BBE™

402 SERIES INFORMATION MANUAL

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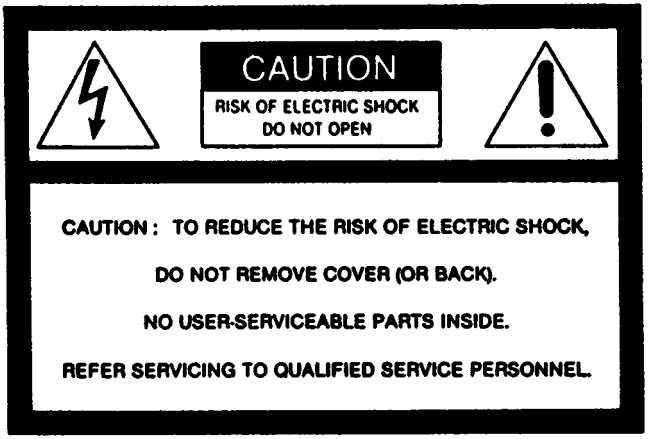
Thank you for buying the Barcus-Berry Electronics Model 402 MAXIE Sound Maximizer. You have selected a component designed with care to solve a set of problems present in all audio systems, large and small. By reading this manual you will be able to gain some understanding into the theory and operation of the Model 402, as well as guidance in maintenance, calibration and troubleshooting.

We suggest that first-time users of the Model 402 read Section II of the manual carefully before using the unit. Experience has shown us that reviewing the functions of the various front and rear panel features of the 402 prior to its use can answer most, if not all, of the questions which Barcus-Berry Electronics' Service Department routinely fields. We are most happy to help a user clear up any confusion, and maintain toll-free (in USA) numbers for this purpose (1-800-558-3963 in California, 1-800-233-8346 outside California). Please feel free to contact our Service Department if further questions arise after reviewing this manual.

TABLE OF CONTENTS

WARNING

To prevent fire or shock hazard, do not expose the unit to rain or moisture.



ATTENTION: RISQUE DE CHOC ELECTRIQUE -- NE PAS OUVRIR.

The lightning flash with arrowhead symbol, within an equilateral triangle, is intended to alert the user to the presence of uninsulated "dangerous voltage" within the product's enclosure that may be of sufficient magnitude to constitute a risk of electric shock to persons.

The exclamation point within an equilateral triangle is intended to alert the user to the presence of important operating and maintenance (servicing) instructions in the literature accompanying the appliance.

SECTION I
PRODUCT DESCRIPTION

The BBE[tm] Model 402 MAXIE Sonic Maximizer is an audio processor which can be used in many semiprofessional and Musical Instrument equipment applications to dramatically improve the quality of reproduced sound. It is rapidly becoming recognized as a simply applied, flexible tool which can solve many of the problems which recording engineers, musicians, and club sound technicians have been attempting to solve with more complicated and expensive equipment. It was designed for use in audio installations where signal is present at what is customarily called "Minus Ten Level" (-10 dBu, or .245 Volt RMS average signal level). This is the signal level used with most consumer sound equipment, disco equipment, smaller recording studio equipment, portable multitrack recorders ("Porta-studios"), and small club PA systems. Using the BBE[tm] Maxie Sonic Maximizer in any of these applications will give remarkable improvements in clarity of reproduced or recorded sound, and will help retain that "live" sound.

The BBE Model 402 Audio Processor was designed to help solve a specific set of problems which are present in any sound system. To put the problem in its most simple terms, there are physical and electrical problems caused by the interaction between amplifiers and speakers in all sound systems which cause reproduced sound to become 'muddied' and less clear than the original. These distortion-causing problems generate phase and amplitude changes which must be dealt with if the sound system is to perform at its best in reproducing audio. (These problems will be discussed in more detail in Section III of this manual).

To help counter the effects of the speaker/amplifier interface, the Model 402 'preconditions' the signal going to the amplifier. A predetermined phase shift, which has been found to be beneficial to virtually all sound systems, is applied across the audio frequency spectrum. In addition, a variable front panel control for each channel allows the user to adjust the amount of harmonic compensation desired.

SECTION II
INSTALLATION AND SETUP

The Model 402 MAXIE is a dual channel, rack mountable device which is designed for use in semiprofessional and musical instrument (MI) applications. It was designed so that it may be installed in a standard 19 inch wide EIA rack space. Rack "ears" are provided with the unit for optional rack mounting. The MAXIE takes up one vertical standard space, or 1.75 inches. Two independent channels of processing are provided within the chassis, sharing a common power supply. This allows maximum flexibility in applications where, for example, one channel may be used for a house mix feed while the other is used for stage monitor processing (which may require a different process level). The two channels are completely independent except for the common power supply. The increased imaging perceived by many users is due to the fact that the signal to each speaker is being properly compensated for the effects of the amplifier/speaker interface.

INPUT

The Model 402 is designed so that an average input level of -10 dBu will give excellent results. Audio connections to the unit are made with either 1/4 inch 'Phone' plugs (Tip-Sleeve mono type) or RCA (phono) connectors. An additional quarter-inch jack is provided for remote actuation of the process/bypass switch. Any push-on/push-off single pole switch will work as a remote. The front panel process/bypass switch must be in the bypass position in order for this jack to function.

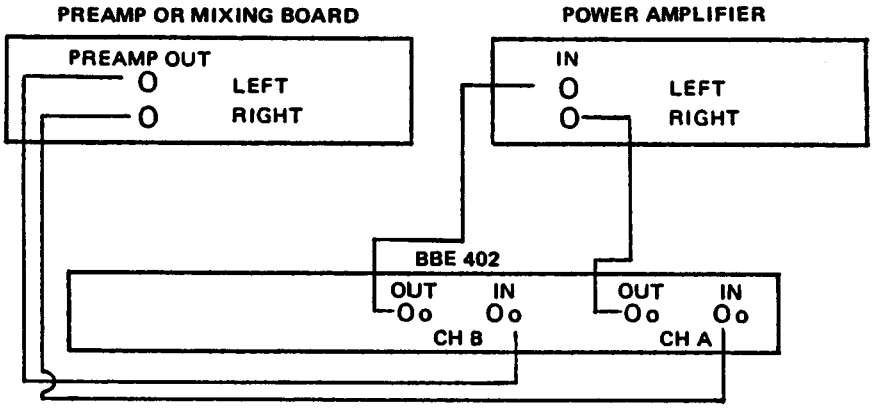


FIGURE 1
INSTALLING BBE^{tm} IN THE PREAMP OR PA SYSTEM LOOP

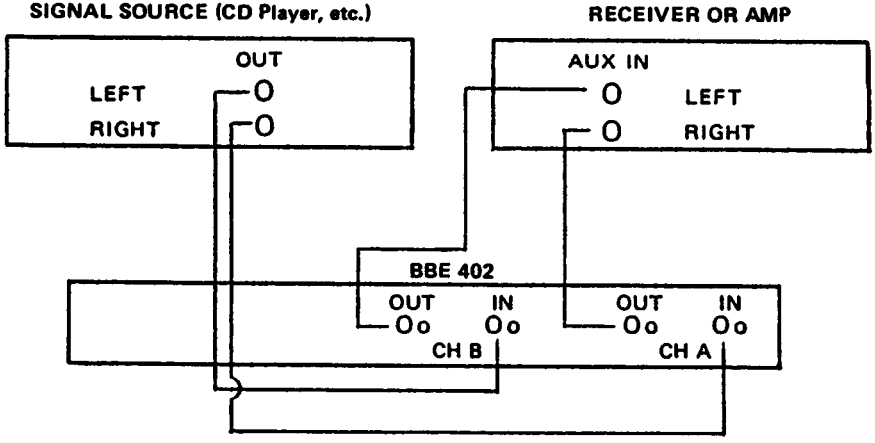


FIGURE 2
USING BBE^{tm} WITH A SINGLE SIGNAL SOURCE

An LED indicator system consisting of an amber, a green, and a red LED for each channel is provided to give some guidance in setting process control levels. The front panel knob should first be adjusted so that average program level flashes the green LED intermittently. This setting will calibrate the 402's circuitry for an 'average' amplitude correction appropriate for the program being sent through the unit.

The process level should always be ultimately set by ear. The LED system is useful primarily as a set-up guide. Adjusting the process control to show constant amber LEDs does not necessarily mean too little processing, only that a minimal amount of processing is taking place. By the same token, red does not mean danger -- only that a good deal of processing is taking place.

'Clip' LEDs are provided to indicate that input levels are approaching excessive amounts. They come on at about +10 dBm.

LOW FREQUENCY GAIN ADJUSTMENT

The Low Freq Level control sets the gain in Process mode from approximately 10 to 200 Hz. This adjustment is provided because in many applications a boost in low bass level seems to "balance" the improved clarity in the mid and high frequency ranges. The control is factory calibrated to unity at 50 Hz with the control set at mid-scale; at least 6 dB of gain at 50 Hz is available by rotating the control clockwise, while counter-clockwise rotation will give over 2 dB of bass attenuation.

SECTION III
THEORY OF OPERATION

Dynamic loudspeakers, as a family, have difficulty dealing with the electrical signals which the amplifier supplies. These dif-

ficulties cause major phase and amplitude non-linearities, which make the sound reproduced by a speaker to differ significantly from the sound produced by the original source.

Phase problems have, in the past, often been relegated to a position of secondary importance in audio system design. However, it is becoming increasingly apparent that phase integrity is essential to accurate sound reproduction. Research shows that the information which the listener translates into the recognizable characteristics of a live performance are intimately tied into the complex time and amplitude relationships between fundamental and harmonic components of a given musical note or sound. These relationships define a sound's 'envelope'.

With a perfectly reproduced musical note, the harmonics reach the listener's ear in a time relationship directly related to their frequencies--as the frontal 'attack transient' propagates, the higher the frequency, the faster its slew rate, and therefore the earlier it arrives at the listener's ear. When this complex time relationship among harmonics is modified by a speaker, the harmonics no longer reach the listener's ear in the proper order. Due to speaker non-linearities, the higher orders are delayed more. Therefore, a lower order harmonic may reach the listener's ear first or perhaps even simultaneously with that of a higher frequency. In some cases, the fundamental may be so time-shifted relative to the harmonic structure that it can reach the listener's ear ahead of some or all harmonics.

If two harmonics arrive at the same time, masking occurs--essentially, the harmonic with the lower amplitude is not heard at a normal level, or possibly cannot be heard at all. Slight overlaps result in changes in the amplitude of the already time-displaced harmonics. The listener perceives changes in the reproduced sound. Such relative terms as 'muddy' and 'smeared' are often used to describe the loss of musical integrity.

With extreme sound coloration, it becomes difficult to tell the difference between instruments. For example, an oboe and a clarinet may easily sound alike. Important sound information is lost to the listener.

Barcus-Berry Electronics' Engineering department has conducted extensive studies of numerous speaker systems over the last ten years. These studies have shown that, while there are differences among various speaker designs in the magnitude of their needs for correction, the overall trend in the type of corrections needed is remarkably consistent. With this knowledge it has been possible to arrive at a 'model speaker', which can serve to indicate corrections to the signal feeding the amplifier/speaker interface.

The hardware implementation of this correction has been designated for the semiprofessional and Musical Instrument sound market as the BBE Model 402. In essence, it applies the knowledge gained in our studies to precompensate the audio signal. Using our understanding of the behavior of the interface model, we have designed the electronic 'complement' of the interface error.

The BBE^{tm} process imparts fixed phase correction for the full program and dynamic corrections to the high frequencies where most harmonic information exists. This is done by breaking the signal into three bands, with crossovers at 150 Hz and 1200 Hz. The low frequency band has an adjustable level relative to the midband. The midband is then used as a point of reference to make dynamic amplitude corrections in both positive and negative directions to the high frequency band. Detectors monitor the levels of incoming midband and high band information and do an intelligent 'comparing of notes' to determine the harmonic content of the program. This information is used to determine the amount of high frequency harmonic content present at the final output of the Model 402.

SECTION IV
MAINTENANCE AND CALIBRATION

Maintenance of the Model 402 is limited to cleaning of the outer surfaces of the unit. Any mild cleanser such as Formula 409 may be used. The chassis and cover are steel finished with a durable polyurethane paint, while the front panel is an anodized aluminum extrusion. A simple periodic cleaning of dust and dirt should be sufficient.

Calibration should be performed if parts are replaced or if a performance check out indicates a problem with calibration. Long-term use has shown that over the life of this unit there is little or no drift of components in the 402 which would cause a change in calibration; a very conservative design philosophy has resulted in a piece of equipment which runs very cool and should give years of trouble-free service.

CALIBRATION PROCEDURE FOR THE BBE^{tm} MODEL 402

EQUIPMENT REQUIRED: Audio Signal Generator
AC Voltmeter

This procedure details calibration of Channel A.
Comments (in brackets) pertain to Channel B.
All tests are done with a signal level of 0dBu (.775 VRMS) except for clip indicator calibration check.

1. Apply AC power. Engage the Process control.
2. Connect a jumper between TP3 (TP6 for Channel B) on the PC board and Signal Ground.
3. Set Channel A Process control to mid-scale.
4. Set Channel A Low Freq Level control to mid-scale.
5. Set the signal generator output to 5 kHz.

6. Connect the Voltmeter to Channel A Output.
7. Adjust R1 (R23 for Channel B) until the Voltmeter indicates 0 dBu (.775 VRMS).
8. Check output amplitude at 50, 500, and 5kHz. All should be at 0 dBu.
9. Set signal generator to 500 Hz and increase generator output level gradually. Verify that the Clip indicator comes on at approx. +10 dBu. (2.45 VRMS)

This completes the calibration of the Model 402.

SECTION V
SERVICE

We recommend that if at all possible a Model 402 which requires repair be sent to our facility. We can normally turn a repair job around in a short time and get it back into the customer's hands far faster than would be the case should someone attempt a repair who has had no experience with the unit. We also appreciate being able to add reliability data to our files so that future revisions may be undertaken if necessary to improve any evolutionary reliability problems.