

# Agilent 5071A Primary Frequency Standard

## Unsurpassed Stability in the Lab or Field

Product Overview



**Agilent Technologies**  
Innovating the HP Way

## Solid performance that's easy to use



### Accuracy and stability

- Standard Cesium Beam Tube  
Accuracy:  $\pm 1 \times 10^{-12}$   
Environmental Stability:  
 $< 1 \times 10^{-13}$  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:  $\pm 5 \times 10^{-13}$   
Environmental Stability:  
 $< 8 \times 10^{-14}$  frequency change  
for any combination of environmental conditions\*  
Long-Term Stability:  
 $< 1 \times 10^{-14}$  for 5-day averaging time

### Fast setup

- Fully-automated, 30-minute warm-up to full specifications
- No adjustments or alignments during setup or operation

### Easy to use

- 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 1-PPS signal

### Remotely manageable

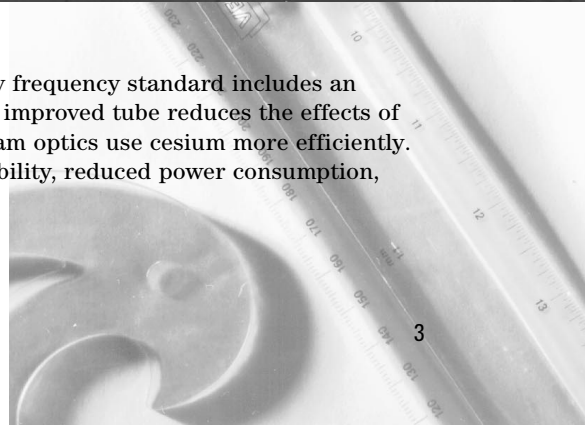
- All controls fully programmable
- Remote status reporting
- Internal battery backup

\* See specifications on page 8.



### **Improved cesium beam tube**

The Agilent Technologies 5071A primary frequency standard includes an improved cesium beam tube design. The improved tube reduces the effects of Ramsey frequency pulling. Also, new beam optics use cesium more efficiently. The result is improved accuracy and stability, reduced power consumption, and increased tube life.



# Guaranteed stability keeps the Agilent 5071A working longer for you

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 5061E cesium standards. This innovative product is the result of Agilent's more than 35 years of experience in the precision frequency standard business.

## The 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.

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

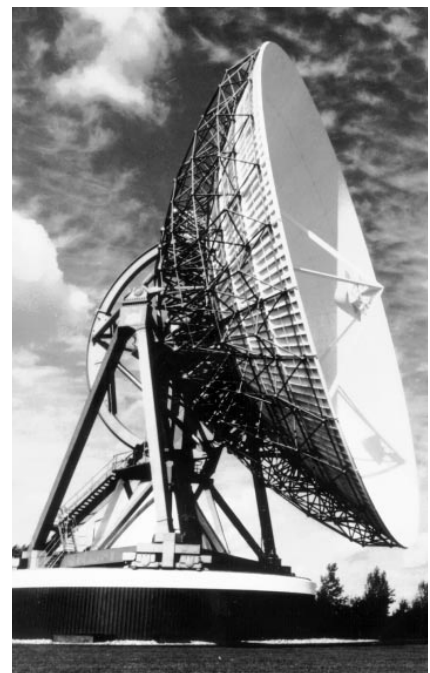
Stable frequency generation is required to transmit and receive signals properly between ground terminals and communication satellites. Frequency flexibility is also needed to adjust for satellite-to-satellite carrier-frequency differences. The 5071A's state-of-the-art technology produces offset and 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 1-PPS signal, greatly simplifying this aspect of satellite communications.



The 5071A's stability and reliability will keep your calibration lab services available.



Satellite communications require stable frequencies that are easily generated by the 5071A.

### **Telephone network synchronization**

Telecommunication systems must be synchronized in time and have the same data rates. If these requirements are not met, entire frames of data may be lost. Data loss is minimized when cesium standards are integrated as master system clocks at the Stratum 1 and International Gateway interface levels. The unit-to-unit frequency accuracy (tracking) of the 5071A prevents data loss due to differing transmission and reception rates.

Unlike other technologies, the 5071A has the reliability required to maximize telecommunication system uptime. Agilent's record for uniquely-designed, high-quality products is unmatched.

Standard options available with the 5071A allow the unit to operate from redundant 48-V sources and produce either DS1- or CEPT-compliant clock signals. See "Telecommunications options" on page 7 for more details.

### **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 cesium standard, or it can be used as a temporary backup should the cesium 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.

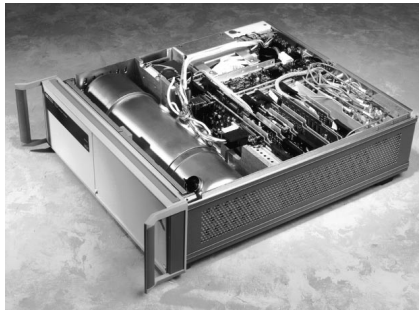
# Cesium II technology delivers unmatched accuracy and stability

## Exceptional accuracy

An improved cesium beam tube and new electronics design—known as Cesium II Technology—make the Agilent 5071A six times more accurate than its predecessor, the 5061B. The intrinsic accuracy of the improved cesium beam tube assures that any 5071A Option 001 will power up to within  $\pm 5 \times 10^{-13}$  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

Agilent's Cesium II technology brings a new level of stability to the cesium clock. The 5071A's outstanding specifications are a result of this advanced technology. The 5071A Option 001 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  $10^5$  seconds (approximately one day).



**The 5071A's enhanced cesium beam tube and electronics package (Cesium II technology) provide increased accuracy and stability.**

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 5071A Option 001 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. The 5071A has demonstrated a mean time between failures (MTBF) of over 100,000 hours, based on actual field repair data which allow it to virtually ignore changes in temperature, humidity, and magnetic fields. Under full environmental conditions, the 5071A Option 001 frequency varies less than 8 parts in  $10^{14}$ .

The 5071A delivers exceptional performance over very long periods of time, greatly increasing the availability of critical time and frequency services.

## Traditional reliability

Hewlett-Packard and Agilent Technologies have been producing cesium frequency sources and related products since 1964. Over 100 million field operating hours in critical military and commercial applications have proven the reliability of cesium standards.

Cesium II technology, because of advancements in tube design, automated maintenance, and extensive use of digital circuitry, offers improved reliability over its predecessor, the 5061B. Backing up this reliability is a 10-year warranty on the standard cesium beam tube and a three-year warranty for the optional high-performance tube.

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

## Full traceability to NIST

Agilent Technologies' Santa Clara, California lab provides NIST traceability to the accuracy measurements made on every 5071A. Traceability to NIST is maintained through the NIST-supplied frequency measurement and analysis system (FMAS). This service exceeds the requirements of MIL-STD-45662A and can be a valuable tool in demonstrating traceability to your customers.

# Ease of use and versatility

## **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 1-PPS 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 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 (5071A Option 001)**

The 5071A Option 001 high-performance cesium beam tube is optimal for the most demanding operations. The Option 001 tube offers a full-environment accuracy specification of  $\pm 5 \times 10^{-18}$ —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.

## **Telecommunications options**

The 5071A primary frequency standard may be optionally equipped to provide output frequencies, impedances, and signal formats required of a primary reference clock in modern telecommunication networks. Configurations are available for both DS1 and CEPT standards. The 5071A can also be equipped to operate from a 48-Vdc central office battery.

Clock rates of 1.544 and 2.048 Mb/s are available. Impedance choices and signaling formats for all current ITU-T specifications are also available. All features found in a standard 5071A are retained when a 1.544- or 2.048-Mb/s option is installed. This includes both programmable 5/10-MHz outputs and the 1-MHz and 100-kHz outputs. The 1-PPS output and sync are only available on the front panel of the instrument.

The 5071A Option 048 equips the frequency standard to operate from 48 Vdc power. Two independent 48-volt power sources may be supplied. The power sources must be of the same polarity, but either polarity may be used.

Each power source in the 5071A Option 048 is isolated and fully fuse-protected. The frequency standard draws power from the source with the higher voltage. Upon source failure the frequency standard will automatically switch to the good source—ensuring uninterrupted operation.

The 5071A Option 048 automatically uses a 48-Vdc source if one is present. The instrument will attempt to use ac power if no dc source is available. The internal battery normally supplied with the 5071A is not available when Option 048 is installed.

For further details, see “Ordering information” on back page.

# Specifications<sup>1</sup>

## Accuracy and stability

Conditions—any combination of:

Temperature	0 to 50 °C
Humidity	0 to 80% (40 °C maximum)
Magnetic Field	dc, 55, 60 Hz; 0 to 0.2 millitesla (2 Gauss) peak—any orientation
Pressure	47 kPa (equivalent to an altitude of 6 km)
Shock and Vibration	100-mm drop

Parameter	Standard cesium beam tube. Values are within:	High-performance cesium beam tube (Option 001)
Accuracy <sup>2</sup>	$\pm 1 \times 10^{-12}$	$\pm 5 \times 10^{-13}$
Frequency Change vs. Environment	$\pm 1 \times 10^{-13}$	$\pm 8 \times 10^{-14}$
Warm-up Time:		
To normal operational status (typical)	15 minutes	15 minutes
To full specifications (typical)	30 minutes	30 minutes
Reproducibility <sup>2</sup>	$\pm 1.0 \times 10^{-13}$	$\pm 1.0 \times 10^{-13}$

## Long-term Stability

Time Domain Stability <sup>2</sup>	Averaging Time	Standard cesium beam tube	High-performance cesium beam tube
5- and 10-MHz outputs	10 <sup>4</sup> seconds	$\leq 2.7 \times 10^{-13}$	$\leq 8.5 \times 10^{-14}$
	10 <sup>5</sup> seconds	$\leq 8.5 \times 10^{-14}$	$\leq 2.7 \times 10^{-14}$
	5 days	$\leq 5.0 \times 10^{-14}$	$\leq 1.0 \times 10^{-14}$
	30 days	$\leq 5.0 \times 10^{-14}$	$\leq 1.0 \times 10^{-14}$
Flicker Floor Value <sup>2</sup>	Guaranteed	$\leq 5.0 \times 10^{-14}$	$\leq 1.0 \times 10^{-14}$
	Typical <sup>3</sup>	$\leq 1.5 \times 10^{-14}$	$\leq 5.0 \times 10^{-15}$

## Sinusoidal output characteristics (all located on rear panel)

Parameter	Ports 1 & 2 *	1 MHz, 100 kHz
Amplitude into 50 Ω load	> 1 Vrms	> 1 Vrms
Isolation <sup>2</sup> between ports	>110 dB (typical)	not specified
Harmonic signals (typical)	<-40 dBc	<-40 dBc
Non-harmonic distortion	<-80 dBc	not specified
Connector type	N	BNC
Source impedance	50 Ω	50 Ω

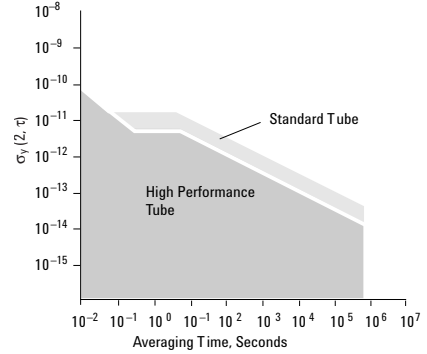
\* Each output can be set to either 5 or 10 MHz from the front panel or by remote command.



5071A rear panel

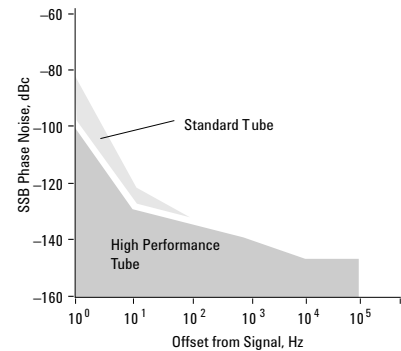
## Frequency stability (5- and 10-MHz outputs):

### Time Domain Stability<sup>2</sup>



Averaging Time (Seconds)	$\sigma_y(2, \tau)^2$	
	Standard cesium beam tube	High-performance cesium beam tube (Option 001)
10 <sup>-2</sup>	$\leq 7.5 \times 10^{-11}$	$\leq 7.5 \times 10^{-11}$
10 <sup>-1</sup>	$\leq 1.2 \times 10^{-11}$	$\leq 1.2 \times 10^{-11}$
10 <sup>0</sup>	$\leq 1.2 \times 10^{-11}$	$\leq 5.0 \times 10^{-12}$
10 <sup>1</sup>	$\leq 8.5 \times 10^{-12}$	$\leq 3.5 \times 10^{-12}$
10 <sup>2</sup>	$\leq 2.7 \times 10^{-12}$	$\leq 8.5 \times 10^{-13}$
10 <sup>3</sup>	$\leq 8.5 \times 10^{-13}$	$\leq 2.7 \times 10^{-13}$
10 <sup>4</sup>	$\leq 2.7 \times 10^{-13}$	$\leq 8.5 \times 10^{-14}$
10 <sup>5</sup>	$\leq 8.5 \times 10^{-14}$	$\leq 2.7 \times 10^{-14}$
5 days	$\leq 5.0 \times 10^{-14}$	$\leq 1.0 \times 10^{-14}$

## Frequency Domain Stability<sup>2</sup>



Offset From Signal (Hz)	SSB Phase Noise <sup>2</sup> dBc	
	Standard cesium beam tube	High-performance cesium beam tube (Option 001)
10 <sup>0</sup>	$\leq -85$	$\leq -100$
10 <sup>1</sup>	$\leq -125$	$\leq -130$
10 <sup>2</sup>	$\leq -135$	$\leq -135$
10 <sup>3</sup>	$\leq -140$	$\leq -140$
10 <sup>4</sup>	$\leq -145$	$\leq -145$
10 <sup>5</sup>	$\leq -145$	$\leq -145$

See page 9 for footnotes.



# Supplemental characteristics<sup>1</sup>

## Time standard

### Clock display

24-hour red LED display of hours, minutes, and seconds

### Clock 1-PPS outputs

All outputs are isolated from each other  
Amplitude:  $\geq 2.4$  V into  $50\ \Omega$   
(output levels are TTL compatible)

Width: 20  $\mu$ s

Rise time:  $< 5$  ns (slew rate  
 $> 10^9$  volts/second at 1.5 volts)

Jitter:  $< 1$  ns rms (pulse-to-pulse or  
pulse-to-10-MHz)

Connectors: BNC

Locations: one on front panel, two on  
rear panel

### Clock synchronization

Automatic synchronization: to within 50 ns  
of reference pulse

Sync pulse: 2 inputs; each may be inde-  
pendently armed

Amplitude: +2 to +10 volts (maximum)  
Pulse width must be less than  
100  $\mu$ s

Width: 100 ns minimum, 100  $\mu$ s maxi-  
mum

Rise time:  $< 50$  ns

Input impedance:  $50\ \Omega$  (nominal)

Time reference: rising edge

Connectors: BNC

Location: one on front panel, one on rear  
panel

Manual synchronization:

Range:  $-0.5$  to  $+0.5$  s

Resolution: 50 ns

### Frequency settability<sup>4</sup>

Resolution:  $6.3 \times 10^{-15}$

Range:  $\pm 1 \times 10^9$

## Internal standby battery (nominal values)

### Capacity

45 minutes at 25 °C from full charge

### Charge time

16 hours maximum from fully discharged  
state

### Charge source

ac input power only

## Remote system interface and control

### RS-232C (DTE configuration)

Provides complete remote control and inter-  
rogation of all instrument functions and  
parameters. RS-232C interface circuits are  
optically isolated and floating with respect  
to 5071A chassis.

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

Connector: 9-pin male rectangular D  
subminiature type

### Status output

Provides a logic output to monitor normal  
and abnormal operation externally.  
Parameters which define abnormal opera-  
tion can be user programmed.

Output: TTL High, normal  
TTL Low, fault

Circuit is TTL open collector with inter-  
nal pullup resistor. Circuit can sink  
up to 10 mA.

Connector: BNC located on rear panel

## Power requirements

Input voltage:

ac: 100, 120 Vac  $\pm 10\%$ , 45 to 440 Hz  
220, 240 Vac  $\pm 10\%$ , 45 to 66 Hz

dc: 22 to 42 Vdc operating (for 48 Vdc  
operation, see Option 048)

Damage level: 55 V

NOTE: Both dc input terminals are float-  
ing. Either input terminal may be con-  
nected to the chassis, or both may be  
left floating. The maximum allowable  
voltage between either input terminal  
and the chassis is 45 V.

Input power (nominal):

ac: Primary power source; unit will draw  
ac power in preference to dc power

Warm-up:

Standard: 100 W, 140 VA

Option 001: Same as standard unit

Operating:

Standard: 50 W, 70 VA

Option 001: 56W, 78 VA

dc:

Warm-up:

Standard: 85 W

Option 001: 85 W

Operating:

Standard: 45 W

Option 001: 50 W

Standby operation:

Unit requires 20% less power

1. Specifications in this product overview refer to the instrument's warranted performance. Supplemental characteristics are typical or nominal values intended to provide information useful in applying the instrument.
2. See NIST Technical Note 1337, "Characterization of Clocks and Oscillators," available from U.S. Government Printing Office, Washington, D.C. 20402-9325 for more information on time and frequency domain stability. Definitions for all terms may be found in the Agilent 5071A Operating and Programming documentation.
3. Typical flicker floor performance measure is based on long-term measurements made by NIST.
4. Settability: The degree to which the frequency of the 5071A may be adjusted to correspond with a reference.

## Environmental

Production units have passed type testing as follows:

Temperature:

Operating: 0 to 55 °C

Non-operating: -40 to +70 °C

Humidity:

0 to 95% relative humidity (at maximum temperature of 45 °C)

Atmospheric pressure:

<  $1 \times 10^{-13}$  change in frequency for pressure change down to 19 kPa (equivalent to an altitude of about 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

EMI: CISPR 22, Class A; CISPR 11, Group 1,

Class A; MIL-STD-461C, Part 7, Class B

dc magnetic field: up to 7.8 Gauss

## Weight

Net weight: 30 kg

Shipping weight: 40 kg

## Dimensions

### Height

133.4 mm

### Width

425.5 mm

### Depth

523.9 mm

This includes spacers which extend 25.4 mm beyond the rear panel.

## Warranty

### Electronics

1 year

### Cesium beam tube

Standard tube: 10 years

High-performance tube

(Option 001): 3 years

## Accessories furnished

Power cord:

180 cm detachable

dc input connector:

part number 1251-0126

(5 contact), Cannon MS3106E-14S-5S (series ME)

Cabinet front handles kit

## Accessories available

Rack Slides: (see options for other rack mounting hardware)

Fixed slides: order part number 1494-0059

## Application note available

Application note 1289, *The Science of Timekeeping*

## Ordering information

<b>Agilent 5071A primary frequency standard options</b>		\$58,167
<b>001</b>	High-performance cesium beam tube	\$12,932
<b>OB2</b>	One extra set of operating and programming documentation	\$41
<b>OBW</b>	Assembly-level service manual (Contact your local Agilent Sales Office for pricing and availability.)	\$111
<b>908</b>	Rack flange kit Use for mounting the 5071A when front handles are not to be used. Also available under part number 5062-3977. WARNING: Do not mount this product by the rack flanges alone. Always use a shelf, rails, or slides.	\$42
<b>913</b>	Rack flange kit Use with front handles supplied with 5071A. Also available under part number 5062-3983. WARNING: Do not mount this product by the rack flanges alone. Always use a shelf, rails, or slides.	\$42
<b>W30</b>	Warranty Two additional years of “Return to Agilent” service on the electronics (the cesium beam tube is warranted separately). This option adds to the basic electronics warranty to provide a total of three years of coverage.	\$1,653
<b>W50</b>	Warranty Four additional years of “Return to Agilent” service on the electronics (the cesium beam tube is warranted separately). This option adds to the basic electronics warranty to provide a total of five years of coverage.	\$3,306

## Telecommunications options

<b>048</b>	48-Vdc Power	\$528
	<p>This option equips the frequency standard to operate from 48-Vdc nominal power. The range that the frequency standard will accept is 40-58 Vdc. Maximum dc power consumption is 100 W. Two independent 48-volt power sources may be supplied. The power sources must be of the same polarity but either polarity may be used. The instrument automatically uses a 48-Vdc source if one is present. If no dc source is available, the instrument will attempt to use ac power. The internal battery normally supplied with the 5071A is not available when Option 048 is installed.</p> <p>The telecom signal options all contain the following outputs:</p> <ul style="list-style-type: none"><li>• 8 kHz frame sync in (TTL level into 50 <math>\Omega</math>)</li><li>• 8 kHz frame sync out (TTL level into 50 <math>\Omega</math>)</li><li>• Sync out (Telecommunications rate 1.544 or 2.048 Mbps) (TTL level into 50 <math>\Omega</math>)</li><li>• Sync out (1.544 or 2.048 MHz), per G.703-10.</li></ul> <p>In addition, each option has a framed output whose characteristics are determined by the following option numbers. The telecommunications signal options comply with ITU recommendations G703 and G704 for electrical signal characteristics and formatted content.</p>	
<b>104</b>	1.544 Mbps, 100 $\Omega$ balanced, super frame (D4)	\$2,111
<b>105</b>	1.544 Mbps, 100 $\Omega$ balanced, extended super frame (ESF)	\$2,111
<b>220</b>	2.048 Mbps, 120 $\Omega$ balanced, common channel signaling	\$2,111
<b>221</b>	2.048 Mbps, 120 $\Omega$ balanced, channel associated signaling	\$2,111
<b>222</b>	2.048 Mbps, 120 $\Omega$ balanced, channel associated signaling with CRC4	\$2,111
<b>270</b>	2.048 Mbps, 75 $\Omega$ unbalanced, common channel signaling	\$2,111
<b>271</b>	2.048 Mbps, 75 $\Omega$ unbalanced, channel associated signaling	\$2,111
<b>272</b>	2.048 Mbps, 75 $\Omega$ unbalanced, channel associated signaling with CRC4	\$2,111

## Agilent Technologies' Test and Measurement Support, Services, and Assistance

Agilent Technologies aims to maximize the value you receive, while minimizing your risk and problems. We strive to ensure that you get the test and measurement capabilities you paid for and obtain the support you need. Our extensive support resources and services can help you choose the right Agilent products for your applications and apply them successfully. Every instrument and system we sell has a global warranty. Support is available for at least five years beyond the production life of the product. Two concepts underlie Agilent's overall support policy: "Our Promise" and "Your Advantage."

### Our Promise

"Our Promise" means your Agilent test and measurement equipment will meet its advertised performance and functionality. When you are choosing new equipment, we will help you with product information, including realistic performance specifications and practical recommendations from experienced test engineers. When you use Agilent equipment, we can verify that it works properly, help with product operation, and provide basic measurement assistance for the use of specified capabilities, at no extra cost upon request. Many self-help tools are available.

### Your Advantage

"Your Advantage" means that Agilent offers a wide range of additional expert test and measurement services, which you can purchase according to your unique technical and business needs. Solve problems efficiently and gain a competitive edge by contracting with us for calibration, extra-cost upgrades, out-of-warranty repairs, and on-site education and training, as well as design, system integration, project management, and other professional services. Experienced Agilent engineers and technicians worldwide can help you maximize your productivity, optimize the return on investment of your Agilent instruments and systems, and obtain dependable measurement accuracy for the life of those products.

**Get assistance with all your test and measurement needs at:**  
[www.agilent.com/find/assist](http://www.agilent.com/find/assist)

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