

# *Space, Defense and Avionics*

**Trusted Performance in  
High-Reliability Timing and  
Frequency Control**



*The most demanding timing applications are in space, defense, and avionics. The environment is the harshest, the need for accuracy the greatest, and the price of failure the highest.*

## OVER 30 YEARS WITHOUT A FAILURE IN SPACE

Symmetricom's Timing, Test and Measurement division is the leading worldwide supplier of atomic clocks, network synchronization and timing solutions.

Symmetricom-TT&M designs, develops, and manufactures cesium, rubidium and quartz timing and frequency control solutions for the space, defense and avionics (SDA) marketplace. With a 30-year track record, we are one of the most experienced and trusted providers in the market.

*In over 30 years, we have never experienced a single failure in space.*

Our customers know our products perform reliably and accurately under the most extreme conditions. Customers also know that we can tailor designs and program support to fit their unique needs.

### Meeting Customer Needs Exceeding Customer Expectations

We offer each customer the right mix of performance, price and features. Our capabilities include:

- Atomic and quartz-based master frequency sources for military, scientific, and commercial spacecraft and tactical airborne applications
- Spacecraft Master Oscillator Groups (MOGs)
- Local oscillators for
  - Transponders
  - Up/down converters
  - GPS receivers
  - Transmitters
  - Transceivers
  - Beacons and other space-borne equipment
- Ruggedized master and local oscillators (atomic and quartz-based) for
  - Avionics applications
  - Surveillance aircraft and UAVs
  - Fighter aircraft and helicopter gunships
  - Shipboard applications
- Low g-sensitivity designs 10E-9, 10E-10, 10E-11
- Grade 1 (Class S), Grade 2 (Class B) and COTS grade programs
- Radiation baselined platforms

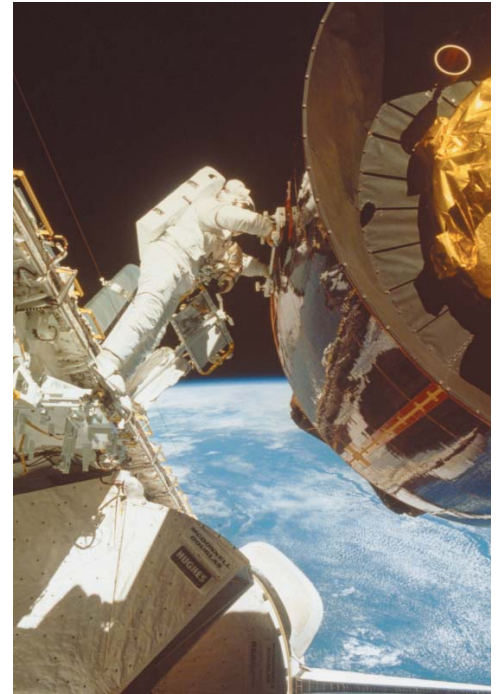
### Harsh Environments, Precise Accuracy, Superior Reliability

The most demanding timing applications are in space, defense and avionics. The environment is the harshest, the need for accuracy the greatest, and the price of failure the highest. High-performance frequency and timing products make modern communications and navigation possible, and set the standards by which time itself can be measured everywhere.

The environmental challenges are unrivaled: extreme temperatures, high radiation, massive g-forces, and severe vibrations — yet products must operate flawlessly — sometimes for years without the possibility of maintenance or repair.

### Accuracy is precise.

Our cesium clocks have worked flawlessly on GPS Block I and II/IIA satellites — maintaining precision millisecond accuracy over an entire decade. Our cesium clocks will also be used on GPS Block IIF satellites — providing the same precision accuracy and high reliability. Rubidium frequency sources within the F-35 Joint Strike Fighter (another Symmetricom project) allow tactical radars to track targets moving at hundreds of miles an hour.



Symmetricom quartz oscillators in mobile communications systems provide the precision that prevent enemy jamming and allow users to communicate easily with each other in a crowded battlespace.

*Timing and frequency control is the fundamental technology that enables communications, command and control systems. These systems depend on the ability to continuously and unambiguously identify reference points in time and space. This is the capability Symmetricom provides.*

# SYMMETRICOM TT&M SPACE, DEFENSE AND AVIONIC PRODUCTS



## 4415 Space Qualified Cesium Frequency Standard

The 4415 is a space qualified cesium frequency standard that produces accurate, stable and spectrally pure sinusoidal signals. This unit is designed for long life and is used in satellite-based timing systems as a master frequency reference.

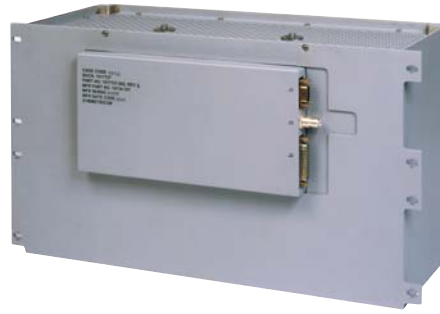
### Key Features:

- Output Frequency 10.23MHz
- 10 year operational life
- Remote monitoring and control
- 1s stability < 1E-11
- Accuracy < 1E-11
- Phase noise
 

1Hz	-85dBc
100Hz	-140dBc
1kHz	-150dBc
- TC < 5E -14/°C
- Size 6.25" x 7.5" x 16.50"  
(158.75 mm x 190.5 mm x 419.1 mm)

### Applications

- Satellite based master frequency reference



## 4133 Militarized Modular Cesium Frequency Standard

The 4133 is a military grade cesium frequency standard that is designed for both shipboard and airborne applications. The unit is a rugged, compact self-contained module that can be easily integrated into precise timing systems.

### Key Features:

- Output Frequency 5MHz
- Accuracy < 2E-12
- 1s stability < 2.7E-11
- Phase noise
 

1Hz	-78dBc
100Hz	-140dBc
- Temp Sensitivity < 2E -12
- Size 19.5" x 10.5" x 7.8"  
(49.5 cm x 26.7 cm x 19.8 cm)

### Applications

- Shipboard time and frequency control
- Airborne time and frequency control
- Electronic warfare master reference



## 8130 Militarized Rubidium Oscillator

The 8130 is a militarized rubidium oscillator designed for tactical applications where shock, vibration, humidity and other environmental factors are a challenge. The 8130 provides a stable frequency with good short and long-term stability. The unit includes an RS-232 interface for monitoring, temperature compensation and frequency adjustments.

### Key Features:

- Output Frequency 5 & 10MHz
- Aging per month < 3E-11
- 1s stability < 1.0E-11
- Phase noise
 

1Hz	-70dBc
100Hz	-120dBc
1kHz	-140dBc
- Temp Sensitivity < 3E -10
- Size 2.87" x 2.92" x 4.04"  
(7.8 cm x 7.41 cm x 10.6 cm)

### Applications

- Tactical Communications
- Ground, Shipboard and Airborne time and frequency control
- Electronic Warfare master reference
- C4/ISR reference

## Over 30 years Without A Single Failure In Space



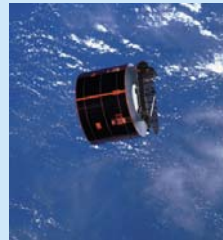
U.S. NAVY  
NST-2 TIMATION



U.S. NAVY



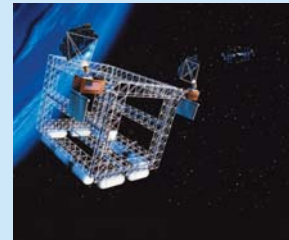
NASA  
LANDSAT-D



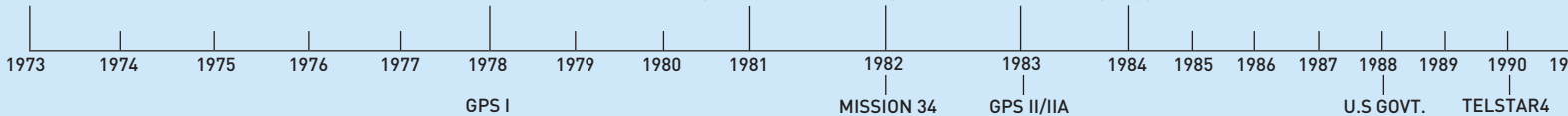
NASA  
LEASAT



NASA  
FLATSATCOM



NASA  
SPACE STATION





# DESIGNED TO DELIVER THE HIGHEST QUALITY PERFORMANCE UNDER



## 8122 and 8123 Airborne Rubidium Oscillators

The 8122 and 8123 are COTS airborne rubidium oscillators designed for integration into fighter aircraft time and frequency control instrumentation. These units serve as master frequency sources in **C**ommunication, **N**avigation and **I**dentification (**CNI**) on-board electronic suites providing precision frequency control over extreme airborne environments typically seen in jet fighter applications.

### Key Features:

- Output Frequency 10MHz and 100MHz
- Output: RF and LVDS
- Aging per month < 5.0E-11
- 1s stability < 1.5E-11
- Phase noise
 

1Hz	-75dBc
100Hz	-125dBc
1kHz	-140dBc
- Temp Sensitivity < 3E -10
- Size 5.80" x 8.1" x 1.2"  
(14.7 cm x 20.6 cm x 3.0 cm)

### Applications

- Airborne time and frequency control
- Electronic Warfare master reference
- C4/ISR reference



## 9400 Satellite Master Oscillator

The 9400 is an OCXO designed for satellite based master reference applications. Rugged and environmentally hardened, the 9400 provides exceptional phase noise and frequency stability in a small, compact package.

### Key Features:

- Output Frequency 5 - 25MHz
- Aging per day < 5E-11
- 1s stability < 2.0E-12
- Phase noise (@ 5MHz)
 

1Hz	-116dBc
100Hz	-150dBc
1kHz	-157dBc
- Temp Sensitivity < 3E -9
- G Sensitivity < 7.E-10 per G
- Size 1.49" x 1.86" x 3.6"  
(3.78 cm x 4.72 cm x 9.14 cm)

### Applications

- Satellite master reference
- Space probe reference
- Satellite time and frequency control



## 9500 Satellite Master Reference

The Symmetricom 9500 is a master oscillator that produces a highly stable, low noise reference frequency output. The environmentally rugged 9500 features and SC cut OCXO and temperature controlled electronics that achieves temperature insensitive performance, excellent short term stability, phase noise and aging characteristics.

### Key Features:

- Output Frequency 4 - 25MHz
- Aging per day < 5.0E-11
- 1s stability < 1.0E-12
- Phase noise (@ 5MHz)
 

1Hz	-116dBc
100Hz	-150dBc
1kHz	-157dBc
- Temp Sensitivity < 3.0E-10
- G Sensitivity < 4E-9 per G
- Size 4.25" x 6.0" x 8.62"  
(10.97 cm x 15.24 cm x 21.89 cm)

### Applications

- Satellite master frequency reference
- Satellite time and frequency control



ENVIAT



CASSINI



EOS



MTSAT



QUICKSCAT



SBIRS HIGH



QUICKBIRD II

1991

EXPLORER  
COLUMBUS/SOHO

1992

1993

INTELSAT VIII  
EOS AM

1994

GPS RECEIVER

1995

ORBCOMM  
SBIRS LOW  
U.S. GOVT.  
GPS RECEIVER

1996

GPS BIK IIF  
QUICKBIRD  
X1

1997

GPS RECEIVER  
EOS  
ADV COM

1998

ETS-8  
EOS-MLS

# THE MOST ADVERSE CONDITIONS IN SPACE AND ON EARTH.



## 9600 and 9700 HF Aerospace Oscillators

The 9600 and 9700 oscillator series are ultra miniature OCXOs. They are designed to provide a high stability frequency output for numerous aerospace platforms. Hybrid circuitry allows for small size and low power consumption without compromising performance or reliability. The 9600 and 9700 platforms are customizable to meet numerous electrical and environmental requirements.

### Key Features:

- Output Frequency 4 - 60MHz
- Aging per day < 5.0E-11
- 1s stability < 2.0E-12
- Phase noise (@ 5MHz)
  - 1Hz -112dBc
  - 100Hz -145dBc
  - 1kHz -157dBc
- Temp Sensitivity 4E-9
- G Sensitivity < 2E-9 per G
- Size 1.33" x 1.33" x 1.33" (3.37 cm x 3.37 cm x 3.37 cm)

### Applications

- Satellite master and local reference
- C4/ISR reference
- Satellite time and frequency control



## 9800 VHF Aerospace Oscillator

The 9800 is an ultra-miniature high frequency OCXO. A frequency range of 50 – 200MHz is attainable while still offering exceptional phase noise and frequency stability. The 9800 is a rugged and environmentally hardened oscillator that is designed for satellite and other spaceborne platforms.

### Key Features:

- Output Frequency 50 - 200MHz
- Aging per day < 2.0E-6
- Phase noise (@ 100MHz)
  - 1Hz -60dBc
  - 100Hz -120dBc
  - 1kHz -150dBc
- Temp Sensitivity 5E-7
- G Sensitivity < 8E-10 per G
- Size 1.33" x 1.33" x 1.33" (3.37 cm x 3.37 cm x 3.37 cm)

### Applications

- Radar warning receiver
- Satellite time and frequency control



## 9210 Low-cost Military OCXO

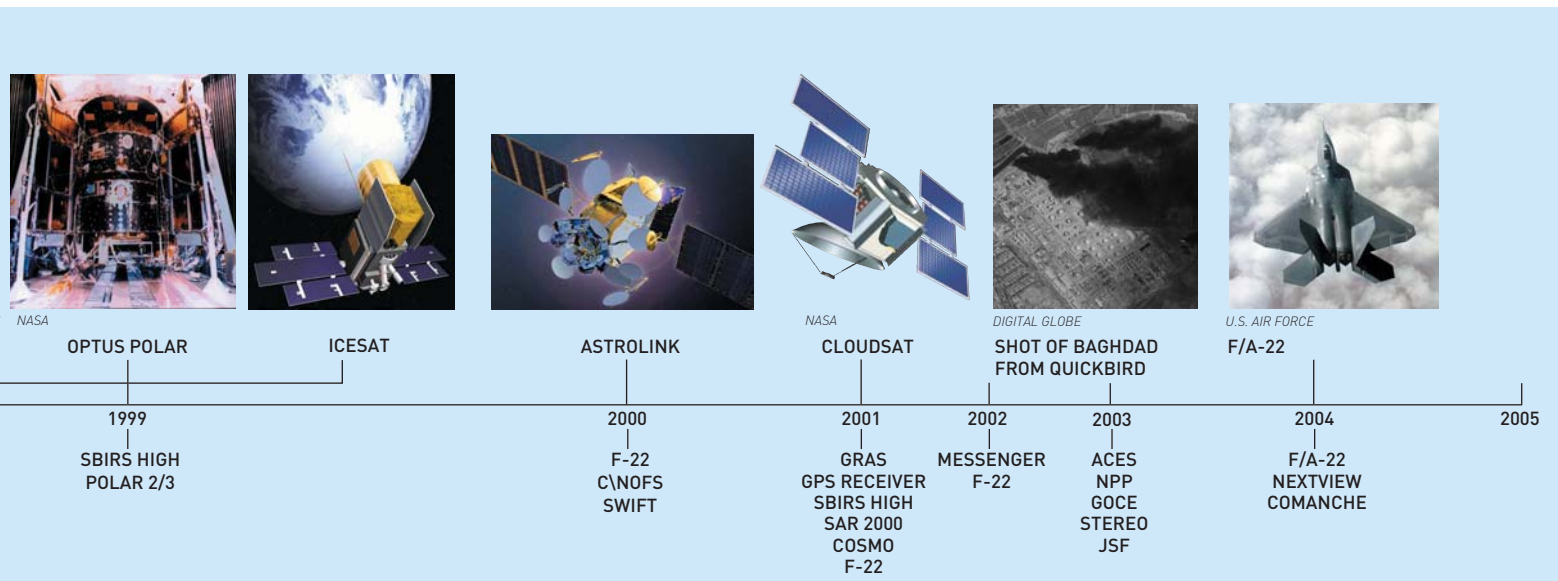
The 9210 is a COTS military OCXO designed for ground tactical and airborne applications where superior frequency stability and phase noise are required. The COTS design uses industry standard pinouts for drop-in replacement of commercial oscillators.

### Key Features:

- Output Frequency 5 or 10MHz
- Aging per day < 1.0E-10
- Phase noise
  - 1Hz -105dBc
  - 100Hz -145dBc
- G Sensitivity < 2E-10 per G
- Size 2.0" x 2.0" x 1.25" (5.1 cm x 5.1 cm x 3.2 cm)

### Applications

- Electronic Warfare reference
- Tactical communications
- C4/ISR reference
- Ruggedized upgrade for commercial oscillator



## How We Earned Our Customers Trust

Customers in this market clearly understand what they need from a technology provider. They can easily identify a short list of market leaders and also recognize that Symmetricom's long list of customers speaks for itself. Here are the facts behind our leadership:

**Technical excellence** — Small size, low power demand, fast warm-up, excellent stability, and superior spectral purity make our products ideal for such SDA applications as radio navigation, satellite transmission, and tracking and guidance. Research and development on next generation technologies including chip scale atomic clocks and optically pumped cesium.

**Product depth** — A choice of cesium, rubidium, or quartz in a range of form factors, performance specs, frequency outputs, price points and environmental

qualifications gives customers a head start in finding the right solution for their specific needs.

**ISO 9001-2000 and MIL-STD certified** — We maintain ISO 9001-2000 and MIL-STD certifications to assure the highest quality design, manufacturing and test facilities available in the industry today.

**Flexible architecture for design into larger assemblies** — In addition to individual precision frequency solutions, Symmetricom has the ability and experience to provide higher-value packages to customers. Higher-value packages can include multiple oscillator redundancy, shock and vibration damping systems, vibration compensation, DC/DC conversion, digital interfaces, distribution, DDS, and other combined solutions for both space and tactical applications.

**Heritage, heritage, heritage** — Providing solutions to the most demanding requirements for over 30 years has not only

given us extensive experience, it has given us an extensive heritage in design and flight — allowing our customers to achieve the maximum degree of success possible. We are proud to have participated in many of the highest-profile programs in the past, and we are delighted at the opportunity to participate in such programs again — now and in the future.

**Flexible business process tailored to your procurement** — We understand that customers in this market have finely tuned requirements — from a technical and performance standpoint, but also in terms of how they like to work with their suppliers. Whether you are a government agency, prime contractor, or purely commercial enterprise, we can customize our designs, documentation and program support to meet your needs.

## Product Breakdown

SDA products come in three basic technologies: ovenized quartz (OCXO), rubidium and cesium:

Technology	Product	Differentiation
OCXO	9400 9500 9600/9700 9800 9210	High-performance, small size, exceptional phase noise Highest-performance commercially-available design Low-power, low-cost, miniature-size, high-performance with low g-sensitivity options VHF OCXO, 50-200 MHz frequency range, miniature-size Low G-sensitivity COTS OCXO; military/airborne applications
Rubidium	8122/8123 8130	Ruggedized COTS, low profile, airborne tactical with frequency distribution and bus level communications Ruggedized military, for airborne and ground tactical applications
Cesium	4133 4415	Military cesium for airborne and shipboard applications Space-qualified, extreme accuracy, high-profile heritage



**SYMMETRICOM, INC.**  
Corporate Headquarters  
2300 Orchard Parkway  
San Jose, California  
95131-1017  
tel: 408.433.0910  
fax: 408.428.7896  
info@symmetricom.com  
www.symmetricom.com

**TT&M DIVISION**  
SDA Facility  
34 Tozer Road  
Beverly, Massachusetts  
01915-5510  
tel: 978.927.8220  
tel: 978.232.1497 [SDA Sales]  
fax: 978.524.4891  
info@SymmTTM.com  
www.SymmTTM.com