REVISIONS			
LTR	DESCRIPTION	DATE (YR-MO-DA)	APPROVED
A	Changes IAW NOR 5962-R050-95	95-01-24	M.A. Frye
B	Add case outline X. Remove vendor CAGE for case outline G. Editorial and technical changes throughout.	96-01-30	M.A. Frye

THE ORIGINAL FIRST PAGE OF THIS DRAWING HAS BEEN REPLACED.

REV																			
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REV STATUS OF SHEETS																
REV	B	B	B	B	B	B	B	B	B	B	B					
SHEET	1	2	3	4	5	6	7	8	9	10	11					

PMIC N/A

STANDARD MICROCIRCUIT DRAWING

THIS DRAWING IS AVAILABLE FOR USE BY ALL DEPARTMENTS AND AGENCIES OF THE DEPARTMENT OF DEFENSE

AMSC N/A

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DRAWING APPROVAL DATE
89-07-27

REVISION LEVEL
B

DEFENSE ELECTRONICS SUPPLY CENTER
DAYTON, OHIO 45444

MICROCIRCUIT, LINEAR, LOW NOISE, HIGH SPEED PRECISION, OPERATIONAL AMPLIFIER, MONOLITHIC SILICON

SIZE	CAGE CODE	
A	67268	5962-88622

SHEET 1 OF 11

DESC FORM 193
JUL 94

9004708 0019144 838

5962-E256-95

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

1. SCOPE

1.1 Scope. This drawing describes device requirements for class B microcircuits in accordance with 1.2.1 of MIL-STD-883, "Provisions for the use of MIL-STD-883 in conjunction with compliant non-JAN devices".

1.2 Part or Identifying Number (PIN). The complete PIN shall be as shown in the following example:

5962-88622	01	G	X
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). The device type(s) shall identify the circuit function as follows:

Device type	Generic number	Circuit function	V_{OS}(μV)
01	LT1028M	Operational amplifier	±80
02	LT1028AM	Operational amplifier	±40

1.2.2 Case outline(s). The case outline(s) shall be as designated in MIL-STD-1835, and as follows:

Outline letter	Descriptive designator	Terminals	Package style
G	MACY1-X8	8	Can
P	GDIP1-T8 or CDIP2-T8	8	Dual-in-line
X	See figure 1	8	Can

1.2.3 Lead finish. The lead finish shall be as specified in MIL-STD-883 (see 3.1 herein). Finish letter "X" shall not be marked on the microcircuit or its packaging. The "X" designation is for use in specifications when lead finishes A, B, and C are considered acceptable and interchangeable without preference.

1.3 Absolute maximum ratings. 1/

Supply voltage:	
T_A = -55°C to +105°C	±22 V
T_A = +105°C to +125°C	±16 V
Input voltage	Equal to supply voltage
Differential input current 2/	±25 mA
Output short-circuit duration	Indefinite
Storage temperature range	-65°C to +150°C
Power dissipation (P_D) 3/:	
Cases G and X	500 mW at 75°C
Case P	750 mW at 75°C
Lead temperature (soldering, 10 seconds)	+300°C
Thermal resistance, junction-to-case (θ_{JC})	See MIL-STD-1835
Thermal resistance, junction-to-ambient (θ_{JA}):	
Case G and X	150°C/W
Case P	100°C/W
Junction temperature (T_J)	+150°C

1.4 Recommended operating conditions.

Supply voltage ($\pm V_S$)	±4.5 V to ±15 V
Ambient operating temperature range (T_A) 4/	-55°C to +125°C

1/ Internal thermal limiting prevents excessive heating that could result in sudden failure. The device can be subjected to accelerated stress with a shorted output and worst-case conditions.
2/ The inputs are protected by back-to-back diodes. Current limiting resistors are not used in order to achieve low noise. If differential input voltage exceeds ±1.8 V, the input current should be limited to 25 mA.
3/ Derate: Case G, 6.7 mW/°C above 75°C; case P, 10 mW/°C above 75°C.
4/ The maximum operating junction temperature is +150°C. At elevated temperatures, the device must be derated based on package thermal resistance.

2. APPLICABLE DOCUMENTS

2.1 Government specification, standards, and bulletin. Unless otherwise specified, the following specification, standards, and bulletin of the issue listed in that issue of the Department of Defense Index of Specifications and Standards specified in the solicitation, form a part of this drawing to the extent specified herein.

SPECIFICATION

MILITARY

MIL-I-38535 - Integrated Circuits (Microcircuits) Manufacturing, General Specification for.

STANDARDS

MILITARY

MIL-STD-883 - Test Methods and Procedures for Microelectronics.
MIL-STD-1835 - Microcircuit Case Outlines.

BULLETIN

MILITARY

MIL-BUL-103 - List of Standard Microcircuit Drawings (SMD's).

(Copies of the specification, standards, and bulletin required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

2.2 Order of precedence. In the event of a conflict between the text of this drawing and the references cited herein, the text of this drawing shall take precedence.

3. REQUIREMENTS

3.1 Item requirements. The individual item requirements shall be in accordance with 1.2.1 of MIL-STD-883, "Provisions for the use of MIL-STD-883 in conjunction with compliant non-JAN devices" and as specified herein. Product built to this drawing that is produced by a Qualified Manufacturer Listing (QML) certified and qualified manufacturer or a manufacturer who has been granted transitional certification to MIL-I-38535 may be processed as QML product in accordance with the manufacturers approved program plan and qualifying activity approval in accordance with MIL-I-38535. This QML flow as documented in the Quality Management (QM) plan may make modifications to the requirements herein. These modifications shall not affect form, fit, or function of the device. These modifications shall not affect the PIN as described herein. A "Q" or "QML" certification mark in accordance with MIL-I-38535 is required to identify when the QML flow option is used.

3.2 Design, construction, and physical dimensions. The design, construction, and physical dimensions shall be as specified in MIL-STD-883 (see 3.1 herein) and herein.

3.2.1 Case outline(s). The case outlines shall be in accordance with 1.2.2 herein and on figure 1.

3.2.2 Terminal connections. The terminal connections shall be as specified on figure 2.

3.3 Electrical performance characteristics. Unless otherwise specified herein, the electrical performance characteristics are as specified in table I and shall apply over the full ambient operating temperature range.

3.4 Electrical test requirements. The electrical test requirements shall be the subgroups specified in table II. The electrical tests for each subgroup are described in table I.

3.5 Marking. Marking shall be in accordance with MIL-STD-883 (see 3.1 herein). The part shall be marked with the PIN listed in 1.2 herein. In addition, the manufacturer's PIN may also be marked as listed in MIL-BUL-103 (see 6.6 herein).

3.6 Certificate of compliance. A certificate of compliance shall be required from a manufacturer in order to be listed as an approved source of supply in MIL-BUL-103 (see 6.6 herein). The certificate of compliance submitted to DESC-EC prior to listing as an approved source of supply shall affirm that the manufacturer's product meets the requirements of MIL-STD-883 (see 3.1 herein) and the requirements herein.

3.7 Certificate of conformance. A certificate of conformance as required in MIL-STD-883 (see 3.1 herein) shall be provided with each lot of microcircuits delivered to this drawing.

3.8 Notification of change. Notification of change to DESC-EC shall be required in accordance with MIL-STD-883 (see 3.1 herein).

3.9 Verification and review. DESC, DESC's agent, and the acquiring activity retain the option to review the manufacturer's facility and applicable required documentation. Offshore documentation shall be made available onshore at the option of the reviewer.

4. QUALITY ASSURANCE PROVISIONS

4.1 Sampling and inspection. Sampling and inspection procedures shall be in accordance with MIL-STD-883 (see 3.1 herein).

4.2 Screening. Screening shall be in accordance with method 5004 of MIL-STD-883, and shall be conducted on all devices prior to quality conformance inspection. The following additional criteria shall apply:

a. Burn-in test, method 1015 of MIL-STD-883.

(1) Test condition A, B, C, or D. The test circuit shall be maintained by the manufacturer under document revision level control and shall be made available to the preparing or acquiring activity upon request. The test circuit shall specify the inputs, outputs, biases, and power dissipation, as applicable, in accordance with the intent specified in test method 1015 of MIL-STD-883.

(2) T_A = +125°C, minimum.

b. Interim and final electrical test parameters shall be as specified in table II herein, except interim electrical parameter tests prior to burn-in are optional at the discretion of the manufacturer.

4.3 Quality conformance inspection. Quality conformance inspection shall be in accordance with method 5005 of MIL-STD-883 including groups A, B, C, and D inspections. The following additional criteria shall apply.

4.3.1 Group A inspection.

a. Tests shall be as specified in table II herein.

b. Subgroups 8, 9, 10, and 11 in table I, method 5005 of MIL-STD-883 shall be omitted.

4.3.2 Groups C and D inspections.

a. End-point electrical parameters shall be as specified in table II herein.

b. Steady-state life test conditions, method 1005 of MIL-STD-883:

(1) Test condition A, B, C, or D. The test circuit shall be maintained by the manufacturer under document revision level control and shall be made available to the preparing or acquiring activity upon request. The test circuit shall specify the inputs, outputs, biases, and power dissipation, as applicable, in accordance with the intent specified in test method 1005 of MIL-STD-883.

(2) T_A = +125°C, minimum.

(3) Test duration: 1,000 hours, except as permitted by method 1005 of MIL-STD-883.

TABLE I. Electrical performance characteristics.

Test	Symbol	Conditions $-55°C \le T_A \le +125°C$ unless otherwise specified	Device type	Group A subgroups	Limits Min	Limits Max	Unit
Input offset voltage	V_{IO} 1/		01	1		±80	µV
			02			±40	
			01	2, 3		±180	
			02			±120	
Input voltage range	V_{IN} 2/		All	1	±11		V
				2, 3	±10.3		
Input bias current	I_{IB}	V_{CM} = 0.0 V	01	1		±180	nA
			02			±90	
			01	2, 3		±300	
			02			±150	
Input offset current	I_{IO}	V_{CM} = 0.0 V	01	1		±100	nA
			02			±50	
			01	2, 3		±180	
			02			±90	
Output voltage swing	V_{OUT}	$R_L \ge 600\ \Omega$	01	4	±10.5		V
			02		±11.0		
		$R_L \ge 2.0\ k\Omega$,	01		±12.0		
			02		±12.3		
			01	5, 6	±10.3		
			02		±10.3		

See footnotes at end of table.

TABLE I. Electrical performance characteristics - Continued.

Test	Symbol	Conditions $-55°C \le T_A \le +125°C$ unless otherwise specified	Device type	Group A subgroups	Limits Min	Limits Max	Unit
Input noise voltage density	e_n	f_O = 10 Hz, T_A = +25°C	01	7		2.4	nV/√Hz
			02			2.2	
		f_O = 1.0 kHz, T_A = +25°C	01			1.2	
			02			1.1	
Input noise current density	i_n	f_O = 10 Hz, T_A = +25°C 3/	01	7		16	pA/√Hz
			02			14	
		f_O = 1.0 kHz, T_A = +25°C 3/	01			1.8	
			02			1.6	
Slew rate	S_R	A_{VCL} = -1	All	4	11.0		V/µs
				5, 6	7.5		
Gain-bandwidth product	GBWP	f_O = 20 kHz, T_A = +25°C 4/	All	7	50		MHz
Average temperature coefficient of input offset voltage	$\frac{\Delta V_{IO}}{\Delta T}$	4/	01	4		2.0	µV/°C
			02			1.3	
Supply current	I_S	I_L = 0.0 mA	01	1		10.5	pA/√Hz
			02			9.5	
			01	2, 3		13.0	
			02			11.5	

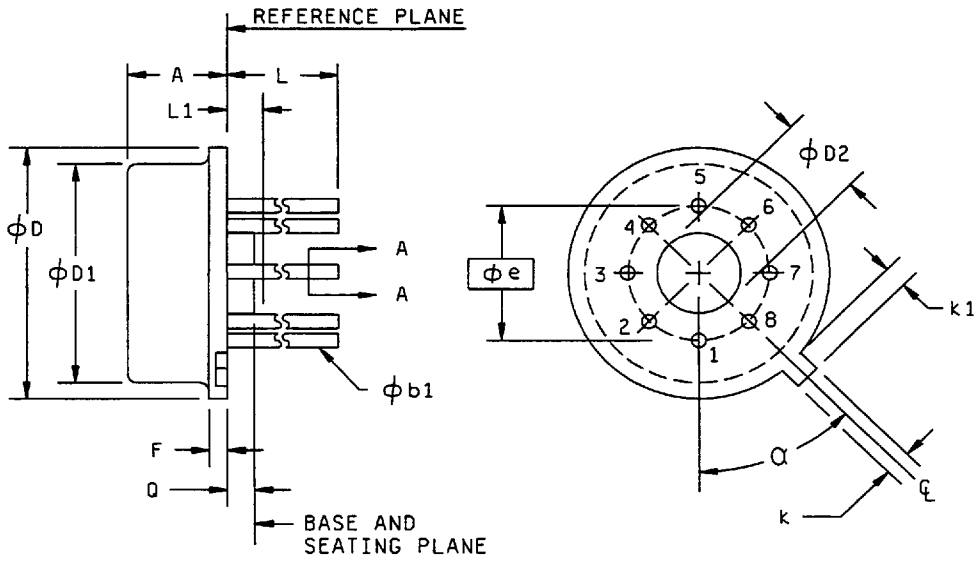
See footnotes at end of table.

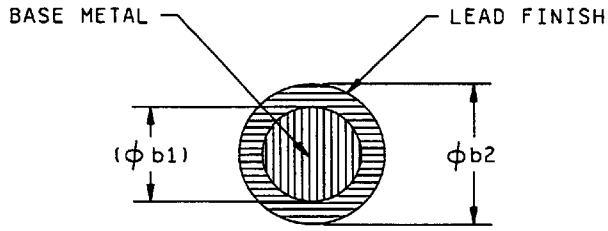
TABLE I. Electrical performance characteristics - Continued.

Test	Symbol	Conditions $-55°C \le T_A \le +125°C$ unless otherwise specified		Device type	Group A subgroups	Limits Min	Limits Max	Unit
Large signal voltage gain	A_{VOL}	V_{OUT} = ±12 V, $R_L \ge 2.0$ kΩ		01	4	5.0		V/μV
				02		7.0		
		V_{OUT} = ±10 V, $R_L \ge 2.0$ kΩ		01	5, 6	2.0		
				02		3.0		
		V_{OUT} = ±10 V	$R_L \ge 1.0$ kΩ	01	4	3.5		V/μV
				02		5.0		
				01	5, 6	1.5		
				02		2.0		
			$R_L \ge 600$ Ω	01	4	2.0		
				02		3.0		
Common mode rejection ratio	CMRR	V_{CM} = ±11.0 V		01	1	110		dB
				02		114		
		V_{CM} = ±10.3 V		01	2, 3	100		
				02		106		
Power supply rejection ratio	PSRR	±4.0 V ≤ V_S ≤ ±18 V		01	1	110		dB
				02		117		
		±4.5 V ≤ V_S ≤ ±16 V		01	2, 3	104		
				02		110		

1/ Input offset voltage measurement are performed by automatic test equipment approximately 0.5 seconds after application of power.
2/ This test is guaranteed by the CMRR test.
3/ Current noise is defined and measured with balanced source resistors. The resultant voltage noise (after subtracting the resistor noise on an rms basis) is divided by the sum of the two source resistors to obtain current noise.
4/ If not tested, shall be guaranteed to the limits specified in table I.

Case outline X





SECTION A-A

FIGURE 1. Case outline.

Case outline X - continued

Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
A	.165	.185	4.19	4.70	
ϕb1	.016	.021	.41	.53	2
ϕb2	.016	.024	.41	.61	
ϕD	.335	.370	8.51	9.40	
ϕD1	.305	.335	7.75	8.51	
ϕD2	.110	.160	2.79	4.06	
e	.230 BSC		5.84 BSC		
F	---	.040	---	1.02	
k	.028	.034	.71	.86	
k1	.027	.045	.69	1.14	3
L	.500	.750	12.70	19.05	2
L1	---	.050	---	1.27	2
Q	.010	.045	.25	1.14	
α	45° BSC		45° BSC		4
Note	1, 5, 6				

NOTES:

1. The US government preferred system of measurement is the metric SI system. However, since this item was originally designed using inch-pound units of measurement, in the event of conflict between the metric and inch-pound units, the inch-pound units shall take precedence.
2. Diameter is uncontrolled in L1 and beyond .500 from the reference plane.
3. Measured from maximum diameter of the product.
4. α is the basic spacing from the centerline of the tab to terminal 1.
5. Leads having a maximum diameter .019 inches measured in gauging plane .054 + .001 - .000 inches below the base plane of the product shall be within .007 of their true position relative to a maximum width tab.
6. This style package may be measured by direct methods or by gauge.

FIGURE 1. Case outline - continued.

Device types	01 and 02
Case outlines	G, P, and X
Terminal number	Terminal symbol
1	V_{OS} TRIM
2	-INPUT
3	+INPUT
4	$-V_S$
5	OVER-COMP
6	OUTPUT
7	$+V_S$
8	V_{OS} TRIM

FIGURE 2. Terminal connections.

TABLE II. Electrical test requirements.

MIL-STD-883 test requirements	(in accordance with method 5005, table I)
Interim electrical parameters (method 5004)	-------
Final electrical test parameters (method 5004)	1*, 2, 3, 4, 5, 6
Group A test requirements (method 5005)	1, 2, 3, 4, 5, 6, 7
Groups C and D end-point electrical parameters (method 5005)	1

* PDA applies to subgroup 1 except for the input offset voltage test.

5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-STD-883 (see 3.1 herein).

6. NOTES

6.1 Intended use. Microcircuits conforming to this drawing are intended for use for Government microcircuit applications (original equipment), design applications, and logistics purposes.

6.2 Replaceability. Microcircuits covered by this drawing will replace the same generic device covered by a contractor-prepared specification or drawing.

6.3 Configuration control of SMD's. All proposed changes to existing SMD's will be coordinated with the users of record for the individual documents. This coordination will be accomplished in accordance with MIL-STD-973 using DD Form 1692, Engineering Change Proposal.

6.4 Record of users. Military and industrial users shall inform Defense Electronics Supply Center when a system application requires configuration control and the applicable SMD. DESC will maintain a record of users and this list will be used for coordination and distribution of changes to the drawings. Users of drawings covering microelectronics devices (FSC 5962) should contact DESC-EC, telephone (513) 296-6047.

6.5 Comments. Comments on this drawing should be directed to DESC-EC, Dayton, Ohio 45444-5270, or telephone (513) 296-5377.

6.6 Approved sources of supply. Approved sources of supply are listed in MIL-BUL-103. The vendors listed in MIL-BUL-103 have agreed to this drawing and a certificate of compliance (see 3.6 herein) has been submitted to and accepted by DESC-EC.