

## Procedure for computing the difference of GPS C/A code measurements

This document describes the computation procedure to obtain the differences of the GPS C/A code measurements between two receivers operated in the same site, where the first receiver may be either a geodetic receiver providing Rinex files or a time transfer receiver providing CGGTTS files and the second receiver provides CGGTTS files (the case of two geodetic receivers is treated in Annex 3). The differences are subsequently used to compute the results of the calibration trip (See Annex 4). The main items are highlighted in blue.

In the case of two time transfer receivers, a single command runs a script `dccggtts.sh` that generates the code differences from the CGGTTS files, along with plots that display the code differences and their time stability.

In the case of one geodetic receiver and one time transfer receiver, a single command runs a script `dccggtts.pl` that transforms Rinex to CGGTTS then invokes the script `dccggtts.sh`, providing the same output as described above.

In both cases, a single step provides the values and statistical uncertainties of the code differences. The scripts are described below.

The scripts and programs are available [here](#). They have been tested but bugs may subsist. Please report any problem to Gérard Petit ([gpetit@bipm.org](mailto:gpetit@bipm.org)) and Laurent Tisserand ([ltisserand@bipm.org](mailto:ltisserand@bipm.org)).

### 0. Quick summary

Details on the script and programs can be found in the following sections. For simplicity, the standard operation of a C/A comparison may be summarized as follows:

1. Retrieve the scripts `dccggtts.pl` and `dccggtts.sh`, and the program `dccggtts.f` [here](#). If one receiver provides Rinex, the program `R2CGGTTSXXXX` should also be retrieved.
2. Retrieve input files for the two receivers to be compared. If one receiver provides Rinex, the Rinex navigation files should also be retrieved.
3. For receivers providing CGGTTS files, it is assumed that accurate coordinates of the antenna phase centers have been previously determined and used to generate the CGGTTS files.
4. Case of one geodetic and one time transfer receiver:  
Run the script `dccggtts.pl <sss1> <yydoy> <dur> GPSC1 <GMsss2> EXT`(see details in section 2)
5. Case of two time transfer receivers:  
Run the script `dccggtts.sh <GMsss1> <GMsss2> m <yydoy> <dur> N` (see details in section 2)
6. Extract code differences and uncertainties from `gmss1gmss2yydoy_dur_C1.pdf`, check the file `gmss1gmss2yydoy_dur.sum` (see a description of the files in section 3), and provide both files.

### 1. Basic principles

If one receiver provides Rinex files, these are first transformed to CGGTTS files using `R2CGGTTSXXXX`. Then the FORTRAN program named `dccggtts.f` forms the GPS C1 code differences from the difference in the REFSYS values of the CGGTTS files. The list of differences is provided along with a statistical analysis. The standard set-up is that the two systems have the same reference clock, but an option exists to process two systems with two different references.

### 2. Operation

#### 2.1 Case of one geodetic and one time transfer receiver

Run the script: `dccggtts.pl <sss1> <yydoy> <dur> GPSC1 <GMsss2> EXT [<OPTION>]`

The script needs the following arguments (the first six are mandatory and the last one is optional):

sss1 = The four-character code of station 1 (traveling system), used to name its Rinex files  
yydoy = first day of Rinex files (last two digits of year + day of year number)  
dur = number of consecutive days to process (maximum advised is 9)  
GMsss2= The six-character code forming the name of the CGGTTS files of station 2 (local system)  
OPTION = LZYYYY: Use files LZYYYYmj.day to report system 2 to the same reference as system 1.  
By default (no option), the two systems use the same reference.

The needed input files are, for each day to be processed:

- One Rinex observation file for system 1, with the usual standard name sss1doy0.yyo;
- One Rinex navigation file with broadcast GPS ephemerides, named brdcdoy0.yyn. brdc navigation files are available e.g. at <ftp://cddis.gsfc.nasa.gov/gps/data/daily/>.
- One CGGTTS file for system 2, with the usual standard name GMsss2mj.day;
- If the option LZYYYY is used, one file named LZYYYYmj.day linking the reference of System 2 to that of System 1.

## 2.2 Case of two time transfer receivers

Run the script: `dccgts.sh <GMsss1> <GMsss2> m[OPT] <yydoy> <dur> N`

The script needs six arguments:

GMsss1 = The six-character code forming the name of CGGTTS files of station 1 (traveling system)  
GMsss2= The six-character code forming the name of CGGTTS files of station 2 (local system)  
m[OPT]= Indicates single frequency. The optional sequence reads L1xxxxxx and indicates that files with name xxxxxxmj.day should be used to transfer the reference of station 1 to station 2.  
By default (no option), the two systems use the same reference.  
yydoy = first day of Rinex files (last two digits of year + day of year number)  
dur = number of consecutive days to process (maximum advised is 9)

## 2.3 Output files

Two ASCII output files are created:

`gmsss1gmsss2yydoy_dur.sum` • [Summary with essential information \(see example below\)](#)  
`gmsss1gmsss2yydoy_dur.lis` Long listing of numeric information

One output file with name `gmsss1gmsss2yydoy_dur_C1.pdf` (see example below) which contains plots of the C/A differences and Time deviations.

In addition, temporary ascii files named `c1.tmp`, `medc1.tmp`, `tdevc1.tmp` are created and overwritten at each run.

## 3. Example of run and output files

TO BE COMPLETED

## 4 Use of the results

To compute the calibration results (Annex 4) it is recommended :

- to use the median values (in dark blue in the example .sum file above, and in the plots) for the values of the raw differences;
- to estimate the uncertainties as the top of the flicker plateau in the Tdev, or to use 0.1 ns as default value if the Tdev continuously decreases to lower values.