



RTX70-1s 70 CM ATV TRANSMITTER

USERS MANUAL



The RTX70-1s transmitter is designed to provide 1Watt continuous duty peak envelope power (sync tip) of video modulated RF in the 70 CM (420-450 MHz) amateur band on 4 switch selected frequencies or internally selected frequency for repeater output use. Any licensed Technician class or higher Radio Amateur may operate this transmitter in accordance with 47 CFR part 97 of the FCC Rules and Regulations. The RTX70-1s 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 sound subcarrier. Transmit / receive power and antenna switching is provided for the companion TVC-4s downconverter.

PLEASE read through this manual before plugging in an 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. More information on ATV can be found on our Application Notes web page at www.hamtv.com.

REAR PANEL:



POWER INPUT JACK. A 2.1 x 5.5mm plug cable is provided for connection to your source of +12 to 14 Vdc. Current draw is <1A in transmit. Center of the plug and the marked side of the cable is +, all black is - or ground. If used at a repeater site, make a cable using RG174 coax. The RTX70-1s works best from a well regulated voltage source with leads no longer than necessary. The transmitter is set up by us from a regulated 13.8 Vdc supply. Do not exceed 15 Vdc input. In case the voltage is reversed there are 16 v zeners on the sound and T/R relay boards which should blow the 1A fuse if this voltage is exceeded.

Any ripple or noise on the DC line may be seen in the transmitted video. For this reason, if a single large power supply is used to power this and other equipment, all leads must connect directly at the power supply terminals, not to an external terminal block. If an external amp is added, it is best to run it from its own separate power supply. The Radio Shack 22-120 regulated power supply will run both the RTX70-1s and TVC-4G.

DOWNCONVERTER POWER JACK. A 6 FT cable is supplied with 2.1 X 5.5 mm plugs on each end to connect from this jack to a TVC downconverter. + power is at this jack when the XMIT / REC switch is in REC and open when in XMIT.

1 AMP FUSE INSIDE. The RTX70-1s itself draws about .7 amp in transmit, and .1 amp plus external downconverter in receive - a 1.0 amp 3AG fuse should handle both.

75 OHMS TO MONITOR. This output provides the composite video from the front panel Video jack during receive to enable you aim the camera and to best adjust the focus and lighting, etc. before transmitting. In transmit, the detected RF at the Antenna jack is at the monitor jack so you can best adjust the video gain. Use a RCA plug 75 Ohm shielded cable to connect to your video monitor or VCR video in.

50 OHMS TO ATV DOWNCONVERTER. This BNC output jack is connected to the antenna input of your 70 CM 420-450 MHz ATV down-converter. Downconverters for other bands are not connected to the RTX70-1s, rather to their own antenna and left on when transmitting on 70cm for full duplex or crossband repeat. If a TVC-4s downconverter is used you will need a short 50 Ohm cable with a male BNC on one end and type N on the other. This can be made up with Radio Shack RG58/U (276-1326) plus UG88 (278-103) and N (278-151) connectors or equivalent. Keep this lead short to minimize losses in receive. The RTX70-1s contains a T/R relay to switch the antenna input as well as DC power between the downconverter and the transmitter.

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 such as Belden 8214, or semi rigid Belden 9913 or Times LMR400. Put the connector together properly. See ARRL Handbook Chapter 37. 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.

If you have a RF power meter, you should read .5 to .8 Watts typically with no video plugged in- blanking pedestal level. With video plugged in and using an average reading meter, it will read less. If using a peakreading meter it will be at least 1 Watt. On initial turn on, do not transmit more than 10 seconds if the reflected power is more than 10% or 2:1 VSWR. You could damage the final power FET. Also, VSWR or being too near your antenna can cause RF interference in your camera or buzz in the audio.

Use a good resonant broad bandwidth 70 CM antenna like the DSFO25-ATV, OAL 5L-70cm, circularly polarized OAL 7CP-70cm or homebrew antennas shown on our app note web page. Do not be tempted to just try it out with a rubber duckie, 2 meter antenna, or other antenna not specifically designed for the video carrier frequency. 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.

EXT KEY JACK. Grounding the tip keys the transmitter. This jack is in parallel with the front panel transmit/receive toggle switch and can be used to key the transmitter from a repeater controller or to provide a grounding key to an external amplifier as long as the amp is run from a 13.8V power supply.

FRONT PANEL:



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 and shielded cable (Radio Shack 15-1535) up to 12' or RG59 for longer runs. When unplugging, only twist clockwise to keep the jack from coming loose.

VIDEO GAIN control. This sets the white level or depth of modulation of the selected video source. In transmit, the knob should be slowly increased clockwise just to the point before white smearing or blooming at the monitor jack or as described back to you from a station located at least a quarter mile away. The distant ATV receiving station can describe your picture back to you over 2 meters.

LINE 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.

LINE AUDIO GAIN control varies the high level audio applied to the subcarrier from the front panel audio input RCA phono jack. Increases the level to the point where the red XMIT light winks off, and then back down the gain slightly. This audio is independent from the mic audio and is mixed in the subcarrier generator. This makes varying the level of a video tape audio verses mic for voice over comments easy.

MIC jack accepts any low Z dynamic 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 VCR line audio input to more direct pickup, commenting while running video tapes, etc. Mikes must have a shielded cable to prevent RF pickup hum and buzz. Unidirectional mics are suggested for full duplex to minimize speaker feedback or to reduce pickup of unwanted sounds and noise. Electret and amplified mics are very susceptible to RF pickup - buzz and should not be used.

MIC GAIN control varies the level of the low Z microphone. It is independent of the line audio level. Speak directly into the microphone at the normal operating distance. Increase the level to the point where the red XMIT light winks off, and then back down the gain slightly. There is a volume compressor that will keep the audio at the standard 25 kHz deviation and 40 kHz peaks. Audio usually drops out about the same time as color does in a snowy picture - P3 - depending on the TV sets audio IF gain and limiting.

CHANNEL SWITCH. This model has 4/5 synthesized channels and are the same as our TVC-4s downconv.:
1 - Open - *can be special programmed for 421.25 MHz
2 - 426.25 MHz also is the open switch default.
3 - 427.25 MHz
4 - 434.00 MHz
5 - 439.25 MHz

*This frequency can only be used with a VSB filter in the antenna line to keep sideband energy from falling outside the band edge at 420 MHz as is done at a repeater site. 439.25 MHz only can be used in Canada and those above the A line - approx 100 miles south of Canada - in the USA since the band edge is 430 MHz.

XMIT/REC switch. It is in parallel with the EXT KEY jack. The red lamp above this switch will light whenever you are in the transmit mode and the audio inputs are below 40 kHz deviation. There can also a delay of up to 1 second for this LED to light eventhough there is RF output. In receive, the applied + voltage appears on the downconverter power jack to power a TVC-4s 70CM ATV downconverter.

POWER ON switch turns on the applied +12 to 14 Vdc to the RTX70-1s. If the green light does not come on, check the internal fuse and why it blew before replacement.

OPERATING NOTES: ATV practices are somewhat different from the other bands and modes. Since we must use directional antennas to make up for the 26 dB higher noise floor difference compared to NBFM due to 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 an area 2 meter FM simplex ATV coordination frequency (146.43 in 434.0 areas, and 144.34 in 439.25 transmit video areas due to the 3rd harmonic relationship).

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. 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. 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 station on 900 or 1200 MHz bands.

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 newsletters, contact your local ARRL SCM, or pick a night and time to start an ATV net. The RTX70-1s is portable enough to give a little demo at your local radio club or hamFest.

IF YOU BELIEVE THE RTX70-1s ISN'T WORKING, check all cables and connections, internal fuse and 16V protection zener, VSWR, power supply and DC voltages at the board test points. Then call or email us and describe the problem or ask any questions you might have. It will save us both time and money if we suggest some things to try that may have been over-looked, or for us to better evaluate the problem. The RTX70-1s can be repaired by us for \$80 plus parts cost in a few days if we believe the problem is customer caused or nothing wrong. If we determine that it was due to our workmanship and materials within a reasonable time and given circumstances then your cost is only the shipping to us. However the repair and service policy stated in our latest catalog will supercede the general policy listed here. Include with the unit a filled out *Return Authorization Form* - download from our web site. It will be sent back normally within 2 days after we receive it. There is no other warranty expressed or implied. We believe this policy is more realistic than the usual 90 day warranty other amateur manufacturers have since various parts have different expected lifetimes.

EXTERNAL AMPLIFIER SET UP. There are amplifier application notes on our web site. Basically, they all setup in the same way.

1. With no video source plugged in, turn the pedestal pot in the ATV exciter/modulator to its maximum power position. Make sure the amp is rated to be linear with 1W in and is connected to a good 50 ohm dummy load or low vswr antenna (less than 10% reflected).
2. With no videoplugged in, turn the internal pedestal pot full CCW. Turn on the amp and transmitter. Note the power out of the amp and that is no more than 90% of the rated amps output. Insert some attenuation if necessary but never detune the trimmer caps as it can distort the video or make the transmitter unstable.
3. Then set the blanking pedestal pot for 50 to 60% of the max pedestal pot power. For example: Mirage D26N. Pedestal pot at full CCW and note the power out of the amp and you get 45W. Then set the pedestal pot .55 x 45 Watts = 25 Watts. This sets the final video to sync ratio. With the Downeast Microwave 7025PA, download and follow the special procedure in our application note.
4. Plug the camera back in and have a distant station on two meters talk your video gain in to just before white clipping or smearing. That's it. Your peak envelope power on sync tip will be the 45 Watts regardless of what the power meter reads.

DX vs. POWER vs. ANTENNA GAIN. The 1W output of the RTX70-1s was chosen to provide an easy low cost entry into the world of ATV, but at the same time give flexibility to all the applications that hams might put the equipment to. 1W connected to OAL 5L-70cm beams for short distance video up to 10 miles with low battery drain public service applications is ideal. But for greater distance or areas of high path attenuation, it's output is matched for the best linearity drive region of Downeast Microwave 7025PA amp. The primary design difference between these amplifiers and others is the addition of various values of capacitors on the transistor bias and collector supply lines to keep the applied voltage constant under the high current swings to 5 MHz of the AM video envelope. Without these caps, 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. See the ATV DX chart on our web site to find the line of sight mileage.

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. 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 separation is also used. A simple starter antenna for home or portable is the ground plane you can make yourself - see our application notes web page. For every 6 dB of increase between two fixed points, you will gain one P unit or double the distance to a farther line of sight point with the same picture level.

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. If you have one of our TVC-4s downconverters you have a low noise figure (≈ 1 dB) and sufficient gain (≈ 25 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 ARRL Handbook.

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.

Ground Plane

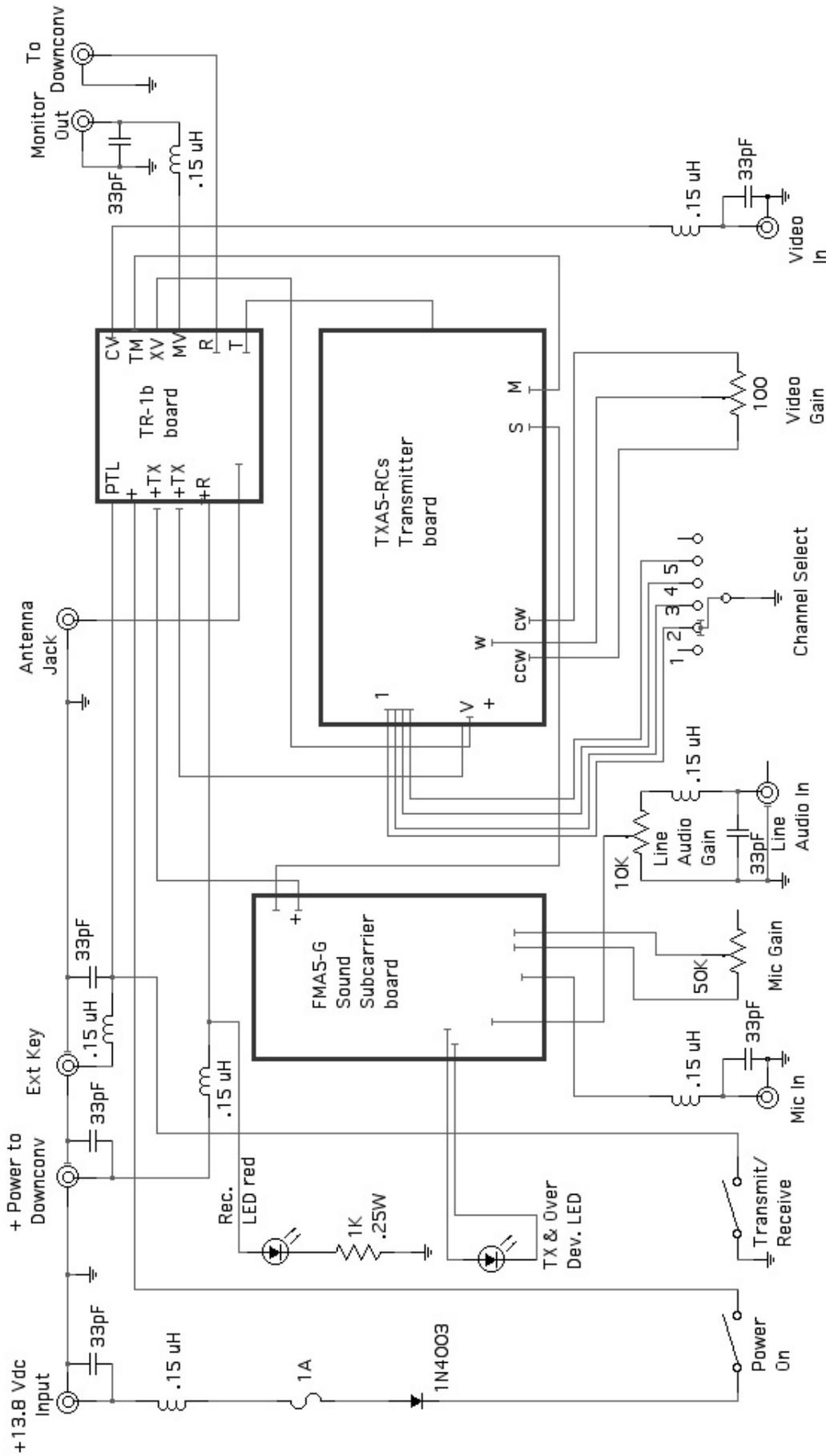
See our app note web page

OAL 5L-70cm 8 dBd 420-450 MHz Yagi Mounts horizontal or vertical. 31" boom ideal for portable & public service uses.

Diamond X510NJ,A 9dBd vertical omni, 17 ft.

Broad band exposed dipole vertical 6-9 dBd omni used at inband repeaters with duplexer.

DSFO-ATV 25 has 16 dBd and 17 ft boom.



P. C. Electronics RTX70-1s chassis wiring diagram
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Channel 1 is reserved for 421.25 MHz repeater TX on special order.
 If accidentally selected, output is 426.25 MHz