

# VLBA Calibration Transfer with External Telescopes

Version 1.0

VLBA Operations Memo No. 34

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Users with VLBA-only data sets can ignore this  
memo and go straight to the AIPS cookbook!!!

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## Abstract

This memo defines the procedures and options for calibrating data sets from the VLBA correlator in the era when calibration data are automatically transferred for VLBA telescopes. It is kept up to date as the calibration-transfer process evolves into its second phase.

## 1 Revision History

- Version 1.0 by Jim Ulvestad, 31 March 1999

## 2 Introduction

Starting soon after April 1, 1999, the VLBA correlator automatically appends calibration data to the end of its FITS output files, as announced in the NRAO newsletter of April 1, 1999. These data are appended as tables of various sorts, which appear automatically as part of the data set loaded by FITLD, and can then be applied directly in the calibration process. Currently, the calibration data are available with the FITS files only for telescopes supplying VLBA-style monitor data. Full sets of tables are available for the 10 VLBA telescopes and (almost) for Effelsberg (EB). Partial information is supplied for VLA (Y) and Green Bank (GB). Data from other telescopes, which do not supply VLBA monitor data, will be added as part of the second phase of implementation of calibration transfer.

Below, we summarize the procedures to be followed for various sets of telescopes, in order to make sure not to accidentally over-write or delete useful information. Further details and specific sets of inputs for AIPS tasks can be found in the latest version of the AIPS cookbook chapter on VLBI, at <http://www.cv.nrao.edu/aips/aipsdoc.html>. **Note that the 15APR99 version of AIPS, or the patched 15OCT98 version, is needed to make use of calibration transfer.**

### 3 Procedures for VLBA Stand-alone Observations

After running FITLD, the user will have version 1 of five tables supplied by calibration transfer for each VLBA telescope. Those tables are

- GC table: telescope gains
- TY table: measured system temperatures
- FG table: flag information
- PC table: pulse-calibration amplitudes and phases
- WX table: weather information

The observer will probably have to use the standard run file called MERGECAL in order to remove duplicate table entries. Previous steps that are now eliminated include

- running VLOG using the input file *name\_cal.vlba*
- manual construction of ANTAB input file using VLOG outputs and the file *vlba\_gains.key*
- running UVFLG using an input file
- running ANTAB using an input file
- running PCCOR using an input file (note that many observers use manual pulse-calibration instead)

Creation of solution (SN) tables can now proceed as described in the cookbook.

### 4 Procedures for VLBA with EB, Y, and/or GB

Table 1 summarizes which ancillary tables contain data for EB, Y, and GB. The subsections that follow explain how to cope with the mixture of tables.

Table 1. Tables with Data from EB, GB, and Y					
	GC	TY	FG	PC	WX
EB	YES	PRELIMINARY	YES	QUESTIONABLE	YES
GB	YES	INCORRECT	PARTIAL	YES	NO
Y	NO	NO	PARTIAL	INCORRECT	NO

#### 4.1 Observations with EB

The user should start by running MERGECAL to eliminate any duplicate table entries. The calibration transfer files currently include correct GC, FG, and WX tables for EB. Preliminary entries in the TY table also are supplied; these values should be final at 6 cm, and may be subject to very slight revision at other wavelengths. Any revisions will be available from EB (at <http://www.mpifr-bonn.mpg.de/EVN/>) a few weeks after the observation. Revised entries can be added by running ANTAB with an input file generated by the user from the later EB data. The ANTAB run can put the TY information into the same table version where all the VLBA telescope system temperatures reside (see cookbook for details); it *will not* over-write or corrupt the VLBA values. All application of these tables can then proceed as for the VLBA-only case.

The PC table includes amplitude and phase information for EB for most frequencies, but these data may be flawed in the current incarnation. Observers should be wary of doing manual pulse-calibration for EB in multi-band observations, since the system is not designed to return to the same phase after a receiver switch.

#### 4.2 Observations with GB

The PC table includes correct entries for GB, since pulse-calibration tones are extracted at the station, so GB can be treated like a VLBA telescope for pulse-calibration purposes. The FG table is correct, but incomplete. It includes only the “back-end” information from the VLBI equipment at GB, with no information about the front end of the telescope (e.g., antenna off source). The WX table contains no information for GB.

The GC table contains the maximum gains for Green Bank at 1.3, 4, 6, 13, and 18–21 cm. These gains are accurate within a few percent for all hour angles at wavelengths of 6 cm and shorter, but are overestimates of the gain at high hour angles at the shortest wavelengths. Spherical harmonic solutions for the gain curves as a function of declination and hour angle have not yet been implemented as part of calibration transfer.

Currently, the TY table contains incorrect data from GB. Correct system temperatures will be e-mailed to the PI from Green Bank. The user should then create an ANTAB input file for GB in the usual, old-fashioned way, and read it in to the same TY (and possibly GC) table (adverbs TYVER and GCVER) that were output by MERGECAL. This will create new information for GB, or will delete and replace incorrect information, without

corrupting or destroying the entries for any other telescopes. Amplitude calibration can then proceed as usual using APCAL.

### 4.3 Observations with Y

The PC table in this case includes incorrect phases and amplitudes for Y (there are no pulse-calibration tones injected at the VLA), and the recommended procedure is to use manual pulse calibration for Y. The FG table is correct, but incomplete, in the same way as for GB.

The TY and GC tables include no information for Y. These data must be supplied in the old way, by specifying the flux density of a source, editing input file *namecal.y* supplied by NRAO, and then running ANTAB. Note again that it is permissible to specify output tables in ANTAB (GCV<sub>ER</sub> and TY<sub>VER</sub>) that are the same as the tables output by MERGECAL. The Y data will be appended with the appropriate antenna number, and will not over-write or corrupt the data for the other antennas. Further amplitude calibration can proceed as usual, using APCAL.

### 4.4 Observations using Combinations of EB, GB, and Y

Observations using more than one of EB, GB, and Y can be processed by carefully combining the recommendations made above.

## 5 Procedures for Other External Telescopes

No information from other external telescopes is present in the ancillary tables provided as part of the correlator output files. Amplitude calibration is straightforward. After construction of an appropriate input file, ANTAB should be run to generate entries for these external telescopes in the same GC and TY tables that were created by MERGECAL for the VLBA antennas. Normal calibration can then proceed using APCAL. Pulse calibration must be done manually for (*at least*) the external telescopes. Flag entries must be made manually using UVFLG (care should be taken to get these entries into a version of the FG table that includes the on-line VLBA information).

## 6 Summary

The above descriptions are intended to help the user with all conceivable combinations of antennas, and probably look more complicated than they are. Of course, the nervous observer can always ignore or delete the provided tables and do everything the old-fashioned way; that option is recommended only for observers who enjoy boring, repetitive tasks.

## 7 Acknowledgments

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