# VLBI Session Pre-Checks
# For VGOS Systems

1. **Walking into your VGOS/VLBI site**

   a. What do you see, hear, or smell?

2. **Experiment SNAP and procedure files**

   a. Run fesh <schedulename> -d

   b. This will get and create the .snp and .prc files for your session

   c. **Legacy:**

      i. Run DRUDG on the session (.skd or .drg) file to create the SNAP and procedure file. Print hardcopies of the schedule and session notes.

      ii. Edit the session procedure file to insert station-specific parameters such as IF distributor attenuator settings.

      iii. Be sure to create a new procedure file for each session from the .skd or .drg file. Do *not* rely on default set-up procedures in the station procedure file in case system set-up parameters have changed such as the frequency sequence.

3. **Computer control**

   a. Check that the FS is controlling the VLBI terminal and antenna. Some stations have multiple operational control systems.

4. **Station timing**

   a. All station clocks should be identified and confirmed synced within spec prior to any VLBI session.

   b. PCFS CPU (2 weeks)

   c. PCFS (correct second)

   d. ACU (Antenna) (Correct second)

   e. GPS ( Offset from station equipment <50 us)

   f. R2DBE (4) (correct second)

g.  R2DBE epoch (4) (time from last sync?)

h.  Mark6 (correct second)

i.  NTP

j.  GPS 1 PPS Offset

    i.  Using a counter with time interval measurement accuracy <100 ns, measure the time interval between the 1pps signals from

    ii.  R2DBE and GPS receiver

    iii.  Maser and GPS receiver.

k.  This offset should be within a few microseconds of each other. This number should be monitored as it could be the first indication of a system failure.

## 5. Feed polarization

a.  Some stations may have multiple receivers and configurations. Before each session you should make sure that the feed polarization is correct.

    i.  For geodetic S/X observations, the correct polarization is RCP.

    ii.  For VGOS use linear X (H) and Y (V).

## 6. Receiver

a.  Confirm Your receiver choice is VGOS and all cable patching is correct

b.  Check that the physical temperatures of the 20 K and 70 K stations in the Dewar are within their normal ranges and are not rising.

c.  Check that other receiver parameters that are monitored are within their normal ranges.

## 7. RF distributor

a.  Confirm output cables are connected to the correct UDC inputs

## 8. Antenna focus

a.  Some antenna sites have moveable feed positions.

    i.  For geodetic and astrometric observations, lock the focus at the position that gives peak response at mid-elevations.

## 9. Antenna pointing

    a. Check antenna pointing on two or more widely-separated sources.

    b. Pointing errors in both axes should be smaller than beamwidth/10 at the highest observation frequency.

    c. The FS command 'fivept' is normally used to automate the measurement.

## 10. System Equivalent Flux Density (SEFD)

    a. The FS command 'onoff' is used to automate the measurement. It measures the SEFD in each frequency band and polarization and the station compares against the nominal historic value.

    b. ONOFF should be run after you open the log file for the session you are about to start

        i. Using a strong radio source of known flux density, measure $T_{source}/T_{sys}$.

        ii. Convert to SEFD by dividing $T_{source}/T_{sys}$ into the source flux density (corrected for size effect if the source angular extent is comparable to, or larger than, the antenna beamwidth).

        iii. .

    c. TCAL "Temp of the noise diode in degrees Kelvin" is generated in the ONOFF procedure. This data should be in the session log file. Further information in the "Ampcal Presentation"

## 11. System temperatures

    a. With the antenna pointed near zenith (clear sky), measure the system temperatures in all broadband channels, and compare against nominal values.

## 12. Phase calibration signal

    a. Confirm your PCAL levels are correct on your PCFS monitor window

## 13. Cable calibration

    a. The cable counter should be operating in single–sample mode, not averaging.

    b. The cable counter reading should be in the normal range.

    c. Single–sample readings should be stable to ±1 μsec.

    d. Check that the cable calibration system measures cable length changes correctly.

        i. Log the cable reading. (Cable command)

        ii. Insert a short cable length in the cable from the ground unit to the antenna unit, and log the cable reading again. (Cablelong command)

        iii. Remove the short cable and log the cable reading again. (Cable command)

iv. Compare the change in readings with the nominal value. (Cablediff command)

## 14. Mark 6 Recording systems

  a. 8-Pack module Installation –

  b. Remove the 8-pack from the shipping box and their shipping covers.

  c. Inspect for damage.

  d. Pull front lever down so that it is horizontal.

  e. Slide 8-pack easily into Mark6 machine until it stops.

  f. Lift front lever which will insert the 8-pack into the connector.

  g. Insert the data cables into the front of the module

  h. Confirm correct location top/bottom

  i. Turn the key switch to the right until it stops.

  j. The module lights will blink in a specific order and pattern

      i. Recognize this and confirm all lights indicate correctly

      ii. This may be you first detection of a module problem

  k. Repeat with multiple modules if required

## 15. Conditioning the modules

  a. If there is time each 8-pack that is received at a station should be conditioned before it is used to verify there has been no shipping damage. This can be done in any appropriate length gap in operations. With the larger modules it may take multiple days to condition. These larger modules should be done over the weekend if possible when there are no operational sessions. Please see attached conditioning memo.

## 16. Meteorological sensors

  a. Check that the values of barometric pressure, temperature, and relative humidity reported by the 'wx' command are reasonable and repeatable.

## 17. More extensive testing

  a. After any **equipment changes** or if a long period of time has elapsed since the last

VLBI session, more extensive testing of the VLBI systems should be carried out. More rigorous testing should also be conducted on a periodic basis (monthly to annually). Such tests could include:

    i.   Measure pointing offsets over the full sky.

   ii.   Check for RFI and for jumps in the phase cal phase and cable cal as the antenna is slewed across the sky.

  iii.   Measure the DC level and AC ripple in the any system or equipment power supplies.

  iv.   Clean all equipment filters and cooling fan port

## 18.  Begin Pre/Ops Checklist

# IVS Operations workshop TOW 2021

## 1. Starting a schedule

    a. The basic steps in starting a schedule are:

    b. Reporting problems when you need urgent help.

    c. An e-mail list has been set up for items needing urgent attention by the IVS Coordinating Center.
       The address is: ivs-urgent@lists.nasa.gov

    d. This list should be used by anyone needing urgent attention by or advice from the Coordinating Center. You can expect an answer normally within a few hours, if the message is sent during US East Coast working hours. Messages sent on weekends or after hours may take a little longer.

    e. Please use this address rather than sending messages to ivs-ops or ivs-stations. If the reply from the Coordinating Center is of interest to a broader audience, we will copy the appropriate lists on the response.

    f. Anyone can post a message to this list. The only recipients for this list are the Coordinating Center staff: Dirk Behrend, Ed Himwich, Cynthia Thomas, Mario Bérubé, and John Gipson.

    g. Examples of the types of messages that should be sent to this list are: problems with schedules, problems running drudg or the Field System, schedules that seem to be made for the wrong date, schedules that do not include the right stations, operational problems during observing, and any urgent issue that impacts operations and you need advice on how to handle.

## 2. Review session notes

    a. This provides one last opportunity to verify that nothing special has been missed in the set-up for this experiment.

## 3. Start schedule

    a. Confirm the antenna source is in the correct wrap zone for your antenna

b. The preferred form of the "schedule" command uses the line number to start with, e.g., "schedule=na225gc,#1", to start at line 1.

## 4. Send the Ready message.

a. The FS utility *msg* will send the information in a standard format and is recommended. Some stations use their own system to send this message.

b. This message summaries your status and lets the world know you are ready. It should be sent to ivs-ops@lists.nasa.gov. Be sure to include the session name in the subject line. Please include the following information.

 i. Comments about anything that may affect the data quality. If you have more than one polarization available it is recommended that you check the polarization to make sure it is correct and note that it has be checked.

 ii. The source and start time for the first scan. This assists the coordinator center in determining if you have the right schedule if an update was issued.

 iii. R2DBE to GPS clock offset. This is needed by the correlator to find fringes. If the backend 1 PPS starts the measurement please report this as the RDBE to GPS offset; if GPS 1 PPS starts, please report it as the GPS to RDBE offset.

 iv. WX: temperature, pressure, humidity, and sky conditions. This assists the analysts in understanding the atmospheric conditions and interpreting the SEFD and Tsys data.

 v. Cable difference. Please report whether a longer cable makes the reading larger or smaller. Please also report the difference you observed in the reading when you lengthened the cable and whether it was nominal (as expected) or not.

 vi. Pointing values: Please report both band and polarization SEFDs, source used for measurement, its azimuth and elevation when measured, and the pointing offsets on each axis. You can include as many sources as you think are useful.

 vii. Tsys values. Please report the system temperature all bands and polarizations.

**5.    Send the Start message**

    a.  This lets the world know that you started and whether there are any problems. Any additional useful information for the record doesn't hurt either. The message should be sent to ivs-ops@lists.nasa.gov  via your automated system.  If this is not functioning an email to the correct address including all of the data can be sent.

## 6. Making comments in the log

    a.  Making comments in the log when problems occur is one of the most important functions of an operator. It is the primary way of information about problems to get to the correlators. Please provide as full a description of a problem and its consequences as possible. Many of the data analysts are not familiar with the acquisition hardware.

    b.  It is important to describe the problem even if not fully understood at the time of detection. If the problem is resolved a full description and solution should be entered into the log.

    c.  In this time of more remote and un-attended operations all local information regarding function entered into the session log is critical.

## 7. Periodic monitoring I: each scan is correct:

    a.  For each scan the following information should be verified:

        i.   source

        ii.  equipment status, scan-check, system errors?

        iii. on-source

## 8. Periodic Monitoring II

    a.  These items need to be checked less frequently than every scan. Every hour is a reasonable interval.

    b.  Sky conditions entered as comments

    in log Cloud cover, wind,

precipitation, etc.

   c. Disk pack full?

   d. Check mk6=mstat?all output to see whether a disk pack has filled up and if so, swap it out with a fresh one. The disk pack that is not being recorded should always be a fresh one and a full disk pack should always be swapped out as soon as possible. This applies even if the one currently being recorded "should" be the last.

## 9. System failures

   a. This may include failure of the main site power, Antenna system, Receiver, Cryogenics, R2DBE, UDC, Mark6, Disk Modules, networks, and power supplies,

   b. All impact data collection and analysis. The decision to continue observing or stop and repair the system depends on the nature of the failure.

## 10.    Post experiment

   a. The post-experiment checks provide an opportunity to "close-the-loop" on the pre-experiment checks and verify that some things that cannot be checked during the experiment, such as the SEFDs, are still okay.

   b. Check cable calibration

   c. This verifies that the cable system still detects the calibrated cable correctly and hence has not failed during the experiment.

   d. Complete end check-list

   e. There are several other items on the end of experiment check-list. This should all be completed. The results of some of the tests will go in the End Message.

   f. Send the Stop Message

       i. The End Message lets the world know you have completed the experiment and your status at the end. This is especially useful for the correlator since it will help them prepare for correlating the data. This

information should all be reported in comments in the log as well. It should be sent to ivs-ops@lists.nasa.gov. Be sure to include the session name in the subject line. The End Message should have the following components:

    ii.  Scans missed

   iii.  List the scans missed, not by line numbers, but by the time spans that data was lost for.

   iv.  Comments

    v.  Please describe any unusual conditions that affected data collection. Please describe any equipment problems. This might not be limited to things that affected the data collection, but also include items that require maintenance.

   vi.  Please include any other information that you think might be useful for the correlator or the data analysts.

  vii.  Stop time

        1.  Indicate the time data collection stopped.

 viii.  Clock offset information

        1.  Report the final clock offset information. Use the same format as described above for the Ready message. Reporting the clock offset a second time may seem redundant but it has two purposes. First in case there was an error in reporting the first value, it provides a back-up. Secondly if there was no error in the first value it can be used to a rough estimate of the clock drift rate. Please also include any information about clock jumps and the time span of data affected by any jumps.

   ix.  Disk Pack

    x.  Report the module inventory in the 'End" message.

g.  Close log

h.  As with the pre-experiment tests, the post-experiment tests should be done as much as possible in the experiment log. Once the post-experiment tests have been completed, you can close the log, either using the "schedule=…" command with a null or non-existent schedule, by changing the log file with a "log=station" command, or by terminating the FS.

i. Send Log   (plog -l) That is a lowercase L

ii. Additional Module Shipping Information

i. If you have any additional information about the shipping such as the routing, this would be a good place to send it.

## 11. Additional Experiments Comments

a. If you have become aware of any additional problems or if there is any special information you either have discovered since the experiment ended or forgot to place in the Stop message, this is a good place to send it. You can of course send follow-up information as often as necessary.

## 12.      Running "logpl"

a. This section describes the basics of running "logpl", a graphically oriented program for plotting data from the log. This program is a more modern version of the old "logex" program (which is still available). Please refer to the "logpl" manual available in PostScript form on the FS servers in the doc sub-directory.

b.  Interactive Use

c. "logpl" can be started from a shell prompt by just entering "logpl". The program uses the X display, so the starting used must have access rights to the X display. If you are using X server and open new window (C-S-W) and type "logpl" at the prompt, it should start okay.

d. Selecting a log file

e. If the FS is running, the log that is open will be selected automatically. If the FS isn't running or if you want to use a different log, use the "File" menu item and select the "New Log File" option. Enter the name of the log file you wish to examine. The directory will default to "/usr2/log" and the extension to ".log".

f. Plotting Data

g. You can plot up to four "channels" of data simultaneously. The menu items "Channel1", "Channel2", and so on are pull-down menus that let you select the data to be plotted for each channel. The "Options" menu item allows you select whether the plot are superimposed or shown separately and whether to connect the points with a line.

h. Entering New Parameters

    i. You can enter new parameters to plot either by updating the logpl.ctl" control file and restarting "logpl" or by interactively using the "Options" menu item and selecting "Edit Selections" options. Any changes that are made interactively are not preserved when "logpl" is terminated.

i. Printing Plots

j. Once you have a plot you would like to print, you can print it as PostScript either to a printer or to a file. Use the "File" menu item and select the "Print" option to print the file.

k. Non-interactive Use

l. "logpl" also has a non-interactive, or command mode, for automated processing. This is particularly useful for automatically generating plot of ancillary data for inspection at shift changes and after the experiment is over. To use "logpl" in command mode use the "-cmd" command line option: "logpl -cmd". You can start processing from a command file automatically by entering: "logpl -cfile xxx" where "xxx" is the name of the command file. You can even select the log file to process on the command line by entering "logpl -log lll -cfile xxx", where "lll" is the name of the log file.

# Westford Station VGOS Operators Notes
2021-04-28

## Pre-setup

### A. DRUDG experiment files

This step is first for two reasons. First, the schedule file is typically available before the day of the experiment. Secondly, the number of modules in a recording group may eventually depend on the experiment. When that is the case, the number needed will conveyed through the listing that is made in this step.

To create the station specific SNAP and procedure files from the session schedule, fetch the schedule from IVS and DRUDG it by entering, in a FS PC shell, the command

### fesh -d<sched>

where <**sched**> is the schedule name, eg **v16033.** If you have manually received the schedule, follow the instructions in the **Manually processing schedules** section of the appendix.

Along with the **.snp** and **.prc** files for the FS, this will create the listings file <sched><stn id>.lst in /usr2/ sched which shows a human readable summary of the schedule. Here <stn id> is the two letter station code, eg "gs" for GGAO. To view this on the FS PC, open in a text viewer; eg, in a FS shell

less /usr2/sched/<sched><stn id>.lst

Review the information in this listings file to ensure you have sufficient storage for the observation.

## Experiment setup

### B. Verify NTP is sync'd
In the FS enter:

### check_ntp

The output is of the form

| remote | refid | st t when poll reach | delay | offset | jitter |
|--------|-------|----------------------|-------|--------|--------|
| *192.168.1.20 | 18.26.4.105 | 2 u  444 1024  377 | 0.208 | -0.336 | 0.396 |
| +192.168.1.21 | 18.26.4.105 | 2 u  167 1024  377 | 0.215 | -0.822 | 0.153 |

The offsets should be small and there must be a server with an asterisk *in the first column. It may take a few minutes to get an *.

### C. Start FS logfile
In the FS, open the experiment log so the set-up will recorded in that log:

### log=<schedule><stn id> # eg v16033gs

### D. Check RDBE Status
From the Field System, check the RDBEs

### rdbe_status

The response values should be **0x0f41**.

      Old Server: The response values should be 0x0941.

If the response is to not correct for any RDBEs, refer to **Setup of RDBEs from a cold start** in the appendix.

### E. Check Mark 6 Status

From the Field System, check the Mark6s

**mk6=dts_id?**

You should receive a sensible response similar to

!dts_id?0:Mark6-4605:1.0.24-1:1.2;

If the response is to not correct for any Mark6s, refer to **Set-up of Mark 6 server from a cold start** in the appendix.

### F. Check MCI Status

To start the MCI server running, in a FS shell, type:
>      **ssh –X 192.52.63.139**
Password is the default Mark5/6 oper password: FS)@repo
>      **cd node_software/V0**  (this is the number 0)
>      **./mci_fenodesrvr 192.52.63.139**

>      Now wait until you get a printout of ~30 data points.  You won't see the values, but the sensors will cycle through the screen.  AD345 is the final of sensor.  When you see this, you can safely minimize the window.  Now the MCI server is logging data.  This saves to a .txt file on the node PC itself, but if you want to quickly check a value, you can use the client program.  In a new shell, type:
>      **ssh –X 192.52.63.139**
Password is the default Mark5/6 oper password: FS)@repo
>      **cd node_software/V0**  (this is the number 0)
>      **./tcpip_client 192.52.63.139**
This will open a prompt in the same shell.  You can now ask for sensor values.  As an example, to check the 20k stage temperature in Kelvin, type:
>      >g_20ktemp
Which will return a value.

If it is working, you will see the readouts for the vacuum pressure and 20K and 70K stages.  If not, see the **Setup MCI server** section in the appendix.

### G. Mount Mark 6 Modules

This step is included just after initial verification that all the devices are working, but before the more detailed pre-experiment checks.  This allows any issues with getting the modules mounted resolved as soon as possible. However, these steps can be done as part of the making the test recording if that is preferred. All commands are entered into the FS unless otherwise noted.

1. This is to help with debugging, display and clear the Mark 6 message queue:

   **mk6=msg?**

2. Initialize module; create, mount, and open module

   Check status:

   **mk6=mstat?all**

   After the two fields: return code and **cplane** status (hopefully **mstat?0:0**) there are 10 fields per group:

   group:slot:eMSN:#disks found:#disks nominal:free space:totalspace:status1:status2:type

It may be easier to read if individual groups are queried; eg. for group 1:

**mk6=mstat?1**

**mk6=group=unprotect:<group>**
**mk6=group=erase:<group>**

If the module has already been initialized, ie status1 is initialized, and the data is no longer needed (**be certain first**), erase it:

If the module has not been initialized (status1 is "unknown" and no eMSN?), initialize it:

**mk6=mod_init=<slot#>:<#disks>:<MSN>:<type>:<new>**

For example

**mk6=mod_init=1:8:HAY%0001:sg:new**

> **Note:** due to a current incompatibility, the FS–Mark 6 connection will timeout during long running commands such as this.
>
> Until this is fixed, you can optionally run this command directly on the Mark 6 from a shell prompt with
>
> ```
> ssh root@mark6a
> da_client
> mod_init=<slot#>:<#disks>:<MSN>:<type>:<new>;
> ```
>
> note the final semicolon is necessary in da_client but is automatically added by the FS.

Create, open and mount the group:

**mk6=group=new:<slots>**
**mk6=group=mount:<slots>**
**mk6=group=open:<slots>**

(Slots is a list of slot numbers included in the group, without any seperators, eg <slots>=12) To query if the group is created properly:

**mk6=group?**

Print out should have the group number at the end. If it is -, something has gone wrong.

## H. Verify RDBE time, offsets, and VDIF epochs

In the FS, check RDBE time, offsets, and VDIF epochs:

**time**

This will display the pps_offset, dot, and gps_offset:

```
2016.320.18:11:39.28/rdbed/!dbe_pps_offset?0:-1.953124995e-08;
2016.320.18:11:39.28/rdbec/!dbe_pps_offset?0:-1.953124995e-08;
2016.320.18:11:39.29/rdbea/!dbe_pps_offset?0:-1.953124995e-08;
2016.320.18:11:39.29/rdbeb/!dbe_pps_offset?0:-1.953124995e-08;
2016.320.18:11:39.29/rdbeb/!dbe_dot?0:2016-320-18-11-39.296s:-0.007s:33;
2016.320.18:11:39.29/rdbea/!dbe_dot?0:2016-320-18-11-39.296s:-0.018s:33;
2016.320.18:11:39.29/rdbed/!dbe_dot?0:2016-320-18-11-39.296s:-0.024s:33;
2016.320.18:11:39.29/rdbec/!dbe_dot?0:2016-320-18-11-39.296s:0.000s:33;
2016.320.18:11:39.29/rdbeb/!dbe_gps_offset?0:-3.758203125e-05;
2016.320.18:11:39.29/rdbed/!dbe_gps_offset?0:-3.758203125e-05;
2016.320.18:11:39.29/rdbea/!dbe_gps_offset?0:-3.758203125e-05;
2016.320.18:11:39.29/rdbec/!dbe_gps_offset?0:-3.758203125e-05;
```

The offsets should be small (GPS typically ± a few tens of µs, PPS less than ±0.1 µs) and the DOT times should be the same the FS log timestamps, within about 0.1 seconds. The third field of 'dot' output is the VDIF epoch. All RDBEs must have the same value, (33 in this case). The VDIF epochs of all RDBEs are also shown in the RDBE status window.

- For old server, the VDIF epochs are not displayed
- **If any of the DOT times are not correct**, the ones that are wrong must be set with 'fmset'. To do this from the FS console, press <Control><Shift>T to start fmset, or type

## fmset

in an FS PC shell.
You can select the RDBE to set by letter: a, b, c, or d.

With that RDBE's time being displayed, verify that the time is correct by comparing it to the FS/Computer time. If it is off by a lot, use '.' to get it close — within a few seconds. Once it is close, you can use '+' and/or '-' to increment and/or decrement the RDBE by a second at time until it agrees with the FS time.

**If the PPS offset is greater in magnitude than ±1e-7 (±0.1 µs)** for an RDBE, it must be resync'd. You can try using the 's' command in 'fmset' for each RDBE that has too large an offset. This command will take approximately 45 seconds per RDBE to complete. If as a result, the PPS offset comes within the tolerance, please check that all the RDBEs are sending data with

## mk6in

If an interface is not showing receipt of data, reinitilize the corresponding RDBE with:


## Ssh wfmark5-19

## Cd /srv/r2dbe_software

## ./r2dbe_init_all


If this does not solve the data transmission problem. or the 's' did not make the offset small enough, restart the RDBE, see **Setup of RDBEs from a cold start** in the appendix.

- For the old server if the PPS offset is too large, you will need to restart the RDBE to re-sync, see **Setup of RDBEs from a cold start** in the appendix.

**If the displayed VDIF epochs are not the same,** use the ';' command for each RDBE to set the epoch to the nominal one.

- For the old server, the only way to verify this is to note that the Mark 6 will not record a test scan when you make one (but there could be other causes besides this one). If this happens and you can determine which RDBEs do not have the current nominal VDIF epoch set its time explicitly. If you don't know which is wrong just set them all explicitly. Use the procedure described below for after June 30 or December 31 to set the time(s).

**If this is the first experiment since December 31 and June 30,** and the RDBEs have not had their epochs reset since that date, they should be reset. Use the ';' command in 'fmset' for each RDBE to set it to the nominal VDIF epoch. The

third field in the 'dot' output above must be the same for all the RDBEs. The VDIF epochs of all RDBEs are also shown in the RDBE status window.

> For the old server, this requires setting the time explicitly for each RDBE with 'fmset' even if it looks correct. Use at least one of ',', '+', '-', or '=' commands and then it is necessary to verify/set the time for each RDBE. The third field of the 'dot' output above will be missing for the old server and the VDIF epoch will not be in the RDBE status window.

If any changes were necessary due to the above considerations, check the values again with:

```
time
```

to verify they are correct. If not, follow the above instructions again and/or seek assistance.

### I.  Initialize pointing

In the FS, initialize pointing configuration and send antenna to a test source:

```
proc=point
initp
casa
```

The following sources are the most reliable for these small antennas:

| Source | Approximate L.S.T. of transit |
|---|---|
| Taurus A | 05:30 |
| Virgo A | 12:30 |
| Cygnus A | 20:00 |
| Cas A | 23:30 |

### J. Set mode and attenuators

While waiting for the antenna to move to the test source, setup the experiment mode and adjust attenuators. In the FS,

```
proc=<schedule><stn id> # eg. 'v16033wf'
setupbb
ifdbb mk6bb
rdbe=dbe_atten=  # sets the attenuators
proc=point
```

### K.  Check RDBEs

Locate the RDBE Monitor window (monit6) or start it by pressing <Control><Shift>6. Noting that for some fields the display switches between IF0 and IF1 every second, check for each RDBE that:

1. DOT ticking and correct time

2. All RDBEs have the same epoch

3. DOT2GPS value small (±a few µs) and stable (varies by 0.1 µs or less)

4. DOT2PPS value small (±0.1 µs) and stable (varies by 0.004 µs or less).

5. RMS values close to **20**. They may be higher if the antenna has reached the source since the "auto" command above. They may be higher or lower if the elevation has changed significantly since the "auto" or there is variable RFI.

6. Tsys IF0 and IF1 about 50-100, may be jumping a bit

7. Phase-cal amplitude about 10-100, phase stable to within a few

   degrees Leave the window open for later monitoring.

### Check multicast for all 4 bands in FS shell prompt:

```
mon<id>
```

example <id>=a, b, c, or d (eg. monaetc.)

```
rdbe=data_connect?
```

Verify that band a,b,c,and d equal 0,1,2, and 3, respectively.  Not for R2dBE yet.

**L.  Checkpointing**

Check that the antenna is now on the source we selected earlier with the FS command

### onsource

The result should be TRACKING. If the antenna status is still SLEWINGwait until you see an onsource message in the FS log window or onsourceindicates tracking.

Once the antenna is onsource, start the pointing check with

### fivept

This will take a few minutes. Once complete fivpt will give you output in the form:

```
          Az         El        xEl_offs  El_offs
xoffset   99.4469    30.8190   0.01417 -0.00806 0.00452 0.00801 1 1 01d0   virgoa
```

The xEl_offs and El_offvalues (ie. the 3rd and 4th columns) are the beam spaces offsets of the pointing fit. The absolute value of these should be less that ~0.025 degrees in each coordinate at Westford. There should also be the flags '1 1' in the 3rd and 4th columns from the end.

Next, measure the SEFDs on test source

### onoff

This will also take a few minutes. Once complete onoff will give you output in the form:

| | source | Az | El | De | I | P | Center | Comp | Tsys | SEFD | Tcal(j) | Tcal(r) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VAL | virgoa | 170.9 | 63.0 | 15a0 | 1 | l | 3016.40 | 0.994352.03 | 2895.6 | | 55.657 | 1.67 |
| VAL | virgoa | 170.9 | 63.0 | 15a1 | 2 | r | 3016.40 | 1.008847.93 | 2549.8 | | 53.201 | 1.60 |
| VAL | virgoa | 170.9 | 63.0 | 15b0 | 3 | l | 5256.40 | 0.994649.58 | 2742.3 | | 55.306 | 1.66 |
| VAL | virgoa | 170.9 | 63.0 | 15b1 | 4 | r | 5256.40 | 1.014841.57 | 2549.6 | | 61.331 | 1.84 |
| VAL | virgoa | 170.9 | 63.0 | 15c0 | 5 | l | 6376.40 | 0.983142.57 | 2294.2 | | 53.891 | 1.62 |
| VAL | virgoa | 170.9 | 63.0 | 15c1 | 6 | r | 6376.40 | 0.986244.09 | 2248.1 | | 50.992 | 1.53 |
| VAL | virgoa | 170.9 | 63.0 | 15d0 | 7 | l | 10216.40 | 1.012151.91 | 3009.5 | | 57.979 | 1.74 |
| VAL | virgoa | 170.9 | 63.0 | 15d1 | 8 | r | 10216.40 | 0.987053.64 | 3084.2 | | 57.496 | 1.72 |
| | source | Az | El | De | I | P | Center | Comp | Tsys | SEFD | Tcal(j) | Tcal(r) |

Verify SEFDs for eight bands are reasonable. They should be in the range ~2000-3000.

Finally, zero the offsets:

### azeloff=0d,0d

(note there is no space between arguments)

**M. Make test recording**

1. Check Mark 6 inputs with

   ### mk6in

   which will show the Gb/s by interface in the FS log. For example, a rate of 2 Gb/s should should look like

   **#popen#mk6in/eth2 2.078 eth3 2.079 eth4 2.079 eth5 2.079 Gb/s**

   If one or more interfaces are not showing the approximate nominal data rate (initially 2 Gb/s per interface), it is likely that the corresponding RDBEs needs to be reconfigured.

   To see more details of the Ethernet ports state for the Mk6, use

   ### mk6=input_stream?

   Sample output:
   ```
   mk6a/!input_stream?0:0:rdbeB:vdif:8224:42:66:eth3:127.0.0.1:12000:0:rdbeC:vdif:8224:42:66:
       eth4:127.0.0.1:12000:0:rdbeA:vdif:8224:42:66:eth2:127.0.0.1:12000:0:rdbeD:vdif
       :8224:42:66:eth5:127.0.0.1:12000:0;
   ```

   which shows rdbeA going to eth2, rdbeB going to eth3, rdbeC going to eth4, and rdbeD going to eth5.

2. The modules and groups should have been set-up already. If not refer to **Mount Mark 6 Modules** above.

3. In FS, record some test data:

**mk6=record=on:30:30** Can be as short as 10 seconds but suggest 30 seconds

verify that lights on the mk6 flash appropriately. You can check recording status with:

**mk6=record?**

It should progress starting as "recording", then transitioning to "off".

**If the status stays "pending",** it may be that not all the RDBEs are sending data. You can check this by using the FS SNAP procedure

**mk6in**

as shown in step #1 above.

If all interfaces are receiving data at the correct rate, it may be that the VDIF epochs of all the RDBEs don't agree. See **Verify RDBE time, offsets, and VDIF epochs** for detail on how to verify/set.
You can also check if the disk is full with

**mk6=rtime?**

4. Once recording ends, check quality:

**mk6=scan_check?**

Results should show vdif, the time when recording was started, 30 seconds of data, 30 GB of data with an 8 Gbps data rate.

> **EH:** data rate will eventually go to 16 and 32 Gbps.

## 4. Start experiment

**A. Start non-FS multi-cast logging**

> **EH:** Once we have InfluxDB logging of data, maybe we can get rid of this logging,

From the FS enter:

**start_mlog**

If there are no errors reported and the "Done" message is printed the logging has been started.

**B. Send "Ready" message**
From FS console window enter Control-Shift-G.

> **EH:** Jason will eventually move **vgos-msg-gui.py** to the FS machines so we can have better functionality. Maybe the placement of the window should be controlled locally by .Xresources.

At this point a GUI window should pop up. Enter the session name, station code (lower case) and select the type of message from the drop down list.

- Click the update values button. This collects the information in real time and the SEFDs from the pointing check in the log file.
- Complete the maser offset value by looking at the maser counter in the maser room.
- In the "to" email address field, send it to **ivs-ops@lists.nasa.gov**
- Enter a brief comment, include weather information.
- Click the send message button when finished.

**Start the remote VNC server for Haystack Monitoring:**
 If there is a power failure, or the Field System must be rebooted, you must start the MCI server and the VNC server running in the background again.  To start VNC, in a new shell window, type:

**startremote**

This will start the VNC server running.  One of the last prints on the screen should be PORT=5900, when you see this you can safely minimize the window.  Now Haystack (Glenn x5457) or anyone else with access can view the desktop.

**C. Start schedule**

In a Linux shell (xterm), look at the list file <schedule><stn id>.lstcreated in the DRUDG step (eg. v16033gs .lst). Find the first observation and note line number 'nnn' after scan name at start of line.
Now, in the FS, start schedule:

**schedule=<session><stn id>,#<nnn>**

(**Note:** the pound sign (#) is required and there should be no spaces in the command)

**D. Send "Start"message**

Send "Start" message using the same procedure as in **Send "Ready" message**.

## 5. Monitor experiment

**A. Monitor scan_check**

To display scan_check results as they come in (and the old ones so far) open the 'scnch' window (Control>< Shift>K).

Results should show vdif, reasonable record start time, about equal seconds and GBs of data (typically 30+), and 8 Gbps data rate. Be aware scan_check*occasionally* fails and the data is okay.

Position and size window for convenient viewing, new output will follow any changed size. You can stop this with <Control>-C

> **EH:** The placement and size of the window can be controlled by .Xresources.

**B. CheckRDBEMonitor**

Check the display for reasonable values periodically, note some fields alternater between IF0 and IF1 every second:

1. DOT ticking and correct time

2. VDIF epochs for all RDBEs agree, if there is any disagreement some will be in inverse video

   > For old server, not applicable.

3. DOT2GPS value small (±a few µs) and stable (varies by 0.1 µs or less).

4. DOT2PPS value small (±0.1 µs) and stable (varies by 0.004 µs or less).

5. While *recording* RMS values are close to 20 for the new server, sometime RFI can cause the value to be off, but it should always be between 10 and 40 during recording. If valeus are outside the nominal ragnget they will be shown in inverse video.

   > For the old server, RMS values close to 32 and inverse video is not used.

6. Tsys IF0 and IF1 about 50-100 (may lower at Wf due to use of a preliminary cal value), may be jumping a bit

7. Phase-cal amplitude about 10-100, phase stable to within a few degrees.

## 6. Post experiment

**A. Stop theschedule**
In the FS, run

**schedule=**

Stop multicastlogging
In the FS, run

**stop_mlog**

**B. CheckpointingandSEFDs**
Select procedure 'point' library

**proc=point**

**If the FS has been restarted since the initial check, you will need to re-initialize the pointing set-up**

**initp**

```
proc=<schedule><stn id> # eg. 'v16033gs'
setupbb
ifdbb mk6bb
auto
proc=point
```

Wait until the antenna is on source. You can either watch the log or check with

**onsource**

The result should be "tracking".

As in the **Check pointing** section in pre-experiment, run a pointing check

**fivept**

and check the "xoffset" offset values are small. Then check the SEFDs

**onoff**

and verify SEFDs for eight bands are reasonable, ~2000-3000.

Finally, zero the offsets

**azeloff=0d,0d**

**C. Send "End" message**

Send "End" message using the same procedure as in **Send "Ready" message**. Include details such as the stop time and the current weather conditions on-site.

**D. Send test scan data files**

In a terminal, log in to the Mark 6

```
ssh mark6a
gator 1 scanname.vdif ~/
dqa –d <filename>.vdif
scp <filename>_*.vdif evlbi1.haystack.mit.edu:/data-st11/vgos/
```

**E. Remove the module for shipping**
In the FS

```
mk6=group=close:<slots>
m6=group=unmount:<slots>
```

Key off disk

**mk6=mstat?all**

**F. Transfer log file**
        This may be done before transferring the test scan.
In FS, close experiment log:

**log=station**

In a terminal, copy the log to CDDIS and Haystack with plog. If you are transferring the most recent log you can use

**plog –l (This is an L)**

Otherwise use

**plog &lt;session&gt; #v16033**

Or if the log file does not conform to the standard naming convention

**plog &lt;log file path&gt; # eg/usr2/log/v16033gs.log**

If this is not successful, see **Manually uploading log files** in the appendix

## 7. Appendix

### A. Setting Up Password-less SSH

It is convenient to setup password-less login for local devices from the Field System PC. You can do this with SSH using public-key cryptography. To generate public/private key pair with SSH (if you don't already have one), run

**ssh-keygen**

Accept the defaults and enter a blank password when prompted.

For each computer you want to enable password-less login, append your public key to .ssh/authorized_keys on the remote host. On a recent versions of the Field System OS (i.e., FSL9 based on Debian Wheezy) use the command (use the target host node name or IP address in place of $host):

**ssh-copy-id$host**

If this is not available use

**cat ~/.ssh/id_rsa.pub | ssh $host 'cat &gt;&gt;~/.ssh/authorized_keys'**

If you do not wish to have *completely* password-less login, an alternative is to encrypt your ssh key with a password and use ssh-agent to unlock it for your session. The upshot is you still have the convenience of password-less login, you just have to enter your password **once** after you login to the FS computer. However this is not recommended for devices that FS procedures use ssh to connect to, including, RDBEs, Mark 6s, MCI, and backend-PCs, which will need to have no prompt for smooth operations.

This is also more secure since the ssh key is encrypted on disk and if anyone ever takes your key, they can not gain access to your systems.
This is a good idea for remote terminals, although is slightly more cumbersome for local access.

To encrypt your private key, enter a password when you generate it. To encrypt an old key, or change its password, use

**ssh-keygen -p -f~/.ssh/id_rsa**

The process for adding your public key to a login to a remote host is the same as above.

Now, when you want to use your ssh key, add it to your ssh-agent with

**ssh-add ~/.ssh/id_rsa**

This will decrypt your private key and allow any ssh clients the current login session to use it without a password.

### B. Setting Up Password-less Log Transfers

> *EH:* replace with new CDDIS transfer set-up procedure, use URL reference

Currently we are using FTP to transfer log files to CDDIS. This is will change in the future. For now, add the following line to the ~/.netrc file:

**machine cddisin.gsfc.nasa.gov login &lt;username&gt; password &lt;password&gt;**

replacing the appropriate fields with your username and password.

### C. Manually uploading log files

*EH*: must be re-written for new CDDIS procedure

In a terminal, copy the log to CDDIS

And to Haystack:

```
cd /usr2/log
ftp cddisin.gsfc.nasa.gov user
<your cddisin username>
password <your cddisin password>
put <session><stn id>.log # eg 'v16033gs' quit
```

scp <session><stn id>.log evlbi1.haystack.mit.edu:/data-st11/vgos/logs

## D. Manually processing schedules

1. Put schedule in **/usr2/sched** on FS PC

2. Run **drudg**, from FS PC shell:

```
cd  /usr2/sched drudg
<schedule>.skd
```

Now, in drudg, give the following commands (ignoring text after #and filling in the variables)

```
<stn id>                # the two-letter station id (eg. 'gs' at GGAO)
3                       # make .snp
12                      # make .prc
9                       # change printer output destination
<schedule><stn id>.lst  # destination file, eg 'v16033gs.lst'
                        # three more <Return>s
5                       # print summary
0                       # exit DRUDG
```

## E. Schedule rotation

1. Start DRUDG with original schedule

2. Pick option 10 in DRUDG.

3. Specify the full fine name for the output file, i.e., include the .skd. I suggest you call it hYYDDD.skd. The "h" is to avoid confusing it with *real* schedules.

4. Pick the start time. YYYY MM DD HH MM SS

5. Pick the duration — usually 24 hours

6. End DRUDG

7. Restart DRUDG with the new file to make the normal output (or skip step #6 reselect schedule, option #8)

## F. Module conditioning

1. Load modules and enter da-client

   **ssh mark6ada-client**

2. In da-client, initialize the modules with the same mod_init command used for experiment set up:

   **mod_init=<slot#>:<#disks>:<MSN>:<type>:<new>;**

3. Create a new group with the modules you want to condition. If more than 1 module is being conditioned, group them together.

   **group=new:WXYZ;**
   **group=mount:WXYZ;**
   **group=open:WXYZ;**

WXYZ=slot 1, 2, 3, or 4. Only enter slots with modules in them.

4. Check to the status. It should say "open:ready" for the modules included in the group.

**mstat?all;**

5. Leave da-client and navigate to bin.

```
<Control>+C
cd /home/oper/bin
```

6. Run the hammer script. After, all 8 lights on each module should be lit.

**nohup hammer.sh&**

7. To break the group, do the mod_init command on each module and reassign groups. If recording on all the modules simultaneously, no further action is needed before an observation besides a test recording.

## G. Setup Field System PC from Coldstart

• Start FS computer

• Login as user **oper**

• Check NTP by running

**ntpq -np**

The output is of the form

```
     remote          refid        st t whenpoll reach     delay    offset  jitter
==========================================================================
*192.168.1.20      18.26.4.105         2 u  444 1024  377     0.208    -0.336    0.396
+192.168.1.21      18.26.4.105         2 u  167 1024  377     0.215    -0.822    0.153
```

The offsets should be small and there must be a server with an asterisk * in the first column. It may take a few minutes to get an *.

• Other local devices that use NTP (antenna, RDBE, Mark6, etc) can now be started

• Start the Field System in the login shell

**fs**

## H. Setup of RDBEs from a coldstart

**Power up RDBEs**

Use the power switch to start or cycle the power of each RDBE to be started.

> New server:
> Check the status of all RDBEs with the FS command
>
> **rdbe_status**
>
> When the RDBEs respond with a status value 0x0f41, skip to **Check/Set RDBE times** **Start**

**RDBE server**

From FS PC shell prompt, login to each RDBE:

**sshroot@rdbe<id>**

use <id>=a, b, c, or d to log into RDBE-<id>.

Then, on each RDBE run

```
rbin
nohup ./rdbe_server 5000 6 & exit
```

Repeat this for each RDBE that has been restarted. You can verify when all the RDBEs have started from the FS with:

**rdbe_status**

There will be an error for each RDBE that is not ready. When all RDBEs respond with a status value 0x0941, proceed to the next step.

**Configure RDBEs**

To initialize the configuration on all RDBEs, use the a new FS window:

**Ssh wfmark5-19**

**Cd /srv/r2dbe_software**

**./r2dbe_init_all**

You should get four "success" messages.

This programs the FPGA and also does the initialization, and sets the front panel data.

**Check/Set RDBE times**

It is **necessary** to check/set the time with fmsetfor an RDBE **every time** it is restarted. The time only needs to be set if it is not correct already.

To do this from the FS console, press <Control><Shift>Tto start fmset, or type

**fmset**

in an FS PC shell.
You can select the RDBE to set by letter: a, b, c, or d.

With that RDBE's time being displayed, verify that the time is correct at the one second level (± a few tenths) by comparing it to the FS/Computer time. If it is off by a lot, use "." to get it close, within a few seconds. Once it is close, you can use +and/or -to increment and/or decrement the RDBE by a second at time until it agrees with the FS time.

Be sure to exit with **<Escape>.**

**I. Set-up of Mark 6 server from a cold start**
Use the power switch to start or cycle the power of each Mark 6 to be started.

**Check Mark 6 connection (New server)**

From the Field System, check the Mark 6 connection

**mk6=dts_id?**

You should receive a sensible response similar to

**!dts_id?0:Mark6-4605:1.0.24-1:1.2;**

If so, you can skip the rest of this section.

**Starting Mark 6 servers**
If you receive an error, check that the Mark 6 servers are running. The programs cplane and dplane need to be running on the Mark 6. These should startup after boot.

To check check if they are running perform

```
ssh root@mark6a
ps aux | grep plane
```

If they are not, start them

```
sudo systemctl start dplane
Sudo systemctl start cplane
```

# Helium System Procedures

## Cold Head Purging procedure

### This procedure is to be used:

A. Cold head replacement
B. Line failure resulting is pressure dropping below 30psig
C. Compressor failure resulting in replacement of compressor
   1. Attach the maintenance manifold to the disconnected ends of the return and supply inlet at the cold head connection.
   2. Reduce the pressure in the cold head to a level of 30 psig by using the maintenance manifold. Reducing the pressure in the cold head to below 30 psig (200 kPa) may introduce more contaminants into the helium circuit. (Ignore this step if cold head was replaced or line failure lowered helium pressure to 0 psig)
   3. Attach a two-stage regulator (0-3000/0-400 psig) and charging line to a helium bottle (99.999% pure). DO NOT OPEN THE BOTTLE VALVE AT THIS TIME. Purge the regulator and charging line as introduced in steps a through d below. Do not use helium gas that is less than 99.999% pure.
        a. Open the regulator a small amount by turning the adjusting knob clockwise until it contacts the diaphragm; then, turn approximately 1/8 to 1/4 turn more, so that the regulator is barely open.
        b. Slowly open the bottle valve, and purge the regulator and line for 10 to 15 seconds. Turn the regulator knob counterclockwise until the helium stops flowing.
        c. Loosely connect the charge line to the 1/8-inch Hoke valve on the maintenance manifold.
        d. Purge the charge line again, as in step a, for 30 seconds, and tighten the charge line flare fitting onto the Hoke valve while the helium is flowing.
   4. Perform in sequence:
        a. Backfill the cold head with helium to a static charge pressure of 195-205 psig (1345-1415 kPa) by adjusting the regulator to the required pressure, and opening the Hoke valve on the manifold. Close the Hoke valve when the pressure is correct.
        b. Depressurize the cold head to 30 and 50 psig 200 and 330 kPa) by slowly opening the ball valve and allowing the helium to bleed out slowly. Do not reduce the pressure to less than 30 psig or the cold head may be further contaminated.
        c. Perform the flushing steps a and b four more times.
        d. Pressurize the cold head to a static charge pressure of 195- 205 psig (1345-1415 kPa) and run the cold head drive motor for 10 to 30 seconds.
        e. Perform steps b through d four more times for a total of 25 flushes and 5 drive-motor runs.
   5. Verify that the cold head is pressurized to the static charge pressure of 195-205 psig (1345-1415 kPa).
   6. Disconnect the maintenance manifold from the helium return and supply lines.
   7. Reconnect the helium return and supply lines to the return and supply connectors at the rear of the compressor. The cryopump is now ready for operation.

# Helium Line Purge process

## This procedure is to be used:

A. Line failure resulting in pressure dropping below 30psig
B. Significant contamination

1. Disconnect the return and supply lines at both the compressor and refrigerator
2. Attach the maintenance manifold to the return and supply lines.
3. Reduce the pressure in lines to a level of 30 psig by using the maintenance manifold. Reducing the pressure in lines to below 30 psig (200 kPa) may introduce more contaminants into the helium circuit. (Ignore this step if line failure lowered helium pressure to 0 psig)
4. Attach a two-stage regulator (0-3000/0-400 psig) and charging line to a helium bottle (99.999% pure). DO NOT OPEN THE BOTTLE VALVE AT THIS TIME. Purge the regulator and charging line as introduced in steps a through d below. Do not use helium gas that is less than 99.999% pure.
    a. Open the regulator a small amount by turning the adjusting knob clockwise until it contacts the diaphragm; then, turn approximately 1/8 to 1/4 turn more, so that the regulator is barely open.
    b. Slowly open the bottle valve, and purge the regulator and line for 10 to 15 seconds. Turn the regulator knob counterclockwise until the helium stops flowing.
    c. Loosely connect the charge line to the 1/8-inch Hoke valve on the maintenance manifold.
    d. Purge the charge line again, as in step a, for 30 seconds, and tighten the charge line flare fitting onto the Hoke valve while the helium is flowing.
5. Perform in sequence:
    a. Backfill the lines with helium to a static charge pressure of 195-205 psig (1345-1415 kPa) by adjusting the regulator to the required pressure, and opening the Hoke valve on the manifold. Close the Hoke valve when the pressure is correct.
    b. Depressurize the lines to 30 and 50 psig 200 and 330 kPa) by slowly opening the ball valve and allowing the helium to bleed out slowly. Do not reduce the pressure to less than 30 psig or the cold head may be further contaminated.
    c. Perform the flushing steps a and b eight more times.
6. If lines are longer than 20 feet repeat sets 1 through 4 at opposite end of line set
7. Disconnect the maintenance manifold from the helium return and supply lines.
8. Reconnect the return and supply lines at both the compressor and cold head

# Cold Head / Compressor Decontamination Procedure

This procedure is to be used:

A. The cold head is ratcheting
B. A significant failure has badly contaminated the helium system
C. Compressor Adsorber has been replaced
D. Helium Line failure caused helium pressure to drop below


1. If the Cold head is already in operation and is ratcheting skip to step 4
2. If the helium system dropped below 30psig while in operation first perform the "Cold head purging procedure" and add helium gas to compressor using "Adding helium gas to compressor procedure"
3. Cool down the cryopump and operate it for one to three hours. If the system will not cool down, proceed to step 3. Operating the cryopump will isolate the contaminants by "freezing" them in the cold head. The contaminants in the helium-gas circuit of the cryopump tend to become frozen inside the cold head. The longer the cryopump is operated beyond the one-hour period, the greater is the amount of contamination that becomes isolated inside the cold head
4. Shut down the cold head and compressor
5. Immediately disconnect the helium supply and return lines from the gas-supply and gas-return connectors at the rear of the compressor. Leave them attached to the cold head.
6. Attach the maintenance manifold to the disconnected ends of the return and supply lines.
7. Reduce the pressure in the cold head to a level of 30 psig by using the maintenance manifold. Reducing the pressure in the cold head to below 30 psig (200 kPa) may introduce more contaminants into the helium circuit. (Ignore this step if cold head was replaced or line failure lowered helium pressure to 0 psig)
8. Attach a two-stage regulator (0-3000/0-400 psig) and charging line to a helium bottle (99.999% pure). DO NOT OPEN THE BOTTLE VALVE AT THIS TIME. Purge the regulator and charging line as introduced in steps a through d below. Do not use helium gas that is less than 99.999% pure.
   a. Open the regulator a small amount by turning the adjusting knob clockwise until it contacts the diaphragm; then, turn approximately 1/8 to 1/4 turn more, so that the regulator is barely open.
   b. Slowly open the bottle valve, and purge the regulator and line for 10 to 15 seconds. Turn the regulator knob counterclockwise until the helium stops flowing.
   c. Loosely connect the charge line to the 1/8-inch Hoke valve on the maintenance manifold.
   d. Purge the charge line again, as in step a, for 30 seconds, and tighten the charge line flare fitting onto the Hoke valve while the helium is flowing.
9. Perform in sequence:
   a. Backfill the cold head with helium to a static charge pressure of 195-205 psig (1345-1415 kPa) by adjusting the regulator to the required pressure, and opening the Hoke valve on the manifold. Close the Hoke valve when the pressure is correct.
   b. Depressurize the cold head to 30 and 50 psig 200 and 330 kPa) by slowly opening the ball valve and allowing the helium to bleed out slowly. Do not reduce the pressure to less than 30 psig or the cold head may be further contaminated.
   c. Perform the flushing steps a and b four more times.

d. Pressurize the cold head to a static charge pressure of 195- 205 psig (1345-1415 kPa) and run the cold head drive motor for 10 to 30 seconds.

e. Perform steps b through d four more times for a total of 25 flushes and 5 drive-motor runs.

10. Verify that the cold head is pressurized to the static charge pressure of 195-205 psig (1345-1415 kPa).

11. Disconnect the maintenance manifold from the helium return and supply lines.

12. Reconnect the helium return and supply lines to the return and supply connectors at the rear of the compressor. The cryopump is now ready for operation.


## Adding Helium Gas to Compressor Procedure

### This procedure is to be used:

A. Normal operational adjustment
B. Line failure


1. Remove the flare cap of the gas charge fitting on the rear of the compressor.

2. Loosely attaching a charging line from the helium pressure regulator on the helium pressure bottle to the 1/4 inch male flare fitting installed on the helium charge valve. A user-supplied helium charging line terminating in a 1/4 inch female flare fitting and a pressure regulator rated at 400 psig delivery pressure is required.

3. Set the helium pressure regulator to 10 to 25 PSI. Allow helium gas to flow through the charging flare fitting for 30 seconds to purge the charging line of air. Then tighten the flare nut at the end of the charge line.

   a. If the compressor is running under normal operating conditions, set the helium pressure regulator to 325 PSI and slowly open the helium charge valve in the rear of the compressor. When the helium supply pressure gauge rises to 250 to 260 PSI, tightly close the charger valve.

   b. If the compressor is not running, set the helium pressure regulator to 250 psig and slowly open the helium charge valve. When the helium supply pressure gauge rises to 190 ±5 PSI, tightly close the charge valve.

4. Insure that the helium charge valve on the compressor is tightly closed. Then shut off the helium pressure regulator on the helium bottle. Remove the charging line from the male flare fitting and reinstall the flare cap.

## Good scan_check

```
2021.074.14:17:56.10?ERROR rz   -2 rdtcd: multicast may not be running, no message received
2021.074.14:18:03.20;mk6=record=on:10:10:test1
2021.074.14:18:04.22/mk6a/!record=0:0;
2021.074.14:18:09.68;mk6=record?
2021.074.14:18:09.71/mk6a/!record?0:0:recording:1:test1a;
2021.074.14:18:10.76?ERROR rz   -2 rdtca: multicast may not be running, no message received
2021.074.14:18:17.12?ERROR rz   -2 rdtcc: multicast may not be running, no message received
2021.074.14:18:17.12?ERROR rz   -2 rdtcb: multicast may not be running, no message received
2021.074.14:18:17.12?ERROR rz   -2 rdtcd: multicast may not be running, no message received
2021.074.14:18:20.72;mk6=scan_check?
2021.074.14:18:21.50/mk6a/!scan_check?0:0:12:1:expxx_stnxx_test1a:4:-:OK:vdif:2021y074d14h18m04s:9.610:9.883:
8.227:0;
```

## Bad scan_check

```
2021.075.05:49:51.07/mk6a/!scan_check?0:140:12:383:vo1074_wf_075-0548:4:-:data?:vdif:2000y001d00h00m00s:0.000
:0.000:0.000:0;
2021.075.05:49:53.10;mk6=record=2021y075d05h52m28s:30:30:075-0552:vo1074:wf;
2021.075.05:49:54.12/mk6a/!record=0:0;
2021.075.05:52:24.65;mk6=rtime?8192;
2021.075.05:52:24.68/mk6a/!rtime?0:0:12:8192:20068.359375:20550:32000;
2021.075.05:52:28.00;mk6=rtime?8192;
2021.075.05:52:28.03/mk6a/!rtime?0:0:12:8192:20068.359375:20550:32000;
2021.075.05:52:32.06/mk6a/!dts_id?0:Mark6-5002:2.0.2-5:1.2;
2021.075.05:52:32.38/mk6a/!input_stream?0:0:rdbeB:vdif:8224:42:66:eth3:127.0.0.1:12000:0:rdbeC:vdif:8224:42:6
6:eth4:127.0.0.1:12000:0:rdbeA:vdif:8224:42:66:eth2:127.0.0.1:12000:0:rdbeD:vdif:8224:42:66:eth5:127.0.0.1:12
000:0;
2021.075.05:53:28.00;mk6=rtime?8192;
2021.075.05:53:28.04/mk6a/!rtime?0:0:12:8192:20068.359375:20550:32000;
2021.075.05:53:28.04;checkmk6
2021.075.05:53:28.05/mk6a/!record=0:0;
```
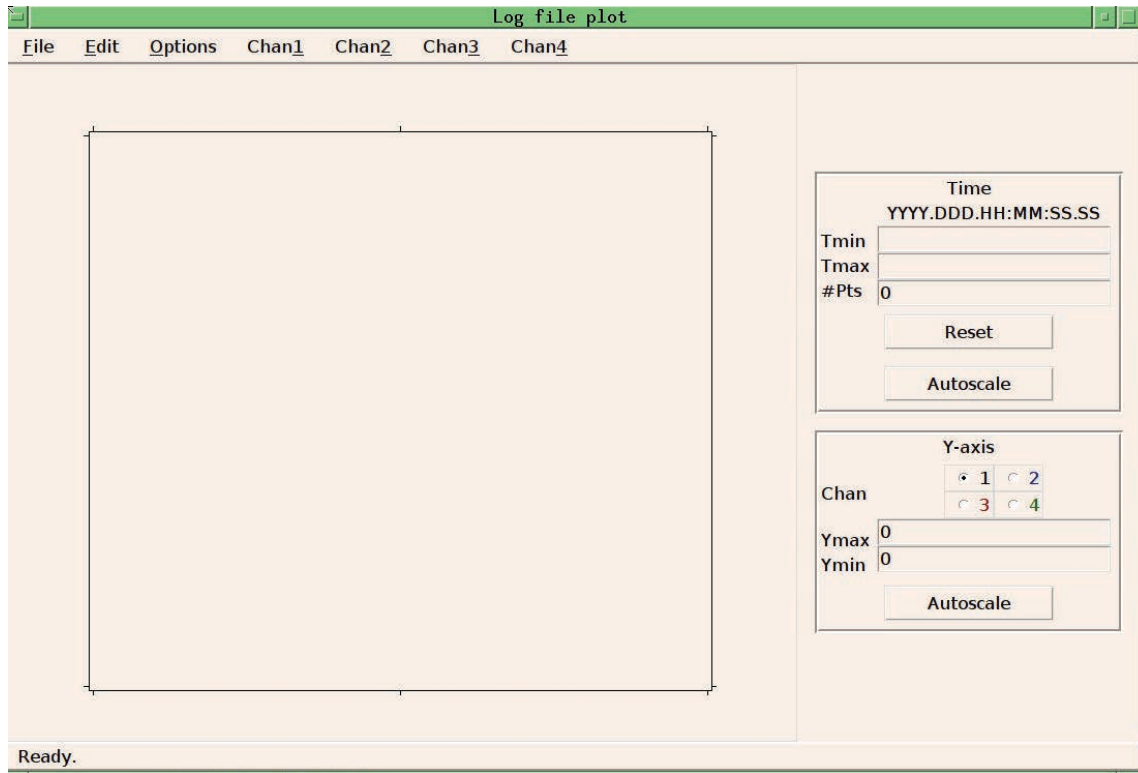
r2dbe power in fs

```
2021.119.18:00:04.34/rdbe_attend/.,.0,7.0,24.6,1,0.0,18.9
2021.119.18:00:04.34/rdbe_attenb/.,.0,2.5,23.8,1,0.0,14.9
2021.119.18:00:04.34/rdbe_attenc/.,.0,3.0,24.2,1,0.0,15.6
2021.119.18:00:04.34/rdbe_attena/.,.0,0.0,21.8,1,0.0,13.9
```
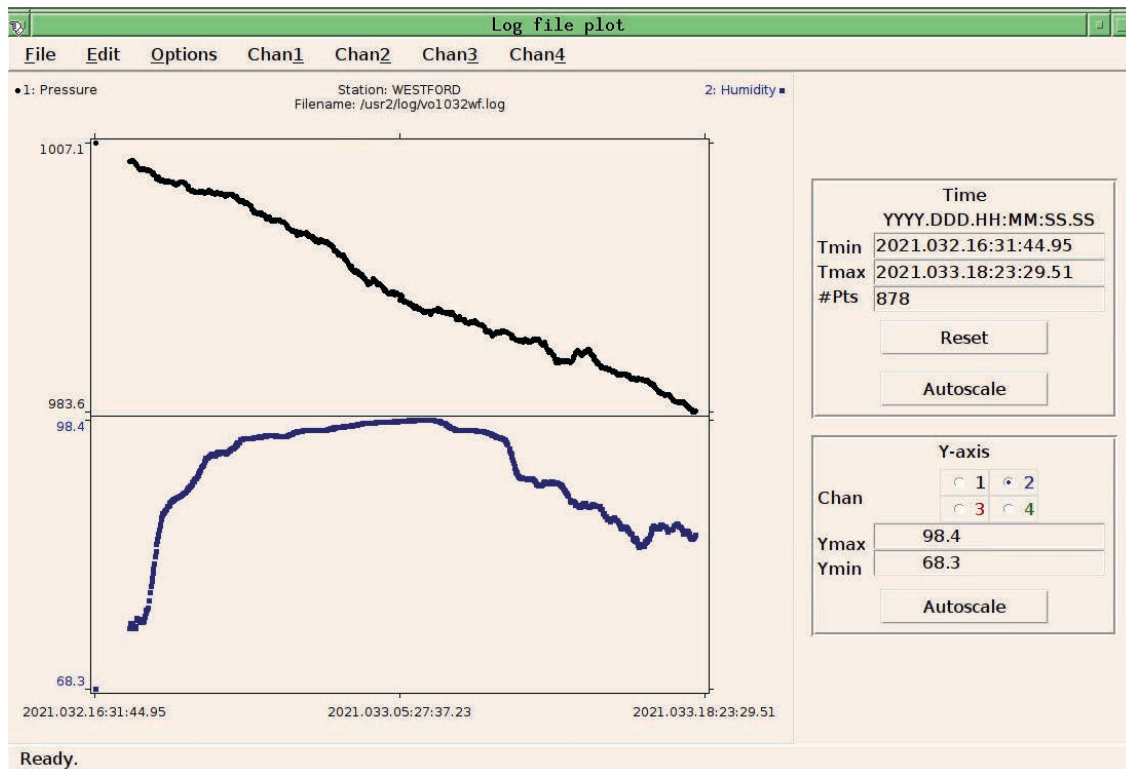
time example

```
2021.074.18:00:06.45/rdbea/!dbe_pps_offset?0:-7.8125e-09;
2021.074.18:00:06.45/rdbec/!dbe_pps_offset?0:-7.8125e-09;
2021.074.18:00:06.45/rdbeb/!dbe_pps_offset?0:-7.8125e-09;
2021.074.18:00:06.45/rdbed/!dbe_pps_offset?0:-7.8125e-09;
2021.074.18:00:06.45/rdbeb/!dbe_dot?0:2021-074-18-00-06.457s:58.448s:42;
2021.074.18:00:06.45/rdbed/!dbe_dot?0:2021-074-18-00-06.457s:28.747s:42;
2021.074.18:00:06.45/rdbec/!dbe_dot?0:2021-074-18-00-06.457s:28.979s:42;
2021.074.18:00:06.45/rdbea/!dbe_dot?0:2021-074-18-00-06.457s:72.897s:42;
2021.074.18:00:06.46/rdbec/!dbe_gps_offset?0:3.7961e-05;
2021.074.18:00:06.46/rdbeb/!dbe_gps_offset?0:3.7953e-05;
2021.074.18:00:06.46/rdbea/!dbe_gps_offset?0:3.7953e-05;
2021.074.18:00:06.46/rdbed/!dbe_gps_offset?0:3.7957e-05;
```
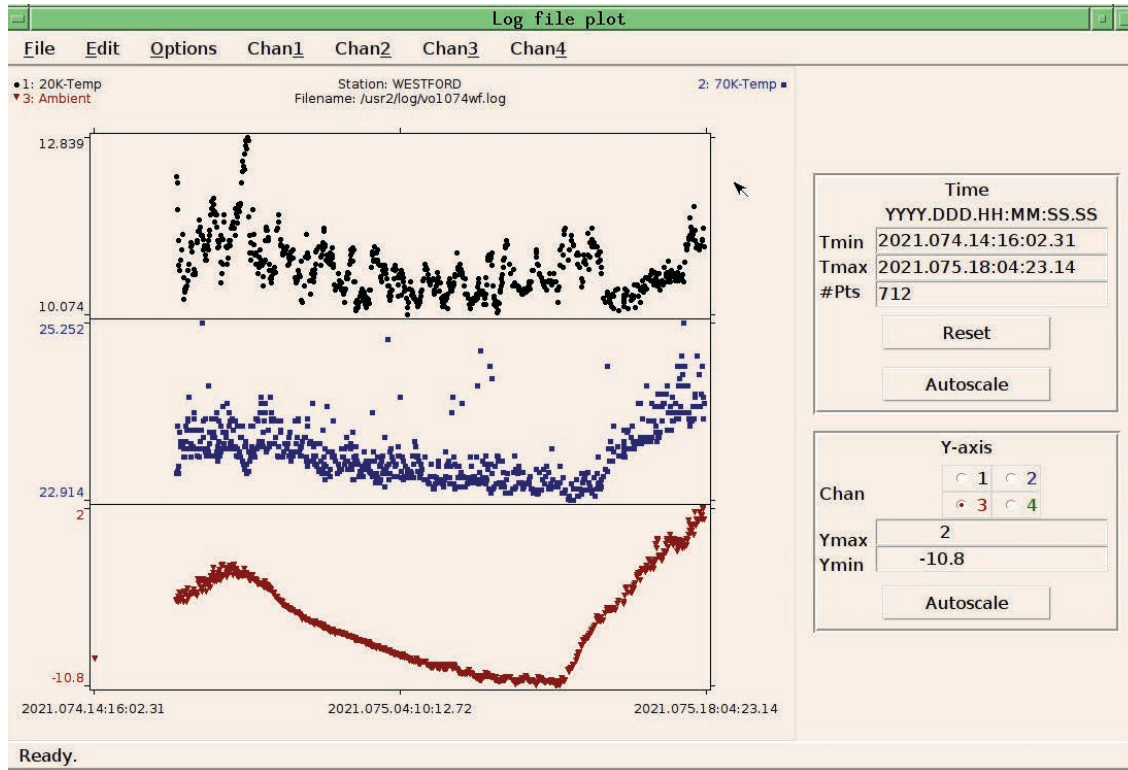
logpl1



logpl2

logpl3



logpl4

| | A | B |
|---|---|---|
| 1 | **Date** | _____ |
| 2 | fesh -d <sched>  Automatically gets files and creates session files | |
| 3 | check_ntp    Verify the NTP is sync'd | |
| 4 | log=<schedule name><station id>    vo1119wf | |
| 5 | rdbe_status            0x0941 | |
| 6 | mk6=dts_id?            !dts_id?0:Mark6-5002:2.0.2-5:1.2; | |
| 7 | Confirm MCI is running by viewing display and confirming clock is running | |
| 8 | mk6=msg?    clears mark6 message queue | |
| 9 | mk6=mstat?1   Query for group 1 | |
| 10 | If needed erase module: | |
| 11 | mk6=group=unprotect:<group> | |
| 12 | mk6=group=erase:<group> | |
| 13 | If needed initialize module: | |
| 14 | mk6=mod_init=<slot>:<#disks>:<msn>:<type>:new   **mk6=mod_init=1:8:HAY%0001:sg:new** | |
| 15 | Create, Mount, and Open the module for operations | |
| 16 | mk6=group=new:<slots>     mk6=group=new:1 | |
| 17 | mk6=group=mount:<slots> | |
| 18 | mk6=group=open:<slots> | |
| 19 | mk6=group?    Confirms if group is created properly | |
| 20 | time          This will display the RDBE pps,dot, and gps | |
| 21 | If there needs to be a time correction use the fmset command | |
| 22 | mk6in  Confirms RDBE data is streaming  Note: not working in CentOS | |
| 23 | If needed to re-initialize the RDBE: | |
| 24 | ssh oper@wfmark5-19      cd /srv/r2dbe_software | |
| 25 | ./r2dbe_init_<id>  id is either a,b,c,d, all | |
| 26 | wait for message "configured successfully"  run setupbb again to set chsel | |
| 27 | Start pointing checks: | |
| 28 | proc=point | |
| 29 | initp | |
| 30 | casa | |
| 31 | proc=<schedule name><station id>    vo1119wf | |
| 32 | setupbb | |
| 33 | ifdbb | |
| 34 | mk6bb | |
| 35 | rdbe=dbe_atten= | |
| 36 | proc=point | |
| 37 | onsource | |
| 38 | fivept   Westford normal offsets less than .025 degrees | |
| 39 | onoff     Sefd numbers 2000-5000 are normal   Note: not working with R2DBEs | |
| 40 | azeloff=0d,0d | |
| 41 | mk6=input_stream? | |
| 42 | mk6=record=on:30:30 | |
| 43 | mk6=record? Do this command while recording to show status | |
| 44 | mk6=rtime?        Displays recording space left on disk | |
| 45 | mk6=scan_check? | |
| 46 | start_mlog      This starts the multicast data   Note: not working with R2DBEs | |

| | A | B |
|---|---|---|
| 47 | Send Ready Message | |
| 48 | Startremote | |
| 49 | Schedule=<session><station id>,#<nnn> | |
| 50 | Send Start message | |
| 51 | Control Shift K   This opens a window displaying scan_cheks from active log file | |
| 52 | Monitor session and enter hourly WX, and operational comments | |
| 53 | End of Session: | |
| 54 | schedule= | |
| 55 | stop_mlog   Note: not working with R2DBEs | |
| 56 | Send Stop message | |
| 57 | Do pointing checks: | |
| 58 | proc=point | |
| 59 | initp | |
| 60 | casa | |
| 61 | proc=<schedule name><station id>    vo1119wf | |
| 62 | setupbb | |
| 63 | ifdbb | |
| 64 | mk6bb | |
| 65 | rdbe-dbe_atten= | |
| 66 | proc=point | |
| 67 | fivept | |
| 68 | onoff            Note: not working with R2DBEs | |
| 69 | azeloff=0d,0d | |
| 70 | Send tests scan to the correlator: | |
| 71 | From the Mark6 terminal: | |
| 72 | gator <slots> <scanname>.vdif ~/ | |
| 73 | Wait till the prompt reappears:  ~5 minutes | |
| 74 | dqa –d <scanname>.vdif | |
| 75 | Wait till prompt reappears ~ 5 minutes | |
| 76 | Send  4 files to Haystack: | |
| 77 | scp <scanname>_*.vdif evlbi1.haystack.mit.edu:/data-st11/vgos/ | |
| 78 | Wait for confirmation from correlator that all data look good Make sure to delete old test scans | |
| 79 | Procedure to remove module for shipping: | |
| 80 | mk6=group=close:<slots> | |
| 81 | mk6=group=unmount:<slots> | |
| 82 | Turn key OFF on disk module | |
| 83 | mk6=mstat?all | |
| 84 | Transfer log session file | |
| 85 | log=station | |
| 86 | Open terminal window | |
| 87 | plog –l        This is an "L" | |