

Active & Passive Hydrogen Masers + GPS-BVA

PRECISE TIME & FREQUENCY STANDARDS

 The most stable Frequency Standards available	
 Rubidium Atomic Standard Hydrogen Masers	Quartzlock Hydrogen Masers Gothic, Plymouth Road, Totnes, Devon TQ9 5LH England Tel: +44 (0)1803 862062 Fax: +44 (0)1803 867962
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TIME & FREQUENCY STANDARDS

'A' Spec

'B' Spec

'GPS-BVA' (A8-MX)

Frequency Outputs 50 Ohms, 1±0.2 Vrms sine	(2) 5MHz (2) 1Hz, (1 pps), >2.5V peak Pulse Width: 10 to 20ms Rise Time: ≤30ns Jitter: ≤100ps		10MHz, 100MHz 2048kHz 2.5V 75 Ohms In addition to standard outputs	1MHz sine & sq 10MHz sine & sq + options In addition to standard outputs
Clock Synchronisation	Auto to within 200ns of ref. pulse. Amplitude: 2.5 to 5V			5...20ns with adj to ±500ms in 1ns steps
Stability, 5MHz Outputs	Average Time (s)			
Allan Variance, $\sigma_y(2, \tau)$	1 10 100 1000 1hour 1 day	≤1.5E-12 ≤5E-13 ≤1.5E-13 ≤5E-14 ≤2E-14 ≤1E-14	2E-12 6E-13 2E-13 6E-14 2E-14	8E-14 8E-14 2E-13 5E-13 5E-14
(Although this is a rugged instrument which operates within +5 to 40°C ambient, the quoted specifications apply while the instrument is confined to a ±1°C ambient temperature change)				
Temp/Freq Coefficient		≤2E-14/°C	5E-15	ask QL
Drift		≤1E-15/Day	6E-14/Mo	nil
Accuracy		≤1.5E-12 over 5 years	1E-12	5E-14
Frequency Trim Range		At least 1E-10	1E-10	±500ms
Setting Resolution		1E-14 Steps	1E-14	1ns
Retrace		≤3E-14 after 24 hrs op	1E-13	5E-14
Phase Noise 5MHz	Offset from Carrier (Hz)	Phase Noise (dBc)		
	1 10 100 1000 10000	-100 -120 -140 -150 -150	-95 -125 -135 -150	-110 -140 -145 -155 -160...-170
Spurs	Harmonics: Non-Harmonics: ≤-100 dBc	≤-30 dBc		-40 dBc -100 dBc
Power Input - ac	220 VAC, ±10%, 100, 120 V±10%, 240 V+5-10%; 45-65 Hz			
Power Input - dc	As an alternative to ac the unit can be powered by an external 22-30 Vdc supply.			
Auto Battery Backup	In case of ac failure the instrument switches to the dc input line.			
Power Consumption		ac <140 VA, dc <90 W	ac 80W	ac 20W
Warm-up Time		≤10 hrs lock. (typ 6 hrs)	8 hours	8 hours, to full spec.
Operating Temperature		+5 to +35°C	+5 to +40°C	0 to +50°C
Storage Temperature		-50°C to +50°C	0 to +50°C	-20 to +50°C
Magnetic Sensitivity		≤2.5E-14/ Gauss	2E-14	ask QL
Pressure	630 to 795 mm Hg (84 TO 106 kPA)			
Humidity		Up to 80% at 25°C	80% 35°C	80% 35°C
Size		11"H x 19"W x 22"D (280 x 480 x 560mm)		2U rack (88 x 480mm)
Weight		120 lbs (55 kg)		12kg
Warranty		1 year. (2...5 year options)		2 years + options
Service Life		15 years		20 years

TIME & FREQUENCY STANDARDS		'A' Spec	'B' Spec	'C' Spec	
Frequency Outputs 50 Ohms, 1±0.2 Vrms sine	(2) 5MHz (2) 100MHz (2) 1Hz, (1 pps) >2.5V pk Pulse Width: 10 to 20ms Rise Time: ≤30ns Jitter: ≤100ps	10MHz & 1.4GHz In addition to standard outputs			
Clock Synchronisation	Auto to 50ns of ref. pulse Amplitude: 2.5 to 5V Width: 1 - 100ms Rise Time: ≤20ns Input Z: 50 Ohms				
Stability $\sigma_y(2,T)$	Average Time (s)				
5MHz & 100MHz Allan Variance	10 ms 100ms 1 10 100 1000 10000/1hr 1 day	≤2.3E-13 ≤2.8E-14 ≤6E-15 ≤3E-15 ≤2E-15 ≤2E-15	≤3E-13 ≤5E-14 ≤1E-14 ≤5E-15 ≤3E-15 ≤5E-15	≤4E-11 ≤6E-12 ≤1E-12 ≤2E-13 ≤3E-14 ≤9E-15 ≤7E-15 ≤7E-15	
(Although this is a rugged instrument which operates within +5 to 35°C ambient, the quoted specifications apply while the instrument is confined to a ±1°C ambient temperature change)					
Aging			≤5E-16/day at delivery ≤3E-16/day after 1 year op		
Accuracy			5E-13 over 5 years	±3E-13	
Frequency Trim Range		1E-6	At least 1E-10	1E-10	
Setting Resolution		1E-15	1E-14 Steps	≤7E-14	
Retrace			≤3E-14 after 24 hrs of op		
SSB Phase Noise (dBc/Hz)	Hz from carrier		5MHz	100MHz	5MHz 10MHz
	1	-110	-110	-95	≤-105 ≤-100
	10	-140	-130	-105	≤-135 ≤-130
	100	-145	-140	-115	≤-145 ≤-135
	1000	-155	-150	-125	≤-150 ≤-140
	10000	-160....-170	-150	-125	≤-150 ≤-145
Frequency Measurement Error (RMS) of Comparator	1 sec 10sec 100sec 1hr or more	5E-14 1E-14 2E-15 1E-16	1E-13 1.5E-14 3E-15 5E-16		
Power Input - AC	115/220 Vac, ±10%, 45 to 430Hz <150 VA power consumption				
Power Input - DC automatic battery back-up	These masers may be powered by an external 22-30 Vdc supply. <100 watts powerconsumption. In case of ac failure the instrument automatically switches to the dc supply.				
Warm Time			240 hours to meet spec		
Operating Temperature		+5 to +35°C	+5 to +35°C		
Temperature Coefficient /°C		5...20E-15	5E-16/°C	≤1E-14	
Storage Temperature			-50°C to +50°C		
Magnetic Sensitivity		2E-14/Gauss	≤1E-14/Gauss		
Pressure			630 to 795 mm Hg		
Humidity			Up to 80% at 25°C		
Size		23.5"H x 23.5"W x 55"D 600 x 600 x 1400mm	27"H x 19"W x 22"D 680 x 480 x 560mm		
Weight			210lbs (90kg)		
Warranty	1 year (2....5 year options)				
Service Life	15 years				

TIME & FREQUENCY STANDARD

APPLICATIONS

Astro Laser ranging • Geodesy • Space Navigation • Glacial Movement • **Defence** • **GPS Satellite monitoring** • Intelligence • **Navigation** • Gravity prospecting • Climatology • **Position fixing** • Support of radar imaging • Calibration • Determination of Earth rotation • National frequency standards • Geo-dynamics • Earthquake research • Heat transport • **Calibration of Cesium, Rubidium & Quartz** • Telecommunications • VBLI • **Fast missile tracking** • Astronomy • Baseline definition • Plate tectonics • **National timekeeping** • Secure telecommunications • Company Laboratory Standard

TECHNOLOGY

The PHM principle of operation is based on a 5 MHz quartz crystal oscillator, frequency locked to the hyperfine transition of the hydrogen atom. The basic block diagram of a Passive Hydrogen Maser is shown in Figure 1.

The Passive Maser is specifically designed to provide an alternative technology to the high performance option cesium oscillators. As shown in Figure 2, the Maser's stability specification is factor of 10 better than the best commercial cesium. Unlike Cesium, the Passive Maser does not have an expensive wear out physics package. In light of the above, the Passive Maser may be the number one choice over high performance option cesium oscillators when better stability and competitive accuracy are needed at comparable price, while at the same time reducing the 10 year life cycle cost.

Applications include: laboratory standard; Stratum 1 primary reference clock; satellite ground station standard, especially valuable for testing GPS disciplined oscillators/syne systems in telephone networks; VLBI; time scales; and others.

GENERAL INFORMATION

The Passive and Active Hydrogen Maser Frequency Standards, and associated instruments are available from Quartzlock. These units have been built in substantial quantities for the last 40 years. The instruments are produced and exported from Quartzlock. Additionally, by special request, the performance of the instruments can be independently certified by the NIST, USA. PTB Germany or NPL, UK.

Complete customer service and support is provided at the customer's installation site, or, when necessary, the equipment can be returned to Quartzlock, or your local Quartzlock agent.

Both Passive and Active Masers have been in use at various institutes including: NIST, Boulder, Co; NRL, Washington, D.C; Smithsonian Astrophysical Observatory, Cambridge, MA; USNO, Washington, D.C; PTB, Braunschweig, Germany; DLR, Munich, Germany, Royal Belgian Observatory, Radio Observatory, Yebees, Spain & NPL's in Japan, S.Korea, UK, Brazil, China, USA, Canada, Sweden, Finland, France and elsewhere.

Quartzlock H Maser compatible instruments



A8-MX
GPS disciplined BVA frequency & time standard, can provide GPS sync to 5ns and satellite/H Maser time transfer facility



A7-MX
Frequency/Phase Measurement system
Resolution <1E16 Drift <1ps/h



A6
Frequency Converter Provides 1Hz & 1pps & 0.1, 1, 5 & 10 MHz sinewave & squarewave outputs



A5
Distribution amplifiers (4, 12, 24 or 32 outputs) Stability 1E-13/s. Phase noise -165dBc at 100Hz. Isolation 130dB@5MHz

A10-Y
Rb + Low noise SC OCXO. Very low noise clean-up loop technology. May be used to improve H Maser phase noise & AVAR.

ALLAN VARIANCE COMPARISON OF CESIUM, PASSIVE & ACTIVE MASERS

