Report of Calibration

NIST Service ID Number 76100S - Frequency Measurement Service

Time and Frequency Division
National Institute of Standards and Technology
Boulder, CO 80303-3328

Customer: ACME Industries
Calibration Laboratory
77 Main Street
Anytown, USA 12345

Contact: Jane Q. Metrologist

Device Under Test (DUT): Cesium Model XYZ

Description of DUT: Cesium Frequency Standard

Period of Calibration: November 2000

1. Description of Calibration Procedure

The calibrations were performed at the customer's site using a computer-controlled data acquisition system. The calibrations are monitored from the NIST laboratories in Boulder, Colorado through a dedicated telephone line, and NIST personnel compile the data used in this report.

Traceability to NIST is established by using a Global Positioning System (GPS) satellite receiver as a transfer standard. A phase comparison between the customer's frequency standard and the GPS receiver is performed using the time interval method. A daily estimate for frequency offset is obtained by making continuous phase comparisons between the frequency standard and GPS signals over a 24-hour period, and fitting a linear least squares line to the phase data. The correlation coefficient (r) indicates the confidence level of the measurement.

Table 1 lists the daily frequency offset estimates and a status code for each calibration. A status code of 0 is used for a valid calibration. Other status codes are used to identify and explain situations when no data were collected, when measurement errors occurred, or when the DUT was out-of-tolerance. Figure 1 is a graph of the daily frequency offset estimates. Table 2 is a statement of measurement uncertainty.

Measurement uncertainty (k = 2) is reported with respect to the national frequency standard for a 24-hour averaging period. Measurement uncertainty is contributed by the GPS receiver, by DUT aging and frequency drift, and by measurement system noise. The GPS receiver contributes an uncertainty of $\pm 2.5 \times 10^{-13}$. Measurement system noise contributes an uncertainty of $\pm 2 \times 10^{-15}$.

2. General Information

NIST supplies the hardware, software, and calibration method used to perform the calibration. When measurement system components fail, NIST is responsible for replacing them. When possible, this is done using an overnight delivery service.

Since calibrations are made at the customer's site, maintaining an acceptable laboratory environment is the responsibility of the customer. The customer is also responsible for following the installation and operating procedures outlined in the *Operator's Manual* supplied with each measurement system.

Table 1 - Daily Frequency Offset Values, Confidence Levels, and Status Codes

Date	Frequency Offset	Confidence Level (r)	Status Code	Comments
2000-11-01	+4.37E-13	+0.65	0	
2000-11-02	+1.82E-13	+0.67	0	
2000-11-03	+3.29E-13	+0.48	0	
2000-11-04	+4.16E-13	+0.67	0	
2000-11-05	-5.87E-14	-0.35	0	
2000-11-06	+1.70E-13	+0.38	0	
2000-11-07	-1.01E-13	-0.18	0	
2000-11-08	+4.49E-13	+0.70	0	
2000-11-09	+1.06E-13	+0.25	0	
2000-11-10	+4.57E-13	+0.67	0	
2000-11-11	+1.16E-13	+0.33	0	
2000-11-12	+1.48E-13	+1.00	0	
2000-11-13	+6.13E-13	+0.79	0	
2000-11-14	+1.64E-13	+0.44	0	
2000-11-15	+2.32E-13	+0.72	0	
2000-11-16	-1.24E-13	-0.72	0	
2000-11-17	+2.74E-13	+0.95	0	
2000-11-18	+8.68E-14	+0.19	0	
2000-11-19	+1.96E-13	+0.71	0	
2000-11-20	+1.69E-13	+0.37	0	
2000-11-21	+3.17E-13	+0.48	0	
2000-11-22	+2.57E-13	+0.72	0	
2000-11-23	+1.14E-13	+1.00	0	
2000-11-24	+1.15E-13	+0.13	0	
2000-11-25	-2.58E-14	-0.26	0	
2000-11-26	+1.55E-13	+0.43	0	
2000-11-27	+1.90E-13	+1.00	0	
2000-11-28	+2.21E-13	+0.95	0	
2000-11-29	+4.84E-13	+0.74	0	
2000-11-30	-1.08E-14	-0.03	0	

Status Key: 0 - Valid Calibration, 1 - No Data, 2 - GPS Reception Error, 3 - GPS Broadcast Error, 4 - Measurement System Error, 5 - DUT error, 6 - DUT change

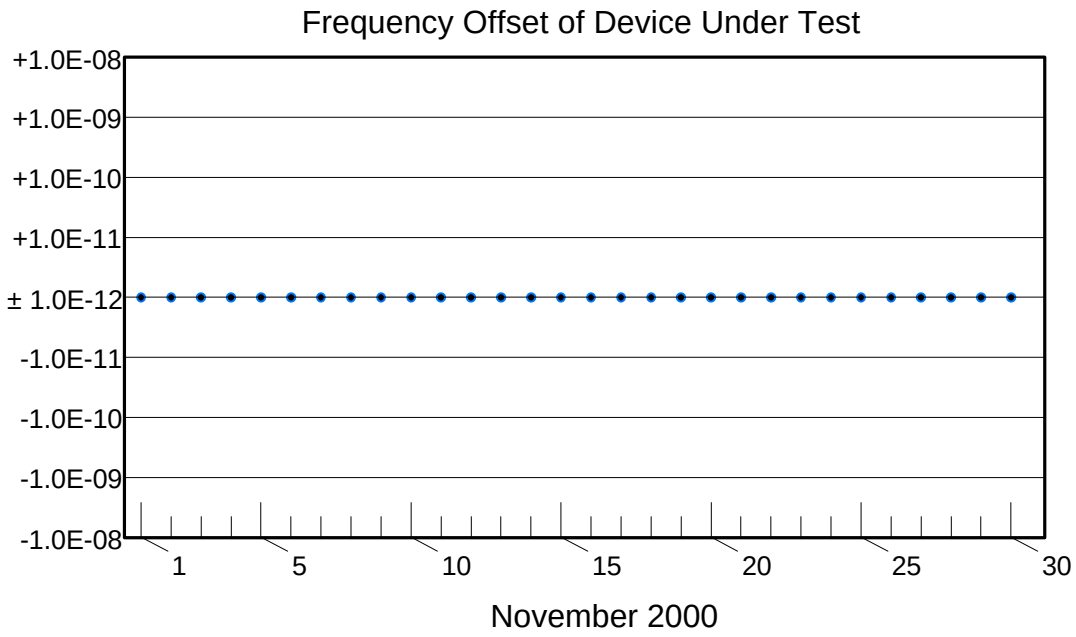

Figure 1 - Graph of Frequency Offset Estimates

Days when data were recorded	30	Uncertainty (U), (k = 2)	+2.49E-13
Days within tolerance (k = 2)	30	FO_{lower} = MFO - U	-4.67E-14
Mean Frequency Offset (MFO)	+2.03E-13	FO_{upper} = MFO + U	+4.52E-13

Table 2 - Uncertainty Statement

This report allows the customer to show traceability to the national frequency standard maintained at NIST. This report shall not be reproduced, except in full, without the written approval of NIST.

Prepared by:

Michael A. Lombardi
Time and Frequency Division
Physics Laboratory
(303) 497-3212

Approved by:

D. Wayne Hanson
For the Director,
National Institute of Standards
and Technology
(303) 497-5233