# PHASIC Testing Environment and Software for STEREO

Andrew Davis, November 15, 2013

This document documents the test setup and software/scripts used for testing the STEREO PHASICS, circa 2003.

The purpose of this document is to document what was done for STEREO, and to inform/guide the design of the SPP PHASIC test program.

## Testing Environment

Testing was performed in Downs Lab 5B.

The test hardware setup consisted of

* An operator (human). The tests were partially-automated, but required human intervention at various stages of each test.
* A test board with a MISC processor, with a socket for the PHASIC to be tested.
* A NIM crate, containing a DC voltage reference. The voltage reference was connected to some [unknown] inputs on the test board, and was controlled by Forth software running on the MISC.
* A Keithley 197A Digital MultiMeter (DMM). This DMM was connected by the operator to DVM+ and DVM- test points on the test board at various stages of each test. This DMM had a GPIB interface that was used to automate its configuration and the acquisition of its measurements.
* A DC calibrator (EDC). This EDC had a GPIB interface that was used to automate its configuration and the setting of its voltage.
* An Airjet temperature inducer, used to control the temperature of the PHASIC. This instrument was controlled manually by the operator.

A Linux workstation (named Lupi) was used to control the tests. The tests were partially-automated, with software on Lupi controlling several pieces of test hardware. Via a GPIB interface, Lupi controlled the Keithley DMM, and the EDC Calibrator. Via a serial RS422 interface, Lupi sent commands to the MISC, and acquired test data from the MISC.

The test software prompted the operator to perform various functions during the test, e.g. recording power-supply currents, changing Airjet temperature settings, etc.

Since Lupi was a Linux box, a custom Linux kernel with appropriate drivers was installed to enable software control of the GPIB and RS422 hardware interface cards. NOTE: This was year 2003. Today, if we decided to use Linux, we would likely use Ethernet-GPIB and Ethernet-RS422 adapters to avoid the need for maintaining Linux GPIB and RS422 drivers.

All test data were logged by the software to files on Lupi for subsequent analysis.

## Software Description

The STEREO PHASIC test software is archived on the SRL UNIX servers at

* /home/stereo/linux/vlsitest (contains the scripts used to run the tests)
* /home/stereo/linux/gpib (contains C src code for gpibcontrol program used to communicate with the GPIB devices)

The Expect scripting language (<http://en.wikipedia.org/wiki/Expect>) was used to control the test flow. Expect is designed to make it easy to manage I/O with multiple devices/terminals/programs from within a single script. Two Expect scripts were used, archived in /home/stereo/linux/vlsitest:

* run\_test\_T: used to run the test suite at 5 preset temperatures (-35C, -15C, 5C, 25C, 45C)
* run\_test\_rt: used to run the test suite at a single temperature (usually room temp)

All of the logfiles produced by these scripts during the STEREO tests are archived in

* /home/stereo/linux/vlsitest /logs

## Test Flow

A summary description of the test flow orchestrated by the run\_test\_T script is presented. The details of the MISC commands, etc. may be found in the script itself (/home/stereo/linux/vlsitest /run\_test\_T).

Many of the tests are initiated by sending a single Forth command to the MISC, which causes the MISC to a series of tests. These Forth commands are defined in /home/stereo/linux/vlsitest/phatest10.f, which is uploaded to the MISC at the start of each test. The test results are transmitted to Lupi by the MISC, over the serial command port, and the run\_test\_X script takes care of logging all results to an appropriately-named logfile.

Unfortunately, I cannot recall any detailed descriptions of what the tests run by the MISC are actually doing (i.e. the Preout, CTEST, TSCAN tests, etc., mentioned below) These descriptions will need to be filled-in by Rick Cook, since they are not documented in phatest10.f.

* Initialize the RS422 serial port
* Prompt operator to enter serial number of the PHASIC being tested
* Initialize logfile (filename based on serial# and date).
* Spawn gpibcontrol program
* Prompt operator to turn on power to ammeters
* Prompt operator to turn OFF power to MISC
* Prompt operator to turn on power to DMM, MISC/PHASIC and set DC calibrator to remote operation.
* Initialize the DMM and configure (auto range, One-shot on GET, read w/prefix)
* Open RS422 serial port for MISC communication
* Initialize the DC Calibrator and set it to 4.0V
* Check that MISC is alive (send CR and check for “OK” response )
* Upload phatest10.f Forth code file to MISC
* Prompt operator to enter several power-supply current readings and the room temperature
* Prompt operator to enter bad channel numbers, if any
* Prompt operator to disconnect EDC (if connected) and to connect the DMM to DVM+ and DVM-
* Command the MISC to take some DC voltage/current measurements, and log the results
* Take some Preout DC measurements, and log the results
  + For each channel N
    - Prompt operator to connect EDC to channel N
    - Measure DMM voltage at EDC levels of 5.0, 5.0, 10.V
    - Command the MISC to take some measurements , and log the results
  + EndFor
* Set EDC back to 4.0V and prompt operator to disconnect EDC
* Command the MISC to take a series of Low-gain and Hi-gain DC measurements and log the results
* Proceed with a series of room-temperature CTEST measurements
  + Prompt operator to connect DMM to Vthresh test-point on test board
  + Measure DMM voltage, set Vthresh = voltage
  + Prompt operator to disconnect DMM
  + Define vmin=2.0, vmax=12.0, vinc=(vmax-vmin)/50
  + Set EDC to vmin
  + Prompt operator to connect EDC to Vthresh via 299kohm resistor, with Gnd clip connected Perform low-gain CTEST scan:
    - For idx=0; idx<=50; idx++
      * Set EDC voltage to (vmin + (idx \* vinc))
      * Send “LG-CTEST” command to MISC, and log the results
    - EndFor
    - Scan the results to find the highest EDC voltage at which all 16 channels are “quiet”. Set Vlgctest = voltage
  + Perform high-gain CTEST scan:
    - For idx=0; idx<=50; idx++
      * Set EDC voltage to (vmin + (idx \* vinc))
      * Send “HG-CTEST” command to MISC, and log the results
    - EndFor
    - Scan the results to find the highest EDC voltage at which all 16 channels are “quiet”. Set Vhgctest = voltage
* Calculate EDC voltage settings Vedct(t) for each of 5 preset temperatures (-35C, -15C, 5C, 25C, 45C) using CTEST results, Vthresh, and some external tables
* Set EDC to Vedct(25C)
* Prompt operator to confirm EDC setting, and EDC connection to Vthresh via 299kohm resistor
* Proceed with a series of room-temperature TSCAN measurements (Low-gain and High-gain)
  + Send “LG-TSCAN” command to MISC, and log the results
  + Send “HG-TSCAN” command to MISC, and log the results
* Proceed with a series of AC tests at 5 preset temperatures (-35C, -15C, 5C, 25C, 45C)
  + For Each Temp in (-35C, -15C, 5C, 25C, 45C)
    - Prompt operator to set Airjet temperature inducer to Temp
    - Set EDC to Vedct(Temp)
    - Send “ACTESTS” command to MISC, and log the results
  + EndFor
* Prompt operator to return Airjet to room temperature, turn off power to test setup, DMM, EDC, NIMBIN…
* Ask operator if an analysis of the test data should be performed, and a report generated. If operater answers “Yes”, then the run\_report\_T shell script called to analyze the data contained in the logfile, and to generate a report (se below).

## Analysis of Test Data

Two shell scripts were used to analyze test data and generate reports. These scripts used as input a logfile created by one of the run\_test\_X scripts. The analysis/report scripts are archived in /home/stereo/linux/vlsitest:

* run\_report\_T: used to analyze data generated by run\_test\_T (5 temperatures)
* run\_report: used to analyze data generated by run\_test\_rt (just room-temperature)

These scripts called other shell scripts, also archived in /home/stereo/linux/vlsitest . See adc\_cal\_analysis, adc\_cal\_analysis2, preout\_analysis, dc\_analysis, dc\_tabulate. Some of these scripts called Gaussian-fitting programs, plotting routines, etc.

The analysis produced reports on thresholds, gains, offsets, linearity, differential linearity, etc. as a function of temperature, for each of the 16 PHASIC channels.

Reports produced by these scripts are archived in

* /home/stereo/linux/vlsitest /reports