



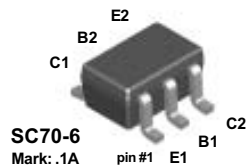
ON Semiconductor®

# 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



The pinouts are symmetrical; pin 1 and pin 4 are interchangeable. Units inside the carrier tape can be of either orientation (0 deg and 180 deg) and will not affect the functionality of the device.

Figure 1. FFB3904 Device Package

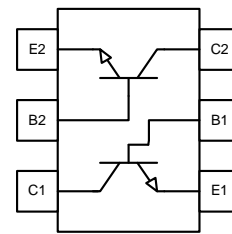


Figure 2. FFB3904 Internal Connection

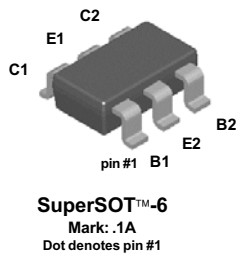


Figure 3. FMB3904 Device Package

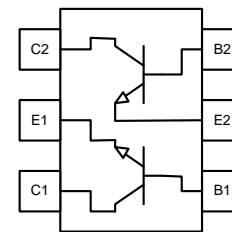


Figure 4. FMB3904 Internal Connection

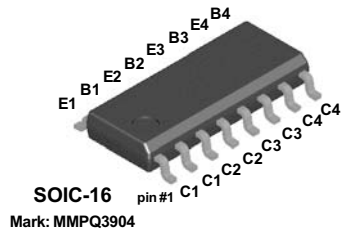


Figure 5. MMPQ3904 Device Package

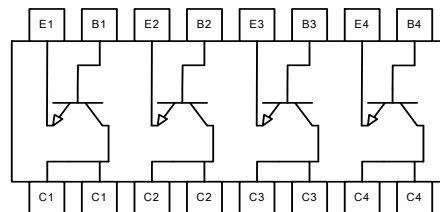


Figure 6. MMPQ3904 Internal Connection

## 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	$I_C = 10\ \mu\text{A}, I_E = 0$	60			V				
$V_{(BR)EBO}$	Emitter-Base Breakdown Voltage	$I_E = 10\ \mu\text{A}, I_C = 0$	6.0			V				
$I_{BL}$	Base 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  $\leq 300\ \mu\text{s}$ , duty cycle  $\leq 2.0\%$ .

## Typical Performance Characteristics

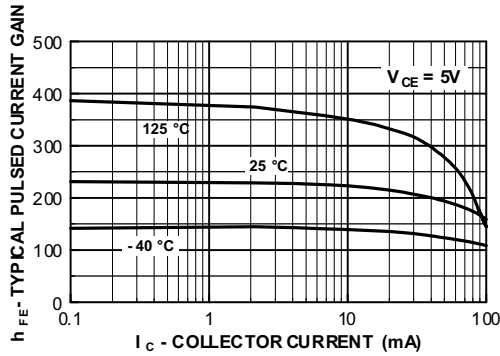


Figure 7. Typical Pulsed Current Gain vs. Collector Current

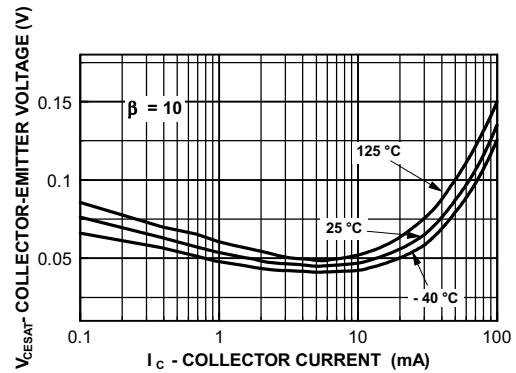


Figure 8. Collector-Emitter Saturation Voltage vs. Collector Current

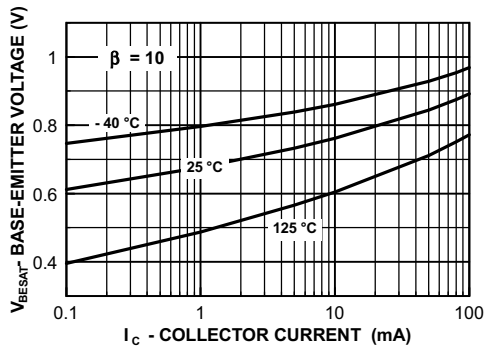


Figure 9. Base-Emitter Saturation Voltage vs. Collector Current

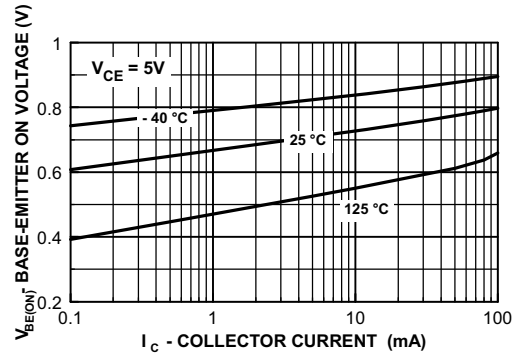


Figure 10. Base-Emitter On Voltage vs. Collector Current

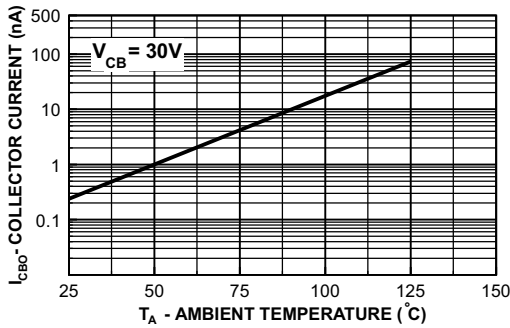


Figure 11. Collector Cut-Off Current vs. Ambient Temperature

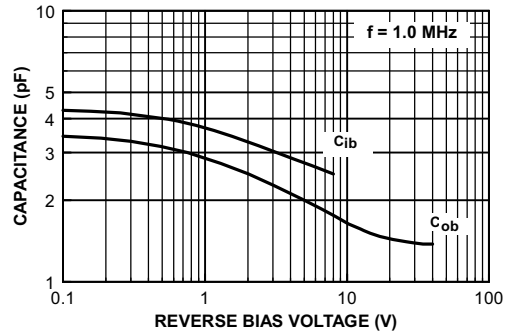


Figure 12. Capacitance vs. Reverse Bias Voltage

Typical Performance Characteristics (Continued)

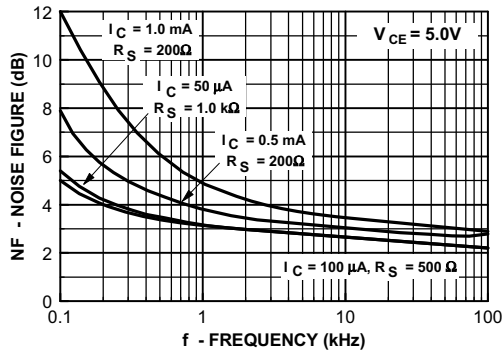


Figure 13. Noise Figure vs. Frequency

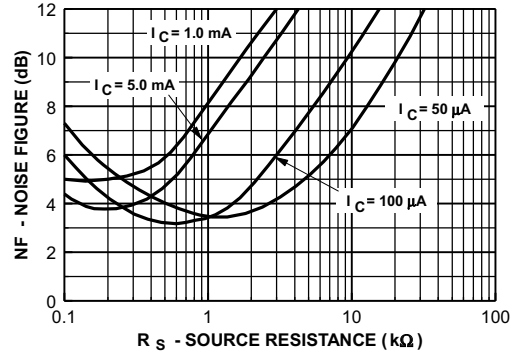


Figure 14. Noise Figure vs. Source Resistance

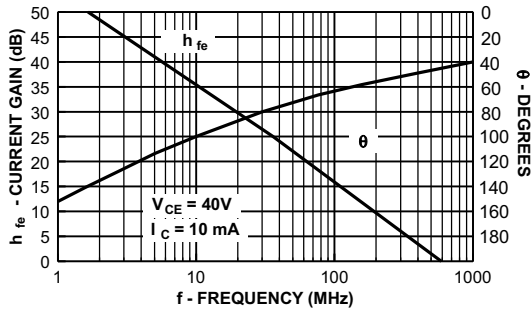


Figure 15. Current Gain and Phase Angle vs. Frequency

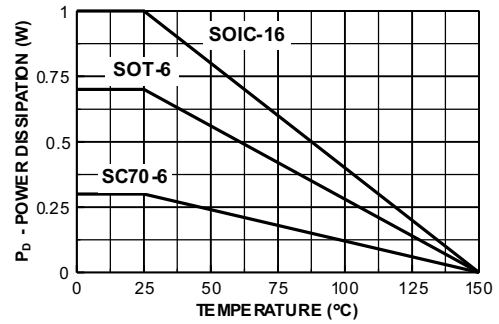


Figure 16. Power Dissipation vs. Ambient Temperature

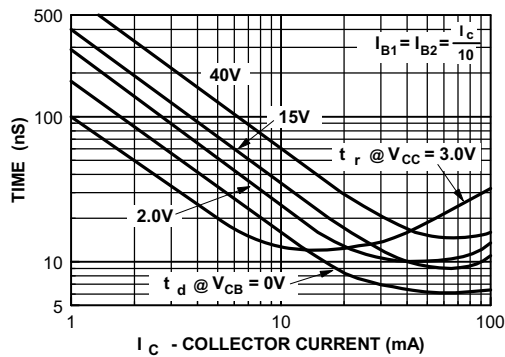


Figure 17. Turn-On Time vs. Collector Current

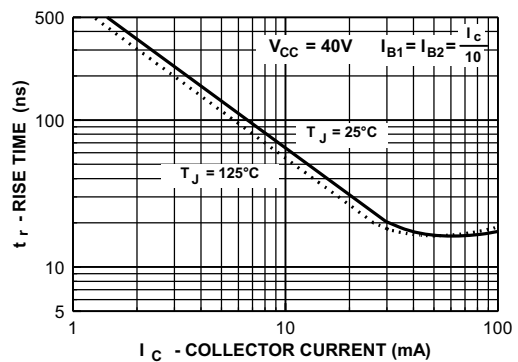
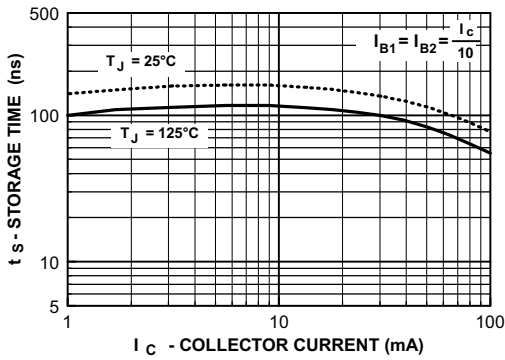
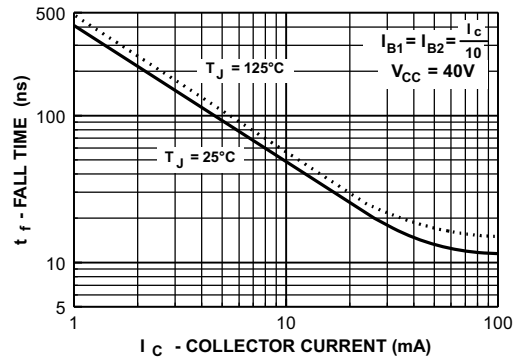


Figure 18. Rise Time vs. Collector Current

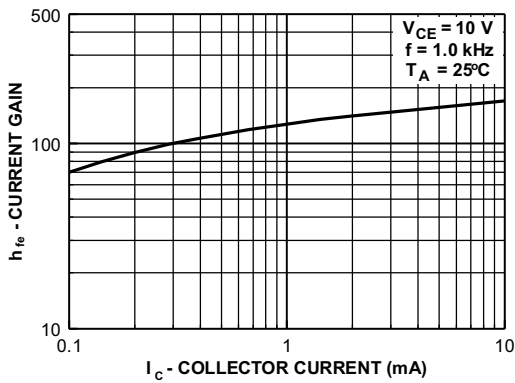
**Typical Performance Characteristics** (Continued)



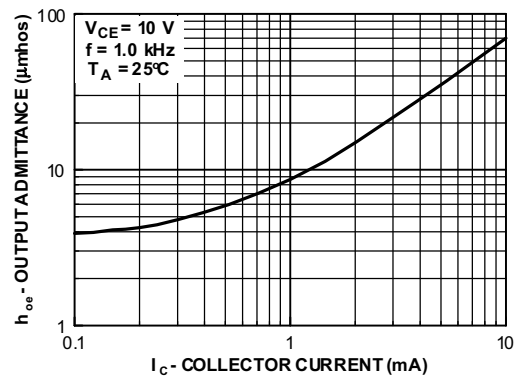
**Figure 19. Storage Time vs. Collector Current**



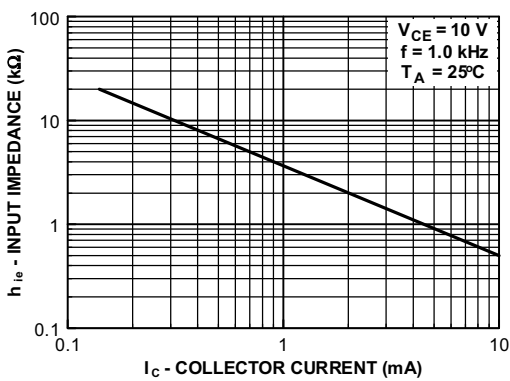
**Figure 20. Fall Time vs. Collector Current**



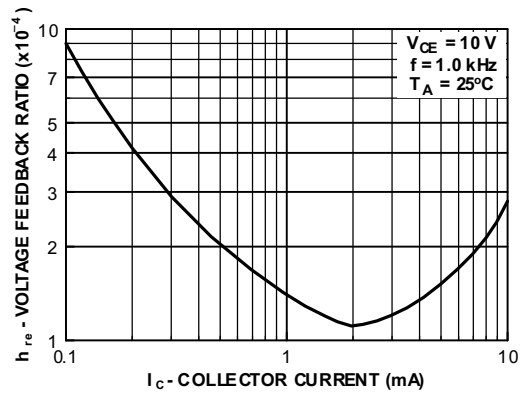
**Figure 21. Current Gain**



**Figure 22. Output Admittance**



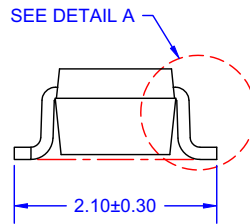
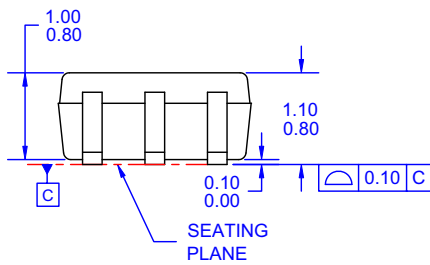
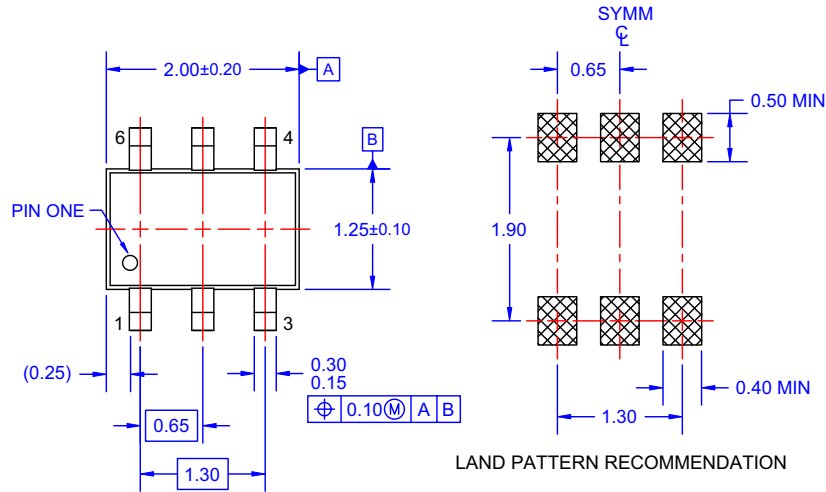
**Figure 23. Input Impedance**



**Figure 24. Voltage Feedback Ratio**

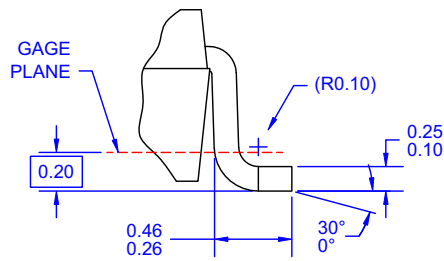
## Physical Dimensions

### SC70 6L



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



**DETAIL A**  
SCALE: 60X

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

Physical Dimensions (Continued)

SSOT 6L

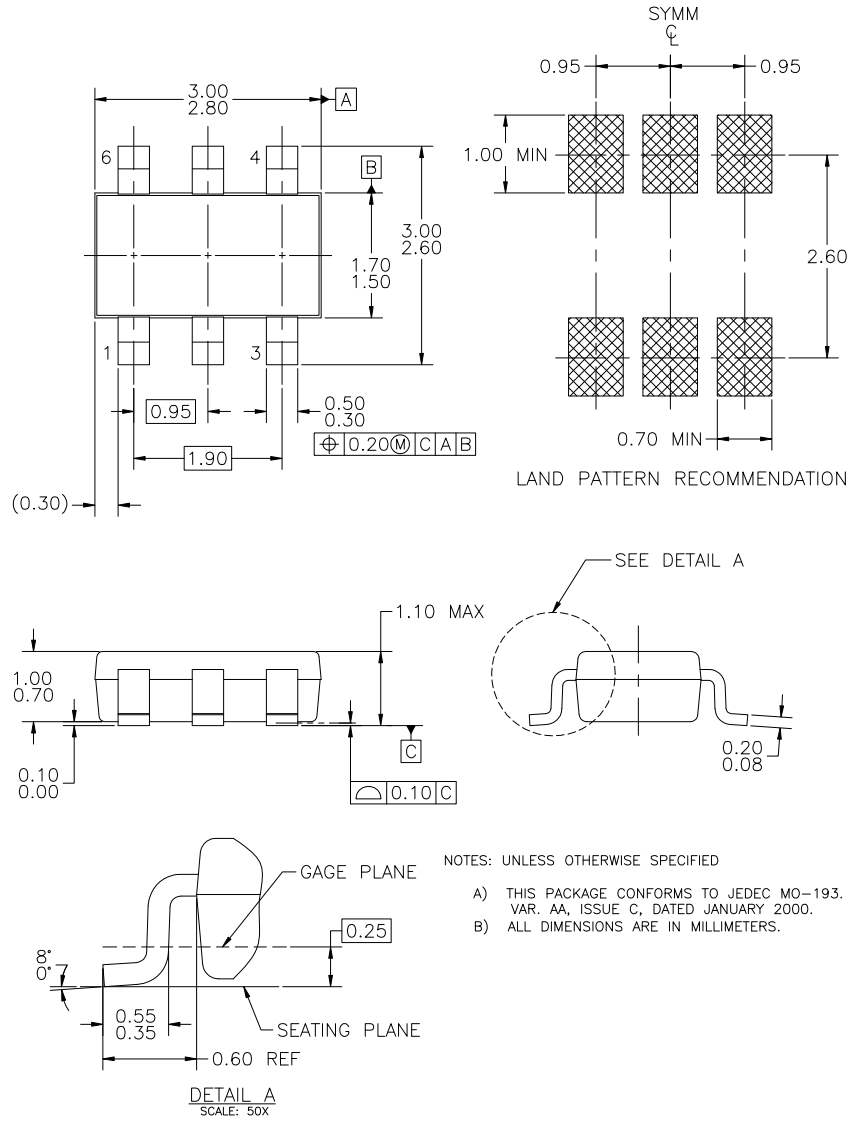


Figure 26. 6-LEAD, SUPERSOT-6, JEDEC MO-193, 1.6 MM WIDE (ACTIVE)



Physical Dimensions (Continued)

SO 16L NB

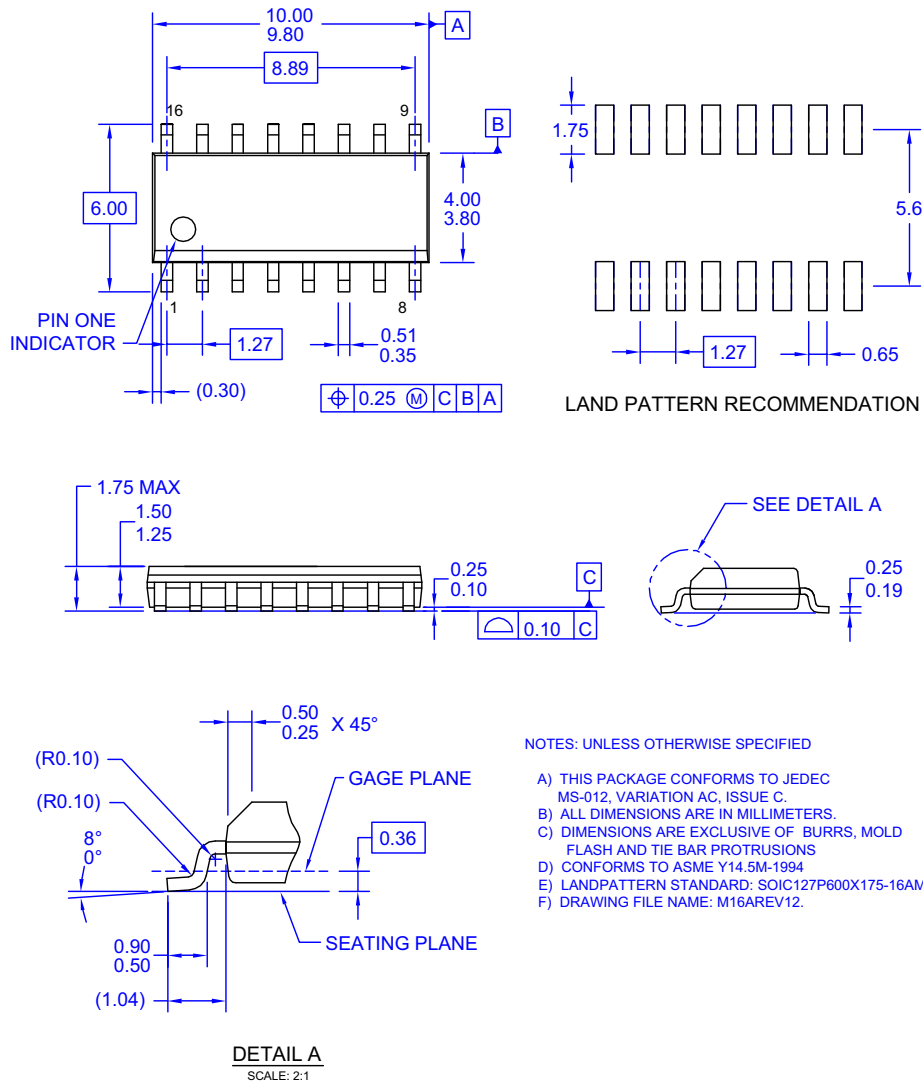



Figure 27. 16-LEAD, SOIC, JEDEC MS-012, 0.150 inch, NARROW BODY (ACTIVE)

ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

## PUBLICATION ORDERING INFORMATION

### LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor  
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA  
**Phone:** 303-675-2175 or 800-344-3860 Toll Free USA/Canada  
**Fax:** 303-675-2176 or 800-344-3867 Toll Free USA/Canada  
**Email:** [orderlit@onsemi.com](mailto:orderlit@onsemi.com)

**N. American Technical Support:** 800-282-9855 Toll Free  
USA/Canada  
**Europe, Middle East and Africa Technical Support:**  
Phone: 421 33 790 2910  
**Japan Customer Focus Center**  
Phone: 81-3-5817-1050

**ON Semiconductor Website:** [www.onsemi.com](http://www.onsemi.com)  
**Order Literature:** <http://www.onsemi.com/orderlit>  
For additional information, please contact your local  
Sales Representative