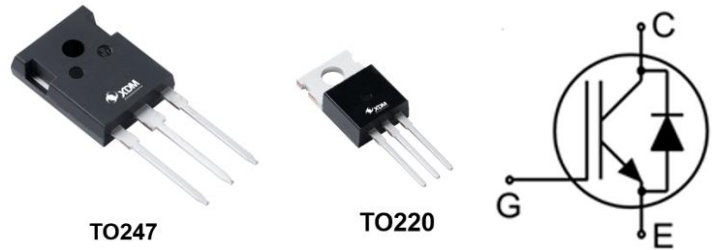


## Trench Field-Stop Technology IGBT

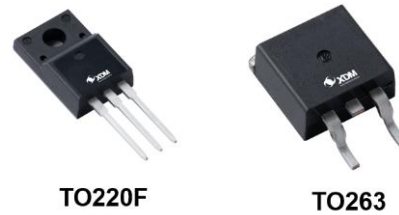
### Features

- 650V, 25A
- $V_{CE(sat)(typ.)} = 1.75V @ V_{GE}=15V, I_C=25A$
- Maximum Junction Temperature 175°C
- Pb-free Lead Plating; RoHS Compliant



### Applications

- Solar Converters
- Uninterrupted Power Supply
- Welding Converters
- Mid to High Range Switching Frequency Converters



### Key Performance and Package Parameters

Order codes	$V_{CE}$	$I_C$	$V_{CEsat}, T_{vj}=25^{\circ}C$	$T_{vjmax}$	Marking	Package
XD025H065AY1H3	650V	25A	1.75V	175°C	D25H65AY1	TO220F
XD025H065AY1L3	650V	25A	1.75V	175°C	D25H65AY1	TO220
XD025H065AY1R3	650V	25A	1.75V	175°C	D25H65AY1	TO263
XD025H065AY1S3	650V	25A	1.75V	175°C	D25H65AY1	TO247

### Absolute Maximum Ratings

Symbol	Parameter	Value	Unit
$V_{CES}$	Collector-Emitter Voltage	650	V
$V_{GES}$	Gate-Emitter Voltage	±20	V
$I_C$	Continuous Collector Current ( $T_C=25^{\circ}C$ )	50	A
	Continuous Collector Current ( $T_C=100^{\circ}C$ )	25	A
$I_{CM}$	Pulsed Collector Current (Note 1)	100	A
$P_D$	Maximum Power Dissipation (TO220F)	37	W
	Maximum Power Dissipation (TO220, TO263)	136	W
	Maximum Power Dissipation (TO247)	166	W
$T_J$	Operating Junction Temperature Range	-40 to 175	°C
$T_{STG}$	Storage Temperature Range	-55 to 150	°C

## Thermal Data

Symbol	Parameter	Conditions	Max.	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case for IGBT	TO220F	4	$^{\circ}\text{C}/\text{W}$
$R_{\theta JC}$	Thermal Resistance, Junction to Case for IGBT	TO220	1.1	$^{\circ}\text{C}/\text{W}$
$R_{\theta JC}$	Thermal Resistance, Junction to Case for IGBT	TO263	1.1	$^{\circ}\text{C}/\text{W}$
$R_{\theta JC}$	Thermal Resistance, Junction to Case for IGBT	TO247	0.9	$^{\circ}\text{C}/\text{W}$

## Electrical Characteristics ( $T_c=25^{\circ}\text{C}$ unless otherwise noted.)

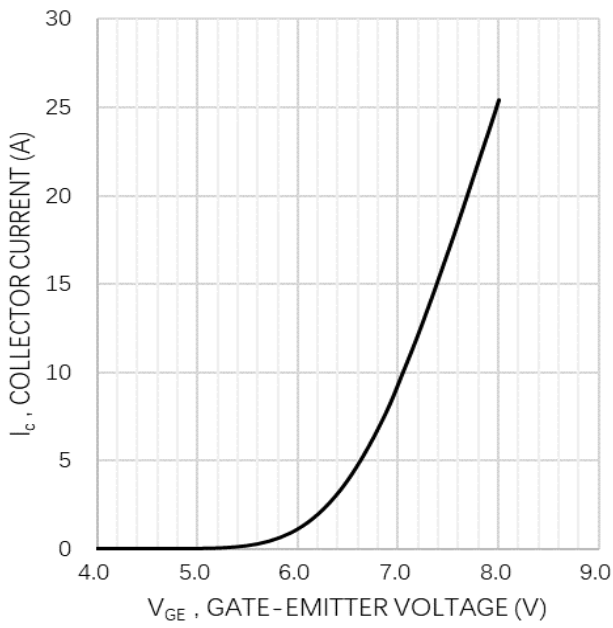
Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$BV_{CES}$	Collector-Emitter Breakdown Voltage	$V_{GE}=0\text{V}$ , $I_C=200\mu\text{A}$	650	---	---	V
$I_{CES}$	Collector-Emitter Leakage Current	$V_{CE}=650\text{V}$ , $V_{GE}=0\text{V}$	---	---	40	$\mu\text{A}$
$I_{GES}$	Gate Leakage Current, Forward	$V_{GE}=20\text{V}$ , $V_{CE}=0\text{V}$	---	---	100	nA
	Gate Leakage Current, Reverse	$V_{GE}=-20\text{V}$ , $V_{CE}=0\text{V}$	---	---	100	nA
$V_{GE(th)}$	Gate Threshold Voltage	$V_{GE}=V_{CE}$ , $I_C=600\mu\text{A}$	5	6	7	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$V_{GE}=15\text{V}$ , $I_C=25\text{A}$ , $T_j=25^{\circ}\text{C}$	---	1.75	2.2	V
$Q_G$	Total Gate Charge	$V_{CC}=520\text{V}$	---	31.2	---	nC
$Q_{GE}$	Gate-Emitter Charge	$V_{GE}=15\text{V}$	---	5	---	nC
$Q_{GC}$	Gate-Collector Charge	$I_C=25\text{A}$	---	18	---	nC
$t_{d(on)}$	Turn-on Delay Time	$V_{CC}=400\text{V}$ $V_{GE}=\pm 15\text{V}$ $I_C=12.5\text{A}$ $R_G=20\Omega$ Inductive Load $T_C=25^{\circ}\text{C}$	---	8.5	---	ns
$t_r$	Turn-on Rise Time		---	30	---	ns
$t_{d(off)}$	Turn-off Delay Time		---	120	---	ns
$t_f$	Turn-off Fall Time		---	57.5	---	ns
$E_{on}$	Turn-on Switching Loss		---	0.22	---	mJ
$E_{off}$	Turn-off Switching Loss		---	0.34	---	mJ
$E_{ts}$	Total Switching Loss		---	0.56	---	mJ
$C_{ies}$	Input Capacitance	$V_{CE}=25\text{V}$	---	1230	---	pF
$C_{oes}$	Output Capacitance	$V_{GE}=0\text{V}$	---	132	---	pF
$C_{res}$	Reverse Transfer Capacitance	$f=1\text{MHz}$	---	39	---	pF

**Diode Characteristics** (  $T_C=25^{\circ}\text{C}$  unless otherwise noted)

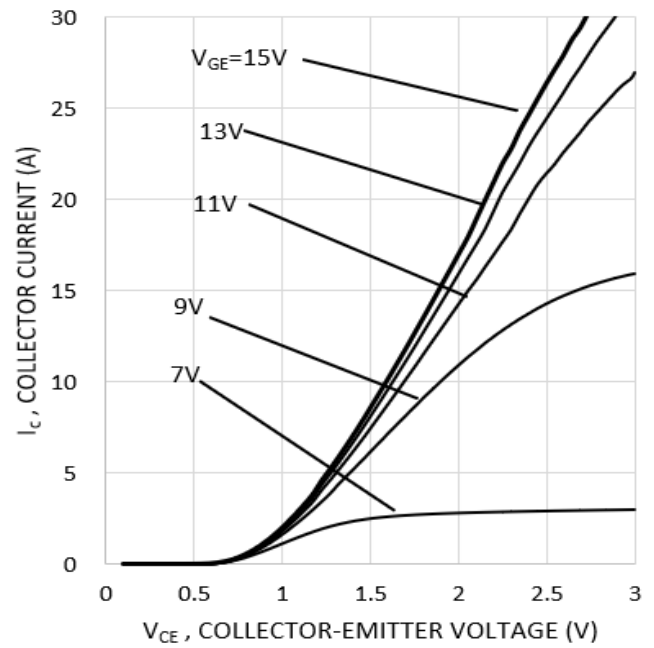
Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$V_F$	Diode Forward Voltage	$I_F=25\text{A}$ , $T_j=25^{\circ}\text{C}$	---	1.55	2.2	V
$t_{rr}$	Diode Reverse Recovery Time	$V_R=400\text{V}$	---	48.7	---	ns
$I_{rr}$	Diode peak Reverse Recovery Current	$I_F=12.5\text{A}$ $dI_F/dt=350\text{A/us}$	---	4	---	A
$Q_{rr}$	Diode Reverse Recovery Charge	$T_C=25^{\circ}\text{C}$	---	224	---	nC

Note1: Repetitive rating, pulse width limited by maximum junction temperature

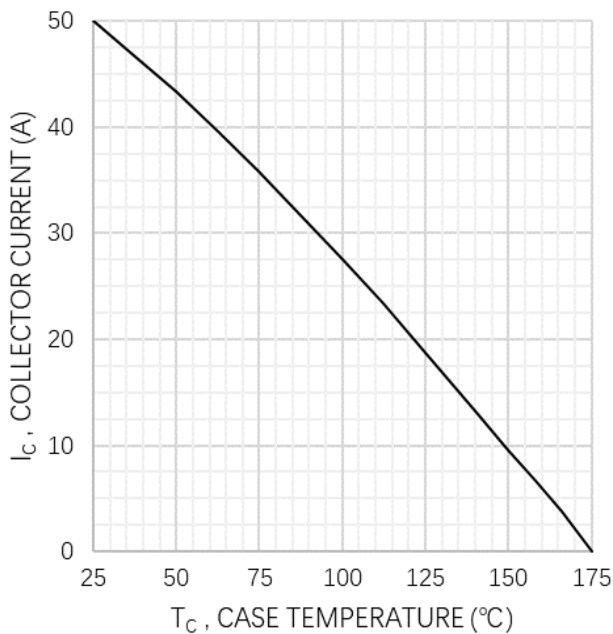
## Typical Characteristics



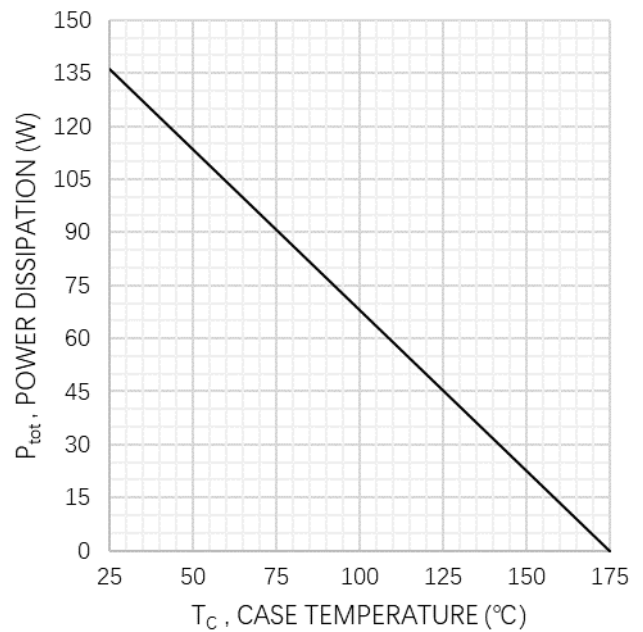
**Fig. 1 Typical transfer characteristics**  
( $V_{CE}=20V$ )



**Fig. 2 Typical output characteristic ( $T_{vj}=25^\circ C$ )**



**Fig. 3 Collector current as a function of case temperature**  
( $V_{GE} \geq 15V, T_{vj} \leq 175^\circ C$ )



**Fig. 4 Power dissipation as a function of case temperature**  
(TO220, TO263)

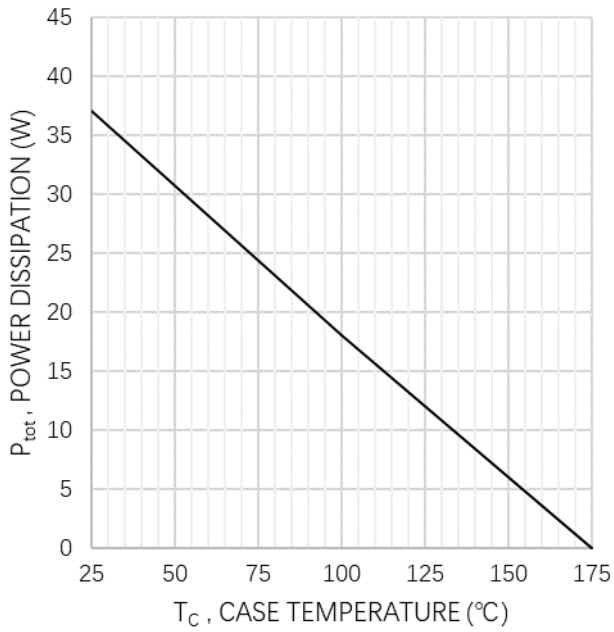


Fig. 5 Power dissipation as a function of case temperature (TO220F)

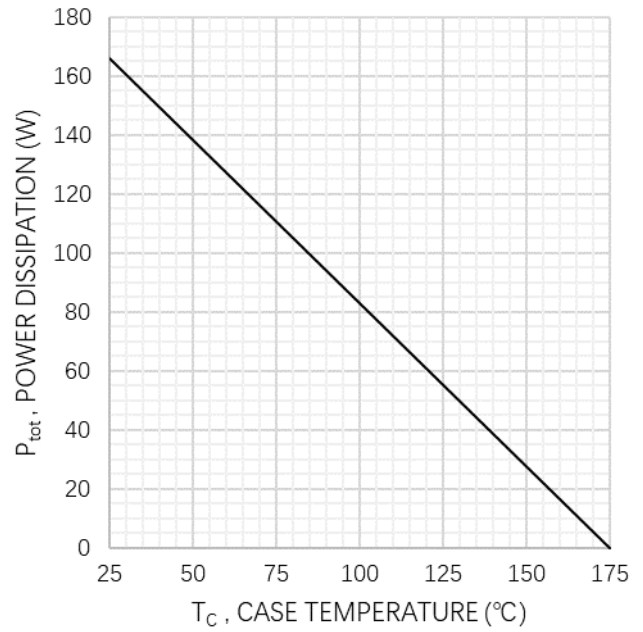


Fig. 6 Power dissipation as a function of case temperature (TO247)

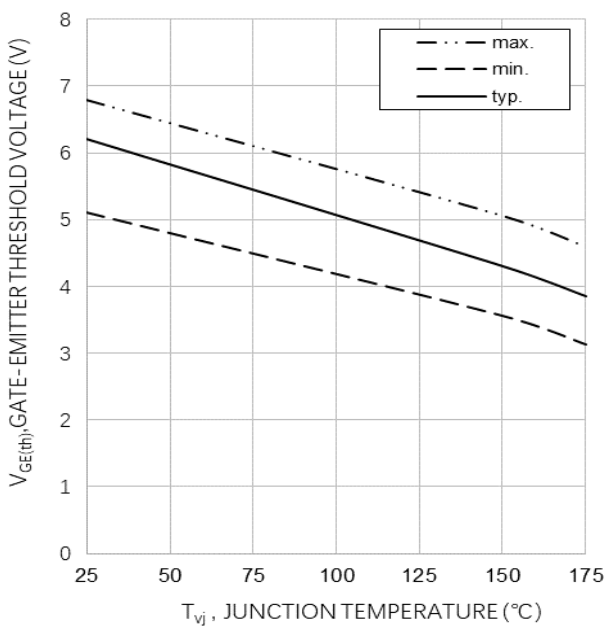


Fig. 7 Gate-emitter threshold voltage as a function of junction temperature (I<sub>C</sub>=0.40mA)

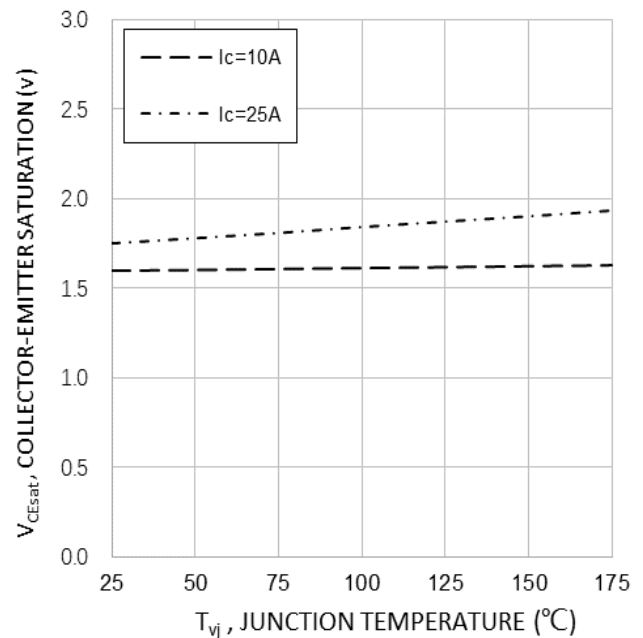
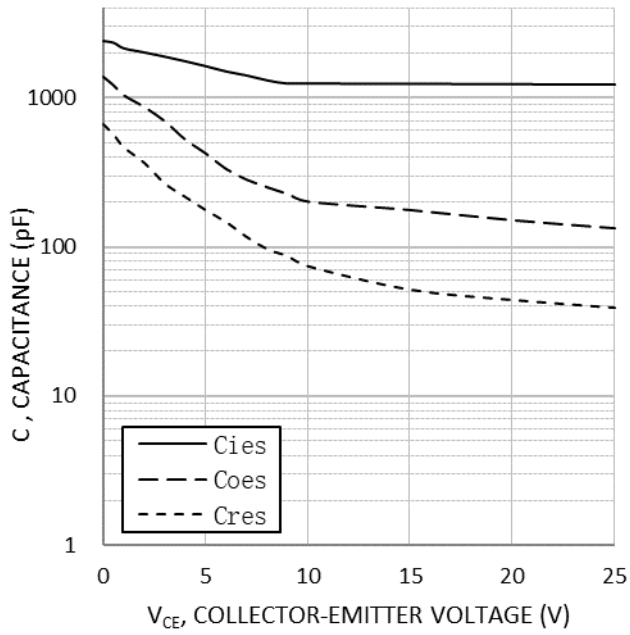
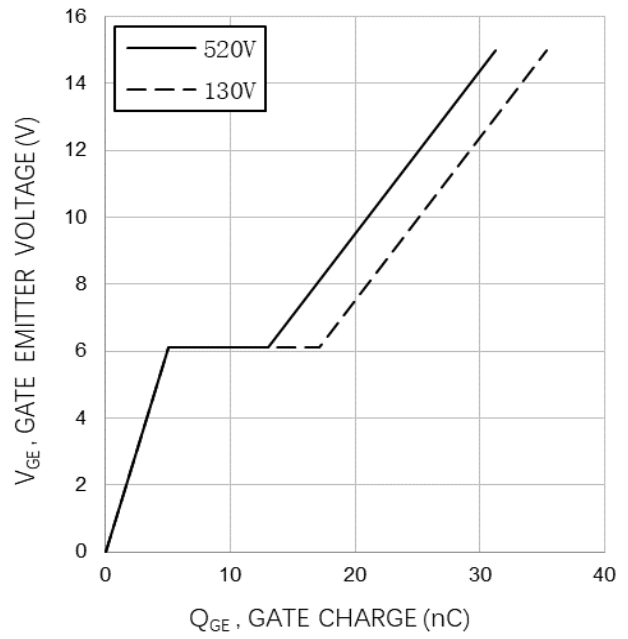


Fig. 8 Typical collector-emitter saturation voltage as a function of junction temperature (V<sub>GE</sub>=15V)



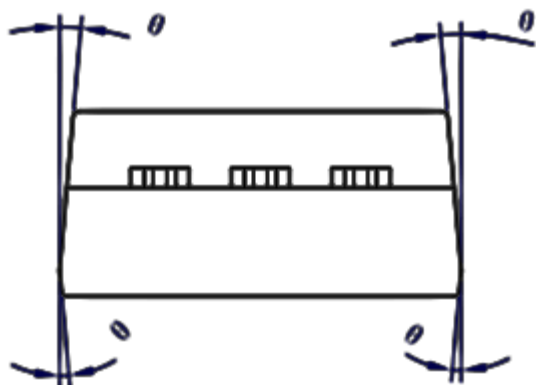
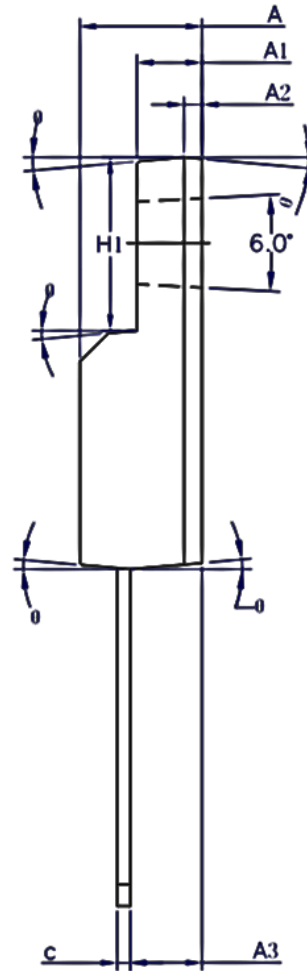
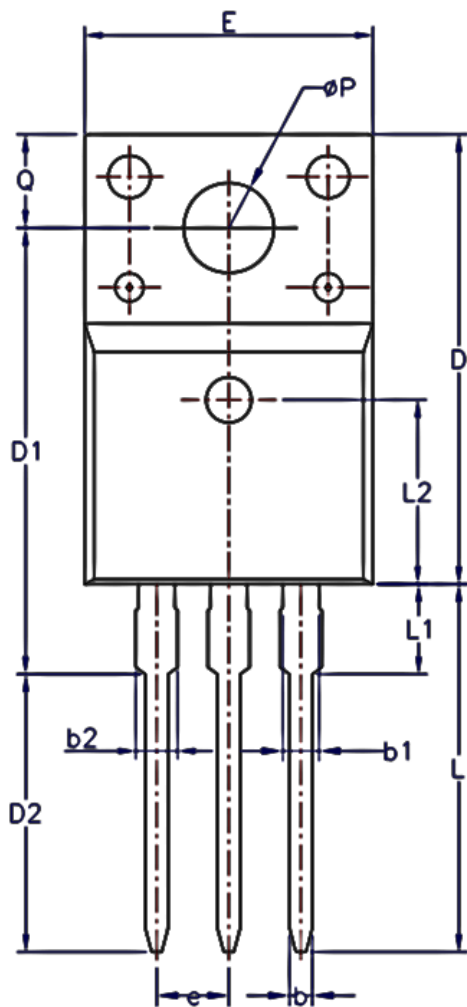
**Fig. 9 Typical capacitance as a function of collector-emitter voltage (V<sub>GE</sub>=0V, f=1MHz)**



**Fig. 10 Typical gate charge (I<sub>C</sub>=50A)**

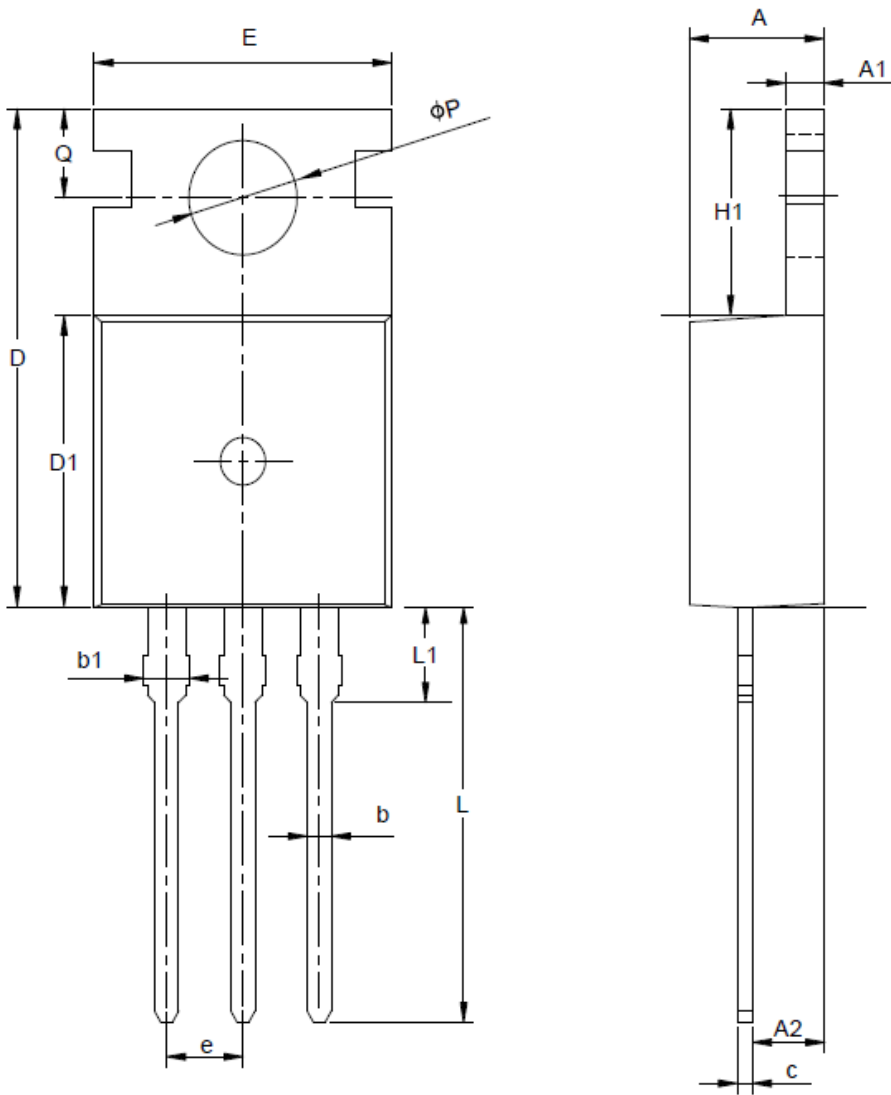
### Package Information

TO-220F



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°

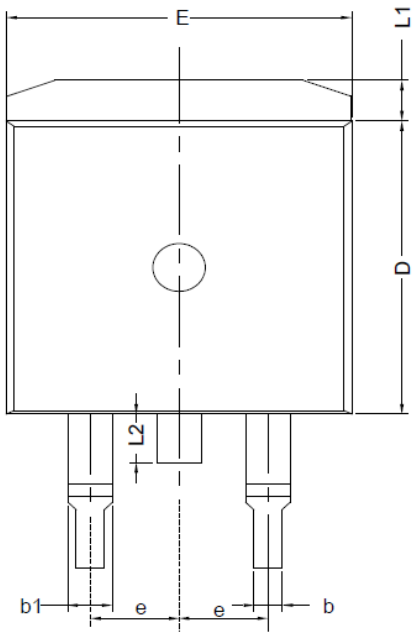
TO-220



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	4.30	4.50	4.70
A1	1.00	1.30	1.50
A2	1.80	2.40	2.80
b	0.60	0.80	1.00
b1	1.00	—	1.60
c	0.30	—	0.70
D	15.10	15.70	16.10
D1	8.10	9.20	10.00
E	9.60	9.90	10.40
e	2.54BSC		
H1	6.10	6.50	7.00
L	12.60	13.08	13.60
L1	—	—	3.95
φP	3.40	3.70	3.90
Q	2.60	—	3.20

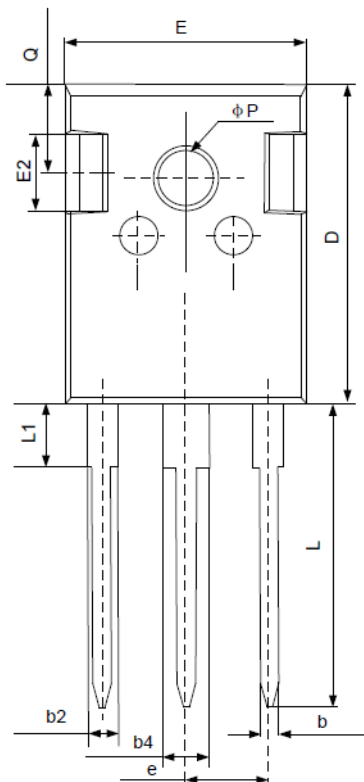


TO-263



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	4.30	4.57	4.72
A1	0	0.10	0.25
b	0.71	0.81	0.91
b1	1.17	—	1.50
c	0.30	—	0.60
c2	1.17	1.27	1.37
D	8.50	—	9.35
E	9.80	—	10.45
e	2.54BSC		
H	14.70	—	15.75
L	2.00	2.30	2.74
L1	1.12	1.27	1.42
L2	—	—	1.75

TO247



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	4.80	5.00	5.20
A1	2.21	2.41	2.59
A2	1.85	2.00	2.15
b	1.11	—	1.36
b2	1.91	—	2.25
b4	2.91	—	3.25
c	0.51	—	0.75
D	20.80	21.00	21.30
E	15.50	15.80	16.10
E2	4.40	5.00	5.20
e	5.44 BSC		
L	19.72	19.92	20.22
L1	—	—	4.30
Q	5.60	5.80	6.00
P	3.40	—	3.80