For Network Personnel Only K.S. LEE

TECHNICAL INFORMATION BULLETIN

MANNED SPACE FLIGHT NETWORK

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Digital Command To Be Delivered This Summer

The digital command systems (DCS) for the MSF Network are now in production at Radiation, Inc., Melbourne, Florida, and delivery is expected to begin during July.

The DCS provides a means for transmitting digital command data through the RF command system from ground stations to orbiting Gemini and Agena vehicles. (The RF command system will be capable of being modulated by the present Mercury tone configuration or by the Gemini DCS.)

The DCS receives inputs from any of several possible sources; i.e., manual, teletype, high-speed data links, or computers. It performs parity checking on incoming data and stores the valid words in a 40 × 512-bit core memory. An indicator on the control console is lighted for each valid word stored. After the memory is loaded with command words, the data may either be displayed (one word at a time) or transmitted. In addition, the Cape Canaveral DCS will remote the memory contents to a DCS at a distant site via a teletype link.

Several prime modes of transmission of command words are provided: (1) AUTO-GEMINI, which transmits all computer words that are identified by their word length of 30 bits; (2) AUTO-AGENA, which transmits all stored program commands, identified by their word length of 35 bits; (3) AUTO-SELECT, which transmits all words that have been previously selected; and (4) MANUAL. In addition, the DCS will transmit two types of noncommand words—clock and velocity meter. Any of the transmission modes can be interrupted by an emergency override, enabling one or more of 64 priority words stored in the memory to be transmitted. After transmitting the priority word(s), the DCS resumes transmission in the mode that was interrupted.

In addition to the described input, display, and transmission capabilities, the DCS has the capability to generate and display GET, Time-to-Retrofire (TR), and Time-to-Equipment-Reset (TX). From the PCM down-link, the DCS also receives and displays CET and TR. The difference between ground and capsule TR is determined and displayed to enable an operator to up-date the capsule TR of the difference becomes unaceptably large.

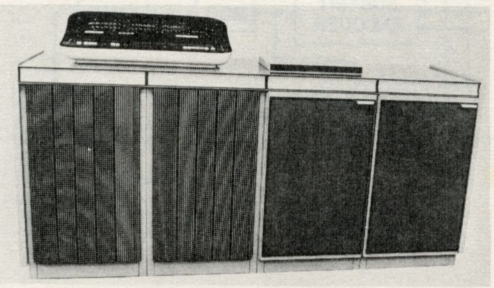


Photo of original digital command equipment. Recent changes will add two racks to the left side to allow for additional features required by the flight control consoles.

The reliability of the data transmission link is enhanced by several features. First, a sub-bit coding technique is used which enables the capsule to recognize when up-link bit errors have occurred. Each vehicle address is coded by a unique 15-sub-bit pattern. The discrete pattern is transmitted to represent a data bit of value ONE. Data bits of ZERO value are represented by the complement of the ONE's pattern. Any other pattern received by the capsule is recognized as an error. The PCM down-link is used to transmit a valid or nonvalid return signal for each word transmitted to the capsule on the up-link, based on the recognition of the vehicle address and proper sub-bit patterns.

The second means of enhancing the reliability of the up-link is achieved through ground equipment redundancy and self-checking. There are two independent data paths from the DCS memory to the transmitting antenna. Each subsystem in each path contains an error detector. Inputs from the individual error detectors are used to provide an automatic path selection and switching capability.

The third provision made for enhancing the up-link reliability is the retransmit capability. The operator can set the system to retransmit automatically, from one to seven times, each word containing an error detected on the ground or in the capsule.

Capabilities of the DCS are summarized below:

Input

Serial (parity checked)
- Teletype
- High speed (6 KC)

Parallel
- NASA computer
- J1 computer (MCC only)

Memory Capacity

512 40-bit words (expandable to 1024 × 60 bits)

Gemini priority	1-32
Gemini command	33-182
Agena priority	257-288
Agena command	289-438
Agena velocity meter	
Test word 1	
Test word 2	
Real time computer input	

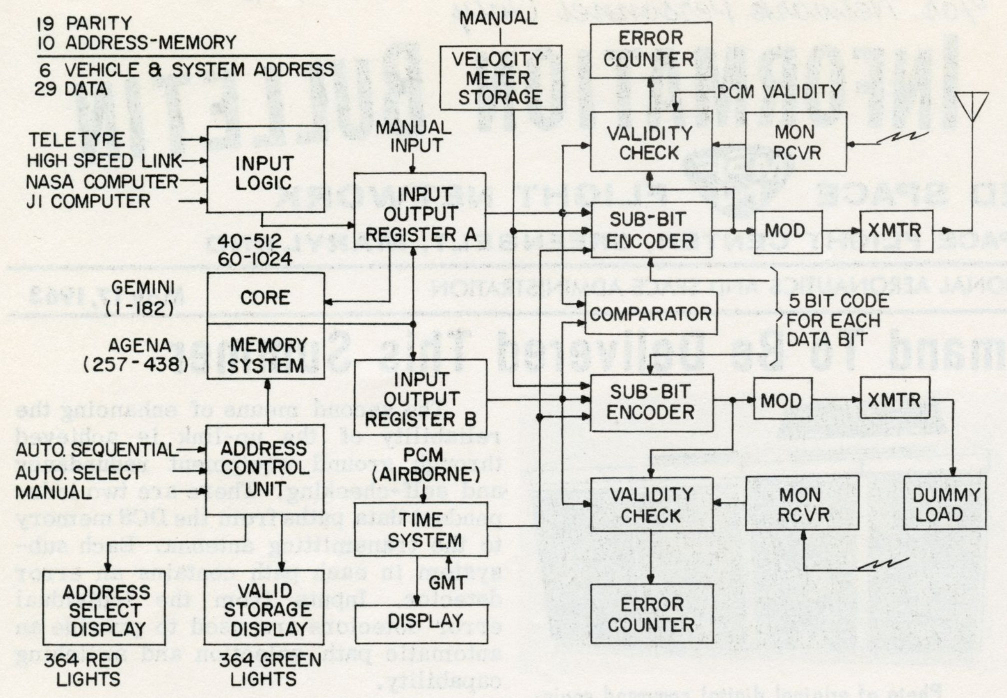
Transmit

Bit rate	200 CPS (expandable to 100 KC)
Sub-bit rate	1 KC (expandable to 500 KC)
Data selection	
Command	1-150 words per system
Priority	1-32 words per system
Clock	TR, TX
Velocity meter	Automatic, manual
Redundant paths	from memory to antenna

About Documentation

The following manuals were revised and revision pages sent to applicable sites:

ME-139	Gates Transmitter Model CS-2029
ME-140	Sta-Level Amplifier
ME-146	Receiver Group OA-192/GR
ME-156	Dual Diversity Combiner
ME-197	Frequency Conversion Equipment
ME-401	Data Transmitter (Verlort)
ME-402	Data Transmitter (FPS-16)



Digital Command System, Simplified Block Diagram

Automatic switchover if transmitting path fails

Retransmission of nonvalid words

Control and Display

All controls capable of being remoted

Automatic operations initiated by PROGRAM-START pushbutton

Displays:

- Address of all valid words stored in memory
- Address of all words selected for transmission or display
- Input/output buffers A&B
- All clocks (5)
- Difference between ground and capsule TR
- All modes and status conditions
- All error conditions

Remote Functions

Selected controls and displays plus control interlock

Ground TR and ET in decimal hours, minutes, and seconds format

Memory contents and/or manually inserted words via teletype

Test

Teletype simulator

Single step operation

Memory self-test

HELP WANTED

To inaugurate a TIB column called HELP WANTED—devised as a petition for help from the network sites—we begin by publishing an item submitted by the Failure Analysis Program people. . .

The objective of the failure analysis program is the improvement of system reliability through statistical analysis of component failure information reported by the sites. Parts consumption is studied to determine if the failure rate is excessive when compared with anticipated life expectancy. Through examination of the failure data, existing trouble areas are revealed. Also by projecting the failure data over definite periods of time, trends are established to forecast potential trouble areas. The analysis program also provides an indication of the effectiveness of corrective action instituted by various EI's.

Meeting the objectives of the program requires that the failure report forms (DD Form 787-1) be properly prepared and submitted. Instructions for using this form are covered in Network Operations Directive 61-1.

When performing an evaluation of reported failures on the basis of an intersite comparison, one of the difficulties encountered is the disparity of reporting between similarly equipped sites. For example, a tabulation of the acquisition aid failures reported to date reveals that two of the sites have reported only 3 and 4 failures, respectively. In comparison, two other sites have reported 338 and 203 failures. The average number of failure reports per site is approximately 95. Evaluation on this basis is limited when attempting to substantiate that a problem is universal throughout the network. It is therefore not unreasonable to assume that all failures are not being reported and, consequently, the evaluation of the system under study is restricted.

Many failure reports lack adequate information. Some of the common deficiences: (1) omission of nomenclature of the subassembly in which the failed part is physically located, (2) absence of the serial number of the affected subassembly, (3) lack of the part number of the failed part, (4) lack of "hours in service" derived from the part replaced, (5) improperly selected or defined "type of failure" information.

Many difficulties could be avoided if a responsible site engineer, or equivalent, would conscientiously review the reports to ascertain that they are prepared as outlined in NOD 61-1 before forwarding to GSFC. The failure analysis program cannot perform effectively unless accurate reports of all failures and replacements are received.

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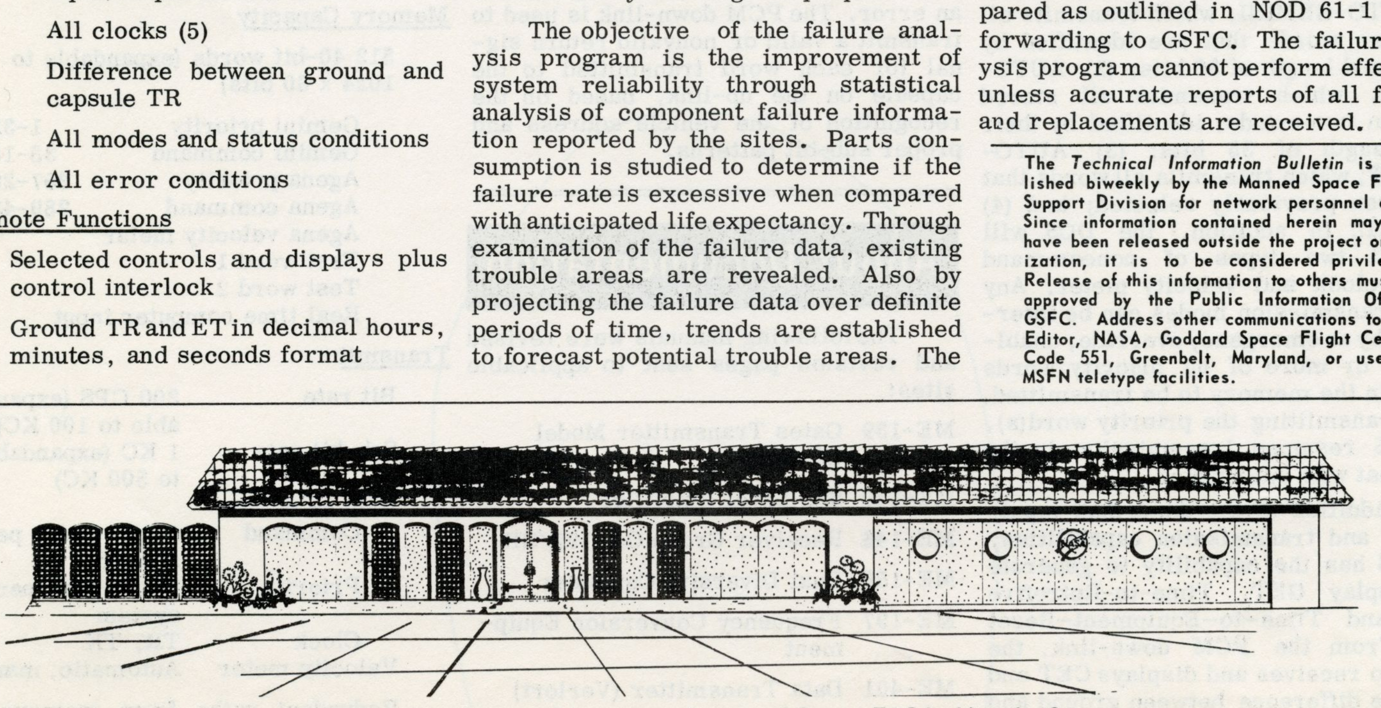

Architect's rendering of front view of proposed Gemini T&C building for Guaymas