

## COMPLEMENTARY SILICON MEDIUM-POWER TRANSISTORS

..designed for general-purpose power amplifier and switching applications.

### FEATURES:

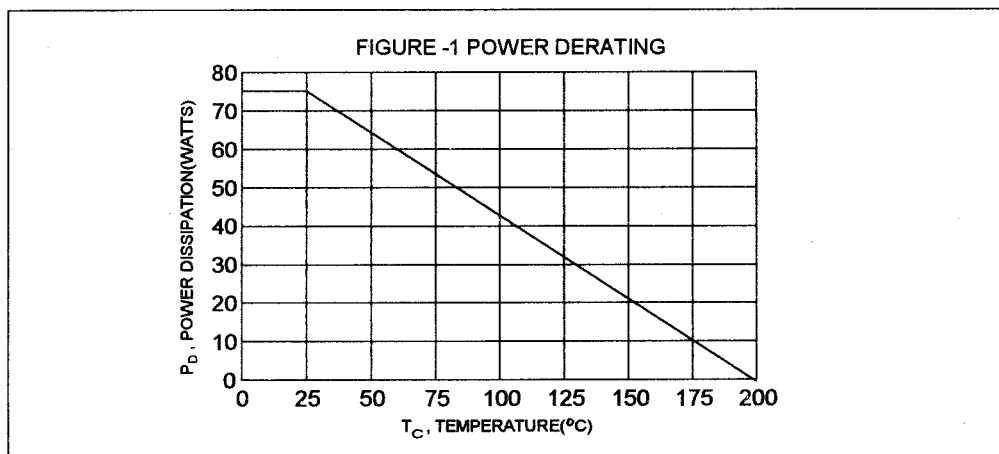
- \* Low Collector-Emitter Saturation Voltage  
 $V_{CE(sat)} = 0.7 \text{ V (Max.) @ } I_C = 1.5 \text{ A}$
- \*Excellent DC Current Gain  
 $hFE = 25-100 @ I_C = 1.5 \text{ A}$
- \* Low Leakage Current-  $I_{CEX} = 0.1 \text{ mA(Max)}$

### MAXIMUM RATINGS

Characteristic	Symbol	2N4231A 2N6312	2N4232A 2N6313	2N4233A 2N6314	Unit
Collector-Emitter Voltage	$V_{CEO}$	40	60	80	V
Collector-Base Voltage	$V_{CBO}$	40	60	80	V
Emitter-Base Voltage	$V_{EBO}$	5.0			V
Collector Current-Continuous -Peak	$I_C$ $I_{CM}$	5.0 10			A
Base Current	$I_B$	2.0			A
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	75 0.43			W W/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	$T_J, T_{STG}$	- 65 to +200			$^\circ\text{C}$

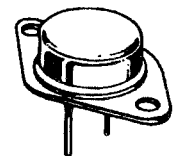
### THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance Junction to Case	$R_{\theta jc}$	2.32	$^\circ\text{C/W}$

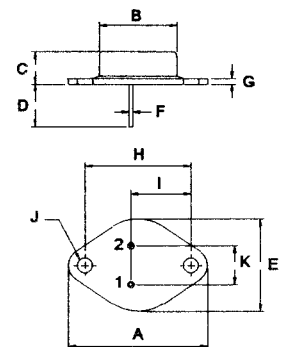


NPN	PNP
2N4231A	2N6312
2N4232A	2N6313
2N4233A	2N6314

5 AMPERE  
COMPLEMENTARY SILICON  
POWER TRANSISTOR  
40-80 VOLTS  
75 WATTS



TO-66



PIN 1. BASE  
2. EMITTER  
COLLECTOR(CASE)

DIM	MILLIMETERS	
	MIN	MAX
A	30.60	32.52
B	13.85	14.16
C	6.54	7.22
D	9.50	10.50
E	17.26	18.46
F	0.76	0.92
G	1.38	1.65
H	24.16	24.78
I	13.84	15.60
J	3.32	3.92
K	4.86	5.34

**2N4231A Thru 2N4233A NPN / 2N6312 Thru 2N6314 PNP**

**ELECTRICAL CHARACTERISTICS (  $T_c = 25^\circ\text{C}$  unless otherwise noted )**

Characteristic	Symbol	Min	Max	Unit
<b>OFF CHARACTERISTICS</b>				
Collector - Emitter Sustaining Voltage (1) ( $I_c = 100\text{ mA}$ , $I_B = 0$ )	2N4231A,2N6312 2N4232A,2N6313 2N4233A,2N6314	$V_{CE(sus)}$	40 60 80	V
Collector Cutoff Current ( $V_{CE} = 30\text{ V}$ , $I_B = 0$ ) ( $V_{CE} = 50\text{ V}$ , $I_B = 0$ ) ( $V_{CE} = 70\text{ V}$ , $I_B = 0$ )	2N4231A,2N6312 2N4232A,2N6313 2N4233A,2N6314	$I_{CEO}$	1.0 1.0 1.0	mA
Collector-Emitter Leakage Current ( $V_{CE} = 40\text{ V}$ , $V_{BE(off)} = 1.5\text{ V}$ ) ( $V_{CE} = 60\text{ V}$ , $V_{BE(off)} = 1.5\text{ V}$ ) ( $V_{CE} = 80\text{ V}$ , $V_{BE(off)} = 1.5\text{ V}$ ) ( $V_{CE} = 40\text{ V}$ , $V_{BE(off)} = 1.5\text{ V}$ , $T_c = 125^\circ\text{C}$ ) ( $V_{CE} = 60\text{ V}$ , $V_{BE(off)} = 1.5\text{ V}$ , $T_c = 125^\circ\text{C}$ ) ( $V_{CE} = 80\text{ V}$ , $V_{BE(off)} = 1.5\text{ V}$ , $T_c = 125^\circ\text{C}$ )	2N4231A,2N6312 2N4232A,2N6313 2N4233A,2N6314 2N4231A,2N6312 2N4232A,2N6313 2N4233A,2N6314	$I_{CEX}$	0.1 0.1 0.1 1.0 1.0 1.0	mA
Collector Cutoff Current ( $V_{CB} = 40\text{ V}$ , $I_E = 0$ ) ( $V_{CB} = 60\text{ V}$ , $I_E = 0$ ) ( $V_{CB} = 80\text{ V}$ , $I_E = 0$ )	2N4231A,2N6312 2N4232A,2N6313 2N4233A,2N6314	$I_{CBO}$	50 50 50	$\mu\text{A}$
Emitter Cutoff Current ( $V_{EB} = 5.0\text{ V}$ , $I_C = 0$ )		$I_{EBO}$	0.5	mA

**ON CHARACTERISTICS (1)**

DC Current Gain ( $I_c = 0.5\text{ A}$ , $V_{CE} = 2.0\text{ V}$ ) ( $I_c = 1.5\text{ A}$ , $V_{CE} = 2.0\text{ V}$ ) ( $I_c = 3.0\text{ A}$ , $V_{CE} = 2.0\text{ V}$ ) ( $I_c = 5.0\text{ A}$ , $V_{CE} = 4.0\text{ V}$ )	$h_{FE}$	40 25 10 4.0	100	
Collector-Emitter Saturation Voltage ( $I_c = 1.5\text{ A}$ , $I_B = 0.15\text{ A}$ ) ( $I_c = 3.0\text{ A}$ , $I_B = 0.3\text{ A}$ ) ( $I_c = 5.0\text{ A}$ , $I_B = 1.25\text{ A}$ )	$V_{CE(sat)}$		0.7 2.0 4.0	V
Base-Emitter Saturation Voltage ( $I_c = 1.5\text{ A}$ , $V_{CE} = 2.0\text{ V}$ )	$V_{BE(on)}$		1.4	V

**DYNAMIC CHARACTERISTICS**

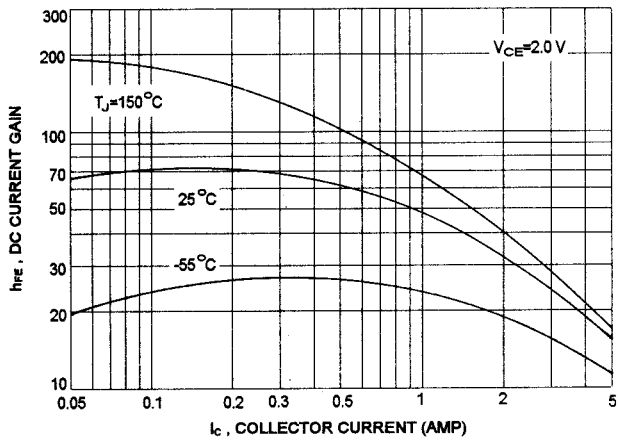
Current Gain - Bandwidth Product (2) ( $I_c = 0.5\text{ A}$ , $V_{CE} = 10\text{ V}$ , $f = 1.0\text{ MHz}$ )	$f_T$	4.0		MHz
Output Capacitance ( $V_{CB} = 10\text{ V}$ , $I_E = 0$ , $f = 0.1\text{ MHz}$ )	$C_{ob}$		300	pF
Small-Signal Current Gain ( $I_c = 0.5\text{ A}$ , $V_{CE} = 10\text{ V}$ , $f = 1.0\text{ KHz}$ )	$h_{fe}$	20		

(1) Pulse Test: Pulse width = 300  $\mu\text{s}$ , Duty Cycle  $\leq 2.0\%$

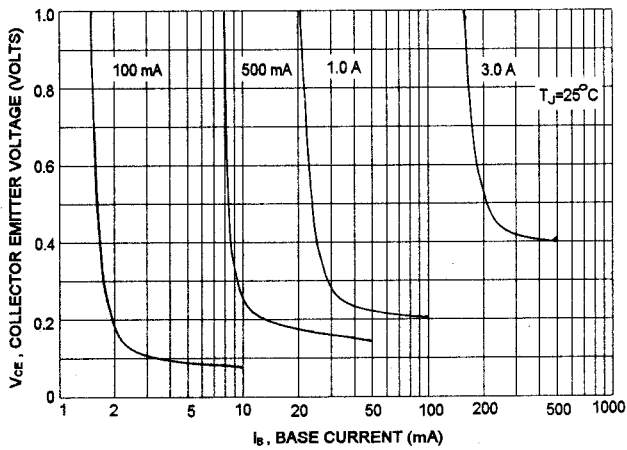
(2)  $f_T = |h_{fe}| \cdot f_{test}$

NPN 2N4231A thru 2N4233A

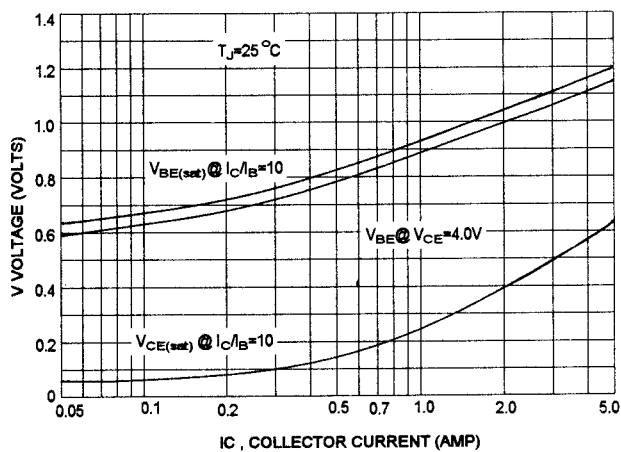
DC CURRENT GAIN



COLLECTOR SATURATION REGION

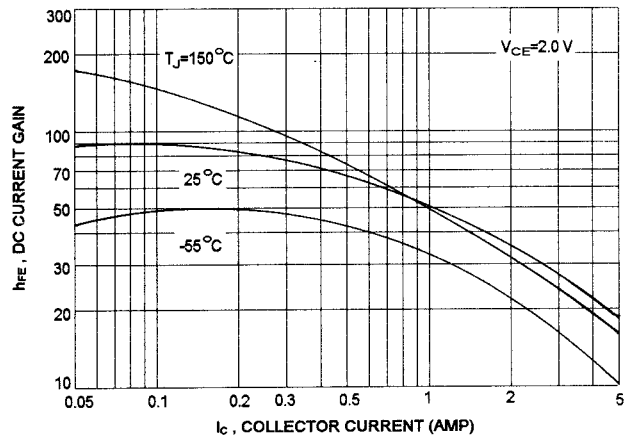


"ON" VOLTAGES

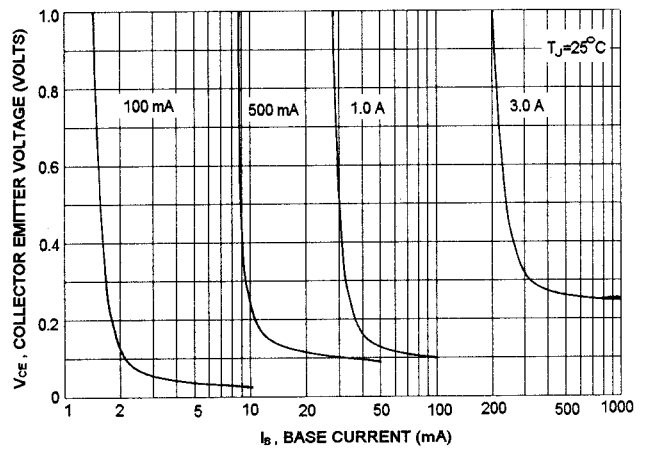


PNP 2N6212 thru 2N6314

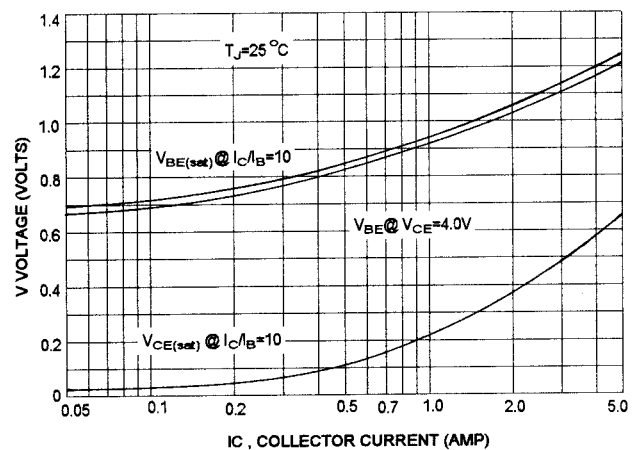
DC CURRENT GAIN



COLLECTOR SATURATION REGION

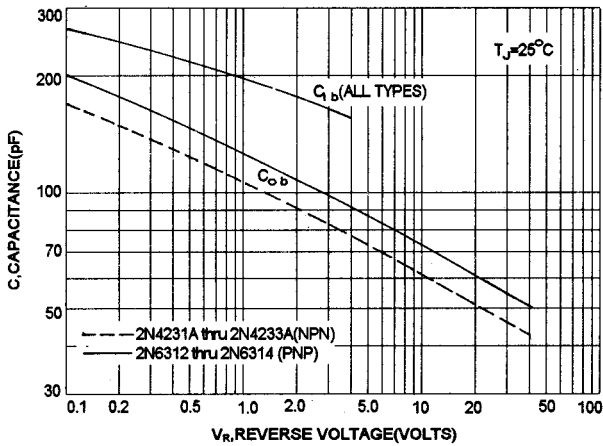


"ON" VOLTAGES

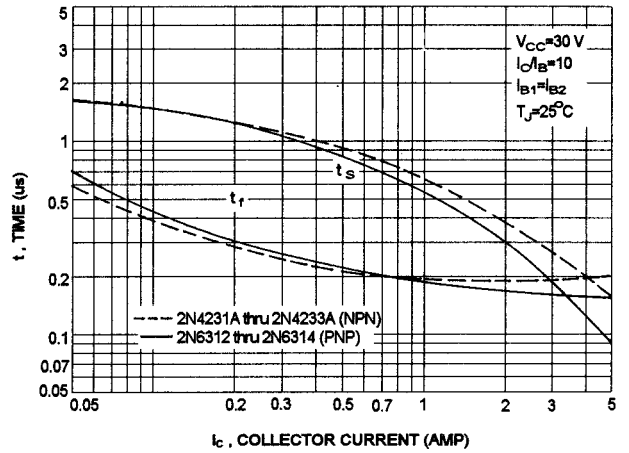


2N4231A thru 2N4233A NPN / 2N6312 thru 2N6314 PNP

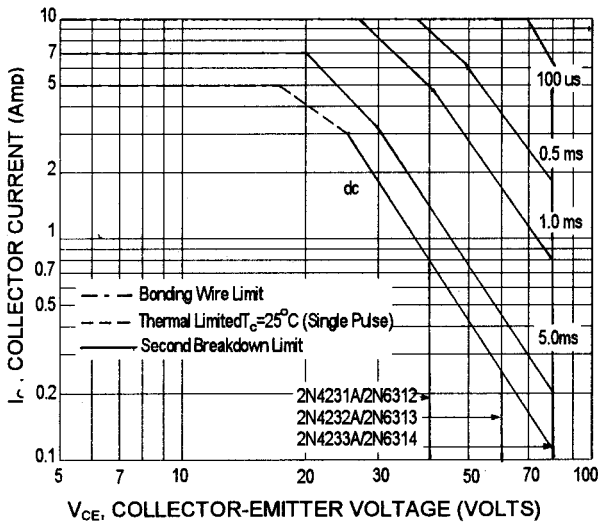
CAPACITANCES



TURN-OFF TIME



ACTIVE-REGION SAFE OPERATING AREA (SOA)



There are two limitation 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 greater dissipation than curves indicate.

The data of SOA curve is base on  $T_{J(PK)} = 200^\circ\text{C}$ ;  $T_c$  is variable depending on conditions. second breakdown pulse limits are valid for duty cycles to 10% provided  $T_{J(PK)} \leq 200^\circ\text{C}$ . At high case temperatures, thermal limitation will reduce the power that can be handled to values less than the limitations imposed by second breakdown.



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