



**cRb-CLOCK Performance**

The cRb-CLOCK is the world's first commercially available portable cold Rubidium microwave atomic clock. The clock is designed for high frequency stability in the short term of  $7 \times 10^{-13}/\sqrt{\tau}$  and for excellent long term frequency stability of  $2.9 \times 10^{-15}$  at one day and typically  $2. \times 10^{-15}$  at 10 days. With this level of performance the cRb-CLOCK can be used as a substitute for Hydrogen masers. The cRb-CLOCK has negligible long term frequency drift and low sensitivity to temperature  $\sim 1 \times 10^{-15}/^{\circ}\text{C}$ .

Exceptional performance is achieved in a small portable package. The entire clock is about the size of a desktop computer 8.77 " , H 15 " , L 18.75 " (22.3 cm X 38.1 cm X 47.6 cm) and weighs 31 kg. The clock can run on both 100-240 VAC as well as +24 VDC. Steady state power consumption is 80 W. The clock outputs 100 MHz, 10 MHz, 5 MHz and 1 PPS with synchronization capability.

## FEATURES

- Excellent short term stability  $7 \times 10^{-13}/\sqrt{\tau}$
- Excellent long term stability  $2 \times 10^{-15}$
- No long term frequency drift
- Clock output at 100 MHz, 10 MHz and 5 MHz
- 1 PPS output with synchronization
- Ethernet monitor port
- Small and portable

## APPLICATIONS

- Atomic frequency standards
- Atomic time scales
- High performance testing facilities
- Laboratory frequency standard
- Trusted time in GPS denied environment
- Astronomy

This research was developed with funding from the Defense Advanced Research Projects Agency (DARPA). The views, opinions and/or findings expressed are those of the author and should not be interpreted as representing the official views or policies of the Department of Defense or the U.S. Government.

Distribution Statement "A" (Approved for Public Release, Distribution Unlimited)

## FRONT PANEL

- Touch Panel Display
- USB Port

## cRb-Clock

## BACK PANEL

- SMA input and output connectors
- AC and DC power connectors
- Ethernet Port

## SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Frequency stability	1 s		7 x 10 <sup>-13</sup>	8 x 10 <sup>-13</sup>	
	10 s		2 x 10 <sup>-13</sup>	3 x 10 <sup>-13</sup>	
	100 s		7 x 10 <sup>-14</sup>	8 x 10 <sup>-14</sup>	
	1000 s		2 x 10 <sup>-14</sup>	3 x 10 <sup>-14</sup>	
	10,000 s		7 x 10 <sup>-15</sup>	8 x 10 <sup>-15</sup>	
	100,000 s		2.9 x 10 <sup>-15</sup>	3 x 10 <sup>-15</sup>	
	10 days		2 x 10 <sup>-15</sup>	3 x 10 <sup>-15</sup>	
Output level	1 PPS	3.7	3.8	5	V
	5 MHz	10	12	15	dBm
	10 MHz	10	12	15	
	100 MHz	10	11	13	
1 PPS	Rise-time 10-90%		1.2	1.5	ns
	Fall-time 90-10%		1.2	1.5	
	Sync error		< 10	10	
Phase noise @ 5 MHz	1 Hz	-	-117	-110	dBc/Hz
	10 Hz	-	-145	-142	
	100 Hz	-	-158	-157	
	1 kHz	-	-175	-163	
	10 kHz	-	-176	-168	
Phase noise @ 10 MHz	1 Hz	-	-112	-108	dBc/Hz
	10 Hz	-	-138	-137	
	100 Hz	-	-150	-147	
	1 kHz	-	-172	-160	
	10 kHz	-	-175	-165	
Phase noise @ 100 MHz	1 Hz	-	-90	-89	dBc/Hz
	10 Hz	-	-120	-117	
	100 Hz	-	-130	-127	
	1 kHz	-	-160	-147	
	10 kHz	-	-170	-168	

## POWER REQUIREMENTS

- AC Operation: 100-240 VAC, 47-63Hz, 100 W max, 80 W steady state
- DC Power: 24 +/- 2 VDC, 7 A, 120 W max, 85 W steady state
- Ion pump power: 12 +/- 1 VDC, 50 mA

## ENVIRONMENT

- Operation Temperature +5 to +35 °C
- Humidity 5% to 95% Non-condensing
- Vertical Alignment +/- 1 degree

## CHASSIS

- cRb-CLOCK W 8.77 ", H 15 ", L 18.75 " (22.3 cm X 38.1 cm X 47.6 cm), Weight 31 kg