

User's Manual

Version 1.1 December 2001

ENGLISH



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FOREWORD

Dear Customer,

We thank you for expressing your confidence in BEHRINGER products by purchasing the BEHRINGER TUBE ULTRAFEX. It is one of my most pleasant tasks to write this preface, as our engineering team has made it possible to enhance the traditional tube circuitry design (particularly for our VINTAGER series of products), and adapt it to meet the high sound quality and dynamics requirements of modern, pro-level audio technology. The fact that we are still fascinated by “antique” tube radios and amps as well as the fine and warm tonal character that we usually associate with them, are the reasons why vacuum tubes have kept their ground even in state-of-the-art circuit topologies used especially in professional audio technology or high-end devices. We are particularly proud that we have found an extremely effective symbiosis between solid-state and tube technologies making them affordable to anybody interested in audio technology. As always, our top-priority concern when developing this device was the demanding end user, in other words: you. It was our major goal to meet your demands. Sure, it meant a lot of hard work to develop such a product, but the fun has made it all worthwhile. The shine in the eyes of the many interested musicians at the Music Fair 1997, when they saw our VINTAGER models for the first time, was a lasting incentive driving our development efforts.

It is our philosophy to share our joy with you, because you are the most important member of the BEHRINGER family. With your highly competent suggestions for new products you’ve greatly contributed to shaping our company and making it successful. In return, we guarantee you uncompromising quality (manufactured under ISO9000 certified management system) as well as excellent technical and audio properties at an extremely favorable price. All of this will enable you to fully unfold your creativity without being hampered by budget constraints.

We are often asked how we can make it to produce such high-grade devices at such unbelievably low prices. The answer is quite simple: it’s you, our customers! Many satisfied customers means large sales volumes enabling us to get better conditions of purchase for components, etc. Isn’t it only fair to pass this benefit back to you? Because we know that your success is our success, too!

I would like to thank all people whose help on “Project TUBE ULTRAFEX” has made it all possible. Everybody has made very personal contributions, starting from the designers of the unit via the many staff members in our company to you, the user of BEHRINGER products.

My friends, it’s been worth the trouble!

Thank you very much,

A handwritten signature in black ink, appearing to read 'U. Behringer', with a long horizontal flourish extending to the right.

Uli Behringer

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1. INTRODUCTION

In purchasing the new TUBE ULTRAFEX T1954, you have acquired an extremely efficient and universal sound processor which combines the sound enhancement features of the ULTRAFEX series with the tube sound of the BEHRINGER ULTRA-TUBE technology. Since its announcement of the first ULTRAFEX model in year 1990, it has caused a sensation. This high-end sound enhancement processor is based on our many years of experience and discoveries in the field of psycho-acoustics. The TUBE ULTRAFEX finds widespread application throughout the world, in renowned studios, sound reinforcement systems as well as in broadcast and TV studios. The sound precision and flexibility of the functions are the main outstanding features of this high-end unit. The TUBE ULTRAFEX is our state-of-the-art sound enhancement system offering a special combination of sound improvement designs. The unit can be used wherever professional sound improvement is required. The BEHRINGER TUBE ULTRAFEX is the no-compromise answer when the situation demands a no-compromise solution.

Advanced BEHRINGER technology

The philosophy behind BEHRINGER products guarantees a no-compromise circuit design and employs the best choice of components. The TUBE ULTRAFEX uses high-quality resistors and capacitors with very tight tolerances, high-grade switches, low-noise operational amplifiers (type 4580) as well other selected components.

Additionally, the unit is manufactured in compliance with the ISO9000 certified management system.

1.1 The Design Concept

Compared to its predecessors, the TUBE ULTRAFEX offers several advanced features and we have succeeded in dramatically refining the audio qualities. The unit now features our new UTC tube circuitry and a new L/C filter switch which offers more power in the bass area. Beside that a new VSP (Variable Sound Processing) circuitry has been added to allow you to use simultaneous exciter and enhancer sound processing.

Since the introduction of the first psycho-acoustic Processors, technology in this field has made tremendous progress. Although the fundamental principles of enhancer and exciter technology have been well-known for a long time, engineers have been able to refine and improve the essential components over and over again. The BEHRINGER company has also contributed considerably to this development:

With the introduction of our "Natural Sonic" processor, we have set new standards. Previously encountered problems of restricted leveling range, plus increased noise level and audible distortion during signal processing, are typical shortcomings of conventional circuit designs. They were completely solved by the development of new circuitry.

The BEHRINGER TUBE ULTRAFEX is equipped with different sound enhancement features which stand for a new achievement in the history of sound processors: The legendary BEHRINGER Natural Sonic principle in combination with the Variable Sound Processing circuitry (VSP) and the integrated Noise Reduction system offer presence and transparency for your music without receiving unwanted noise. The Bass Processor additionally adds power to the bottom end. The innovative Surround Processor enables extra depth and width for stereo signals. As a special feature the TUBE ULTRAFEX comes with the new ULTRA-TUBE technology (UTC) that adds warmth and translucency to your music.

In the TUBE ULTRAFEX two selected 12AX7/ECC83 vacuum tubes are used. These triodes are capable of handling a large dynamic range with little microphony. In addition to that their relative ruggedness and above average life span and you can see why it's one of the most popular and reliable pre-amp tubes on the market. These features also ensure you their availability for many years to come.

Failsafe relays have been incorporated into the design of the BEHRINGER TUBE ULTRAFEX, which automatically and silently bypass the unit in the event of power supply disconnection or failure. These relays are also active at switch-on to isolate the TUBE ULTRAFEX until the power rails have settled, thus preventing the possibility of a potentially damaging switch-on thump.

1.2 Before You begin

Your BEHRINGER TUBE ULTRAFEX was carefully packed in the factory and the packaging was designed to protect the unit from rough handling. Nevertheless, we recommend that you carefully examine the packaging and its contents for any signs of physical damage, which may have occurred in transit.

⚠ If the unit is damaged, please do not return it to the shipping company immediately, otherwise claims for shipping claims must be made by the consignee.

The BEHRINGER TUBE ULTRAFEX fits into two standard rack spaces with an additional 4" depth for the connectors on the back panel.

Be sure that there is enough space around the unit for cooling, especially when used on high temperature devices such as power amplifiers etc.

⚠ Before you connect your TUBE ULTRAFEX to a power source, make sure the voltage matches the voltage required by the unit.

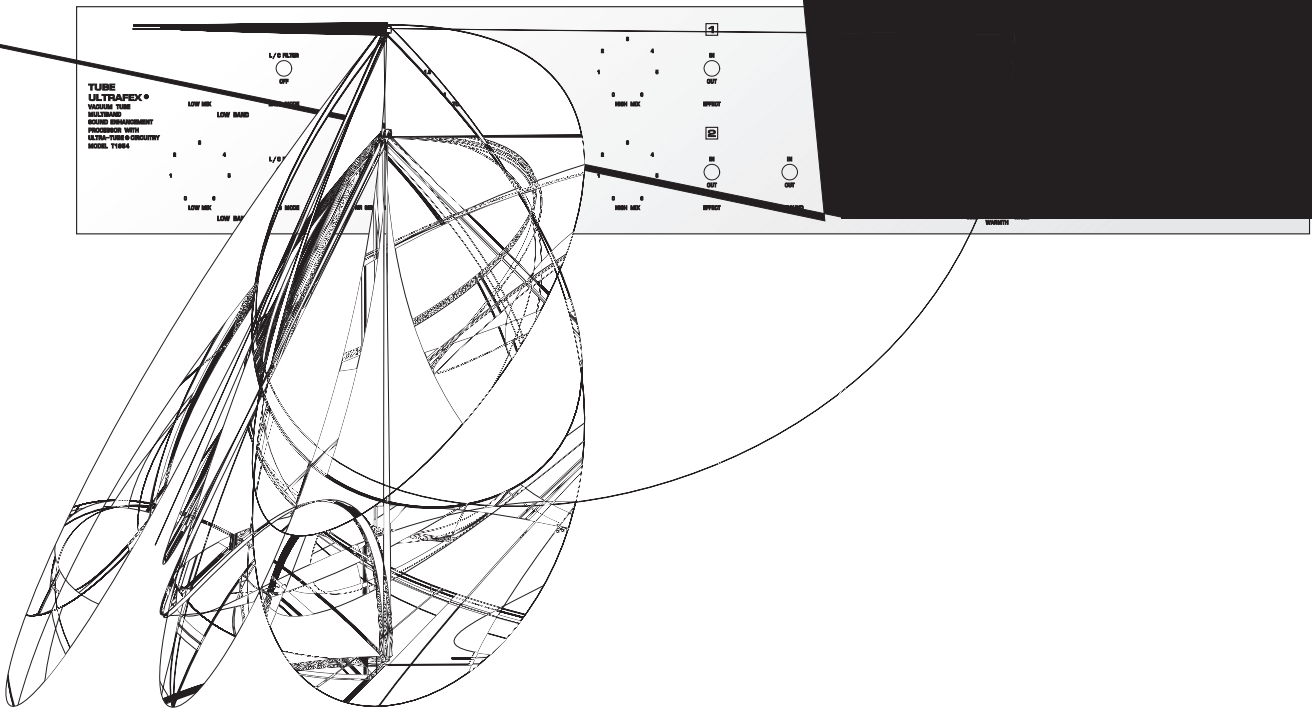
The mains connection of the TUBE ULTRAFEX is made by using a standard IEC power cord. It meets all of the international safety certification requirements and includes a proper ground connection.

⚠ Please ensure that only qualified persons install the unit. During installation and operation the user must have sufficient knowledge of static charges might affect the operation of the TUBE ULTRAFEX.

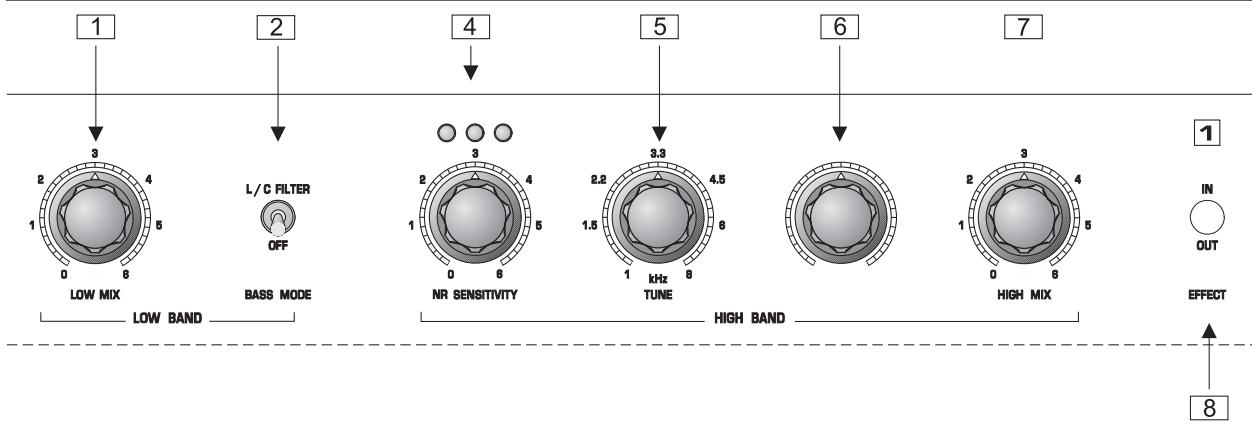
Additional information you will find in Chapter 5 "INSTALLATION AND OPERATION".

As a standard the audio inputs and outputs on the TUBE ULTRAFEX are balanced. The unit to other devices in a balanced configuration to allow for common mode rejection. The automatic servo function detects unbalanced connections and corrects them (6-dB correction).

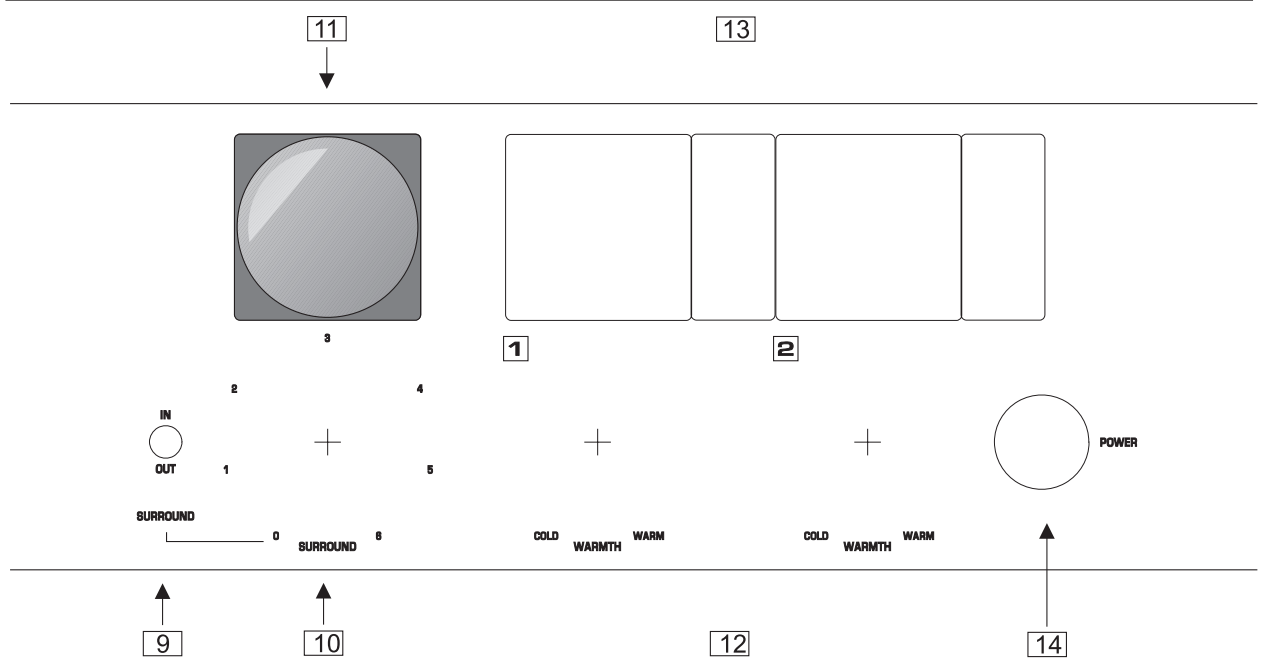
1.3 Control Elements



TUBE ULTRAFEX T1954



TUBE ULTRAFEX T1954



- 17] *AUDIO IN*. These are the audio inputs of your TUBE ULTRAFEX, available both as balanced 1/4" TRS connectors and XLR connectors.
- 18] *AUDIO OUT*. These are the audio outputs of your TUBE ULTRAFEX. Matching phone jack and XLR connectors are wired in parallel. These outputs can be transformer-balanced by retrofitting the optional output transformer OT-1. The reference level is +4 dBu and the maximum level comes to +21 dBu.

2. OPERATION

2.1 Introduction

The BEHRINGER TUBE ULTRAFEX combines the legendary sound enhancement possibilities with the musical tube sound of the UTC technology.

The BEHRINGER UTC technology

The BEHRINGER TUBE ULTRAFEX uses our newly developed UTC technology, a development resulting from two years of intensive research work by our engineering team. This technology overcomes the problems related to tube circuitry (see Chapter 3) and generates upper harmonics even at low levels to give your recordings more warmth and power.

The BEHRINGER Natural Sonic Processor: sound enhancement of classical and pop music

The BEHRINGER Natural Sonic principle is based on frequency-selective phase shifting in conjunction with program-dependent equalization and pulse enlargement. An automatic and natural correction during signal processing offers a quality of sound enhancement that has been almost inconceivable until now. Program-dependent control permits the "musical" and unobtrusive transparency required for classical music material, yet also provides the necessary brilliance for pop recordings. Owing to its dynamic control, and in contrast with conventional units, the circuitry does NOT introduce any additional noise, non-related harmonics or distortion.

The VSP (Variable Sound Processing) circuit

The new VSP (Variable Sound Processing) circuit used for the first time in the TUBE ULTRAFEX, allows for variably fading over from enhancer to exciter mode. Using the PROCESS control clockwise, the exciter circuit comes in additionally to provide a variable and carefully adjusted processing of high frequencies. The result is an increased brilliance and transparency. Fading over from one effect to the other can thus adapt the effects perfectly to the respective program material.

Built-in Noise Reduction system

Due to physical reasons, exciters and enhancers principally increase noise of the processed program material. Therefore, we have incorporated a switchable noise reduction system which is capable of automatically fading out any additional noise.

Bass Processor

The TUBE ULTRAFEX is equipped with a separate Bass Processor which allows for sound enhancement in the lower frequency band. The newly developed, switchable LC filter produces a more dry and substantial bass sound. Processing the bass range means an optimum completion of high-frequency processing and opens up new dimensions in the field of sound processing.

Surround Processor

A switchable Surround Processor has also been integrated into the TUBE ULTRAFEX. With this processor the intensity of the stereo effect can be dramatically improved (see chapter 4.5 for additional information).

2.2 The Position of the TUBE ULTRAFEX in the Signal Path

The perfect position for inserting the TUBE ULTRAFEX in the signal path depends on the terms of reference:

The stereo structure of the TUBE ULTRAFEX suggests to connect the device with the subgroup or main inserts. If your mixer does not have inserts you can also position the TUBE ULTRAFEX between the Main Mix output and a recording device. Moreover the use between signal processors and a mixer makes sense.

Of course, you can also use the channels of the TUBE ULTRAFEX independent of each other. So you can process two mono signals independently.

2.3 Basic Setting

We recommend setting the controls as indicated in the following section. This will give you a better idea of switch and control functionality:

- ▲ Set the SURROUND IN/OUT switch to position OUT and the L/C FILTER switch to position OFF. Turn the TUNE controls to center position and all other controls fully CCW. Set the EFFECT IN/OUT switch to position IN.
- ▲ You may find that getting to know a dual channel processor like the TUBE ULTRAFEX is easier when you concentrate on one channel first. If you have a mixer connect the TUBE ULTRAFEX to the insert of one channel only. See also the Chapters 2.1 and 3 for the right connection.

2.4 Adjustment of the Bass Processor

Apart from processing the upper harmonic ranges, users of the BEHRINGER TUBE ULTRAFEX have access to an innovative Bass Processor.

The numerous stages of processing during the recording, reproduction, copying and effecting processes, increasingly delay the phase of the bass frequencies, when compared to the remaining frequency ranges. This is why the low-frequency range suffers from a loss in power and fundamental bass definition.

With the help of frequency-selective phase shift combined with sub-bass boost, the Bass Processor of the BEHRINGER TUBE ULTRAFEX is capable of compensating for this loss, giving the program material new bass presence. Using the MODE switch, you can select between two different bass sounds.

Be extremely careful when using the Bass Processor: excessive use of the Bass Processor might lead to speaker damage. The amplified sub-bass frequencies may well place a heavy load on the amplifier and the woofers. Therefore, carefully adjust the Bass Processor and observe the power rating of your system!


2.5 Adjustment of the Noise Reduction System

With the SENSITIVITY control you can now adjust the noise reduction system.

The noise reduction system prevents noise from becoming audible during pauses and soft pieces in the program material. The enhancer/exciter signal is reduced dynamically when the signal drops below the value set by the NR SENSITIVITY control. The NR SENSITIVITY also controls the sensitivity of the enhancer/exciter. When the NR SENSITIVITY control is turned clockwise more harmonics are added by the enhancer/exciter section. Turn the control counter-clockwise with lower signals and further clockwise for loud signals.

Use the three LEDs above the control to monitor the effect to avoid “pumping” or other side effects.

When more LEDs light up the enhancer/exciter is increasingly active. When all three light up the Noise reduction system is inactive. When none light up the effect signal is muted, the enhancer/exciter is inactive. Try to set it up so that at soft pieces only one LED lights up and all three light up at loud pieces.


 **When the NR SENSITIVITY control is turned so far counter-clockwise that no LEDs light up, the effect signal is muted and the settings for the enhancer/exciter are inactive. When this happens, simply turn up the NR SENSITIVITY until the LEDs light up.**

2.6 Adjustment of the Enhancer/Exciter System

Now you can start processing the high frequencies. Turn the HIGH MIX control clockwise and notice how the high frequencies become more pronounced and transparent. When you turn the TUNE control, the frequency at which the effect begins is changed, the PROCESS control changes the way the effect operates. When set to ENHANCER only frequencies that are present in the original signal are used, when set to EXCITER artificial harmonics are generated based on the frequencies present in the signal. When the control is turned clockwise the sound gains brilliance but also sharpness. Use the exciter on instruments which do not have an abundance of upper harmonics i.e. bass guitars, to give them more brilliance and “Punch”. Use the enhancer, to boost high frequency information that is already present.

Because the effect of an enhancers/exciter is impressive at first, there is a danger of overdoing the effect. We recommend that you make frequent A/B comparisons (IN/OUT) between the original and the processed signals. Rule of thumb: sound-enhancing effects should be “missed” when absent instead of directly audible.

Remember, less is more. Used with care an exciter can greatly improve the intelligibility while extreme settings can become sharp after a while.

 **When exposed to high sound pressure level (as in a recording studio) the ears can show signs of fatigue, resulting in a decreased sensitivity to high frequencies. Take regular breaks when you are using this, or any other sound equipment.**

2.7 Adjustment of the Tube Stage

With the settings you have achieved so far a considerable sound improvement can be made. You may not know this, but you have already benefitted from the tube stage of the TUBE ULTRAFEX. Even when the WARMTH control is turned fully counter-clockwise, subtle and hardly noticeably warmth and musicality is added to the signal. You can now drastically increase the effect by turning up the WARMTH control.

Increasing amounts of upper harmonics generated by the new UTC circuitry are then added to the signal. This leads to more musical and transparent highs which combine perfectly with the enhancer/exciter effect, which can perhaps even be reduced a little in favour of the warm tube sound. You can monitor the amount of warmth that is added with a glance at the WARMTH meter.

2.8 Adjustment of the Surround Processor

Sound quality during signal transmission is given top priority today. The signal is processed with the help of reverb devices, compressors, exciters, denoisers etc. to produce a compact, low-noise and transparent sound.

However, the fact that hearing impression depends largely upon the positioning of the instruments within the stereo panorama is often enough neglected. Using the Surround Processor of the TUBE ULTRAFEX, the intensity of the stereo effect can be dramatically improved. The program material gains in liveliness, loudness and transparency. As in a cinema with its special acoustics, the listener has the impression that the orchestral instruments are placed all around him. The Surround Processor enlarges the stereo basis dependent on the program material, without audibly colouring the sonic image.

The function of the Surround Processor is based on the derivation of a special signal, which is generated from the difference of the left and right channel. This signal is then delayed program-dependently and mixed with the original signal. The difference between the two channels is the "stereo substance" whose ambience and spatial information is improved by delaying the signal.

Due to the described function, the Surround Processor is principally useful only with stereo program material.

3. APPLICATIONS

3.1 Sound Enhancement during Replay

For this application, the BEHRINGER TUBE ULTRAFEX follows the master or multi-track recorder, i.e., inserted between tape machine and mixer (or amplifier). Of course, a cassette recorder, or similar, can also be used as signal source.

If a companding noise reduction system is used in this situation, it should precede the TUBE ULTRAFEX.

3.2 Sound Enhancement during Recording

The sound enhancing effect can be increased by using the BEHRINGER TUBE ULTRAFEX not only during replay but during recording. This method of sound processing is recommended, in particular, if the subsequent storage medium is of poor quality. When doing tape duplications, the enhancer signal added during the recording will compensate for the loss in quality which occurs when several generations of copies are made from the master tape.

In this scenario, insert the TUBE ULTRAFEX directly after the master output of the mixer into the recording path of the master or multi-track machine.

In particularly difficult cases, we recommend using the TUBE ULTRAFEX both during recording and replay.

3.3 Enhancing the Sound of Subgroups, Monitor and Effect Paths

For this application there are several options:


1. If your mixer features subgroup outputs with insert points, you can process the subgroups separately.
2. You can also combine monitor and effect paths and route them via the BEHRINGER TUBE ULTRAFEX to a free input channel. The respective signals have to be taken “pre-fader”, the respective channels must be muted. It will be useful to insert the TUBE ULTRAFEX as the last component in the chain of effects devices. The summed signals will then be routed through the TUBE ULTRAFEX, and sent back to the master via the “effect returns”. The channels need be muted. Set up the mix as usual with the faders and determine which “monitor” or “effect send” controls the signal portions to be routed to the BEHRINGER TUBE ULTRAFEX. With the help of the “effect return” control you can adjust the amount of the sound enhancing signal which is added to the summed signals. Be sure that the channels are muted for this kind of application, since the combination of original signals via the summed, as well as the effects path, may lead to phase cancellations (comb filter effect).

3.4 Enhancing the Sound of Tape Duplication

Even under the most favourable of conditions, presence, liveliness and transparency of the program material will suffer during each copying process. These losses are particularly obvious when copying cassettes while simultaneously using a noise reduction system.

With the BEHRINGER TUBE ULTRAFEX, losses during tape duplication can be avoided or compensated for. Provided that the original is of good enough quality with only low noise levels. It is even possible to produce “super” copies which sound even better than the original.

For this purpose, the TUBE ULTRAFEX is inserted between the line outputs of the source machine and the inputs of the target machine. Machines with post-head listening control (setting “tape”) allow you to check the quality of the copy while duplicating the tape.

 **If the tape noise is fairly high, a different strategy is required, since the TUBE ULTRAFEX can effectively process the frequency ranges in which the most predominant noise portions can be found. We recommend attenuation of noisy high frequencies, either with an equalizer or – better still – with a “single-ended” noise reduction system. The TUBE ULTRAFEX will process those frequencies with all their natural clarity - but without the tape noise.**

We would like to point out in this section that we offer an extremely powerful noise reduction system – the DENOISER SNR2000. The noise produced by magnetic tapes or any other signal sources can be dramatically reduced with the BEHRINGER DENOISER SNR2000. Not only the noise produced by mixers, effects devices etc., but also by synthesizers, guitars etc., can be effectively reduced. Copied tapes and cassettes will benefit from low noise and high dynamics.

The TUBE ULTRAFEX when used in conjunction with the DENOISER SNR2000 will prove an ideal combination for sound enhancement. Please contact us for further information or visit our website at www.behringer.com!

3.5 Enhancing the Sound of Instruments

The bandwidth of most electronic musical instruments is limited by its “sampling rate”. The BEHRINGER TUBE ULTRAFEX can improve the sound, so that synthesizers, samplers and drum machines have a more natural and transparent sound.

With the TUBE ULTRAFEX even tiny details within the sound of acoustic musical instruments such as guitars etc., can be emphasized without affecting the overall sound of the instrument. Drum instruments such as toms, bass drums etc., benefit from a “punch” and thus achieve a more powerful, precise and defined sound.

Please note that low-level signal sources such as microphones, guitars etc. should pass through a pre-amplifier before the processing stage, since the TUBE ULTRAFEX is a line-level device.

3.6 Enhancing the Sound of P.A. Systems

If used in P.A. and other sound reinforcement systems for background or live music, the BEHRINGER TUBE ULTRAFEX offers astounding advantages:

1. In audio systems for announcements and background music, the TUBE ULTRAFEX is placed in a similar way to recording and tape duplication - directly before the power amp. The intelligibility and range of your system will be improved and the sonic image will become clear and transparent, even at low volume levels. Problems caused by background noise fluctuations, room acoustics (reflections), and speaker setup can be solved more easily.

For instance, in discos or clubs you do not need to constantly readjust the high frequencies as the place becomes increasingly crowded; you will be able to protect your speaker system and the hearing of visitors.

Background music in bars and restaurants can be heard easily. It does not annoy your guests because its volume had to be turned up too far.

2. The sound of any P.A. system will be improved by using the TUBE ULTRAFEX. For example, the vocals of music groups or speech transmissions will be considerably more transparent and intelligible, the instruments can be distinguished more easily. The bass will gain in "depth" and power.
3. The TUBE ULTRAFEX will increase the speaker systems' acoustic performance and its ability to penetrate a room, particularly in places with difficult acoustics. The system also needs less effective amplifier power, since the subjectively heard volume level increases. Powerful and detailed sound reproduction can also be achieved in "weak" systems.

3.7 Sound Enhancement in HiFi and Video

Of course, the BEHRINGER TUBE ULTRAFEX can also find applications in the fields of hifi and video. The unit is simply placed between the signal source (cassette recorder, tuner, VCR etc.) and the power amplifier. We recommend using the "tape monitor" inputs most pre-amplifiers provide, thus the TUBE ULTRAFEX can be switched into any signal source.

4. TECHNICAL BACKGROUND

4.1 The BEHRINGER TUBE ULTRAFEX ...

- ▲ increases presence and transparency. The program material will sound lively and natural again.
- ▲ improves the intelligibility of speech: voices become clearly articulated, text easily intelligible, the transparency of the vocal increases.
- ▲ provides a distinct sound improvement, particularly for instruments played in a percussive style - "slapped" bass guitars or drums will sound incredibly "funky".
- ▲ provides better stereo imaging: the sound becomes more differentiated, the positioning of the speakers is much easier, yet the signal remains fully mono-compatible.
- ▲ does not require any decoding process, since sound enhancement with the TUBE ULTRAFEX is not created independently of the signal itself, and remains available even during numerous processing or copying stages. Even digital recordings or CD replaying will gain from the use of the TUBE ULTRAFEX.
- ▲ increases the listener's awareness. Even with low sound pressure levels, the TUBE ULTRAFEX avoids listening fatigue.
- ▲ finds useful application in hifi systems by providing better resolution of the sonic image, due to its suitability for the studio and its outstanding specifications. In particular, the processing of old analog recordings (disks and tapes) proves to be very efficient with the TUBE ULTRAFEX.
- ▲ produces a more powerful and fuller bass which does not sound muddy. All recordings will benefit from the "dry" and precisely defined bass contouring.
- ▲ produces an improved spatial enhancement and stereo effect intensity with the Surround Processor without audibly colouring the sonic image.

4.2 Psycho-acoustic Background

The term psycho-acoustics refers to the psychological aspect of hearing — in contrast to the physiological transfer of impulses (transmission of nervous impulses). Psycho-acoustics examines the effect of sound on the listener and the reasons for certain sonic impressions. How a sound is interpreted is influenced by a lot of factors, most of them can hardly be measured yet are fairly important. For instance, those portions which are responsible for the spatial localization of a sound. Nevertheless, they determine the quality of a recording to an extraordinarily large extent.

There are also portions of the audio spectrum which we perceive as “presence” or “naturalness”. If this kind of information is missing, the recording suffers from a loss in “freshness”, “liveliness” and spatial transparency.

Furthermore, natural harmonics are essential components of the sound. Often enough, they only represent a minor portion of the signal and are easily lost. It’s the harmonic structure that makes a tone colour unique. Without this structure, different instruments would not be distinguishable. When comparing acoustic musical instruments, for instance acoustic guitars, you will note that even two instruments from the same series have a different sound. Numerous factors determine the sound of an instrument: the design and materials to name but two, but with such bearing on the eventual sound produced by that instrument.

From a physical point of view, a guitar produces a tone by means of a vibrating string which, in turn, sets air in motion. The subsequent propagating sound waves reach the ear and are identified by the brain as a tone. Since the string vibrates within itself, the tone consists of not only the fundamental oscillation but also innumerable upper harmonics which are based on the fundamental wave.

The complex vibrations of the string are transferred to the body which, in turn, is also set in motion. The combination of string and body produces the sound of the instrument. For example, certain harmonics may be amplified due to resonance effects in the body, while other frequencies may be canceled due to the properties of the wood.

This phenomenon creates complex sounds and is underlined by the fact that a combination of harmonics can produce additional tones, known as interference or residual tones. All of these tiny sound portions contribute to the sound of certain instruments. The human ear, which is highly sensitive, can detect even minimum changes in the harmonic structure of a sound.

By experiencing the CD quality of 32-bit converters etc., we have made considerable advances toward the naturalness of sound, yet still recordings do not sound like the music in a concert hall. Why is there a difference?

Here, the keyword is “intelligent hearing”: the visual contact with the musicians enables us to concentrate our attention on a certain instrument which results in an intensification of the sonic experience. The listener sitting in front of a speaker system lacks this spatial experience and at the same time the visual feedback aspect of listening to live music. The perceived positioning of instruments is made even more difficult since the dispersion of the sound is not homogeneous, i.e., widely panoramic, but usually reduced to two sound sources.

In particular, the loss of upper harmonics during the transmission of the sound additionally affects the perceived positioning of the instruments and the transmission of room ambiance. The reason for this loss in sound quality is the inadequacy of the sound recording and reproduction processes.

Each link in the transmission chain — from the microphone via mixers, effects devices, tape recorders amplifiers etc., to the loudspeakers — causes a loss in sound quality. Each time the sound is processed, it becomes audibly less “natural”.

4.3 On Psycho-acoustic Devices

Although the psycho-acoustic effect of enhancers and exciters etc., has been known for several decades, the function of these devices has been deliberately surrounded in mystique, to increase their appeal.

However, it is fairly clear that all devices in this field are based on certain technically repeatable methods of functioning. Basically, three principles apply:

- ▲ Sound improvement by means of dynamic frequency correction.
- ▲ The generation of a “wider” sound with the help of phase shifting with respect to delay times.
- ▲ The enrichment of the program material with artificially generated harmonics.

Independently of each other, each of these methods produces a certain effect which is perceived as a subjec-

tive enhancement within the sound.

These methods are described in more detail in the following:

4.3.1 Frequency correction

The boosting or cutting of certain frequency ranges is the simplest form of sound modification. Equalizers can correct the sonic image in order to produce a sound that is more pleasing to each taste.

So-called “treble boosters” achieve this effect by emphasizing the high frequencies, which the listener perceives as a transparent sonic image.

Within the BEHRINGER TUBE ULTRAFEX, any frequency correction is combined with a frequency-dependent phase shift, which results in a sound that is “warmer” and more musical.

4.3.2 Phase shifting

The term phase shift describes the displacement of a signal’s phase in relation to its point of origin. As a matter of principle, the phase shift produces a delay within the signal.

If the delayed signal is added to the original signal, the resultant signal becomes “wider”. Below time delay values of 20 msec. the brain perceives the delayed arrival of the two signals as the arrival of one signal, which results in the desired “pulse enlargement” effect, sometimes called “3-D” effect by other manufacturers.

The effect produced by so-called “chorus” units is based on the same principle of phase shift and signal delay. Here, several delayed signals are added to evenly intensify this effect.

The BEHRINGER TUBE ULTRAFEX is equipped with a frequency-selective phase shift circuit that comprises several stages. Due to the program-dependent delayed signal, the sonic impression becomes more vivid, as with an orchestra, where the musical liveliness is the result of inaccurate “entries” by musicians.

4.3.3 Artificial harmonics generation

By 1955 an American, Charles D. Lindridge, had already invented the first “EXCITER” (a unit that EXCITES upper harmonics), when he presented a unit for “improving the sound of music and speech”. He enriched signal sources with artificially generated upper harmonics and found that both sound quality, transparency and perceived positioning of musical instruments could be considerably improved using this effect. He was granted an American patent on his circuit design under the number US 2 866 849.

Compared to modern technology, Lindridge’s circuit was anything but fully developed, however, it featured many of the aspects found in today’s modern circuit designs.

Psycho-acoustic discoveries and greater knowledge, gathered over the years, have allowed for new and improved circuit designs, through the use of advanced technology.

4.4 The Bass Processor of the TUBE ULTRAFEX

Apart from processing the upper harmonic ranges, users of the TUBE ULTRAFEX have access to an innovative Bass Processor.

The numerous stages of processing during the recording, reproduction, copying and effecting processes, increasingly delay the phase of the bass frequencies, when compared to the remaining frequency ranges. This is why the low-frequency range suffers from a loss in power and fundamental bass definition.

With the help of frequency-selective phase shift combined with sub-bass boost, the Bass Processor of the TUBE ULTRAFEX is capable of compensating for this loss, giving the program material new bass presence. Using the MODE switch, you can select between two different bass sounds.

Be extremely careful when using the Bass Processor: excessive use of the Bass Processor might lead to speaker damage. The amplified sub-bass frequencies may well place a heavy load on the amplifier and the woofers. Therefore, carefully adjust the Bass Processor and observe the power rating of your system!

4.5 The Surround Processor of the TUBE ULTRAFEX

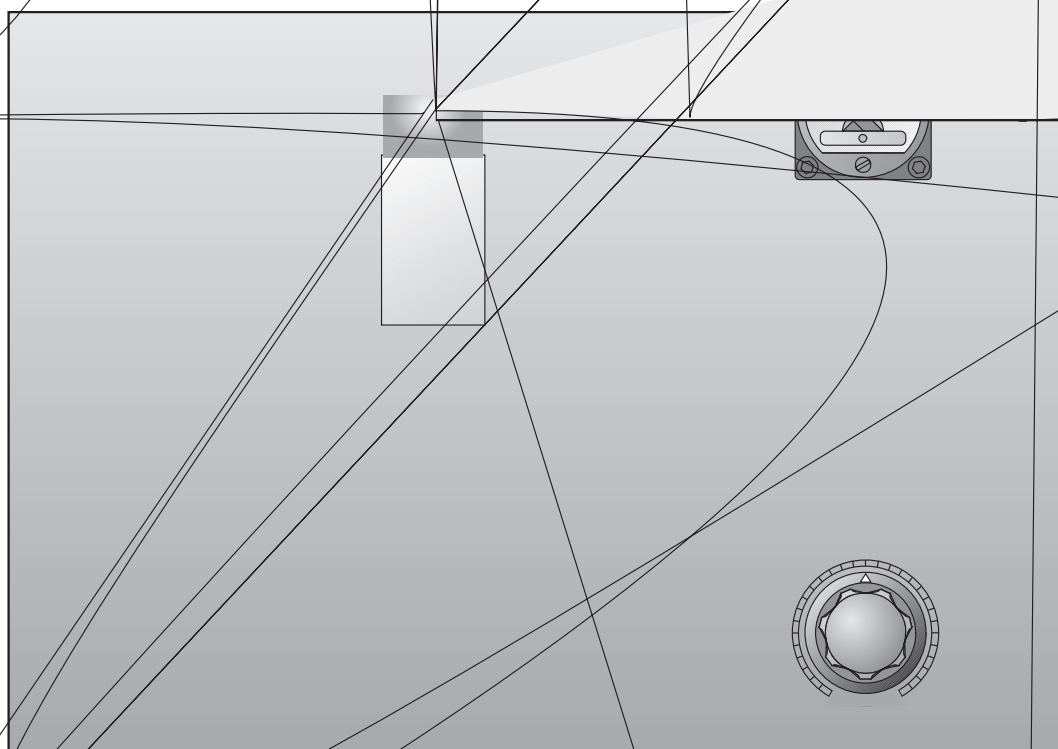
Sound quality during signal transmission is given top priority today. The signal is processed with the help of Reverb devices, Compressors, Exciters, Denoisers etc. to produce a compact, low-noise and transparent sound. However, the fact that hearing impression depends largely upon the positioning of the instruments within the stereo panorama is often enough neglected. Using the Surround Processor of the TUBE ULTRAFEX, the intensity of the stereo effect can be dramatically improved. The program material gains in liveliness, loudness and transparency. As in a cinema with its special acoustics, the listener has the impression that the orchestral instruments are placed all around him. The Surround Processor enlarges the stereo basis dependent on the program material, without audibly colouring the sonic image.

The function of the Surround Processor is based on the derivation of a special signal, which is generated from the difference of the left and right channel. This signal is then delayed program dependently and mixed with the original signal. The difference between the two channels is the "stereo substance" whose ambient and spatial information is improved by delaying the signal. Due to the described function, the Surround Processor is principally useful only with stereo program material.

4.6 The Vacuum Tubes of the TUBE ULTRAFEX

4.6.1 UTC circuit

Our engineering team has made it possible to enhance the traditional tube circuitry (particularly for our TUBE ULTRAFEX) and adapt it to meet the high sound quality and dynamics requirements of modern, pro-level audio technology. The fact that we are still fascinated by "antique" tube radios and amps as well as the fine and warm tonal character that we usually associate with them, are the reasons why vacuum tubes have kept their ground even in state-of-the-art circuit topologies used especially in professional audio technology or high-end devices. We are particularly proud that we have found a highly effective symbiosis between solid-state and tube technologies making them affordable to almost anybody in audio technology.



professional studios. Manufacturers try with ever new algorithms to get the most out of DSP's (Digital Signal Processors), the heart of any digital system.

Still, many audio engineers, particularly old hands often prefer using both old and new tube-equipped devices. As they want to use their warm sound character for their productions, they are ready to accept that these "little darlings" produce a higher noise floor than modern, transistor-based devices. As a consequence, you can find a variety of tube-based microphones, equalizers, pre-amps and compressors in today's recording and mastering environments. The combination of semiconductor and tube technologies gives you the additional possibility of using the best of both worlds, while being able to make up for their specific drawbacks.

4.6.2 Tube history

Due to many patent litigations, it is difficult to determine exactly when the tube was "born". First developments in tube technology were reported between 1904 and 1906. It was a research task of that time to find a suitable method for receiving and rectifying high frequencies. On April 12, 1905, a certain Mr. Fleming was granted a patent for his "hot-cathode valve" which was based on Edison's incandescent lamp. This valve was used as a rectifier for high-frequency signals. Robert von Lieben was the first to discover (probably by chance) that the anode current can be controlled by means of a perforated metal plate (grid) – one of the milestones in the development of amplification tubes. In 1912, Robert van Lieben finally developed the first tube for the amplification of low-frequency signals. Initially, the biggest problem was to produce sufficient volume levels, which is why resonance step-ups (though impairing the frequency response) were used to maximize the attainable volume. Later, the objective was to optimize the electroacoustic transducers of amplifiers in such a way that a broad frequency band could be transmitted with the least distortion possible.

However, a tube-specific problem is its non-linear amplification curve, i.e. it modifies the sound character of the source material. Despite all efforts to ensure a largely linear frequency response, it had to be accepted that tube devices produce a "bad" sound. Additionally, the noise floor generated by the tubes limited the usable dynamics of connected storage media (magnetic tape machines). Thus, a one-to-one reproduction of the audio signal's dynamics (expressed as the difference between the highest and lowest loudness levels of the program material) proved impossible. To top it all, tube devices required the use of high-quality and often costly transducers and sophisticated voltage supplies.

With the introduction of semiconductor technologies in the field of audio amplification, it soon became clear that the tube would have to give way to the transistor, as this device featured an enormously enhanced signal-to-noise ratio, required a less complex power supply and yielded an improved frequency response. Plus, semiconductor-based circuits can be realized much more easily - for less money.

Two decades later, the introduction of binary signal processing meant the beginning of a new era of recording media that provided plenty of dynamic response and allowed for the loss-free copying of audio signals. As digital media were enhanced, however, many people began to miss the warmth, power and liveliness they knew from analog recordings. This is why purists still today consider digital recordings as "sterile" in sound.

4.6.3 Design and functional principle of tubes

Tubes can be roughly classified according to the number of electrodes they use. There are tubes with two, three or five electrodes usually referred to as diodes, triodes or pentodes.

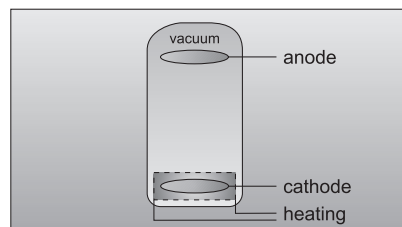


Fig. 4.2: Diode

The *diode* contains two electrodes in a vacuum glass bulb that have electrical connection to the outside. The vacuum allows for a free movement of electrons. When one of the electrodes is heated up (= thus becoming a cathode), it begins to emit electrons. When a positive DC voltage is applied to the other electrode (= anode), the negative electrons start to migrate from the cathode to the anode. With reverse polarity between cathode

and anode, a current flow is not possible because the unheated anode emits more or less no electrons. This design was used, for example, as a rectifier in the power supplies of amplifiers. The magnitude and velocity of the flow of electrons depend on the cathode's temperature, the material it consists of, and the magnitude of the anode voltage. When the electrons hit the anode they produce heat that is dissipated by using large anode plates.

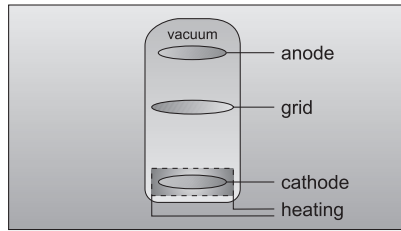
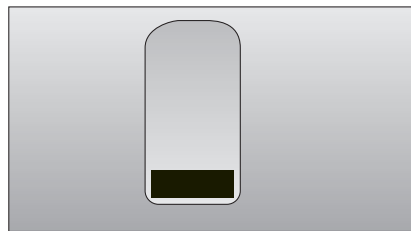


Fig. 4.3: Triode

The *triode* has an additional metal grid between anode and cathode. By applying a negative voltage, this grid can be used to control the internal resistance of the tube, and hence the anode current. When the grid bias voltage (voltage between cathode and grid) becomes negative, the current flowing to the anode is reduced because the negatively charged grid repels the arriving electrons. As a consequence, there are less electrons to reach the anode. When the bias voltage shifts towards zero, the flow of electrons accelerates. When it finally becomes zero or even positive, the grid current begins to flow which considerably reduces the current flowing to the anode and can possibly destroy the tube. Triodes are most commonly used in pre-amps, often in pairs arranged in one tube (twin triode).



you overdrive a transistor you get a sudden square deformation of the sine signal applied at the input, which produces an extreme harmonic spectrum at the output.

Non-linear distortions are measured with a distortion factor that consists of the total harmonic distortion [k] and partial harmonic distortions [k_n]. The latter are defined as the ratio between the voltage of a single harmonic and the voltage of the distorted overall signal. Thus, the content of even harmonics is expressed as k_2, k_4, \dots and that of odd harmonics as k_1, k_3, \dots .

$$k_n = \frac{U_n}{U}$$

Formula for calculating partial harmonic distortion

The total harmonic distortion is the root of all squared distortion factors of the second and third degrees. Since the higher harmonics have only little impact on the measured results, they can be neglected.

$$k = \sqrt{k_2^2 + k_3^2}$$

Formula for calculating total harmonic distortion

In tube circuits the distortion factor k_2 is used to describe an effect which the human ear classifies as “pleasant”. Also the frequency bands in which distortion occurs play an important role because the human ear differentiates very clearly, in particular, in the frequency range of human speech.

4.6.5 The best of both worlds

Despite many efforts neither manufacturers nor developers have succeeded so far in simulating these positive properties of the tube by means of other devices. Additionally, the natural capabilities of the tube to act as a soft limiter can only be mimicked with highly sophisticated circuitry. Today’s studio technology requirements are therefore met by a combination of both high-grade semiconductor and tube technologies. In this context, tubes no longer serve their original purpose as amplifiers, but are used for the detailed shaping of sound.


4.6.6 Studio applications

In a recording studio tubes do not perform the same task as they do in an overdriven guitar amp, where the considerably higher saturation of the tube(s) leads to a full and often deliberate modification of the input signal (in many cases combined with a heavy increase in noise floor levels). In the studio more subtle effects are needed. Here, tube circuits add life to the signal’s tonal character and increase its power to make itself heard. Often, tubes also increase the signal’s perceived loudness (in relation to the unprocessed signal), i.e. the perceived loudness goes up although the volume level remains the same. This is because the dynamic range of the applied audio signal is limited by the tube circuit, while the amplitude of the signal with the lowest loudness is raised. Thus, increasing tube saturation produces a slight compression effect over the entire dynamic range.

A similar effect can be perceived when analog tape is saturated. This saturation effect also compresses the recorded audio material and produces additional harmonics.

5. INSTALLATION

Your BEHRINGER TUBE ULTRAFEX was carefully packed in the factory and the packaging was designed to protect the unit from rough handling. Nevertheless, we recommend that you carefully examine the packaging and its contents for any signs of physical damage, which may have occurred in transit.

 **If the unit is damaged, please do not return it to us, but notify your dealer and the shipping company immediately, otherwise claims for damage or replacement may not be granted. Shipping claims must be made by the consignee.**


5.1 Rack mounting


The BEHRINGER TUBE ULTRAFEX fits into two standard 19" rack units of space. Please allow at least an additional 4" depth for the connectors on the back panel. Be sure that there is enough air space around the unit for cooling and please do not place the TUBE ULTRAFEX on high temperature devices such as power amplifiers etc. to avoid overheating.

5.2 Mains Connection

Before you switch on the unit, check that it is configured to match your AC mains voltage requirements. If it does not comply, then it is necessary to switch the operating voltage to the correct supply requirements BEFORE turning on the unit, otherwise the unit could be severely damaged. You will find this combined fuse holder/voltage selector at the back, adjacent to the IEC receptacle. The AC voltage selection is defined by the position of the fuse holder. If you intend to change the operating voltage, remove the fuse holder and twist it by 180 degrees before you reinsert it. Matching the two markers monitors the selected voltage.

IMPORTANT: This does not apply for general export models which are built for one operating voltage only.

 **If the unit is switched to another operating voltage, the fuse rating must be changed. See the technical specifications in the appendix.**

 **Blown fuses need to be replaced only with fuses of the correct type and rating! See the technical specifications in the appendix.**

The mains connection of the TUBE ULTRAFEX is made by using a mains cable and a standard IEC receptacle. It meets all of the international safety certification requirements.

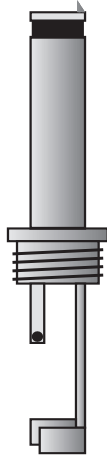
 **Please make sure that all units have a proper ground connection. For your own safety, it is advisable not to remove the ground connection within the units or at the supply, or fail to make this connection at all.**

5.3 Audio Connections

As standard, the BEHRINGER TUBE ULTRAGAIN is installed with electronically servo-balanced inputs and outputs. This circuit design features automatic hum and noise reduction for balanced signals and thus allows for trouble-free operation, even at high operating levels. Externally induced mains hum etc. will be effectively suppressed. The automatic servo-function recognizes the presence of unbalanced connectors and adjusts the nominal level internally to avoid level differences between the input and output signals (correction 6 dB).

 **Please ensure that only qualified persons install and operate the TUBE ULTRAFEX. During installation and operation the user must have sufficient electrical contact to earth. Electrostatic charges might affect the operation of the TUBE ULTRAFEX!**

Critical applications may require to build up a transformer-balanced configuration for the output signals, so as to avoid interference from ground loops or potential differences. For this purpose, we offer our high-quality output transformer OT-1 as a retrofit kit.



6. SPECIFICATIONS

Audio inputs

Connectors	XLR and 1/4" TRS connector
Type	RF filtered, servo-balanced input
Impedance	50 kOhms balanced, 25 kOhm unbalanced
Max. Input Level	+21 dBu balanced and unbalanced (unity gain)
CMRR	typ. 40 dB, >55 dB @ 1 kHz

Audio outputs

Connectors	XLR and 1/4" TRS connector
Type	Electronically servo-balanced output stage (optional transformer-balanced)
Impedance	60 Ohms balanced, 30 Ohm unbalanced
Max. Output Level	+21 dBu, +20 dBm balanced and unbalanced

System specifications

Bandwidth	18 Hz to 30 kHz, +/-3 dB
Signal-to-noise ratio	>100 dB, unweighted, 22 Hz to 22 kHz
THD	0.008 % typ. @ +4 dBu, 1 kHz, Gain 1 0.04 % typ. @ +20 dBu, 1 kHz, Gain 1
IMD	0.01 % typ. SMPTE
Crosstalk	<-100 dB, 22 Hz to 22 kHz

Bass Processor

Type	"Dual Mode" Bass Processor
Low Mix	variable (0 to 6)

Multiband Processor

Type	"Natural Sonic" Processor with VSP (Variable Sound Processing)
NR Sensitivity	variable (0 to 6)
Tune	variable (1 to 8 kHz)
Process	variable (enhancer to exciter)
High Mix	variable (0 to 6)

Surround section

Surround	variable (0 to 6)
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Function switches and controls

L/C Filter	switches the bass sound from "Soft" to "Tight"
Effect In/Out	activates the relay controlled hard bypass
Surround In/Out	activates the Surround Processor
Warmth	variable

Power supply

Mains voltages	USA/Canada	120 V ~, 60 Hz
	U.K./Australia	240 V ~, 50 Hz
	Europe	230 V ~, 50 Hz
	General export model	100-120 V ~, 200-240 V ~, 50-60 Hz
Power consumption	25 Watts	
Fuse	100-120 V ~:	T 1 A H
	200-240 V ~:	T 500 mA H
Mains connection	standard IEC receptacle	

Physical

Dimensions	approx. 3 1/2" (89.5 mm) x 19" (482.6 mm) x 8 1/2" (217 mm)
Net weight	approx. 8.0 kg
Shipping weight	approx. 10.0 kg

BEHRINGER is constantly striving to maintain the highest professional standards. As a result of these efforts, modifications may be made from time to time to existing products without prior notice. Specifications and appearance may differ from those listed or shown.

7. WARRANTY

§ 1 WARRANTY CARD/ONLINE REGISTRATION

To be protected by the extended warranty, the buyer must complete and return the enclosed warranty card within 14 days of the date of purchase to BEHRINGER Spezielle Studiotechnik GmbH, in accordance with the conditions stipulated in § 3. Failure to return the card in due time (date as per postmark) will void any extended warranty claims.

Based on the conditions herein, the buyer may also choose to use the online registration option via the Internet (www.behringer.com or www.behringer.de).

§ 2 WARRANTY

1. BEHRINGER (BEHRINGER Spezielle Studiotechnik GmbH including all BEHRINGER subsidiaries listed on the enclosed page, except BEHRINGER Japan) warrants the mechanical and electronic components of this product to be free of defects in material and workmanship for a period of one (1) year from the original date of purchase, in accordance with the warranty regulations described below. If the product shows any defects within the specified warranty period that are not due to normal wear and tear and/or improper handling by the user, BEHRINGER shall, at its sole discretion, either repair or replace the product.

2. If the warranty claim proves to be justified, the product will be returned to the user freight prepaid.

3. Warranty claims other than those indicated above are expressly excluded.

§ 3 RETURN AUTHORIZATION NUMBER

1. To obtain warranty service, the buyer (or his authorized dealer) must call BEHRINGER (see enclosed list) during normal business hours **BEFORE** returning the product. All inquiries must be accompanied by a description of the problem. BEHRINGER will then issue a return authorization number.

2. Subsequently, the product must be returned in its original shipping carton, together with the return authorization number to the address indicated by BEHRINGER.

3. Shipments without freight prepaid will not be accepted.

§ 4 WARRANTY REGULATIONS

1. Warranty services will be furnished only if the product is accompanied by a copy of the original retail dealer's invoice. Any product deemed eligible for repair or replacement by BEHRINGER under the terms of this warranty will be repaired or replaced within 30 days of receipt of the product at BEHRINGER.

2. If the product needs to be modified or adapted in order to comply with applicable technical or safety standards on a national or local level, in any country which is not the country for which the product was originally developed and manufactured, this modification/adaptation shall not be considered a defect in materials or workmanship. The warranty does not cover any such modification/adaptation, irrespective of whether it was carried out properly or not. Under the terms of this warranty, BEHRINGER shall not be held responsible for any cost resulting from such a modification/adaptation.

3. Free inspections and maintenance/repair work are expressly excluded from this warranty, in particular, if caused by improper handling of the product by the user.

This also applies to defects caused by normal wear and tear, in particular, of faders, potentiometers, keys/buttons and similar parts.

4. Damages/defects caused by the following conditions are not covered by this warranty:

- ▲ misuse, neglect or failure to operate the unit in compliance with the instructions given in BEHRINGER user or service manuals.

- ▲ connection or operation of the unit in any way that does not comply with the technical or safety regulations applicable in the country where the product is used.

- ▲ damages/defects caused by force majeure or any other condition that is beyond the control of BEHRINGER.

5. Any repair or opening of the unit carried out by unauthorized personnel (user included) will void the warranty.

6. If an inspection of the product by BEHRINGER shows that the defect in question is not covered by the warranty, the inspection costs are payable by the customer.

7. Products which do not meet the terms of this warranty will be repaired exclusively at the buyer's expense. BEHRINGER will inform the buyer of any such circumstance. If the buyer fails to submit a written repair order within 6 weeks after notification, BEHRINGER will return the unit C.O.D. with a separate invoice for freight and packing. Such costs will also be invoiced separately when the buyer has sent in a written repair order.

§ 5 WARRANTY TRANSFERABILITY

This warranty is extended exclusively to the original buyer (customer of retail dealer) and is not transferable to anyone who may subsequently purchase this product. No other person (retail dealer, etc.) shall be entitled to give any warranty promise on behalf of BEHRINGER.

§ 6 CLAIM FOR DAMAGES

Failure of BEHRINGER to provide proper warranty service shall not entitle the buyer to claim (consequential) damages. In no event shall the liability of BEHRINGER exceed the invoiced value of the product.

§ 7 OTHER WARRANTY RIGHTS AND NATIONAL LAW

1. This warranty does not exclude or limit the buyer's statutory rights provided by national law, in particular, any such rights against the seller that arise from a legally effective purchase contract.

2. The warranty regulations mentioned herein are applicable unless they constitute an infringement of national warranty law.

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