

## Contents of the data repository for the 2025 update to the CIPM list “Recommended values of standard frequencies”

**Input and output data files** from a MATLAB® implementation of the least-squares algorithm described in [1], in ASCII format. Their contents follow the notation of [1] and [2].

### *Input data file:*

ClockInputData2025\_mod\_basis\_n=153\_TAI\_05092025\_ExpandUncV1\_AdHocCorrV2\_2.dat

|                  |  |   |
|------------------|--|---|
| Line 1           | Contains the number of independently adjusted frequency ratios (14 in the case of the 2025 adjustment, ) |   |
| Lines 2 – 15     | Contain the starting values of these adjusted frequency values, labelled s1 to s14                       |   |
| Line 16          | Contains the number of input frequency ratio measurements (153 in the case of the 2025 adjustment)       |   |
| Lines 17 – 169   | Contain these input frequency ratio measurements:  |   |
|                  | Column 1   | Unique label used to identify the measurement   |
|                  | Column 2   | Identifier for the type of measurement, e.g. nu1 for an absolute frequency measurement of $\nu_1$ , nu_3_over_nu12 for an optical frequency ratio measurement $\nu_3/\nu_{12}$ , using the notation of Table 1 in [2] |
|                  | Column 3   | Value of the measured absolute frequency or frequency ratio   |
|                  | Column 4   | Uncertainty of the measured absolute frequency or frequency ratio   |
|                  | Column 5   | Reference in which the measurement result was reported (full details provided in separate file <a href="#">Reference_list_for_input_data_2025.pdf</a> ).  |
| Line 170         | Contains the number of correlation coefficients included (1168 in the case of the 2025 adjustment)       |   |
| Lines 171 – 1338 | Contain the correlation coefficients   |   |
|                  | Column 1   | Label specifying the correlation coefficient concerned, using the unique measurement labels   |
|                  | Column 2   | Value of the correlation coefficient  |

**Output data files:**

(i) ClockOutputData2025\_mod\_basis\_n=153\_TAI\_05092025\_ExpandUncV1\_AdHocCorrV2\_2 (1).dat

(ii) ClockOutputCovData2025\_mod\_basis\_n=153\_TAI\_05092025\_ExpandUncV1\_AdHocCorrV2\_2.dat

|             |  |   |
|-------------|--|---|
| File (i)    |  |   |
| Line 1 – 2  | Contain information about the software used to generate the output file, the date and time at which the analysis was carried out and by whom                                 |   |
| Remainder   | Structured with labels to aid human readability, into the following sections:  |   |
|             | The input data used  | As in the input data file   |
|             | The output data  | Number of iterations required in the least-squares adjustment for the solution to converge            |
|             |  | Final values of the adjusted frequency ratios   |
|             |  | Final values of all other possible frequency ratios   |
|             |  | Final values of absolute frequencies  |
|             |  | Normalised residuals for the input data, explicitly identifying > 1 sigma outliers                    |
|             |  | The Birge ratio for the adjustment  |
|             |  | The data and time that the data analysis was completed  |
| File (ii)   |  |   |
| Lines 1 – 4 | Contain information about the software used to generate the output file, the date and time at which the analysis was carried out and by whom, and the name of the input file |   |
| Remainder   | Structured with labels to aid human readability, into the following sections:  |   |
|             | Covariance matrix  | Output covariance matrix from the adjustment, given in the basis set $v_1/v_{15} \dots v_{14}/v_{15}$ |
|             | Matrix of correlation coefficients   | Correlation coefficients between the values of the absolute frequencies                               |

## Explanatory files

### [\*Notes\\_on\\_analysis\\_procedure\\_2025.pdf\*](#)

A short description of the analysis procedure used in the 2025 update to the recommended frequency values.

### [\*Guidelines\\_correlations\\_TAI.pdf\*](#)

Method used to compute correlation coefficients arising through the use of the same primary or secondary frequency standards to access the SI second, taking into account the increased number and weight of optical frequency standards contributing to TAI since the 2021 update.

### [\*ROCIT\\_guidelines\\_on\\_correlations.pdf\*](#)

Guidelines on the evaluation and reporting of correlation coefficients between frequency ratio measurements, including a recommended reporting template and worked examples. Produced as part of the EMPIR-funded ROCIT project.

## References to published input data

### [\*Reference\\_list\\_for\\_input\\_data\\_2025.pdf\*](#)

A full list of references for the input data used in the 2025 update to the recommended frequency values.

## References

- [1] H. S. Margolis and P. Gill, Least-squares analysis of clock frequency comparison data to deduce optimized frequency and frequency ratio values, *Metrologia* 52, 628 – 634 (2015).
- [2] H. S. Margolis, G. Panfilo, G. Petit, C. Oates, T. Ido and S. Bize, The CIPM list ‘Recommended values of standard frequencies’: 2021 update, *Metrologia* 61, 035005 (2024).