EcAMSat Beacon Packet Decoding

1. Introduction

Operating at 437.100 MHz FM, the EcAMSat beacon sends an AX.25 packet every 5 seconds, similar to the format of the GeneSat-1, PharmaSat, O/OREOS, and SporeSat beacons; the packet contains data about the spacecraft systems operation. The beacon will initiate transmission 30 minutes after ejection into orbit from ISS.

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

EcAMSat.org   E11C0100008B021F89026602000036009E0900423FB3490940

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

KE7EGC>UNDEF,TELEM/1: <<UI>>:

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

Raw in Hex	Raw in Dec	Computation Value	Final Value
E11C01 $\rightarrow$ E1 1C 01 $\rightarrow$	225 28 1 $\rightarrow$	$225*16^0 + 28*16^2 + 1*16^4$ $\rightarrow$	72929

The timestamp in the example packet is 72929 seconds.

The packet definition indicates that there are field that assume the value of various sensors on the spacecraft and are dictated by the value of the *Well Number* field.

Name	Size (Bytes)	Description	Valid Field for Well Number	Units
Website	11	EcAMSat.org	All	NA
Reserved	3	<space>		
BusTime	6	Bus Time	All	Seconds
SolarI	4	Solar panel 1 current	0	ADC counts
		Solar panel 2 current	1	ADC counts
		Solar panel 3 current	2	ADC counts
		Solar panel 4 current	3	ADC counts
SolarT	4	Solar panel 1 temp	0	Centidegrees C
		Solar panel 2 temp	1	Centidegrees C
		Solar panel 3 temp	2	Centidegrees C
		Solar panel 4 temp	3	Centidegrees C
Health0	2	Bus' power port status	0	Bit field
		Startup counter	1	Integer
		Spacecraft to ground ID	2	Integer
		Experiment phase	3	Bit field
Health1	4	Payload1T	0	Centidegrees C
		Radiation value	1	Events per 30s
		CommI	2	ADC counts
		CommV	3	ADC counts
Health2	4	BatteryV	0	ADC counts
		CommV	1	ADC counts
		SensorsV	2	ADC counts
		BusV	3	ADC counts
Health3	4	PayloadHeaterI	0	ADC counts
		PayloadI	1	ADC counts
		Bus Data Page	2	Integer
		Register File Wrap Count	3	Integer
PageNumber	4	Payload Data Page	All	Integer
CardTempM	4	Median card temperature	All	Centidegrees C
Well Number	2	Well Number	All	Integer
TaosR	4	TAOS Reading: Red LED	All	Frequency
TaosG	4	TAOS Reading: Green LED	All	Frequency
TaosB	4	TAOS Reading: Blue LED	All	Frequency
Total Bytes	64			

Table 1 – EcAMSat Beacon Packet Definition

3. Beacon Data Calibration

Values specified in ADC counts can be converted to engineering units using calibration curve in Table-2.

Field Name	Sensor Name	Unit	Formula	m	b
Payload1T	Payload Board	Deg-C	Payload T =m*(CT)+b	0.0554	-15.75
Solar1I	Solar 1 Current	mA	Solar1I =m*(CT)+b	1.8678	3.41
Solar2I	Solar 2 Current	mA	Solar1I =m*(CT)+b	0.9542	-1.07
Solar3I	Solar 3 Current	mA	Solar1I =m*(CT)+b	1.8785	-0.41
Solar4I	Solar 4 Current	mA	Solar1I =m*(CT)+b	0.9562	-1.04
CommI	Comm Current	mA	CommI =m*(CT)+b	4.3330	16.27
Payload1HeaterI	Payload1Heater Current	mA	Payload1HeaterI =m*(CT)+b	3.2922	8.04
Payload1I	Payload1 Current	mA	Payload1I =m*(CT)+b	3.4281	-22.69
CommV	Comm Voltage	Volts	CommV =m*(CT)+b	0.0119	0.01
SensorsV	Sensors Voltage	Volts	SensorsV =m*(CT)+b	0.0130	-0.48
BusV	Bus Voltage	Volts	BusV =m*(CT)+b	0.0059	0.00
Battery V	Bus Voltage	Volts	Vbatt =m*(CT)+b	0.0119	-0.05
Radiation Sensor	Gamma Radiation	uRad	mRad=m*(CT)+b	0.0013	0

Table 2 - EcAMSat data calibrations