RTOF History file

1. General remarks

1.1. RTOF models

For the ROSINA RTOF instrument 4 models were built: a structural model (STM) with no functionality, an electrical qualification model (EQM) with full functionality, a flight model (FM) and a flight spare model (FS). The FM and FS are identical and both were fully qualified. In the end the FS was flown as it performed slightly better than the FM. The names were, however, kept in order not to confuse the models. FS now therefore means flight model in space, whereas FM is the model in the lab.

1.2. RTOF anomalies

1.2.1. High voltage discharges:

During instrument development there was a high voltage discharge on the EQM during one oft he thermal vacuum test. This discharge happened on the high voltage electronics board and killed some components. It was therefore decided to pot the high voltage electronics, especially the 9 kV converter, from which all high voltages are deduced. This seemed to cure the problem. However, after 6 months in space RTOF started to behave non-nominally and during tests in spring 2005, there was a clear degradation of the high voltages. The highest voltage which could be reached at that stage was 2.6 kV. Intensive study of the FM finally led to a reproduction of the error also in the lab, which allowed to find the cause of the anomaly. It was seen that the high voltage converter and its isolated wires sparked beneath the potting due to outgassing of the potting and the isolation of the wires. In space this caused a parallel resistance to ground which limited the high voltage achievable. After extensive testing on ground a solution based on a SW upload was found and successfully applied to the instrument in space in spring 2010. This SW change included a regulation of the fixed 9kV converter by switching it on/off with a variable duty cycle, regulated by the DPU. The voltage was set to 2 kV. As all high voltages are deduced from this single power supply except the detector voltage, this meant that all voltages had to be lower than 2 kV. The highest voltages are used for the reflectron. The drift voltage, which corresponds to the ion energy, was set at 1000 V compared to its nominal voltage of 3000 V. This has the following implications for the scientific performance of RTOF.

- The flight time is appr. 1.7 times longer, which means that for a given maximum flight time, the mass range is lower than in the nominal case.
- The energy of the impacting ions is lower, which decreases the sensitivity of the detector.
- All other voltages had to be changed accordingly, which led to a lot of optimization done in space and frequent SW uploading.
- These changes in voltages, even if the ion energy stays constant lead to slightly different flight time and therefore to a slightly different mass scale.

The user of the RTOF data has therefore to be careful when comparing data of different periods between optimisation as sensitivity, peak shape, and mass scale may change.

1.2.2. Filament failure

On May 27, 2015 the filament 1 in the storage source failed permanently. After careful investigation the use of filament 2 was initiated on July 10, 2015. Subsequently there were new optimizations done for the storage source ion source. This filament lasted for the rest of the mission.

2. RTOF calibration

The FS model which is the model integrated on Rosetta has undergone a basic calibration (limited set of gases because of contamination). Voltages at that time were the nominal voltages with a drift voltage of 3 kV. These data therefore can only be used as comparison with the FM. The FM model has undergone a complete calibration after launch with nominal voltages. After the high voltage failure, the calibration was repeated with the low drift voltage and as many species as possible have / will be calibrated. These data will be archived as raw data, as well as derived data (fragmentation patterns, sensitivities) as soon as they are available.

The two sensors show the same fragmentation patterns for the species were data from the FS are available. Due to their identical design it can be assumed that this holds for all species. While absolute sensitivities are unknown for the FS in space, relative sensitivities are also identical between FS and FM. To derive the absolute sensitivity the user has to use COPS data for the same time as COPS gives the total absolute density at the S/C location. On how to use COPS data the reader is deferred to the COPS user guide.

3. SW patches during the comet mission phase

3.1. March 2014

Software patch version 8.3

29-03-2014

Software version 8.3 - Main branch of the DPU.29-03-14

New parameter settings (for a description of the voltages see ROSINA user manual):

Parameter change 29-03-2014

BP_SS	-21.6	BP_OS	-5.2
A1_SS	-331.2	A1_OS	-370.7
A2_SS	-995.1	A2_OS	-1021.5
SL_SS	-798.0	SL_OS	-792.1
MCP_SS	2700.0	MCP_OS	2700.0
Gr_SS	-8.2	Gr_OS	-4.9
P_SS	-246.1	P_OS	-211.2
R1	-63.3	R1	-52.2
R2	-555.7	R2	-556.8
RL	-912.9	RL	-878.5
		E2_OS	-14.69
		ELA_OS	-11.87
		ELB_OS	-10.88
RepA_SS	-180.0	RepA_OS	-200.0
RepB_SS	-180.0	RepB_OS	-200.0
D	-1800.0	D	-1800.0

3.2. April 2014

Software patch version 8.4

08-04-2014

Rosina SW Load (main branch of the DPU) solving the anomalies detected during the precommissioning of DFMS/RTOF (changing the RTOF regulation settings).

Software version 8.4 - Main branch of the DPU.

Parameter change: => T_on from 2.1ms to 6.3ms

Software patch version 8.5

14-04-2014

Rosina SW Patch (main branch of the DPU) solving the anomalies detected during the precommissioning of DFMS/RTOF.

Software version 8.5 - Main branch of the DPU.

Parameter change 14-04-2014

BP_SS	-24.0	BP_OS	-18.5
A1_SS	-210.0	A1_OS	-318.0
A2_SS	-430.0	A2_OS	-918.7
SL_SS	-1665.0	SL_OS	-1671.2
MCP_SS	2700.0	MCP_OS	2700.0
Gr_SS	-8.0	Gr_OS	-0.3
P_SS	-107.0	P_OS	-90.6

R1	-54.8	R1	-28.6
R2	-342.0	R2	-382.1
RL	-1710.0	RL	-1693.7
		E2_OS	-14.69
		ELA_OS	-11.87
		ELB_OS	-10.88
RepA_SS	-180.0	RepA_OS	-200.0
RepB_SS	-180.0	RepB_OS	-200.0
D	-1000.0	D	-1000.0

3.3. June 2014

Software patch version 8.6

23-06-2014

Rosina SW Patch (main branch of the DPU) solving the anomalies detected during the precommissioning of DFMS/RTOF.

Software version 8.6 - Main branch of the DPU.

Software patch version 8.7

01-06-2014

Rosina SW Patch (main branch of the DPU) solving the anomalies detected during day 176 operation.

Software version 8.7 - Main branch of the DPU.

3.4. July 2014

Software patch version 8.8

22-07-2014

Rosina SW Load (main branch of the DPU) solving anomalies detected during operation, COPS pressure gradient calculation and improving RTOF optimization and compression.

Software version 8.8 - Main branch of the DPU.

3.5. October 2014

Parameter change: 17-10-2014

BP_SS	-33.4	BP_OS	-5.1
A1_SS	-210.0	A1_OS	-220.6
A2_SS	-700.0	A2_OS	-537.9
SL_SS	-1715.0	SL_OS	-1820.0
MCP_SS	2700.0	MCP_OS	2700.0

Gr_SS	-0.15	Gr_OS	-4.3
P_SS	-99.1	P_OS	-69.9
R1	-53.7	R1	-15.6
R2	-376.5	R2	-413.9
RL	-1825.0	RL	-1633.2
		E2_OS	-10.5
		ELA_OS	-12.7
		ELB_OS	-12.3
RepA_SS	-120	RepA_OS	-200.0
RepB_SS	-120	RepB_OS	-200.0
D	-1000.0	-1000.0	

3.6. December 2014

Parameter change: 10-12-2014

BP_OS	-5.1
A1_OS	-220.6
A2_OS	-537.9
SL_OS	-1820
MCP_OS	2700
Gr_OS	-4.3
P_OS	-69.8
R1_OS	-15.6
R2_OS	-413.9
RL_OS	-1633.2
E2_OS	-47.8
ELA_OS	-12.2
ELB_OS	-10.8
RepA_OS	-1
RepB_OS	-1

3.7. March 2015

Software patch version 8.9

16-03-2015

Rosina SW Load (main branch of the DPU) solving anomalies detected during operation, adding internal instrument modes, changing the RTOF threshold setting.

Software version 8.9 - Main branch of the DPU.

3.8. April 2015

Parameter change:

8-4-15

E1_OS	-13.3
BP_SS	14.3
A1_SS	-210.0
A2_SS	-700.0
SL_SS	-1715.0
MCP_SS	2750.0
Gr_SS	48.0
P_SS	-127.1
R1	-53.7
R2	-376.5
RL	-1825.0
RepA_SS	-120
RepB_SS	-120

3.9. May 2015

Software patch version 8.A

11-05-2015

Rosina Full SW upload (main branch of the DPU) solving the compression anomalies of the RTOF instrument, changing the RTOF regulation settings and the RTOF ion modes table settings.

Software version 8.A - Main branch of the DPU.

May 2015

3.10. October 2015

Software patch version 8.B

07-10-2015

Rosina SW Patch (main branch of the DPU) setting the redundant RTOF storage source filament as default, after the failure of the main filament on the 27.05.2015; update of new voltages values (optimized for the redundant filament) in the RTOF table.

Software version 8.B - Main branch of the DPU.

3.11. December 2015

Parameter change:

10.12.15

BP_SS	-33.4
A1_SS	-210.0
A2_SS	-700.0
SL_SS	-1715.0
MCP_SS	2750.0

Gr_SS	-0.2
P_SS	-99.1
R1	-53.7
R2	-376.5
RL	-1825.0
RepA_SS	-120
RepB_SS	-120

3.12. February 2016

Software patch version 8.C

17-02-2016

Rosina SW Patch (main branch of the DPU) changing the RTOF threshold levels of the detectors, allowing easy change of the filament in DFMS and COPS tables, adding a new mode for DFMS for masses above 140 amu and new sequence of modes for DFMS.

Software version 8.C - Main branch of the DPU.

Parameter change:

24-02-16

BP_SS	-33.4
A1_SS	-210.0
A2_SS	-700.0
SL_SS	-1715.0
MCP_SS	2750.0
Gr_SS	-0.2
P_SS	-99.1
R1	-53.7
R2	-376.5
RL	-1825.0
RepA_SS	-120
RepB_SS	-120

4. Summary of events

Phase	MTP	STP	Start	Comments
PRL	-	-	29/03/2014	SW UPLOAD - V83FS
			08/04/2014	SW PATCH - V84FS
			14/04/2014 - 24/04/2014	SW UPLOAD - V85FS
	3		29/05/2014	Self optimization of M511
	3			Self optimization of M521

	3			Self optimization of M516
	3			Self optimization of M513
	3		31/05/2014	DPU reboot
	4	6	23/06/2014	SW PATCH - V86FS
	4	6	27/06/2014	Self optimization of M511
	4	6	27/06/2014	Self optimization of M521
	4	6	27/06/2014	Self optimization of M526
	4	6	28/06/2014	Self optimization of M513
	4	6	28/06/2014	Self optimization of M523
			01/07/2014	SW UPLOAD - V87FS
	5	10	26/07/2014	Self optimization of M511
	5	10	26/07/2014	Self optimization of M521
	5	10	26/07/2014	Self optimization of M526
	5	10	26/07/2014	Self optimization of M523
			22/07/2014 - 25/07/2014	SW UPLOAD - V88FS
	7	16	02/09/2014	1st Manual optimization of M521
	7	16	02/09/2014	Optimized parameters are set temporarly for M521
	8	21	03/10/2014	2nd Manual optimization of M521
	8	23	17/10/2014	Optimized parameters are set permanently for M521
	8	23	17/10/2014	Optimized parameters are set temporarly for M523 & M553
	8	23	17/10/2014	RTOF 400s integration test
	9	26	30/10/2014	Update M521 and M523 with 400s integration
	9	27	05/11/2014	Optimized parameters are set permanently for M523
	9	27	05/11/2014	Cover set to position 14
ESC1	10	33	10/12/2014	Update M504 and M510 with 400s integration
	10	33	10/12/2014	Optimized parameters are set permanently for M504
	10	33	10/12/2014	Optimized parameters are set permanently for M510
	10	33	10/12/2014	E1_OS is set temporarly for M510
	10	33	10/12/2014	Change RTOF M523 threshold 2 => 3
	10	33	10/12/2014	Change RTOF M523 threshold 3 => 2
	10	33	10/12/2014	Change RTOF M521 threshold 4 => 5
	10	33	10/12/2014	Change RTOF M521 threshold 5 => 4
	11	37	31/12/2014	SS Threshold test
	11	37	31/12/2014	OS Threshold test
	12	39	14/01/2015	DPU reboots due to compression of M553, M521 & M523 back to 200s integration
	12	39	14/01/2015	
	12	39	15/01/2015	
	12	39	17/01/2015	Update M521 and M523 with 400s integration
	~~12~~	~~41~~	~~28/01/2015~~	~~SS Threshold test~~
	~~12~~	~~41~~	~~28/01/2015~~	~~OS Threshold test~~
	13	43	13/02/2015	SS Threshold test
	13	43	13/02/2015	OS Threshold test
	13	43	13/02/2015	RTOF Sensor Error: RM_SL_I
	13	43	14/02/2015	RTOF Sensor Error: RM_SL_I
ESC2	14	47	16/03/2015	SW UPLOAD - V89FS
	14	48	19/03/2015	Cover commanded to position 1 (didn't work)
	14	49	25/03/2015	Set MCP_OS = 2'750V (temporarly)

			29/03/2015	DPU boot after S/C safe mode (28/03/2015)
	15	51	08/04/2015	Set MCP_OS = 2'750 V in EEPROM (permanently)
	15	51	08/04/2015	Set MCP_SS = 2'750 V in EEPROM (permanently)
	15	51	08/04/2015	Set new voltages for M521 in EEPROM (permanently)
	15	51	08/04/2015	Set new voltages for M511 in EEPROM (permanently)
			10/04/2015	Cover commanded to position 1 (successful)
	15	52	15/04/2015	1st optimization matrix for M521 & M526
	15	52	18/04/2015	1st optimization matrix for M511 & M516
	16	55	11/05/2015	SW UPLOAD - V8AFS
	16	55	11/05/2015	Default parameters are set back permanently for all modes
	16	56	13/05/2015	2nd optimization matrix for M521
	16	56	17/05/2015	3rd optimization matrix for M521
	16	58	27/05/2015	SS Filament #1 emission cannot go higher than 32 mA
	17	59	05/06/2015	Optimized parameters are set temporarly for M521
ESC3	18	63	01/07/2015	Fil 1 (SS) test: M51 (40 min)
	18	64	08/07/2015	Fil 1 (SS) test: M51 + M521 + M181
	18	65	15/07/2015	Changed RTOF FS filament 1 => 2 (M181 & M521)
	19	67	29/07/2015	4th optimization matrix for M521
	19	69	12/08/2015	4th optimization matrix for M521 (again)
	20	71	26/08/2015	5th optimization matrix for M521 (1/3)
	20	72	02/09/2015	5th optimization matrix for M521 (2/3)
	20	72	03/09/2015	5th optimization matrix for M521 (3/3)
	20	73	11/09/2015	6th optimization matrix for M521
	21	78	07/10/2015	SW PATCH - V8BFS
ESC4	22	81	05/11/2015	Optimized parameters are set temporarly for M521 (and are not set back to default)
	22	81	05/11/2015	Optimized parameters are set temporarly for M511 (and are not set back to default)
	23	83	18/11/2015	1st optimization matrix for M521 (Fil2)
	23	85	02/12/2015	2nd optimization matrix for M521 (Fil2)
			03/12/2015	
	24	87	16/12/2015	Set new voltages for M521 in EEPROM (permanently)
	25	94	03/02/2016	OS Threshold test
	26	96	17/02/2016	SW PATCH - V8CFS
	26	96	17/02/2016	Error in the Repeller voltages set in V8CFS
	26	96	19/02/2016	Regulation error (OS spectra)
	26	97	24/02/2016	"Correct" voltages for M521 set in EEPROM (permanently)
	34	128	20/09/2016	Set MCP_SS = 2'900 V in EEPROM (permanently)