

# D.W. FEARN



## **VT-15** **Vacuum Tube** **Recording Channel**

## **Operating Instructions**

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## **Certificate of RoHS Compliance**

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

The following products are compliant:

VT-1  
VT-2  
VT-3  
VT-4  
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



## VT-15 Vacuum Tube Recording Channel Final Test Report

Serial Number \_\_\_\_\_ Mains Voltage 120/240 set to \_\_\_\_\_  
 Date \_\_\_\_\_ Tested by \_\_\_\_\_ VU Calibrated to \_\_\_\_\_ dBm  
 Test Equipment \_\_\_\_\_ Microphone \_\_\_\_\_

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### Frequency Response:

20 cps to 20 kc/s +/- \_\_\_\_\_ dB

### THD+Noise:

20 cps \_\_\_\_\_ %

200 cps \_\_\_\_\_ %

2 kc/s \_\_\_\_\_ %

20 kc/s \_\_\_\_\_ %

### Noise:

\_\_\_\_\_ dB below +4 dBm out

Equivalent Input Noise \_\_\_\_\_ dB

### Operational Tests

#### Microphone Preamplifier:

-20 pad \_\_\_\_\_

Lo-Z input \_\_\_\_\_

Phase Reverse \_\_\_\_\_

+48V \_\_\_\_\_

Line Input \_\_\_\_\_

Instrument Input \_\_\_\_\_

C->E Switching \_\_\_\_\_

#### Compressor:

Threshold \_\_\_\_\_

Attack \_\_\_\_\_

Release \_\_\_\_\_

Harder/Softer \_\_\_\_\_

VU GR Calibration \_\_\_\_\_

VU Output Calibration \_\_\_\_\_

Sidechain HPF \_\_\_\_\_

#### Equalizer:

LFB \_\_\_\_\_

LFC \_\_\_\_\_

HFB \_\_\_\_\_

HF Q \_\_\_\_\_

HF C \_\_\_\_\_

Listening Test \_\_\_\_\_

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## **Limited 5-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-15 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-15. Vacuum tubes are excepted from the 5-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.

## History of the VT-15 Vacuum Tube Recording Channel

With the success of the VT-1/VT-2 Vacuum Tube Microphone Preamplifiers, the VT-4 LC Equalizer, the VT-7 Stereo Compressor, and the VT-I/F and VT-3 Vacuum Tube DIs, there was a great temptation to combine the features of all of these products into one recording channel.

But I had a problem with the concept. I did not want to be tied into having the compression come before the equalization, or vice-versa, so a prime design goal was to make the order of the processing switchable. That way the user has a choice of compression before equalization or equalization before compression. Different circumstances require different approaches to processing.

Achieving this switching with a minimum of noise and level change was solved quickly, but all the switching in the audio path could result in a degradation of the noise performance of the VT-15.

By definition, an “all-in-one” box has many compromises over using separate units. I was not satisfied with the VT-15 until the overall performance was as close as possible to using a VT-1/VT-7/VT-4. The final result is a box that has about 4dB more noise than the separate units under most circumstances – a negligible difference for most applications.

Because the VT-15 is capable of a tremendous amount of gain (about 90dB in the first prototype), it became a bit tricky to use properly. As long as you were familiar with optimizing gain structure in a studio environment, it worked great. But not everyone has that background, and in the heat of a session, it may get neglected. The result could be distortion – and not the kind you would normally find pleasing. Optimizing the gain structure and headroom was an ongoing project, complicated by a period of 18 months when we could not keep up with the orders for our VT-7 Stereo Compressor. In fact, I put the VT-15 project on hold entirely for six months. When I returned to it over the summer of 2007, the pieces fell into place and the VT-15 was ready to meet the world.

The mic preamp is identical to the VT-1/VT-2 circuit with one exception: an instrument input has been added. The compressor is identical to one channel of the VT-7 Stereo Compressor. The equalization is a highly-simplified version of the VT-4 LC Equalizer, with just one frequency for the low-frequency boost, low-frequency cut, high-frequency boost, and the high-frequency cut. The chosen frequencies were based on my experience using the VT-4 and feedback from many users.

Can the VT-15 replace the VT-1/VT-2, VT-7, and VT-4? Not really. The separate units have features that are just not practical to duplicate in the VT-15. But for many applications, the VT-15 provides the next best thing.

November 2007.



# 1. SPECIFICATIONS

Mic Input	150 ohms
Input Load Impedance	1.5k ohms
Minimum Input Level	-65 dBm nominal
Maximum Input Level @ 20 cps	-30 dBm without pad -5 dBm with 20 dB pad
Instrument Input impedance	1 Megohm
Line Input Load Impedance	40k ohms
Maximum Line Input Level @ 20 cps	+25dBm (+35dBm with pad)
Gain	<60 dB optimum (capable of 75dB)
Frequency Response	± 0.25 dB 20 cps to 20 kc ± 0.5 dB 11 cps to 28 kc -3 dB @ 0.5 cps & 50 kc
THD + Noise	<0.25% 20 cps to 20 kc
Intermodulation Distortion	SMPTE: <0.80%
Signal to Noise Ratio	72 dB typical operation
Equivalent Input Noise	-124 dbm typical operation
Output	low-Z, transformer balanced
Maximum Output Level	+22 dBm unterminated

# 1.

## **SPECIFICATIONS (CONT'D)**

Compression Range	up to 30dB
Compression method	Pulse-width modulator
Equalizer:	
Low-frequency Boost	100 cps, shelving
Low-frequency Cut	80 cps, shelving
High-frequency Boost	9.8 kc, peaking
High-frequency Q	0.6 to 1.7
High-frequency Cut	
12 kc, shelving	
Power	
Requirements	100, 120, or 220 VAC 50/60Hz, 50 W
Dimensions	19" (48.26cm) W 5.25" (13.34cm) H 9" (22.86cm) D (VT-2 13" 22.9cm)
Weight	18 lbs (8.16kg)

(specifications are preliminary and subject to change)

## 2. DESCRIPTION

The D.W. Fearn VT-15 utilizes circuitry developed for the VT-1/VT-2 Vacuum Tube Microphone Preamplifiers, the VT-7 Stereo Compressor, and the VT-4 LC Equalizer.

The Model VT-15 Recording Channel 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, electric instrument, or line-level signal is connected to a VT-15 input, and the VT-15 provides a line-level output. In most situations, the VT-15 will feed directly to the input of the recorder.

The microphone preamplifier section is a recreation of the classic tube preamps of the 1960s, updated with improved modern passive components and computer-aided circuit optimization. Because of the unique qualities of vacuum tubes, the VT-15 has a clarity, transparency, and warmth that solid state preamps lack. Its modern design and construction allows the VT-15 to exceed the performance of vintage vacuum tube preamps. 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, a phase (polarity) reversal switch, a switchable input network to accommodate very low impedance microphones (typically transformerless types), and a true VU meter. The input can be switched to a front-panel quarter-inch jack for recording electric instruments.

The compressor in the VT-15 is identical to a single channel of the D.W. Fearn VT-7 Stereo Compressor. In many ways, the VT-15 compressor recreates the sound of the classic tube compressors of the 1960s, but using modern gain control circuitry. The actual gain control element is a pulse-width modulator, driven by solid-state circuitry. However, the audio path is entirely class-A triode vacuum tubes. There are controls for compression threshold, gain, attack and release times, and compression characteristics.

The equalization section of the VT-15 is based on the D.W. Fearn VT-4 Vacuum Tube LC Equalizer. It uses identical circuitry, but is limited to just one frequency each in the low boost, low cut, high boost, and high cut sections. These were the frequencies most often used on the VT-4. The low frequency boost and cut have shelving curves. The high-frequency boost is a peaking type, with adjustable Q. The high-frequency cut is shelving. All the controls are continuously adjustable.

The input and output transformers are custom-made for us by Jensen Transformers, Inc. All power supplies are solid state and fully regulated. All internal switching uses sealed, gold-contact relays for low noise and long, quiet operation. The relays never need cleaning.

A combination of four 6072A and two 6N1P dual triodes are used in the VT-15.

A total of 12 separate power supply voltages are required internally for the VT-15 circuitry. All are solid-state and fully regulated.

The VT-15 is not mass-produced. Each one is hand-made and meticulously tested and listened to before shipment to the customer. It is built with pride and precision. The VT-15 is designed and built to perform in your studio for decades to come.



## 3. INSTALLATION

The VT-15 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-15 Recording Channel
- 2) Line cord
- 3) This instruction manual

### **Mounting**

The VT-15 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. Ideally, a ventilated panel at least 1 rack unit high (1.75 inches) should be installed above and below the VT-15 (and around any other heat producing equipment for that matter). Be sure the bottom vent slots are not blocked. It is essential that air can flow into the bottom and out of the top of the VT-15. 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-15 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-15 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-15 are selected for minimum microphonic response, it is a good practice to avoid mounting locations that subject the VT-15 to very high sound or vibration levels.

### **Power**

The VT-2 is designed to operate from 100, 120, or 220-240 volt, 50/60 Hz power. The unit will be shipped set for the voltage specified in the order, but may be changed in the field if necessary. Switching between 120V and 220V operation is simple: a recessed switch on the rear panel can be set to either voltage. The fuse value should be changed as well: 2A SB for 100/120V operation, and 1A SB for 220V operation. (For 100V operation, a simple internal wiring change is required. 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 VT-15 is less susceptible to grounding problems than many studio devices.

### **Connections**

The INPUT connector is a XLR-3 female wired with pin 1 ground, pin 2 “+” or “high,” and pin 3 “-” or “low.” The same input is used for either mic input or line input. The input matches 150 ohm microphones or 600-ohm line signals and is transformer balanced.

The OUTPUT connectors are XLR-3 male wired with pin 1 ground, pin 2 “+” or “high,” and pin 3 “-” or “low.” The VT-15 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 3AG slow-blow type, 2 amp for 100 or 120 VAC operation, and 1 amp for 220-240 volts.

The AC input connector is used with the mating line cord (supplied). For 120 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 VT-15 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.

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.

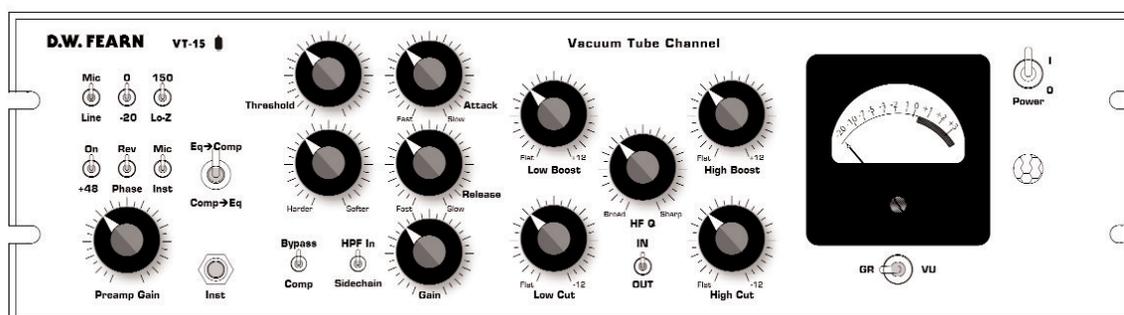
Whether the shield is connected to pin 1 of the output connector depends on the standard in your studio. The shield should be connected to ground at only one end of the output cable; however, although not recommended, the shields can often be connected at both ends without a problem.

## 4. OPERATION

### INITIAL SET-UP IS CRITICAL

#### for getting the best performance from your VT-15!

The VT-15 has tremendous versatility, but with that versatility comes the potential for for very unpleasant sound. Think of the VT-15 as a small studio chain in one box: mic preamp, compressor, and equalizer. In most studios, these would be three separate pieces of equipment and you would patch them together in a chain feeding your recorder. The VT-15 is the same concept, except that the “patching” is done inside the VT-15. And just like a bad gain structure in your mic pre/comp/eq will seriously degrade the performance, the same is true with the VT-15. **Improper gain structure, in the VT-15 or in separate units, will increase the noise, reduce the headroom, and increase distortion.** So follow these steps for the initial set-up of the VT-15. They provide the proper starting point, and optimize the gain structure for best performance.



**Figure 1. VT-15 front panel controls and indicators**

#### **A Note about Powering Down the VT-15**

Because the VT-15 is designed so that the most often used settings do not energize the corresponding internal switching relay, when you turn off the power to the unit, it will revert to the Mic input, whether you were using Mic or Line. If you are feeding a line-level signal into the VT-15, removing the power will immediately switch it to Mic input. Since the tube filaments and power supplies will continue to operate for about 20 seconds after power is turned off, the level could increase significantly during that time. Be sure to turn down the Preamp Gain control before turning off the Power switch. Or make sure that the VT-15 will not be feeding your monitors on shut-down. This will not hurt the VT-15, but it could damage your hearing or your speakers if the level were to suddenly jump 50dB!

**Control Set-up**

Input toggle switches:

Mic/Line switch - as appropriate for the source

0/-20 switch - 0

150/Lo-Z switch - 150 (unless you are using a non-standard impedance mic)

+48 switch - on for phantom-powered condenser mics, otherwise off

Rev/Phase switch - down (no phase reversal)

Mic/Inst switch - Mic position

Preamp Gain - 10 o'clock position

Compressor Controls:

Eq->Comp switch - in the Comp->Eq position (down)

Threshold - full counterclockwise

Harder/Softer - mid-point

Attack - mid-point

Release - mid-point

Gain - full counterclockwise

Bypass/Comp switch - Comp position

HPF In switch - out (down)

EQ Controls:

All knobs fully counterclockwise (flat)

In/Out switch - In (up)

Other controls:

GR/VU switch - VU position

Power switch - On (up)

Set-up Procedure

1. After the controls are set, have the performer start and adjust the Preamp Gain control for a normal reading on the VU meter. Peaks should rarely go into the red (0VU).
2. If the level is too high, switch in the -20 pad.
3. Switch the VU meter to the GR position.
4. Turn up the Threshold control until the the VU meter indicates compression. Typically you will use from 2 to 10dB of compression most of the time.
5. Adjust the Attack, Release, and Harder/Softer controls for the desired sound.

6. Adjust the Eq controls for the desired sound. (Remember to use the Boost and Cut together to shape the sound.)
7. Switch the VU meter back to the VU position.
8. Adjust the Gain control for a normal indication. Peaks should rarely go into the red (0VU).

This procedure will provide you with the optimum gain structure in the VT-15. Headroom will be maximum and noise will be minimum.

After the initial set-up, you can fine-tune the controls for exactly the sound you are looking for. **However, you will rarely have to change the Preamp Amp gain after the initial set-up.**

Here is detailed information on the VT-15 controls:

### **Mic 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 VT-15 input. This can be achieved with a dedicated line from an XLR connector in the studio to each VT-15 in the control room. Although long input cable runs have little effect on the performance of the VT-15, it is preferable to keep the input line as short as possible. Avoid locating the VT-15 where it will be subjected to high sound levels or excessive vibration (such as on a drum riser).

### **Line Input**

The Input connector can also accept a line-level (+4dBm, balanced, 600-ohm nominal) signal. The front panel “Mic/Line” switch should be in the “Line” position. A line-level signal into the VT-15 while the unit is set for “Mic” will result in very high level and extreme distortion. Although this will not harm the VT-15, it could be dangerous to your speakers and your ears! So make sure the switch is set appropriately before making the connections.

Many of the other switches are usable while in the “Line” position. The “-20” pad in particular may be useful if the input signal has a higher-than-normal level. The “150/Lo-Z” and “+48” switches are locked out in the “Line” position. The “Phase” switch is still active and may be useful.

### **Instrument Input**

The “Mic/Inst” switch changes the input source from the read-panel XLR connector to the front panel one-quarter inch “Inst” input. This jack is used for recording electric instruments such as electric bass, electric guitar, electronic keyboards, etc. Any device that would normally be plugged into a guitar amp or DI box will properly match the VT-15 “Inst” input.

### **Output**

The output of the VT-15 is line level, transformer balanced. Note that vacuum tube equipment is more sensitive to load impedance than solid state units. The VT-15 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-15 has an input termination switch, that switch should be in the “off” position.

The VT-15 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 grounded in unbalanced configurations.

## **CONTROLS (see Figure 1.)**

The VT-15 front panel is divided into three main areas of controls. On the left is the Input section, to its right is the Compressor section, further right is the Equalizer section, and far right is the output and power section.

### **Input Toggle Switch Section**

The group of 6 toggle switches in the upper left sets up the VT-15 input configuration.

**1. Mic/Line switch:** In the Mic position, the XLR input connector on the rear panel accepts mic level signals: nominally 150-ohm, balanced, at a -50dBm level. The Line position is for +4dBm, balanced, 600-ohm signals.

**2. 0/-20 switch:** This is a 20dB pad that can be inserted on either the mic or line signal. In the “0” position, microphone or line audio is connected directly to the input transformer. This provides the proper amplification for most condenser microphones and line-level signals, and will be used in most situations. In the “0” position, the VT-15 can accept up to about a -30 dBm input signal at 20 cps with full gain (53 dB) in the Mic position, and approximately +14dBm in the Line position, without an increase in distortion.

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 for the “0” position. 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 VT-15 pad should be determined by experimentation. For the cleanest sound it is generally preferable to pad at the microphone first, then at the VT-15 if necessary. The sound of some microphones will change slightly from the “0” to “-20” position. This is a function of the interaction between the microphone transformer and the VT-15 input transformer.

Sometimes a line-level signal will be too high for the VT-15 Line input. The -20 position can be useful in this situation.

**3. 150/Lo-z:** Some microphones, particularly transformerless-output condenser mics, have a non-standard output impedance, typically 50 to 80 ohms. (The AES standard is 150 ohms.) The Lo-Z position often provides a better match to these microphones. The level is not changed, but the microphone loading is improved for these low-impedance mics. Use your ears to decide which position sounds best to you.

**4.+48 volt phantom power on/off switch:** Supplies 48 volts for phantom powered condenser microphones. Switch the 48 volts off for dynamic and ribbon microphones, or condenser microphones with their own power supplies (e.g. vacuum tube condensers). This function is locked-out when in the Line position. The phantom powering circuit used in the VT-15 is suitable for use with all Neumann microphones, 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. When turned off, the phantom-power resistors are completely disconnected from the circuit in the VT-15.

**5. Rev/Phase switch:** Usually in the Normal position except when it is necessary to reverse the polarity of a microphone or line signal. It does not function on the Inst input. This switch revers-

es the polarity of the output of the VT-15. A detailed discussion of the application of phase reversal of individual microphones is beyond the scope of this manual.

Even when there is only one microphone being recorded, it may be useful to try the “Reverse” position of the Phase 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 subtle, but 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 Phase 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.

For a vocalist monitoring his or her voice in the headphones, the position of the Phase switch will drastically alter the performer’s perception of their own voice. If there is no other reason not to, try both positions of the Phase switch to see which is preferred.

**6. Mic/Inst switch:** Switches between the rear panel input connector (for mic or line input) and the front panel 1/4” Inst jack.

**7. Preamp Gain:** Adjusts the input level, mic, instrument, or line.

#### **Compressor Controls**

**Threshold** The Threshold control adjusts the point where compression begins. With the control all the way down, there is no compression and the VT-15 operates as a straight amplifier. As the control is turned clockwise, the amount of compression increases. This can be monitored on the VU meter (in the GR position), or by ear. The input level will also affect the range of the Threshold control, so adjusting the Preamp Gain control will also change the amount of compression. **However, for best performance, use the set-up procedure on page 19.**

**Gain** Whenever compression is applied, the signal is reduced in level by the amount of gain reduction. The Gain control allows you to make up the lost gain as necessary. At the full counter-clockwise position, the gain of the VT-15 (with no compression) is about -3dB. The maximum gain available is about 15dB.

**Attack** This control adjusts the time it takes the VT-7 gain reduction circuitry to react to a signal. It might seem that the faster the attack time, the better, but very fast attack times will result in significant distortion on material with a lot of low frequency content (this is true of all compressors). As the control is turned clockwise, the attack time becomes longer. Often with percussive sounds it is advantageous to have fairly long attack times to allow the initial transient of the sound to pass through the VT-15 without gain reduction. Experiment with the Attack control on percussive material to see how it changes the sound. Generally speaking, a fast attack time is best when complete control of the maximum instantaneous level is required. This might be desirable to protect a digital input from overload. However, a more natural sound is usually obtained with a slightly slower attack time. Long attack times can be useful as an effect, adding power to percussive instruments.

**Release** The Release control adjusts how long it takes for the gain to return to normal after a sound ceases (or drops in level). Fast release times add more energy to the sound, but can

add distortion to low frequency sounds. (This is true of all compressors.) A fast release time adds density to the sound, often with the compression becoming more obvious. Long release times make the compression less obvious and more natural, but can “punch holes” in the lower level audio under certain conditions of high percussive levels.

**Harder/Softer** This control adjusts the nature of the compression curve. Toward the “Harder” end of the control, the compression ratio is higher and the levels more tightly controlled. At the “Softer” end, the compression ratio is lower and the compression is more gentle. This is not merely a ratio control, however, as other parameters also change as the control is adjusted. More than any other control, this one needs to be adjusted by ear. This control interacts with the Threshold, Attack, and Release controls, so after changing the Softer/Harder control, you should experiment with others to obtain the effect you desire. Its technical operation is complicated to explain, so it is much easier to understand it simply by experimenting.

**Sidechain HPF** In the HPF In position, a high-pass (low cut) filter is inserted in the sidechain. This makes the compression less bass-sensitive and may be useful on mixes that have a very heavy bass content. It will reduce “pumping” of the mix from bass or bass drum hits, and increase the amount of low-end in the mix. The roll-off of bass sensitivity is a very gentle curve (about 6dB per octave) and has little effect above 150Hz. Using the HPF will also permit shorter Attack and Release times without adding any low-frequency distortion.

#### **Equalization Controls:**

The equalizer section of the VT-15 is derived from the D.W. Fearn VT-4 LC Equalizer. It is a much simplified version of the VT-4, but it retains the same basic circuitry and sound of the VT-4. The most commonly-used frequencies from the VT-4 were chosen for the VT-15.

A key technique in using the VT-15 equalization controls is to use the Boost and Cut controls together. It may seem counterintuitive to boost and cut at the same time, but doing it that way is what adds some of the “magic” of the eq.

There is no formula for setting the VT-15 eq controls. Simply experiment and find what works best for your application.

The **HF Q** control adjusts the shape of the High Boost curve, from very broad to moderately sharp.

All the curves on the VT-15 are shelving type with the exception of the High Boost, which has a peaking type curve. All curves are rather gentle and will affect a wide range of frequencies. Use the Boost and Cut controls together to modify the shape of the curve.

Keep in mind that the VT-15 is not designed to be a “corrective” equalizer. It is designed to enhance sound that is already pretty good. If you need to correct a frequency response problem, you will find many other outboard equalizers that are better suited. That said, the VT-15 can add wonderfully power to the bass and a beautiful high shimmer to sounds. Often that is all that is needed to make the track perfect.

**Meter switch** Switches the VU meter between monitoring the amount of compression (GR) and the output level (VU).

The **VU Meter** measures the output level through an isolation amplifier. It is calibrated so that a +4 dBm output will indicate 0 on the meter. This is the standard “0 VU” level for all professional audio recording equipment built since the early 1970s. “0 VU” on the VT-15

should result in “0 VU” on a properly aligned recorder. (This reference level can be changed; see the Maintenance Section.) This is a true VU meter, and conforms to ASA Standard C16.5-1954.

In the GR position, the VU meter monitors the amount of gain reduction (compression). As the VT-15 warms up, the normal “0VU” position of the meter needle (with no compression) may drift slightly. This has no effect on the sound of the VT-15 nor the accuracy of the gain reduction measurement.

**Power switch and indicator** Primary power is applied to the VT-15 circuits when the Power switch is in the up position. The amber pilot lamp and VU meter back-lighting indicate that the unit is on. It takes about twenty seconds for the VT-15 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.

### **Bench Test**

If desired, test the VT-15 before installation. The source generator should be set to -50 dBm, 150 ohms impedance, balanced, and the output should feed a balanced bridging input of the audio analyzer. Measured bandwidth should be 22 cps to 22 kc to obtain the same readings as the factory test results. Compare your measurements with the test data supplied with VT-15. Keep the results for comparison in future maintenance tests.

### **Initial Set-Up**

The VT-15 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 VT-15 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 VT-15 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.

### **SUGGESTIONS:**

You have chosen to use the VT-15 because of the superior sound it provides. To gain the maximum benefit from your investment, it is important that you hook up the VT-15 so that other factors do not adversely affect the sound quality.

1. 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.
2. There should be no additional cables, connectors, junction boxes, patch jacks, etc. between the mic and the VT-15 input.
3. The output of the VT-15 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. THEORY OF OPERATION

### Preamp Section

#### Input section

Microphone level (150 ohm source impedance, balanced, -50 dBm nominal) or line level (600-ohm source, +4dBm nominal) audio enters through the XLR-3 female INPUT connector to the Input selector switch bank. In the 0 position, the input is connected directly to the input transformer. The load imposed on the microphone is 1500 ohms, but varies slightly with frequency but is never lower than 1100 ohms. In the -20 position, the input passes through a balanced 20 dB pad. This pad is designed to maintain approximately the same load on the microphone as the input transformer.

In the Line position, a balanced pad of approximately 50dB attenuation is inserted on the input. In the Line position, the 48V phantom power and Lo-Z switches are locked-out.

The Mic/Inst switch changes the input from the rear panel XLR Input connector to the one-quarter inch front panel Inst jack. The audio from the Inst jack is fed directly to the grid of the first amplifier stage, bypassing all the input switching. The load impedance on the Inst input is 1 megohm.

All switching is through sealed gold-contact instrumentation relays with bifurcated contacts.

#### Phantom powering

+51 from the phantom power supply is switched on and off by the front panel +48 switch. A resistor drops the voltage as required depending on the current being drawn by the condenser microphone electronics. This makes the phantom power supply universal for most 12 and 48 volt condenser microphones. The phantom powering resistors are precision matched to 0.10% or better. They provide exactly equal voltage to pins 2 and 3 respectively of the input connector. The switching is through sealed gold-contact instrumentation relays with bifurcated contacts. In the "Off" position, the phantom power resistors are completely disconnected from the Input connector. When the VT-15 is in the Line position, the 48V switch is locked out.

#### Phase reversal switch

In the Normal position, input/output phase (polarity) is maintained (which must be inverted due to the design of the circuit). The balanced output is polarity reversed in the Reverse position. Switching is accomplished with a sealed, gold-contact instrumentation relay with bifurcated contacts.

#### Input transformer

The input transformer is custom-made for D.W. Fearn by Jensen Transformers, Inc. and represents the state of the art in transformer design. This is the same transformer that we use on the D.W. Fearn VT-1/VT-2 microphone preamplifiers. It exhibits extremely flat frequency

response, low phase shift, excellent square wave response, low distortion, and high noise immunity. The secondary of is connected directly to the grid of the first amplifier stage.

### **First stage**

The first stage is a selected 6072 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 potentiometer (Preamp Gain).

### **Third Stage**

The arm of the Preamp Gain 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.

### **Preamp Output Stage**

The output stage operates as a cathode follower, presenting a comparatively low output impedance (approximately 800 ohms). The cathode output is coupled through a proprietary polypropylene capacitor to either the Equalizer or Compressor section.

### **Compression Section**

Audio from the mic preamp is fed to the input of the pulse-width modulator (PWM) board, which provides the gain reduction. The audio output of the PWM goes through sidechain circuitry which determines the control voltage and hence the amount and characteristics of the compression.

The compressor preamp consists of two stages of a 6072A dual triode, which then feeds either the Line Amp or the Equalizer circuitry.

### **Equalization Section**

The passive LC (inductor/capacitor) equalization is inserted either at the mic preamp output or the compressor output. A 6N1P dual triode makes up the gain and then feeds either the Compressor input or the Line Amp.

### **Line Amp Section**

Either the eq output or the compressor output feeds a 6N1P dual triode with both sections in parallel to provide line-level output. The output transformer is custom-made for us by Jensen Transformers, Inc. and is the same transformer we use on all of our products.

### **VU Meter and Meter Amplifier**

A two-stage IC operational amplifier is used to isolate the VU meter from the VT-15 output. An output sample is derived from the primary of the output transformer. The meter calibration is set with a 20-turn trimmer potentiometer. Reference level (0 VU) can be set from -20 to over +20dBm. The level indicator is a custom true VU meter conforming to ASA Standard C16.5-1954.

### **Power Supplies**

Primary power from the AC mains is connected to the VT-15 through a standard IEC power input connector. A rear-panel voltage selector slide switch selects either 120 or 220V operation (the switch is labeled "115/230"). The VT-15 can also operate on 100V power with an internal wiring change. The mains fuse is slow-blow type 3AG, rated at 2A for 100/120V operation and 1A for 230V operation. The VT-15 can operate on either 50 or 60Hz power.

The Power switch energizes all power supplies. The Pilot lamp is a type 1819 bulb, operated far below its rated voltage of 28. The life of the bulb is lengthened, and the light output is more compatible with other modern studio equipment. The power transformer is a toroidal unit custom-made for the VT-15.

### **Filament Supply**

The power transformer output is rectified by a bridge rectifier and filtered before being regulated by a three-terminal regulator. This supply also powers all the switching relays in the VT-15, as well as the pilot lamp and VU meter lamps.

### **+/- 15V Supply**

The solid-state control circuitry for the VT-15 compressor requires regulated +15 and -15V supplies.

### **B+ Supply**

Seven separate regulated voltages are required for the plates of the VT-15. 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.

### **+48 Supply**

The regulator circuitry is on the power supply printed circuit board. The actual output of this supply is 51 volts, which is reduced to 48 volts through the decoupling resistor at the microphone input (see Phantom Power, above).



## 6. MAINTENANCE

The VT-15 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, the VU meter calibration, and to sidechain alignment trimpots. Eighteen 6-32 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).

### Bottom Cover Removal

**WARNING! High voltages are exposed when the bottom cover of the VT-15 is removed. Refer all servicing to the factory or to technicians who are experienced in working on vacuum tube equipment. Voltages over 400 are used in the VT-15. Contact with these voltages could result in serious injury or death.**

Removing the bottom cover allows access to the VT-15 circuitry, the pulse width modulator board adjustments, and the filament voltage adjustment. Eighteen 6-32 phillips-head screws must be removed.

### Alignment

The VT-15 compressor is complicated to align and requires test equipment nor normally found in most studios. If alignment is required, the VT-15 should be returned to the factory, or contact the factory for detail alignment instructions. Mis-alignment of the VT-15 will result in very poor (and possibly bizarre) performance. Do not touch any adjustments!

### Vacuum Tubes

Four 6072A tubes and two 6N1P tubes are used in the VT-15. If tube replacement is needed, contact the factory for instructions and tube layout. The 6072A mic preamp input tube and the compressor preamp tube are quite critical for proper performance. There can be as much as a 15 dB difference in noise level among an assortment of tubes, and the tubes used in these stages should be carefully chosen to maintain low noise. Selected low-noise tubes are available from D. W. Fearn. Other tubes are far less critical and almost any quality off-the-shelf 6N1P will perform satisfactorily. 12AY7 tubes may be substituted for the 6072A tubes, but with reduced performance.

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-15 and compare the results to previous measurements.

Tubes also 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 VT-15 output, with 50 dB gain, any microphonic response above -55 dBm is excessive. Replacement is indicated unless the VT-15 always operates in a quiet and vibration-free environment.

Remember that vacuum tubes may be quite hot during operation. Protect your fingers during tube replacement. The VT-15 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. There are only a limited number of NOS (new old-stock) 6072A tubes in the world. Treat each one carefully.

### **Electrolytic Capacitors**

The VT-15 is 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 VT-15 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 decouplers. In choosing a replacement, the same considerations as with the filter capacitors should be followed.

### **VU Meter Calibration**

The meter amplifier circuit is stable and re-adjustment of the meter calibration is not normally required. If the output reference level needs to be changed, here is the procedure:

1. Remove the VT-15 top cover (see above).
2. Terminate the output in the same impedance as the VT-15 will normally be feeding. This will almost always be a high-impedance bridging termination of 20k ohms or more.
3. Apply AC power. Allow at least an hour warm-up. Feed a 1 kc tone at about -45 dBm into the VT-15 input.
4. Measure the output and set the Preamp Gain control for +4 dBm (or whatever reference is desired).
5. Set the Meter Calibration trimmer potentiometer for 0 VU on the VT-15 meter. Be sure the meter is in the VU position. This control is a 25-turn pot so the adjustment is easy. A small screwdriver or alignment tool is necessary. The control is located on the relay printed circuit board on the top of the chassis, on the far left side and it is the only trim pot on this board.
6. Replace the top cover. Be sure the ventilation slots are over the tubes (towards the back).

## **7. Troubleshooting Factory Check-Out Warranty Repair**

### **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 VT-15 to the factory for repair. Call first, however, for shipping information.

### **Factory Check-Out**

We will always provide free testing and alignment of any of our products. There is no charge except for shipping in and out, and any parts that are not covered by the warranty. Call for instructions. We can usually return a properly-performing VT-15 in a couple of days. If repairs are needed, we will discuss it with you before proceeding. We always operate any repaired VT-15 for at least 24 hours to make sure it is operating properly before return.

### **Warranty Repair**

If the VT-15 should develop a problem during the five-year warranty period, call the factory for return shipping instructions. We will repair and return your VT-15 quickly. Note that the warranty does not cover vacuum tubes, which must be periodically replaced.