LEAMING SAP-1 and SAP-2
SECOND AUDIO PROGRAM GENERATORS

INSTRUCTION BOOK
IB 091611-01D

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QUICKSTART

If you are familiar with BTSC standards and SAP generators, perhaps these brief hints will be enough to set up your SAP generator. If not, refer to the following pages, which cover the subject in greater detail.

1. Connect power:
   There are two versions of the SAP generator, the SAP-1 and the SAP-2.
   The SAP-1 contains an internal power supply which operates from 105-125 VAC, 50-60 Hz; just connect the mains plug to a conventional 120-volt AC outlet.
   The SAP-2 is designed to be powered by a Leaming BTSC Stereo Generator; any MTS-2 with 8-pin Remote connector, or MTS-4 with audio AGC, or MTS-5, is suitable to power the SAP-2, which requires +18 V regulated.

2. Connect video sync:
   to SAP-1 connect VIDEO LOOP to “F” connectors on rear panel.
   to SAP-2 from Leaming BTSC generator (MTS-2 or -4 or -5) to Pin 2 of 5-pin Remote connector block.

3. Connect SAP subcarrier output to main TV audio modulator, generally:
   for SAP-1, to BTSC-compatible (mono) modulator.
   for SAP-2, to Leaming (or compatible) BTSC stereo generator.

4. Connect audio program input(s).

5. Set SAP subcarrier LEVEL / 4.5 MHz deviation.

6. Set AUDIO LEVEL(s).

1.0 INTRODUCTION:

The SAP-1 and SAP-2 are similar. Both are designed to encode a monaural audio signal into the standard BTSC format for use as a Second Audio Program channel for television transmission. Typical uses include transmission of second language programming, local radio stations, weather reports, and FSK data. The SAP-1 and SAP-2 differences are noted here.

1.1 SAP-1:

The following describes the SAP-1 as it is normally configured and used. It is also possible to configure the SAP-1 to function as described further below for the SAP-2; anything the SAP-2 can do, the SAP-1 can also do, if so-configured (see Section 2.5)

Two program-audio inputs are provided on the SAP-1; one for the SAP program and another for the MAIN (mono) program. A separate level control is provided for each input. The MAIN and SAP inputs are processed and combined into a composite multiplex signal which is sent to a wideband TV audio modulator. The SAP-1 feeds its output to the wideband (50 Hz-100 kHz) audio inputs on the TV audio modulator:

The SAP-1 displays SAP and MAIN audio program levels with dual peak-reading 5-segment LED bargraphs.

The SAP-1 includes dual automatic audio gain controls (AGC), one for the SAP channel, the other for the MAIN channel. These can significantly reduce the program level variations that often occur when the program source changes.

1.1.1 Any BTSC-compatible wideband TV audio modulator may be used, if it is configured for BTSC SAP, which is the same configuration used for BTSC stereo (75 µS pre-emphasis defeated and 15 kHz low-pass defeated).

The SAP audio program is connected to the SAP generator, and the Main (mono) audio program is routed to the second audio input of the SAP-1, where it is pre-emphasized and mixed with the SAP program's subcarrier. Feed the output of the SAP generator to the wideband input of the TV audio modulator.

1.1.2 Alternatively, if the TV audio modulator (mono or stereo) is equipped with both a Main audio input and a SAP (or Auxiliary) subcarrier input, those inputs would normally be used. In this case, the Main audio program would not be connected to the SAP-1, but only to the primary input of the TV audio modulator. The SAP audio program would be connected only to the SAP-1, as usual. The output of the SAP-1 feeds the SAP (or Auxiliary) subcarrier input of the TV audio modulator.

The SAP-1 obtains its sync lock from baseband video, which may be looped-through to a video modulator or scrambler.

1.2 **SAP-2:**

The SAP-2 has two baseband audio inputs, A and B. The dual inputs permit switching to an alternate audio source, such as a local commercial, on the SAP channel. The alternate signal is selectable by either a front panel switch, or by remote control (contact closure to ground). Individual level controls are provided for each input.

The SAP-2 displays the “A” and “B” audio program levels with dual peak-reading 5-segment LED bargraphs.

The SAP-2 includes an automatic audio gain control (AGC); This can significantly reduce the program level variations that often occur when the program source changes.

The output of the SAP-2 feeds a dedicated SAP input on a companion BTSC stereo generator, such as the Leaming MTS-2, -4, or -5 series generators. There it is mixed with the BTSC stereo signal. This composite audio modulates the 4.5 MHz audio carrier, either within the BTSC stereo generator, or at an external wideband audio modulator in the TV channel modulator (depending on the BTSC stereo generator/TV modulator interface).

The SAP-2 obtains power and video sync from its companion BTSC stereo generator.

2.0 INSTALLATION, SAP-1 and SAP-2:

Mount the SAP generator onto a Leaming PMU 413 rack adapter panel. The SAP-1 & -2 are each enclosed in aluminum enclosures, and each occupies 1/3 of a Leaming PMU 413 19" panel mount (1-3/4" high). Connect Sync, Power, Audio Input, and SAP Subcarrier Output lines as follows:

2.1 **VIDEO SYNC LOOP IN-OUT (SAP-1 only, "F" connectors):** Connect the video (before scrambling) thru the SAP-1's video loop. This is a hard-wired loop with a high-impedance tap into the SAP-1, used to synchronize the audio subcarrier with the horizontal sync.

2.2 **THE AUDIO AND REMOTE CONNECTORS** on the SAP generator are a combination plug/screw-terminal type. To wire the connector, simply pull the body of the connector straight back, off the plug inside the chassis. Strip the insulation off the signal wires (approx. 3/16"), slip the wire into the clamp, and tighten the screw. After the wires have been secured, replace the connector body on the plug.

The SAP generator uses three separate connector blocks. To avoid possible connector damage, observe pin/body alignment when installing. The connector groups and pin assignments are noted on the chassis. They are as follows, as observed from the rear of the chassis:

2.3 **POWER INPUT / REMOTE CONTROL BLOCK:** Uses a 5-pin connector: Pin assignments are:

Pin 1**;** REMOTE A/B SELECT (SAP-2 only): Connect (to ground via external switch) if remote A/B control is desired. The normal mode, with front-panel A/B switch in center (REM) position is Input A selected with the remote line open (or at +5 V).

Pin 2; SYNC INPUT**:** Connect with shielded cable to sync output from Leaming BTSC stereo generator, unless using Video Loop on SAP-1 for sync.

NOTE: Connect only one video sync input to the SAP generator; either the Video Loop, or a Leaming stereo generator's stripped sync. If both were connected, the stripped sync would feed back onto the video line, causing interference.

Pin 3; Ground**:** Connect to power supply 0 V. (Ground) if using external source of 18 volts. Also connect to shield on sync cable if using pin 1.

Pin 4; POWER INPUT (+18V): Connect to positive 18 volts if your SAP generator does not have an internal power supply / power cord.

NOTE: All Leaming SAP generators may be powered by +18 V
The SAP-2 is normally shipped set to operate from +18 V, derived from certain Leaming BTSC stereo generators, such as the MTS-2 or MTS-4 (with AGC only) or -5 series. The older MTS-4 (without audio AGC) cannot deliver sufficient power to operate a SAP generator. The SAP-1 is normally operated from its 120-volt line cord. Do not attempt to use an external source of power if using the internal 120-volt supply.

Pin 5; REMOTE ON (SAP SUBCARRIER ENABLE): Connect (to ground via external switch) if remote SAP subcarrier on-off control is desired. The normal mode, with front-panel CARRIER switch in center (OFF) position, is Carrier Off with the remote line open (or at +5 V).

NOTE: Grounding the respective remote control line selects the alternate mode, SAP Subcarrier On and/or Input B, only if the respective switch on the front panel is in the Remote (center) position.

The remote ground may be made by hard-contact switch or relay, or by any suitable solid-state device, which can pull a 10 k-ohm line from +5 V to within 2 V of ground, and release it with over 100 k-ohms.

2.4 **SAP SUBCARRIER OUTPUT:** Uses a 3-pin connector: 1, Ground; 2, High; 3, Low. (For optimum results, use twisted-pair cable with an overall shield).

The SAP-1's output, when used to process the MAIN and the SAP audio programs, must be connected to the wideband audio input of the main TV audio modulator. The TV audio modulator must be a wide-band type, set up in the BTSC mode (pre-emphasis defeated), even though no stereo is present.

Alternatively, the SAP-1's output, if used to process only the SAP audio, and not the MAIN (mono) audio, may be connected the same as a SAP-2 (below): To a dedicated SAP or Auxiliary subcarrier input on a TV audio modulator.

The SAP-2's subcarrier output (78 kHz) should be connected to a dedicated SAP subcarrier input of a BTSC Stereo TV audio modulator, such as a Leaming MTS-2, MTS-4, or MTS-5 stereo generator.

2.4.1 If driving an unbalanced load, the SAP generator's High (+) output line carries the signal and the Low (-) output line, which may also be the shield drain for the signal cable, must be connected to the chassis ("-" or "L", low) of the load (TV audio modulator).

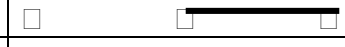
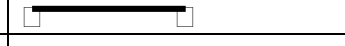
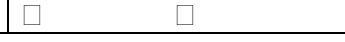
If the SAP generator is being powered by the device being fed the SAP carrier signal, the shield drain wire in the signal cable and / or the sync signal cable provides a satisfactory return for the 18 volt power, but be sure that the power source 0-volt (ground) line is also connected to a pin on the SAP generator marked G (ground), and be sure that the SAP carrier output "-" pin is connected to a line which is either the "-" (or L, low) on the device being fed the SAP carrier.

2.4.2 If driving a balanced load, use shielded two-conductor cable (Three conductors total, High, Low, & Drain, in that cable). The shield normally should be grounded at both ends (source and load), in order to minimize noise.

2.5 **AUDIO INPUTS; A/SAP AND B/MAIN:** These use a 5-pin connector:
For optimum results, use two twisted-pair cables, each with an overall shield.
1, B/MAIN High.
2, B/Main Low
3, Ground.
4, A/SAP High;
5, A/SAP Low;

On both the SAP-1 and the SAP-2, the A input is always used for the (primary) SAP program. Use of the B input differs, and is jumper-jack configurable (JP666 & JP737):

2.5.0 JUMPER-JACK CHART

	SAP-1 SAP-2	FACTORY SETTINGS
JP 737		SAP AUDIO A/B SWITCHING DISABLED
		SAP AUDIO A/B SWITCHING ENABLED
JP 666		MAIN AUDIO + SAP
		DUAL SAP AUDIO INPUTS
JP 665		PRE-EMPHASIS ENABLED
		PRE-EMPHASIS DISABLED

The SAP-1 generally uses the B input for the MAIN channel (Mono) audio program, if any, which is mixed with the SAP subcarrier and applied to the wideband audio input of a BTSC-compatible TV audio modulator. To do this, connect the center and forward pins of JP666 together with a push-on jumper jack. This position is marked “SAP-1” on the top of the circuit board.
Also ensure that the two pins of JP665, “MAIN PRE-EMPH”, are connected together with a jumper jack, unless the main channel audio already has had 75 uS pre-emphasis applied elsewhere in the signal processing chain. If JP665 is not installed, the frequency response of the Main channel will be flat, rather than pre-emphasized. JP665 is normally installed at the factory.

NOTE: If stereo is also present, to avoid interfering with the stereo program, JP666 MUST be in the “SAP-2 (ALL)” position, NOT in the forward (“SAP-1”) position.

The SAP-2 generally uses the B input for an alternate SAP program, such as a local commercial. Enable A/B switching by connecting the center and rear pins of JP737 together with a push-on jumper jack. This position is marked “SAP-2 (& SAP-1, B=MAIN)” on the top of the circuit board.

If configured as a SAP-1 (JP666 in forward position), and if it is desired that the main channel program audio (which is connected to the “B/MAIN” input) be delivered to the SAP channel during local commercial insert, connect the center and rear pins of JP737, as for a SAP-2, enabling A/B switching. Otherwise, to prevent the A/B switch from connecting the SAP-channel audio program source to the B/MAIN channel audio program, connect the forward and center pins of JP737 together with a jumper jack. This position is also marked “SAP-1” on the top of the circuit board.

2.5.1 If the signal source is unbalanced, the High terminal carries the signal and the shield is to be connected to the Low terminal. The Low terminal may also be connected to the ground terminal at the SAP generator, if necessary in order to minimize noise.

2.5.2 If the signal source is balanced, the shield normally should be grounded at both ends, but in some cases, it may be desirable to ground the shield at one end only, generally at the input to the SAP generator, in order to minimize noise.

3.0 SETUP CARRIER LEVELS / DEVIATION:

3.1 **SAP SUBCARRIER ON/OFF AND INDICATOR:** Following connection of the sync, power input, and SAP subcarrier output lines, observe the green SAP CARRIER ON LED on the front panel of the SAP generator; when power is first applied, the SAP ON LED should be dark. If the SAP CARRIER switch is already in either the ON or TEST position, the SAP ON LED should illuminate after a brief delay, indicating that the SAP carrier has achieved lock and is coupled to the output. Thereafter, the SAP On LED should illuminate immediately whenever the SAP carrier is switched on from the front panel, or, if the SAP carrier switch is in the center position, by grounding the Remote line on the back panel. If Video Sync to the SAP generator is not present, the CARIER ON LED will dim noticeably. Under these conditions, the SAP carrier frequency is not locked in synchronization with Horizontal Sync, but will generally remain close enough to the correct frequency to be useable on many receivers. Any flashing of the SAP CARRIER ON LED should be investigated, as it will result in the user loosing the SAP program whenever the CARRIER ON LED is totally dark.

3.2 **SAP SYSTEM CHARACTERISTICS:**
The following is a brief introduction to the SAP channel and its interface to the TV audio modulator.

The SAP audio program frequency-modulates a 78 kHz subcarrier. That 78 kHz SAP subcarrier is added to the main program audio (either mono baseband, or BTSC multiplex stereo composite), and this combination of the main audio and SAP subcarrier frequency-modulates the 4.5 MHz audio carrier. The 4.5 MHz audio carrier is then combined with the video and further processed, but that is beyond what need be considered for an understanding of the SAP interface.

Notice that the 4.5 MHz carrier is being frequency-modulated by another FM carrier, the 78 kHz SAP subcarrier. This 78 kHz subcarrier is at a constant amplitude (because it is frequency-, not amplitude-, modulated by the SAP audio program). This causes a constant deviation of the 4.5 MHz main audio carrier, independent of the SAP audio program. The deviation of the 4.5 MHz carrier by the SAP subcarrier is set at the BTSC standard, ±15 kHz. Significantly lower deviation would result in noisy SAP audio, and a higher deviation could cause the 4.5 MHz carrier to exceed its allowed band occupancy. Consequently, it is important to accurately set the deviation of the 4.5 MHz audio carrier by the SAP subcarrier, even though it has no direct effect on the transmitted SAP audio level.

3.3 **SETTING THE 4.5 MHZ AUDIO CARRIER DEVIATION**: The procedure for setting the deviation of the TV audio modulator's 4.5 MHz carrier varies slightly, depending on the specific hardware being interfaced. Section 3.3.1 details the procedure used with the SAP-1; the SAP-2 is covered in Section 3.3.2.

3.3.1 SETTING SAP CARRIER LEVEL / 4.5 MHZ AURAL CARRIER DEVIATION WITHOUT BTSC STEREO (SAP-1):

First, equipment configuration check. Verify that the TV modulator is a wideband type and that the 75 microsecond pre-emphasis has been defeated, just as for BTSC stereo.

Second, interconnection check. Verify that the SAP generator is hooked into the system as described in Section 2, as it will now be necessary to have SAP carrier output to the TV audio modulator, and, for a SAP-2, DC power.

Third, 4.5 MHz deviation test signal. Leaming SAP generators produce a 2.5 V p-p signal at 78,670 Hz when the CARRIER switch is in the TEST position, if the CARRIER LEVEL potentiometer is in mid-position. (These controls are on the front panel of the SAP generator). This will be the correct setting to feed the SAP carrier input on any Leaming stereo generator, but other brands of TV-audio modulators have various sensitivities.

Fourth, zero (kill) the audio programs on the channel (mono and SAP), if any are present (Any program audio controlled by the SAP generator is automatically muted when in the TEST mode).

Fifth, if not feeding a system which already is equipped with BTSC stereo, set the TV audio modulator's deviation (aural carrier deviation). With the SAP generator producing the TEST signal, adjust the TV audio modulator's deviation control to produce approximately ±25 kHz, as indicated by the peak flasher LED on the TV audio modulator (Not the audio-level LED's on the SAP generator).

NOTE: The TV audio modulator's deviation control is the one previously used to set the TV mono audio program level, prior to BTSC SAP. This "master" deviation control, once set correctly for BTSC Stereo multiplex, or SAP carrier injection levels, must no longer be used to change audio levels in the system, as the result would be incorrect deviation of the 4.5 MHz audio carrier by the SAP subcarrier or the BTSC stereo multiplex signal. The latter results in grossly degraded stereo separation with only a few tenths of a dB error. The audio program levels must be adjusted at (or before) the BTSC SAP and/or stereo generators.

NOTE: The SAP carrier will appear on a spectrum analyzer as two sidebands approx. 16 dB lower in level and equally spaced 78,670 Hz above and below the 4.5 MHz carrier. If necessary, also adjust the SAP CARRIER LEVEL control on the front panel of the SAP generator; generally, leaving it mid-position is satisfactory, but if the deviation control on the audio modulator being fed is at either extreme, it may be desirable to also adjust the carrier level at the SAP generator. If this is done to a video modulator which already is being fed stereo, it is imperative that the video modulator be re-calibrated using the (Bessel-null) test tone in the stereo generator; thereafter, all SAP carrier level adjustments must be made with the control on the front panel of the SAP generator. Otherwise, the stereo left-right separation will be significantly below optimum.

Sixth, switch the SAP generator from TEST to SAP ON. The deviation of the 4.5 MHz carrier will drop to ±15 kHz and the 78 kHz SAP subcarrier sidebands will drop to approx. 20 dB below the 4.5 MHz audio carrier level on the spectrum analyzer (View with no audio programs present).

Seventh, set the SAP and MAIN (mono) audio program levels. Use the controls and meter on the SAP generator (See 4.3 below). This completes the setup.

NOTE: The original mono audio-only deviation indicator on the 4.5 MHz TV audio modulator will indicate "EXCESSIVE" DEVIATION, as it will be reading mono audio deviation plus the deviation caused by the SAP carrier. THIS IS NORMAL with SAP (or BTSC stereo) active; switching the SAP carrier off will produce a "normal" deviation indication from the mono audio alone.

To recap SAP 78 kHz Carrier Level/4.5 MHz Carrier Deviation
Set without BTSC Stereo:

a) Verify that the TV audio modulator is set for BTSC SAP (same as for stereo), not mono.
b) Verify that the SAP generator is correctly connected into the system.

c) Kill the mono and SAP audio on the channel, and use the TEST signal built-into the SAP generator. Set the aural carrier deviation control on the TV audio modulator to produce approximately ±25 kHz deviation of the 4.5 MHz audio carrier, as indicated by the LED flasher, or a deviation meter, or a spectrum analyzer.

NOTE: This carrier level/deviation setting is to be considered permanent. It has no effect on SAP audio program levels, and should not be used for mono program level adjustment. Set audio levels with the appropriate controls and meter on the front of the SAP-1. Ignore the peak flasher on the TV audio modulator, as it will now be subjected to ±40 kHz deviation during peak mono-plus-SAP periods. It was calibrated for ±25 kHz=100% (peak) deviation in regular mono, so it will probably flash often when the SAP carrier is also on.

d) Switch the SAP-1 Carrier to SAP ON.

Then set the audio levels, using the controls and meters on the SAP generator (Described in 4.3).

3.3.2 SETTING THE SAP CARRIER LEVEL / 4.5 MHZ AURAL CARRIER DEVIATION WITH BTSC STEREO (SAP-2 GENERALLY, BUT POSSIBLY SAP-1):

First, equipment configuration check. Be sure that the BTSC stereo generator has been set up correctly. Follow the instructions provided with the stereo generator. (If the channel is already functioning in stereo, it may safely be assumed that this has been done.)

NOTE: If using an audio carrier generator external to the BTSC stereo generator, such as a wideband audio modulator in a TV channel modulator, the "master" deviation control, once set correctly for BTSC stereo injection levels, must never be used to change SAP carrier level, or any audio levels, in the system. The result would be drastically impaired stereo channel separation, due to incorrect deviation of the 4.5 MHz audio subcarrier level. The audio levels must be adjusted at (or before) the BTSC stereo generator and the SAP generator.

Second, interconnection check. Verify that the SAP generator is hooked into the system as described in Section 2, as it will now be necessary to have SAP carrier output to the TV stereo audio modulator, and DC power into the SAP generator, if it is not powered from the 120 volt mains.

Third, Aural carrier deviation test signal. Leaming SAP generators produce a 78 kHz test signal when the CARRIER switch is in the TEST position (This control is on the front panel of the SAP generator). The SAP generator must be connected normally in order to produce the test signal. Switch the SAP generator to the TEST mode. Switch the stereo generator to MONO to kill the stereo pilot.

Fourth, zero (kill) all the audio programs on the channel (stereo and SAP), if any are present.

NOTE: SAP-1 and SAP-2 generators will automatically switch off the SAP audio in the TEST mode. However, the stereo audio program levels must be zeroed manually. (Do not place the stereo generator in its TEST mode, because that will produce an audio signal, generally a 10.396 kHz Bessel-null test tone).

Fifth, set the SAP carrier level/audio carrier deviation. Use the CARRIER LEVEL control on the front panel of the SAP generator to set the 4.5 MHz audio carrier deviation to ±25 kHz. If using an internal 4.5 MHz audio modulator built into a Leaming BTSC stereo generator, and if no auxiliary aural carrier deviation meter is available, the correct SAP carrier level may be closely approximated by setting the CARRIER LEVEL control to half-rotation (12 o'clock). If using an external TV audio modulator, the peak flasher/deviation meter on the modulator should indicate ±25 KHz deviation.

NOTE: The correct deviation of the 4.5 MHz audio carrier by the 78 kHz SAP carrier, when in the TEST mode, will appear on a spectrum analyzer as two sidebands approx. 16 dB lower in level and equally spaced 78,670 Hz above and below the 4.5 MHz audio carrier.

Sixth, switch the SAP generator from TEST to SAP ON. The deviation of the 4.5 MHz carrier will drop to ±15 kHz, and the spectrum analyzer display will show the 78 kHz SAP subcarrier sidebands at approx. 20 dB below the 4.5 MHz audio carrier level on the spectrum analyzer (View with no audio programs present).

Seventh, set the SAP audio program level. Use the control and meter on the SAP generator (See 4.3 below).

Eighth, switch the stereo generator to the stereo mode, and restore the stereo audio. Set the stereo audio levels, using the controls and meters on the BTSC stereo generator. This completes the setup.

NOTE: If using a 4.5 MHz wideband audio modulator external to the stereo generator, the deviation indicator on the TV audio modulator may indicate "EXCESSIVE" DEVIATION, as it will be reading stereo audio deviation <u>plus</u> the deviation caused by the SAP carrier. THIS IS NORMAL with either BTSC stereo or SAP active, and more so with both; switching the SAP carrier off, and the BTSC stereo to mono, will produce a "normal" deviation indication from the mono audio alone.

To recap SAP 78 kHz Carrier Level/4.5 MHz Carrier Deviation
Set with BTSC Stereo:

a) Confirm that the BTSC stereo generator was correctly installed, following the instructions which came with it.

NOTE: Leave the "master" aural carrier deviation control on any (external) TV audio modulator set per the procedure in the BTSC stereo generator instruction manual.

b) Verify that the SAP generator is correctly installed.
c) Switch the SAP-2 Carrier to TEST and the stereo generator to MONO (not TEST).
d) Kill the stereo audio program levels (or stereo test signal), and kill the SAP program, if switching the SAP unit to TEST didn't do it. (Do not change the "master" deviation control setting on the TV audio modulator.)
e) Adjust the 78 kHz SAP CARRIER LEVEL on the front of the SAP-1 to cause the 4.5 MHz TV audio carrier to deviate ±25 kHz, as indicated by the LED flasher, or a deviation meter, or by a spectrum analyzer at the TV audio modulator. (78 kHz Sidebands down approx. 16 dB from audio carrier in TEST, down approx. 20 dB in CARRIER ON.)
If using a Leaming stereo generator, this can be closely approximated by setting the SAP CARRIER LEVEL control to mid-position. This will be very close to the specified ±25 kHz test / ±15 kHz run deviations.

NOTE: This carrier level setting is to be considered permanent. It has <u>no</u> effect on SAP audio program levels.

f) Switch the SAP-2 Carrier from TEST to SAP ON. Set SAP audio levels with the appropriate controls and LED bar meters on the front of the SAP-2.

g) Switch the stereo generator to STEREO. Set the stereo audio levels with the appropriate controls and meters on the front of the stereo generator.

NOTE: If using the Composite Baseband Multiplex feed to an external TV audio modulator, instead of a 4.5 MHz modulator built into the BTSC stereo generator, ignore the overly-active peak flasher on the TV audio modulator, as it will now be subjected to ±70 kHz deviation during peak stereo-plus-SAP periods. It was calibrated for ±25 kHz=100% (peak) deviation in regular mono, so it will flash often when the stereo is on, and even more when the SAP carrier is also on.

3.4 **A FURTHER EXPLANATION OF SAP DEVIATION:**

The SAP carrier (5H, or 78,670 kHz) is to cause a constant deviation of ±15 kHz of the 4.5 MHz audio carrier. (The SAP subcarrier itself may deviate ±10 kHz when fully modulated by SAP program audio, but that is factory-set within the SAP generator and is not part of the installation setup). When viewed on a spectrum analyzer, the SAP subcarrier sidebands appear at 78,670 kHz displacement from, and approx. 20 dB below, the (4.5 MHz) audio carrier, when in the normal SAP CARRIER ON (±15 kHz) mode. In the TEST mode (±25 kHz), the SAP subcarrier sidebands are approx. 4 dB higher, at an amplitude approx. 16 dB below the audio carrier. These sidebands are most easily viewed on a spectrum analyzer when all audio modulation is removed from both the stereo and the SAP channels, and when the stereo generator is switched to mono, to remove the 15,734 Hz stereo pilot.

3.5 **VIDEO SYNC VERIFICATION:**

Observe the green SAP CARRIER ON / SYNC UNLOCKED LED on the front panel of the SAP generator. When power is first applied, with video sync connected, and SAP CARRIER switch ON, the CARRIER LED should be dim for a few moments, then may flash briefly, then become fully bright and steady, indicating that sync lock has been achieved. If the LED continues to be only dimly illuminated, verify that the SAP generator is receiving either clean horizontal sync from a Leaming BTSC stereo generator, or, in the case of the SAP-1, clean video. Be sure the SAP-1 is not connected to both horizontal sync (pin 2 of the 5-pin connector on the rear panel) and video (the "F" or BNC connectors on the rear panel). The SAP-1 must see one or the other, not both. If a videotape is the source, and if it is not time-base corrected, the SAP CARRIER LED may flash periodically as the SAP generator attempts to track the variations of the incoming sync. This is normal, and will not degrade the SAP program noticeably. The SAP carrier is crystal-controlled, and can even operate with no video sync whatsoever, although some SAP receivers may not be able to function properly unless the SAP subcarrier is sync-locked, as it normally is.

4.0 **OPERATION:**

4.1 **SET THE SAP CARRIER SWITCH** to the SAP ON mode (fully-right).

4.2 **SET THE A/B INPUT SELECTOR SWITCH** to correspond with the input you are using (see 2.5, above).

NOTE: The A/B selector switch is functional only when configured as a SAP-2 (or SAP-1 with B=MAIN option), where the switch serves to select the SAP channel input, program A or B. The A/B switch has a center position, which enables the remote A/B select line, pin 2 of the Power/Remote connector on the rear panel.

4.3 **ADJUST THE AUDIO LEVEL CONTROLS** (Input A or B) on the SAP generator so the Program Level meter reads approx. 0 VU (occasional flashing of the yellow LED on loud program material; the red +3 LED should flash only very rarely, if at all).

4.4 **AUDIO LEVELS and AGC CONSIDERATIONS**

Their are two audio level controls on the front panel of the SAP-1 / SAP-2: "A / SAP" and "B / MAIN". 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 through the front-panel access holes to adjust the corresponding level control so that the meter reads 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 ON INDICATOR**:

When the audio AGC is on, the AGC ON 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 AGC ON LED may dim if the program level remains very low for approx. 15 seconds or more. If the AGC ON LED dims 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 potentiometer so that the LED is usually illuminated.

If the incoming program level increases substantially from the initial setting, the yellow 0 VU LED may remain steadily illuminated, indicating that the audio AGC is maintaining a relatively constant peak output level. If the yellow 0 VU LED is on steadily, or for a significant time, the input level should be manually reduced somewhat with the appropriate front-panel potentiometer, in order to maintain optimum program dynamics.

In general, when the AGC is on, the ON LED should always be fully illuminated, unless there has been at least 15 seconds of near-silence (signal peak levels over 20 dB below the recent peak levels), in which case the ON LED will dim. 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.

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.

5.0 **SPECIFICATIONS**

Frequency Response, SAP ch.	50 Hz - 10 kHz, ±1 dB
Freq. Resp, Main ch. (SAP-1 only)	50 Hz –15 kHz, ±1 dB
Distortion, SAP ch.	1% max THD
THD, Main ch. (SAP-1 only)	0.5% max.
Signal-to-Noise, SAP ch.	50 dB min
S/N, Main Ch. (SAP-1 only)	70 dB
Nominal Input Level (APL)	0 dBm, adjustable ±10 dB
Peak-to-Average ratio	10 dB
Audio Input Impedance	100 k-ohms, balanced
Audio Processing, SAP ch.	BTSC standard dbx-TV companding, dbx© licensed
Pre-emphasis, Main ch. (SAP-1)	75 micro-seconds
Automatic Gain Control (AGC)	Adaptive-slope, 2:1 (dB) at & below APL, transitioning to >5:1 (dB) above PPL
AGC Attack time	5 mS, nom.
AGC Release time	20 S / 10 dB, nom.
Limiter	Peak clipper at 15 dB above APL (always in-circuit, but virtually never active when AGC is enabled)
SAP Subcarrier Frequency	5H (78,670 Hz), locked to video sync
SAP Subcarrier Output Level	Adjustable, 0...2.5 V p-p 1.5 V p-p std. @ mid-position (to produce ±15 kHz deviation of 4.5 MHz)
SAP Subcarrier Test Level	1.67 X Output Level above, to produce ±25 kHz deviation
SAP Subcarrier Deviation	±10 kHz at 100% modulation
Subcarrier Output Impedance	60 ohms, balanced or unbalanced, to drive 600 ohm or higher Z load
Front Panel Controls	Input Level (2) Input selector switch (SAP-2) AGC On/Off switch SAP On/Off-Remote/Test switch SAP Carrier Level

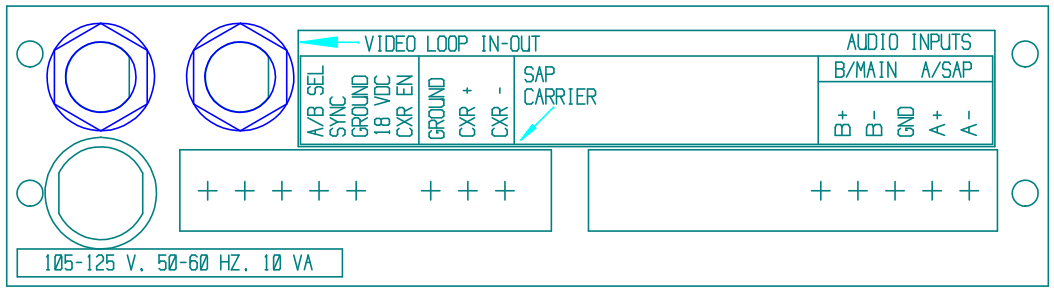
SPECIFICATIONS, cont'd

Audio Level Indicators	Peak-reading 5-segment LED bargraphs Upper, A / SAP; Lower, B / MAIN (Dark in TEST mode)
Status Indicators	A / B Input Selection, SAP-2: (Two LEDs, both on = TEST mode) AGC ON / active SAP Carrier ON/ Carrier Sync Unlocked, bright/dim LED
Rear Panel Connectors	Two 5-pin plug blocks, one 3-pin plug block: Audio Inputs, 5-pin plug block: SAP-1: SAP and Main SAP-2: A and B Pin 1 B/Main + Pin 2 B/Main - Pin 3 Ground Pin 4 A/SAP + Pin 5 A/SAP - Subcarrier Output, 3-pin plug block: Pin 1 Gnd Pin 2 Hi, Pin 3 Low: Power / Remote 5-pin plug block: Pin 1 Remote A/B Select (SAP-2, Ground=B) Pin 2 Sync Input Pin 3 Ground Pin 4 Power Input (SAP-2, +18 volts) Pin 5 Remote SAP Enable (Ground=Carrier on) Two F-type connectors (BNC optional): (SAP-1) Video Sync Loop In & Out
Size, Weight, & Mount (Std. 19" rack)	1.75" H x 5.5" W x 17-1/2" D (excluding connectors) 3-1/2 lb. Net, 6 lb. shipping Requires 1/3 Leaming PMU 413 panel
Power Requirement	
SAP-1	105-125 V, 50-60 Hz, 5 VA
SAP-2	18 VDC, 100 mA (from MTS-2 or MTS-4 or MTS-5)

VIDEO IN-OUT LOOP

IF SAP-1, must be connected to Baseband Video (Not Scrambled) if sync is not fed to SAP from screw-terminal plug strip on Leaming Stereo Generator.
IF VIDEO LOOP IS USED, Do Not use Sync Input (Pin 2) on terminal strip below.

Terminate resistively if Video Loop Input is used and if video is not looped through to another device.



REMOTE A/B INPUT SELECT
(SAP-2 ONLY); OPEN or +5V for "A" Input, or at GROUND to select "B" Audio Input

SYNC Input from Leaming BTSC Stereo Generator

(This sync input is not used if Video is connected to above loop-thru)

GROUND for 18 Volt power

POWER Input +18 V from Leaming MTS-2, or MTS-4A
IF 120 VAC POWER IS CONNECTED TO THIS UNIT,
DO NOT APPLY ANY POWER TO THIS CONNECTOR

REMOTE SAP CARRIER CONTROL; Connect to GROUND for CARRIER ON
Leave OPEN or at +5V for CARRIER OFF

A/SAP AUDIO INPUT

B/MAIN AUDIO INPUT

SAP CARRIER OUTPUT TO WIDEBAND TV AUDIO MODULATOR

IF SAP-1, TO WIDEBAND AUDIO MODULATOR. This line carries the regular Mono Audio at baseband, from the MAIN input on the SAP-1, plus the 78 kHz SAP Subcarrier modulated by the SAP Audio Input.

IF SAP-2, TO DEDICATED SAP or AUXILIARY INPUT of BTSC (STEREO) MODULATOR. This line carries only the 78 KHz SAP subcarrier modulated by audio from either input "A" or "B" of the SAP-2.

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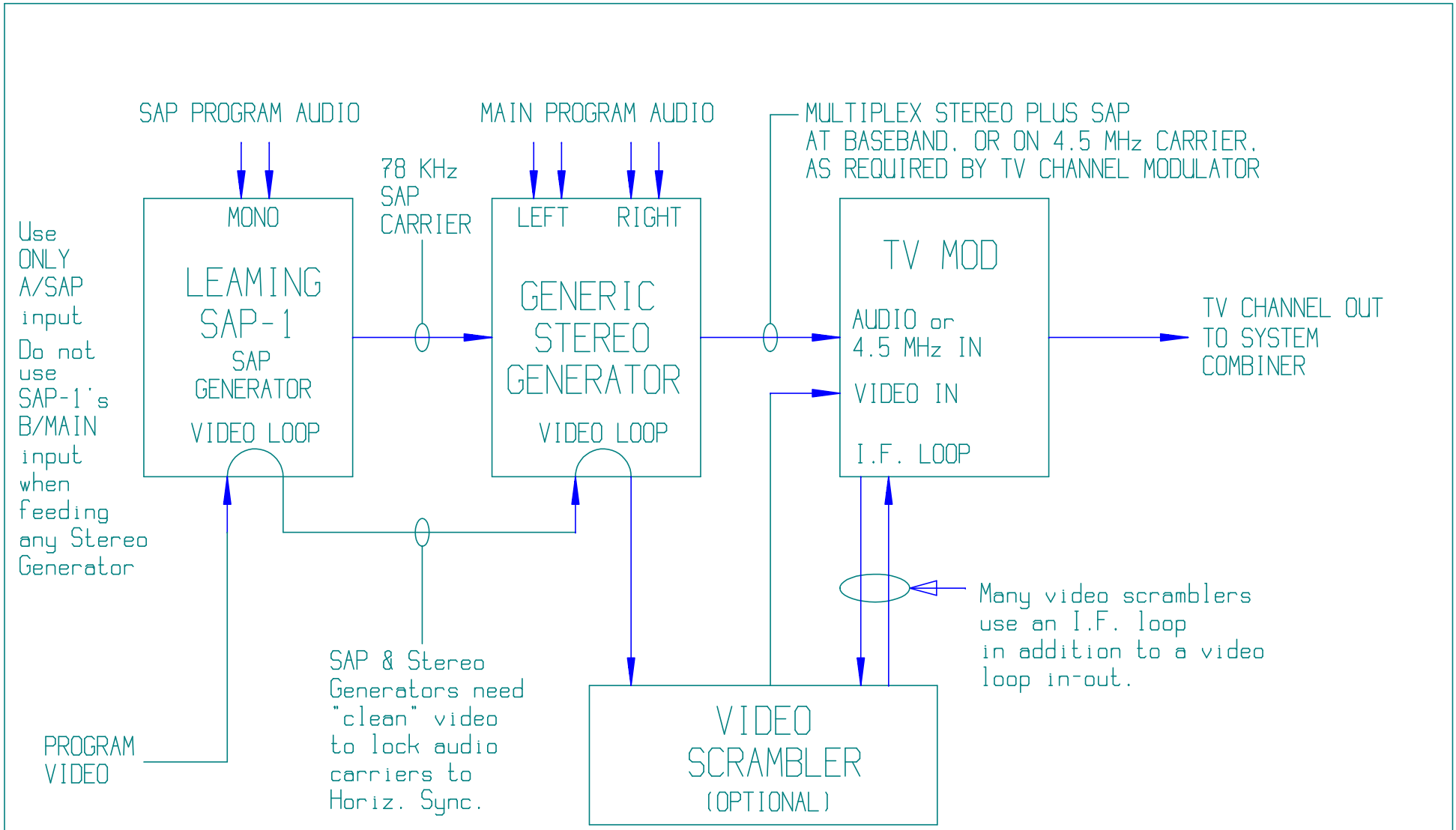
CONNECTIONS, SAP-1A & SAP-2A

LEAMING INDUSTRIES, INC.
3972 Barranca Parkway, J608, Irvine, Calif. 92606 (949) 743-5233

BY: K.G.Rauch	DATE: 27 FEB 02	DWG.NO. ADSP1AB	REV.
CKD: R.F.L.	DATE:	AD 091611-04	B

SYM	REVISION DESCRIPTION	REV/CKD BY	DATE



D13

SAP-1 to STEREO GENERATOR INTERCONNECT

LEAMING INDUSTRIES, INC.

3972 Barranca Parkway, J608, Irvine, Calif. 92606 (949) 743-5233

BY: K.G.Rauch	DATE: 27 FEB 02	DWG.NO. ADSAP13B	REV.
CKD: R.F.L.	DATE:	AD 091611-03	B

SYM	REVISION DESCRIPTION	REV/CKD BY	DATE