# GPS Receiver Suggestions from Successful Users

I received a note from Mitchell Janoff "I wanted to thank you for posting the information on the HP Z3801A on your web site. I recently purchased one of these units from a gentleman in Korea who was also selling on Ebay. I might have been more cautious if I had read your web site before my purchase. It turns out I was pretty lucky. My unit is factory wired for 110v AC (uses a standard PC type power cord) operation and also has a standard 9 pin RS232 input. Since it also came with the antenna, setting it up was a snap.

I did need to get a null modem for the connection to the computer, but otherwise I didn't have any problems. Tom Van Baak gave me the UTC diag. Instruction and the reboot tip. Thanks again for providing a valuable resource.

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Additional information from Chuck Zabilski, WB6MOB, on modifying the receiver to use RS232:
"I just modified a Z3801A GPS receiver and I discovered a way to get it to interface at the RS-232 level and not have to resort to RS-422. The main board has a set of uninstalled headers marked RS-232 and RS-422 respectively near the DB-25 connector. These are arranged as 3 rows of 8 connections on 0.100 inch spacing. By installing 3 rows of 8 male headers I am able to select between the RS-422 and RS-232. In terms of the jumpers and headers, I could only verify that the 1st 5 actually connected anywhere, but I went ahead and installed all 8 headers time 3 rows. The only other thing required is to flip the board over and remove the five 0 Ohm jumpers which preselected the RS-422 interface. Once these surface mount jumpers (resistors) are removed, the newly installed headers select RS-422 or RS-232."

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In addition, Chuck WB6MOB modified his receiver to have a self contained power supply:
"Also the Volgen SPN75 power supply fits (barely) within the GPS receiver (towards the front). I installed an IEC 320 AC power connector in place of the DC connector and the receiver is self contained for AC in one package."
K8CU notes: This is a commercial switching power supply: Volgen SPN75-48S. Available from Digikey part number 62-1043-ND.

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A note from Ken, W6GHV : He has identified an economical switching supply that fits inside the Z3801A case. Jameco has a 48 V @ 1.35 Amp switching power supply for $29.95, as their part number 201953. The power supply mating connectors are their part numbers 104432 and 104731 (page 79 of their printed catalog). This is an open frame switcher.

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Chuck, WB6MOB also offered the following on selecting UTC time: "There has been some comment about how to switch the Z3801A from reporting GPs time to UTC time. A document from Symmetricom discusses an undocumented command :diag:GPs:utc 1 to switch from GPS to UTC (:diag:GPs:utc 0 will switch from UTC to GPS). Although issuing this command this will subsequently report that the time mode is UTC, the receiver needs to be reset or rebooted for the change to take effect.

Newer firmware supports a :syst:pon command older firmware does not. Rather than unplug or power down the receiver, the self test command *tst? will perform a reboot of the receiver."
K8CU notes: I tested this on my receiver, and it appears to work. A reboot of the receiver requires that GPs acquisition be established again. This takes the receiver a minute or so to complete.

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I received a note from Dennis Polito, W6DEN:

"I wanted to thank you for the fine article regarding this GPS receiver. The information that you compiled made the conversion and start up process relatively easy. I recently purchased one from Hi-tech Cafe and I was able to get it up and running last night. I have a couple of

questions for you.

The 10 MHz output as measured on my HP 5345A is a bit high, 10.00000131 to be precise. I compared the output to a HP 5061A Cesium standard and it is indeed off frequency. Satstat reports FFOM as a value of 1. If and when this value reaches 0 will the 10 MHz output then be correct? How long does it normally take for FFOM to achieve 0? I have had the unit on for about 3 hours as the longest power on cycle. I ran the survey and the receiver is now running in hold mode.

Answer - In the manual, HP states that "the receiver typically reaches stable state 24 hours after power-up, and it will learn best if its experiences no holdover in the first 24 hours....thus, it is recommended that the receiver is always kept locked to GPS during the first 24 hours." When FFOM (Frequency Figure of Merit) reaches zero, the 10 MHz output frequency characteristics should meet accuracy specifications of < 1 x $10^{-9}$, one day average.

( Feedback: Dennis later reported to me that another Z3801A was tested and had the same apparent frequency offset. He then found that the synthesizer in his cesium standard was the source of the error.)

My antenna has approximately 70' of RG-58 feed line, should there be a feed line delay factored in? If so, do you know what the delay factor is for this feed line? I get excellent signal strength numbers on all six satellites.

Answer - Since I use my receiver only for frequency purposes, and not for timing, I did not enter my specific feed line numbers into Satstat. That is why the Satstat photo above shows an antenna delay of zero ns. The delay factor is related to the specific velocity factor of your coax. If the cable you use has no additional signal delay time caused by the cable dielectric material (a velocity factor of 100%), the delay factor would be the time it takes light to travel the length of the coax. Light travels almost exactly one nanosecond per foot. RG/58 with a polyethylene dielectric (not foam) has a velocity factor of 66%. The specific calculations:

Speed of Light = 186,284 miles per second.
5,280 (feet per mile) X 186,284 = 983,579,520 feet per second
983,579,520 X ($10^{-9}$) = .98357952 foot per nanosecond
.98357952 x 66% = .6491624832 (speed through RG/58)
1/.6491624832 (one over x function) = 1.5404463842 or 1.54 ns per foot delay

So for your length of cable.....70 feet of RG/58 has a time delay of 107.8 nanoseconds. The HP manual gives some examples of other cables and various lengths.

The Satstat clock reports a +13 second error. The query "show accumulated leap" reports +13 seconds. Can this value be reset to 0?

Answer - You are set up to view GPS time. Setting the time to reflect UTC time (see note by WB6MOB above) will correct this apparent error. Since GPS time is "perfect", it is off from UTC by the number of leap seconds that have been added to UTC since GPS time began in January of 1980. As of today, there have been 13 leap seconds added to UTC to compensate for variations in the earth's rotational speed. More information on this can be seen on the U.S. Naval Observatory web site.

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Cliff Ward, W5LF reports: I have two of these fine devices and the Ebay ads say they run on 32 to 48 vdc. I can tell you plainly that neither of mine will even start without 48v or more on them, with or without adding 7-8000pf at 70 of electrolytics across the dc input (which didn't work for me). Mine will start at 48 vdc but won't run at less than 46.7 volts or so.

K8CU notes:The Z3801A is specified by HP (depending upon model) as either a nominal minus 54 or plus 27 volt device. The best bet is to keep the voltage at the nominal value specified by HP. This way any out of specification internal DC to DC converters are satisfied, and the units will perform normally. Reports from other users confirm this.

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I had an email exchange a few weeks ago regarding a power supply problem with the Z3801A. I will copy portions of it here: I have just had a very strange and distressing thing happen, and I'd like to ask you if you have any thoughts. I have two Z3801s, bought on eBay some weeks ago. I checked them out with an antenna and computer when I got them, and they seemed to work flawlessly. I put them aside 'til tonight, when a power supply I ordered was available. This is a serious HP multiple-output supply, 0-50V, .8amps.

I connected it to one unit and found the supply voltage jumping around, a flaw I attributed to the switchers inside the Z3801. Putting a 1000uF cap across the leads fixed that, and the voltage settled down to a perfectly steady 48.00V and .560 amps. My intention was to wait 'til the oven warmed up and see how much lower the steady-state current would become. Although I had no antenna or computer connected to the Z3801, it seemed to power up OK. So far, so good. However a few minutes later, the unit died! No lights, zero power drain. Power supply still reading 48.00 volts.

Not having a clue, I figured maybe something went wrong inside the Z3801, so I connected the second one. It powered up, the current read .559 amps, and all was well. Until, a couple of minutes later, it, too, died! Now they're both dead. I have no schematic. I see no fuses. And I can't imagine what I could have done to kill them. OTOH, the coincidence of both dying minutes after power was applied is too much to believe.

So, and I hope you'll forgive me for the unsolicited inquiry, have you ever heard of anything like this? I have the manual for the unit, but no PS or other schematic, and I'm reluctant to rip it apart 'til I've at least asked someone familiar with the unit.

My response was this: Okay, from my standpoint, your power supply is the culprit. Do NOT use it anymore until you are certain what is going on. The good news is that there are fuses inside the unit, and they are in the primary circuit. Go to my web-site, and scroll down to the part of the page that shows the Z3801A power supply. I describe two fuses in the primary circuit. These are different values, but look like little resistors. They are called "Pico" fuses. Look in the lower left hand side of the photograph to see them. An ohm-meter check on them will reveal what their condition is. There is another fuse described in the circuit, but it is used in the outer oven controller.

Hopefully, all that has happened is that your power supply has taken out the primary fuse(s). I suggest building up another power supply (transformer-diode bridge-big cap) and control the voltage with a variable variac on the transformer primary. Then test your receivers with this.

"Ripping it apart" as you describe is no big deal. All you need is a Torx size 10 driver, and simply remove the top cover. Your DC to DC converter is visible, and is right on top. You can check the fuses without removing anything inside the box. Try this, and let me know what you come up with.

The interesting return email response: Hi again! Thought you'd be interested in the resolution of this problem.

1: There's nothing wrong with the power supply
2: There isn't and wasn't anything defective with either Z3801.

Rather, the power supply is TOO GOOD, and there's a subtle design defect in the Z3801. Key is the power supply rating: .8A maximum current, and the fact that the Z3801 uses switching supplies. A switcher characteristic is one of "negative resistance" on the input. To provide a constant power output, as the input voltage decreases, the input current increases. It turns out that with a 48V supply, the Z3801 takes ~.56 amps on turn-on. However, after a few minutes, the current drain sharply increases, presumably because the oven supply is switched on. With a normal high-current supply (or CO battery), this extra few hundred MA wouldn't be noticed. But with a lab supply set to .8A maxiumm, when the oven turns on, the supply is called on momentarily to exceed its output rating. It goes into current limiting, and the output voltage starts to drop.

Enter the Z3801 switcher: As soon as it sees the supply voltage drop, it will try to take more current, causing the voltage to drop even faster. This negative feedback cycle drains the PS output capacitor (and the cap that I added for good measure) fast enough to exceed the energy rating of the picofuse which protects the capacitor by blowing out!

After figuring out this scenario on the way home, I tried a very simple experiment. I INCREASED the PS voltage from 48.00 to 50.50V,its maximum rating. At this voltage, the maximum current (briefly) seems to be about 780mA, and it eventually equilibrates at around 440mA. The "subtle design defect" is the fact that there is no current limiter (other than the fuse) on the input of the switcher. Of course it could be argued that if one uses a heavier supply it's not necessary, but there could certainly be an occasion where primary power is interrupted with a big capacitor remaining across the Z3801 input.

Finally, the most astonishing thing about this adventure is that it only took me a couple of minutes to find a big reel of 3A Picofuses in the stockroom!