Mark5C Voltage and Temperature Measurements

Walter Brisken, Bob McGoldrick, Doug Gerrard & Steve Durand

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Abstract Here we examime two environmental factors that may contribute to an unacceptably large failure rate of Mark5C disk recording in recent tests. The temperature of operating Mark5C modules, 28 to 39 C as indicated by data reported through the disks' SMART system, indicate compliance with the specified operating range of 5 to 55 C. The voltages going to the disks, measured on the module back-plane, hint at a possible under-voltage, especially when two modules are powered on. Specifically, the 5 V and 12 V supplies were seen as low as 4.8 V and 11.2 V respectively. Specifications for voltage when operating could not be found.

1   Introduction

The VLBA antennas are now all outfitted with Mark5C recorders attached to ROACH Digital Back-ends (RDBEs). The Mark5C is an evolution of the previous Mark5A and Mark5B recorders. With the Mark5C, the baseband data enters the unit through a 10 Gb Ethernet port sitting on a daughter board which itself is directly attached to the Amazon disk controller card.

In recent tests of the combined RDBE/Mark5C systems we have encountered a large number of Mark5 errors. In one particular test, 3 of 9 modules had problems requiring intervention before recording could ensue. Many potential contributers to the failures were identified including the operating environment of the disks, software/firmware, handling of modules, mating of the modules to the backplanes, and disk infant mortality. This memo investigates two envirnomental factors that were deemed potential causes of poor reliabiity: voltage and temperature.

2   Description of module problems

All discussion in this memo refers to Mark5C modules composed of 2 TB Western Digital RE4 drives with model number WD2003FYYS. The Haystack Disk Recording System (DRS) software is used for collection of data. Module maintenance is performed using DRS to some extent and also some software tools that are part of the DiFX software correlator utility suite.

Two kinds of problemss have been common. In one case, recording of one scan is successful, but recording fails on subsequent scans. A reboot is not enough to correct this problem. A module erasure allows one scan to be written with errors on subsequent scans. The second causes the Mark5C unit to hang when the DRS program or a different utility initializes the Mark5C module. For both cases the disks themselves seem not to be damaged as they worked when returned to Socorro.

3   Voltage measurements

To investigate disk drive voltages within the Mark5C units, a SATA module shell had several wires in a bundle soldered to power line traces on the module backplane. Both the 5 V and 12 V traces near disks 0 and 4 were measured. Testing used a correlator Mark5 unit (stripped-down Mark5A; i.e., no I/O card) with a Turbo Cool 510 XE power supply. The design of the SATA module places disks 0 to 3 (disks closest to the handle) on one power bus and disks 4 to 7 (back of the module) to another. This is apparently used to stagger the disk spin up. Figure 1 shows the four voltage measurements over the course of 40 seconds after module power-on measured while the other disk module was powered on.

The 5 V power was seen to drop as low as 4.8 V and the 12 V to 11.2 V, both in a transient manner during initialization. The steady state 12 V supply to disks 0 to 3 returned to a full 12 V after initialization,
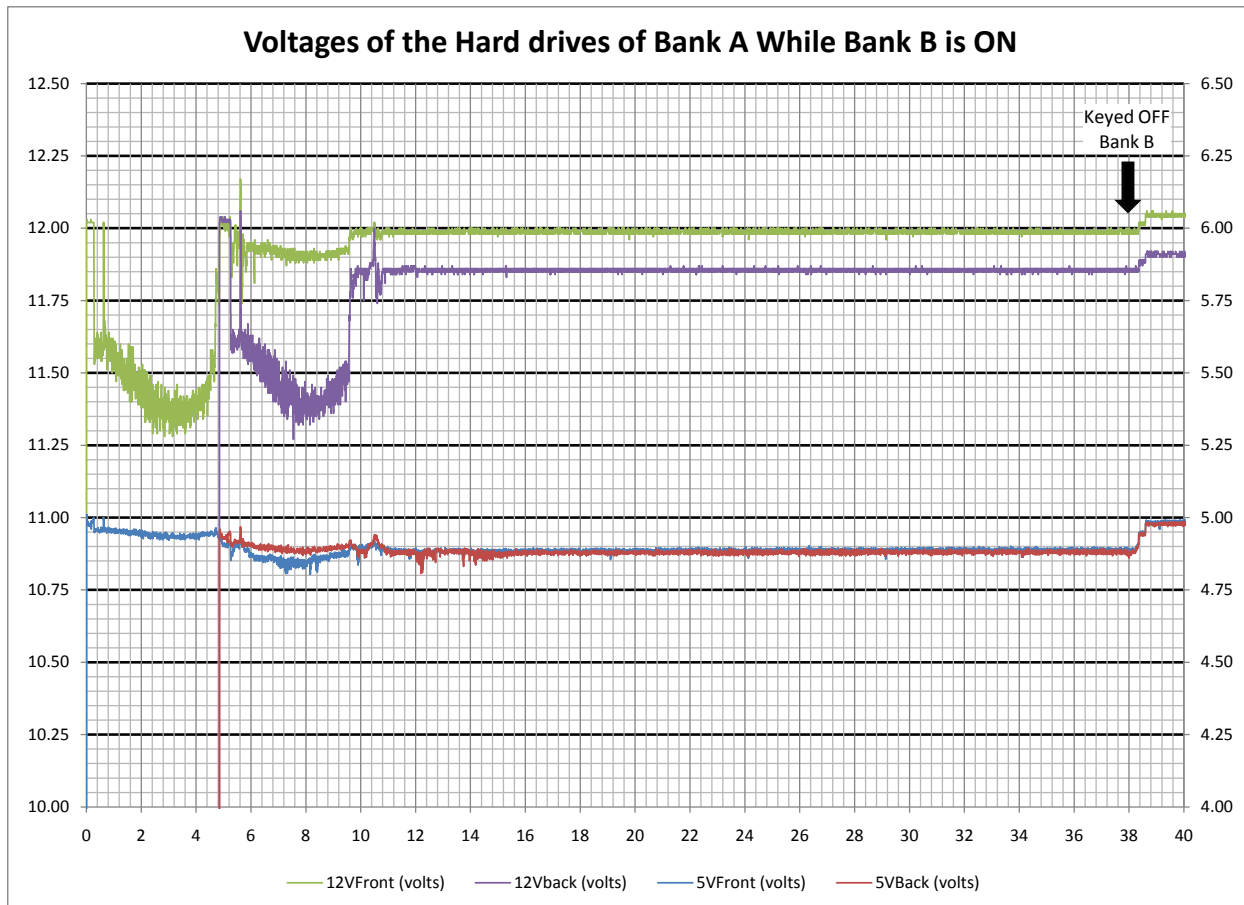
Figure 1: This figure shows the voltages measured on a module during its spin-up and initialization in the case that a disk module is already powered on and in steady state in the other bank. The green and purlple traces show the 12 V power to disks 0 and 4 respectively (see left hand scale). The blue and red traces show the 5 V power to disks 0 and 4 (see right hand scale).

but the 12 V supply to disks 4 through 7 recovered only to 11.85 V and both 5 V supplies levelled off just udner 4.9 V. No documentation could be found indicating minimum and maximum voltages for operation.

4 Temperature measurements

The Mark5C units at the VLBA sites are housed inside racks that are fed cold air from the bottom. While designed with good engineering practices, no measurements had been previously made to evaluate the cooling within the rack. A piece of software (DiFX utility `vsn`) was modified with an option that allowed it to query the Self-Monitoring, Analysis and Reporting Technology (SMART; http://en.wikipedia.org/wiki/S.M.A.R.T.) system of the disks within a Mark5 module using the StreamStor API function `XLRReadSmartValues()`. SMART monitor point with ID 194 reports the internal disk temperature and is supported by the model of disk drive used in the modules being tested. Correct operation of this utility was tested by installing a room temperature disk in a Mark5 unit installed at the correlator which blows ambient air over the disks. Temperature readings of 22 to 23 C were reported in all modules tested immediately after power on. After 30 minutes the temperature rose typicall to 34 to 38 C. In all cases there was a 2
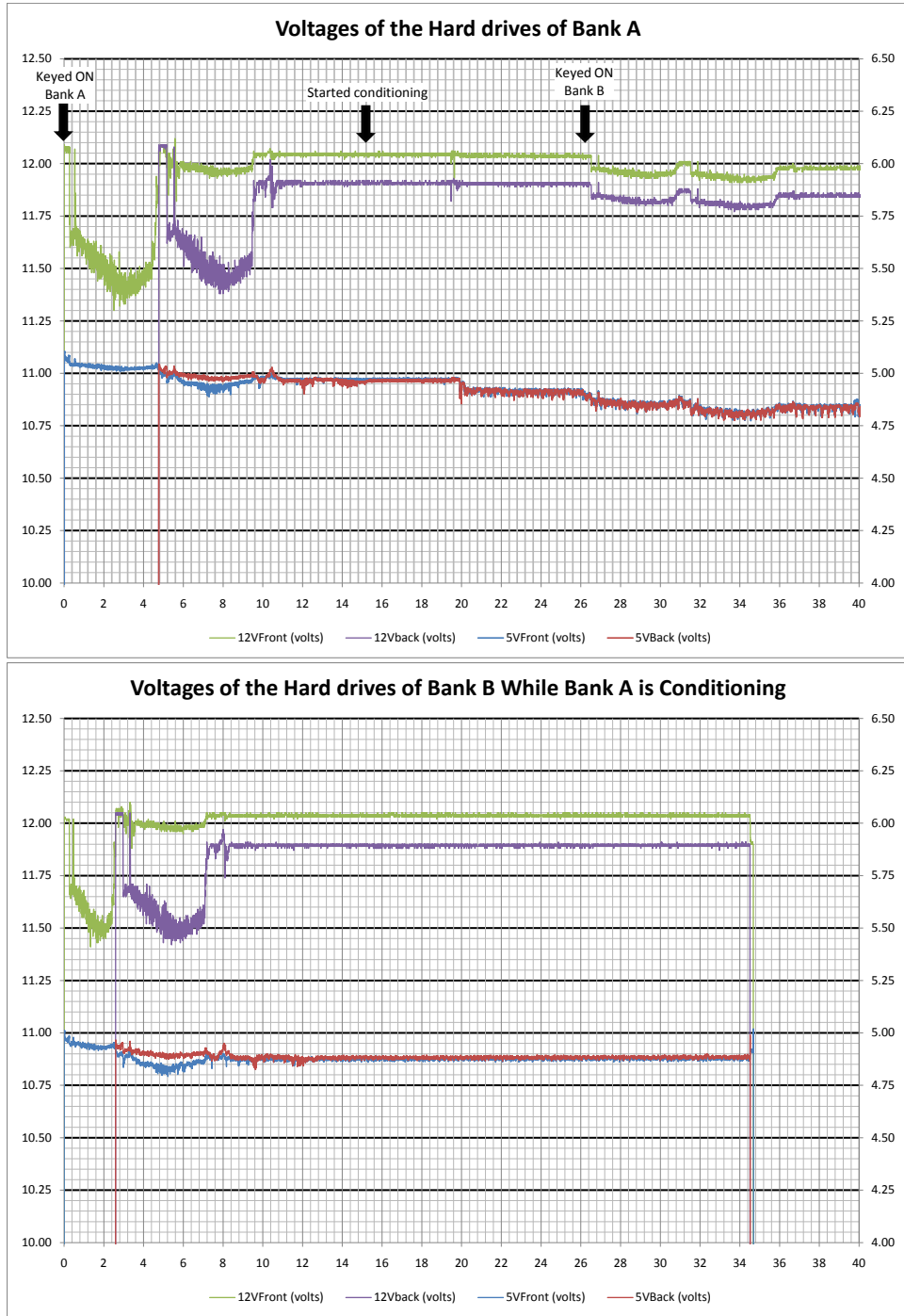
Figure 2: Similar to Figure 1 but in two different situations. Top: Module in bank A is measured while it is turned on, started conditioning, and the other bank is turned on. Bottom: Module in bank B is measured while module in bank A is turned on and conditioning is started.

to 4 C increase in drive temperature from disk 0 (front) to disk 7 (back). The same test was performed on modules that had been running for hours within Mark5C units at the BR, MK, NL, PT and SC VLBA antennas. All disks were found to have temperatures in the 28 to 39 C range. The specification document for the particular drive suggests an operating temperature range of 5 to 55 C. These tests strongly suggest that operating temperature is not a likely contributer to failure.