

University of Vigo - LUME-1 satellite

Telemetry modulation, codes and format

Physical layer

TTC frequency	437,060 MHz
S/C EIRP	30 dBm
S/C antenna	Turnstile
S/C polarization	RHCP / LHCP

Data link layer

Modulation	GFSK
Bitrate	4800 / 9600 bps
Sync word	0x930B51DE
Frame format	ASM+Golay (AX100 mode 5)
Bit encoding	NRZ, most significant bit first
Scrambling	CCSDS randomization
Channel coding	Reed-Solomon (255, 223)

A demodulator and decoder based on GNU Radio is available:

<https://github.com/mndza/gr-sattools>

Network layer - CSP

All the packets transmitted by the satellite use the CSP (Cubesat Space Protocol) protocol (<https://github.com/libcsp/libcsp>).

Priority	Source	Destination	Destination Port	Source Port	Reserved	HMAC	XTEA	RDP	CRC	Data
2 bits	5 bits	5 bits	6 bits	6 bits	4 bits	1 bit	1 bit	1 bit	1 bit	Variable
0x02	0x01	0x0F	0x0E	Variable	Variable	0x00	0x00	0x00	0x00	Variable

Transport layer - TM transfer frames

Inside the CSP data field, TM transfer frames are used to encapsulate upper layer data. The TM transfer frames are an adaptation of CCSDS TM transfer standards.

The following table contains the definition of TM transfer frames used for the transmission of beacons (non-reliable channel):

Version number	S/C ID	Virtual channel ID	Virtual channel frame counter	First header pointer	Empty frame	OCF presence	Sequence flags	Fixed length frame	Data	Packet Errors	Frame Errors	Frame Error Control
2 bits	10 bits	4 bits	8 bits	11 bits	1 bit	1 bit	2 bits	1 bit	Var.	16 bits	16 bits	16 bits
0x00	0x41	0x01	Variable	0x00	0x00	0x01	0x03	0x00	Var.	Variable	Var.	Var.

When the satellite is in communication with the ground station a reliable channel is established between the station and the satellite using CSP RDP protocol. The TM transfer frames field values change to reflect this situation:

Version number	S/C ID	Virtual channel ID	Virtual channel frame counter	First header pointer	Empty frame	OCF presence	Sequence flags	Fixed length frame	Data	Packet Errors	Frame Errors	Frame Error Control
2 bits	10 bits	4 bits	8 bits	11 bits	1 bit	1 bit	2 bits	1 bit	Var.	16 bits	16 bits	16 bits
0x00	0x41	0x02	Variable	Variable	Var.	0x01	Var.	0x01	Var.	Variable	Var.	Var.

Application layer - CCSDS Space Packets + ECSS Packet Utilization Standard (PUS)

TM transfer frames transport standard CCSDS SpacePackets implementing ECSS PUS services. A detailed description of PUS packets can be found in "ECSS, Telemetry and telecommand packet utilization. ECSS-E-ST-70-41C. 15 April 2016".

Packet Version	Packet Type	Secondary Header Flag	Application Process Id	Sequence Flags	Packet Name	Packet Data Length	Secondary Header	User Data	PEC
3 bits	1 bit	1 bit	11 bits	2 bits	14 bits	16 bits	Variable	Variable	16 bits
0x00	0x00	0x01	0x01	0x03	Variable	Variable	Sub-struct. A	Sub-struct. B	Var.

For clarity, a description of housekeeping report packets (TM[3,25]) is included below in order to make easier the decoding of dashboard beacons from the satellite:

PUS Version	Time Reference	Service Type	Message Subtype	Type Counter	Destination Id	Day	Milliseconds of the day
4 bits	4 bits	8 bits	8 bits	16 bits	16 bits	16 bits	32 bits
0x01	Variable	0x03	0x19	Variable	0x03e8	Variable	Variable

ID	Parameters
16 bits	Variable
Variable	Variable

Dashboard telemetry beacons

The satellite transmits a burst of 5 packets every 30 seconds. Each packet contains a TM frame with a single SpacePacket inside. Standard PUS service 3 (Housekeeping) is used to format these SpacePackets

Five different beacons are transmitted, each one with a different ID:

- **ID=1 - B1-OBC:** Telemetry from the main on-board computer.
- **ID=2 - B2-EPS:** Telemetry from the power subsystem.
- **ID=3 - B3-TTC+GSSB:** Telemetry from the TTC and the antenna deployment system.
- **ID=4 - B4-ADCS:** telemetry from the ADCS subsystem.
- **ID=5 - B5-Temps:** temperatures of different subsystems of the satellite platform.

All the parameter values are calibrated, no calibration equations are needed.

Dashboard telemetry beacons contents

ID=1		
B1-OBC	Type	Units
P_OBC_BOOT_CAUSE	uint32	
P_OBC_BOOT_COUNT	uint16	reboots
P_OBC_CLOCK	uint32	seconds
P_OBC_CURFLASH	uint16	mA
P_OBC_FS_MOUNTED	uint8	
P_OBC_RAM_IMAGE	int8	
P_OBC_TEMP_A	int16	(x0.1) degC
P_OBC_TEMP_B	int16	(x0.1) degC
P_OBC_TICKS	uint32	ticks
P_OBC_MAG_X	float	
P_OBC_MAG_Y	float	
P_OBC_MAG_Z	float	
P_OBC_OBC_MEMFREE	uint32	bytes
P_OBC_OBC_BUFFERFREE	uint32	bytes
P_OBC_OBC_UPTIME	uint32	bytes
P_OBC_GYRO_X	float	deg/s
P_OBC_GYRO_Y	float	deg/s
P_OBC_GYRO_Z	float	deg/s
P_OBC_GYRO_TEMP	float	degC
P_OBC_FLASH_TOTAL	int64	bytes
P_OBC_FLASH_USED	int64	bytes
P_OBC_FLASH_FREE	int64	bytes
P_OBC_GPIO_TEST	uint8	
P_OBC_GPIO_SW	uint8	
P_OBC_GPIO_PWR	uint8	
P_OM_STATE	uint8	
P_OM_SW_VERSION	string[32]	
P_OP_TR_CONN	uint8	
P_OP_TR_CONN_ACTIVE	uint8	

ID=2		
B2-EPS	Type	Units
P_EPS_OUTPUT_OFF_DELTA_0	uint16	ms
P_EPS_OUTPUT_OFF_DELTA_1	uint16	ms
P_EPS_OUTPUT_OFF_DELTA_2	uint16	ms
P_EPS_OUTPUT_OFF_DELTA_3	uint16	ms
P_EPS_OUTPUT_OFF_DELTA_4	uint16	ms
P_EPS_OUTPUT_OFF_DELTA_5	uint16	ms
P_EPS_OUTPUT_OFF_DELTA_6	uint16	ms
P_EPS_OUTPUT_OFF_DELTA_7	uint16	ms
P_EPS_OUTPUT_ON_DELTA_0	uint16	ms
P_EPS_OUTPUT_ON_DELTA_1	uint16	ms
P_EPS_OUTPUT_ON_DELTA_2	uint16	ms
P_EPS_OUTPUT_ON_DELTA_3	uint16	ms
P_EPS_OUTPUT_ON_DELTA_4	uint16	ms
P_EPS_OUTPUT_ON_DELTA_5	uint16	ms
P_EPS_OUTPUT_ON_DELTA_6	uint16	ms
P_EPS_OUTPUT_ON_DELTA_7	uint16	ms
P_EPS_WDT_CSP_PINGS_LEFT_0	uint8	
P_EPS_WDT_CSP_PINGS_LEFT_1	uint8	
P_EPS_BOOTCAUSE	uint8	
P_EPS_CURSUN	uint16	mA
P_EPS_CURIN_0	uint16	mA
P_EPS_CURIN_1	uint16	mA
P_EPS_CURIN_2	uint16	mA
P_EPS_CUROUT_0	uint16	mA
P_EPS_CUROUT_1	uint16	mA
P_EPS_CUROUT_2	uint16	mA
P_EPS_CUROUT_3	uint16	mA
P_EPS_CUROUT_4	uint16	mA

P_EPS_CURROUT_5	uint16	mA
P_EPS_CURSYS	uint16	mA
P_EPS_TEMP_0	uint16	degC
P_EPS_TEMP_1	uint16	degC
P_EPS_TEMP_2	uint16	degC
P_EPS_TEMP_3	uint16	degC
P_EPS_TEMP_4	uint16	degC
P_EPS_TEMP_5	uint16	degC
P_EPS_BATTMODE	uint8	
P_EPS_PPTMODE	uint8	
P_EPS_COUNTER_BOOT	uint32	reboots
P_EPS_LATCHUP_0	uint16	latchups
P_EPS_LATCHUP_1	uint16	latchups
P_EPS_LATCHUP_2	uint16	latchups
P_EPS_LATCHUP_3	uint16	latchups
P_EPS_LATCHUP_4	uint16	latchups
P_EPS_LATCHUP_5	uint16	latchups
P_EPS_COUNTER_WDT_CSP_0	uint32	
P_EPS_COUNTER_WDT_CSP_1	uint32	
P_EPS_COUNTER_WDT_GND	uint32	
P_EPS_COUNTER_WDT_I2C	uint32	
P_EPS_OUTPUT_0	uint8	
P_EPS_OUTPUT_1	uint8	
P_EPS_OUTPUT_2	uint8	
P_EPS_OUTPUT_3	uint8	
P_EPS_OUTPUT_4	uint8	
P_EPS_OUTPUT_5	uint8	
P_EPS_OUTPUT_6	uint8	
P_EPS_OUTPUT_7	uint8	
P_EPS_WDT_GND_TIME_LEFT	uint32	
P_EPS_WDT_I2C_TIME_LEFT	uint32	
P_EPS_VBATT	uint16	mV
P_EPS_VBOOST_V_0	uint16	mV

P_EPS_VBOOST_V_1	uint16	mV
P_EPS_VBOOST_V_2	uint16	mV
P_EPS_WDTCSPC_0	uint8	
P_EPS_WDTCSPC_1	uint8	

ID=3		
B3-TTC_GSSB	Type	Units
P_GSSB_NX_REBOOT_COUNT	uint8	reboots
P_GSSB_NX_CURRENT_STATE	uint8	
P_GSSB_NX_ANTENNA_STATE	uint8	
P_GSSB_NX_ATTEMPTS_TOTAL	uint16	attempts
P_GSSB_NY_REBOOT_COUNT	uint8	reboots
P_GSSB_NY_CURRENT_STATE	uint8	
P_GSSB_NY_ANTENNA_STATE	uint8	
P_GSSB_NY_ATTEMPTS_TOTAL	uint16	attempts
P_GSSB_PX_REBOOT_COUNT	uint8	reboots
P_GSSB_PX_CURRENT_STATE	uint8	
P_GSSB_PX_ANTENNA_STATE	uint8	
P_GSSB_PX_ATTEMPTS_TOTAL	uint16	attempts
P_GSSB_PY_REBOOT_COUNT	uint8	reboots
P_GSSB_PY_CURRENT_STATE	uint8	
P_GSSB_PY_ANTENNA_STATE	uint8	
P_GSSB_PY_ATTEMPTS_TOTAL	uint16	attempts
P_TTC_TEMP_BRD	int16	(x0.1) degC
P_TTC_LAST_RFERR	int16	Hz
P_TTC_LAST_RSSI	int16	dBm
P_TTC_TOT_RX_BYTES	uint32	bytes
P_TTC_RX_BYTES	uint32	bytes
P_TTC_TOT_RX_COUNT	uint32	packets
P_TTC_RX_COUNT	uint32	packets
P_TTC_TOT_TX_BYTES	uint32	bytes
P_TTC_TX_BYTES	uint32	bytes
P_TTC_TOT_TX_COUNT	uint32	packets
P_TTC_TX_COUNT	uint32	packets
P_TTC_TEMP_PA	int16	(x0.1) degC
P_TTC_BOOT_CAUSE	uint32	
P_TTC_BGND_RSSI	int16	dBm
P_TTC_ACTIVE_CONF	uint8	

P_TTC_BOOT_COUNT	uint16	reboots
P_TTC_LAST_CONTACT	uint32	
P_TTC_TX_DUTY	uint8	

ID=4		
B4-AOCS	Type	Units
P_AOCS_EXTMAG_VALID	uint8	
P_AOCS_EXTMAG_X	float	
P_AOCS_EXTMAG_Y	float	
P_AOCS_EXTMAG_Z	float	
P_AOCS_GPS_POS_DEV_X	float	
P_AOCS_GPS_POS_DEV_Y	float	
P_AOCS_GPS_POS_DEV_Z	float	
P_AOCS_GPS_POS_X	float	
P_AOCS_GPS_POS_Y	float	
P_AOCS_GPS_POS_Z	float	
P_AOCS_GPS_VALID	uint8	
P_AOCS_GYRO_VALID	uint8	
P_AOCS_GYRO_X	float	
P_AOCS_GYRO_Y	float	
P_AOCS_GYRO_Z	float	
P_AOCS_MAG_X	float	
P_AOCS_MAG_Y	float	
P_AOCS_MAG_Z	float	
P_AOCS_MAG_VALID	uint8	
P_AOCS_STATUS_RUN	int8	
P_AOCS_ACS_MODE	int8	
P_AOCS_ADS_MODE	int8	
P_AOCS_EPHEM_MODE	int8	
P_AOCS_BDOT_DETUMB	uint8	
P_AOCS_BOOT_CAUSE	uint32	
P_AOCS_BOOT_COUNT	uint16	reboots

P_AOCS_CURGSSB1	uint16	mA
P_AOCS_CURGSSB2	uint16	mA
P_AOCS_CURPWM	uint16	mA
P_AOCS_CURGPS	uint16	mA
P_AOCS_CURWDE	uint16	mA

ID=5		
B5-Temps	Type	Units
P_AOCS_SUNS_TEMP_PX	float	degC
P_AOCS_SUNS_TEMP_NX	float	degC
P_AOCS_SUNS_TEMP_PY	float	degC
P_AOCS_SUNS_TEMP_NY	float	degC
P_AOCS_SUNS_TEMP_PZ	float	degC
NOT_USED	float	N/A
P_AOCS_EXTMAG_TEMP_32	float	degC
P_AOCS_FSS_TEMP_PX	float	degC
P_AOCS_FSS_TEMP_NX	float	degC
P_AOCS_FSS_TEMP_PY	float	degC
P_AOCS_FSS_TEMP_NY	float	degC
P_AOCS_FSS_TEMP_PZ	float	degC
NOT_USED	float	N/A
NOT_USED	float	N/A
NOT_USED	float	N/A
P_AOCS_GYRO_TEMP_32	float	degC
P_AOCS_TEMP_A	int16	(x0.1) degC
P_AOCS_TEMP_B	int16	(x0.1) degC
P_EPS_TEMP_0	int16	degC
P_EPS_TEMP_1	int16	degC
P_EPS_TEMP_2	int16	degC
P_EPS_TEMP_3	int16	degC
P_EPS_TEMP_4	int16	degC
P_EPS_TEMP_5	int16	degC

P_OBC_TEMP_A	int16	(x0.1) degC
P_OBC_TEMP_B	int16	(x0.1) degC
P_OBC_GYRO_TEMP	float	degC
P_TTC_TEMP_BRD	int16	(x0.1) degC
P_TTC_TEMP_PA	int16	(x0.1) degC

Housekeeping Reports contents

ID=6		
S-Band	Type	Units
P_SBAND_UPTIME	uint32	s
P_SBAND_BOOTCOUNT	uint16	boots
P_SBAND_TEMP_EXT	int16	degC
P_SBAND_TEMP_INT	int16	degC
P_SBAND_VCURR	uint16	mA
P_SBAND_I_BOARD	int16	mA
P_SBAND_VDETI	uint16	V
P_SBAND_VDETA	uint16	V
P_SBAND_VDETB	uint16	V
P_SBAND_BOOTCAUSE	uint16	cause

ID=7		
TOTEM	Type	Units
P_EPS_CUROUT_5	uint16	mA
P_EPS_LATCHUP_5	uint16	latch-ups
P_EPS_OUTPUT_5	uint8	en/dis

ID=8		
HUMPL	Type	Units
P_EPS_CUROUT_4	uint16	mA
P_EPS_LATCHUP_4	uint16	latch-ups
P_EPS_OUTPUT_4	uint8	en/dis
P_HUMPL_T	int16	degC
P_HUMPL_2V5_I	uint16	mA
P_HUMPL_3V3_I	uint16	mA
P_HUMPL_ERROR	uint8	error
P_HUMPL_OPMODE	uint8	mode

ID=9		
TTC	Type	Units
P_TTC_TEMP_BRD	int16	(x0.1) degC
P_TTC_LAST_RFERR	int16	Hz
P_TTC_LAST_RSSI	int16	dBm
P_TTC_TOT_RX_BYTES	uint32	bytes
P_TTC_RX_BYTES	uint32	bytes
P_TTC_TOT_RX_COUNT	uint32	packets
P_TTC_RX_COUNT	uint32	packets
P_TTC_TOT_TX_BYTES	uint32	bytes
P_TTC_TX_BYTES	uint32	bytes
P_TTC_TOT_TX_COUNT	uint32	packets
P_TTC_TX_COUNT	uint32	packets
P_TTC_TEMP_PA	int16	(x0.1) degC
P_TTC_BOOT_CAUSE	uint32	
P_TTC_BGND_RSSI	int16	dBm
P_TTC_ACTIVE_CONF	uint8	
P_TTC_BOOT_COUNT	uint16	reboots
P_TTC_LAST_CONTACT	uint32	
P_TTC_TX_DUTY	uint8	

ID=10		
OBC	Type	Units
P_OBC_BOOT_CAUSE	uint32	
P_OBC_BOOT_COUNT	uint16	reboots
P_OBC_CLOCK	uint32	seconds
P_OBC_CURFLASH	uint16	mA
P_OBC_FS_MOUNTED	uint8	
P_OBC_RAM_IMAGE	int8	
P_OBC_TEMP_A	int16	(x0.1) degC
P_OBC_TEMP_B	int16	(x0.1) degC
P_OBC_TICKS	uint32	ticks
P_OBC_MAG_X	float	
P_OBC_MAG_Y	float	
P_OBC_MAG_Z	float	
P_OBC_OBC_MEMFREE	uint32	bytes
P_OBC_OBC_BUFFERFREE	uint32	bytes
P_OBC_OBC_UPTIME	uint32	bytes
P_OBC_GYRO_X	float	deg/s
P_OBC_GYRO_Y	float	deg/s
P_OBC_GYRO_Z	float	deg/s
P_OBC_GYRO_TEMP	float	degC
P_OBC_FLASH_TOTAL	int64	bytes
P_OBC_FLASH_USED	int64	bytes
P_OBC_FLASH_FREE	int64	bytes
P_OBC_GPIO_TEST	uint8	
P_OBC_GPIO_SW	uint8	
P_OBC_GPIO_PWR	uint8	
P_OM_STATE	uint8	
P_OM_SW_VERSION	string[32]	
P_OP_TR_CONN	uint8	
P_OP_TR_CONN_ACTIVE	uint8	

ID=11		
EPS-All	Type	Units
P_EPS_OUTPUT_OFF_DELTA_0	uint16	ms
P_EPS_OUTPUT_OFF_DELTA_1	uint16	ms
P_EPS_OUTPUT_OFF_DELTA_2	uint16	ms
P_EPS_OUTPUT_OFF_DELTA_3	uint16	ms
P_EPS_OUTPUT_OFF_DELTA_4	uint16	ms
P_EPS_OUTPUT_OFF_DELTA_5	uint16	ms
P_EPS_OUTPUT_OFF_DELTA_6	uint16	ms
P_EPS_OUTPUT_OFF_DELTA_7	uint16	ms
P_EPS_OUTPUT_ON_DELTA_0	uint16	ms
P_EPS_OUTPUT_ON_DELTA_1	uint16	ms
P_EPS_OUTPUT_ON_DELTA_2	uint16	ms
P_EPS_OUTPUT_ON_DELTA_3	uint16	ms
P_EPS_OUTPUT_ON_DELTA_4	uint16	ms
P_EPS_OUTPUT_ON_DELTA_5	uint16	ms
P_EPS_OUTPUT_ON_DELTA_6	uint16	ms
P_EPS_OUTPUT_ON_DELTA_7	uint16	ms
P_EPS_WDT_CSP_PINGS_LEFT_0	uint8	
P_EPS_WDT_CSP_PINGS_LEFT_1	uint8	
P_EPS_BOOTCAUSE	uint8	
P_EPS_CURSUN	uint16	mA
P_EPS_CURIN_0	uint16	mA
P_EPS_CURIN_1	uint16	mA
P_EPS_CURIN_2	uint16	mA
P_EPS_CUROUT_0	uint16	mA
P_EPS_CUROUT_1	uint16	mA
P_EPS_CUROUT_2	uint16	mA
P_EPS_CUROUT_3	uint16	mA
P_EPS_CUROUT_4	uint16	mA
P_EPS_CUROUT_5	uint16	mA
P_EPS_CURSYS	uint16	mA
P_EPS_TEMP_0	int16	degC

P_EPS_TEMP_1	int16	degC
P_EPS_TEMP_2	int16	degC
P_EPS_TEMP_3	int16	degC
P_EPS_TEMP_4	int16	degC
P_EPS_TEMP_5	int16	degC
P_EPS_BATTMODE	uint8	
P_EPS_PPTMODE	uint8	
P_EPS_COUNTER_BOOT	uint32	reboots
P_EPS_LATCHUP_0	uint16	latchups
P_EPS_LATCHUP_1	uint16	latchups
P_EPS_LATCHUP_2	uint16	latchups
P_EPS_LATCHUP_3	uint16	latchups
P_EPS_LATCHUP_4	uint16	latchups
P_EPS_LATCHUP_5	uint16	latchups
P_EPS_COUNTER_WDT_CSP_0	uint32	
P_EPS_COUNTER_WDT_CSP_1	uint32	
P_EPS_COUNTER_WDT_GND	uint32	
P_EPS_COUNTER_WDT_I2C	uint32	
P_EPS_OUTPUT_0	uint8	
P_EPS_OUTPUT_1	uint8	
P_EPS_OUTPUT_2	uint8	
P_EPS_OUTPUT_3	uint8	
P_EPS_OUTPUT_4	uint8	
P_EPS_OUTPUT_5	uint8	
P_EPS_OUTPUT_6	uint8	
P_EPS_OUTPUT_7	uint8	
P_EPS_WDT_GND_TIME_LEFT	uint32	
P_EPS_WDT_I2C_TIME_LEFT	uint32	
P_EPS_VBATT	uint16	mV
P_EPS_VBOOST_V_0	uint16	mV
P_EPS_VBOOST_V_1	uint16	mV
P_EPS_VBOOST_V_2	uint16	mV
P_EPS_WDTCSPC_0	uint8	

P_EPS_WDTCSPC_1	uint8	
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ID=12		
EPS-Out	Type	Units
P_EPS_CURROUT_0	uint16	mA
P_EPS_CURROUT_1	uint16	mA
P_EPS_CURROUT_2	uint16	mA
P_EPS_CURROUT_3	uint16	mA
P_EPS_CURROUT_4	uint16	mA
P_EPS_CURROUT_5	uint16	mA
P_EPS_CURSYS	uint16	mA
P_EPS_LATCHUP_0	uint16	latchups
P_EPS_LATCHUP_1	uint16	latchups
P_EPS_LATCHUP_2	uint16	latchups
P_EPS_LATCHUP_3	uint16	latchups
P_EPS_LATCHUP_4	uint16	latchups
P_EPS_LATCHUP_5	uint16	latchups
P_EPS_OUTPUT_0	uint8	
P_EPS_OUTPUT_1	uint8	
P_EPS_OUTPUT_2	uint8	
P_EPS_OUTPUT_3	uint8	
P_EPS_OUTPUT_4	uint8	
P_EPS_OUTPUT_5	uint8	
P_EPS_OUTPUT_6	uint8	
P_EPS_OUTPUT_7	uint8	

ID=13		
EPS-In	Type	Units
P_EPS_CURSUN	uint16	mA
P_EPS_CURIN_0	uint16	mA
P_EPS_CURIN_1	uint16	mA
P_EPS_CURIN_2	uint16	mA
P_EPS_VBOOST_V_0	uint16	mV
P_EPS_VBOOST_V_1	uint16	mV
P_EPS_VBOOST_V_2	uint16	mV

ID=14		
EPS-Status	Type	Units
P_EPS_WDT_CSP_PINGS_LEFT_0	uint8	pings
P_EPS_WDT_CSP_PINGS_LEFT_1	uint8	pings
P_EPS_BOOTCAUSE	uint8	
P_EPS_BATTMODE	uint8	
P_EPS_PPTMODE	uint8	
P_EPS_COUNTER_BOOT	uint32	reboots
P_EPS_COUNTER_WDT_CSP_0	uint32	reboots
P_EPS_COUNTER_WDT_CSP_1	uint32	reboots
P_EPS_COUNTER_WDT_GND	uint32	reboots
P_EPS_COUNTER_WDT_I2C	uint32	reboots
P_EPS_WDT_GND_TIME_LEFT	uint32	s
P_EPS_WDT_I2C_TIME_LEFT	uint32	s
P_EPS_VBATT	uint16	mV
P_EPS_WDTCSPC_0	uint8	
P_EPS_WDTCSPC_1	uint8	

ID=15		
Temps.	Type	Units
P_AOCS_SUNS_TEMP_PX	float	degC
P_AOCS_SUNS_TEMP_NX	float	degC
P_AOCS_SUNS_TEMP_PY	float	degC
P_AOCS_SUNS_TEMP_NY	float	degC
P_AOCS_SUNS_TEMP_PZ	float	degC
NOT_USED	float	
P_AOCS_EXTMAG_TEMP_32	float	degC
P_AOCS_FSS_TEMP_PX	float	degC
P_AOCS_FSS_TEMP_NX	float	degC
P_AOCS_FSS_TEMP_PY	float	degC
P_AOCS_FSS_TEMP_NY	float	degC
P_AOCS_FSS_TEMP_PZ	float	degC
NOT_USED	float	
NOT_USED	float	
NOT_USED	float	
P_AOCS_GYRO_TEMP_32	float	degC
P_AOCS_TEMP_A	int16	(x0.1) degC
P_AOCS_TEMP_B	int16	(x0.1) degC
P_EPS_TEMP_0	int16	degC
P_EPS_TEMP_1	int16	degC
P_EPS_TEMP_2	int16	degC
P_EPS_TEMP_3	int16	degC
P_EPS_TEMP_4	int16	degC
P_EPS_TEMP_5	int16	degC
P_OBC_TEMP_A	int16	(x0.1) degC
P_OBC_TEMP_B	int16	(x0.1) degC
P_OBC_GYRO_TEMP	float	degC

ID=16		
AOCS-OBC	Type	Units
P_AOCS_STATUS_RUN	int8	
P_AOCS_ACS_MODE	int8	
P_AOCS_ADS_MODE	int8	
P_AOCS_EPHEM_MODE	int8	
P_AOCS_BDOT_DETUMB	uint8	
P_AOCS_BOOT_CAUSE	uint32	
P_AOCS_BOOT_COUNT	uint16	boots
P_AOCS_CLOCK	uint32	s
P_AOCS_CURFLASH	uint16	mA
P_AOCS_CURGSSB1	uint16	mA
P_AOCS_CURGSSB2	uint16	mA
P_AOCS_CURPWM	uint16	mA
P_AOCS_FS_MOUNTED	uint8	
P_AOCS_RAM_IMAGE	uint8	
P_AOCS_TEMP_A	int16	(x0.1) degC
P_AOCS_TEMP_B	int16	(x0.1) degC
P_AOCS_TICKS	uint32	ticks
P_AOCS_CURGPS	uint16	mA
P_AOCS_CURWDE	uint16	mA
P_EPS_CUROUT_1	uint16	mA
P_EPS_LATCHUP_1	uint16	latchups
P_EPS_OUTPUT_1	uint8	

ID=17		
GSSB	Type	Units
P_GSSB_NX_NEXT_KNIFE	uint8	
P_GSSB_NX_COARSE_SUNSENSOR	uint16	
P_GSSB_NX_ATTEMPTS_SINCE_BOOT	uint8	attempts
P_GSSB_NX_REBOOT_COUNT	uint8	reboots
P_GSSB_NX_DELAY_TILL_DEPLOY	uint16	s
P_GSSB_NX_PANEL_TEMPERATURE	int16	(x0.1) degC
P_GSSB_NX_CURRENT_STATE	uint8	
P_GSSB_NX_ANTENNA_STATE	uint8	
P_GSSB_NX_ATTEMPTS_TOTAL	uint16	attempts
P_GSSB_NY_NEXT_KNIFE	uint8	
P_GSSB_NY_COARSE_SUNSENSOR	uint16	
P_GSSB_NY_ATTEMPTS_SINCE_BOOT	uint8	attempts
P_GSSB_NY_REBOOT_COUNT	uint8	reboots
P_GSSB_NY_DELAY_TILL_DEPLOY	uint16	s
P_GSSB_NY_PANEL_TEMPERATURE	int16	(x0.1) degC
P_GSSB_NY_CURRENT_STATE	uint8	
P_GSSB_NY_ANTENNA_STATE	uint8	
P_GSSB_NY_ATTEMPTS_TOTAL	uint16	attempts
P_GSSB_PX_NEXT_KNIFE	uint8	
P_GSSB_PX_COARSE_SUNSENSOR	uint16	
P_GSSB_PX_ATTEMPTS_SINCE_BOOT	uint8	attempts
P_GSSB_PX_REBOOT_COUNT	uint8	reboots
P_GSSB_PX_DELAY_TILL_DEPLOY	uint16	s
P_GSSB_PX_PANEL_TEMPERATURE	int16	(x0.1) degC
P_GSSB_PX_CURRENT_STATE	uint8	
P_GSSB_PX_ANTENNA_STATE	uint8	
P_GSSB_PX_ATTEMPTS_TOTAL	uint16	attempts
P_GSSB_PY_NEXT_KNIFE	uint8	
P_GSSB_PY_COARSE_SUNSENSOR	uint16	

P_GSSB_PY_ATTEMPTS_SINCE_BOOT	uint8	attempts
P_GSSB_PY_REBOOT_COUNT	uint8	reboots
P_GSSB_PY_DELAY_TILL_DEPLOY	uint16	s
P_GSSB_PY_PANEL_TEMPERATURE	int16	(x0.1) degC
P_GSSB_PY_CURRENT_STATE	uint8	
P_GSSB_PY_ANTENNA_STATE	uint8	
P_GSSB_PY_ATTEMPTS_TOTAL	uint16	attempts
P_GSSB_PZ_COARSE_SUNSENSOR	uint16	
P_GSSB_PZ_REBOOT_COUNT	uint8	reboots
P_GSSB_PZ_PANEL_TEMPERATURE	int16	(x0.1) degC

ID=18		
AOCS-Status	Type	Units
P_AOCS_STATUS_RUN	int8	
P_AOCS_BDOT_TORQUER_0	float	
P_AOCS_BDOT_TORQUER_1	float	
P_AOCS_BDOT_TORQUER_2	float	
P_AOCS_STATUS_CSS	int8	
P_AOCS_ACS_MODE	int8	
P_AOCS_ADS_MODE	int8	
P_AOCS_EPHEM_MODE	int8	
P_AOCS_ACS_DMODE	int8	
P_AOCS_ADS_DMODE	int8	
P_AOCS_EPHEM_DMODE	int8	
P_AOCS_BDOT_DMAG_0	float	
P_AOCS_BDOT_DMAG_1	float	
P_AOCS_BDOT_DMAG_2	float	
P_AOCS_BDOT_RATE_0	float	
P_AOCS_BDOT_RATE_1	float	
P_AOCS_BDOT_DETUMB	uint8	
P_AOCS_STATUS_BDOT	int8	
P_AOCS_STATUS_EPHEM	int8	
P_AOCS_STATUS_ETIME	int8	
P_AOCS_STATUS_EXMAG	int8	
P_AOCS_STATUS_FSS_0	int8	
P_AOCS_STATUS_FSS_1	int8	
P_AOCS_STATUS_FSS_2	int8	
P_AOCS_STATUS_FSS_3	int8	
P_AOCS_STATUS_FSS_4	int8	
P_AOCS_STATUS_FSS_5	int8	
P_AOCS_STATUS_FSS_6	int8	
P_AOCS_STATUS_FSS_7	int8	

P_AOCS_STATUS_GPS	int8	
P_AOCS_STATUS_GYRO	int8	
P_AOCS_STATUS_IGRF	int8	
P_AOCS_LOOPTIME	uint16	
P_AOCS_STATUS_MAG	int8	
P_AOCS_MAXLOOPTIME	uint16	
P_AOCS_DBMAIN	uint8	
P_AOCS_DBTASK	uint8	
P_AOCS_STATUS_SGP4	int8	
P_AOCS_STATUS_J2ELE	int8	
P_AOCS_STATUS_J2PRO	int8	
P_AOCS_STATUS_HTPA_0	int8	
P_AOCS_STATUS_HTPA_1	int8	
P_AOCS_STATUS_UKF	int8	
P_AOCS_SPIN_MODE	int8	
P_AOCS_STATUS_EXGYR	int8	
P_AOCS_ACS_TIME	uint32	
P_AOCS_ADS_TIME	uint32	
P_AOCS_EPHEM_TIME	uint32	
P_AOCS_SENS_TIME	uint32	

ID=19		
AOCS-UKF_1	Type	Units
P_AOCS_UKF_PDIAG_0	float	
P_AOCS_UKF_PDIAG_1	float	
P_AOCS_UKF_PDIAG_2	float	
P_AOCS_UKF_PDIAG_3	float	
P_AOCS_UKF_PDIAG_4	float	
P_AOCS_UKF_PDIAG_5	float	
P_AOCS_UKF_PDIAG_6	float	
P_AOCS_UKF_PDIAG_7	float	
P_AOCS_UKF_PDIAG_8	float	
P_AOCS_UKF_PDIAG_9	float	
P_AOCS_UKF_PDIAG_10	float	
P_AOCS_UKF_PDIAG_11	float	
P_AOCS_UKF_Z_0	float	
P_AOCS_UKF_Z_1	float	
P_AOCS_UKF_Z_2	float	
P_AOCS_UKF_Z_3	float	
P_AOCS_UKF_Z_4	float	
P_AOCS_UKF_Z_5	float	
P_AOCS_UKF_Z_6	float	
P_AOCS_UKF_Z_7	float	
P_AOCS_UKF_Z_8	float	
P_AOCS_UKF_Z_9	float	
P_AOCS_UKF_Z_10	float	
P_AOCS_UKF_Z_11	float	
P_AOCS_UKF_Z_12	float	
P_AOCS_UKF_X_0	float	
P_AOCS_UKF_X_1	float	
P_AOCS_UKF_X_2	float	
P_AOCS_UKF_X_3	float	

P_AOCS_UKF_X_4	float	
P_AOCS_UKF_X_5	float	
P_AOCS_UKF_X_6	float	
P_AOCS_UKF_X_7	float	
P_AOCS_UKF_X_8	float	
P_AOCS_UKF_X_9	float	
P_AOCS_UKF_X_10	float	
P_AOCS_UKF_X_11	float	
P_AOCS_UKF_X_12	float	

ID=20		
AOCS-UKF_2	Type	Units
P_AOCS_UKF_ZPRED_0	float	
P_AOCS_UKF_ZPRED_1	float	
P_AOCS_UKF_ZPRED_2	float	
P_AOCS_UKF_ZPRED_3	float	
P_AOCS_UKF_ZPRED_4	float	
P_AOCS_UKF_ZPRED_5	float	
P_AOCS_UKF_ZPRED_6	float	
P_AOCS_UKF_ZPRED_7	float	
P_AOCS_UKF_ZPRED_8	float	
P_AOCS_UKF_ZPRED_9	float	
P_AOCS_UKF_ZPRED_10	float	
P_AOCS_UKF_ZPRED_11	float	
P_AOCS_UKF_ZPRED_12	float	
P_AOCS_UKF_Q_0	float	
P_AOCS_UKF_Q_1	float	
P_AOCS_UKF_Q_2	float	
P_AOCS_UKF_Q_3	float	
P_AOCS_UKF_W_0	float	
P_AOCS_UKF_W_1	float	
P_AOCS_UKF_W_2	float	

ID=21		
AOCS-UKF_3	Type	Units
P_AOCS_UKF_INECLIPSE	uint8	
P_AOCS_UKF_ENABLE_0	uint8	
P_AOCS_UKF_ENABLE_1	uint8	
P_AOCS_UKF_ENABLE_2	uint8	
P_AOCS_UKF_ENABLE_3	uint8	
P_AOCS_UKF_ENABLE_4	uint8	
P_AOCS_UKF_ENABLE_5	uint8	
P_AOCS_UKF_ENABLE_6	uint8	
P_AOCS_UKF_ENABLE_7	uint8	
P_AOCS_UKF_ENABLE_8	uint8	
P_AOCS_UKF_ENABLE_9	uint8	
P_AOCS_UKF_ENABLE_10	uint8	
P_AOCS_UKF_ENABLE_11	uint8	
P_AOCS_UKF_ENABLE_12	uint8	
P_AOCS_UKF_CTRLM_0	float	
P_AOCS_UKF_CTRLM_1	float	
P_AOCS_UKF_CTRLM_2	float	
P_AOCS_UKF_CTRLT_0	float	
P_AOCS_UKF_CTRLT_1	float	
P_AOCS_UKF_CTRLT_2	float	
P_AOCS_UKF_SUNMAX_0	float	
P_AOCS_UKF_SUNMAX_1	float	
P_AOCS_UKF_SUNMAX_2	float	
P_AOCS_UKF_SUNMAX_3	float	
P_AOCS_UKF_SUNMAX_4	float	
P_AOCS_UKF_SUNMAX_5	float	
P_AOCS_UKF_CHOICE	uint8	
P_AOCS_UKF_RATE_0	float	
P_AOCS_UKF_RATE_1	float	

P_AOCS_UKF_RATE_2	float	
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ID=22		
AOCS-Ephem_1	Type	Units
P_AOCS_EPHEM_RATE_IO_0	float	
P_AOCS_EPHEM_RATE_IO_1	float	
P_AOCS_EPHEM_RATE_IO_2	float	
P_AOCS_EPHEM_RATE_IO_3	float	
P_AOCS_EPHEM_MAGECI_0	float	
P_AOCS_EPHEM_MAGECI_1	float	
P_AOCS_EPHEM_MAGECI_2	float	
P_AOCS_EPHEM_DMAGECI_0	float	
P_AOCS_EPHEM_DMAGECI_1	float	
P_AOCS_EPHEM_DMAGECI_2	float	
P_AOCS_EPHEM_QUAT_IO_0	float	
P_AOCS_EPHEM_QUAT_IO_1	float	
P_AOCS_EPHEM_QUAT_IO_2	float	
P_AOCS_EPHEM_QUAT_IO_3	float	
P_AOCS_EPHEM_JDATE	double	
P_AOCS_EPHEM_RECI_0	float	
P_AOCS_EPHEM_RECI_1	float	
P_AOCS_EPHEM_RECI_2	float	
P_AOCS_EPHEM_SUNECI_0	float	
P_AOCS_EPHEM_SUNECI_1	float	
P_AOCS_EPHEM_SUNECI_2	float	
P_AOCS_EPHEM_VECI_0	float	
P_AOCS_EPHEM_VECI_1	float	
P_AOCS_EPHEM_VECI_2	float	
P_AOCS_EPHEM_T_ECLIP	int32	
P_AOCS_EPHEM_QUAT_IE_0	float	
P_AOCS_EPHEM_QUAT_IE_1	float	

P_AOCS_EPHEM_QUAT_IE_2	float	
P_AOCS_EPHEM_QUAT_IE_3	float	
P_AOCS_EPHEM_QUAT_IL_0	float	
P_AOCS_EPHEM_QUAT_IL_1	float	
P_AOCS_EPHEM_QUAT_IL_2	float	
P_AOCS_EPHEM_QUAT_IL_3	float	
P_AOCS_EPHEM_RATE_IL_0	float	
P_AOCS_EPHEM_RATE_IL_1	float	
P_AOCS_EPHEM_RATE_IL_2	float	
P_AOCS_EPHEM_RATE_IL_3	float	

ID=23		
AOCS-Ephem_2	Type	Units
P_AOCS_J2_A	float	km
P_AOCS_J2_ARGPER	float	rad
P_AOCS_J2_ECCANOM	float	rad
P_AOCS_J2_EPOCH	double	s
P_AOCS_J2_INCL	float	rad
P_AOCS_J2_MEANANOM	float	rad
P_AOCS_J2_N	float	rad/s
P_AOCS_J2_P	float	km
P_AOCS_J2_PECI_0	float	
P_AOCS_J2_PECI_1	float	
P_AOCS_J2_PECI_2	float	
P_AOCS_J2_RAAN	float	rad
P_AOCS_J2_TRUEANOM	float	rad
P_AOCS_J2_VECI_0	float	km
P_AOCS_J2_VECI_1	float	km
P_AOCS_J2_VECI_2	float	km

ID=24		
AOCS-Ctrl	Type	Units
P_AOCS_CTRL_BMOMENT_0	float	
P_AOCS_CTRL_BMOMENT_1	float	
P_AOCS_CTRL_BMOMENT_2	float	
P_AOCS_CTRL_BTORQUE_0	float	
P_AOCS_CTRL_BTORQUE_1	float	
P_AOCS_CTRL_BTORQUE_2	float	
P_AOCS_CTRL_EULEROFF_0	float	
P_AOCS_CTRL_EULEROFF_1	float	
P_AOCS_CTRL_EULEROFF_2	float	
P_AOCS_CTRL_M_0	float	Am ²
P_AOCS_CTRL_M_1	float	Am ²
P_AOCS_CTRL_M_2	float	Am ²
P_AOCS_CTRL_REFRATE_0	float	
P_AOCS_CTRL_REFRATE_1	float	
P_AOCS_CTRL_REFRATE_2	float	
P_AOCS_CTRL_REFQ_0	float	
P_AOCS_CTRL_REFQ_1	float	
P_AOCS_CTRL_REFQ_2	float	
P_AOCS_CTRL_REFQ_3	float	
P_AOCS_CTRL_ERRRATE_0	float	
P_AOCS_CTRL_ERRRATE_1	float	
P_AOCS_CTRL_ERRRATE_2	float	
P_AOCS_CTRL_IERRQ_0	float	
P_AOCS_CTRL_IERRQ_1	float	
P_AOCS_CTRL_IERRQ_2	float	
P_AOCS_CTRL_IERRQ_3	float	
P_AOCS_CTRL_MWTORQUE_0	float	
P_AOCS_CTRL_MWTORQUE_1	float	
P_AOCS_CTRL_MWTORQUE_2	float	

P_AOCS_CTRL_MWTORQUE_3	float	
P_AOCS_CTRL_MWMOMENT_0	float	
P_AOCS_CTRL_MWMOMENT_1	float	
P_AOCS_CTRL_MWMOMENT_2	float	
P_AOCS_CTRL_MWMOMENT_3	float	
P_AOCS_CTRL_MWSPEED_0	float	
P_AOCS_CTRL_MWSPEED_1	float	
P_AOCS_CTRL_MWSPEED_2	float	
P_AOCS_CTRL_MWSPEED_3	float	
P_AOCS_CTRL_ERRQ_0	float	
P_AOCS_CTRL_ERRQ_1	float	
P_AOCS_CTRL_ERRQ_2	float	
P_AOCS_CTRL_ERRQ_3	float	

ID=25		
AOCS-SensBasic	Type	Units
P_AOCS_TORQUER_CALIB_0	float	
P_AOCS_TORQUER_CALIB_1	float	
P_AOCS_TORQUER_CALIB_2	float	
P_AOCS_SUNS_VALID	uint8	
P_AOCS_SUNS_TEMP_0	float	degC
P_AOCS_SUNS_TEMP_1	float	degC
P_AOCS_SUNS_TEMP_2	float	degC
P_AOCS_SUNS_TEMP_3	float	degC
P_AOCS_SUNS_TEMP_4	float	degC
P_AOCS_SUNS_TEMP_5	float	degC
P_AOCS_EXTMAG_VALID	uint8	
P_AOCS_EXTMAG_TEMP_32	float	degC
P_AOCS_EXTMAG_0	float	
P_AOCS_EXTMAG_1	float	
P_AOCS_EXTMAG_2	float	
P_AOCS_SUNS_0	float	
P_AOCS_SUNS_1	float	
P_AOCS_SUNS_2	float	
P_AOCS_SUNS_3	float	
P_AOCS_SUNS_4	float	
P_AOCS_SUNS_5	float	
P_AOCS_GYRO_NORM_0	float	
P_AOCS_GYRO_NORM_1	float	
P_AOCS_GYRO_NORM_2	float	
P_AOCS_GYRO_TREND_0	float	
P_AOCS_GYRO_TREND_1	float	
P_AOCS_GYRO_TREND_2	float	
P_AOCS_GYRO_VALID	uint8	
P_AOCS_GYRO_0	float	

P_AOCS_GYRO_1	float	
P_AOCS_GYRO_2	float	
P_AOCS_GYRO_TEMP_32	float	degC
P_AOCS_MAG_0	float	
P_AOCS_MAG_1	float	
P_AOCS_MAG_2	float	
P_AOCS_MAG_VALID	uint8	
P_AOCS_SUNS_RAW_0	uint16	
P_AOCS_SUNS_RAW_1	uint16	
P_AOCS_SUNS_RAW_2	uint16	
P_AOCS_SUNS_RAW_3	uint16	
P_AOCS_SUNS_RAW_4	uint16	
P_AOCS_SUNS_RAW_5	uint16	
P_AOCS_TORQUER_DUTY_0	float	
P_AOCS_TORQUER_DUTY_1	float	
P_AOCS_TORQUER_DUTY_2	float	

Other telemetry packets

Apart from the beacons described in previous sections, the satellite can generate other telemetry packets. A detailed description of PUS packets can be found in “ECSS, Telemetry and telecommand packet utilization. ECSS-E-ST-70-41C. 15 April 2016”. Telemetry packets out of the PUS standard will be described in following sections.

In the table below you can find:

- **Packet ID:** composed by the service ID and the packet subtype ID as defined in the PUS standard (TM[<service>, <subtype>]).
- **Packet description:** a brief description of the packet meaning and contents.
- **Generation:** when this packet is generated on -board:
 - Periodic: the packet is generated autonomously with a certain period.
 - Event: the packet is generated autonomously when an event occurs
 - TC execution: the packet is generated only under specific telecommand from GS

Packet ID	Packet description	Generation
TM[1,1]	successful acceptance verification report	TC execution
TM[1,2]	failed acceptance verification report	TC execution
TM[1,3]	successful start of execution verification report	TC execution
TM[1,4]	failed start of execution verification report	TC execution
TM[1,5]	successful progress of execution verification report	TC execution
TM[1,6]	failed progress of execution verification report	TC execution
TM[1,7]	successful completion of execution verification report	TC execution
TM[1,8]	failed completion of execution verification report	TC execution
TM[1,10]	failed routing verification report	TC execution
TM[3,10]	housekeeping parameter report structure report	TC execution
TM[3,12]	diagnostic parameter report structure report	TC execution
TM[3,25]	housekeeping parameter report	Periodic
TM[3,26]	diagnostic parameter report	Periodic
TM[3,35]	housekeeping parameter report periodic generation properties report	TC execution
TM[3,36]	diagnostic parameter report periodic generation properties report	TC execution
TM[3,41]	parameter functional reporting definition report	TC execution
TM[5,1]	informative event report	Event
TM[5,2]	low severity anomaly report	Event
TM[5,3]	medium severity anomaly report	Event
TM[5,4]	high severity anomaly report	Event

TM[5,8]	disabled event definitions list report	TC execution
TM[6,6]	dumped raw memory data report	TC execution
TM[6,10]	checked raw memory data report	TC execution
TM[9,3]	CDS time report	Periodic
TM[9,134]	CSP node time report	TC execution
TM[11,10]	time-based schedule detail report	TC execution
TM[11,13]	time-based schedule summary report	TC execution
TM[14,134]	application process forward-control configuration content report	TC execution
TM[15,13]	packet store content summary report	TC execution
TM[15,19]	packet store status report	TC execution
TM[15,134]	application process storage-control configuration content report	TC execution
TM[17,2]	are-you-alive connection test report (pong)	TC execution
TM[17,129]	CSP ping test report	TC execution
TM[20,2]	parameter value report	TC execution
TM[21,7]	request sequence execution status report	TC execution
TM[21,10]	request sequence checksum report	TC execution
TM[21,14]	aborted request sequence report	TC execution
TM[21,129]	request sequence content report	TC execution
TM[128,11]	Uptime report	TC execution
TM[128,13]	Routing table report	TC execution
TM[128,15]	CSP node ident report	TC execution
TM[128,21]	Contact start ACK	TC execution
TM[128,24]	Contact end ACK	TC execution
TM[131,6]	Close connection Ack	TC execution
TM[141,2]	all EPS housekeeping report	TC execution
TM[141,4]	EPS VI housekeeping report	TC execution
TM[141,6]	EPS OUT housekeeping report	TC execution
TM[141,8]	EPS WDT housekeeping report	TC execution
TM[141,10]	EPS BASIC housekeeping report	TC execution
TM[141,12]	EPS configuration 1 report	TC execution
TM[141,14]	EPS configuration 2 report	TC execution
TM[142,7]	AOCS state report	TC execution
TM[142,16]	AOCS basic HK report	TC execution

TM[142,33]	RW status report	TC execution
TM[142,35]	RW diagnostic report	TC execution
TM[142,57]	GPS sample report	TC execution
TM[142,62]	GPS ASCII response report	TC execution
TM[142,64]	GPS tracking status report	TC execution
TM[142,66]	GPS receiver status report	TC execution
TM[142,68]	GPS temperature report	TC execution
TM[142,79]	magnetorquers output level report	TC execution
TM[142,82]	PPS last value report	TC execution
TM[142,84]	GPS last sample report	TC execution
TM[143,2]	interstage status report	TC execution
TM[143,10]	interstage configuration report	TC execution
TM[143,13]	GSSB solar panel sensors report	TC execution
TM[143,15]	FSS sensors report	TC execution
TM[150,2]	TOTEM Service Status report	TC execution
TM[150,21]	extracted file report	TC execution
TM[150,23]	data erased report	TC execution
TM[150,25]	database report	TC execution
TM[150,31]	extracted file report	TC execution
TM[150,33]	data erased report	TC execution
TM[150,35]	database report	TC execution
TM[150,37]	loaded file report	TC execution
TM[152,2]	HUMPL Status report	TC execution
TM[152,13]	HUMPL message housekeeping	TC execution
TM[152,15]	HUMPL message event-A	TC execution
TM[152,17]	HUMPL message event-E	TC execution
TM[152,19]	HUMPL memory test report	TC execution
TM[152,21]	HUMPL reception packet test report	TC execution
TM[152,23]	HUMPL reception test report	TC execution
TM[152,25]	HUMPL communication report	TC execution
TM[152,27]	HUMPL error report	TC execution
TM[152,29]	HUMPL signal report	TC execution

Telemetry packets: non-standard PUS packets description

TM[9,134]

PacketUserDataField		
TM_9Data		
timestamp		pec
day	ms	
uint (16 bits) units = day	uint (32 bits) units = ms	uint (16 bits)

TM[14,134]

PacketUserDataField				
TM_14Data				
N	rules			pec
	apid	service	subtype	
uint (8 bits)	uint (16 bits)	uint (8 bits)	uint (8 bits)	uint (16 bits)
repeated N times				

TM[15,134]

PacketUserDataField					
TM_15Data					
packetStoreId	N	rules			pec
		apid	service	subtype	
uint (8 bits) min. value = 0 max. value = 6	uint (8 bits)	uint (16 bits)	uint (8 bits)	uint (8 bits)	uint (16 bits)
repeated N times					

TM[17,129]

PacketUserDataField	
TM_17Data	
timeMs	pec
i64 (32 bits) units = ms (1)	uint (16 bits)

TM[21,129]

PacketUserDataField				
TM_21Data				
requestSeqId	N	entry		pec
		delay	request	
str (64 bits)	uint (16 bits)	uint (32 bits) units = ms	spk (0 to 4096 bits)	uint (16 bits)

repeated N times

TM[128,11]

PacketUserDataField		
TM_128Data		
node	uptime	pec
uint (8 bits)	uint (32 bits) units = s	uint (16 bits)

TM[128,13]

PacketUserDataField	
TM_128Data	
route	pec
str (800 bits)	uint (16 bits)

TM[128,15]

PacketUserDataField						
TM_128Data						
node	hostname	model	revision	date	time	pec
uint (8 bits)	str (160 bits)	str (240 bits)	str (160 bits)	str (96 bits)	str (72 bits)	uint (16 bits)

TM[128,21]

No data fields

TM[128,24]

No data fields

TM[131,6]

PacketUserDataField	
TM_131Data	
connId	pec
uint (8 bits) min. value = 0 max. value = 2	uint (16 bits)

TM[141,2]

PacketUserDataField																						
TM_141Data																						
vboost_0	vboost_1	vboost_2	vbatt	curin_0	curin_1	curin_2	cursun	cursys	curout_0	curout_1	curout_2	curout_3	curout_4	curout_5	output_0	output_1	output_2	output_3	output_4	output_5	output_6	output_7
uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)

PacketUserDataField													
TM_141Data													
hk													
output_on_delta_0	output_on_delta_1	output_on_delta_2	output_on_delta_3	output_on_delta_4	output_on_delta_5	output_on_delta_6	output_on_delta_7	output_off_delta_0	output_off_delta_1	output_off_delta_2	output_off_delta_3	output_off_delta_4	output_off_delta_5
uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)

PacketUserDataField															
TM_141Data															
output_off_delta_5	output_off_delta_6	output_off_delta_7	latchup_0	latchup_1	latchup_2	latchup_3	latchup_4	latchup_5	wdt_i2c_time_left	wdt_gnd_time_left	wdt_csp_pings_left_0	wdt_csp_pings_left_1	counter_wdt_i2c	counter_wdt_gnd	counter_wdt_csp
uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (32 bits)	uint (32 bits)	uint (8 bits)	uint (8 bits)	uint (32 bits)	uint (32 bits)	uint (32 bits)

PacketUserDataField												
TM_141Data												
counter_wdt_csp_0	counter_wdt_csp_1	counter_boot	temp_0	temp_1	temp_2	temp_3	temp_4	temp_5	bootcause	battmode	pptmode	pec
uint (32 bits)	uint (32 bits)	uint (32 bits)	i64 (32 bits)	i64 (32 bits)	i64 (32 bits)	i64 (32 bits)	i64 (32 bits)	i64 (32 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (16 bits)

TM[141,4]

PacketUserDataField									
TM_141Data									
hk									pec
vboost_0	vboost_1	vboost_2	vbatt	curin_0	curin_1	curin_2	cursun	cursys	
uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)

TM[141,6]

PacketUserDataField																				
TM_141Data																				
hk																			pec	
curout_0	curout_1	curout_2	curout_3	curout_4	curout_5	output_0	output_1	output_2	output_3	output_4	output_5	output_6	output_7	output_on_delta_0	output_on_delta_1	output_on_delta_2	output_on_delta_3	output_on_delta_4		output_on_delta_5
uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)

PacketUserDataField																
TM_141Data																
hk																pec
output_on_delta_6	output_on_delta_7	output_off_delta_0	output_off_delta_1	output_off_delta_2	output_off_delta_3	output_off_delta_4	output_off_delta_5	output_off_delta_6	output_off_delta_7	latchup_0	latchup_1	latchup_2	latchup_3	latchup_4	latchup_5	
uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)

TM[141,8]

PacketUserDataField								
TM_141Data								
hk								pec
wdt_i2c_time_left	wdt_gnd_time_left	wdt_csp_pings_left_0	wdt_csp_pings_left_1	counter_wdt_i2c	counter_wdt_gnd	counter_wdt_csp_0	counter_wdt_csp_1	
uint (32 bits)	uint (32 bits)	uint (8 bits)	uint (8 bits)	uint (32 bits)	uint (32 bits)	uint (32 bits)	uint (32 bits)	uint (16 bits)

TM[141,10]

PacketUserDataField										
TM_141Data										
hk									pec	
counter_boot	temp_0	temp_1	temp_2	temp_3	temp_4	temp_5	bootcause	battmode		pptmode
uint (32 bits)	i64 (32 bits)	i64 (32 bits)	i64 (32 bits)	i64 (32 bits)	i64 (32 bits)	i64 (32 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (16 bits)

TM[141,12]

PacketUserDataField											
TM_141Data											
cfg1											
output_normal_value_0	output_normal_value_1	output_normal_value_2	output_normal_value_3	output_normal_value_4	output_normal_value_5	output_normal_value_6	output_normal_value_7	output_initial_on_delay_0	output_initial_on_delay_1	output_initial_on_delay_2	output_initial_on_delay_3
uint (8 bits)	uint (8 bits)	i64 (32 bits)	i64 (32 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)

PacketUserDataField											
TM_141Data											
cfg1											
output_safe_value_0	output_safe_value_1	output_safe_value_2	output_safe_value_3	output_safe_value_4	output_safe_value_5	output_safe_value_6	output_safe_value_7	output_initial_on_delay_0	output_initial_on_delay_1	output_initial_on_delay_2	output_initial_on_delay_3
uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)

PacketUserDataField											
TM_141Data											
cfg1											
output_initial_on_delay_3	output_initial_on_delay_4	output_initial_on_delay_5	output_initial_on_delay_6	output_initial_on_delay_7	output_initial_off_delay_0	output_initial_off_delay_1	output_initial_off_delay_2	output_initial_off_delay_3	output_initial_off_delay_4	output_initial_off_delay_5	output_initial_off_delay_6
uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)

PacketUserDataField						
TM_141Data						
cfg1						
output_initial_off_delay_5	output_initial_off_delay_6	output_initial_off_delay_7	vboost_0	vboost_1	vboost_2	pec
uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)

TM[141,14]

PacketUserDataField				
TM_141Data				
cfg2				
batt_maxvoltage	batt_safevoltage	batt_criticalvoltage	batt_normalvoltage	pec
uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)

TM[142,7]

PacketUserDataField								
TM_142Data								
state								pec
acs_state	desired_acs_state	ads_state	desired_ads_state	ephem_state	desired_ephem_state	acssub_yspin	acssub_lowp	uint (16 bits)
uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (16 bits)

TM[142,16]

PacketUserDataField													
TM_142Data													
hk												pec	
jdate	q_0	q_1	q_2	q_3	w_0	w_1	w_2	pos_0	pos_1	pos_2	eclipse		
dbl	flt	flt	flt	flt	flt	flt	flt	flt	flt	flt	flt	uint	uint
(64 bits)	(32 bits)	(32 bits)	(32 bits)	(32 bits)	(32 bits)	(32 bits)	(32 bits)	(32 bits)	(32 bits)	(32 bits)	(32 bits)	(8 bits)	(16 bits)

TM[142,33]

PacketUserDataField													
TM_142Data													
status												pec	
enable_0	enable_1	enable_2	enable_3	speed_0	speed_1	speed_2	speed_3	torque_0	torque_1	torque_2	torque_3		
uint	uint	uint	uint	flt	flt	flt	flt	flt	flt	flt	flt	uint	
(8 bits)	(8 bits)	(8 bits)	(8 bits)	(32 bits)	(32 bits)	(32 bits)	(32 bits)	(32 bits)	(32 bits)	(32 bits)	(32 bits)	(32 bits)	(16 bits)

TM[142,35]

PacketUserDataField			
TM_142Data			
diagnostic			pec
mw	current	time	
uint	uint	uint	uint
(8 bits)	(16 bits)	(16 bits)	(16 bits)

TM[142,57]

PacketUserDataField															
TM_142Data															
sample															pec
posxyz_0	posxyz_1	posxyz_2	velxyz_0	velxyz_1	velxyz_2	jdate	satellitesSol	satellitesTrack	gpsVelDeviation_0	gpsVelDeviation_1	gpsVelDeviation_2	gpsPosDeviation_0	gpsPosDeviation_1	gpsPosDeviation_2	
flt	flt	flt	flt	flt	flt	dbl	uint	uint	flt	flt	flt	flt	flt	flt	uint
(32 bits)	(32 bits)	(32 bits)	(32 bits)	(32 bits)	(32 bits)	(64 bits)	(8 bits)	(8 bits)	(32 bits)	(32 bits)	(32 bits)	(32 bits)	(32 bits)	(32 bits)	(16 bits)

TM[142,62]

PacketUserDataField	
TM_142Data	
data	pec
str	uint
(0 to 1440 bits)	(16 bits)

TM[142,64]

PacketUserDataField																
TM_142Data																
status				N	sat											pec
sol_status	pos_type	cutoff	num_of_chans		prn	glofreq	ch_tr_status	psr	doppler	c_no	locktime	psr_res	reject	psr_weigth		
uint (32 bits)	uint (32 bits)	flt (32 bits)	uint (32 bits)	uint (8 bits)	uint (16 bits)	uint (16 bits)	uint (32 bits)	dbl (64 bits)	flt (32 bits)	flt (32 bits)	flt (32 bits)	flt (32 bits)	uint (32 bits)	flt (32 bits)	uint (16 bits)	

repeated N times

TM[142,66]

PacketUserDataField						
TM_142Data						
rxstatus						pec
error	nr_stats	rxstat	aux1stat	aux2stat	aux3stat	
uint (32 bits)	uint (32 bits)	uint (32 bits)	uint (32 bits)	uint (32 bits)	uint (32 bits)	uint (16 bits)

TM[142,68]

PacketUserDataField	
TM_142Data	
temperature	pec
flt (32 bits)	uint (16 bits)

TM[142,79]

PacketUserDataField			
TM_142Data			
pwm_0	pwm_1	pwm_2	pec
flt (32 bits)	flt (32 bits)	flt (32 bits)	uint (16 bits)

TM[142,82]

PacketUserDataField			
TM_142Data			
jdate	unixtime	valid	pec
dbl (64 bits)	uint (32 bits)	uint (8 bits)	uint (16 bits)

TM[142,84]

PacketUserDataField								
TM_142Data								
sample								pec
posxyz_0	posxyz_1	posxyz_2	velxyz_0	velxyz_1	velxyz_2	jdate	valid	
flt (32 bits)	flt (32 bits)	flt (32 bits)	flt (32 bits)	flt (32 bits)	flt (32 bits)	dbl (64 bits)	uint (8 bits)	uint (16 bits)

TM[143,2]

PacketUserDataField									
TM_143Data									
address	status								pec
	i2c_res	deploy_in_s	number_of_deploys	active_knife	state	total_number_of_deploys	reboot_deploy_cnt	release_status	
uint (8 bits)	i64 (32 bits)	uint (16 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (16 bits)	uint (8 bits)	uint (8 bits)	uint (16 bits)

TM[143,10]

PacketUserDataField											
TM_143Data											
address	setting									pec	
	std_time_ms	increment_ms	short_cnt_down	max_repeat	rep_time_s	switch_polarity	status	locked	reboot_deploy_cnt		
uint (8 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (16 bits)

TM[143,13]

PacketUserDataField					
TM_143Data					
address	uuid	sensor			pec
		i2c_res	sun_voltage	panel_temp	
uint (8 bits)	uint (32 bits)	i64 (32 bits)	uint (16 bits)	i64 (32 bits)	uint (16 bits)

TM[143,15]

PacketUserDataField								
TM_143Data								
address	uuid	sun_0	sun_1	sun_2	sun_3	temp0	temp1	pec
uint (8 bits)	uint (32 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	flt (32 bits)	flt (32 bits)	uint (16 bits)

TM[150,2]

PacketUserDataField				
TM_150Data				
N	serviceDetails			pec
	serviceName	serviceStatus	serviceTime	
uint (8 bits)	str (160 bits)	uint (3 bits)	uint (29 bits)	uint (16 bits)

repeated N times

TM[150,21]

PacketUserDataField									
TM_150Data									
filterBitmask	sourceTypeeld	priority	timestampLow		timestampHigh		rowCount	fileSize	pec
			dayLow	msOfDayLow	dayHigh	msOfDayHigh			
uint (8 bits)	uint (32 bits)	uint (8 bits)	uint (16 bits)	uint (32 bits)	uint (16 bits)	uint (32 bits)	uint (32 bits)	uint (32 bits)	uint (16 bits)

TM[150,23]

PacketUserDataField									
TM_150Data									
filterBitmask	sourceTypeeld	priority	timestampLow		timestampHigh		rowsErased	rowsTotal	pec
			dayLow	msOfDayLow	dayHigh	msOfDayHigh			
uint (8 bits)	uint (32 bits)	uint (8 bits)	uint (16 bits)	uint (32 bits)	uint (16 bits)	uint (32 bits)	uint (32 bits)	uint (32 bits)	uint (16 bits)

TM[150,25]

PacketUserDataField									
TM_150Data									
filterBitmask	sourceTypeeld	priority	timestampLow		timestampHigh		rowsSelected	rowsTotal	pec
			dayLow	msOfDayLow	dayHigh	msOfDayHigh			
uint (8 bits)	uint (32 bits)	uint (8 bits)	uint (16 bits)	uint (32 bits)	uint (16 bits)	uint (32 bits)	uint (32 bits)	uint (32 bits)	uint (16 bits)

TM[150,31]

PacketUserDataField									
TM_150Data									
filterBitmask	sourceTypeeld	priority	timestampLow		timestampHigh		rowCount	fileSize	pec
			dayLow	msOfDayLow	dayHigh	msOfDayHigh			
uint (8 bits)	uint (32 bits)	uint (8 bits)	uint (16 bits)	uint (32 bits)	uint (16 bits)	uint (32 bits)	uint (32 bits)	uint (32 bits)	uint (16 bits)

TM[150,33]

PacketUserDataField									
TM_150Data									
filterBitmask	sourceTypeeld	priority	timestampLow		timestampHigh		rowsErased	rowsTotal	pec
			dayLow	msOfDayLow	dayHigh	msOfDayHigh			
uint (8 bits)	uint (32 bits)	uint (8 bits)	uint (16 bits)	uint (32 bits)	uint (16 bits)	uint (32 bits)	uint (32 bits)	uint (32 bits)	uint (16 bits)

TM[150,35]

PacketUserDataField									
TM_150Data									
filterBitmask	sourceTypeeld	priority	timestampLow		timestampHigh		rowsSelected	rowsTotal	pec
			dayLow	msOfDayLow	dayHigh	msOfDayHigh			
uint (8 bits)	uint (32 bits)	uint (8 bits)	uint (16 bits)	uint (32 bits)	uint (16 bits)	uint (32 bits)	uint (32 bits)	uint (32 bits)	uint (16 bits)

TM[150,37]

PacketUserDataField		
TM_150Data		
rowsImported	rowsTotal	pec
uint (32 bits)	uint (32 bits)	uint (16 bits)

TM[152,2]

PacketUserDataField	
TM_152Data	
status	pec
uint (16 bits)	uint (16 bits)

TM[152,13]

PacketUserDataField						
TM_152Data						
hk						pec
status	current_3v3	current_2v5	temperature	operation_mode	error_code	
uint (16 bits)	uint (16 bits)	uint (16 bits)	i64 (32 bits)	uint (8 bits)	uint (8 bits)	uint (16 bits)

TM[152,15]

PacketUserDataField							
TM_152Data							
event						data	pec
status	code	doppler_shift	timestamp	sensor_id	length		
uint (16 bits)	uint (8 bits)	uint (16 bits)	uint (32 bits)	uint (16 bits)	uint (8 bits)	uint (0 to 256 bits)	uint (16 bits)

TM[152,17]

PacketUserDataField							
TM_152Data							
event						data	pec
status	code	doppler_shift	timestamp	sensor_id	length		
uint (16 bits)	uint (8 bits)	uint (16 bits)	uint (32 bits)	uint (16 bits)	uint (8 bits)	uint (0 to 256 bits)	uint (16 bits)

TM[152,19]

PacketUserDataField										
TM_152Data										
memTest										pec
status	code	current_3v3	current_2v5	temperature	timestamp	sectors_tested	pages_with_error	address_read	data	
uint (16 bits)	uint (8 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (32 bits)	uint (16 bits)	uint (8 bits)	uint (24 bits)	uint (528 bits)	uint (16 bits)

TM[152,21]

PacketUserDataField													
TM_152Data													
rxTestPkt											packet	pec	
status	code	current_3v3	current_2v5	temperature	timestamp	frequency_shift	power	transceiver	processing_result	packet_length			
uint (16 bits)	uint (8 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (32 bits)	uint (16 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (8 bits)	uint (0 to 640 bits)	uint (16 bits)

TM[152,23]

status	code	current_3v3	current_2v5	temperature	timestamp	transceivers_enabled	transceiver_freq_deviation	first_tracking_time	second_tracking_time	signal_detection_bw	first_tracking_bw	second_tracking_bw	signal_detection_method
uint (16 bits)	uint (8 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (32 bits)	uint (8 bits)	uint (64 bits)	uint (8 bits)	uint (8 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (8 bits)

PacketUserDataField						
TM_152Data						
rxTest						
new_signal_detection_power_threshold	signal_lost_detection_power_threshold	end_packet_detection_power_threshold	new_signal_detection_frequency_error_threshold	signal_lost_detection_frequency_error_threshold	end_packet_detection_max_length_threshold	
uint (32 bits)	uint (32 bits)	uint (32 bits)	uint (64 bits)	uint (64 bits)	uint (8 bits)	

rf_stage_operation_options	packet_processing_options	test_time	max_power_received	minimum_freq_error	signals_lost_first_tracking	signals_oob_in_first_tracking	signals_lost_second_tracking	signals_oob_in_second_tracking	too_short_pkts	lost_pkts	error_pkts
uint (8 bits)	uint (8 bits)	uint (16 bits)	uint (32 bits)	uint (64 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)

correct_pkts	pec
uint (16 bits)	uint (16 bits)

TM[152,25]

PacketUserDataField													
TM_152Data													
comm													
status	code	current_3v3	current_2v5	temperature	timestamp	transceivers_enabled	transceiver_freq_deviation	first_tracking_time	second_tracking_time	signal_detection_bw	first_tracking_bw	second_tracking_bw	signal_detection_method
uint (16 bits)	uint (8 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (32 bits)	uint (8 bits)	uint (64 bits)	uint (8 bits)	uint (8 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (8 bits)

PacketUserDataField					
TM_152Data					
comm					
new_signal_detection_power_threshold	signal_lost_detection_power_threshold	end_packet_detection_power_threshold	new_signal_detection_frequency_error_threshold	signal_lost_detection_frequency_error_threshold	end_packet_detection_max_length_threshold
uint (32 bits)	uint (32 bits)	uint (32 bits)	uint (64 bits)	uint (64 bits)	uint (8 bits)

PacketUserDataField												
TM_152Data												
comm												
rf_stage_operation_options	max_power_received	minimum_freq_error	signals_lost_first_tracking	signals_oob_in_first_tracking	signals_lost_second_tracking	signals_oob_in_second_tracking	too_short_pkts	lost_pkts	error_pkts	correct_pkts	events_A_generated	
uint (8 bits)	uint (32 bits)	uint (64 bits)	uint (64 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (64 bits)	uint (64 bits)	uint (16 bits)

PacketUserDataField	
TM_152Data	
error	
events_E_generated	pec
uint (16 bits)	uint (16 bits)

TM[152,27]

PacketUserDataField							
TM_152Data							
error							pec
status	code	current_3v3	current_2v5	temperature	timestamp	error_code	
uint (16 bits)	uint (8 bits)	uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (32 bits)	uint (8 bits)	uint (16 bits)

TM[152,29]

PacketUserDataField									
TM_152Data									
signal									pec
current_3v3	current_2v5	temperature	timestamp	transceivers_enabled	transceiver_freq_deviation	signal_detection_bw	max_power_received	minimum_freq_error	
uint (16 bits)	uint (16 bits)	uint (16 bits)	uint (32 bits)	uint (8 bits)	uint (64 bits)	uint (16 bits)	uint (32 bits)	uint (64 bits)	uint (16 bits)