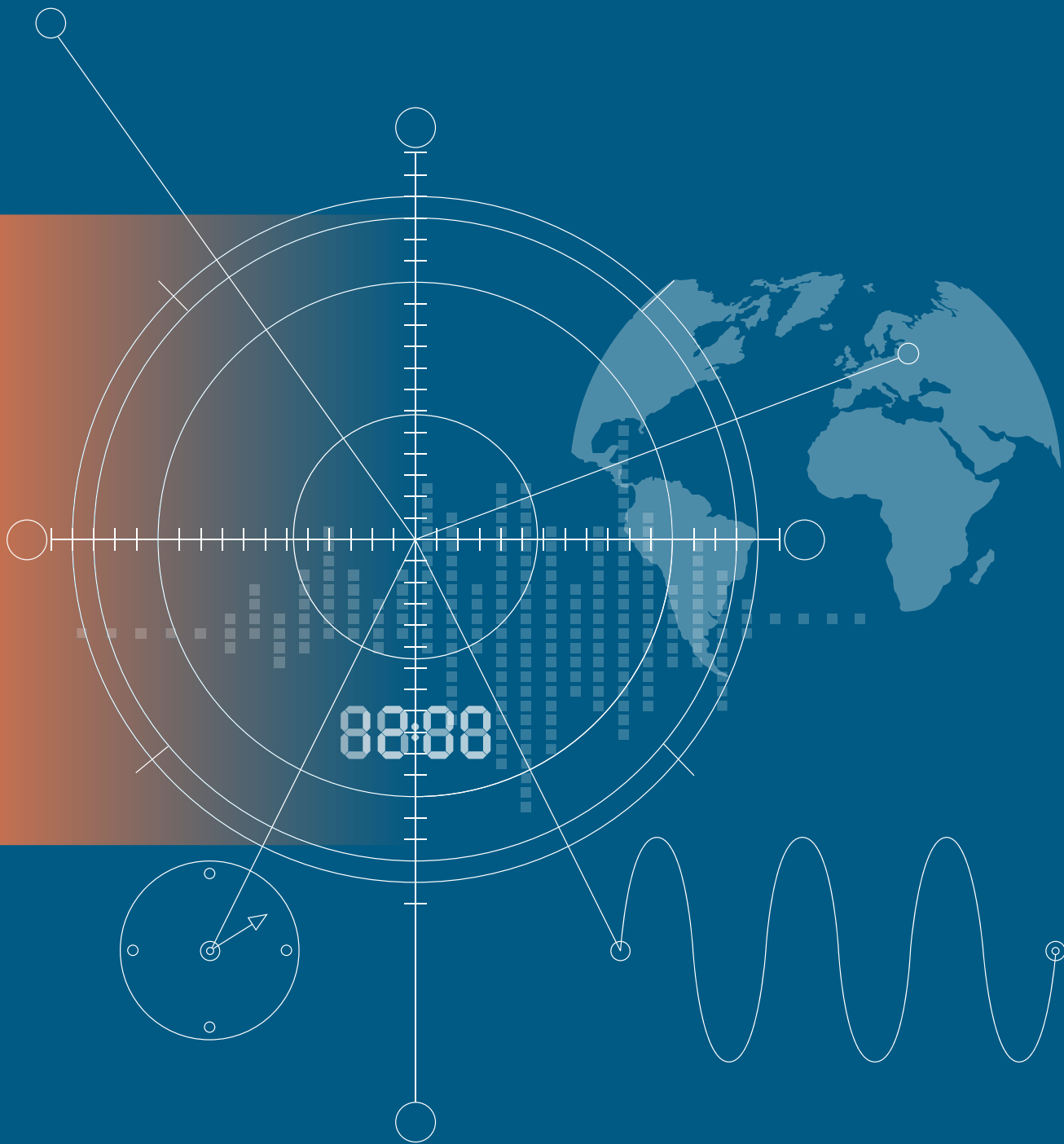


Symmetricon's hydrogen, cesium and rubidium standards, and quartz oscillators have supported more military communications, satellite ground stations, and test & measurement applications than any other precision frequency references in the world. Approximately 90% of the total weighting of all cesium clocks that contribute to the international timescale are ours, giving substance to our claim that the world runs on Symmetricon time.

Our precision frequency references are the result of many years of research and development performed in the areas of atomic physics, electronics engineering and software design. This has resulted in precision frequency standards that deliver exceptional performance and unsurpassed accuracy, stability and reliability in the most challenging of environments.

We design and manufacture our own physics packages, in which a resonance in the hydrogen, cesium or rubidium atom is used as the basis for the stability and accuracy of an output reference signal. We also design and manufacture the supporting electronics, software and packaging for our products.



Your Network. Optimized.

# Cesium Product Matrix



CsIII



Cs-4000



5071A

	CsIII	Cs4000	5071A
Accuracy (standard perf./high perf.)	<1E-12 / N/A	<1E-12 / N/A	<1E-12 / <5.0E-13
Stability (10S)(standard perf./high perf.)	<8.5E-12 / N/A	<8.5E-12 / N/A	<8.5E-12 / <3.5E-12
Stability (flicker floor) (standard perf./high perf.)	<5E-14 / N/A	<5E-14 / N/A	<5E-14 / <1E-14
Phase noise 1 Hz offset	-95 dBc (5 MHz)	-95 dBc (5 MHz)	-106 dBc (5 MHz)
RF outputs (sine)	2 total	6 total	4 total
1 MHz	0	1	1
5 MHz	1	2	1
10 MHz	1	2	1
100 kHz	0	1	1
TTL output (10 MHz)	1	optional	N/A
1PPS output	1	3	3
Custom outputs	N/A	optional	N/A
1PPS sync input	1	2	2
Operating voltage	AC/DC	AC/DC	AC/DC
Battery backup	N/A	optional	standard
Time of day	N/A	optional	standard
Warranty electronics/tube	2 yr./12 yr.	2 yr./12 yr.	2 yr./12 yr.
Warranty electronics/high perf. tube	N/A	N/A	2 yr./5 yr.
Ethernet interface	N/A	standard	N/A
RS-232 control and monitoring	standard	standard	standard
Monitor 3 software	standard	standard	N/A
Telecom synthesizer T1/E1	optional	optional	N/A
Front panel interface	N/A	optional	standard
Portability kit	optional	N/A	N/A
Dimensions	19" x 15" x 3.5"	19" x 21" x 5.2"	19" x 21" x 5.2"
Weight	<30 lbs.	<50 lbs.	<70 lbs.
MTBF	>130,000 hours	>145,000 hours	>160,000 hours

# 5071A

## Primary Frequency Standard

### KEY FEATURES

- Menu-driven Operation
- Easy-to-read Clock and Message Displays
- Complete Status Information
- Automatic Logging of Major Internal Events
- Full Clock and Frequency Control
- Automatic Synchronization of 1PPS Signal
- CE Compliant

### KEY SPECIFICATIONS

- Standard Long-Life Cesium Beam Tube
  - Accuracy:  $\pm 1 \times 10^{-12}$
  - Environmental Stability:  $\leq 1 \times 10^{-13}$  Frequency Change for Any Combination of Environmental Conditions
  - Long-Term Stability:  $\leq 5 \times 10^{-14}$  for 5-Day Averaging Time
- Optional High-performance Tube
  - Accuracy:  $\pm 5.0 \times 10^{-13}$
  - Environmental Stability:  $\leq 8 \times 10^{-14}$  Frequency Change for Any Combination of Environmental Conditions
  - Long-Term Stability:  $\leq 1.0 \times 10^{-14}$  for 5-Day Averaging Time

The 5071A primary frequency standard has the accuracy and stability you need for both laboratory and field applications. A stability specification for 30-day averaging time means the 5071A will keep extremely predictable time and phase for long periods. Further, the 5071A can be used for long-term averaging of noisy signals such as GPS.

The 5071A is easy to use. No more manual start-up steps or complicated adjustments—everything is automatic. A logical menu structure simplifies front panel operations, selections, and status reporting. Remote control features tailor the 5071A for complete operation and manageability in virtually any location.

The 5071A is a direct descendant of and replacement for the veteran 5060A, 5061A and 5061B cesium standards. This innovative product is the result of more than 35 years of experience in the precision frequency standard business.

### 5071A—MEETING THE NEEDS OF LEADING-EDGE METROLOGY AND CALIBRATION LABS

Timekeeping and National Standards Laboratories verify the stability and accuracy of their in-house cesium standards to Coordinated Universal Time (UTC), provided by the Bureau International des Poids et Mesures (BIPM) in Paris. A standard's accuracy and reliability determine the quality of service these timekeeping labs provide. Of even greater concern is the stability of a standard. Stability directly affects a laboratory's ability to deliver timekeeping and calibration services to its clients.

The 5071A offers exceptional stability and is the first cesium standard to specify its stability for averaging times longer than one day. The instrument takes into account environmental conditions that can heavily influence a cesium standard's long-term stability. Digital electronics continuously monitor and optimize the instrument's operating parameters.



5071A Primary Frequency Standard

Thus, the 5071A's response to environmental conditions such as temperature and humidity are virtually eliminated. The 5071A primary frequency standard maintains its accuracy and stability, even in unstable environments.

### SATELLITE COMMUNICATIONS

Stable frequency generation is required to transmit and receive signals properly between ground terminals and communication satellites. Frequency flexibility is also needed to adjust for satellite-to-satellite carrier-frequency differences. The 5071A's state-of-the-art technology produces offset and primary frequencies with the same guaranteed stability.

For secure communications, precise timing synchronization ensures that encrypted data can be recovered quickly. Frequency-agile signals also require exact synchronization between transmitter and receiver during channel hops.

The 5071A automates the synchronization to any external 1PPS signal, greatly simplifying this aspect of satellite communications.

### THE 5071A AND GPS

The 5071A primary frequency standard can work very well with a GPS timing receiver to produce and maintain highly accurate time and frequency.

The GPS system provides accurate time, frequency, and location information worldwide by means of microwave radio broadcasts from a system of satellites. Timing accuracy for the GPS system is based, in large part, on the accuracy and stability of a number of 5071A primary frequency standards. These standards are maintained by the GPS system, the US Naval Observatory, and various timing laboratories around the world which contribute to UTC, the world time scale.

Because of their accurate time reference, GPS signals processed by a good GPS timing receiver, can provide highly accurate time and frequency outputs. However, since GPS receivers rely on very low level microwave signals from the satellites, they sometimes lose accuracy because of interfering signals, local antenna problems, or bad satellite data.

In spite of these problems, a GPS timing receiver can be an excellent backup and reference to a local 5071A primary frequency standard. The GPS receiver provides an independent reference that can be used to verify the accuracy of a caesium standard, or it can be used as a temporary backup should the caesium standard need repair. The local 5071A standard has better short-term stability, better output signal quality, and is not perturbed by interfering signals, intermittent signal loss, or bad satellite data.

With these characteristics, the synergy created by combining a good quality GPS timing receiver and a 5071A primary frequency standard can produce a highly robust, inexpensive, and redundant frequency and time system.

### EXCEPTIONAL ACCURACY

The intrinsic accuracy of the improved cesium beam tube assures that any high-performance 5071A will power up to within  $\pm 5.0E-13$  of the accepted standard for frequency. This is achieved under full environmental conditions in 30 minutes or less—and without the need for any adjustments or alignments.

### UNSURPASSED STABILITY

The 5071A high-performance cesium beam tube guarantees stability to be better than 1 part in  $10^{14}$  for averaging times of five days or greater. The 5071A is the first cesium standard to specify stability for averaging times longer than  $1 \times 10^5$  seconds (approximately one day).

The 5071A is also the first cesium standard to specify and guarantee a flicker floor. Flicker floor is the point at which the standard's stability ( $\sigma_y(2, \tau)$ ) does not change with longer averaging. The high-performance 5071A Flicker floor is guaranteed to be 1 part in  $10^{14}$  or better. Long-term measurements at the National Institute of Standards and Technology (NIST) show that the flicker floor is typically better than  $5 \times 10^{-15}$ .

Unstable environments are normal for many cesium standard applications. The 5071A features a number of microprocessor-controlled servo loops which allow it to virtually ignore changes in temperature, humidity, and magnetic fields.

The 5071A delivers exceptional performance over very long periods of time, greatly increasing the availability of critical time and frequency services. Actual measurements made at NIST have demonstrated that a 5071A with the High- Performance CBT will drift no more than  $5 \times 10^{-14}$  over the entire life of the CBT.

## TRADITIONAL RELIABILITY

The 5071A has demonstrated an average mean time between failures (MTBF) of greater than 160,000 hours since its introduction in 1992. This data is based on actual field repair data. Backing up this reliability is a 12-year warranty on the Standard Long-Life Cesium Beam Tube and a five-year warranty for the highperformance tube.

Complete repair and maintenance services are available at four strategically located service centers worldwide.

## FULL TRACEABILITY TO NIST

Symmetricon provides NIST traceability to the accuracy measurements made on every 5071A. Traceability to NIST is maintained through the NIST-supplied Time measurement and analysis system (TMAS). This service exceeds the requirements of MIL-STD-45662A and can be a valuable tool in demonstrating traceability to your customers.

## STRAIGHTFORWARD OPERATION

Internal microprocessor control makes start-up and operation of the 5071A extremely simple. Once connected to an ac or dc power source, the 5071A automatically powers up to its full accuracy specifications. No adjustments or alignments are necessary during power-up or operation for the life of the cesium tube.

An intuitive menu structure is accessible via the front panel LCD display and keypad. These menus—Instrument State, Clock Control, Instrument Configuration, Event Log, Frequency Offset and Utilities—logically report status and facilitate control of the instrument. These functions are described below.

### Instrument State

Overall status is displayed, including any warnings in effect. Key instrument parameters such as C-field current, electron multiplier voltage, ion pump current, and cesium beam tube oven voltage are available. You can initiate a hard copy report of this data on your printer with the push of a button.

### Clock Control

Set the time and date, schedule leapseconds, adjust the epoch time (in 50-ns steps), and automatically synchronize the 1PPS signal to within 50 ns of an external pulse using this menu.

### Instrument Configuration

Set the instrument mode (normal or standby) and assign frequencies (5 or 10 MHz) to the two independently programmable output ports; configure the RS-232C data port.

### Event Log

Significant internal events (power source changes, hardware failures, warning conditions) are automatically recorded with the time and date of their occurrence. A single keystroke produces a hard copy on your printer for your records.

### Frequency Offset (Stability)

Output frequencies may be offset by as much as 1 part in  $10^9$  in steps of approximately 6.3 parts in  $10^{15}$ . All product stability and output specifications apply to the offset frequency.

### Utilities

The firmware revision level and cesium beam tube identification information can be displayed.

## HIGH-PERFORMANCE CESIUM BEAM TUBE

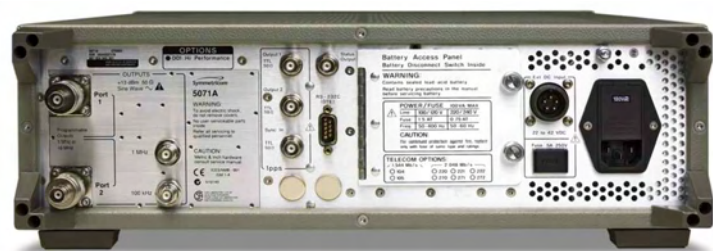
The 5071A high-performance cesium beam tube is optimal for the most demanding operations. The high performance tube offers a full-environment accuracy specification of  $\pm 5.0E-13$ —two times better than the specification for the standard tube. Stability is also significantly improved. The high-performance tube reaches a Flicker floor of  $1 \times 10^{-14}$  or better, and long-term measurements at NIST show that the flicker floor is typically better than  $5 \times 10^{-15}$ .

## INTEGRATED SYSTEMS AND REMOTE OPERATION

Today, cesium standards are often integrated into telecommunication, satellite communication, or navigation systems as master clocks. To accommodate these environments, the 5071A provides complete remote control and monitoring capabilities. Instrument functions and parameters can be interrogated programmatically.

Communication is accomplished via the standard commands for programmable instruments (SCPI) language and a dedicated RS-232C port. Also, a rear panel logic output can be programmed to signal when user-defined “abnormal” conditions exist.

For uninterruptible system service, an internal battery provides 45 minutes of backup in case of ac power failure. Thus, the 5071A can be managed easily even in the most remote locations.



Rear View

5071A SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

• Frequency outputs	
Frequency	5MHz & 10MHz <sup>1</sup>
Format	Sine
Amplitude	≥1Vrms
Harmonic	≤-40dBc
Non harmonic	≤-80dBc
Connector	N
Load impedance	50Ω
Location	rear panel
Isolation between ports	≥110dB (typical)
Frequency	100kHz & 1MHz
Format	Sine
Amplitude	≥1Vrms
Harmonic	≤-40dBc
Load impedance	50Ω
Location	rear panel
Connector	BNC
• Timing outputs	
Format	1PPS
Amplitude	≥2.4V into 50Ω [TTL Compatible]
Pulse width	20us
Rise time	≤5ns
(slew rate >10 <sup>-9</sup> volts/second at 1.5V)	
Jitter	≤1ns rms
Connector	BNC
Load impedance	50Ω
Location	One front panel Two rear panel Timing Inputs
Automatic synchronization to	within 50ns of reference pulse
Sync input	(2) 1PPS
(each may be independently armed)	
Amplitude	+2 to +10V Max
Pulse width	100nS min to 100us max
Rise time	≤50ns
Jitter	≤1ns rms
Connector	BNC
Load impedance	50Ω
Location	One front panel One rear panel
Manual sync	
Range	-0.5 to +0.5s
Resolution	50ns

Remote System Interface and Control

RS-232-C (DTE Configuration)  
Complete remote control and interrogation of all instrument functions and parameters

Software command set: Standard Commands for Programmable Instruments (SCPI), version 1990.0 adapted for RS-232C

Connector: 9-pin male rectangular D subminiature type  
Location: rear panel

Alarm (TTL): BNC  
Output: TTL High, normal  
TTL low, fault

Circuit is TTL open collector with internal pull-up resistor. Circuit can sink up to 10mA  
Location: rear panel

• Accuracy and long term stability		
Conditions - and any combination of		
Temperature	0°C to 50°C	
Humidity	0 to 85% (40°C max)	
Magnetic field	dc, 55, 60Hz, 2G peak any orientation	
Shock and vibration	100-mm drop	
	<b>Standard Performance</b>	
	<b>High Performance</b>	
Accuracy	±1.0E-12	±5.0E-13
Frequency change vs environment	±1.0E-13	±8.0E-14
Warm-up time (typical)	30 Min	30 Min
Reproducibility	±1.0E-13	±1.0E-13
Stability		
Range	±1.0E-9	±1.0E-9
Resolution	6.3E-15	6.3E-15
Control:	Via RS-232 port	

• Stability	<b>Standard Performance</b>	<b>High Performance</b>
Avg. Time (s)	Allan Deviation	Allan Deviation
0.01	≤7.5E-11	≤7.5E-11
0.1	≤1.2E-11	≤1.2E-11
1	≤1.2E-11	≤5.0E-12
10	≤8.5E-12	≤3.5E-12
100	≤2.7E-12	≤8.5E-13
1,000	≤8.5E-13	≤2.7E-13
10,000	≤2.7E-13	≤8.5E-14
100,000	≤8.5E-14	≤2.7E-14
5 days	≤5.0E-14	≤1.0E-14
30 days	≤5.0E-14	≤1.0E-14
Flicker floor		
Guaranteed	≤5.0E-14	≤1.0E-14
Typical	≤1.5E-14	≤5.0E-15

SSB Phase noise

Offset (Hz)	10MHz Output	5MHz Output
1	≤-100dBc	≤-106dBc
10	≤-130dBc	≤-136dBc
100	≤-145dBc	≤-145dBc
1,000	≤-150dBc	≤-150dBc
10,000	≤-154dBc	≤-154dBc
100,000	≤-154dBc	≤-154dBc

ENVIRONMENTAL AND PHYSICAL SPECIFICATIONS

• General environment	
Temperature	
Operating	0°C to 55°C
Non-operating	-40°C to 70°C
Humidity	0 to 95%RH (45C max)
Magnetic field	dc, 55, 60Hz 0 to 2 gauss peak - any orientation
Atmospheric pressure	≤1E-13 change in frequency for pressure down to 19kPa (equivalent to an altitude of 12.2km)
Shock and vibration	
	Mil-T-28800D, Type III, class 5
	Hammer Blow Shock Test, Mil-S-901C, Grade A, Class 1, Type A
	Mile-STD, 167-1 (phase noise)
EMI:	Conducted and radiated emissions per CISPR 11/EN 55011, Group 1, Class A
EMC:	per MIL-STD-461C, Part 7, Class B dc magnetic field up to 7.8 Gauss
<b>AC Power requirements</b>	
Operating voltage	100, 120 Vac ±10%, 45 to 440 Hz
	220, 240 Vac ±10%, 45 to 66 Hz
Frequency	45 to 440Hz
	45 to 66Hz
Power	
Operating	50W (Standard Performance)
	58W (High Performance)
	100W

DC Power requirements

22 to 42 VDC	
Operating	45W (Standard Performance)
	50W (High Performance)
Warm-up	85W
Internal Standby battery	
Capacity	45 minutes from full charge
Charge time	16 hours max from fully discharged state
Charge source	ac input power supply

Dimensions/weight

Height	133.4 mm
Width	425.5 mm
Depth	523.9 mm
Weight	30 kg
MTBF	>160,000 hrs.

<sup>1</sup> Each output can be set to either 5 or 10MHz from the front panel or by remote control.

<sup>2</sup> Lifetime accuracy (high-performance CBT only) after a minimum two-month warm-up. Change no more than 5.0E-14 for the life of the CBT.

ORDERING INFORMATION

	<b>Part No</b>
High Performance Tube	5071A-C001
Standard Performance Tube	5071A-C002
High Performance Tube with 48 VDC Option	5071A-C007
Standard Performance Tube with 48 VDC Option	5071A-C008



# Cs4000

## Cesium Frequency Standard

### STANDARD FEATURES

- Multiple RF Outputs
- CsIII Technology
- AC & DC Inputs
- Internal Battery Back-up
- Color Touch Panel User Interface
- Ethernet Interface
- CE Compliant

### OPTIONAL FEATURES

- T1/E1 Outputs
- No Touch Panel User Interface
- 24VDC Input
- Custom Outputs Available

The Symmetricom Cs4000 is a new cesium frequency standard platform that provides exceptional performance in a configurable 3U rack mount chassis. The Cs4000 is designed for high precision timing and frequency applications requiring high stability, low noise RF and 1PPS reference signals. Symmetricom's advanced Cesium III digital technology is the engine that drives this exceptional performance.

The Cs4000 includes a new color front panel Graphical User Interface (GUI) that provides easy to use monitoring and control of the instrument. All functional control of the cesium and optional output cards are managed via the front panel GUI. The GUI is a touch panel LCD screen that provides easy at a glance access to cesium health, control and configuration data. Remotely, you now have two methods of interfacing with the Cs4000. A new Ethernet interface provides monitoring capability via an embedded web page server. Both static IP

and DHCP are supported. The Cs4000 also provides an RS-232 port that allows the user comprehensive monitor and control access via ASCII commands or via Symmetricom's Monitor 3 windows based utility program.

The Cs4000 is designed to provide standard and custom output signal formats. The standard outputs include, 100kHz, 1, 5, 10MHz and 1PPS. Optional outputs include T1 and E1 both of which support multiple signaling and alarming formats. Realizing that custom signaling is part of many system designs, the Cs4000 has a custom output area that can support most signaling requirement. Because of this, the standard output signals are not affected and can be utilized along with whatever custom format is required.

The Cs4000 meets the challenges of laboratory standards, satcom terminals, mobile communications systems and a wide variety of test and measurement applications.



Cs4000 Cesium Frequency Standard



**Cs4000 SPECIFICATIONS**

**ELECTRICAL SPECIFICATIONS**

- Frequency outputs
    - Frequency: 1 ea 100kHz & 1MHz Sine
    - Amplitude: 1Vrms
    - Harmonic: <-40dBc
    - Non harmonic: <-80dBc
    - Connector: BNC
    - Load impedance: 50Ω
    - Location: rear panel
    - Frequency: 2 ea 5 & 10 MHz Sine
    - Amplitude: 1Vrms
    - Harmonic: <-40dBc
    - Non harmonic: <-80dBc
    - Connector: Type N
    - Load impedance: 50Ω
    - Location: rear panel
  - Timing outputs
    - Format: Three 1PPS
    - Amplitude: >3.0V into 50Ω
    - Pulse width: 20µs positive pulse
    - Rise time: <5ns
    - Jitter: <1ns rms
    - Connector: BNC
    - Load impedance: 50Ω
    - Location: rear panel (2)  
front panel (1)
  - Timing inputs
    - Sync input: Two 1PPS
    - Connector: BNC
    - Load impedance: 50Ω
    - Location: rear panel (1)  
front panel (1)
  - Remote system interface and control
    - RS-232-C (DTE Configuration)
    - Complete remote control and interrogation of all instrument functions and parameters
    - Connector
      - RS-232-C: 9-pin male rectangular D subminiature type
      - Location: rear panel (1)
- Network interface**
- Physical Layer: 10 base 100 TX (IEEE 802.3)
  - Connector: RJ45
  - Location: rear panel (1)
  - Transport: TCP/IP
  - Protocol: HTTP
  - Alarm (TTL): BNC
  - Location: rear panel
  - Output TTL: high, normal
  - TTL low, fault
  - Circuit is TTL open collector with internal pullup resistor
  - Circuit can sync up to 10mA

**PERFORMANCE SPECIFICATIONS**

- Performance
  - Accuracy: ±1.0E-12
  - Warm-up time: 30 Min (typical)
  - Reproducibility: ±2.0E-13
  - Stability
    - Range: ±1.0E-9
    - Resolution: 1.0E-15

- Stability
 

AvgTime (s)	Allan Deviation
1	≤1.2E-11
10	≤8.5E-12
100	≤2.7E-12
1,000	≤8.5E-13
10,000	≤2.7E-13
100,000	≤8.5E-14
Floor	≤5.0E-14
- SSB Phase noise
 

Offset (Hz)	5MHz Output
1	≤-95dBc
10	≤-130dBc
100	≤-145dBc
1,000	≤-155dBc
10,000	≤-155dBc
100,000	≤-160dBc

**ENVIRONMENTAL & PHYSICAL SPECIFICATIONS**

- General environment
  - Operating
    - Temperature: 0°C to 50°C
    - Humidity: 95% up to 50°C (non-condensing)
  - Non-operating (transport)
    - Temperature (storage): -30°C to 70°C
    - Temperature (short term): -40°C to 75°C
  - Magnetic field: 0 to 2 gauss
  - Shock: 30g/11ms, 3 axis
  - Vibration: MIL-T-28800E, Type III, Class 5
  - Altitude (operating): 0 to 50,000'
- AC Power requirements
  - Operating voltage (±10%): 100 to 240 VAC
  - Frequency: 47 to 63 Hz
  - Power
    - Operating: <65W
    - Warm-up: <80W
- DC Power requirements
  - 36 - 75VDC\*
  - 60W (Operating)
  - 70W (Warm Up)
- \* 24VDC (22 - 36VDC) Power supply option available
- Dimensions: 17.22" W x 5.22" H x 20.63" D (43.73 cm x 13.25 cm x 52.40 cm)
- Internal standby battery
  - Capacity: 45 minutes @ 25°C from full charge (without front panel display)  
20 minutes @ 25°C from full charge (with front panel display)
  - Charge time: 16 hours maximum from fully discharged state
  - Charge source: AC or DC
- Weight: 45 lbs. (20.4 Kg)
- MTBF: >145,000 hrs.

**ORDERING INFORMATION**

- |   |           |
|---|-----------|
| <b>Part No.</b>                         |           |
| • 48VDC, Display, Battery, Ethernet     | 14645-111 |
| • 24VDC, Display, Battery, Ethernet     | 14645-112 |
| • 48VDC, Display, Battery, T1, Ethernet | 14645-123 |
| • 48VDC, Display, Battery, E1, Ethernet | 14645-115 |
| • 48VDC, No Display                     | 14645-105 |
| • 24VDC, No Display                     | 14645-106 |



Rear view of Cs4000



# CsIII

## Cesium Frequency Standard Model 4310B

### KEY FEATURES

- Third Generation Cesium Technology
- 2U Compact Rack Mount
- AC & DC inputs
- Remote Monitoring & Control
- 5 & 10MHz Outputs
- 1PPS Sync input
- 1PPS Output
- <30 lbs
- CE Compliant

### OPTIONAL FEATURES

- T1/E1 Outputs
- Portability Kit

Symmetricom's CsIII is a lightweight, compact, economical cesium frequency standard. The technology developed for the CsIII is an evolutionary step forward in the quest for higher stability, lower phase noise and longer life. An ever-increasing base of demanding users in communications, timing, synchronization and other applications take advantage of this performance.

The CsIII is configured with 5 and 10MHz sinewave outputs, a 10MHz TTL output a 1PPS sync input and a 1PPS timing output. All monitoring and control of the unit is done via the serial interface and Symmetricom's proprietary Monitor3 software.

Packaged in a 2U, 19-inch rack mounted chassis, the CsIII weighs less than 30 lbs. An optional portability kit and T1/E1 synthesizer are available for added functionality and versatility.

The CsIII comes standard with a 2-year electronics warranty and 12-year tube warranty.

The CsIII is ideal for SATCOM, Calibration, Metrology and many other Test & Measurement applications that required cesium stability and accuracy.



CsIII Cesium Frequency Standard

## CsIII SPECIFICATIONS

### ELECTRICAL SPECIFICATIONS

• Frequency outputs

Frequency:	1 each 5 MHz and 10 MHz
Format:	Sine
Amplitude:	1 Vrms
Harmonic:	<-40dBc
Non harmonic:	<-80dBc
Connector:	BNC
Load impedance:	50Ω
Location:	rear panel

Frequency:	10 MHz
Format:	TTL
Amplitude:	>2.2V
Load impedance:	50Ω
Location:	rear panel
Connector:	BNC

• Timing outputs

Format:	1PPS
Amplitude:	>3.0V into 50Ω (TTL compatible)
Pulse width:	20μs positive pulse
Rise time:	<5ns
Jitter:	<1ns rms
Connector:	BNC
Load impedance:	50Ω
Location:	rear panel

• Timing inputs

Sync input:	1PPS
Amplitude:	>3.0V into 50Ω (TTL compatible)
Pulse width:	20μs positive pulse
Rise time:	<5ns
Jitter:	<1ns rms
Connector:	BNC
Load impedance:	50Ω
Location:	rear panel

### REMOTE SYSTEM INTERFACE AND CONTROL

RS-232-C (DTE Configuration)

Complete remote control and interrogation of all instrument functions and parameters

Connector	RS-232-C:	9-pin male rectangular D subminiature type
Location:		rear panel
Alarm (Relay):		9-pin female rectangular D subminiature type
Location:		rear panel

• Performance parameters

Accuracy:	±1.0E-12
Warm-up time (typical):	30 minutes
Reproducibility:	±2.0E-13
Settability	
Range:	±1.0E-9
Resolution:	1.0E-15
Control:	Via RS-232 port

• Stability

Averaging Time(s)	Allan Deviation
1	<1.2E-11
10	<8.5E-12
100	<2.7E-12
1,000	<8.5E-13
10,000	<2.7E-13
100,000	<8.5E-14
floor	<5.0E-14

• SSB Phase noise

Offset (Hz)	5MHz output
1	<-95dBc
10	<-130dBc
100	<-145dBc
1,000	<-155dBc
10,000	<-155dBc
100,000	<-160dBc

### ENVIRONMENTAL & PHYSICAL SPECIFICATIONS

• General Environment

Temperature	
Operating:	0°C to 50°C
Non-operating:	-40°C to 70°C
Humidity:	95% up to 50°C
Magnetic field:	0 to 2 gauss
Altitude (operating):	0 to 50,000 feet

• AC Power requirements

Operating voltage (±10%):	100 to 240 VAC
Frequency:	47 to 63 Hz
Power	

Operating:	65W
Warm-up:	90W

• DC Power requirements

22 to 36 VDC
36 to 75 VDC
30W 1.3A @ 24V (Operating)
65W 2.7A @ 24V (Warm Up)

• Dimensions/Weight

Height:	3.50" (89.9mm)
Width	
Front panel:	19.00" (483mm)
Instrument	17.31" (440mm)
Depth:	15.0" (381mm)
Weight:	<30lbs (13.5kg)
MTBF:	>130,000 hrs.

### ORDERING INFORMATION

- 24VDC
- 48VDC

### Part No.

- 14534-110
- 14534-109



CsIII connections

# 8040C

## Rubidium Frequency Standard

### STANDARD FEATURES

- Six Configurable Outputs
- RF & Pulse Outputs
- AC Input
- Remote Monitoring & Control
- GPS Disciplining
- CE Compliant

### OPTIONAL FEATURES

- Twelve Configurable Outputs
- Low Phase Noise

Today's precision test equipment requires a stable reference to make accurate frequency measurements. The equipment used varies depending on stability, accuracy and output signal format. All of these parameters can lead to a multitude of configurations, platforms and products that can be expensive to implement and maintain.

The Symmetricom 8040C solves this problem by providing a stable and accurate frequency reference with multiple output signal formats in an easy to install 1U rack mountable chassis.

Unlike other units, the 8040C offers configurable RF outputs, GPS disciplining and a RS-232 interface for command and control.

The 8040C has six outputs, each of which can be user configured to provide a 1, 5 or 10MHz sine or square wave or 1PPS output. The standard configuration for the 8040C has three 10MHz, one 5MHz, one 1MHz and one 1PPS output.

A 1PPS input allows the 8040C to be disciplined by a GPS receiver for improved frequency accuracy and long-term stability. The 8040C auto adaptive algorithm allows plug and play connectivity for easy GPS disciplining.

The 8040C is field configurable, allowing the instrument to support changing functionality in evolving systems.

If more outputs are required, the 8040C can be purchased with an option card that adds six additional outputs bringing the total output configuration to twelve. The option card, like the standard unit, can be configured for any combination of available frequency or format.

Also available is a low phase noise version that provides a greater than 30 dB improvement in close in phase noise.

The 8040C is designed around Symmetricom's award winning SA.22C rubidium oscillator, which is deployed worldwide as the reference oscillator in wireless base stations.



8040C Rubidium Standard

8040C SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

	Standard	Low Noise
• Frequency outputs		
Frequency:	1, 5 & 10MHz	1, 5 & 10MHz
Format:	Sinewave	Sinewave
Amplitude:	1Vrms	1Vrms
Harmonic:	<-40dBc	<-40dBc
Non-harmonic:	<-60dBc	<-80dBc
Connector:	BNC	BNC
Load impedance:	50Ω	50Ω
Location:	rear panel	rear panel
Frequency:	1,5 & 10MHz	1,5 & 10MHz
Format:	TTL	TTL
Amplitude:	>3V Peak	>3V Peak
Pulse width:	50% duty cycle	50% duty cycle
Connector:	BNC	BNC
Load impedance:	50Ω	50Ω
Location:	rear panel	rear panel
• Timing outputs		
Format:	1PPS	1PPS
Amplitude:	>3V	>3V
Pulse width:	400ns	400ns
Rise time:	<20nS	<20nS
Jitter:	<10pS RMS	<10pS RMS
Connector:	BNC	BNC
Load impedance:	50Ω	50Ω
Location:	rear panel	rear panel
• Timing inputs		
Sync input:	1PPS	1PPS
Amplitude:	TTL compatible	TTL compatible
Connector:	BNC	BNC
Load impedance:	50Ω	50Ω
Location:	rear panel	rear panel

PERFORMANCE PARAMETERS

• Accuracy at shipment:	<±5E-11	<±5E-11
• Retrace:	<±5E-11	<±5E-11
On-off-on:	24h, 24h, 24h @ 25°C	
• Control range:	±1E-6 with 1E-12 resolution	±1E-6 with 1E-12 resolution
• Warm-up time		
Time to lock:	<5 minutes	<5 minutes
Time to <1E-9:	<8 minutes	<8 minutes
• GPS Disciplining		
Time for valid output:	<20 minutes	<20 minutes
Frequency accuracy:	<1E-12	<1E-12
• Stability		
Avg. Time (s)	Allan Deviation	Allan Deviation
1	<3.0E-11	<1.5E-11
10	<1.0E-11	<8E-12
100	<3.0E-12	<2.5E-12
• Aging		
Monthly:	<5E-11	<5E-11
Yearly:	<5E-10	<5E-10

	Standard	Low Noise
• SSB phase noise		
Offset (Hz)	10MHz	10MHz
1	-72dBc	-100dBc
10	-95dBc	-130dBc
100	-130dBc	-144dBc
1,000	-140dBc	-150dBc
10,000	-148dBc	-150dBc
• Remote system interface & control		
RS-232-C (DTE configuration)		
Connector		
RS-232:	9-pin male rectangular D	9-pin male rectangular D
Location:	rear panel	rear panel
Protocol:	8 data bits	8 data bits
	1 stop bit	1 stop bit
Baud rate:	57600	57600

ENVIRONMENTAL & PHYSICAL SPECIFICATIONS

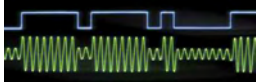
- General environment (operating)
  - Temperature: 0°C to 50°C
  - Temperature coefficient: <3E-10
  - Storage temperature: -40°C to 70°C
  - Humidity: 95% up to 50°C
  - Magnetic field: DC (±2 Gauss)
  - Magnetic sensitivity: <4E-11/Gauss
  - Altitude (operating): 0 to 50,000 feet
- AC power requirements
  - 90 to 240 VAC
  - 47 to 63 Hz
  - 25W (operating)
  - 45W (warm-up)
- Dimensions/Weight
  - 19"W x 1.75"H x 12"D
  - <6 lbs.
- MTBF = 232,500 hours IAW Telcordia (Bellcore) SR332, Issue 1

ORDERING INFORMATION

	Part No.
• 6 output standard performance	15230-101
• 12 output standard performance	15230-102
• 6 output low phase noise	15230-104
• 12 output low phase noise	15230-105



8040C connections (shown with 12 output option)



# XPRO

## High-Performance Rubidium Oscillator

### STANDARD FEATURES

- 10MHz Output
- 1PPS Output
- $<5E-11$  per month aging
- Digital monitor & control
- RoHs 5/6 compliant

### OPTIONAL FEATURES

- $<1E-11$  per month aging

The Symmetricom XPRO is a high performance rubidium oscillator designed for a wide range of telecommunications and test and measurement applications. The XPRO is a drop in replacement for our venerable LPRO, which has been widely installed in wireless base station applications, RF test equipment and other applications where an embedded high performance oscillator is required.

The XPRO leverages over 35 years of proven rubidium atomic physics with advanced digital electronics architecture to provide an exceptionally stable oscillator that meets the most demanding performance requirements.

The XPRO with its low profile and standard connector interface is designed for ease of integration into time and frequency systems. Great care has been taken in the design to minimize EMI emissions and susceptibility, including the use of a filtered 9 pin D-connector, SMA for the RF output and a shielded outer cover.

The XPRO is designed for long operating periods without maintenance (long life Rb lamp, extended crystal control range). The XPRO, with a  $5E-11$  per month aging, will maintain  $1E-9$  frequency accuracy for 10 years or longer without recalibration. A low aging rate option is available for XPRO that will provide  $1E-11$  per month aging providing an even more robust reference source.

Standard outputs are 10MHz, 1PPS and a rubidium lock status bit. All monitoring and control is done via the RS-232 interface allowing the user access to comprehensive status and control parameters.



XPRO High-Performance Rubidium Oscillator

**XPRO SPECIFICATIONS**

**ELECTRICAL SPECIFICATIONS**

**RF Output**

- Frequency: 10MHz
- Format: Sinewave
- Amplitude: +7.8 ± 0.8dBm
- Load impedance: 50Ω @ 10MHz
- Connector: SMA
- Qty: 1

**1PPS Output**

- Rise time: <5nS
- Pulse width: <20μS
- Level: >4.5V (15pF Load)
- Jitter: <1ns RMS
- Connector: DB-9
- Qty: 1

**PERFORMANCE PARAMETERS**

- Phase noise (SSB), E(f), dBc/Hz
- SB Freq
  - 1 Hz <-80
  - 10 Hz <-90
  - 100 Hz <-128
  - 1 kHz <-145
  - 10 kHz <-155
- Spectral purity
  - Harmonics: <-60dBc
  - Non-harmonics: <-80dBc
- Aging
  - Monthly (after 1 month): <±5.0E-11/Month
  - 10 years: <±1.0E-9
- Frequency accuracy at shipment: <±5.0E-11 (@ +25°C)
- Frequency retrace <±2.5E-11 (on-off-on: 24h, 48H, 24H at 25°C)
- Short term stability α<sub>y</sub> (τ) (Allan deviation)
  - τ (sec)
  - 1 <1.0E-11
  - 10 <3.2E-12
  - 100 <1.0E-12
- Frequency control
  - Analog freq. adj. range: ±1.5E-9 (0 - 5V) Digital freq. adj. res: ±1.0E-6 with 2.0E-12 resolution
- Warm-up
 

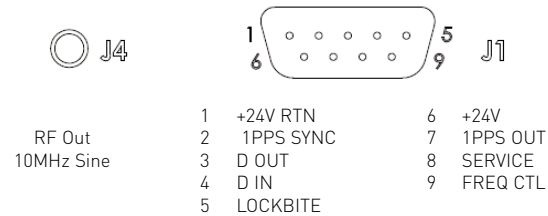
	<b>-20°C</b>	<b>+25°C</b>
Time to lock:	<8.7 min	<6 min
Time to <1E-9:	<10.2 min	<8 min
Time to <4E-10	<12.7 min	<10.6 min
- Max input (Amps) @24V: <1.45A <1.43A
- Input voltage range: +19 to 32 Vdc
- Voltage sensitivity: 0.72E-11/V (over input voltage range)
- Input power, quiescent
  - +24 Vdc @ -25°C: <13W
  - +19 Vdc @ +65°C: <8.5W
- Lock status (BITE) 5VCMOS
  - low = Lock
  - high = Unlock
- RS-232 control/monitor interface
  - Provides ID, status/monitor information, and frequency/operating parameter adjustments. Protocol: 57,600, 8, 1, None, No flow control.

**ENVIRONMENTAL & PHYSICAL SPECIFICATIONS**

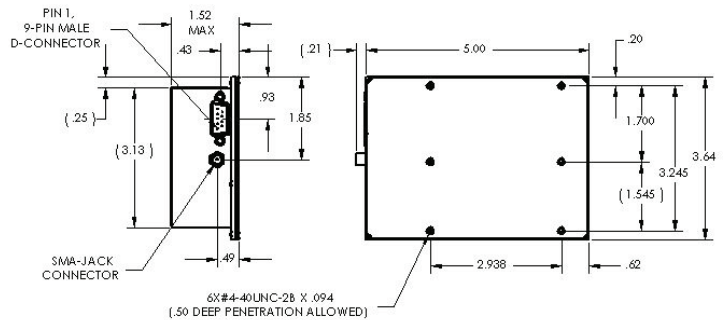
- Temperature
  - Operating: -25°C to +70°C baseplate
  - Storage: -55°C to +85°C
- Sensitivity: <6.0E-10 over op. temp. range <3E-10 (0°C to 50°C)
- Altitude
  - Operating: -200 to 40,000'
  - Non-operating: -200 to 70,000'
- Magnetic sensitivity: dc(≤2Gauss) ≤ ±1.0E-11/Gauss
- RH (operating): ≤85% non-condensing Meet or exceed Telcordia GR-63-CORE Issue .2, April 2002, section 4.1.2
- Vibration
  - Operating: Meets or exceeds Telcordia GR-63-CORE Issue .2, April 2002 section 4.4.3 and 5.4.2 (no unlock, 1.0g peak sine @ 5 - 100Hz)
  - Non-operating: Telcordia GR-63-CORE, Issue .2, April 2002, section 4.4.4 and 5.4.3, curve 1 or Figure 4-3 (1.5g peak max sine @ 5-500Hz)
- EMI: Compliant to FCC Part 15 Class B (conducted and radiated emissions) and complies with EN55022B emissions (radiated and conducted) and EN50082-1 (immunity).
- MTBF:
 

Ground Benign	Temperature	MTBF
	20°C	1,175,359 hrs
	40°C	591,317 hrs
	60°C	243,402 hrs
- Input connector: (1) DB-9 (All input power, monitoring, 1PPS)
- RF Connector: (1) SMA
- Dimensions
  - Height: 1.5" (3.81cm)
  - Width: 3.7" (12.7cm)
  - Depth: 5.0" (9.4cm)
  - Weight: <1.1lbs (<500g)

**XPRO CONNECTION DIAGRAM**



**XPRO OUTLINE DRAWING**



# 8200

## Ruggedized Rubidium Oscillator

### STANDARD FEATURES

- 10MHz Output
- Hermetically Sealed
- Shock/Vibration Hardened
- Digital Monitor & Control
- <1.0 Inches High

### OPTIONAL FEATURES

- 5MHz Output

The Symmetricom 8200 is a ruggedized rubidium oscillator designed for ground tactical, shipboard and airborne applications where superior frequency stability under diverse environmental conditions is required. Advanced communications, navigation and targeting systems require precision oscillators that can withstand a wide range of operating environments with minimal degradation in frequency accuracy and stability. The 8200 support these applications with superior phase noise and excellent short and long term frequency stability.

The 8200 is unique in that it combines excellent short and long term frequency stability in a small, low profile package measuring less than 1.0 inches high.

The long life rubidium lamp and extended crystal control range of the 8200 helps extend operating periods and minimize maintenance intervals. An alarm signal derived from the basic physics operation indicates when output

frequency is outside roughly  $\pm 5E-8$  of absolute frequency offset. The low temperature coefficient and excellent frequency stability extend holdover performance.

The height and footprint easily meet the requirements for 1U VME applications. Use of a filtered D-Connector for I/O signals minimizes EMI emissions and susceptibility. For ease of integration, the Symmetricom 8200 only needs one input supply voltage and will allow direct plug-in into another circuit board.

The 8200 is designed around proven rubidium technology that has been deployed in numerous airborne, shipboard and ground tactical platforms for over thirty years.



8200 Rubidium Oscillator



## 8200 SPECIFICATIONS

(All specifications at 25°C unless otherwise noted)

### ELECTRICAL SPECIFICATIONS

• <b>RF Output</b>	<b>8200</b>
Frequency:	5 or 10MHz
Format:	Sinewave
Amplitude:	0.7V rms nominal
Load impedance:	50 ohms @ 5 or 10MHz
Connector:	SMA
Qty:	1

### PERFORMANCE PARAMETERS

• Phase noise (SSB), E(f), dBc/Hz (Static)	
<b>SB Freq</b>	10 MHz
1 Hz	<-72
10 Hz	<-90
100 Hz	<-128
1 kHz	<-140
10 kHz	<-148
• Spectral purity	
Harmonics:	<-30dBc
Non-harmonics:	<-75dBc (<150MHz)* <-80dBc (>150MHz) * <-70dBc at 147.5MHz ±300kHz
• Aging	
Monthly (after 1 month):	<±5.0E-11/month
10 years:	<±1.0E-9
• Frequency accuracy at shipment:	<±5.0E-11 (@ +25° C)
• Frequency retrace	<±5.0E-11 (on-off-on: 24h, 24H, 24H @ 25°C)
• Short term stability $\alpha_y$ ( $\tau$ ) [Allan deviation]	
$\tau$ (sec)	
1	<3.0E-11
10	<1.0E-11
100	<3.0E-12
• Frequency control	
Analog freq. adj. range:	±1.5E-9, 0 - 5V into 5k $\Omega$
Digital freq. adj. res:	±1.0E-6 with 1.0E-12 resolution
• Warm-up	-40°C
• Time to lock:	<8 min
• Time to <1E-9:	<10 min
• Max. @ 28V:	<20W
• Input voltage range:	+15 to 32 Vdc (Protected against reverse polarity & transients)
• Voltage sensitivity:	<5.0E-12 (10% voltage change from nom. 28 Vdc)

• Input power, quiescent:	
+28 Vdc @ -40°C baseplate	<16W
+28 Vdc @ +25°C baseplate	<12W
+28 Vdc @ +80°C baseplate	<8 W
• Lock Status (BITE)	
TTL low = Lock	
TTL high = Unlock	
• RS-232 control/monitor interface	Provides ID, status/monitor information, and frequency/operating parameter adjustments. Protocol: 9600, 8, 1, None, No flow control.

### ENVIRONMENTAL & PHYSICAL SPECIFICATIONS

• Temperature	
Operating:	-40° C to +80° C baseplate
Storage:	-55° C to +95° C
Sensitivity:	<3.0E-10 over op. temp. range
• Thermal shock (non-operating):	MIL-STD-202, Method 107, Test Condition A, 10 cycles -55° C to 85° C
• Orientation sensitivity:	<5.0E-11 for any orientation
• Pressure sensitivity:	<1.0E-13/mbar
• Altitude	
Operating:	Sea level to 40,000' (12,192 m)
Non-operating:	Sea level to 80,000' (24,384 m)
• Magnetic field sensitivity: dc(≤2Gauss)	≤ ±4.0E-11/Gauss
• Relative humidity (operating):	0 to 95% RH per MIL-STD-810, Method 507.4
• Salt fog:	MIL-STD-810, Method 509.4
• Vibration:	MIL-STD-810, Method 514.5, Procedure I
Operating:	Category 24, Minimum Integrity, 7.7 grms @ 0.04 g <sup>2</sup> /Hz 20 Hz -1kHz, 15 min/axis (maintain lock)
Non-operating:	Category 24, Minimum Integrity, 15.4 grms @ 0.16 g <sup>2</sup> /Hz 20 Hz -1kHz, 30 min/axis
• Shock:	MIL-STD-202, Method 213
Operating:	30g, 11msec, half-sine (maintain lock)
Non-operating:	50g, 11msec, half-sine
• EMI	
MIL-STD-461	
Emissions:	CE102, RE102
Susceptibility:	CS101, CS114, RS103
• MTBF:	MIL-HDBK-217F, 90,000 hours. Ground fixed @ +40°C baseplate
• On-Off cycling endurance:	5000 cycles at 10°C baseplate
• Input connector:	(1) DB-15 (All input power, monitoring, I/O)
• Dimensions	
Height:	0.95"
Width:	4.00"
Depth:	4.63"
Volume:	17.6 in <sup>3</sup>
Weight:	<1.5 lbs

# 1050A

## Quartz Frequency Standard

### KEY FEATURES

- Low Aging, to  $<5.0E-11$  Per Day
- 1 MHz, 5 MHz and 10 MHz Outputs;
- Front Panel Monitors and Function Meter
- Precise Frequency Tuning Via Front Panel Control
- Low Phase Noise,  $-160\text{dBc}$  @ 10 kHz
- Internal Battery and Automatic Charger

### OPTIONAL FEATURES

- External Disciplining
- 1PPS Output

Symmetricom's 1050A Quartz Frequency Standard is a multiple output instrument suitable for 19" rack mounting. The instrument features a selected third overtone SC-cut precision quartz crystal with drive levels optimized for very low aging, excellent short and long term frequency stability, and retrace characteristics.

The quartz crystal oscillator exhibits unusually high spectral purity at frequencies close to the carrier frequency permitting multiplication to millimeter-wave frequencies with excellent signal-to-noise ratio. A single stage solid-state oven, advanced design and careful component selection techniques ensures the instrument's highly stable operation and ruggedness. Normally operated from a 115 or 230 VAC, 47 to 400 Hz power source, the instrument also offers a built-in standby battery and internal battery charger. Switch over to this internal battery is automatic in the event of external power failure.

Operating controls and monitors are conveniently located on the front panel. LED status monitors indicate Power On, Power Alarm, Oven Ready (oscillator at operating temperature) Battery On and Battery Charge. A built-in meter and thumb wheel switch permit

monitoring of supply voltage, control voltage, oscillator oven and battery voltage and battery charging current. Five digital thumb wheel switches permit offset of the frequency over a range of  $4E-7$ . Rear panel connections include fused power input connections and 1 MHz, 5 MHz and 10 MHz output BNC connectors. 1 PPS outputs are also available. A frequency-control voltage can be applied through a BNC connector for external tuning of the crystal oscillator.

The 1050A satisfies a wide variety of applications with stringent requirements for precision time and frequency in radar systems, missile range timing systems, deep space communications, satellite command terminals, GPS monitoring stations, calibration labs and test equipment.



1050A Quartz Frequency Standard

## 1050A SPECIFICATIONS

### ELECTRICAL SPECIFICATIONS

- Outputs
 

Frequency:	1 MHz, 5 MHz, and 10 MHz
Output amplitude:	0.9 Vrms to 1.5 Vrms into 50Ω
Harmonic distortion:	-40 dB
Spurious signals	
5 MHz:	-80dB
1 MHz, 10 MHz:	-70db
- Aging per day:\* 1.0E-10
- Short term stability:
 

<b>Averaging Time</b>	<b>Allan Deviation</b>
1 s	1.0E-12
10 s	1.0E-12
100 s	1.0E-12
- SSB phase noise (bandwidth = 1 Hz)
 

<b>Offset from signal</b>	<b>5 MHz</b>
1 Hz	-116dBc
10 Hz	-140dBc
100 Hz	-150dBc
1000 Hz	-157dBc
10000 Hz	-160dBc
- Frequency adjustment range
 

Front panel 5 digit:	4.0E-7
----------------------	--------
- Maximum frequency change
 

Overoperating temperature:	1.0E-9
Due to load change (50Ω ± 10%):	5.0E-11

### ENVIRONMENTAL & PHYSICAL SPECIFICATIONS

- Temperature ranges
 

Operating:	0°C to 50°C
Storage:	-60°C to 80°C
Storage with battery:	-40°C to 60°C
- Power requirements
 

	<b>Standard</b>	<b>Disciplined</b>
DC input:	26 to 30V, 8W @ 25°C	26 to 30V, 13W @ 25°C
AC input:	115 or 230V±10%, 47 to 400Hz, 20W @ 25°C	115 or 230V±10%, 47 to 400Hz, 30W @ 25°C

\* Aging typically improves to a level of parts in E-11 per day.  
Observed aging rates as low as 1.0E-12 reported after years of unperturbed operation.

- Internal battery and automatic charger

- |                         |                              |                                |
|-------------------------|------------------------------|--------------------------------|
| Charge capacity @ 25°C: | <b>Standard</b><br>~10 hours | <b>Disciplined</b><br>~6 hours |
|-------------------------|------------------------------|--------------------------------|
- Dimensions
 

Height:	3.5" (89 mm)
Width:	19" (483 mm)
Depth:	18" (457 mm)
  - Weight: 33 lbs. (15 kg)
- ### OPTIONS
- 015 External Disciplining Option
 

Warm-up time to lock:	30 minutes
External phase lock	
External oscillator frequency:	5 MHz
External oscillator level:	1 V rms
Resolution:	±2.5E-12
Loop time constant (switch selectable):	1 s or 100 s
Digital tuning range:	2.0E-8
Automatic acquisition:	2.0E-8

### ORDERING INFORMATION

- |  |                              |
|--|------------------------------|
| • 1050A Standard Configuration                     | <b>Part No.</b><br>02507-103 |
| • 1050A Standard Configuration with 1PPS Option    | 02507-107                    |
| • 1050A with 015 Disciplining Option               | 02492-103                    |
| • 1050A with 015 Disciplining Option & 1PPS Option | 02492-107                    |



1050A connections

# 4145B

## Ultra-Clean Phase-Locked Oscillator

### KEY FEATURES

- High Performance: Cleans up the Signal From a Cs Frequency Standard
- Utilizes the Best Quartz Technology: BVA and SC
- Selectable Time Constants: 10, 50, 200 or 400 Seconds to Optimize Performance
- Exceptional Short and Medium-Term Stability (typical):
  - L (1 Hz) = -125 dBc/Hz at 5 MHz
  - L (10 kHz) = -165 dBc/Hz at 10 MHz
  - $\sigma_y = 1.5 \times 10^{-13}$  from 1 to 1000 seconds
- Standard 19" Chassis: Mounts in Standard Hardware Rack

The 4145B Ultra-clean phase-locked oscillator filters the output from a high-performance Cs frequency standard and improves both the phase noise and Allan deviation. The 4145B is the best choice when you need improved short and medium-term performance than a Cs provides.

Please contact Symmetricom with any specific requirements.



4145B Ultra-Clean Phase-Locked Oscillator

### 4145B SPECIFICATIONS

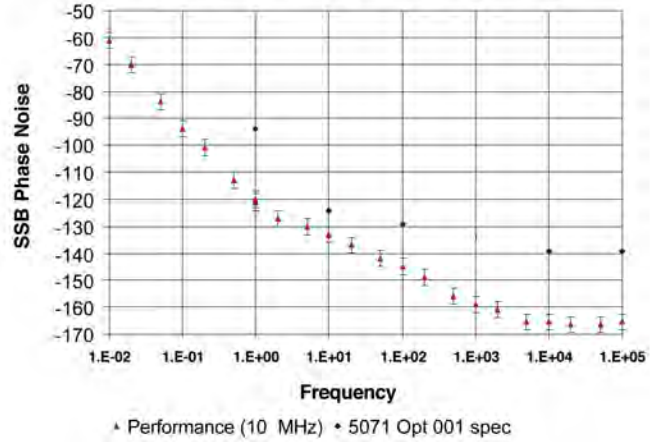
#### ELECTRICAL SPECIFICATIONS

- Input voltage: 85 - 264 V AC
- Input frequency: 47-63 Hz
- Input DC voltage: 24 Vdc + 10%
- Power consumption: 50Ω (max)
- Connector: IEC plug
- Stability (Allan Deviation)
  - 1s 3x10<sup>-13</sup>
  - 100s 3x10<sup>-13</sup>
- Phase noise **L(f) at 10MHz**
  - 1 Hz -120 dBc/Hz
  - 10 Hz -130 dBc/Hz
  - 100 Hz -140 dBc/Hz
  - 1 kHz -155 dBc/Hz
  - 10 kHz -160 dBc/Hz
  - 100 kHz -160 dBc/Hz

#### ENVIRONMENTAL & PHYSICAL SPECIFICATIONS

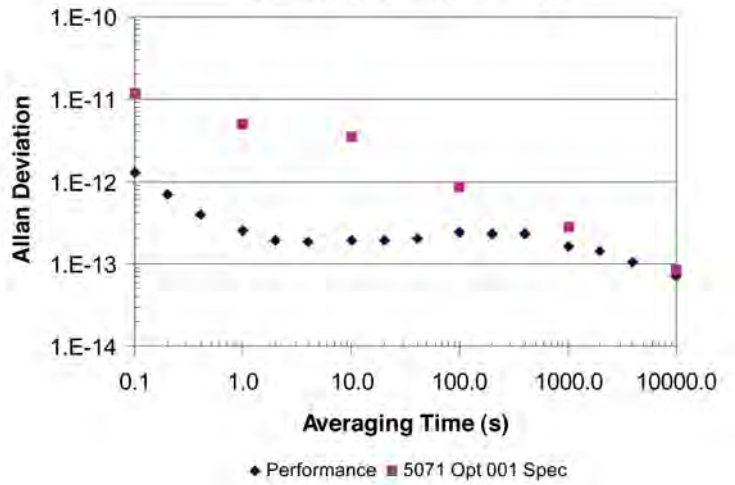
- Weight: 9 Kg [20 lbs]
- Dimensions: 43.2cm x 13.3cm x 55.9 cm (17" x 5.25" x 22")

4145B Phase Noise Performance



4145B Phase Noise Performance

4145B Short-Term Stability



4145B Short-Term Stability

# 1000B

## Ultra-Stable Crystal Oscillator

### KEY FEATURES

- Low Aging,  $5.0E-11$  Per Day
- Low Phase Noise,  $-160\text{dBc}$  at 10 kHz
- Independently Buffered Outputs
- Linearized Electronic Frequency Control
- Fast Warm-Up, 15 Minutes to  $2.0E-8$
- $0^{\circ}\text{C}$  to  $55^{\circ}\text{C}$  Operating Temperature Range

Symmetricom's 1000B achieves low aging rates by utilizing high-performance SC-cut quartz crystal resonators. The specified aging is reached within 30 days of continuous operation, and typically continues to improve. Several users report observed aging rates as low as  $1E-12$  per day after years of continuous operation.

A dewar-insulated oven provides superior temperature stability over the full temperature range. The maximum frequency change over the operating temperature range is  $<5E-9$ . An oven temperature indicator (10mV per degree K) is provided at the power connector.

The oscillator circuit produces phase noise of  $-116\text{ dBc}$  at 1 Hz and  $-160\text{ dBc}$  at 10 kHz. Low noise, high isolation buffer amplifiers provide four independent outputs. The buffer amplifiers isolate outputs from load variations. An internal voltage regulator minimizes fluctuations due to power supply ripple.

Linearized electronic frequency control allows the use of servo loop techniques for fine frequency tuning. Linearity is better than 5% over the specified tuning range. The 1000B crystal oscillator meets the demands of a wide range of applications for military and industrial environments. The oscillator is found in precision frequency counters and synthesizers, GPS receivers, microwave multiplier chains, phase noise calibration test equipment, Stratum II telecommunications applications, radar and tactical communications systems, secure communications systems, satellite ground terminals and space flight systems.



1000B Ultra-Stable Crystal Oscillator

1000B SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

- Frequency: (4) 5MHz
- Amplitude: (2) 1Vrms, (2) 0.5 Vrms
- Harmonic distortion: <-40dBc
- Spurious signals: <-80dBc
- Short term stability:
  - 1s <1.0E-12
  - 10s <1.0E-12
- Aging per day (see note 1) (after 30 days of operation) <1.0E-10
- Phase noise (-dBc/Hz):
  - 1 <-116dBc
  - 10 <-140dBc
  - 100 <-150dBc
  - 1000 <-157dBc
  - 10kHz <-160dBc
  - 100kHz <-160dBc
- Temperature coefficient: <1.0E-9
- Frequency adjustment range
  - Tuning slope: Positive
  - Control range: 0 to 10V
- Load change (50Ω +/-10%) <5.0E-11
- Input voltage
  - Oven supply: 18 to 30VDC
  - Electronics supply: 18 to 30VDC

- Supply sensitivity
  - 1% change in input <1.0E-11
- EMI susceptibility (side bands)
  - 0.1Vrms on power supply inputs
  - 10 Hz to 104 Hz <-100dBc
- Temperature
  - Operating: 0°C to 55°C
  - Non-operating: -40°C to 85°C
- Power requirements
  - Warm-up: <13W
  - Operating at 25°C: <3.5W
- Warm-up to 2.0E-8 of final frequency: <15 minutes
- Oven monitors temperature: 10mv/C
- Dimensions: 3.0"W x 6.54"D x 3.0"H
- Weight: <1.5lbs (0.67kg)
- Connectors
  - RF (J1 - J4): SMA
  - Power (J5): 9 pin D-subminiature

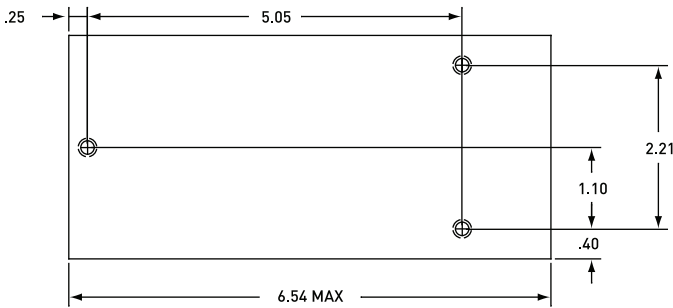
ORDERING INFORMATION

Part No.

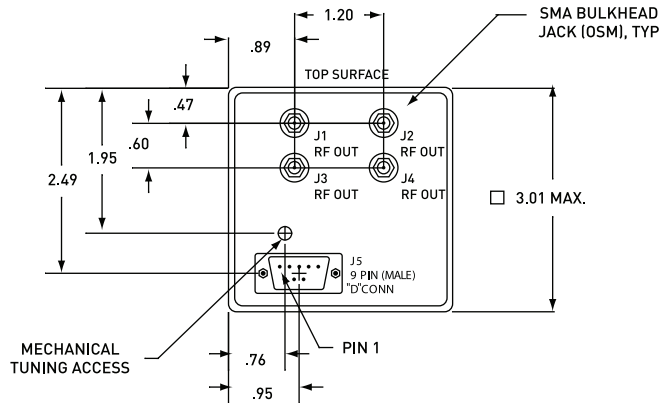
• 1000B with (4) 5MHz outputs	05818-103
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Note 1: Aging typically improves to a level of parts in 1E-11 per day (1E-8/year). After years of unperturbed operation, some users have observed aging rates as low as 1E-12.

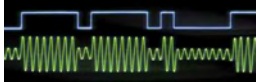
ENVIRONMENTAL & PHYSICAL SPECIFICATIONS



Bottom View



Front View



# MHM 2010

## Active Hydrogen Maser

### KEY FEATURES

- Patented Magnetic Quadrupole for Superior Atomic Beam Focusing
- Very Low Hydrogen Usage (< 0.01 Mole Per Year) for Extended Maintenance-Free Operation
- Unique, Stand-Alone, Cavity Auto Tuning Feature
- Proprietary Teflon Coating Technique, Eliminating Any Re-Coating Requirement and Extending Maintenance Free Life
- CE Compliant

Symmetricon's MHM 2010™ is the only commercially available active hydrogen maser with stand-alone cavity switching auto tuning manufactured in the USA. This technique enables the MHM 2010 to deliver long-term stability normally only attributed to the most stable of cesium atomic standards.

Each MHM 2010 is manufactured to exacting quality standards and carefully checked at each stage to insure a top quality product. Once built, the units are subjected to extensive performance testing, verifying all aspects of operation.

Before shipment, each unit goes through rigorous testing and performance monitoring to insure that the unit meets or exceeds all specifications.



MHM 2010 Active Hydrogen Maser



MHM 2010 SPECIFICATIONS

**STABILITY**

- Allan deviation (measured in 1Hz bandwidth):
 

1s	2.0E-13
10s	3.0E-14
100s	7.0E-15
1000s	3.2E-15
Floor*	3.0E-15
  - Long term: <2.0E-16 per day\*
  - Auto tuning: no external reference required
- \* Achieved after extended period of unperturbed, continuous operation.

**ENVIRONMENTAL**

- Temperature sensitivity: <1.0E-14/°C
- Magnetic sensitivity: <3.0E-14/Gauss
- Power source sensitivity: <1.0E-14

**CONTROL**

- Synthesized frequency resolution: 7.0E-17
  - Frequency control range: 7.0E-10
- Note : The synthesizer maintains continuous phase throughout frequency change.

**AVAILABLE OUTPUTS**

- | Frequency | Amplitude      |
|-----------|----------------|
| 5 MHz     | 13dBm (3 each) |
| 10 MHz    | 13dBm          |
| 100 MHz   | 13dBm          |
- Load impedance: 50Ω

**TIMING OUTPUT**

- Format: 1PPS (positive going pulse)
- Amplitude: >3 V into 50Ω (TTL compatible)
- Pulsewidth: 20 μs
- Rise time: <3 ns
- Jitter: <10 ps RMS

**TIMING INPUT**

- Auto-sync input: 1PPS
- Amplitude: >3 V into 50Ω (TTL compatible)
- Pulsewidth: ≥20 μs
- Rise time: <5 ns
- Jitter: <1 ns RMS
- Synchronization input to output: <15 ns

**PHASE NOISE  $\mathcal{L}(f)$**

- | Outputs | 5 MHz    | 10 MHz   |
|---------|----------|----------|
| 1 Hz    | ≤-112dBc | ≤-106dBc |
| 10 Hz   | ≤-130dBc | ≤-124dBc |
| 100 Hz  | ≤-148dBc | ≤-142dBc |
| 1 KHz   | ≤-155dBc | ≤-149dBc |
| 10 KHz  | ≤-155dBc | ≤-149dBc |
| 100 KHz | ≤-155dBc | ≤-149dBc |

**POWER**

- Operating voltage: 85 to 264 VAC
- Frequency range: 47 to 63 Hz
- Peak power: 150W
- Operating power: 75W
- External DC input: 22 to 28 VDC  
3.1A (typical)
- Standby battery: 8 hours operation

**PHYSICAL SPECIFICATIONS**

- Height: 42.0" (106.68 cm)
- Width: 18.0" (45.72 cm)
- Depth: 30.0" (76.0 cm)
- Weight: 475 lbs. (without batteries\*)

\* Add 66 lbs. for batteries

**ORDERING INFORMATION**

- |  | Part No.  |
|--|-----------|
| • (3) 5 MHz, (1) 10 MHz, (1) 100 MHz                             | 75001-101 |
| • (3) 5 MHz, (1) 10 MHz, (2) 100 MHz                             | 75001-102 |
| • (3) 5 MHz, (1) 10 MHz, 1 PPS Sync, 1PPS output                 | 75001-103 |
| • (3) 10 MHz, 1 PPS Sync, (2) 1PPS output                        | 75001-104 |
| • (2) 5 MHz, (1) 100 MHz, 1 PPS Sync, 1PPS output                | 75001-105 |
| • (2) 5 MHz, (2) 10 MHz, 1 PPS Sync, (2) 1PPS output             | 75001-106 |
| • (2) 5 MHz, (2) 10 MHz, (1) 100MHz                              | 75001-107 |
| • (2) 5 MHz, (1) 10 MHz, (1) 100MHz, 1 PPS Sync, 1PPS output     | 75001-108 |
| • (3) 5 MHz, (2) 10 MHz, (2) 100MHz                              | 75001-109 |
| • (3) 5 MHz, (3) 10 MHz  | 75001-110 |
| • (4) 5 MHz, (2) 10 MHz  | 75001-111 |
| • (3) 10 MHz, (2) 100MHz, 1 PPS Sync, (2) 1PPS output            | 75001-112 |
| • (3) 5 MHz, (1) 10 MHz, (2) 100MHz, 1 PPS Sync, 1PPS output     | 75001-113 |
| • (3) 5 MHz, (1) 10 MHz, (1) 100MHz, 1 PPS Sync, (2) 1PPS output | 75001-114 |



MHM 2010 Back Panel Configuration

# AOG-110

## Auxiliary Output Generator

### KEY FEATURES

- 5 MHz Low Phase Noise Outputs
- Output Phase Offset Programmable to 1 Picosecond
- Output Frequency Programmable to 1.0E-19 Fractionally Over 5.0E-8 Range
- Temperature Control Insures Thermal Stability
- RF Subsystem Developed from Hydrogen Maser Technology
- Second Generation Microprocessor Control
- Digital Phase and Frequency Control Menu Driven Interface with Keypad Access
- LCD Display Provides Easy Access to Configuration and Performance Information
- Full System Control via RS-232 Compatible Interface
- Password Protected Remote Operation Provides Security
- Absolute and Relative Frequency Control
- Dual-Mode, Timed Frequency Control Allows Interval Frequency and Final Frequency Settings
- Output Relative Phase Control Over User Defined Intervals
- Suspend And Resume Available on Programmed Intervals
- Real-Time Clock Set and Adjust

Symmetricom's Auxiliary Output Generator™, designated the AOG-110, solves performance and capability issues associated with the use of high stability frequency standards. Until now, intermediate offset generators that extended a standard's frequency range without a performance sacrifice were difficult or impractical to obtain. Now, the AOG-110 is available with a 5 MHz output, programmable over a broad frequency range with extremely high resolution and precise phase control at an economical price.

The 5 MHz output, available on three buffer-isolated output ports, features a high performance crystal oscillator phase-locked to the external standard's output reference and employs heterodyne techniques developed for Symmetricom's Atomic Hydrogen Maser. Internally, the 5 MHz is used to develop one pulse per second (1PPS) which is available as an output. The 1PPS output can be synchronized to an external 1PPS reference by the AOG's operator controls.

The output frequency is controlled by directly offsetting a phase accumulator (synthesizer) in the PLL chain. The maximum synthesized fractional frequency range is  $\pm 1E-7$ , with a fractional resolution of  $1E-19$ . By altering the frequency output over a precise time interval, output phase control is achieved. Typically, the user defines the desired phase offset and time interval within which the offset is made. Once set, the AOG-110 automatically

implements the appropriate frequency offset and precise time interval. Direct control over both frequency and time interval is available.

The frequency, phase and 1PPS synchronization of the AOG are independently controlled through a menu-driven interface on the front panel. The interface also provides operational status information. The local interface consists of an LCD display, a real-time clock display, and a 16-key keypad coupled to a microprocessor. An RS-232 serial port is available for remote operation. Generally the operator uses either exclusive local control or exclusive remote control. Shared control between local and remote interface is available. Remote control supports password protection that requires entry of a code before the use of local controls is possible. Numerous other options include: baud rate, parity and data format; unit identification number; settable VCO phase-locked loop (PLL) bandwidth and real time clock format. Storage of these options in a nonvolatile memory prevents loss due to power failure or removal.

The AOG-110 remote command set includes 11 commands for frequency, phase control, security control, status, on-line help and 1PPS synchronization control. All commands are parsed for correct syntax and operational range prior to execution. Commands that contain errors are rejected and reported to the remote console without affecting the 5 MHz output.



AOG-110 Auxiliary Output Generator