First aid II when you buy an HP5065A

Version 1.0

The document ”First aid when you buy an HP5065A”, was written in case you need to work on a HP5065A whose history is unknown or sold as faulty. Teaches us that almost all capacitors need to be replaced, as it must be installed a new bridge rectifier and heat sinks.
All these steps are necessary to stop or prevent the corrosive action of the capacitors, as well as prevent PCBs continue to be damaged by excess temperature due to the dissipation of power diodes.

Let's see what other actions is good to do before and after switching-on the frequency standard.

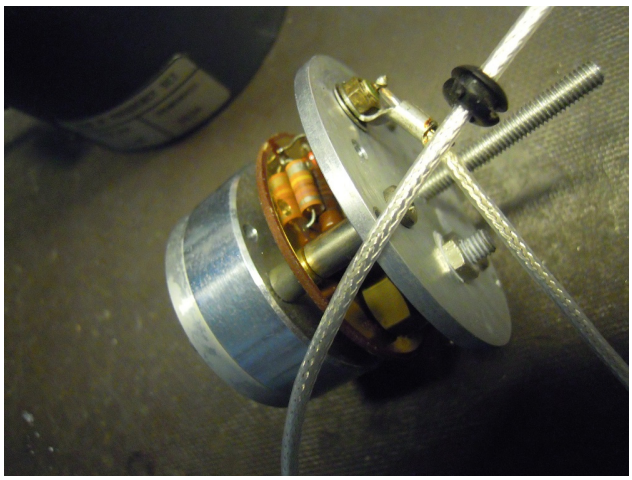
If you have the opportunity to do some checking before buying a HP5065A not working, there are some simple tests you can do with a multimeter. These tests may save you a lot of money and avoid buying an object almost impossible to fix.

Burning Lamp heater

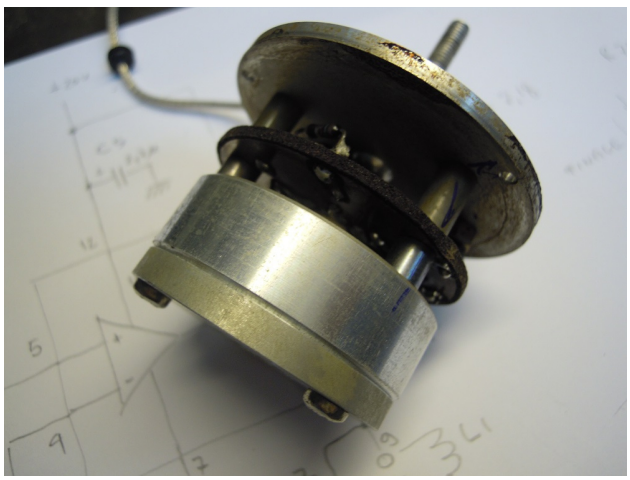
The more serious fault that can happen to a HP5065A is burning lamp heater, one of two ovens in the physics Part of Rubidium, RVFR A12.

Position of the Lamp

Typical Lamp temperature

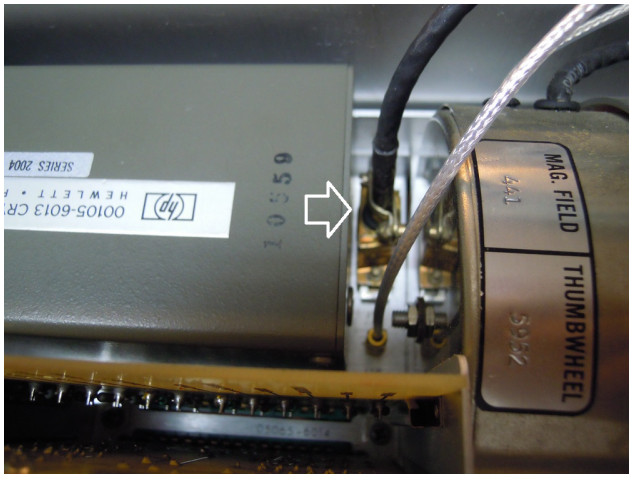


Good Lamp assy removed

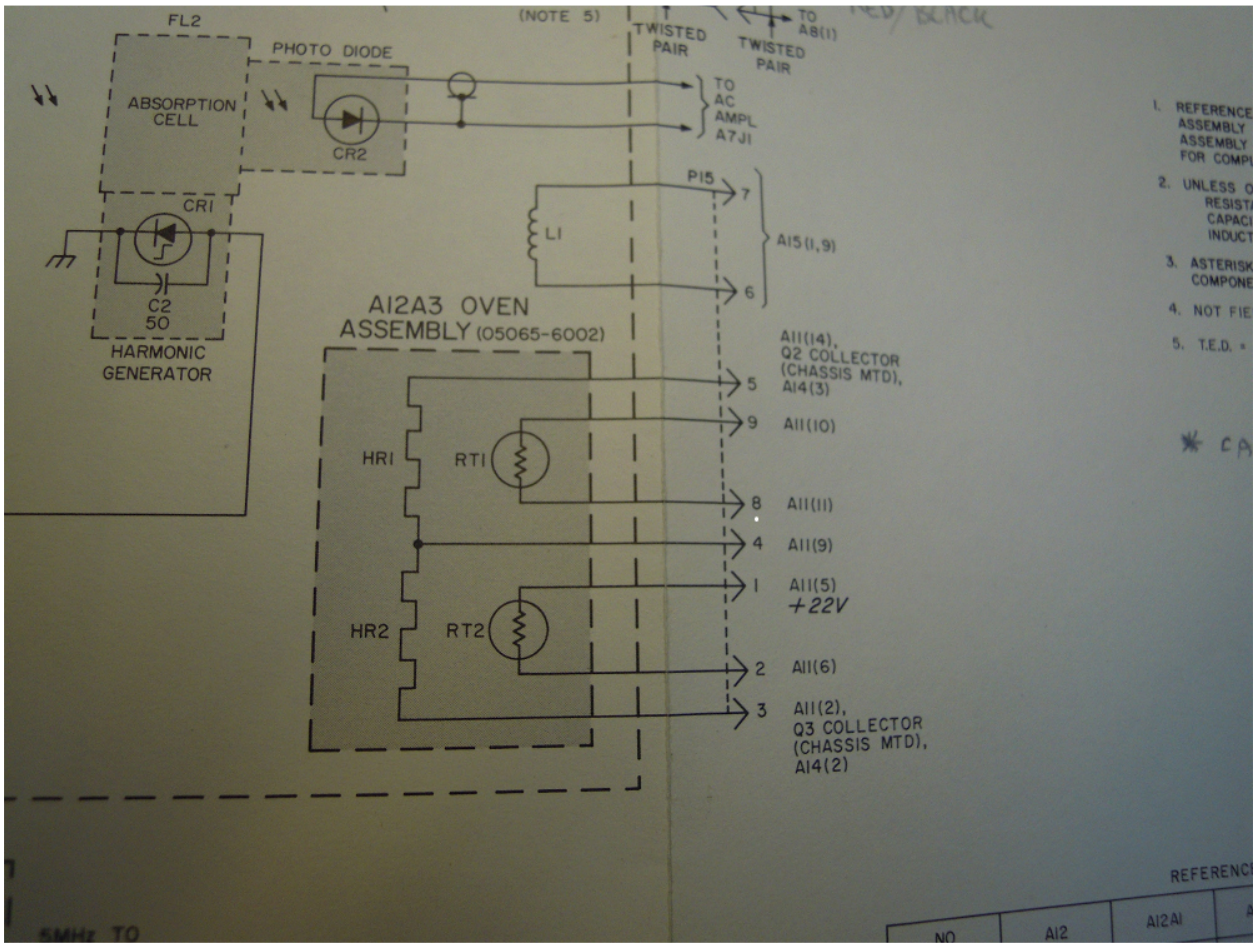


Burned Assy.

The pictures show two lamp assembly, one in normal working order and the other burned as is possible to see from the black color of the PCB. In some cases the temperature reaches very high values and the more sensitive parts melt gluing the Lamp assembly to the internal aluminium cilinder.
To have some confidence that the circuits of the oven of RVFR is in good condition can be measured through the connector P15 both windings of two heaters and the two thermistors which have the function of temperature sensors.



P15 position



P15 schematic

Pin to test	Ohms measured range	Description
1-2	1900-2500	Cell thermistor
3-4	50-54	Cell heater
4-5	50-54	Lamp heater
8-9	1900-2500	Lamp thermistor

The thermistor value is temperature sensitive so even if the HP5065A is turned off for a long time they are sensitive to the room temperature.
The table refers to room temperatures of around 25-30 degrees Celsius. If the ovens has been turned off from a short time, reading can be distorted because their thermal insulation maintains internally high temperature for hours.

Some useful info to repair the Lamp oven

I have never rebuilt the heater lamp, so I asked about Corby Dowson, an exellent expert who has already done so. The following information comes from his experience.
Suggest that you do this only if you have great experience, motivation or you together from someone who has already done.
If you want to try fixing the heater winding there are some precautions to be observed.

These ovens can fail either shorted to the oven cylinder or have interwinding shorts.
You have to remove the yellow thermal insulation to release the internal aluminium cylinder.
The original heater winding was insulated twisted pair wound directly onto the aluminum oven cylinder. The twisting operation is very important because an imbalance of the two wires that make up the heater winding would generate a magnetic field that would change the frequency generated by Rubidium standards.

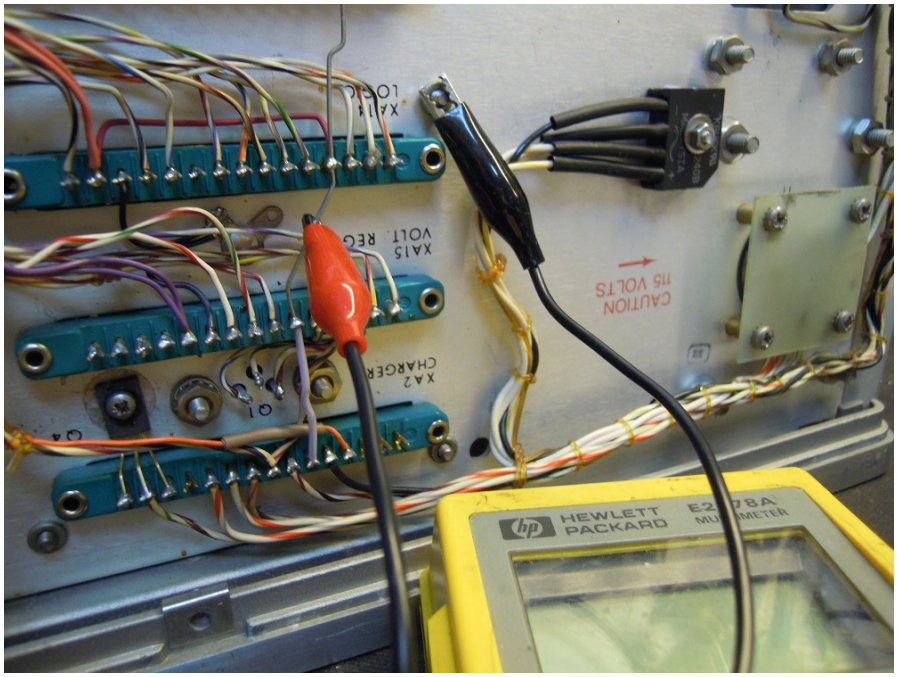
Wire material: teflon insulated heater wire, Pelican P2332ADVFEP.009BL.
See: http://www.pelicanwire.com/store/pelicanwire/resistance-heating/insulated-resistance-heating.html

The wire is approx. 5 Ohms/ft.,use 10ft. for a 50 Ohm heater; double the wire then twisted tightly. Twist around 7 twists per inch.
This is then wound onto the oven cylinder which is first covered with a single layer of kapton tape.
The original thermistor have to be replaced with a DigiKey 615-1007-ND.
The thermistor MUST be surrounded by heat sink compound.
It is suggested to install a digiKey TO220 100 degree thermal cutout switch for future protection. It is mounted to the top of the lamp assy. using one of the 3 original mounting screws. The thermistor and heater wires are brought out tie wrapped along the original cable and then soldered to the appropriate pins on the db9 connector.

Reassemble the RVFR using thermal insulation foam for high temperatures.
Unfortunately there are no pictures that relate to this task.

First Power on

After checking the AC voltage setting, remove the upper and lower covers and connect a digital voltmeter between ground and +20 Volts, measuring point you see shown in the figure.



Switch on the HP5065A plugging the power cord and read the voltmeter. The voltage have to be 20 +/-0.2V. If the voltage is out of tolerance but not far from 20 Volts wait about an hour to allow the thermal stability. This voltage is the main source of supply of all equipment so it is important that it be properly calibrated. To adjust place the A15 on the extender board and adjust R17 to 20V as described before.

Circuit Checks

The circuit check is used to verify the correct working of the main circuit of the HP5065A.

When you switch on for the first time an unknown HP5065A, after checking the 20V voltage with multimeter, it is good to keep under control the heating phase of three ovens: Lamp, Cell and Oscillator.
Approximately all three measurements on the circuit check will indicate the full scale positive. This means that the heaters are fully heating up. After about 30 minutes the instrument will be between 10 and 50 depending on the initial calibration and ambient temperature. The three ovens will reach balance in this time sequence: Lamp, Oscillator and Cell. For more information and exceptions read notes * 1 and * 2.
To get an idea of the correct meter indication please check the table stuck on the back of the front cover of each HP5065A.
All indications in the circuit check table are to be considered after heating and with full functionality.

Circuit check table

Switch position	Normal indication	Description	Action on wrong reading
Battery	35 to 45	Voltage of the internal battery if option 002 is installed.	A2/battery
Supply	38 to 42	+20V internal main voltage	A15
Lamp oven	10 to 40 *1	Lamp oven after the warmup	RVFR or A15
Cell oven	10 to 45 *2	Cell oven after the warmup	RVFR or A15
Osc oven	35 to 45 *3	Oscillator oven after the warmup	A10
Photo I	25 to 50	Photo detector current installed inside the RVFR. Rubidium Lamp on indication.	RVFR,A7
5MHz	38 to 42	5MHz output level	A10,A13
Control	−50 to +50	OCXO control voltage from the integrator A9	Verify the oscillator coarse tune. A9,A10
Error	zero	Fundamental 137Hz error	A8,A12,A7
2^{nd} harmonic	20 to 40	274Hz voltage levelfrom A7	RVFR,A7,A3,A14,A17,A15
1MHz	38 to 42	After push Start. 1MHz output voltage	A6
100kHz	38 to 42	After push Start. 100kHz output voltage	A4

*1 The Lamp oven requires less time than the Cell oven to reach its final temperature will be about 98 Celsius.

*2 The Cell oven requires more time than the other two oven to reach its final temperature will be about 68 Celsius.

*3 The Osc oven meter indication can vary according to the type of installed oscillator. If the HP10811 is in, the meter will behave like the other two ovens, initially shows the full scale and then position will be as described in the meter's table.
If the 00105 oscillator is in, he has a mechanical preheater and a linear Oven, for this reason, the response of the meter will be different and there will be two possibilities as preheaters may have different temperature set point.
If the setpoint of the preheater is quite lower than the crystal setpoint, the meter will behave like for the HP10811 except that the time to reach thermal setpoint will be much longer.
If the setpoint of the preheater is very close to the final crystal temperature, the meter initially will go to full scale then go to zero and after some time go back to full scale only to find, after some time, the setpoint value. This occurs as a result of the preheater over-shoot that initially exceed the temperature setpoint of crystal, then switch off permanently to give space to work the internal oven.
If an 00105 is installed, Osc oven will always be the last to reach thermal stability than the other two oven.

To get 1 and 100 kHz regenerative dividers are used which need to be enabled via the Start switch every power-on.

start switch

Continuous operation

At this point we need to close the loop of the standard generator. Set the Function switch on OPER., and switch the Circuit Check to 2nd Harmonic. The second harmonic is crucial because it is the control signal comes from the RVFR for the OCXO frequency control. Its level must be between 20 and 40.

If the HP5065A is operational and has not been turned off by years, by pressing the LOGIC RESET, green bulb lights up Continuous Operation, but as often happens on the level of the second harmonic will be incorrect and the lamp will remain switched off.

If the HP5065A has been in storage for longher than two months, there is a possibility of Cell Flooding occurring in the RVFR tube. If after one hour of warm-up from initial turn-on no or low level second harmonic is present, than cell flooding can be suspected.

You have to remember that this type of standard is designed to be always powered, even its target frequency stability will be achieved only after about several days after being switched on.

At this point there are two ways, one is to make a troubleshooting as described in the manual and in particular the Turn-on procedure After Long Storage described on page 3-1 manual pn 05065-9041.

A way to fix the Cell flooding is described by Corby Dowson:

Now say that the unit is in storage for years. Very slowly at ambient temperatures ALL the rubidium will effuse out into the cell and coat the walls of the tube with a thin coating of rubidium. When you turn the unit on and warm it up there is way too much rubidium in the cell and it absorbs almost all the light at the rubidium line frequency.
This is cell flooding. In this situation the TED and or turning the unit back off will not draw enough rubidium back into the tip for proper operation.
Performing the procedure in the book passes 1 amp thru the TED cooling it much more than normally. This causes the rubidium to be drawn back into

the neck at a faster rate. It will usually take 6 days to fully "de-flood" the cell. If your signal does not improve after the 6days then cell flooding was not the problem. After reconnecting the TED then operate the unit for a few more days to allow the Rubidium level to stabilize at the normal temperature.
I usually find it safer to use a 5VDC supply thru a 5 ohm 10 watt resistor to supply the current rather than a constant current supply at such a small voltage. You do not want to burn out the TED!

Another way is simply to switch-on and wait for some days/weeks.
During this period the level of the second harmonic will increase quickly with some unstability initially, and then stabilize after a few days/weeks, depend from the previous storage time and temperature.
After obtaining an appropriate level of second harmonic, check the green light is switched on by pressing the RESET LOGIC.

If you have the orange light on means that your OCXO is out frequency, proceed with the COARSE adjustment and then FINE by setting to zero the meter in the position CONTROL of the Circuit Check.

The purpose of this document is to have a first II approach to the operation of a HP5065A which was abandoned for a long time. All calibration procedures are still necessary and are well described in the Operating and Service Manual but have to do with in-depth knowledge.

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Addendum:

HP5065A Standard and special options

01 digital clock
01M mechanical clock
02 internal battery backup
03 combine 01 and 02
03M combine 01M and 02
H04 remote alarm on Continue Operation fail (BNC on the rear panel)
H10-1 one 10 MHz output (www.timeok.it)
H10-2 two 10 MHz output
Specific.H42 combine 02 and 5.12MHz output