

Group 1-2 calibrations for UTC

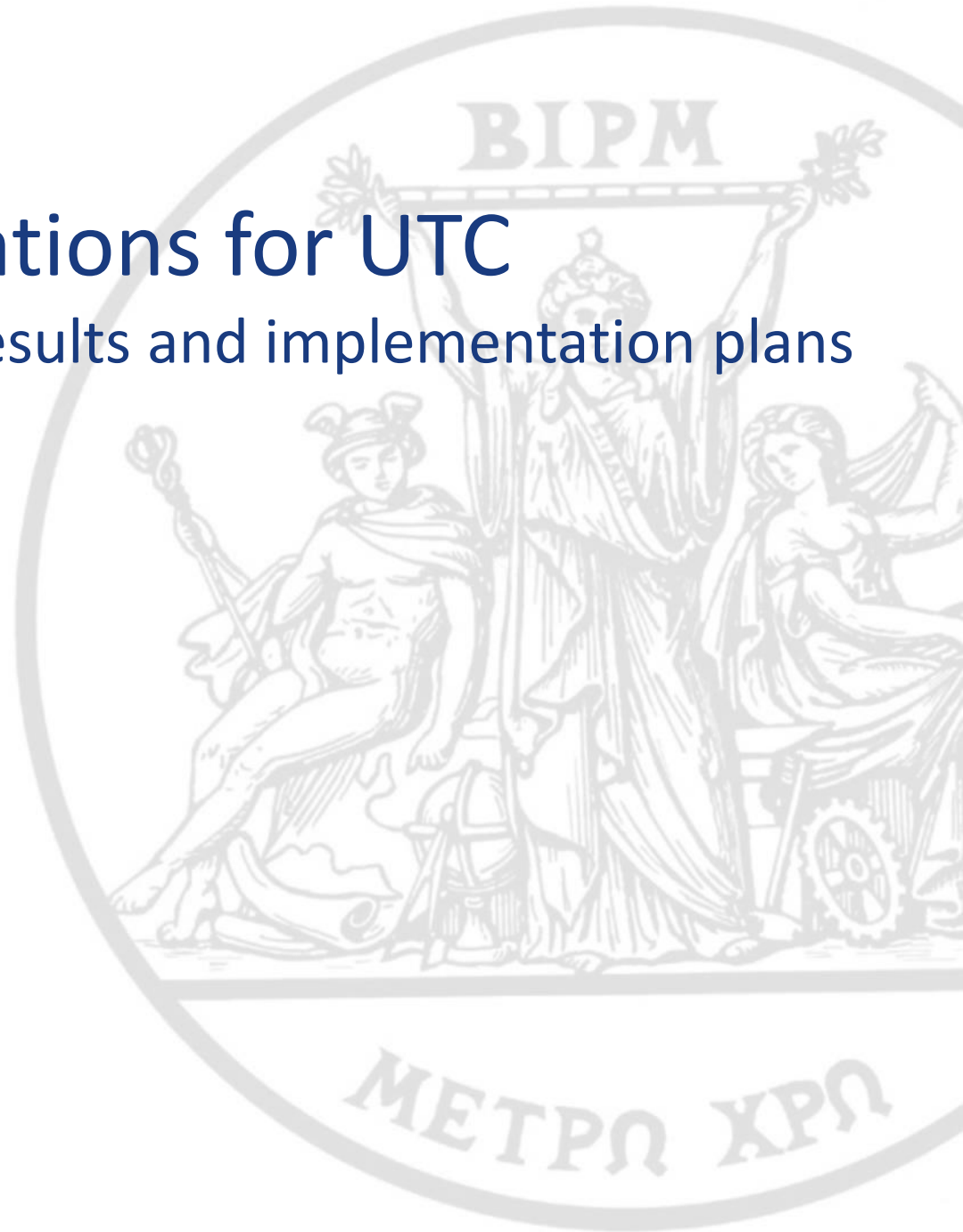
Update on guidelines, results and implementation plans

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BIPM Time Department

GNSS WG Meeting

5 April 2016



Outline

- ◆ Calibration Guidelines: Updates
- ◆ Status of GPS Group 1 and Group 2 calibrations
- ◆ Implementation in BIPM Circular T

BIPM Guidelines for GNSS calibrations

- ◆ « BIPM Guidelines for GNSS calibrations » Update v3.2 in February 2016
- ◆ Covers evolution of a calibrated system between two calibration exercises
 - Change in set-up (affecting only REFDLY)
 - or change in some elements (antenna cable?)
 - or replacement of a full system
 - or ...
- ◆ What should be done?
 - If change affects only REFDLY AND if calibration results are expressed as INTDLY or SYSDLY, just measure and report the new REFDLY value. No change in Calibration Identifier (Cal_Id) nor in u_{CAL} .
 - In all other cases, the laboratory should perform and report a “transfer of calibration”


Transfer of calibration

◆ Transfer of calibration (TC)

- Typically done by simultaneous operation of two systems in common-clock;
 - ◆ Either the new receiver in parallel to the old one
 - ◆ Or using a backup receiver to bridge between the new system/set-up and the old one
- Short report to be transmitted to the BIPM;
- Cal_Id (znnn-YYYY) will be expanded to reflect the TC
 - ◆ Same system as was initially calibrated: New Cal_Id = znnn-YYYY-TC1
 - ◆ New system: New Cal_Id = znnn-YYYY-SSSS-TC1 where SSSS is the originally calibrated system
 - ◆ TC counter can be incremented (TC2, TC3 ...), each time with a report
 - ◆ BIPM will expand u_{CAL} by 1 ns in quadrature.

Calibrations web page

<http://www.bipm.org/jsp/en/TimeCalibrations.jsp>



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BIPM calibrations of time transfer equipment

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→ The BIPM Time Department manages the calibration of time transfer systems used to generate UTC. Calibrations may be carried out by the BIPM, by the RMOs, by individual time laboratories or, in some cases, by other entities such as manufacturers. These pages give access to the calibration results and reports for all techniques contributing to UTC.

Starting 2015, calibrations in laboratories contributing to UTC follow specific guidelines. For more information please click on the Documentation tab above.

Current calibration results (available via the "Current files" tab above) are labelled with a calibration identifier (Cal_ID) to enable the process yielding the results to be traced. The Cal_ID is used to report calibration information in Section 5 of Circular T; an example is given here.

The calibration identifiers are of the form znnn-YYYY where

- z identifies the type of calibration;
- nnn is a number assigned by the BIPM;
- YYYY indicates the year (typically the start of the calibration exercise).

The types of calibration are:

- z = 0: For TWSTFT links, whatever the technique used for the link calibration. nnn then is the calibration identification of the ITU format.
- z = 1: For GNSS systems, with GNSS calibration campaigns under the supervision of the BIPM; nnn then identifies a report corresponding to a calibration trip; see details in the GNSS Guidelines.
- z = 2: For GNSS systems, calibrated with other techniques (e.g. manufacturer calibration, absolute calibration, or transfer using a calibrated link); nnn then identifies a report and is a sequential number within the year.

Calibrations made before 2014 have been included in the current scheme by assigning a Cal_ID when a full report is available. The history of calibrations until 2014 can also be accessed in its original form through the "Archive" tab above.

On line 09/04/2015

Intended to host all reports of UTC calibrations

WARNING: ftp contents have been moved from <ftp://tai.bipm.org/TFG/> to <ftp://ftp2.bipm.org/pub/tai/> on 24/03/2016.

BIPM calibrations of time transfer equipment

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Year	Cal_ID	Type of Calibration	Other info.	Last updated
2014	1001-2014	GPSP3	Initial-Group1-trip	February 17, 2016
2014	0374-2014	TW	Europe-IT	June 2, 2015
2014	0377-2014	TW	Europe-OP	June 2, 2015
2014	0380-2014	TW	Europe-ROA	June 2, 2015
2014	0381-2014	TW	Europe-SP	June 2, 2015
2014	0391-2014	TW	USNO	April 8, 2015
2014	2001-2014	CA	AOS	April 8, 2015
2014	2002-2014	CAP3	SIQ	April 8, 2015
2014	2003-2014	CA	IMBH	April 7, 2015

2014 Cal_ID Type of Calibration Other info. Last updated

Showing 9 entries (filtered from 64 total entries) [First](#) [Previous](#)

Year

- 1993
- 1994
- 1995
- 1996
- 1997
- 1998
- 1999
- 2000
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- 2011
- 2012
- 2013
- 2014
- 2015

Copy area: EM L M PR QM RI T TF U

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- Display completed by « Last updated ».
- Eventually will be accessed through the future database.

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Year	Cal_ID	Type of Calibration	Other info.	Last updated
2013	1101-2013	GPSP3	AOS-GUM	March 10, 2016
2015	1101-2015	GPSP3	ESOC	February 23, 2016
2015	1102-2015	GPSP3	MKES	February 23, 2016
2014	1001-2014	GPSP3	Initial-Group1-trip	February 17, 2016
2015	2001-2015	CA	NMB	January 26, 2016
2011	0214-2011	TW	NEST	January 8, 2016
2015	0295-2015	TW	VSL	January 7, 2016
2015	0392-2015	TW	USNO	January 7, 2016
2012	0284-2012	TW	CH	January 7, 2016
2008	2003-2008	CATW	BEV	January 7, 2016
2014	0374-2014	TW	Europe-IT	June 2, 2015
2014	0377-2014	TW	Europe-OP	June 2, 2015
2014	0380-2014	TW	Europe-ROA	June 2, 2015
2014	0381-2014	TW	Europe-SP	June 2, 2015
2014	0391-2014	TW	USNO	April 8, 2015
2014	2001-2014	CA	AOS	April 8, 2015
2014	2002-2014	CAP3	SIQ	April 8, 2015
2013	2001-2013	CA	MTC	April 8, 2015
2013	2002-2013	CA	SASO	April 8, 2015
2013	2003-2013	CA	UME	April 8, 2015
2012	0281-2012	TW	SU	April 8, 2015
2012	1001-2012	P3	ORB	April 8, 2015
2012	1011-2012	P3	ESTC	April 8, 2015
2012	1012-2012	P3	ESTC	April 8, 2015
2012	1013-2012	P3	NIM	April 8, 2015

Status of G1-2 calibrations

Status of planned and requested GPS calibration exercises

Information in these tables is provided on a best-effort basis and do not imply a commitment of the mentioned institutions or individuals. The tables will be updated as required, please send all updates to tai@bipm.org or gpetit@bipm.org.

The first table provides a summary of the planned calibration exercises and the attributed calibration identifiers.

Cal Id	Umbrella	Responsible	Planned period	Visits	Type	Links to documents	Comments	Notes
1001-2016	BIPM	BIPM/G. Petit	02/2016 onwards	NIM, NICT, TL To be continued in EURAMET G1 labs	GPS-P1/P2 C1	N/A	Group 1 trip	(1)
1011-2016	Euramet	ROA/H. Esteban	Start 02/2016	ROA(G1), BIM, UME, BoM (FYROM), DMDM, IMBiH, INRIM		N/A		(2)
1012-2016	Euramet	PTB/A. Bauch	Start 04/2016	PTB(G1), DLR, BEV, METAS, VSL		N/A		(3)
1013-2016	OP	OP	2016	OP(G1), PTB(G1), ROA(G1), INRIM, SP		N/A	Under Galileo TVF	(4)
1014-2016	NIM	NIM/K. Liang	04/2016	NIM(G1), NTSC				(5)
1015-2016	NIM	NIM/K. Liang	06/2016	NIM(G1), BIRM				(5)


- ◆ Group 1 (2016) started (9 visits total)
- ◆ Group 2: 13 visits planned so far

Implementation for Circular T

- January 2016: New form of Circular T

- $$u_{\text{CAL}}(t) = (u_{\text{CALO}}^2 + u_{\text{AG}}^2 [+ u_{\text{AL}}^2])^{1/2}$$

- Typically u_{CALO} is 1.7 ns for G1, 2.5 ns (default) for G2 trips (closure), 4 ns (default) for “golden system” (no closure).

 5 - Time links used for the computation of TAI, calibrations information and corresponding uncertainties.

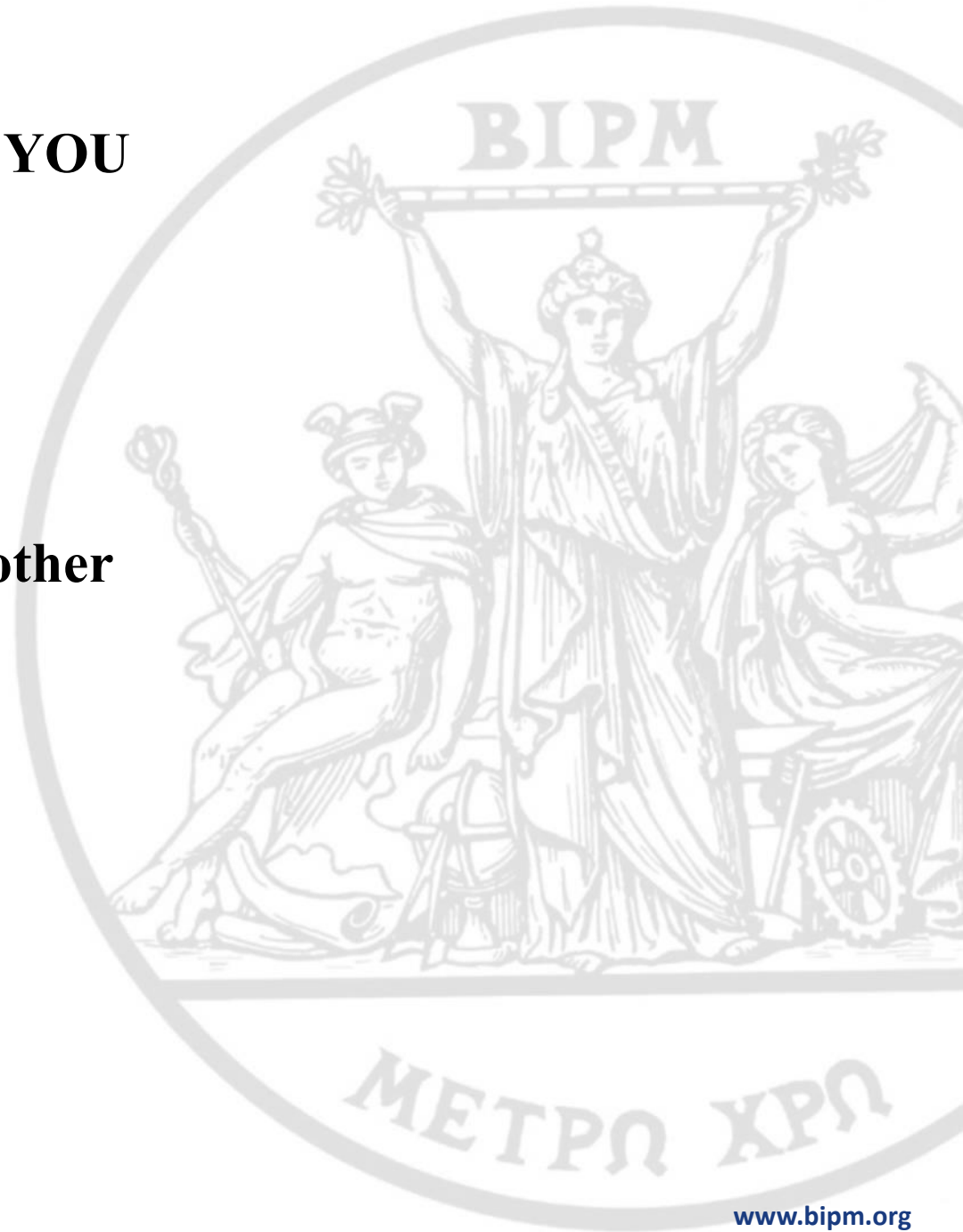
Link	Type	Equipment	Cal_ID1	/ Cal_ID2	$u_{\text{CALO}}/\text{ns}$	u_{CAL}/ns	u_{AG}/ns	AI/ns	YYMM
AOS /PTB	GPSPPP	AO_4 /PT02	1101-2013	/ 1001-2014	0.3	2.7	1		
APL /PTB	GPSPPP	AP__ /PT02	NA_AI	/ 1001-2014	0.3	11.2	10	24.3	1511
AUS /PTB	GPSPPP	AU01 /PT02	1002-2010	/ 1001-2014	0.3	5.4	2		
BEM /PTB	GPS MC	BM37 /PT05	2004-2008	/ 1005-2008	1.5	8.6	5		
BIRM /PTB	GPS MC	BI01 /PT05	NC_AI	/ 1005-2008	1.5	20.0		-30.0	0709
BY /PTB	GPS MC	BY__ /PT05	NA_AI	/ 1005-2008	1.5	8.6	5	53.0	0804
CAO /PTB	GPS MC	CA__ /PT05	NC	/ 1005-2008	8.0	20.0			
CNM /PTB	GPS MC	CN00 /PT05	NA_AI	/ 1005-2008	3.0	11.2	10	-27.3	0804
CNMP /PTB	GPS MC	MP__ /PT05	1002-2004	/ 1005-2008	3.5	11.2	10		
DFNT /PTB	GPS P3	DN__ /PT02	NC_AI	/ 1001-2014	0.7	20.0		10.3	1507
DMDM /PTB	GPSPPP	ZM68 /PT02	NA	/ 1001-2014	0.3	7.3	2		
DTAG /PTB	GPSPPP	DT01 /PT02	NA	/ 1001-2014	0.3	7.6	3		
EIM /PTB	GPS MC	EI__ /PT05	1011-2007	/ 1005-2008	7.5	7.8	6		
ESTC /PTB	GPSPPP	ES03 /PT02	1012-2012	/ 1001-2014	0.3	5.4	2		
HKO /PTB	GPSPPP	HKO2 /PT02	NA_AI	/ 1001-2014	0.3	7.3	2	11.6	1509
IFAG /PTB	GPSPPP	IF13 /PT02	1011-2011	/ 1001-2014	0.3	5.4	2		
IGNA /PTB		NL							
IMBH /PTB	GPSPPP	BH01 /PT02	NA_AI	/ 1001-2014	0.3	7.0	0	31.6	1505
INPL /PTB	GPS P3	IL02 /PT02	NA_AI	/ 1001-2014	0.7	7.7	3	-46.8	1212
INTL /PTB	GPS MC	IN__ /PT05	NC	/ 1005-2008	2.5	20.0			
INXE /PTB	GPSPPP	NXRA /PT02	NC	/ 1001-2014	0.3	20.0			
JV /PTB	GPSPPP	JV__ /PT02	NC_AI	/ 1001-2014	0.3	20.0		130.0	1509
KEBS /PTB	GPS MC	KE__ /PT05	NC	/ 1005-2008	1.5	20.0			
KIM /PTB	GPS MC	KI02 /PT05	NC_AI	/ 1005-2008	2.0	20.0		-30.6	0901
KRIS /PTB	GPSPPP	KRZ1 /PT02	1003-2005	/ 1001-2014	0.3	11.2	10		
KZ /PTB	GPSGLN	KZ01 /PT05	2002-2008	/ 1005-2008	1.5	8.6	5		
LT /PTB	GPS MC	LT01 /PT05	1007-2006	/ 1005-2008	2.0	7.8	6		

Future training course

- The BIPM plans to organize (within 1 year) a training course on calibrations
- Practical issues linked to calibration measurements, laboratory set-up etc...
- More details later

THANK YOU

**Thanks to all Group 1 and other
participating laboratories**



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