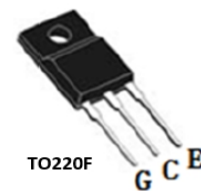
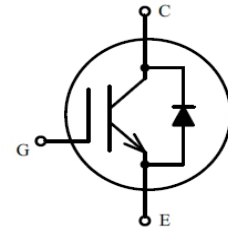


IGBT in advanced TrenchFS Technology with soft and fast recovery anti-parallel diode
具有先进 TrenchFS 技术的 IGBT 且反并联软快恢复二极管

Features:

特性

- 650V TrenchFS technology
650V 沟槽栅场终止技术
- Low conduction and switching losses
低导通和开关损耗
- Positive temperature coefficient
饱和电压正温度系数
- Short Circuit withstand time-5 μ s
具备5 μ s短路承受能力



Applications:

应用

- Industrial sewing machine
工业缝纫机

Type 型号	V _{CE} [V] 集电极-发射极电压	I _C [A] 集电极电流	V _{CEsat} [V] 饱和电压	T _{jmax} [°C] 最高结温	Marking 标记	Package 封装
BGF15T65SD	650	15	1.8	175	15T65SD	TO220F-3



Maximum Rated Values

最大额定参数

Parameter 参数	Symbol 符号	Value 值	Unit 单位
Collector-emitter voltage, $T_j \geq 25^\circ\text{C}$ 集电极-发射极电压, $T_j \geq 25^\circ\text{C}$	V_{CE}	650	V
Collector current, $T_c = 25^\circ\text{C}$ 集电极电流, $T_c = 25^\circ\text{C}$	I_C	30	A
Collector current, $T_c = 100^\circ\text{C}$ 集电极电流, $T_c = 100^\circ\text{C}$	I_C	15	
Pulsed collector current, t_p limited by $T_{j\max}$ 集电极脉冲电流, 脉宽时间受 $T_{j\max}$ 限制	$I_{C\text{puls}}$	60	
Diode forward current, $T_c = 25^\circ\text{C}$ 二极管正向电流, $T_c = 25^\circ\text{C}$	I_F	30	
Diode forward current, $T_c = 100^\circ\text{C}$ 二极管正向电流, $T_c = 100^\circ\text{C}$	I_F	15	
Diode pulsed current 二极管脉冲电流	$I_{F\text{puls}}$	60	
Gate-emitter voltage 栅极-发射极电压	V_{GE}	± 20	V
Short Circuit withstand time $V_{GE} = 15\text{V}, V_{CC} \leq 400\text{V}, T_j \leq 150^\circ\text{C}$ 短路耐受时间	t_{sc}	5	us
Total power dissipation, $T_c = 25^\circ\text{C}$ 总耗散功率, $T_c = 25^\circ\text{C}$	P_{tot}	37.5	W
Operating junction temperature 最高结温	$T_{j\max}$	175	°C
Operating junction temperature 工作结温	$T_{j\text{op}}$	-40...+150	
Storage temperature 储存温度	T_{stg}	-55...+150	
Soldering temperature, 1.6mm from case for 10s 焊接温度	T_{st}	260	
Mounting Torque M3 锁装力矩	M_d	0.6	Nm



Thermal Resistance

热阻

Parameter 参数	Symbol 符号	Value 值	Unit 单位
IGBT Thermal resistance junction to case IGBT 结-管壳热阻	$R_{th(j-c)}$	4.0	$^{\circ}\text{C}/\text{W}$
Diode Thermal resistance junction to case 二极管结-管壳热阻	$R_{th(j-c)}$	7.9	$^{\circ}\text{C}/\text{W}$
Thermal resistance junction to ambient 结-环境热阻	$R_{th(j-a)}$	62.5	$^{\circ}\text{C}/\text{W}$

Electrical Characteristic at $T_j = 25^{\circ}\text{C}$ (unless otherwise specified)

$T_j=25^{\circ}\text{C}$ 时电学特性（除非特别声明）

Parameter 参数	Symbol 符号	Conditions 条件	Value 值			Unit 单位
			Min. 最小值	Typ. 典型值	Max. 最大值	

Static Characteristic

静态特性

Collector-emitter breakdown voltage 集电极-发射极击穿电压	$V_{(BR)CES}$	$V_{GE}=0\text{V},$ $I_C=100\mu\text{A}$	650	-	-	V	
Collector-emitter saturation voltage 集电极-发射极饱和电压	V_{cesat}	$V_{GE}=15\text{V},$ $I_C=15\text{A}$	$T_j=25^{\circ}\text{C}$	-	1.8		2.1
			$T_j=150^{\circ}\text{C}$	-	2.3		-
Diode forward voltage 二极管正向电压	VF	$V_{GE}=0\text{V},$ $I_F=15\text{A}$	$T_j=25^{\circ}\text{C}$	-	1.9		2.4
			$T_j=150^{\circ}\text{C}$	-	1.6	-	
Gate-emitter threshold voltage 栅极-发射极阈值电压	$V_{GE(th)}$	$I_C=300\mu\text{A},$ $V_{CE}=V_{GE}$	4.5	5.5	6.5		
Collector-emitter cut-off current 集电极-发射极截止电流	I_{CES}	$V_{CE}=650\text{V},$ $V_{GE}=0\text{V}$	-	-	100	μA	
Gate-emitter leakage current 栅极-发射极漏电流	I_{GES}	$V_{CE}=0\text{V},$ $V_{GE}=\pm 20\text{V}$	-200	-	200	nA	

Dynamic Characteristic

动态特性

Input capacitance 输入电容	C_{ies}	$V_{CE}=25\text{V},$ $V_{GE}=0\text{V},$ $f=1\text{MHz}$	-	812	-	pF
Output capacitance 输出电容	C_{oes}		-	63	-	
Reverse transfer capacitance 反向传输电容	C_{res}		-	8	-	



Gate charge 门极电量	Q_G	$V_{CC}=400V, I_C=30A,$ $V_{GE}=15V$	-	21.1	-	nC
Short circuit current 短路电流	$I_{C(sc)}$	$V_{CC}=400V, V_{GE}=15V,$ $tpsc \leq 5\mu s, T_j=150^\circ C$	-	50	-	A

Switching Characteristic at $T_j=25^\circ C$ (Inductive Load)

$T_j=25^\circ C$ 时开关特性 (感性负载)

Parameter 参数	Symbol 符号	Conditions 条件	Value 值			Unit 单位
			Min. 最小 值	Typ. 典型 值	Max. 最大 值	
IGBT Characteristic IGBT 特性						
Turn-on delay time 开通延迟时间	$t_{d(on)}$	$T_j=25^\circ C,$ $V_{CC}=400V,$ $I_C=15A,$ $V_{GE}=-7.5/15V,$ $R_G=10\Omega,$ Energy losses include "tail" and diode reverse recovery.	-	125	-	ns
Rise time 上升时间	t_r		-	59	-	
Turn-off delay time 关断延迟时间	$t_{d(off)}$		-	60	-	
Fall time 下降时间	t_f		-	79	-	
Turn-on energy 开通损耗	E_{on}		-	0.33	-	mJ
Turn-off energy 关断损耗	E_{off}		-	0.21	-	
Total switching energy 总开关损耗	E_{ts}		-	0.54	-	

Anti-Parallel Diode Characteristic

反并联二极管特性

Reverse recovery time 反向恢复时间	t_{rr}	$T_j=25^\circ C,$ $V_R=400V,$ $I_F=15A,$ $diF/dt=100A/\mu s$	-	186	-	ns
Recovered charge 恢复电荷	Q_r		-	320	-	nC
Peak reverse recovery current 反向恢复峰值电流	I_{RM}		-	3.3	-	A



Switching Characteristic at $T_j=150^\circ\text{C}$ (Inductive Load)

$T_j=150^\circ\text{C}$ 时开关特性 (感性负载)

Parameter 参数	Symbol 符号	Conditions 条件	Value 值			Unit 单位
			Min. 最小值	Typ. 典型值	Max. 最大值	
IGBT Characteristic						
IGBT 特性						
Turn-on delay time 开通延迟时间	$t_{d(on)}$	$T_j=150^\circ\text{C}$, $V_{CC}=400\text{V}$, $I_C=15\text{A}$, $V_{GE}=-7.5/15\text{V}$, $R_G=10\Omega$, Energy losses include "tail" and diode reverse recovery.	-	32	-	ns
Rise time 上升时间	t_r		-	91	-	
Turn-off delay time 关断延迟时间	$t_{d(off)}$		-	74	-	
Fall time 下降时间	t_f		-	135	-	
Turn-on energy 开通损耗	E_{on}		-	0.50	-	mJ
Turn-off energy 关断损耗	E_{off}		-	0.30	-	
Total switching energy 总开关损耗	E_{ts}		-	0.80	-	

Anti-Parallel Diode Characteristic

反并联二极管特性

Reverse recovery time 反向恢复时间	t_{rr}	$T_j=150^\circ\text{C}$, $V_R=400\text{V}$, $I_F=15\text{A}$, $diF/dt=100\text{A}/\mu\text{s}$	-	252	-	ns
Recovered charge 恢复电荷	Q_r		-	920	-	nC
Peak reverse recovery current 反向恢复峰值电流	I_{RM}		-	4.8	-	A



ELECTRICAL CHARACTERISTICS

特性曲线

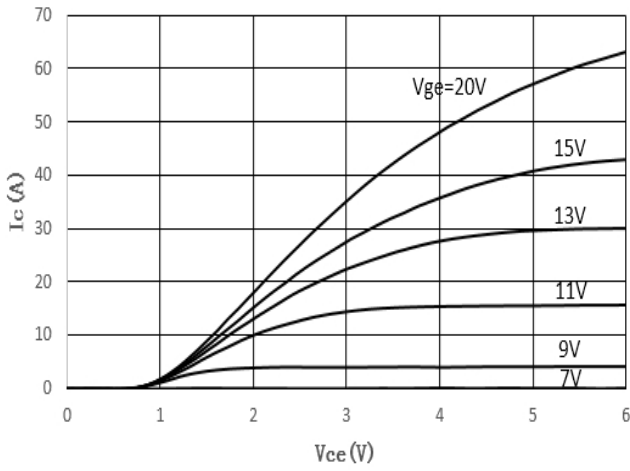


Figure 1. Typical output characteristic($T_j=25^\circ\text{C}$)

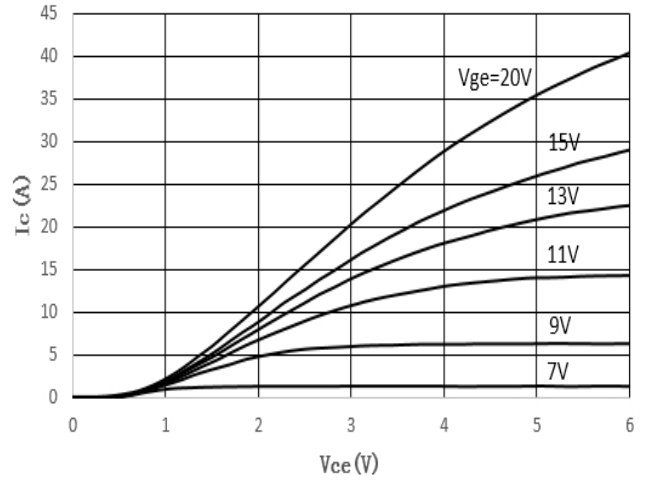


Figure 2. Typical output characteristic($T_j=150^\circ\text{C}$)

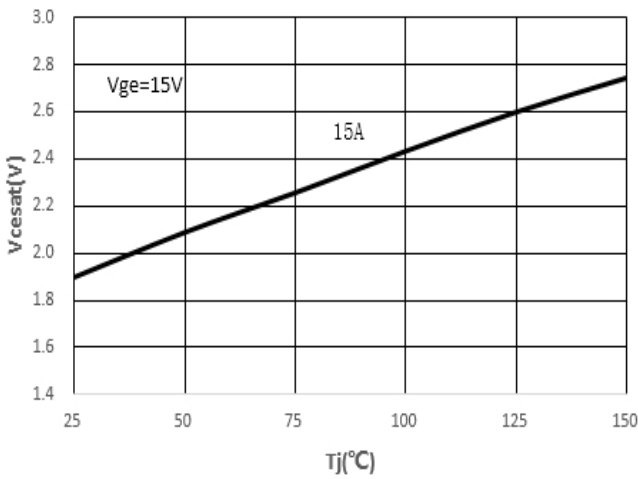


Figure 3. V_{cesat} vs. T_j

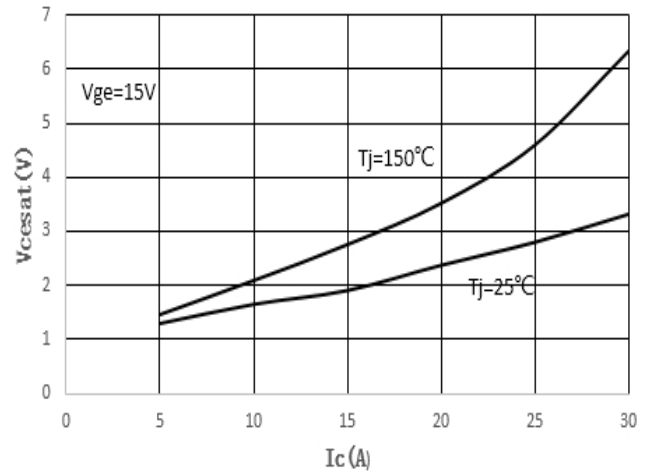


Figure 4. V_{cesat} vs. I_c

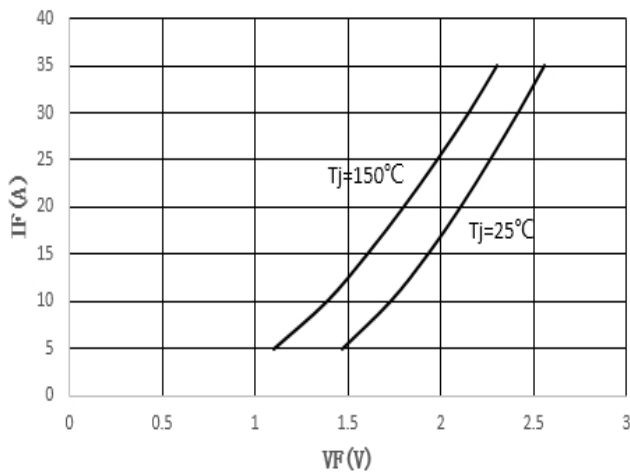


Figure 5. I_F vs V_F

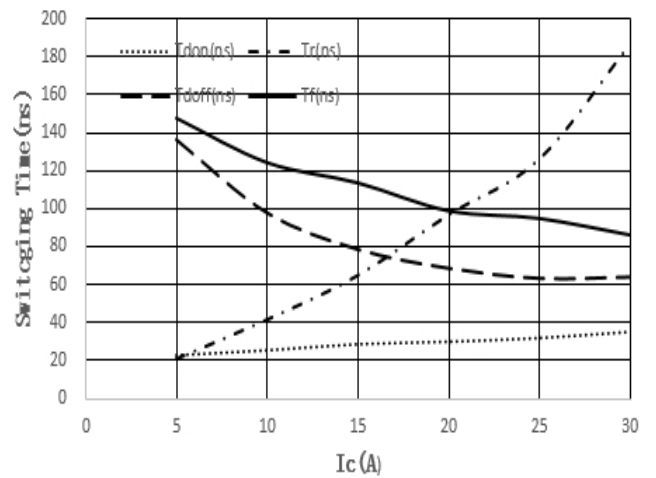


Figure 6. Switching times vs I_c
($T_j=150^\circ\text{C}, V_{GE}=15\text{V}, V_{CE}=400\text{V}, R_G=10\ \Omega$)

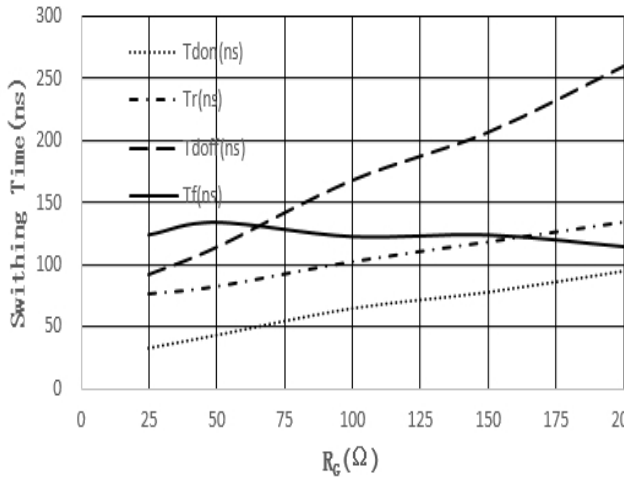


Figure 7. Switching times vs R_G
($T_j=150^\circ\text{C}, V_{CE}=400\text{V}, V_{GE}=15\text{V}, I_C=15\text{A}$)

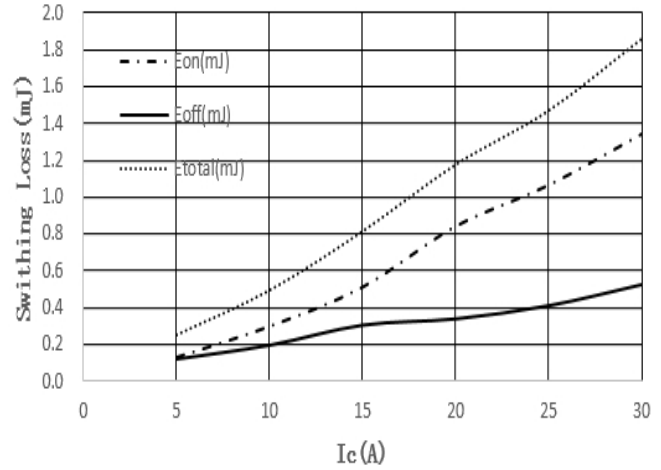


Figure 8. Switching energy losses vs I_c
($T_j=150^\circ\text{C}, V_{CE}=400\text{V}, V_{GE}=15\text{V}, R_G=10\ \Omega$)

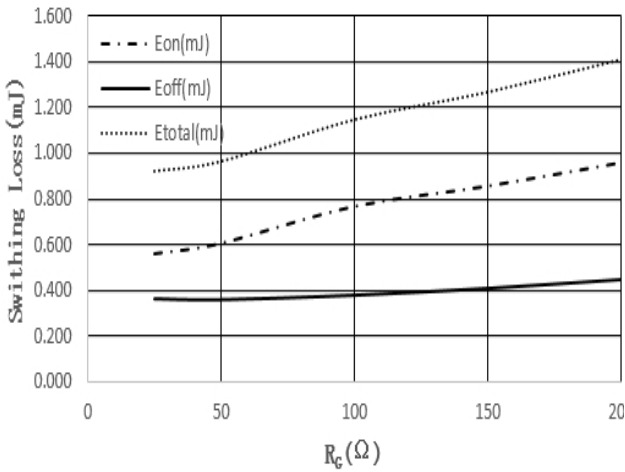


Figure 9. Switching energy losses vs R_G
($T_j=150^\circ\text{C}, V_{CE}=400\text{V}, V_{GE}=15\text{V}, I_C=15\text{A}$)

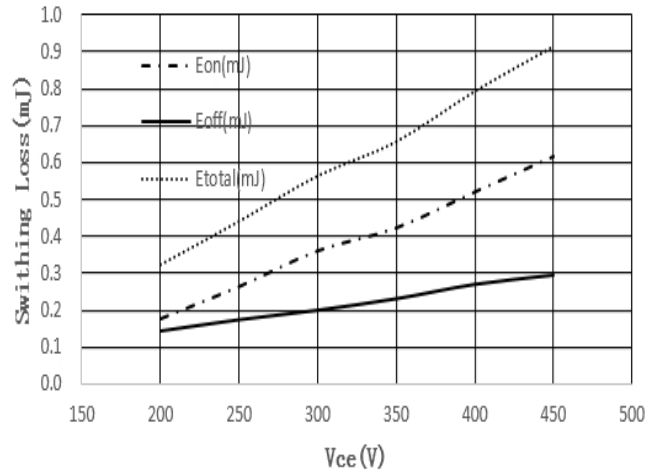


Figure 10. Switching energy losses vs V_{CE}
($T_j=150^\circ\text{C}, V_{GE}=15\text{V}, I_C=15\text{A}, R_G=10\ \Omega$)

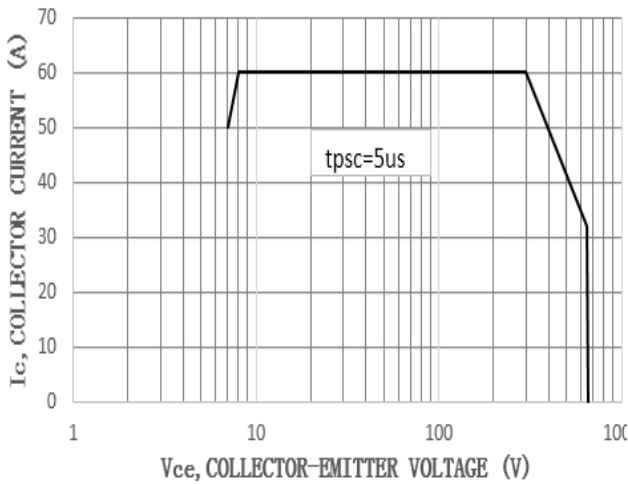
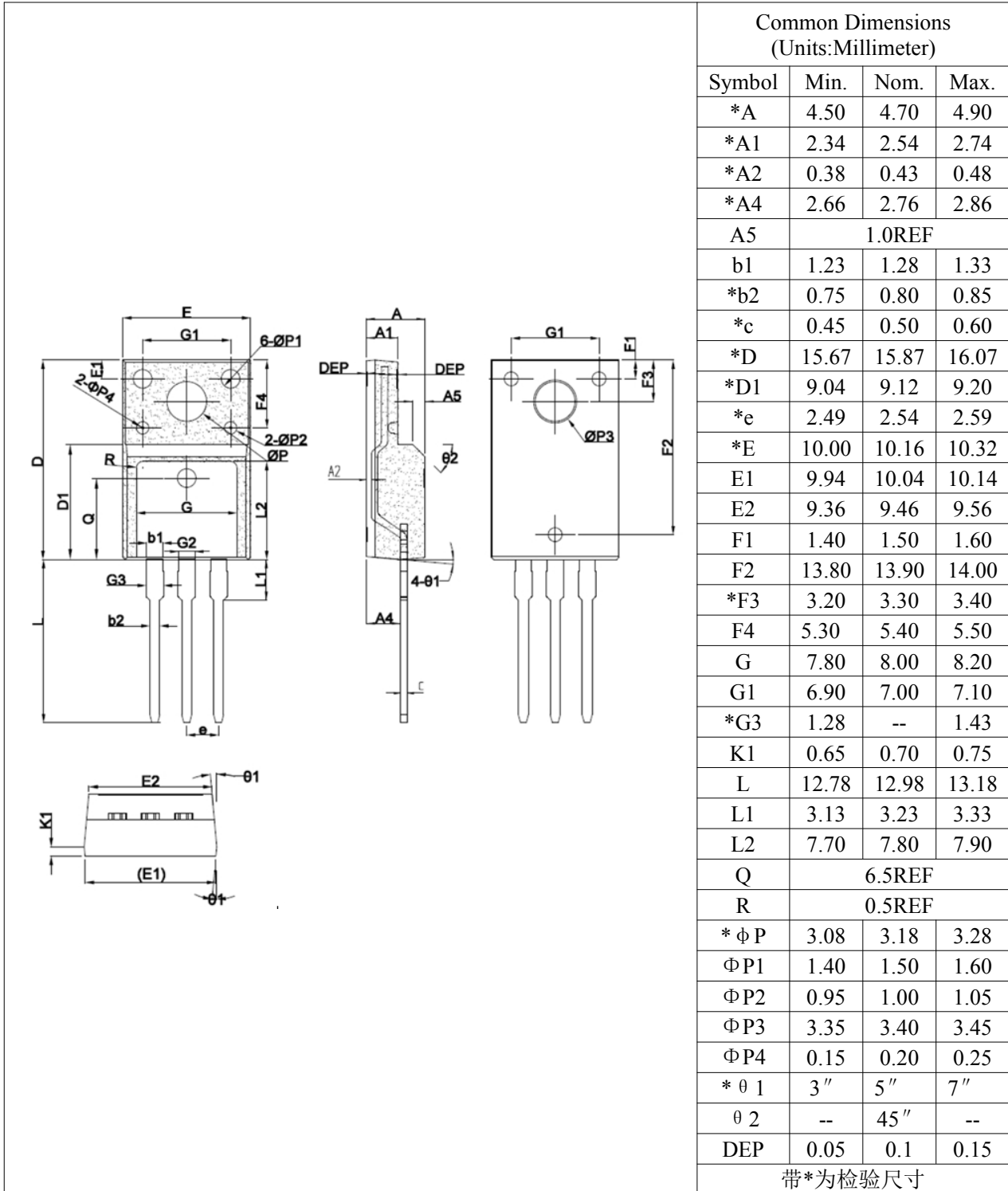


Figure 11. Safe Operating Area for TO-220F



TO220F-3 Outline Dimensions:
TO220F-3 外形尺寸



Packing
包装

Packing	pcs/tube	tube/ inner box	inner box/ carton	pcs/carton
Tube	50	8	5	2000



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