NCS Minicomputer Systems Status Report

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Implementation of the Network Control System (NCS) requires the use of 17 minicomputer systems. The functional requirements for these systems within the NCS are discussed, and details of the minicomputer block diagrams, mechanical configuration, interface characteristics, and software support are presented.

I. Introduction

Implementation of the Network Control System (NCS) entails the use of 17 minicomputer systems (14 on-line systems and three operational backup systems) to accomplish the necessary processing tasks assigned to the NCS. A competitive procurement was initiated to obtain the required minicomputer systems, and a JPL Source Evaluation Board (SEB) was convened to select the successful proposer. The contractor selected by the SEB is Modular Computer Systems Incorporated (ModComp), Fort Lauderdale, Florida, and on December 21, 1973, JPL Contract No. 953793 was awarded ModComp to provide the required hardware, software, and support services associated with the minicomputer systems. This article presents a synopsis of the equipment and services being supplied by ModComp.

II. Functional Requirements

The NCS implementation requires six unique minicomputer system hardware configurations. Table 1 indicates the NCS subsystem application for each of the six configurations; Table 2 presents a summary of the required interface capacity and certain key characteristics of the Central Processing Unit (CPU) for each of the six minicomputer configurations. Each minicomputer system is a stand-alone, self-contained assembly, in its own equipment cabinets, and does not share electronic assemblies or power supplies with any other minicomputer system.

A. Functional Block Diagrams

Figure 1 is a functional block diagram of the NCS showing the interconnection between the various minicomputer systems and their peripheral equipment and the functional use of all the equipment. Figures 2 and 3 illustrate the detailed block diagrams of the minicomputer systems themselves. Since minicomputer system Configurations 1 through 5 are basically similar, varying only in memory size and number of interfaces, Fig. 2 illustrates a Configuration 3 system as a typical representative of Configurations 1 through 5. The Configuration 6 minicomputer system is sufficiently more complex in its interfaces to warrant the inclusion of the separate block diagram shown in Fig. 3.

B. Mechanical Configuration

The minicomputer systems are housed in standard DSIF equipment cabinets supplied to the vendor by JPL. Figure 4 illustrates a typical physical layout of minicomputer system Configurations 1 through 5. The Configuration 6 minicomputer system (not illustrated) requires three cabinets because of the expanded interface capacity.

Connector panels are installed in the minicomputer system cabinets to provide a common point of interface for all interconnecting cables. The interface connector panel is used for all underfloor cable connections to the minicomputer system. The front connector panel allows easy connection of rollup peripheral devices such as paper tape handling equipment.

C. Interfaces

Standardization of electrical interfaces to the minicomputer systems permits a large degree of freedom in functional assignment of many of the interface ports. The various types of electrical interfaces available are described below:

1. DSN standard interface. Each minicomputer system is equipped with several DSN standard interface ports conforming to the requirements of JPL Specification ES 508534. These ports are used in the NCS to interconnect several minicomputer systems, through the use of the Star Switch Controller, and to connect to magnetic tape units.

2. RS-232 interfaces. Both synchronous and asynchronous serial interfaces conforming to EIA Standard RS-232 are provided for interfacing peripheral equipment such as cathode-ray tube (CRT) terminals, line printers, and card readers. The RS-232 interface type will also accommodate the console I/O device and paper tape reader/punch assemblies.

3. Interrupts. Up to 14 externally generated interrupt signals can be accommodated by the minicomputer systems via 50-ohm coaxial cable connection. Signal levels and timing are such that interrupt signals generated by existing equipment designed to interface to older computers can be handled without modification.

4. Time interface. Provision has been made in the minicomputer systems to input GMT in both binary and BCD format. Six parallel 16-bit-word digital interfaces are provided for this purpose.

5. Disk interfaces. Since disk drive interfaces are somewhat specialized and contain device-peculiar timing signals, no attempt has been made to standardize them. Therefore, all minicomputer system disk drives are connected through the manufacturer's standard interface.

6. Software. ModComp is providing standard software in both object and source code form for use in the minicomputer systems. The standard software includes:

(1) Loaders/dumps.

(2) MAX III operating system.

(3) MAX II/III support system.

(4) Diagnostics.

(5) SAX III.

(6) MAX II/III extended macro-assembler.

(7) Extended FORTRAN IV.

(8) Overlay FORTRAN IV.

(9) Math library.

(10) FORTRAN run-time library.

(11) Process input/output (I/O) and system subroutines.

In addition to the standard software, ModComp is providing special I/O handlers and diagnostic programs to accommodate DSN standard peripheral equipment procured to JPL specification requirements.

III. Installation

As of June 1974, 13 minicomputer systems have been delivered by ModComp. Nine systems are installed in Building 230 for NCS Block II testing and integration; one system is temporarily installed at Foothill-B for use in the ModComp maintenance training courses; one system is temporarily installed in Building 161 for use in NCS software development; and two systems are awaiting installation in the permanent NCS facility in Building 202.

Additional system information and performance history will be provided in future articles.

Table 1. NCS subsystems

Configuration	NCS subsystem title	Quantity required
1	Display (DISP)	2
2	Network Communication Equipment (NCE)	2
3	Test and Training (T&T)	2
4	Command Real-Time Monitor (RTM) (CMD-RTM)	1
4	Monitor RTM (MON-RTM)	2
5	Telemetry RTM (TLM-RTM)	2
5	Tracking RTM (TRK-RTM)	1
6	Central Communications Terminal (CCT)	2

Note: The three spare minicomputer systems are Configuration 3 systems

Table 2. Minicomputer system configuration summary

Item	Interface	Configuration 1	2	3	4	5	6
		Configuration quantities required					
		2	2	2	3	3	2
		NCS application					
		DISP	NCE	T&T	CMD-RTM MON-RTM	TLM-RTM TRK-RTM	CCT
		Quantities per configuration					
MOD II/25 CPU		1	1	1	1	1	1
Memory Size		32K	32K	64K	32K	64K	32K
Hardware floating point option				1		1	
Interval timer option		1	1	1	1	1	1
2.5-M-byte cartridge disk	ModComp standard	2	2	2	2	2	2
20-M-byte disk file	ModComp standard						1
Console I/O device port	RS-232C async	1	1	1	1	1	1
Paper tape read/punch port	RS-232C async	1	1	1	1	1	1
DMA port	NCS standard	3	5	3	3	3	32
Magnetic tape unit port	NCS standard	1		1			2
External interrupts	Coax	6	6	6	6	6	6
I/O interrupts	Coax	8	8	8	8	8	8
GMT input	Digital	96 bits	96 bits	96 bits	96 bits	96 bits	96 bits
High-speed printer	RS-232C sync	1					
Low-speed printer	RS-232C async	1		2			
Card reader	RS-232C async	1		1			
CRT operator terminal	RS-232C async	2		2	1	1	

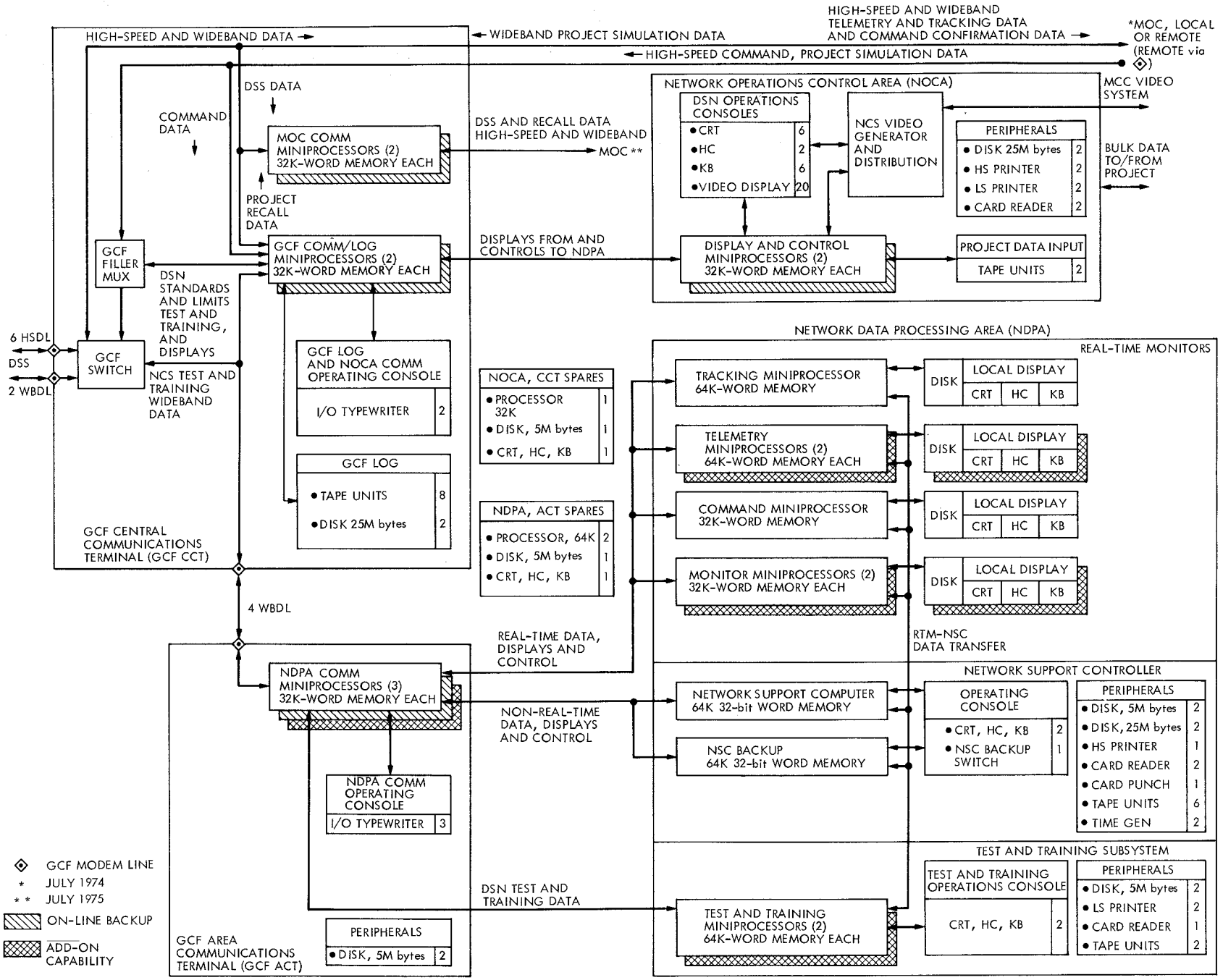


Fig. 1. Network Control System detailed configuration diagram

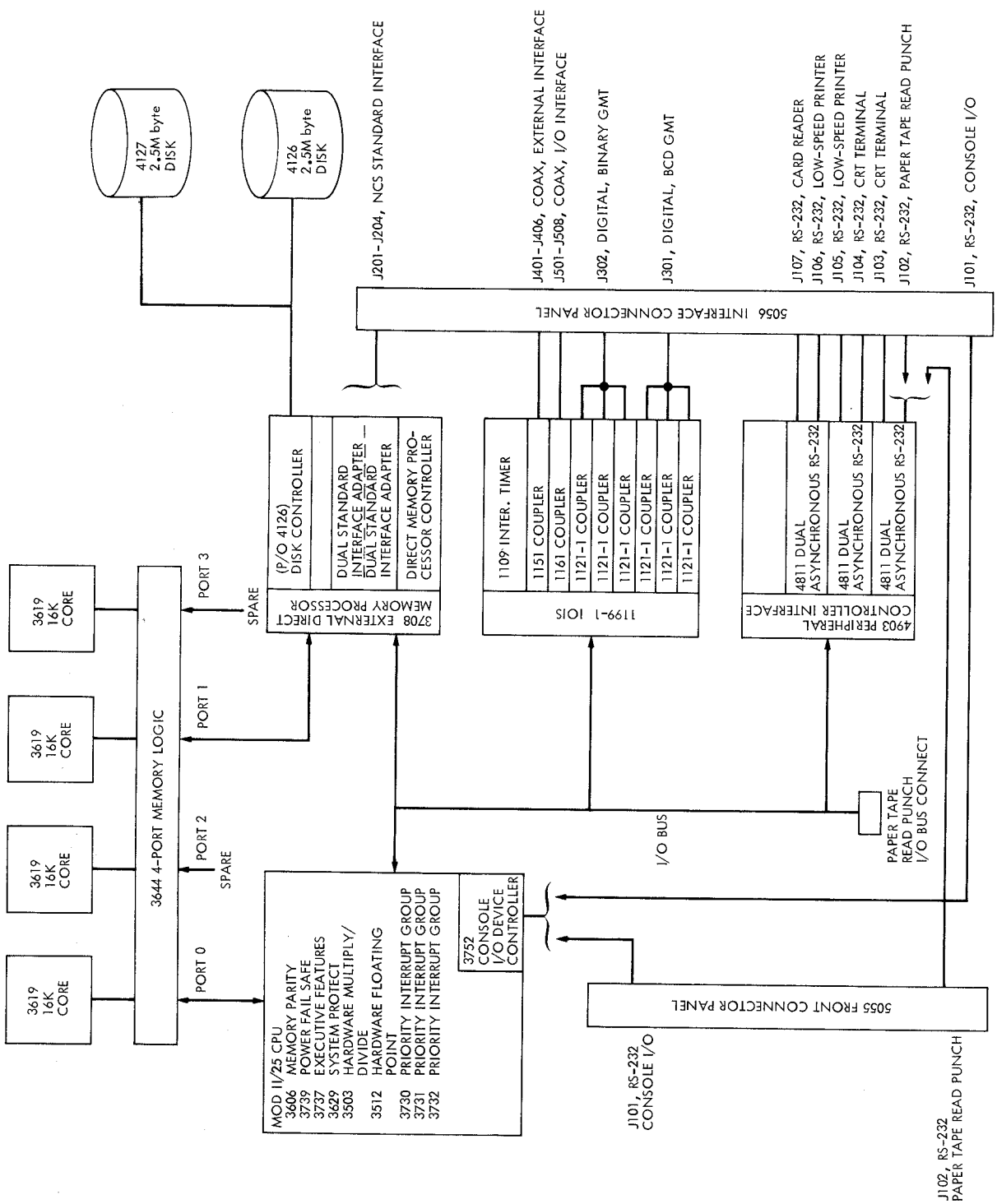


Fig. 2. Minicomputer system Configuration 3 block diagram

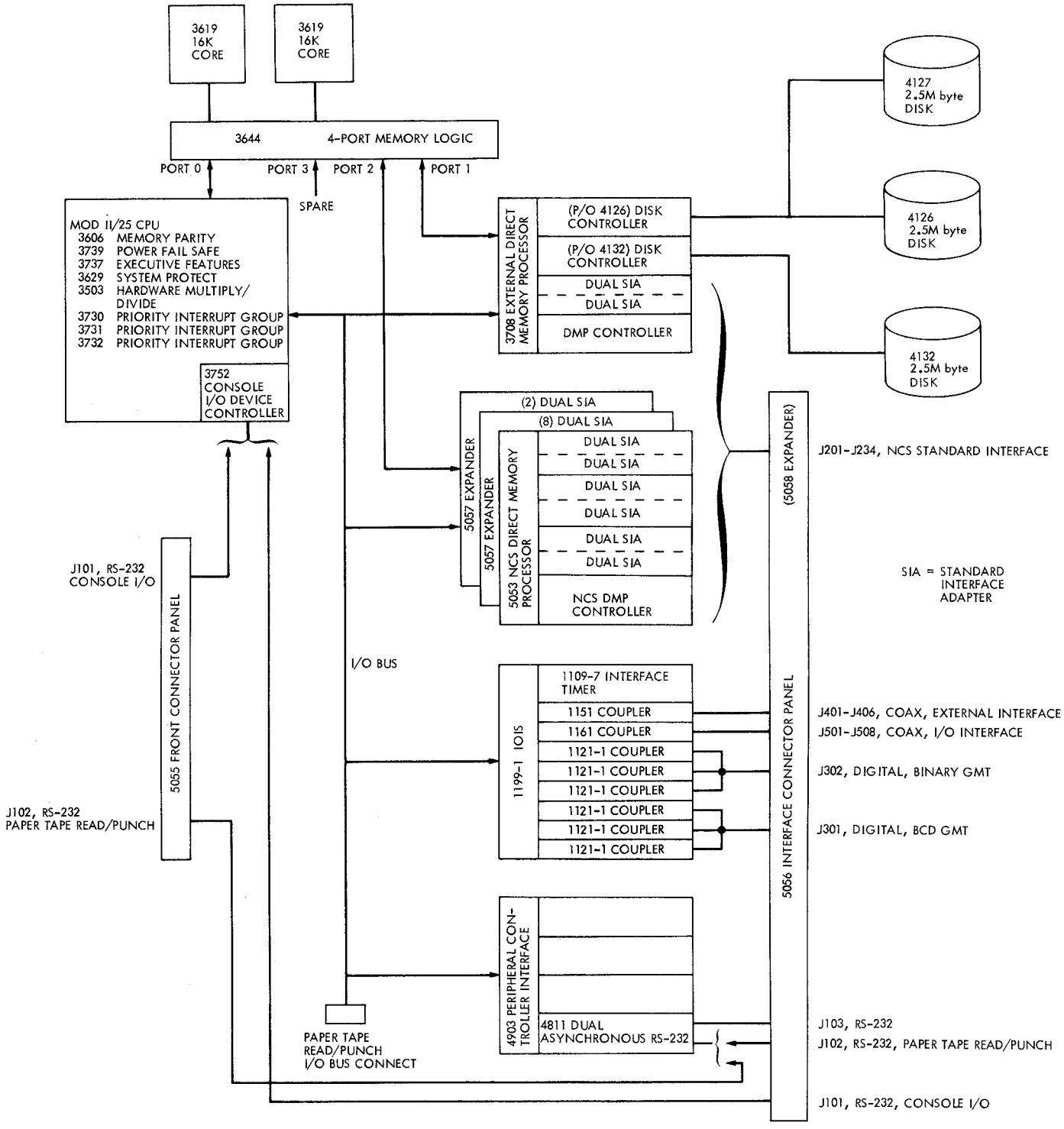
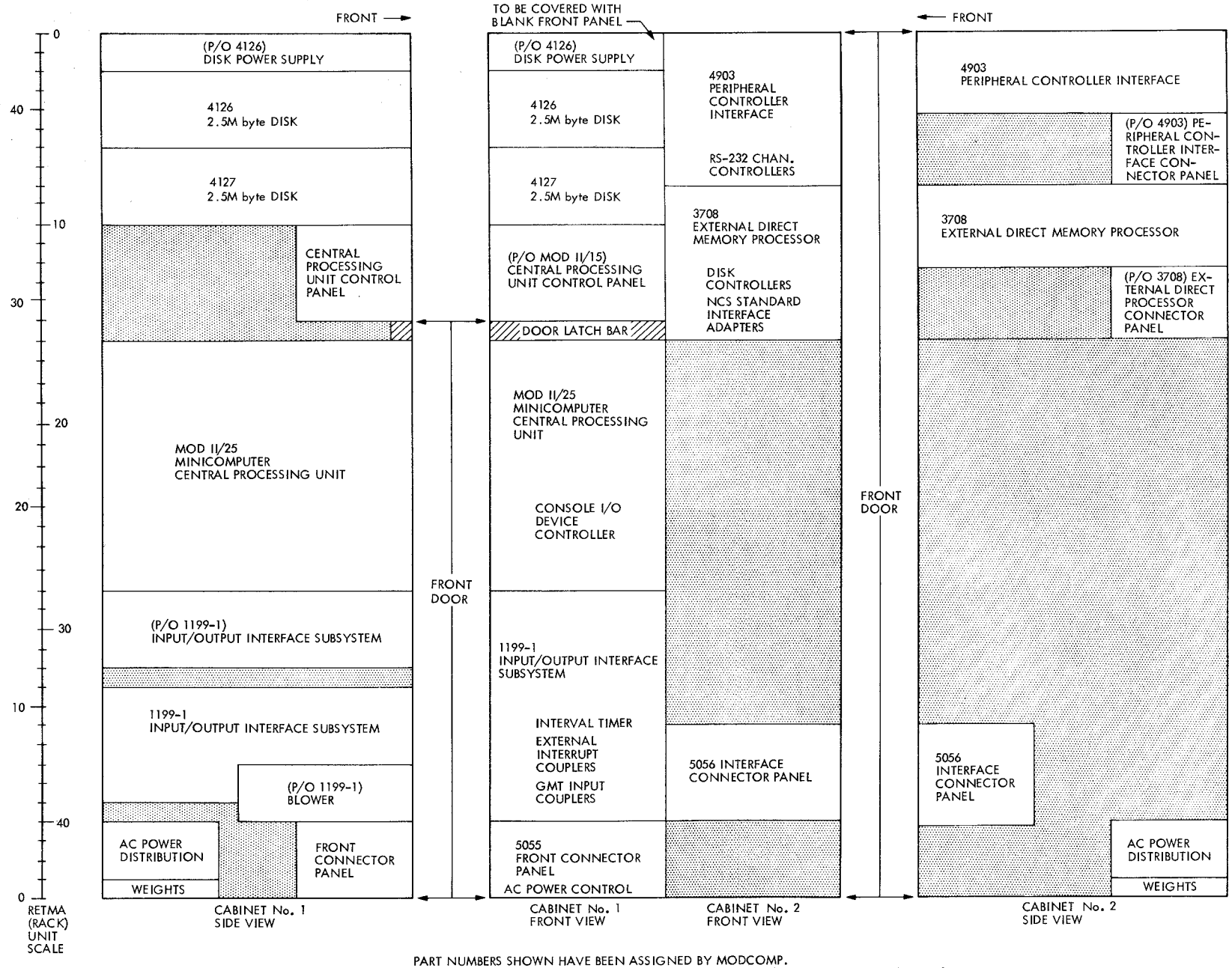


Fig. 3. Minicomputer system Configuration 6 block diagram



PART NUMBERS SHOWN HAVE BEEN ASSIGNED BY MODCOMP.
CABINET No. 1 - JPL PART No. 9336147-92. CABINET No. 2 - JPL PART No. 9336147-93.
ALL CABINETS EQUIPPED WITH FULL REAR DOORS. ALL DOORS, FRONT AND REAR
HINGE ON RIGHT SIDE OF DOOR.

Fig. 4. Cabinet assembly layout, minicomputer system Configurations 1 through 5