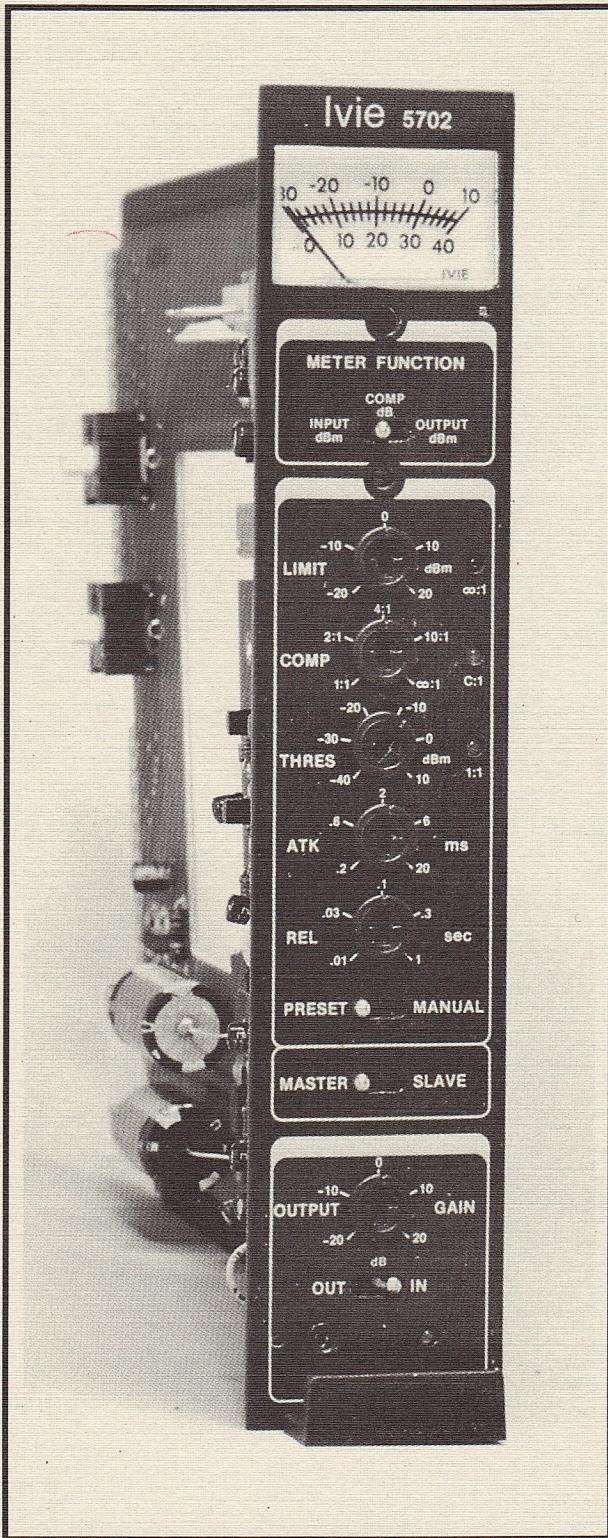




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5702 MANUAL



Operation and
Owners Manual
for the
**5702 Compressor
Limiter**
5000 Modular Sound System

Printed in U.S.A.

INTRODUCTION

The 5702 Compressor/Limiter is a professional piece of equipment designed for use in the most demanding applications. It has many features specifically designed for sound reinforcement and teleconference applications.

The 5702 may be used to protect loudspeakers and amplifiers from overloads, or in paging systems to accommodate a wide variety of announcers. Teleconferencing systems are made more pleasant by the use of the 5702 in the gated mode. Announcements may be compressed to "sound" louder.

The compressor can be used to match the large dynamic range of live program material to the more restricted dynamic range of the sound system. By employing a "Soft Knee" compression curve, the 5702 provides smooth, inaudible compression of program material. Compression does not occur abruptly when the signal reaches the threshold setting, but occurs over a transition range, or "window," of 8dB. The compression ratio is gradually increased over this "window" from no compression (1:1) to the ratio set by the compression control on the front panel.

Another important feature of the 5702 is its quasi-RMS detector. The detector monitors the audio signal and tells the voltage controlled attenuator (VCATT) when gain reduction (compression) is required. Because normal program material is not sinusoidal, but rather complex in waveform, it is important that the detector properly interpret the complex waveform. The quasi-RMS detector is not fooled by complex waveforms. It accurately detects their RMS value. This detector, coupled with the "Soft Knee" compression curve, provides accurate, inaudible compression.

In addition to the normal mode of compression, the 5702 also offers a GATED compression mode. In the GATED mode the compressor acts normally, with one exception: when the signal to the compressor is discontinued, the compressor remains at the present level of compression, awaiting the next signal. In the NORMAL, or non gated mode, the amount of compression would return to zero.

The MASTER/SLAVE function of the 5702 allows multiple units to be ganged together for multi-channel operation. When used in a stereo application this feature prevents any shift of the stereo image during compression.

A front panel meter and meter function switch allow the monitoring of input and output levels in dBm, and the amount of compression in dB. This greatly facilitates the setup

and monitoring of the system and the compressor. A meter trim control allows the meter zero reference to be offset by ± 10 dB from a reference of 0 dBm.

The 5702 provides the standard features found on all 5000 modules. These include a front panel test point, a signal presence LED, in addition to bus assign switches, etc.

COMPRESSOR/LIMITER INPUT

The input impedance of the 5702 is $10,000 \Omega$ and it can accept a maximum input signal level of +22 dBm. It has two signal input paths. One path is via the 10 position Bus Assign Switch, and the other path is the Direct Input via the TB-40. This input structure is common to all modules in the 5000 system. The Direct Input provides access to the input on the module without going through the motherboard. The Direct Input connection appears on the TB-40 mounted on the Mainframe directly behind the module. The input terminal is "M" (See the TB-40 diagram inside the rear cover of this manual) and its companion ground terminal is "S". The Direct Input may be isolated from the motherboard by cutting the wire jumper adjacent to the 10 position bus assign switch labeled "IN," as shown in Figure 1 below:

5702 INPUT BLOCK DIAGRAM

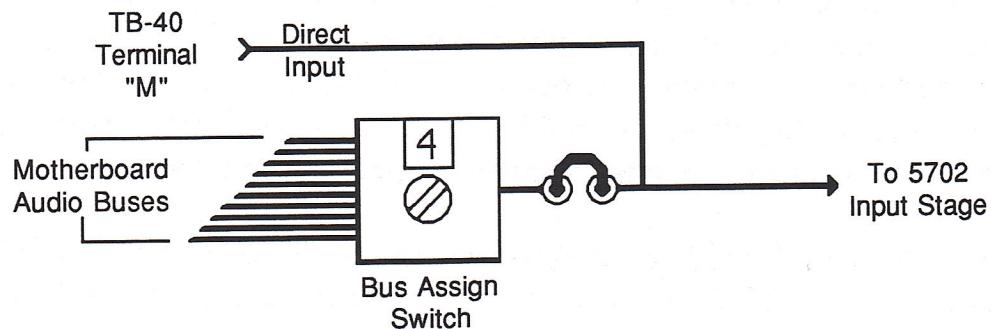


Figure 1

COMPRESSOR/LIMITER OUTPUT

The 5702 is capable of driving a 600Ω load to a maximum output level of +18 dBm. The output of the 5702, much like its input, is controlled by the bus selector switch and wire jumper. There is also a Direct Output which can be accessed via the TB-40. The Direct Output appears on the TB-40 at terminal "11" with a companion ground on terminal "12." The Direct Output may be isolated from the motherboard audio buses by

cutting the wire jumper adjacent to the bus assign switch labeled "OUT." In the majority of applications, however, the output of the compressor is assigned to one of the 10 audio buses via the Bus Assign Switch.

BALANCED INPUT/OUTPUT

If a balanced direct input or output is required, a TBT-600 Transformer/Terminal Block should be used. See the 5001 Mainframe manual and TBT-600 manual for more information.

FRONT PANEL METER

The meter on the 5702 provides the capabilities of monitoring the input and output signal levels, and the amount of compression applied to the signal. The top scale of the meter, -30 to 10, is calibrated in dBm (0dBm = .775 Volts into 600 Ω). This scale is to be used whenever the Meter Function Switch is in the "INPUT dBm" or "OUTPUT dBm" position. The meter is factory calibrated to read 0dBm when a 0dBm signal is present at either the input or the output of the 5702. The "0" reference of the meter may be set by the user from -10dBm to +10dBm. When the reference level is changed, the absolute calibration of the meter scale will not be accurate, but the relative calibration will be accurate.

The calibration control for the zero reference is located on the front panel, directly below the Meter Function Switch, and directly above the Limit Control. DO NOT adjust any of the calibration controls located on the printed circuit board, including those labeled "Meter Gain" and "Meter Offset." All controls located on the printed circuit board are for factory calibration purposes only. Changing them will cause problems. Calibration of the meter is accomplished by inputting a signal of known level to the 5702 and adjusting the meter calibration control for the desired indication.

The bottom scale of the meter is calibrated in dB. This scale is read whenever the Meter Function Switch is set to the "COMP dB" position. This indicates the amount of compression, in dB, applied to the signal. For example: if a signal level of +10dBm were applied to the input of the 5702 and the Limit Control were set to 0dBm, the meter would indicate 10dB of compression, as read on the lower meter scale.

FRONT PANEL LED's

There are four LED's located on the front panel of the 5702. Three of these LED's are located on the right side of the module, aligned in a vertical column, and are labeled "1:1", "C:1" and " $\infty:1$." These three LED's provide a highly visible indication of the status of the compressor and the limiter. Additionally, they are beneficial in initial setup of the 5702 because they provide visual indication of both compressor and limiter activation.

The fourth LED is located at the bottom, right corner of the 5702, adjacent to the TEST POINT. As is common to all modules in the 5000 system, this LED is the audio "Signal Presence" LED and bypass indicator.

1:1 LED

The color of this LED is green, and it is illuminated when there is no compression applied to the signal, either by the compressor or the limiter. The 1:1 indicates the compression ratio of the input signal as compared to the output signal. A 1:1 (one-to-one) compression ratio means that for every 1dB increase in signal level at the input of the module, there will be a corresponding 1dB increase in output level. This is just another way of saying that no compression is being applied to the signal.

C:1 LED

This LED is yellow in color and is illuminated whenever the compressor is activated. Because the compression ratio of the compressor is adjustable over a range of from 1:1 to $\infty:1$, the compression constant is specified by using the capital letter "C." If the compression ratio is set to 4:1, then "C" equals 4. A compression ratio of 4:1 means that for each 4dB of increase in input signal level, the output level will increase by only 1dB. As the yellow LED gradually comes on, the green 1:1 LED is gradually turned off. The level at which C:1 is activated is determined by the setting of the THRES. (Threshold) control.

$\infty:1$ LED

This LED is red in color and is illuminated whenever the limiter is activated. The symbol " $\infty:1$ " represents the compression ratio of infinity-to-one, which is the compression ratio of the limiter. A compression ratio of infinity-to-one means that for an infinite increase in input level, the output level remains at a constant level.

SIGNAL PRESENCE LED

The 5702 has a yellow LED located on the lower right corner of the front panel. This LED indicates the presence of an audio signal at output of the module. The intensity of the LED will vary according to the amplitude of the audio signal. Every audio module in the 5000 system has a signal presence LED. They visually indicate the flow of the audio signal through the system, providing a valuable troubleshooting aid.

FRONT PANEL CONTROLS

METER FUNCTION SWITCH

The Meter function Switch determines which function the meter will monitor. The meter can monitor the input level, the output level, and the amount of compression. Refer to the "FRONT PANEL METER" section of this manual (page 3) for more detailed information.

LIMIT

The limiter is a compressor whose compression ratio is permanently set at infinity to one ($\infty:1$). Because the compression ratio is permanently set, there is no need for a COMP. (Compression) control as found on the compressor section of this module.

The Limit Control sets the point at which the limiter is activated. This control operates in the same manner as the THRES. control does for the compressor. If the Limit Control is set at 0dBm, it will limit any signal that is greater than 0dBm. Signals that are less than 0dBm will not be affected by the limiter. The $\infty:1$ LED will be illuminated whenever the limiter is activated.

The limiter employs a "feed-forward" type circuit so that compression does not occur abruptly, but limiting occurs gradually. The transition from 1:1 to $\infty:1$ occurs over an 8dB range. This provides a more natural sounding compression.

In practical application, the limiter can be used to prevent the sound system from being overdriven into distortion. The Limit Control should be adjusted so that the maximum signal level sent to the amplifiers is just below the level that would cause the amplifiers to clip or distort. This control is best adjusted under actual operating conditions using typical program material. This is easily done in the following manner: With the Limit Control turned full clockwise (20 dBm), increase the level of the program material until

it causes the amplifier's clipping indicator to come on. Then turn the Limit Control counter-clockwise until the clipping indicators on the amplifiers turn off. The limiter is now limiting the signal to a level just below the clipping point of the amplifiers.

COMP. (Compression Ratio)

This control allows the adjusting of the compression ratio of the compressor. The compression ratio is adjustable from 1:1 (No compression) to ∞ :1 (Infinite compression). In typical applications, it is set somewhere between 2:1 and 4:1 which provides a very natural sounding amount of compression. The compressor also employs the same type of feed-forward compression circuitry found in the limiter. This means that the compression does not occur abruptly, but rather occurs over an 8dB range. The compressor can be defeated by setting the compression ratio to 1:1. The C:1 LED will indicate when the compressor is activated, but obviously, there will be no compression of the signal with a 1:1 compression ratio.

THRES. (Threshold)

The Threshold Control allows the selection of the amplitude, or signal level at which the compressor begins to compress the signal. The compressor may be set to activate on signal levels ranging from as low as -40dBm up to +10dBm. With such a large range of adjustment, the compressor may be set so that the signal is always being compressed, or set so that the signal is being compressed only at very high levels.

The yellow C:1 LED adjacent to the Compression Control will be illuminated when the compressor is activated. There is a direct correlation between this LED being illuminated, the setting of the Threshold Control and the input signal level.

Another indication that the signal is being compressed is provided the meter - when the Meter Function Switch is set to the COMP. dB position. As the signal level increases past the threshold point, the meter will indicate the amount of compression in dB.

PRESET/MANUAL

This switch affects the ATK. (Attack) and the REL. (Release) controls. The switch selects either the internal preset attack and release times, or the attack and release times as set by the ATK. and REL. front panel controls. When the switch is set to the PRESET position, the two front panel controls, ATK. and REL., are disabled and the

factory preset attack and release times are enabled.

The preset values for these two controls are: Attack = 2ms.; Release = 0.1 sec. The preset value for the release time when the compressor is in the gated mode is ten times longer than when it is in the normal mode. The preset value is changed from 0.1 sec to 1 sec. There is no change in the ATK. time when in the gated mode. These values have been found to be close to optimum in over 85% of the normal applications.

When the switch is set to the MANUAL position, the ATK. and REL. controls are enabled. This allows the user to set these controls according to his own preference. An instant comparison may be made between the preset and the user settings by switching between PRESET and MANUAL.

ATK. (Attack)

This control sets how fast the compressor will respond to a signal exceeding the threshold setting. This control is operational only when the PRESET/ MANUAL Switch is set to MANUAL. The attack time is adjustable over a range from 0.2ms. to 20ms., in both the normal and gated mode. The attack time is calculated for a 20dB change in input signal level to effect a 63% reduction in output signal level.

REL. (Release)

This control sets the rate of release from the compressed state to a normal state. It is operational only when the PRESET/MANUAL switch is set to MANUAL. The release times on the front panel are calculated on the basis of how long it will take the compression to decrease 20dB in level after the release of compression.

When the 5702 is placed in the GATED mode, all release times are increased by a factor of ten. The release times in the GATED mode are .1 to 10 seconds.

MASTER/SLAVE

Unless the 5702 is being used with another 5702 in a master/slave configuration, its MASTER/SLAVE switch must be in the MASTER position. This switch allows two or more 5702's to be slaved together. When units are slaved together, the VCATT's (voltage controlled attenuators) of both units are acted upon equally by the detectors of both compressors. This provides for proper maintenance of multi-channel imaging in a multi-channel system. For example, in a stereo or two channel system, it is important

to maintain the same relative levels from the two channels. If the level of one channel is lower than the other, then the stereo image will appear to shift to the channel with the louder level. If two independent compressors are employed in the two channels, this may cause an image shift problem. It is evident that greater compression in one channel will cause a level discrepancy, and thus a shift in center image. In the MASTER/SLAVE mode, the output of the two detectors is summed together and then sent to the two VCATTs. This assures that both compressors will be acted upon equally.

To use the MASTER/SLAVE feature of the 5702, one module must be assigned as the MASTER and the other module as the SLAVE. The two modules must be placed in adjacent slots in the Mainframe. As you face the front of Mainframe, the 5702 on the left will be the MASTER and the 5702 on the right will be the SLAVE. The module to the left should have its MASTER/SLAVE Switch set to the MASTER position, and the module on the right should be set to SLAVE. *If both modules are set to the MASTER mode, they will act independently of one another even when they are in adjacent slots.*

When two or more modules are combined in a MASTER/SLAVE configuration, the following front panel controls on all SLAVES will be disabled: LIMIT, COMP., THRES., ATK., REL., and PRESET/MANUAL. The detectors of all slaves will be summed at the MASTER 5702, and will be controlled according to the MASTER's front panel controls. This signal is then routed to all VCATTs that are slaved together, including the VCATT in the master 5702.

The meter on each module will still function independently and will display both the input and output levels. Of course, when switched to the COMP. dB position, all meters will indicate the same amount of compression. The OUTPUT GAIN and IN/OUT controls still function independently for 5702's in the SLAVE mode.

OUTPUT GAIN

The gain of the 5702 is adjustable over a 40dB range (± 20 dB). The maximum output level from the module is +18dBm. This control allows for adjustments to be made in the output level of the module to interface with various other modules and external electronics.

Keep in mind that when the 5702 is switched out of the circuit or automatically placed in the bypass mode, any boost or cut in signal level made by the OUTPUT GAIN control will be lost. This means that should the OUTPUT GAIN control be set

anywhere except unity gain, there will be a change in level when the module is bypassed.

IN/OUT

The IN/OUT switch allows the 5702 to be switched in and out of the circuit - or totally bypassed. This switch can be used to compare the compressed signal to a non-compressed signal. When the switch is placed in the OUT position, the signal is not routed through the 5702 at all (See Figure 2 on the following page), and the yellow signal presence LED on the front panel will flash on and off to give visual indication that the switch is in the OUT position. *As previously mentioned, if the 5702 has been set up to provide an overall increase or decrease in gain, a noticeable change in level will occur when the IN/OUT switch is changed to the OUT position.*

When the switch is in the OUT position, the meter circuit still functions. It will show the input and output level to be the same, and will also indicate the amount of compression which, obviously, will be zero.

REMOTE BYPASS

The function of the IN/OUT switch may be duplicated at a remote location. This is accomplished by connecting a SPST switch to TB-40 terminals R and S. When terminal R is shorted to terminal S, the 5702 is switched to the OUT position. *Please note that if the front panel IN/OUT switch is in the OUT position, the remote switch can not return it to the IN position. For the remote switch to be fully functional, the front panel switch must be kept in the IN position.*

AUTOMATIC BYPASS

The 5702 has an automatic bypass feature. The input of the module is "hard wired" directly to the output via a relay. When power is flowing through the 5702, the relay is open which routes the signal through the 5702, but when the unit is turned off, or if the DC power supply fails, the relay closes, shorting the input to the output, which automatically bypasses the 5702. Figure 2 on the following page shows a detailed diagram of the input and output of the 5702, the automatic bypass relay, and the associated circuitry.

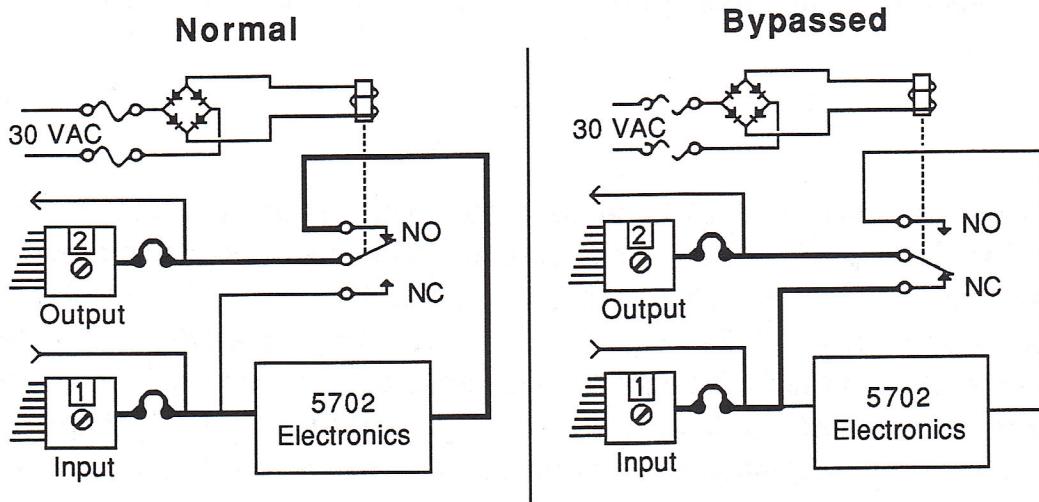


Figure 2

FRONT PANEL TEST POINT

There is an audio test point located on the front panel below the OUT/IN switch. This test point is connected to the master output of the 5702 through a $604\ \Omega$ resistor. It is a convenient point to monitor the audio signal at the output of the compressor/limiter. Real-time analyzers, AC voltmeters, or oscilloscopes may be connected at this point to evaluate and document system performance.

The test point is designed to accept and retain the scope probe of either the Ivie IE-30A Real Time Analyzer, or the PC-40 Audio Analysis System. The spring-loaded, hook tip of these probes should be unscrewed exposing the probe tip. This tip will be retained when firmly inserted into the test point. The ground clip lead of the probe should be clipped to the chassis of the 5001 Mainframe.

INTERNAL CONTROLS AND OPTIONS

DIRECT AC VCATT CONTROL

An external audio signal may be used to control the 5702's VCATT. This control signal should be connected to terminals N and P of the TB-40. Terminal P is for the audio signal, and terminal N is for the shield. The wire jumper labeled EXT AC IN must be cut (See Figure 3 on the following page). The input impedance is $5,000\ \Omega$.

WIRE JUMPER OPTIONS

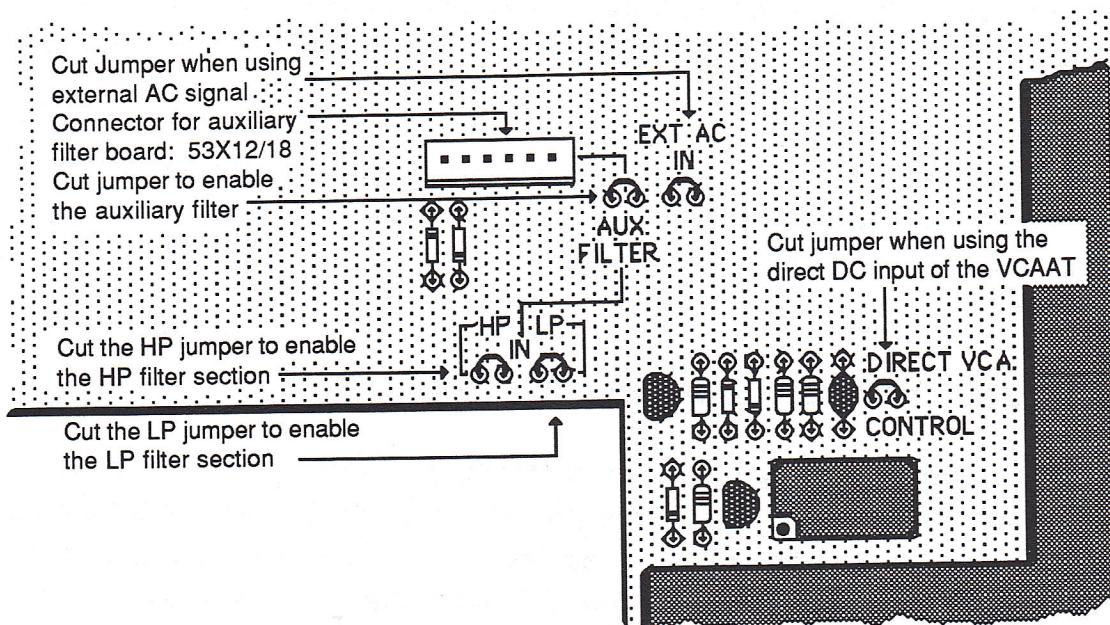


Figure 3

DIRECT DC VCATT CONTROL

The heart of any compressor is the part of the circuit that actually controls the amplitude of the audio signal. In the 5702, this circuit is a voltage controlled attenuator (VCATT). Normally, the control voltage is derived from a circuit that detects the level of the audio signal through the module.

The 5702 has a provision that allows the VCATT to be controlled from an external DC source. This can be accomplished by first cutting the VCA jumper on the printed circuit board (See Figure 3 above), and then applying a DC control voltage to the terminals on the 5702's TB-40. A DC voltage from 0 to -9 volts may be applied to terminal 13 as referenced to terminal 14. The audio signal will receive no attenuation with a control voltage on 0 volts, but will be attenuated at the rate of 10dB per volt, up to a maximum of 90dB, when -9 volts is applied.

AUXILIARY FILTER

An auxiliary audio filter may be inserted in the audio line going to the detector for the compressor. This filter does not affect the audio signal through the module, only the signal to the detector. This allows special emphasis to be placed on certain

frequencies when determining compression. The 5702 has a connector on the main printed circuit card to accept an auxiliary filter. This connector will accept either the 53X12 or 53X18 crossover card normally used with the 5301 and 5303 equalizer modules. Either the High pass or Low pass filter section of the crossover may be used.

There are two jumpers that must be cut when an auxiliary filter is used. The wire jumper labeled AUX FILTER must be cut to insert the filter into the audio chain. Then either the HP (high pass) jumper or the LP (low pass) jumper must be cut to select the desired filter section. Cutting the HP jumper selects the high pass filter, while the cutting the LP jumper selects the low pass filter.

G/N (Gated/Normal Compression Mode)

In addition to its NORMAL mode of compression, the 5702 also has a GATED compression mode. Mode selection is determined by the position of the slide switch labeled N and G. This slide switch is located on the printed circuit board, directly behind the REL. control. When the switch is set to the N (N = Normal) the 5702 performs the same as many other high quality compressors.

With the switch in the G (G = Gated) position, the compressor operates in the gated mode. This mode has application in teleconferencing and paging. The difference between GATED and NORMAL is straight forward: In the GATED mode, all the release times are 10 times longer than indicated on the front panel. In certain applications, the GATED mode will greatly enhance the sound quality.

In the NORMAL mode, the compressor will compress a signal whenever the signal goes above a certain level. When the signal stops, compression stops. The GATED mode, however, operates differently. When a signal is removed from the compressor, the compressor remains "frozen" at the last level of compression until a new signal is received. Then the compressor follows that signal, compressing or not compressing, as needed.

In some applications, this is highly useful. For example, in paging from a noisy ambient condition, the pager would likely yell a little to overcome the background noise. His yell would cause compression to occur. In the NORMAL mode, compression would stop during voice pauses, and the background noise through the microphone into the system would increase. Voice again would cause compression and background noise would decrease. The "pumping" up and of background noise is an unpleasant effect. The GATED mode would prevent this pumping by maintaining compression during pauses.

Figure 4 below shows the location of the GATED/NORMAL switch, the fuses, input and output selector switches and the jumpers associated with those switches.

5702 INTERNAL CONTROLS

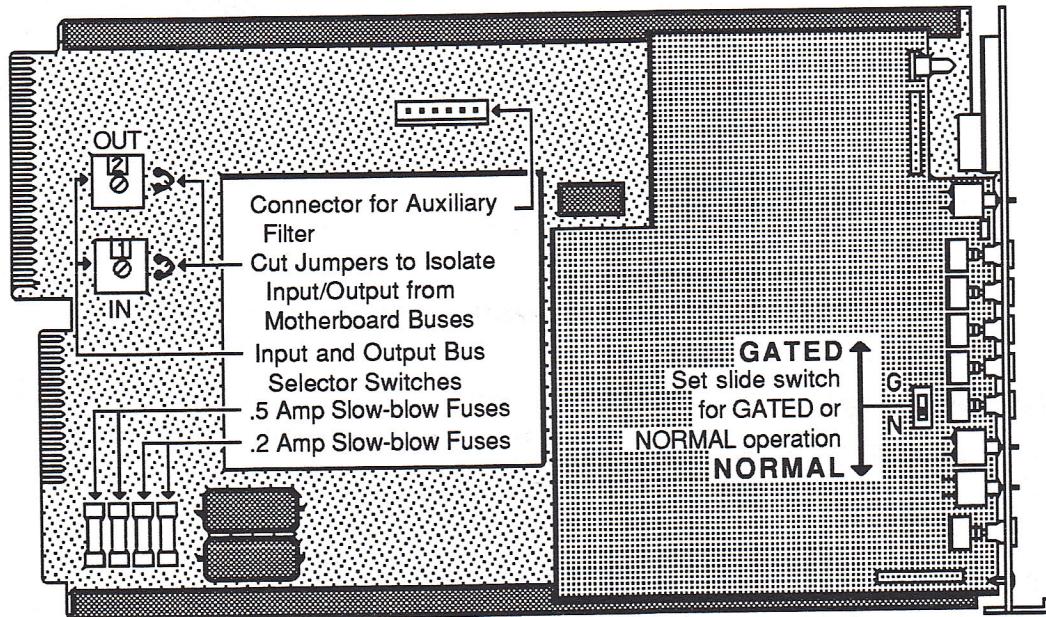


Figure 4

FUSES

The 5702 has four slow-blow fuses as show above: two (2) 0.2 amp and two (2) 0.5 amp fuses. Should any of these fail, they should be replaced with fuses of exactly the same rating. Should they again fail after replacement, the 5702 requires servicing. *Replacing the fuses with a fuse larger than the recommended values may damage the module and will void the warranty.*

SETUP PROCEDURE

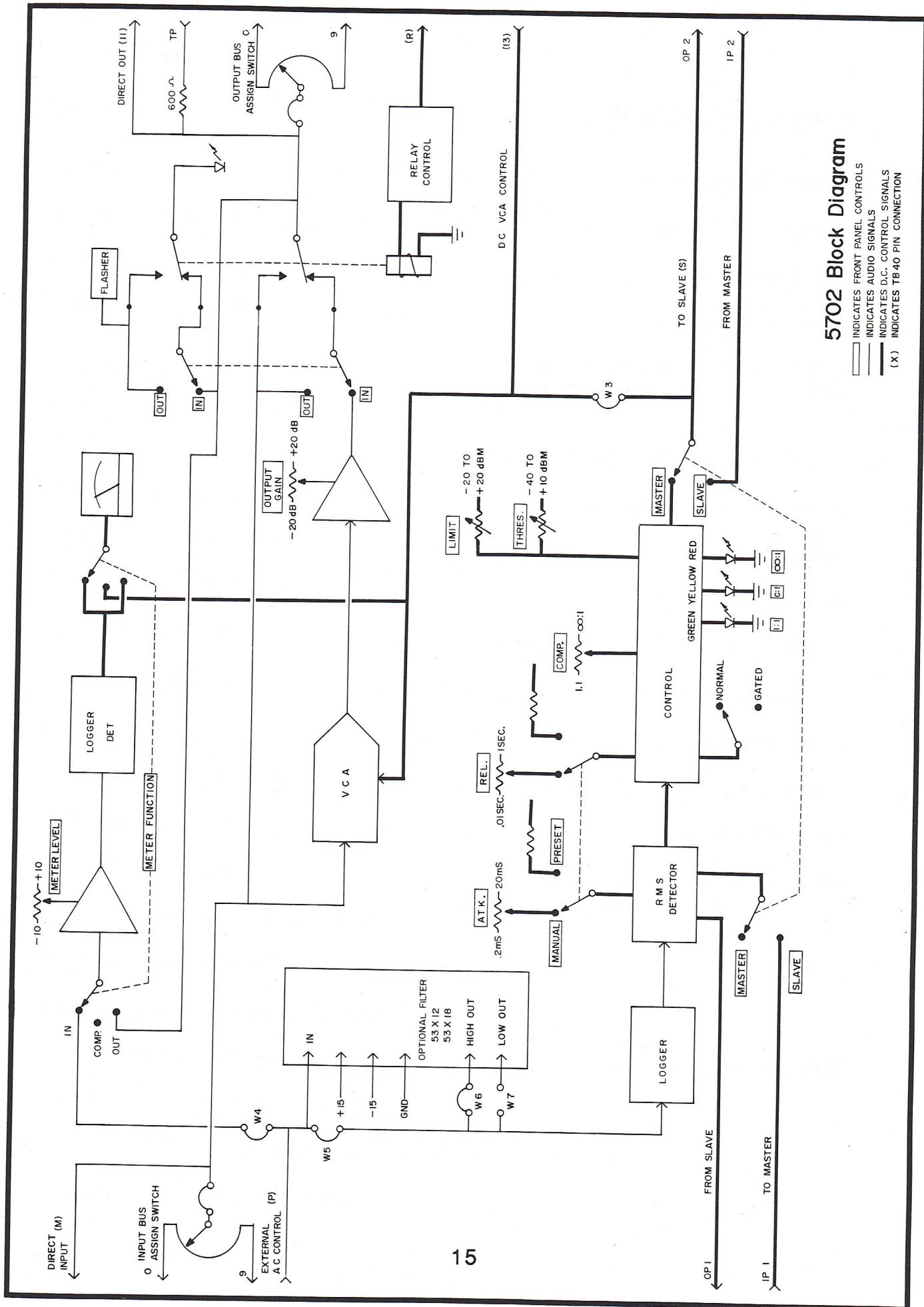
This procedure outlines the steps to follow when setting up the 5702 for use in a sound reinforcement system. In this application the 5702 is being used to prevent the system from clipping or distorting.

1. First set all the controls as outlined on the following page. With the controls set as

outlined, the 5702 will not affect the signal flowing through it. This gives us a clean slate to work with.

METER FUNCTION	-----	INPUT dBm
LIMIT	-----	+20dBm
COMP.	-----	1:1
THRES.	-----	10dBm
ATK.	-----	2ms
REL.	-----	.1Sec
PRESET/MANUAL	-----	PRESET
MASTER/SLAVE	-----	SLAVE
OUTPUT GAIN	-----	0
OUT/IN	-----	IN
GATE/NORMAL (internal)	-----	NORMAL

2. Input program material into the sound system at a sufficient level to cause the amplifiers to clip on the peaks. This is the upper limit of the dynamic range of the sound system.
3. Turn the **LIMIT** control counter-clockwise until the amplifiers are just out of clipping. The red LED labeled ∞ :1 should now be flashing on during the peaks in the program material. The limiter is now limiting the signal to a level below the clipping point of the amplifier.
4. Set the **COMP.** control to 2:1. This is a very moderate amount of compression.
5. With the program material still playing through the system, turn the **THRES.** control counter-clockwise until the yellow LED labeled C:1 begins to come on. This indicates that the compressor in the 5702 is being activated. Continue to turn this control counter-clockwise until the red **LIMIT** LED flashes only occasionally, and then only on extreme program peaks.
6. Adjust the **OUTPUT GAIN** control as required.
7. Use the **METER** to confirm the amount of compression, input level and output level.



5702 Block Diagram

 INDICATES FRONT PANEL CONTROLS

— INDICATES AUDIO SIGNALS

(X) INDICATES D.C. CONTROL SIGNALS
— INDICATES TB40 PIN CONNECTION

"DISCARDED" FIN CONNECTION

SPECIFICATIONS

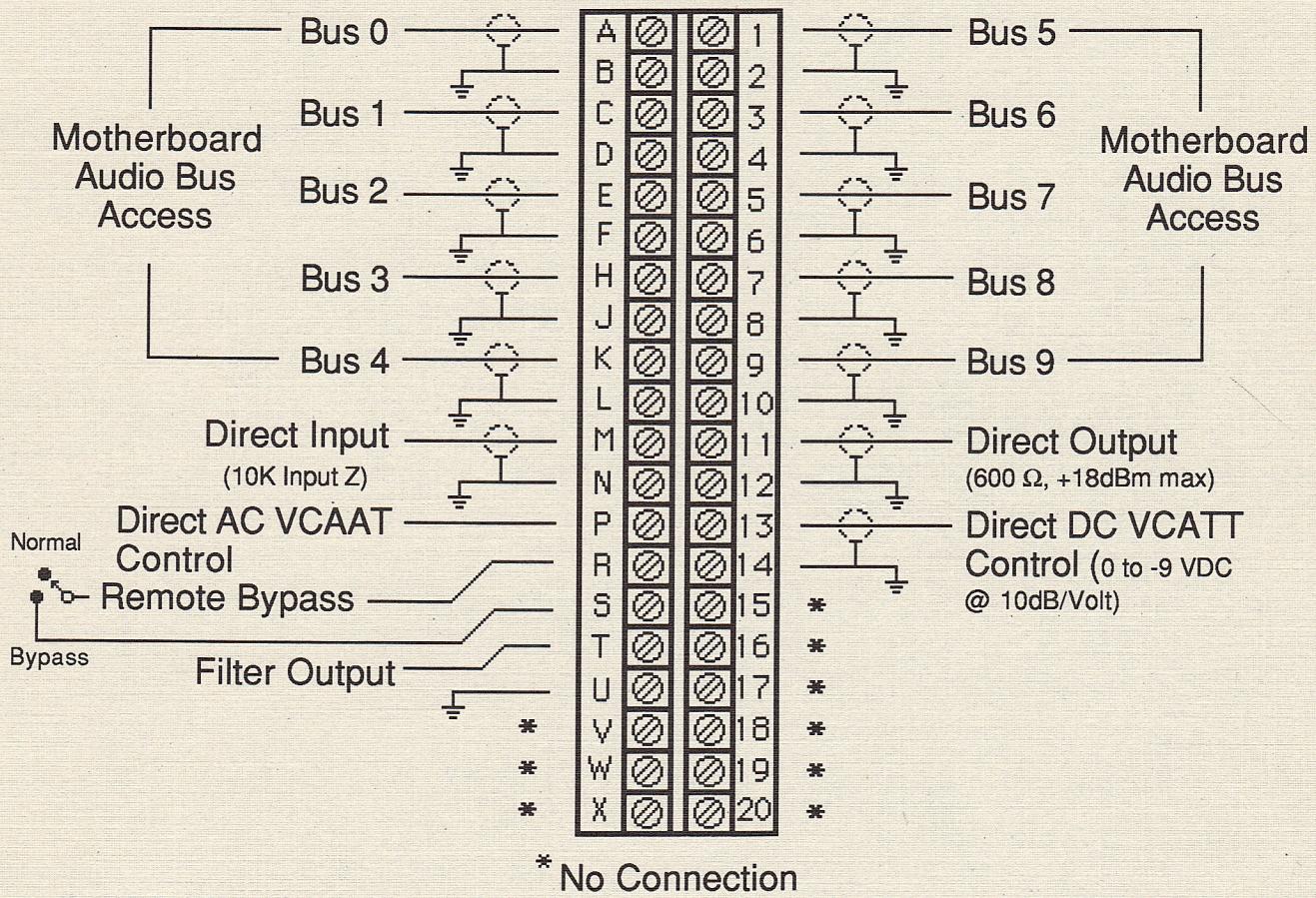
Power Consumption	8 Watts
Frequency Response	$\pm .5$ dB 20 Hz to 20 kHz
Input Impedance	10,000 Ω
Maximum Input Level	+22 dBm
Distortion (THD) In Compression or Limit, +10dBm Input and 0dBm Output	Less than .05% @ 1 kHz Less than .05% @ 100 Hz
Output Impedance	\geq 600 Ω
Maximum Output Level	+18 dBm
Meter Range	40dB
Meter Offset	Adjustable: -10 to +10 dB
Output Gain	Adjustable: -20 to +20 dB
Compression Ratio	Adjustable: 1:1 to ∞ :1
Limiter Compression Ratio	Fixed @ ∞ :1
Compression Threshold	Adjustable -40 to +10 dBm
Limiter (Threshold)	Adjustable -20 to +20 dBm
Attack Time	Manual: .2 to 20 ms Preset: 2ms = 20dB Signal Change and 63% Reduction in Output Level 1ms = 30dB Change, 4ms = 10 dB Change
Release Time	Manual: .01 to 1 Second Preset: .1 Second = 20 dB Change In Gated Mode, Release Time Multiplied by 10 Gated Release Time = 1 Second

SPECIFICATIONS CONTINUED

Equivalent Input Noise ----- -88 dBm
A weighted, 0dB Output Gain
600 Ω Termination on Input.

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5702 TB-40 Connections