



超结-场效应晶体管 Super Junction -MOSFET FHP65R360A/FHD65R360A/FHF65R360A

主要参数 MAIN CHARACTERISTICS

ID	13A
VDSS	650 V
Rdson-typ (@Vgs=10V)	0.33Ω
Qg-typ	23nC

产品特性 FEATURES

低栅极电荷	Low gate charge
低 Crss (典型值 0.8pF)	Low Crss (typical 0.8pF)
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

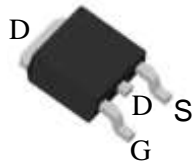
用途 APPLICATIONS

高频开关电源	High efficiency switch mode power supplies
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封装形式 Package



TO-220
FHP series

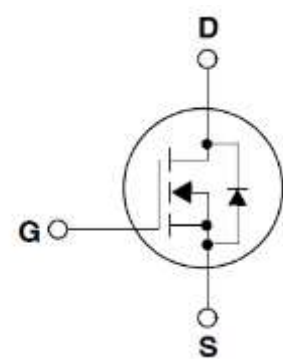


TO-252
FHD series



TO-220F
FHF series

等效电路 Equivalent Circuit



绝对最大额定值 ABSOLUTE RATINGS (Tc=25°C)

项目 Parameter	符号 Symbol	数值 Value			单位 Unit
		FHP65R360A	FHD65R360A	FHF65R360A	
最高漏极-源极直流电压 Drain-Source Voltage	V _{DS}	650			V
连续漏极电流* Drain Current -continuous *	I _D (T _C =25°C)	13			A
	I _D (T _C =100°C)	8.2			A
最大脉冲漏极电流 (注 1) Drain Current - pulse (note 1)	I _{DM}	52			A
最高栅源电压 Gate-Source Voltage	V _{GS}	±30			V
单脉冲雪崩能量 (注 2) Single Pulsed Avalanche Energy (note 2)	E _{AS}	163			mJ
雪崩电流 (注 1) Avalanche Current (note 1)	I _{AS}	3.3			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
漏源电压斜率 Drain Source voltage slope (V _{ds} =480V)	dv _{ds} /dt	50			V/ns
耗散功率 Power Dissipation	P _D (T _C =25°C)	105		31	W
	-Derate above 25°C	0.89		0.24	W/°C
最高结温及存储温度 Operating and Storage Temperature Range	T _J , T _{STG}	-55~+150			°C
引线最高焊接温度 Maximum Lead Temperature for Soldering Purposes	T _L	300			°C

*漏极电流由最高结温限制, 最大占空比 D=0.7

*Drain current limited by maximum junction temperature, Maximum duty cycle D=0.7

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	650	-	-	V
击穿电压温度特性 Breakdown Voltage Temperature Coefficient	ΔBV _{DSS} /ΔT _J	I _D =250μA, referenced to 25°C	-	0.6	-	V/°C
零栅压下漏极漏电流 Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} =650V, V _{GS} =0V, T _C =25°C	-	-	1	μA
		V _{DS} =480V, T _C =125°C	-	-	100	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	2.0	3.0	4.0	V
静态导通电阻 Static Drain-Source On-Resistance	R _{DS(ON)}	V _{GS} =10V , I _D =6.5A	-	0.33	0.36	Ω
动态特性 Dynamic Characteristics						
输入电容 Input capacitance	C _{iss}	V _{DS} =100V, V _{GS} =0V, f=1.0MHz	-	810	-	pF
输出电容 Output capacitance	C _{oss}		-	30	-	
反向传输电容 Reverse transfer capacitance	C _{rss}		-	0.8	-	
开关特性 Switching Characteristics						
栅电阻 Gate Resistance	R _g	f=1.0MHz, V _{DS} OPEN	-	6.5	-	Ω
延迟时间 Turn-On delay time	t _{d(on)}	V _{DS} =400V, I _D =6.5A, R _G =10Ω V _{GS} =10V (note 4, 5)	-	11.5	-	ns
上升时间 Turn-On rise time	t _r		-	23.5	-	ns
延迟时间 Turn-Off delay time	t _{d(off)}		-	43	-	ns
下降时间 Turn-Off Fall time	t _f		-	21.5	-	ns
栅极电荷总量 Total Gate Charge	Q _g	V _{DS} =400V , I _D =13A , V _{GS} =10V (note 4, 5)	-	23	-	nC
栅-源电荷 Gate-Source charge	Q _{gs}		-	6	-	nC
栅-漏电荷 Gate-Drain charge	Q _{gd}		-	9	-	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	-	-	13	A
正向最大脉冲电流 Maximum Pulsed Drain-Source Diode Forward Current		I _{SM}	-	-	52	A
正向压降 Drain-Source Diode Forward Voltage	V _{SD}	V _{GS} =0V, I _S =13A	-	0.9	1.4	V
反向恢复时间 Reverse recovery time	t _{rr}	V _{GS} =0V, I _S =6.5A , V _{DS} =400V, dI _F /dt=100A/μs (note 4)	-	250	-	ns
反向恢复电荷 Reverse recovery charge	Q _{rr}		-	1.8	-	μC
反向峰值恢复电流 Peak reverse recovery current	I _{rrm}		-	14.9	-	A

热特性 THERMAL CHARACTERISTIC

项目 Parameter	符号 Symbol	FHP65R360A	FHD65R360A	FHF65R360A	单位 Unit
结到管壳的热阻 Thermal Resistance, Junction to Case	Rth(j-c)	1.2	1.2	4.0	°C/W
结到环境的热阻 Thermal Resistance, Junction to Ambient	Rth(j-A)	62	62	80	°C/W

注释:

- 1: 脉冲宽度由最高结温限制
- 2: $I_{AS}=3.3A$, $V_{DD}=50V$, $R_G=25\ \Omega$, 起始结温 $T_J=25^\circ C$
- 3: $I_{SD}\leq 13A$, $di/dt\leq 200A/\mu s$, $V_{DD}\leq B_{VDSS}$, 起始结温 $T_J=25^\circ C$
- 4: 脉冲测试: 脉冲宽度 $\leq 300\mu s$, 占空比 $\leq 2\%$
- 5: 基本与工作温度无关

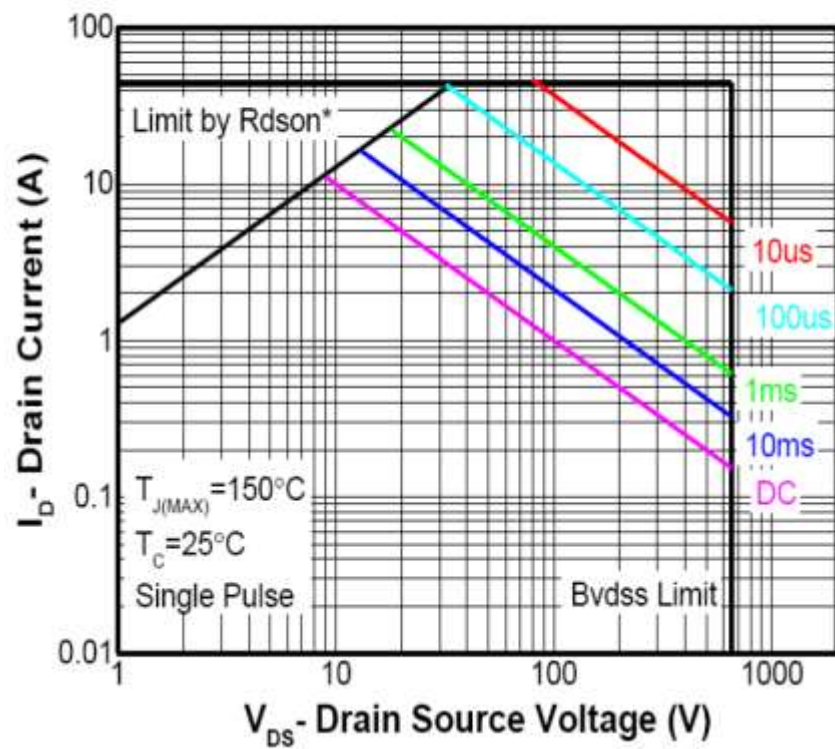
Notes:

- 1: Pulse width limited by maximum junction temperature
- 2: $I_{AS}=3.3A$, $V_{DD}=50V$, $R_G=25\ \Omega$, Starting $T_J=25^\circ C$
- 3: $I_{SD}\leq 13A$, $di/dt\leq 200A/\mu s$, $V_{DD}\leq B_{VDSS}$, Starting $T_J=25^\circ C$
- 4: Pulse Test: Pulse Width $\leq 300\mu s$, Duty Cycle $\leq 2\%$
- 5: Essentially independent of operating temperatur

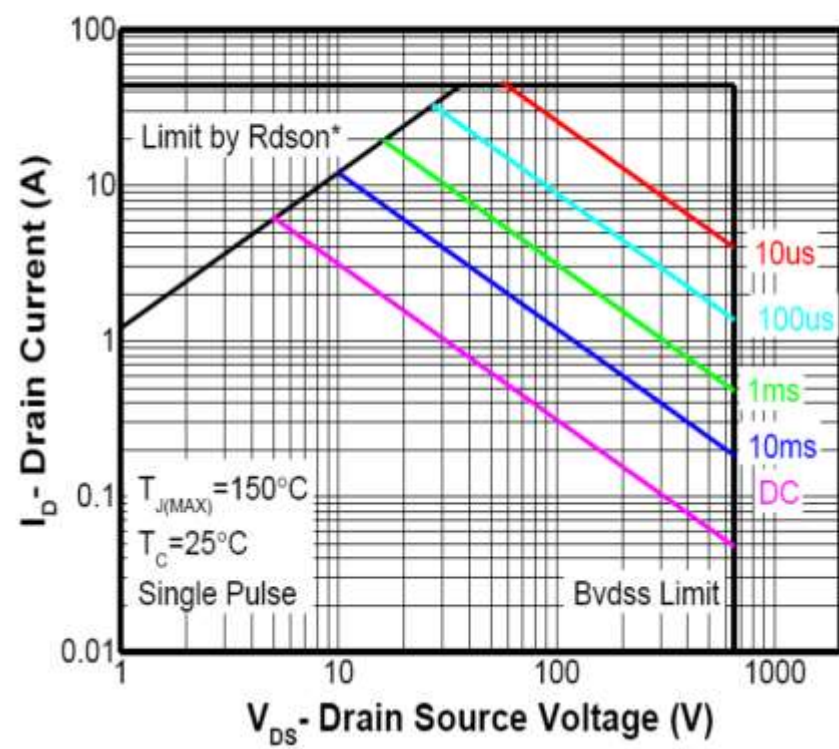
典型特性曲线

ELECTRICAL CHARACTERISTIC CURVE

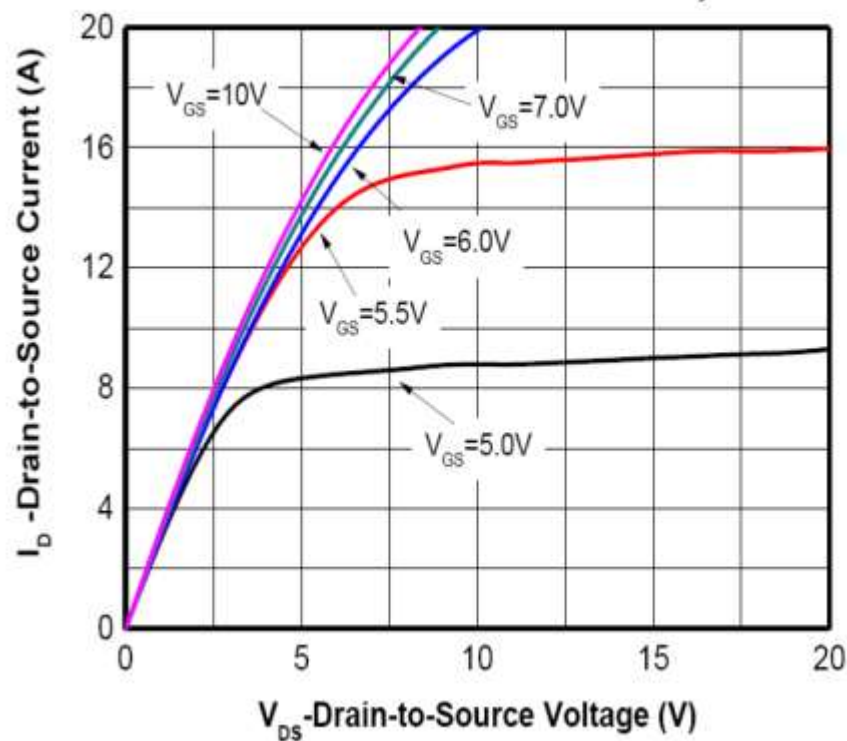
Safe operating area TC=25 °C
TO-220, TO-252



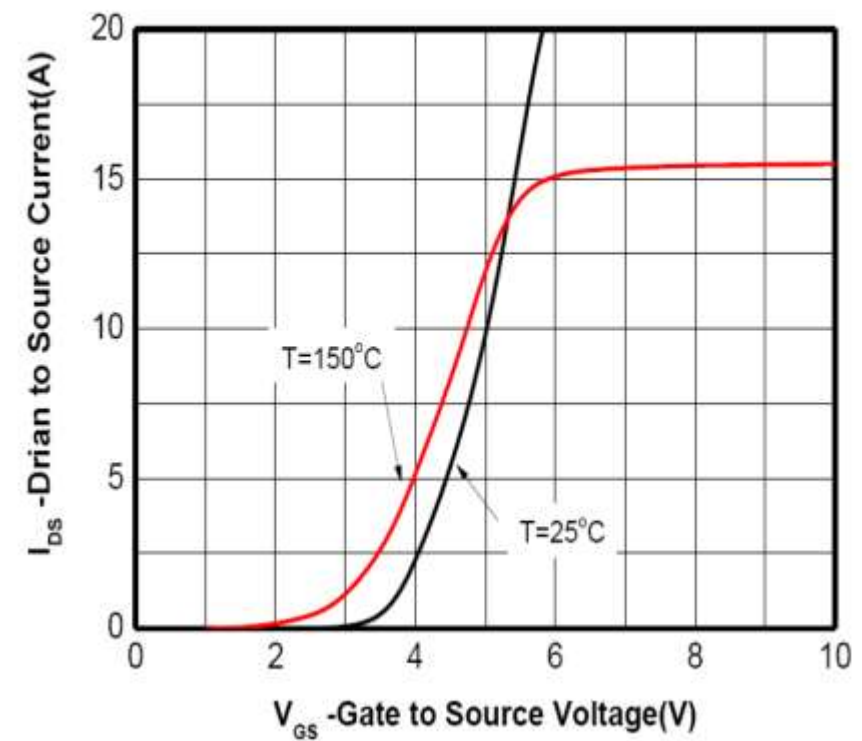
Safe operating area TC=25 °C
TO-220F



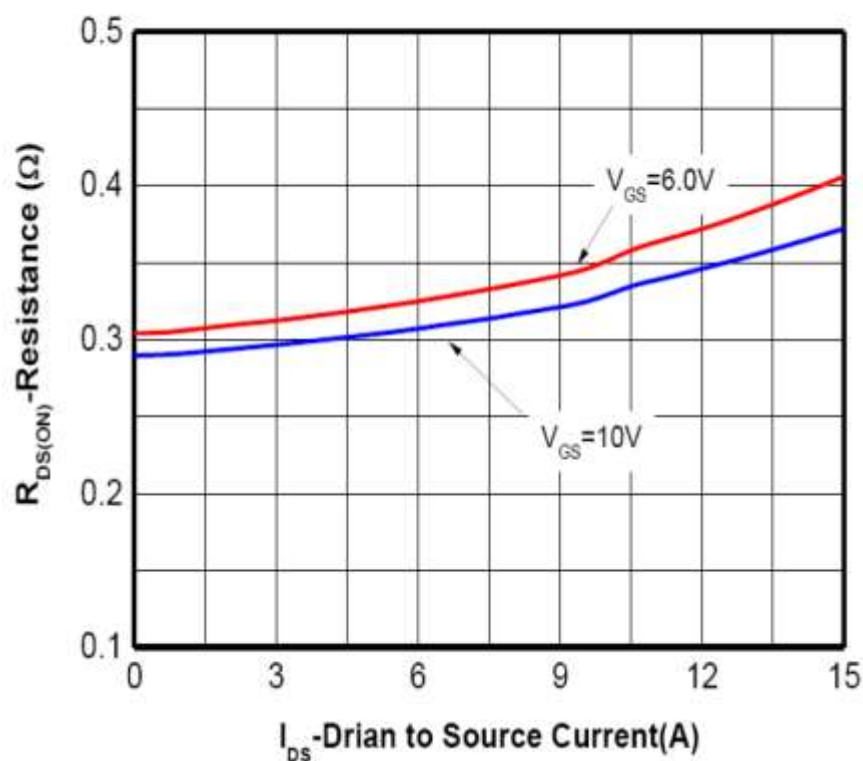
Typ. output characteristics Tj=25 °C



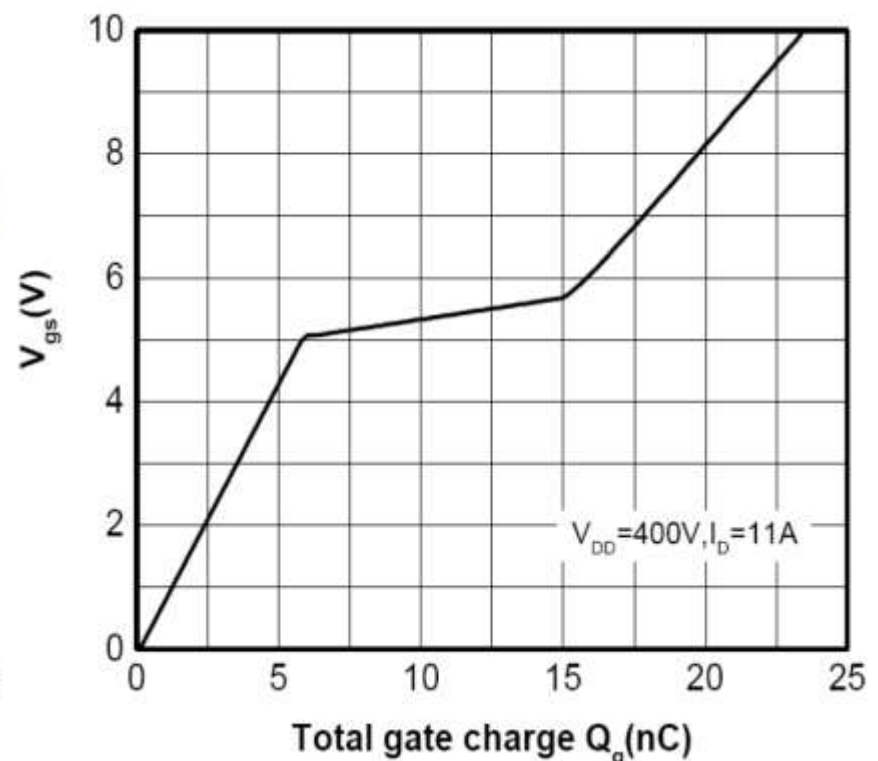
Typ. transfer characteristics



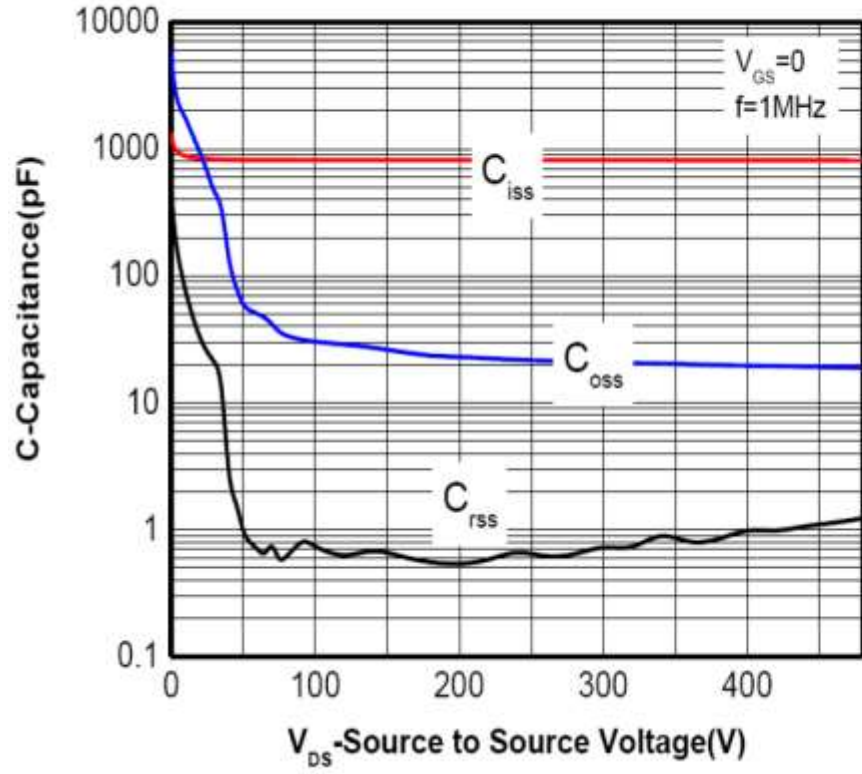
Typ. drain-source on-state resistance



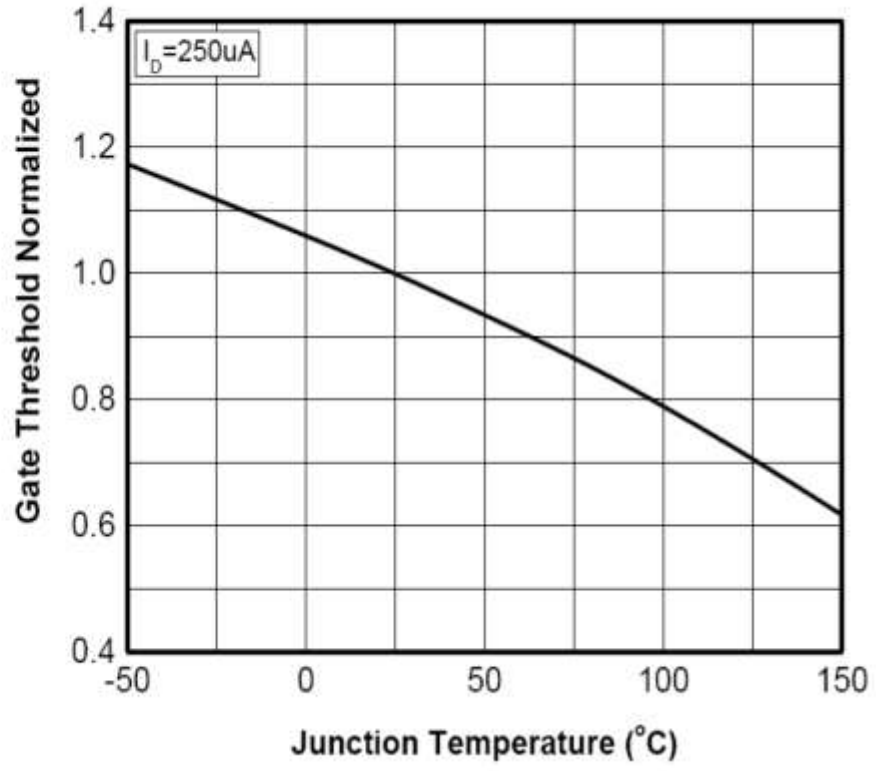
Typ. gate charge characteristics



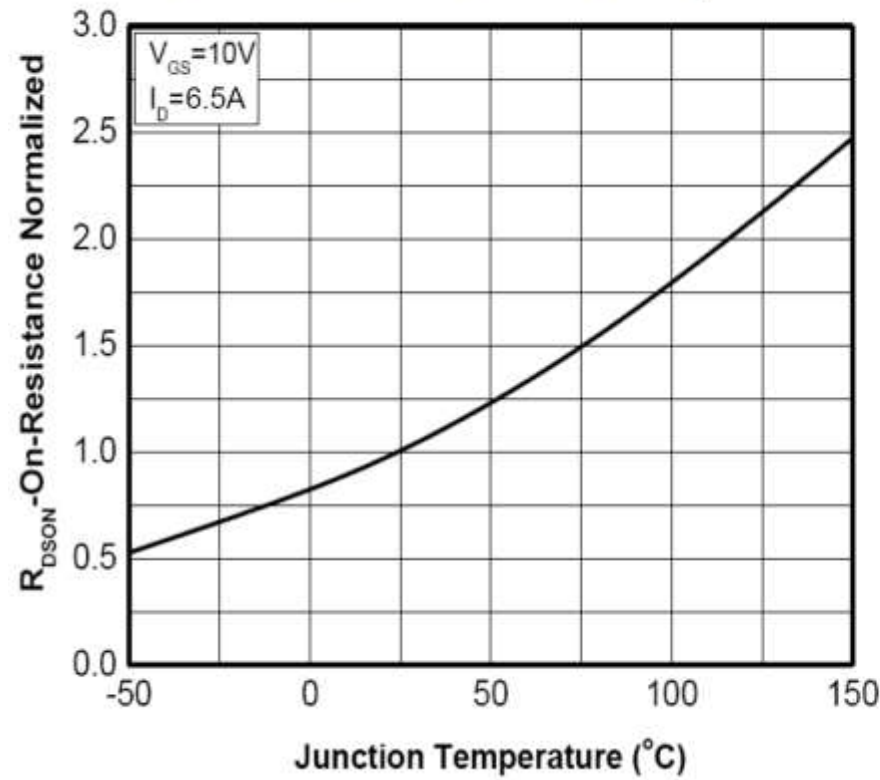
Typ. capacitances



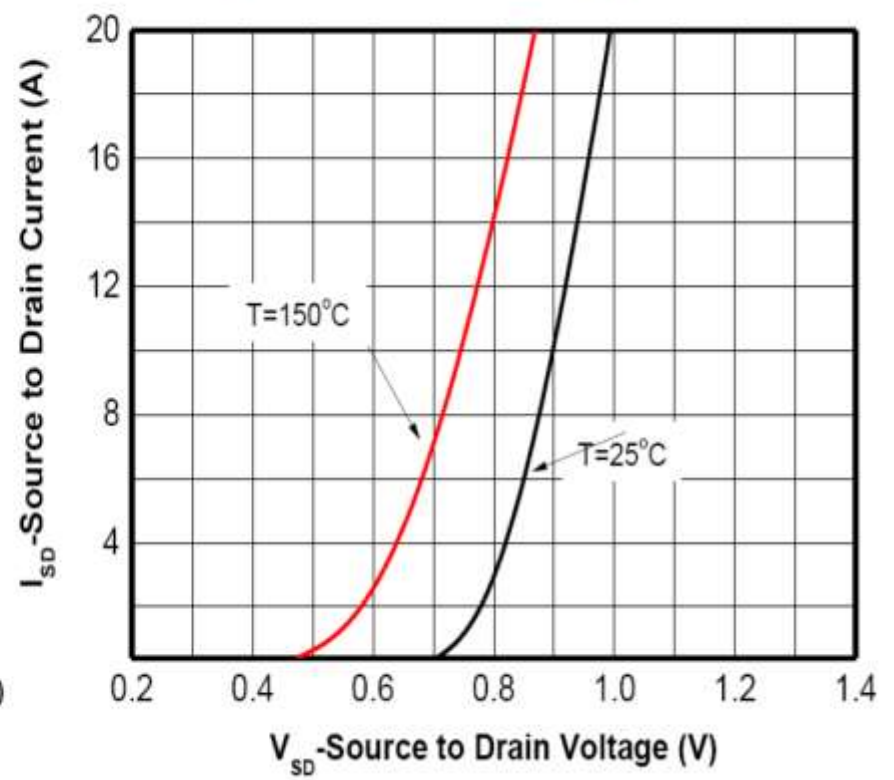
Normalized $V_{GS(th)}$ characteristics



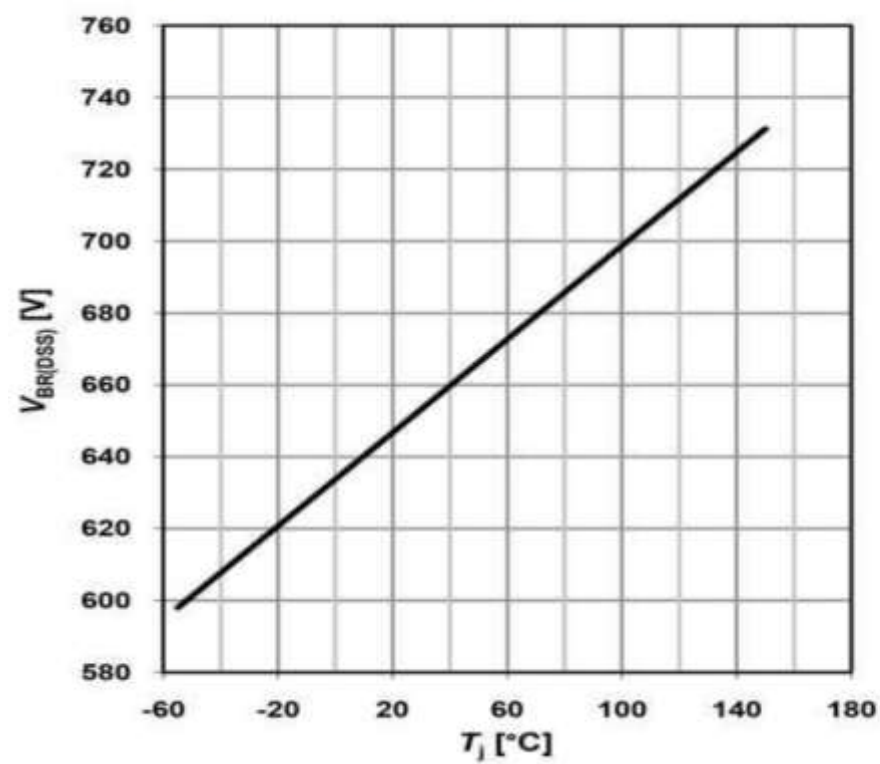
Normalized on-resistance vs temperature



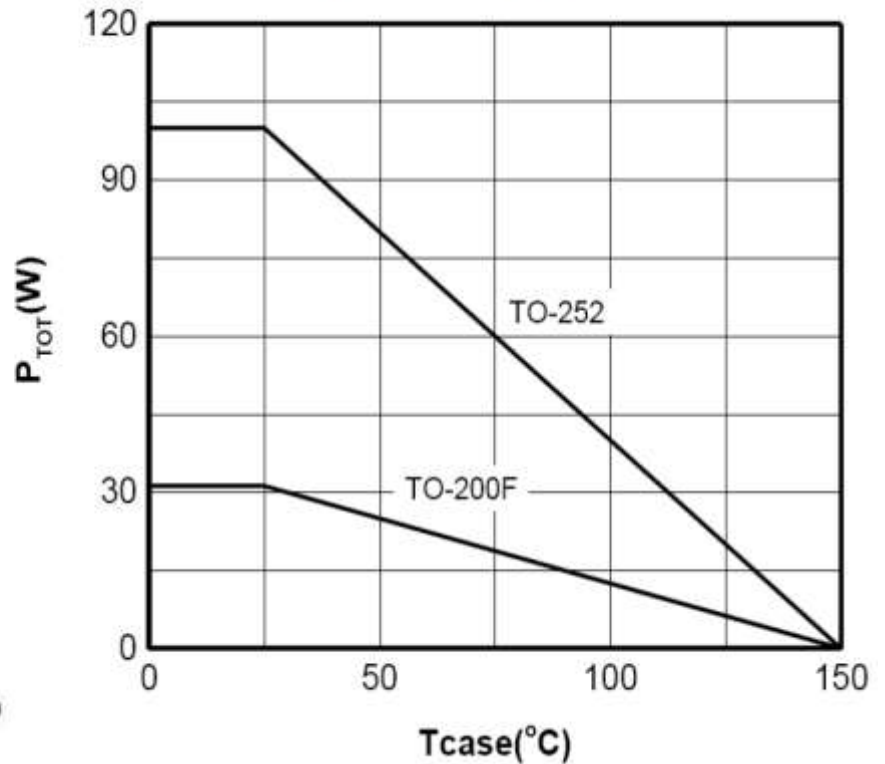
Forward characteristics of reverse diode



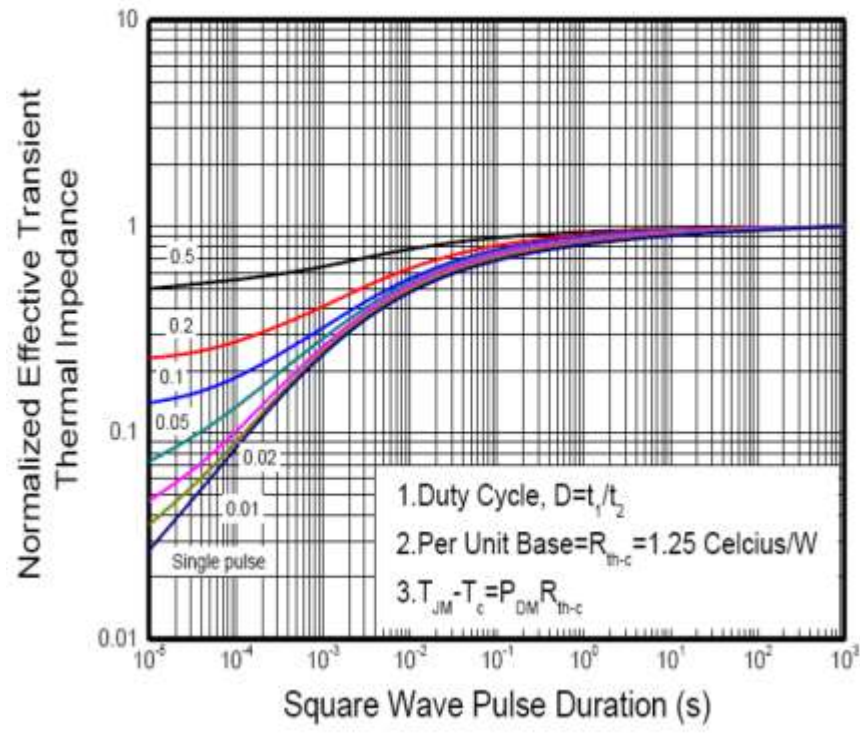
Drain-source breakdown voltage



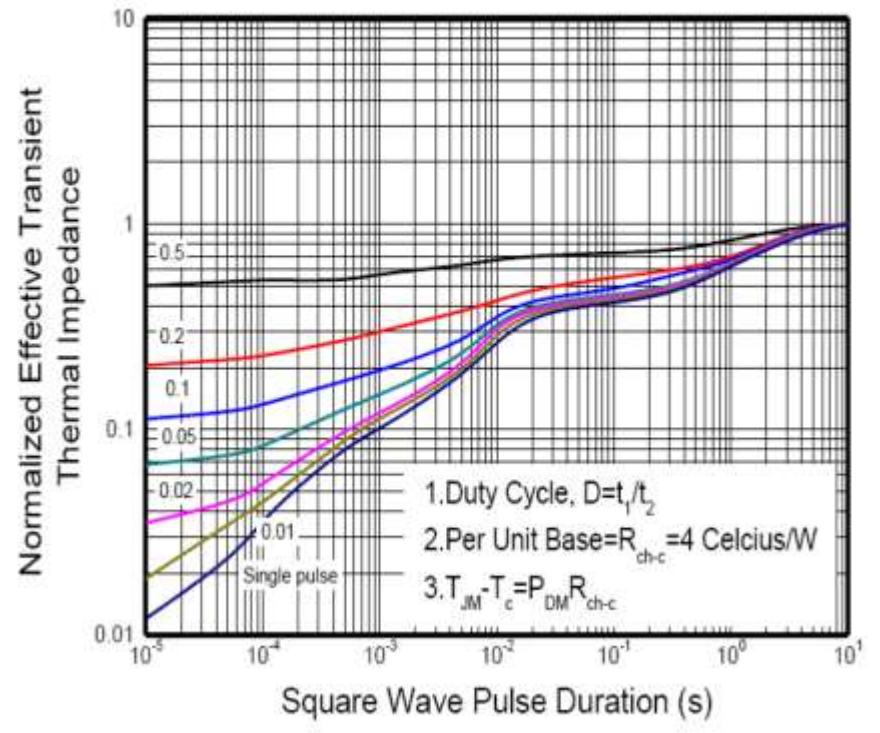
Power dissipation



Max. transient thermal impedance
TO-220, TO-252

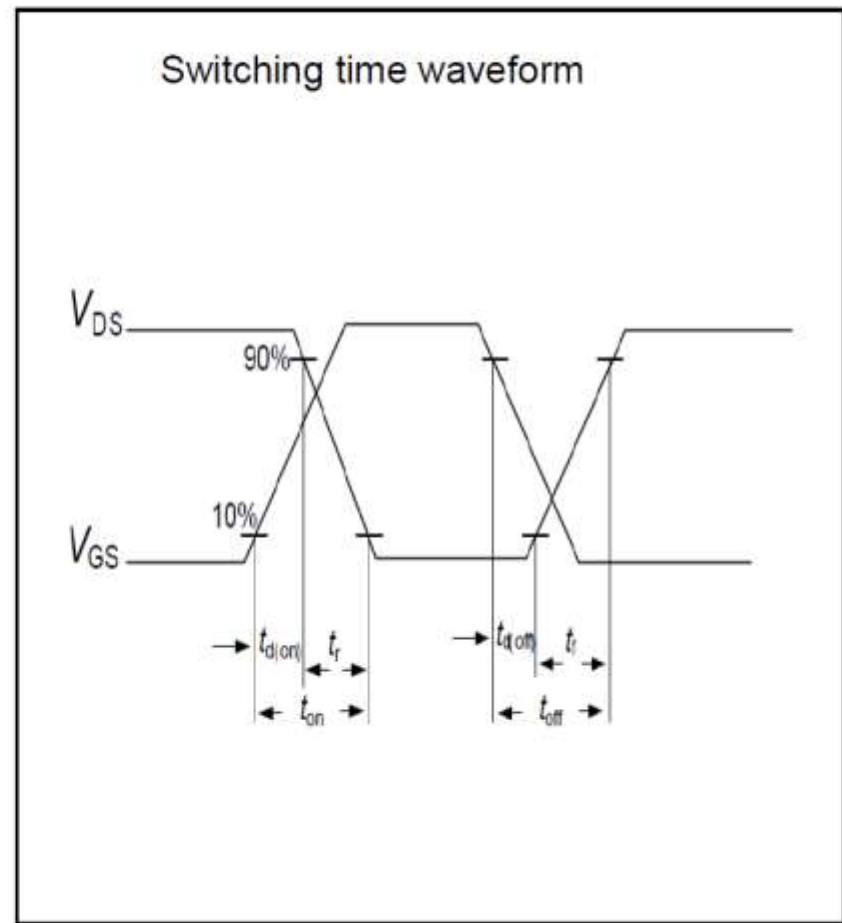
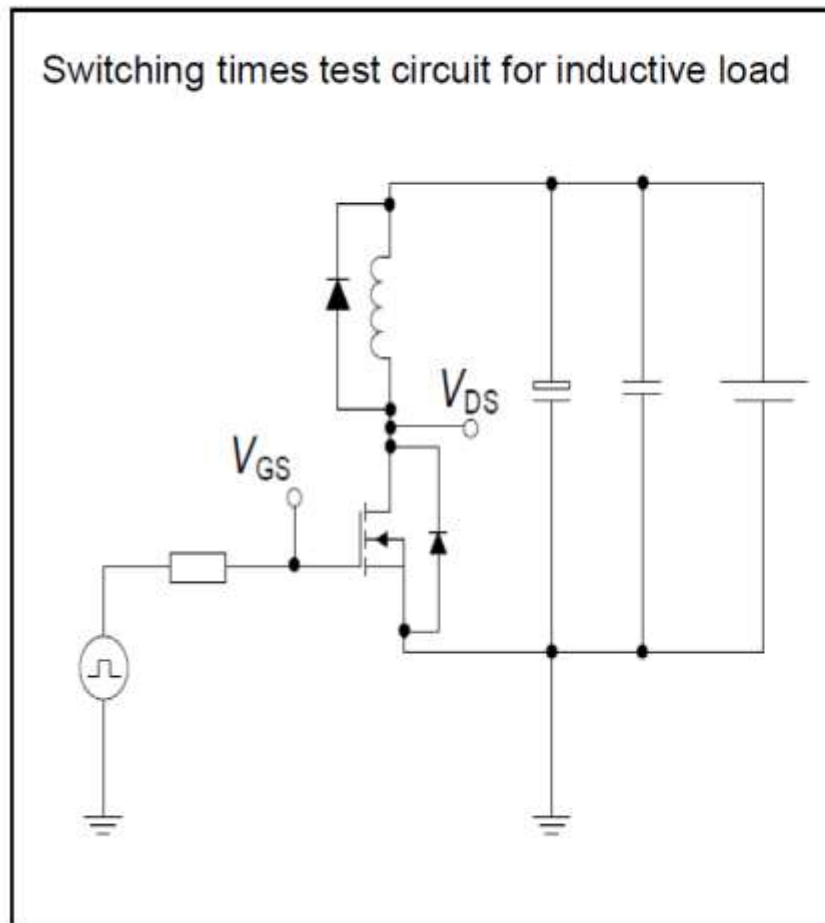


Max. transient thermal impedance
TO-220F

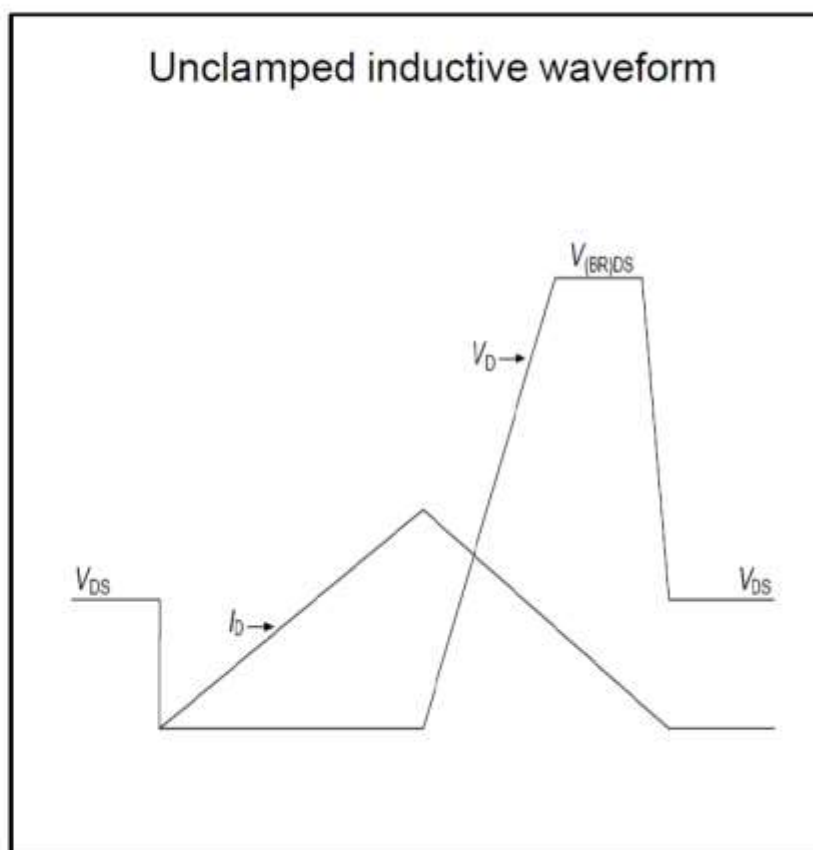
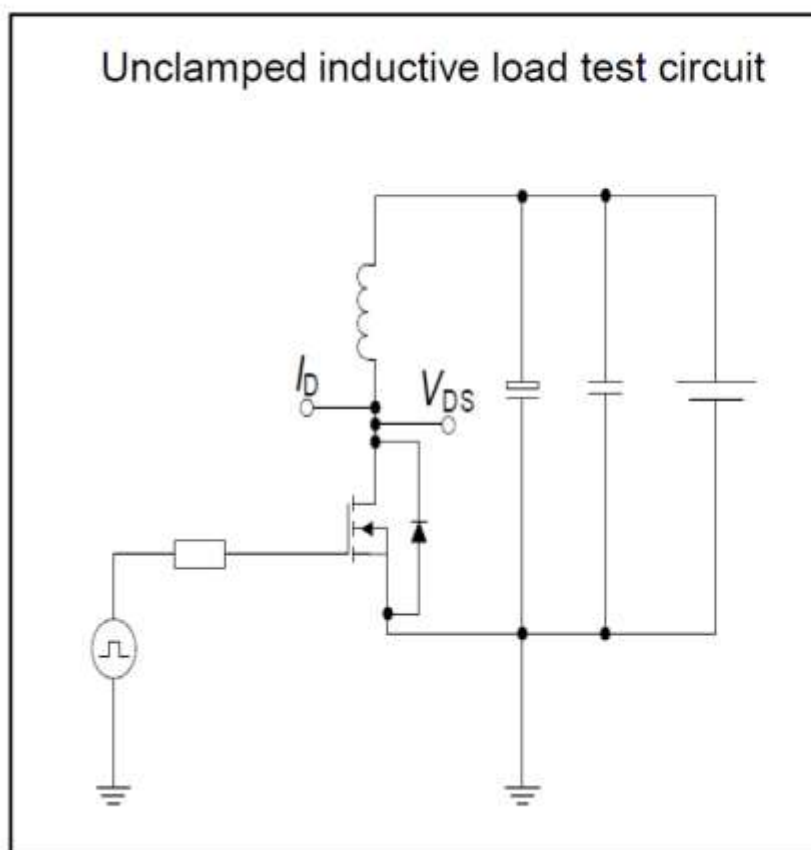


测试电路 Test circuits

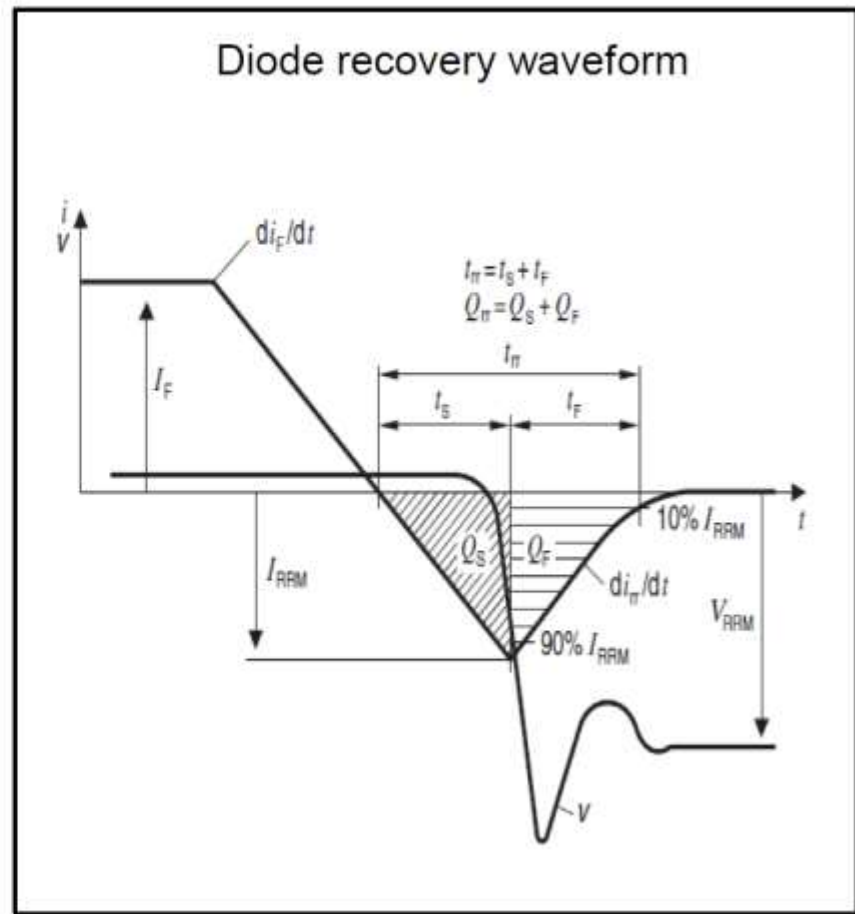
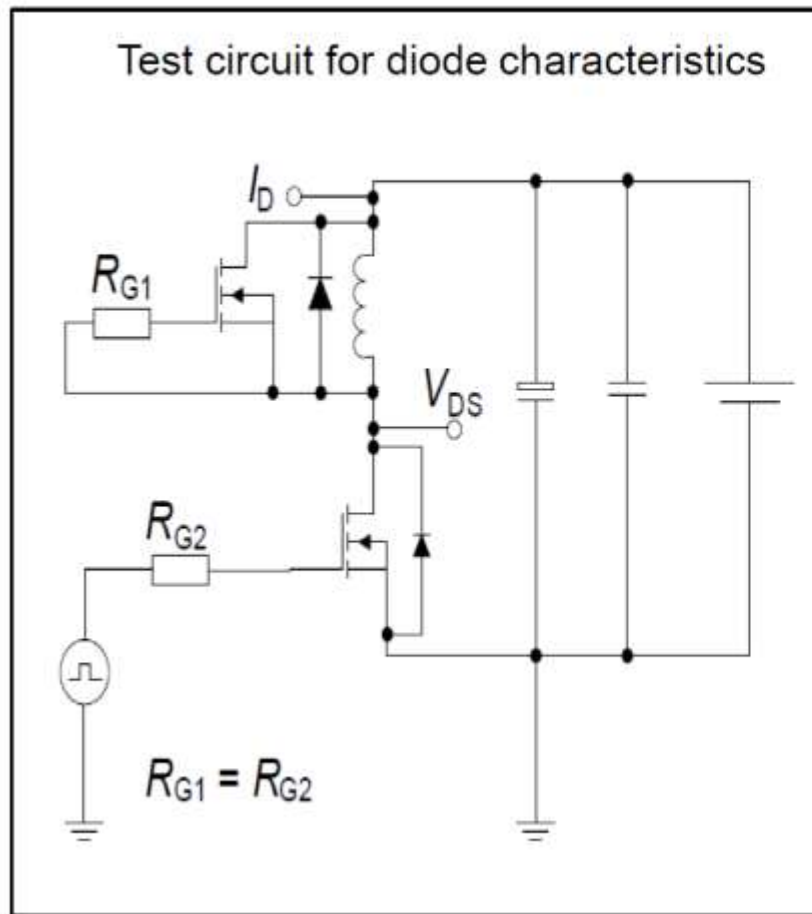
Switching times test circuit and waveform for inductive load



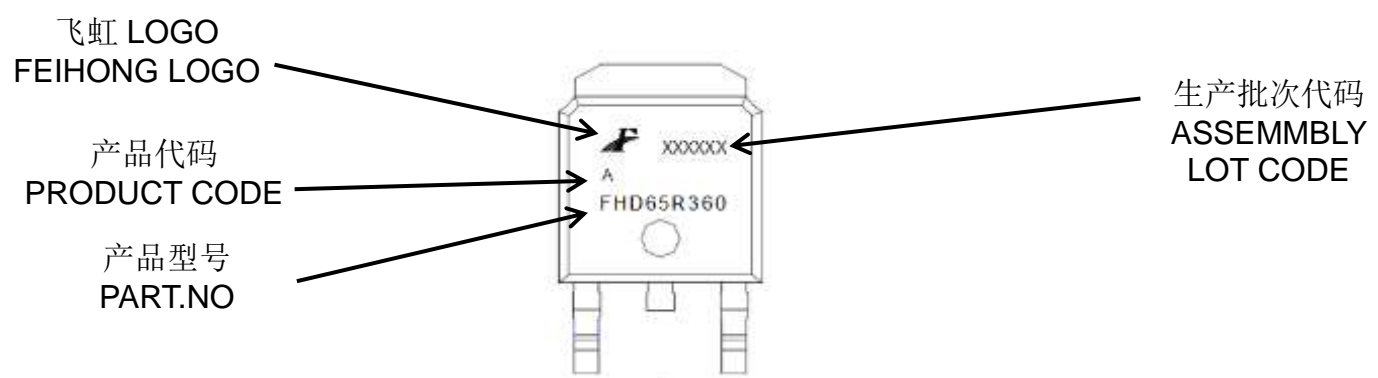
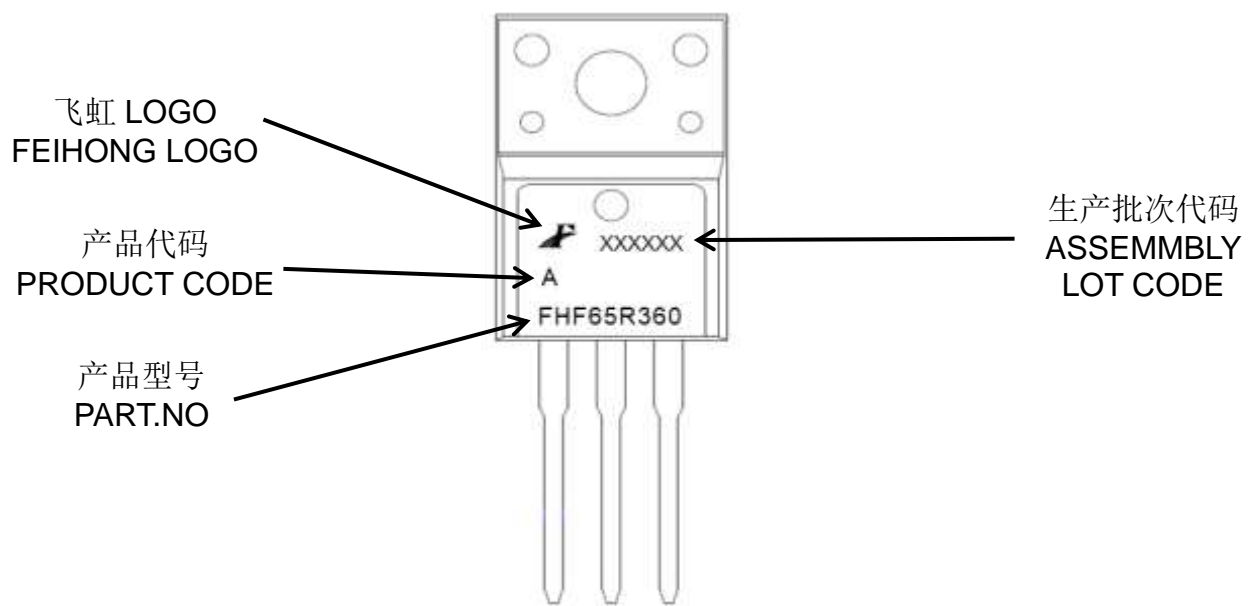
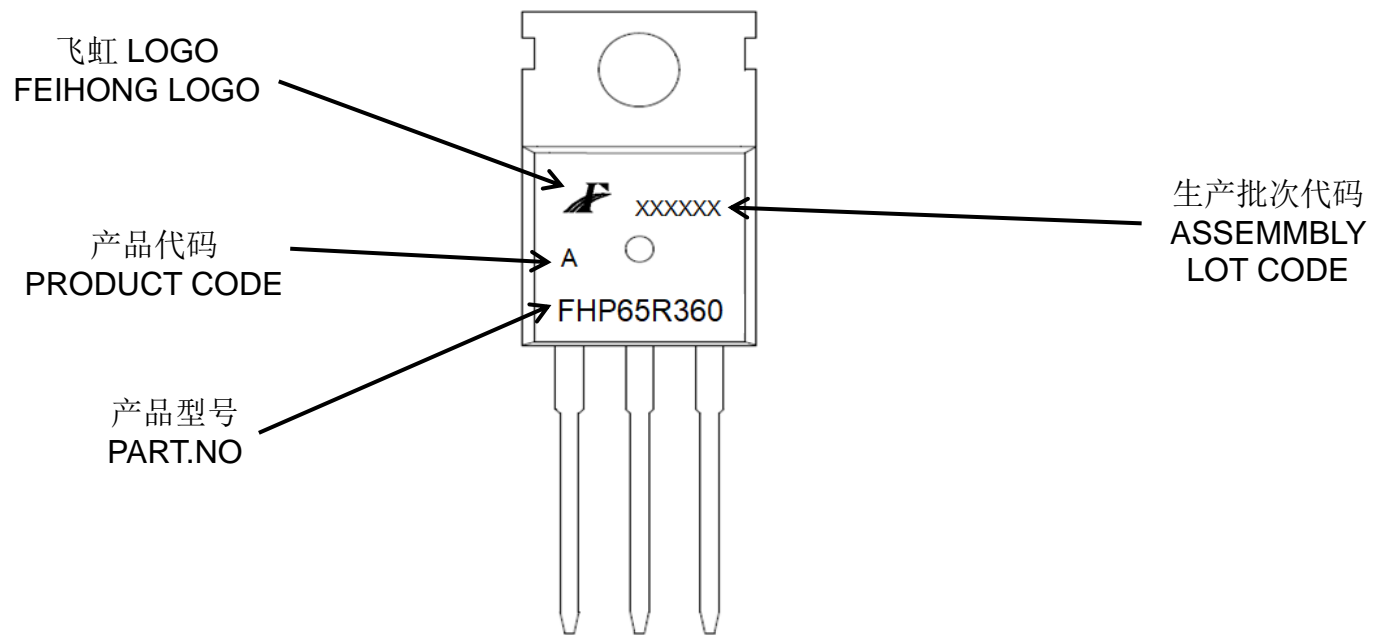
Unclamped inductive load test circuit and waveform



Test circuit and waveform for diode characteristics

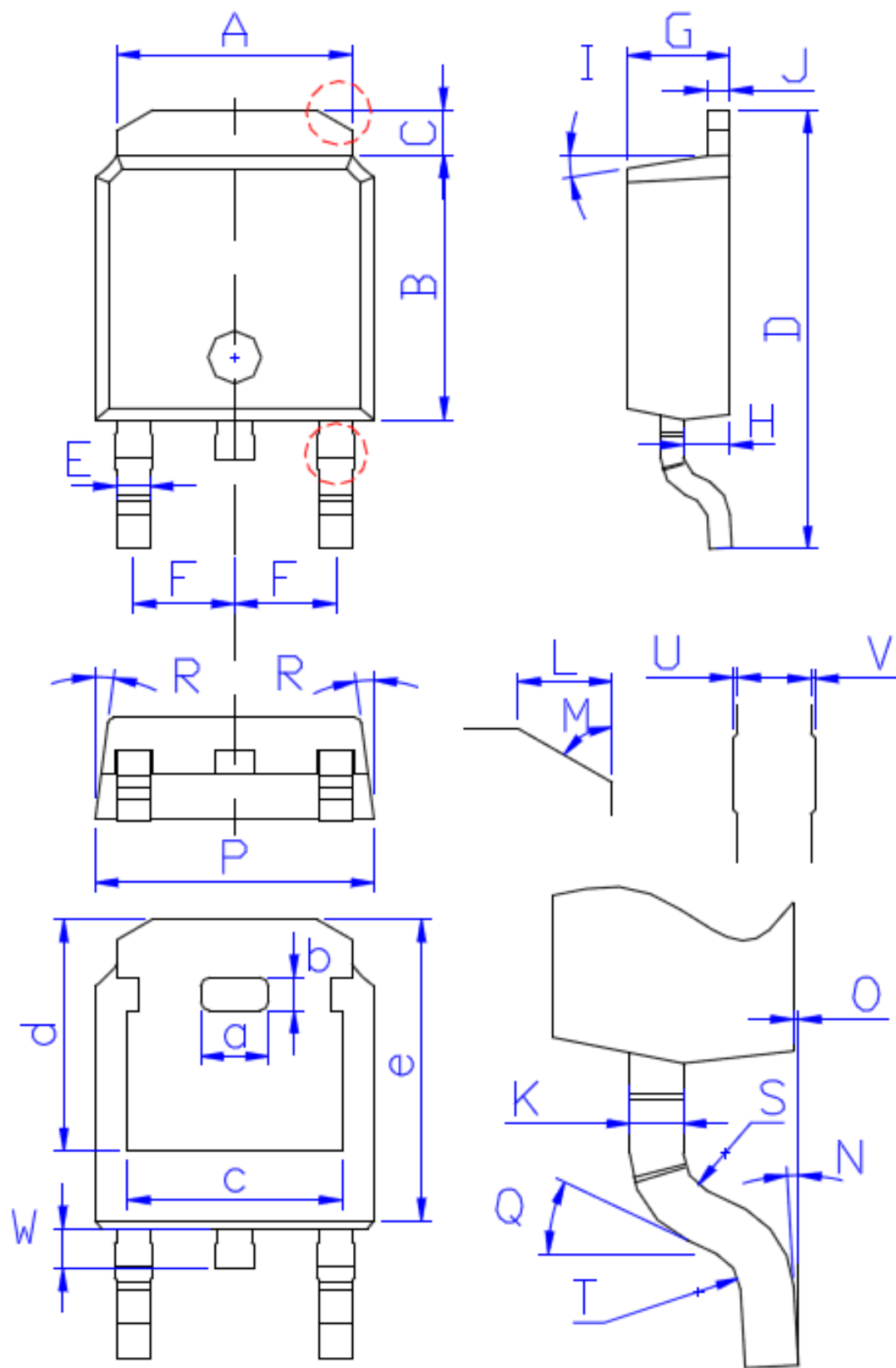


印记 Marking:



外形尺寸: Package Dimension:

TO-252

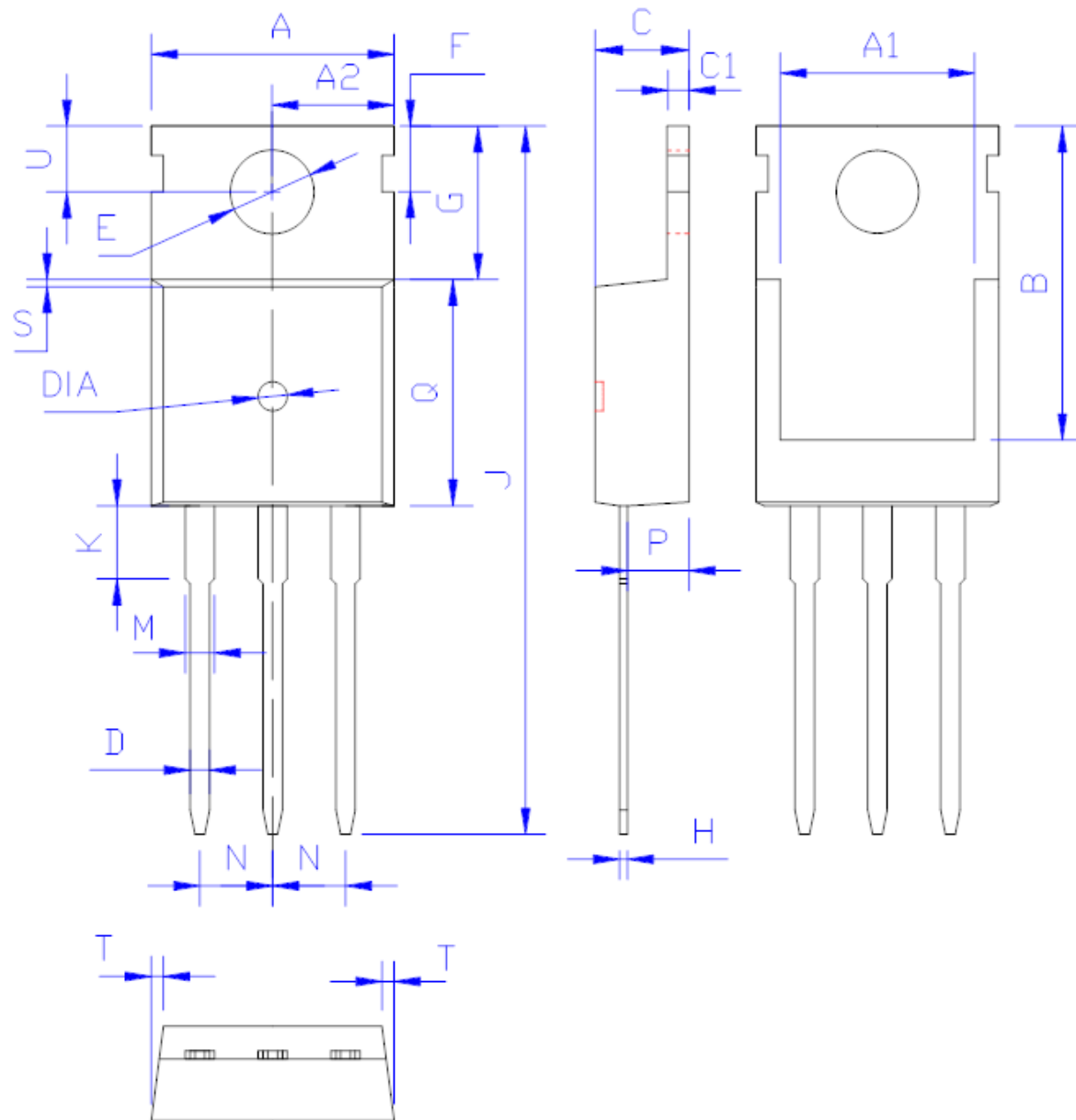


DIM	MILLIMETERS
A	5.34 ± 0.30
B	6.00 ± 0.30
C	1.05 ± 0.30
D	9.95 ± 0.30
E	0.76 ± 0.15
F	2.28 ± 0.15
G	2.30 ± 0.30
H	1.06 ± 0.30
I	$(4-10)^\circ$
J	0.51 ± 0.15
K	0.52 ± 0.15
L	0.80 ± 0.30
M	60°
N	$(0-10)^\circ$
O	0.05 ± 0.05
P	6.60 ± 0.30
Q	25°
R	$(4-8.5)^\circ$
S	R0.40
T	R0.40
U	0.05 ± 0.05
V	0.05 ± 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

(Units: mm)

外形尺寸： Package Dimension:

TO-220



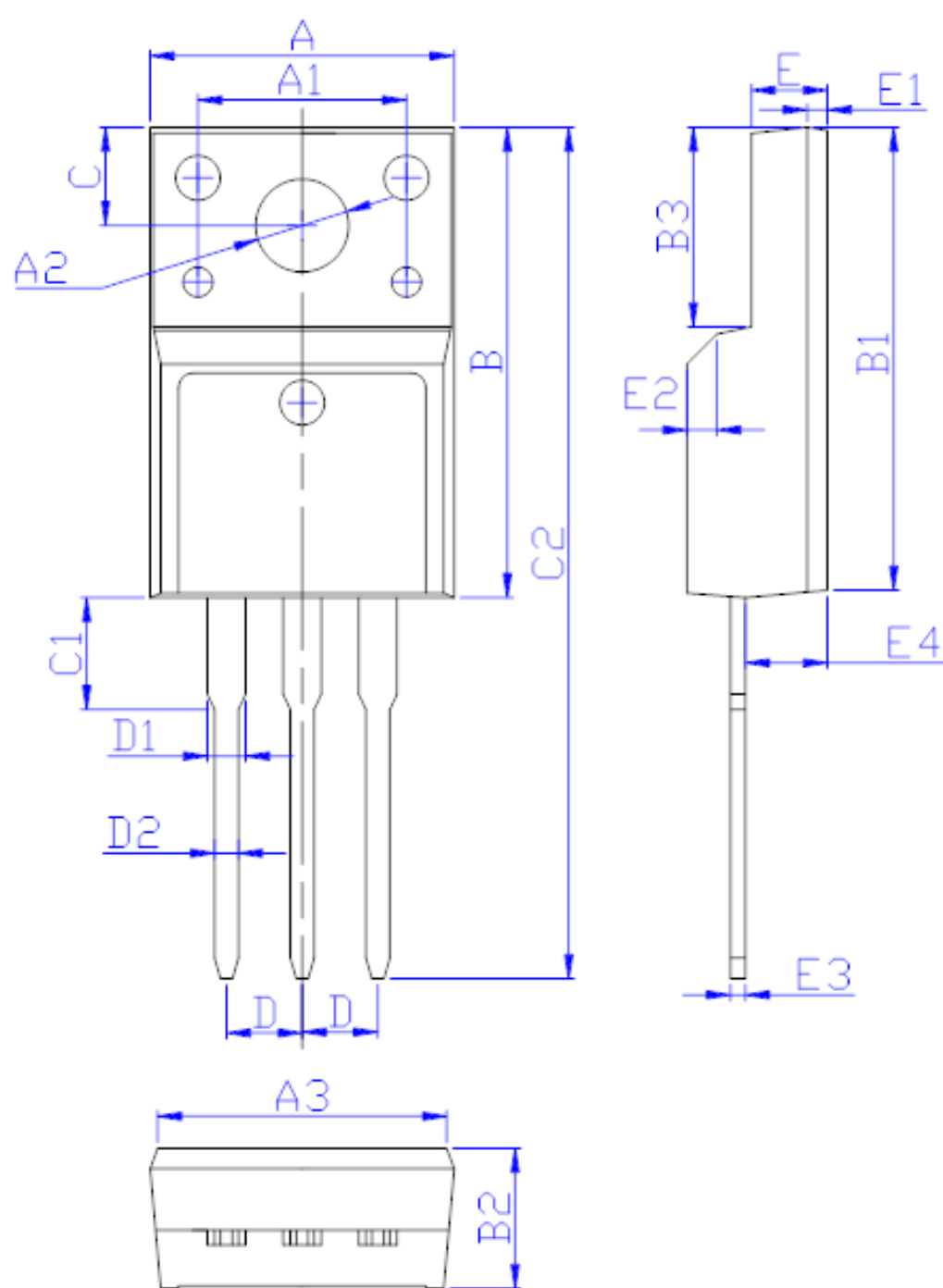
DIM	MILLIMETERS
A	10.00±0.30
A1	8.00±0.30
A2	5.00±0.30
B	13.20±0.40
C	4.50±0.20
C1	1.30±0.20
D	0.80±0.20
E	3.60±0.20
F	3.00±0.30
G	6.60±0.40
H	0.50±0.20
J	28.88±0.50
K	3.00±0.30
M	1.30±0.30
N	Typical 2.54
P	2.40±0.40
Q	9.20±0.40
S	0.25±0.15
T	0.25±0.15
U	2.80±0.30
DIA	宽 1.50±0.10 深 0.50 MAX

(Units: mm)

外形尺寸:

Package Dimension:

TO-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)