Manual for Radio-Amateurs

for receiving and decoding telemetry data of the PEGASUS satellite

DOCUMENT CHANGE RECORD	
Project: PEGASUS - Communication	
Change Status Log:	
V0.5, 22. 5. 2017, MT	Document created from previous documents
V1.0, 24. 5. 2017, MT	CRC, FEC, description added, O-Beacon explained

Abbreviations

ADCS	Attitude Control System
AID	Address Identifier
CALL	Call Sign (Ham Radio Call Sign) of the satellite
CRC	Cyclic Redundancy Checksum
E-Beacon	EPS-Beacon
EPS	Electrical Power System
FEC	Forward Error Correction (RS Code)
GPS	Global Positioning System
GS	Ground Station
IARU	International Amateur Radio Union
ILEOP	Initial Launch and Early Orbit Phase
LEOP	Launch and Early Orbit Phase
MCC	Mission Control Center
OBC	Onboard Computer
O-Beacon	OBC-Beacon
PCB	Printed Circuit Board
PID	Protocol Identifier
RS	Reed Solomon
RSSI	Received Signal Strength Indication
RTC	Real Time Clock
S-Beacon	STACIE-Beacon
SDC	Space Data Center
Side-P	Side Panels
STG	Space Tech Group
STACIE	Space Telemetry And Command Interface
TRX	Transceive, Transceiver
TX	Transmit, Transmitter
TT-64	Thomas Turetschek 64 byte protocol
WOD	Whole Orbit Data

1 Radio Engineering Parameter of Pegasus

The satellite Pegasus is a 2U CubeSat with 2 redundant TRX modules on one PCB. This communication module is called STACIE. The two 90° crossed dipole antennas are used independently by the two TRX modules. STACIE is supplied by the two independent power busses of the satellite. Thus, the communication system of Pegasus is operating independently and redundantly.

Downlink Frequency	436,670 MHz
TX power max	30dBm, 1W
Modulation	GFSK
Polarisation	Linear
Protocol	TT-64

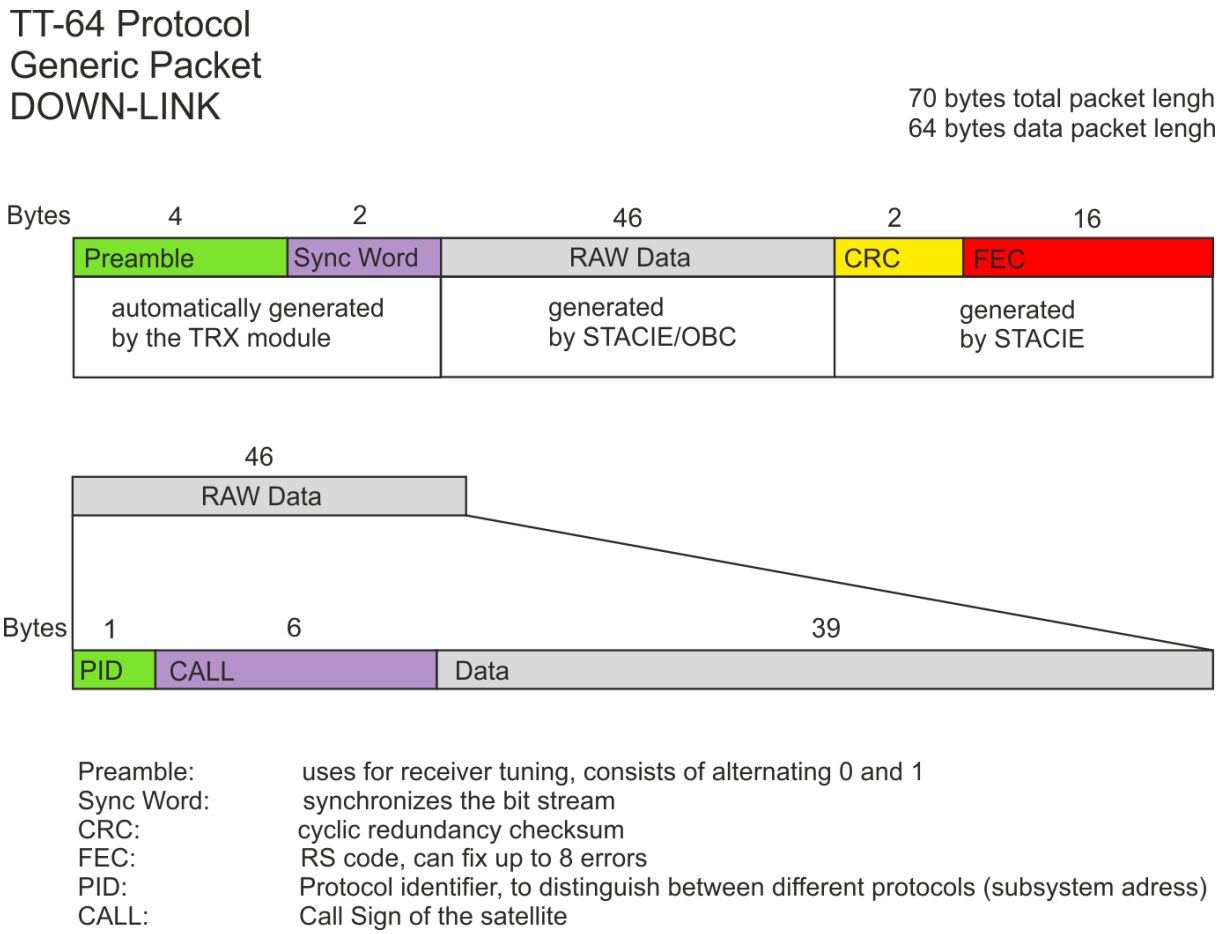
2 TT-64 Protocol

The TT-64 protocol regulates the data transfer between the satellite and the GS in both directions (air interface). The TT-64 protocol supports the time division multiplex method (semi duplex communication).

A complete data packet consists of a 70 bytes string, whereas 6 bytes are created automatically by the TRX module of the communication interface STACIE for synchronizing and receiver tuning. The remaining 64 bytes are data bytes. The last 18 bytes are used for CRC and FEC.

2.1 Down-Link

From the 46 bytes of data, 1 byte must be the PID and 6 bytes the CALL. The CALL is the official call sign of the satellite.



Preamble:	uses for receiver tuning, consists of alternating 0 and 1
Sync Word:	synchronizes the bit stream
CRC:	cyclic redundancy checksum
FEC:	RS code, can fix up to 8 errors
PID:	Protocol identifier, to distinguish between different protocols (subsystem adress)
CALL:	Call Sign of the satellite

2.2 PID Regulation

The PID regulates if the OBC or STACIE is the responsible subsystem of the data packet, the direction of the packet and an assignment to a special beacon.
With the PIDs it is possible to distinguish between the different beacons and route them to the beacon dependent decoding operations.

Assigned PIDs

Content	hex	binary
S Beacon	0xC0	11000000
E Beacon	0xC1	11000001
O Beacon 1/2	0x53	01010011
O Beacon 2/2	0x56	01010110

2.3 CALL

The assigned call sign of the satellite PEGASUS is ON03AT

Symbol	O	N	0	3	A	T
Hex	0x4F	0x4E	0x30	0x33	0x41	0x54
Binary	01001111	01001110	00110000	00110011	01000001	01010100

2.4 FEC and CRC

In principle there is no need to use FEC and CRC for receiving and decoding the beacons. Anyway, if CRC and FEC are not used by the decoding operation, there is no indication of errors in the raw data.

CRC
The Cyclic Redundancy Checksum (CRC) is a standard
CRC16 Checksum

FEC
The Forward Error Correction (FEC) is a Reed Solomon (RS) code with the following Specifications:
RS(n=64,k=48)
Generator-polynomial-coefficients:
[79,44,81,100,49,183,56,17,232,187,126,104,31,103,52,118]
It is possible to repair 8 errors per 64bit packet.

3 Beacons

There exist 3 different types of beacons, the E-Beacon (EPS Beacon), the S-Beacon (STACIE Beacon) and the O-Beacon (OBC-Beacon).
2 Subsystems are able collecting telemetry data and give the command for transmitting it, the OBC and STACIE. In normal operation mode, only the OBC Beacon will be transmitted. The other beacons are only sent on request from the GS.
As long as the OBC has not taken over the command (ILEOP) or is in a sleep (safe) mode (or is not working), STACIE is sending 2 beacons alternately, the E-Beacon and the S-Beacon.

3.1 E-Beacon

The E-Beacon consists of the EPS telemetry. STACIE collects this telemetry from the EPS over the I^2C interface between EPS and STACIE. The OBC is not involved in this action.
The E-Beacon is only sent, if the OBC operation status does not allow sending O-Beacons.
The PID is 0xC1
Data Packet

Data sequence of the E-Beacon

Byte #	Name	Unit	Format	bit	Description
0	PID			8	0xC1 (EPS-Beacon ID)
1	CALL			8	0x4F (O)
2	CALL			8	0x4E (N)
3	CALL			8	0x30 (0)
4	CALL			8	0x33 (3)
5	CALL			8	0x41 (A)
6	CALL			8	0x54 (T)
7	I_PV2_5V	A	Fix 3.4	8	Current through FET3-2 between PV2-bus and 5V converter
8	I_PV1_5V	A	Fix 3.4	8	Current through FET3-1 between PV1-bus and 5V converter
9	V_PV2	V	UFix 3.5	8	Voltage at PV2-bus, Solarbus 2
10	V_5V_IN	V	UFix 3.5	8	Voltage at the input of the 5V converter measured at FET3-1
11	I_PV1_3V3	A	Fix 3.4	8	Current through FET5-1 between PV1-bus and 3V3 converter
12	I_PV2_3V3	A	Fix 3.4	8	Current through FET5-2 between PV2-bus and 3V3 converter
13	V_PV1	V	UFix 3.5	8	Voltage at PV1-bus, Solarbus 1
14	V_3V3_IN	V	UFix 3.5	8	Voltage at the input of the 3V3 converter measured at FET5-2
15	Temp_BAT1SW	°C	Fix 7.0	8	Temp near BAT1 switches
16	Temp_5V	°C	Fix 7.0	8	Temp near 5V converter

17	I_PV1_HV	A	Fix 3.4	8	Current through FET4-1 between PV1-bus and HV supply
18	I_PV2_HV	A	Fix 3.4	8	Current through FET4-2 between PV2-bus and HV supply
19	V_3V3_OUT	V	UFix 3.5	8	Voltage at the output of the 3V3 converter
20	V_HV	V	UFix 3.5	8	Voltage at the output of the HV supply to the PPTs measured at FET4-2
21	I_PV2_BAT1	A	Fix 3.4	8	Current through FET1-2 between PV2-bus and battery 1
22	I_PV1_BAT1	A	Fix 3.4	8	Current through FET1-1 between PV1-bus and battery 1
23	V_5V_OUT	V	UFix 3.5	8	Voltage at the output of the 5V converter
24	V_BAT1	V	UFix 3.5	8	Voltage of the battery 1
25	I_PV2_BAT2	A	Fix 3.4	8	Current through FET2-2 between PV2-bus and battery 2
26	I_PV1_BAT2	A	Fix 3.4	8	Current through FET2-1 between PV1-bus and battery 2
27	Version of EPS			8	Versions Number of EPS
28	STACIE 0/1			8	E-Beacon send by STACIE 0/1 (A/C)
29	V_BAT2	V	UFix 3.5	8	Voltage of the battery 2
30	Temp_BAT1	°C	Fix 7.0	8	Temp of BAT1 on the battery holder
31	Temp_BAT2	°C	Fix 7.0	8	Temp of BAT2 on the battery holder
32	Status 1	-	boolean	8	B7 (MSB): 3V3-1 on, B6: 3V3-2 on, B5: 3V3-3 on, B4: 3V3-Backup on, B3: 5V-1 on, B2: 5V-2 on, B1: 5V-3 on, B0 (LSB): 5V-4 on
33	Status 2	-	boolean	8	B7 (MSB): Power Low Warning (EPS will enter in Power Down Mode soon after this warning), B6: Bat1 connected to PV1, B5: Bat2 connected to PV2, B4: 3V3 on, B3: 5V on, B2-B0 (LSB): Mode: 000 Debug Mode, 001 Boot Mode, 010 Flight Mode, 011 Power Down Mode, 100 Safe Mode,
34	Status 3	-	boolean	8	B7 (MSB): 3V3 Burst Mode on, B6: 5V Burst Mode on, B5: Bat1 connected to PV2, B4: Bat2 connected to PV1, B3: Temperature warning flag, B2: CC1 connection okay flag, B1: CC2 connection okay flag, B0 (LSB): RBF
35	Status 4 EPS			8	
36	BeaconCount S			8	Beacon Count of STACIE Beacons
37	Reboot_MC	-	UFix 8	8	Number of reboots since RBF of the main controller
38	Reboot_CC1	-	UFix 8	8	Number of reboots since RBF of the first communication controller
39	Reboot_CC2	-	UFix 8	8	Number of reboots since RBF of the second communication controller
40	Vcc_CC1	V	UFix 3.5	8	Supply voltage of CC1
41	Temp_CC1	°C	Fix 7.0	8	Temperature of the internal sensor of CC1
42	Vcc_CC2	V	UFix 3.5	8	Supply voltage of CC
43	Temp_CC2	°C	Fix 7.0	8	Temperature of the internal sensor of CC2
44	Status_CC1	-	boolean	8	B7 (MSB)-B6: CC Mode: 00 Boot Mode, 01 Flight Mode, 10 Safe Mode, 11 CC1 unavailable, B5: mcTimeoutFlag, B4: RBF (CC1 only), B3: EN_I2C, B2: Bat1 connected to PV1, B1: Bat2 connected to PV2, B0 (LSB): 3V3-Backup on

45	Status_CC2	-	boolean	8	B7 (MSB)-B6: CC Mode: 00 Boot Mode, 01 Flight Mode, 10 Safe Mode, 11 CC2 unavailable, B5: mcTimeoutFlag, B4: TBD B3: EN_I2C, B2: Bat1 connected to PV1, B1: TBD, B0 (LSB): 3V3-Backup on
	CRC			16	
	FEC			128	

3.2 S-Beacon

The S-Beacon consists of the STACIE telemetry. The telemetry is generated and stored in the communication subsystem STACIE and immediately available by internal storage.
The OBC is not involved in this action. The S-Beacon is only sent, if the OBC operation status does not allow sending O-Beacons. If O-Beacons or other packets from the OBC are sent, a S-Beacon is sent after every 30th packet sent by the OBC.

The PID is 0xC0

Data Packet

Data sequence of the S-Beacon

Byte #	Name	Bit	Value	Description
0	PID	1	0xC0	Stacie Beacon ID
1	Call Sign	6	0x4F	O
2	Call Sign		0x4E	N
3	Call Sign		0x30	0
4	Call Sign		0x33	3
5	Call Sign		0x41	A
6	Call Sign		0x54	T
7	USP	2	Low Byte	Supply Voltage of Stacie in mV
8			High Byte	
9	TRX Temp	1		Temperature of Stacie's Communication Module
10	Idle RSSI	1		Received Signal Strength Indication, without TRX

11	RX RSSI	1		Received Signal Strength Indication, during RX
12	Antenna Dep	1		0= not deployed, 1=deployed For Antenna 1, 2, 3, 4
13	Stacie OP	1		Operational Mode: 0=Normal, 2=Sleep, 3=Beacon, 4=Deployment, 8=Shutdown
14	T-Comp On/Off	1		Temperature Compensation On/Off (1=on, 0=off)
15	Reset Counter	2	Low Byte	Reset after last mP-Flash
16			High Byte	
17	Uplink Error	1		Uplink Error rate
18	OBC Send Packet counter btw. Beacons	1		Packets send between 2 Stacie Beacons
19	BeaconInterval	2	Low Byte	Stacie Beacon intervall in seconds
20			High Byte	
21	Reserved	8		
22				
23				
24				
25				
26				
27				
28				
29	SID	1		0=STACIE A, 1=STACIE C
30	TxSelReason	1		Weight why Stacie is Master
31	reason remote	1		Weight of partner-stacie, 0=No answer
32	sTime	4	Byte 0	Stacie Up-Time in mseconds since last reset
33			Byte 1	
34			Byte 2	
35			Byte 3	
36	Reserved	1		
37	BeaconCount	1		Number of Beacons send from Stacie
38	Reserved	8		
39				
40				

41				
42				
43				
44				
45				
	CRC	2		
	FEC	16		

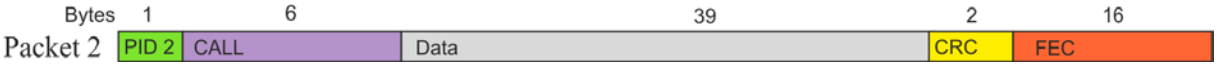
3.3 O-Beacon

The O-Beacon consists of OBC, STACIE, EPS, µPPT, GPS and ADCS telemetry. The OBC is collecting and storing the telemetry of the different subsystems. The OBC is sending the collected data in two packets to STACIE, which is adding the CRC and the FEC before it is transmitting it.

Each packet has its own PID, thus if one packet is lost, the other packet can be decrypted by the GS.
The PID of the first packet is 0x53 and of the second packet 0x56.
Telemetry marked with WOD (Whole Orbit Data) in the commend fields is telemetry, which is required by QB50. The WOD telemetry is also displayed in the public area of the MCC.
In the subsystem section of the table, there is written from which subsystem the telemetry is collected.

The O-Beacon 1 consists mainly of the EPS telemetry and some telemetry of STACIE and from the OBC.
The O-Beacon 2 consist mainly of the GPS data, ADCS and Side Panels data and a huge amount of OBC status parameter (Boolean).

Data Packets



OBC BEACON 1/2						
#	Name	Unit	Format	Bit	Commend	Subsystem
0	PID			8	0x53 (OBC-Beacon ID 1)	
1	CALL			8	0x4F (O)	
2	CALL			8	0x4E (N)	

3	CALL			8	0x30 (0)	
4	CALL			8	0x33 (3)	
5	CALL			8	0x41 (A)	
6	CALL			8	0x54 (T)	
7	V_PV1	V	UFix 3.5	8	WOD	EPS
8	V_PV2	V	UFix 3.5	8	WOD	EPS
9	V_5V_IN	V	UFix 3.5	8		EPS
10	V_3V3_IN	V	UFix 3.5	8		EPS
11	V_5V_OUT	V	UFix 3.5	8	WOD	EPS
12	V_3V3_OUT	V	UFix 3.5	8	WOD	EPS
13	I_PV1_5V	A	Fix 3.4	8	WOD as I_5V	EPS
14	I_PV2_5V	A	Fix 3.4	8	WOD as I_5V	EPS
15	I_PV1_3V3	A	Fix 3.4	8	WOD as I_3V3	EPS
16	I_PV2_3V3	A	Fix 3.4	8	WOD as I_3V3	EPS
17	Temp_BAT1SW	°C	Fix 7.0	8	WOD as Temp_EPS	EPS
18	Temp_5V	°C	Fix 7.0	8	WOD as Temp_EPS	EPS
19	V_HV	V	UFix 3.5	8		EPS
20	I_PV1_BAT1	A	Fix 3.4	8	WOD as I_Bat1	EPS
21	I_PV2_BAT1	A	Fix 3.4	8	WOD as I_Bat1	EPS
22	I_PV1_BAT2	A	Fix 3.4	8	WOD as I_Bat2	EPS
23	I_PV2_BAT2	A	Fix 3.4	8	WOD as I_Bat2	EPS
24	V_BAT1	V	UFix 3.5	8	WOD	EPS
25	V_BAT2	V	UFix 3.5	8	WOD	EPS
26	Vcc_CC2	V	UFix 3.5	8		EPS
27	Vcc_CC1	V	UFix 3.5	8		EPS
28	Temp_BAT1	°C	Fix 7.0	8	WOD (as Temp Bat)	EPS
29	Temp_BAT2	°C	Fix 7.0	8	WOD (as Temp Bat)	EPS
30	Status 1	-	boolean	8		EPS
31	Status 2	-	boolean	8		EPS
32	Status 3	-	boolean	8		EPS
33	Status_CC1	-	boolean	8		EPS
34	Status_CC2	-	boolean	8		EPS
35	Reboot_MC	-	boolean	8		EPS
36	Reboot_CC1	-	boolean	8		EPS
37	Reboot_CC2	-	boolean	8		EPS
38	Temp A	°C		8	WOD (Temp TT&C), STACIE A temperature	STACIE
39	Temp C	°C		8	WOD (Temp TT&C), STACIE C temperature	STACIE
40	RSSI A (X+)			8	Receive Signal Strength Indicator of STACIE A	STACIE
41	RSSI C (X-)			8	Receive Signal Strength Indicator of	STACIE

					STACIE C	
42	STACIE Mode A			4	operating mode of STACIE A	STACIE
42	STACIE Mode C			4	operating mode of STACIE C	STACIE
43	state machine			8	WOD (OBC Status) Bit 7: SU Script active (1 if science script is running or waiting for next time table entry/next day) Bit 6: SU Powered (1 if Science Unit is active and powered on) Bit 5: ADCS enabled (1 if enabled 0 if disabled) Bit 4: n.u. Bit 3..0:"OBC Mission State" (0 – Standby)	OBC
44	CmdCnt			8	OBC Mission Counter	OBC
45	CmdCnt			8	OBC Mission Counter	OBC
	CRC			16		
	FEC			128		
	OBC BEACON 2/2					
#	Name	Unit	Format	Bit	Commend	Subsystem
0	PID			8	0x56 (OBC-Beacon ID 2)	
1	CALL			8	0x4F (O)	
2	CALL			8	0x4E (N)	
3	CALL			8	0x30 (0)	
4	CALL			8	0x33 (3)	
5	CALL			8	0x41 (A)	
6	CALL			8	0x54 (T)	
7	Date		ddmmyy	14	Date of GPS data (when fix success, RTC if no fix since last OBC reset)	GPS
	Time		hhmmss	17	Time of GPS data (when fix success, RTC if no fix since last OBC reset)	GPS
	Fix		Bool	1		GPS

	Number of Satellites seen			4		GPS
	Lattitude		9000.0000N	28	Bits: 1 sign, 7 deg, 7 mins int ,13 mins fract	GPS
	Longitude		18000.0000W	29	Bits: 1 sign, 8 deg, 7 mins int ,13 mins fract	GPS
	Altitude			20	in m	GPS
				7	Fill bits	GPS
22	ADCS Status			8		ADCS
23	ADCS Angle Dev			8		ADCS
24	crystal_oszillator_used	-	Bool	1	1… Crystal oszillator operational	OBC
24	power_source	-	Bool	1	0… 3.3V_SPA, 1… V_Backup	OBC
24	last_reset_source1	-	Bool	1	Two bits showing the last reset source	OBC
24	last_reset_source2	-	Bool	1	POR: 0b00, EXTR: 0b01, WDTR: 0b10; BODR: 0b11	OBC
24	eps_cc_used	-	Bool	1	0…CC1, 1… CC2	OBC
24	obc_powersave	-	Bool	1	OBC controller is in powersave mode	OBC
24	obc_3v3_spa_enabled	-	Bool	1	This is the standard power supply rail of the OBC!	OBC
24	task_sensors_running:	-	Bool	1	Main sensor task is running	OBC
25	task_maintenance_running	-	Bool	1	Mandatory maintenance task is running	OBC
25	statemachine_initialized	-	Bool	1	Statemachine task is initialized	OBC
25	rtc_synchronized	-	Bool	1	RTC time and date is up to date	OBC
25	i2c0_initialized	-	Bool	1	I2C interface is operational	OBC
25	i2c1_initialized	-	Bool	1	I2C interface is operational	OBC
25	i2c2_initialized	-	Bool	1	I2C interface is operational	OBC
25	ssp0_initialized	-	Bool	1	SSP interface is operational	OBC
25	ssp1_initialized	-	Bool	1	SSP interface is operational	OBC
26	supply_switches_initialized	-	Bool	1	GPIOs for power supply switching are intitialized	OBC
26	i2c_switches_initialized	-	Bool	1	I2C switches are	OBC

					initialized	
26	rtc_initialized	-	Bool	1	Real time clock is operational	OBC
26	adc_initialized	-	Bool	1	Adc is operational	OBC
26	uart_gps_initialized	-	Bool	1	UART interface operational	OBC
26	uart_ttc2_initialized	-	Bool	1	UART interface operational	OBC
26	uart_mnlp_initialized	-	Bool	1	UART interface operational	OBC
26	uart_ttc1_initialized	-	Bool	1	UART interface operational	OBC
27	timer0_initialized	-	Bool	1	Timer initialized	OBC
27	watchdog_initialized	-	Bool	1	Watchdog initialized	OBC
27	timer1_initialized	-	Bool	1	Timer initialized	OBC
27	eps_cc1_operational	-	Bool	1	Eps CC1 communication ok	OBC
27	eps_cc2_operational	-	Bool	1	Eps CC2 communication ok	OBC
27	eeprom1_initialized	-	Bool	1	Eeprom initialized	OBC
27	eeprom2_initialized	-	Bool	1	Eeprom initialized	OBC
27	eeprom3_initialized	-	Bool	1	Eeprom initialized	OBC
28	mag_bp_initialized	-	Bool	1	Mag BP communication ok	OBC
28	mag_bp_boom_initialized	-	Bool	1	Magnetometer on boom initialized	OBC
28	gyro1_initialized	-	Bool	1	Low rate gyro initialized	OBC
28	gyro2_initialized	-	Bool	1	Low rate gyro initialized	OBC
28	msp_initialized	-	Bool	1	Msp JTAG programmer initialized	OBC
28	onboard_mag_initialized	-	Bool	1	Onboard magnetometer operational	OBC
28	onboard_tmp100_initialized	-	Bool	1	Onboard TMP100 temperature sensor operational	OBC
28	mpu_initialized	-	Bool	1	Mpu gyro initialized	OBC
29	flash1_initialized	-	Bool	1	External flash storage initialized	OBC
29	flash2_initialized	-	Bool	1	External flash storage initialized	OBC
29	spa_initialized	-	Bool	1	Sidepanel operational	OBC
29	spb_initialized	-	Bool	1	Sidepanel operational	OBC
29	spc_initialized	-	Bool	1	Sidepanel operational	OBC
29	spd_initialized	-	Bool	1	Sidepanel operational	OBC

29	sa_initialized	-	Bool	1	Science adapter operational	OBC
29	bp_initialized	-	Bool	1	Bottompanel operational	OBC
30	gps_initialized	-	Bool	1	Gps initialized	OBC
30	ttc1_initialized	-	Bool	1	Ttc initialized	OBC
30	ttc2_initialized	-	Bool	1	Ttc initialized	OBC
30	science_module_initialized	-	Bool	1	Science MODULE communication ok	OBC
30	spa_vcc_on	-	Bool	1	Power supply of SPA enabled	OBC
30	spb_vcc_on	-	Bool	1	Power supply of SPB enabled	OBC
30	spc_vcc_on	-	Bool	1	Power supply of SPC enabled	OBC
30	spd_vcc_on	-	Bool	1	Power supply of SPD enabled	OBC
31	bp1_vcc_on	-	Bool	1	Power supply of Bottom panel 1 enabled	OBC
31	bp2_vcc_on	-	Bool	1	Power supply of Bottom panel 2 (boom) enabled	OBC
31	sa_vcc_on	-	Bool	1	Power supply science adapter enabled	OBC
31	i2c_sw_a_on	-	Bool	1	I2C of SPA is connected	OBC
31	i2c_sw_b_on	-	Bool	1	I2C of SPb is connected	OBC
31	i2c_sw_c_on	-	Bool	1	I2C of SPC is connected	OBC
31	i2c_sw_d_on	-	Bool	1	I2C of SPD is connected	OBC
31	onboard_mag_powersafe	-	Bool	1	Onboard magnetometer is in powersave	OBC
32	gyro_powesafe	-	Bool	1	Low rate gyro is in powersave	OBC
32	mpu_powersafe	-	Bool	1	MPU is in powersave	OBC
32	tmp100_powersafe	-	Bool	1	TMP100 is in powersave	OBC
32	mag_bp_powersave	-	Bool	1	Magnetometer on bottompanel is in powersave	OBC
32	mag_bp_boom_powersave	-	Bool	1	Magnetometer on boom is in powersave	OBC
32	mnlp_5v_enabled:	-	Bool	1	5V power supply for MNLP is enabled	OBC
32	rtc_oszillator_error	-	Bool	1	Oszillator of RTC is	OBC

					not operational	
32	eeprom_page_cycle_overflow	-	Bool	1	At least one EEPROM page has > 1e6 cycles	OBC
33	ssp0_frequent_errors	-	Bool	1	SSP interface produces errors frequently	OBC
33	ssp1_frequent_errors	-	Bool	1	SSP interface produces errors frequently	OBC
33	i2c0_frequent_errors	-	Bool	1	I2C interface produces errors frequently	OBC
33	i2c1_frequent_errors	-	Bool	1	I2C interface produces errors frequently	OBC
33	i2c2_frequent_errors	-	Bool	1	I2C interface produces errors frequently	OBC
33	timer0_running	-	Bool	1	Timer is operational and running	OBC
33	timer1_running	-	Bool	1	Timer is operational and running	OBC
33	default_config_used	-	Bool	1	Default configuration of OBC is used	OBC
34	error_code;	-	uint8_t	8	Hardware error code	OBC
35	error_code_before_reset;	-	uint8_t	8	Last hardware error code before reset	OBC
36	resets counter	-	uint32_t	32	Reset counter since mission start	OBC
40	Temp SP X-			8	temperature sidepanel X-	SideP
41	Temp SP X+			8	temperature sidepanel X+	SideP
42	Temp SP Y-			8	temperature sidepanel Y-	SideP
43	Temp SP Y+			8	temperature sidepanel Y+	SideP
44	Script Slots			8	bit 7: Cmd Scrip Slot 1(8) loaded bit 6..0: Science Script Slot 7,6,5,4,3,2,1 loaded	OBC
45	Script Slot			8	bit 7..4: n.u. bit 3..0:Cmd Script Slot 5(12),4(11),3(10),2(9) loaded	OBC
	CRC			16		
	FEC			128		

OBC Beacon 1/2
CmdCnt: Counter if commands were received and processed, even if they had no impact.

OBC Beacon 2/2
GPS Time and Date: as long as the GPS has no fix, the RTC Date and -Time of the OBC since the last reset is recorded in these telemetry sections. (Epoche Time 1.1.2015)
If the GPS is reporting a fix, the RTC is UTC.