Instruction Manual
ATM-1600
NTSC Broadcast
Television Modulator

P/N 0020-5020
Rev.C1, March 1993

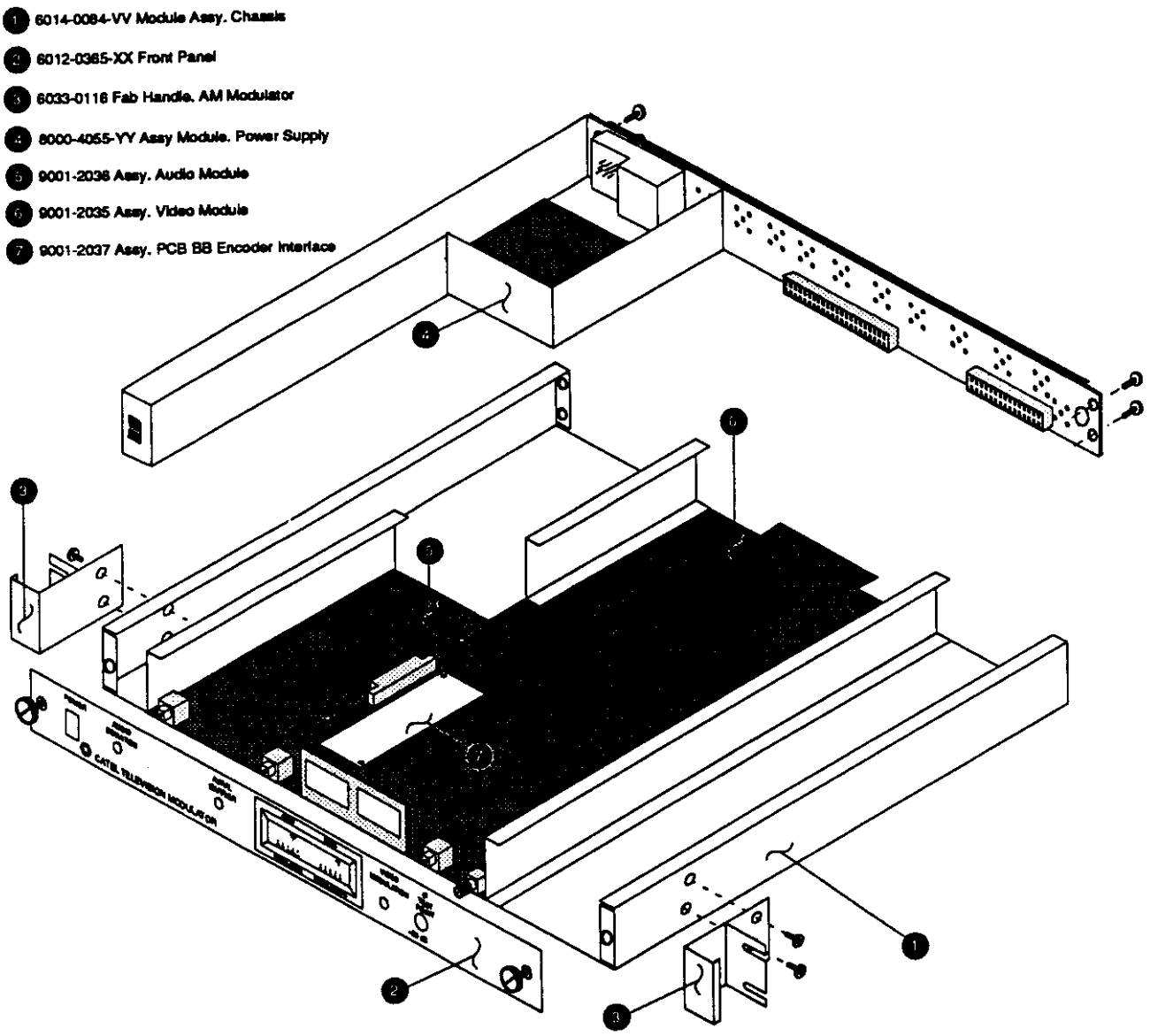

Figure 5-1
ATM-1600 Final Assembly
Internal View

WARRANTY

Catel warrants new equipment purchased hereunder to be free from defects in workmanship and material for a period of one (1) year of the date of purchase. Catel agrees to make good, F.O.B. Catel's factory, all defective parts of such new equipment which are returned to Catel's factory, transportation prepaid.

All equipment returned for repair under warranty requires prior authorization, with a return authorization number assigned by the factory or an authorized factory representative. As in the case of new goods, return shipments will be made F.O.B. factory and are insured unless otherwise specified. Claims for visible or concealed damages are to be filed by the purchaser with the carrier within five (5) days after receipt of the goods.

This warranty will not apply to equipment which has been subject to misuse, neglect, accident, incorrect wiring not Catel's own, improper installation, unauthorized modification or use in violation of our instructions, nor will it extend to units where the serial number has been removed or defaced.

Equipment furnished by Catel but manufactured by another company shall bear no warranties other than the special hours-of-use or other warranties extended by and enforceable against the manufacturer at the time of delivery to the purchaser for the period stated in that warranty.

THIS WARRANTY IS EXPRESSED IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY AND THE IMPLIED WARRANTY OF FITNESS FOR ANY PARTICULAR PURPOSE. CATEL SHALL NOT BE LIABLE FOR ANY DAMAGES, INCLUDING BUT NOT LIMITED TO, INDIRECT, CONSEQUENTIAL OR SPECIAL DAMAGES ARISING OUT OF OR IN CONNECTION WITH THE SALE , USE OR PERFORMANCE OF THE PRODUCT. NO REPRESENTATION BY ANY EMPLOYEE OF CATEL MADE ORALLY OR BY CONDUCT SHALL CONSTITUTE A WARRANTY.

Since its formation in 1968, Catel Telecommunications has manufactured high performance video and audio products to support the needs of the broadcast and cable television industries, as well as other operators of broadband communications systems. For over 20 years, Catel has demonstrated the innovation and financial stability to serve a growing base of satisfied customers.

Catel offers fully integrated optical and electronic systems and is committed to solving customer problems through economical application of optical and radio frequency technologies. It continues to pioneer advances in these and other related technologies via substantial research and development. Because of a commitment to protect customer investment, Catel manufactures compatible products, offers flexible system architectures, and provides the means of graceful migration to new generations of technology.

Long known for reliable products, Catel has evolved into a major supplier of systems for the industries it serves. Further, Catel's commitment to quality extends from design into manufacturing and through ongoing systems support.

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LIST OF ILLUSTRATIONS

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EQUIPMENT SPECIFICATIONS

Video

Input	Composite NTSC video, negative sync.
Input Level	1.0 V p-p for 87.5% modulation. ± 6 dB adjustment range
Input Impedance	High impedance loop-through (for 75 ohm circuit)
Return Loss	30 dB minimum, 25 Hz to 6.0 MHz with 75Ω, 1% external terminator (supplied)
Frequency Response	± 0.5 dB, 25 Hz to 4.18 MHz
White Level Clipper	Adjustable 85 - 95% (internal adjustment)
Modulation Range	To 95% modulation depth
Differential Gain	2% maximum at 87.5% modulation depth, 10-90% APL
Differential Phase	0.5° maximum at 87.5% modulation depth, 10-90% APL
Video Signal-to-Noise	>63 dB weighted, measured with Tektronix 1450-1
AM Hum and Noise	60 dB Minimum below 87.5% modulation depth
Sync Compression	0.25 dB maximum at 87.5% modulation depth
Tilt	1% maximum on 60 Hz squarewave
K-Factor, 2T Pulse	2%
Group Delay	Meets FCC Regulations Sec. 73.687 (a) (3) requirements for broadcast exciters
Video Sense	TTL Output: HI = 5 V, with Video in; LOW = 0 V, with no Video in

Audio

Input Type	Monaural: High-impedance bridging, (600Ω (external) balanced or unbalanced)
	BTSC/MTS: 75Ω unbalanced input
Input Level	Monaural: 0 dBm, ± 10 dB
	BTSC/MTS: 1.0 V p-p, ± 10 dB
Capability	Monaural or BTSC/MTS with switchable preemphasis network, or separate inputs. MTS bandwidth to 120 kHz
Frequency Response	Monaural: within ± 0.5 dB of 75 µs preemphasis, 30 Hz to 15 kHz
	BTSC/MTS: Defined by stereo encoding unit
THD	Monaural: 0.5% maximum at ±25 kHz deviation, 30 Hz to 15 kHz
	BTSC/MTS: Defined by stereo encoding unit
FM Hum and Noise	60 dB minimum below ±25 kHz deviation, 30 Hz to 15 kHz, monaural
Intercarrier Frequency Accuracy	4.5 MHz ± 100 Hz, any combination of specified modulation and operating temperature
BTSC/MTS Stereo Channel Separation	40 dB minimum, 50 Hz to 10 kHz
SCA	
Maximum Input Level	4.0 Volts peak-to-peak
Nominal Input Level (67 kHz Subcarrier)	2.2 Volts peak-to-peak

LIST OF EQUIPMENT

Broadcast Television Modulator, Chassis and Power Supply Assy.	9001-2031-XX
PCB Extraction Tool	6099-0027
Cable Power Cord, 3-Cond. Detachable	7923-0023
ATM-1600 Accessory Kit (F)	8000-2610
CABLE, COAX 6.00" F CONN (2 ea.)	5120-1060
TERMINATOR MALE BNC	5211-0026
PACKING SLIP	6910-0015
SCR. PHIL W/NYLON WSHR 10-32 X 5/8" (4 ea.)	7157-1010
PLASTIC BAG, 9" X 12" X 4 MIL RECLOSABLE	7600-0029
TERMINATION, 75 OHM, F DC-550 MHZ	5218-0028
ATM-1600 Accessory Kit (BNC)	8000-2611
CABLE, COAX 6.00" BNC CONN (2 ea.)	5120-2050
TERMINATOR MALE BNC (2 ea.)	5211-0026
PACKING SLIP	6910-0015
SCR. PHIL W/NYLON WSHR 10-32 X 5/8" (4 ea.)	7157-1010
PLASTIC BAG, 9" X 12" X 4 MIL RECLOSABLE	7600-0029
Video Modulator Module	9001-2035
Audio Modulator Module	9001-2036
ATM-1600 BROADCAST TV MOD. MANUAL	0020-5020

Optional Equipment

Baseband Encoder Interface	9001-2037
Aural Subcarrier Processor	9001-2038

EQUIPMENT SPECIFICATIONS (CONT.)

Electrical

AC Power Input	90-260 VAC, 47-63 Hz
Maximum Input Power	19 Watts
Fuse	3AG, 1/2 amp slow blow

Environmental

Operating Temperature	-30° to +50° C
Operating Humidity	95% maximum, non-condensing,

Mechanical

Size	1.75" H x 19" W x 17" D
Weight	12 lbs
Chassis	Steel

Internal Controls

BTSC/Mono audio selection
SCA Input (ON/OFF)
Internal/External 45.75 Mhz reference

Front Panel Controls

Power ON/OFF Switch
Video Modulation Control
Aural Carrier Control (level)
Audio Deviation Control

Front Panel Indicators

Audio Deviation Meter
Video Modulation Meter
-20 dB IF Test Point

EQUIPMENT SPECIFICATIONS (CONT.)

Aural Subcarrier (Optional)

Input Signal	a. Separate composite video and 4.5 MHz aural subcarrier or b. Composite video/4.5 MHz aural subcarrier
Input Levels	
Aural Subcarrier	+35 dBmV ±5 dB at 4.5 MHz
Composite Video	1.0 v p-p ±6 dB
Input Impedance	75 ohms

IF Output

Output Type	Separate Visual and Aural IF outputs, and a combined IF output
Output Impedance	75 Ω
Output Return Loss	>16 dB
Output Level	+ 40 dBmV, minimum with normal setup, All input/output ports
Frequency Accuracy	± 200 Hz of 45.75 MHz visual or 41.25 MHz aural IF, any combination of specified modulation and operating temperature
ICPM	<3° at 87.5% modulation depth
Aural AM Noise	< -55 dB at 41.25 MHz
IF VSB Output Attenuation	Visual Carrier +0.7 to 4.18 MHz: ± 0.5 dB relative to + 200 kHz
IF Output Power Attenuation	Visual Carrier -1.25 MHz -38 dBc -2.25 MHz and below -60 dBc +4.75 MHz -38 dBc +5.25 MHz and above -60 dBc

External Signal Sources

IF Reference Signal	45.75 MHz CW carrier
Level	+ 30 to +50 dBmV
Impedance	75 Ω
Options	
Baseband Encoding	Optional interface for Zenith Z-TAC Encoder
4.5 MHz Aural Input	Optional input for 4.5 Mhz aural carrier, monaural or BTSC/MTS from off-air demodulator or stereo generator

EQUIPMENT SPECIFICATIONS (CONT.)

Rear Panel Connectors

AC Fuse Block
Audio Hi-Z (Input Terminal Block)
BTSC IN (Special) (BNC)
SCA IN (Special) (BNC)
Video In (BNC)
Video Out (BNC)
Gate In (Z-TAC encoding) (F or BNC)
Aural Out (F or BNC)
Aural In (F or BNC)
Visual Out (F or BNC)
Visual In (F or BNC)
Comp IF Out (F or BNC)
IF Ref (F or BNC)
RF Out (F or BNC)
Video Sense (Terminal Block)

1.0 GENERAL

1.1 Introduction

The purpose of this manual is to introduce Catel's ATM-1600 Broadcast Television Modulator (ATM-1600), explain its options and features, and give some examples of its uses. In addition, detailed sections have been devoted to the installation and operation of the ATM-1600. The manual concludes with a thorough description of its circuitry and a parts list to order spare or replacement parts.

1.2 General Description

The ATM-1600 is a high performance modulator designed for use in broadcast television and broadband applications. Refer to Block Diagram, Figure 1-1. The modulator converts audio/video signals to IF carriers to drive a transmitter upconverter. The configuration described in this manual is for the NTSC format. However, PAL B/G, PAL I, or SECAM D/K versions of the ATM-1600 are available.

The ATM-1600 is composed of a chassis/power supply and two different modules: one for audio and another for video (refer to Figure 1-2). The design is based on the use of plug-in circuit boards which can be removed and/or replaced at will, e.g., an optional 4.5 MHz Aural Subcarrier Processor module could replace the Audio Modulator as required.

The ATM-1600 Broadcast Television Modulator chassis is designed for installation in standard (EIA) 19 inch racks, and occupies one (1) vertical mounting space (1.75 inches high). User adjustments, monitor points and bar graph modulation meters are located on the chassis front panel (refer to Figure 2-2). The input and output connectors are located at the rear along with an AC power input block and fuse holder (refer to Figure 2-3).

The ATM-1600 accepts baseband video and audio signals (monaural or BTSC) which modulate 45.75 and 41.25 MHz carriers respectively. Loop-out connectors for the aural and visual IF carriers are provided on the rear panel. Following the loop, the visual IF signal passes through a surface acoustic wave (SAW) filter to sharply define the passband edges. Next the aural and visual IF carriers are combined, when required, and sent to the composite IF output connector on the rear of the panel.

1.3 Features

1. Broadcast VSB-AM modulation
2. BTSC/MTS compatible
3. Surface acoustic wave (SAW) IF filtering
4. Selectable internal/external 45.75 MHz reference
5. Bar graph modulation meters

1.4 Options

4.5 MHz Aural Subcarrier Processor—Replaces the Audio Modulator when a 4.5 MHz aural subcarrier input is required (monaural or BTSC) versus a baseband audio input.

Baseband Encoder Interface (Zenith Z-TAC)—Provides an interface to the video module for scrambling signals.

1.5 Applications

In its standard configuration the ATM-1600 accepts baseband audio and video from sources such as a satellite receiver, off-air demodulator, VCR or a live audio/video input. The audio may be monaural, 30 to 15 kHz, or BTSC/MTS, 30 Hz to 120 kHz. An optional 4.5 MHz Subcarrier Processor replaces the standard Audio Modulator when the audio source is at 4.5 MHz such as from a BTSC generator or off-air demodulator.

For broadcast use the aural and visual IF loops on the chassis rear panel provide access points to excite a transmitter upconverter and RF output amplifier. The same IF

loops allow the user to interface a variety of IF encoders to the ATM-1600 for scrambling purposes. An internal interface for the Zenith Z-TAC scrambling system is available as an option.

The NTSC version of the ATM-1600 may be changed to one of the other currently available versions (PAL B/G, PAL I or SECAM D/K) by ordering the appropriate audio/video modules.

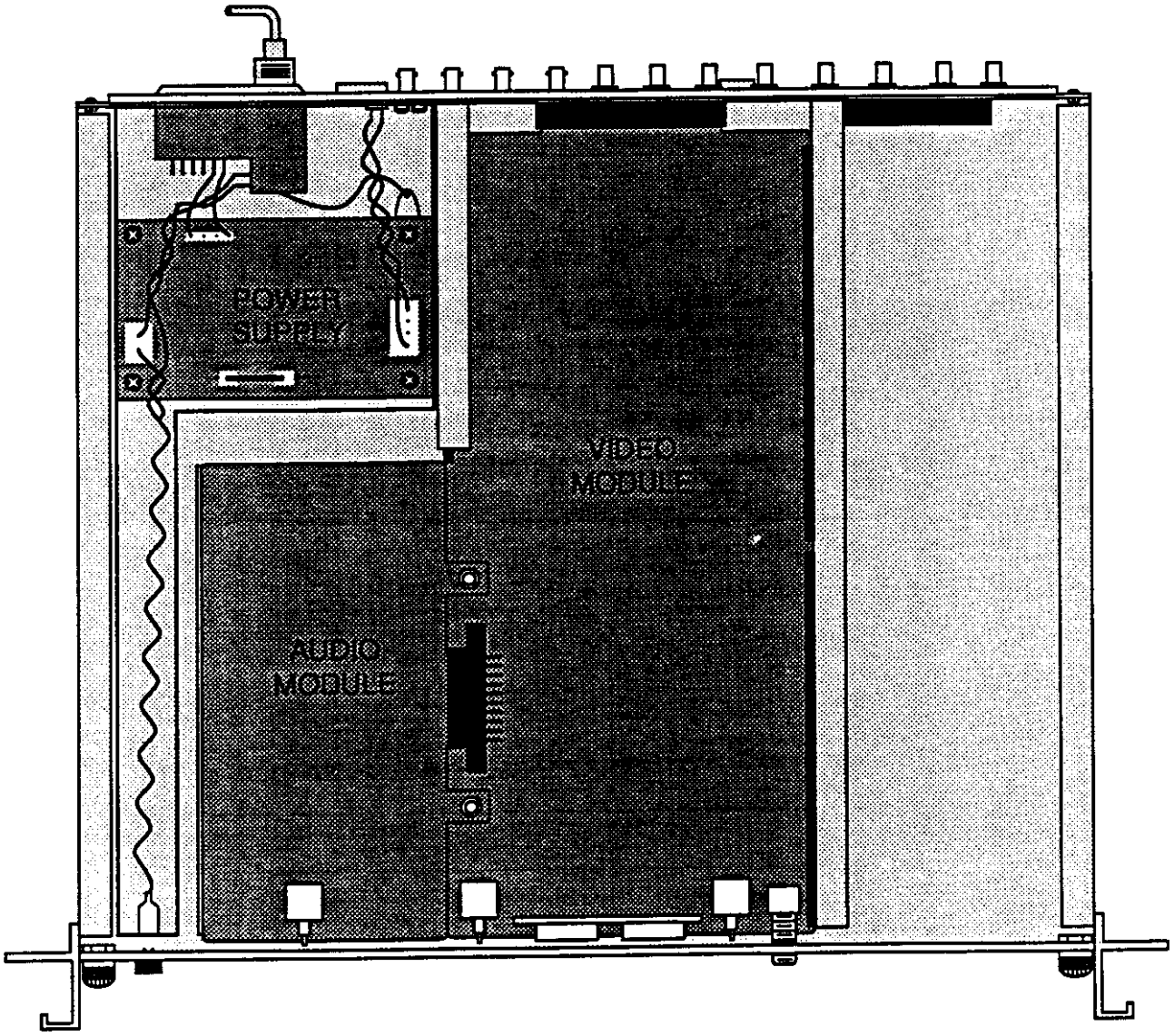


Figure 1-2
ATM-1600
Internal Top View

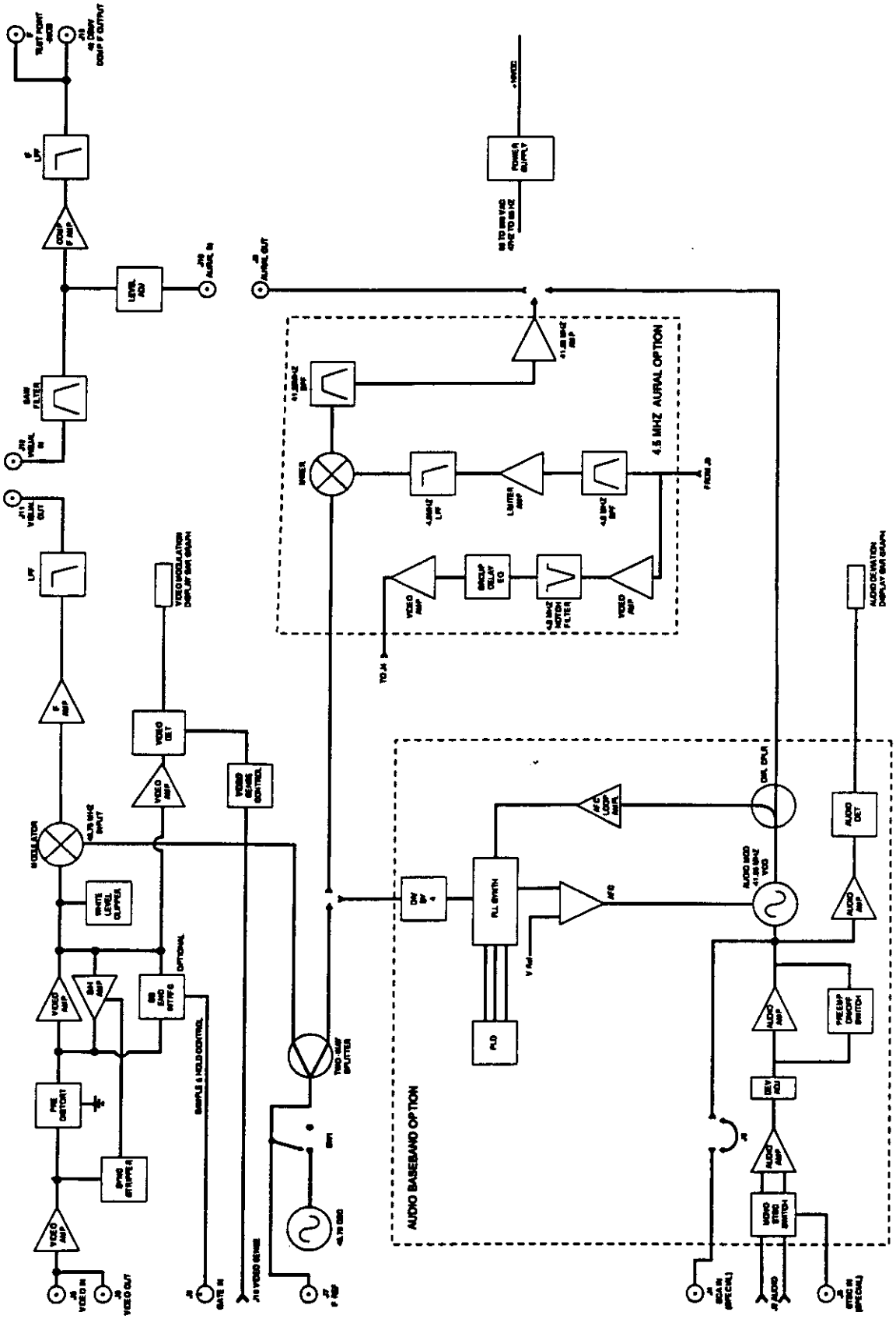


Figure 1-1
ATM-1600 Block Diagram

2.0 INSTALLATION

2.1 Introduction

Proper installation of the ATM-1600 will ensure peak performance, dependability and ease of operation. Installation includes the following steps:

Receiving and Inspection
Chassis Installation
Power Requirements
Cabling the Equipment

2.2 Receiving and Inspection

Inspect the shipping container for visible damage. If the container or packing materials are damaged, they should be saved in case a claim needs to be filed with the carrier. Any obvious damage to the container, packing materials, or equipment should be noted on the receiving papers at time of delivery. Notify the carrier as soon as reasonably possible in those cases where delivery is taken prior to finding suspected damage to the shipment.

If physical damage to the system is suspected, do not perform any operational test. This is to prevent operator exposure to potential hazards, and further damage to the equipment.

Catel tests every shipped product to ensure that all are operating correctly prior to shipment, and makes every effort to ensure that equipment will arrive in a safe and timely manner. However, if the equipment is not operational upon receipt, and there is no evidence of shipping damage, it may be necessary to return the equipment for repair or replacement. If so, contact the Catel Repair Department and request a return authorization (RA) number.

All returned equipment should be adequately packed with the RA number on the outside of the box. A packing slip should be included, stating the equipment defect, return shipping address and RA number.

2.3 Chassis Installation

The ATM-1600 chassis is intended to be mounted in standard (EIA) 19-inch racks. Installation will be made from the front of the rack. A rack mount kit (P/N 8000-1601) is provided with each chassis. The chassis cabinet is equipped with handles used for mounting purposes. The handles are capable of supporting a fully loaded chassis provided all four rack mount bolts are used.

2.4 Power Requirements

The ATM-1600 requires a power source of 90 - 260 VAC 47-63 Hz single phase. Switching in the ATM-1600 is not required over this voltage range. Current consumption is less than .150 AC amperes. The unit is fused with a 1/2 amp slow blow fuse; see Figure 2-1 for fuse replacement; the Fuse Pull handle ejects the fuse after the power cord is removed and the fuse cover is slid to the left.

Warning

Before switching on the ATM-1600, its protective ground terminal must be connected to the AC power source ground. The main power cord should be inserted in an outlet with a protective ground contact. Do not negate the grounding protection by using an extension cable, power cord or auto transformer without a protective ground conductor. Failure to ground the ATM-1600 properly could result in serious personal injury.

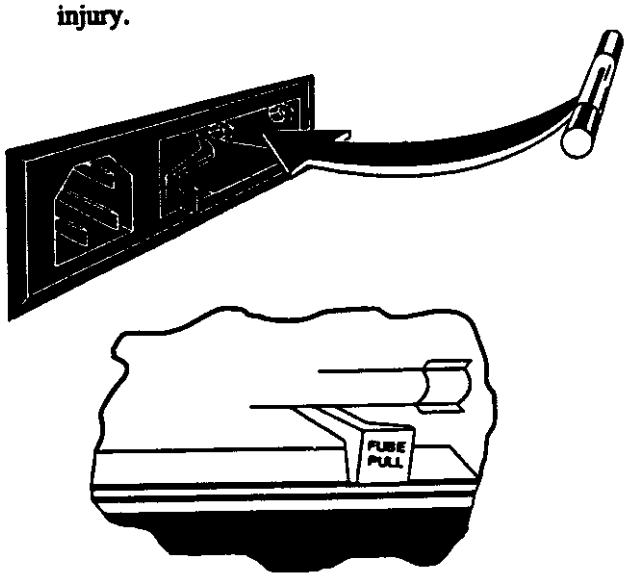


Figure 2-1
ATM-1600
Power & Fuse Assembly

subcarrier input on connector J3. J4 is then normally connected to J5, Video In.

5 **VIDEO IN/OUT, J5, J6**—Provides high impedance loop-through connections for the baseband video signal source. Connect the video source to J5 and terminate J6 with a supplied 75 ohm terminator, P/N5211-0026 for non-loop through operation.

6 **IF REF, J7**—Provides either input or output of 45.75 MHz CW IF carrier reference. Impedance in either operating mode is 75 ohms, nominal.

OUTPUT MODE (normal, stand-alone operating mode): Video Modulator switch (SW1) placed in INT. position. J7 provides 45.75 MHz CW output at +40 dBmV level. May be used as a 45.75 MHz source for coherent system operation or may be applied to a frequency counter for measurement of the visual IF frequency. J7 must be terminated with a supplied 75 ohm terminator (P/N 5218-0028, F; P/N 5211-0026, BNC) when not used as a signal source.

INPUT MODE: Video Modulator switch (SW1) placed in EXT. position, J7 accepts a 45.75 MHz CW input at a +40 dBmV level from an HRC comb generator or from another reference unit.

7 **GATE IN, J8**—Accepts timing pulses from a baseband encoding scrambler such as the Zenith Z-TAC system. Provides necessary timing information to the video modulator for proper clamp operation with scrambled video.

8 **AURAL IN/OUT, J9, J10**—Normally used as an aural IF source to drive a transmitter upconverter, also provides an interconnection between the modulator's 41.25 MHz aural IF circuits and an IF encoder for pay TV scrambling. Jumper J9 to J10 with supplied cable assembly (P/N 5120-1060, F; P/N 5120-2050, BNC) for IF signal continuity in non-scrambled operation when a composite output is needed at J13 COMP OUT. The aural IF input and output interface level is + 40 dBmV.

9 **VIDEO SENSE, J16** —This monitors the presence of video on J5, VIDEO IN. An LED lamp or other alarm circuits may be connected between the Video Sense terminal and ground for remote indication of video status. The video sense output is TTL, with high equaling 5 V with video in, and low equaling 0 V with no video in.

10 **VISUAL IF OUT/IN, J11, J12**—Provides interconnections between the modulator's 45.75 MHz visual IF circuits and an IF encoder for pay TV

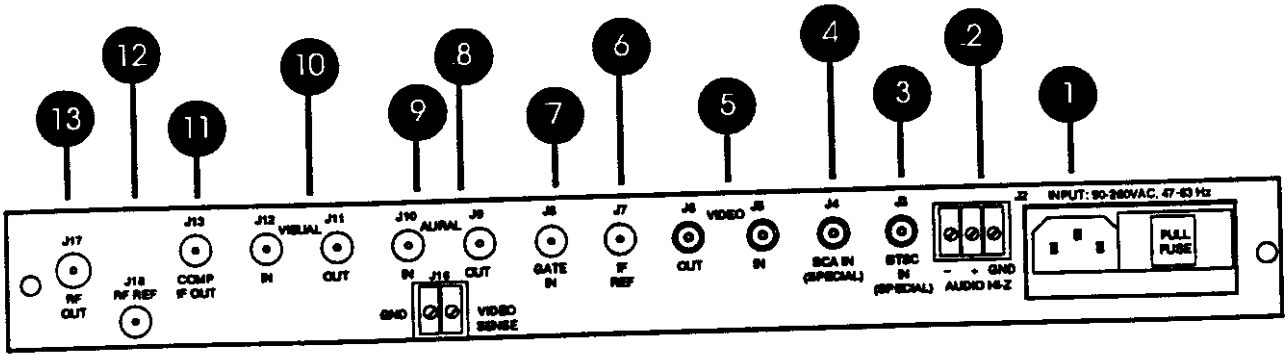


Figure 2-3
ATM-1600 Rear Panel

2.5 Front Panel

The ATM-1600 front panel, its indicators, the possible adjustments, and the connectors available are shown in detail in Figure 2-2

1. **POWER**—Applies line voltage to the ATM-1600 power supply.

2. **AUDIO DEVIATION**—This control sets the aural carrier deviation with a baseband monaural or composite BTSC input.

3. **AURAL CARRIER**—This adjustment controls the aural carrier level at the COMPOSITE IF OUT rear panel connector (J13).

4. **AUDIO DEVIATION**—Deviation of the audio carrier is indicated on the front panel bar graph, with a baseband monaural or composite BTSC input.

5. **VIDEO MODULATION-%**—This bar graph provides a visual indication of video modulation percentage.

6. **VIDEO MODULATION**—Adjust visual carrier modulation depth, with a baseband video input.

7. **IF TEST POINT -20 dB**—The "F" type connector allows monitoring of the composite IF output using a spectrum analyzer or other instruments. The signal at this test point is 20 dB down from the output.

2.6 Rear Panel

The ATM-1600 rear panel, its connectors, their uses, and loops required to implement special options are shown in detail in Figure 2-3.

1. **INPUT 90-260 VAC, 47-63 Hz**—Input connector for line power. This power module also contains the line fuse.

2. **AUDIO HI-Z, J2**—Accepts baseband audio (monaural) for direct FM modulation of the 41.25 MHz VCO in the Audio Modulator. Input level is 0 dBm, ± 10 dB. J2 is terminated externally with a 600 ohm impedance matching resistor, when bridging is not required.

3. **BTSC IN (SPECIAL), J3**—Accepts a composite BTSC input for direct FM modulation of the 41.25 MHz VCO in the Audio Modulator. Input level is 1.0 V p-p ± 0.5V.
   If the optional Aural Subcarrier Processor is used, this connector accepts a 4.5 MHz aural subcarrier, or composite video/4.5 MHz aural subcarrier input. Aural subcarrier input level is +35 dBmV ±5 dB. Video input level is 1v p-p ±6 dB.

4. **SCA IN (SPECIAL)** —This connector is normally used as an SCA input. SCA input level will be 2.5Vp-p, ±0.5V, and is used with a monaural baseband audio input, only.
   If the optional 4.5 MHz Aural Subcarrier Processor is used, this connector becomes the filtered video output from a composite video/4.5 MHz aural

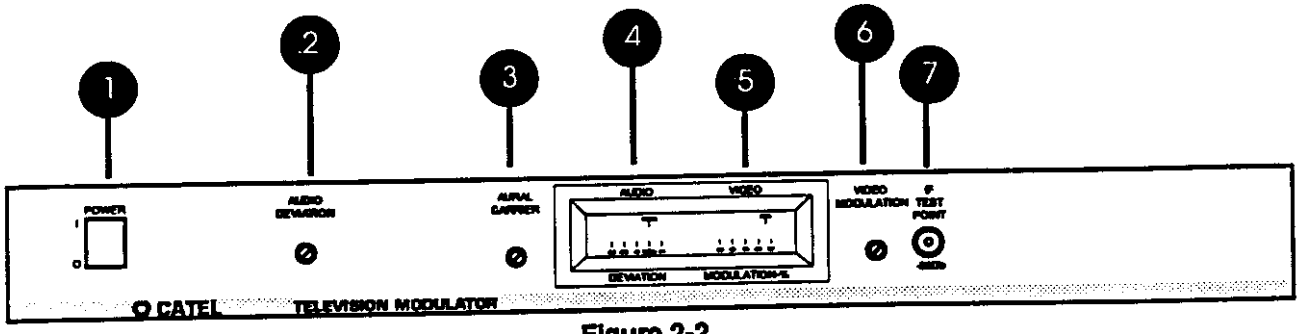


Figure 2-2
ATM-1600 Front Panel

SWITCH/JUMPER	USE	COMMENTS
SW1 and SW2 in mono position	Allows for a baseband audio input, 30 to 15kHz, and enables audio pre-emphasis network.	The baseband audio input is into terminal strip J2 on the rear chassis panel. input level should be 0dBm ±10dB.
SW1 and SW2 in BTSC position	For composite BTSC input, 30 to 120 kHz and disables audio pre-emphasis network.	The composite BTSC input is into BNC connector J3 on the rear chassis panel. Input level should be 1.0 V p-p ±0.5V.
J6 ON	Allows for a separate SCA input, mono audio only	SCA input should be on BNC connector J4 on the rear chassis panel.
J6 OFF	No SCA input.	Jumper should be in the OFF position with no SCA input.

Table 2-1
Audio Switch and Jumper Options

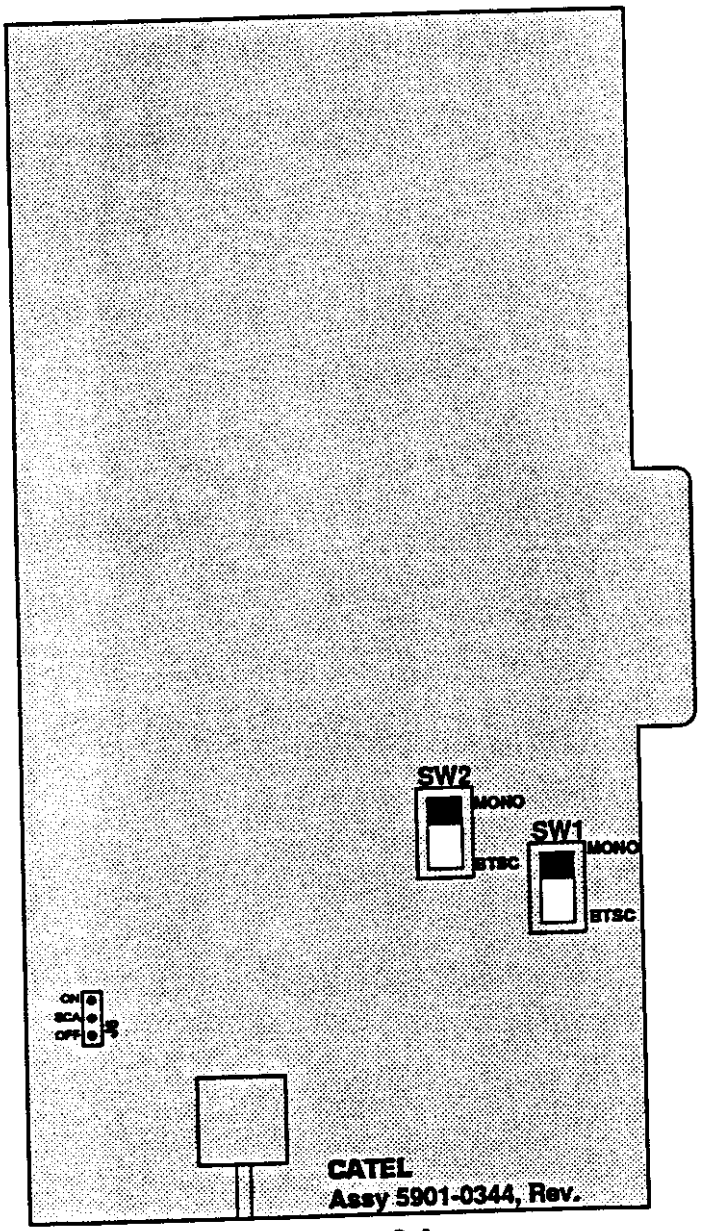


Figure 2-4
Audio Switch and Jumper Locations

scrambling. Jumper J11 to J12 with supplied cable assembly (P/N 5120-1060, F; P/N 5120-2050, BNC) for IF signal continuity in non-scrambled operation. The visual IF input and output interface level is +40 dBmV.

11. **COMP IF OUT, J13**—Provides a video plus audio composite IF output from the Video Modulator, or visual IF only if the rear panel aural IF loop through is broken. Normally used as an IF source to drive a transmitter upconverter.

12. **RF REF, J18**—Not used

13. **RF OUT, J17**—Not used

2.7 Switch and Jumper Options

The ATM-1600 is designed with switch and jumper connections on the PC board assemblies which allow the user to select from various options on the assemblies. These options provide flexibility in applying the modules to specific and unique applications. Switch and jumper options on the video and audio modules should be set according to the information shown in their respective table's; Table 2 -1 for audio; Table 2-2 for video. Switch and jumper locations are shown on Figure 2-4 (Audio), Figure 2-5 (Video).

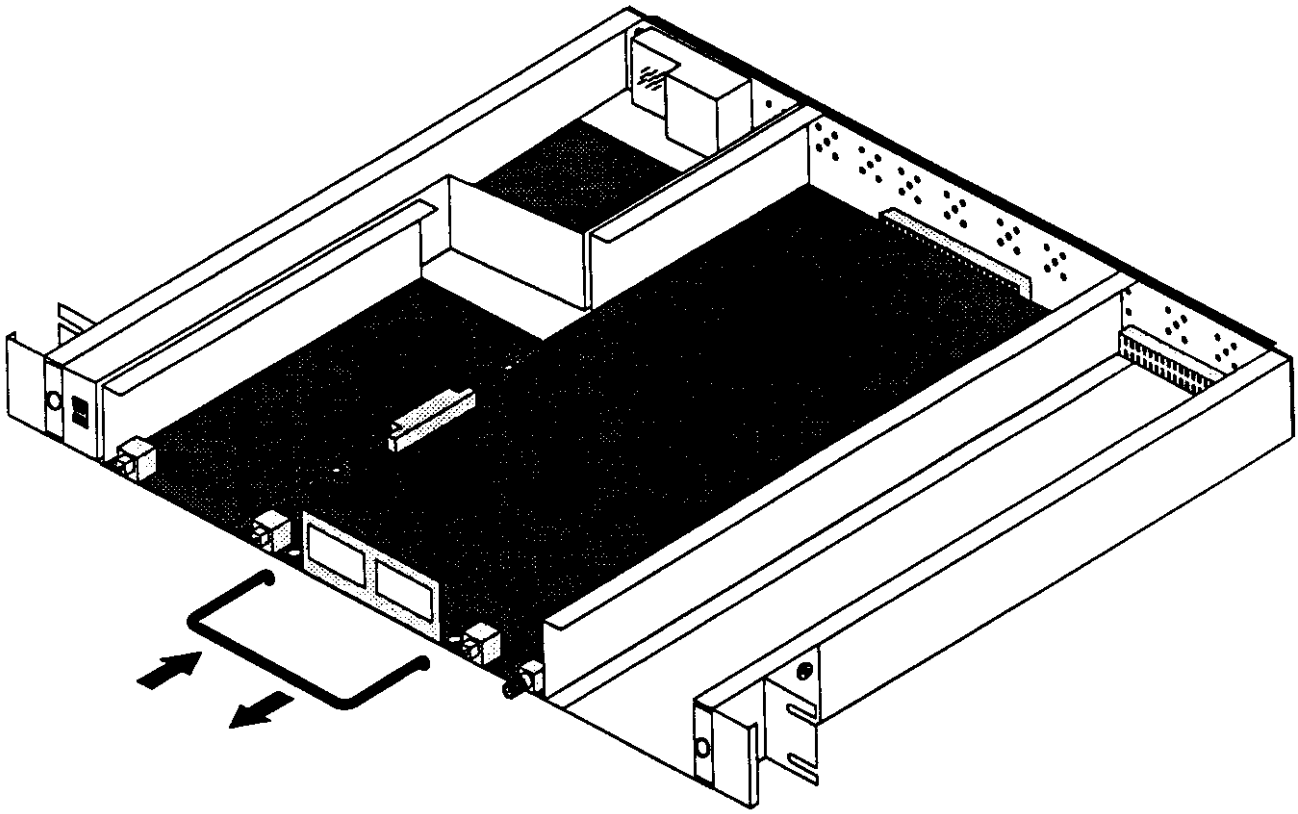
2.8 Module Removal/Installation

The ATM-1600 modules are configured and installed at the factory, however they may be removed to change internal switch settings or to be replaced, e.g., an optional 4.5 MHz Aural Subcarrier Processor could replace the Audio Modulator if required.

The ATM-1600 ON/OFF power switch must be in the OFF position prior to module removal or installation.

To remove the modules, loosen the two thumb screws and remove the ATM-1600 front panel. Using the ATM-1600 PCB Extraction Tool (P/N 6099-0027) remove the Audio and Video Modulator modules as one assembly as shown in Figure 2-6. Remove the two screws holding the modules together; the two modules may now be separated.

To install the modules, insert a module (either the Audio Modulator or 4.5 MHz Aural Subcarrier Processor) into the edge connector of the Video Modulator module, install the two screws. Reinsert both modules as one assembly into the ATM-1600 chassis. Replace the chassis front panel and secure with the two thumb screws.



Step 1
Insert Extraction Tool from the top of the video board into the holes provided.

Step 2
Remove both video and audio boards at the same time by pulling away from the chassis.

Figure 2-6
PC Board Removal
(Internal View)

SWITCH/JUMPER	USE	COMMENTS
SW1 Internal	Selects the internal IF REF Frequency.	Provides 45.75 MHz CW output at +40 dBmV to J7
SW1 External	Selects an external IF REF Frequency.	CW 45.75 MHz signal input is on connector J7. Input level should be 40dBmV ± 10dB
J8, J2, J9	Used to plug in optional Z-TAC interface board.	This optional board allows use of the Zenith Z-TAC scrambling system.
J10 pins 2 to1; J12 in	Combines the visual and aural IF carriers after the IF SAW filter.	Normal.
J10 pins 2 to 3; J12 out	Combines the visual and aural IF carriers before the IF SAW filter.	An option used in systems where the IF carriers are encoded.

Table 2-2
Video Switch and Jumper Options

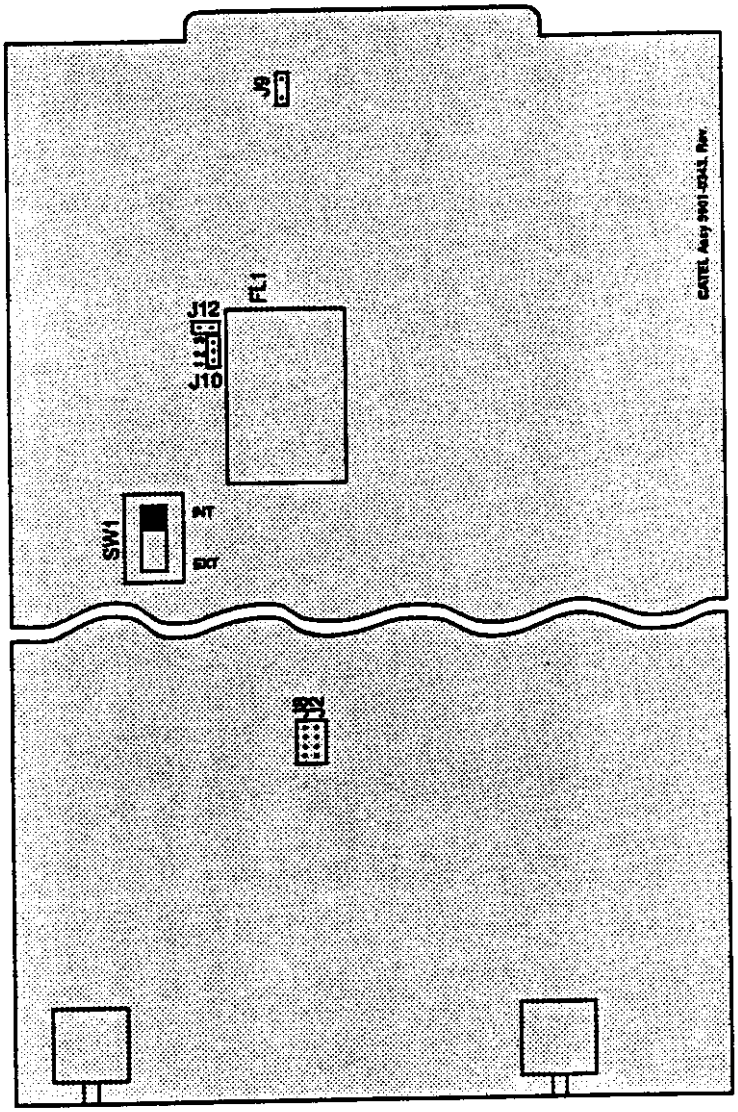


Figure 2-5
Video Switch and Jumper Locations

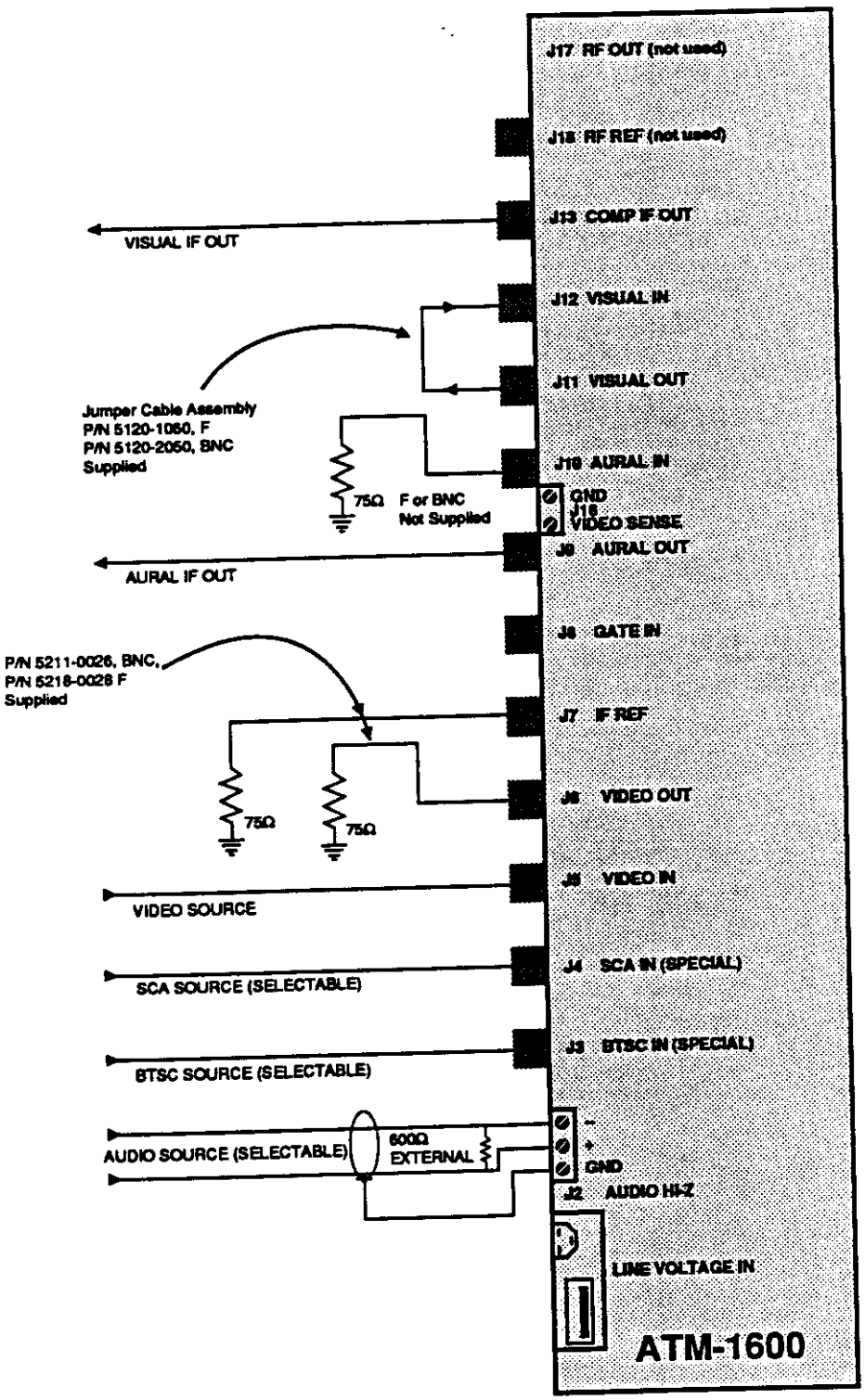


Figure 2-7
Normal Input/Output Connections

2.9 Cabling the Equipment

Input and output connections will vary depending on the user applications. For the most common video, audio, and IF modulator connections refer to the following figures.

Figure 2-7, ATM-1600 rear panel connections with baseband video and audio inputs (monaural) and SCA input (selectable) or composite BTSC audio input (selectable).

Figure 2-8, ATM-1600 rear panel connections with separate baseband video and 4.5 MHz aural subcarrier inputs (optional) BTSC or monaural.

Figure 2-9, ATM-1600 rear panel connections with a composite video/4.5 MHz aural subcarrier input (optional), BTSC or monaural.

Figure 2-10, ATM-1600 rear panel connections, encoded visual/aural IF.

Figure 2-11, ATM-1600 rear panel connections baseband scrambler.

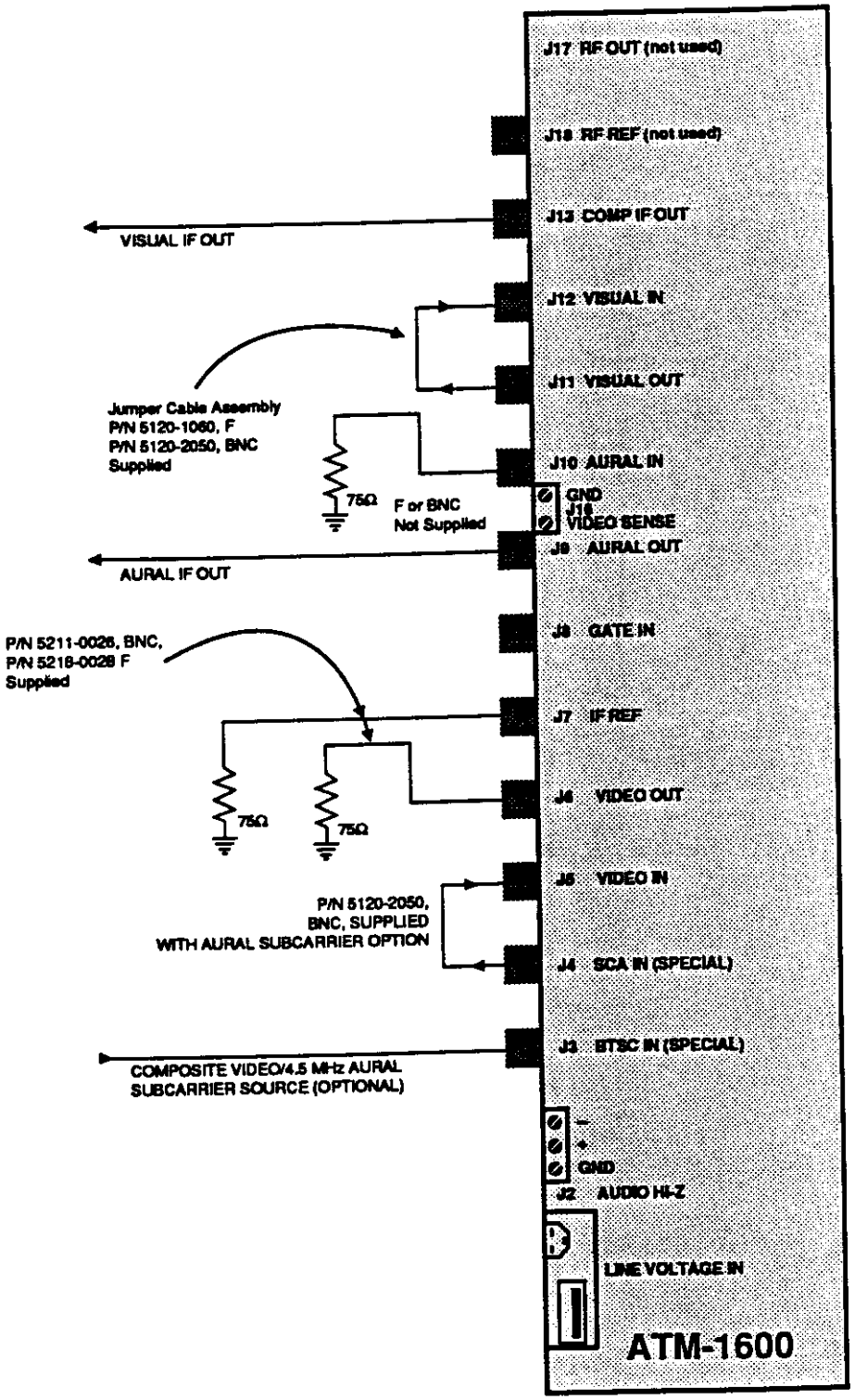


Figure 2-9
Input/Output Connections with Optional Composite Video/4.5 MHz Aural Subcarrier Input

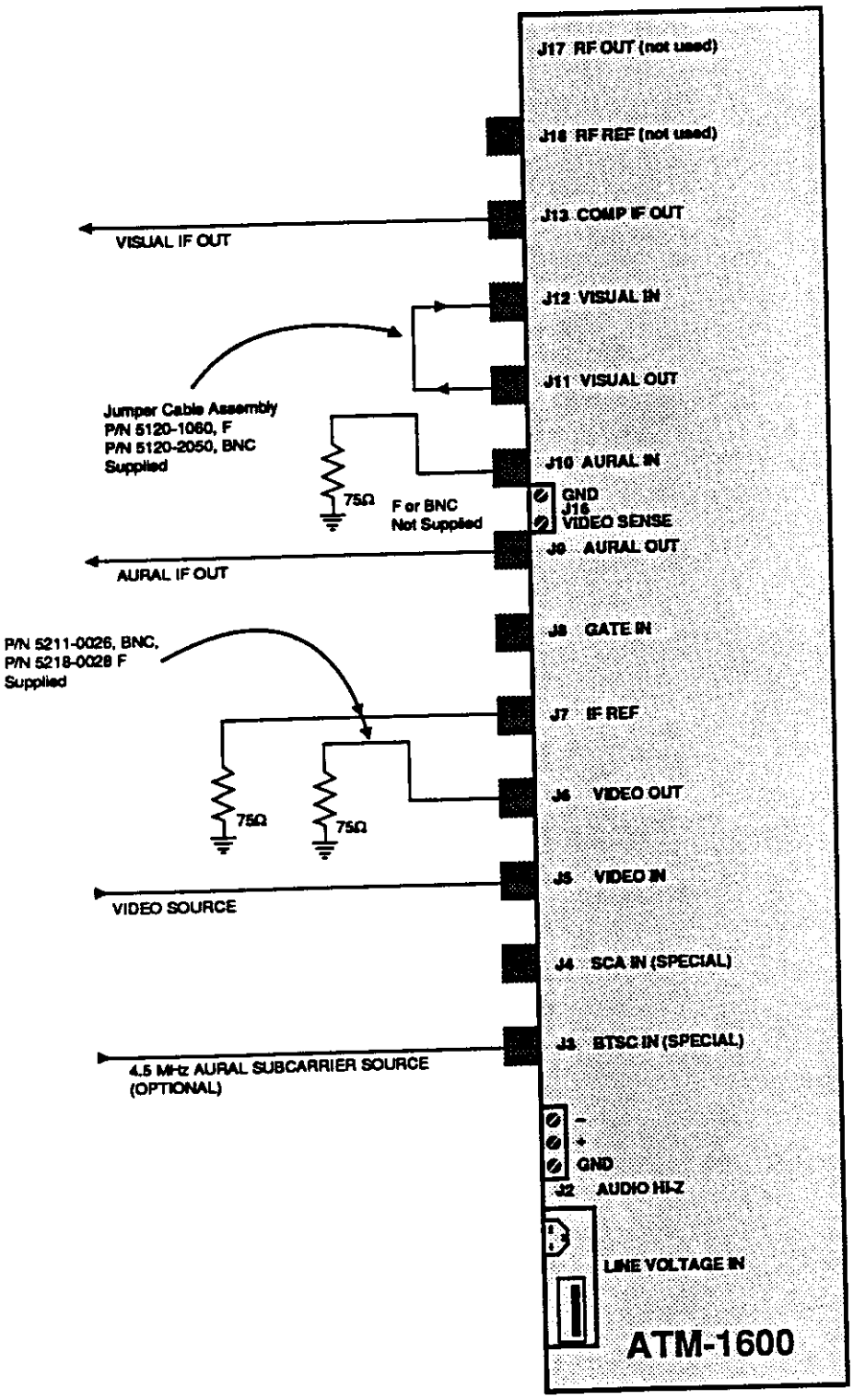


Figure 2-8
Input/Output Connections with Optional 4.5 MHz Aural Subcarrier Input

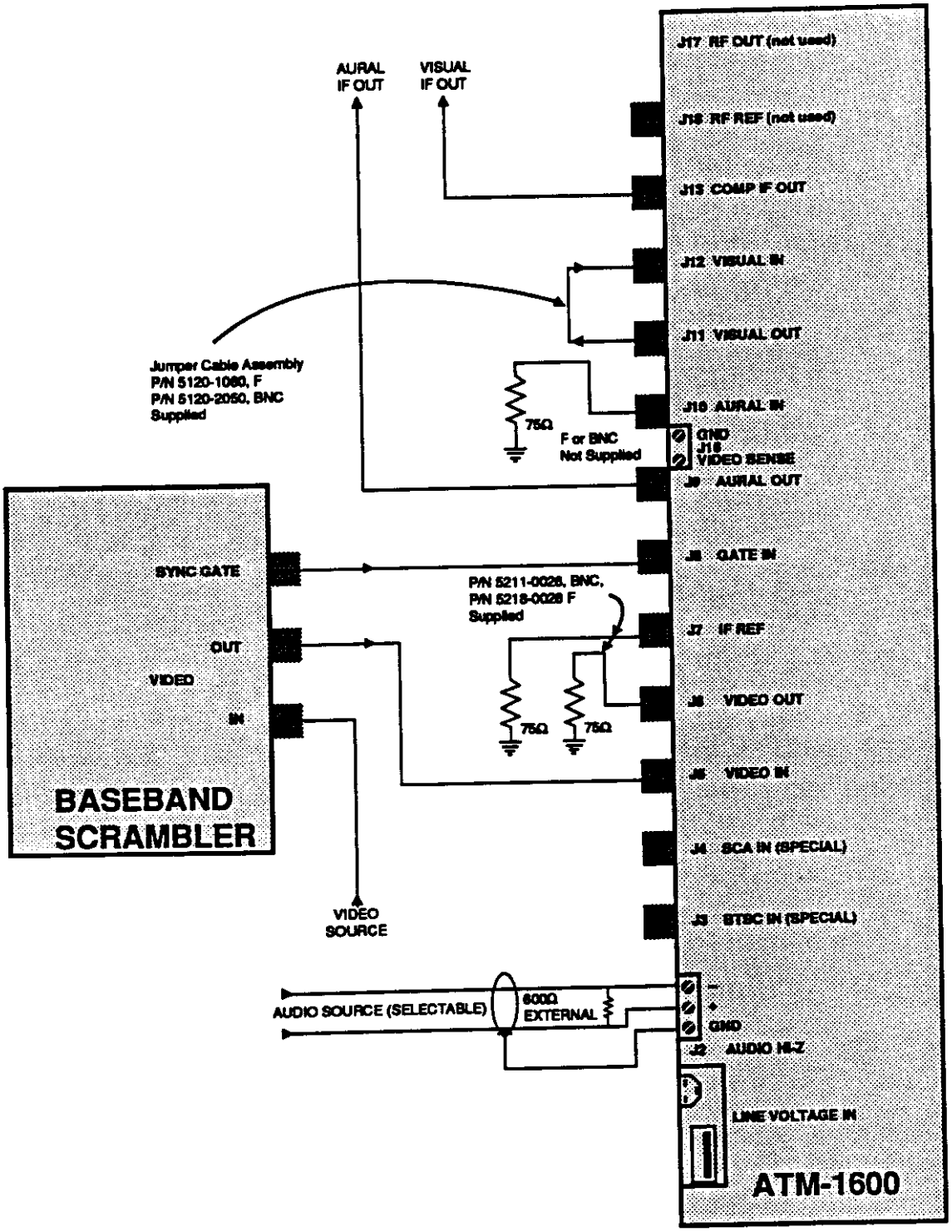


Figure 2-11
Baseband Scrambler Connections

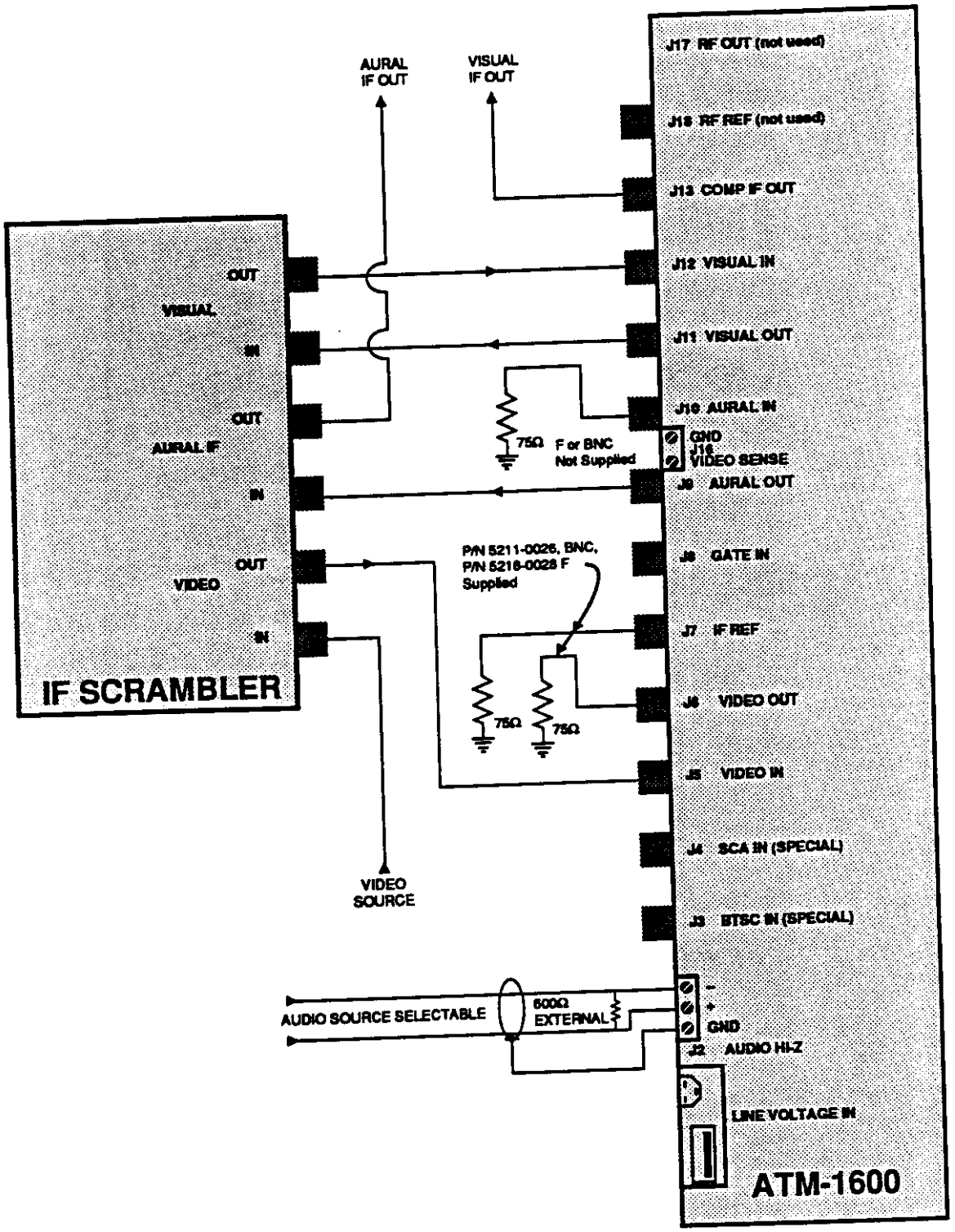


Figure 2-10
Encoded Visual/Aural IF Connections

3.0 OPERATION

3.1 Introduction

Procedures in this section describe how to adjust the ATM-1600 for optimum performance. The equipment has been thoroughly tested at the factory and only minor adjustments should be required.

3.2 Setup

Connect coax cables and audio leads to the rear chassis panel in accordance with the instructions in Section 2 of this manual and as user applications dictate.

The following test equipment will be required for proper adjustments of the ATM-1600.

RF Spectrum analyzer, 50 MHz Capability
Video test generator or video source
Audio oscillator or audio source
BTSC generator with composite or 4.5 MHz output
Frequency Counter
TV Demodulator
Waveform Monitor
Vectorscope
Step Attenuator

Plug the AC power cord into the power line module and the AC power source. Place the POWER ON/OFF switch, located on the front panel, in the ON position.

3.3 Video Modulation Adjustment

Connect a video test generator to J5 (VIDEO IN) of the ATM-1600 and set it at a level that is standard for the system. Select a full-field test signal with full video amplitude. A color bars or un-modulated stair-step signal is preferred. Ensure the video loop through at J6 (VIDEO OUT) is terminated.

Connect a spectrum analyzer to the front panel IF TEST POINT. The modulated visual IF carrier signal should be approximately +20 dBmV at this "F" type connector. Use the following spectrum analyzer settings:

Frequency	45.75 MHz for NTSC
Bandwidth	Maximum or > 300 kHz
Scan Width	Zero
Trigger	AC Line
Video Filter	None
Scan time	2 msec/division or adjusted to display at least one picture field.

Fine tune the spectrum analyzer for maximum display peak amplitude of the visual IF signal. Adjust the amplitude and log dB/division controls for nearly a full scale display.

The modulation percentage is read directly in decibels as the difference between the peak (sync tip) and the minimum (peak white) of the video waveform. Use the following table to convert the dB ratio to percentages.

Ratio	Modulation %
14 dB	80
16 dB	84
18 dB	87.5*
20 dB	90

Table 3-1
dB/Modulation RatioTable

If required, adjust the VIDEO MODULATION control on the ATM-1600 front panel to produce a peak-white video modulation percentage of 87.5% on the spectrum analyzer. The ATM-1600 front panel VIDEO MODULATION indicator should read 87.5% also.

If required, adjust the AUDIO DEVIATION control on the ATM-1600 front panel for the first Bessel null. The front panel meter will indicate -6 dB.

A composite BTSC signal may be inserted into J3 (BTSC IN) of the ATM-1600. The BTSC level should be 1.0 V p-p into 75 ohms. The aural IF carrier will deviate as much as ± 50 kHz. The front panel AUDIO MODULATION meter should indicate a maximum of 0 dB.

3.6 Subsidiary Communications Authorization (SCA) input

Ensure the Audio Modulator switch options are configured for monaural/SCA input. Refer to Figure 2-4 and Table 2-1.

Connect the SCA subcarrier source to J4 (SCA IN, SPECIAL) of the ATM-1600 rear panel.

Connect a spectrum analyzer to J9 (AURAL OUT) on the chassis rear panel. The SCA modulated aural IF carrier should be approximately + 40 dBmV at this connector. Adjust the analyzer to clearly resolve and display the SCA subcarrier.

Modulation of the aural IF carrier by the SCA subcarrier must not exceed FCC Regulations, (Sec. 73.682 (c)). Normally, the SCA subcarrier is set for approximately -18 dB relative to the 41.25 MHz aural IF carrier level. If required, adjust the SCA subcarrier source to achieve a -18 dB level relative to the 41.25 MHz aural IF carrier. The audio deviation meter does not accurately (understates) display the SCA deviation; therefore, it should not be used to set the SCA levels.

3.7 Aural Carrier Level Adjustment, Monaural/BTSC

The 41.25 MHz aural IF carrier level is adjustable only if the aural IF loop through is connected on the chassis rear panel. The IF output is on J13 (COMP IF OUT) where both the aural and visual IF are present.

Connect a spectrum analyzer to J13 (COMP IF OUT) on the ATM-1600 chassis rear panel. Adjust the analyzer to resolve and display both the aural and visual IF carriers. The visual IF (45.75 MHz, NTSC) carrier level should be +40 dBmV: the aural IF (41.25 MHz, NTSC) carrier level will be dependent on the front panel AURAL CARRIER control.

The maximum aural carrier power is 20% of peak visual carrier power, and the minimum is 10% (see FCC Regulations Sec. 73.1570 (c) (2)). Normally the aural IF carrier is set for -8 dB relative to the visual IF carrier level, in order to comply with Sec.73. If required, adjust the AURAL CARRIER control to achieve an aural carrier level of -8 dB relative to the visual IF carrier level.

3.8 4.5 MHz Subcarrier Input, Monaural/BTSC

If the 4.5 MHz Audio Subcarrier Processor module has not been installed, refer to Paragraph 2.8 module removal/installation procedures.

Connect a 4.5 MHz subcarrier source to BTSC IN (SPECIAL) (J3) on the ATM-1600 rear panel. Subcarrier input level should be +35 dBmV, ± 5 dB into 75 ohms.

If a composite video/4.5 MHz aural subcarrier input is used, connect the source to J3 BTSC IN (SPECIAL), on the ATM-1600 rear panel. Connector J4 SCA IN (SPECIAL) becomes a filtered video output (video minus the 4.5 MHz subcarrier) and must be looped to J5, VIDEO IN.

The AUDIO DEVIATION meter and the AUDIO DEVIATION control will not be operating. The audio deviation is set by the 4.5 MHz subcarrier source.

The aural IF carrier level at J13 (COMP IF OUT) may be set by the ATM-1600 front panel control AURAL CARRIER.

3.4 Audio Deviation Adjustment, Monaural

The AUDIO DEVIATION control on the ATM-1600 front panel is factory adjusted to produce 25 kHz peak deviation with a 400 Hz, 0 dBm audio input. With this test tone input to terminal strip J2 (AUDIO), terminated with a 600 ohm load, the front panel AUDIO MODULATION meter will indicate -6 dB. The AUDIO DEVIATION control can compensate for different audio input levels and should be adjusted to obtain a maximum indication of -6 dB on the front panel meter.

The following procedure has been provided for verification and troubleshooting purposes.

On the ATM-1600 rear panel connect an audio oscillator to J2 (AUDIO), terminated with a 600 ohm load. Set the oscillator output frequency, using a counter, to 10396 Hz, and the output level for -14.2 dBm into 600 ohms.

Connect a spectrum analyzer to J9 (AURAL OUT) on the chassis rear panel. The modulated aural IF carrier should be approximately +40 dBmV at this connector. Use the following spectrum analyzer settings.

Center Frequency:	41.25 MHz
Bandwidth:	3 kHz
Scan width:	20 kHz/division
Trigger:	AC line
Scan time:	2 msec
Video filter:	None

The aural carrier should have multiple sidebands 10396 Hz away. When the deviation is at 25 kHz, the aural carrier power will be zero. The sidebands will contain all the signal energy. This indicates the first Bessel modulation null of the carrier. If required, adjust the AUDIO DEVIATION control on the ATM-1600 front panel for the first Bessel null.

A 400 Hz test tone may now be inserted to J2 (AUDIO) of the ATM-1600. The test tone output level should be 0 dBm into 600 ohms. The aural IF carrier deviation will be 25 kHz peak and the front panel AUDIO MODULATION meter should indicate -6 dB.

3.5 Audio Deviation Adjustment, Composite BTSC Stereo

Ensure the Audio Modulator switch options are configured for BTSC input. Refer to Table 2-1 of this manual. The AUDIO DEVIATION control on the ATM-1600 is factory adjusted to produce 50 kHz peak deviation with a composite BTSC input of 1.0 V p-p with the BTSC input to J3 (BTSC IN) on the rear panel. The front panel AUDIO MODULATION meter will indicate 0 dB maximum. The AUDIO DEVIATION control can compensate for different BTSC input levels and should be adjusted to get a maximum indication of 0 dB on the front panel meter.

The following procedure has been provided for verification and troubleshooting purposes.

Connect an audio oscillator to J3 (BTSC IN) of the ATM-1600 rear panel. Set the oscillator output frequency, using a counter, to 10396 Hz, and the output level for 0 dBm into 75 ohms.

Connect a spectrum analyzer to J9 (AURAL OUT) on the chassis rear panel. The modulated aural IF carrier should be approximately +40 dBmV at this connector. Use the following spectrum analyzer settings.

Center Frequency:	41.25 MHz
Bandwidth:	3kHz
Scan width:	20 kHz/division
Trigger:	AC line
Scan time:	2 msec
Video filter:	None

The aural carrier should have multiple sidebands 10396 Hz away. When the deviation is at 25 kHz, the aural carrier power will be zero. The sideband will contain all the signal energy. This indicates the first Bessel modulation null of the carrier.

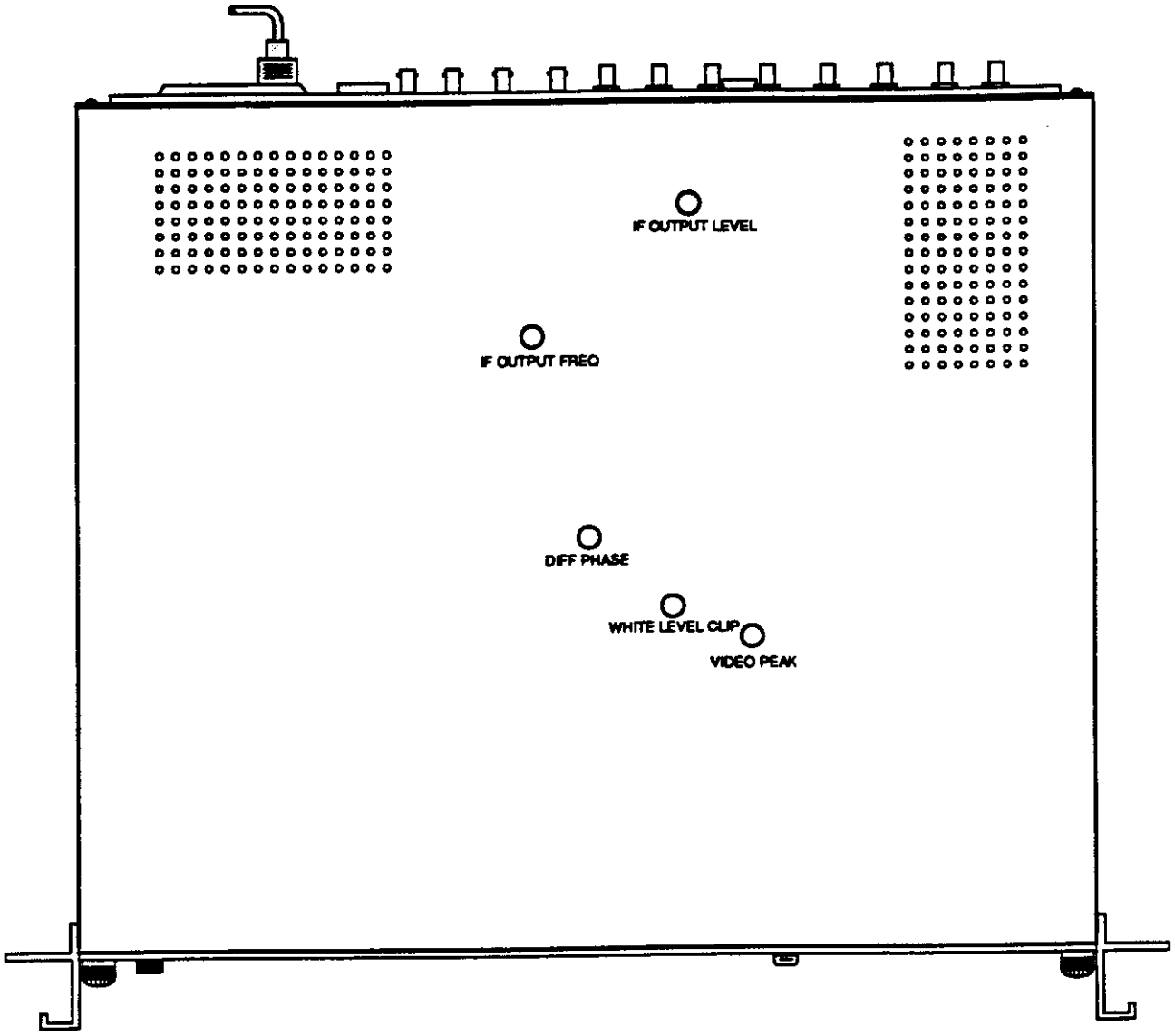


Figure 3-1
Adjustment Access through Top Panel

3.9 External 45.75 MHz Input

Ensure the Video Modulator switch options are configured for an external 45.75 MHz input. Refer to Figure 2-5 and Table 2-2.

On the ATM-1600 rear panel, J7 (IF REF) accepts a 45.75 CW input at a +40 dBmV level from an HRC comb generator or from another reference standard. The resulting aural and visual IF signals may be monitored on the front panel IF TEST POINT, provided the IF loop outs are connected on the chassis rear panel.

3.10 Visual IF Frequency Calibration

Ensure the video modulator switch SW1 is configured for INT, refer to Figure 2-5 and Table 2-2.

On the ATM-1600 rear panel, remove the 75 ohm terminator from connector J7, IF REF, and connect a frequency counter.

The ATM-1600 visual output frequency should be at 45.75 MHz ± 200 Hz. If not, adjust L12 which is accessible through an opening in the ATM-1600 Top Panel, labeled IF OUTPUT FREQ. See Figure 3-1. Use a plastic inductor (hex head) alignment tool for this adjustment. Remove the frequency counter and replace the 75 ohm terminator.

3.11 Visual Output Level Calibration

Connect a spectrum analyzer to J13 COMP IF OUT. The measured output level of the 45.75 MHz visual IF carrier should be + 40 dBmV. If not, adjust R176 which is accessible through an opening in the ATM-1600 Top Panel, labeled IF OUTPUT LEVEL. See Figure 3-1. Use a small (flat bladed) screwdriver for this adjustment.

3.12 Calibration for White Level Clipper, Video Frequency Response and Differential Phase

Connect the test equipment as in Figure 3-2. Set the waveform generator for a COMPOSITE output. Set the demodulator to SYNCHRONOUS, SYNC TIP detection and SOUND TRAPS OUT. Set the step attenuator to 0 dB attenuation.

3.12.1 White Level Clipper

Adjust R42 WHITE LEVEL CLIP, which is accessible through an opening in the ATM-1600 Top Panel, for its maximum counter-clockwise position. See Figure 3-1. Use a small (flat bladed) screwdriver for this adjustment.

Temporarily set the video modulation depth to 100% by adjusting the VIDEO MODULATION control on the ATM-1600 front panel, to a point where the video peaks are at 120 IRE as seen on the waveform monitor. Readjust WHITE LEVEL CLIP (R42), to a point just below amplitude compression. Reset the front panel VIDEO MODULATION control back to 87.5%.

3.12.2 Video Frequency Response

Set the waveform generator for a MULTIBURST WAVEFORM. Adjust R6 VIDEO PEAK, which is accessible through an opening in the ATM-1600 Top Panel, for best multiburst flatness from the lowest frequency burst at 0.5 MHz to the highest frequency burst at 4.18 MHz. See Figure 3-1. Use a small (flat bladed) screwdriver for this adjustment.

3.12.3 Differential Phase

Set the demodulator to SYNCHRONOUS, SYNC TIP detection with ZERO CARRIER REF. ON and sound TRAPS OUT. Set the step attenuator to 1.0 dB attenuation. The right-hand step chroma peak should be at 105 IRE units, with the zero carrier reference at 120 IRE units. Calibrate the vectorscope vector length to the graticule circle. Set the demodulator to ENV. detector mode, and the vectorscope to DIFF. PHASE.

Adjust DIFF PHASE control C60 which is accessible through an opening in the ATM-1600 top panel, to minimize the differential phase reading. See Figure 3-1. Use a small (flat bladed) screwdriver for this adjustment.

Switch the demodulator between ENV. and SYNCHRONOUS, SYNC TIP detection modes and adjust the DIFF. PHASE control to minimize measured differential phase in both detection modes. The resulting differential phase in both detection modes should be less than 0.3°.

4.0 CIRCUIT DESCRIPTION

4.1 Introduction

Information is this section describes each module individually. If a module contains PC board switch or jumper options, the locations are illustrated in Section 2. Schematic drawings have been provided in this Section to facilitate understanding of the equipment.

4.2 Chassis

The ATM-1600 chassis consists of the following: basic steel enclosure, removable front panel and removable sub-chassis with +18 VDC universal switching AC power supply and back plane board. The chassis will accept one audio/video assembly with provision for an RF converter assembly.

User adjustments to the audio and video modules are made through openings in the chassis front panel, which also provides for the modulator ON-OFF switch, Modulation Indicators and the IF test point; refer to paragraph 2.5. Two thumb screws allow removal of the front panel for audio/video assembly access or replacements; refer to paragraph 2.8.

Non-user calibration adjustments for various video and IF parameters are accessible through openings in the Chassis Top Panel; refer to paragraph 3.12

The internal +18 VDC power supply accepts any input from 90 to 260 VAC, 47 to 63 Hz. No switching or adjustments to the sub-chassis or power supply are necessary. The power supply should be properly fused for safe operation; refer to paragraph 2.4.

Refer to the schematic diagram of Figure 4-1 for power supply circuit design information. The input AC line voltage is applied to the input rectifier DB1 and filter C7. The resulting DC voltage passes to the switching transformer T2 and the switching power MOSFET Q1. The switching frequency is 30 kHz with a maximum duty cycle of 85%. The T2 output voltage is rectified and filtered by D7 and its associated LC network. The resulting +18 VDC output at TB2 is set by VR1. Overvoltage protection is provided by DZ1 and SCR1.

A small portion of the DC voltage is fed back to the output voltage sense circuit IC1 and IC2 which vary the duty cycle of the current mode controller IC3. The controller supplies gate drive to the MOSFET switch. This voltage control loop maintains a constant voltage at the DC output terminal, TB2.

Overload protection is provided by the MOSFET source resistor R3 and the current mode controller IC3. The voltage at pin 3 of IC3 is monitored and compared to a level derived from the output voltage sense circuit IC1 and IC2. Abnormal operating conditions occur when the power supply output is overloaded or if output voltage sensing is lost. Under these conditions the current mode controller, IC3 will shut off the gate drive to MOSFET switch Q1.

Input/output connections as well as internal module connections and DC routing are made through a common back plane board and sub-chassis wiring; refer to Figure 4-2.

4.3 Audio Modulator

Refer to the schematic diagram Figure 4-3 for circuit design and to Figure 2-4 for switch and jumper options locations. The Audio Modulator is a direct FM transmitter designed to supply an aural IF signal at a frequency of 41.25 MHz for NTSC.

Input to the unit is switchable from baseband audio, through a balanced, bridging input, to a composite BTSC signal, through an unbalanced 75Ω input via SW1 and SW2. The input networks are bridged by an audio amplifier U1A that feeds an audio buffer amplifier U1B through potentiometer R1, used as a level control (AUDIO DEVIATION, front panel). The audio buffer amp drives an AC/DC converter circuit and the modulator VCO, and provides the pre-emphasis characteristic. The 75 µsec pre-emphasis is removable via SW1.

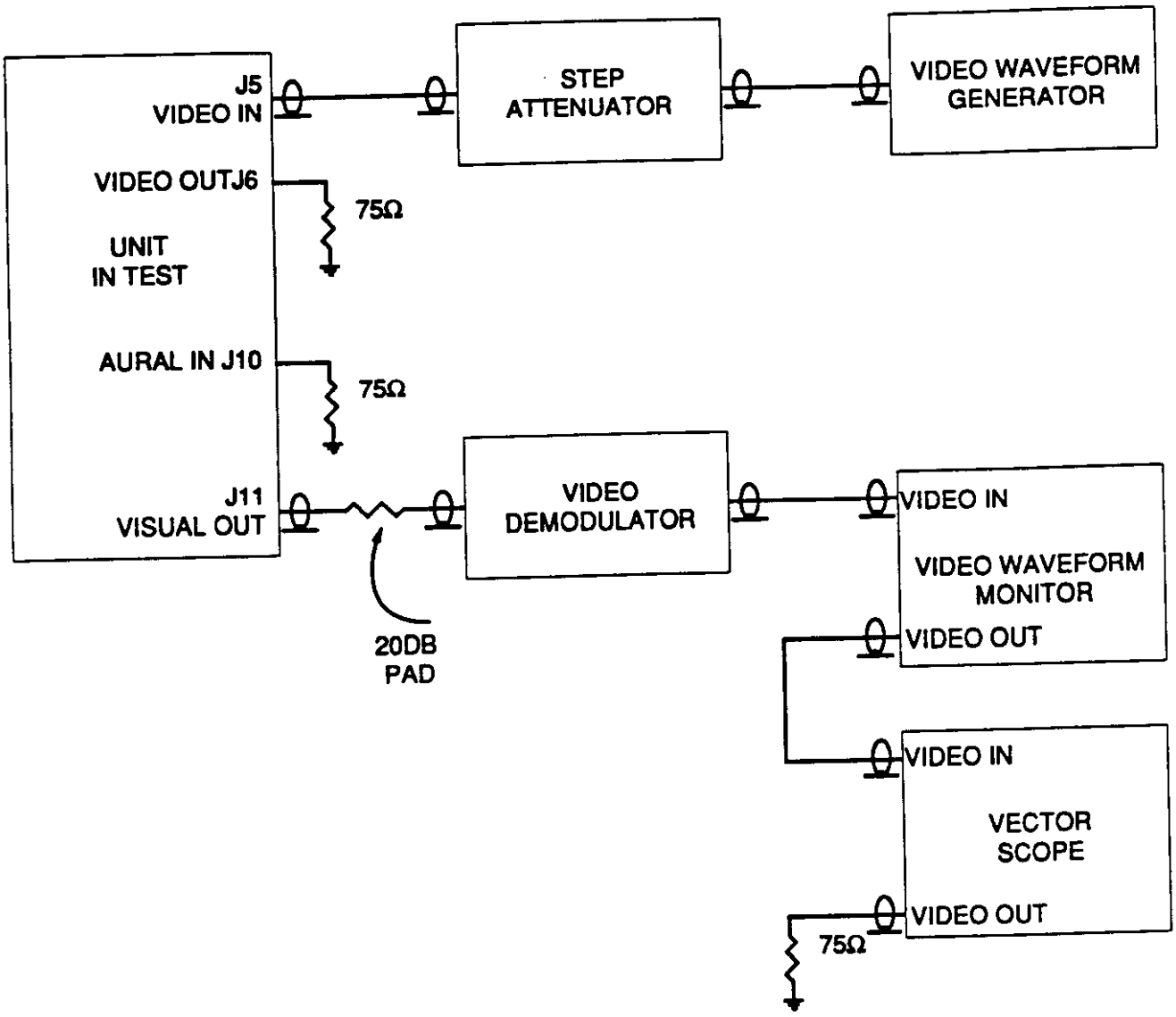


Figure 3-2
Video Modulation Waveform Tests

9A, U9B, diodes CR3, CR4, CR5 and CR6 form a ecision AC/DC converter circuit. The circuit converts e AC audio into a DC signal to operate the front panel eviation meter. First the output is fed into U10 which ovides the necessary voltage gain and level translation. 58 is a zeroing control that sets the lower end of the scale the deviation meter, R56 is used for the higher end.

he 41.25 MHz VCO consists of amplifier U8, tank circuit 4, and capacitors in the U8 output circuit. Varactor diode R2 is used in the tuned circuit as the voltage variable lement. The modulating audio circuit is fed from the arm f deviation control R44 through R45 to CR2. The oper- ting frequency of the VCO is determined by L4, C40, C44, C47, C48, and CR2. L4 is the VCO center frequency djustment on the circuit board.

The VCO output, from L4, is fed to buffer amplifier U7 which provides gain and isolates the VCO circuitry. The R38 level adjustment in the U7 circuit sets the modulator F output to +40 dBmV at rear panel connector J9, (AU- RAL OUT). L7, C52 and C53 is a parallel tuned resonant circuit adjusted to 41.25 MHz. The tuned circuit matches the U7 output to 75 ohms.

A sample of the VCO 41.25 MHz signal is taken off directional tap T1 and is fed through amplifier Q5 to PLL synthesizer U4. The PLL synthesizer also takes inputs from PLD U5 and a countdown circuit. The PLD delivers a clock frequency and necessary reference data to the synthesizer from a crystal oscillator in the video module. A 45.75 MHz unmodulated reference signal is fed into the U2, U3 countdown circuit. The output of the countdown circuit is sent to "osc in" on the PLL synthesizer. The PLL synthesizer generates an error voltage which is sent back to varactor diode CR2 to lock the VCO output frequency. Thus the 41.25 MHz system is locked to the 45.75 MHz reference.

Two on board regulators provide +15 and +5 V output and regulate against current and input voltage variations. The main +5 V is isolated from the digital +5 V for noise reduction purposes.

4.4 Video Modulator

Refer to the schematic diagram Figure 4-4 for circuit design and to Figure 2-5 for switch and jumper options locations. The Video Modulator module accepts a baseband video input and generates a 45.75 MHz visual IF carrier as the primary output.

The video input, from the rear panel connector J5 (VIDEO IN), is fed into the two-stage feedback amplifier Q1 and Q2. This amplifier provides a high input impedance to the video source, and buffers the input video signal from the video module circuits.

Variable resistor R6 is a factory adjustment, together with C1; their purpose is to boost the high end of the video response curve. In series with R6, R7 is the factory adjusted video modulation calibration control. R7 calibrates the front panel video modulation control to 87.5% with a 1 V p-p video input.

The R7 output is fed to the Q3/Q4 feedback amplifier which serves as a buffer between the input video and the phase equalizer network. Video is then fed to the front panel VIDEO MODULATION control R15. Q5 and Q6 form a feedback pair amplifier that provides frequency shaping in conjunction with R19 and C14.

The Q5 /Q6 output goes to the main video amplifier, Q7, Q8, Q9 and Q10. This amplifier provides video drive to the diode modulator stage.

The sync tip clamp, and white level clipper circuits are associated with the main video amplifier. The sync tip clamp circuit references the sync tips to a specific DC reference level.

The white level clipper limits the white level amplitude so that over modulation of the video carrier does not take place.

The sync tip clamp circuit consist of U1, Q11, Q12. The white level clipper consist of Q13, CR1, CR2.

r sync tip operation, a reference voltage is fed to pin 1 d video is fed to pin 5 of comparator U1. The U1 ference voltage is obtained from a voltage divider that cludes potentiometer R113 labeled MONITOR CAL. the circuit board. R113 sets the reference voltage to a escribed value for correct operation of the video ampli- r.

e output of comparator U1, at pin 6, goes into Q11 and 12 which act as a sync tip level detector and provide a C correction signal fed back to the base of Q7 through J2, and R23.

summary, the sync tip clamp circuit involves a feedback op from Q7, through Q8, Q9, Q10, U1, Q11 and Q12. rom the emitter of Q12, a DC correction voltage is fed ck to the base of Q7 to set the sync tip operating point the emitter of Q10.

he white level clipper exerts its influence on Q10 through signal path from the Q13 emitter, CR1, to the Q10 nitter. Through this path, Q10 is biased so that it can no nger furnish additional video drive to a diode bridge in e video modulator.

he biasing of Q10 puts a limit on modulation depth and revents carrier cut-off caused by over modulation and the esulting distortion and sync buzz.

he modulation depth, in the white level clipper circuit, is djusted by potentiometer R42, a user screwdriver adjust- ent on the circuit board labeled WHITE CLIP LVL.

he output video amplifier, from the Q10 emitter, drives he video modulator circuit consisting of R68, L19, R69 nd diode bridge modulator CR8, CR9, CR10, and CR11. R113, labeled MONITOR CAL. on the circuit board, is actory adjusted to calibrate the diode bridge to generate 7.5% modulation at the standard video input level to the ATM-1600. R113 forms a voltage divider with R112 and hermistor RT1 to pin 3 of operational amplifier U4B.

he R113/R112/RT1 combination sets the reference volt- ge at the U4B output, Pin 1. This output provides a low mpedance drive point for CR9 and CR11. The CR9 and CR11 junction is a fixed voltage point. The video signal is fed to the other side of the diode bridge, at the junction of CR8 and CR10.

When the voltage at the CR8/CR10 junction is equal to the voltage at the CR9/CR11 junction, the bridge is balanced. The RF drive out of transformer T6 is cancelled out and zero power results, across the two junctions, representing 100% modulation. When the levels at the junctions are different, the bridge is unbalanced allowing the RF drive from T6 to go through the modulator stage and to module pin J1-P, the (VISUAL OUT) terminal. The modulation percentage is proportional to the difference in level between the CR8/CR10 and CR9/CR11 junctions.

Factory adjustment C60 across T6, is an adjustable capacitor used to balance out the static phase error that causes differential phase. C60 is adjusted to minimize differential phase.

Input to the modulation percentage detector is from Q10 emitter (from the output video amplifier). The signal is fed through emitter follower, Q22, to diode detector circuit, CR4, CR5 and CR6. The output of the diodes is a DC voltage proportional to the video drive into Q22.

The output of the diode circuit, CR6, is fed into an operational amplifier, U6B. used to provide a visual indication on the MODULATION % bar graph indicator on the front of the Video Modulator .

Transistor Q17, Crystal Y1, tank circuit inductor L10, feedback inductor L12, and C47 comprise a 45.75 MHz oscillator. The oscillator output goes to buffer amplifier Q18.

The buffer amplifier output, at the Q18 collector, is fed through a low pass filter, L13, C52, and C53, and then into directional taps T3 and T4. The directional taps function and routing are as follows:

T3, 45.75 MHz in and out. When SW1, the user EXT/INT switch on the PCB is in the INT position, 45.75 MHz is fed from module pin J1-H to the rear panel connector J7 (IF REF). When SW1 is in the EXT position, the module accepts an external 45.75 MHz source, fed into connector J7 (IF REF).

4.5 Baseband Encoder Interface

The baseband encoder interface allows the modulator to be used in a baseband video scrambling system. Baseband encoded scrambling requires a baseband encoder interface board assembly part number 9001-2037 in the video modulator module. This assembly replaces the normal sync tip clamp circuit with a gated clamp which is enabled only during the appropriate time interval for video sync.

Timing information is supplied to the modulator by an encode gate signal originating in the baseband encoder. The encode gate timing pulses trigger a series of one-shot timers and associated electronic switches in the encoder interface board assembly. This process gates on the clamping circuits during the suppressed sync interval.

Refer to the block diagram, Figure 4-5, and timing diagram, Figure 4-6.

Central to the operation of the baseband encoder interface assembly is a current mode (Norton) amplifier, U4, acting as a sync level sensing feedback element between the modulator's video amplifier output and the bias input. This circuit automatically adjusts the sync clamping level so that current through R10, into the non-inverting input

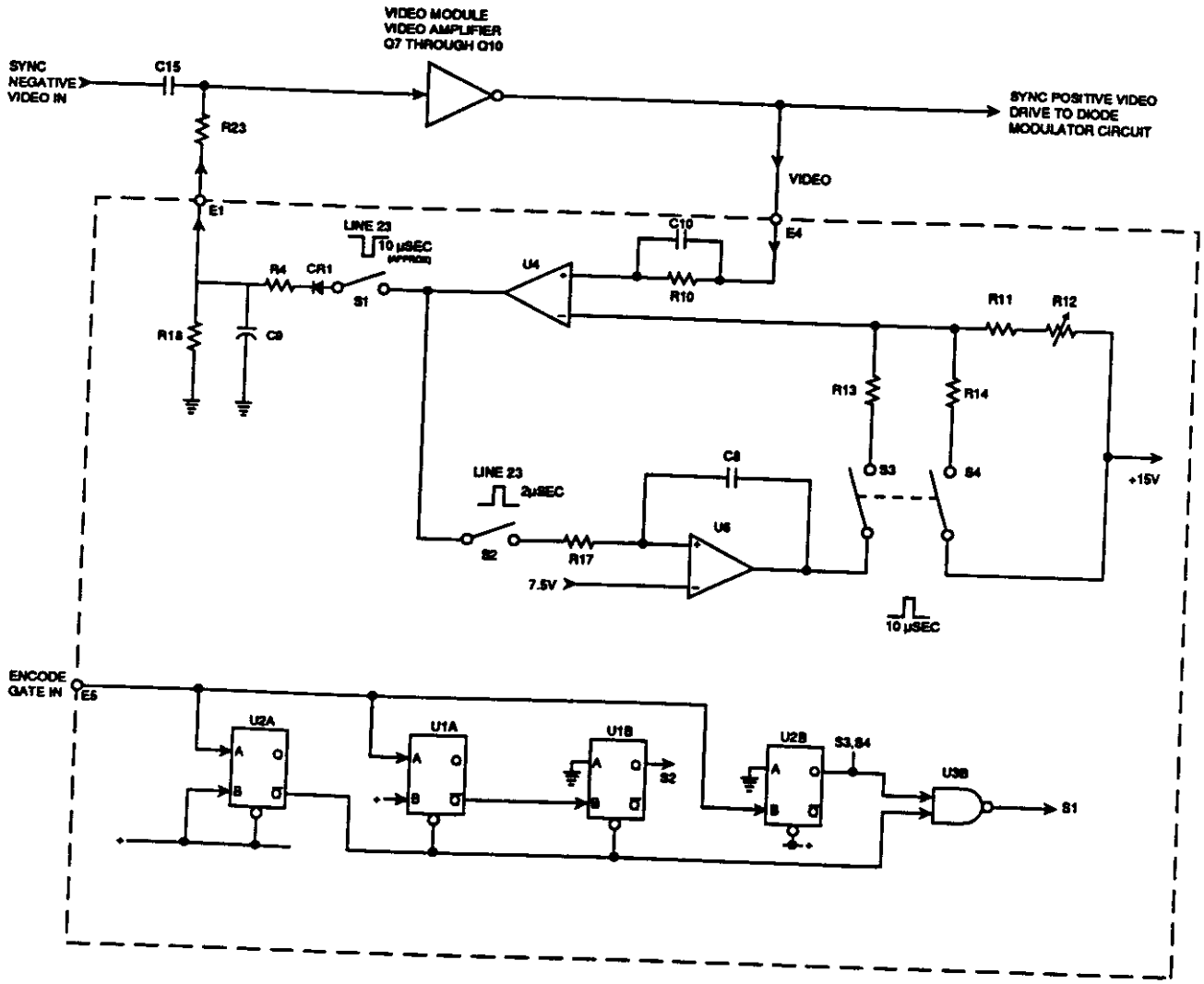


Figure 4-5
Baseband Encoder Interface Assembly, Block Diagram

T4, 45.75 MHz to module Pins J2-3 and J2-C. The feed to the audio module used to lock up the Aural IF generating circuits.

The video modulator carrier drive consists of buffer amplifier Q19 and all components between T4 and T6. The circuit supplies CW visual IF carrier drive to the video modulator.

R100, labeled CARRIER DRIVE on the circuit board, is a factory adjusted variable resistor that adjusts the RF drive level to the modulator. This level is set to a prescribed value to maintain the lowest distortion.

The circuit containing Q20 and Q21 and associated components, including capacitors and inductors leading to the module pin J1-P output, is the modulated visual IF output amplifier.

The modulated output from the diode bridge in the video modulator circuit is fed to differential amplifier Q20 and Q21.

The amplifier output is taken from the collector of Q20 and fed to output level potentiometer R105, a factory adjustment labeled OUTPUT LVL CAL on the circuit board.

R105 is associated with coupling transformer T7 which goes into low pass filter C64, C65, C66, L16 and L17. The low pass filter output goes to module pin J1-P which is connected to rear panel J11 (VISUAL OUT). R105 is adjusted to obtain a +40 dBmV output.

Q40 amplifies visual IF, Q42 amplifies aural IF, and with jumpers J10 pins 2-3 and J12 out, visual and aural IF signals are fed through directional tap transformer T10. T10 adds the aural IF to the visual IF before the SAW filter, FL1. The combination of components in the Q40 emitter circuit helps to flatten the response over a 40-47 MHz bandwidth.

The J10 and J12 jumpers are used to add the aural signal to the visual IF signal as follows: J10 pins 2-3 and J12 out connection adds the aural signal to the visual IF before the SAW filter. A J10 pins 1-2 and J12 in connection adds the aural signal after the SAW filter. In some applications, the SAW filter bandpass is too narrow to allow passage of the aural signal; then the jumpers J10 pins 1-2 and J12 in are used.

Transistor Q14 forms an IF amplifier that compensates for SAW filter losses. Q14 also forms a buffer between the SAW filter and the LC filter in the Q14 collector circuit. The trimmer potentiometer, R176 allows a small adjustment in gain to maintain unity gain throughout the module amplifier circuits.

The LC filter, L36, L37, C119, C120, C121, C122, and C123, compensates for the SAW filter's slope of the passband response. The pi pad, R183, R184, and R185 helps isolate any perturbations caused by the composite IF outputs affecting the LC filter.

The transformer T5 forms a 3 dB signal splitter to drive U20 and U21. These amplifiers boost the signal to a +40 dBmV output at pins J1-15 and J1-16

At pin J1-K aural IF input, the pi pad R189, R190, and R191 insure a good return loss and isolates the broadband aural IF amplifier Q42.

Following Q42 is a electronic attenuator circuit consisting of C138, C139, CR20, CR21, L41, R197 through R205.

R205 is the AURAL CARRIER front panel adjustment for setting the level of the aural IF carrier referenced to the visual IF carrier.

On the rear panel, J16 monitors the presence of video on J5, VIDEO IN. Output from J16 is positive logic TTL. Output is high with video input (+5 V through 1k ohm source) with an internal pullup resistor. Output is low with no video input (0.4 V maximum). Resistive loads down to zero ohms are acceptable. An LED lamp may be connected between the Video Sense terminal and ground for remote indication of video status.

At the initiation of sync suppression, electronic switch S1 opens for a time period equal to the low state of the enable gate.

Electronic switch S2 closes for two microsecond; S3 and S4 close for ten microseconds. This switching sequence closes the feedback loop around U4 and the integrator circuit, U6, C8 and R17. At this time, the U4 inverting input reference current includes R11/R12, R13, and U6/R14 current paths.

The feedback loop circuit, including integrator U6, stabilizes with the sync clamp referenced to the suppressed sync level established at the first line with suppressed sync. The active video component remains at the same bias level as with unscrambled sync. During the remainder of the video frame, electronic switch S1 remains closed and S2 remains open. Further switching of S1 and S2 is inhibited until one-shot U2A can reset during the next vertical interval when the enable gate becomes inactive. To maintain clamping on the suppressed sync amplitude, electronic switches S3 and S2 continue to close for a period of ten microseconds during each line in response to the encode gate signal.

4.6 Aural Subcarrier Processor

Refer to the schematic diagram in Figure 4-7 for circuit design information. The Aural Subcarrier Processor converts a 4.5 MHz aural subcarrier input to 41.25 MHz using 45.75 MHz as the reference. The aural subcarrier input may be included with a composite NTSC video signal.

The 4.5 MHz input from J3, BTSC IN (SPECIAL), on the ATM-1600 rear panel, passes through an initial 4.5 MHz band pass filter, FL1. The filter output goes to the amplifier stages of Q7, Q8 and Q9. L8, L9 and associated components make up the second 4.5 MHz band pass filter. The Q10/Q11 circuit is a limiter followed by a low pass filter consisting of L11, C23 and C24. This filter attenuates harmonics of 4.5 MHz produced by the Q10/Q11 limiter.

U1 is a four quadrant multiplier used as a mixer. After filtering and limiting, 4.5 MHz is fed to pin 1, of U1. A 45.75 MHz CW signal is fed to pin 8 of U1 via P1 and transformer T3. The signals are mixed and the U1 output signal, on pins 6 and 9, is processed through circuits that tune to the 41.25 MHz difference frequency.

Components L12 through L14 and C29 through C35 form a 41.25 MHz bandpass filter. The signal is then amplified by U2, the gain of which is determined by the DC level set by R51, the output level control. L16, R54, C39 and C40 form a 41.25 band pass filter that reduces second and third harmonics. The 41.25 MHz output is sent to the video modulator, via P1.

If a composite NTSC video signal is used with the 4.5 MHz aural subcarrier input, the signal feeds a two stage feedback amplifier, Q1 and Q2. A terminating resistor, R1, provides a 75 ohm input impedance to the video source. R2 sets the module video output level for unity gain. C48 is used to flatten the output video frequency response.

The amplifier output goes to a video filter consisting of T1, L2, L3 and C2 through C6. The filter removes the aural subcarrier at 4.5 MHz. Following the video filter is the phase equalizer network.

The phase equalizer network consists of components C50, L18, R14, L4 through L7 and C7 through C11. The network corrects for any group delay distortion caused by the preceding video filter.

The output from the phase equalizer feeds the output video amplifier, U4. The amplifier output goes to J4, SCA IN (SPECIAL), on the ATM-1600 rear panel.

An on-board voltage regulator, U3 provides a +15 VDC output to regulate against current and input voltage variations.

of U4, matches the reference inverting input current of U4.

In the non-scrambled mode the reference current to the U4 inverting input is set by variable resistor R12 in series with R11. The encoded gate line remains inactive, (high) thus preventing operation of the one-shot timers and electronic switches. Electronic switch S1 is closed; S2, S3 and S4 are open, allowing U4 and associated components to act as a conventional sync tip referenced clamp circuit. Variable resistor R12 calibrates the video bias level, as required for normal sync by adjusting the reference current into U4. In the scrambled mode, the encode gate line is activated. This causes operation of the one-shot timers and the electronic switches, as indicated in the timing diagram. At the beginning of the vertical sync interval., sync is not suppressed and the encode gate line remains inactive. Beginning at line 23, sync is suppressed by the encoder and the encode gate line is driven low as shown in the timing diagram.

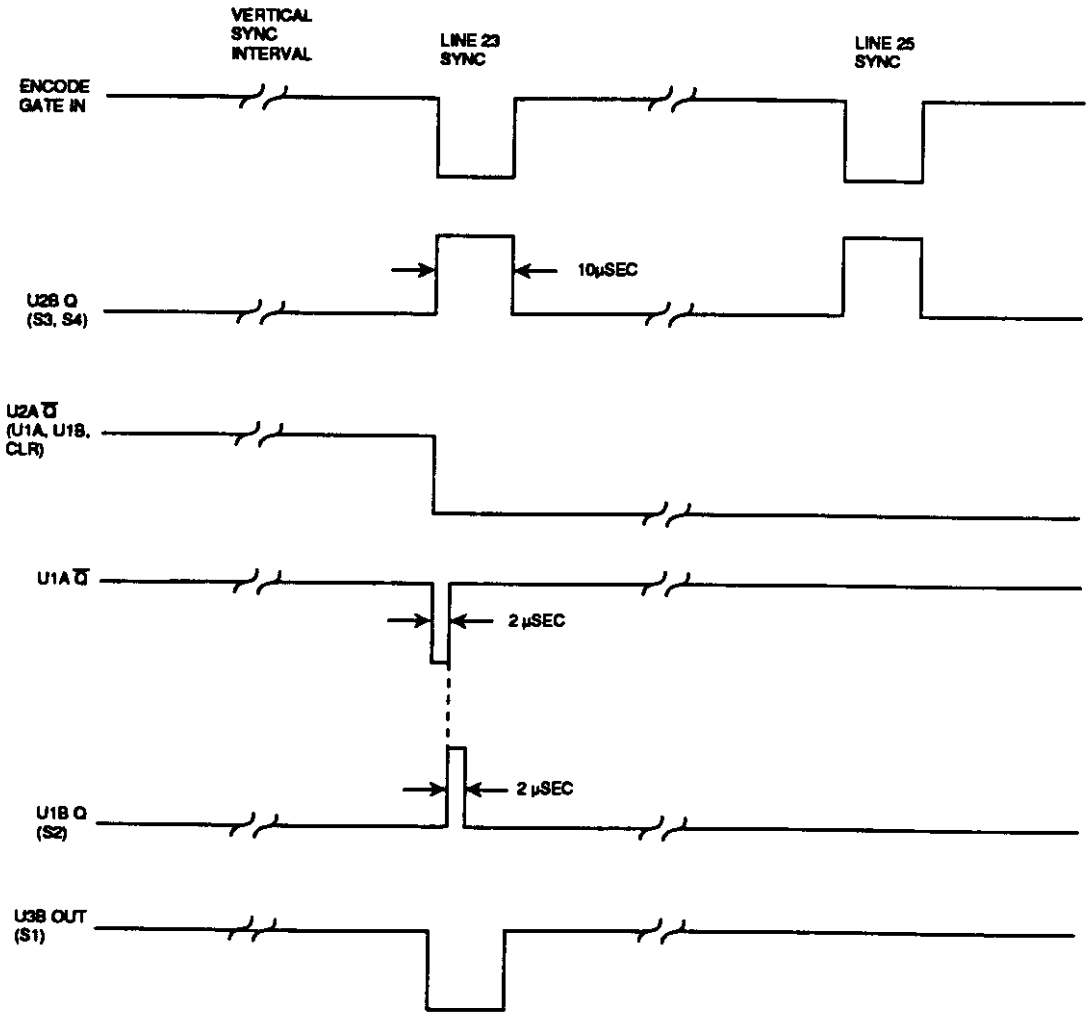


Figure 4-6
Baseband Encoder Interface Assembly, Timing Diagram