

dbx

Model 224X

Type II
Noise-Reduction System
for Tape

Instruction Manual

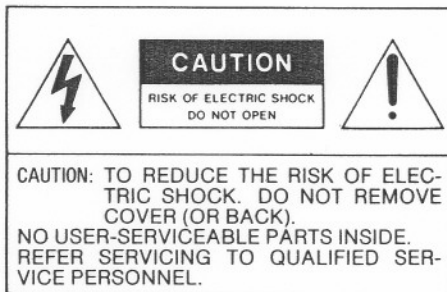
INSPECTION and INSTALLATION

Your unit was carefully packed at the factory in a protective carton. Nevertheless, be sure to examine both carton and contents for any signs of damage that may have occurred during shipping. If there is such evidence, don't destroy the carton or any of the packing material, and notify your dealer or distributor immediately.

In any case it is a good idea to save the carton and packing materials should you ever need to ship your unit in the future.

In addition to a model 224X and this instruction manual, the carton should contain a set of hookup cables with RCA phono, or pin, plugs, a warranty/registration card, and a pair of brackets for mounting the unit into a standard audio equipment rack.

No special cooling or ventilation is required in any installation; other components may be stacked above or below the 224X provided they don't generate excessive heat.



This symbol is intended to alert you of the presence of uninsulated dangerous voltage within the unit's enclosure that may be of sufficient magnitude to constitute a risk of electric shock to persons.



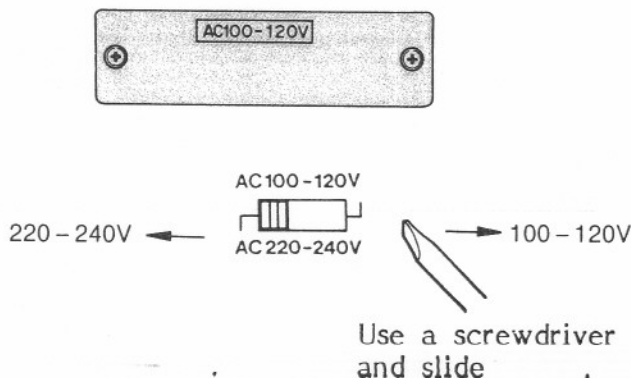
This symbol is intended to alert you of the presence of important operating and maintenance instructions in the literature accompanying the unit.

WARNING: To Prevent Fire or Shock Hazard, Do Not Expose This Appliance to Rain or Moisture.

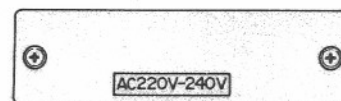
VOLTAGE CONVERSION

If you ever need to change the voltage setting, unscrew the small voltage cover plate near the ac cord, move the switch with a small screwdriver, turn the plate upside down (180°, in other words, which exposes the switch in its new voltage position), and screw it back on. Don't turn the plate over.

For 100-120V ac:



For 220-240V ac:
Important: This setting is only for European model and not for UL listed model.



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SPECIFICATIONS

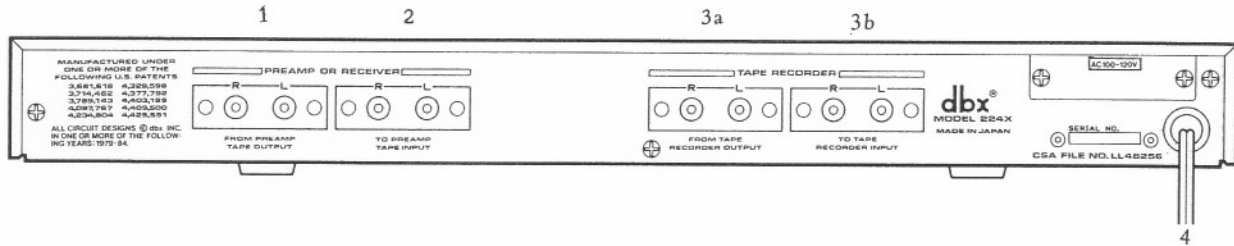
Effective noise reduction	40 dB or more, deck-dependent
Frequency response	+0.5 dB 40 Hz- 20 kHz, -1 dB at 35 Hz, -2 dB at 30 Hz
Dynamic range.	greater than 104 dB
Total harmonic distortion (THD).	0.1% 100 Hz- 20 kHz, less than 0.5% 30-100 Hz
Intermodulation distortion (IMD) IHF or SMPTE	0.2%
Equivalent input noise	-88 dBV
Maximum input and output	6.5 V
Level range for unity gain (level match)	Set at 200 mV; adjustable from 20 mV to 2 V; for convenience in matching levels of other equipment; precise setting not crucial for proper operation.
Dimensions.	1-3/4" h x 17-5/32" w x 8-3/4" d (4.5 x 43.6 x 22.2 cm)
Power requirements	see rear of unit

Notes

- 1) Specifications are subject to change without notice.
- 2) All data are for 20 Hz-20 kHz unless otherwise specified; line inputs are driven by a source impedance of 1 k-ohms and outputs are loaded by 10 k-ohms in parallel with 1000 pF; all voltages are rms (root-mean-square).
- 3) Dynamic range is defined as the difference between the maximum rms output signal and A-weighted noise. All noise figures are A-weighted.
- 4) Frequency-response figures are for pink noise (or music).
- 5) SMPTE IMD is measured with 60 Hz and 7 kHz mixed 4:1; IHF (difference-tone) IMD is measured with 19 kHz and 20 kHz mixed 1:1; output 1 V.
- 6) Inputs and outputs have identical polarity.
- 7) All dbx home products are designed to be used with components whose output impedance is less than or equal to 5 k-ohms. All units are designed to drive loads of at least 5 k-ohms in parallel with 1000 pF or less.

REAR CONNECTIONS

Turn your system off and the volume control all the way down. "Preamp" will mean your preamp, receiver, or integrated amp -- or the tape-monitor (record/play) loop of an equalizer or other component. In hooking things up, let cables with red plugs be the right channel.

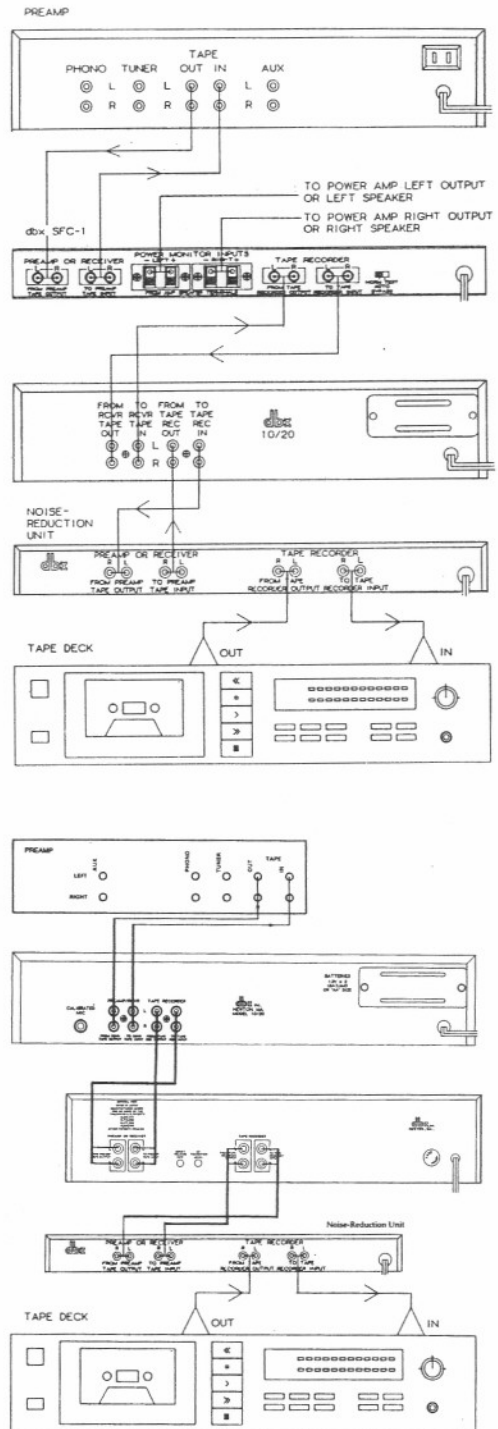
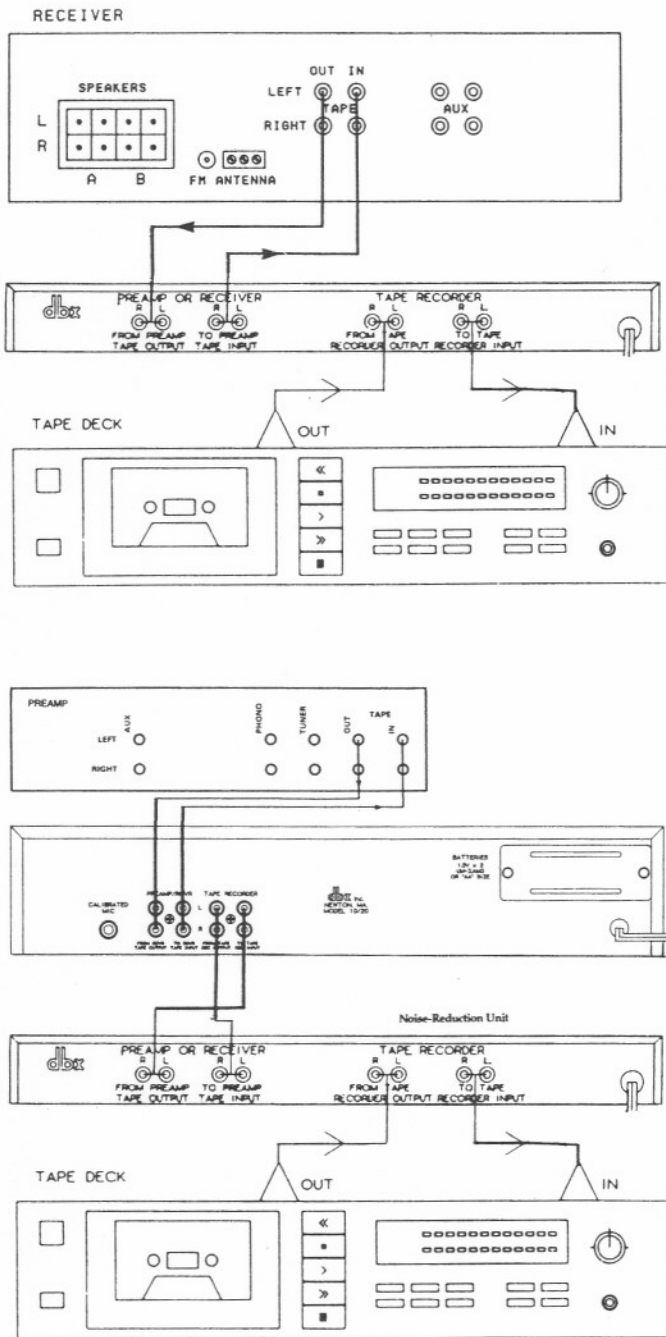


- 1 FROM PREAMP TAPE OUTPUT. Connect your preamp's Tape Out to these inputs.
- 2 TO PREAMP TAPE INPUT. Connect these outputs to your preamp's Tape In. (Note that with some components Tape Out is called Tape Rec and Tape In is called Tape Play or Tape Monitor, and there are other variations.)
- 3 TAPE RECORDER jacks. This is where you hook up your tape deck. Connect its Outputs to (a) the 224X's input jacks called FROM TAPE REC OUTPUT, and connect (b) the 224X output jacks called TO TAPE REC INPUT to the deck's Inputs.

For the more technically minded, 1 is the Encoder Input, 2 is the Decoder Output, 3a is the Decoder Input, and 3b is the Encoder Output.

- 4 POWER CORD. Connect this cable to the appropriate power source. If you ever need to change the voltage setting, unscrew the small voltage cover plate near the ac cord, move the switch with a small screwdriver, turn the plate upside down (180°, in other words, which exposes the switch in its new voltage position), and screw it back on. Don't turn the plate over.

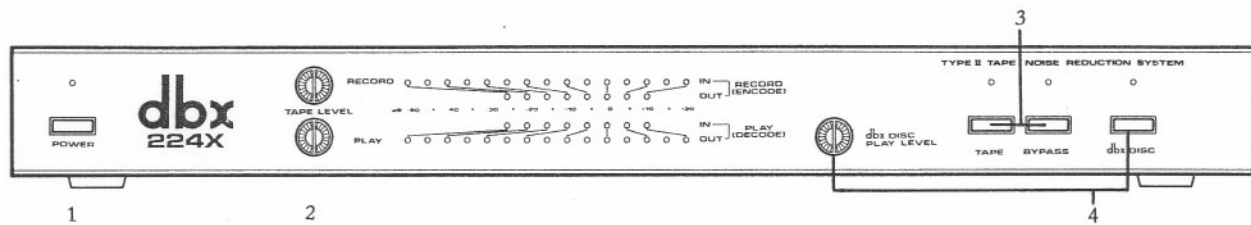
TYPICAL HOOKUPS



As just described, connect your new unit in one of the tape-monitor loops on your preamp and then connect your tape deck to the 224X. Note that your preamp's tape-monitor button or switch (the loop you put the 224X into) has to be set to Tape; otherwise, you won't be able to get signals to and from your new component. If your preamp has separate Rec Out and Input Select (so you can listen to one thing while taping another), leave the Select knob on Tape and choose program sources with Rec Out.

In a complicated system, "chaining" components in successive tape loops is the best idea, being certain that the 224X and the tape deck are always kept together, as shown. If your stereo system is above a certain level of complexity, consider the dbx 200X or 400X Program-Route Selector.

FRONT CONTROLS



- 1 **POWER.** This is the on/off button. The red LED lights up when the 224X is on.
- 2 **TAPE LEVEL:RECORD and :PLAY.** These thumb knobs, along with the output control of your cassette deck (if it has one), let you adjust the levels of the encoder (recording circuit) and decoder (playing circuit) inside the 224X so that everything through your system matches up -- the sound levels (loudness) as well as the LED display. Your unit comes already set to typical levels, but at some point you'll probably want to play with the knobs and watch the LED rows. In any case, the settings needn't be exact. For a full explanation of the proper setting procedure (and what everything means), see the Usage Notes.
- 3 **TAPES, BYPASS.** Push **Tape** to record or play a dbx-encoded tape. If you unintentionally push it (or leave it) in with other tapes, no harm will be done, but they'll sound funny (usually both swallowed and surging). Push **Bypass** in to play any tape that wasn't made with dbx Type II noise reduction; it takes the 224X out of the system. You will use it for conventional prerecorded tapes or tapes made with other (e.g., Dolby*) noise reduction. You'll also want to use it to make a non-dbx tape of your own -- for example, if your car tape player doesn't yet include dbx, or to make a copy of something for a friend who doesn't have dbx noise reduction.
- 4 **dbx DISC button and PLAY LEVEL thumb knob.** Push this button to play any specially encoded dbx records that you own or may buy -- either listening to them or taping them. The thumb knob lets you adjust their loudness, so that they play at the same level as your regular records. See the Usage Notes.

Caution: to avoid any possibility of damaging your stereo, push only one of these buttons at a time.

*"Dolby" is a registered trademark of Dolby Laboratories Licensing Corp.

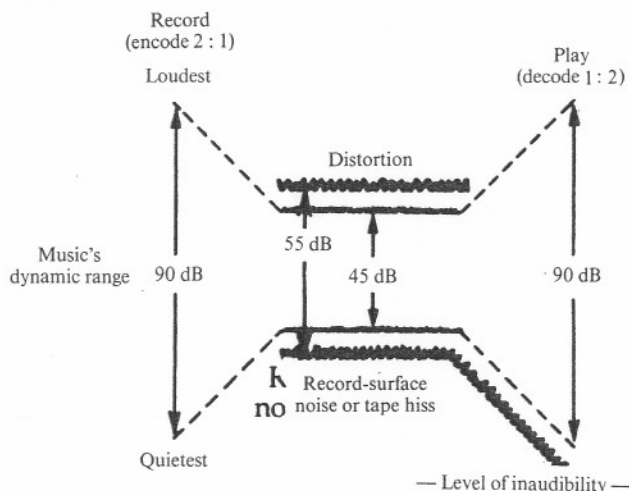
ABOUT NOISE REDUCTION

Analog taping has always been the major source of noise in most recorded music. Faint and not-so-faint hiss was so common behind recorded and broadcast music that just about everyone got used to it. In the late 1960s, Dolby Laboratories devised a circuit that mildly but significantly reduced tape hiss, and it's now standard on cassette decks. (A stronger version was recently introduced.) Since then, recording techniques as well as tapes have gotten much quieter, and many listeners are more alert to hiss anyway. And now that the digital era is finally here (which for most listeners means much quieter source material), the need for completely effective tape noise reduction is urgent. This is what your new dbx 224X gives you.

For all audible intents and purposes, the 224X eliminates tape hiss. But it also increases the overall dynamic-range capacity of a tape deck, letting you record both louder and softer sounds than you used to. (The difference between loudest and softest is the definition of dynamic range.) The combined result is that the 224X will let you make tapes with virtually nothing added, ones as quiet as (and in almost all cases indistinguishable from) the original. Being a two-step (encode/decode) process, dbx noise reduction can't do anything to improve noisy original sources (records, broadcasts, other tapes) -- it won't make them quieter, in other words -- but it doesn't let any noise be added. (We make dynamic-range expanders to help quiet, clean up, and "punch up" -- restore impact to -- restricted and/or noisy programs.) With a really quiet source and a quiet deck, the tape copy will be crystal-clear and just as wide in dynamic range.

If you haven't used dbx before, you may be startled at how close to identical the tape copy sounds. Even the dynamic range potentially available from Compact Discs, with their silent backgrounds, may be captured by your tape deck. This statement holds for no other noise-reduction system.

Described simply, the dbx system works by compressing the dynamic range of the source and altering its frequency response during recording (the "encoding" of the signal), and then by expanding the dynamic range of the tape and "undoing" the frequency-response alterations in perfect mirror-image fashion during playback ("decoding"). During recording, tape decks generate hiss below the taped signal by about 45-65 dB, depending on the deck and the tape, and during dbx playback this noise gets pushed down an additional 40-55 dB, depending on the deck, the tape, and the program material. The result is an enormous potential dynamic range -- enough room to tape even live performances. This figure depicts the process in simple terms:



Then there are dbx-encoded records and cassettes, whose absence of surface noise or hiss and whose sonic "ease" -- unstrained clarity -- are amazing. They sound like CDs, except they don't require a special player. The technological principle is the same as for taping: the recordings are pressed or duplicated in encoded (compressed) form, from conventional and digital master tapes, and when you play them back through your 224X, all surface and other noise is again shoved down more than 30 dB below the very softest music (and some 90 dB below the loud passages). The best your other vinyl records and prerecorded cassettes can do is perhaps 65 dB between the loudest moments and the surface noise and rumble, and that's true only for the special "audiophile" ones; a conventional recording or tape does well to beat 55-dB dynamic range. Also, dbx records have little or no inner-groove distortion (near the center of the record) and pre-echo (that's when you faintly hear the music one revolution before it actually begins).

Owning these records and cassettes is like having your own copy of the master tape -- without having to buy a CD player.

USING YOUR 224X

To make and play back a dbx-encoded cassette

Check the preamp's tape-monitor switch, then press the 224X's Tape button in. Operate your cassette deck as you usually do, only with the Dolby switch(es) off. After you have set your deck to Record, adjust its record-level controls so that the loudest passages you're recording hit around +3 on the meter. (See the discussion of levels, below and next page.) To monitor with a so-called three-head deck, simply compare Source and Tape on the deck.

To play the tape, leave the preamp and the 224X both set to Tape, and adjust any output-level controls on the deck as necessary. If the tape is not dbx-encoded, set the 224X to Bypass and turn the deck's Dolby switch on. Note that a few prerecorded cassettes still are made with no noise reduction at all.

To play (or tape) a dbx record

Again check that the preamp is set to tape monitor, and switch it to the proper phono setting. Push in dbx Disc on the 224X and play the record. Be careful not to turn up the volume too high on your preamp at first just because you can't hear anything before the music starts. This sequence holds for making a dbx-encoded tape of a dbx record; simply operate the deck as usual, again with recording levels at a healthy high level. It's not possible to monitor this tape being made -- switching the cassette deck from Source to Tape and back has no effect.

To make a conventional cassette of a dbx record

If for some reason you want to make a non-dbx tape of a dbx record -- for example, a Dolby copy -- you have to change the hookup. Connect your deck's Inputs to the 224X outputs called To Preamp Tape Input (leave the 224X's From Preamp Tape Output connected to the preamp's Tape Out). Connect the preamp's Tape In to the deck's Outputs. Push the dbx Disc button on the 224X, start the dbx record, and record as usual. Be sure to pay extra attention to levels (see next page), because dbx records have enormous, Compact Disc-like dynamic range and unconstricted peaks. And don't forget to undo all this new hookup when you're done, restoring everything to the way it was before.

Using the 224X with a graphic equalizer (or similar sound processor)

See the hookup diagrams. Nothing must come between the 224X and your tape deck or else the 224X will not work properly. Therefore, graphic equalizers and the like go between the 224X and your preamp.

Recording Levels and dbx Noise Reduction

For the most part we're assuming that you own a good-quality, recently manufactured cassette deck with fast-acting metering (not slow needles) and recent-vintage Type-I or -II cassettes. Set any peak/average or fast/slow switch on the deck to the former position. Using dbx noise reduction with such a setup, you can, depending on the program material, record several dB (2-5, say) above the deck's 0 mark. (This also assumes that the deck's 0 is "Dolby level," as is commonly the case these days.) Levels on open-reel decks, because the tape is wider and moving faster, can be set even hotter, especially at the decks' higher speeds. The point is that there are no fixed rules for level setting; often it's best to do it initially by ear, aiming perhaps 3 dB below where you hear the beginnings of distortion on playback. How your copy sounds is more important than any specific numbers; our suggestions here are guidelines only. If your deck has monitoring capability and the event you're taping can be repeated, it takes only a few seconds to set good levels by listening. Just find the loudest passages and take a few passes at them, starting at +4 or so and backing off as necessary.

Note that the spectral content of the program material will govern success in choosing recording levels as much as anything. Compact Discs usually call for more care than mono LPs from the '50s, and you would want to tape a CD of one of the large-scale 20th-century orchestral works with keen attention to levels. Heavily compressed pop/rock (as on FM) can generally be recorded at high levels, as can material without a lot of very high-frequency energy, like piano. But percussion (e.g., jazz drumming with lots of cymbal), choral music (especially massed female voices), or synthesizer requires much more caution, for its high frequencies overload all tape pretty readily.

Note also that the lower the noise floor of the tape deck, the better the results with dbx noise reduction. Unlike Dolby (and some other systems), dbx noise reduction employs aggressive, 2:1:2 compression/expansion (companding) over the full audio bandwidth, with the goal of eliminating tape hiss from audibility. For this goal to be successfully achieved, the deck has to be quiet and/or there have to be high frequencies (overtones) in the program material to mask any noise that remains. Most modern cassette decks are quiet enough for good results on almost all material. But occasionally, material with few high frequencies may be reproduced with faint artifacts -- barely discernible bursts of noise -- called noise modulation. Male speech or solo, dryly miked bass or piano, for example, sometimes does not have enough overtones to mask the sound of the deck's self-noise being modulated by the dbx circuitry. This is especially a potential problem when recording levels aren't kept high enough, when the deck's noise floor is not kept far enough below the signal. Fortunately, most of the material that might present these problems can be recorded at healthy high levels without saturating the cassette. But if upping levels to their maximum doesn't yield completely satisfactory results in your listening situation, then consider how to make your cassette deck into a quieter unit.

You might begin by cleaning and demagnetizing it yourself, or have it serviced. You also can switch tape and/or tape type, even to the extent of using Type IV, the so-called metal tapes. (And many of the "hotter" new Type-I tapes will accept higher-level signals in the mid-range and above.) If you have manual-biasing capability, you can try slightly overbiasing the deck for the tape (the recorded sound may be a little duller, but again, you can record higher-level midrange and treble signals). And finally, one way to make any cassette deck a few dB quieter on its own is just to switch in its Dolby-B circuit. Then go on and use your 224X normally. With Dolby added there is always an increased potential for audible frequency-response errors (mistracking) if the deck and tape are not perfectly matched in bias, equalization, and especially sensitivity, but this is always true of Dolby noise reduction, and dbx won't make the problem any worse. The benefit of selectively adding Dolby B to dbx (only as needed) may be no noise modulation on any of the difficult program material, and if there are unacceptable errors in frequency balance due to Dolby, they probably can be pretty readily corrected. Don't forget to mark the cassette NR boxes appropriately if you do decide to give this a try.

Changing the Level Controls

The top LED row (Record/Encode:In) will light according to the level of your pre-amp's Tape Out; in other words, it displays the incoming signal level. To set the second row (Record/Encode:Out) to a good matching level, first put on some music. Pop FM has easy-to-follow levels because it's all the same loudness, but any music will do. Then turn the top (Record) thumb knob -- a small-coin edge will work as well as your thumb -- until the first yellow (0) LED lights up on moderately loud passages and the last red LED lights up rarely. This sets the output of the encoder to optimize its dynamic range.

The third row will be governed by the output of your tape deck, which in turn is governed both by how hot you record (which you don't want to alter merely to get a nice light show) and by any output-level control the deck has. If it does have such a control, just tape whatever music you're listening to and set the output level until the third row's

0 LED lights whenever the one right above it does. If your deck doesn't have an output-level control, don't worry -- most decks are unity-gain (level-matched) within a couple of dB, depending on tape sensitivity and so on. But even if this row doesn't line up with the one above it, go on to the adjustment of the fourth row.

The bottom row (Play/Decode:Out) is controlled by the bottom (Play) thumb knob. Again, turn it to line up its first yellow LED with the one in the top row. Now you're all set: your noise-reduction system and tape deck are level-matched from input to output.

To match the levels of conventional records with dbx records, turn the dbx Disc Play Level knob while playing a dbx record until the bottom row's first yellow LED lines up under its counterpart in row three.

As we have mentioned, none of this level-setting need be absolutely precise; in fact, there is a very wide tolerance within which the 224X will do its job perfectly. Level-matching does, however, make for a neater display, and it means that the loudness of your music won't change as you select among various sources, dbx and others. The numbers and lines by the LEDs show electronically what dbx companding noise reduction is all about -- it's the "butterfly" diagram (p. 5), only turned sideways.

We think your new 224X will make a genuine difference to your enjoyment of music. You hardly realize how much tape hiss you've been putting up with until it's eliminated.

WARRANTY and FACTORY SERVICE

All dbx products are covered by a limited warranty (warranties for products purchased outside the USA are valid only in the country of purchase and the USA). For details, consult your warranty/registration card or your dealer/distributor.

The dbx Customer Service Dept. will help you use your new product. For answers to questions and information beyond what's in this manual, write to:

dbx
71 Chapel St.
Newton, Mass. 02195 USA
Attn: Customer Service

You also may call (617) 964-3210 during business hours (USA Eastern time). The Telex is 92-2522.

Should problems arise, consult your dealer or distributor. If it becomes necessary to have your equipment serviced at the factory, repack the unit, including a note with a description of the problem and the date of purchase, and send the unit freight prepaid to the above address, marking it Attn: Repairs.

FOR USERS IN THE UNITED KINGDOM

Important

The wires in the unit's mains lead are coloured in accordance with the following code:

Blue: Neutral
Brown: Live.

As the colours of the wires in the mains lead of this apparatus may not correspond with the coloured markings identifying the terminals in your plug, proceed as follows:

The blue wire must be connected to the terminal marked with the letter N or coloured black;

The brown wire must be connected to the terminal marked with the letter L or coloured red.

Ensure that all terminals are securely tightened and that there are no loose strands of wire.

Warning

This unit must be protected by a 3-amp fuse, preferably using a fused plug. Also, do not remove the cover without first disconnecting the unit from the mains supply.

NOTES

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