

**LEAMING INDUSTRIES MTS-5  
BTSC STEREO GENERATOR**

INSTRUCTION BOOK  
IB 009095-01 C

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## MTS-5 TABLE OF CONTENTS

<u>SECTION</u>	<u>PARAGRAPH</u>	<u>PAGE</u>
<b>1.0</b>	<b>QUICKSTART</b>	<b>3</b>
<b>2.0</b>	<b>INTRODUCTION TO THE MTS-5</b>	<b>3</b>
<b>3.0</b>	<b>INSTALLATION</b>	<b>4</b>
3.1	AUDIO INPUT	4
3.1.1	SECOND (B) AUDIO INPUT	4
3.2	VIDEO SYNC IN CONNECTIONS	5
3.3	COMPOSITE BASEBAND OR 4.5 MHz FEED TO TV MODULATOR	5
3.3.1	BASEBAND STEREO MULTIPLEX TO TV MODULATOR	5
3.3.2	4.5 MHz AUDIO CARRIER WITH VIDEO	6
3.3.3	4.5 MHz AUDIO CARRIER SEPARATE FROM VIDEO	6
3.4	VIDEO SCRAMBLING	6
<b>4.0</b>	<b>OPERATION</b>	<b>7</b>
4.1	SETTING THE AUDIO CARRIER DEVIATION	7
4.1.1	SPECTRUM ANALYZER AND TEST TONE METHODS	7
4.1.2	USING THE METER OR PEAK FLASHER ON THE TV MODULATOR	8
4.2	AUDIO CARRIER LEVEL ADJUSTMENT	8
4.3	"A"/"B" AUDIO INPUTS	8
4.3.1	LOCAL & REMOTE AUDIO INPUT SELECTION	9
4.3.2	INTERNAL SAP "B" INPUT	9
4.4	STEREO AUDIO LEVELS and AGC CONSIDERATIONS	9
4.5	AUDIO AGC OK & HI INDICATORS	10
4.6	STEREO / VIDEO SYNC LED	11
4.7	SAP CARRIER ON LED	11
4.8	SAP CARRIER LEVEL SETTING	11
4.9	SAP AUDIO LEVEL; OK & HI LEDS	11
<b>5.0</b>	<b>SPECIFICATIONS</b>	<b>12</b>
<b>6.0</b>	<b>AUDIO PERFORMANCE EVALUATION</b>	<b>14</b>
<b>7.0</b>	<b>TROUBLESHOOTING</b>	<b>14</b>
7.1	COMMON SETUP ERRORS	14
7.2	TROUBLESHOOTING WITH A STEREO DECODER	14
7.2.1	USE YOUR EARS	15
7.3	TROUBLESHOOTING WITHOUT A STEREO DECODER	15
7.3.1	TROUBLESHOOTING WITH A SPECTRUM ANALYZER	15
7.3.2	TROUBLESHOOTING WITH AN OSCILLOSCOPE	16
<b>8.0</b>	<b>INTERNAL SAP GENERATOR INSTALLATION</b>	<b>17</b>
<b>APPENDIX</b>	<b>CONNECTION DRAWINGS</b>	<b>19</b>

## **1.0 QUICKSTART**

This section is provided for those who want to skip directly to connecting the MTS-5 into their system. At the minimum, please see the Connection Diagrams in the Appendix at the rear of this manual, and read the remainder of this section (1.X).

- 1.1 Configure Video Modulator to accept BTSC Stereo in the format you wish to use. Refer to Section 3.3.
- 1.2 Loop baseband video through the MTS-5 on its way to the video modulator. Refer to Section 3.2.
- 1.3 Connect the output of the MTS-5 to your TV channel modulator (use either baseband multiplex or 4.5 MHz). Refer to Section 3.3.
- 1.4 Connect Program Audio to the MTS-5. Refer to Section 3.1.
- 1.5 Connect AC Line Power.
- 1.6.1 If using Baseband Multiplex Stereo feed to audio modulator in video modulator, adjust Aural Carrier Deviation at video modulator. Refer to Section 4.1.
- 1.6.2 If using 4.5 MHz feed to video modulator, adjust CARRIER LEVEL output of MTS-5. Refer to Section 4.2.
- 1.7 Adjust AUDIO LEVELS at MTS-5. Refer to Section 4.4

## **2.0 INTRODUCTION TO THE MTS-5**

The Learning MTS-5 provides a space-efficient means of generating high-quality TV audio in BTSC stereo format, and optionally, also in SAP (Second-Audio-Program) format.

The MTS-5 generates the U.S. broadcast-standard BTSC format, including dbx® companding. Left and Right baseband audio inputs are processed into a composite multiplex stereo signal. This signal is available from the MTS-5 both at baseband and on a 4.5 MHz carrier. Separate video sync input and 4.5 MHz audio carrier output loops are standard.

The MTS-5 has dual stereo inputs. The second input may be used for local ad insertion, or as an audio backup.

The MTS-5 includes automatic audio gain controls (AGC), which can significantly reduce the program level variations that often occur when the program source changes.

The MTS-5 displays audio program levels with dual peak-reading 10-segment LED bargraphs, and AGC status with OK & HI LED indicators.

A Second Audio Program (SAP) generator sub-board may be easily snapped onto the main MTS-5 board; only a few internal jumpers need to be re-positioned on the main board. No calibration is required, other than setting the SAP audio input level from the front panel of the MTS-5. The optional SAP sub-board is also equipped with AGC, and peak-level/AGC status indicators.

In addition, for those who may prefer an external SAP generator, a SAP carrier input is provided on the MTS-5. The Learning SAP-1 or SAP-2 can be powered by the MTS-5.

A Bessel-null calibration test tone is built-in to ensure a simple and accurate setup when the composite baseband interface is used.

A thorough complement of front-panel switches, level controls, and LED indicators facilitates use of the MTS-5's features.

### **3.0 INSTALLATION**

Refer to the CONNECTIONS drawings at the end of this book for illustrations of how the MTS-5 hooks to the other components in the system. Note that it is always necessary for the video to loop through the MTS-5 in order to phase-lock the stereo pilot to the horizontal sync of the video.

#### **3.1 AUDIO INPUT**

For signals from a balanced source, connect a shielded audio cable pair from the left channel of your stereo audio program source to the left channel of Input "A" ("A Audio In", "LEFT") on the MTS-5. Run an additional shielded cable pair from the right channel of your program source to the right "A" input ("A AUDIO IN", "RIGHT"). Be sure that the + goes to the +, and the - goes to the -.

For signals from an unbalanced source, connect the high to the "+" and the shield to the "-". Also, tie the "-" to the "G" (Ground) terminal if the two chassis are not otherwise electrically grounded to each other.

**NOTE:** The screw-terminal strips located on the back panel of the MTS-5 may be removed (unplugged) for ease in wiring, and detachment also facilitates reading the pin identification on the rear label.

##### **3.1.1 SECOND (B) AUDIO INPUT**

"Input B" can be used for local ad insertion or backup audio. The B input is wired in the same procedure as that listed in Section 3.1, with the exception that it is wired into Input B (B Audio In) on the back of the MTS-5, rather than Input A. See Section 4.3 for information regarding the selection of A/B inputs, and the optional use of the main (stereo) audio's "B" input to also feed an alternate signal to the optional internal SAP generator.

## 3.2 VIDEO SYNC IN CONNECTIONS

The MTS-5's "VIDEO LOOP IN" must be connected to baseband video (unscrambled), to permit the stereo pilot within the MTS-5 to frequency-lock to it. The "VIDEO LOOP OUT" is to be connected as noted in 3.3.1, 3.3.2, or 3.3.3, depending on the format selected.

## 3.3 COMPOSITE BASEBAND OR 4.5 MHz FEED TO TV MODULATOR

TV channel modulators generally accept BTSC stereo in either of two common formats:

- 1) As a Composite (Multiplexed) Baseband "audio" or
- 2) On a 4.5 MHz subcarrier.

The MTS-5 provides both formats simultaneously. Either format produces satisfactory results. The selection of which format to use is dependent on what your TV modulator will accept, and which has been adopted as the preferred method in your system.

Refer to connection diagrams D2 through D4 (located at the rear of this manual)

### 3.3.1 BASEBAND STEREO MULTIPLEX TO TV MODULATOR

This method uses the audio modulator built into the video modulator; the 4.5 MHz modulator in the MTS-5 is not used. First, verify that your TV modulator is capable of accepting a baseband multiplex BTSC audio signal.

**NOTE:** All video modulators require configuration to accept a BTSC stereo multiplex signal, instead of mono audio. In most cases, this may be accomplished by re-positioning a few switches or jump-jacks in the modulator. Specifically, the 75  $\mu$ S pre-emphasis, and any audio limiting, if present, must be removed. The modulator must have a wide "audio" bandwidth (flat through approx. 110 kHz). Contact your TV modulator manufacturer for configuration instructions.

Once your TV modulator has been properly configured to accept BTSC stereo as a baseband multiplex signal, refer to diagram D2 (at the rear of this manual) for an illustration of the external hookup:

Connect the "VIDEO SYNC IN" loop "OUT" on the MTS-5 to the "Video In" on your TV modulator.

Then connect a shielded audio cable from the "BTSC MULTIPLEX OUT" on the MTS-5 to the "Audio In" on the TV modulator.

**NOTE:** The BTSC MULTIPLEX OUTPUT of the MTS-5 is not balanced, When driving a balanced load, the + (Red) goes to the +, any one of the MTS-5's G (Chassis

Ground) terminals goes to - (Black), and another G (chassis ground) terminal goes to the shield (drain) wire.

For signals to an unbalanced load, connect the + (red, high) to the +, and the shield (and Black, if present) to "G" (Ground) terminals at both the MTS-5 and the video modulator.

**NOTE:** If you are using the 4.5 MHz (Audio Carrier) output of the MTS-5, instead of the baseband multiplex output of the MTS-5, there is no need to connect anything to the "Audio In" of the video modulator or the "BTSC MULTIPLEX OUT" on the MTS-5.

### 3.3.2 4.5 MHz AUDIO CARRIER WITH VIDEO

If the TV modulator you are using accepts the 4.5 MHz audio carrier on the same cable as video, rather than on a separate cable from video, refer to diagram D3:

Connect a jumper cable from the "VIDEO SYNC OUT" of the MTS-5 to the "AUDIO CARRIER IN" of the MTS-5.

Connect another cable from the "AUDIO CARRIER OUT" on the MTS-5 to the "Video plus 4.5 MHz Input" on your TV modulator.

**NOTE:** If you are using the BTSC MULTIPLEX OUT (baseband) of the MTS-5, instead of the AUDIO CARRIER OUT (4.5 MHz) of the MTS-5, there is no need to connect anything to the AUDIO CARRIER OUT of the MTS-5.

### 3.3.3 4.5 MHz AUDIO CARRIER SEPARATE FROM VIDEO

If the TV modulator you are using requires separate video and 4.5 MHz inputs, refer to diagram D4:

Connect one cable from the "VIDEO SYNC OUT" connector on the MTS-5 to the "Video In" on the TV modulator.

Connect another cable from the "AUDIO CARRIER OUT" on the MTS-5 to the "Audio Carrier In" on the TV channel modulator. Then install a 75 ohm terminating resistor on the "AUDIO CARRIER IN" connector on the MTS-5.

## 3.4 VIDEO SCRAMBLING

Because most video scramblers work at TV I.F. (45.75 & 41.25 MHz), the stereo connections are generally unaffected. However, if there is any possibility that the video is scrambled at baseband, loop the unscrambled video through the MTS-5 before the scrambler; the MTS-5 will not function properly if it is receiving sync-suppressed baseband video (i.e. the stereo pilot cannot sync to baseband-scrambled video).

## 4.0 OPERATION

### 4.1 SETTING THE AUDIO CARRIER DEVIATION

If you are using the 4.5 MHz Audio Carrier Output of the MTS-5, its deviation has been calibrated at the factory; it is not field-adjustable. Skip to Section 4.2.

If you are using the composite baseband multiplex output of the MTS-5, the aural carrier deviation must be accurately set at the TV channel modulator. (Otherwise, stereo channel separation will be less than optimum.)

The TEST position of the "TEST MONO STEREO" switch (located on the MTS-5's front panel) activates a test tone, and shuts off the audio inputs, to facilitate setting the deviation of an external audio modulator.

The most convenient and accurate way of verifying correct deviation is to use the test tone and a spectrum analyzer to observe the first Bessel-null of the carrier.

As alternate methods, you may use either the meter or the peak modulation ( $\pm 25$  kHz) light on your TV modulator.

**NOTE:** If a video scrambler is being used in conjunction with the BTSC stereo generator, to avoid possible interaction with the calibration tone, the scrambler should be off or in the bypass mode while setting the audio deviation.

#### 4.1.1 SPECTRUM ANALYZER & TEST TONE METHODS:

Move the "TEST MONO STEREO" switch to the "TEST" (left) position. Both the "A" & "B" input lights will extinguish. Using a spectrum analyzer, look at the audio carrier from your TV modulator. (For a clear picture, 20 kHz to 50 kHz resolution per division is suggested.) Using the front-panel deviation control on the TV modulator, null the carrier (to the first Bessel-null; see diagram 4-1).

To verify that the deviation is adjusted correctly, check the amplitude of the 15.734 kHz stereo pilot sidebands relative to the audio carrier. To do so, set the test switch to the "STEREO" (right) position and, at reduced audio input levels, look at the audio carrier and both sidebands using a spectrum analyzer (one sideband should be 15.734 kHz above the audio carrier and another sideband should be 15.734 kHz lower than the audio carrier). If the deviation is properly adjusted, the two sidebands should be approximately 16 dB down from the carrier (Refer to diagram 4-2). If they are not, after repeating the Bessel Null procedure, repair and calibration of the equipment is needed.

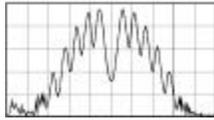


Figure 4-1A  
Correct Bessel-null

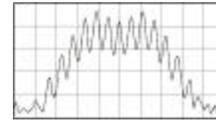


Figure 4-1B  
Incorrect Bessel-null

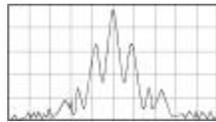


Figure 4-2  
Main Audio Carrier with  
Pilot Carrier Sidebands

Horizontal:

20 kHz/div

Vertical:

10 dB/div

(All Views)

#### 4.1.2 USING THE METER OR PEAK FLASHER ON THE TV MODULATOR:

If you are using the meter on your TV modulator to set the deviation, move the "TEST MONO STEREO" switch to "TEST" (left position). Increase the Aural Carrier Deviation (not Level) until the "±25 kHz" or "100%" or "0 VU" light on the TV modulator comes on. Then, back it off until the light "just" goes off.

**NOTE:** If SAP or scrambling is being used, be sure that it is off or in the bypass mode while setting the deviation.

**OPERATIONAL NOTE:** The audio peak flasher on the TV modulator may flash during normal stereo operation, and more so if SAP is also present.

#### 4.2 AUDIO CARRIER LEVEL ADJUSTMENT

When using the 4.5 MHz audio carrier output from the MTS-5, the carrier level must be adjusted, generally both at the MTS-5 and at the TV modulator. In a typical case, such as when an MTS-5 feeds a Scientific Atlanta 6350, the audio carrier level is adjusted first at the MTS-5 while monitoring the TV channel output of the SA 6350 with a spectrum analyzer: Increase the carrier level at the MTS-5 until the output of the 6350 ceases to increase, indicating that the 6350 has achieved limiting. This is the optimum drive level to the 6350; less drive results in noisier audio, and more drive may splatter the audio into the video. Then adjust the Aural Carrier Level on the 6350 to set it at the desired output level, which is usually 15 dB below the (unmodulated) video carrier.

#### 4.3 "A"/"B" AUDIO INPUTS

LEDs indicate which input is active, as selected remotely, or by the front-panel switch (which can enable or override the remote control). If power is applied, and neither "A" nor "B" is illuminated, the MTS-5's TEST/MONO/STEREO switch is in Test mode.

#### 4.3.1 LOCAL & REMOTE AUDIO INPUT SELECTION:

Selection of "A" or "B" inputs, or switching the optional SAP carrier on, may be accomplished either locally, or remotely. The "A" and "B" positions of the front panel switch will override remote A/B control.

By grounding a line connected to the A/B terminal on the rear panel of the MTS-5, if the front-panel switch is in the center "REM" position, the "B" inputs will be selected.

The "REM" terminal is normally pulled to +5 volts by a resistor; any switch, relay, or appropriate logic device capable of sinking 0.5 mA and pulling the line to within a volt of ground may be used.

#### 4.3.2 INTERNAL SAP "B" INPUT:

The internal SAP generator is normally connected to the SAP audio program input at all times. This is generally not a problem, because much of the equipment which can insert local commercials can switch both the mono SAP audio and the stereo program audio. If it cannot handle all three channels (Left, Right, & SAP), the MTS-5's A/B switch can handle the stereo, leaving the commercial insert equipment to handle the mono SAP program switch-over.

In the event that it is desired to switch the SAP audio to the same signal as the stereo channel's "B" signal, and at the same time as the stereo channel switches to the "B" channel, a jump-jack internal to the MTS-5 can be positioned to accomplish this. That location is labeled P725, and it is on the main MTS-5 board, just in front of the SAP sub-board. Then, when the main (stereo) channel's "B" input is selected (either locally or remotely), that same stereo audio program will also be delivered (in mono) to the SAP channel. The "B" SAP program level is pre-calibrated; if the stereo level is correct, the SAP level will be correct.

If no jump-jack is installed on P725, the internal SAP's audio is always straight-through (unswitched).

#### 4.4 STEREO AUDIO LEVELS and AGC CONSIDERATIONS

The MTS-5 is furnished with two sets of level controls on the front panel: "A LEVEL" "LEFT" & "RIGHT" and "B LEVEL" "LEFT" & "RIGHT". Stereo audio program levels are monitored with dual peak-reading LED bargraph meters.

While listening to the audio program, with the audio AGC OFF, use a small flat-blade screwdriver thru the front-panel access holes to adjust the corresponding level controls so that both the left and the right meters read approximately 0 VU (regular flashes of the yellow LEDs on program peaks). The red +3 VU LEDs may flash briefly with very loud program peaks.

**NOTE:** It is recommended that the program be listened to while adjusting the audio level controls, to ascertain that the peak indicators are flashing only on material that is intended to be loud.

If desired, the audio AGC may be switched on after setting the audio levels. There should be no significant level change during normal program, but any over-modulation will be quickly reduced (within milliseconds); conversely, prolonged under-modulation will be gradually increased. The under-modulation correction is 1:2 dB; that is, if the 15-second time-averaged peak input level drops 10 dB, the peak output level will drop only 5 dB. The maximum under-modulation gain increase is limited to approximately 12 dB, in order to avoid increasing background noise excessively.

#### 4.5 AUDIO AGC OK & HI INDICATORS:

When the audio AGC is on, the OK LED is illuminated whenever the incoming audio program level is within the normal range of the AGC, where the AGC can "silently" maintain good program dynamics.

The OK LED may extinguish if the program level remains very low for approx. 15 seconds or more. If the OK LED extinguishes regularly, listen to the audio program to determine whether or not it is intended to be very quiet. If not, re-adjust the appropriate front-panel potentiometers so that the OK LED, but not the HI LED, is usually illuminated.

If the incoming program level increases substantially from the initial setting, the HI LED will become brighter and remain steadily illuminated, and the OK LED will extinguish, indicating that the audio AGC is maintaining a relatively constant peak output level. If the HI LED is on steadily, or for a significant time, the input level should be manually reduced somewhat with the appropriate front-panel potentiometers, in order to maintain optimum program dynamics.

It is not essential to switch the AGC off to make minor adjustments of the level controls; the VU meters give a continual indication of the outgoing audio levels, and the OK & HI LEDs give a long-term indication of how hard the AGC is working. In general, the OK LED should always be illuminated, unless there has been a 15-second period of silence (signal peak levels over 20 dB below the recent peak levels), in which case the OK LED will extinguish. At that time, the AGC will return to its standby gain setting, awaiting the arrival of program material, at which time it will automatically re-activate.

The HI LED should flash occasionally and very briefly on exceptionally loud program peaks. The HI LED should not normally remain on for more than a few milliseconds. If it does remain illuminated, the program levels should probably be manually reduced, to optimize the AGC's range. (There may be a several-second delay before extinguishing the OK and HI indicators after the incoming program level is reduced, but there is essentially no delay before illumination as the program level is increased.)

Whenever setting the audio levels, observe the VU indicators, and listen to and watch the program, to ensure that the adjustments you are making are appropriate. Unless you are compensating for a known problem elsewhere, mechanically position the Left and Right potentiometers identically to maintain normal channel balance.

#### 4.6 STEREO / VIDEO SYNC LED

The Stereo LED, on the front panel above the "TEST MONO STEREO" switch, will dim if the MTS-5 has lost video sync. The MTS-5 will continue to produce the BTSC signal, but the stereo image may shift slightly. If the Stereo LED dims, the cabling between the video source and the MTS-5 should be checked.

#### 4.7 SAP CARRIER ON LED:

This LED is illuminated whenever the SAP carrier (internal or external SAP) is switched on at the MTS-5, either by remote control or front-panel switch.

#### 4.8 SAP CARRIER LEVEL SETTING

(External SAP generator only; if using the MTS-5's optional "plug and play" internal SAP generator, the MTS-5's SAP level control regulates the SAP audio program level; the internal SAP generator's carrier level has been factory-calibrated.)

If no internal SAP generator is installed in the MTS-5, the MTS-5 will accept a carrier from an external SAP generator. Adjust the SAP carrier level control to illuminate the MTS-5's green SAP OK LED, leaving the yellow SAP HI LED extinguished. That will produce  $\pm 15$  kHz deviation of the audio carrier by the 5F<sub>H</sub> (78,670 Hz) SAP carrier.

#### 4.9 SAP AUDIO LEVEL; OK & HI LEDS:

These LEDs serve triple-duty:

A) If using external SAP, they indicate carrier level, which may be adjusted with the adjacent potentiometer.

B) If using the optional internal SAP generator, these LEDs indicate the SAP audio program level, which is also adjusted with the adjacent potentiometer. (The LED and potentiometer functions change when the internal SAP generator is installed.)

C) With the internal SAP, if the audio AGC is on, the LEDs indicate the SAP AGC activity (see 4.5, above; the SAP and the stereo AGC's function identically).

## 5.0 SPECIFICATIONS

Frequency Response	(overall)
Stereo:	20 Hz to 15 kHz, $\pm 1$ dB
Optional internal SAP:	50 Hz to 10 kHz, $\pm 1$ dB
Distortion	
Stereo:	0.5% max. THD
Optional Internal SAP:	1% max. THD
Separation	>30 dB, 20 Hz to 10 kHz typ.;
	>26 dB, 20 Hz to 13.5 kHz
Signal-to-Noise Ratio	>65 dB, overall through receiver & expander
Pilot Protection	>50 dB at 15,734 Hz
Test Tone	2.5 V <sub>p-p</sub> @ 10.4 kHz
Compressor, L-R	dbx® licensed (BTSC Standard)
Nominal Input Level (APL)	0 dBm, adjustable $\pm 10$ dB
Peak Input Level	10 dB above nominal
Audio Input Impedance	100 k-ohms, balanced
SAP Input Level (External carrier)	1.4 to 10 V p-p into 100 k-ohms, adjustable
Composite Stereo Baseband Output Level	0.1 V <sub>p-p</sub> /kHz dev. into hi-z load (Source impedance = 75 ohms; min. load 600 ohms)
4.5 MHz Output Level	0.4 V p-p into 75-ohm loop, adjustable
4.5 MHz Freq. Tolerance	Locked to video at 286 F <sub>H</sub> ; if no video, may drop 1 kHz to 4.499 MHz.
4.5 MHz Harmonics	>-50 dB re: .250 V p-p
Deviation, Peak	$\pm 25$ kHz, mono $\pm 50$ kHz, stereo $\pm 5$ kHz, pilot $\pm 15$ kHz, SAP
	> $\pm 100$ kHz maximum
Controls (Front Panel)	AGC On/Off Input Levels, A & B, Left & Right A/B Input sw. w/ Remote position Test/Mono/Stereo switch SAP Carrier switch SAP Carrier Level 4.5 MHz Carrier Level

## 5.0 SPECIFICATIONS, continued

LED Indicators	AGC OK, HI Dual (L&R) Peak-reading 10-segment bargraphs, A/B Input Stereo On SAP Carrier On SAP OK, HI
Connectors (Rear Panel)	Video (sync) Input Loop; 4.5 MHz Output Loop (Four F-type std.; BNC opt.) Audio Input A; Audio Input B; Composite Stereo Out & SAP Input Remote A/B Select & Sync Output (Four detachable screw- terminal plugs)
Audio Input Connectors (Two)	PIN 1 R+ PIN 2 R- PIN 3 G PIN 4 L+ PIN 5 L-
BTSC Multiplex Output & SAP Carrier Input	PIN 1 SAP + PIN 2 SAP - PIN 3 BTSC + PIN 4 Ground
Remote Control & Sync Output	PIN 1 A/B Input Select PIN 2 Sync Output PIN 3 Ground PIN 4 18 V Output PIN 5 SAP Remote CXR On
Size	1.6 inches H x 8.75 inches W x 18 inches D. Mounts on 1/2 of a PMU422 19-inch panel mount
Weight	5 lb.
Power	105-125 V, 50-60 Hz, 5 VA 210-250 VAC (factory config.)

## **6.0 AUDIO PERFORMANCE EVALUATION**

When verifying performance specifications of the MTS-5, be sure that none of its features interfere with the item being tested. Specifically, frequency response tests should be run with the AGC off, and at a level approximately 20 dB below 100% modulation. The reason is that the standard pre-emphasis will cause apparent frequency response errors, when running either with the AGC on, or at 100% modulation at high frequencies, due to AGC action and/or over-modulation limiting.

## **7.0 TROUBLESHOOTING**

### **7.1 COMMON SETUP ERRORS**

If the problem is low program level when listening in mono, but the stereo level seems OK, the phase of either the Left channel or the Right channel (but not both) needs to be reversed. Refer to sections 3.1, 4.3, and 4.4.

If the problem is somewhat excessive noise, and you are using the 4.5 MHz connection to the video modulator (not the baseband multiplex connection), the front-panel Audio Carrier Level control of the MTS-5 probably needs to be set higher. Refer to section 4.2.

If the program is overly sibilant ("hissy"; too much treble), and you are using the baseband multiplex connection to the video modulator (not the 4.5 MHz aural carrier), it is very likely that the TV modulator has not been configured to accept Baseband Multiplex Stereo. In addition, poor separation will be caused by this same error. Once the video modulator is properly configured, follow the setup instructions in section 4.1.

*EXPLANATORY NOTE:* The likely reason that the TV Channel Modulator may not have been configured to accept a BTSC Multiplex Stereo signal is that, when shipped from the factory, Channel Modulators are typically configured to accept Mono Program Audio, not Multiplex Stereo. Usually, it is simple to re-configure the modulator, for BTSC stereo, using its internal jumper-jacks or switches. (Refer to the Channel Modulator's instruction manual for instructions.)

*NOTE:* Mono uses 75 microsecond pre-emphasis, and may have a 15 kHz audio low-pass filter. However, BTSC stereo requires its pre-emphasis to be in the stereo generator, not at the modulator. In addition, the modulator must have flat frequency response up to at least 50 kHz, and possibly up to 110 kHz (depending on whether SAP and PRO channels are in use).

### **7.2 TROUBLESHOOTING WITH A STEREO DECODER**

First, determine that the MTS-5 alone is functioning normally. If you have access to a Leaming TSD (Television Stereo Decoder), or any other suitable stereo decoder, connect it directly to the output of the MTS-5 stereo generator. Follow the instructions that came with the stereo decoder.

## 7.2.1 USE YOUR EARS

Even if you are connecting audio-analyzer instrumentation to the stereo decoder, also listen to the stereo program from the audio outputs of the stereo decoder. Human ears can usually detect significant problems much more quickly than meters, and audible traits of the problem will generally reveal its cause.

Once the MTS-5 has been determined to be functioning normally, connect the MTS-5 back to the video modulator, and connect the stereo decoder to a monitor output of the cable system, through a set-top converter box if necessary. Repeat the performance tests. Re-read section 6.0 through 7.1.

If no professional stereo decoder is available, connect the channel to a known-good stereo TV.

Use appropriate attenuators in the line to keep from overloading the monitor's front-end.

## 7.3 TROUBLESHOOTING WITHOUT A STEREO DECODER

If no stereo decoder is available, but a spectrum analyzer or an oscilloscope is available, and an audio signal generator is also available, some troubleshooting is still possible.

### 7.3.1 TROUBLESHOOTING WITH A SPECTRUM ANALYZER

To help determine if the MTS-5 is at fault, check the 4.5 MHz output of the MTS-5 (even if you are not using it), directly at the back panel the MTS-5, with a spectrum analyzer. Use the procedure in section 4 of this manual. If the sidebands appear as described (and illustrated in Figs. 4-1A and 4-2), the test tone and the stereo pilot of the MTS-5 are functioning correctly.

Next, while still observing the stereo pilot on the spectrum analyzer, apply audio to both Left and Right channels at 0 VU (100% modulation). The aural carrier should appear frequency-modulated, deviating  $\pm 25$  kHz from the center frequency. Then turn down the audio on one channel (either Left or Right) while leaving the other at 0 VU. Modulated Sidebands should appear, centered at approx. 32 kHz above and below the aural carrier.

Reconnect the MTS-5 into the video modulator and connect the spectrum analyzer to the channel output of the video modulator (or the cable system) and tune the spectrum analyzer to the aural carrier frequency of that TV channel. Repeat the tests from the preceding paragraph; the results should look identical, if the interface with the video modulator is correct, and if any video scrambling has been bypassed.

If these appear normal, the MTS-5 is generally functioning correctly. However, this simple test only indicates that the MTS-5 has an output which is modulated by the audio, and that the hookup to the video modulator is possibly correct. It cannot show that the internal calibration of the stereo

generator is correct. For that, and to verify correct interface with the video modulator, a stereo decoder is essential.

### 7.3.2 TROUBLESHOOTING WITH AN OSCILLOSCOPE

If just an oscilloscope is available, it is still possible to check the basic normality of the composite baseband multiplex output of the MTS-5.

Place the "TEST MONO STEREO" switch in the "TEST" position. The output should be 10.4 kHz at 2.5 Vp-p. Next, with no audio input to the MTS-5, move the "TEST MONO STEREO" switch to the "STEREO" position. The output should be the 15,734 Hz pilot at 0.5 Vp-p (ignore the noise peaks; read the "average" peak). The absolute values are not critical, but the 5:1 ratio is critical. If this ratio is correct, the test tone and the stereo pilot of the MTS-5 are functioning correctly.

**NOTE:** When in the stereo mode, the 15,734 Hz sine-wave-shape on the oscilloscope will appear slightly noisy. This is normal, caused by the difference-channel compander operating at very high gain in the absence of an audio signal.

Next, while still observing the stereo pilot on the oscilloscope, connect an audio signal generator to the Left and Right audio inputs of the MTS-5. Set the signal generator to produce a 1000 Hz tone at approx. 1 volt RMS. Connect the oscilloscope to sync on the audio signal generator. Set the MTS-5 input level controls to cause an indication of 0 VU (100% modulation) on the MTS-5's meters.

The baseband output should appear on the oscilloscope as a 2.5 Vp-p 1000 Hz sine wave with a 0.5 Vp-p 15,734 Hz sine wave riding on it. Then turn down the audio on one channel (either Left or Right) while leaving the other at 0 VU. An envelope should appear on the oscilloscope similar to that above, but with an amplitude-modulated 31,468 Hz tone added (the Difference Channel Carrier). The phase and amplitude of the modulated envelope are difficult to describe, because of the effects of the dbx® difference-channel companding, but if what you see resembles this, the MTS-5 does have a modulated output. For more meaningful evaluation, a stereo decoder is necessary.

## **8.0 INTERNAL SAP GENERATOR INSTALLATION & CONFIGURATION**

- 8.1 Installation of the optional SAP generator sub-board in the MTS-5 requires a Phillips screwdriver, to remove the screws which hold the MTS-5 to its Leaming PMU422 rack mounting panel, and then to remove the cover of the MTS-5.
- 8.2 Prior to removing the MTS-5 from the rack, disconnect all rear-panel connectors, to facilitate handling the MTS-5, and to reduce the likelihood of damaging the connecting cables. Mark all cables to help identify them during re-connection.
- 8.3 Also, prior to removing the MTS-5's cover, unplug the AC line cord, to prevent accidental damage to the MTS-5 during installation of the SAP generator sub-board, and to eliminate any possible shock hazard.
- 8.4 After the MTS-5's cover is removed, and before installing the SAP sub-board, remove the (blue) jump-jack connecting pins 1 and 2 of P712. The 12 pins of this connector are the interface between the MTS-5 and the SAP sub-board. Stow the jump-jack on ONE of the pins of P725, for possible use when configuring the SAP's "B" audio input (See 8.9, below).
- 8.5 To enable the SAP's audio / AGC indicators, four other jump-jacks must be repositioned. These are P717A, P717K, P718A, and P718K. The four are in a row, just behind the LED indicator sub-board, near it's right end (as viewed from the top front). When no internal SAP is installed, the jacks are in the forward position (to enable external SAP carrier level indication). When an internal SAP sub-board is installed, jump-jacks on P717-718 must be moved to their rear position.

**NOTE:** If this is not done, the audio and AGC OK/HI level indications will be incorrect.

As these jump-jacks are quite closely spaced, the use of needle-nose pliers is recommended when re-positioning the jump-jacks.

- 8.6 Inspect the SAP sub-board; ensure that four 3/16" nylon spacer-retainers are installed on the bottom (not component) side of the sub-board), one in in each of the four 3/16" diameter holes at the corners of the sub-board. (The spacers are the same size at each end; either end may go up.)

**CAUTION:** Be sure that the MTS-5 has been disconnected from the power line; when the spacer/retainers are pressed into their mounting holes, because the main board will flex downward, and wires extending from its bottom will probably touch the chassis. If power were present, damage to the unit would result. (The warranty does not cover vaporized copper traces.)

In addition, if the safety (green, ground, third) wire is not properly connected, the jolt could shock you. Unplug for your health!

- 8.7 Align the sub-board, component side up, with J712 directly above P712. The pins of P712 go up through the SAP sub-board, then into J712: To facilitate mating, set the two rear spacer/retainers on, but not yet fully in, their mating holes in the main MTS-5 board. Slip J712 onto P712. The spacer/retainers will seat on the main board. Using a 1/4" or 5/16" nutdriver over each spacewwr/retainer, one at a time, firmly press on the top side of the sub-board at each of the four spacer/retainers to seat their tabs into the mating holes.

**NOTE:** The nylon tabs may need gentle coercing to get them through their board-mounting holes. It may help to wiggle the nutdriver a bit, to slide the tabs in progressively, rather than straight-down. In extreme cases, it may be necessary to gently fold the tabs slightly toward each-other (with strong fingers or delicate pliers), prior to setting the sub-board in place.

#### 8.9 CONFIGURATION OF SAP A/B PROGRAM SWITCH

The MTS-5 has full stereo A/B program switching capability, but limited internal SAP A/B switching. Under most conditions, this is not a problem. Under normal conditions, all SAP program audio is delivered to the SAP audio connector on the rear panel. If it is desired that SAP audio be switched to a "B" line for local insert, that may be handled in one of two ways, depending on the source of the SAP's "B" audio program:

If the SAP's "B" audio can be the same signal as the main program's "B" input, that is handled internally in the MTS-5, by installing a jump-jack connecting the two pins of P725 (on the main MTS-5 board, just in front of the SAP sub-board, near U725 and to the right of P&J712.) When so configured, the SAP "B" audio level is internally coupled to the main (stereo) channel's "B" front-panel controls. If the main channel level is correct, the SAP channel level will be correct.

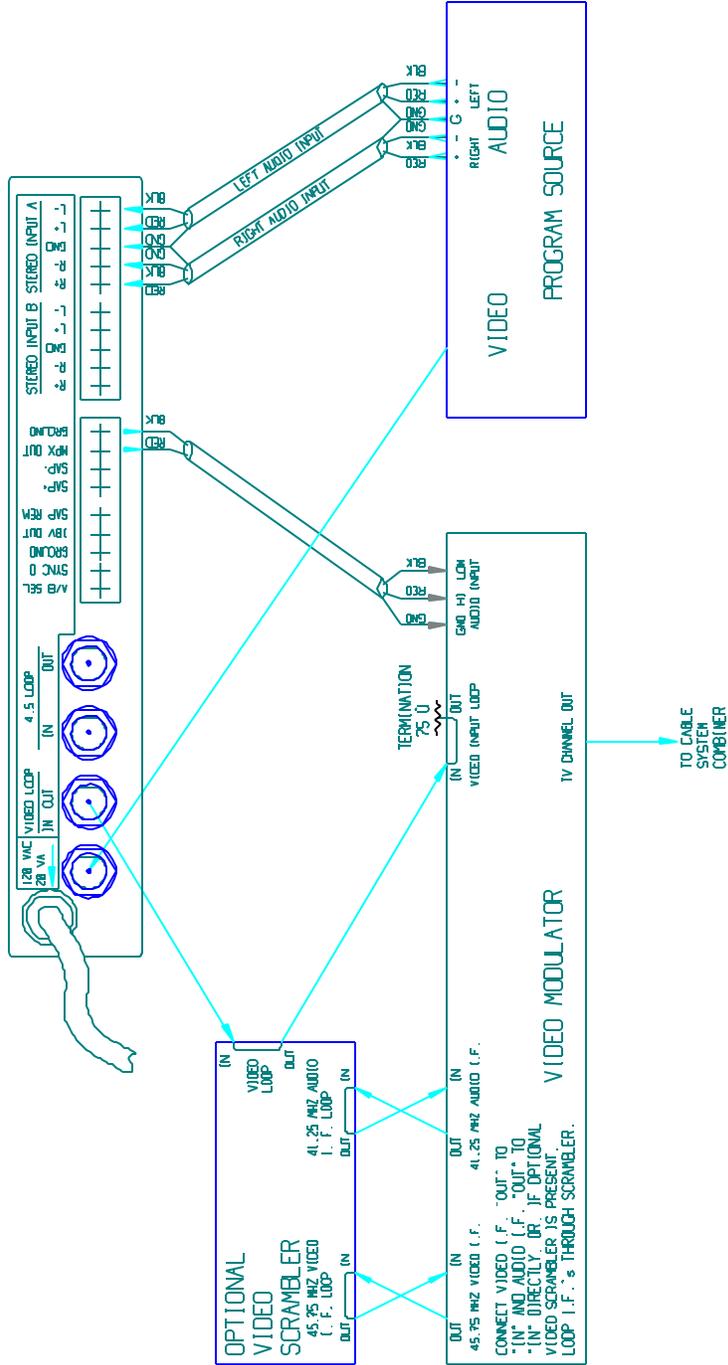
If the SAP channel's "B" program is derived from a separately-provided source, that must be switched external to the MTS-5, generally by the local-commercial switchgear. That switchgear should have provision for setting the "A" and "B" program levels independently.

If that switchgear is not capable of handling the two channels of stereo plus a third channel with SAP, the MTS-5's internal A/B switch can handle the stereo program, leaving the external switchgear free to handle the SAP program, and also to signal the MTS-5 to switch the main program (stereo) to the "B" input.

8.10 Re-install the cover on the MTS-5, connect the cables, including a new one for the SAP audio input, and verify that all works.

8.11 Refer to Section 4.5, above, for information on use of the SAP channel's Audio AGC OK & HI LED indicators. The only difference is that the SAP channel's indicators also illuminate when the AGC is off, flashing to indicate instantaneous SAP program level. When the AGC is switched on, the function of the SAP OK & HI LEDs changes to indicate how "hard" the AGC is working to keep the level within an acceptable range. (One switch actuates both the stereo AGC and the SAP AGC.) This display also illuminates quickly on peaks, but is considerably slower to extinguish, because the AGC release is very gradual, especially in the OK range.

STEREO GENERATOR REAR VIEW



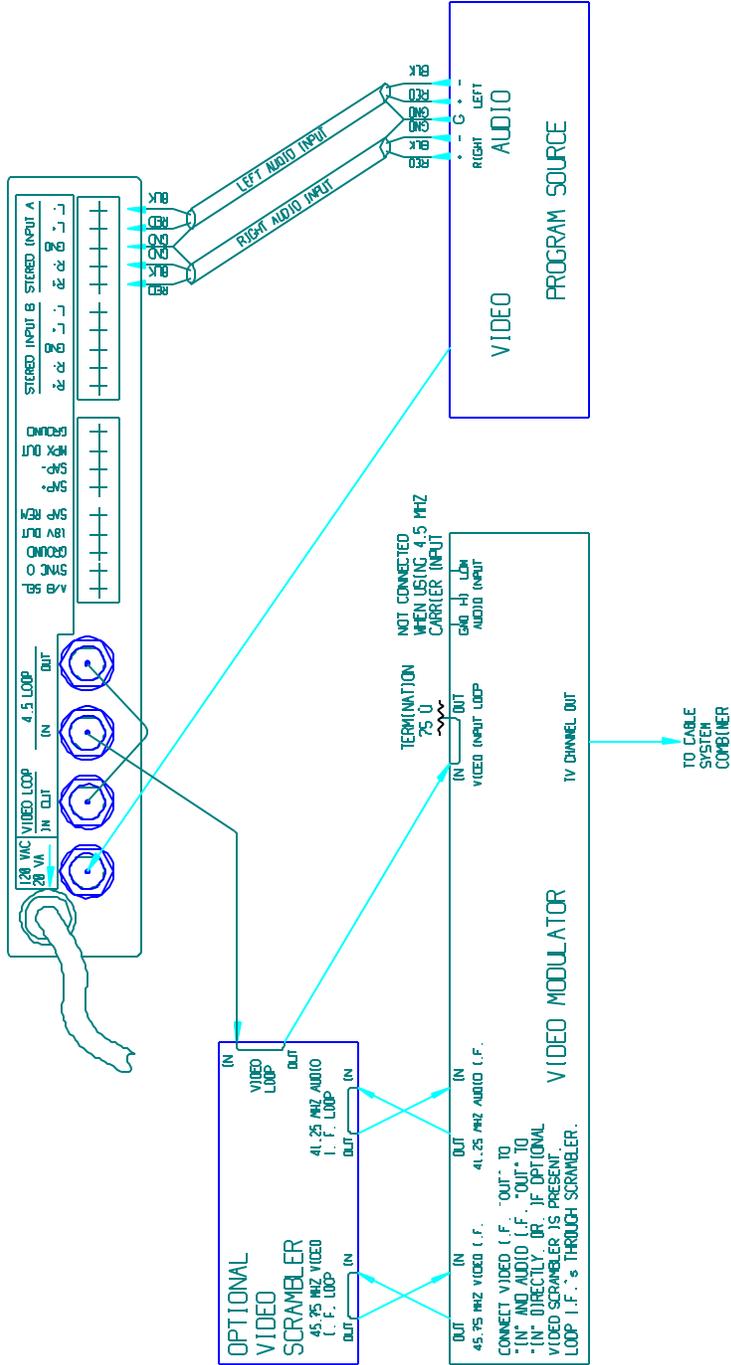
D2

STEREO BASEBAND (COMPOS. MPX.)  
 CONNECTIONS. MTS-5 TO VIDEO MOD.

LEARNING INDUSTRIES, INC.  
 3905 Barranca Parkway, #608, Irvine, Calif. 92618-1919 714-523-1844  
 DR: K. G. Rauch DATE: 10 APR 82 DES. NO.: A0554180  
 UNIT: AD 003095-12 B

SYM REVISION DESCRIPTION REV DCD RT DATE

STEREO GENERATOR REAR VIEW



D3

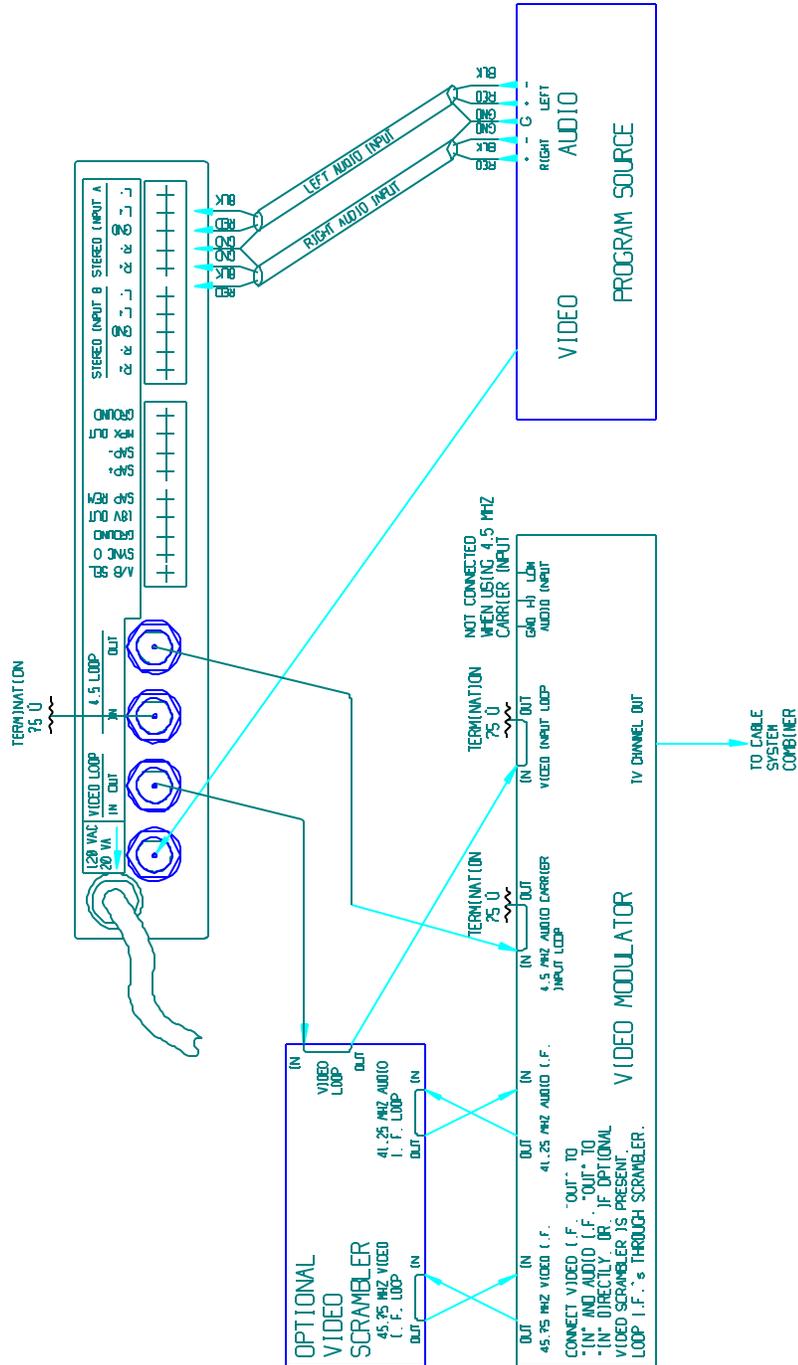
STEREO @ 4.5 MHz WITH VIDEO CONNECTIONS. MTS-5 TO VIDEO MOD.

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 CRO. R. F. L. DATE: AD 003095-13 B

SYM REVISION DESCRIPTION

REV DKO RT DATE

STEREO GENERATOR REAR VIEW



STEREO 4.5 MHz SEPARATE FROM VIDEO CONNECTIONS. MTS-5 TO VIDEO MOD.

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