REVISIONS			
LTR	DESCRIPTION	DATE (YR-MO-DA)	APPROVED

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

PMIC N/A

STANDARDIZED MILITARY 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: 91-07-10

REVISION LEVEL:

DEFENSE ELECTRONICS SUPPLY CENTER
DAYTON, OHIO 45444

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

SIZE	CAGE CODE	
A	67268	5962-89627

SHEET 1 OF 11

DESC FORM 193
SEP 87

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5962-E1375

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

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

5962-89627	01	G	X
Drawing number	Device type (1.2.1)	Case outline (1.2.2)	Lead finish per MIL-M-38510

1.2.1 Device type(s). The device type(s) shall identify the circuit function as follows:

Device type	Generic number	Circuit function	Slew rate (V/μs)
01	HA-5127	Operational amplifier	7.0 minimum
02	HA-5137	Operational amplifier	14 minimum
03	HA-5147	Operational amplifier	28 minimum

1.2.2 Case outline(s). The case outline(s) shall be as designated in appendix C of MIL-M-38510, and as follows:

Outline letter	Case outline
G	A-1 (8-lead, .370" x .185"), can package
P	D-4 (8-lead, .405" x .310" x .200"), dual-in-line package
2	C-2 (20-terminal, .358" x .358" x .100"), square chip carrier package

1.3 Absolute maximum ratings.

Voltage between +V and -V terminals	44 V dc
Differential input voltage	0.7 V dc 1/
Voltage at either input terminal	+V to -V
Input current	25 mA
Differential output current	Short circuit protected
Storage temperature range	-65°C to +150°C
Lead temperature (soldering, 10 seconds)	+275°C
Maximum power dissipation (P_D):	
Case G	1.02 W 2/
Case P	1.22 W 2/
Case 2	1.19 W 2/
Thermal resistance, junction-to-case (θ_{JC})	See MIL-M-38510, appendix C
Thermal resistance, junction-to-ambient (θ_{JA}):	
Case G	98°C/W
Case P	92°C/W
Case 2	84°C/W
Junction temperature (T_J)	+175°C

1/ For differential input voltages greater than 0.7 V, the input current must be limited to 25 mA to protect the back-to-back input diodes.
2/ Derate above T_A = +75°C as follows: Case G = 10.2 mW/°C
Case P = 12.2 mW/°C
Case 2 = 11.9 mW/°C

1.4 Recommended operating conditions.

Positive supply voltage (+V)	15 V dc
Negative supply voltage (-V)	-15 V dc
Common mode input voltage (V_{CM})	$\leq$ (+V - -V)/2
Load resistance (R_L)	600Ω
Ambient temperature range (T_A)	-55°C to +125°C

2. APPLICABLE DOCUMENTS

2.1 Government specification, standard, and bulletin. Unless otherwise specified, the following specification, standard, 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-M-38510 - Microcircuits, General Specification for.

STANDARD

MILITARY

MIL-STD-883 - Test Methods and Procedures for Microelectronics.

(Copies of the specification, standard, 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.

3.2 Design, construction, and physical dimensions. The design, construction, and physical dimensions shall be as specified in MIL-M-38510 and herein.

3.2.1 Case outline(s). The case outline(s) shall be in accordance with 1.2.2 herein.

3.2.2 Terminal connections. The terminal connections shall be as specified on figure 1.

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 marked with the PIN listed in 1.2 herein. In addition, the manufacturer's PIN may also be marked as listed in 6.6 herein

TABLE I. Electrical performance characteristics.

Test	Symbol	Conditions 1/ $-55°C < T_A < +125°C$ unless otherwise specified	Group A subgroups	Device type	Limits Min	Limits Max	Unit
Input offset voltage	V_{IO}	V_{CM} = 0.0 V	1	All		±100	mV
			2,3	All		±300	mV
Input bias current	I_B	V_{CM} = 0.0 V	1	All		±80	nA
			2,3	All		±150	nA
Input offset current	I_{IO}	V_{CM} = 0.0 V, $+R_S$ = 10 kΩ, $-R_S$ = 10 kΩ	1	All		±75	nA
			2,3	All		±135	nA
Common mode range	+CMR	+V = 4.7 V, -V = -25.3 V	1,2,3	All	10.3		V
	-CMR	+V = 25.3 V, -V = -4.7 V	1,2,3	All	-10.3		V
Large signal voltage gain	$+A_{VOL}$	V_{OUT} = 0.0 V and 10 V, R_L = 2.0 kΩ	4	All	700		kV/V
			5,6	All	300		kV/V
	$-A_{VOL}$	V_{OUT} = 0.0 V and -10 V R_L = 2.0 kΩ	4	All	700		kV/V
			5,6	All	300		kV/V
Common mode rejection ratio	+CMRR	ΔV_{CM} = 11 V	1	All	100		dB
		ΔV_{CM} = 10 V	2,3	All	100		dB
	-CMRR	ΔV_{CM} = -11 V	1	All	100		dB
		ΔV_{CM} = -10 V	2,3	All	100		dB

See footnotes at end of table.

TABLE I. Electrical performance characteristics - Continued.

Test	Symbol	Conditions 1/ $-55°C < T_A < +125°C$ unless otherwise specified	Group A subgroups	Device type	Limits Min	Limits Max	Unit
Output voltage swing	$+V_{OUT1}$	R_L = 2.0 kΩ	4,5,6	All	11.5		V
	$-V_{OUT1}$	R_L = 10 kΩ	4,5,6	All	-11.5		V
	$+V_{OUT2}$	R_L = 600Ω	4	All	10		V
	$-V_{OUT2}$	R_L = 600Ω	4	All	-10		V
Power supply rejection ratio	+PSRR	$\Delta\pm V$ = 14 V	1	All	86		dB
		$\Delta\pm V$ = 13.5V	2,3	All	86		dB
	-PSRR	$\Delta\pm V$ = 14 V	1	All	86		dB
		$\Delta\pm V$ = 13.5 V	2,3	All	86		dB
Output current	$+I_{OUT}$	V_{OUT} = -10 V, T_A = +25°C	4	All	16.5		mA
	$-I_{OUT}$	V_{OUT} = 10 V, T_A = +25°C	4	All	-16.5		mA
Quiescent power supply current	$+I_{CC}$	V_{OUT} = 0.0 V, I_{OUT} = 0.0 mA	1,2,3	All		4.0	mA
	$-I_{CC}$	V_{OUT} = 0.0 V, I_{OUT} = 0.0 mA	1,2,3	All		-4.0	mA
Offset voltage adjustment	$+V_{IO}$ (adj)	2/	1,2,3	All	V_{IO} -1.0		mV
	$-V_{IO}$ (adj)	2/	1,2,3	All	V_{IO} +1.0		mV

See footnotes at end of table.

TABLE I. Electrical performance characteristics - Continued.

Test	Symbol	Conditions 1/ $-55°C \le T_A \le +125°C$ unless otherwise specified	Group A subgroups	Device type	Limits Min	Limits Max	Unit
Slew rate	+SR	V_{OUT} = -3.0 V to 3.0 V, R_L = 2.0 kΩ	7	01	7.0		V/µs
			8 4/		7.0		
		V_{OUT} = -4.0 V to 4.0 V, R_L = 2.0 kΩ	7	02	14		V/µs
			8 4/		14		
			7	03	28		V/µs
			8 4/		28		
	-SR	V_{OUT} = 3.0 V to -3.0 V, R_L = 2.0 kΩ	7	01	7.0		V/µs
			8 4/		7.0		
		V_{OUT} = 4.0 V to -4.0 V, R_L = 2.0 kΩ	7	02	14		V/µs
			8 4/		14		
			7	03	28		V/µs
			8 4/		28		
Rise time 3/	t_r	V_{OUT} = 0.0 mV to 200 mV, R_L = 2.0 kΩ, T_A = +25°C	7	01		150	ns
				02		100	ns
				03		50	ns
Fall time 3/	t_f	V_{OUT} = 0.0 mV to -200 mV, R_L = 2.0 kΩ, T_A = +25°C	7	01		150	ns
				02		100	ns
				03		50	ns
Overshoot	+OS	V_{OUT} = 0.0 mV to 200 mV, R_L = 2.0 kΩ, T_A = +25°C	7	All		40	%
	-OS	V_{OUT} = 0.0 mV to -200 mV, R_L = 2.0 kΩ, T_A = +25°C	7	All		40	%
Average offset voltage drift 4/	$\frac{\Delta V_{IO}}{\Delta T}$	V_{CM} = 0.0 V	1,2,3	All		1.9	µV/°C

See footnotes at end of table.

TABLE I. Electrical performance characteristics - Continued.

Test	Symbol	Conditions 1/ $-55°C \le T_A \le +125°C$ unless otherwise specified		Group A subgroups	Device type	Limits Min	Limits Max	Unit
Differential input resistance 4/	R_{IN}	V_{CM} = 0.0 V, R_L = 2.0 kΩ, T_A = +25°C		4	All	0.8		MΩ
Low frequency peak-to-peak noise 4/	E_{np-p}	0.1 Hz to 10 Hz, R_L = 2.0 kΩ, T_A = +25°C		4	All		0.25	μVp-p
Input noise voltage density 4/	E_n	R_S = 20Ω, R_L = 2.0 kΩ, T_A = +25°C	f_o = 10 Hz	4	All		8.0	5/
			f_o = 1.0 kHz	4	All		6.5	5/
Input noise current density 4/	I_n	R_S = 2.0 MΩ, R_L = 2.0 kΩ, T_A = +25°C	f_o = 10 Hz	4	All		5.0	6/
			f_o = 1.0 kHz	4	All		0.8	6/
Unity gain bandwidth 4/	UGBW	V_O = 100 mV, R_L = 2.0 kΩ, T_A = +25°C		4	01	5.0		MHz
Gain bandwidth product 4/	GBWP	V_O = 100 mV, R_L = 2.0 kΩ, T_A = +25°C	f_o = 50 kHz	4	02	60		MHz
				4	03	120		MHz
			f_o = 1.0 MHz	4	02	45		MHz
				4	03	100		MHz

See footnotes at end of table.

TABLE I. Electrical performance characteristics - Continued.

Test	Symbol	Conditions 1/ $-55°C \le T_A \le +125°C$ unless otherwise specified	Group A subgroups	Device type	Limits Min	Limits Max	Unit
Full power bandwidth 4/ 7/	FPBW	V_{PK} = 10 V, R_L = 2.0 kΩ, T_A = +25°C	4	01	111		kHz
				02	220		kHz
				03	445		kHz
Settling time 4/	t_s	To 0.1% for a 10 V step, R_L = 2.0 kΩ, T_A = +25°C	9	01		2.0	µs
				02		1.5	µs
				03		600	µs
Output resistance 4/	R_{OUT}	Open loop, T_A = +25°C	4	All		100	Ω
Quiescent power consumption 8/	P_C	V_{OUT} = 0.0 V, I_{OUT} = 0.0 mA	1,2,3	All		120	mW

1/ +V = 15 V, -V = -15 V, R_S = 50Ω, R_L = 100 kΩ, C_L = 50 pF, and V_{OUT} = 0.0 V unless otherwise specified.

2/ Offset adjustment range is V_{IO} (measured) ±1.0 mV minimum referred to output. This test is for functionality only to assure adjustment through 0.0 V.

3 Measured between 10 percent and 90 percent points.

4/ If not tested, shall be guaranteed to the limits specified in table I.

5/ nV per the square root of the frequency expressed in Hz.

6/ pA per the square root of the frequency expressed in Hz.

7/ Full power bandwidth = $\frac{SR}{2\pi V_{PK}}$.

8/ Quiescent power consumption based on quiescent supply current test maximum (no load outputs).

Device types	All	
Case outlines	P and G	2
Terminal number	Terminal symbol	
1	BAL	NC
2	-IN	BAL
3	+IN	NC
4	-V	NC
5	NC	-IN
6	OUT	NC
7	+V	+IN
8	BAL	NC
9	---	NC
10	---	-V
11	---	NC
12	---	NC
13	---	NC
14	---	NC
15	---	OUT
16	---	NC
17	---	+V
18	---	NC
19	---	NC
20	---	BAL

FIGURE 1. Terminal connections.

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-ECS 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-ECS 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 section 4 of MIL-M-38510 to the extent specified in 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 using the circuit submitted with the certificate of compliance (see 3.6 herein).

(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 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 using the circuit submitted with the certificate of compliance (see 3.6 herein).

(2) T_A = +125°C, minimum.

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

TABLE II. Electrical test requirements.

MIL-STD-883 test requirements	Subgroups (per method 5005, table I)
Interim electrical parameters (method 5004)	
Final electrical test parameters (method 5004)	1*,2,3,4,5,6,7
Group A test requirements (method 5005)	1,2,3,4,5,6,7, 8**,9**
Groups C and D end-point electrical parameters (method 5005)	1

* PDA applies to subgroup 1.
** Subgroups 8 and 9 are guaranteed, if not tested, to the limits specified in table I.

5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-M-38510.

6. NOTES

6.1 Intended use. Microcircuits conforming to this drawing are intended for use when military specifications do not exist and qualified military devices that will perform the required function are not available for OEM application. When a military specification exists and the product covered by this drawing has been qualified for listing on QPL-38510, the device specified herein will be inactivated and will not be used for new design. The QPL-38510 product shall be the preferred item for all applications.

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-481 using DD Form 1693, Engineering Change Proposal (Short Form).

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-ECS, telephone (513) 296-6022.

6.5 Comments. Comments on this drawing should be directed to DESC-ECS, Dayton, Ohio 45444, or telephone 513-296-5375.

6.6 Approved sources of supply. Approved sources of supply are listed in MIL-BUL-103. The vendors listed 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-ECS.