

In the following pages, you find an excerpt from IBM NIST TAI-1 time transfer receiver reference manual. Besides the introduction, only the chapters relevant to the receiver calibration have been extracted.

NIST TAI-1 Time Transfer Receiver

Reference Manual



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I. Introduction

The NIST TAI-1 Time Transfer Receiver (Figure 1) continuously measures the time standard of a national metrology institute (NMI) and produce files in the Consultative GPS and GLONASS Time Transfer Sub-committee (CGGTTS) data format. When connected to the Internet, the receiver will automatically transfer the CGGTTS files to the Bureau International des Poids et Mesures (BIPM). These files allow the NMI to contribute to International Atomic Time (TAI) and Coordinated Universal Time (UTC).

The TAI-1 receiver was calibrated at the National Institute of Standards and Technology (NIST) in the United States and is easy to install and use. The NMI must mount the supplied GPS antenna and cable, connect a stable 5 or 10 MHz signal to serve as a time interval counter time base, connect a 1 Hz signal from their UTC time scale, and connect the receiver to the Internet.

The remainder of this manual explains how to install and operate the TAI-1 receiver, and how to submit files to the BIPM. If the TAI-1 receiver does not perform as described here, please contact NIST (via email to lombardi@nist.gov) so that updates to the software and/or documentation can be made.



Figure 1. NIST TAI-1 Time Transfer Receiver.

VII. Receiver Specifications

The receiver specifications are listed in Table 5. A technical paper providing more details is appended to this manual and referenced below.

Table 5. NIST TAI-1 Receiver specifications.

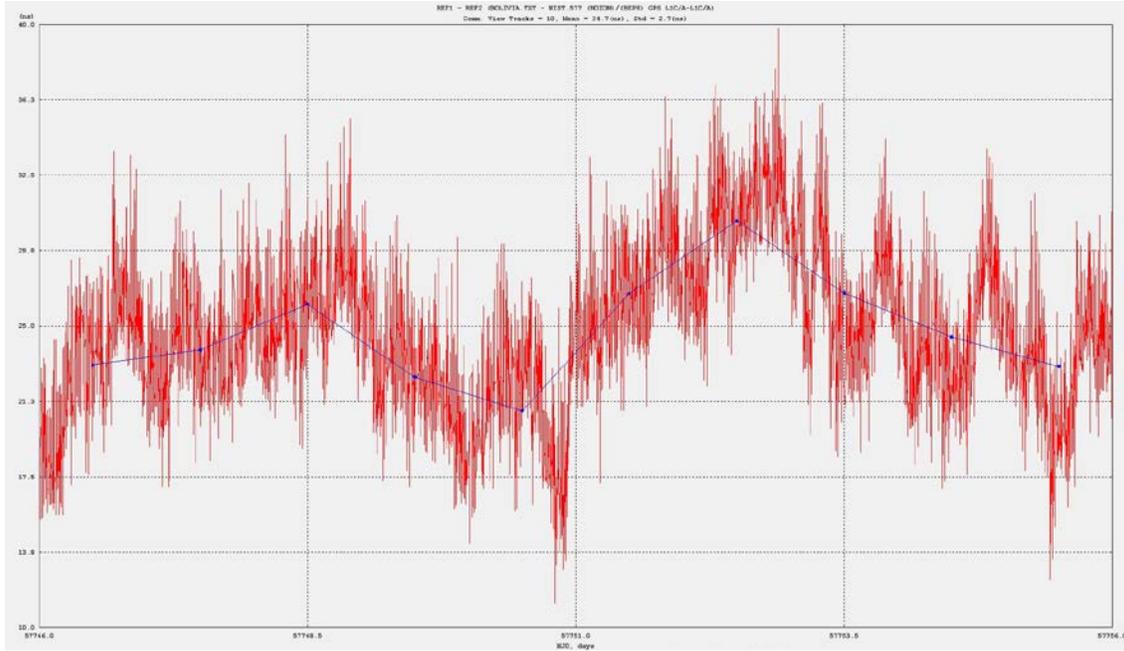
Category	Parameter	Specification
GPS receiver	Receiver frequency	1575.42 MHz (L1 band)
	Number of channels	12
	Receiver board	i-Lotus M12M Timing Oncore
	Receiver interface	RS-232, 9600 baud
	Timing output	1 pulse per second
	Antenna	Novatel GPS-701-GG
	Antenna cable	Times Microwave LMR-400
GPS Software	Control software	NIST TAI-1 software
	File Format	CGGTTS multi-channel GPS
	Tropospheric model	NATO STANAG 4294
	Ionospheric model	Klobuchar
Time Interval Counter	Manufacturer	NIST
	Time base	External, 5 or 10 MHz
	Single shot resolution	< 50 ps
Computer	Microprocessor	Intel Atom, 1800 MHz
	Operating System	Microsoft Windows 7, 32-bit
	Architecture	Single Board computer, passive backplane, ISA and PCI slots
Chassis	Manufacturer	Tri-Map International
	Display size	10.4" LCD
	Display resolution	1024 × 768
	Dimensions	482 mm × 545 mm × 177 mm

Reference

M. Lombardi, A. Novick, and V. Zhang, "A Low-Cost Time Transfer Receiver for Contributions to Coordinated Universal Time," *Journal of Research of the National Institute of Standards and Technology*, vol. 119, pp. 583-601, 2014.

VIII. Receiver Calibration

The TAI-1 receiver was calibrated at NIST over a 10-day interval by comparing it to the NIST reference receiver and by utilizing UTC(NIST) as a common-clock. A graph of the comparison is shown below, and the table below the graph lists the calibration results. As a result of the calibration, the INT delay and CAB delays have been entered into the receiver configuration (see Table 1).



Antenna Cable	Length	45.0 m
	CAB delay	178.5 ns
Day Number	Date (MJD)	Time Difference (ns)
1	2016-12-24 (57746)	23.1
2	2016-12-25 (57747)	23.8
3	2016-12-26 (57748)	26.1
4	2016-12-27 (57749)	22.5
5	2016-12-28 (57750)	20.8
6	2016-12-29 (57751)	26.6
7	2016-12-30 (57752)	30.2
8	2016-12-31 (57753)	26.6
9	2017-01-01 (57754)	24.5
10	2017-01-01 (57755)	23.0
Calibration Results (ns)	INT DLY (average time difference)	24.7
	Standard deviation	2.7