

Initial Group 1 calibration trip (Cal_Id 1001-2014)

Summary

Several visits of the BIPM equipment 'B3TS' to Group 1 laboratories have been carried out between April 2013 and September 2014 to carry out tests of the equipment. These visits were successful and it was decided to consider them as the start of the initial Group 1 calibration trip.

Because the set-up of the B3TS was not constant in all visits, the trip is actually separated in several phases:

- Phase 1 (March-April 2013). BIPM-OP-BIPM with the two traveling receivers BP0T and BP0U;
- Phase 2 (April 2013-September 2014). BIPM-PTB-BIPM-TL-BIPM-NMIJ-NICT-BIPM-NIM-BIPM-ROA-BIPM with the two traveling receivers BP1C and BP0U;

The starting session (at BIPM) for the second phase corresponds to the closing session of the first phase.

- Phase 3 (September 2014-November 2015). BIPM-SU-BIPM with the traveling receiver BP1K;
- Phase 4 (January-June 2015). BIPM-NIST-USNO-BIPM-OP-BIPM-PTB-BIPM with the two traveling receivers BP1C and BP0U.

The full report of the Group 1 trip is split in several sub-reports

All files indexed in this report can be accessed [here](#)

- **Reports of operations and raw data processing (one for each phase)**

- [1001-2014-Phase1-cv.pdf](#)
- [1001-2014-Phase2-cv.pdf](#)
- [1001-2014-Phase3-cv.pdf](#)
- [1001-2014-Phase4-cv.pdf](#)

- **Excel sheet for differential calibration computations**

- [1001-2014-calcul.xls](#)

- **Reports of differential calibration computations (one for each phase)**

- [1001-2014-Phase1-report.pdf](#)
- [1001-2014-Phase2-report.pdf](#)
- [1001-2014-Phase3-report.pdf](#)
- [1001-2014-Phase4-report.pdf](#)

- **Report on selecting reference values to compute final results of this trip**

[TM243_Group1-reference-values_V7.pdf](#)

- **Final results for the visited systems**

Table 1 lists the final values of P1/P2/C1 INTDLY values from the 1001-2014 Group 1 trip, along with information on the REFDLY and CABDLY values used in the processing of the calibration results.

For any link A-B, the uncertainty resulting from the calibration, $U_B(A-B)$, is computed as

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

where U_{CAL0} is the conventional value chosen for the whole calibration trip and where ΔU_{CAL} is generally zero, except for some systems for specific reasons. See the reports of differential calibration computations for all information on U_{CAL0} and ΔU_{CAL} . The values ΔU_{CAL} are indicated in Table 1.

For P3 links, U_{CAL0} is chosen as 1.7 ns (maximum value from the four phases).

For single frequency links, U_{CAL0} is 1.2 ns but should be complemented by a component for systematic errors in the ionospheric model.

Table 1. Final P1/P2 INTDLY values from the 1001-2014 Group 1 trip. Values of REFDLY and CABDLY at the epoch of calibration and the resulting P3 Total delay TOTDLY are also indicated for reference (all values in ns). The values ΔU_{CAL} are to be used in equation (1).

System	BIPM	Date	INTDLY P1	INTDLY P2	INTDLY C1	REFDLY	CABDLY	Note	TOTDLY P3	ΔU_{CAL}
BPOR	BPOR	2014.7	222.6	224.8	225.8	270.3	133.4	(1)	82.3	0.0
PHASE 2										
TWTF	TL1Z	2014.0	305.8	314.1	305.9	52.0	119.8	(2)	360.8	0.4
NC02	NC02	2014.2	219.7	225.9	222.8	429.7	248.5	(3)	28.9	0.0
SEPA		2014.2	217.4	222.3	220.4	406.1	213.4	(3)	17.1	0.0
IMEJ	IM06	2014.4	2.4	4.5	-1.3	0.0	0.0	(3,4)	-0.8	0.0
IMEU	IM03	2014.4	-25.7	-12.7	-23.8	115.5	250.3	(3,5)	89.0	0.0
BJNM	IM05	2014.4	74.0	81.7	75.8	315.3	125.0	(3)	-128.2	0.0
RO_4		2014.7	199.7	204.0	203.0	218.9	217.5	(3)	191.7	0.0
RO_5	RO_5	2014.7	2.2	-0.4	1.7	0.3	0.0	(3,4)	5.9	0.0
ROAP	RO_6	2014.7	54.8	52.0	56.1	218.3	66.7	(3)	-92.5	0.0
RO_7	RO_7	2014.7	55.6	53.4	56.7	171.5	81.9	(3)	-50.6	0.0
NMOC (G2)	NMOC	2014.2	307.7	320.3		32.4	234.1		489.9	0.0
PHASE 3										
SU19	SU19	2015.5	-29.0	-27.5	-27.3	194.5	48.2	(3)	-177.6	0.0
PHASE 4										
NIST	NI00	2015.1	-72.0	-71.9	-72.0	80.0	275.5	(3)	123.3	0.0
NIS3		2015.1	-8.6	-20.7	-8.6	1545.8	298.5	(3)	-1237.2	0.0
NIS4		2015.1	-9.8	-21.4	-9.8	1516.5	298.0	(3)	-1210.4	0.0
USN6	US06	2015.2	-6.5	-9.6	-6.5	0.0	0.0	(6)	-1.7	0.0
USN7	US07	2015.2	-6.1	-9.1	-4.9	0.0	0.0	(6)	-1.5	0.0
OPMT	OP02	2015.4	310.2	321.6	311.0	100.1	156.5	(3)	349.0	0.0
OPM7		2015.4	270.7	273.9	272.1	128.1	0.0	(3)	137.7	
OPM8		2015.4	270.8	274.0	272.2	124.6	0.0	(3)	141.3	
PTBB	PT02	2015.4	303.9	319.3	304.4	74.0	301.7	(3)	507.8	0.0
PTBG	PT03	2015.4	301.0	323.5	301.1	46.4	251.4	(3)	471.2	0.0

Notes:

- (1) BPOR is included in order to provide reference for BIPM-led specific calibrations.
- (2) REFDLY value measured before a change of set-up and not corresponding to the calibration set-up. Results are expressed as INTDLY for consistency with the CGGTTS V2 format but **they should NOT be used as true INTDLY values**: Only the “Total delay” as defined in CGGTTS V2E format (TOTDLY = INTDLY + CABDLY – REFDLY) is a meaningful result.
- (3) REFDLY value corresponding to the calibration setup and measured during the calibration.
- (4) For GTR50, all reported values are corrections with respect to the internal values.
- (5) Javad E-GGD. Details of INTDLY definition to be checked.
- (6) All reported values are corrections with respect to values used by USNO to generate data.

Version history

V1.7 2015/07/10: Final results to be implemented in G1 receivers.

V1.8 2016/01/20: Includes results for SU19, not previously available.

V1.9 2016/07/13: Correct typos and add some documentary info. No change in numerical results.

V2.0 2017/01/06: Adds results for C1 INTDLYs, including link to V7 of the document TM243_Group1-reference-values. No change in P1/P2 results.