Sulzer 2.5C quartz oscillator

Description

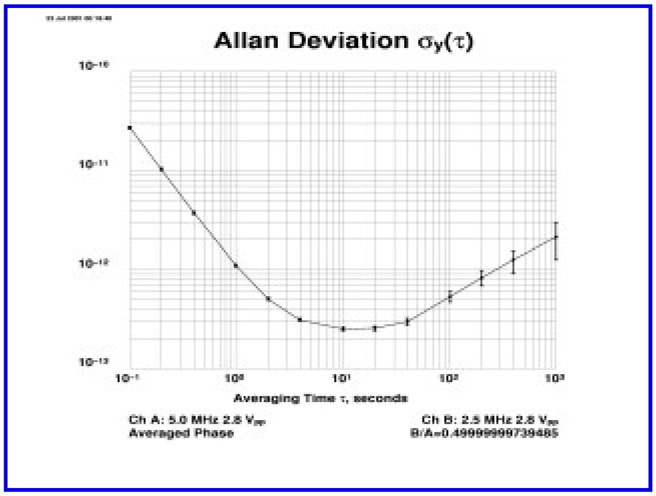
The **Sulzer 2.5C** is a very high-quality double oven 2.5 MHz AT-cut crystal frequency standard from the early 1960's. It is exceptional even by today's standards, easily outperforming modern OCXO such as the HP 10811A in stability and frequency drift.

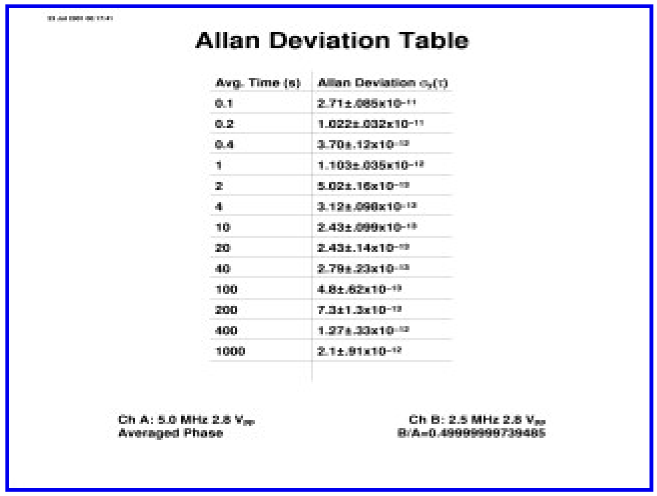
Short-term stability of parts in 10^{-13} and drift rates of parts in 10^{-11} per day are not uncommon. The oscillator electronics included dividers producing 1 MHz and 100 kHz outputs in addition to the primary 2.5 MHz output (or should we say 2.5 Mc ;-). See Sulzer 2.5B and 2.5C schematic for details. Also available in wide version.

After 30 to 40 years (were the 60's that long ago!) some old Sulzer oscillators either no longer work or they have excessive phase noise or frequency instability (e.g., the proportional oven circuits have problems). The one below appears to have survived the years very well.

Photo Gallery

Measured Performance Summary (see below or click to enlarge images)

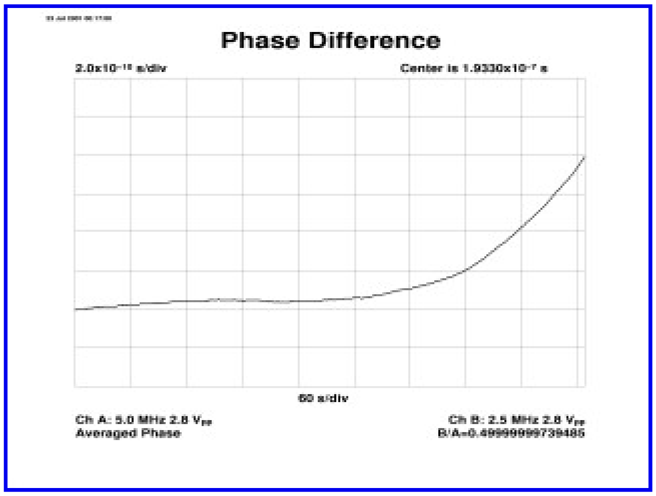


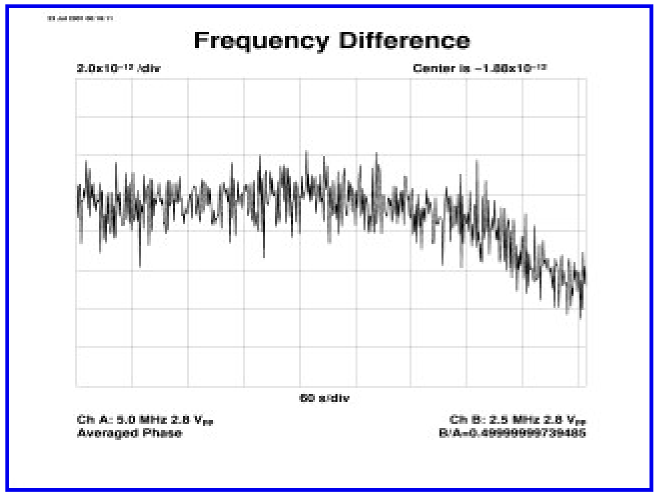


Allan Deviation Table

Avg. Time (s)	Allan Deviation $\sigma_y(\tau)$
0.1	$2.71 \pm .085 \times 10^{-11}$
0.2	$1.022 \pm .032 \times 10^{-11}$
0.4	$3.70 \pm .12 \times 10^{-12}$
1	$1.103 \pm .035 \times 10^{-12}$
2	$5.02 \pm .16 \times 10^{-13}$
4	$3.12 \pm .098 \times 10^{-13}$
10	$2.43 \pm .099 \times 10^{-13}$
20	$2.43 \pm .14 \times 10^{-13}$
40	$2.79 \pm .23 \times 10^{-13}$
100	$4.8 \pm .62 \times 10^{-13}$
200	$7.3 \pm 1.3 \times 10^{-13}$
400	$1.27 \pm .33 \times 10^{-12}$
1000	$2.1 \pm .91 \times 10^{-12}$

Ch A: 5.0 MHz 2.8 V_{pp}
Averaged Phase
Ch B: 2.5 MHz 2.8 V_{pp}
B/A=0.49999999739485



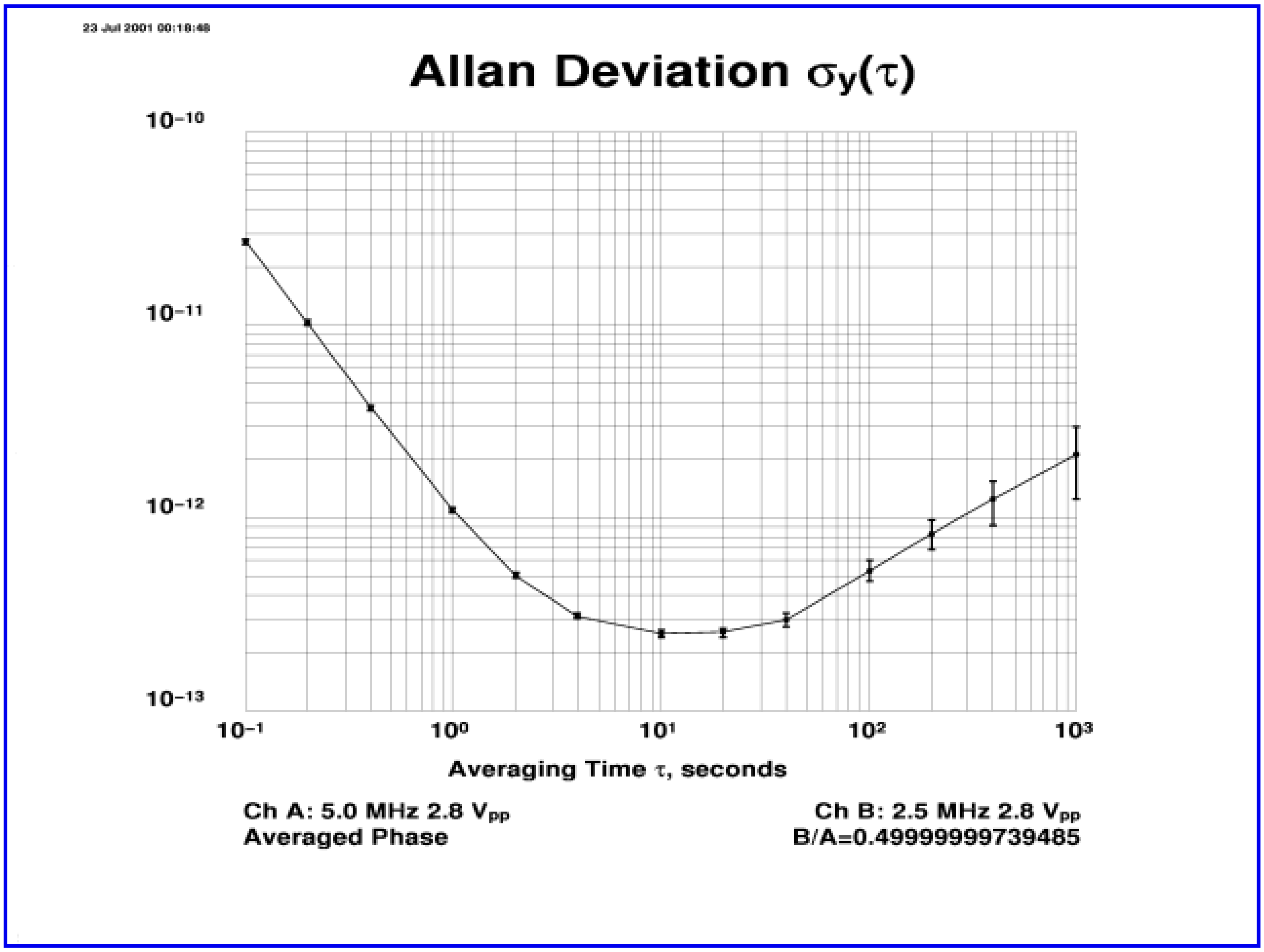


Oscillator Short-term Performance (large images)

The **four** stability plots were obtained with a TSC 5110A Time Interval Analyzer frequency stability measurement system and a homebrew scheme to produce online *webcopy* images rather than printer *hardcopy* plots. With 0.1 picosecond (100 fs) resolution and an embedded PC the 5110A calculates and displays auto-scaled log-log Allan Deviation plots in real-time for tau as short as 0.01 second and as long as you are patient. The noise floor of the 5110A is on the order of 10^{-17} and a Hydrogen Maser was used for the reference channel so the measurement system is typically orders of magnitude more stable than the unit under test. Thus for all tau up to a day or week the plots below can be assumed to be absolute rather than relative to the reference oscillator.

- **Allan Deviation** is a standard log-log plot of frequency stability. Tau ranges from 0.01 or 0.1 seconds out to 10^4 or 10^5 seconds (depending on how long the measurement run was). The plots are true Allan Deviation when the sampling mode is "Instantaneous Phase" and Modified Allan Deviation when the mode is "Averaged Phase". The mode is indicated on the lower left of the plot.
- **Allan Deviation Table** are the data points, including uncertainty, for each tau plotted.
- **Phase Difference** is the raw phase difference between the reference and the oscillator under test. After an hour into a run this plot is less interesting for quartz standards (since the 5110A does not remove frequency drift during a run).
- **Frequency Difference** shows the computed two sample difference in frequency at one second sample times, plotted with 60 seconds per grid line, for approximately 10 minutes full-scale. The plot shows the most recent 10 minutes of differences regardless of the duration of the run. This plot graphically reveals

oscillator performance from about 1 to 1000 seconds: the magnitude and character of the wiggles within grid lines reflect stability on the order of seconds to tens of seconds while the overall character of the band across the plot shows stability on the order of hundreds of seconds. The Allan Deviation for tau between 1 s to 100 s are statistical summaries of this information, of course, but sometimes seeing the raw wiggles of a phase plot can give insight into oscillator behavior.



23 Jul 2001 00:17:41

Allan Deviation Table

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0.1	$2.71 \pm .085 \times 10^{-11}$
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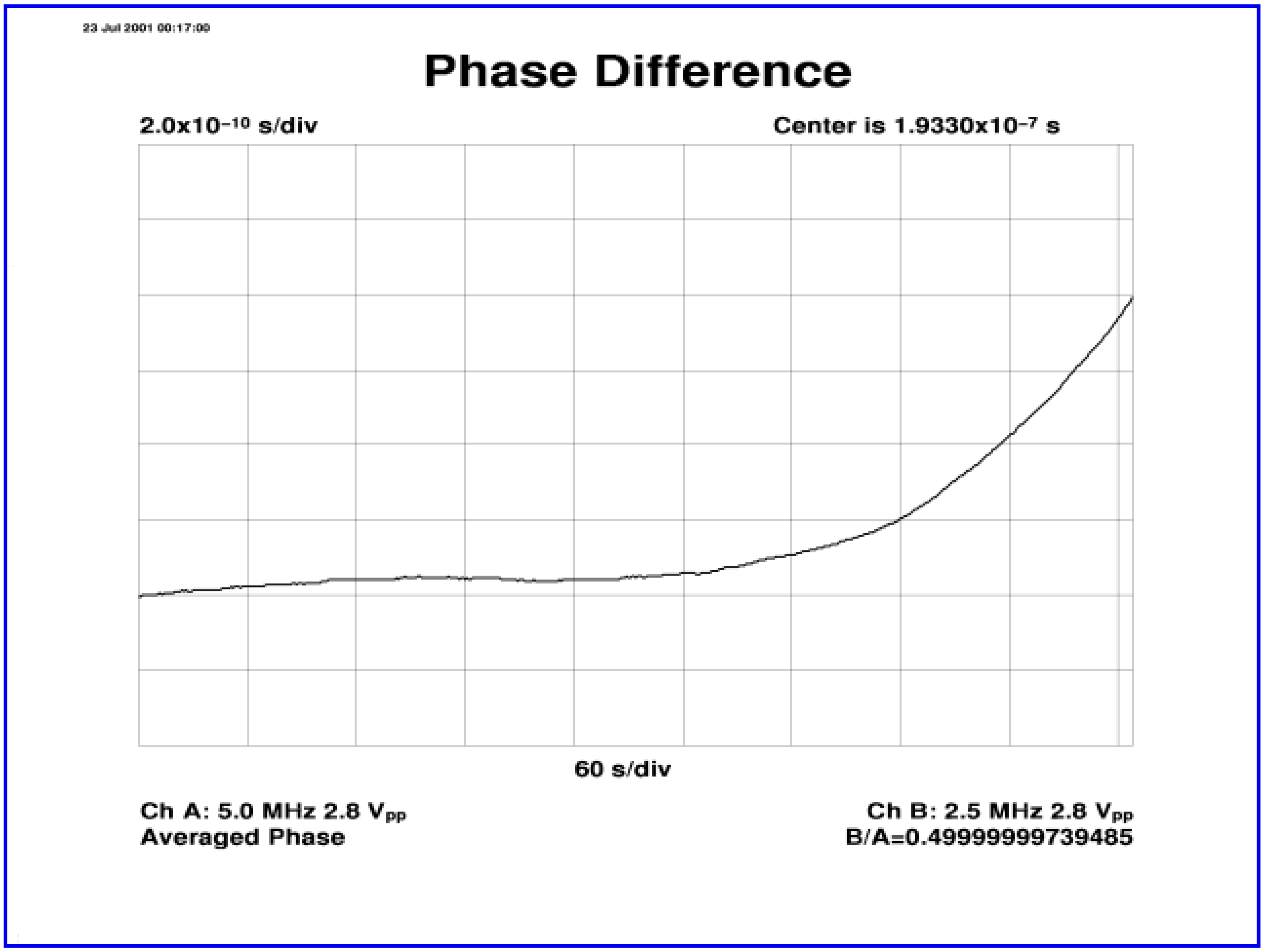
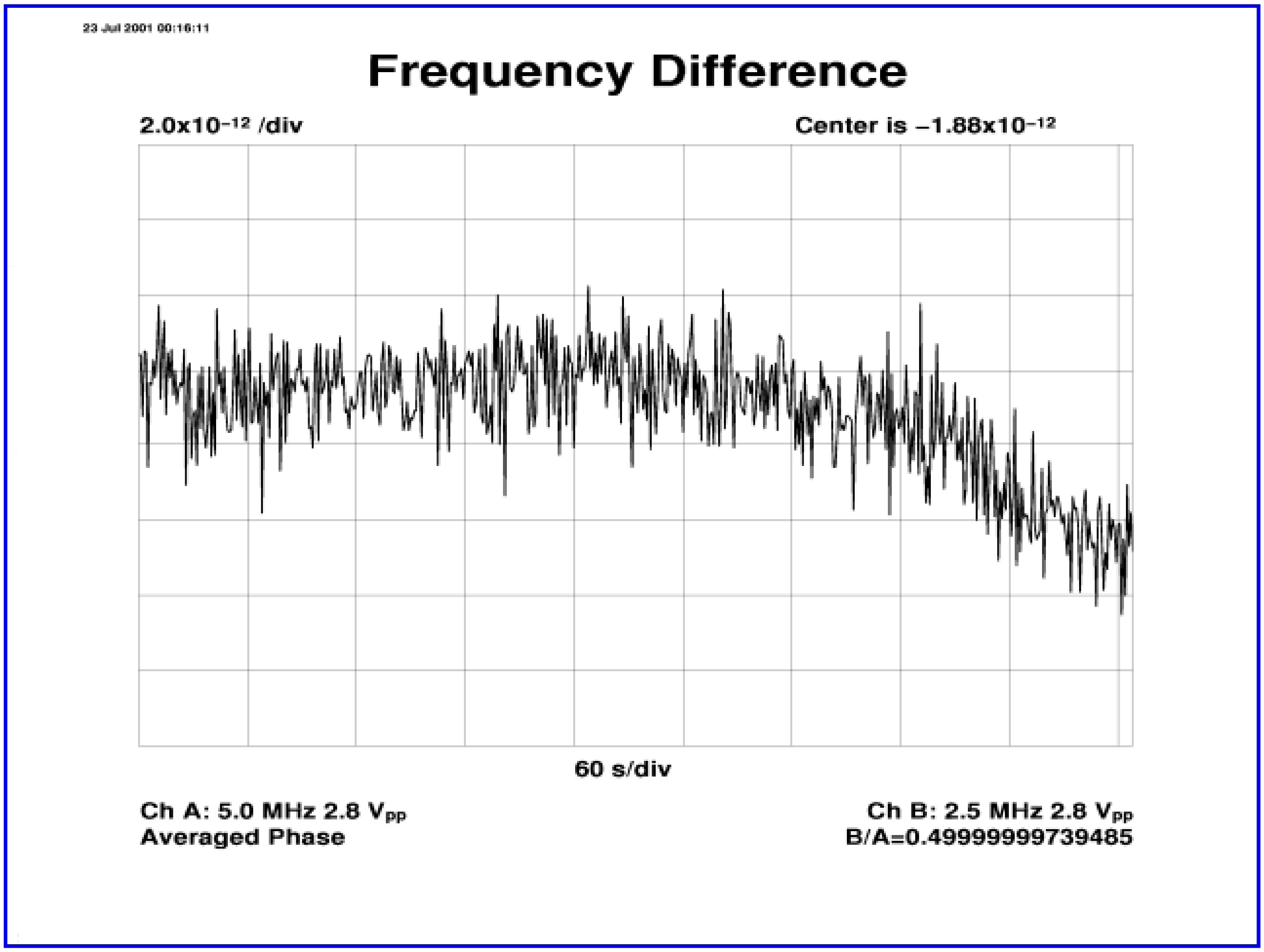

23 Jul 2001 00:17:00
Phase Difference
2.0x10⁻¹⁰ s/div
Center is 1.9330x10⁻⁷ s
60 s/div
Ch A: 5.0 MHz 2.8 Vpp
Averaged Phase
Ch B: 2.5 MHz 2.8 Vpp
B/A=0.49999999739485



Oscillator Long-term Performance

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