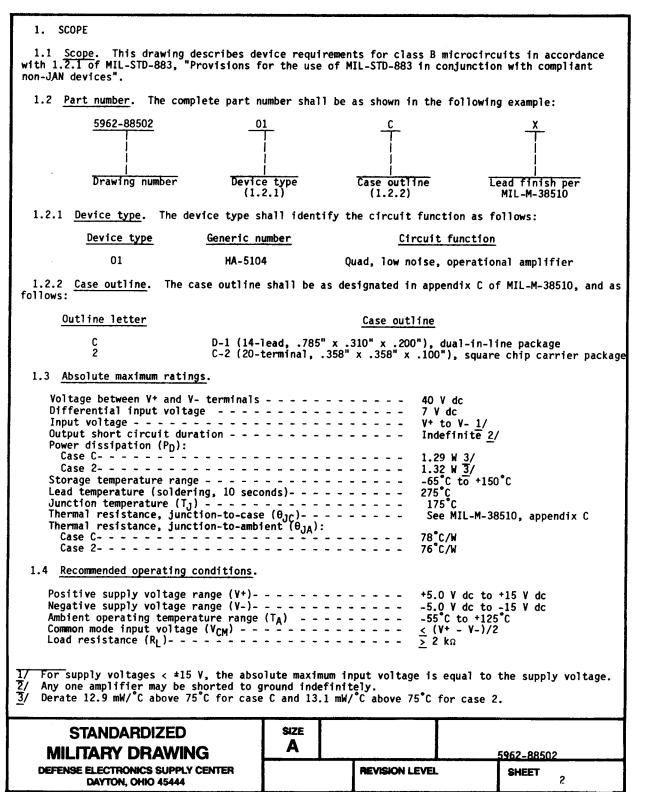| REVISIONS			
LTR	DESCRIPTION	DATE (YR-MO-DA)	APPROVED

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

PMIC N/A	PREPARED BY	DEFENSE ELECTRONICS SUPPLY CENTER DAYTON, OHIO 45444

STANDARDIZED MILITARY DRAWING

CHECKED BY

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

AMSC N/A

DRAWING APPROVAL DATE
12 MAY 1989

REVISION LEVEL

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

SIZE	CAGE CODE	
A	67268	5962-88502

SHEET	1	OF	10

DESC FORM 193
SEP 87

1. SCOPE

1.1 <u>Scope</u>. 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 <u>Part number</u>. The complete part number shall be as shown in the following example:

```
5962-88502              01              C              X
    |                    |              |              |
    |                    |              |              |
    |                    |              |              |
Drawing number       Device type    Case outline   Lead finish per
                      (1.2.1)        (1.2.2)        MIL-M-38510
```

1.2.1 <u>Device type</u>. The device type shall identify the circuit function as follows:

Device type	Generic number	Circuit function
01	HA-5104	Quad, low noise, operational amplifier

1.2.2 <u>Case outline</u>. The case outline shall be as designated in appendix C of MIL-M-38510, and as follows:

Outline letter	Case outline
C	D-1 (14-lead, .785" x .310" x .200"), dual-in-line package
2	C-2 (20-terminal, .358" x .358" x .100"), square chip carrier package

1.3 <u>Absolute maximum ratings</u>.

```
Voltage between V+ and V- terminals - - - - - - - - - - - - -    40 V dc
Differential input voltage  - - - - - - - - - - - - - - - -     7 V dc
Input voltage - - - - - - - - - - - - - - - - - - - - - - - -   V+ to V- 1/
Output short circuit duration - - - - - - - - - - - - - - - -   Indefinite 2/
Power dissipation (PD):
   Case C- - - - - - - - - - - - - - - - - - - - - - - - - - - 1.29 W 3/
   Case 2- - - - - - - - - - - - - - - - - - - - - - - - - - - 1.32 W 3/
Storage temperature range - - - - - - - - - - - - - - - - - -  -65°C to +150°C
Lead temperature (soldering, 10 seconds)- - - - - - - - - - -  275°C
Junction temperature (TJ) - - - - - - - - - - - - - - - - - -   175°C
Thermal resistance, junction-to-case (θJC)- - - - - - - - -    See MIL-M-38510, appendix C
Thermal resistance, junction-to-ambient (θJA):
   Case C- - - - - - - - - - - - - - - - - - - - - - - - - - - 78°C/W
   Case 2- - - - - - - - - - - - - - - - - - - - - - - - - - - 76°C/W
```

1.4 <u>Recommended operating conditions</u>.

```
Positive supply voltage range (V+)- - - - - - - - - - - - -    +5.0 V dc to +15 V dc
Negative supply voltage range (V-)- - - - - - - - - - - - -    -5.0 V dc to -15 V dc
Ambient operating temperature range (TA) - - - - - - - - -     -55°C to +125°C
Common mode input voltage (VCM) - - - - - - - - - - - - - -    ≤ (V+ - V-)/2
Load resistance (RL)- - - - - - - - - - - - - - - - - - - -    ≥ 2 kΩ
```

1/ For supply voltages < ±15 V, the absolute maximum input voltage is equal to the supply voltage.
2/ Any one amplifier may be shorted to ground indefinitely.
3/ Derate 12.9 mW/°C above 75°C for case C and 13.1 mW/°C above 75°C for case 2.

2. APPLICABLE DOCUMENTS

2.1 Government specification and standard. Unless otherwise specified, the following specification and standard, 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 and standard 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 Terminal connections. The terminal connections shall be as specified on figure 1.

3.2.2 Case outline. The case outline shall be in accordance with 1.2.2 herein.

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

3.4 Marking. Marking shall be in accordance with MIL-STD-883 (see 3.1 herein). The part shall be marked with the part number listed in 1.2 herein. In addition, the manufacturer's part number may also be marked as listed in 6.4 herein.

3.5 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 6.4. The certificate of compliance submitted to DESC-ECS prior to listing as an approved source of supply shall state that the manufacturer's product meets the requirements of MIL-STD-883 (see 3.1 herein) and the requirements herein.

3.6 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.

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

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Test	Symbol	Conditions $-55°C \leq T_A \leq +125°C$ 1/ unless otherwise specified	Group A subgroups	Limits		Unit
				Min	Max	
Input offset voltage	V_{IO}	$V_{CM} = 0$ V	1		±2.5	mV
			2, 3		±3.0	
Input offset current	I_{IO}	$V_{CM} = 0$ V, $R_S^+ = 10$ kΩ, $R_S^- = 10$ kΩ	1		±75	nA
			2, 3		±125	
Input bias current	I_{IB}^+	$V_{CM} = 0$ V, $R_S^+ = 10$ kΩ, $R_S^- = 100$ Ω	1		±200	nA
			2, 3		±325	
	I_{IB}^-	$V_{CM} = 0$ V, $R_S^+ = 100$ Ω, $R_S^- = 10$ kΩ	1		±200	
			2, 3		±325	
Common mode voltage range	CMR^+	$V^+ = 3$ V, $V^- = -27$ V	1, 2, 3	+12		V
	CMR^-	$V^+ = 27$ V, $V^- = -3$ V		-12		
Common mode rejection ratio	$CMRR^+$	$\Delta V_{CM} = +5$ V, $V^+ = +10$ V, $V^- = -20$ V, $V_{OUT} = -5$ V	1, 2, 3	86		dB
	$CMRR^-$	$\Delta V_{CM} = -5$ V, $V^+ = +20$ V, $V^- = -10$ V, $V_{OUT} = +5$ V				
Output current	I_{OUT}^+	$V_{OUT} = -5$ V	1, 2, 3	+10		mA
	I_{OUT}^-	$V_{OUT} = +5$ V		-10		
Quiescent power supply current	I^+	$V_{OUT} = 0$ V, $I_{OUT} = 0$ mA	1 / 2, 3		6.5 / 7.5	mA
	I^-		1 / 2, 3		-6.5 / -7.5	
Power supply rejection ratio	$PSRR^+$	$V^+ = +10$ V and +20 V, $V^- = -15$ V	1, 2, 3	86		dB
	$PSRR^-$	$V^- = -10$ V and -20 V, $V^+ = +15$ V				

See footnotes at end of table.

Test	Symbol	Conditions $-55°C \leq T_A \leq +125°C$ 1/ unless otherwise specified	Group A subgroups	Limits		Unit
				Min	Max	
Large signal voltage gain	$A_{VOL}+$	$V_{OUT} = 0$ V and $+10$ V, $R_L = 2$ kΩ	4, 5, 6	100		V/mV
	$A_{VOL}-$	$V_{OUT} = 0$ V and -10 V, $R_L = 2$ kΩ				
Output voltage swing	$V_{OS1}+$	$R_L = 2$ kΩ	4, 5, 6	+10		V
	$V_{OS1}-$			-10		
	$V_{OS2}+$	$R_L = 10$ kΩ		+12		
	$V_{OS2}-$			-12		
Overshoot	+OS	$V_{OUT} = 0$ V to $+200$ mV 8/	9, 10, 11		35	%
	-OS	$V_{OUT} = 0$ V to -200 mV 8/				
Slew rate	SR+	$V_{OUT} = -3$ V to $+3$ V 8/	7 / 8 2/	1 / .7		V/μs
	SR-	$V_{OUT} = +3$ V to -3 V 8/	7 / 8 2/	1 / .7		V/μs
Rise time 3/	t_r	$V_{OUT} = 0$ V to 200 mV 8/	9 / 10, 11 2/		200 / 250	ns
Fall time 3/	t_f	$V_{OUT} = 0$ V to -200 mV 8/	9 / 10, 11 2/		200 / 250	ns
Differential input 2/ resistance	R_{IN}	$V_{CM} = 0$ V, $T_A = +25°C$	4	250		kΩ
Input noise voltage 2/	E_N	$R_S = 20\Omega$ $T_A = +25°C$ — $f_0 = 1.0$ kHz / $f_0 = 10$ Hz	4		6.0 / 15.0	4/
Input noise current 2/	I_N	$R_S = 2$ MΩ $T_A = +25°C$ — $f_0 = 1.0$ kHz / $f_0 = 10$ Hz	4		3.0 / 15.0	5/

See footnotes at end of table.

TABLE I. Electrical performance characteristics - Continued.

Test	Symbol	Conditions $-55°C \leq T_A \leq +125°C$ 1/ unless otherwise specified	Group A subgroups	Limits		Unit
				Min	Max	
Unity gain bandwidth 2/	UGBW	$V_{OUT} \leq 200$ mV, $T_A = +25°C$ 8/	4	5		MHz
Full power bandwidth 2/ 6/	FPBW	$V_{PEAK} = 10$ V 8/	4	15.9		kHz
			5, 6	11.0		
Closed loop stable gain 2/	CLSG	$R_L = 2.0$ kΩ, $C_L = 50$ pF	4, 5, 6	1.0		V/V
Output resistance 2/	R_{OUT}	$T_A = +25°C$	4		150	Ω
Quiescent power consumption 7/	P_C	$V_{OUT} = 0$ V, $I_{OUT} = 0$ mA	1, 2, 3		225	mW
Channel separation 2/	CS	$R_S = 1$ kΩ, $A_{VCL} = 100$ V/V, $V_{IN} = 100$ mV rms at 10 kHz referred to input, $T_A = +25°C$	4	90		dB

1/ $V+ = +15$ V, $V- = -15$ V, $R_S = 100Ω$, $R_L = 500$ kΩ and $V_{OUT} = 0$ V, unless otherwise specified.

2/ If not tested, shall be guaranteed to the limits specified.

3/ Rise and fall times measured between 10 and 90 percent points.

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

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

6/ Full power bandwidth = $SR/2\pi V_{PEAK}$.

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

8/ $A_{VCL} = 1$ V/V, $R_L = 2$ kΩ, $C_L = 50$ pF and $R_S = 50Ω$.

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Device type	01	
Case outlines	C	2
Terminal Number	Terminal symbol	
1	OUTPUT 1	NC
2	INPUT 1 -	OUTPUT 1
3	INPUT 1 +	INPUT 1 -
4	V+	INPUT 1 +
5	INPUT 2 +	NC
6	INPUT 2 -	V+
7	OUTPUT 2	NC
8	OUTPUT 3	INPUT 2 +
9	INPUT 3 -	INPUT 2 -
10	INPUT 3 +	OUTPUT 2
11	V-	NC
12	INPUT 4 +	OUTPUT 3
13	INPUT 4 -	INPUT 3 -
14	OUTPUT 4	INPUT 3 +
15		NC
16		V-
17		NC
18		INPUT 4 +
19		INPUT 4 -
20		OUTPUT 4

FIGURE 1. Terminal connections.

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3.8 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 3.5 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. Tests shall be as specified in table II herein.

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 3.5 herein).

        (2) $T_A = +125°C$, minimum.

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

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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, 7,9
Group A test requirements (method 5005)	1,2,3,4,5,6,7, 8**,9,10**,11**
Groups C and D end-point electrical parameters (method 5005)	1

*   PDA applies to subgroup 1.
** Subgroups 8, 10 and 11, if not tested, shall be
    guaranteed to the specified limits of table 1.

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

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6.4 Approved source of supply. An approved source of supply is listed herein. Additional sources will be added as they become available. The vendor listed herein has agreed to this drawing and a certificate of compliance (see 3.5 herein) has been submitted to DESC-ECS.

Military drawing part number	Vendor CAGE number	Vendor similar part number 1/
5962-8850201CX	34371	HA1-5104/883
5962-88502012X	34371	HA4-5104/883

1/ Caution. Do not use this number for item acquisition. Items acquired to this number may not satisfy the performance requirements of this drawing.

Vendor CAGE number	Vendor name and address
34371	Harris Semiconductor P.O. Box 883 Melbourne, FL 32901

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