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14. Abstract/Notes

        This document presents the description of the Data Collecting Satellite On-Board Supervision Subsystem for the Preliminary Design Review. In addition, the physical characteristics, performance analysis, reliability and design feasibility of the On-Board Supervision Subsystem are discussed.

15. Remarks

CONTENTS

APPENDIX A

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LIST OF FIGURES

LIST OF TABLES

1 - INTRODUCTION

This document and its reference documents contain all the necessary information for the On-Board Supervision Subsystem Preliminary Design Review (PDR).

Section 3.1 contains an overall description of the subsystem including specifications, architecture, block diagram and software features.

Section 3.2 describes the subsystem properties like power consumption, size, weight, operating models, telemetry and telecommand necessities, thermal control requirements, etc.

The performance requirements are described in Section 3.3, together with the explanation how the project meets these requirements.

Section 3.4 shows the feasibility of the present project, including packaging aspects, parts availability, tools availability, time schedule, etc.

The parts, materials and processes lists for the manufacturing of the flight model can be found in section 3.5.

Section 3.6 presents the reliability analysis of the subsystem, including derating factors, single point failure list and a preliminary estimation of the subsystem reliability.

Finally, section 3.7 describes the functional tests plan.

2 - APPLICABLE AND REFERENCE DOCUMENTS

2.1 - APPLICABLE DOCUMENTS

a) A - ETC - 0001 - "System Specification - S1";

b) A - ETC - 0002 - "Satellite Specification";

c) A - ERC - 0001 - "Design and Construction Specification";

d) A - EAB - 0001 - "Environmental Specification";

e) A - ECE - 0001 - "EMC Specification";

f) A - EIF - 0001 - "Spacecraft to Launch Vahicle Interface Definition";

g) A - EIF - 0002 - "Spacecraft to Ground Interface Definition;

h) A - ETC - 0007 - "On Board Supervision Subsystem Specification".

2.2 - REFERENCE DOCUMENTS

a) DE PAULA, A. R., DE BRITO, A. C., GOES, A. O. C. A., MASS, B. J., REIS, C. S., BERGAMINI, E. W., PESSOTA, F. A., DE OLIVEI RA, J. R., MALDONADO, J. C., ALONSO, J. D. D., JOHANSEN, K. J., KATO, M., MARTINS, R. C. O., MENDES, R. A., CEREDA, R. L. D., CINTRA, S. A. R., Síntese do padrão INPE de supervi são de bordo (PISB) aplicado à MECB 1. Estado Geral do Proje to em Setembro de 1983, INPE, 1984, INPE - 3111 - RTR/049.

b) Texas Instruments, SBP 9989 - Advanced 16-Bit I^2L Microprocessor, 1982.

c) JOHANSEN, K. J., PESSOTA, F. A., ASTRO B/3 - The On-Board Computer: a detailed description, INPE, 1986 (Under preparation).

d) ALONSO, J. D. D., CALIMAN, J. C., ARIAS, R., POB - The On-Board Operational Program: a preliminary design, INPE, 1986 (Under preparation).

e) MENDES, R. A., CODIR - The Direct Telemetry Encoder: a detailed description, INPE, 1986 (Under preparation).

f) Data Collecting Satellite Interface Data Sheet.

g) READ, W. S., Electronic equipment and cabling design and fabrication requirements and processing techniques. Vol. I, II and III, JPL, 1983. JPL - DM 509306D.

h) IEEE Standard for Software Test Documentation, IEEE, 1983.
IEEE Std 829-1983.

i) CEREDA, R. L. D., MTSB - Monitor de Testes para Sistemas   de
Supervisão de Bordo. Estado geral do projeto em dezembro de
1984, INPE, 1985. INPE - 3584-NTI/242.

j) DE PAULA, A. R., TUDE, E. A. P., DE MORAIS, P. R., DA SILVEIRA,
V. B., Análise preliminar da confiabilidade e da   redundân
cia para o Satélite de Coleta de Dados da MECB, INPE, 1984.
INPE-3208 - NTI/211.

3 - INFORMATION FOR THE PDR

3.1 - SUBSYSTEM DEFINITION

The On-Board Supervision Subsystem (OBS) is based on the INPE On-Board Supervision Standard (PISB) described in Section 2.2.a. The OBS executes the following functions:

a) Receives 24-bit serial load commands from the TC decoder, assembles them in Operation Process Packets (PPO's), verifies the consistency of the PPO's, decodes them and executes the appropriate subroutines to generate immediate and time-tagged command pulses.

b) Acquires the telemetry signals from the subsystem, preprocesses them, assembles them in frames and sends these frames to the S-Band Transponder.

c) Acquires the telemetry from the subsystems in a programmed rate, preprocesses them, assembles them in frames and stores the frames.

d) Sends the storage telemetry frames multiplexed with real-time telemetry frames and On-Board Supervision house-keeping data under ground request.

The On-Board Supervision Subsystem is composed of four parts, namely, a Processing and Communication Unit (UPC), a Distributed Processing and Communication Unit (UPD&C), a Direct Telemetry Encoder (CODIR) and an On-Board Operational Program (POB).

The On-Board Supervision Subsystem and its connections to the other satellite subsystem are presented in Figure 1.
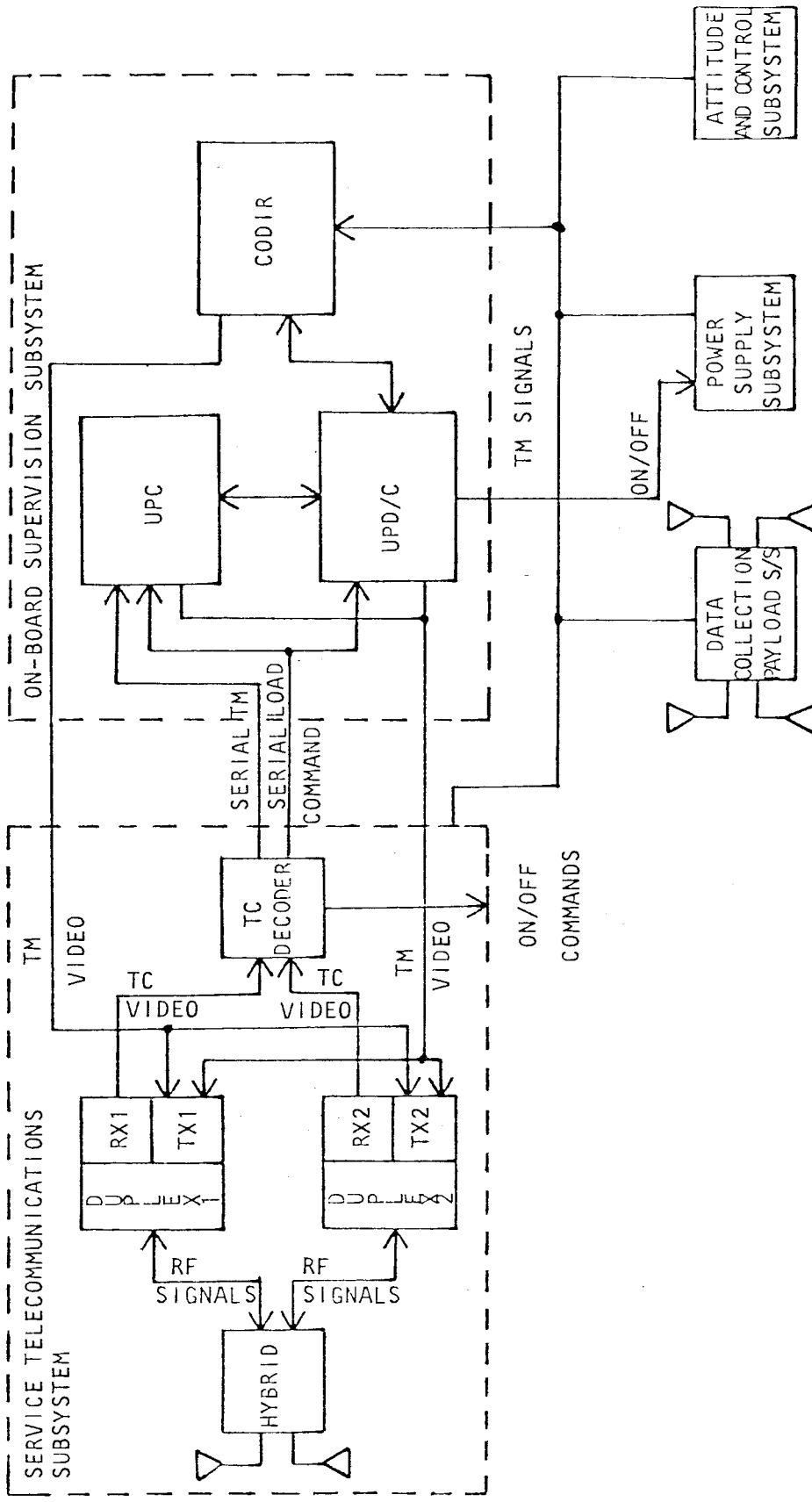
Fig. 1 - The on-Board Supervision Subsystem and its connections to the other subsystems.

The UPC and UPD/C compose the On-Board Computer called ASTRO B/3. The On-Board Computer, the CODIR and their interconnections are shown in Figure 2.
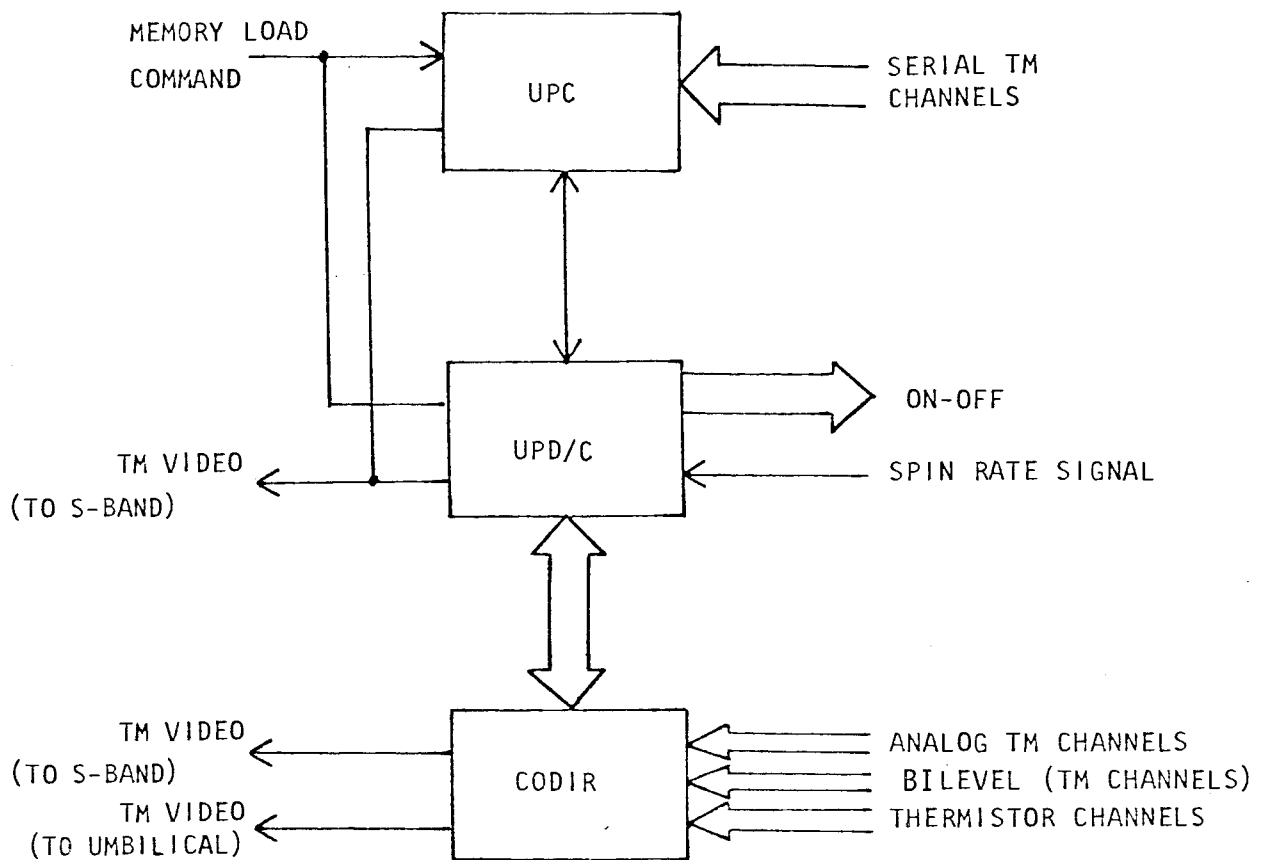
Fig. 2 - The On-Board Computer and the CODIR, their interconnections and I/O signals.

The UPC receives the 24-bit serial load commands from the TC decoder and sends messages to the UPD/C to generate on/off commands to the different subsystems. In addition, the UPC receives serial telemetry messages from the UPD/C, which are formated in frames. These frames are stored in memory when the satellite is not in visibility with ground stations and sent to the S-Band Transponder, when in visibility.

The UPD/C generates on/off commands to the subsystems under UPC request, preprocesses the telemetry signals multiplexed in the CODIR and sends the acquired telemetry to the UPC. If the UPC fails, the UPD/C receives the 24-bit serial load commands from the TC decoder and generates the on/off commands to the subsystems. In addition, the UPD/C formats the acquired telemetry in frames and sends it to the S-Band Transponder, however it can not receive the serial telemetry from the subsystems, namely,from the TC decoder.

The CODIR multiplexes the telemetry channels under UPD/C control and sends the selected telemetry signal to the UPD/C. It also multiplexes the telemetry channel under its own control, converts the analog telemetry to digital data, formats the acquired telemetry in frames and sends them to the S-Band Transponder and to the umbilical connector.

The On-Board Operational Program is composed of a set of routines implanted in the UPC and UPD/C. These routines define the operation to be executed by the On-Board Computer to accomplish the tasks assigned to it.

The following sections describe the On-Board Computer (3.1.1), the POB (3.1.2) and the CODIR (3.1.3) in more details.

3.1.1 - ASTRO B/3 - THE ON-BOARD COMPUTER

As mentioned in section 3.1, the On-Board Computer is composed of the UPC and the UPD/C. During normal operation the UPC acts as the master and the UPD/C as the slave. In the case of a UCP failure, the UPD/C takes the UPC functions over, except for the subsystem serial telemetry acquisition. These two processing units are interconnected to a serial bus, which is responsible for the message exchange between them.

The UPC and UPD/C are composed of standard subunits as depicted in Figure 3.

UCP - The Central Processing Subunit consists of a Processor Module (MPR), a Programmable System Interface(IPS)and a Clock Module (URG).

MPR - The Processor Module is based on the microprocessor SBP9989 from Texas Instruments Section 2.2.b). It controls the data, address and CRU bus, generates the control signals for the other subunits and receives the interrupt control signal, from the IPS. Its function is to execute the POB (On-Board Operational Program) with its application programs.

IPS - The Programmable System Interface is basically an interrupt controller that receives up to 15 interrupt requests from the different subunits and generates the interrupt control signals through a priority encoder, which are sent to the UCP.

Further, it provides selection signals for the subunits and for its own internal modules that are generated by a decoder from the CRU hardware base address.

It also generates set and reset pulses for the subunit UCP and contains facilities to read memory location address and syndrome word, which are   stored in a proper register after a memory error detection.

URG - The Clock Module provides the processing unit clock signals and the on-board actual time for time-tagged commands. The spacecraft clock may be adjusted (advanced or retarded) under ground command and software control.

MAIN MEMORY - This subunit stores the POB and its application programs as well as the acquired telemetry frames. The whole storage capacity is 32 K words of 16 bits devided into a RAM section of up to 24 K words and a PROM section of up to 4 K words.

The main memory presents fault tolerant features. The RAM section is protected by The Hamming Code that provides the capability to correct single bit errors and to detect double bit errors. The PROM sections contains a check sum word.

TRAF - The Failure Handling subunit has the function of signaling to the UCP the occurence of a RAM failure (single bit or double bit error). Further, it can define one or more RAM protected regions (read only region). The TRAF also contains a watch dog timer in charge of controlling the UCP time slice duration.

CSBD - The Serial Data Bus Communicator provides message exchanging between the two processing units. The transmitter encodes the 16 - bit message in a Manchester II, adds a parity bit and sends the encoded message to the serial bus. The receiver checks if the message is valid and signals to the UCP, through an interrupt request, that a valid message was received.

CSTC/TM - The Serial Command and the emetry Communicator are composed of the Telecommand Receiver (TCRX) and the Telemetry Transmitter (TMTX). The Telecommand Receiver is essentially an input port of the UCP, acting as an interface between the TC Decoder and the UCP of either the UPC or the UPD/C. The Telemetry Transmitter has the function of generating the telemetry video by concatenating the 16 bit words received from the CPU, encoding the bit stream in biphase and modulating it in PSK. At the end of each telemetry frame the transmitter adds a 16 bit CRC word.
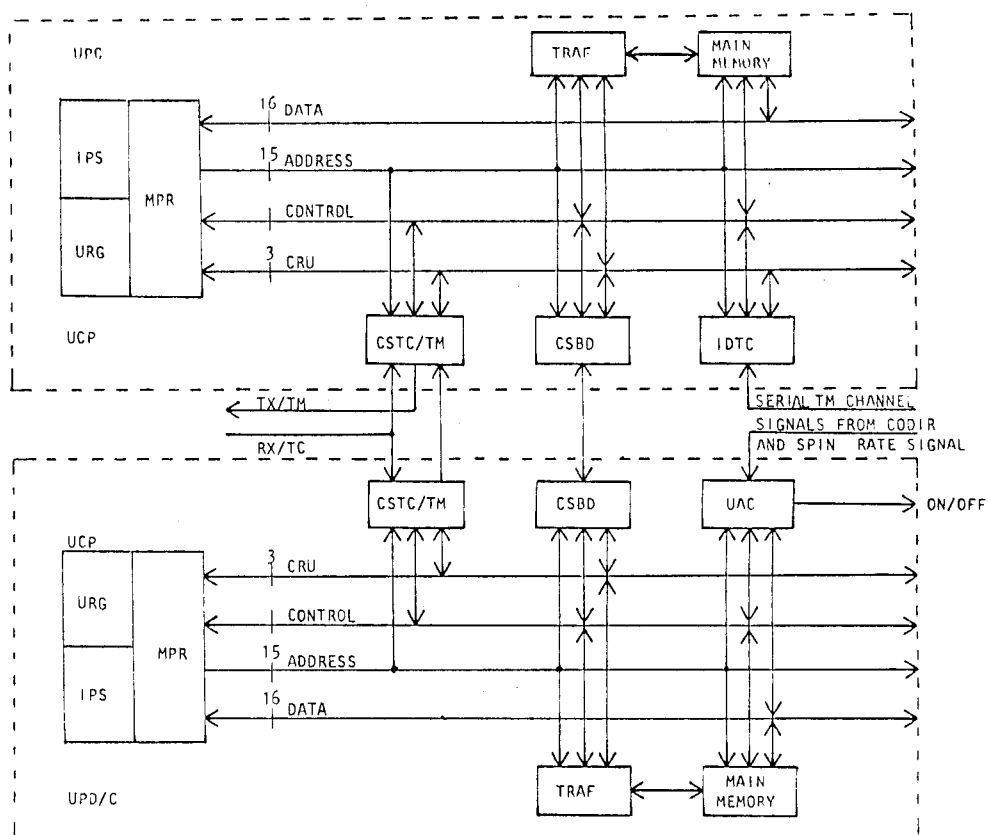
Fig. 3 - Block diagram of the On-Board Computer.

UAC - It is the Acquisition and Control Subunit. It performs the acquisition of analog and digital data, multiplexed in the CODIR, under UAC control. Further it sends control pulses to relay located in the different subsystems.

IDTC - It is the Serial Telemetry Interface Subunit, located in the UPC, which acquires the serial telemetry from the subsystems, mamely, from the TC Decoder. This telemetry data is stored in a specific memory region to be assembled and sent to the ground station.

A detailed description of the UPC and UPD/C subunits is presented in Section 2.2.c.

3.1.2 - ON-BOARD OPERATIONAL PROGRAM (POB)

The On-Board Computer software, termed On-Board Operational Program (POB), consists of two hierarchical layers:

a) Executive: A basic software which provides a virtual machine interface between hardware and application programs. It defines a multiprogramming/multiprocessing environment.

b) Application Programs: Use the basic software to implement the project requirements.

3.1.2.1 - EXECUTIVE

The Executive provides the following:

a) a scheduling system to enable Application Programs to be executed correctly;

b) an interface to enable the On-Board Computer to receive telecommands (TC) and to send the telemetry (TM);

c) facilities to enable Application Program communication and synchronization:

d) error handling mechanisms;

e) facilities to enable interaction between Application Programs and On-Board equipment;

f) interprocessor communication via message passing.

The Executive is a set of Nuclei (one for each processing unit), which implements multiprogramming at local level and multiprocessing at global level.

The basic computation work unit of the Application Program is termed Process. The execution of the Processes is controlled by the Nucleus.

The Data Structure is the information necessary to execute the Nucleus procedures and includes the following information.

a) Process Control Block (BCP)

A set of information items that describes the process features like state, priority, workspace, program counter, etc.

b) Process State Queue

An information structure to facilitate the search of a special process with a determined state.

c) Message Queue

An information structure that links message buffers to be consumed by the process.

A Nucleus contains the following modules:

a) Communication and Synchronization Primitives

Basic routines which enable interprocess communication/

synchronization, dynamic memory allocation, process scheduling and operation mode change;

b) Interrupt Handling Routines

Interruptions provide an on-board time base (BT), error detection, peripheral requests, etc.

c) Input/Output Monitors

Drivers which form a mapping between actual hardware interfaces and the data handling process.

d) Initialization

A ROM resident module enables the system essential modules to be loaded into the RAM. This module also provides load of software modules from ground stations.

e) Error Handling

A basic routine that executes the analysis and recovery procedures when an error is detected.

3.1.2.2 - APPLICATION PROGRAMS

The Application Program layer consists of a set of processes that communicates with other processes through message exchange.

The structure of an application process is modular, consisting of a BCP definition and an associated program.

The execution of one process is determined by the scheduler according to its priority.

Application Programs are mission dependent corresponding to the users requirements.

The Application Programs are divided into two classes: on-board supervision programs and equipment monitoring programs.

3.1.2.2.1 - ON-BOARD SUPERVISION PROGRAMS

The on-board supervision programs consist of a set of routines that provides the following facilities:

a) communication protocol between ground segment and on-board segment;

b) interprocessor communication protocol;

c) housekeeping service.

3.1.2.2.2 - EQUIPMENT MONITORING PROGRAMS

The equipment monitoring programs meet the user requirements using the facilities provided by the Executive.

These programs realize data acquisition and control of the on-board subsystems according to the mission specification.

The equipment control is realized by specific processes under ground control.

The data acquisition depends on the system operation mode, as follows:

a) Real-time data telemetry is collected during visibility at a rate of 20 samples per minute per channel.

b) Storage data telemetry is collected at two rates: 1 sample per minute per channel and 1/6 sample per minute per channel under ground request.

A detailed description of the POB is presented in Section   2.2.d.

3.1.3 - DIRECT TELEMETRY ENCODER

Basically the Direct Telemetry Encoder (CODIR) is a unit that acquires telemetry signal, formats that acquired telemetry in frames and sends them to the S-Band transponder and to the umbilical connector.

The data from the sub-system is sent to two sets of multiplexers both inside the CODIR. The first set is controlled by the CODIR and the second one is controlled by the UAC of the UPD/C which receives the corresponding multiplexed output.

The telemetry data acquired from the subsystems by the multiplexer under CODIR control is formatted in a 128 octet frame as depicted in Figure 4.
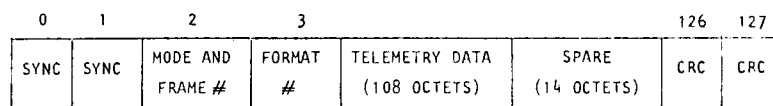
0	1	2	3			126	127
SYNC	SYNC	MODE AND FRAME #	FORMAT #	TELEMETRY DATA (108 OCTETS)	SPARE (14 OCTETS)	CRC	CRC

Fig. 4 - CODIR Telemetry Frame.

The telemetry frames are continously generated at a rate of two frames per second producing a bit stream of 2048 bps. The bit string is bi-phase encoded and modulates a 65.563 KHz square wave subcarrier in PSK, producing the telemetry video that is sent to the S-Band transponder and to the umbilical connector.

A block diagram of the CODIR is depicted in Figure 5 and a detailed description is presented in Reference 2.2.e.
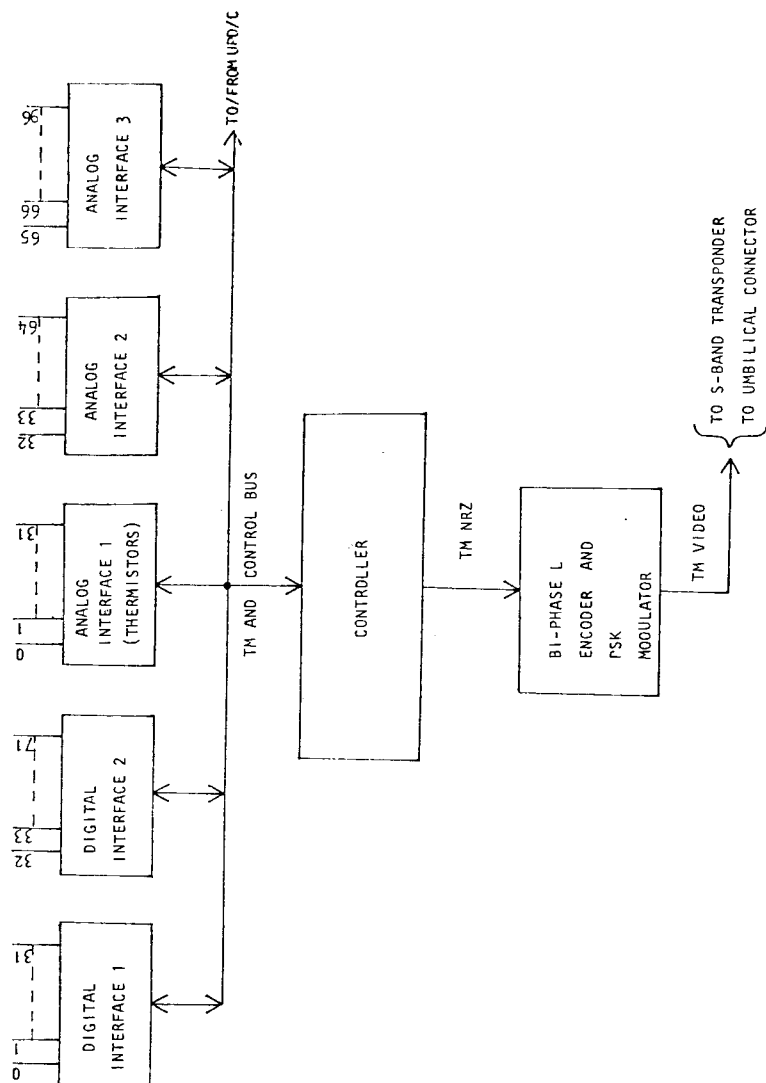
Fig. 5 - Direct telemetry encoder block diagram.

3.2 - SUBSYSTEM PROPERTIES

The OBS properties are described in Section 2.2.f: "On Board Supervision Subsystem Data Collecting Satellite Interface Data Sheet".

3.3 - PERFORMANCE REQUIREMENTS

The processing units of the OBS subsystem are based on the microprocessor SBP 9989, which is driven by a clock of 1.441792 MHz. For each memory access the microprocessor requests one wait period resulting in a memory access time of 2.1 μsec and an average instruction execution time of 22 μsec (30.000 instructions per second).

The processing time slice (TS) is 250 msec and the estimated maximum operational system processing time per TS is 50 msec resulting in 200 msec (or 6.000 instructions) per TS for the application processes. The estimated processing time to execute the application process will be discussed next for the worst case. This occurs when the satellite is in visibility and the OBS is receiving PPO's and sending real-time and storage telemetry frames.

3.3.1 - TELECOMMAND FUNCTION

The Operation Process Packets (PPO's) sent by the Ground Station have a variable size limited from 24 to 508 octets. The PPO's are transmitted to the OBS by a set of 24-bit serial load commands. Each serial command carries two PPO octets. The serial commands are transmitted at the maximum rate of 20.83 per second (or one each 48 msec).

The estimated time for an OBS routine to receive and to assemble each serial command in a PPO is 2 msec. Since the maximum number of serial commands per TS is 5.3, the total time spent by the routine per TS is 10.6 msec.

The PPO consistency is verified once for each received PPO and requires a maximum time of 10 msec. The worst case occurs for minimum size PPO that is received in 576 msec resulting in a processing time of 9.3 msec per TS.

The processing time required to decode a PPO is a function of its size and is estimated to be (50 + 2n) msec, where n is the number of octets of the PPO. Therefore, for the minimum size PPO (worst case), the decoder routine execution time is 98 msec per PPO or 43 msec per TS.

When the PPO is received by the UPC it sends a message, comprising the on/off commands to the UPD/C. The maximum transmission time is 10 msec per PPO or 4.4 msec per TS.

Finally, the processing time to generate 4 on/off pulses is 4 msec or 2 msec per TS.

Therefore, the maximum processing time to process a PPO and to generate on/off pulses is approximately 65 msec. Assuming that all this processing is executed in two TS's after the reception of a minimum size PPO, the first on/off pulse is generated in less than 0.5 sec after the reception of the PPO.

3.3.2 - TELEMETRY FUNCTION

The UPD/C requires 90 μsec to acquire an analog telemetry signal and 140 μsec to acquire bilevel telemetry signals. To acquire all the 96 analog signal and all 72 bilevel signals it takes to the UPD/C less than 10 msec.

When the acquired telemetry signals are sent to the UPC, a processing time of 20 msec is required.

The real-time telemetry frame size is 128 octets, which is transmitted at the rate of 2kbps (one frame per 0.5 sec). The maximum processing time to format a telemetry frame is 30 msec and the routine to transmit the telemetry frame requires 0.3 msec per two octets or approximately 20 msec per frame. Therefore, the maximum processing time to generate and to transmit a real-time telemetry frame is 80 msec per frame or 40 msec per TS.

When storage telemetry is multiplexed with real-time telemetry, an additional processing time of 300 msec is required per telemetry format (six 128 octet frames) resulting in a processing time of 25 msec per TS.

3.3.3 - PROCESSING TIME

The maximum processing time required to execute the telecommand and the real-time and storage telemetry functions is 130 msec per TS. The remaining 70 msec processing time in each TS will be used for housekeeping and diagnosis routines.

Concluding, the proposed OBS architecture satisfies the performance requirements defined in Section 2.1.h.

3.4 - FEASIBILITY OF THE DESIGN

The OBS subsystem was designed with components specified in the Qualified Parts List used by ESA, CNES, NASA and JPL. The only exceptions are the Manchester Encoder-Decoder manufactured by Harris and the 54 HC series components. Harris produces a radiation resistant version for the HD 15530 that will be qualified by INPE and the 54 HC series components are in qualification process by JPL.

The selected architecture for the processing units of the OBS is the classic architecture for microcomputer. A breadboard of the OBS was developed and the hardware was validated functionally. The software is in development and will be initially validated in the

HP 64000 Development Station. Later, the complete subsystem will be validated using the On-Board Supervision Test Monitor MTSB. The MTSB is a microcomputer developed to test the OBS. It emulates the OBS inputs, supervises the external serial bus and the internal processing unit bus and analyzes the OBS outputs.

Two techniques were utilized for packaging the electronic components of the OBS:

a) leadless chip carriers mounted on multilayer ceramic boards,

b) dual in line chips mounted on P.C. boards.

Both techniques are qualified for space application. Based on the results obtained by testing the OBC bread-board, the proposed design for the OBS is feasible to be manufactured at INPE facilities within the proposed time schedule.

3.5 - PART LISTS, MATERIAL AND PROCESSES

The part lists for electrical/electronic components utilized in the On-Board Computer and in the Direct Telemetry Encoder are presented in Sections 2.2.c and 2.2.e respectively.

A list of processes to be utilized for packaging the electronic components is presented in Appendix A. Most of the processes are described in Section 2.2.g.

3.6 - RELIABILITY

3.6.1 - DERATING FACTOR ANALYSIS

TBD

3.6.2 - SINGLE POINT FAILURE ANALYSIS

The different functions executed by the OBS subsystems

utilize different modules of this subsystem. Consequently, each function has to be analyzed independently to determine its single point failure. To facilitate the analysis, the OBS functions are classified as:

a) TC reception and pulse generation;

b) real time telemetry;

c) single ended storage telemetry;

d) serial telemetry.

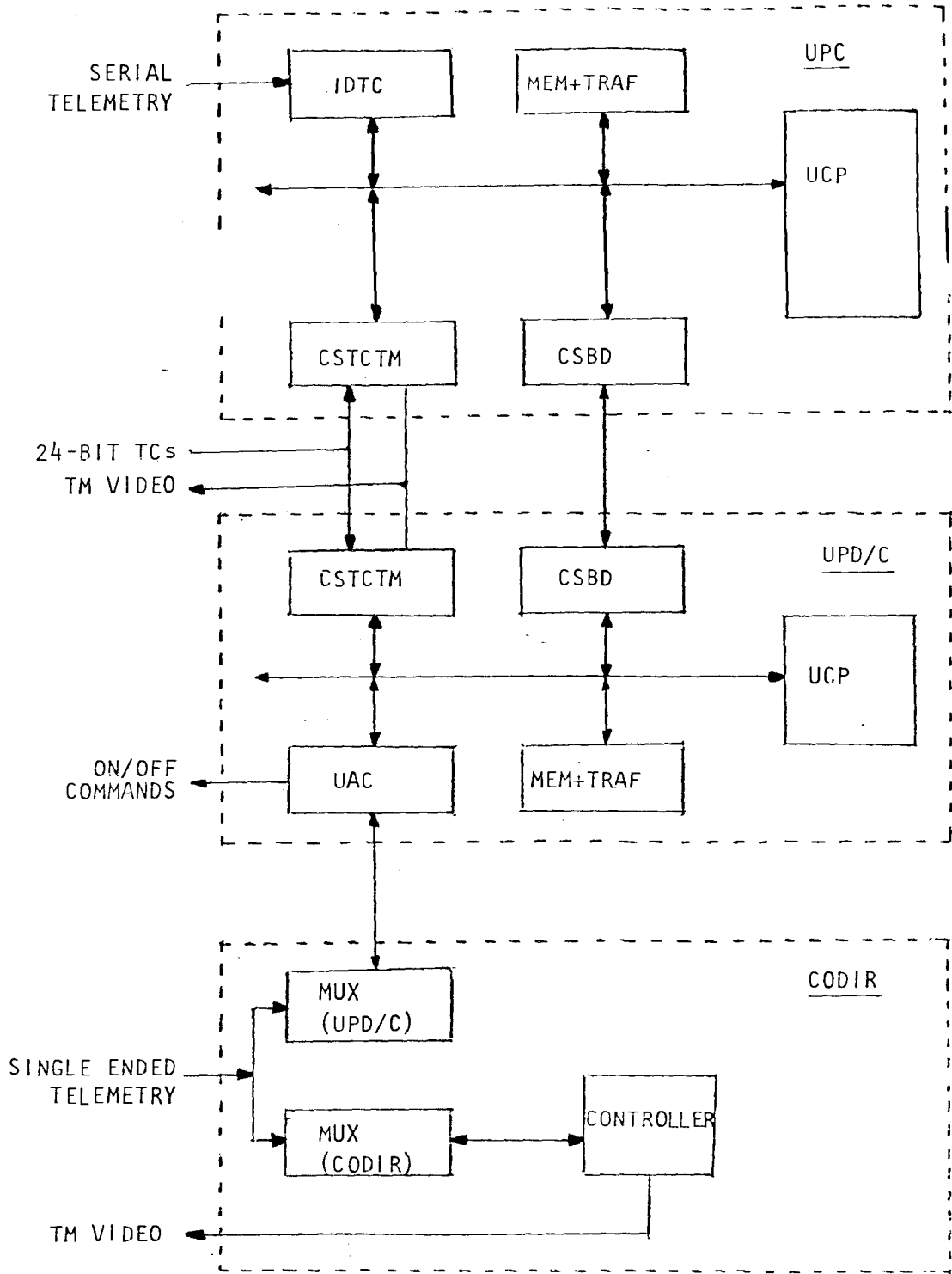The analysis is based on the block diagram presented in Figure 6 and the results are described in Table 1.

Fig. 6 - OBS block diagram.

TABLE 1

SINGLE POINT FAILURE AND CRITICALBILITY ANALYSIS

FAULTY MODULE	CONSEQUENCE
UCP or MEM or TRAF (UPC)	- Loss of the capability to acquire serial telemetry - Loss of redundancy to receive TC's - Loss of redundancy to send storage telemetry
CSTCTM(UPC)	- Loss of redundancy to receive TC's - Loss of redundancy to send storage telemetry
IDTC (UPC)	- Loss the capability to acquire serial telemetry
CSBD (UPC)	- Loss the redundancy to send storage and serial telemetry - Loss the redundancy to receive and decode TC's
CSBD (UPD/C)	- Loss the redundancy to send storage and serial telemetry - Loss the redundancy to receive and decode TC's
UCP or MEM or TRAF (UPD/C)	- Loss the capability to generate on/off pulses - Loss the capability to acquire storage telemetry - Loss the redundancy to acquire real time telemetry - Loss the redundancy to send serial telemetry
UAC (UPD/C)	- Loss the capability to generate on/off pulses - Loss the capability to acquire storage telemetry - Loss the redundancy to acquire real-time telemetry
CSTCTM (UPD/C)	- Loss the redundancy to receive TCs - Loss the redundancy to send real time and storage telemetry
MUX (UPD/C)	- Loss the capability to acquire storage telemetry - Loss the redundancy to acquire real-time telemetry
MUX or CONTROLLER (CODIR)	- Loss the reduncancy to acquire and send real-time telemetry

3.7 - TESTS

3.7.1 - TEST RESULTS

Not available yet.

3.7.2 - TEST PLAN

3.7.2.1 - SUBSYSTEM LEVEL

The test plan described in this section is related to the functional test of the OBS at subsystem level and the tests are organized by the functions to be executed by the OBS. To accomplish the tests, the OBS is connected to the OBS Test Monitor (MTSB) through the 24-bit serial command channel and through the telemetry video channel. The MTSB is described in Section 2.2.i.

a) Command Operation

The immediated and time-tagged commands will be tested by sending Operation Process Packets provided by the MTSB to generate on/off pulses at proper outputs. The pulses will be checked by connecting the HP 1530 Logic Analyzer at the pulse outputs. In addition, test relays will also be connected at the pulse outputs and their status signals will be applied at the telemetry channels and verified by the MTSB via the real-time telemetry frames.

b) Real-Time Telemetry

The real-time telemetry will be tested by applying predetermined signals, generated by the MTSB, at each OBS telemetry channel input and verifying whether the correct value will be presented in the real-time telemetry frame received by the MTSB.

c) Storage Telemetry

The storage telemetry including the spin rate signal will be tested by applying a predetermined time-varying signal generated by the MTSB at each OBS telemetry input and verifying whether the correct value will be presented in the storage telemetry frames, received by the MTSB.

d) OBS Self - test

Diagnosis routines will be implemented in the OBS for self-testing. These routines will be activated by an Operation Process Packet which will provide the test paramenters. In response, the test results will be sent to the MTSB to be analyzed.

3.7.2.2 - SYSTEM LEVEL

At the system level, the OBS will be tested by the Checkout Station by sending Operation Process Packets and analyzing the received telemetry frames.

a) Command Operation

The immediated and time-tagged commands will be tested by sending Operation Process Packets generated by the Checkout Station and by analyzing the status of the relays presented in the real-time telemetry frame received by the Checkout Station.

b) Telemetry

The real-time and storage telemetry will be tested by comparing the value of the acquired telemetry presented in the telemetry frames received by the Checkout Station with the expected value of the telemetry.

c) <u>OBS Self-test</u>

The OBS self-testing routine will be activated by an Operation Process Packet sent by the Checkout Station. The test results will be sent in telemetry frames, which will be analyzed in the Checkout Station.

d) <u>Command Sensitivity</u>

The command sensitivity will be tested as a function of the receiver input power to show the threshold of the complete chain. The threshold is defined as the power level at which at least 50% of the commands are verified.

3.7.2.3 - <u>OBS SOFTWARE</u>

The software will be validated utilizing the OBS bread board connected to the HP 64000 Development Station and to the MTSB, following the procedures defined in Section 2.2.h.

Wrong patterns will be generated by the MTSB in the Load Memory Commands to test the capability of the Command Analyzer Routine to detect them. The verification of the test will be accomplished by analyzing the telemetry frames received by the MTSB.

3.7.3 - <u>DESIGN VERIFICATION MATRIX</u>

The OBS Design Verification Matrix is presented in Table 2 and the Test MATRIX in Table 3.

TABLE 2

OBS DESIGN VERIFICATION MATRIX

REQUIREMENT	VERIFICATION METHOD				
	ANALYSIS	SUBSYSTEM TEST	INSPECTION	SYSTEM TEST	IN ORBIT TEST
COMMAND OPERATION		X		X	
REAL-TIME TELEMETRY		X		X	
STORAGE TELEMETRY		X		X	
SOFTWARE VALIDATION		X			
SELF - TEST		X		X	X
COMMAND SENSITIVITY				X	
FRAME ACCEPTANCE		X			

TABLE 3

OBS TEST MATRIX

	REFERENCE	AFTER RANDOM AND SINE VIBRATION	DURING THERMAL VACUUM	FINAL
COMMAND FUNCTION	X	X	X	X
TELEMETRY FUNCTION	X	X	X	X
SELF - TEST	X	X	X	X
EMI and EMC				X
GROUND ISOLATION	X			X

APPENDIX A

The following tables present the process list to be applied in the OBS manufacture.

	NOME DO EQUIPAMENTO			LPR Nº
		MECB/SS		Folha 02 de 03
	LISTAGEM DE PROCESSOS	ÁRVORE/PROD.	MODELO	P/N
ITEM	NOME DO PROCESSO	NÚMERO DO PROCESSO/ORIGEM/PROCESSO		LOCAL DA APLICAÇÃO
11	SPLICING OF ELECTRICAL HOOKUP WIRE	ZBE-1092-0001	JPL	ON-BOARD COMPUTER AND
12	SHIELDED TERMINALS	ZBE-1092-00D2	"	DIRECT TELEMETRY ENCODER
13	COAX CONNECTORS, MATING, UNMATING AND PROTECTION	ZBE-1092-0003	"	"
14	CONNECTORS, CRIMP TYPE, MULTIPIN, ASSEMBLY OF	ZBE-1092-0004	"	"
15	RADIO FREQUENCY CONNECTORS, ASSEMBLY OF	ZBE-1092-0005	"	"
16	CONNECTOR INSTALLATION, RETANGULAR MINIATURE, DETAIL SPECIFICATION FOR	LS 500 452	"	"
17	FABRICATION AND USE OF LACING TIES	ZBE-1091-0001	"	"
18	BONDING OF PRINTED WIRING, TERMINAL AND INSULATION BOARDS WITH ECCO BOND 55/9	ZBE-1061-0007	"	"
19	MODIFICATION AND REWORK OF PLANAR ELECTRONIC SUB-ASSEMBLY	ZBE-1061-0005	"	"
20	APPLICATION OF SOLITHANE 113/300 CONFORMAL COATING (FLUORESCENT AND NONFLUORESCENT)	ZBE-1061-0006	"	"
21	CONFORMAL ENCAPSULATION OF ELECTRICAL CONDUCTOR	ZBE-1D72-0003	"	"

Emitido por: Alírio C. de Brito   Aprovado por: Aprovado G.P.:

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Ministério da Ciência e Tecnologia
INSTITUTO DE PESQUISAS ESPACIAIS

NOME DO EQUIPAMENTO

LISTAGEM DE PROCESSOS

ITEM	NOME DO PROCESSO	NÚMERO DO PROCESSO	ÁRVORE/PROD. ORIGEM/PROCESSO	LOCAL DA APLICAÇÃO
22	POTTING OF SUBMINIATURE, RET CONNECTORS	ZBE-1074-0001	JPL	ON-BOARD COMPUTER AND
23	SPOT BONDING OF COMPONENTS PARTS WIHT STYCAST 1095/9	ZBE-1041-0008	JPL	DIRECT TELEMETRY ENCODER
24	SPDT BONDING ELECTRONIC PARTS W/SOLITHANE 113/300 FILLED POLYURETHANE	ZBE-1041-0009	JPL	"
25	ANODIC COATING FOR ALUMINUM AND ALUMINUM ALLOYS	MIL-A 8625,CLASS 2	MILITARY	"
26	SOLDERING PROCESS FOR SURFACE MOUNTING DEVICES	T.B.D.	INPE	"
27	REPAIR AND REWORK OF MULTILAYER CERAMIC MODULES	T.B.D.	INPE	"
28	CLEANING OF MULTILAYER CERAMIC MODULES	T.B.D.	INPE	"
29	CLEAN ROOM AND WORK STATION REQUIREMENTS	FED - STD - 209	FEDERAL	"
30	VACUUM OUTGASSING OF POLYMERS (MICRO-VCM), DETAIL SPEC	TS 507035	JPL	"

Emitido por: Alfrio C. Brito   Aprovado por: Aprovado G.P.:

Nome: Data   Nome: Data   Nome: Data   Nome: Data

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TÍTULO

ON BOARD SUPERVISION SYSTEM – PRELIMINARY DESIGN REVIEW.

AUTORIA

Alderico Rodrigues de Paula Jr.
Klaus Juergen Johansen

PROJETO/PROGRAMA

SUBORD

DIVISÃO

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Chefe do Dept.º de Eng.º de Computação
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POR: Maria do Carmo S. Soares

4-8-86
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