FAIRCHILD

SEMICONDUCTOR ™

FFB3904

SC70-6
Mark: .1A   **pin #1**
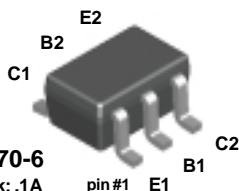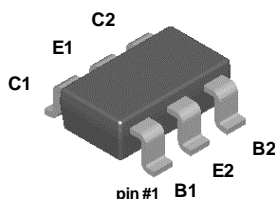
NOTE: The pinouts are symmetrical; pin 1 and pin 4 are interchangeable. Units inside the carrier can be of either orientation and will not affect the functionality of the device.
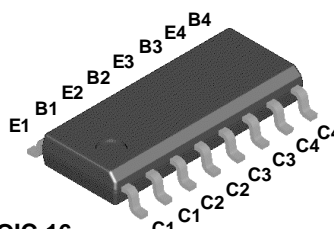
FMB3904

pin #1

SuperSOT™-6
Mark: .1A
Dot denotes pin #1

MMPQ3904

SOIC-16   **pin #1**
Mark: MMPQ3904

NPN Multi-Chip 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* $T_A = 25°C$ 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	°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.
3) All voltages (V) and currents (A) are negative polarity for PNP transistors.

Thermal Characteristics $T_A = 25°C$ unless otherwise noted

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

NPN Multi-Chip General Purpose Amplifier
(continued)

Electrical Characteristics $T_A = 25°C$ unless otherwise noted

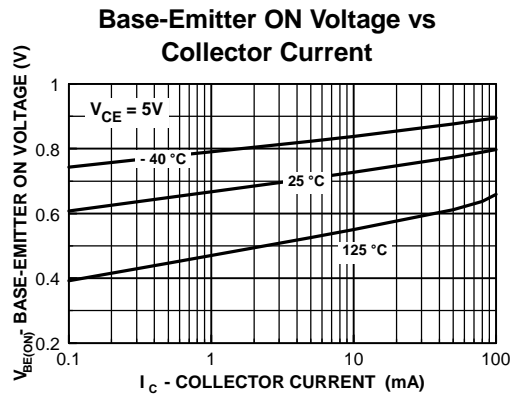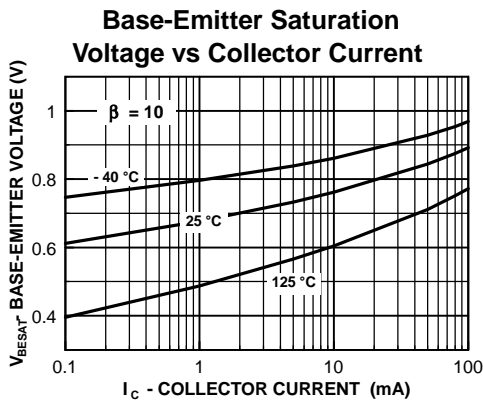| Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
OFF CHARACTERISTICS						
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	$I_C = 1.0$ mA, $I_B = 0$	40			V
$V_{(BR)CBO}$	Collector-Base Breakdown Voltage	$I_C = 10$ µA, $I_E = 0$	60			V
$V_{(BR)EBO}$	Emitter-Base Breakdown Voltage	$I_E = 10$ µA, $I_C = 0$	6.0			V
I_{BL}	Base Cutoff Current	$V_{CE} = 30$ V, $V_{EB} = 0$			50	nA
I_{CEX}	Collector Cutoff Current	$V_{CE} = 30$ V, $V_{EB} = 0$			50	nA
ON CHARACTERISTICS*						
h_{FE}	DC Current Gain	$I_C = 0.1$ mA, $V_{CE} = 1.0$ V **MMPQ3904** $I_C = 1.0$ mA, $V_{CE} = 1.0$ V **MMPQ3904** $I_C = 10$ mA, $V_{CE} = 1.0$ V **MMPQ3904** $I_C = 50$ mA, $V_{CE} = 1.0$ V $I_C = 100$ mA, $V_{CE} = 1.0$ V	40 30 70 50 100 75 60 30		300	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$I_C = 10$ mA, $I_B = 1.0$ mA $I_C = 50$ mA, $I_B = 5.0$ mA			0.2 0.3	V V
$V_{BE(sat)}$	Base-Emitter Saturation Voltage	$I_C = 10$ mA, $I_B = 1.0$ mA $I_C = 50$ mA, $I_B = 5.0$ mA	0.65		0.85 0.95	V V
SMALL SIGNAL CHARACTERISTICS (MMPQ3904 only)						
f_T	Current Gain - Bandwidth Product	$I_C = 10$ mA, $V_{CE} = 20$ V, $f = 100$ MHz		250		MHz
C_{obo}	Output Capacitance	$V_{CB} = 5.0$ V, $I_E = 0$, $f = 140$ kHz		4.0		pF
C_{ibo}	Input Capacitance	$V_{EB} = 0.5$ V, $I_C = 0$, $f = 140$ kHz		8.0		pF

*Pulse Test: Pulse Width ≤ 300 µs, Duty Cycle ≤ 2.0%

NOTE: All voltages (V) and currents (A) are negative polarity for PNP transistors.

NPN Multi-Chip General Purpose Amplifier
(continued)

Typical Characteristics

Typical Pulsed Current Gain vs Collector Current

h_{FE} - TYPICAL PULSED CURRENT GAIN

V_{CE} = 5V

125 °C

25 °C

- 40 °C

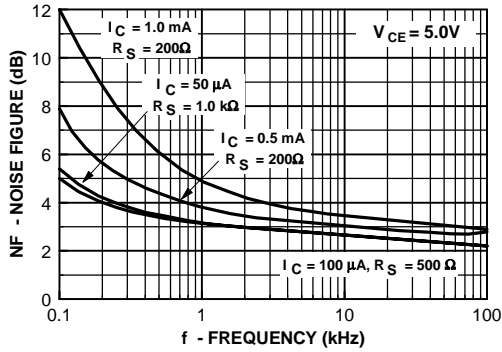I_C - COLLECTOR CURRENT (mA)

Collector-Emitter Saturation Voltage vs Collector Current

V_{CESAT} - COLLECTOR-EMITTER VOLTAGE (V)

β = 10

125 °C

25 °C

- 40 °C

I_C - COLLECTOR CURRENT (mA)

Base-Emitter Saturation Voltage vs Collector Current

V_{BESAT} - BASE-EMITTER VOLTAGE (V)

β = 10

- 40 °C

25 °C

125 °C

I_C - COLLECTOR CURRENT (mA)

Base-Emitter ON Voltage vs Collector Current

$V_{BE(ON)}$ - BASE-EMITTER ON VOLTAGE (V)

V_{CE} = 5V

- 40 °C

25 °C

125 °C

I_C - COLLECTOR CURRENT (mA)

Collector-Cutoff Current vs Ambient Temperature

I_{CBO} - COLLECTOR CURRENT (nA)

V_{CB} = 30V

T_A - AMBIENT TEMPERATURE (°C)

Capacitance vs Reverse Bias Voltage

CAPACITANCE (pF)

f = 1.0 MHz

C_{ibo}

C_{obo}

REVERSE BIAS VOLTAGE (V)

NPN Multi-Chip General Purpose Amplifier
(continued)

Typical Characteristics (continued)

Noise Figure vs Frequency

NF - NOISE FIGURE (dB)

$I_C = 1.0$ mA
$R_S = 200\Omega$

$V_{CE} = 5.0$V

$I_C = 50$ µA
$R_S = 1.0$ kΩ

$I_C = 0.5$ mA
$R_S = 200\Omega$

$I_C = 100$ µA, $R_S = 500$ Ω

f - FREQUENCY (kHz)

Noise Figure vs Source Resistance

NF - NOISE FIGURE (dB)

$I_C = 1.0$ mA

$I_C = 5.0$ mA

$I_C = 50$ µA

$I_C = 100$ µA

R_S - SOURCE RESISTANCE (kΩ)
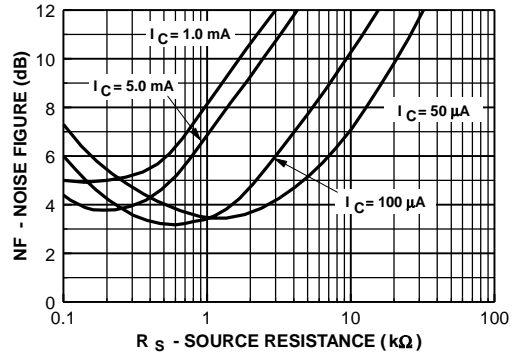
Current Gain and Phase Angle vs Frequency

h_{fe} - CURRENT GAIN (dB)

θ - DEGREES

h_{fe}

θ

$V_{CE} = 40$V
$I_C = 10$ mA

f - FREQUENCY (MHz)
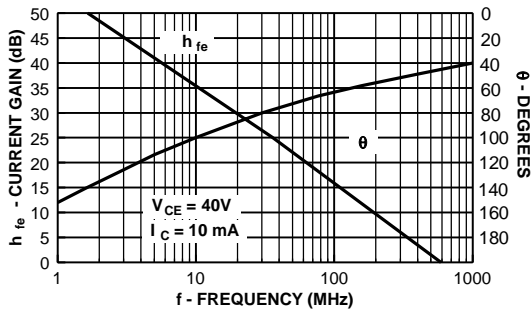
Power Dissipation vs Ambient Temperature

P_D - POWER DISSIPATION (W)

SOIC-16

SOT-6

SC70-6

TEMPERATURE (ºC)
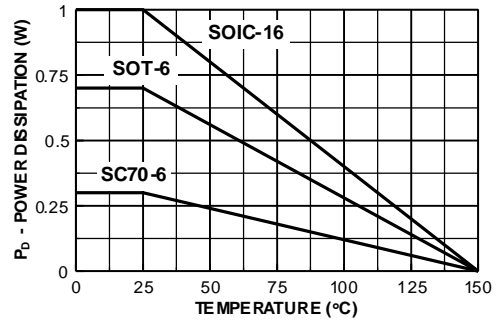
Turn-On Time vs Collector Current
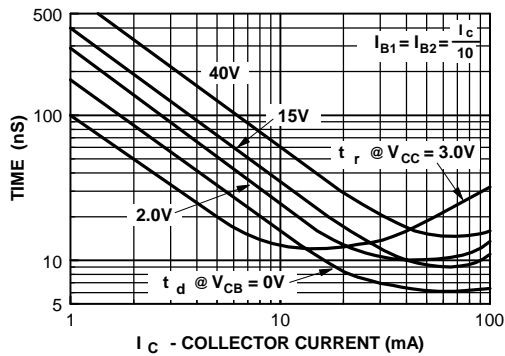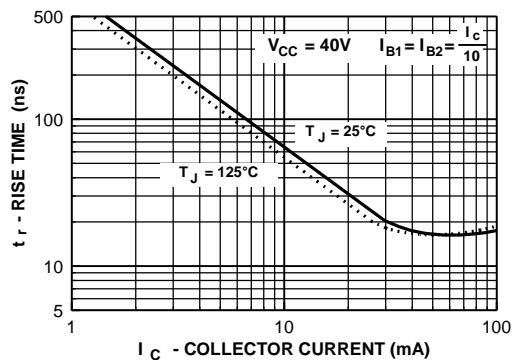
TIME (nS)

$I_{B1} = I_{B2} = \dfrac{I_C}{10}$

40V

15V

t_r @ $V_{CC} = 3.0$V

2.0V

t_d @ $V_{CB} = 0$V

I_C - COLLECTOR CURRENT (mA)

Rise Time vs Collector Current

t_r - RISE TIME (ns)

$V_{CC} = 40$V $I_{B1} = I_{B2} = \dfrac{I_C}{10}$
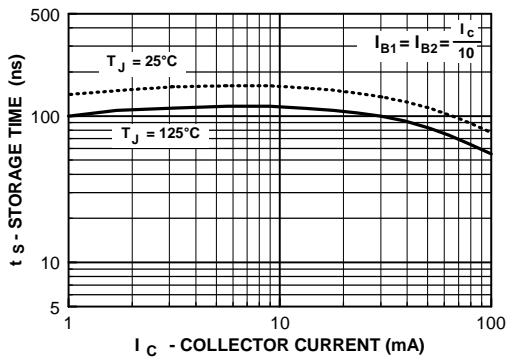
$T_J = 25$°C

$T_J = 125$°C

I_C - COLLECTOR CURRENT (mA)

NPN Multi-Chip General Purpose Amplifier
(continued)

Typical Characteristics (continued)

Storage Time vs Collector Current
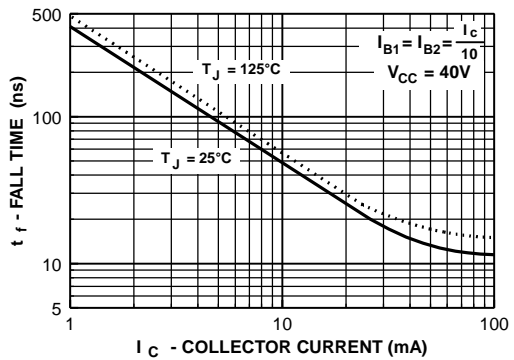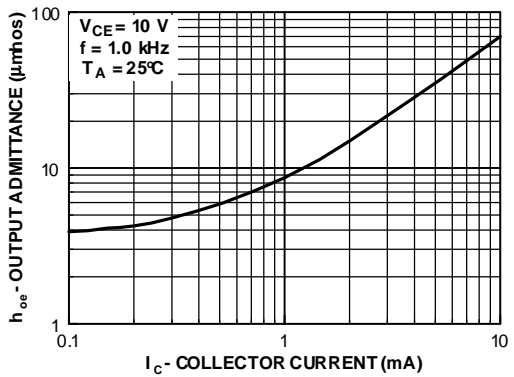

$I_{B1} = I_{B2} = \frac{I_c}{10}$

$T_J = 25°C$

$T_J = 125°C$

t_S - STORAGE TIME (ns)

I_C - COLLECTOR CURRENT (mA)

Fall Time vs Collector Current

$I_{B1} = I_{B2} = \frac{I_c}{10}$

$V_{CC} = 40V$

$T_J = 125°C$

$T_J = 25°C$

t_f - FALL TIME (ns)

I_C - COLLECTOR CURRENT (mA)

Current Gain

$V_{CE} = 10\ V$
$f = 1.0\ kHz$
$T_A = 25°C$

h_{fe} - CURRENT GAIN

I_C - COLLECTOR CURRENT (mA)

Output Admittance

$V_{CE} = 10\ V$
$f = 1.0\ kHz$
$T_A = 25°C$

h_{oe} - OUTPUT ADMITTANCE (μmhos)

I_C - COLLECTOR CURRENT (mA)

Input Impedance

$V_{CE} = 10\ V$
$f = 1.0\ kHz$
$T_A = 25°C$

h_{ie} - INPUT IMPEDANCE (kΩ)

I_C - COLLECTOR CURRENT (mA)

Voltage Feedback Ratio

$V_{CE} = 10\ V$
$f = 1.0\ kHz$
$T_A = 25°C$

h_{re} - VOLTAGE FEEDBACK RATIO ($\times 10^{-4}$)

I_C - COLLECTOR CURRENT (mA)

NPN Multi-Chip General Purpose Amplifier
(continued)
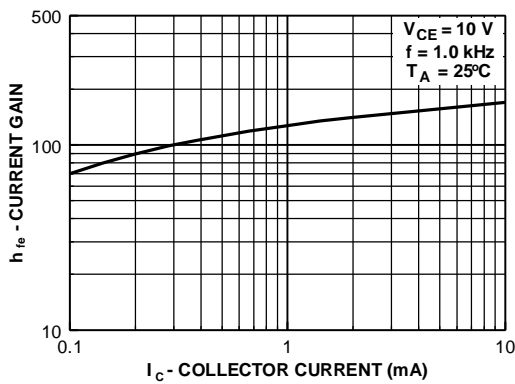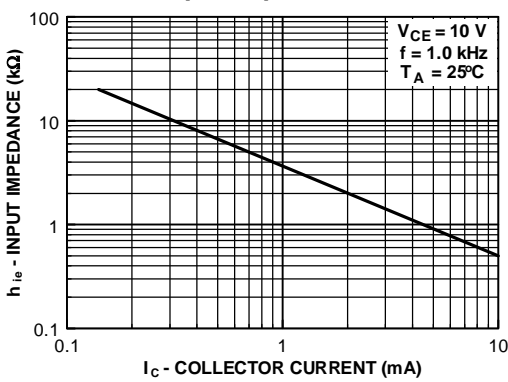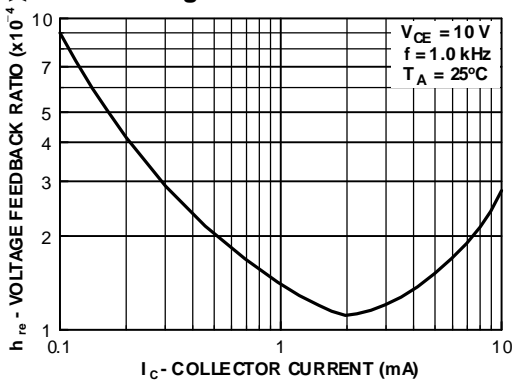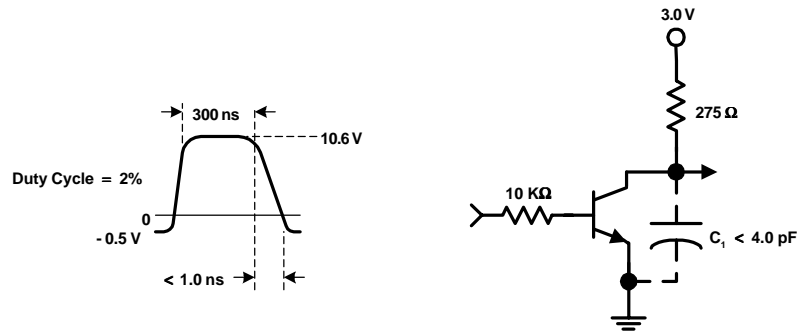
Test Circuits

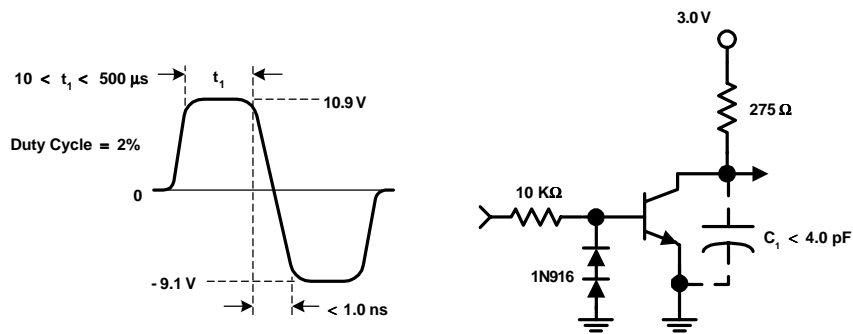**FIGURE 1: Delay and Rise Time Equivalent Test Circuit**

FIGURE 2: Storage and Fall Time Equivalent Test Circuit

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DOME™	ISOPLANAR™	Quiet Series™	
E²CMOS™	MICROWIRE™	SILENT SWITCHER ®	
EnSigna™	OPTOLOGIC™	SMART START™	
FACT™	OPTOPLANAR™	SuperSOT™-3	
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