X-324-68-279

PREPRINT

NASA TM X- 63319

ISIS-A EXPERIMENT DATA PROCESSING AND DISPLAY CONSOLE

GPO PRICE $ _____

CSFTI PRICE(S) $ _____

Hard copy (HC) _____

Microfiche (MF) _____

ff 653 July 65

JULY 1968

GSFC

GODDARD SPACE FLIGHT CENTER

GREENBELT, MARYLAND

X-324-68-279

ISIS-A EXPERIMENT

DATA PROCESSING AND DISPLAY CONSOLE

Test and Evaluation Division
Systems Reliability Directorate

July 1968

GODDARD SPACE FLIGHT CENTER
Greenbelt, Maryland

ISIS-A EXPERIMENT
DATA PROCESSING AND DISPLAY CONSOLE

Prepared by: Robert W. Rhodes

Robert W. Rhodes
Electronics Test Branch

Reviewed by: Philip Yaffee

Philip Yaffee
Head, Electronics Test Branch

Approved by: J H Boeckel

John H. Boeckel
Deputy Chief, Test and Evaluation Division

PROJECT STATUS

This is a report on the data processing and display console designed for the ISIS-A spacecraft. The equipment is presently being used to aid in the integration of the spacecraft.

Authorization

Test and Evaluation Division Charge No: 324-872-11-26-01

ISIS-A EXPERIMENT

DATA PROCESSING AND DISPLAY CONSOLE

Robert W. Rhodes

Test and Evaluation Division

SUMMARY

This report describes a data processing and display system designed for the ISIS-A spacecraft. The system was designed to fulfill two specific needs. It provides displays for the five experiments for which displays are not available in the RCA Victor (RCAV) ground station equipment (GSE), and it provides back-up decommutation capability for the PCM data signal. The system can accept data from the RCAV GSE or provide its own data and synchronization signals from the outputs of its self-contained receivers.

The system was designed using commercial equipment and logic cards wherever possible. The general logic design was straightforward and is not presented in detail.

CONTENTS

	Page
INTRODUCTION	1
ISIS-A TELEMETRY FORMAT	1
SYSTEM DESCRIPTION	1
RF and Video Section	4
Decommutation Section	4
Data Synchronizer	4
Format Synchronizer	4
Storage and Digital-to-Analog Converter	6
Displays	6
CONCLUSIONS	6

ILLUSTRATIONS

Figure		Page
1	ISIS-A Experiment Data Processing and Display Console	2
2	Block Diagram of Console	3
3	Format Synchronizer	5
4	Storage and Digital/Analog Converters	7

ISIS-A EXPERIMENT

DATA PROCESSING AND DISPLAY CONSOLE

Robert W. Rhodes
Test and Evaluation Division

INTRODUCTION

The ISIS-A spacecraft will carry ten experiments for ionospheric study. Five of these are RF-oriented, and five are direct measurement types. RCA Victor (RCAV) of Montreal will provide the ground station equipment (GSE) for spacecraft operation and data decommutation. This GSE will include displays required for the RF-oriented experiments and data output lines for the direct measurement experiments. The Electronics Test Branch undertook to provide displays for the direct measurement experiments and a measure of redundacy in decommutation capability. The system was designed to include the required displays, a PCM bit and format synchronizer, and sufficient additional circuitry to provide data outputs for the experiments in exactly the same form as the RCAV GSE.

ISIS-A TELEMETRY FORMAT

The ISIS-A telemetry system is divided into two subsystems — essentially, a real time subsystem and an accelerated playback mode subsystem. The real time subsystem operates in the 136 MHz, and the playback subsystem in the 400 MHz telemetry band.

The real time subsystem will use one FM and one PM transmitter. All of the direct measurement data, plus housekeeping, cosmic noise, and spacecraft clock, will be transmitted in PCM on the PM transmitter. The sounder and VLF data, along with essential housekeeping and spacecraft clock, will be transmitted on the FM transmitter, with the housekeeping and clock on a 30 kc subcarrier.

SYSTEM DESCRIPTION

The equipment is completely self-contained in four mobile racks (Figure 1). A block diagram of the system is shown in Figure 2. The data from the direct measurement experiments, and the housekeeping data and clock signal necessary

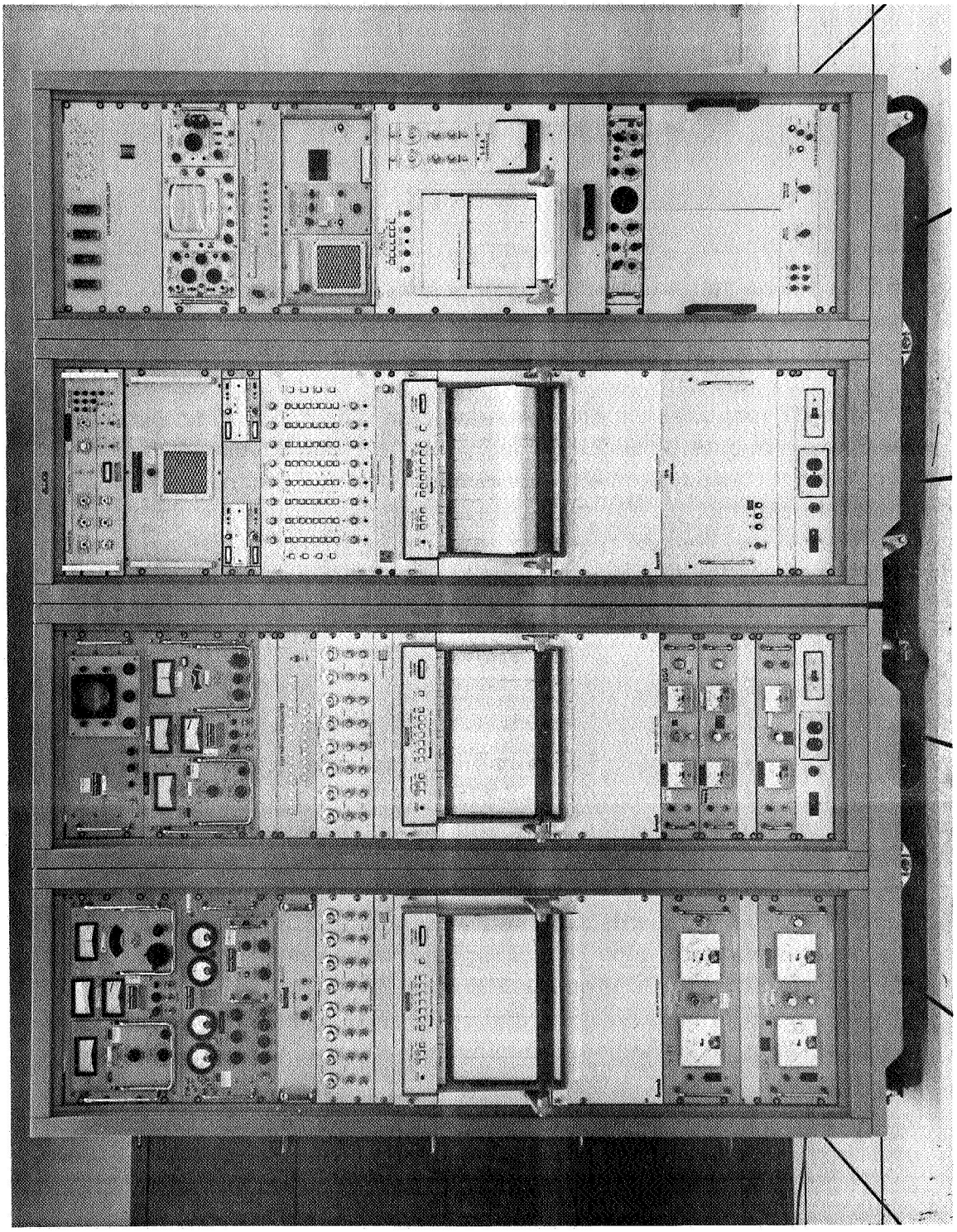

Figure 1. ISIS-A Experiment Data Processing and Display Console

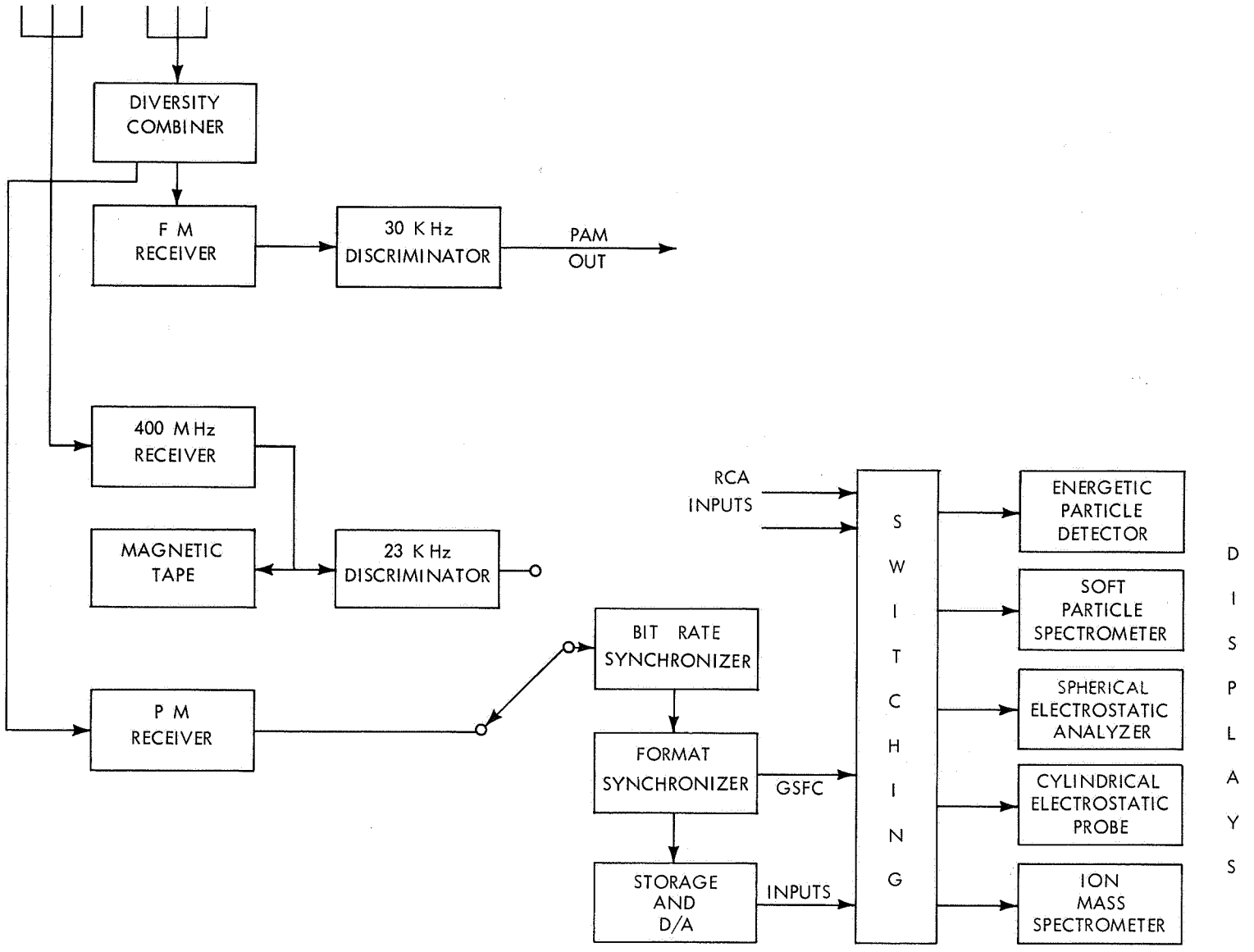

Figure 2. Block Diagram of Console

to identify and interpret these data are of prime concern. For this reason, the 400 MHz video is recorded on an instrumentation magnetic tape recorder and played back at one-quarter the recording speed into a 23.25 kHz discriminator. This allows recovery of the PCM data at the normal real time rate.

The basic item of interest from the FM receiver is the housekeeping data on the 30 kHz subcarrier. Therefore, the video is fed into a 30 kHz discriminator. The PM receiver video is fed directly to a PCM bit synchronizer which can also accept the output of the 23.25 kHz discriminator. The video from both 136 MHz receivers is also recorded, along with the 400 MHz signal and time and voice information.

The clock signal and data from the bit synchronizer is fed to a format synchronizer. This strips out digital data and spacecraft clock information and sends analog data (still in digital form) to the appropriate storage and digital-to-analog conversion locations. The digital and analog data outputs go to a large switching matrix which also receives the same data in the same form from the RCAV GSE. The matrix feeds the data, from one source or the other, to the various displays.

RF and Video Section

Defense Electronics TMR-5A receivers with appropriate plug-ins are used for the 136 MHz receivers. For isolation, they are fed from a Nems-Clarke multicoupler. The 400 MHz receiver is a Defense Electronics TMR-6A. A Defense Electronics SDU-3 spectrum display is also included for monitoring the RF signals. The FM subcarrier discriminators are Data Control Systems Model GFD-3s.

Decommutation Section

The decommutation section is divided into three parts — the data synchronizer, the format synchronizer, and the storage and digital-to-analog converters.

Data Synchronizer — The PCM video is fed into a Telemetrics Model 6103 digital signal synchronizer which reconstructs the data and generates a bit rate clock signal.

Format Synchronizer — Serial data is shifted into a 16 bit shift register (Figure 3) which sends parallel data to storage and to the frame synchronization detector. The clock signal from the synchronizer is used to shift the register. It is also divided down through a series of counters to give word rate pulses and frame rate pulses. The output of the frame synchronization detector resets all

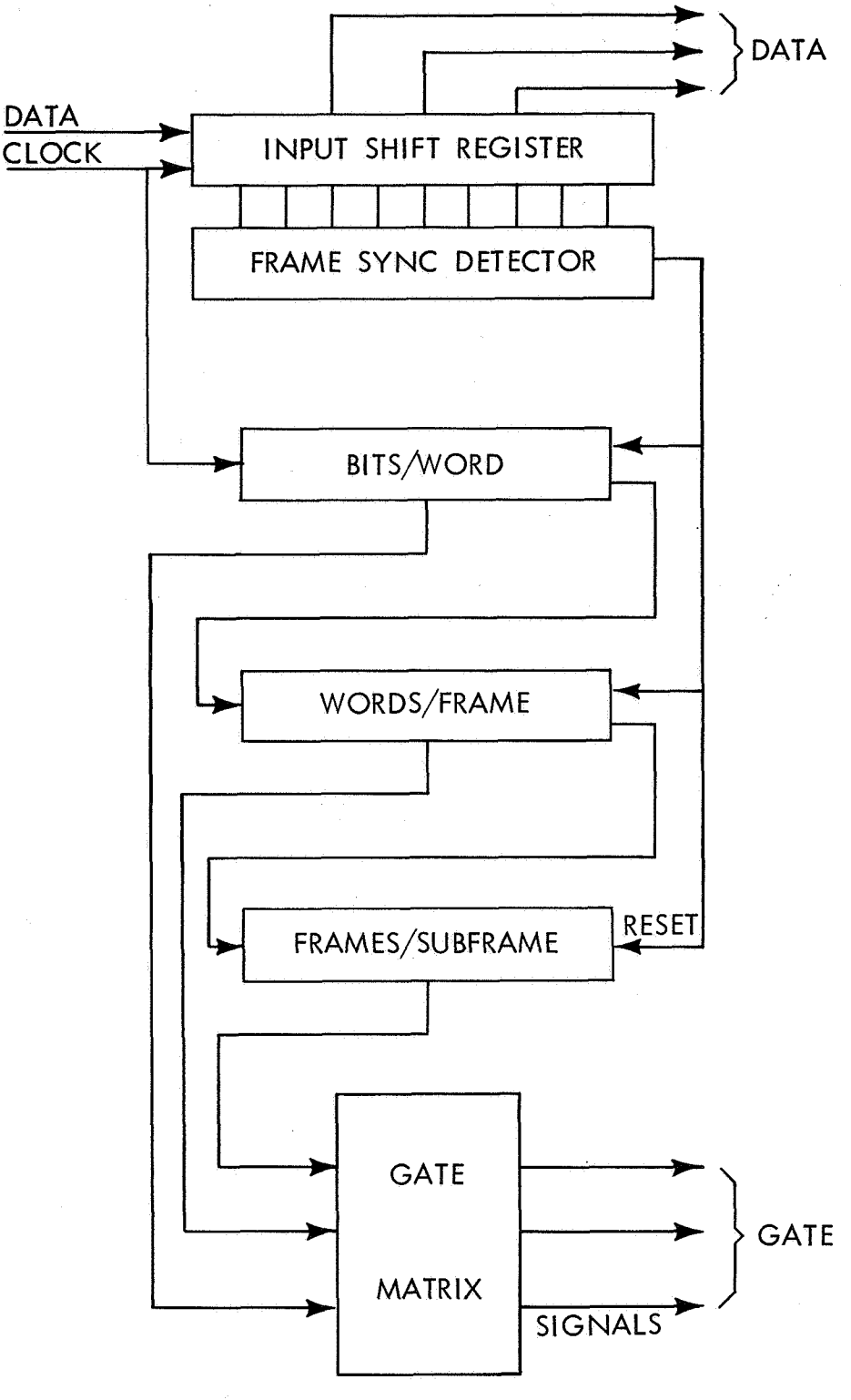

Figure 3. Format Synchronizer

counters to the proper state. The parallel output of the counters feeds the gating matrix which provides the storage transfer signals.

Storage and Digital-to-Analog Converters — Digital Storage is provided for every channel and flag to be displayed and for the spacecraft clock information (Figure 4). The parallel data is presented to all data storage registers. It is gated in by the appropriate transfer pulse from the gating matrix. Each storage register for analog data feeds a digital-to-analog converter and operational amplifier. This is used to convert data to the same zero to 5 volt scale as used in the original experiment. The digital storage drives the displays directly.

The spacecraft information is fed into a shift register one bit at a time, because the data is subcommutated, and gated into a storage register for parallel output. It is shifted out of the shift register at a much slower rate for the strip chart recorders.

Displays — With one exception, all of the analog data is displayed on Brush oscillographs. One parameter is displayed on a special meter. The digital flags are displayed on lights and some channels are displayed on the oscillographs. The energetic particle detector data is all digital and is printed out on a 20 column line printer (Franklin 2000 series).

All records are tagged with the spacecraft clock information. This appears as a BCD code on the event marker channel on the oscillograms and is printed along with the data on the line printer.

CONCLUSIONS

The Data Processing and Display Console is currently being used during the integration of the ISIS-A spacecraft and will be used during the environmental test and launch activities.

The equipment has been very useful in allowing all the direct measurement experimenters to analyze their data simultaneously and check for mutual interference.

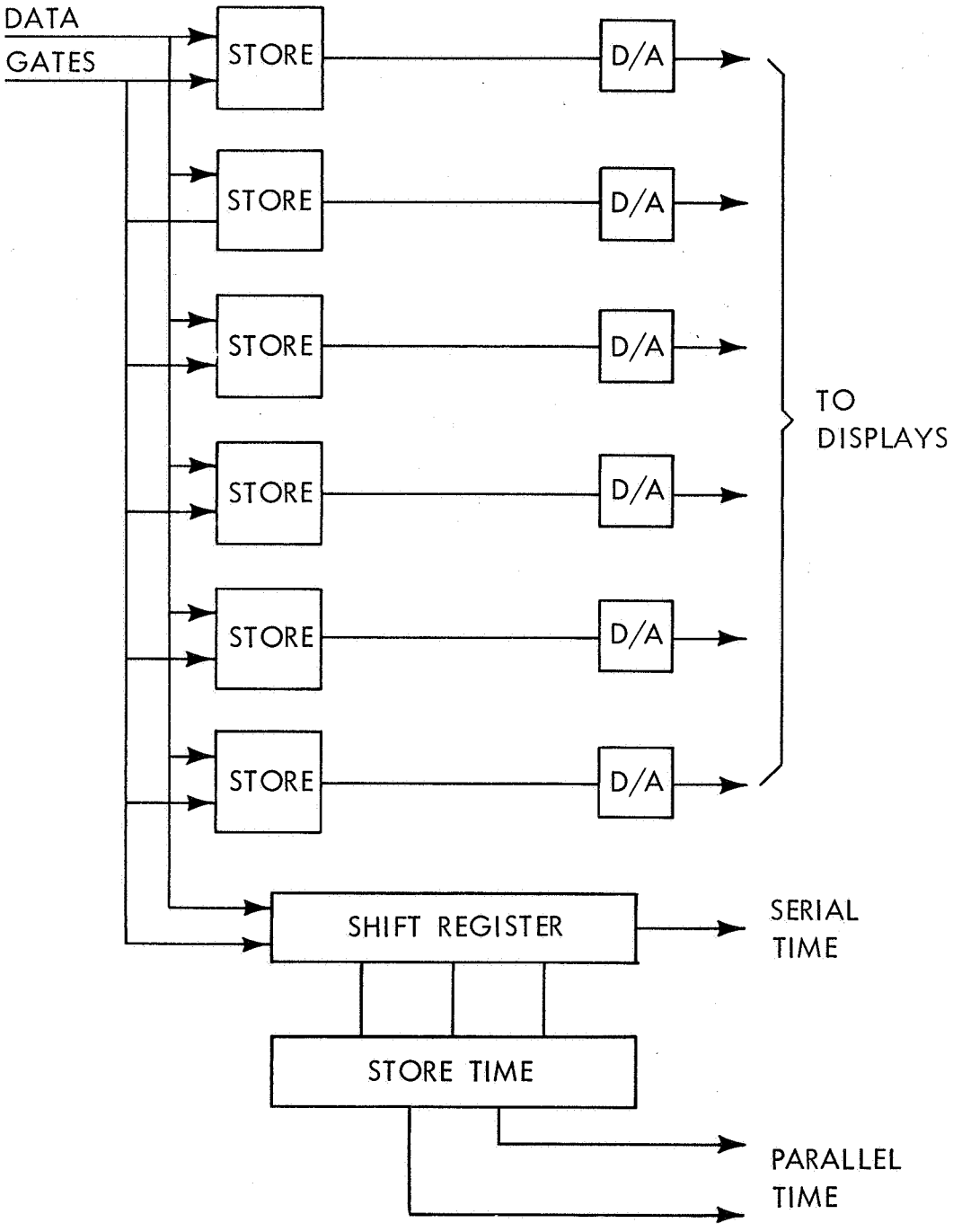

Figure 4. Storage and Digital Analog Converters