

# MODULUS – Ptolemy

## Ptolemy Mode Description: Module K – Prepare reference gas mn1

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## 1. Introduction

This document describes the command sequence and operation of Ptolemy Module K – Prepare reference gas mn1. An aliquot of reference gas which has previously been prepared by module J remains trapped behind V10. The module admits the reference gas into manifold1 in preparation for injection into GC channel C.

### 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

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## 2. Prepare reference gas mn1 Module

Prior operation of module J – prepare reference gas mn2 results in a portion of the reference gas being trapped within the volume of R6. Overtime this trapped gas will escape, however Module K can use this trapped gas rather than using another aliquot from the reference gas container. The module is completed with V16 open, ready for execution of module F – Channel C (O&H isotopes)

### 2.1 Sequence outline

1. Measure temperature of AD590. Measure pressure of all pressure gauges. Measure currents on the 5V and 28V voltage rails.
2. Evacuate any gas from manifolds 1&2 by opening V4, V7 and V16. Close V7 after 25 seconds.
3. Admit reference gas into both manifolds. Monitor pressure in manifolds for 10 seconds.
4. Close valves V4 and V10.
5. Measure pressure of all pressure of both manifolds. Measure 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 V16 open. Ptolemy will remain in this state until commanded to start the next module (Module F – Channel C (O&H isotopes)) or commanded into Safe mode.

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## 2.2 Resources

Start State – All Ptolemy subsystems off  
End State – V16 open

Subsystems operated:

Valves: V4, V7, V10, V16

Data Volume:

Aux Science packets 3  
Spectrum packets 0  
Number of spectra 0

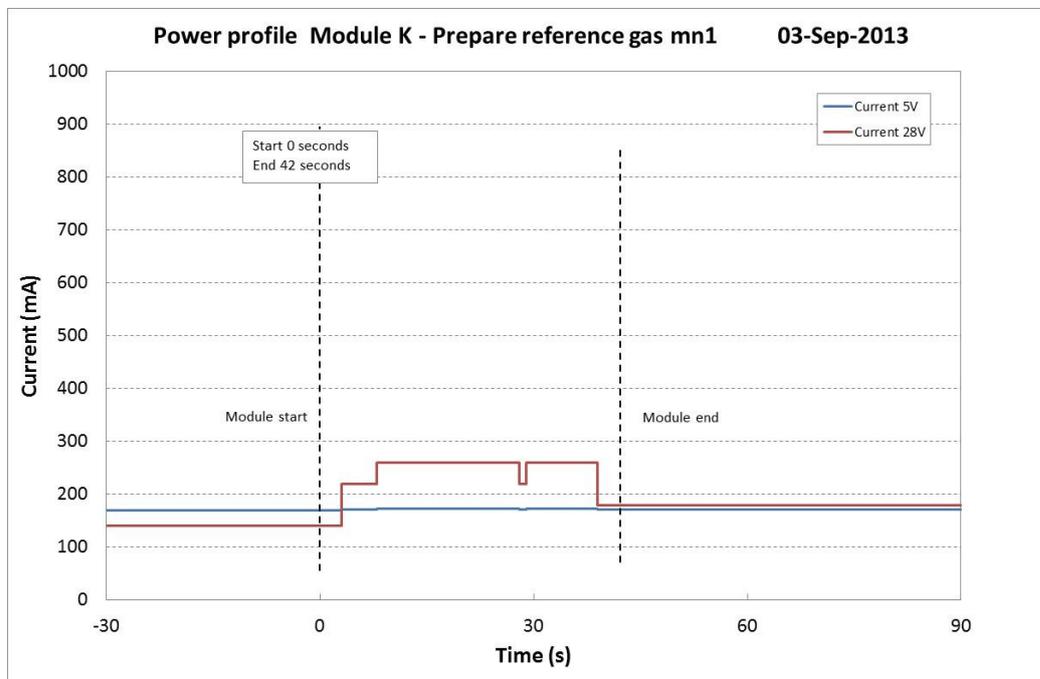
Resources:

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

Power profile	5.2V Supply Rail		28V supply rail	
	Current (mA)	Power (W)	Current (mA)	Power (W)
Nominal:				
Average	173	0.90	240	6.72
Maximum	173	0.90	260	7.28

Duration 42 s  
Total energy 320 J

Calculated power profile



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### 2.3 Ptolemy Models

A summary of the use of Module K – Prepare reference gas mn1 with the various Ptolemy models is given below.

Model	Use	Power Profile (c.f. FM)	Timing (c.f. FM)	Sensors
FM	Any time	-	-	-
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)

Module K – Prepare reference gas mn1 only uses excess reference gas from the prior operation of module J. If reference gas has not been previously prepared then no reference gas is lost.

#### 2.3.2 Qualification Model (QM)

Module K – Prepare reference gas mn1 does not use any limited resources and can be used in air or vacuum conditions. The timing and power profile will be similar to the FM.

#### 2.3.3 Chemistry Set Simulator (CSS)

Module K – Prepare reference gas mn1. 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 K – Prepare reference gas mn1. 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.

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### 3. Operation Module K – Prepare reference gas mn1

#### 3.1 Load Ptolemy Memory

The Module K – Prepare reference gas mn1 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 5  
Number of words 107  
Sequence control CC00 to CC05  
Memory address page 5 offset C000 – C0D4

Load memory of Module K – Prepare reference gas mn1 TC1 of 5

**1F3C CC00 0039 1006 0200 9701 0005 C000  
0016 28CE 2890 2892 2894 2896 2898 28D4  
28D6 3000 0128 CE28 9028 9228 9428 9628  
9828 D428 D630 0001 28CE 2890 2892 AC69**

Load memory of Module K – Prepare reference gas mn1 TC2 of 5

**1F3C CC01 0039 1006 0200 9701 0005 C02C  
0016 2894 2896 2898 28D4 28D6 3000 0100  
0700 1F28 9628 9830 0001 2896 2898 3000  
0128 9628 9830 0001 2896 2898 3000 32C0**

Load memory of Module K – Prepare reference gas mn1 TC3 of 5

**1F3C CC02 0039 1006 0200 9701 0005 C058  
0016 0128 9628 9830 0001 000D 2896 2898  
3000 0428 9628 9830 0004 2896 2898 3000  
0428 9628 9830 0004 2896 2898 3000 1581**

Load memory of Module K – Prepare reference gas mn1 TC4 of 5

**1F3C CC03 0039 1006 0200 9701 0005 C084  
0016 0400 0C30 0001 0013 2896 2898 3000  
0228 9628 9830 0002 2896 2898 3000 0228  
9628 9830 0002 2896 2898 3000 0200 E3D2**

Load memory of Module K – Prepare reference gas mn1 TC5 of 5

**1F3C CC04 0033 1006 0200 9701 0005 C0B0  
0013 1200 0628 9628 9828 D428 D630 0001  
2896 2898 28D4 28D6 3000 0128 9628 9828  
D428 D630 0001 FFFF 959B**

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### 3.2 Execution of Module K – Prepare reference gas mn1

The sequence to execute of Module K – Prepare reference gas mn1 in a standalone mode is as follows:

1. Start with Ptolemy switched on and having transmitted the Ptolemy Initialisation TCs
2. Check Memory Module K
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 K – Prepare reference gas mn1
7. Once the Prepare reference gas mn1 module has been completed then transmit TC to set Ptolemy into Safe mode

TC: Check Memory Module K

**1F3C F10C 0013 1006 0900 9702 0005 C000  
0064 0005 C0C8 0007 31CC**

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	C000	0064	6012
0005	C0C8	0007	F2CE

TC: Parameter update – define Module K start address

**1F3C F12C 000D 10C3 0100 2012 0002 0005  
C000 0B26**

Updates parameter 0x2012 with two words to define the start address as EEPROM page 5 0xC000

TC: Start Module K – Prepare reference gas mn1

**1F3C F14C 0007 10C1 0D00 0002 9110**

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The TCs listed below were used to execute Module K on the CSS on 05-Sep-2013 having initialised Ptolemy with Initialisation(1).seq (AD4)

Check memory	1F3C F10C 0013 1006 0900 9702 0005 C000 0064 0005 C0C8 0007 31CC
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 F12C 000D 10C3 0100 2012 0002 0005 C000 0B26
Start Module K	1F3C F14C 0007 10C1 0D00 0002 9110
Select Safe mode	1F3C F004 0005 10C1 FF00 C48F

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### 4. Script Module K – Prepare reference gas mn1

Script file name: FSS2 Module K - Prepare reference gas, mn1 (03-Sep-2013)

41 Commands

Time (s)	Command	Comments
3	Loop, , Begin, 3, , Aux Data, AD590, , , , Aux Data, pG1, , , , Aux Data, pG2, , , , Aux Data, pG3, , , , Aux Data, pG4, , , , Aux Data, pG5, , , , Aux Data, i5V, , , , Aux Data, i28V, , , , Time Delay, , , , 1, Loop, , End, , , □	Measure temperature of AD590. Measure pressure of all pressure gauges. Measure currents on the 5V and 28V voltage rails.
29	Valve, V4, Open, , , Valve, V16, Open, , , Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 1, Loop, , End, , , Valve, V7, Open, , , Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 4, Loop, , End, , , Valve, V7, Close, , , Time Delay, , , , 1,	Evacuate any gas from manifolds 1&2 by opening V4, V7 and V16. Close V7 after 25 seconds.
39	Valve, V10, Open, , , Loop, , Begin, 5, , Aux Data, pG4, , , , Aux Data, pG5, , , , Time Delay, , , , 2, Loop, , End, , ,	Admit reference gas into both manifolds. Monitor pressure in manifolds for 10 seconds.
39	Valve, V10, Close, , , Valve, V4, Close, , ,	Close valves V4 and V10.
	Loop, , Begin, 3, , Aux Data, pG4, , , , Aux Data, pG5, , , , Aux Data, i5V, , , , Aux Data, i28V, , , , Time Delay, , , , 1,	Measure pressure of all pressure of both manifolds. Measure currents on the 5V and 28V voltage rails.

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42	Loop, , End, , ,	

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