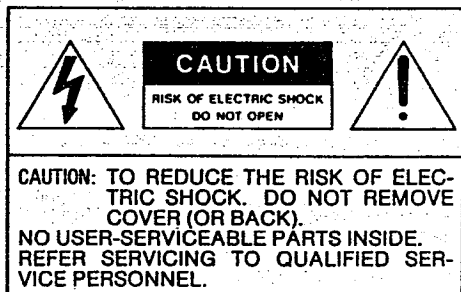


dbx 160X
SINGLE-CHANNEL
COMPRESSOR/LIMITER
INSTRUCTION MANUAL



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.



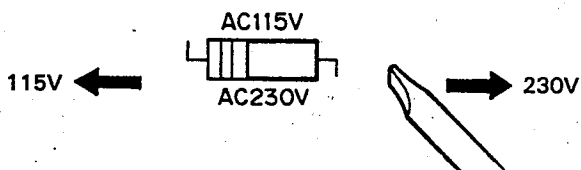
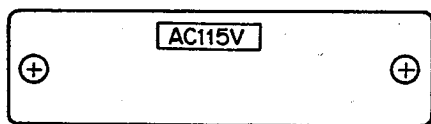
This symbol is intended to alert you of the presence of important operating and maintenance instructions in the literature accompanying the unit.

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.

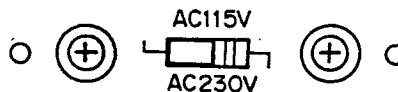
For 115V ac:



Use a screwdriver and slide

For 230V ac:

Important: This setting is only for the European model and not for UL listed model.



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1.0 INTRODUCTION

1.1 PRODUCT DESCRIPTION

The dbx Model 160X is a single channel compressor/limiter that features an exclusive *combination of the dbx Over Easy and "hard knee"* compression characteristics. dbx Over Easy compression permits extremely smooth, almost inaudible transitions into compression due to the gradual change of compression ratio around the threshold. The 160X offers the user the choice of using the Over Easy curve or a mathematically precise "hard" threshold—at any compression ratio selected. The Over Easy curve, coupled with dbx's true-RMS level detector, wide-range Blackmer voltage-controlled amplifier (VCA) and feed-forward circuitry, makes it *possible to achieve large amounts of compression without adverse audible side effects*. These features also allow the 160X to actually be set for *INFINITY+™ compression*. This is a special negative compression effect whereby the program dynamics are inverted above the set threshold (i.e., the higher the input level, the lower the output level).

The detectors of *two Model 160X's can be coupled so that stereo programs are compressed with stable imaging*, by means of a simple patch cable between the two units. *The stereo coupling can be disengaged instantly* by a front panel pushbutton.

Program-dependent attack and release times assure natural sound without the need for continuous manual adjustments. *Threshold and compression ratios are adjustable over a wide range*, so virtually any line level signal can be processed effectively. *Output gain is also adjustable* over a very wide range (± 20 dB). These features make the Model 160X compatible with the operating levels of virtually all professional sound and creative audio equipment.

For metering, the 160X provides a true RMS dual wide-range LED array which simultaneously shows *the amount of gain reduction* up to 40 dB* and *the input or output level* from -40 dB to +20 dB, depending on the setting of a front panel switch.

The 160X also features a true *"hard-wired bypass"* switch, separate detector inputs, Tip/Ring/Sleeve phone jacks as well as barrier strip connectors, balanced active inputs and +24 dBm single-ended output drive capability which can be field-modified to provide transformer or active balanced operation.

The dbx Model 160X is well suited to a broad range of applications including tape recording, disc mastering, radio and TV production and broadcast, live concert sound reinforcement, mobile and theatrical production.

IMPORTANT FOR UK USERS

The wires in this mains lead are colored in accordance with the following code:

Blue: Neutral

Brown: Live

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

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

The wire that is colored brown must be connected to the terminal that is marked with the letter L or colored 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.

*The 160X is capable of greater than 60 dB of compression.

1.2 160X FRONT PANEL

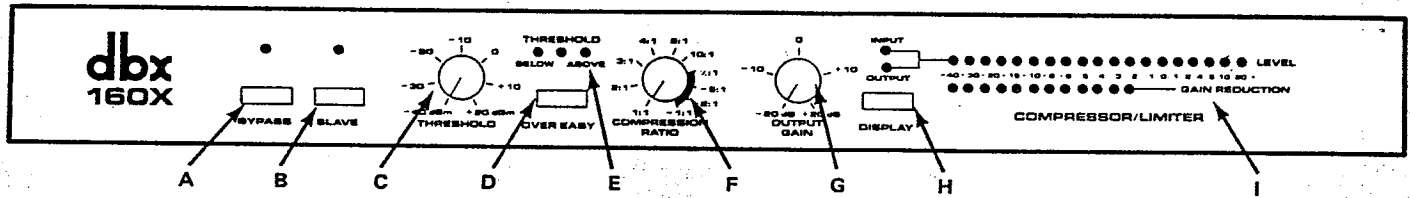


Fig. 1-1 — Model 160X Front Panel

A. BYPASS SWITCH AND INDICATOR

Depressing the BYPASS button creates a "hard-wire bypass" of the 160X's circuitry by connecting the input directly to the output; the LED above the switch turns ON in Bypass mode.

B. SLAVE SWITCH AND INDICATOR

Depressing the SLAVE button on one 160X of a stereo pair determines that the *other* 160X will be the Master (the controlling unit). The LED above the SLAVE button turns ON when the 160X is in SLAVE mode, indicating that the front panel functions (with the exception of BYPASS and DISPLAY select switches) are deactivated and under control of the Master 160X. When neither 160X is in SLAVE mode, each will operate normally as a mono compressor/limiter.

C. THRESHOLD CONTROL

Adjusting this knob sets the threshold of compression from -40 dBm (7.8 mV) to 20 dBm (7.8 V). In hard-knee compression mode, the threshold is defined as that point above which the output level no longer changes on a 1:1 basis with changes in the input level. In Over Easy mode, the threshold of compression is defined as the approximate middle of the Over Easy threshold region, as shown in Figure 3-1.

D. OVER EASY SWITCH

Depressing this button changes the threshold mode to dbx's Over Easy characteristic, and allows the middle (amber) THRESHOLD LED to turn ON when the signal is in the Over Easy region. When this button is out, the 160X operates as a hard-knee compressor/limiter.

E. THRESHOLD INDICATORS

These three LEDs indicate the relationship of the input signal level to the threshold of compression. The green "BELOW" LED is ON when the signal is below threshold and the red "ABOVE" LED is ON when the signal is above threshold. When the 160X is switched to Over Easy mode, the amber LED is ON when the signal is in the Over Easy region (Refer to Figure 3-1).

F. COMPRESSION RATIO CONTROL

Rotating this control in a clockwise direction increases the maximum amount of compression from 1:1 (no compression) up to infinity:1 (no increase in RMS output regardless of input level increases above threshold); further clockwise rotation increases compression into the INFINITY+ region, up to a maximum of -1:1 (i.e., a 1 dB decrease in input level causes a 1 dB increase in output level). In the INFINITY+ region, the 160X inverts the program dynamics for special effects.

G. OUTPUT GAIN CONTROL

Adjusting this control varies the amount of fixed gain (up to ± 20 dB) in the 160X's output amplifier stage. The OUTPUT GAIN control *does not* interact with the threshold of compression.

H. DISPLAY FUNCTION SWITCH AND INDICATORS

Depressing this button causes the upper LED array to display the INPUT level to the 160X. With the button out, the OUTPUT signal level is displayed. A pair of LEDs immediately above the DISPLAY switch indicates the selected display status.

I. LEVEL AND GAIN REDUCTION DISPLAYS

The upper row of 19 LEDs displays either the INPUT or OUTPUT level, as selected with the DISPLAY switch. This display is factory set so that 0 dB is equivalent to +4 dBm input or output level (1.23 V rms), but may be reset with the rear panel METER CALIBRATION trimmer. (See Section 3.5 for recalibration instructions.)

The lower row of 12 LEDs displays up to 40 dB of GAIN REDUCTION being caused by the 160X. (Fixed gain changes commanded by the OUTPUT GAIN control are not displayed by the gain change LEDs but are reflected in the output level display.)

1.3 160X REAR PANEL

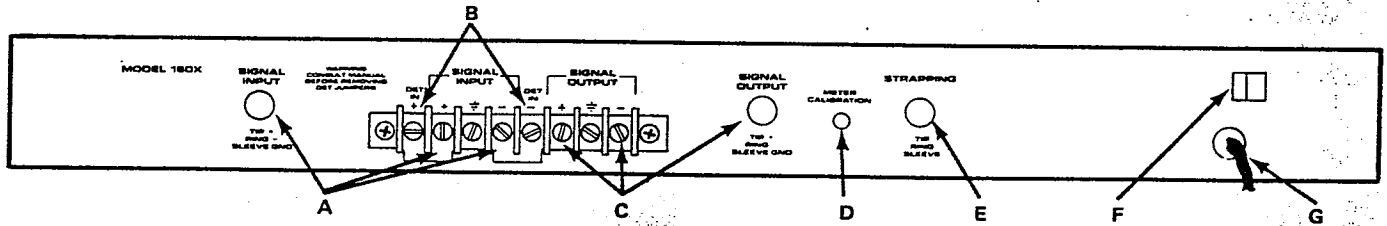


Fig. 1-2 - Model 160X Rear Panel

A. SIGNAL INPUT JACK AND TERMINALS

The Tip/Ring/Sleeve phone jack and barrier strip are wired in parallel; either SIGNAL INPUT accepts the incoming audio signal for processing by the 160X. The phone jack accepts a standard 3-circuit 1/4-inch (6.3 mm) phone plug for a balanced input source, or a 2-circuit (Tip/Sleeve) phone plug for an unbalanced source.

B. DETECTOR INPUT (DET IN) TERMINALS

The 160X comes from the factory with these terminals connected to the adjacent SIGNAL INPUT (+) and (-) terminals by metal straps. By removing the strapping, the detector input can be separated from the signal input for special processing applications.

C. SIGNAL OUTPUT JACK AND TERMINALS

The Tip/Ring/Sleeve phone jack and barrier strip are wired in parallel; either SIGNAL OUTPUT feeds the program from the 160X to the next device in the audio path. As supplied from the factory, the output (-) is internally connected to the output (+) whenever the 160X is *not* in bypass mode (see Section 2.4 for optional output configurations).

D. METER CALIBRATION CONTROL

This screw-driver-adjustable trimmer may be used to precisely calibrate the front panel's upper LED display so a 0 dB INPUT or OUTPUT level is equivalent to any signal level from -15 dBm (138 mV) to +10 dBm (2.45 V).

E. STRAPPING JACK

When a suitable patch cord (Tip/Ring/Sleeve phone plugs on a 2-conductor, shielded cable) joins this connector to the STRAPPING jack on another Model 160X, and when one of the units is switched to SLAVE mode, the two units may then be utilized for processing a stereo program.

F. AC LINE VOLTAGE REQUIREMENT INDICATOR

This recessed indicator displays the nominal AC line voltage for which the 160X has been set at the factory.

G. AC POWER CABLE

Connect this cable to any 50 or 60 Hz AC power source of the correct line voltage, as shown by the AC LINE VOLTAGE Requirement Indicator above. The Model 160X requires a maximum of 12 watts AC power.

WARNING:

Be sure to verify both the actual line voltage and the voltage for which your Model 160X was wired, as indicated on the rear panel of your unit. Connection to an inappropriate power source may result in extensive damage which is not covered by the warranty.

1.4 SPECIFICATIONS

Input Impedance	Signal input: 50 k Ω , unbalanced; 100 k Ω , balanced. Detector input: 230 k Ω , unbalanced; 460 k Ω , balanced.
Input Level	+24 dBm maximum.
Output Impedance	22 Ω , designed to drive 600 Ω or greater.*
Output Level	+24 dBm into 600 Ω or greater.
Threshold Range	Variable from -40 to +20 dBm (7.8 mV to 7.8 V RMS).
Compression Ratio	Over Easy: Program-dependent, affected by THRESHOLD, COMPRESSION RATIO settings (COMPRESSION RATIO control determines maximum compression ratio), continuously variable from 1:1 to ∞ :1 to -1:1. Hard-knee: COMPRESSION RATIO setting defines exact compression ratio, continuously variable from 1:1 to ∞ :1 to -1:1.
Maximum Compression	>60 dB
Threshold Characteristic	Over Easy or hard-knee (switch selectable).
Attack Time ⁽¹⁾	Program-dependent: 15 ms for 10 dB increase in input level (above threshold), 5 ms for 20 dB, 3 ms for 30 dB.
Release Time	Program-dependent; varies automatically from 0-500 ms, affected by settings of front panel controls.
Output Gain	Variable from -20 to +20 dB.
Slew Rate	>10 V/us
Dynamic Range ⁽²⁾	>113 dB
Equivalent Input Noise (unweighted)	<-89 dBm, 20 Hz - 20 kHz.
Frequency Response	+0, -1dB, 20 Hz - 20 kHz.
Distortion Below Threshold ⁽³⁾	2nd harmonic 0.07%; 3rd harmonic 0.07%.
Distortion Above Threshold ⁽⁴⁾	2nd harmonic 0.07%; 3rd harmonic 0.2%
Metering	19 LED INPUT or OUTPUT display from -40 to +20 dB, 12 LED GAIN REDUCTION display from -1 to -40 dB.
Meter Zero Set	-15 dBm to +10 dBm.
Indicators	BELOW/threshold/ABOVE (green, yellow, red), INPUT (red), OUTPUT (red), SLAVE (yellow), BYPASS (red).
Controls and Switches	THRESHOLD, COMPRESSION RATIO, OUTPUT GAIN, DISPLAY function switch, meter zero adjust, BYPASS switch, SLAVE switch, OVER EASY switch.
Connectors	Input/output: TRS phone jacks and barrier terminal. Detector: barrier terminal Strapping: TRS phone jack
Dimensions	1-3/4" H x 19" W x 9-1/4" D (4.4 cm x 48.3 cm x 18.4 cm).
Weight	6.5 lbs (3.0 kg)
Power Requirements	115/220 VAC \pm 10%, 50-60 Hz, 12 W
Accessories	AB-1 active balanced output card.

(1) Measured in the infinite compression region of the threshold curve, time required to reduce signal by 63% of level increase (above threshold).

(2) Defined as the difference between the maximum signal level and the "A" weighted noise floor as measured at the output.

(3) Measured at 1 kHz, 0 dBm input and output.

(4) Figures are typical at infinite compression, 1 kHz, 0 dBm input and output - 2nd harmonic is relatively unaffected by compression ratio, time constants and frequency, while 3rd harmonic decreases with slower time constants, higher frequencies and lower compression ratios.

*Transformer for isolated floating output available directly from:
Jensen Transformers, 10735 Burbank Blvd., North Hollywood, CA 91601. (See Section 2.3.4.)

2.0 INSTALLATION

2.1 UNPACKING AND INSPECTION

The Model 160X was carefully packed at the dbx factory in a carton designed to protect the unit from rough handling. Nevertheless, we recommend careful examination of the shipping carton and its contents for any sign of physical damage which may have occurred during shipment. If damage is evident, do not destroy any of the packing material or the carton, and immediately notify your dbx dealer.

It is a good idea to save all packing materials for effective protection when shipping the unit.

The carton should contain:

- A. The Model 160X Compressor/Limiter ready for rack mounting.
- B. Model 160X Instruction Manual.
- C. Warranty Card.

2.2 MOUNTING

The Model 160X chassis has integral brackets for mounting into a standard 19 in (483 mm) wide equipment rack and occupies a single 1-3/4 in (44.5 mm) rack space. No special ventilation or cooling is required since the unit itself does not generate appreciable heat. However, as with all solid-state signal processing equipment, it should not be subject to excess heat. While the chassis and circuitry are well shielded against radio frequency and electro-magnetic interference, extreme RFI/EMI fields should be avoided.

NOTE: The Model 160X is not equipped with a power ON/OFF switch but instead is designed to be connected to a switched outlet on your equipment rack. Since the 160X draws very little AC power, it can also be plugged into an unswitched AC outlet and left ON at all times.

2.3 INPUT AND OUTPUT SIGNAL CONNECTIONS

2.3.1 From Balanced and Unbalanced Inputs

NOTE: The 1/4" (6.3 mm) phone jacks provided for signal input and output connection are wired directly to the corresponding barrier strip terminals and may be used interchangeably with those terminals.

The Model 160X inputs are balanced electronically by means of differential amplifiers. As such, they will not unbalance a balanced source, and they may be used with unbalanced sources as well.

NOTE: In this manual, a *balanced* line is defined as one which utilizes two-conductor shielded cable wherein both center conductors carry the signal, oppositely polarized, and both have equal but opposite potential difference from ground. An *unbalanced* line generally utilizes single conductor carrying the signal while the shield remains at ground potential.

Figure 2-1 illustrates the connection of balanced signal sources to the Model 160X's SIGNAL INPUT terminals, and Figure 2-2 shows unbalanced sources connected to these inputs.

NOTE: For proper operation when feeding the 160X from an *unbalanced* source, the (-) terminal at the 160X's input must be connected to a (≡) terminal as shown.

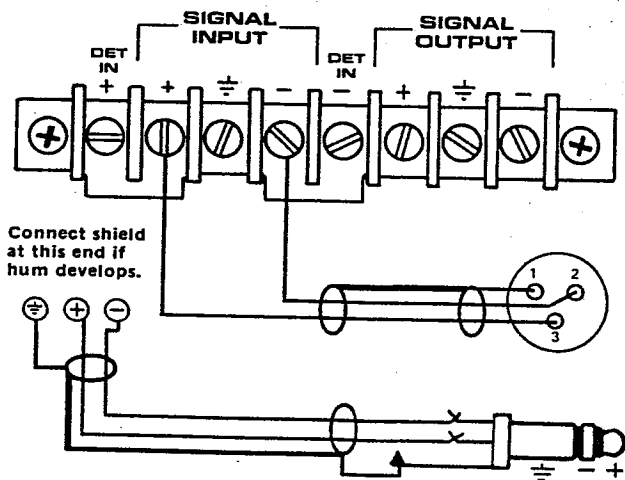


Fig. 2-1 — Connecting Balanced Sources to the Model 160X.
NOTE: 160X input and output 1/4" (6.3 mm) phone jacks are wired directly to corresponding barrier strip terminals.

Fig. 2-2 — Connecting Unbalanced Sources to the Model 160X

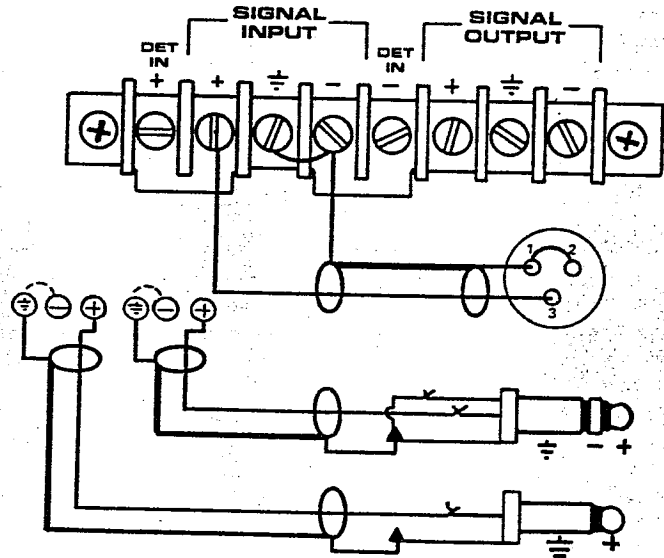


Fig. 2-2A — With Single-Conductor Shielded Cable

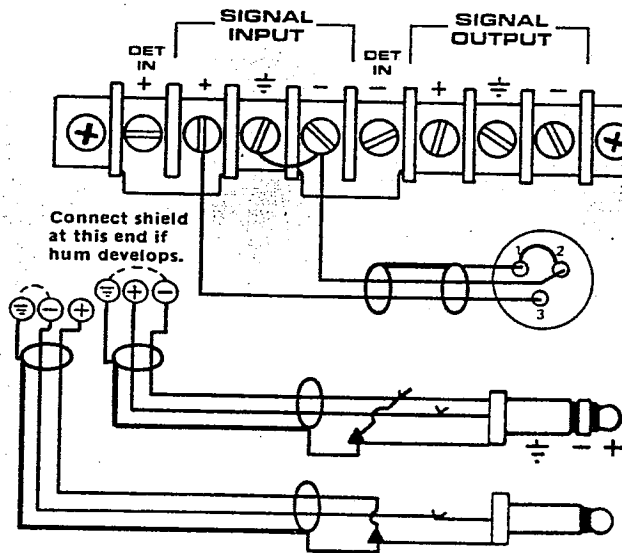


Fig. 2-2B — With Dual-Conductor Shielded Cable
NOTE: 160X input and output 1/4" (6.3 mm) phone jacks are wired directly to corresponding barrier strip terminals.

2.3.2 To Balanced and Unbalanced Outputs

The Model 160X output is driven by an unbalanced, single-ended line amplifier. This output stage will drive up to + 24 dBm into 600 Ω or greater loads and is suitable for connection to most studio equipment, balanced or unbalanced.

NOTE: When using long interconnecting cables between the 160X output and other processing equipment, in very high RFI/EMI environments or in tricky grounding situations, balanced or isolated outputs may be desirable or necessary. In these cases, isolation transformers may be user-installed, as described in Section 2.3.4., or the AB-1 active unbalanced output card may be installed as described in Section 2.3.3.

Figure 2-3 illustrates the unbalanced connection of the Model 160X's SIGNAL OUTPUT terminals to balanced inputs, and Figure 2-4 to unbalanced inputs.

Notice that the output has signal high (+), low (-) and ground (\equiv) terminals, just as with the balanced inputs. The 160X's signal output is connected directly to its signal input in BYPASS mode, so these terminals permit a balanced input to remain balanced at the 160X's output when the unit is bypassed. Further, when the AB-1 active balanced output card or Jensen 123-S type output isolation transformer is installed (Section 2.3.3 and 2.3.4) the terminals provide standard balanced connections. As delivered from the factory (unbalanced output), the low (-) terminal and ground (\equiv) SIGNAL OUTPUT terminals are internally connected when the Model 160X is not in BYPASS mode.

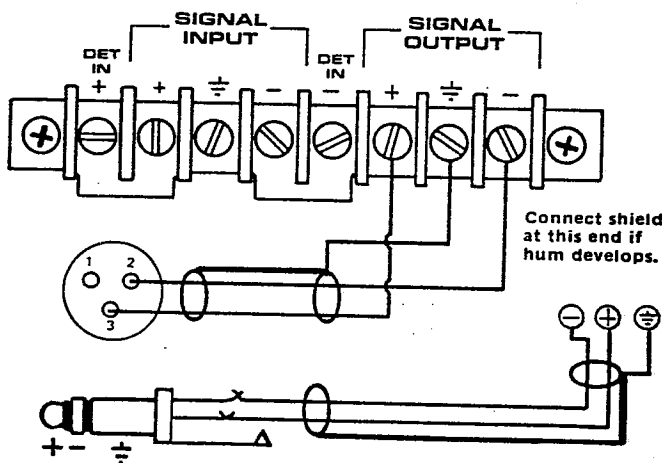


Fig. 2-3 — Connecting the Model 160X's Output to a Balanced Load

NOTE: 160X input and output 1/4" (6.3 mm) phone jacks are wired directly to corresponding barrier strip terminals.

Fig. 2-4 — Connecting the Model 160X's Output to an Unbalanced Load

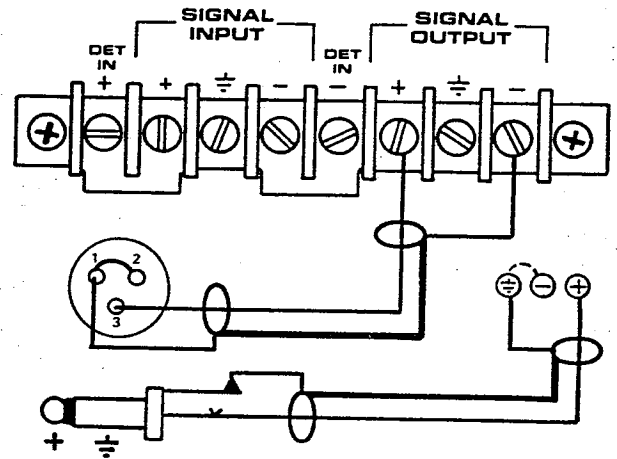


Fig. 2-4A — With Single Conductor Shielded Cable

NOTE: If used with AB-1 card, connect shield to (\equiv) instead of (-) when using single conductor cable.

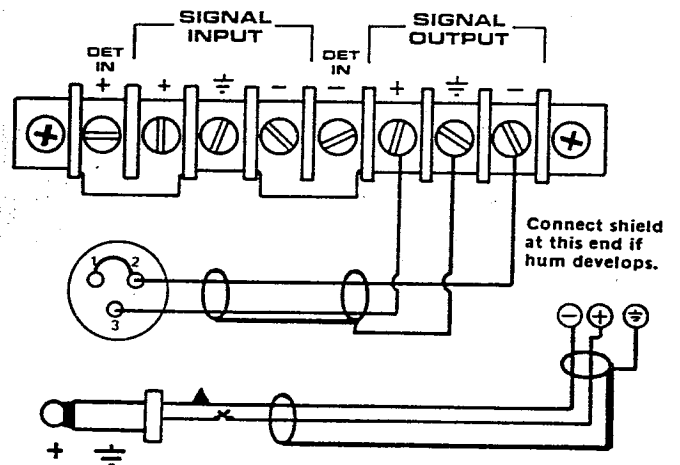


Fig. 2-4B — With Dual Conductor Shielded Cable

NOTE: 160X Input and Output 1/4" (6.3 mm) phone jacks are wired directly to corresponding barrier strip terminals.

2.3.3 Installing Optional AB-1 Balanced Output

The Model 160X is designed to accept the dbx Model AB-1 active balanced output card for those situations in which a balanced output drive is desired. To install the AB-1, follow the procedure below.

CAUTION

Dangerous AC voltages exist inside the Model 160X. Only qualified service technicians should perform the following procedure.

1. Unplug the Model 160X from the AC mains.
2. To open the unit for access to the main circuit board, first remove the screws securing both rack ears, and set them aside.
3. Next, remove the remaining screws, which secure the top cover to the chassis.
4. Locate the jumpers (JP108 and JP110) in the positions shown at the rear of the 160X main circuit board, and cut or unsolder and remove them.
5. Referring to Figure 2-5, find the location on the 160X main circuit board where the AB-1 plugs in. Insert the AB-1 into its Molex connector oriented with the hole in the AB-1 circuit board positioned over the spacer, which will act as a support for it.

6. Using the machine screw provided with the AB-1, fasten the AB-1 to the spacer.

7. Reverse the disassembly procedure (steps 1 and 2) to attach the top cover and rack ears.

8. The Model 160X output stage is now actively balanced. It is suggested that the rear panel be marked accordingly to distinguish it from a stock 160X.

NOTE: Model 160X's active balanced output is now ground referenced and SHOULD NOT BE OPERATED WITH THE (+) OR (-) SIGNAL OUTPUT TERMINAL CONNECTED TO THE (\equiv) TERMINAL (increased distortion will result). Unbalanced loads can be connected between either the (+) or (-) SIGNAL OUTPUT terminal and (\equiv).

The gain of the 160X has been adjusted during the AB-1 installation procedure so that a balanced input and a balanced load will see unity gain through the unit when it is operating in the below-threshold region with the OUTPUT gain set at 0 (i.e., no gain change being performed). If an unbalanced load is connected to the (+) or (-) SIGNAL OUTPUT terminal and the (\equiv) terminal, a 6 dB loss in gain will occur. This can be compensated for by adjusting the OUTPUT gain control to add 6 dB of gain under that circumstance.

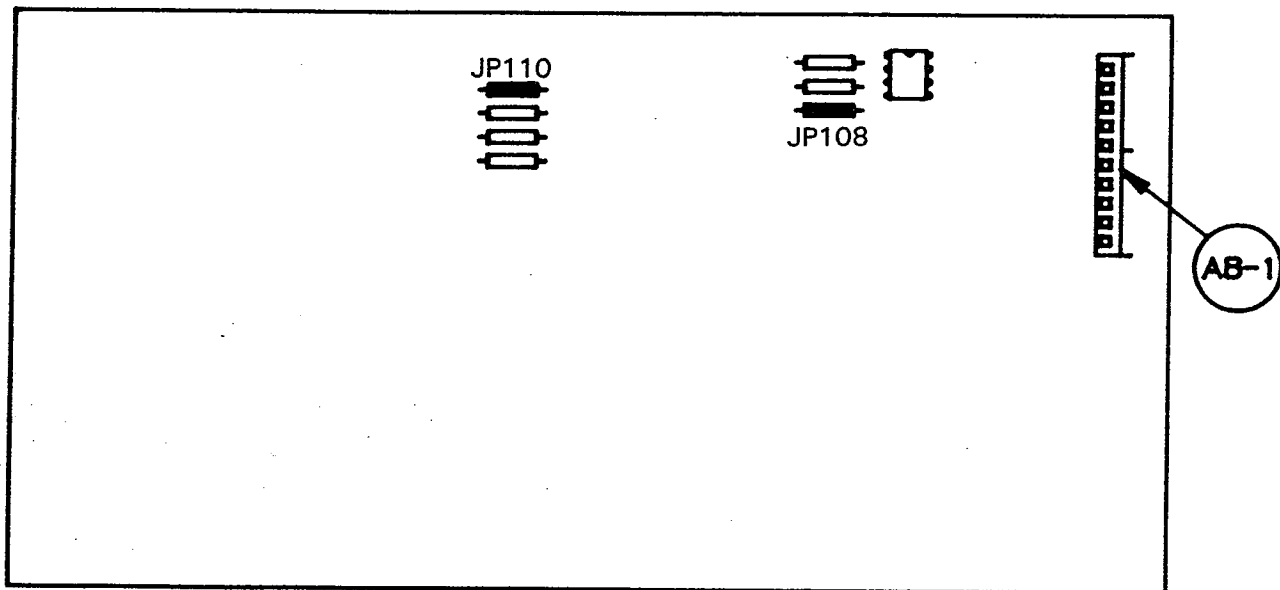


Fig. 2-5 - Model 160X Main Circuit Board
Note location of Molex Connector for mounting AB-1.

2.3.4 Installing Output Isolation Transformer

The 160X main circuit board is drilled to accept the Jensen Model JE-123S-PC or JE-123S-LPC transformer. These were selected because they do not degrade the Model 160X's outstanding electrical performance. Both models have a 1:1 turns ratio; however, the JE-123S-PC has a steel core, and is capable of handling slightly higher maximum levels before saturation, whereas the somewhat more costly JE-123S-LPC has a nickel core which handles a bit less level but which keeps distortion very low. Under worst case conditions (saturation at 20 Hz) the JE-123S-LPC handles +24 dB maximum level (1% THD), dropping to less than 0.03% THD at 20 dB below saturation. Distortion is further cut roughly by 1/2 for each octave higher in frequency. The bandwidth is greater than 350 kHz (350,000 Hz) and there is less than 2° of phase shift at 20 kHz. These transformers are manufactured and available directly from Jensen Transformers (for address see the Specification Section).

The addition of either transformer provides a balanced, floating output stage. *dbx recommends installing transformers only when an isolated output is needed.* (The JE-123S-LPC is preferred due to its lower distortion.) To do so, follow the procedure given below.

CAUTION

Dangerous AC voltages exist inside the Model 160X. Only qualified service technicians should perform the following procedure.

1. Unplug the Model 160X from the AC mains.
2. To open the unit for access to the main circuit board, first remove the screws securing both rack ears, and set them aside.

3. Next, remove the remaining screws, which secure the top cover to the chassis.

4. Referring to Figure 2-6, find the location on the 160X's circuit board for the mounting location of the transformer. Within the transformer-mounting area are two jumpers (JP101 and JP102). Cut or unsolder these jumpers.

5. Insert the transformer from the top side of the board, pressing its pins firmly into the socket cups provided. The JE-123S-PC and -LPC are symmetrical (primary and secondary windings are identical), so orientation on the 160X circuit board is not critical; if the pins line up, they are correctly installed.

6. Reverse the disassembly procedure (steps 1 and 2) to attach the top cover and rack ears.

7. The Model 160X output is now balanced and floating, since there is no ground reference. It is suggested that that rear panel be labeled accordingly, indicating that a balanced, floating output is installed.

NOTE: Wiring diagrams Figure 2-3 for balanced loads and Figure 2-4 (A) for unbalanced loads will provide optimum performance from the isolated output stage.

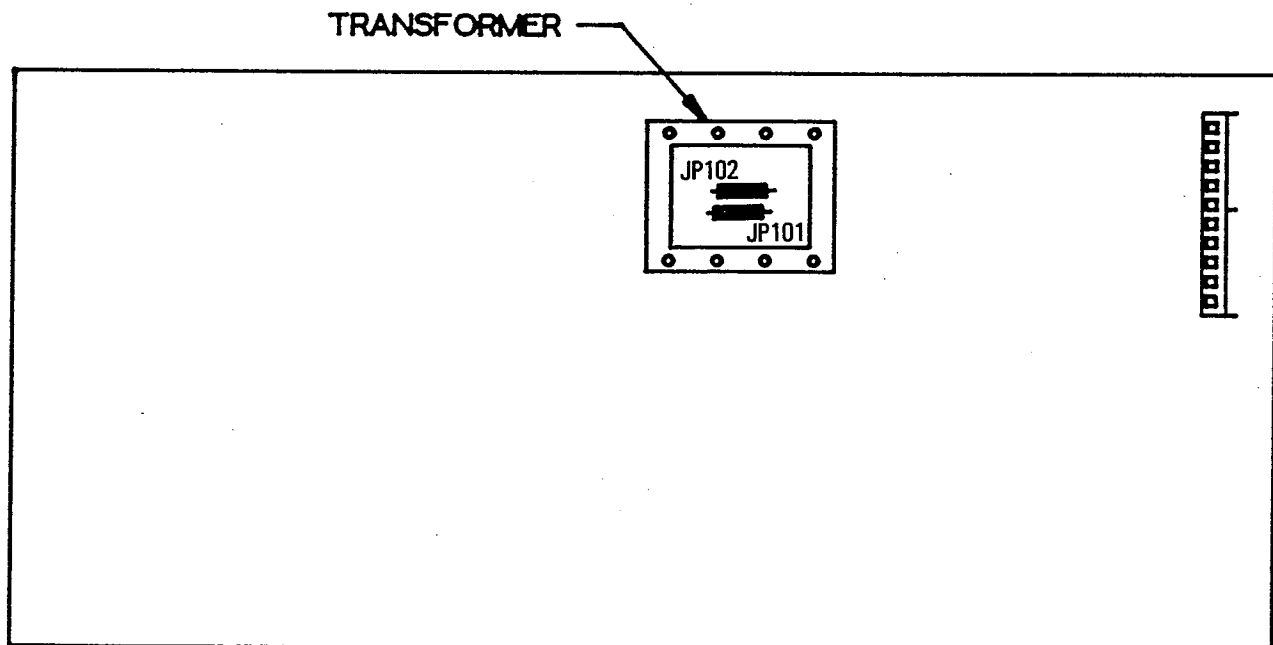


Fig. 2-6 – Model 160X Main Circuit Board

Note pre-drilled location for mounting Jensen JE-123S-PC or JE-123S-LPC transformer.

2.3.5 Level Detector Input

For normal compressor/limiter operation, leave the factory-installed straps connected between the DETECTOR IN (+) and the SIGNAL INPUT (+) terminals and the DETECTOR IN (-) and SIGNAL INPUT (-) terminals. To gain access to the 160X's detector circuitry for insertion of an auxiliary device, remove the strapping and wire the auxiliary device's output to the 160X's DET IN terminals. Feed the auxiliary device's input with the same signal fed to the 160X's SIGNAL INPUT. Follow the wiring and grounding suggestions given in section 2.3.1. In certain situations, the auxiliary device may need to be inserted in the signal path, not in the detector path. In such cases, signal is fed to the input of that device, and also to the DETECTOR INPUT, and the auxiliary device's output is fed to the 160X SIGNAL INPUT.

For convenience, we recommend wiring an additional Tip/Ring/Sleeve phone jack in your patch bay to the 160X DET IN terminals, with normalling contacts wired to the SIGNAL INPUT

terminals as shown in Figure 2-7. When the separate detector is not needed, simply remove the plug from the detector input jack in your patch bay and the SIGNAL INPUT will be automatically jumpered to the detector.

2.4 STEREO STRAPPING

When you wish to link two Model 160Xs for processing a stereo program, a patch cable must be connected between the STRAPPING jacks on the two units. Use a standard 1/4 in (6.3 mm) Tip/Ring/Sleeve patch cord, or wire one as shown in Figure 2-8. Be sure to use shielded cable.

Once the cable is connected to the two 160Xs it may be left in place at all times. When both units' SLAVE switches are disengaged (button OUT), the 160Xs operate completely independently; stereo operation is achieved simply by depressing the SLAVE switch on either unit (SLAVE LED turns ON).

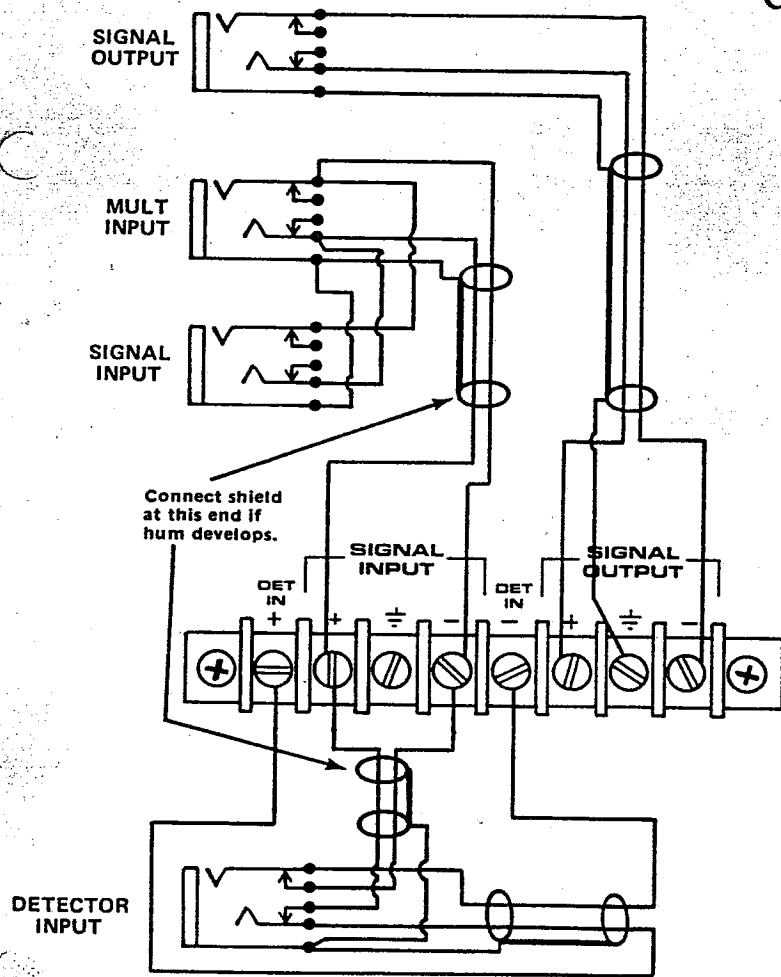


Fig. 2-7 - A Normalling Phone Jack for Convenient Plug-In Access to the Detector Input

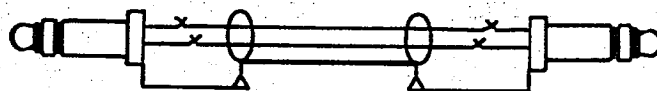


Fig. 2-8 - Stereo Strapping Cable

3.0 OPERATION

3.1 OUTPUT CONTROL

This control sets the amount of fixed gain in the 160X's output stage over a range of ± 20 dB. Fixed gain added or subtracted by the OUTPUT control from signal passing through the 160X is not affected by the setting of the THRESHOLD control. Gain changes brought about when the input signal exceeds the THRESHOLD reference setting are in *addition* to those caused by the OUTPUT control.

3.2 THRESHOLD CONTROL

In hard-knee mode this control sets a reference level above which input signals will be processed by the 160X's gain change circuitry in the manner defined by the setting of the RATIO control. Input signals which fall below this level will pass through the 160X unprocessed (except for fixed gain changes directed by the OUTPUT control).

In Over Easy mode, signals begin to gradually activate the 160X's gain change circuitry as they *approach* the THRESHOLD reference level and they do not get fully processed in the manner defined by the RATIO control until they have passed somewhat above the THRESHOLD

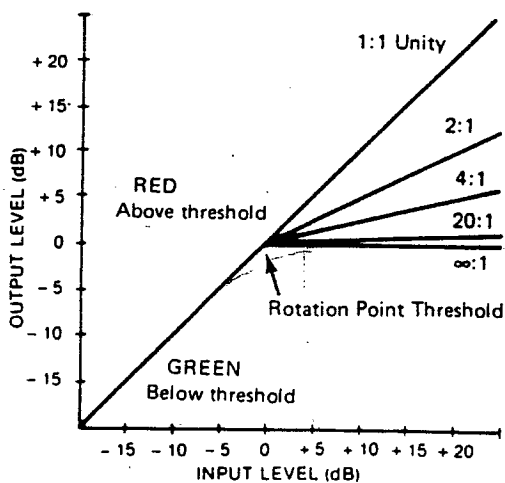
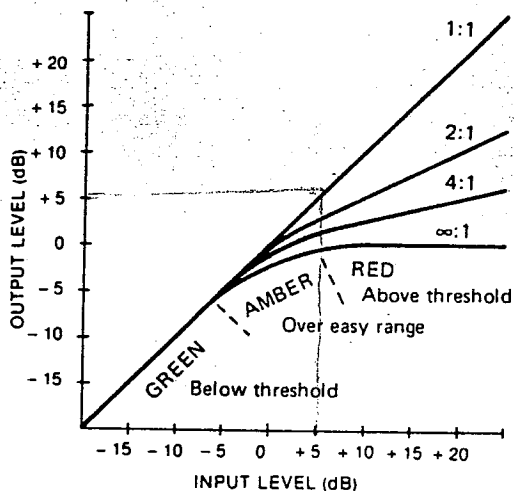


Fig. 3-1 - Over Easy vs. Hard-Knee Compression

reference level. In Over Easy mode there is no distinct point at which processing begins, and the THRESHOLD setting corresponds to a point on the input/output transfer curve midway between the onset of processing and that point at which the transfer curve corresponds to the setting of the RATIO control (Figure 3-1).

NOTE: The THRESHOLD setting relates to the signal level seen by the DETECTOR input. In normal operation, the program signal input is connected directly to the detector input. If this is not the case, the signal actually present at the detector input will determine whether and how the 160X processes the signal coming into its SIGNAL INPUT.

3.3 RATIO CONTROL

When an input signal is above the THRESHOLD reference level, the setting of this control determines the number of dB by which the input signal must change in level to produce a 1 dB increase in the signal level at the output of the 160X. A setting of 2:1 indicates an input:output ratio wherein a 2 dB increase in input signal (above threshold) will produce a 1 dB increase in output signal. A setting of $\infty:1$ indicates that an infinite increase in input level would be required to raise the output level by 1 dB.

The 160X's RATIO control covers the entire range from 1:1 to $\infty:1$ and, in addition, goes to Infinity+ (negative) ratios. At a setting of -1:1, the above threshold input signal must *decrease* by 1 dB in level to *increase* the signal at the output of the 160X by 1 dB.

The control curve of the RATIO potentiometer has been designed to provide total operator control, with scale expansion at the subtle lower ratios for easy, repeatable settings.

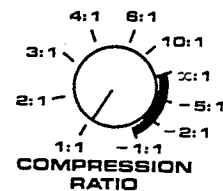


Fig. 3-2B - Ratio Control

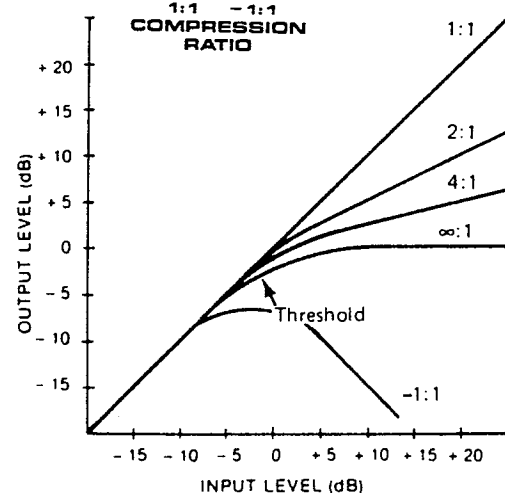


Fig. 3-2A - Typical Transfer Curves

Fig. 3-2 - Ratio

3.4 STEREO STRAPPING

Two channels of program material do not necessarily constitute a stereo program. A stereo program is one where the two channels are recorded and/or mixed to create the illusion of a single, unified "panorama" of sound. The stability of the psychoacoustic "image" of each sound source within the stereo program depends upon its ability to maintain a specific phase and amplitude relationship from left to right channel.

If two independent compressors are used to process the stereo program, a loud sound occurring in one channel will cause a gain reduction only in that channel. This gain reduction would cause the perceived image of any sound spread between the two channels to move toward the side which had not been compressed, because the spread signal would be momentarily softer in the compressed channel. This can be avoided by linking the two compressors in such a way that both channels receive the same amount of compression — an amount equal to the maximum "needed" by either channel at that moment. On the 160X, this is accomplished by means of the STRAPPING jacks; a cable between these jacks permits the RMS detectors of both units to "talk" to one another — but only when one of the units' SLAVE buttons is depressed. Each compressor then senses the incoming signal level, which is compared to the threshold set on the master (the unit whose SLAVE button is *not* depressed). If the compression is required by *either* channel, both channels are subject to compression — the same amount of it — so the stereo image remains stable.

When compressing a stereo program with a pair of 160Xs, only the master unit controls need be adjusted.

3.5 METER CALIBRATION

The INPUT/OUTPUT LEVEL DISPLAY in the 160X is factory-calibrated to indicate "0" when the signal level is +4 dBm (1.23 V) at either the input or output of the 160X, depending on the DISPLAY function switch position. (The METER CALIBRATION control does not affect the GAIN CHANGE LEDs.)

To recalibrate the LEVEL DISPLAY, depress the DISPLAY button to meter the INPUT LEVEL, and feed a 1 kHz signal at the selected nominal operating level (the level desired for a "0 dB" meter indication) to the 160X's SIGNAL INPUT. Then adjust the rear panel METER CALIBRATION control until the meter indicates "0 dB."

4.0 TYPICAL APPLICATIONS

4.1 SMOOTHING VARIATIONS IN VOCAL LEVEL

When the distance between a vocalist and a microphone changes, variations in signal level occur. Start with the 160X adjusted for low compression (around 2:1) and adjust the THRESHOLD control for optimum results, then increase RATIO if necessary.

4.2 SMOOTHING VARIATIONS IN INSTRUMENT LEVEL

To achieve a smoother electric-bass sound, compress the instrument's output with a ratio of about 4:1. Compression lessens the loudness variations among the strings and increases the sustain. Other instruments, such as horns, vary in loudness depending on the note being played, and benefit similarly.

NOTE: When compressing a stereo program with a pair of 160Xs, the factors affecting a compression curve, and the actual compression and threshold settings, are like those previously covered with reference to single channels of program material. However, it will generally be found that large amounts of compression are more audible in a mixed stereo program than they might be on the separate tracks that were mixed to create the program.

4.3 RAISING A SIGNAL OUT OF A MIX

Since reducing dynamic range increases the *average* signal level and meter readings by a small amount, a single track can be raised out of a mix by boosting its level slightly and applying compression. It is also possible to separate certain vocals or instruments from a mono program already mixed by following the procedure in Section 4.6.1.

4.4 PREVENTING TAPE SATURATION

With programs of widely varying levels, compression can prevent recording levels from saturating tape tracks (see also Section 4.7.1).

4.5 SPEAKER PROTECTION

Compressors are frequently used to prevent excessive program levels from damaging drivers in a sound-reinforcement system. Limiting also benefits intelligibility by allowing low-level input signals to be reproduced through the system at higher volume. In a musical performance, this provides additional intimacy as the vocalist's whispers are heard clearly at each seat in the house. The Over Easy curve utilized by the 160X permits a very high amount of compression (10:1 or greater) to be used in many situations. Vocalists and musicians don't get the sense of being "choked back", but high average levels can be maintained without the speaker damage which would normally occur due to excessive heat buildup in the drivers.

In circumstances where the 160X is expected to cause no change in gain unless an emergency arises (wildly excessive levels) some operators set the RATIO to $\infty:1$, the THRESHOLD to the highest permissible level, and operate the unit in hard-knee mode. (In hard-knee mode, the 160X will perform in the manner of its predecessor, the 160.) As a general rule, the compressors should be *as close to the amplifiers as possible* in the signal chain. If the 160X is placed before the EQ, for example, a potentially damaging boost in EQ won't be seen by the unit and the speakers may be damaged. (See Section 4.6.2.) For maximum sound-pressure levels, large sound-reinforcement systems frequently use a separate compressor on each output of the electronic crossover(s). For a stereo sound-reinforcement system, stereo strapping cables should be run between the 160Xs in each band (low-low, mid-mid, etc).

4.6 INFINITY+™ COMPRESSION

It has been noted that with a full-scale Infinity + setting of -1:1, a 1 dB *decrease* of input level above THRESHOLD causes a 1 dB *increase* of output level. It can be seen how this differs from the full counter-clockwise setting of 1:1, where the transfer function is linear (e.g., a 1 dB *decrease* of input level causes a 1 dB *decrease* of output level).

A total dynamic reversal of the entire program being processed will not occur unless the THRESHOLD is set very low (e.g., -40 dBm) and all the program material falls above the threshold level. More often, some of the program input will be below threshold, and will therefore have normal dynamics — that is, the output level will change linearly with changes of input level. As the input level rises above threshold, however, the output level will begin to decrease. The audible results will differ with different types of program material and different settings. With instruments having fast attack times, such as a picked guitar, a harpsichord, or a drum, a low threshold will all but eliminate the attack transient. Interesting effects can be obtained by setting a moderate threshold with instruments with a slower attack, such as wind instruments or bowed strings; the level will build normally up to the threshold, then begin going lower, the output will become very quiet as the instrument is generating its loudest sound, perhaps quieter than when the note first began.

4.7 USING THE DETECTOR INPUT

4.7.1 Detector EQ For Signal Enhancement

It is possible to separate certain vocals and instruments from a mix by frequency-weighted compression. With an equalizer inserted ahead of the detector input (but not in the audio path), the equalization settings do not shift the timbre or frequency response of the audio signal. They merely alter the threshold response of the com-

pressor on a "frequency-weighted" basis (see Figure 4-1). With this arrangement, raising certain frequencies on the equalizer causes them to be suppressed in the audio signal. A relatively high threshold setting can allow normal sounds to be unaffected while solo and very loud sounds are held back. (Of course, when compression does occur, the level of the entire program is affected.) Depending on the threshold setting, lower-level fundamentals or harmonics will not cause compression, and the program is not subject to the phase shift normally caused by program equalization.

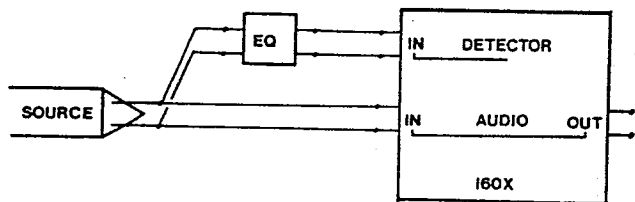


Fig. 4-1 - EQ In Detector Path

The converse of the above EQ technique may also be used; dipping the equalizer bands causes any sound with dominant energy in the affected register to pull the level up because the 160X will detect less need for compression.

During the recording of cymbals and tom-toms, a compressor with an equalizer in the detector path can help prevent tape saturation. The equalizer can be adjusted for boost with a peak of about 5 kHz, causing the cymbal to be compressed on a very loud crash, stopping tape saturation at high frequencies where there is less headroom. However, gentle tapping of a drumstick or brushing of the cymbal will not be held back. Assuming the tom-tom is a lower-frequency instrument and can be better tolerated by the tape, it has less need for compression. The equalization in the detector circuit means that the compressor is not triggered as readily by a loud tom-tom beat as by an equally loud cymbal crash.

In the absence of a more sophisticated de-esser, small amounts of high-frequency boost in the detector path can frequently help in the processing of vocals which have been very brightly equalized or which suffer from a prominent "ess" sound.

4.7.2 Detector EQ For Speaker Protection

If a single compressor is to be used with a multi-way speaker system (i.e., before the crossover, after EQ), the system operator is faced with the problem of keeping the entire system level down below the point of destruction of the most sensitive component. If, for example, mid-range drivers are frequently damaged, the whole system must be operated at a lower sound pressure level or additional mid-range drivers must be added. By inserting an equalizer in the detector path of the 160X, it can be made *more sensitive* to frequencies in the range handled by the sensitive drivers. The system can then be run at higher average levels and will only be dropped back when damaging signals are present.

4.7.3 Detector EQ For Broadcast

By inserting a pre-emphasis filter network in the detector path of a 160X processing pre-emphasized audio, higher average signal levels can be run within the headroom limitations of the broadcast chain.

4.7.4 Anticipatory Compression

By feeding the program directly to the 160X's detector input and sending the audio signal through a delay line before the audio input, the unit can "anticipate" the need for a gain change; see Figure 4-2. With some experimentation, the effect can be that of "zero" attack time at a given frequency. Additional signal delays beyond this "zero" time will then cause the compressor to finish reducing the gain before the leading edge of the loud passage even enters the signal input. This will suppress the program material preceding the loud passage. The 160X will then begin to recover from compression (release) before the loud passage has dropped back down toward the set threshold. This will cause the output level to surge higher as the note or passage should be decaying. This special effect obtained with time delay sounds similar to the inversion of dynamic envelopes produced during reverse playback of a tape recording. When coupled with Infinity+ compression, highly unusual effects can be achieved.

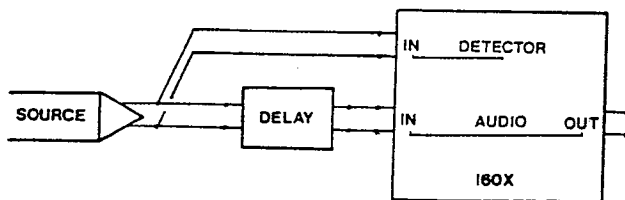


Fig. 4-2 - Delay In Signal Path

5.0 TECHNICAL INFORMATION

5.1 BLOCK DIAGRAM

