

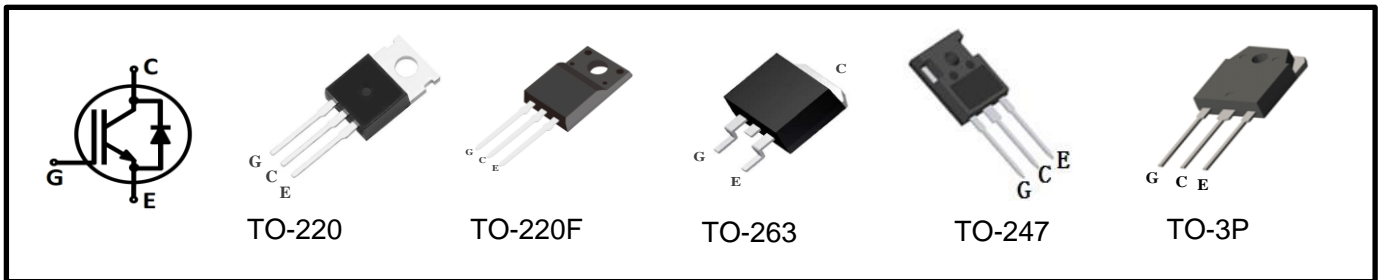
## Features

- Easy parallel switching capability due to positive temperature coefficient in  $V_{CEsat}$
- Low  $V_{CEsat}$ , fast switching
- High ruggedness, good thermal stability
- Very tight parameter distribution

## Applications

- Motor Drives

Type	Marking	Package Code
MPBP20N65EF	MP20N65EF	TO-220
MPBA20N65EF	MP20N65EF	TO-220F
MPBC20N65EF	MP20N65EF	TO-263
MPBW20N65EF	MP20N65EF	TO-247
MPBT20N65EF	MP20N65EF	TO-3P



## Maximum Rated Values <sup>1</sup>

Parameter	Symbol	Value				Unit				
		220F	263/ 220	247	3P					
Collector-emitter voltage	$V_{CE}$	650				V				
DC collector current <sup>2</sup>	$I_C$	40				A				
$T_C=25^\circ\text{C}$										
$T_C=100^\circ\text{C}$							20			
Pulsed collector current <sup>3</sup>							60			
Diode forward current <sup>2</sup>	$I_F$	40				A				
$T_C=25^\circ\text{C}$										
$T_C=100^\circ\text{C}$							20			
Diode pulsed current <sup>3</sup>							60			
Short circuit withstanding time $V_{GE} = 15\text{V}, V_{CC} \leq 400\text{V}$	$t_{SC}$	5				us				
Gate-emitter voltage	$V_{GE}$	$\pm 20$				V				
Transient Gate-emitter voltage ( $t_p \leq 10\mu\text{s}$ )		$\pm 30$								

1: Reference standard: JEESD-022 2: limited by  $T_{jmax}$  3:  $T_p$  limited by  $T_{jmax}$  ;



Parameter	Symbol	Value				Unit
		220F	263/220	247	3P	
Power dissipation						W
$T_C=25^\circ\text{C}$	$P_{\text{tot}}$	55	214	166	166	
$T_C=100^\circ\text{C}$		28	107	83	83	
Operating junction temperature	$T_j$	-55~175				°C
Storage temperature	$T_{\text{stg}}$	-55~150				

### Thermal Characteristics

Parameter	Symbol	Max				Unit
		220F	263/220	247	3P	
IGBT thermal resistance, junction-case	$R_{\text{thJC}}$	2.7	0.7	0.9	0.9	K/W
Diode thermal resistance, junction-case	$R_{\text{thJCD}}$	3.8	1.6	1.9	1.9	

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

#### Static Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Collector-emitter breakdown voltage	$V_{(\text{BR})\text{CES}}$	$V_{\text{GE}}=0\text{V}$ , $I_C=0.25\text{mA}$	650	-	-	V
Collector-emitter saturation voltage	$V_{\text{CE}(\text{sat})}$	$V_{\text{GE}}=15\text{V}$ , $I_C=20\text{A}$ $T_j=25^\circ\text{C}$	-	1.45	1.90	
		$T_j=125^\circ\text{C}$	-	1.53	-	
		$T_j=150^\circ\text{C}$	-	1.55	-	
Diode forward voltage	$V_F$	$V_{\text{GE}}=0\text{V}$ , $I_F=20\text{A}$ $T_j=25^\circ\text{C}$	-	1.55	1.80	
		$T_j=125^\circ\text{C}$	-	1.44	-	
		$T_j=150^\circ\text{C}$	-	1.40	-	
G-E threshold voltage	$V_{\text{GE}(\text{th})}$	$I_C=250\mu\text{A}$ , $V_{\text{CE}}=V_{\text{GE}}$	4.5	5.8	6.5	mA
C-E leakage current	$I_{\text{CES}}$	$V_{\text{CE}}=650\text{V}$ , $V_{\text{GE}}=0\text{V}$ $T_j=25^\circ\text{C}$	-	-	0.01	
		$T_j=150^\circ\text{C}$	-	-	1.0	
G-E leakage current	$I_{\text{GES}}$	$V_{\text{CE}}=0\text{V}$ , $V_{\text{GE}}=20\text{V}$	-	-	250	nA



### Dynamic Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Input capacitance	$C_{iss}$	$V_{CE}=25V,$ $V_{GE}=0V,$ $f=1MHz$	-	2091	-	pF
Output capacitance	$C_{oss}$		-	69	-	
Reverse transfer capacitance	$C_{rss}$		-	32	-	
Gate charge	$Q_G$	$V_{CC}=300V, I_C=20A,$ $V_{GE}=15V$	-	113	-	nC

### IGBT Switching Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Turn-on delay time	$t_{d(on)}$	$T_j=25^{\circ}C,$ $V_{CC}=400V,$ $I_C=20A,$ $V_{GE}=0/15V,$ $R_G=10\Omega,$ Inductive load	-	79	-	ns
Rise time	$t_r$		-	39	-	
Turn-off delay time	$t_{d(off)}$		-	155	-	
Fall time	$t_f$		-	52	-	
Turn-on energy	$E_{on}$		-	0.373	-	mJ
Turn-off energy	$E_{off}$		-	0.376	-	
Total switching energy	$E_{ts}$		-	0.749	-	
Turn-on delay time	$t_{d(on)}$	$T_j=150^{\circ}C,$ $V_{CC}=400V,$ $I_C=20A,$ $V_{GE}=0/15V,$ $R_G=10\Omega,$ Inductive load	-	71.2	-	ns
Rise time	$t_r$		-	38.8	-	
Turn-off delay time	$t_{d(off)}$		-	211.2	-	
Fall time	$t_f$		-	103.6	-	
Turn-on energy	$E_{on}$		-	0.618	-	mJ
Turn-off energy	$E_{off}$		-	0.594	-	
Total switching energy	$E_{ts}$		-	1.212	-	



## Diode Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Diode reverse recovery time	$t_{rr}$	$T_j=25^{\circ}\text{C}$ , $V_R=400\text{V}$ , $I_F=20\text{A}$ , $di_F/dt=520\text{A}/\mu\text{s}$	-	74	-	ns
Diode reverse recovery charge	$Q_{rr}$		-	0.389	-	$\mu\text{C}$
Diode peak reverse recovery current	$I_{rrm}$		-	7.8	-	A
Diode reverse recovery time	$t_{rr}$	$T_j=150^{\circ}\text{C}$ , $V_R=400\text{V}$ , $I_F=20\text{A}$ , $di_F/dt=588\text{A}/\mu\text{s}$	-	130	-	ns
Diode reverse recovery charge	$Q_{rr}$		-	1.421	-	$\mu\text{C}$
Diode peak reverse recovery current	$I_{rrm}$		-	20.4	-	A

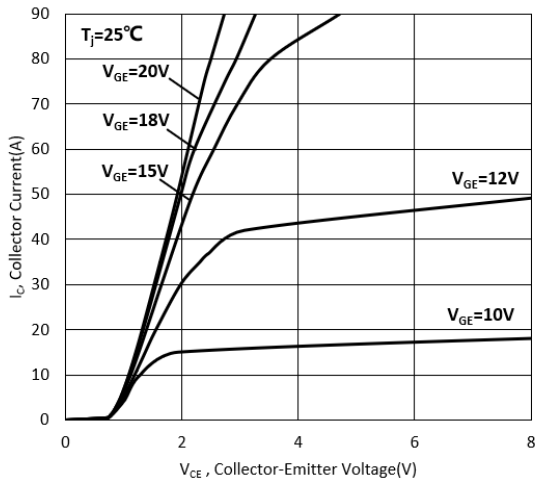


Figure 1. Typical output characteristic ( $T_j = 25^\circ\text{C}$ )

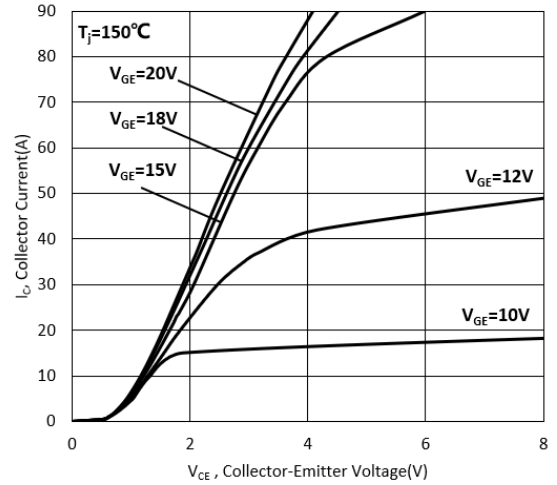


Figure 2. Typical output characteristic ( $T_j = 150^\circ\text{C}$ )

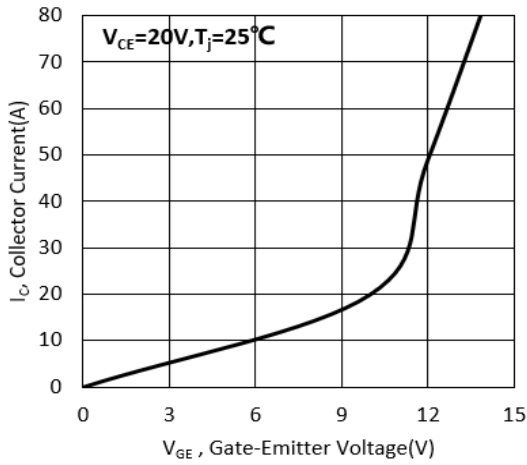


Figure 3. Typical transfer characteristic ( $T_j = 25^\circ\text{C}$ )

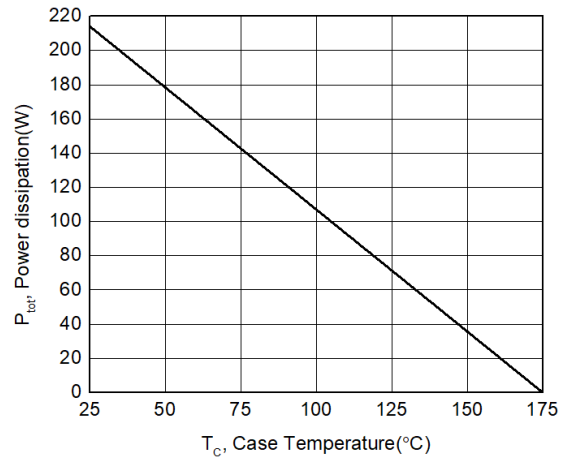


Figure 4. Power dissipation as a function of case temperature (TO-220)

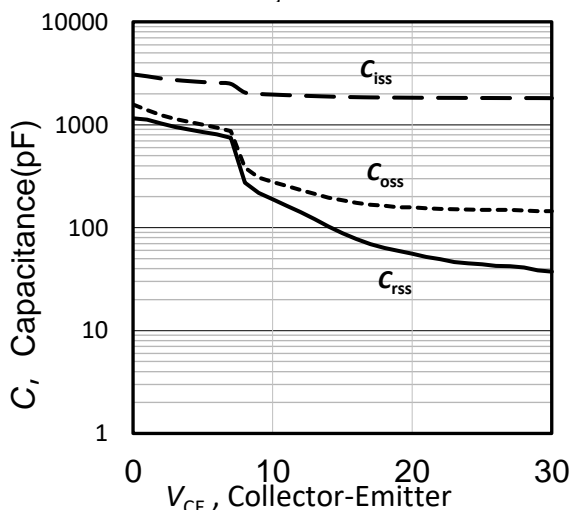


Figure 5. Capacitance characteristic ( $V_{GE} = 0\text{V}$ ,  $f = 1\text{MHz}$ )

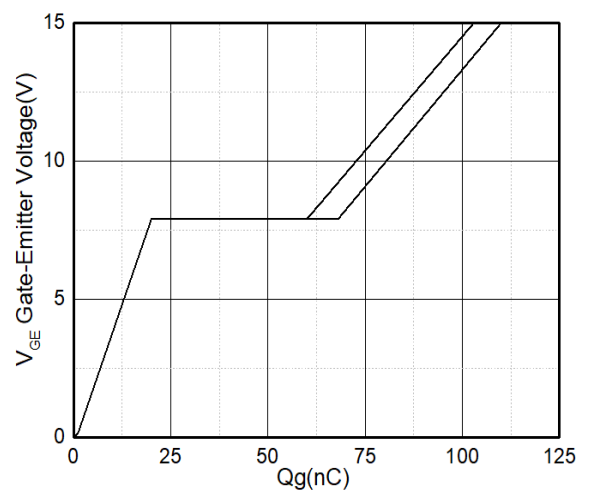


Figure 6. Typical gate charge ( $I_C = 20\text{A}$ )

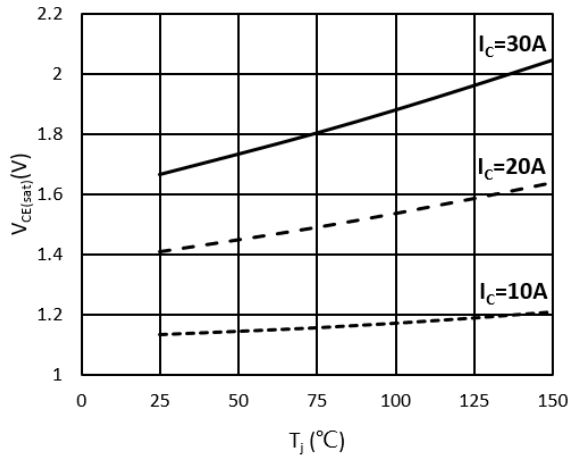


Figure 7.  $V_{CESAT}$  as a function of junction temperature ( $V_{GE}=15V$ )

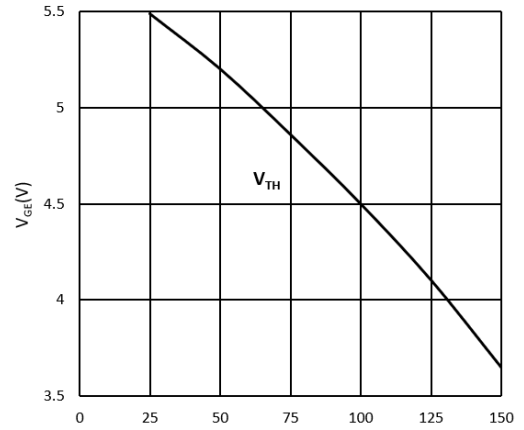


Figure 8.  $V_{TH}$  as a function of junction temperature ( $I_{CE}=250\mu A$ )

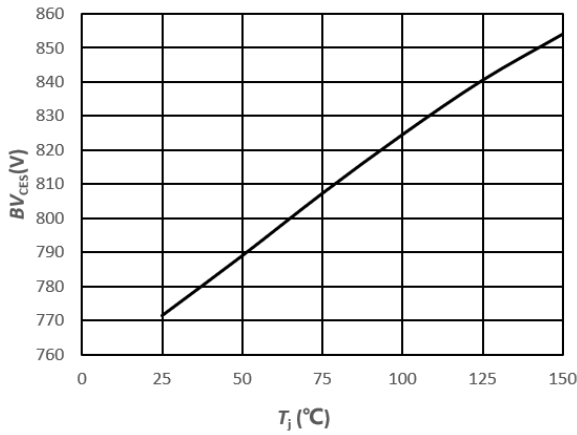


Figure 9.  $BV$  as a function of junction temperature ( $I_{CE}=250\mu A$ )

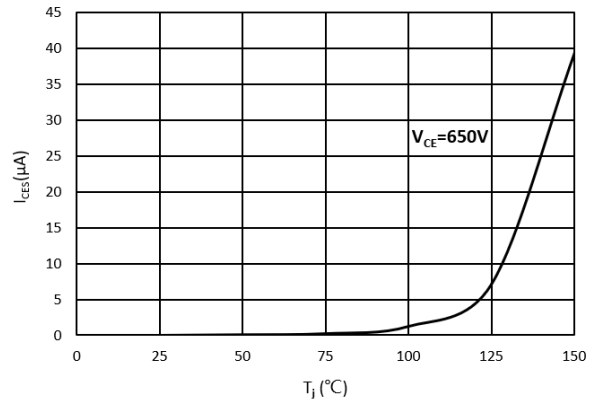


Figure 10.  $I_{CES}$  leakage current as a function of junction temperature

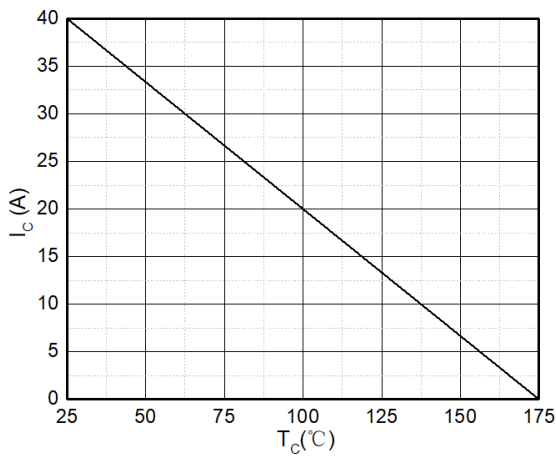


Figure 11. Collector current as a function of case temperature ( $V_{GE} \geq 15V$ ,  $T_j \leq 175^\circ C$ )

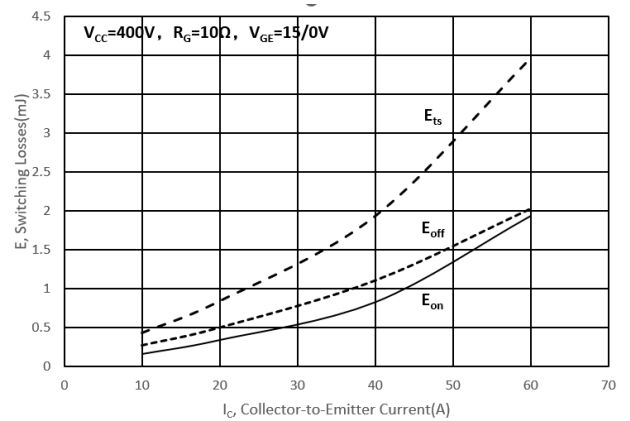


Figure 12.  $E_{on}$ ,  $E_{off}$  as a function of  $I_C$  ( $T_j=25^\circ C$ )

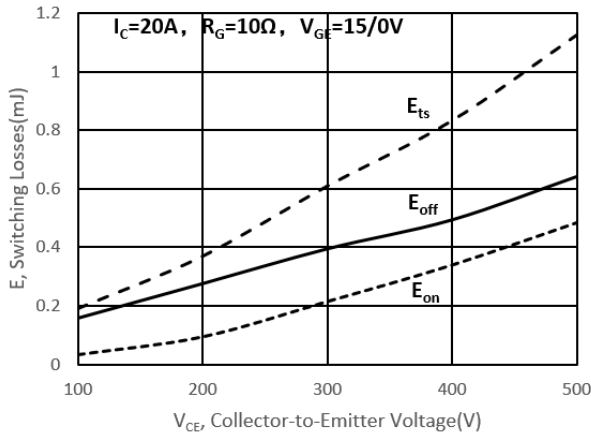


Figure 13.  $E_{on}$ ,  $E_{off}$  as a function of  $V_{CE}$  ( $T_j=25^\circ C$ )

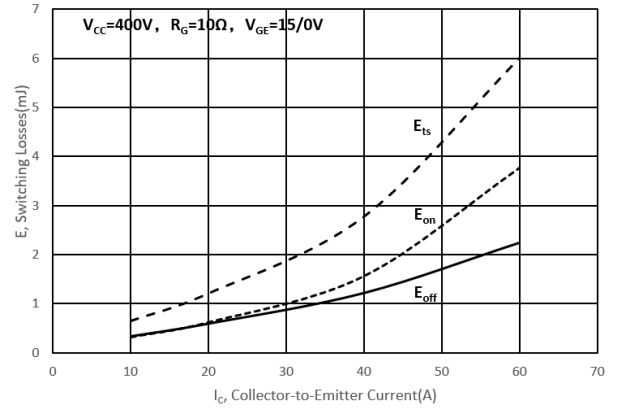


Figure 14.  $E_{on}$ ,  $E_{off}$  as a function of  $I_C$  ( $T_j=150^\circ C$ )

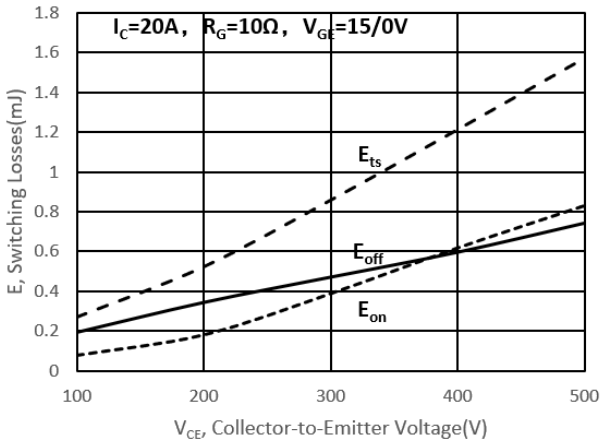


Figure 15.  $E_{on}$ ,  $E_{off}$  as a function of  $V_{CE}$  ( $T_j=150^\circ C$ )

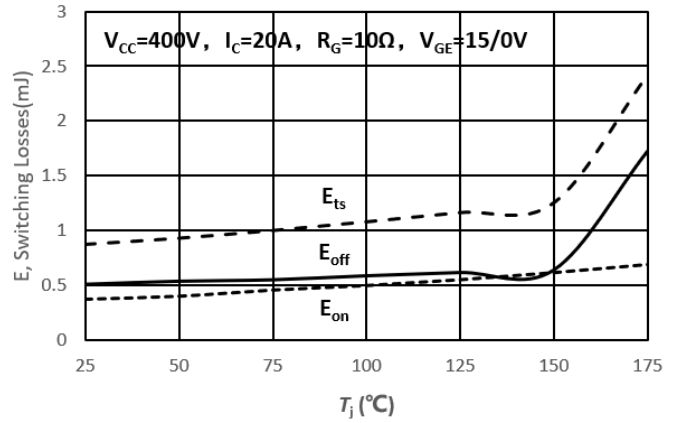
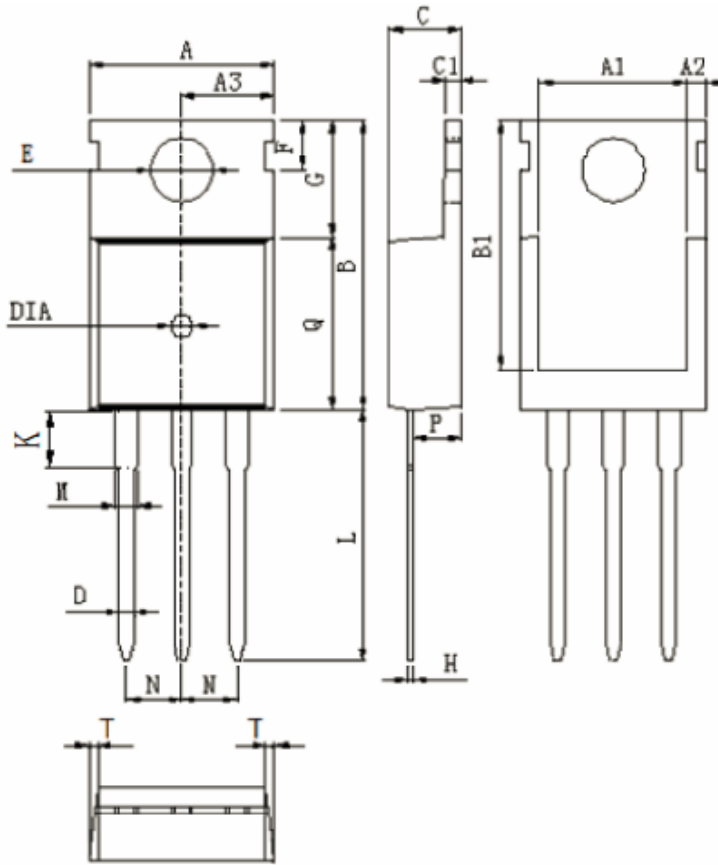


Figure 16.  $E_{on}$ ,  $E_{off}$  as a function of junction temperature

TO-220-3L

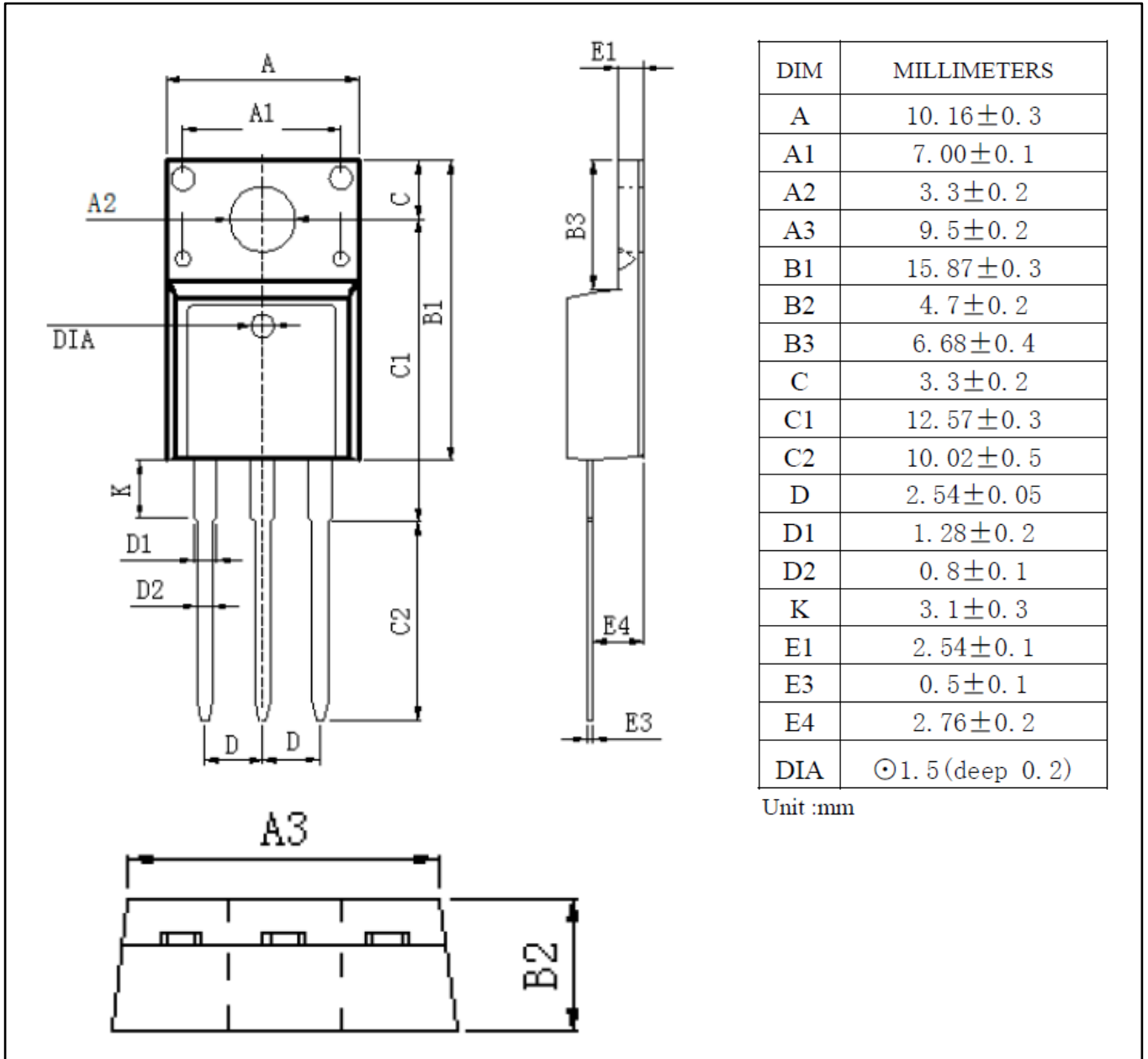


DIM	MILLIMETERS
A	10.0±0.3
A1	8.64±0.2
A2	1.15±0.1
A3	5.0±0.2
B	15.8±0.4
B1	13.2±0.3
C	4.56±0.1
C1	1.3±0.2
D	0.8±0.2
E	3.6±0.2
F	2.95±0.3
G	6.5±0.3
H	0.5±0.1
K	3.1±0.2
L	13.2±0.4
M	1.25±0.1
N	2.54±0.1
P	2.4±0.3
Q	9.0±0.3
T	W:0.35
DIA	⊙1.5 (deep 0.2)

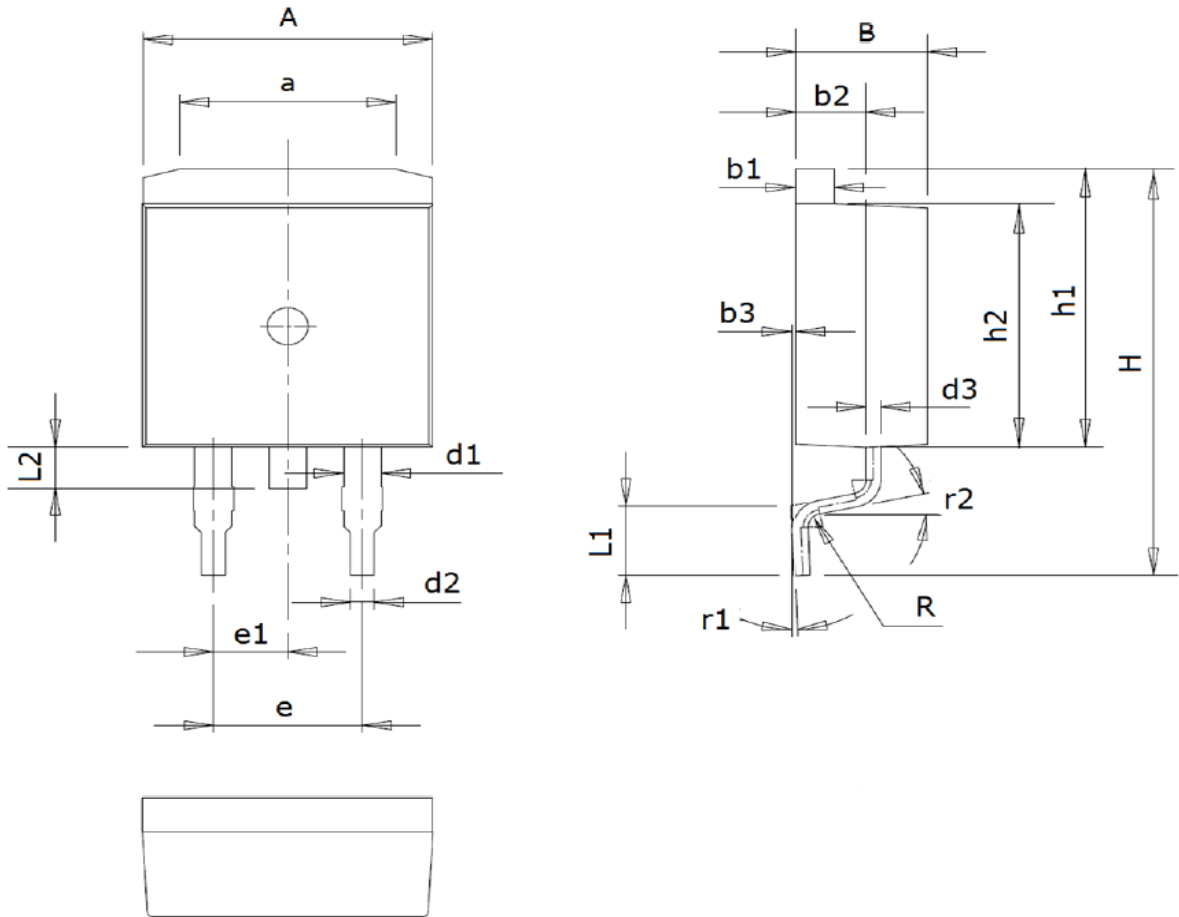
Unit :mm



TO-220F-3L

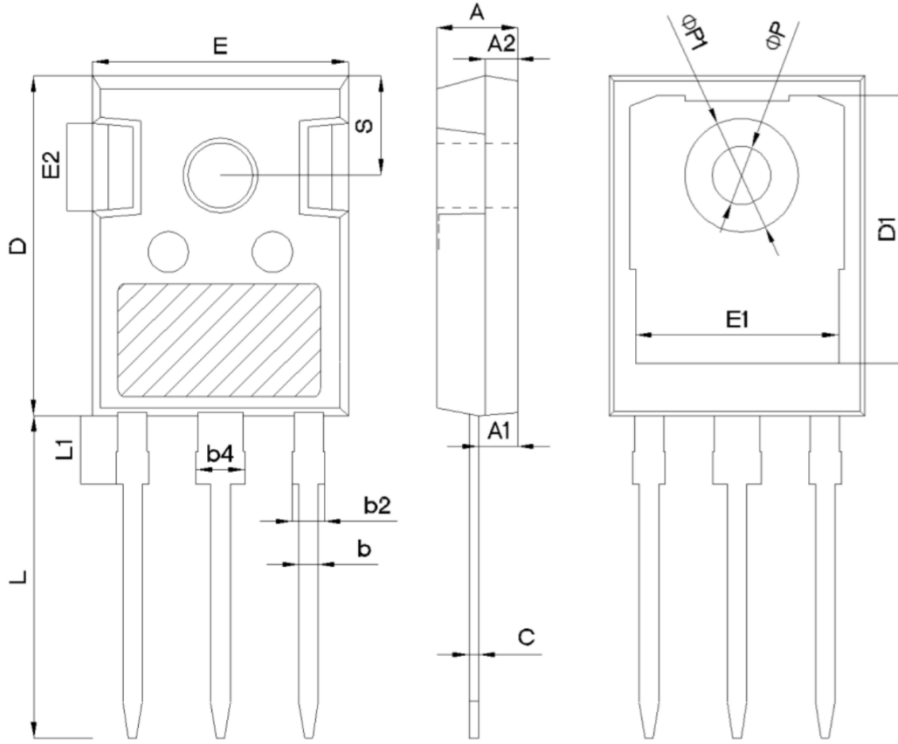


TO-263



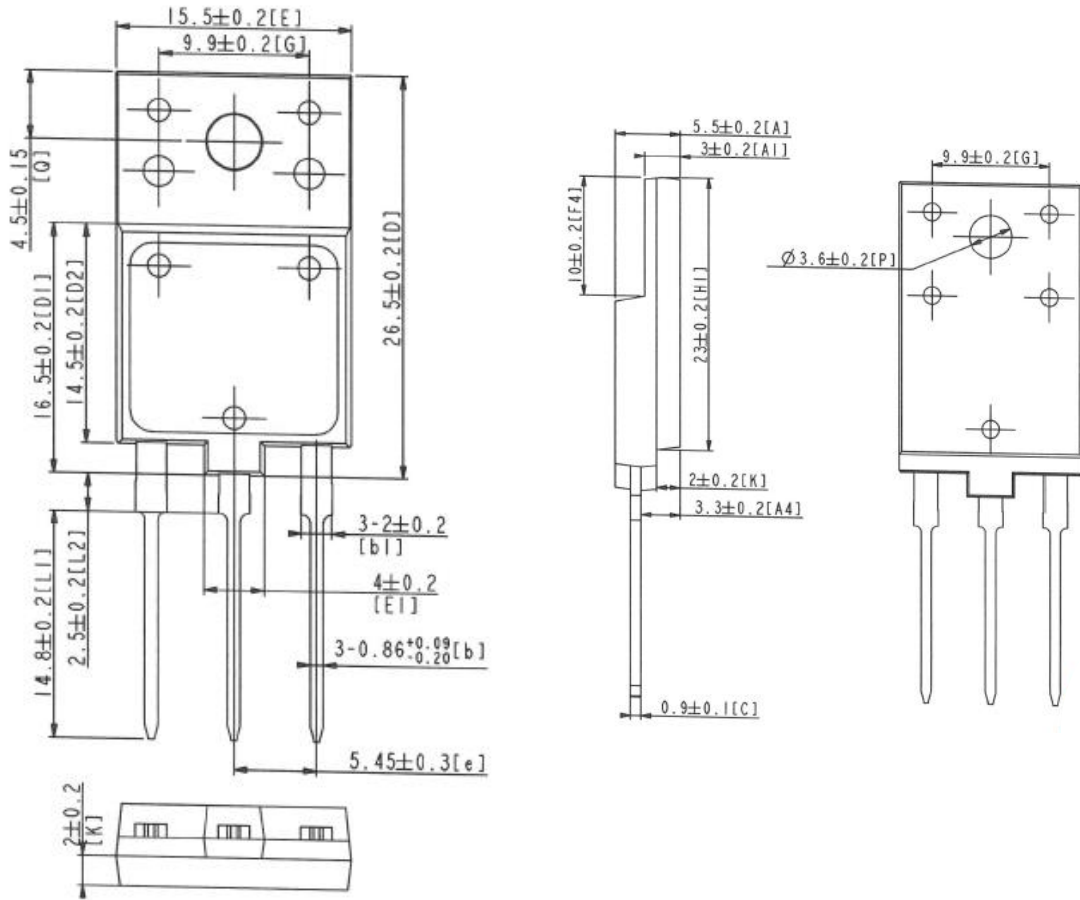
Symbol	Dimensions (mm)	Symbol	Dimensions (mm)	Symbol	Dimensions (mm)
A	9.86~10.26	d2	0.7~0.96	L1	2.0~2.6
a	7.0~7.8	d3	0.3~0.53	L2	1.3~1.8
B	4.37~4.77	e	5.08	R	0.5
b1	1.22~1.42	e1	2.54	r1	0-9°
b2	2.2~2.6	H	14.7~15.5	r2	12°
b3	0~0.25	h1	10.3~10.7		
d1	1.17~1.47	h2	9.1~9.4		

TO-247-3L



SYMBOL	mm		
	MIN	NOM	MAX
A	4.80	5.00	5.20
A1	2.21	2.41	2.61
A2	1.85	2.00	2.15
b	1.11	1.21	1.36
b2	1.91	2.01	2.21
b4	2.91	3.01	3.21
c	0.51	0.61	0.75
D	20.70	21.00	21.30
D1	16.25	16.55	16.85
E	15.50	15.80	16.10
E1	13.00	13.30	13.60
E2	4.80	5.00	5.20
E3	2.30	2.50	2.70
e	5.44BSC		
L	19.62	19.92	20.22
L1	-	-	4.30
ΦP	3.40	3.60	3.80
ΦP1	-	-	7.30
S	6.15BSC		

TO-3P



SYMBOL	mm		
	MIN	NOM	MAX
A	5.3	5.5	5.7
A1	2.8	3.0	3.2
b	0.66	0.86	0.95
b1	1.8	2.0	2.2
A4	3.1	3.3	3.5
C	0.8	0.9	1
D	26.3	26.5	26.7
D1	16.3	16.5	16.7
D2	14.3	14.5	14.7
P	3.4	3.6	3.8
E	15.3	15.5	15.7
E1	3.8	4.0	4.2
e	5.15	5.45	5.75
G	9.7	9.9	10.1
Q	4.35	4.5	4.65
L1	14.6	14.8	15
L2	2.3	2.5	2.7
K	1.8	2	2.2
F4	9.8	10	10.2
H1	22.8	23	23.2
K	1.8	2	2.2



**Revision History:**

Revision	Date	Subjects (major changes since last revision)
1.0	2022-03	Initial version
1.1	2023-01	Add the graphs



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