MODULUS – Ptolemy

Ptolemy Mode Description: Module J – Prepare reference gas mn2

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CHANGE RECORD

DATE	CHANGE DETAILS	ISSUE
01 March 2012	Document created	1.0
22 June 2012	Document edited inclusion of power profile	1.1
03 September 2013	Module script changed following FSS GRM testing campaign	2.0

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1. Introduction

This document describes the command sequence and operation of Ptolemy Module J – Prepare reference gas mn2. An aliquot of reference gas contained in a volume behind LV-5 is admitted into manifold2 for analysis through either the direct channel or GC channel B.

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

2. Prepare reference gas mn2 Module

This module prepares an aliquot of reference gas so that a direct comparison can be made between the comet sample and a sample of known isotopic composition. The reference gas is stored in a volume behind LV-5. LV-5 is operated to give a pressure of 0.3 bar in manifold2. A byproduct of this sequence is that reference gas also enters into the volume containing R6.

2.1 Sequence outline

1. Measure the temperature of manifold2 and the AD590. Measure the pressure in manifold2 and the helium carrier gas system. Monitor the currents on the 5V and 28V voltage rails.
2. Evacuate any residual gas in manifold2, behind V10 and V13.
3. Admit reference gas into manifold2 by operating LV-5 at full power to give a target pressure of 0.3 Bar on pG5.
4. Switch off LV-5 and close V10.
5. Measure the pressure in manifold2. Monitor the currents on the 5V and 28V voltage rails.

The detailed Ptolemy sequence is listed in section 4.

At the end of the sequence Ptolemy returns to standby mode with Valve V11 open. Ptolemy will remain in this state until commanded to start the next module (Module G – Direct channel (Bulk composition) or Module E – Channel B (C&N isotopes)) or commanded into Safe mode.

2.2 Resources

Start State – All Ptolemy subsystems off
End State – V11 open

Subsystems operated:
Valves: V7, V10, V11 and V13
L-Valves: LV-5

Data Volume:

Aux Science packets	3
Spectrum packets	0
Number of spectra	0

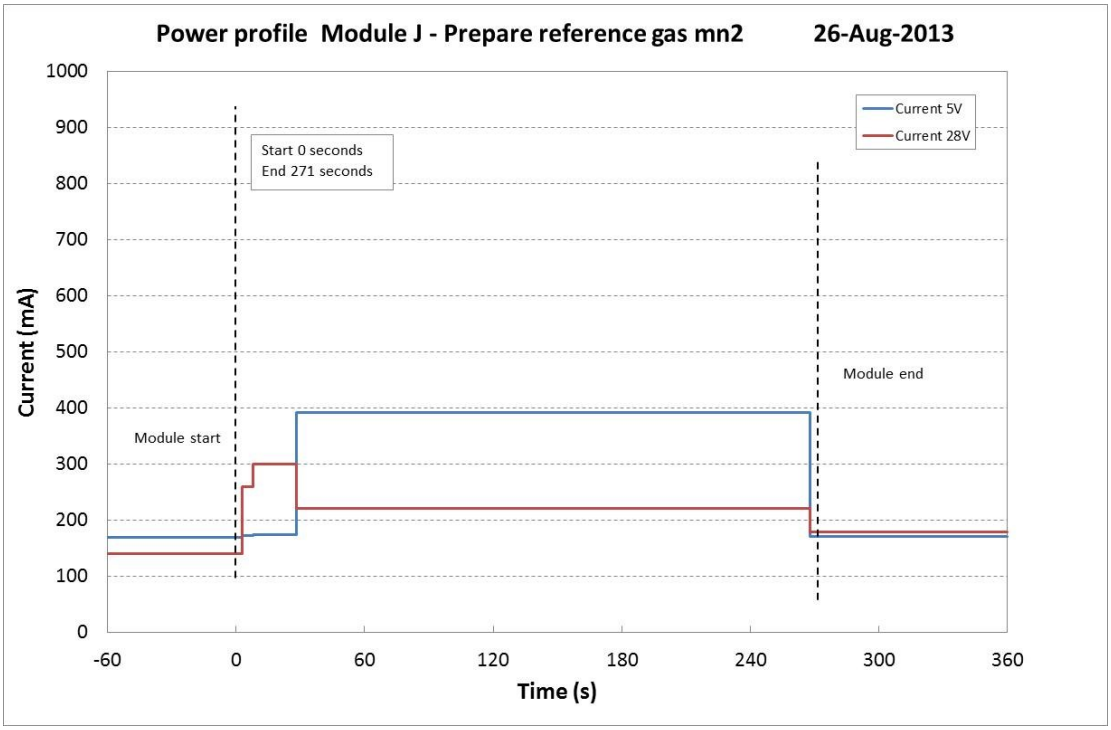
Resourses

Helium used	none
Hydrogen used	none
Oxygen used	none
Reference gas	2 ml
Nano-tip use	none

Power profile Nominal:	5.2V Supply Rail		28V supply rail	
	Current (mA)	Power (W)	Current (mA)	Power (W)
Average	367	1.91	227	6.36
Maximum	392	2.04	300	8.40

Duration 271 s
Total energy 2240 J

Calculated power profile



2.3 Ptolemy Models

A summary of the use of Module J – Prepare reference gas mn2 with the various Ptolemy models is given below.

Model	Use	Power Profile (c.f. FM)	Timing (c.f. FM)	Sensors
FM	Limited	-	-	-
QM	Partially limited	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)

Module J – Prepare reference gas mn2 uses 2ml of the limited resource of reference gas. Once depleted, Ptolemy will no longer be able to calibrate results against known isotopic reference gases.

2.3.2 Qualification Model (QM)

Module J – Prepare reference gas mn2 uses the limited resource of the reference gas. Once depleted, reference gas can be replaced from the lab gas mixture that was used to fill the FM reference gas container. The timing and power profile will be similar to the FM.

2.3.3 Chemistry Set Simulator (CSS)

Module J – Prepare reference gas mn2. 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)

Module J – Prepare reference gas mn2. 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 Module J – Prepare reference gas mn2

3.1 Load Ptolemy Memory

J – Prepare reference gas mn2, the commands have to be loaded onto Ptolemy EEPROM using the Ptolemy Load Memory TC (AD1). The TCs to upload the module 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 6
Number of words 118
Sequence control CC50 to CC55
Memory address page 5 offset C500 – C5EA

Load memory of Module J – Prepare reference gas mn2TC1 of 6

```
1F3C CC50 0039 1006 0200 9701 0005 C500
0016 28C2 28CE 2890 2892 2898 28D4 28D6
3000 0128 C228 CE28 9028 9228 9828 D428
D630 0001 28C2 28CE 2890 2892 2898 CC1D
```

Load memory of Module J – Prepare reference gas mn2TC2 of 6

```
1F3C CC51 0039 1006 0200 9701 0005 C52C
0016 28D4 28D6 3000 0100 1900 1500 1328
9830 0001 2898 3000 0128 9830 0001 2898
3000 0128 9830 0001 000D 2898 3000 68E4
```

Load memory of Module J – Prepare reference gas mn2TC3 of 6

```
1F3C CC52 0039 1006 0200 9701 0005 C558
0016 0428 9830 0004 2898 3000 0428 9830
0004 2898 3000 0400 0C00 180A 390E 6648
FF28 9828 8830 0014 2898 2888 3000 E620
```

Load memory of Module J – Prepare reference gas mn2TC4 of 6

```
1F3C CC53 0039 1006 0200 9701 0005 C584
0016 1428 9828 8830 0014 2898 2888 3000
1428 9828 8830 0014 2898 2888 3000 1428
9828 8830 0014 2898 2888 3000 1428 6BF4
```

Load memory of Module J – Prepare reference gas mn2TC5 of 6

```
1F3C CC54 0039 1006 0200 9701 0005 C5B0
0016 9828 8830 0014 2898 2888 3000 1428
9828 8830 0014 2898 2888 3000 140A 3800
1228 9828 D428 D630 0001 2898 28D4 862B
```

Load memory of Module J – Prepare reference gas mn2TC6 of 6

```
1F3C CC55 001D 1006 0200 9701 0005 C5DC
0008 28D6 3000 0128 9828 D428 D630 0001
FFFF 015E
```

3.2 Execution of Module J – Prepare reference gas mn2

The sequence to execute of Module J – Prepare reference gas mn2in a Standalone mode is as follows:

1. Start with Ptolemy switched on and having transmitted the Ptolemy Initialisation TCs
2. Check Memory Module J
3. Transmit TC to set Ptolemy into Standby mode
4. Transmit TC to enable the relevant Ptolemy subsystems
5. Transmit TC to define module start address
6. Transmit TC to Begin of Module J – Prepare reference gas mn2
7. Once the Prepare reference gas mn2 module has been completed then transmit TC to set Ptolemy into Safe mode

TC: Check Memory Module J

1F3C F10B 0013 1006 0900 9702 0005 C500
0064 0005 C5C8 0012 04ED

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	C500	0064	9FD9
0005	C5C8	0012	E86F

TC: Parameter update – define Module J start address

1F3C F12B 000D 10C3 0100 2012 0002 0005
C500 8C44

Updates parameter 0x2012 with two words to define the start address as EEPROM page 5 0xC500

TC: Start Module J – Prepare reference gas mn2

1F3C F14B 0007 10C1 0D00 0002 20BB

The TCs listed below were used to execute Module J on the CSS on 30-Aug-2013 having initialised Ptolemy with Initialisation(3).seq (AD4)

Check memory	1F3C F10B 0013 1006 0900 9702 0005 C500 0064 0005 C5C8 0012 04ED
Start Standby	1F3C C000 000B 10C1 0000 0009 0000 0000 CE64
Hazard enable	1F3C C000 000B 10C2 0100 FFFF FBFF 0070 3239
Update parameter	1F3C F12B 000D 10C3 0100 2012 0002 0005 C500 8C44
Start Module I	1F3C F14B 0007 10C1 0D00 0002 20BB
Select Safe mode	1F3C F004 0005 10C1 FF00 C48F

4. Script Module J – Prepare reference gas mn2

Script file name: FSS2 Module J - Prepare reference gas, manifold 2 (26-Aug-2013)

38 Commands

Time (s)	Command	Comments
3	Loop, , Begin, 3, , Aux Data, tENC2, , , , Aux Data, AD590, , , , Aux Data, pG1, , , , Aux Data, pG2, , , , Aux Data, pG5, , , , Aux Data, i5V, , , , Aux Data, i28V, , , , Time Delay, , , , 1, Loop, , End, , ,	Measure the temperature of manifold2 and the AD590. Measure the pressure in manifold2 and the helium carrier gas system. Monitor the currents on the 5V and 28V voltage rails.
28	Valve, V13, Open, , , Valve, V11, Open, , , Valve, V10, Open, , , Loop, , Begin, 5, , Aux Data, pG5, , , , Time Delay, , , , 1, Loop, , End, , , Valve, V7, Open, , , Loop, , Begin, 5, , Aux Data, pG5, , , , Time Delay, , , , 4, Loop, , End, , , Valve, V7, Close, , , Valve, V13, Close, , ,	Evacuate any residual gas in manifold2, behind V10 and V13.
268	L-Valve, LV5, Open, 0.3, 255, 5 Loop, , Begin, 12, , Aux Data, pG5, , , , Aux Data, tLV5, , , , Time Delay, , , , 20, Loop, , End, , ,	Admit reference gas into manifold2 by operating LV-5 at full power to give a target pressure of 0.3 Bar on pG5.
268	L-Valve, LV5, Close, , , Valve, V10, Close, , ,	Switch off LV-5 and close V10
271	Loop, , Begin, 3, , Aux Data, pG5, , , , Aux Data, i5V, , , , Aux Data, i28V, , , , Time Delay, , , , 1, Loop, , End, , ,	Measure the pressure in manifold2. Monitor the currents on the 5V and 28V voltage rails.
