EARTH RADIATION BUDGET SATELLITE (ERBS) ORBITING PROFILES AND Ni–Cd USE

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Summary

The Earth Radiation Budget Satellite (ERBS) is one of the more recently launched satellites of the Goddard Space Flight Center. This paper presents the flight data of the two 50 A h NASA standard batteries that are being flown on the ERBS. Trend characteristics of the batteries were collected over a period of two years. The parameters that were followed are: the battery end-of-discharge voltage, time in peak power track and time in constant current mode. All were plotted *versus* mission elapsed time. The slopes exhibited by the parameters indicate no adverse trends that would signify any appreciable degradation in the batteries.

Introduction

The ERBS was launched on Oct. 5, 1984 from the Space Shuttle Challenger to a 600 km circular orbit with an inclination of 57 degrees from the equator. This orbital configuration gives ERBS a 97-minute orbital period and occasional periods of full-sunlit orbits.

The ERBS power system has a peak power tracker, a constant current trickle charge mode ($C/50$), and an on-line ampere hour integrator. These components, together with the VT limiting capability, control the charging of the two batteries connected in parallel. The batteries share a common load. Charge control is dependent on the warmer battery, which is battery number 1. The batteries are charged to 32.12 V (1.46 V/cell), equivalent to the Goddard VT6, at an average temperature of 9 °C. The average depth of discharge the batteries are subjected to is 10%.

A typical single orbit power profile of the ERBS is shown in Fig. 1. As shown, as soon as the solar arrays see sunlight the peak power track takes over and charges the batteries until the voltage reaches the selected VT setting. From there the voltage limiting mode of charging takes place, as indicated by the taper charge, until the ampere hour integrator indicates 100% State of Charge. The batteries are then charged at the constant current mode equivalent to a $C/50$ charge rate. Figure 2 shows the orbital power

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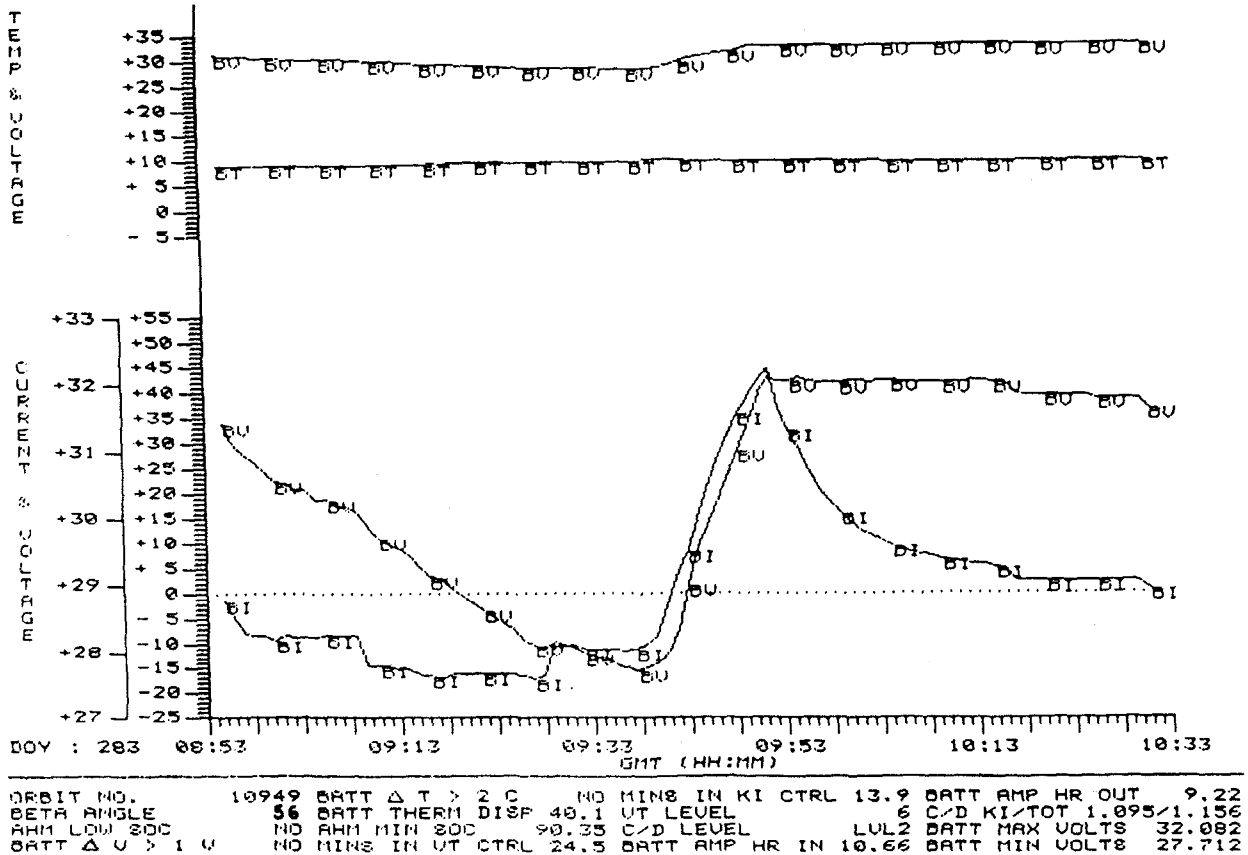
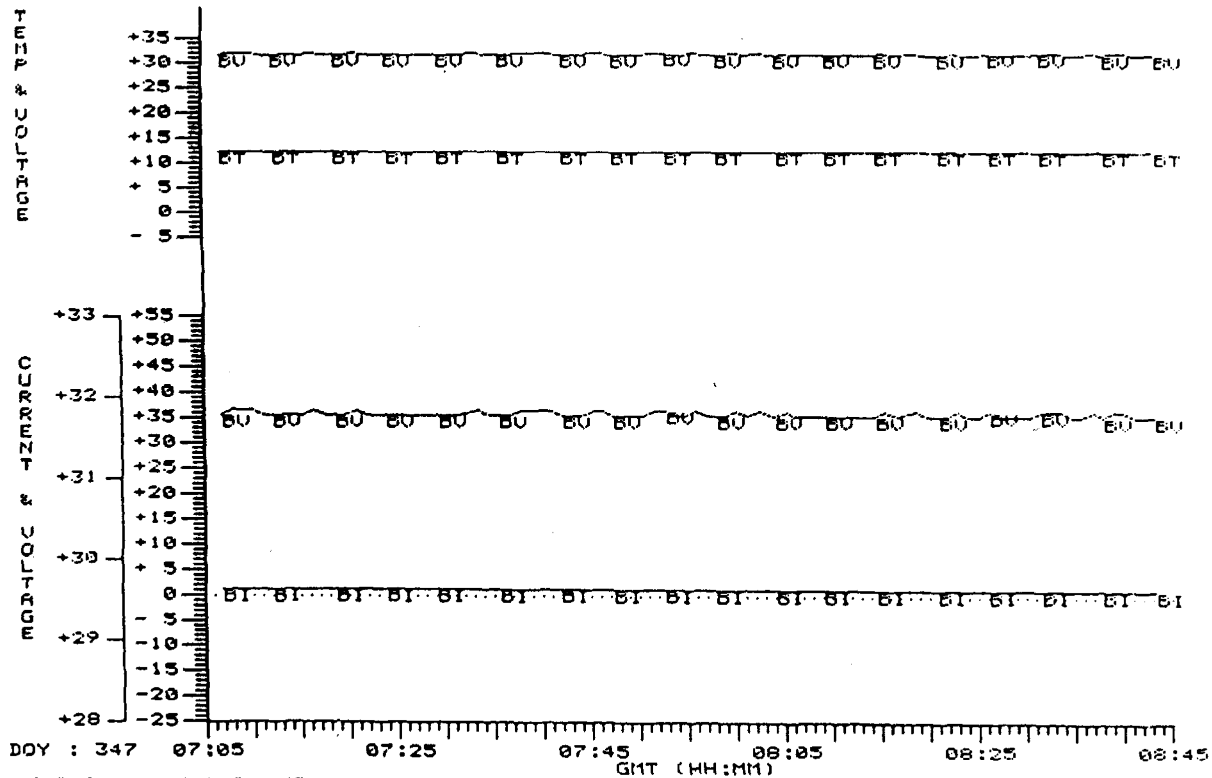


BV = Battery Voltage BT = Battery Temperature BI = Battery Current

Fig. 1. ERBS orbital power profile.



ORBIT NO. 1018	BATT Δ T > 2 C NO	MINS IN KI CTRL 0.0	BATT AMP HR OUT 0.00
BETA ANGLE 11	BATT THERM DISP ≈ 45.8	VT LEVEL 6	C/D KI/TOT <0.000
AHM LOW SOC NO	AHM MIN SOC 100.00	C/D LEVEL LVL2	BATT MAX VOLTS 31.845
BATT Δ V > 1 V NO	MINS IN VT CTRL 0.0	BATT AMP HR IN 0.00	BATT MIN VOLTS 31.797

BV = Battery Voltage   BT = Battery Temperature   BI = Battery Current

Fig. 2. ERBS orbital power profile.

profile when the spacecraft is in full-sun. Note that the batteries remain at a constant current charge and the temperature is about 4 - 5 °C above the orbital average of 9 °C.

Flight data presentation

To provide consistency in the data used in following the selected battery parameters, a similar orbit comparison technique was used. Data from 45° and 90° sun angles were selected due to their availability, although data from the 90° sun angle region, which happens to be the worst case eclipse period, give a more representative end-of-discharge voltage. All the data were taken from the orbital power profiles run for the selected sun angles.

Figures 3 and 4 show the Time in Peak Power Tracking and Time in Constant Current Charge, respectively. Both parameters were plotted *versus* mission elapsed time. Pertinent spacecraft configuration and load conditions for all the data used in both Figures as well as in Fig. 5 are as follows:

Sun angle: 45 ± 5°
Minimum state of charge: 93 ± 0.5%
Loads: No power amplifier usage
Current at end-of discharge: 12 ± 2 A

Sun angle: 90 ± 2.5°
Minimum state of charge: 91 ± 1%
Loads: No power amplifier usage
Current at end-of-discharge: 10 ± 1.5 A.

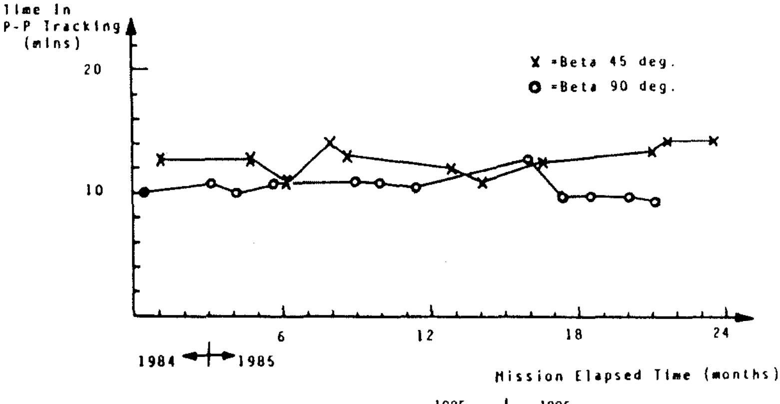


Fig. 3. Time in peak power tracking *vs.* mission elapsed time.

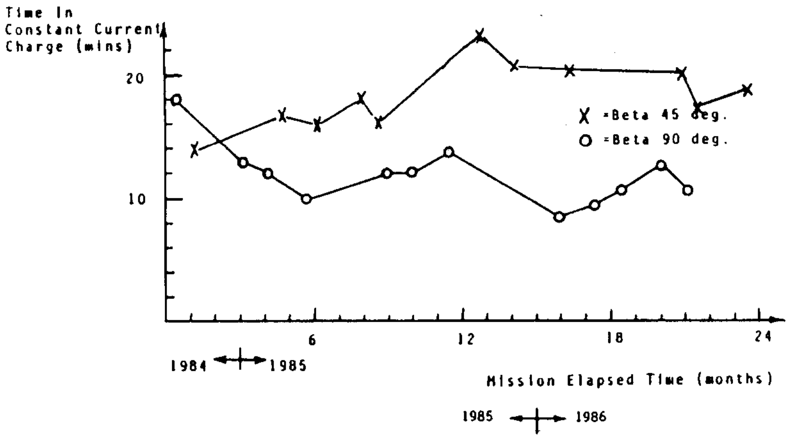


Fig. 4. Time in constant current charge *vs.* mission elapsed time.

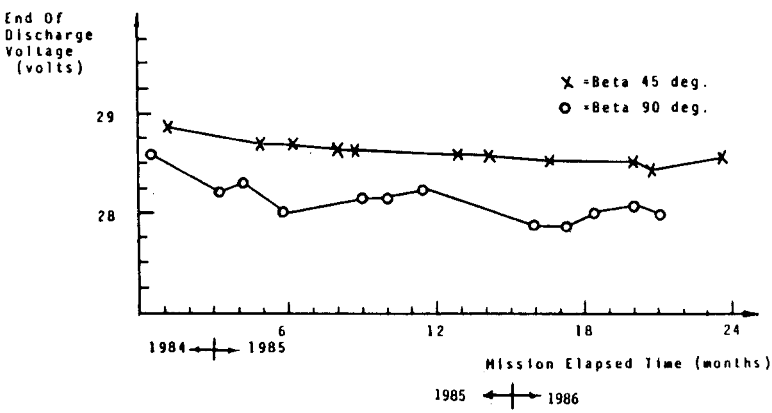


Fig. 5. End of discharge voltage *vs.* mission elapsed time.

Of the three parameters followed, only the End of Discharge Voltage *versus* mission elapsed time (Fig. 5) shows any trend. The plot shows a slight decrease in the end of discharge voltage over the two-year period.

Reference

1 P. C. Lyman, ERBS power subsystem trend data, Ball Aerospace Systems Division, *SER ERBS 05-57, Rev. B, 09-19-86.*