REVISIONS			
LTR	**DESCRIPTION**	**DATE**	**APPROVED**
A	Add JEDEC reference 51-7 under section 2. Add condition “f = 1 kHz” to both Equivalent input noise voltage tests under Table I. Add note to case outlines X and Y under Figure 1. Update document paragraphs to current requirements. - ro	19-07-01	C. 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																						
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REV STATUS OF PAGES	**REV**		A	A	A	A	A	A	A	A	A	A	A	A	A	A	A		
	PAGE		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		

PMIC N/A	**PREPARED BY** RICK OFFICER	**DEFENSE SUPPLY CENTER COLUMBUS COLUMBUS, OHIO 43218-3990**
Original date of drawing YY-MM-DD 06-04-27	**CHECKED BY** TOM HESS	**TITLE** MICROCIRCUIT, LINEAR, QUAD, OPERATIONAL AMPLIFIER, MONOLITHIC SILICON
	APPROVED BY RAYMOND MONNIN	
	SIZE A / **CODE IDENT. NO.** 16236	**DWG NO.** V62/06622
	REV A	**PAGE** 1 **OF** 15

AMSC N/A

5962-V043-19

1. SCOPE

1.1 Scope. This drawing documents the general requirements of a high performance quad 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:

V62/06622	-	01	X	E
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).

Device type	Generic	T_A	V_{IO} max at 25°C	Max V_{CC}	Circuit function
01	LM2902KAV-EP	-40°C to +125°C	3 mV	32 V	Quad operational amplifier
02	LM2902KV-EP	-40°C to +125°C	7 mV	32 V	Quad operational amplifier
03	LM2902-EP	-40°C to +125°C	7 mV	26 V	Quad operational amplifier
04	LM2902KAV-EP	-55°C to +125°C	3 mV	32 V	Quad operational amplifier
05	LM2902KV-EP	-55°C to +125°C	7 mV	32 V	Quad operational amplifier
06	LM2902-EP	-55°C to +125°C	7 mV	26 V	Quad operational amplifier

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

Outline letter	Number of pins	JEDEC PUB 95	Package style
X	14	MO-153	Plastic small outline
Y	14	MS-012-AB	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:

Finish designator	Material
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

1.3 Absolute maximum ratings. 1/

Supply voltage range (V_{CC}): 2/
- Device types 01, 02, 04, 05 ..... 32 V
- Device types 03, 06 ..... 26 V

Differential input voltage (V_{ID}): 3/
- Device types 01, 02, 04, 05 ..... ±32 V
- Device types 03, 06 ..... ±26 V

Input voltage (either input):
- Device types 01, 02, 04, 05 ..... -0.3 V to 32 V
- Device types 03, 06 ..... -0.3 V to 26 V

Duration of output short circuit (one amplifier) to ground at
- (or below) T_A = 25°C, $V_{CC} \leq$ 15 V ..... Unlimited 4/

Package thermal impedance (θ_{JA}):
- Case X ..... 113°C/W 5/ 6/
- Case Y ..... 101°C/W 5/ 6/

Operating virtual junction temperature range (T_J) ..... 142°C

Storage temperature range (T_{STG}) ..... -65°C to +150°C 7/

Electrostatic discharge:
- Human body model: ..... > 2 kV
- Charge device model ..... 2 kV for K suffix devices
- Machine model: (all pins) ..... >200 V

1.4 Recommended operating conditions. 8/

Operating free-air temperature range (T_A) ..... -55°C to +125°C

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 and V_{CC} specified for the measurement of I_{OS}, are with respect to the network GND.

3/ Differential voltages are at IN+ with respect to IN-.

4/ Short circuits from outputs to V_{CC} can cause excessive heating and eventual destruction.

5/ Maximum power dissipation is a function of $T_J(max)$, θ_{JA}, and T_A. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(max) - T_A) / \theta_{JA}$. Operating at the absolute maximum T_J of 142°C can affect reliability.

6/ The package thermal impedance is calculated in accordance with JESD 51-7.

7/ Long term high-temperature storage and/or extended use at maximum recommended operating conditions may result in reduction of overall device life. See manufacturer for additional information on enhanced plastic packaging.

8/ 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.

2. APPLICABLE DOCUMENTS

JEDEC Solid State Technology Association

JEDEC 51-7 – High Effective Thermal Conductivity Test Board for Leaded Surface Mount Packages
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 outline. The case outline 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.

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.

TABLE I. Electrical performance characteristics. 1/

Test	Symbol	Conditions 2/ V_{CC} = 5 V unless otherwise specified		Temperature, T_A	Device type	Limits		Unit
						Min	Max	
Input offset voltage	V_{IO}	V_{CC} = 5 V to 32 V,	Non A devices	25°C	01,02, 04,05		7	mV
		$V_{IC} = V_{ICR}$min,		-55°C to +125°C			10	
		V_O = 1.4 V	A suffix devices	25°C			3	
				-55°C to +125°C			4.5	
Temperature drift	$\Delta V_{IO} / \Delta T$	R_S = 0 Ω		-55°C to +125°C	01,02, 04,05	7 typical		µV/°C
Input offset current	I_{IO}	V_O = 1.4 V		25°C	01,02, 04,05		50	nA
				-55°C to +125°C			150	
Temperature drift	$\Delta V_{IO} / \Delta T$			-55°C to +125°C	01,02, 04,05	10 typical		pA/°C
Input bias current	I_{IB}	V_O = 1.4 V		25°C	01,02, 04,05		-250	nA
				-55°C to +125°C			-500	
Common mode input voltage range	V_{ICR}	V_{CC} = 5 V to 32 V		25°C	01,02, 04,05	0 to V_{CC} -1.5		V
				-55°C to +125°C		0 to V_{CC} -2		
High level output voltage	V_{OH}	R_L = 10 kΩ		25°C	01,02, 04,05	V_{CC} -1.5		V
		V_{CC} = 32 V, R_L = 2 kΩ		-55°C to +125°C		26		
		V_{CC} = 32 V, $R_L \geq$ 10 kΩ		-55°C to +125°C		27		
Low level output voltage	V_{OL}	R_L = 10 kΩ		-55°C to +125°C	01,02, 04,05		20	mV
Large signal differential voltage amplification	A_{VD}	V_{CC} = 15 V, $R_L \geq$ 2 kΩ,		25°C	01,02, 04,05	25		V/mV
		V_O = 1 V to 11 V		-55°C to +125°C		15		
Amplifier to amplifier coupling		f = 1 kHz to 20 kHz, 3/ input referred		25°C	01,02, 04,05	120 typical		dB

See footnotes at end of table.

TABLE I. Electrical performance characteristics – Continued. 1/

Test	Symbol	Conditions 2/ V_{CC} = 5 V unless otherwise specified	Temperature, T_A	Device type	Limits		Unit
					Min	Max	
Common mode rejection ratio	CMRR	$V_{IC} = V_{ICR}min$	25°C	01,02, 04,05	60		dB
Supply voltage rejection ratio ($\Delta V_{CC} / \Delta V_{IO}$)	k_{SVR}		25°C	01,02, 04,05	60		dB
Crosstalk attenuation	V_{O1} / V_{O2}	f = 1 kHz to 20 kHz	25°C	01,02, 04,05	120 typical		dB
Output current	I_O	V_{CC} = 15 V, V_{ID} = 1 V, V_O = 0	25°C	01,02, 04,05	-20		mA
			-55°C to +125°C		-10		
		V_{CC} = 15 V, V_{ID} = -1 V, V_O = 15 V	25°C		10		
			-55°C to +125°C		5		
		V_{ID} = -1 V, V_O = 200 mV	25°C		12		µA
Short circuit output current	I_{OS}	V_{CC} at 5 V, V_O = 0, GND at -5 V	25°C	01,02, 04,05		±60	mA
Supply current (four amplifiers)	I_{CC}	V_O = 2.5 V, no load	-55°C to +125°C	01,02, 04,05		1.2	mA
		V_{CC} = 32 V, V_O = 0.5 V_{CC}, no load	-55°C to +125°C			3	
Slew rate at unity gain	SR	V_{CC} = ±15 V, R_L = 1 MΩ, C_L = 30 pF, V_I = ±10 V, see figure 3	25°C	01,02, 04,05	0.5 typical		V/µs
Unity gain bandwidth	B_1	V_{CC} = ±15 V, R_L = 1 MΩ, C_L = 20 pF, see figure 3	25°C	01,02, 04,05	1.2 typical		MHz
Equivalent input noise voltage	V_n	V_{CC} = ±15 V, R_S = 100 Ω, V_I = 0 V, f = 1 kHz, see figure 4	25°C	01,02, 04,05	35 typical		nV/$\sqrt{Hz}$

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/ Unless otherwise specified, all characteristics are measured under open loop conditions, with zero common input voltage.
3/ Due to proximity of external components, ensure that coupling is not originating via stray capacitance between these external parts. Typically, this can be detected, as this type of coupling increases at higher frequencies.

TABLE I. Electrical performance characteristics – Continued. 1/

Test	Symbol	Conditions 2/ V_{CC} = 5 V unless otherwise specified	Temperature, T_A	Device type	Limits		Unit
					Min	Max	
Input offset voltage	V_{IO}	V_{CC} = 5 V to 26 V, V_O = 1.4 V,	25°C	03,06		7	mV
		V_{IC} = V_{ICR}min,	-55°C to +125°C			10	
Input offset current	I_{IO}	V_O = 1.4 V	25°C	03,06		50	nA
			-55°C to +125°C			300	
Input bias current	I_{IB}	V_O = 1.4 V	25°C	03,06		-250	nA
			-55°C to +125°C			-500	
Common mode input voltage range	V_{ICR}	V_{CC} = 5 V to 26 V	25°C	03,06	0 to V_{CC} -1.5		V
			-55°C to +125°C		0 to V_{CC} -2		
High level output voltage	V_{OH}	R_L = 10 kΩ	25°C	03,06	V_{CC} -1.5		V
		V_{CC} = 26 V, R_L = 2 kΩ	-55°C to +125°C		22		
		V_{CC} = 26 V, $R_L \geq$ 10 kΩ	+25°C		23		
Low level output voltage	V_{OL}	$R_L \leq$ 10 kΩ	-55°C to +125°C	03,06		20	mV
Large signal differential voltage amplification	A_{VD}	V_{CC} = 15 V, $R_L \geq$ 2 kΩ,	25°C	03,06	100 typical		V/mV
		V_O = 1 V to 11 V	-55°C to +125°C		15		
Common mode rejection ratio	CMRR	V_{IC} = V_{ICR}min	25°C	03,06	50		dB
Supply voltage rejection ratio (ΔV_{CC} / ΔV_{IO})	kSVR		25°C	03,06	50		dB
Crosstalk attenuation	V_{O1} / V_{O2}	f = 1 kHz to 20 kHz	25°C	03,06	120 typical		dB

See footnotes at end of table.

TABLE I. Electrical performance characteristics – Continued. 1/

Test	Symbol	Conditions 2/ V_{CC} = 5 V unless otherwise specified	Temperature, T_A	Device type	Limits		Unit
					Min	Max	
Output current	I_O	V_{CC} = 15 V, V_{ID} = 1 V, V_O = 0	25°C	03,06	-20		mA
			-55°C to +125°C		-10		
		V_{CC} = 15 V, V_{ID} = -1 V, V_O = 15 V	25°C		10		
			-55°C to +125°C		5		
		V_{ID} = -1 V, V_O = 200 mV	25°C		30 typical		µA
Short circuit output current	I_{OS}	V_{CC} at 5 V, V_O = 0, GND at -5 V	25°C	03,06		±60	mA
Supply current (four amplifiers)	I_{CC}	V_O = 2.5 V, no load	-55°C to +125°C	03,06		1.2	mA
		V_{CC} = 26 V, V_O = 0.5 V_{CC}, no load	-55°C to +125°C			3	
Slew rate at unity gain	SR	V_{CC} = ±15 V, R_L = 1 MΩ, C_L = 30 pF, V_I = ±10 V, see figure 3	25°C	03,06	0.5 typical		V/µs
Unity gain bandwidth	B1	V_{CC} = ±15 V, R_L = 1 MΩ, C_L = 20 pF, see figure 3	25°C	03,06	1.2 typical		MHz
Equivalent input noise voltage	V_n	V_{CC} = ±15 V, R_S = 100 Ω, V_I = 0 V, f = 1 kHz, see figure 4	25°C	03,06	35 typical		nV/$\sqrt{Hz}$

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/ Unless otherwise specified, all characteristics are measured under open loop conditions, with zero common input voltage.

Case X

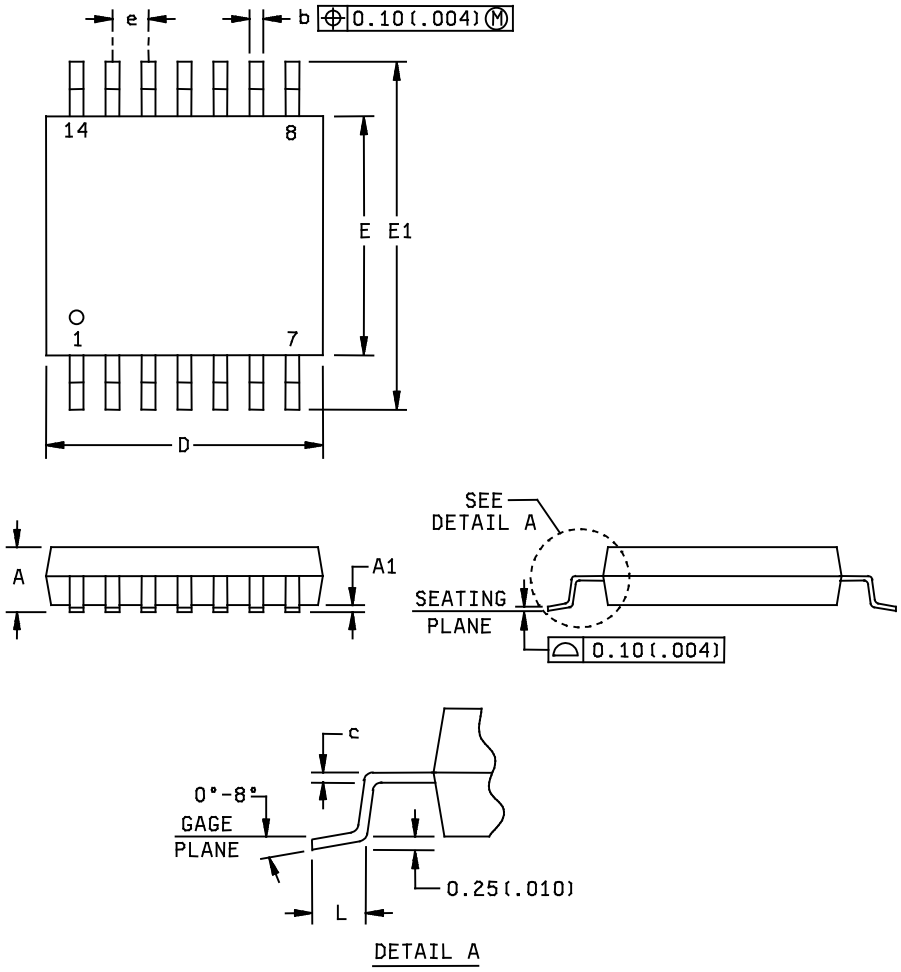

FIGURE 1. Case outlines.

DEFENSE SUPPLY CENTER, COLUMBUS COLUMBUS, OHIO	SIZE A	CODE IDENT NO. 16236	DWG NO. V62/06622
		REV A	PAGE 9

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

NOTES:
1. All linear dimensions are in millimeters, inch dimensions are for reference only.
2. For dimension D, body length does not include mold flash, protrusion, or gate burrs. Mold flash, protrusion, or gate burrs shall not exceed 0.15 mm (0.006 inch) per side.
3. For dimension E, body width does not include interlead flash. Interlead flash shall not exceed 0.25 mm (0.009 inch) per side.
4. Fall within JEDEC MO-153.

FIGURE 1. Case outlines - Continued.

Case Y

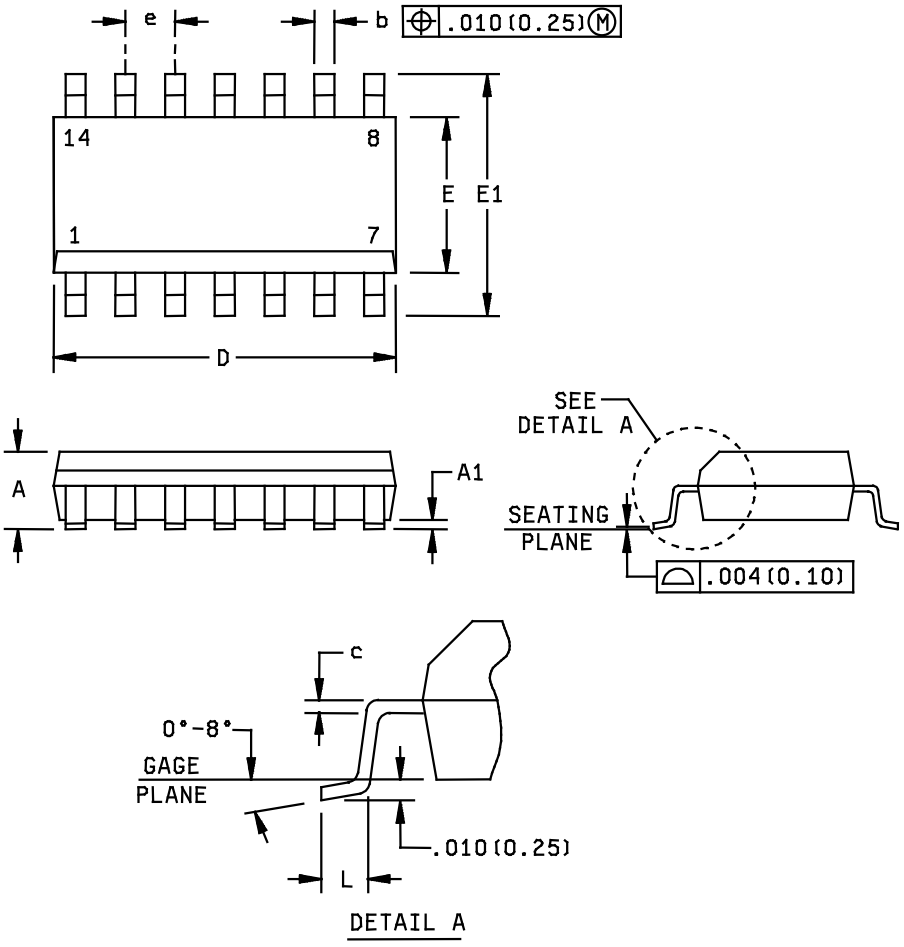

FIGURE 1. Case outlines - Continued.

Symbol	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
A	---	.069	---	1.75
A1	.004	.010	0.10	0.25
b	.012	.020	0.31	0.51
c	.007	.010	0.17	0.25
D	.337	.344	8.55	8.75
E	.150	.157	3.80	4.00
E1	.228	.244	5.80	6.20
e	---	.050 BSC	---	1.27 BSC
L	.016	.050	0.40	1.27

NOTES:
1. All linear dimensions are in inches, millimeters are for reference only.
2. For dimension D, body length does not include mold flash, protrusion, or gate burrs. Mold flash, protrusion, or gate burrs shall not exceed 0.006 inch (0.15 mm) per end.
3. For dimension E, body width does not include interlead flash. Interlead flash shall not exceed 0.017 inch (0.43 mm) per side.
4. Fall within JEDEC MS-012-AB.

FIGURE 1. Case outlines - Continued.

Device types	01, 02, 03, 04, 05, 06
Case outlines	X and Y
Terminal number	Terminal symbol
1	1OUT
2	1IN-
3	1IN+
4	V_{CC}
5	2IN+
6	2IN-
7	2OUT
8	3OUT
9	3IN-
10	3IN+
11	GND
12	4IN+
13	4IN-
14	4OUT

FIGURE 2. Terminal connections.

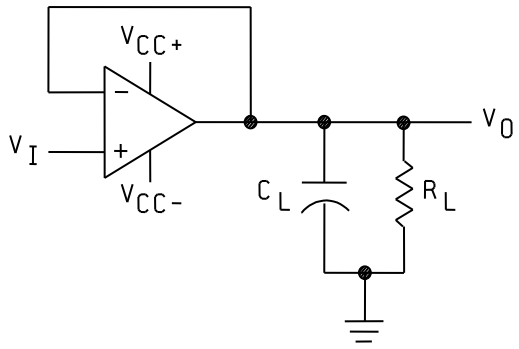

FIGURE 3. Unity gain amplifier.

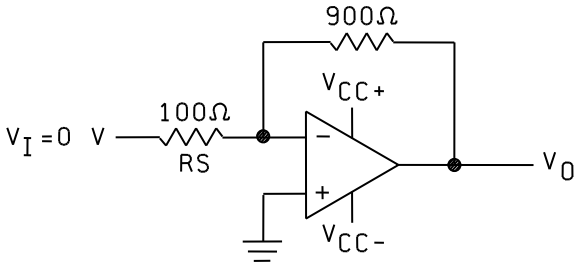

FIGURE 4. Noise test circuit.

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 1/	T_A	V_{IO} max at 25°C	Max V_{CC}	Device manufacturer CAGE code	Package 2/	Top side marking	Vendor part number
V62/06622-01XE	-40°C to +125°C	3 mV	32 V	01295	Reel of 2500	LM2902E	LM2902KAVQPWREP
V62/06622-01YE	-40°C to +125°C	3 mV	32 V	3/	Reel of 2500	LM2902E	LM2902KAVQDREP
V62/06622-02XE	-40°C to +125°C	7 mV	32 V	3/	Reel of 2000	2902KVE	LM2902KVQPWREP
V62/06622-02YE	-40°C to +125°C	7 mV	32 V	3/	Reel of 2500	2902KVE	LM2902KVQDREP
V62/06622-03XE	-40°C to +125°C	7 mV	26 V	3/	Reel of 2000	2902EP	LM2902QPWREP
V62/06622-03YE	-40°C to +125°C	7 mV	26 V	3/	Reel of 2500	2902EP	LM2902QDREP
V62/06622-04XE	-55°C to +125°C	3 mV	32 V	01295	Reel of 2000	2902KAE	LM2902KAVMPWREP
V62/06622-04YE	-55°C to +125°C	3 mV	32 V	3/	Reel of 2500	2902KAE	LM2902KAVMDREP
V62/06622-05XE	-55°C to +125°C	7 mV	32 V	3/	Reel of 2500	2902KME	LM2902KVMPWREP
V62/06622-05YE	-55°C to +125°C	7 mV	32 V	3/	Reel of 2500	2902KME	LM2902KVMDREP
V62/06622-06XE	-55°C to +125°C	7 mV	26 V	3/	Reel of 2500	2902ME	LM2902MPWREP
V62/06622-06YE	-55°C to +125°C	7 mV	26 V	3/	Reel of 2500	2902ME	LM2902MDREP

1/ The vendor item drawing establishes an administrative control number for identifying the item on the engineering documentation.
2/ Package drawings, standard packaging quantities, thermal data, symbolization, and PCB design guidelines are available from the manufacturer.
3/ Product preview. Contact vendor for device availability.

CAGE code	Source of supply
01295	Texas Instruments, Inc. Semiconductor Group 8505 Forest Ln. PO Box 660199