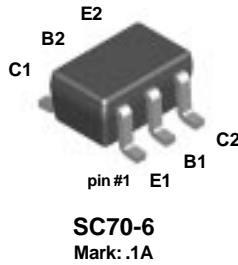
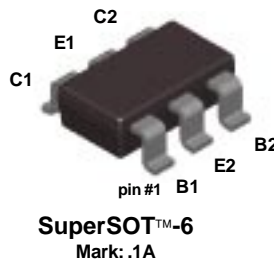


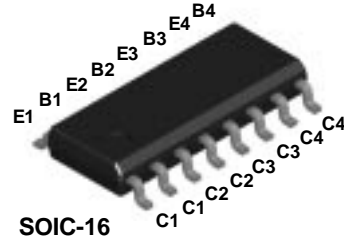
## FFB3904



## FMB3904



## MMPQ3904



### NPN General Purpose Amplifier

This device is designed as a general purpose amplifier and switch. The useful dynamic range extends to 100 mA as a switch and to 100 MHz as an amplifier. Sourced from Process 23.

#### Absolute Maximum Ratings\*

$T_A = 25^\circ\text{C}$  unless otherwise noted

| Symbol         | Parameter  | Value       | Units            |
|----------------|--|-------------|------------------|
| $V_{CEO}$      | Collector-Emitter Voltage                        | 40          | V                |
| $V_{CBO}$      | Collector-Base Voltage                           | 60          | V                |
| $V_{EBO}$      | Emitter-Base Voltage                             | 6.0         | V                |
| $I_C$          | Collector Current - Continuous                   | 200         | mA               |
| $T_J, T_{stg}$ | Operating and Storage Junction Temperature Range | -55 to +150 | $^\circ\text{C}$ |

\*These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.

#### NOTES:

- 1) These ratings are based on a maximum junction temperature of 150 degrees C.
- 2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

#### Thermal Characteristics

$T_A = 25^\circ\text{C}$  unless otherwise noted

| Symbol          | Characteristic                          | Max     |         |          | Units                     |
|-----------------|---|---------|---------|----------|---------------------------|
|                 |   | FFB3904 | FMB3904 | MMPQ3904 |                           |
| $P_D$           | Total Device Dissipation                | 300     | 700     | 1,000    | mW                        |
|                 | Derate above $25^\circ\text{C}$         | 2.4     | 5.6     | 8.0      | mW/ $^\circ\text{C}$      |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | 415     | 180     |          | $^\circ\text{C}/\text{W}$ |
|                 | Effective 4 Die                         |         |         | 125      | $^\circ\text{C}/\text{W}$ |
|                 | Each Die                                |         |         | 240      | $^\circ\text{C}/\text{W}$ |

# NPN Multi-Chip General Purpose Amplifier

(continued)

## Electrical Characteristics

$T_A = 25^\circ\text{C}$  unless otherwise noted

| Symbol                     | Parameter                           | Test Conditions                    | Min | Typ | Max | Units |
|----------------------------|-------------------------------------|------------------------------------|-----|-----|-----|-------|
| <b>OFF CHARACTERISTICS</b> |                                     |                                    |     |     |     |       |
| $V_{(BR)CEO}$              | Collector-Emitter Breakdown Voltage | $I_C = 1.0\text{ mA}, I_B = 0$     | 40  |     |     | V     |
| $V_{(BR)CBO}$              | Collector-Base Breakdown Voltage    | $I_C = 10\ \mu\text{A}, I_E = 0$   | 60  |     |     | V     |
| $V_{(BR)EBO}$              | Emitter-Base Breakdown Voltage      | $I_E = 10\ \mu\text{A}, I_C = 0$   | 6.0 |     |     | V     |
| $I_{BL}$                   | Base Cutoff Current                 | $V_{CE} = 30\text{ V}, V_{EB} = 0$ |     |     | 50  | nA    |
| $I_{CEX}$                  | Collector Cutoff Current            | $V_{CE} = 30\text{ V}, V_{EB} = 0$ |     |     | 50  | nA    |

## ON CHARACTERISTICS\*

|               |                                      |  |                             |  |              |        |
|---------------|--------------------------------------|--|-----------------------------|--|--------------|--------|
| $h_{FE}$      | DC Current Gain                      | $I_C = 0.1\text{ mA}, V_{CE} = 1.0\text{ V}$<br>$I_C = 1.0\text{ mA}, V_{CE} = 1.0\text{ V}$<br>$I_C = 10\text{ mA}, V_{CE} = 1.0\text{ V}$<br>$I_C = 50\text{ mA}, V_{CE} = 1.0\text{ V}$<br>$I_C = 100\text{ mA}, V_{CE} = 1.0\text{ V}$ | 40<br>70<br>100<br>60<br>30 |  | 300          |        |
| $V_{CE(sat)}$ | Collector-Emitter Saturation Voltage | $I_C = 10\text{ mA}, I_B = 1.0\text{ mA}$<br>$I_C = 50\text{ mA}, I_B = 5.0\text{ mA}$   |                             |  | 0.2<br>0.3   | V<br>V |
| $V_{BE(sat)}$ | Base-Emitter Saturation Voltage      | $I_C = 10\text{ mA}, I_B = 1.0\text{ mA}$<br>$I_C = 50\text{ mA}, I_B = 5.0\text{ mA}$   | 0.65                        |  | 0.85<br>0.95 | V<br>V |

## SMALL SIGNAL CHARACTERISTICS

|           |                                  |  |  |     |  |     |
|-----------|----------------------------------|--|--|-----|--|-----|
| $f_T$     | Current Gain - Bandwidth Product | $I_C = 10\text{ mA}, V_{CE} = 20\text{ V},$<br>$f = 100\text{ MHz}$  |  | 450 |  | MHz |
| $C_{obo}$ | Output Capacitance               | $V_{CB} = 5.0\text{ V}, I_E = 0,$<br>$f = 1.0\text{ MHz}$  |  | 2.5 |  | pF  |
| $C_{ibo}$ | Input Capacitance                | $V_{EB} = 0.5\text{ V}, I_C = 0,$<br>$f = 1.0\text{ MHz}$  |  | 6.0 |  | pF  |
| NF        | Noise Figure (except MMPQ3904)   | $I_C = 100\ \mu\text{A}, V_{CE} = 5.0\text{ V},$<br>$R_S = 1.0\text{ k}\Omega, f = 10\text{ Hz to } 15.7\text{ kHz}$ |  | 2.0 |  | dB  |

## SWITCHING CHARACTERISTICS

|       |              |   |  |     |  |    |
|-------|--------------|---|--|-----|--|----|
| $t_d$ | Delay Time   | $V_{CC} = 3.0\text{ V}, V_{BE} = 0.5\text{ V},$ |  | 18  |  | ns |
| $t_r$ | Rise Time    | $I_C = 10\text{ mA}, I_{B1} = 1.0\text{ mA}$    |  | 20  |  | ns |
| $t_s$ | Storage Time | $V_{CC} = 3.0\text{ V}, I_C = 10\text{ mA}$     |  | 150 |  | ns |
| $t_f$ | Fall Time    | $I_{B1} = I_{B2} = 1.0\text{ mA}$               |  | 25  |  | ns |

\*Pulse Test: Pulse Width  $\leq 300\ \mu\text{s}$ , Duty Cycle  $\leq 2.0\%$

FFB3904 / FMB3904 / MMPQ3904

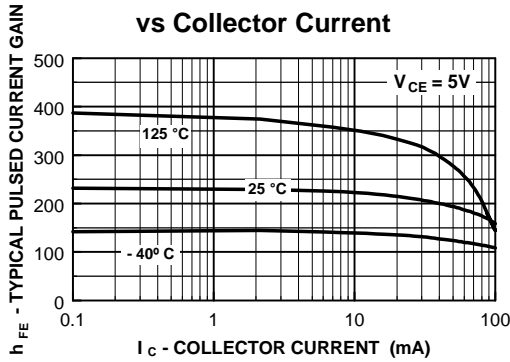
# NPN Multi-Chip General Purpose Amplifier

(continued)

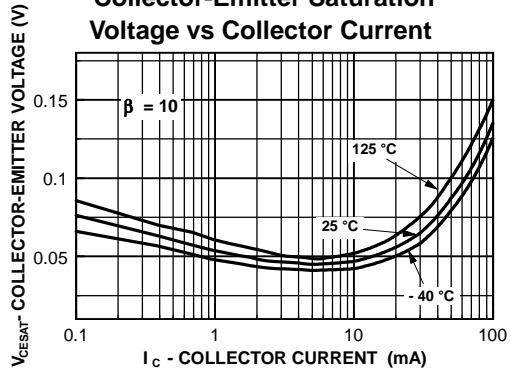
FFB3904 / FMB3904 / MMPQ3904

## Typical Characteristics

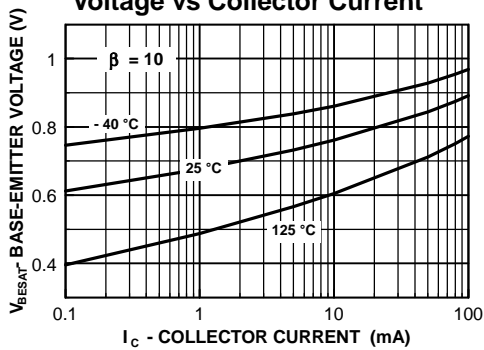
### Typical Pulsed Current Gain vs Collector Current



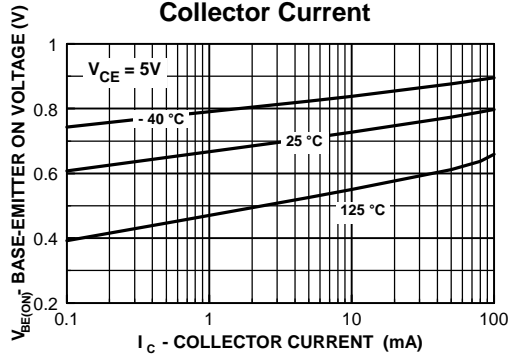
### Collector-Emitter Saturation Voltage vs Collector Current



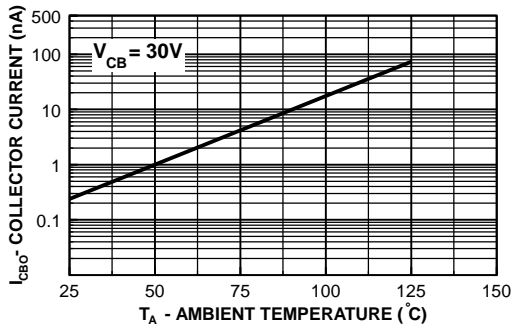
### Base-Emitter Saturation Voltage vs Collector Current



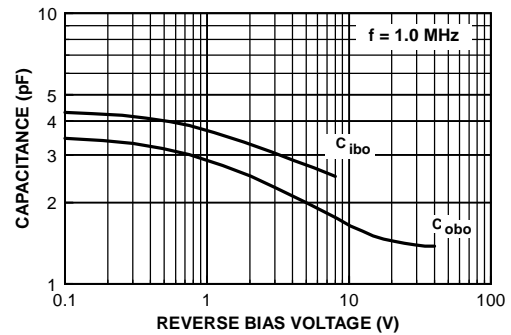
### Base-Emitter ON Voltage vs Collector Current



### Collector-Cutoff Current vs Ambient Temperature



### Capacitance vs Reverse Bias Voltage



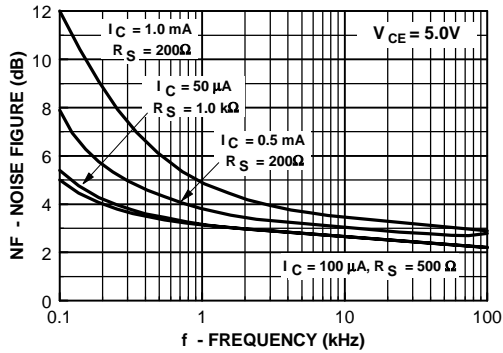
# NPN Multi-Chip General Purpose Amplifier

(continued)

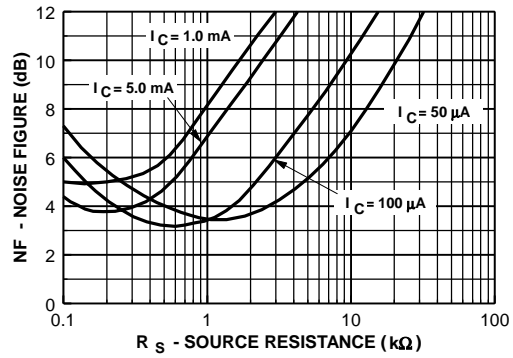
FFB3904 / FMB3904 / MMPQ3904

## Typical Characteristics (continued)

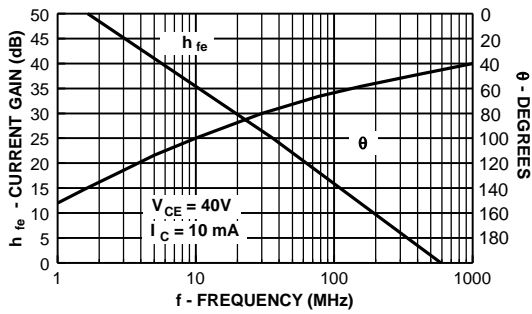
### Noise Figure vs Frequency



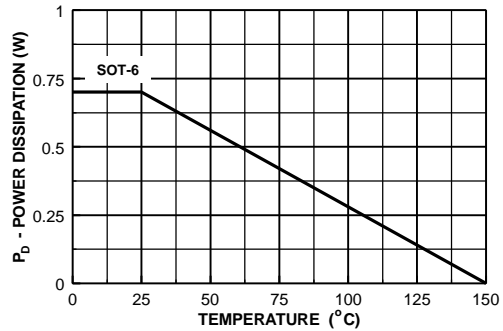
### Noise Figure vs Source Resistance



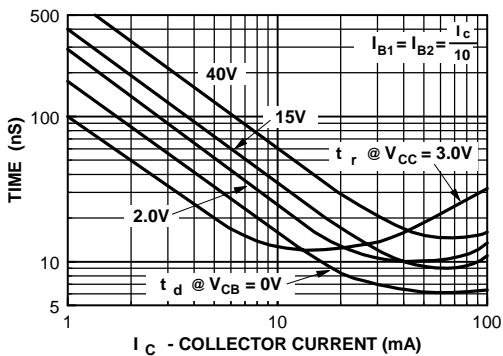
### Current Gain and Phase Angle vs Frequency



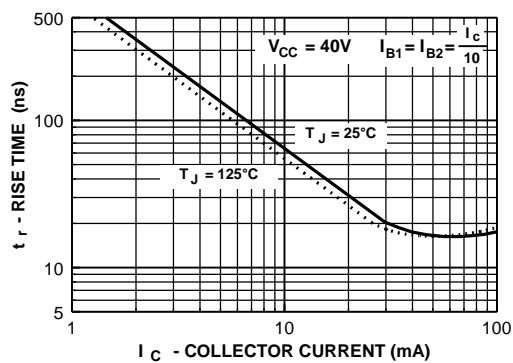
### Power Dissipation vs Ambient Temperature



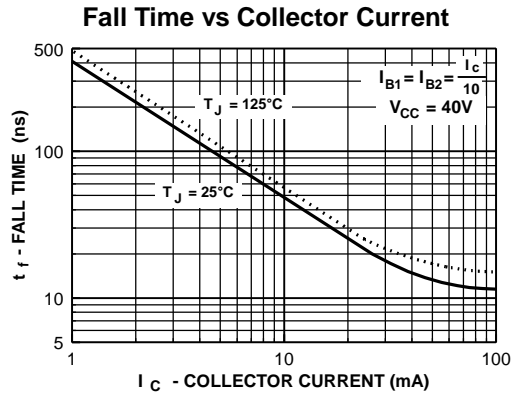
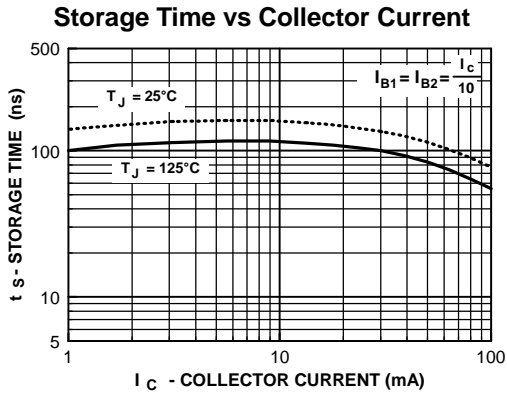
### Turn-On Time vs Collector Current



### Rise Time vs Collector Current



Typical Characteristics (continued)



Test Circuits

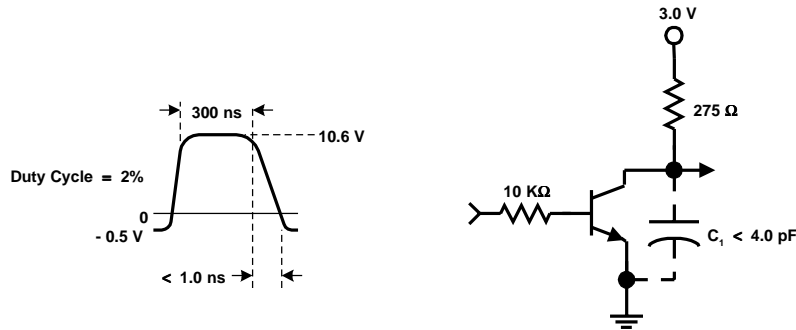


FIGURE 1: Delay and Rise Time Equivalent Test Circuit

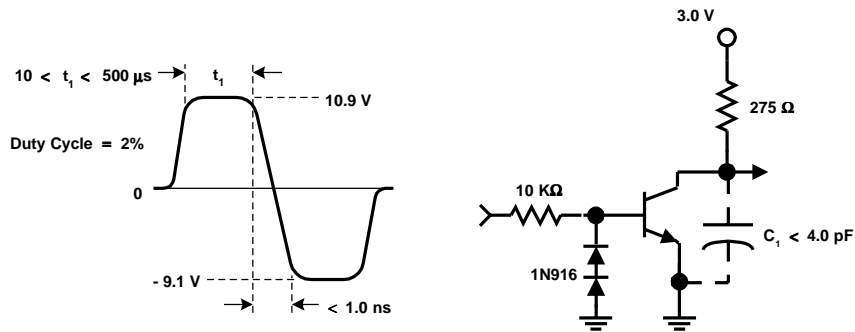


FIGURE 2: Storage and Fall Time Equivalent Test Circuit