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Please note: As part of the Fairchild Semiconductor integration, some of the Fairchild orderable part numbers will need to change in order to meet ON Semiconductor's system requirements. Since the ON Semiconductor product management systems do not have the ability to manage part nomenclature that utilizes an underscore (_), the underscore (_) in the Fairchild part numbers will be changed to a dash (-). This document may contain device numbers with an underscore (_). Please check the ON Semiconductor website to verify the updated device numbers. The most current and up-to-date ordering information can be found at www.onsemi.com. Please email any questions regarding the system integration to Fairchild_questions@onsemi.com.

November 2014

KA324 / KA324A / KA2902
Quad Operational Amplifier

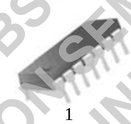
Features

- Internally Frequency Compensated for Unity Gain
- Large DC Voltage Gain: 100 dB
- Wide Power Supply Range:
  KA324 / KA324A: 3 V ~ 32 V (or ±1.5 V ~ 16 V)
  KA2902: 3 V ~ 26 V (or ±1.5 V ~ 13 V)
- Input Common Mode Voltage Range Includes Ground
- Large Output Voltage Swing: 0 V to V_{CC} -1.5 V
- Power Drain Suitable for Battery Operation

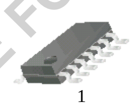
Description

The KA324 series consist of four independent, high gain, internally frequency compensated operational amplifiers which were designed specifically to operate from a single power supply over a wide voltage range. Operation from split power supplies is also possible so long as the difference between the two supplies is 3 V to 32 V. Application areas include transducer amplifier, DC gain blocks and all the conventional OP Amp circuits which now can be easily implemented in single power supply systems.

14-DIP



14-SOP



Ordering Information

Part Number	Operating Temperature Range	Top Mark	Package	Packing Method
KA324	0 to +70°C	KA324	MDIP 14L	Rail
KA324A		KA324A	MDIP 14L	Rail
KA324DTF		KA324D	SOP 14L	Tape and Reel
KA324ADTF		KA324AD	SOP 14L	Tape and Reel
KA2902DTF	-40 to +85°C	KA2902D	SOP 14L	Tape and Reel

Block Diagram

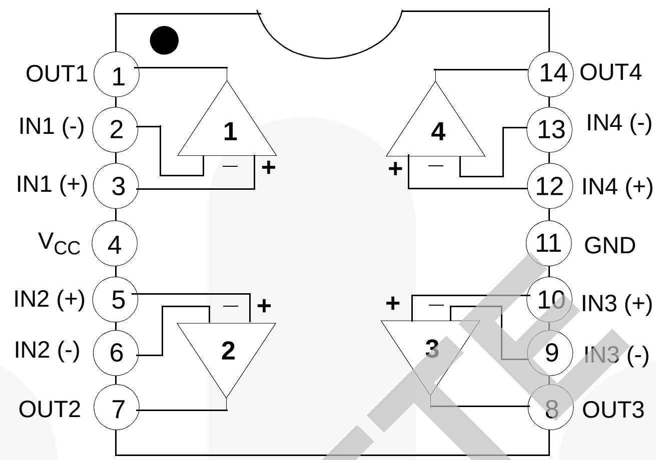


Figure 1. Block Diagram

Schematic Diagram

(One Section Only)

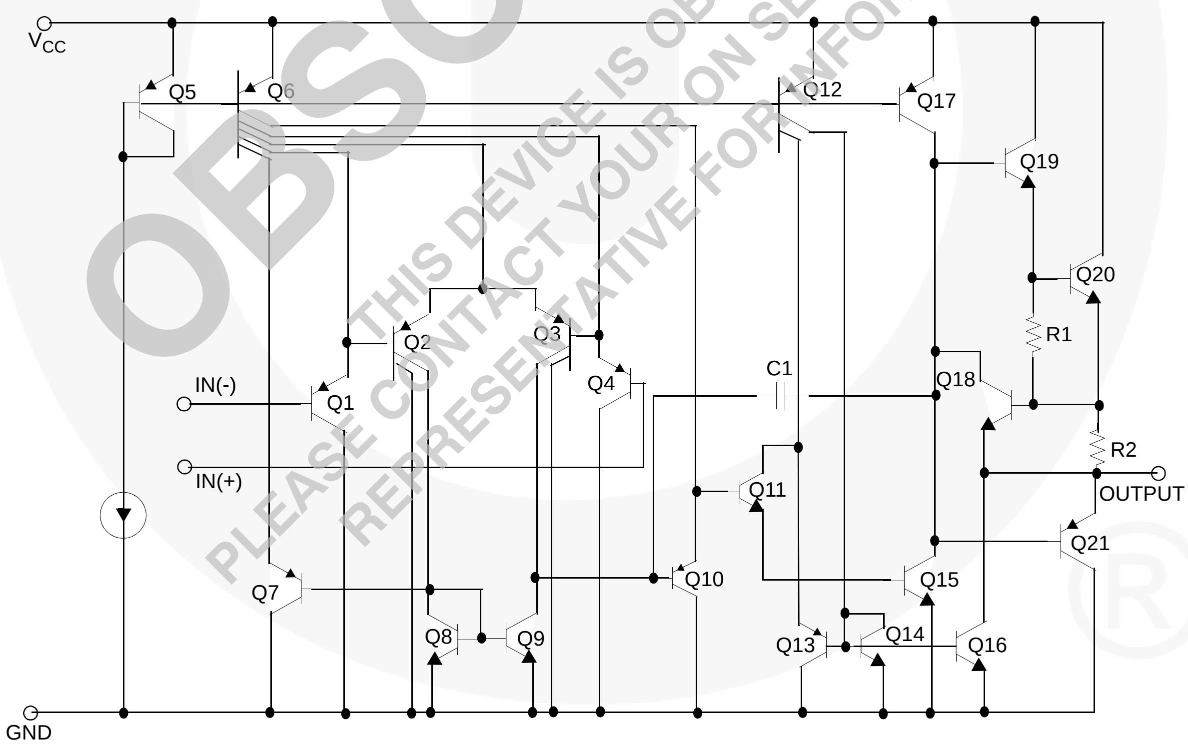


Figure 2. Schematic Diagram

Absolute Maximum Ratings

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°C unless otherwise noted.

Parameter	Symbol	KA324 / KA324A	KA2902	Unit
Power Supply Voltage	V_{CC}	±16 or 32	±13 or 26	V
Differential Input Voltage	$V_{I(DIFF)}$	32	26	V
Input Voltage	V_I	-0.3 to +32	-0.3 to +26	V
Output Short Circuit to GND $V_{CC} \leq$ 15 V, T_A = 25 °C (One Amp)	-	Continuous	Continuous	-
Operating Temperature Range	T_{OPR}	0 to +70	-40 to +85	°C
Storage Temperature Range	T_{STG}	-65 to +150	-65 to +150	°C

Thermal Characteristics

Values are at T_A = 25°C unless otherwise noted.

Symbol	Parameter		Value	Unit
P_D	Power Dissipation, T_A = 25 °C	**14-DIP**	1310	mW
		14-SOP	640	
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient, Max.	**14-DIP**	95	°C/W
		14-SOP	195	

Electrical Characteristics

Values are at V_{CC} = 5.0 V, V_{EE} = GND, T_A = 25 ℃, unless otherwise specified.

Symbol	Parameter	Conditions	KA324			KA2902			Unit
			Min.	Typ.	Max.	Min.	Typ.	Max.	
V_{IO}	Input Offset Voltage	V_{CM} = 0 V to V_{CC} - 1.5 V, $V_{O(P)}$ = 1.4 V, R_S = 0 Ω(1)	-	1.5	7.0	-	1.5	7.0	mV
I_{IO}	Input Offset Current	V_{CM} = 0 V	-	3	50	-	3	50	nA
I_{BIAS}	Input Bias Current	V_{CM} = 0 V	-	40	250	-	40	250	nA
$V_{I(R)}$	Input Common Mode Voltage Range	(1)	0	-	V_{CC} -1.5	0	-	V_{CC} -1.5	V
I_{CC}	Supply Current	R_L = ∞, V_{CC} = 30 V, (KA2902, V_{CC} = 26 V)	-	1.0	3.0	-	1.0	3.0	mA
		R_L = ∞, V_{CC} = 5 V	-	0.7	1.2	-	0.7	1.2	mA
G_V	Large Signal Voltage Gain	V_{CC} = 15 V, R_L = 2 kΩ, $V_{O(P)}$ = 1 V to 11 V	25	100	-	25	100	-	V/mV
$V_{O(H)}$	Output Voltage Swing	(1) R_L = 2 kΩ	26	-	-	22	-	-	V
		(1) R_L = 10 kΩ	27	28	-	23	24	-	V
$V_{O(L)}$		V_{CC} = 5 V, R_L= 10 kΩ	-	5	20	-	5	100	mV
CMRR	Common-Mode Rejection Ratio	-	65	75	-	50	75	-	dB
PSRR	Power Supply Rejection Ratio	-	65	100	-	50	100	-	dB
CS	Channel Separation	f = 1 kHz to 20 kHz(2)	-	120	-	-	120	-	dB
I_{SC}	Short Circuit to GND	V_{CC} = 15 V	-	40	60	-	40	60	mA
I_{SOURCE}	Output Current	$V_{I(+)}$ = 1 V, $V_{I(-)}$ = 0 V, V_{CC} = 15 V, $V_{O(P)}$ = 2 V	20	40	-	20	40	-	mA
I_{SINK}		$V_{I(+)}$ = 0 V, $V_{I(-)}$ = 1 V, V_{CC} = 15 V, $V_{O(P)}$ = 2 V	10	13	-	10	13	-	mA
		$V_{I(+)}$ = 0 V, $V_{I(-)}$ = 1 V, V_{CC} = 15 V, $V_{O(R)}$ = 200 mV	12	45	-	-	-	-	µA
$V_{I(DIFF)}$	Differential Input Voltage	-	-	-	V_{CC}	-	-	V_{CC}	V

Notes:

1. V_{CC} = 30 V for KA324, V_{CC} = 26 V for KA2902.
2. This parameter, although guaranteed is not 100% tested in production.

Electrical Characteristics (Continued)

Values are at V_{CC} = 5.0 V, V_{EE} = GND, unless otherwise specified.
The following specification apply over the range of 0°C ≤ T_A ≤ +70°C for the KA324, and the -40°C ≤ T_A ≤ +85°C for the KA2902.

Symbol	Parameter	Conditions	KA324			KA2902			Unit
			Min.	Typ.	Max.	Min.	Typ.	Max.	
V_{IO}	Input Offset Voltage	V_{ICM} = 0 V to V_{CC} -1.5 V, $V_{O(P)}$ = 1.4 V, R_S = 0 Ω (3)	-	-	9.0	-	-	10.0	mV
$\Delta V_{IO}/\Delta T$	Input Offset Voltage Drift	R_S = 0 Ω (4)	-	7.0	-	-	7.0	-	μV/ °C
I_{IO}	Input Offset Current	V_{CM} = 0 V	-	-	150	-	-	200	nA
$\Delta I_{IO}/\Delta T$	Input Offset Current Drift	R_S = 0 Ω (4)	-	10	-	-	10	-	pA/ °C
I_{BIAS}	Input Bias Current	V_{CM} = 0 V	-	-	500	-	-	500	nA
$V_{I(R)}$	Input Common Mode Voltage Range	(3)	0	-	V_{CC} -2.0	0	-	V_{CC} -2.0	V
G_V	Large Signal Voltage Gain	V_{CC} = 15 V, R_L = 2.0 kΩ, $V_{O(P)}$ = 1 V to 11 V	15	-	-	15	-	-	V/mV
$V_{O(H)}$	Output Voltage Swing	(3) R_L = 2 kΩ	26	-	-	22	-	-	V
		(3) R_L = 10 kΩ	27	28	-	23	24	-	V
$V_{O(L)}$		V_{CC} = 5 V, R_L= 10 kΩ	-	5	20	-	5	100	mV
I_{SOURCE}	Output Current	$V_{I(+)}$ = 1 V, $V_{I(-)}$ = 0 V, V_{CC} = 15 V, $V_{O(P)}$ = 2 V	10	20	-	10	20	-	mA
I_{SINK}		$V_{I(+)}$ = 0 V, $V_{I(-)}$ = 1 V, V_{CC} = 15 V, $V_{O(P)}$ = 2 V	5	8	-	5	8	-	mA
$V_{I(DIFF)}$	Differential Input Voltage	-	-	-	V_{CC}	-	-	V_{CC}	V

Notes:

3. V_{CC} = 30 V for KA324, V_{CC} = 26 V for KA2902.
4. These parameters, although guaranteed are not 100% tested in production.

Electrical Characteristics (Continued)

Values are at V_{CC} = 5.0 V, V_{EE} = GND, T_A = 25 ℃, unless otherwise specified.

Symbol	Parameter	Conditions		KA324A Min.	KA324A Typ.	KA324A Max.	Unit
V_{IO}	Input Offset Voltage	V_{CM} = 0 V to V_{CC} -1.5 V, $V_{O(P)}$ = 1.4 V, R_S = 0 Ω(5)		-	1.5	3.0	mV
I_{IO}	Input Offset Current	V_{CM} = 0 V		-	3	30	nA
I_{BIAS}	Input Bias Current	V_{CM} = 0 V		-	40	100	nA
$V_{I(R)}$	Input Common-Mode Voltage Range	(5)		0	-	V_{CC} -1.5	V
I_{CC}	Supply Current	V_{CC} = 30 V, R_L = ∞		-	1.5	3.0	mA
		V_{CC} = 5 V, R_L = ∞		-	0.7	1.2	mA
G_V	Large Signal Voltage Gain	V_{CC} = 15 V, R_L = 2 kΩ, $V_{O(P)}$ = 1 V to 11 V		25	100	-	V/mV
$V_{O(H)}$	Output Voltage Swing	(5)	R_L = 2 kΩ	26	-	-	V
			R_L = 10 kΩ	27	28	-	V
$V_{O(L)}$		V_{CC} = 5 V, R_L = 10 kΩ		-	5	20	mV
CMRR	Common-Mode Rejection Ratio	-		65	85	-	dB
PSRR	Power Supply Rejection Ratio	-		65	100	-	dB
CS	Channel Separation	f = 1 kHz to 20 kHz(6)		-	120	-	dB
I_{SC}	Short Circuit to GND	V_{CC} = 15 V		-	40	60	mA
I_{SOURCE}	Output Current	$V_{I(+)}$ = 1 V, $V_{I(-)}$ = 0 V, V_{CC} = 15 V, $V_{O(P)}$ = 2 V		20	40	-	mA
I_{SINK}		$V_{I(+)}$ = 0 V, $V_{I(-)}$ = 1 V, V_{CC} = 15 V, $V_{O(P)}$ = 2 V		10	20	-	mA
		$V_{I(+)}$ = 0 V, $V_{I(-)}$ = 1 V, V_{CC} = 15 V, $V_{O(P)}$ = 200 mV		12	50	-	µA
$V_{I(DIFF)}$	Differential Input Voltage	-		-	-	V_{CC}	V

Notes:

5. V_{CC}=30V for KA324A.
6. This parameter, although guaranteed is not 100% tested in production.

Electrical Characteristics (Continued)

Values are at V_{CC} = 5.0 V, V_{EE} = GND, unless otherwise specified.
The following specification apply over the range of 0°C ≤ T_A ≤ +70°C for the KA324A.

Symbol	Parameter	Conditions		KA324A Min.	KA324A Typ.	KA324A Max.	Unit
V_{IO}	Input Offset Voltage	V_{CM} = 0 V to V_{CC} -1.5 V, $V_{O(P)}$ = 1.4V, R_S = 0Ω(7)		-	-	5.0	mV
$\Delta V_{IO}/\Delta T$	Input Offset Voltage Drift	R_S = 0 Ω (8)		-	7	30	μV/°C
I_{IO}	Input Offset Current	V_{CM} = 0 V		-	-	75	nA
$\Delta I_{IO}/\Delta T$	Input Offset Current Drift	R_S = 0 Ω (8)		-	10	300	pA/°C
I_{BIAS}	Input Bias Current	V_{CM} = 0 V		-	40	200	nA
$V_{I(R)}$	Input Common-Mode Voltage Range	(7)		0	-	V_{CC} -2.0	V
G_V	Large Signal Voltage Gain	V_{CC} = 15 V, R_L= 2.0 kΩ		15	-	-	V/mV
$V_{O(H)}$	Output Voltage Swing	(7)	R_L = 2 kΩ	26	-	-	V
			R_L = 10 kΩ	27	28	-	V
$V_{O(L)}$		V_{CC} = 5 V, R_L = 10 kΩ		-	5	20	mV
I_{SOURCE}	Output Current	$V_{I(+)}$ = 1 V, $V_{I(-)}$ = 0 V, V_{CC} = 15 V, $V_{O(P)}$ = 2 V		10	20	-	mV
I_{SINK}		$V_{I(+)}$ = 0 V, $V_{I(-)}$ = 1 V, V_{CC} = 15 V, $V_{O(P)}$ = 2 V		5	8	-	mA
$V_{I(DIFF)}$	Differential Input Voltage	-		-	-	V_{CC}	V

Notes:

7. V_{CC}=30V for KA324A.
8. This parameter, although guaranteed is not 100% tested in production.

Typical Performance Characteristics

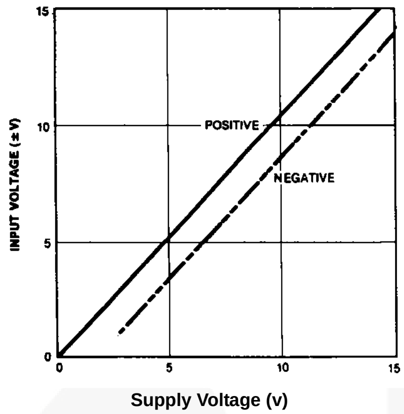


Figure 3. Input Voltage Range vs. Supply Voltage

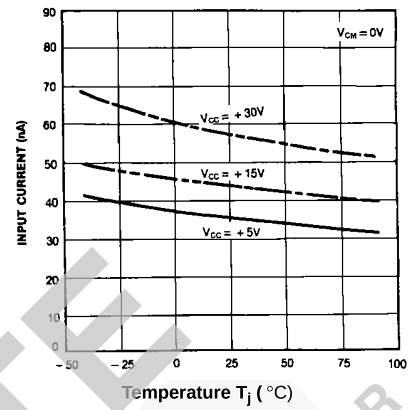


Figure 4. Input Current vs. Temperature

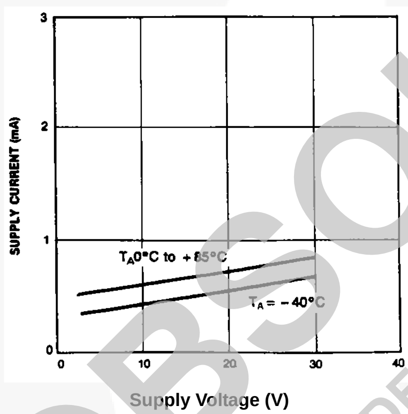


Figure 5. Supply Current vs. Supply Voltage

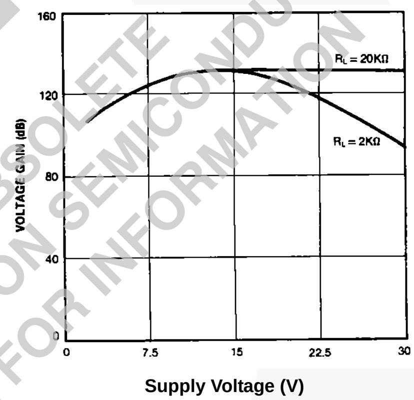


Figure 6. Voltage Gain vs. Supply Voltage

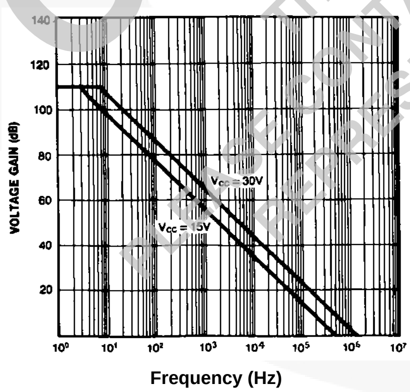


Figure 7. Open Loop Frequency Response

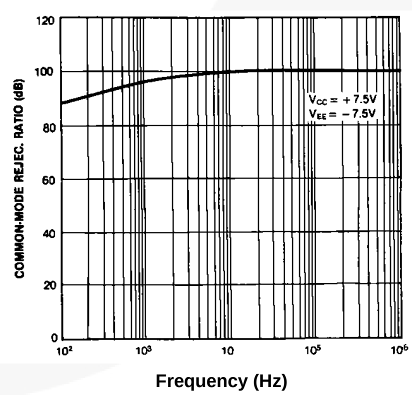


Figure 8. Common Mode Rejection Ratio

Typical Performance Characteristics (Continued)

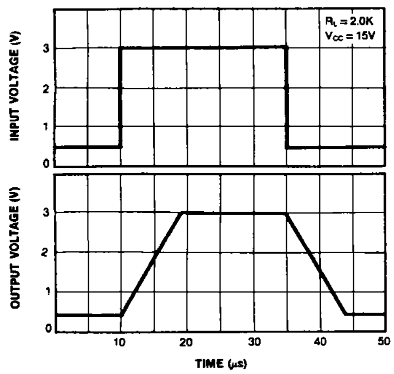


Figure 9. Voltage Follower Pulse Response

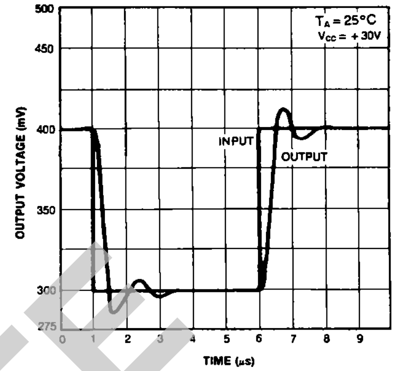


Figure 10. Voltage Follower Pulse Response (Small Signal)

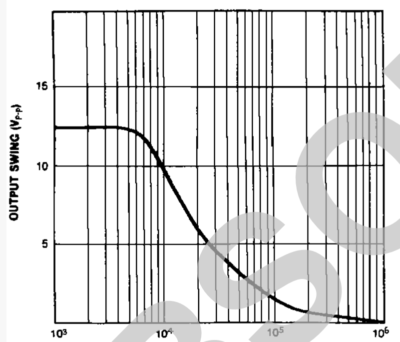


Figure 11. Large Signal Frequency Response

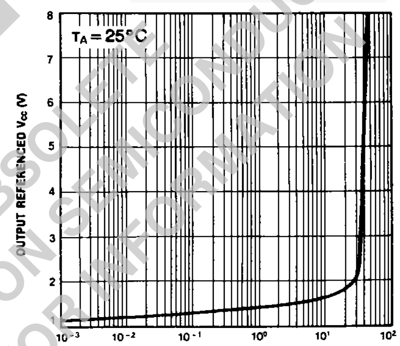


Figure 12. Output Characteristics vs. Current Sourcing

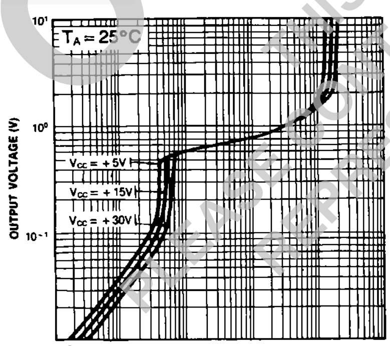


Figure 13. Output Characteristics vs. Current Sinking

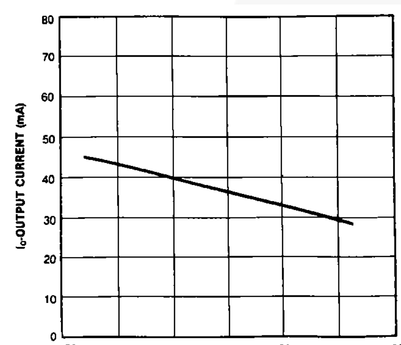
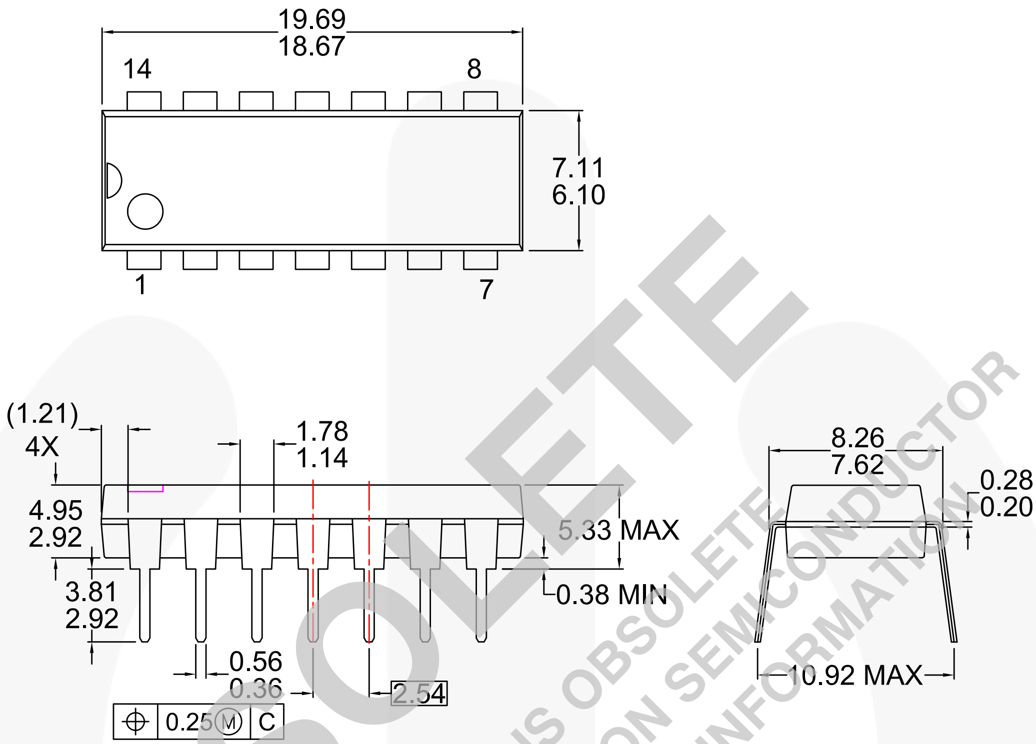


Figure 14. Current Limiting vs. Temperature

Physical Dimensions



NOTES: UNLESS OTHERWISE SPECIFIED

THIS PACKAGE CONFORMS TO

A) JEDEC MS-001 VARIATION AA

B) ALL DIMENSIONS ARE IN MILLIMETERS.

DIMENSIONS ARE EXCLUSIVE OF BURRS,

C) MOLD FLASH, AND TIE BAR EXTRUSIONS.

D) DIMENSIONS AND TOLERANCES PER ASME Y14.5-1994

E) DRAWING FILE NAME: MKT-N14AREV8

Figure 15. 14-LEAD, MDIP, JEDEC MS-001, .300 INCH WIDE

Physical Dimensions

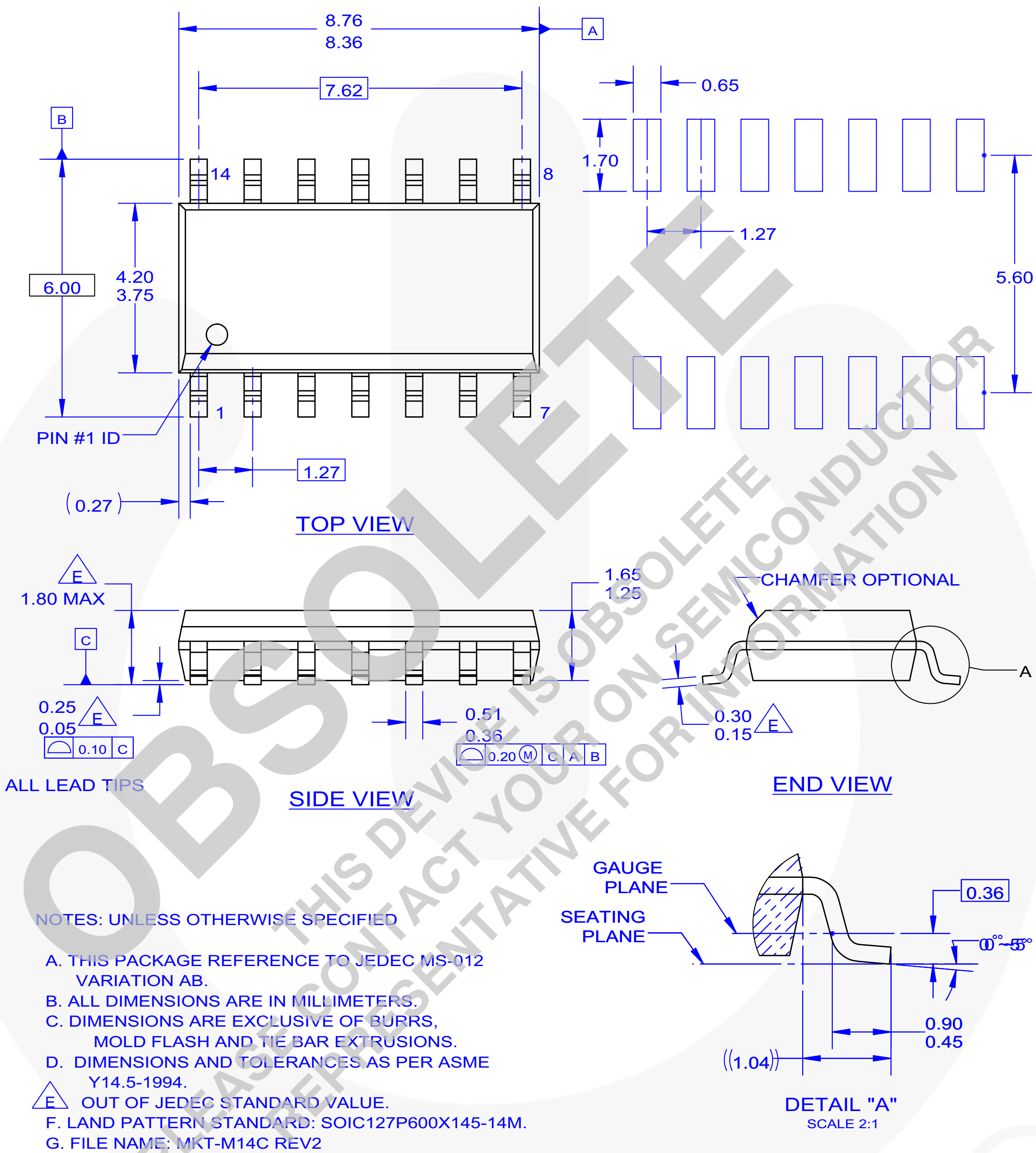


Figure 16. 14-Lead, SOIC, NON-JEDEC, .150 INCH NARROW BODY, 225SOP

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2. A critical component in any component of a life support, device, or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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PRODUCT STATUS DEFINITIONS

Definition of Terms

Datasheet Identification	Product Status	Definition
Advance Information	Formative / In Design	Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
No Identification Needed	Full Production	Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.
Obsolete	Not In Production	Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only.

Rev. I72

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