

# GPS calibration of INRIM and SP equipment with respect to OP G1 (1013-2016)

## Summary

In February-June 2016, the LNE-SYRTE conducted a trip to calibrate GPS equipment owned by INRIM (UTC laboratory IT) and RISE (UTC laboratory SP). The trip started and finished at the LNE-SYRTE, providing closure with respect to OP Group1 reference receiver OPMT.

The operations and report of measurements are described in the [report by OP](#). Note that, the Group 1 laboratory PTB was also included in the trip. Its results are not reported here but may be found in the report.

In May 2018, the RISE conducted a transfer of calibration from the receiver SP01, part of the original trip, to new receivers. The operations and report of measurements are described in the [report by RISE](#).

- **Final results for the equipment calibrated in the original trip**

The INTDLY values given in Table 1 have been computed by LNE-SYRTE using INTDLY values of OPMT from the Group 1 trip [1001-2016](#), obtained after this calibration trip. The rationale for this choice is discussed in the report by OP. These INTDLY values should not be updated to reflect later changes in the conventional INTDLY values of OPMT.

For a P3/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 at the time of calibration, as given conventionally to Group 2, and where  $\Delta U_{CAL}$  (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 Calibration guidelines v3.2 in <ftp://ftp2.bipm.org/pub/tai/publication/gnss-calibration/guidelines/>.

Table 1. Final P1/P2 INTDLY values from the 1013-2016 trip. Values of REFDLY and CABDLY during the calibration and the resulting P3 Total delay TOTDLY are also indicated for reference (all values in ns).

System	BIPM	Date	INTDLY P1	INTDLY P2	REFDLY	CABDLY	Note	TOTDLY P3	$\Delta U_{CAL}$
SP01	SP01	2016.2	<b>234.1</b>	<b>246.0</b>	0.0	0.0	(1)	215.7	0.0
SP02	SP02	2016.2	<b>235.7</b>	<b>244.6</b>	0.0	0.0	(1)	221.9	0.0
IENG	IT1Z	2016.4	<b>308.6</b>	<b>318.9</b>	384.3	136.6		45.0	0.0
GTRB	IT__	2016.4	<b>-34.8</b>	<b>-20.8</b>	22.8	131.0	(2)	51.8	0.0
GTRI	IT2_	2016.4	<b>-143.7</b>	<b>-131.4</b>	19.4	210.9	(2)	28.8	0.0
INR7		2016.4	<b>229.8</b>	<b>231.1</b>	525.8	0.0	(3)	-298.0	0.0

Notes:

(1) Results for SP01 and SP02 are Total Delay values (TOTDLY = INTDLY + CABDLY-REFDLY).

(2) Results for IT2\_ and IT\_\_ (GTR50 receivers) are full INTDLY values, **NOT** changes with respect to values entered in the receiver. Expressed as changes, the values are (-0.3 ns P1, +0.3 ns P2) for GTRB, (-0.2 ns P1, +0.1 ns P2) for GTRI.

(3) Results for INR7 are System Delay values (SYSDLY = INTDLY + CABDLY).

- **Transfer of calibration performed by SP in May 2018**

The TOTDLY values given in Table 2 for SP01 and SP02 have been updated by RISE to account for set-up changes posterior to the original calibration. The TOTDLY values SP03, SP04, SP05 and RIT1 have been computed by RISE from the SP01 values. See the [report by RISE](#).

The values  $\Delta U_{CAL}$  for use in equation (1) have been computed from uncertainties given in the report by SP.

Table 2. Final P1/P2 TOTDLY values for SP receivers with respect to UTC(SP). “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	TOTDLY P1	TOTDLY P2	REF	Note	$\Delta U_{CAL}$	Impl. date
SP01	SP01		<b>237.4</b>	<b>253.1</b>	UTC(SP)	(1)	1.1	57630
SP02	SP02		<b>237.8</b>	<b>252.0</b>	UTC(SP)	(1)	1.1	57630
SP03	SP03	2017/05/01	<b>270.7</b>	<b>267.4</b>	UTC(SP)	(1)	1.2	58362
SP04	SP04	2017/05/01	<b>350.3</b>	<b>348.1</b>	UTC(SP)	(1)	1.2	58362
SP05	SP05	2017/05/01	<b>203.1</b>	<b>197.8</b>	UTC(SP)	(1)	1.2	58362
RIT1	RIT1	2017/05/01	<b>275.2</b>	<b>271.8</b>	UTC(SP)	(1)	1.2	58362

Notes:

(1) Results for all SP receivers are Total Delay values ( $TOTDLY = INTDLY + CABDLY - REFDLY$ ).

#### Version history

V1.0 2017/03/20: Final results from Issue 1.3 of the OP Calibration report, to be implemented in G2 receivers.

V1.1 2018/08/30: Added the new TOTDLY values for SP01 and SP02 due to set-up changes posterior to the original calibration and the transfer of calibration from SP01 to SP03, SP04, SP05 and RIT1.