GeneSat-1 Beacon Packet Decoding

1. Introduction

Operating at 437.075 MHz FM, the GeneSat-1 beacon sends an AX.25 packet every 5 seconds; the packet contains data about the spacecraft systems operation. The beacon will initiate transmission as soon as the spacecraft is deployed from its carrier on the 4th stage of the launch vehicle.

The data portion of the AX.25 packet is 64 bytes long and contains only standard ASCII characters. Each character represents a HEX value. Below is an example of the 64-byte long raw data:

GeneSat1.org46CD0000000000000000024006A009F0000000000C600000000

Depending on the TNC being use, the data string could be preceded by the following set of characters:

KE7EGC>UNDEF,TELEM:

which denotes sender and recipient of the packet. Ignore this when decoding the packet.

2. Beacon Packet Format

The 64 byte long data packet is divided in fields with fixed sizes as described in Table 1. Note that most of the fields contain different information depending on the value of field *Well Number*.

The values in each field are coded in a '*Little Endian by Pairs*' fashion, also known as '*Circular Endian'*. In this coding, each pair of ASCII characters form a byte and those bytes are written from MSB to LSB. For example, the second field –*BusTime*- in the beacon example of Section 1 is decoded as follows:

Raw in Hex		Raw in Dec		Computation	Value
46CD00	→	70 205 00	→	70 + 205 * 256 + 00 * 65536	52550

Bus Time in the example packet is 52550 seconds.

Name	Size (Bytes)	Description	Valid Field for Well Number	Units
Website	12	GeneSat1.org	All	NA
BusTime	6	Bus time	All	Seconds
SolarI1_Temp1	4	Solar panel 1 current	Even	ADC counts
		Temp sensor 1	Odd	ADC counts
SolarI2_Temp2	4	Solar panel 2 current	Even	ADC counts
		Temp sensor 2	Odd	ADC counts
SolarI3_Temp3	4	Solar panel 3 current	Even	ADC counts
		Temp sensor 3	Odd	ADC counts
SolarI4_Temp4	4	Solar panel 4 current	Even	ADC counts
		Temp sensor 4	Odd	ADC counts
PLI_RadCount	4	Payload current	Even	ADC counts
		Radiation value	Odd	Events per 30s
CommI_CommV	4	MHX current	Even	ADC counts
		MHX Voltage	Odd	ADC counts
Health	2	Bus' power port status	MOD 3 = 0	8 boolean flags
		Startup counter	MOD 3 = 1	Integer
		Spacecraft to ground ID	MOD 3 = 2	Integer
ExpSampleTime	6	Experiment: Sample time	All	Seconds
ExpTempM	4	Experiment: Median temperature	All	Millidegrees C
Well Number	2	Experiment: Well Number	All	Integer
ExpOD	4	Experiment: Optical density	All	Frequency
ExpFL	4	Experiment: Flouresence	All	Frequency
Total Bytes	64			

Note 1: Experiment well will increment by one every time a beacon packet is transmitted.

Note 2: When the well number is odd, HS Data X will consist of Solar panel currents. When the well number is even, HS Data X will consist of Temp sensor readings.

Note 3: All Data is in hexidecimal format.

Table 1 - GeneSat-1 Beacon Packet Definition

3. Beacon Data Calibration

Values specified in ADC Counts can be converted to engineering units using calibration curves described in Table 2. Note that the calibration curves may be adjusted over time, so be sure to check back for an updated set of equations.

Beacon Data									
Name	**Description**	**Type**	**Plot Units**	**Sensor Location**	**Curve Type**	**Formula**	**m**	**b**	**Comments**
BusTime	System Time	Time	Sec	C and DH Board	Abscissa	TimeStamp=INTEGER(CT)	na	na	4 Bytes. Counts in seconds.
Temp1	Temp @ Solar Panel 1	AD590, S/N: 14	Deg-C	Center, Mounting Panel	line	T1 =m*(CT)+b	0.0453	-1.107	X range = 0 -1023, Temp. range = -1.1 1C - 45.27 C
Temp2	Temp @ Payload Enclose	AD590, S/N: 18	Deg-C	Center, Optic side, outside enclose	line	T2 =m*(CT)+b	0.0456	-1.299	X range = 0 -1023, Temp. range = -1.3 C - 45.38 C
Temp3	Temp @ Solar Panel 2	AD590, S/N: 16	Deg-C	Center, Mounting Panel	line	T5 =m*(CT)+b	0.0458	-0.6926	X range = 0 -1023, Temp. range = -0.69 C - 46.15 C
Temp4	Temp @ Main Comm	AD590, S/N: 20	Deg-C	Side close to the antenna	line	T6 =m*(CT)+b	0.0452	-1.1886	X range = 0 -1023, Temp. range = -1.19 C - 45.09 C
Solar1I	Solar Panel 1 Current	Current	mA	EPS	line	Solar1I =m*(CT)+b	0.9589	-4.4677	X range = 5 -1023,Current range =0.33 mA -977.47 mA
Solar2I	Solar Panel 2 Current	Current	mA	EPS	line	Solar1I =m*(CT)+b	0.9581	-2.9282	X range = 4 -1023,Current range =0.9 mA - 978.13 mA
Solar3I	Solar Panel 3 Current	Current	mA	EPS	line	Solar1I =m*(CT)+b	1.0346	-4.5276	X range = 2 -1023,Current range =0.55 mA -976.4 mA
Solar4I	Solar Panel 4 Current	Current	mA	EPS	line	Solar1I =m*(CT)+b	0.9558	-1.3528	X range = 2 -1023,Current range =0.56 mA -977.37 mA
CommI	Main Comm Current	Current	mA	EPS	line	CommI =m*(CT)+b	2.1126	7.3483	X range = 1 -485,Current range =9.46 mA - 1031.97 mA, Circuit will be cut off if CT>485 or I > 1031mA
PLI	Payload Current	Current	mA	EPS	line	Payload1I = m*(CT)+b	0.4791	0.611	X range = 0 -975,Current range =0.611 mA -467.7 mA, Circuit will be cut off if CT>975 or I > 467.7mA
CommV	Main Comm Voltage	Voltage	Volts	EPS	line	CommV =m*(CT)+b	0.012	-0.012	On X range = 213-437,On Voltage range =5V -2.8V, Circuit will be cut off if CT<213 or V< 2.8V
RadCount	Gamma Radiation Sensor	Radiation	uRad	658 CT average.	line	mRad=m*(CT)+b	0.0015	0	Gamma source, 1.0uCi, 1173.2 keV/1332.5 keV dirctetecd face to the sensor.m=(2 samples/minute)*(60uRad/CT)*(1mRad/1000 uRad)
Health	Subsystems Power State	Boolean	N/A	na	na	na	na	na	power vector [8:0]= [Batt_heater not_used not_used Payload_heater Beacon Payload Sensors Comm]
ExpSampleTime	Experiment Time	Time	Sec	Payload Main Electronics	Abscissa	TimeStamp= INTEGER(CT)	na	na	4 Bytes. Counts in seconds.
ExpTempM	Exp. Average Temp.	Temperature, mean	Deg-C	Payload Heater Plate	line	TM=m*(CT)+b	0.006400	0.0124	
Well Number	Well being measured	Integer Enumerator	Well #	Software incrementer		Well=INTEGER(CT)	na	na	Well number used to ID DarkI, OD, and FL data below. Uses 1 byte in the data packet.
ExpOD	Optical Density Reading	Freq as Function of light	ODU	Optics, TAOS Detector	line	OD_Taos=m*(CT)+b	1	0	x10 to remove onboard divide by 10.
ExpFL	Flourescence Reading	Freq as Function of light	RFU	Optics, TAOS Detector	line	FL_Taos=m*(CT)+b	1	0	x10 to remove onboard divide by 10.

Table 2 – Calibration Curves (12/9/06)