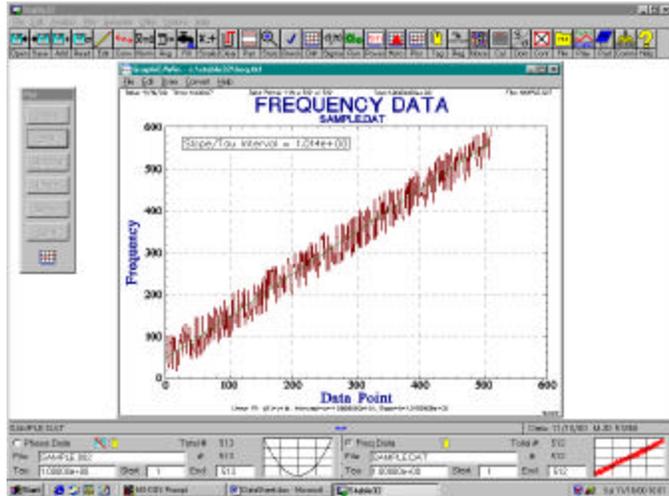# Stable32 Frequency Stability Analysis

Stable32 is a 32-bit Microsoft Windows® program for the analysis of frequency stability. It includes all the functions necessary to manipulate, analyze and plot time and frequency stability data.

Features Stable32 file operations include opening phase and frequency data files, combining data, and storing all or a portion of the data. Data is stored in ASCII format, with gaps indicated by a value of zero, and may be input from any source that generates up to 8 columns of comma or space-delimited data, with or w/o timetags. Stable32 can also read and process data from Timing Solutions Corporation clock measurement systems. All storage and calculations are performed with double precision for a virtually unlimited number of data points. Editing functions include displaying, editing, inserting, deleting, and filling gaps in phase and frequency data. Conversion between phase and frequency data is supported, as is outlier detection and removal. Timetags may be generated for indexing, or used to locate and fill gaps in the data. Plotting and printing can be done for all or a portion of the data, with drift fits and automatic or user-defined scales and titles. Analysis functions include basic statistics (max, min, avg, median and std dev), drift, drift removal, normalization, scaling, gap and outlier detection and removal, as well as Allan, total and Hadamard variance stability statistics, dynamic stability, histograms, and power spectrum, all over selectable limits with gaps ignored. Stability analysis includes point and automatic calculation and plotting of normal and overlapping Allan deviation, modified Allan deviation, time deviation, total deviation, modified and Hadamard total deviation, modified time total deviation, and normal and overlapping Hadamard deviation, as well as Thêo1, ThêoH, MTIE and TIE rms. The PSD can be expressed as $S_y(f)$, $S_x(f)$, $S_\phi(f)$ or $£(f)$. Means are available to estimate the noise type and to set selectable confidence intervals. Stability data can be saved, edited, read and re-plotted. Simulated power-law clock noise may be generated, and time-frequency domain conversions may be done for power-law noise processes. A calendar is provided for date, day-of-year, GPS Week # and MJD.

Functions All Stable32 functions are accessed by menus and toolbars as shown below:

- **Open**   Open a data or archive file from disk
- **Drift**   Calculate drift for x(t) and y(t) data
- **Save**   Save a data file to disk
- **Sigma**   Calculate Allan or other deviation
- **Add**   Merge a data file from disk
- **Run**   Calculate stability statistics
- **DAVAR**   Calculate dynamic stability
- **Read**   Read a stability data file

- **Power**   Plot power spectrum
- **Print**   Print phase or freq data
- **Histogram** Plot histogram
- **ACF**   Plot autocorrelation function
- **Exit**   Exit Stable32 program
- **Phase**   Plot phase data
- **Edit**   Edit current data
- **Frequency** Plot frequency data
- **Convert**   Convert between x(t) & y(t) data
- **Noise**   Generate simulated clock noise
- **Normalize** Remove mean value from data
- **Timetags**   Generate timetag data
- **Average**   Combine data into longer tau
- **Calendar**   Display a DOY/MJD calendar
- **Fill**   Fill gaps in data
- **Domain**   Time-freq domain conversions
- **Regularize** Insert gaps using timetags
- **Notepad**   Invoke the Notepad text editor
- **Scale**   Scale data (+,•, slope)
- **Play**   Replay a *.TKF plot file
- **Part**   Delete part of data
- **Configure** Set configuration options
- **File**   Set filenames
- **Clear**   Clear data array
- **About**   Display Stable32 information
- **Statistics** Calculate basic statistics
- **Index**   Display Help index
- **Check**   Check frequency data for outliers
- **Help**   Display help information

The top rows of the screen contain the menu and toolbar, and the bottom lines display the status of the phase and frequency data currently in memory, including zoomable plots of the data. The usual Windows® user interface conventions are used.

Data Plotting Stable32 includes functions for high-resolution phase and frequency data plotting, with optional title, subtitle, annotations and drift lines. The data and time axes may be scaled to other units. The plot scales may be automatically determined or manually chosen. The plots include time and date, file name, data point range, averaging time and line parameters. A number of line options are available. The plotting routines use the GraphiC® library for on-screen and publication-quality hard copy graphic printouts. The screen plots may be zoomed, stored in a file for replay by the included Play/Win program, or converted to other formats for import into other programs.
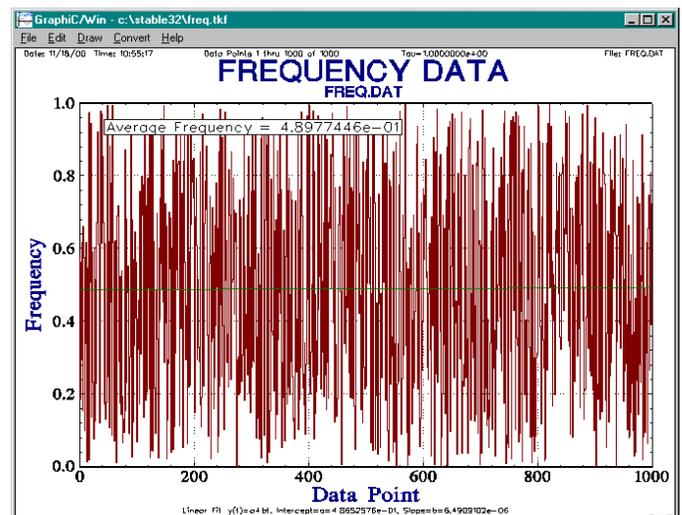
Data Analysis Stable32 includes functions for basic statistics, drift, variance, histograms, autocorrelation, and power spectrum analysis. The basic statistics are # data points and gaps, maximum, minimum, average, plot scales and standard deviation.
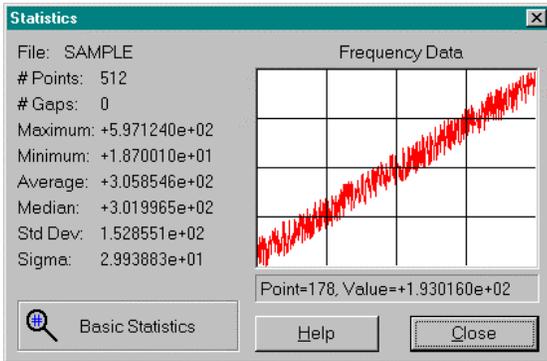

Frequency drift analysis includes 2nd difference, 3-point and quadratic fits to phase data, and linear, bisection, logarithmic and diffusion fits to frequency data. Frequency drift may be removed from the phase or frequency data. Variance analysis includes normal, overlapping, modified and time Allan deviations, Total, and Hadamard deviations for phase and frequency data. The averaging time may be chosen as any multiple of the basic data up to the maximum permitted for the particular calculation. Confidence limits are given, and single or double confidence intervals can be established for overlapping data using X^2 statistics and the estimated noise type. An example of a Stable32 drift analysis screen is shown below. This screen is typical of those for all Stable32 functions, including analysis choices and numerical results. The Stable32 drift analysis methods include linear, log, diffusion, bisection, quadratic, 3-point and 2nd difference. Linear fitting and endpoint matching is available to calculate and remove frequency offset from phase data.
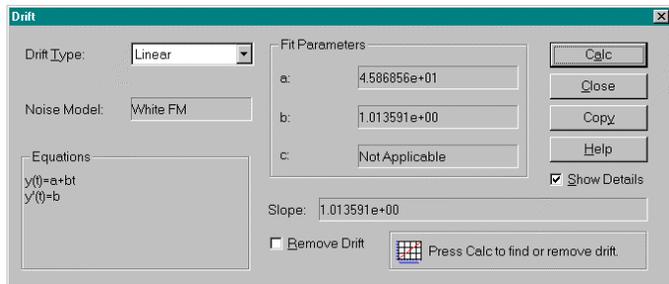

Stability Analysis Stable32 stability analysis methods include normal, overlapping, modified and time Allan deviations, total, modified, time and Hadamard total deviation, and normal and overlapping Hadamard deviation, Thêo1 & Thêo1, as well as MTIE and TIE rms. These statistics are available either at a single averaging time with the Sigma function, or over a range of averaging times with the Run function, with automatic bias corrections and error bars
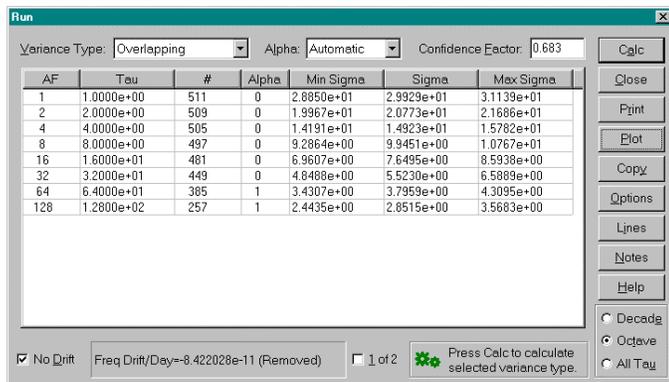
The results of the latter operation can be printed in tabular form or plotted as shown below. Automatic or user-defined noise typing is available, and decade, octave or all tau increments may be selected. The stability plot can include noise lines, specification limits and masks, and a variety of titles, sub-titles, messages and annotations.
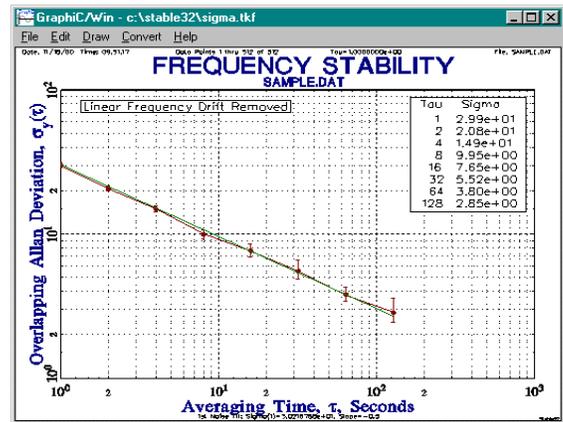
Other Functions Other Stable32 analysis functions include dynamic stability, power spectra, $S_y(f)$, $£(f)$, $S_f(f)$ and $S_x(f)$, autocorrelation, noise ID, histograms and time-frequency domain conversions. In addition, simulated power law clock noise may be generated and analyzed.
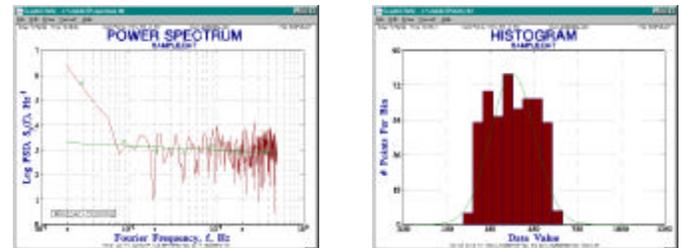
Documentation Stable32 is supported by a 280 page User Manual that fully describes the installation and operation of the program. Examples are included that show the use of the major features and functions. Stable32 can be used for both routine data analysis of frequency stability measurements and as an educational tool. The ability to generate and analyze simulated clock noise is an effective way to learn the techniques of frequency stability analysis. The Stable32 program also includes on-line help.

Ordering Information The single-quantity price of Stable32 (inc. US shipping via 1st class mail) is $395. Copies of Stable32 may be purchased directly from Hamilton Technical Services. A check or purchase order should accompany your order. Stable32 is supplied on a CD with an installation program and is not copy protected. Backup copies may be made and may be installed on any number of computers within the immediate user group that purchased it, but only one copy of each unit purchased may be used at any time. Additional copies of the software or its documentation may not be distributed to others. Stable32 is sold with a 30-day refund policy to insure your satisfaction. Free support/updates are provided for 1 year.

Software for Frequency Stability Analysis

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