

**MNCLC420A-X-RH REV 2A0**

 Original Creation Date: 05/16/00  
 Last Update Date: 08/02/01  
 Last Major Revision Date: 07/18/01

**HIGH SPEED, VOLTAGE FEEDBACK OPERATIONAL AMPLIFIER:  
 ALSO AVAILABLE GUARANTEED TO 300K RAD(Si) TESTED TO  
 MIL-STD-883, METHOD 1019.5**

**General Description**

The CLC420A is an operational amplifier designed for applications requiring matched inputs and integration or transimpedance amplification. Utilizing voltage feedback architecture, the CLC420A offers a 300MHz bandwidth, a 1100V/us slew rate and a 4mA supply current (power consumption of 40mW,  $\pm 5V$  supplies).

Applications such as differential amplifiers will benefit from 70dB common mode rejection ratio and an input offset current of 0.2uA(typ). With its unity-gain stability, 2pA/SqRtHz current noise(typ), combined with a settling time of 18ns to 0.01% make the CLC420A ideal for D/A converters, pin diode receivers and photo multiplier amplifiers. All applications will find 70dB power supply rejection ratio attractive.

**Industry Part Number**

CLC420A

**Prime Die**

UB1366A

**NS Part Numbers**

 CLC420AE-QML  
 CLC420AJ-QML  
 CLC420AJFQML  
 CLC420AWG-QML  
 CLC420AWGFQML

**Controlling Document**

SEE FEATURES SECTION

**Processing**

MIL-STD-883, Method 5004

**Quality Conformance Inspection**

MIL-STD-883, Method 5005

Subgrp	Description	Temp ( °C)
1	Static tests at	+25
2	Static tests at	+125
3	Static tests at	-55
4	Dynamic tests at	+25
5	Dynamic tests at	+125
6	Dynamic tests at	-55
7	Functional tests at	+25
8A	Functional tests at	+125
8B	Functional tests at	-55
9	Switching tests at	+25
10	Switching tests at	+125
11	Switching tests at	-55

**Features**

- 300MHz small signal bandwidth
- 1100V/us slew rate
- Unity-gain stability
- Low distortion, -60dBc at 20MHz
- 0.01% settling in 18ns
- 0.2uA input offset current
- 2pASqRtHz current noise

CONTROLLING DOCUMENTS:

CLC420AE-QML	5962-9175801M2A
CLC420AJ-QML	5962-9175801MPA
CLC420AJFQML	5962F9175801MPA
CLC420AWG-QML	5962-9175801MXA
CLC420AWGFQML	5962F9175801MXA

**Applications**

- Active filters/integrators
- Differential amplifiers
- Pin diode receivers
- Log amplifiers
- D/A converters
- Photo multiplier amplifiers

**(Absolute Maximum Ratings)**

(Note 1)

Supply Voltage (V±)		±7 Vdc
Output Current (Iout)		70 mA
Common Mode Input Voltage (Vcm)		V±
Differential Input Voltage		10 V
Power Dissipation (Pd)		112 mW
(Note 2)		
Thermal Resistance		
(ThetaJA) Junction to Ambient		
LCC	(Still Air)	100 C/W
	(500 LFPM)	68 C/W
Ceramic DIP	(Still Air)	125 C/W
	(500 LFPM)	72 C/W
Ceramic SOIC	(Still Air)	205 C/W
	(500 LFPM)	125 C/W
(ThetaJC) Junction to Case		
LCC		25 C/W
Ceramic DIP		23 C/W
Ceramic SOIC		24 C/W
Junction Temperature (Tj)		+175 C
Storage Temperature Range		-65 C ≤ Ta ≤ +150 C
Lead Temperature		
(Soldering, 10 seconds)		+300 C
Package Weight		
(Typical)		
Ceramic SOIC		220 mg
Ceramic DIP		1075 mg
LCC		470 mg
ESD Tolerance		
(Note 3)		
ESD Rating		2000V

Note 1: Absolute Maximum Ratings are limits beyond which damage to the device may occur. Operating Ratings are conditions for which the device is functional, but do not guarantee specific performance limits. For guaranteed specifications and test conditions see the Electrical Characteristics. The guaranteed specifications apply only for the test conditions listed. Some performance characteristics may degrade when the device is not operated under the listed test conditions.

Note 2: The maximum power dissipation must be derated at elevated temperatures and is dictated by Tjmax (maximum junction temperature), ThetaJA (package junction to ambient thermal resistance), and TA (ambient temperature). The maximum allowable power dissipation at any temperature is Pdmax = (Tjmax - TA)/ThetaJA or the number given in the Absolute Maximum Ratings, whichever is lower.

Note 3: Human body model, 100pF discharged through 1.5K Ohms.

### **Recommended Operating Conditions**

Supply Voltage ( $V_{\pm}$ )	$\pm 5$ Vdc
Gain Range ( $A_v$ )	$\pm 1$ to $\pm 10$
Operating Temperature Range	$-55\text{ C} \leq T_a \leq +125\text{ C}$

## Electrical Characteristics

### DC PARAMETERS: Open Loop Characteristics (SEE NOTE 4)

(The following conditions apply to all the following parameters, unless otherwise specified.)  
 DC:  $V_{\pm} = \pm 5$  Vdc,  $A_v = +1$ , Load Resistance  $R_l = 100$  Ohms, tested parameters use  $R_s = 500$  Ohms, otherwise, feedback resistance ( $R_f$ ) = 0 Ohms. Temp. Range:  $-55\text{ C} \leq T_A \leq +125\text{ C}$ . (Note 3)

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
+Iin	Input Bias Current (NonInverting)		4		-10	+10	uA	1, 2
			4		-20	+20	uA	3
-Iin	Input Bias Current (Inverting)		4		-10	+10	uA	1, 2
			4		-20	+20	uA	3
Vio	Input Offset Voltage		4		-2.0	+2.0	mV	1
			4		-3.5	+3.5	mV	2
			4		-3.2	+3.2	mV	3
Tc (+Iin)	Average +Input Bias Current Drift		1, 4			60	nA/C	2
			1, 4			120	nA/C	3
Tc (-Iin)	Average -Input Bias Current Drift		1, 4			60	nA/C	2
			1, 4			120	nA/C	3
Tc (Vio)	Average Input Offset Voltage Drift		1, 4			15	uV/C	2, 3
Iio	Input Offset Current		4		-1.0	1.0	uA	1
			4		-2.0	2.0	uA	2
			4		-3.0	3.0	uA	3
Tc (Iio)	Average Input Offset Current Drift		1, 4			10	nA/C	2
			1, 4			20	nA/C	3
Aol	Open Loop Gain		4		56		dB	1, 2
			4		52		dB	3
Icc	Quiescent Supply Current (No Load)		4			5.0	mA	1, 2, 3
PSRR	Power Supply Rejection Ratio	$V_+ = +4.5\text{V to }+5.0\text{V}$ , $V_- = -4.5\text{V to }-5.0\text{V}$	4		60		dB	1, 2
			4		55		dB	3
CMRR	Common Mode Rejection Ratio	$V_{cm} = \pm 1\text{V}$	4		65		dB	1, 2
			4		60		dB	3
Rind	Differential Mode Input Resistance		1, 4		1		MOhm	4, 5
			1, 4		0.5		MOhm	6
Cind	Differential Mode Input Capacitance		1, 4			2	pF	4, 5, 6

## Electrical Characteristics

### DC PARAMETERS: Open Loop Characteristics (SEE NOTE 4) (Continued)

(The following conditions apply to all the following parameters, unless otherwise specified.)

DC:  $V_{\pm} = \pm 5$  Vdc,  $A_v = +1$ , Load Resistance  $R_l = 100$  Ohms, tested parameters use  $R_s = 500$  Ohms, otherwise, feedback resistance ( $R_f$ ) = 0 Ohms. Temp. Range:  $-55$  C  $\leq$   $T_A \leq$   $+125$  C. (Note 3)

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
Rinc	Common Mode Input Resistance		1, 4		0.5		MOhm	4, 5
			1, 4		0.25		MOhm	6
Cinc	Common Mode Input Capacitance		1, 4			2	pF	4, 5, 6
+Vcm	Common Mode Input Voltage		1, 4		+2.8		V	4, 5
			1, 4		+2.5		V	6
-Vcm	Common Mode Input Voltage		1, 4			-2.8	V	4, 5
			1, 4			-2.5	V	6
+Iout	Output Current		1, 4		+50		mA	4, 5
			1, 4		+30		mA	6
-Iout	Output Current		1, 4			-50	mA	4, 5
			1, 4			-30	mA	6
Rout	Output Impedance	At dc	1, 4			0.2	Ohm	4, 5
			1, 4			0.3	Ohm	6
+Vo	Output Voltage Swing	No Load	4		+3		V	1, 2
			4		+2.8		V	3
		R <sub>l</sub> = 100 Ohms	4		+2.5		V	1, 2, 3
-Vo	Output Voltage Swing	No Load	4			-3	V	1, 2
			4			-2.8	V	3
		R <sub>l</sub> = 100 Ohms	4			-2.5	V	1, 2
			4			-2.2	V	3

## Electrical Characteristics

### AC PARAMETERS: Frequency Domain Response (SEE NOTE 4)

(The following conditions apply to all the following parameters, unless otherwise specified.)  
 AC:  $V_{\pm} = \pm 5$  Vdc,  $A_v = +1$ , Load Resistance  $R_l = 100$  Ohms, tested parameters use  $R_s = 500$  Ohms, otherwise, feedback resistance ( $R_f$ ) = 0 Ohms. Temp. Range:  $-55$  C  $\leq T_A \leq +125$  C. (Note 3)

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
GFPL	Gain Flatness Peaking Low	At 0.1 MHz to 100 MHz, $V_{out} < 0.4$ Vpp	4			1.4	dB	4
			4			1.6	dB	5
			4			1.4	dB	6
GFPH	Gain Flatness Peaking High	At 100 MHz, $V_{out} < 0.4$ Vpp	4			3.0	dB	4
			4			3.0	dB	5
			4			5.0	dB	6
GFR	Gain Flatness Rolloff	At 0.1 MHz to 100 MHz, $V_{out} < 0.4$ Vpp	4			1.0	dB	4, 6
			4			2.0	dB	5
		At 0.1 MHz to 30 MHz, $A_v = -1$ , $R_f = 500$ Ohms, $V_{out} < 0.4$ Vpp	4			1.4	dB	4
			4			1.6	dB	5
			4			1.4	dB	6
SSBW	Small Signal Bandwidth	-3dB bandwidth, $V_{out} < 0.4$ Vpp	1, 4		200		MHz	4, 6
			1, 4		130		MHz	5
		-3dB bandwidth, $A_v = -1$ , $R_f = 500$ Ohms, $V_{out} < 0.4$ Vpp	4		65		MHz	4
			4		65		MHz	6
			4		45		MHz	5
LSBW	Large Signal Bandwidth	-3dB bandwidth, $V_{out} < 5$ Vpp	1, 4		25		MHz	4
			1, 4		20		MHz	5, 6
		-3dB bandwidth, $A_v = -1$ , $R_f = 500$ Ohms, $V_{out} < 5$ Vpp	1, 4		35		MHz	4
			1, 4		30		MHz	5, 6
Lpd	Linear Phase Deviation	At 0.1 MHz to 100 MHz	1, 4			1.8	Deg.	4, 6
			1, 4			2.5	Deg.	5

## Electrical Characteristics

### AC PARAMETERS: Distortion and Noise (SEE NOTE 4)

(The following conditions apply to all the following parameters, unless otherwise specified.)

AC:  $V_{\pm} = \pm 5$  Vdc,  $A_v = +1$ , Load Resistance  $R_l = 100$  Ohms, tested parameters use  $R_s = 500$  Ohms, otherwise, feedback resistance ( $R_f$ ) = 0 Ohms. Temp. Range:  $-55$  C  $\leq$  TA  $\leq$   $+125$  C. (Note 3)

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
HD2	2nd Harmonic Distortion	2 Vpp at 20 MHz	4			-40	dBc	4
			4			-40	dBc	5, 6
		2 Vpp at 20 MHz, $A_v = -1$	4			-40	dBc	4
			4			-40	dBc	5, 6
HD3	3rd Harmonic Distortion	2 Vpp at 20 MHz	4			-45	dBc	4, 6
			4			-40	dBc	5
		2 Vpp at 20 MHz, $A_v = -1$	4			-40	dBc	4
			4			-35	dBc	5
			4			-40	dBc	6
Vn	Input Referred Noise Voltage	At 1 MHz to 200 MHz	1, 4			5.3	nV/sq rtHz	4, 6
			1, 4			6	nV/sq rtHz	5
Icn	Input Referred Noise Current	At 1 MHz to 200 MHz	1, 4			2.6	pA/sq rtHz	4
			1, 4			2.3	pA/sq rtHz	5
			1, 4			2.9	pA/sq rtHz	6



## Electrical Characteristics

### AC PARAMETERS: Time Domain Response (SEE NOTE 4)

(The following conditions apply to all the following parameters, unless otherwise specified.)

AC:  $V_{\pm} = \pm 5$  Vdc,  $A_v = +1$ , Load Resistance  $R_l = 100$  Ohms, tested parameters use  $R_s = 500$  Ohms, otherwise, feedback resistance ( $R_f$ ) = 0 Ohms. Temp. Range:  $-55\text{ C} \leq T_A \leq +125\text{ C}$ . (Note 3)

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
Trs	Rise and Fall Time	0.4 V step, $C_l < 10\text{pF}$ , measured between 10% and 90% points	1, 4			2	nS	9, 11
			1, 4			3	nS	10
		0.4 V step, $A_v = -1$ , $R_f = 500$ Ohms, $C_l < 10\text{ pF}$ , measured between 10% and 90% points	1, 4			5.5	nS	9, 11
			1, 4			7.8	nS	10
Trl	Rise and Fall Time	5 V step $C_l < 10\text{ pF}$ , measured between 10% and 90% points	1, 4			20	nS	9, 10
			1, 4			25	nS	11
		5 V step, $A_v = -1$ , $R_f = 500$ Ohms, $C_l < 10\text{ pF}$ , measured between 10% and 90% points	1, 4			9.5	nS	9
			1, 4			10	nS	10, 11
Ts	Settling Time	2V step at 0.01% of the final value, $C_l < 10\text{ pF}$	1, 4			25	nS	9, 10, 11
		2V step at 0.1% of the final value, $C_l < 10\text{ pF}$	1, 4			18	nS	9, 10, 11
Os	Overshoot	0.4 V step, $C_l < 10\text{ pF}$	1, 4			25	%	9, 10
			1, 4			35	%	11
+Sr	Slew Rate	Rising edge, Measured $\pm 1$ V with 5 V step, $C_l < 10\text{ pF}$	1, 4		750		V/uS	9
			1, 4		600		V/uS	10, 11
		Rising edge, $A_v = -1$ , Measured $\pm 1$ V with 5 V step, $R_f = 500$ Ohms, $C_l = < 10\text{ pF}$	1, 4		500		V/uS	9
			1, 4		430		V/uS	10, 11
-Sr	Slew Rate	Falling Edge, Measured $\pm 1$ V with 5 V step, $C_l < 10\text{ pF}$	1, 4		750		V/uS	9
			1, 4		600		V/uS	10, 11
		Falling Edge, $A_v = -1$ , Measured $\pm 1$ V with 5 V step, $R_f = 500$ Ohms, $C_l < 10\text{ pF}$	1, 4		500		V/uS	9
			1, 4		430		V/uS	10, 11

Note 1: If not tested, shall be guaranteed to the limits specified.

Note 2: Group A testing only.

Note 3: The algebraic convention, whereby the most negative value is a minimum and the most positive is a maximum, is used in this table. Negative current shall be defined as conventional flow out of a device terminal.

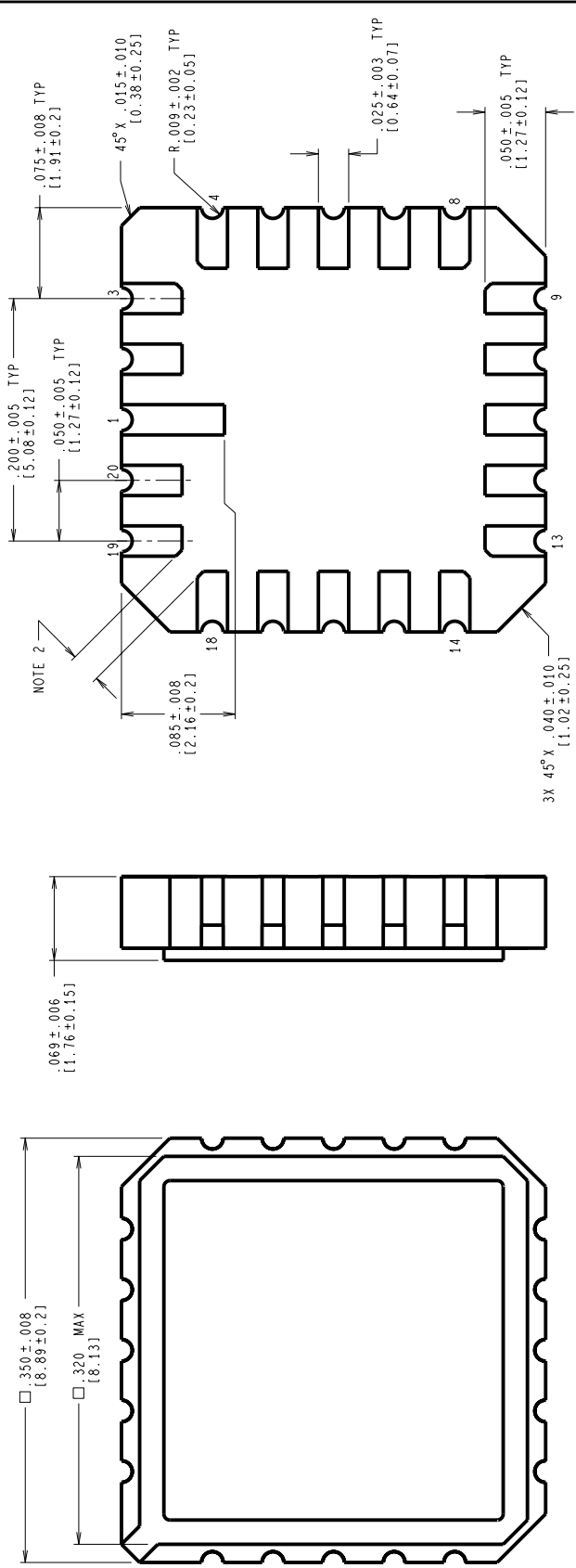
Note 4: Pre and post irradiation limits are identical to those listed under AC and DC electrical characteristics except as listed in the Post Radiation Limits Table. These parts may be dose rate sensitive in a space environment and demonstrate enhanced low dose rate effect. Radiation end point limits for the noted parameters are guaranteed only for the conditions as specified in MIL-STD-883, Method 1019.5

## Graphics and Diagrams

GRAPHICS#	DESCRIPTION
07070HRA2	CERAMIC SOIC (WG), 10 LEAD (B/I CKT)
07081HRA3	CERDIP (J), 8 LEAD (B/I CKT)
07086HRA2	LCC (E), TYPE C, 20 TERMINAL (B/I CKT)
E20ARE	LCC (E), TYPE C, 20 TERMINAL(P/P DWG)
J08ARL	CERDIP (J), 8 LEAD (P/P DWG)
P000376A	CERAMIC SOIC, 10 LEAD (PINOUT)
P000430A	CERDIP (J), 8 LEAD (PINOUT)
P000444A	LCC (E), TYPE C, 20 TERMINAL (PINOUT)
WG10ARC	CERAMIC SOIC (WG), 10 LEAD (P/P DWG)

See attached graphics following this page.

REVISIONS			
LTR	DESCRIPTION	E.C.N.	DATE
E	REVISE AND REDRAW	10005	02/10/94 DEG/

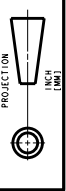


CONTROLLING DIMENSION IS INCH  
VALUES IN [ ] ARE MILLIMETERS

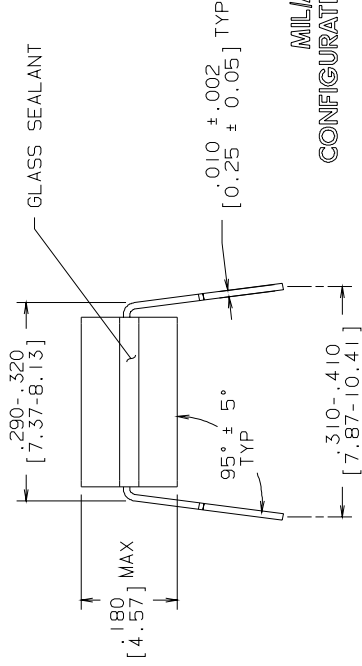
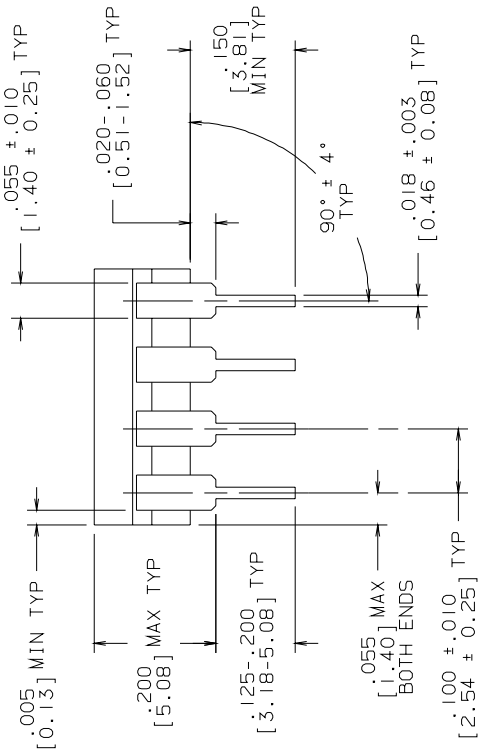
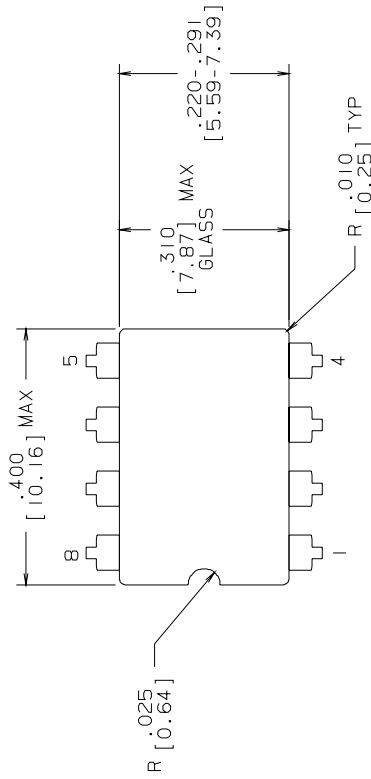
NOTES: UNLESS OTHERWISE SPECIFIED.

- LEAD FINISH TO BE ONE OF THE FOLLOWING:
  - 50 MICRONS/12.7 MICROMETERS MINIMUM GOLD PLATING OVER 50-350 MICRONS/1.27-8.89 MICROMETERS NICKEL.
  - SOLDER DIP. SOLDER THICKNESS PER LATEST REVISION OF MIL-STD-1835.
- CORNER PADS MAY HAVE A  $45^\circ \times 0.20$  IN/0.51mm MAXIMUM CHAMFER TO ACCOMPLISH THE .015 IN/0.38mm DIMENSION.
- REFERENCE JEDEC REGISTRATION MS-004, VARIATION CB, DATED 7/90.

MIL/AERO CONFIGURATION CONTROL	
NATIONAL SEMICONDUCTOR CORPORATION 2300 Semiconductor Drive, Santa Clara, Ca. 95052-8090	
APPROVALS	DATE
DRN: <i>Deane Gedy</i>	02/10/94
DFTG: CHK.	
ENGR: CHK.	
APPROVAL	
LEADLESS CHIP CARRIER, TYPE C, 20 TERMINAL	
SCALE	SIZE
N/A	C
DRAWING NUMBER	
MKT-E20A	
REV	E
DO NOT SCALE DRAWING	
SHEET 1 of 1	



R E V I S I O N S			
LTR	DESCRIPTION	E. C. N.	DATE
L	REVISE PER CURRENT STD; REDRAW	10002	09/21/93
			BY/APP'D TL/



MILAERO  
CONFIGURATION CONTROL  
MIL-M-38510  
CONFIGURATION CONTROL

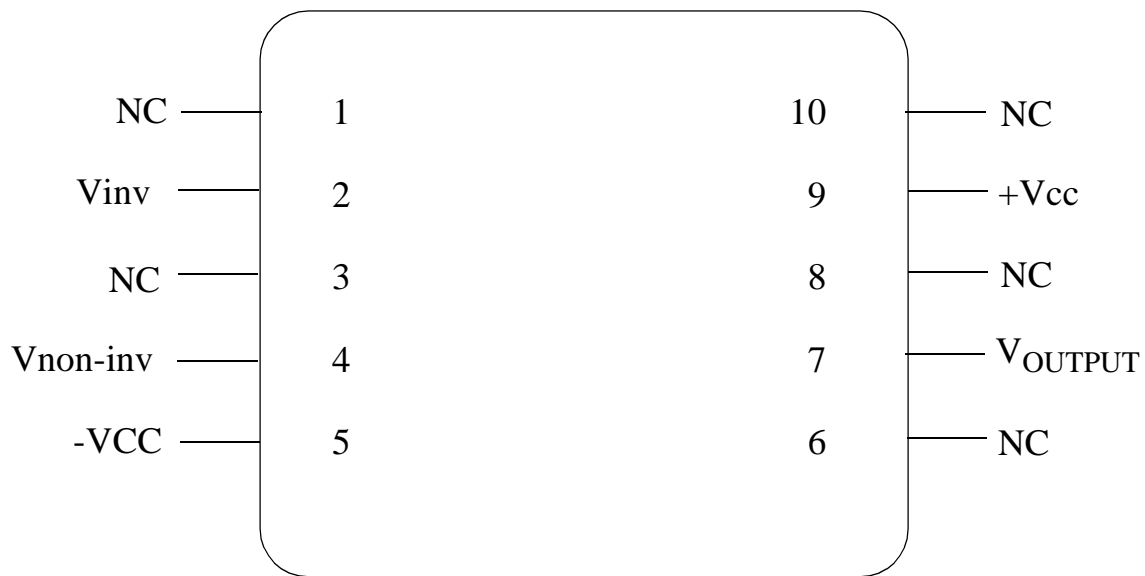
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ENGR. CHK.	
APPROVAL	
 PROJECTION INCH [MM]	
SCALE	DRAWING NUMBER
N/A	B MKT-J08A
DO NOT SCALE DRAWING	SHEET 1 OF 1

NATIONAL SEMICONDUCTOR CORPORATION  
2900 Semiconductor Drive, Santa Clara, CA 95052-8090

CERDIP (J),  
8 LEAD

NOTES: UNLESS OTHERWISE SPECIFIED

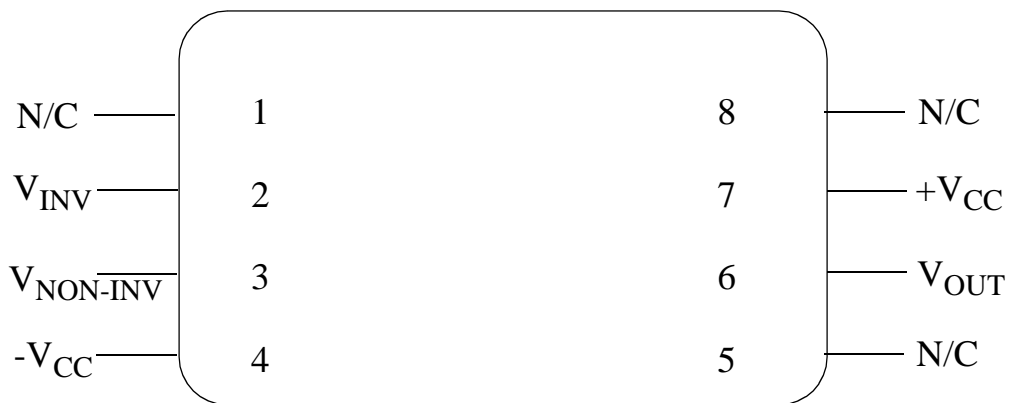
- LEAD FINISH TO BE 200 MICROMETERS / 5.08 MICROMETERS MINIMUM SOLDER MEASURED AT THE CREST OF THE MAJOR FLATS.
- JEDEC REGISTRATION MO-036, VARIATION AA, DATED 04/1981.



CLC420AWG-QML  
10 - LEAD CERAMIC SOIC  
CONNECTION DIAGRAM  
TOP VIEW  
P000376A



National Semiconductor™  
MIL/AEROSPACE OPERATIONS  
2900 SEMICONDUCTOR DRIVE  
SANTA CLARA, CA 95050



CLC420J

8 - LEAD DIP

CONNECTION DIAGRAM

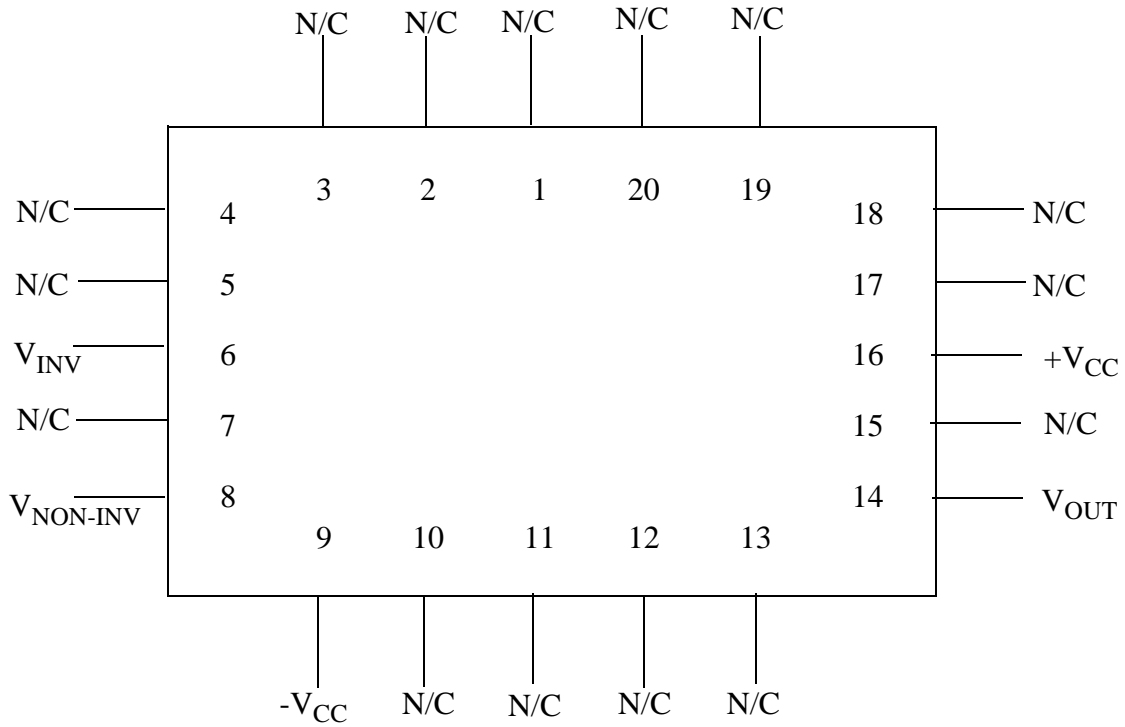
TOP VIEW

P000430A



National Semiconductor™

MIL/AEROSPACE OPERATIONS  
2900 SEMICONDUCTOR DRIVE  
SANTA CLARA, CA 95050



**CLC420E**  
**20 - LEAD LCC**  
**CONNECTION DIAGRAM**  
**TOP VIEW**  
**P000444A**

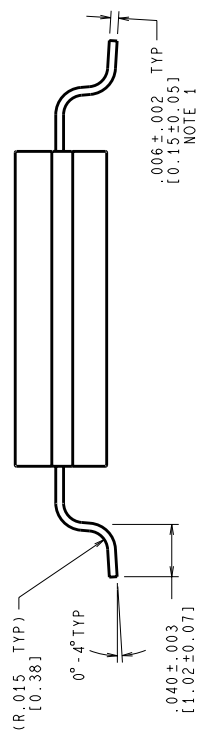
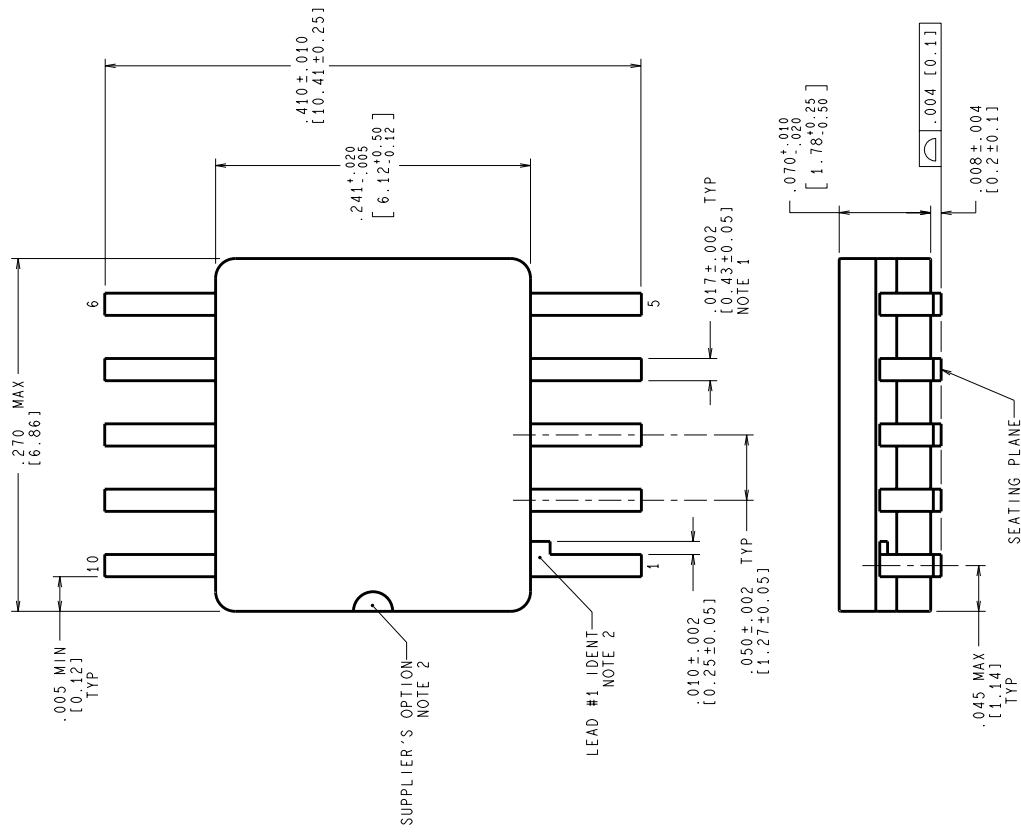


National Semiconductor™

MIL/AEROSPACE OPERATIONS  
 2900 SEMICONDUCTOR DRIVE  
 SANTA CLARA, CA 95050

REVISIONS

LTR	DESCRIPTION	E.C.N.	DATE	BY/APP'D
A	RELEASE TO DOCUMENT CONTROL	11374	02/29/1996	MS/KH
B	LD PITCH TOL WAS ±.005; CHANGE LD RADIUS TO REF DIM; REMOVE THE OTHER R.006±.002 DIM. .040±.003 WAS .037±.003	11441	04/19/1996	MS/KH
C	R .015(0.38) WAS R .006(0.15)	11838	10/08/1997	TL/



CONTROLLING DIMENSION IS INCH  
VALUES IN | ARE MILLIMETERS

MIL-PRF-38535  
CONFIGURATION CONTROL

NOTES: UNLESS OTHERWISE SPECIFIED

- LEAD FINISH: SOLDER DIPPED WITH Sn60 OR Sn63 SOLDER CONFORMING TO MIL-PRF-38535 TO A MINIMUM THICKNESS OF 200 MICRONS/ 5.08 MICROMETERS. SOLDER MAY BE APPLIED OVER LEAD BASIS METAL OR Sn PLATE. MAXIMUM LIMIT MAY BE INCREASED BY .003 IN/ 0.08mm AFTER LEAD FINISH APPLIED.
- LEAD 1 IDENTIFICATION SHALL BE:
  - A NOTCH OR OTHER MARK WITHIN THIS AREA
  - A TAB ON LEAD 1, EITHER SIDE
- NO JEDEC REGISTRATION AS OF FEBRUARY 1996.

APPROVALS	DATE	SCALE	SIZE	DRAWING NUMBER	REV
DRN: MARYA SUCHY	02/29/96	N/A	C	(SC)MKT-WG10A	C
DATE: 02/29/96					
CHK: [Signature]					
CHK: [Signature]					
PROJECTION					
NATIONAL SEMICONDUCTOR 2800 Semiconduc. dr., Santa Clara, CA 95052-8090					
CERPACK, 10 LEAD, GULL WING					
DO NOT SCALE DRAWING					
SHEET 1 of 1					



### Revision History

Rev	ECN #	Rel Date	Originator	Changes
0A0	M0003713	07/11/01	Rose Malone	Initial MDS Release: MNCLC420A-X-RH, Rev. 0A0. Added Rad Hard Devices. and Added Min. limits to Iio test. Changed Subgroup 3 test limit from 2.6uA to 3.0uA to improve test yields. Replaces MDS: MNCLC420A-X, Rev. 0B0
1A0	M0003811	08/02/01	Rose Malone	Update MDS: MNCLC420A-X-RH, Rev. 0A0 to MNCLC420A-X-RH, Rev. 1A0. Change to Electrical Section, typo in Vn parameter units change from mV/Hz to nV/sqrtHz
2A0	M0003828	08/02/01	Rose Malone	Update MDS: MNCLC420A-X-RH, Rev. 1A0 to MNCLC420A-X-RH, Rev. 2A0. Electrical Section Icn parameter units column from pA/Hz to pA/sqrtHz.