



ON Semiconductor®

# FFB3904 / FMB3904 / MMPQ3904 NPN Multi-Chip General Purpose Amplifier

## Description

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.

## Block Diagram

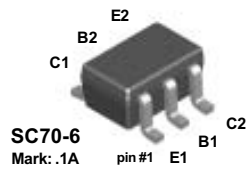


Figure 1. FFB3904 Device Package

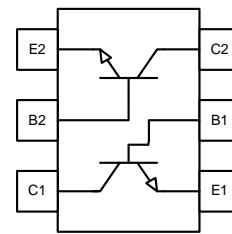


Figure 2. FFB3904 Internal Connection

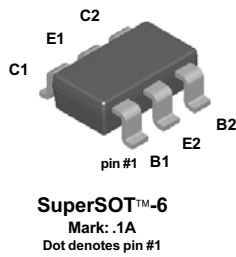


Figure 3. FMB3904 Device Package

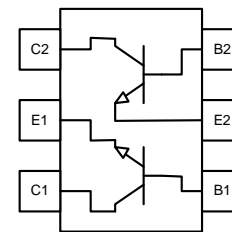


Figure 4. FMB3904 Internal Connection

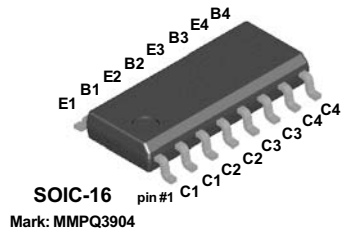


Figure 5. MMPQ3904 Device Package

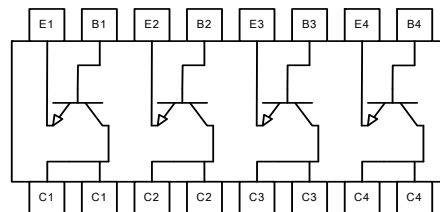


Figure 6. MMPQ3904 Internal Connection

## Ordering Information

Part Number	Top Mark	Package	Packing Method
FFB3904	.1A	SC70 6L	Tape and Reel
FMB3904	.1A	SSOT 6L	Tape and Reel
MMPQ3904	MMPQ3904	SOIC 16L	Tape and Reel

## Absolute Maximum Ratings<sup>(1)</sup>

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only. Values are at  $T_A = 25^\circ\text{C}$  unless otherwise noted.

Symbol	Parameter	Value	Unit
$V_{CEO}$	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	$^\circ\text{C}$

### Note:

1. These ratings are based on a maximum junction temperature of  $150^\circ\text{C}$ . These are steady-state limits. ON Semiconductor should be consulted on applications involving pulsed or low-duty cycle operations.

## Thermal Characteristics<sup>(2)</sup>

Values are at  $T_A = 25^\circ\text{C}$  unless otherwise noted.

Symbol	Parameter	Max.			Unit
		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		$^\circ\text{C}/\text{W}$
	Thermal Resistance, Junction to Ambient, Effective 4 Die			125	
	Thermal Resistance, Junction to Ambient, Each Die			240	

### Note:

2. PCB size: FR-4 76 x 114 x 0.6T mm<sup>3</sup> (3.0 inch x 4.5 inch x 0.062 inch) with minimum land pattern size.

## Electrical Characteristics

Values are at  $T_A = 25^\circ\text{C}$  unless otherwise noted.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
<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	$I_C = 10\text{ }\mu\text{A}, I_E = 0$	60			V
$V_{(BR)EBO}$	Emitter-Base Breakdown Voltage	$I_E = 10\text{ }\mu\text{A}, I_C = 0$	6.0			V
$I_{BL}$	Base Cut-Off Current	$V_{CE} = 30\text{ V}, V_{BE} = -3\text{ V}$			50	nA
$I_{CEX}$	Collector Cut-Off Current	$V_{CE} = 30\text{ V}, V_{BE} = -3\text{ V}$			50	nA
<b>On Characteristics<sup>(3)</sup></b>						
$h_{FE}$	DC Current Gain	FFB3904, FMB3904	$I_C = 0.1\text{ mA}, V_{CE} = 1.0\text{ V}$	40		
		MMPQ3904		30		
		FFB3904, FMB3904	$I_C = 1.0\text{ mA}, V_{CE} = 1.0\text{ V}$	70		
		MMPQ3904		50		
		FFB3904, FMB3904	$I_C = 10\text{ mA}, V_{CE} = 1.0\text{ V}$	100		300
		MMPQ3904		75		
		All Devices	$I_C = 50\text{ mA}, V_{CE} = 1.0\text{ V}$	60		
		All Devices	$I_C = 100\text{ mA}, V_{CE} = 1.0\text{ V}$	30		
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$I_C = 10\text{ mA}, I_B = 1.0\text{ mA}$			0.2	V
		$I_C = 50\text{ mA}, I_B = 5.0\text{ mA}$			0.3	
$V_{BE(sat)}$	Base-Emitter Saturation Voltage	$I_C = 10\text{ mA}, I_B = 1.0\text{ mA}$	0.65		0.85	V
		$I_C = 50\text{ mA}, I_B = 5.0\text{ mA}$			0.95	
<b>Small-Signal Characteristics (MMPQ3904 only)</b>						
$f_T$	Current Gain-Bandwidth Product	$I_C = 10\text{ mA}, V_{CE} = 20\text{ V},$ $f = 100\text{ MHz}$		250		MHz
$C_{ob}$	Output Capacitance	$V_{CB} = 5.0\text{ V}, I_E = 0,$ $f = 140\text{ kHz}$		4.0		pF
$C_{ib}$	Input Capacitance	$V_{BE} = 0.5\text{ V}, I_C = 0,$ $f = 140\text{ kHz}$		8.0		pF

**Note:**

3. Pulse test: pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2.0\%$ .

## Typical Performance Characteristics

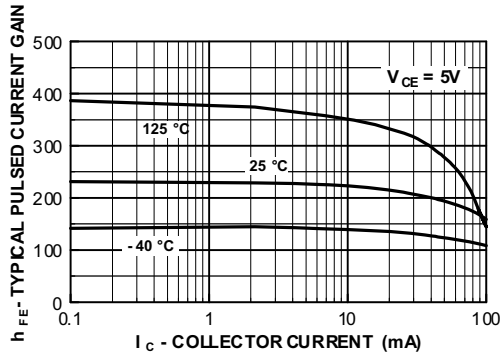


Figure 7. Typical Pulsed Current Gain vs. Collector Current

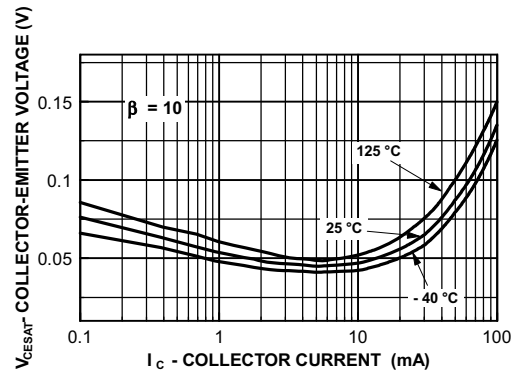


Figure 8. Collector-Emitter Saturation Voltage vs. Collector Current

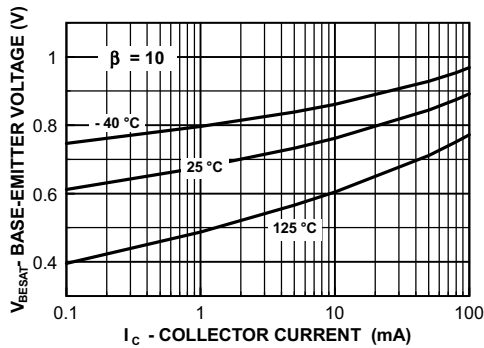


Figure 9. Base-Emitter Saturation Voltage vs. Collector Current

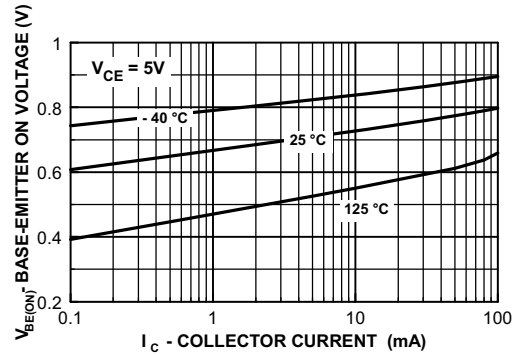


Figure 10. Base-Emitter On Voltage vs. Collector Current

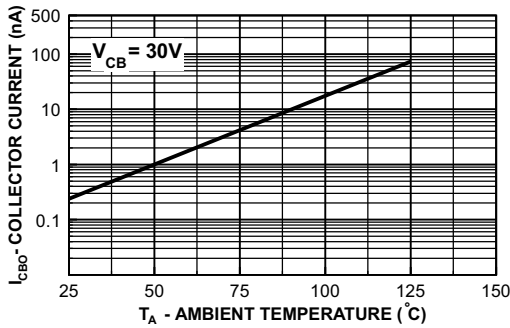


Figure 11. Collector Cut-Off Current vs. Ambient Temperature

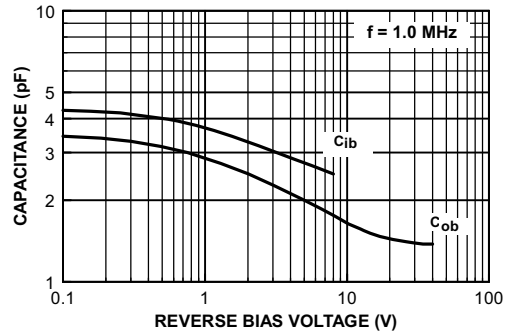
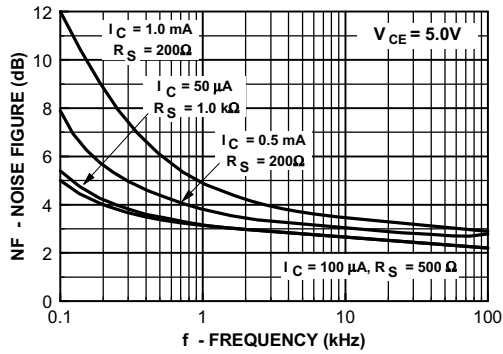
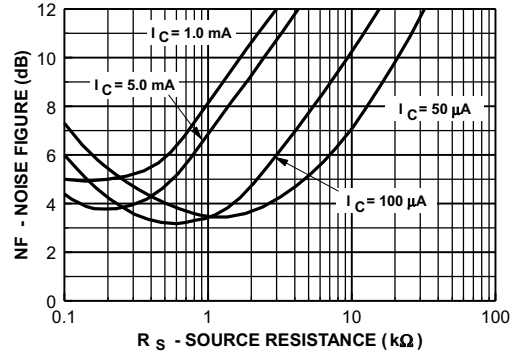


Figure 12. Capacitance vs. Reverse Bias Voltage

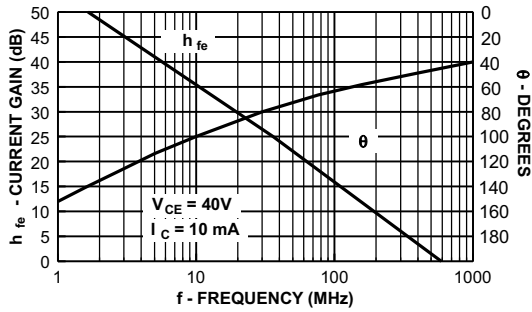
**Typical Performance Characteristics** (Continued)



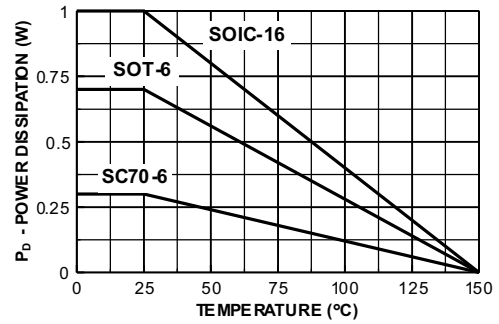
**Figure 13. Noise Figure vs. Frequency**



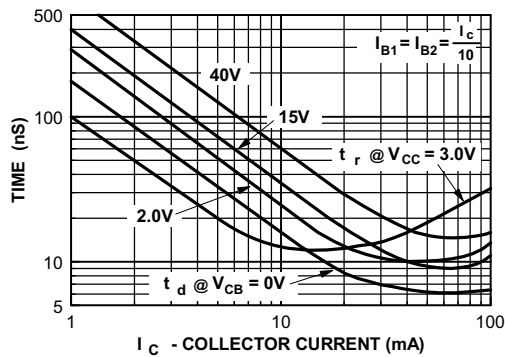
**Figure 14. Noise Figure vs. Source Resistance**



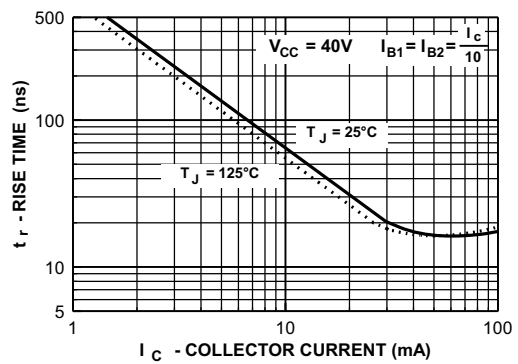
**Figure 15. Current Gain and Phase Angle vs. Frequency**



**Figure 16. Power Dissipation vs. Ambient Temperature**

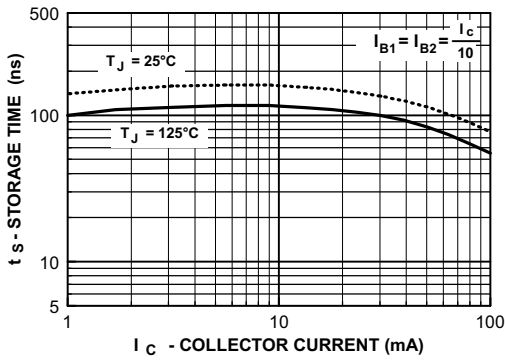


**Figure 17. Turn-On Time vs. Collector Current**

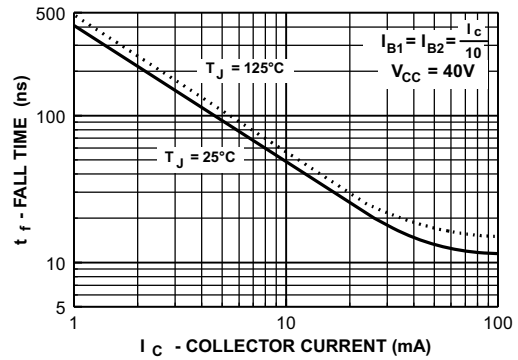


**Figure 18. Rise Time vs. Collector Current**

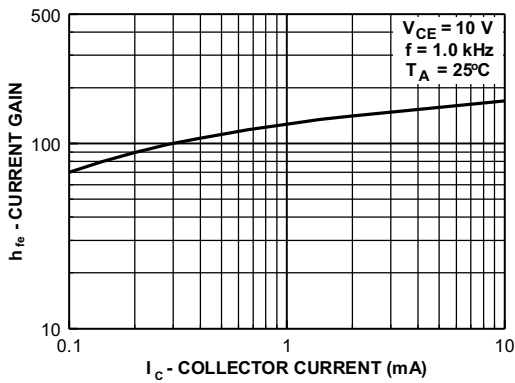
**Typical Performance Characteristics** (Continued)



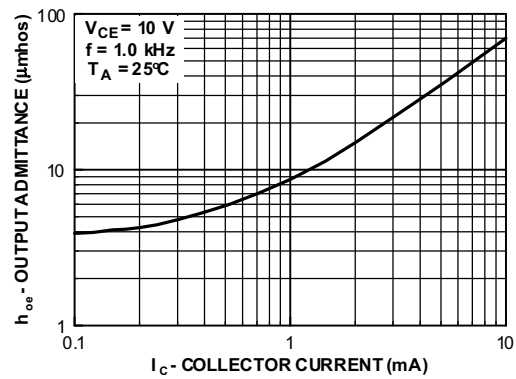
**Figure 19. Storage Time vs. Collector Current**



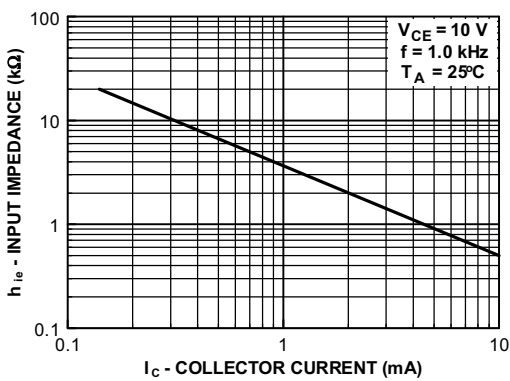
**Figure 20. Fall Time vs. Collector Current**



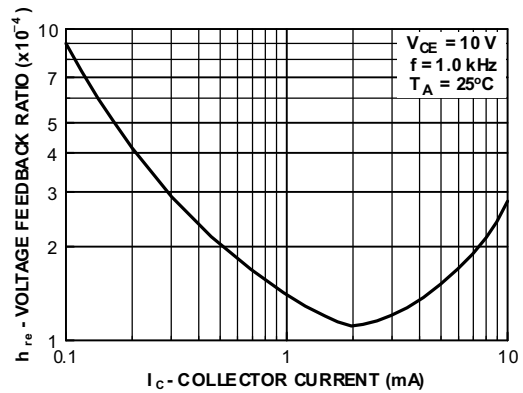
**Figure 21. Current Gain**



**Figure 22. Output Admittance**



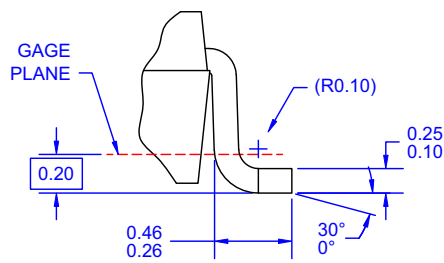
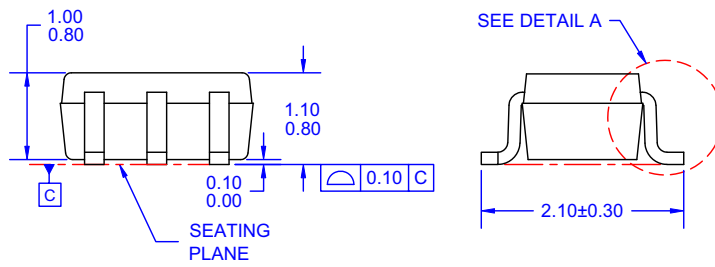
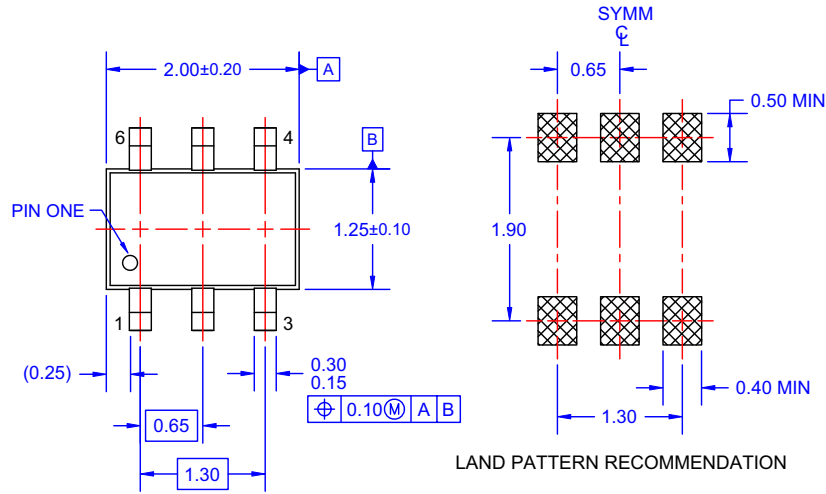
**Figure 23. Input Impedance**



**Figure 24. Voltage Feedback Ratio**

Physical Dimensions

SC70 6L



**DETAIL A**  
SCALE: 60X

NOTES: UNLESS OTHERWISE SPECIFIED

- A) THIS PACKAGE CONFORMS TO EIAJ SC-88, 1996.
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS DO NOT INCLUDE BURRS OR MOLD FLASH.
- D) DRAWING FILENAME: MKT-MAA06AREV6

Figure 25. 6-LEAD, SC70, EIAJ SC-88, 1.25 MM WIDE (ACTIVE)

Physical Dimensions (Continued)

SSOT 6L

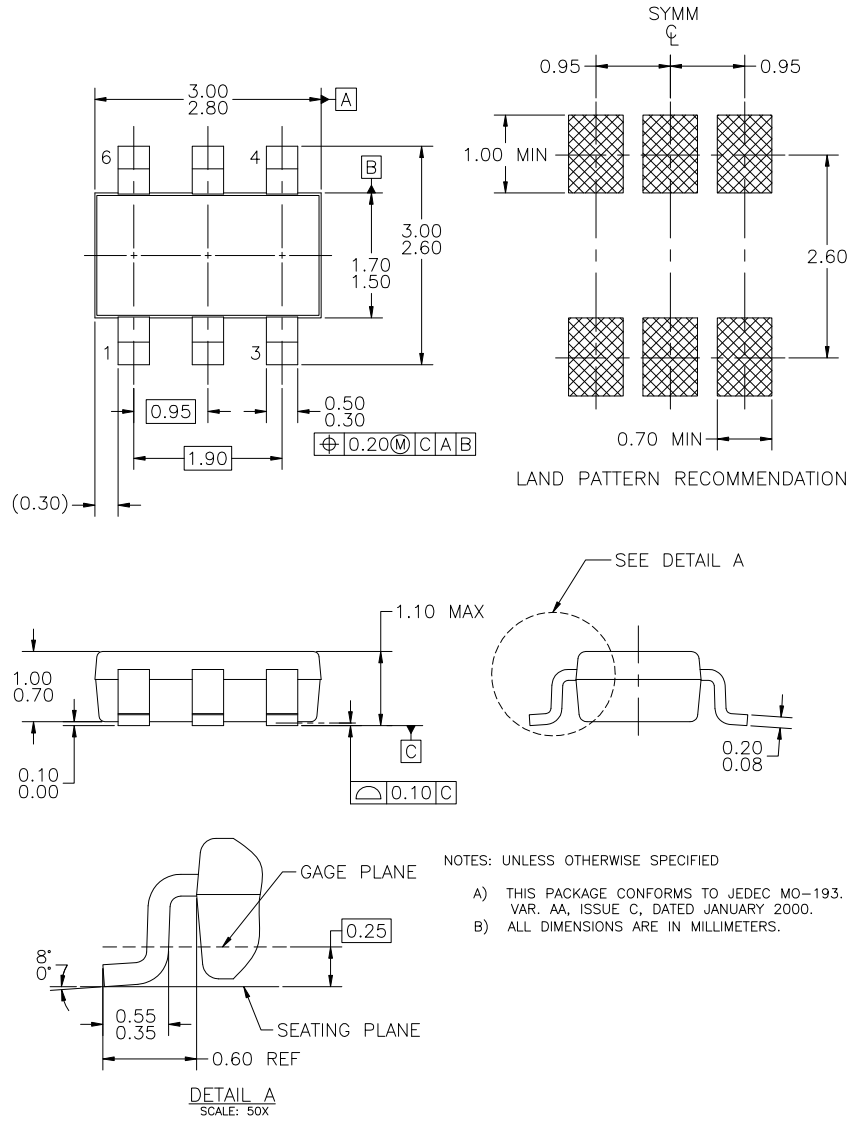


Figure 26. 6-LEAD, SUPERSOT-6, JEDEC MO-193, 1.6 MM WIDE (ACTIVE)



Physical Dimensions (Continued)

SO 16L NB

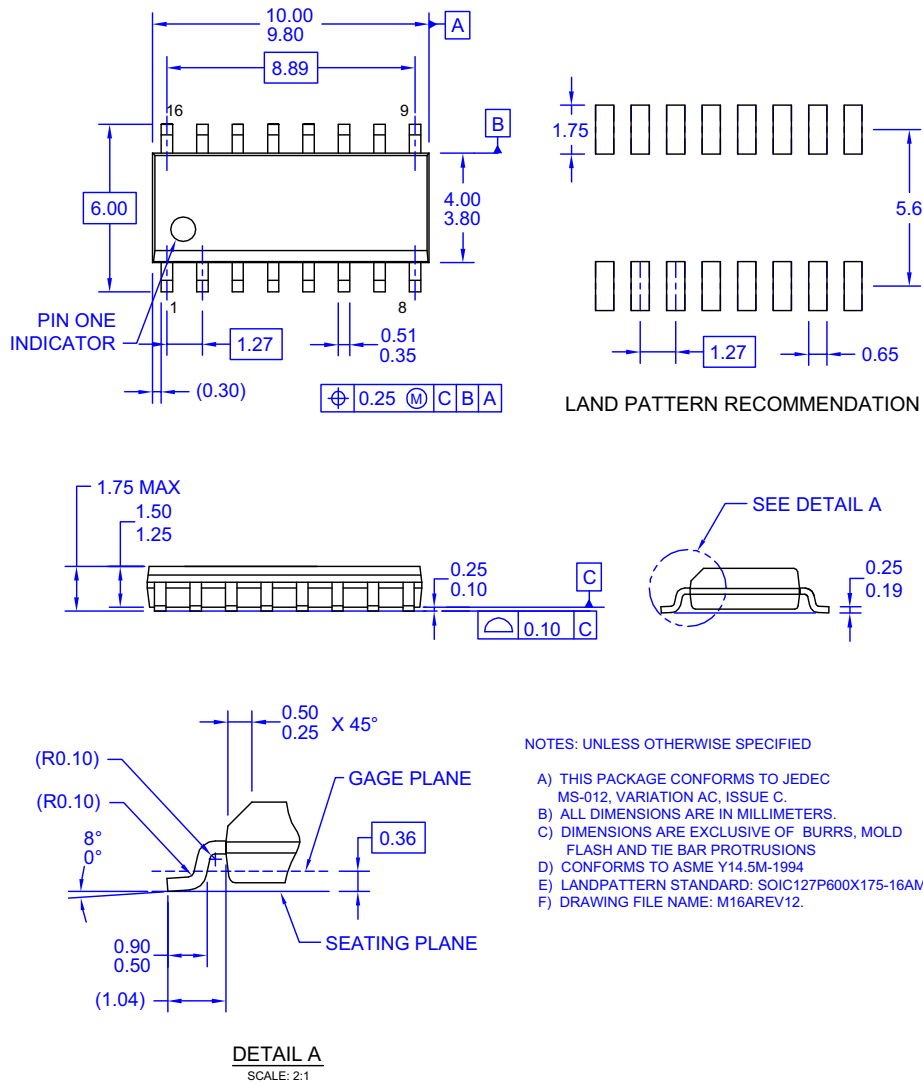


Figure 27. 16-LEAD, SOIC, JEDEC MS-012, 0.150 inch, NARROW BODY (ACTIVE)

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