

												REVISIONS												
												LTR	DESCRIPTION						DATE		APPROVED			
												A	Add device types 03 and 04. Add case outlines U and Z. - ro						04-03-26		R. MONNIN			
												B	Remove device manufacturer CAGE code 01295 as a source of supply for device types -01ZA, -03XA, and -03ZA. Correct lead finishes on last page. Update boilerplate. - CFS						05-11-02		Thomas M. Hess			
												C	Under Table I conditions of VDD = 5 V and ± 5 V, AVD tests, delete RL = 10 M Ω and replace with RL = 1 M Ω . Add notes to figures U, X, and Y. Case X has been updated from JEDEC package MO-12 to MO-12-AA. Case Y has been updated from JEDEC package MO-12 to MO-12-AB. Update document paragraphs to current requirements. - ro						19-04-03		Charles F. Saffle			
																								
CURRENT DESIGN ACTIVITY CAGE CODE 16236 HAS CHANGED NAMES TO: DLA LAND AND MARITIME COLUMBUS, OHIO 43218-3990																								
Prepared in accordance with ASME Y14.24												Vendor item drawing												
REV																								
PAGE																								
REV	C	C	C	C	C	C	C	C	C	C	C													
PAGE	18	19	20	21	22	23	24	25	26	27	28													
REV STATUS OF PAGES		REV		C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C			
		PAGE		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17				
PMIC N/A				PREPARED BY RICK OFFICER								DEFENSE SUPPLY CENTER COLUMBUS COLUMBUS, OHIO 43218-3990												
Original date of drawing YY-MM-DD 03-01-28				CHECKED BY TOM HESS								TITLE MICROCIRCUIT, LINEAR, OPERATIONAL AMPLIFIER, MONOLITHIC SILICON												
				APPROVED BY RAYMOND MONNIN																				
				SIZE A		CODE IDENT. NO. 16236						DWG NO. V62/03618												
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1. SCOPE

1.1 Scope. This drawing documents the general requirements of a high performance operational amplifier microcircuit, with an operating temperature range of -55°C to +125°C.

1.2 Vendor Item Drawing Administrative Control Number. The manufacturer's PIN is the item of identification. The vendor item drawing establishes an administrative control number for identifying the item on the engineering documentation:

<u>V62/03618</u>	-	<u>01</u>	<u>X</u>	<u>E</u>
Drawing number		Device type (See 1.2.1)	Case outline (See 1.2.2)	Lead finish (See 1.2.3)

1.2.1 Device type(s).

<u>Device type</u>	<u>Generic</u>	<u>Circuit function</u>
01	TLC2272A-EP	Dual operational amplifier
02	TLC2274A-EP	Quad operational amplifier
03	TLC2272-EP	Dual operational amplifier

1.2.2 Case outline(s). The case outline(s) are as specified herein.

<u>Outline letter</u>	<u>Number of pins</u>	<u>JEDEC PUB 95</u>	<u>Package style</u>
U	14	MO-153	Plastic small outline
X	8	MS-012	Plastic small outline
Y	14	MS-012	Plastic small outline
Z	8	MO-153	Plastic small outline

1.2.3 Lead finishes. The lead finishes are as specified below or other lead finishes as provided by the device manufacture:

<u>Finish designator</u>	<u>Material</u>
A	Hot solder dip
B	Tin-lead plate
C	Gold plate
D	Palladium
E	Gold flash palladium
F	Tin-lead alloy (BGA/CGA)
Z	Other

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1.3 Absolute maximum ratings. 1/

Supply voltage (+VDD)	+8 V dc 2/
Supply voltage (-VDD)	-8 V dc 2/
Differential input voltage (VID)	±16 V dc 3/
Input voltage range (VI) (any input)	-VDD -0.3 V to +VDD 2/
Input current (II) (any input)	±5 mA
Output current (IO)	±50 mA
Total current into +VDD	±50 mA
Total current out of -VDD	±50 mA
Duration of short-circuit at (or below) 25°C	Unlimited 4/
Continuous total power dissipation	See dissipation rating table
Storage temperature range	-65°C to +150°C 5/
Lead temperature 1.6 mm (1/16 inch) from case for 10 seconds	+260°C

1.4 Recommended operating conditions. 6/

Supply voltage (±VDD)	±2.2 V dc minimum to ±8 V dc maximum
Input voltage (VI)	-VDD minimum to +VDD - 1.5 V dc maximum
Common mode input voltage (VIC)	-VDD minimum to +VDD - 1.5 V dc maximum
Operating free-air temperature (TA)	-55°C minimum to +125°C maximum

Dissipation rating table

Case outlines	TA ≤ 25°C power rating	Derating factor above TA = 25°C	TA = 70°C power rating	TA = 85°C power rating	TA = 125°C power rating
X	725 mW	5.8 mW/°C	464 mW	337 mW	145 mW
Y	950 mW	7.6 mW/°C	608 mW	494 mW	190 mW
Z	525 mW	4.2 mW/°C	336 mW	273 mW	105 mW
U	700 mW	5.6 mW/°C	448 mW	364 mW	---

- 1/ Stresses beyond those listed under “absolute maximum rating” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- 2/ All voltage values except differential voltages are with respect to the midpoint between +VDD and -VDD.
- 3/ Differential voltages are at the +IN with respect to the -IN. Excessive current will flow if input is brought below -VDD - 0.3 V.
- 4/ The output may be shorted to either supply. Temperature and/or supply voltages must be limited to ensure that the maximum dissipation rating is not exceeded.
- 5/ Long term high temperature storage and/or extended use at maximum recommended operating conditions may result in a reduction of overall device life.
- 6/ Use of this product beyond the manufacturers design rules or stated parameters is done at the user's risk. The manufacturer and/or distributor maintain no responsibility or liability for product used beyond the stated limits.

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2. APPLICABLE DOCUMENTS

JEDEC Solid State Technology Association

JEDEC PUB 95 – Registered and Standard Outlines for Semiconductor Devices

(Copies of these documents are available online at <https://www.jedec.org>.)

3. REQUIREMENTS

3.1 Marking. Parts shall be permanently and legibly marked with the manufacturer's part number as shown in 6.3 herein and as follows:

- A. Manufacturer's name, CAGE code, or logo
- B. Pin 1 identifier
- C. ESDS identification (optional)

3.2 Unit container. The unit container shall be marked with the manufacturer's part number and with items A and C (if applicable) above.

3.3 Electrical characteristics. The maximum and recommended operating conditions and electrical performance characteristics are as specified in 1.3, 1.4, and table I herein.

3.4 Design, construction, and physical dimension. The design, construction, and physical dimensions are as specified herein.

3.5 Diagrams.

3.5.1 Case outlines. The case outlines shall be as shown in 1.2.2 and figure 1.

3.5.2 Terminal connections. The terminal connections shall be as shown in figure 2.

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TABLE I. Electrical performance characteristics. 1/

Test	Symbol	Conditions	Temperature, T _A	Device type	Limits		Unit
					Min	Max	
VDD = 5 unless otherwise specified.							
Input offset voltage	V _{IO}	±VDD = ±2.5 V, R _S = 50 Ω, V _{IC} = 0 V, V _O = 0 V	25°C	01		950	μV
			-55°C to +125°C			1500	
			25°C	03		2500	
			-55°C to +125°C			3000	
Temperature coefficient of input offset voltage	αV _{IO}	±VDD = ±2.5 V, R _S = 50 Ω, V _{IC} = 0 V, V _O = 0 V	25°C to +125°C	01	2 typical		μV/°C
				03	2 typical		
Input offset voltage 2/ long term drift		±VDD = ±2.5 V, R _S = 50 Ω, V _{IC} = 0 V, V _O = 0 V	+25°C	01	0.002 typical		μV/mo
				03	0.002 typical		
Input offset current	I _{IO}	±VDD = ±2.5 V, R _S = 50 Ω, V _{IC} = 0 V, V _O = 0 V	25°C	01,03		60	pA
			-55°C to +125°C			800	
Input bias current	I _{IB}	±VDD = ±2.5 V, R _S = 50 Ω, V _{IC} = 0 V, V _O = 0 V	25°C	01,03		60	pA
			-55°C to +125°C			800	
Common mode input voltage	V _{ICR}	V _{IO} ≤ 5 mV, R _S = 50 Ω	25°C	01,03	0 to 4		V
			-55°C to +125°C		0 to 3.5		
High level output voltage	V _{OH}	I _{OH} = -20 μA	25°C	01,03	4.99 typical		V
		I _{OH} = -200 μA	25°C	01,03	4.85		
			-55°C to +125°C		4.85		
		I _{OH} = -1mA	25°C	01,03	4.25		
			-55°C to +125°C		4.25		

See footnote at end of table.

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TABLE I. Electrical performance characteristics – continued. 1/

Test	Symbol	Conditions	Temperature, T _A	Device type	Limits		Unit
					Min	Max	
V _{DD} = 5 unless otherwise specified – continued.							
Low level output voltage	V _{OL}	V _{IC} = 2.5 V, I _{OL} = 50 μA	25°C	01,03	0.01 typical		V
		V _{IC} = 2.5 V, I _{OL} = 500 μA	25°C	01,03		0.15	
			-55°C to +125°C			0.15	
		V _{IC} = 2.5 V, I _{OL} = 5 mA	25°C	01,03		1.5	
			-55°C to +125°C			1.5	
Large signal differential voltage amplification	A _{VD}	V _{IC} = 2.5 V, V _O = 1 V to 4 V, R _L = 10 kΩ referenced to 2.5 V	25°C	01,03	10		V/mV
		-55°C to +125°C	10				
		V _{IC} = 2.5 V, V _O = 1 V to 4 V, R _L = 1 MΩ referenced to 2.5 V	25°C	01,03	175 typical		
Differential input resistance	r _{id}		25°C	01,03	10 ¹² typical		Ω
Common mode input resistance	r _i		25°C	01,03	10 ¹² typical		Ω
Common mode input capacitance	c _i	f = 10 kHz, cases U and Z	25°C	01,03	8 typical		pF
Closed loop output impedance	z _o	f = 1 MHz, A _V = 10	25°C	01,03	140 typical		Ω
Common mode rejection ratio	CMRR	V _{IC} = 0 V to 2.7 V, V _O = 2.5 V, R _S = 50 Ω	25°C	01,03	70		dB
		-55°C to +125°C	70				
Supply voltage rejection ratio (ΔV _{DD} / ΔV _{IO})	k _{SVR}	V _{DD} = 4.4 V to 16 V, V _{IC} = V _{DD} / 2, no load	25°C	01,03	80		dB
		-55°C to +125°C	80				
Supply current	I _{DD}	V _O = 2.5 V, no load	25°C	01,03		3	mA
			-55°C to +125°C			3	

See footnote at end of table.

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TABLE I. Electrical performance characteristics – continued. 17

Test	Symbol	Conditions	Temperature, T _A	Device type	Limits		Unit
					Min	Max	

Slew rate at unity gain	SR	VO = 1.25 V to 2.75 V, RL = 10 k Ω referenced to 2.5 V, CL = 100 pF referenced to 2.5 V	25°C	01,03	2.3	1.7	V/ μ s
			-55°C to +125°C				

Equivalent input noise voltage	V _n	f = 10 Hz f = 1 kHz	25°C	01,03	50 typical	9 typical	nV / $\sqrt{\text{Hz}}$

Peak to peak equivalent input noise voltage	V _{NPP}	f = 0.1 Hz to 1 Hz f = 0.1 Hz to 10 Hz	25°C	01,03	1 typical	1.4 typical	μ V

Equivalent input noise current	I _n		25°C	01,03	0.6 typical		fA / $\sqrt{\text{Hz}}$
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Total harmonic distortion plus noise	THD + N	VO = 0.5 V to 2.5 V, f = 20 kHz, A _v = 1, RL = 10 k Ω referenced to 2.5 V	25°C	01,03	0.0013 % typical	0.004 % typical	
		VO = 0.5 V to 2.5 V, f = 20 kHz, A _v = 10, RL = 10 k Ω referenced to 2.5 V					
		VO = 0.5 V to 2.5 V, f = 20 kHz, A _v = 100, RL = 10 k Ω referenced to 2.5 V				0.03 % typical	

Gain bandwidth product	GBWP	f = 10 kHz, RL = 10 k Ω referenced to 2.5 V, CL = 100 pF referenced to 2.5 V	25°C	01,03	2.18 typical		MHz
Maximum output swing bandwidth	WBOM	O(P) = 2 V, A _v = 1, RL = 10 k Ω referenced to 2.5 V, CL = 100 pF referenced to 2.5 V	25°C	01,03	1 typical		MHz

See footnote at end of table.

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TABLE I. Electrical performance characteristics – continued. 1/

Test	Symbol	Conditions	Temperature, T _A	Device type	Limits		Unit
					Min	Max	
VDD = 5 unless otherwise specified – continued.							
Settling time	t _s	To 0.1 % step 0.5 V to 2.5 V, A _V = -1 , R _L = 10 kΩ referenced to 2.5 V, C _L = 100 pF referenced to 2.5 V	25°C	01,03	1.5 typical	μs	
		To 0.01 % step 0.5 V to 2.5 V, A _V = -1 , R _L = 10 kΩ referenced to 2.5 V, C _L = 100 pF referenced to 2.5 V			2.6 typical		
Phase margin at unity gain	φ _m	R _L = 10 kΩ referenced to 2.5 V, C _L = 100 pF referenced to 2.5 V	25°C	01,03	50° typical		
Gain margin		R _L = 10 kΩ referenced to 2.5 V, C _L = 100 pF referenced to 2.5 V	25°C	01,03	10 typical	dB	

1/ Testing and other quality control techniques are used to the extent deemed necessary to assure product performance over the specified temperature range. Product may not necessarily be tested across the full temperature range and all parameters may not necessarily be tested. In the absence of specific parametric testing, product performance is assured by characterization and/or design.

2/ Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at T_A = 150°C extrapolated to T_A = 25°C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

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TABLE I. Electrical performance characteristics – continued. 1/

Test	Symbol	Conditions	Temperature, T _A	Device type	Limits		Unit
					Min	Max	
V _{DD} = ±5 unless otherwise specified.							
Input offset voltage	V _{IO}	R _S = 50 Ω, V _{IC} = 0 V, V _O = 0 V	25°C	01		950	μV
			-55°C to +125°C			1500	
			25°C	03		2500	
			-55°C to +125°C			3000	
Temperature coefficient of input offset voltage	αV _{IO}	R _S = 50 Ω, V _{IC} = 0 V, V _O = 0 V	25°C to +125°C	01	2 typical		μV/°C
				03	2 typical		
Input offset voltage <u>2</u> / long term drift		R _S = 50 Ω, V _{IC} = 0 V, V _O = 0 V	+25°C	01	0.002 typical		μV/mo
				03	0.002 typical		
Input offset current	I _{IO}	R _S = 50 Ω, V _{IC} = 0 V, V _O = 0 V	25°C	01,03		60	pA
			-55°C to +125°C			800	
Input bias current	I _{IB}	R _S = 50 Ω, V _{IC} = 0 V, V _O = 0 V	25°C	01,03		60	pA
			-55°C to +125°C			800	
Common mode input voltage	V _{ICR}	V _{IO} ≤ 5 mV, R _S = 50 Ω	25°C	01,03	-5 to 4		V
			-55°C to +125°C		-5 to 3.5		
Maximum positive peak output voltage	V _{OM+}	I _O = -20 μA	25°C	01,03	4.99 typical		V
		I _O = -200 μA	25°C	01,03	4.85		
			-55°C to +125°C		4.85		
		I _O = -1mA	25°C	01,03	4.25		
			-55°C to +125°C		4.25		

See footnote at end of table.

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TABLE I. Electrical performance characteristics – continued. 1/

Test	Symbol	Conditions	Temperature, T _A	Device type	Limits		Unit
					Min	Max	
V _{DD} = ±5 unless otherwise specified – continued.							
Maximum negative peak output voltage	VOM-	V _{IC} = 0 V, I _O = 50 μA	25°C	01,03	-4.99 typical		V
		V _{IC} = 0 V, I _O = 500 μA	25°C	01,03	-4.85		
			-55°C to +125°C		-4.85		
		V _{IC} = 0 V, I _O = 5 mA	25°C	01,03	-3.5		
			-55°C to +125°C		-3.5		
Large signal differential voltage amplification	AVD	V _O = ±4 V, R _L = 10 kΩ	25°C	01,03	20		V/mV
		-55°C to +125°C	20				
		V _O = ±4 V, R _L = 1 MΩ	25°C	01,03	300 typical		
Differential input resistance	r _{id}		25°C	01,03	10 ¹² typical		Ω
Common mode input resistance	r _i		25°C	01,03	10 ¹² typical		Ω
Common mode input capacitance	c _i	f = 10 kHz, cases U and Z	25°C	01,03	8 typical		pF
Closed loop output impedance	z _o	f = 1 MHz, A _V = 10	25°C	01,03	130 typical		Ω
Common mode rejection ratio	CMRR	V _{IC} = -5 V to 2.7 V, V _O = 0 V, R _S = 50 Ω	25°C	01,03	75		dB
		-55°C to +125°C	75				
Supply voltage rejection ratio (ΔV _{DD} / ΔV _{IO})	kSVR	V _{DD} = ±2.2 V to ±8 V, V _{IC} = 0 V, no load	25°C	01,03	80		dB
		-55°C to +125°C	80				
Supply current	I _{DD}	V _O = 2.5 V, no load	25°C	01,03		3	mA
			-55°C to +125°C			3	

See footnote at end of table.

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TABLE I. Electrical performance characteristics – continued. 1/

Test	Symbol	Conditions	Temperature, T _A	Device type	Limits		Unit
					Min	Max	
V _{DD} = ±5 unless otherwise specified – continued.							
Slew rate at unity gain	SR	V _O = ±1 V,	25°C	01,03	2.3		V/μs
		R _L = 10 kΩ, C _L = 100 pF	-55°C to +125°C		1.7		
Equivalent input noise voltage	V _n	f = 10 Hz	25°C	01,03	50 typical		nV / $\sqrt{\text{Hz}}$
		f = 1 kHz			9 typical		
Peak to peak equivalent input noise voltage	V _{NPP}	f = 0.1 Hz to 1 Hz	25°C	01,03	1 typical		μV
		f = 0.1 Hz to 10 Hz			1.4 typical		
Equivalent input noise current	I _n		25°C	01,03	0.6 typical		fA / $\sqrt{\text{Hz}}$
Total harmonic distortion plus noise	THD + N	V _O = ±2.3 V, A _V = 1, f = 20 kHz, R _L = 20 kΩ	25°C	01,03	0.0011 % typical		
		V _O = ±2.3 V, A _V = 10, f = 20 kHz, R _L = 20 kΩ			0.004 % typical		
		V _O = ±2.3 V, A _V = 100, f = 20 kHz, R _L = 20 kΩ			0.03 % typical		
Gain bandwidth product	GBWP	f = 10 kHz, R _L = 10 kΩ, C _L = 100 pF	25°C	01,03	2.25 typical		MHz
Maximum output swing bandwidth	BOM	V _{O(PP)} = 4.6 V, A _V = 1, R _L = 10 kΩ, C _L = 100 pF	25°C	01,03	0.54 typical		MHz
Settling time	t _s	To 0.1 % step = -2.3 V to 2.3 V, A _V = -1, R _L = 10 kΩ, C _L = 100 pF	25°C	01,03	1.5 typical		μs
		To 0.01 % step = -2.3 V to 2.3 V, A _V = -1, R _L = 10 kΩ, C _L = 100 pF			3.2 typical		
Phase margin at unity gain	φ _m	R _L = 10 kΩ, C _L = 100 pF	25°C	01,03	52° typical		
Gain margin		R _L = 10 kΩ, C _L = 100 pF	25°C	01,03	10 typical		dB

1/ Testing and other quality control techniques are used to the extent deemed necessary to assure product performance over the specified temperature range. Product may not necessarily be tested across the full temperature range and all parameters may not necessarily be tested. In the absence of specific parametric testing, product performance is assured by characterization and/or design.

2/ Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at T_A = 150°C extrapolated to T_A = 25°C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

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TABLE I. Electrical performance characteristics. 1/

Test	Symbol	Conditions	Temperature, T _A	Device type	Limits		Unit
					Min	Max	
VDD = 5 unless otherwise specified.							
Input offset voltage	V _{IO}	±VDD = ±2.5 V, R _S = 50 Ω, V _{IC} = 0 V, V _O = 0 V	25°C	02		950	μV
			-55°C to +125°C			1500	
			25°C	04		2500	
			-55°C to +125°C			3000	
Temperature coefficient of input offset voltage	αV _{IO}	±VDD = ±2.5 V, R _S = 50 Ω, V _{IC} = 0 V, V _O = 0 V	25°C to +125°C	02	2 typical		μV/°C
				04	2 typical		
Input offset voltage <u>2</u> / long term drift		±VDD = ±2.5 V, R _S = 50 Ω, V _{IC} = 0 V, V _O = 0 V	+25°C	02	0.002 typical		μV/mo
				04	0.002 typical		
Input offset current	I _{IO}	±VDD = ±2.5 V, R _S = 50 Ω, V _{IC} = 0 V, V _O = 0 V	25°C	02,04		60	pA
			-55°C to +125°C			800	
Input bias current	I _{IB}	±VDD = ±2.5 V, R _S = 50 Ω, V _{IC} = 0 V, V _O = 0 V	25°C	02,04		60	pA
			-55°C to +125°C			800	
Common mode input voltage	V _{ICR}	V _{IO} ≤ 5 mV, R _S = 50 Ω	25°C	02,04	0 to 4		V
			-55°C to +125°C		0 to 3.5		
High level output voltage	V _{OH}	I _{OH} = -20 μA	25°C	02,04	4.99 typical		V
		I _{OH} = -200 μA	25°C	02,04	4.85		
			-55°C to +125°C		4.85		
		I _{OH} = -1mA	25°C	02,04	4.25		
			-55°C to +125°C		4.25		

See footnote at end of table.

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TABLE I. Electrical performance characteristics – continued. 1/

Test	Symbol	Conditions	Temperature, T _A	Device type	Limits		Unit
					Min	Max	
VDD = 5 unless otherwise specified – continued.							
Low level output voltage	VOL	VIC = 2.5 V, IOL = 50 μA	25°C	02,04	0.01 typical		V
		VIC = 2.5 V, IOL = 500 μA	25°C	02,04		0.15	
			-55°C to +125°C			0.15	
		VIC = 2.5 V, IOL = 5 mA	25°C	02,04		1.5	
			-55°C to +125°C			1.5	
Large signal differential voltage amplification	AVD	VIC = 2.5 V, VO = 1 V to 4 V, RL = 10 kΩ referenced to 2.5 V	25°C	02,04	10		V/mV
		-55°C to +125°C	10				
		VIC = 2.5 V, VO = 1 V to 4 V, RL = 1 MΩ referenced to 2.5 V	25°C	02,04	175 typical		
Differential input resistance	rid		25°C	02,04	10 ¹² typical		Ω
Common mode input resistance	ri		25°C	02,04	10 ¹² typical		Ω
Common mode input capacitance	ci	f = 10 kHz	25°C	02,04	8 typical		pF
Closed loop output impedance	zo	f = 1 MHz, Av = 10	25°C	02,04	140 typical		Ω
Common mode rejection ratio	CMRR	VIC = 0 V to 2.7 V, VO = 2.5 V, Rs = 50 Ω	25°C	02,04	70		dB
		-55°C to +125°C	70				
Supply voltage rejection ratio (ΔVDD / ΔVIO)	kSVR	VDD = 4.4 V to 16 V, VIC = VDD / 2, no load	25°C	02,04	80		dB
		-55°C to +125°C	80				
Supply current	IDD	VO = 2.5 V, no load	25°C	02,04		6	mA
			-55°C to +125°C			6	

See footnote at end of table.

DEFENSE SUPPLY CENTER, COLUMBUS COLUMBUS, OHIO	SIZE A	CODE IDENT NO. 16236	DWG NO. V62/03618
		REV C	PAGE 13

TABLE 1. Electrical performance characteristics – continued. 1/

Test	Symbol	Conditions	Temperature, T _A	Device type	Limits		Unit
					Min	Max	

Slew rate at unity gain	SR	VO = 0.5 V to 2.5 V, RL = 10 k Ω referenced to 2.5 V, CL = 100 pF referenced to 2.5 V	25°C	02,04	2.3	1.7	V/ μ s
			-55°C to +125°C				

Equivalent input noise voltage	V _n	f = 10 Hz f = 1 kHz	25°C	02,04	50 typical	9 typical	nV / $\sqrt{\text{Hz}}$
			25°C		1 typical	1.4 typical	

Peak to peak equivalent input noise voltage	V _{NPP}	f = 0.1 Hz to 1 Hz f = 0.1 Hz to 10 Hz	25°C	02,04	1 typical	1.4 typical	μ V
			25°C		0.6 typical	$\sqrt{\text{fA / Hz}}$	

Equivalent input noise current	I _n		25°C	02,04	0.0013 % typical	0.03 % typical	
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Total harmonic distortion plus noise	THD + N	VO = 0.5 V to 2.5 V, f = 20 kHz, AV = 1, RL = 10 k Ω referenced to 2.5 V	25°C	02,04	0.0013 % typical	0.004 % typical	
		VO = 0.5 V to 2.5 V, f = 20 kHz, AV = 10, RL = 10 k Ω referenced to 2.5 V					
		VO = 0.5 V to 2.5 V, f = 20 kHz, AV = 100, RL = 10 k Ω referenced to 2.5 V					

Gain bandwidth product	GBWP	f = 10 kHz, RL = 10 k Ω referenced to 2.5 V, CL = 100 pF referenced to 2.5 V	25°C	02,04	2.18 typical		MHz
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Maximum output swing bandwidth	WBOM	O(P) = 2 V, AV = 1, RL = 10 k Ω referenced to 2.5 V, CL = 100 pF referenced to 2.5 V	25°C	02,04	1 typical		MHz
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See footnote at end of table.

DEFENSE SUPPLY CENTER, COLUMBUS COLUMBUS, OHIO		SIZE A	CODE IDENT NO. 16236	DWG NO. V62/03618
REV C		PAGE 14		

TABLE I. Electrical performance characteristics – continued. 1/

Test	Symbol	Conditions	Temperature, T _A	Device type	Limits		Unit
					Min	Max	
VDD = 5 unless otherwise specified – continued.							
Settling time	t _s	To 0.1 % step 0.5 V to 2.5 V, A _V = -1 , R _L = 10 kΩ referenced to 2.5 V, C _L = 100 pF referenced to 2.5 V	25°C	01,03	1.5 typical	μs	
		To 0.01 % step 0.5 V to 2.5 V, A _V = -1 , R _L = 10 kΩ referenced to 2.5 V, C _L = 100 pF referenced to 2.5 V			2.6 typical		
Phase margin at unity gain	φ _m	R _L = 10 kΩ referenced to 2.5 V, C _L = 100 pF referenced to 2.5 V	25°C	01,03	50° typical		
Gain margin		R _L = 10 kΩ referenced to 2.5 V, C _L = 100 pF referenced to 2.5 V	25°C	01,03	10 typical	dB	

1/ Testing and other quality control techniques are used to the extent deemed necessary to assure product performance over the specified temperature range. Product may not necessarily be tested across the full temperature range and all parameters may not necessarily be tested. In the absence of specific parametric testing, product performance is assured by characterization and/or design.

2/ Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at T_A = 150°C extrapolated to T_A = 25°C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

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TABLE I. Electrical performance characteristics – continued. 1/

Test	Symbol	Conditions	Temperature, T _A	Device type	Limits		Unit
					Min	Max	
V _{DD} = ±5 unless otherwise specified.							
Input offset voltage	V _{IO}	R _S = 50 Ω, V _{IC} = 0 V, V _O = 0 V	25°C	02		950	μV
			-55°C to +125°C			1500	
			25°C	04		2500	
			-55°C to +125°C			3000	
Temperature coefficient of input offset voltage	αV _{IO}	R _S = 50 Ω, V _{IC} = 0 V, V _O = 0 V	25°C to +125°C	02	2 typical		μV/°C
				04	2 typical		
Input offset voltage <u>2</u> / long term drift		R _S = 50 Ω, V _{IC} = 0 V, V _O = 0 V	+25°C	02	0.002 typical		μV/mo
				04	0.002 typical		
Input offset current	I _{IO}	R _S = 50 Ω, V _{IC} = 0 V, V _O = 0 V	25°C	02,04		60	pA
			-55°C to +125°C			800	
Input bias current	I _{IB}	R _S = 50 Ω, V _{IC} = 0 V, V _O = 0 V	25°C	02,04		60	pA
			-55°C to +125°C			800	
Common mode input voltage	V _{ICR}	V _{IO} ≤ 5 mV, R _S = 50 Ω	25°C	02,04	-5 to 4		V
			-55°C to +125°C		-5 to 3.5		
Maximum positive peak output voltage	V _{OM+}	I _O = -20 μA	25°C	02,04	4.99 typical		V
		I _O = -200 μA	25°C	02,04	4.85		
			-55°C to +125°C		4.85		
		I _O = -1mA	25°C	02,04	4.25		
			-55°C to +125°C		4.25		

See footnote at end of table.

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TABLE I. Electrical performance characteristics – continued. 1/

Test	Symbol	Conditions	Temperature, T _A	Device type	Limits		Unit
					Min	Max	
V _{DD} = ±5 unless otherwise specified – continued.							
Maximum negative peak output voltage	V _{OM} -	V _{IC} = 0 V, I _O = 50 μA	25°C	02,04	-4.99 typical		V
		V _{IC} = 0 V, I _O = 500 μA	25°C	02,04	-4.85		
			-55°C to +125°C		-4.85		
		V _{IC} = 0 V, I _O = 5 mA	25°C	02,04	-3.5		
			-55°C to +125°C		-3.5		
Large signal differential voltage amplification	A _{VD}	V _O = ±4 V, R _L = 10 kΩ	25°C -55°C to +125°C	02,04	20		V/mV
		V _O = ±4 V, R _L = 1 MΩ	25°C		02,04	300 typical	
		Differential input resistance	r _{id}		25°C	02,04	
Common mode input resistance	r _i		25°C	02,04	10 ¹² typical		Ω
Common mode input capacitance	c _i	f = 10 kHz	25°C	02,04	8 typical		pF
Closed loop output impedance	z _o	f = 1 MHz, A _V = 10	25°C	02,04	130 typical		Ω
Common mode rejection ratio	CMRR	V _{IC} = -5 V to 2.7 V, V _O = 0 V, R _S = 50 Ω	25°C -55°C to +125°C	02,04	75		dB
			75				
Supply voltage rejection ratio (ΔV _{DD} / ΔV _{IO})	k _{SVR}	V _{DD} = ±2.2 V to ±8 V, V _{IC} = 0 V, no load	25°C -55°C to +125°C	02,04	80		dB
					80		
Supply current	I _{DD}	V _O = 0 V, no load	25°C	02,04		6	mA
			-55°C to +125°C			6	

See footnote at end of table.

DEFENSE SUPPLY CENTER, COLUMBUS COLUMBUS, OHIO	SIZE A	CODE IDENT NO. 16236	DWG NO. V62/03618
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TABLE I. Electrical performance characteristics – continued. 1/

Test	Symbol	Conditions	Temperature, T _A	Device type	Limits		Unit
					Min	Max	
V _{DD} = ±5 unless otherwise specified – continued.							
Slew rate at unity gain	SR	V _O = ±2.3 V, R _L = 10 kΩ, C _L = 100 pF	25°C	02,04	2.3		V/μs
			-55°C to +125°C		1.7		
Equivalent input noise voltage	V _n	f = 10 Hz	25°C	02,04	50 typical		nV / $\sqrt{\text{Hz}}$
		f = 1 kHz			9 typical		
Peak to peak equivalent input noise voltage	V _{NPP}	f = 0.1 Hz to 1 Hz	25°C	02,04	1 typical		μV
		f = 0.1 Hz to 10 Hz			1.4 typical		
Equivalent input noise current	I _n		25°C	02,04	0.6 typical		fA / $\sqrt{\text{Hz}}$
Total harmonic distortion plus noise	THD + N	V _O = ±2.3 V, A _V = 1, f = 20 kHz, R _L = 10 kΩ	25°C	02,04	0.0011 % typical		
		V _O = ±2.3 V, A _V = 10, f = 20 kHz, R _L = 10 kΩ			0.004 % typical		
		V _O = ±2.3 V, A _V = 100, f = 20 kHz, R _L = 10 kΩ			0.03 % typical		
Gain bandwidth product	GBWP	f = 10 kHz, R _L = 10 kΩ, C _L = 100 pF	25°C	02,04	2.25 typical		MHz
Maximum output swing bandwidth	BOM	V _{O(PP)} = 4.6 V, A _V = 1, R _L = 10 kΩ, C _L = 100 pF	25°C	02,04	0.54 typical		MHz
Settling time	t _s	To 0.1 % step = -2.3 V to 2.3 V, A _V = -1, R _L = 10 kΩ, C _L = 100 pF	25°C	02,04	1.5 typical		μs
		To 0.01 % step = -2.3 V to 2.3 V, A _V = -1, R _L = 10 kΩ, C _L = 100 pF			3.2 typical		
Phase margin at unity gain	φ _m	R _L = 10 kΩ, C _L = 100 pF	25°C	02,04	52° typical		
Gain margin		R _L = 10 kΩ, C _L = 100 pF	25°C	02,04	10 typical		dB

1/ Testing and other quality control techniques are used to the extent deemed necessary to assure product performance over the specified temperature range. Product may not necessarily be tested across the full temperature range and all parameters may not necessarily be tested. In the absence of specific parametric testing, product performance is assured by characterization and/or design.

2/ Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at T_A = 150°C extrapolated to T_A = 25°C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

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Case U

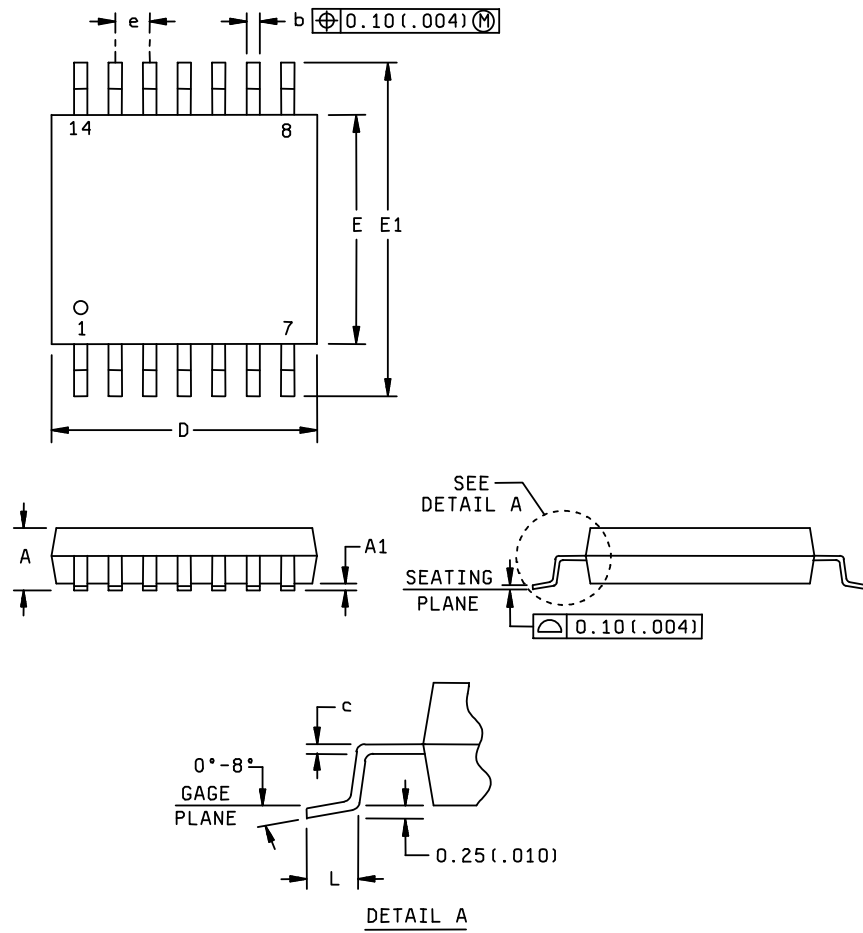


FIGURE 1. Case outlines - Continued.

DEFENSE SUPPLY CENTER, COLUMBUS COLUMBUS, OHIO	SIZE A	CODE IDENT NO. 16236	DWG NO. V62/03618
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Case U – continued.

Symbol	Dimensions			
	Millimeters		Inches	
	Min	Max	Min	Max
A		1.20		.047
A1	0.05	0.15	.002	.006
b	0.19	0.30	.007	.012
c	0.15 NOM		.006 NOM	
D	4.90	5.10	.193	.201
E	4.30	4.50	.169	.177
E1	6.20	6.60	.244	.260
e	0.65 BSC		.026 BSC	
L	0.50	0.75	.020	.030
n	14 leads		14 leads	

NOTES:

1. All linear dimensions are in millimeters (inches).
2. This case outline is subject to change without notice.
3. For dimension D, body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not to exceed .006 inch (0.15 mm).
4. For dimension E, body does not include interlead flash. Interlead flash shall not exceed .010 inch (0.25 mm) each side.
5. Fall within JEDEC MO-153.

FIGURE 1. Case outlines - Continued.

DEFENSE SUPPLY CENTER, COLUMBUS COLUMBUS, OHIO	SIZE A	CODE IDENT NO. 16236	DWG NO. V62/03618
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Case X

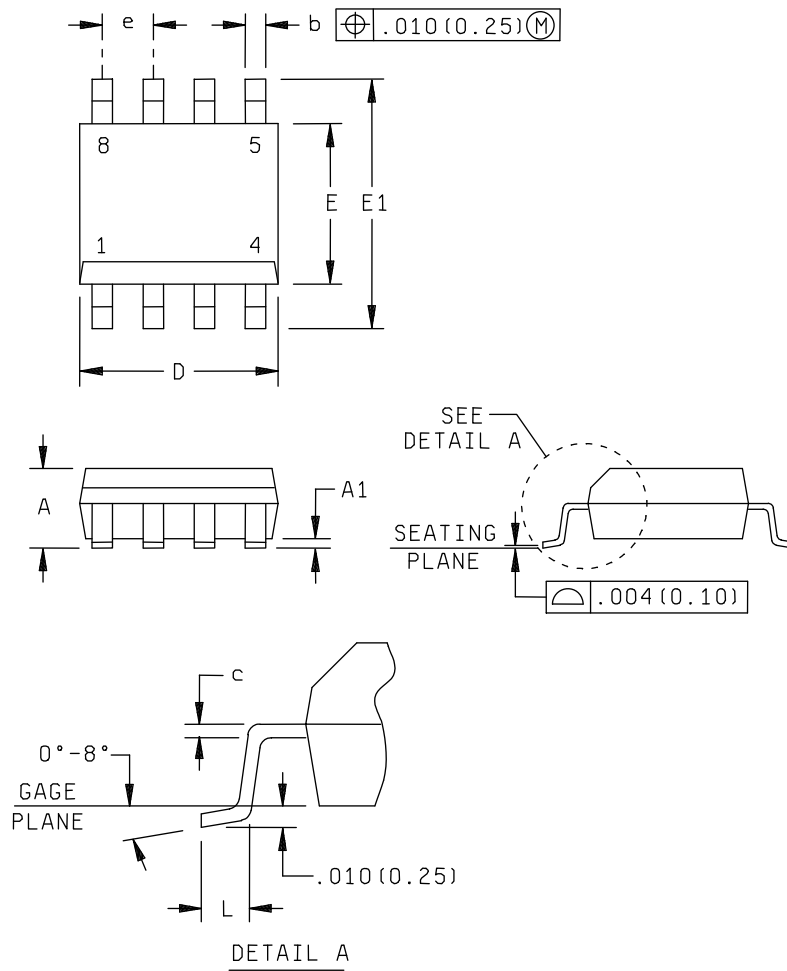


FIGURE 1. Case outlines – continued.

DEFENSE SUPPLY CENTER, COLUMBUS COLUMBUS, OHIO	SIZE A	CODE IDENT NO. 16236	DWG NO. V62/03618
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Case X- continued.

Symbol	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
A	---	0.069	---	1.75
A1	0.004	0.010	0.10	0.25
b	.012	0.020	0.31	0.51
c	.005	.010	0.13	0.25
D	0.189	0.197	4.80	5.00
e	0.050		1.27	
E	0.150	0.157	3.80	4.00
E1	0.228	0.244	5.80	6.20
L	0.016	0.050	0.40	1.27
n	8 leads		8 leads	

NOTES:

1. All linear dimensions are in inches (millimeters).
2. This case outline is subject to change without notice.
3. For dimension D, body length does not include mold flash, protrusions, or gate burrs.
Mold flash, protrusions, or gate burrs shall not to exceed .006 inch (0.15 mm).
4. For dimension E, body does not include interlead flash. Interlead flash shall not exceed .017 inch (0.43 mm) each side.
5. Fall within JEDEC MO-012-AA.

FIGURE 1. Case outlines. – continued.

DEFENSE SUPPLY CENTER, COLUMBUS COLUMBUS, OHIO	SIZE A	CODE IDENT NO. 16236	DWG NO. V62/03618
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Case Y

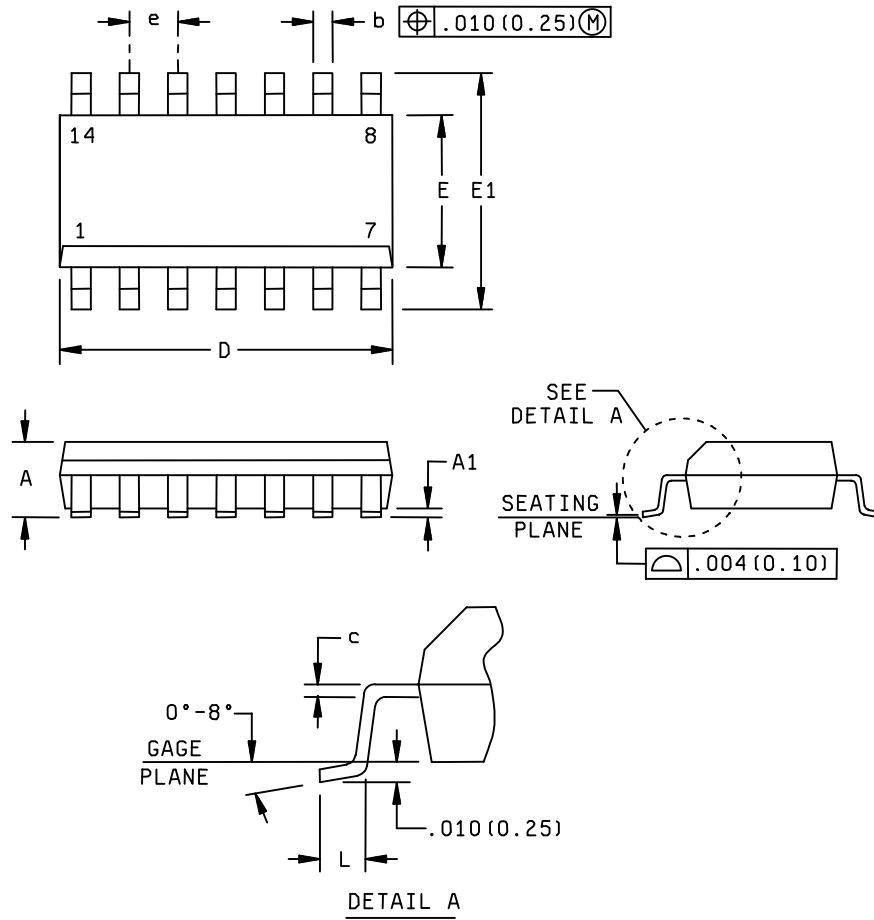


FIGURE 1. Case outlines – continued.

DEFENSE SUPPLY CENTER, COLUMBUS COLUMBUS, OHIO	SIZE A	CODE IDENT NO. 16236	DWG NO. V62/03618
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Case Y- continued.

Symbol	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
A	---	0.069	---	1.75
A1	0.004	0.010	0.10	0.25
b	0.014	0.020	0.35	0.51
c	.005	.010	0.13	0.25
D	0.337	0.344	8.55	8.75
e	0.050 BSC		1.27 BSC	
E	0.150	0.157	3.80	4.00
E1	0.228	0.244	5.80	6.20
L	0.016	0.050	0.40	1.27
n	14 leads		14 leads	

NOTES:

1. All linear dimensions are in inches (millimeters).
2. This case outline is subject to change without notice.
3. For dimension D, body length does not include mold flash, protrusions, or gate burrs.
Mold flash, protrusions, or gate burrs shall not to exceed .006 inch (0.15 mm).
4. For dimension E, body does not include interlead flash. Interlead flash shall not exceed .017 inch (0.43 mm) each side.
5. Fall within JEDEC MO-012-AB.

FIGURE 1. Case outlines. – continued.

DEFENSE SUPPLY CENTER, COLUMBUS COLUMBUS, OHIO	SIZE A	CODE IDENT NO. 16236	DWG NO. V62/03618
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Case Z

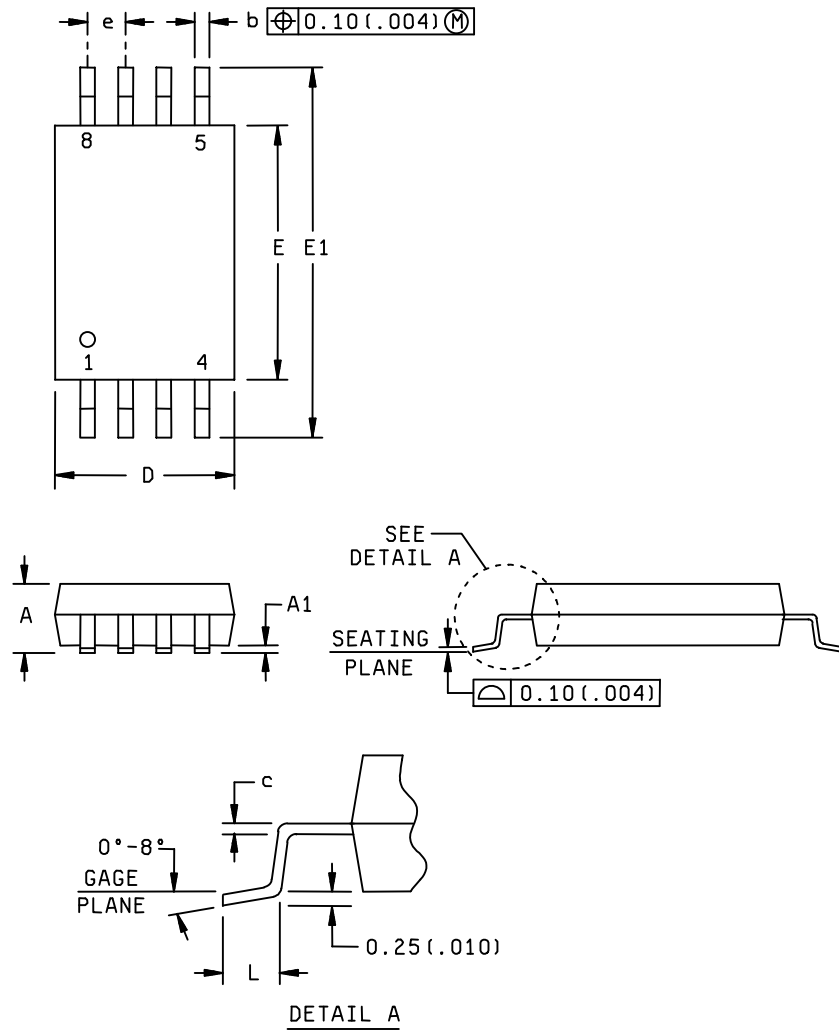


FIGURE 1. Case outlines – Continued.

DEFENSE SUPPLY CENTER, COLUMBUS COLUMBUS, OHIO	SIZE A	CODE IDENT NO. 16236	DWG NO. V62/03618
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Case Z- continued.

Symbol	Dimensions			
	Millimeters		Inches	
	Min	Max	Min	Max
A		1.20		0.047
A1	0.05	0.15	0.002	0.006
b	0.19	0.30	0.007	0.012
c	0.15 NOM		0.006 NOM	
D	2.90	3.10	0.114	0.122
E	4.30	4.50	0.169	0.177
E1	6.20	6.60	0.244	0.260
e	0.65 NOM		0.026 NOM	
L	0.50	0.75	0.020	0.030
n	8 leads		8 leads	

NOTES:

1. All linear dimensions are in millimeters (inches).
2. This case outline is subject to change without notice.
3. Body dimensions do not include mold flash or protrusion, not to exceed 0.006 inch (0.15 millimeters).
4. Fall within JEDEC MO-153.

FIGURE 1. Case outlines - Continued.

DEFENSE SUPPLY CENTER, COLUMBUS COLUMBUS, OHIO	SIZE A	CODE IDENT NO. 16236	DWG NO. V62/03618
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Device types	01 and 03	02 and 04
Case outlines	X and Z	U and Y
Terminal number	Terminal symbol	
1	1 OUT	1 OUT
2	1 –IN	1 –IN
3	1 +IN	1 +IN
4	-V _{DD} / GND	+V _{DD}
5	2 +IN	2 +IN
6	2 –IN	2 –IN
7	2 OUT	2 OUT
8	+V _{DD}	3 OUT
9	---	3 –IN
10	---	3 +IN
11	---	-V _{DD}
12	---	4 +IN
13	---	4 –IN
14	--	4 OUT

FIGURE 2. Terminal connections.

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4. VERIFICATION

4.1 Product assurance requirements. The manufacturer is responsible for performing all inspection and test requirements as indicated in their internal documentation. Such procedures should include proper handling of electrostatic sensitive devices, classification, packaging, and labeling of moisture sensitive devices, as applicable.

5. PREPARATION FOR DELIVERY

5.1 Packaging. Preservation, packaging, labeling, and marking shall be in accordance with the manufacturer's standard commercial practices for electrostatic discharge sensitive devices.

6. NOTES

6.1 ESDS. Devices are electrostatic discharge sensitive and are classified as ESDS class 1 minimum.

6.2 Configuration control. The data contained herein is based on the salient characteristics of the device manufacturer's data book. The device manufacturer reserves the right to make changes without notice. This drawing will be modified as changes are provided.

6.3 Suggested source(s) of supply. Identification of the suggested source(s) of supply herein is not to be construed as a guarantee of present or continued availability as a source of supply for the item. DLA Land and Maritime maintains an online database of all current sources of supply at <https://landandmaritimeapps.dla.mil/Programs/Smcr/>.

Vendor item drawing administrative control number <u>1/</u>	Device manufacturer CAGE code	Vendor part number	Top side marking
V62/03618-01XE	01295	TLC2272AMDREP	2272AE
V62/03618-01ZA	<u>2/</u>	TLC2272AMPWREP	2272AE
V62/03618-02UE	01295	TLC2274AMPWREP	2274AE
V62/03618-02YE	01295	TLC2274AMDREP	2274AE
V62/03618-03XA	<u>2/</u>	TLC2272MDREP	2272E
V62/03618-03ZA	<u>2/</u>	TLC2272MPWREP	2272E
V62/03618-04UE	<u>2/</u>	TLC2274MPWREP	2274E
V62/03618-04YE	01295	TLC2274MDREP	2274E

1/ The vendor item drawing establishes an administrative control number for identifying the item on the engineering documentation.

2/ Not available from an approved source of supply.

CAGE code

01295

Source of supply

Texas Instruments, Inc.
Semiconductor Group
8505 Forest Lane
P.O. Box 660199
Dallas, TX 75243

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