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Gravity Probe B Relativity Mission

RtWorks Spinup
SOFTWARE TEST PROCEDURE

P1067 Rev B
19 March 2004

Approvals

NAME	SIGNATURE	DATE
Pete Carley *LM, Designer*		
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Tom Langenstein ITAR Assessment Performed, ITAR Control Req'd? _____ ☐

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History

REV	DATE	AUTHOR	COMMENTS
-	9/10/2003	R. Sharbaugh	Initial version
A	11/7/2003	J. Qiu	MCR #258, control effort averaging functionality test added (section 8.6), version #s removed from section 7 table and average.c row added.
B	3/19/04	P. Carley	MCR #299 Gyro charge measurement test added Curve Fit Functionality Test Deleted as this capability has been removed.

1 SCOPE

This document details the software test procedure for the RtWorks displays used on POD[de][67]

2 OPERATIONAL PERSONNEL

Pete Carley
Jeff Wade
Qualified QA Rep: Kelly Burlingham

3 RISKS & CONSTRAINTS

Generic data used in all test cases herein may provide different results from live data.

4 APPLICABLE DOCUMENTS

Document	Document No.	ALIAS
POD Configurations at LM and SU	S0475	
MOC Configuration Control, IONET LAN	S0476	
MOC RtWorks Spinup SDD	S0928	

5 QUALITY ASSURANCE PROVISIONS

Quality Assurance must be given 24 hour notification before this test is run; presence is at their discretion.

QA Notified Date & Time: _____ By: _____ QA Initials: _____

6 TEST ENVIRONMENT

Software Configurations	Version Number
GNDR/T	

7 TEST CASES AND FILE VERSION MATRIX

See attachment for listing of files and their SCCS version numbers.

The following sections describes how to test

RtWorks Spinup Version _____

Start Date & Time: _____

Executed By: _____ Signature: _____

Witnessed By: _____ Signature: _____

8 SOFTWARE VERIFICATION PLAN

SDD Section	Test Case
5.1	Limit_Chk_Func
5.1	SpinSpeed_Func
5.1	Plot_Func
5.1	Spinup_Integrated_Test
5.1	Average_Test
5.1	Chg_Meas_Test
5.1	GMA_Flow

8.1 LIMIT CHECKING FUNCTIONALITY

8.1.1 TEST ID: Limit_Chk_Func

8.1.2 Introduction

This test will verify the limit checking capabilities of the Spinup HCI.

8.1.3 Test

Inputs: A message file will be used as input. The file will contain a predefined set of values. These values will violate limits for each group, one group at a time. A command file shall be created to use the message file as the data source.

Procedure: Start the Spinup HCI using a command file calling out the message file mentioned in the inputs section:

```
setenv RTHOME /apps/licensed/rtworks
source $RTHOME/bin/rtinit.csh
setenv LD_LIBRARY_PATH ${LD_LIBRARY_PATH}:/apps/licensed/matlab_lib/bin/sol2
setenv RTNOLICENSE 1
cd $BUILD_PATH/spinup/hci
```

```
spinup_hci -command $COMMON_PATH/spinup/tests/limit_chk.cm
```

Bring up the HCI control window via <CTRL>-W keyboard combination. Step through the message file one frame at a time by entering "run 1" in the control window. After the first frame, verify all template buttons are green, the top level view is nominal, and all the group values are green. Enter "run 1" again. This will set one value in the Gyro1 group to out-of-limits. Verify the Gyro1 template button turns red and the top level view Gyro1 box is blinking red. Verify the out-of-limits value on the group page is red. Another "run 1" will set the value back to its nominal value. Repeat these steps until all groups have been tested.

After groups are checked, select a different limit file from the Limit File selection menu. Verify changes to the group pages. Re-run the message file until all groups are verified.

8.1.4 Pass Fail Criterion

Success Criteria: When all values are nominal, the top level view shall have no blinking boxes. The template buttons shall be green. The actual values on group page shall be green. When a limit is violated, the corresponding group box on the top level view shall blink either red or yellow depending on the limit violation. The template button shall turn red or yellow. The out-of-limits items' actual value shall be displayed in red or yellow on the group page. When an out-of-limits item goes back in limits, the views shall return to nominal state. When a new file is selected, the new file contents are reflected in the group pages.

RESULTS:

COMPLETED: _____

QA: _____

PASS/FAIL: _____

8.2 SPIN SPEED CALCULATION FUNCTIONALITY

8.2.1 TEST ID: SpinSpeed_Func

8.2.2 Introduction

This test will verify the spin speed calculation of the Spinup HCI. It will also verify the functionality of the spin speed and spin speed derivative plots.

8.2.3 Test

Inputs: A message file will be used as input. The file will contain a predefined set of values so that the expected outputs shall be known and easily verified. The input values shall be such that the spin speed shall increase by known increments every frame while in FFT decimated mode. The FFT mode will then be set to non-decimated mode and the input values will then be such that the spin speed shall decrease by known decrements every frame. A command file shall be created to use the message file as the data source.

Procedure: Start the Spinup HCI using the command file mentioned in the inputs section:

```
setenv RTHOME /apps/licensed/rtworks
source $RTHOME/bin/rtinit.csh
setenv LD_LIBRARY_PATH ${LD_LIBRARY_PATH}:/apps/licensed/matlab_lib/bin/sol2
setenv RTNOLICENSE 1
```

```
cd $BUILD_PATH/spinup/hci
spinup_hci -command $COMMON_PATH/spinup/tests/spin_speed.cm
```

Bring up the HCI control window via <CTRL>-W keyboard combination. Step through the message file one frame at a time by entering "run 1" in the control window. After each frame, verify the spin speed and spin speed derivative values for each gyro. Verfiy the expected data is plotted. Repeat for each gyro view.

8.2.4 Pass Fail Criterion

Success Criteria: The spin speed and spin speed derivative shall be monitored to verify the correct values are displayed for each frame.

RESULTS:

COMPLETED: _____

QA: _____

PASS/FAIL: _____

8.3 PLOT FUNCTIONALITY

8.3.1 TEST ID: Plot_Func

8.3.2 Introduction

This test will verify the plots of the Spinup HCI.

8.3.3 Test

Inputs: A message file will be used as input. The file will contain a predefined values for each plotted item. A command file shall be created to use the message file as the data source.

Procedure: Start the Spinup HCI using the command file mentioned in the inputs section:

```
setenv RTHOME /apps/licensed/rtworks
source $RTHOME/bin/rtinit.csh
setenv LD_LIBRARY_PATH ${LD_LIBRARY_PATH}:/apps/licensed/matlab_lib/bin/sol2
setenv RTNOLICENSE 1
cd $BUILD_PATH/spinup/hci
spinup_hci -command $COMMON_PATH/spinup/tests/spinup_plots.cm
```

Bring up the HCI control window via <CTRL>-W keyboard combination. Run through the message file by entering "run" in the control window. Verfiy the expected data is plotted. Scale the plots as necessary by positioning the cursor over the desired plot, middle clicking, and selecting Y-axis->Scale to Data. Restart the message file by entering the "run" directive as necessary for all views.

8.3.4 Pass Fail Criterion

Success Criteria: The X and Y ranges are set as expected from the spinup_plot_ranges.dat file. The data is plotted correctly as the message file runs.

RESULTS:

COMPLETED: _____

QA: _____

PASS/FAIL: _____

8.4 SPINUP HCI INTEGRATED TEST

8.4.1 TEST ID: Spinup_Integrated_Test

8.4.2 Introduction

This test will verify the Spinup HCI's integration with the GndRT system.

8.4.3 Test

Inputs: The ITF will be used to provide data to the Pod. The MOC shall be used with Pod D as the main pod and Pod E in shadow mode. The Spinup HCI shall receive its data from Pod D.

Procedure: Start the Spinup HCI using the start_spinup_hci script on pod workstations D6 and E6:

```
$BUILD_PATH/spinup/start_spinup_hci
```

While in 32K format, log several events (log mission_spcp event with eventnumber #) and verify results on both Pod D and E. Verify vehicle time on both pods and Spinup HCI. Load the 2K Spinup Format. Verify the spin speed calculation is active and all plots are active.

8.4.4 Pass Fail Criterion

Success Criteria: Verify logged events and vehicle times are consistent. Verify data being received on Spinup HCI. Verify spin speed, charge measurement values being calculated. Verify plots are active.

RESULTS:

COMPLETED: _____

QA: _____

PASS/FAIL: _____

8.5 CONTROL EFFORT AVERAGING FUNCTIONALITY

8.5.1 TEST ID: Average_Test

8.5.2 Introduction

This test will verify the control effort average calculation for the Spinup HCI .

8.5.3 Test

Inputs: A message file will be used as input. The file will contain a predefined set of values so that the expected outputs shall be known and easily verified. The input values shall be such that the

control efforts for each gyro and axis shall increase by known increments every 10 frames. The input values will stabilize for several frames before decreasing by known decrements to another value. The input will again stabilize for several frames before increasing to the same higher value. The input will stabilize at this value for several frames before decreasing to the same lower value, at which the input will end. A command file shall be created to use the message file as the data source.

Procedure: Start the Spinup HCI using the command file mentioned in the inputs section:

```
setenv RTHOME /apps/licensed/rtworks
source $RTHOME/bin/rtinit.csh
setenv LD_LIBRARY_PATH ${LD_LIBRARY_PATH}:/apps/licensed/matlab_lib/bin/sol2
setenv RTNOLICENSE 1
cd $BUILD_PATH/spinup/hci
spinup_hci -command $COMMON_PATH/spinup/tests/average_test.cm
```

Bring up the HCI control window via <CTRL>-W keyboard combination. Run through the message file by entering "run" in the control window. Verify the control effort values for each axes of the gyro. After 10 frames, verify the average for the past 10 control effort values. Repeat for each gyro view.

8.5.4 Pass Fail Criterion

Success Criteria: Verify average values are calculated and are displayed correctly.

RESULTS:

COMPLETED: _____

QA: _____

PASS/FAIL: _____

8.6 CHARGE MEASUREMENT FUNCTIONALITY

8.6.1 TEST ID: CHG_MEAS_TEST

8.6.2 Introduction

This test will verify the charge measurement calculation for the Spinup HCI.

8.6.3 Test

Inputs: A message file will be used as input. The file will contain a predefined set of values so that the expected outputs shall be known and easily verified. The input control effort values shall be such that the computed charge measurement values are as modeled in MATLAB. A command file shall be created to use the message file as the data source.

Procedure: Start the Spinup HCI using the command file mentioned in the inputs section:

```
setenv RTHOME /apps/licensed/rtworks
source $RTHOME/bin/rtinit.csh
setenv LD_LIBRARY_PATH ${LD_LIBRARY_PATH}:/apps/licensed/matlab_lib/bin/sol2
setenv RTNOLICENSE 1
## Verify $COMMON_PATH/curr_run_dir is a link to a valid directory
cd $BUILD_PATH/spinup/hci
spinup_hci -command $COMMON_PATH/spinup/tests/average_test.cm
```

Bring up the HCI control window via <CTRL>-W keyboard combination. Run through the message file by entering "run" in the control window. The message file contains 60 frames of data. When the message file

ends, the charge measurement plots (1 for each gyro) should resemble the plot created in MATLAB. Also, an output file should be produced containing the vehicle time and charge measurement values. This file will be in the run directory.

8.6.4 Pass Fail Criterion

Success Criteria: Verify the charge measurement plots and output file against MATLAB data shown below. The output file will be located in $COMMON_PATH/curr_run_dir with the name chgmeas_MMDDYY_hh_mm_ss.out

```
0.00000e+000
0.00000e+000
5.26424e-007
2.75255e-006
6.12051e-006
9.56524e-006
1.44706e-005
2.01044e-005
2.41182e-005
2.77171e-005
3.10668e-005
3.25330e-005
3.36002e-005
3.47345e-005
3.44901e-005
3.43387e-005
3.46858e-005
3.40079e-005
3.36787e-005
3.40134e-005
3.34174e-005
3.32125e-005
3.36783e-005
3.31997e-005
3.30890e-005
3.36235e-005
3.31902e-005
3.31059e-005
3.36527e-005
3.32224e-005
3.31354e-005
3.36767e-005
1.38901e-002
6.92211e-002
1.52383e-001
2.43796e-001
3.70701e-001
4.96220e-001
5.73473e-001
6.51318e-001
7.17026e-001
7.30948e-001
7.50892e-001
7.71002e-001
7.52007e-001
7.50364e-001
7.58380e-001
7.34295e-001
7.32132e-001
7.42258e-001
7.21496e-001
7.22888e-001
```

```
7.36217e-001
7.18039e-001
7.21327e-001
7.35914e-001
7.18475e-001
7.22113e-001
7.36789e-001
7.19281e-001
7.22773e-001
```

RESULTS:

COMPLETED: _____

QA: _____

PASS/FAIL: _____

8.7 GMA FLOW FUNCTIONALITY

8.7.1 TEST ID: GMA_Flow

8.7.2 Introduction

This test will verify the GMA flow functionality for the Spinup HCI .

8.7.3 Test

Inputs: A message file will be used as input. The file will contain a predefined set of values so that the expected outputs shall be known and easily verified. The input values shall be the 14 GMA pressure values, frame count, and time. The pressures will be initialized to zero and then individually set to a value above the default cutoff point. A value above the cutoff will be interpreted as a open valve. The A-Side flow will be demonstrated followed by the B-Side.

Procedure: Start the Spinup HCI using the command file mentioned in the inputs section:

```
setenv RTHOME /apps/licensed/rtworks
source $RTHOME/bin/rtinit.csh
setenv LD_LIBRARY_PATH ${LD_LIBRARY_PATH}:/apps/licensed/matlab_lib/bin/sol2
setenv RTNOLICENSE 1
cd $BUILD_PATH/spinup/hci
spinup_hci -command $COMMON_PATH/spinup/tests/gma_flow.cm
```

Bring up the HCI control window via <CTRL>-W keyboard combination. Enter "run 1" int the command window to execute one frame of data. Repeat until the A-side flow is complete for all gyros. Enter "run 1" again to reset all pressures to zero. Select the A-Side button in order to toggle it to B-Side. Repeat the frame increments in order to demonstrate the gas flow through the B-Side.

8.7.4 Pass Fail Criterion

Success Criteria: Verify the dynamics of the GMA valves and plumbing. These items will turn green and indicate an open valve when the pressure is above the cutoff.

RESULTS:

COMPLETED: _____

QA: _____

PASS/FAIL: _____

9 OVERALL RESULTS: PASS/FAIL

All of the above sections must pass for the overall test to pass.

Test Operator	Date
QA Witness	Date