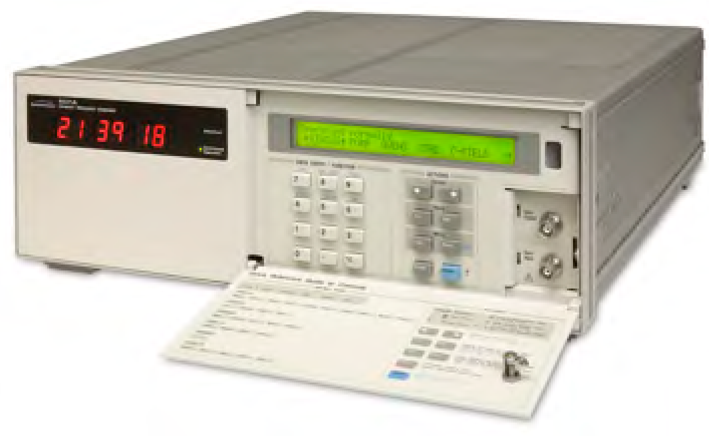
DATA SHEET

5071A

Primary Frequency Standard



Key Features

- Easy to use with automatic startup and intuitive menu structure
- Fast Set up: - 5.0E-13 accuracy in 30 minutes or less
- Integrated clock and message displays
- Multiple timing and frequency inputs outputs with easy access at front and rear
- Automatic synchronization of 1 PPS signal
- Remote interface and control including alarm output
- CE Compliant

Key Benefits

- Maintains exceptional accuracy and stability even in unstable environments - Unsurpassed Stability in the Lab or Field
- Accuracy: - ±1.0E-12; ±5.0E-13 for High Performance
- Stability: ≤1.2E-11 @ 1Hz; ≤5.0E-12 for High Performance
- Environmental Stability: <1.0 E-13; <8.0 E-14 for High Performance for any combination of Environmental Conditions
- Long Term Stability: <5.0 E-14; <1.0 E-14 for high Performance for 5 – day averaging time
- Proven Reliability with an average mean time between failures (MTBF) of greater than 160,000 hours
- Full traceability to NIST
- AC and DC input and Internal battery back-up

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.

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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 shortterm 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 ±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 1.0E + 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 (σ_y (2, τ)) 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 5.0E-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 5.0E-14 over the entire life of the CBT.

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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 10-year warranty on the Standard Long-Life Cesium Beam Tube and a 5-year warranty for the high-performance tube.

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

Full Traceability to NIST

Microsemi® 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 (Settability)

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 ±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 1.0E-14 or better, and long-term measurements at NIST show that the flicker floor is typically better than 5.0E-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.

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Specifications

ELECTRICAL SPECIFICATIONS

• Frequency outputs	(4)
Frequency	[2] 5 MHz & [1] 10 MHz
Format	Sine
Amplitude	≥1Vrms
Harmonic	≤-40 dBc
Non harmonic	≤-80 dBc
Connector	N
Load impedance	50Ω
Location	rear panel
Isolation between ports	≥110 dB (typical)
Frequency	[1] 100 kHz & [1] 10 MHz
Format	Sine
Amplitude	≥1 Vrms
Harmonic	≤-40 dBc
Load impedance	50Ω
Location	rear panel
Connector	BNC
• Timing outputs	(3) 1PPS
Format	1PPS
Amplitude	≥2.4 V into 50Ω (TTL Compatible)
Pulse width	20 μs
Rise time	≤5 ns (slew rate >10^{-9} volt/second at 1.5 V)
Jitter	≤1 ns rms
Connector	BNC
Load impedance	50Ω
Location	One front panel Two rear panel Timing Outputs Automatic synchronization to within 50 ns of reference pulse
• Sync input	(2) 1 PPS (each may be independently armed)
Amplitude	+2 to +10 V Max
Pulse width	100 ns min to 100 μs max
Rise time	≤50 ns
Jitter	≤1 ns rms
Connector	BNC
Load impedance	50Ω
Location	One front panel One rear panel
Manual sync	
Range	-0.5 to +0.5 s
Resolution	50 ns

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

	Standard Performance	High Performance
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
Settability		
Range	±1.0E-9	±1.0E-9
Resolution	6.3E-15	6.3E-15
Control:	via RS-232 port	

• Stability	Standard Performance	High Performance
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)	10 MHz Output	5 MHz Output
1	≤-100dBc	≤-106dBc
10	≤-130dBc	≤-136dBc
100	≤-145dBc	≤-145dBc
1,000	≤-150dBc	≤-150dBc
10,000	≤-154dBc	≤-154dBc
100,000	≤-154dBc	≤-154dBc

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Specifications

ENVIRONMENTAL AND PHYSICAL SPECIFICATIONS

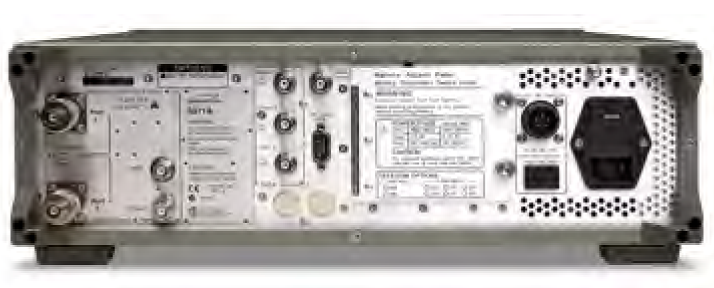
• General environment	
Temperature	
Operating	0°C to 55°C
Non-operating	-40°C to 70°C
Humidity	0 to 95% RH (45°C max)
Magnetic field	DC, 55, 60Hz 0 to 2 gauss peak - any orientation
Atmospheric pressure	≤1.0E-13 change in frequency for pressure down to 19 kPa (equivalent to an altitude of 12.2 km)
Shock 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
AC Power requirements	
Operating voltage	100, 120 VAC ±10%, 45 to 440 Hz 220, 240 VAC ±10%, 45 to 66 Hz
Frequency	45 to 440 Hz 45 to 66 Hz
Power	
Operating	50 W (Standard Performance) 58 W (High Performance)
Warm-up	100 W
DC Power requirements	
22 to 42 VDC	
Operating	45 W (Standard Performance) 50 W (High Performance)
Warm-up	85 W
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.

[1] Each output can be set to either 5 or 10 MHz from the front panel or by remote control.

[2] 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

ORDERING INFORMATION	Part No
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



Rear View

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