

# TC70-20S 70 cm ATV TRANSCEIVER USERS MANUAL



The TC70-20S transceiver is designed to provide over 20 Watt p.e.p. (sync tip), continuous duty, of AM video modulated RF in the 70 cm (420-450 MHz) Amateur band in transmit, and downconvert the whole band to TV channel 3 (61.25 MHz) or 4 (67.25 MHz) to enable receiving on any standard NTSC television set or VCR with a tuner.

Before transmitting, you should find out from local ATVers which two of the four common USA frequencies - 439.25, 434.0, 427.25 or 426.25 MHz - are used in your area per the local band plan to avoid mutual interference with other mode users. Generally, the more populated areas which have FM voice repeaters below 444 MHz will use 434.0 MHz instead of 439.25 MHz as the primary ATV frequency to get away from receiving interference. 426.25 MHz is the most common secondary frequency for simplex. All four frequencies are close enough to cable channels 58 to 60 for the TV sets AFC to lock on. However, cable TV tuners are not as sensitive as the tuneable tuner in the TC70-20S or TVC-4G. 421.25 MHz can only be used if there is a VSB filter in the antenna coax to remove the lower sound and color subcarriers below the band edge at 420 MHz and therefore only used by repeater outputs.

Any licensed code free Technician class or higher Radio Amateur may operate this transmitter in accordance with 47 CFR part 97 of the FCC Rules and Regulations. The TC70-20S accepts U.S.A. standard composite video (1 volt pk-pk) from any source such as color or black and white TV cameras or camcorders, VCRs, or computers for transmission. Audio from these sources or a low impedance dynamic mic is also transmitted on the 4.5 MHz FM sound subcarrier. PAL video may also be used but the sound subcarrier must be special ordered to be set for the specific frequency used - 5.5 to 6.5 MHz.

**PLEASE** read through this manual before plugging in any cables and attempting operation. Each connector and control is described here to enable your proper hookup and operation. Also the unique video practices associated with ATV and the 70 cm band are described.

## REAR PANEL:

Keep 3" minimum clearance around the heat sink and top of box for convection cooling or add a fan.



**POWER INPUT JACK.** A 4 pin plug and 3 ft long #18 cable is provided for connection to your source of 12 to 14 Vdc. Pin 1 is ground (black) and pin 2 (red) is +. The TC70-20S works best connected directly to the terminals of a well regulated power supply with leads no longer than necessary. The transmitter is set up by us with a regulated 13.8 Vdc supply, if the voltage is <13.3 Vdc see amplifier / pedestal set up on page 5. Do not exceed 15 Vdc input. There is a 16 v zener which should blow the fuse if this voltage is exceeded or the supply leads get cross connected, but semiconductors have been known to protect fuses. Any ripple or noise on the DC line may be seen in the transmitted video. You will need a 13.8 Vdc regulated power supply capable of 4 Amps continuous. There is a 5 Amp fuse inside the unit.

**Downconverter Output to TV** is at this jack during receive for connection to your TV receiver antenna input. Run a 75 Ohm RG6 coax with F connectors. Radio Shack has cables made up in various lengths (15-1530). If your TV does not have a 75 Ohm coax input, use a balun at the TV (15-1140). Tune the TV to channel 3 or 4 depending on which ever is weakest or not on the air in your area. With the TC70-20S still off, fine tune the TV set, with the AFC off, for all snow and no adjacent channel feedthru. Now turn on the TC70-20S and slowly tune the REC TUNE knob for the best picture from a known close by ATV station. If you prefer to drive a video monitor directly instead of a TV, plug in the Rch3 receiver to this output. Once you have a picture, rotate your antenna for least snow or strongest picture. Then ask the ATV transmitting station to swing his antenna for the strongest picture. It's best to coordinate the tuning and antenna rotation on 2 meter FM. The most popular ATV coordination frequencies are 144.34 and 146.430 MHz simplex. Select the one that does not have a 3rd harmonic within the video passband on 70 cm. The video transmitting station then talks to you on the sound subcarrier, and the receiving stations talk back at the same time (full duplex) on 2 meters.

**TRANSMIT VIDEO MONITOR OUTPUT.** This provides composite video of your demodulated RF directly from the antenna output during transmission periods to enable you to best adjust the video gain, set focus and lighting, etc., rather than a distant station describing these back to you on 2 meters. In receive it outputs the phono jack video input to enable your setting up the picture on the monitor as you receive another station on the TV. Use a RCA plug shielded cable to connect to your video monitor or VCR video in. If your TV receiver does not have a video input, the Radio Shack 15-1273 RF Modulator can take the composite video and modulate it up to channel 3 or 4 to make another TV set into a monitor. Attempting to see your own video over the air with a TV set at the same QTH most often gives false

indications due to overload and reflections. Even receiving the 2nd harmonic 40 or more dB down around channel 80, or on cable channels between 57 and 60 can give an erroneous indication of transmitted picture quality. Only the monitor output will be accurate, except when reset to drive an external power amplifier.

**50 OHM 70 CM ANTENNA.** A UG21 type N plug is provided to attach to low loss .5" size 50Ω coax. Losses at 70 cm are very high in transmission lines. We suggest using the foam filled types (3.5 dB/100') such as Belden 8214, or semi rigid (2.5 dB/100') Belden 9913. Take great care to put the N plug together properly - see last page. The type N connector has good moisture resistance and low loss at UHF but use two layers of vinyl tape or coax seal on all outside connections to prevent moisture contamination. The antenna and feed line are the most important part of your ATV system, and therefore the last item to just try and get by with.

Check out your antenna system with a RF power meter. On initial turn on, do not transmit more than 10 seconds if the reflected power is more than 10% (2.0 W max) or 2:1 VSWR. You could blow the M57716 power module. Also, VSWR or being too near your antenna can cause RF pickup interference in your camera or buzz in the audio. With no video connected, the RF power meter should read between 11 to 15 Watts blanking pedestal power. Sync tip, p.e.p., equals 1.68 times the blanking power.

Use a good resonant broad bandwidth 70 cm antenna such as the High-performance 432-Mhz Yagi's described in the 1995-2002 ARRL Handbook Chapter 20 or commercially made antennas like the Old Antenna Lab 5L-70cm, DSFO-ATV-25, or circularly polarized KLM 435-18C & 435-40CX, or Diamond F718L and NR-770H omnis. Do not be tempted to just try it out with a rubber duckie, 2 meter antenna, broadcast UHF TV or other antenna not specifically designed for the video carrier frequency or 50 ohms. Place the antenna as high as practical, at least above the trees or roof tops. See the section on DX vs. Power vs. Gain on page 4.

## FRONT PANEL:



**TX FREQ.** Transmit frequency switch select, use only the 2 ATV frequencies per your local band plan to prevent interference - check with local ATVers before first getting on. The switch is 6 position, 4 are used as marked. The open positions default to 426.25 MHz or special ordered frequency.

**VIDEO INPUT.** This input accepts any standard NTSC composite video into 75Ω from cameras, VCRs, computers, SSTV or RTTY converters, home satellite converters, etc. Use RCA phono plug shielded cable (Radio Shack 15-1535). Push RCA phono plugs straight in, but pull and twist off only in the clock wise direction to keep jacks tight.

**AUDIO INPUT.** High level line audio usually from the same source as plugged into the companion Video input is plugged into this jack using another RCA phono plug shielded cable. Minimum level is .1 v pk-pk into a 10K load. The level is controlled by the line audio gain knob.

**VIDEO GAIN** control. This sets the white level or depth of modulation of the selected video source. The knob should be slowly increased clockwise just to the point of white smearing or blooming as seen on an external video monitor, and then backed down a little. The viewfinder in a color camera can also be used if it can accept external video into it, as some do for VCR playback. If you do not have any kind of monitor, you might try having a distant ATV receiving station describe your picture back to you over 2 meters. See monitor output paragraph.

**LINE AUDIO GAIN** control. Nominal input is .1 to 1 Vp-p. This control is independent of the mic audio gain. The mic and line audio is mixed in the subcarrier generator. In the off position, the whole sound subcarrier board is turned off.

**MIC GAIN** control sets the level from the low impedance mic jack. This audio is mixed with the line audio and its level is varied independently. If you connect the audio from your home VCR or camcorder, you can use the mic input to voice over comment.

**MIC** jack accepts any low Z dynamic or low Z Amplified electret camcorder mic in the range of 100 - 600 Ohms with a mini plug. Mic audio is active at all times and mixes with the camera or external audio inputs to enable greater pickup, commenting while running video tapes, etc. Mikes must have a shielded cable to prevent RF pickup hum and buzz. Some electret and amplified mics are very susceptible to RF pickup and may need the addition of a small 220 pF disc cap (RS 272-124) directly across the mic element. Presently Radio Shack makes 2 different replacement remote-control dynamic omnis for portable recorders (33-2001 & -1067) that work well and some provide the "push to look" plug also. The 33-2001 has a wind screen which is preferred for portable work. The unidirectional 33-3015 or 33-3021 is used for full duplex to minimize speaker feedback.

**PTL** submini jack. Push To Look is like push to talk only with video. Grounding the tip keys the transmitter.

**RECEIVE TUNE** control varies the varicap voltage in the VCO in the GaAsfet downconverter between 420 and 450 MHz (0 to 10 on the knob) in receive plus some overlap to accommodate conversion down to TV channels 2, 3 or 4. 434 is between 3 and 5 on the knob into channel 3.

**XMIT/REC** switch. It is in parallel with the PTL jack. The red lamp above this switch will light whenever you are in the transmit mode and the green lamp lights in receive.

**POWER ON** switch turns on the applied +12 to 14 Vdc to the TC70-20S. If the green light does not come on, check the internal 5 Amp 3AG fuse and the reason for it to blow before replacement. If the leads were reversed or an overvoltage condition and fuses keep blowing, check the 16 Volt 5 Watt zener at the power on switch and/or 78L08 regulator on the TVC-2G for a short and replace if necessary

### INTERNAL CONTROLS

Your TC70-20S comes to you all set up to operate, do not make any internal adjustments unless you have the proper test equipment, tools and experience. The power is set for 22 Watts p.e.p. with 13.8 Vdc applied - a RF power meter will show the blanking pedestal setup of 11 to 13 Watts with no video applied, or less under video modulation. Refer to the board layouts on pages 6 & 7 for pot locations.

**RF POWER OUT** 250 Ohm pot on the end of the TXA5-70 exciter board controls the drive to the M57716 power module. This is used to reduce the output power when driving an external amplifier. See the procedure on page 5 and 7. You must unplug any video input then set the TXA5-70S board 1K pedestal pot CCW for maximum output first before adjusting the peak power output, then reset the pedestal pot to 60% of peak. Your Transceiver may go as high as 28 Watts at full RF pot CW, but decreased linearity and sound sync buzz may occur above 20 Watts. Going from 20 to 28 Watts p.e.p. gives insignificant change at the other end anyway.

**OPERATING NOTES:** ATV practices are somewhat different from the other bands and modes. Since we must use directional antennas to make up for the 23 dB higher noise floor difference compared to NBFM due to receiver bandwidth (15 kHz vs. 3 MHz), the probability of someone pointing their beam at you while at the same time you at them and calling CQ is very low. This is why many ATV contacts are initiated by calling or listening on a 2 meter FM simplex ATV coordination frequency (146.43 for 434.0 & 144.34 for 439.25).

Two meters, even for FM, has about 9 dB less path loss than 70cm so that all possible ATVers can be received on 2 meter FM using just an omni antenna. You will find with experience the correlation between 2 meter simplex and 70cm ATV DX. It is much easier for all local ATVers to monitor a squelched 2 meter FM simplex channel than to try tuning and swinging the 70cm beam looking for sync bars or listening to TV speaker noise. Once another ATVer comes up on 2 meters, you can roughly swing the beams on each other before turning on the ATV transmitter. Then, if the picture is better than 20% snow, the video transmitting station can talk on the sound subcarrier, and all those receiving him can talk back at the same time on 2 meters (full duplex) to comment on picture content, etc. Others listening to the 2 meter channel are often hooked into ATV this way. You can also run full duplex audio and video with another ATV station on 33 or 23 cm.

It is more fun as time goes on to have many hams put their families, other hobbies, and varied interests on the screen. Let others know your 2 meter ATV freq. by publishing in local radio clubs, contact your local ARRL SCM, or pick a night and time to start an ATV net. The TC70-20S is portable enough to give a little demo at your local radio club or hamfest.

**IF YOU BELIEVE THE TC70-20S ISN'T WORKING**, check all cables, connections, power supply, internal fuse and the reverse polarity 16volt protection zener connected to it, board test point DC voltages and VSWR. If you reversed the power cable, applied more than 16 Vdc or close by lightning strike, the protection zener may have shorted before the fuse blew. You can replace it with a Radio Shack 15V 1W zener. Measure the RF Out TP DC Voltage on page 7. If you can't determine the trouble, call us and describe the problem or ask any questions you might have. It will save us both time if we suggest some things to try that may have been over-looked, or for us to better evaluate the problem. The TC70-20S can be repaired by us for \$75 plus parts cost in a few days if we believe the problem is customer caused, or only your shipping cost to us if we determine that it was due to our workmanship and materials within a reasonable time and given circumstances. Include with the unit your name, call, street address - no PO box - Visa or Mastercard numbers, expiration date and exact name as on the card, and a description of the problem. There is no other warranty expressed or implied. See our latest catalogue for our full service and return policies.

**DX vs. POWER vs. ANTENNA GAIN.** The >20 Watt output of the TC70-20S is a good practical power level for most all ATV applications. 20 Watts p.e.p. connected to a good beam will easily hit a local repeater if you have line of sight between the antennas. Line of sight (absolutely no obstructions in the path) is the most important factor. It is better to add a dB or two coax length to reach a better antenna location. In addition 20 watts to an inverted ground plane on the belly of an aircraft will get snow free pictures to an emergency operations center using a 8 dBd omni or beam 35 miles away. Double the distances for a P4 picture. Adding a 100 p.e.p. amplifier will multiply the distance by 2.2 or add a little better than one P unit. Amplifiers used for ATV must be designed specially for the high current swings to 5 MHz of the AM video envelope. Without stiff bias and supply voltage, the color and sync become distorted.

While it is almost impossible to predict actual ATV DX due to different terrain and conditions, the line of sight snow free picture distance can be calculated given all the controllable factors. We must know the transmitter peak envelope power (p.e.p. - sync tip), coax loss, and antenna gain over a dipole. At the receive end, we must also know the system noise figure and bandwidth. The chart below assumes the TC70-20S transceiver, TVC-4G GaAsfet downconverter connected to a good TV set with 3 MHz IF bandwidth, 3 dB loss in coax at both ends, and snow free defined as a carrier to noise ratio of 40 dB (100 to 200 microvolts).

The distances in miles are shown with various transmit and receive end gains. To find the possible DX under line of sight conditions find your antenna model or equivalent gain across the top. Then go down to the receive ends antenna or gain. Now read the miles that corresponds to your transmit power level.

<b>XMIT.</b> Antenna	3 dBd Ground Plane	8 dBd F718x 5L-70cm	16 dBd gain DSFO-25ATV beam
<b>REC.</b> Ground Plane	7	12	21
5L-70cm	14	21*	60
FO-25	21	53	133 Miles

The purpose of the DX chart is to enable you to better figure what is needed in your system to have the best chance of getting good pictures where you want them. This is especially important to repeater owners or those setting up for a public service event to figure the expected area of coverage. A simple starter antenna for home or portable is the ground plane you can make yourself - see ARRL Handbook pages 20.55 to 20.57. The DB Products DB420 is a popular high gain broadband omni exposed dipole vertical used at single antenna/duplexer inband repeaters - two Diamond F718x antennas with >20 ft vertical separation is also used. If a repeater is running 20 Watts to a DB420 or F718x omni, it could be snowfree to a station 21\* miles away using a 5L-70cm beam. The distance will double or half with each 6 dB change. For instance if you mounted a Mirage KP-2 GaAsfet preamp at the antenna to save the 3 dB coax loss and went to dual beams for 3 more dB gain, you would be able to see a station of the same power and antenna at the same picture to noise ratio twice as far away, or one P unit stronger at the same distance. 3dB more gain from dual beams puts your transmit DX 1.4 times farther.

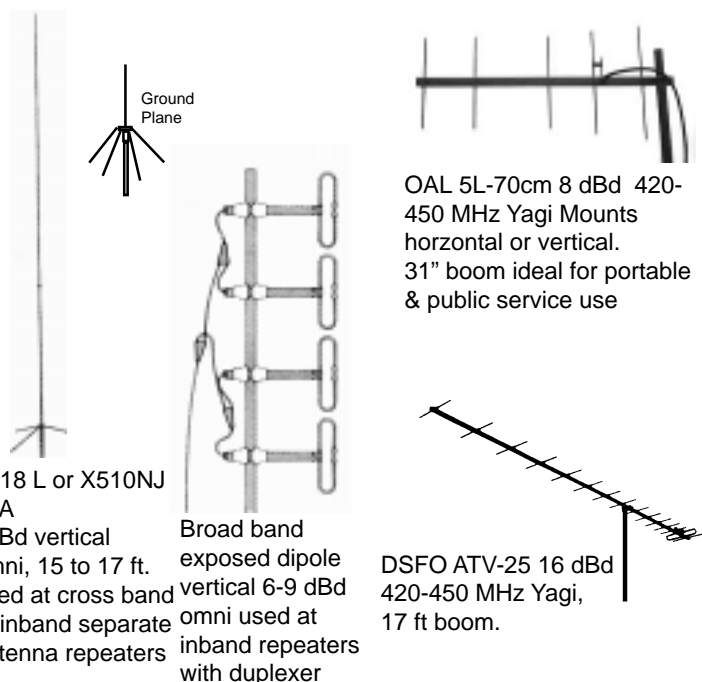
Obviously, putting most of your time and money into the antenna system pays off in both transmit and receive. Adding more power does nothing to improve the receive DX. P. C. Electronics GaAsfet downconverters (TVC-2G, TVC-4G, or TVCX-70) have a low noise figure (≈1 dB) and sufficient gain (≥20 dB) to put your receiving system at the noise floor.

The theoretical noise floor for a 3 MHz wide 70CM ATV system with a perfect 0 dB noise figure is .8 microvolts (-109 dBm).

So adding another preamp at the shack will do nothing but pump up your AGC on noise making you more susceptible to intermod and overload interference without improving the sensitivity. Only changing to lower loss coax or adding a good quality GaAsfet preamp at the antenna will give you a little sensitivity improvement.

Since most cases are not line of sight, the distance will be lessened depending on the amount and type of trees, foliage, hills, buildings, etc., in the path. On the other hand, there is temperature inversion ducting, especially in the summer months, or knife edge refraction that can equal or better the chart estimates. The RF horizon is about 10 miles for an antenna height of 50 ft - Miles = 2x sq.root antenna height in feet. If the other station also has an antenna height of 50 ft then you should get good results over the 20 mile path in flat terrain. Antenna height is most important at UHF (see The ARRL Antenna Book pages 1-4) Other sources of ATV information can be found in the 94-01 ARRL Handbook chapter 12.

**ANTENNA POLARIZATION** must be the same in any area or you could be losing up to 20 dB by being opposite. Polarization in any area seems to be more of an emotional rather than technical decision. If most of the ATVers come from the weak signal or 432 SSB/DX group or using 439.25, they will push for horizontal. The FMers or those using 434.0 will push for vertical. The main motivation is not to have to get separate antennas for each mode of interest. Technically there is little difference between polarization's above 300 MHz according to a US Army study. However, below 300 MHz horizontal is generally better. Vertical polarization is preferred in areas that have a repeater or want omni directional coverage for weather radar or other public service applications due to the fact that there are many manufacturers of high gain vertical omnidirectional antennas for base station as well as mobile. Horizontal omni gain takes many more elements for the same gain as vertical and few are made commercially. So this is a regional decision that should be made by the local ATV community. One alternative is for individual ATVers to use circular polarized antennas, which works great for all modes. There are many exaggerated claims for antenna gain and performance. When you select yours, it should have sufficient bandwidth, and go by the actual measured gains published from the various VHF/UHF Conference contests rather than advertisements and unsubstantiated articles.

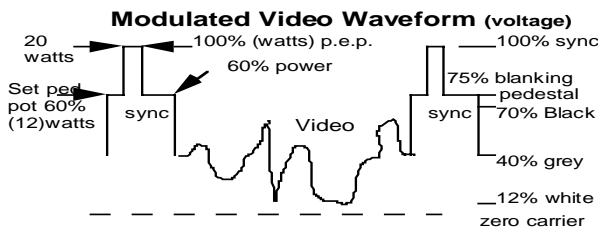


## REALIGNMENT OR TRANSMIT FREQ. CHANGE

A non-standard USA ATV frequency other than 439.25, 434.0, 427.25 or 426.25 MHz can be obtained by special ordering a replacement PIC from us. There are 4 unused solder pads for special frequencies that are selected by switching the pad to ground.

Only those frequencies should be used that conform to your local 70cm band plan. ATV is a wide band mode and can cause interference to other modes that may be operating within 1 MHz of the video carrier. Other modes will interfere with ATV reception if they are within the standard 6 MHz VSB TV channel. Refer to the TXA5-70S board layout on page 7 for test point locations.

All peaking is done with no video connected and the 1K pedestal pot at maximum power (full CCW). Use a small insulated tuning tool on the trimmer caps, and slowly rotate in the slot with very little downward pressure. Peak C2 and 3 only at the test point with a DC Voltmeter. Set the RF Power pot for 20 watts, then reset the pedestal pot to 12 Watts with a RF Power meter into 50 Ohms.



The sound subcarrier frequency is set to 4500 kHz +/- 2 kHz by the 18μH variable inductor with a counter at the FMA5 board output. Do not try to reset by listening to a TV set as it will give a false peak, be off in another TV, or give a crosshatch beat in color video if off frequency or injection level set too high. The amount of injection is set by the 500 Ohm pot to 15 to 18 dB down from the sync tip ( $\leq -15$  dBc) by us with a spectrum analyzer. Deviation pot is set at the 25 kHz broadcast standard by the soft limiter.

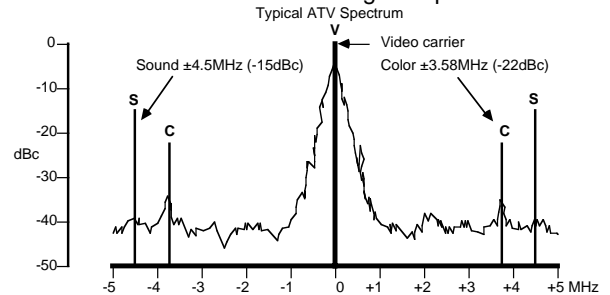
## PEDESTAL & LINEAR AMPLIFIER SETUP

The RF power and video pedestal must be reset to compensate for the differences between transmitters, amplifier gain curves, and applied DC voltage changes. Failure to make this setup will result in rolling or unstable video. You will need to readjust the TC70-20S for a supply voltage that is more than 1/2 Volt different than the 13.8 Vdc used to set it up at the factory. Do not run the TC70-20S from the same supply as an external amplifier or you may get distorted video or instabilities. Follow this set up procedure:

1. Disconnect any video input to the TC70-20S.
2. Turn pedestal pot on TXA5-70S board to full CCW and RF power pot to full CW - see page 7 for locations. If the external amp has a max input limit, preset to 1/2 that.
3. Connect amp output through a RF power meter to dummy load or antenna with no more than 10% reflected power.
4. Turn on transmitter and quickly set the RF out pot for no more than 90% of rated amp peak envelope power - ie. DXP-U150 = 135 watts, D1010N-ATV = 90 watts.
5. Set pedestal pot for 60% or the peak power set - ie. if 90 watts, set pedestal for  $90 \times .6 = 54$  watts. For the TC70-20S by itself  $20 \times .6 = 12$  watts.

You may now reconnect the video and set video gain for best picture as described by a distant station, the transmit monitor output in this case may no longer be accurate. The monitor level in transmit will have to be readjusted with the pot on the DMTR board any time the output power is changed. Usually less video gain is necessary with an amp; do not over drive into white clipping. The pedestal control sets the video to sync ratio by clamping the blanking power level at the set value and stretching the sync tip to maximum regardless of the video gain control or average picture contrast. We suggest the Diamond SX-1000 multirange RF power meter or Bird power meter with appropriate slugs for barefoot and amplifier setups. Never adjust the pedestal with video connected.

The sync tip power (peak envelope power) on the TC70-20S and any linear amps will still be the max power you read before the reduction to the blanking pedestal due to the sync stretcher in the modulator. Any further reading of an "average" reading RF Wattmeter is meaningless as they do not respond normally to modulation above 100 kHz and the reading will vary depending on the picture contrast. An all white picture will give the lowest reading, and an all black one will read about the same as the blanking set up.



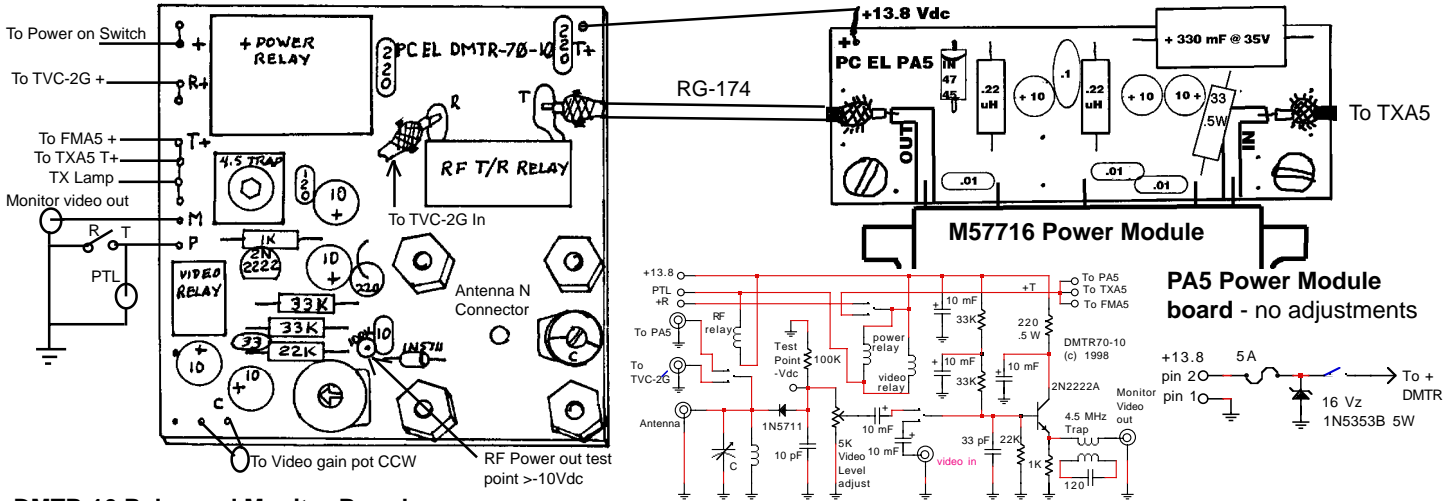
The spectrum above is normal AM double sideband from an ATV transmitter. If your transmissions interfere with other band users near your lower sideband sound or color subcarriers, you may need a VSB filter in your antenna line. We suggest the DCI 8 pole VSB filter available from us. However, it will also attenuate any other frequency you may wish to tune to, so is only good for one frequency simplex or crossband repeater operation. Vestigial sideband filtering should not be confused with SSB, it's completely different. With VSB, nothing is done to the carrier and less than 5% of the sideband power is cut off. VSB only rolls off the lower sideband starting at .75 MHz below the video carrier frequency. FCC defines VSB as having the lower color and sound sidebands down more than 60 dB below the peak power (see spectrum above and also fig. 6 on pg 20-3 in the 1987 to 1994 or fig. 12.61 in the 1995-2002 ARRL Handbooks). The only way to achieve this with amateur "linear" amplifiers is to put a VSB filter in the antenna line. VSB filtering is not necessary at the transmitter except in the case of a repeater near the band edge below 424.6 MHz, in the presence of other transmitters with the possibility of creating transmitter intermod, or if there are other mode users near you that receive interference from your LSB subcarriers.

## 70 cm ATV FREQUENCIES

Frequencies and antenna polarities vary in different parts of the country. ATV repeaters and Frequency Coordination Councils are listed in the ARRL Repeater Directory. There are only 2 ATV channels available in the 70 cm band without the possibility of mutual interference. Broadcast TV skips adjacent channels in a given area to avoid interference. The separation then is 12 MHz. If there is an inband repeater, then simplex is sometimes run on the repeater input, or another frequency with the possible interference accepted. Some areas have gone to crossband repeat with the output on either the 33 cm band (923.25) or 23 cm band (1253.25) which frees up one of the two 70cm frequencies for simplex, and the other for repeater input. Also the simplex frequency can be used for full duplex operation with another station on 910.25 or 1289.25 MHz. Crossband repeat or duplex allows receiving your own video back with just the addition of another antenna and downconverter.

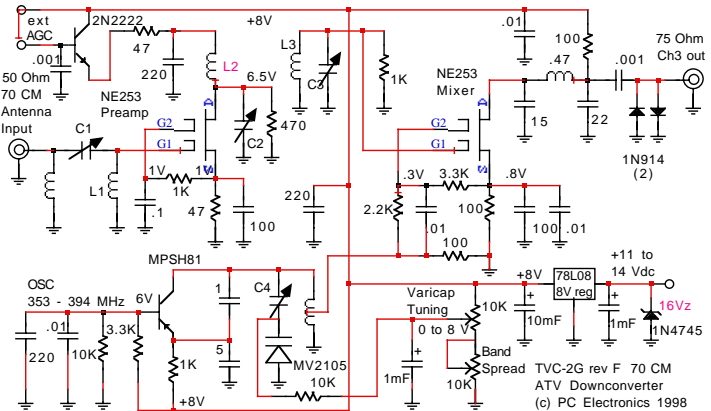
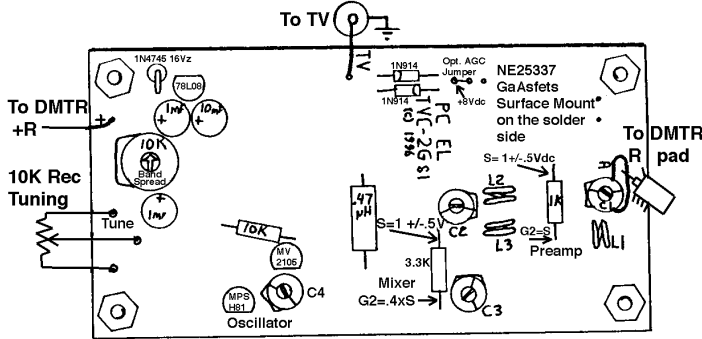
The primary 70 cm frequencies are 439.25 and 434.0 in the USA depending on the level of FM repeater activity in the 440-450 MHz segment, or satellite operation in the 435-438 MHz segment. With a video carrier on 439.25, you can give interference to FM stations on your color and sound subcarrier frequencies around 442.83 and 443.75, and receive interference in the picture from those transmitting below 444 MHz. With 434.0, your sideband energy will be about 40 dB down at 435 MHz which will only interfere with satellite stations very close to you, but their transmissions will tear up your received video. The most popular secondary simplex frequency is 426.25. This frequency is usually clear in most areas and is shared with point to point links and control channels between 420-431 MHz.

**DO NOT ADJUST ANY OF THESE BOARDS WITHOUT PROPER TEST EQUIPMENT AND EXPERIENCE**



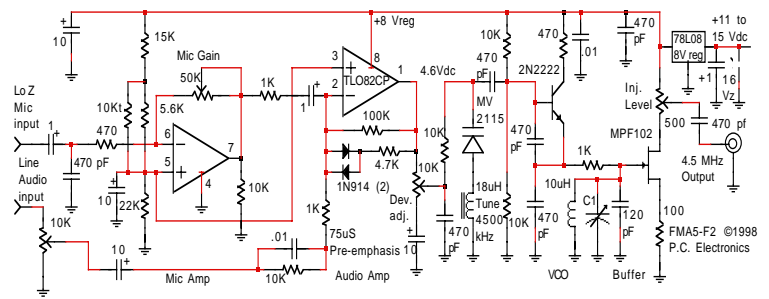
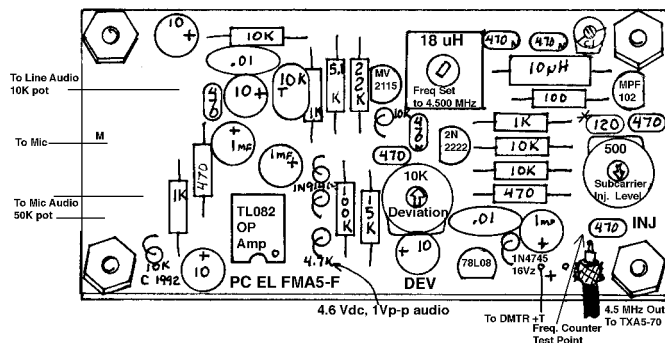
**DMTR-10 Relay and Monitor Board**

Transmit monitor video level out is adjusted with the 5K pot on the bottom of the board. Reset to 1 Vp-p if you reset the RF power output. It may work in your monitor if a linear amp is added. The 100K resistor test point can be used with a DC voltmeter for final RF peaking and pedestal setting if a RF Watt meter is not available. The Trimmer cap C is peaked and need not be touched, do not detune this cap to reduce power, it could blow the power module - use the RF power pot on the TXA5-70S board - see next page. The extra unused +R and +T pads can be used for controlling external devices by jumpering to the open power connector pins 3 or 4 (1/2 Amp max).



**TVC-2G Downconverter**

No adjustments. The 10K pot on the front panel varies the varicap voltage between 0 (lowest frequency) and 8 Vdc to change the frequency. C1, 2 and 3 are bandpass filters peaked for the 420-444 MHz ATV frequencies. C4 sets the local oscillator frequency. C4 is factory set to roughly 434 MHz into CH3 with the knob between 3 and 5. No adjustments are necessary if CH 4 is used as there is plenty of excess tuning range. If you believe the GaAsfets have popped from lightning, etc., check with a Voltmeter at the Source and Gate 2 leads. G2 ≤ S voltage. Generally they may be popped if the source or gate 2 is above 2 Vdc.



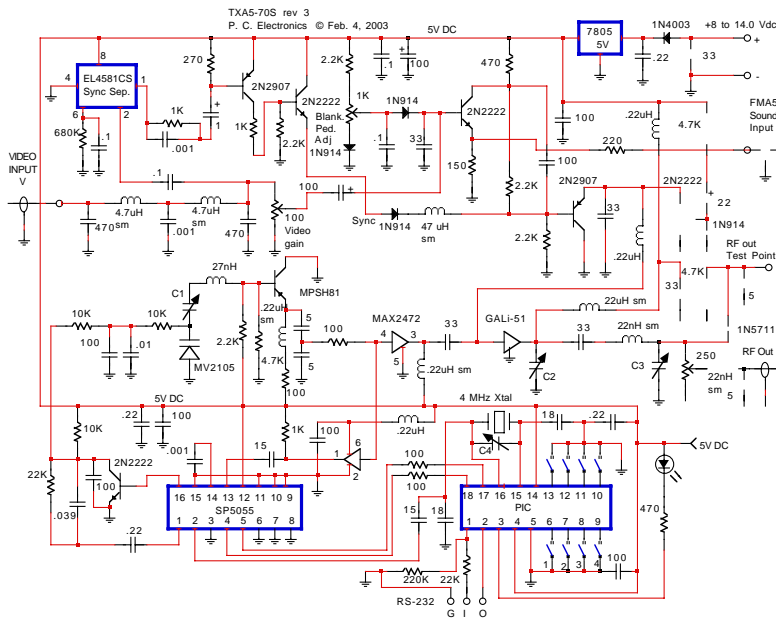
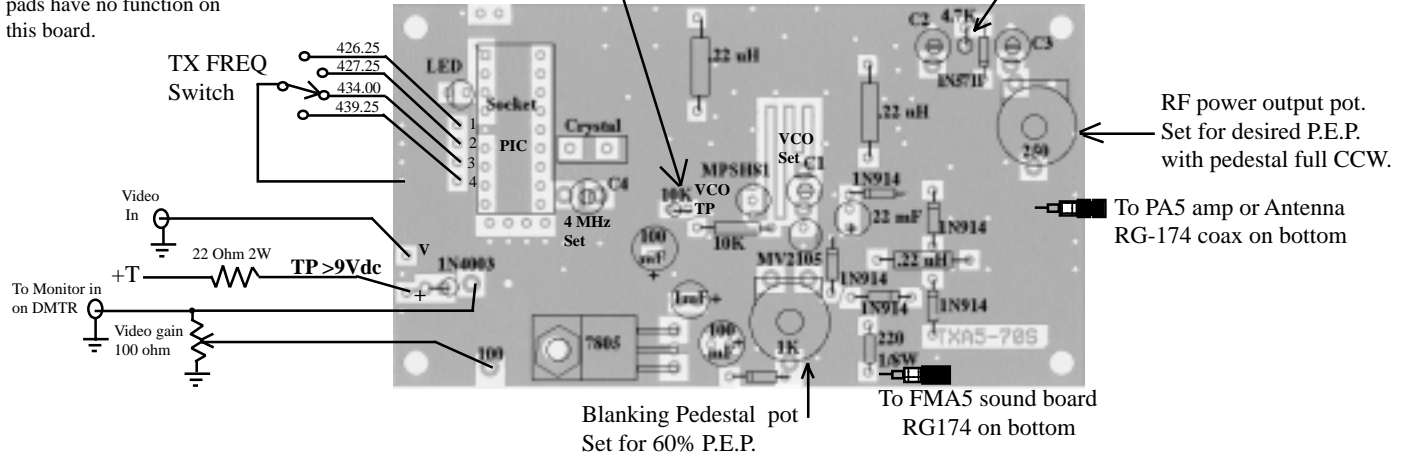
**FMA5-F Sound Subcarrier Generator**

The front panel 10K Line audio and 50K Mic audio pots vary the audio gain. The switch on the line audio pot turns on power to this board. The 10K deviation pot on the board is roughly set to just start soft limiting at 25 kHz deviation and hard limit around 40 kHz deviation. The 500 Ohm subcarrier injection pot is set to no less than 15 dB down from peak sync by us with a spectrum analyzer. If set any higher, the 4.5 MHz subcarrier will give increased sync buzz from limiting during white video periods and sync time as well as crosshatch intermod beat with color video. If set too low, the sound will drop out with increasingly snowy pictures or not give best sound when the downconverter is tuned for best picture at the other end. Sound will normally drop out when color does in snowy conditions. The 18 uH inductor is set to within 2 kHz of 4.500 MHz with a frequency counter connected to the subcarrier output pad.

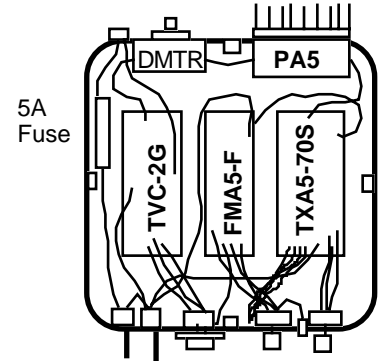
LED is off at all times and the IOG RS232 solder pads have no function on this board.

**VCO TP.** Factory set for 3.5 V at 439.25 MHz .  
426.25 >.5 Vdc, 439.25 <4.0 Vdc.

**RF Out TP.** Final, Peak C2 & C3  
-1 to -3Vdc. Pedestal at full CCW



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**TXA5-70S Exciter Modulator - Read this completely before touching any adjustments.**

There are two pots on this board that you may have occasion to readjust. The blanking pedestal pot is common to all the P. C. Electronics transmitters. It is used to accurately set the video to sync ratio whether running barefoot with the TC70-20S by itself or through an external amplifier. The sync stretcher circuit clamps to the video blanking pedestal to keep a constant sync and blanking level regardless of video gain and average picture level.

To set the blanking pedestal, disconnect any video input, and connect a RF power meter (Bird with 25E / 100E slug or Diamond SX1000) in the antenna line after any amp. Turn the 1K pedestal pot full CCW. Turn on the transmitter and quickly (<20 sec.) set the peak power output with the 250 Ohm RF Power pot to 20 Watts. If driving an external amp, set to no more than 90% of the amps maximum rated output (multiply max power noted by .9). This will be your constant peak envelope power on the sync tip. Do not exceed 90 Watts if driving a Mirage D3010N-ATV. If driving other amps, make sure you don't exceed the maximum rated input drive at any time by measuring and presetting the TC70-20S's power level before connecting the amp - D1010N-ATV preset to 8 Watts. Next reduce the p.e.p. power by 60% (multiply the peak envelope power just set by .6) using the 1K pedestal pot. This will be the constant blanking pedestal power. Now you can connect video and adjust the front panel video gain pot for best picture just before white limiting. Do not adjust any board pots or trimmer caps with video connected, and only adjust power out with the RF level pot, never any of the trimmer capacitors - it could cause instability and poor linearity in the video.

**RF Realignment.**

Your TC70-20S is aligned at the factory for any frequency from 426.25 to 439.25 and 20 Watts peak envelope power. Other frequencies within the band can be obtained by ordering a specially programmed replacement PIC. P.e.p. power should not be more than 10% different between these two frequencies. If the RF Out pot is readjusted, you may want to repeak C2 and 3 for maximum power output. C2 and C3 must always be peaked with no video connected and the pedestal pot at full CCW. After the desired peak envelope power is set with the RF Out pot and C2 and 3 have been repeaked, reset the pedestal pot for 60% of what ever the peak envelope power is. Only then can you plug the video back in. The peak envelope power you set will be the same value you set and is the power at the sync tip even though the power meter will now read much lower, unless you have a video peak reading RF Wattmeter.

C4 nets the 4 MHz synthesizer reference crystal. While not necessary for ATV - TV sets AFC will lock up within +/- 1 MHz - , this cap can be adjusted with a frequency counter to the exact selected video carrier frequency if desired.

C1 sets the VCO frequency and is factory adjusted for 3.5 to 4.0 Vdc at the VCO Test Point with 439.25 MHz selected. Do not touch this cap unless operating into a dummy load.

## WHAT CAN YOU PUT ON ATV?

Any Technician class or higher radio amateur can transmit ATV to other amateurs on amateur frequencies above 420 MHz, and Novices on 1270-1295 MHz. Besides showing you and your gear in the shack, you can show and describe your latest projects in detail, copy schematics, help debug computer programs, put on your own home video tapes and movies, computer graphics & games, repeat Space Shuttle video from the NASA Select satellite channel, repeat SSTV, RTTY, Packet, etc. to ATV. You can repeat computer generated weather radar or satellite video for skywarn and emergency amateur radio groups. Transmit the local radio club meeting to those that physically can't make it. Virtually any non-commercial video from your camera, VCR or NTSC compatible computer is simply plugged into the video in jack and sent exactly as you would see it on the local monitor.

ATV is a big help for getting an overview of an operational situation during parades, races, search and rescue, major fires, and other disasters. Public service is a great way to have fun with your ATV gear. Your transmissions must be controlled by licensed hams, and directed primarily to another ham. ATV has been used for public service in vehicles, portable, boats, airplanes and helicopters. For portable, the TC70-20S can be carried in a knap-sack, a short coax run to a 1/4 wave ground plane clipped onto a headset/mic, and plugged into a 6 Amp/hr gel cell battery. The OAL 5L-70cm beam is only 31" long, 8 dB gain and its >60 degree beamwidth cuts down the multipath ghost problem from reflected RF coming in from the sides and back at the receive site. 2 Radio Shack 5 ft mast sections and tripod fit easily in the car with the beam for portable operations.

If used in an aircraft for fun or remote damage assessment with emergency service groups or CAP, run RG400 (available at businesses that do cellular telephone installation in cars) or RG142 coax instead of RG58 coax to the antenna. Ordinary coax will put noise in the picture due to vibration modulation - there is enough attenuation change as the ohmic contact between adjacent strands of the coax shield rub back and forth. Use only a stiff quarter-wave spike on the bottom of the aircraft to minimize radiation nulls as the plane banks - do not use gain antennas. FAA certified antennas for the amateur bands are available from Comant (562) 946-6694. Snow free line of sight DX with the quarter wave on the belly to a 9-10 dB omni (F718) on the ground is 25 miles.

## WHAT CAN'T YOU DO WITH ATV?

All the FCC rules and regs in part 97 apply (47 CFR). The ARRL FCC Rule Book is a good reference that explains all these by practical examples. All amateur transmissions must be directed to another amateur with few exceptions for control, tests or emergencies (97.111, 97.215, 97.401 to 97.405). Therefore ATV cannot be used for surveillance purposes for personal, business or law enforcement. You cannot "broadcast" (97.113) to a non-amateur or retransmit any other radio service (except Space Shuttle Video and audio) or music. ATV cannot be used as a cheap link for local cable or public access community TV systems, church services, video or movie production directly or indirectly. Basically you cannot use Amateur radio to further any business purpose, profit or non-profit or activity contrary to Federal, State, or local law. There are other frequencies and licensing for these purposes. 8

Teachers who are licensed radio Amateurs can transmit to another amateur, classroom to classroom, or to other schools as long as it is used to demonstrate Amateur radio or radio communications or for fun between school radio clubs. They cannot, however, transmit normal lessons, broadcast school sporting events or other school business.

## STATION IDENTIFICATION.

You must identify with your call letters every 10 minutes and at the end of every transmission (97.119). This can be done by voice on the sound subcarrier or by call letters on the screen. If done on video, the letters must be large enough to be easily seen in the picture. Many just put up a large call sign with black letters on white board on the shack wall in normal camera view. You can get fancy by overlaying your call letters over the camera video with an OSD board in the video line, or computer generated special effects. In weak signal conditions, it has been found that large, fat black letters on a white background which fill the whole screen show up best in the snow. Others use a computer and switch between the camera and a generated graphic call sign.

## LIGHTS, CAMERA, ACTION.

Proper lighting makes a big difference in picture contrast quality. It is best to have a light at, or just behind, the camera directed at the subject to remove shadows caused by the usual overhead lights. Do not crank up the video gain control to bring up dark areas as the bright areas will over modulate giving sync buzz, instability and may splatter the band.

With color cameras, try to use only one type of lighting...do not mix sun light through a window, incandescent and florescent lamps with each other or the colors will shift as you swing the camera. Set the color camera white balance every time you first turn on the camera by aiming at an all white sheet illuminated by the same type of light in the scenes you will be showing. For outdoors, especially public service events, CCD or MOS cameras are preferred over vidicon types as they will not normally be damaged if accidentally aimed at the sun.

Since a picture is worth a thousand words, you will note that you will run out of subject matter faster than voice modes. So the more people you can get on ATV, the greater the things to show. Pick an ATV net night and publicize it at your local radio club by having them include the time, video and 2 meter talkback frequency in the club newsletter. Better yet start off by giving them a talk/demo. Once they see their first picture they are usually hooked - this can be as simple as connecting an outside 440 MHz antenna of the same polarity you are using to a cable ready TV set to cable channel 57 through 60 - these cable channels correspond to frequencies between 421.25 to 439.25 MHz and are different than over the air broadcast channels. To keep the net interesting vary each net night of the month with a theme: everybody has to show a family member, a project, wear a hat, make a new call ID sign, a pet, 1-2 minute personal video tape, etc. - ENJOY!

For more general or background information on ATV check out page 12.46 in the 1995-2002 ARRL Handbook and Amateur Television Quarterly Magazine. There are also ATV remailers on the internet - contact us at: [tom@hamtv.com](mailto:tom@hamtv.com) for the latest internet addresses and ATV repeater group web pages. Our web site: [www.hamtv.com](http://www.hamtv.com) (c) 2002 P. C. Electronics