VLBA ACQUISITION MEMO #289

RECORDER TEST PROCEDURES

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The purpose of this memo is to specify certain tests which the VLBA software can routinely carry out to check out the VLBA recording system. Two categories of tests are covered. The first group of tests should be carried out while the VLBA recording equipment is being used for observing. These tests verify that the equipment is or isn't working properly for the current observation. Tests which involve playback of tapes are included here, because a convenient time to playback a tape is after the tape has been recorded, and before the tape has been removed by the site technician. The other group of tests must be carried out when the recording system is not being used for astronomy. These tests include comprehensive tests which are designed to uncover any problems with the equipment. Some tests are applicable in both situations, as noted in the memo. VLBA Acquisition memo #224 has already been written on this subject by Alan Rogers, and parts of that memo are repeated here.

TESTS WHILE SYSTEM IS BEING USED FOR OBSERVING

1. Bypass Verify

Use the mini decoder to decode time and track ID on all tracks which are assigned. Report back any errors, specifying whether time or track ID, or both cannot be decoded. This test may be done at any time when the recording heads are enabled.

2. Phase Cal Verify

Use the Quality Analyzer to extract Phase Cal tones on each assigned track. The Phase Cal parameters which must be passed to the formatter are to be sent at the beginning of the experiment, so that the formatter will not require a configure command during observing. This test is presently limited to S band and X band observing at the sites where Phase Cal has been installed. Any failure of this test should be reported. A suggested definition for a failure is an amplitude below 2%, and 2 consecutive phase readings which are more than 2 degrees different. (These limits may change as we learn more about how the phase cal works) Bypass mode is used to do this test, so the test must be carried out when the recording heads are enabled.

3. Recording Quality Verify

Play back parts of the tape, checking all tracks which were assigned. The check should include decoding the time and track ID, and taking error rates. Once the time and track ID are decoded, a check should be done to be sure that the time is the time expected, and the track ID is for the track that is expected. The error rates should meet the VLBA specification of 3×10^{-4}. Any check which fails should be reported.

4. Headstack Parameter Verify

Select a track which has been written on the tape, but do not select track 0 or track 35. Play the tape, and use the mini decoder to verify that the track has been found. Then, move the headstack +698.5 microns, and peak up the headstack on the selected track n, using head n-1. Then, move the headstack to -698.5 microns from the original position and peak up the headstack on the selected track n, using head n+1. When peaking the head, be sure that a track really is

found. This can be accomplished by checking the track ID with the mini decoder. Report an LVDT scale factor error if the track is not found within 10 microns of the expected location. Also, check the forward to reverse offset by playing back the selected track in reverse, and peaking on the track to be sure that it is within 8 microns of the expected location. Report an offset error if the headstack position is not within this range.

5. Bandpass Verify

Use the mini decoder to capture some data from each assigned track, perform software autocorrelation and transform to bandpass. Bandpasses can be obtained to within 10% with about 1000 bits correlated for each of 8 lags. Report anomalous bandpass shapes. This check must performed at a time when the recording heads are enabled.

OTHER TESTS

1. Zero Baseline Check

A zero-baseline test is one in which artificial fringes are obtained from a single station. Traditionally this test has been made by leaving the odd-numbered baseband converters set as if being used in an experiment. The even-numbered converters are then set to the same sequence as the odd. Thus converters 1 and 2, for example, will be looking at the same frequency band and their outputs should be perfectly correlated. The correlation phase however, while repeatable, will be arbitrary since no two converters have exactly the same cable lengths. The baseband converters which are to be correlated with each other are directed to tracks which may be simultaneously saved in the Data Buffer Module of the Formatter. Since up to 4 tracks may be saved at once in the Data Buffer Module, 2 correlations may be performed with a single "grab" of data. After the tracks have been saved in the Data Buffer Module, a correlation can be performed on the station computer. Any failure to correlate should be reported. Since there are 16 sidebands at a station, a full Zero Baseline Check would require 8 "grabs" of data.

2. BYPASS VERIFY

This test is identical to the test in part 1 of the first section, except that all 36 of the tracks are to be tested. This test is to be done on both tape recorders at the site. Report back any errors.

3. CHECK QUALITY ANALYSIS SYSTEM

A. CHECK FOR CLOCK ERRORS

Check the error flags to see if the channel A or channel B clock is missing (bits 12 and 13 of address 0x2247). Report the error, if one exists.

B. DECODE AUXILIARY DATA AND TIME

This test is to be performed on each of the two tape recorders at a site. The recorder is selected in address 0x2399. The tape recorder must be in bypass mode with the recording heads enabled for the rest of the Quality Analysis module tests. Select a track for channel A and another for channel B in the tape recorder. Use the Quality Analysis module to decode the auxiliary data and timecode for channel A and channel B. The field to capture is selected in address 0x239A, and the start capture command is in address 0x2389. Report any errors if the expected track ID and timecode are not found. Note that Mark III format must be used in order for the proper track ID to be found.

C. CHECK FOR PARITY, RESYNC, NOSYNC, AND CRCC ERRORS

In bypass mode, no errors should be found. Cycle through all tracks, two at a time, and do an error check on each pair of tracks. To do the error check on a pair of tracks, the quality analysis must be started by sending a command to address 0x2388, and stopped 1 second later by a command to the same address. The results must be taken from the formatter array which is located at addresses 0x23C8 - 0x23CB. Check to see that the total number of samples for channel A and channel B are approximately equal to the sample rate at which the formatter is set. Report an error if this is not the case. Also check to see that the error counts are zero for the various kinds of errors. If they are nonzero, report the errors.

CHECK MOVEMENT OF HEADSTACK

Move the headstack 4 times; 10 microns in the in direction, 200 microns in the in direction, 10 microns in the out direction, and 200 microns in the out direction. After each movement, check that the headstack reached the expected destination. Report an error any time that the headstack does not reach its expected destination.

CHECK MOVEMENT OF TAPE

Load the tape (if necessary), turn off the recording heads, and run the tape about 1000 feet forward, then 1000 feet in the reverse direction. Report an error if anything unexpected happens, such as being unable to load the tape, or the tape recorder losing vacuum while the tape is moving. Check the reel counters each time they are read by the station computer to be sure that are moving in the expected direction. This check should only be done when the tape is moving at full speed, not when the tape is ramping. After power up, the numbers in these counters are meaningless until the tape has moved. If the reel counters change direction when the tape doesn't change direction, report an error.

PHASE CAL VERIFY

This test verifies much more than the recording system. For the recording system, the test verifies that the sampled data is finding its way all the way through the formatter and tape recorder, and back to the formatter Quality Analysis module. For the rest of the system, it can verify the path of the data all the way from the receiver to the recording system. To thoroughly test all possible data paths through the formatter is impractical because it would take hours. Instead, I suggest that for each BBC sideband the following test be done. Assign tracks 2 and 3 to the sideband which is being tested, and disconnect the other tracks from any sampler output. Then, check for phase cal tones on all tracks twice. Report errors if tones are found on tracks which are not assigned to a baseband converter, or if tones are not found on the assigned tracks. Report an error if the phase is unstable. Do the same test for each sideband of each baseband converter, but assign the next two tracks each time. After all 16 sidebands have been tested, all 32 data tracks will also have been tested. If it is desired to check all 4 IFs, a part of this test could be repeated for each IF. If phase cal injectors are not available, two baseband converters can be used to create a tone which can be detected by the phase cal detector.

BANDPASS VERIFY

The same test as described in the first section can be done during a thorough check of the system.