

D.W.FEARN

VT-4

Vacuum Tube LC Equalizer



Operating Instructions

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HAND-CRAFTED PROFESSIONAL RECORDING EQUIPMENT

HAZELRIGG INDUSTRIES

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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

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Limited 7-Year Warranty

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

This warranty does not extend to any VT-4 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; or by unauthorized modification of the VT-4. 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 makes no other warranties, express or implied, including any implied warranty of merchantability and fitness for a particular purpose.

SPECIFICATIONS

(All measurements are for each channel and are made at +4dBm in and out, Eq switched in but all controls set to flat.)

Input	600 ohms
Input Load Impedance	40k ohms
Minimum Input Level	-20 dBm nominal
Maximum Input Level @ 20 cps	+25 dB 0 dB
Gain	± 0.5 dB 20 cps to 20 kc -3dB@0.5cps&80 kc
Frequency Response	<0.10% 20 cps to 20 kc
THD + Noise	SMPTE: <0.80%
Intermodulation Distortion	82 dB minimum low-Z, transformer balanced
Signal to Noise Ratio	82 dB minimum low-Z, transformer balanced
Output	+22 dBm unterminated
Maximum Output Level	120 or 220 VAC 50/60Hz, 85 W
Power Requirements	19" (48.26cm) W 5.25" (13.34cm) H 9" (22.86cm) D (VT-2 13" 22.9cm)
Dimensions	
Weight	14 lbs (6.35 kg)

Note: Throughout this manual, frequency is specified in cps (cycles per second) or kc (kilocycles per second). These units of measurement correspond to Hz and kHz respectively. Specifications subject to change without notice

EQ FEATURES

(All controls are independent and can be used in any combination)

**Low Cut at 30, 40, 100, or 400 Hz,
0 to -18 dB shelving in 2 dB steps**

**Low Boost at 20, 40, 60, or 140 Hz,
0 to 12 dB shelving in 2 dB steps**

**Mid Cut at 200, 300, 400, 500, 600, or 700 Hz,
0 to -16 dB in 2 dB steps**

**High Boost at 2, 3, 4, 5, 8, 10, 12, or 16 kHz,
0 to 14 dB in 2 dB steps**

High Bandwidth Q of 0.6, 0.8, 1.0, 1.4, or 1.7

**High Frequency Cut at 1.7, 4, 10, or 28 kHz,
0 to -14 dB shelving in 2 dB steps**

**Gain adjustable from -9 to +9 dB,
referenced to +4 dBm, in 3 dB steps**

Note: Throughout this manual, frequency is specified in cps (cycles per second) or kc (kilocycles per second). These units of measurement correspond to Hz and kHz respectively. Specifications subject to change without notice

HISTORY OF THE VT-4

Throughout my career in recording, there have always been a few equalizers that stood out as being exceptional. Among my favorites are the 1970s-era Neve input-strip eqs, and the Trident CB9066 parametric. I began my equalizer development project by first building a series of test circuits, using all the various tone-modification techniques. After listening to a wide variety of equalization circuits, it was obvious to me that the passive inductor-capacitor (LC) circuit was the one that sounded the most musical and natural to me.

In thinking about how I use equalization, I realized that having simultaneous boost and cut at the low and end frequencies was often very useful. For mid-frequencies, I found that I always cut, usually around 400 Hz, and never had any reason to boost in that range. If I were using a parametric equalizer, I invariably tended to use the low-Q (broadest) settings, and if I had a choice between shelving or peaking on the high and low end, I almost always preferred the shelving curve.

So the VT-4 was designed around those preferences -- low-Q curves, shelving, with simultaneous boost and cut, mid-range cut but not boost, and using passive LC circuitry.

The amplification stages would be vacuum tube, and since the VT-1/VT-2 mic preamps have had such a gratifying acceptance in the world of recording, it was important to preserve the same sonic characteristics that distinguished the preamps. I decided to try the Svetlana 6N1P dual triode, and was pleasantly surprised to find that it is a wonderful-sounding tube, with many of the same sonic characteristics as the 6072A used in my preamps. The active tube circuitry fell into place with relatively little effort. Now it was time to make the equalization circuitry work the way I wanted.

To start, I used the filter design tables developed by Bell Labs in the 1930s. That got the project off the ground and it was starting to sound pretty good. For several months, I listened to a variety of music through a prototype equalizer while I was working on other things, and gradually narrowed-in on what sounded really good and what didn't. I would frequently have a box of capacitors and clip leads next to the prototype and often clipped-in a different value here or there and continued listening. Eventually, the final frequencies, curves, control operation, etc. was determined. To this day, I have only a vague idea of what the actual curves look like. Equalizers, like all audio equipment, should please your ears, not your test equipment.

My experience with Jensen Transformers Inc. was so positive that I knew from the beginning that I would utilize their products. The first couple of prototypes used inductors that I wound myself, but for production units more-consistent inductors would be necessary. Jensen agreed to manufacture the necessary inductors to my specifications, and the quality of the parts is astounding.

2. DESCRIPTION

The Model VT-4 Vacuum Tube LC Equalizer is designed to provide recording professionals with a sonically superior outboard processing device. It is typically used in sound recording studios for modifying the frequency response characteristics of an individual track. A pair of VT-4s can be used to process a stereo mix with precise matching between units.

It is designed for use in the professional recording environment. It accepts all standard low-impedance (nominally 600 ohm) line-level (nominally +4 dBm) signals. The output is line-level (+4 dBm) low-impedance, transformer-isolated and designed to feed bridging inputs. It is built to sound great for a long time, with top quality parts used throughout; all the transformers, inductors and many other components are custom-made for the VT-4.

All power supplies are solid state and fully regulated. All rotary controls use high-quality silver-contact switches for precise repeatability and matching between units.

Much of the circuitry for the VT-4 is based on the highly-successful D.W. Fearn VT-1 and VT-2 Vacuum Tube Microphone Preamplifiers. Since line-level signals are utilized in the VT-4, Class-A Svetlana 6N1P dual triodes are used for all amplifier stages. The input transformer, inductors in the passive equalization circuitry, and the output transformer are custom-made for us by Jensen Transformers Inc.

The VT-4 is not mass-produced. Each one is hand-made and meticulously tested and listened to before shipment to the customer.

The philosophy behind the VT-4 is: use only the best components in an optimized circuit, and build it with pride and precision. The VT-4 is designed and built to perform in your studio for decades to come.

3. INSTALLATION

The VT-4 is carefully packed for shipment and it should survive all but the most brutal handling. If there is any damage, keep the shipping material for use during any possible claim for damage with the shipper.

Included in the box:

- 1) The VT-4 Equalizer
- 2) Line cord
- 3) This instruction manual

Mounting

The VT-4 is designed for installation in a standard 19 inch rack. It requires 5.25 inches of vertical space, but additional spacing between it and adjacent equipment is recommended for adequate cooling. Be sure the bottom vent slots are not blocked. It is essential that air can flow into the bottom, top and sides of the VT-4. 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 VT-4 uses 8 vacuum tubes and generates considerable heat -- 85 watts. It needs some room around it to keep it from becoming too hot, which will shorten the life of some of the internal components. The VT-4 has a small fan on the back panel. A ventilated panel at least 1 rack unit high (1.25 inches) should be installed above and below the VT-4 (and around any other heat producing equipment for that matter).

The VT-4 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 VT-4 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 VT-4 are selected for minimum microphonic response, it is a good practice to avoid mounting locations that subject the VT-4 to very high sound or vibration levels.

Input and Output Connections

Gold-plated XLR connectors are used for inputs and outputs. The input connector is female and the output male.

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.

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.

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 out- put cable; however, although not recommended, the shields can often be connected at both ends without a problem.

Input

Since the input cable will be carrying very high-quality audio, it is important that a well-shielded cable is used.

Output

The output of the VT-4 is line level, transformer balanced. Note that vacuum tube equipment is more sensitive to load impedance than solid state units. The VT-4 design was 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 VT-4 has an input termination switch, that switch should be in the “off” position.

The VT-4 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 the ground in unbalanced configurations.

4. OPERATION

The use of most controls on the VT-4 Equalizer is self-explanatory. One feature to note is that controls may be used in any combination. For example, use of both the Low Cut and Low Boost controls at the same time can result in some extraordinary effects. This also applies to the High Boost and High Cut.

The Mid-Cut control has a relatively low Q at minimal attenuation settings. Thus, the band covered is quite broad. As the Mid Cut control is advanced, the Q becomes sharper and effects the selected frequency more narrowly. Low attenuation settings (-2 to -6) are effective for removing some of the “mid-range muddle” than can degrade a recording. The higher settings are useful to null-out an annoying resonance.

The High Cut control is useful for reducing noise. The highest frequency setting (28 kHz) is particularly useful for digital recording. Attenuation in this range may help avoid effects common with anti-aliasing filters in A-D converters.

The Input control allows processing of a wide range of input levels. Also, extreme amounts of boost could overload the input of the device being feed by the VT- 5. Reducing the Input control setting may be helpful in this circumstance. It also allows the overall output level of the VT-4 to be reduced to provide a better level to the recorder. Settings above the “0” position are useful when processing signals from semi- pro gear that typically have a lower output level.

Like all recording gear, there is no right or wrong when using the VT-4. Use your ears and select settings that achieve your sonic goal. But avoid boosting frequencies when there is no effect (such as boosting the extreme highs on a bass guitar), since doing so may only increase noise.

5. THEORY OF OPERATION

Input section

Line level (600 ohm source impedance, balanced, +4 dBm nominal) audio enters through the XLR-3 female INPUT connector to the seven-position Input level control. The input is balanced-bridging, with an impedance of 40k ohms. The input transformer is made by Jensen Transformers Inc. The input switch is a passive pad on the primary of input transformer. A two-stage Class-A triode amplifier utilizing 6N1P vacuum tubes provides isolation from the input of the VT-4 to the passive LC equalization circuitry.

Equalization section

All equalization is accomplished with passive LC (inductor/capacitor) circuitry. The inductors are custom-made for the VT-4 by Jensen Transformers Inc. All capacitors are polystyrene or polypropylene types. The rotary switches are semi-sealed, silver-contact types selected for quiet operation and long life.

Output section

The output amplifier is similar to the Input section, using a two-stage, Class-A 6N1P triode amplifier with a cathode-follower output. The output is transformer-balanced, using a custom-made Jensen transformer. The output is optimized for feeding bridging inputs, which are standard in the recording industry. Either a balanced or unbalanced source may be fed.

Power Supplies

Both the filament and B+ power supplies are solid-state and fully regulated. The filaments are operated on regulated DC. A custom-made toroidal power transformer supplies the proper voltages and has primary windings for 110-130, or 220-240 VAC. The power switch, mains voltage selector (115/230VAC), and line fuse are on the back panel.

6. MAINTENANCE

The VT-4 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 replaced eventually.

Top Cover Removal

Removing the top cover allows access to the vacuum tubes. Phillips-head screws must be removed. When replacing the cover, position it so that the slotted ventilation holes are over the tubes (towards the back).

Vacuum Tubes

Four 6N1P tubes are used in the VT-4. V101 and V201 are the input stage and V102 and V202 are the output stages. 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. It is recommended that you periodically perform a quick noise and distortion check on the VT-4 and compare the results to previous measurements. Replacement tubes may be obtained from us (tested and graded for low-noise and micro-phonics), or other suppliers.

Rotary Switches

The rotary switches in the VT-4 were chosen for their self-cleaning property. In a clean environment (non-smoking, with frequent room and equipment vacuum cleaning), and with regular use, the rotary switches should require little attention for years. But if cleaning becomes necessary, we recommend using De-Oxit (Caig Laboratories). Follow the instructions provided with the product.

If the switches are not used regularly, oxide and dirt can build up on the contacts. Rotate the switches through their range a few times on a weekly basis to keep them clean.

Gain trim

The In/Out gain matching can be adjusted with trim pots on the capacitor boards on the bottom chassis of the VT-4. This is set at the time of manufacture and does not require adjustment.

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 product to the factory for repair. Call first, however, for shipping information.

Warranty Repair

If the VT-4 should develop a problem during the five-year warranty period, call the factory for return shipping instructions. We will repair and return your VT-4 quickly. Note that the warranty does not cover vacuum tubes, which must be periodically replaced.