

ATVC-4 Plus

Amateur Television Repeater Controller

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Description

Installing an amateur television repeater takes some real planning and quality equipment. "Thinking about putting up an ATV repeater" by Tom O'Hara of P.C. Electronics is a valuable document which discusses frequencies, propagation, site coordination, antennas, transmitters, receivers, and filtering. An important device that ties all this equipment together is the ATV repeater controller.

ATVC-4 Plus is Intuitive Circuit's second generation Amateur Television repeater controller. We've spent years producing quality ATV products and really listened to what ATVers wanted in an inexpensive ATV repeater controller.

ATVC-4 Plus has many features including:

Five video input sources

- Four of the five video inputs have individual sync detection circuitry allowing for true priority based ATV receiver switching
- The fifth video input accepts video from any video id generator like the OSD-ID (PC)
- All five sources can be switched remotely via DTMF command

Four audio input sources

- All four sources can be mixed
- All four sources can be switched on and off remotely via DTMF command
- Line level and speaker level inputs are supported
- A jumper configuration allows for control radio monitoring over the ATV audio output

Non-volatile storage including

- ATV Transmitter hang-time
- Morse Code (CW) speed
- Morse Code (CW) repeater callsign
- Nine digit DTMF password
- Beacon mode status
- ATV receiver inputs allowed to key the ATV transmitter

Additional features

- Robust Morse Code (CW) telemetry feedback
- A beacon mode
- The ability to add dozens of video and audio sources

Specifications

Dimensions:	6" x 3.85"
Input voltage:	12.0 to 13.8 volts DC (200 ma max.)
Operating temperature:	-10° to +70° C
Microprocessor:	Microchip 16C62B-04I/SP
Video input sources:	4 sync detectable + 1 ID generated
Video level and impedance:	1 volt peak to peak, 75 ohms
Audio input sources:	4 line level + 1 control radio (DTMF)
Audio input levels:	0.1V to 4.0V peak to peak
Audio input impedance:	10K ohms
Control audio input impedance:	100K ohms
TX relay contact rating:	2 amps @ 13.8 volts
DTMF password:	0 to 9 digits. Valid digits 0123456789ABC*#

Installation

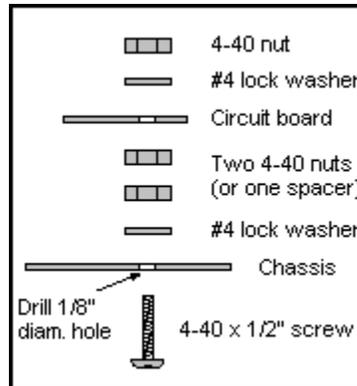
The following is the list of ATVC-4 Plus circuit board pads (places to solder wires to). Please follow common electronic safety precautions when soldering.

Pad	Attach To
Video In #1 (VID 1)	ATV receiver video output, repeater room camera, etc.
Video In #2 (VID 2)	ATV receiver video output, repeater room camera, etc.
Video In #3 (VID 3)	ATV receiver video output, repeater room camera, etc.
Video In #4 (VID 4)	ATV receiver video output, repeater room camera, etc.
Audio In #1 (AUD 1)	ATV receiver audio output, repeater room mic, etc.
Audio In #2 (AUD 2)	ATV receiver audio output, repeater room mic, etc.
Audio In #3 (AUD 3)	ATV receiver audio output, repeater room mic, etc.
Audio In #4 (AUD 4)	ATV receiver audio output, repeater room mic, etc.
Control Audio In (CTRL)	Control radio audio output
AUDIO OUT	ATV transmitter audio input
ID Video In (ID VID)	ID generator video output
VIDEO OUT	ATV transmitter video input
13.8 VDC +	Regulated +12 to +13.8 volt supply
13.8 VDC -	Ground from power supply
C1	Regulated + 13.8 VDC supply for the ATV transmitter (maximum two amps)
NC1	EMPTY

NO1	ATV transmitter DC input
C2	GND or +13.8 VDC (for the ATV amplifier trigger)
NC2	EMPTY
NO2	ATV amplifier trigger jack (for the ATV amplifier trigger)

Board Mounting

Mount the ATVC-4 Plus board into a shielded enclosure like the CAB 247 to protect it from RF. For each of the four mounting holes be sure to use two 4-40 nylon nuts or one 1/4" nylon spacer between the ATVC-4 Plus board and chassis to prevent the bottom of the ATVC-4 Plus board from shorting to the chassis.



Programming

ATVC-4 Plus has four on-board LED's to indicate status. The green LED (D1) shows the presence of power and will remain on while power is supplied to the circuit. The yellow LED (D3) blinks during the power-up sequence and then will light whenever a valid DTMF digit is being decoded. The amber LED (D4) indicates when the video ID relay is energized and the red LED (D2) indicates when the ATV transmitter is active.

Programming ATV-4 Plus is simple process which allows the repeater owner to customize the repeater hang time, DTMF password, Morse Code ID message (up to 100 characters), and Morse Code speed (1 to 25 words per minute). The Morse Code ID message is required to meet FCC requirements by identifying the repeater every ten minutes during an active QSO and at the end of the transmission. Upon applying power to ATVC-4 Plus the yellow LED (D3) will blink ten times if a valid Morse Code message is stored in the non-volatile eeprom. If at power-up the yellow LED blinks twenty times then the eeprom is empty indicating there is no stored Morse Code message.

To enter the ATVC-4 Plus programming mode first apply power to ATVC-4 Plus. During the yellow LED (D3) blink sequence press and release the # key on a DTMF encoder source that is hooked to the control audio source (CTRL) input. While in the programming mode the yellow LED (D3) will stay lit except during a valid DTMF entry. Audio via the "AUDIO OUT" jack will also give important feedback. If there is any invalid entry the controller will restart the power-up sequence allowing you the chance to reenter the programming mode and try again.

Programming Steps:

1. Enter the programming mode (see above).
2. Enter the two digit repeater hang time (e.g 10). Valid entries are 01 to 99. The hang time is how many seconds the transmitter will stay keyed after the incoming signal is lost or DTMF command 00# has been received. Two beeps will follow indicating success.
3. Enter the two digit words-per-minute (WPM) Morse Code speed (e.g. 20). Valid entries are 01 to 25. This is also the speed at which all telemetry information will be sent from ATVC-4 Plus. Two beeps will follow indicating success.
4. Enter the Morse Code message (all are two digit entries) from the table below. Each Morse Code character entry will be echoed to "AUDIO OUT". Once done enter a 99. For example, 23 08 30 13 20 45 27 99 is the message "N8UDK/R".

5. Enter the number of digits the of DTMF password. Valid entries are 0 to 9. A DTMF password protects the repeater from illegal access. If 0 is entered then no DTMF password is required to access the repeater. Two beeps will follow indicating success.
6. The final step is to enter the actual password DTMF digits (if 0 wasn't specified in step 4). Enter the number of DTMF digits specified in step 4. Two beeps will follow indicating success for each digit.
7. At this point the yellow LED (D3) will turn off and you are exited from the programming mode.

For example after entering the programming mode 10 20 23 08 30 13 20 45 27 99 3 A B C would specify a 10 second hang time, 20 words per minutes CW speed, N8UDK/R is the Morse Code ID message, and 3 digit password of ABC.

Note: The ATVC-4 Plus normal behavior is to play the Morse Code message every ten minutes during an active QSO. Alternatively if you enter no Morse Code message (i.e. enter the two digit WPM speed followed by a 99) then the video ID source is used exclusively for repeater identification. A CW ID message is recommended.

Note: If a DTMF password was programmed then the DTMF password must be entered before each DTMF command below.

Morse Code character set:

0 = 00	A = 10	K = 20	U = 30	= = 40	AR = 50
1 = 01	B = 11	L = 21	V = 31	: = 41	SK = 51
2 = 02	C = 12	M = 22	W = 32	; = 42	SN = 52
3 = 03	D = 13	N = 23	X = 33	(= 43	SPACE = 53
4 = 04	E = 14	O = 24	Y = 34) = 44	
5 = 05	F = 15	P = 25	Z = 35	/ = 45	
6 = 06	G = 16	Q = 26	. = 36	" = 46	
7 = 07	H = 17	R = 27	, = 37	' = 47	
8 = 08	I = 18	S = 28	? = 38	KA = 48	
9 = 09	J = 19	T = 29	- = 39	AS = 49	EXIT = 99

Sync Detect Frequency Adjustments

ATVC-4 Plus has four independent video sync detection circuits which allows the continuous monitoring of video inputs VID1, VID2, VID3, and VID4 for valid video sync. The frequency of each sync decoder is set by using a frequency counter connected to the corresponding test point. **With no video connected** carefully adjust each frequency pot to within +- 100 Hz of 15734 Hz for NTSC or +- 100 Hz of 15625 Hz for PAL. This is done at the factory so no adjustment is normally required.

Pot	Adjusts	Test Point
R38	Video source #1 (VID1) sync detect frequency +- 100 Hz of 15734 Hz for NTSC or +- 100 Hz of 15625 Hz for PAL	TP1
R51	Video source #2 (VID2) sync detect frequency +- 100 Hz of 15734 Hz for NTSC or +- 100 Hz of 15625 Hz for PAL	TP2
R60	Video source #3 (VID3) sync detect frequency +- 100 Hz of 15734 Hz for NTSC or +- 100 Hz of 15625 Hz for PAL	TP3

R69	Video source #4 (VID4) sync detect frequency +- 100 Hz of 15734 Hz for NTSC or +- 100 Hz of 15625 Hz for PAL	TP4
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Video Signal Sensitivity Adjustments

Each sensitivity pot adjusts how strong the corresponding incoming ATV receiver video signal is required to key the ATV transmitter. It is similar to a squelch knob on a radio.

Pot	Adjusts
R44	Video source #1 (VID1) ATV receiver signal strength sensitivity
R53	Video source #2 (VID2) ATV receiver signal strength sensitivity
R62	Video source #3 (VID3) ATV receiver signal strength sensitivity
R71	Video source #4 (VID4) ATV receiver signal strength sensitivity

Audio Level Adjustments

ATVC-4 Plus' four audio input sources AUD1, AUD2, AUD3, and AUD4 are mixable. The controller expects LINE level audio inputs (i.e. ATV receiver audio output or VCR audio output) so pads are available at each of the four audio inputs to insert a 100 ohm parallel resistor to knock down SPEAKER levels (like a 144.34 radio) to LINE levels. It is also important to remember when adjusting the audio balancing pots to verify the Morse Code ID can still be heard so the repeater maintains the FCC identification requirement and the CW telemetry can be reliably heard.

Pot	Adjusts
R39	Audio source #1 (AUD1) audio level
R40	Audio source #2 (AUD2) audio level
R41	Audio source #3 (AUD3) audio level
R42	Audio source #4 (AUD4) audio level
R43	Morse Code audio level

Jumper	Purpose
JMP1	If the left two pins of JMP1 are jumpered you will hear the normal audio in input (AUD 3) retransmitted through the repeater if setting A3 is on. By moving the jumper to the right two pins of JMP1 you will instead hear the control radio audio repeated. The purpose for the feature is to allow you to hear the control DTMF tones over your TV as well as the operator talking on the control frequency. Remember to also add the 100 ohm parallel resistor near the "CTRL" pads to knock down the SPEAKER level to LINE level.

Operation

There are three conditions in which ATVC-4 Plus will key the ATV transmitter:

1. A user enters 00* on the control radio frequency, which forces the ATV repeater to transmit. This allows the controlling of video and audio sources at the repeater site (e.g. a room camera). The repeater will remain on until 00# is entered.
2. Sync is detected on a video source which has been configured to allow the keying of the ATV transmitter. ATVC-4 Plus continuously monitors all four video inputs (VID 1 - VID 4) for sync from a valid video signal source such as an ATV receiver. If sync is found it then checks to see if activity on that specific video source is allowed to key the ATV transmitter (settings 01 - 04). For example if "VID 1" has an ATV receiver attached to it and "VID 2" has a link (e.g. Space Shuttle) ATV receiver attached to it then the DTMF commands 01* and 02* would allow activity from either receiver to key the ATV transmitter. When sync is detected on the Space Shuttle link ATVC-4 Plus switches to the "VID 2" ATV receiver video and "AUD 2" ATV receiver audio then keys the ATV transmitter. If at any point sync appears on "VID 1" then video (VID 1) and audio (AUD 1) are automatically selected because of the higher priority. If the "VID 1" source drops then VID2/AUD2 are switched back on with the Space Shuttle being shown once again.
3. When the beacon mode is enabled and the ATV transmitter is idle for ten minutes.

Regardless of the situation that keys the ATV transmitter, ATVC-4 meets the FCC legal requirements for repeater identification. Every ten minutes (when the transmitter is active) the Morse Code call sign identification message is mixed with the selected audio sources (avoiding QSO interruptions). The exception to this is if no Morse Code ID message is stored in the eeprom. If this is the case then every ten minutes during an active QSO the ID generated video source "ID VID" is displayed for ten seconds. Either way, at the end of a transmission the ID generated video source is displayed for the programmed hangtime with the optional Morse Code ID followed by the transmitter dropping.

Manual video source selection:

Manual video source selection can be performed at any time. The five video sources are mutually exclusive which means only one source can be selected at a time. The switching is done by sending a momentary DTMF digit 1, 2, 3, 4, or 5. (5 is the ID generated video). For example if there is a camera at the repeater site attached to "VID 4" then 00* would force the repeater transmitter on with the Video ID generator screen (VID 5) selected by default. Pressing 4 would show the attached repeater site camera (VID 4) and a 00# would drop the transmitter.

Manual audio source selection:

The four audio sources are selected (*) and unselected (#) via the DTMF commands A1, A2, A3 and A4. Unlike the video sources which are mutually exclusive, the audio sources can be mixed. For example if "AUD 1" has the ATV receiver audio attached to it and "AUD 4" has a radio tuned to 144.34 MHz audio attached to it then by sending A1* and A4* the ATV receiver audio will be mixed with the 144.34 audio. Adjust the audio in pots (R39 - R42) to balance the audio levels. Audio inputs 1, 2, 3, and 4 are LINE level inputs (i.e. ATV receiver audio output or VCR audio output). Pads are available at each of the four audio inputs to insert a parallel resistor to knock down SPEAKER levels (like our 144.34 radio) to LINE levels. So in the example above, an 100 ohm resistor would be inserted to the pads next to "AUD 4" to knock down the radio SPEAKER level to a LINE level. It is also important to remember when adjusting the audio balancing pots to verify the Morse Code ID can still be heard so the repeater maintains the FCC identification requirement and you can reliably hear the telemetry.

Beacon mode:

ATVC-4 Plus has a beacon mode which is activated and deactivated through DTMF command AB. Once activated (AB*), ATVC-4 Plus will perform the following five steps every ten minutes when the repeater is idle:

1. Switch to the video ID source (ID VID)
2. Key the ATV transmitter
3. Play the Morse Code repeater ID once
4. Wait twenty seconds
5. Drop the ATV transmitter

Telemetry:

ATVC-4 Plus' telemetry (status of the repeaters settings) can be requested via DTMF commands B0 through B5. The Morse Code telemetry information is sent over the ATV repeater audio (i.e. received on your TV). A Morse Code O (dah dah dah) is sent for settings that are ON and a Morse code F (dit dit dah dit) for settings that are off. For example if "B0", the beacon mode status, is requested then one Morse Code character will be sent. If the beacon mode is on then a dah dah dah is sent, otherwise the beacon mode is off and dit dit dah dit is sent. If

"B2", the audio sources status, is requested then four Morse Code characters will be sent. Each one corresponding to the respective audio source 1-4 state.

Adding additional video, audio, and control sources:

There is a cost effective, scalable solution to increase the number of ATVC-4 Plus selectable video and audio sources as well as adding the control of an unlimited number of external devices such as repeater room lights, pan/tilt rotors, etc. The secret is to add independent DTMF decoder boards to the same control audio path and program ATVC-4 Plus with a password (more of a board ID in this case).

Here is an example to add 8 additional video sources to the repeater:

Program ATVC-4 Plus with the single DTMF password of "C". Additional trailing DTMF digits can appended for additional security.

A single DTMF-8 board will be our video switcher. It is programmed for mode 4 (mutually exclusive) with a password of 91. The eight NO (normally open) relays are wired to various video cameras, color bar generators, etc. The eight COM (commons) are tied together and connected to "VID 4" on the ATV-4 Plus. The control radio audio output, which is attached to the ATVC-4 Plus "CTRL" audio input, is also attach to the DTMF-8 control audio input.

To view the eight additional video sources enter the following DTMF commands:

- C00* forces the ATV transmitter on
- C4 selects video source 4 on the ATVC-4 Plus
- 91 1 through 91 8 switch the eight additional video sources
- C00# turns the ATV transmitter off

Remember this example could be expanded to add dozens of audio sources, repeater room control devices, etc.

ATVC-4 Plus DTMF Commands

DTMF	Latched settings - followed by * = on, # = off
00	Force ATV transmitter on (without need for incoming ATV receiver horizontal sync)
01	Allow sync signal of "Video In #1" to key ATV transmitter - CW (o)n or o(f)f ack follows
02	Allow sync signal of "Video In #2" to key ATV transmitter - CW (o)n or o(f)f ack follows
03	Allow sync signal of "Video In #3" to key ATV transmitter - CW (o)n or o(f)f ack follows
04	Allow sync signal of "Video In #4" to key ATV transmitter - CW (o)n or o(f)f ack follows
A1	Manual selection of audio source #1 (AUD 1)
A2	Manual selection of audio source #2 (AUD 2)
A3	Manual selection of audio source #3 (AUD 3)
A4	Manual selection of audio source #4 (AUD 4)
AB	Beacon mode - (see description above) - CW (o)n or o(f)f ack follows

DTMF	Manual video source selection (momentary press and release)
1	Select video source #1 (VID1)
2	Select video source #2 (VID2)
3	Select video source #3 (VID3)
4	Select video source #4 (VID4)

5	Select video source #5 (ID VID)
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DTMF	Repeater telemetry via Morse code (momentary press and release)
B0	Send on/off status of "beacon mode" (AB)
B1	Send on/off status of the four "allow sync to key" settings (01 - 04)
B2	Send on/off status of the four audio sources (A1 - A4)
B3	Play current sync status of the four video input sources
B4	Send repeater ID
B5	Send controller software revision

Trouble Shooting Tips

Problem	Solution
Green LED off (won't power up)	Check Power supply output (12 - 13.8 VDC). Check polarity to ATVC-4 Plus board.
Unable to program or yellow LED doesn't change state when DTMF tone is applied	Check "Control Audio In" (CTRL) polarity. Decrease volume of ATVC-4 Plus radio audio (possible over driving audio input). Increase volume of ATVC-4 Plus radio audio.
Incoming receiver video doesn't cause ATVC-4 Plus to key transmitter	Check that the appropriate "allow sync" 01-04 setting is on. Check the corresponding Frequency and Sensitivity pots.

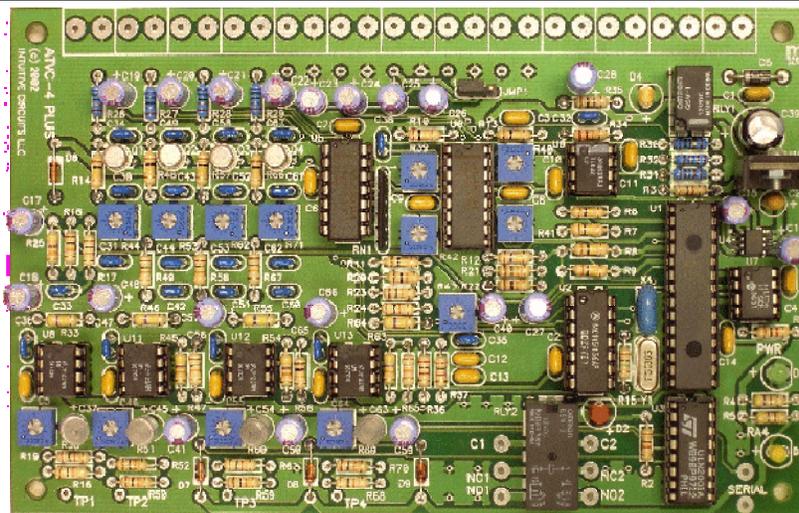


Fig 1.0 - Front view of the ATVC-4 Plus circuit board

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