Beacon format
SMKA "Norby"

The Norby ultra-small spacecraft (SMSA) transmits basic telemetry to

radio beacon at a frequency of 436.7 MHz with a period of 1 minute, changing every minute

modulation:

Lora (bw = 250.0; sf = 10; cr = 5)

FSK (9.6 kbit / s; Modul.factor = 1.0, Data shaping = 1.0 (GSK), Preamble = 0xAA (8 bytes), CRC = on, DCfree = whitening)

The frame structure is described with Kaitai Struct, the language for describing binary data in Appendix 1. The interpretation of the parameters and their dimension are given in Table 1.

norby_beacon.ksy

You can send the received telemetry data to norby@cosmos.nsu.ru

Table 1. Structure of the lighthouse

Start of frame mark (0x0FF1)	-
Frame identifier	-
Frame number	-
Frame recording (generation) time	-

Beacon header	
Active DBK number	-
The number of restarts of the active DBK	-
Mode number in which the SMKA is located	-
Active DBK transmitter power	W
MC temperature of active DBK	° C
Active DBK module status, bit mask	-
Bias voltage across the active DBK power amplifier	AT
Last Received Signal Level (RSSI) active. DBK	dBm
Rel. the signal / noise ratio of the latter is received. signal (SNR) active. DBK	dB
TMI archive record pointer	-
Rel. the signal / noise ratio of the latter is received. signal (SNR) dezh. DBK	dB
MS status	Bit mask
Mon status	Bit mask
MS temperature	° C
Nut status MON	Bit mask
Glonass height	m
Latitude according to Glonass	degrees
Longitude by Glonass	degrees
Date and time by Glonass sensor	date Time
Magnetic induction module	
The angular velocity vector in the SC spacecraft	degree / s
The angle between a pair of vectors of priority 1	degree
The angle between a pair of vectors of priority 2	degree
Median temperature DSG1	° C
Median temperature DSG6	° C
SOP module board temperature	° C
SOP module status (including active SOP number)	Bit mask
DSG status	Bit mask
Orientation number (copy for TMI)	-
Median panel temperature + X	° C
Median panel temperature -X	° C
The status of solar panels (including FEP)	Bit mask
Full battery level in mAh	mAh
AB status	Bit mask
Battery charge and discharge keys status,	Bit mask

Pit line status subsystems	Bit mask
Full battery charging / discharging power	mW
Full generated power SB	mW
Total power consumption of the spacecraft	mW
PMM median temperature (single sensor)	° C
PAM median temperature	° C
PDM median temperature	° C
SES module system elements status	Bit mask
TMI package checksum	-

Appendix 1. Kaitai Struct binary data structure

```
meta:
  id: norby
  file-extension: norby
  endian: le
seq:
  - id: header
    type: header
  - id: payload
    type: payload
    size: header.length - 14
types:
  header:
    seq:
      - id: length
        type: u1
      - id: receiver_address
```

```
            type: u4
        - id: transmitter_address
            type: u4
        - id: transaction_number
            type: u2
        - id: reserved
            size: 2
        - id: msg_type_id
            type: s2
payload:
    seq:
        - id: frame_start_mark
            contents: [0xf1, 0x0f]
        - id: frame_definition
            type: u2
        - id: frame_number
            type: u2
        - id: frame_generation_time
            type: u4
        - id: brk_title
            type: str
            size: 24
            encoding: windows-1251
        - id: brk_number_active
            type: u1
        - id: brk_restarts_count_active
            type: u4
        - id: brk_current_mode_id
            type: u1
        - id: brk_transmitter_power_active
            type: s1
        - id: brk_temp_active
            type: s1
```

```
- id: brk_module_state_active
    size: 2
- id: brk_voltage_offset_amplifier_active
    type: u2
- id: brk_last_received_packet_rssi_active
    type: s1
- id: brk_last_received_packet_snr_active
    type: s1
- id: brk_archive_record_pointer
    type: u2
- id: brk_last_received_packed_snr_inactive
    type: s1
- id: ms_module_state
    size: 2
- id: ms_payload_state
    size: 2
- id: ms_temp
    type: s1
- id: ms_payload_power_state
    type: u1
- id: sop_altitude_glonass
    type: s4
- id: sop_latitude_glonass
    type: s4
- id: sop_longitude_glonass
    type: s4
- id: sop_date_time_glonass
    type: u4
```

```
- id: sop_magnetic_induction_module
    type: u2
- id: sop_angular_velocity_vector
    size: 6
- id: sop_angle_priority1
    type: u2
- id: sop_angle_priority2
    type: u2
- id: sop_median_temperature1
    type: s1
- id: sop_median_temperature6
    type: s1
- id: sop_board_temp
    type: s1
- id: sop_state
    size: 2
- id: sop_state_dsg
    size: 6
- id: sop_orientation_number
    type: u1
- id: ses_median_panel_x_temp_positive
    type: s1
- id: ses_median_panel_x_temp_negative
```

five


```
    type: s1
- id: ses_solar_panels_state
    size: 5
```

```
- id: ses_charge_level
    type: u2
- id: ses_battery_state
    size: 3
- id: ses_charging_keys_state
    size: 2
- id: ses_power_line_state
    type: u1
- id: ses_total_charging_power
    type: s2
- id: ses_total_generated_power
    type: u2
- id: ses_total_power_load
    type: u2
- id: ses_median_pmm_temp
    type: s1
- id: ses_median_pam_temp
    type: s1
- id: ses_median_pdm_temp
    type: s1
- id: ses_module_state
    size: 5
- id: crc16
    type: u2
```