

VSB-70 Fast-Scan TV Transceiver

Operating Manual



FOREWORD

Congratulations on your purchase of the VSB-70 Fast-Scan Television Transceiver. It will provide you with excellent quality live amateur television transmitting and receiving capabilities.

To fully enjoy the benefits of the VSB-70, please read this manual carefully before operating the transceiver. If you have questions, I encourage you to contact an AEA authorized dealer or one of our technical support representatives at:

Advanced Electronic Applications, Inc.
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Lynnwood, WA 98036
Customer Service: (206) 775- 7373
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CompuServe User ID: 76702,1013

73,

C. Mike Lamb, N7ML
President

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1. INTRODUCTION

The AEA model VSB-70 is a Fast-Scan Television (FSTV) transceiver that operates on the amateur 420 to 440 MHz band. The transmitter features two local oscillator crystal-controlled channels and an output of one watt PEP on sync peaks. Receive operation can transceive or use variable tuning.

In transmit, baseband NTSC video and audio are converted to Vestigial Sideband (VSB) video with the FM audio subcarrier in the 70 cm band. This is the same format as used by broadcast television. Video cameras, Camcorders and video cassette recorders with video and audio output jacks can be used to generate the baseband video and audio for transmission. A separate front panel microphone jack may also be used for audio input. Either color or black and white video may be used. Television channel 3 or 4 may be used to monitor your broadcast signal.

If you live in an area where channel 3 is used by a commercial television station, your VSB-70 must be configured for channel 4, and vice versa. If you purchased the wrong configuration, you can change the local oscillator crystals and retune the unit for the opposite configuration. See chapter 4, Channel Selection.

For receive, the 70 cm television signal is converted to either television channel 3 or 4. A standard color or black and white television is used for reception. The same television is used for monitoring your transmission. The VSB-70 uses a GaAsFET preamplifier which provides for a system noise figure of less than 1.5 dB. Either crystal-controlled or VFO receive tuning may be selected.

In addition to the video source and television set, a 13.6 volt regulated power supply and 70 cm antenna are necessary. AEA also offers the RLA-70 linear amplifier with MPS-100 power supply and the 430-16 antenna to complete your ATV station.

To transmit, an amateur technician or higher class license is required.

426.25

2. FRONT PANEL DESCRIPTION

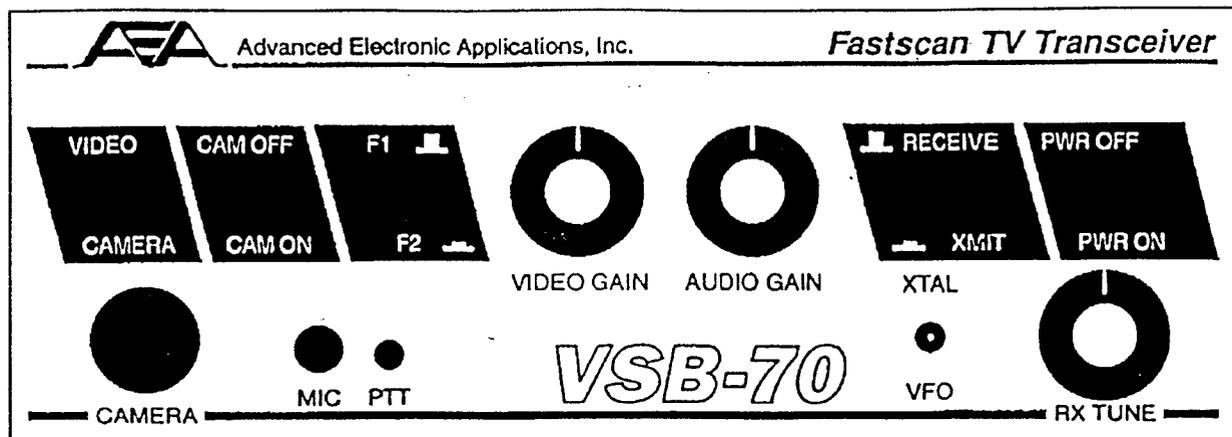


Figure 1

Front panel controls, indicators and connectors are described below and illustrated in Figure 1:

NAME	FUNCTION	TYPE
VIDEO/CAMERA	Selects CAMERA 10-pin connector input on front panel or AUDIO IN and VIDEO IN jacks on the rear panel	Push-button switch
CAM OFF/CAM ON	Controls power to video camera	Push-button switch
F1/F2	Selects crystal-controlled oscillators F1 or F2	Push-button switch
VIDEO and AUDIO GAIN	Adjust video and audio (respectively) signal input level to the transceiver	Variable Resistors
RECEIVE/XMIT	Switches between transmit and receive modes. Red lamp is lit when transmitting.	Push-button switch
PWR OFF/PWR ON	Switches +13.6 VDC input power and lights red lamp.	Push-button switch
RX TUNE	Tunes variable oscillator for receive signals (420-440 MHZ).	Variable resistor
XTAL/VFO	In the XTAL position the receiver frequency is determined by the F1/F2 crystals. In the VFO position, the receiver frequency is determined by the RX TUNE control.	Toggle switch
CAMERA	For video camera cable connection	10-pin connector
MIC	For external 600 ohm microphone connection	Plug-in 3.5 mm phone jack
PTT	For push-to-talk input from microphone. Selects transmit mode when keyed. 12V @ 60 mA.	Plug-in 2.5 mm phone jack

3. REAR PANEL DESCRIPTION

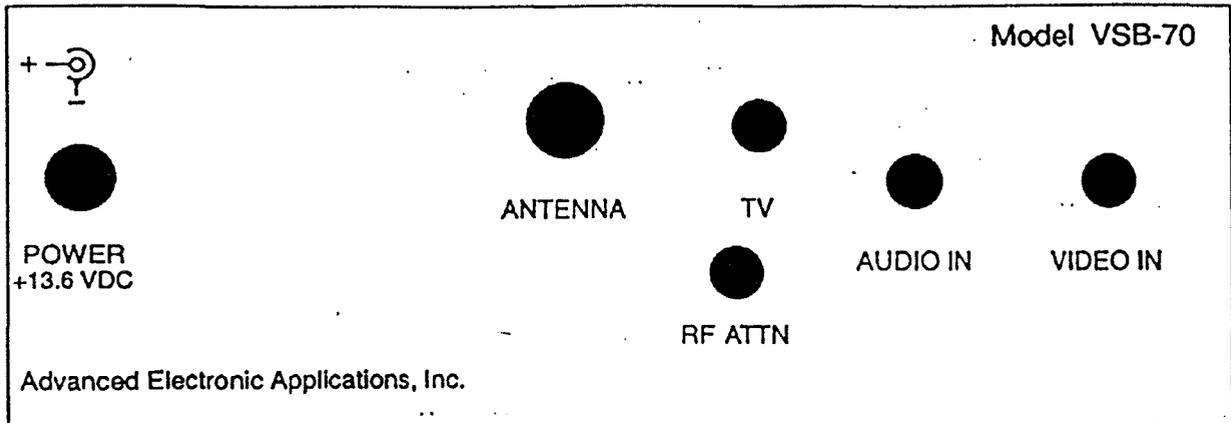


Figure 2

The VSB-70 rear panel connectors are listed below and illustrated in Figure 2:

NAME	FUNCTION	TYPE
POWER +13.6 VDC	Input power to VSB-70. Center pin must be +13.6 to +14 volts DC from a well-regulated source	Barrel jack, 5 mm, J7
ANTENNA	Connects to 70 cm antenna or external amplifier	Coax connector, BNC
TV	Connects to television receiver	Coax Connector, Type F
AUDIO IN	Input connection for audio signals from VCR or camera adapter	RCA phono jack
VIDEO IN	Input connection for video signals from VCR or camera adapter	RCA phono jack
RF ATTN	Adjusts the receive preamplifier gain. If overload of the receiver occurs due to a mast mounted receive amplifier, the gain of the transceiver may be lowered by turning the adjustment CCW. At full gain the receive conversion gain is typically 28 db. With the RF ATTN adjustment fully CCW the gain is reduced to about 16 db.	Screwdriver adjustment

4. INSTALLATION

Unpack the VSB-70 carefully. Check for signs of damage. If any damage is noted, contact your dealer or the freight company. Keep any cartons and packing materials for the dealer's inspection. Consider keeping the container and packing materials in case the unit must be shipped in the future.

The VSB-70 is designed to transmit and receive in the 420 MHz to 440 MHz range. These instructions are for installation. Operation instructions are given on page 7. Complete the installation as follows:

Warning!

Warning!

DO NOT TRANSMIT WITHOUT A LOAD!

The transceiver must **NOT** transmit into a load with an SWR higher than 1.8:1. Damage may result from transmitting without an antenna or dummy load.

1. Connect a coax cable from your 70 cm antenna to the BNC ANTENNA connector on the rear panel of the VSB-70.
2. To transmit live video: connect your video camera or Camcorder to the CAMERA connector on the front panel of the VSB-70. Connect to VIDEO and AUDIO jacks on the rear panel if a Camcorder with adapters is used. Put VIDEO/CAMERA switch in the appropriate position.
3. To transmit VCR video: connect your VCR video and audio output signals to the VIDEO IN and AUDIO in jacks, respectively, on the rear panel. Press VIDEO/CAMERA push-button switch to VIDEO (latched out).
4. Connect your television receiver to the Type F (TV coax) connector on the rear panel

NOTE!

NOTE!

Your television receiver will display transmit and receive video on channel 3 or 4. The VSB-70 is delivered with the channel 3 jumper installed. To change to the alternate channel, follow the instructions on page 6.

5. If your camera does not have a built-in microphone, connect your microphone to the MIC jack on the front panel.
6. If your microphone uses push-to-talk keying, connect the PTT line to the PTT jack on the front panel.

5. CHANNEL SELECTION

VSF-70's are shipped with two local oscillator crystals installed. The crystals will provide operation at 434.00 MHz (F1) and 439.25 (F2) with channel 3 enabled for receiving and monitoring transmissions. You may be in a service area that requires selecting the other channel. If you have a local TV channel 3 or 4, choose the unused channel. You must install the correct crystal and set the unit to operate on the selected channel. The following procedures and table provide the information you need to change the channel selection.

Crystals must be selected from the table below for the desired channel and operational frequency. to change from channel 3 to 4 or vice versa, contact AEA, Inc., to order the crystals you need.

VSF-70 MIXING CRYSTALS

NOTE!

NOTE!

If you install or change any crystals, you must perform the CRYSTAL INSTALLATION PROCEDURE below.

TRANSMIT FREQUENCY (MHz)	CHANNEL 3 (MHz) / AEA part #	CHANNEL 4 (MHz) / AEA part #
421.25	90.00 / 090-890.00	88.50 / 090-888.50
426.25	91.25 / 090-891.25	89.75 / 090-889.75
434.00 * (factory installed)	93.1875 / 090-893.18	91.6875 / 090-891.68
439.25 * (factory installed)	94.500 / 090-894.50	93.000 / 090-893.00

The above crystals can be ordered direct from AEA or through your local dealer. Suggested price: \$15 each.

The selection of channel 3 or 4 for display on your television receiver is determined by the position of a jumper on the circuit board inside the VSF-70. To change the current channel selection of your VSF-70, perform the following:

1. Remove the power cord and the cover from VSF-70..
2. Refer to page 12 to locate jumper JP2.
3. Install JP2 to connect the center post to either "3" or "4" for the channel desired.
4. Perform the crystal installation procedure below.

CRYSTAL INSTALLATION PROCEDURE

Equipment required for tuning: Bird or PEP wattmeter (1 watt), .075 inch non-metallic tuning tool, desired crystal.

Do not adjust any inductors or variable capacitors other than the ones referred to in this manual's tuning procedures (this page and page 10) as the circuits are factory tuned.

The VSF-70 is delivered with F1 = 434 MHz and F2 = 439.25 MHz as the transmit/receive operational frequencies. The unit is configured for either channel 3 or 4. Check the outside of the box to check which channel your VSF-70 is con-

figured for The other local oscillator crystals are purchased for optional TX/RX frequencies and TV channels. To install a crystal, complete the following:

1. Remove the power cord, then remove the top cover.
2. Use page 12 to locate the crystal socket (Y1 or Y2) and the corresponding ADJUST (F1 or F2) on the circuit board.
3. Install the new crystal in the socket as desired.
4. Connect a video camera, Camcorder or VCR to the appropriate connector.
5. Connect a power meter and reasonably well-matched load (less than 1.8:1 SWR) to the antenna coax connector of the VSB-70 to read transmit power.
6. Select the desired crystal by pressing the F1/F2 push-button.
7. Press RECEIVE/XMIT push-button switch to XMIT (red LED on).
8. Turn the power on and begin transmitting.
9. Using a standard .075 inch hex non-metallic tuning tool (available at most electronic supply stores), turn the F1 or F2 ADJUST (as appropriate) for maximum output signal on your power meter. When the signal strength is maximum, the oscillator is correctly tuned. If a series of lines or dots show on the received picture, slightly retune the F1 or F2 adjust, accordingly.

6. TRANSMIT MODE OPERATION

WARNING!

WARNING!

NEVER TRANSMIT WITHOUT A LOAD!

Your VSB-70 needs a dummy load or antenna with a relatively close impedance match connected before transmitting. *Equipment damage may result* from transmitting into no load or a load resulting in an SWR of more than 1.8:1!

1. Check power, camera or VCR, microphone, television receiver and antenna connections to VSB-70 connectors.
2. Press PWR OFF/PWR ON push-button switch to ON (red LED lights).
3. To transmit live with your video camera, press the CAM OFF/CAM ON push-button switch ON (latched in).
4. Check your video camera or Camcorder for power.
5. Press the VIDEO/CAMERA push-button switch to CAMERA (latched in).
6. To transmit VCR video, press the VIDEO/CAMERA push-button switch (latched out).
7. Select transmit frequency:
 F1 = 434.0 MHz, F2 = 439.25 MHz. Check that the F1/F2 switch is in the appropriate position.
 Optional frequencies: 421.25, 426.25 or 439.25 MHz (if installed). Check that F1/F2 switch is set to the appropriate position.

8. Press RECEIVE/XMIT push-button switch to select transmit mode (latched in, red LED lights).
9. Begin transmitting. On your television receiver, check for video and audio signal quality and strength.
10. Adjust VIDEO GAIN AND AUDIO GAIN controls for signal quality and strength.

If you are using a Bird or equivalent power meter which reads average RF power, it will read 0.6 watts minimum with a black video source. This is the equivalent of one watt PEP on sync peaks.

7. RECEIVE MODE OPERATION

1. Press the RECEIVE/XMIT switch to receive mode (latched out, LED off).
2. Select transmit frequency:
F1 = 434.0 MHz, F2 = 439.25 MHz. Check that the F1/F2 switch is in the appropriate position.
Optional frequencies: 421.25, 426.25 or 439.25 MHz (if installed). Check that F1/F2 switch is set to the appropriate position.

If you do not have a local oscillator crystal for the frequency you wish to receive, or the transmitting station's signal does not appear clearly, turn the RX TUNE switch to VFO and adjust for best signal quality. The operating range of the VFO is from 420 to 440 MHz.

8. SYSTEM DESCRIPTION

The VSB-70 provides all of the signal conditioning necessary to perform NTSC video composite television transmission and reception in the 420 to 440 MHz band. The system is designed around a single conversion hardware architecture which utilizes the same television channel (3 or 4) for transmit and receive signal conversion. Vestigial Sideband (VSB) filtering is utilized to minimize adjacent channel interference. The bandpass filter is tailored to the characteristics that a television receiver is designed to receive.

Two local oscillator crystal sockets are provided for transmission and reception modes, and a VFO is provided for reception of signals which have drifted such that crystal-controlled reception is difficult or impossible, or when different transmit and receive frequencies are used, such as when using a repeater.

A linear Class A output amplifier has been optimized for one watt Peak Envelope Power (PEP.) on sync peaks with extremely low levels of intermodulation distortion. Front-end reception is performed with a low-noise GaAsFET preamplifier which provides the system with an overall receiver noise figure of less than 1.5 dB within the 420-445 MHz band.

The functional operation of the transmit and receive modes is described below. References are made to the component location diagram (Figure 4). The block diagram (Figure 5) and schematic (Figure 6) may also be useful.

TRANSMITTER DESCRIPTION

Video and audio signals may be input from a video camera, Camcorder or VCR. Video and audio signals (baseband) from a video camera or Camcorder are input via a standard 10-pin Canon connector on the front panel of the VSB-70. Camera or VCR signals are input as separate video and audio signals to the VIDEO IN and AUDIO IN jacks on the rear panel. Audio input from an external microphone may be added via the MIC front panel jack. PTT may be utilized to switch the VSB-70 into transmit mode from an external microphone.

Video baseband signals are input to an amplifier which extends (restores) the sync peaks to compensate for external amplifier gain compression or cabling loss. The gain for the amplifier is variable and accessible from the front panel via the VIDEO GAIN control. The expansion level is adjusted with R-39 (internal potentiometer). Audio baseband signals are amplified with a variable gain amplifier as well. The gain for the audio amplifier is adjustable from the front panel via the AUDIO GAIN control.

The video baseband signal modulates a crystal controlled IF carrier frequency for channel 3 or 4. The audio baseband signal modulates a VCO at 4.5 MHz. The modulated signals are then mixed to form a double-sideband video composite signal at either 61.25 MHz (channel 3) or 67.25 MHz (channel 4). The selection of IF channels 3 or 4 is determined by the position of jumper JP2 and the crystal installed in the channel 3 or 4 oscillator (see page 12).

The IF signal is then VSB filtered. The Surface Acoustic Wave (SAW) Filter eliminates the major portion of the lower sideband of the IF signal. The resulting signal is not a true Single Sideband (SSB) signal as a portion of the lower video sideband is retained. The primary purpose in employing VSB is to reduce or eliminate interchannel interference while retaining significant video information in the lower sideband of the IF carrier.

The IF output of the VSB filter is amplified and then up-converted to the RF output frequency by mixing with one of the two local oscillators (LO). Selection of the LO frequency is done with the front panel F1/F2 switch. The LO frequency is generated from a crystal oscillator which has been multiplied by a factor of four.

For transmission monitoring, the IF information presented to the mixer is amplified then filtered to remove the LO and both RF sidebands. The user may view transmitted IF signals on channel 3 or 4 of any standard US television set from the TV connector located on the rear panel.

For transmission the desired RF sideband resulting from the mixing process is amplified then filtered to remove the LO and lower sideband mixing products. The RF carrier then drives the RF power amplifier, which consists of two discrete actively biased transistor amplifiers Q2 & Q4. The amplifier will deliver one watt PEP on sync peaks (black video) with a lower audio sideband attenuation of better than 42 dB. The user may change the output power by adjusting C104 (see Figure 4) to accommodate external power amplifier requirements. If power output is increased above 1 watt PEP, amplifier distortion specifications are not guaranteed.

RECEIVER DESCRIPTION

RF signals present at the antenna connector on the rear panel are switched to the double tuned low-noise GaAsFET preamplifier. The preamplifier has been optimized for gain, thermal noise and image rejection. As a result, the receiver conversion noise figure is better than 1.5 dB in the 430 MHz band.

The RF signal is then down-converted to a channel 3 or 4 IF by mixing with a user-selectable LO. RX TUNE on the front panel may be used to manually tune in a station which has drifted to the extent that reception with one of the crystal oscillators is compromised. The desired IF sideband is filtered to remove the LO and image sideband then presented to the TV output connector on the back panel. The signal at the TV connector may be viewed on channel 3 or 4 of any standard US television set.

OUTPUT POWER LEVEL ADJUSTMENT

Warning!

Warning!

Adjust only C104, L13, L14, R39, and R98 per the instructions in this manual. Any other adjustments should be made only by a qualified technician using a spectrum analyzer, tracking generator, synthesizer, frequency generator, dummy load and wattmeter. Currently, a \$50.00 charge will apply to all units which are returned to AEA for re-tuning.

Your VSB-70 has been delivered with the output power preset to one watt PEP on sync peaks into a 50 ohm load. There are occasions when it is necessary to adjust the output power to a different level (such as interfacing with an external power amplifier). The output power level may be adjusted by rotating C104 (see Figure 4) while a black level signal is input to the unit.

The procedure for adjusting the output power level is as follows:

1. Follow the instructions for TRANSMIT MODE OPERATION using a video camera or Camcorder for the signal source (i.e. turn on the unit and optimize the picture quality).
2. Cover the lens of your video camera or Camcorder with a black lens cap. This provides the black level input signal to the unit.

Adjust C104 (see page 12) with the non-metallic tuning tool until the power is at the desired level. A power meter must be used to determine the absolute power level. If you have a high-quality PEP power meter, then adjust the power level directly from the indicated output reading. If you have a Bird (or equivalent) power meter, then scale the desired level relative to 0.6 watts. For example, a Bird power meter will read 0.3 watts for a 0.5 watt PEP (0.6×0.5) output power level.

Warning!

Warning!

The variable capacitors are not designed to be repeatedly adjusted – they can become unstable and loose. Do not repeatedly tune these capacitors!

SYNC STRETCHER AND ZERO VIDEO GAIN SYNC ADJUSTMENTS

Two internal controls adjust the sync signal characteristics. Adjusting R98 CCW (counter-clockwise) will increase the level of the synchronization pulse to compensate for compression of the signal in external amplifiers. It is recommended that the control be left in the full CW (clockwise) position as operation of an amplifier at maximum power severely degrades the linearity of the amplifier.

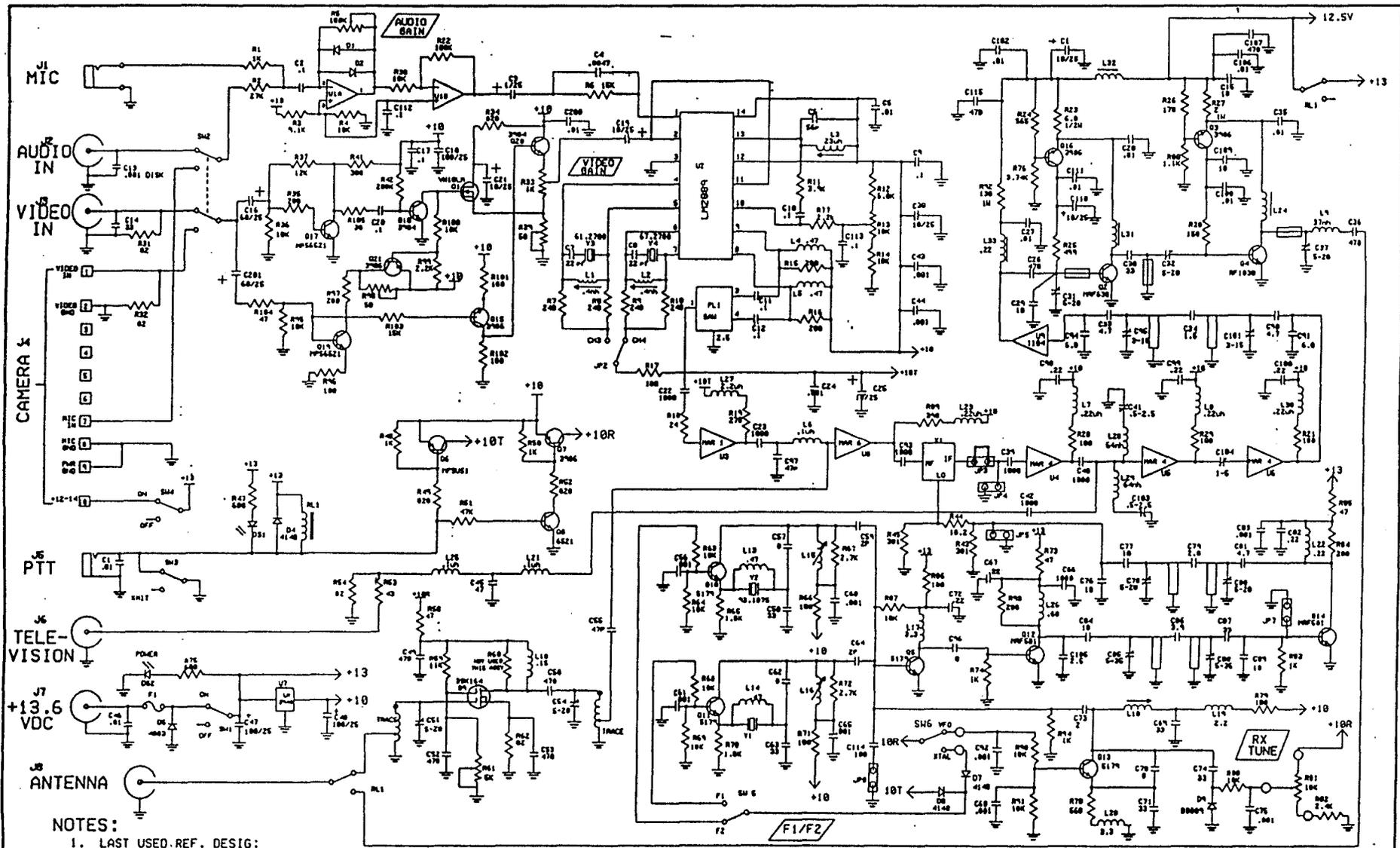
A circuit has been incorporated in the VSB-70 that provides sync pulses even when the front panel video gain control has been reduced to zero. The internal control R39 sets the sync level at zero video gain. An oscilloscope is necessary for adjustment of this control. Monitor the baseband video on pin 2 of U2 with normal video input. Set the front panel video gain control fully CCW and adjust R39 for the same level of sync pulses.

FREQUENCY CONTROL

Transmit/Receive signals are mixed with frequencies generated in a separate oscillator section that provides two/three switched selections to match transmission or reception frequencies for Amateur Television. Your VSB-70 was delivered with two crystals (F1 & F2) which provide operation at 434 and 439.25 MHz, respectively.

For an example of the frequency control circuit operations, assume you will be using channel 3:

- The 93.1875 MHz F1 frequency is doubled, filtered, doubled again and filtered producing 372.75 MHz to the mixer.
- The 372.75 MHz is added to the 61.25 MHz transmit frequency by the mixer giving a final transmit frequency of 434 MHz.
- The same 372.75 MHz signal is subtracted from a 434 MHz receive signal giving the 61.25 MHz channel 3 frequency to your television receiver.

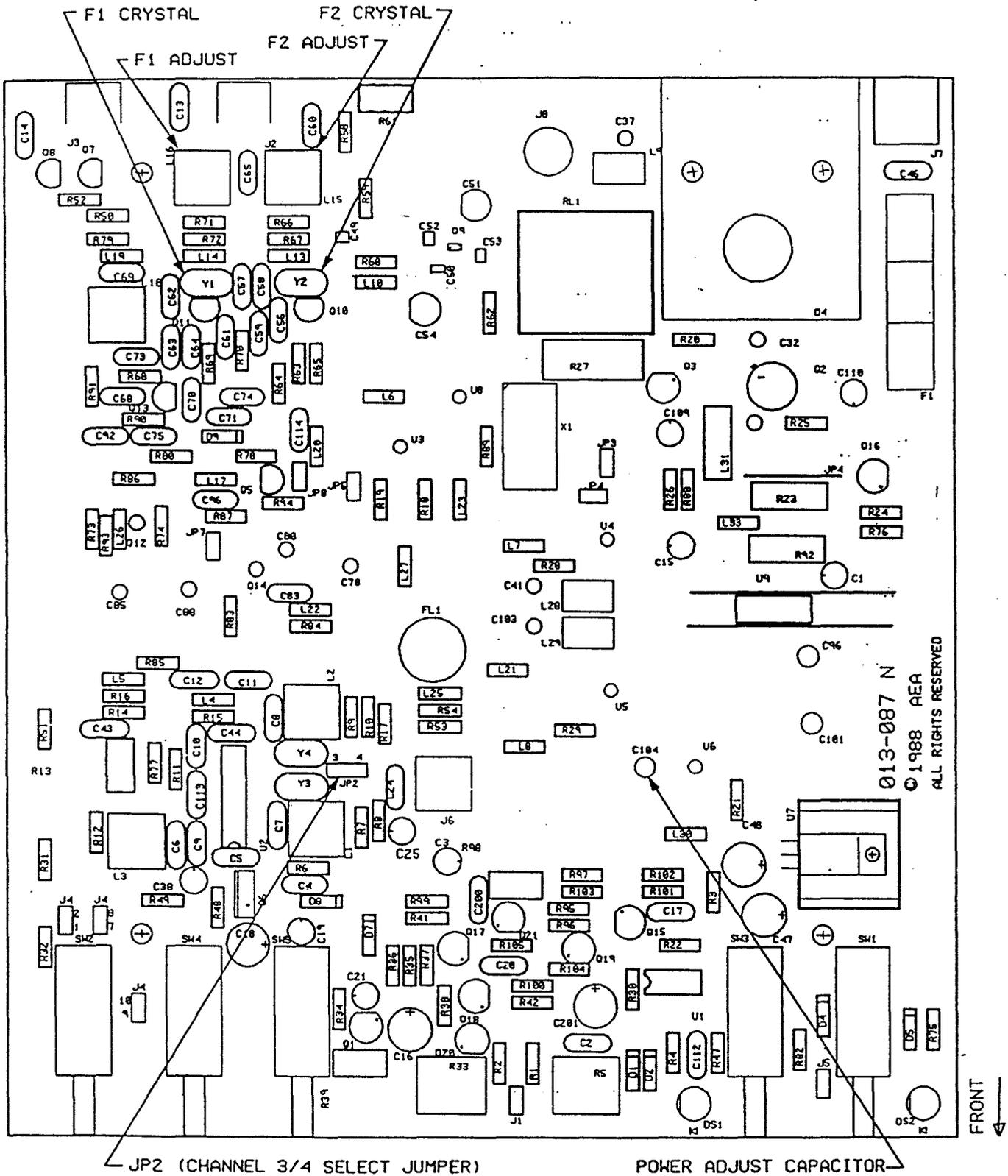


- NOTES:
1. LAST USED REF. DESIG:
C115 L33 U9 J8
R105 Q21 O9
 2. UNUSED REF. DESIG.:
R46, R55, R56, R57, R60, R81,
L11, L12, D6

AEA ADVANCED ELECTRONIC APPLICATIONS, INC.			
TITLE SCHEMATIC DIAGRAM			
VSB-70			
SIZE B	PRODUCTION RELEASE	012-071-1	REV N
DRAWN P. HARTLEY	DATE 1-25-91	SHEET 1 OF 1	

9. SCHEMATIC DIAGRAM

10. PARTS PICTORIAL



12. WARRANTY

LIMITED WARRANTY

ADVANCED ELECTRONIC APPLICATIONS, INC. warrants to the original purchaser that this product shall be free from defects in material or workmanship for ninety days from the date of original purchase. In order to obtain warranty service: 1) Complete and mail the warranty registration card within 10 days to Advanced Electronic Applications, Inc., and 2) Send written notification to the address below or telephone as soon as possible after discovering a possible defect:

Advanced Electronic Applications, Inc.
Attention: Service Department
2006-196th St. S.W.
Lynnwood, WA 98036

The written notification must include a copy of the invoice. Include a description of the defective part or condition, with details of the electrical connections to associated equipment and list such equipment. Please enclose your name, phone number, and address. Shipping charges for any parts or units submitted for replacement under this warranty must be paid by the purchaser.

Correct maintenance, repair and use are important to insure proper performance from this product. Carefully read the Instruction Manual. This warranty does not apply to any defect AEA determines is caused by 1) Improper maintenance or repair, including the installation of parts or accessories that do not conform to the quality and specification of the original parts; 2) Misuse, abuse, neglect, or improper installation; 3) Accidental or intentional damage. The field installation of circuits according to the explicit instructions of AEA will not nullify this warranty.

All implied warranties, if any, terminate ninety days from the date of original purchase. AEA is not responsible for damage to other equipment or property or any other consequential damages. Some states do not allow limitations of how long an implied warranty lasts or do not allow the exclusion of incidental or consequential damages, therefore, the above limitations and exclusions may not apply to you.

This warranty gives specific legal rights. You may also have other rights which vary from state to state.