Instruction Manual
ATM-1600
NTSC Broadcast
Television Modulator

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

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.

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.

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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

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

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.)

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.)

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

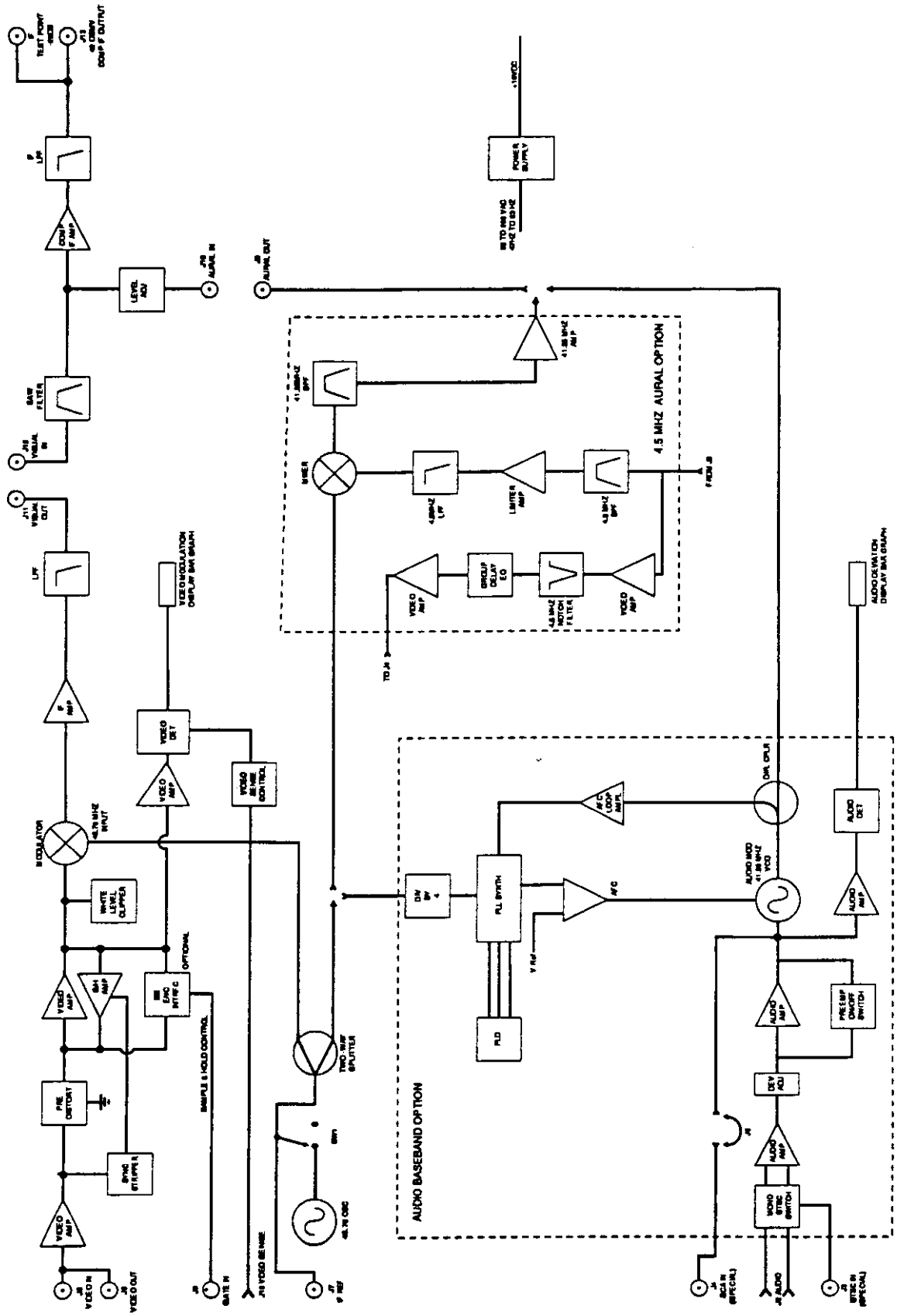


Figure 1-1
ATM-1600 Block Diagram

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.

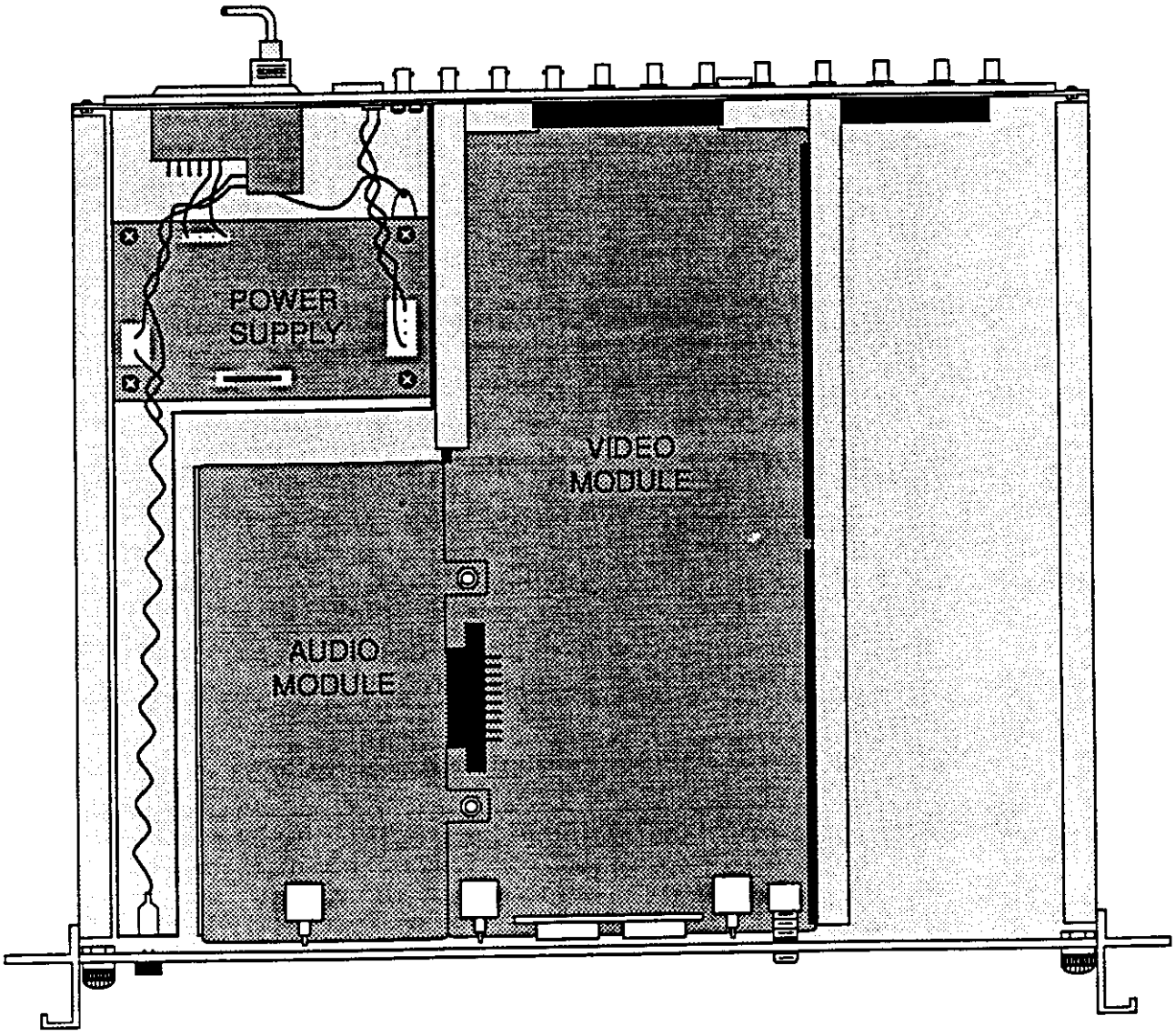


Figure 1-2
ATM-1600
Internal Top View

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.

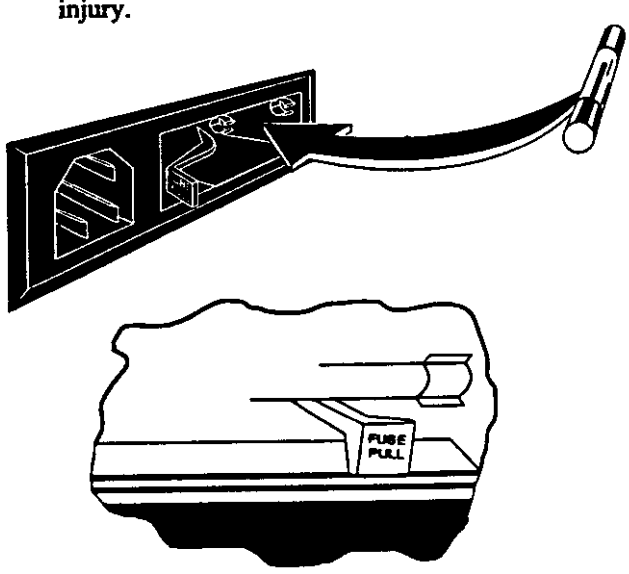


Figure 2-1
ATM-1600
Power & Fuse Assembly

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

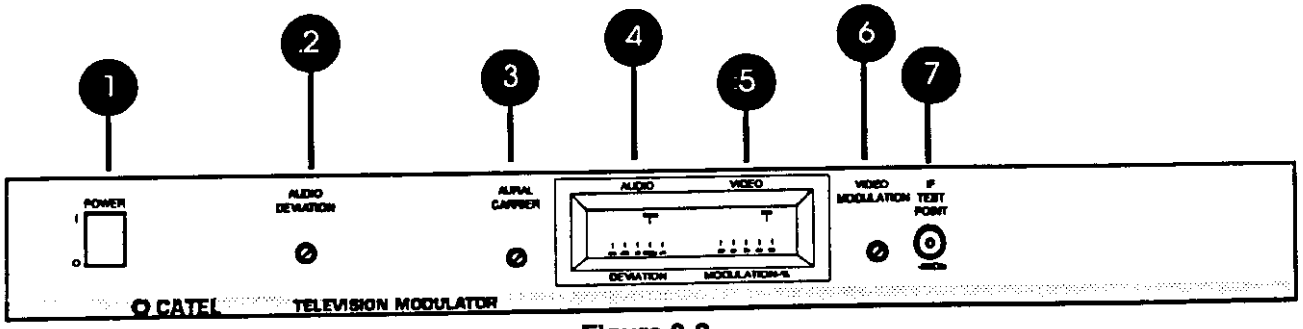


Figure 2-2
ATM-1600 Front Panel

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

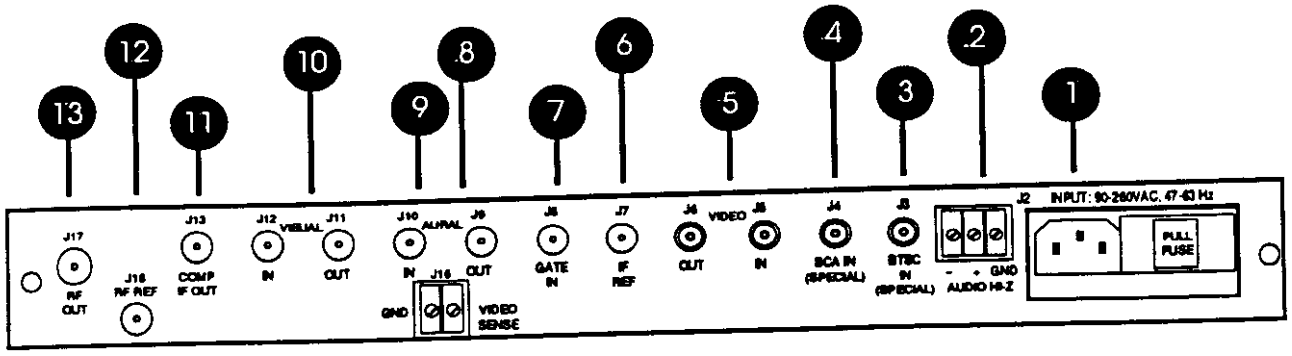


Figure 2-3
ATM-1600 Rear Panel

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).

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

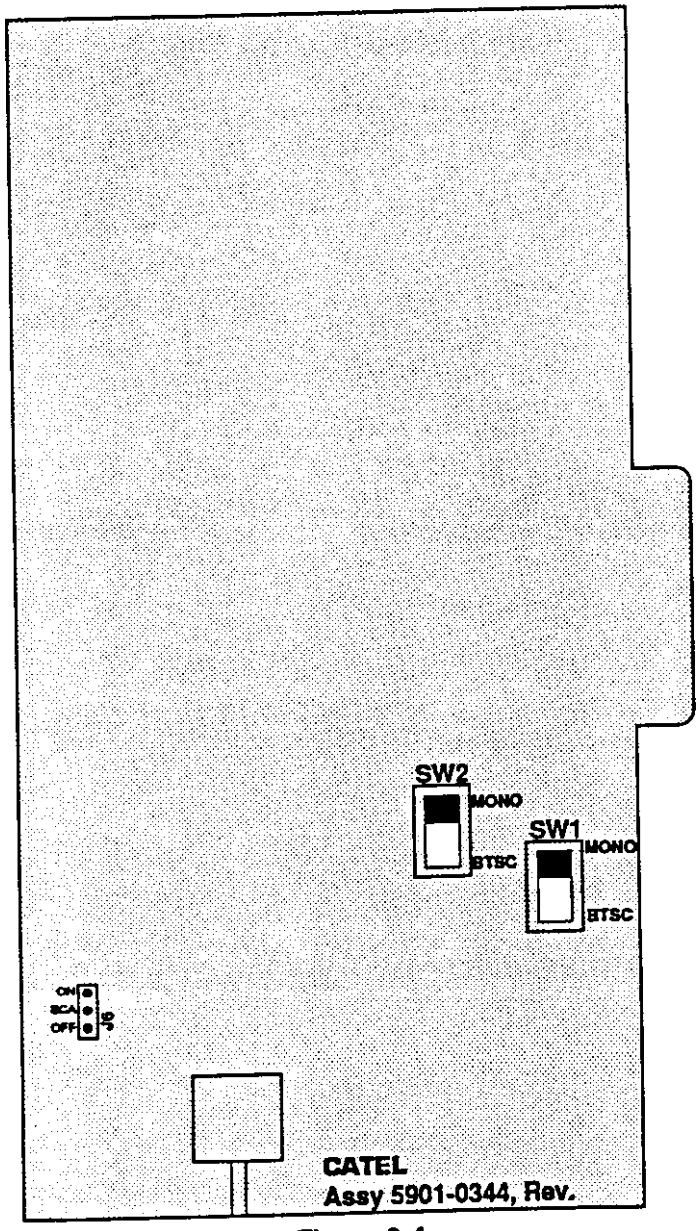


Figure 2-4
Audio Switch and Jumper Locations

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

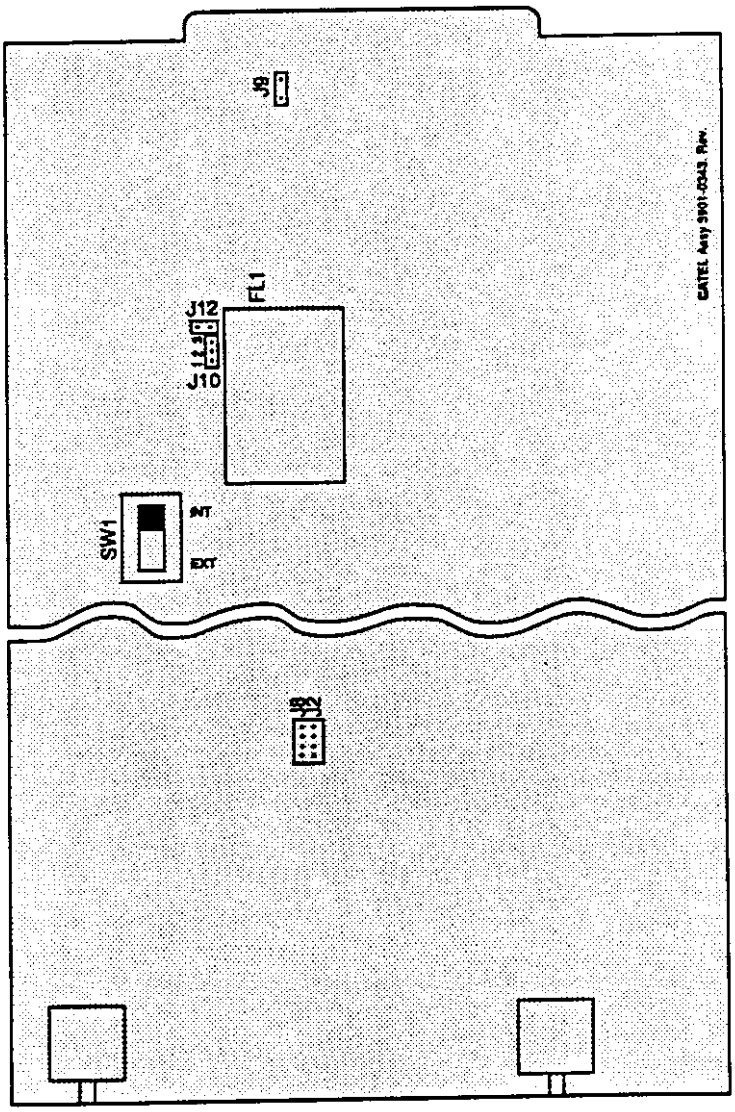


Figure 2-5
Video Switch and Jumper Locations

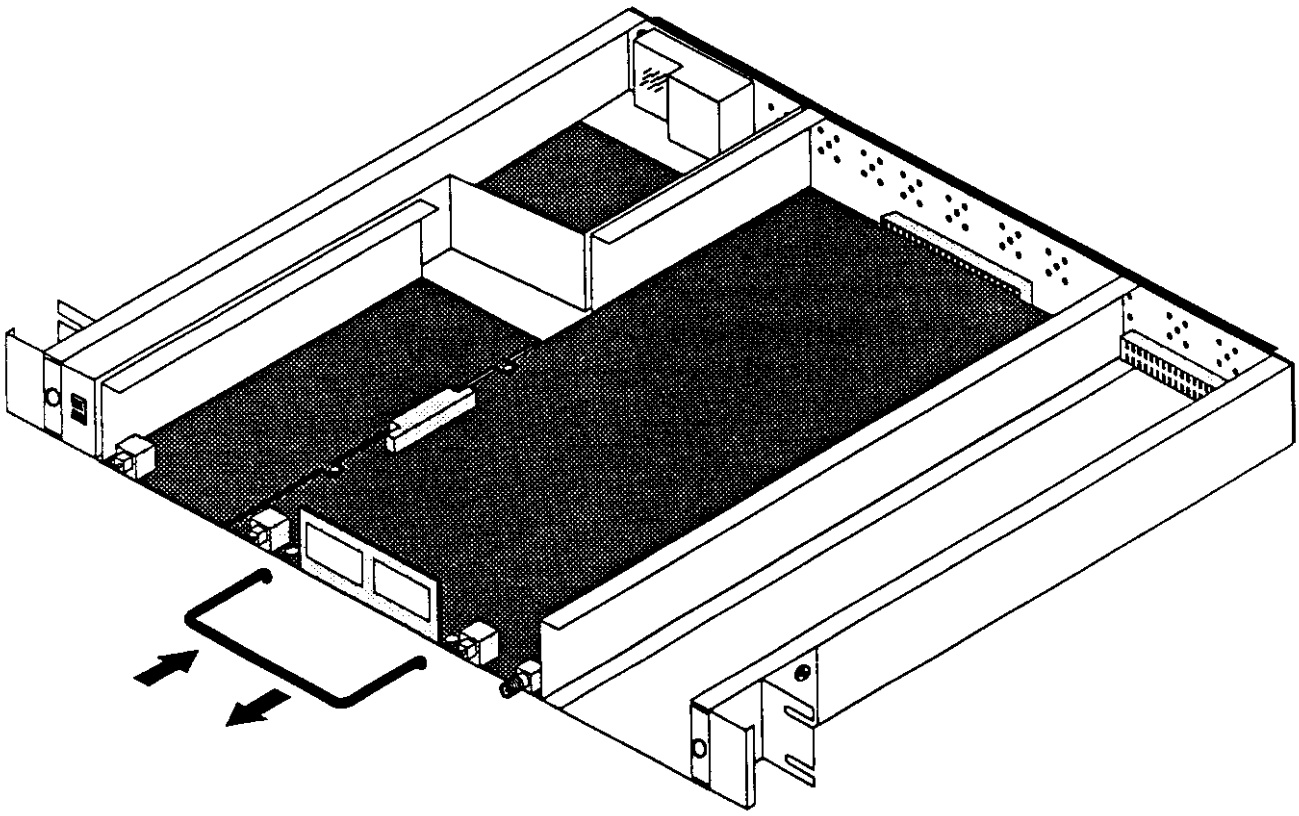
2.8 Module Removal/Installation

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)

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.

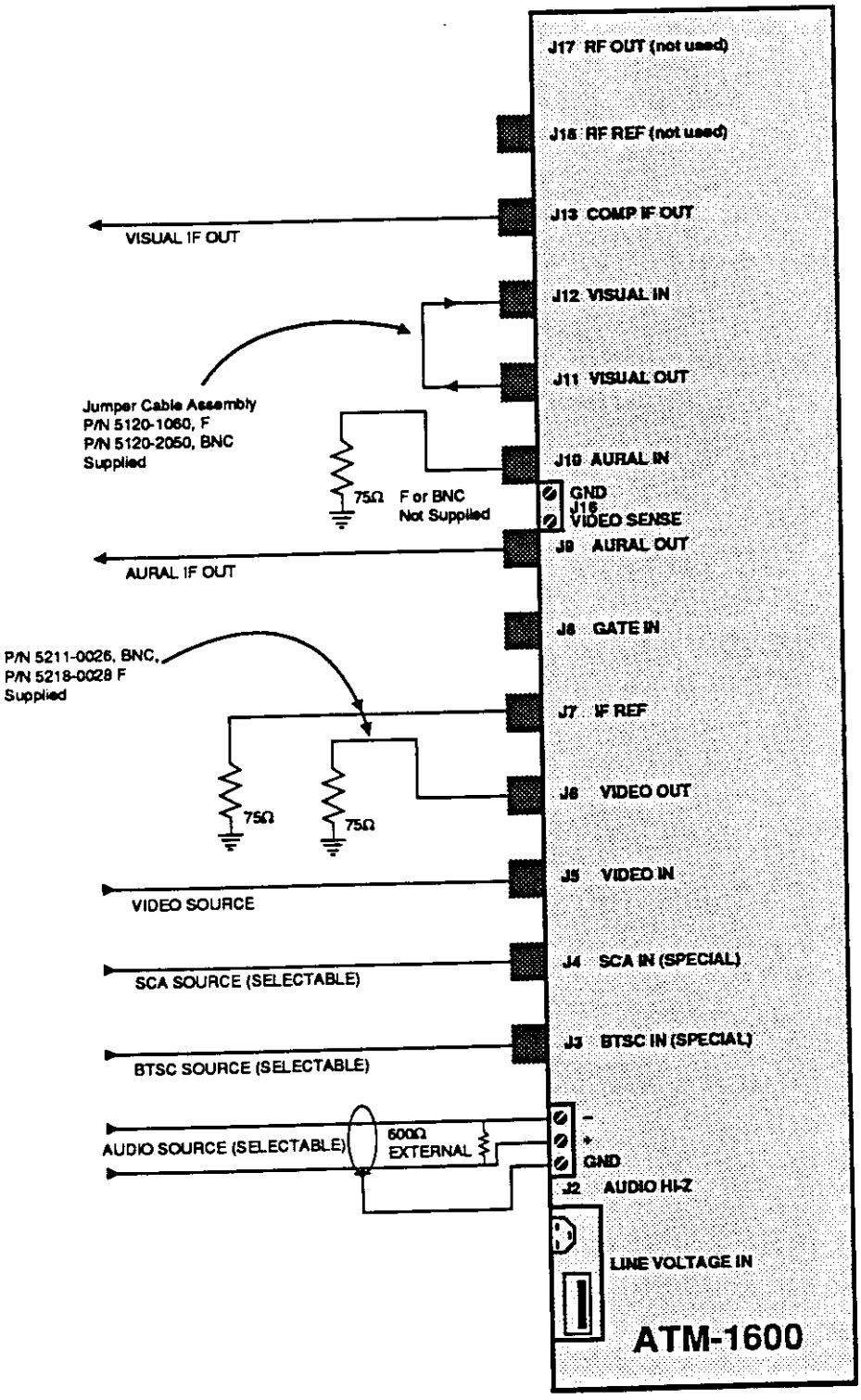


Figure 2-7
Normal Input/Output Connections

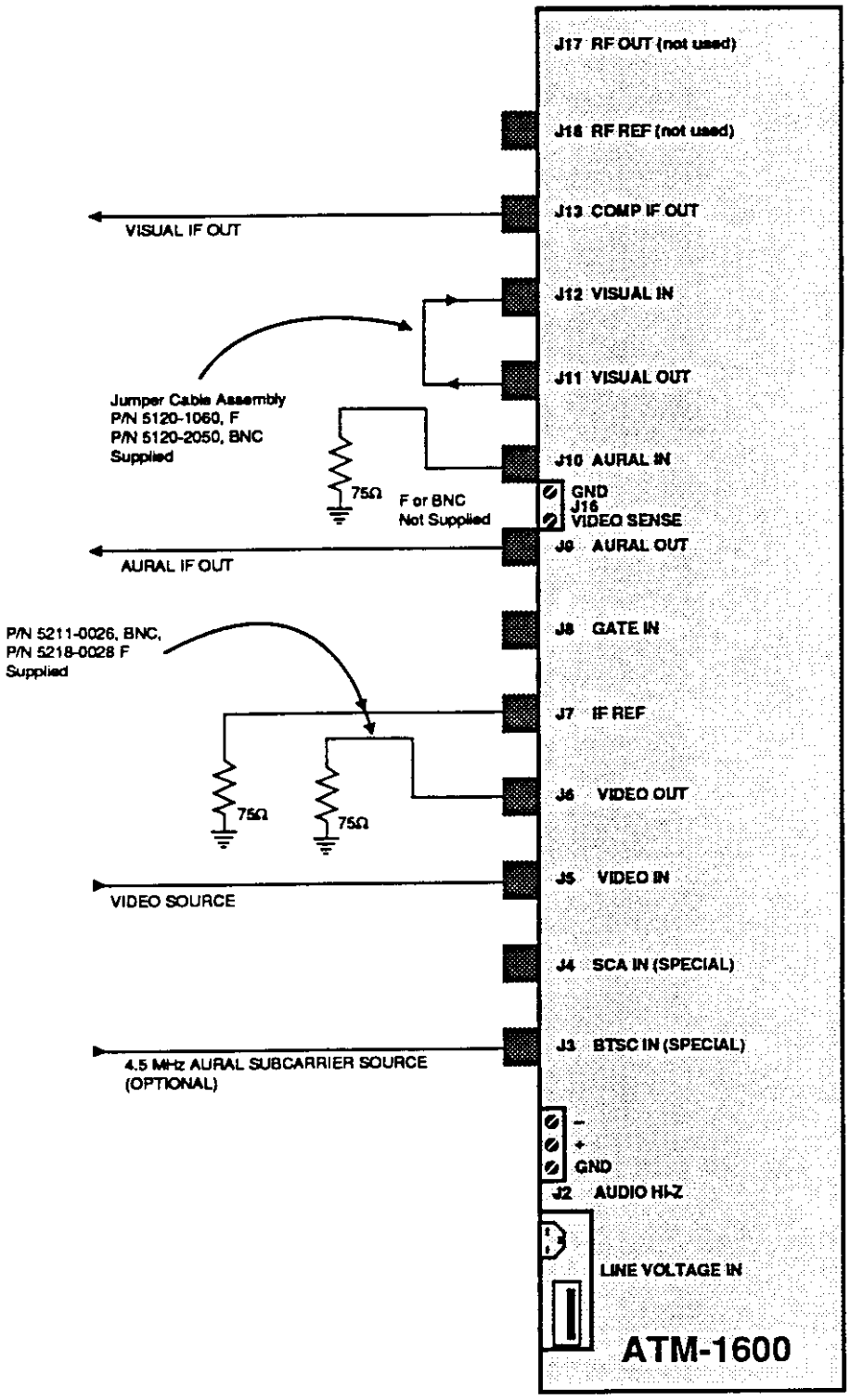


Figure 2-8
Input/Output Connections with Optional 4.5 MHz Aural Subcarrier Input

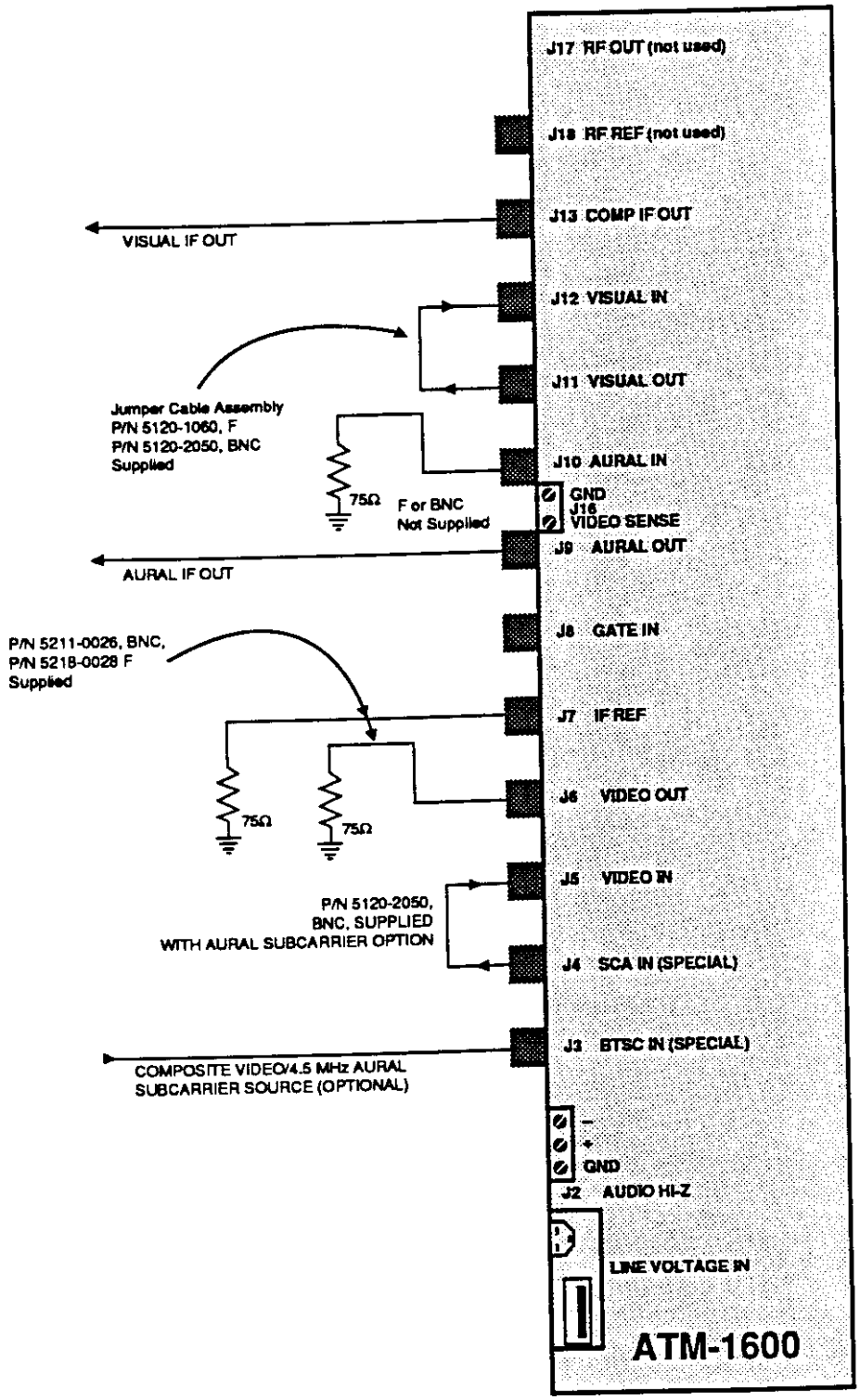


Figure 2-9
Input/Output Connections with Optional Composite Video/4.5 MHz Aural Subcarrier Input

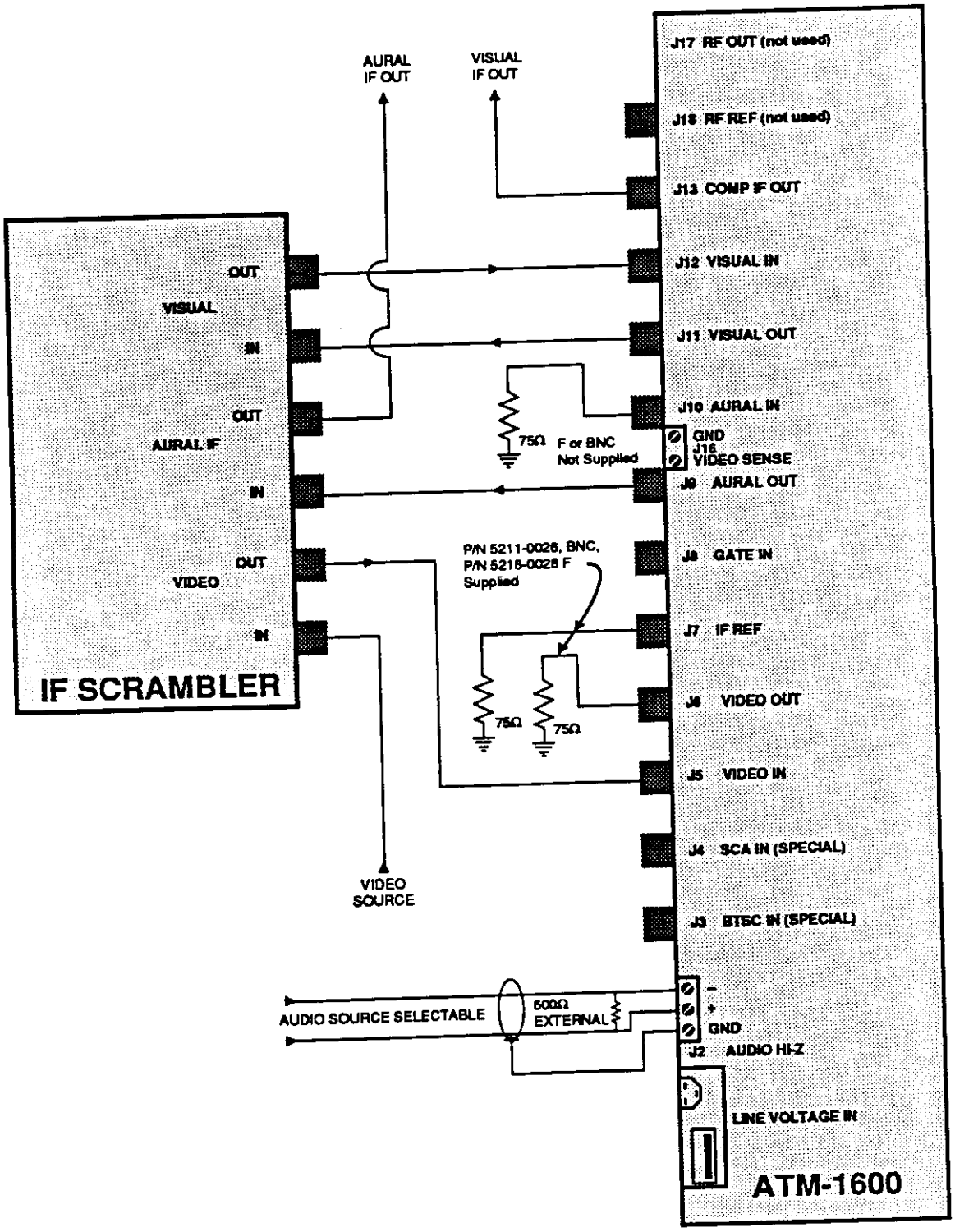


Figure 2-10
Encoded Visual/Aural IF Connections

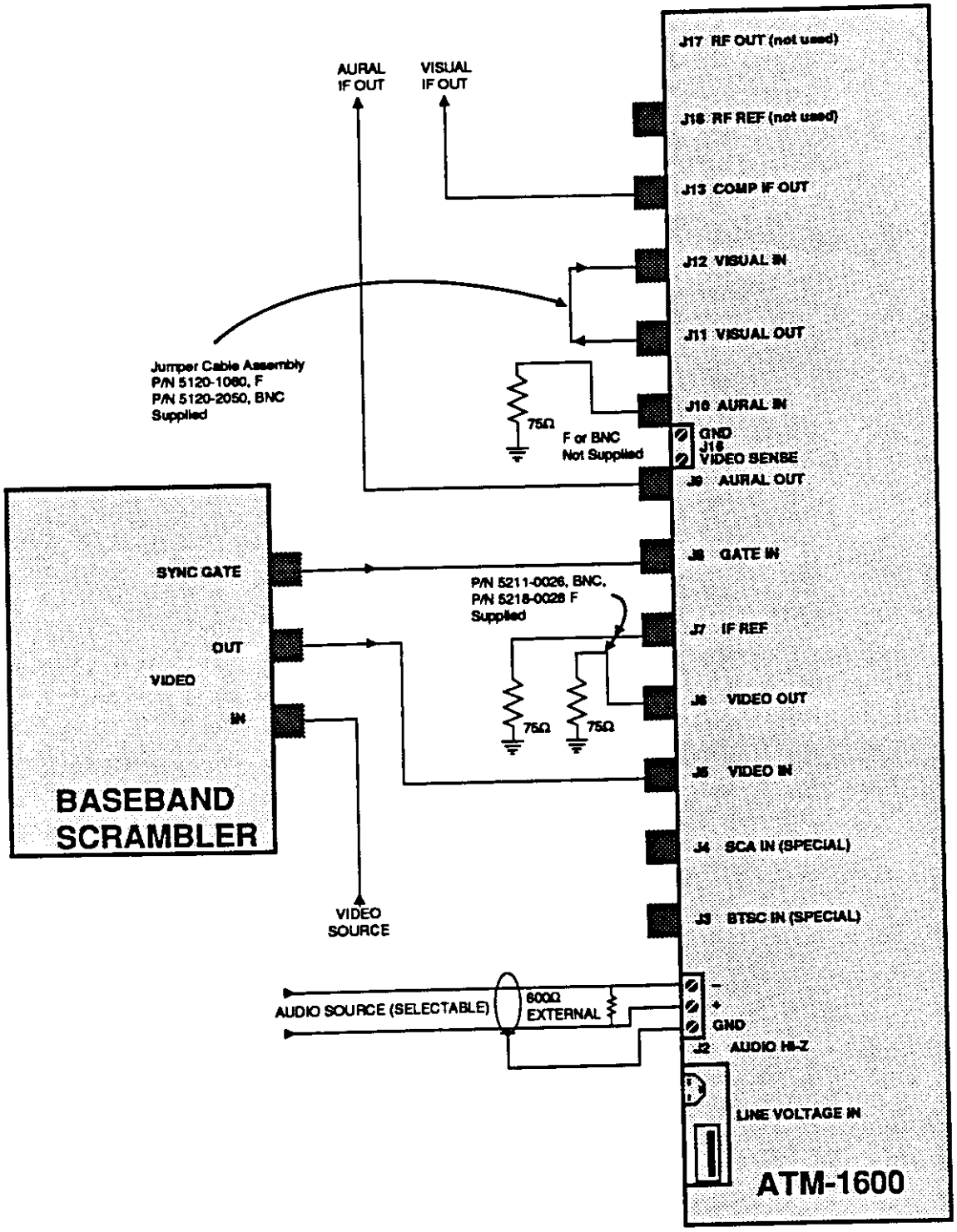


Figure 2-11
Baseband Scrambler Connections

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.

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.

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.

3.9 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°.

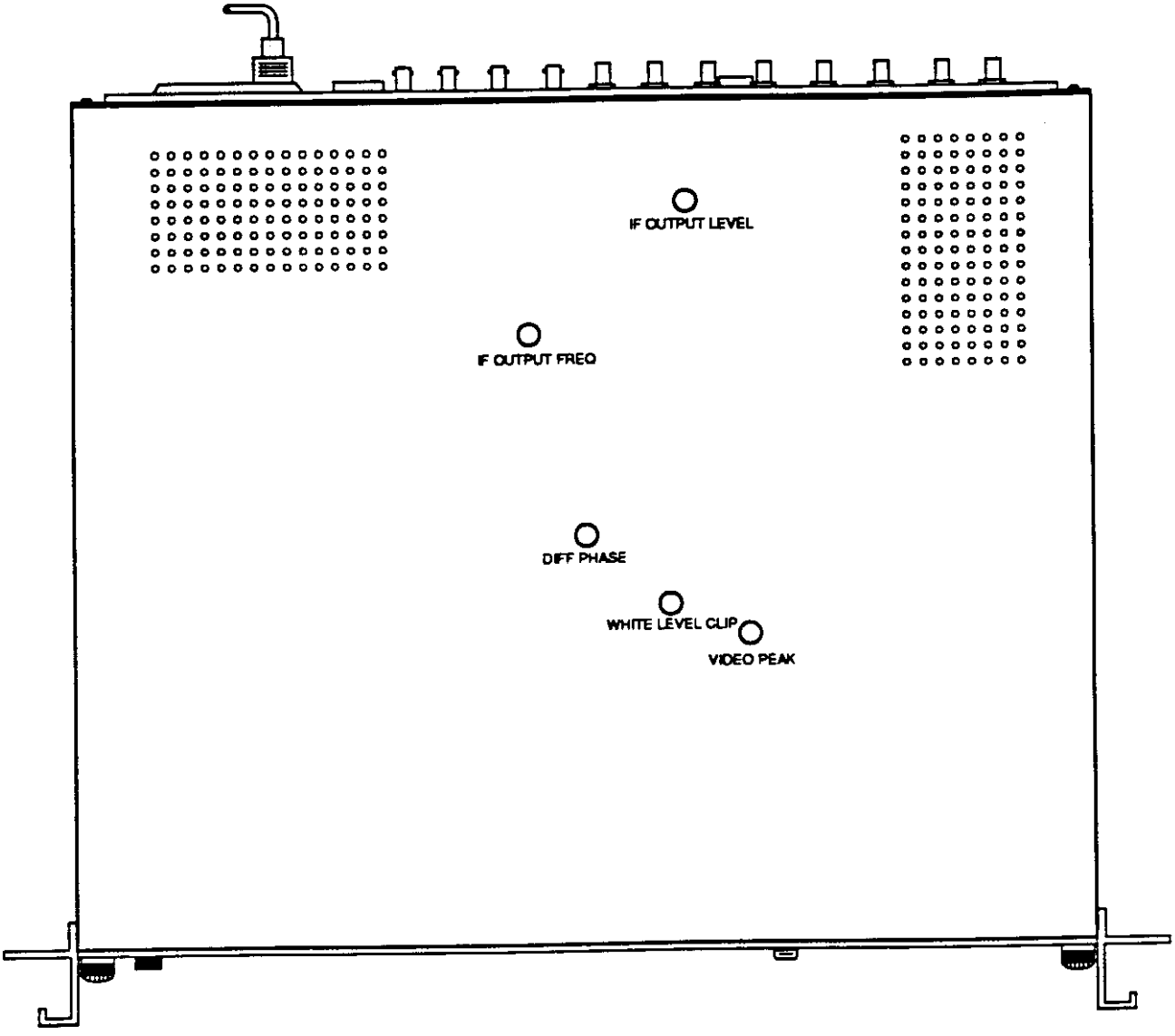


Figure 3-1
Adjustment Access through Top Panel

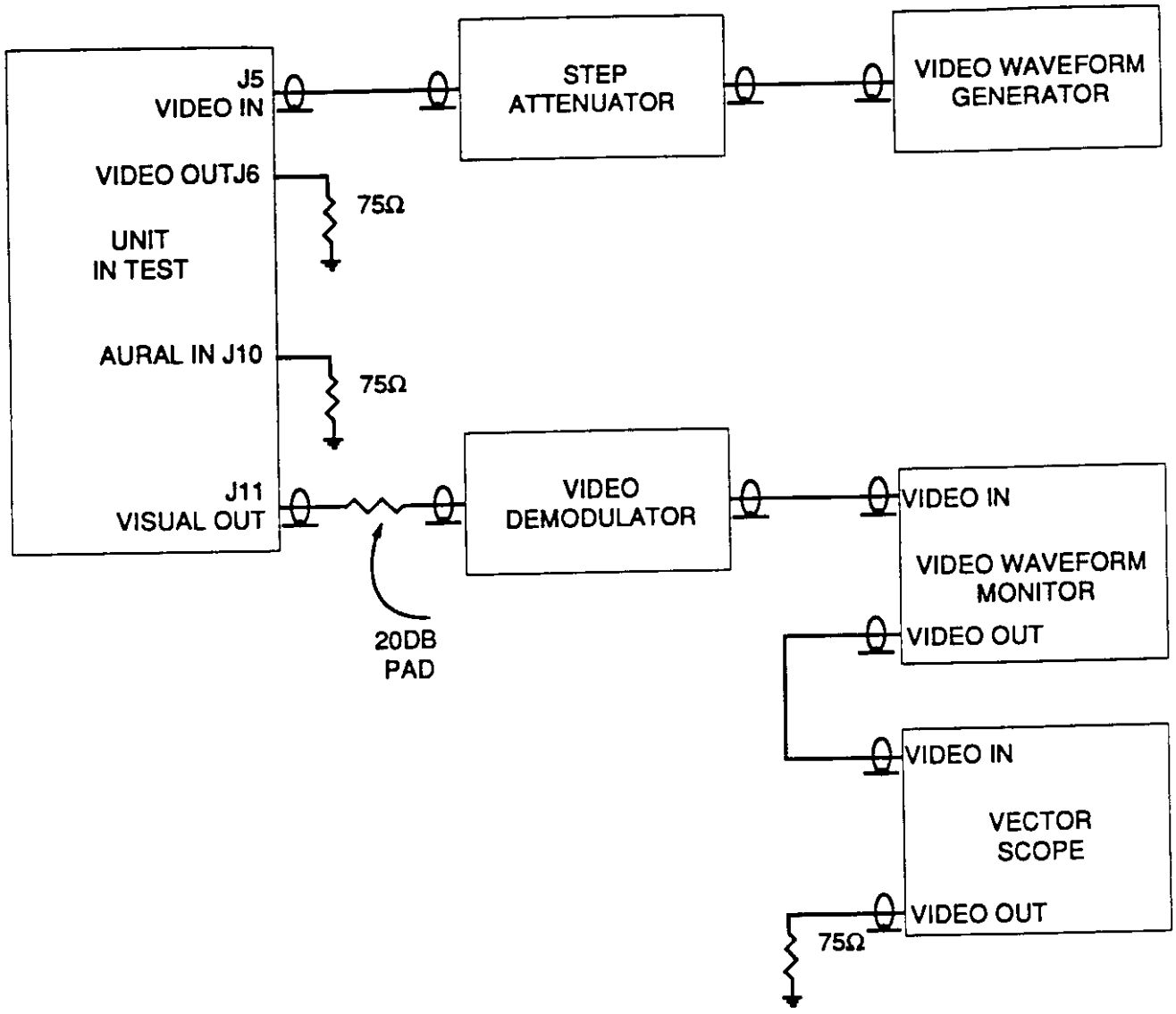


Figure 3-2
Video Modulation Waveform Tests

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.

U9A, U9B, diodes CR3, CR4, CR5 and CR6 form a precision AC/DC converter circuit. The circuit converts the AC audio into a DC signal to operate the front panel deviation meter. First the output is fed into U10 which provides the necessary voltage gain and level translation. R58 is a zeroing control that sets the lower end of the scale on the deviation meter, R56 is used for the higher end.

The 41.25 MHz VCO consists of amplifier U8, tank circuit L4, and capacitors in the U8 output circuit. Varactor diode CR2 is used in the tuned circuit as the voltage variable element. The modulating audio circuit is fed from the arm of deviation control R44 through R45 to CR2. The operating frequency of the VCO is determined by L4, C40, C44, C47, C48, and CR2. L4 is the VCO center frequency adjustment 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 IF output to +40 dBmV at rear panel connector J9, (AURAL 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.

For sync tip operation, a reference voltage is fed to pin 1 and video is fed to pin 5 of comparator U1. The U1 reference voltage is obtained from a voltage divider that includes potentiometer R113 labeled MONITOR CAL. on the circuit board. R113 sets the reference voltage to a prescribed value for correct operation of the video amplifier.

The output of comparator U1, at pin 6, goes into Q11 and Q12 which act as a sync tip level detector and provide a DC correction signal fed back to the base of Q7 through J2, J8 and R23.

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

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

The biasing of Q10 puts a limit on modulation depth and prevents carrier cut-off caused by over modulation and the resulting distortion and sync buzz.

The modulation depth, in the white level clipper circuit, is adjusted by potentiometer R42, a user screwdriver adjustment on the circuit board labeled WHITE CLIP LVL.

The output video amplifier, from the Q10 emitter, drives the video modulator circuit consisting of R68, L19, R69 and diode bridge modulator CR8, CR9, CR10, and CR11. R113, labeled MONITOR CAL. on the circuit board, is factory adjusted to calibrate the diode bridge to generate 87.5% modulation at the standard video input level to the ATM-1600. R113 forms a voltage divider with R112 and thermistor RT1 to pin 3 of operational amplifier U4B.

The R113/R112/RT1 combination sets the reference voltage at the U4B output, Pin 1. This output provides a low impedance 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).

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 LI7. 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.

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

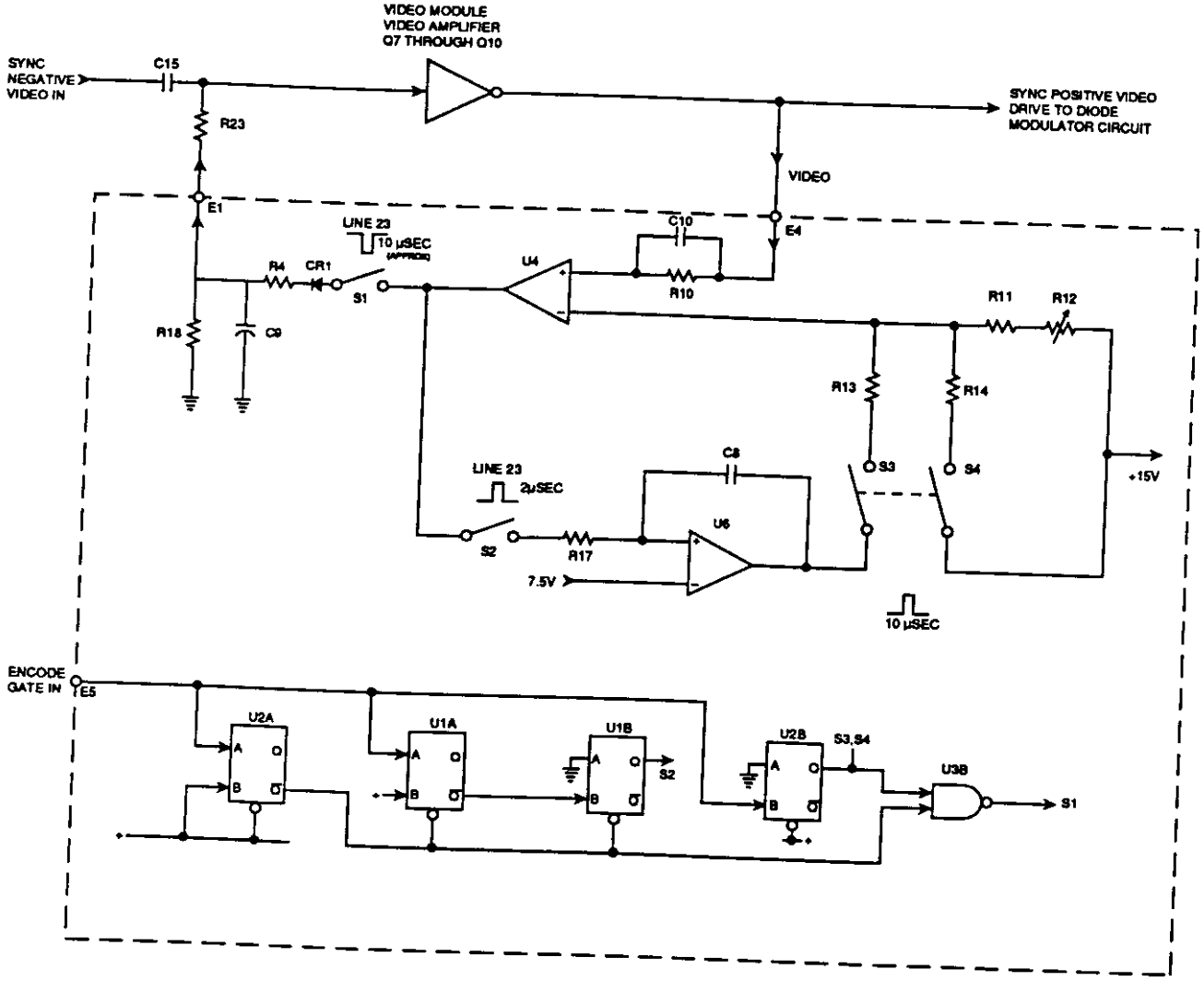


Figure 4-5
Baseband Encoder Interface Assembly, Block Diagram

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.

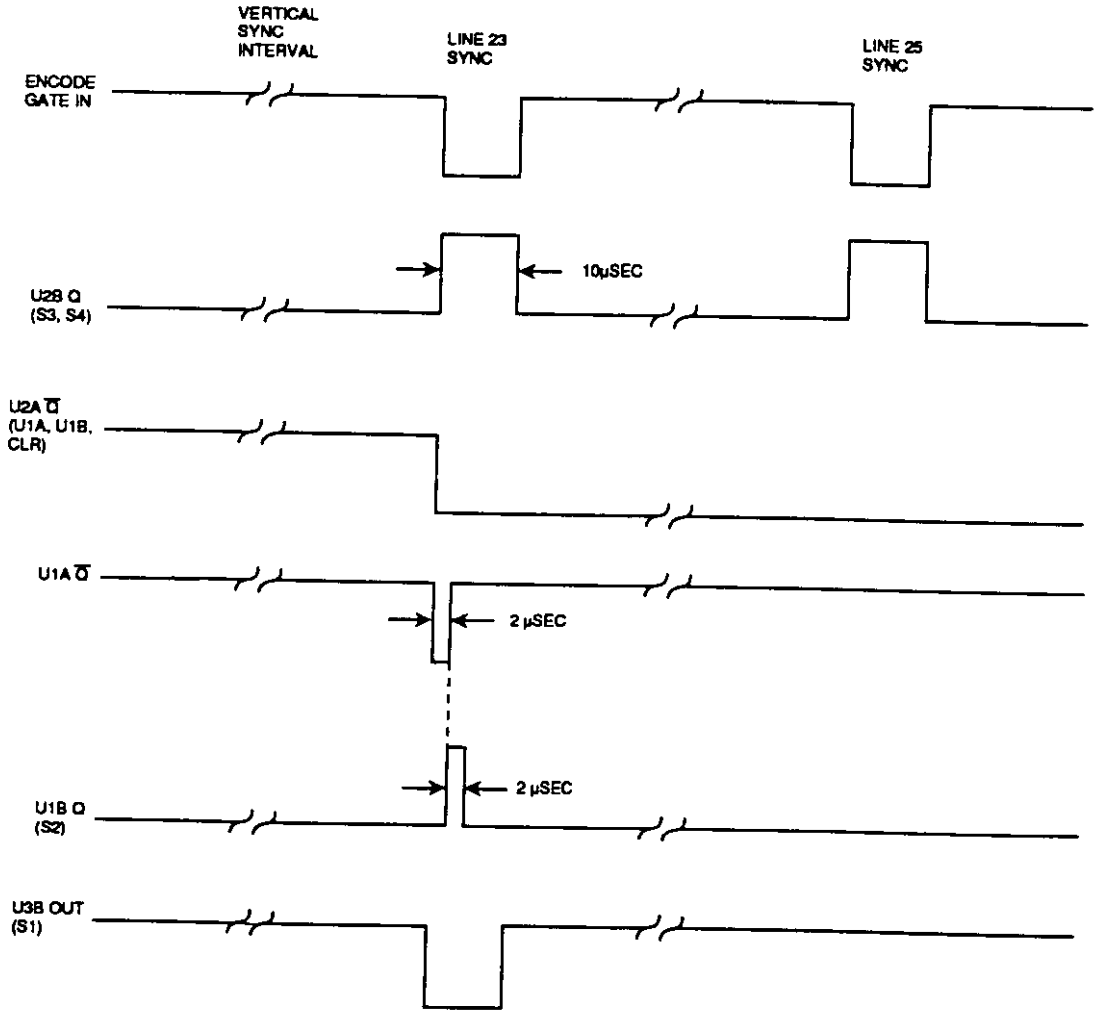


Figure 4-6
Baseband Encoder Interface Assembly, Timing Diagram

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.

5.0 PARTS LIST

5.1 Introduction

This Section of the manual provides a list of parts for each assembly covered by this manual. The list contains a break down of each assembly by component part number, component description and reference designation. Figure 5-1 shows an exploded view of the ATM-1600 and identifies major subassemblies. Parts location diagrams, Figure 5-2 for the Audio Modulator, Figure 5-3 For the Video Modulator and Figure 5-4 for the Aural Subcarrier Processor have been provided to assist in locating individual components.

The parts lists contain many abbreviations. Some of the abbreviations used in this list are as follows:

BD	Board
STL	Steel
ASSY	Assembly
CER	Ceramic
FXD	Fixed
MET	Metal
VAR	Variable
RAL	Radial
ADJ	Adjustable

5.2 Ordering Information

When ordering replacement parts, give the quantity, reference designator, part number and description for each item ordered. The part that will be supplied against an order for a replacement item may not be an exact duplicate of the original part; however, it will be a satisfactory replacement differing only in minor mechanical or electrical characteristics. Such differences will not impair the operation of the equipment.

Catel maintains a complete stock of replacement parts for your Catel equipment. We recommend ordering all replacement parts from Catel to ensure compatibility of components and having your order filled promptly.

Order from:
Catel Telecommunications
4050 Technology Place
Fremont, CA 94537-5122

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATOR
9001-2031-XX ATM-1600,FINAL ASSY.		
2832-0802	NUT,KEP.6-32X5/16A/F.STEEL/CAD.PL.	
6012-0365-XX	PANEL ATM-1600	
6014-0084-VV	MODULE ASSY,CHASSIS,T.V.MODULATOR	
6033-0116	FAB HANDLE AM MODULATION	
6820-0421	NUT,HEX 4-40 STD.PATT STL/ZINC	
6910-0003	LABEL. MODEL/SERIAL NO.	
7112-0408	SCR.PAN/PHIL.#4-40X1/2 STL/ZN.P	
7122-0403	SCR.FLAT/PHIL.#4-40X3/16 STL/ZN.P	
7122-0606	SCR.FLT/PHIL.#6-32X3/8 STL/ZN.P	
7212-0605	SCR.PHIL/PAN 6-32X5/16 STL/Z IN/WS	
7923-0023	CABLE POWER CORD 3-COND DETACHABLE	
8000-4055-YY	ASSY MODULE POWER SUPPLY, ATM-1600	
8000-2610	ACCESSORY KIT	
9001-2031-XX	ATM-1600 FINAL ASSY.DWG	

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATOR
8000-4055-YY ASSY MODULE POWER SUPPLY, ATM-1600		
5901-0340-YY	ASSY PCB, BACK PLANE, ATM-1600	
5501-0040	SWITCH, ROCKER SPDT 5A120V PNLMT	
5601-0023	CONN., AC POWER, FILTERED 6J4	
5602-0041	PWR SPLY, SGL OUT 18V/1.25A 90-260 VIN	
6012-0366-ZZ	REAR PANEL FAB, T.V. MODULATOR	
7612-0404	SCR, BINDER/PHIL 4-4-X1/4 STL/ZINC	
6014-0083	CHASSIS, BKT. CRS, TV MDULATOR	
7112-0204	SCR, PAN HD. PHL #2-56X1/4LGN ZN.PL	
5101-0255	ASSY CABLE, 2 CONDUCTORS	
5105-0256	ASSY CABLE, 2 CONDUCTORS	
7301-0003	TUBING, HEAT SHRINK. 1/8D BLACK	
7910-2005	WIRE, STRANDED, 20CA, 7/28 PVC GRN	
5227-0020	TERMINALS SOLDER	
6821-0004	NUT 3/8" X 32 X 3 1/2 THK. STL/CAD.PL	
5562-0001	FUSE, 1/2A SLOW BLOW	
5901-0340-YY ASSY PCB BACK PLANE, ATM-1600		
1007-5103	CAP CER Z5V DISC .01 UF 20% 50V	C1
4612-2106	INDUCTOR FXD MOLDED 10 UH 10%	L1
4707-0531-08	INDUCTOR AIR CORE 8T 1/4 22GA	L3
5216-0022	CLIP LOCKING 2 PIN	J1
5216-0039	CONNECTOR "F" PCB	J7,8,9,10,11,12, 13,17
5216-0092	CONN.COAX.,RF,PCB,PRESS-FIT,COM.BNC	J3,4,5,6
5216-0105	CONN CARD EDGE RCPT 2X22 .156 ST	J15
5216-0107	CONN CARD EDGE 20 PIN DUAL	J14
5223-0012	TERMINAL BLOCK 3POS .250C/C ST	J2
5223-0036	TERMINAL BLOCK 2POS SCR CONN	J16
5900-0340	FAB PCB BACK PLANE	
7921-0012	CABLE COAX SEMI-RGD.75 OHM.085DIA	

5602-0041 ASSY. POWER SUPPLY, SGL OUT 18V/1.25A 90-260 VIN

(Non-Catel assembly, information provided for reference only; may only be ordered from Catel as a complete assembly under P/N 5602-0041)

	JUMPER WIRE	J2
	JUMPER WIRE	J1
	RESISTOR CARBON FILM, 57K, 2W	R2
	RESISTOR CARBON FILM, 10R, 1/4W	R19
	RESISTOR CARBON FILM, 15R, 1/4W	R52
	RESISTOR CARBON FILM, 100R, 1/4W	R7,12
	RESISTOR CARBON FILM 330R 1/4W	R10
	RESISTOR CARBON FILM 470R 1/4W	R14

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATOR
5602-0041	ASSY. POWER SUPPLY, SGL OUT 18V/1.25A 90-260 VIN (Cont.)	
	RESISTOR CARBON FILM 3K3 1/4W	R13
	RESISTOR CARBON FILM 3K9 1/4W	R15
	RESISTOR CARBON FILM 5K1 1/4W	R6,8,9
	RESISTOR CARBON FILM 27K 1/4W	R17
	RESISTOR CARBON FILM 2K2 1/4W	R11
	RESISTOR CARBON FILM 4R7 1/2W	R21
	RESISTOR METAL FILM 330R 2W	R16,20
	RESISTOR WIRE WOUND NF OR56 1W	R3
	VR 2K	VR1
	NTS 5RO	R1
	CAPACITOR EL SM 47µ 25V	C8
	CAPACITOR EL KME 1000µ 25V	C17,18
	CAPACITOR EL SME 1000µ 25V	C20,21
	CAPACITOR "TANTA" 1µ 16V	C15
	CAPACITOR EL SMG 100µ 400V	C7
	CAPACITOR "X" .1µ 250V	C1
	CAPACITOR "Y" 2200P 400V	C6
	CAPACITOR POLYESTER 152 50V	C4
	CAPACITOR POLYESTER 103 50V	C11,12,13,14
	CAPACITOR CREAMIC 102 1KV	C22
	CAPACITOR CERAMIC 103 1KV	C3
	CAPACITOR CERAMIC 471 2KV	C10
	INDUCTOR	L4
	INDUCTOR	L1
	TRANSFORMER	T2
	C-M CHOKE	T1
	BRIDGE DIODE	DB1
	ZENER DIODE 18V 1W	DZ1
	SCR	SCR1
	FAST RECOVERY DIODE	D4
	FAST RECOVERY DIODE	D7, D6
	MOSFET	Q1
	IC	IC3
	IC (CTR:60-130%) PC713	IC1
	IC	IC2
	CONNECTOR-PIN HEADER 5273-04	TB2
	CONNECTOR-PIN HEADER 5277-02	TB1
	FUSE CLIP	(F1)
	FUSE 2A 250V	F1
	TRANSISTOR SOCKET	(IC2)
	TRANSISTOR SOCKET	(SCR1)
	SONY BOND	(L1)

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATOR
5602-0041 ASSY. POWER SUPPLY, SGL OUT 18V/1.25A 90-260 VIN (Cont.)		
	HEAT SINK	HS1
	HEAT SINK CLIP	(HSQ1)
	LABEL "S/N"	(C7)
	LABEL "SPECIFICATION"	(C18)
	PCB (88, 18)	
	SILICON RUBBER	(R2,16)
	SILICON RUBBER TUBE	(HS1-Q1)
9001-2036 FINAL ASSY. AUDIO BD.,ATM-1600		
5901-0344	ASSY PCB AUDIO MODULATOR, ATM-1600	
6822-0421	NUT,KEP 4-40 1/4AF STD PATT STL/Z	
7112-0406	SCR.PAN/PHIL.#4-40X3/8 STL/ZN.P	
7921-0014	CABLE,COAX.RG187A/U. TEFLON	
5901-0344 ASSY PCB AUDIO MODULATOR, ATM-1600		
1011-2826	CAP MICA DIPPED 82 PF 1% 500 V	C53
1045-2186	CAP CER NPO DISC 18 PF 5% 500V	C52
1156-3277	CAP CER X5F DISC 270 PF 10% 1KV	C1,2,3,8
1182-4754	CAP POLSTRN FILM TBL 7500PF2.5%125V	C12
1219-0002	CAP AL 100 UF 80/20% 35V	C11
1219-0014	CAP AL 22 UF 20% 35V 2000H/85C	C6,7,10,18,22,42,9
1256-1226	CAP TANT PLZD SOL DIPP 2.2UF 10%35V	C26
1256-1686	CAP TANT PLZD SOL DIPP 6.8UF 10%35V	C4,5
1287-5103	CAP CER ML Z5U DIPPED .01UF 20%50V	C57,58,59,66,68 C17,21,29,67,
1287-6103	CAP CER ML Z5U DIPPED .1 UF 20% 50V	C13,27,28,34,35 C60,61,64,65,41
1287-7103	CAP CER ML Z5U DIPPED 1 UF 20% 50V	C23,24,30
1295-2474	CAP CER ML NPO 47 PF 5% 100V	C31
1295-3333	CAP CER ML NPO 330 PF 5% 50V	C19,20
1300-0016	CAP VAR CER 1.2-6.5PF 250V	C40
1366-6333	CAP CER ML X7R .33 UF 10% 100V	C25
152089-6	TRANSFORMER	T1
153316-16	INDUCTOR,ADJUSTABLE,16.5T	L4,7
2045-2430	RES FXD CARB COMP 1W 43 OHM 5%	R62
2055-2100	RES FXD CARB FILM 1/4W 10 OHM 5%	R70
2055-2750	RES FXD CARB FILM 1/4W 75 OHM 5%	R2,50
2055-3100	RES FXD CARB FILM 1/4W 100 OHM 5%	R35,47
2055-3220	RES FXD CARB FILM 1/4W 220 OHM 5%	R18
2055-3470	RES FXD CARB FILM 1/4W 470 OHM 5%	R31
2055-3510	ES FXD CARB FILM 1/4W 510 OHM 5%	R57
2055-4100	ES FXD CARB FILM 1/4W 1K OHM 5%	R34,41
2055-4150	ES FXD CARB FILM 1/4W 1.5K OHM 5%	R36
2055-4200	ES FXD CARB FILM 1/4W 2K OHM 5%	R46,79

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATOR
5901-0344 ASSY PCB AUDIO MODULATOR, ATM-1600 (cont.)		
2055-4360	ES FXD CARB FILM 1/4W 3.6K OHM 5%	R37
2055-4390	ES FXD CARB FILM 1/4W 3.9K OHM 5%	R78
2055-4430	ES FXD CARB FILM 1/4W 4.3K OHM 5%	R73
2055-4470	ES FXD CARB FILM 1/4W 4.7K OHM 5%	R42,45,49
2055-5100	ES FXD CARB FILM 1/4W 10K OHM 5%	R3,4,7,10,11,12,17, R21-25,32,33,39,40 R43,48,63,64,67 R71,72,77
2055-5220	RES FXD CARB FILM 1/4W 22K OHM 5%	R68
2055-5270	RES FXD CARB FILM 1/4W 27K OHM 5%	R60
2055-5330	RES FXD CARB FILM 1/4W 33K OHM 5%	R76
2055-5470	RES FXD CARB FILM 1/4W 47K OHM 5%	R20,26,27
2055-5910	RES FXD CARB FILM 1/4W 91K OHM 5%	R30
2055-6100	RES FXD CARB FILM 1/4W 100K OHM 5%	R5,6,8,9,19,65,69,74
2055-6150	RES FXD CARB FILM 1/4W 150K OHM 5%	R55
2055-6180	RES FXD CARB FILM 1/4W 180K OHM 5%	R28,29
2061-3121	RES FXD MET FILM 1/8W 121 OHM 1%	R66
2061-3511	RES FXD MET FILM 1/8W 511 OHM 1%	R14
2061-4130	RES FXD MET FILM 1/8W 1.3K OHM 1%	R83
2061-4178	RES FXD MET FILM 1/8W 1.78K OHM 1%	R61
2061-4274	RES FXD MET FILM 1/8W 2.74K OHM 1%	R75
2061-5133	RES FXD MET FILM 1/8W 13.3K OHM 1%	R13
2061-5200	RES FXD MET FILM 1/8W 20K OHM 1%	R53
2061-5332	RES FXD MET FILM 1/8W 33.2K OHM 1%	R15
2061-5402	RES FXD MET FILM 1/8W 40.2K OHM 1%	R54
2061-6100	RES FXD MET FILM 1/8W 100K OHM 1%	R51,52
2226-0014	RES VAR CER 1-TRN 1/2W 10KOHM 10%	R38,44
2226-0025	POT 10K	R1
2326-0006	RES VAR M-TRN 1/2W 10K OHM10% T/ADJ	R58
2326-0104	RES VAR M-TRN 1/2W 100K0HN10% T/ADJ	R56
2601-0005	RES 1.0 OHM 1% 1W WIREWOUND	R16
3120-0003	DIODE 1N4154	CR3,4,5,6
3120-0006	DIODE 1N4148	CR1
3151-0026	DIODE VARACTOR MV409 26-32PF 20VR	CR2
3231-1004	TRANS SILICON NPN GENL PRP 2N3904	Q6
3231-2026	TRANS SILICON NPN UHF-VHF NE41632	Q3,5
3241-1006	TRANS SILICON PNP GNL PRP 2N3906	Q4
3311-0008	IC LIN VREG +5V LM7805CT VS=35V	Q2
3311-0028	IC LIN VREG +15V LM7815CT VS=35V	Q1
3312-0053	IC LIN OP AMP LF353N DUAL VS=18	U1
3312-0074	IC LIN OP AMP LM358N DUAL	U6
3313-0034	IC LIN FREQ SYN MB1504P PLL	U4
3322-0020	IC DIG FF DUAL D 74AC74PC CMOS	U2

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATOR
5901-0344 ASSY PCB AUDIO MODULATOR, ATM-1600 (cont.)		
3325-0035	IC DIG COUNTER 74HC4040N 12-STAGE	U3
3542-1013	DIODE RED LED	DS1
4602-1476	INDUCTOR FXD MOLDED 4.7 UH 10%	L5,6
4611-1156	INDUCTOR FXD MOLDED 1.5 UH 10%	L2
4612-2106	INDUCTOR FXD MOLDED 10 UH 10%	L1,8,9
5222-0037	3 POST JACK	J6
5222-0038	2 POST JACK	J2,3,4,5
5701-0001	ATM1600 AUDIO PLD	U5
5900-0344	FAB PCB ATM-1600 AUDIO MODULATOR	
7921-0014	CABLE,COAX.RG187A/U. TEFLON	
860010-119	CAP,ELECT,RADIAL,1UF,50V	C16,32,33 C56,62
860010-121	CAP,ELECT,RAD,3.3UF,50V	C55
860010-123	CAP,EL,RAD,10UF,16V+75-10	C54
860049-115	IC LIN OP AMP CA3240AE VS=36V	U9,10
860049-32	IC LIN IF/RF AMP CA3028AS	U7,8
900048-103	CAP CER N330 DISC 5.1 PF 5% 500V	C44
900048-104	CAP CER N750 DISC 5.1 PF 5% 500V	C47
900048-32	CAP CER NPO DISC 20 PF 5% 500V	C48
900048-49	CAP CER X5F DISC 100 PF 10% 500V	C63
900048-9	CAP CER NPO DISC 2.2 PF .25 500V	C39,46
900066-1	SWITCH,SLIDE T.V.	SW1,2
1287-4103	CAP CER 1000PF PER MIL-C-11015	C14,15,36,37 C38,43,45,49 C50,51
2061-5165	RES 16.5K 1/8W 1%	R59
1N751A	DIODE,ZENER	CR1
2055-41802	RES FXD CARB FILM 1/4W 1.8K OHM 5%	R1
5220-00122	HDR ASSY 1X22 .025 SQ .100 RT ANG	J1
5900-0348	FAB PCB BAR GRAPH	
860026-27	I.C. LED DISPLAY	U1,2
9001-2035 FINAL ASSY. VIDEO BD.,ATM-1600		
5901-0343	ASSY PCB ATM-1600 VIDEO MODULATOR	
5901-0348	ASSY PCB BAR GRAPH	
6822-0421	EA NUT,KEP 4-40 1/4AF STD PATT STL/Z	
7112-0406	EA SCR.PAN/PHIL.#4-40X3/8 STL/ZN.P	
7921-0014	CABLE,COAX.RG187A/U. TEFLON	
5901-0343 ASSY PCB ATM-1600 VIDEO MODULATOR		
1011-2476	CAP MICA DIPPED 47 PF 1% 500 V	C66
1011-3226	CAP MICA DIPPED 220 PF 1% 500 V	C57
1015-3106	CAP MICA DIPPED 100PF 5% 500V	C49

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATOR
5901-0343 ASSY PCB ATM-1600 VIDEO MODULATOR (cont.)		
1015-4114	CAP MICA DIPPED 1100PF 5% 100V	C86
1043-2107	CAP CER NPO DISC 10 PF 5 % 1 KV	C64,67
1044-1153	CAP CER NPO DISC 1.5 PF .25 50 V	C16,59
1045-2126	CAP CER NPO DISC 12 PF 5% 500V	C46
1045-2133	CAP CER NPO DISC 13 PF 5% 50V	C82
1045-2156	CAP CER NPO DISC 15 PF 5% 50 V	C121
1045-2186	CAP CER NPO DISC 18 PF 5% 500V	C37,38
1106-2227	CAP CER N750 DISC 22 PF 10% 1KV	C47
1186-4153	CAP POLY MET MLD RECT.0015UF 10%63V	C87
1191-2916	CAP MICA DIPPED 91 PF 1% 500V	C14,81,85
1219-0015	CAP AL 1000UF 20% 16V 1000H/85C	C92
1219-0023	CAP AL 100 UF 20% 25V 2000H/85C	C13,21,22
1256-1106	CAP TANT PLZD SOL DIPP 1 UF 10%35V	C20,40,41
1256-2106	CAP TANT PLZD SOL DIPP 10 UF 10%35V	C25,39,71,76,90
1256-2227	CAP TANT PLZD SOL DIPP 22 UF 10%50V	C91
1287-4103	CAP CER ML X7R DIPPED 1000PF 10%50V	C23,24,42 43,44,45,48 50,51,54,55 56,58,63 110,111,112 113,116,118, 143,124,125 127,128,130 131,132, 134 135,136,137 138,139,140 141,142,144
1287-5103	CAP CER ML Z5U DIPPED .01UF 20%50V	C18,61,62 70,72,73,88 89,129
1295-2474	CAP CER ML NPO 47 PF 5% 100V	C122
1295-3394	CAP CER ML NPO 390 PF 5% 100V	C75
1400-0010	CAP VAR AIR 2-10PF 125V	C120
152036-3	TRANSFORMER	T10
152069-12	INDUCTOR,VARIABLE	L37
152069-6	INDUCTOR,VARIABLE	L36
152089-6	TRANSFORMER	T3,4,13
152492-10	INDUCTOR,POT CORE	L3
152492-11	INDUCTOR,POT CORE	L2,5
152492-12	INDUCTOR,POT CORE	L6
152492-16	INDUCTOR POT CORE	L4
152492-9	INDUCTOR,POT CORE	L7
152493-5	TRANSFORMER,ADJ,POT CORE	T2
152493-6	TRANSFORMER,ADJ,POT CORE	T1
153316-16	INDUCTOR,ADJUSTABLE,16.5T	L10,12
153343-5	TRANSFORMER,OUTPUT	T7
153344-4	TRANSFORMER,MODULE	T6
1650-0007	CAP 5-50PF TEFLON VAR	C123
2015-7180	RES FXD CARB COMP 1/8W 1.8M OHM 5%	R138
2025-4150	RES FXD CARB COMP 1/4W 1.5K OHM 5%	R57,137
2055-1470	RES FXD CARB FILM 1/4W 4.7 OHM 5%	R213,177
2055-2100	RES FXD CARB FILM 1/4W 10 OHM 5%	R12,77,199

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATOR
5901-0343 ASSY PCB ATM-1600 VIDEO MODULATOR (cont.)		
2055-2160	RES FXD CARB FILM 1/4W 16 OHM 5%	R166,195
2055-2180	RES FXD CARB FILM 1/4W 18 OHM 5%	R161,190
2055-2220	RES FXD CARB FILM 1/4W 22 OHM 5%	R168
2055-2270	RES FXD CARB FILM 1/4W 27 OHM 5%	R184
2055-2330	RES FXD CARB FILM 1/4W 33 OHM 5%	R101,102
2055-2560	RES FXD CARB FILM 1/4W 56 OHM 5%	R211,94
2055-2620	RES FXD CARB FILM 1/4W 62 OHM 5%	R112
2055-2750	RES FXD CARB FILM 1/4W 75 OHM 5%	R89,90,91 169,170,197 198,209
2055-3100	RES FXD CARB FILM 1/4W 100 OHM 5%	R25,26,29,30 R61,82,85,131
2055-3130	RES FXD CARB FILM 1/4W 130 OHM 5%	R175
2055-3150	RES FXD CARB FILM 1/4W 150 OHM 5%	R186
2055-3180	RES FXD CARB FILM 1/4W 180 OHM 5%	R103
2055-3220	RES FXD CARB FILM 1/4W 220 OHM 5%	R5,10,18,20,32 R36,196,206,134 139,167,210,212
2055-3270	RES FXD CARB FILM 1/4W 270 OHM 5%	R93,95
2055-3300	RES FXD CARB FILM 1/4W 300 OHM 5%	R11,164,70,194
2055-3330	RES FXD CARB FILM 1/4W 330 OHM 5%	R207
2055-3360	RES FXD CARB FILM 1/4W 360 OHM 5%	R98
2055-3430	RES FXD CARB FILM 1/4W 430 OHM 5%	R178,183,185, 14
2055-3470	RES FXD CARB FILM 1/4W 470 OHM 5%	R3,4,9,17,43 24,27,28,88,99
2055-3620	RES FXD CARB FILM 1/4W 620 OHM 5%	R120,160 R162,189,191
2055-3680	RES FXD CARB FILM 1/4W 680 OHM 5%	R122
2055-3820	RES FXD CARB FILM 1/4W 820 OHM 5%	R19,104
2055-4100	RES FXD CARB FILM 1/4W 1K OHM 5%	R2,8,13,16,60,68 69,83,123,171
2055-4130	RES FXD CARB FILM 1/4W 1.3K OHM 5%	R163,192
2055-4200	RES FXD CARB FILM 1/4W 2K OHM 5%	R165,193
2055-4220	RES FXD CARB FILM 1/4W 2.2K OHM 5%	R73,84,97,172,200
2055-4240	RES FXD CARB FILM 1/4W 2.4K OHM 5%	R203
2055-4270	RES FXD CARB FILM 1/4W 2.7K OHM 5%	R133,208
2055-4330	RES FXD CARB FILM 1/4W 3.3K OHM 5%	R31,96,173
2055-4360	RES FXD CARB FILM 1/4W 3.6K OHM 5%	R119
2055-5100	RES FXD CARB FILM 1/4W 10K OHM 5%	R1,23,34,35 40,41,55,80 86,87,140
2055-5120	RES FXD CARB FILM 1/4W 12K OHM 5%	R56,204
2055-5220	RES FXD CARB FILM 1/4W 22K OHM 5%	R37,59,143
2055-5470	RES FXD CARB FILM 1/4W 47K OHM 5%	R58,126
2055-6200	RES FXD CARB FILM 1/4W 200K OHM 5%	R142
2055-6680	RES FXD CARB FILM 1/4W 680K OHM 5%	R121
2055-7100	RES FXD CARB FILM 1/4W 1M OHM 5%	R75,76
2061-3453	RES FXD MET FILM 1/8W 453 OHM 1%	R49
2061-3523	RES FXD MET FILM 1/8W 523 OHM 1%	R71
2061-3562	RES FXD MET FILM 1/8W 562 OHM 1%	R53
2061-3619	RES FXD MET FILM 1/8W 619 OHM 1%	R38

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATOR
5901-0343 ASSY PCB ATM-1600 VIDEO MODULATOR (cont.)		
2061-3825	RES FXD MET FILM 1/8W 825 OHM 1%	R44,45
2061-4110	RES FXD MET FILM 1/8W 1.1K OHM 1%	R33,202
2061-4150	RES FXD MET FILM 1/8W 1.5K OHM 1%	R116,128
2061-4178	RES FXD MET FILM 1/8W 1.78K OHM 1%	R39
2061-4200	RES FXD MET FILM 1/8W 2K OHM 1%	R72
2061-4232	RES FXD MET FILM 1/8W 2.32K OHM 1%	R51
2061-4249	RES FXD MET FILM 1/8W 2.49K OHM 1%	R118
2061-4392	RES FXD MET FILM 1/8W 3.92K OHM 1%	R115
2061-4432	RES FXD MET FILM 1/8W 4.32K OHM 1%	R22
2061-4470	RES FXD MET FILM 1/8W 4.7K OHM 1%	R74,81,117 129,201
2061-4499	RES FXD MET FILM 1/8W 4.99K OHM 1%	R46
2061-4634	RES FXD MET FILM 1/8W 6.34K OHM 1%	R108
2061-5113	RES FXD MET FILM 1/8W 11.3K OHM 1%	R136
2061-5261	RES FXD MET FILM 1/8W 26.1K OHM 1%	R132
2135-3330	RES FXD CARB FILM 1/2W 330 OHM 5%	R54,187
2226-0004	RES VAR CFR 500 OHMS	R6
2226-0007	RES VAR CER 1-TRN 1/2W 5K OHM 10%	R127
2226-0014	RES VAR CER 1-TRN 1/2W 10KOHM 10%	R42,106
2226-0023	RES VAR MLD 1W 1K OHM 10% PNL MT	R15,205
2226-0026	RESISTOR VAR. PC MTG 1K 10%	R7
2226-0029	RES 200 OHM 1/2W	R105,176
2226-0030	RES VAR PC MT CERMT 100R 1/2W 10%	R113
2226-0031	RES VAR 1-TRN 1/2W 50 OHM10%T/ADJ	R100
2326-0016	RES VAR M-TRN 1/2W 1K OHM 10% T/ADJ	R50,52
2601-0005	RES 1.0 OHM 1% 1W WIREWOUND	R48,188
3120-0003	DIODE 1N4154 CR1,2,4,5	CR6,7
3231-1004	TRANS SILICON NPN GENL PRP 2N3904	Q15,16,25,27
3231-2023	TRANS SILICON NPN AMPLIFIER MPS3563	Q17
3231-2027	TRANS SILICON NPN AMPLIFIER MPS6521	Q1,3,5,7 Q9,10,12,13
3232-4002	TRANS SILICON NPN POWER AMP PT4579	Q14,18,19,20,21 Q40,42
3241-2006	TRANS SILICON PNP AMPLIFIER MPS6523	Q2,4,6,8,11,22
3251-0017	TEANS JEFT N-CHAN LN 30V 2N4222	Q26
3311-0008	IC LIN VREG +5V LM7805CT VS=35V	U2
3311-0028	IC LIN VREG +15V LM7815CT VS=35V	U3
3312-0074	IC LIN OP AMP LM358N DUAL	U4
3312-0093	IC LIN VIDEO AMP NE592N	U10
3313-0031	IC LIN SYNC SEP LM1881N	U11
3400-0012	AMPL,HYB.500MHZ MWA-120	U20,21
4200-0001	PKG,CAN,AL,.51SQINTL,.906H	L36,37
4500-0007	TRANSFORMER SPLITTER	T5
4500-0015	TRANSFORMER 6T 4:1	T12

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATOR
5901-0343 ASSY PCB ATM-1600 VIDEO MODULATOR (cont.)		
4602-0337	INDUCTOR FXD MOLDED .33 UH 20%	L19,13
4602-1476	INDUCTOR FXD MOLDED 4.7 UH 10%	L11,39,43
4602-2106	INDUCTOR FXD MOLDED 10 UH 10%	L8,14,15,18 L30,31,32 L40,42
4611-1156	INDUCTOR FXD MOLDED 1.5 UH 10%	L34
4611-1336	INDUCTOR FXD MOLDED 3.3 UH 10%	L20
4611-2156	INDUCTOR FXD MOLDED 15 UH 10%	L41
4612-3105	INDUCTOR FXD MOLDED 100 UH 5%	L23
4614-1009	INDUCTOR FXD MOLDED .33 UH 5% /SCD	L16
4614-1013	INDUCTOR .47UH 5% MOLDED /SCD	L17
5216-0040	CONNECTOR F FEMALE RT ANGLE PC M	J4
5216-0104	CONN CARD EDGE RCPT 20 DL .156RTANG	J3
5222-0035	JUMPER MINI FOR	J2,5,6,7,8,10
5222-0037	3 POST JACK	J5,6,7,10
5222-0038	2 POST JACK	J9,16
5222-0039	JACK, CONNECTOR	J8,2
5413-1001	CRYSTAL 45.751 MHZ PER S.C.D	Y1
5900-0343	FAB PCB ATM-1600 VIDEO MODULATOR	
6163-0001	PAD TRANS FOR	Q14,18,19,20,40, 42
6820-0421	NUT,HEX 4-40 STD.PATT STL/ZINC	FOR J3
7114-0410	SCR,PAN,PHIL#4-40X5/8LG SS	FOR J3
7921-0014	CABLE,COAX.RG187A/U. TEFLON	
860010-118	CAP,MONO,.1UF,50V,20%	C2,77
860010-66	CAP.,VAR.,2-5PF	C60
860010-79	CAP AL 4.7UF 20% 35V 2000/85 RADIAL	C19,15,83
860020-3	CORE,BEAD B1,2,3	FOR Q17,21 AND R213
860026-13	DIODE	CR21,20
860026-29	DIODE	CR8,9,10,11
860049-115	IC LIN OP AMP CA3240AE VS=36V	U6,13
860049-32	IC LIN IF/RF AMP CA3028AS	U1
860049-64	IC LIN DRIVER LM3914N DISPLAY	U9
860049-86	IC LIN DRIVER LM3915N GRAPH DIS	U8
860100-15	THERMISTOR,100 OHMS	RT1
860101-1	HEATER,CRYSTAL	HR1
900048-32	CAP CER NPO DISC 20 PF 5% 500V	C17
900048-40	CAP CER N330 DISC 43 PF 5% 500V	C119
900048-44	CAP CER N750 DISC 62 PF 5% 500V	C52
900048-46	CAP CER N750 DISC 75 PF 5% 500V	C53,65
900048-49	CAP CER X5F DISC 100 PF 10% 500V	C1,84,115
900048-85	CAP CER X5F DISC 3300PF 10% 500V	C114,117,133
900066-1	SWITCH,SLIDE T.V.	SW1
900075-13	CAPACITOR,1675PF	C4
900075-18	CAPACITOR,MICA,125PF	C3

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATOR
5901-0343 ASSY PCB ATM-1600 VIDEO MODULATOR (cont.)		
900075-2	CAPACITOR,207PF	C10,11
900075-24	CAPACITOR MICA,110PF	C5
900075-3	CAPACITOR,233PF	C7,8
900075-4	CAPACITOR,427PF	C12
900075-5	CAPACITOR,575PF	C9
900075-9	CAPACITOR,550PF	C6
900095-1	SAW FILTER 44.025 MHZ,CTI151	FL1
2061-5243	RESISTOR,24.3K,1/4W,1%	R109
2061-6280	RESISTOR,280K,1/4W,1%	R107
2061-3432	RESISTOR,432 OHMS,1/8W	R21
9001-2037 ASSY PCB BB ENCODER INTERFACE FOR ATM-1600		
153525-2	BASEBAND ENCODER	
5101-0251	ASSY CABLE 4 PIN CONNECTOR	
6820-0421	NUT,HEX 4-40 STD.PATT STL/ZINC	
6842-0002	WASHER FLAT #4 STL	
6851-0017	STANDOFF 4-40 1/4 HEX 1/2 LG.THRD.	
6852-0039	SPACER 1/4ID 3/8 OD.,.016 THK.	
7112-0414	SCR.PAN/PHIL.#4-40X7/8 STL/ZN.P	
7162-0404	SCR BINDER/PHIL 4-40X1/4 STL/ZINC	
153662-2	ASSY CABLE,2 PIN CONN.	
153525-1 BASEBAND ENCODER INTERFACE		
1015-3206	CAP MICA DIPPED 200PF 5% 500V	C2,4
1015-4104	CAP MICA DIPPED 1000PF 5% 100V	C3,5
1219-0023	CAP AL 100 UF 20% 25V 2000H/85C	C1
153526-1	BD,BASE BAND ENC INTRFACE	
153527	SCHEMATIC,BASE BD ENC INTERFACE	
153661-1	CONN ASY,4 PIN	
153662-1	COMM ASY,2 PIN	
2055-4220	RES FXD CARB FILM 1/4W 2.2K OHM 5%	R4
2055-4300	RES FXD CARB FILM 1/4W 3K OHM 5%	PR1
2055-4560	RES FXD CARB FILM 1/4W 5.6K OHM 5%	R10,11,17
2055-5100	RES FXD CARB FILM 1/4W 10K OHM 5%	R2,5,6,7,8
2055-5150	RES FXD CARB FILM 1/4W 15K OHM 5%	R18
2055-5270	RES FXD CARB FILM 1/4W 27K OHM 5%	R9
2055-5750	RES FXD CARB FILM 1/4W 75K OHM 5%	R14
2055-6160	RES FXD CARB FILM 1/4W 160K OHM 5%	R13
2226-0016	POT 5K 1/2W 10%	
3120-0003	DIODE 1N4154	CR1
3323-0014	IC DIG MULTIVIB MC14528B DUAL CMOS	U2
3332-0003	IC DIG ANALOG SW CD4066 QUAD MOS	U5

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATOR
153525-1 BASEBAND ENCODER INTERFACE (cont.)		
860010-115	CAP CER ML X7R DIPPD .01 UF,10% 50V	C7
860010-119	CAP ELECT,RADIAL,1UF,50V	C6
860010-24	CAPACITOR,0.1UF,100V	C8
860010-84	CAPACITOR,0.33UF	C9
860049-112	IC DIG MULTIVIB 74C221 DUAL CMOS	U1
860049-113	IC LIN OP AMP LM359N	U4
860049-114	IC LIN OP AMP OP081-1P VS=18V	U6
860049-50	IC DIG NAND 2-IN CD4011AE QUAD	U3
860085-10	SOCKET,16 PIN DIP	
860085-9	SOCKET,14 PIN DIP	
900034-124	RES FXD CARB FILM 1/4W 120K OHM 5%	R3
900048-37	CAP CER NPO DISC 33 PF 5% 500V	C10
900048-57	CAP CER X5F DISC 220 PF 10% 500V	C11
9001-2038 FINAL ASSY. AURAL SUBCARRIER PROCESSOR		
4200-001	SHIELD CAN	
6822-0620	NUT	
7112-0604	SCREW	
5901-0356	ASSY. PCB AURAL SUBCARRIER PROCESSOR	
5120-2050	BNC CABLE	
5901-0356 ASSY. PCB AURAL SUBCARRIER PROCESSOR		
1156-4107	CAP CER 1000 PF	C22,25,26,27,28,36,37,38,41, 42,43,52
1256-1106	CAP TANT IUF 35V	C44,47
1219-0015	CAP ELECT 1000 UF 16V	C1,49,12,13
1095-1826	CAP CER 8.2 PF	C19
900048-28	CAP CER 13 PF	C18
1011-2156	CAP MICA 15PF	C21,32
900048-32	CAP CER 20 PF	C30,34
1045-1686	CAP CER 6.8 PF	C16
1011-2276	CAP MICA 27 PF	C2,46
1011-2366	CAP MICA 36 PF	C3,23,24
1046-2396	CAP CER 39 PF	C17,20
1011-2476	CAP MICA 47 PF	C5,14,39
1011-2826	CAP MICA 82 PF	C29
1011-2916	CAP MICA 91 PF	C4,40
1011-2686	CAP MICA 68 PF	C6,45
1015-3106	CAP MICA 100 PF	C10
1011-3126	CAP MICA 120 PF	C35

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATOR
5901-0356 ASSY. PCB AURAL SUBCARRIER PROCESSOR (CONT.)		
1015-3364	CAP MICA 360 PF	C7
1011-3476	CAP MICA 470 PF	C15
1015-3516	CAP MICA 510 PF	
1182-4393	CAP POLY 3900 PF	C8
900044-19	CAP 0.68 PF	C31,C33
2601-0005	RES 1 Ω 1% 1W	R55
2055-2750	RES 75 Ω	R23
2055-3200	RES 200 Ω	R36
2055-3220	RES 220 Ω	R7
2055-3300	RES 300 Ω	R45
2055-3470	RES 470 Ω	R4,5
2055-3510	RES 510 Ω	R9
2055-3560	RES 560 Ω	R44,19
2055-4100	RES 1K Ω	R6,8,,22,25,26,27,31,37,53,54
2055-3100	RES 100 Ω	R48,13
2055-4150	RES 1.5K Ω	R24
2055-4360	RES 3.6K Ω	R41
2055-4430	RES 4.3K Ω	R42
2055-4470	RES 4.7K Ω	R30,50,52
2055-4330	RES 3.3K Ω	R47
2055-4680	RES 6.8K Ω	R38
2055-5100	RES 10K Ω	R35,39,40,43,46,49
2055-5150	RES 15K Ω	R32,33
2055-5470	RES 47K Ω	R29
2055-6100	RES 100K Ω	R28,34
20612750	RES 75 Ω 1%	R1,16,20
2226-0026	VAR RES 1K Ω	R2
2226-0014	VAR RES 10K Ω	R51
4612-2106	IND FXD MOLD 10 UH	L17
4602-1226	IND FXD MOLD 2.2 UH	L15
4612-2475	IND FXD MOLD 47 UH	L11
4612-2825	IND FXD MOLD 82 UH	L10
151757-17	IND AIR CORE 17T	L16
4701-2006	IND AIR 6T 1/8D 20 AWG	L1
4850-7535	35T #30 BIFILAR TWIST, 27.7 UH	L4
4852-2820	20 1/2T #28, 2 UH	L5,6
4852-3235	35 1/2T #32, 5.6 UH	L7
152492-13	IND POT CORE	L8
152492-16	IND POT CORE	L9
153316-16	IND VAR 16.5 T	L12,13,14
152492-8	IND POT CORE	L2

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATOR
5901-0356 ASSY. PCB AURAL SUBCARRIER PROCESSOR (CONT.)		
152492-11	IND POT CORE	L3
5610-0198-1	TRANSFORMER POT CORE	T1
152330-1	TRANSFORMER	T2
150186-1	TRANSFORMER	T3
3231-2027	TRANS MPS 6521	Q1,7
3241-2006	TRANS MPS 6523	Q2,4,6
2N5088	TRANS 2N5088	Q8,9,10,11
3311-0008	IC LIN VREG LM 7815	U3
3312-0009	IC MULTIPLIER MC 1496	U1
860049-111	IC LIN AMP CA3028	U2
5601-0020	FILTER 4.5 MHZ BPF	FL1
5222-0037	JUMPER JACK 3 POST	J2
5222-0005	JUMPER	J2
5900-0356	FAB PCB ATM-1600 AURAL SUBCARRIER PROCESSOR	
2055-4240	RES 2.4K Ω	R3,8,11
2055-4120	RES 1.2K Ω	R12,10,21
2055-4180	RES 1.8K Ω	R18
2055-3390	RES 390 Ω	R17
2055-1680	RES 6.8K Ω	R14
2061-3453	RES 453 Ω 1%	R15
1176-5333	CAP .033 UF	C50
1219-0029	CAP ELECT 100 UF	C51
1256-1477	CAP TANT 4.7 UF	C53
133--0002	CAP ADJ 10-40 PF	C48
4601-0226	IND FXD MOLD .22 UH	L18
EL2020	IC VIDEO AMP	U4
3164-1626	DIODE 1N4735A	D1

8000-2610 ATM-1600 ACCESSORY KIT (F CONN)		
5120-1060	CABLE, COAX 6.00" (2) F CONN	
5211-0026	TERMINATOR MALE BNC	
6910-0015	PACKING SLIP	
7157-1010	SCR. PHIL W/NYLON WSHR 10-32 X 5/8"	
7600-0029	PLASTIC BAG, 9" X 12" X 4 MIL RECLOSABLE	
5218-0028	TERMINATION, 75 OHM, F DC-550 MHZ	

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATOR
8000-2611 ATM-1600 ACCESSORY KIT (BNC CONN)		
5120-2050	CABLE, COAX 6.00" (2) BNC CONN	
5211-0026	TERMINATOR MALE BNC (2)	
6910-0015	PACKING SLIP	
7157-1010	SCR. PHIL W/NYLON WSHR 10-32 X 5/8"	
7600-0029	PLASTIC BAG, 9" X 12" X 4 MIL RECLOSABLE	

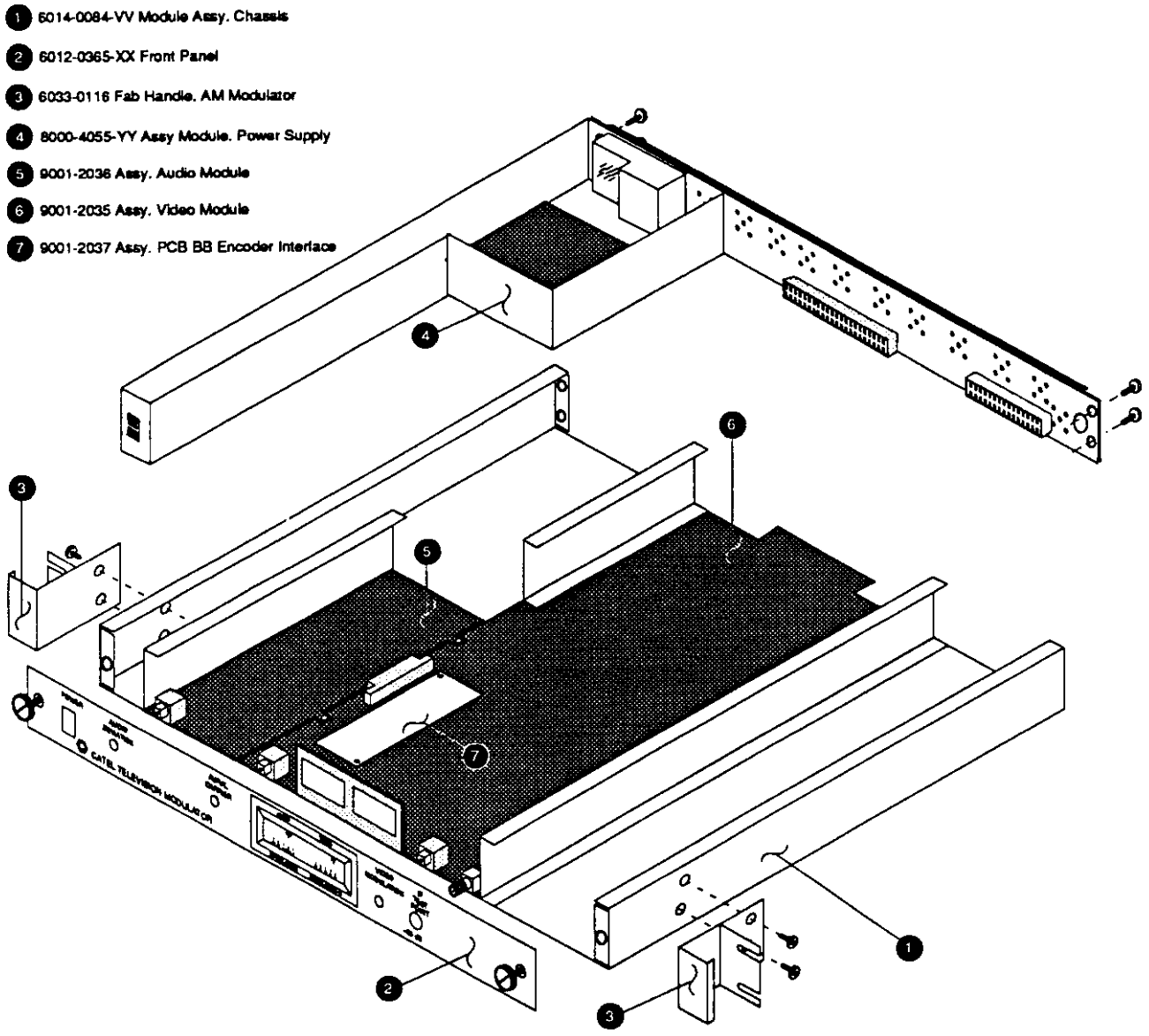


Figure 5-1
ATM-1600 Final Assembly
Internal View

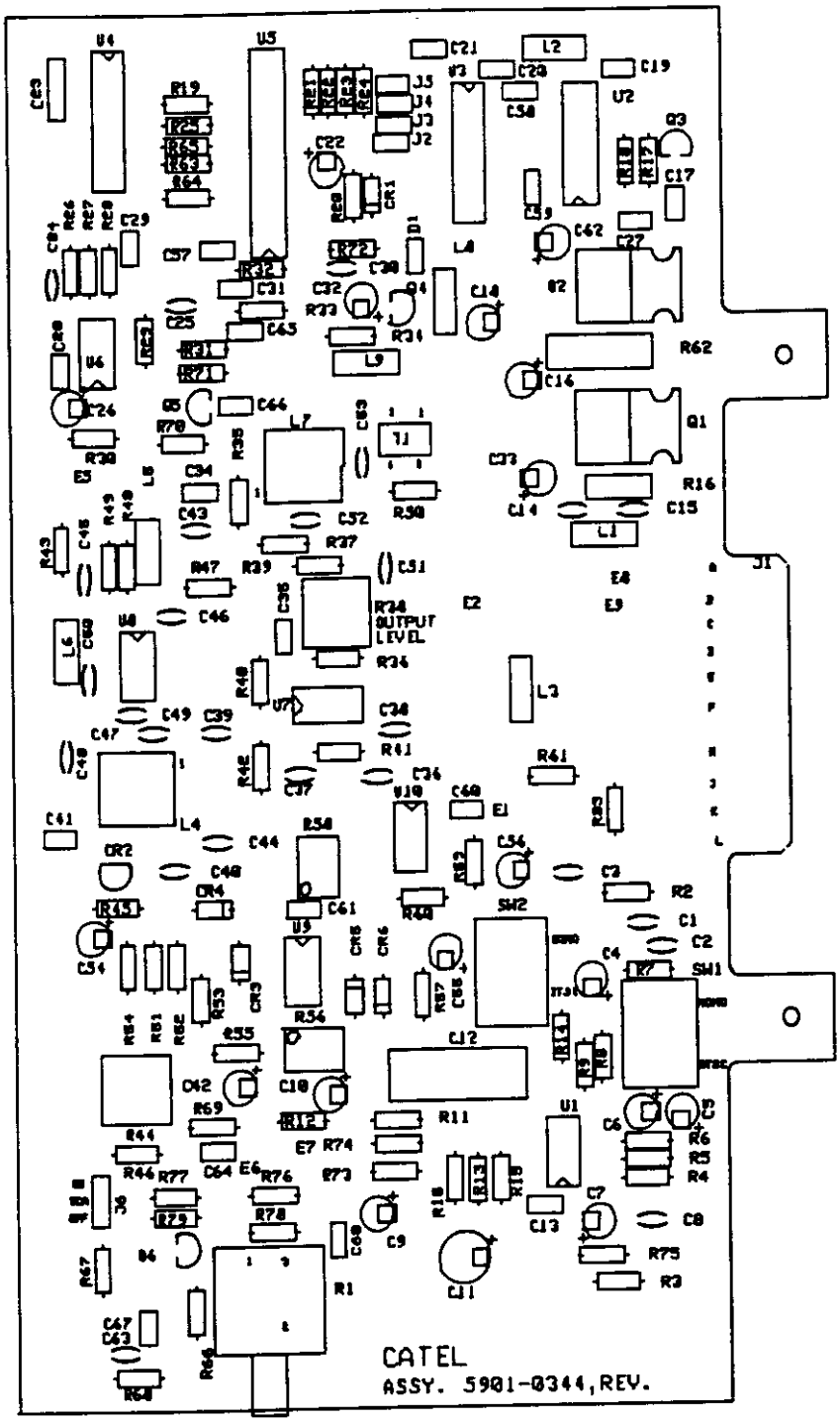


Figure 5-2
PCB Parts Location Diagram
Audio Modulator