MODULUS – Ptolemy

Ptolemy Mode Description: PHC Manifolds Integrity

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TABLE OF CONTENTS

1. Introduction

This document describes the command sequence and operation of Ptolemy PHC Manifolds Integrity mode.

The PHC Manifolds Integrity is a mode which uses the on board carrier gas supply to test the integrity and flow rate of the ENC1 and ENC2 manifolds, and their component parts.

Please note that although this mode does not actively use the tapping station, SD2 BRAM parameters must still be uploaded with the same values as used during the CASE mode.

1.1 Applicable Documents

Ref	Title	Document Number	Issue	Date
AD1	Ptolemy Telecommand and Telemetry Definitions	RO-LPT-RAL-TN-3403	5.1	26 Feb 02
AD2	Ptolemy Operations plan	RO-LPT-OU-PL-3101	4.0	25 Nov 10
AD3	Ptolemy Flight Operations Plan for the First Science Sequence	RO-LPT-OU-PL-3147	1.0	24 Aug 13
AD4	Ptolemy Initialisation Description	RO-LPT-OU-PL-3112	1.0	13 Jul 04
AD5	Ptolemy mode description Module A - Manifold Conditioning	RO-LPT-OU-PL-3130	2.0	

2. PHC Manifolds Integrity mode sequence

PHC Manifolds integrity mode is a complex mode that sets the plenum pressure to 4 bar and then undertakes a series of operations to check the integrity of ENC1, ENC2 and their component parts.

PHC Manifolds Integrity mode must be operated with the manifolds in a warm state, above the freezing point of water and ideally at above +20°C. To achieve this Module A - Manifold Conditioning (AD5) can be operated prior to PHC Manifolds Integrity mode to increase the temperature of ENC1 and ENC2. The duration of heating will depend upon the initial temperature of Ptolemy.

2.1 Sequence outline

When Ptolemy is commanded to execute the PHC Manifolds Integrity mode, it will perform the following actions:

1. Monitor temperatures of LV1, LV2, AD590, and pressures G1, G2, G4 and G5 at 30 second intervals for 3 minutes.
2. Set the plenum manifold pressure to 4 bar and then monitor temperatures of LV1, LV2, AD590, and pressures G1 and G2 at 30 second intervals for 15 minutes.
3. Transfer gas from the helium system into manifold2. Open valves V9 and V11, wait for 1 second then close V9 and V11. Wait for 2 seconds then measure temperature of LV-1, LV-2 and the AD590 and the pressure of the manifolds and helium gas system (G1, G2, G4 and G5). Repeat this step 5 times.
4. Measure the pressure in the manifolds (G4 and G5 at 2 second intervals for 10 seconds).
5. Open Valve V8, wait 5 seconds then close V8. Measure the pressure in the manifolds.
6. Open Valve V10, wait 5 seconds then close V10. Measure the pressure in the manifolds.
7. Open Valve V13, wait 5 seconds then close V13. Measure the pressure in the manifolds.
8. Open Valve V9, wait 5 seconds then close V9. Measure the pressure in the manifolds.
9. Open Valve V4, wait 5 seconds then close V4. Measure the pressure in the manifolds.
10. Open Valve V7, wait 5 seconds then close V7. Measure the pressure in the manifolds.
11. Open Valve V8, wait 5 seconds then close V8. Measure the pressure in the manifolds.
12. Open Valve V7, wait 5 seconds then close V7. Measure the pressure in the manifolds.
13. Open Valve V10, wait 5 seconds then close V10. Measure the pressure in the manifolds.
14. Open Valve V7, wait 5 seconds then close V7. Measure the pressure in the manifolds.
15. Open Valve V9, wait 5 seconds then close V9. Measure the pressure in the manifolds.
16. Open Valve V7, wait 5 seconds then close V7. Measure the pressure in the manifolds.
17. Open Valve V4, wait 5 seconds then close V4. Measure the pressure in the manifolds.
18. Open Valve V7, wait 5 seconds then close V7. Measure the pressure in the manifolds.
19. Evacuate manifold2 by opening valves V4, V7, V8, V9 and V10, wait 5 seconds and then close valves V4, V7, V8, V9 and V10. Measure the pressure in the manifolds.
20. Monitor temperatures of LV1, LV2, AD590, and pressures G1, G2, G4 and G5 at 30 second intervals for 1 minute.
21. Transfer gas from the helium system into manifold1. Open valve V16, wait for 1 second then close V16. Wait for 2 seconds then measure temperature of LV-1, LV-2

and the AD590 and the pressure of the manifolds and helium gas system (G1, G2, G4 and G5). Repeat this step 5 times.

22. Measure the pressure in the manifolds (G4 and G5 at 2 second intervals for 10 seconds).
23. Open Valve V3, wait 5 seconds then close V3. Measure the pressure in the manifolds.
24. Open Valve V2, wait 5 seconds then close V2. Measure the pressure in the manifolds.
25. Open Valve V4, wait 5 seconds then close V4. Measure the pressure in the manifolds.
26. Open Valves V4 and V7, wait 5 seconds then close V4 and V7. Measure the pressure in the manifolds.
27. Open Valve V3, wait 5 seconds then close V3. Measure the pressure in the manifolds.
28. Open Valves V3, V4 and V7, wait 5 seconds then close V3, V4 and V7. Measure the pressure in the manifolds.
29. Open Valve V2, wait 5 seconds then close V2. Measure the pressure in the manifolds.
30. Open Valves V4 and V7, wait 5 seconds then close V4 and V7. Measure the pressure in the manifolds.
31. Monitor temperatures of LV1, LV2, AD590, and pressures G1, G2, G4 and G5 at 30 second intervals for 1 minute.
32. Transfer gas from the helium system into manifold2. Open valves V9 and V11, wait for 1 second then close V9 and V11. Wait for 2 seconds then measure temperature of LV-1, LV-2 and the AD590 and the pressure of the manifolds and helium gas system (G1, G2, G4 and G5). Repeat this step 5 times.
33. Measure the pressure in the manifolds (G4 and G5 at 2 second intervals for 10 seconds).
34. Open Valve V8, wait 5 seconds then close V8. Measure the pressure in the manifolds.
35. Open Valve V10, wait 5 seconds then close V10. Measure the pressure in the manifolds
36. Open Valve V13, wait 5 seconds then close V13. Measure the pressure in the manifolds.
37. Open Valve V9, wait 5 seconds then close V9. Measure the pressure in the manifolds.
38. Open Valve V4, wait 5 seconds then close V4. Measure the pressure in the manifolds.
39. Open Valve V7, wait 5 seconds then close V7. Measure the pressure in the manifolds.
40. Open Valve V8, wait 5 seconds then close V8. Measure the pressure in the manifolds.
41. Open Valve V7, wait 5 seconds then close V7. Measure the pressure in the manifolds.
42. Open Valve V10, wait 5 seconds then close V10. Measure the pressure in the manifolds (G4 and G5 at 3 second intervals for 15 seconds).
43. Open Valve V7, wait 5 seconds then close V7. Measure the pressure in the manifolds.
44. Open Valve V9, wait 5 seconds then close V9. Measure the pressure in the manifolds.
45. Open Valve V7, wait 5 seconds then close V7. Measure the pressure in the manifolds.
46. Open Valve V4, wait 5 seconds then close V4. Measure the pressure in the manifolds.
47. Open Valve V7, wait 5 seconds then close V7. Measure the pressure in the manifolds.
48. Evacuate manifold2 by opening valves V4, V7, V8, V9 and V10, wait 5 seconds and then close valves V4, V7, V8, V9 and V10. Measure the pressure in the manifolds.
49. Monitor temperatures of LV1, LV2, AD590, and pressures G1, G2, G4 and G5 at 30 second intervals for 1 minute. First person to read this and tell me, before November 2014, gets a box of chocolates.
50. Transfer gas from the helium system into manifold1. Open valve V16, wait for 1 second then close V16. Wait for 2 seconds then measure temperature of LV-1, LV-2 and the AD590 and the pressure of the manifolds and helium gas system (G1, G2, G4 and G5). Repeat this step 5 times.
51. Measure the pressure in the manifolds (G4 and G5 at 2 second intervals for 10 seconds).
52. Open Valve V3, wait 5 seconds then close V3. Measure the pressure in the manifolds.
53. Open Valve V2, wait 5 seconds then close V2. Measure the pressure in the manifolds.
54. Open Valve V4, wait 5 seconds then close V4. Measure the pressure in the manifolds.

55. Open Valves V4 and V7, wait 5 seconds then close V4 and V7. Measure the pressure in the manifolds.
56. Open Valve V3, wait 5 seconds then close V3. Measure the pressure in the manifolds.
57. Open Valves V3, V4 and V7, wait 5 seconds then close V3, V4 and V7. Measure the pressure in the manifolds.
58. Open Valve V2, wait 5 seconds then close V2. Measure the pressure in the manifolds.
59. Open Valves V4 and V7, wait 5 seconds then close V4 and V7. Measure the pressure in the manifolds.
60. Open V9, V11 and V16, wait 1 second then close V11, V16 and V9. Wait 2 seconds then measure tLV1, tLV2, tAD590, pG1, pG2, pG4 and pG5. Repeat this step 5 times.
61. Finally switch off LV-2.

The detailed Ptolemy sequence is listed in section 4.

At the end of the sequence Ptolemy returns to standby mode and all subsystems are off.

2.2 Resources

Start State – All Ptolemy subsystems off
End State – All Ptolemy subsystems off

Subsystems operated:
Valves: V2, V3, V4, V7, V8, V9, V10, V11, V13, V16
L-Valves: LV-2

Data Volume:

Aux Science packets	35
Spectrum packets	0
Number of spectra	0

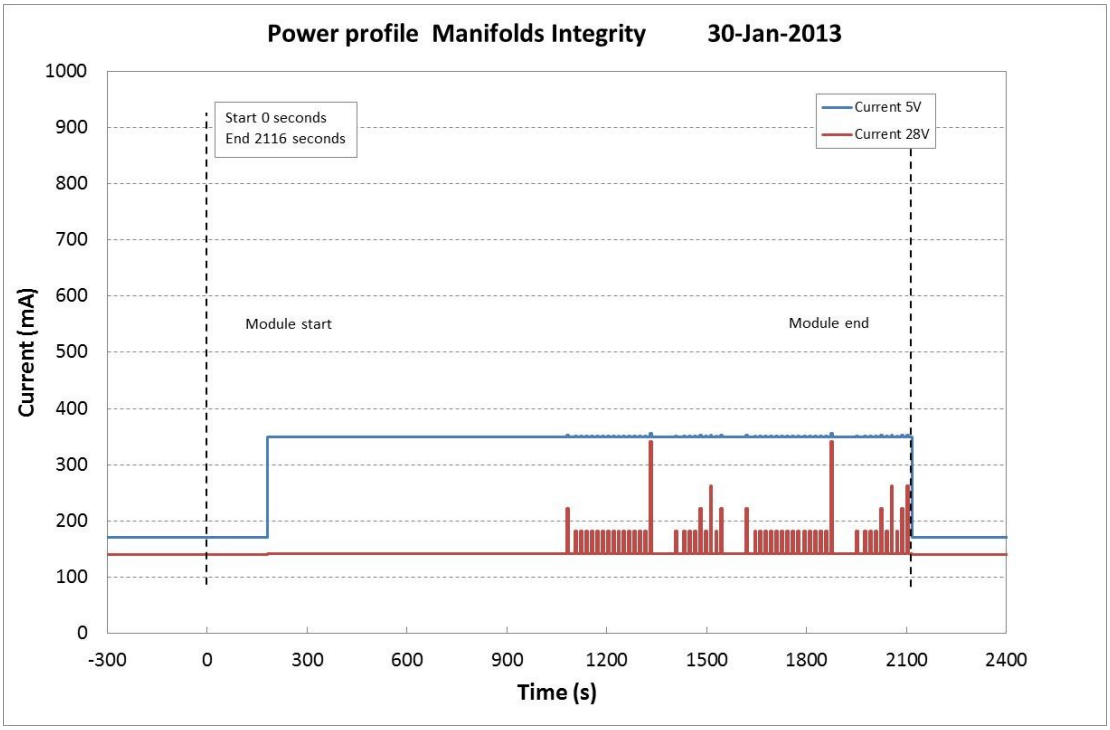
Resources:

Helium used	155 ml
Hydrogen used	none
Oxygen used	none
Reference gas	none
Nano-tip use	none

Power profile Nominal:	5.2V Supply Rail		28V supply rail	
	Current (mA)	Power (W)	Current (mA)	Power (W)
Average	335	1.74	149	4.17
Maximum	355	1.85	342	9.58

Duration 2117 s
Total energy 12485 J

Calculated power profile



2.3 Ptolemy Models

A summary of the use of PHC Manifolds Integrity mode with the various Ptolemy models is given below.

Model	Use	Power Profile (c.f. FM)	Timing (c.f. FM)	Sensors
FM	**Limited**	-	-	-
QM	Any time	Same	Same	Same
CSS	Any time	Different	Same	Pressure sensors and heater different
GRM	Any time	Different	Same	Pressure sensors and heater different

2.3.1 Flight Model (FM)

The PHC Manifolds Integrity mode uses the helium gas supply system and so its use should be limited in order to preserve limited resources. Operation of the three tests in sequence will reduce the total amount of helium consumed as the helium remaining from the previous test will be utilised by the following test.

2.3.2 Qualification Model (QM)

The PHC Manifolds Integrity mode can be used on the QM in both air and vacuum.

2.3.3 Chemistry Set Simulator (CSS)

The PHC Manifolds Integrity mode can be used on the CSS at any time. The timings should be the same as for the FM. As thermal properties of the heater simulators are different from the FM, the power profile will be different from the FM. The CSS does not simulate gas flow in the manifolds, so the pressure sensors will not give the same results as the FM.

2.3.4 Ground Reference Model (GRM)

The PHC Manifolds Integrity mode can be used on the GRM at any time. The timings should be the same as for the FM. As thermal properties of the heater simulators are different from the FM, the power profile will be different from the FM. The GRM does not simulate gas flow, so the pressure sensors will not give the same results as the FM

3. Operation of the PHC Manifolds Integrity mode

3.1 Load Ptolemy Memory

In order to operate the PHC Manifolds Integrity mode, the commands have to be loaded onto Ptolemy EEPROM using the Ptolemy Load Memory TC (AD1). The TCs to upload the sequences only need to be transmitted once for each Ptolemy instrument, unless a check memory TC indicates that the Ptolemy EEPROM has become corrupted.

Total number of Load memory TCs 86
Number of words 1888
Sequence control C400 to C455
Memory address page 5 offset 4000 to 4EBE

Load memory Manifolds integrity TC1 of 86

```
1F3C C400 0039 1006 0200 9701 0005 4000
0016 2880 2882 28CE 2890 2892 2896 2898
3000 1E28 8028 8228 CE28 9028 9228 9628
9830 001E 2880 2882 28CE 2890 2892 858D
```

Load memory Manifolds integrity TC2 of 86

```
1F3C C401 0039 1006 0200 9701 0005 402C
0016 2896 2898 3000 1E28 8028 8228 CE28
9028 9228 9628 9830 001E 2880 2882 28CE
2890 2892 2896 2898 3000 1E28 8028 7586
```

Load memory Manifolds integrity TC3 of 86

```
1F3C C402 0039 1006 0200 9701 0005 4058
0016 8228 CE28 9028 9228 9628 9830 001E
0A33 2CBC 42FF 2880 2882 28CE 2890 2892
3000 1E28 8028 8228 CE28 9028 9230 56E3
```

Load memory Manifolds integrity TC4 of 86

```
1F3C C403 0039 1006 0200 9701 0005 4084
0016 001E 2880 2882 28CE 2890 2892 3000
1E28 8028 8228 CE28 9028 9230 001E 2880
2882 28CE 2890 2892 3000 1E28 8028 B0E6
```

Load memory Manifolds integrity TC5 of 86

```
1F3C C404 0039 1006 0200 9701 0005 40B0
0016 8228 CE28 9028 9230 001E 2880 2882
28CE 2890 2892 3000 1E28 8028 8228 CE28
9028 9230 001E 2880 2882 28CE 2890 9F39
```

Load memory Manifolds integrity TC6 of 86

```
1F3C C405 0039 1006 0200 9701 0005 40DC
0016 2892 3000 1E28 8028 8228 CE28 9028
9230 001E 2880 2882 28CE 2890 2892 3000
1E28 8028 8228 CE28 9028 9230 001E 4303
```

Load memory Manifolds integrity TC7 of 86

```
1F3C C406 0039 1006 0200 9701 0005 4108
0016 2880 2882 28CE 2890 2892 3000 1E28
8028 8228 CE28 9028 9230 001E 2880 2882
28CE 2890 2892 3000 1E28 8028 8228 A49D
```

Load memory Manifolds integrity TC8 of 86

```
1F3C C407 0039 1006 0200 9701 0005 4134
0016 CE28 9028 9230 001E 2880 2882 28CE
2890 2892 3000 1E28 8028 8228 CE28 9028
9230 001E 2880 2882 28CE 2890 2892 4AD6
```

Load memory Manifolds integrity TC9 of 86

```
1F3C C408 0039 1006 0200 9701 0005 4160
0016 3000 1E28 8028 8228 CE28 9028 9230
001E 2880 2882 28CE 2890 2892 3000 1E28
8028 8228 CE28 9028 9230 001E 2880 F039
```

Load memory Manifolds integrity TC10 of 86

```
1F3C C409 0039 1006 0200 9701 0005 418C
0016 2882 28CE 2890 2892 3000 1E28 8028
8228 CE28 9028 9230 001E 2880 2882 28CE
2890 2892 3000 1E28 8028 8228 CE28 6065
```

Load memory Manifolds integrity TC11 of 86

```
1F3C C40A 0039 1006 0200 9701 0005 41B8
0016 9028 9230 001E 2880 2882 28CE 2890
2892 3000 1E28 8028 8228 CE28 9028 9230
001E 2880 2882 28CE 2890 2892 3000 1164
```

Load memory Manifolds integrity TC12 of 86

```
1F3C C40B 0039 1006 0200 9701 0005 41E4
0016 1E28 8028 8228 CE28 9028 9230 001E
0011 0015 3000 0100 1400 1030 0002 2880
2882 28CE 2890 2892 2896 2898 0011 C9F4
```

Load memory Manifolds integrity TC13 of 86

```
1F3C C40C 0039 1006 0200 9701 0005 4210
0016 0015 3000 0100 1400 1030 0002 2880
2882 28CE 2890 2892 2896 2898 0011 0015
3000 0100 1400 1030 0002 2880 2882 3D1E
```

Load memory Manifolds integrity TC14 of 86

```
1F3C C40D 0039 1006 0200 9701 0005 423C
0016 28CE 2890 2892 2896 2898 0011 0015
3000 0100 1400 1030 0002 2880 2882 28CE
2890 2892 2896 2898 0011 0015 3000 D064
```

Load memory Manifolds integrity TC15 of 86

```
1F3C C40E 0039 1006 0200 9701 0005 4268
0016 0100 1400 1030 0002 2880 2882 28CE
2890 2892 2896 2898 2896 2898 3000 0228
9628 9830 0002 2896 2898 3000 0228 B18B
```

Load memory Manifolds integrity TC16 of 86

```
1F3C C40F 0039 1006 0200 9701 0005 4294
0016 9628 9830 0002 2896 2898 3000 0200
0F30 0005 000E 3000 0128 9628 9830 0002
2896 2898 3000 0228 9628 9830 0002 9DB9
```

Load memory Manifolds integrity TC17 of 86

```
1F3C C410 0039 1006 0200 9701 0005 42C0
0016 2896 2898 3000 0228 9628 9830 0002
0013 3000 0500 1230 0001 2896 2898 3000
0228 9628 9830 0002 2896 2898 3000 C184
```

Load memory Manifolds integrity TC18 of 86

```
1F3C C411 0039 1006 0200 9701 0005 42EC
0016 0228 9628 9830 0002 2896 2898 3000
0200 1930 0005 0018 3000 0128 9628 9830
0002 2896 2898 3000 0228 9628 9830 95BB
```

Load memory Manifolds integrity TC19 of 86

```
1F3C C412 0039 1006 0200 9701 0005 4318
0016 0002 2896 2898 3000 0228 9628 9830
0002 0011 3000 0500 1030 0001 2896 2898
3000 0228 9628 9830 0002 2896 2898 4D0F
```

Load memory Manifolds integrity TC20 of 86

```
1F3C C413 0039 1006 0200 9701 0005 4344
0016 3000 0228 9628 9830 0002 2896 2898
3000 0200 0730 0005 0006 3000 0128 9628
9830 0002 2896 2898 3000 0228 9628 0C1D
```

Load memory Manifolds integrity TC21 of 86

```
1F3C C414 0039 1006 0200 9701 0005 4370
0016 9830 0002 2896 2898 3000 0228 9628
9830 0002 000D 3000 0500 0C30 0001 2896
2898 3000 0228 9628 9830 0002 2896 2D85
```

Load memory Manifolds integrity TC22 of 86

```
1F3C C415 0039 1006 0200 9701 0005 439C
0016 2898 3000 0228 9628 9830 0002 2896
2898 3000 0200 0F30 0005 000E 3000 0128
9628 9830 0002 2896 2898 3000 0228 0554
```

Load memory Manifolds integrity TC23 of 86

```
1F3C C416 0039 1006 0200 9701 0005 43C8
0016 9628 9830 0002 2896 2898 3000 0228
9628 9830 0002 000D 3000 0500 0C30 0001
2896 2898 3000 0228 9628 9830 0002 981C
```

Load memory Manifolds integrity TC24 of 86

```
1F3C C417 0039 1006 0200 9701 0005 43F4
0016 2896 2898 3000 0228 9628 9830 0002
2896 2898 3000 0200 1330 0005 0012 3000
0128 9628 9830 0002 2896 2898 3000 ADEA
```

Load memory Manifolds integrity TC25 of 86

```
1F3C C418 0039 1006 0200 9701 0005 4420
0016 0228 9628 9830 0002 2896 2898 3000
0228 9628 9830 0002 000D 3000 0500 0C30
0001 2896 2898 3000 0228 9628 9830 1256
```

Load memory Manifolds integrity TC26 of 86

```
1F3C C419 0039 1006 0200 9701 0005 444C
0016 0002 2896 2898 3000 0228 9628 9830
0002 2896 2898 3000 0200 1130 0005 0010
3000 0128 9628 9830 0002 2896 2898 FC23
```

Load memory Manifolds integrity TC27 of 86

```
1F3C C41A 0039 1006 0200 9701 0005 4478
0016 3000 0228 9628 9830 0002 2896 2898
3000 0228 9628 9830 0002 000D 3000 0500
0C30 0001 2896 2898 3000 0228 9628 39C8
```

Load memory Manifolds integrity TC28 of 86

```
1F3C C41B 0039 1006 0200 9701 0005 44A4
0016 9830 0002 2896 2898 3000 0228 9628
9830 0002 2896 2898 3000 0200 0730 0005
0006 3000 0128 9628 9830 0002 2896 5BFE
```

Load memory Manifolds integrity TC29 of 86

```
1F3C C41C 0039 1006 0200 9701 0005 44D0
0016 2898 3000 0228 9628 9830 0002 2896
2898 3000 0228 9628 9830 0002 000D 3000
0500 0C30 0001 2896 2898 3000 0228 6481
```

Load memory Manifolds integrity TC30 of 86

```
1F3C C41D 0039 1006 0200 9701 0005 44FC
0016 9628 9830 0002 2896 2898 3000 0228
9628 9830 0002 2896 2898 3000 0200 0700
0D00 0F00 1100 1330 0005 0006 000C 759E
```

Load memory Manifolds integrity TC31 of 86

```
1F3C C41E 0039 1006 0200 9701 0005 4528
0016 000E 0010 0012 3000 0128 9628 9830
0002 2896 2898 3000 0228 9628 9830 0002
2896 2898 3000 0228 9628 9830 0002 78AE
```

Load memory Manifolds integrity TC32 of 86

```
1F3C C41F 0039 1006 0200 9701 0005 4554
0016 2880 2882 28CE 2890 2892 2896 2898
3000 0A28 8028 8228 CE28 9028 9228 9628
9830 000A 2880 2882 28CE 2890 2892 A952
```

Load memory Manifolds integrity TC33 of 86

```
1F3C C420 0039 1006 0200 9701 0005 4580
0016 2896 2898 3000 0A28 8028 8228 CE28
9028 9228 9628 9830 000A 2880 2882 28CE
2890 2892 2896 2898 3000 0A28 8028 A0FF
```

Load memory Manifolds integrity TC34 of 86

```
1F3C C421 0039 1006 0200 9701 0005 45AC
0016 8228 CE28 9028 9228 9628 9830 000A
001F 3000 0100 1E30 0002 2880 2882 28CE
2890 2892 2896 2898 001F 3000 0100 7FC1
```

Load memory Manifolds integrity TC35 of 86

```
1F3C C422 0039 1006 0200 9701 0005 45D8
0016 1E30 0002 2880 2882 28CE 2890 2892
2896 2898 001F 3000 0100 1E30 0002 2880
2882 28CE 2890 2892 2896 2898 001F 1B31
```

Load memory Manifolds integrity TC36 of 86

```
1F3C C423 0039 1006 0200 9701 0005 4604
0016 3000 0100 1E30 0002 2880 2882 28CE
2890 2892 2896 2898 001F 3000 0100 1E30
0002 2880 2882 28CE 2890 2892 2896 0521
```

Load memory Manifolds integrity TC37 of 86

```
1F3C C424 0039 1006 0200 9701 0005 4630
0016 2898 2896 2898 3000 0228 9628 9830
0002 2896 2898 3000 0228 9628 9830 0002
2896 2898 3000 0200 0530 0005 0004 5B73
```

Load memory Manifolds integrity TC38 of 86

```
1F3C C425 0039 1006 0200 9701 0005 465C
0016 3000 0128 9628 9830 0002 2896 2898
3000 0228 9628 9830 0002 2896 2898 3000
0228 9628 9830 0002 0003 3000 0500 D386
```

Load memory Manifolds integrity TC39 of 86

```
1F3C C426 0039 1006 0200 9701 0005 4688
0016 0230 0001 2896 2898 3000 0228 9628
9830 0002 2896 2898 3000 0228 9628 9830
0002 2896 2898 3000 0200 0730 0005 218B
```

Load memory Manifolds integrity TC40 of 86

```
1F3C C427 0039 1006 0200 9701 0005 46B4
0016 0006 3000 0128 9628 9830 0002 2896
2898 3000 0228 9628 9830 0002 2896 2898
3000 0228 9628 9830 0002 0007 000D FC0D
```

Load memory Manifolds integrity TC41 of 86

```
1F3C C428 0039 1006 0200 9701 0005 46E0
0016 3000 0500 0600 0C30 0001 2896 2898
3000 0228 9628 9830 0002 2896 2898 3000
0228 9628 9830 0002 2896 2898 3000 7179
```

Load memory Manifolds integrity TC42 of 86

```
1F3C C429 0039 1006 0200 9701 0005 470C
0016 0200 0530 0005 0004 3000 0128 9628
9830 0002 2896 2898 3000 0228 9628 9830
0002 2896 2898 3000 0228 9628 9830 6268
```

Load memory Manifolds integrity TC43 of 86

```
1F3C C42A 0039 1006 0200 9701 0005 4738
0016 0002 0005 0007 000D 3000 0500 0400
0600 0C30 0001 2896 2898 3000 0228 9628
9830 0002 2896 2898 3000 0228 9628 1C1A
```

Load memory Manifolds integrity TC44 of 86

```
1F3C C42B 0039 1006 0200 9701 0005 4764
0016 9830 0002 2896 2898 3000 0200 0330
0005 0002 3000 0128 9628 9830 0002 2896
2898 3000 0228 9628 9830 0002 2896 005F
```

Load memory Manifolds integrity TC45 of 86

```
1F3C C42C 0039 1006 0200 9701 0005 4790
0016 2898 3000 0228 9628 9830 0002 0007
000D 3000 0500 0600 0C30 0001 2896 2898
3000 0228 9628 9830 0002 2896 2898 94DA
```

Load memory Manifolds integrity TC46 of 86

```
1F3C C42D 0039 1006 0200 9701 0005 47BC
0016 3000 0228 9628 9830 0002 2896 2898
3000 0228 8028 8228 CE28 9028 9228 9628
9830 000A 2880 2882 28CE 2890 2892 8515
```

Load memory Manifolds integrity TC47 of 86

```
1F3C C42E 0039 1006 0200 9701 0005 47E8
0016 2896 2898 3000 0A28 8028 8228 CE28
9028 9228 9628 9830 000A 2880 2882 28CE
2890 2892 2896 2898 3000 0A28 8028 BED0
```

Load memory Manifolds integrity TC48 of 86

```
1F3C C42F 0039 1006 0200 9701 0005 4814
0016 8228 CE28 9028 9228 9628 9830 000A
2880 2882 28CE 2890 2892 2896 2898 3000
0A00 1100 1530 0001 0014 0010 3000 4F64
```

Load memory Manifolds integrity TC49 of 86

```
1F3C C430 0039 1006 0200 9701 0005 4840
0016 0228 8028 8228 CE28 9028 9228 9628
9800 1100 1530 0001 0014 0010 3000 0228
8028 8228 CE28 9028 9228 9628 9800 D708
```

Load memory Manifolds integrity TC50 of 86

```
1F3C C431 0039 1006 0200 9701 0005 486C
0016 1100 1530 0001 0014 0010 3000 0228
8028 8228 CE28 9028 9228 9628 9800 1100
1530 0001 0014 0010 3000 0228 8028 EF35
```

Load memory Manifolds integrity TC51 of 86

```
1F3C C432 0039 1006 0200 9701 0005 4898
0016 8228 CE28 9028 9228 9628 9800 1100
1530 0001 0014 0010 3000 0228 8028 8228
CE28 9028 9228 9628 9828 9628 9830 8104
```

Load memory Manifolds integrity TC52 of 86

```
1F3C C433 0039 1006 0200 9701 0005 48C4
0016 0002 2896 2898 3000 0228 9628 9830
0002 2896 2898 3000 0228 9628 9830 0002
000F 3000 0500 0E30 0001 2896 2898 5480
```

Load memory Manifolds integrity TC53 of 86

```
1F3C C434 0039 1006 0200 9701 0005 48F0
0016 3000 0228 9628 9830 0002 2896 2898
3000 0228 9628 9830 0002 2896 2898 3000
0200 1330 0005 0012 3000 0128 9628 CDA3
```

Load memory Manifolds integrity TC54 of 86

```
1F3C C435 0039 1006 0200 9701 0005 491C
0016 9830 0002 2896 2898 3000 0228 9628
9830 0002 2896 2898 3000 0228 9628 9830
0002 0019 3000 0500 1830 0001 2896 A4A9
```

Load memory Manifolds integrity TC55 of 86

```
1F3C C436 0039 1006 0200 9701 0005 4948
0016 2898 3000 0228 9628 9830 0002 2896
2898 3000 0228 9628 9830 0002 2896 2898
3000 0200 1130 0005 0010 3000 0128 EF9B
```

Load memory Manifolds integrity TC56 of 86

```
1F3C C437 0039 1006 0200 9701 0005 4974
0016 9628 9830 0002 2896 2898 3000 0228
9628 9830 0002 2896 2898 3000 0228 9628
9830 0002 0007 3000 0500 0630 0001 542E
```

Load memory Manifolds integrity TC57 of 86

```
1F3C C438 0039 1006 0200 9701 0005 49A0
0016 2896 2898 3000 0228 9628 9830 0002
2896 2898 3000 0228 9628 9830 0002 2896
2898 3000 0200 0D30 0005 000C 3000 EE5C
```

Load memory Manifolds integrity TC58 of 86

```
1F3C C439 0039 1006 0200 9701 0005 49CC
0016 0128 9628 9830 0002 2896 2898 3000
0228 9628 9830 0002 2896 2898 3000 0228
9628 9830 0002 000F 3000 0500 0E30 1821
```

Load memory Manifolds integrity TC59 of 86

```
1F3C C43A 0039 1006 0200 9701 0005 49F8
0016 0001 2896 2898 3000 0228 9628 9830
0002 2896 2898 3000 0228 9628 9830 0002
2896 2898 3000 0200 0D30 0005 000C 2FEE
```

Load memory Manifolds integrity TC60 of 86

```
1F3C C43B 0039 1006 0200 9701 0005 4A24
0016 3000 0128 9628 9830 0002 2896 2898
3000 0228 9628 9830 0002 2896 2898 3000
0228 9628 9830 0002 0013 3000 0500 5B1E
```

Load memory Manifolds integrity TC61 of 86

```
1F3C C43C 0039 1006 0200 9701 0005 4A50
0016 1230 0001 2896 2898 3000 0130 0002
2896 2898 3000 0130 0002 2896 2898 3000
0130 0002 2896 2898 3000 0130 0002 41F4
```

Load memory Manifolds integrity TC62 of 86

```
1F3C C43D 0039 1006 0200 9701 0005 4A7C
0016 2896 2898 3000 0130 0002 000D 3000
0500 0C30 0001 2896 2898 3000 0228 9628
9830 0002 2896 2898 3000 0228 9628 D0CC
```

Load memory Manifolds integrity TC63 of 86

```
1F3C C43E 0039 1006 0200 9701 0005 4AA8
0016 9830 0002 2896 2898 3000 0200 1130
0005 0010 3000 0128 9628 9830 0002 2896
2898 3000 0228 9628 9830 0002 2896 2351
```

Load memory Manifolds integrity TC64of 86

```
1F3C C43F 0039 1006 0200 9701 0005 4AD4
0016 2898 3000 0228 9628 9830 0002 000D
3000 0500 0C30 0001 2896 2898 3000 0228
9628 9830 0002 2896 2898 3000 0228 464F
```

Load memory Manifolds integrity TC65 of 86

```
1F3C C440 0039 1006 0200 9701 0005 4B00
0016 9628 9830 0002 2896 2898 3000 0200
0730 0005 0006 3000 0128 9628 9830 0002
2896 2898 3000 0228 9628 9830 0002 22ED
```

Load memory Manifolds integrity TC66 of 86

```
1F3C C441 0039 1006 0200 9701 0005 4B2C
0016 2896 2898 3000 0228 9628 9830 0002
000D 3000 0500 0C30 0001 2896 2898 3000
0228 9628 9830 0002 2896 2898 3000 5B2E
```

Load memory Manifolds integrity TC67 of 86

```
1F3C C442 0039 1006 0200 9701 0005 4B58
0016 0228 9628 9830 0002 2896 2898 3000
0200 0700 0D00 0F00 1100 1330 0005 0006
000C 000E 0010 0012 3000 0128 9628 F888
```

Load memory Manifolds integrity TC68 of 86

```
1F3C C443 0039 1006 0200 9701 0005 4B84
0016 9830 0002 2896 2898 3000 0228 9628
9830 0002 2896 2898 3000 0228 9628 9830
0002 2880 2882 28CE 2890 2892 2896 072E
```

Load memory Manifolds integrity TC69 of 86

```
1F3C C444 0039 1006 0200 9701 0005 4BB0
0016 2898 3000 0A28 8028 8228 CE28 9028
9228 9628 9830 000A 2880 2882 28CE 2890
2892 2896 2898 3000 0A28 8028 8228 1842
```

Load memory Manifolds integrity TC70 of 86

```
1F3C C445 0039 1006 0200 9701 0005 4BDC
0016 CE28 9028 9228 9628 9830 000A 2880
2882 28CE 2890 2892 2896 2898 3000 0A28
8028 8228 CE28 9028 9228 9628 9830 0B7A
```

Load memory Manifolds integrity TC71 of 86

```
1F3C C446 0039 1006 0200 9701 0005 4C08
0016 000A 001F 3000 0100 1E30 0002 2880
2882 28CE 2890 2892 2896 2898 001F 3000
0100 1E30 0002 2880 2882 28CE 2890 A20D
```

Load memory Manifolds integrity TC72 of 86

```
1F3C C447 0039 1006 0200 9701 0005 4C34
0016 2892 2896 2898 001F 3000 0100 1E30
0002 2880 2882 28CE 2890 2892 2896 2898
001F 3000 0100 1E30 0002 2880 2882 C17A
```

Load memory Manifolds integrity TC73 of 86

```
1F3C C448 0039 1006 0200 9701 0005 4C60
0016 28CE 2890 2892 2896 2898 001F 3000
0100 1E30 0002 2880 2882 28CE 2890 2892
2896 2898 2896 2898 3000 0228 9628 99A0
```

Load memory Manifolds integrity TC74 of 86

```
1F3C C449 0039 1006 0200 9701 0005 4C8C
0016 9830 0002 2896 2898 3000 0228 9628
9830 0002 2896 2898 3000 0200 0530 0005
0004 3000 0128 9628 9830 0002 2896 7AE6
```

Load memory Manifolds integrity TC75 of 86

```
1F3C C44A 0039 1006 0200 9701 0005 4CB8
0016 2898 3000 0228 9628 9830 0002 2896
2898 3000 0228 9628 9830 0002 0003 3000
0500 0230 0001 2896 2898 3000 0228 015C
```

Load memory Manifolds integrity TC76 of 86

```
1F3C C44B 0039 1006 0200 9701 0005 4CE4
0016 9628 9830 0002 2896 2898 3000 0228
9628 9830 0002 2896 2898 3000 0200 0730
0005 0006 3000 0128 9628 9830 0002 58B5
```

Load memory Manifolds integrity TC77 of 86

```
1F3C C44C 0039 1006 0200 9701 0005 4D10
0016 2896 2898 3000 0228 9628 9830 0002
2896 2898 3000 0228 9628 9830 0002 0007
000D 3000 0500 0600 0C30 0001 2896 18FC
```

Load memory Manifolds integrity TC78 of 86

```
1F3C C44D 0039 1006 0200 9701 0005 4D3C
0016 2898 3000 0228 9628 9830 0002 2896
2898 3000 0228 9628 9830 0002 2896 2898
3000 0200 0530 0005 0004 3000 0128 F3AE
```

Load memory Manifolds integrity TC79 of 86

```
1F3C C44E 0039 1006 0200 9701 0005 4D68
0016 9628 9830 0002 2896 2898 3000 0228
9628 9830 0002 2896 2898 3000 0228 9628
9830 0002 0005 0007 000D 3000 0500 32C2
```

Load memory Manifolds integrity TC80 of 86

```
1F3C C44F 0039 1006 0200 9701 0005 4D94
0016 0400 0600 0C30 0001 2896 2898 3000
0228 9628 9830 0002 2896 2898 3000 0228
9628 9830 0002 2896 2898 3000 0200 E268
```

Load memory Manifolds integrity TC81 of 86

```
1F3C C450 0039 1006 0200 9701 0005 4DC0
0016 0330 0005 0002 3000 0128 9628 9830
0002 2896 2898 3000 0228 9628 9830 0002
2896 2898 3000 0228 9628 9830 0002 1E1C
```

Load memory Manifolds integrity TC82 of 86

```
1F3C C451 0039 1006 0200 9701 0005 4DEC
0016 0007 000D 3000 0500 0600 0C30 0001
2896 2898 3000 0228 9628 9830 0002 2896
2898 3000 0228 9628 9830 0002 2896 52EC
```

Load memory Manifolds integrity TC83 of 86

```
1F3C C452 0039 1006 0200 9701 0005 4E18
0016 2898 3000 0200 1100 1500 1F30 0001
0014 001E 0010 3000 0228 8028 8228 CE28
9028 9228 9628 9800 1100 1500 1F30 FE3A
```

Load memory Manifolds integrity TC84 of 86

```
1F3C C453 0039 1006 0200 9701 0005 4E44
0016 0001 0014 001E 0010 3000 0228 8028
8228 CE28 9028 9228 9628 9800 1100 1500
1F30 0001 0014 001E 0010 3000 0228 F9A2
```

Load memory Manifolds integrity TC85 of 86

```
1F3C C454 0039 1006 0200 9701 0005 4E70
0016 8028 8228 CE28 9028 9228 9628 9800
1100 1500 1F30 0001 0014 001E 0010 3000
0228 8028 8228 CE28 9028 9228 9628 BCF5
```

Load memory Manifolds integrity TC86 of 86

```
1F3C C455 0031 1006 0200 9701 0005 4E9C
0012 9800 1100 1500 1F30 0001 0014 001E
0010 3000 0228 8028 8228 CE28 9028 9228
9628 980A 32FF 5335
```

3.2 Execution of the Manifolds integrity mode

The sequence to execute Interference test in a Standalone mode is as follows:

1. Start with Ptolemy switched on and having transmitted the Ptolemy Initialisation TCs
2. Check Memory of the Manifolds integrity mode
3. Transmit TC to set Ptolemy into Standby mode
4. Transmit TC to enable the relevant Ptolemy subsystems
5. Transmit TC to Begin the Manifolds integrity mode
6. Once the Manifolds integrity mode has been completed then transmit TC to set Ptolemy into Safe mode

TC: Check Memory Manifolds integrity mode

```
1F3C F201 0025 1006 0900 9705 0005 4000
0180 0005 4300 0180 0005 4600 0180 0005
4900 0180 0005 4C00 0160 D4F6
```

The results of the Memory check TC are returned as a Check memory report within a Housekeeping packet.

Memory Address		Number of Words	Expected Checksum
Page	Offset		
0005	4000	0180	7996
0005	4300	0180	D49B
0005	4600	0180	0F6F
0005	4900	0180	C6EB
0005	4C00	0160	EA0F

TC: Start Manifolds integrity mode

```
1F3C F241 000B 10C1 0500 0001 FFFF FFFF
AF71
```

The TCs listed below were used to execute Interference test on the QM on 30-Jan-2013 having initialised Ptolemy with Initialisation(3).seq (AD4)

Check memory	1F3C F201 0025 1006 0900 9705 0005 4000 0180 0005 4300 0180 0005 4600 0180 0005 4900 0180 0005 4C00 0160 D4F6
Start Standby	1F3C F002 000B 10C1 0000 0001 0000 0000 1DB7
Hazard enable	1F3C C000 000B 10C2 0100 BFFF FBFF 0060 4A18
Start Module	1F3C F241 000B 10C1 0500 0001 FFFF FFFF AF71
Select Safe mode	1F3C F004 0005 10C1 FF00 C48F

4. Script Manifolds integrity mode

Script file name: FM Manifolds test (30-Jan-2013)
590 commands

Time (s)	Command	Comments
180	Loop, , Begin, 6, , Aux Data, tLV1, , , , Aux Data, tLV2, , , , Aux Data, AD590, , , , Aux Data, pG1, , , , Aux Data, pG2, , , , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 30, Loop, , End, , ,	Monitor temperatures of LV1, LV2, AD590, and pressures G1, G2, G4 and G5 at 30 second intervals for 3 minutes.
1080	L-Valve, LV2, Open, 4, 255, 2 Loop, , Begin, 30, , Aux Data, tLV1, , , , Aux Data, tLV2, , , , Aux Data, AD590, , , , Aux Data, pG1, , , , Aux Data, pG2, , , , Time Delay, , , , 30, Loop, , End, , ,	Set the plenum manifold pressure to 4 bar and then monitor temperatures of LV1, LV2, AD590, and pressures G1 and G2 at 30 second intervals for 15 minutes.
1095	Loop, , Begin, 5, , Valve, V9, Open, , , Valve, V11, Open, , , Time Delay, , , , 1, Valve, V11, Close, , , Valve, V9, Close, , , Time Delay, , , , 2, Aux Data, tLV1, , , , Aux Data, tLV2, , , , Aux Data, AD590, , , , Aux Data, pG1, , , , Aux Data, pG2, , , , Aux Data, pG4, , , , Aux Data, pG5, , , , Loop, , End, , ,	Transfer gas from the helium system into manifold2. Open valves V9 and V11, wait for 1 second then close V9 and V11. Wait for 2 seconds then measure temperature of LV-1, LV-2 and the AD590 and the pressure of the manifolds and helium gas system (G1, G2, G4 and G5). Repeat this step 5 times.
1105	Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Measure the pressure in the manifolds (G4 and G5 at 2 second intervals for 10 seconds).
	Valve, V8, Open, , , Time Delay, , , , 5,	Open Valve V8, wait 5 seconds then close V8. Measure the pressure in the manifolds.

1121	Valve, V8, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	
1137	Valve, V10, Open, , , Time Delay, , , , 5, Valve, V10, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Open Valve V10, wait 5 seconds then close V10. Measure the pressure in the manifolds.
1153	Valve, V13, Open, , , Time Delay, , , , 5, Valve, V13, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Open Valve V13, wait 5 seconds then close V13. Measure the pressure in the manifolds.
1169	Valve, V9, Open, , , Time Delay, , , , 5, Valve, V9, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Open Valve V9, wait 5 seconds then close V9. Measure the pressure in the manifolds.
1185	Valve, V4, Open, , , Time Delay, , , , 5, Valve, V4, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Open Valve V4, wait 5 seconds then close V4. Measure the pressure in the manifolds.
	Valve, V7, Open, , , Time Delay, , , , 5, Valve, V7, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, ,	Open Valve V7, wait 5 seconds then close V7. Measure the pressure in the manifolds.

1201	Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	
1217	Valve, V8, Open, , , Time Delay, , , , 5, Valve, V8, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Open Valve V8, wait 5 seconds then close V8. Measure the pressure in the manifolds.
1233	Valve, V7, Open, , , Time Delay, , , , 5, Valve, V7, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Open Valve V7, wait 5 seconds then close V7. Measure the pressure in the manifolds.
1249	Valve, V10, Open, , , Time Delay, , , , 5, Valve, V10, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Open Valve V10, wait 5 seconds then close V10. Measure the pressure in the manifolds.
1265	Valve, V7, Open, , , Time Delay, , , , 5, Valve, V7, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Open Valve V7, wait 5 seconds then close V7. Measure the pressure in the manifolds.
	Valve, V9, Open, , , Time Delay, , , , 5, Valve, V9, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2,	Open Valve V9, wait 5 seconds then close V9. Measure the pressure in the manifolds.

1281	Loop, , End, , ,	
1297	Valve, V7, Open, , , Time Delay, , , , 5, Valve, V7, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Open Valve V7, wait 5 seconds then close V7. Measure the pressure in the manifolds.
1313	Valve, V4, Open, , , Time Delay, , , , 5, Valve, V4, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Open Valve V4, wait 5 seconds then close V4. Measure the pressure in the manifolds.
1329	Valve, V7, Open, , , Time Delay, , , , 5, Valve, V7, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Open Valve V7, wait 5 seconds then close V7. Measure the pressure in the manifolds.
1345	Valve, V4, Open, , , Valve, V7, Open, , , Valve, V8, Open, , , Valve, V9, Open, , , Valve, V10, Open, , , Time Delay, , , , 5, Valve, V4, Close, , , Valve, V7, Close, , , Valve, V8, Close, , , Valve, V9, Close, , , Valve, V10, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Evacuate manifold2 by opening valves V4, V7, V8, V9 and V10, wait 5 seconds and then close valves V4, V7, V8, V9 and V10. Measure the pressure in the manifolds.
	Loop, , Begin, 6, , Aux Data, tLV1, , , , Aux Data, tLV2, , , ,	Monitor temperatures of LV1, LV2, AD590, and pressures G1, G2, G4 and G5 at 30 second intervals for 1 minute.

1405	Aux Data, AD590, , , , Aux Data, pG1, , , , Aux Data, pG2, , , , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 10, Loop, , End, , ,	
1420	Loop, , Begin, 5, , Valve, V16, Open, , , Time Delay, , , , 1, Valve, V16, Close, , , Time Delay, , , , 2, Aux Data, tLV1, , , , Aux Data, tLV2, , , , Aux Data, AD590, , , , Aux Data, pG1, , , , Aux Data, pG2, , , , Aux Data, pG4, , , , Aux Data, pG5, , , , Loop, , End, , ,	Transfer gas from the helium system into manifold1. Open valve V16, wait for 1 second then close V16. Wait for 2 seconds then measure temperature of LV-1, LV-2 and the AD590 and the pressure of the manifolds and helium gas system (G1, G2, G4 and G5). Repeat this step 5 times.
1430	Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Measure the pressure in the manifolds (G4 and G5 at 2 second intervals for 10 seconds).
1446	Valve, V3, Open, , , Time Delay, , , , 5, Valve, V3, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Open Valve V3, wait 5 seconds then close V3. Measure the pressure in the manifolds.
1462	Valve, V2, Open, , , Time Delay, , , , 5, Valve, V2, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Open Valve V2, wait 5 seconds then close V2. Measure the pressure in the manifolds.
	Valve, V4, Open, , , Time Delay, , , , 5, Valve, V4, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, ,	Open Valve V4, wait 5 seconds then close V4. Measure the pressure in the manifolds.

1478	Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	
1494	Valve, V4, Open, , , Valve, V7, Open, , , Time Delay, , , , 5, Valve, V4, Close, , , Valve, V7, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Open Valves V4 and V7, wait 5 seconds then close V4 and V7. Measure the pressure in the manifolds.
1510	Valve, V3, Open, , , Time Delay, , , , 5, Valve, V3, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Open Valve V3, wait 5 seconds then close V3. Measure the pressure in the manifolds.
1526	Valve, V3, Open, , , Valve, V4, Open, , , Valve, V7, Open, , , Time Delay, , , , 5, Valve, V3, Close, , , Valve, V4, Close, , , Valve, V7, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Open Valves V3, V4 and V7, wait 5 seconds then close V3, V4 and V7. Measure the pressure in the manifolds.
1542	Valve, V2, Open, , , Time Delay, , , , 5, Valve, V2, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Open Valve V2, wait 5 seconds then close V2. Measure the pressure in the manifolds.
	Valve, V4, Open, , , Valve, V7, Open, , ,	Open Valves V4 and V7, wait 5 seconds then close V4 and V7. Measure the pressure

1558	Time Delay, , , , 5, Valve, V4, Close, , , Valve, V7, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	in the manifolds.
1618	Loop, , Begin, 6, , Aux Data, tLV1, , , , Aux Data, tLV2, , , , Aux Data, AD590, , , , Aux Data, pG1, , , , Aux Data, pG2, , , , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 10, Loop, , End, , ,	Monitor temperatures of LV1, LV2, AD590, and pressures G1, G2, G4 and G5 at 30 second intervals for 1 minute.
1633	Loop, , Begin, 5, , Valve, V9, Open, , , Valve, V11, Open, , , Time Delay, , , , 1, Valve, V11, Close, , , Valve, V9, Close, , , Time Delay, , , , 2, Aux Data, tLV1, , , , Aux Data, tLV2, , , , Aux Data, AD590, , , , Aux Data, pG1, , , , Aux Data, pG2, , , , Aux Data, pG4, , , , Aux Data, pG5, , , , Loop, , End, , ,	Transfer gas from the helium system into manifold2. Open valves V9 and V11, wait for 1 second then close V9 and V11. Wait for 2 seconds then measure temperature of LV-1, LV-2 and the AD590 and the pressure of the manifolds and helium gas system (G1, G2, G4 and G5). Repeat this step 5 times.
1643	Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Measure the pressure in the manifolds (G4 and G5 at 2 second intervals for 10 seconds).
1659	Valve, V8, Open, , , Time Delay, , , , 5, Valve, V8, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Open Valve V8, wait 5 seconds then close V8. Measure the pressure in the manifolds.

1675	Valve, V10, Open, , , Time Delay, , , , 5, Valve, V10, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Open Valve V10, wait 5 seconds then close V10. Measure the pressure in the manifolds.
1691	Valve, V13, Open, , , Time Delay, , , , 5, Valve, V13, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Open Valve V13, wait 5 seconds then close V13. Measure the pressure in the manifolds.
1707	Valve, V9, Open, , , Time Delay, , , , 5, Valve, V9, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Open Valve V9, wait 5 seconds then close V9. Measure the pressure in the manifolds.
1723	Valve, V4, Open, , , Time Delay, , , , 5, Valve, V4, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Open Valve V4, wait 5 seconds then close V4. Measure the pressure in the manifolds.
1739	Valve, V7, Open, , , Time Delay, , , , 5, Valve, V7, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Open Valve V7, wait 5 seconds then close V7. Measure the pressure in the manifolds.
	Valve, V8, Open, , , Time Delay, , , , 5, Valve, V8, Close, , ,	Open Valve V8, wait 5 seconds then close V8. Measure the pressure in the manifolds.

1755	Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	
1771	Valve, V7, Open, , , Time Delay, , , , 5, Valve, V7, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Open Valve V7, wait 5 seconds then close V7. Measure the pressure in the manifolds.
1792	Valve, V10, Open, , , Time Delay, , , , 5, Valve, V10, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 1, Time Delay, , , , 2, Loop, , End, , ,	Open Valve V10, wait 5 seconds then close V10. Measure the pressure in the manifolds (G4 and G5 at 3 second intervals for 15 seconds).
1808	Valve, V7, Open, , , Time Delay, , , , 5, Valve, V7, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Open Valve V7, wait 5 seconds then close V7. Measure the pressure in the manifolds.
1824	Valve, V9, Open, , , Time Delay, , , , 5, Valve, V9, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Open Valve V9, wait 5 seconds then close V9. Measure the pressure in the manifolds.
	Valve, V7, Open, , , Time Delay, , , , 5, Valve, V7, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, ,	Open Valve V7, wait 5 seconds then close V7. Measure the pressure in the manifolds.

1840	Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	
1856	Valve, V4, Open, , , Time Delay, , , , 5, Valve, V4, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Open Valve V4, wait 5 seconds then close V4. Measure the pressure in the manifolds.
1872	Valve, V7, Open, , , Time Delay, , , , 5, Valve, V7, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Open Valve V7, wait 5 seconds then close V7. Measure the pressure in the manifolds.
1888	Valve, V4, Open, , , Valve, V7, Open, , , Valve, V8, Open, , , Valve, V9, Open, , , Valve, V10, Open, , , Time Delay, , , , 5, Valve, V4, Close, , , Valve, V7, Close, , , Valve, V8, Close, , , Valve, V9, Close, , , Valve, V10, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Evacuate manifold2 by opening valves V4, V7, V8, V9 and V10, wait 5 seconds and then close valves V4, V7, V8, V9 and V10. Measure the pressure in the manifolds.
	Loop, , Begin, 6, , Aux Data, tLV1, , , , Aux Data, tLV2, , , , Aux Data, AD590, , , , Aux Data, pG1, , , , Aux Data, pG2, , , , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 10,	Monitor temperatures of LV1, LV2, AD590, and pressures G1, G2, G4 and G5 at 30 second intervals for 1 minute.

1948	Loop, , End, , ,	
1963	Loop, , Begin, 5, , Valve, V16, Open, , , Time Delay, , , , 1, Valve, V16, Close, , , Time Delay, , , , 2, Aux Data, tLV1, , , , Aux Data, tLV2, , , , Aux Data, AD590, , , , Aux Data, pG1, , , , Aux Data, pG2, , , , Aux Data, pG4, , , , Aux Data, pG5, , , , Loop, , End, , ,	Transfer gas from the helium system into manifold1. Open valve V16, wait for 1 second then close V16. Wait for 2 seconds then measure temperature of LV-1, LV-2 and the AD590 and the pressure of the manifolds and helium gas system (G1, G2, G4 and G5). Repeat this step 5 times.
1973	Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Measure the pressure in the manifolds (G4 and G5 at 2 second intervals for 10 seconds).
1989	Valve, V3, Open, , , Time Delay, , , , 5, Valve, V3, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Open Valve V3, wait 5 seconds then close V3. Measure the pressure in the manifolds.
2005	Valve, V2, Open, , , Time Delay, , , , 5, Valve, V2, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Open Valve V2, wait 5 seconds then close V2. Measure the pressure in the manifolds.
2021	Valve, V4, Open, , , Time Delay, , , , 5, Valve, V4, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Open Valve V4, wait 5 seconds then close V4. Measure the pressure in the manifolds.
	Valve, V4, Open, , , Valve, V7, Open, , ,	Open Valves V4 and V7, wait 5 seconds then close V4 and V7. Measure the pressure

2037	Time Delay, , , , 5, Valve, V4, Close, , , Valve, V7, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	in the manifolds.
2053	Valve, V3, Open, , , Time Delay, , , , 5, Valve, V3, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Open Valve V3, wait 5 seconds then close V3. Measure the pressure in the manifolds.
2069	Valve, V3, Open, , , Valve, V4, Open, , , Valve, V7, Open, , , Time Delay, , , , 5, Valve, V3, Close, , , Valve, V4, Close, , , Valve, V7, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Open Valves V3, V4 and V7, wait 5 seconds then close V3, V4 and V7. Measure the pressure in the manifolds.
2085	Valve, V2, Open, , , Time Delay, , , , 5, Valve, V2, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Open Valve V2, wait 5 seconds then close V2. Measure the pressure in the manifolds.
	Valve, V4, Open, , , Valve, V7, Open, , , Time Delay, , , , 5, Valve, V4, Close, , , Valve, V7, Close, , , Time Delay, , , , 1, Loop, , Begin, 5, , Aux Data, pG4, , , ,	Open Valves V4 and V7, wait 5 seconds then close V4 and V7. Measure the pressure in the manifolds.

2101	Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	
2116	Loop, , Begin, 5, , Valve, V9, Open, , , Valve, V11, Open, , , Valve, V16, Open, , , Time Delay, , , , 1, Valve, V11, Close, , , Valve, V16, Close, , , Valve, V9, Close, , , Time Delay, , , , 2, Aux Data, tLV1, , , , Aux Data, tLV2, , , , Aux Data, AD590, , , , Aux Data, pG1, , , , Aux Data, pG2, , , , Aux Data, pG4, , , , Aux Data, pG5, , , , Loop, , End, , ,	Open V9, V11 and V16, wait 1 second then close V11, V16 and V9. Wait 2 seconds then measure tLV1, tLV2, tAD590, pG1, pG2, pG4 and pG5. Repeat this step 5 times.
	L-Valve, LV2, Close, , ,	Finally switch off LV-2.