



**NISTIR 8296-01**

# **NIST Time and Frequency Bulletin**

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This publication is available free of charge from:  
<https://doi.org/10.6028/NIST.IR.8296-01>

January 2020



U.S. Department of Commerce  
*Wilbur L. Ross, Jr., Secretary*

National Institute of Standards and Technology  
*Walter Copan, NIST Director and Under Secretary of Commerce for Standards and Technology*







3. BROADCAST OUTAGES OVER FIVE MINUTES AND WWVB PHASE PERTURBATIONS

OUTAGES OF 5 MINUTES OR MORE						PHASE PERTURBATIONS 2 ms			
Station	Nov 2019	MJD	Began UTC	Ended UTC	Freq.	Nov 2019	MJD	Began UTC	End UTC
WWVB	None					None			
WWV	None					None			
WWVH	None					None			

4. NOTES ON NIST TIME SCALES AND PRIMARY STANDARDS

Primary frequency standards developed and operated by NIST are used to provide accuracy (rate) input to the BIPM and to provide the best possible realization of the SI second. NIST-F1 and NIST-F2, cold-atom cesium fountain frequency standards, have served as the U.S. primary standards of time and frequency since 1999. The uncertainty of NIST-F2 is currently about 1 part in  $10^{16}$ .

The AT1 scale is run in real-time by use of data from an ensemble of cesium standards and hydrogen masers. It is a free-running scale whose frequency is maintained as nearly constant as possible by choosing the optimum weight for each clock that contributes to the computation.

UTC is generated at the BIPM by use of a post-processed time-scale algorithm and is not available in real-time. The parameters that we use to generate UTC(NIST) in real-time are therefore based on an extrapolation of UTC from the most recent available data.

UTC(NIST) is generated as an offset from our real-time scale AT1. Time steps are never used. Instead, the frequency is steered so that the time output remains close to UTC. This is accomplished by using data published by the BIPM in its *Circular T* and by weekly estimates of UTC, which are published by the BIPM as *rapid UTC* or *UTCr*. Changes in the frequency may be made as often as once per week and are limited to  $\pm 2.3 \times 10^{-14}$ . The frequency of UTC(NIST) is kept as stable as possible at other times.

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## 5. UTC(NIST) – AT1 PARAMETERS

The table below lists parameters that are used to define UTC(NIST) with respect to our real-time scale AT1. To find the value of UTC(NIST) - AT1 at any time  $T$  (expressed as a Modified Julian Date, including a fraction if needed), the appropriate equation to use is the one for which the desired  $T$  is greater than or equal to the entry in the  $T_0$  column and less than the entry in the last column. The values of  $x_{ls}$ ,  $x$ , and  $y$  for that month are then used in the equation below to find the desired value. The parameters  $x$  and  $y$  represent the offsets in time and frequency, respectively, between UTC(NIST) and AT1; the parameter  $x_{ls}$  is the number of leap seconds applied to both UTC(NIST) and UTC, as specified by the IERS. Leap seconds are not applied to AT1.

$UTC(NIST) - AT1 = x_{ls} + x + y(T - T_0)$					
Month	$x_{ls}$ (s)	$x$ (ns)	$y$ (ns/d)	$T_0$ (MJD)	Valid until 0000 on: (MJD)
Dec 19	-37	-480210.45	-36.50†	58843	58849
Dec 19	-37	-479989.95	-36.75†	58837	58843
Dec 19	-37	-479284.10	-37.15	58818	58837
Nov 19	-37	-478912.60	-37.15†	58808	58818
Nov 19	-37	-478389.70	-37.35†	58794	58808
Nov 19	-37	-478167.40	-37.05*	58788	58794
Oct 19	-37	-477871.00	-37.05	58780	58788*
Oct 19	-37	-477011.95	-37.35	58757	58780†
Sep 19	-37	-475891.45	-37.35	58727	58757
Aug 19	-37	-474995.05	-37.35	58703	58727
Aug 19	-37	-474735.35	-37.10	58696	58703†
Jul 19	-37	-473696.55	-37.10	58668	58696
Jul 19	-37	-473584.35	-37.40	58665	58668†
Jun 19	-37	-473172.95	-37.40	58654	58665
Jun 19	-37	-472949.75	-37.20	58648	58654†
Jun 19	-37	-472469.4	-36.95	58635	58648†
May 19	-37	-471878.2	-36.95	58619	58635
May 19	-37	-471327.7	-36.70	58604	58619†
Apr 19	-37	-471107.5	-36.70	58598	58604
Apr 19	-37	-470592.3	-36.80	58584	58598†
Apr 19	-37	-470222.3	-37.00	58574	58584†
Mar 19	-37	-470074.3	-37.00	58570	58574
Mar 19	-37	-469817.05	-36.75	58563	58570†
Mar 19	-37	-469560.5	-36.65	58556	58563†
Mar 19	-37	-469304.65	-36.55	58549	58556†
Mar 19	-37	-469083.25	-36.90	58543	58549†
Feb 19	-37	-468788.05	-36.90	58535	58543
Feb 19	-37	-468528.35	-37.10	58528	58535†
Feb 19	-37	-468053.85	-36.50	58515	58528†
Jan 19	-37	-468017.35	-36.50	58514	58515
Jan 19	-37	-467244.55	-36.80	58493	58514†

† Rate change in mid-month

\*Provisional value