product data

GPS PicoReference

Pico Second Resolution Test Set

Main Features

- Rubidium frequency reference
- GPS disciplined
- PicoSecond resolution
- Clock characterization such as quartz crystal oscillator, Rubidium atomic clocks and cesium clocks
- Complete calibration test set

PicoReference Product Characteristics

- GPS disciplined Rb clock: Auto-adaptive SmarTiming
- Compact: 1U rack mount chassis
- Testing Frequency Range: 1-30 MHz
- Reference Frequency: Integrated GPS-locked Rubidium clock
- Phase time resolution and noise: <2ps rms
- Output Frequency : 4x 10MHz/4x 1PPS or 8 x 10 MHz
- User programmable SYNTH output
- Integrated smart auto calibration

The GPS PicoReference includes two modules: a Frequency Reference module and a Measurement module.

Measurement Module Description

This module is based on a heterodyne architecture with a double frequency conversion to reach a resolution around the pico-second level.

The GPS PicoReference™ is a low-cost, high-performance frequency reference and measurement test set. It integrates a smart GPS and a Rubidium reference, features a flexible 1-30MHz frequency testing range and a cutting-edge 1 ps measurement resolution. It's ideally designed for clock characterization and calibration applications.

The following figure shows the typical system noise. The module integrates autonomous software, enabling the GPS PicoReference to work with an external 10MHz reference or through its built-in 10MHz reference module. The flexible testing frequency range is any frequencies between 1 - 30 MHz.

Additionally, the following 3 outputs are available to perform extra measurements using an external frequency counter:

- 1KHz output, using a crystal-filter based PLL to restrict the bandwidth to only 1Hz
- 1KHz output, providing about 100KHz bandwidth
- 1PPS output

The module also contains a clock recovery interface circuit. It extracts the clock rate of a E1 (2048KHz) or T1 (1544KHz) line in order to be able to measure it with the measurement module.

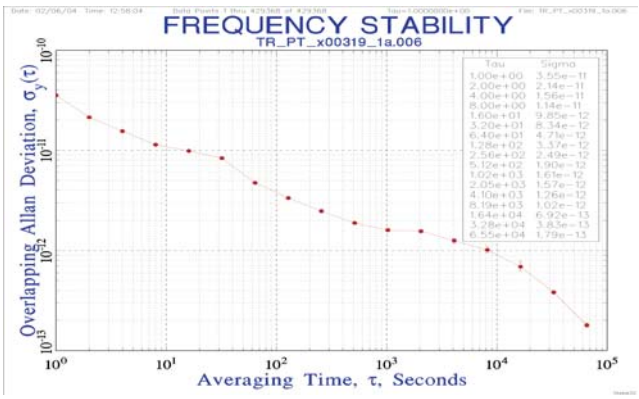

Fig. 1 - Frequency Stability Performance

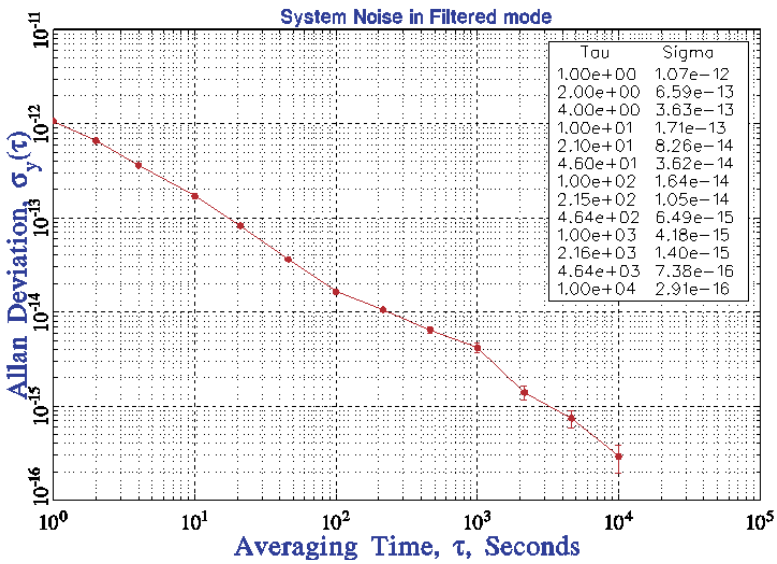

Fig. 2 - Noise Measurement Performance at 10MHz

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PicoReference Technical Specifications

Electrical

Spec	GPS PicoReference	
Reference module	**Standard**	**Options**
RFOUT Frequency Number of Output	10MHz 4x backplane 1x faceplate	10MHz 8x backplane 1x faceplate **(ordering code: 8RF**)
PPSOUT Functionality Number of Output	1PPS See SmarTiming section 4x backplane 1x faceplate	1PPS **(ordering code: 8RF**) 1x faceplate
Short Term Stability 1s 10s 100s	 3E-11 1E-11 3E-12	**(ordering code: S**) 1E-11 3E-12 1E-12
Phase Noise (dBc/Hz) *(RFOUT: 10 MHz)* 1Hz 10Hz 100Hz 1kHz 10kHz	 -75 -95 -125 -145 -145	**(ordering code: S)** -80 -100
Aging *(Measured after 3 months of continuous operation)*	< 5E-11 / month *(typical: 3E-11 / month)*	
Frequency Retrace Off/On *(In stable temperature, gravity, pressure and magnetic field conditions)*	< 5E-11 24 hr / 1 hr	
RFOUT Levels Output Impedance Harmonics Spurious f_0 ± 100kHz (SYNTH Off)	 Sine wave, 0.5 Vrms (±10% / 50 W), 1x faceplate **Sine wave, 1.0 Vrms (±10% / 50 W), 4x backplane **(** ordering code: 8RF 8x**)** 50 W ±20% < -25dBc < -80dBc	
SYNTHESIZER (SYNTH) Output level Frequency range Resolution Spurious	 Square wave 3.3V LV CMOS 0 to 20 MHz 3.97mHz (Fout= N´60'000'000/2^{32}) -35dBc (1-10 MHz) -30dBc (10-20 MHz)	
GPS Antenna Connector	SMA	
Measurement module	**Standard version**	
Reference Frequency	10 MHz	
DUT Center Frequency Range	1 MHz – 30 MHz	
Clock Recovery circuit	E1 & T1	
Measurement Noise at 10 MHz (Maximum Relative Frequency Deviation During Measurements < $1x10^{-9}$)	< 2ps	
Measurement Noise at 10 MHz (Maximum Relative Frequency Deviation During Measurements < $1x10^{-7}$)	< 10ps	
Input Signal Level	+3 dBm to +17 dBm	
Input Impedance	50 Ohms ±20%	
Connectors Type	BNC	
PC Port	Standard 9600 b/s – Serial (COM1 or COM2 or COM3 or COM4)	

SmarTiming+® Functionality

Spec	GPS PicoReference
	Standard
PPSOUT Output level Pulse width (PW) or duty cycle	1PPS CMOS 0-5V (+- 20 mA sink/source) User settable, 0 to 1s in 133ns/step
PPSOUT to PPSREF Sync Error In Sync mode	< 50 ns No GPS PPSRef noise, ± 1°C temp fluctuations
PPSOUT to PPSREF (DE) Programmable delay (In Track mode)	0 to 1 s in 133 ns steps
PPSOUT Holdover Time Stability	Within ± 2°C 1 ìs/24 hr
Smart Loop Time Constant Phase/Frequency User settable	Auto-adaptive 1000 to 100,000 sec User settable Sync/Track mode ** Selected by RS232 interface *** Sync: phase/time alignment; Track: frequency alignment*

Power

Spec	GPS PicoReference
	Standard
Power Supply	AC input 85-264VAC
Power Input Fluctuation	±10% of nominal supply voltage (230V~)
Input Frequency	47 – 63 HZ
Power Consumption @25°C	< 25W after warm-up
Connector Type	IEC plug

GPS Antenna

Spec	GPS PicoReference	
	Standard	**Option**
Antenna Types Cable Length Lightening Surge Protector	Patch antenna kit 6 m / 19.7' Not applicable	Rooftop antenna kit 5+15m / 16.4' + 49' Included **(ordering code: RA)**

Standard GPS Antenna
A GPS patch antenna with 6 meters (19.6') of cable is included in the normal package. This antenna can be installed close to a window. If installed in a region susceptible to lightning, a surge arrestor must be installed. For the installation, please refer to our GPSource user manual, section "Safe GPS Antenna installation".

Optional Rooftop GPS Antenna Kit (Ordering code: RA)
This kit contains the following items: -a roof antenna, -a cable of 15 meter (49'), -a cable of 5 meter (16.4'), -a lightning arrestor

Custom GPS Antenna
The customer can install another antenna. In such case, the antenna connector of the device supplies 5V/30 mA for the amplifier. Please note that the device is CE tested only for an antenna cable less than 30 meters (98'). For the installation, please refer to our AppNote "Custom GPS Antenna Installation".

Environment

Spec	GPS PicoReference
	Standard
Operating Temperature	0 to 40°C *(Relative humidity: 10-85%)*
Storage	-25 to 55°C
Transportation	-25 to 70°C

Physical

Spec	GPS PicoReference	
	Standard	**Option**
Size	445 x 300 x 44 mm (1U)	
Weight	2.2 Kg	
Mounting	Tabletop feet	19" rack mountable ears **(ordering code: E)**

Back Panel

N°	Type	Definition	I/O
J1	SMA	GPS antenna connection	I
J2	SUB-D9-F	Reference module Serial communication RS232	I/O
J3-J6	BNC	4x 10MHz sine reference outputs	O
J7-J10	BNC	4x 1PPS outputs (4x 10 MHz sine reference outputs with option code 8RF)	O
J11	SUB-D9-F	Measurement module Serial communication RS232	I/O
J12	IEC PLUG	Power connection	I
S1	SWITCH	On/Off switch	-

Front Panel

N°	Type	Definition	I/O
J13	BNC	Measurement module 10MHz reference	I
J14	BNC	Measurement module 1PPS reference for external counter	O
J15	BNC	1KHz filtered for external counter	O
J16	BNC	1KHz non filtered for external counter	O
J17	BNC	Device under test input signal	I
J18	BNC	10MHz sine reference output	O
J19	BNC	1PPS output	O
J20	BNC	SYNTH output	O
J21	BNC insulated	E1 clock recovery input	I
J22	BNC	E1 clock recovery output	O
J23	BNC insulated	T1 clock recovery input	I
J24	BNC	T1 clock recovery output	O
I1	Green LED	Measurement module locked indicator	-
I2	Red LED	Measurement module unlocked indicator	-
I3	Green LED	Power indicator	-
I4	Green LED	Sync or Track mode enabled	-
I5	Red LED	Rubidium clock locked alarm	-
I6	Green LED	1PPS GPS applied	-
S2	SWITCH	Free run, Sync or track selection switch	-

Ordering Information

PicoReference Picosecond resolution test set

Options and assessories

Option ST32 Stable32 postprocessing and analysis SW

Option 8RF 8x 10 MHz outputs instead of 4x 10 MHz plus 4x 1-pps

Option E Rackmount ears

Option S Improved short term stability (Rubidium oscillator)

Option RA Rooftop GPS Antenna incl 20 m downlead and lightning arrestor

Option ExtW-3 Extended Warranty to 3 years

Option ExtW-5 Extended warranty to 5 years

Included with shipment

GPS patch antenna
EUR power cable
US power cable
Users manual on CD
RS232 communication cable to PC
PicoReference installation SW on CD

Specifications subject to change without prior notice

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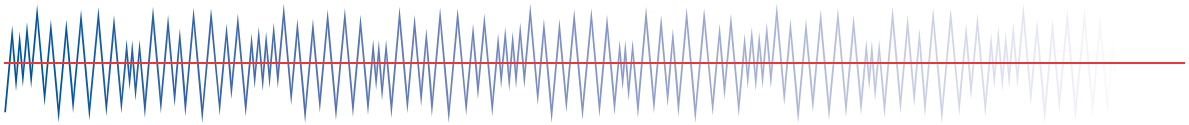
- Experts in time & frequency calibration, measurement and analysis

Pendulum Instruments is a company of the Orolia Group



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