Using LOGPEEK

Logpeek is a PASSCAL program for viewing State of Health (SOH) files from zipped RefTek130 files, raw RefTek files or .log files created by PASSCAL's **rt2ms** program. An overview and detailed instructions for use of the various options follows. This guide uses logpeek version 2015.148.

Within this document:
Commands, Top-level menu buttons, and General scripts are in bold.
Command-line usage is highlighted yellow
Second level menu button/options are italicized.
URLs and email addresses are blue.

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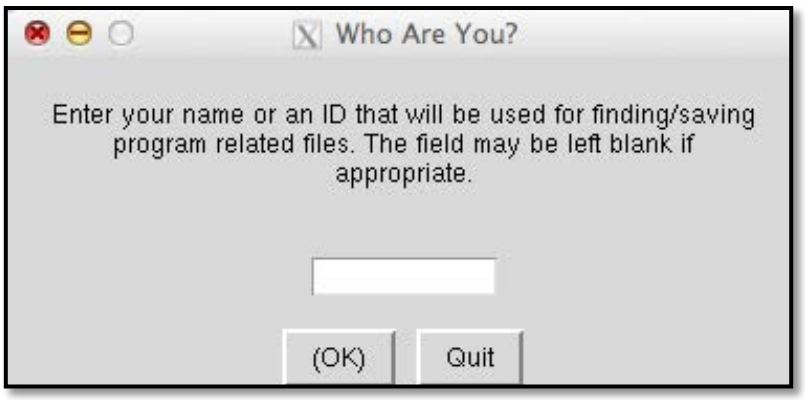
Introduction to using logpeek – A Basic How-To Guide

Starting logpeek

Open logpeek by typing **logpeek** in a terminal window or by selecting the PASSOFT menu in the dock and clicking on the logpeek icon. From the command line, use **logpeek** –c (current directory) to open files in the current working directory rather than the default directory in the setups file. Use **logpeek** -g (full window display flag) if you are having problems with window sizing when switching from one display type to another. The –g option will start logpeek with the main program window fully within the display.

Before the logpeek GUI opens, the *Who Are You?* Popup window appears. This allows the program to find and/or save program related files for individual users.



The *Who Are You?* popup window

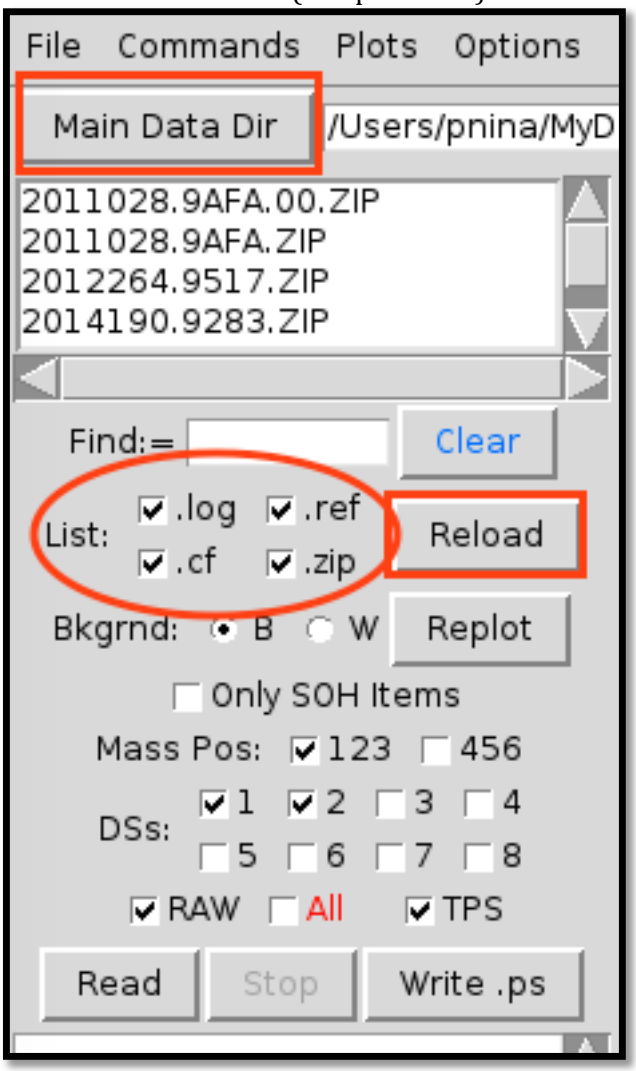
The first time the program is run on a computer the *Really?* popup window appears signifying that no setup files were found. Click the **OK** button to start the program and initialize the user ID.

The *Really?* popup window

Check if the program is up to date. Click on the **Help** button at the top of the GUI and select *Check For Updates*. If a more current version exists, download it and unzip the file. Copy the file **newlogpeek.py** to /opt/passcal/lib/python/logpeek and change the name to **logpeek.py**. You might want to rename the old version **logpeekOldVersion.py** or something similar. Root permission is required. Use **sudo** or **su** to move and rename the file.

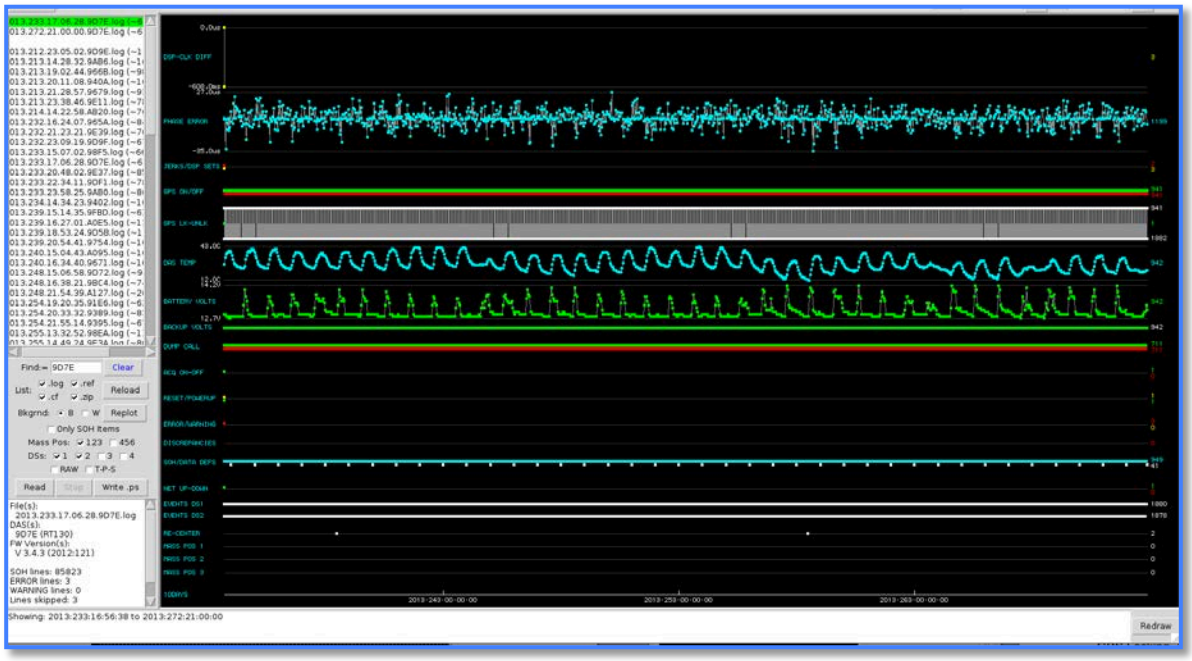
Loading files

Logpeek remembers the last directory used and will automatically start with that directory. If files are located elsewhere use the **Main Data Dir** button in the upper left corner of the GUI to navigate to the directory containing the files or call the program from the command line in the working directory using the –c option as mentioned above. Use the list of checkboxes on the left side of the GUI to control the types of files (.log, .ref, .cf, and .zip). Note that the default is for all readable file types to be loaded. To view a disk folder add .cf (compact flash) to the filename.



Check the type of files to view and **Browse** to the data directory
Reload the files if adding or removing a data type after loading data

The **Find** field can be used to bring a specified file to the top of the file selection list. Once a file is selected, use the **Read** button to open the file. Multiple files can be selected and opened. If files are from multiple dataloggers, logpeek will open a popup window to verify that it was intended to open files from different dataloggers.



logpeek GUI with one data file selected and plotted

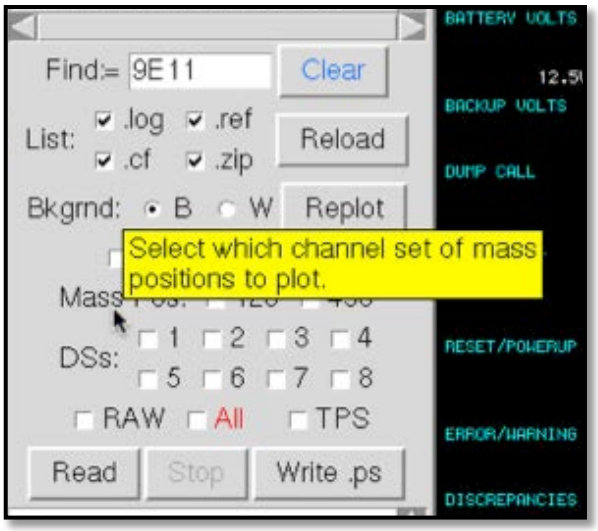
Additional data streams other than SOH channels can be viewed using logpeek. Selecting the *Only SOH Items* option will force logpeek to only plot the SOH channels and will override the selection of any other data streams. To plot mass position voltages, check the appropriate box before loading the file. logpeek can also plot raw data. Check the *RAW* box and the *DSs: 1* (and/or any other programmed datastream) before loading the data. Mass position voltages and raw data are available when viewing .zip, .ref or .cf files.

Plotting mass positions and raw data from data stream 1

To load a .log file (or several) and look at the SOH messages without plotting the SOH data you can **Shift-CTRL-click** on the file to open the SOH messages in a new window as shown below.

SOH messages window opened using Shift-CTRL-click on a .log file

Hover the mouse over the check boxes on the left side of the GUI and get information about the functions. The command buttons are not set up for pop-up help.

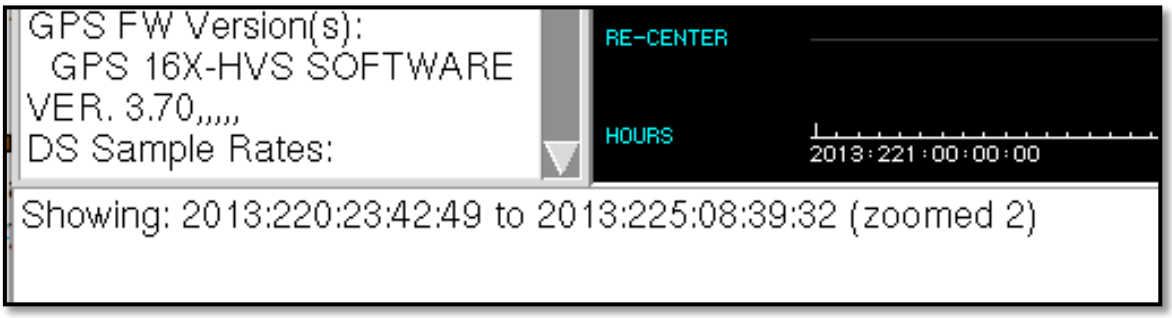


Hover the mouse to get information

Navigation and General Usage Tips

Hover the mouse over the **Hints** label in the upper right corner of the GUI and a yellow window will appear with various user hints for navigating the plotting area.

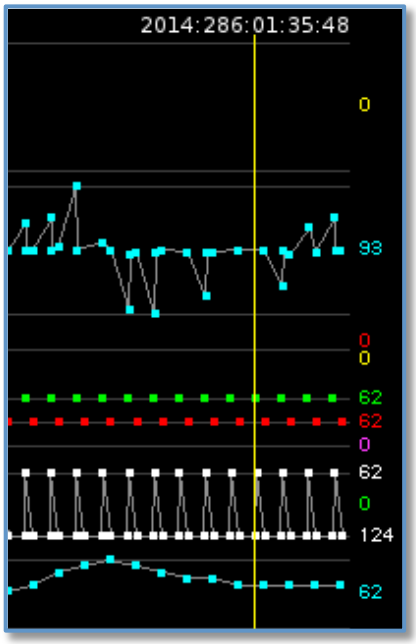
Zooming: Zoom in by **shift-clicking** in the plotting area to define a time window to magnify. Zoom out by **shift-clicking** in the trace label area. Look at the message in the status barto determine zoom magnification.



The display is at zoom level 2

Scrolling: Scroll through time by clicking on times at the bottom of the GUI. Click on the right (forward in time) and the display will jump 90% of the current display to the right. Click on the left (backward in time) and the display will jump 90% of the current display to the left.

Add Vertical Time Rule: Display a Vertical Time Rule by holding the **CTRL** key and clicking in the plot window. **CTRL-clicking** at the far left of the plot window displays the time rule at the beginning of the plot while **CTRL-clicking** at the far right of the plot window displays the time rule at the end of the plot window.

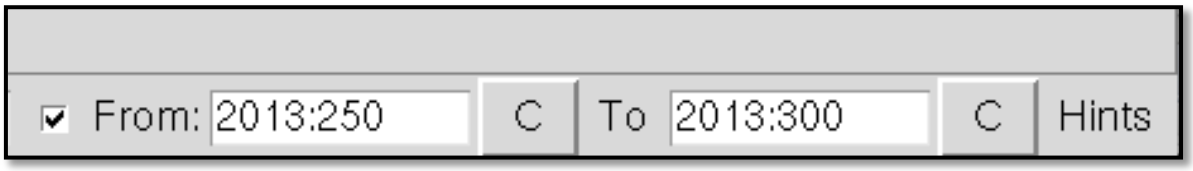


Use CTRL-click to display a vertical time rule

Display SOH Messages for a Data Point: **Clicking** on any data point in the main window highlights the message for that point in the *SOH Messages* window.

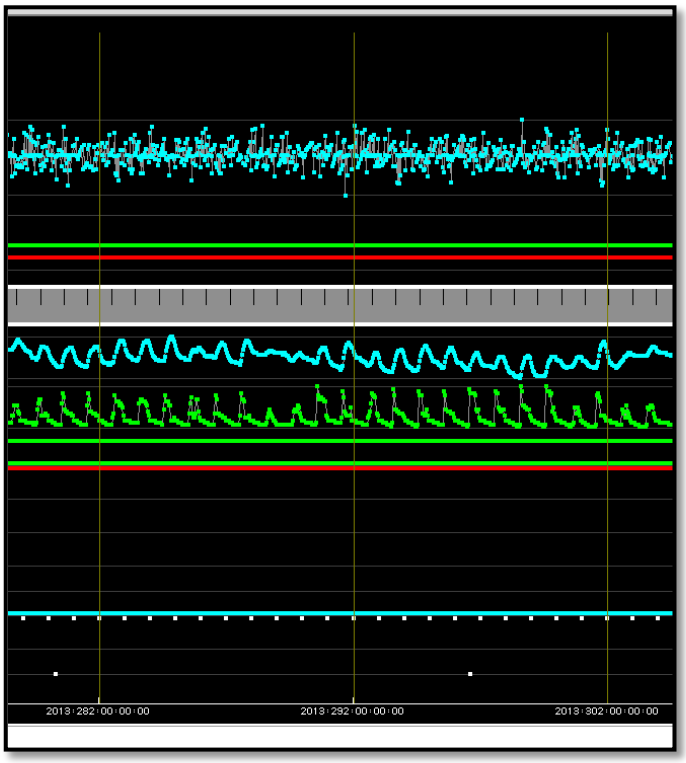
Remove Data Points: **Right-click** on the data point(s) to make them disappear. The file must be reloaded to get the data point(s) back.

Limit Data Range: The **From** and **To** menu boxes at the right of the directory field can be used to limit the date range for .ZIP, .cf, or .ref files. Fill in the dates and check the box to apply the required dates. Use the **C** box to view a calendar that can display the dates in either DOY or calendar date format. Entering just a **From** date will tell LOGPEEK to plot from that date to the end of the selected source, and likewise, just entering a **To** date will plot from the beginning of the selected source to the To date. The plotted times are from 00:00 on the From date to 24:00 on the To date. Simply uncheck the box if you want to plot the entire data range. **NOTE**: this option does not work with the smaller .log files.



Limit the amount of data displayed from large files by using the From: and To: fields

Add Grid Lines: **CTRL-click** on the time axis to extend the time grid lines to the top of the page as shown in the figure below.

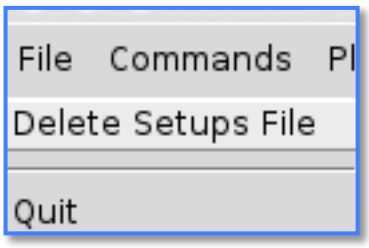


Vertical time grid lines turned on by a CTRL-click on the time axis

Menu and Main Page Commands

This section gives a brief overview of the pull-down menus at the top of the GUI.

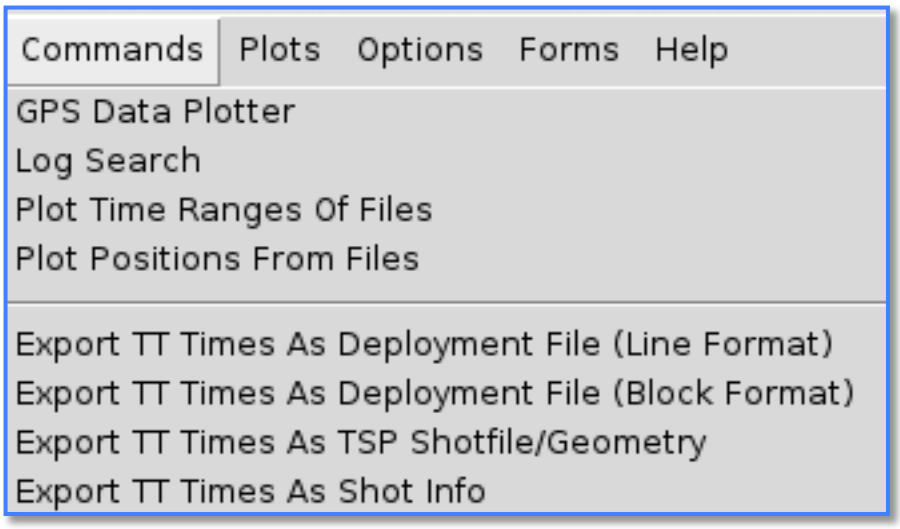
The File Menu:



The **File** pull-down menu options

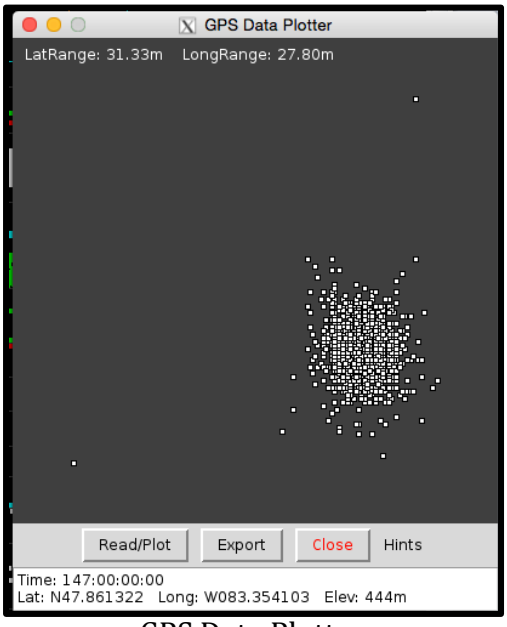
Delete Setups File is a way to reset the program if the current setups file is causing problems. The setups file tells the program where to look for data and defaults to the last directory used by logpeek.
Quit closes the program.

The Commands Menu*:*



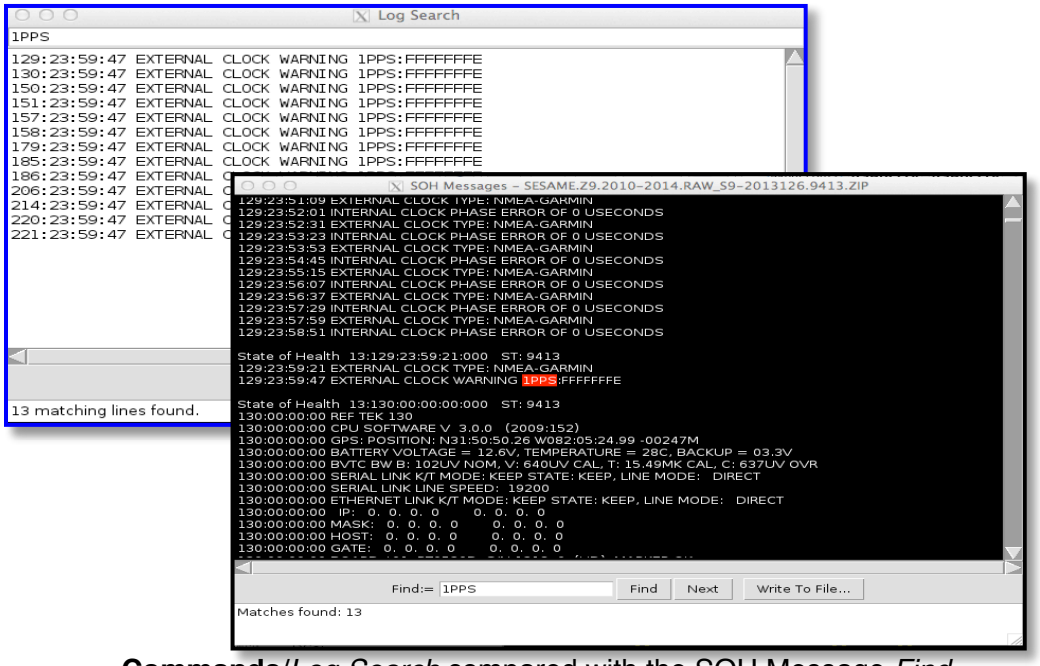
The **Commands** pull-down menu options

GPS Data Plotter draws a scatter plot of the GPS positions from the selected data file. Hover over the *Hints* area for more information. Clicking on a point displays the time, latitude, longitude, and elevation in the status window. Use the *Export* button to download the data to a tab-delimited file. Right clicking a point deletes it (an outlier for example) from the calculation. Recover the deleted point by reloading the data for the plot. Duplicate points are not plotted.



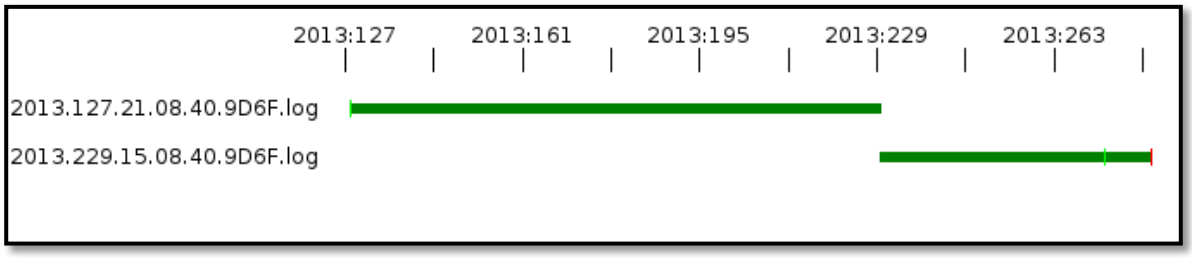
GPS Data Plotter

Log Search opens a pop-up window that allows you to search the SOH messages log. This is a quick way to search but does not show the messages in context (see figure below). Another way to search in the SOH message file is to use the *Find:* option in the SOH Message window.



Commands/*Log Search* compared with the SOH Message *Find*

Plot Time Ranges of Files is a good way to see if any data are missing. Choose the data files and logpeek creates a plot of the time ranges of the selected data. There are two options for viewing the data. Click on the radio button *All* to show the data in chronological order or *Each* to simply plot the time range of each selected station without a time scale. This option may be helpful for spotting gaps in the data. The small green ticks represent acquisition on and the red ticks acquisition off.

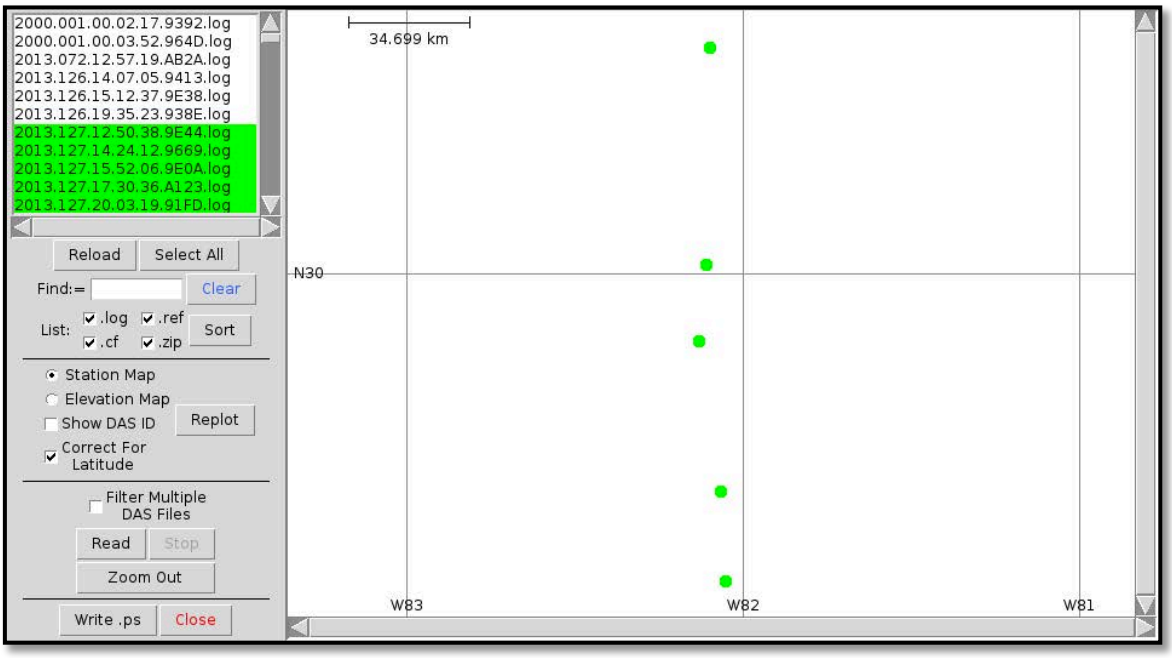


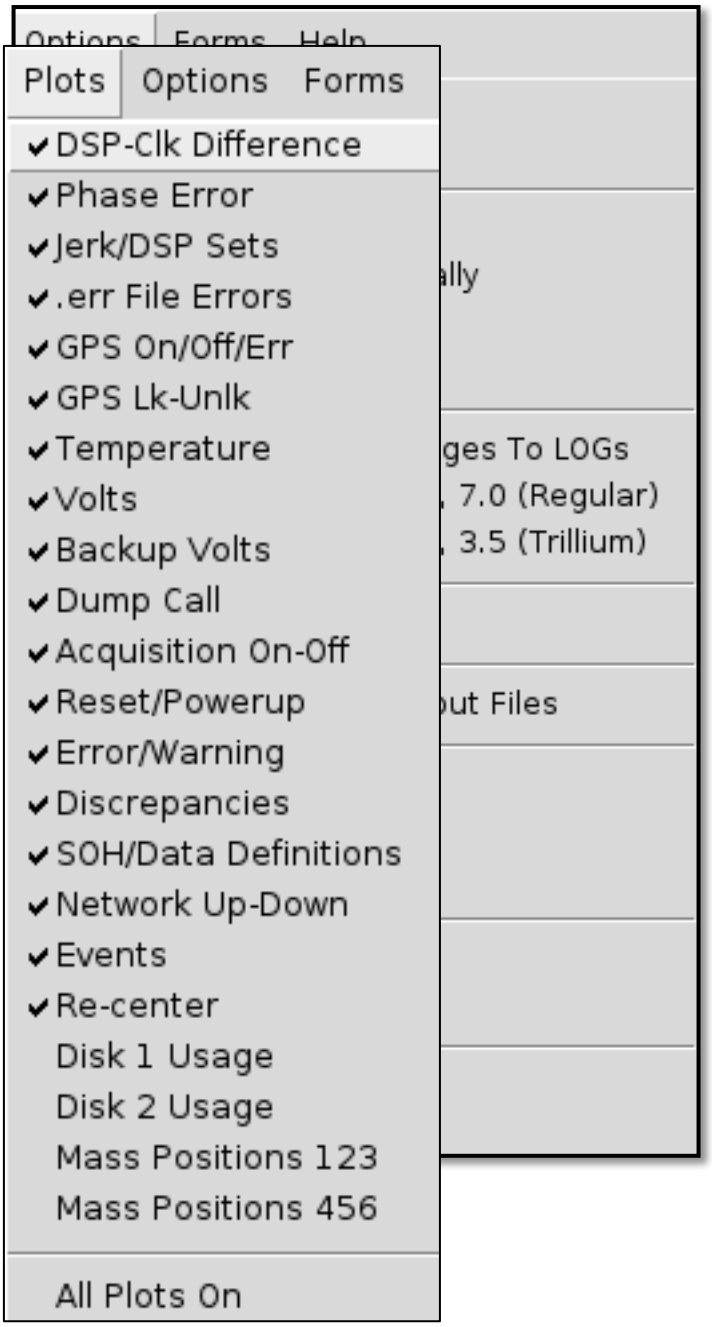
Time ranges of selected data (using the *All* option)

Time ranges of selected data (using the *Each* option)

Plot Position from Files creates a simple map of the station locations on a latitude/longitude grid. The location is a simple average of the 2nd five GPS fixes found in the log file (skipping the first 5 fixes ensures the early fixes, after reboot or power up for example, do not affect the average).

Map of selected stations using *Plot Positions from Files*





The Plots Menu:

The **Plots** pull-down menu options

The **Plots** pull-down menu lists all possible SOH values available for plotting. The default is to plot all the curves except for Mass Positions (Check the boxes as described in the **General Usage** section above to see mass positions). Toggle the curves on/off and the display will replot the data to reflect the changes. Use the *All Plots On* option at the bottom to restore all the curves.

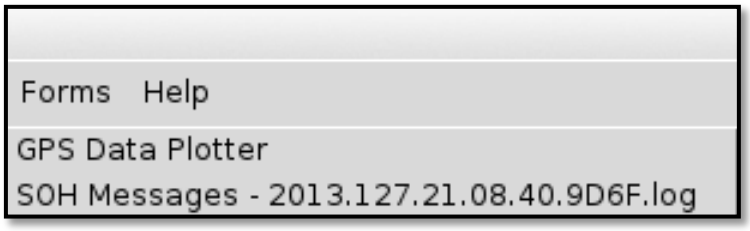
The Options Menu:

The **Options** pull-down menu choices

The **Options** pull-down menu customizes a number of parameters as shown above. Toggle options on or off by clicking on them. Helpful options are to *Plot Timing Problems* that will plot all lines in

the SOH files even if the timestamps are not in order. Normally, when this option is not checked, logpeek will ignore lines that are time stamped earlier than preceding lines. The lines that logpeek skips are displayed in yellow in the SOH messages display.

The Forms Menu:

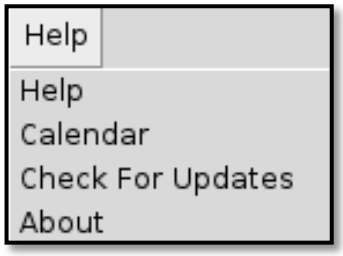


The **Forms** pull-down menu choices

The **Forms** pull-down menu shows the logpeek windows that are open. In the example above the *GPS Data Plotter* window is open as is the *SOH Messages* window for the specified file.

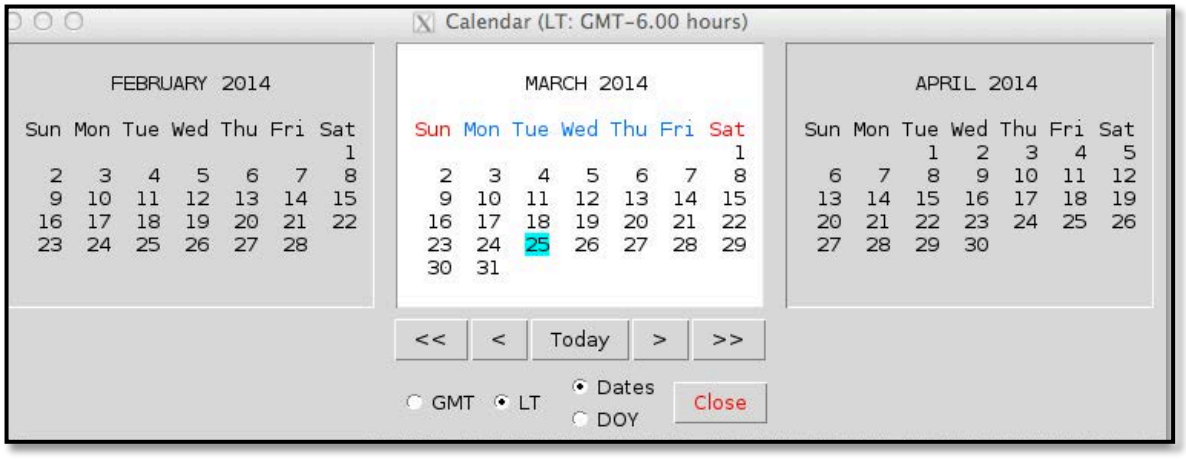
The Help Menu:

The **Help** pull-down menu displays the options for program *Help* and a couple of other useful features as shown in the figure below. Get information about the configuration and version by clicking on *About*.



The **Help** pull-down menu choices

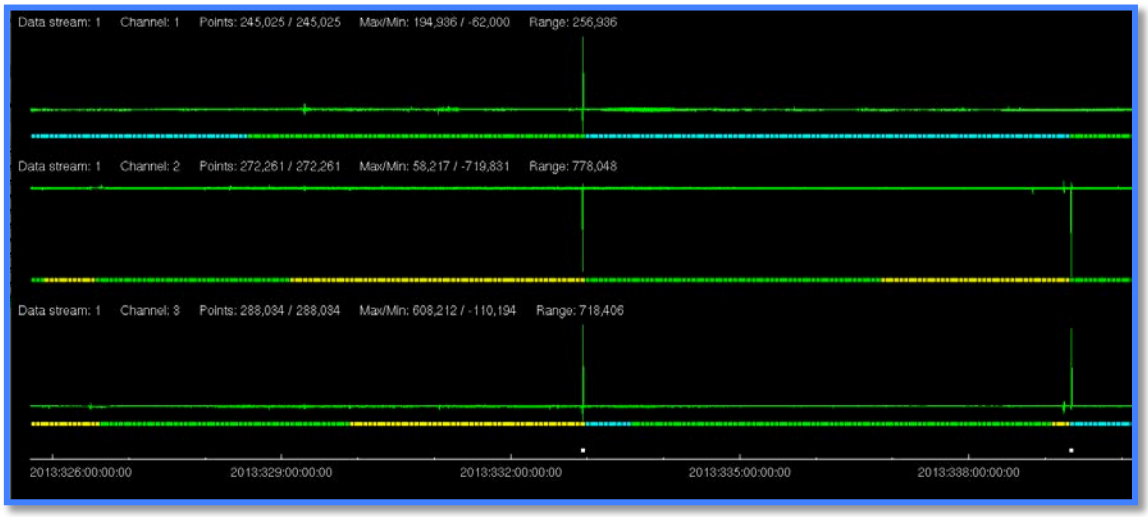
The *Calendar* can be set to either dates or day of year (DOY), as well as local time (LT) or GMT. To scroll ahead to the next month use (>) or to the next year use (>>).



The *Calendar* option

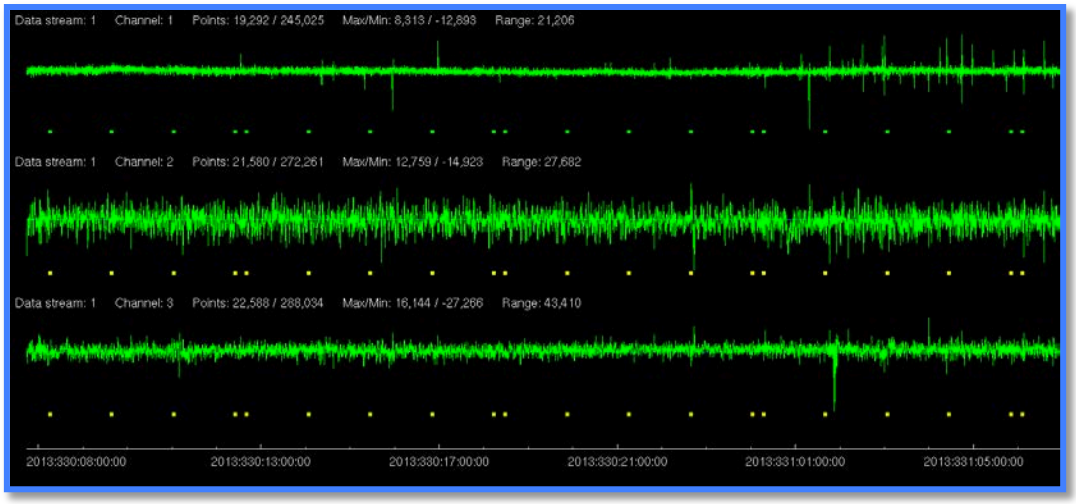
Plotting RAW Data (a quick look at the data)

Logpeek can plot raw data if it is available. Check the *RAW* box and the *DSs: 1* (or any datastream to plot) before loading the data from a .zip, .ref or .cf file. Verify that the *Only SOH Items* option is unchecked since selecting this option will force logpeek to only plot the SOH channels and will override the selection of any other data streams. Selecting the RAW data option will plot each channel of the selected data stream in a separate window in addition to plotting the SOH data in the main display window. If mass position voltages are also plotted, the color-coded mass position voltages and mass position re-centers (white dots) will be plotted in the same window as the raw data as shown below.

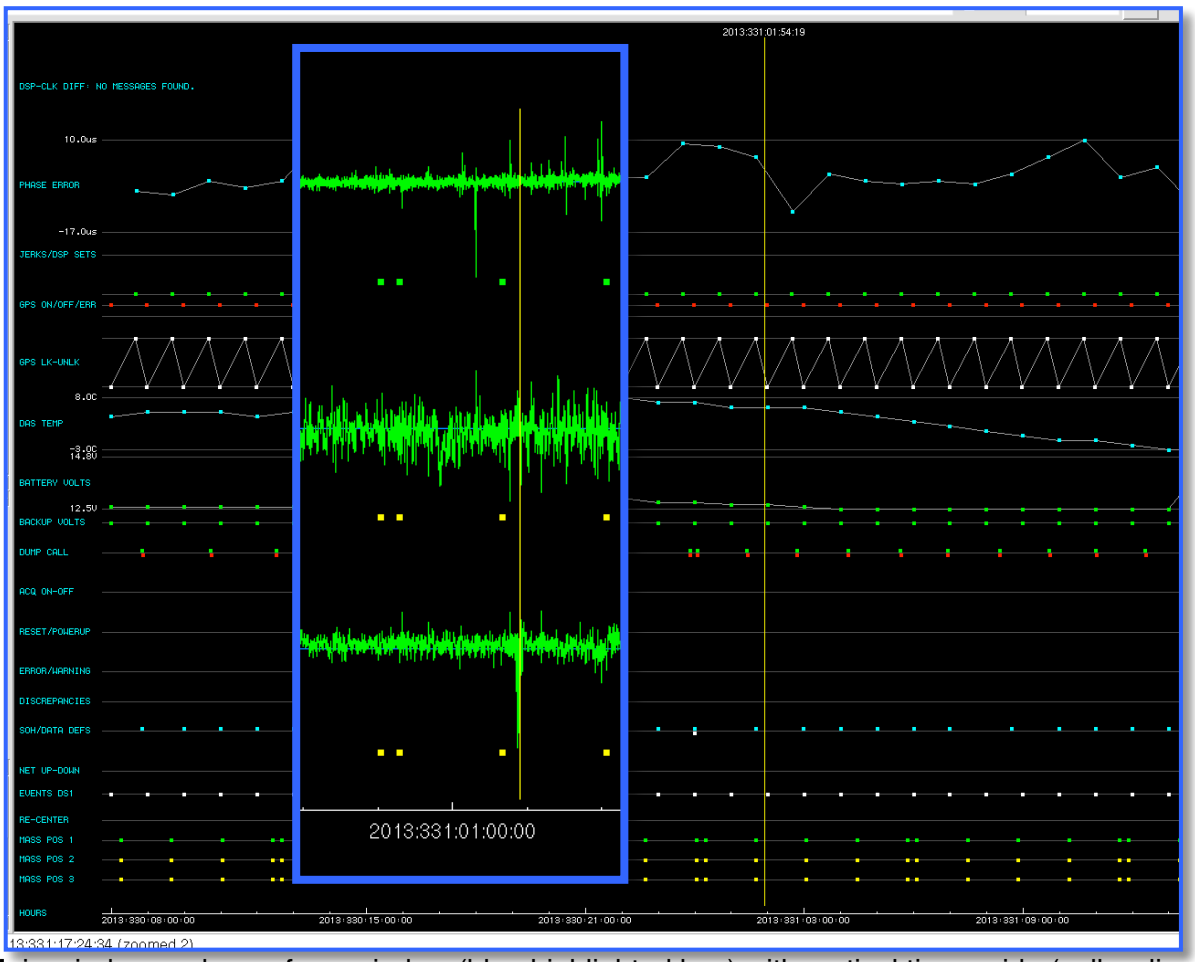


Waveforms from a .ZIP file

To zoom in on a section of the raw waveform data, you must select and zoom in on the desired time window in the main SOH window. **CTLR-clicking** in either window brings up a vertical time guide in both the raw data window and the main SOH window to aid in zooming in on a section of data. Any zooming done in the main SOH window is reflected in the raw data window.



Zoomed-in waveforms from a .ZIP file



Main window and waveform window (blue highlighted box) with vertical time guide (yellow line)

Using Time-Power-Squared Plots

Time-Power-Squared (TPS) plots of the raw data in .zip, .ref, and .cf files can also be plotted. Check the TPS box at the left of the GUI as well as the DSs to plot. These plots display the average-amplitude-squared, computed every five minutes over the entire time range displayed in the main plot. Each horizontal line contains one entire day of data from 0000 – 2400 GMT. Each 5-minute block is color-coded according to the average amplitude of that period. If one or more days of data are missing logpeek plots a black square for each day.

There are four Average Counts ranges: Antarctic, Low, Medium, and High. You can select the range by using an "A", "L", "M", or "H" radio button in the plot. Tables of color values are shown below and a color scale is also shown in the TPS plot window. Each color is a range and represents all values between the selected color and the next lowest color. For example a red color in the Low color scheme is anything between +/- 20,000 – 200,000 counts.

Antarctic

Color	Average Counts
Dark Gray – Black	No data
Dark Blue	+/- 10
Cyan	+/- 100
Green	+/- 1000
Yellow	+/- 10,000
Red	+/- 100,000
Magenta	1,000,000

Light Gray - White	> +/- 1,000,000

Low

Color	Average Counts
Dark Gray – Black	No data
Dark Blue	+/- 20
Cyan	+/- 200
Green	+/- 2000
Yellow	+/- 20,000
Red	+/- 200,000
Magenta	2,000,000
Light Gray - White	> +/- 2,000,000

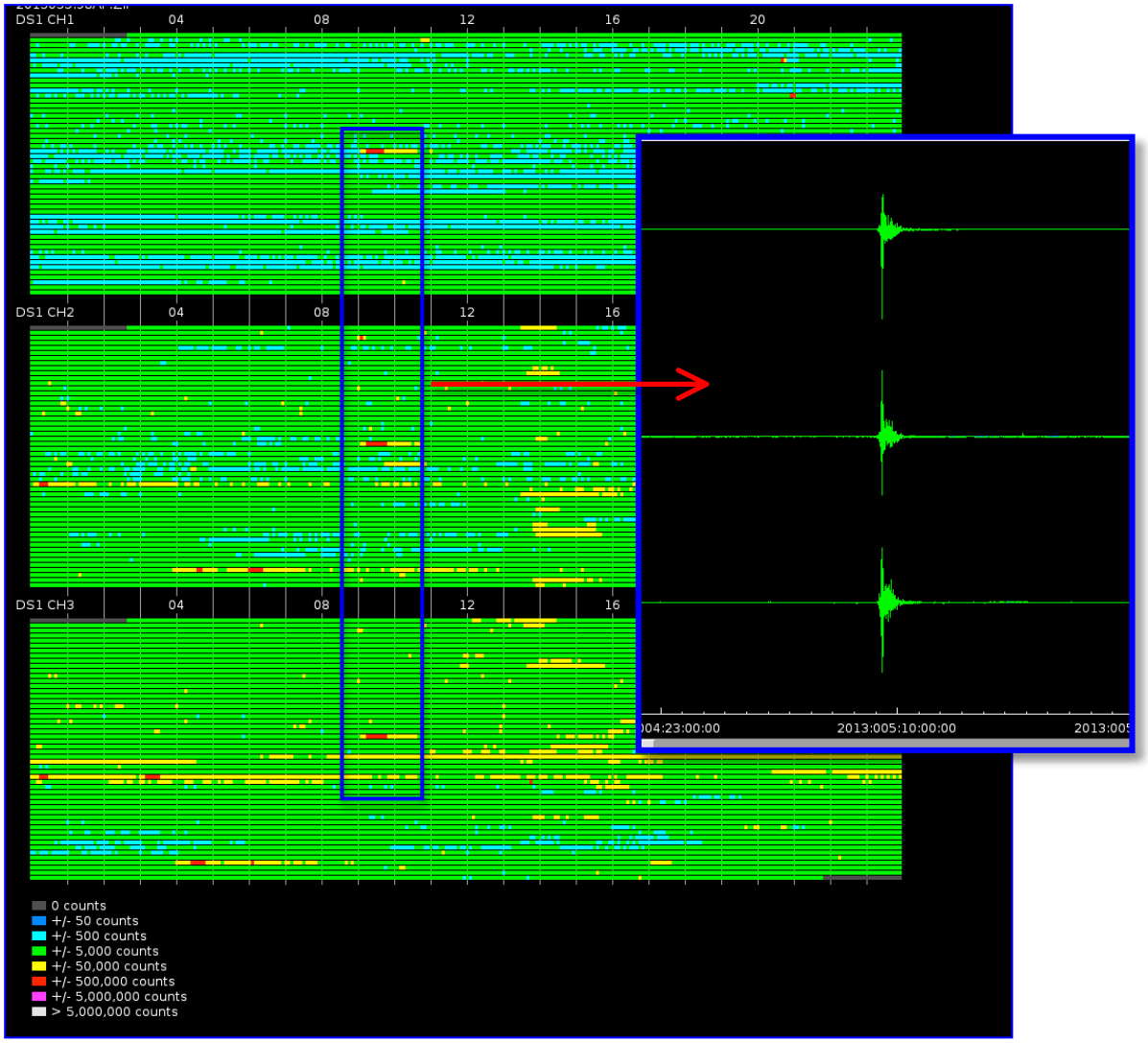
Medium

Color	Average Counts
Dark Gray – Black	No data
Dark Blue	+/- 50
Cyan	+/- 500
Green	+/- 5000
Yellow	+/- 50,000
Red	+/- 500,000
Magenta	5,000,000
Light Gray - White	> +/- 5,000,000

High

Color	Average Counts
Dark Gray – Black	No data
Dark Blue	+/- 80
Cyan	+/- 800
Green	+/- 8000
Yellow	+/- 80,000
Red	+/- 800,000
Magenta	8,000,000
Light Gray - White	> +/- 8,000,000

Click on a point to display the 5-minute average counts in the status bar. **CTRL-click** on a point to display a vertical time rule in the data plot window and show the 5 minute average counts in the status bar of the TPS plot. This feature can be useful for marking where to zoom in on the data as well as comparing the raw data with the TPS plot. Mass re-centers, earthquakes, and data spikes will show up as higher counts. These plots provide a quick way to assess data for quiet and noisy time periods.



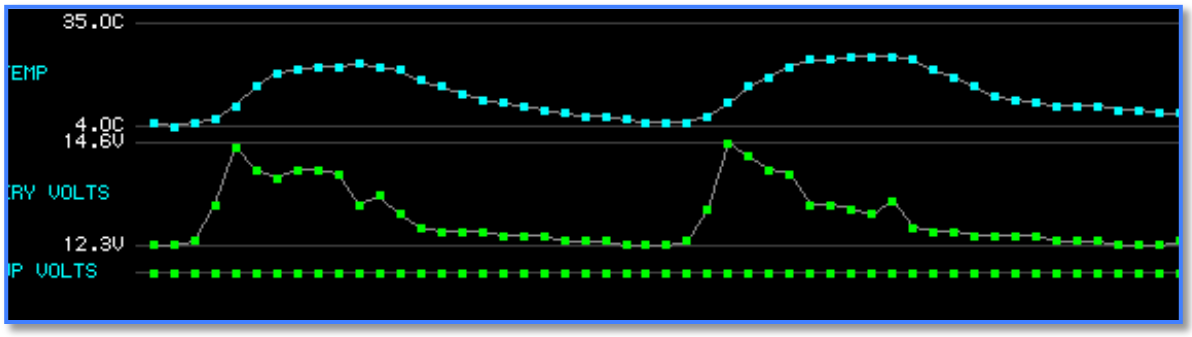
TPS plot – the red squares near the middle of the plot are an earthquake

Quality Checking the Data

During a service run the following points should be reviewed to determine the overall health of the station.

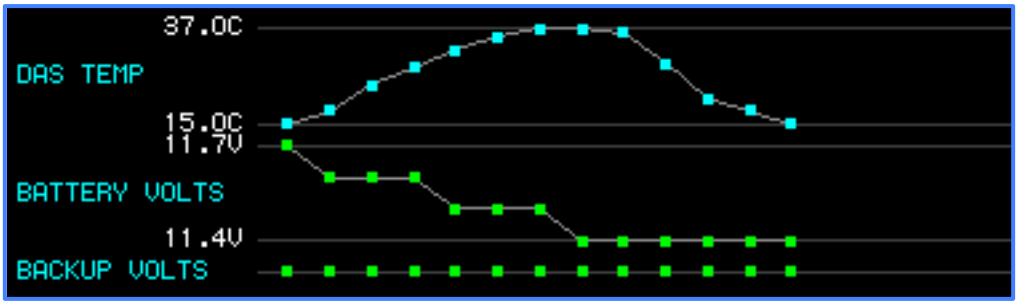
Power

Look at the battery voltage. Are the solar panels (if used) recharging the battery? Notice, in the example below, how the battery voltage (with the help of the solar panel) increases during the day (along with the temperature shown in light blue) and discharges slowly at night. How much is the battery discharging at night? Is the battery discharging at an appropriate rate if not using solar panels?



Temperature (upper), battery volts (middle), and backup battery (lower)

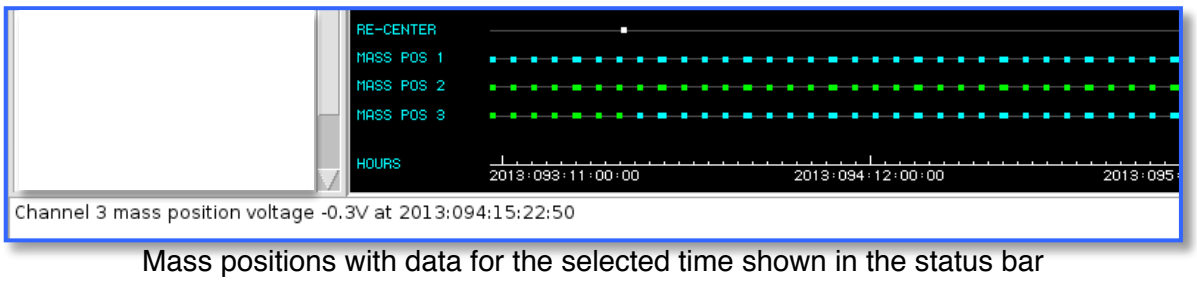
Below is an example of a faulty power system. Either the charge controller or solar panel is not working properly, or there is a poor connection in the wiring or connectors. The figure shows a battery that is slowly discharging and is either disconnected or not taking a charge from the solar panel. Note how the voltage keeps decreasing even though temperature increasing (light blue) indicates that the solar panel should be receiving sunlight (verified with the time mark at the bottom of the plot) and charging the battery.



Example of a fault in the power system – voltage drops until the system shuts down

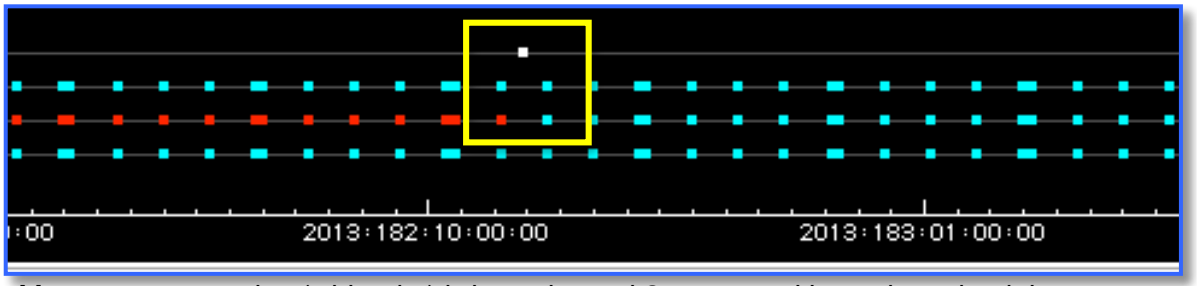
Mass Positions

The mass position amplitudes plot as colors near the bottom of the GUI (if selected). Cooler colors (blue) are low numbers and warmer colors (red) are higher numbers. Click on a dot to display its channel and voltage information in the status bar.



Mass positions with data for the selected time shown in the status bar

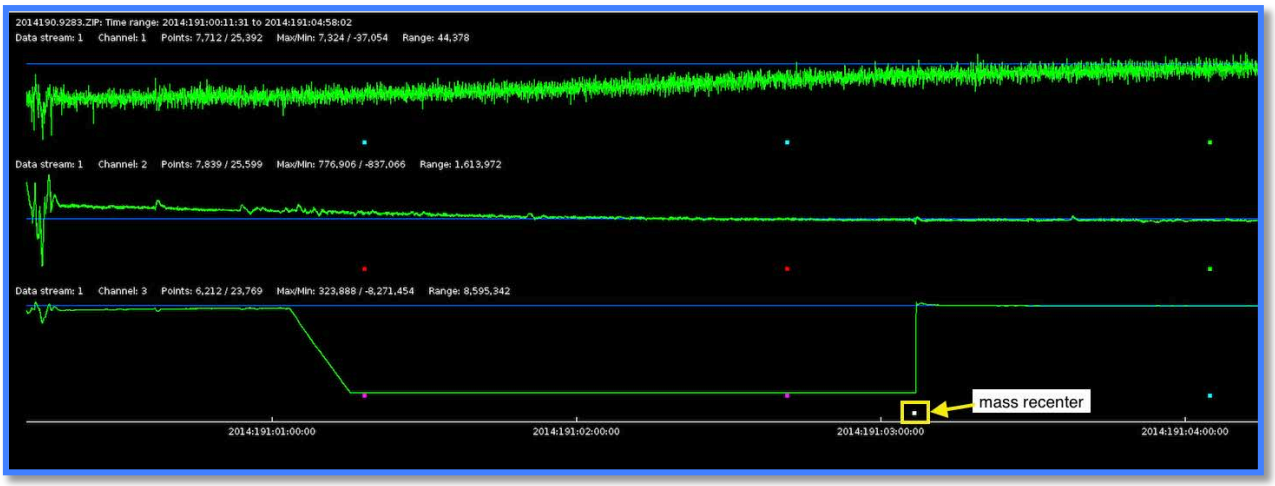
Mass position voltages that are out of range (hot colors) can be brought back into range by a re-center pulse (white dot) as shown in the example below. After the re-center the mass position voltages return to normal (cool colors). Make sure the appropriate mass position voltage range is selected for the type of sensor used. See the Options pull-down menu.



Mass re-center pulse (white dot) brings channel 2 mass position voltage back into range.

Mass Position Problems

The example below shows raw waveform data from a sensor where the E/W mass is pegged and the N/S mass is drifting out. A mass re-center pulse (white dot) fixed the problem.

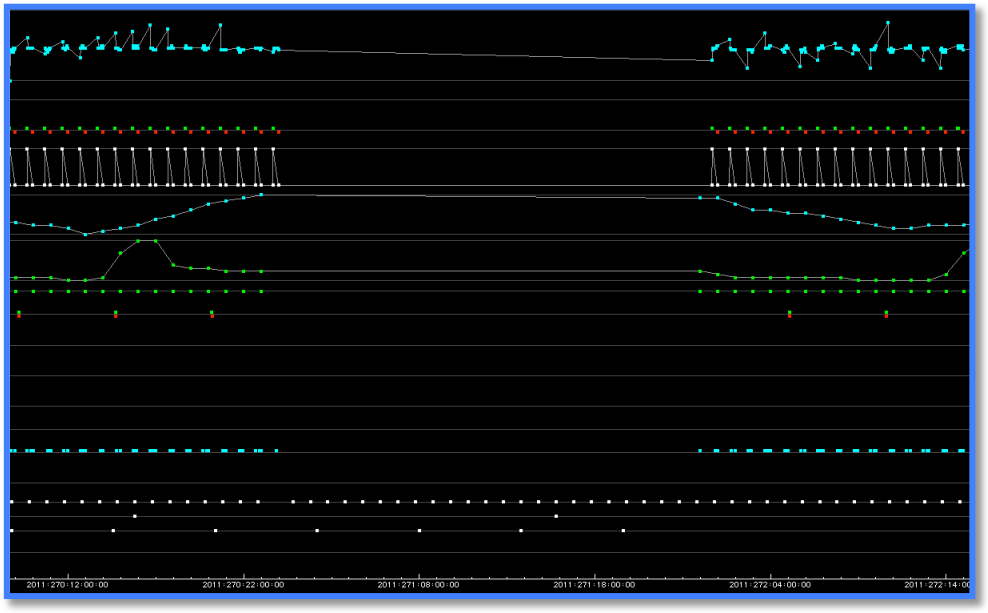


Mass positions pegged and drifting, fixed by a re-center pulse

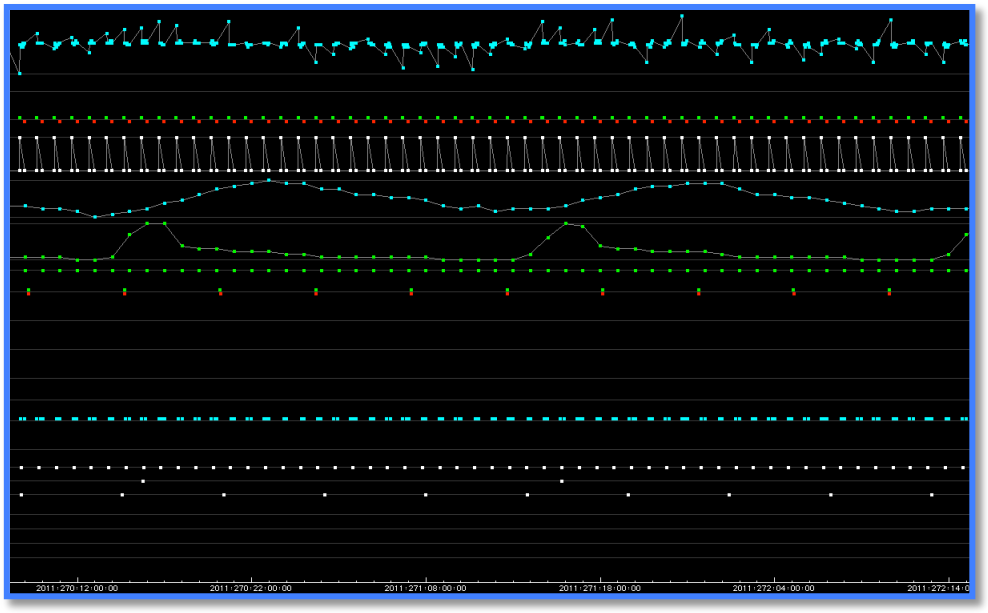
Gaps in the Data

Sometimes the information plotted in logpeek appears to be missing information. In the example below the SOH information disappears in the middle of the figure and only the events plots are continuous. This kind of problem can happen if the data were not completely downloaded from the compact flash disk.

Some missing data due to incomplete downloading from the cf card



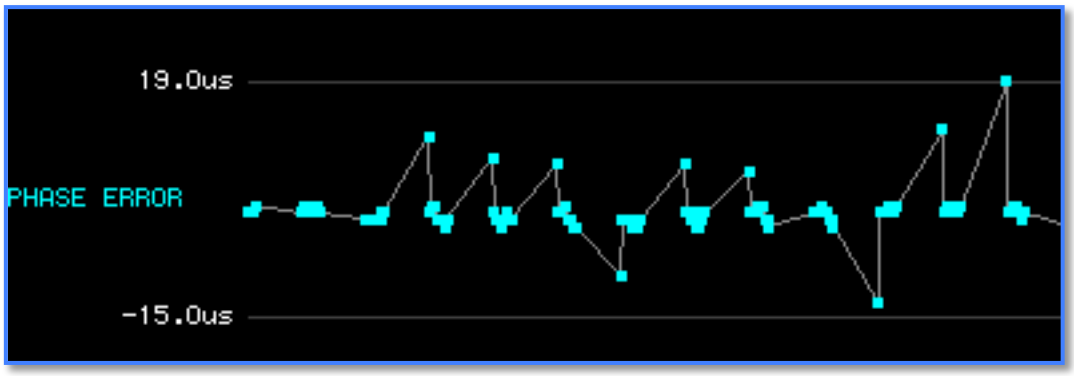
The data should be re-downloaded from the original disk using **Neo**. The example below shows the same data and time frame with all of the expected data plotted.



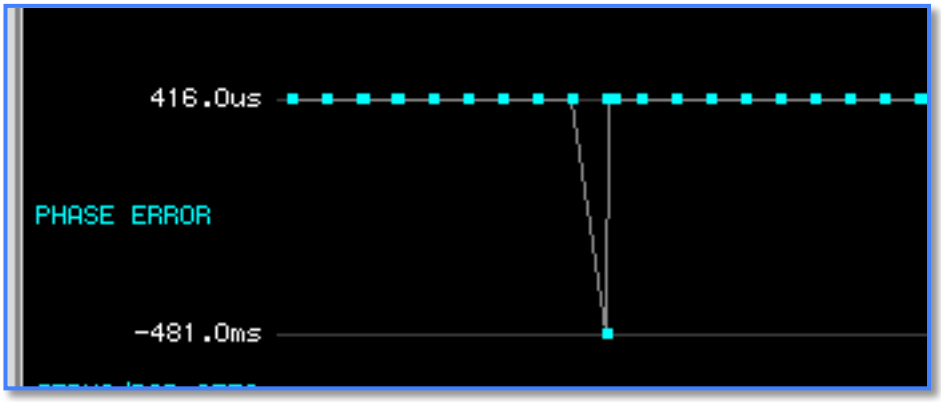
All data is plotted after another try at downloading using Neo

Phase Errors

Look at the range of the phase errors. Often phase errors are seen that are too small to affect the data. Only phase errors larger than the ½ the sample interval may affect the data. For example, if data are recorded at 40sps, the sample interval is 1/40sps = 0.025 seconds. Therefore errors of < 0.0125 seconds (12.5 milliseconds or 12,500 microseconds) can be disregarded while those larger than this should be marked as timing questionable.



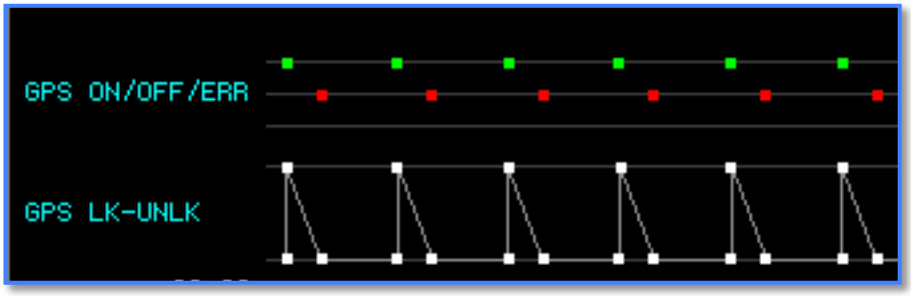
Phase errors much less than ½ the sample interval for 40 Hz data



This large phase error should be investigated further, as it is greater than ½ the sample interval for 40 Hz data

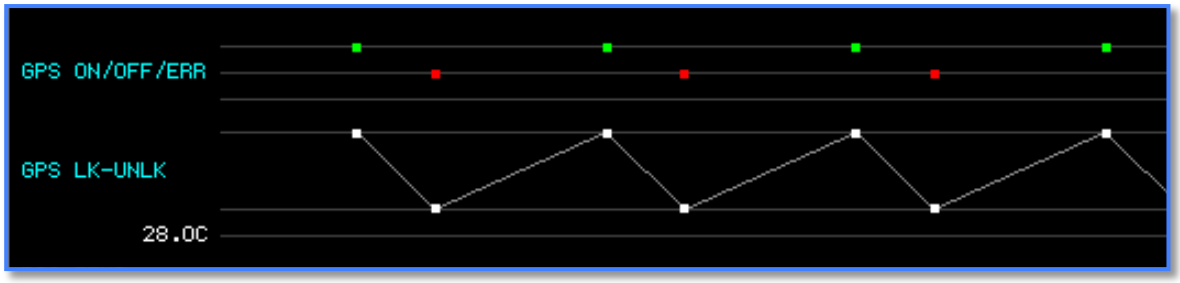
GPS Locking

Check that the GPS is locking and unlocking regularly. The pattern seen in logpeek depends on the type of GPS receiver. The saw-tooth example below is from an older receiver. The clock turns on and locks once each hour. The GPS is unlocked, the clock turns on, registers that it is unlocked, locks, and then 20 minutes later unlocks and turns off.



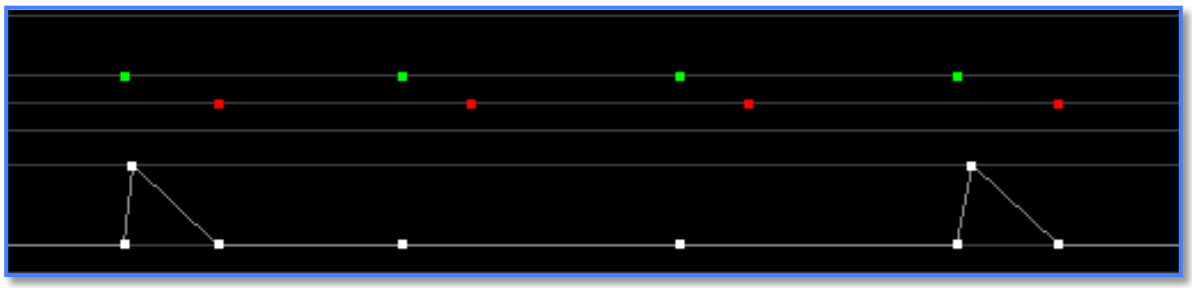
GPS turns on and locks (green dot) – unlocks and turns off (red dot) 20 minutes later

Some newer receiver models allow the clock to lock almost instantly after powering on resulting in a different lock/unlock pattern as shown below. Note the missing GPS-UNLK dot. The duration of time that the clock is locked is 20 minutes in both figures. The type of clock is identified in the log file; logpeek lists it in the lower left-hand box of the main window.



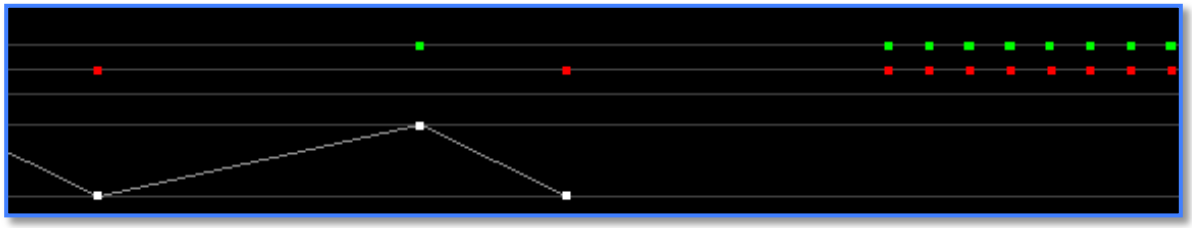
GPS receiver locks instantly (green dot) and turns off 20 minutes later (red dot)

Below is an example where the clock fails to lock for a period of time and then locks again. If this happens at the same time on several stations in the same network it could be indicative of several factors including a satellite outage or poor satellite reception.



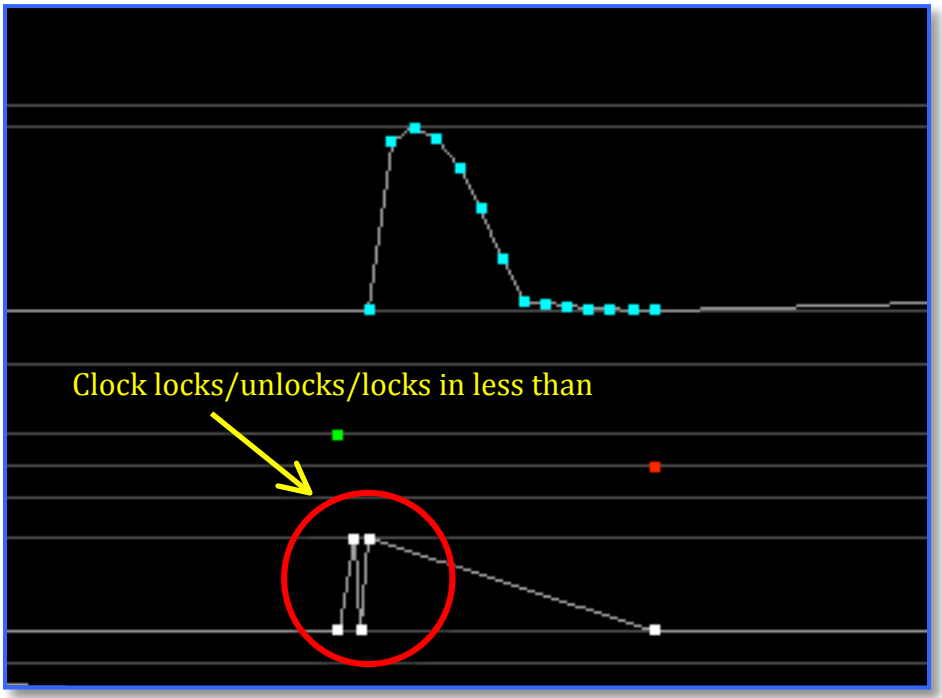
GPS loses lock for 2 hours and then resumes normal operation

The example below shows that there is no communication between the external GPS module and the RT130. After this occurs, the RT130 tries to wake up the GPS every 10 minutes. Most likely the clock and/or clock cable will have to be replaced.

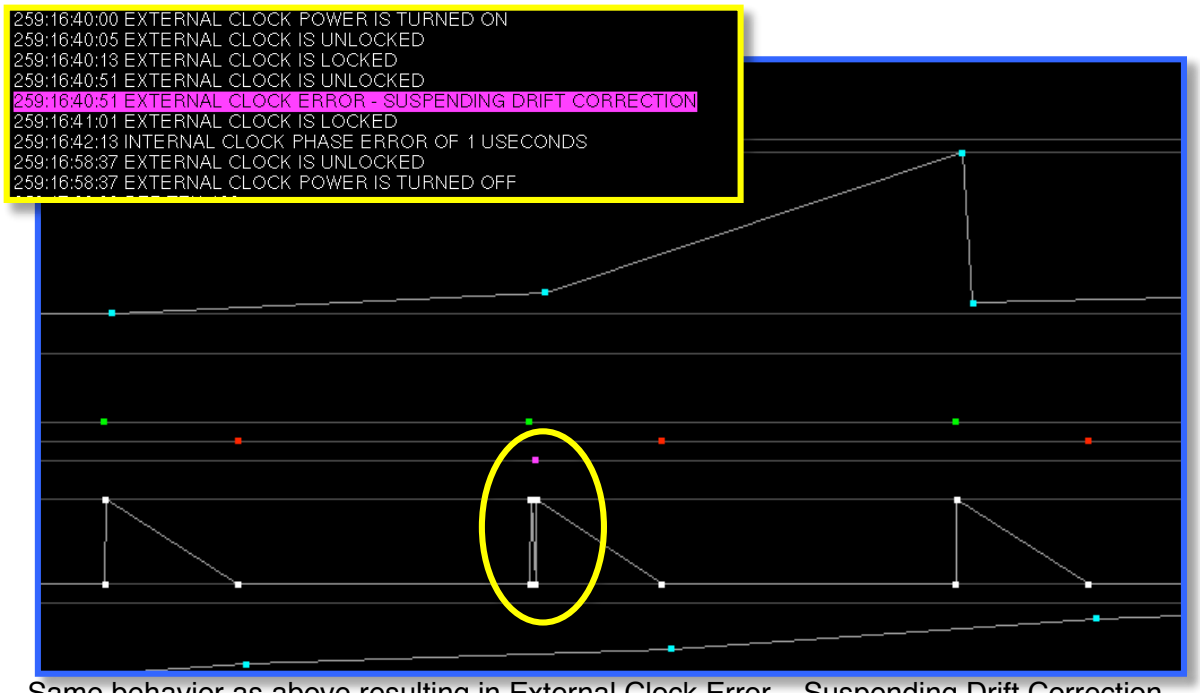


DAS loses communication with the GPS module – DAS sends GPS on and off commands every 10 minutes (red and green dots) trying to wake up the GPS

An example of a jittery clock is shown below. These errors are described differently for different versions of RT130 firmware. For firmware versions 3.0.0 or earlier they are labeled as "EXTERNAL CLOCK WARNING 1PPS" as shown in the upper example below. For firmware 3.4.0 (or later) the errors are labeled "EXTERNAL CLOCK ERROR – SUSPENDING DRIFT CORRECTION" as shown in the lower example below. These errors are likely the result of a weak satellite signal to the GPS. If this problem is caused by a minor problem with the GPS constellation, the same problem will occur on nearby stations that "see" the same patch of sky. These errors could also be due to a clock going bad and in that case the clock will most likely have to be replaced.



Jittery clock lock/unlock producing 1PPS warning (firmware earlier than 3.4.0)

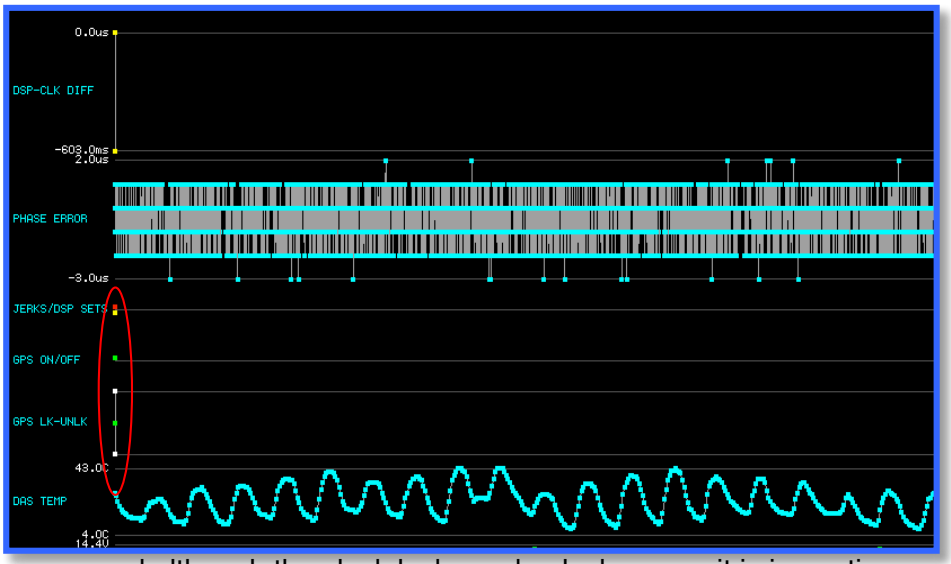


Same behavior as above resulting in External Clock Error – Suspending Drift Correction message (firmware 3.4.0 or later)

Continuous GPS mode

Below shows an example where information seems to be missing for the GPS lock-unlock field. One way this can happen is if the GPS was left in the continuous setting instead of the cycled setting.

The logpeek screen below shows a section where there is a single data point for the GPS powering up and then one point for the GPS unlocked and one point for the GPS lock. The phase error messages are very regular and very small (+2 to -3microseconds). The main reason that most experiments do not adopt the continuous on GPS setting is that it draws more current and therefore uses more power.

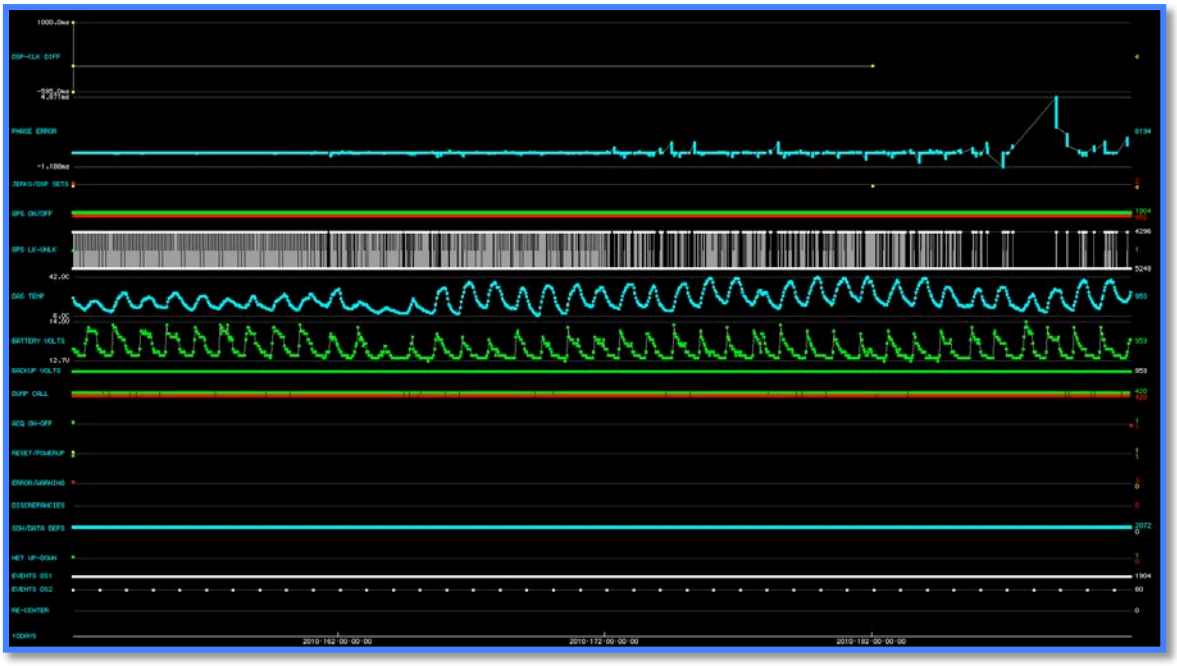


GPS turns on and although the clock locks and unlocks once, it is in continuous mode.

Clock Failing

A more common reason for what appears to be missing data on the GPS LK-UNLK line is that the clock is missing some locks. This may be due to minor issues with the constellation or sky view or can be indicative of a more serious problem if the condition worsens. In the example below the station started out with consistent clock locking and then transitions to the clock failing to lock more often until by day 2010:186 the lock fails to lock for several days.

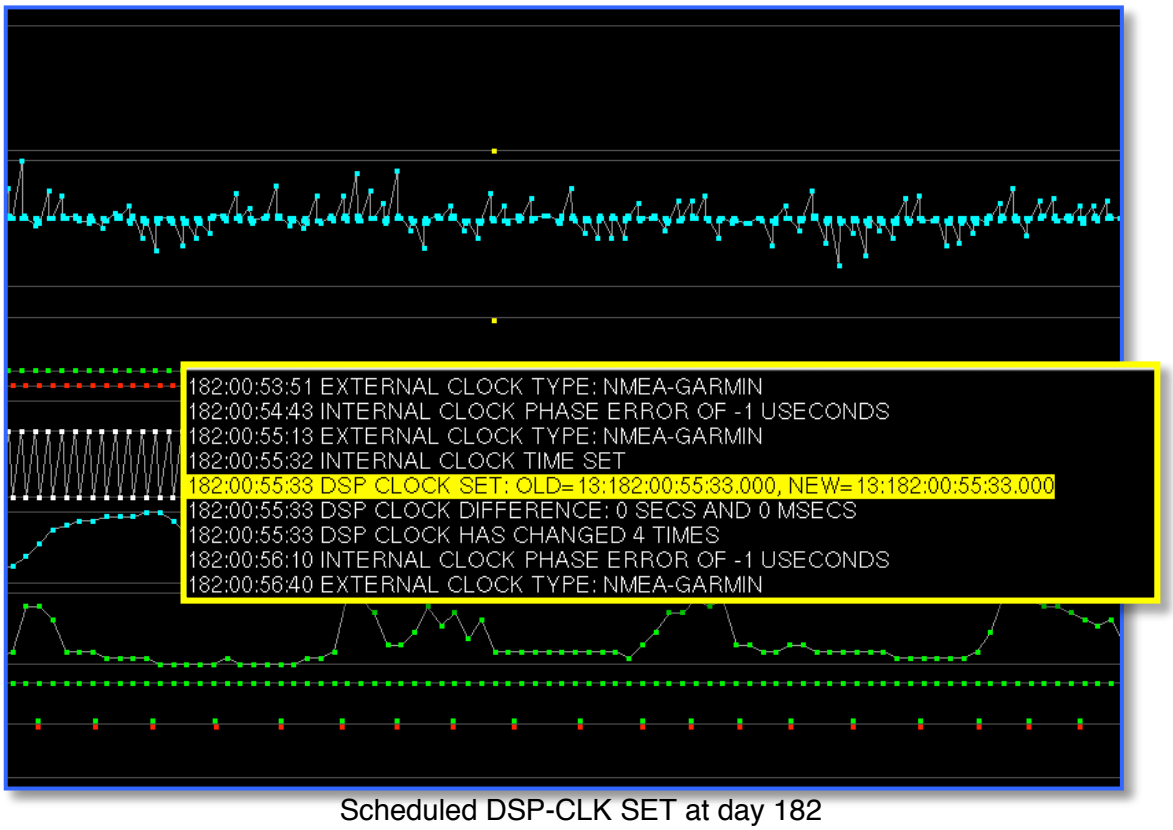
The timing is suspect from 2010:186-2010:189, due to intermittent and irregular clock locks, therefore these data were marked "timing questionable", using fixhdr. Without regular clock locks and phase error reports it cannot be determined if the timing is accurate within the precision desired. In a case like this the GPS location should be inspected to ensure that there is a clear sky view. By comparing the number of satellites obtained with a hand-held GPS to the number shown in the DAS, it can be determined if the sky view is unobstructed. The GPS should be replaced if the sky view is unobstructed and logpeek shows the behavior below.



GPS clock locks intermittently and may be failing

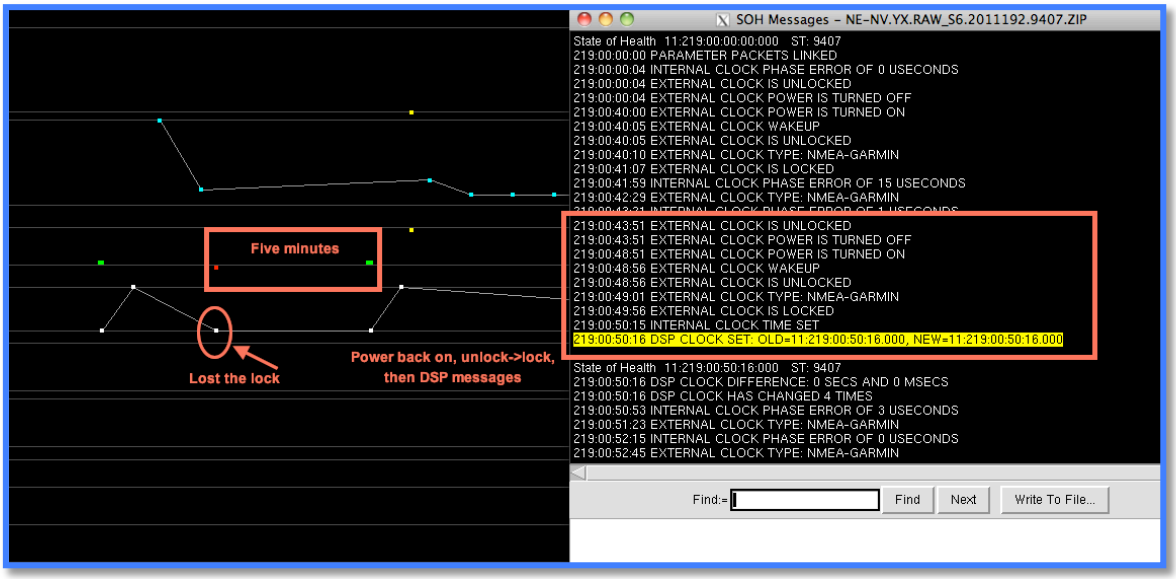
DSP CLOCK DIFFERENCE errors

DSP-CLK DIFF of 0 secs and 0 msec coupled with DSP CLOCK SETS with no time change. DSP sets are scheduled to occur on 1 January and 1 July (days 001 and 182 – see below).



Scheduled DSP-CLK SET at day 182

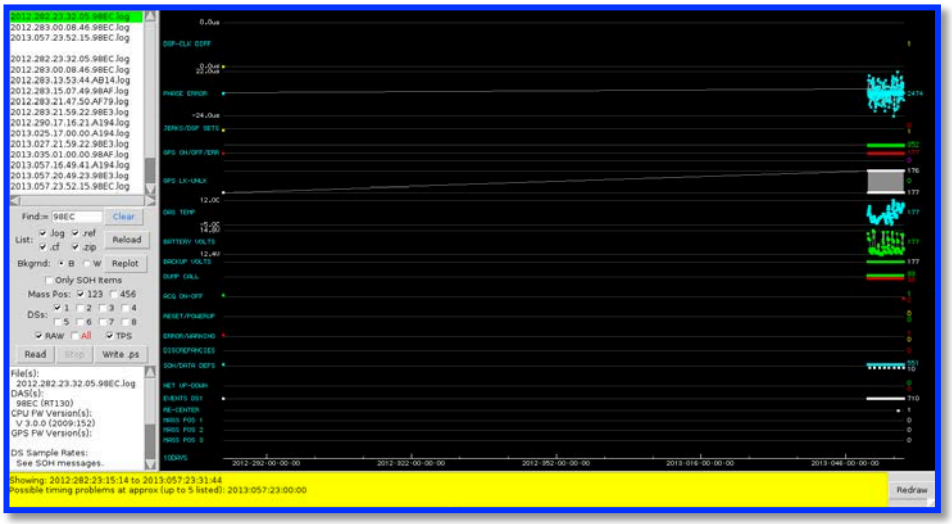
Another example of a zero time difference for DSP CLOCK SET is when a GPS loses a lock or is unable to lock (see below). It will turn the clock off with the SOH message "EXTERNAL CLOCK POWER IS TURNED OFF", wait five minutes and then try again. When the GPS finally gets a lock, it issues a DSP set message with zero time change as well as a DSP-CLK DIFF of zero. There is no problem with data collected during this time period but it may indicate that the clock is going bad, warranting a replacement during the next service visit.



DSP CLOCK SET when GPS regains a lock

Possible Timing Problem errors

If logpeek suspects there are possible timing errors, as shown in the extreme example below, there will be a message highlighted in yellow in the status bar when the file initially loads. This may or may not be true, and merits further investigation. This message will disappear while viewing the log file, and a *Timing Error* window will appear with a list of data that contain possible timing problems.



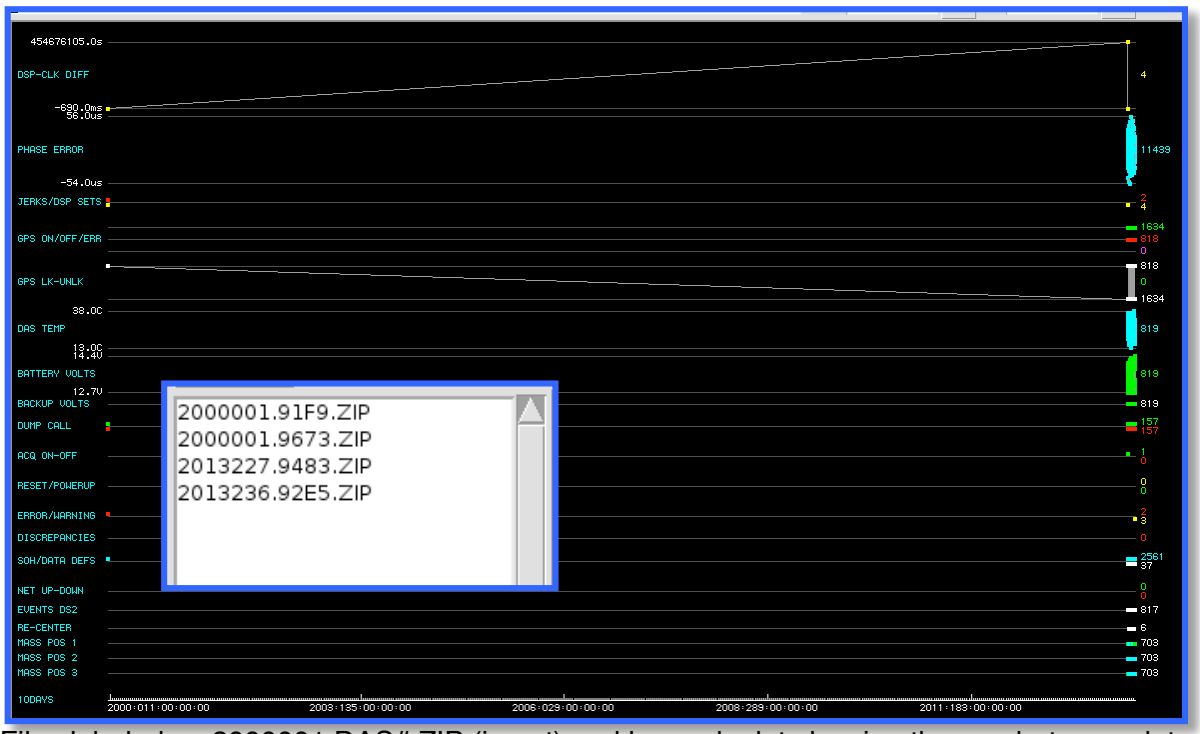
Timing errors identified by logpeek

Year 2000 Start Dates

In some circumstances the DAS will start recording SOH information before the clock has locked. Thus the DAS does not know what time it is - resulting in the ZIP file having a name starting with 200001 as shown below. This is commonly the result of a station losing and then regaining power and having the RT130 backup battery fail as well. Once the power is back on the DAS (not knowing that it doesn't know the correct time) starts recording SOH messages and automatically restarts acquisition even if the clock has not yet locked.

As soon as the clock locks, the SOH and data are marked with the correct time. Logpeek will plot 2000 SOH data in year the 2000 along the time scale marked at the bottom of the logpeek main window.

The year 2000 information looks like it is first in the order of events, but upon closer inspection, it becomes clear that the files were not recorded in 2000. If you look at the file creation date using **Finder** (on a Mac) or using ls –l from the command line, you can see when the file was actually created and determine where it fits into the greater logfile picture. In general, all data marked as year 2000 that is generated during this time period before the clock locks should not be archived and the resulting channel-day volumes from the year 2000 should not be archived either. No other timing correction or notation is needed.



Files labeled as 2000001.DAS#.ZIP (insert) and logpeek plot showing the gap between data with the correct time and data marked as year 2000