

主要参数 MAIN CHARACTERISTICS

ID	38 A
VDSS	600 V
Rdson-typ (@Vgs=10V)	86 mΩ
Qg-typ	57.8 nC

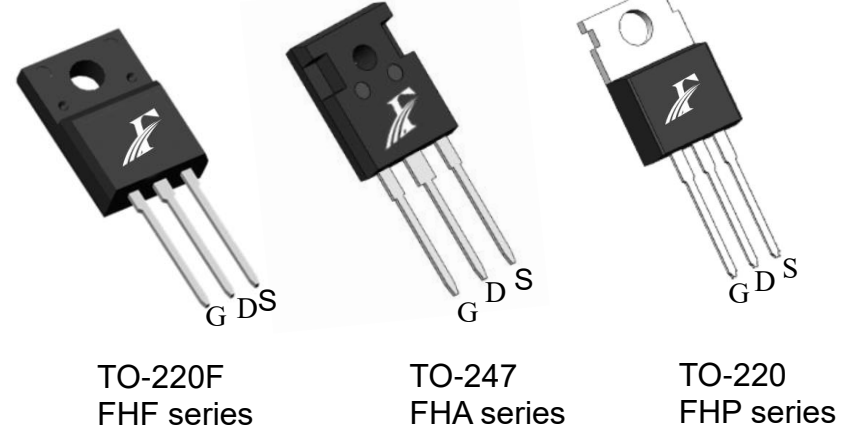
用途 APPLICATIONS

高频开关电源	High efficiency switch mode power supplies
LLC半桥	LLC half-bridge
电动汽车充电器	EV Charger

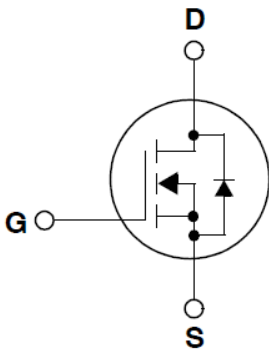
产品特性 FEATURES

多层外延工艺	Multi-Epi process SJ-FET
低栅极电荷	Low gate charge
低 Crss (典型值 2.5 pF)	Low Crss (typical 2.5 pF)
开关速度快	Fast switching
100%经过雪崩测试	100% avalanche tested
100%经过热阻测试	100% DVDS tested
100%经过 Rg 测试	100% Rg tested
高抗 dv/dt 能力	Improved dv/dt capability
符合 RoHS 标准	ROHS compliant
内置 FRD	Built-in fast recovery diode

封装形式 Package



等效电路 Equivalent Circuit



绝对最大额定值 ABSOLUTE RATINGS (Tc=25℃)

项目 Parameter	符号 Symbol	数值 Value			单位 Unit
		FHP60R099AF	FHF60R099AF	FHA60R099AF	
最高漏极-源极直流电压 Drain-Source Voltage	Vds	600			V
连续漏极电流* Drain Current -continuous *	Id (Tc=25℃)	38			A
	Id (Tc=100℃)	22.5			A
最大脉冲漏极电流 (注 1) Drain Current – pulse (note 1)	IDM	152			A
最高栅源电压 Gate-Source Voltage	Vgs	±30			V
单脉冲雪崩能量 (注 2) Single Pulsed Avalanche Energy (note 2)	EAS	180			mJ
雪崩电流 (注 1) Avalanche Current (note 1)	IAS	6			A
二极管反向恢复最大电压变化速率 (注 3) Peak Diode Recovery dv/dt (note 3)	dv/dt	15			V/ns
耗散功率 Power Dissipation	PD (TC=25℃)	210	40	261	W
	-Derate above 25℃	1.68	0.32	2.08	W/℃
最高结温及存储温度 Operating and Storage Temperature Range	TJ, TSTG	-55~+150			℃
引线最高焊接温度 Maximum Lead Temperature for Soldering Purposes	TL	260			℃

*漏极电流由最高结温限制

*Drain current limited by maximum junction temperature

电特性 ELECTRICAL 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
关态特性 Off –Characteristics						
漏－源击穿电压 Drain-Source Voltage	BV _{DSS}	I _D =250μA, V _{GS} =0V	600	-	-	V
击穿电压温度特性 Breakdown Voltage Temperature Coefficient	ΔBV _{DSS} /Δ T _J	I _D =250μA, referenced to 25℃	-	0.6	-	V/℃
零栅压下漏极漏电流 Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} =600V,V _{GS} =0V, T _C =25℃	-	-	10	μA
		V _{DS} =480V,V _{GS} =0V, T _C =125℃	-	300	-	μA
栅极体漏电流 Gate-body leakage current	I _{GSS} (F/R)	V _{DS} =0V, V _{GS} =±30V	-	-	±100	nA
通态特性 On-Characteristics						
阈值电压 Gate Threshold Voltage	V _{GS(th)}	V _{DS} = V _{GS} , I _D =250μA	3.0	3.8	5.0	V
静态导通电阻 Static Drain-Source On-Resistance	R _{DS(ON)}	V _{GS} =10V , I _D =19A	-	86	99	mΩ
动态特性 Dynamic Characteristics						
栅电阻 Gate Resistance	R _g	f=1.0MHz,V _{DS} =OPEN	-	1.1	-	Ω
输入电容 Input capacitance	C _{iss}	V _{DS} =25V, V _{GS} =0V, f=1.0MHz	-	2130	-	pF
输出电容 Output capacitance	C _{oss}		-	612	-	
反向传输电容 Reverse transfer capacitance	C _{rss}		-	2.5	-	
开关特性 Switching Characteristics						
延迟时间 Turn-On delay time	t _{d(on)}	V _{DS} =400V, I _D =19A, R _G =2Ω, V _{GS} =10V (note 4, 5)	-	40.2	-	ns
上升时间 Turn-On rise time	t _r		-	29.4	-	ns
延迟时间 Turn-Off delay time	t _{d(off)}		-	87.2	-	ns
下降时间 Turn-Off Fall time	t _f		-	8.4	-	ns
栅极电荷总量 Total Gate Charge	Q _g	V _{DS} =400V , I _D =19A , V _{GS} =10V (note 4, 5)	-	57.8	-	nC
栅－源电荷 Gate-Source charge	Q _{gs}		-	17.2	-	nC
栅－漏电荷 Gate-Drain charge	Q _{gd}		-	18.8	-	nC
漏－源二极管特性及最大额定值 Drain-Source Diode Characteristics and Maximum Ratings						
正向最大连续电流 Maximum Continuous Drain -Source Diode Forward Current	I _S		-	-	38	A
正向最大脉冲电流 Maximum Pulsed Drain-Source Diode Forward Current	I _{SM}		-	-	152	A
正向压降 Drain-Source Diode Forward Voltage	V _{SD}	V _{GS} =0V, I _S =19A	-	0.9	1.4	V
反向恢复时间 Reverse recovery time	t _{rr}	V _{GS} =0V, I _S =19A ,dI _F /dt=100A/μs (note 4)	-	138	-	ns
反向恢复电荷 Reverse recovery charge	Q _{rr}		-	0.7	-	μC
反向恢复峰值电流 Peak reverse recovery current	I _{rrm}		-	10.1	-	A

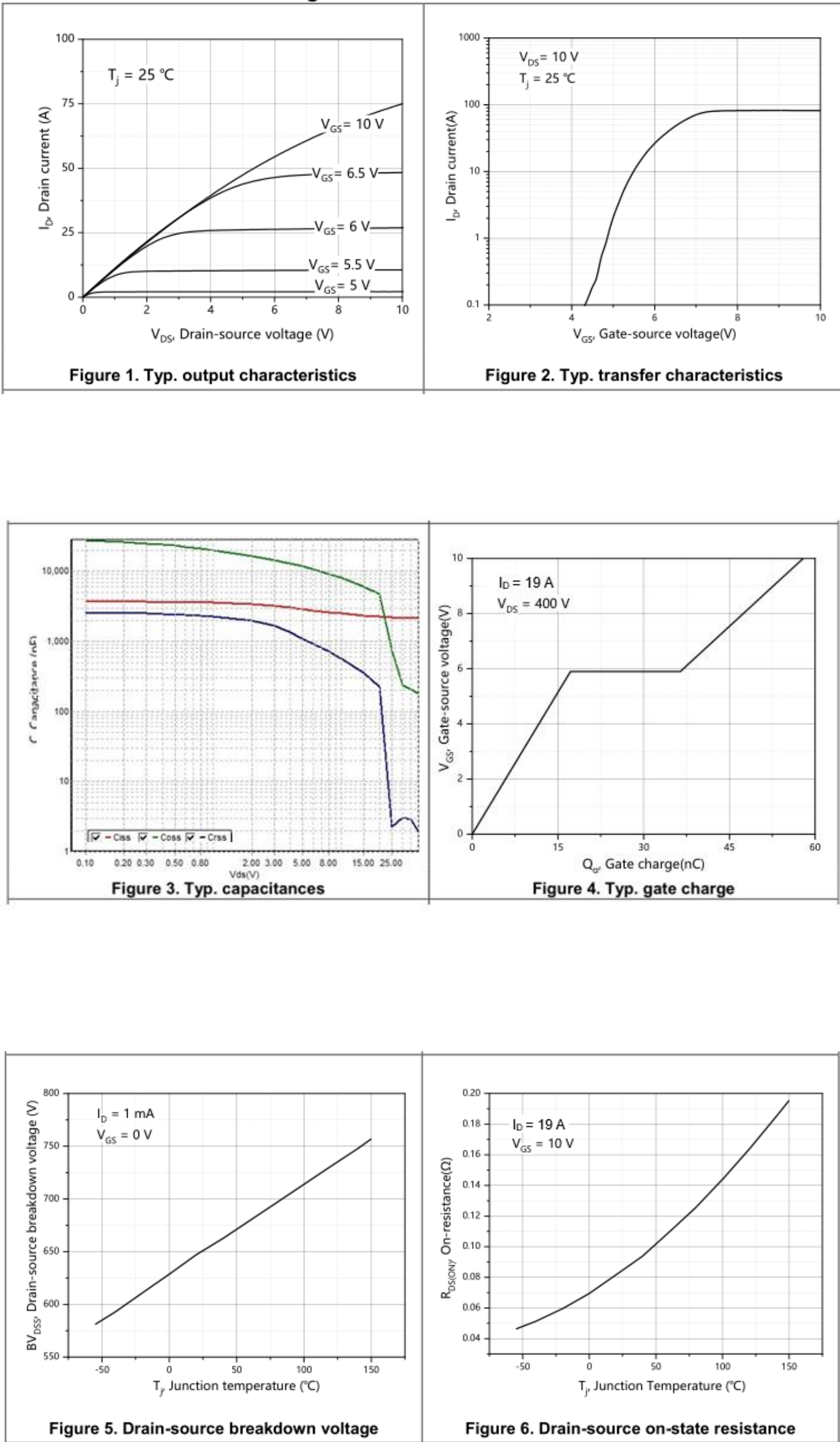
热特性 THERMAL CHARACTERISTIC

项目 Parameter	符号 Symbol	FHP60R099AF	FHF60R099AF	FHA60R099AF	单位 Unit
结到管壳的热阻 Thermal Resistance, Junction to Case	Rth(j-c)	0.59	3.12	0.48	℃/W
结到环境的热阻 Thermal Resistance, Junction to Ambient	Rth(j-A)	62.5	62.5	50	℃/W

注释：
1：脉冲宽度由最高结温限制
2：L=10mH, IAS=6A, VDD=50V, RG=25 Ω,起始结温 TJ=25℃
3：ISD ≤38A,di/dt ≤200A/μs,VDD≤BVDSS,起始结温 TJ=25℃
4：脉冲测试：脉冲宽度 ≤300μs,占空比≤2％
5：基本与工作温度无关

Notes:
1: Pulse width limited by maximum junction temperature
2: L=10mH, IAS=6A, VDD=50V, RG=25 Ω,Starting TJ=25℃
3: ISD ≤38A,di/dt ≤200A/μs,VDD≤BVDSS, Starting TJ=25℃
4: Pulse Test: Pulse Width ≤300μs,Duty Cycle≤2％
5: Essentially independent of operating temperature

Typical Characteristics



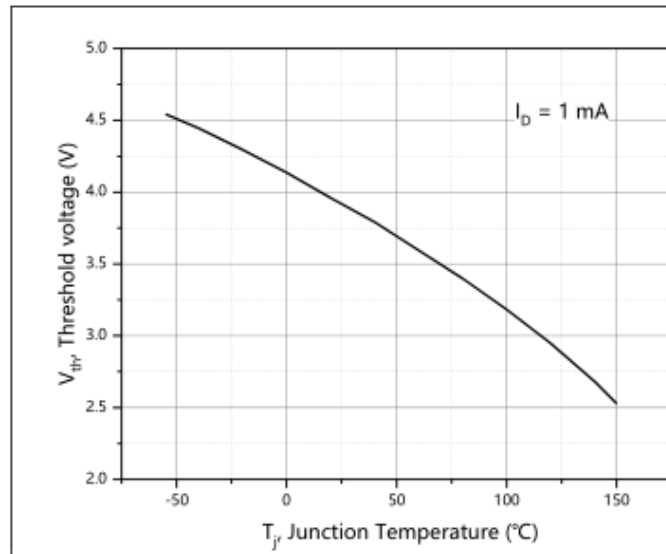


Figure 7. Threshold voltage

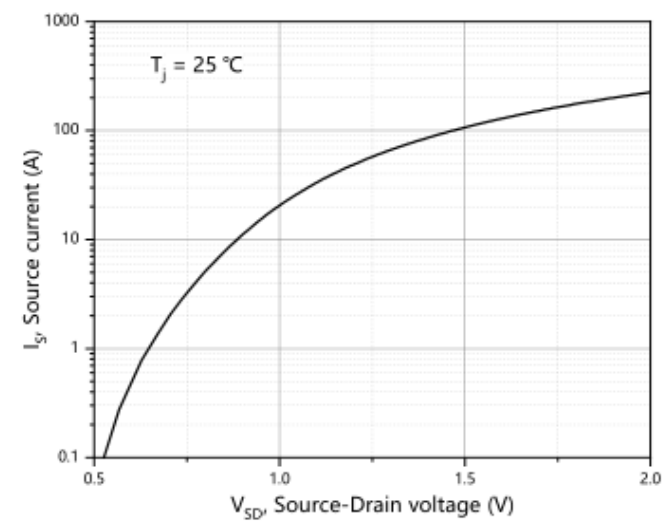


Figure 8. Forward characteristic of body diode

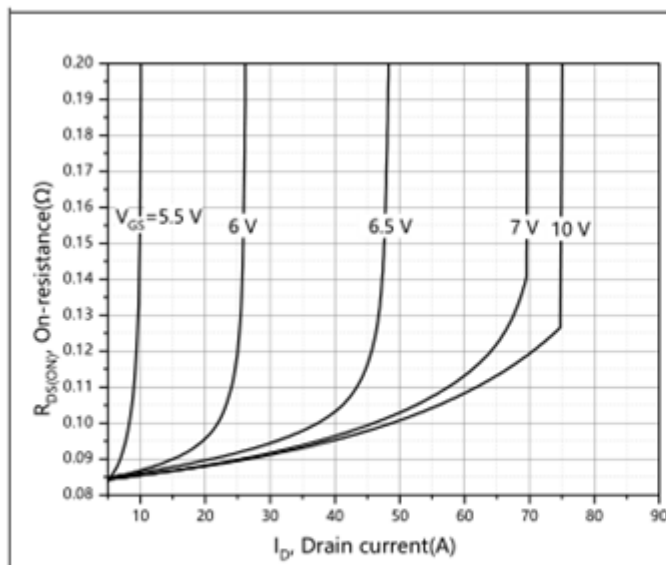


Figure 9. Drain-source on-state resistance

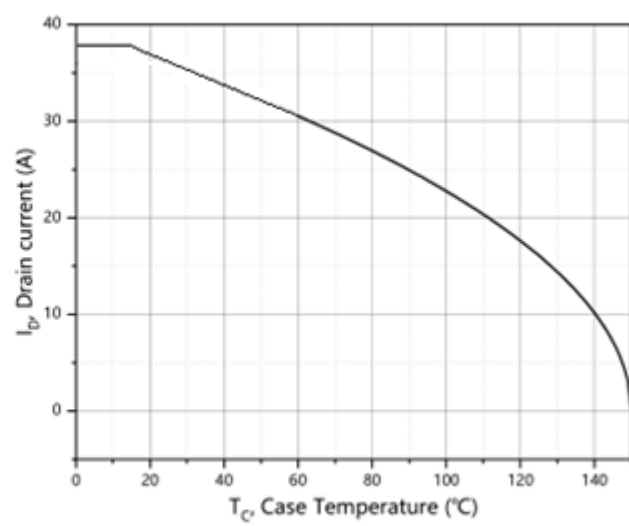


Figure 10. Drain current

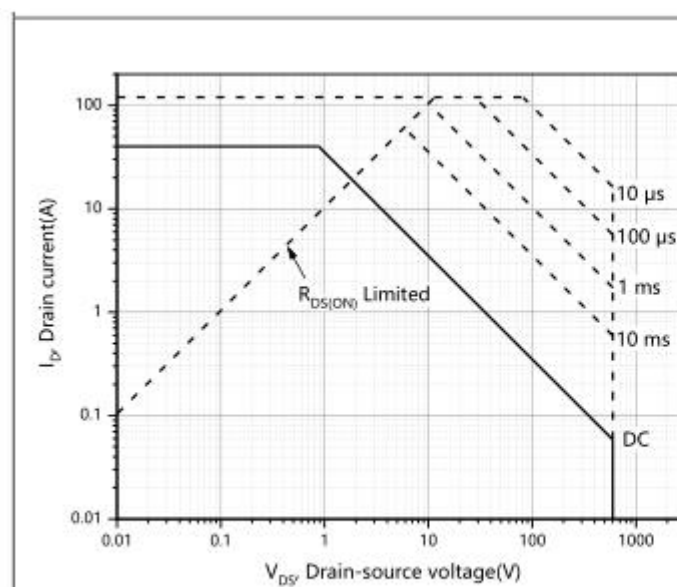


Figure 11. Safe operation area for $T_C = 25 \text{ °C}$

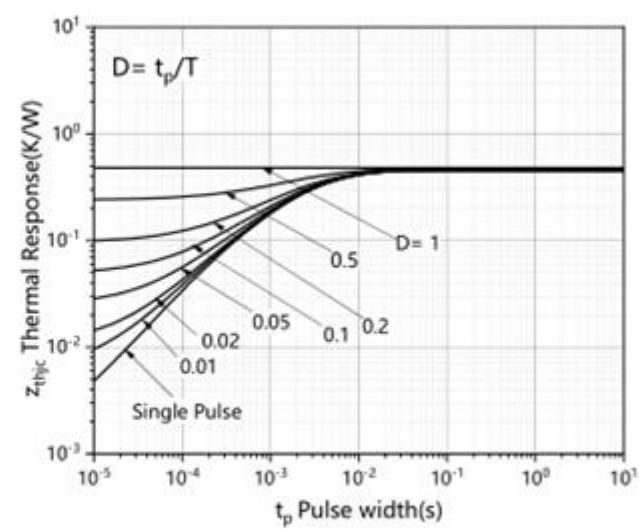
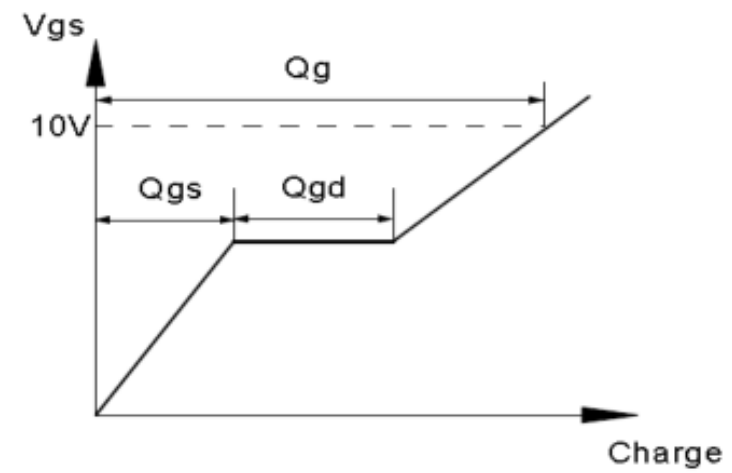
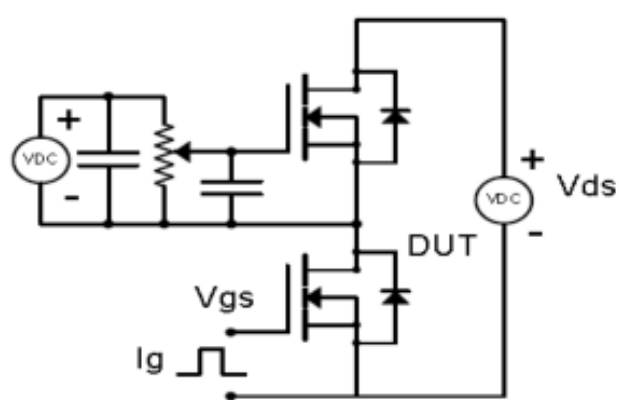


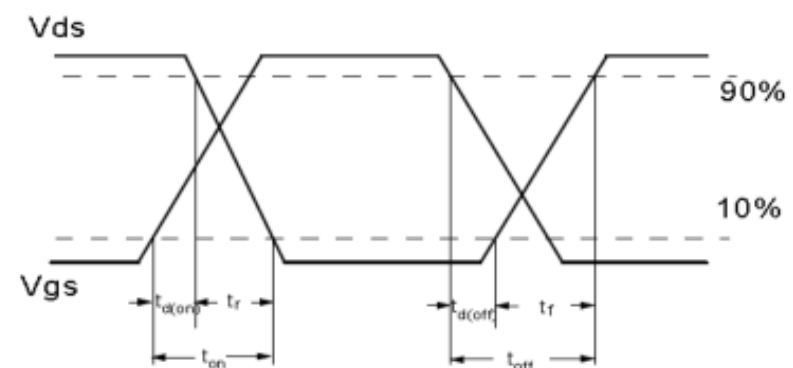
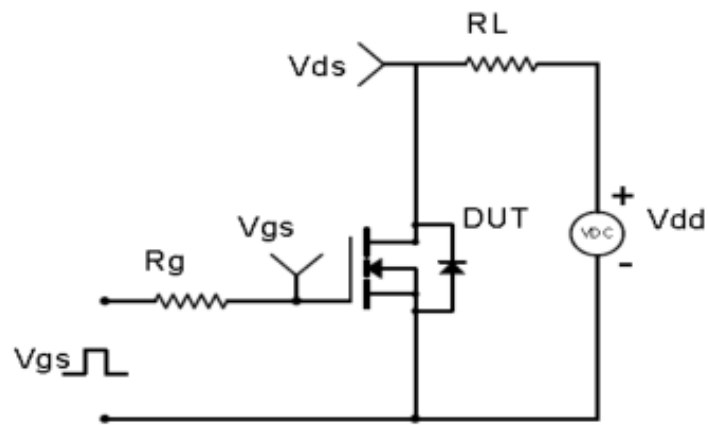
Figure 14. Max. transient thermal impedance

Test Circuit & Waveform

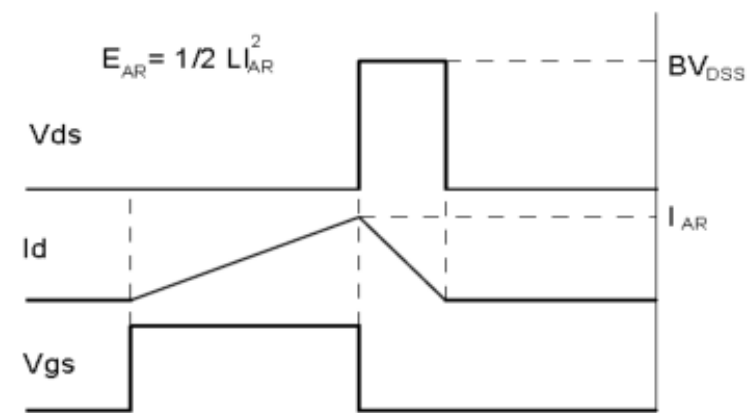
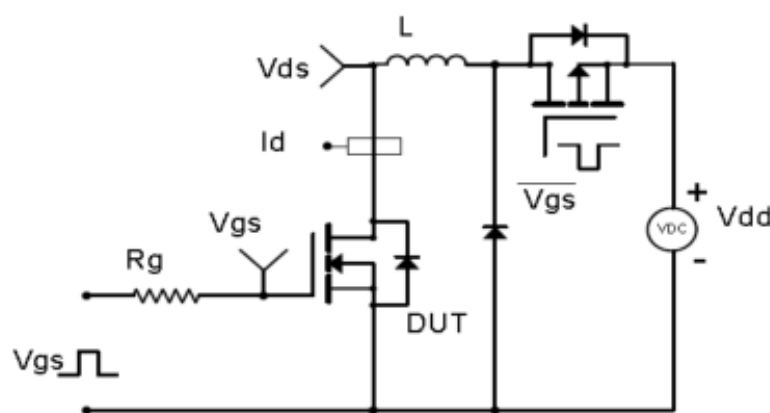
Gate Charge Test Circuit & Waveform



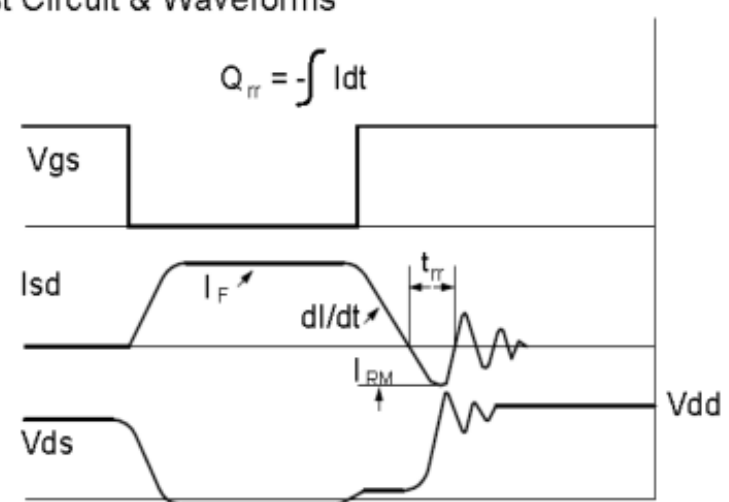
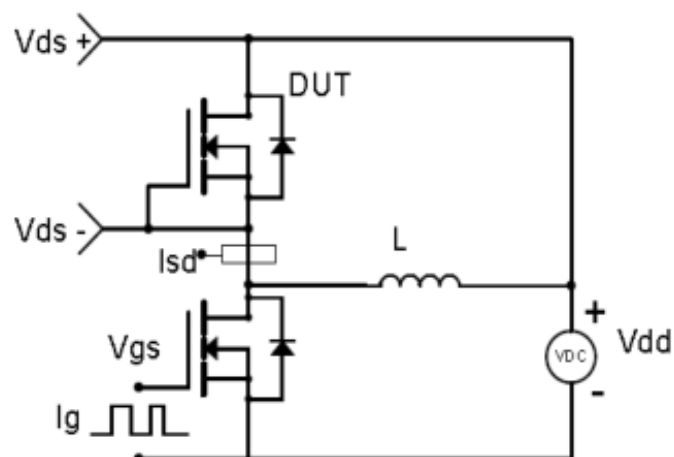
Resistive Switching Test Circuit & Waveforms



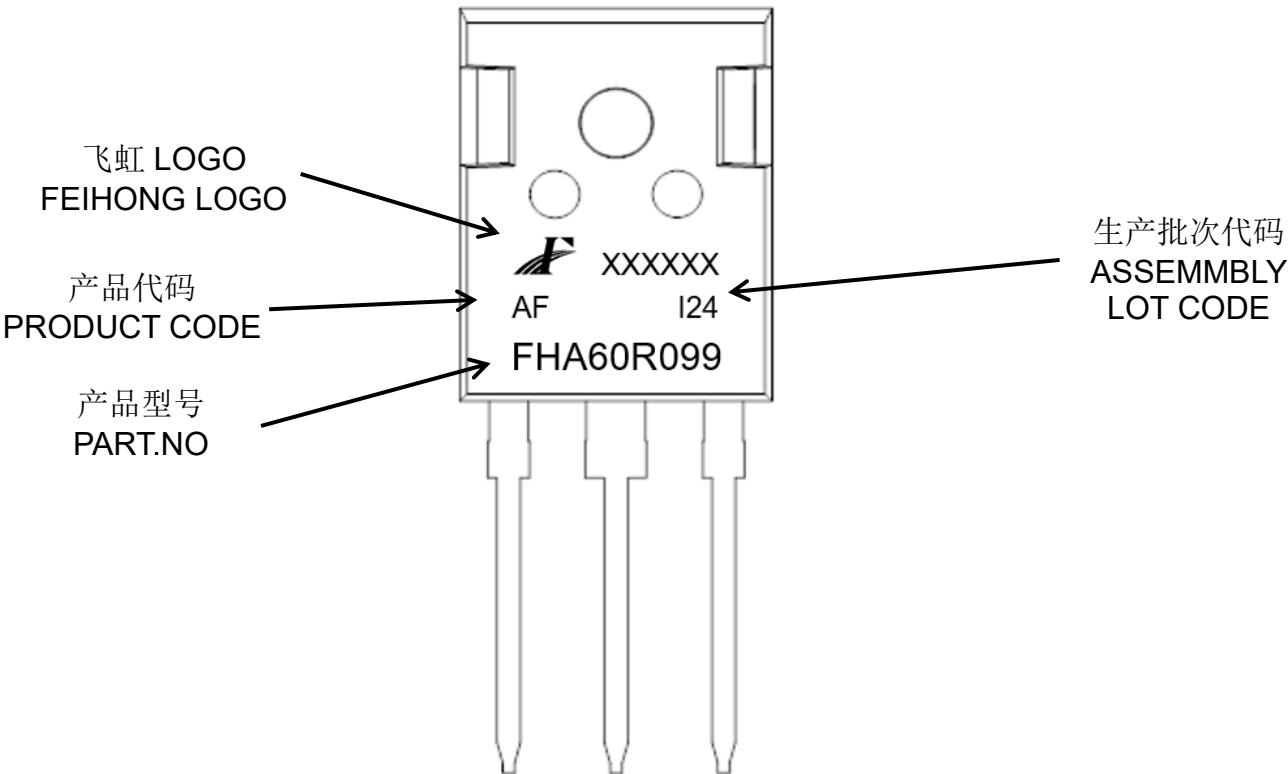
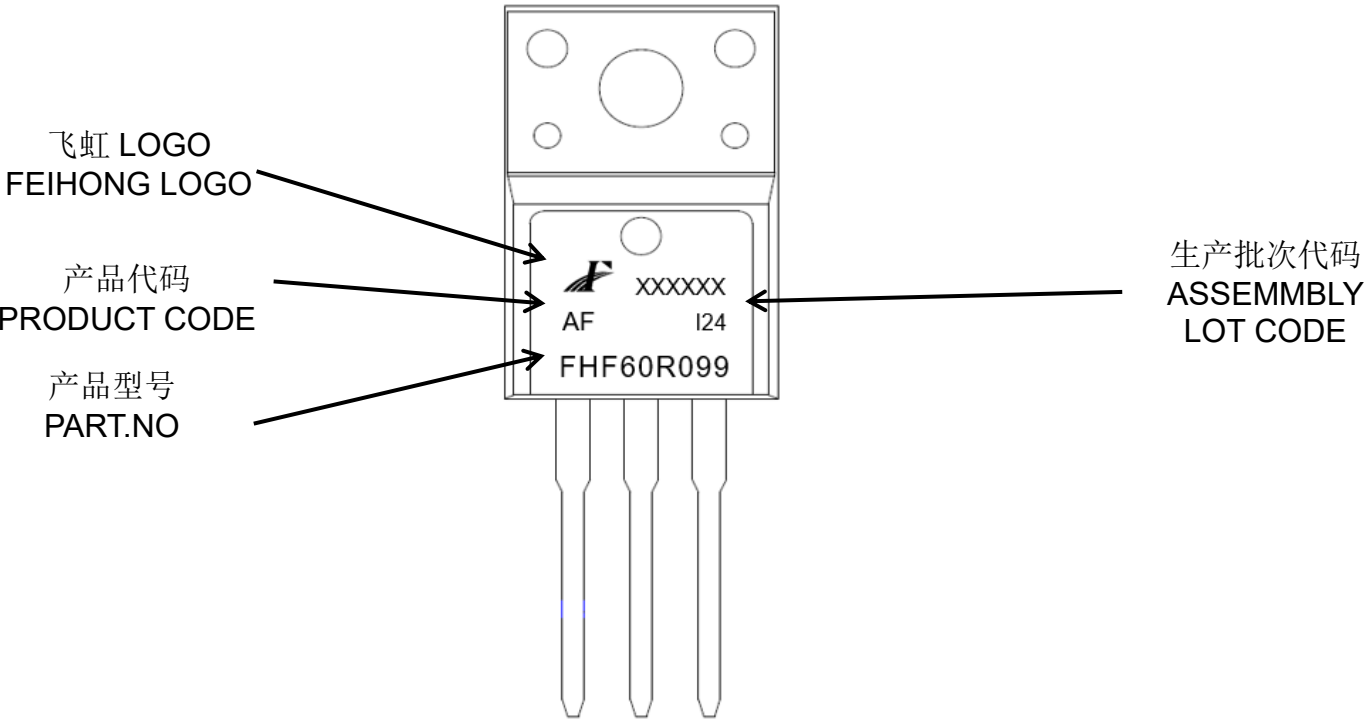
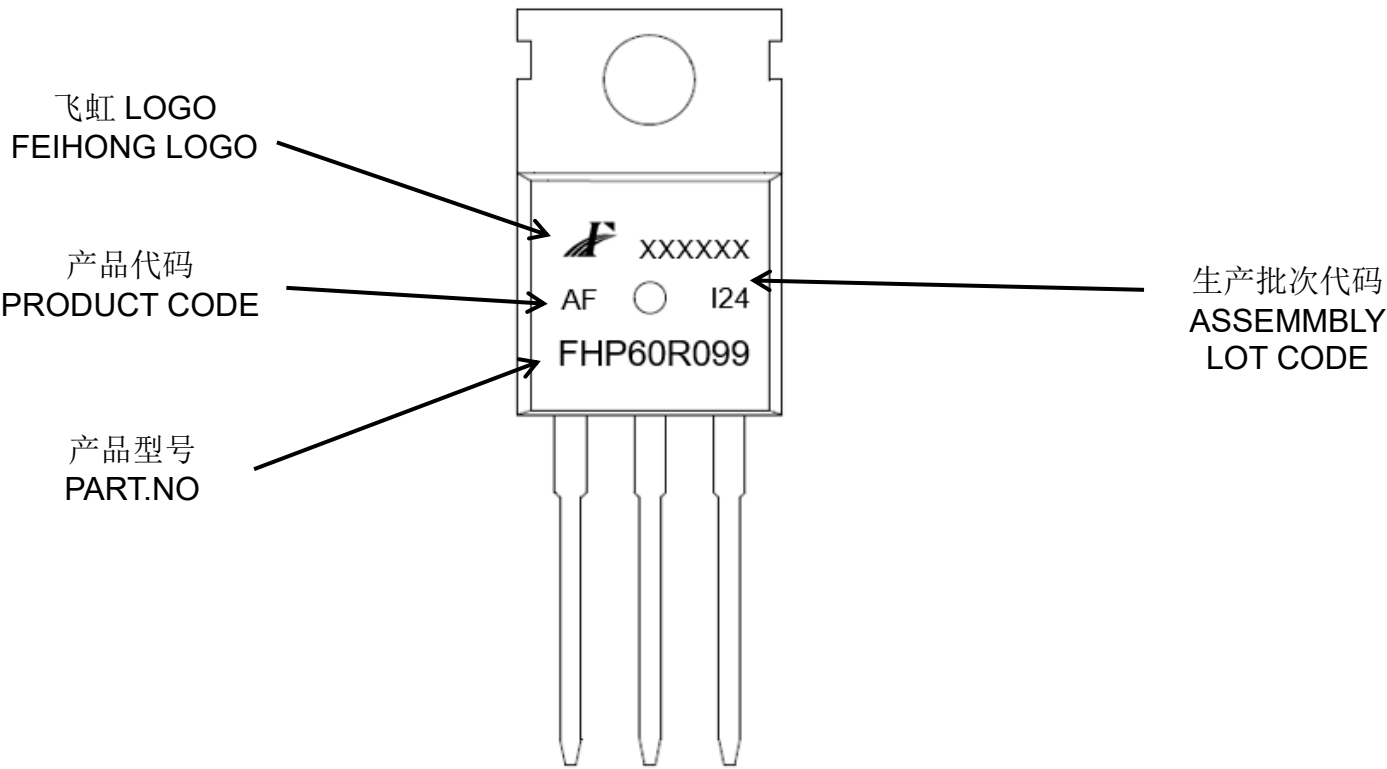
Unclamped Inductive Switching (UIS) Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms



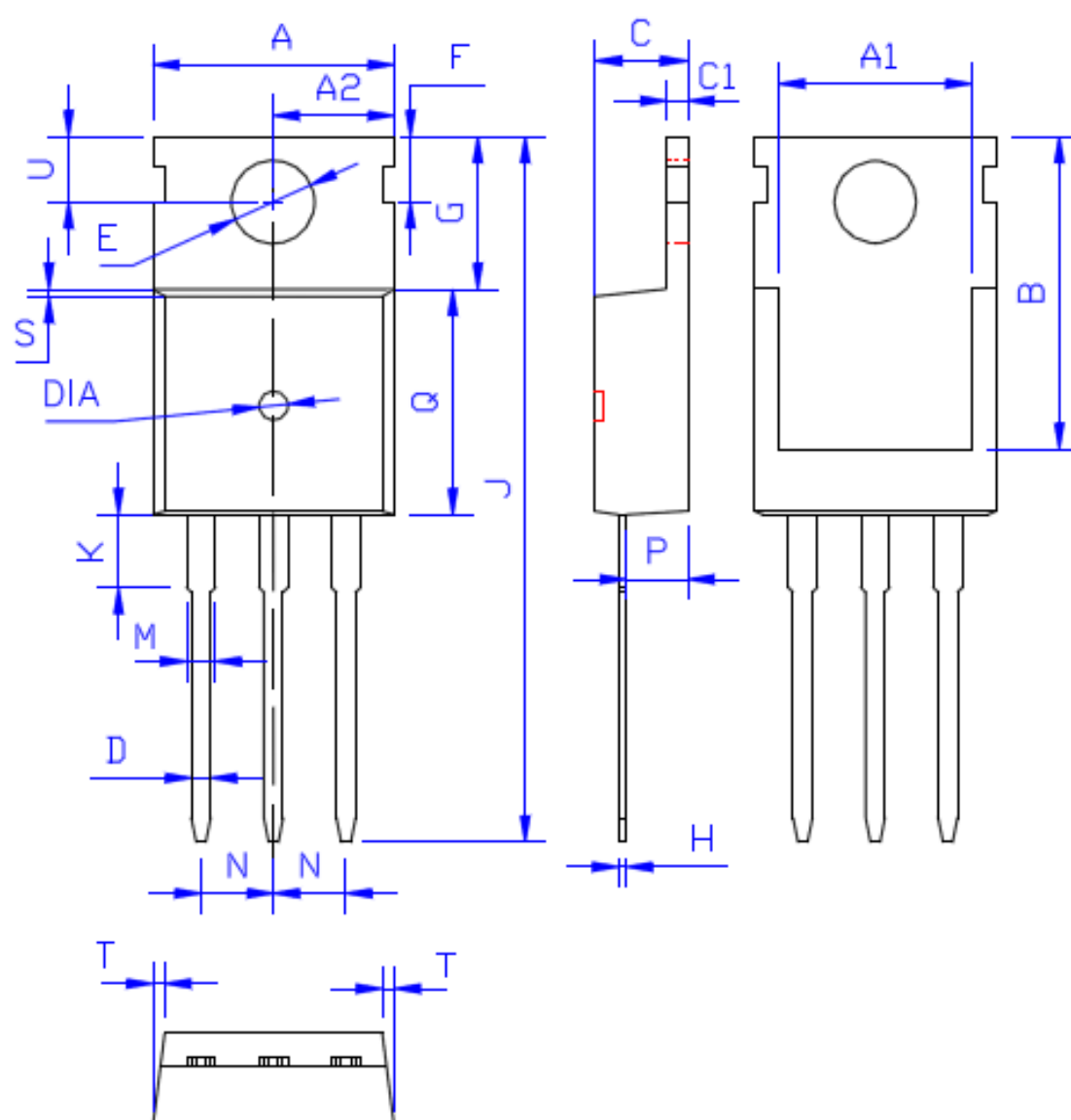
印记 Marking:



外形尺寸:

Package Dimension:

TO-220



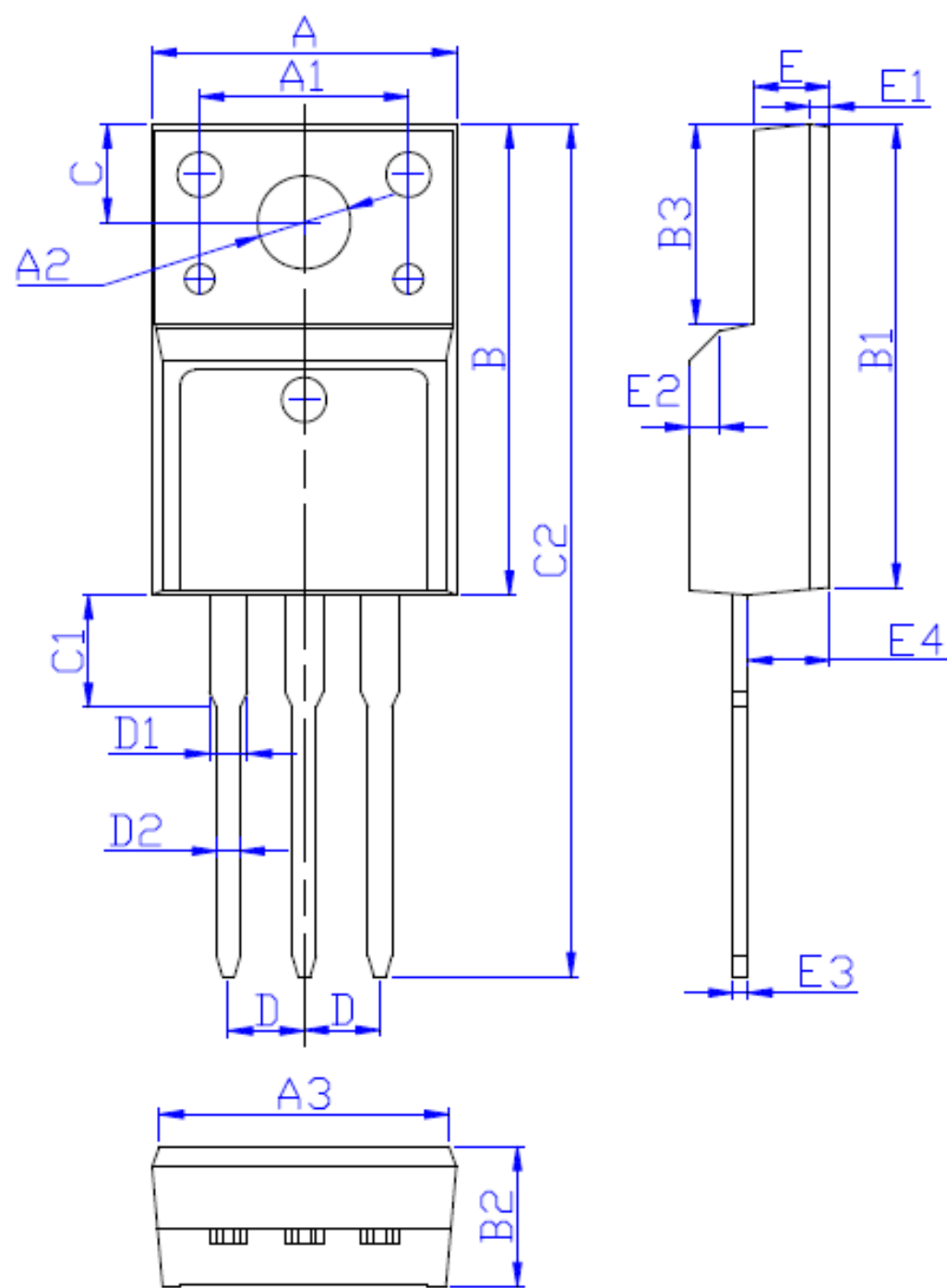
DIM	MILLIMETERS
A	10.00±0.30
A1	8.00±0.30
A2	5.00±0.30
B	13.20±0.40
C	4.50±0.20
C1	1.30±0.20
D	0.80±0.20
E	3.60±0.20
F	3.00±0.30
G	6.60±0.40
H	0.50±0.20
J	28.88±0.50
K	3.00±0.30
M	1.30±0.30
N	Typical 2.54
P	2.40±0.40
Q	9.20±0.40
S	0.25±0.15
T	0.25±0.15
U	2.80±0.30
DIA	宽 1.50±0.10 深 0.50 MAX

(Unit: mm)

外形尺寸:

Package Dimension:

TO-220F



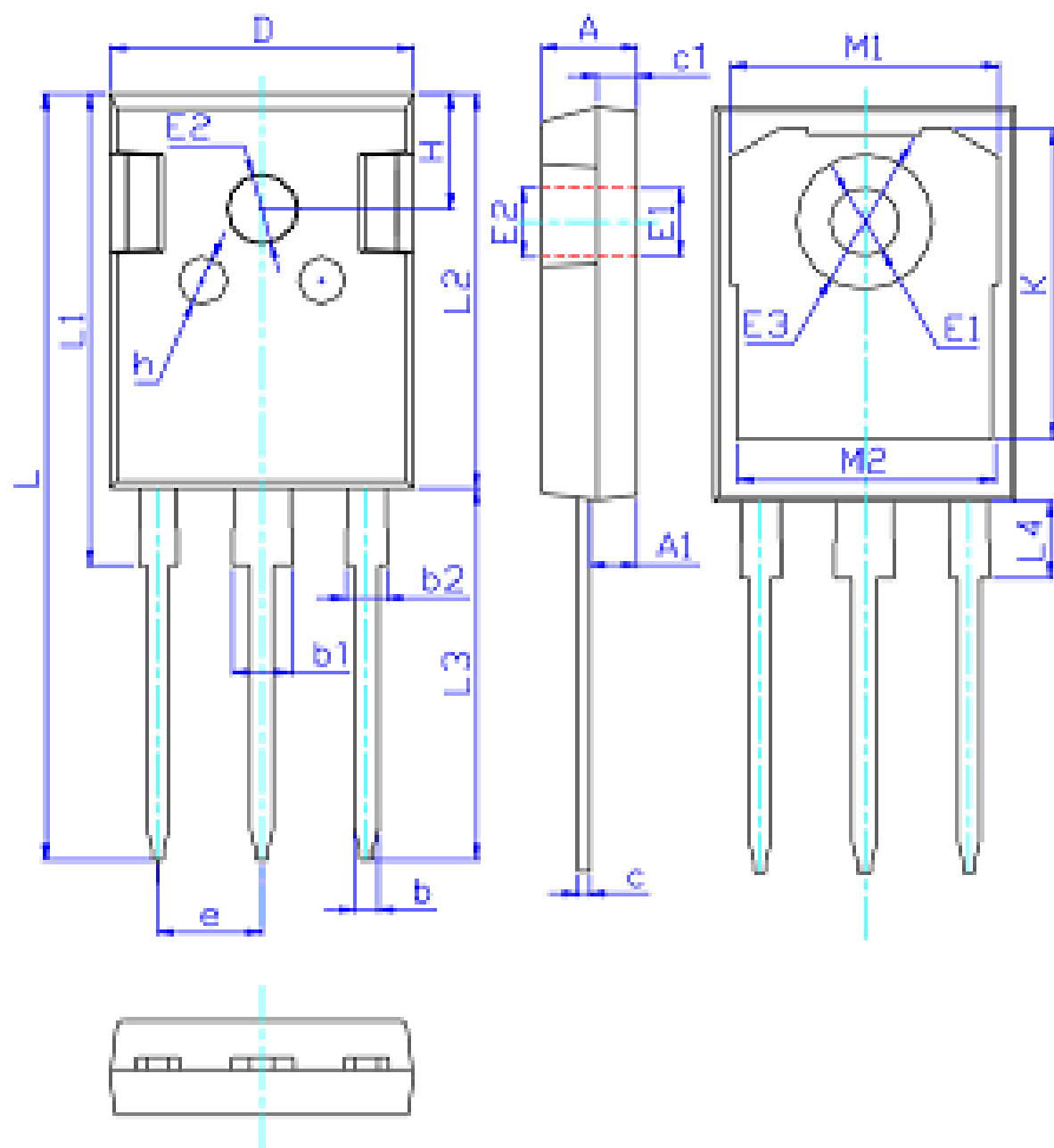
DIM	MILLIMETERS
A	10.16±0.30
A1	7.00±0.20
A2	3.12±0.20
A3	9.70±0.30
B	15.90±0.50
B1	15.60±0.50
B2	4.70±0.30
B3	6.70±0.30
C	3.30±0.25
C1	3.25±0.30
C2	28.70±0.50
D	Typical 2.54
D1	1.47 (MAX)
D2	0.80±0.20
E	2.55±0.25
E1	0.70±0.25
E2	1.0×45°
E3	0.50±0.20
E4	2.75±0.30

(Unit:mm)

外形尺寸:

Package Dimension:

TO-247



标注	尺寸(mm)
A	5.00±0.05
A1	2.41±0.05
b	1.2±0.05
b1	3.05±0.05
b2	2.05±0.05
c	0.60±0.05
c1	2.00±0.05
D	15.80±0.10
E1	3.60±0.05
E2	3.70±0.05
E3	7.19±0.05
L	40.92±0.10
L1	24.95±0.10
L2	21.00±0.10
L3	19.92±0.10
L4	4.10±0.05
e	5.44±0.05
H	6.15±0.05
h	2.50±0.05
K	16.45±0.10
M1	14.00±0.10
M2	13.30±0.10