HAZELRIGG INDUSTRIES

VLC

Vacuum Tube
Preamplifier/EQ/DI

Operating Instructions

How to Contact us:

Telephone:

567-DW FEARN
(567-393-3276)

Shipping Address:

124 Tartan Terrace
Chalfont, PA 18914
U.S.A.

e-mail: support@hazelriggindustries.com
www.dwfearn.com

D.W. FEARN

HAND-CRAFTED PROFESSIONAL RECORDING EQUIPMENT

HAZELRIGG INDUSTRIES

124 Tartan Terrace
Chalfont, PA, U.S.A.
Tel: 567-393-3276

Certificate of RoHS Compliance

D.W. Fearn / Hazelrigg Industries is committed to manufacturing products that are fully-compliant with the EU RoHS Directive.

The following products are compliant:

VT-1, VT-2, VT-24, VLC(-1)
VT-3, VT-I/F, VDI
VT-4, VT-5
VT-7
VT-15
LP-1
PDB

This declaration is based on our understanding of the current RoHS Directive and from information provided by the supplier material declarations with regard to materials contained in the component that make up our products.

Douglas W. Fearn
President

VLC Vacuum Tube Microphone Preamplifier
Final Test Report

Serial Number _____ **Mains Voltage:**_____**VAC**

Date_____ **Tested by**_____

THD+Noise:

20 cps _____ **%**

200 cps_____**%**

2 kc/s _____ **%**

20 kc/s_____**%**

Equalizer:

LF Cut _____

LF Boost _____

HF Boost _____

HF Cut _____

Operational Tests:

+48V _____

-20 pad_____

Phase Reverse _____

EQ In _____

Line Input _____

Instrument Input _____

Listening Test _____

Table of Contents

List of Illustrations

Limited 7-Year Warranty

During the warranty period, D.W. Fearn / Hazelrigg Industries will, at no additional charge, repair or replace defective parts with new parts.

This warranty does not extend to any VLC that has been damaged or rendered defective as a result of accident, misuse, or abuse; by the use of parts not manufactured or supplied by D.W. Fearn / Hazelrigg Industries; or by unauthorized modification of the VLC. Vacuum tubes are excepted from the 7-year warranty, but are warranted for 90 days from date of purchase.

Except as expressly set forth in this Warranty, D.W. Fearn / Hazelrigg Industries makes no other warranties, express or implied, including any implied warranty of merchantability and fit- ness for a particular purpose.

D.W. Fearn / Hazelrigg Industries shall not be liable for technical or editorial errors or omissions in this manual, nor for incidental or consequential damages resulting from the use of this material.

SPECIFICATION

Input	150 ohms
Input Load Impedance	1.5k ohms
Minimum Input Level	-65 dBm nominal
Maximum Input Level	-30 dBm without pad -5 dBm with 20 dB pad
Instrument Input Impedance	1 Megohm
Line Input Load Impedance	40k ohms
Gain	55 dB minimum
Frequency Response	± 0.5 dB 20 cps to 20 kc
THD + Noise	<0.35% 20 cps to 20 kc
Intermodulation Distortion	SMPTE: <0.80%
Signal to Noise Ratio	72 dB typical operation
Equivalent Input Noise	-124 dbm maximum
Output	low-Z, transformer balanced
Maximum Output Level	+22 dBm unterminated
Power Requirements	120 or 220 VAC 50/60Hz, 25 W
Dimensions	19" (48.26cm) W 3.5" (13.34cm) H 14" (22.86cm) D
Weight	12.5 lbs. (5.66 kg)

Description

The VLC Vacuum Tube Microphone Preamplifier/EQ/DI is designed to provide recording professionals with a sonically superior input device. It is typically used in sound recording studios for recording individual tracks. A quality microphone is connected to a VLC input, and the VLC provides a line-level output. In most situations, the VLC will feed directly to the input of the recorder.

The VLC is an adaptation of the D.W. Fearn VT-15 channel strip. Because of the unique qualities of vacuum tubes, the VLC has a clarity, transparency, and warmth that solid state preamps lack. Its modern design and construction allows the VLC to exceed the performance of vintage vacuum tube preamps.

It is designed for use in the professional recording environment. It accepts all low impedance balanced microphones. It features a regulated +48 volt supply for phantom powering condenser microphones, a switchable 20 dB input pad, and phase (polarity) reversal switch. It is built to sound great for a long time, with top quality parts used throughout.

All three power supplies (filament, phantom power, and B+) are solid state and fully regulated. The Attenuation control potentiometer is a conductive plastic type for long, noise-free operation.

The VLC is not mass-produced. Each one is hand-made and meticulously tested and listened to before shipment to the customer.

Installation

The VLC is carefully packed for shipment and should survive all but the most brutal handling. If there is any damage, keep the shipping material for use during any claim for damage with the shipper.

Included in the box:
1) The VLC Instrument Interface
2) Line cord
3) This instruction manual

Mounting

The VLC is designed for installation in a standard 19 inch rack. It requires 3.5 inches of vertical space, but additional spacing between it and adjacent equipment is recommended for adequate cooling. Ideally, a ventilated panel at least 1 rack unit high (1.25 inches) should be installed above and below the VLC (and around any other heat producing equipment for that matter). Be sure the bottom vent slots are not blocked. Equipment that runs cool can last for a very long time.

In tight equipment enclosures, be sure there is adequate air flow. Forced air cooling will benefit all your equipment.

The VLC can also be used without a rack, placed on a table, counter, or even on the floor. Optional rubber feet are available, when requested at the time of the order.

Moderate electrical and magnetic fields in the vicinity of the VLC should not cause any degradation in noise performance, due to the well-shielded construction, but proximity to devices with motors or large power transformers (i.e. tape machines or power amps) should be avoided.

Although the vacuum tubes in the VLC are selected for minimum microphonic response, it is a good practice to avoid mounting locations that subject the VLC to very high sound or vibration levels.

Power

The VLC is designed to operate from 120 or 220-240 volt, 50/60 Hz power. The unit will be shipped wired for the voltage specified in the order, but may be changed in the field if necessary (Call the factory for detailed instructions). The ground pin of the power cord is internally connected to the chassis. This configuration is standard in professional equipment and is required by most electrical codes. A grounding screw is provided on the back panel for installations that

use separate chassis grounding. If ground loop hum is detected, a careful check of the studio grounding scheme is needed. The VLC is less susceptible to grounding problems than many studio devices.

Connections (see Figure 1)

The INPUT connectors are XLR-3 females wired with pin 1 ground, pin 2 "+" or "high," and pin 3 "-" or "low." The 'MICROPHONE INPUT' matches 150 ohm (nominal) microphones and is transformer balanced. 'LINE INPUT' is for 600 ohm line-level signals.

The OUTPUT connector is XLR-3 male wired with pin 1 ground, pin 2 "+" or "high," and pin 3 "-" or "low." The VLC is optimized for feeding balanced bridging inputs (Virtually all modern audio equipment has bridging inputs). The output is transformer-balanced.

The "GND" terminal is for use when an external grounding scheme is utilized.

The Fuse is a 5mm x 20mm 1 amp for 115 VAC operation, and 0.5 amp for 220-240 volts.

The AC input connector is used with the mating line cord (supplied). For 115 VAC operation, this cord is a Belden 17250 or equivalent.

The unit does not utilize any RFI filtering, and no RFI has been experienced, even when the VLC is operated in close proximity to AM, FM, and TV broadcast transmitters.

Input and Output Connections

See Figure 1. Gold-plated XLR connectors are used for inputs and outputs. The input connectors are female and the outputs male.

Figure 1. The VLC rear panel connectors

All connectors are wired according to AES standard: pin 1 is ground (shield), pin 2 is "high" or "+," and pin 3 is "low" or "-." A positive voltage on pin 2 of the input will result in a positive voltage on pin 2 of the output (with the Phase Reverse switch set to Normal).

Grounding and Shields

A full discussion of proper studio wiring schemes is beyond the scope of this manual, but, in general, the Input-mating XLR connector must have the cable shield connected to pin 1. With most microphones, this shield must also be connected to pin 1 at the microphone end of the cable.

Whether the shield is connected to pin 1 of the output connector depends on the standard in your studio. The shield should be connected to ground at only one end of the output cable; however, although not recommended, the shields can often be connected at both ends without a problem.

OPERATION

Input

Since the input cable will be carrying very low level audio, it is important that a well-shielded cable is used. There should be no additional connectors, patch jacks, switches, etc. between the microphone and the VLC input. This can be achieved with a dedicated line from an XLR connector in the studio to each VLC in the control room. Although long input cable runs have little effect on the performance of the VLC, it is preferable to keep the input line as short as possible.

One successful method is to place the VLC in the studio with only a short cable to the microphone. Line level from the VLC output is then fed back to the control room. Avoid locating the VLC where it will be subjected to high sound levels or excessive vibration (such as on a drum riser).

Output

The output of the VLC is line level, transformer balanced. Note that vacuum tube equipment is more sensitive to load impedance than solid state units. The VLC design is optimized for feeding a balanced bridging input (20k ohms or greater). When feeding a 600 ohm load, there may be a slight degradation of some of the specifications. In modern studio equipment, bridging line inputs are universal. If the device being fed by the VLC has an input termination switch, that switch should be in the “off” position.

The VLC can feed balanced or unbalanced inputs with no need for any modification in output wiring. Either pin 2 or 3 can be grounded, although pin 2 is normally used as the ”hot” and pin 3 as ground unbalanced configurations.

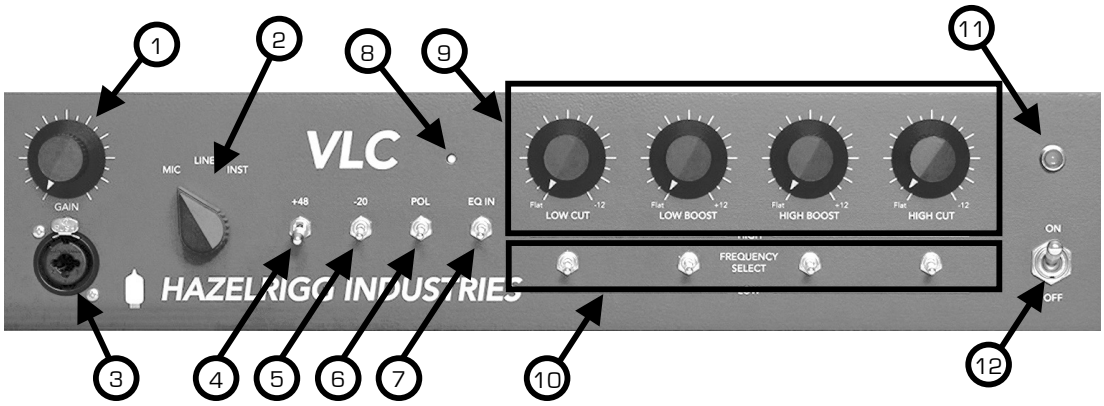

Figure 2. VLC front panel controls and indicators

CONTROLS (see Figure 2.)

Gain (1)

The Gain control (1) is between the second and third amplification stages of the VLC. It should be adjusted to provide the desired output level to the console or recorder.

In some situations, the Gain control can have an effect on VLC distortion, but at +4 dBm output the input stages will overload before the output. If you find that you need to run the Gain control near the bottom of its range, the input level may be too high and you might want to experiment with the microphone pad (if it has one), the VLC -20 switch position, or both. Let your ears be the judge. Slight to moderate overdriving of the VLC often adds “edge,” “power,” or “excitement” to the sound.

If it is necessary to operate the Gain control near the top of its range, the input level is too low and any padding at the mic or on the VLC should be reduced or removed.

Input switch (2)

The input switch selects between 3 inputs: microphone, line and direct (1/4”). When recording with a microphone, the selector should be in the ‘MIC’ position. When using the VLC as a hardware processor, choose the ‘LINE’ position. If you are using the VLC with a bass, guitar or any instrument that has a ¼” output use the ‘INST’ position in conjunction with the input on the front panel.

Front panel XLR / ¼" combo (3)

The front combo jack adds convenient access to patch in a microphone for quick setup. It also contains the ¼" input.

+48 Volt (4)

The +48 switch is actuated by first pulling out, then moving to the upper position.

Solid-state condenser microphones in professional environments are usually phantom powered; the microphone electronics are DC powered through the audio cable. This is accomplished by feeding the positive side of a 48 volt power supply to both pin 2 and 3 of the input connector (through precision matched resistors), and the negative to pin 1 (ground). The DC voltage is recovered at the microphone with negligible effect on the audio signal.

Vacuum tube condenser mics and dynamic microphones do not require this power and the +48 switch (4) should be turned off when using non-phantom powered mics. Although leaving the +48 on will not damage any properly wired balanced mic, some ribbon mics have reportedly been damaged when connected or disconnected from phantom powering. Also, some engineers feel that the performance of some dynamic mics may be subtly degraded with the phantom power on.

The phantom power circuit used in the VLC is suitable for use with all Neumann micro- phones, AKG 12 and 48 volt microphones, B&K phantom powered mics, all Schoeps mics, Shure SM81 and 85 mics, Crown PZM mics, and virtually all other phantom-powered mics that require any voltage between 12 and 48 volts.

When turned off, the phantom-power resistors are completely disconnected from the circuit in the VLC.

-20 (5)

In the "-20" position, a pad is inserted between the input connector and the input transformer. This position would be used when the level is too high. On condenser microphones that have a switchable pad, it will usually be necessary to use a -10 or -20 dB pad in the mic when recording very high sound levels to prevent overload of the microphone electronics. Whether this is used in

conjunction with or as a substitute for the VLC pad should be determined by experimentation. For the cleanest sound it is generally preferable to pad at the microphone first, then at the VLC if necessary. The sound of some microphones will change slightly with the -20 position. This is a function of the interaction between the microphone transformer and the VLC input transformer.

POL (6)

This switch reverses the polarity of the output of the VLC.

Even when there is only one microphone being recorded, it may be useful to try the up position of the polarity control. Although there is supposed to be standardization in polarity throughout the professional audio equipment industry, it is possible that a wiring error or the use of vintage equipment built before standardization may reverse the polarity in the recording/monitoring chain. The effect of reversed absolute polarity is usually subtle, but can be significant with some sounds. If the reverse position sounds better, use it.

With more than one microphone on the same sound source (or picking up leakage from another sound source), the POL switch may have a profound effect on the audio quality. Whichever position sounds best is correct. A check of monaural compatibility (by summing the various mics) should also be performed.

EQ In (7)

This engages the equalizer into the audio path. When the EQ is not engaged the audio goes through a pad that mimics the overall audio loss of the EQ.

Output Signal Indicator (8)

The bi-color LED (8) displays output directly from the secondary of the output transformer, through an isolation amplifier. Ideally, the indicator should show green while re-recording signal. The LED is calibrated to turn red when nearing the upper input level of most digital audio convertors.

Boost and Cut (9)

The VLC contains a passive-style equalizer. The boost circuit employs an inductor in conjunction with a capacitor to achieve the desired boost frequencies. The boost and cut pots adjust the levels of equalization.

Frequency selection (10)

The frequencies for each boost and cut can be selected independently. In the upper position the frequency selection is harmonically higher; in the lower position the selection is harmonically lower.

Power switch and indicator (12 & 11)

Primary power is applied to the VLC circuits when the Power switch (12) is in the up position. The red pilot lamp (11) indicates that the unit is on. It take about twenty seconds for the preamp to start working, but it is suggested that you turn on the power at least five minutes prior to use. The tubes are often noisy until all the internal elements reach a stable operating temperature.

Initial Set-Up

The VLC should be installed as detailed in the Installation section. With the outputs connected to an appropriate destination (typically to audio recorder inputs), configure the studio to monitor the VLC output. Apply power and wait about twenty seconds for the tube filaments to get up to temperature. Check for hum, buzz, or other noise. For the first few minutes after a cold start it is not unusual for the VLC to produce hiss, pops, and microphonic "clanks" as the internal elements of the tubes expand from the heat. Correct any ground loop problems before proceeding.

The controls should be set as follows. The numbers refer to Figure 2 on page 14.

- **Power(12).....On**
- **Input Selector(2).....MIC**
- **Gain(1).....Mid-point**
- **POL(6).....Normal**
- **EQ In(7).....Down**
- **+48 (4).....as required for mic**

If necessary, use the POL reverse switch. The +48 switch should be off except when needed for phantom powered microphones.

The best indication of proper operation of the VLC is how it sounds. This preamplifier has a wide operating range and quite often the exact position of the controls is relatively non-critical.

Be certain that the output level of the VLC is appropriate for the device connected to the output. +4 dBm is the accepted standard level for all professional recording equipment. Some older equipment may be designed for 0 dBm or +8 dBm, either of which can be easily accommodated by the VLC.

SUGGESTIONS:

You have chosen to use the VLC because of the superior sound it provides. To gain the maximum benefit from your investment, it is important that you hook up the VLC so that other factors do not adversely affect the sound quality.

1. The VLC can be located in the studio or in the control room, but use the shortest possible cable between the mic and the VLC.
2. Use the best quality mic cable you can. We don't believe you have to use esoteric wire, but do use a good cable designed for low impedance microphones. A quality cable with gold-contact connectors is best.
3. There should be no additional cables, connectors, junction boxes, patch jacks, etc. between the mic and the VLC input.
4. The output of the VLC should be fed directly to the recorder through the shortest practical length of quality cable. Avoid additional cables, connectors, junction boxes, punch blocks, or patch jacks. Use gold contact connectors if possible. Do not go through the mixing console unless you absolutely need its features for the track you are cutting.
5. In general, for superior sound, we recommend recording directly to the recorder with no processing. Any processing can be added in the mix, if necessary. You may find that far less processing is required when using the VLC. If processing is required while recording the track, insert the processing device after the VLC and before the recorder.

THEORY OF OPERATION

Input section

The first stage is a selected 6072 tube configured as a Class A voltage amplifier with a gain of approximately 30. Negative feedback from the plate of the second stage reduces distortion, flattens the frequency response, and makes the gain of the first two stages less dependent on individual vacuum tube characteristics.

Second stage

The output of the first stage is coupled to the grid of the second stage through a polystyrene capacitor. This stage operates as a Class A voltage amplifier with a gain of approximately 30. The plate is coupled through a polypropylene capacitor to the top of a conductive plastic rotary potentiometer (Gain).

Third Stage

The arm of the Attenuation potentiometer feeds the grid of the third stage (a 6072A), which also operates Class A with a gain of approximately 30. This stage is capacitively-coupled to the grid of the output stage through a polystyrene capacitor.

Output Stage

The output stage operates as a cathode follower, presenting a comparatively low output impedance (approximately 800 ohms).

Equalization Section

The passive LC (inductor/capacitor) equalization is inserted at the mic preamp output.

Line Amp Section

The EQ output feeds a 6072 line amp stage. The cathode output of the final stage is coupled through a proprietary polypropylene capacitor to the primary of the output transformer.

Power Supplies

Primary power from the AC mains is connected to the VLC through a standard IEC power input connector. The Power switch energizes all three power supplies. A fuse, accessible on the IEC input connector, protects the VLC. The power transformer is a toroidal unit custom-made for the VLC and has primary taps for 115 and 220-240 volt operation. A switch on the rear makes it quick and easy to go between voltages. Be sure to also change the fuse to the appropriate value.

Filament supply

The power transformer output is rectified by a bridge rectifier and filtered before being regulated to 12.0 volts by a three-terminal regulator. The negative output of this supply is grounded. Although the tube filament is rated for 12.6 volts, utilization of 12.0 volts has no effect on the operation of the VLC.

B+ supply

Two separate regulated voltages are required for the plates of the VLC. The B+ is filtered with long-life, low-leakage computer-grade filter capacitors before being regulated and extensively bypassed and decoupled. The negative side of the supply is grounded.

MAINTENANCE

The VLC is built with only the highest quality parts and will prove to be extremely reliable. Vacuum tubes and electrolytic capacitors, however, have a finite useful life and must be periodically replaced.

Top Cover Removal

Removing the top cover allows access to the vacuum tube. Eighteen 4-40 machine screws must be removed.

Vacuum Tubes

Four 6072A tubes are used in the VLC. There can be as much as a 15 dB difference in noise level among an assortment of tubes, and the tubes used in the first position should be carefully chosen to maintain low noise. Selected low-noise tubes are available from Hazelrigg Industries.

Tube life is difficult to predict, but it will probably be measured in years. Catastrophic tube failure is rare with this type of device, but a gradual increase in noise, microphonics, distortion, or a reduction in headroom, should indicate the need for replacement.

Tubes sometimes develop a microphonic response — they will respond to ambient noise and vibration. This can be an insidious problem since measurements in a quiet room will indicate perfect performance. Gently tapping the tube shields while listening to the output at a normal monitor level should reveal nothing more than a slight “clank.” On a peak-reading meter connected to the VLC output, with 50 dB gain, any microphonic response above -55 dBm is excessive. Replacement is indicated unless the VLC always operates in a quiet and vibration-free environment.

Although you could purchase a batch of 6072A tubes and select the quietest one(s) for the first tube position, it may be cost effective to buy a low-noise tube from us. Current prices are $51.00 for a selected low-noise 6072A, and $25.00 for a tested but less rigorous noise-spec 6072A. We test the tubes in a VT-2 after a burn-in period and grade them according to noise, microphonic response, distortion, and other characteristics. A low-noise tube from us will meet the original VLC specifications.

The base pins of vacuum tubes supplied by Hazelrigg Industries have been chemically treated for low contact resistance and oxidation prevention. When handling these tubes, care should be taken to avoid removing or contaminating the treatment. Use a lint-free cloth or paper towel to avoid direct contact between any part of the tube and your fingers.

Remember that vacuum tubes may be quite hot during operation. Protect your fingers during tube replacement. The preamplifier should be turned off before removing tubes. Allow at least one minute for the filter capacitors to discharge before tube removal or insertion.

Tubes are made of glass and will break if dropped or even bumped in a critical area. Handle with care.

Electrolytic Capacitors

Hazelrigg Industries products are designed and built to last for a long, long time, and it is possible that some components (e.g. electrolytic capacitors) may reach the end of their life long before the equipment becomes obsolete. The electrolytic capacitors used in the VLC typically will last at least twenty years. If there is a measurable and/or audible increase in 120 cps noise, the filter capacitors should be suspected. They should be replaced with new capacitors of equivalent capacitance and voltage rating, and the replacements should be specified for a minimum ten-year service life. Electrolytic capacitors are also used as plate and cathode decouplers. In choosing a replacement, the same considerations as with the filter capacitors should be followed.

TROUBLESHOOTING

Most problems will be traced to defective vacuum tubes. However, if normal tests do not easily reveal the problem, feel free to call the factory for assistance. If you lack access to a qualified service technician with vacuum tube equipment repair experience, you may return the VLC to the factory for repair. Call first, however, for shipping information.

WARRANTY REPAIR

If the VLC should develop a problem during the 7-year warranty period, call the factory for return shipping instructions. We will repair and return your VLC quickly. Note that the warranty does not cover vacuum tubes, which must be periodically replaced.