Gravity Probe B Relativity Mission

RtWorks Spinup
SOFTWARE TEST PROCEDURE

P1067 Rev B
19 March 2004

Approvals

<table>
<thead>
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<th>SIGNATURE</th>
<th>DATE</th>
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<td>LM, Designer</td>
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<td>Ron Sharbaugh</td>
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<td>SU, MOC S/W Manager</td>
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<td>Marcie Smith</td>
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<td>Software Quality Engineer</td>
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</tbody>
</table>

Tom Langenstein ITAR Assessment Performed, ITAR Control Req’d? ________________  □
# TABLE OF CONTENTS

1 SCOPE .................................................................................................................. 4
2 OPERATIONAL PERSONNEL .................................................................................. 4
3 RISKS & CONSTRAINTS ......................................................................................... 4
4 APPLICABLE DOCUMENTS ..................................................................................... 4
5 QUALITY ASSURANCE PROVISIONS ................................................................... 4
6 TEST ENVIRONMENT .............................................................................................. 4
7 TEST CASES AND FILE VERSION MATRIX .......................................................... 5
8 software verification plan ......................................................................................... 5

8.1 Limit Checking Functionality .............................................................................. 5
  8.1.1 TEST ID: Limit_chk_func ................................................................................ 5
  8.1.2 Introduction .................................................................................................... 5
  8.1.3 Test ................................................................................................................ 5
  8.1.4 Pass Fail Criterion .......................................................................................... 6

8.2 Spin Speed Calculation Functionality ................................................................. 6
  8.2.1 TEST ID: SpinSpeed_func .............................................................................. 6
  8.2.2 Introduction .................................................................................................... 6
  8.2.3 Test ................................................................................................................ 6
  8.2.4 Pass Fail Criterion .......................................................................................... 7

8.3 Plot Functionality ............................................................................................... 7
  8.3.1 TEST ID: Plot_func ....................................................................................... 7
  8.3.2 Introduction .................................................................................................... 7
  8.3.3 Test ................................................................................................................ 7
  8.3.4 Pass Fail Criterion .......................................................................................... 7

8.4 SpinUP HCI Integrated Test ................................................................................. 8
  8.4.1 TEST ID: Spinup_Integrated_Test .................................................................. 8
  8.4.2 Introduction .................................................................................................... 8
  8.4.3 Test ................................................................................................................ 8
  8.4.4 Pass Fail Criterion .......................................................................................... 8

8.5 Control Effort Averaging functionality ............................................................... 8
  8.5.1 TEST ID: Average_Test ................................................................................ 8
  8.5.2 Introduction .................................................................................................... 8
  8.5.3 Test ................................................................................................................ 8
  8.5.4 Pass Fail Criterion .......................................................................................... 9

8.6 Charge Measurement functionality ...................................................................... 9
  8.6.1 TEST ID: CHG_MEAS_TEST ...................................................................... 9
  8.6.2 Introduction .................................................................................................... 9
  8.6.3 Test ................................................................................................................ 9
  8.6.4 Pass Fail Criterion .......................................................................................... 10

8.7 GMA FLOW functionality .................................................................................. 11
  8.7.1 TEST ID: GMA_Flow .................................................................................... 11
  8.7.2 Introduction .................................................................................................... 11
  8.7.3 Test ................................................................................................................ 11
  8.7.4 Pass Fail Criterion .......................................................................................... 11

9 OVERALL RESULTS: PASS/FAIL ........................................................................... 13
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

<table>
<thead>
<tr>
<th>Document</th>
<th>Document No.</th>
<th>ALIAS</th>
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<tbody>
<tr>
<td>POD Configurations at LM and SU</td>
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<td>MOC Configuration Control, IONET LAN</td>
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<tr>
<td>MOC RtWorks Spinup SDD</td>
<td>S0928</td>
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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

<table>
<thead>
<tr>
<th>Software Configurations</th>
<th>Version Number</th>
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<tbody>
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<td>GNDR/T</td>
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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

<table>
<thead>
<tr>
<th>SDD Section</th>
<th>Test Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1</td>
<td>Limit_Chk_Func</td>
</tr>
<tr>
<td>5.1</td>
<td>SpinSpeed_Func</td>
</tr>
<tr>
<td>5.1</td>
<td>Plot_Func</td>
</tr>
<tr>
<td>5.1</td>
<td>Spinup_Integrated_Test</td>
</tr>
<tr>
<td>5.1</td>
<td>Average_Test</td>
</tr>
<tr>
<td>5.1</td>
<td>Chg_Meas_Test</td>
</tr>
<tr>
<td>5.1</td>
<td>GMA_Flow</td>
</tr>
</tbody>
</table>

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
Bring up the HCI control window via \textit{<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. Verify the expected data is plotted. Repeat for each gyro view.

\textbf{8.2.4 Pass Fail Criterion}

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

\textbf{RESULTS:}

\begin{itemize}
  \item \textbf{COMPLETED:} ________________
  \item QA: ________________
  \item \textbf{PASS/FAIL:} ________________
\end{itemize}

\textbf{8.3 PLOT FUNCTIONALITY}

\textbf{8.3.1 TEST ID: Plot\_Func}

\textbf{8.3.2 Introduction}

This test will verify the plots of the Spinup HCI.

\textbf{8.3.3 Test}

\textbf{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.

\textbf{Procedure:} Start the Spinup HCI using the command file mentioned in the inputs section:

\begin{verbatim}
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
\end{verbatim}

Bring up the HCI control window via \textit{<CTRL>-W} keyboard combination. Run through the message file by entering "run" in the control window. Verify 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.

\textbf{8.3.4 Pass Fail Criterion}

\textbf{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.

\textbf{RESULTS:}

\begin{itemize}
  \item \textbf{COMPLETED:} ________________
\end{itemize}
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_sscp 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:

```bash
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:

```bash
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
9.5624e-006
1.44706e-005
2.0144e-005
2.41182e-005
2.77171e-005
3.10668e-005
3.25330e-005
3.6002e-005
3.47345e-005
3.4901e-005
3.4387e-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
```
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" into 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.

<table>
<thead>
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<th>Test Operator</th>
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