NOMAD

Data Operations Handbook

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Document change record

version/issue	version/issue date	Paragraphs affected	Reason for change
0.0	November 8th 2013	all	creation of document
0.1	November 15th 2013	all	correction by B. Ristic, inputs by M. Leese
0.2	January 23th 2014	UVIS frames	inputs by M. Leese
0.3	January 27th 2014	TELECOMMANDS	adding and erasing TC35 commands
0.4	February 21st 2014	TELEMETRY	new inputs from IAA
0.5	March 19th 2014	1553 - NOMAD HSK 1 + EVENTS (table 1)	byte "heater supervisor" added by IAA; event codes changed
0.6	April 4th 2014	1553 - NOMAD HSK 1 + EVENTS (table 1)	COM_BOARD_TEMP replaced by DC_DC_TEMP; event "3" becomes "boot loader run count"
0.7	April 7th 2014	TELECOMMANDS, TELEMETRY (1553)	small modifications by B. Ristic and C. Pastor TELECOMMANDS: names of "get file ststus" command changed, TELEMETRY (1553): calibration values TBD, typo corrections
0.8	April 10th 2014	TELEMETRY (1553), FILE_SYSTEM	TELEMETRY (1553): conversion formulas for SO/LNO housekeeping FILE_SYSTEM: context files modified
0.9	May 29yh 2014	TELEMETRY (1553)	conversion formulas modified and completed
0.10	June 3th 2014	TELEMETRY (1553)	new conversion formula for -5V rail current in UVIS housekeeping
			name of 12 V rail parameters modified to 10 V rail in UVIS housekeeping
			raw parameter limits, converted parameter limits and units added for UVIS housekeeping
0.11	June 12th 2014	TELEMETRY (SpW)	in TM(22) and TM(25) parameter SOFTWARE_VERSION is replaced by
			in TM(22) and TM(25) parameter LAST_TELECOMMAND is fixed to 150 bytes
			in TM(22) and TM(25) parameter SIZE_OF_TC_COPY can have 6 discrete values (25, 50, 75, 100, 125, 150) depending on the number of subdomains used
		FILE_SYSTEM	BOOT DATA FILE table has changed
			FILE_SYSTEM table has changed
			PATCH_BACKUP_FILE table has been removed
		TELEMETRY (1553)	in TM(36) a parameter is added OPERATION_SEQUENCE_COUNT (4 bytes). Consequently the parameter codes are updated for all parameters in TM(36)
			Table 23 added with RESULT CODE parameters list
		PACKET FORMATS	packet TM(36) is modified (due to change above)
0.12	July 25th 2014	FILE_SYSTEM	modyfying CONTEXT_FILE
		TELEMETRY (1553)	adding two events in EVENT_PARAMETER
0.13	Aug 13th 2014	TELEMETRY (1553)	table 19 UVIS HSK parameters - some units have changed from V to mA
			table 1 EVENT parameters - some parameter numbers have been modified (numbers containing "-"); NMHK1060 becomes NMHK1099
			NMHK2618 in tables 17 and 18: transfert function was erronous - has been corrected
		FILE_SYSTEM	size of SO_AOTF_COP table and LNO_AOTF_COP table changed from 7k to 17k
			Context file (table 2): UVIS_UNDER_CURRENT_OFF becomes UVIS_OVER_CURRENT_OFF
		TELEMETRY (SpW)	length of packet TM(29) changed from 56 to 58
0.14	August 20th 2014	TELEMETRY (1553)	table 17 and 18 - units of FPA1_FULL_SCALE_TEMP_LNO and FPA2_ZOOMED_TEMP_LNO modified
			table 22 - contingency list modified
		FILE_SYSTEM	line added on bottom of table 1 - FILES IN FILE SYSTEM
1.0	August 21st 2014	none	official release of document
1,1	October 7th 2014	TELEMETRY (1553)	table 1 - event 130 : parameter name "trap_type" changed to "watchdog_error".
			table 22 - contingency list modified
		TELEMETRY (SpW)	TM(25) - name SO_SCIENCE_DATA changed to LNO_SCIENCE_DATA
1,2	October 14th 2014	TELEMETRY (SpW)	Remarks by J. Brumfit (refreshed pointings to tables)
1,3	October 17th 2014	TELEMETRY (SpW)	Remark by J. Brumfit (UVIS COP_ROW_TABLE modified)
1,4	October 17th 2014	TELECOMMANDS	clarification of COMPRESSION_ALGORYTHM parameter
		TELEMETRY (1553)	table 23 (RESULT_CODE) modified
		FILE_SYSTEM	sizes of COP tables now exact in bytes
1,5	November 10th 2014	TELEMETRY (SpW)	Added table 25 with LAST TELECOMMAND structure for SO and LNO channels
1,6	November 18th 2014	TELEMETRY (SpW)	Table 24. NMTM2890 changed to NMTM2885
1,7	November 26th 2014	TELEMETRY (1553)	Table 19. Transfer function updated, changes to the UVIS HK parameter conversion factors from "as designed" to "FM as built". Examples of raw and calculated values added. Description of some parameters (temp 1-3) slightly changed. The raw value range for POSITIVE_5V_RAIL_CURRENT changed.
		TELEMETRY (SpW)	Table 24. NMTM2861, NMTM2731 parameter description changed to LED control (previously called ADC range)

		TELEMETRY (1553)	Table 17+18. Examples of raw and calculated value ranges added. The transfer function corrected for temperature of the sensor 1 through 3 and the AOTF. Additional footnote added.
1,8	February 15th 2015	TELEMETRY (1553)	Table 2. Transfer functions updated after calibrations on SINBAD PFM. The current units changed to A (previously mA). The parameter names ADC_1_REFERENCE_VOLTAGE and ADC_2_REFERENCE_VOLTAGE level changed to 3.3 V (previously 2.4 V). The description column also changed for these 2 parameters (3.38 V vs. 2.4 V previously). Examples of raw and calculated values added.
		FILE_SYSTEM	context file (table 3): LNO TEMPERATURE AND DATA CONTINGENCY SUPERVISORS "block" changed to LNO TEMPERATURE, DATA AND FLIP MIRROR CONTINGENCY SUPERVISORS. Within this block spare parameter (3 bits) was removed and 3 new parameters related to flip mirror (1 bit each) are inserted. SFS "block" moved to the end of the context file and within this block parameter STEPPER_MAX_STEP_CONTIGENCY_INCREMENT was added.
		TELEMETRY (SpW)	Footnote (e) added for parameter NMTM2890 "UVIS_SCIENCE_DATA". Also general footnote (f) added about UVIS science packet. TM(28) contains first the "Copy of COP rows", then the "UVIS HSK parameters". Previously this was inversed and has now been corrected.
1,9	1st of March 2015	TELEMETRY (1553)	Table 2: the SO/LNO/UVIS temperatures reshifted within the table because 3 temperature readings were mixed-up/inverted (previously SO,LNO,UVIS. Now, LNO,UVIS,SO) on SINBAD side. Also transfer function is updated to get more precise values. Table 9: LAST_CONTINGENCY_CODE description added. Table 1: event code 140 (IS_FILE_SYSTEM explained). event code 10 (force_heater_status explained). event code 130 (WATCHDOG_ERROR explained). event code 131 (SENSOR_INDEX explained and table 26 added). Table 26 "SENSOR INDEX" added. Table 22 updated: code 255 added, code 25 explained that it will never be used. Table 23 completly updated. Table 27 "FILE MANAGER OPERATIONS REPORT" added. TM(34): CHECK_COUNT parameter. (1…7)
		FILE_SYSTEM	"BOOT DATA FILE"-table updated "FILES IN FILE SYSTEM"-table file_ID:19,20,..255 changed to 19,20,..254 "CONTEXT FILE"-table: UVIS_OVER_CURRENT changed to spare Prom data (from EEPROM) typical values added SINBAD flight model memory map added.
		TELEMETRY (SpW)	TM(22)(25) CHANNEL_ID and FLIP_MIRROR_INFO parameters explained. Footnote (a): extra info added. System log TM(60): 60' changed to 10'
		TELECOMMANDS	TC(35)-create empty file. The parameter BYTE_SIZE changed to MAX_BYTE_SIZE. Check memory type changed to 33 (previously 32, long lasting typo that nobody spotted…)
2.0	1st of March 2015	none	final release of document
2.1	10th of March 2015	TELEMETRY (1553)	footnote (c) added: linear approximation to be used for NMHK2618 and NMHK2318 (table 17 and table 18)
2.2	12th of March 2015	FILE_SYSTEM	Names of heater temperature parameters in context file updated to: heater_so_low_code, heater_so_high_code, heater_lno_low_code, heater_lno_high_code, heater_uvis_low_code, heater_uvis_high_code
2,3	26th of March 2015	TELEMETRY (1553)	Table 14 and 16: The parameter names for NMHK1344 and NMHK1364 changed to PACKET_DISCARDED_COUNT instead of WRITE_SYNC_ERROR Table 17 and 18: The footnote (c) is removed. We are using now full 4th order polynominal.
2.4	14th of April 2015	FILE_SYSTEM	Table 3. Names of parameters in context file (SINBAD SENSOR LIMITS block) updated to: LNO_DETECTOR_LOW_COUNT_TEMPERATURE, LNO_DETECTOR_HIGH_COUNT_TEMPERATURE, SO_LOW_COUNT_TEMPERATURE, SO_HIGH_COUNT_TEMPERATURE, LNO_LOW_COUNT_TEMPERATURE, LNO_HIGH_COUNT_TEMPERATURE, UVIS_LOW_COUNT_TEMPERATURE, UVIS_HIGH_COUNT_TEMPERATURE
2.5	5th of May	TELEMETRY (1553)	Table 2. NMHK1117 HEATER_CURRENT transfer function changed.

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This document contains the Data Operations Handbook of NOMAD

* sheet "TELECOMMANDS" : all telecommands including their parameters
* sheet "TELEMETRY (1553)" : all 1553 bus telemetry including their parameters
* sheet "TELEMETRY (SpW)" : all spacewire bus telemetry including their parameters
* sheet "PACKET FORMATS" : the structure of telecommands and 1553 + spacewire telemetry packets
* sheet "FILE SYSTEM" : some useful info on the SINBAD file system

Applicable and reference documents

RD01	EXM-NO-REP-IAA-00002 - NOMAD Software Architecture and Design Document
RD02	EXM-NO-TNO-AER-00022-issxrevx-TMTCStrategy - TC and TM Strategy for SO and LNO
RD03	EXM-NO-TNO-OPU-00010 - TC and TM Strategy for UVIS

Telecommands (always via 1553)

code	name	1553 subaddress	function	sub-function	timing	structure						telemetry generated
						type	packet size	data			checksum	blue = 1553 red = SpaceWire
						1 byte	3 bytes	data code	data length	data name	2 bytes	
NMTC2000	TC(20)	9	start operation	N/A	async	20	44	NMTC2001	2 bytes	SO_START_TIME	CC	TM(22), TM(23), TM(25), TM(26), TM(27), TM(28)
								NMTC2002	2 bytes	SO_START_SCIENCE_1		TM(29) (every 30 s via 1553)
								NMTC2003	2 bytes	SO_START_SCIENCE_2		TM(29) (every 1 s via SpW for solar occ)
								NMTC2004	1 byte	SO_DURATION_REFERENCE_1		TM(29) (every 15 sec via SpW for nadir)
								NMTC2005	1 byte	SO_DURATION_REFERENCE_2		
								NMTC2006	2 bytes	SO_DURATION_TIME		
								NMTC2007	1 byte	SO_COP_GENERAL		
								NMTC2008	1 byte	SO_COP_PRECOOLING		
								NMTC2009	2 bytes	SO_COP_SCIENCE_1		
								NMTC2010	2 bytes	SO_COP_SCIENCE_2		
								NMTC2011	2 bytes	UNO_START_TIME		
								NMTC2012	2 bytes	UNO_START_SCIENCE_1		
								NMTC2013	2 bytes	UNO_START_SCIENCE_2		
								NMTC2014	1 byte	UNO_DURATION_REFERENCE_1		
								NMTC2015	1 byte	UNO_DURATION_REFERENCE_2		
								NMTC2016	2 bytes	UNO_DURATION_TIME		
								NMTC2017	1 byte	UNO_COP_GENERAL		
								NMTC2018	1 byte	UNO_COP_PRECOOLING		
								NMTC2019	2 bytes	UNO_COP_SCIENCE_1		
								NMTC2020	2 bytes	UNO_COP_SCIENCE_2		
								NMTC2021	2 bytes	UVIS_START_TIME		
								NMTC2022	2 bytes	UVIS_DURATION_TIME		
								NMTC2023	2 bytes	UVIS_COP_ROW		
NMTC3000	TC(30)	10	patch memory	N/A	async	30	min = 13 max = 64	NMTC3001	1 byte	PATCH_COUNT = c = 1 ... 9	CC	none
								NMTC3002	4 bytes	PATCH_ADDRESS_A1		
								NMTC3003	1 byte	PATCH_SIZE_S1 = N1 = 1 ... 52		
								NMTC3004	N1 bytes	PATCH_DATA_D1		
								...	...	...		
								NMTC30xx	4 bytes	PATCH_ADDRESS_Ac		
								NMTC30xx	1 byte	PATCH_SIZE_Sc = Nc = 1 ... 52		
								NMTC30xx	Nc bytes	PATCH_DATA_Dc		
NMTC3100	TC(31)	11	dump memory	N/A	async	31	11	NMTC3101	4 bytes	DUMP_ADDRESS	CC	TM(32)
								NMTC3102	1 byte	DUMP_SIZE = N = 1 ... 53		
NMTC3300	TC(33)	13	check memory	N/A	async	33	min = 13 max = 49	NMTC3301	1 byte	CHECK_COUNT = c = 1 ... 7	CC	TM(34)
								NMTC3302	4 bytes	CHECK_ADDRESS_A1		
								NMTC3303	2 bytes	CHECK_SIZE_C1 = N1 = 1 ... 1023		
								...	...	...		
								NMTC33xx	4 bytes	CHECK_ADDRESS_Ac		
								NMTC33xx	2 bytes	CHECK_SIZE_Sc = Nc = 1 ... 1023		
NMTC3500	TC(35)	15	file manager operation	append to file	async	35	min = 10 max = 64	NMTC3501	1 byte	OPERATION_CODE = 10	CC	TM(36) if SEND_REPORT = 1
								NMTC3502	1 byte	FILE_ID		
								NMTC3503	1 byte	(1 bit) SEND_REPORT		
								NMTC3504		(7 bits) BYTE_SIZE = N = 1 ... 55		
								NMTC3505	N bytes	PATCH_BYTES		
				update file	async	35	min = 14 max = 64	NMTC3501	1 byte	OPERATION_CODE = 11	CC	TM(36) if SEND_REPORT = 1
								NMTC3506	1 byte	FILE_ID		
								NMTC3507	4 bytes	RELATIVE_OFFSET		
								NMTC3508	1 byte	(1 bit) SEND_REPORT		
								NMTC3509		(7 bits) BYTE_SIZE = N = 1 ... 51		
								NMTC3510	N bytes	PATCH_BYTES		
				update column file	async	35	min = 18 max = 64	NMTC3501	1 byte	OPERATION_CODE = 12	CC	TM(36)
								NMTC3511	1 byte	FILE_ID		
								NMTC3512	2 bytes	ROW_BYTE_SIZE		
								NMTC3513	2 bytes	START_ROW		
								NMTC3514	2 bytes	END_ROW		
								NMTC3515	2 bytes	START_COLUMN		
								NMTC3516	1 byte	BYTE_SIZE = N = 1 ... 47		
								NMTC3517	N bytes	PATCH_BYTES		
				copy entire file	async	35	9	NMTC3501	1 byte	OPERATION_CODE = 13	CC	TM(36)
								NMTC3518	1 byte	FILE_ID_SOURCE		
								NMTC3519	1 byte	FILE_ID_DESTINATION		
				copy partial file	async	35	21	NMTC3501	1 byte	OPERATION_CODE = 14	CC	TM(36)
								NMTC3520	1 byte	FILE_ID_SOURCE		
								NMTC3521	4 bytes	SOURCE_RELATIVE_OFFSET		
								NMTC3522	4 bytes	SOURCE_BYTE_SIZE		
								NMTC3523	1 byte	FILE_ID_DESTINATION		
								NMTC3524	4 bytes	DESTINATION_RELATIVE_OFFSET		
				fill file with memory area	async	35	17	NMTC3501	1 byte	OPERATION_CODE = 15	CC	TM(36)
								NMTC3525	1 byte	FILE_ID		
								NMTC3526	1 byte	COMPRESSION_ALGORITHM (d)		
								NMTC3527	4 bytes	SOURCE_ADDRESS		
								NMTC3528	4 bytes	SOURCE_BYTE_SIZE		
				create empty file	async	35	43	NMTC3501	1 byte	OPERATION_CODE = 20	CC	TM(36)
								NMTC3529	4 bytes	MAX_BYTE_SIZE		
								NMTC3530	32 bytes	FILE_NAME		
				delete last file	async	35	7	NMTC3501	1 byte	OPERATION_CODE = 21	CC	TM(36)
				erase file content	async	35	8	NMTC3501	1 byte	OPERATION_CODE = 22	CC	TM(36)
								NMTC3531	1 byte	FILE_ID		
				reset file system	async	35	7	NMTC3501	1 byte	OPERATION_CODE = 30	CC	TM(36)
				decompress file	async	35	17	NMTC3501	1 byte	OPERATION_CODE = 31	CC	TM(36)
								NMTC3532	1 byte	FILE_ID_SOURCE		
								NMTC3533	1 byte	FILE_ID_DESTINATION		
								NMTC3534	4 bytes	DESTINATION_RELATIVE_OFFSET		
								NMTC3535	4 bytes	UNCOMPRESSED_SIZE		
				download compressed file	async	35	8	NMTC3501	1 byte	OPERATION_CODE = 40	CC	TM(36), TM(37)
								NMTC3536	1 byte	FILE_ID		
				print file status	async	35	8	NMTC3501	1 byte	OPERATION_CODE = 41	CC	TM(36)
								NMTC3537	1 byte	FILE_ID		
				print full status	async	35	7	NMTC3501	1 byte	OPERATION_CODE = 42	CC	TM(36)
				print file system status	async	35	7	NMTC3501	1 byte	OPERATION_CODE = 43	CC	TM(36)
NMTC4000	TC(40)	19	safe mode	N/A	async	40	6	N/A	N/A	N/A	CC	TM(10)
NMTC5000	TC(50)	20	ready to power off	N/A	async	50	6	N/A	N/A	N/A	CC	TM(10)
NMTC7000	TC(70) (c)	21	custom command	enable forced powering of ops heaters	async	70	7	NMTC7001	1 byte	OPERATION_CODE = 1	CC	TM(10) (except in EIM) Poland
				disable forced powering of ops heaters	async	70	7	NMTC7001	1 byte	OPERATION_CODE = 2	CC	TM(10) (except in EIM) Poland
				flip mirror to nadir position	async	70	11	NMTC7001	1 byte	OPERATION_CODE = 10	CC	TM(10) Poland
								NMTC7002	1 byte	STEPPER_SPEED		
								NMTC7003	2 bytes	MAX_STEP_NUMBER		
								NMTC7004	1 byte (b)	(1 bit) LS_NADIR_NOMINAL_ENABLING (a)		
								NMTC7005		(1 bit) LS_NADIR_OVERSHOOT_ENABLING (a)		
								NMTC7006		(1 bit) LS_SOLAR_NOMINAL_ENABLING (a)		
								NMTC7007		(1 bit) LS_SOLAR_OVERSHOOT_ENABLING (a)		
				flip mirror to solar position	async	70	11	NMTC7001	1 byte	OPERATION_CODE = 11	CC	TM(10) Poland
								NMTC7002	1 byte	STEPPER_SPEED		
								NMTC7003	2 bytes	MAX_STEP_NUMBER		
								NMTC7004	1 byte (b)	(1 bit) LS_NADIR_NOMINAL_ENABLING (a)		
								NMTC7005		(1 bit) LS_NADIR_OVERSHOOT_ENABLING (a)		
								NMTC7006		(1 bit) LS_SOLAR_NOMINAL_ENABLING (a)		
								NMTC7007		(1 bit) LS_SOLAR_OVERSHOOT_ENABLING (a)		

				flip mirror to launch position	async	70	11	NMTC7001	1 byte	OPERATION_CODE = 12	CC	TM(10)
								NMTC7002	1 byte	STEPPER_SPEED		
								NMTC7003	2 bytes	MAX_STEP_NUMBER		
								NMTC7004	1 byte (b)	1 bit) LS_NADIR_NOMINAL_ENABLING (a)		
								NMTC7005		1 bit) LS_NADIR_OVERSHOOT_ENABLING (a)		
								NMTC7006		1 bit) LS_SOLAR_NOMINAL_ENABLING (a)		
								NMTC7007		1 bit) LS_SOLAR_OVERSHOOT_ENABLING (a)		
				arm pin puller (step 1)	async	70	7	NMTC7001	1 byte	OPERATION_CODE = 20	CC	"arm pin puller" and "fire pin puller" to be seen as 1 command (in 2 steps) TM(10) (event = "pinpuller fired" if arm+fire successful, event = "pinpuller disarmed" if arm not followed by fire within 30 s)
				fire pin puller (step 2)	async	70	7	NMTC7001	1 byte	OPERATION_CODE = 21	CC	arm pin puller and "fire pin puller" to be seen as 1 command (in 2 steps) TM(10) (event = "pinpuller fired" if arm+fire successful, event = "pinpuller disarmed" if arm not followed by fire within 30 s)

(a) "0" to enable the limit switch (LS), "1" to disable the limit switch (LS)

(b) this bytes contains 4 spare bits (at MSB side) and 4 significant bits (at LSB side)

(c) additional TC(70) exist with OPERATION_CODE = 100, 101 and 102 for laboratory tests (direct commanding of SO channel). These are not implemented in deliverable models

(d) possible values for COMPRESSION_ALGORYTHM: 0x12 (no compression), 0x56 (MKPROM compression), 0xF9 (ZUB compression)

Telemetry via 1553

code	name	1553 subaddress	function	timing	structure							
					type	packet size	timestamp	TM count	data			checksum
					1 byte	3 bytes	8 bytes	2 bytes	code	data length	name	2 bytes
NMHK1000	TM(10)	22	event	async (30") (b)	10	21	NMHK1001	NMHK1002	NMHK1010	1 byte	EVENT_CODE	CC
									see table 1	4 bytes	EVENT PARAMETER	
NMHK1100	TM(11)	5	NOMAD HK 1	sync (30")	11	53	NMHK1101	NMHK1102	see table 2	32 bytes	SINBAD_SENSORS	CC
									see table 3	1 byte	ADC_1_SENSOR_SUPERVISOR	
									see table 4	1 byte	ADC_2_SENSOR_SUPERVISOR	
									see table 5	1 byte	HEATER_SUPERVISOR	
									see table 6	1 byte	NOMAD_POWER_STATUS	
									see table 7	1 byte	NOMAD_FLIP_MIRROR_STATUS	
NMHK1200	TM(12)	6	NOMAD HK 2	sync (30")	12	39	NMHK1201	NMHK1202	see table 8	1 byte	OPERATIONAL_MODE	CC
									see table 9	11 bytes	CONTINGENCIES	
									see table 10	11 bytes	EVENTS	
NMHK1300	TM(13)	7	NOMAD HK 3	sync (30")	13	54	NMHK1301	NMHK1302	see table 11	4 bytes	1553_BUS	CC
									see table 12	4 bytes	SPACE_WIRE	
									see table 13	1 byte	MAIN_CHANNEL	
									see table 14	14 bytes	STATISTICS_MAIN	
									see table 15	1 byte	REDUNDANT_CHANNEL	
									see table 16	14 bytes	STATISTICS_REDUNDANT	
NMHK2300	TM(23)	2	SO HK	sync (30") (a)	23	50	NMHK2301	NMHK2302	see table 17	34 bytes	SO_HOUSEKEEPING	CC
NMHK2600	TM(26)	3	LNO HK	sync (30") (a)	26	50	NMHK2601	NMHK2602	see table 18	34 bytes	LNO_HOUSEKEEPING	CC
NMHK2900	TM(29)	4	UVIS HK	sync (30") (a)	29	58	NMHK2901	NMHK2902	see table 19	42 bytes	UVIS_HOUSEKEEPING	CC
NMHK3200	TM(32)	12	dump memory report	async (30") (b)	32	min = 12 max = 64			NMHK3201	4 bytes	DUMP_ADDRESS	CC
									NMHK3202	1 byte	DUMP_SIZE = N = 1 ... 53	
									NMHK3203	N bytes	DUMP_DATA	
NMHK3400	TM(34)	14	check memory report	async (30") (b)	34	min = 15 max = 63			NMHK3401	1 byte	CHECK_COUNT (1...7)	CC
									NMHK3402	4 bytes	CHECK_ADDRESS_A1	
									NMHK3403	2 bytes	CHECK_SIZE_S1	
									NMHK3404	2 bytes	CHECK_DATA_D1	
									...	...	...	
									NMHK34xx	4 bytes	CHECK_ADDRESS_Ac (c = 1 ... 7)	
									NMHK34xx	2 bytes	CHECK_SIZE_Sc (c = 1 ... 7)	
									NMHK34xx	2 bytes	CHECK_DATA_Dc (c = 1 ... 7)	
NMHK3600	TM(36)	16	file manager operation report (see table 27)	async (30") (b)	36	22			NMHK3601	1 byte	OPERATION_CODE	CC
									NMHK3602	4 bytes	OPERATION_SEQUENCE_COUNT	
									NMHK3603	4 bytes	RESULT_CODE (see table 23)	
									NMHK3604	1 byte	FILE_ID	
									NMHK3605	4 bytes	BYTE_SIZE	
									NMHK3606	2 bytes	CHECKSUM	

(a) if channel is switched on

(b) created asynchronously - transmitted at 30 sec clock tick

Table 1. EVENT_PARAMETER

Sub function (event type)	EVENT_CODE		EVENT_BYTE_1			EVENT_BYTE_2			EVENT_BYTE_3			
	code	value	code	length	name	code	length	name	code	length	name	code
INFORMATION												
NOMAD in safe mode	NMHK1010	1										
NOMAD in observing mode		2										
boot loader run count		3	NMHK1090	4 bytes	RUN_COUNT							
system log TM(60) generated		4										
flip mirror to default position (nadir)		5	NMHK1011	1 byte	(4 bits) spare	NMHK1013	1 byte	(4 bits) spare	NMHK1015	2 bytes	STEPS_COUNTER	
			NMHK1012		(4 bits) LS_STATUS (c) (table 20)	NMHK1014		(4 bits) LS_ENABLING (d) (table 21)				
flip mirror to contingency position (solar)		6	NMHK1016	1 byte	(4 bits) spare	NMHK1018	1 byte	(4 bits) spare	NMHK1020	2 bytes	STEPS_COUNTER	
			NMHK1017		(4 bits) LS_STATUS (c) (table 20)	NMHK1019		(4 bits) LS_ENABLING (d) (table 21)				
flip mirror to launch position		7	NMHK1021	1 byte	(4 bits) spare	NMHK1023	1 byte	(4 bits) spare	NMHK1025	2 bytes	STEPS_COUNTER	
			NMHK1022		(4 bits) LS_STATUS (c) (table 20)	NMHK1024		(4 bits) LS_ENABLING (d) (table 21)				
sinpuller fired		8										
end of measurement cycle		9										
force heater operation		10	NMHK1026	3 bytes	spare							NMHK1027
												NMHK1028
ERRORS												
SpW error: error sending data	NMHK1010	100										
SpW error: main channel error		101										
SpW error: redundant channel error		102										
TC rejected: error in bytesize		110	NMHK1092	1 byte	spare	NMHK1093	3 bytes	WRONG_TC_SIZE				
TC rejected: error in checksum		111	NMHK1094	2 bytes	spare				NMHK1095	2 bytes	WRONG_CHECKSUM_TYPE	
TC rejected: unknown TC		112	NMHK1096	3 bytes	spare							NMHK1097
TC rejected: error in parameters		113	NMHK1032	3 bytes	spare							NMHK1033
TC not allowed in safe mode		114	NMHK1034	3 bytes	spare							NMHK1035
TC not allowed in observing mode		115	NMHK1036	3 bytes	spare							NMHK1037
flip mirror: max number of steps taken		120	NMHK1056	1 byte	(4 bits) spare	NMHK1058	1 byte	(4 bits) spare	NMHK1060	2 bytes	STEPS_COUNTER	
			NMHK1057		(4 bits) LS_STATUS (c) (table 20)	NMHK1059		(4 bits) LS_ENABLING (d) (table 21)				
flip mirror: already in commanded position		121	NMHK1041	1 byte	(4 bits) spare	NMHK1043	1 byte	(4 bits) spare	NMHK1045	2 bytes	STEPS_COUNTER	
			NMHK1042		(4 bits) LS_STATUS (c) (table 20)	NMHK1044		(4 bits) LS_ENABLING (d) (table 21)				
flip mirror: to default position - error limit switch (e)		122	NMHK1046	1 byte	(4 bits) spare	NMHK1048	1 byte	(4 bits) spare	NMHK1050	2 bytes	STEPS_COUNTER	
			NMHK1047		(4 bits) LS_STATUS (c) (table 20)	NMHK1049		(4 bits) LS_ENABLING (d) (table 21)				
flip mirror: to contingency position - error limit switch (f)		123	NMHK1051	1 byte	(4 bits) spare	NMHK1053	1 byte	(4 bits) spare	NMHK1055	2 bytes	STEPS_COUNTER	
			NMHK1052		(4 bits) LS_STATUS (c) (table 20)	NMHK1054		(4 bits) LS_ENABLING (d) (table 21)				
pin puller disarmed - no firing command received		124										
system reboot by watchdog		130	NMHK1099	3 bytes	spare							NMHK1061
sensor out of range		131	NMHK1070	3 bytes	spare							NMHK1071
contingency detected		132	NMHK1080	3 bytes	spare							NMHK1081
file system error		140	NMHK1083	1 byte	(7 bits) spare	NMHK1085	1 byte	FILE_ID	NMHK1086	2 bytes	CURRENT_CHECKSUM	
			NMHK1084		(1 bit) IS_FILE_SYSTEM (0 = is a file, 1= is file system)							

(c) "0" if limit switch (LS) is pressed, "1" if limit switch (LS) is not pressed

(d) "0" if limit switch (LS) is enabled "1" if limit switch (LS) is disabled

(e) when "LS nadir nominal switch enabled but not pressed" OR "LS nadir nominal switch disabled while LS nadir overshoot enabled switch and not pressed"

(f) when "LS solar nominal switch enabled but not pressed" OR "LS solar nominal switch disabled while LS solar overshoot enabled switch and not pressed"

Table 2. SINBAD_SENSORS

code	parameter name	transfer function	size (bits)	description
NMHK1103	DC_DC_MODULE_TEMPERATURE	real_val (°C) = 0.1362*code - 273.2	16	temperature of DC/DC module
NMHK1104	POWER_BOARD_TEMPERATURE	real_val (°C) = 0.1362*code - 273.2	16	temperature of POW board
NMHK1105	LNO_DETECTOR_TEMPERATURE	real_val (°C) = -0.0721*code + 99.702	16	temperature of LNO cold section
NMHK1106	LNO_TEMPERATURE	real_val (°C) = -4.7346538E-09*code*code*code + 3.1940866E-05*code*code - 0.093183624*code + 121.48852	16	temperature of LNO
NMHK1107	UVIS_TEMPERATURE	real_val (°C) = -4.7346538E-09*code*code*code + 3.1940866E-05*code*code - 0.093183624*code + 121.48852	16	temperature of UVIS
NMHK1108	SO_TEMPERATURE	real_val (°C) = -4.7346538E-09*code*code*code + 3.1940866E-05*code*code - 0.093183624*code + 121.48852	16	temperature of SO
NMHK1109	ADC_1_REFERENCE_VOLTAGE_0_V	real_val (V) = code*(5/4095)	16	reference voltage 0 V for ADC1
NMHK1110	ADC_1_REFERENCE_VOLTAGE_3_3_V	real_val (V) = code*(5/4095)	16	reference voltage 3.38 V for ADC1
NMHK1111	SO_VOLTAGE	real_val (V) = 0.0105*code - 0.116	16	voltage for SO
NMHK1112	LNO_VOLTAGE	real_val (V) = 0.0107*code - 0.1282	16	voltage for LNO
NMHK1113	UVIS_VOLTAGE	real_val (V) = 0.0106*code - 0.117	16	voltage for UVIS
NMHK1114	SO_CURRENT	real_val (A) = 0.0003*code - 0.0413	16	current of SO

NMHK1115	LNO_CURRENT	real_val (A) = 0.0003*code - 0.0511	16	current of LNO
NMHK1116	UVIS_CURRENT	real_val (A) = 4E-05*code - 0.0111	16	current of UVIS
NMHK1117	HEATER_CURRENT	real_val (A) =0.00013825*code - 0.0147	16	current op operational heaters
NMHK1118	ADC_2_REFERENCE_VOLTAGE_3_3_V	real_val (V) = code*(5/4095)	16	reference voltage 3.38 V for ADC2

Table 3. ADC_1_SENSOR_SUPERVISOR

code	parameter name	transfer function	size (bits)	description
NMHK1120	NMHK1121 SPARE	N/A	2	spare
	NMHK1122 DC_DC_MODULE_TEMPERATURE_SUPERVISOR	N/A	1	supervisor of status of DC/DC module temperature (0=n
	NMHK1123 POWER_BOARD_TEMPERATURE_SUPERVISOR	N/A	1	supervisor of status of POW board temperature (0=off,
	NMHL1124 LNO_DETECTOR_TEMPERATURE_SUPERVISOR	N/A	1	supervisor of status of LNO cold section temperature (0
	NMHK1125 SO_TEMPERATURE_SUPERVISOR	N/A	1	supervisor of status of SO temperature (0=off, 1=on)
	NMHK1126 LNO_TEMPERATURE_SUPERVISOR	N/A	1	supervisor of status of LNO temperature (0=off, 1=on)
	NMHK1127 UVIS_TEMPERATURE_SUPERVISOR	N/A	1	supervisor of status of UVIS temperature (0=off, 1=on)

Table 4. ADC_2_SENSOR_SUPERVISOR

code	parameter name	transfer function	size (bits)	description
NMHK1130	NMHK1131 SPARE	N/A	1	spare
	NMHK1132 SO_VOLTAGE_SUPERVISOR	N/A	1	supervisor of status of SO voltage (0=off, 1=on)
	NMHK1133 LNO_VOLTAGE_SUPERVISOR	N/A	1	supervisor of status of LNO voltage (0=off, 1=on)
	NMHK1134 UVIS_VOLTAGE_SUPERVISOR	N/A	1	supervisor of status of UVIS voltage (0=off, 1=on)
	NMHK1135 SO_CURRENT_SUPERVISOR	N/A	1	supervisor of status of SO current (0=off, 1=on)
	NMHK1136 LNO_CURRENT_SUPERVISOR	N/A	1	supervisor of status of LNO current (0=off, 1=on)
	NMHK1137 UVIS_CURRENT_SUPERVISOR	N/A	1	supervisor of status of UVIS current (0=off, 1=on)
	NMHK1138 HEATER_CURRENT_SUPERVISOR	N/A	1	supervisor of status of heater current (0=off, 1=on)

Table 5. HEATER_SUPERVISOR

code	parameter name	transfer function	size (bits)	description
NMHK1160	NMHK1161 SPARE	N/A	4	spare
	NMHK1162 HEATER_CONTROL_SUPERVISOR	N/A	1	supervisor of heater control (0=off, 1=on)
	NMHK1163 HEATER_SO_TEMPERATURE_SUPERVISOR	N/A	1	supervisor of SO heater temperature (0=off, 1=on)
	NMHK1164 HEATER_LNO_TEMPERATURE_SUPERVISOR	N/A	1	supervisor of LNO heater temperature (0=off, 1=on)
	NMHK1165 HEATER_UVIS_TEMPERATURE_SUPERVISOR	N/A	1	supervisor of UVIS heater temperature (0=off, 1=on)

Table 6. NOMAD_POWER_STATUS

code	parameter name	transfer function	size (bits)	description
NMHK1140	NMHK1141 SPARE	N/A	2	spare
	NMHK1142 OPERATIONAL_HEATER_POWER_STATUS	N/A	1	heater power status (0=off, 1=on)
	NMHK1143 SO_POWER_STATUS	N/A	1	SO power status (0=off, 1=on)
	NMHK1144 LNO_POWER_STATUS	N/A	1	LNO power status (0=off, 1=on)
	NMHK1145 UVIS_POWER_STATUS	N/A	1	UVIS power status (0=off, 1=on)
	NMHK1146 SINBAD_POWER_LINE_REDUNDANT_STATUS	N/A	1	SINBAD power line redundant status (0=off, 1=on)
	NMHK1147 SINBAD_POWER_LINE_MAIN_STATUS	N/A	1	SINBAD power line main status (0=off, 1=on)

Table 7. NOMAD_FLIP_MIRROR_STATUS

code	parameter name	transfer function	size (bits)	description
NMHK1150	NMHK1151 SPARE	N/A	4	spare
	NMHK1152 STEPPER_LIMIT_SWITCH_NADIR_NOMINAL_STATUS	N/A	1	limit switch nadir nominal status (0=pressed, 1=not pre
	NMHK1153 STEPPER_LIMIT_SWITCH_NADIR_OVERSHOOT_STATUS	N/A	1	limit switch nadir overshoot status (0=pressed, 1=not p
	NMHK1154 STEPPER_LIMIT_SWITCH_SOLAR_NOMINAL_STATUS	N/A	1	limit switch solar nominal status (0=pressed, 1=not pre
	NMHK1155 STEPPER_LIMIT_SWITCH_SOLAR_OVERSHOOT_STATUS	N/A	1	limit switch solar overshoot status (0=pressed, 1=not p

Table 8. OPERATIONAL_MODE

code	parameter name	transfer function	size (bits)	description
NMHK1210	CURRENT_OPERATIONAL_MODE	N/A	8	operational mode (87=safe mode, 165=science mode)

Table 9. CONTINGENCIES

code	parameter name	transfer function	size (bits)	description
NMHK1220	CONTINGENCY_COUNT	N/A	16	contingency count
NMHK1221	LAST_CONTINGENCY_SECONDS	sinbad_seconds	32	last contingency seconds
NMHK1222	LAST_CONTINGENCY_MICRO_SECONDS	sinbad_micro_seconds	32	last contingency microseconds
NMHK1223	LAST_CONTINGENCY_CODE	N/A	8	last contingency code (255=no value, other value = contigency code)

Table 10. EVENTS

code	parameter name	transfer function	size (bits)	description
NMHK1230	EVENT_COUNT	N/A	16	event count
NMHK1231	LAST_EVENT_SECONDS	sinbad_seconds	32	last event seconds
NMHK1232	LAST_EVENT_MICRO_SECONDS	sinbad_micro_seconds	32	last event microseconds
NMHK1233	LAST_EVENT_CODE	N/A	8	last event code

Table 11. 1553_BUS

code	parameter name	transfer function	size (bits)	description
NMHK1310	BUS_1553_SENT_BYTE	N/A	32	bytes sent over 1553 bus

Table 12. SPACE_WIRE

code	parameter name	transfer function	size (bits)	description
NMHK1320	SPACE_WIRE_SENT_BYTE	N/A	32	bytes sent over SpaceWire

Table 13. SPACE_WIRE_MAIN_CHANNEL

code	parameter name	transfer function	size (bits)	description
NMHK1330	SPW_STATUS_MAIN	N/A	8	possible values: error_reset (0), error_wait (1), ready (2), started (3), connecting (4), running (5), uninitialized (14)

Table 14. SPACE_WIRE_STATISTICS_MAIN

code	parameter name	transfer function	size (bits)	description
NMHK1340	LINK_ERROR_MAIN	N/A	16	transmission link error main channel
NMHK1341	PARITY_ERROR_MAIN	N/A	16	parity error main channel
NMHK1342	ESCAPE_ERROR_MAIN	N/A	16	escape error main channel
NMHK1343	CREDIT_ERROR_MAIN	N/A	16	credit error main channel
NMHK1344	PACKET_DISCARDED_COUNT_MAIN	N/A	16	number of discarded packets due to AMBA errors in spw main channel
NMHK1345	DISCONNECT_ERROR_MAIN	N/A	16	disconnect error main channel
NMHK1346	PACKET_SENT_COUNT_MAIN	N/A	16	number of packets sent on main channel

Table 15. SPACE_WIRE_REDUNDANT_CHANNEL

code	parameter name	transfer function	size (bits)	description
NMHK1350	SPW_STATUS_REDUNDANT	N/A	8	possible values: error_reset (0), error_wait (1), ready (2), started (3), connecting (4), running (5), uninitialized (14)

Table 16. SPACE_WIRE_STATISTICS_REDUNDANT

code	parameter name	transfer function	size (bits)	description
NMHK1360	SX_LINK_ERROR_REDUNDANT	N/A	16	Transmission link error redundant channel
NMHK1361	PARITY_ERROR_REDUNDANT	N/A	16	parity error redundant channel
NMHK1362	ESCAPE_ERROR_REDUNDANT	N/A	16	escape error redundant channel
NMHK1363	CREDIT_ERROR_REDUNDANT	N/A	16	credit error redundant channel
NMHK1364	PACKET_DISCARDED_COUNT_REDUNDANT	N/A	16	Number of discared packets due to AMBA errors on spw_redundant_channel
NMHK1365	DISCONNECT_ERROR_REDUNDANT	N/A	16	Disconnect error redundant channel
NMHK1366	PACKET_SENT_COUNT_REDUNDANT	N/A	16	Number of packets sent on redundant channel

Table 17. SO HOUSEKEEPING

code	parameter name	transfer function (a)	size (bits)	description
NMHK2310	POSITIVE_12_V_MEASURED_ON_SO_CCC	real_val (V) =code*(3/8192)*(47+12)/12	16	12 V measured on CCC board of SO
NMHK2311	NEGATIVE_12_V_MEASURED_ON_SO_CCC	real_val (V) =code*(3/8192)*(47+12)/12	16	-12 V measured on CCC board of SO
NMHK2312	POSITIVE_8_5_V_MEASURED_ON_SO_HSK	real_val (V) = code*(3/8192)*(33.2+10)/10	16	8.5 V measured on HSK board of SO
NMHK2313	NEGATIVE_8_5_V_MEASURED_ON_SO_HSK	real_val (V) = code*(3/8192)*(33.2+10)/10	16	-8.5 V measured on HSK board of SO
NMHK2314	POSITIVE_3_3_V_MEASURED_ON_SO_CCC	real_val (V) = code*(3/8192)*(2.5+10)/10	16	3.3 V measured on CCC board of SO
NMHK2315	POITIVE_2_5_V_MEASURED_ON_SO_CCC	real_val (V) = code*(3/8192)	16	2.5 V measured on CCC board of SO
NMHK2316	POSITIVE_5_V_MEASURED_ON_SO_HSK	real_val (V) = code*(3/8192)*(10+10)/10	16	5 V measured on HSK board of SO
NMHK2317	NEGATIVE_5_V_MEASURED_ON_SO_HSK	real_val (V) = code*(3/8192)*(10+10)/10	16	-5 V measured on HSK board of SO
NMHK2318	FPA_1_FULL_SCALE_TEMPERATURE_SO	x=code*(3/8192)*(10/29.1) real_val (°K) =- 460,66*x^6+x^5+1053,2*x^4-x^3- 813,45*x^2+ 227,36*x+539,7	16	SO focal plane array full scale temperture
NMHK2319	FPA_2_ZOOMED_TEMPERATURE_SO	real_val (V) = code*(3/8192)	16	SO focal plane array zoomed temperature
NMHK2320	SENSOR_1_TEMPERATURE_SO	real_val (°C) = (code*(3*1000/8192)+3/11)/51	16	temperature sensor 1 near SO AOTF housing
NMHK2321	SENSOR_2_TEMPERATURE_SO	real_val (°C) = (code*(3*1000/8192)+3/11)/51	16	temperature sensor 2 near SO grating structure
NMHK2322	SENSOR_3_TEMPERATURE_SO	real_val (°C) = (code*(3*1000/8192)+3/11)/51	16	temperature sensor 3 near SO detector structure
NMHK2323	AOTF_TEMPERATURE_SO	real_val (°C) = (code*(3*1000/8192)+3/11)/51	16	temperature inside SO AOTF box
NMHK2324	RF_AMPLITUDE_SO	real_val (V) = code*(3/8192)	16	RF amplitude of SO AOTF driver
NMHK2325	GROUND_MEASURED_ON_SO_HSK	real_val (V) = code*(3/8192)	16	ground potential measured on SO HSK board
NMHK2326	MOTOR_POWER_DAC_CODE_SO	real_val = code	16	SO cooler motor power DAC control

(a) the raw value should be treated as a 14-bit signed value (padded with 2 leading zeroes).

(b) In the infrared channels (SO and LNO) we use a 14-bit ADC. We are treating the 16-bit value as a 14-bit signed value (if you ignore the 2 most significant bits). Before conversion, please apply following rule: if (code =< 8191) then (code = code) else (code = code - 16384)

Table 18. LNO HOUSEKEEPING

code	parameter name	transfer function (a)	size (bits)	description
NMHK2610	POSITIVE_12_V_MEASURED_ON_LNO_CCC	real_val (V) =code*(3/8192)*(47+12)/12	16	12 V measured on CCC board of LNO
NMHK2611	NEGATIVE_12_V_MEASURED_ON_LNO_CCC	real_val (V) =code*(3/8192)*(47+12)/12	16	-12 V measured on CCC board of LNO
NMHK2612	POSITIVE_8_5_V_MEASURED_ON_LNO_HSK	real_val (V) = code*(3/8192)*(33.2+10)/10	16	8.5 V measured on HSK board of LNO
NMHK2613	NEGATIVE_8_5_V_MEASURED_ON_LNO_HSK	real_val (V) = code*(3/8192)*(33.2+10)/10	16	-8.5 V measured on HSK board of LNO
NMHK2614	POSITIVE_3_3_V_MEASURED_ON_LNO_CCC	real_val (V) = code*(3/8192)*(2.5+10)/10	16	3.3 V measured on CCC board of LNO
NMHK2615	POSITIVE_2_5_V_MEASURED_ON_LNO_CCC	real_val (V) = code*(3/8192)	16	2.5 V measured on CCC board of LNO
NMHK2616	POSITIVE_5_V_MEASURED_ON_LNO_HSK	real_val (V) = code*(3/8192)*(10+10)/10	16	5 V measured on HSK board of LNO
NMHK2617	NEGATIVE_5_V_MEASURED_ON_LNO_HSK	real_val (V) = code*(3/8192)*(10+10)/10	16	-5 V measured on HSK board of LNO
NMHK2618	FPA_1_FULL_SCALE_TEMPERATURE_LNO	x=code*(3/8192)*(10/29.1) real_val (°K) =- 460,66*x^6+x^5+1053,2*x^4-x^3- 813,45*x^2+ 227,36*x+539,7	16	LNO focal plane array full scale temperture
NMHK2619	FPA_2_ZOOMED_TEMPERATURE_LNO	real_val (V) = code*(3/8192)	16	LNO focal plane array zoomed temperature
NMHK2620	SENSOR_1_TEMPERATURE_LNO	real_val (°C) = (code*(3*1000/8192)+3/11)/51	16	temperature sensor 1 near LNO AOTF housing
NMHK2621	SENSOR_2_TEMPERATURE_LNO	real_val (°C) = (code*(3*1000/8192)+3/11)/51	16	temperature sensor 2 near LNO grating structure
NMHK2622	SENSOR_3_TEMPERATURE_LNO	real_val (°C) = (code*(3*1000/8192)+3/11)/51	16	temperature sensor 3 near LNO detector structure
NMHK2623	AOTF_TEMPERATURE_LNO	real_val (°C) = (code*(3*1000/8192)+3/11)/51	16	temperature inside LNO AOTF box
NMHK2624	RF_AMPLITUDE_LNO	real_val (V) = code*(3/8192)	16	RF amplitude of LNO AOTF driver
NMHK2625	GROUND_MEASURED_ON_LNO_HSK	real_val (V) = code*(3/8192)	16	ground potential measured on LNO HSK board
NMHK2626	MOTOR_POWER_DAC_CODE_LNO	real_val = code	16	LNO cooler motor power DAC control

(a) the raw value should be treated as a 14-bit signed value (padded with 2 leading zeroes).

(b) In the infrared channels (SO and LNO) we use a 14-bit ADC. We are treating the 16-bit value as a 14-bit signed value (if you ignore the 2 most significant bits). Before conversion, please apply following rule: if (code =< 8191) then (code = code) else (code = code - 16384)

Table 19. UVIS HOUSEKEEPING (FM "as built")

code TM(29) - 1553	code TM(28)	code TM(29) -SpW	parameter name	transfer function	size (bits)	description
NMHK2910	NMTM2810	NMTM2910	POSITIVE_10_V_RAIL_VOLTAGE	real_val (V) = code * (3980/4096) / 20000 * (100+20)	16	10V_POS
NMHK2911	NMTM2811	NMTM2911	NEGATIVE_10_V_RAIL_VOLTAGE	real_val (V) = -code* (3980/4096) / 20000 * 100	16	10V_NEG
NMHK2912	NMTM2812	NMTM2912	POSITIVE_5_V_RAIL_VOLTAGE	real_val (V) = code* (3980/4096) / 20000 * (20+30.1)	16	5V_POS
NMHK2913	NMTM2813	NMTM2913	NEGATIVE_5_V_RAIL_VOLTAGE	real_val (V) = -code * (3980/4096) / 20000 * 50	16	5V_NEG
NMHK2914	NMTM2814	NMTM2914	POSITIVE_12_V_RAIL_CURRENT	real_val (mA) = code* (3980/4096) * 0.2	16	(+12V rail current)
NMHK2915	NMTM2815	NMTM2915	NEGATIVE_12_V_RAIL_CURRENT	real_val (mA) = code* (3980/4096) * 0.2	16	(-12V rail current)
NMHK2916	NMTM2816	NMTM2916	POSITIVE_5_V_RAIL_CURRENT	real_val (mA) = code* (3980/4096) * 0.2	16	(+5V rail current)
NMHK2917	NMTM2817	NMTM2917	NEGATIVE_5_V_RAIL_CURRENT	real_val (mA) = code* (3980/4096) * 0.002	16	(-5V rail current)
NMHK2918	NMTM2818	NMTM2918	CCD_IMAGE_CLOCK_HIGH	real_val (V) = code* (3980/4096) / 20000 * (20 +80)	16	CCD image clock HI
NMHK2919	NMTM2819	NMTM2919	CCD_IMAGE_CLOCK_LOW	real_val (V) = code* (3980/4096) /1000	16	CCD image clock LO
NMHK2920	NMTM2820	NMTM2920	CCD_READOUT_REGISTER_HIGH	real_val (V) = code* (3980/4096) / 20000 * (20 +80)	16	CCD readout register HI
NMHK2921	NMTM2821	NMTM2921	CCD_READOUT_REGISTER_LOW	real_val (V) = code* (3980/4096) /1000	16	CCD readout register LO
NMHK2922	NMTM2822	NMTM2922	SUBSTRATE_VOLTAGE_VSS	real_val (V) = code* (3980/4096)/ 2490 * (6.8+2.49)	16	Substrate Voltage (VSS)
NMHK2923	NMTM2823	NMTM2923	OUTPUT_GATE_VOLTAGE_VOG	real_val (V) = code* (3980/4096) /1000	16	Output gate voltage (VOG)
NMHK2924	NMTM2824	NMTM2924	OUTPUT_DRAIN_VOLTAGE_VOD	real_val (V) = code * (3980/4096) / 20000 * (249+20)	16	Output drain voltage (VOD)
NMHK2925	NMTM2825	NMTM2925	RESET_TRANSISTOR_DRAIN_VOLTAGE_VRD	real_val (V) = code* (3980/4096) / 20000 * (20+150)	16	Reset transistor drain voltage (VRD)
NMHK2926	NMTM2826	NMTM2926	DIODE_DRAIN_VOLTAGE_VDD	real_val (V) = code* (3980/4096) / 20000 * (20+226)	16	Diode drain voltage (VDD)
NMHK2927	NMTM2827	NMTM2927	TEMPERATURE_1	real_val (°C) = code* (3980/4096) /2.49 - 273.27	16	Temp 1 (Proximity Board)
NMHK2928	NMTM2828	NMTM2928	TEMPERATURE_2	real_val (°C) = code* (3980/4096) /2.49 - 273.27	16	Temp 2 (CCD)
NMHK2929	NMTM2829	NMTM2929	TEMPERATURE_3	real_val (°C) = code* (3980/4096) /2.49 - 273.27	16	Temp 3 (Detector Board)
NMHK2930	NMTM2830	NMTM2930	MOTOR_CURRENT_A	real_val (mA) = code* (3980/4096)* 0.2	16	Motor current

Table 20. LIMIT SWITCH STATUS BITS

bit	function
7 (MSB)	spare
6	spare
5	spare
4	spare
3	status NADIR_NOMINAL switch
2	status NADIR_OVERSHOOT switch
1	status SOLAR_NOMINAL switch
0 (LSB)	status SOLAR_OVERSHOOT switch

Table 21. LIMIT SWITCH ENABLING BITS

bit	function
7 (MSB)	spare
6	spare
5	spare
4	spare
3	enabled/disabled NADIR_NOMINAL switch
2	enabled/disabled NADIR_OVERSHOOT switch
1	enabled/disabled SOLAR_NOMINAL switch
0 (LSB)	enabled/disabled SOLAR_OVERSHOOT switch

Table 22. CONTINGENCY LIST

contingency code	description
Sensor contingencies	
0	SINBAD DC/DC module temperature sensor above range
1	SINBAD POW board temperature sensor above range
2	heater on - current sensor above range
3	heater on - current sensor below range
4	heater off - control enabled - current sensor above range
5	SO channel temperature sensor above range
6	SO channel temperature sensor below range
7	SO channel voltage sensor above range
8	SO channel voltage sensor below range
9	SO channel on - current sensor above range
10	SO channel on - current sensor below range

11	LO channel off - current sensor above range
12	LNO detector temperature sensor above range
13	LNO detector temperature sensor below range
14	LNO channel temperature sensor above range
15	LNO channel temperature sensor below range
16	LNO channel voltage sensor above range
17	LNO channel voltage sensor below range
18	LNO channel on - current sensor above range
19	LNO channel on - current sensor below range
20	LNO channel off - current sensor above range
21	UVIS channel temperature sensor above range
22	UVIS channel temperature sensor below range
23	UVIS channel voltage sensor above range
24	UVIS channel voltage sensor below range
25	UVIS channel on - current sensor above range (contigency code not used)
26	UVIS channel on - current sensor below range
27	UVIS channel off - current sensor above range
Channel contingencies	
28	LO channel no data
29	LNO channel no data
30	UVIS channel no data
31	LNO flip mirror error going to default position
32	LNO flip mirror error going to contingency position
33	LNO flip mirror does not stop movement
255	No contigency

Table 23. RESULT CODE

Result Code	name	description
0	Operation OK	Operation sucessfully applied
-40	File corrupted	Source/destination file has wrong size or name
-41	File checksum error	Error in the source/destination file checksum
-42	Offset out of range	Offset in file or data bytes size to update file are out of range (greater than the file size or ma
-43	File name already exists	The name of the new file already exists
-44	Cannot add more files in file system	The file system has raised the maximum number of file, 255.
-45	No room in file system	The file system has not free space to store more files
-46	Cannot delete a default file	It is not allowed to delete the first 19 files
-47	Error in file compression	Error in file compression
-48	Error in file decompression	Error in file decompression
-49	Error getting data from EEPROM	Error getting data from EEPROM
-50	File system corruption	Some files or the file system are corrupted (corruption implies wrong size, name or checksum)

Table 26. SENSOR INDEX

sensor index	sensor name
0	DC DC temperature sensor
1	Power board temperature sensor
2	LNO detector temperature sensor
3	LNO channel temperature sensor
4	UVIS channel temperature sensor
5	LO channel temperature sensor
6	ADC 1 voltage reference 0 V
7	ADC 1 voltage reference 3.3 V
8	LO channel voltage sensor
9	LNO channel voltage sensor
10	UVIS channel voltage sensor
11	LO channel current sensor
12	LNO channel current sensor
13	UVIS channel current sensor
14	Heater current sensor
15	ADC 2 voltage reference 3.3 V

Table 27. FILE MANAGER OPERATIONS REPORT

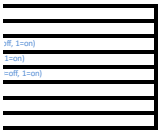
Op. Code	File op. name	Result code		File ID
		Code	Meaning	
10	Append to file	0	Operation OK	file ID
		-40	File corrupted	file ID
		-41	File checksum error	file ID
		-42	Offset out of range	file ID
11	Update file	0	Operation OK	file ID
		-40	File corrupted	file ID
		-41	File checksum error	file ID
		-42	Offset out of range	file ID
12	Update column file	0	Operation OK	file ID
		-40	File corrupted	file ID
		-41	File checksum error	file ID
		-42	Offset out of range	file ID
13	Copy entire file	0	Operation OK	destination file ID
		-40	File corrupted	source/destination file ID
		-41	File checksum error	source/destination file ID
		-42	Offset out of range	destination file ID
14	Copy partial file	0	Operation OK	destination file ID
		-40	File corrupted	source/destination file ID
		-41	File checksum error	source/destination file ID
		-42	Offset out of range	source/destination file ID
15	Fill file with memory area	0	Operation OK	destination file ID
		-40	File corrupted	destination file ID
		-41	File checksum error	destination file ID
		-42	Offset out of range	destination file ID
		-48	Error in file decompression	destination file ID
20	Create empty file	0	Operation OK	new file ID
		-43	File name already exists	file ID of the file with this name
		-44	Cannot add more files in file system	file system max file count
		-45	No room in file system	file system file count
21	Delete last file	0	Operation OK	deleted file id
		-46	Cannot delete a default file	last file ID
22	Erase file content	0	Operation OK	file ID
30	Reset file system	0	Operation OK	0
		-49	Error getting data from EEPROM	file ID of the (last) erroreus file
31	Decompress file	0	Operation OK	destination file ID
		-40	File corrupted	source/destination file ID
		-41	File checksum error	source/destination file ID
		-42	Offset out of range	destination file ID
		-48	Error in file decompression	source file ID
40	Download compressed file	0	Operation OK	source file ID
		-40	File corrupted	source file ID
		-41	File checksum error	source file ID
		-47	Error in file compression	source file ID
41	Print file status	0	Operation OK	file ID
		-40	File corrupted	file ID
		-41	File checksum error	file ID
42	Print full status	0	Operation OK	0 (not applicable)
		-50	File system corruption	0 (not applicable)
43	Print file system status	0	Operation OK	0 (not applicable)
		-50	File system corruption	0 (not applicable)

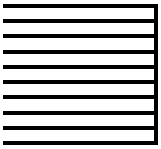
Generated after telecommand + repetition rate
TC(40), TC(50), TC(70) + at event
continuously
continuously
continuously
TC(20) - continuously
TC(20) - continuously
TC(20) - continuously
TC(31) - once
TC(33) - once
TC(35) - once

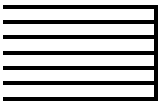
EVENT_BYTE_4	
length	name
1 byte	(7 bits) spare
	(1 bit) force_heater_status (1 = force enabled, 0 = force disabled)
1 byte	WRONG_TC_TYPE
1 byte	TC_CODE
1 byte	TC_CODE
1 byte	TC_CODE
1 byte	WATCHDOG_ERROR (1=trap error, 2=RTEMS fatal error, 3=Leon error, 4=1553 error)
1 byte	SENSOR_INDEX (see table 26)
1 byte	CONTINGENCY_CODE (see table 22)

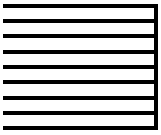
			Sensors ADC readout (decimal format, ADC counts, expected values)	
Raw Value Range	Calculated Value Range	Calculated Units	Nominal or channel OFF (approx. value)	Channel ON (approx. Value)
1638 to 2739	-50.10 to 99.85	deg C		
1638 to 2739	-50.10 to 99.85	deg C		
0 to 3747	99.70 to -170.46	deg C		
362 to 4095	91.72 to -49.61	deg C		
362 to 4095	91.72 to -49.61	deg C		
362 to 4095	91.72 to -49.61	deg C		
0 to 10	0 to 0.013	V	1	
2702 to 2826	3.3 to 3.45	V		2776
11 to 3059	0 to 32	V	12	2856
12 to 3003	0 to 32	V	12	2820
11 to 3030	0 to 32	V	12	2832
139 to 3000	0 to 0.859	A	139	2400-3000

173 to 3013	0 to 0.85	A	173	2400-3000
310 to 4095	0 to 0.153	A	310	3300-4095
106 to 4095	0 to 0.55	A	106	approx. 3000
2702 to 2826	3.3 to 3.45	V		2782









Raw Value Range	Calculated Value Range	Calculated Units
-8192 to 8191	-14.75 to 14.75	V
-8192 to 8191	-14.75 to 14.75	V
-8192 to 8191	-12.96 to 12.96	V
-8192 to 8191	-12.96 to 12.96	V
-8192 to 8191	-3.75 to 3.75	V
-8192 to 8191	-3 to 3	V
-8192 to 8191	-6 to 6	V
-8192 to 8191	-6 to 6	V
0 to 8191	74.46 to 539.7	deg K
-8192 to 8191	-3 to 3	V
-8192 to 8191	-58.83 to 58.82	deg C
-8192 to 8191	-58.83 to 58.82	deg C
-8192 to 8191	-58.83 to 58.82	deg C
-8192 to 8191	-58.83 to 58.82	deg C
-8192 to 8191	-3 to 3	V
-8192 to 8191	-3 to 3	V
-8192 to 8191	0 to 8191	ADU

Raw Value Range	Calculated Value Range	Calculated Units
-8192 to 8191	-14.75 to 14.75	V
-8192 to 8191	-14.75 to 14.75	V
-8192 to 8191	-12.96 to 12.96	V
-8192 to 8191	-12.96 to 12.96	V
-8192 to 8191	-3.75 to 3.75	V
-8192 to 8191	-3 to 3	V
-8192 to 8191	-6 to 6	V
-8192 to 8191	-6 to 6	V
0 to 8191	74.46 to 539.7	deg K
-8192 to 8191	-3 to 3	V
-8192 to 8191	-58.83 to 58.82	deg C
-8192 to 8191	-58.83 to 58.82	deg C
-8192 to 8191	-58.83 to 58.82	deg C
-8192 to 8191	-58.83 to 58.82	deg C
-8192 to 8191	-3 to 3	V
-8192 to 8191	-3 to 3	V
0 to 8191	0 to 8191	ADU

	Raw Value Range	Calculated Value Range	Example Raw Value (code) on FM	Example Calculated Value on FM	Calculated Units
	1500 to 1833	9 to 11	1677	9,777	V
	1800 to 2200	minus 9 to minus 11	2037	-9,897	V
	1600 to 2400	4 to 6	2012	4,897	V
	1600 to 2400	minus 4 to minus 6	2033	-4,939	V
	0 to 500	0 to 100	194	37,7	mA
	0 to 500	0 to 100	131	25,458	mA
	0 to 250	0 to 50	157	30,511	mA
	0 to 5000	0 to 10	88	0,171	mA
	1600 to 3000	8 to 15	2429	11,801	V
	0 to 3000	0 to 3	611	0,594	V
	1600 to 3000	8 to 15	2216	10,766	V
	0 to 3000	0 to 3	606	0,589	V
	2087 to 2870	8 to 11	2447	8,871	V
	1000 to 5000	1 to 5	3042	2,956	V
	2007 to 2379	27 to 32	2230	29,144	V
	1764 to 2236	15 to 19	1980	16,353	V
	1788 to 2033	22 to 25	2005	23,963	V
	530 to 930	minus 60 to + 100	797	37,62	deg C
	530 to 930	minus 60 to + 100	777	29,816	deg C
	530 to 930	minus 60 to + 100	775	29,035	deg C
	0 to 600	0 to 120	20, 268, 506	3,887, 52.08, 98.334	mA

Byte Size	Checksum
file updated byte size	file updated checksum
file byte size	file checksum
file byte size	file checksum
file byte size	file checksum
file updated byte size	file updated checksum
file byte size	file checksum
file byte size	file checksum
file byte size	file checksum
file updated byte size	file updated checksum
file byte size	file checksum
file byte size	file checksum
file byte size	file checksum
destination file byte size	destination file checksum
source/destination file byte size	source/destination file checksum
source/destination file byte size	source/destination file checksum
destination file byte size	destination file checksum
destination file byte size	destination file checksum
source/destination file byte size	source/destination file checksum
source/destination file byte size	source/destination file checksum
source/destination file byte size	source/destination file checksum
destination file byte size	destination file checksum
destination file byte size	destination file checksum
destination file byte size	destination file checksum
destination file byte size	destination file checksum
0	0
0	0
file size of the file with this name	checksum of the file with this name
0	file system checksum
0	file system checksum
deleted file byte size	deleted file checksum
last file byte size	last file checksum
file byte size	file byte size
file system file count	file system checksum
file system file count	file system checksum
destination file byte size	destination file checksum
source/destination file byte size	source/destination file checksum
source/destination file byte size	source/destination file checksum
destination file byte size	destination file checksum
source file byte size	source file checksum
source file byte size	source file checksum
source file byte size	source file checksum
source file byte size	source file checksum
source file byte size	source file checksum
file byte size	file checksum
file byte size	file checksum
file byte size	file checksum
file system file count	file system checksum
file system file count	file system checksum
file system file count	file system checksum
file system file count	file system checksum

Telemetry via SpaceWire

code	name	sub address	function	timing	type 1 byte
NMTM2200	TM(22)	N/A	SO science	async	22
NMTM2500	TM(25)	N/A	LNO science	async	25
NMTM2700	TM(27)	N/A	UVIS applied parameters	async	27
NMTM2800	TM(28)	N/A	UVIS science	async	28
NMTM2900	TM(29) (b)	N/A	UVIS HK	async	29
NMTM3700	TM(37)	N/A	file manager download file report	async	37 (type 1)

					37 (type 2)
NMTM6000	TM(60)	N/A	system log	sync (10')	60

(a) described in SO/LNO TM/TC Strategy document (RD02) --> during science phase the size of SO/LN

(b) same data as TM(29) in 1553 channel

(c) described in UVIS TM/TC Strategy document (RD03)

(d) N=1,2,3 for normal science; N=15 for downloading full frames (dark sky calibration, testing, ...)

(e) N = 1.25; TM (28) UVIS SCIENCE packets with length 2710 bytes. It is explained by OU that these

(f) It is also worth pointing out that UVIS can be sending 1 packet (size 6378 bytes = 2096*3+90) of

Table 24. UVIS_COP_ROW_VALUES

code TM(27)	code TM(28)	parameter name
NMTM2711	NMTM2841	MODE
NMTM2712	NMTM2842	ACQUISITION_MODE
NMTM2713	NMTM2843	BIAS_AVERAGE
NMTM2714	NMTM2844	DARK_AVERAGE
NMTM2715	NMTM2845	SCIENCE_AVERAGE
NMTM2716	NMTM2846	V_START
NMTM2717	NMTM2847	V_END
NMTM2718	NMTM2848	H_START
NMTM2719	NMTM2849	H_END
NMTM2720	NMTM2850	VOD_VALUE
NMTM2721	NMTM2851	VRD_VALUE
NMTM2722	NMTM2852	START_DELAY
NMTM2723	NMTM2853	ACQUISITION_DELAY
NMTM2724	NMTM2854	INTEGRATION_TIME
NMTM2725	NMTM2855	NUMBER_OF_ACQUISITIONS
NMTM2726	NMTM2856	NUMBER_OF_FLUSHES
NMTM2727	NMTM2857	DARK_TO_OBSERVATION_STEPS
NMTM2728	NMTM2858	OBSERVATION_TO_DARK_STEPS
NMTM2729	NMTM2859	MOTOR_DELAY
NMTM2730	NMTM2860	MOTOR_START_POSITION
NMTM2731	NMTM2861	FLAG_REGISTER
NMTM2732	NMTM2862	
NMTM2733	NMTM2863	
NMTM2734	NMTM2864	
NMTM2735	NMTM2865	
NMTM2736	NMTM2866	
NMTM2737	NMTM2867	
NMTM2738	NMTM2868	
NMTM2740	NMTM2870	HORIZONTAL_AND_COMBINED_BINNING_SIZE
NMTM2750	NMTM2880	CONTROL_BITS
	NMTM2885	REVERSE_FLAG_AND_DATA_TYPE_FLAG_REGISTER

Table 25. LAST TELECOMMAND STRUCTURE

code TM(22) i = 1, … , 6	code TM(25) i = 1, … , 6	parameter name
NMTM2209-i-01	NMTM2509-i-01	spare
NMTM2209-i-02	NMTM2509-i-02	AOTF power cmd
NMTM2209-i-03	NMTM2509-i-03	write cooler parameters
NMTM2209-i-04	NMTM2509-i-04	start accumulation
NMTM2209-i-05	NMTM2509-i-05	force AOTF enable
NMTM2209-i-06	NMTM2509-i-06	hsk enable
NMTM2209-i-07	NMTM2509-i-07	DEGF
NMTM2209-i-08	NMTM2509-i-08	DVAF
NMTM2209-i-09	NMTM2509-i-09	force size AB
NMTM2209-i-10	NMTM2509-i-10	prog enable
NMTM2209-i-11	NMTM2509-i-11	SBSF
NMTM2209-i-12	NMTM2509-i-12	detector enable
NMTM2209-i-13	NMTM2509-i-13	NRACC
NMTM2209-i-14	NMTM2509-i-14	DWNL
NMTM2209-i-15	NMTM2509-i-15	DWYA
NMTM2209-i-16	NMTM2509-i-16	BF
NMTM2209-i-17	NMTM2509-i-17	DEIT
NMTM2209-i-18	NMTM2509-i-18	spare
NMTM2209-i-19	NMTM2509-i-19	DS
NMTM2209-i-20	NMTM2509-i-20	DDS
NMTM2209-i-21	NMTM2509-i-21	DVS
NMTM2209-i-22	NMTM2509-i-22	spare
NMTM2209-i-23	NMTM2509-i-23	spare
NMTM2209-i-24	NMTM2509-i-24	TGA
NMTM2209-i-25	NMTM2509-i-25	AOPS
NMTM2209-i-26	NMTM2509-i-26	AOFS
NMTM2209-i-27	NMTM2509-i-27	spare
NMTM2209-i-28	NMTM2509-i-28	spare
NMTM2209-i-29	NMTM2509-i-29	PFCM
NMTM2209-i-30	NMTM2509-i-30	CED1
NMTM2209-i-31	NMTM2509-i-31	CED2
NMTM2209-i-32	NMTM2509-i-32	CED3
NMTM2209-i-33	NMTM2509-i-33	spare
NMTM2209-i-34	NMTM2509-i-34	PCP
NMTM2209-i-35	NMTM2509-i-35	spare
NMTM2209-i-36	NMTM2509-i-36	C1
NMTM2209-i-37	NMTM2509-i-37	spare
NMTM2209-i-38	NMTM2509-i-38	spare
NMTM2209-i-39	NMTM2509-i-39	C2

NMTM2209-i-40	NMTM2509-i-40	spare
NMTM2209-i-41	NMTM2509-i-41	spare
NMTM2209-i-42	NMTM2509-i-42	C3

packet size	timestamp	TM count	data	
3 bytes	8 bytes	2 bytes	code	length
min = 242 max = 11762	NMTM2201	NMTM2202	NMTM2203	8 bytes
			NMTM2204	1 byte
			NMTM2205	1 byte
			NMTM2206	44 bytes
			NMTM2207	2 byte
			NMTM2208	4 bytes
			NMTM2209	25 bytes
				25 bytes
				25 bytes
				25 bytes
				25 bytes
				25 bytes
			NMTM2210	N bytes
min = 242 max = 11762	NMTM2501	NMTM2502	NMTM2503	8 bytes
			NMTM2504	1 byte
			NMTM2505	1 byte
			NMTM2506	44 bytes
			NMTM2507	2 byte
			NMTM2508	4 bytes
			NMTM2509	25 bytes
				25 bytes
				25 bytes
				25 bytes
				25 bytes
				25 bytes
			NMTM2510	N bytes
48	NMTM2701	NMTM2702	NMTM2703	1 byte
			see table 24	31 bytes
min = 2186 max = 31530	NMTM2801	NMTM2802	see table 24	32 bytes
			see table 19 in sheet "TELEMETRY (1553)"	42 bytes
			NMTM2890	N x 2096 bytes
58	NMTM2901	NMTM2902	see table 19 in sheet "TELEMETRY (1553)"	42 bytes
55			NMTM3701	1 byte
			NMTM3702	2 bytes
			NMTM3703	4 bytes
			NMTM3704	4 bytes

			NMTM3705	4 bytes
			NMTM3706	32 bytes
			NMTM3707	2 bytes
min = 10 max = 1024			NMTM3710	1 byte
			NMTM3711	2 bytes
			NMTM3712	Nd bytes
max = 4096			NMTM6001	max 4090 bytes

IO_SCIENCE DATA is 16bytes+320 pixels*24lines/pixel*1.5 byte/pixel = 11536 bytes. Total size of TM(22)(2

e are the standard UVIS packets. These are created when “off chip binning” is performed. In that case a da
three lines every 1s (or 15s) or 3 packets of one line (2096+90 = 2186 bytes/packet) each 1s (or 15s). Not

size (bits)		desc
8		Functional mode for this set of scans
8		CCD readout mode
8		Number of 'Bias' scans to average.
8		Number of 'Dark' scans to average.
8		Number of 'Science' scans to average.
8		Top Right Corner, Y - Coordinate
8		Bottom Left Corner, Y - Coordinate
16		Top Right Corner, X - Coordinate
16		Bottom Left Corner, X - Coordinate
16		Value to apply to VOD DAC
16		Value to apply to VRD DAC
8		Delay from start command
16		Delay between two successive acquisitions
16		Exposure delay before the CCD readout starts.
16		Number of acquistions to return in current sweep
8		Number of flush operations to carry out
8		Steps to drive motor from dark to observation mode
8		Steps to drive motor from observation mode to dark
8		Sets stepper motor drive frequency
8		Sets the starting pole position for the SO and NADIR motor seq
1		bit 0 (Lsb) = LED control
1		b1 = Loop Dark
1		b2 = Integration time increment
1		b3 = sci HK
1		b4 = locate Dark
1		b5 = LED
1		b6 = Motor Hold
1		b7 = Set on/off chip binning
8		Horizontal and Combined binning
16		Control bits
8		Reverse flag + Data type flag

byte nr	size (bits)	desc
0	5	spare
	1	AOTF power command flag
	1	write coolers parameter flag
	1	start accumulations flag
1	1	force AOTF enable flag
	1	housekeeping enable flag
	1	detector gain flag
	1	detector video amplifier flag
	1	force size A/B flag
	1	programming enable flag
	1	spectral background subtraction flag
	1	detector enable flag
2	8	number of accumulations
3	8	height of detector window (i.e. number of lines in detector win
4	8	number of first line in detector window
5	8	binning factor
6	24	detector integration time
7		
8		
9	5	spare
	1	detector supply flag
	1	data source flag
	1	data valid source flag
10	8	spare
11	1	spare
	7	AOTF delay
12	8	AOTF power setting
13	32	AOTF frequency setting
14		
15		
16		
17	8	spare
18	4	spare
	1	closed loop flag
	1	cooler enable flag 1
	1	cooler enable flag 2
	1	cooler enable flag 3
19+20	3	spare
	13	cooler set point (target temperature)
21	8	spare
22	4	cooler closed loop coefficient 1
	4	spare
23	2	spare
	4	cooler closed loop coefficient 2

	2	spare
24	4	spare
	4	cooler closed loop coefficient 3

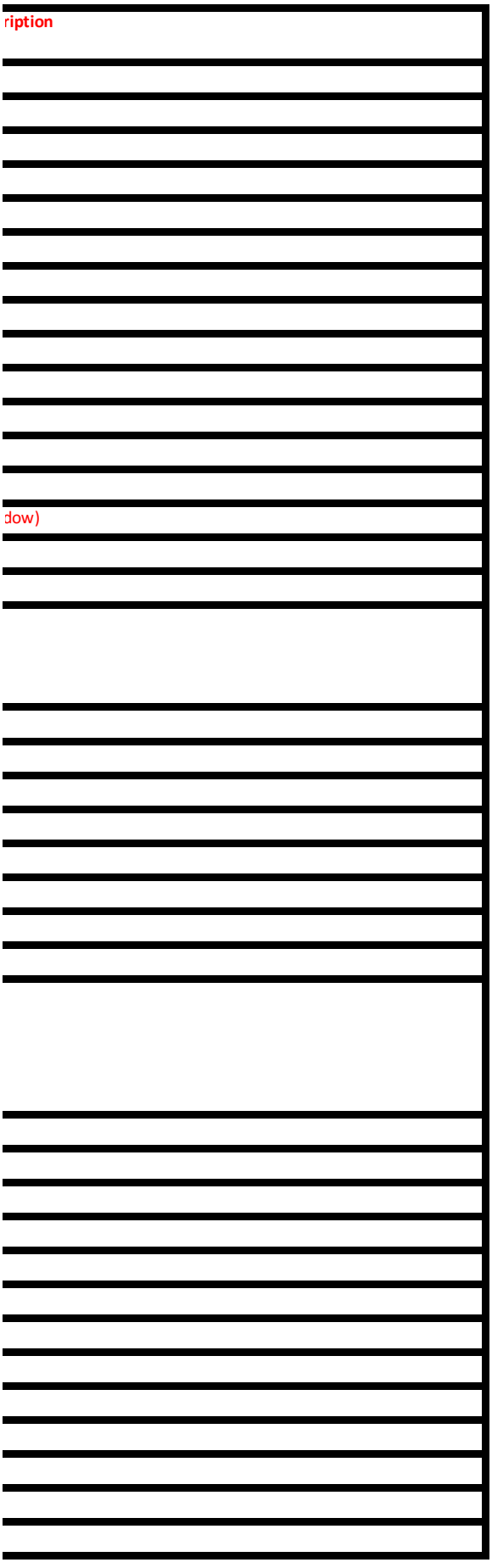
name	checksum 2 bytes	generated after telecommand + repetition rate
TC_EXECUTION_TIMESTAMP	CC	TC(20) - continuously
CHANNEL_ID (1= SO, 2= LNO)		
FLIP_MIRROR_INFO (0= contingency position(solar), 1= default position(nadir), 255= unknow position)		
HSK_TIMESTAMP (8 bytes)		
HSK_TM_COUNT (2 bytes)		
LAST_HOUSEKEEPING_DATA (34 bytes)(see table 17)		
SIZE_OF_TC_COPY (25 ,50, 75, 100, 125 or 150)		
SIZE_OF_SCIENCE_DATA = N = 16 or 11536		
LAST_TELECOMMAND SUBDOMAIN_1 (see table 25)		
LAST_TELECOMMAND SUBDOMAIN_2 (see table 25)		
LAST_TELECOMMAND SUBDOMAIN_3 (see table 25)		
LAST_TELECOMMAND SUBDOMAIN_4 (see table 25)		
LAST_TELECOMMAND SUBDOMAIN_5 (see table 25)		
LAST_TELECOMMAND SUBDOMAIN_6 (see table 25)		
SO_SCIENCE_DATA (a)		
TC_EXECUTION_TIMESTAMP	CC	TC(20) - continuously
CHANNEL_ID (1= SO, 2= LNO)		
FLIP_MIRROR_INFO (0= contingency position(solar), 1= default position(nadir), 255= unknow position)		
HSK_TIMESTAMP (8 bytes)		
HSK_TM_COUNT (2 bytes)		
LAST_HOUSEKEEPING_DATA (34 bytes)(see table 18)		
SIZE_OF_TC_COPY (25 ,50, 75, 100, 125 or 150)		
SIZE_OF_SCIENCE_DATA = N = 16 or 11536		
LAST_TELECOMMAND SUBDOMAIN_1 (see table 25)		
LAST_TELECOMMAND SUBDOMAIN_2 (see table 25)		
LAST_TELECOMMAND SUBDOMAIN_3 (see table 25)		
LAST_TELECOMMAND SUBDOMAIN_4 (see table 25)		
LAST_TELECOMMAND SUBDOMAIN_5 (see table 25)		
LAST_TELECOMMAND SUBDOMAIN_6 (see table 25)		
LNO_SCIENCE_DATA (a)		
UVIS_RESET_SELECTOR	CC	TC(20) - once
UVIS_COP_ROW_VALUES		
UVIS_COP_ROW_VALUES	CC	TC(20) - continuously
UVIS_HOUSEKEEPING		
UVIS_SCIENCE_DATA (N=1, ..., 15) (c)(d) (e) (f)		
UVIS_HOUSEKEEPING	CC	TC(20) - continuously
FILE_ID	CC	TC(35) with OPERATION_CODE = 40
CHUNK_NUMBER = 0		Always at least 2 TM(37) are sent, one of type 1 and one (or more) of type 2 (depending on file size)
START_ADDRESS_TEMP_FILE		
USED_BYTES_TEMP_FILE		

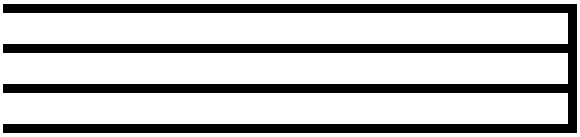
MAX_BYTES_TEMP_FILE		
NAME_COMPRESSED_FILE		
CHECKSUM_TEMP_FILE		
FILE_ID	CC	
CHUNK_NUMBER = 1 (optional 2, 3, …)		
FILE_DATA (Nd = 1 … 1015)		
LOG_LIST	CC	continuously Rate depends on occupancy of SINBAD and number of events (between 1' and 10')

5) is then 11762 bytes.During the precooling phase the size of SO/LNO_SCIENCE DATA is 16 bytes hence total size of TM(22)(25) packets is

ta string of 2.5 bytes x 1048 is created. This mode is set by putting bit 7 “On/Off Chip Binning” to 0 in parameter “Flag Register” (see table
e that first UVIS science packet (and only first packet) of each observation has a size of 4282 bytes (2096*2+90).

ription
uences

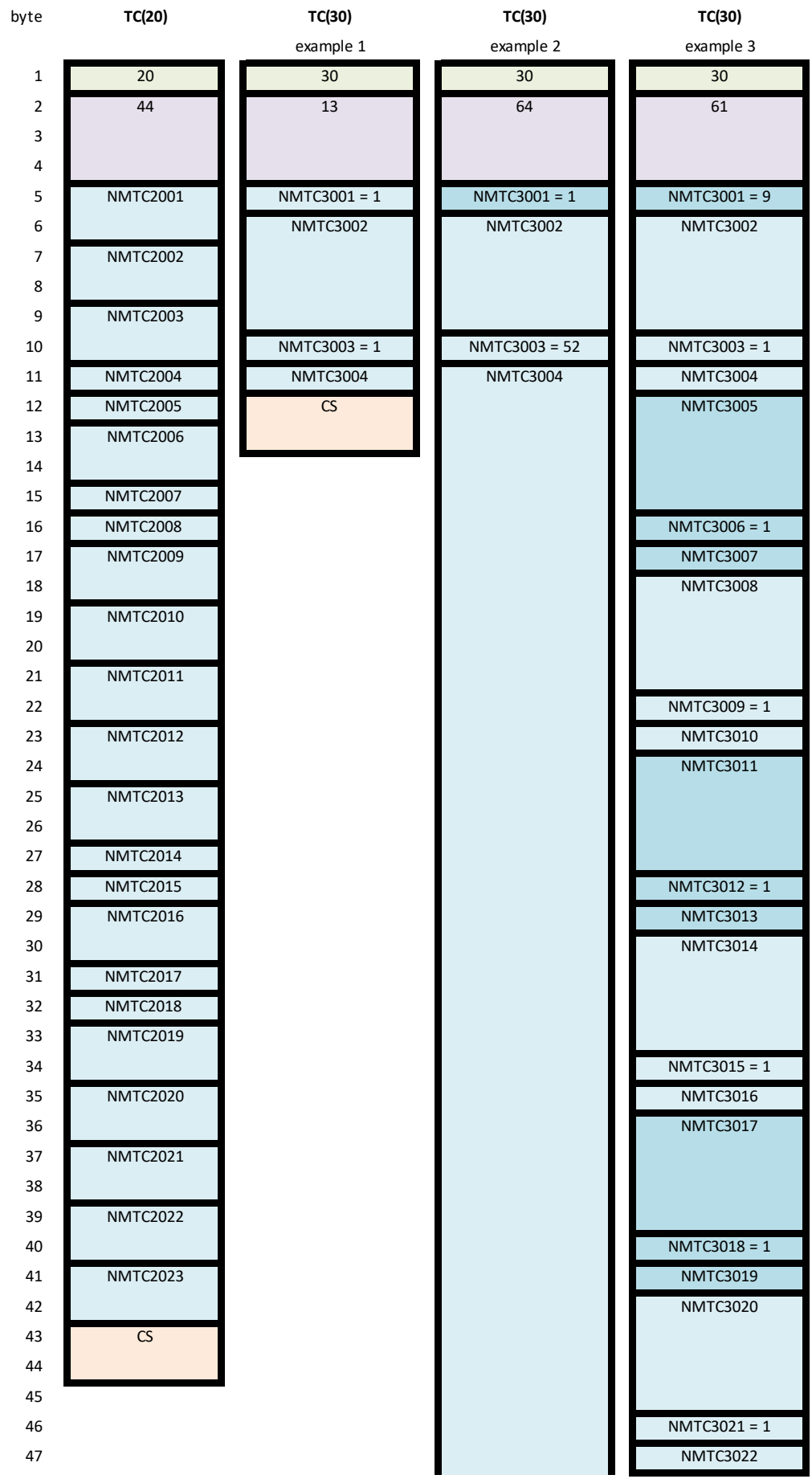

ription
dow)



242 bytes.

24 below) in the UVIS COP rows.

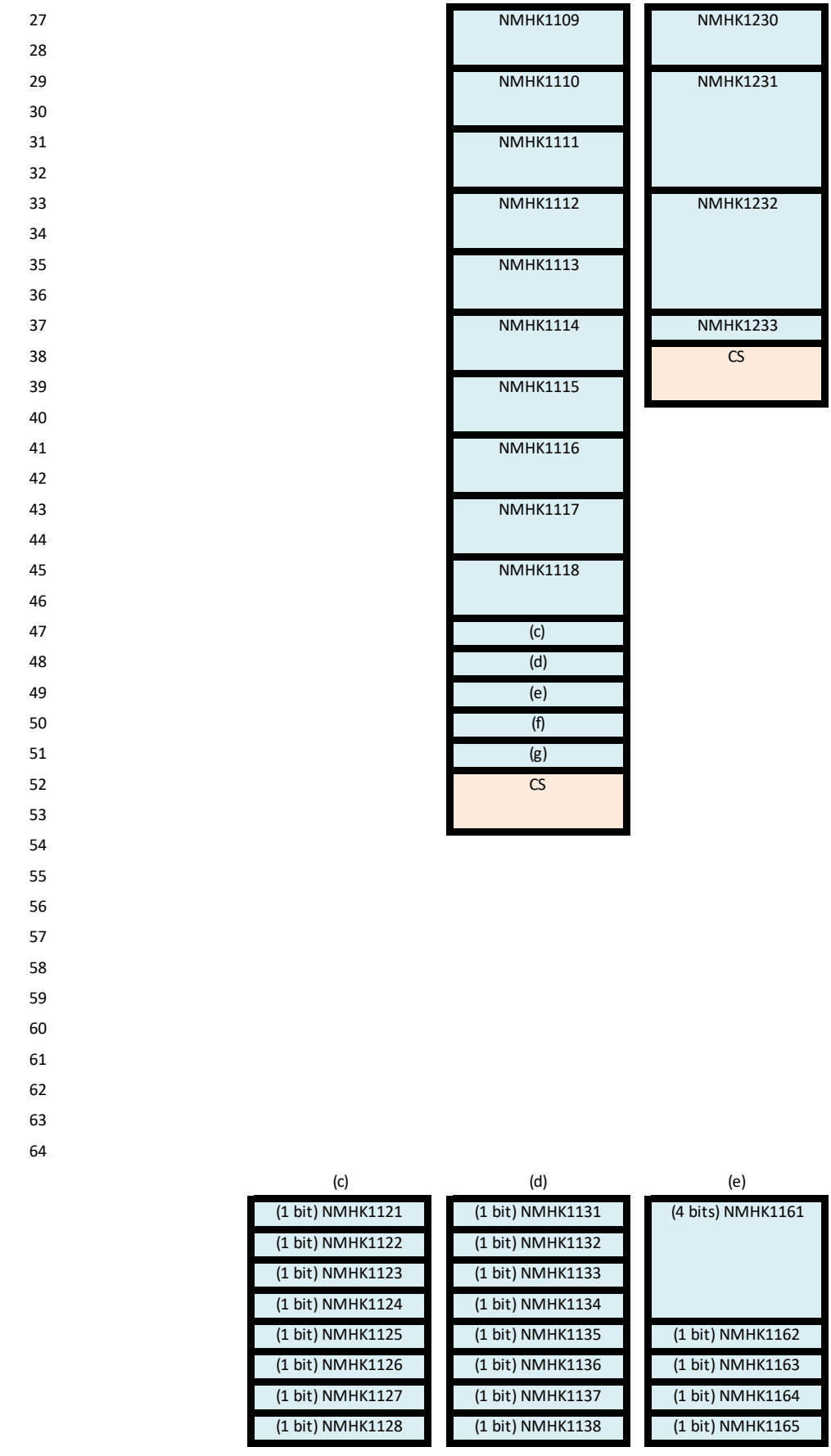
Formats for telecommands over 1553



48		NMTC3023
49		
50		
51		
52		NMTC3034 = 1
53		NMTC3025
54		NMTC3026
55		
56		
57		
58		NMTC3027 = 1
59		NMTC3028
60		CS
61		
62		
63	CS	
64		

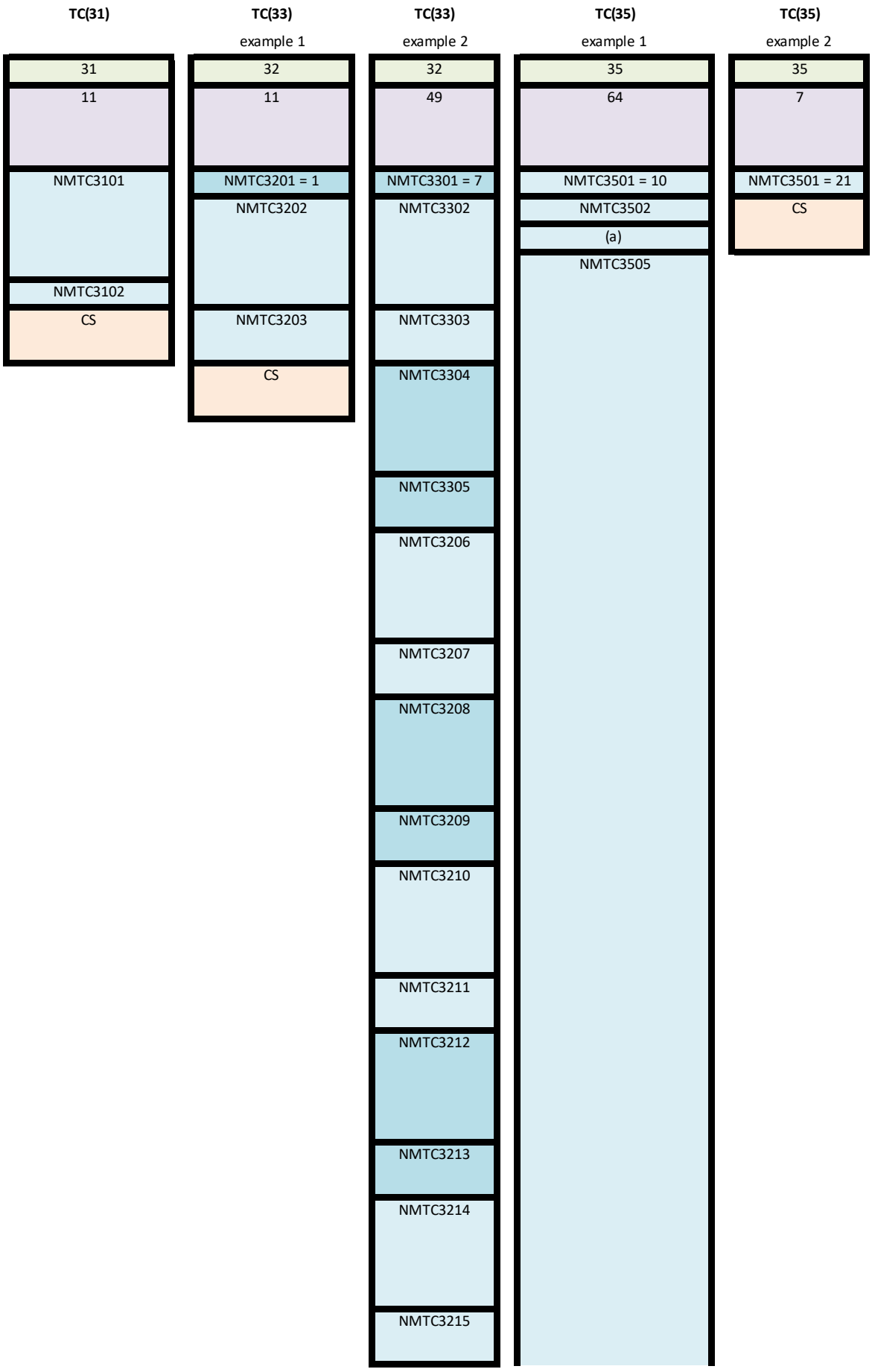
Formats for telemetry over 1553

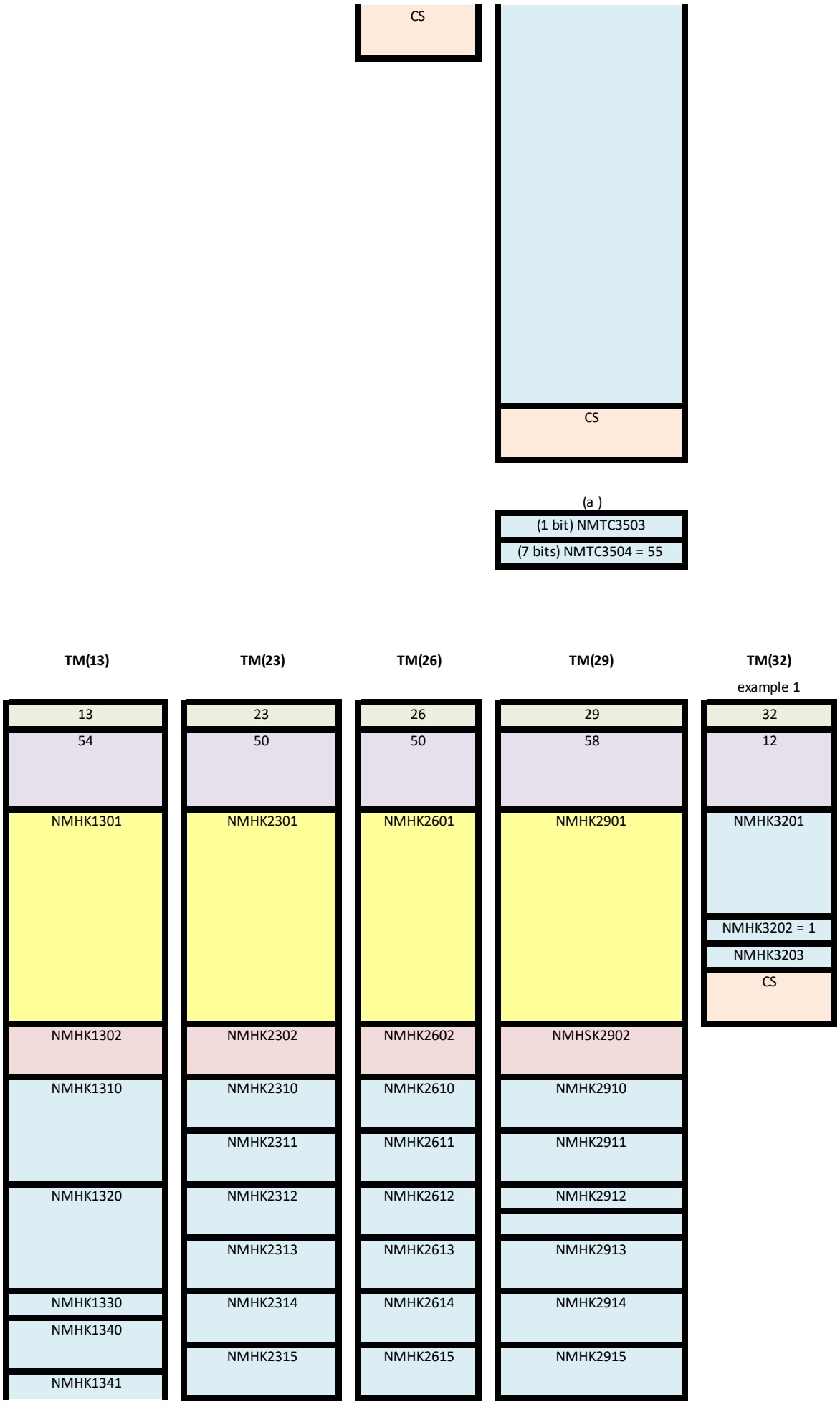
byte	TM(10)	TM(11)	TM(12)
1	10	11	12
2	21	53	39
3			
4			
5	NMHK1001	NMHK1101	NMHK1201
6			
7			
8			
9			
10			
11			
12			
13	NMHK1002	NMHK1102	NMHK1202
14			
15	NMHK1003	NMHK1103	NMHK1210
16	NMHK1004		NMHK1220
17		NMHK1104	
18			NMHK1221
19		NMHK1105	
20	CS		
21		NMHK1106	
22			NMHK1222
23		NMHK1107	
24			
25		NMHK1108	
26			NMHK1223



Formats for telemetry over SpaceWire

byte	**TM(22)** example "long"	**TM(25)** example "short"	
1	22	25	1
2	11762	242	2
3			3
4			4
5	NMTM2201	NMTM2501	5
6			6
7			7
8			8
9			9
10			10
11			11
12			12
13	NMTM2201	NMTM2502	13
14			14
15	NMTM2203	NMTM2502	15
16			16
17			17
18			18
19			19
20			20
21			21
22			22
23	NMTM2204	NMTM2503	23
24	NMTM2205	NMTM2504	24
25	NMTM2206	NMTM2506	25
26	(44 bytes)	(44 bytes)	26
	...	...	27
67			28
68			29
69	NMTM2207	NMTM2507	30
70			31
71	NMTM2208	NMTM2508	32
72			33
73			34
74			35
75	NMTM2209	NMTM2509	36
76	(150 bytes)	(150 bytes)	37
	...	...	38
223			39
224			40
225	NMTM2210	NMTM2510	41
226	(11536 bytes)	(16 bytes)	42
	...	...	43
11759		239	44
11760		240	45
11761	CS	241 CS	46
11762		242	47
			48


TC(31)
31
11
NMTC3101
NMTC3102
CS
TC(33)
example 1
32
11
NMTC3201 = 1
NMTC3202
NMTC3203
CS
TC(33)
example 2
32
49
NMTC3301 = 7
NMTC3302
NMTC3303
NMTC3304
NMTC3305
NMTC3206
NMTC3207
NMTC3208
NMTC3209
NMTC3210
NMTC3211
NMTC3212
NMTC3213
NMTC3214
NMTC3215
TC(35)
example 1
35
64
NMTC3501 = 10
NMTC3502
(a)
NMTC3505
TC(35)
example 2
35
7
NMTC3501 = 21
CS


CS
CS
(a)
(1 bit) NMTC3503
(7 bits) NMTC3504 = 55
TM(13)
TM(23)
TM(26)
TM(29)
TM(32)
example 1
13
54
NMHK1301
NMHK1302
NMHK1310
NMHK1320
NMHK1330
NMHK1340
NMHK1341
23
50
NMHK2301
NMHK2302
NMHK2310
NMHK2311
NMHK2312
NMHK2313
NMHK2314
NMHK2315
26
50
NMHK2601
NMHK2602
NMHK2610
NMHK2611
NMHK2612
NMHK2613
NMHK2614
NMHK2615
29
58
NMHK2901
NMHSK2902
NMHK2910
NMHK2911
NMHK2912
NMHK2913
NMHK2914
NMHK2915
32
12
NMHK3201
NMHK3202 = 1
NMHK3203
CS

(f)

(2 bits) NMHK1141
(1 bit) NMHK1142
(1 bit) NMHK1143
(1 bit) NMHK1144
(1 bit) NMHK1145
(1 bit) NMHK1146
(1 bit) NMHK1147

(g)

(4 bits) NMHK1151
(1 bit) NMHK1152
(1 bit) NMHK1153
(1 bit) NMHK1154
(1 bit) NMHK1155

TM(27)

27
48
NMTM2701
NMTM2702
NMTM2703
NMTM2711
NMTM2712
NMTM2713
NMTM2714
NMTM2715
NMTM2716
NMTM2717
NMTM2718
NMTM2719
NMTM2720
NMTM2721
NMTM2722
NMTM2723
NMTM2724
NMTM2725
NMTM2726
NMTM2727
NMTM2728
NMTM2729
NMTM2730
(h)
NMTM2740
NMTM2750
CS

TM(28)

example N=3

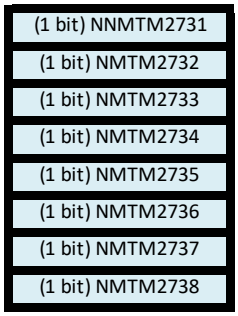
1	28
2	6378
3	
4	
5	NMTM2801
6	
7	
8	
9	
10	
11	
12	
13	NMTM2802
14	
15	NMTM2810
16	(42 bytes)
	…
55	
56	
57	NMTM2841
58	(32 bytes)
	…
87	
88	
89	NMTM2880
90	(6288 bytes)
	…
6375	
6376	
6377	CS
6378	

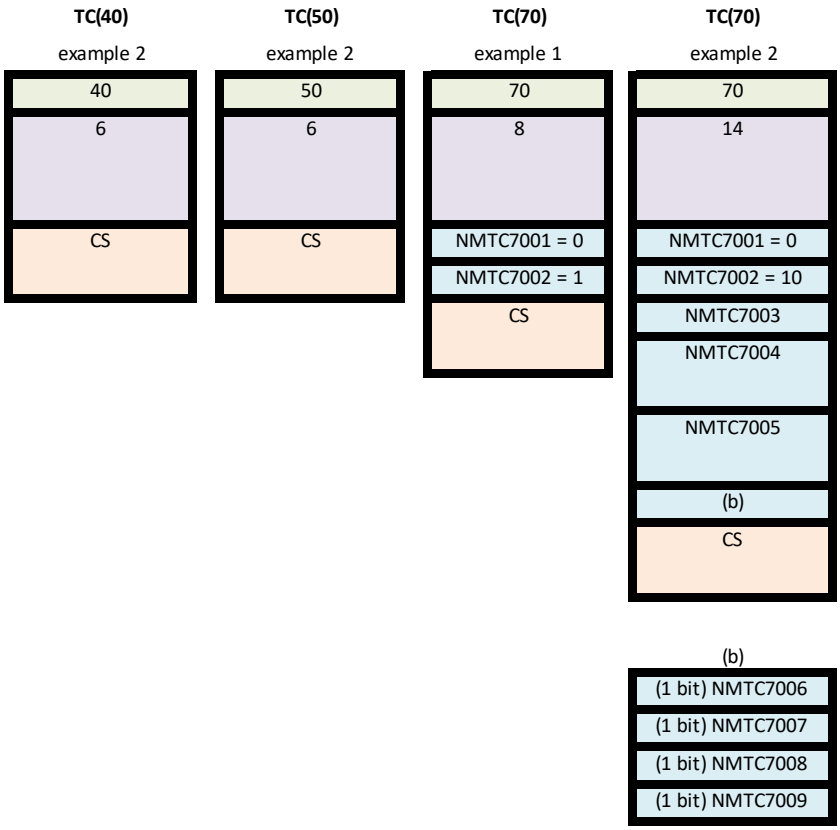
TM(37)

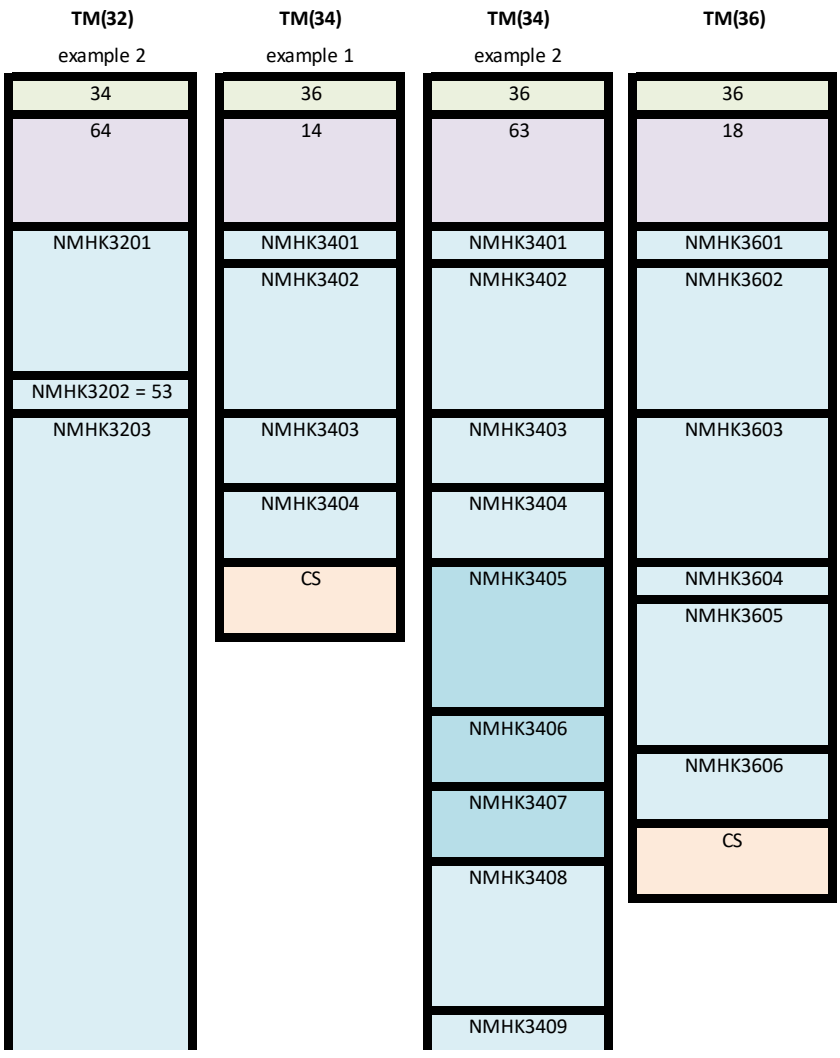
type 1

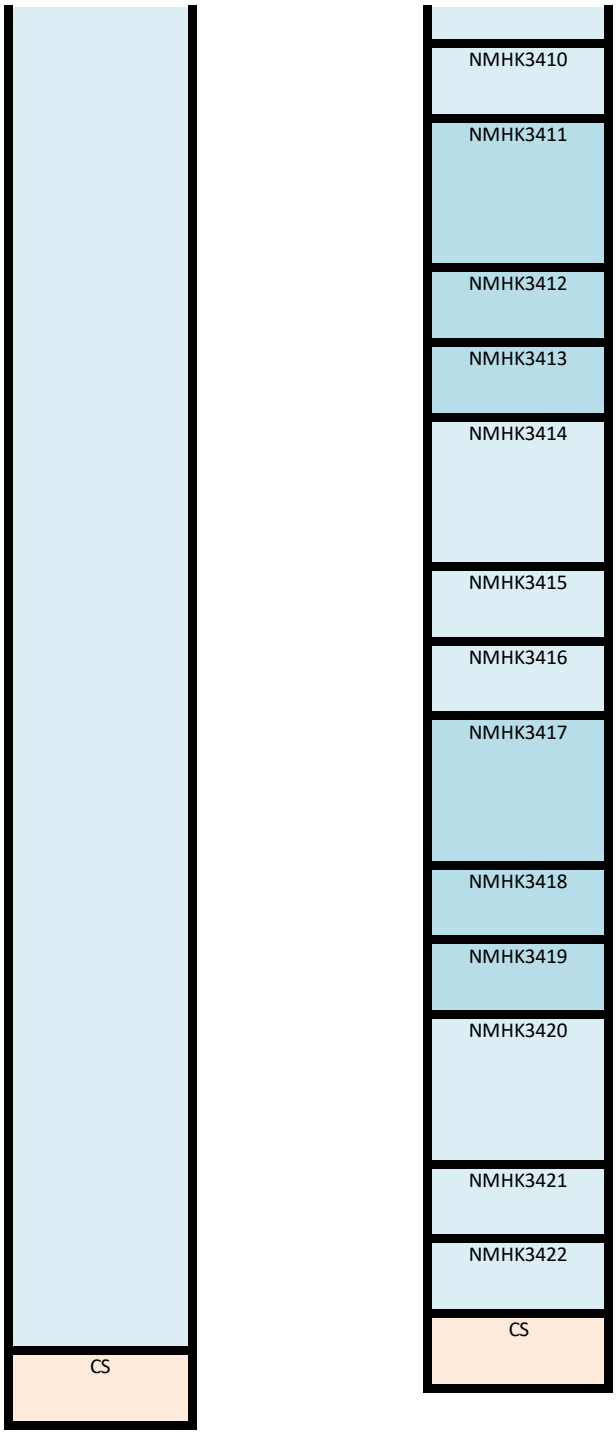
1	37
2	55
3	
4	
5	NMTM3701
6	NMTM3702 = 0
7	
8	NMTM3703
9	
10	
11	
12	NMTM3704
13	
14	
15	
16	NMTM3705
17	
18	
19	
20	NMTM3706
21	(32 bytes)
	…
50	
51	
52	NMTM3706
53	
54	CS
55	

(h)


(1 bit) NNMTM2731
(1 bit) NMTM2732
(1 bit) NMTM2733
(1 bit) NMTM2734
(1 bit) NMTM2735
(1 bit) NMTM2736
(1 bit) NMTM2737
(1 bit) NMTM2738


TC(40)
example 2
40
6
CS
TC(50)
example 2
50
6
CS
TC(70)
example 1
70
8
NMTC7001 = 0
NMTC7002 = 1
CS
TC(70)
example 2
70
14
NMTC7001 = 0
NMTC7002 = 10
NMTC7003
NMTC7004
NMTC7005
(b)
CS
(b)
(1 bit) NMTC7006
(1 bit) NMTC7007
(1 bit) NMTC7008
(1 bit) NMTC7009


TM(32)
example 2
34
64
NMHK3201
NMHK3202 = 53
NMHK3203
TM(34)
example 1
36
14
NMHK3401
NMHK3402
NMHK3403
NMHK3404
CS
TM(34)
example 2
36
63
NMHK3401
NMHK3402
NMHK3403
NMHK3404
NMHK3405
NMHK3406
NMHK3407
NMHK3408
NMHK3409
TM(36)
36
18
NMHK3601
NMHK3602
NMHK3603
NMHK3604
NMHK3605
NMHK3606
CS


NMHK3410
NMHK3411
NMHK3412
NMHK3413
NMHK3414
NMHK3415
NMHK3416
NMHK3417
NMHK3418
NMHK3419
NMHK3420
NMHK3421
NMHK3422
CS
CS

TM(37)

type 2

1	37
2	1024
3	
4	
5	NMTM3710
6	NMTM3711
7	
8	NMTM3712
9	(1015 bytes)
	...
1021	
1022	
1023	CS
1024	

TM(60)

example max size of 4096 bytes

1	60
2	4096
3	
4	
5	NMTM6001
6	
	...
4093	
4094	
4095	CS
4096	