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ROSINA Contingency Recovery Procedure

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Document Change Record

Document Change Record					
Issue	Rev.	Pages changed, added, removed	Date	Reasons for Changes	Approval
1	-	All	15.03.2002	Initial Issue	
1.0		6	09.07.2002	Emergency boot	

List of reference documents

RD1   ROS-Man-1009   ROSINA User Manual
RD2   ROS-TUB-SP-05/2.3.   ROSETTA/ROSINA, DPU – S/C Event
                                    Packets

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1 General

ROSINA is a highly autonomous instrument. All housekeeping values from the three sensors are constantly monitored by the DPU. Whenever such a value is outside the specified limits the DPU takes corrective actions according to appendix A and issues a sensor error report which is sent as an event to ground.Therefore the on ground monitoring can be restricted to such sensor error events and to DPU error events.

2 Failure detection and recovery strategy

2.1 List of possible failures (incomplete), see FMECA:

Unit	Failure	Method of Analysis	Handled by	Recovery
DPU	Power converter	TBD	TC	Redundant
	Processor	TBD	TC	Redundant
	Interfaces to sensor	TBD		None
RTOF	High voltage breakdown in ion source	TBD	TC	Switch off faulty unit, measurement possible with the other unit
	Filament burnout	TBD	TC	Redundant
	High voltage breakdown in Reflectron	TBD		None
	Pulser breakdown	TBD	TC	Switch off faulty unit, measurement possible with the other channel
	Detector failure, degradation	TBD	TC	Switch off faulty unit, measurement possible with the other channel
	Cover opening failure	Cover Status	TC	Fail Safe Mechanism

Unit	Failure	Method of Analysis	Handled by	Recovery
DFMS	High voltage breakdown in ion source or transfer optics	TBD		None

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	Filament burnout	TBD	TC	Redundant
	High voltage breakdown in zoom optics	TBD	TC	Switch off, measurement possible without zoom optics
	Two dimensional detector failure, degradation	TBD	TC	Switch off faulty unit, measurement possible with the channeltron
	Initial cover opening failure	Cover Status	TC	Fire redundant actuator
	Cover opening failure	Cover Status	TC	Fail Safe Mechanism
	High voltage breakdown in ESA	TBD		None

Unit	Failure	Method of Analysis	Handled by	Recovery
COPS	Burnout of filament	Filament current HK	TC	Switch to redundant filament
	TBD	TBD		TBD

2.2 DPU errors

2.2.1 Errors monitored by the DPU

The status of the different DPU subsystems (memory, interfaces, power switches) is monitored constantly by the DPU itself. If an error occurs the appropriate action (memory error correction, power cycle) is taken and one of the following events is sent to ground:

YRNG3007   EID44100   DPU latch-up report
YRNG3008   EID44101   DPU memory error report
YRNG3009   EID44102   DPU general error report
YRNG300A   EID44103   DPU sensor I/F error report

For a description of these error reports refer to the document RD2. They contain the status of the DPU, the identification of the error and useful parameters. In this case the experimenter should be notified as soon as possible.

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2.2.2 Emergency Boot

For the Rosina DPU emergency situation that the complete program contents in EEPROM is lost, a special booting mode is implemented in the boot software remaining in a PROM. In the time frame between switch on and **10s** after switch on the DPU is in this special booting mode, where only memory load command packets for software download are accepted. No TM packets except TC acknowledge and execution packets are generated during this mode. 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. After the complete S/W was loaded successfully, the DPU will start program execution with the new S/W immediately.

It is important that the first memory load command is sent before the 10s after power-on are timed-out! Therefore, the nominal switch-on OBCP could not be used for the emergency handling. There has to be an emergency OBCP, which starts the S/W load from S/C SSMM within the 10s.

2.2.3 Errors which cannot be monitored by the DPU

If telemetry is not sent by ROSINA for more than 5 minutes, the following procedure should be executed:

1. TC: ZRNP100E, disable science
2. If TM is still not generated after 1 min., TC: ZRNP101A, TM reset
3. If TM is still not generated after 1 min, power cycle ROSINA (TBC)

2.3 Sensor errors

All housekeeping values of the sensor are constantly monitored by the DPU. If a housekeeping value is outside a given range the DPU takes an appropriate action (repetition of command, switching off of faulty unit, etc.). For a complete list of all monitored housekeeping and the appropriate action taken by the DPU see appendix A. At the same time an event is generated (YRNG300B, EIF44104, sensor error) and sent to ground. For a description of these error reports refer to the document RD2. They contain the status of the sensor, the identification of the housekeeping value affected and its actual value. In this case the experimenter should be notified as soon as possible.

3 Appendix A: Sensor HK monitored by the ROSINA DPU

3.1 DFMS houskeeping monitoring

RSDB	Description	HK Type	Std./Ext. Pack.	Monitoring if	Sampling frequency	Transmission frequency S/C	Range	Criti-cality	Action, if outside range	Used for regulation	Remarks
NRNAD101	Ion source heater Enabled	Flag	Std.	No measurement with IS heater operation	2s	1 min	On/Off	3	9		
NRNAD101	GCU 1 heater Enabled	Flag	Std.	Measurement with GCU operation	200 ms /synchronized with measurement	1 min	On/Off, switching	3	10		
NRNAD101	GCU 2 heater Enabled	Flag	Std.	Measurement with GCU operation	200 ms /synchronized with measurement	1 min	On/Off, switching	3	10		
NRNAD101	Cover motor Disabled	Flag	Std.	Measurement	2s / synchronized with measurement	1 min	On	3	TBD		
NRNAD101	Non operational mode Enabled	Flag	Std.	Measurement	2s / synchronized with measurement	1 min	On	TBD			
NRNAD101	Command Error	Flag	Std.	Measurement	2s / synchronized with measurement	1 min		TBD			

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NRNAD101	HV Safe Status	Flag	Std.	Measurement	2s / synchronized with measurement	1 min	Off	3	TBD			
NRNAD101	HV Reduced Status	Flag	Std.	Measurement	2s / synchronized with measurement	1 min	Off	3				
NRNAD103	number of HK packets sent		Std.	DPU generated		1 min	not applicable	n.a.				
NRNAD104	number of DFMS commands processed		Std.	DPU generated		1 min	not applicable	n.a.				
NRNAD105	number of wrong DFMS commands		Std.	DPU generated		1 min	not applicable	n.a.				
NRNAD106			Std.	DPU generated		1 min	not applicable	n.a.				
NRNAD107	number of DFMS science packets sent by DPU		Std.	DPU generated		1 min	not applicable	n.a.				
NRNAD108			Std.	DPU generated		1 min	not applicable	n.a.				
NRNAD109			Std.	DPU generated		1 min	not applicable	n.a.				
NRNAD10A			Std.	DPU generated		1 min	not applicable	n.a.				

			Std.	DPU generated		1 min	not applicable	n.a.			
NRNAD10B											
NRNAD10C	Accumulation time of MCP or CEM detector		Std.	DPU generated		1 min	not applicable	n.a.			
NRNAD10D	Total number of counts on detector		Std.	DPU generated		1 min	not applicable	n.a.			
NRNAD10E			Std.	DPU generated		1 min	not applicable	n.a.			
NRNAD10F			Std.	DPU generated		1 min	not applicable	n.a.			
NRNAD110			Std.	DPU generated		1 min	not applicable	n.a.			
NRNAD111			Std.	DPU generated		1 min	not applicable	n.a.			
NRNAD112	MEP main current monitor (all loads except ASP, FDP)	Measured	Std.	Measurement	2s / synchronized with measurement	1 min	< 0.4 A	2	TBD		Monitored for power consumption
NRNAD113	MEP floating voltage current monitor (ASP, FDP)	Measured	Std.	Measurement	2s / synchronized with measurement	1 min	< 0.3 A	2	TBD		Monitored for power consumption
NRNAD114	Meshed grid voltage	Measured	Std.	Measurement	2s /synchronized with measurement	1 min/with science data	Nominal value ± TBD %	2	set flag low or high		transmitted only as off/low/high/ok flag

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NRNAD115	Ion source box voltage	Measured	Std.	Measurement	2s /synchronized with measurement	1 min/with science data	Nominal value ± TBD %	2	set flag low or high		transmitted only as off/low/high/ok flag
NRNAD116	Gas calibration unit 1 input pressure (high pressure gauge)	Measured	Std.	Measurement with GCU operation	200 ms /synchronized with measurement	1 min	TBD	3	6		Monitored for extensive gas loss
NRNAD117	Gas calibration unit 1 valve heater current	Measured	Std.	Measurement with GCU operation	200 ms /synchronized with measurement	1 min		3	5		
NRNAD118	Gas calibration unit 1 output pressure (Mini Pirani)	Measured	Std.	Measurement with GCU operation	200 ms /synchronized with measurement	1 min	TBD range	3	06.Jul	GCU operation	Monitored for uncontrolled pressure rise
NRNAD119	Gas calibration unit 2 input pressure (high pressure gauge)	Measured	Std.	Measurement with GCU operation	200 ms /synchronized with measurement	1 min	TBD	3	6		Monitored for extensive gas loss
NRNAD11A	Gas calibration unit 2 valve heater current	Measured	Std.	Measurement with GCU operation	200 ms /synchronized with measurement	1 min		3	5		
NRNAD11B	Gas calibration unit 2 output pressure (Mini Pirani)	Measured	Std.	Measurement with GCU operation	200 ms /synchronized with measurement	1 min	TBD range	3	06.Jul	GCU operation	Monitored for uncontrolled pressure rise
NRNAD11C	Gas calibration unit 1 temperature sensor 1 ("tank side")	Measured	Std.	Measurement with GCU operation	200 ms /synchronized with measurement	1 min	-30 to +60 °C (TBC)	3	5		
NRNAD11D	Gas calibration unit 1 temperature sensor 2 ("sensor side")	Measured	Std.	Measurement with GCU operation	200 ms /synchronized with measurement	1 min	-30 to +60 °C (TBC)	3	5		
NRNAD11E	Gas calibration unit 2 temperature sensor 1 ("tank side")	Measured	Std.	Measurement with GCU operation	200 ms /synchronized with	1 min	-30 to +60 °C (TBC)	3	5		

				measurement							
NRNAD11F	Gas calibration unit 2 temperature sensor 2 ("sensor side")	Measured	Std.	Measurement with GCU operation	200 ms /synchronized with measurement	1 min	-30 to +60 °C (TBC)	3	5		
NRNAD120	Strip current flowing in the channeltron	Measured	Std.	Measurement	2s /synchronized with measurement	1 min/with science data	TBD range	3	TBD		
NRNAD121	Current collected at channeltron anode	Measured	Std.	Not applicable	science data	science data	not applicable	n.a.	no action	CEM gain control	will be high gain analog output for FS
NRNAD122	Cover motor current	Measured	Std.	No measurement with cover operation	2s	1 min		2	4		
NRNAD123	Cover Hall Counter	Flag ?	Std.	No measurement with cover operation	2s	1 min		2	TBD		
NRNAD124	Cover Motor Counter	Flag ?	Std.	No measurement with cover operation	2s	1 min		2	TBD		
NRNAD125	Cover Open Status	Flag	Std.	No measurement with cover operation	2s	1 min		2	TBD		
NRNAD125	Cover Closed Status	Flag	Std.	Measurement without cover operation	2s / synchronized with measurement	1 min	True/False	2	TBD		
NRNAD126	CEM threshold setting	DAC	Std.	Measurement	2s /synchronized with measurement	1 min/with science data	Nominal value ± TBD %	2	2/set flag low or high		transmitted only as off/low/high/ok flag

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NRNAD127	CEM front side high voltage setting	DAC	Std.	Measurement	2s /synchronized with measurement	1 min /with science data	Nominal value ± 50V (TBC)	2	1 / 2 /set flag low or high		transmitted only as off/low/high/ok flag
NRNAD128	CEM high voltage current of regulation loop	Measured	Std.	Measurement	2s / synchronized with measurement	1 min	Nominal value ± TBD % or TBD range	3 (TBC)	TBD		
NRNAD129	Acceleration voltage setting	DAC	Std.	Measurement	2s /synchronized with measurement	1 min/with science data	Nominal value ± TBD %	2	1 / 2 /set flag low or high		transmitted only as off/low/high/ok flag
NRNAD12A	Acceleration voltage current of regulation loop	Measured	Std.	Measurement	2s / synchronized with measurement	1 min	Nominal value ± TBD % or TBD range	3 (TBC)	TBD		
NRNAD12B	Temperature measured for the ion source	Measured	Std.	Measurement	2s	1 min	-80 to +500 °C	2	set flag low or high	IS heater operation	
NRNAD12C	Acceleration voltage error output of regulation loop	Measured	Std.	Measurement	2s / synchronized with measurement	1 min	Nominal value ± TBD % or TBD range	3 (TBC)	TBD		
NRNAD12D	CEM high voltage error output of regulation loop	Measured	Std.	Measurement	2s / synchronized with measurement	1 min	Nominal value ± TBD % or TBD range	3 (TBC)	TBD		
NRNAD12E	Reference Ground of channeltron output	Measured	Std.	Measurement	2s / synchronized with measurement	2 min	n/a				
NRNAD12F	Filament 1 biasing	Measured	Std.	Measurement	2s /synchronized with measurement	1 min/with science data	Nominal value ± TBD %	2	3 / set flag low or high		
NRNAD130	Filament 2 biasing	Measured	Std.	Measurement	2s /synchronized with	1 min/with science data	Nominal value ± TBD %	2	3 / set flag low or high		

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				measurement						
NRNAD130 HV Ion source Enabled	Flag	Ext.	Measurement	2s / synchronized with measurement	5 min			4	no action	
NRNAD130 HV Transfer Lens Enabled	Flag	Ext.	Measurement	2s / synchronized with measurement	5 min			4	no action	
NRNAD131 Filament 1 emission current	Measured	Std.	Measurement	2s /synchronized with measurement	1 min/with science data	Nominal value ± TBD %	3	3 / set flag low or high	
NRNAD131 HV Source Lens Enabled	Flag	Ext.	Measurement	2s / synchronized with measurement	5 min			4	no action	
NRNAD131 HV Source Entrance Slit Enabled	Flag	Ext.	Measurement	2s / synchronized with measurement	5 min			4	no action	
NRNAD132 Filament 1 current	Measured	Std.	Measurement	2s /synchronized with measurement	1 min/with science data	Nominal value ± TBD %	3	TBD / set flag low or high	
NRNAD132 Filament 1 Enabled	Flag	Ext.	Measurement	2s / synchronized with measurement	5 min			4	no action	
NRNAD132 Filament 2 Enabled	Flag	Ext.	Measurement	2s / synchronized with measurement	5 min			4	no action	
NRNAD133 Filament 2 emission current	Measured	Std.	Measurement	2s /synchronized with measurement	1 min/with science data	Nominal value ± TBD %	3	TBD / set flag low or high	

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NRNAD134	Filament 2 current	Measured	Std.	Measurement	2s /synchronized with measurement	1 min/with science data	Nominal value ± TBD %	3	TBD / set flag low or high		
NRNAD135	Electron repeller voltage	Measured	Std.	Measurement	2s /synchronized with measurement	1 min/with science data	Nominal value ± TBD %	2	set flag low or high		
NRNAD136	Ion repeller 1 voltage	Measured	Std.	Measurement	2s /synchronized with measurement	1 min/with science data	Nominal value ± TBD %	2	set flag low or high		transmitted only as off/low/high/ok flag
NRNAD137	Ion repeller 2 voltage	Measured	Std.	Measurement	2s /synchronized with measurement	1 min/with science data	Nominal value ± TBD %	2	set flag low or high		transmitted only as off/low/high/ok flag
NRNAD138	Ion suppressor voltage	Measured	Std.	Measurement	2s /synchronized with measurement	1 min/with science data	Nominal value ± TBD %	2	set flag low or high		transmitted only as off/low/high/ok flag
NRNAD139	Source lens left output voltage	Measured	Std.	Measurement	2s /synchronized with measurement	1 min/with science data	Nominal value ± TBD %	3	TBD / set flag low or high		
NRNAD13A	Source lens right output voltage	Measured	Std.	Measurement	2s /synchronized with measurement	1 min/with science data	Nominal value ± TBD %	2	set flag low or high		transmitted only as off/low/high/ok flag
NRNAD13B	Source exit slit output voltage	Measured	Std.	Measurement	2s /synchronized with measurement	1 min/with science data	Nominal value ± TBD %	2	set flag low or high		transmitted only as off/low/high/ok flag
NRNAD13C	Beta deflector output voltage	Measured	Std.	Measurement	2s /synchronized with measurement	1 min/with science data	Nominal value ± TBD %	2	set flag low or high		transmitted only as off/low/high/ok flag
NRNAD13D	Transfer lens right output voltage	Measured	Std.	Measurement	2s /synchronized with	1 min/with science data	Nominal value ± TBD %	2	set flag low or high		transmitted only as off/low/high/ok

				measurement							flag
NRNAD13E	Transfer lens left output voltage	Measured	Std.	Measurement	2s /synchronized with measurement	1 min/with science data	Nominal value ± TBD %	2	set flag low or high		transmitted only as off/low/high/ok flag
NRNAD13F	Internal ASP HV Bias setting	DAC	Std.	Measurement	2s / synchronized with measurement	1 min		4	no action		
NRNAD140	Internal ASP HV Bias current of regulation loop	Measured	Std.	Measurement	2s / synchronized with measurement	1 min	TBD (provided by T. Magoncelli)	3	TBD		
NRNAD141	HV FDP reference setting	DAC	Std.	Measurement	2s / synchronized with measurement	1 min		4	no action		
NRNAD142	ASP D reference voltage	Measured	Std.	Measurement	2s / synchronized with measurement	1 min		4	no action		
NRNAD143	Entrance slit switch condenser 1 setting	DAC	Std.	Measurement	2s /synchronized with measurement	1 min/with science data	Nominal value ± TBD %	2	set flag low or high		transmitted only as off/low/high/ok flag
NRNAD144	Entrance slit switch condenser 2 setting	DAC	Std.	Measurement	2s /synchronized with measurement	1 min/with science data	Nominal value ± TBD %	2	set flag low or high		transmitted only as off/low/high/ok flag
NRNAD145	Zoom quadruple 2 setting	DAC	Std.	Measurement	2s /synchronized with measurement	1 min/with science data	Nominal value ± TBD %	2	set flag low or high		transmitted only as off/low/high/ok flag
NRNAD146	Electrostatic analyzer inner toroid fine setting	DAC	Std.	Measurement	2s /synchronized with measurement	1 min/with science data	Nominal value ± TBD %	2	set flag low or high		transmitted only as off/low/high/ok flag

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NRNAD146	Electrostatic analyzer ???	DAC	Ext.	Measurement	2s / synchronized with measurement	5 min		4	no action		
NRNAD147	Electrostatic analyzer outer toroid fine setting	DAC	Std.	Measurement	2s /synchronized with measurement	1 min/with science data	Nominal value ± TBD %	2	set flag low or high		transmitted only as off/low/high/ok flag
NRNAD148	Electrostatic analyzer coarse setting	DAC	Std.	Measurement	2s /synchronized with measurement	1 min/with science data	Nominal value ± TBD %	2	set flag low or high		transmitted only as off/low/high/ok flag
NRNAD149	Zoom quadruple 1 setting	DAC	Std.	Measurement	2s /synchronized with measurement	1 min/with science data	Nominal value ± TBD %	2	set flag low or high		transmitted only as off/low/high/ok flag
NRNAD14A	Hexapole setting	DAC	Std.	Measurement	2s /synchronized with measurement	1 min/with science data	Nominal value ± TBD %	2	set flag low or high		transmitted only as off/low/high/ok flag
NRNAD14B	Rotation quadruple setting	DAC	Std.	Measurement	2s /synchronized with measurement	1 min/with science data	Nominal value ± TBD %	2	set flag low or high		transmitted only as off/low/high/ok flag
NRNAD14C	Matsuda plates setting	DAC	Std.	Measurement	2s /synchronized with measurement	1 min/with science data	Nominal value ± TBD %	2	set flag low or high		transmitted only as off/low/high/ok flag
NRNAD14D	CEM repeller setting	DAC	Std.	Measurement	2s /synchronized with measurement	1 min/with science data	Nominal value ± 10V (TBC)	2	2/set flag low or high		transmitted only as off/low/high/ok flag
NRNAD150	Temperature measured on the sector magnet	Measured	Std.	Measurement	2s /synchronized with measurement	1 min/with science data		4		mass settings (calculation of VACCL)	transmitted as value

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NRNAD152	MCP back side high-voltage 1	Measured	Std.	Measurement	2s /synchronized with measurement	1 min/with science data	Nominal value ± 10V (TBC)	2	1/2/set flag low or high		Nominal value for Back >= -300V and <= 40V ! (TBC)
NRNAD153	MCP back side high-voltage 2	Measured	Std.	Measurement	2s /synchronized with measurement	1 min/with science data	Nominal value ± 10V (TBC)	2	1/2/set flag low or high		Nominal value for Back >= -300V and <= 40V ! (TBC)
NRNAD154	Temperature measured in detector proximity electronics	Measured	Std.	Measurement	2s / synchronized with measurement	1 min	> +50 °C	3	Deactivate RDP heater	RDP heater operation	If LEDA temperature measurement failes, LEDA temperature will be replaced by RDP temperature
NRNAD155	Temperature measured internally in LEDA512 chip behind MCP	Measured	Std.	Measurement	2s /synchronized with measurement	1 min	< +20-TBD °C	3	Activate RDP heater if RDP temperature < +50°C	RDP heater operation	
NRNAD156	Output signal of faraday cup	Measured	Std.	Measurement	2s /synchronized with measurement	1 min/with science data	n/a	4			
NRNAD157	Status of Faraday cup electrometer low range relay	Flag	Std.	Measurement	2s / synchronized with measurement	1 min	-3 to +3 V	4			
NRNAD158	Status of Faraday cup electrometer medium range relay	Flag	Std.	Measurement	2s / synchronized with measurement	1 min	-3 to +3 V	4			
NRNAD159	MCP front side high-voltage	Measured	Std.	Measurement	2s /synchronized with measurement	1 min/with science data	Nominal value ± 50V (TBC)	2	1/2/set flag low or high		

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NRNAD15A	MCP high voltage convertor primary current	Measured	Std.	Measurement	2s / synchronized with measurement	1 min	< TBD upper limit (provided by T. Magoncelli)	2	1		
NRNAD15B	Repeller voltage on Faraday cup	Measured	Std.	Measurement	2s / synchronized with measurement	2 min	TBD	4			
NRNAD15C	Faraday Cup Repeller Enabled	Flag	Std.	Measurement	2s /synchronized with measurement	with science data	On/Off	2	set flag low or high		transmitted only as off/on flag
NRNAD15C	Remote detector pack heater Enabled	Flag	Std.	Measurement	2s / synchronized with measurement	1 min	On/Off	3	8		RDP heating successful ?
NRNAD15C	MCP/LEDA Accumulation busy	Flag	ext.	Measurement	2s / synchronized with measurement	5 min	On/Off	4			
NRNAD15C	MCP HV Enabled	Flag	ext.	Measurement	1 min / synchronized with measurement	5 min	On/Off	4			
NRNAD15C	MCP HV Reduced Status	Flag	ext.	Measurement	1 min / synchronized with measurement	5 min	On/Off	4			
NRNAD15C	MCP HV Safe Status	Flag	ext.	Measurement	1 min / synchronized with measurement	5 min	On/Off	4			
NRNAD161	Temperature measured in the MEP-A board (command and data handler)	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min	-30 to +60 °C (TBC)	3	TBD		
NRNAD162	Temperature measured in the MEP-N board (low voltage power supply)	Measured	Ext.	Measurement	2s / synchronized	5 min	-30 to +60 °C (TBC)	3	TBD		

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				with measurement						
NRNAD163	Cover motor temperature	Measured	Ext.	No measurement with cover operation	2s	5 min		2	4	
NRNAD164	MEP D reference reduced	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min		4	no action	
NRNAD165	MEP E reference reduced	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min		4	no action	
NRNAD166	Spare									will be low gain analog output of CEM for FS
NRNAD167	Spare									
NRNAD168	MEP reference voltage	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min		4	no action	
NRNAD169	Temperature measured in the MEP-G board (Ion source control)	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min	-30 to +60 °C (TBC)	3	TBD	
NRNAD16A	Source lens left reference program voltage	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min		4	no action	
NRNAD16B	Source lens right reference program voltage	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min		4	no action	
NRNAD16C	Source exit slit reference program voltage	Measured	Ext.	Measurement	2s / synchronized	5 min		4	no action	

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					with measurement						
NRNAD16D	Beta deflector reference program voltage	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min		4	no action		
NRNAD16E	Transfer lens right reference program voltage	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min		4	no action		
NRNAD16F	Transfer lens left reference program voltage	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min		4	no action		
NRNAD170	Temperature measured in the MEP-H board (transfer optics voltage reference)	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min	-30 to +60 °C (TBC)	3	TBD		
NRNAD171	Raw -2.8kV reference voltage	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min		4	no action		
NRNAD172	Beta deflector opto-coupler drive voltage	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min		4	no action		
NRNAD173	Source exit slit opto-coupler drive voltage	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min		4	no action		
NRNAD174	Source lens right opto-coupler drive voltage	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min		4	no action		
NRNAD175	Source lens left opto-coupler drive voltage	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min		4	no action		

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NRNAD176	Transfer lens right opto-coupler drive voltage	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min		4	no action	
NRNAD177	Transfer lens left opto-coupler drive voltage	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min		4	no action	
NRNAD178	Raw -2.8kV converter drive voltage	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min		4	no action	
NRNAD179	Analog power monitor	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min		4	no action	
NRNAD17A	Raw -2.8kV voltage	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min		4	no action	
NRNAD17B	Raw -2.8kV converter current	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min	TBD (provided by T. Magoncelli)	3	TBD	
NRNAD17C	analyzer part, electrostatic analyzer coarse voltage, DAC value	Measured	Ext.	Measurement	2s / synchronized with measurement	6 min				
NRNAD17D	Internal ASP HV Bias monitor	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min		4	no action	
NRNAD17E	HV FDP reference error output of regulation loop	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min		4	no action	
NRNAD17F	Zoom quadruple 2 vertical error output of regulation loop	Measured	Ext.	Measurement	2s / synchronized with	5 min		4	no action	

					measurement					
NRNAD180	Zoom quadruple 2 horizontal error output of regulation loop	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min		4	no action	
NRNAD181	Entrance slit switch condenser 2 error output of regulation loop	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min		4	no action	
NRNAD182	Entrance slit switch condenser 1 error output of regulation loop	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min		4	no action	
NRNAD183	Electrostatic analyzer error output of regulation loop	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min		4	no action	
NRNAD184	Electrostatic analyzer error output of regulation loop	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min		4	no action	
NRNAD185	Zoom quadruple 1 vertical error output of regulation loop	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min		4	no action	
NRNAD186	Zoom quadruple 1 horizontal error output of regulation loop	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min		4	no action	
NRNAD187	CEM Repeller error output of regulation loop	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min		4	no action	
NRNAD188	Hexapole error output of regulation loop	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min		4	no action	

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NRNAD189	Rotation quadruple error output of regulation loop	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min		4	no action		
NRNAD18A	Matsuda plates error output of regulation loop	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min		4	no action		
NRNAD18B	Temperature measured in the ASP-C board (power supply electrostatic analyzer)	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min	-30 to +60 °C (TBC)	3	TBD		
NRNAD18C	Temperature measured in the ASP-B board (digital control)	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min	-30 to +60 °C (TBC)	3	TBD		
NRNAD18D	ASP 15 V supply voltage	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min		4	no action		
NRNAD18E	Internal ASP HV Bias turned on	Flag	Ext.	Measurement	2s / synchronized with measurement	5 min		4	no action		
NRNAD18E	ASP-A HV output Enabled	Flag	Ext.	Measurement	2s / synchronized with measurement	5 min		4	no action		
NRNAD18E	ASP-C HV output Enabled	Flag	Ext.	Measurement	2s / synchronized with measurement	5 min		4	no action		
NRNAD18E	ASP-D HV output Enabled	Flag	Ext.	Measurement	2s / synchronized with measurement	5 min		4	no action		
NRNAD18E	ASP-E HV output Enabled	Flag	Ext.	Measurement	2s / synchronized with	5 min		4	no action		

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				measurement							
NRNAD18E	ASP HV Safe Status (inhibits ASP HV Ena and ASP A Ena through ASP E)	Flag	Ext.	Measurement	2s / synchronized with measurement	5 min			4	no action	
NRNAD18E	ASP HV Reduced Status Enabled (HV reduced by 8)	Flag	Ext.	Measurement	2s / synchronized with measurement	5 min			4	no action	
NRNAD18F	Floating detector pack 0 Volt refererence	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min		0V ± 0.5V (TBC)	3	1 / 2	
NRNAD190	Floating detector pack -5 V supply voltage	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min		0V ± 0.5V (TBC)	3	1 / 2	
NRNAD191	Floating detector pack +5 V supply voltage	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min		0V ± 0.5V (TBC)	3	1 / 2	
NRNAD192	Floating detector pack +7.5 V supply voltage	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min		+7,5V ± 0.5V (TBC)	3	1 / 2	
NRNAD193	Floating detector pack -7.5 V supply voltage	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min		+7,5V ± 0.5V (TBC)	3	1 / 2	
NRNAD194	Temperature measured in reference circuit on FDP-A	Measured	Ext.	Measurement	2s / synchronized with measurement	5 min			4	no action	
				Measurement	synchronized with measurement	1 min		-3 to +3 V	4	TBD	

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General remark: In case of filament 2 operation, the monitoring procedure for FIL 1 Emis and FIL 2 Emis have to be exchanged !

Legend

Criticality	Description	Montioring, action items
1	emergency case	immediate switch off, emergency handling by operator
2	short time effects	immediate and appropriate action by DPU
3	long time effects	observation for a certain time, appropriate action by DPU
4	not critical at all	no monitoring, no actions

Action	Description
1	Turn DFMS off, turn DFMS on again, return to current sensor state. If problem still exists, turn DFMS completely off until appropriate reaction by operator.
2	Turn DFMS off, turn DFMS on again, repeat current measurement mode. If problem still exists, turn DFMS completely off until appropriate reaction by operator.
3	Turn off filament, try it again. If problem still exists, turn DFMS completely off until appropriate reaction by operator.
4	Stop cover operation, TBD further action.
5	Stop GCU operation, TBD further action.
6	Turn DFMS off, TBD further action.
7	Stop GCU operation, if problems still exists, turn DFMS completely off, TBD further action.
8	Stop RDP heater operation, try it again. If problems still exists, TBD further action.
9	Stop IS heater operation, try it again. If problems still exists, TBD further action.
10	Stop GCU operation, try it again. If problems still exists, TBD further action.

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3.2 RTOF houskeeping monitoring

RSDB	HK-Mnemonic old	Description	HK Type	Std./Ext. Pack.	Monitoring if	Sampling frequency	Transmission frequency S/C	Range	Criti-cality	Action, if outside range	Used for regulation	Remarks
0	NRNAR101	RTOF Std. HK Header		std		2s	1 min					
1		WCS or ETS (Main controller Data Retpath)		std		2s	1 min					
		Spare		std		2s	1 min					
		Data path_WCS readout or ETS readout (WCS Path)	Flag	std		2s	1 min					
		Data path_ETS readout or WCS readout (ETS Path)	Flag	std		2s	1 min					
2	NRNAR103	RTOF HK counter	Value	std		2s	1 min					
4	NRNAR104	RTOF Cmd counter	Value	std		2s	1 min					
6	NRNAR105	RTOF Cmd Error counter	Value	std		2s	1 min					
8	NRNAR106	RTOF Cmd Error position	Value	std		2s	1 min					
10	NRNAR107	RTOF Science counter	Value	std		2s	1 min					
12	NRNAR108	RTOF Science Error counter	Value	std		2s	1 min					
14	NRNAR109	RTOF Science Error position	Value	std		2s	1 min					
16	NRNAR10A	RTOF S/W mode	Value	std		2s	1 min					
18	NRNAR10B	RTOF S/W status	Value	std		2s	1 min					

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20	NRNAR10C	only for WCS (Number of Cycles)	Value	std		2s	1 min				
22	NRNAR10D	Status Bits 1		std		2s	1 min				
		power supply 9 kV enable status	Flag	std		2s	1 min		4		
		power supply 70 V enable status	Flag	std		2s	1 min		4		
		power supply ortho MCP enable status	Flag	std		2s	1 min		4		
		power supply storage MCP enable status	Flag	std		2s	1 min		4		
		power supply hard mirror enable status	Flag	std		2s	1 min		4		
		power supply pulser enable status	Flag	std		2s	1 min		4		
		Spare	Flag	std		2s	1 min				
		ETS Ram Test Active	Flag	std		2s	1 min		4		
		ETS Ram Test Status	Flag	std		2s	1 min		4		
		ETS Ram Test Data	Flag	std		2s	1 min		4		
		Input Selection: Ion, Gas or Calibrator (Input Select)	Flag	std		2s	1 min		4		
		ETS Output Enable	Flag	std		2s	1 min		4		
		Equivalent Time Sampling_Controller	Flag	std		2s	1 min		4		
24	NRNAR10E	ETS Lower Readout Address	Value	std		2s	1 min		4		
26	NRNAR10F	ETS Upper Readout Address	Value	std		2s	1 min		4		
28	NRNAR110	Status Bits 2		std		2s	1 min		4		
		Spare	Flag	std		2s	1 min				
		Filament emission controller Fil 2 Storage Status	Flag	std		2s	1 min		4		
		Filament emission controller Fil 1 Storage Status	Flag	std		2s	1 min		4		

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		Filament emission controller Fil 2 Ortho Status	Flag									
				std		2s	1 min			4		
		Filament emission controller Fil 1 Ortho Status	Flag									
				std		2s	1 min			4		
		Filament emission controller I Status	Flag	std		2s	1 min			4		
		Filament emission controller EH Ortho Status	Flag									
				std		2s	1 min			4		
		Filament emission controller EH Storage Status	Flag									
				std		2s	1 min			4		
		Equivalent Time Sampling_Postprocessor (ETS Lower Readout Address Bit 16)	Flag									
				std		2s	1 min			4		
		Equivalent Time Sampling_Postprocessor (ETS upper Readout Address Bit 16)	Flag									
				std		2s	1 min			4		
		Equivalent Time Sampling_Postprocessor (ETS Lower Range)	Flag									
				std		2s	1 min			4		
		Equivalent Time Sampling_Postprocessor (ETS Upper Range)	Flag									
				std		2s	1 min			4		
30	NRNAR111	Spare		std		2s	1 min					
32	NRNAR112	Filament emission controller_Orthosource_Filament Heater_current [mA] (MC_FEC_ION_FIHEAT_I)	measured		FEC is running							
				std		2s	1 min			2	11	nominal range TBD
34	NRNAR113	Filament emission controller_Storagesource_Filament Heater_current [mA] (MC_FEC_GAS_FIHEAT_I)	measured		FEC is running							
				std		2s	1 min			2	11	nominal range TBD

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36	NRNAR114	Orthosource repeller voltage #A	measured	std		2s	1 min			3			
38	NRNAR115	Ortho source repeller voltage #B	measured	std		2s	1 min			3			
40	NRNAR116	Storage source repeller voltage #A	measured	std		2s	1 min			3			
42	NRNAR117	Storage source repeller voltage #B	measured	std		2s	1 min			3			
44	NRNAR118	Orthosource filament voltage	measured	std		2s	1 min			3			
46	NRNAR119	Storage source filament voltage	measured	std		2s	1 min			3			
48	NRNAR11A	Filament emission controller_Storagesource_Filament emission_current [µA] (MC_Filament emission controller_Storage_FIL_I)	measured	std		2s	1 min			3			
50	NRNAR11B	Filament emission controller_Orthosource_Entrance1_voltage (MC_Filament emission controller_Ortho_ENT1_V)	measured	std		2s	1 min			3			
52	NRNAR11C	Filament emission controller_Orthosource_Entrance1_current = Emission current [µA] (MC_Filament emission controller_Ortho_ENT1_I)	measured	std		2s	1 min			3			
54	NRNAR11D	Storagesource trap voltage	measured	std		2s	1 min			3			
56	NRNAR11E	Filament emission controller_voltage_~+24V (MC_Filament emission controller_HVVG_V)	Flag On or off; measured	std		2s	1 min			3			
58	NRNAR11F	Filament emission controller_voltage_~+24V (MC_Filament emission controller_HEAT_VG_V)	Flag On or off; measured	std		2s	1 min			3			
60	NRNAR120	Temperature of Filament emission controller	measured	std		2s	1 min			3			

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62	NRNAR121	GCU_Storagesource_Power On or Off (MC_GCU_POW_#1)	measured								
			std			200 ms	1 min		3		
64	NRNAR122	GCU_Orthosource_Power On or Off (MC_GCU_POW_#2)	measured								
			std			200 ms	1 min		3		
66	NRNAR123	Current in gas calibration unit 1	measured	GCU POWER ON							
			std			200 ms	1 min		2	12	has to be 0 in standby On time maximal TBD
68	NRNAR124	Current in gas calibration unit 2	measured	GCU POWER ON							
			std			200 ms	1 min		2	12	has to be 0 in standby On time maximal TBD
70	NRNAR125	Output pressure of gas calibration unit 1	measured	GCU POWER ON							
			std			200 ms	1 min	maximum level TBD	2	12 yes	
72	NRNAR126	Output pressure of gas calibration unit 2	measured	GCU POWER ON							
			std			200 ms	1 min	maximum level TBD	2	12 yes	
74	NRNAR127	Temperature of pirani in gas calibration unit 1	measured								
			std			200 ms	1 min		3		
76	NRNAR128	Temperature of pirani in gas calibration unit 2	measured								
			std			200 ms	1 min		3		
78	NRNAR129	Gas Extraction Pulser_Temperature (MC_GEX_TEMP)	measured								
			std			2 s	1 min		3		
80	NRNAR12A	Hard mirror_Pulse width (MC_HM_PW)	measured	std			2 s	1 min		3		
82	NRNAR12B	hard mirror pulse delay	measured	std			2 s	1 min		3		
84	NRNAR12C	hard mirror pulser temperature	measured	std			2 s	1 min		3		
86	NRNAR12D	Torque on cover opening mechanism motor	measured								
			std			2 s	1 min		3		????
88	NRNAR12E	Temperature on cover opening mechanism motor	measured								
			std			2 s	1 min		3		

90	NRNAR12F	Cover opening mechanism Motor Position		std		2 s	1 min					
		Motor On	Flag	std		2 s	1 min		4			
		Motor Positioning	Flag	std		2 s	1 min		4			
		Motor Velocity	Flag	std		2 s	1 min		4			
		Open Switch	Flag	std		2 s	1 min		2	13		May only be reached in Search Switch Function
		Closed Switch	Flag	std		2 s	1 min		2	13		May only be reached in Search Switch Function
		Hall sensor in motor Error	Flag	std		2 s	1 min		3			
		Hall sensor Error Fatal	Flag	std		2 s	1 min		2	14		
		Motor Position	Flag	std		2 s	1 min		2	13		Measured ! FLAG ?? When Position exceeds range TBD
92	NRNAR130	Main controller Power State 2		std		2 s	1 min					
		WCS VDD On	Flag	std		2 s	1 min					
		WCS VDD Off	Flag	std		2 s	1 min					
		WCS VCC On	Flag	std		2 s	1 min					
		WCS VCC Off	Flag	std		2 s	1 min					
		Heater Storage source On	Flag	std		2 s	1 min		4			
		Heater Storage source Off	Flag	std		2 s	1 min		4			
		Heater Ortho source On	Flag	std		2 s	1 min		4			
		Heater Ortho source Off	Flag	std		2 s	1 min		4			
		Motor Hall sensor Enable	Flag	std		2 s	1 min		4			
		Motor Hall sensor Disable	Flag	std		2 s	1 min		4			
		Motor Direction Open	Flag	std		2 s	1 min		4			

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		Motor Direction Close	Flag	std		2 s	1 min		4			
		Motor Power On	Flag	std		2 s	1 min		4			
		Motor Power Off	Flag	std		2 s	1 min		4			
		Motor High Torque On	Flag	std		2 s	1 min		4			
		Motor High Torque Off	Flag	std		2 s	1 min		4			
94	NRNAR131	Main controller Pulser State		std		2 s	1 min					
		Storage Pulser On	flag	std		2 s	1 min		4			
		Storage Pulser Off	flag	std		2 s	1 min		4			
		Hard mirror Pulser On	flag	std		2 s	1 min		4			
		Hard mirror Pulser Off	flag	std		2 s	1 min		4			
		Ortho Pulser On	flag	std		2 s	1 min		4			
		Ortho Pulser Off	flag	std		2 s	1 min		4			
		Spare	flag	std		2 s	1 min		4			
96	NRNAR132	Main controller Power State 6		std		2 s	1 min					
		Spare	Flag	std		2 s	1 min		4			
		Disable ETS Latch Up (Disable ETS LU)	Flag	std		2 s	1 min		4			
		Enable ETS Latch Up (Enable ETS LU)	Flag	std		2 s	1 min		4			
		Equivalent Time Sampling_analog voltage_On (ETS VCA On)	Flag	std		2 s	1 min		4			
		Equivalent Time Sampling_analog voltage_Off (ETS VCA Off)	Flag	std		2 s	1 min		4			
		Equivalent Time Sampling_15V_On (ETS VDD On)	Flag	std		2 s	1 min		4			
		Equivalent Time Sampling_15V_Off (ETS VDD Off)	Flag	std		2 s	1 min		4			

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		Equivalent Time Sampling_5V_On (ETS VCC On)	Flag								
				std		2 s	1 min		4		
		Equivalent Time Sampling_5V_Off (ETS VCC Off)	Flag								
				std		2 s	1 min		4		
		Equivalent Time Sampling_operation voltage_~58V_On (ETS VSH/VE On)	Flag								
				std		2 s	1 min		4		
		Equivalent Time Sampling_operation voltage_~58V_Off (ETS VSH/VE Off)	Flag								
				std		2 s	1 min		4		
98	NRNAR133	Main controller Power State 8		std			1 min				
		Gas calibration unit 1 On	Flag	std		200 ms	1 min		4		
		Gas calibration unit 1 Off	Flag	std		200 ms	1 min		4		
		Gas calibration unit 2 On	Flag	std		200 ms	1 min		4		
		Gas calibration unit 2 Off	Flag	std		200 ms	1 min		4		
		Gas calibration unit 1 Valve On	Flag	std		200 ms	1 min		4		
		Gas calibration unit 1 Valve Off	Flag	std		200 ms	1 min		4		
		Gas calibration unit 2 Valve On	Flag	std		200 ms	1 min		4		
		Gas calibration unit 2 Valve Off	Flag	std		200 ms	1 min		4		
		Filament emission controller_5V_On (Filament emission controller VCC On)	Flag								
				std		2 s	1 min		4		
		Filament emission controller_5V_Off (Filament emission controller VCC Off)	Flag								
				std		2 s	1 min		4		
		Filament emission controller_15V_On (Filament emission controller VDD On)	Flag								
				std		2 s	1 min		4		
		Filament emission controller_15V_Off (Filament emission controller VDD Off)	Flag								
				std		2 s	1 min		4		
		Filament emission controller_24V_On (Filament emission controller Heater VG On)	Flag								
				std		2 s	1 min		4		

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		Filament emission controller_24V_Off (Filament emission controller Heater VG Off)	Flag									
				std		2 s	1 min			4		
		Filament emission controller_24V_On (Filament emission controller HV VG On)	Flag									
				std		2 s	1 min			4		
		Filament emission controller_24V_Off (Filament emission controller HV VG Off)	Flag									
				std		2 s	1 min			4		
100	NRNAR134	Main controller_WCS_TEMP = ETSL_TEMP	measured									NEW: ETSLIGHT_TEMP
				std		2 s	1 min			3	17	
102	NRNAR135	ETS temperature on clock circuitry	measured	std		2 s	1 min			3	15	Max TemperatureTBD
104	NRNAR136	ETS temperature on digital circuitry	measured	std		2 s	1 min			3	15	Max TemperatureTBD
106	NRNAR137	Entrance Lens_B_Orthosource_voltage=lower lens (PSDC_ELB_I)	measured									
				std		2 s	1 min	Set value ±5%		3		
108	NRNAR138	Entrance Lens_A_Orthosource_voltage=upper lens (PSDC_ELA_I)	measured									
				std		2 s	1 min	Set value ±5%		3		
110	NRNAR139	Extraction Grid_Orthosource_voltage (PSDC_GR_I)	measured									
				std		2 s	1 min	Set value ±5%		3		
112	NRNAR13A	Backplane_Orthosource_voltage (PSDC_BP_I)	measured									
				std		2 s	1 min	Set value ±5%		3		
114	NRNAR13B	Extraction Grid_Storagesource_voltage (PSDC_GR_G)	measured									
				std		2 s	1 min	Set value ±5%		3		
116	NRNAR13C	Backplane_Storagesource_voltage (PSDC_BP_G)	measured									
				std		2 s	1 min	Set value ±5%		3		
118	NRNAR13D	high voltage Storage Source lense	measured	std		2 s	1 min	Set value ±10%				
120	NRNAR13E	Accerleration_2_Storagesource_voltage (high voltage1_A2_G)	measured									
				std		2 s	1 min	Set value ±10%		3		

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122	NRNAR13F	Acceleration_1_Storagesource_voltage (high voltage1_A1_G)	measured									
			std		2 s	1 min	Set value ±10%	3			
124	NRNAR140	high voltage on ortho source lense	measured	std		2 s	1 min	Set value ±10%				
126	NRNAR141	Acceleration_2_Orthosource_voltage (high voltage1_A2_I)	measured									
			std		2 s	1 min	Set value ±10%	3			
128	NRNAR142	Accleration_1_Orthosource_voltage (high voltage1_A1_I)	measured									
			std		2 s	1 min	Set value ±10%	3			
130	NRNAR143	high voltage on storage source pulser	measured									Pulse Voltage P_GAS ???
			std		2 s	1 min	Set value ±10%	3			
132	NRNAR144	high voltage on ortho source pulser	measured									Pulse Voltage P_ION ???
			std		2 s	1 min	Set value ±10%	3			
134	NRNAR145	Drift_voltage (high voltage1_D)	measured	std		2 s	1 min	Set value ±5%	3			
136	NRNAR146	high voltage Hard mirror3	measured	std		2 s	1 min	Set value ±5%	3			PSU_HM3
138	NRNAR147	high voltage reflectron 1	measured	std		2 s	1 min	Set value ±5%	3			PSU_R1
140	NRNAR148	high voltage reflectron 2	measured	std		2 s	1 min	Set value ±5%	3			PSU_R2
142	NRNAR149	high voltage on reflectron lense	measured	std		2 s	1 min	Set value ±5%	3			PSU_RL
144	NRNAR14A	high voltage Hard mirror1	measured	std		2 s	1 min	Set value ±5%	3			PSU_HM1
146	NRNAR14B	high voltage Hard mirror2	measured	std		2 s	1 min	Set value ±5%	3			PSU_HM2
148	NRNAR14C	high voltage Hard mirror lense	measured	std		2 s	1 min	Set value ±5%	3			PSU_HML
150	NRNAR14D	high voltage on ortho source detector	measured	std		2 s	1 min	Set value ±5%	2	18		M_I
152	NRNAR14E	high voltage on storage source detector	measured	std		2 s	1 min	Set value ±5%	2	18		M_G
154	NRNAR14F	Entrance2_Orthosource_voltage (PSDC_E2_I)	measured									
			std		2 s	1 min	Set value ±5%	3			
156	NRNAR150	Temperature_Backplane_Orthosource (PSDC_Temp_BP_I)	measured									
			std		2 s	1 min			4			
158	NRNAR151	Temperature_Backplane_Storagesource (PSDC_Temp_BP_G)	measured									
			std		2 s	1 min			4			

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160	NRNAR152	Temperature_Multi channel plates_Orthosource (PSU_Temp_MCP_I)	measured								
			std		2 s	1 min			3		
162	NRNAR153	Temperature_Multi channel plates_Storagesource (PSU_Temp_MCP_G)	measured								
			std		2 s	1 min			3		
164	NRNAR154	Temperature of high voltage board 1	measured	std		2 s	1 min		3	19	
166	NRNAR155	Temperature of low voltage board	measured	std		2 s	1 min		3	19	
168	NRNAR156	WCS Flags		std		2 s	1 min				Not used -- ETS LIGHT version
		Command Error		std		2 s	1 min				
		Spare		std		2 s	1 min				
		Heart beat 1		std		2 s	1 min				
		Heart beat 2		std		2 s	1 min				
		Data ready		std		2 s	1 min				
		WCS busy		std		2 s	1 min				
		Spare		std		2 s	1 min				
169		WCS Active Table		std		2 s	1 min				
170	NRNAR157	ETS Status 1		std		2 s	1 min				
		ETS Ortho Pulser Status	flag	std		2 s	1 min		4		
		ETS Storage Pulser Status	flag	std		2 s	1 min		4		
		ETS Synchronization Status	flag	std		2 s	1 min		4		
		ETS Trigger Status	flag	std		2 s	1 min		4		
		ETS Data Readout Status	flag	std		2 s	1 min		4		
		ETS Acquisition Status	flag	std		2 s	1 min		4		
		ETS Delayed time sampling Status Cancel	flag	std		2 s	1 min		4		

		ETS Delayed time sampling Status	flag	std		2 s	1 min		4		
171		ETS Status 2		std		2 s	1 min		4		
		ETS Input Status	flag	std		2 s	1 min		4		
		ETS Cal. Power Status	flag	std		2 s	1 min		4		
		ETS ADC High resolution mode Status	flag	std		2 s	1 min		4		
		ETS RAM Threshold	Value	std		2 s	1 min		4		
		ETS FIFO Threshold	Value	std		2 s	1 min		4		
		ETS Latchup Enabled	flag	std		2 s	1 min		4		
		ETS Latchup Detected	flag	std		2 s	1 min		3	16	
172	NRNAR158	ETS Status 3		std		2 s	1 min				
		ETS ADC Power Status	flag	std		2 s	1 min		4		
		ETS ADC Threshold	Value	std		2 s	1 min		4		
		ETS mass line mode Mode	Value	std		2 s	1 min		4		
		Spare		std		2 s	1 min				
173		ETS Threshold Level	Value	std		2 s	1 min		4		
174	NRNAR159	ETS Extraction Delay	Value	std		2 s	1 min		4		
176	NRNAR15A	ETS Time of flight	Value	std		2 s	1 min		4		
178	NRNAR15B	ETS Cal. Start Delay	Value	std		2 s	1 min		4		
180	NRNAR15C	ETS Cal. Pulse Height	Value	std		2 s	1 min		4		
182	NRNAR15D	ETS Cal. Pulse Width	Value	std		2 s	1 min		4		
184	NRNAR15E	Spare		std		2 s	1 min				
		3.5 Extended RTOF Packetblock, Length 56 words									

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Pos	RSDB	Name		ext							
0	NRNAR160	RTOF Ext. HK Header		ext		2 s	5 min				
1		Spare		ext		2 s	5 min				
2	NRNAR161	Filament emission controller_Plus VCC_voltage (Filament emission controller_PVCC_V)	measured	ext		2 s	5 min	+-5% of nominal 5V	3	21	FEC Supply out of range
4	NRNAR162	Filament esmission controller_Minus VCC_voltage (Filament emission controller_MVCC_V)	measured	ext		2 s	5 min	+-5% of nominal -5V	3	21	FEC Supply out of range
6	NRNAR163	Filament emission controller_Plus VDD_voltage (Filament emission controller_PVDD_V)	measured	ext		2 s	5 min	+-5% of nominal 15V	3	21	FEC Supply out of range
8	NRNAR164	Filament emission controller_Minus VDD_voltage(Filament emission controller_MVDD_V)	measured	ext		2 s	5 min	+-5% of nominal -15V	3	21	FEC Supply out of range
10	NRNAR165	Temperature on gas calibration unit tank 1	measured	ext	GCU Power On	2 s	5 min	> Maximum TBD	3	20	
12	NRNAR166	Temperature on gas calibration unit tank 2	measured	ext	GCU Power On	2 s	5 min	> Maximum TBD	3	20	
14	NRNAR167	Gas calibration unit pressure 1 on tank side	measured	ext		2 s	5 min		4		
16	NRNAR168	Gas calibration unit pressure 2 on tank side	measured	ext		2 s	5 min		4		
18	NRNAR169	Gas Extraction Pulser_+5V (Main controller_GEX_PVCC)	measured	ext	Pulser Power On	2 s	5 min	+-5% of nominal 5V	3	22	Pulser Supply out of range
20	NRNAR16A	Gas Extraction Pulser_28V (Main controller_GEX_VD)	measured	ext	VD ON	2 s	5 min	+-5% of nominal 28V	3	22	Pulser Supply out of range

22	NRNAR16B	Ion Extraction Pulser_+5V (Main controller_IEX_PVCC)	measured	ext		2 s	5 min	+-5% of nominal 5V	3	22		Pulser Supply out of range
24	NRNAR16C	Ion Extraction Pulser_28V (Main controller_IEX_VD)	measured	ext		2 s	5 min	+-5% of nominal 28V	3	22		Pulser Supply out of range
26	NRNAR16D	Hard Mirror_+5V analog (Main controller_Hard mirror_PVCA)	measured	ext		2 s	5 min	+-5% of nominal 5V	3	22		Pulser Supply out of range
28	NRNAR16E	Hard Mirror_28V (Main controller_Hard mirror_VD)	measured	ext		2 s	5 min	+-5% of nominal 28V	3	22		Pulser Supply out of range
30	NRNAR16F	Main controller_WCS_PVCC PVCA ???		ext		2 s	5 min	+-5% of nominal 5V	3	23		= ETSLIGHT PVCA
32	NRNAR170	Main controller_WCS_MVCC MVCA ??		ext		2 s	5 min	+-5% of nominal -5V	3	23		= ETSLIGHT MVCA
34	NRNAR171	Main controller_WCS_PVCC PVDD ???		ext		2 s	5 min	+-5% of nominal 15V	3	23		= ETSLIGHT PVDD
36	NRNAR172	Main controller_WCS_MVCC MVDD ???		ext		2 s	5 min	+-5% of nominal -15V	3	23		= ETSLIGHT MVDD
38	NRNAR173	Main controller_WCS_PVCC		ext		2 s	5 min	+-5% of nominal 5V	3	23		= ETSLIGHT PVCC
40	NRNAR174	Motor_Switch_open position (Main controller_OMain controller_SW_OPEN)	measured	ext	Motor Power On	2 s	5 min	TBD	2	13		
42	NRNAR175	Motor_Switch_close position (Main controller_OMain controller_SW_CLOSED)	measured	ext	Motor Power On	2 s	5 min	TBD	2	13		
44	NRNAR176	Heater_Orthosource_24V (Main controller_HEAT_Ortho_VG)	measured	ext	FEC Heater Power On	2 s	5 min	+-5% of nominal 24V	3	24		FEC_HEAT_VG Heater Supply out of range
46	NRNAR177	Heater_Storagesource_24V (Main controller_HEAT_Storage _VG)	measured	ext		2 s	5 min	+-5% of nominal 24V	3	24		FEC_HEAT_VG Heater Supply out of range
48	NRNAR178	Main controller_ETS_33V	measured	ext		2 s	5 min	+-10% of nominal 3.3V	3	25		ETS Supply out of range
50	NRNAR179	Equivalent Time Sampling_Plus VCA_voltage (Main controller_ETS_PVCA)	measured	ext	ETS is powered	2 s	5 min	+-5% of nominal 5V	3	25		ETS Supply out of range

52	NRNAR17A	Equivalent Time Sampling_Minus VCA_voltage (Main controller_ETS_MVCA)	measured		ETS is powered						
				ext		2 s	5 min	+-5% of nominal -5V	3	25	ETS Supply out of range
54	NRNAR17B	Equivalent Time Sampling_8V (Main controller_ETS_VE)	measured		NEVER !						
				ext		2 s	5 min				Not used anymore !!!!
56	NRNAR17C	Equivalent Time Sampling_Plus VDD_voltage (Main controller_ETS_PVDD)	measured		ETS is powered						
				ext		2 s	5 min	+-5% of nominal 15V	3	25	ETS Supply out of range
58	NRNAR17D	Equivalent Time Sampling_Minus VDD_voltage (Main controller_ETS_MVDD)	measured		ETS is powered						
				ext		2 s	5 min	+-5% of nominal -15V	3	25	ETS Supply out of range
60	NRNAR17E	Equivalent Time Sampling_operation voltage for Analog Digital Converter_~58V (Main controller_ETS_VSH)	measured		ETS ADC section is powered						
				ext		2 s	5 min	+-20% of nominal 58V	3	25	ETS Supply out of range
62	NRNAR17F	Main controller_Spare --> ETSLIGHT_PVCA	measured		ETS LIGHT is powered						ETSLIGHT PVCA ETS LIGHT supply out of range
				ext		2 s	5 min	+-5% of nominal 5V	3	26	
64	NRNAR180	Main controller_Spare		ext		2 s	5 min				
66	NRNAR181	Power supply unit +5_Volt value	measured	ext		2 s	5 min	5V ±10%	1		
68	NRNAR182	Power supply unit -5_Volt value	measured	ext		2 s	5 min	-5V ±10%	1		
70	NRNAR183	Power supply unit +15_Volt value	measured	ext		2 s	5 min	15V ±10%	1		
72	NRNAR184	Power supply unit -15_Volt value	measured	ext		2 s	5 min	-15V ±10%	1		
74	NRNAR185	Power supply unit +24_Volt value	measured	ext		2 s	5 min	24V ±10%	1		
76	NRNAR186	Power supply unit +8_Volt value	measured	ext		2 s	5 min	8V ±10%	4		Not used anymore by ETS
78	NRNAR187	Power supply unit +5_Add_Volt value	measured	ext		2 s	5 min	5V ±10%	1		
80	NRNAR188	Power supply unit +40_Volt value	measured	ext		2 s	5 min	Set value ±10%	1		
82	NRNAR189	Power supply unit +70_Volt value	measured	ext		2 s	5 min	Set value ±10%	1		

84	NRNAR18A	Power supply unit +5_Cur	measured	ext		2 s	5 min	TBD ±TBD%	2			
86	NRNAR18B	Power supply unit -5_Cur	measured	ext		2 s	5 min	TBD ±TBD%	2			
88	NRNAR18C	Power supply unit +15_Cur	measured	ext		2 s	5 min	TBD ±TBD%	2			
90	NRNAR18D	Power supply unit -15_Cur	measured	ext		2 s	5 min	TBD ±TBD%	2			
92	NRNAR18E	Power supply unit +24_Cur	measured	ext		2 s	5 min	TBD ±TBD%	2			
94	NRNAR18F	Power supply unit +40/70_Cur	measured	ext		2 s	5 min	TBD ±TBD%	2			
96	NRNAR190	Power supply unit_+5V_Additional_current	measured	ext		2 s	5 min	TBD ±TBD%	2			
98	NRNAR191	Power supply unit +8_Cur	measured	ext		2 s	5 min	TBD ±TBD%	4			Not used by any board
100	NRNAR192	WCS Data Size		ext		2 s	5 min					
104	NRNAR193	Postprocessor (ETS number of extractions High)	value	ext		2 s	5 min		4			
		Postprocessor (number of extractions High value)	value	ext		2 s	5 min		4			
106	NRNAR194	Postprocessor (ETS number of extractions Low)	value	ext		2 s	5 min		4			
		Postprocessor (number of extractions Low value)	value	ext		2 s	5 min		4			
		Postprocessor (number of extractions Status)	value	ext		2 s	5 min		4			
108	NRNAR195	Spare 1		ext		2 s	5 min					
110	NRNAR196	Spare 2		ext		2 s	5 min					

General remark: In case of filament 2 operation, the monitoring procedure for FIL 1 Emis and FIL 2 Emis have to be exchanged !

Legend

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Criticality	Description	Montioring, action items
1	emergency case	immediate switch off, emergency handling by operator
2	short time effects	immediate and appropriate action by DPU
3	long time effects	observation for a certain time, appropriate action by DPU
4	not critical at all	no monitoring, no actions

Action	Description
1	Turn RTOF off, turn RTOF on again, return to current sensor state. If problem still exists, turn RTOF completely off until appropriate reaction by operator.
2	Turn RTOF off, turn RTOF on again, repeat current measurement mode. If problem still exists, turn RTOF completely off until appropriate reaction by operator.
3	Turn off filament, try it again. If problem still exists, turn RTOF completely off until appropriate reaction by operator.
4	Stop cover operation, TBD further action.
5	Stop GCU operation, TBD further action.
6	Turn RTOF off, TBD further action.
7	Stop GCU operation, if problems still exists, turn RTOF completely off, TBD further action.
8	Stop RDP heater operation, try it again. If problems still exists, TBD further action.
9	Stop IS heater operation, try it again. If problems still exists, TBD further action.
10	Stop GCU operation, try it again. If problems still exists, TBD further action.
11	Decrease Filament Heater level fast until the 24V current is in a nominal range
12	Switch off GCU valve
13	Stop Motor by switching motor power off
14	Stop Motor and try to drive it without hall sensor
15	ETS CLOCKBOARD OVERTEMP: Switch off ETS

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16	ETS LATCHUP DETECTED : TBD
17	ETS LIGHT OverTemperature : TBD
18	MCP Problem - Decrease MCP voltage TBD
19	Overtemperature on PSU Boards : TBD
20	GCU Overtemperature : Possibility to loose gas through valve
21	FEC Supply out of range
22	Pulser Supply out of range (used for Gas/Ion/HM-Pulser
23	ETS Light Supply out of range
24	Fec Heater Supply voltage out of range : Power down Heater by setting MC to 0 and switching Heaters off
25	ETS Supply out of range Power down ETS
26	ETS LIGHT Supply out of range Power down ETS LIGHT

Pink marked fields are related to the waveform capture system and will be changed for the FS

3.3 COPS houskeeping monitoring

RSDB	HK-Mnemonic old	Description	HK Type	Std./Ext. Pack.	Monitoring if	Sampling frequency	Transmission frequency S/C	Range	Criti-cality	Action, if outside range	Used for regulation	Remarks
NRNAC101	COPS Std. HK Header											
	Range Status											
	Command Error	COPS command Error	Flag	Std.	Measurement	2s	1min	On / Off	TBD			
	Spare											
	Filament Ion Range	Config of the electrometer for the Ion current in Nude Gauge	Flag	Std.	Measurement with Nude Gauge	2s	1min	Low / Medium / High	4	no action		
	Microtip Ion Range	Config of the electrometer for the Ion current in Ram Gauge	Flag	Std.	Measurement with Ram Gauge	2s	1min	Low / Medium / High	4	no action		
	Filament Imission Range	Config for the Immision current measurement in Nude Gauge	Flag	Std.	Measurement with Nude Gauge	2s	1min	Low / High	4	no action		
	Microtip Imission Range	Config for the Immision current measurement in Ram Gauge	Flag	Std.	Measurement with Ram Gauge	2s	1min	Low / High	4	no action		
NRNAC102	COPS HK counter	Housekeeping counter	counter	Std.	Measurement	2s	1min	not applicable	TBD			
NRNAC103	COPS Cmd counter	Command counter	counter	Std.	Measurement	2s	1min	not applicable	TBD			
NRNAC104	COPS Cmd Error	Command	counter	Std.	Measurement	2s	1min	not	TBD			

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	counter	error counter						applicable				
NRNAC105	COPS Cmd Error position											
NRNAC106	COPS HK Error counter	Housekeeping errors counter	counter	Std.	Measurement	2s	1min	not applicable	TBD			
NRNAC107	COPS S/W mode											
NRNAC108	COPS S/W status											
NRNAC109	Pressure NG	Pressure in the Nude Gauge	Calculated	Std.	Measurement with Nude Gauge	2s	1min	<1E-4 / <1E-5 (TBC)	1 / 2			
NRNAC10A	Pressure RG	Pressure in the Ram Gauge	Calculated	Std.	Measurement with Ram Gauge	2s	1min	<1E-4 / <1E-5 (TBC)	1 / 2			
NRNAC10B	Calibration factor NG	Value entering in the calculation of the Nude Gauge pressure	Fixed value	Std.	Measurement with Nude Gauge	2s	1min	not applicable	4	no action		
NRNAC10C	Calibration factor RG	Value entering in the calculation of the Ram Gauge pressure	Fixed value	Std.	Measurement with Ram Gauge	2s	1min	not applicable	4	no action		
NRNAC10D	Active Filament/Microtips	Filament or/and Microtips activated	Flag	Std.	Measurement	2s	1min	Filament / Micotips	4	no action		
	Spare											
	Microtips Array	Microtips configuration, shows wich Microtip groups are enabled or not	Flag array	Std.	Measurement with Ram Gauge	2s	1min	1 to 8 Micotips On /Off	4	no action		
	Spare			Std.								
	Filament	Filament configuration, left or right	Flag	Std.	Measurement with Nude Gauge	2s	1min	Left / Right	4	no action		

		filament enabled										
NRNAC10E	Spare											
NRNAC10F	Ion I Filament	Ion current in the Nude Gauge	Measured	Std.	Measurement with Nude Gauge	2s	1min	> 0pA	3	3		
NRNAC110	Ion I Microtip	Ion current in the Ram Gauge	Measured	Std.	Measurement with Ram Gauge	2s	1min	> 0pA	3	3		
NRNAC111	Imission I Filament	Trapped current at Nude Gauge grid	Measured	Std.	Measurement with Nude Gauge	2s	1min	< 1000uA depending on mode (high)	3	5		
NRNAC112	Imission I Microtip	Trapped current at Ram Gauge grid	Measured	Std.	Measurement with Ram Gauge	2s	1min	< 1000uA depending on mode (high)	3	5		
NRNAC113	AnodeGrid V Filament	Voltage applied to the grid of the Nude Gauge	Measured	Std.	Measurement with Nude Gauge	2s	1min	Nominal value ± 5%	2	5		
NRNAC115	AnodeGrid V Microtip	Voltage applied to the grid of the Ram Gauge	Measured	Std.	Measurement with Ram Gauge	2s	1min	Nominal value ± 5%	2	5		
NRNAC116	Filament I	Current in the selected filament	Measured	Std.	Measurement with Nude Gauge	2s	1min	< 1A	2	5		
NRNAC117	Extraction V Microtip	Extraction voltage applied for mtips in the Ram Gauge	Measured	Std.	Measurement with Ram Gauge	2s	1min	< 80V	2	6		
NRNAC118	Total Emission I	Total current	Measured	Std.	Measurement	2s	1min	< 20mA	3	5		

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	Microtip	through the Microtips			with Ram Gauge			(TBC)			
NRNAC119	+12V I	Current consumed by the +12V (includes current for +5V)	Measured Std.		Measurement	2s	1min	< 180mA (TBC)	3	5	
NRNAC11A	Spare										
NRNAC11B	COPS Ext. HK Header										
	Spare										
NRNAC11C	Electr. Temp	Temperature of the electronic (board2)	Measured Ext.		Measurement	2s	1min	-30 to +60 °C (TBC)	3	TBD	
NRNAC11D	Sensor Temp	Temperature of the Ram Gauge	Measured Ext.		Measurement	2s	1min	-30 to +60 °C (TBC)	3	TBD	
NRNAC11E	+12V Filament	+12V power supply for Nude Gauge electronic	Measured Ext.		Measurement with Nude Gauge	2s	1min	Nominal value ± 3%	3	5	
NRNAC11F	-12V Filament	-12V power supply for Nude Gauge electronic	Measured Ext.		Measurement with Nude Gauge	2s	1min	Nominal value ± 3%	3	5	
NRNAC120	+12V Microtip	+12V power supply for Ram Gauge electronic	Measured Ext.		Measurement with Ram Gauge	2s	1min	Nominal value ± 3%	3	5	
NRNAC121	-12V Microtip	-12V power supply for Ram Gauge electronic	Measured Ext.		Measurement with Ram Gauge	2s	1min	Nominal value ± 3%	3	5	

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General remark: In case of filament 2 operation, the monitoring procedure for FIL 1 Emis and FIL 2 Emis have to be exchanged !

Legend

Criticality	Description	Montioring, action items
1	emergency case	immediate switch off, emergency handling by operator
2	short time effects	immediate and appropriate action by DPU
3	long time effects	observation for a certain time, appropriate action by DPU
4	not critical at all	no monitoring, no actions

Action	Description
1	Turn COPS off, turn COPS on again, return to current sensor state. If problem still exists, turn COPS completely off until appropriate reaction by operator.
2	Turn COPS off, turn COPS on again, repeat current measurement mode. If problem still exists, turn COPS completely off until appropriate reaction by operator.
3	Turn off filament, try it again. If problem still exists, turn COPS completely off until appropriate reaction by operator.
5	Stop GCU operation, TBD further action.
6	Turn COPS off, TBD further action.