BEFORE PROCEEDING WITH COMPLETE UNPACKING AND SETUP
PLEASE READ THE SECTION ON UNPACKING AND INSPECTION

UREI
ELECTRONIC
PRODUCTS

# model 7110
# LIMITER/COMPRESSOR

JBL Incorporated
8500 BALBOA BOULEVARD
P.O. BOX 2200
NORTHRIDGE, CA. 91329 USA
PHONE: ( 818 ) 893-8411
TELEX: 4720424

# Table of Contents

# Section One Introduction

## 1.1 Preface

Thank you for purchasing this JBL/UREI product. We have prepared this instruction manual to enable you to achieve optimum utility and performance from your new Limiter/Compressor. We encourage you to read and to make use of the material contained in this manual. We welcome your suggestions and comments on our products and on this manual.

This manual is dedicated to all the people who are interested in learning about the capabilities and limitations of our products in order to best use them. Learn, Enjoy and Share.

## 1.2 Unpacking and Inspection

Your new JBL/UREI Limiter/Compressor was carefully packed at the factory, and the container was designed to protect the unit during shipment. Nevertheless, we recommend careful examination of the shipping carton and its contents for any sign of physical damage which may have occurred in transit.

If damage is evident, do not destroy any of the packing material or the carton, and immediately notify the carrier of a possible claim for damage. Damage claims must be made by you.

The shipping carton should contain:

The JBL/UREI Model 7110 Limiter/Compressor

This Instruction Manual

An envelope containing Rack Mounting Hardware

## 1.3 About this Manual

The diagrams and information on the following few pages provide an overview of the controls, indicators and connectors of the Model 7110 Limiter/Compressor. For those already experienced in the use of Compressors and Limiters, these few pages should be enough to get you "up and running." Additional detailed information follows in the Installation, Operating/Application, and Theory of Operation sections. No matter what your level of expertise, we encourage you to look through this manual to gain a better understanding of how this product works, and how it will help you with the task at hand.

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Note: In this manual, unless otherwise specified, 0 dBu is equivalent to 0.775 volts and 0 dBm is one milliwatt in a circuit with a load impedance of 600 ohms.

## 1.4 Front Panel

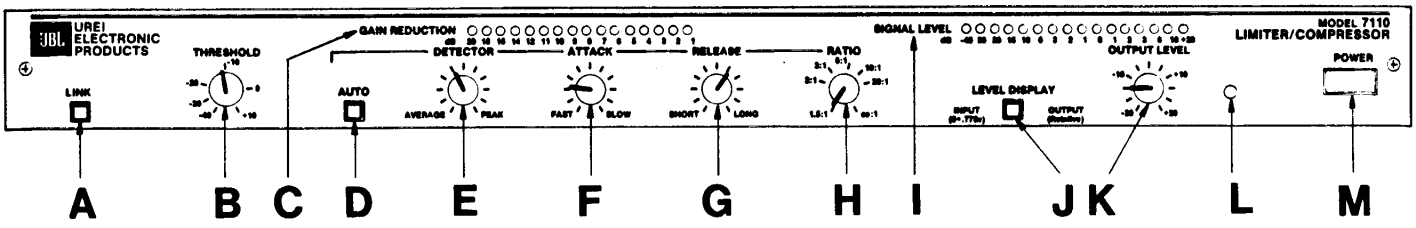


Figure 1 - The Front Panel

### A. LINK Switch

Depress this switch to strap multiple units together for gain reduction tracking. An LED indicates that the switch is depressed. See Section 3.5.

### B. THRESHOLD Control

Adjusts the level at which gain reduction begins.

### C. GAIN REDUCTION Display

16 Segment LED display indicates the amount of gain reduction in dB.

### D. AUTO Switch

Auto ON presets the Detector, Attack and Ratio controls and engages a program dependent Release circuit. An LED indicates that the switch is depressed.

### E. DETECTOR Control

Adjusts the peak detector threshold from 0 to 20 dB above the average detector threshold.

### F. ATTACK Control

Adjusts the attack time of the average detector from 1 millisecond at full CCW rotation to 50 milliseconds at full CW rotation.

### G. RELEASE Control

Adjusts the release time constant from 50 milliseconds to 2 seconds for 10 dB of release.

### H. RATIO Control

Controls the relationship of the change in input level to the change in output level.

### I. SIGNAL LEVEL Display

16 segment LED display indicates input or output level.

J. LEVEL DISPLAY Switch

Switches the signal level display to show either Input or Output Level. Two LEDs indicate the switch position.

K. OUTPUT LEVEL Control

Changes output level ±20 dB.

L. Output Level Reference Trim

Front panel adjustment of "zero reference" for the output level display. "0" may be set from -10 to +8 dBu. See Section 2.8.

M. Power Switch

Push to turn the unit on. Push again to turn the unit off. One or more status indicator LEDs will be on when the unit is powered up. After the power is switched on, there is a 3 second delay before any processed signal is passed through the unit. During this time, and at any time power is off, the input signal is passed directly to the output.

## 1.5 Rear Panel

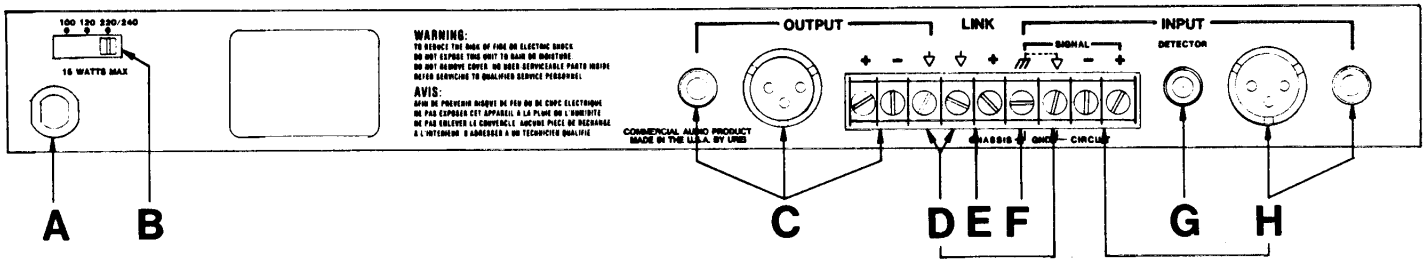


Figure 2 - The Rear Panel

A. AC Line Cord

B. Line Voltage Select Switch (7110EX export model only)

Selects Line Voltage of nominal 100, 120 or 220/240 VAC. See Section 2.1.

C. Output

The unbalanced output is available at the male XL- type connector, the 1/4 inch phone jack and/or at the terminals of the barrier strip. The output may be converted to floating, balanced with an optional output transformer. See Section 2.5 for pinout and 2.10 for instructions on installing the optional transformer.

D. Signal Ground

The signal ground is available at the output terminal strip (GND), at the input barrier strip, at the ring and sleeve of the phone jacks and pin 1 of the XL connectors. This is the ground common to all the internal analog circuitry.

E. Link

Two or more 7110s may be linked together for gain reduction tracking through the Link terminal. This is a high impedance point, and shielded cable should be used. See Section 3.5.

F. Chassis Ground

The chassis ground is connected to the mechanical ground pin of the AC line plug, and is connected to signal ground (GND) via a 1000 ohm resistor, a 0.1 microfarad capacitor, and a removable barrier strip jumper, all in parallel. The jumper may be removed if it is necessary to isolate signal ground from chassis ground. See Section 2.2.

G. Detector

This is the input to the Gain Reduction detector and is normalled from the audio input connectors. Balanced or unbalanced signals may be connected through the 1/4 inch phone jack in the same manner as normal audio signals. Tip is "+", ring is "-" and sleeve is ground. See Section 3.6.

H. Input Signal

The input signal can be applied at the female XL-type connector (pin 3 "+", pin 2 "-"), the 1/4 inch phone jack (tip is "+", ring is "-" and sleeve is ground), and/or at the "+" and "-" terminals of the barrier strip. Either balanced or unbalanced inputs are acceptable.

## Section Two Installation

### 2.1 AC Power Connection & Line Voltage Conversion

There are two versions of the Model 7110. The standard 7110 can be powered from nominal 120 VAC, 60 Hz mains as found in the USA. The 7110 has no Supply Voltage Select Switch on the rear panel, and may be plugged into any standard 120 VAC grounded receptacle.

The 7110EX export model is equipped with a three-position Supply Voltage Select Switch on the rear panel which allows operation from AC Mains Voltages of 100-240 VAC 50-60 Hz found in other areas of the world. As shipped, the 7110EX is set for 220 to 240 VAC operation, and the line cord provided is the parallel-blade U-ground as found in the USA or Canada. To convert the unit for operation with other mains voltages or outlet types, use the following procedure:

1. Be sure the 7110EX is not connected to any power source.

2. Slide the Supply Voltage Select Switch to the appropriate range.

3. Install a suitable plug or adaptor to mate the existing line cord with the power receptacle. The 7110EX line cord uses IEC Standard color code in which Brown is Line, Blue is Neutral, and Green/Yellow is Mechanical Ground.

**Caution: This unit may be damaged if operated with the Supply Voltage Select Switch set incorrectly for the line voltage applied. Also, verify that the mains are AC since, in some countries, DC mains exist.**

## 2.2 Grounding

For safe operation the 7110 must be connected to a good mechanical ground. This provides a current path for any voltage which might appear on the chassis due to a severe electrical fault in the Limiter/Compressor. Without this path the unit might be a shock hazard. In addition, a good quality ground on the chassis provides shielding from external fields and minimizes radiation of internal fields to the outside world. To comply with safety regulations in many localities, and to protect our customers, we provide this product with a ground connection through a three-wire power cord.

In many situations this will present no problem. But there are instances where a hum or buzz will be introduced due to a phenomenon known as a ground loop. This results when there is a significant potential between the audio ground of the previous piece of equipment and the mechanical ground to which the 7110 has been connected.

If this is the case, the first attempt at a solution should be to remove the strap on the rear panel barrier strip which connects audio ground and chassis. Removal of this strap may have a significant effect on reducing the hum. Audio ground will then be referenced from the signal source, and the chassis ground will be separate but still connected to mechanical ground for shock protection.

In some instances the voltage difference between the grounds will be so great that a direct connection to mechanical ground is not possible without hum in the output. Use of an isolation transformer in the input signal line may allow the signal to be connected while maintaining ground isolation. Check for this using a 3 prong to 2 prong AC adaptor between the power cord and the power outlet, temporarily ungrounding the unit. Try the 7110 both with and without the ground strap on the barrier strip. Determine which connection works best. Remember, for safety you must still have a connection to chassis ground. This is normally made through a properly grounded third pin connection.

## 2.3 Mounting

Rack mount your Limiter/Compressor with the enclosed rack mounting hardware. The 7110 is equipped with rack ears which may be moved forward to allow the controls to be recessed and/or the optional security cover mounted flush with the front of the rack ears. If you wish to take advantage of this feature, remove the four screws which attach each rack ear to the chassis, and remount the rack ears using the four holes farthest toward the front of the chassis.

The Model 7110 will operate satisfactorily over a range of ambient temperatures from 0° C to +50° C ( +32° F to +122° F ), and up to 80% non-condensing relative humidity.

If the unit is installed in an equipment rack, console or other area along with high heat producing equipment (such as power amplifiers), adequate ventilation should be provided to assure longest component life. Also, while internal circuitry susceptible to hum pickup is sufficiently shielded from moderate electromagnetic fields, avoid mounting the unit immediately adjacent to large power transformers, motors etc.

## 2.4 Input Connections

The 7110 will not unbalance floating or balanced output sources, since the input circuits consist of balanced, differential amplifiers. Balanced wiring is the preferred style, especially when running long lines, due to the ability of a balanced input to reject signals (such as hum fields) which are induced equally into both of the signal carrying conductors. Even if the previous piece of equipment has an unbalanced output it may be advantageous to wire it to the input of the 7110 as though it were balanced. This takes advantage of the ability of the input to reject common-mode noise. Wire the connectors according to the table below.

Table 1 Balanced Input Wiring

| Signal | XL Pin # | Phone Jack | Barrier Strip |
|---|---|---|---|
| High | 3 | Tip | + |
| Low | 2 | Ring | – |
| Ground | 1 | Sleeve | GND |

To use an unbalanced source, wire the signal carrying conductor of the cable from that source to the "+" terminal of the barrier strip, phone jack tip or XL connector pin 3, and wire the shield to the "-" terminal of the barrier strip phone jack ring or XL connector pin 2. The unused barrier strip terminal, phone jack sleeve or XL pin 1, may also also be connected to shield ground if that is compatible with your system grounding. (See the section on Grounding.)

We recommend that two-conductor shielded cable be used, even in an installation using unbalanced wiring. Do not depend on the shield wire itself to complete the signal connection. Stranded shield wires are more subject to breakage, especially in portable installations, than the more protected internal insulated wires. Using this wiring system, the worst that would happen with a broken shield would be a rise in noise or hum due to the lack of shielding. If the ground connection were completely lost, this would result either in loss of audio or a terrible loud hum.

## 2.5 Output Connections

The 7110 outputs are unbalanced, delivering up to 10 Volts rms into a 600 ohm or higher impedance load (+22 dBu). The output is available at three points on the rear panel by way of a barrier strip, 1/4 inch phone jack or an XL connector. Wiring is: Output on Pin 3 of XL, tip of phone jack and "+" terminal of the barrier strip; Audio Common to Pin 1 and 2 of the XL, ring and sleeve of the phone jack and "-" and GND terminals of the barrier strip.

## 2.6 Using Floating or Balanced Cables for Longer Runs

Shielded cables are required for all input and output signals. If the output cable lengths are greater than 4.5 m to 6 m (15 to 20 ft), consider installing isolation transformers (600 ohm:600 ohm) at each end of the cable. This allows dual-conductor shielded cable to be used in a floating mode, greatly reducing the possibility of radio frequency interference (RFI) or hum. If the equipment to which the 7110 output is connected has a balanced or floating input, only one transformer need be installed . An accessory output transformer is available for the 7110 which wires directly to the circuit board inside the unit. See Section 2.10 for details of installation and wiring.

Similarly, longer input cables should be balanced or floating to reduce susceptibility to RFI and hum. If the output of the device feeding the 7110 is balanced or floating, no transformer is required at all; simply use a dual-conductor shielded cable. If the input source is unbalanced, an isolation transformer should be used at the source device's output.

With shorter cables, particularly where interconnected equipment is mounted in a single rack or is powered by the same AC receptacle, there is less need for balanced or floating input and output cables.

If the unit is modified to incorporate the optional output transformer, it is important to remember that connection must be made to both "+" and "-" terminals of the output. The output will drive any load of 600 ohms or greater and does not require a resistive termination. If the 7110 is driving a long line (in excess of 30 meters [100 feet]) a 620 ohm termination resistor at the other end of the line from the 7110, in combination with the use of balanced lines, will reduce the possibility of noise pickup in those lines.

## 2.7 Impedance and Termination for 600 Ohm Lines

In the USA the early history of the audio industry is very closely tied to the history and technology of the telephone industry. Much early equipment used for public address systems, recording, broadcast and reproduction of sound was either designed by or heavily influenced by the scientists and engineers at Bell Telephone Laboratories. The technology that they and others developed has had a lasting influence on the design and specification of all audio products. Among their contributions was the 600 ohm transmission line.

The 600 ohm line was developed because of a need for a standardized impedance for long distance transmission lines. Transmission and reception equipment using vacuum tubes, transformers, and passive equalization and mixing networks require known source and load impedances to achieve predictable results. Because much of the early professional audio equipment was designed by telephone company people or used similar types of equipment, it is not surprising that the 600 ohm line became a standard in the professional audio industry.

Correct use of the 600 ohm transmission line requires a signal source with an exact 600 ohm source impedance, and a receiving device which also has a 600 ohm input impedance. If a device does not have the correct impedance, it must be modified until it does. In the case of a device with a lower than required source impedance this would require addition of a series buildout resistor (or two in the case of a balanced line). In the case of a higher impedance input a resistor across the input will suffice. Other variations require either a resistive network or transformer to match impedances.

The input impedance of the 7110 is very high, and the actual output source impedance is approximately 40 ohms. Therefore, if the 7110 is to be used in a 600 ohm system, attach a 620 ohm resistor across the input terminals to terminate the source, and build out the output impedance with a 560 ohm resistor in series with the output (or one 270 ohm resistor in each leg of a balanced system.)

Most modern audio systems do not require the use of 600 ohm transmission line practices. This is for two reasons. First, most audio systems are relatively small (especially as compared to a telephone network) and the cabling between parts of the system is under more careful control, and second, modern audio electronic products are no longer designed to require the use of a 600 ohm line. Matching of input and output impedances is no longer necessary because the output impedance of a device may be made very low and the input impedance very high. Multiple inputs may thus be connected in parallel to the same source with ease and no loss of signal level.

## 2.8 Output Level Reference Trim

A screwdriver adjustment trim control is provided through a small hole in the front panel between the Output Level control and the Power switch. This allows the output meter "0" to be adjusted to the reference level of the system. As shipped from the factory the meter is adjusted to read "0" at 0 dBu (0.775 volts) so that at unity gain the Input and Output meters track. You may change this if you wish. The trimpot will adjust the meter to read "0" through an output range of -10 to +8 dBu. The procedure is to send a sine wave signal through the 7110 as it is connected in the system, and adjust the Output Level control to achieve the system reference level at the output of the 7110 as read on an external reference meter. Then, adjust the trimpot in the 7110 to make the output meter on the 7110 read "0".

## 2.9 Security Cover

In some installations it may be necessary to safeguard the 7110 control settings from deliberate or accidental mis-adjustment. In some environments the controls may benefit from additional protection against entry of dirt and dust.

The Model SC6 Security Cover offers protection for all operating controls of 1-3/4 in (44 mm) panel height JBL-UREI Electronic Products. The Security Cover is a five-sided box of smoked-gray plexiglass. It attaches to the front panel of the unit with two 6-32 x 2 in. Phillips head machine screws. Control positions and display status may be viewed through the cover after installation.

As noted earlier, the 7110 may be rack mounted in two different ways: flush mounted with the panel and rack ears in the same plane, or recess mounted with the rack ears extending forward so that the controls do not extend beyond the front panel of the rack ears. With the unit flush mounted the Security Cover will extend approximately 1-1/4 in. (32 mm) in front of the front surface of the rack ears. With the unit recess mounted the Security Cover is flush with the rack ears.

Installation of the Security Cover is simply a matter of placing it against the front panel of the unit, pushing the screws through the holes in the cover and screwing them into the two holes provided on the front panel. Note that the screws in the Security Cover match up with the holes in the front panel in only one orientation. Take care not to scratch the front panel of the unit with the screws. The Security Cover may be cleaned with any mild, non-abrasive

cleaner and a clean cloth.

2.10 Installation of Optional Output Transformer

**Caution**: The installation of the optional output transformer requires that the unit be opened. This may expose the user to dangerous AC voltages. These instructions are meant for the use of qualified service personnel only. DO NOT OPEN THE MODEL 7110 UNLESS YOU KNOW WHAT YOU ARE DOING.

1. The optional output transformer converts the unbalanced output of the 7110 to a balanced, floating output. The part number to order is UREI # 16-14550.

2. Unplug the Model 7110 from the AC Mains and remove the top and bottom covers. Two screws attach each cover on each side of the chassis, the rear edge of the cover lifts up and the cover slides to the rear.

3. Find the location for the transformer in the center of the printed circuit board. Unsolder the two components, R21 and JW 40 which are located within the dotted outline for the transformer. Remove any solder from all of the transformer mounting holes.

4. Insert the transformer in the PC board. Before soldering bend two opposite corner leads over to provide a good mechanical mounting. Check to make sure that the transformer will not move. Solder all pins of the transformer.

5. Reinstall top and bottom covers. Make sure to get the front edges of the covers into the slots in the front panel.

6. Wiring of the output connectors is now changed to reflect the balanced output. "+" is on pin 3 of the XL, tip of the phone jack and "+" of the barrier strip; "-" is on pin 2 of the XL, ring of the phone jack and "-" of the barrier strip; ground is on pin 1 of the XL, sleeve of the phone jack and "GND" of the barrier strip.

7. The output transformer has a slight gain and, therefore, the Output Level Reference trimpot should be adjusted according to the procedure in Section 2.8.

## Section Three Operation/Application

### 3.1 Turn On Procedure

After the power is switched on, there is a 3 second delay before any processed signal is passed through the unit. During this time, and at any time that the power is turned off, the input signal is passed directly to the output.

### 3.2 Compressors and Limiters – Definitions and Functions

Before operating the Model 7110 with program material, it may be helpful to become familiar with the terminology used in this manual.

Compressors and Limiters are typically used in applications where the dynamic range of the program material is:

1. Too large to be processed by the succeeding equipment.

2. Too large to be aesthetically pleasing.

3. Required to be reduced to achieve some other artistic goal.

3. Where the peak-to-peak amplitude is too great for the headroom of the following equipment.

4. Where the average level is too great for succeeding equipment; e.g. loudspeakers.

The two different names Limiter and Compressor generally refer to the degree to which the dynamic range is restricted. The relationship of change of input level to output level is called the compression ratio. If, for example an increase of 8 dB input signal level should cause the output to increase by only 2 dB, this would represent a 4:1 compression ratio.

Although no strict standards exist, amplifiers with compression ratios of up to 8:1 are typically considered Compressors, while those with ratios higher than 8:1 are called Limiters. By the definition just given the 7110 may be considered a compressor or a limiter depending on the position of the ratio control. This manual will generally use the phrase compression to mean either compression or limiting.
The transfer characteristic shown in Figure 3 indicates the difference between a low compression ratio and a high compression ratio. As the input signal increases from the bottom left corner of the graph along the straight line A indicating unity gain, it reaches a point called the threshold point. Up until that time the compressor has had no effect on the signal level. After the signal level reaches the threshold, the compressor reduces its gain according to the amount by which the input signal exceeds threshold, and the setting of the ratio control. As you can see from the two curves the low ratio control setting, shown as curve B, gives a much more gentle change to the output level than does the higher ratio setting shown by curve C. The Threshold control adjusts the point at which compression starts to happen. In many cases, much of the program material is below the threshold level and is not affected by the action of the compressor.

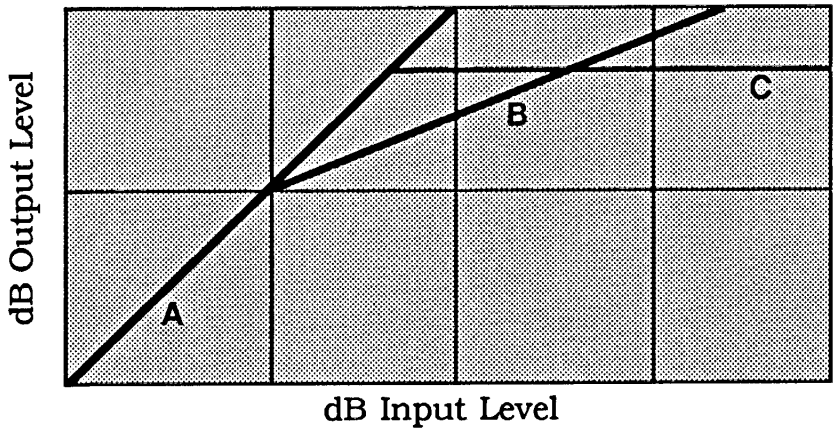


Figure 3

The compression ratio is generally understood to be constant. That is, no matter how much gain reduction is taking place, the ratio of input change to output change is the same. This results in a straight line from the threshold point. As you can see from the curves in Figure 4, the initial compression ratio of the 7110 is not linear. Rather it starts at a very low value and gradually increases to the setting of the front panel ratio control. This smooth "knee" has been a feature of UREI limiters from the days of the famous LA2A and is a major reason for their popularity. It reduces the initial effect of limiting action and makes the limiter less obtrusive in its action. We use the term Smart-Slope™ to refer to this characteristic in the 7110. The two curves show the different effect on low ratio and high ratio settings.

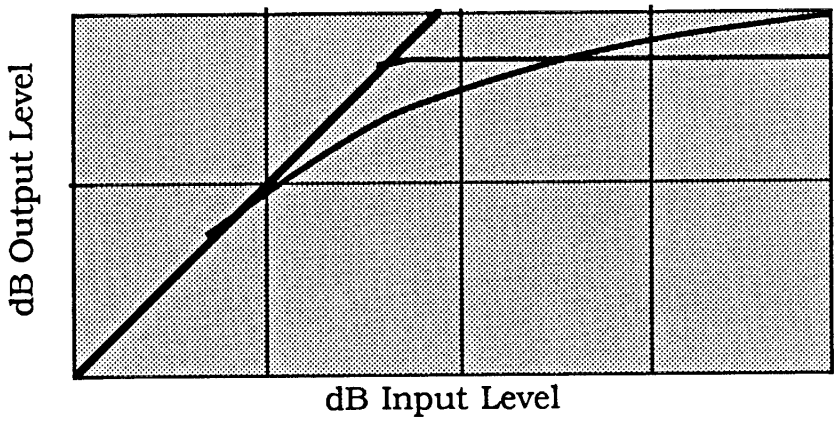


Figure 4

The attack time of the Model 7110 is the time it takes for the unit to respond to a signal which exceeds threshold. The average responding section of the 7110 has a variable attack time of 1 to 50 milliseconds. The peak responding section has a fixed attack time of less than 100 microseconds.

The release time is the time which it takes for the compressor to return to its normal gain after the signal which has caused compression has fallen below the threshold level. The release time of the average responding section of the 7110 is also variable from 50 milliseconds to 2 seconds for 10 dB of release.

As noted above, the 7110 actually consists of two compressors in the same package–one with an average responding detector, and one with a peak responding detector. The difference between the two detectors is their time constant–that is, the length of time that signal must exceed the threshold level before limiting action is initiated, and the speed with which the limiting action is removed as the signal is reduced in amplitude. There are good reasons for each, and we will discuss several of them now. But first we need to understand the difference between the average signal level and the peak signal level in program material. The average level is just that–the average. Taken over some period of time, including periods of silence (if any), periods of very high amplitude signal, and periods where the signal level is somewhere in-between. The peak level is the maximum level that a signal achieves, again measured during some time period.

It is important to realize that in audio program material that the ear responds roughly to the average signal level, while the electronics may have limitations that are based on the peak signal level. Different types of audio program material, from different sources, have different peak-to-average ratios. From the flute, which produces almost sine-wave pure tones with a

peak-to-average ratio of 3 dB—to the human voice, with a peak-to-average ratio of around 10 dB (depending highly on the particular voice)—to the plucked string instruments and electronic synthesizers, which may have peak-to-average ratios of 20 dB and higher. Depending on what we are trying to achieve with our compressor, we may need an average responding type, peak type or both. In the 7110 we do have both.

If we are using a compressor to match the perceived levels of different sounds in an overall mix, we will probably be primarily concerned with the average level, because that approximately matches the response of the human ear. Peak signals of short duration may be literally too fast to be heard. But, when we get these peak signals into an audio system, they may give us problems. The first is overload, the second is noise. Overload occurs because each piece of electronic equipment in our audio chain is powered by a DC voltage. If our audio signal attempts to exceed that DC voltage, it cannot. If this occurs for an extended period of time, we will definitely hear it. But we may hear it after only a very short time, depending on the design of the equipment, and what additional problems the overload causes. These may range from mild to severe. Severe examples include: severe distortion; latch-up; overmodulation of radio transmitters with resulting interference to adjoining frequencies, severe distortion or signal drop-out; excess modulation of record cutting styli causing groove cut-through; massive overload of digital systems, etc.

The first, and most obvious, remedy to overload is to reduce the signal level. This may work in some cases, and not in others. The major problem with reducing the signal level is that it degrades the signal-to-noise ratio of the system. If we only need to turn it down by 3 dB, that may be acceptable. But a 20 dB decrease will likely not be–especially if the offending high amplitude signal is present only occasionally. We could try to control this by hand, but, if the situation occurs with regularity, some type of automatic control will provide more predictable and consistent results.

As we discussed earlier, the difference between peak and average is time. Now we can begin to see where we want an average responding compressor versus a peak responding type. If our program material is a vocalist, and the vocalist is weaving and bobbing around the microphone, there may be some major variations in the electrical output of the microphone. These variations may be so great that the sound of the vocalist is lost beneath some accompaniment at one moment, and completely drowns out the accompaniment at the next moment. This is not artistically satisfactory. We would like a better balance between the vocal and the music. What we have here is a problem with the average level of the vocalist–a job for the average limiter. Or take another case: we have a saxophone that we can't turn up loud enough to balance in our mix, because the peak-to-average ratio of the sax sound is so great. If only we could cut down some of those peaks that the ear doesn't hear... And now we have a job for the peak limiter.

The front panel control labelled Detector is the means by which we choose predominantly average or peak compression, and in what balance. Think of it as a second threshold control. With the control set full CCW to the Average mark, the threshold for peak limiting is 20 dB higher than that for average limiting. This serves as a sort of "safety net" allowing small amounts of average compression (which typically sounds better than large amounts) to be used while still retaining protection against high amplitude, short duration signals As the control is rotated clockwise toward the Peak setting the threshold for peak signals is progressively reduced. You therefore have very good control over the actual peak-to-average ratio of the program material.

It was stated earlier that the compressor does not affect the signal below threshold. This is not strictly true. Actually the amount of gain reduction "cranked in" by the compressor affects all of the signal passing through the device, not just the high level signals. It is important to remember this when using the compressor in order to avoid some unwanted side-effects of the compression process. "Pumping" is the phrase used to describe the rise and fall of signal levels due to compressor action. It will be apparent because its timing will coincide with the limiting action. This may be due to excess limiting, incorrect settings of attack and release times, etc. "Breathing" is a similar problem, especially with noise, and is usually a result of too much compression and/or an inappropriate choice of attack and release times. It is especially bothersome when the original program material is not very quiet. Use of a compressor tends to degrade signal-to-noise ratios because it quickly turns down the high amplitude signals, while allowing the lower level signals to be relatively untouched. This often means that the lower level signals will be turned up in amplitude. Any accompanying noise will also be raised in level. If you are not careful, the overall result may be a lot more noise. Remember that any signal existing on the program signal that goes through the limiter will be so affected. This may therefore mean an increase in crosstalk. Use of faster attack times and longer release times will aid in reducing these effects.

## 3.3 Getting Started

With the Meter Select Switch set to Input, you can see the level of the signal that is being fed to the 7110. "0" is 0 dBu or 0.775 volts. Note that the Threshold control has numbers marked around it. These match the input level, and give you an idea of where the signal level is relative to the threshold level. For example, if the meter is reading -20, and the Threshold control is set to -10, the average signal is approximately 10 dB below threshold. (Note that this is only approximate as the Input/Output meter reads average level. Peaks may actually cause limiting even with this setting, depending on how high they are, and how the Detector control is set. The Gain Reduction Meter will always show how much actual compression is being used.)

The most powerful controls on this product are the attack time and peak to average ratio. Adjust them first, with the release time set to short. Then, lengthen the release time for the most pleasing result. A good starting point is with the Detector, Attack, Release and Ratio controls all at 12 o'clock. Adjust the Threshold control for 5 dB of compression, set the Output Level control to read "0" on peaks and listen to the results. Then start changing controls as necessary to achieve the particular effect you want.

## 3.4 The Auto Switch

The Auto Switch disables the front panel control of Detector, Attack, Release and Ratio and fixes these controls at factory preset values. These values have been chosen to sound good over a wide range of different program material. In addition, a circuit is engaged to provide for program-dependent release. We know that there are times when there just isn't time to spend setting up a myriad of dials and switches–the show must go on. It is in these kinds of situations, among others, that the Auto feature will shine. Just push the Auto button, set the amount of limiting with the Threshold control, the output level with the Output Level control, and you're done. The 7110 will give you good control, without compromising your sound. Later, when you have time, and if you feel the need, set the Detector, Attack, Release and Ratio controls to 12 o'clock, take the 7110 out of Auto mode, and adjust as necessary.

## 3.5 Linking Multiple Limiters

Two or more limiters may need to track together. In stereo programming this is important to avoid what is called "image shift". This results when two compressors, one per channel, are set to control the overall mix level. If they are not tied together, and one compressor acts alone, only that channel will be turned down. The other channel then becomes apparently louder. If there is any program material in common to both channels, it will appear to move toward the channel which is louder. To prevent this, the two compressors must be tied together. On the 7110 this is done through the Link terminal on the barrier strip. Use a piece of single-conductor shielded wire between the Link pins on the 7110's. Connect the shield grounds of the cable to the ground terminals on the barrier strips. Push the Link switch on the front panel of each 7110 to activate the Link connection. Push the switch again to make the units operate independently. The cable may be left in place.

When using multiple compressors in the Link mode, all front panel controls of all limiters should be set to the same positions.

## 3.6 Using the Direct Input to the Gain Reduction Control Amplifier

The Model 7110 Limiter/Compressor has an additional input connector (1/4 inch phone jack) on the rear panel labelled Detector Input, which gives direct access to the input of the gain reduction control circuit. This feature adds to the versatility of the unit in two basic areas:

(1) It allows the limiting action to be controlled by some other audio signal, instead of the signal being compressed. One example of this is known as "ducking". In this application the compressor is used to reduce the level of one signal whenever another "more important" signal is present. The example most used is that of an announcer talking over some other program material. The program material is normally passed through the compressor with little or no compression. But, whenever the announcer speaks, the compressor turns down the program material. The Threshold control, as always, sets the level for the threshold and therefore the amount by which the program material will be turned down. Careful adjustment of attack and release times is very important to avoid an overly "processed" sound. The exact adjustments will depend highly on the nature of the program material, and exactly how much "ducking" is desired. The detector control will want to be in the average position, since we are adjusting loudness.

(2) Another way in which the Detector Input may be used is to take the program signal, process it through some other device, such as an equalizer, and use that processed signal to drive the detector. One such application is known as a "de-esser". In this application the program signal is fed in parallel to the inputs of the 7110 and an equalizer which is set up to boost high frequencies above about 5 kHz. The output of the equalizer, returned through the Detector Input, drives the Gain Reduction circuit. Because of the equalizer, the circuit has a frequency-dependent threshold which, in this case, is more sensitive to the presence of high frequency program material. Some talkers have an overabundance of high frequencies in their "esses", and this type of circuit may be used to improve the "listenability" of their speech. The detector control will want to be set toward Peak, and the Attack and Release controls set to fast response.

(3) In the world of creative music mixing, Anything Goes. And the detector input offers the capability to modify the sound in ways that are beyond the scope of this manual. One example though, to get you started... Drive the Detector Input with a very low frequency sine wave signal. The audio program material can be made to rise and fall with the sine wave. Controls on the 7110 should probably be set for fast attack and release, high ratio and peak detection. This is called envelope detection.

## Section Four Theory of Operation

IMPORTANT NOTE

The following descriptions of the circuitry used in the limiter/compressor are presented here in order that the professional user may have a general understanding of how the unit works. They are not intended as a guide for service. Service on this product should be performed only by qualified technicians. THERE ARE NO USER SERVICEABLE PARTS INSIDE.

### 4.1 Input Amplifier

The input signal is applied to a differential amplifier, which accepts either balanced or unbalanced sources. Common mode rejection is typically better than 40 dB. The input terminals have 470 pF capacitors shunted to the input ground (GND) for RF input immunity.

### 4.2 Gain Reduction VCA

The VCA, IC2, passes audio, and applies attenuation or gain by changing a DC control voltage. The control law is set for 100 mV of control change for 1 dB of level change.

### 4.3 Output Amplifier

Following the gain reduction VCA, IC3 drives current boosting transistors Q4 and Q5 through diodes CR2 and CR3. Resistors R14 and R15 supply output stage bias; diodes CR4 and CR5 are short circuit protection; R19 provides overall feedback and optional transformer T1 gives the unit a fully floating output.

### 4.4 Gain Reduction Control Amplifier

The Model 7110 is a feed-forward limiter, and incorporates a full wave rectifier, logging circuit, separate peak and average responding detectors, and summing amplifiers to generate the necessary DC control voltage for the VCA which changes the gain of the audio signal. The output level control is also incorporated in the Gain Reduction control circuit.

### 4.5 Relay Circuit

In the absence of power the relay is de-energized and connects the input terminals directly to the output terminals. When power is applied a separate power supply consisting of CR24,25 and C45 supplies rectified and filtered DC to power the relay. The DC voltage is connected to the Relay through transistors Q6 and Q7. Q6 turns on immediately with application of power, but Q7 turn on is delayed by RC network R125,C46. The time constant of the network is chosen to ensure that all internal circuits in the Limiter/Compressor have reached a stable operating point, and that therefore no odd clicks or thumps will be generated by the unit into succeeding components. As the relay turns on, the relay contacts connect the output

terminals to the output of the 7110. At turn-off, or loss of power to the unit, the relay DC supply drops quickly. Transistor Q6 turns off quickly and removes power from the relay which returns to its rest position, bypassing the unit.

## 4.6 Input/Output Display

The Input/Output Display circuit is designed to give the operator a visual display of program signal level as an aid in setting the Input and Output levels for best headroom and signal-to-noise, and to aid in setting Threshold. The signal to be displayed is selected by switch SW3, one half of which turns on either LED DS3 or DS4 to indicate switch position. Output signal level reference is adjusted by potentiometer R72 and IC9B. The signal is coupled through a full wave rectifier circuit using IC9A and D. The display is average responding. The output of the rectifier feeds a multi-section window comparator. The threshold voltages for the comparators are set by a resistor ladder comprised of R107-R123.

The outputs of the comparators connect to a series string of LEDs which are driven through constant current source Q8. The comparators are arranged in such a manner that an input voltage lower than threshold causes the comparator output to be low, sinking current for all LEDs lower in the string and simultaneously preventing the higher LEDs from illuminating. As the input voltage exceeds the threshold for an individual comparator its output goes high, and the next higher LED illuminates. Ultimately, as the signal level continues to increase all sixteen comparators' outputs go high and the LED string is connected to the negative power supply.

## 4.7 Gain Reduction Display

The display of gain reduction is accomplished similarly to Input/Output as described above, with the exception that the DC control voltage for the VCA is used directly to drive the circuit.

## 4.8 Power Supply

AC mains power to the 7110 is converted to DC in the power supply. The supply is a straightforward linear style. Stepdown transformer T1 supplies low voltage AC to a bridge rectifier consisting of diodes CR20-23. The full wave rectified DC is filtered by capacitors C43 and C44 and regulated by Integrated Circuit Voltage Regulators VR1 and 2.

The Power Supply in the Model 7110-EX is similar, with the addition of a tapped AC Mains transformer and a switch to select the taps for nominal 100, 120 or 220/240 VAC.

## Section Five Maintenance

### 5.1 General

The Model 7110 is all solid state, ruggedly constructed and uses the finest components. As such it will provide years of trouble free use with normal care. All parts are conservatively rated for their application. NO SPECIAL PREVENTIVE MAINTENANCE IS REQUIRED. THERE ARE NO USER SERVICEABLE PARTS INSIDE.

The metal and plastic surfaces of the Limiter/Compressor may be cleaned with a damp cloth. In case of heavy dirt, a non-abrasive household cleaner such as Formula 409 or Fantastik® may be used. DO NOT SPRAY THE CLEANER DIRECTLY ONTO THE FRONT OF THE UNIT AS IT MAY DESTROY THE LUBRICANTS USED IN THE SWITCHES AND CONTROLS! Spray onto a cloth and then use the cloth to clean the unit.

### 5.2 Repairs and Warranty

This product is warranted by the manufacturer to the original purchaser against defects in material and workmanship for a period of two years from the date of purchase. Complete terms of the Limited Warranty are stated on the Warranty Card packed with this manual. We suggest that you retain a copy of your dated sales receipt for proof of warranty status should that be necessary.

If you wish to return the unit directly to the factory, please call or write to the Customer Service Department at the Service address listed on the title page of this manual for a Return Authorization Number. All products returned to the factory must be accompanied by a Return Authorization Number, and must be shipped prepaid. COD shipments will not be accepted.

For prompt service, ship the unit to the factory with the RA number marked on the shipping label. Be sure that it is well packed in a sturdy carton, with shock absorbing material such as styrofoam pellets or "bubble-pack" surrounding the unit. Pay particular attention to protecting the controls and switches and make sure that the unit cannot drift around in the shipping box. Shipping damage caused by inadequate packing is not covered by the JBL/UREI warranty. Tape a note to the top of the unit describing the problem, include your name and a phone number where we may contact you if necessary, and give us instructions for returning the product. We will pay return shipping costs on any repair covered under the terms of this warranty.

Field repairs are not normally authorized during the warranty period, and repair attempts by unqualified personnel may invalidate the warranty.

Customers outside the USA should contact their local JBL/UREI Professional Products dealer for warranty assistance. Do not return products to the factory unless you have been given specific instructions to do so.

## Section Six Specifications

### ELECTRICAL:

| | |
|---|---|
| Audio Input: | Differential amplifier. May be used balanced or unbalanced, bridging. |
| Input Impedance: | 94 kohm balanced, 47 kohm unbalanced. |
| Maximum Input Level: | +22 dBu.* |
| Detector Input: | Same as Audio Input. |
| Output : | Unbalanced. Less than 40 Ω source impedance. |
| Maximum Output Level: | +22 dBm* into 600 ohm load (20 Hz - 20 kHz). |
| Frequency Response: | ±1 dB, 20 Hz to 20 kHz. |
| Gain: | ± 20 dB. |
| Attack Time: | Average Detector: Adjustable, 1-50 milliseconds.<br>Peak Detector: Fixed, less than 100 microseconds. |
| Release Time: | Adjustable, 100 milliseconds to 5 seconds for 10 dB of release.<br>Peak Detector: Fixed, 10 milliseconds. |
| Compression Ratio: | Adjustable from 1.5:1 to infinity:1. |
| Threshold of Limiting: | Adjustable from -40 dBu to +10 dBu. |
| Power Requirements: | 105 to 125 VAC, 60 Hz, 15 W max. (7110)<br><br>90 to 110 VAC, 50/60 Hz, 15 W max. (7110-EX)<br>105 to 125 VAC, 50/60 Hz, 15 W max.<br>205 to 264 VAC, 50/60 Hz, 15 W max. |
| Environment: | Operating, 0°C to +50°C.<br>Storage, -20°C to +60°C. |

### PHYSICAL:

| | |
|---|---|
| Front Panel: | 44 x 483 mm (1-3/4 x 19 in) EIA rack mount. |
| Depth Behind Panel: | 220 mm (8.675 in) with rack ears flush.<br>250 mm (9.85 in) with rack ears forward. |
| Finish: | Aluminum extruded rack ears, Polycarbonate overlaid front panel.<br>Chassis is black painted steel. |
| Net Weight: | 3.4 kg (7.5 lbs). |

* 0 dBu = 0.775 Volts RMS 0 dBm = 1 milliwatt.

| REVISIONS | | | | |
|---|---|---|---|---|
| ZONE | LTR | DESCRIPTION | DATE | APPROVED |
| | | | | |

INPUT BUFFER

DETECTOR BUFFER

RECTIFIER

LOGGING

RATIO

PEAK DETECTOR

DISTORTION TRIM

OPTIONAL UREI TRANSFORMER 16-14558

LINK SWITCH (FP)

OUTPUT LEVEL (FP)

DISPLAY RECTIFIER

OUTPUT LEVEL REFERENCE TRIM

CONTROL INPUT

EXPORT AC WIRING
UREI TRANSFORMER
# 16-14959

POWER SUPPLY

INPUT/OUTPUT DISPLAY

GAIN REDUCTION DISPLAY

7. AUTO SWITCH SHOWN ENGAGED
6. R2*,R3* ARE RESISTOR NETWORKS
5. "PCB Reference" INDICATES DISPLAY RIBBON CABLE PIN LOCATIONS.
4. (FP) INDICATES FRONT PANEL CONTROL
3. ⏚ INDICATES CHASSIS GROUND
2. ▽ INDICATES CIRCUIT GROUND
1. RESISTOR VALUES ARE IN OHMS.

NOTES: UNLESS OTHERWISE SPECIFIED.

| | |
|---|---|
| NEXT ASSY | USED ON |
| APPLICATION | |

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±

MATERIAL

FINISH

DO NOT SCALE DRAWING

CONTRACT NO.

| APPROVALS | DATE |
|---|---|
| DRAWN J SWANSON | 4/11/89 |
| CHECKED C. Cohen | 4/11/89 |

UNITED RECORDING ELECTRONICS INDUSTRIES
8460 SAN FERNANDO RD., SUN VALLEY, CALIFORNIA 91352

# SCHEMATIC
# LIMITER/COMPRESSOR

| SIZE | MODEL NO. | DRAWING NO. |
|---|---|---|
| D | 7110 | 16051 B |

SCALE | SHEET OF