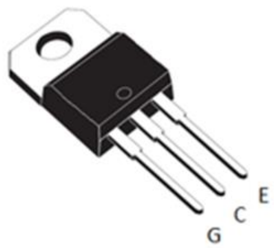
YGF15N65TSA1,YGP15N65TSA1

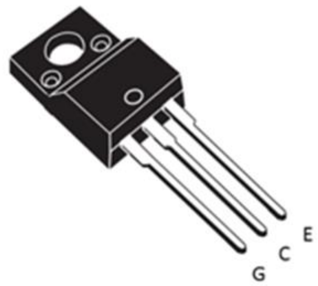
650V 15A Trench Field Stop IGBT

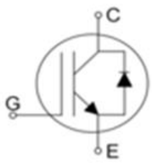
FEATURES

- High breakdown voltage to 650V for improved reliability
- Trench-Stop Technology offering :
  - ➢ Very tight parameter distribution
  - ➢ High ruggedness, temperature stable behavior
  - ➢ High speed switching
  - ➢ Low switching losses
  - ➢ Low V_{CEsat}
  - ➢ Easy parallel switching capability due to positive temperature coefficient in V_{CEsat}

V_{CE}	**650**	**V**
I_C	**15**	**A**
$V_{CE(sat)}$ I_C=15A	**1.7**	**V**







APPLICATION

- Soft switching applications
- Air conditioning
- Motor drive inverter
- Converter with high switching frequency

Product	Package	Packaging
YGF15N65TSA1	TO-220F	Tube
YGP15N65TSA1	TO-220	Tube

Maximum Ratings

Parameter	Symbol	Value		Unit
Collector-Emitter Breakdown Voltage, $T_j \geqslant 25℃$	V_{CE}	650		V
DC collector current, limited by T_{jmax} T_C = 25°C T_C = 100°C	I_C	30 15		A
Diode Forward current, limited by T_{jmax} T_C = 25°C T_C = 100°C	I_F	30 15		A
Continuous Gate-emitter voltage	V_{GE}	±25		V
Transient Gate-emitter voltage ($t_p \leq 10\mu s$,D＜0.01)	V_{GE}	±30		V
Turn off safe operating area $V_{CE} \leq 650V$, $T_j \leq 175°C$, $t_p = 1\mu s$	-	45		A
Pulsed Collector Current V_{GE} =15V,t_p limited by T_{jmax}	I_{CM}	45		A
Diode Pulsed Current, t_p limited by T_{jmax}	I_{Fpuls}	30		A
		TO220	TO220F	
Power dissipation , T_C=25°C	P_{tot}	150	39	W
Power dissipation , T_C=100°C	P_{tot}	75	20	W
Max. Junction Temperature	$T_{J,max}$	175		°C
Operating junction temperature	$T_{J,op}$	-40...+175		°C
Storage temperature	T_{stg}	-55...+150		°C
Soldering temperature, wave soldering 1.6mm (0.063in.) from case for 10s	-	260		°C
Mounting torque, M3 screw Maximum of mounting processes: 3	M	0.6		Nm

Thermal Resistance

Parameter	Symbol	TO-220F	TO-220	Unit
IGBT thermal	$R_{\theta(j-c)}$	3.8	1	K/W
Diode thermal	$R_{\theta(j-c)}$	4.2	2.1	K/W
Thermal resistance,junction -	$R_{\theta(j-a)}$	50	40	K/W

Electrical Characteristics of the IGBT（T_j= 25℃ unless otherwise specified）：

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Static						
Collector-Emitter breakdown voltage	BV_{CES} ①	V_{GE}=0V , I_C=250μA	650	-	-	V
Gate threshold voltage	$V_{GE(th)}$	V_{GE}=V_{CE}, I_C=500μA	4.9	5.7	6.5	V
Collector-Emitter Saturation voltage	$V_{CE(sat)}$	V_{GE}=15V, I_C=15A T_j = 25°C T_j = 175°C	- -	1.65 2.0	2.15 -	V
Zero gate voltage collector current	I_{CES}	V_{CE}=650V,V_{GE}= 0V T_j = 25°C T_j = 175°C	- -	- -	40 1000	μA
Gate-emitter leakage current	I_{GES}	V_{CE}=0V,V_{GE}= ± 20V	-	-	400	nA
Transconductance	g_{fs}	V_{CE}=20V, I_C=15A	-	10	-	S

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Dynamic						
Input capacitance	C_{ies}	V_{CE} = 25V, V_{GE} = 0V, f = 1MHz	-	1308	-	pF
Output capacitance	C_{oes}		-	48	-	
Reverse transfer capacitance	C_{res}		-	13	-	
Gate charge total	Q_g	V_{CC} = 520V, I_C =15A, V_{GE} = 15V	-	48	-	nC
Gate to emitter charge	Q_{ge}		-	12	-	
Gate to collector charge	Q_{gc}		-	21	-	
Internal Gate Resistance	$R_{G,int}$	f = 1 MHz	-	1.5	-	Ω

Note：

① BVces testing without filter could damage the device. BVces is guaranteed by Ices@650V test

Switching Characteristic, Inductive Load

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Dynamic						
Turn-on Delay Time	$t_{d(on)}$	T_j=25°C , V_{CE} = 400V, I_C = 15A, V_{GE} = 0/15V, R_g=5Ω	-	6.17	-	ns
Rise Time	t_r		-	26.9	-	ns
Turn-off Delay Time	$t_{d(off)}$		-	38.2	-	ns
Fall Time	t_f		-	100.8	-	ns
Turn-on Energy	E_{on}		-	0.34	-	mJ
Turn-off Energy	E_{off}		-	0.23	-	mJ
Turn-on Delay Time	$t_{d(on)}$	T_j=150°C , V_{CE} = 400V, I_C = 15A, V_{GE} = 0/15V, R_g=5Ω	-	6.34	-	ns
Rise Time	t_r		-	27.7	-	ns
Turn-off Delay Time	$t_{d(off)}$		-	48.9	-	ns
Fall Time	t_f		-	172.3	-	ns
Turn-on Energy	E_{on}		-	0.39	-	mJ
Turn-off Energy	E_{off}		-	0.42	-	mJ

Electrical Characteristics of the DIODE

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Diode Forward Voltage	V_{FM}	I_F =15A T_j=25°C T_j=175°C	-	1.65 1.50	-	V
Reverse Recovery Time	T_{rr}	T_j=25°C, I_F= 15A, V_R = 400V, di_F/dt =790A/µs	-	114	-	ns
Reverse Recovery Current	I_{rr}		-	18.5	-	A
Reverse Recovery Charge	Q_{rr}		-	0.82	-	µC

Fig. 1 Output characteristic V_{CE} vs. I_C at 25℃

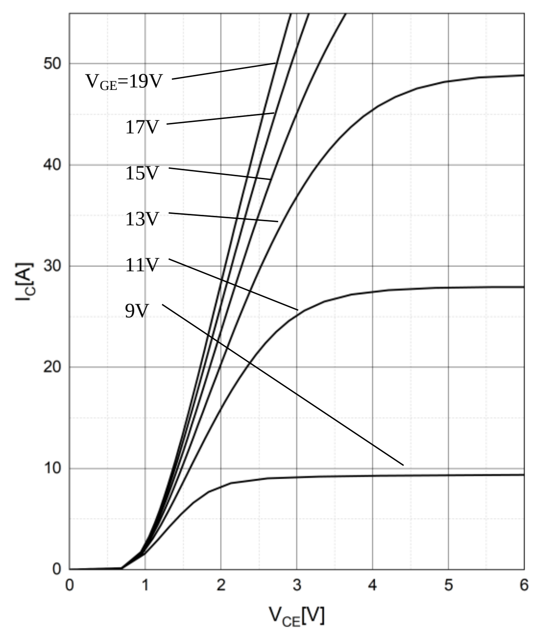


Fig. 2 Output characteristic V_{CE} vs. I_C at 175℃

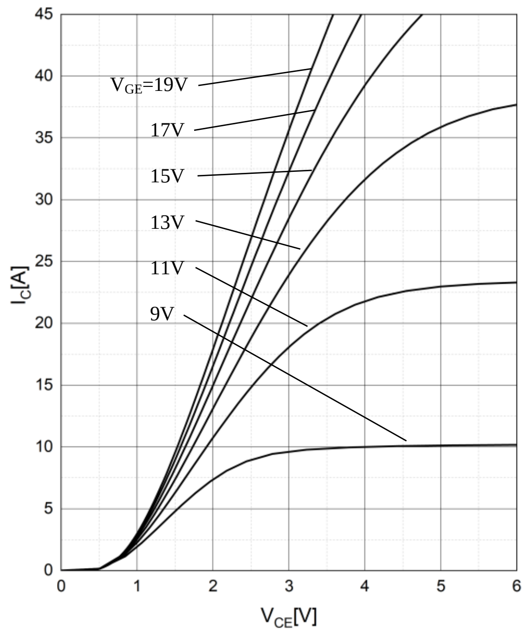


Fig. 3 Transfer characteristic V_{GE} vs. I_C

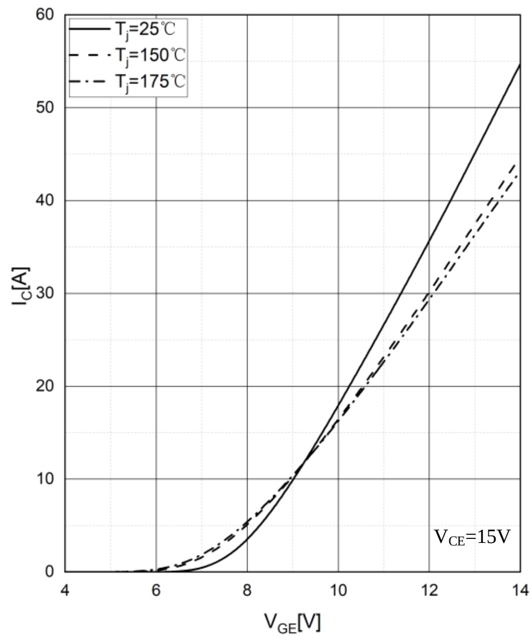


Fig. 4 Collector-emitter saturation voltage as a function of junction temperature V_{CEsat} vs. T_j

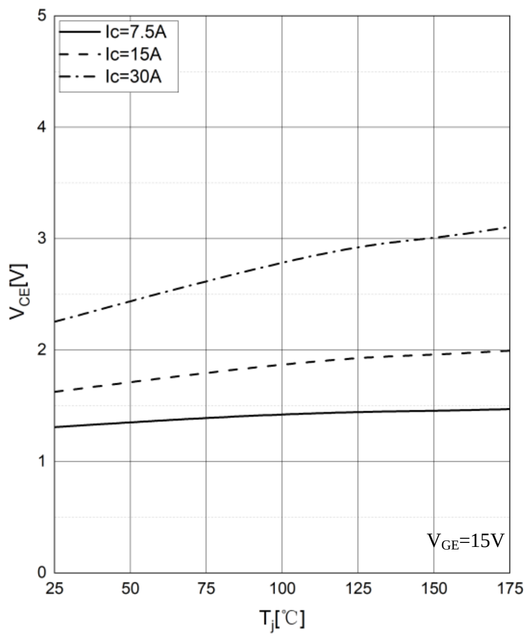


Fig. 5 Gate-emitter threshold voltage as a function of junction temperature $V_{GE(th)}$ vs. T_j

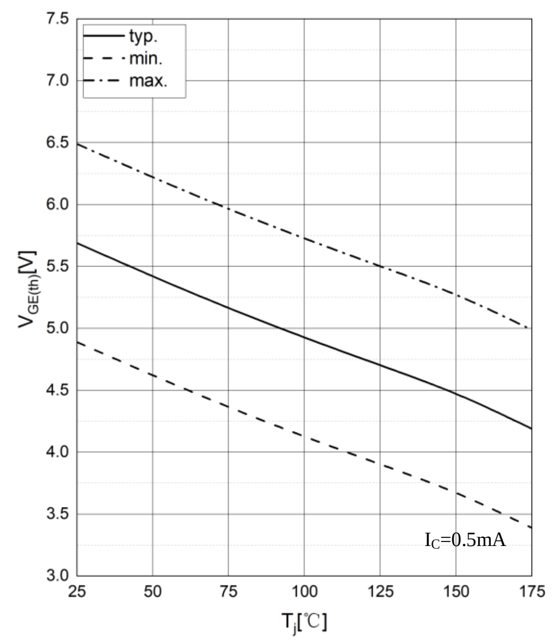


Fig. 6 Gate charge Q_G

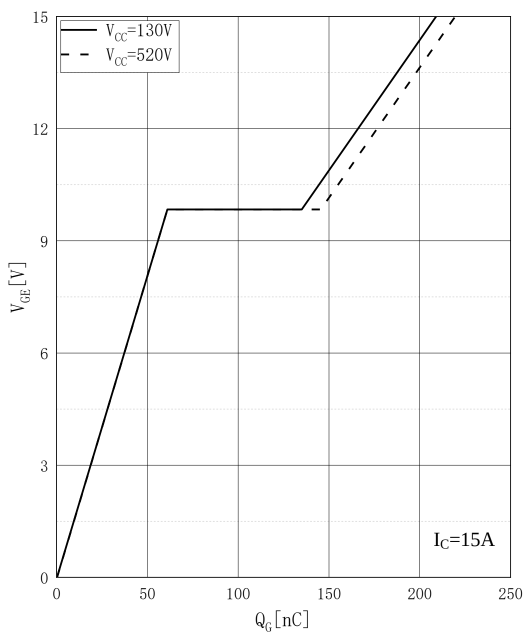


Fig. 7 Capacitance characteristic

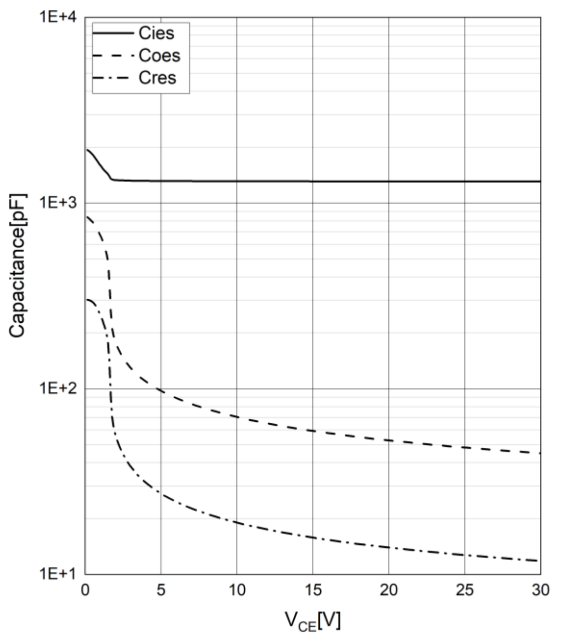


Fig. 8 Diode forward current as a function of forward voltage V_F vs. I_F

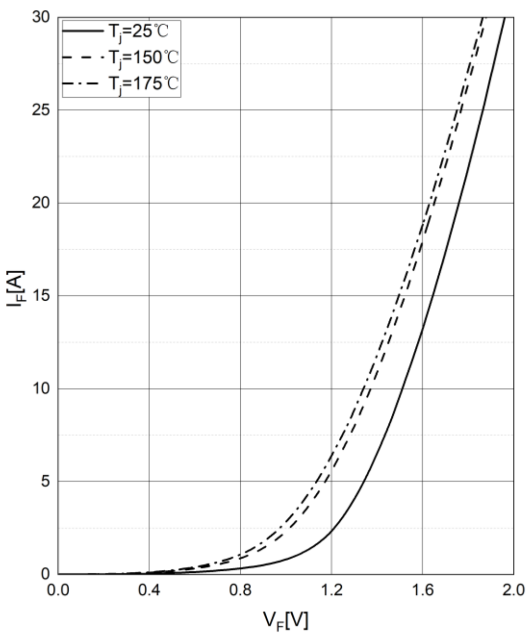


Fig. 9 Diode forward voltage as a function of junction temperature V_F vs. T_j

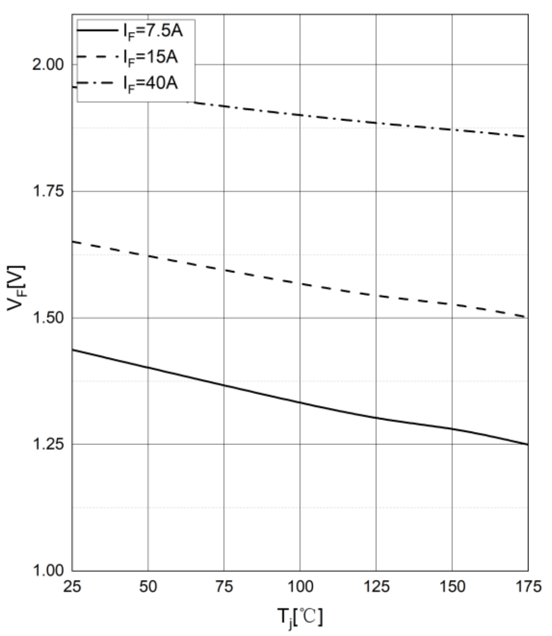


Fig. 10 Switching times vs. Collector current I_C

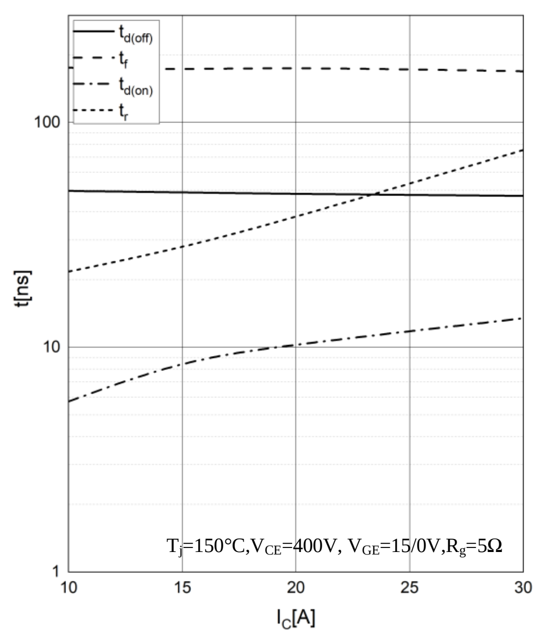


Fig. 11 Switching times vs. Gate resistor R_g

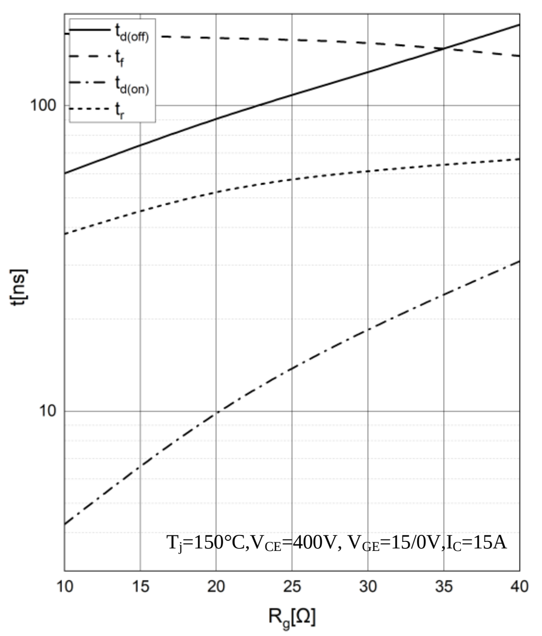


Fig. 12 Switching times vs. Junction temperature T_j

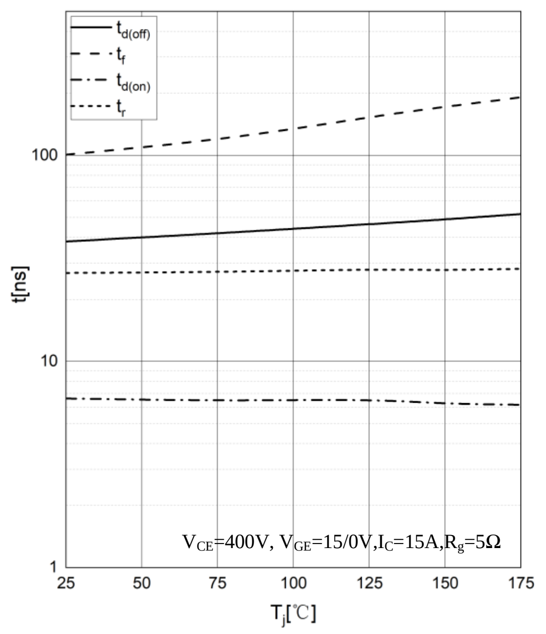


Fig. 13 Switching energy loss vs. Collector current I_C

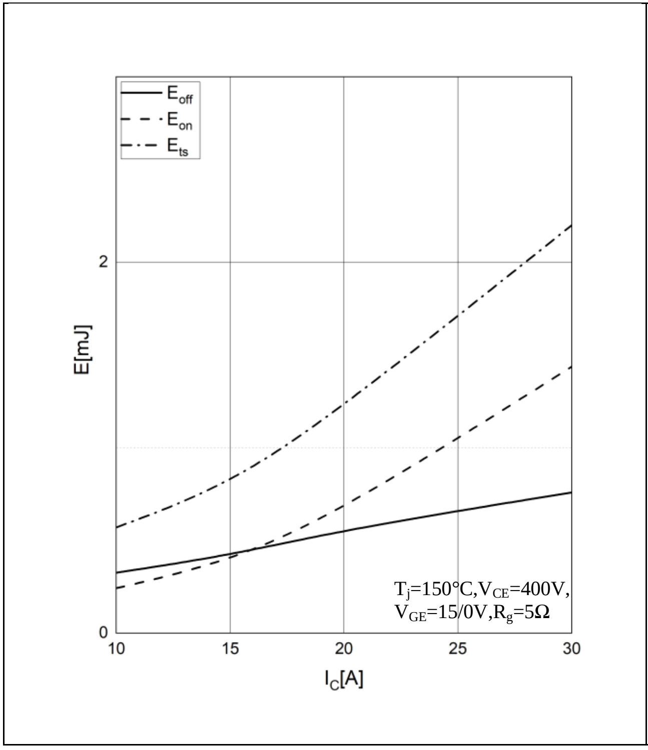


Fig. 14 Switching energy loss vs. Gate resistor R_g

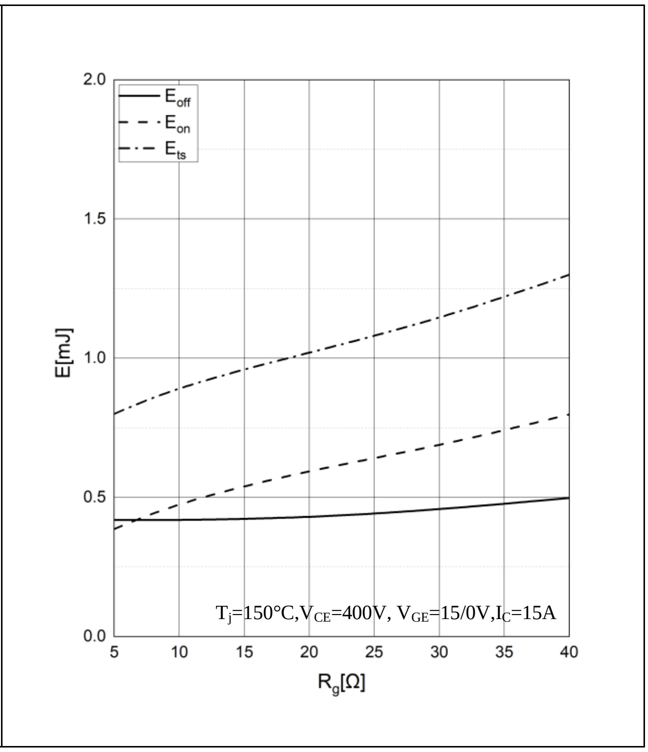


Fig.15 Switching energy loss vs. Junction temperature T_j

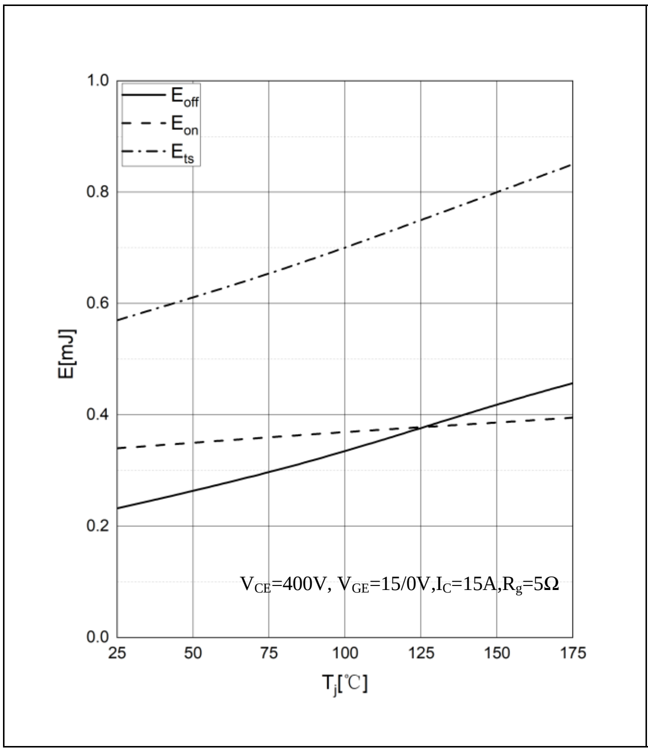


Fig. 16 Switching energy loss vs. Collector-emitter voltage V_{CE}

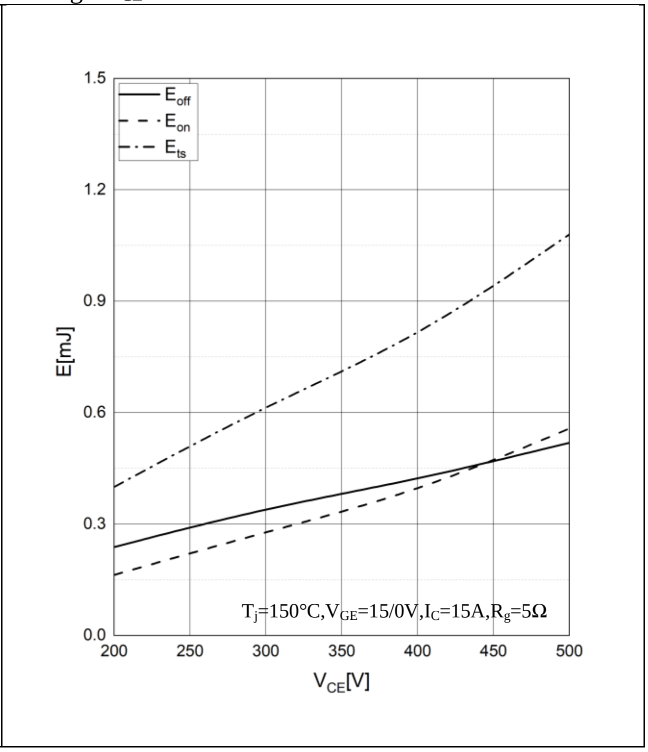


Fig. 17 Reverse recovery times as a function of diode current slope t_{rr} vs. di_F/dt

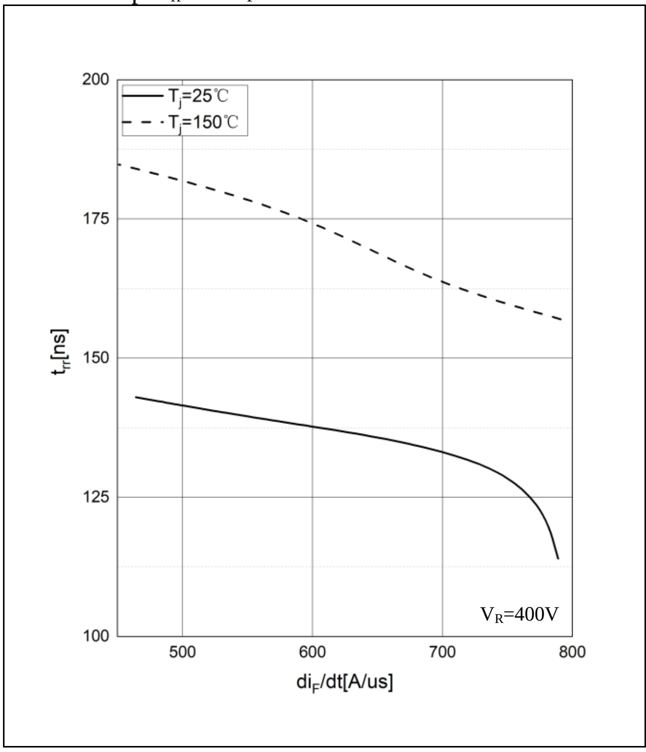


Fig. 18 Reverse recovery charge as a function of diode current slope Q_{rr} vs. di_F/dt

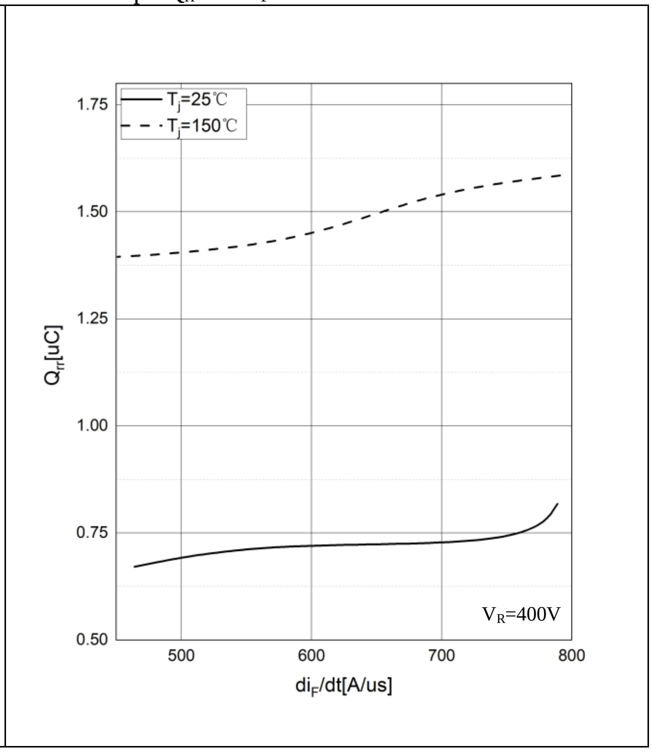


Fig. 19 Reverse recovery current as a function of diode current slope I_{rr} vs. di_F/dt

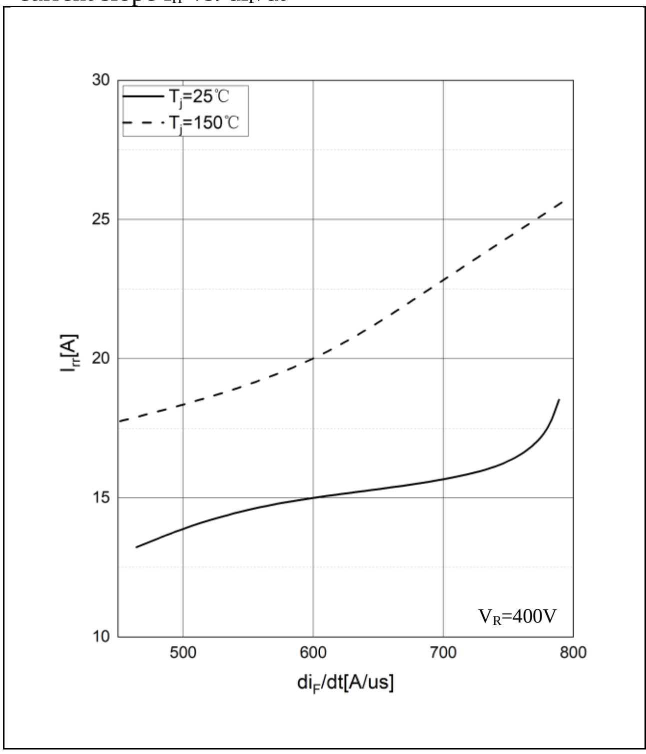


Fig. 20 Reverse recovery energy as a function of diode current slope E_{rr} vs. di_F/dt

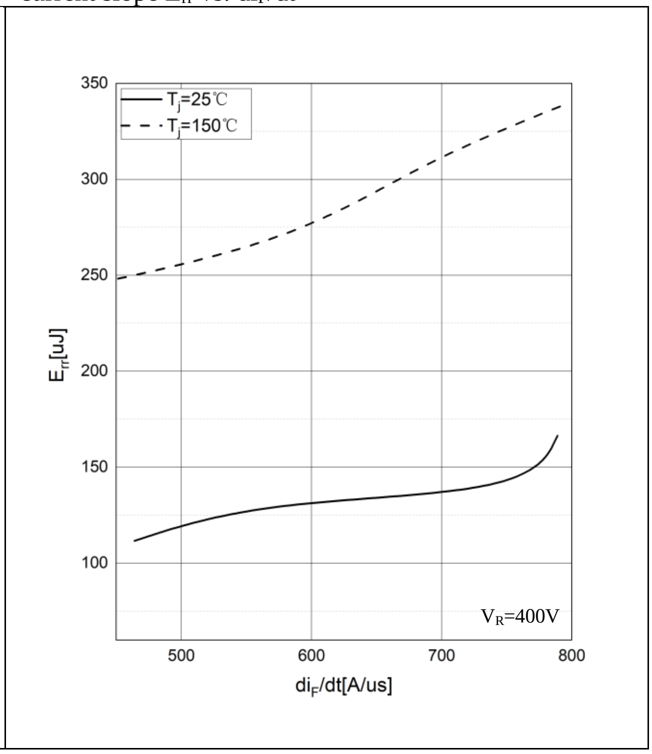


Fig. 21 FBSOA characteristic for TO220

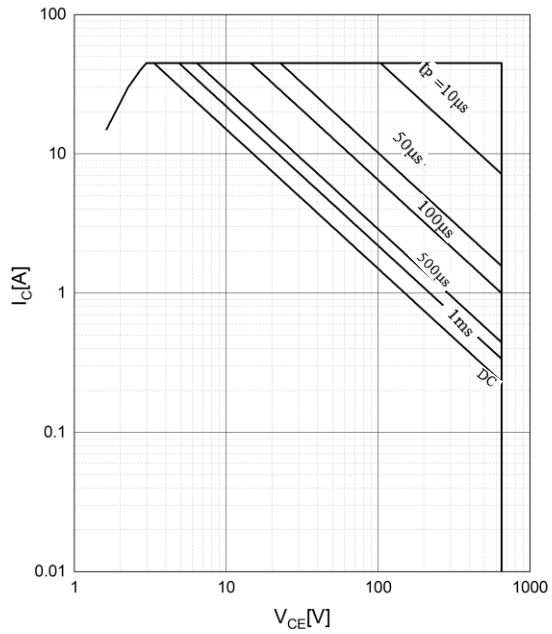


Fig. 22 FBSOA characteristic for TO220F

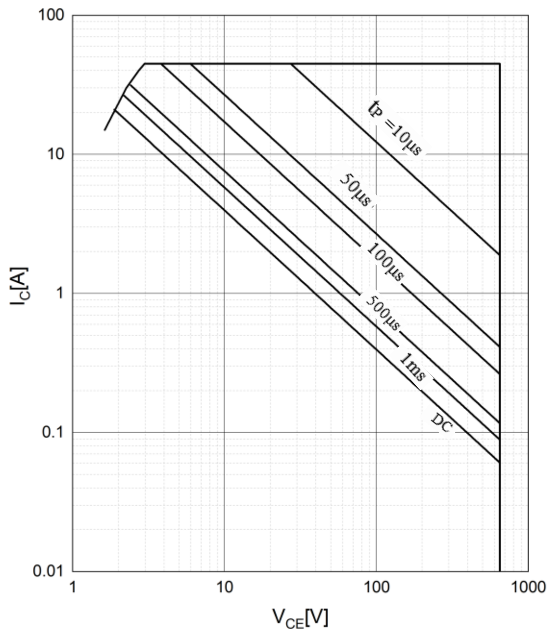


Fig. 23 IGBT transient thermal impedance Z_{thjc} for TO220

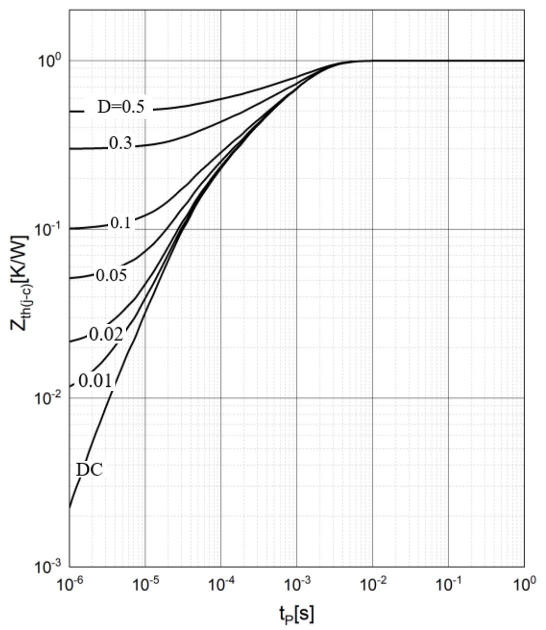


Fig. 24 IGBT transient thermal impedance Z_{thjc} for TO220 F

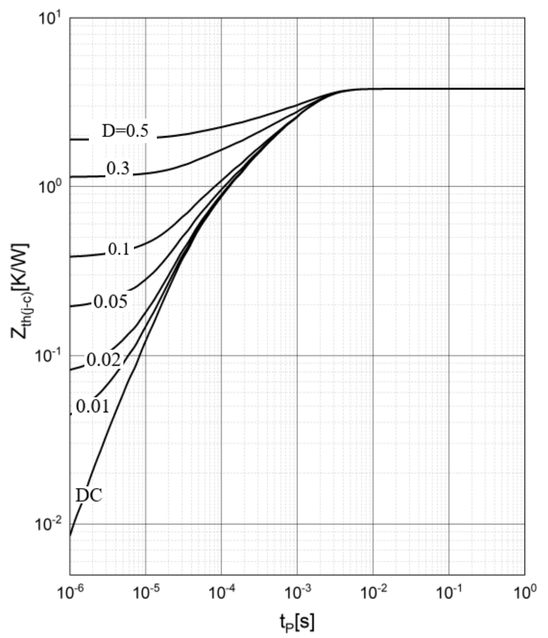


Fig. 25 Diode transient thermal impedance Z_{thjc} for TO220

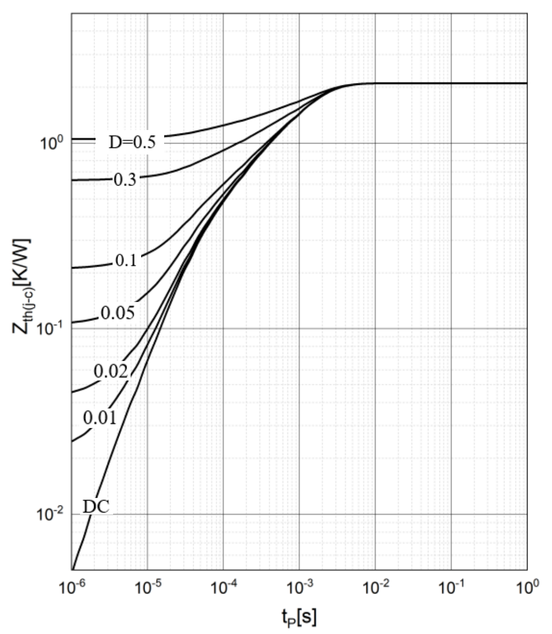


Fig. 26 Diode transient thermal impedance Z_{thjc} for TO220F

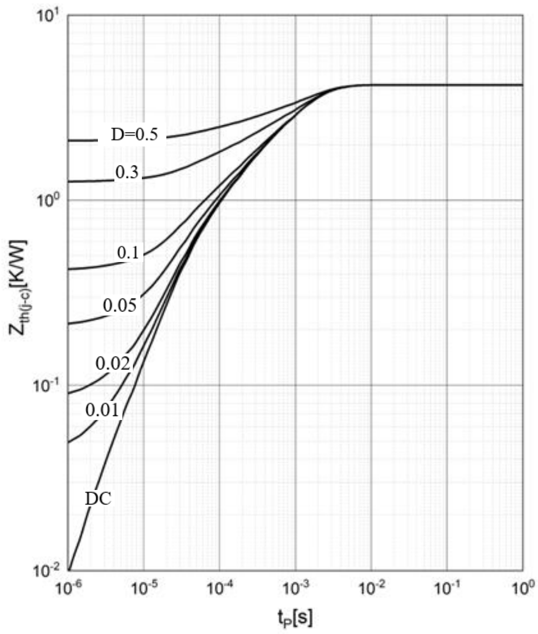


Fig. 27 Power dissipation as a function of case temperature P_{tot} vs. T_C for TO220

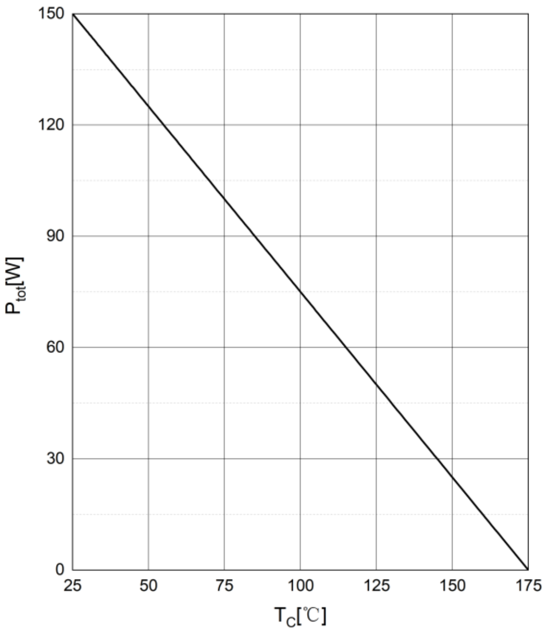
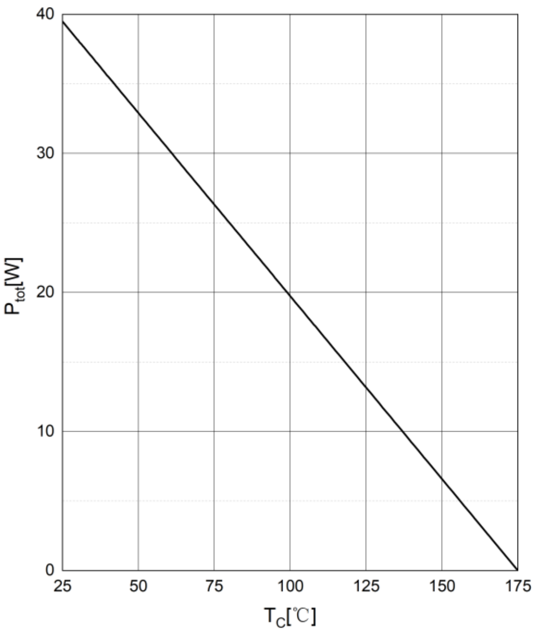
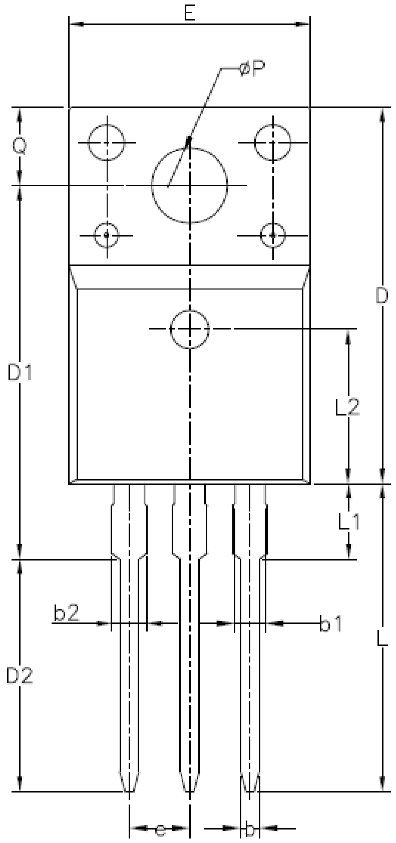
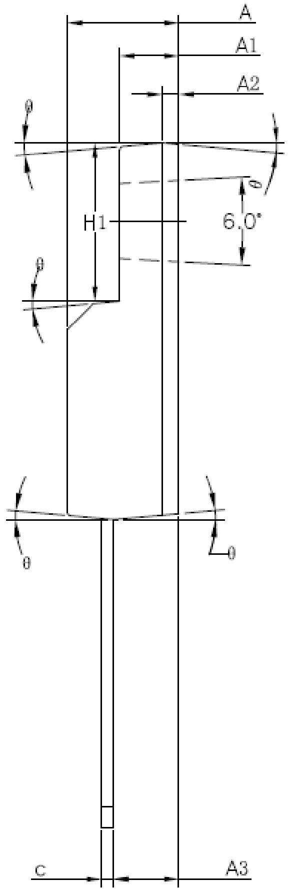


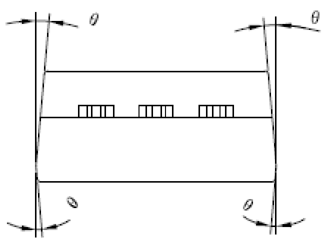
Fig. 28 Power dissipation as a function of case temperature P_{tot} vs. T_C for TO220F



TO-220F package information

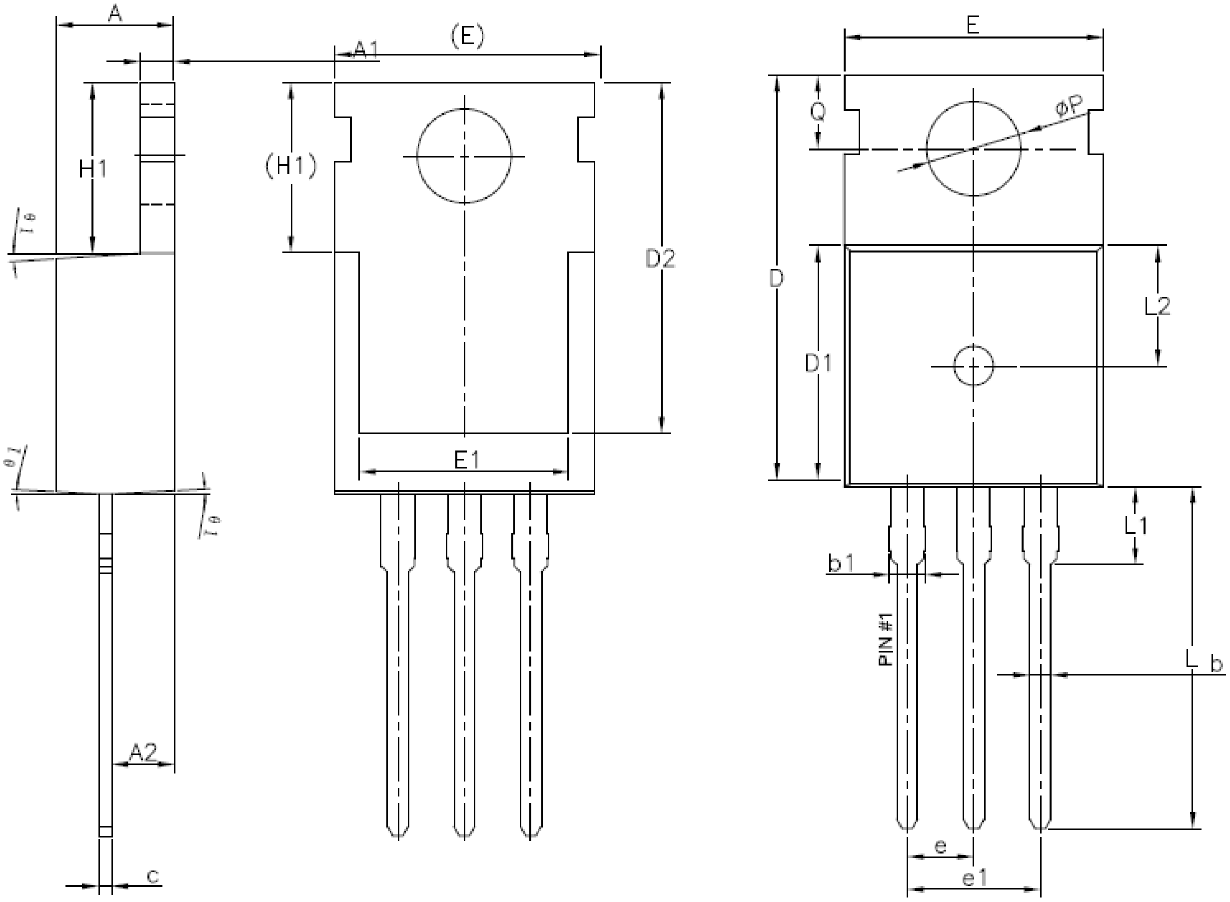




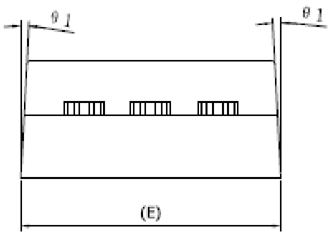


SYMBOL	MIN	NOM	MAX
A	4.50	4.70	4.83
A1	2.34	2.54	2.74
A2	0.70 REF		
A3	2.56	2.76	2.93
b	0.70	–	0.90
b1	1.18	–	1.38
b2	–	–	1.47
c	0.45	0.50	0.60
D	15.67	15.87	16.07
D1	15.55	15.75	15.95
D2	9.60	9.80	10.0
E	9.96	10.16	10.36
e	2.54BSC		
H1	6.48	6.68	6.88
L	12.68	12.98	13.28
L1	–	–	3.50
L2	6.50REF		
øP	3.08	3.18	3.28
Q	3.20	–	3.40
θ1	1°	3°	5°

TO-220 package information



SYMBOL	MIN	NOM	MAX
A	4.40	4.50	4.60
A1	1.27	1.30	1.33
A2	2.30	2.40	2.50
b	0.70	–	0.90
b1	1.27	–	1.40
c	0.45	0.50	0.60
D	15.30	15.70	16.10
D1	9.10	9.20	9.30
D2	13.10	–	13.70
E	9.70	9.90	10.20
E1	7.80	8.00	8.20
e	2.49	2.54	2.59
e1	5.03	5.08	5.12
H1	6.30	6.50	6.70
L	12.78	13.08	13.38
L1	3.30	–	3.50
L2	4.50	4.60	4.70
ØP	3.55	3.60	3.65
Q	2.73	–	2.87
θ1	1°	3°	5°



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