

## COMPLEMENTARY SILICON MEDIUM-POWER TRANSISTORS

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

### FEATURES:

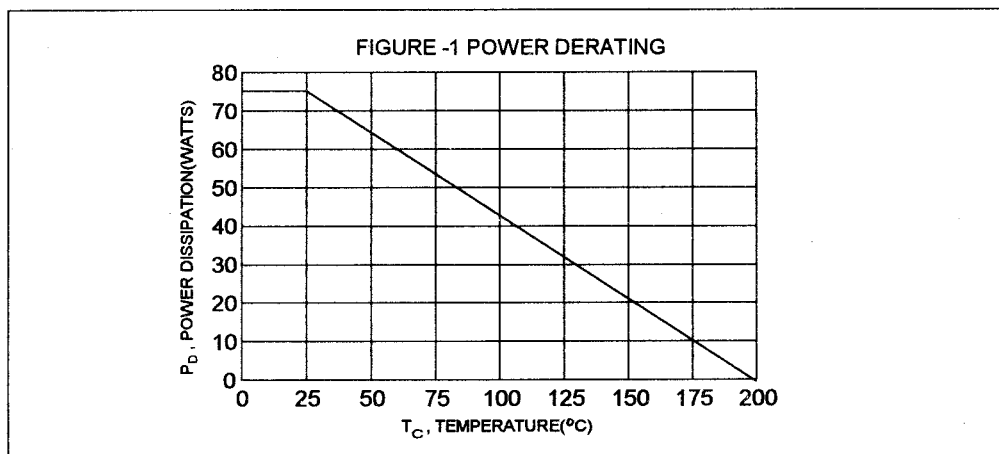
- \* Low Collector-Emitter Saturation Voltage  
 $V_{CE(sat)} = 0.7 \text{ V (Max.) @ } I_C = 1.5 \text{ A}$
- \*Excellent DC Current Gain  
 $hFE = 25-100 @ I_C = 1.5 \text{ A}$
- \* Low Leakage Current-  $I_{CEX} = 0.1 \text{ mA(Max)}$

### MAXIMUM RATINGS

| Characteristic                                                                        | Symbol            | 2N4231A<br>2N6312 | 2N4232A<br>2N6313 | 2N4233A<br>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<br>-Peak                                                 | $I_C$<br>$I_{CM}$ | 5.0<br>10         |                   |                   | A                        |
| Base Current                                                                          | $I_B$             | 2.0               |                   |                   | A                        |
| Total Power Dissipation @ $T_C = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$             | 75<br>0.43        |                   |                   | W<br>W/ $^\circ\text{C}$ |
| Operating and Storage Junction<br>Temperature Range                                   | $T_J, T_{STG}$    | - 65 to +200      |                   |                   | $^\circ\text{C}$         |

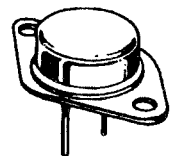
### THERMAL CHARACTERISTICS

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

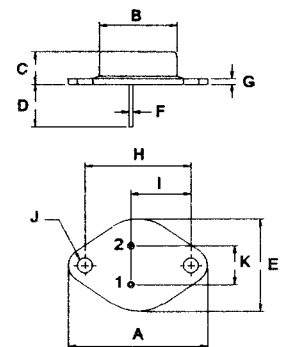


| NPN     | PNP    |
|---------|--------|
| 2N4231A | 2N6312 |
| 2N4232A | 2N6313 |
| 2N4233A | 2N6314 |

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 |
|----------------|--------|-----|-----|------|
|----------------|--------|-----|-----|------|

**OFF CHARACTERISTICS**

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

**ON CHARACTERISTICS (1)**

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

**DYNAMIC CHARACTERISTICS**

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

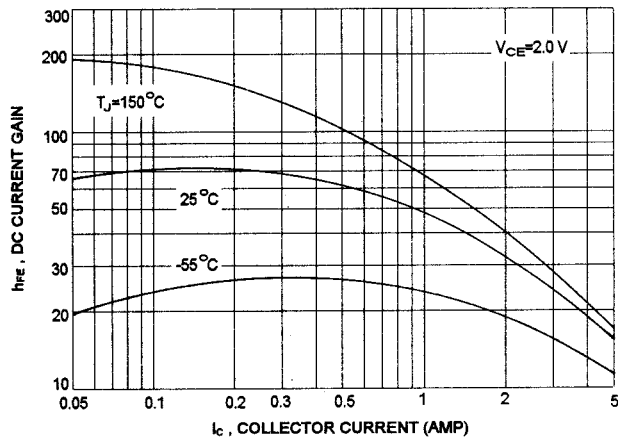
(1) Pulse Test: Pulse width = 300  $\mu\text{s}$ , Duty Cycle  $\leq 2.0\%$

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

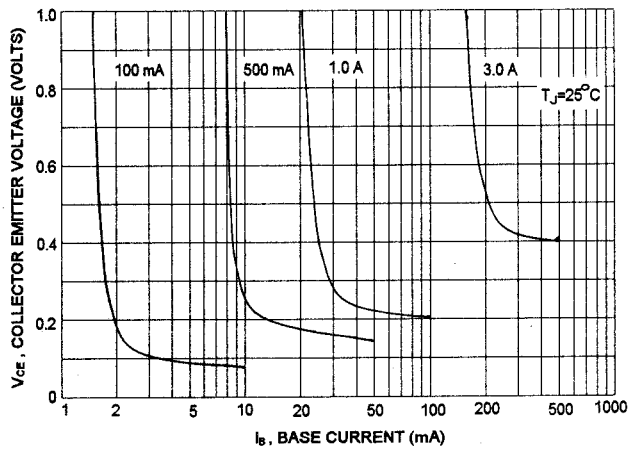
# 2N4231A thru 2N4233A NPN / 2N6312 thru 2N6314 PNP

## NPN 2N4231A thru 2N4233A

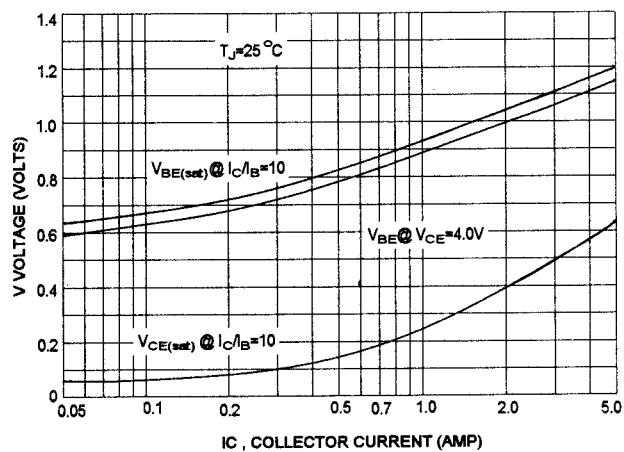
### DC CURRENT GAIN



### COLLECTOR SATURATION REGION

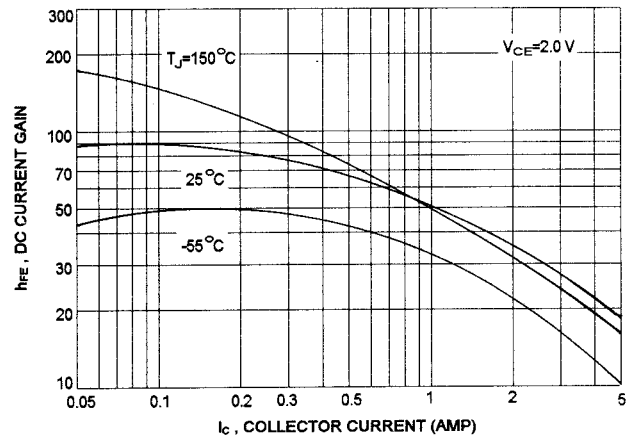


### "ON" VOLTAGES

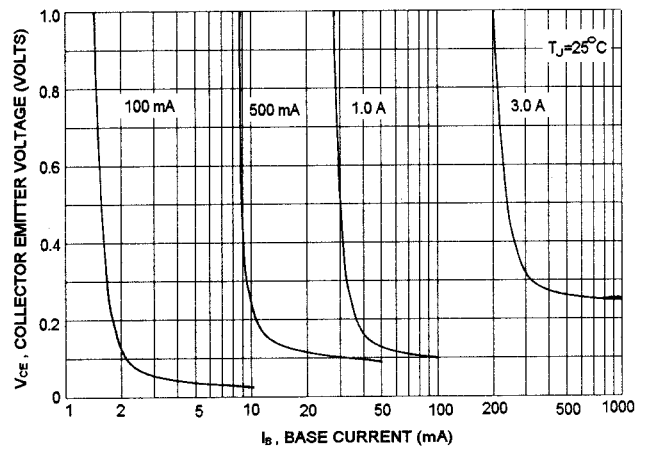


## PNP 2N6212 thru 2N6314

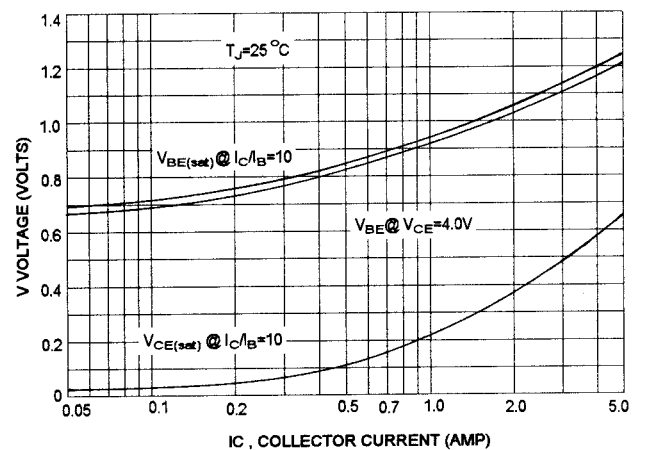
### DC CURRENT GAIN



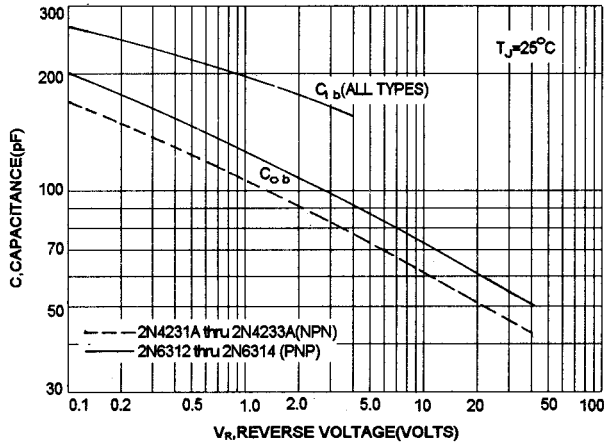
### COLLECTOR SATURATION REGION



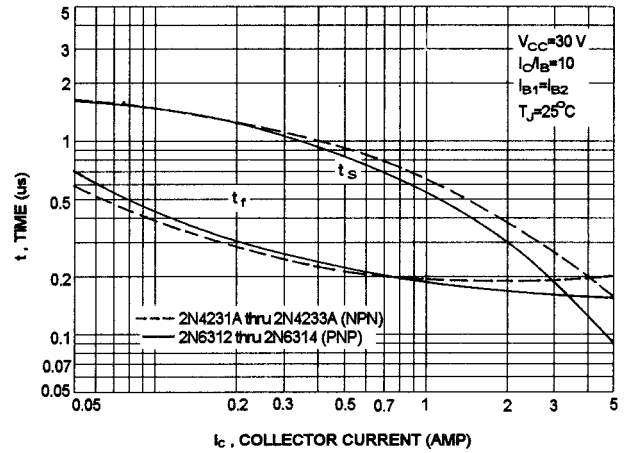
### "ON" VOLTAGES



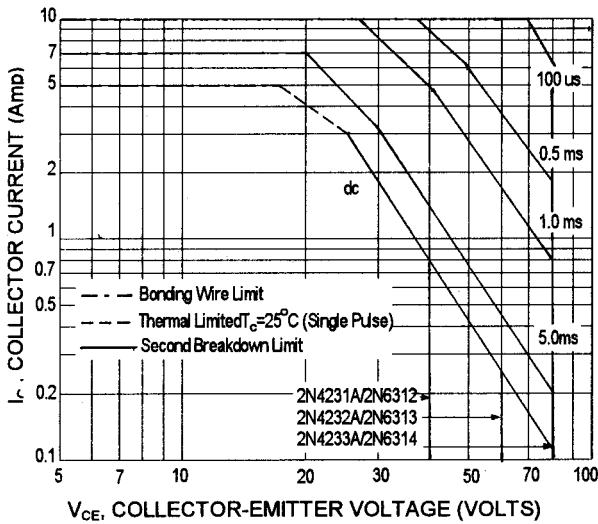
### CAPACITANCES



### 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.