The RVS-8 audio Voter
by LDG Electronics, Maryland
(supplemental manual, by Karl Shoemaker)

Introduction

This manual is a supplement to the factory one to assist the technician and further enhance understanding of the RVS-8 voter. It is in no way to circumvent or challenge the OEM specs, philosophy or design, as the Author supports the manufacture and embraces their technology. It may be updated (without notice) with the effective date at the end of this manual, which supercedes previous versions. Some diagrams are rotated on pages therefore, this manual was intended to be (duplex) printed out as a hard copy with the pages in a 3-ring binder. It's best viewed and read in this manor.

This manual has four sections in this order:

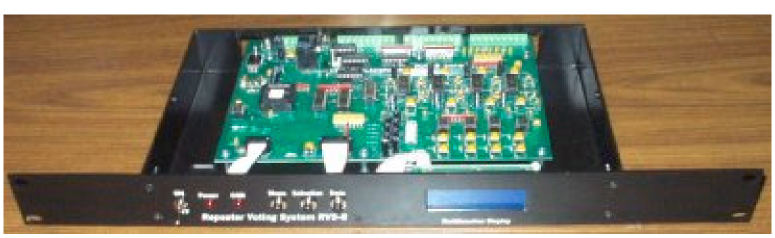
- Overview of the unit (this section)
- Theory of Operation
- Modifications, tips and notes
- Alignment

A few manufactures have produced voter equipment such as Motorola, GE, Raven, Raytheon, Doug Hall and LDG Electronics. The last two being economy types for amateur repeaters and do not require a status tone from the remotes to work. As of 2013 the DHE has been discontinued so the only known one left is the LGD Electronics RVS-8 voter. This manual will cover that unit.

The RVS-8 probably went through some changes and versions since it was introduced over a decade ago. A comparison chart is started, here, but not completed due to time for research. Take this into consideration if you are upgrading from an older unit.

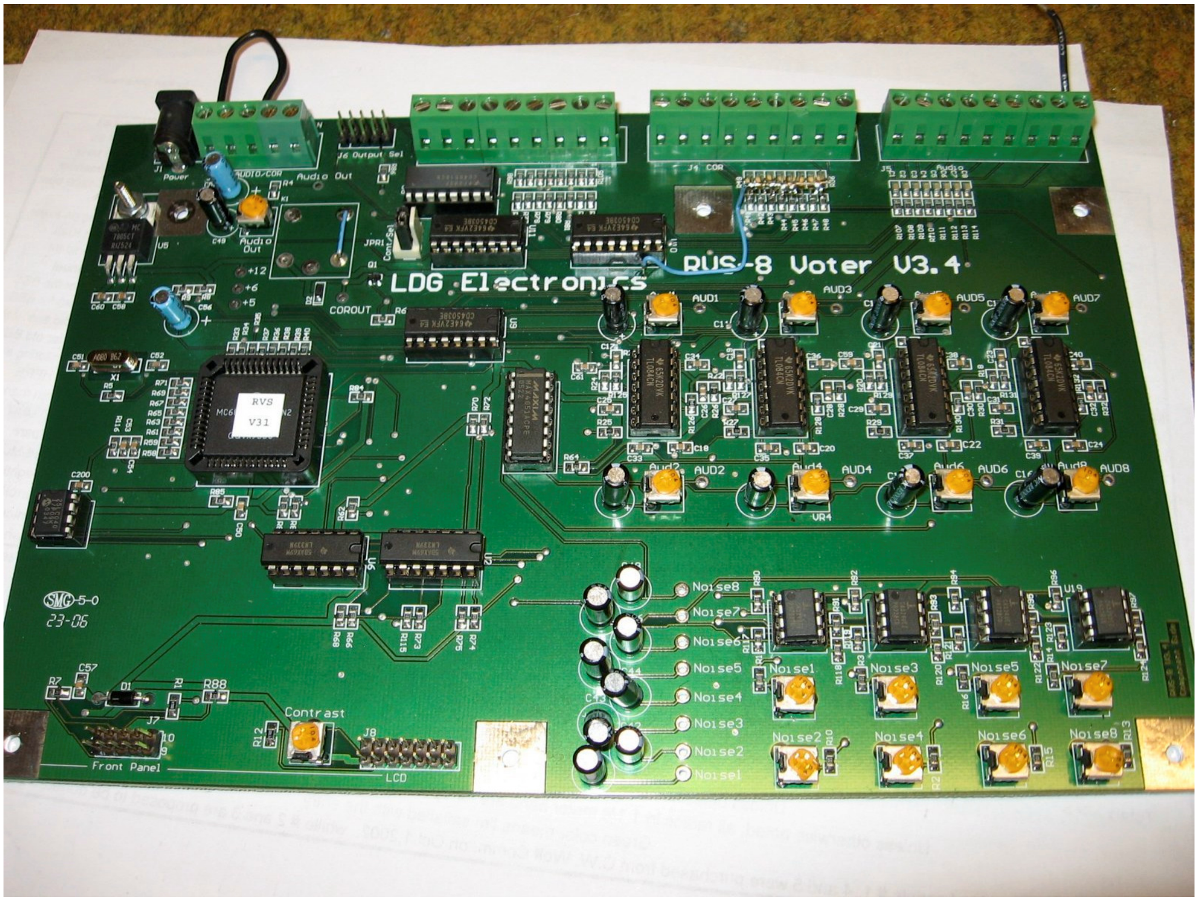
Vintage-Versions	Manual	Board	Schematic	Firmware & 2
Original	?	?	?	?
Before 2001	?	?	?	?
2001	2.1	2.1	2.0	2.1
2005-2007	1.0	3.4	3.2	?
2008-	Unknown – please contact the factory			

The front panel as shown in stock form.



The rear connection points.......

And the main board. Note that some modifications have been done in this picture.



Acronym list: (for the novice)

RVS Model of this Voter by LGD Electronics, Maryland.
COR Carrier Operated Relay, AKA carrier operated squelch, COS, RUI, RUS, etc.
CTCSS Continuous Tone Coded Squelch System, AKA, tone, PL, CG, QC, etc.
TLP Test Level Point.
SRG Spokane Repeater Group (organization this voter is being used).
MCP Master Control Point (where the voter, controller, timers, IDer, etc. are located.
PCB Printed Circuit Board.
LMR Land Mobile Radio, AKA, 2-way radio.
dbm Logarithmic measurement of some test points on the unit (in bridge mode).
SMD Surface Mounted Device (resistor, capacitor, transistor, etc.)

Other points for HW version 3.1 and schematic version 3.2:

Some of these were issues and solutions, found for SRG requirements; others, just information:

- The silk screening on the board has a version, for clarification only (no issue).

- The disagreements with the board and manual have been (factory) corrected.

- Front panel: both LEDs are red in color. They were replaced with colors that were more meaningful, such as green for power and yellow for COR activity (red is for alarms and decodes, normally). The LCD screen is easy to read using the proper letter casing; no changes needed. System status and menu settings are done with the front panel buttons. It's believed these settings are non-volatile.

- R7 value has been corrected to a 1K ohm, as not to over drive the (LED) power indicator. R1 is still a 470-ohm however; future research is being done in 2013 before changing that one to 1K.

- The schematic is nicely PC generated however, a little distracting with all the coloring; a BW version was made for this manual. (not an issue-personal preference)

- Upper and lower case on the schematic has been corrected and appears much better. A larger copy is included in this manual as well.

- The PTT output relay provides complete (reference) isolation to external equipment. The Author determined it was unnecessary therefore, it was removed and a jumper installed in its place.

- Some bench time was invested to determine the schematic term of "NCx", meaning "No Connection" with a reference number. The later version's schematic now has an "X" by the non-connections.

- COR inputs are not "open collector", active “low" compatible however, a solution was found by the Author by installing a pull-up resistor array, discussed later in this manual.

- The OEM manual's setup section may be misleading. It talks about setting each input level for "1.0 volts peak to peak", etc. Then a separate (pot) adjustment calls for 3.5 volts, with noise from the receiver. One would assume that's 3.5 volts, peak-peak too, however, is not the case. Its DC (positive voltage reading). Once this was discovered after significant bench time, the alignment was a breeze. The rest of the (small) manual is adequate for operation. The pictures are a nice touch, as well. SRG standard uses log, not (linear) voltages for audio references, which is discussed later in this manual.

- The audio output adjustment (VR18) is backwards; CCW turning increases the output level.

- There appeared to be a problem with excessive levels into the unit. Bad voting and squelch tickle (leaking) through was observed. Both of these issues are addressed later in this manual.

- The 2-year warranty is excessively generous. Also, the repair support is very understanding.

- The OEM manual describes the input ports as “channels”. This terminology is carried throughout the OEM manual. To support LDG's philosophy this manual will call the input ports, channels as well.

- The unit does not provide a squelched audio input-output. Therefore, it's best to use squelched audio from the receivers going into the RVS-8. This was heavily researched in 2013 by the Author and is discussed in great detail later in this manual. Over 20 hours, over a period of 2 months, was spent on R&D to find a solution to this issue. This was the driving force to produce this manual (supplement) to help others with the same issue.

- There were some errors, then later, changes, to some of the component circuit designators. For example, most of the adjustment pot labels were changed. Original designators were R17 through R24 for the "AUD" adjustments and R41 through R48 for the "Noise" adjustments for schematic Revision 2.0. These were change to VR1 through VR8 and VR9 through VR16 respectively, for schematic Revision 3.2. The latter makes better sense to the Author as well.

Theory of Operation:

Introduction:

A "voter" is a device used in a LMR base station, or (better yet) a repeater station. Several remote (input) receivers at various remote locations pick up a user's weak signal, and then are transported them back to a Master Control Point (MCP) by means of dedicated RF, wireline or IP channels for each of those remote receivers. At the MCP the voter "decides" which of the "best" user signal will be heard by the control station, or (better yet) sent back out to the remoted (supported) system output transmitter for all to enjoy the best reception possible. This can provide superior reception and user coverage over a conventional single Tx/Rx repeater station at one remote site. This comes with a price, starting with cost (equipment, sites, etc.) advanced experience, understanding and high maintenance discipline and standards by the supporting technicians. Voters come in two basic types; time domain or signal-to-noise quality (S/N). The latter is more popular and effective for best LMR communications. They also need some type of signaling to “tell” the voter a signal is there. This is accomplished either with a status tone (ST) or a carrier active indicator (COR/COS, etc.)

The RVS-8 is an 8-channel signal to noise voter that takes in signaling and audio for each channel, “decides” the best channel and sends that to an associated station controller or transmitter. Each channel is “weighted” with a micro-controller. Signaling is necessary to inform the voter when there is activity. This can be in the form of E&M modem card contact closure-interface (microwave), a local receiver’s COR or a downlink receiver’s COR (remoted receiver-transmitter RF link). In the acronym list COR had several references because of different manufacture’s term. The term “COR” is used exclusively throughout this manual. Also, COR active polarity is a consideration when interfacing with the RVS-8. More is discussed on this matter in greater detail.

COR:

COR inputs on J4, for each channel “informs” the voter there is activity on a channel and to start analyzing it. Without COR input the voter may not vote on start-up transmissions and may ignore changing activity on other channels even if those have a good signal. Keep this into account in the event troubleshooting is necessary.

Each COR input can be programmed for active going high or going low, independently, via the front panel. Each COR channel can be disabled via J3. These disable inputs can be programmed for active high or low, independently as well. The lines are buffered via U9~U11, outputting 16 lines. The COR and disable lines are parallel on the output (for each channel) therefore, each disable line can disable each COR line (independently) at this point. (sum logic).

These lines gated (sampled) at 81 Hz. They are then converted to 5v logic with voltage dividers of R33~R40 and R71, 69, 67, 65, 63, 61, 59 and 58, for channels 1~8 respectively. To clarify with an example, channel one COR buffered line on U9, pin 3, is parallel with the disable buffered line on U10, pin 3. From here they go into U1, micro-controller, pins of 9~16 for channels 1~8, respectively. It’s COR output on pin 30 is sent to a buffer, U2, pin 9. U2’s output on pin 14 turns on Q1 and its relay, K1 with form “C” contacts to J2, terminals 3~5.

Tip: Obviously, if the voter is at a remote site, don’t disable all 8 channels at the some time, preventing control access, requiring a trip to the site. That may be a reason to have an alternative control path to the voter site. SRG’s MCP does not use the “disable” inputs therefore, is not an issue in this case.

Audio:

The audio inputs (AUDIN1~AUDIN8) convert the audio into something meaningful for the micro-controller to analyze (weigh) each channel. The conversion is done by amplifying a portion of the audio and rectifying that into a DC voltage indirectly proportional to the quieting of each audio channel.

Operational amplifiers, U12 through U15 handle the audio functions. For each channel are three amps. The first amp is used for each channel output (OUTAUD1~OUTAUD8). From there each channel goes to an audio switch, U7. The second amp is a high pass filter from around 3 KHz and responds up to 10 KHz.

The third amp for is driven into clipping in the positive direction only. This is done by biasing (rail/voltage reference) of the third amp on pin 3. The output of the third amp's DC component is filtered for channel 1~8 by C41~C47, respectively. The DC voltage produced at these points (A/D0~A/D7) go into U1 inputs of E0~E7. The DC voltage is around 0 during a full quite signal or no signal (standby condition). For a noisy (or full noise, open squelch) it's 3 to 5 volts positive. More on this later in this manual.

The input signal quality for each channel can be displayed on the front panel with menu selection. These figures are inverted from the DC levels and shown in three digits. For example, an inactive channel will show a "000". A rather noisy signal will be around a "100", while a full quite signal will be around a "255" on the panel. COR has to be active at least on one channel for these figures to appear on the front panel, at least for startup.

The micro-controller analyzes all active channels and selects the best one, via output lines on pins 29~27 (SELA~SELC respectively). They go to the input of U6, pins 7, 9, and 11 respectively. U6 buffers the outputs on pins 13, 14 and 1 (OUTSELA~OUTSELC respectively). They drive U7 in pins 11~9, respectively. U7 demultiplexes these lines and connects one of the 8 input audio channels (X0~X7) to its output on pin 3. The output level can be adjusted via VR18, then sent to J2, terminal 2. Maximum output is –10 dbm (with SRG modifications; much higher as OEM). U7 is further discussed later in this manual.

U6's OUTSELA~OUTSELC lines also drive demultiplexer/switch U8. U8 outputs discrete lines for external voting indication (or control) via J6. One purpose for external control would be not to use the RVS-8's audio path; only the voter selection lines to control such external audio device. This would be in the case the RVS-8 does not meet the frequency response requirement for a repeater system. At this point, however, the Author has determined the response for the RVS-8 is acceptable in the range of 50Hz ~ 6KHz. Therefore, J6 is not used at this time. U8 is further discussed later in this manual.

History, Research, Development and Tips:

In the event you are having any problems with the RVS-8 this section may help you. The Author went through a long process to get the present voter working properly. Some history:

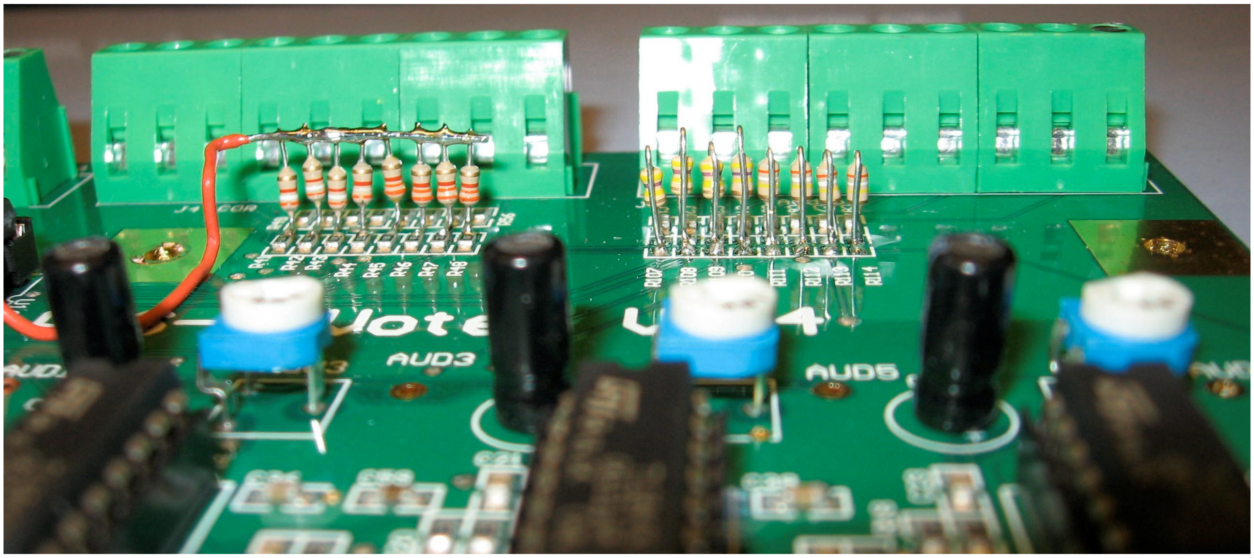
SRG's original MCP was built in 1995 with a time domain voter (TDV) the Author designed, built and installed. It had it's own squelch for each channel, using "AND" squelch technology from a CTCSS tone panel feeding it. The tone panel did not process the audio channels (audio was on carrier squelch at this point). Since the tone panel controlled the COR, the voter used that signal to effectively protect the audio channels as well. However, this type of voter had another issue that fixed stations not actively voting to a better channel (stuck on a noisy channel). To address this problem a better (active) voter was being considered during this period.

When LGD Electronics was found and the first voter was purchased in 2005 it did not work as expected. First, it was understood the RVS-8 had squelch (mute) circuitry built-in for each channel for a simple "drop-in" replacement of the TDV. This apparently is not the case. Second, the levels for proper voting were not achieved easily. Third, COR input active low had no pull-up resistors. Because of the MCP's interfacing these became issues. Normally, warranty is easily voided if any modifications are done on a new piece of equipment. Therefore, the Author choose to return the unit it for a refund. It was realized that further research and development would be necessary to utilize the RVS-8.

After significant research a second unit was purchased and installed in 2007 for SRG's MCP. COR/PTT and audio voting were the two main areas of interfacing needed to allow the voter to work properly. At this point, modifications to the RVS-8 were determined to be necessary. It was discovered years later that the factory gave some (warranty) latitude for field modifications therefore, was moot.

COR:

The disable and COR inputs have "pull-down" resisters provided (internally on the PCB) for active going high mode. However, there are no "pull-up" resisters for the opposite mode (active going low). It was (apparently) assumed the standby positive voltage was to be supplied by the customer's external equipment for this mode. The disable inputs are not used so that's not an issue. However, SRG does use active going low for COR/PTT lines out of a receiver. To clarify, during no activity SRG equipment's (output collector) NPN transistors are relaxed (hi resistance). During activity they go low to ground (resistively less than 50 ohms). (Typically are 2N3904s). Therefore, the first modification was to install a pull-up resistor array. First, it was done on the barrier strip outside the unit and later inside, by soldering a 1/8-watt resistor on each COR input then referenced to 12v inside the unit as shown in this image (array on the left). This raises the COR input standby voltage. After some variances, 1.5 K ohm was the final value used for each channel. Because of the OEM pull-downs were left in the unit, this gave a divided voltage of 13.48 for each inactive input. In 2013 it was discovered this is a (factory) recognized modification with a similar document from them that uses 4.7K resistors.



If you note carefully you'll see that some of the resistors are mixed values. This picture was taken during R&D experimenting with different values for both COR and audio inputs.

In 2016 it was found the hysteresis setting appears to affect the COR gating more than the S/N therefore was left on value of 0.

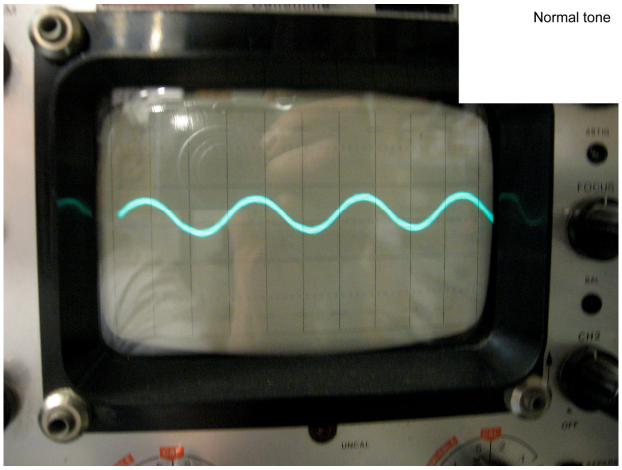
<u>Audio:</u>

Operational amplifiers are commonly used for buffering and high gain amplification. Most of them have two inputs; inverted and non-inverted with a "-" and "+" sign on each input, respectively. One common method is to set the rail/reference point (DC) with the + input and use the "-" (inverted) as an audio input. The gain can be controlled by sending some of the op-amp's output back into the inverting input, called a loop. Gain can be calculated with a ratio of resistance of output's loop to the input. For example, if the loop has a 100K ohm resistor and the input resistor is the same, the op-amp's gain is 1 (unity). If you increase the loop resistance it causes an increase of voltage gain, normally expressed in log. With a variable resister (potentiometer) the gain can be continuously adjusted from 0 to maximum, within the operational limits. In some circuits the gain can be designed near 60 db such as the COR/AF board the Author designed using the LM324 quad amp with a 5 Meg ohm loop pot. However, most SRG designs use a loop resistance of 2 Meg ohms or less.

You may have noticed another array on the right side of this image. When the first unit was installed 2005 it appeared the OEM manual's alignment procedure caused input levels too high, causing mis-voting and non-voted channels leaking into the voted channel's audio path. After years of (intermittent) research the Author determined the problem might have been from higher than "normal" audio content in the frequency range the voter is tuned to analyze the channels. During a recent inquiry the factory indicated the voter would work with conventional (de-emphasized) or flat receivers however, the Author now believes the higher frequency content of a flat receiver causes overloading and the problems mentioned above.

Therefore, the SRG alignment procedure seemed to correct these problems. Lowering the inputs also gave easy DC adjustment for the second step of each channel. The DC adjustment pots now give you a range of 2.86~5.16 v. On the LCD panel channel quality figure this comes out to 106 ~ 000, respectively.

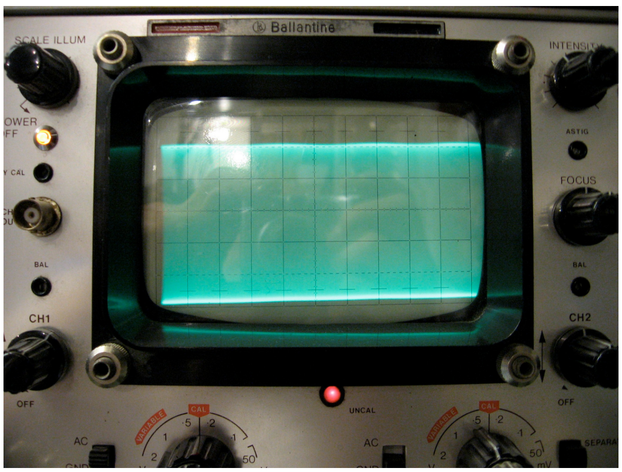
For a flat system the DC figure (for each channel) will be 2.0v**, while a conventional system the DC figure (per OEM manual) will be 3.5v. This setting this gives you 075 on the panel.



Normal tone

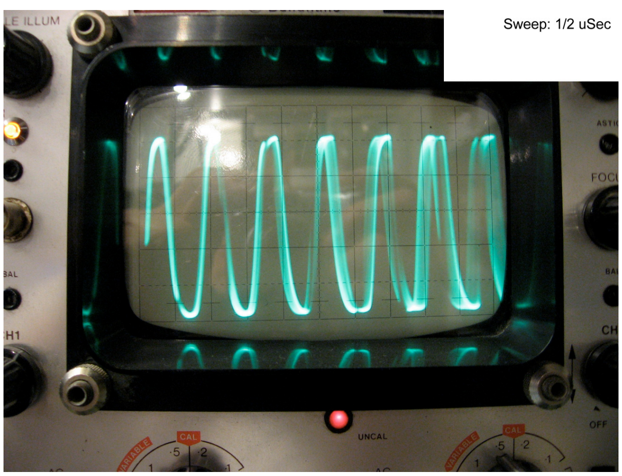
The image shown here is a normal, clean tone observed on an oscilloscope during alignment (3 KHz deviation into a receiver).

From the last discussion about turning down the level at the "TP"s, there appears to be another issue that surfaced. Down towards the bottom of the adjustment there's a point that a high frequency oscillation occurs. If you are using a meter for alignment you may get confused in your reading when this occurs. This condition can be best observed with an oscilloscope at the test points, as shown in the center image. For clarity, the alignment tone was removed during this observation.



By increasing the scope's sweep to ½ of a microsecond the oscillation can be observed more clearly, as shown in the bottom image. By a rough calculation the oscillation frequency appears to be about 1 MHz (about 2 divisions full cycle with ½ uS second sweep).

It was also confirmed the oscillation is not coming from the link receiver by disconnecting such receiver during this observation *. Also, the power source was checked for purity.



Sweep: 1/2 uSec

The solution to this problem is to lower the audio input sensitivity for all the channels. This was performed in 2013 by changing the audio input resistor value (R107~R114) from 1K to 470K ohm, using 1/8w resistors. There's an image of this earlier in this manual.

The audio level adjustment (VR1~VR8) range was improved, to stay away from this oscillation problem. As anticipated, the ability obtain the 3.5 VDC adjustment (for the next alignment step) of each channel was still there.

This modification appears to simplify alignment. As time permits research may reveal another solution or explanation to this issue. There may be a valid reason for it, unknown to the Author at this time.

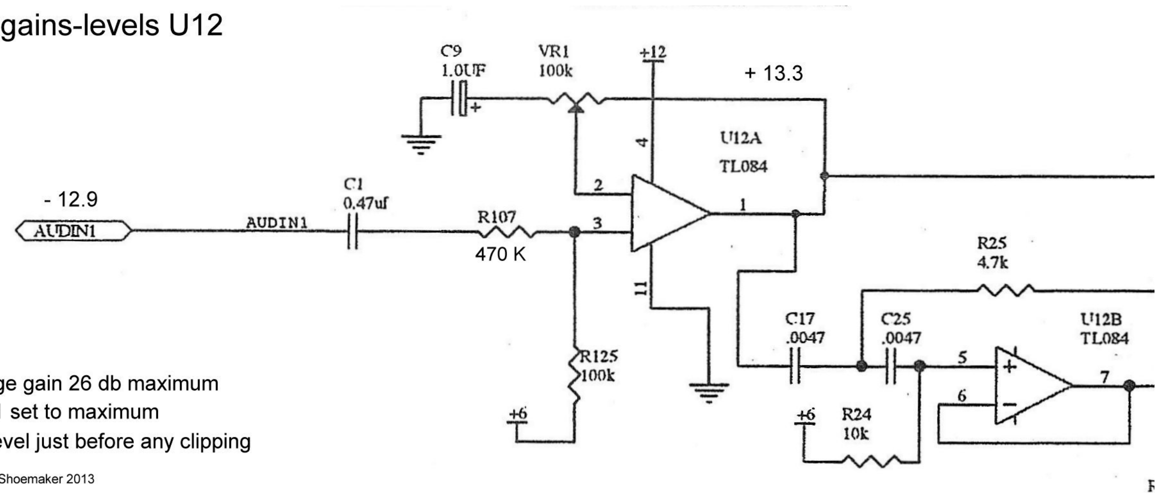
Please note that removing SMDs are tricky without a hot gas bonder. If you don't feel qualified you may seek assistance in this matter. It's assumed damage to components or the PCB is not covered under the warranty.

*For flat receivers using a second IF of 455 KHz it's possible that can carry to the "AF" output. To address that condition the COR/AF board has an (optional) trap/filter tunable to that frequency. In the case of using a Micor receiver does not have that issue.

** Current SRG specification however, this may change due to experimentation and improvements. See the alignment section for the final level.

Some further testing found that the stage maximum output (before clipping) is a +13.2 dbm. For this test the (VR1) gain was set to maximum requiring the input level of –12.8, giving the (new) gain capability of 26 db. This still should be plenty for most link receivers, plus the gain can be turned down for receivers with higher output level. The Author found it useful to establish some stage gain figures and other DC measurements, now, as a benchmark. This may be useful to you too, later, if the event of a marginal problem and troubleshooting is necessary.

Stage gains-levels U12

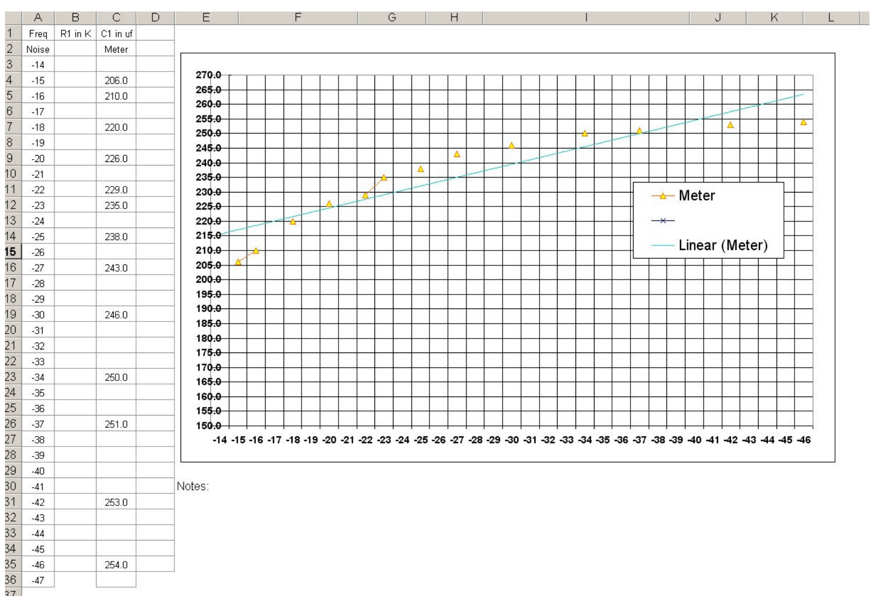


First stage gain 26 db maximum
with VR1 set to maximum
Output level just before any clipping

Tests by Karl Shoemaker 2013

Note: In the event your receiver’s TLP is lower than –13 leave the input resistors (R107~R114) as OEM.

During testing a quieting to panel indication plot was performed in rough form several years ago. At the time the Author was not familiar with Excel charting but this will give you an idea what to expect.



	A	B	C	D
1	Freq	R1 in K	C1 in uf	
2	Noise		Meter	
3	-14			
4	-15		206.0	
5	-16		210.0	
6	-17			
7	-18		220.0	
8	-19			
9	-20		226.0	
10	-21			
11	-22		229.0	
12	-23		235.0	
13	-24			
14	-25		238.0	
15	-26			
16	-27		243.0	
17	-28			
18	-29			
19	-30		246.0	
20	-31			
21	-32			
22	-33			
23	-34		250.0	
24	-35			
25	-36			
26	-37		251.0	
27	-38			
28	-39			
29	-40			
30	-41			
31	-42		253.0	
32	-43			
33	-44			
34	-45			
35	-46		254.0	
36	-47			

One last thought on the high pass filter (mentioned earlier): If there is any noise on the transport circuit for a remote receiver this may cause mis-voting. This is especially true for flat systems.

U7: (no squelch gates provided)

The RVS-8's front panel menu has some status's you can monitor. One is to display what channel is being voted. This is a good place to leave the display. When the (COR) activity stops it will continue to display "x-current voted". This is your first clue of a potential problem. Research lead the Author to believe when COR activity stops <u>that last selection stays</u> connected to the U7 output. To clarify, there is no muting (squelch) going on here during standby. One may assume the unit would change this display message into something more meaningful when activity stops however, this appears not to be the case. This was a very significant discovery by the Author.

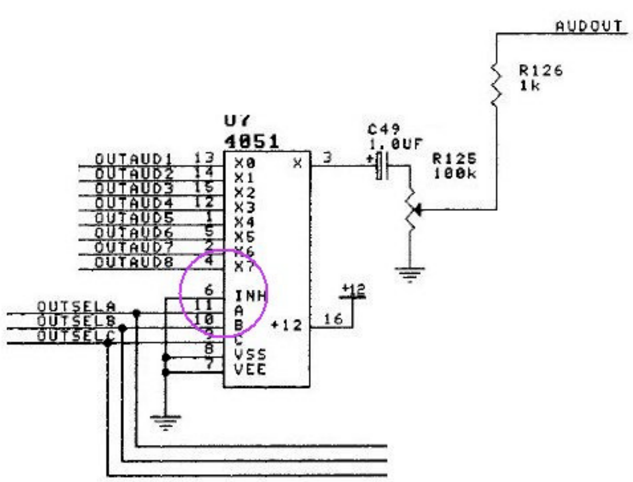
In the case for SRG's MCP the COR lines are tone protected, but the audio paths are not because the internal audio path stays open even during system standby. The block diagram on page 11 illustrates this. For RFI getting into the system creates a problem. Most repeaters have a rather short tail; therefore, this may not be noticed. However, SRG's repeater has a long tail (20-30 seconds in some cases) so the problem was apparent and annoying. This was endured for several years, until the Author found a promising solution in 2013 (since 2005).

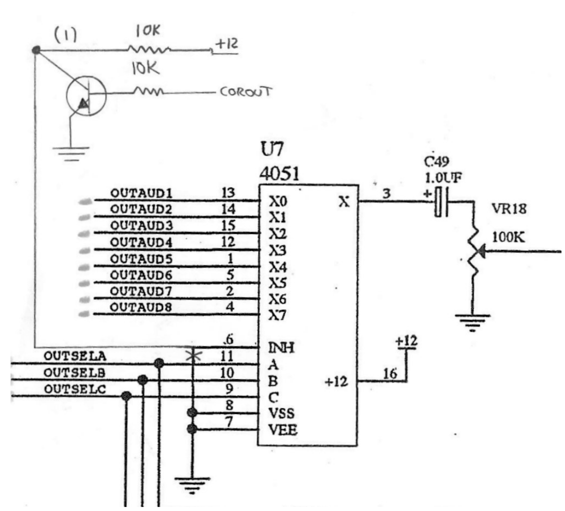
Referring to the diagram (below), U7 is an audio switch for channels 1~8 for inputs "X0~X7", respectively. The output is on "X" at pin 3. The micro-controller does not appear to have a (COR) line to tell U7 (directly) to squelch all channels during standby. This arrangement bypasses any tone protection that was built into the MCP.

U7 has a disable (input) function on pin 6 called "INH" as identified with the violet circle. Grounding pin 6 enables the paths while keeping it high disables paths. Since the stock design grounds pin 6 all the time U7 passes audio all the time. Therefore, if the audio inputs (from the receivers) are not squelched and even if there is no COR activity to keep the repeater keyed up during the tail, any audio coming into the voter will be heard on the output.

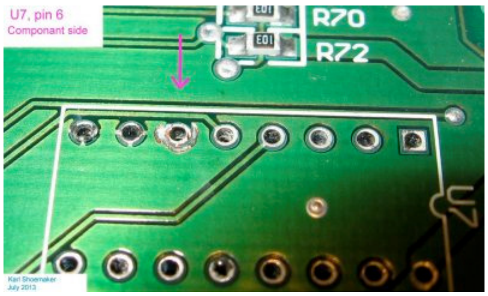
By lifting U7, pin 6 to a high will disable the (audio) output during standby thus, muting any (carrier squelch) interference coming in from a receiver. For proper operation U7's output pin 6 has to go low quickly during activity. This was easily engineered by using the "COROUT" line. A close by 12v source, (inverting) transistor and the appropriate resistors were used, all mounted on the solder side of the board to result in the following (modified) circuit for U7 on the right image.

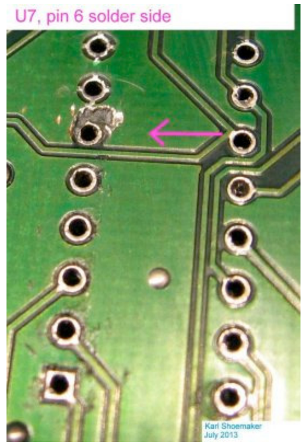
If your system is running tone coded squelch (AND squelch) take this into consideration when interfacing with external tone protection equipment, such as providing your own (CTCSS) squelch circuits and dealing with RFI or control issues.

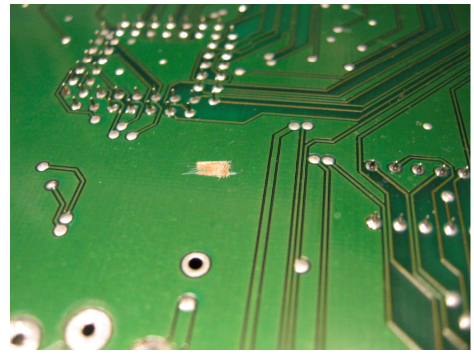


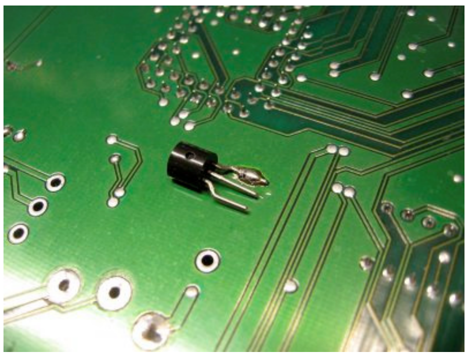


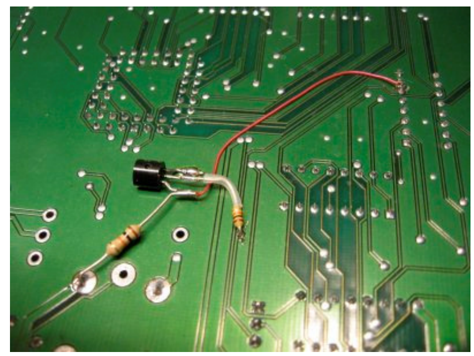
This is the area of the modification, component side. After considerations for the physical location of the components it was decided to mount them on the solder side. It was necessary to remove U7, its socket and cut-isolate pin 6 from ground as showed in the images below. This was a very tedious task, better left to experienced (depot level) repairmen familiar with SMDs. After cutting, cleaning and inspecting the eyelets for pin 6 and surrounding area a resistance (meter) check was made to verify isolation.





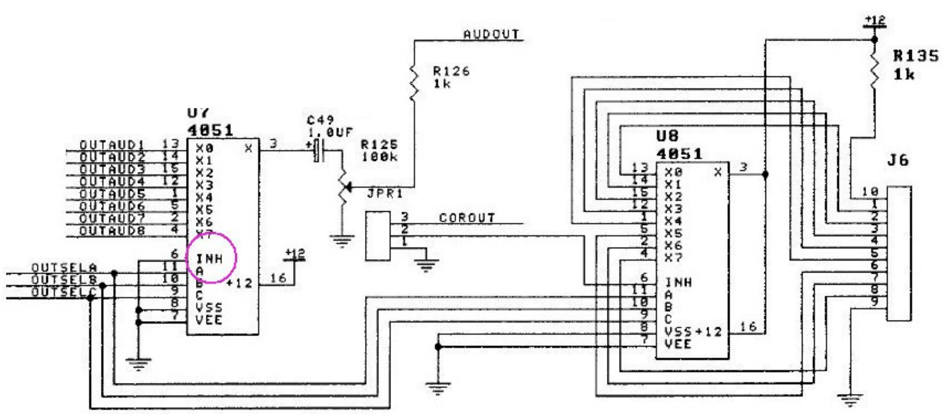






Then a ground spot was created (for the transistor) by scraping away a block of the (green) PCB covering to expose the copper ground. It was tinned and the transistor's emitter lead was soldered there. The resistors and jumper wire were added with shrink, where appropriate. Parts used were a 2N3904, a tiny wire jumper and two 10K resistors, one being 1/8 watt for appropriate close area consideration.

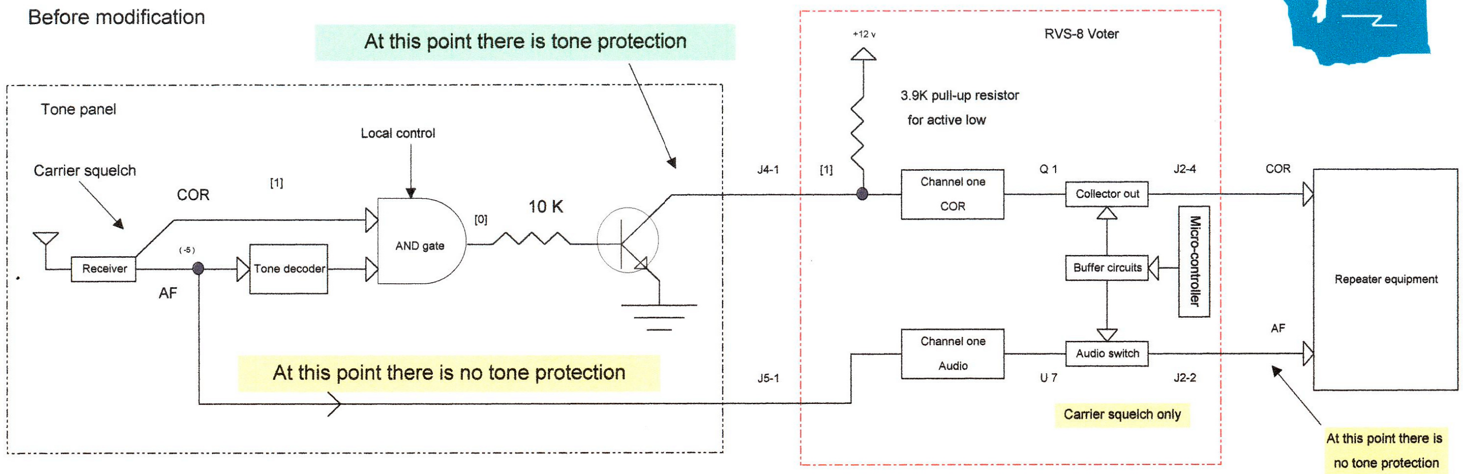
An alternative method is to "piggyback" the U7 socket, with a modified socket (isolating pin 6) then plugging the IC on the second socket. Obviously, a flying tie-joint would be needed to complete the circuit modification as previously described.



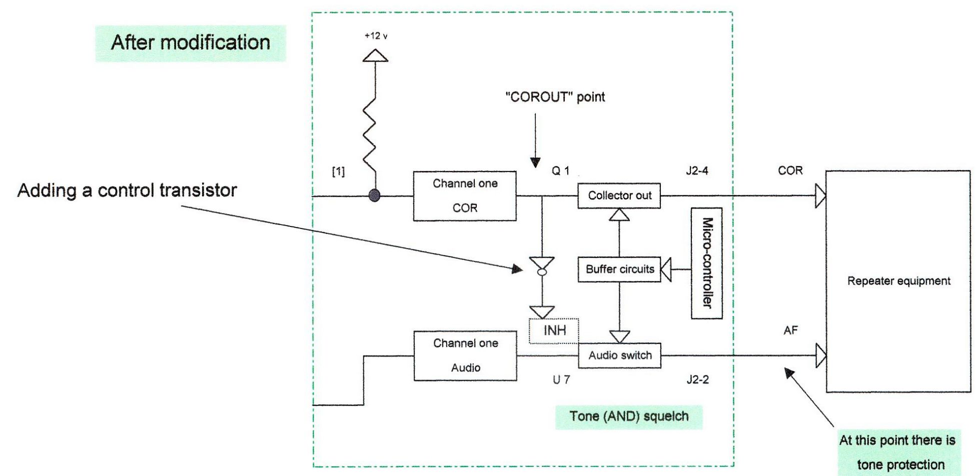
There's another circuit similar to U7 and its function. Looking at U8, being an 8-channel indication (or control) output, for external equipment does address pin 6 to some degree. With JPR1 in the "1" position enables the output all the time therefore, the indication would stay active (as the same as U7 arraignment). If its in position "3" (strapped to "COROUT") it produces the wrong logic state. To clarify, putting a low on pin 6 enables the output during standby. During activity it goes high, which disables U8's output. This makes no sense however; its possible JPR1 was an afterthought or future function not relevant to this issue or known to the Author (such as a post-activity vote indicator).

BLOCK & LEVEL

Before modification



After modification



NOTES:

CTCSS (tone panel) is 8-ports

Panel decodes valid user tone (links are passive and flat in response)

Panel takes in COR from link receivers

Panel converts both signals into an "AND" squelch COR output

Receiver audio feeds this panel and the voter

Receiver audio does not go through this panel

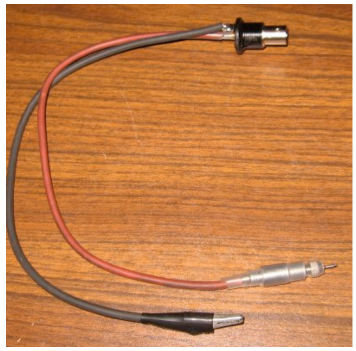
Voter has no squelch

Therefore, voter audio output is no longer tone protected, as stock (OEM)

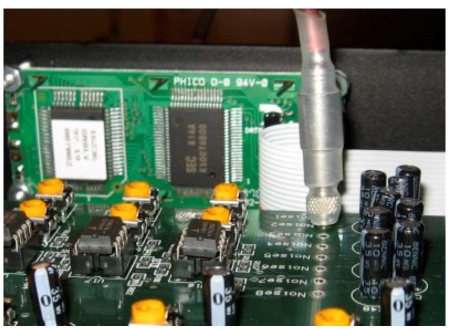
Design by: Karl Shoemaker, AK2O 2014

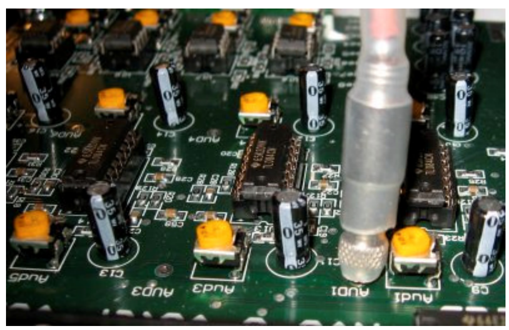
The alignment procedure (either in this manual or the OEM one) asks you to probe some TPs (test points) while adjusting some pots. Considering the probe, ground return and adjustment may take up several hands. Some tips are presented here to free up some hands (and people).

The first tip (pun intended) is too large (OD) to fit in the PCBs eyelets (used for measuring test points). This takes up another hand. To solve this problem you can file it down to decrease the OD of the tip so it will. To free up the other hand the return test lead (to ground) can have an alligator clip installed, then to grab a ground on the PCB edge. Better yet, a (ground) pin jack can be added to the unit. A nice spot on the chassis is the rear on the right, near the power-input connector for the (return) tip to plug into.



During alignment you are asked to adjust the pots while probing test points. The "Noise-x" TPs and pots are properly spaced apart for easy test pin insertion and pot adjustment as shown in the left image. However, the "AUD-x" TPs are in a tight area as seen in the right image. Performing the above modifications to your probe avoids slippage and possible damage to a circuit.





The second to the last step in the alignment procedure is assuming you wish the voter's channels weighted evenly. In the case you have a problem with an input receiver being interfered with a noise source that the voter may not response to (such as power line arcing), you could make the problem transparent by making the voter into not "wanting" that channel as much. By turning up the DC bias (noise pot) for that problematic channel the voter will skip over that channel unless it's real quite (user is strong and quite into it). Later, repairs, such as locating the arcing source and fixing it can be done in the summer, then you can restore that channel's reference to normal.

If you choose to use Q1’s collector as a direct (COR) output you’ll need to remove the relay K1 and install a jumper for output on J2-4. If you turn the RVS-8 off it will key any external equipment from D2 providing a “low” path (from the supply’s circuits) therefore, remove D2 as part of this modification.

In the event there’s a strange problem with the unit and power cycling will not clear it up you can do a hard reset with a monetary ground on pin 17 of U1.

As of 2013 it’s not confirmed these modifications won’t violate any warranty. Before attempting them it may be best to contact the factory, prior to. It’s hoped these points will increase the understanding of the RVS-8 voter and help the installer with issues that may come up. Now, on to the final section, which is the alignment (setup), on the next page.

Setup & Alignment:

Introduction:

The following alignment procedure in this document reflects developments and modifications by the Author described earlier in this manual. This alignment procedure is an alternate from the factory manual ver 1.1, page 13. It uses levels that are more in line with the Author's specifications and definitions. This might work for you as well. Otherwise, the factory manual and procedure may be appropriate.

The OEM indicates the voter is looking for either flat or de-emphasized (but not mixed) audio from all the inputs. Therefore, all the receivers need to be the same response. If you violate this rule the voter probably won't work properly. This is the most common problem found with a voted radio system and is mentioned in the OEM manual. This was previously discussed in this manual as well.

The (AC) audio levels for each channel can be different however; it's best to keep them the same. A good way to do this is establish audio level references, called audio Test Level Points (TLPs). It may help later in troubleshooting, including the ability to swap channels around should there be a suspected problem with the voter. The accurate method for this is in dBu, in "bridged" / unspecified impedance (load) measurement on an unspecified impedance of a circuit. Since some LMR/amateur folks struggle with anything other than "volts", and AC meter scales are in "dbm" we will call out the measurements in that in this manual just for simplicity. For example, SRG's MCP audio points are –5 dbm at this time. However, this is subject to change from R&D for improvements on the system.

The peak-peak voltage figure (the OEM manual describes) was converted to something more meaningful to the Author therefore, the alignment TP levels turn out to be about a –1 dbm. Per the manual, the second (noise) adjustment was not possible to obtain the +3.5 VDC figures. If you have the same issue, it was addressed earlier in this manual.

There are 8 adjustment pots for the 8 audio inputs called "AUD-x". There are also 8 adjustment pots for the 8 AF-DC conversion levels called "Noise-x". You will be adjusting the "AUD"s first, then the "Noise"s. Do this for each of the 8 channels. Refer to the factory manual for the locations of these test points on the PCB. For this alignment it's assumed you have the RVS-8 on the bench with a test receiver. A single test receiver can be used to set up each channel. Otherwise, the same procedure can be performed at the site, using the existing equipment (receivers). The receiver should be checked for optimization prior to alignment of the RVS-8, including to verify the receiver is on-frequency and proper audio output TLP.

Procedure:

Connect the unit's channel 1 with a link (or local) receiver with its outputs of audio and COR, and power it and the RVS-8 up for standby mode. You will be using a RF signal generator, at a medium level, on frequency, into the receiver.

Set the signal generator for a strong signal (-60 dbm is plenty) and modulate with a 1 KHz tone, deviated at 3.0 KHz (not at TLP). Maintain this setting for all the channels. This will produce a clean, "test" signal to align the RVS-8 with no receiver IF distortion or similar issues for this step.

Connect an AC voltmeter in bridge mode (high impedance) to the first "AUD" test point (TP11) (eyelet in the PCB). Adjust the first channel; with VR1 for a -10 dbm level at that point.

Drop the signal generator's RF input to the receiver and open the receiver's (carrier) squelch to produce full noise into this channel. Adjust this channel's noise pot VR9 for + 2.6 * volts DC at test point "A/D0", (TP3). This is your noise reference. It's a DC level, indicating full receiver noise.

Repeat these steps for the rest of the channels (2 ~ 8) with audio pots VR2~8 and DC pots VR10~16, respectively. This will get the unit aligned close enough for installing at the remote site. In other words, the remote "circuits" will be good-to-go. If you have installed the unit at the operational site/rack you could re-align all eight channels for each individual receiver connected to each channel. (tone level and DC reference). For conventional systems this may optimize the system.

* 3.5 volts for a conventional system.

Parts Listing:

Most of the part listing is in the kit assembly manual. In the event you don’t have it information in this manual may assist you in troubleshooting a problem with the unit.

ID	DIP	Device/Spec	Purpose
U1	No	68HC11	Micro-controller, heart of the system.
U2	14	LM339	Buffer/level converter. (U20 on old version drawing)
U3	8	X250XX	252LC040, EEPROM.
U4	--	---------	(not found on board version 3.4).
U5	No	7805	Voltage regular, 5v for most of the unit’s circuits.
U6	14	LM339	Buffer/level converter.
U7	16	CD4051	Audio switch, to “AUDOUT” point on rear panel.
U8	16	CD4051	Demultiplexer, for external equipment on J6.
U9	16	CD4503	Buffer/interface for input lines “RAWCOR”.
U10	16	CD4503	Buffer/interface for input lines “RAWCOR’ & “RAWDIS”.
U11	16	CD4503	Buffer/interface for input lines “RAWDIS”.
U12	14	TL084	Audio buffering and amplification for channels 1 & 2.
U13	14	TL084	Audio buffering and amplification for channels 3 & 4.
U14	14	TL084	Audio buffering and amplification for channels 5 & 6.
U15	14	TL084	Audio buffering and amplification for channels 7 & 8.
U16	8	CA3240	DC rectifier (bias reference) for channels 1 & 2.
U17	8	CA3240	DC rectifier (bias reference) for channels 3 & 4.
U18	8	CA3240	DC rectifier (bias reference) for channels 5 & 6.
U19	8	CA3240	DC rectifier (bias reference) for channels 7 & 8.
U21	4?	MAX232	??
X1	No	Crystal	Time base for U1; 8 MHz.
J1	Coaxial		Main power input (+12v).
J2	Screw barrier		Voted audio and COR outputs to station equipment (controller, Tx, etc.).
J3	Screw barrier		Disable inputs for channels 1~8. (Default program is active going high).
J4	Screw barrier		COR inputs for channels 1~8, (for SRG is active going low).
J5	Screw barrier		Audio inputs for channels 1~8 (from remote/local receivers).
J6	Screw barrier		Vote indicator (or control) output for external equipment.
J7	10	Header	Connects the main board to the front panel menu buttons. .
J8	14	Header	Connects the main board’s control lines to the LCD on the front panel.
VR1	Pot	100K	Audio input reference, channel 1
VR2	Pot	100K	Audio input reference, channel 2
VR3	Pot	100K	Audio input reference, channel 3
VR4	Pot	100K	Audio input reference, channel 4
VR5	Pot	100K	Audio input reference, channel 5
VR6	Pot	100K	Audio input reference, channel 6
VR7	Pot	100K	Audio input reference, channel 7
VR8	Pot	100K	Audio input reference, channel 8
VR9	Pot	100K	Noise to DC reference, channel 1
VR10	Pot	100K	Noise to DC reference, channel 2
VR11	Pot	100K	Noise to DC reference, channel 3
VR12	Pot	100K	Noise to DC reference, channel 4
VR13	Pot	100K	Noise to DC reference, channel 5
VR14	Pot	100K	Noise to DC reference, channel 6
VR15	Pot	100K	Noise to DC reference, channel 7
VR16	Pot	100K	Noise to DC reference, channel 8
VR17	Pot	100K	Contrast adjustment front panel LCD
VR18	Pot	100K	Voted audio output to J2 (turns in reverse)