

GNSS calibration of TP and VSL receiver with respect to PTB G1 (1013-2021)

Summary

In May-August 2021, the Physikalisch-Technische Bundesanstalt conducted a trip to calibrate GNSS equipment owned by the Institute of Photonics and Electronics, Czech Academy of Sciences (UTC laboratory TP) and the Van Swinden Laboratory (VSL, The Netherlands). The trip started and finished at the PTB, providing closure with respect to the PTB Group1 reference receiver PT13. The operations and report of measurements are described in the [report by PTB](#).

- **Final results for the calibrated systems**

The INTDLY values of the receivers given in Table 1 have been computed by PTB based on the results of the Group 1 trip [1001-2018](#) for PT13 (GPS and Galileo) and should not be updated to reflect later changes in the conventional INTDLY values of the reference receiver.

For a P3/E3/PPP UTC link A-B involving any Group 1 and any receiver in this trip, the uncertainty resulting from the calibration, $U_B(A-B)$, is computed as

$$U_B(A-B) = (U_{CAL0}^2 + \Delta U_{CAL}(A)^2 + \Delta U_{CAL}(B)^2)^{1/2} \quad (1)$$

where $U_{CAL0} = 2.5$ ns is the conventional Group 2 value, and where ΔU_{CAL} (generally zero) is specified for each system.

Changes in the set-up of the receivers after the calibration must be accounted for as described in section A.3.6 of the most recent Calibration guidelines in <https://webtai.bipm.org/ftp/pub/tai/publication/gnss-calibration/guidelines/>.

Table 1. Final P1/P2/C1/E1/E5a INTDLY values from the 1013-2021 exercise. Values of REF DLY and CAB DLY used to compute calibration results are also indicated for reference. All values are in ns. “Meas. Date” refers to the first day of the differential calibration, to which the calibration results can be applied. “Impl. Date” is the MJD when the results should be implemented in the receiver.

System	BIPM	Meas. date	INTDLY P1	INTDLY P2	INTDLY C1	INTDLY E1	INTDLY E5a	REF DLY	CAB DLY	Note	ΔU_{CAL}	Impl. date
TP01	TP01	2021/06/11	20.1	24.0	21.1	20.7	24.7	0.0	149.8		0.0	59486
TP02	TP02	2021/06/11	19.4	21.3	20.2	20.2	23.4	10.6	137.6		0.0	59486
VSLF	VS06	2021/07/27	53.2	61.7	54.9	54.5	73.1	180.7	124.7		0.0	59486

Notes:

- **Transfer of calibration performed by VSL in 2024**

The INTDLY values given in Table 2 have been computed by the VSL using INTDLY values for the receiver VS06 taken in Table 1. DU_{CAL} is computed from the report by VSL, excluding terms relating to the antenna cable delay measurements.

Table 2. Final P1/P2 INTDLY values for VS07. Values of REF DLY (with respect to the indicated REF) and of CAB DLY during the calibration are also indicated for reference. “Meas. Date” refers to the first day of the

differential calibration, to which the calibration results can be applied. “Impl. Date” is the MJD when the results were implemented in the receiver.

System	BIPM	Meas. date	INTDLY P1	INTDLY P2	INTDLY E1	INTDLY E5a	REF DLY	CAB DLY	Note	ΔU_{CAL}	Impl. date
VSLG	VS07	2024/08/01	21.1	22.5	21.7	21.4	32.3	124.8		0.5	60855

- **Transfer of calibration performed by VSL in 2026**

The INTDLY values given in Table 2 have been computed by the VSL using INTDLY values for the receiver VS07 taken in Table 3. ΔU_{CAL} is computed from the report by VSL, excluding terms relating to the antenna cable delay measurements.

Table 3. Final P1/P2/C1/E1/E5a INTDLY values for VS08. Values of REF DLY (with respect to the indicated REF) and of CAB DLY during the calibration are also indicated for reference. “Meas. Date” refers to the first day of the differential calibration, to which the calibration results can be applied. “Impl. Date” is the MJD when the results were implemented in the receiver.

System	BIPM	Meas. date	INTDLY P1	INTDLY P2	INTDLY E1	INTDLY E5a	REF DLY	CAB DLY	Note	ΔU_{CAL}	Impl. date
VS08	VS08	2026/02/07	22.7	29.9	25.1	35.1	21.2	124.7		0.7	61089

Version history

V1.0 2021/09/09: Publication of results from V1.2b of the PTB report.

V1.1 2026/02/26: Transfers of calibration by VSL