TECHNICAL DESCRIPTION

Measurements are made in the time domain and consist of time difference measurements between a reference source and a measurement source. Measurements may be made on passive devices such as amplifiers by splitting a source output and comparing the time delay through the device under test with the direct path. In this way the time or phase stability of the amplifier may be measured. Unlike a general purpose time interval meter, the inputs must be substantially sine wave and at either 5MHz or 10MHz. The resolution is much better than even the fastest counters, being around 50fs for a single measurement.

The A7-A is a completely new design using phase locked multipliers as opposed to the harmonic multipliers used in Quartzlock's other phase/frequency comparator, the A7. Several new features have been added. The frequency input range is much wider, enabling measurements on VCXOs and OCXOs. Two resolutions are provided, with multiplication factors of 10^3 and 10^5. This optimises measurement on very stable sources such as rubidium and caesium oscillators and hydrogen masers, as well as lower stability sources. Phase and frequency mode are as the A7, although the sampling rate in phase mode is now selectable from the front panel to be from 1ms to 1000s. A variable bandwidth IF filter has been added. This essentially sets the measuring bandwidth and allows sources with considerable phase noise to be filtered. This has particular advantages in frequency mode where the apparent jitter of a real time frequency readout can be reduced. A Rubidium frequency standard can be adjusted using 100ms gates to an accuracy of $1x10^{-12}$.

The comparator will operate at either 5MHz or 10MHz with automatic switching. The inputs are 50Ω impedance, and a level of between 0dBm and +13dBm is required at both inputs. The absolute accuracy of both reference and measurement inputs should be less than +/-50 in 10^6. The maximum frequency difference should be less than +/-10 in 10^6 in low resolution mode and less than +/-100 in 10^9 in high resolution mode. The inputs are provided with level indicators.

The comparator has two modes of operation, frequency measurement mode and phase difference mode. In frequency mode the moving coil meter indicates fractional frequency difference and the internal counter is configured as a frequency counter. Meter full scale ranges are selectable from the front panel in the range $+/-10^{-7}$ to$+/-10^{-12}$. The internal counter is configured as a frequency counter with appropriate gate times selected. The frequency measured is actually the sum of the multiplied frequency difference at the inputs of the A7-A plus 100kHz. The RMS resolution is typically better than 5 parts in 10^{14} for a 1 second gate.

In phase mode, the meter is configured to read phase difference between the reference and the measurement inputs. The full scale range is selectable between +/-10us to +/- 100ps. An extended range phase detector is used so phase roll over will be between +10 and 0 on the meter if the frequency is increasing, and between -10 and 0 on the meter if the frequency is decreasing. The meter shows relative phase difference between the reference and measurement inputs. Because of the multiplication process in the comparator, the absolute phase difference is not available. A phase reset key is provided that zeros the indicated phase to within +/- 100ps.

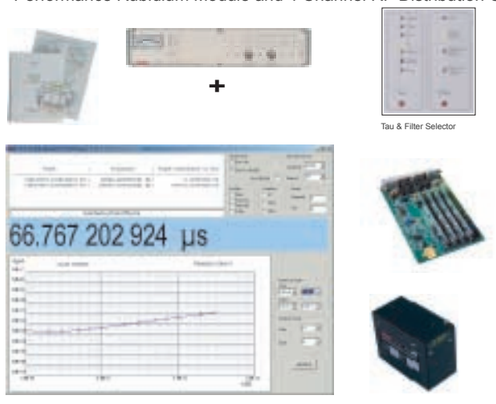
In phase mode the internal counter is configured as a time interval meter and measures the time difference between pulses on it's A channel and B channel. The pulse rate is set from the front panel of the A7-A. The time difference between the pulses is the multiplied time difference between the inputs to the A7-A. Thus if the counter has 1ns time interval resolution, the effective resolution (multiplication factor 10^5) at the input of the A7-A is 10fs. In practice this resolution is not achievable due to instrument noise. Single shot time resolution has been measured at 50fs.

The counter supplied with A7-MX is an internal time interval counter card that comes with its own virtual front panel software. Measurements may be stored on hard disk for later analysis. The counter is capable of storing ASCII formatted readings in computer memory at at least 1000 readings per second. An external counter with sufficiant resolution and sample rate may be used.

A sophisticated software package to provide instantanious graphical represenation plus Stable 32, is supplied for analysis of data (A7-MX). It supports every possible type of time domain stability analysis, as well as conversion to the frequency domain for close in phase noise analysis.

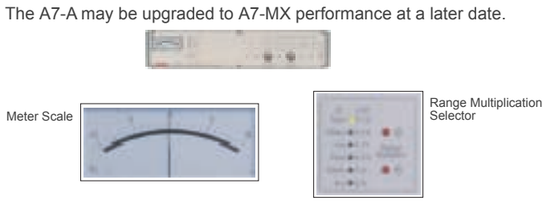
A7-MX

A7-MX supplied with internal TIC providing RS232 for connection to a PC, Options: - Stable32 Frequency Analysis Software, High Performance Rubidium Module and 4 Channel RF Distribution Card.



A7-A

The A7-A may be upgraded to A7-MX performance at a later date.



Quartzlock (UK) Ltd
Gothic, Plymouth Road,
Totnes, Devon TQ9 5LH,
England
Tel: +44 (0) 1803 862 062
Fax: +44 (0) 1803 867 962

Quartzlock (USA)
P.O. Box 6094,
Astoria, NY 11106
USA
Sales
Tel: 718 614 8672
jrm1950@yahoo.com
Technical Service
Tel: 719 228 0540
Fax: 719 228 9009

Web: www.quartzlock.com
e-mail: quartzlock@quartzlock.com

Quartzlock
A7 A & MX
E-16 Resolution

Frequency, Phase & Phase Noise Measurement System

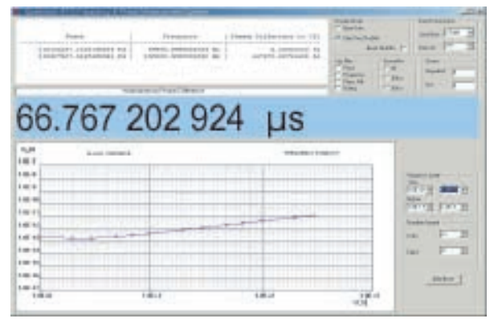
A7-A replaces: Adret 4110 , Tracor 527E, R&S XSRM-Z3, HP K34-59991 (but with higher spec)
A7-A becomes A7-MX with internal time interval counter option & software (option A7-X)

NEW 2004

- ☐ Internal time interval counter card
- ☐ AVAR software included Stable32 supplied
- ☐ RS232 connect to any PC
- ☐ 32000 data points
- ☐ Data stored in A7-MX
- ☐ Crash proof with 24Vdc Battery Back Up
- ☐ On screen plot visual immediately
- ☐ Large digital display of ΔØ or Δf

FEATURES

- ■ Very high resolution: 50fs single shot
- ■ Very low noise: σ 1s <$5x10^{-14}$
- ■ Ultra fast measurement time
- ■ Sample rate: 1000 readings/second
- ■ A7-A (Analogue): simple to use E-13 resolution
- ■ A7-M (Metrology): best available E-16 resolution
- ■ Selectable filters, resolutions & tau's
- ■ Phase/ frequency on analogue meter



APPLICATIONS

- ☐ Stability analysis
- ☐ Phase noise analysis
- ☐ Atomic frequency standard calibration
- ☐ Active & passive components
- ☐ ADEV, Modified ADEV, TVAR, MTIE etc
- ☐ Temperature & Phase testing

BENEFITS

- ☐ Unskilled operation
- ☐ World leading performance
- ☐ Versitility of application
- ☐ Precision product characterisation
- ☐ "National Measurement" level with H-Maser

STANDARD SPECIFICATIONS & A7-M TEST RESULTS

INPUTS	
a) Reference	5 or 10MHz sine wave +/- 50 x 10^{-6}
b) Measurement	5 or 10MHz sine wave +/- 50 x 10^{-6}
c) Input levels:	+0dBm to +13dBm into 50 Ω
d) Max Freq difference (Filter off):	Low resolution +/- 10 x 10^{-6} High resolution +/- 100 x 10^{-9}
OUTPUTS	
a) Counter A channel	100kHz square wave CMOS/TTL (frequency mode) 10us pulse CMOS/TTL (phase difference mode)
b) Counter B channel	10us pulse CMOS/TTL (phase difference mode)
c) Counter external reference	10MHz CMOS/TTL
FILTER Nominal 3dB Bandwidths	Selectable bandwidth IF filter reduces measurement noise 200Hz, 60Hz, 10Hz
FRACTIONAL FREQ. MULTIPLICATION Selectable	High resolution 10^5 Low resolution 10^3
MEASUREMENT RESOLUTION	
a)	Using external frequency/ time interval counter with 1ns or better time interval resolution
Frequency difference mode	High resolution 1 x 10^{-13}/gate time Low resolution 1 x 10^{-12}/gate time Gate times 1ms to 3200s
Phase difference mode	(High resolution: filter off)
RMS resolution (single measurement)	50fs (Measured as the standard deviation of 1000 phase difference measurements/ 1s)

STANDARD SPECIFICATIONS & A7-M TEST RESULTS

Short-term stability (Allan variance)	<$5x10^{-11}$ 1ms <$1x10^{-14}$ 10s <$5x10^{-12}$ 10ms <$2x10^{-15}$ 100s <$5x10^{-13}$ 100ms <$5x10^{-16}$ 1000s <$5x10^{-14}$ 1s <$1x10^{-16}$ 10000s
Sampling interval	1ms to 1000s in decade steps
Drift	<1ps per hour typical at constant ambient temperature <5ps per day typical at constant ambient temperature
Drift with temperature	<2ps per °C
b) **Frequency difference mode**	Using internal moving coil meter Full scale ranges +/- 1x10^{-7} to +/- 1x10^{-12} in decade steps Time constant 20ms to 10s linked to range Displayed noise <$2x10^{-13}$ peak Zero drift <$2x10^{-13}$/ hour
Phase difference mode	Full scale ranges +/- 10us to +/- 100ps in decade steps Displayed noise TBD Zero drift TBD
MECHANICAL	2U full rack unit
POWER SUPPLY	120/ 240V AC line 50W max24V DC battery back up with auto switching Current consumption 1A max (+ 2A for op17, 1A for op1)
STANDARD EQUIPMENT (A7-MX) (Installed & tested)	Internal Time Interval Card
Options (A7-A & A7-MX)	Add input splitter (enables noise floor measurements) Rubidium frequency standard Built in 4 channel distribution amplifier (rear panel connectors) Stable 32 frequency and phase analysis software