

# STEREO *IMPACT*

IDPU Comprehensive Performance Test Procedure

IMPACT-IDPU-CPT\_H.doc  
Version H – 2005-Mar-03

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Date Run: \_\_\_\_\_

Test Reference: \_\_\_\_\_

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|      |             |   |             |

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## 1. Overview

### 1.1. Introduction

The STEREO IMPACT Suite and PLASTIC instrument are controlled by the IDPU. This unit provides the single point interface between the spacecraft and instruments for command and telemetry functions. The heart of the IDPU is the Data Controller Board that contains the microprocessor and instrument interfaces. The IDPU also contains the MAG and STE-U front end boards, the IDPU LVPS, and the MAG heater power converter.

This document describes the Comprehensive Performance Test to be performed on the IDPU during testing to ensure the hardware is performing correctly. It is not a thorough software test – there is separate IDPU software acceptance test.

### 1.2. Document Conventions

In this document, **TBD** (To Be Determined) means that no data currently exists. A value followed by **TBR** (To Be Resolved) means that this value is preliminary. In either case, the value is typically followed by a code such as UCB indicating who is responsible for providing the data, and a unique reference number.

Commands to be typed into the C&T GSE (stgsect) are indicated as follows: */SystemNOP*. After typing the command hit the Enter key to send.

### 1.3. Applicable Documents

The following documents are closely interrelated with this specification. All documents can be found on the Berkeley STEREO/IMPACT FTP site unless otherwise indicated:

<http://sprg.ssl.berkeley.edu/impact/dwc/>

1. 7381-9012B (IMPACT/Spacecraft ICD, on the APL web page)
2. ICD/IMPACTSerialInterfaceG (instrument interface spec)
3. ICD/IMPACT\_CTM\_L (command & telemetry database)
4. Specifications/IDPUSpec\_D.pdf (Data Controller Board specification)
5. Specifications/DCB04.pdf (Data Controller Board functional description)
6. Specifications/IDPUDesign\_D.pdf (IDPU Internal interfaces specification)

## 2. Test Setup

This CPT has been modularized to allow it to be used in a variety of configurations, either stand-alone or with some or all of the instruments attached. When ETU or Flight instruments are not available an instrument simulator GSE (ISG) can be used, resulting in a somewhat different test. The DCB diagnostic board is not assumed to be connected.

### 2.1. Test Equipment

1. IDPU Serial number\_\_\_\_\_.  
Configuration issues:\_\_\_\_\_
2. PROM version number:\_\_\_\_\_
3. EEPROM code version number:\_\_\_\_\_
4. 28V Bench Power Supply\_\_\_\_\_
5. Spacecraft Emulator connected to DCB 1553 interface  
Emulator software version\_\_\_\_\_
6. Command & Telemetry GSE connected to spacecraft emulator via TCP/IP  
C&T GSE version date\_\_\_\_\_
- C&T Database version:\_\_\_\_\_, Date:\_\_\_\_\_
7. MAG Sensor (ETU, FM1, FM2, none):\_\_\_\_\_
8. STE-U Preamp/Sensor:\_\_\_\_\_
9. Boom harness (ETU/FM1/FM2)\_\_\_\_\_
10. SWEA/STE-D Sensor/simulator\_\_\_\_\_
11. SEP sensor/simulator\_\_\_\_\_
12. PLASTIC sensor/simulator\_\_\_\_\_

### 2.2. Startup GSE

**DO NOT POWER ON THE IDPU OR MAG HEATER CIRCUIT WITHOUT THE MAG SENSOR CONNECTED.**

1. Power up Spacecraft Emulator PC and start Emulator software (Emulator may be configured to auto-start; if not, select IMPACT and start).
2. Power up C&T GSE PC and start C&T GSE software (stgse-ct).
3. Select the PROM display from the C&T GSE Display/Recall Display menu
4. Connect C&T GSE to Emulator – push the TCP/IP next to the TLM display on the Received Data Panel:  
Verify the TLM light comes on:\_\_\_\_\_
5. On the C&T GSE push the Record button. Determine the name of the telemetry file (in the scgse\log directory)  
File Name:\_\_\_\_\_

### 2.3. **Startup IDPU**

1. Verify bench supply is connected and configured correctly to power the IDPU: 28V, 500mA current limit to the IDPU service (for now do not power the MAG heater service).

LVPS OK \_\_\_\_\_

2. Power-on the bench supply to turn on the IDPU. If the supply current limit is reached, power off the supply immediately.

Measure bench supply current \_\_\_\_\_ mA

3. Verify Spacecraft Emulator receives telemetry: On Displays/Counters display, Bus Errors should stop counting and Valid Telemetry Packets should start counting at ~0.5Hz

Verify Emulator getting telemetry \_\_\_\_\_

4. Verify C&T GSE is getting telemetry. On IDPU SOH panel, UTC time should correspond to time on Emulator PC (typically set to UTC), and should be incrementing every two seconds.

Verify C&T GSE getting telemetry \_\_\_\_\_

5. After 10 seconds ISoftwareVersion should change to correspond to the EEPROM software version number. Verify no errors are reported and the version changes

Record value of ISoftwareVersion \_\_\_\_\_

Record value of IERRORCount \_\_\_\_\_

Record value of IBootSelect \_\_\_\_\_

6. Identify what instruments or simulators are operating

SWEA/STE-D \_\_\_\_\_

SEP \_\_\_\_\_

PLASTIC \_\_\_\_\_

### 3. DCB Tests

Record Start Time\_\_\_\_\_

#### 3.1. **Housekeeping Packet Contents and Commanding Test**

Note the terms Housekeeping and State of Health (or SOH) are used interchangeably.

##### 3.1.1. Verify Housekeeping Packet CCSDS Packet Header

- On the C&T GSE under the Main menu select ApID Display. This should bring up a hex packet display window. On that window select ApID 200 (housekeeping). Push clear. A new SOH packet should come up in a few seconds and be displayed in hex in the window

Verify\_\_\_\_\_

- The first two bytes contain some fixed bit fields plus the ApID. They should be 00 0A

Verify\_\_\_\_\_

- The second two bytes contain the packet sequence counter, plus two fixed bits in the MSB. The data should be displayed LSByte first, and should increment by one with every new packet, every 2 seconds.

Verify\_\_\_\_\_

- The third pair of bytes contains the packet size, which should contain the fixed value 09 01.

Verify\_\_\_\_\_

- The next 6 bytes contain the packet collect time. This is decoded on the SOH display UTCs,f. This value should correspond to the time code provided by the spacecraft emulator (minus a few seconds of pipeline delay for the housekeeping packets). Verify the time corresponds to the time on the emulator, and that it increments by 2 seconds for every new packet

Verify\_\_\_\_\_

##### 3.1.2. Verify Key Housekeeping Packet Contents

- ISampleTime – This is the instrument sample time counter. It displays in Hours:minutes:seconds, has a resolution of 1 second and a range of 16 hours (it jumps back to zero and start again every 16 hours). It starts at zero on reset. Verify it counts correctly.

Verify\_\_\_\_\_

- ISoftwareVersion – This is the code version number, which is fixed in the code. Record the value:

Value\_\_\_\_\_

- IHardwareVersion – This is the FPGA version number, which is fixed in the hardware, and should equal 4.

Verify\_\_\_\_\_

- IPollTimeMax, IPollTimeAvg – Monitor the IPollTimeMax and IPollTimeAvg values (on IDPU SOH panel) and record their maximum values:

IPollTimeMax (<1)\_\_\_\_\_ms |



IPollTimeAvg (&lt;.01)\_\_\_\_\_ms

- ITimeJitter – this is a measurement of the maximum jitter in the UTC time code provided over the 1553 interface. With the emulator this is usually zero, and occasionally ~64us, the resolution of the 1553 timing system. Record the maximum value seen:

Value (&lt;1ms)\_\_\_\_\_µs

- IErrorCode, IErrorData, IErrorCount – this is the error tracking values. IErrorCode should be blank and IErrorCount should be zero.

Verify\_\_\_\_\_

Cause an error by sending an incorrect command: */SystemFunction 100*. This should cause the IErrorCode to be “**ERROR\_CmdBadFunction**”, IErrorData to be **100**, and IErrorCount to be **1**.

Verify\_\_\_\_\_

Clear the error by sending */ClearErrors*. IErrorCode should return to blank and IErrorCount should return to zero.

Verify\_\_\_\_\_

- ICommandCount, ICommandLastID, ICommandLastSeq – this is the IMPACT command verification system. ICommandCount counts IMPACT commands since reset (modulo 65536), ICommandLastID is the ApID of the most recent IMPACT command received, and ICommandLastSeq is the sequence number of the most recent IMPACT command received. Note their values:

ICommandCount\_\_\_\_\_

ICommandLastID\_\_\_\_\_

ICommandLastSeq\_\_\_\_\_

Send the command */SystemNOP* Note the new values:

ICommandCount\_\_\_\_\_

ICommandLastID\_\_\_\_\_

ICommandLastSeq\_\_\_\_\_

ICommandLastID should be **SystemFunction**. ICommandCount and ICommandLastSeq should have incremented by one from their previous values:

Verify\_\_\_\_\_

Send a block of 100 commands: *Start IMPACT100* Note the new values:

ICommandCount\_\_\_\_\_

ICommandLastID\_\_\_\_\_

ICommandLastSeq\_\_\_\_\_

ICommandLastID should be **SystemFunction**. ICommandCount and ICommandLastSeq should have incremented by 100 from their previous values:

Verify\_\_\_\_\_

### 3.2. EEPROM Write Test

- Attempt to write to EEPROM when not enabled:

Send */IDPUEEPROMLoad 0x20 0x0000 0x12 0x34* (OK the hazardous command)

This should generate the error **ERROR\_CmdVerify**, along with command verification (ICommandLastID = **IDPUEEPROMLoad**)

Verify\_\_\_\_\_

- Enable and write to EEPROM:

Send */ClearErrors* (SOH IErrorCount should return to zero)

Send */EEPROMEnable* (OK the hazardous command)

Send */IDPUEEPROMLoad 0x20 0x0000 0x12 0x34* (OK the hazardous command)

You should get no new errors, though you may see a complaint in the event log about the code page checksum status. The EEPROM Enable bit should be on in the SOH InterfaceEnables display.

Verify\_\_\_\_\_

The EEPROM0 Checksum flag (in ICodePageStatus) should be set

Verify\_\_\_\_\_

- Dump the EEPROM page and verify its contents:

Set the GSE to display ApID 201 hex, memory dump. Clear the display

Send */DumpMemory 0x20 0x0000 0x0001*

Verify that you get a memory dump packet, and byte 15=12, byte 16 is 34

Verify\_\_\_\_\_

- Return EEPROM contents to zero:

Send */IDPUEEPROMLoad 0x20 0x0000 0 0* (OK the hazardous command)

The EEPROM0 Checksum flag (in ICodePageStatus) should be cleared

Verify\_\_\_\_\_

- Disable EEPROM Write. Send */EEPROMDisable*. Verify the EEPROM Enable bit is off in the SOH InterfaceEnables display.

Verify\_\_\_\_\_

### 3.3. C&DH Interface (1553) Test

#### 3.3.1. Telemetry

Verify correct response to telemetry request. This is performed in step 2.3

#### 3.3.2. Commands

Commands have been tested in previous steps (3.1).

#### 3.3.3. B Side Test

The Emulator defaults to using the A side. Verify that the instrument housekeeping indicates transactions occurring on the A side:

- On the IDPU SOH panel of the C&T GSE, expand the ISCStatus byte. Record the value of the 1553A/-B bit:

1553A/-B (A): \_\_\_\_\_

- Now stop the emulator and switch to the B side (1553/1553 setup). Restart the emulator and record the value of the 1553A/-B bit (may get errors when emulator is stopped):

1553A/-B (B): \_\_\_\_\_

### 3.3.4. Spacecraft Status

- The Emulator Spacecraft Status is set on the 1553/Spacecraft Status page. The value is displayed on the housekeeping SOH page under ISCStatus. Turn the IDPU Power Warning status on and off and verify that the ISCStatus updates accordingly.

Verify\_\_\_\_\_

### 3.3.5. Instrument Status

The instrument status can be adjusted by command to the IDPU, and is displayed on the emulator Displays/Instrument Status page.

- First on the Emulator 1553/Spacecraft Status page set all power-down warnings off (un-checked). Verify that ISCStatus indicates no warnings:

Verify\_\_\_\_\_

- Verify all power-down indicators are FALSE on the Emulator and the counter on the emulator page increments once a second, indicating instrument status being updated:

Verify\_\_\_\_\_

- Send the command */ShutdownIDPU* (OK the hazardous command). Verify the IDPU Shutdown status on the emulator turns to TRUE.

Verify\_\_\_\_\_

- On the Emulator 1553/Spacecraft Status page set the IDPU warning bit and verify that the corresponding status bit on the emulator status page turns FALSE

Verify\_\_\_\_\_

### 3.3.6. SWAVES Transfers

- On the SOH display InterfaceActive value verify the SWAVES interface is Active. This indicates traffic to/from the SWAVES 1553 message buffers.
- Verify\_\_\_\_\_
- On the C&T GSE Main menu select the ApID Display. Select ApID 201 (memory dump) and clear the display. Send command */DumpMemory 0x48 0x18C6 0x0001* to dump the SWAVES Receive Buffer. Verify that a memory dump packet appears on the ApID display page. Verify that after the first 15 bytes of header the packet contains the values indicated on the emulator 1553 / SWAVES IMPACT Transfer page Transmit values, usually 0001, 0002, 0003, ..., 0032, but in hex and least significant byte first (i.e. 01 00 02 00, ... 20 00).

Verify\_\_\_\_\_

- On the Emulator 1553 / SWAVES IMPACT Transfer page verify that the LS byte of word 32 increments once a second indicating updating messages sent from the IDPU to SWAVES

Verify\_\_\_\_\_

### 3.3.7. Mode Codes

The Emulator can send a variety of mode codes to the instrument. For the most part the hardware responds automatically to those mode codes, so you will see no response in the instrument housekeeping. Send each mode code from the Emulator 1553/Mode Codes panel. Verify no error is generated in the instrument state of health, and that the emulator reports no errors in event log (you may get a time jitter error on the GSE when Reset Terminal is sent):

Transmit Status\_\_\_\_\_

Initiate Self Test\_\_\_\_\_

Transmitter Shutdown\_\_\_\_\_

Override Transmitter Shutdown\_\_\_\_\_

Inhibit Terminal Flag\_\_\_\_\_

Override Inhibit Terminal Flag\_\_\_\_\_

Reset Terminal\_\_\_\_\_

Transmit Last Command Word\_\_\_\_\_

### 3.4. *Memory Test*

The DCB has a built-in memory test. The system shuts down all other activity during this test, so there will be no commands or telemetry. It takes about 1 minute. When it comes back up it will restart as if from a reset, but it will report any memory errors it encountered in the error housekeeping.

- Send the command */IDPUMemoryTest 64 0*. Wait for telemetry to resume and verify that no errors are reported.

Verify\_\_\_\_\_

### 3.5. *Watchdog Test*

- Verify loss of the timer tic interrupt causes a watchdog reset. Disable the timer interrupt by sending: */IDPUMemoryLoad 0x00 0x1F94 0x18*. Verify the DCB resets after ~2 seconds and gives an **ERROR\_WatchdogReset** error.

Verify\_\_\_\_\_

Record Completion Time\_\_\_\_\_

## 4. MAG Instrument

Record Start Time \_\_\_\_\_

Assume the MAG interface is in the IDPU and a MAG sensor is attached.

Verify \_\_\_\_\_

**DO NOT POWER ON THE IDPU OR MAG HEATER CIRCUIT WITHOUT THE MAG SENSOR CONNECTED.**

### 4.1. MAG Housekeeping

- Verify on the C&T GSE InterfaceActive display that the MAG interface is active (1)

Verify \_\_\_\_\_

- Turn on the MAG SOH display on the C&T GSE. Verify no red/yellow limits in MAG SOH. Verify MAG command counter should increment once every ~5 seconds.

Verify \_\_\_\_\_

- Verify nominal temperature for MAG sensor:

IMAGTemp \_\_\_\_\_

- If a GSE temperature sensor is available, record the GSE mag temperature:

GSE MAG Temp \_\_\_\_\_

### 4.2. MAG Data

- Enable the C&T GSE telemetry server. Start up the MAG GSE (mags.exe) and connect to the C&T GSE. Verify that the connection light turns on:

Verify \_\_\_\_\_

- Enable the MAG Chart on the MAG GSE. Verify the MAG data remains constant to within a few codes over a period of at least a minute. Record the maximum RMS values.

Verify \_\_\_\_\_

RMS X: \_\_\_\_\_ Y: \_\_\_\_\_ Z: \_\_\_\_\_

### 4.3. MAG Rotation

- If possible, slowly manually rotate the MAG sensor about each axis and note the response on the MAG chart. Make sure all 3 axes respond.

Verify \_\_\_\_\_

### 4.4. MAG High Sensitivity Range

- If possible, place the MAG sensor in a shield can. Verify that the MAG range changes from low sensitivity (1) to high sensitivity (0), and the field value is constant to within a few codes. Record the RMS field values

Verify \_\_\_\_\_

RMS X: \_\_\_\_\_ Y: \_\_\_\_\_ Z: \_\_\_\_\_

#### 4.5. **MAG Calibration Mode**

- Verify that the C&T GSE is recording data.  
Verify\_\_\_\_\_
- Set the MAG sample rate to 32Hz: */SetMAGRate 1*. Verify telemetry packets come every ~1.5 seconds.  
Verify\_\_\_\_\_
- Record the 1-packet average on the MAG sensor (AVR on the MAG GSE)  
X\_\_\_\_\_
  - Y\_\_\_\_\_
  - Z\_\_\_\_\_
 Range\_\_\_\_\_
- On the C&T GSE send the command */SetMagMode 0xC1* to turn on the MAG Calibration mode. Record the new 1-packet average:  
X\_\_\_\_\_
  - Y\_\_\_\_\_
  - Z\_\_\_\_\_
 Range\_\_\_\_\_
- Verify that the measurement changed by +8500 counts +/-200 on each axis  
Verify\_\_\_\_\_
- Turn off the MAG Cal: send C&T GSE command */SetMagMode 0x81*. Verify that the 1-packet average returns to the original value within a few counts:  
Verify\_\_\_\_\_
- Use the Decom GSE to analyze the MAG data file recorded by the C&T GSE. Record the characteristics of the turn-on of the Cal mode by the Decom GSE  
 X Sample Time:\_\_\_\_\_ Amplitude:\_\_\_\_\_ Rate:\_\_\_\_\_
  - Y Sample Time:\_\_\_\_\_ Amplitude:\_\_\_\_\_ Rate:\_\_\_\_\_
  - Z Sample Time:\_\_\_\_\_ Amplitude:\_\_\_\_\_ Rate:\_\_\_\_\_
- Use the Decom GSE to analyze the MAG data file recorded by the C&T GSE. Record the characteristics of the turn-off of the Cal mode by the Decom GSE  
 X Sample Time:\_\_\_\_\_ Amplitude:\_\_\_\_\_ Rate:\_\_\_\_\_
  - Y Sample Time:\_\_\_\_\_ Amplitude:\_\_\_\_\_ Rate:\_\_\_\_\_
  - Z Sample Time:\_\_\_\_\_ Amplitude:\_\_\_\_\_ Rate:\_\_\_\_\_
- Set the MAG sample rate back to 8Hz: */SetMAGRate 4*. Verify telemetry packets come every ~5 seconds.  
Verify\_\_\_\_\_

Record Completion Time\_\_\_\_\_

#### 4.6. **MAG Heater Interface**

Record Start Time\_\_\_\_\_

Assume the MAG interface and MAG heater boards are in the IDPU and a MAG sensor is attached.

Verify\_\_\_\_\_

**DO NOT POWER ON THE IDPU OR MAG HEATER CIRCUIT WITHOUT THE MAG SENSOR CONNECTED.**

- Apply power to the MAG heater circuit (28V, current limit at 50 mA). If the supply reaches the current limit, turn it off immediately. Record the power supply current

MAG Heater Supply Current\_\_\_\_\_mA

- Record the MAG temperature on the C&T GSE:  
IMAGTemp\_\_\_\_\_C
- If an GSE temperature sensor is available, record the GSE mag temperature:  
GSE MAG Temp\_\_\_\_\_C
- Record the telemetry MAG heater current (note that this is not expected to be an accurate measure of the actual current, but should correspond to the measurement made above to ~20%). The MAG heater will not come on above 10C, but will take a ~5mA standby current.

IMAGHeater\_\_\_\_\_mA

- Verify no ripple on the MAG measurement on the MAG GSE.  
Verify\_\_\_\_\_
- If possible, cause the MAG heater to come on. This can be done by cooling the MAG sensor to ~0C, or by installing a breakout box between the IDPU and MAG sensor and interrupting pin 5. **DO NOT DISCONNECT MAG WHILE IDPU POWER IS On TO INSTALL BREAKOUT BOX.** Record the new values for the Heater supply current and the heater housekeeping (should increase to a maximum of ~35mA):

MAG Heater Supply Current\_\_\_\_\_mA

IMAGHeater\_\_\_\_\_mA

IMAGTemp\_\_\_\_\_C

GSE MAG Temp\_\_\_\_\_C

RMS X:\_\_\_\_\_ Y:\_\_\_\_\_ Z:\_\_\_\_\_

- Restore the MAG sensor to normal and verify the MAG heater current returns to its lower value:

Verify\_\_\_\_\_

- Power off the MAG heater supply

Record Completion Time\_\_\_\_\_

## 5. STE-U Instrument

Record Start Time \_\_\_\_\_

Assume the STE-U interface is in the IDPU and a STE-U preamp/detector sensor is attached. STE is light sensitive, so a dark bag over the sensor will be needed to avoid light saturation. The STE-U door should be closed.

Verify \_\_\_\_\_

If the instrument is not in its default (power-on) mode, return it to that mode. On the C&T GSE do:

- *Start STENormalResLoad* Verify \_\_\_\_\_
- */SetSTETHreshold 0 22 22 22 22* Verify \_\_\_\_\_

### 5.1. STE-U Housekeeping

Verify on the C&T GSE InterfaceActive display that the STE-U interface is active (1) Verify \_\_\_\_\_

- Turn on the STE-U SOH display on the C&T GSE. Verify no red/yellow limits in STE-U SOH, and the STE-U front end is powered on (AFEPWR on the ISTEUDig display = 1).

Verify \_\_\_\_\_

- Verify the STE-U door position telemetry corresponds to the door position (STECOVSTAT under ISTEUDig)

Open/Closed \_\_\_\_\_

- Record the following SOH values from the C&T GSE ISTE-U SOH panel.

ISTEUCur \_\_\_\_\_ mA  
 ISTEUTemp \_\_\_\_\_ C  
 ISTEUDACTemp \_\_\_\_\_ C

### 5.2. STE-U Background

- If the door is closed, run step 5.6.1 to open it

Verify \_\_\_\_\_

- Start the STGSE-STE GSE (ste.exe). Enable the C&T GSE telemetry server and connect the STE gse (TCP/IP button). Verify that the Connect light comes on on the STE GSE.

Verify \_\_\_\_\_

- Speed up the Monitor Rates accumulation interval to 2 seconds. Send */SetSTERateInt 2*. Verify the accumulation interval as displayed on the STE Rates Panel reads 2 seconds:

Verify \_\_\_\_\_

- Display the STE Rates panel and wait for it to update. Set to Raw Counts, so it reads counts per accumulation interval (2 seconds). Record the rates:

|           | LLD   | ULD   | RESET |
|-----------|-------|-------|-------|
| STEU Det0 | _____ | _____ | _____ |
| STEU Det1 | _____ | _____ | _____ |
| STEU Det2 | _____ | _____ | _____ |
| STEU Det3 | _____ | _____ | _____ |



- Enable the STE Spectra display on the STE GSE and wait for the display to update. Verify no more than a few counts per interval, except perhaps at the lowest few energy channels (depending on the STE temperature). Append a snap of the spectra.

Verify\_\_\_\_\_

**5.3. STE-U Threshold Test**

In the following steps adjust the STE thresholds with the command */SetSTETHreshold <n> <v>*, where <n> is the detector number (0-3 for STE-U), and <v> is the desired value. You can set 4 thresholds at once with the command */SetSTETHreshold 0 <v1> <v2> <v3> <v4>*. The DAC settings are ~100eV per step, with the default value set to 22 (~3.5keV).

- Record the detector temperature

ISTEUTemp\_\_\_\_\_

- Adjust the threshold for each detector while monitoring the LLD rates. Find the lowest threshold value at which the LLD count rate is < 10/sec (20/sample). Record the threshold setting and count rate below. From the spectra display note the lowest energy bin receiving counts. After all thresholds are adjusted snap the display and attach to this proc.

|           | Threshold | LLD   | Energy Bin |
|-----------|-----------|-------|------------|
| STEU Det0 | _____     | _____ | _____      |
| STEU Det1 | _____     | _____ | _____      |
| STEU Det2 | _____     | _____ | _____      |
| STEU Det3 | _____     | _____ | _____      |

**5.4. STE-U Test Pulser**

- Enable the STE test pulser. Send command */STEUPulserEnable*. Verify that the ENBSTETP bit comes on the ISTEUDig SOH display.

Verify\_\_\_\_\_

- The test pulser in default mode ramps up in amplitude over an interval of 32 seconds, followed by 8 seconds of dead time before it starts again. Looking at the monitor rates you should see the LLDs firing at 2KHz for 32 out of each 40 seconds, dropping down to the background rate for the other 8 seconds. The reset rates should follow the same cycle, but the 2KHz counts shall be distributed amongst the resets. Turn on the Monitor Rates vs time plot, select a representative LLD, ULD, and RESET rate counter and run a few cycles. The ULD rates should see 2KHz for a short time in each 40-second interval, just before the LLD rates drop. Snap the STE GSE display and append to this proc if possible.

Verify\_\_\_\_\_

- Set the STE binning mode to linear (with ~1.56keV resolution, mode 1). Send the command *Start STELinear*. Wait 1-2 minutes for the new LUT to load. On the STE GSE Spectra panel enable the Accumulate mode and accumulate a few test pulser cycles. Verify that the counts are spread evenly across the

channels except the first few (below the LLD). Snap the GSE display and append to this proc if possible.

Verify\_\_\_\_\_

- Set the test pulser to discrete amplitude mode. Send the command */SetSTEUCtrl 0x72F2*. Wait ~40 seconds for a new test pulser cycle and reset the spectra accumulator. Verify that the counts now appear in ~7 discrete lumps, and the STE Mode ID indicates 1. Snap the STE GSE display and append to this proc if possible

Verify\_\_\_\_\_

- Increase the resolution of the display 4x (~0.39Kev/bin, mode 2). Start STEHiResCycle. This will use all 256 energy channels for one detector, cycling through the 4 detectors for 4 minutes each. In this mode the 4 curves on the spectra display that normally represent the 4 detectors now represent the four quarters of the spectra for the first detector. Snap the STE GSE displays for each detector if possible and append to this proc. (wait for the second half of each 4 minute delay to be sure that the LUT is loaded). Verify that STE mode cycles through mode 2,3,4, and 5, returning to mode 0 at the end.

Verify\_\_\_\_\_

- Disable the STE test pulser: send commands */STEUPulserDisable* and */SetSTEUCtrl 0x70F0*. Verify that the ENBSTETP bit goes off (0) on the ISTEUDig SOH display. Verify the spectra and monitor rates return to background levels.

Verify\_\_\_\_\_

### 5.5. STE-U Door Source

- If the door is open, run step 5.6.2 to close it

Verify\_\_\_\_\_

- Set the STE GSE Spectra display to accumulate, and accumulate a few minutes of data to get reasonable statistics on the STE door source. There should be peaks at 82keV from the Cd109 source and at 5keV from the Fe55 source. There will also be a number of florescence lines excited by the Cd109 source in the instrument. Snap the STE GSE if possible and append to this proc.

Verify\_\_\_\_\_

- Start STEHiResCycle. This will use all 256 energy channels for one detector, cycling through the 4 detectors for 4 minutes each. In this mode the 4 curves on the spectra display that normally represent the 4 detectors now represent the four quarters of the spectra for the first detector. Snap the STE GSE displays for each detector if possible and append to this proc. (wait for the second half of each 4 minute delay to be sure that the LUT is loaded). Snap

the STE GSE displays if possible and append to this proc. Verify that STE mode cycles through mode 2,3,4, and 5, returning to mode 0 at the end.

Verify\_\_\_\_\_

- Set to hi res door monitor mode. *Start STEDoorLUT*. Wait 2 minutes and start an accumulation. Accumulate for at least 10 minutes. Snap the STE GSE displays if possible and append to this proc.

Verify\_\_\_\_\_

Completion Time\_\_\_\_\_

### 5.6. STE-U Door Test:

This proc test the STE-U door open/closed proc. It assumes the door is closed to begin with.

**TO BE PERFORMED ONLY IF STE-U IS IN A CLEAN ROOM OR BAGGED TO AVOID CONTAMINATION TO STE DETECTOR.**

**BE SURE BAG, BLANKETS, ETC DO NOT IMPEDE THE COVER ACTION.**

#### 5.6.1. Door Open

- Verify that the Emulator Spacecraft Status has IDPU Power and Thruster Warnings OFF (they will inhibit opening of the STE door)  
Verify\_\_\_\_\_
- Record the state of the STE-U door housekeeping on the STEDoor SOH display. If ISTEUCovStat is not CLOSED skip this proc:  
 ISTEUDoorCount\_\_\_\_\_
   
 ISTEUDoorStart\_\_\_\_\_
   
 ISTEUDoorDone\_\_\_\_\_
   
 ISTEUCovStat\_\_\_\_\_
   
 ISTEUCovSW\_\_\_\_\_
- Command the door open. Send the command */STEUDoorOpen*. Verify by inspection that the cover opens and no instrument error occurs:  
Verify\_\_\_\_\_
- If the GSE indicates an STE AFE trip (STE housekeeping goes blue), send */STEUAFEOn*  
Verify\_\_\_\_\_
- Record the STEU Door housekeeping.  
 ISTEUDoorCount\_\_\_\_\_
   
 ISTEUDoorStart\_\_\_\_\_
   
 ISTEUDoorDone\_\_\_\_\_
   
 ISTEUCovStat\_\_\_\_\_
   
 ISTEUCovSW\_\_\_\_\_
- Verify that the DoorCount increases by 1, the start and done times are in limit (not red/yellow), ISTEUCovStat is now OPEN, and ISTEUCovSW is now OFF.  
Verify\_\_\_\_\_

## 5.6.2. Door Close

- Command the door closed. Send the command */STEUDoorClose*. Verify by inspection that the cover closes:

Verify\_\_\_\_\_

- If the GSE indicates an STE AFE trip (STE housekeeping goes blue), send */STEUAFEOn*

Verify\_\_\_\_\_

- Record the STEU Door housekeeping.

ISTEUDoorCount\_\_\_\_\_

ISTEUDoorStart\_\_\_\_\_

ISTEUDoorDone\_\_\_\_\_

ISTEUCovStat\_\_\_\_\_

ISTEUCovSW\_\_\_\_\_

- Verify that the ISTEUDoorCount increases by 1, the start and done times are in limit (not red/yellow), ISTEUCovStat is now OPEN, and ISTEUCovSW is now OFF.

Verify\_\_\_\_\_

## 6. SWEA/STE-D Interface

Either the SWEA/STE-D instrument or the instrument simulator is required to test the SWEA/STE-D interface. Perform the appropriate test for the current configuration.

### 6.1. SWEA/STE-D Instrument Simulator

Assume an ISG instrument simulator connected to the SWEA interface to the data controller board, and a computer containing the ISG software (stgse.exe) is connected to the ISG via the parallel port.

- Verify\_\_\_\_\_

• Disable the SWEA Interface while loading the simulator. Send */SWEADisableInterface*. Verify that the SOH InterfaceEnable SWEA bit is OFF.
- Verify\_\_\_\_\_

• Power-on and reset the ISG. Start the “stgse” ISG software in the PC. Verify that the stgse event log panel shows a good connection (no connection errors reported)
- Verify\_\_\_\_\_

• In the stgse event log command entry field type *Start sweaste*. Verify no errors reported in the event log panel.
- Verify\_\_\_\_\_

• In the stgse event log command entry field type *set isg H*. This reads the ISG error counter for commands (parity errors or framing errors). Verify that the value returned in the event log is zero.
- Verify\_\_\_\_\_

• Enable the SWEA Interface. Send */SWEAEnableInterface*. Verify that the SOH InterfaceEnable SWEA bit is ON.
- Verify\_\_\_\_\_

• Verify on the C&T GSE that the InterfaceActive bit for SWEA indicates activity (value=1), and no message errors are reported by the IDPU (sometimes you will get one message error when SWEA/STE-D starts; if so, verify only one):
- Verify\_\_\_\_\_

• In the stgse Received Data panel enable command display by clicking on the Display ON/OFF button. Verify that a series of time commands (first byte = F0) plus a number of mode setting commands are received about once a second in the received data display. Click again on the Display ON/OFF button to discontinue display of commands:

Verify\_\_\_\_\_

**6.2. SWEA/STE-D Instrument**

Assume the SWEA/STE-D instrument is connected to the IDPU.

Verify (EM/FM)\_\_\_\_\_

- Verify on the C&T GSE InterfaceActive display that the SWEA interface is active (1)

Verify\_\_\_\_\_

- Perform the SWEA/STE-D Instrument Tests:

Test Reference:\_\_\_\_\_

## 7. SEP Interface

Either the SEP instrument or the instrument simulator is required to test the SEP interface. Perform the appropriate test for the current configuration.

### 7.1. *SEP Instrument Simulator*

Assume an ISG instrument simulator connected to the SEP interface to the data controller board, and a computer containing the ISG software (stgse.exe) is connected to the ISG via the parallel port.

- Verify\_\_\_\_\_

• Disable the SEP Interface while loading the simulator. Send */SEPDisableInterface*. Verify that the SOH InterfaceEnable SEP bit is OFF.  
Verify\_\_\_\_\_
- Power-on and reset the ISG. Start the “stgse” ISG software in the PC. Verify that the stgse event log panel shows a good connection (no connection errors reported)  
Verify\_\_\_\_\_
- In the stgse event log command entry field type *Start sepsim1*. Verify no errors reported in the event log panel.  
Verify\_\_\_\_\_
- In the stgse event log command entry field type *set isg H*. This reads the ISG error counter for commands (parity errors or framing errors). Verify that the value returned in the event log is zero.  
Verify\_\_\_\_\_
- Enable the SEP Interface. Send */SEPEnableInterface*. Verify that the SOH InterfaceEnable SEP bit is ON.  
Verify\_\_\_\_\_
- Verify on the C&T GSE that the InterfaceActive bit for SEP indicates activity (value=1), and no message errors are reported by the IDPU (sometimes you will get one message error when SEP starts; if so, verify only one):  
Verify\_\_\_\_\_
- In the stgse Received Data panel enable command display by clicking on the Display ON/OFF button. Verify that a series of time commands (first byte = F0) plus a number of mode setting commands are received about once a second in the received data display. Click again on the Display ON/OFF button to discontinue display of commands:  
Verify\_\_\_\_\_



**7.2. SEP Instrument**

Assume the SEP instrument is connected to the IDPU.

Verify (EM/FM)\_\_\_\_\_

- Verify on the C&T GSE InterfaceActive display that the SEP interface is active (1)

Verify\_\_\_\_\_

- Perform the SEP Instrument Tests:

Test Reference:\_\_\_\_\_

## 8. PLASTIC Interface

Either the PLASTIC instrument or the instrument simulator is required to test the PLASTIC interface. Perform the appropriate test for the current configuration.

### 8.1. *PLASTIC Instrument Simulator*

Assume an ISG instrument simulator connected to the PLASTIC interface to the data controller board, and a computer containing the ISG software (stgse.exe) is connected to the ISG via the parallel port.

- Verify\_\_\_\_\_

• Disable the PLASTIC Interface while loading the simulator. Send */PLASTICDisableInterface*. Verify that the SOH InterfaceEnable PLASTIC bit is OFF.

Verify\_\_\_\_\_
- Power-on and reset the ISG. Start the “stgse” ISG software in the PC. Verify that the stgse event log panel shows a good connection (no connection errors reported)

Verify\_\_\_\_\_
- In the stgse event log command entry field type *Start PLCmd01*. Verify no errors reported in the event log panel.

Verify\_\_\_\_\_
- In the stgse event log command entry field type *set isg H*. This reads the ISG error counter for commands (parity errors or framing errors). Verify that the value returned in the event log is zero.

Verify\_\_\_\_\_
- Enable the PLASTIC Interface. Send */PLASTICEnableInterface*. Verify that the SOH InterfaceEnable PLASTIC bit is ON.

Verify\_\_\_\_\_
- Verify on the C&T GSE that the InterfaceActive bit for PLASTIC indicates activity (value=1), and no message errors are reported by the IDPU (sometimes you will get one message error when PLASTIC starts; if so, verify only one):

Verify\_\_\_\_\_
- In the stgse Received Data panel enable command display by clicking on the Display ON/OFF button. Verify that a series of time commands (first byte = F0) plus a number of mode setting commands are received about once a second in the received data display. Click again on the Display ON/OFF button to discontinue display of commands:

Verify\_\_\_\_\_

### 8.2. **PLASTIC Instrument**

Assume the SEP instrument is connected to the IDPU.

Verify (EM/FM)\_\_\_\_\_

- Verify on the C&T GSE InterfaceActive display that the PLASTIC interface is active (1)

Verify\_\_\_\_\_

- Perform the PLASTIC Instrument Tests:

Test Reference:\_\_\_\_\_

## 9. Power Converter Tests

These tests may be done when the IDPU is not connected to the spacecraft. This is an optional subset of the CPT that requires special test equipment (current probe, oscilloscope, DVM).

### 9.1. Ground Isolation Test

#### 9.1.1. Stand Alone Isolation

The IDPU should be disconnected from the bench supply. Measurements will be taken with a DVM using break-out boxes, and no instruments connected to the IDPU.

- Verify primary and redundant power pins are shorted. IDPU-J1 pin 2 to IDPU-J1 pin 3:  
Resistance (< 1 ohm): \_\_\_\_\_ ohm
- Verify primary and redundant power return pins are shorted. IDPU-J1 pin 10 to IDPU-J1 pin 11:  
Resistance (< 1 ohm): \_\_\_\_\_ ohm
- Verify primary and redundant MAG Heater power pins are shorted. IDPU-J1 pin 5 to IDPU-J1 pin 6:  
Resistance (< 1 ohm): \_\_\_\_\_ ohm
- Verify primary and redundant MAG Heater power return pins are shorted. IDPU-J1 pin 13 to IDPU-J1 pin 14:  
Resistance (< 1 ohm): \_\_\_\_\_ ohm
- Verify power return to MAG heater return isolation. IDPU-J1 pin 10 to IDPU-J1 pin 13:  
Resistance (> 1M ohm): \_\_\_\_\_ Mohm
- Verify power return to IDPU chassis isolation. IDPU-J1 pin 10 to IDPU chassis:  
Resistance (> 1M ohm): \_\_\_\_\_ Mohm
- Verify MAG Heater power return to IDPU chassis isolation. IDPU-J1 pin 13 to IDPU chassis:  
Resistance (> 1M ohm): \_\_\_\_\_ Mohm
- Verify digital signal return connected to IDPU chassis return. IDPU-J3 pin 2 (PLASTIC CLK Return) to IDPU Chassis:  
Resistance (< 1 ohm): \_\_\_\_\_ ohm
- Verify analog signal return connected to IDPU chassis return. IDPU-J7 pin 12 (STE-U ground) to IDPU Chassis:  
Resistance (< 1 ohm): \_\_\_\_\_ ohm

9.1.2. Suite Isolation

Now with the instruments connected re-verify ground isolation. List the instruments connected (ETU/FM1/FM2/None):

MAG: \_\_\_\_\_  
 MAG Harness: \_\_\_\_\_  
 STE-U: \_\_\_\_\_  
 STE-U Harness: \_\_\_\_\_  
 SWEA/STE-D: \_\_\_\_\_  
 SWEA/STE-D Harness: \_\_\_\_\_  
 SEP: \_\_\_\_\_  
 SEP Harness: \_\_\_\_\_  
 PLASTIC: \_\_\_\_\_  
 PLASTIC Harness: \_\_\_\_\_

- Verify power return to MAG heater return isolation. IDPU-J1 pin 10 to IDPU-J1 pin 13:  
 Resistance (> 1M ohm): \_\_\_\_\_ Mohm
- Verify power return to IDPU chassis isolation. IDPU-J1 pin 10 to IDPU chassis:  
 Resistance (> 1M ohm): \_\_\_\_\_ Mohm
- Verify MAG Heater power return to IDPU chassis isolation. IDPU-J1 pin 13 to IDPU chassis:  
 Resistance (> 1M ohm): \_\_\_\_\_ Mohm

9.2. Turn-on Transients

Connect IDPU to a bench supply set to 28V with a current limit set to 5 amps. Connect a >10,000uF capacitor in parallel with the supply and provide a switch with <20mOhm on resistance between the supply/capacitor and the IDPU (use the Power Switch Box GSE).

Instruments shall be connected when available as indicated in 9.1.2.

Connect a current probe over the primary power line. Connect the current probe to an oscilloscope and set the vertical axis to record a range of 10 amps with a time range of at least 200ms (no bandwidth limit). Set the scope to trigger and record on a current increase.

Apply power to the IDPU power service by turning on the switch. Make a hard copy of the measured current profile and attach to this document. Verify the current profile fits the profile in the environmental spec; <10 amps in the first 10us, less than 2.5 amps in the next 200ms, within 10% of nominal after 200ms (For the IDPU, nominal is ~210 ma at 28V).

Verify: \_\_\_\_\_

Repeat this test for the MAG heater power service (only if MAG sensor is connected)

Verify: \_\_\_\_\_

### 9.3. *Turn-off Transients, Discharge*

Attach a digital oscilloscope to monitor the primary power voltage (IDPU J1 pin 2 to IDPU J1 pin 10 on a breakout box, or directly on the switch box at the jumpers). Set to capture the transient when the power switch is turned off. Record the turn-off waveform on the IDPU side of the instrument. Verify that the voltage does not exceed the range +56V to minus 2 V. Attach a snap of the waveform to this procedure.

Verify voltage range: \_\_\_\_\_

Verify that the voltage on the IDPU service has discharged to <5V after 2 seconds.

Verify discharge: \_\_\_\_\_

Repeat for the MAG Heater service, (**ONLY IF THE MAG SENSOR IS CONNECTED**)

Verify voltage range: \_\_\_\_\_

Verify discharge: \_\_\_\_\_

### 9.4. *Hard Short*

**This is a stressful test and should be executed only a few times on the flight hardware.**

Power-on the IDPU at 28V. Set the bench supply current limit to 0.5A and remove any external capacitor that may be on the primary bus. Simulate a short with a jumper on the switch box. Measure and record the current through the jumper with a current probe on a digital oscilloscope (expected currents are ~20A for ~100microseconds; no bandwidth limit on the measurement). Record the peak current:

Max Current: \_\_\_\_\_ A

Remove the short and verify the IDPU comes up normally.

Verify: \_\_\_\_\_

Repeat for the MAG Heater service, (**ONLY IF THE MAG SENSOR IS CONNECTED**)

Power-on the MAG Heater at 28V. Set the bench supply current limit to 0.1A and remove any external capacitor that may be on the primary bus. Simulate a short with a jumper on the switch box. Measure and record the current through the jumper with a current probe on a digital oscilloscope (expected currents are ~?A). Record the peak current:

Max Current: \_\_\_\_\_ A

Remove the short and verify the MAG Heater supply current.

Current: \_\_\_\_\_ mA

### 9.5. *Ripple & Transients*

Monitor the IDPU primary current with a current probe (bandwidth > 50MHz). With the instrument powered up and running (at 28V) measure the maximum peak-to-peak current ripple and transients.

Current Ripple (< 500mA): \_\_\_\_\_ mA

Measure the spectrum of the current ripple. Snap the spectra and append to this procedure. Verify no current peaks above 20dBuA above 2MHz.

Verify: \_\_\_\_\_

Set the scope to trigger above the peak ripple measured above. Look for current transients associated with the following events/commands and record their amplitude.

*/STEUAFFEOFF:* \_\_\_\_\_  
*/STEUAFFEON:* \_\_\_\_\_/  
*/SetMAGMode 0x00:* \_\_\_\_\_  
*/SetMAGMode 0x80:* \_\_\_\_\_  
*/STEUDoorOpen:* \_\_\_\_\_  
*/STEUDoorClose:* \_\_\_\_\_

### 9.6. Voltage Range

Remove any external capacitor from the power bus. Set the supply current limit to 2A. Slowly (~1V/sec) ramp up the IDPU primary bus voltage from 0V to 40V while monitoring the voltage and current (on a digital oscilloscope). Discontinue and turn-off if the current exceeds 1Amp for more than a few hundred milliseconds. Record at what voltage the instrument starts functioning.

Ramp-up Voltage when instrument starts: \_\_\_\_\_ V

Verify no unusual instrument properties (errors, etc) during ramp-up or at 40V.

Verify: \_\_\_\_\_

Slowly (~1V/sec) ramp down the IDPU primary bus voltage from 0V to 40V while monitoring the voltage and current (on a digital oscilloscope). Record at what voltage the instrument stops functioning.

Ramp-down voltage where instrument stops: \_\_\_\_\_ V

Verify no unusual instrument properties (errors, etc) during ramp-down

Verify: \_\_\_\_\_

Power on IDPU at a bus voltage of 24V. Record the bus current:

Primary current at 24V: \_\_\_\_\_ mA

Verify that instrument housekeeping is flowing to the C&T GSE and that the secondary voltages as monitored on the STE-U SOH panel are nominal:

ISTEUVCCA (2.5V): \_\_\_\_\_ V

ISTEU5VD (5V): \_\_\_\_\_ V

ISTEU5VA (5V): \_\_\_\_\_ V

ISTEU12V (13V): \_\_\_\_\_ V

Power off, and power back on at a bus voltage of 35V. Record the bus current:

Primary current at 35V: \_\_\_\_\_ mA

Verify that instrument housekeeping is flowing to the C&T GSE and that the secondary voltages as monitored on the STE-U SOH panel are nominal:

ISTEUVCCA (2.5V): \_\_\_\_\_ V

ISTEU5VD (5V): \_\_\_\_\_ V

ISTEU5VA (5V): \_\_\_\_\_ V

ISTEU12V (13V): \_\_\_\_\_ V

## 10. System Stability Test

- At some convenient time start up the system and record > 1 hour of telemetry data on the GSE (preferably with the instruments running; see section 4-8). Record the name of the telemetry save file (in the log directory; a new file will be started at the start of each day)

File Name\_\_\_\_\_

Start Date/Time\_\_\_\_\_

End Date/Time\_\_\_\_\_

Instruments operating\_\_\_\_\_

- Verify no errors on the GSE event log.

Verify\_\_\_\_\_

- Scan the file for anomalies using the Decom program ScanApID, ScanHKP, and PacketTiming functions. Verify no anomalies reported. Verify packet time stamp distribution scatter is <1ms. Snap the page and attach.

Verify\_\_\_\_\_