

HOTRONIC

AP41

TBC/FRAME SYNCHRONIZER

OPERATOR'S MANUAL



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PREFACE

This Operator's Manual describes the Hotronic AP41 TBC/Frame Synchronizer. It encompasses section 1, 2 and 3, and is self-bound with the intent that it can be used by itself. It may also be combined to become an integral part of the Maintenance Manual.

This manual provides familiarization, installation, operation and maintenance information for Hotronic product users and customer service representatives.

The AP41 series contains:-

INPUT: Composite or Y/C or SDI SMPTE 259M

OUTPUT: simultaneous Composite, Y/C, Y_{PR} P_B and SDI

The AP41 could be classified into the following models:-

AP41	Composite inputs, composite output only, full bandwidth, Genlock, Digital Proc Amp upgradable to other AP41 models
AP41-SW	Composite and Y/C inputs, composite output, full bandwidth, Genlock, Digital Proc Amp, upgradable to other AP41 models
AP41-SF	Composite and Y/C inputs and outputs, full bandwidth, Genlock, Digital Proc Amp, Freeze Frame/Field, Upgradable to other AP41 models
AP41-SP	Composite, Y/C, SDI inputs. Composite and Y/C output (D/A converter), Genlock, Digital Proc Amp, Freeze Frame/Field, upgradable to other AP41 models
AP41-SPD	Composite, Y/C input; composite, Y/C, SDI output (A/D converter), Genlock, Digital Proc Amp, Freeze Frame/Field.
Option D	Optional SDI input for all AP41 models.
Option YUV	YUV output for all AP41 models.

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GENERAL DESCRIPTION

The AP41 TBC/Frame Synchronizer corrects time base errors and synchronizes video signal originating from any heterodyne color video tape recorder (VTR) that utilizes NTSC television standards. It also synchronizes satellite video signal to a house sync. When processing the video signal from any heterodyne VTR, the Hotronic AP41 produces a video output signal conforming to standards.

The AP41 utilizes digital storage and processing techniques to accomplish time base corrections and frame synchronization. Time base errors are eliminated by digitizing and storing the input video signal at a rate determined by video input frequencies, and then retrieving the digitized video at a rate determined by an internal frequency that may be gen-locked to a reference. The digital memory stores the whole frame. In freeze mode, a whole frame is frozen. Freeze field or frame is selectable.

The Hotronic AP41 contains an internal digital sync generator which provides composite sync, composite blanking, vertical blanking, vertical drive, horizontal drive, and burst flag. When properly gen-locked to either composite video or reference black burst, the sync generator can serve as a second source of station synchronization signals. The AP41 also contains sync generation circuitry which provides advanced sync to the VTR supplying the input video signal.

The Hotronic AP41 contains a fully adjustable processing amplifier. Primary controls on the front panel allow adjustment of video level, chroma level, set-up level and hue. The four controls are center-detented and preset to unity. Through the front panel miniature switch adjustments, system sub-carrier phase, Gen-Lock horizontal phase, and picture position could be adjusted.

The video output from the Hotronic AP41 provides the time base corrected signal. When bypassing the AP41, the video input is routed directly to the video output.

APPLICATION

The Hotronic AP41 is used to increase the stability of a monochrome or a NTSC color video signals in broadcast, CATV, CCTV or other television production studios. Use of the AP41 optimizes the price/performance ratio of existing studio equipment by allowing the use of less expensive video tape recording equipment during all phases of television production without sacrificing quality. The operational flexibility of the AP41 increases the efficiency of most production tasks through simplification, and in many cases increases the capabilities of the preset production equipment.

The Hotronic AP41 operates with virtually any non-segmented VTR or VCR. It is compatible with capstan servo VTR's or power line-lock VTR's. The AP41 accepts monochrome or heterodyne color input without operator intervention. It doesn't matter whether the color video signal is from vertically-locked VTR or from an inexpensive home VTR, the output of the AP41 is color interlaced for immediate broadcast. Fades, wipes, and other special effects can be accomplished by locking the AP41 to the special effects generator.

Although the AP41 is not specifically designed for portable operation, the compact size and light weight make it ideal for use in mobile and remoted studios. The AP41 thus makes it possible to produce broadcast quality video on the spot with minimum of equipment.

Detailed information for using the AP41 is provided in sections II and III. Knowledge of the signal processing capabilities of the AP41 will enable studio personnel to utilize it to their advantage, even beyond the applications explained in this manual.

DEFINITION OF TERMS

<u>TERM</u>	<u>DEFINITION/MEANING</u>
FRAME LOCK VTR	A capstan servo VTR that locks to the correct field sequence in a frame.
HETERODYNE COLOR	A composite color video signal whose chrominance and burst are stable but whose horizontal frequency is not precisely related to the burst frequency.
LINE LOCK VTR	A VTR without a capstan servo that locks to the frequency of its AC power source and not to the vertical or horizontal sync component of the video signal.
NON-SEGMENTED VTR	A VTR whose head switch occurs once per field near the end or beginning of the active video field.
VERTICAL (V LOCK VTR)	A capstan servo VTR that locks to the vertical sync component of an external video reference signal.
FRAME SYNCHRONIZATION	Input signal through AP41 is totally synchronized with reference signal.



SPECIFICATION

Video Signal

Accepts non-segmented Heterodyne and Monochrome 525 line/60 Hz VIDEO SIGNALS. Y/C 3.58 Input
SDI SMPTE 259M

Recorder Interface

Any non-segmented VTR.

Correction range

1 Frame memory

Signal to Noise Ratio

58 dB (p-p signal to rms noise)

Residual Time Base Error

Differential phase better than 2°

Differential gain better than 2%

MONOCHROME ± 10 ns

Bandwidth

Y/C (S-VHS)

6 MHz (-3 dB) Y (Luminance)

Composite/SDI 5.5 MHz comb filter

Gen Lock Range

Adjustable, more than $\pm 2\mu$ s

K Factor (2T)

Y/C mode 1%

Physical

Size

17" wide x 1 3/4" high x 9 1/4" deep

Rack mountable

Power

Less than 30W

Weight

12-15 lbs.

Ambient Temperature

10° - 40° operating

Input Signals

Video

IV composite video signal (75 Ohms, terminated) or Y/C 3.58

SDI SMPTE 259M

Gen Lock

Black burst or standard NTSC composite video signal

Output signals

Video

IV p-p @ 75 ohms, terminated composite or Y/C or SDI.

Sync Drives

Adv. Sync. IV p-p @ ohms

Significant Advantage

Perhaps the most significant advantage of the AP41 over other TBC's is its functional efficiency. The digital processing amplifier controls are presetable. Each control has a maximum useful dynamic range. Front panel buttons select different operational modes.

Specifications are subject to change without notice

INSTALLATION

GENERAL

When shipped, the Hotronic AP41 has all of the modules installed. The unit should be removed from the shipping container and inspected for any obvious shipping damage. The AP41 is shipped fully assembled and ready for immediate use. Ensure that the ventilation fan opening is free of packing material.

EQUIPMENT LOCATION

The AP41 should be located in an area which can afford adequate accessibility for operation and maintenance. Installation of the unit over a heat producing apparatus should be avoided. A minimum clearance of 2 inches should be allowed at the rear and front of the AP41. All parts required for rack mounting are included with the AP41.

ELECTRICAL REQUIREMENT

The AP41 is wired for 110 or 220 volts and 50 or 60 Hz. To protect personnel, the AP41 must be connected to earth ground. The AP41 is supplied with a three-conductor power cable that, when connected to an appropriate A/C outlet, it grounds the unit.

SYSTEM INTERCONNECTIONS

Signal connections for the AP41 will vary with the system in which it is used. 75 ohms coaxial cable with BNC connectors and/or S-VHS (Y/C) 4-pin connectors should be used.

All signal BNC connectors and S-VHS (Y/C) 4-pins connectors are at the rear panel.

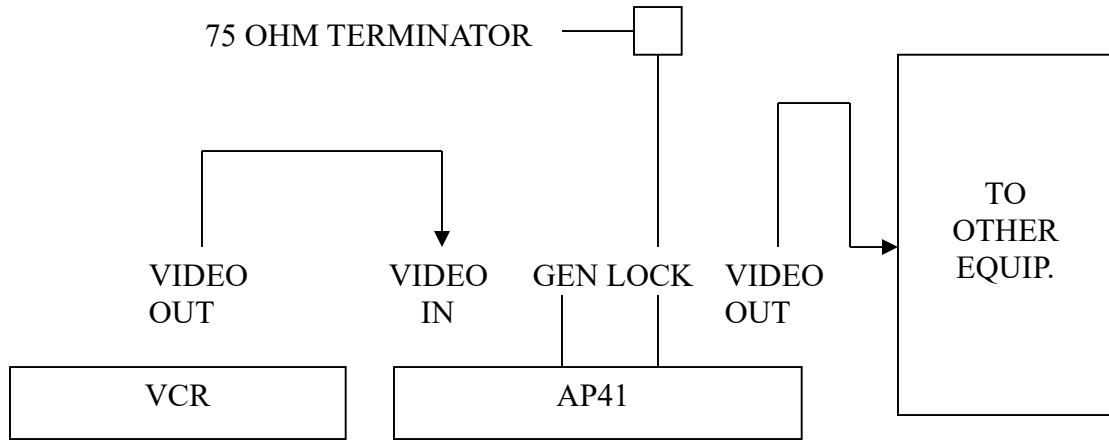


FIGURE 2-1 PHYSICAL DIMENSION

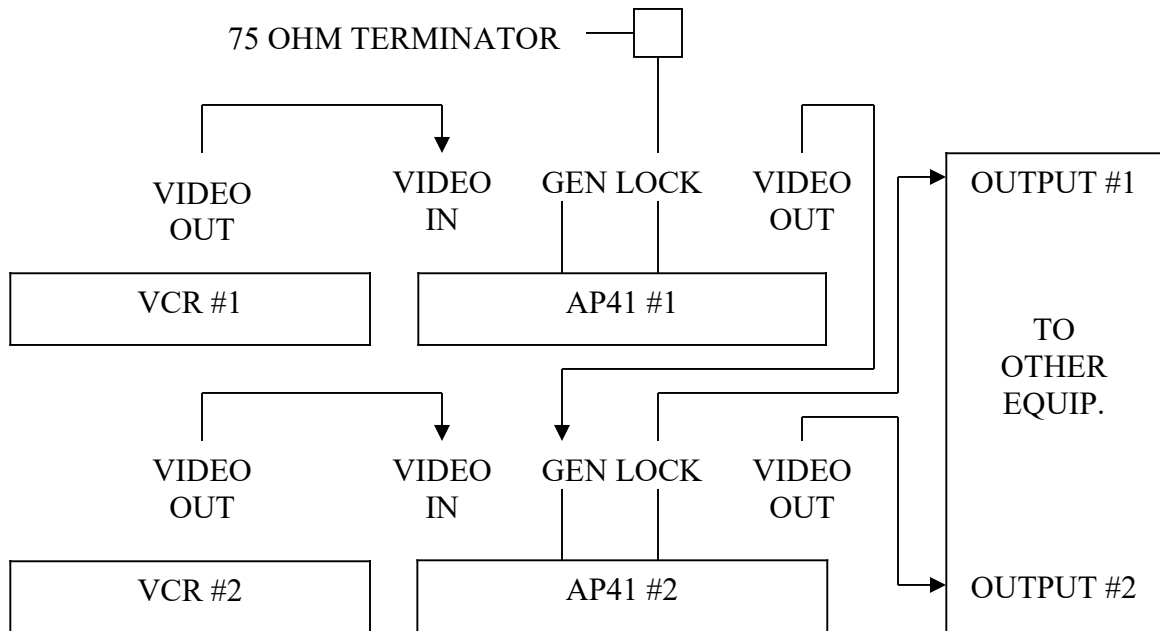
DESCRIPTION OF CONNECTORS

<u>CONNECTOR</u>	<u>DESCRIPTION</u>
VIDEO INPUT	These connectors accept video from VTR, satellite or camera. Either NTSC composite or S-VHS at these inputs through the BNC or 4-pin connector, respectively. Input signal to be processed is selected by the COMP/S-VHS switch located on the front panel.
GEN-LOCK INPUT	If a composite video signal or black burst is applied to one of these connectors, the other connector should be terminated by a 75 ohms terminator. The AP41 will automatically lock to the incoming signal, otherwise, it will internally lock. A green light on the front panel confirms that the AP41 is “Gen-Locked” to an external source.
VIDEO OUT	When Normal/Bypass switch is set to normal, this output is the time-base-corrected video signal. When the Normal/Bypass switch is set to bypass, or when power is removed from the AP41, the signal applied at the video input connector appears at the video output (Composite only).
Y/C OUT	
Y P _R P _B OUT	
SDI	SMPTE 259M compliant

INSTALLATION



Installation Diagram for one TBC



Installation Diagram for (2) TBCs

FIGURE 2-3

Internal Circuit Boards and Timing Adjustments.

Internally, the AP41 contains a main circuit board consisting of the analog and digital sections. The power supply is a separate unit from the main circuit board. The main circuit board contains the following sections:

1. Input analog signal processor section.
2. Sync separator section.
3. Memory control section.
4. Output clock generator section.
5. Digital to Analog converter section.

<u>REF DESIGNATION</u>	<u>ADJUSTMENT DESCRIPTION</u>
C42	K factor adjustment
C55	Bandwidth adjustment
C60	Bandwidth adjustment
C107	Tune this to obtain 1V at this point
C279	Y2; 14.31818MHz adjustment
R48	Y gain adjustment
R65	Y- DC adjustment
R75	Chroma gain adjustment
R334	U gain adjustment
R345	U DC offset
R350	V gain adjustment
R361	V DC offset

INSTALLATION ADJUSTMENT

After installing the Hotronic AP41, it may be desirable to make some internal adjustments to optimize the operation of the AP41 in the studio. All internal adjustments are preset at the factory and should be changed after operating the AP41 and determining exactly what adjustments are needed. For the adjustments that can be made during installation and operation, please refer to the AP41 “adjustment set-up” on page 23-24 and “adjustment designation and description” on page 13.

OPERATION

GENERAL

The information in this section explains operating controls, indicators and how to set or adjust front panel controls. After installation, the AP41 will operate automatically once the operator initially sets the controls.

PROMARY CONTROLS AND INDICATORS

All primary controls and indicators are located on the front panel. These controls and indicators are the ones that the operator most frequently need to access during operation. Figure 3-1 illustrates the primary controls and provides a quick reference for setting the controls for all applications. Table 3-1 explains each control and indicator.

ONE TIME ADJUSTMENT CONTROLS

These controls are located on the front panel. These controls do not require frequent access by the operator. Figure 3-1 illustrates the one time adjustment controls and provides a quick reference for setting them for all applications. Table 3-1 describes each control.

SWITCH SETTINGS

Refer to Table 3-1 on page 19 to set switches to the appropriate application.

INITIAL ADJUSTMENTS

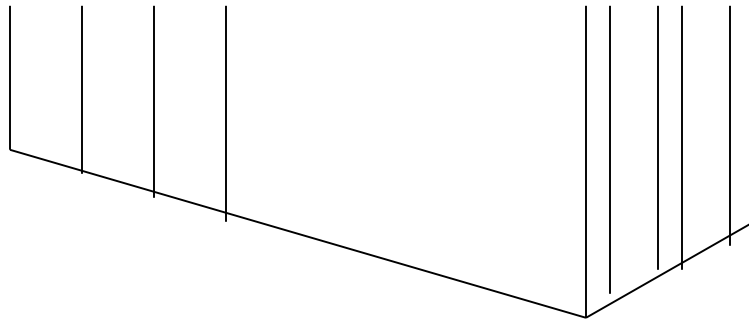
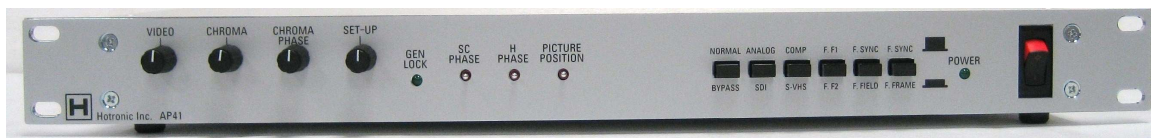
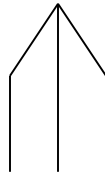
Upon complete installation of the AP41 in any system configuration, certain adjustments may be required to establish system capability. There are many methods to make the timing output of the AP41 coincide with a studio reference signal (House Sync). One suggested method is as follows:

- A. Connect the HOTRONIC AP41 as shown in Figure 3-2. The Gen-Lock LED indicator should be on. Make sure that the reference video signal is stable.
- B. Ensure that the vector scope, waveform monitor and color picture monitor are locked to the reference sync and sub-carrier.
- C. While playing a pre-recorded color bar tape, note the position of the horizontal sync pulse as viewed on the waveform monitor.
- D. Switch between the output of the AP41 and the synchronous color bar signal, while adjusting the "H" phase with the miniature switch until the horizontal sync pulse of the AP41 coincides with the horizontal sync pulse of the synchronous color bar.

- E. Observe the vector scope, switch to synchronous color bar, place the color dots in the appropriate squares by adjusting the phase control of the vector scope.
- F. Switch between the synchronous color bar test signal and the output of the AP41 with the miniature switch. Adjust the sub-carrier phase control so that the color dots of the AP41 coincides with the dots of the color bar test signal.

Now the AP41 is totally synchronized with the color bar test signal. Special effects, mixes, etc... may now be performed using the AP41 to process VTR signal as a source.

ONE TIME ADJUSTMENT CONTROLS



PRIMARY CONTROLS

FIGURE 3-1

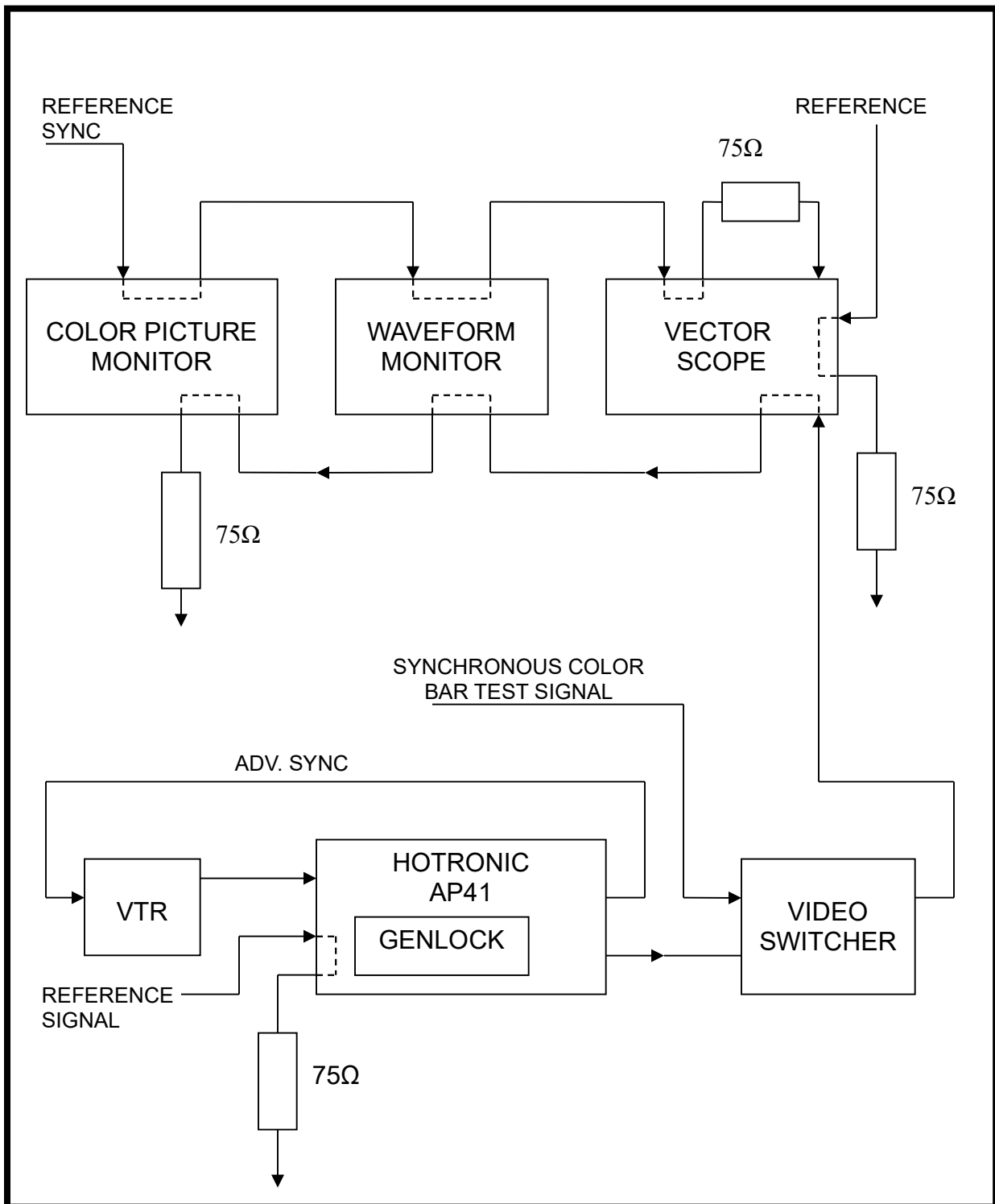


FIGURE 3-2 Timing Hotronic AP41 into a Video Switcher

TABLE 3-1

DESCRIPTION OF FRONT PANEL CONTROLS AND INDICATORS

NOMENCLATURE	DESCRIPTION
Power Switch	Pushing this switch to the “UP” position turns the AP41 “ON”, and pushing it to the “DOWN” position turns the AP41 “OFF”. When this switch is in the “OFF” position, the signal applied to the composite video input connector is routed directly to the video out connector.
Power ON LED	This LED is located next to the power switch. When the unit is on, the LED will be lit.
Gen-Lock LED	When this LED is ON, the AP41 is locked to a reference signal. Otherwise the AP41 will automatically work with an internal sync generator when no Gen-Lock signal is applied to the Gen-Lock input located at the rear of the unit.
NORMAL/BYPASS	OUT position is a operate mode, and IN position is the bypass mode.
COMP/ S-VHS	This switch selects between composite and Y/C (S-VHS) input. On the OUT position composite input is selected, while in the IN position Y/C (S-VHS) input is selected.
F.F1/F.F2	This switch selects Field 1 or Field 2 when F. FIELD/ F. FRAME switch is set to F. FIELD mode.
F. FIELD/F. FRAME	When F. FIELD is selected, the AP41 will freeze the video picture and display Field 1 or Field 2, depending on the field selected by the F. F1/F. F2 select switch. When F. FRAME is selected, the AP41 will freeze and display the whole frame.

TABLE 3-1 (CONTINUED)
PROC AMP CONTROL

NOMENCLATURE	DESCRIPTION
VIDEO LEVEL	When the video level control is set to the center detent position, the AP41 is preset for unity gain. Turn the control clockwise and the video gain is increased. Turn the control counter-clockwise and the video gain is decreased. The adjustable range is more than $\pm 3\text{dB}$.
CHROME LEVEL	When the chroma control is set to the center detent position, the chroma gain of the AP41 is preset to unity chroma gain. Turn the control clockwise and the chroma gain is increased. Turn the control counter-clockwise and the chroma gain is decreased.
HUE	The adjustable Hue range is more than 90 degrees.
SET UP	When the set-up control is set to the center detent position, the set-up level is preset to unity. Turn the control clockwise and the set-up level is increased. Turn the control counter-clockwise and the set-up level is decreased. The adjustable range is more than $\pm 10\text{ IRE}$.

TABLE 3-1 (CONTINUED)
FRONT PANEL SWITCHES

NOMENCLATURE	DESCRIPTION
NORMAL/BYPASS	OUT position is the operating mode, and IN position is the bypass mode.
ANALOG/SDI	This switch selects between analog and SDI input. OUT position selects analog input. By switching COMP/S-VHS switch to select between COMP and Y/C (S-VHS) component input. IN position is for SDI input strictly.
COMP/S-VHS	This switch selects between composite and Y/C (S-VHS) component input. OUT position selects composite input; IN position selects Y/C (S-VHS) input.
F.F1/F.F2	In Freeze mode, Field 1 and Field 2 is selectable.
F. SYNC/F. FIELD	When this switch is in the OUT position, the AP41 operates as a Frame Synchronizer. When this switch is in the IN position, FREEZE FIELD mode is chosen.
F. SYNC/F. FRAME	When this switch is in the OUT position, the AP41 operates as a Frame Synchronizer. When this switch is in the IN position, FREEZE FRAME mode is chosen.

TABLE 3-1 (CONTINUED)
FRONT PANEL SYSTEM ADJUSTMENTS

S.C. PHASE	The system phase control adjusts the phase of the burst and chroma of the AP41 with respect to the color phase of the reference signal applied to the Gen-Lock connector. The control is used to compensate for variations in cable length. The adjusting range is more than 90 degrees.
H PHASE	This control adjusts the phase of the horizontal sync pulse of the AP41 with respect to the phase of the Gen-Lock reference signal.
PICTURE POSTION	This adjustment allows the operator to adjust the horizontal position of the active video signal without affecting the horizontal sync.

AP41 ADJUSTMENT SET-UP

The adjustment set up of the AP41 allows the operator to adjust the equipment to meet their requirement. There is an adjustment header JP7 in the middle of the PCB, it named from left to right, AJ1; AJ2; AJ3 and AJ4.

ANALOG INPUTS CALIBRATION AND VERTICAL BLANK ADJUSTMENT

- A. Set all potentiometers in the PROC AMP section in their center detent position to make the detents to be their mid value, and follow the steps below:
 1. Turn the power OFF.
 2. Short AJ1 with the provided jumper; leave AJ2; AJ3 and AJ4 open.
 3. Turn the power ON.
 4. Wait for the Genlock LED blinks for few seconds, this shows the potentiometers center setting is done.
 5. Remove the jumper from AJ1, the Genlock LED will blink for a longer time, this shows all the values are stored.
 6. Keep the AJ1 open, otherwise the stored values will be lost.
 7. Turn the power OFF. All detent values are stored and will effect in next power up.
- B. Use SDI input signal to calibrate Composite, Y, C, U, V output signals, and set the H position and sub-carrier phase.
- C. Calibrate analog input signal gain.
 1. Calibrate composite input gain:
 - a). Turn the power OFF, short AJ2 with the provided jumper; leave AJ1; AJ3 and AJ4 open. Set all potentiometers to their detent positions.
 - b). Select composite input (the composite/S-VHS switch in **OUT** position), turn the power ON.
 - c). Lift the Sub-carrier Phase switch lever upwards, the Genlock LED will blink. By lifting the lever each time, the Y gain increase by one step. Press the Sub-carrier Phase switch lever downwards to decrease Y gain by one step.
 - d). Lift the H phase switch lever upwards, the Genlock LED will blink. By lifting the lever each time, the C gain increase by one step. Press the H phase switch lever downwards to decrease the C gain by one step.
 - e). When the desired Y and C values are set, remove the jumper from AJ2, the Genlock LED will blink for a longer period, this shows all the values are stored.
 - f). Keep the AJ2 open, otherwise the stored value will be lost.

2. Calibrate S-VHS input gain:

- a). Turn the power OFF, short AJ3 with the provided jumper; leave AJ1; AJ2 and AJ4 open. Set all potentiometers to their detent positions.
- b). Select S-VHS input (the composite/S-VHS switch in **IN** position), turn the power ON.
- c) - f). Repeat the steps c) to f) in the calibrate composite input gain to set the S-VHS input gain.

D. Set the vertical blank.

1. Turn the power OFF, short AJ4 with the provided jumper; leave AJ1; AJ2 and AJ3 open.
2. Turn the power ON. In this mode, the set up of both analog and SDI output signals are set to the top position as the vertical blank reference.
3. Lift the Sub-carrier phase switch lever upwards, the Genlock LED will blink. By lifting the lever each time, the vertical blank move to right by one line. Press the Sub-carrier phase switch lever downwards each time, the vertical blank move to left by one line.
4. When the desired vertical value is set, remove the jumper from AJ3, the Genlock LED will blink for a longer period; this shows the value is stored.
5. Turn the power OFF. Now all set up are done and will effect in next power up.

TROUBLE SHOOTING

PROBLEM/SYMPTOM	INSPECTION OR ADJUSTMENT
No Power	Check power connector on rear, make sure it is plugged in correctly. Check fuse located in power supply.
No Video Output	Push Bypass/Normal button in to see if the Video Out has output (bypass mode).
Won't Gen-Lock	Check Gen-Lock signal cable and input. Input Gen-Lock signal should be composite video signal or black burst. (Vector spins on the Gen-Lock signal must be a stable stand-vector signal).

HOTRONIC, INC.

AP41

WARRANTY

Hotronic, Inc. warrants each AP41 against defective materials for a period of one year and workmanship for a period of ninety days. This warranty does not apply to any AP41 that has been repaired or altered by anyone other than an authorized factory representative. No other warranty is expressed or implied. Hotronic, Inc. specifically disclaims the implied warranties of merchantability and fitness for a particular purpose.

Hotronic reserves the right to make product or part improvement without assuming any obligation to install them in previously manufactured units.

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