

# MOSPEC

## COMPLEMENTARY SILICON HIGH-POWER TRANSISTORS

General Purpose-Amplifier and Switching Application..

### FEATURES:

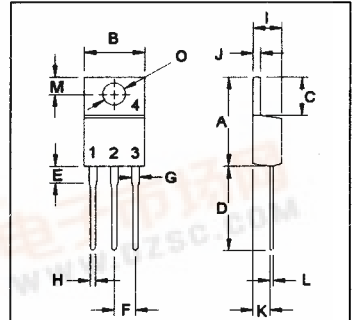
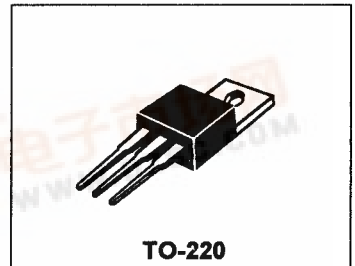
- \* Collector-Emitter Sustaining Voltage -  
 $V_{CEO(sus)} = 120V$  (Min)- TIP31D, TIP32D  
 140V (Min)- TIP31E, TIP32E  
 160V (Min)- TIP31F, TIP32F
- \* Current Gain-Bandwidth Product-  
 $f_T = 3.0MHz$ (Min) @  $I_C = 1.0 A$

### MAXIMUM RATINGS

| Characteristic  | Symbol         | TIP31D<br>TIP32D | TIP31E<br>TIP32E | TIP31F<br>TIP32F | Unit               |
|---|----------------|------------------|------------------|------------------|--------------------|
| Collector-Emitter Voltage   | $V_{CEO}$      | 120              | 140              | 160              | V                  |
| Collector-Base Voltage  | $V_{CBO}$      | 160              | 180              | 200              | V                  |
| Emitter-Base Voltage  | $V_{EBO}$      | 5.0              |                  |                  | V                  |
| Collector Current - Continuous<br>- Peak                                  | $I_C$          | 3.0<br>5.0       |                  |                  | A                  |
| Base Current  | $I_B$          | 1.0              |                  |                  | A                  |
| Total Power Dissipation @ $T_C = 25^\circ C$<br>Derate above $25^\circ C$ | $P_D$          | 40<br>0.32       |                  |                  | W<br>W/ $^\circ C$ |
| Operating and Storage Junction<br>Temperature Range                       | $T_J, T_{STG}$ | -65 to +150      |                  |                  | $^\circ C$         |

| NPN    | PNP    |
|--------|--------|
| TIP31D | TIP32D |
| TIP31E | TIP32E |
| TIP31F | TIP32F |

3.0 AMPERE  
COMPLEMENTARY SILICON  
POWER TRANSISTORS  
120-160 VOLTS  
40 WATTS

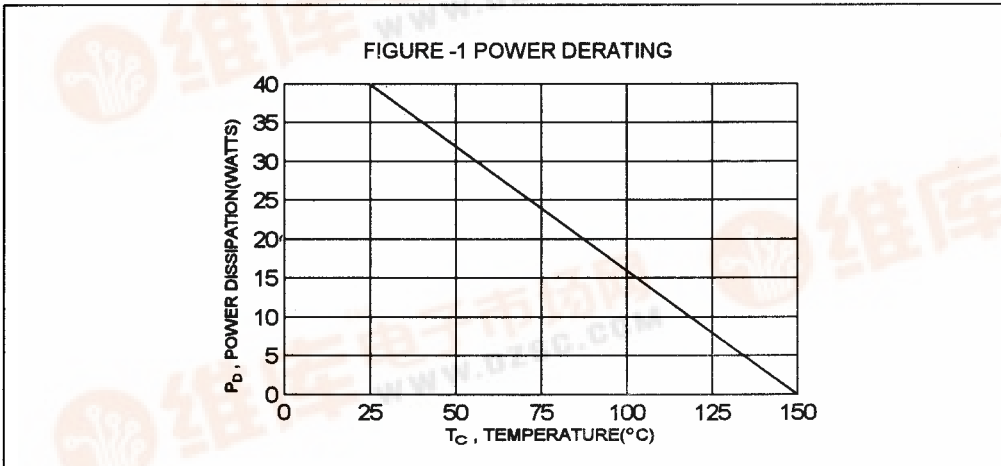


PIN 1.BASE  
2.COLLECTOR  
3.EMITTER  
4.COLLECTOR(CASE)

| DIM | MILLIMETERS |       |
|-----|-------------|-------|
|     | MIN         | MAX   |
| A   | 14.68       | 15.31 |
| B   | 9.78        | 10.42 |
| C   | 5.01        | 6.52  |
| D   | 13.06       | 14.62 |
| E   | 3.57        | 4.07  |
| F   | 2.42        | 3.66  |
| G   | 1.12        | 1.36  |
| H   | 0.72        | 0.96  |
| I   | 4.22        | 4.98  |
| J   | 1.14        | 1.38  |
| K   | 2.20        | 2.97  |
| L   | 0.33        | 0.55  |
| M   | 2.48        | 2.98  |
| O   | 3.70        | 3.90  |

### THERMAL CHARACTERISTICS

| Characteristic                      | Symbol          | Max   | Unit         |
|-------------------------------------|-----------------|-------|--------------|
| Thermal Resistance Junction to Case | $R_{\theta jc}$ | 3.125 | $^\circ C/W$ |



TIP31D, TIP31E, TIP31F NPN / TIP32D, TIP32E, TIP32F PNP

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

| Characteristic | Symbol | Min | Max | Unit |
|----------------|--------|-----|-----|------|
|----------------|--------|-----|-----|------|

OFF CHARACTERISTICS

|   |  |               |                   |    |
|---|--|---------------|-------------------|----|
| Collector -Emitter Breakdown Voltage (1)<br>( $I_C = 30\text{ mA}, I_B = 0$ )   | TIP31D, TIP32D<br>TIP31E, TIP32E<br>TIP31F, TIP32F | $V_{(BR)CEO}$ | 120<br>140<br>160 | V  |
| Collector Cutoff Current<br>( $V_{CE} = 90\text{ V}, I_B = 0$ )   |  | $I_{CEO}$     | 0.3               | mA |
| Collector Cutoff Current<br>( $V_{CE} = 160\text{ V}, V_{BE} = 0$ )<br>( $V_{CE} = 180\text{ V}, V_{BE} = 0$ )<br>( $V_{CE} = 200\text{ V}, V_{BE} = 0$ ) | TIP31D, TIP32D<br>TIP31E, TIP32E<br>TIP31F, TIP32F | $I_{CES}$     | 0.2<br>0.2<br>0.2 | mA |
| Emitter-Base Cutoff Current<br>( $V_{EB} = 5.0\text{ V}, I_C = 0$ )   |  | $I_{EBO}$     | 1.0               | mA |

ON CHARACTERISTICS (1)

|   |  |               |           |   |
|---|--|---------------|-----------|---|
| DC Current Gain<br>( $I_C = 1.0\text{ A}, V_{CE} = 4.0\text{ V}$ )<br>( $I_C = 3.0\text{ A}, V_{CE} = 4.0\text{ V}$ ) |  | $h_{FE}$      | 25<br>5.0 |   |
| Collector-Emitter Saturation Voltage<br>( $I_C = 3.0\text{ A}, I_B = 750\text{ mA}$ )                                 |  | $V_{CE(sat)}$ | 2.5       | V |
| Base-Emitter On Voltage<br>( $I_C = 3.0\text{ A}, V_{CE} = 4.0\text{ V}$ )  |  | $V_{BE(on)}$  | 1.8       | V |

DYNAMIC CHARACTERISTICS

|  |  |          |     |     |
|--|--|----------|-----|-----|
| Current-Gain-Bandwidth Product<br>( $I_C = 0.5\text{ A}, V_{CE} = 10\text{ V}, f = 1.0\text{ MHz}$ ) |  | $f_T$    | 3.0 | MHz |
| Small-Signal Current Gain<br>( $I_C = 0.5\text{ A}, V_{CE} = 10\text{ V}, f = 1.0\text{ KHz}$ )      |  | $h_{fe}$ | 20  |     |

SWITCHING CHARACTERISTICS

|              |  |           |     |    |
|--------------|--|-----------|-----|----|
| Turn On Time | $I_C = 1.0\text{ A}, I_{B1} = -I_{B2} = 0.1\text{ A}$<br>$V_{BE(off)} = -4.3\text{ V}, R_L = 30\Omega$ | $t_{on}$  | 0.6 | us |
| Off Time     |  | $t_{off}$ | 2.8 | us |

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

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

FIGURE 2 - SWITCHING TIME EQUIVALENT CIRCUIT

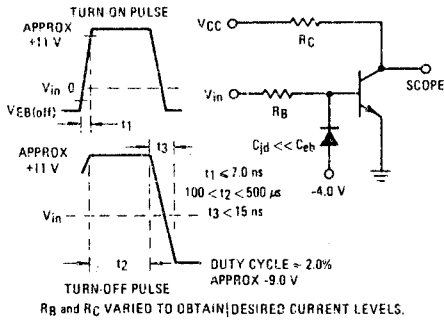


FIG-3 TURN-ON TIME

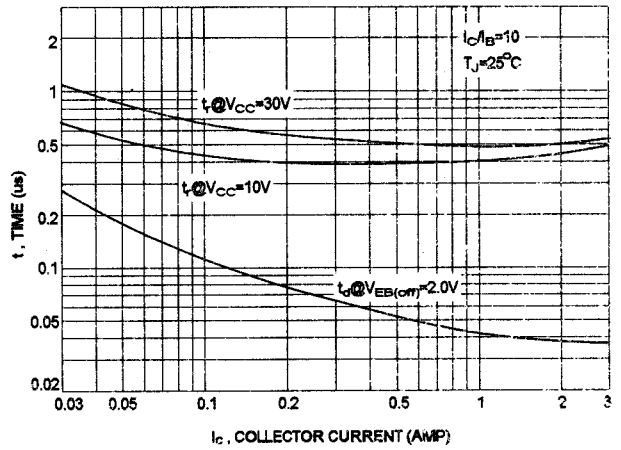


FIG-4 DC CURRENT GAIN

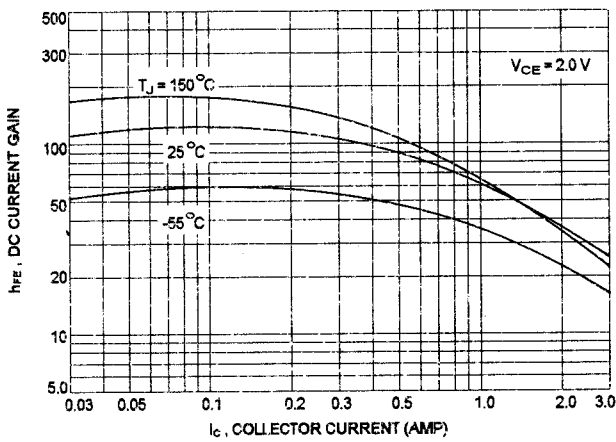


FIG-5 TURN-OFF TIME

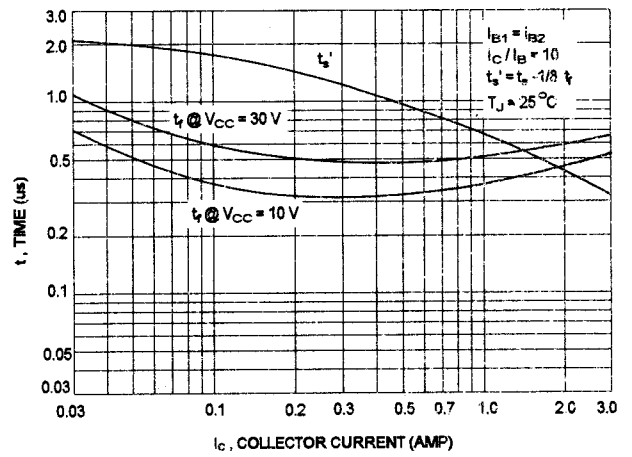
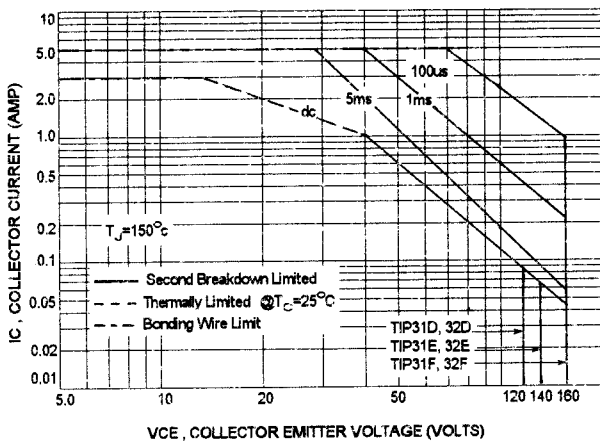


FIG-6 ACTIVE REGION SAFE OPERATING AREA



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 FIG-6 curve is base on  $T_{J(PK)} = 150^\circ\text{C}$ ;  $T_C$  is variable depending on power level. second breakdown pulse limits are valid for duty cycles to 10% provided  $T_{J(PK)} \leq 150^\circ\text{C}$ . At high case temperatures, thermal limitation will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

FIG-7 COLLECTOR SATURATION REGION

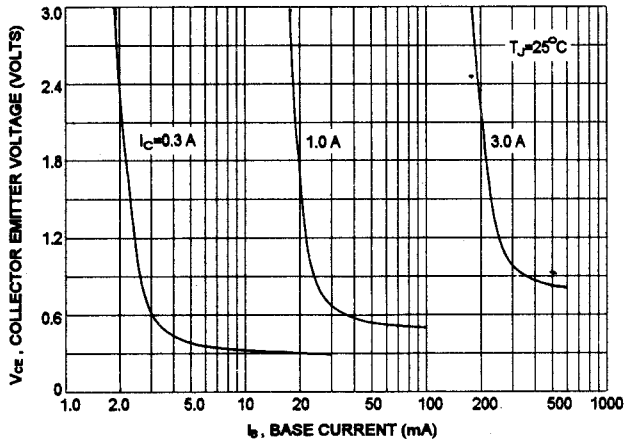


FIG-8 CAPACITANCES

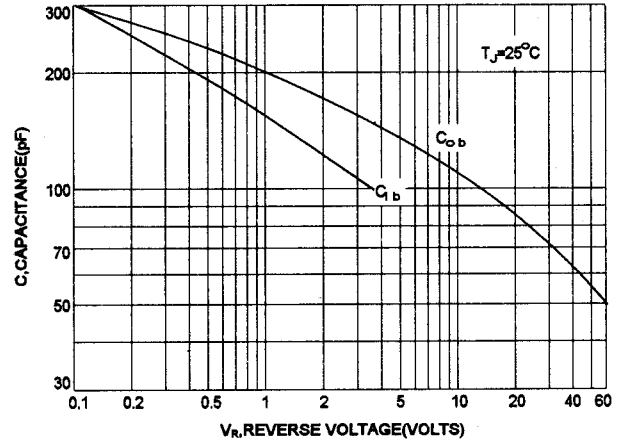


FIG-9 "ON" VOLTAGE

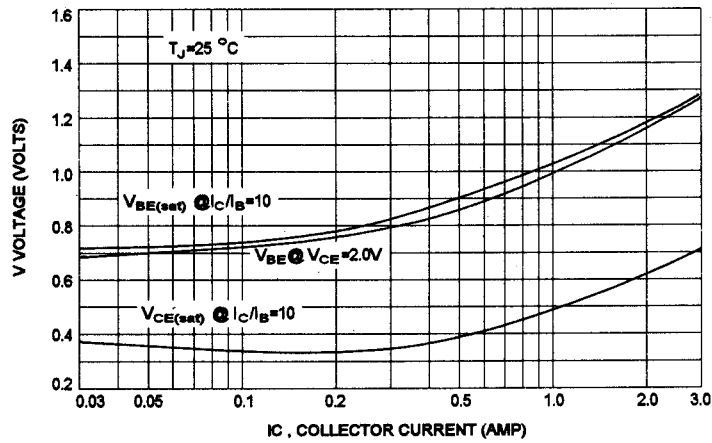


FIG-10 COLLECTOR CUT-OFF REGION

