

AE TECHRON INC.®

Technical Manual



***LVC608/LVC623 and
LVC2016
Power Supply Amplifiers***

AE TECHRON INC.®

***LVC608/ LVC623/LVC2016
Power Supply Amplifiers***

Technical Manual

© ***AE TECHRON INC.*** 2002

2507 Warren St. Elkhart IN 46516 U.S.A.

Phone: (574) 295-9495

Fax: (574) 295-9496

E-Mail: Sales@aetechron.com

www.aetechron.com

LVC 608 200HF Supplemental Manual

The LVC608 200-HF has been modified to allow much higher frequencies than would normally be available, because of this several changes have been made to the input section.

The LVC 608-200HF differs from the standard LVC-608 in these ways:

- 1) The LVC 608-200HF has a specially optimized high frequency capable input card. This input card differs from the standard LVC 608 input card in the following ways:
 - a. Each channel will accept a balanced (or unbalanced) input on a 1/4-inch phone jack or a balanced three-pin female XLR on the back panel, (these are wired in parallel for each channel).
 - b. It does not have voltage and current monitor outputs.
 - c. It supports only controlled voltage operation, controlled current operation is not available.
- 2) Page 1-5, power chart does not apply.
- 3) Pages 1-10 to 1-13 and 1-15 to 1-16 do not apply to this model.
- 4) Parallel mono operation at high frequency is not recommended.

AE TECHRON INC.®

Limited One-Year Warranty

SUMMARY OF WARRANTY

AE TECHRON INC., of Elkhart, Indiana (Warrantor) warrants to you, the ORIGINAL COMMERCIAL PURCHASER ONLY of each NEW **AE TECHRON INC.** product, for a period of one (1) year from the date of purchase, by the original purchaser (warranty period) that the product is free of defects in materials or workmanship and will meet or exceed all advertised specifications for such a product. This warranty does not extend to any subsequent purchaser or user, and automatically terminates upon your sale or other disposition of our product.

ITEMS EXCLUDED FROM WARRANTY

We are not responsible for product failure caused by misuse, accident or neglect. This warranty does not extend to any product on which the serial number has been defaced, altered, or removed. It does not cover damage to loads or any other products or accessories resulting from **AE TECHRON INC.** product failure. It does not cover defects or damage caused by the use of unauthorized modifications, accessories, parts, or service.

WHAT WE WILL DO

We will remedy, at our sole discretion, any defect in materials or workmanship by repair, replacement, or refund. If a refund is elected, you must make the defective or malfunctioning component available to us free and clear of all liens or other encumbrances. The refund will be equal to the actual purchase price, not including interest, insurance, closing costs, and other finance charges less a reasonable depreciation on the product from the date of original purchase. Warranty work can only be performed at our authorized service centers or at our factory. Expenses in remedying the defect will be borne by **AE TECHRON INC.**, including one-way surface freight shipping costs within the United States. (Purchaser must bear the expense of shipping the product between any foreign country and the port of entry in the United States and all taxes, duties, and other customs fees for such foreign shipments.)

HOW TO OBTAIN WARRANTY SERVICE

When you notify us of your need for warranty service, we will give you an authorization to return the product for service. All components must be shipped in a factory pack or equivalent which, if needed, may be obtained from us for a nominal charge. We will take corrective actions within a reasonable time of the date of receipt of the defective product. If the repairs made by us are not satisfactory, notify us immediately.

DISCLAIMER OF CONSEQUENTIAL AND INCIDENTAL DAMAGES

You are not entitled to recover from us any consequential or incidental damages resulting from any defect in our product. This includes any damage to another product or products resulting from such a defect.

WARRANTY ALTERATIONS

No person has the authority to enlarge, amend, or modify this warranty. The warranty is not extended by the length of time for which you are deprived of the use of this product. Repairs and replacement parts provided under the terms of this warranty shall carry only the unexpired portion of this warranty.

DESIGN CHANGES

We reserve the right to change the design of any product from time to time without notice and with no obligation to make corresponding changes in products previously manufactured.

LEGAL REMEDIES OF PURCHASER

There is no warranty that extends beyond the terms hereof. This written warranty is given in lieu of any oral or implied warranties not contained herein. We disclaim all implied warranties, including, without limitation, any warranties of merchantability or fitness for a particular purpose. No action to enforce this Warranty shall be commenced later than ninety (90) days after expiration of the warranty period.

AE TECHRON INC. Customer Service Department
2507 Warren St. Elkhart, IN, 46516, U.S.A.
(574) 295-9495

Revision Control

Revision

0 (Initial Release)
A

Date

November 2002
May 2004

Page Number

Corrections on 1-5, 1-6, 1-7

Revision Number

A

Contents

Section 1- Pre Installation

1.1 Safety Conventions	1-2
1.2 Product Design.....	1-3
1.2.1 General Description	1-3
1.2.2 Specifications	1-4
1.2.3 Front Panel Functions	1-9
1.2.4 Back Panel Functions	1-10
1.2.5 Plug-in Module.....	1-11
1.2.6 Input Card	1-12
1.3 Ground Loop Removal	1-14
1.4 Constant Current Compensation	1-15

Section 2- Installation

2.1 Unpacking	2-1
2.2 Mounting	2-2
2.3 Cooling	2-3
2.4 Making Connections	2-5
2.4.1 Dual Channel Hookup	2-6
2.4.2 Bridge-Mono Hookup	2-8
2.4.3 Parallel-Mono Hookup	2-10
2.4.4 Connecting Power	2-12

Section 3- Applications

3.1 Introduction.....	3-1
3.2 Amplifier Capability	3-2
3.2.1 Series-Mono Application	3-2
3.2.2 Parallel-Mono Application	3-2
3.3 Plug-in Modules.....	3-3
3.4 AC Power Applications	3-4
3.4.1 AC Power Draw and Thermal Dissipation	3-4

Section 4- Principles of Operation

4.1 Overview	4-1
4.2 Features	4-2
4.3 Front End Operation	4-3
4.3.1. Balanced Gain Stage	4-3
4.3.2 Variable Gain Stage	4-3
4.3.3 Error Amp	4-3
4.4 Voltage Amplification.....	4-4
4.4.1 Voltage Translators	4-4
4.4.2 Last Voltage Amplifiers.....	4-4

Section 5- Service Information

5.1 Qualified Service	5-1
5.1.1 Factory Service	5-1
5.2 Shipping Instructions	5-2

1

Pre- Installation

This section describes safety conventions used within this document and provides essential information about **Models LVC 608, LVC 623 and LVC 2016** amplifiers. Hereafter referred to as the **LVC 608/623/2016 Series** except in specific circumstances. Review this material before installing or operating the amplifier.

AE TECHRON is committed to continuous product improvement. Technical progress may result in minor variations between this manual and a particular unit.

Any significant changes or customizations will be reflected in revisions of this manual. Customers are encouraged to promptly add any additional information, about their particular unit, to this manual.



1.1 Safety Conventions

The LVC 608/623/2016 Series amplifiers are highly sophisticated instruments. Accordingly, this document provides full information on the amplifiers including service procedures. Safety should be your primary concern as you use these products and follow these procedures.

Special hazard alert instructions appear throughout this manual. Note the following examples:



DANGER

DANGER represents the most severe hazard alert. **Extreme bodily harm or death will occur if these guidelines are not followed. Note the explanation of the hazard and instructions for avoiding it.**



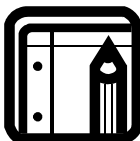
WARNING

WARNING alerts you to hazards which could result in severe injury or death. Note the explanation of the hazard and the instructions for avoiding it.



CAUTION

CAUTION indicates hazards which could result in potential personal injury or equipment or property damage. Once again, note the explanation of the hazard and the instructions for avoiding it.



NOTE: A Note represents information, which needs special emphasis but does not represent a hazard.

1.2. Product Design



1. 2. 1 General Description

The **AE TECHRON LVC 608/623/2016 Series** are dual channel power supply amplifiers designed for use in low and medium power systems. They accomplish this with extremely low harmonic and intermodulation distortion and low noise.

All this power is concentrated into a 3.5-inch rack mount package. From the front panel, you can control and monitor the input signals.

- A push button power switch activates an **AMBER “ON”** indicator.
- **GREEN LED** indicator show when the amplifier is in **OVERLOAD**.

On the back panel:

- Input is connected using bare wires.
- Loads connect to a unique output block, which combines heavy duty binding bolts and dual banana connectors.

Other features include the ability to:

- Switch from Dual Mode to Bridge Mono or Parallel Mono Mode with a 3-position slide switch.
- Select three different gain values for either channel with two more 3-position slide switches located inside the input compartment.

The **LVC 608/623/2016 Series** use the latest technology and miniaturized design to provide the highest power and value for its size, weight and price. Its patented-bridged bridge- circuitry offers many advantages over conventional designs. In Dynamic thermal protection provides years of reliability.

All **AE TECHRON** amplifiers are tested at the factory to assure operation at full efficiency upon delivery. Custom configurations are available, as well as full system implementations.

1.2.2 Specifications

Specifications are for units in Dual Mode driving both channels into 8-ohm loads, (26 dB = 20 times voltage gain) and operating from 120 VAC, unless otherwise specified.

- “Standard 1 kHz Power” refers to maximum average power in watts at 1 kHz with 0.1% THD.
- “Full Bandwidth Power” refers to maximum average power in watts from 20 Hz to 20 kHz with 0.1% THD.

Performance

Frequency Response: ± 0.1 dB from 20 Hz to 20 kHz at 1 watt.

Phase Response: $\pm 10^\circ$ from 10 Hz to 20 kHz at 1 watt.

Signal to Noise Ratio: At 26-dB gain, better than 105 dB (A-weighted) below full output.

Total Harmonic Distortion (THD): $<0.05\%$ from 20 Hz to 1 kHz, increasing linearly to 0.1% at 20 kHz at full output.

I. M. Distortion: $<0.05\%$ from 410 milliwatts to full output at 26-dB gain, with an 8-ohm load.

Slew Rate: >13 V per microsecond.

Load Impedance: Rated for 16, 8, 4, and 2-ohm use. Safe with all load types, even reactive ones.

Required AC Mains: 60 Hz, 120VAC with 15-20A service. Other voltages are available by special order.

LVC 608 Power

Output Power: Measurements taken at 1 kHz at .05% THD with amplifiers operating in controlled voltage mode.

One Channel Driven:

Ohms	40mSec Burst		5 Minute Continuous Sine		1 Hour Continuous Sine	
	Watts	Volts	Watts	Volts	Watts	Volts
4	325	36	306	35	293	34.2
8	225	42.4	225	42.4	210	41
16	129	45.5	129	45.5	129	45.5

Two Channel Bridged (Max. voltage):

Ohms	40mSec Burst		5 Minute Continuous Sine		1 Hour Continuous Sine	
	Watts	Volts	Watts	Volts	Watts	Volts
4	750	54.7	625	50	50	14.2
8	655	72.4	586	68.5	255	45.2
16	450	84.9	402	80.2	402	80.2

Two Channels Paralleled (Max. Current):

Ohms	40mSec Burst		5 Minute Continuous Sine		1 Hour Continuous Sine	
	Watts	Volts	Watts	Volts	Watts	Volts
2	665	36.4	551	33.2	492	31.4
4	450	42.4	396	39.8	396	39.8

LVC 623 Power

Continuous Duty/Low Impedance Single Channel

Ohms	40mSec			5 Minutes			Continuous		
	Watts	Volts	Amps	Watts	Volts	Amps	Watts	Amps	Volts
2	354	27	13	354	26.6	13	354	13	26.59
4	240	31	8	240	31	8	242	8	31.1
8	148	34	4	148	34.4	4	145	4	34
16	89	38	2	89	37.8	2	89	2	37.78

Bridged Mono (Maximum Voltage)

Ohms	40mSec			5 Minutes			Continuous		
	Watts	Volts	Amps	Watts	Volts	Amps	Watts	Amps	Volts
4	0	0	0	583	48.3	12	538	12	46.4
8	0	0	0	431	58.7	7	431	7	58.7
16	0	0	0	289	68	4	290	4	68.1

Parallel Mono (Maximum Current)

Ohms	40mSec			5 Minutes			Continuous		
	Watts	Volts	Amps	Watts	Volts	Amps	Watts	Amps	Volts
1				552	23.5	24	520	23	22.8
2	420	29	14	418	28.9	14	418	14	28.9
4	290	34	9	289	34	9	289	9	34
8	166	36	5	165	36.3	5	165	5	36.3

LVC 2016 Power

Pulse/High Impedance Single Channel

Ohms	40mSec			5 Minutes			Continuous		
	Watts	Volts	Amps	Watts	Volts	Amps	Watts	Amps	Volts
2`	1050								
4	800	57	14	514	45.35	11	87	5	18.7
8	520	64	8	525	64.8	8	525	8	64.8
16	406	81	5	406	80.6	5	406	5	80.6

Bridged Mono (Maximum Voltage)

Ohms	40mSec			5 Minutes			Continuous		
	Watts	Volts	Amps	Watts	Volts	Amps	Watts	Amps	Volts
4	2070	91	23						
8	1585	113	14	1602	113.2	14	114	4	30.2
16	1035	129	8	995	126.2	8	994	8	126.1

Parallel Mono (Maximum Current)

Ohms	40mSec			5 Minutes			Continuous		
	Watts	Volts	Amps	Watts	Volts	Amps	Watts	Amps	Volts
2	1605	57	28	114	15.1	8	114	8	15.1
4	1035	64	16	995	63.1	16	995	16	63.1
8	603	69	9	602	69.4	9	597	9	69.1

Controls

Front Panel: A push “On/Off” power switch; also, a signal level control for each channel.

Back Panel: A 3-position switch selects Dual, Bridge-Mono, or Parallel-Mono Mode.

Internal: A 3-position switch, located inside at the bottom of the input well, selects 20, 70, or 140-voltage gain for each channel.

Indicators

Amber Enable Indicator shows on/off status of low-voltage power supply.

A Green OVERLOAD indicator for each channel flashes dim green to show a signal is present at the input, and flashes brightly in the rare event distortion of any kind exceeds 0.05%, including input overload.

Input/Output

Input Impedance: Greater than 10 K ohms, balanced, and 5 K ohms, unbalanced.

Output Impedance: Less than 10 milliohms in series with less than 2 microhenries.

Connectors

Inputs: Euro-style screw terminals will accept up to 16 gauge bare wire.

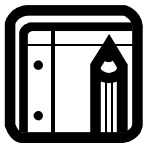
Outputs: Unique output bus with dual banana jacks on 3/4 inch centers, and high current ring or spade lug barrier connectors.

AC Line: Standard plug

Construction

Material: Black splatter-coat steel chassis with specially designed flow-through front to rear ventilation system with computer-controlled forced air-cooling.

Dimensions: 19 inch (48.3 cm) wide, 3.5 inch (8.9 cm) high, 16 inch (40.3 cm) deep behind front mounting surface, and 2.875 inches (7.3 cm) in front of the mounting surface.



NOTE: Allow 3 inches in back for adequate airflow.

Shipping Weight:

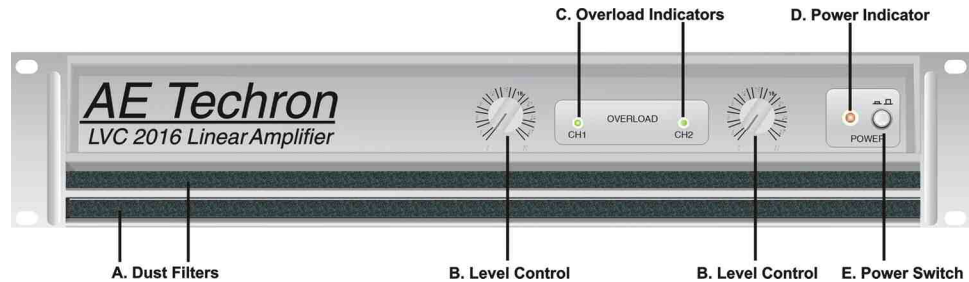
LVC 608 - 39 lbs. (17.9 kg.) net, 55 lbs. (21.6 kg).

LVC 2016/623 – 51 lbs. (23.5 kg.) net, 65 lbs. (29.5 kg.).

Mounting: Standard BIA 310 front-panel rack mount with supports for supplemental rear corner mounting.

1.2.3 Front Panel Functions

The following illustration, with captioned call-outs, provides a visual location of the LVC 608/623/2016 Series front panel functions.



A. Dust Filters

The dust filters remove large particles from the air drawn in by the cooling fans. Check the filters regularly to prevent clogging. The filter elements can be easily removed for cleaning by gently pulling them away from the front panel.

B. Level Control

The output level for each channel is set with these controls. Each control has 31 detents for precise adjustment.

C. Overload Indicators

When a large input signal causes an input overload or output clipping, these green indicators flash *brightly* with a 0.1 second hold, otherwise, they indicate the presence of a distortion-free signal.

D. Power Indicator

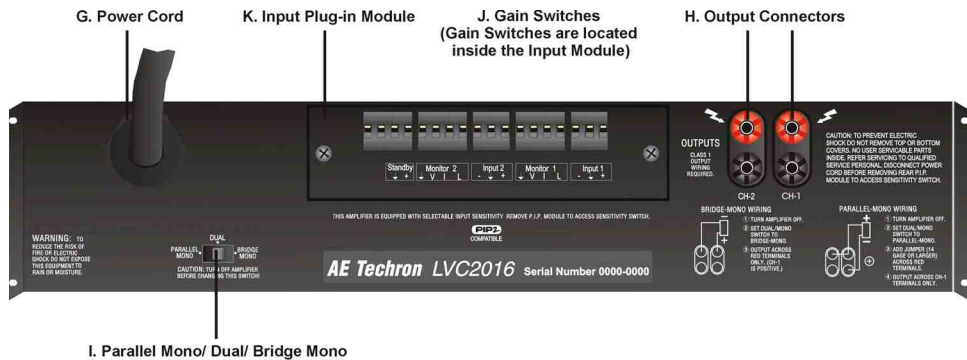
This amber indicator lights when the amplifier is connected to AC power and turned “On”.

E. Power Switch

This push button is used to turn the amplifier “On” and “Off”. When turned on, the output is muted for about four seconds to protect your system from start-up transients.

1.2.4 Back Panel

The following illustration, with captioned call-outs, provides a visual location of the LVC 608/623/2016 Series back panel functions.



G. Power Cord

North American units set up for 120 VAC, 60 Hz power are shipped with a grounded 125 volt, 30 amp NEMA TT30P plug; units shipped outside North America are provided without a plug.


H. Output Connectors

This high-current output block is provided for output connection. Its connectors accept banana plugs, spade lugs or bare wire.

I. Parallel Mono/ Stereo/ Bridge Mono

This switch is used to select one of three- output modes; Parallel Mono, Stereo or Bridge Mono.



 WARNING
The amplifier should be “Off” for at least 10 seconds before changing this switch

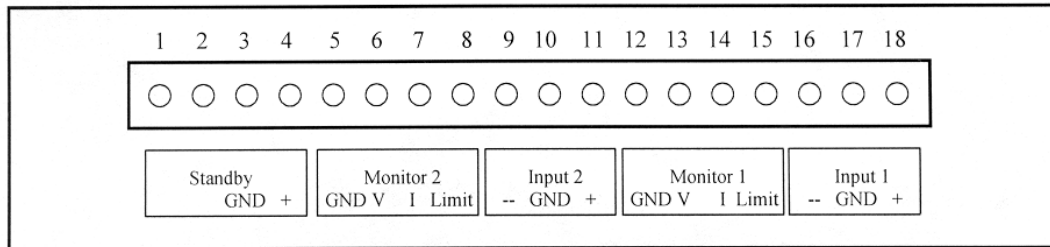
J. Gain Switches

These three-position switches are used to select a voltage gain of 20,70 or 140 gain for each channel.

K. Input Plug-in Module

The versatility of plug-in modules makes it easy to customize the input, and other functions of the amplifier, to your needs.

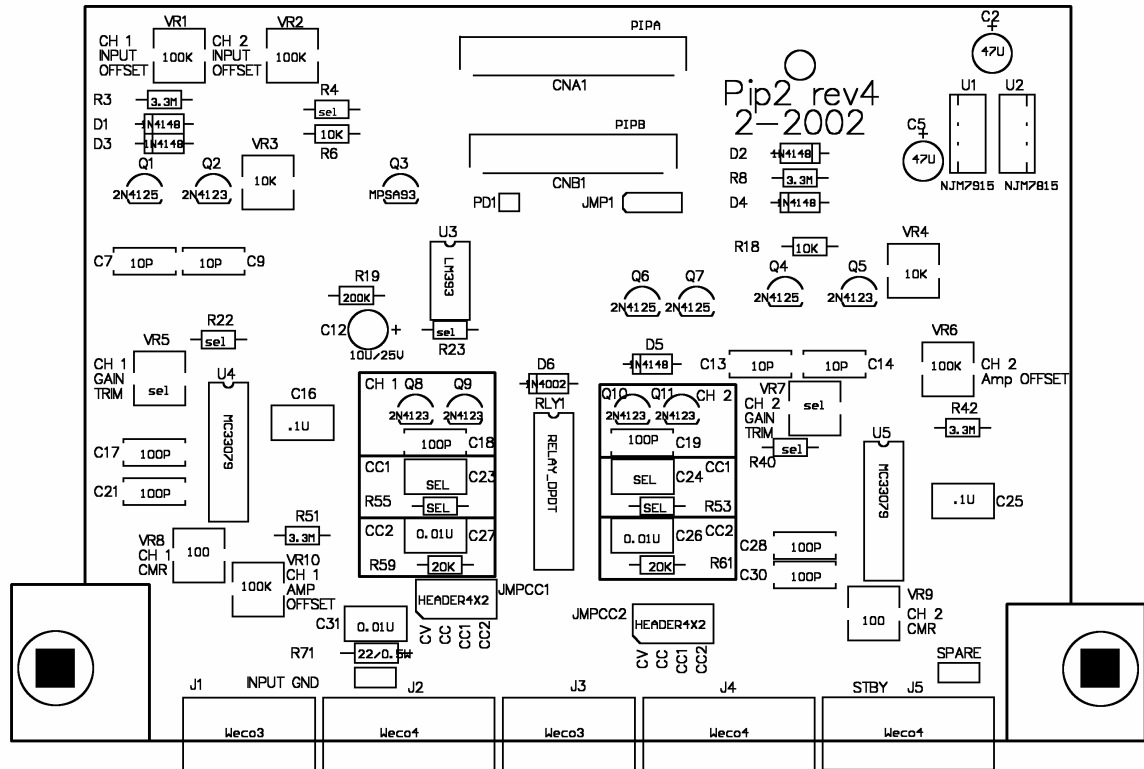
1.2.5 Details of the LVC 608/623/2016 Series Plug-In Module



Pin Function

- 1,2, Available for additional features
- 3,4 Standby, When Pins 3 and 4 are shorted output section of amplifier forced into standby.
- 5 Ground pin for use with pins 6, 7, and 8
- 6 Voltage monitor, will have 1/20th of voltage at output of Channel 2. Pin 6 is inactive when amplifier is used in either mono mode.
- 7 Current monitor, will have 1 volt for every 3 amps of current at output of Channel 2, pin is inactive when amplifier is used in either mono mode.
- 8 When in Constant Current -mode provides a user definable maximum current, when in Constant Voltage mode provides a user definable maximum voltage for Channel 2. Uses control voltages of 0 - +8 VDC. Pin is inactive when amplifier is used in either mono mode.
- 9-11 Balanced input for Channel 2. Pins 9 or 11 can be connected to Pin 10 if an unbalanced input is desired. Pins 9 and 11 are not active when amplifier is used in either mono mode.
- 12 Ground pin for use with pins 13, 14, and 15.
- 13 Voltage monitor, will have 1/20th of voltage at output of Channel 1, when operated in 2 channel or Parallel Mono mode and 1/40th of the voltage when operated in Bridged Mono mode. Pin 13 is active in all modes of operation.
- 14 Current monitor will have 1 volt for every 3 amps of current at output of Channel 1, when operated in 2 channel or Bridge Mono mode. When operated in Parallel Mono mode 1 volt for every 6 amps of output current. Pin 14 is active in all modes of operation.
- 15 When in Constant Current mode provides a user definable maximum current, when in Constant Voltage mode provides a user definable maximum voltage for Channel 1. Uses control voltages of 0 - +8VDC. Pin 15 is active in all modes of operation.
- 16-18 Balanced input for Channel 1. Pins 16 or 18 can be connected to Pin 17 if an unbalanced input is desired. Pins 16 and 18 are active in all modes of operation.

1.2.6 The CCPIP Input Card



Component Side View of the CCPIP Input Card

Channel One Controls

VR8 Adjusts common mode rejection for balanced input on channel 1.

VR1 Adjusts DC offset of Channel 1 of input card (measured at Pin 7 of U4)

VR10 Adjusts DC offset of Channel 1 of amplifier (measured at output of amplifier). Should be adjusted if gain of amplifier is changed.

JMPCC1

CV - Puts Channel 1 in Constant Voltage Mode

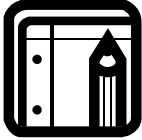
CC - Puts Channel 1 in Constant Current Mode

(CC or CV must be jumped for channel to operate)

CC1 - Constant Current compensation 1 for Channel 1 connects C 23 and R55

CC2 - Constant Current compensation 2 for Channel 1 connects C27 and R59

Input Card Continued...



NOTE: C 18 - In parallel with compensation controls stability when in Constant Current Mode

Channel 2 Controls:

- VR9** Adjusts common mode rejection for balanced input on channel 2
- VR2** Adjusts DC offset of Channel 2 of input card (measured at Pin 7 of U3)
- VR6** Adjusts DC offset of Channel 2 of amplifier (measured at output of amplifier). Should be adjusted if gain of amplifier is changed.

JMPCC2

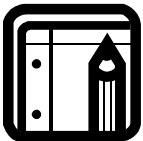
CV - Puts Channel 2 in Constant Voltage Mode

CC - Puts Channel 2 in Constant Current Mode

(CC or CV must be jumped for channel to operate)

CC1 - Constant Current compensation 1 for Channel 2 connects C24 and R53

CC2 - Constant Current compensation 2 for Channel 2 connects C26 and R61



NOTE: C19 - In parallel with compensation controls stability when in Constant Current Mode

1.3 Ground Loop Removal

Hum and noise problems caused by ground loops are one of the most common problems that plague power amplifier systems.

Theoretically, ground loops will never occur if one and only one ground path is allowed between the **LVC 608/623/2016**, the signal source and the load. The input and output grounds of the amplifier should not be externally joined since this external ground path will form a loop with the internal ground path. The output ground is connected to the chassis on the rear connector panel, allowing the chassis mounting to be a possible source of ground loops. If other devices attached to the amplifier inputs and outputs are mounted in an electrically common rack and are likewise internally chassis-ground joined, ground loops may be formed. When this occurs, isolate the most appropriate units from the rack so a loop is not formed.

Another source of ground loop trouble is the third wire of the AC main connector. Only one piece of equipment in a system should connect this terminal to the system's signal ground.

Unintentional feedback of output signals into input signal lines can result in system oscillations, or gain errors.

Input signals should never be supplied to the amplifier via the current carrying output common lead. Supply the input signal to the amplifier via its own independent ground lead, one not connected to the output signal ground.

1.4 Constant Current Compensation

The following is a guideline for compensating amplifiers in the controlled current mode. Constant voltage mode does not require compensation. For this procedure, use C 104 and R109. Jumper JMP is in the CC position.

- a) Calculate the approximate value of the resistor using the following formula:

$$R_c = 20,000 \times 3.14 \times L \times BW$$

- **R_c** is compensation resistance in ohms.
- **L** is load inductance in henries.
- **BW** is bandwidth in hertz.

- b) Calculate the approximate value of the capacitor using the following formula:

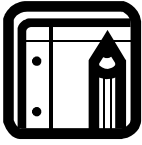
$$C_c = L / (R \times R_c)$$

- **C_c** is compensation capacitance farads.
- **L** is load inductance in henries.
- **R** is resistance of load in ohms.
- **R_c** is compensation resistance in ohms.

- c) Find the optimum values of the resistor and the capacitor by using an RC decade box:

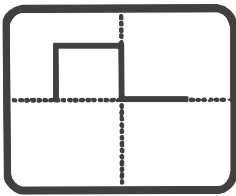
1. Use a short pair of twisted wires to connect the box to the main board.
2. Dial in the calculated values.
3. Connect load to output at "output" and "sampled common" terminals.
4. Input square wave at highest frequency used in application with generator set for minimum amplitude.
5. Connect oscilloscope to current monitor with ground.
6. Enable the amplifier from Standby to Ready and observe oscilloscope.
7. If the system is stable (no oscillations), increase generator amplitude to a workable level and go to step 11.
8. If the system oscillates, switch to Standby and try different compensation values.
9. If the system still oscillates, increase the value of the capacitor by factors of three until stable.
10. After refining further the values of the R and C, find the optimum values of R109 and C104, by adjusting according to the observed oscilloscope waveform illustrated on the facing page.
11. After the optimum values have been found, remove the RC decade box and install components with values shown on the decade box. *Slight adjustment of values may be needed due to use of decade box.*

Controlled Current Compensation Continued...

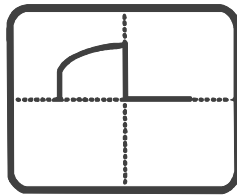


NOTE: In multiple amplifier systems, expect to decrease the value of R109 in series systems (by 1/2 for 2 units), and increase the value (double for 2 units) in parallel systems.

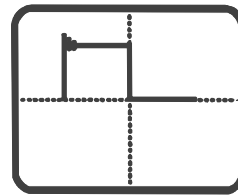
Compensation Waveforms:



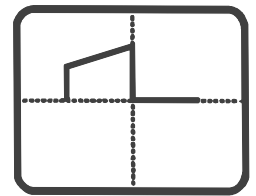
Box 1



Box 2



Box 3



Box 4

From Left to Right:

Box 1: Optimum Compensation

Box 2: Increase R109

Box 3: Decrease R109

Box 4: Increase C104

Installation

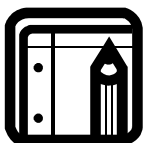
This section describes general guidelines for installing the **Model LVC 608/623/2016 Series Amplifier** with special emphasis on system installations.

2.1 Unpacking

Every **AE TECHRON Model LVC 608/623/2016** is carefully inspected and tested prior to leaving the factory. Carefully unpack and inspect the unit for damage in shipment. Besides the amplifier, you should find this manual and mounting hardware in the package.

- 1) Inspect the crating for **ANY** signs of damage.
 - a.) Make written notes of any damage for future reference.
 - b.) If damage is found notify the transportation company immediately.
 - c.) Save the shipping carton and packing materials as evidence of damage for the shipper's inspection.
 - d.) If severe damage is apparent, **DO NOT** proceed until a representative of the shipping company is present.
- 2) Uncrate/unpack the amplifier.
- 3) Save the packing materials for later use in transporting **OR** shipping the unit.

AE TECHRON will cooperate fully in the case of any shipping damage investigation. In any event, replacement-packing materials are available from **AE TECHRON**.



NOTE: Never ship this unit without proper packaging.


2.2 Mounting

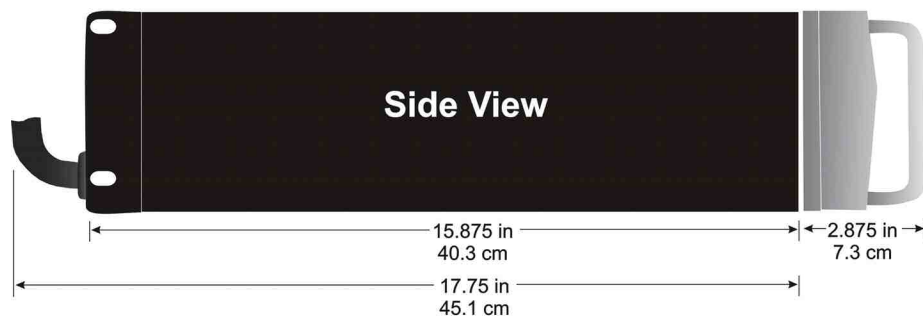
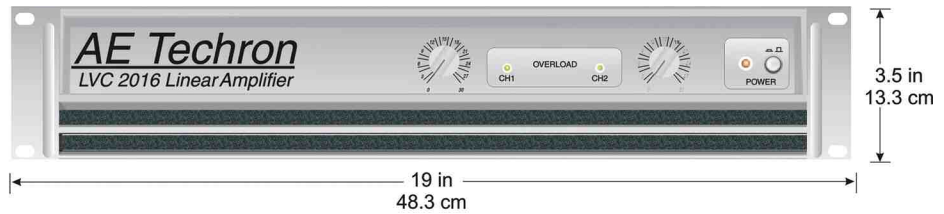
The LVC 608/623/2016 is designed for standard 19-inch (48.3 cm) rack mounting and "stack" mounting without a cabinet. For optimum cooling and rack support, multiple units should be stacked directly on top of each other.



 WARNING
To reduce the risk of <i>ELECTRIC SHOCK</i> or <i>FIRE HAZARD</i> , DO NOT expose the LVC 608/623/2016 to rain or moisture.



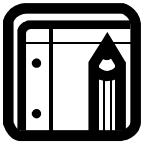
 CAUTION
Always support the back of the unit. Provide extra support if the unit will be transported.



Mounting Dimensions

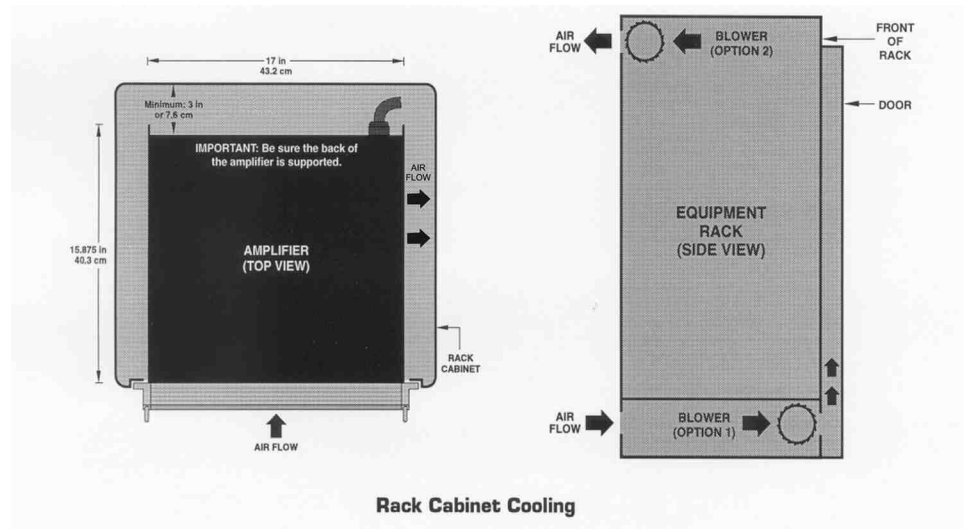
2.3 Cooling

NEVER block the air vents in the front or sides of the amplifier. These amplifiers **DO NOT** need to be mounted with space between them. If you must leave open spaces in a rack for any reason, close them with blank panels or poor airflow will result. Allow for airflow of at least 75 cubic feet (2.1 cubic meters) per minute per unit. Additional airflow may be required when driving low-impedance loads at consistently high output levels.



NOTE: Refer to Section 3 *Applications* for detailed information on thermal dissipation.

When mounting the amplifier in a rack cabinet, the back wall of the rack should be at least 3 inches (7.6 cm) away from the back of the amplifier chassis as shown below.



If your rack has a door that could block airflow to the amplifier's air intakes, you must provide adequate airflow by installing a grille in the door or by pressurizing the air behind the door. Wire grilles are recommended over perforated panels because they tend to cause less air restriction. A good choice for pressurizing the air behind the rack cabinet door is to mount a "squirrel cage" blower inside the rack (Option 1 above).

Cooling Continued...

At the bottom of the rack, mount the blower so it blows outside air into the space between the door and front of the amplifiers, pressurizing the "chimney" behind the door. This blower should not blow air into or take air out of the space behind the amplifiers. For racks without a door, you can evacuate the rack by mounting the blower at the top of the rack so that air inside the cabinet is drawn out the back (Option 2 previous page).

If the air supply is unusually dusty, you might want to pre-filter it using commercial furnace filters to prevent rapid loading of the unit's own air filters. When needed, the unit's filters can be cleaned with mild dish detergent and water. You may want to allow at least two additional inches of depth for cables and connectors extending out from the back.



CAUTION

DO NOT Install the **LVC 608/623/2016** in a small sealed chamber of any kind. Improper operation and overheating will result.

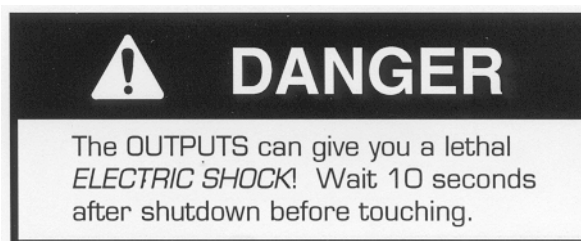
2.4 Making Connections

Before beginning the installation of your amplifier, please check the following:

- ✓ Remove all power from the unit. **Do Not** have the AC cord plugged in.
- ✓ Turn input level control down (fully counter clockwise).

The input and output jacks are located on the back panel. Use care in making connections, selecting signal sources, and matching loads. During hookup take the following precautions:

1. **Use only shielded cable on inputs.** The higher the density of the shield (the outer conductor), the better the cable. Spiral wrapped shield is not recommended.
2. **The output wire and connectors should be heavy enough** to carry the intended current to the load.
3. **Use good quality connectors** with proper strain relief.
 - Do not use connectors that have any tendency to short circuit.
 - Do not use connectors that can be plugged into AC power receptacles.
4. **Keep unbalanced input cables as short as possible.** Avoid lengths greater than 10 feet.
5. **Do not run signal (input) cables together with high level wiring** such as load (output) wires or AC cords (lowers most hum and noise).
6. **Do not short the ground lead of an output cable to the input signal ground.** Oscillations may result.
7. **Operate the amplifier from proper AC current.** Supply voltage must be 50 or 60 Hz (depending on model) and no more than 10% above or below the selected line voltage. Failure to comply with these frequency limits may damage the unit and result in unreliable operation.
8. **Never connect the output to a power supply output, battery, or power main.** These connections will cause serious damage to the amplifier.
9. **Do not permit unqualified personnel to tamper with circuitry.** Do not make unauthorized circuit modifications. Serious damage to the amplifier and/or safety hazards may result.



2.4.1 Dual Channel Hookup

In Dual Mode, installation is very intuitive: input Channel 1 feeds output Channel 1, and input Channel 2 feeds output Channel 2.

To activate Dual Mode:

1. Turn off the amplifier.
2. Wait 10 seconds for the power supply to discharge.
3. Slide the Dual/Mono switch to the center position.
4. Connect the output wiring as shown below.

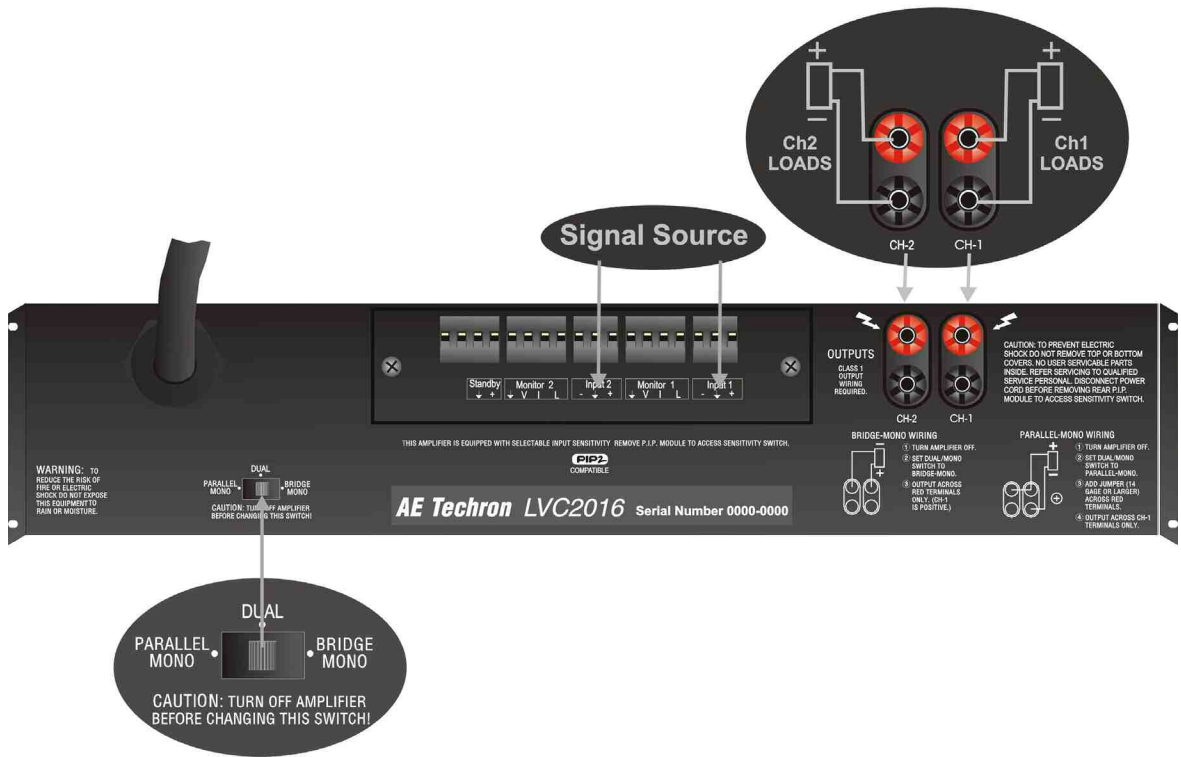
The high-current output block has three sets of output connectors per channel so multiple loads can be easily connected. Two sets accept banana plugs, while the third set accepts spade lugs or bare wire. Observe correct load polarity and be very careful not to short the two outputs.



CAUTION

In Dual mode never parallel the outputs or parallel them with the output of another amplifier.

Dual Mode

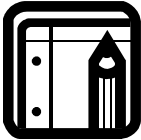


2.4.2 Bridge-Mono Hookup

Bridge-Mono Mode is intended for driving loads with total impedance of 4 ohms or more (see Section 2.4.3 if the load is less than 4 ohms). Installing the amplifier in Bridge-Mono Mode is very different from the other modes and requires special attention.

To activate Bridge-Mono Mode:

1. Turn the amplifier off.
2. Wait at least 10 seconds.
3. Slide the Dual/Mono switch to the right (as you face the back of the amplifier).



NOTE: Both outputs receive the signal from the Channel 1 input with the output of Channel 2 inverted so it can be bridged with the Channel 1 output.

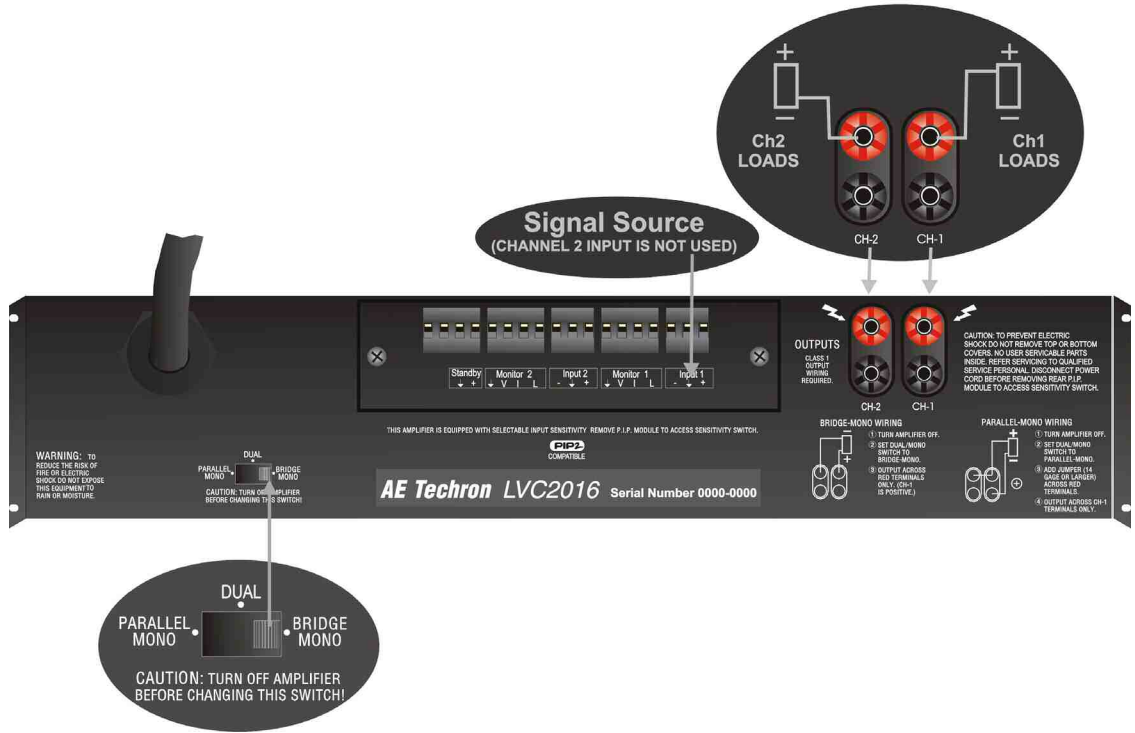
AND

NOTE: The Channel 2 input and level controls are disconnected in Bridge Mono Mode. A signal-feeding Channel 2 will have no effect on the output.

4. Connect the load across the Channel 1 and 2 positive (+) terminals.
5. Attach the positive lead from the load to Channel 1.
6. Attach the negative lead from the load to Channel 2.

The negative (-) terminals are **NOT** used and should **NOT** be shorted. In addition, the connected load ***must be floating referenced to ground.***

Bridge Mono



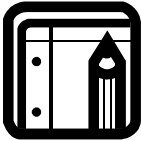
2.4.3 Parallel-Mono Hookup

Parallel-Mono Mode is intended for driving loads with a total impedance of less than 4 ohms (see Section 2.4.2 if the load is 4 ohms or greater). Installing the amplifier in Parallel-Mono Mode is very different from the other modes and requires special attention.

To activate Parallel-Mono Mode:

1. Turn off the amplifier
2. Wait at least 10 seconds
3. Slide the Dual/Mono switch to the left (as you face the back panel).
4. Connect the input signal to Channel 1, and do not use the Channel 2 input

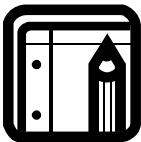
Both outputs will now receive the signal from the Channel 1 input.



NOTE: The Channel 2 input and level controls are disconnected in Parallel-Mono Mode. A signal-feeding Channel 2 will have no effect on the output.

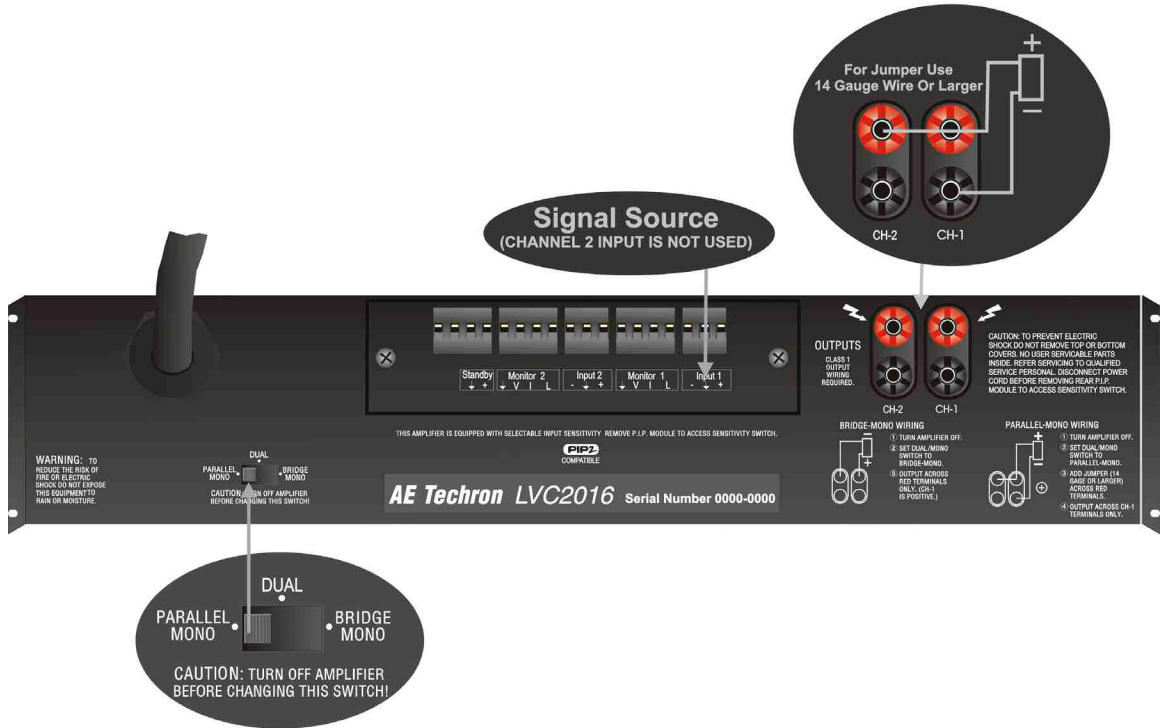
To complete connections:

5. Install a jumper wire between the positive (+) outputs of Channel 1 and 2 that is at least 14 gauge in size.
6. Connect the load to the output of Channel 1 as shown below.
7. Connect positive (+) lead from the load to the positive (+) Channel 1 terminal
8. Connect the negative (-) lead from the load to the negative (-) Channel 1 terminal.



NOTE: Remember to remove the jumper between the positive output terminals before changing to Bridge-Mono or Dual Modes (improper operation will result if you don't).

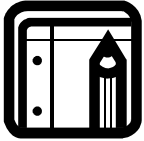
Parallel Mono



2.4.4 Connecting Power

The LVC 608/623/2016 uses a 3-wire (grounded) AC line system. At times, the third wire ground may introduce a ground loop into the system.

Each LVC 608/623/2016 is supplied from the factory with an appropriate AC cord.



NOTE: Units destined for other parts of the world are provided without a plug.

Whenever possible, connect the power cord to an isolated power circuit with adequate current (see Section 3 *Applications* for detailed information on current draw).

Excessive line voltages of more than 11% above the amplifier's rated line voltage will activate the overvoltage protection circuitry. For example, do not exceed a line voltage of 133V AC for units set up for 120V AC operation.

All specifications in this manual were measured using 120V AC, 60 Hz power mains unless otherwise noted. Specifications are derived using a peak main voltage equal to the true peak of a 120V RMS sine wave with all available channels fully loaded. Performance variations can occur at other AC main voltages and line frequencies. In addition, line regulation problems will directly affect the output power available from the amplifier.

A qualified technician can set up your amplifier for different AC main voltages and frequencies by changing the power supply connections on the control board inside the amplifier. The proper procedures are outlined inside the top cover of the amplifier and in this manual in Section 3 *Applications*.



Applications

This section describes the uses of the **AE TECHRON Model LVC 608/623/2016** amplifier, its capabilities, and various associated system configurations. Review this material before attempting to change the amplifier.

3.1 Introduction

This section is included for customers who may need to customize the **LVC 608/623/2016** for a new application. For these users, this section provides general theory and guidance.

This section assumes significant competence on your part in terms of amplifier systems, electronic components, and generally sound electronic working practices. You are encouraged to contact **AE TECHRON** for assistance with any modification or configuration of the **LVC 608/623/2016**.



WARNING

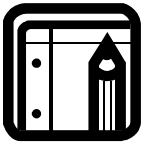
Except as recommended in this manual, do not attempt to change the circuitry of the amplifier. This could invalidate the warranty, damage the equipment, or harm the operator.

3.2 Amplifier Capability

Model LVC 608/623/2016 is a well-built power supply amplifier. It is capable of delivering precision power levels in a wide range of demands and with a variety of loads. When demands exceed the limits, there are several ways to increase the amplifier's capability. If these special operating modes are still unable to meet power requirements, contact **AE TECHRON** and/or consider using an **AE TECHRON** model or models with higher power handling capacity.

The **LVC 608/623/2016** has three main operating modes; Dual, Bridge-Mono, and Parallel-Mono. The Dual Mode is considered standard with the Mono Modes used in special applications. There are a number of precautions, which should be taken when operating the amplifier in either Mono Mode.

- ✓ The input must be to Channel 1 **ONLY**.
- ✓ The input to Channel 2 and controls for Channel 2 are **NOT** defeated in either mono mode, therefore no connection to Channel 2 may be made in either mono mode.
- ✓ The Channel 2 level control should be turned down (counter clockwise) fully in either mono mode.



NOTE: Gain Switch for Channel 2 makes no difference.

3.2.1 Bridge-Mono Applications

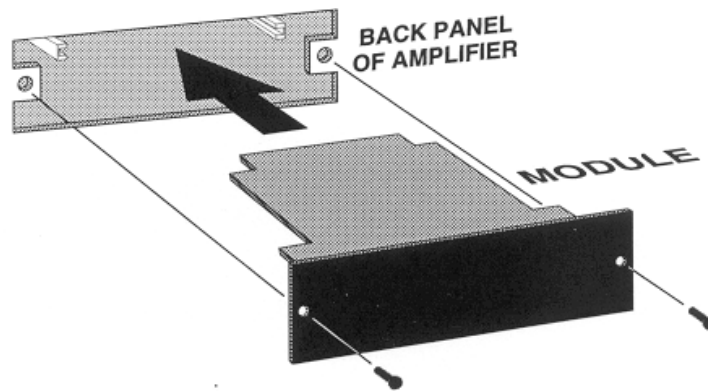
Bridge-Mono is intended for loads of 4 ohms or greater. The feedback loop for Channel 1 also drives the input to Channel 2 in this mono mode. The input to Channel 2 is, however, inverted. This causes the output of Channel 2 to be of equal magnitude and opposite polarity (for double voltage output). The output of the amplifier is balanced, and channel hot output is connected to load hot (+), Channel 2 hot output is connected to load return (-).

3.2.2 Parallel-Mono Application

Parallel Mono is intended for loads less than 4 ohms in a monaural amplifier configuration. The Channel 1 and 2 amplifier hot outputs must be shorted by an external shorting buss (10 AWG or larger). The amplifier output to the load(s) is taken from either channel's hot output to load hot, and either channel's negative output to the load return (-). The shorting buss must be removed prior to changing from Parallel Mono to either other mode.

3.3 Plug-In Modules

This is an excellent way to customize the amplifier for different applications in a relatively short amount of time. The **LVC 608/623/2016** amplifiers are equipped with an input module inside the back panel. The modules install easily as shown below.



Installing an Input Module

3.4 AC Power Applications

This section provides detailed information about power drawn from the AC mains and heat dissipation by the amplifier. Also, this section shows how to change the amplifier to operate from a different AC voltage and/or frequency.

3.4.1 AC Power Draw and Thermal Dissipation

The amount of power and current drawn, and the amount of heat produced under various conditions are presented here. These calculations are intended to provide a realistic and reliable depiction of the amplifier. The following assumptions were made:

- The amplifier's available Channels are loaded, and full, standard 1 kHz power is being delivered.
- Quiescent power draw is 90 watts.
- Quiescent heat dissipation equals 105 btu/hr at 90 watts.

Here are the equations used to calculate the data presented on the following page:

$$\text{AC Mains Power Draw (watts)} = \frac{\text{Standard 1 kHz power with both channels driven (watts)} \times \text{Duty Cycle}}{\text{Amplifier Efficiency}} + \text{Quiescent Power Draw (90 watts)}$$

The quiescent power draw of 90 watts is typical, and assumes the cooling fans are not running.

$$\text{Thermal Dissipation (Btu/Hr)} = \left[(1 - \text{Power to Loads}) + \frac{\text{Quiescent Power Draw (90 watts)}}{\text{Amplifier Efficiency}} \right] \times 3.415$$

OR

$$\text{Thermal Dissipation (btu/hr)} = \left(\frac{\text{Standard 1 kHz power each channel (watts)} \times \text{Duty Cycle} \times \text{Amplifier Inefficiency}}{\text{Amplifier Efficiency}} + \text{Quiescent Power Draw (90 watts)} \right) \times 3.415$$

The constant 3.415 converts watts to btu/hr. Thermal dissipation in btu is divided by the constant 3.968 to get kcal. To convert the power draw in watts to current draw in amperes, use the following equation:

$$\text{Current Draw (amperes)} = \frac{\text{AC Mains Power Draw (watts)}}{\text{AC Mains Voltage} \times \text{Power Factor (.83)}}$$

Principles of Operation

This section of the manual explains the general operating principles of an **AE TECHRON LVC 608/623/2016** grounded bridge power amplifier. Topics covered include Front End, Grounded Bridge, and ODEP.

4.1 Overview

Your **AE TECHRON** variable impedance amplifier incorporates several new technological advancements including low-stress output stages, real-time computer simulation of output transistor conditions, an advanced heat diffuser embodiment, a modular system for signal input and processing, and the articulated **variable** impedance power supplies.

Custom protection circuitry limits temperature and current to safe levels while making the amplifier highly reliable and tolerant of faults. Unlike many lesser amplifiers, it can operate at its voltage and current limits without self-destructing.

Real-time computer simulation is used to create an analogue of the junction temperature of the output transistors (hereafter referred to as the “output devices”). Current is limited only when the device temperature becomes excessive and just by the minimum amount necessary. This patented approach is called ODEP or Output Device Emulation Protection. It maximizes the available output power and eliminates overheating, the major cause of output device failure.

The amplifier is protected from all common hazards that plague high power amplifiers including shorted, open or mismatched loads, overloaded power supplies, excessive temperature, chain-destruction phenomena, input overload damage and high frequency blowups. The unit protects loads from turn-on and turn-off transients. The amplifier is also protected from internal faults.

The patented four-quadrant topology used in the grounded output stages is called the **grounded bridge**. The **grounded bridge** topology takes full advantage of the power supplies delivering peak-to-peak voltages to the load that are twice the voltage seen by the output devices and twice the voltage generated by the power supplies.

The **grounded bridge** topology is ground-referenced. Because the required current exceeds the limits of presently available components, composite output devices are constructed to function as gigantic NPN and PNP devices. Each output stage has two composite NPN and two composite PNP devices.

Overview Continued...

The devices connected to the load are referred to as "high-side NPN and PNP" and the devices connected to ground are referred to as "low-side NPN and PNP". Positive current is delivered to the load by increasing conductance simultaneously in the high-side NPN and low-side PNP stage, while decreasing conductance of the high-side PNP and low-side NPN in synchrony.

The two channels may be used together to double the voltage (Bridge-Mono) or the current (Parallel-Mono) presented to the load. This feature gives the user flexibility in maximizing the power available to the load.

Our thermal diffusers (heat sinks) are fabricated from custom, convoluted fin stock that provides an extremely high ratio of area to weight. All power devices are mounted directly to massive heat spreaders that are electrically alive. Electrifying the heat spreaders improves thermal performance by eliminating the insulating interface underneath the power devices.

4.2 Features

AE TECHRON LVC 608/623/2016 amplifiers utilize numerous innovations including grounded bridge and ODEP technologies. Cooling techniques make use of the what is essentially air conditioner technology. Air flows bottom to top, and front to side. Air flows a short distance across a wide heat sink. Output transistors are of the metal can type rather than plastic case. This allows for a significantly higher thermal margin for the given voltage and current ratings. All devices used are tested and graded to ensure maximum reliability. Another electronic technique used is negative feedback. Almost all power amplifiers utilize negative feedback to control gain and provide stability, but **AE TECHRON** uses multiple nested feedback loops for maximum stability and greatly improved damping.

Features specific to the **AE TECHRON LVC 608/623/2016 Series** include three separate power transformers (one for each channel and one for low voltage), a full time full speed fan, slew rate limiting, and protection circuit for muting delay or protective action. This amplifier can operate in either a Bridged or Parallel Mono Mode as well as Dual Mode. A sensitivity switch allows selection of input voltage required for rated output. Level controls are mounted on the front panel and are of the rotary type.

4.3 Front End Operation

The front end is comprised of three stages: Balanced Gain Stage (BGS), Variable Gain Stage (VGS), and the Error Amp. **Figure 4.1** shows a simplified diagram of a typical front end with voltage amplification stages.

4.3.1 Balanced Gain Stage (BGS)

Input to the amplifier is balanced. The shield may be isolated from chassis ground by an RC network to interrupt ground loops via the Ground Lift Switch. The non-inverting (hot) side of the balanced input is fed to the non-inverting input of the first op-amp stage. The inverting (negative) side of the balanced input is fed to the inverting input of the first op-amp stage. A potentiometer is provided for common mode rejection adjustment. Electrically, the BGS is at unity gain. The BGS is a non-inverting stage. Its output is delivered to the Variable Gain Stage.

4.3.2 Variable Gain Stage (VGS)

From the output of the BGS, the signal goes to the VGS where gain is determined by the position of the Sensitivity Switch, and level is determined by the level control. VGS is an inverting stage with the input being fed to its op-amp stage. Because gain after this stage is fixed at 26 dB (factor of 20), greater amplifier sensitivity is achieved by controlling the ratio of feedback to input resistance.

4.3.3 Error Amp

The inverted output from the VGS is fed to the non-inverting input of the Error Amp op-amp stage through an AC coupling capacitor and input resistor. Amplifier output is fed back via the negative feedback (NFb) loop resistor. The ratio of feedback resistor to input resistor fixes gain from the Error Amp input to the output of the amplifier at 26 dB. Diodes prevent overdriving the Error Amp. Because the Error Amp amplifies the difference between input and output signals, any difference in the two waveforms will produce a near open loop gain condition which in turn results in high peak output voltage. The output of the Error Amp, called the Error Signal (ES) drives the Voltage Translators.

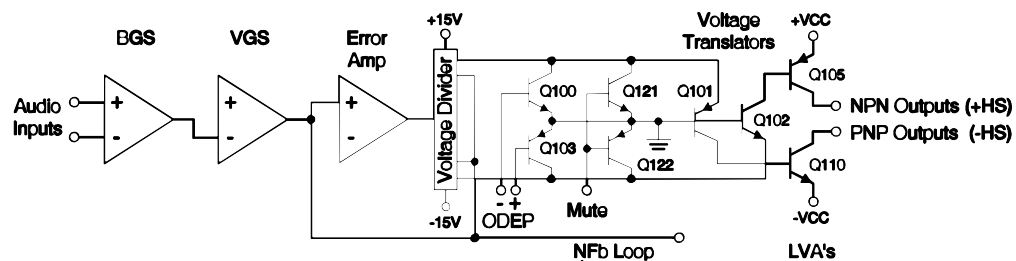


Figure 4-1 Typical Amplifier Front End and Voltage Amplification Stages

4.4 Voltage Amplification

The Voltage Translator stage separates the output of the Error Amp into balanced positive and negative drive voltages for the Last Voltage Amplifiers (LVAs), translating the signal from ground referenced $\pm 15V$ to $\pm V_{cc}$ reference. LVAs provide the main voltage amplification and drive the High Side output stages. Gain from Voltage Translator input to amplifier output is a factor of 25.2.

4.4.1 Voltage Translators

A voltage divider network splits the Error Signal (ES) into positive and negative drive signals for the balanced voltage translator stage. These offset reference voltages drive the input to the Voltage Translator transistors. A nested NFB loop from the output of the amplifier mixes with the inverted signal riding on the offset references. This negative feedback fixes gain at the offset reference points (and the output of the Error Amp) at a factor of -25.2 with respect to the amplifier output. The Voltage Translators are arranged in a common base configuration for non-inverting voltage gain with equal gain. They shift the audio from the $\pm 15V$ reference to VCC reference. Their outputs drive their respective LVA.

Also tied into the Voltage Translator inputs are ODEP limiting transistors and control/protection transistors. The ODEP transistors steal drive as dictated by the ODEP circuitry (discussed later). The control/protection transistors act as switches to totally shunt audio to ground during the turn-on delay, or during a DC/LF or Fault protective action.

4.4.2 Last Voltage Amplifiers (LVAS)

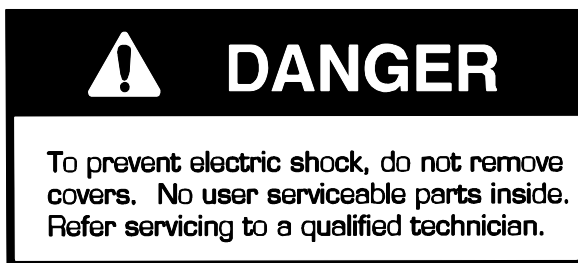
The Voltage Translator stage channels the signal to the Last Voltage Amplifiers (LVA:s) in a balanced configuration. The +LVA and -LVA, with their push-pull effect through the Bias Servo, drive the fully complementary output stage. The LVAs are configured as common emitter amplifiers. This configuration provides sufficient voltage gain and inverts the audio. The polarity inversion is necessary to avoid an overall polarity inversion from input jack to output jack, and it allows the NFB loop to control Error Amp gain by feeding back to its non-inverting input (with its polarity opposite to the out- put of the VGS). With the added voltage swing provided by the LVAS, the signal then gains current amplification through the Darlington emitter-follower output stage.

Service Information

This amplifier has sophisticated circuitry, which should only be serviced by a fully trained technician.

5.1 Qualified Service

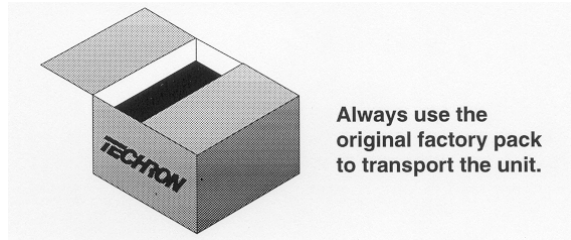
AE TECHRON INC. will provide service to the original purchaser of each new **AE TECHRON LVC 608/623/2016** for a period of one (1) year from the date of purchase if all conditions of the warranty have been met. When you notify us of your need for warranty service, we will give you an authorization to return the product for service.



Warranty work can only be performed at our authorized service centers or at our factory. Expenses in remedying the defect will be borne by **AE TECHRON INC.** including one-way surface freight shipping costs within the United States. (Purchaser must bear the expense of shipping the product between any foreign country and the port of entry in the United States and all taxes, duties, and other customs fees for such foreign shipments.)

5.1.1 Factory Service

To obtain factory service, write a letter describing as fully as you can the problem and send it along with your proof of purchase and the defective unit. For warranty service, we will pay for ground shipping back to you if you are within the continental United States. After repair and thorough testing the factory will return your serviced unit via truck. Please contact us if other arrangements are required.



5.2 Shipping Instructions

1. When sending an **AE TECHRON** product to the factory for service, be sure to write a letter describing the problem and reason for service and enclose it inside your unit's shipping pack.
2. To assure the safe transportation of your unit to the factory, ship it in an original factory-packing container. If you don't have one, call or write **AE TECHRON INC.'S** Parts Department. With the exception of polyurethane or wooden crates, any other packing material will not be sufficient to withstand the stress of shipping. Do not use loose, small size packing materials.
3. **Do Not** ship the unit in any kind of cabinet (wood or metal). Ignoring this warning may result in extensive damage to the unit and the cabinet. Accessories are not needed-do not send the instruction manual, cables or other hardware.
4. If you have any questions, please call or write the **AE TECHRON INC.** Technical Support Group:

Phone: (574) 295-9495

FAX: (574) 295-9596

E-Mail: Lshank@aetechron.com

5. Shipments to **AE TECHRON INC.** should be made as described below:

AE TECHRON INC.
2507 Warren Street
Elkhart, Indiana 46516 U.S.A.