Rockwell Collins 651S-1/1A Receiver

Scrap Book

Preface: The Small Print

When using the information on these pages for your work please note the following terms and conditions. By using any of the information presented you accept these terms. Thank you!

Restoration Projects Philosophy

The purpose of many restoration projects described here is to bring the antique equipment back into working condition close to original specifications while generally preserving their historic electronic and mechanical design. This means that often new components (e.g. capacitors) need to be used - in many cases NOS will not do - which sometimes require small mechanical modifications to the set.

This treatment does not conform to "museum" standards that require everything to be left or restored to original. This is an entirely different approach. It is up to you to decide what you want to do.

Modifications and Homebrew Projects

The projects shown are for information only with the main goal to motivate fellow amateurs and hobbyists to start on similar projects. Comments for improvements are always welcome. They are always "prototypes" and not a kit. You'll have to find your own parts. No warranty is given nor implied that they actually work in your situation.

And please note that a modified piece of equipment looses its collector value - but brings joy to its successful operator!

Copyright

Regulations

Many of the described obsolete radios (or computers) no longer fulfill today's requirements for e.g. electrical safety, EMC, used bandwidth, levels of harmonics or spurs or intermodulation. While at times suitable corrective action is included in my descriptions, many times it is not. It is your responsibilty to make sure your equipment conforms to the requirements in your own country.

Safety while Working on the Projects

*It is your own responsibility and all-important to always observe proper safety procedures in your work. Some of these projects - certainly almost all vacuum-tube circuits - involve high voltages, some lethal indeed. Make sure you understand what you are doing or else get some qualified help here. Just look at **this page** to see some tips on this one.*

Always "Switch to Safety" when you work on your equipment! Please pay attention to proper grounding of all metal chassis and enclosures and consider the use of GFCI breakers to your shack/workbench.

This information and much more can be found on my website hb9aik.ch

Table of Contents

1 Replacement of Display Units (tubes or Collins LED modules)

To find the green display tubes or the DL-747 LEDs has proven to be extremely difficult so I came up with a simple alternative:

This solution is special in that it applies to receivers with the original green tubes or the later Collins LED module mod ***but here no modification to the receiver*** is needed!

1.1 New 7-Segment Displays

The **7-segment displays** used are HER (high efficiency red) Agilent (HP) HDSP-H103 (14.2 mm high digits) common cathode types. They're made from AlGaAs material (not GaAs only) and produce about 600 µcd of light at 1 mA. This is a lot more than standard LED displays and thus allows the use of the original tube circuit to drive the LED elements! Unfortunately they're available red only, the green ones need 4 mA for the same brightness.

The **651S-1 circuit** from board **A14** provides about **1.5 mA** from the 25 VDC (nom) supply rail. The cathode is grounded (available on socket pin 9) and pin 6 is no longer used here so it does not matter whether the radio has been converted to LEDs or not. Thus the „Warning“ sticker included with the Collins LED mod can be ignored at this point.

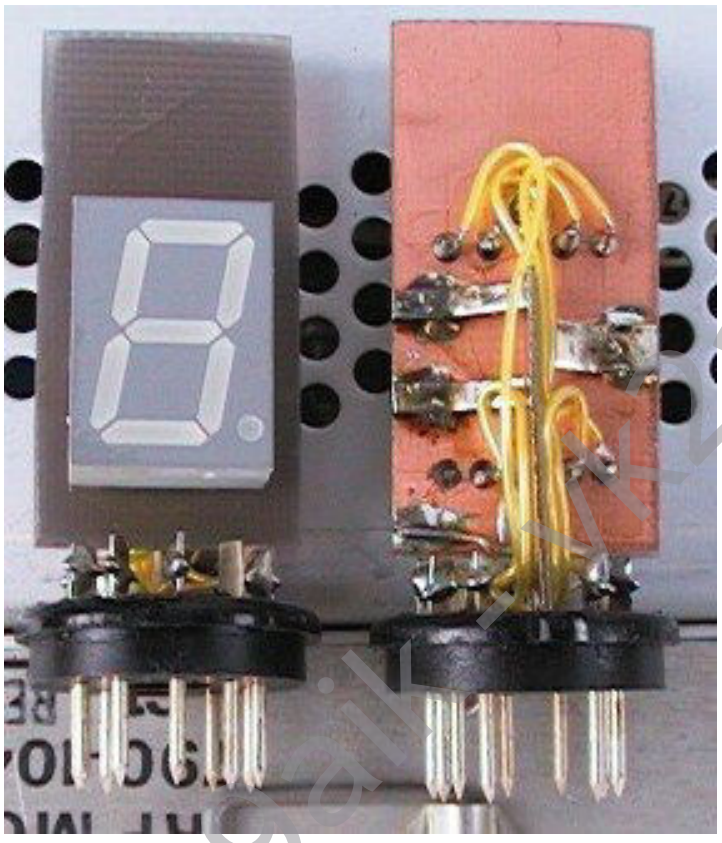
Explanatory Note: *in the original tube circuit there is a 100 Ohm resistor to +5VDC - providing the filament voltage - while after the Collins LED mod +5VDC is directly applied to pin 6 to supply the module*.

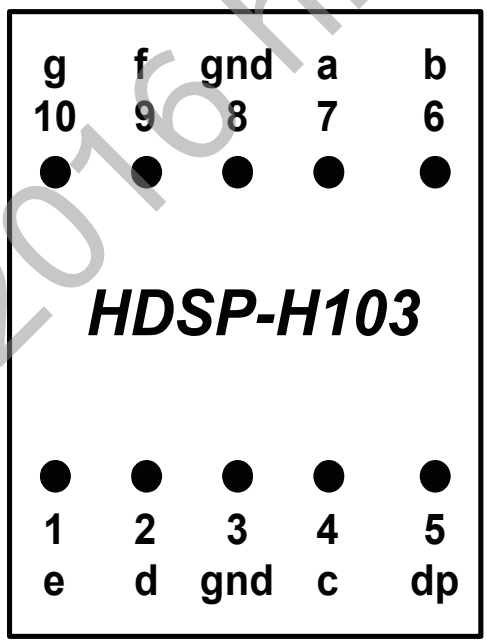
The wiring to the socket pins follows the segments: A=1, B=8, C=7, D=5, E=3, F=2, G=4, cathode=1. There are no other components required (no inverter IC as in the original Collins mod), the display works like the tube did, just no filament and nice and bright.

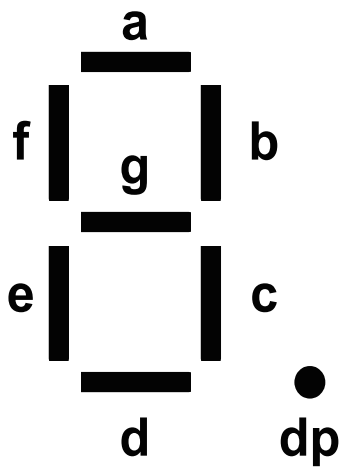
The **LED displays** are mounted individually on 9 pin base plugs (N.O.S.) using a blank drilled p. c. board and point to point wiring. The LED display is soldered to the board with cathode pins 3 and 8. The board surface is connected to pin 1 on the socket. Just watch orientation and position of the board when mounted on the 9 pin plug. The boards could be a bit closer to the front panel compared to my modules (e.g. in line with pins 3 and 7). The result is very satis-factory and no difficult disassembly or mod to the radio required.

You can instantly go back to the Collins design if and when desired.

1.2 Module (as built, six needed)







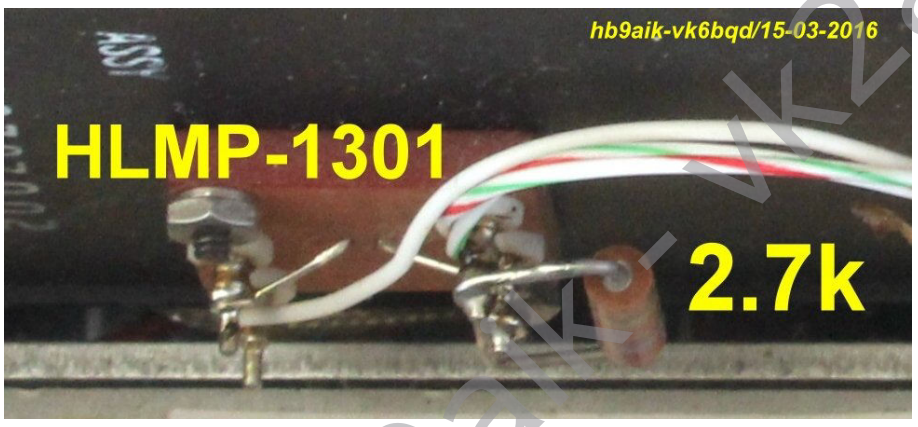
1.3 The Decimal Points

The **decimal point displays** could be solved the Collins way by activating the d.p. on a LED module through a resistor (value t.b.d. depending on whether in the receiver the 100Ohm resistor is still in place or not to achieve matching light intensity).

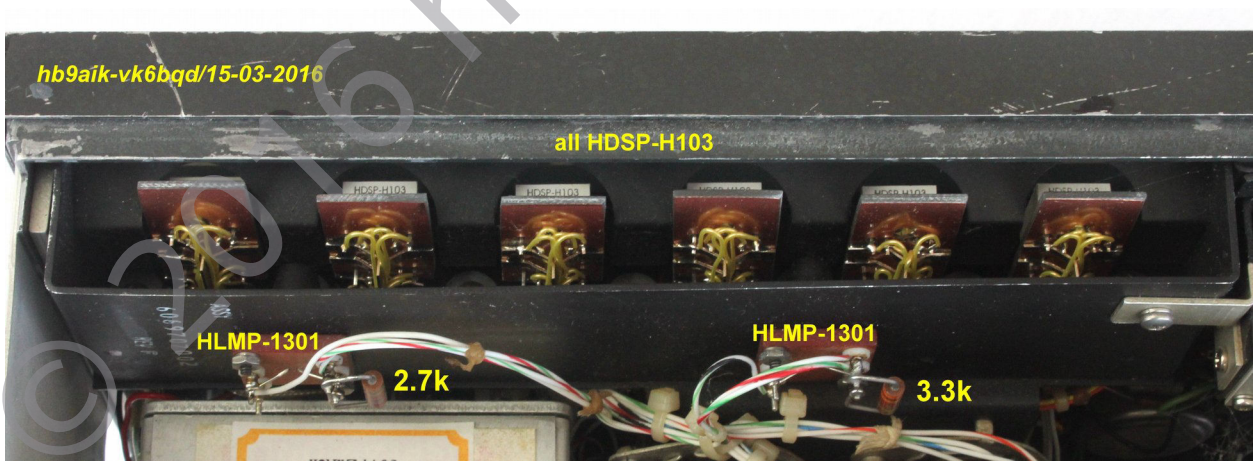
In my Project however HER Agilent (HP) HLMP-1301 LEDs were used **in place of the light bulbs** in their original plastic fittings. With this solution the decimal points appear in their original locations and remain as , and . respectively.

Replace the 150 Ohm series resistors to the +25 VDC rail with 2.7/3.3 kohm resp. To obtain the necessary brightness, this is a mod to the rx and requires some disassembly work to to the front panel to remove the fittings and fit the LEDs. I thought it worthwhile.

For details refer to the picture.



1.4 Overall Picture



Original Document:
Dec. 2002 hb9aik - vk6bqd
Revised 03-2007 and 03-2016

2 Fan replacement

2.1 Phase 1: 115V AC Fan

The 115VAC fan was replaced with a NOS ball bearing unit (DEC spare) in **Radio #2 152**.

The DEC units turn faster and make more noise with the original 1kOhm series resistor than the old original fan. This R205 was increased with a separate 260Ohm power resistor to reduce speed as the noise was considered too high. With 560Ohm in series with R205 the fan still turns but picks up speed very slowly – might risk to not start at all.

This setup was used for several years but the radio was rather noisy when moved to new, quieter surroundings due to the noise from the ball bearing being transferred to the chassis. Also the fan was large and stuck out behind the cabinet. When the radio failed and had to go to the workshop anyway it was decided to - once again - change the fan.

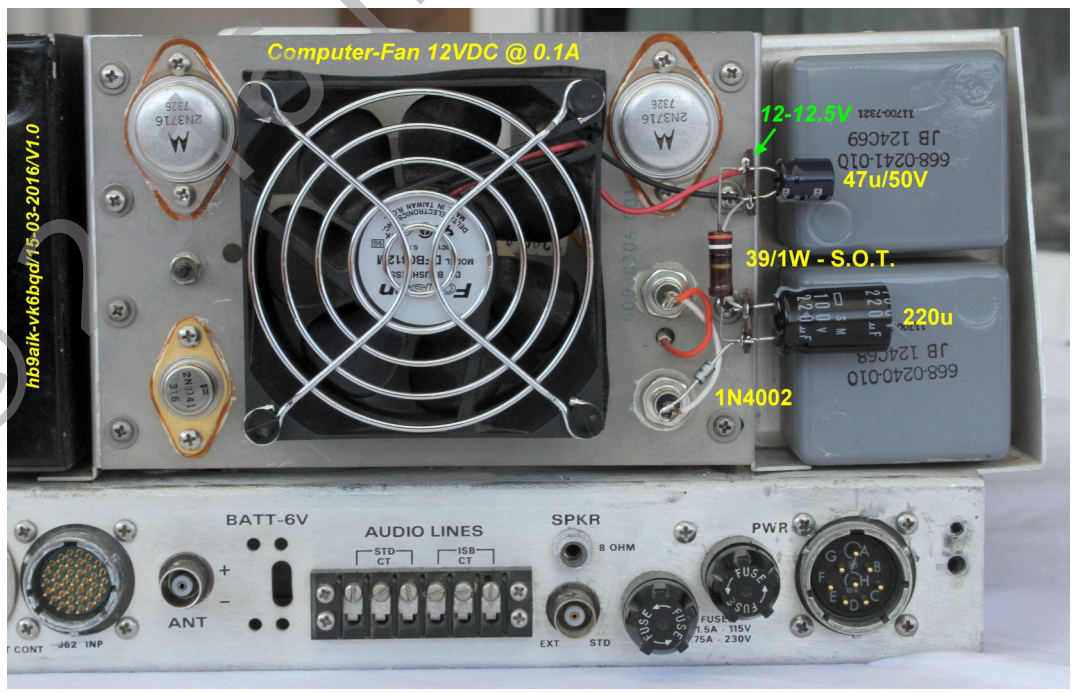
2.2 Phase 2: 12V DC Fan

Standard computer fans are easy to get and produce less noise due to advanced shaping of the blades but mostly require 12VDC to run them. So where to get the power for the fan without further loading the pass transistors on the heat sink?

The solution was found right beside the fan on the rear side of the heat sink: The output of CR203 and CR204 which goes on to the series choke L202 . A rectified half-wave voltage with a DC offset can be observed there which can be used to charge an additional capacitor (220uF) through a 1N4002 diode. This results in around 16VDC under load, still with ripple.

A series resistor is needed to drop this to 12V for the fan (39ohms/1W here, select for the fan used in a test) and a capacitor (22uF/50V) takes care of the current spikes from the inverter in the fan. No EMC problems were observed in the receiver.

The fan used is a 12V/0.1A model, this is still audible but was needed to provide sufficient air flow. A test of over 24h @ 25°C showed a very reasonable temperature of the heatsink. The choice of the fan can certainly still be optimized, this one happened to be in stock.



3 Power Supply Electrolytics, Replacement

Although no damage was visible, the 1973 capacitors in **Radio #2 152** were replaced with NOS units taken from my stock due to age and long hours.

The big capacitors are now quality unused NOS, reformed before installation and enough identical units are available from stock to modify all my radios – thus the choice of values. It should be noted that lower values could affect undervoltage operation – this was not tested as great drops are not a problem here (230V single phase standard).

More generally though C205 and C207 being „Computer Grade“ may probably be left in in most cases – none has failed in any of my 4 radios - but **C210 must be replaced**, it is a standard component and gets quite warm in its „heated“ location.

Todays low ESR industrial grade capacitors designed for use in switching power supplies would also be fine for the two big units, such fine performance was simply not available in standard components in the late 60ies or early 70ies.

3.1 +5V supply

- C210 1'000uF/50V with Rifa Long Life 680uF/40V
- C205 30'000uF/50V with Computer Grade 24'000uF/50V (DEC spare)

Notes:

- The new C205 is longer and thinner than its old counterpart and required a different clamp and mounting.
- 2'200uF was tried for **C210** but this raises input to regulator from +10V nom. to +14V, *overheating Q201*. 680uF (in stock then) was found to produce +10.6V on test, the original 1000uF should be ok as well. Choose 105°C industrial quality due to its location and the high ripple current.
- Ripple measured on C205 is less than 50mVrms, on C207 less than 150mVrms. Lower uF values did not appear to change p.s. performance (see note above).

3.2 +15V supply

- C207 9'000uF/50V with Computer Grade 6'000uF/50V (DEC spare)

Note:

- The new C207 has the same diameter as the former unit and could easily be installed.

4 Rear Remote Control Connectors: Pinouts

Remote Control Output J63 ***Remote Control Input J62***

1		Ground		**1**		Monitor IN
2		20 Mhz	BCD output	**2**		Monitor Return
3		10 Mhz	BCD output	**3**		Monitor Shield
4		8 Mhz	BCD output	**4**		Control IN
5		4 Mhz	BCD output	**5**		Control Return
6		2 Mhz	BCD output	**6**		Control Shield
7		1 Mhz	BCD output	**7**		Carrier IN
8		800 kHz	BCD output	**8**		Carrier Return
9		400 kHz	BCD output	**9**		Carrier Shield
10		200 kHz	BCD output	**10**		Address 1
11		100 kHz	BCD output	**11**		Address 2
12		80 kHz		**12**		Address 3
13		40 kHz		**13**		Address 4
14		20 kHz		**14**		Address 5
15		10 kHz		**15**		+3VDC
16		8 kHz		**16**		Ground
17		4 kHz		**17**		+15VDC SW
18		2 kHz		**18**		+15VDC Return
19		1 kHz		**19**		RF Level
20		+5VDC		**20**		IF AGC IN
21		-15VDC SW		**21**		ISB AGC IN
22		+28VDC		**22**		Open to mute
23		Preselector blank pulse		**23**		Spare
24		Spare		**24**		Gnd to rcv
25		+5VDC Reserved		**25**		+5VDC
26		Aux Mon 1		**26**		Audio P.M.
27		Aux Mon 2		**27**		Spare
28		Spare		**28**		-15VDC cont
29		Spare		**29**		Spare
30		Spare		**30**		Spare
31		Spare		**31**		Spare
32		Spare		**32**		Spare
33		Spare		**33**		Spare
34		Spare		**34**		Reserved for Audio
35		Spare		**35**		Reserved for Audio
36		Spare		**36**		Reserved for Audio
37		Spare		**37**		Spare