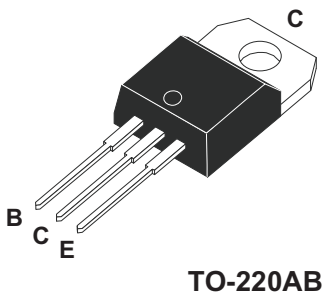
Complementary Silicon Power Transistor
3A/40~100V/40W

FEATURES

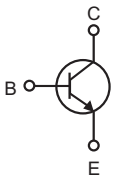
- Complementary NPN-PNP transistors
- Low collector-emitter saturation voltage
- Satisfactory linearity of foward current transfer ratio h_{FE}
- TO-220AB package which can be installed to the heat sink with one screw
- Collector - Emitter Saturation Voltage: $V_{CE(sat)} = 1.2V_{dc}$ (MAX.) @ $I_C = 3A$
- Collector - Emitter Saturation Voltage:
  $V_{CEO(sus)} = 40V_{dc}$ (Min.) - TIP31,TIP32
  $= 60V_{dc}$ (Min.) - TIP31A,TIP32A
  $= 80V_{dc}$ (Min.) - TIP31B, TIP32B
  $= 100V_{dc}$ (Min.) - TIP31C, TIP32C
- DC Current Gain $h_{FE} = 25$ (Min.) @ $I_c = 1.0A$
- High Current Gain - Bandwidth product $f_T = 3.0$ MHz (Min.) @ I_c=0.5A

APPLICATIONS

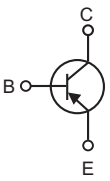
- Audio amplifier
- General purpose switching and amplifier



TO-220AB



TIP31(NPN)



TIP32(PNP)

ABSOLUTE MAXIMUM RATINGS (T_C = 25°C)

SYMBOL	PARAMETER		VALUE				UNIT
			TIP31 TIP32	TIP31A TIP32A	TIP31B TIP32B	TIP31C TIP32C	
V_{CBO}	Collector to base voltage (I_E = 0)		40	60	80	100	V
V_{CEO}	Collector to emitter voltage (I_B = 0)		40	60	80	100	
V_{EBO}	Emitter to base voltage (I_C = 0)		5				
I_C	Collector current		3				A
I_{CM}	Collector peak current (t_p < 5mS)		5				
I_B	Base current		1				
P_C	Collector power dissipation (Derate above 25°C)	@T_C = 25°C	40 (0.32)				W(W/°C)
		@T_A = 25°C	2.0 (0.016)				
T_j	Junction temperature		150				°C
T_{stg}	Storage temperature		-65 to 150				
E	Unclamped inductive load energy (Note 1)		32				mJ

Note: 1. This rating is based on the capability of the transistor to operate safely is a circuit of:
I_C = 1.8A, L = 20mH, R_{BE} = 100Ω, P.R.F = 10Hz, V_{CC} = 20V

THERMAL CHARACTERISTICS (T_C = 25°C)

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th(j-c)}$	Maximum thermal resistance, junction to case	3.1	°C/W
$R_{th(j-a)}$	Maximum thermal resistance, junction to ambient	62.5	°C/W

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise specified)

SYMBOL	PARAMETER	CONDITIONS		MIN	MAX	UNIT
◎ **Off Characteristics**						
$V_{CEO(SUS)}$	Collector to emitter sustaining voltage (Note 1)	I_C = 30mA, I_B=0	TIP31,TIP32	40		V
			TIP31A,TIP32A	60		
			TIP31B,TIP32B	80		
			TIP31C,TIP32C	100		
I_{CEO}	Collector cutoff current	V_{CE} = 30V, I_B = 0	TIP31,TIP32 TIP31A,TIP32A		0.3	mA
		V_{CE} = 60V, I_B = 0	TIP31B,TIP32B TIP31C,TIP32C			
I_{EBO}	Emitter cutoff current	V_{EB} = 5V, I_C = 0			1.0	
I_{CES}	Collector cutoff current	V_{CE} = 40V, V_{EB} = 0	TIP31,TIP32		200	μA
		V_{CE} = 60V, V_{EB} = 0	TIP31A,TIP32A		200	
		V_{CE} = 80V, V_{EB} = 0	TIP31B,TIP32B		200	
		V_{CE} = 100V, V_{EB} = 0	TIP31C,TIP32C		200	
◎ **On Characteristics**						
h_{FE}	Forward current transfer ratio (DC current gain)	V_{CE} = 4V, I_C = 1.0A		25		
		V_{CE} = 4V, I_C = 3A		10	75	
$V_{CE(sat)}$	Collector to emitter saturation voltage (Note1)	I_C = 3A, I_B = 0.375A			1.2	V
$V_{BE(on)}$	Base to emitter voltage (Note1)	I_C = 3A, V_{CE} = 4V			1.8	
◎ **Dynamic Characteristics**						
f_T	Current gain - Bandwidth product (note 2)	I_C = 0.5A, V_{CE} = 10V, f_{test} = 1MHz		3.0		MHZ
h_{fe}	Small signal current gain	I_C = 0.5A, V_{CE} = 10V, f = 1KHz		20		

Note 1. Pulsed : Pulse duration ≤ 300 μS, duty cycle ≤ 2.0%.
Note 2. $f_T = |h_{fe}| \cdot f_{TEST}$
Note 3. For PNP type voltage and current are negative.

Fig.1 Power derating

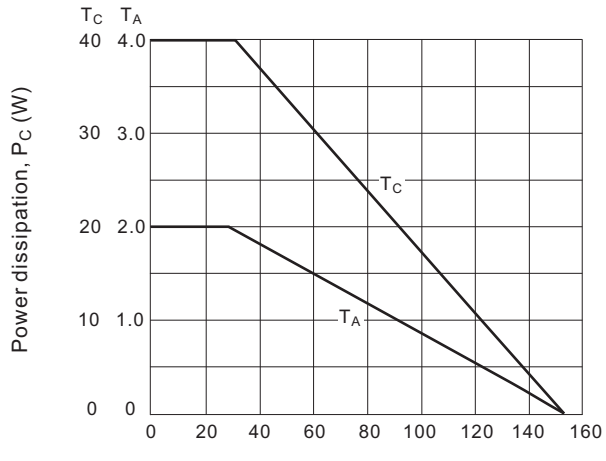
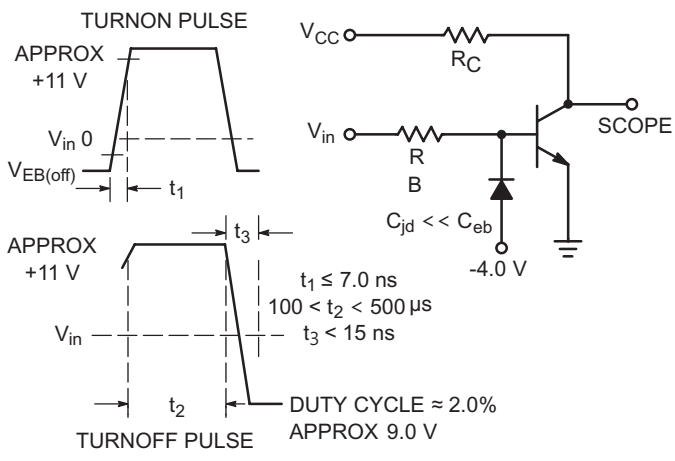


Fig 2. Switching Time Equivalent Circuit



R_B and R_C VARIED TO OBTAIN DESIRED CURRENT LEVELS.

Fig.3 Turn-on time

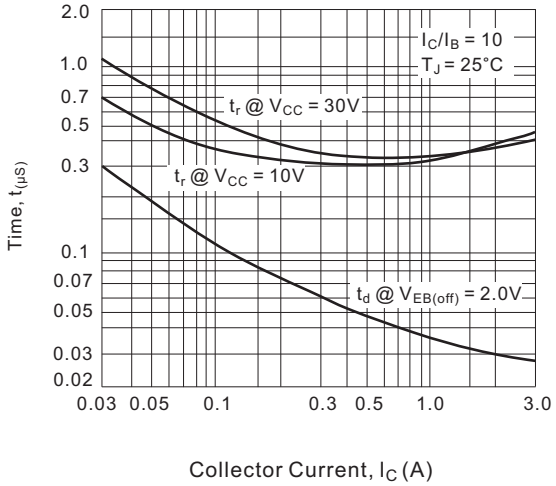


Fig.4 Turn-off time

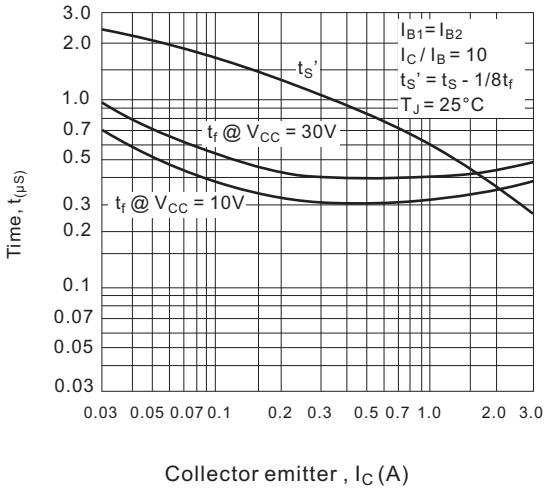
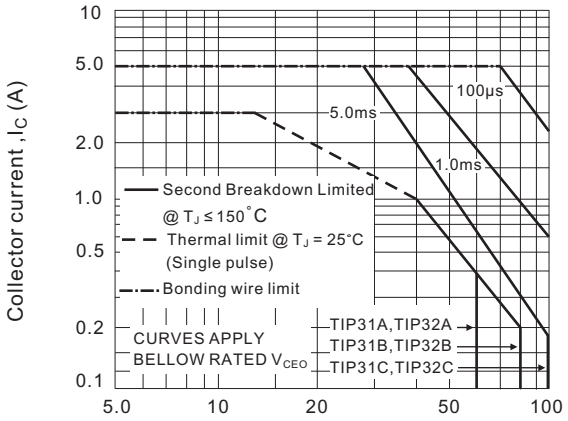


Fig.5 Active region safe operating area



There are two limitations on the power handling ability of a transistor: average junction temperature and second breakdown. Safe operating area curves indicate I_C-V_{CE} limits of the transistor that must be observed for reliable operation; i.e., the transistor must not be subjected to

The data of fig.5 is based on $T_{J(pk)}$ = 150°C; T_C is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to10% provided $T_{J(pk)} \leq$ 150°C $T_{J(pk)}$ may be calulated form the data in Figure 13. At high case temperatures, thermal limitations will reduce the power that can be handled to valuesless than the limitations by second breakdown.

Fig.6 Capacitance

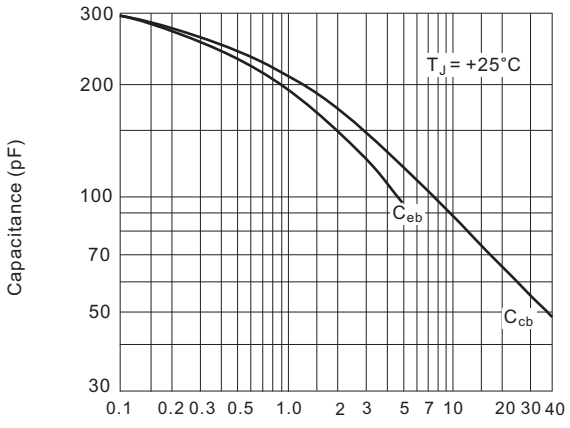


Fig.7 Dc current gain

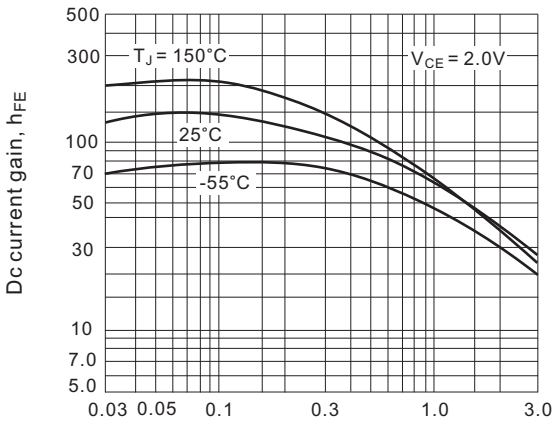


Fig.8 Collector saturation region

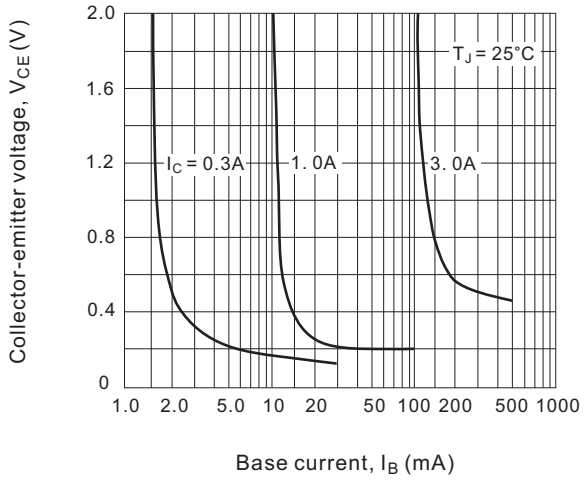


Fig.9 "On" voltages

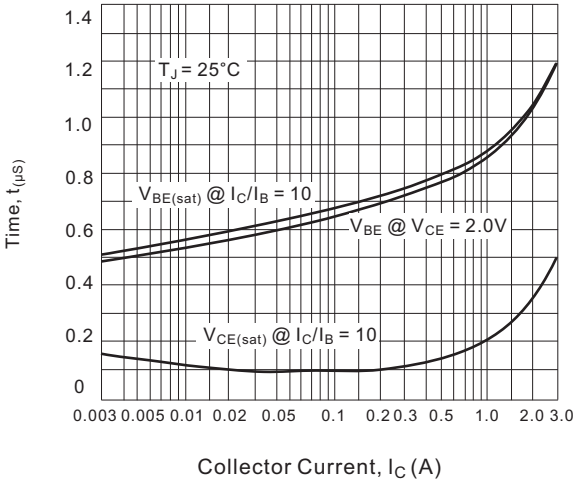


Fig.10 Temperature coeffcients

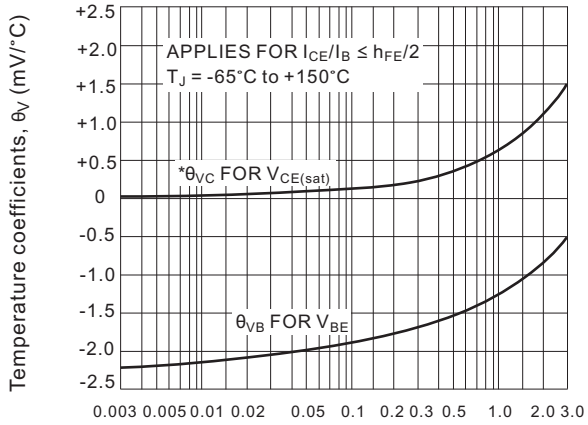


Fig.11 Collector cut-off region

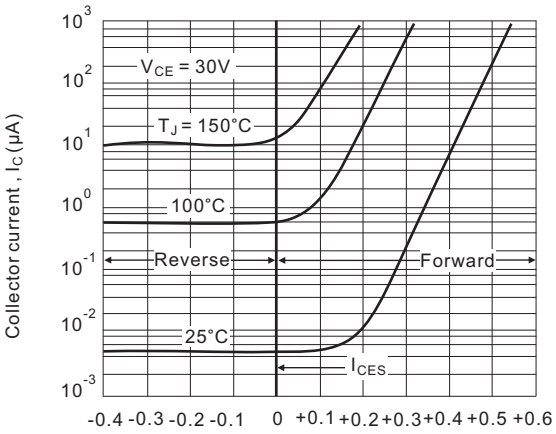


Fig.12 Effects of base-emitter resistance

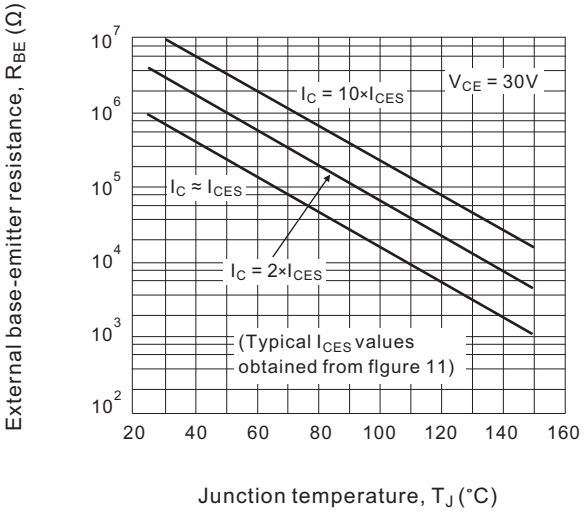
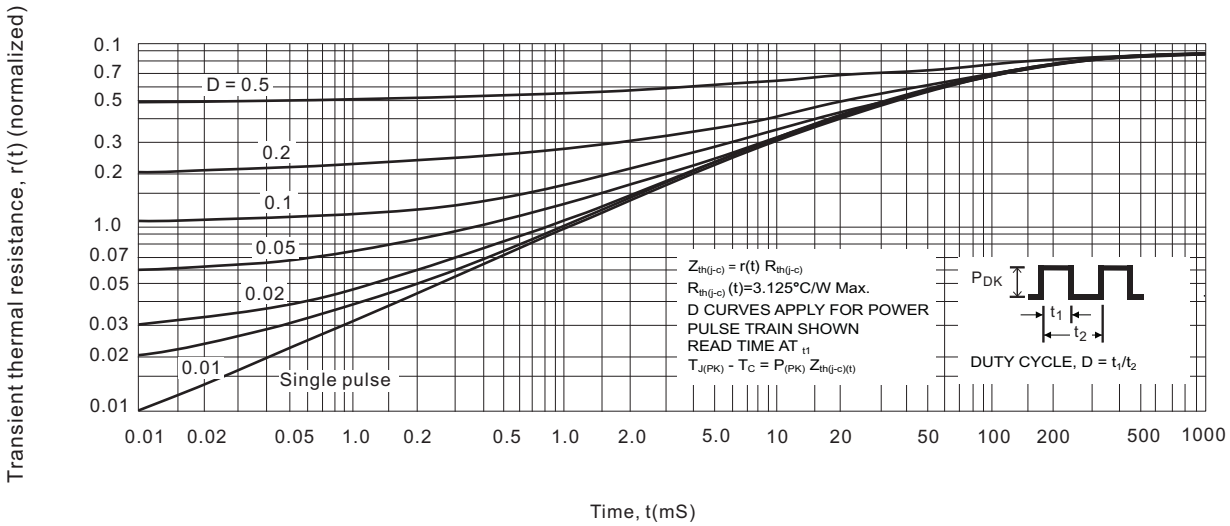


Fig.13 Thermal response



Case Style

TO-220AB