dbx

BX1
Configurable Multichannel Power Amplifier

Instruction Manual

INSPECTION and INSTALLATION

Your BX1 was carefully packed at our Newton factory in its protective carton. Nonetheless, examine both carton and contents for signs of shipping damage. If there is such evidence, don't destroy the carton or packing materials and notify your dealer immediately.

In any case it's essential to save the carton and packing for transporting the BX1.

The BX1 may be located virtually anywhere except near a heat source (e.g., radiators) or in hot sunlight. It may be placed on a rug provided the fins don't ride down into the pile, although it's probably wiser not to. It also is best not to stack other components atop it because, while the stray magnetic field of the BX1 is relatively small, doing so may generate or increase hum throughout your stereo system, as well as interfere with ventilation.

WARNING

**TO PREVENT FIRE OR SHOCK HAZARD,
DO NOT EXPOSE THIS COMPONENT
TO RAIN OR MOISTURE.**

This triangle, which appears on your component, alerts you to the presence of uninsulated dangerous voltage inside the enclosure — voltage that may be sufficient to constitute a risk of shock.

This triangle also appears on your component, and it alerts you to important operating and maintenance instructions in this accompanying literature.

CAUTION
To Reduce Further the Risk
of Shock, Do Not Remove
the Cover or Back. There Are
No User-Serviceable Parts
Inside; Refer All Servicing
to Qualified Personnel.

CONTENTS

THANK YOU

...for your purchase of the dbx BX1 Configurable Power Amplifier. We set out to make the best power amplifier we knew of, and we hope you agree that we succeeded. We also hope that your BX1 fully satisfies whatever demands your home-entertainment system may make upon it.

CAUTION

The BX1 is, as you know, an unusually powerful audio amplifier, among the most powerful built for any use. In some respects it is not very different from an ac wall outlet. So be careful in using it and especially in making connections to it, for the sake of your speakers and, more important, your own safety. Never make or change connections when the amplifier is on or newly turned off. (In the latter case, wait two or three minutes before proceeding.)

SPECIFICATIONS
Minimum Performance, IHF standards

Power
2 channels, continuous W/ch:

	8 ohms	4 ohms	2 ohms	1 ohm
(audio band)	400	650	800	1200
(rated distortion)	(26 dBW)	28 dBW)	(29 dBW)	(31 dBW) (short-term, limited by fusing)

4 channels, continuous W/ch:

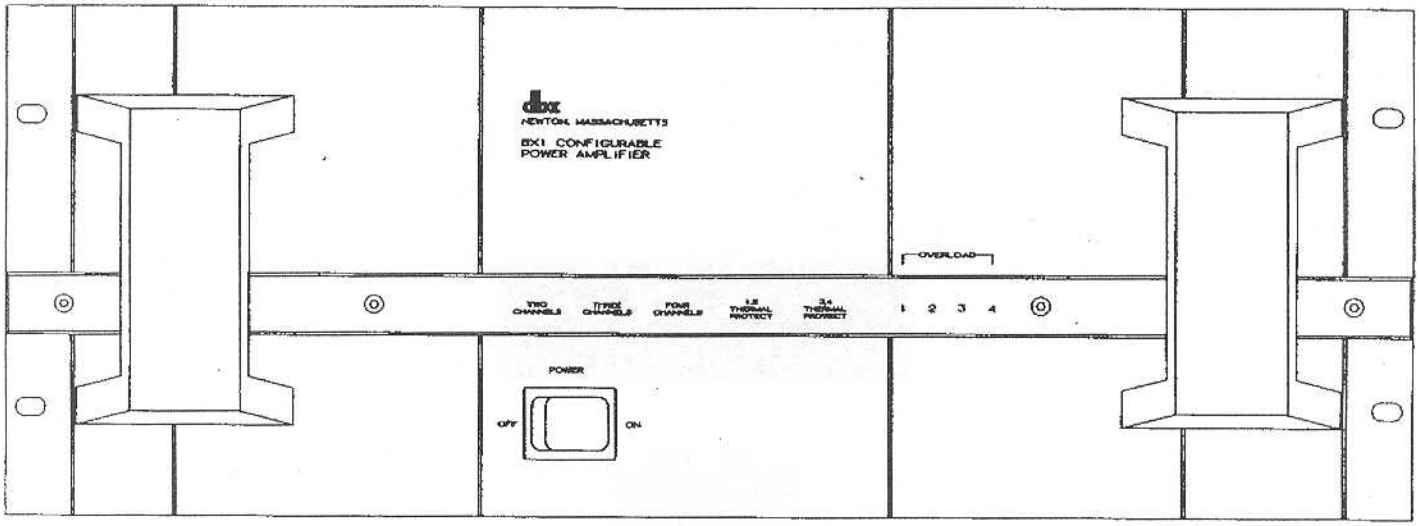
	8 ohms	4 ohms	2 ohms	1 ohm
(same conditions)	100 (20 dBW)	200 (23 dBW)	325 (25 dBW)	400 (26 dBW)

Current capability	100 A peak into 0.1 ohm with the IHF dynamic-headroom signal; 20 A continuous
Dynamic headroom (IHF)	1.5 dB (e.g., 1200 watts into 2 ohms)
Distortion (all types)	0.05% or less, to rated output
Slew rate	200 V/µs (100 V/µs in 4-channel configuration)
Sensitivity	1 V for rated output
Bandwidth	-3 dB points @ 3 Hz and 160 kHz
Frequency response	20 Hz-20 kHz ±0.075 dB, load-invariant
Noise	96 dBA below 1 W, 116 dBA below rated 8-ohm power 4-channel, 119 dBA below rated 8-ohm power 2-channel.
Separation	90 dB @ 1 kHz, 70 dB @ 20 kHz
Damping	Greater than 100 @ 20 kHz, 1000 @ 2 kHz, 2000 at 200 Hz
Limiting	None. (Circuit thermally protects itself when output devices exceed their safe operating area.)
Input impedance	48.5 k-ohms in parallel with 200 pF
Fuses (3 sets)	2 for ac mains; 1 each for speakers (user decides value of these fuses, which lie inside feedback loop to prevent degradation of the sound); also for internal power supply (not user-accessible).
Circuit topology	Complementary throughout amp, input to output. Highest-quality film capacitors used throughout. 8 x 250 W high-speed bipolar devices/ch (total of 32); 2 x 3200 VA toroidal transformers w/ 2 taps each (1.6 kVA/ch); separate rectifiers for each channel, filtered w/ 2 x 22,000 µF caps per channel (= 0.18 F). ±55 V power supply rails, each channel. Gain = 29 dB. Input is ac-coupled; output is dc-servoed to less than ±5 mV offset; no inductor at output.
Dimensions	19"w x 7"h x 24.5"d (483 x 178 x 622 mm)
Weight	84 lbs (38 kg)

Subject to change.

Made in USA.

FRONT



Power

This switch turns the amp on and off, with a muted delay of a few seconds before signal passes. It will not hurt anything to leave the BX1 on all the time, even your electric bill, because the quiescent (idling) current draw is low: less than half an ampere (less than a 60-watt lightbulb). But note that one danger in leaving any amp on is from preamp on/off transients, which will greet your speaker drivers at high power. Therefore, you may wish to turn the BX1 on and off for each use, the safest procedure with all power amplifiers being On Last, Off First. Or leave your whole system on.

Sonically it makes little or no audible difference what you do, although some audiophiles believe that leaving an amp on improves its sound, and it is true that, as with all amplifiers, BX1 measured performance becomes optimal after a few minutes' warmup.

Configuration

Be sure that the lit Two Channels/Three Channels/Four Channels designation corresponds to the number of inputs and outputs (speakers) you have connected to the BX1. No harm will come to the amp from making a mistake in this regard, but nothing good will come of it either — no improvement in power or sonic quality.

Thermal Protect

These lights tell you one of the channels is too hot and is shut down, no longer supplied with ac power. In the highly unlikely event this happens, you will have to consider reducing levels, improving ventilation, changing speaker load, and the like.

Overload

These LEDs show an overdriven condition -- clipping (of the waveform peaks) is the jargon -- anywhere within the BX1. Specifically, the clip-indicator circuit compares input with output and registers any significant difference. The LEDs will light before you hear anything untoward, probably, just to let you know. Your first response should be to reduce the level; too much clipping can damage speakers. These LEDs also show a blown fuse or the presence of dc at the output (servo failure).

REAR

The speaker connectors are "five-way" binding posts; you'll find our supplied dual-banana-plug cable terminations easiest to work with. With a small screwdriver partly unscrew the small fastening screws in the plastic well of the dual bananas (careful -- if you overdo it they'll fall out), exposing the holes where your cable wire goes. These holes will accept even thick wire provided you've twisted it to prevent strands; pin-style terminations into these holes are another option. Be sure to keep your wire sides and the dual-banana connector sides matched up consistently from cable to cable, for ease of proper phasing. Tighten the screws down hard and you're done.

Your dealer can assist should you need it.

Any loudspeaker system we know of, of any impedance or reactance (inductive and/or capacitive), may be connected to the BX1.

As mentioned, for optimal performance of your BX1, ensure that the number of inputs and outputs you are using in your system corresponds to the 4/3/2-channel switch setting. You will not damage the amp or your speakers otherwise, but you won't get the performance you paid for.

Here are the speaker hookups. It all sounds harder than it is.

4-Channel Operation

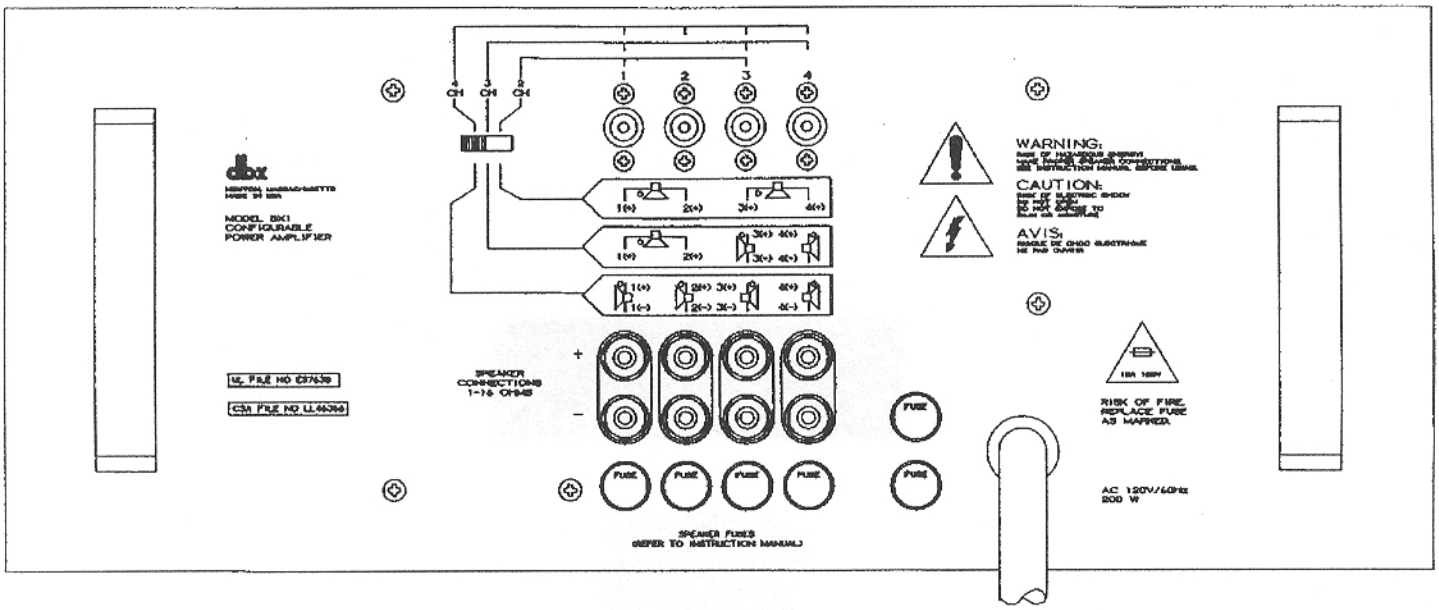
Set the switch to the left, as marked.
Connect your four inputs -- left/right front and left/right side or rear -- to the four jacks 1-4.
Connect your four speakers as shown in the bottom diagram, to the four BX1 output terminals, vertically (red/black), 1-4. Red is the positive-going-voltage output; the diagram shows this with a dot as well as the + (plus) sign. This ensures correct phase in your speaker hookups.

3-Channel Operation

Set the switch to the middle, as marked.
Connect your three inputs -- left/right front and single (mono) subwoofer or single (mono) side or rear (or center) -- to jacks 1, 3, and 4, also as marked.
Connect your three speakers as shown in the middle diagram, to the first pair (1 and 2) of red terminals (horizontal) and the last two conventional red/black terminals, vertically, 3 & 4.
Red 1 is the positive-going-voltage output for the subwoofer or side/rear speaker, while red (as opposed to black) is the same for the front speakers; the middle diagram shows all this with a dot as well as the + (plus) sign. This ensures correct phase in the speaker hookups.

2-Channel Operation

Set the switch to the right, as marked.
Connect your two inputs to jacks 1 and 3, as shown.
Connect your pair of speakers as shown in the top diagram, to the four red terminals, vertically. Red 1 and 3 are the positive-going-voltage outputs; the diagram shows this with a dot as well as the + (plus) sign. This ensures correct phase in the speaker hookup.



Speaker Fuses

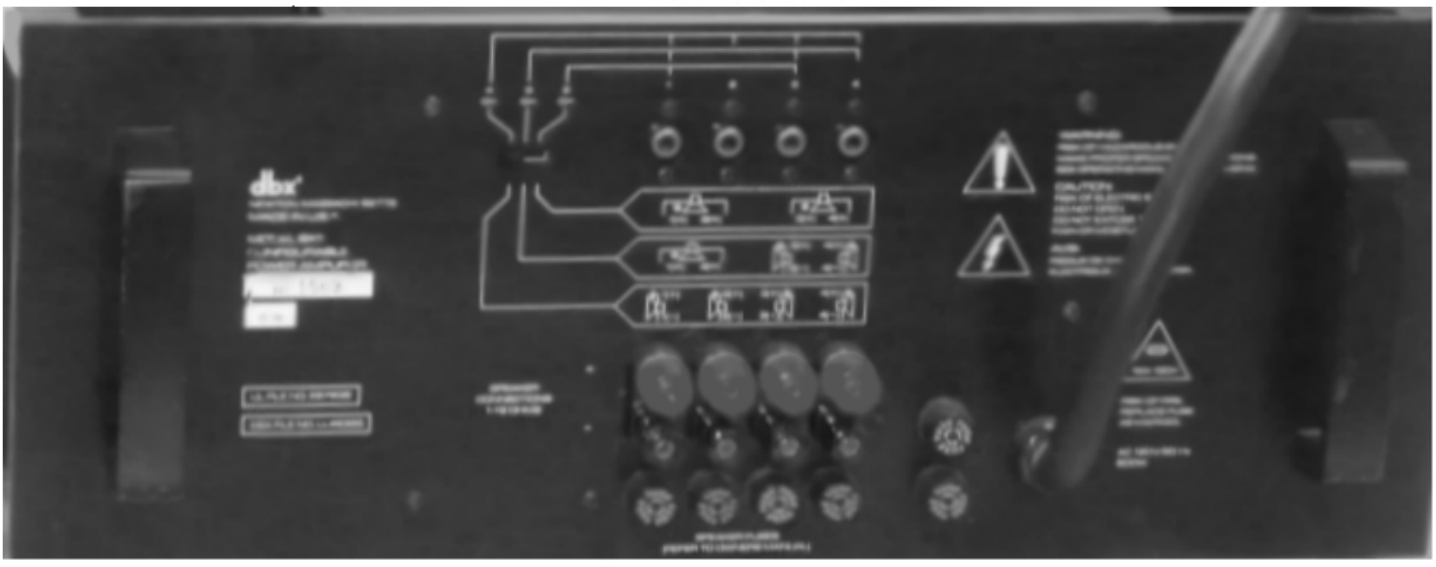
3A fuses are installed. 7A fuses are included for 2-channel operation and/or low-impedance speakers. It is possible to damage your speakers more readily with the latter than with the former; as necessary, try intermediate values to balance protection against maximum loudness. If your speaker manufacturer recommends a specific different fuse or rating, use it instead! Note that none of these fuses has the ability to affect the sonic performance of the BX1 (by changing its output impedance) because they are inside its feedback loop.

If a replaced fuse blows right away, there's a problem. Check all speaker wiring (at the speaker, too) and if necessary consult your dealer.

A speaker may keep on producing sound with a blown fuse; the sound will be much lower in level and usually distorted. In such circumstances, then, check fuses first. Note that the clip light for that channel will have come on.

Ac Fuses

If these blow, replace them, but if they blow a second time consult your dealer, for there's a problem. When this fuse blows there will be no sound from that side.



MISCELLANY

Ac Power

Your wall jack must be able to provide 15 amps, with more capability better. It also is best not to have other equipment on this line, at least not other heavy-current equipment (heater, air conditioner, etc.).

Speaker Wire

For connecting your speakers, use at least 16-gauge lamp- or zipcord, available at hardware stores. 14-gauge thickness is preferable for runs greater than 20 feet, 12-gauge for runs longer than 30 feet. Thinner wire won't hurt anything; it simply has the potential to decrease transfer of power and fidelity of response. "Audiophile" cable is fine as well; the BX1 itself is internally wired with Monster Cable, one of the popular brands of this new genre.

Switchers and Speaker Systems

Most speaker-switching components today -- such as those made by ABX, Adcom, Audio Authority, Switchcraft, etc. -- do not have a common ground and can be used with any amplifier, including separate stereo amplifiers used in bridged mode as two mono amps. The BX1 in its 2- and 3-channel configurations is such a bridged amp, and it too can be used with non-common-ground switchers like those listed. Frequency response may be altered slightly because of the added impedance of the switcher wiring, but that's all.

HOWEVER: there do exist common-ground switch boxes, usually inexpensive devices for modest systems and applications. These cannot be used with the BX1 in its 2- and 3-channel configurations, nor with any other separate pair of stereo amps used in bridged fashion. Such switchers are dangerous and should be replaced by one of the non-common-ground type.

Likewise most headphone boxes. We assume you won't connect headphones directly to the BX1 outputs, but if you do, be certain that the BX1 is in its 4-channel configuration, the phones connected to two of them.

Likewise speakers that rely on a common-ground wire connected between them for generating special "stereo" effects. The most common of this type is certain models in the Polk line. They cannot be used with the BX1 in its 2-channel configuration -- or with any other pair of separate amps.

THE TECHNOLOGY AND PHILOSOPHY BEHIND THE dbx BX1

BACKGROUND

For the last year it has become clear that the advanced home theater is becoming reality. The popularity of the VCR, of videodiscs, and especially of the CD; improvements in television monitors and TV sound (including stereo TV, co-developed by dbx); a new generation of speakers with unconventional imaging (again including dbx in a breakthrough role); the acceptance of Dolby Surround sound and the general renewed interest in multichannel music playback -- all are converging. The serious videophile and music-lover finally can begin to assemble a sophisticated home entertainment system, including source material, and have the most remarkable audio and video experiences in his or her own listening room.

With this in mind, the engineering department at dbx set out to design a multi-channel configurable (switchable) audio power amplifier to be at the heart of such a system, an amp that would set new standards for versatility, power, performance, and value. The assignment was to make the best amplifier the engineers knew how to make, one they themselves would want to own.

Your BX1 is the result, an amplifier of unprecedented performance characteristics.

As with other dbx products, there is no magic in the BX1 other than straightahead, fundamental engineering at its most brilliant. We became familiar with the myriad other power amplifiers on the market today, and with the claims made for them by their designers, by reviewers, and by their audiophile and dealer fans. Although there are some fine power amplifiers on the market, it didn't appear too difficult to surpass most of today's top models by creatively and thoroughly applying basic engineering to well-known, albeit not always well-understood, problems. We set out to do nothing particularly revolutionary in our design, but we were determined to do everything right, to achieve a synergistic, intelligent, everything-has-been-thought-of product. Most of it may have been done before, yet not all in one amplifier.

And that, we feel, is revolutionary enough.

POWER from VOLTAGE SOURCES

The specific performance goals for the BX1 were tremendous power, along with absolute stability and accuracy in transferring that power to any load -- the only constraint being that there would be no fan to get rid of heat.

Other power amplifiers do their best when driving relatively resistive loads of not very low impedance. But many fine speakers are both low in impedance and reactive, not resistive, meaning they fight the amp. Amps as a rule don't do well with such speakers. They cease to be <u>power</u> amps.

Here's why. Power, measured in watts, is the product of voltage and current. Recall the venerable analogy that voltage is like water pressure and current is like flow, as in gallons per second. The ideal amplifier works as a voltage source, delivering the same "pressure" (that is, amplifying the signal and doing nothing more) regardless of the load put on it. Load in this analogy would be the diameter of the hose. A true voltage source has just this tremendous potential, delivering "water" and "water pressure" no matter how large or small the hose diameter is or what sort of chamber the hose ends in (which could be an analogy for reactance). In electricity, this is what the electric company provides at your wall outlet -- 120 V ac irrespective of load for the most part.

Power delivered from a true voltage source would change linearly with load: 100 watts into 8 ohms should, with a voltage source, correspond to 50 watts into 16 ohms, 200 watts into 4 ohms, 400 watts into 2 ohms, 800 watts into 1 ohm, and 1600 watts in 0.5 ohm. But most amps cannot produce high power when the speaker load is antagonistic -- either very low in impedance or reactive, storing some of the energy and sending it back to the amp. Many amps that put 100 watts into 8 ohms yield 75 watts into 4 ohms and a mere 15 watts into 2 ohms.

Note that your dbx BX1 is not a perfect voltage source; its wattage doesn't fully double as impedance halves. It just comes closer to this ideal than other amps.

For some reason it is only recently that the importance of high current capability has become widely acknowledged, although there's still no IHF standard for current delivery by audio amplifiers, and Japanese and other designers have for decades underestimated the current demands of numerous good loudspeakers while playing potent music. Many influential reviewers, furthermore, still regularly miss the importance of this point. Canadian academic researchers have demonstrated that the situation is even worse than imagined, that real speakers reproducing music often have very low impedances in significant frequency ranges and make large current demands. Former amp designer Tomlinson Holman and colleagues in the Boston audio world analyzed this and other amplifier problems a decade ago, but the influence of their work has been curiously limited.

Even today, some of the better amplifiers that do claim high current capability cannot really deliver enough in tough situations. Other moderately high-current amps do okay only because of fans, to help get rid of the heat that accompanies power delivery. This is one way (a good way, in fact) to go about the task -- except that fans destroy the quiet background that a power amp should also provide.

To quantify this discussion of current, the dbx BX1 into 0.1 ohm (almost a short circuit, the hardest load, and worse than any speaker) will provide 20 amps for a half-hour and 100 amps peak with the IHF dynamic-headroom signal. So far as we know, this is unprecedented.

The key to such an achievement is heat dissipation, which is really the name of the game in power amp design. A hot amp can't cut it; a cool one can. We knew from the start that we wanted to use natural convection only in the BX1. Thus we have a very large number of thin fins in a small area, yielding very high thermal efficiency: 0.35° C per watt. This too is unusual if not revolutionary; our heat sinks are not extruded like those of other manufacturers, they're glued in with a thermal epoxy. (The BX1 couldn't be manufactured any other way.) Doing this lets you get just about as much out of a 250-watt transistor as it can give.

The power of a power amp is supposed to move the speaker, but some of it must be wasted, dissipated in the output stage into the air as heat. With a reactive load at a low impedance, as in a speaker with a large "phase angle" between its voltage and current demands, a lot more heat needs to be dissipated lest the transistors get severely stressed and the unit shut down or misbehave. With the BX1 we simply calculated how much heat needed to be gotten rid of with a reactive load at a given low impedance and "sinked" the unit accordingly, so it could get rid of the heat continuously.

The recent, much-praised high-headroom amp designs do not do this. They do not exhibit their high headroom into reactive loads and/or low impedances. They deliver their highest power only briefly in any case and only with easy loads. These approaches do represent a good, cost-effective idea, but they are not ideal for today's digital and optimized-analog sources. Such amps put out their best for only a half-second or less, only once in a while, and only into more or less friendly speakers. If a second drum roll comes along right away and/or the speakers are difficult, they run out of steam.

Not the dbx BX1. Its power capabilities are continuous. All the time, day and night, irrespective of signal or load, to the limits of your house wiring, or your speakers, or your hearing.

SONICS

Does the BX1 sound good? Well, that depends on what you mean.

Many other amps actually change their sound -- their frequency response -- from speaker to speaker. In the audio magazines and in the audio salons, there's endless discussion about the "sound" of power amplifiers. Some say tube amps are sweetest, but when they're measured, sometimes the highs are rolled off and the lows boosted. Others swear by mosfet designs, but when they are analyzed properly they simply behave (and sound) like other good designs. Occasionally there seems to be deliberate "improving": three years ago the most famous audiophile amp was measured by the largest audio magazine and shown to have a broad, smooth 0.5-1 dB rise from 2 kHz to 15 kHz, a clearly audible treble boost in other words, and in this case not even due to stressful speaker load! Any amp will sound more "open" and "airy" with the treble turned up a little.

In any event, amps esoteric and otherwise are described by subjective reviewers as warm, or grainy, or silky, or harsh, or clean, or gritty, depending on whether they like what they hear.

At dbx we don't think an amp should sound like any of these things, ever, with any speaker. We don't think an amp should sound "anything." We also know there are good, demonstrable reasons why even measurably flat power amplifiers sound different, and sound different with different speakers.

Perhaps the main reason is called amplifier output impedance (or, when the output impedance of the amp is divided into 8 ohms, damping factor).

The fact is that the vast majority of power amps have an output inductor, to isolate the amp from its load (cable and speaker) at ultrasonic frequencies. This inductor raises the output impedance with frequency. With a nominally 4-6 ohm speaker whose own impedance heads down toward 3 or 2 ohms at 8-10 kHz and above (a hardly uncommon situation) and which is connected to the amp by several feet of even thick audiophile wire, a frequency-dependent voltage divider is effectively formed, which causes variations in response.

Typically this variation might range from 0.25 to 0.75 dB around 10 kHz. Such an alteration would mean that careful comparative listening of well-recorded harpsichord, drum brushwork, or cymbal crashes could well reveal clear and consistent differences among given amplifiers. Nothing mystical to it.

The BX1 has no output inductor. Its output impedance is less than 80 milliohms at 20 kHz (damping factor over 100). This is part of what we call Load-Invariant Response. The frequency response of the BX1 will not vary from speaker to speaker; it is flat, unchanging into <u>any</u> speaker we know of. The only change to the musical signal between going into the amp and coming out of the amp is scale. Remember the tired phrase "straight wire with gain"?

NOISE

Another drawback of many power amps is that they're simply not as quiet as they should be. They make noise by themselves (hum or fan noise), and they produce noise through the speakers. Every amp should have an inherent A-weighted noise floor that lies 95 dB or more below 1 watt of output (or around 115 dB or more below rated output). A lot don't. A new amp that was recently praised by a renowned subjective reviewer as unusually quiet is specified at 86 dB below 1 W, a typical, hardly outstanding figure.

True, power amp noise is not a major problem in audio unless you have very efficient speakers. But as we see it, good design is good design; there's no reason for amps to be noisier than the BX1.

Second, we think every consumer amp should have enough heat sinks not to need a fan. Yet it's startling how many amps are "undersinked" or kick in a noisy fan when levels get high. This may not be a problem when the music is loud, but usually the fan must stay on for continued cooling down when we're back to pianissimo in the music. Of course, if an amp is seriously undersinked, eventually it cuts out or shuts down under tough conditions, and this, too, we discovered, is not an uncommon phenomenon.

The BX1 has lots and lots of heat sink -- over 2900 square inches, or 20+ square feet! -- to get rid of lots of heat from the 32 output transistors. Under almost any conditions the BX1 runs comparatively cool for a power amp.

PROTECTION

When overdriven, many other amps sound bad and/or do harmful things. They protest when they are driven too hard or loaded down unhappily. They have protection circuitry that misbehaves and may blow tweeters. They current-limit. They pass dc. They produce high-level high harmonics that sound excruciating and can damage drivers.

The BX1 does none of this, either. It has no protection circuitry. When it is overdriven into clipping it does not ring or go into oscillation; it distorts briefly (the SPL will be deafening), and the affected channel, if it senses that things are getting hotter than it can get rid of the heat, turns off. That's all. When it cools down, it comes back on. The BX1 wants only to protect itself, safely, with minimum audible consequence.

FEEDBACK

There is a lot of nonsense in circulation about the wonderfully useful circuit topology called negative feedback.

All amps have negative feedback, all of them. Period. Ads and literature that say otherwise aren't on the level.

Negative feedback may be overall -- this is sometimes called global by engineers. Or it may surround a given stage or stages -- this is called local. Sometimes, to evade the phrase, the word "degeneration" is substituted to describe local feedback, but they're the same thing. Feedback is a comparison of the output signal with the input signal, with departures by the former from the latter being by and large corrected. Negative feedback is a very good thing, so don't worry about it; everyone uses it. Anyone who says different is uninformed or lying.

The BX1 therefore uses a combination of local and global negative feedback -- not a lot -- wherever appropriate.

By the way, the only signal fuses in the BX1 are in the feedback loop, so any effects from them are eliminated. There are good reasons not to have fuses actually in the signal path. Fuses themselves, as pieces of wire, are resistors, and their resistance varies with their temperature. This fact will cause frequency-response changes depending on the level of the signal, which will heat up the fuse. In other words, louder sound can mean changed sonics and less power. To avoid this, you could get rid of fuses -- but that would be unsafe. In the BX1, by having the signal fuses within the feedback loop, we employed a "eat your cake and have it" solution: protection with no sonic variations.

See the engineers' discussion later on for more on negative feedback.

NULL TESTS

The "null" test has come back in the news among audiophiles, having been incorporated as a sonic trim feature into some new power amps.

Not unlike negative feedback, nulling entails canceling amplifier output with a phase-inverted version of its input and seeing what sorts of distortions show up. If an amp were perfect, the theory goes, there would be none of these distortions: the null would effect perfect cancelation.

The idea is an old one and sounds great. Unfortunately, null tests are uselessly sensitive, uselessly revealing.

What should a null test show us?

A good test would look for signal-related, nonlinear products such as harmonic distortion, intermodulation distortion, and transient intermodulation distortion. It would ignore small amounts of inaudible, linear distortions, particularly phase shift. Such a test has been proposed for decades.

Unfortunately, the revived null test as currently discussed fully registers the faintest phase shifts.

Only an amp that amplifies frequencies from dc (0 Hz) to light will have no phase shifts whatsoever. Such a reckless-bandwidth amp would be dangerous, and not perform well for audio purposes. An amp that responds to dc may be useful in a laboratory, but our ears do not hear this low, or close to it, and there's no music there to hear. (If we did hear dc we would be in trouble with weather fronts.) Worse, amplifying direct current is hazardous. Any small dc offset in the preamp, or any switching transients, would be faithfully applied to your woofers. This causes needless strain at best. And if your preamp ever fails in such a way as to cause dc to appear at its output, your woofers can burn up and start a fire in your listening room.

At the other end of the spectrum, amplifying frequencies that lie out in the radio bands, hundreds and thousands of times outside the audio band, may make an amp more susceptible to RFI, oscillation, and ringing. And this also places needless strain on speakers: living near a radio or TV station with such an amp can burn up tweeters. The new amps that come with a trim actually peak up frequency response around 400 kHz, in order to eliminate minuscule phase shift at 20 kHz! As almost everyone admits, and as a recent review in one of the large audio magazines put it, the effects of such a trim are inaudible.

We at dbx do not hold with reckless design. For example, the BX1 is not dc-coupled. There is a large high-quality polycarbonate ac-coupling capacitor at the input, making response down a few dB at 3 Hz but necessarily causing a few degrees of phase shift at 20 Hz, many orders of magnitude below even the threshold of audibility. The BX1 also is dc-servoed to less than 10 mV of offset worst-case, typically 1 mV.

As for the other end of the spectrum, the BX1 rolls off at 160 kHz, as one would want (as mentioned, in order to work, all amplifiers are lowpass filters). This rolloff is sufficiently high to eliminate any audible effects but low enough to protect against RFI and tweeter failure.

For nonlinear distortions the BX1 nulls to -70 dB. Through the midrange, including linear distortions such as phase shift, it nulls to less than -40 dB.

None of this phase shift has any consequence for sound reproduction; everyone who has really examined the subject concurs in this. Zero phase shift is not a worthy design goal. The null test is simply another sales ploy.

CLASS

Class AB describes a design in which both polarities of output devices are on (class A) during low-level operation but only one polarity of output device at a time (class B) is used for high-level operation. In a competent (properly biased) design, the changeover from A to B occurs at a high enough level that the distortion generated is entirely negligible. In class A design, both polarities of output device are always operated at the maximum current the amp can deliver, regardless of signal. While this may seem ideal theoretically, it's a very wasteful, hot-running topology. The dbx BX1 is an AB design, class A at low levels, where zero crossover distortion may conceivably count for something, switching to B at higher levels for efficiency.

FROM THE DESIGN ENGINEERS

To touch on other topics, such as mosfet pros and cons, transient IM distortion, and to delve more into negative feedback and circuit topologies, we turn to the words of the BX1's design engineers, Gary Hebert and Richard Aylward, reviewing the conception of the power amp with Engineering Vice-President Les Tyler and manual author David Moran.

FRONT END and NEGATIVE FEEDBACK

"First, what we did was evaluate several front-end topologies without regard to output devices, to find out which topologies have what advantages. This analysis took place before any overall feedback, frequency compensation, etc. -- all under open-loop conditions. It was an examination of distortion, bandwidth, and so on of the front end on its own, with reasonably low distortion resulting in the case of the BX1, which was pleasing. Distortion was down to 0.3% using moderate amounts of local negative feedback, or degeneration, only. Some companies will tell you that local degeneration is not negative feedback, but if they go to the source and read Black's paper, the original treatise on negative feedback, they will see where they are wrong.

". . . Our very fast, highly regulated circuit execution was so satisfactory that the final amount of all feedback needed turned out to be pretty moderate.

OUTPUT DEVICES, MOSFETS, and BIPOLARS

"Then it became a straightforward matter of seeing that, of the output-device choices, bipolars offered the most benefits, the most power for the least number of devices: the most elegant solution. They were miles ahead of mosfets.

"Some of the traditional arguments on behalf of mosfets that we considered were that they were fast, indestructible, and distorted in superior fashion. Well, they <u>are</u> fast if you can drive them fast, and to do this you have to build a mini-power amp, usually made up of bipolars, to run them! In an audio power amp your speed in any case will be limited by the front end and loop closure, not speed of output device. The BX1 is tremendously fast in its slewing rate of 200 V/µs. Again, it was a matter of making the right choices. <u>Everything</u> you want can be done with bipolars if you design the thing right. Such a fast slew eliminates any worry about TIM, which is a kind of input clipping where the feedback can't keep up with the signal.

"Mosfets also are not indestructible. They can blow up. Their self-destruct mechanisms are different from bipolars, that's all. In fact, the bipolars used in the BX1, when heated to the same temperature as the popular mosfets, will dissipate more than twice as much power.

". . . In the same vein, in the BX1 enough attention was paid so that none of the stages can get saturated. You drive the thing to clipping and nothing saturates. It's simply good, conservative design. It's not different with other good power amps but it is different with bad power amps, and for some reason there are a lot of them out there, ones with something fundamentally screwy in their design.

"As for distortion, let's quote from the Hitachi data book on their own good and widely used mosfets: '...since a power MOS FET amplifier has a distortion about 20 dB larger than a bipolar transistor amplifier, it is necessary to design for a larger open loop gain and larger negative feedback than in a bipolar transistor circuit.'

"So we went with bipolars and a moderate amount of negative feedback. A final reason was the amount of SOA (safe-operating area) per part. Using mosfets to achieve what we achieve with bipolars, and dissipate enough heat, would have been impossible without a fan. We would have needed twice as many devices.

STABILITY

"Once we found the best devices we turned our attention to making the circuit stable under any kind of load, and this related to front-end design using very high-speed driving devices. We used extremely fast ring-emitter driver transistors, of moderate power, so fast that they don't have a lot of phase shift, which helps amplifier stability.

"Output inductors are used for stability by most other designers, but they cause response variations in the high frequencies with many speakers. If you remove them from amps that have them, the amps will oscillate at high frequencies. It is not easy to have it all -- no inductor, rock-solid stability into reactive loads, and high slew rate. But the BX1 does. It will drive a 2.2-μF capacitor.

LOW-FREQUENCY RESPONSE

"Dc coupling at the input is mistakenly thought by some to improve audible bass response. In fact it's genuinely dangerous to be able to amplify direct current. Having an ac-coupling capacitor -- a single polycarbonate one in the case of the BX1 -- eliminates the danger and does no sonic harm whatsoever. It makes the response down a few dB below 3 Hz and contributes a few microseconds of phase shift as well. That's it. It's the only sane way to do it. It does buy you less than perfect-looking null tests in the bass.

"We also use a dc servo to get offset down below 10 mV worst-case, typically below 1 mV; otherwise you have to use a big nasty electrolytic capacitor in the feedback loop to set dc unity gain. We like only superb-quality capacitors. For dc safety we also have output fuses to blow and an overload indicator to turn on and shut the channel down in the presence of dc.

NULL TESTS

"If you are going to go ahead and use null tests to look at alleged subtleties of amp sound, we concur in the Peter Walker/Quad position of actually using a phase-correction network so that slight shifts are ignored and you are seeing only low-level distortions.

CHANNEL ISOLATION and POWER SUPPLIES

"Those who care about such things should know that the BX1 in stereo configuration is a true dual-mono design, with only the ac line cord shared. After the line cord, it's all separate; there are even separate poles on the power switch. It is almost a quad-mono design, in fact, for in 4-channel mode the front and rear pairs are each powered from a separate massive toroidal transformer, with individual secondaries, rectifiers, and filter capacitors for each channel. All wiring at the high-current level is Monster Cable.

PARTS

"The amplifier modules are composed of discrete components except for an op-amp dc servo. The topology is complementary differential pairs with emitter degeneration, buffered with complementary emitter followers, followed by a complementary voltage-gain stage with emitter degeneration, followed by complementary triple-Darlington current-gain stages.

CONCLUSION

"In a nutshell, the BX1 will produce virtually whatever voltage it's being asked to produce regardless of how much current you ask for from it, even into reactive loads. Quietly, relatively coolly -- and with waveform fidelity. We don't know how we could have done it any better."

WARRANTY and SERVICE

dbx warrants this product to be free from defective materials and workmanship for a period of three (3) years from the date of first consumer purchase from an authorized dealer. If you are uncertain as to whether a dealer is authorized, contact us. The unit must be delivered by you or your representative with proof of purchase to one of our authorized service agencies.

Please save your sales slip, and please return the warranty registration card (doing so will establish a convenient proof-of-purchase date in case your sales slip gets lost). Note that not doing so doesn't affect your rights under this warranty; we ask you to simply because it's helpful to us.

For shipping, pack the unit carefully, in its original or other suitable packing. All merchandise must be prepaid and will be returned freight-paid. Include your or the sender's name and address, telephone number, and reason for return. Insure your shipment, and in the US use UPS or similar carrier, not Parcel Post.

FOR INFORMATION ON YOUR NEAREST SERVICE STATION, contact your authorized dealer or call (round the clock, 7 days a week) 1 800 447-4700; have your Zip Code available for the operator.

For non-service problems and questions NOT covered in this manual, call (US Eastern time, business hours) our Customer Service, at 1 617 964-3210.

This warranty automatically transfers to subsequent owners, but does not extend to any of our products that have been subject to misuse, abuse, modification, neglect, accident, incorrect wiring not our own, or to use in violation of operating instructions furnished by us. Nor does it extend to any units altered or repaired for warranty defect by anyone other than an authorized service agency, nor to units with defaced, removed, or modified serial numbers. It is limited to, at our discretion, repair or replacement of the product.

This warranty does not cover any incidental or consequential damages and is in lieu of all other warranties expressed or implied, including those of merchantability and fitness, and no representative or person is authorized to assume for us any other liability in connection with the sale of our products.

Some states don't allow limitations on how long an implied warranty lasts and/or on exclusion or limitation of incidental or consequential damages, so the above limitations or exclusions may not apply to you. This warranty gives you specific rights; you may also have other rights, which vary from state to state.

For products purchased outside the USA, this warranty is valid only in the country of purchase and the USA.

NOTE again: For information on your NEAREST US SERVICE STATION, contact your authorized dealer or call anytime 1 800 447-4700; have your Zip Code available for the operator.

dbx
71 Chapel Street
PO 100C
Newton, Massachusetts 02195 USA
Tel: (617) 964-3210 Fax: (617) 527-5288 Tlx: 92-2522

IMPORTANT INFORMATION SUPPLEMENT TO THE dbx BX-1 MANUAL

1) 2-CHANNEL OPERATION, page 4, last entry.

In line 4, "vertically" should be "horizontally". As shown, 2-channel operation calls for the banana-plug hookup to go across the RED output terminals -- horizontally.

2) SPEAKER FUSES, page 5.

If you're playing percussive or explosive material (artillery) and the sound cuts out and the clip lights come on, you've blown a speaker fuse. Low-level distorted sound will still be heard. Go to the supplied 7A fuses; if the same thing happens (most likely with very low-impedance speakers), increase to 10A, 12A, even 15A ratings. However, you now may damage your speakers, and we take no responsibility for that. Please note that blowing speaker fuses in no way reflects on BX-1 performance; the fuses are there to protect your speakers, not the amp! Also note that BX-1 speaker fuses do not -- cannot -- affect the sound, for they lie in the amp's feedback loop.

3) "OVERLOAD" (CLIP) LIGHTS, page 3.

Yes these LEDs will come on at very high power levels. What they're giving you is performance information, indicating that the BX-1 is generating a few percent distortion (or more). That's all. There's nothing in particular to worry about. Amps without such lights do exactly the same thing.

These LEDs also indicate a blown speaker fuse as well as the presence of direct current at the output. The latter is serious -- if the LEDs stay on and the speaker fuses aren't blown, see your dealer.

SUPPLEMENT TO dbx MODEL BX-1 POWER AMPLIFIER OWNER'S MANUAL
JUNE 1988

FURTHER RECOMMENDATIONS FOR OPTIMUM BX-1 PERFORMANCE

The dbx Model BX-1 is a special, high powered, high performance amplifier. It is really two stereo power amplifiers in one, sharing a common AC power cord. At power up, it draws a current equivalent to four power amps being turned on at once. We have tested the BX-1 in both laboratory and home listening environments and offer the following suggestions for achieving maximum enjoyment in listening.

Any high powered amplifier like the BX-1 may be subject to two common operational problems. One is that the amp may trip household circuit breakers (especially when it is turned on) if the breaker is not heavy enough or if too many items are plugged into the same circuit. The other is that the amp may emit audible mechanical buzz or hum if it is on the same circuit with certain types of light dimmers or variable speed motors.

These problems are easy to prevent. The best way is to allow the BX-1 to be plugged into its own 30-amp circuit. This will prevent both problems. The BX-1 may trip 15 or 20 amp circuits, depending on the type of breaker used. Also, avoid the use of extension cords. Only if absolutely required, use the shortest possible 12- or 14-gauge extension cord. Compare it to the supplied BX-1 power cord to be sure that it's comparable heavy duty.

Isolation from dimmers and motors will result in best performance of the amplifier. If it is impractical for you to isolate your BX-1 from your dimmer circuit, we offer the following advice. There are two types of light dimmers: SCR and Triac. It appears to be only the SCR type which causes an audible performance "glitch". These dimmers produce DC which in turn causes hum or buzz to emanate from the amplifier. The Triac type dimmer produces interference, but seems to do it without producing DC. The BX-1 can handle this with much better results. Unfortunately, it is not easy to tell which type of device (SCR or Triac) is used in a particular dimmer. We suggest you consult the manufacturer of the dimmer you use.

We hope that you use and enjoy your dbx BX-1 Power Amplifier for many years to come. The above recommendations are part of our continuing commitment to bring you the best performance from our products. If you require further assistance, or would like information on our other products, please contact:

dbx Customer Relations
Department BX-1
71 Chapel Street
Newton, MA 02195 USA

Thanks!