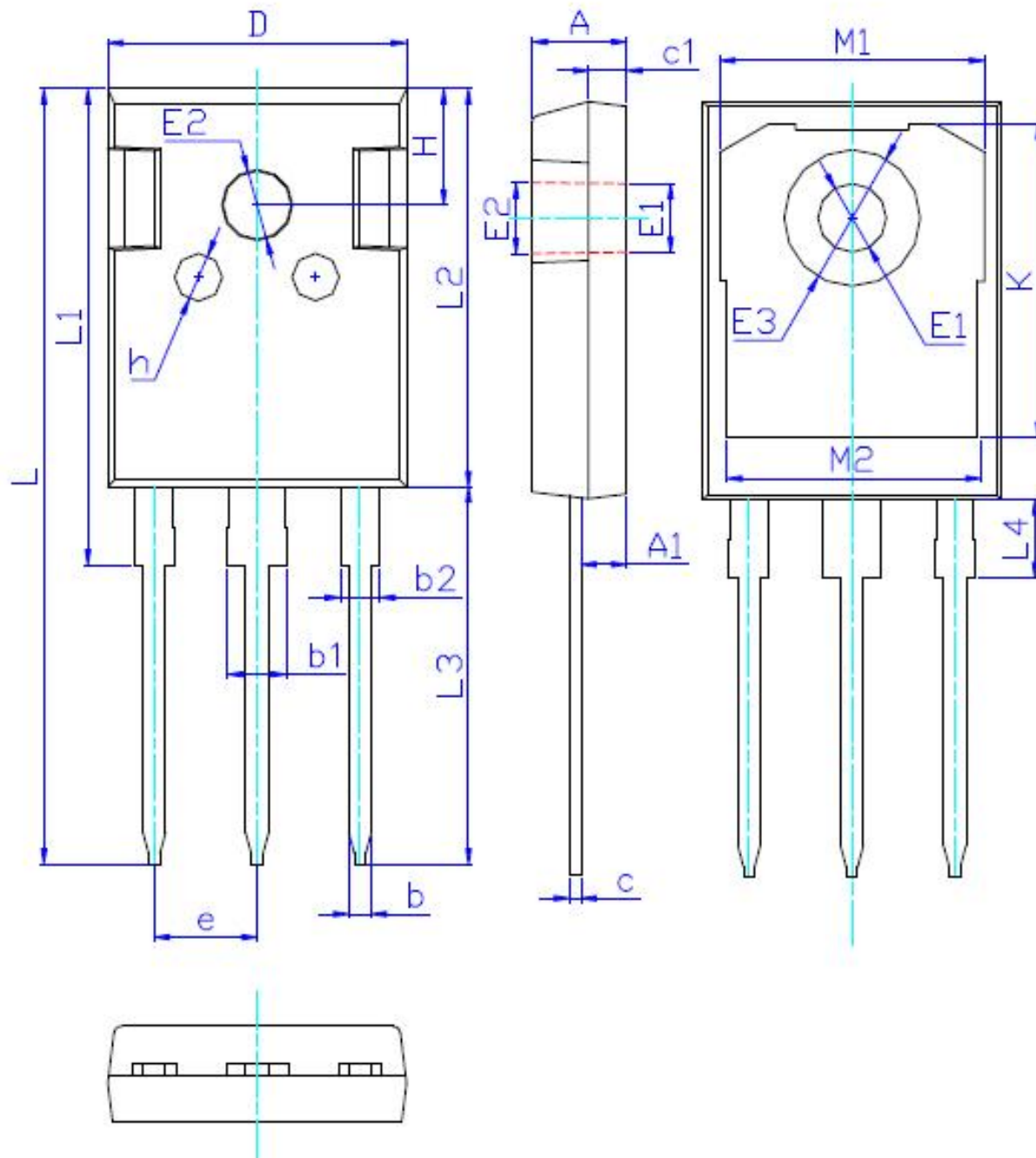
印记 Marking:



外形尺寸:

Package Dimension:

TO-247



标注	尺寸(mm)
A	5.00 ± 0.20
A1	2.41 ± 0.15
b	1.2 ± 0.10
b1	3.10 ± 0.10
b2	2.10 ± 0.10
c	0.60 ± 0.10
c1	2.00 ± 0.15
D	15.80 ± 0.20
E1	3.60 ± 0.15
E2	3.70 ± 0.15
E3	7.19 ± 0.15
L	40.92 ± 0.25
L1	24.95 ± 0.15
L2	21.00 ± 0.20
L3	19.92 ± 0.20
<b>L4</b>	<b>4.10 ± 0.15</b>
e	5.44 ± 0.15
H	6.15 ± 0.15
h	2.50 ± 0.15
<b>K</b>	<b>16.45 ± 0.20</b>
<b>M1</b>	<b>14.00 ± 0.20</b>
<b>M2</b>	<b>13.30 ± 0.20</b>