

# Link calibration of JATC GNSS (GPS) receiver

8 December, 2022

## 1. Description of equipment and operations

Link calibration of one GNSS receiver, JA02, has been performed with respect to JA01, which is previously calibrated within CAL\_ID 1201-2018.

The GPS P3 total delay for JA02 receiver was calibrated. Dates and receivers used for calibration are showed in Table 1. The complete information about the receiver set-up and the signal distribution system can be found in the Annex-A.

Table 1. Summary information of calibration campaign.

Institute	Status of equipment	Dates of measurements	Receiver type	BIPM code	RINEX name
JATC	Reference	59540-59548	PolaRx4TR	JA01	JA01
JATC	To be calibrated	59540-59548	GTR55	JA02	JA02

## 2. Calibration procedure and results

The calibration has been performed based on GPS P3 CGGTTS files. Data from 2021-11-22 to 2021-11-30 (MJD 59540-59548) were used for this link calibration. UTC (JATC) is the signal source for both receivers. Each receiver is connected to a dependent antenna.

Table 2 summarizes the Common Clock Differences (CCD) values for JA02 receiver relative to the reference receiver JA01. Annex A shows plots of raw data.

Table 2 GPS P3 CCD values ( in ns).

Link	MJD	CCD mean values (GPS P3)	Sigma
JA01-JA02	59540-59548	3.1	0.72

## 3. Uncertainty estimation

The uncertainty of total delay values is given by:

$$u_{CAL} = \sqrt{u_a^2 + u_b^2} \quad (1)$$

where  $u_a$  is statistical uncertainty, and  $u_b$  is systematic uncertainty. The  $u_a$  is related to the instability of the common clock data and determined by the Sigma in Table 2. The systematic uncertainty is given by:

$$u_b = \sqrt{\sum_{i=1}^n u_{b,i}^2} \quad (2)$$

Table 3 summarizes the systematic uncertainty for this link calibration campaign.

Table 3. Systematic uncertainty contributions (in ns).

Uncertainty	Value	Description
$u_{b1}$	2.9	Calibration uncertainty of JA01 (in Cirt 407)

#### 4. Calibration results

The final results of the link calibration are summarized in Table 4.

Table 4 Summary of GPS relative calibration results (in ns).

Receiver	CAL_ID	REFDLY	CABDLY	TOTDLY (GPS P3)	SYSDLY (GPS P3)	U <sub>CAL</sub>	Note
JA01	1201-2018	344.2	*	-107.0	237.2	2.9	(1)
JA02	*	194.6	*	3.1	197.7	3.0	

**Note:** (1) Due to the equipment update of UTC (JATC), the REFDLY of JA01 receiver changed from 341.8 ns to 344.2 ns since 2019-02-20 (MJD 58534).

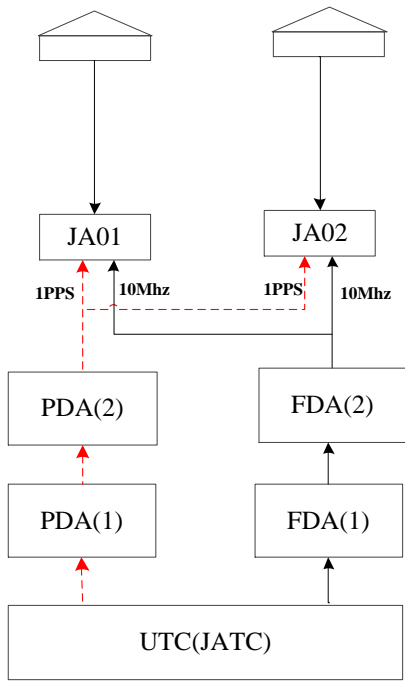
#### Reference

[1] BIPM Circular T 407, 2021.

[2] BIPM. CAL\_ID 1201-2018, GPS calibration of JATC receiver by NTSC.

## ANNEX-A: Calibration information sheet and plots of raw data

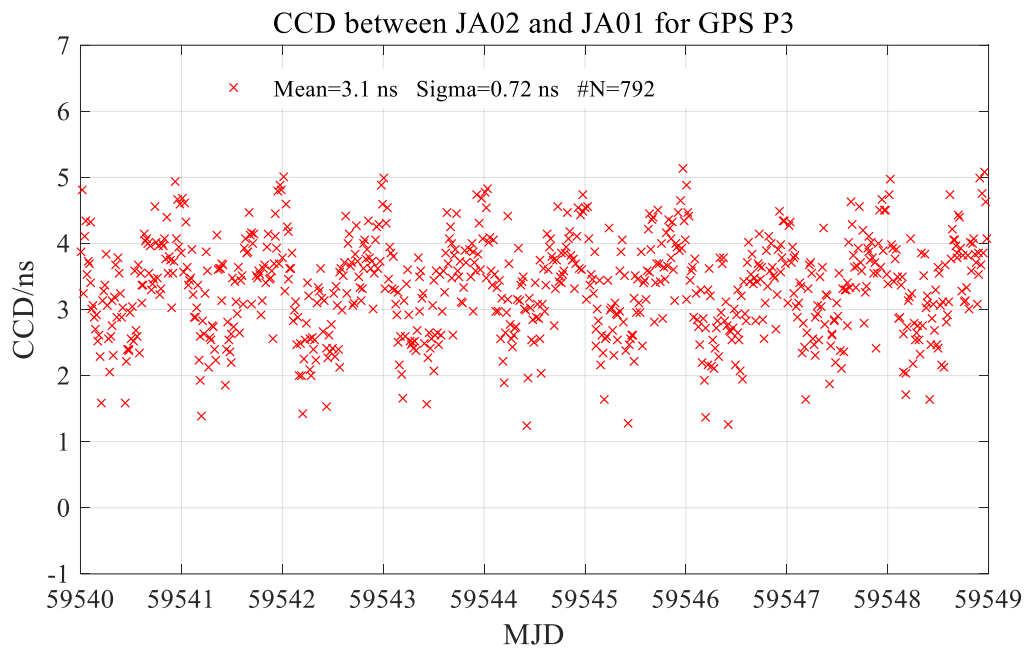
Information on the system		
	Reference:	To be calibrated:
4-character BIPM code	JA01	JA02
• Receiver maker and type:	SEPT POLARX4TR	GTR55
Receiver serial number:	3009580	1906002
1 PPS trigger level /V:	1	1
• Antenna cable maker and type:	-	-
Phase stabilised cable (Y/N):	Y	Y
Length outside the building /m:	About 30m	About 30m
• Antenna maker and type:	SEPCHOKE_MC NONE	NOV850
Antenna serial number:	-	NMLK19180045U
Temperature (if stabilised) /°C	23±0.5°C	23±0.5°C
Data used for the generation of JA02 CGGTTS files		
• Coordinates reference frame:	ITRF 2008	
Latitude or X /m:	-1735235.35	
Longitude or Y /m:	4976845.31	
Height or Z /m:	3580528.21	
General information for JA02		
• Rise time of the local UTC pulse:	3.2ns	
• Is the laboratory air conditioned:	yes	
Set temperature value and uncertainty:	23±0.5°C	
Set humidity value and uncertainty:	55%±3%	



**Receivers's set-up of JATC**

**CCD Plots of raw data**

**JA02**



**Notes: Mean is mean value of CCD. #N is the number of epoch.**