

Preliminary Technical Service Manual

MODEL 463X

OverEasy® Noise Gate Expander

dbx Professional Products

dbx®

Manufactured under one or more of the following U.S. patents: 3,377,792; 3,681,618; 3,714,462; 3,789,143; 4,097,767; 4,329,598; 4,403,199; 4,409,500; 4,425,551; 4,473,795. Other patents pending.

This dbx-branded product has been manufactured by AKG Acoustics, Inc.

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463X Noise Gate Expander

The dbx model 463X is the simplest, easiest-to-use noise-gate expander on the market. (It's also easy on the budget.) Modeled after our 904 modular noise gate, the 463X is designed for the recordist/mixer, instrumentalist, ENG technician, sound contractor — indeed, for anyone who needs a friendly processor that gets rid of unwanted noise between notes or sounds.

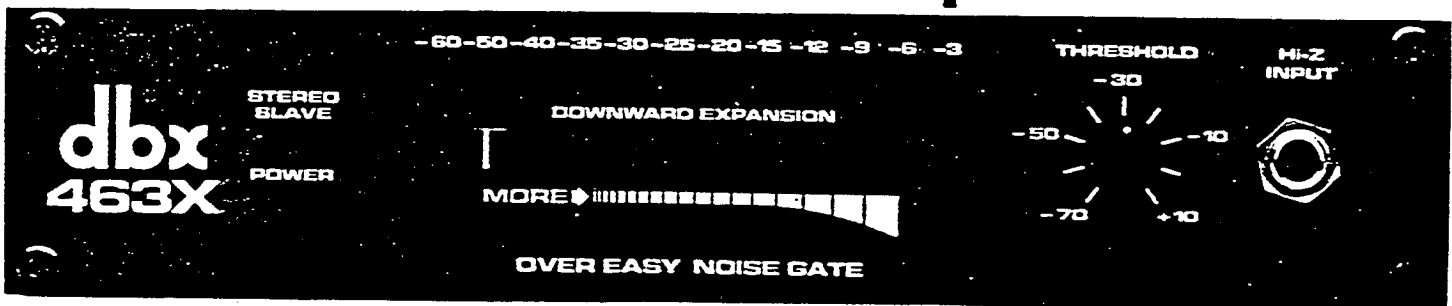
The important operating feature of the 463X is the single-slider action, which enables quick setting of the amount and severity of gating. There's also a knob for setting the threshold point where this gating occurs. In an instant you can change the gating characteristics — and the noisiness and overall sound of the program — by ear.

The single-ended input and output let the user patch into the signal path at line level. For the performer, there's a high-impedance input jack on the front as well. Plug in, connect the 463X to the amp or board, and you're on your way. (The Hi-Z input defeats the rear input and has its own trim for a wide range of instrument/pickup levels.) Finally, there's a "Key" input for special applications like frequency-sensitive gating.

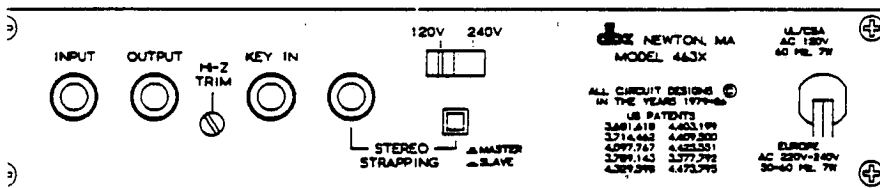
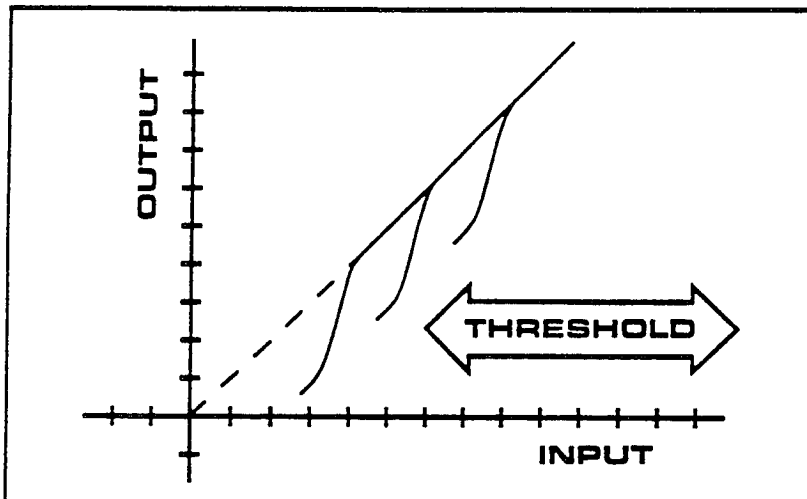
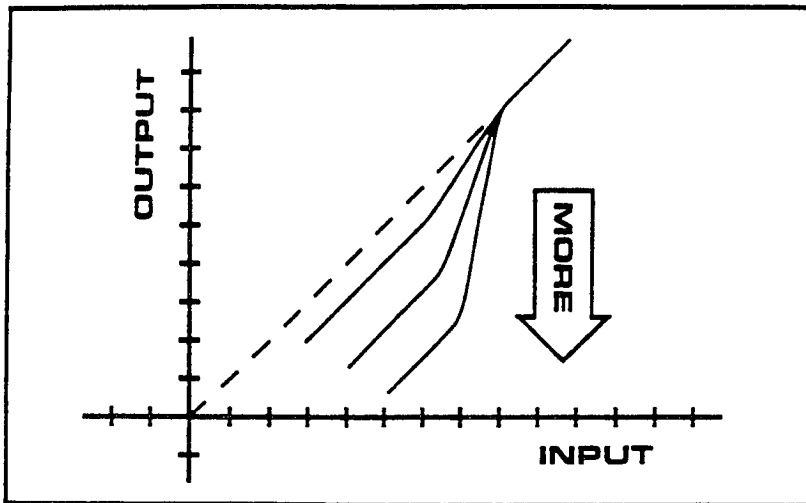
Two 463Xes become a master/slave stereo pair of noise gates at the push of a button and a single connection cable. However, if you pair a 463X with a 163X OverEasy Compressor/Limiter, you have a choice of configurations. If the 163X is the slave and the 463X the master, you'll have a stereo pair of 463Xes — the 163X turns into a 463X. And if it's the other way around (the 163X the master and the 463X the slave), then the 463X turns into a 163X and you have a stereo pair of 163X Compressor/Limiters.

Features

- Single-slider action
- Adjustable threshold
- 1/4" front-panel high-impedance input
- Stereo-strappable
- 600-ohm output to +18 dBv
- Key input for special applications



Circuit Characteristics



463X Performance Specifications

Frequency response
20 Hz-20 kHz ± 1 dB

THD
0.2% (unity gain)

Equivalent input noise
-85 dBV unweighted (unity gain)

Maximum input
18 dBV to soft clipping

Maximum output
18 dBV into 600 ohms

Input impedance
391 k-ohms, single-ended

Output impedance
22 ohms, single-ended (designed to drive 600 ohms or greater)

KEY input impedance
62 k-ohms

Threshold range
+10 to -60 dBV (OverEasy)

Attenuation range
0-70 dB, depending on input level and slider setting

Gain (no gating)
Unity (rear jack);
0-20 dB, adjustable (instrument input)

Downward expansion ratio
Adjustable from none to 6:1, front slider

Attack time
Approximately 1 ms, program- and slider-dependent

Release time
10-500 ms, program- and slider-dependent

Power requirements
100-120/220-240 V ac, switchable; 50-60 Hz; 7 W

Notes

- 1) Specifications are subject to change.
- 2) All voltages are rms (root-mean-square).
- 3) 0 dBV is defined as 0.775 V regardless of load impedance. Subtract 2.2 from the dBV figure to convert to dBV (i.e., referred to 1 V). When the load impedance is 600 ohms, this particular dBV is also known as "dBm."
- 4) Noise figures are for 20 Hz-20 kHz.
- 5) Attack time is the time required to restore the signal to 63% of the input level after it has gone above the OverEasy threshold; release time is the time required for the signal to be reduced to 63% of its final gated level.

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INSPECTION and INSTALLATION

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

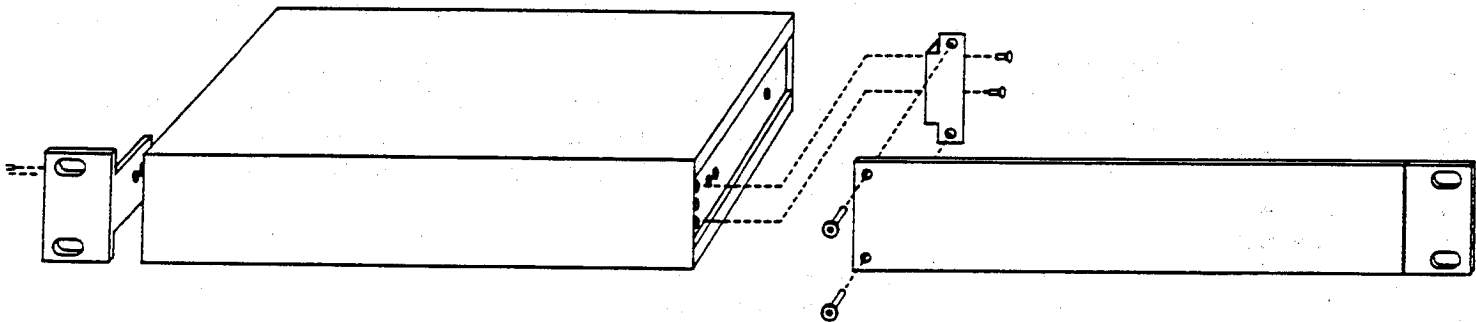
It's a good idea in any case to save the carton and packing should you ever need to ship the unit.

In the event of initial problems, contact your dealer first; your unit was thoroughly inspected and tested at the factory.

The carton should contain this owner's manual, a 463X, of course, and a warranty/registration card. Please fill the card out and send it to us. The carton also should contain hardware for rack-mounting both a single unit (screws, a long [half-rack-width] ear, a small L-bracket, and a short rack ear) and two units together (side plates along with a screwdriven joiner). See below.

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

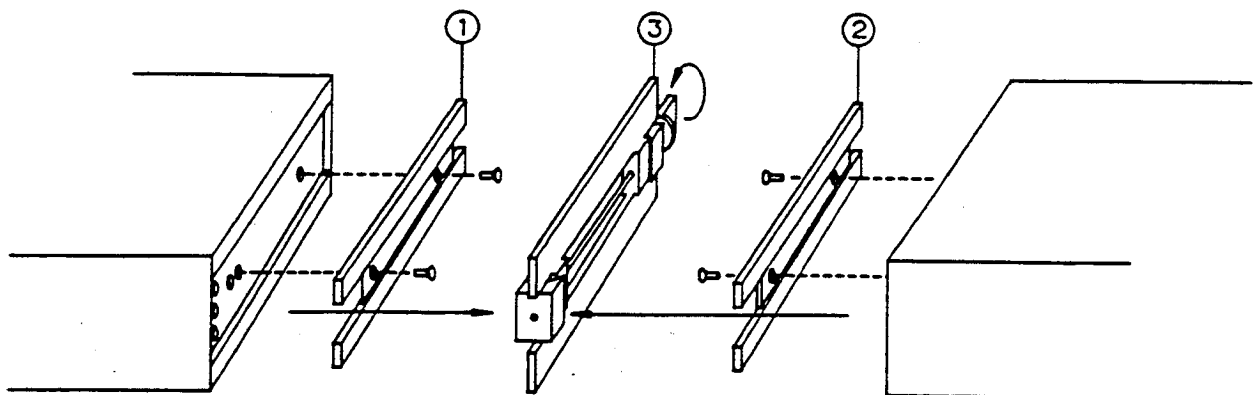
Here's rack-mounting for a single unit:



It may help to line everything up on a table as you tighten the screws. The enclosed sticker with circuit-action graphs may be placed on the long rack ear.

Here's rack-mounting for a pair of 463Xes or for a 463X and a 163X or other "-63X" series units:

- 1 & 2) Attach side panels;
- 3) Bring units together, lining up the side panels with the screw-joiner catches, and then gently tighten the screw to close the catches.



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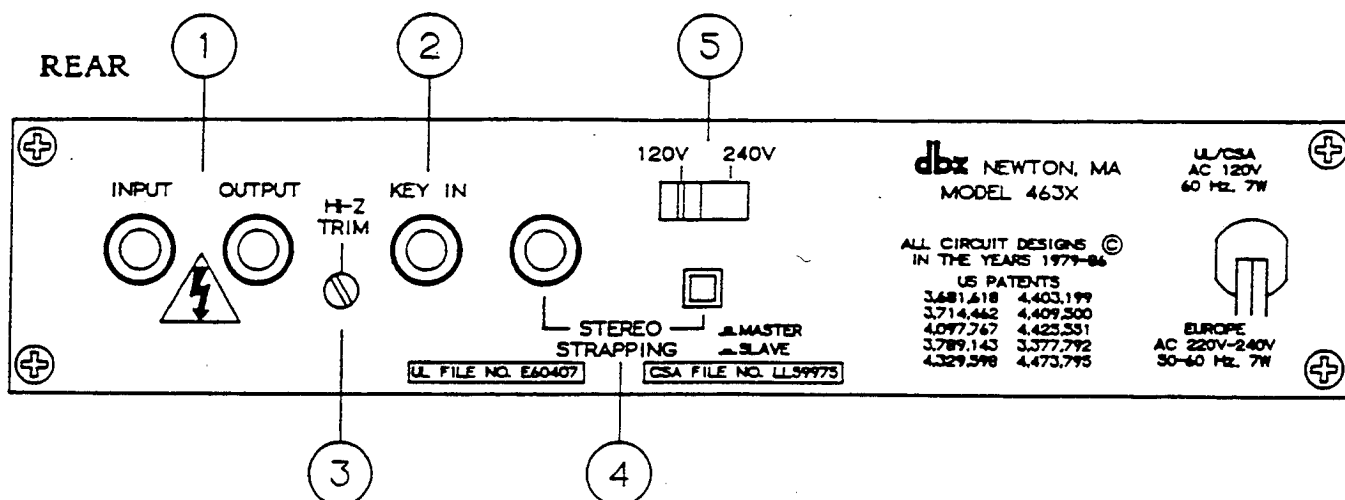
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SPECIFICATIONS

Frequency response	20 Hz-20 kHz \pm 1 dB
THD	0.2% (unity gain)
Equivalent input noise	-85 dBv unweighted (unity gain)
Maximum input	18 dBv to soft clipping
Maximum output	18 dBv into 600 ohms
Input impedance	391 k-ohms, single-ended
Output impedance	22 ohms, single-ended (designed to drive 600 ohms or greater)
KEY input impedance	62 k-ohms
Threshold range	+10 to -60 dBV (OverEasy)
Attenuation range	0-70 dB, depending on input level and slider setting
Gain (no gating)	Unity (rear jack); 0-20 dB, adjustable (instrument input)
Downward expansion ratio	Adjustable from none to 6:1, front slider
Attack time	Approximately 1 ms, program- and slider-dependent
Release time	10-500 ms, program- and slider-dependent
Power requirements	100-120/220-240 V ac; switchable; 50-60 Hz; 7 W

Notes

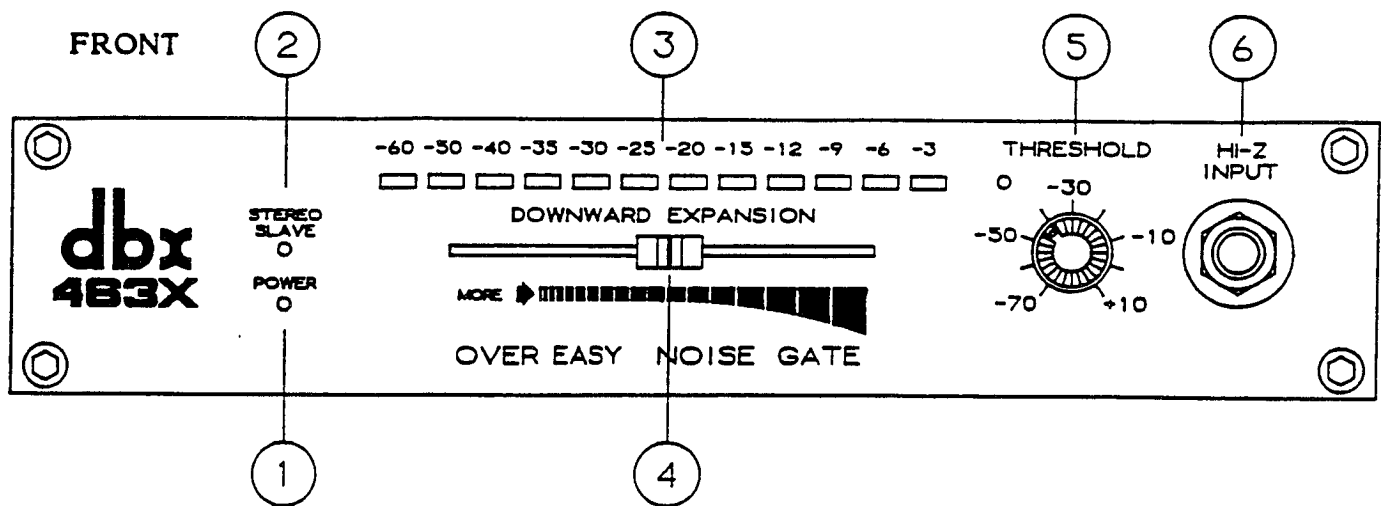
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- 1 **INPUT, OUTPUT.** These jacks are for a line-level input and output and are the standard 2-circuit ("mono") 1/4" phone type, where the tip carries the signal and the sleeve carries the ground.
- 2 **KEY IN.** Use this jack if you want to control the 463X gating action from an external source, allowing you to alter the dynamics of one signal with another. Same plug type as above. Key In will be discussed in detail in the Applications Note.
- 3 **Hi-Z trim.** This screwdriver control sets the gain of the preamp for the Hi-Z input only (see front panel). The gain is set at the factory at +20 dB (all the way right, or clockwise) and shouldn't be changed unless your instrument's output is very hot. All the way left (ccw) is unity (0 dB) gain.
- 4 **STEREO STRAPPING jack and button.** Connect this jack to the same jack on another 463X and you have a true rms-detecting stereo noise gate. Connect it to a 163X and you have the same thing — a stereo pair of noise gates — provided this first unit remains the Master. But if you connect it to a 163X and press the button in, to Slave, this unit becomes a 163X and you have a true stereo pair of 163X compressor/limiters. Neat, huh? The jack is a 1/4" 3-circuit ("stereo") phone type (tip/ring/sleeve); use 3-circuit plugs and cables only, for anything else won't work. Of course, be sure to disconnect everything for independent operation.

Note that you must leave the Master/Slave button out, at Master, for normal 463X (non-stereo) operation as well as for stereo operation as a Master. Pushing it in, to Slave (the front-panel LED will light), deactivates the controls and forces the unit to obey the Master's settings when a second 463X or a 163X is properly connected and switched. (If you push the button in when no Master is connected, it's a bypass switch for the gate only; the preamp still works.)

- 5 **VOLTAGE SWITCH.** This must be properly set for your ac voltage; be sure to check before plugging in and powering up. For nominal 220-V operation an adaptor plug on the ac cord will be required.

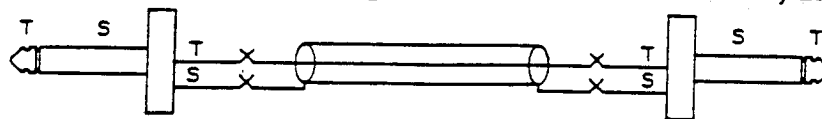


- 1 **POWER LED.** This indicates when the unit is connected to a live ac outlet.
- 2 **STEREO SLAVE LED.** See previous page; this indicates that the unit has been set by its rear switch to be the Slave in a 163X or 463X team.
- 3 **DOWNWARD EXPANSION LEDs.** These 12 LEDs show in dB how much the signal is being gated.
- 4 **DOWNWARD EXPANSION slider.** For any signal that goes below the threshold point (see below), moving this slider to the right -- MORE -- increases the amount of gating, pushing that signal's level down both farther and faster than the signal's natural decay rate. The ultimate amount of this attenuation depends on the slider position, of course, as well as on how far below threshold the signal is in the first place. We'll discuss this in detail presently.
- 5 **THRESHOLD.** This thumb knob sets the point where gating begins, the level below which a signal is attenuated. Set fully clockwise (+10) and the signal will begin to be pushed down even when it's still loud. Turn the knob counterclockwise and the signal is not gated until it has dropped to a low level on its own. At full ccw, the gate is inactivated and the 463X effectively bypassed. Ideally, the knob should be set such that only wanted signal is above the threshold, and below it is only unwanted signal or noise.
THRESHOLD LED. This will light whenever the signal level goes above the threshold point. It's very useful for setting levels and adjusting the 463X to work at exactly the right times.
- 6 **Hi-Z input jack.** This connects to the 463X's low-noise FET preamp. There's enough gain that virtually all low-level instruments can be plugged in directly -- guitars, basses, keyboards, even high-impedance mikes. As explained, there's a gain trim on the rear for very hot instruments (likely to be useful with some synthesizers, etc.). Note that this jack overrides the rear line-level input.

HOOKUPS

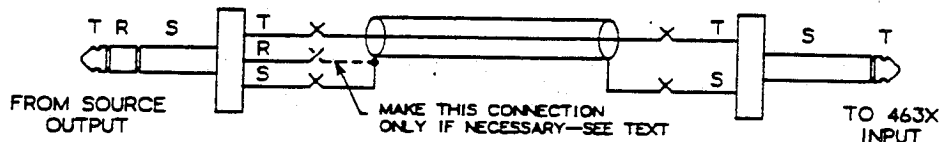
Inputs and Outputs

The line-level inputs and outputs are single-ended (unbalanced) and should be connected to other such equipment with single-conductor shielded cable, as shown here.



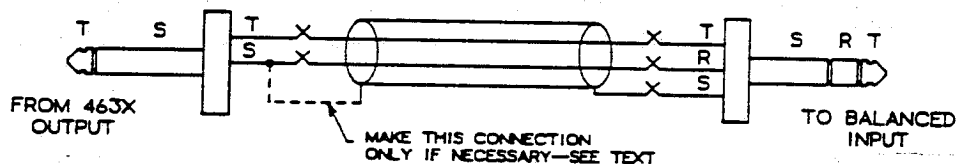
2-Circuit ("Mono") Plugs and Single-Conductor Shielded Cable

This will work fine for balanced inputs, too, but if the 463X input is connected to source equipment with balanced outputs, the next hookup should be used. Most balanced sources will work without the dotted connection between the ring (-) output and the sleeve (the ground -- this is true for "active-balanced" and "ground-referenced" outputs). This floating condition unbalances a balanced source, which is usually okay. However, some sources require the dotted connection, e.g., "transformer-isolated" balanced outputs. We recommend making the connection only if necessary for your installation, because some active balanced and ground-referenced outputs may be damaged by doing so. Consult the owner's manual.



Balanced Outputs and the 463X Line Input, Single-Conductor Shielded Cable

To take advantage of the balancing capability provided by the balanced inputs, the following connection may be used when the 463X output is connected to a device with balanced inputs.



Balanced Inputs and the 463X Line Output, Two-Conductor Shielded Cable

The connection between the shield and the sleeve at the 463X end of the cable should be made only if hum develops in your installation.

The Key input jack provides a direct connection to the 463X's "brains" -- its level-sensing circuitry, or rms detector -- without disturbing the normal audio path. This feature lets you control the gating from an external signal source, or lets you add processing (e.g., equalization) to the control path only. This jack overrides the detector's normal connection to the main input signal (see the block diagram, p. 9). Plugs and cabling are the same as in the two illustrations above.

The Hi-Z (instrument) input is single-ended (unbalanced) also and should be connected to instrument outputs with single-conductor shielded cable as shown at the top of this page for line-level jacks.

SETTING UP

Which Input?

Use the rear-panel (line) input in recording when the instrument to be gated is already preamplified, such as through a direct box or mixing console. Synthesizers sometimes can plug in here, too. And of course when mixing or submixing, the signal from the deck (or mixing console) goes here as well.

In performance, this input again is useful for connection to synthesizer high-level outputs or line-level outputs of guitar and bass preamps (before the feed to the power amp).

Use the front-panel Hi-Z input in the studio for adding quick (direct-input) overdubs and for the convenience of carrying a guitar or bass into the control room (no hassle of lugging an amp). In performance, any instrument can plug directly into this input (synths included), as well as most high-impedance microphones.

Setup

Start with the slider fully left, and while the music (or whatever) is playing adjust the Threshold knob so that the Threshold LED turns on — flashes — with the sound you want to keep.

Then slowly push the slider right until the desired amount of attenuation is achieved. Moving it right increases not only the amount but also the speed of the gating.

Then readjust the Threshold knob.

Vocals and instruments like bass guitar call for mild settings, toward the middle of the range, which yield smooth results. Percussive sounds like kick or snare drum want more severe (deeper and faster) gating, with settings toward the right. Since hearing the point where gating begins is easier than seeing it (with the Threshold LED), zero in on exactly the sound you're going for by fine-tuning the Threshold knob. There are no "typical" settings, because an exact one necessarily depends on widely varying levels and program material.

The Hi-Z trim

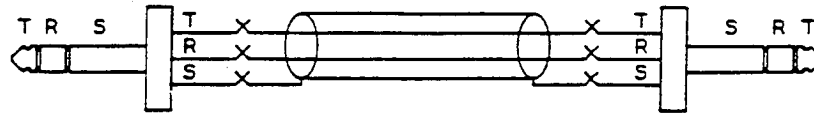
This screwdriver trim is rarely necessary in practical applications; most of the time it won't need to be adjusted. It should be reset **ONLY** if you hear distortion (over-driving) while using the Hi-Z input. The mike or instrument signal is probably over-driving the Hi-Z input and the gain must be changed (by means of the trim).

To adjust it, play your instrument or mike through the 463X with the slider to the far left. Listen to the output of the 463X. Turn the Hi-Z trim down (ccw) until the distortion disappears. If distortion is still audible with the trim all the way down, the problem is not in the 463X.

Stereo Gating

True stereo gating, as opposed to dual-mono gating, which you can achieve with two independent units, is important when a stereo signal is to be attenuated and its channel balance and imaging preserved. Dual-mono gating won't do this; instruments and their reverberation (decay tails) can wander or jump around, because the two channels may have different levels at different times. As mentioned, a pair of 463Xes or a 463X and a properly connected 163X will give you true rms stereo-tracking gating; your sound and your mixes will readily show the benefits.

Use this mode whenever imaging must remain stable. A cable as shown below is what's needed to link two 463Xes (or a 463X and a 163X). It's 2-conductor shielded (3-wire) with standard 1/4" tip/ring/sleeve phone plugs at the ends. Shielding is essential, and keep the cable short, too, to minimize hum pickup. Don't use mono cable or plugs (tip/sleeve) lest you damage the rms detectors.



3-Circuit ("Stereo") Plugs and Dual-Conductor Shielded Cable

Don't fail to disconnect the units from ac power when hooking up a stereo pair; you'll avoid a potentially loud (and damaging) pop.

Also see the assembly drawing at the bottom of the inside front cover.

After you've decided which unit is the Slave by pressing in the rear button, the yellow LED on the front will light. As explained earlier, the front controls are inactivated (will have no effect) and the LED bar graph will be blank since the amount of attenuation is exactly the same for both Master and Slave.

When you want to have two independently operating units, as we have said, remove the strapping cable and leave both Master buttons out.

ABOUT NOISE GATING

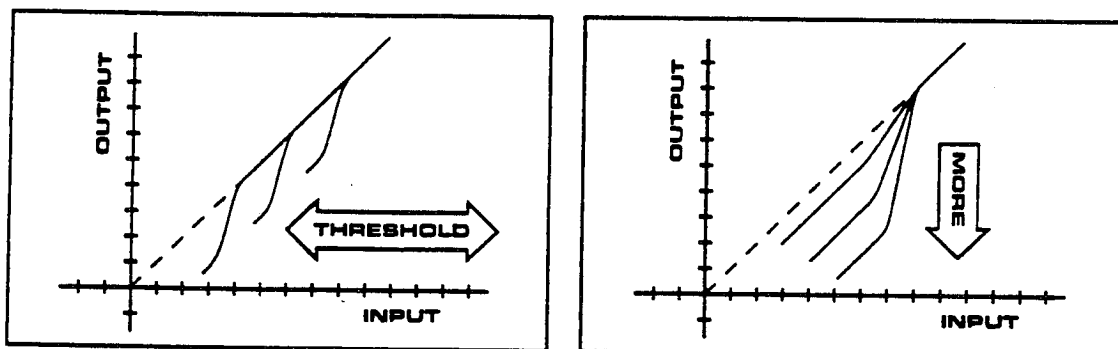
Although the basic idea behind gating is simple — attenuate the background noise whenever the signal of interest is absent — there's more than one way to go about it.

Classic gating is to use a fixed amount of attenuation (say, 30 dB) whenever the signal level drops below a given point, the Threshold. Essentially, the signal is switched off whenever its level is insufficient.

Another approach is downward expansion, where the amount of attenuation is based on how far down the signal has dropped below threshold.

The 463X takes this latter approach. As the signal level drops down below threshold, it gets pushed, or expanded, down farther yet. How much so depends on the expansion ratio, the ratio of change in input level to change in output level. For example, if the signal has dropped 10 dB below threshold and the ratio is 1:5, the signal will get forced down to 50 dB below threshold.

The slider on the 463X adjusts this ratio — and at the same time it changes the release rate of the circuit and sets the final attenuation limit. This combination of functions on one slider makes the 463X a unit that can be easily set for smooth gating of a very wide variety of source material. Low ratios, light attenuation, and slower release rates are obtained with the slider in mid-position. High ratios, heavy attenuation, and faster release rates result, of course, from settings farther to the right — MORE. Below are the explanatory circuit-action illustrations accompanying your unit.



APPLICATIONS

Noise reduction

As we've said, the basic purpose of a noise gate is to remove unwanted background sounds in the spaces between desired foreground sounds. But note that there has to be some real distance in level between the unwanted and wanted material — at least a few dB — in order for the 463X to "get its foot in the door." If levels are too close (e.g., because of earlier compression or because the mikes were closer to the unwanted than to the wanted sound), the gating efforts of the 463X will go for naught.

One of the common uses for a gate is to tighten or "dry up" drum sounds. As with most dynamics processing, it's ideal if there's a separate mike on each drum and cymbal (or group of cymbals) and each is individually gated. Each mike is auditioned separately and the gate threshold adjusted to eliminate the sound of all but the desired drum. (Hint: start with the threshold very low, so all the sounds come through, then increase it until only the desired drum is left.) It's likely that you'll find the far-right slider settings best for most drums, while milder positions are usually better for cymbals and some toms. When things are adjusted correctly, each drum will sound tight, punchy, and dry — detailed and defined.

When you don't have enough mikes (or 463Xes!) to cover each drum, then group them: snare and center toms, side toms, bass, cymbals. The idea is to get as close as possible to only one mike on at a time, so only one sound is picked up, instead of several.

Another common use for a gate is in vocal recording. Especially after compression, the noises picked up by a mike an inch away from a singer's mouth can be very obtrusive. Try the 463X in its middle slider settings to gate out these noises. Other applications include keeping live drum tracks from "contaminating" an acoustic-piano track, and general solving of other sorts of leakage problems.

Changing sound quality

There's more to gating than just keeping out unwanted background noises: you can use the 463X gate to change sonic character. This is because gates can be used to reduce or otherwise alter the quality of instrumental ambience and reverb. As the sound decays after an instrument stops, its reverberation level will fall through the 463X Threshold setting, below which it can be made to die out more or less quickly — in any case faster than the natural sound. Experiment with changing the "tail" of the sound; the correct setting will nearly eliminate reverb.

In other situations, a 463X can be used to prevent or reduce leakage among mikes in sound reinforcement or during panel discussions. Simply set the Threshold control below the level of the music or speech. Similarly, in broadcasting, a 463X can be used to clean up noisy feeds (land lines, ENG audio) if it's placed at the output. Wind or air-conditioning noise during a remote interview can be controlled as well: proper attenuation can keep noise during pauses from being either loud (obtrusive-sounding) or too soft (peculiar-sounding) — or modulated.

Hum

Instruments with magnetic pickups (like a bass guitar) often exhibit some buzz or hum between notes, which may be aggravated by compression (which will pull it all up into annoying audibility). Gating will knock it back down again.

MIDI (musical instrument digital interface) keyboard stacks

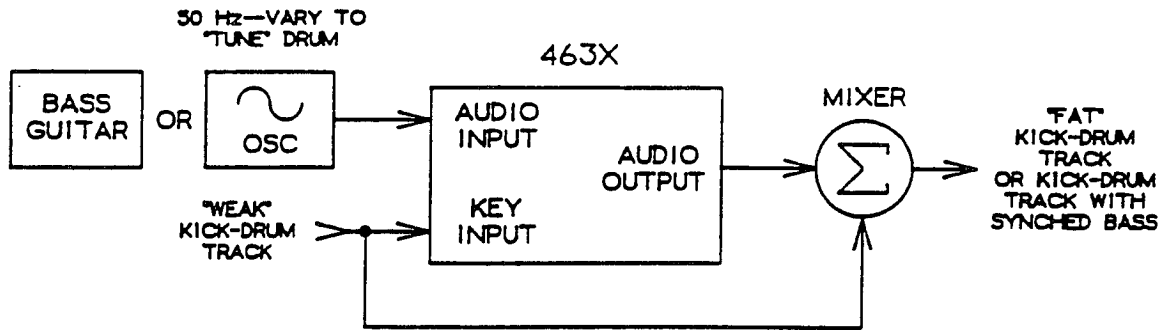
When all of the outputs of a complex synthesizer setup are summed, the resultant noise can be substantial when no notes are being played. Hum, rolling buzz, that strange digital grunge — all of this can accumulate. Set the Threshold knob so the gate begins attenuating (the light goes out) just as the last note decays into the sea of background noise, and then move the slider until the noise is no longer audible. You should get a smoother transition as the notes now fade into silence.

Multiple keyboard stacks (especially during a performance) call for a compressor and a gate used together. The compressor will keep the lid on during wild crescendos, avoiding speaker distortion, while the gate will keep the ensemble tight and clean — silent when it should be.

Keyed gating

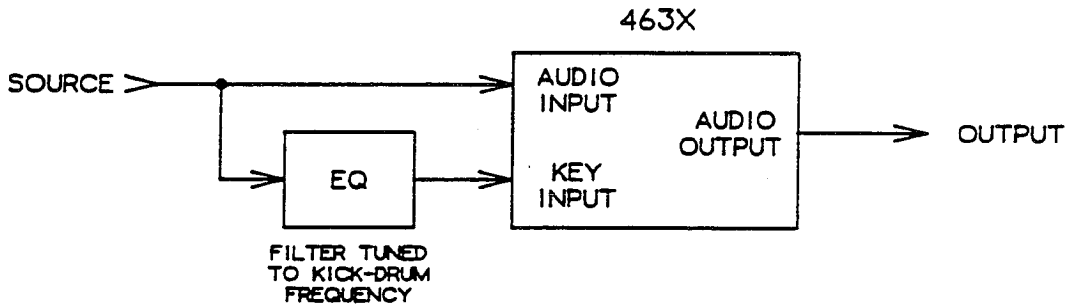
Controlling the gating of one signal by another permits perfectly in-synch playing and overdubbing among individual instruments. Another use of this function is adding sounds in synch with an existing track, "fattening" it. An example of the former would be synchronizing a bass guitar and a kick drum; an example of the latter would be using

the drum signal to key an oscillator which is set to an appropriate frequency to tune and punch up the drum sound. See diagram.



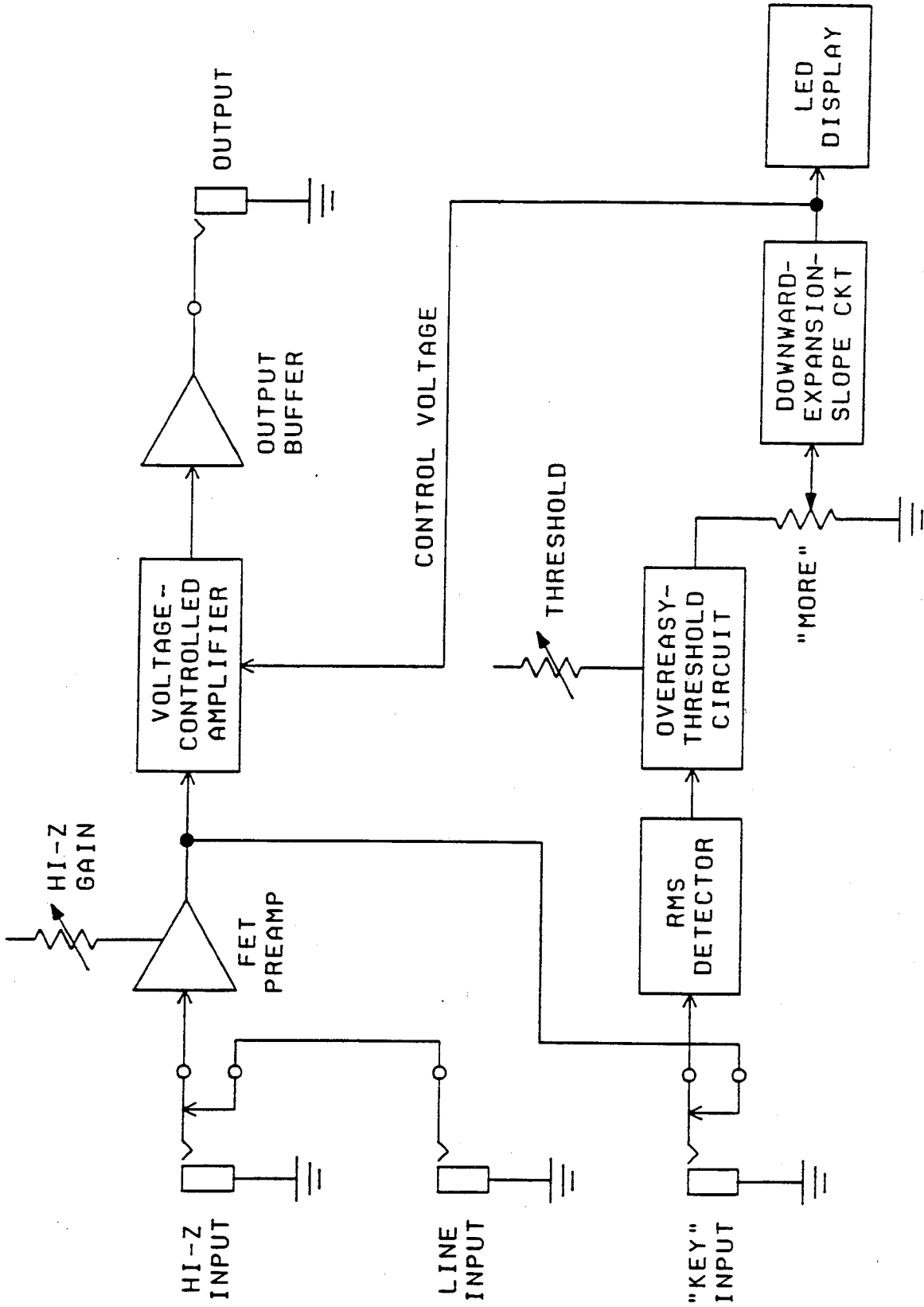
Selective gating

You can also do frequency-sensitive gating, which lets you tune the response of the gating action. This is especially useful when gating signals that are nearly buried in noise. If, for example, you're gating a kick drum in a track with lots of leakage, you can tune in to the frequency of the kick with an EQ and the gate will respond only to the drum. See below.



NOTES

BLOCK DIAGRAM



Circuit Descriptions (Theory of Operation)

Audio Signal Path

Preamp (Input Buffer)

The incoming audio signal is first buffered by the LF353 type op-amp, OA1A. Ac coupling is through C2 to the FET input stage of OA1A. The input impedance of 391k ohms is determined by the sum of R1 and R2. C1 provides some RF suppression, shunting to ground high frequency signals greater than about 1MHz. When the front panel Hi-Z input is used, R3 is connected to ground through the sleeve of the input plug activating the gain trim, R4. The gain can be adjusted from unity (0dB) to a maximum of 10 (20dB). When the rear panel input is used, the signal travels via shielded cable through the tip-shunt of the front panel jack and then to OA1A. One end of R3 is now left open and the circuit will have unity gain regardless of the setting of R4. Correct operation of this circuit can be checked at TP1. R5, R6 and zener diodes CR1 and CR2 provide soft clipping on input signals greater than +18dBv.

VCA

The output of OA1A is then ac coupled through C5 and R7 to the input of the Voltage Controlled Amplifier (VCA), IC1. The ratio of the input current (at pin 1) to the output current (pin 8) is controlled by the voltage applied to pins 2 and 4. Positive voltages here produce attenuation and negative voltages produce gain. The actual scaling is -6mV per dB. If, for example, the voltage applied to pins 2 and 4 is +36mV, then the current gain will be -6dB and the output current will be half as big as the input current. Since the output signal at pin 8 is a current, it cannot be viewed easily on an oscilloscope and is best checked after it has been converted into a voltage by the Output Buffer described below. R11 is used to adjust the VCA symmetry and is set to minimize distortion and offset. For a complete description of the VCA design and operation see dbx application note AN106

Output Buffer

The output current of the VCA is fed to the summing junction (pin 2) of the Output Buffer, OA2, and converted into a voltage by R14. This signal is then fed to the Output jack through R17. R17 provides some protection to OA2 from improper output connections and sets the output impedance at 22 ohms. The other 22 ohm resistor, R16, is inside the feedback loop and does not contribute to the output impedance. C6 and C7 roll off the gain at very high frequencies, necessary for the closed-loop stability of the op-amp. This 5534 op-amp will drive a 600 ohm load to +18dBv.

Control Voltage Path

RMS Detectors (general)

The heart of the level sensing circuitry in the 463X is the dbx patented RMS integrated circuit. This IC takes an ac signal at its input and produces a dc voltage at its output that is proportional to the true rms level directly in dB. The input (pin 1) is a current, requiring a resistor in series from a voltage source, and acts basically like a summing junction. This input resistor sets the nominal level at which the output (pin 7) is 0 volts. This output is a low impedance voltage source and can drive external circuits directly. The scaling of the output is always +6mV/dB. Along with this dc voltage is a small amount of ripple which is at twice the input frequency. The "RMS SYM" trim pot adjusts this ripple for perfect symmetry. Attack and release time constants are adjustable with external components connected to pin 6. For a more detailed explanation of this IC see dbx application note AN110

RMS Detector (463X)

In addition to feeding the VCA, the output of OA1 is also sent to the RMS detector, IC2. The output of IC2 (pin 7) is 0.000 volts when the input current (pin 1) is 5.7 micro-amps. This is the "Level Match" point and corresponds to an input level of about -10dBv at C12. This level is calibrated exactly via R25. For example, with the scaling of +6mV/dB, the output voltage (at TP6) will be +120mV when the input level is +10dBv (20dB above level match) and will be -120mV when the input level is -30dBv (20dB below level match). The RMS symmetry is adjusted by R31 and is calibrated such that with a 50Hz input signal the ripple component is a pure 100 Hz sine wave at about 70mV p-p at TP11.

The maximum speed at which output of this detector changes when the input signal suddenly gets smaller is called the "Release Rate" and determines the basic rate at which the 463X will "downward-expand" or gate the signal. This rate is set by the non-linear capacitor circuit made up of OA1B and its associated components connected to pin 6 of the detector. When the voltage changes at pin 6 are large, this circuit looks like a small capacitor and sets the release rate at 125dB/second. When the voltage changes are small, this circuit looks like a much larger capacitor with a release rate of about 25dB/second. This unique feature eliminates any increase in distortion at low frequencies.

When connected to another 463X for stereo operation, pin 6 of the detector is tied directly to pin 6 of the detector in the other unit via the ring on the Stereo Strapping jack. By making this connection, the audio levels of each unit are combined, and the output of the detector at pin 7 is the true rms sum of the two levels, regardless of the relative phase between them.

Threshold Circuit

The output of the RMS Detector is then fed to the OverEasy threshold circuit made up of OA4A, OA5A, OA5B, and their associated components. OA4A is an inverting summer that sums the voltages from the RMS Detector, front panel Threshold control, R38, and the temperature compensating diode, CR4. Also added here is a small offset voltage from R69 to calibrate the Threshold control. When the inversion of the sum of these voltages is less than zero, CR5 is reverse biased and the output at TP12 is 0 volts. This is the case when the level of the audio signal is greater than the setting of the Threshold control and no gating is desired. When the output of OA4A is greater than zero, as is the case when the audio signal is below the Threshold setting, CR5 will begin to conduct, causing a control voltage to be generated. This control voltage is then further processed by the Attenuation Limit and Expansion Processor circuits where it ultimately goes to the VCA which attenuates the audio signal. The turn-on characteristics of CR5 give the circuit a gentle transition into gating for the first 6dB or so of downward expansion.

OA5A acts as a comparator and turns on the yellow Threshold LED whenever the audio signal level is above the Threshold setting. The minus input to this comparator comes from the output (pin 1) of OA4A described above. The plus input comes from OA5B which subtracts out the temperature compensating voltage that was added in at OA4A. This voltage is normally about 300mV but gets pushed to 7.5 V when the Slave switch is activated. This insures that the LED will be off during Slave operation.

Attenuation Limit Circuit

When the voltage at TP4 is less than about 100mV, OA4B acts as an inverter with a gain of 14.6. As the voltage increases above this level, CR26 begins to conduct and will ultimately limit the output voltage from OA4B to 1.4 V. This controls the maximum amount of attenuation at the VCA. Resistors R44 and R68 form a voltage divider for the feedback through the diode, allowing the output to go to 1.4 volts even though the voltage across the diode is 0.5 volts.

Expansion Processor

The amplitude of this control voltage is adjusted by the front panel potentiometer R67, the More control. This is where the actual amount of gating action is set by the user. The gating characteristics are further modified by OA3B and CR3, which create an additional "OverEasy" circuit. When the control voltage levels are small, CR3 is in its transition region of conduction and the gating action is relatively slow and gentle. As the control voltage becomes large, as is the case when the More control is set to its maximum position, CR3 is biased full on and the resulting gating action is fast and severe. The temperature compensating voltage from CR4 is summed in through R40 along with a small offset adjustment voltage from R18.

OA3A is an inverting buffer for the signal through CR3 with a gain of minus two. Its output is sent to the LED display, the tip of the Strapping jack, and the VCA. R24 is added inside the feedback loop to help protect this op-amp from improper connections at the Strapping jack. When the Slave switch, S1, is activated the output of OA3A is disconnected and the VCA now gets its control voltage from the signal externally connected to the tip of the Strapping jack. The control voltage is scaled at 16mV/dB at this point and is divided down to 6mV/dB at the VCA by R8 and R12.

LED Display

Q1 provides a constant current of approximately 10mA for the string of 12 LEDs. The comparators IC3, IC4, and IC5, shunt this current to the -15v supply when the control voltage (16mV/dB) is less than the reference at the minus input of each comparator section. When the control voltage exceeds the reference voltage, the comparator section becomes an open circuit and allows the current to flow through the LED connected to that section, turning it on. All LEDs above this point will be on, and all LEDs below this point will be off. When the "Slave" switch is pressed, this current is sent to the Slave LED, turning it on and the entire string off.

Power Supply

The voltage selector switch, located on the rear panel, connects the dual primary windings of the power transformer in parallel for 120 volt operation and in series for 240 volt operation. The center tapped secondary of the transformer reduces the primary voltage to about 48v ac rms, which is full-wave rectified by the diodes CR21, CR22, CR23, and CR24. The plus and minus 24v dc is smoothed by capacitors C28, C29, C30 and C31 and checked at TP7 and TP8. The voltage regulators VR1 and VR2 reduce this voltage to a constant + and - 15 volts dc which is used for most of the circuitry in the 463X and can be monitored at TP9 and TP10 respectively. The front panel "Power" LED is connected to the -24v supply through R66 and is used to indicate connection to a live ac mains.

Troubleshooting and alignment

Before attempting any troubleshooting or alignment, study the 463X owners manual to familiarize yourself with the unit. The manual covers the operation of all controls, specifications for inputs and outputs, correct hook-up etc. The following procedures assume a basic understanding of the operational details of the 463X.

1. Instruments Required:

- A. Audio-frequency sine-wave oscillator with 50-ohm output impedance (Krohn-Hite 4200A or equivalent).
- B. Oscilloscope with 10-MHz bandwidth and 2mV per division sensitivity. (Philips PM 3233 or equivalent)
- C. Dc voltmeter capable of measuring 1mV (Fluke 8060A or equivalent).
- D. Ac voltmeter with rms response (Fluke 8086A or equivalent).
- E. Distortion meter, with low distortion oscillator if necessary, capable of measuring THD to less than 0.02%. (Sound Technology Model 1700B or equivalent)

2. Inspection and warm-up:

Inspect the unit for any signs of external damage such as a cut line cord or broken controls. Check the position of the voltage selector switch on the rear panel and ensure that it is set correctly for the ac mains voltage you are using. Connect the 463X to a live ac outlet and let it warm up for at least 10 minutes before making any adjustments.

3. Disassembly:

Be sure the 463X is disconnected from any ac outlet. Refer to the exploded mechanical view and locate the four corner rear panel screws. Remove only these corner screws and slide out the rear panel about 4 inches. Carefully disconnect the transformer secondary cables from the main PCB by sliding apart at the connector. Pull only on the connector body, if you pull on the wires they may break. Set the rear panel aside for now and remove the four corner screws from the front panel using the special hex wrench supplied in the accessory kit. The front panel and main PCB will now slide out of the chassis intact.

Inspect the PCB for any signs of damage such as burnt-out resistors or broken wires. It is not necessary to remove the front panel from the main PCB unless service is necessary on the LED board or the Level Set pot. Reconnect the transformer secondary to the main PCB, connect the line cord to a live ac outlet, and let the unit warm back up for a few minutes.

4. Power Supply Check:

Before attempting any calibration or troubleshooting, check that the power supply is working correctly. Verify the following:

Probe location	Test Condition	Tolerance
TP9	+15.00v	+/- 500mV
TP10	-15.00v	+/- 500mV
TP7	+24 V dc	+/- 3 V dc, 750mV ripple
TP8	-24 V dc	+/- 3 V dc, 750mV ripple

5. Alignment Procedure:

Under normal conditions, the 463X should not require re-calibration for the life of the unit. Alignment is necessary only if the unit has been disturbed mechanically or if replacement of critical components has been necessary.

A. RMS Symmetry:

1. Connect the audio oscillator to the rear panel Input jack on the 463X.
2. Set the oscillator for 50Hz, at -10dBV (0.316v rms).
3. Monitor TP11 with an oscilloscope and adjust R31 for a symmetrical 100Hz sine wave. The amplitude of this sinewave should be 70mV p-p (+/- 15mV). See Photo 1.

B. RMS Level:

1. Set oscillator for 1kHz at -10dBv.
2. Monitor TP1 with the ac voltmeter and verify -10dBv level (+/- 0.15dBv).
3. Monitor TP6 with the dc voltmeter and adjust R25 for a reading of 0.000 volts (+/- 10mV).

C. VCA Symmetry:

1. Remove oscillator from rear panel Input jack and connect it to the rear panel Stereo Strapping jack. Use a tip/ring/sleeve type plug with the signal from the oscillator connected to the tip, ground to the sleeve, and no connection to the ring (this is important).
2. Press the Slave switch on the rear panel and verify that the Slave LED on the front panel is lit.
3. With the oscilloscope connected to the rear panel Output jack, adjust R11 for minimum ac content in the waveform. The peak to peak amplitude should be less than 5mV. See figures 3,4.
4. Remove connection from Strapping jack and return Slave switch to the normal (out) position.

D. Hi-Z Gain Trim:

1. Set oscillator for 1kHz at -20dBv and connect to the front panel Hi-Z Input jack with a standard two conductor tip/sleeve plug.
2. Set R4 (Hi-Z trim) fully CCW and verify a -20dBv reading with the ac voltmeter at TP1 (+/- 1.5 dB).
3. Set R4 fully CW and verify 0.0dBv at TP1 (+/- 2.5dB).

E. Threshold Calibration and Range Check:

1. Set front panel Threshold control to midposition (-30 panel marking).
2. Set front panel More control full right.
3. Set oscillator for a 1kHz sine wave at -40dBv and connect it to the rear panel Key In jack.
4. Slowly increase the oscillator signal level until yellow Threshold LED turns on.
5. Using the ac voltmeter, verify that oscillator level is now -30dBv (+/- 6dB).
6. Using the ac voltmeter for reference, decrease the oscillator level by 2.0dB.
7. Verify that the Threshold LED is now off.
8. Locate and adjust R18 CCW until all Downward Expansion (DE) LEDs are off.
9. Adjust R18 CW until only the first (-3) DE LED is lit.
10. Increase the oscillator level until the yellow Threshold LED just turns on.

11. Verify that all DE LEDs are now off.
12. Set Threshold control CW and verify that all DE LEDs now on (+/- 1 LED).
13. Increase the oscillator level until all the DE LEDs are off and the Threshold LED is off.
14. Verify that the oscillator level is now 13dBv (+/- 5dB).
- 14a. Slowly decrease the oscillator level and verify that the DE LEDs turn on one LED at a time until all DE LEDs are on.
15. Remove the oscillator connection from the Key In jack.
16. Rotate the Threshold control CCW until the Threshold LED turns on.
17. Verify that the indicator dot on Threshold control is now between the -60 and -70 markings on the front panel.

F. More Range Check:

1. Set the Threshold control CW.
2. Set the More control full right.
3. Verify that all the DE LEDs are now lit.
4. Set the More control to midposition (indicator line on the More control must be between the -20 and -25 DE LEDs).
5. Verify that the rightmost 6 DE LEDs are lit (+/- 1 LED).
6. Set MORE control full left.
7. Verify all DE LEDs now off.

G. Noise Check:

1. Remove any connections from the Input jacks.
2. Set the More slider fully left and the Threshold control CCW.
3. Connect ac voltmeter to the rear panel Output jack and verify that the noise level is less than -80dBv. Use a 20Hz to 20kHz bandwidth filter, if available, on the input to the meter for a more accurate reading.
4. If an "A" weighting filter is available, connect it to the input of the meter and verify the noise level to now be less than -85dBv.

H. Frequency Response Check:

1. Set oscillator for 0.0dBv at 1kHz and connect to rear panel Input jack.
2. Connect ac voltmeter to rear panel Output jack. (Be sure to remove any filters if used in the Noise Check.)
3. Set the More slider fully left.
4. Set oscillator to 20Hz and verify that the meter reads 0.0dBv (+/- 1dB).
6. Repeat step 5 for 100Hz, 10kHz, and 20kHz.

I. Distortion Check:

1. Connect a low distortion oscillator to the rear panel Input jack and set it for 0dBv at 1kHz.
2. Set the More slider fully left and the Threshold control CCW.
3. With a suitable distortion analyzer, spectrum analyzer or THD meter connected to the rear panel Output jack, verify that THD is less than 0.08%.
4. Set the Threshold control CW and adjust the More control so that the first two DE LEDs turn on.
4. Repeat steps 3 and 4 for 40Hz. THD should be less than 0.25%.
5. Repeat steps 3 and 4 for 10kHz. THD should be less than 0.1%.

PROPERLY CALIBRATED RMS WAVEFORM

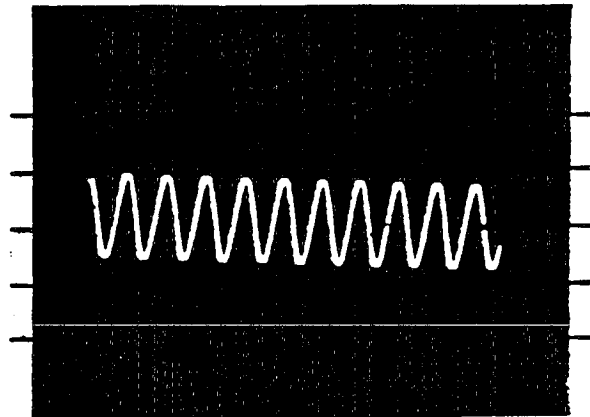


Photo 1

dbxinc. P.C. ASSEMBLY
OVER-EASY NOISEGATE

USED ON 463X

PL 360546

REV.
04

ITEM	REF. DESIGNATION	DESCRIPTION	PART NUMBER	QTY
1		P.C. BOARD FABRICATION	260546	1
2				
3				
4				
5	R1,5,47,48,49,50,51,62,63	RESISTOR 1K 1/4W 5%	054102	9
6	R2,	390K	054394	1
7	R3,68	4K7	054472	2
8	R4	POT TRIM 50K (INST GAIN)	070274	1
9	R6,26,	RESISTOR 2K2 1/4W 5%	054222	2
10	R7	18K	054183	1
11	R8	80R6 1%	018069	1
12	R10,21,43,70,75	100K 5%	054104	5
13	R11	POT 50K (VCA SYM)		1
14	R12	RESISTOR 49R9 1/4W 1%	014999	1
15	R13,45	5K6 5%	054562	2
16	R14	20K 1%	012002	1
17	R15,23	20K 5%	054203	2
18	R16,17,29	22	054223	3
19	R18,25,31	POT, TRIM 50K (OFFSET)		3
20	R19	RESISTOR 470K 1/4W 5%	054474	1

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ITEM	REF. DESIGNATION	DESCRIPTION	PART NUMBER	QTY
21	R20,40	RESISTOR 47K 1/4W 5%	054473	2
22	R22,41	10K	054103	2
23	R24,73	100	054101	2
24	R27	6R8	054689	1
25	R28	62K	054623	1
26	R30	22K	054223	1
27	R32	22M	054226	1
28	R33	560K	054564	1
29	R34	2M	054205	1
30	R35	220	054201	1
31	R36	8M2	054825	1
32	R37	4K99 1%	014991	1
33	R38	POT, VERT. MOUNT, 50K, (F.P.)		1
34	R39	RESISTOR 309K 1/4W 1%	013093	1
35	R42	10K	011002	1
36	R46	82K 5%	054823	1
37	R52,53,54,55,56	1K6	054162	5
38	R57,58	3K3	054332	2
39	R59	182K 1%	011823	1
40	R60	RESISTOR 2K 1/4W 5%	054202	1

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Inc. OVER-EASY NOISEGATE

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ITEM	REF. DESIGNATION	DESCRIPTION	PART NUMBER	QTY
41	R61	RESISTOR 2K7 1/4W 5%	054272	1
42				
43	R65	39K	054393	1
44	R66	2K4 1/2W		1
45	R67	POT, SLIDE, 50K (F.P.)	070358	1
46	R69	RESISTOR 470K 1/4W 5%	054474	1
47				
48	R74	RESISTOR 1K5 1/4W 5%	054152	1
49	R9	RESISTOR 47 1/4W 5%	054470	1
50	R64	RESISTOR 100K 1/4W 1%	011003	1
51	R72,76	RESISTOR 49K9 1/4W 1%	014992	2
52	R44	RESISTOR 8K2 1/4W 5%	054822	1
53	R71	RESISTOR 6M8 1/4W 5%	054685	1
54	C1	CAPACITOR, 120P, CD, Y5E 10%	121271	1
55	C2	" 100N, MY, MIN, 50V 5%	123149	1
56	C3,4,8,9,10,11,18,19,20,21,22	} 10N, CD, Z5U, ±20%	121535	16
57	C23,24,25,26,27			
58	C5	CAPACITOR 3U3/50V, RAD EL ±20%	127100	1
59	C6,7,38	100P, CD, NPO, 500V, 10%	121257	3
60	C12,16	CAPACITOR, 330N, MY, MINI, 50V, 10%	123212	2

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ITEM	REF. DESIGNATION	DESCRIPTION	PART NUMBER	QTY
61	C13, 15, 32, 33	CAPACITOR, 10/50V, RADEL. ±20%	127202	4
62	C14, 34	" 1N, CD, Y5E, 500V 10%	121432	2
63	C17	" 68N, CD, NPO		1
64	C28, 29	" 470/35V, RAD, EL +50% -10%	127490	2
65	C30, 31, 36, 37	" 1/50V, RAD EL +50% -10%	127084	4
66	C35	CAPACITOR, 200P, CD, Y5F, 100V ±10%	121306	1
67				
68				
69	IC2	IC, RMS MPC1253H2	146742	1
70	IC1	IC, VCA 4PC1252H2	146732	1
71	IC3, 4, 5	IC, LM339N	146271	3
72				
73				
74	OA1	OP AMP LF353N	146241	1
75	OA2	OP AMP NE5534N	146281	1
76	OA3, 4, 5	OP AMP RC4558P	146061	3
77				
78				
79				
80				

PL 360546

dbxP.C. ASSEMBLY
OVER-EASY NOISEGATE

USED ON

463X

PL 360546

REV.

04

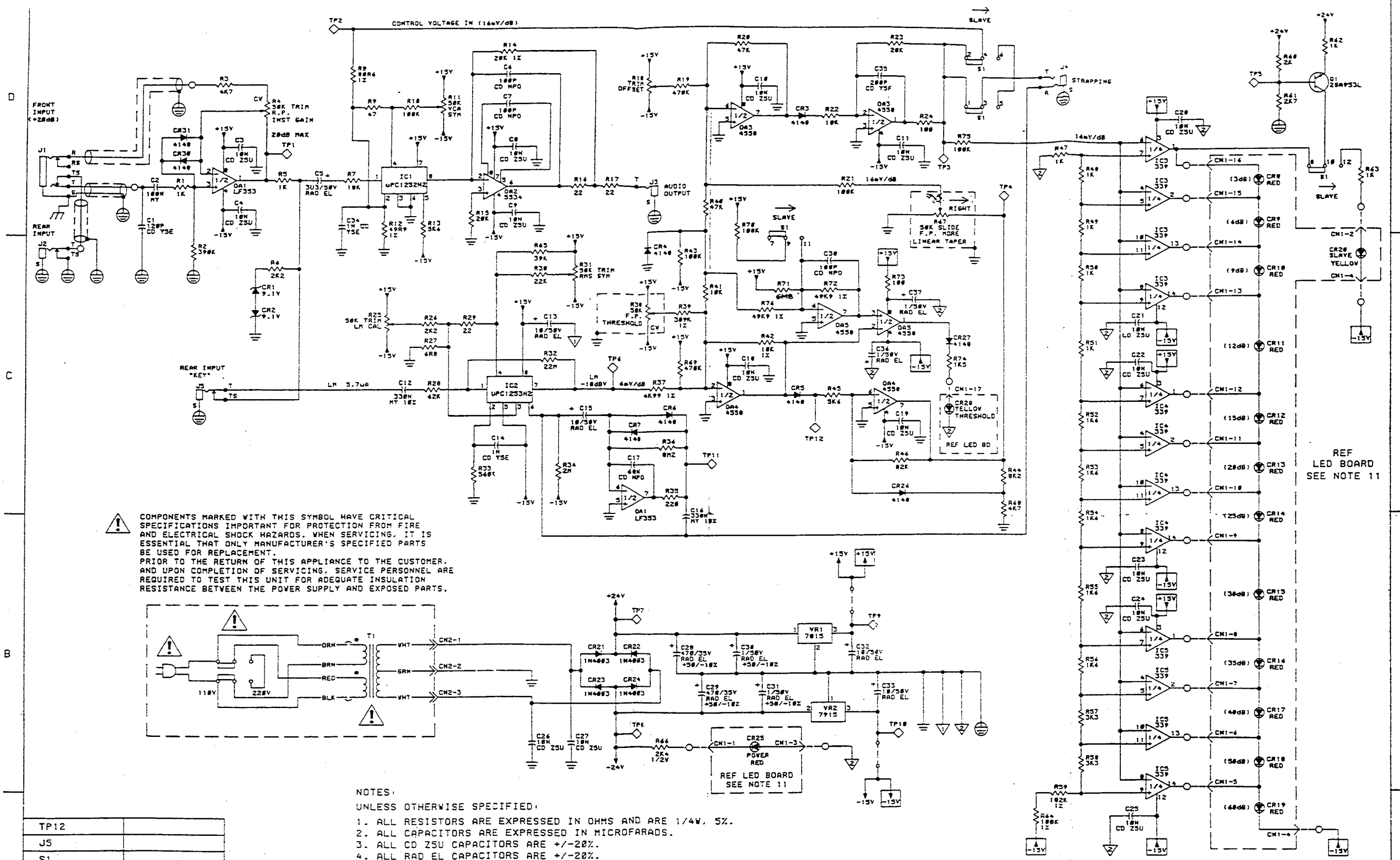
ITEM	REF. DESIGNATION	DESCRIPTION	PART NUMBER	QTY
81	CR1, 2	DIODE, ZENER 9.1V	140001	2
82	CR 3, 4, 5, 6, 7, 26, 27,	} IN4148	140031	9
83	30, 31			
84	CR29,	NOT USED		—
85				
86				
87	CR 21, 22, 23, 24	DIODE IN4003	140022	4
88				
89				
90				
91				
92				
93	Q1	TRANSISTOR, PNP SILICON, 2SA953L	142149	1
94				
95				
96	VR1	VOLTAGE REGULATOR 7815 +15V.	146366	1
97	VR2	VOLTAGE REGULATOR 7915 -15V.	146367	1
98				
99	S1	SWITCH, 4PDT	250065	1
100				

PL 360546

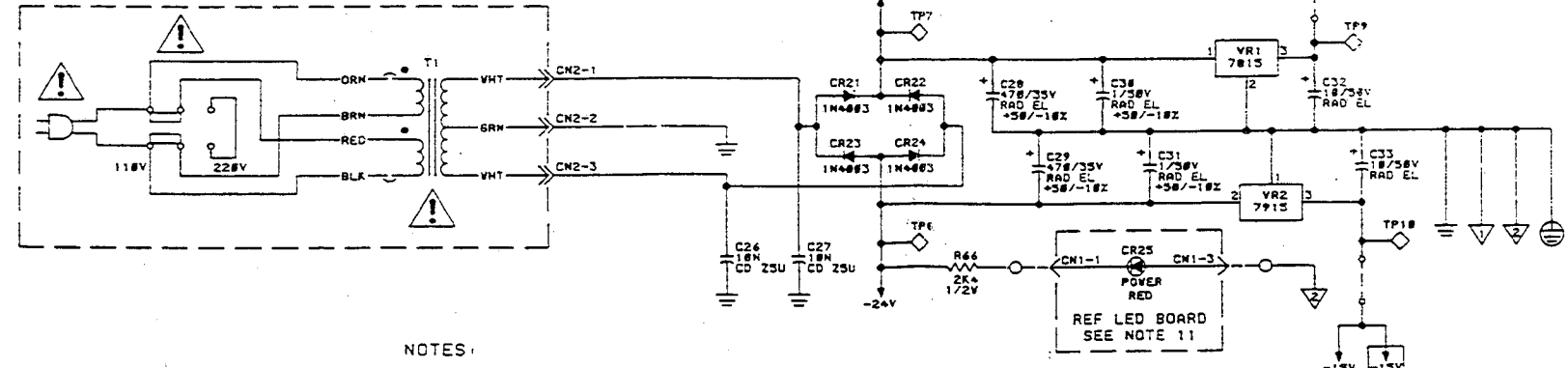
ITEM	REF. DESIGNATION	DESCRIPTION	PART NUMBER	QTY
101				
102		TRANSFORMER	230080	1
103		CONN HOUSING FEMALE, 3-PIN		1
104		TERMINAL CRIMP		3
105	CN2	CONN, MALE, 3 PIN RIGHT ANGLE		1
106	J1 *	PHONE JACK		1
107	J2, 5	PHONE JACK		2
108	J3	" "		1
109	J4	" "		1
110		SHIELDED CABLE, 1 CONDUCTOR		2
111		" " , 2 "		1
112	Y1-Y33,	JUMPER, ZERO-OHM	110085	33
113	TPI-12	TEST POINT PINS		12
114				
115		LED BOARD ASSY	460564	1
116		SPACER		2
117		SCREW, PAN HD, X-REC		2
118		WASHER, INT. TOOTH		2
119		TIE WRAP		2
120				

PL 360546

*ITEM 106 IS PART OF MAIN ASSY



⚠ COMPONENTS MARKED WITH THIS SYMBOL HAVE CRITICAL SPECIFICATIONS IMPORTANT FOR PROTECTION FROM FIRE AND ELECTRICAL SHOCK HAZARDS. WHEN SERVICING, IT IS ESSENTIAL THAT ONLY MANUFACTURER'S SPECIFIED PARTS BE USED FOR REPLACEMENT. PRIOR TO THE RETURN OF THIS APPLIANCE TO THE CUSTOMER, AND UPON COMPLETION OF SERVICING, SERVICE PERSONNEL ARE REQUIRED TO TEST THIS UNIT FOR ADEQUATE INSULATION RESISTANCE BETWEEN THE POWER SUPPLY AND EXPOSED PARTS.



- NOTES:
UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE EXPRESSED IN OHMS AND ARE 1/4W, 5%.
 2. ALL CAPACITORS ARE EXPRESSED IN MICROFARADS.
 3. ALL CD Z5U CAPACITORS ARE +/-20%.
 4. ALL RAD EL CAPACITORS ARE +/-20%.
 5. ⚡ DENOTES GROUND IS CONNECTED TO MAIN GROUND AT ONLY ONE POINT.
 6. ⚡ DENOTES GROUNDS ARE TIED TOGETHER AND CONNECTED TO MAIN GROUND AT ONLY ONE POINT.
 7. ⚡ DENOTES GROUNDS ARE TIED TOGETHER AND CONNECTED TO MAIN GROUND AT ONLY ONE POINT.
 8. ⚡ DENOTES VOLTAGES ARE TIED TOGETHER AND CONNECTED TO SUPPLY VOLTAGE AT ONLY ONE POINT.
 9. ⚡ DENOTES VOLTAGES ARE TIED TOGETHER AND CONNECTED TO SUPPLY VOLTAGE AT ONLY ONE POINT.
 10. ALL SWITCHES ARE SHOWN IN THE "OUT" POSITION.
 11. REFERENCE LED BOARD PARTS LIST NO. PL360564

TP12	
J5	
S1	
T1	
VR2	
Q1	
OA5	
IC5	
CR31	CR29
C38	
R76	
LAST USED	NOT USED
REFERENCE DESIGNATIONS	

463X		USED ON
dbx		
SCHEMATIC		
OVEREASY NOISEGATE		
SCALE: NONE	SIZE NUMBER	REV
SHEET 1 OF 1	C 340546	03

A

B

C

D

A

B

C

D

