1330A
Ensembling off-air frequency reference

apparateq

Electronics for Research and Science

PRELIMINARY INFORMATION

- **Novel, multiple LW time service ensembling**

- **Robust to fading**

- **Low ADEV**

- **Quick acquisition**

- **Settable source frequencies**

- **OCXO as standard**

- **Reporting feature**

- **Dual DC power for redundancy**

- **10 MHz reference outputs**

The 1330A represents a new approach to off-air receivers. Rather than trying to lock to one long-wave service, as traditional off-air receivers would do, the 1330A statistically processes a multitude of services to minimize the frequency error of its on-board oscillator. The result is a dramatic increase in reception robustness, and reduction of the Allan deviation.

Traditional off-air frequency reference receivers have been plagued by too high an Allan deviation, and have been prone to cycle slips, especially around sunrise and sundown. With the 1330A, these are symptoms of the past.

The 1330A typically finds use as a laboratory frequency reference, often at sites where a lack of sky view prevents GNSS reception. The 1330A also finds use as an independent source taking part in the quality monitoring of other frequency sources.

The 1330A is not a PLL (phase locked-loop) receiver, but is essentially a multiple-source FLL (frequency locked-loop) receiver. Following this, and having fully digital control, the 1330A does not suffer from the typical drawbacks of legacy off-air receivers.


Specifications and characteristics

Frequency range	10 – 250 kHz, tracking of up to 5 user-defined frequencies simultaneously
Supply *)	9 – 30 V DC, ≤15 W during OCXO warm-up, ≤7 W during continuous operation. Auxiliary back-up with diode OR'ing, reverse voltage protected.
Antenna inputs	Dual, BNC, +5 V / +12 V switchable power
Ref. output	Dual, BNC, 10 MHz, 1 V RMS sine wave, 50 Ω
Short-term stability *)	Typ. 1 x 10^{-11} (1 s), Phase noise ≤ -90 dBc/Hz @ 1 Hz
Control interface	Ethernet, monitoring application running in web browser
Holdover *)	Aging 1 x 10^{-7} (one year, free-running)
Measures	213 mm (W) x 77 mm (H) x 130 mm (D)

*) Preliminary specifications; The parameters are yet to be fully characterized.
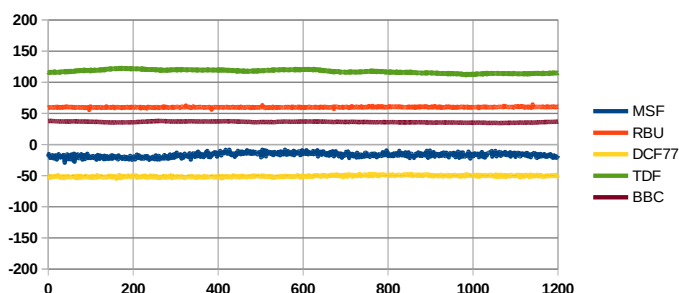
Typical received phase for an ensemble of 5 services: MSF (60 kHz), RBU (66⅔ kHz), DCF77 (77.5 kHz), TDF (162 kHz), and BBC (198 kHz) over a period of 20 minutes around noon.
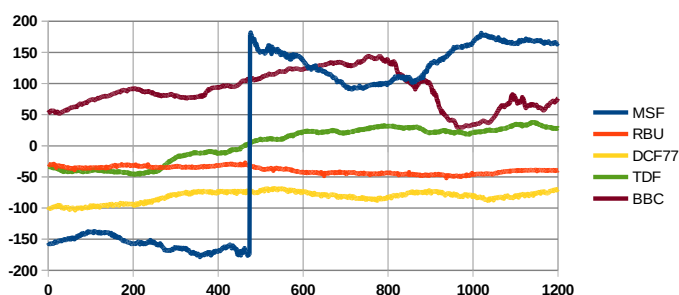

The phase of the same 5 services captured later the same day, close to midnight. The 1330A is designed to react gracefully under these real-life conditions.

In order to reduce down-time, the 1330A includes dual power inlets, intended for a main supply and a back-up battery. Furthermore, the 1330A continuously stores central operational parameters in non-volatile memory which facilitates OCXO aging compensation and a fast re-acquisition after a total power-down.

Thanks to the weighting algorithm with dynamic loop parameter control the 1330A provides both a much faster acquisition and a much narrower reception bandwidth than previous off-air designs. Once locked, the 1330A automatically goes through a learning scheme into a deep mode with excellent hold-over qualities.
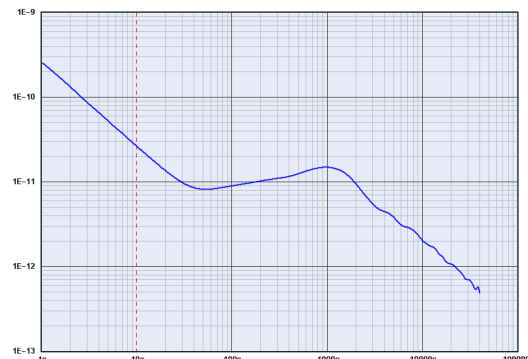
Typical Allan deviation (ADEV) over one week around summer solstice, equinox, and winter solstice, while receiving the above 5 services at Apparateq's premises in Denmark using a loop antenna. The ADEV will eventually depend on local conditions, the trajectories, and transmitter events that may take place.

The 1330A supports two active antenna inputs, and the 1330A automatically selects the input with the best signal quality for each frequency in use.

For further information on how to put the 1330A into use consult our application note "Off-air ensemble receiver drives new applications."

Apparateq provides solutions to measurement challenges within science, research and metrology. Check out our web pages, or call us, to learn how we may help you.