



N 沟道增强型场效应晶体管

N-CHANNEL MOSFET

FHU4N65A/FHP4N65A/FHD4N65A/FHF4N65A

**主要参数 MAIN CHARACTERISTICS**

ID	4A
VDSS	650V
Rdson-typ ( @Vgs=10V)	1.9Ω
Qg-typ	13.3nC

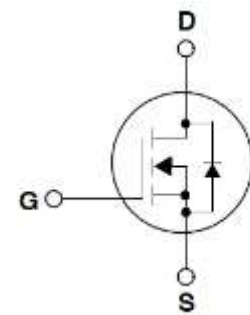
**产品特性 FEATURES**

低栅极电荷	Low gate charge
低 Crss (典型值 17pF)	Low Crss (typical 17pF)
开关速度快	Fast switching
100%经过雪崩测试	100% avalanche tested
高抗 dv/dt 能力	Improved dv/dt capability
RoHS 产品	RoHS product

**用途 APPLICATIONS**

高频开关电源	High efficiency switch mode power supplies
电子镇流器	Electronic ballast
LED 电源	LED power supply

**等效电路 Equivalent Circuit**



**封装形式 Package**



**绝对最大额定值 ABSOLUTE RATINGS (Tc=25°C)**

项目 Parameter	符号 Symbol	数值 Value				单位 Unit
		FHU4N65A	FHP4N65A	FHD4N65A	FHF4N65A	
最高漏极-源极直流电压 Drain-Source Voltage	V <sub>DS</sub>	650				V
连续漏极电流* Drain Current -continuous *	I <sub>D</sub> (T <sub>C</sub> =25°C)	4				A
	I <sub>D</sub> (T <sub>C</sub> =100°C)	2.5				A
最大脉冲漏极电流 (注 1) Drain Current – pulse (note 1)	I <sub>DM</sub>	16				A
最高栅源电压 Gate-Source Voltage	V <sub>GS</sub>	±30				V
单脉冲雪崩能量 (注 2) Single Pulsed Avalanche Energy (note 2)	E <sub>AS</sub>	128				mJ
雪崩电流 (注 1) Avalanche Current (note 1)	I <sub>AR</sub>	1.9				A
重复雪崩能量 (注 1) Repetitive Avalanche Current (note 1)	E <sub>AR</sub>	4.4				mJ
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	5.0				V/ns
耗散功率 Power Dissipation	P <sub>D</sub> (T <sub>C</sub> =25°C)	75	75	75	30	W
	-Derate above 25°C	0.6	0.6	0.6	0.24	W/°C
最高结温及存储温度 Operating and Storage Temperature Range	T <sub>J</sub> , T <sub>STG</sub>	150, -55 to 150				°C
引线最高焊接温度 Maximum Lead Temperature for Soldering Purposes	T <sub>L</sub>	300				°C

\*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
<b>关态特性 Off –Characteristics</b>						
漏-源击穿电压 Drain-Source Voltage	BV <sub>DSS</sub>	I <sub>D</sub> =250μA, V <sub>GS</sub> =0V	650	-	-	V
击穿电压温度特性 Breakdown Voltage Temperature Coefficient	ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	I <sub>D</sub> =250μA, referenced to 25°C	-	0.66	-	V/°C
零栅压下漏极漏电流 Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> =650V, V <sub>GS</sub> =0V, T <sub>C</sub> =25°C	-	-	10	μA
		V <sub>DS</sub> =520V, T <sub>C</sub> =125°C	-	-	100	μA
栅极体漏电流 Gate-body leakage current	I <sub>GSS</sub> (F/R)	V <sub>DS</sub> =0V, V <sub>GS</sub> =±30V	-	-	±100	μA
<b>通态特性 On-Characteristics</b>						
阈值电压 Gate Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> =250μA	2.0	-	4.0	V
静态导通电阻 Static Drain-Source On-Resistance	R <sub>DS(ON)</sub>	V <sub>GS</sub> =10V , I <sub>D</sub> =2A	-	1.9	2.3	Ω
正向跨导 Forward Transconductance	g <sub>fs</sub>	V <sub>DS</sub> = 15V, I <sub>D</sub> =2A (note 4)	-	2.5	-	S
<b>动态特性 Dynamic Characteristics</b>						
输入电容 Input capacitance	C <sub>iss</sub>	V <sub>DS</sub> =25V, V <sub>GS</sub> =0V, f=1.0MHz	-	560	-	pF
输出电容 Output capacitance	C <sub>oss</sub>		-	45	-	
反向传输电容 Reverse transfer capacitance	C <sub>rss</sub>		-	17	-	
<b>开关特性 Switching Characteristics</b>						
延迟时间 Turn-On delay time	t <sub>d(on)</sub>	V <sub>DS</sub> =325V, I <sub>D</sub> =4A, R <sub>G</sub> =25Ω V <sub>GS</sub> =10V (note 4, 5)	-	64	-	ns
上升时间 Turn-On rise time	t <sub>r</sub>		-	24	-	ns
延迟时间 Turn-Off delay time	t <sub>d(off)</sub>		-	28	-	ns
下降时间 Turn-Off Fall time	t <sub>f</sub>		-	200	-	ns
栅极电荷总量 Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> =520V , I <sub>D</sub> =2A , V <sub>GS</sub> =10V (note 4, 5)	-	13.3	-	nC
栅-源电荷 Gate-Source charge	Q <sub>gs</sub>		-	3.0	-	nC
栅-漏电荷 Gate-Drain charge	Q <sub>gd</sub>		-	4.8	-	nC
<b>漏-源二极管特性及最大额定值 Drain-Source Diode Characteristics and Maximum Ratings</b>						
正向最大连续电流 Maximum Continuous Drain-Source Diode Forward Current		I <sub>S</sub>	-	-	4	A
正向最大脉冲电流 Maximum Pulsed Drain-Source Diode Forward Current		I <sub>SM</sub>	-	-	16	A
正向压降 Drain-Source Diode Forward Voltage	V <sub>SD</sub>	V <sub>GS</sub> =0V, I <sub>S</sub> =2A	-	-	1.4	V
反向恢复时间 Reverse recovery time	t <sub>rr</sub>	V <sub>GS</sub> =0V, I <sub>S</sub> =2A ,dI <sub>F</sub> /dt=100A/μs (note 4)	-	390	-	ns
反向恢复电荷 Reverse recovery charge	Q <sub>rr</sub>		-	1.85	-	uC

## 热特性 THERMAL CHARACTERISTIC

项目 Parameter	符号 Symbol	FHU4N65A	FHP4N65A	FHD4N65A	FHF4N65A	单位 Unit
结到管壳的热阻 Thermal Resistance, Junction to Case	Rth(j-c)	1.53	1.2	1.53	3.47	°C/W
结到环境的热阻 Thermal Resistance, Junction to Ambient	Rth(j-A)	100	62.5	100	62.5	°C/W

注释:

Notes:

- 1: 脉冲宽度由最高结温限制
- 2: L=25mH, IAS=4A, VDD=48V, RG=25 Ω, 起始结温 TJ=25°C
- 3: ISD ≤4A, di/dt ≤100A/μs, VDD≤BVDSS, 起始结温 TJ=25°C
- 4: 脉冲测试: 脉冲宽度 ≤300μs, 占空比≤2%
- 5: 基本与工作温度无关

- 1: Pulse width limited by maximum junction temperature
- 2: L=25mH, ID=4A, VDD=48V, RG=25 Ω, Start TJ=25°C;
- 3: ISD ≤4A, di/dt ≤100A/μs, VDD≤BVDSS, Starting TJ=25°C
- 4: Pulse Test: Pulse Width ≤300μs, Duty Cycle≤2%
- 5: Essentially independent of operating temperatur

# 特性曲线

## (ELECTRICAL CHARACTERISTICS (curves))

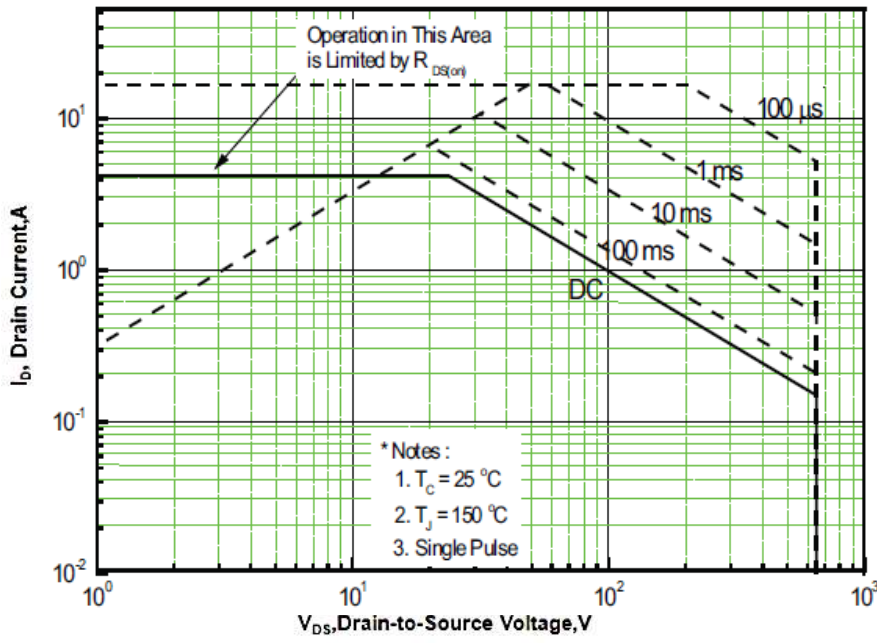


Figure 1 Maximum Forward Bias Safe Operating Area

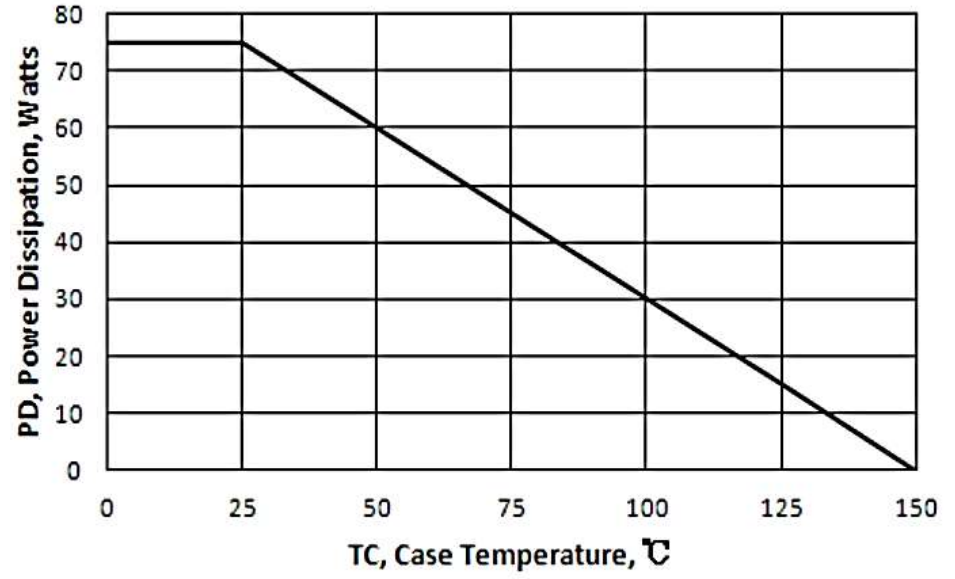


Figure 2 Maximum Power Dissipation vs Case Temperature

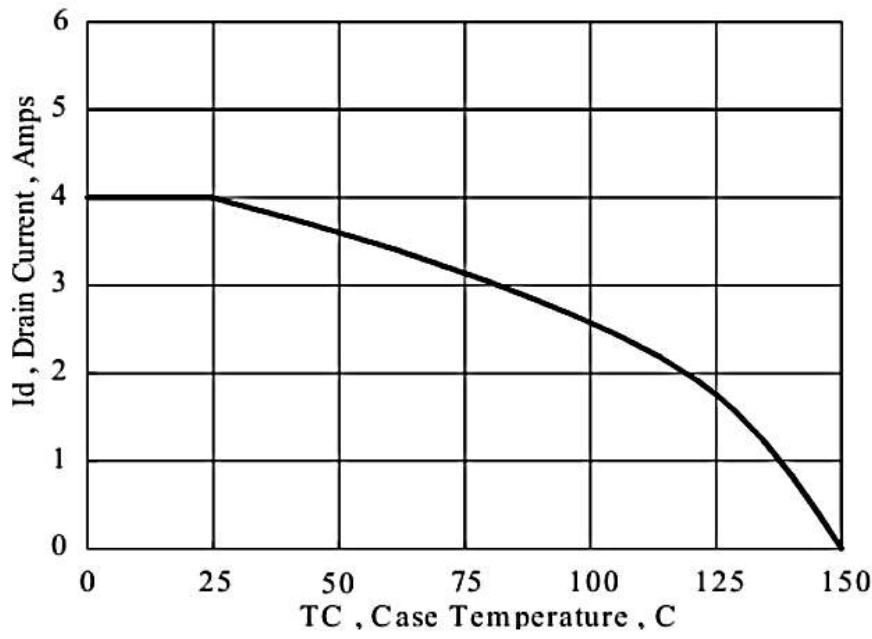


Figure 3 Maximum Continuous Drain Current vs Case Temperature

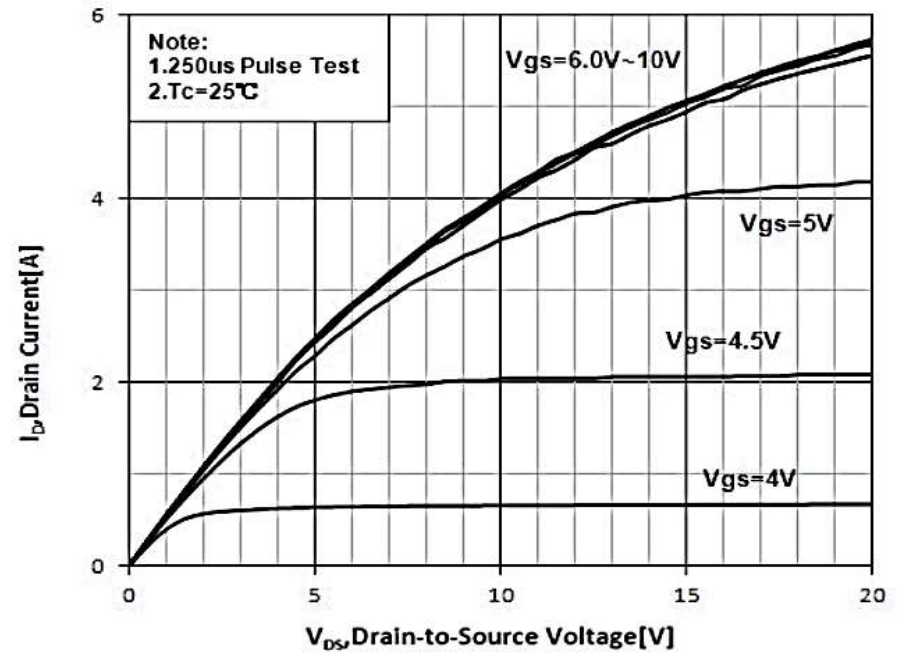


Figure 4 Typical Output Characteristics

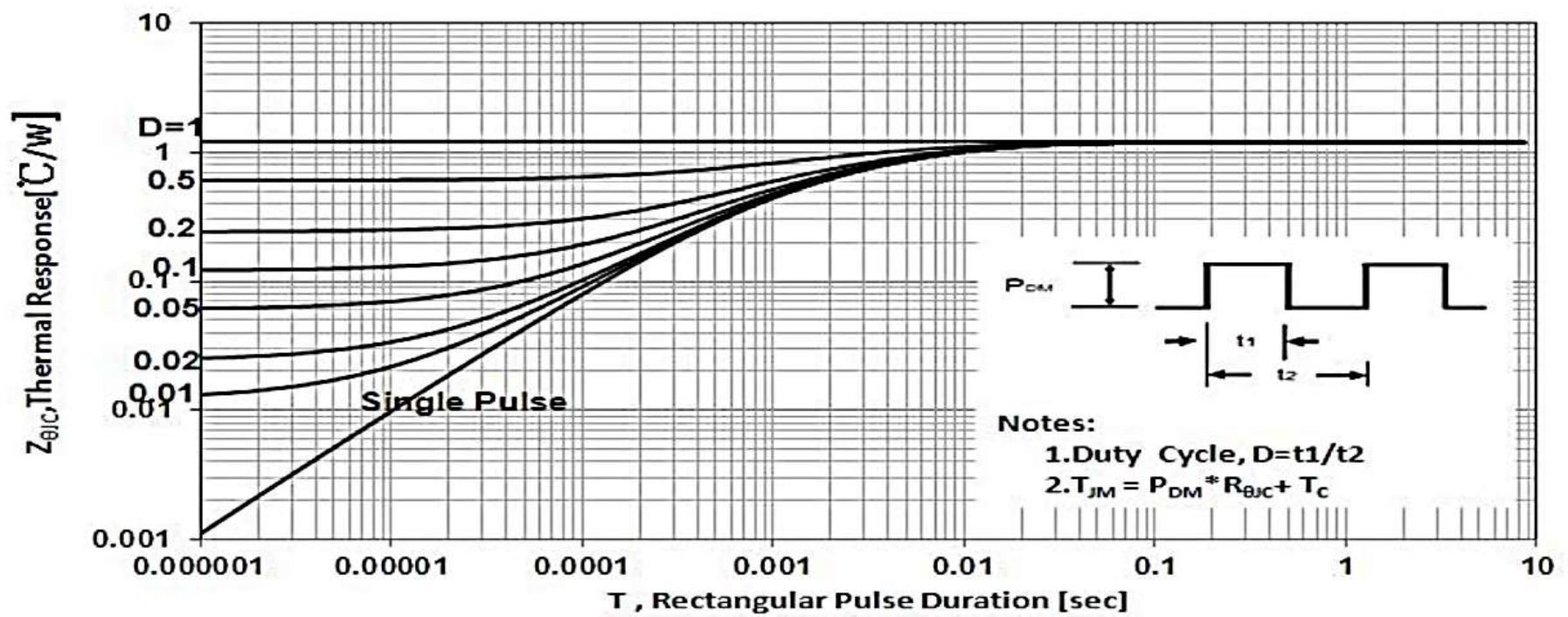


Figure 5 Maximum Effective Thermal Impedance, Junction to Case

# 特性曲线 (ELECTRICAL CHARACTERISTICS (curves))

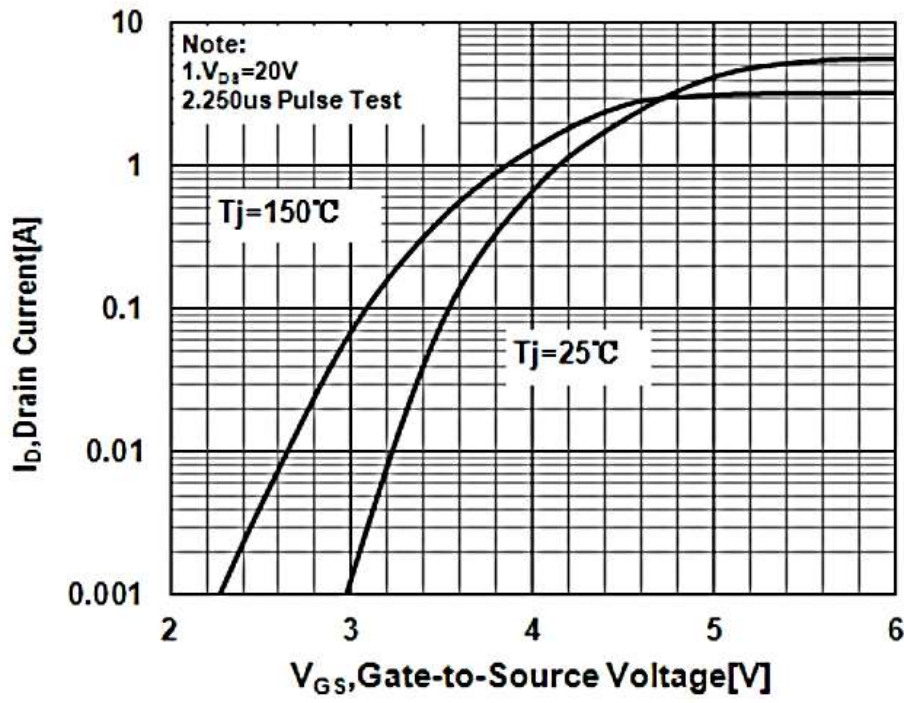


Figure 6 Typical Transfer Characteristics

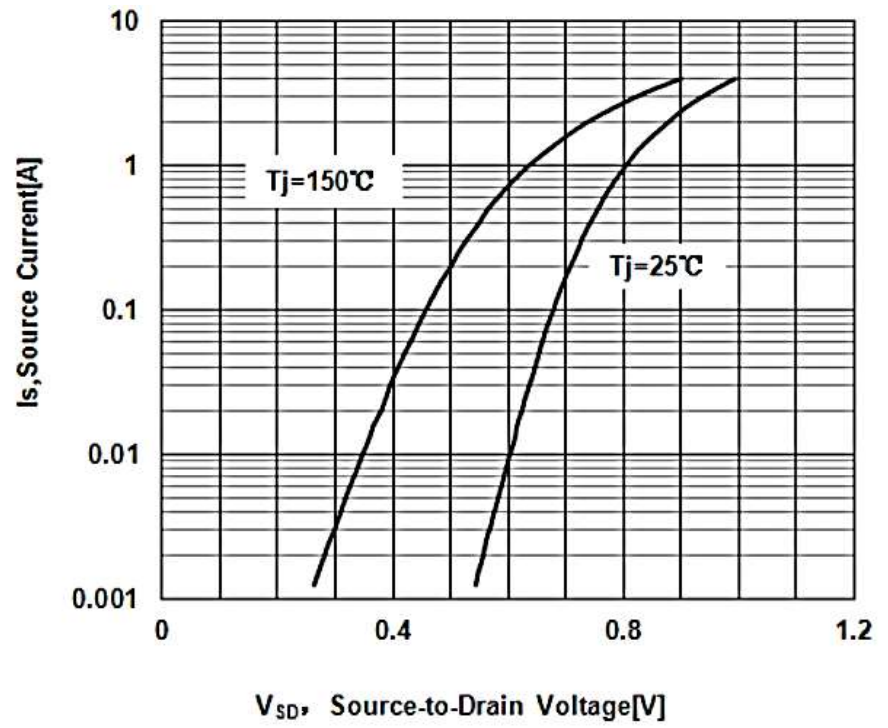


Figure 7 Typical Body Diode Transfer Characteristics

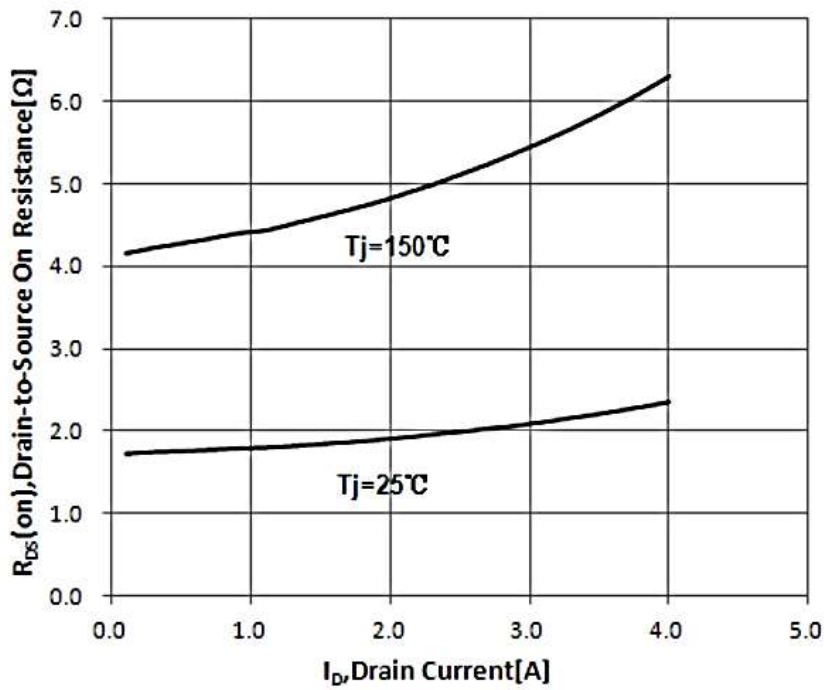


Figure 8 Typical Drain to Source ON Resistance vs Drain Current

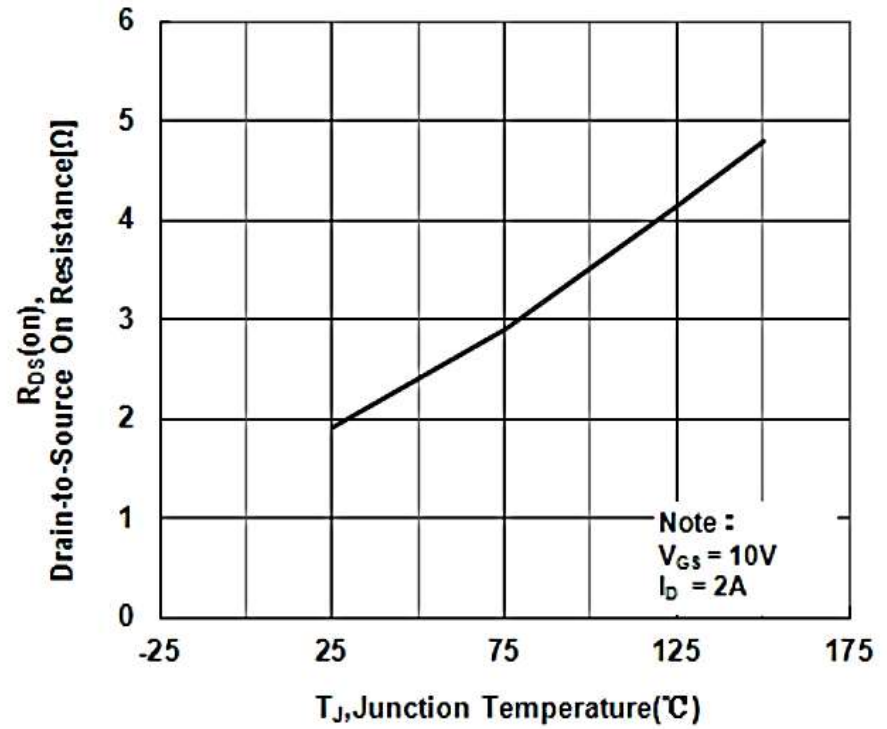


Figure 9 Typical Drain to Source on Resistance vs Junction Temperature

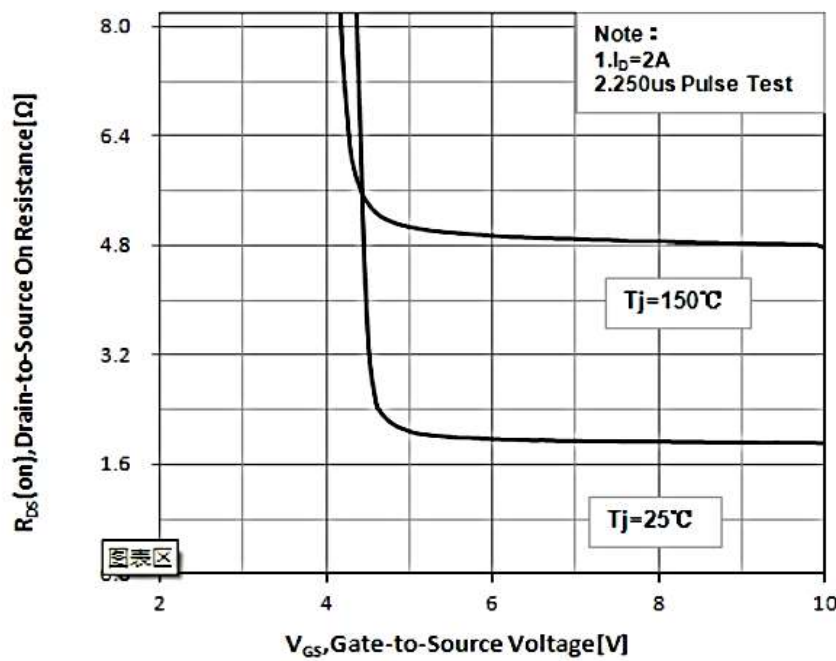


Figure 10 Drain to Source ON Resistance vs Gate-to-Source Voltage

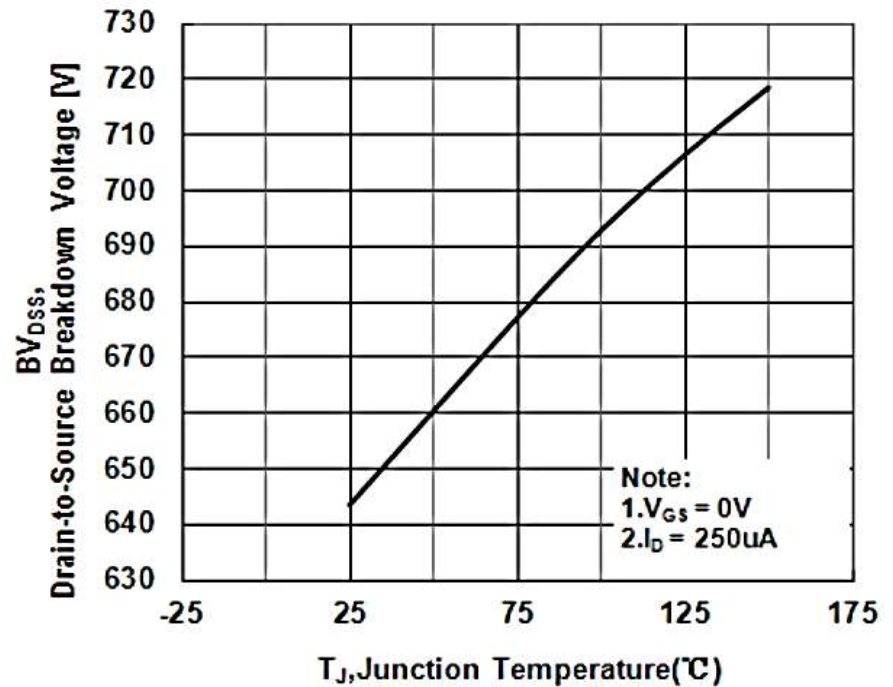


Figure 11 Typical Breakdown Voltage vs Junction Temperature

## 特性曲线 (ELECTRICAL CHARACTERISTICS (curves))

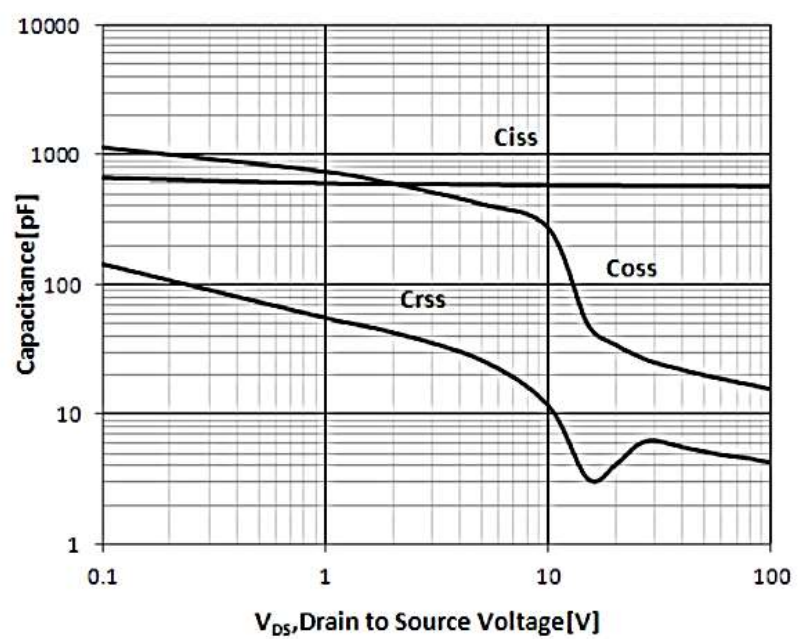


Figure 12 Typical Capacitance vs Drain to Source Voltage

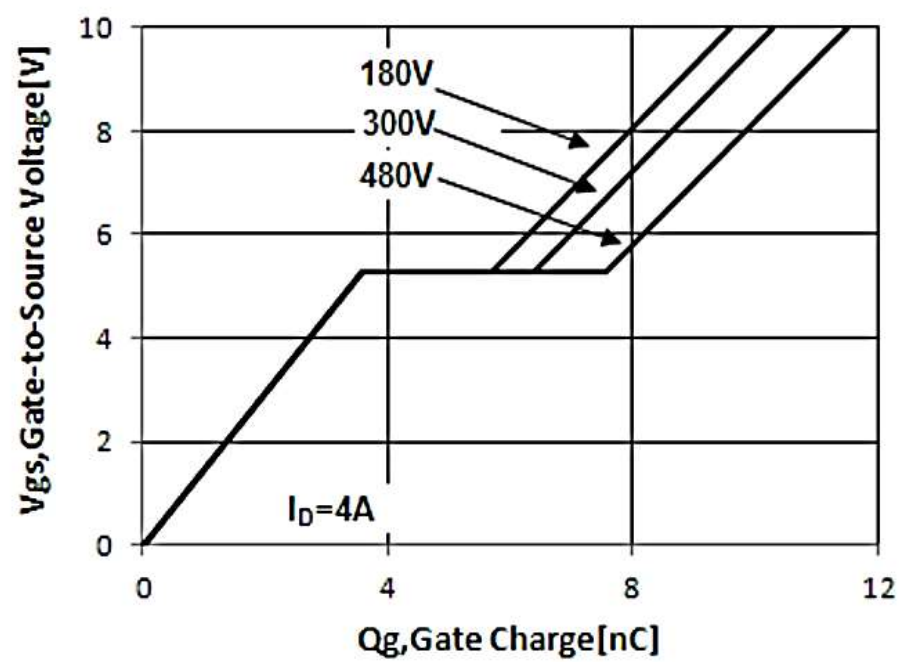
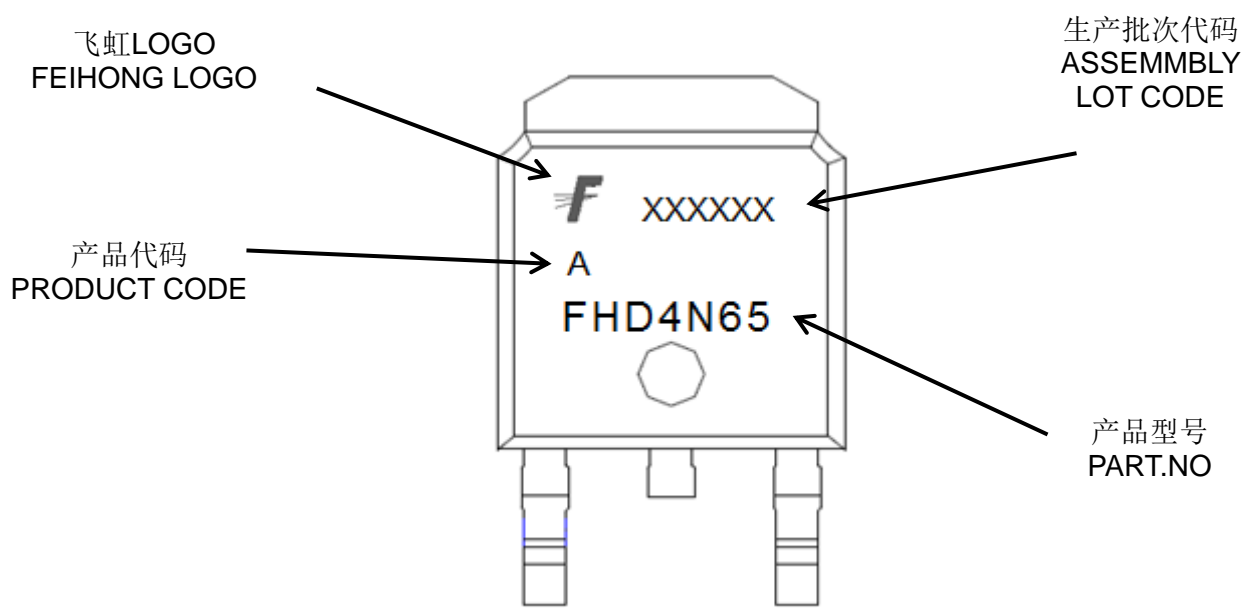
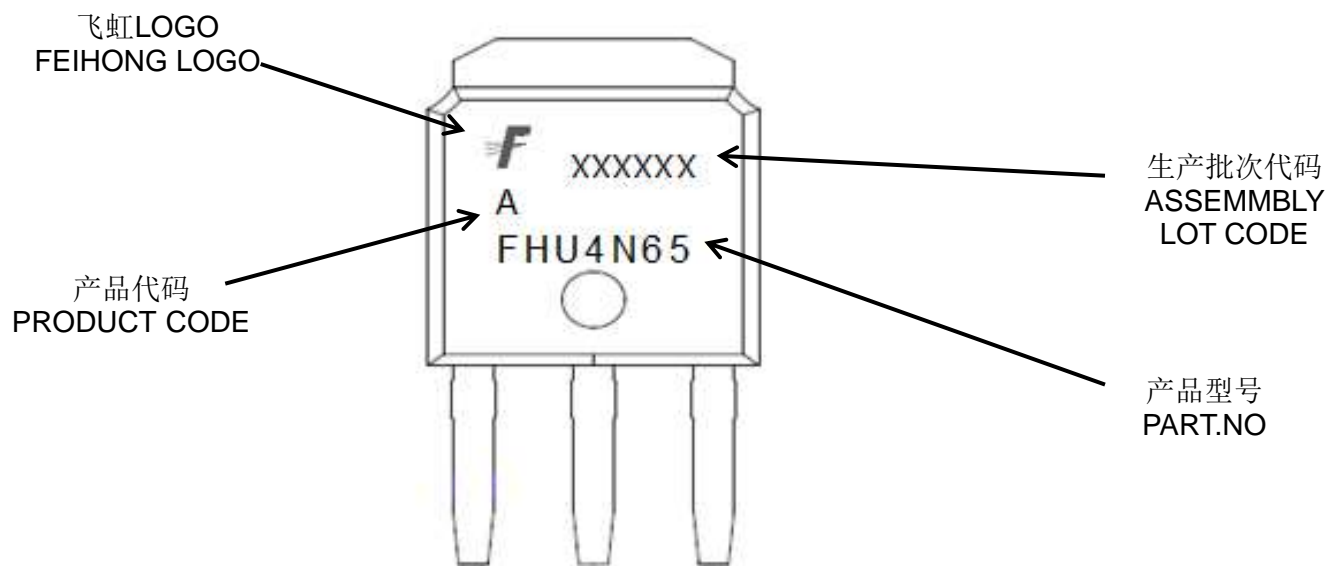
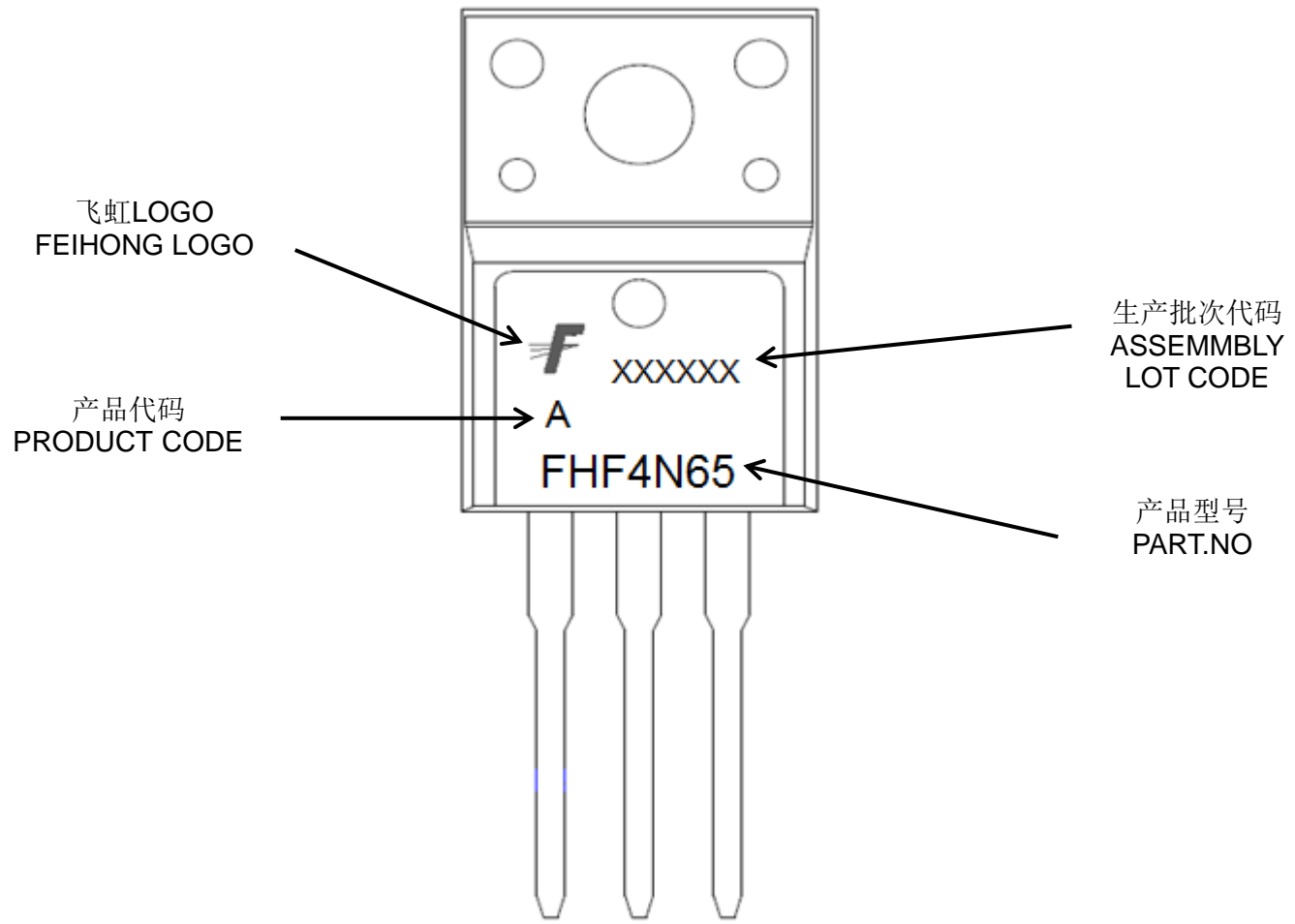
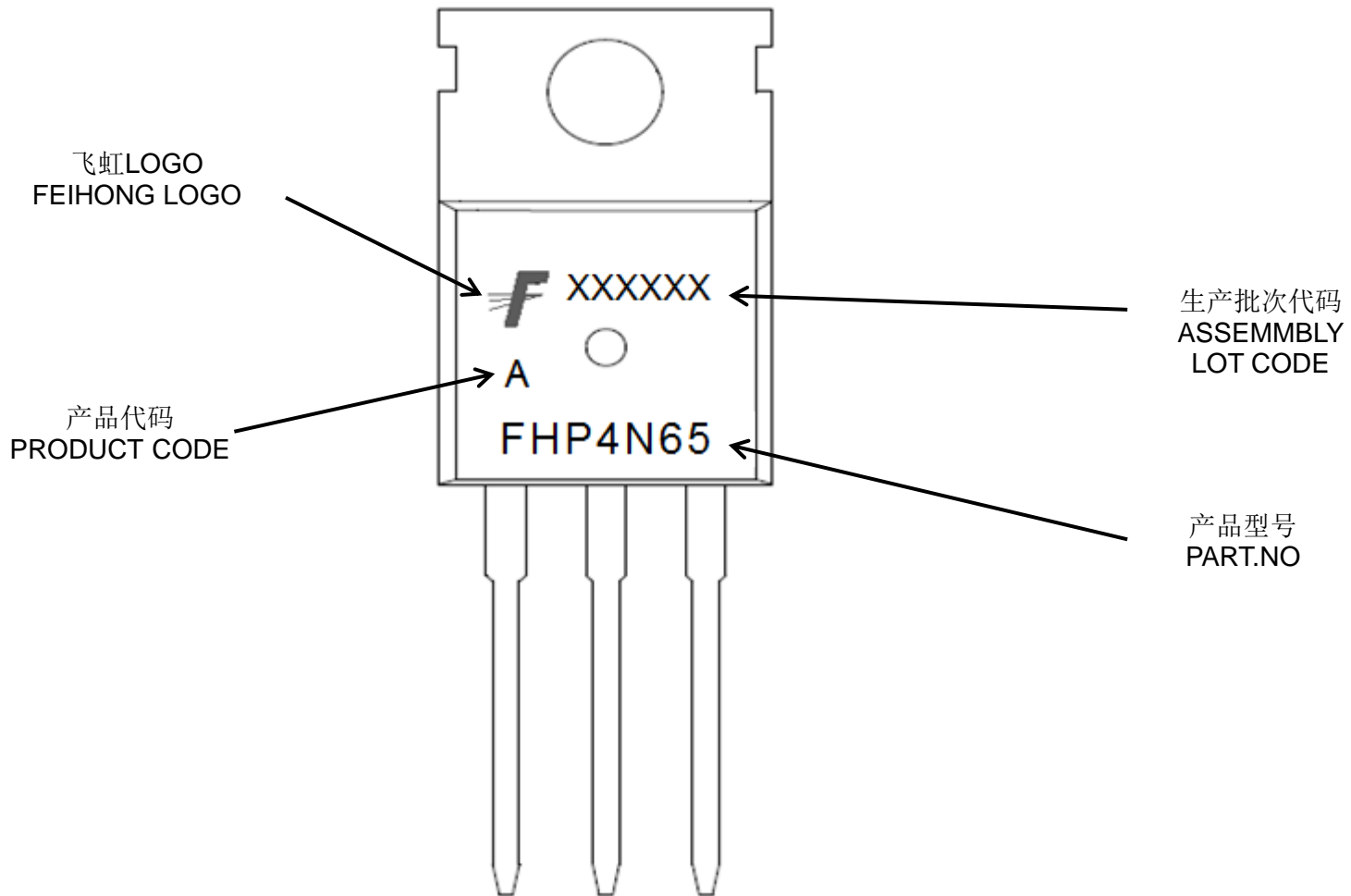


Figure 13 Typical Gate Charge vs Gate to Source Voltage

印记 Marking:

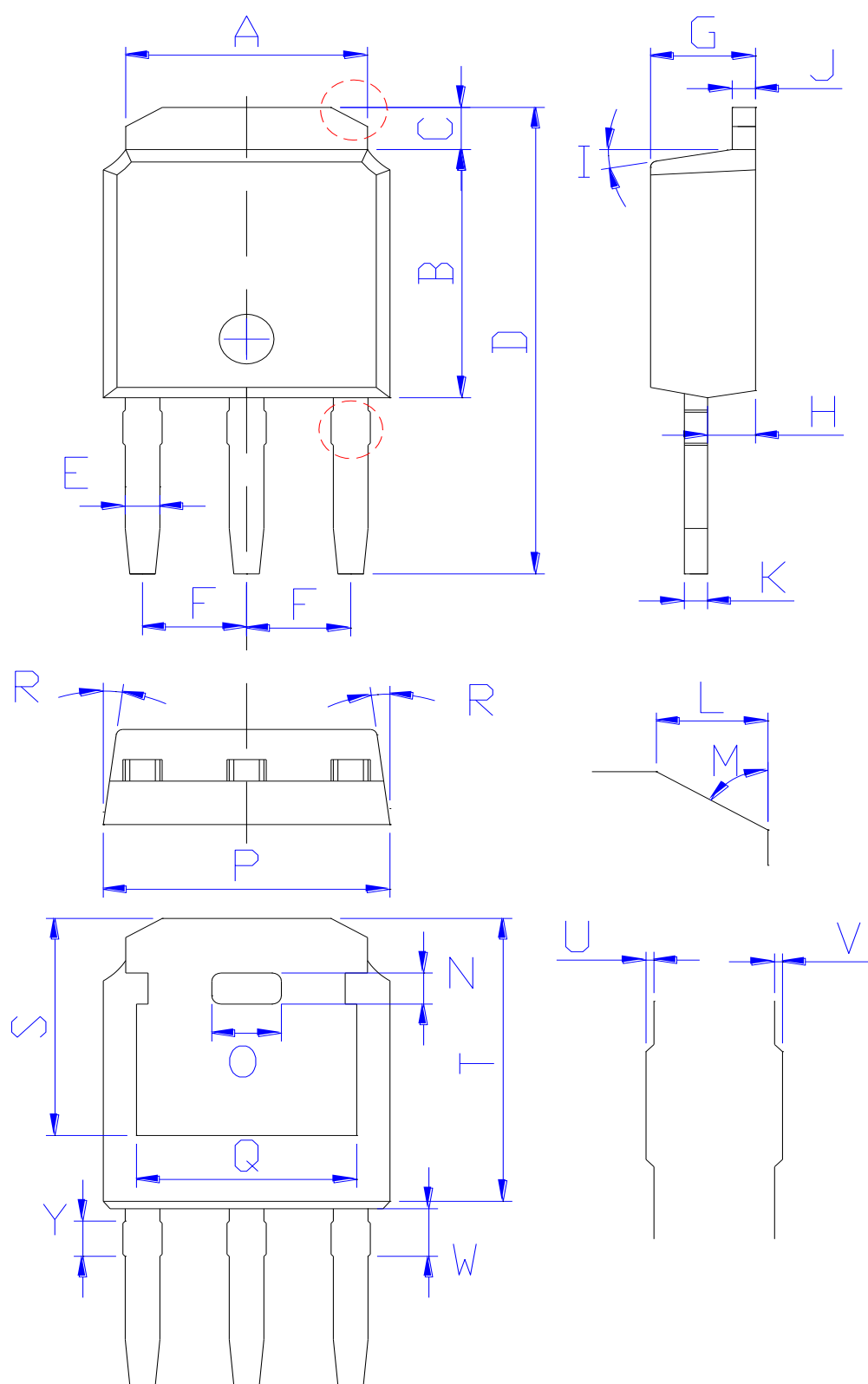






外形尺寸：  
Package Dimension:

TO-251

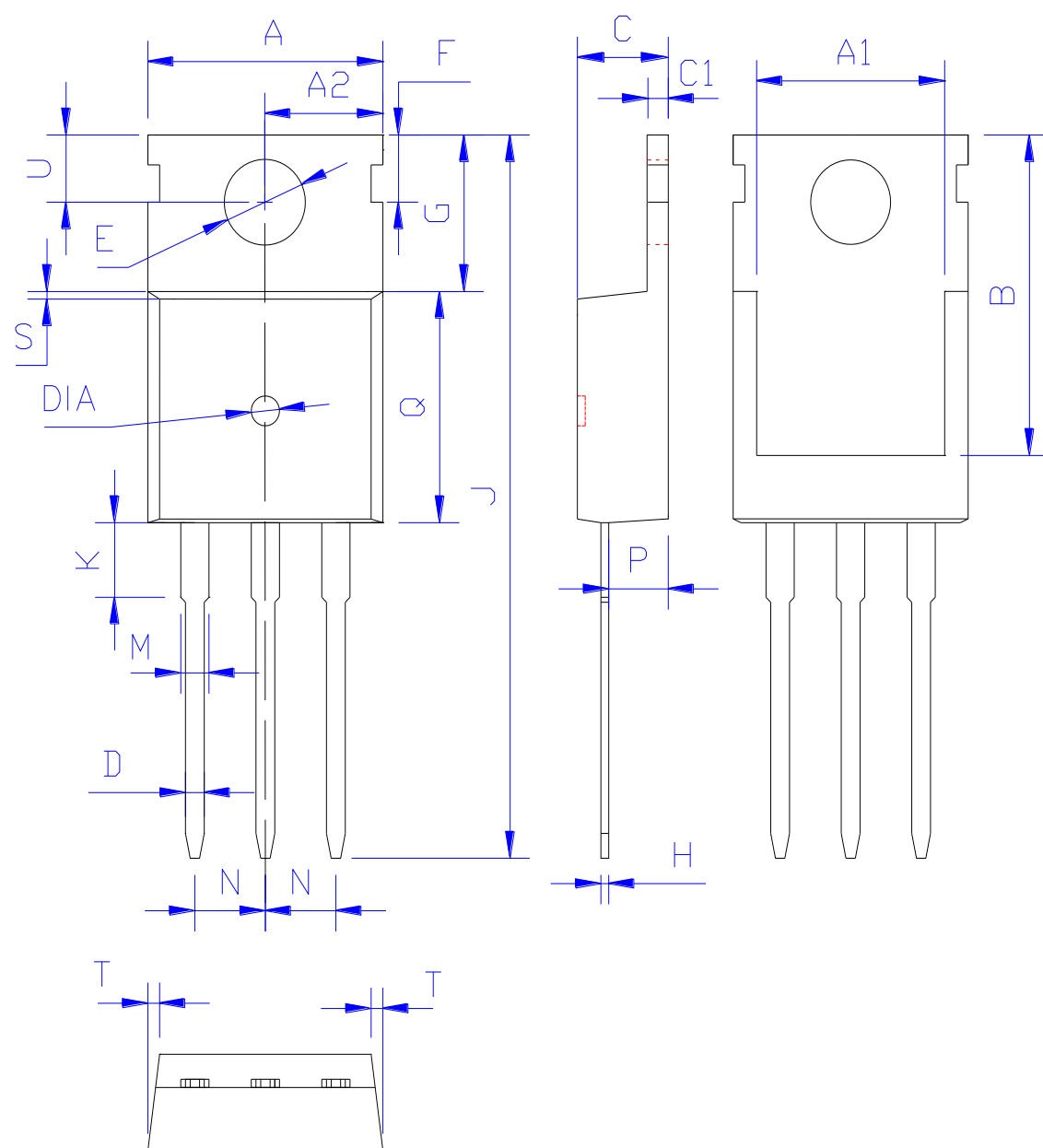


DIM	MILLIMETERS
A	5.34±0.30
B	6.00±0.30
C	1.05±0.30
D	11.31±0.30
E	0.76±0.15
F	2.28±0.15
G	2.30±0.30
H	1.06±0.30
I	(4-10)°
J	0.51±0.15
K	0.52±0.15
L	0.80±0.30
M	60°
N	0.75±0.30
O	1.80±0.30
P	6.60±0.30
Q	4.85±0.30
R	(4-8.5)°
S	5.30±0.30
T	6.90±0.30
U	0.05±0.05
V	0.05±0.05
W	1.15±0.25
Y	0.85±0.25

(Units: mm)

外形尺寸:  
Package Dimension:

TO-220

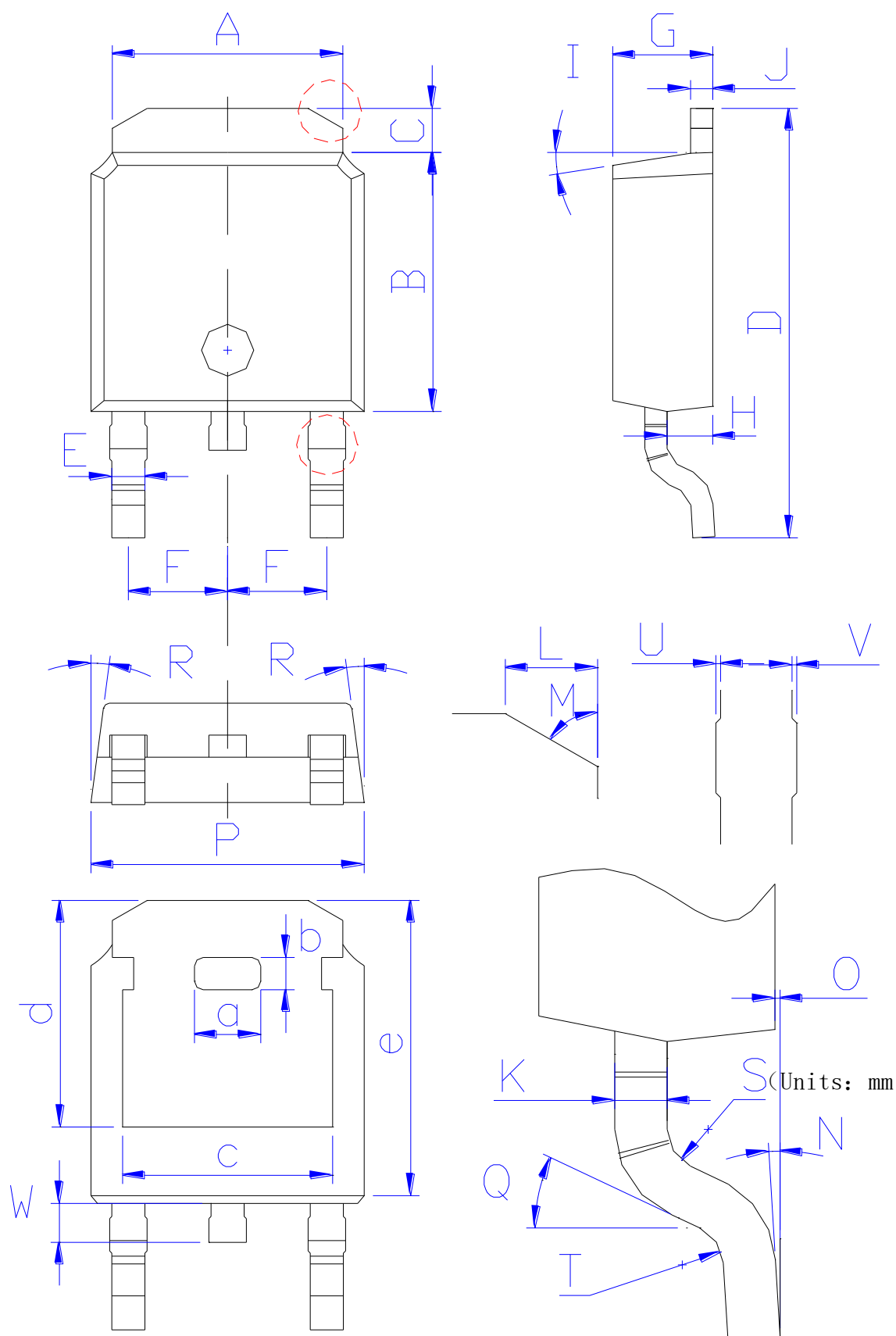


DIM	MILLIMETERS
A	10.00±0.30
A1	8.00±0.30
A2	5.00±0.30
B	13.20±0.40
C	4.50±0.20
C1	1.30±0.20
D	0.80±0.20
E	3.60±0.20
F	3.00±0.30
G	6.60±0.40
H	0.50±0.20
J	28.88±0.50
K	3.00±0.30
M	1.30±0.30
N	Typical 2.54
P	2.40±0.40
Q	9.20±0.40
S	0.25±0.15
T	0.25±0.15
U	2.80±0.30
DIA	宽 1.50±0.10 深 0.50 MAX

(Units: mm)

外形尺寸：  
Package Dimension:

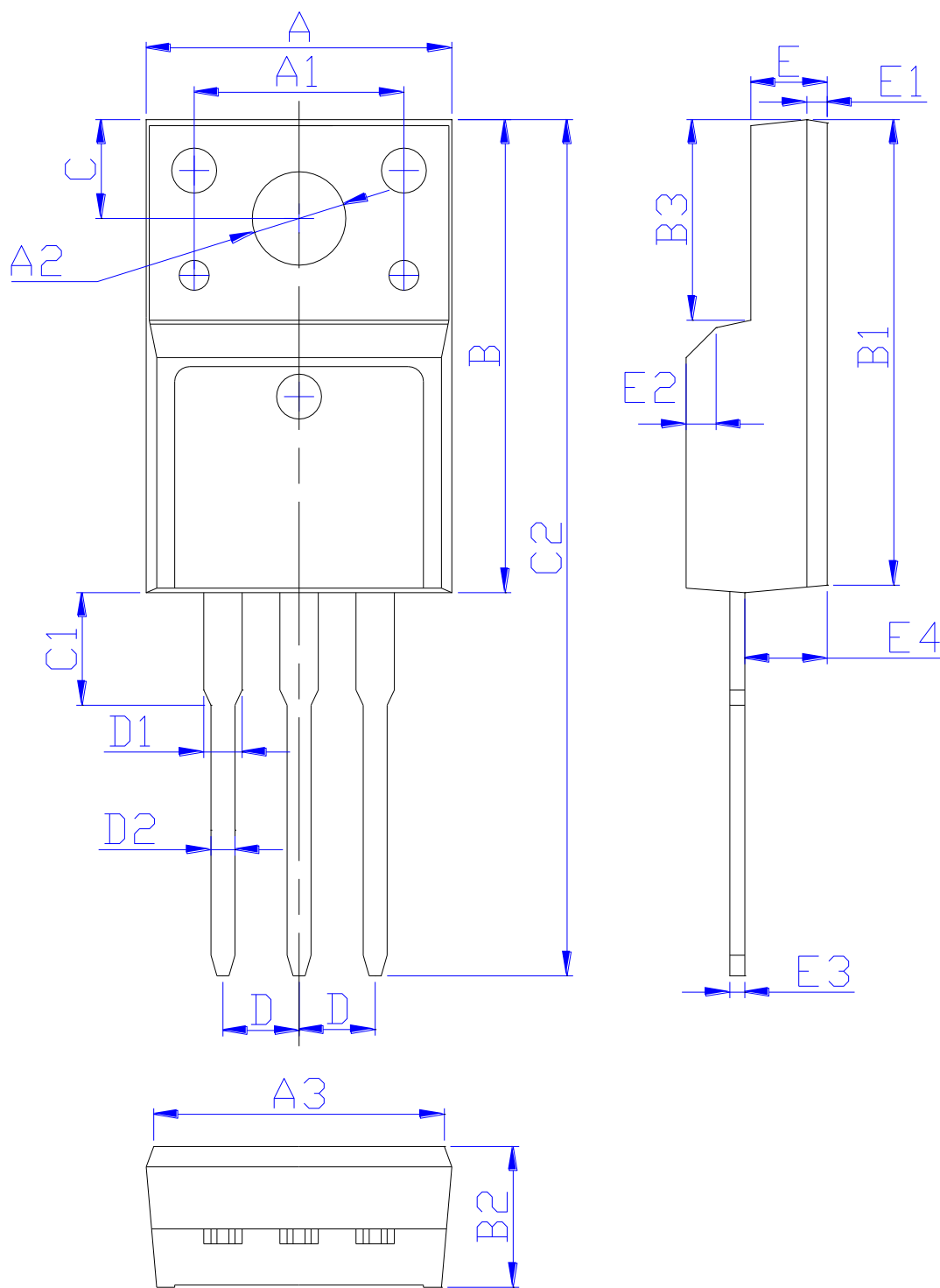
TO-252



DIM	MILLIMETERS
A	5.34±0.30
B	6.00±0.30
C	1.05±0.30
D	9.95±0.30
E	0.76±0.15
F	2.28±0.15
G	2.30±0.30
H	1.06±0.30
I	(4-10)°
J	0.51±0.15
K	0.52±0.15
L	0.80±0.30
M	60°
N	(0-10)°
O	0.05±0.05
P	6.60±0.30
Q	25°
R	(4-8.5)°
S	R0.40
T	R0.40
U	0.05±0.05
V	0.05±0.05
W	0.90±0.30
a	1.80±0.30
b	0.75±0.30
c	4.85±0.30
d	5.30±0.30
e	6.90±0.30

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

(Units: mm)