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ROSETTA
ROSINA

FS S/W
Operations
Manual

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Document Change Record

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1. Applicable Documentation

Document Name	Document Number	Revision
AD[1] ESA ROSETTA EID/A	RO–EST–RS–3001/EID A	2
AD[2] ESA ROSINA EID/B	RO–EST–RS–3013/EID B	1
AD[3] ESA ROSETTA EID/C	RO–EST–RS–3001/EID C	1
AD[4] ROSINA RSDB Input	-	19.04.2002

2. Reference Documentation

Document Name	Document Number	Revision
RD[1] DPU Hardware Description	ROS-TUB-ID-03/1.0	07.06.2000
RD[2] Rosina EID-B 2.8	RO-EST-RS-3013/EIDB	13.07.2001
RD[3] DPU Housekeeping Reports	ROS-TUB-SP-02/3.0	19.04.2002
RD[4] DPU Science Data Packets	ROS-TUB-SP-03/2.0	19.04.2002
RD[5] S/C – DPU Command Packets	ROS-TUB-SP-04/2.4	19.04.2002
RD[6] DPU Event Packets	ROS-TUB-SP-05/2.3	04.07.2001
RD[7] DPU Memory Management Services	ROS-TUB-SP-06/1.4	30.11.2001
RD[8] DPU Context Transfer Service	ROS-TUB-SP-07/1.1	19.04.2002
RD[9] DPU Boot Sequence	ROS-TUB-SP-08/1.1	04.04.2002
RD[10] Rosina Mode Change Commands	ROS-TUB-MA-05/2.4	17.04.2002

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3. Introduction

3.1 General

The ROSINA FS instrument is a delicate instrument requiring great precautions with respect to handling, cleanliness, and operation. Whereas the DPU is a normal electronics box containing neither high voltages nor pyros and can therefore be handled by standard rules, all three sensors have to be handled with exceptional care, see RO-ROS-MAN-1006 for details. That means there are many restrictions on FS operations during normal S/C tests. The Cover Opening Mechanism is not operable at all. All high voltages, gas calibration units, filaments, ion source, and heaters can only be tested during SPT! However, the DPU and the digital electronics of the sensors can be fully tested, as the data flow from and to the sensors can be simulated even if the sensors themselves have a very limited configuration. All different major operation modes and data transmission profiles can be tested with the DPU.

3.2 Documentation

The ROSINA reference document RD[1] gives a short overview of the DPU hardware.

The ROSINA reference documents RD[3] .. RD[9] describe all telecommand and telemetry packets of the S/C interface and were used to fill in the ROSINA RSDB templates and for software implementation.

The different major operation modes are listed in RD[2] chapter 2.8.2.1.

4. Operation Modes

4.1 Mode Definitions

Table 4.1 shows the major operation mode definitions for the instrument, the state of the different units, the average power consumption, and the mode command parameter.

No.	Experiment Mode	DPU	DFMS	RTOF	COPS	Power Usage (W)	Command Parameter (hex)
0	Instrument Off	Off	Off	Off	Off	0	-
D1	DPU Booting	On	Off	Off	Off	6	-
D2	DPU Standby	On	Off	Off	Off	4.5	0x80d2
D3	DPU Emergency	On	Off	Off	Off	4.5	0x80d3
D4	DPU Ground Test	On	Off	Off	Off	6	0x80d4
D5	DPU S/W Patch	On	Off	Off	Off	6	0x80d5
S1	RTOF Standby	On	Off	Stby	Micro	22	0x80a1
S1T	RTOF Standby Test	On	Off	Stby	Off	18	0x80b1
E1	RTOF Emergency	On	Off	On	Micro	22	0x80e1
G1	RTOF Ground Test	On	Off	Stby	Off	18	0x80f1
1L	RTOF Low Power (Gas)	On	Off	On	Micro	22	0x8101
1G	RTOF Gas	On	Off	On	Micro	28	0x8201
1I	RTOF Ion	On	Off	On	Micro	23	0x8301
1	RTOF Full (Gas + Ion)	On	Off	On	Micro	40	0x8001
S2	DFMS Standby	On	Stby	Off	Micro	28	0x80a2
S2T	DFMS Standby Test	On	Stby	Off	Off	24	0x80b2
E2	DFMS Emergency	On	On	Off	Micro	28	0x80e2
G2	DFMS Ground Test	On	Stby	Off	Off	24	0x80f2
2	DFMS Normal	On	On	Off	Micro	28	0x8002
3	DFMS Narrow	On	On	Off	Full	33	0x8003
S4	RTOF+DFMS Standby	On	Stby	Stby	Micro	43	0x80a4
E4	RTOF+DFMS Emergency	On	On	On	Micro	48	0x80e4
G4	RTOF+DFMS Gr. Test	On	Stby	Stby	Stby	32	0x80f4
4	RTOF+DFMS Single	On	On	On	Full	54	0x8004
S5	COPS Standby	On	Off	Off	Stby	8	0x80a5
E5	COPS Emergency	On	Off	Off	On	8	0x80e5
G5	COPS Ground Test	On	Off	Off	Stby	8	0x80f5
5M	COPS Microtips	On	Off	Off	Micro	10	0x8105
5	COPS Full	On	Off	Off	Full	11	0x8005

Table 4.1: Major Operation Modes

The operation mode number can be classified using the following scheme (x = DPU mode, y = Sensor mode, z = Sub-mode):

0:      All Off

Dx: DPU only modes

y1z: RTOF modes (incl. COPS)

y2z: DFMS modes (incl. COPS)

y3z: DFMS special mode (incl. COPS)

y4z: RTOF, DFMS + COPS modes

y5z: COPS only modes

The operation mode of the instrument can be changed by issuing the DPU command P50 (RD[5]) 'Set Operation Mode' with the first command parameter set to the value showed in table 4.1 and the other 4 parameters set to 0 (for ground testing only!).

(Database: ZRNP4001 with PRNGP401 = Table 4.1,
*   PRNGP402 = 0,*
*   PRNGP403 = 0,*
*   PRNGP404 = 0,*
*   PRNGP405 = 0)*

4.2 Mode Transition

Mode changes are only possible between:

- DPU only modes (Dx) and Sensor standby / ground test modes (S1z.. S5z, F1 .. F5), or v.v.

- Sensor standby modes (S1z .. S5z) and other sensor operation modes (y1z .. y5z), or v.v.

After each mode change command an operation mode change event report (EID 44005) should be generated by the DPU (*Database: YRNG3005*).

For details see Rosina Mode Change Commands document RD[10].

4.3 Mode Display

The main instrument mode (low-byte value of command parameter in table 4.1) is shown in the standard DPU housekeeping report (*Database: NRNDP116*).

5. Power Switching

5.1 Switch On Procedure

The following procedure should be used for nominal ROSINA switch on:

	Test Step	Nominal value
1	Power on ROSINA through the LCL	ON, I < 0.35A
2	Send time update command between **20s** and 60s after power on	
3	Wait for default HK generation	
4	Verify that POST event report (EID 44001) is generated (YRNG3001)	Passed: Event report
5	Verify that default HK report (SID 1) is generated (YRNP1001)	OK
6	Verify that DPU Mode is D4	NRNAP10B = 0xD400

In the time frame between switch on and 10s after switch on the DPU is in booting mode, where only memory management command packets for software updates are allowed and no TM packet is generated. A time update command is ignored, any other command packet will produce a not acknowledge TM packet. If NO command packet is received within 10s after the last packet, the booting mode is canceled and the DPU will try to boot from EEPROM.

To simplify testing, the mode of the FS DPU after switch on is the 'DPU Ground Test' mode and housekeeping data will be generated every 2 seconds. Normal HK generation (once a minute) can be achieved by switching to 'DPU Standby' mode.

5.2 Switch Off Procedure

The following procedure should be used for nominal ROSINA switch off:

	Test Step	Nominal value
1	Send "D2 DPU Standby" command (*ZRNP4001 with PRNGP401 = 0x80D2,* *PRNGP402 = 0x01,* *PRNGP403 = 0,* *PRNGP404 = 0,* *PRNGP405 = 0)*	
2	Verify that command was accepted and executed	Passed: Acceptance & Execution Report
3	Verify that switch off ready event report (EID 44301) was generated (YRNG300D)	Passed: YRNG300D
4	Power off ROSINA through the LCL	OFF, 0 A

The Shut down command provides a safe step-by-step switch off of the sensor electronics (if any was powered). However, in case of emergency, ROSINA can be switched off immediately at any time.

6. Telemetry

6.1 Housekeeping Packets

Table 6.1 shows all major operation modes and the generated housekeeping reports. The detailed description is in RD[3].

Mode No.	Average Data Rate (bits/s)	Peak Data Rate (bits/s)	Polling Period (s)	Packet Size (words)	SID	Description
D2	7	35	16	24	1	Std. DPU HK every 1 min
				35	17	Ext. DPU HK every 5 min
D3	140	140	4	35	17	Ext. DPU HK every 4 s
D4	280	560	1	35	17	Ext. DPU HK every 2 s
D5	140	140	4	35	17	Ext. DPU HK every 4 s
S1T	35	184	16	123	5	Std. RTOF HK every 1 min
				190	21	Ext. RTOF HK every 5 min
S1 1L 1G 1I 1	43	220	16	152	13	Std. RTOF+COPS HK every 1 min
				226	29	Ext. RTOF+COPS HK every 5 min
E1	880	880	4	226	29	Ext. RTOF+C HK every 4 s
G1	1472	3520	1	190	21	Ext. RTOF HK every 2 s
S2T	34	180	16	114	3	Std. DFMS HK every 1 min
				180	19	Ext. DFMS HK every 5 min
S2 2 3	42	216	16	143	11	Std. DFMS+COPS HK every 1 min
				216	27	Ext. DFMS+COPS HK every 5 min
E2	864	864	4	216	27	Ext. DFMS+C HK every 4 s
G2	1440	2880	1	180	19	Ext. DFMS HK every 2 s
S4 4	70	365	16	242	15	Std. D+R+C HK every 1 min
				371	31	Ext. D+R+C HK every 5 min
E4	1460	1460	4	371	31	Ext. D+R+C HK every 4 s
G4	2920	5840	1	371	31	Ext. D+R+C HK every 2 s
S5 5M 5	15	71	16	53	9	Std. COPS HK every 1 min
				71	25	Ext. COPS HK every 5 min
E5	284	284	4	71	25	Ext. COPS HK every 4 s
G5	568	1136	1	71	25	Ext. COPS HK every 2 s

Note: Gx Modes are for Ground Test only!
      Max. average HK data rate during normal operation is 70 bits/s (mode 4).
      Max. average HK data rate in emergency situation is 1460 bits/s (mode E4).
      Monitoring packet SID 32 is sent with every std. or ext. HK packet (every 2/4s or 1min.)!

Table 6.1: Housekeeping Reports

6.2 Event Packets

Table 6.2 shows all normal and anomalous event packets. The detailed description is in RD[6].

Sub Type	EID	RSDB	Packet Size (words)	Description
1	44001	YRNG3001	9	Power-On self test report
1	44002	YRNG3002	10	Program memory test report
1	44003	YRNG3003	10	Data memory test report
1	44004	YRNG3004	10	EEPROM test report (ground test only)
1	44005	YRNG3005	12	Operation mode change report
1	44006	YRNG3006	17	Sensor switch-on report
1	44007	YRNG3010	10	Progress report
1	44008	YRNG3011	28	Table Setting report
2	44100	YRNG3007	7	DPU latch-up report
2	44101	YRNG3008	13	DPU memory error report
2	44102	YRNG3009	11	DPU general error report
2	44103	YRNG300A	14	Sensor I/F error report
2	44104	YRNG300B	11	Sensor error report
3	44200			
4	44300	YRNG300C	3	COPS Pressure Alert
4	44301	YRNG300D	2	Switch-Off Ready Alert

Table 6.2: Event Reports

The normal event packets are generated after the following events:

EID	Generated After
44001	Power-On self test of DPU (**20s** after switch on)
44002	Only on error during program memory test
44003	Only on error during data memory test
44004	Only on error during EEPROM test
44005	After operation mode change executed
44006	After Sensor power switch-on
44007	After major function progress (e.g. cover operation)
44008	After 'GetTableSetting' command

The anomalous event packets can be generated for test purposes by the DPU command P3

(Database: ZRNP1003 with   *PRNGP103 = 0x8400*
PRNGP104 = First 4 parameter bytes of report (e.g. pressure
      and gradient for COPS pressure alert event).
PRNGP105 = EID).

Since the COPS sensor can be operated during TV test only, the pressure will not be available for data distribution. For testing the pressure can be simulated by sending the DPU command P3.

(Database: ZRNP1003 with   *PRNGP103 = 0x8400*
PRNGP104 = 0x0000xxyy with xx = pressure, yy = gradient
PRNGP105 = 0x00).

6.3 Science Data Packets

The detailed description of science data packets is in RD[4]. During the FS tests only the worst case packets for each sensor are generated as listed in table 6.3. Since the FS is not fully operable during S/C tests, only background noise is read out as science data (except for SPT where real spectrum data is generated).

Type No.	Type Ident.	Name	Length	Packet Count	Usage	Description
D1	0x81	MCP Dual Raw	2062	2	Test + Calibration	8 HK + 2050 LEDA (A+B)
D6	0x86	MCP Full Raw High	103302	51	Full spectrum high	100 * (8 + 1024)
D40	0x40	CEM Full Raw High	Max. 32834	Max. 17	Full or single spectrum	X * (8 HK + 4 * Y CEM)
D42	0x42	FAR Full Raw High	Max. 8810	Max. 5	Full or single spectrum	X * (8 HK + 2 * Y FAR)
R20	0x14	ETS Full Raw	Max. 393740	Max. 193	Test + Calibration	123 HK + (X + 5) * 3 ETS
R21	0x15	ETSL Full Raw	Max. 393740	Max. 193	Test + Calibration	123 HK + (X + 5) * 3 ETSL
R22	0x16	ETS Select Raw	16354	8	300 mass * 18 points	123 HK + 16215 ETS

Table 6.3: Science Data during FS tests

7. Telecommand

All general command packets are supported as described in the RSDB.

7.1 Private Commands

The detailed description of DPU command packets is in RD[5]. For the FS all commands are accepted and executed (service 1 reports), and have internal functionality.

Table 7.1 lists the most critical direct commands for the cover opening mechanism, gas calibration units, filaments, ion source, and heaters, which **must not** be send during the FS tests (except SPT)!!

S/C pyro commands	All commands related to the covers must not be activated
Cover cmds (ZRND2003 with PRNGG206 = 8, ZRNR2003 with PRNGG206 = 8)	All commands related to the covers must not be activated
DFMS/RTOF filament cmds (ZRND2002 with PRNGG205 = 1..11, ZRNR2003 with PRNGG206 = 5)	All commands related to filaments must not be activated except during SPT's
COPS filament cmds (ZRNC2002 with PRNGG205 = 1..3, ZRNC2003 with PRNGG206 = 3..4)	All commands related to filaments or microtips for COPS must not be activated except in a vacuum below 10^{-6} mbar
COPS voltage cmds (ZRNC2003 with PRNGG206 = 1)	No voltages for the COPS ram gauge must be set except in a vacuum below 10^{-6} mbar
Heater cmds (ZRND2002 with PRNGG205 = 4..5)	Ion source and RDP heaters must not be activated during ground operation except during SPT's
GCU cmds (ZRNP2002 with PRNGP202 = 1)	All commands related to GCU must not be activated except during SPT's

Table 7.1: FS Critical Commands

7.2 Memory Management Commands

The detailed description of memory management command packets is in RD[7]. **For a memory load command test only the IDs and address ranges listed in table 7.2 are allowed.**

ID	Word Width (bits)	Address Range	Description
120	48	–	Not allowed
121	48	0x0007E000 .. 0x0007FFFF	Program Memory test
122	48	–	Not allowed
123	48	–	Not allowed
124	32	–	Not allowed
125	32	–	Not allowed
126	32	0x000FE000 .. 0x000FFFFF	Data 1 Memory test
127	32	–	Not allowed
128	16	–	Not allowed

Table 7.2: Allowed Memory Load Commands