

TO-220



**Pin Definition:**

1. Base
2. Collector
3. Emitter

**PRODUCT SUMMARY**

<b><math>BV_{CEO}</math></b>	400V
<b><math>BV_{CBO}</math></b>	700V
<b><math>I_C</math></b>	12A
<b><math>V_{CE(SAT)}</math></b>	1.5V @ $I_C / I_B = 12A / 3A$

**Features**

- High Voltage
- High Speed Switching

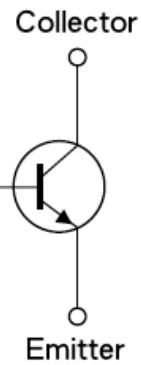
**Structure**

- Silicon Triple Diffused Type
- NPN Silicon Transistor

**Ordering Information**

Part No.	Package	Packing
TS13009CZ C0	TO-220	50pcs / Tube

**Block Diagram**



**Absolute Maximum Rating** ( $T_a = 25^\circ\text{C}$  unless otherwise noted)

Parameter	Symbol	Limit	Unit	
Collector-Base Voltage	$V_{CBO}$	700V	V	
Collector-Emitter Voltage	$V_{CEO}$	400V	V	
Emitter-Base Voltage	$V_{EBO}$	9	V	
Collector Current	$I_C$	DC	12	A
		Pulse	24	
Base Current	$I_B$	DC	6	A
		Pulse	12	
Total Power Dissipation	$P_D$	100	W	
Operating Junction Temperature	$T_J$	+150	$^\circ\text{C}$	
Operating Junction and Storage Temperature Range	$T_{STG}$	- 55 to +150	$^\circ\text{C}$	

Note: Single Pulse.  $P_W = 300\mu\text{s}$ , Duty  $\leq 2\%$

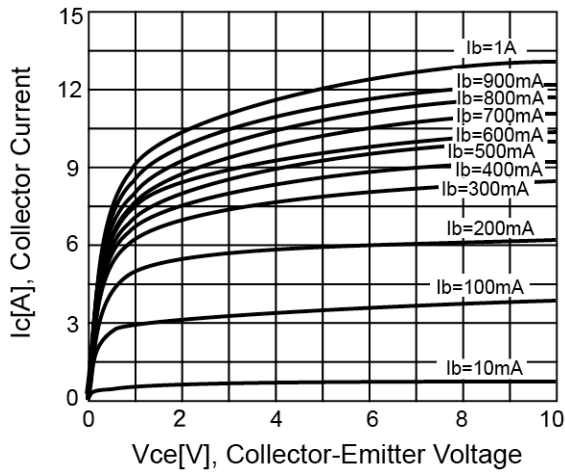
### Electrical Specifications (Ta = 25°C unless otherwise noted)

Parameter	Conditions	Symbol	Min	Typ	Max	Unit
<b>Static</b>						
Collector-Base Voltage	$I_C = 1\text{mA}, I_B = 0$	$BV_{CBO}$	700	--	--	V
Collector-Emitter Breakdown Voltage	$I_C = 10\text{mA}, I_E = 0$	$BV_{CEO}$	400	--	--	V
Emitter-Base Breakdown Voltage	$I_E = 1\text{mA}, I_C = 0$	$BV_{EBO}$	9	--	--	V
Collector Cutoff Current	$V_{CE} = 400\text{V}, I_B = 0$	$I_{CEO}$	--	--	1	mA
Collector Cutoff Current	$V_{CB} = 700\text{V}, I_E = 0$	$I_{CBO}$	--	--	1	mA
Emitter Cutoff Current	$V_{EB} = 9\text{V}, I_C = 0$	$I_{EBO}$	--	--	1	mA
Collector-Emitter Saturation Voltage	$I_C = 5\text{A}, I_B = 1\text{A}$	$V_{CE(SAT)1}$	--	--	1	V
	$I_C = 8\text{A}, I_B = 1.6\text{A}$	$V_{CE(SAT)2}$	--	--	1.5	
	$I_C = 12\text{A}, I_B = 3\text{A}$	$V_{CE(SAT)3}$	--	--	3	
Base-Emitter Saturation Voltage	$I_C = 5\text{A}, I_B = 1\text{A}$	$V_{BE(SAT)1}$	--	--	1.2	V
	$I_C = 8\text{A}, I_B = 1.6\text{A}$	$V_{BE(SAT)2}$	--	--	1.6	
DC Current Gain	$V_{CE} = 5\text{V}, I_C = 5\text{A}$	$h_{FE}$	8	--	40	
	$V_{CE} = 5\text{V}, I_C = 8\text{A}$		6	--	30	
<b>Dynamic</b>						
Frequency	$V_{CE} = 10\text{V}, I_C = 0.5\text{A}$	$f_T$	4	--	--	MHz
Output Capacitance	$V_{CB} = 10\text{V}, f = 0.1\text{MHz}$	$C_{ob}$	--	180	--	pF
<b>Resistive Load Switching Time (Ratings)</b>						
Delay Time	$V_{CC} = 125\text{V}, I_C = 8\text{A},$ $I_{B1} = I_{B2} = 1.6\text{A}, t_P = 25\mu\text{s}$ Duty Cycle $\leq 1\%$	$t_d$	--	0.06	0.1	$\mu\text{s}$
Rise Time		$t_r$	--	0.45	1	$\mu\text{s}$
Storage Time		$t_{STG}$	--	2.8	3.3	$\mu\text{s}$
Fall Time		$t_f$	--	0.3	0.5	$\mu\text{s}$

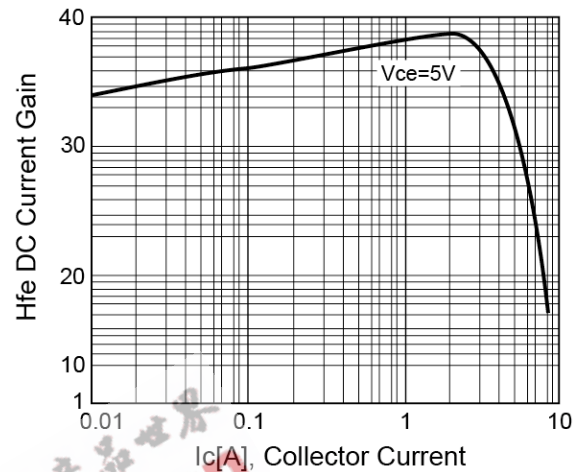
Note: pulse test: pulse width  $\leq 300\mu\text{s}$ , duty cycle  $\leq 2\%$

**Electrical Characteristics Curve** ( $T_a = 25^\circ\text{C}$ , unless otherwise noted)

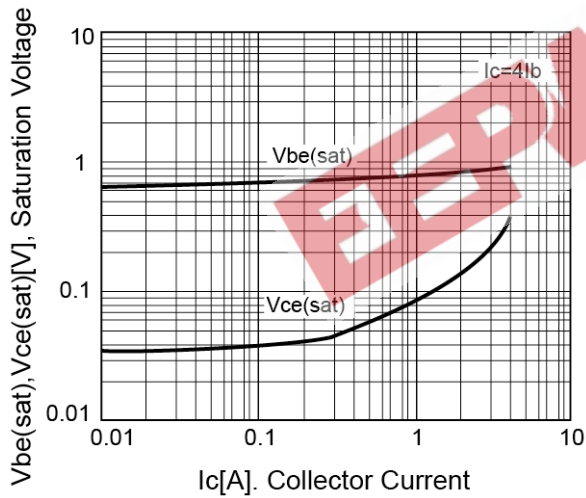
**Figure 1. Static Characteristics**



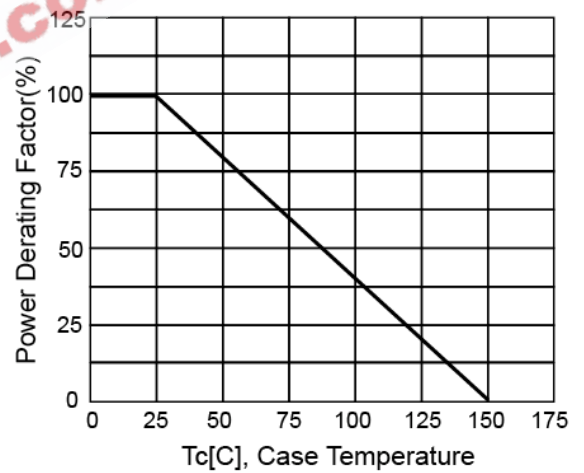
**Figure 2. DC Current Gain**



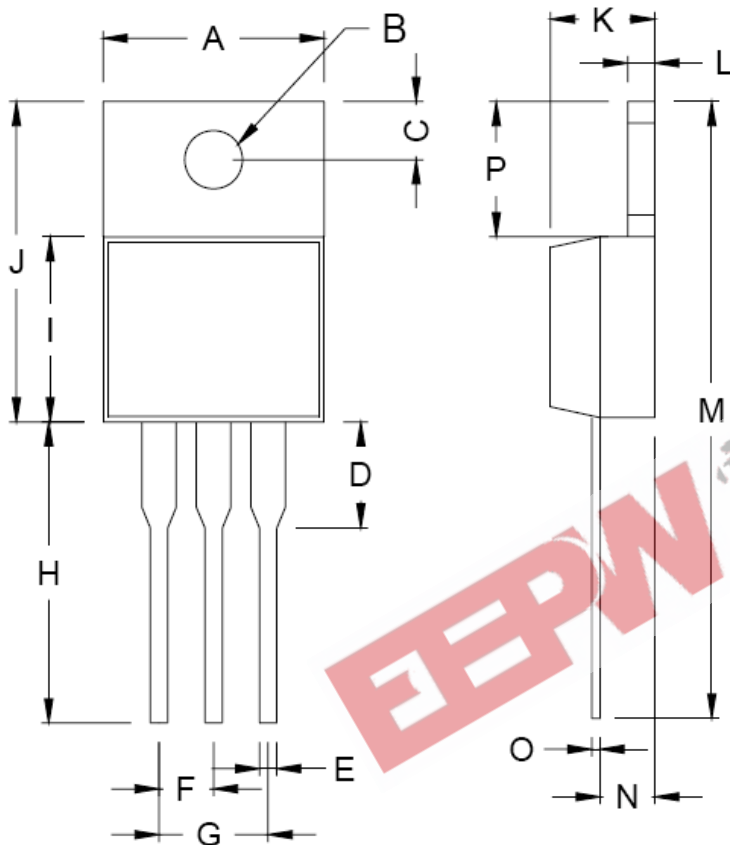
**Figure 3.  $V_{CE(SAT)}$  v.s.  $V_{BE(SAT)}$**



**Figure 4. Power Derating**

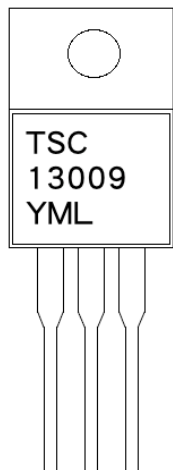


**TO-220 Mechanical Drawing**



TO-220 DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	10.000	10.500	0.394	0.413
B	3.740	3.910	0.147	0.154
C	2.440	2.940	0.096	0.116
D	-	6.350	-	0.250
E	0.381	1.106	0.015	0.040
F	2.345	2.715	0.092	0.058
G	4.690	5.430	0.092	0.107
H	12.700	14.732	0.500	0.581
J	14.224	16.510	0.560	0.650
K	3.556	4.826	0.140	0.190
L	0.508	1.397	0.020	0.055
M	27.700	29.620	1.060	1.230
N	2.032	2.921	0.080	0.115
O	0.255	0.610	0.010	0.024
P	5.842	6.858	0.230	0.270

**Marking Diagram**



- Y** = Year Code
- M** = Month Code  
(A=Jan, B=Feb, C=Mar, D=Apl, E=May, F=Jun, G=Jul, H=Aug, I=Sep, J=Oct, K=Nov, L=Dec)
- L** = Lot Code

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