Instructions to use K-4 VLBI system with FS9 software

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1 Introduction

The K-4 VLBI data acquisition system has been developed by Communications Research Laboratory and are currently used at several VLBI stations. The system can be used for various modes of geodetic and astronomical VLBI observations. Recently, NASA Field System software has been implemented to be able to control the K-4 system. In this document, characteristics and specifications of the K-4 VLBI system are briefly described and instructions to use Field System to control the K-4 VLBI system are presented.

2 K-4 VLBI System

The K-4 VLBI data acquisition system at an observation station consists of the units listed below. In addition to these units, there are output interface units and correlator systems necessary at the time of correlation processing, but these systems are not supported by the Field System software and will not be described here.

- Local Oscillator ... 7632A, 7624
- Video Converter ... 7631A, 7623
- Input Interface ... DFC1100, DFC2100
- Data Recorder ... DIR1000, DIR1000L, DIR1000M
- Tape Changer (Optional) ... DMS24

The local oscillator unit generates phase locked local frequency signals based on a reference 10MHz (or 5MHz) signal. These signals are provided to the video converter unit where the IF signal is down-converted to video band signals by using image rejection mixers and low-pass filters. The model 7632A is capable to generate 16 local frequency signals from 99.9 MHz through 519.99 MHz, whereas the model 7624 is capable to generate 8 local frequency signals from 499.99 MHz through 999.99 MHz. The model 7631A video converter can convert 16 video channels and is used with the 7632A local oscillator unit. The model 7623 video converter can convert 8 video channels and is used with the 7624 local oscillator unit. In this case, two sets of each unit are used to configure 16 observation channels for usual geodetic VLBI experiments. Both video converter units have multiple low pass filters and the selectable bandwidths depend on the actual configuration of the unit.

Input interface unit digitizes the video band signals and record these signals by controlling the data recorder unit. DFC1100 has a single observation mode of 1 bit sampling - 16 channel - 4 Mbps (64 Mbps total). All three models of the data recorder unit can be used with the DFC1100 input interface unit. On the other hand, DFC2100 can be used with multiple observation modes. Among of these modes, only three observation modes, i.e. 1) 1bit-16ch.-4Mbps, 2) 1bit-16ch.-8Mbps, and 3) 1bit-16ch.-16Mbps, are currently supported by correlators at Koganei (CRL) and Tsukuba (GSI) correlators, and are supported by FS9 software. The difference of the three models of data recorder unit is the maximum speed of the data recording. The maximum recording speed of model DIR1000 is 256 Mbps and all three observation modes are possible. On the other hand, the maximum recording speeds of DIR1000L and DIR1000M are 128 Mbps and 64 Mbps, respectively.

Tape changer unit can change 24 ID1 cassette tapes for un-attended continuous observations. The current version of the FS9 software does not support the unit yet. The implementation is under progress.

3 Setup

First, the `/usr2/control/equip.ctl` file should be edited to reflect the actual configuration of the data acquisition equipments. The type of rack should be set as either k41 if the combination of model 7632A and 7631A is used, or k42 if the combination of model 7624 and 7623 is used. The type of recorder should be set as either k41 if the DFC1100 is used, or k42 if the DFC2100 is used.

Next, data and control cables should be connected. The input interface unit and the data recorder unit is connected with one data cable (VCD cable: blue) and one control cable (RS-422 cable: black). The data cable should be connected to the `DATA OUT` connector of the input interface unit and to the `DATA INPUT` connector of the data recorder unit. The control cable should be connected to the `TO DR` connector of the input interface unit and to the `REMOTE 4` connector of the data recorder unit. All the K-4 VLBI equipments are controlled via GP-IB data communication bus from the FS9 host computer except for the data recorder unit is actually controlled by the input interface unit via RS-422 but all the communications from the FS9 host related with the data recorder are done with the input interface unit. Each unit has a switch to set the GP-IB address. After setting a unique address to each unit, all the units should be connected to the FS9 host computer by GP-IB cables. Total length of the GP-IB cable should be kept as short as possible to prevent possible communication troubles (GP-IB specification allows up to 20 meters in total). Then edit the `/usr2/control/ibad.ctl` file and specify the configured GP-IB addresses. A sample file is shown below.

```
tc=dev02,4
d4=dev04,4
v4=dev05,4
l4=dev06,4
ca=dev07,0
```

In this example, the tape changer (`tc`) is set to the address 2 and the input interface (`d4`) is set to the address 4, etc. If the k41 rack is selected (i.e. model 7632A local oscillator unit and model 7631A video converter unit), `'v4'` and `'l4'` are used to specify the GP-IB addresses of the video converter and the local oscillator unit, respectively. If the k42 rack is selected (i.e. model 7624 local oscillator unit and model 7623 video converter unit), `'va'` and `'vb'` are used

to specify two GP-IB addresses of the two video converter units, and, `'la'` and `'lb'` are used to specify two GP-IB addresses of the two local oscillator units.

Lastly, the file `/usr2/control/dev.ctl` should be edited to reflect which GP-IB devices are used at the FS9 host computer. Use `'board'` for the GP-IB board device name if a NI GP-IB communication board is used, and use `'/dev/ttyXX'` if a GPIB-RS232C converter box is used where XX depends on the actual configuration of the RS232C port (S1 for com1 port for example).

4 Regular Operations

Once all the equipments are connected and all the control files are properly edited, run FS9 software and issue a command `rec=init` from the FS9 console terminal. If the configurations were correct, the time code on the front panel of the input interface unit turns to all-zero for about a second and then returns to the normal state. This command initialize the unit and is often required after the system configurations were modified. Then execute `tape` command to check the data recorder unit, `vc` and `vclo` commands to check the K41 type rack, and `va vb vcla vclb` commands to check the K42 type rack. If the configurations were correct, responses will be shown in the log window.

If these commands did not work properly, be sure to update the FS9 software to newer versions. The curreently available official version does not support the K4 devices as of this time, and the actual version which is required to use the K4 VLBI system will be announced in the near future. At the time of observations, a procedure file and a snap command file have to be prepared by using DRDUG software later than the version NRV980302.

The K-4 VLBI system and other VLBI systems can be connected to the FS9 host computer simultaneously. Which system is actually used can be switched by editing the `equip.ctl` file. If one of the control files are modeified, `fs` program must be restarted to make these changes effective.

5 Related Documents

Following is a list of related documentations. If you do not have these documents, please request these documents to `koyama@crl.go.jp` or to `weh@vega.gsfc.nasa.gov`.

- Journal of the Communications Research Laboratory, vol. 38 (1991), *'special issue on the results of VLBI experiments at the Communications Research Laboratory (1984-1990)'*
- IERS TDC News, *issued biannually by Communications Research Laboratory*
- Proceedings of the Technical Workshop for APT and APSG, Kashima, December 1996
- VLBI Software Documentation, Field System, *NASA/Goddard Space Flight Center, Space Geodesy Program*