VRC-176 MANUAL BY N3OC
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Tadiran VRC-176

Introduction

This document is an attempt to provide some documentation for the Tadiran VRC-176 & VRC-176A military radio sets. To date, no manual has been available for the VRC-176, although scans of the original manuals do exist for the RT-936 (PRC-174) transceiver contained in it.

I have blueprint size working copies of the original production drawings for most of the modules in the VRC-176 & CP-769, but these are way too large to include in this document. Contact me if you have a need for a specific drawing. These are probably the only VRC-176 schematics available in the USA.

This document is by no means a complete manual for the radio set, but it is a starting point and will be added to as additional information is discovered.

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Model Complement

The VRC-176 & VRC-176A radio set consists of the following major assemblies:

RT-936 (PRC-174) transceiver
MT-1760/VRC-176 mount
AM-1760/VRC-176 (or AM-1760A-HF) 100 watt amplifier
CP-769 antenna coupler
CX-1762 ATU (coupler) control cable
CX-4720 DC power cable
CX-1763 dogbone cable
CG-409 RF cable (BNC-M to BNC-M)
15' vehicle whip (part number needed)

VRC-176A Differences

The VRC-176A is almost identical to the VRC-176. In fact, all internal modules are swappable between the two. The only difference is the front panel module.

The VRC-176 has a front panel module with no digital frequency display, and a 66 pin front connector that matches with the 66-pin "round" connector used on export versions of the RT-936.

The VRC-176A has a digital display added to the front panel module, and a 66-pin front connector that matches with the 61-pin "small hex" connector used on the Israeli versions of the RT-936.

Oddly enough, both dogbone cables are marked CX-1763 even though they have very different connectors on each end.

There appear to be a couple up-level revisions to some of the modules inside the AM-1760A amplifier, but none that prevent module swapping between each version of the unit. There is also one jumper added on the motherboard between the R/T's PTT and the PA module, but it is not clear what this jumper does. I removed it and nothing changed.

AM-1760 top view

Module Listing

The following table is the module listing for the VRC-176 and VRC-176A:

2121-91810-00	2A1 Front panel module, VRC-176
2121-91150-00	2A1 Front panel module, VRC-176A
2121-91830-00*	2A3 Variable att., pre-driver, driver (VPD) module
2121-91840-00*	2A4 Pre amplifier module
2121-91850-00*	2A5 Power amplifier module
2121-91860-00*	2A6 Harmonic filters module
2121-91870-00*	2A7 ALC module
2121-91880-00*	2A8 Interface module
2121-91890-00*	2A9 Power supply, high, module (40V)
2121-91900-00*	2A10 Power supply, medium, module (12V)
2121-91910-00*	2A11 Power supply, low, module (5V)
2121-91920-00*	2A12 Audio module
2121-91930-00*	2A13 Power sensor module
2121-91950-00*	2A14 Rear panel assembly
2121-91820-00	Case assembly
2121-92080-00	Upper cover assembly
2121-92090-00	Bottom cover assembly
2132820-B	Motherboard
2132070-A	2A1A4A2 module VRC-176A display board

***HAVE SCHEMATIC**

Disassembly

The AM-1760 is easily disassembled. Remove the top and bottom covers using a straight-blade screwdriver.

Remove the front panel by loosening all six screws using a 1/8" hex key. Gently pry the front panel straight off slightly. There are still cables connected behind it. ***Be very careful that you do not stress these cables by removing the panel too far until you reach behind and disconnect them!***

Once the front panel is clear, remove the input and output RF cables. The input RF cable is a push-on SMA connector, and the output RF cable is a screw-on SMA connector.

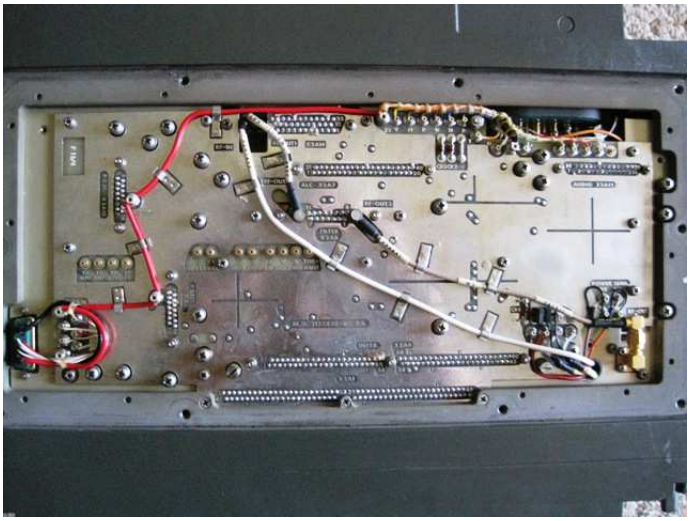
Remove the X2A14 power amplifier assembly by loosening all six hex screws using a 1/8" hex key. Note that is not necessary to remove the fan cover or fan to remove the X2A14 module. Once the screws are loose, pull the entire module straight out of the back of the amplifier chassis. All connections are on one connector and it will pull straight out.

AM-1760 power amplifier assembly

To remove individual modules from the motherboard, locate the Phillips head screws that correspond to module being removed. Note modules can have either two, three or four screws holding them in. Once the screws are loosened, use the module puller handles located on the inside of the top lid stowed under two spring clips. Thread these into the top of the module to assist pulling the module out.

Power Distribution

The motherboard contains test points for the 40V, 24V, 12V and 5V power supplies.



AM-1760 motherboard

It is safe to power the unit by connecting 24V to the large red wire on the bottom of the mother board, and ground. This will allow some simple power supply troubleshooting on the bench. Connecting it directly in this way bypasses the on/off switch so be aware of that.

The low power supply module supplies 5V, the medium power supply module supplies 12V, and the high power supply module supplies 40V. 24V is supplied directly by the radio set power and has no module. Note that the 24V and 40V test points are not active unless the radio is keyed. There will be 0V on the 24V test point, and 24V on the 40V test point until the radio is keyed. Only the 5V and 12V test points are valid unless the set is keyed.

Servicing the AM-1760

Without the proper extension cables, servicing the AM-1760 can be a challenge since the dogbone cable that interconnects it with the RT-936 is extremely short. It is possible to service the AM-1760 if you are extremely careful and unscrew the dogbone cable shell at the AM-1760 connector exactly one quarter turn counter-clockwise.

Servicing the AM-1760

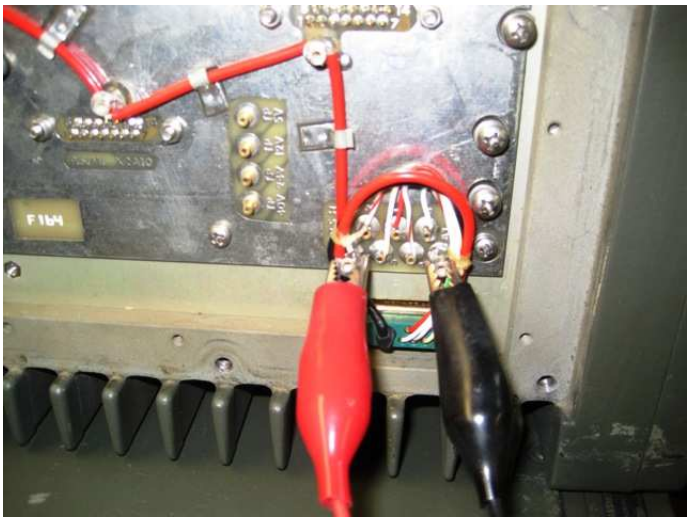
The above picture shows the AM-1760 sitting on top of the RT-936 on it's right side, with the dogbone cable shell unscrewed slightly CCW to accommodate this position.

If your dogbone cable does not want to loosen its shell, don't force it. You can bend the cable 90 degrees without loosening the shell if you are very careful.

Close-up of servicing the AM-1760

This allows access to the top and bottom of the AM-1760 while the unit is connected to the RT-936 and can be operated for testing.

In this configuration, the RT-936 is still plugged into the mount, and powered by the normal power cable going to the mount. But since the AM-1760 is removed from the mount's connector, you must supply 24V to the AM-1760 from a separate source.

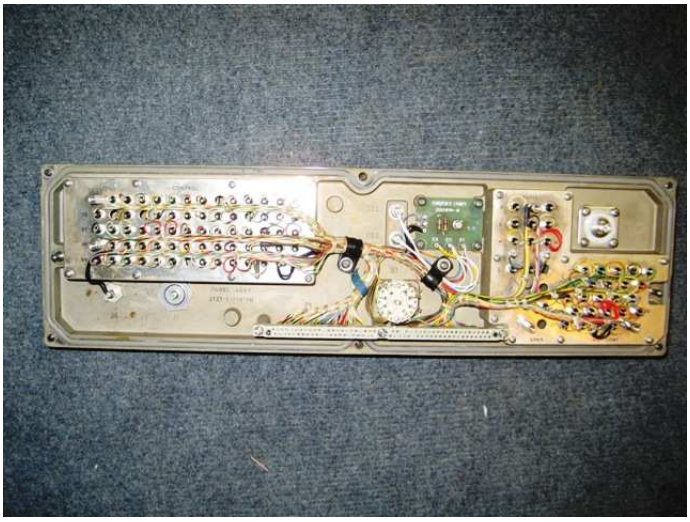


Powering the AM-1760 while servicing

In this case, a set of clip leads is being used to provide +24V and ground to the AM-1760 motherboard directly. Be careful doing this, you can easily fry something if you get it wrong, but when set up correctly this does work and you can operate the AM-1760 under full power for testing and troubleshooting.

Front Panel

The front panel is fairly simple, and provides interconnection between the AM-1760 mother board and the external connectors for the RT-936, the antenna coupler, and audio accessories. It also contains the OFF/LOW/HIGH switch to control the amplifier function. The AM-1760A front panel is the same, but contains an additional circuit to read the RT-936 frequency switch BCD lines and display the frequency on an LED display. All inputs and outputs are filtered with feed through capacitors.



VRC-176 Front Panel

See the disassembly section for instructions on how to remove the front panel. ***Be very careful to remove both the input and output RF coax before you pull the front panel off too far.*** Otherwise, you will be replacing SMA connectors on coax cables that are already very short.

The following tables list the interconnection points and signal names in the front panel module for both the VRC-176 and the VRC-176A.

Front Panel 2121-91810-00

SIGNAL NAME	P1	RT CONTROL	ANT CONT	AUDIO	SPKR	S1	ON/OFF BD	DS1 CP	DS2 AM
10KHZ BCD2	1	11							
AM	2	37							
SSB	3	42							
DATA	4	22							
NCW	5	20							
10KHZ BCD8	6	45							
WCW	7	21							
TRANSIT	8	19							
BP (PA) +26V	9	56							
NO MATCH	10	48							
ALC	11	54							
TUNE	12	29							
100KHZ BCD8	13	7							
100KHZ BCD4	14	18							
100KHZ BCD2	15	35							
100KHZ BCD1	16	58							
10KHZ BCD1	17	3							
TX LEVEL	18	28							
100HZ BCD4	19	12							
1KHZ BCD4	20	6							
IND	21	13							
N/C	22	43							
100HZ BCD2	23	4							
10KHZ BCD4	24	25							
BATT CHK	25	27	4						
ON	26	39	6						
R/T	27	41	8						
COUPLER 14	28		14						
N/C	29								
S1A COMM	30					S1A COMM			
SAVE	31	47							
COUPLER 22	32		22						
COUPLER 9	33		9						
COUPLER 11	34		11						
COUPLER 12	35	31	12						
PTT	36	52		F					
PTT 12V	37	55							
N/C	38	9							
COUPLER 21	39		21						
COUPLER 1	40		1						
COUPLER 24	41		24						
COUPLER 16	42		16						
N/C	43								
COUPLER 20	44		20						
VOL REMOTE	45	15	3						
1MHZ BCD8	46	44							
1MHZ BCD4	47	24							
1MHZ BCD2	48	59							
1MHZ BCD1	49	36							
FO UNLOCK	50	30							
MHZ BCD1	51	2							
MHZ BCD2	52	10							
N/C	53								
AUDIO L	54			L					
GND	55	66	23	E	A		E		
GND	56	66	23	E	A		E		
GND	57	66	23	E	A		E		
AUDIO C	58			C					
AUDIO D	59			D					
POWER	60		18	K					
POWER	61		18	K					
POWER	62		18	K					
100HZ BCD1	63	5							
VRC ON	64					S1B LO, S1B HI			
UNKNOWN	65	62							
N/C	66								
KHZ BCD8	67	1							
GROUND	68			E					
AUDIO H	69			H					
N/C	70								
N/C	71								
SPKR AUD HI	72				D				
UNKNOWN	73	65							
1KHZ BCD1	74	34							
SQUELCH? N/C?	75	46							
RT DIF / VRC HI PWR	76	33				S1A HI			
100HZ BCD8	77	26							
1KHZ BCD2	78	17							
FIXED AUDIO	79	57		J					
MIC GND	80	49							
MIC HI	81	50							
PHONE (RX HI)	82	51		A					
LT (M.N. BP)	83	61							
CP ALARM LIGHT	84						E3	DS1	
COUPLER 7	85		7						
COUPLER 5	86		15						
COUPLER 2	87		2						
USB	88	40	17						
COUPLER 5	89		5						
S METER	90	32	19						
+12V		53					B		
COUPLER 10		63	10						
COUPLER 13		64	13						
N/C				B					
LIGHT COMMON							E2	DS1	DS2
AM PWR LIGHT							E1		DS2
RT SW 12V						S1B COM	C		

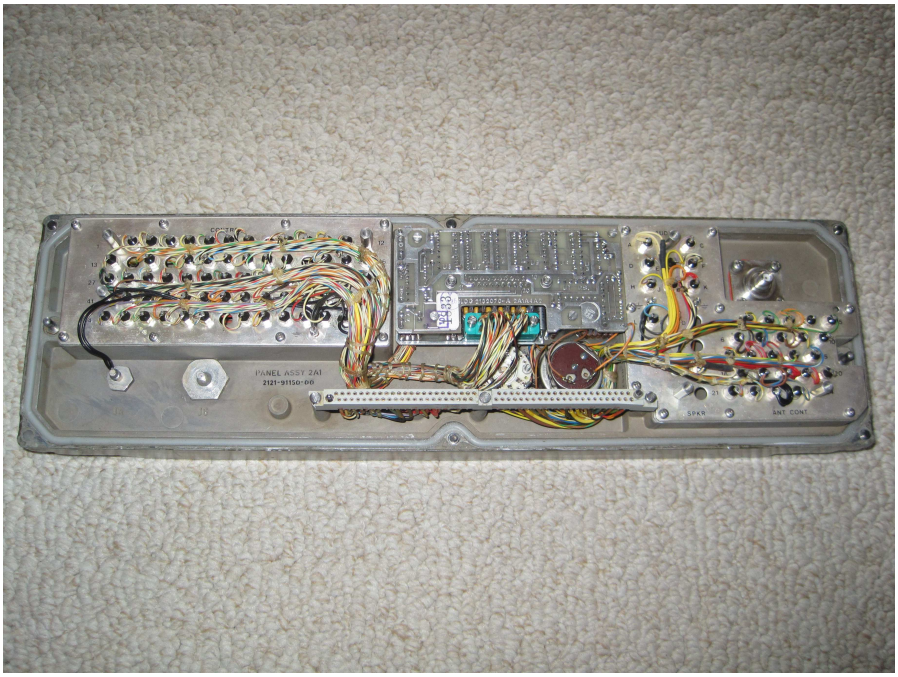
Front Panel 2121-91150-00

SIGNAL NAME	P1	RT CONTROL	ANT CONT	AUDIO	SPKR	S1	ON/OFF BD	DISPLAY BOARD P1	WIRE COLOR
KHZ BCD8	67	1						GG	WHT/ORN
MHZ BCD1	51	2						H	WHT/YEL/BRN
10KHZ BCD1	17	3						I	WHT/BRN/BLK
100HZ BCD2	23	4						O	WHT/YEL/BRN
100HZ BCD1	63	5						R	WHT/GRN/BRN
1KHZ BCD4	20	6						AA	WHT/RED/BLU
100KHZ BCD8	13	7							WHT/ORN/BLK
N/C	38	9							
MHZ BCD2	52	10						F	WHT/GRN/BRN
10KHZ BCD2	1	11						L	WHT/YEL/BLK
100HZ BCD4	19	12						Q	WHT/GRY/RED
IND	21	13							
VOL REMOTE	45	15	3						
1KHZ BCD2	78	17						CC	WHT/ORN/GRN
100KHZ BCD4	14	18						N	WHT/BLU/BLK
TRANSIT	8	19							
NCW	5	20							
WCW	7	21							
DATA	4	22							
1MHZ BCD4	47	24						D	WHT/BLU/BRN
10KHZ BCD4	24	25						EE	WHT/BRN/BLK
100HZ BCD8	77	26						U	WHT/GRN/YELL
BATT CHK	25	27	4					Y	GRN/BLK
TX LEVEL	18	28							
TUNE	12	29							
FO UNLOCK	50	30							
COUPLER 12	35	31	12						
S METER	90	32	19						
RT DIF / VRC HI PWR	76	33				S1A HI			GRN/BRN
1KHZ BCD1	74	34							
100KHZ BCD2	15	35						E	WHT/GRY/BLK
1MHZ BCD1	49	36						X	YEL/BRN
AM	2	37							
ON	26	39	6						
USB	88	40	17						
R/T	27	41	8						
SSB	3	42							
N/C	22	43							
1MHZ BCD8	46	44						C	WHT/ORN/RED
10KHZ BCD8	6	45						FF	WHT/YEL/GRY
SQUELCH? N/C?	75	46						B	ORN/BLU
SAVE	31	47							

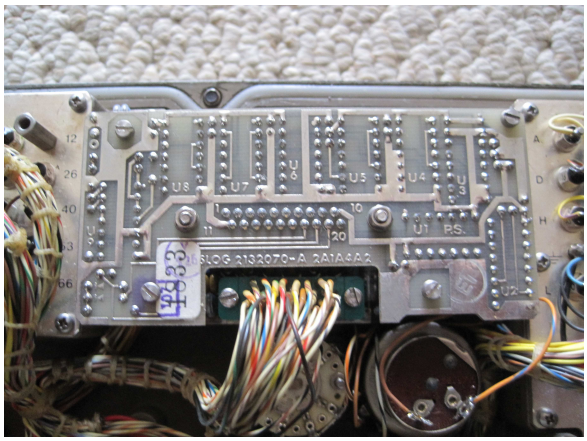
NO MATCH	10	48						V	WHT/RED
MIC GND	80	49							
MIC HI	81	50							
PHONE (RX HI)	82	51		A					
PTT	36	52		F					
+12V		53					B		
ALC	11	54							
PTT 12V	37	55							
BP (PA) +26V	9	56							
FIXED AUDIO	79	57		J					
100KHZ BCD1	16	58						G	WHT/VIO/BRN
1MHZ BCD2	48	59						K	WHT/BLU/BRN
LT (M.N. BP)	83	61							
UNKNOWN	65	62							
COUPLER 10		63	10						
COUPLER 13		64	13						
UNKNOWN	73	65							
GND	55	66	23	E	A		E		
GND	56	66	23	E	A		E		
GND	57	66	23	E	A		E		
COUPLER 14	28		14						
N/C	29								
S1A COMM	30					S1A COMM			
COUPLER 22	32		22						
COUPLER 9	33		9						
COUPLER 11	34		11						
COUPLER 21	39		21						
COUPLER 1	40		1						
COUPLER 24	41		24						
COUPLER 16	42		16						
N/C	43								
COUPLER 20	44		20						
N/C	53								
AUDIO L	54			L					
AUDIO C	58			C					
AUDIO D	59			D					
POWER	60		18	K					
POWER	61		18	K					
POWER	62		18	K					
VRC ON	64					S1B LO, S1B HI			
N/C	66								
GROUND	68			E				HH	BLK
AUDIO H	69			H					
N/C	70								
N/C	71								
SPKR AUD HI	72				D				
CP ALARM LIGHT	84						E3		
COUPLER 7	85		7						

COUPLER 5	86		15						
COUPLER 2	87		2						
COUPLER 5	89		5						
DISP BRIGHT POT								J	WHT/ORN/BRN
DISP BRIGHT POT								M	
DISP BRIGHT POT								P	
DISP POWER								Z	BRN
N/C				B					
LIGHT COMMON							E2		
AM PWR LIGHT							E1		
RT SW 12V						S1B COM	C		

The VRC-176A front panel is almost identical to the VRC-176 front panel, with the exception of some additional wiring and the display decoder circuitry. The front panels are swappable between the two, but be aware the radio control connector may be different and require a different dogbone cable. VRC-176A's seem to connect to the small hex (Israeli version) PRC-174 connector, and VRC-176's seem to connect to the large round (export version) PRC-174 connector.



VRC-176A Front Panel



VRC-176A Display Board

ALC Board Adjustments

Here is some information on adjusting the pots on the ALC board. Most issues with the VRC-176 sounding like it is dropping out seem to be helped by adjusting these pots. Remember, we don't have the official alignment procedure, so the information presented below is what I have determined from trial and error and a printout from the Tadiran autotest system and should help you set up your ALC module to be close. The amplifier in these units is robust and has no problem putting out over 125 watts, but set them at a hair above 100 to be safe (101-104, something like that).

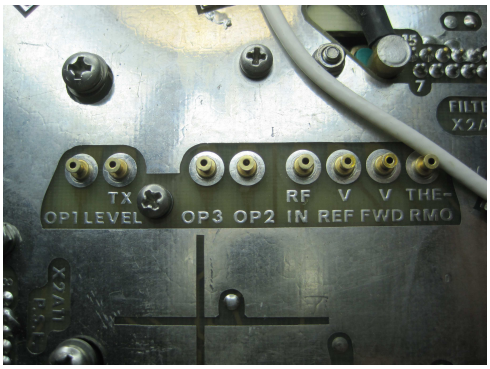
I just recently acquired the schematics for the VRC-176, and am still digesting how the ALC module works. Included with this was a printout from what appeared to be a rudimentary autotest system that shows some alignment voltages for these adjustments. This seems to be the major alignment/setup point in the VRC-176.

ALC Module Adjustments

IN (R42)	Input adjustment from PRC-174.
HC (R75)	High power CW mode. Set for 100w out in CW mode, amp on hi.
LS (R46)	Low power SSB mode. Set for 20w out in SSB mode, amp on low.
HS (R47)	High power SSB mode. Set for 100w out in SSB mode, amp on hi.
TU (R37)	Tune level. Not sure of adjustment.
LC (R52)	Low power CW mode. Set for 20w out in CW mode, amp on low.

CL (R95) Believed to be ALC cutoff level. Not all modules have this adjustment.

These pots appear to be wired backwards from what you might think. Usually CCW increases the power, and CW decreases it. So be prepared for that. Use a small flat blade jeweler's screwdriver or an alignment tool to adjust these.



Motherboard Test Points

IN – this adjustment seems to be the input drive level from the PRC-174 to the amplifier, and ends up controlling the ALC voltage of the AM-1760 amplifier. It does not have much affect on most radios, and some seem to be touchier on others. If your audio seems to be chopping up, start here and increase the IN adjustment (CCW) a few turns. When setting this from scratch, I turn it down all the way (fully CW) and see if the amp drops out completely. Some will not. Then I turn it CCW while injecting a tone into the mic input until the amp gates on to full power, then increase it a few more turns CCW. If you have a RT/Amp combination that this adjustment seems to have no effect on, then I recommend setting the pot in the middle, about 8 turns from either end. You can tell when any of these pots are at the end by a clicking sound as you turn it repeatedly.

The ALC board schematic and the ALC test procedure pass/fail points seem to suggest that you monitor the DC voltage on pin 34 of the ALC module while injecting a tone into the mic input of the PRC-174, and adjust the IN control for at least 2VDC. The test printout I have shows a result of 2.1 volts as good. There is no maximum shown, so I would adjust for slightly above the minimum.

HC – Put the RT on CW, and key it up with the amp on high power. You should get a 100 watt carrier out. If not, adjust HC to set it at 100 watts. CL also has an effect also. Adjust HC until the maximum power you can get just starts to go down, then adjust CL for 100 watts out. The schematic and ALC test limit results indicate you should adjust R75 (HC) for a VFWD of between1.2 and 1.5 volts at the VFWD test point in the center of the motherboard.

HS – Now inject a tone in the mic jack of the RT, and key it up on SSB with the amp on high power. You should get a 100 watt PEP signal out. Make sure you are using a wattmeter that reads PEP properly. If you do not get 100 watts out, adjust HS until you do. If you still cannot get 100 watts out, be advised that HC still seems to have some effect on SSB. Adjust HS a hair below the maximum PEP power you can get out, then go back and touch up HC and that should increase the PEP power to 100 watts. Then go back and re-check CW and if it has changed, use

CL (not HC) to set the CW signal back to 100 watts. Then go back and check SSB and it should still be 100 watts. The schematic and ALC test limit results indicate you should adjust R47 (HS) for a VFWD of between .9 and 1.3 volts at the VFWD test point in the center of the motherboard.

LC – Put the amp on the low power setting, and the RT on CW and key it. You should get 20 watts out. If not, adjust LC for 20 watts out. The schematic and ALC test limit results indicate you should adjust R52 (LC) for a VFWD of between .4 and .65 volts at the VFWD test point in the center of the motherboard.

LS – Inject a tone in the mic jack of the RT, and ket it up on SSB with the amp on low power. You should get 20 watts out. If not, adjust LS for 20 watts out. The schematic and ALC test limit results indicate you should adjust R46 (LS) for a VFWD of between .3 and .6 volts at the VFWD test point in the center of the motherboard.

TU – I think this has something to do with the output level that is used to tune the CP-769 coupler. I have no info on this adjustment, so leave it alone unless you have a CP-769 coupler and are having problems getting it to tune. It is adjusted for a VFWD of between .4 and .65 volts but we don't know the setup conditions to test this. Since those test voltages are identical to LOCW (LC) test voltages, one might assume that you adjust TU with the AM-1760 set to low power and the PRC-174 generating a CW signal, making the test conditions the same as for the LC adjustment.

CL – As previously stated, this is most likely ALC limit. Adjusting this has an effect on overall output power. Until we know more, it is suggested that you adjust HC as stated above in the HS section. There is an internal CLC test point (TP6) on the module, which is adjusted for between 6 and 6.4 volts, but it is not accessible from the outside of the module.

Audio Quality Issues

There seems to be somewhat of a transmit audio quality issue with the VRC-176 and VRC-176A. The VRC-176A seems to be a little worse than the plain VRC-176.

These units seem to gate the amplifier circuits by sensing exciter RF from the RT unit, and not simply on PTT. If the input RF falls below the threshold in the amplifier, the amp gates off and power drops down to exciter level. The amplifier also has a variable attenuator in the pre amplifier/driver section, and may be attempting to dynamically adjust the input attenuation to match the input level from the RT. This seems to not work very well under some situations.

And to make matters worse, the VRC-176A seems to have a "no man's land" where the amplifier is partially gated on (if that is possible) resulting in some non-linear sounding audio.

If your unit seems to be gating off more than it should, try adjusting the IN pot on the ALC module CCW a bit to increase the input level. See the above section for information on setting up the ALC module.

Until a more definitive solution is found, the best defense against this seems to provide the RT with plenty of mic audio and therefore plenty of drive signal to the amplifier gating circuit. If you are lazy on the mic, the amp will close up, or worse yet end up in the no man's land where it is half gated on and transmits distorted audio.

I have spent a lot of time looking for this problem, and right now it looks like it is coming from the variable attenuator module in the PA deck. Until we get a manual for this (if we ever get one) this might be the best we can do. I swapped every module between a fairly good sounding VRC-176 and a fairly bad sounding VRC-176A and the only guidance I can offer is the above setup information for the ALC module, and hitting the RT with plenty of transmit audio when speaking. (I am looking into the possibility of a mod to fix the variable attenuator at the proper level for 20 watts of drive from the RT and maybe that will end this problem once and for all.)

Proper alignment of the ALC module seems to help also.

Alarms

The VRC-176 and VRC-176A have two alarms that will be displayed on the front panel.

The first is a coupler alarm, and on the VRC-176 will illuminate the C lamp on the front panel. On the VRC-176A, the frequency display will alternate between the frequency and a C. You can still operate the radio set with a coupler alarm, and it is normal to have a continuous coupler alarm when the CP-769 coupler is not connected.

The second alarm is an amplifier alarm, usually triggered by unacceptable reflected power being sensed by the AM-1760. On the VRC-176 it will illuminate the A lamp on the front panel. On the VRC-176A, the frequency display will alternate between the frequency and an A. You cannot continue to operate the radio set with an A alarm, and it will also trigger the error beeps and flashing LED on the RT-936. This condition must be rectified before you can transmit.