

# MOSPEC

## COMPLEMENTARY SILICON HIGH-POWER TRANSISTORS

General Purpose-Amplifier and Switching Application..

### FEATURES:

- \* Collector-Emitter Sustaining Voltage -  
 $V_{CE(sus)} = 120V$  (Min)- TIP33D, TIP34D  
 $140V$  (Min)- TIP33E, TIP34E  
 $160V$  (Min)- TIP33F, TIP34F
- \* Current Gain-Bandwidth Product-  
 $f_T = 3.0MHz$  (Min) @  $I_C = 0.5 A$

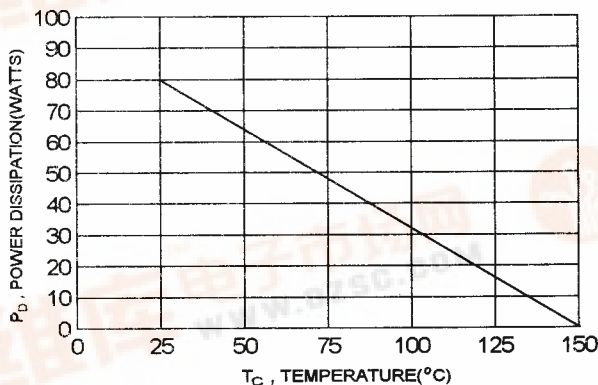
### MAXIMUM RATINGS

| Characteristic                                                            | Symbol         | TIP33D<br>TIP34D | TIP33E<br>TIP34E | TIP33F<br>TIP34F | 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                |                  |                  | V                  |
| Collector Current - Continuous<br>- Peak                                  | $I_C$          | 10<br>15         |                  |                  | A                  |
| Base Current                                                              | $I_B$          | 3                |                  |                  | A                  |
| Total Power Dissipation @ $T_C = 25^\circ C$<br>Derate above $25^\circ C$ | $P_D$          | 80<br>0.64       |                  |                  | W<br>W/ $^\circ C$ |
| Operating and Storage Junction<br>Temperature Range                       | $T_J, T_{STG}$ | -65 to +150      |                  |                  | $^\circ C$         |

### THERMAL CHARACTERISTICS

| Characteristic                      | Symbol          | Max  | Unit         |
|-------------------------------------|-----------------|------|--------------|
| Thermal Resistance Junction to Case | $R_{\theta jc}$ | 1.56 | $^\circ C/W$ |

FIGURE -1 POWER DERATING



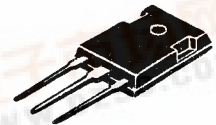
NPN PNP

TIP33D TIP34D

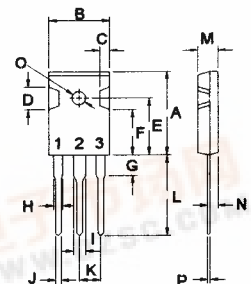
TIP33E TIP34E

TIP33F TIP34F

10 AMPERE  
COMPLEMENTARY SILICON  
POWER TRANSISTORS  
120-160 VOLTS  
80 WATTS



TO-247 (3P)



PIN 1.BASE  
2.COLLECTOR  
3.EMITTER

| DIM | MILLIMETERS |       |
|-----|-------------|-------|
|     | MIN         | MAX   |
| A   | 20.63       | 22.38 |
| B   | 15.38       | 16.20 |
| C   | 1.90        | 2.70  |
| D   | 5.10        | 6.10  |
| E   | 14.81       | 15.22 |
| F   | 11.72       | 12.84 |
| G   | 4.20        | 4.50  |
| H   | 1.82        | 2.46  |
| I   | 2.92        | 3.23  |
| J   | 0.89        | 1.53  |
| K   | 5.26        | 5.66  |
| L   | 18.50       | 21.50 |
| M   | 4.76        | 5.24  |
| O   | 3.25        | 3.65  |

**TIP33D,TIP33E,TIP33F NPN / TIP34D,TIP34E,TIP34F 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>( $I_C = 30\text{ mA}$ , $I_B = 0$ )                                                                                   | TIP33D,TIP34D<br>TIP33E,TIP34E<br>TIP33F,TIP34F | $V_{(BR)CEO}$ | 120<br>140<br>160 | V  |
| Collector Cutoff Current<br>( $V_{CE} = 90\text{ V}$ , $I_B = 0$ )                                                                                                 |                                                 | $I_{CEO}$     | 0.7               | mA |
| Collector Cutoff Current<br>( $V_{CE} = 160\text{ V}$ , $V_{BE} = 0$ )<br>( $V_{CE} = 180\text{ V}$ , $V_{BE} = 0$ )<br>( $V_{CE} = 200\text{ V}$ , $V_{BE} = 0$ ) | TIP33D,TIP34D<br>TIP33E,TIP34E<br>TIP33F,TIP34F | $I_{CES}$     | 0.4<br>0.4<br>0.4 | 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>( $I_C = 3.0\text{ A}$ , $V_{CE} = 4.0\text{ V}$ )               | $h_{FE}$      | 40<br>20 |            |   |
| Collector-Emitter Saturation Voltage<br>( $I_C = 3.0\text{ A}$ , $I_B = 0.3\text{ A}$ )<br>( $I_C = 10\text{ A}$ , $I_B = 3.3\text{ A}$ ) | $V_{CE(sat)}$ |          | 1.0<br>4.0 | V |
| Base-Emitter On Voltage<br>( $I_C = 3.0\text{ A}$ , $V_{CE} = 4.0\text{ V}$ )<br>( $I_C = 10\text{ A}$ , $V_{CE} = 4.0\text{ V}$ )        | $V_{BE(on)}$  |          | 1.6<br>3.0 | V |

**DYNAMIC CHARACTERISTICS**

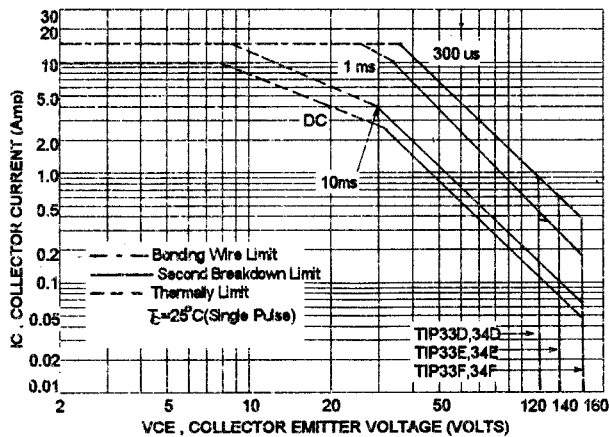
|                                                                                                            |          |     |  |     |
|------------------------------------------------------------------------------------------------------------|----------|-----|--|-----|
| Current-Gain-Bandwidth Product<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>( $I_C = 0.5\text{ A}$ , $V_{CE} = 10\text{ V}$ , $f = 1.0\text{ KHz}$ )      | $h_{fe}$ | 12  |  |     |

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

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

## TIP33D,TIP33E,TIP33F NPN / TIP34D,TIP34E,TIP34F PNP

FIG-2 ACTIVE- REGION SAFE OPERATING AREA

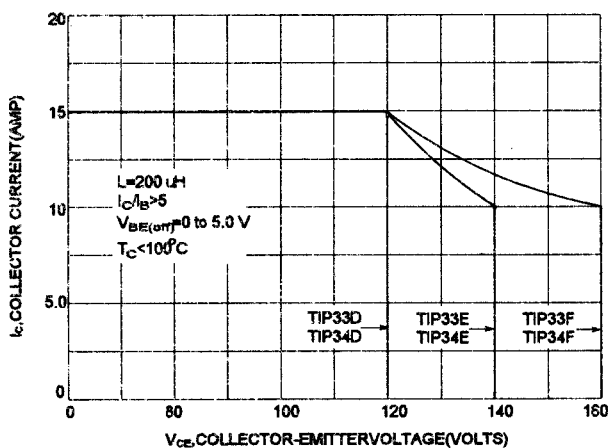


### FORWARD BIAS

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-2 is base on  $T_C = 25^\circ\text{C}$ ;  $T_{J(PK)}$  is variable depending on power level. Second breakdown pulse limits are valid for duty cycles to 10% but must be derated when  $T_C \geq 25^\circ\text{C}$ , second breakdown limitations do not derate the same as thermal limitations.

FIG-3 REVERSE BIAS SAFE OPERATING AREA



### REVERSE BIAS

For inductive loads, high voltage and high current must be sustained simultaneously during turn-off, in most cases with the base-to-emitter junction reverse biased under these conditions the collector voltage must be held to a safe level at or below a specific value of collector current. This can be accomplished by several means such as active clamping, RC snubbing, load line shaping, etc. the safe level for these devices is specified as Reverse Bias Safe Operating Area and represents the voltage-current condition allowable during reverse biased turn-off. This rating is verified under clamped conditions so that the device is never subjected to an avalanche mode. FIG-3 gives the RBSOA characteristics.

FIG-4 DC CURRENT GAIN

