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TX70-5s 70 CM ATV TRANSMITTER

USERS MANUAL

The TX70-5s transmitter is designed to provide >4Watts peak envelope power (sync tip) of video modulated RF in the 70 CM (420-450 MHz) amateur band on any of 4 switch selected frequencies - 439.25, 434.0, 427.25 and 426.25 MHz - with a duty cycle of 15 minutes on and 5 off. Longer key down periods can be done at reduced power or by blowing air on the enclosure.

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 TX70-5s accepts U.S.A. standard composite video (1 volt pk-pk) from any source such as color or black and white cameras with video output or camcorders, VCR's, or DVR's 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 a companion high sensitivitty TVC-4s downconverter. A cable ready TV may also be used to receive: 439.25 MHz equals cable channel 60, 434 can be received on cable channel 59, and 427.25 or 426.25 received on cable channel 58.

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.

TX70-5s ATV Transmitter Quick Start

Place the transmitter on a flat surface with no other objects within 2 inches. This is important for convection cooling, especially the right side during key down periods greater than 5 minutes - the enclosure will become warm to the touch. If key down periods will exceed 30 minutes or the ambient temperature is above 80 degrees, air needs to be blown over the top and right side of the enclosure or turn the power down to 3Wpep (no video).

Connect the red lead from the DC power jack to a good regulated 12 to 14 Vdc >2A power supply or battery directly and the black lead to negative or ground. Longer leads or junction boxes with other gear could put noise in the picture.

Connect a good low VSWR 70cm Antenna using low loss 50 Ohm coax to the antenna jack. Best not to use adaptors, but strictly N plugs with 420 MHz and above.to minimize losses. If you have a RF power meter that is rated for 70cm, you can put it in the antenna coax line for the initial VSWR and system tests.

Select the local ATV frequency from the 4 (ch 1 not used) available on the front panel channel switch. Make contact with a close by ATVer on the 2 meter coordination and talk back frequency to make sure the frequency or repeater is clear and have some one to comment on your tests. Watching yourself on another TV in the shack can give false results from overload or multipath.

Flip the Power switch to on and the green LED will light if you connected to the power supply correctly. Flip the XMIT/REC switch to XMIT and the green will go off (as well as the downconverter if connected) and the red LED and RF output will come on in 2-3 seconds. Verify less than 10% reflected power within 15 seconds before further operation. We set the Peak envelope power for 4.2 Watts at the lowest power channel with no video. If all is OK, you can plug in the camera video, line and or mic audio and optional video monitor. Set the Mic and/or Line Audio gain as you speak normally at normal distance up to the point that the red LED winks off, then slightly back down. When the XMIT switch is on, you are still transmitting when the red LED winks off during audio over deviation peaks. Have the local ATVer talk your antenna rotation in for best picture via two meter voice.

Please read the detailed information on each connector and control that follows in this manual.

REAR PANEL:

POWER INPUT JACK. A 4 pin plug 2 ft cable is provided for connection to your source of +12 to14 Vdc and to a downconverter. Currant draw is <2A in transmit. Pin 1 is DC ground and a black wire. Pin 2 is + and red. A cable with a coaxial plug on the end connects to pins 3 (-) and 4 (+) to output to a downconverter in receive. Power coaxial plug is center +. The TX70-5s 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 is a internal series diode to prevent damage to the unit. 16 v zeners on the sound and T/R relay boards should blow the internal 2A 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.

DOWNCONVERTER POWER. A 2 ft cable is supplied with a 2.1 X 5.5 mm plug on the end to connect from this jack to a TVC downconverter. DC power (center is +) is at this jack when the XMIT / REC switch is in REC and open when in XMIT.

2 AMP FUSE INSIDE. The TX70-5s itself draws about 1.5 amp in transmit, and .1 amp plus external downconverter in receive - A 2.0 amp 3AG fuse should handle both.

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

50 OHM 70 CM ANTENNA. A UG21 type N plug is provided to attatch 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, or buy a ready made cable. 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 4 to 5 Watts forward power typically with no video plugged in - peak sync level. With video plugged in and using an average reading meter, it will read less, and down to half with an all white picture, but sync tip power will still be the same as measured with no video plugged in. This is the nature of cable analog NTSC or AM video transmission, similar to SSB voice peak and average RF power measurements with complex analog modulation.

On initial turn on, do not transmit more than 15 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 5.

75 OHMS TO MONITOR. This output provides the composite video from the front panel Video jack during receive to enable you to aim the camera and to best adjust the focus and lighting, etc. before transmitting. In transmit, there is no output. 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 downconverter or cable channel TV. Downconverters for other bands are not connected to the TX70-5s, but 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, a short 50 Ohm cable with a male BNC on one end and type N adaptor on the other is supplied. If a TV set to cable channels 57 - 60 is used instead of a downconverter, you will need to make a BNC to F 50 or 75 Ohm cable or use adaptors. The TX70-5s contains a T/R relay to switch the antenna input as well as DC power between the downconverter and the transmitter.

FRONT PANEL:

VIDEO INPUT. This input accepts any standard NTSC 1Vp-p 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 or RG-6 for longer runs. When unplugging, only twist clockwise to keep the jack from working lose over time.

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.

LINE AUDIO GAIN control varies the high level audio applied to the subcarrier from the front panel audio input RCA phono jack. Increase the level to the point where the red XMIT light winks off, and then back down the gain slightly. This audio is independent and mixed with the mic audio. This makes varying the level of a video tape audio verses mic for voice over comments easy. Peak deviation is set by an internal pot on the FMA5-G sound subcarrier board.

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 give 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 from the sides. Electret and amplified mics are very susceptible to RF pickup - buzz and should not be used.

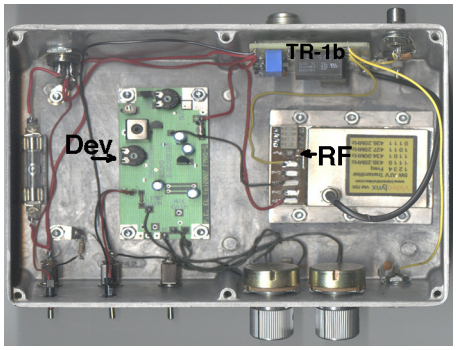
MIC GAIN control varies the level of the low Z dynamic mic. It is independent of the line audio level. Speak directly into the microphone at the normal operating distance. Increase the level to the point where the red XMIT light winks off, and then back down the gain slightly. There is a volume compressor 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 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
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 there 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 making <40 kHz peak deviation. There is a delay of 2 to 3 seconds for this LED to light and the RF output to come up. 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 TX70-5s. If the green light does not come on, check the fuse, polarity and determine why it blew before replacement.



INTERNAL:

Also reference the wiring diagram on page 6.

RF POWER OUT Control. A pot is located on the VM-70XS module between the frequency select and Vin solder pads to set power from 0-5W. Do not adjust unless you have a 70CM RF power meter, 50 Ohm dummy load or antenna connected with a VSWR of less than 1.5:1. Never exceed 5.0W with no video connected. Permanent damage to the Videolynx VM-70XS module can result from higher power, VSWR or ambient temperature which causes the module to exceed 149 degrees Fahrenheit.

The variable capacitor on the TR-1b board (rear wall of the chassisis) is NOT to be used to vary the power output. This cap is to fine tune any reactance in the antenna jack and relay line and must always remain peaked for maximum power output. Detuning will present a higher VSWR to the VM-70XS module and could damage it.

AUDIO DEVIATION. Peak deviation is controlled by a pot on the FMA5-G board for no more than 40kHz or 25 kHz average. If you don't have a communication monitor tuned to 4.5 MHz above the video carrier, you can come close by comparing the sound level with a cable broadcast channel.

EXTERNAL LINEAR AMPLIFIER SET UP. There are specific model amplifier application notes on our web site and why some work on ATV and others do not. Basically, they all setup in the same way.

1. With no video source plugged in, turn the RF power pot on the VM-70XS module to its minimum power position (CCW). Make sure the amp is rated to be linear class A, AB or B and is connected to a good 50 Ohm dummy load or low vswr antenna (less than 10% reflected).

2. Turn on the amp and transmitter. Slowly increase the TX70-5s output to the amplifiers rated 1 dB compression power output level. In most Amateur amplifiers, this is about 1/2 the rated maximum CW, FM or SSB peak envelope power. For instance, the Mirage D100-ATVN will take less than 1W to give 50 W pep in the ATV mode.

3. Plug the camera back in and have a distant station on two meters talk back to check your picture to make sure there is stable sync - no rolling. When amplifiers gain compress from over drive, the sync tips get compressed and the picture becomes unstable. You may have to back the RF Power pot down until it becomes stable.

OPERATING NOTES: ATV practices are somewhat different from the other bands and modes. It is easy for another ham near you to look for your video transmission by connecting a roof top 70cm antenna to their TV set to cable channel 58, 59 or 60 and talking back to you on 2 meters. See our ATV Application Notes web page for info on making a 70cm ground plane or simple beams if they do not have one. 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). 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.

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 TX70-5s is portable enough to give a little demo at your local radio club or hamfest.

IF YOU BELIEVE THE TX70-5s ISN'T WORKING, check all cables and connections, internal fuse and 16V protection zener, VSWR, power supply and DC voltages at the boards. 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 TX70-5s 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. Normal turn around is 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.

DX vs. POWER vs. ANTENNA GAIN. The >4W output of the TX70-5s 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. 4W connected to OAL 5L-70cm beams for short distance video up to 20 miles with low battery drain public service applications is ideal. But for greater distance or areas of high path attenuation, you may need to move the antenna to find a magic spot, increase antenna gain or add an amp. The primary design difference between ATV 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 possible 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 are 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.

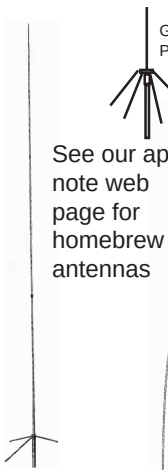
Obviously, putting most of your time and money into the antenna system pays off in both transmit and receive. Adding more power does nothing to improve the receive DX. If you have one of our TVC-4s downconverters you have a low noise figure (≈1 dB) and sufficient gain (≈25 dB) to put your receiving system at the noise floor.

Monitoring yourself with a TV set to *cable* channel 58. 59 or 60 in the same room can give erroneous results due to overload and multipath reflections. Best to have a close by ham with an outside 70cm antenna describe your video quality.

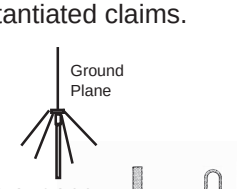
The theoretical noise floor for a 3 MHz wide 70CM ATV system with a perfect 0 dB noise figure is .8 microvolts (-109 dBm). So adding another preamp at the shack will do nothing but pump up your AGC on noise making you more susceptible to intermod and overload interference without improving the sensitivity. Only changing to lower loss coax or adding a good quality <1dB NF preamp at the antenna will give you a little sensitivity improvement.

Since most paths are not line of sight, the distance will be lessened depending on the density and type of trees, foliage, hills, buildings, etc., in the way. 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.

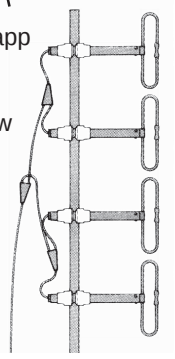
ANTENNA POLARIZATION must be the same in any area or you could be losing up to 20 dB by being opposite. Polarization in any area seems to be more of an emotional rather than technical decision. If most of the ATVers come from the weak signal or 432 SSB/DX group or using 439.25, they will push for horizontal. 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 claims.



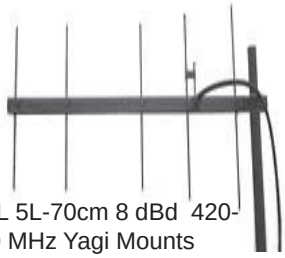
Diamond X510NJ,A 9dBd vertical omni, 17 ft.



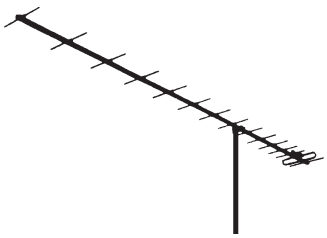
See our app note web page for homebrew antennas



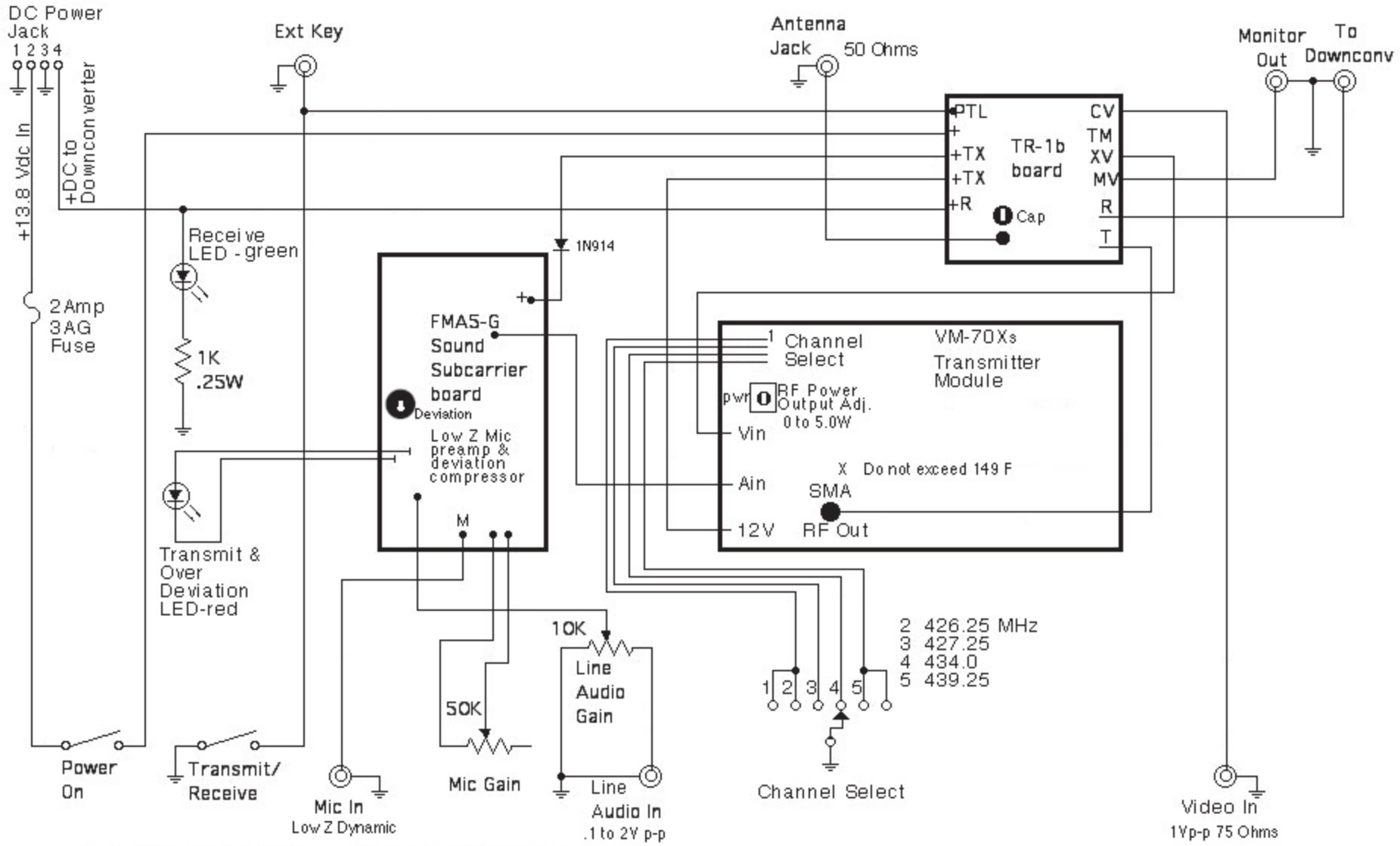
Broad band exposed dipole vertical 6-9 dBd omni used at inband repeaters with duplexer.



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



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



P. C. Electronics TX70-5s chassis wiring diagram