

**LA24 - LINEAR AMPLIFIER FOR MAGNETIC  
ACTUATORS  
PRODUCT AND WARRANTY INFORMATION**



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**Version : 1.1.1**  
**Date: 13/03/09**

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## **CAUTION: READ BEFORE OPENING**

For safety purposes these instructions must be read before use of this product.

This power amplifier is dedicated to magnetic actuators.

Only qualified personnel should work on or around this equipment and only after becoming thoroughly familiar with all warnings, safety notices, and procedures contained herein.

The successful and safe operation of this equipment is dependent on proper handling, installation and operation.

A "qualified person" is one who is familiar with the installation, construction and operation of the equipment and the hazards involved. In addition, he/she has the following qualifications :

- is trained and authorized to energize, de-energize, clean, and ground equipment in accordance with established practices,
- is trained in the proper care and use of protective equipment in accordance with established safety practices.

## TABLE OF CONTENTS

1.	SYNOPTIC		4
2.	GENERAL DESCRIPTION		6
3.	Main connexions	6	
4.	Operating instruction for the LINEAR power supply, AC/DC converter, (LC24)		7
5.	Operating instruction for the amplifier (la24)	7	
5.1.	General instructions	7	
5.2.	Current control and current limitation	8	
5.3.	Open/closed loop		8
6.	Trouble Shooting		9
7.	Warranty Conditions and exceptions		10
8.	Inspection upon receipt	10	
9.	After-sales service	10	
	ANNEX 1: Selection of main power (on LA24)		11
	ANNEX 2: Effect of the current limitation		12
	ANNEX 3: Understanding the factory verification sheet		14
	ANNEX 4: LA24 TECHNICAL DATA SHEET		15
	ANNEX 5 : Trouble shooting form		17

## 1. SYNOPTIC

The linear electronic LA24 multi-channel consists in a 19 inches casing to the following dimensions:

Rack 42F
: 260 mm
: 310 mm
Height: 160 mm

The rear panel includes the main power connection, the ON/OFF switch and the fuses. The front panel includes the connections with actuators, orders and the switches to close the loop (SERVO) (Cf. Figure 1). The rack can include other boards described in separate documentations.

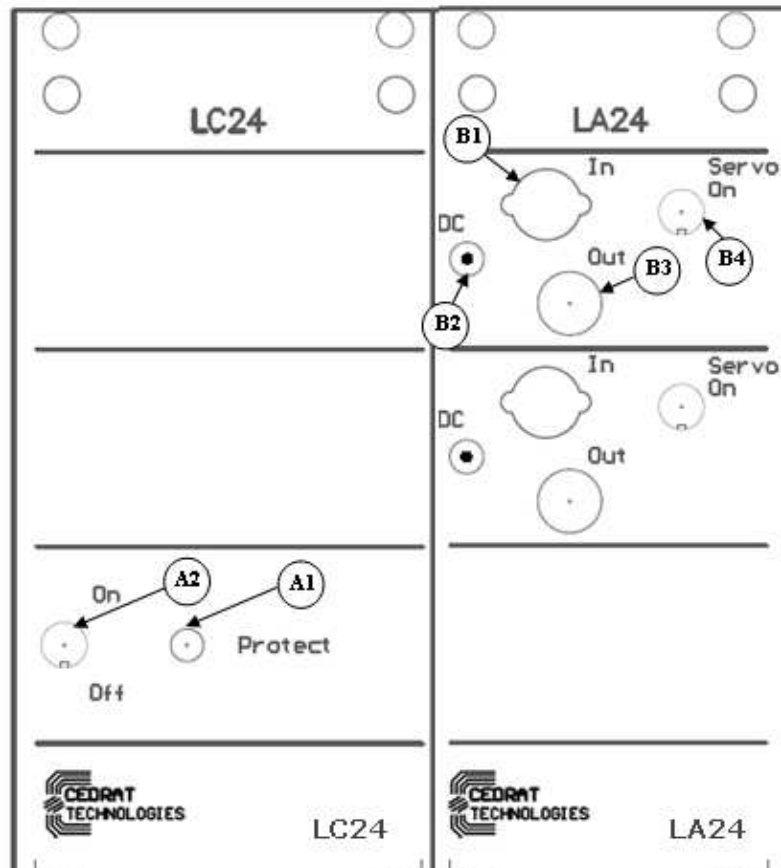


Figure 1 - Front panel of the LA24

REFERENCE	DESIGNATION
<b>1<sup>st</sup> module</b>	Main power supply unit - LC24
A1	Led protect
A2	Vp voltage switch
<b>2<sup>nd</sup> module</b>	Linear amplifier - LA24
B1	Order BNC connector - channel 1
B2	DC offset order potentiometer (10 turn screw)- channel 1
B3	Closed loop selector (SERVO ON / OFF) - channel 1
B4	LEMO connector for magnetic actuator - channel 1

### WARNING

**A special care in the use of the LEMO connections should be taken in plugging and unplugging them: you have to pull onto the connector and not the cable.**

**It is strictly forbidden to connect the electrical output channels in parallel.**

## 2. GENERAL DESCRIPTION

The linear electronic LA24 is dedicated to the supply and control of magnetic actuators from CEDRAT TECHNOLOGIES. The LA24 consists in a power supply with a maximal power given in the attached technical data sheet, including:

- A linear power supply (LC24) providing a continuous voltage from the main power (1<sup>st</sup> module),
- A linear amplifier (LA24) dedicated to capacitive load allowing excitation of piezoelectric actuators between -20 and 150 V (2<sup>nd</sup> module),

## 3. MAIN CONNEXIONS

Main: 230 V AC / 50 Hz
LC24
use 1: 250 V F type 0.5 A fuse 2: 250 V F type
Main: 110 VAC / 60 Hz (on request)
LC24
e 1: 250 V F type 1 A fuse 2: 250 V F type

## 4. OPERATING INSTRUCTION FOR THE LINEAR POWER SUPPLY, AC/DC CONVERTER, (LC24)

This module produces from the mains, the regulated DC voltage to the amplifier functioning needs:

- +15 / -15 V : signal processing,
- +48 / -48 V : direct voltage,
- 5 A: max. Current.

It is possible to neutralise supplied power voltages by using the switch A2. This switch is the easiest way to disable the piezoelectric actuator as soon as required.

This module is protected against over temperature, over voltage and over current conditions.

It is recommended to keep free space all around the electronic rack while driving in order to make the ventilation easier and to obtain the nominal performance of the driving electronics.

## 5. OPERATING INSTRUCTION FOR THE AMPLIFIER (LA24)

### 5.1. GENERAL INSTRUCTIONS

The linear amplifier allows to apply to the actuator a signal comparable to the order's one, with a gain of 150mA/V (see Figure 2).

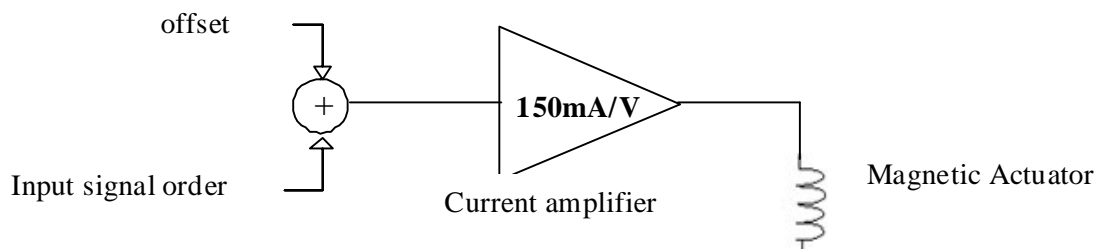


Figure 2 - Principle of linear current amplifier

The actuator is not at the electronics' GND, so it is recommended to use a differential voltage probe to do the measurement.

The order may be applied in two different and complementary manners:

- static offset (potentiometer): B2 screw,
- dynamic order.

These two signals are added and their sum should fall between -1,5A and 1.5A.

To connect the actuator to the current amplifier, the standard cable available is a coaxial LEMO connector EFG.0B.302.HLM in one end and wires in second end.

### **5.2. CURRENT CONTROL AND CURRENT LIMITATION**

If the order signal is below -10 V or above 10 V, a protective diode and the power amplifier saturation will clamp the signal so that the current applied to the actuator stays roughly between -1,5A and 1,5A.

There is some limitation to the constant gain of the amplifier. Indeed, when the variation speed of the input signal (order) increases, the current limitation of the amplifier limits the slew rate of the output voltage. This current limitation varies with the power amplifier (LA24) version (see annex 3).

Note: the use of a digital input signal (B1) may generate parasitic noise so that an additional filter may be necessary.

### **5.3. OPEN/CLOSED LOOP**

By default, the open/closed loop selector should be set on the mode open loop (SERVO OFF); in that mode, the amplifier applies a current gain of 150mA/V to the input.

A displacement sensor, its conditioner and a servo controller will be necessary to use the closed loop (SERVO ON); otherwise the order will be set to zero.



## 6. TROUBLE SHOOTING

**PROBLEMS:** THE PLUGGED MAGNETIC ACTUATOR DOES NOT MOVE WHILE THE REAR CONNECTION AND THE A2 ARE SWITCHED ON

ACTION	POSSIBLE CAUSES
<p>Check the led A1 :</p> <p>a) If A1 is off</p> <ul style="list-style-type: none"> <li>- check the main cable and the fuses at the rear panel</li> </ul> <p>b) If A1 is red</p> <ul style="list-style-type: none"> <li>- check the connection lines to the magnetic actuator / disconnect every LEMO cable. Test the electronics with the unplugged and plugged magnetic actuator, as follows</li> <li>- switch A2 off                             <ul style="list-style-type: none"> <li>If A1 is green                                     <ul style="list-style-type: none"> <li>- switch A2 on</li> </ul> </li> </ul> </li> </ul> <p>if the electronics works,</p> <p>if the electronics doesn't work,</p> <p>If A1 is red</p> <ul style="list-style-type: none"> <li>- Wait for 10 minutes and switch A7 on</li> </ul> <p>if the electronics works,</p> <p>if the electronics doesn't work,</p>	<ul style="list-style-type: none"> <li>- misconnection with main cable or burnt fuses</li> <li>- The electronics is in protection</li> <li>- May be a short circuit through the cable connection or through the magnetic actuator occurred</li> <li>- an external parasitic noise might have disturbed it</li> <li>- a breakdown is certain</li> <li>- The electronics was in thermal protection and needed to cool itself down</li> <li>- a breakdown is certain</li> </ul>

**PROBLEMS:** INCOHERENT RESPONSE FROM THE ACTUATOR IN OPEN LOOP

ACTION	POSSIBLE CAUSES
<p>Check the output signal (B4)</p> <p>If the DC offset is wrong, turn (B2) to settle it*</p>	<ul style="list-style-type: none"> <li>- the DC offset may be wrong</li> </ul>

\* 10 turns potentiometers are used: do not hesitate to rotate the potentiometers and keep attention to the 'clac' noise arising at the end of the trimmer range.

The customer is not entitled to modify the power supply or the linear amplifier. The only manipulations allowed to him are described in the set here above, including the replacement of (the) external fuse(s). For any other matter or breakdown suspicion, we suggest the customer to contact the local vendor.

## **7. WARRANTY CONDITIONS AND EXCEPTIONS**

The equipment is warranted for one year, including parts and labour, and only under standard technical conditions as outlined above and expressly mentioned in the technical data sheet. Repairs will be carried out at CEDRAT TECHNOLOGIES or through your vendor. Shipping, handling and insurance costs to return a part for repair must be paid by the customer.

**Interventions or attempts to service or repair the LA24 by any unauthorised persons will invalidate this warranty.**

## **8. INSPECTION UPON RECEIPT**

This product has been inspected and shown to operate correctly at the time of shipment, as verified by the Factory Verification Form that accompanies the power supply.

Immediately upon receipt of the product, it should be inspected carefully for any signs of damage that may have occurred during shipment. If any damage is found, a claim should be filed with the carrier.

The package should also be inspected for completeness according to the enclosed packing list. If an order is incorrect or incomplete, contact your distributor. CEDRAT TECHNOLOGIES recommends the customer to keep the original package for any further carriage of the electronic product.

## **9. AFTER-SALES SERVICE**

If a device requires service, please contact CEDRAT TECHNOLOGIES or your local vendor. Please include the device model and serial number in all correspondence with CEDRAT TECHNOLOGIES or your vendor.

**ANNEX 1: SELECTION OF MAIN POWER (ON LA24)**



110 V



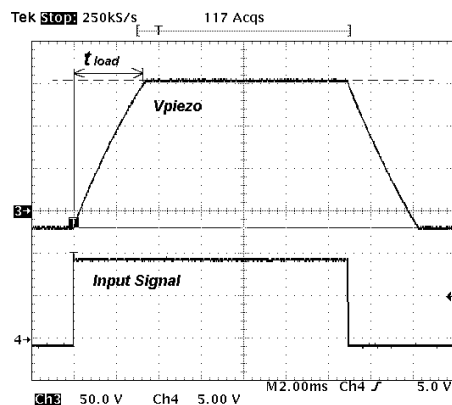
230 V

## ANNEX 2: EFFECT OF THE CURRENT LIMITATION

With a linear amplifier the applied voltage to the actuator is directly proportional to the input signal. The gain of the power amplifier LA24 is set to 150mA/V. So, to obtain the whole stroke of a given actuator, one should input a signal varying from -10V to 10V. The applied current on the actuator will then vary from -1,5A to 1,5A. There is some limitation to the constant gain of the amplifier. Indeed, when the variation speed of the input signal (order) increases, the current limitation of the amplifier limits the slew rate of the output voltage. The current provided to a magnetic actuator is depending on its inductance and on the variation speed of the applied voltage.

<p>The current for a inductive load is given by the following expression:</p> $I_{manetic} = \frac{V_{lim}}{\sqrt{R^2 + (2\pi fL)^2}}$	<p>The max frequency for a triangle signal is given by:</p> $f_{triangle\ max} = \frac{1}{2 \times t_{load}}$
<p>For a given current limitation, the shortest load time is given by:</p> $t_{load} = \frac{L \times I_{lim}}{V_{lim} + R \times \Delta I}$	<p>If we consider a sine signal, then the maximal frequency is given by:</p> $f_{sin\ max} = \frac{\sqrt{\left(\frac{V_{lim}}{I_{lim}}\right)^2 - R^2}}{2\pi \times L}$

Figure A 1 - Current limitation



### Ratings of LA24 on magnetic loads

Considering a scale variation of  $\Delta I = 1,5V$  and taking into account the current limitation of the LA24, the following table summarises the load time and bandwidth values for different magnetic loads:

Inductance (mH)	Resistance ( $\Omega$ )	Time Load ( $\mu s$ )	Triangle max Frequency (Hz)	Sinus max Frequency (Hz)
3	50	26,06	19185	8529
30	50	260,62	1918,5	852,9
300	5	1874	266,85	89,94
300	50	2606,2	191,85	85,29
300	500	895,82	558,15	525,14

## ANNEX 3: UNDERSTANDING THE FACTORY VERIFICATION SHEET

# Linear Amplifier Factory Verification

Stamp and signature

Date of test (DD/MM/YY)

09/02/09

LA24 n° 08-008

Test performed by

CH.1

I

Magnetic actuator  
Impedance

Output current versus sine Input voltage

Electrical conditions:

Load: L=30mH, R=50Ω

Measurement apparatus:

TDS 3014

Current probe:

PR30 100mV/ A

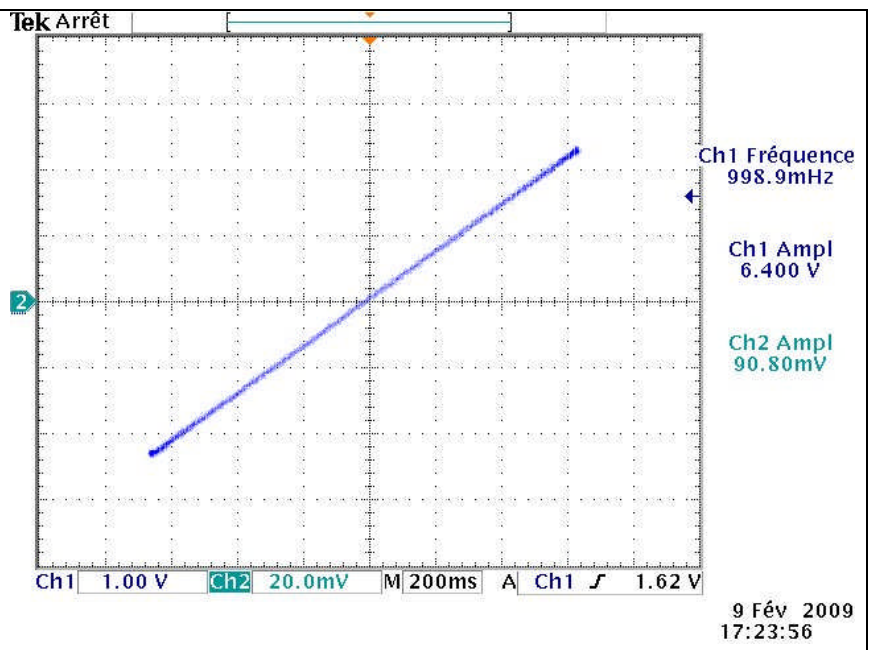
Input frequency : 1 Hz

Oscilloscope:

Ch.1: Input Voltage (Probe x1)

Ch.2: Output Voltage (Probe x1)

Gain LA24: 150mA / V



Test Verification

## ANNEX 4: LA24 TECHNICAL DATA SHEET

### Table of standard properties of use and measurement

The properties defined in the table below, are set up according to the technical conditions of use and measurement. These properties are warranted within their variation range and in compliance with the standard technical conditions of use.

Properties LA24	Standard technical conditions	Unit	Nominal values	Min. values	Max. values
Notes			-		
Function			Linear amplifier		
Max. number of channels			3		
Cooling			Forced air		
Protection			Thermal Short circuit		
Negative supply voltage	Standard environment	V	-68	-64,6	-71,4
Positive supply voltage	Standard environment	V	68	64,6	71,4
Min. input voltage	Standard environment	V	-10	-9,5	-10,5
Max. input voltage	Standard environment	V	10	9,5	10,5
Min. output current	Standard environment	A	-1,5	-1,4	-1,6
Max. output current	Standard environment	A	1,5	1,4	1,6
Min. output voltage	Standard environment	V	48	45,6	50,4
Max. output voltage	Standard environment	V	-48	-45,6	-50,4
Gain	Standard environment	mAV	150	142,5	157,5
Signal to noise ratio	Noise measurement conditions	dB	85	80	100
Unloaded output bandwidth (-3dB)		Hz	Depend on charge		
Input impedance		kOhms	10	9,5	10,0
Output impedance		Ohms	4,7	4,5	4,9
Mass		g	720	-	-
Dimensions		mm	10F wide, 3H high	-	-

➤ Properties standard technical conditions of use and measurement

Quasistatic excitation	: AC current between -1,5A and 1,5A at 1 Hz
Environment	: Ambient temperature (15-25°C) and dry air (Humidity < 50 % rH)
Standard main supply	: Main according to directive HD472; could be adapted to 110 VAC on request
Noise measurement conditions	: Excitation 0.5 Vrms ; reading bandwidth 1 Hz to 1 kHz

Properties LC24	Standard technical conditions	Unit	Nominal values	Min. values	Max. values
Notes			-		
Function			Bipolar AC/DC linear converter		
Cooling			Natural convection		
Protection			Thermal Overcurrent Overvoltage		
Main voltage	Standard main supply	VAC	230	190	250
Main frequency	Standard main supply	Hz	50	45	65
Negative output voltage	Standard environment	VDC	-68	-64,6	-71,4
Positive output voltage	Standard environment	VDC	68	64,6	71,4
Pulse Current limitation	Standard environment	A	5	4,75	5,25
Mass		g	680	-	-
Dimensions		mm	12F wide, 3H high	-	-

Any technical conditions of use, different from those defined above, can lead to temporary or definitive alterations of properties. Thank you to contact CEDRAT TECHNOLOGIES before using actuators under non standard technical conditions.

➤ Factory tests carried out

Test 1: Load and discharge time

Test 2: Linearity output current vs. input voltage

➤ Extra factory tests

Test 3: Gain and linearity in closed loop

Test 4: Step response in closed loop (sensor output voltage versus command voltage)

Test 5: Bode diagram



## **ANNEX 5 : TROUBLE SHOOTING FORM**

In case of trouble or breakdown with the electronic device, this form must be completed by the customer in order to :

- allow Cedrat Technologies to authorise the product return back to the factory,
- help Cedrat Technologies in repairing it.

**Product:** Please give mention here the references and delivery date,

**History:** Please summarise here every action which has been performed with the device since the delivery,

**Problem description:** Please describe here the problems faced with the electronics and which are not described in the paragraph 7,

**Notations:** Please define here the short term used for external devices plugged in the electronics in order to make the writing of "problem identification" easier,

**Problem identification:** Please summarise and describe here, using the "notations", the operation that could lead to problem identification,

**Action:** Please mention and update here every action undertaken by yourself, by Cedrat Technologies or by your local vendor,

***Please note that you need to get the authorisation from CEDRAT TECHNOLOGIES before sending back the hardware.***