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SPAR-R.677

FEASIBILITY STUDY OF A GENERAL PURPOSE SPACECRAFT BUS

VOLUME I
TECHNICAL REPORT

ERRATA ADDENDUM

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ERRATA ADDENDUM
FEASIBILITY STUDY OF A
GENERAL PURPOSE SPACECRAFT BUS

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FOREWORD

All holders of SPAR-R.677, "Feasibility Study of a General Purpose Spacecraft Bus", are requested to append the respective errata sheets to each of Volumes I, II and III, in their possession. Issuing of this errata document has become necessary due to a number of minor errors and inconsistencies in the original documents. Inconvenience caused to the readers is sincerely regretted.

Page No.	Section No.	Correction
1-2	1.1	Change last sentence of this section to read:- "In synchronous orbit, the spacecraft is spun down and a 3-axis zero momentum control system with a microwave attitude sensor is used".
1-2	1.2	Replace entire section with the following:- Reaction Control Subsystem Consisting of high thrust engines for precession manoeuvres during the spinning phases; with low thrust engines for attitude and station acquisition, and for attitude control, including momentum dumping, and stationkeeping during the 3-axis synchronous orbit phase of the mission.
1-3	1.6	Change second sentence to read:- This structure will be designed and qualified to withstand at least an additional 100 lbs. of payload, thus catering for any launch vehicle capability increase which may occur in the foreseeable future.
2-5	2.1.2.2	Delete the following:- It is assumed that extensive use of the NASA tracking stations will be made and for this purpose, a compatible S-band ranging transponder will be carried on board the spacecraft. Replace with:-

		It is assumed that the Telesat tracking station network will be used.
2-7	2.1.2.4	After "........T + 2 hours", add "where T is the time at transfer orbit injection,"
2-10	2.1.4	Delete "....non-spinning earth sensor...." add "....microwave attitude sensor...."
* 2-11, 2-12	2.1.5.3	Replace the first paragraph of this section with the following:- "The satellite will be three-axis stabilized during its on-orbit operation. The on-orbit attitude controller uses a magnetic bearing reaction wheel about the pitch axis and a set of thrusters as actuators. The roll, pitch and yaw errors will be sensed by a microwave attitude sensor. Pitch control is effected by varying the speed of the reaction wheel. Roll and yaw errors are controlled by the thrusters".
2-12	2.1.5.4	Replace the entire section with the following:- "The angular momentum imparted to the satellite in pitch, by external secular disturbance torques, will be stored in the reaction wheel, leading to a non-zero mean wheel speed. Periodic momentum dumping using the pitch thrusters will be conducted. The fuel required for momentum dumping will depend on the pitch disturbance torques. The dumping operation may be carried out autonomously on board."

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3-3	3.1.1	Third paragraph of this section. After "non-spinning earth sensor" Add - "or microwave attitude sensor" Seventh paragraph of this section. Change '3137A' to read '3731A'.
3-14	3.2.2	Change last sentence of fourth paragraph of this section to read:- For the apogee motor and nozzle blankets, aluminized Kapton sheets, plus two layers of crinkled stainless steel foil have been used, instead of the aluminized Mylar layers.
3-17	3.2.4	Replace the entire section with the following:- <u>Reaction Control Subsystem</u> (See Figure 3-7) The Bus incorporates the Reaction Control Subsystem used to provide control torques during both the spinning and non-spinning phases of the mission. It is mounted on the thrust tube and bulkheads of the Bus and integrated at this primary structure level of assembly. The RCS is a dual thrust level, blowdown mass expulsion propulsion subsystem utilizing all titanium surface tension tankage. Propellant, neat hydrazine, N_2H_4, is isolated and directed within the subsystem by latching valves. High thrust catalytic engines are used for precession during the spinning phases, low thrust electrothermal engines are used for attitude acquisition and on-orbit attitude control and low thrust superheated

electrothermal engines are used for station acquisition and keeping. Line and inlet filters are installed in this subsystem to ensure cleanliness. The Electrical Control Unit (ECU) of the RCS interfaces with the ACS, Power and TT&C subsystems and provides engine and heater drivers, power conditioning and signal conditioning for RCS telemetry.

Gaseous nitrogen is loaded into the four propellant tanks through respective fill and vent valves, and drives hydrazine through the subsystem. As fuel is expended during the mission, the driving pressure decreases resulting in a corresponding reduction in thrust from the engines.

Hydrazine is loaded into the four propellent tanks through two fill and drain valves. Pressure transducers monitor subsystem pressure upstream of tank latching valves. There are two high thrust engines and sixteen low thrust engines (of which six are capable of being superheated). These thrusters are isolated into four groups by latching valves arranged to provide maximum redundancy associated with minimum mass. Heaters are required on thrust chambers, valves, lines and tanks to ensure adequate performance and to prevent fuel from freezing during spacecraft cooldown periods. These heaters are grouped functionally to maximize redundancy while minimizing command requirements.

At least single point failure protection exists for all engines and functions as described in section 5.2.

*	3-23	3.3.1	Change '0.2°' to '0.02°'
	4-7	4.1.5.2	Replace (c) by:-
			(c) Engine thrust: i) low thrust > .01 lbf end of life. ii) high thrust between 1 and 5.5 lbf
		4.1.5.3	(a) Change "6 years" to "8 years" (d) Change "50V" to "35 to 40V"
		4.1.5.4	(b) Change "2120 lbs" to "2125 lbs. minimum"
	4-9	Table 4.2.1-3	Change "(Motor Fired 54)" to "(Motor Fired 56)"
			Change "(Propellant & Inserts 903)" to "(Propellant & Inerts 901)"
	4-12	4.2.1.3	Replace entire section with:-
			RCS
			The dry weight of the reaction control subsystem is 64.1 lbs. which includes tank struts and brackets. The propellant weight of 150.2 lbs. is sufficient for the worst case (1985 launch) six year mission. Pressurant weighs 3.6 lbs. resulting in a total subsystem weight of 217.9 lbs.
		4.2.1.4	Second paragraph - change '4 lb.' to '1 lb.'
		4.2.1.6	Change:- '903 lbs.' to '901 lbs.' ' 54 lbs.' to ' 56 lbs.'
	5-10	Table 5.1.1.3.2-1	Under 'weight' column change:- "13.68" to "10.68" " 6.33" to " 6.93" "101.8" to "98.8" "84.95" to "85.55"

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		Under "On-orbit Power" column change:- "45.6" to "35.6"
5-17	Table 5.1.1.4-1	Under 'WHECON Conventional Bearing Wheel' column change:- "101.8" to "98.8" Under 'WHECON Magnetic Bearing Wheel' column change:- "84.95" to "85.55"
5-19	5.1.1.5	Replace entire section with:- "The Hybrid control system with a single magnetic bearing reaction wheel has been chosen for the General Purpose Bus Satellite primarily because of its minimum weight. However this choice was made late in the study. Originally the WHECON system had been chosen and subsequent ACS and RCS descriptions relate to this.
5-26	5.2.1	Replace first sentence with:- The RCS requirements have been synthesized from spacecraft and mission parameters and are presented below.
5-35	5.2.1.6	Para. (a): Change this paragraph to read: It shall be assumed that acceleration, vibration and acoustic levels will be similar to those used on the CTS project for the 2914 Delta launch vehicle (refer to para. 4.2 and 4.3 of SPAR-SG.359, Volume II of this report).
5-52	5.2.2.9 Table 5.2.2.9-1	Under "Nominal Estimated Dry Weight" add "(Typical for an all catalytic system)" Change "+20 Allowance" to "+2% Allowance" Change "194.64" to "194.62"

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		Change "154.0" to "153.80" Under "194.62" add "(includes 4.59 lbm pressurant)" Under "153.80" add "(includes 3.60 lbm pressurant)" Change "218" to "217.87"
5-53, 5-54	5.2.4	References 7, 8 and 9: Change "Muych" to "Murch"
5-65	5.3.3.1.3	Change 'Figure 3-5' to 'Figure 3-8'
5-87	Table 5.4-1	Units for P_c and P_{allow} should be # not #in.
5-90	5.4.2.1.1	Para b): Immediately above the table add the statement "Sweep Rate: 2 octaves per minute". Under the "Frequency" column: Seventh line: change 5-10 Hz to 5-9 Hz Eighth line: change 10-14 Hz to 9-14 Hz Under the "Input Acceleration" column: First line:- Change '2.3' to '0.5" d.a.' Seventh line:- Change '2.0' to '0.5" d.a.'
5-91	5.4.2.1.3	Change the word "<u>excluding</u>" to "<u>including</u>" Add the following:- This gives an added growth allowance of 200 lb. (100 lb. extra payload, 100 lb. of apogee motor fuel)

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