
6

Specifications

Introduction

This chapter provides the technical specifications for the 5071A. Specifications describe the instrument's warranted performance. Supplemental characteristics are intended to provide information useful to apply the instrument by giving typical or nominal, but nonwarranted performance parameters.

Chapter Summary

- | | |
|---|-----|
| • Accuracy and Stability | 6-3 |
| • Frequency Stability (5- and 10-MHz outputs) | 6-4 |
| • Sinusoidal Output Characteristics | 6-4 |
| • Supplemental Characteristics | 6-5 |
| • Telecommunications Options | 6-7 |

Specifications

Accuracy and Stability

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 Vibration: 100-mm drop

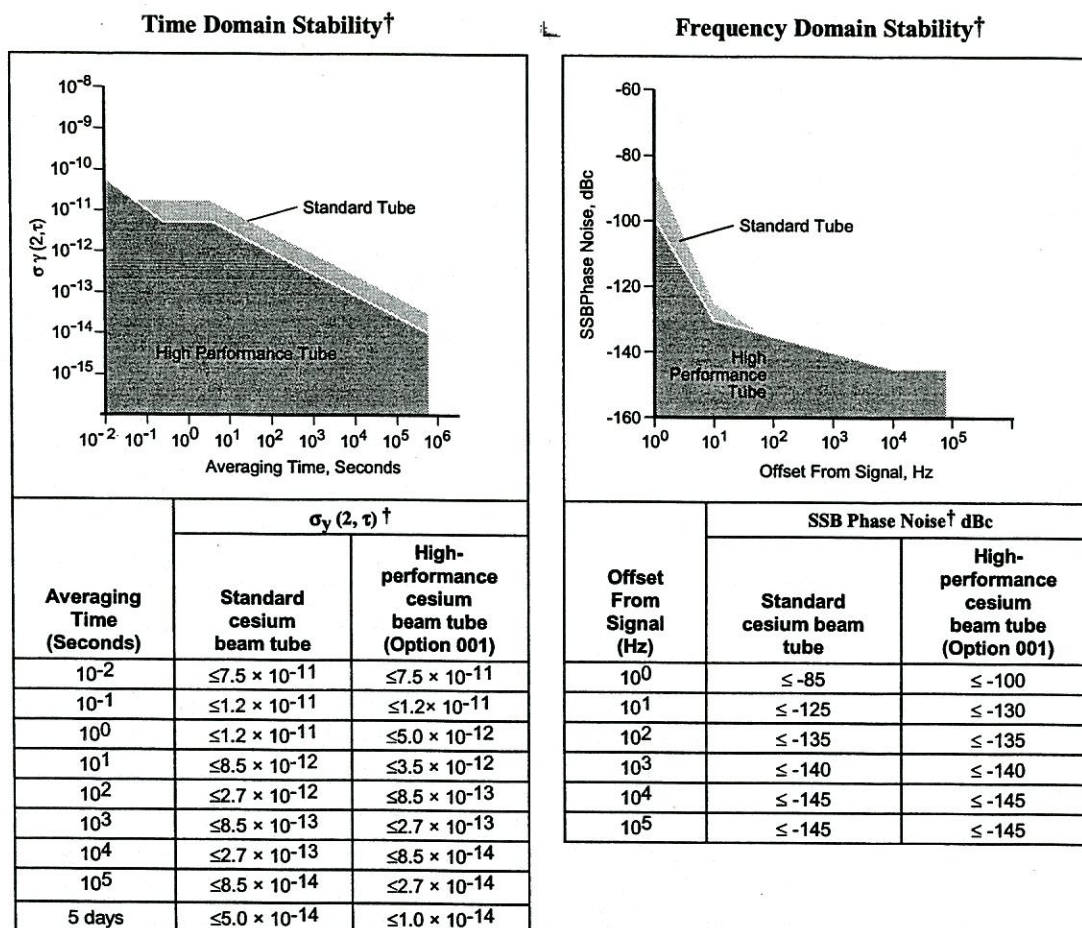
Parameter		Standard Cesium Beam Tube. Values are within:	High-performance Cesium Beam Tube (Option 001).
Accuracy†		$\pm 1 \times 10^{-12}$	$\pm 5 \times 10^{-13}$
Frequency Change vs Environment		$\pm 1 \times 10^{-13}$	$\pm 8 \times 10^{-14}$
Warm-up Time: To normal operation status (typical) To full specifications (typical)		15 minutes 30 minutes	15 minutes 30 minutes
Reproducibility†		$\pm 1.0 \times 10^{-13}$	$\pm 1.0 \times 10^{-13}$
Long-term Stability			
Time domain Stability† 5- and 10-MHz outputs	Averaging Time		
	10 ⁴ seconds	$\leq 2.7 \times 10^{-13}$	$\leq 8.5 \times 10^{-14}$
	10 ⁵ 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†	Guaranteed	$\leq 5.0 \times 10^{-14}$	$\leq 1.0 \times 10^{-14}$
	Typical†	$\leq 1.5 \times 10^{-14}$	$\leq 5.0 \times 10^{-15}$

† Footnotes are defined starting on page 6-7.

Specifications

Frequency Stability (5- and 10-MHz Outputs):

Frequency Stability (5- and 10-MHz Outputs):



Sinusoidal Output Characteristics (all located on rear panel):

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

(1) Each output can be set to either 5 or 10 MHz from the front panel or by remote command.

† Footnotes are defined starting on page 6-7.

Specifications

Supplemental Characteristics †

Supplemental Characteristics †

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: ≥ 2.4 V into 50Ω (output levels are TTL compatible).

Width: $20\ \mu\text{s} \pm 10$ ns

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 independently armed.

Amplitude: $+2$ to $+10$ volts (maximum). Pulse width must be less than 100 μs maximum.

Width: 100 ns minimum,

100 μs maximum.

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†

Resolution: 6.3×10^{-15}

Range: $\pm 1.0 \times 10^{-9}$

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 interrogation 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 operation can be user programmed.

Output: TTL High, Normal

TTL Low, Fault

Circuit is TTL open collector with internal pull-up 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 48).

Damage level: 55 V.

NOTE: Both dc input terminals are floating. Either input terminal may be connected 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: 100W, 140 VA.

Option 001: Same as standard unit.

Operating:

Standard: 50W, 70 VA.

Option 001: 56W, 78 VA.

dc:

Warm-up:

Standard: 85W.

Option 001: 85W

Operating:

Standard: 45W

Option 001: 50 W.

Standby operation:

Unit requires 20% less power.

† Footnotes are defined starting on page 6-7.

Specifications

Supplemental Characteristics † (continued)

Supplemental Characteristics † (continued)

Environmental

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 × 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-461 C, 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*.

5071A Options

001: High Performance Cesium Beam Tube.

5071A Options (continued)

OB2: One Extra Set of Operating and Programming Documentation

OBW: Assembly-level Service Manual (Contact your local Agilent Sales Office for pricing and availability.)

908: Rack Flange Kit. Use for mounting the 5071A when front handles will not 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.

913: 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.

W30: 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.

W50: 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.

† Footnotes are defined starting on page 6-7.

Specifications

Telecommunications Options

Telecommunications Options

048: 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 100W. Two independent 48-Vdc power sources may be supplied. The power sources must be of the same polarity but either polarity may be used. The instrument automatically uses 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.

The telecom signal options all contain the following outputs:

- 8kHz frame sync in (TTL level into 50 Ω)
- 8kHz frame sync out (TTL level into 50 Ω)
- Sync out (Telecommunications rate 1.544 or 2.048 Mbps) (TTL level into 50 Ω)
- Sync out (1.544 or 2.048 MHz), per G.703-10.

In addition, each option has a framed output whose characteristics are determined by the following option numbers. The telecommunications signal outputs comply with ITU recommendations G.703 and G.704 for electrical signal characteristics and formatted content.

- 104:** 1.544 Mbps, 100 Ω balanced, super frame (D4)
- 105:** 1.544 Mbps, 100 Ω balanced, extended super frame (ESF)
- 220:** 2.048 Mbps, 120 Ω balanced, common channel signaling
- 221:** 2.048 Mbps, 120 Ω balanced, channel associated signaling
- 222:** 2.048 Mbps, 120 Ω balanced, channel associated signaling with CRC4
- 270:** 2.048 Mbps, 75 Ω unbalanced, common channel signaling
- 271:** 2.048 Mbps, 75 Ω unbalanced, channel associated signaling
- 272:** 2.048 Mbps, 75 Ω unbalanced, channel associated signaling with CRC4

Footnotes:

Accuracy: The degree to which the 5071A output frequency differs from that of the accepted definition. The currently-accepted definition is that of the 13th General Conference of Weights and Measures and is based on Cesium (The hyperfine resonance of the Cesium 133 atom in zero magnetic field is 9.192631770 GHz.). In practice, this involves comparison with some generally-accepted physical embodiment of this definition such as one of the time standards in the international time scale (TIA) monitored by the BIH (Bureau International L'Heure) in Paris, France. The specified accuracy of the 5071A is intrinsic and is maintained without calibration.

Flicker Floor: The level at which the Allan variance time domain stability measurement remains constant with increased averaging time. The Allan Variance statistical method for measuring time domain stability responds in several ways to various noise processes in a cesium standard. Many of these noise processes produce contributions which average out or decrease as the averaging time increases. Flicker noise, on the other hand, gives rise to an Allan variance independent of averaging time. Thus, the Allan variance of a typical frequency standard will decrease with increasing time, until a relatively constant value is reached. This value is known as the *flicker floor*.

Flicker Floor Value, Typical: Typical flicker floor performance measure is based on long-term measurements made by NIST.

Frequency Domain Stability: (also called single-sideband phase noise or additive noise). Describes the spectral noise in the specified output signal caused by phase modulation from internal noise sources. The measurement is normalized by expressing the ratio of noise power (in a 1-Hz bandwidth) to the signal power, then measured as a function of offset from that signal. For more information see NIST Technical Note 1337, Characterization of Clocks and Oscillators available from the Superintendent of documents, U.S. Government Printing Office, Washington DC 20402-9325.

Specifications

Footnotes

Frequency Settability: The degree to which the frequency of the 5071A may be adjusted to correspond with a reference without loss of stability.

Isolation: The degree to which one output of the 5071A is affected by changes in loading on another output of the same standard. In practice, this represents a change in amplitude, frequency, or phase as seen at one terminal due to the effect of placing a short, open, or reactance on another terminal. In the 5071A, both the Port 1 and Port 2 high isolation output frequencies are derived from the same source; there is no measurable change in frequency. The change in amplitude or phase is measured as the level of the sideband at one port, which results from applying and removing the load at a low frequency rate at the other port. The measurement is the level of the resulting sideband compared to the nominal output level, expressed in decibels.

Reproducibility: The degree to which the 5071A will reproduce the same frequency from one occasion to another after an interruption in operation. This does not include any calibration procedure but may require degaussing.

Supplemental Characteristics: Specifications refer to the instruments' warranted performance. Supplemental characteristics are typical or nominal values intended to provide information useful in applying the instrument.

Time Domain Stability: (also called short-term stability); The standard deviation of fractional frequency fluctuations in the specified output signal due to random noise in the cesium standard. The mathematical method by which it is calculated is called the Root Allan Variance. Symbolically, it is represented by the term $\sigma_y(2, \tau)$ where σ_y is the standard deviation, 2 means that measurements are taken in pairs, and τ is the measurement time.

In the 5071A specifications, values for all averaging times are shown in one chart for convenience. However, short-term stability specifications for averaging times in excess of 1000 seconds are valid only under laboratory conditions (temperature 25 ± 5 °C, relative humidity 45% $\pm 10\%$). For more information on time domain stability, see NIST Technical Note 1337, Characterization of Clocks and Oscillators available from the Superintendent of documents, U.S. Government Printing Office, Washington D.C. 20402-9325.