



SOUND PERFORMANCE LAB

SPL

Manual



QureTM

Model 9738

Dual Channel Parametric Tube/LC Equalizer

Manual

By Hermann Gier and Paul White

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Dear customer,

Thank you for the confidence you have shown towards SPL electronics GmbH by purchasing the SPL QURE. You have decided to use a tool of high performance which sets you in the position to have faster success and a better sound quality in your music productions and pre-masterings. As a typical SPL unit the QURE combines exemplary specifications and high manufacturing standard with excellent sound quality to provide you a precious component for recording purposes. Please read this manual carefully to ensure you have all the information you need to use the QURE. We wish you every success with it.

Your Sound Performance Lab-Team

I would like to start with my thanks to all our staff, who created what is to be described here. The importance of their exceptional qualification and talents cannot be overestimated. Special thanks to Wolfgang Neumann for his exceptional creativity in EQ and filter design.

Our products are often tested and compared in many publications and by our customers themselves and constantly valued with best results. I would like to pass on this broad appreciation to those, who deserve it – my excellent colleagues.

Hermann Gier

Foreword

Thanks

Introduction

The QURE is a parametric equalizer for creative sound design

The QURE combines a technology-mix of five decades of audio engineering

Exemplary specification contribute to the excellency of this EQ

The QURE circuitry improves presence, clarity and depth. It can also be used to cure recordings from digital harshness.

A new LCR network combined with a 12AX7 tube reacts on the dynamic response of the audio and alters THD and phase response.

Congratulations on purchasing the QURE, one of the most advanced and musical sounding parametric equalizer currently available.

The QURE is a fully parametric equalizer, specially designed to meet the most demanding studio applications. It is designed as 3-band, two-channel system with input and output gain controls, high-cut and low-cut filters as well as the new QURE-circuitry for the creative and corrective sound shaping of vocals, instruments and complex stereo material. Both balanced XLR and balanced stereo jacks are provided for signal connections to and from the QURE.

Its musically optimized parametric filters, based on a sophisticated refinement of state-variable-filter technology (SVF), include proportional bandwidth, tube technology for a warm and fat sounding mid-range, LC filtering for clear and transparent upper frequencies, transistor and semi-conductor technology for a voluminous low end.

The proportional-Q principle provides precise control over a frequency range, from 15 Hz to 21 kHz, while the low noise level of -99dB (A-weighted), and the enormous dynamic range of 113 dB, make the QURE ideally suited for mastering and cutting. By employing circuitry designed around the principles of perceived sound, rather than simply designing by numbers, the QURE overcomes the limitations of conventional parametric equalizers.

The QURE circuitry

The QURE circuitry is a new SPL development which gives the name for the unit and also represents a new technology, which uses coils to increase the presence of vocals and the depth of the music. At the same time it is ideally suited to cure recordings from digital harshness. The name is derived from 'cure' in combination with Q from EQ.

The signal runs through a tube circuitry featuring a Sovtek 12AX7 double triode tube in a mixed current/voltage coupling mode. This stage is extremely clip-resistant and produces a pleasant and musical sounding tube-THD spectrum.

The QURE ON switch puts a coil/condenser/resistor filter network (LCR) into the tube output stage. This network is integrated into the coupling path of the tube and reacts on the dynamic response of the input signal by influencing THD spectra and phase response. The QURE potentiometer changes the frequency response and produces a fresh and silky top-end and a mid-range free of sharpness and harshness. The presence and 'aura' of vocals is largely improved.

Proportional Q

Unlike most other equalizers which use constant-Q filters, the QURE adopts the proportional-Q principle to realize maximum musicality. Conventional constant-Q designs keep the amplitude constant, regardless of the adjusted bandwidth (Q). The disadvantage of this is, when it comes to sound creation, frequencies above and below the center frequency are often boosted so intensely that they lose their musicality. With proportional-Q it is quite different; the amplitude of the processed frequency band is reduced as the bandwidth broadens. Adjusting the bandwidth back to a narrow bandwidth (high Q), will increase the amplitude of the center frequency to its former level. Furthermore, with proportional-Q, there is no need to constantly readjust the boost/cut control when varying the bandwidth – as is usually necessary with constant-Q equalizers. It is generally perceived that equalizers based upon constant-Q designs produce acoustically comparable results, and suffer from limitations in the areas of sound flexibility and musicality. Often there is only one truly usable position on the Q-control.

The proportional-Q principle offers a wide range of possible potentiometer settings and makes it easier to identify the desired frequencies within the sound spectrum – even subtle nuances become clearly audible. Equalizing with proportional-Q is therefore more intuitive and subjectively musical than with constant-Q equalizers. The QURE forms its response curve around the center frequency with a bell-like response, so that frequencies closer to the center frequency are emphasized slightly more; frequencies further from the center are less affected. The development of these filter curves was the result of extensive listening tests, and the result is an equalizer that combines technical excellence and precision with unsurpassed musicality.

The Frequency Bands

The QURE is configured as a two-channel, 3-band equalizer with a separate hard-bypass switch for each band. The filters are connected in series. The three filter bands cover a frequency range from 15 Hz to 21 kHz. In addition each channel is equipped with high- and low-cut filters.

Tuning the equalizer is very intuitive because the frequency control law has been designed to match the characteristics of the human hearing system. The perfectly linear phase response of the QURE circuitry, combined with its wide bandwidth, contributes to the sonic excellence of this esoteric equalizer.

The mid-band features the 'non-reciprocal response' of the BOOST/CUT control which qualifies this band to operate as a notch filter, too. Cutting is allowed to -36 dB at high Q (Q5) whereas the low and high band offer cutting of -15 dB. The sonic advantage of the 'non-reciprocal response' design is the vast dynamic response making the filter sound very open and clear.

With the musical proportional-Q principle the amplitude of the processed frequency band is reduced as the bandwidth broadens.

Equalizing with proportional-Q is more intuitive and subjectively musical than with constant-Q equalizers.

The QURE is a two-channel, 3-band equalizer with the filter bands connected in series

The mid-band features a 'non-reciprocal response' of the BOOST/CUT control

Stepped potentiometers for easy recall; individual bypass for each filter band

Central grounded shield layout, single op-amps, Sovtek tubes, custom made condensers and potentiometers

General Features

To allow easy recall of all control settings the QURE is equipped with stepped potentiometers throughout. The number of steps is optimized to the control function: 11 steps for bandwidth, 31 steps for frequency and boost/cut, and 41 steps for input gain, HF/LF Cut filters, and QURE control. Each band can individually be switched in and out of the signal path making comparison easy and avoiding the need to nullify the boost/cut control.

Each filter is mounted on a separate printboard featuring a 'central grounded shield layout' (CGSL) for maximum rejection of interfering frequencies. Single op-amps are used throughout to minimize noise and THD. The tubes in use are the well-acclaimed Sovtek 12 AX 7. Furthermore selected custom made condensers are used to produce harmonical and pleasant sounding THD spectra. The frequency controls are also custom made featuring a control characteristic that is designed to realize a gentle frequency sweep with a musically optimized control range.

Overview

- 2x 3-band EQ with variable HF and LF cut filters
- QURE circuitry (Tube + LCR)
- Variable input gain (-12 dB to + 18 dB)
- Variable output gain (-7 dB to + 4 dB)
- Hard-bypass for each filter band and both cut filters
- Master relay hard-bypass for entire unit
- Central Grounded Shield Layout
- SPL super-balancing hybrids (CCMR -90 dB)
- Tube warm up circuitry for prolonged tube-life
- Overrated internal toroidal power supply
- PREMIUM-Version (recommended):
LUNDAHL in- & output transformers (LL1539 & LL1540)

Operation Safety

The housing of the QURE has the standard 19"-EIA format and occupies 2U (88.9 mm) in your rack. When installing the unit in a 19"-rack, the rear side of the unit needs some support, especially in a touring case.

Choose the installation location of your unit carefully:

The QURE should not be installed near units which produce strong magnetic fields or extreme heat. Avoid placing it in direct sunlight.

Also avoid locations subject to vibration and excessive dust, heat, cold, or moisture.

Keep it away from sources of hum such as transformers or motors.

Do not install the QURE directly above or below power amplifiers.

Check that the voltage details quoted on the back panel are the same as your local mains electricity supply. Use a minus (-) screwdriver to set the voltage selector to the voltage for the area in which the unit will be used.

Never cover up the ventilation slots on the top of the unit. If, during operation, the sound is interrupted or indicators no longer illuminate, or if abnormal odor or smoke is detected, or if liquids are spilled on the unit, immediately disconnect the power cord plug and contact your dealer.

WARNING: Do not open the cabinet of this unit, because to do so might result in damage to the unit, or injury by electric shock. If any foreign object or substance enters the unit, contact your dealer for assistance. To reduce the risk of electric shock, do not expose this appliance to rain or moisture.

To prevent damage by lightning, disconnect the power cord from the household AC outlet during an electrical storm. When disconnecting the power cord from the household AC outlet, grasp the plug; do not pull the cord. Refer servicing to qualified personnel only!

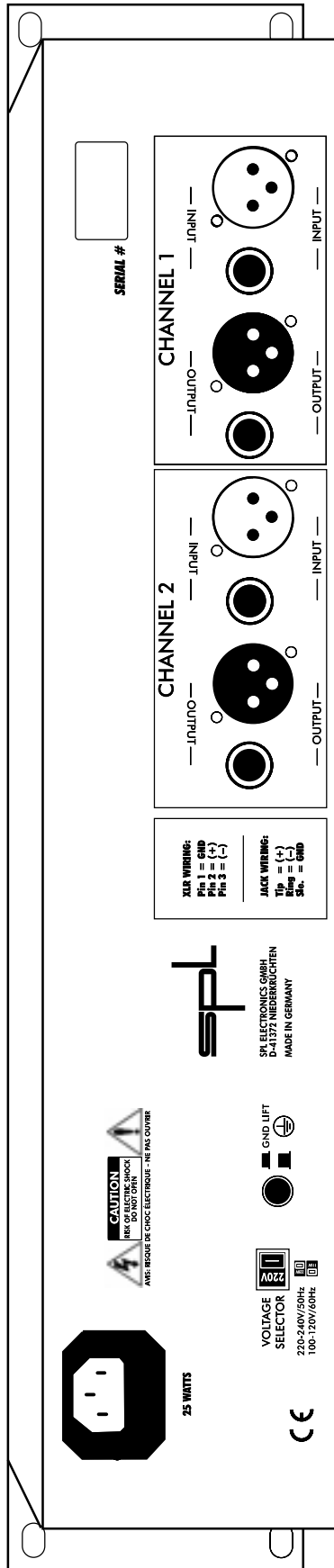
Do not apply excessive force when using switches and controls. When moving the unit, be sure to first disconnect the power cord from the household AC outlet, and disconnect cords connected to other equipment.

Do not attempt to clean the unit with chemical solvent as this might damage the finish. Only clean the QURE with a clean, soft, lint-free cloth.



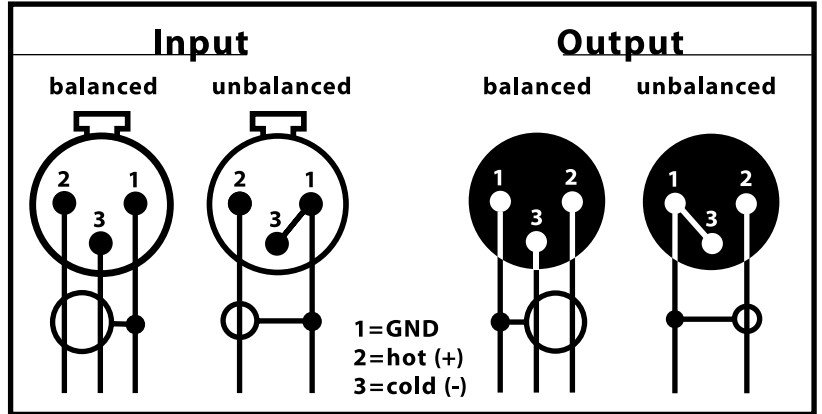
Important security advices

Connections



THE QURE is fitted with both XLR connectors and TRS stereo jacks for balanced operation, though the jacks may be used with unbalanced connections simply by plugging in mono jack-plugs. The level difference that normally occurs when a balanced input or output is used unbalanced is automatically compensated for.

Should the need arise to use the XLR connectors in an unbalanced system, pin 3 of the XLRs should be grounded. Inserting a mono jack also unbalances the XLRs.



Both output stages operate in parallel, so it is possible to connect two different destination units simultaneously, for example to record to two different media at the same time or split the output between a mixer and effects processor. However, only one type of input (jack or XLR) should be connected at a time – the QURE is not intended to be used as a mixer!

To ensure optimal signal quality, SPL has developed a super-balancing hybrid input/output stage using all laser-trimmed resistors with a tolerance of 0.01%. This approach has resulted in high CCMR (common mode rejection) values better than -90 dB at 1 kHz.

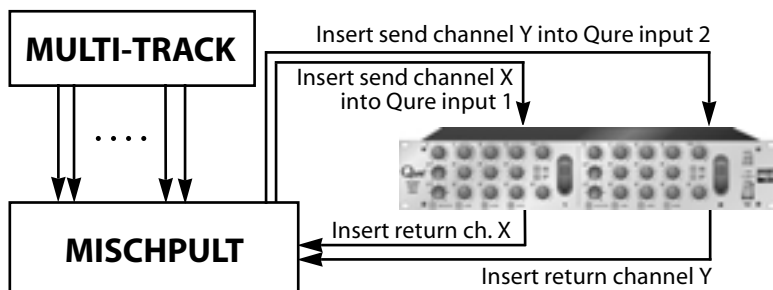
As a precaution, before connecting the QURE switch off the power to the unit and to all connected units.



1. Processing single instruments or vocals

To process single instruments or vocals insert the two separate QURE channels into the specific **inserts** of your console to process two signals independently.

Note that the MASTER switch will bypass **both** channels together. Use the bypass switch of each filter band when processing two independent sources.

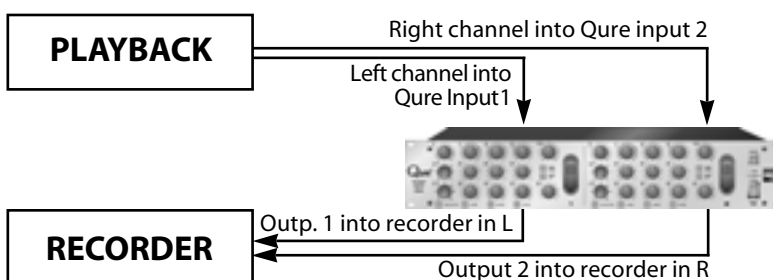


You can also insert the unit into the **master breaks** during mixdown or into the sub-groups, when specific elements of the mix are being treated selectively.

When patching the QURE into the sub-groups or master-breaks of the console, note if they are switched 'pre' or 'post' fader. They should best be switched 'pre' fader, so that a variation of the master fader does not affect the input level of the QURE. The effect level and the treated sound will then remain unchanged.

2. Processing final mixes

To process a final mix, either while mixing or during post-production prior to cutting insert the QURE into the **master inserts** of your console or right in between a playback and a recording unit.



The special characteristics of the QURE allow you to add weight and punch to the bass end of a mix or to lift harmonic detail out of the top end of a mix, without inadvertently adding harshness or muddiness to the sound. In this respect, the QURE can produce results every bit as dramatic as those achieved using sub-bass synthesizers or harmonic generators, but without adding distortion to the original signal.

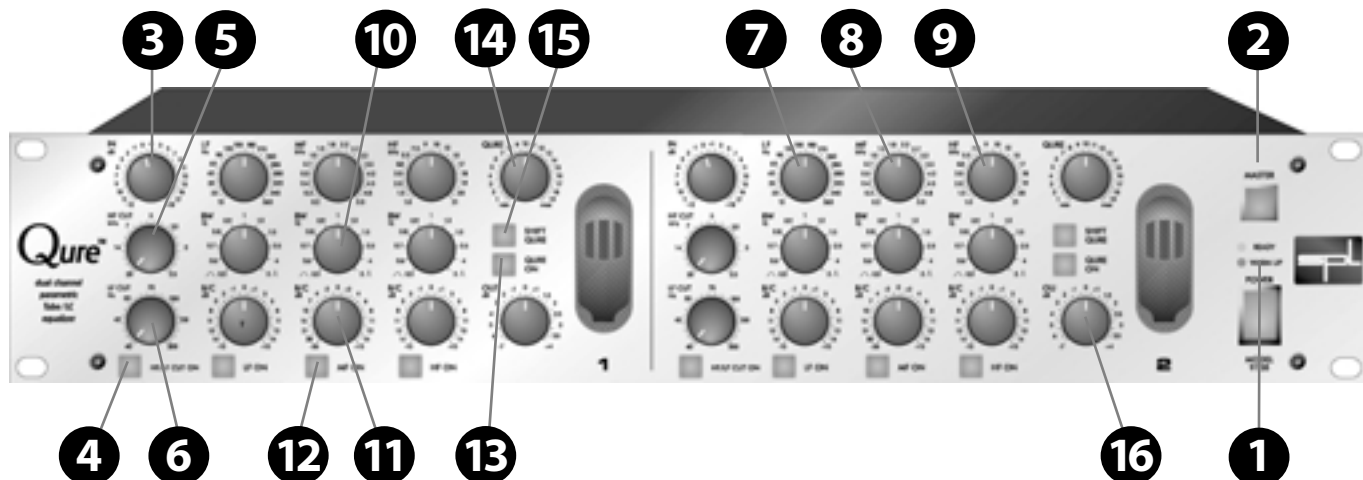
Application 1:

The QURE inserted into two individual tracks

Application 2:

The QURE between playback and recording unit to treat a final mix

Control Elements



WARM UP & READY

1

The QURE features a special relay circuitry that slowly builds up the 275 volts over a period of 45 sec. Thereby the lifetime of the tubes is increased by up to four times. In pre-mastering this circuitry guarantees a reproducible sound for a long time. The tubes in use are Sovtek 12 AX 7s.

The WARM UP-LED (red) illuminates after the main power has been switched on. After 45 seconds it switches to READY (orange-LED). The in- and outputs of the tubes are de-coupled at 10Hz with condensers of high voltage and capacity (1 microFarad/ 400 V/5 %) to minimize offset and humming noise.

If the unit is already switched to active with the MASTER switch during the warm up period you will not hear any processing until the QURE switches to READY. Then the processed signal is switched to the outputs. Although you may not have done any equalization to the signal you will hear a little difference between the processed and the unprocessed signal because the tubes already produce a portion of their typical sound.

MASTER

2

MASTER switches the QURE's entire sound processing on or off. The illuminated switch indicates that the QURE has been activated.

The MASTER function is a relay-hard-bypass function which links the input socket directly with the output socket to bypass all filters by pressing just one button.

To increase operation reliability the QURE monitors the power supply's primary and secondary voltages and switches automatically to hard bypass once certain tolerances have been exceeded (power failure safety).

3***IN***

The QURE features an IN control that enables you to set the level at which the QURE filters operate. The level can be changed between -12 dB and +18 dB.

To run the unit hotter set the level between the 0 dB-position and the clockwise position (up to +18 dB). This will result in a more intensely processed sound. Conversely, in order to achieve milder processing, set the level between the 0 dB-position and the counter clockwise position (up to -12 dB).

4***HF/LF CUT ON***

The IN control is followed by high (HF) and a low frequency (LF) cut filters with individual frequency controls. The HF/LF CUT ON is the hard-bypass switch for both filters. If the cut filters are not needed the HF/LF CUT ON switch routes the audio around this section to provide maximum audio quality when in bypass (LED is not illuminated).

The HF CUT and LF CUT are usually used as a pair to provide control over the extremes of the audio spectrum.

5***HF CUT***

The HF CUT filter is a 2nd order Butterworth filter defining the upper roll-off frequency the audio is to have.

Fully counter clockwise the control is set to its starting position of 20 kHz. Even if the HF/LF CUT filters are activated there is hardly any audible frequency limitation to the spectrum. All frequencies below 20 kHz are passing through. Turning clockwise reduces the upper roll-off frequency until fully clockwise the minimum roll-off frequency of 2.5 kHz is reached.

Diagram 3 illustrates the frequency response curves for the highest roll-off (20 kHz) and the lowest roll-off frequency (2.5 kHz).

6***LF CUT***

The LF CUT filter is also a 2nd order Butterworth filter defining the lower roll-off frequency the audio is to have.

Fully counter clockwise the control is set to its starting position of 40 Hz. All frequencies above 40 Hz are passing through. Turning clockwise increases the lower roll-off frequency until fully clockwise the maximum roll-off frequency of 200 Hz is reached.

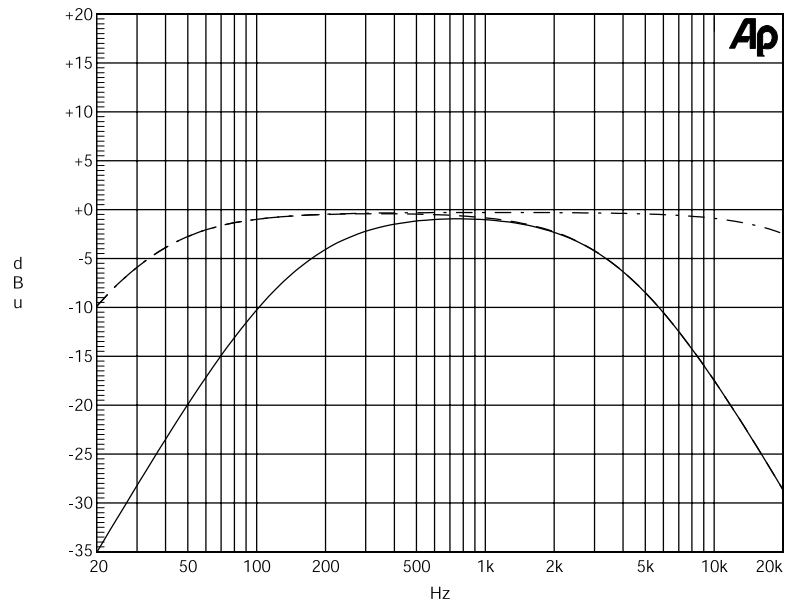
Diagram 3 (page 12) illustrates the frequency response curves for the lowest roll-off (40 Hz) and the highest roll-off frequency (200 Hz).

Diagram 3:

Frequency responses for the lowest (40Hz) and highest roll-off (200Hz).

HF CUT: 20kHz to 2.5kHz

LF CUT: 40Hz to 200Hz



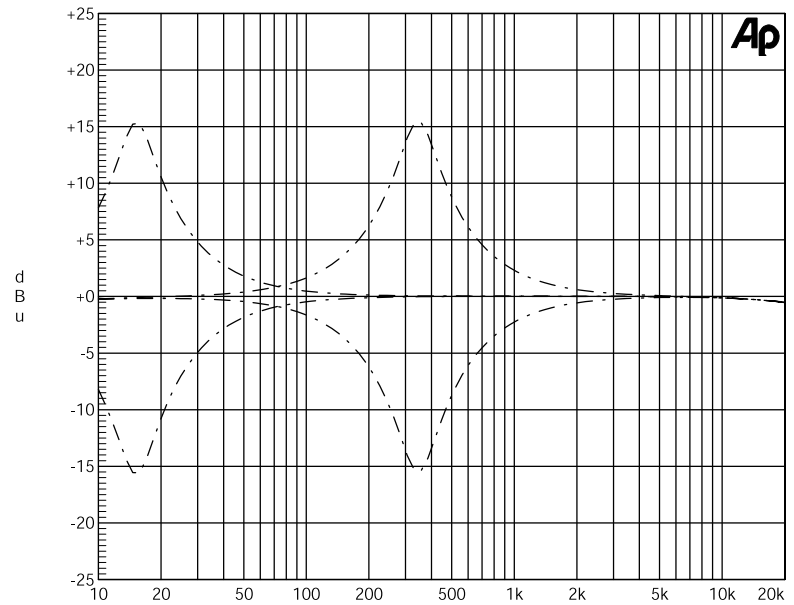
LF (Low Freq.)



The low frequency control (LF) operates over more than four octaves. The center frequency can be varied between 15Hz and 365Hz.

Diagram 4:

Frequency responses for the lowest (15Hz) and highest (365Hz) LF control setting at max. B/C and Q5

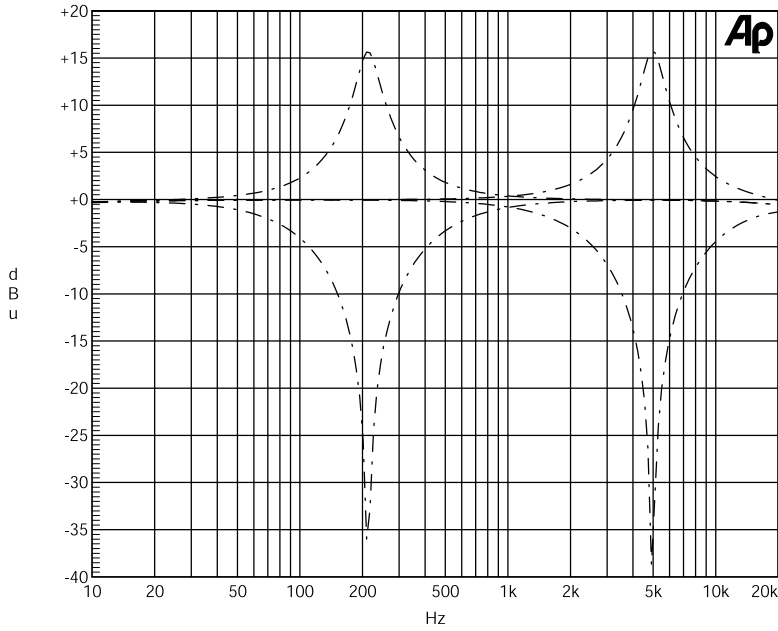


The mid frequency control (MF) also covers more than four octaves. The center frequency can be varied between 200 Hz and 5 kHz.

8 MF (Mid Freq.)

Diagram 5:

Frequency responses for the lowest (200 Hz) and highest (5 kHz) MF control value at max. B/C and Q5

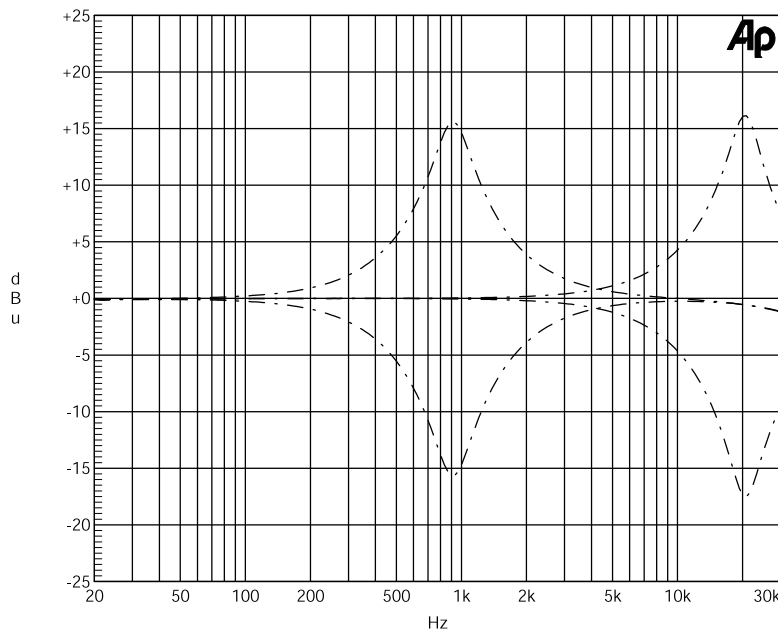


The high frequency control (HF) covers more than four octaves. The center frequency can be varied between 1 kHz and 21 kHz.

9 HF (High Freq.)

Diagram 6:

Frequency responses for the lowest (1 kHz) and highest (21 kHz) HF control setting at max. B/C and Q5



BW (Bandwidth) 10

The bandwidth (BW) control is identical for all three frequency bands. The BW control determines the width (or the Q) the frequency curve around the selected center frequency is to have.

The parameter is measured as a quotient Q of the following formula:

$$Q = \sqrt{(f_o f_u) / (f_o - f_u)}$$

f_o is the upper corner frequency and f_u the lower corner frequency measured at the -3 dB point of the frequency curves. Narrow bandwidth corresponds with a high Q and vice versa.

The BW is set to 'high Q' (Q5) when turned fully counter clockwise. The influenced range covers approximately 0.2 octaves. Turning the BW control fully clockwise selects 'low Q' values (Q0.5) covering approximately 2.5 octaves.

Diagram 7:

All 11 steps of the BW control from smallest Q (Q5) to broadest Q (Q0,5) are shown. The center frequency is 1kHz. The diagram is valid for both LF and HF band.

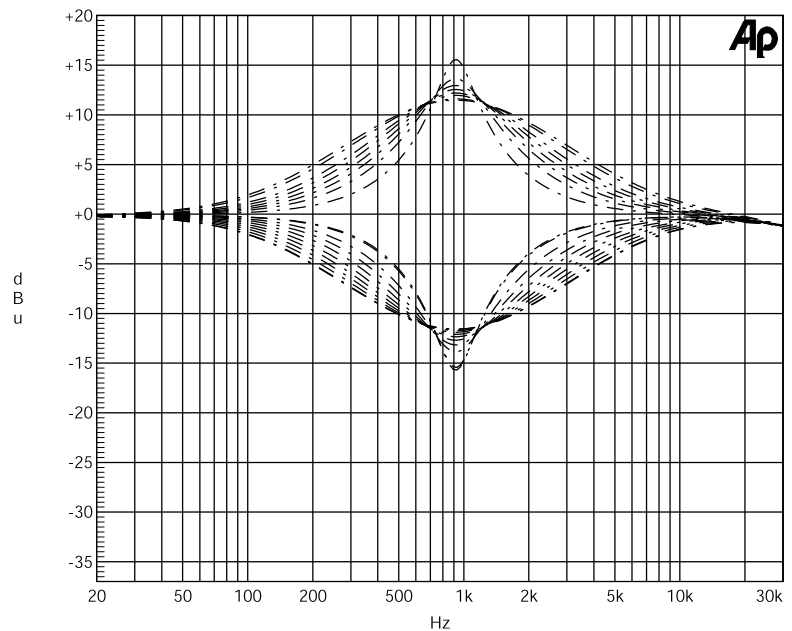
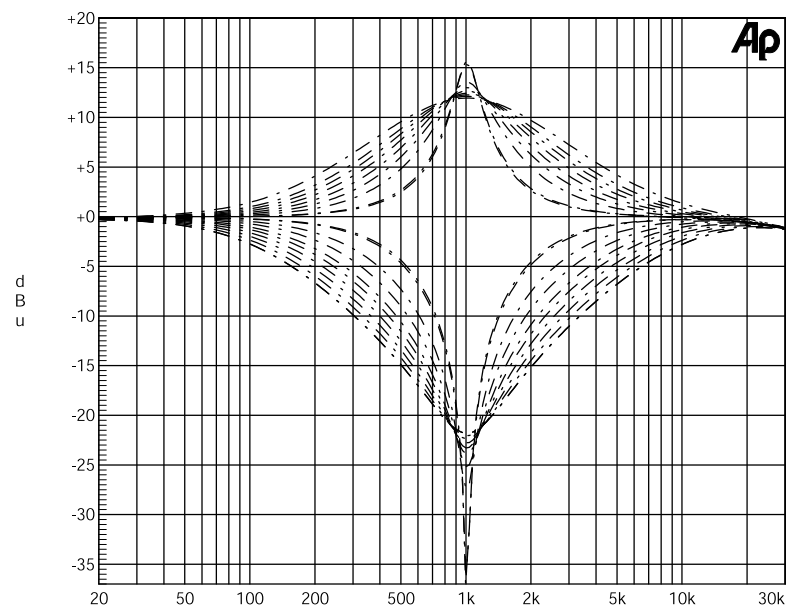


Diagram 8:

As diagram 7, but for the non-reciprocal response of the MF band.



The QURE utilizes the proportional-Q principle, also known as 'variable Q'. The amplitude varies depending on the Q setting.

Using low-Q values, automatically readjusts the amount of boost or cut selected to keep the subjectively perceived loudness constant. With constant-Q equalizers there is often only a limited range of useable settings. Sometimes this is so narrow, you may wonder why the Q control was not permanently fixed at the point it sounded really good. Above that position it often starts to sound harsh and peaky, and below with the broad bandwidth, the sound is colored so you need to constantly re-set the boost/cut control. Not so with proportional-Q. The Q control provides useable settings over the entire range – giving you more versatility to be creative. EQ adjustments with proportional-Q sound a lot more musically related and offer a greater range of possible Q-choices that really sound good and appropriate. Diagram 7 and 8 show frequency responses with varying Q and maximum B/C.

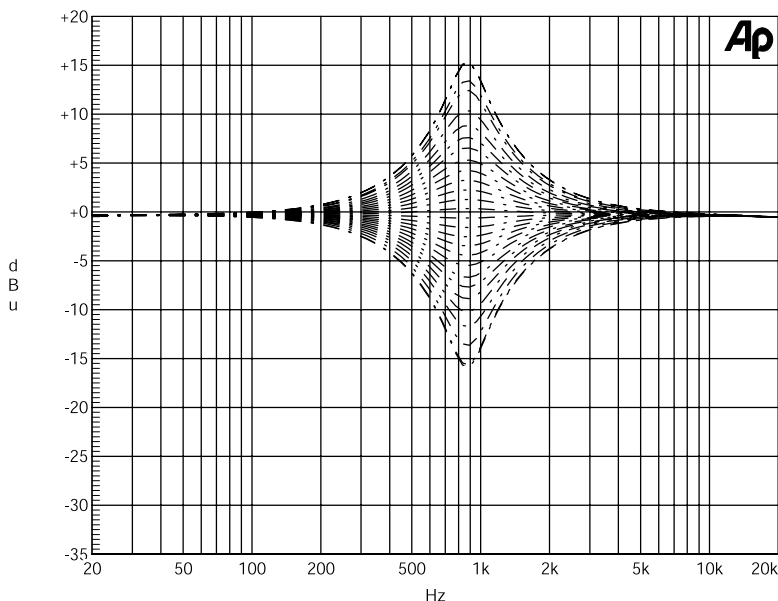
Proportional-Q automatically readjusts the amount of boost or cut to keep the subjectively perceived loudness constant

Tips on adjusting the bandwidth

Q adjustments are largely depending on the character of the source material and whether processing single instruments or vocals or final mixes.

Q values between 1 and 2 are useful to equalize vocals, guitars, keyboard sounds and suchlike. When the bandwidth is broader than half an octave it is easy to find and to manipulate the characteristic elements. Very narrow Q values (Q3 to Q5) are often used with high frequencies to eliminate disturbing frequencies within cymbal sounds or to precisely emphasize the kick frequency of the bass-drum or snare. Broader Qs are selected when boosting dull source material which has lost high frequency content due to de-noising, de-clicking and/or de-essing. To process bass frequencies Q values are chosen between Q0.5 and Q0.8. Q values between Q0,8 and Q1.2 are recommendable for frequencies between 100Hz and ca. 700Hz.

The BOOST/CUT control (B/C) of the LF and the HF frequency band provides control ranges of +/- 15dB.



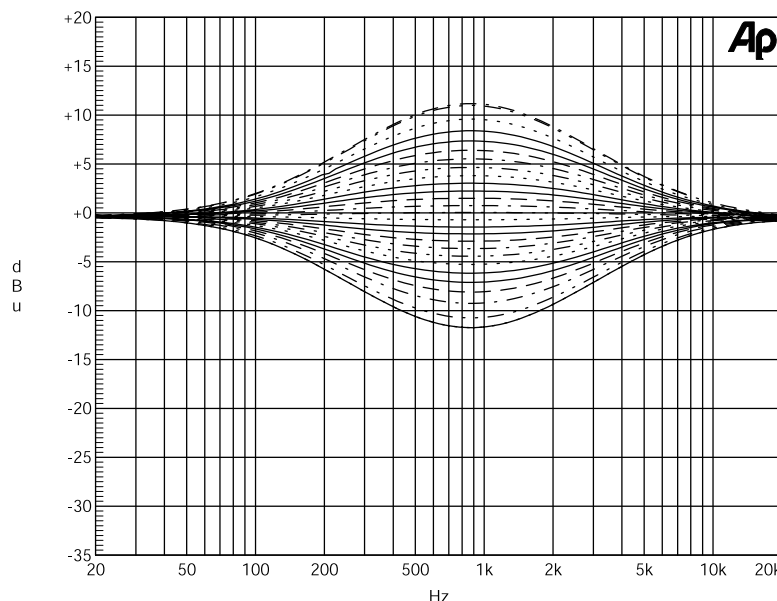
11 B/C (Boost/Cut)

Diagram 9:

Symmetrical frequency responses at maximum boost and cut and high Q (+/- 15dB, Q5) for LF and HF bands.

Diagram 10:

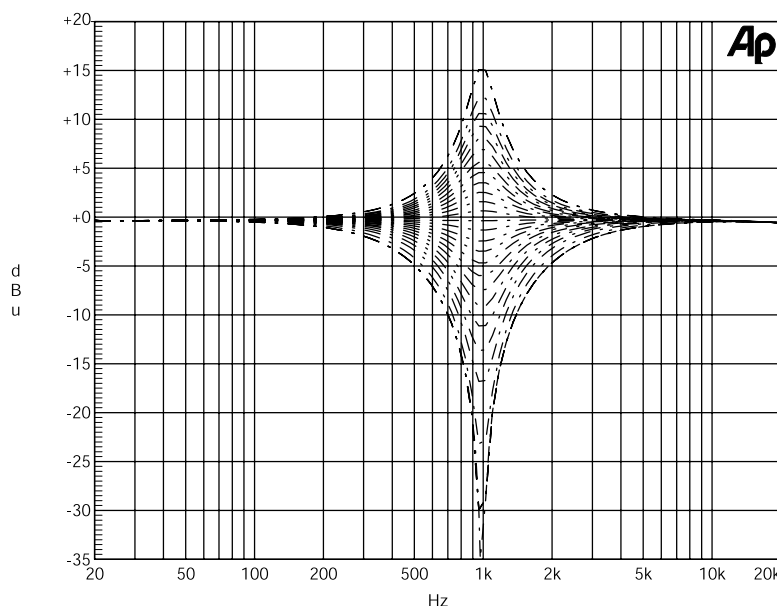
Frequency responses for max. BOOST/CUT and low Q adjustments (+/- 15 dB, Q 0.5) for the LF and HF bands



The BOOST/CUT control of the MF band realizes maximum boost of 15 dB and maximum cut of -36 dB. This response is called 'non-reciprocal response'. Due to the enormous headroom of this filter design the sound of the MF band is even more open and transparent and almost unlimited in dynamic response.

Diagram 11:

Non-reciprocal responses of the MF band (+/- 15 dB, Q 5)



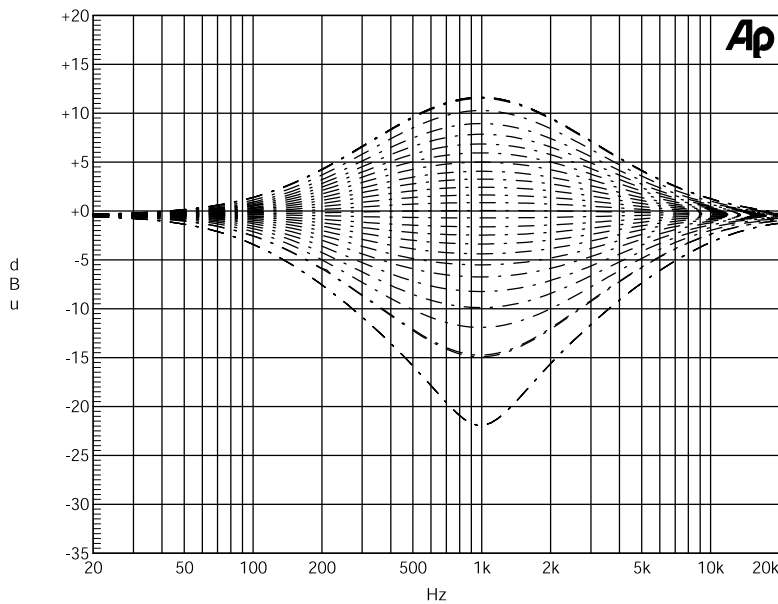
Stepped potentiometers for easy recall and precision adjustments of 0.5 dB

All B/C controls feature stepped potentiometers with 31 detents which allow adjustments in steps of 0.5 dB. Due to the non-reciprocal response of the MF band the cut values are adjustable in 1 dB steps.

Setting up procedure: When trying to locate the precise frequency range requiring adjustment, set the B/C control fully clockwise to provide maximum boost. By sweeping through the frequency ranges, it should be easy to locate the precise frequency range that needs cutting or boosting.

Diagram 12:

Non-reciprocal responses of the MF band (+/-15 dB, Q0.5)



Once found, the B/C control can be backed off to provide the desired degree of cut or boost and the Q setting adjusted by ear. Initially, it helps to bypass the other equalizer sections so that you can work on each equalizer independently.

When the equalizer sections have been set independently, they can be switched in simultaneously with the MASTER switch and further adjustments made if required. The OUT control can be used to restore any level change caused by intensive EQ cutting or boosting. Where more subtle treatments are required, the QURE's exploitation of psychoacoustic principles enables it to significantly improve the focus, tonal balance and general clarity of detail within a mix, with the bare minimum of processing. This is particularly important when a client wants to improve the sound of a mix but doesn't want to make any significant change to the overall tonal balance. Even filter boost/cut settings of half a dB can bring about significant changes in the perceived quality of the mix being treated.

Each filter band has an individual hard-bypass switch. It makes comparison between processed and unprocessed signal easy without having to reset the B/C control as with conventional EQ designs.

The QURE ON switch activates the new QURE tube and coil circuitry which is especially designed to clarify vocals and increase their presence while at the same time the dimensionality of the mix is improved.

Another interesting application is to combat digital harshness. The QURE circuitry creates a 'sonic blur' which softens harsh and edgy sounds and reduces ear fatigue.

12 **LF/MF/HF ON**

13 **QURE ON**

*Integrating a coil/condenser/
resistor filternetwork (LCR)
into the signal path*

The QURE ON switch puts a coil/condenser/resistor filternetwork (LCR) into the tube output stage. This network is integrated into the coupling path of the tubes and reacts on the dynamic response of the input signal changing THD spectra and phase responses. It sounds similar to a 'closed shelving bandpass' frequency response, but with a time frame in which harmonics are newly created or become more present in close relation to the dynamic response of the source material.

Diagrams 13 and 14 show how the harmonic content is altered of a period of 30 seconds. Diagram 13 shows a standard sweep from 1kHz to 4kHz within that time frame and the corresponding harmonical spectrum. Diagram 14 shows the treated signal with the QURE circuitry. The comparison shows, although both diagrams represent a *linear frequency response*, that the harmonical structure after the QURE treatment is enhanced, new harmonics have been created and existing harmonics show a more stable response. Also, so-called 'cross-harmonics' (between the main harmonics) are more intense. What cannot be seen are the effects on phase response.

*Tips on using the
QURE circuitry*

How to use the QURE circuitry

By activating the QURE circuitry the overall output level raises inevitable by +2 dB. There are two ways to compensate for this effect.

1. Activate the QURE circuitry (Press QURE ON) which lets the output level raise by about 2 dB. Use the mid-range filter (MF) to cut harsh or annoying frequencies with a medium or broader bandwidth to achieve a linear frequency response. Use the QURE control to select the frequency range. With the SHIFT QURE switch you can jump from a high frequency range (2 kHz-6 kHz) to a lower frequency range (400 Hz-2 kHz).

2. Activate the QURE circuitry (Press QURE ON) which lets the output level raise by about 2 dB. Turn the OUT control counter clockwise and compensate for the level increase.

QURE

14

The QURE potentiometer changes the frequency response and produces a fresh and silky top-end and a mid-range free of sharpness and harshness.

Especially vocals gain clarity and presence. They seem to step right in your face while at the same time the dimensionality of the music is getting bigger. This sound pattern is achieved by simultaneously influencing THD spectra and phase responses.

The QURE potentiometer changes the center frequency of processing from 2 kHz (counter clockwise) to 6 kHz (clockwise). To process a deeper frequency spectrum use the SHIFT QURE switch (see 15).

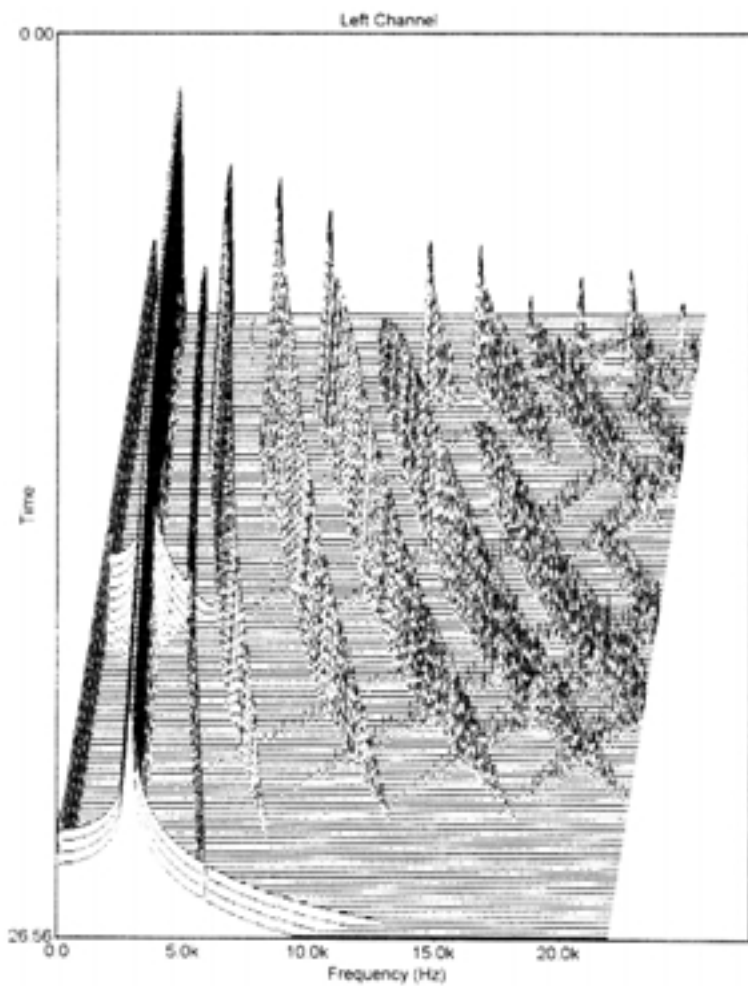


Diagram 13:

The diagram shows a frequency sweep from 1 kHz to 4 kHz with the corresponding harmonical structure over a period of about 30 seconds.

The frequency response is linear.

The MF band is active with B/C set to zero.

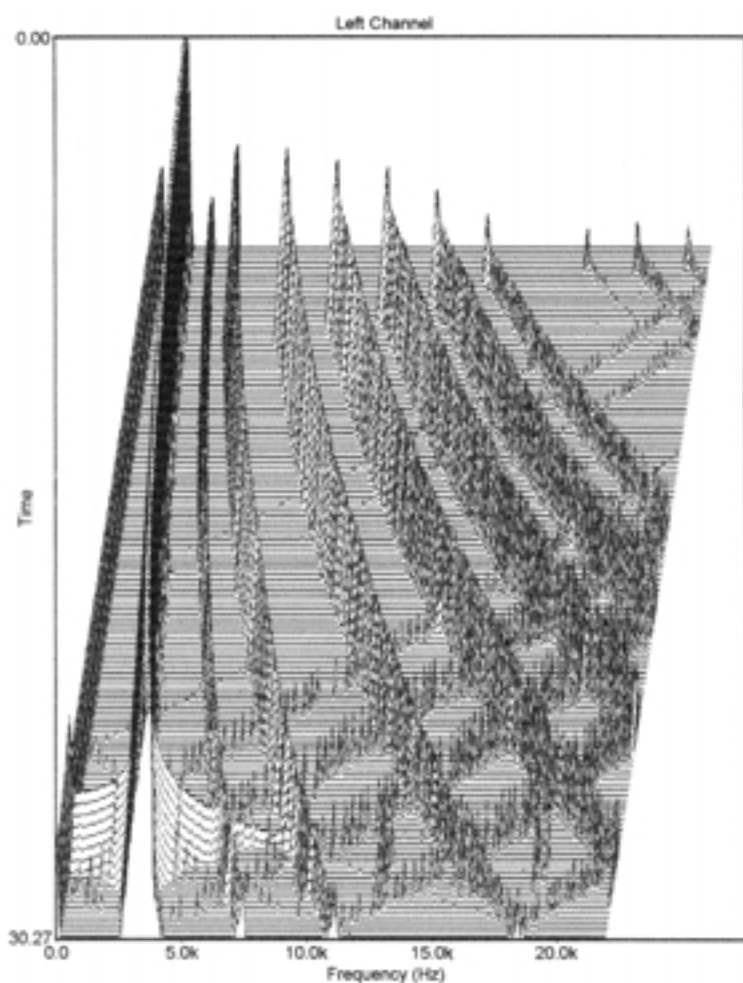


Diagram 14:

By activating the QURE-circuitry the harmonical content is changed.

The MF-Band was used to create a linear frequency response.

Now the harmonics are much more regular, almost equalized. The density is increased and also new harmonics which are missing in the upper diagram are now present.

SHIFT QURE

- 15** The SHIFT QURE switch changes the controllable frequency range of the QURE control from 2kHz-6kHz (SHIFT QURE not active) to 400Hz-2kHz when the SHIFT QURE is active and the status-LED illuminates.

OUT

- 16** The signal runs through a tube circuitry featuring a Sovtek 12AX7 double triode tube in a mixed current/voltage coupling mode. The output stage is extremely clip-resistant and produces a pleasant and musical sounding tube-THD spectrum.

The OUT-control can attenuate up to -7 dB in case that extense equalization has been used or to compensate for the 2 dB level increase when the QURE circuitry is active. Cut values are provided up to +4dB which may be used when intensive cutting has led to a lower signal level.

Power Supply

Special care has gone into the design of the power supply of the QURE. The power supply is the heart of an electronic system: The better it is, the better the whole system works and – in an audio system – the better it sounds.

This power supply is based around a custom made 35 VA toroidal transformer and is designed to minimize induced hum and noise due to the non existence of an air-gap. All required voltages (230 V, 6.3 V and 2x15 V, 12 V) have an individual wiring in the transformer and are smoothed separately afterwards.

The primary voltage may be selected between 230 V/50 Hz and 115 V/60 Hz by means of a recessed slide switch on the rear panel.

The rear-panel ground-lift switch may be used where ground loops are causing hum problems. When the GND LIFT switch is set to off, the circuit ground is no longer connected to the chassis ground. The power cord connector is a 3-wire, U-ground, standard IEC mains connector for a detachable power cord (enclosed) with an inbuilt mains filter.

Transformer, power cord and mains connector have VDE, UL and CSA approvals. At 115 V/60 Hz the fuse value for the primary voltage is 1 A and for 230 V/50 Hz the fuse is 500 mA.

On the secondary side of the power supply, an RC combination is used to filter out noise and hum voltages from the mains side. Both half-waves are smoothed with 6000 microFarad capacitors in the positive and negative voltage path (recommended PREMIUM version: 28.200 microFarad). Both pathes use precision voltage regulators, as deviations of only a few millivolts can result in audible changes such as a diffuse sound pattern.

The operational voltage of the tubes (275 V) is heavily smoothed and electronically regulated. The heating voltage (6.3 V) is supplied by an individual wiring within the transformer. So-called »hum-trimmers« adjust the tubes' heating voltage and minimize the hum voltages.

Both inputs and outputs of the tubes are smoothed with condensers of high voltage and condenser values (1 microFarad/400 V/5%) to minimize offset voltages. The tubes are de-coupled at about 10 Hz.

All relays are operated via an individual voltage regulator and are therefore separated from the audio operating voltage.

Custom made toroidal transformer with five separate wirings.

Voltage selector

*Ground-lift switch
Mains filter*

*FUSES (primary voltages):
115 V: 1A
230 V: 500 mA*

Extensive filtering and de-coupling guarantee stable power and avoid audible changes such as a diffuse sound pattern.

*High voltage tube operation
(275 volts)*

Specifications

Input & Output

Instrumentation amplifier, electronically balanced
(differential) transformerless

Nominal input level	6 dB
Input impedance	= 22 kOhms
Output impedance	< 600 Ohms
Max. input level	+14 dBu
Max. output level	+20 dBu
Minimum load ohms	600 Ohms
Relay Hard Bypass	yes
Power Fail Safety	yes

Measurements

Frequency response:	10 Hz-100 kHz (100 kHz = -3 dB)
EQ frequency range	15 Hz-21 kHz
CCMR (common mode rejection)	-90 dBu @ 1kHz
THD & N	0,01855% @ 1kHz
S/N CCIR 468-3	-85 dBu
S/N A-weightened	-99 dBu

Power Supply

Toroidal transformer	35 VA
Fuse (primary)	500 mA (230 V/50 Hz) ... 1000 mA (115 V/60 Hz)
Ground-Lift switch	yes
Voltage selector	yes

Dimensions

Housing	Standard EIA 19"/2U, 482 x 88 x 237 mm
Weight	4,9 kg

Note: 0 dBu = 0.775 V

Subject to change without notice.

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Bedienungsanleitung

Manual

