620-720 DATA COMMUNICATION SYSTEMS

15 November 1968
CONTENTS

PART I
INTRODUCTION

Sanders Associates, Inc. 1 to 4
Display Products 5 to 10

PART II
SANDERS 731 DATA
COMMUNICATIONS BUFFER

731 Introduction 11 to 15
731-0. Local Transmission 16 to 19
731-1. Remote Transmission 20 to 24

PART III
THE 720 SYSTEM

The Sanders 701 Control Unit 25 to 27
Model 708 Data Display 28 to 31
Sanders 7242 Keyboard Line 32 to 31
Hard-Copy Options 35 to 38
Advantages 39

PART IV
THE 620 SYSTEM

Features and Capabilities 40 to 44
Advantages 45

PART V
SYSTEMS AND SOFTWARE SUPPORT

First Level 47 thru 51
Installation Support 52 thru 54

PART VI
CONCLUSION

Conclusion 55 to 56

DISPLAY SYSTEMS COMPONENT
ILLUSTRATIONS

Computer Driven H/S Graphic Display System - 900 Series 8
Sanders 720 Display System 9
Sanders 731 Data Communications Buffer 11
731 Rack Mounted in Control Unit Cabinet 12
Back Panel - DCB Buffer 13
Mod 731-0 DCB, Local Transmission 16
701 Control Unit 25
708 Data Display 28
7242 Keyboards 32
Hardcopy 35
620 Stand Alone System 40
INTRODUCTION

The Data Systems Division of Sanders Associates, Inc. was founded to provide a large research, marketing and support organization for the sale of commercial data displays. Since its inception, through continuing research and product development, the Division has become recognized as an industry leader offering a variety of sophisticated and reliable alphanumeric displays and peripheral equipment and providing nationwide field support. This publication is intended for management personnel and presents the Data Systems Division product line, discusses system configurations and software considerations in a formal manner. Should any questions arise several Technical Publications are available and the local Sanders Representative will be pleased to provide all assistance possible.

*SA*
Sanders Associates since its inception has been deeply involved in electronics and communications.
The company is playing an ever increasing part in many vital roles for our country. Counterclockwise, beginning in the upper left, we see illustrated our:

- Ocean Systems installations at Nashua, New Hampshire; Portland, Maine; and Milford, New Hampshire
- Electronic countermeasures test range at Merrimack, N.H.
- Flexprint Division and flight facilities at Manchester, N. H.
- Test stand construction at Plainview, New York, location of the Sanders/Diebold 500 Data Retrieval System
- Mithras Division in Cambridge, Mass. laser development and nuclear research
- International Ground Support Division located at Reston, Virginia
- Fuzing and Arming development and manufacturing facilities at Bedford, Mass.
- Microwave research and development located at Ledge Street in Nashua, N.H.
- Main manufacturing facility at Canal Street in Nashua and
- New Corporate Headquarters featured as the centerpiece located in South Nashua.

Sanders also has sales offices in most major cities in the United States and an International Office in London, England and Toronto, Canada.
COMPANY HISTORY

FOUNDED 1952

- PRESENT EMPLOYMENT OVER 10,000
- FY’68 SALES OVER $190,000,000
- 10 PLANTS
- 5 STATES
- 12 REGIONAL OFFICES
- WORLD WIDE BUSINESS ACTIVITIES

Sanders is a dynamic, highly responsive user oriented, electronic systems company now employing over 10,000 people.

Sanders Associates, Inc., was founded in 1952 by Royden C. Sanders Jr. and eleven other Raytheon employees who were involved in the development of continuous wave radar.
Sanders Associates, Inc. has many years background and experience in computer controlled data management systems for both military and commercial applications.

Sanders contributed to the monitoring and control of the mighty Saturn V rocket shown at lift-off!
A view of the Saturn V control room.

Four similar complexes, each with 28 large high speed Sanders Graphic Displays, monitor and control each Saturn V launch.
Development of Display Systems at Sanders.

The unique high speed yoke developed for the complex Saturn V Monitor System is incorporated in the 620/720 display line providing special features. Integrated circuits throughout make low cost possible.
The 960 display system depicted here is a high speed Graphic Display with the following features:

- 20 inch diameter viewing area
- Up to 6000 alphanumeric characters
- Up to 10,000 inches of vectors at 500,000 inches per second
- Various character sizes
- CPU core memory for refresh
- Photopen
The preceding pages illustrate the company's wide experience in display design and development and expertise in all areas. The 720 system was a logical development from the larger Saturn V Monitors and the 620 followed to fill needs expressed in a very comprehensive market survey taken in 1967.
MAJOR COMPONENTS OF SANDERS 720 SYSTEM

- Model 731 Data Communications Buffer (Computer Interface)
- Model 701 Control Unit
- Model 708 Display Terminal
- Model 7242 Keyboard

The functions and operational features of the above components will be described in order as this presentation develops.
The Sanders 731 Data Communication Buffer (D.C.B.) is a small sophisticated piece of logic and electronic design serving as an interface between IBM Model 360 computers and Sanders 620 and 720 Commercial Data Display terminals.
The D.C.B. is housed in the upper portion of a cabinet which can also contain a control unit and power supply. It occupies approximately 12 vertical inches of rack space.
Back Panel - Data Communications Buffer

This back view features tag and data line channel connections and communication line connections for local and remote operation.
The answers to this important question follow.
This interface provides complete IBM System 360 compatibility for:

- Models 30, 40, 44, 50 and 65
- Local and remote mode at varying transmission speeds
- The latest release of IBM supported Access Methods and Operating Systems without modification to IBM software.
- Replaces IBM 2701 Data Adapter Unit which can only maintain two full-duplex communication lines at a major cost reduction per line.

<table>
<thead>
<tr>
<th>LOCAL SYSTEMS</th>
<th>REMOTE SYSTEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>OS</td>
<td>DOS</td>
</tr>
<tr>
<td>GPS</td>
<td>BTAM</td>
</tr>
<tr>
<td>QTAM</td>
<td>QTAM</td>
</tr>
</tbody>
</table>
If high speed local transmission capabilities are required, the Sanders 731 MOD O Data Communications Buffer is designed and engineered to fill your needs. It is a very compact unit measuring only 20 × 17.5 × 12 inches.
The 731 MOD O is intended for use on the selector channel and operates in burst mode at an average transmission rate of 47.5K characters per second. The 731 MOD O is shown terminating the channel but it can be located at any position on the channel as it handles I/O lines with standard channel control responses.
The Model O is capable of sustaining eight communication lines connected by means of Parallel Transmission adapters. The average transmission rate is 47,500 characters per second.
A typical configuration for local operation for the Sanders 720 Display System. Some peripheral options are also shown. The light pen will rapidly position the cursor anywhere on the screen and the split screen option enables two operators, each with separate keyboard, to operate the display independent of one another.
The Sanders Model 731-1 D.C.B. is used to interface remote 620/720 Communications Systems to IBM system 360 computers.
This unit is attached to the IBM Multiplexor channel and operates at various transmission speeds from 110 bits per second to 2400 bits per second.
The Model 1 houses up to eight transmission line adapters. Three types of adapters are available offering a variety of data transmission speeds and any mix is allowable.

The Serial Transmission Adapter allows for direct cable connection between the display system and the computer interface without the use of a data set.
Typical system configurations for remote multi-drop and dedicated line environments. Components shown here will be discussed as this presentation develops.
Systems Configuration for remote communication systems using the Sanders Serial Transmission adapter and the Sanders 716 Serial Distributor.
The Control Unit cabinet has room for the 701 and associated power supply as well as the 731 Data Communication Buffer. Features seen in the back view are detailed in diagram below.
701 CONTROL UNIT

PROVIDES ALL COMMAND AND CONTROL FUNCTIONS TO HANDLE UP TO 12 DISPLAYS:

- 3 DISPLAYS WITH 1024 CHARACTERS MEMORY
- 6 DISPLAYS WITH 512 CHARACTER MEMORY
- 12 DISPLAY WITH 256 CHARACTER MEMORY

The 701 CU provides control functions for the 720 Communication System.
The 701 Control Unit contains up to 3 magnetostrictive delay line memories each of which may be subdivided between 4 displays.
Each character on the Sanders 708 Display, the entry/retrieval device for the Sanders 720 System, is created in 21.5 microseconds by a 16 stroke racetrack character generator.

Sanders 720 Display System 16 Stroke Racetrack
708 DISPLAY

- 2048 DISPLAYABLE POSITIONS
- P31 (GREEN) PHOSPHOR

OPTIONS

<table>
<thead>
<tr>
<th>SCREEN ORIENTATION</th>
<th>CHARA/LINE</th>
<th>NO LINES</th>
</tr>
</thead>
<tbody>
<tr>
<td>VERTICAL</td>
<td>52</td>
<td>40</td>
</tr>
<tr>
<td>HORIZONTAL</td>
<td>64</td>
<td>32</td>
</tr>
<tr>
<td>HORIZONTAL</td>
<td>84</td>
<td>32</td>
</tr>
</tbody>
</table>

Various line sizes are available with the 708 display and each of the 2048 screen positions is a displayable position.
MEMORY SAVE

If one feature of the Sanders 620/720 display systems could be considered the outstanding one MEMORY SAVE would be that feature. It makes it possible to display the 1024, 768 (620 system), 512 or 256 characters in memory over any of the 2048 displayable screen positions, providing the best means for efficient message presentation. There is little or no line and space restriction and it is possible to display up to 50% more data in most formats than that displayed by competitive displays which do not have the MEMORY SAVE feature and use a fixed raster scan. With the Sanders Terminal:

- a horizontal tab takes up one position in memory and moves the cursor four places to the right on the screen;
- a carriage return takes one position and moves the cursor to the left of the screen and down one line;
- a vertical tab occupies one position in memory and moves the cursor to the left and down four lines.

These features save many memory positions when setting up a format and allow Sanders great flexibility in the display of data. With a fixed raster display there is a one-to-one relationship between memory and screen positions and to move the cursor down four lines, for formatting purposes, when there are 64 characters per line, necessarily requires the loss of 256 memory positions which will be blank. A vertical tab achieves the same result with a Sanders Display and only one memory position is used - a saving of 255 positions!

Above is a graphic illustration of the advantages of Memory Save, an exclusive Sanders feature. The shaded area represents the amount of memory space lost with a fixed raster display each time a new line is required. It can easily be seen that a high percentage of memory is necessarily blank if a readable, aesthetically appealing, format is to be presented. Not so with Sanders!
This figure shows the general data flow in the 720 Communication System. Both digital and analog internal circuitry is employed. Input/output, editing and storage functions are implemented by the former while analog circuitry in the cathode-ray tube translation section converts ASCII code to analog voltages and currents which drive the CRT. These signals cause the English alphanumeric equivalent of the ASCII coded characters which are stored in memory, to be displayed on the screen.
Operator commands are initiated from the keyboard which generates a 7 bit ASCII output code for all alphanumeric, edit, and special function keys.

Using the keyboard, it is possible to move the cursor to (address) any of 3 kinds of memory sequents - blocks, lines, and fields. This can also be achieved under program control.

- **A block** is any data delimited by (or between) two successive Home characters.
- **A line** is any data delimited by successive Home, Vertical Tab, or Carriage Return characters.
- **A field** is any data delimited by successive Home, Vertical Tab, Carriage Return or Horizontal Tab characters.

Transmission of the proper addressing sequence to the 720 from the computer causes the cursor to seek out a particular block, a particular line within the block and even a particular field within the line. An operator cannot cross block-boundaries hence indicative and format information is protected.
MODEL 7242 KEYBOARD FEATURES

- VERY RELIABLE, HALF-STROKE, MICRO SWITCH KEYS
- ELECTRONIC INTERLOCK AND ROLL-OFF FOR HIGH SPEED KEYING
- 64 ALPHANUMERIC CHARACTER KEYS
- 12 EDIT AND I/O FUNCTION KEYS

The fast and efficient Sanders keyboards evolved from a major research and development effort.
SANDERS KEYBOARD FAMILY

OPTIONS

STANDARD TYPEWRITER STYLE

KEYPUNCH STYLE

ADDING MACHINE STYLE

The typewriter style keyboard has proved most popular. However, the keypunch style with the numeric keys located in positions similar to that of an IBM "029" keypunch makes it possible for keypunch operators to rapidly learn the use of the equipment. The adding machine style keyboard has the numeric keys set-up in a block similar to that of a 10 key adding machine and greatly facilitates the high speed entry of numeric information.
Hard-Copy!

A TTY-based word processor is available for more sophisticated document preparation. A word processor system offers a variety of benefits: it extends the versatility and flexibility of the system, and opens up new application areas. Sanders has designed a word processor system for the 920 Information Manager, employing a large-scale, high-speed magnetic disk for storage of documents. Sanders also offers a word processor which can be used with the 520 Information Manager. For more information on the Sanders word processor, please contact your nearest Sanders office.

Hard-copy needs are met with either Teletype or faster Kleinschmidt* printers in a variety of configurations.

*Sanders 620 Communication System Only.
Flexibility

Hard-copy peripherals offered by Sanders Associates provide the ability to copy the screen image onto paper at a remote terminal.

A 706 hard-copy adapter from one to three 2706 channel multiplexors are required. Each multiplexer will route output to from one to twelve printers. With twelve printers, four teletypes on each 2706 would be the optimum configuration as each 2706 operates independently and associated printers are serviced individually in a hard wired sequence.

NOTE: The Display keyboard is locked when its associated Teletype is printing.

Hard-copy can originate and be routed in several ways to provide the greatest possible flexibility.

Display Initiated:

(1) From the display to the printer directly

(2) From the display to the computer where the Hard-Copy Macro* is used to serialize multi-block formats, then back to the display, then printer, or directly to the printer; (see no. 2 below)

(3) From the display to the printer then to the computer.

Computer Initiated:

(1) From the computer to the display then to the printer if the Sanders 620 System is employed.

(2) From the computer to the printer directly with the Dedicated Buffer Option. See page 37.

*See description of this Macro under First Level Support.
Computer Initiated Hard-Copy

This method is used when there is a need for on-line high volume printing capabilities. Simultaneous use of the display and printers is possible and buffering of hard-copy output is under computer control allowing for maximum system throughput.
HARD-COPY PRINTER OPTIONS

MODEL 33 TELETYPE - LIMITED DUTY CYCLE
MODEL 35 TELETYPE - HEAVY DUTY CYCLE
FRICION ON SPROCKET FEED FOR BOTH
TYPE 33 & 35 PRINTERS
64 OR 84 CHARACTERS/LINE

A motor-controller and time-delay, to switch off the Teletype motor when the unit is not in use, is a standard feature of the limited duty Model 33 Teletype and on the heavy duty Model 35 Teletype.
Why the 720 System?

ADVANTAGES
OF THE 720 DATA DISPLAY SYSTEM

- MEMORY SAVE-DATA DISPLAYABLE
  OVER 2048 POSITIONS

- UNIQUE COLLECTION OF EDITING CAPABILITIES

- 3 MEMORY SIZES: 1024, 512, OR 256 CHARACTERS

- ABILITY TO ADDRESS ANY OF THREE KINDS OF MEMORY SEGMENTS
  BLOCKS, LINES, AND FIELDS INDIVIDUALLY

- RESTRICTION OF OPERATORS TO SPECIFIC WORK AREAS
  FOR FORMAT PROTECTION

The preceding discussion on the features of the components which make up the Sanders 720 Data Display System illustrate the capabilities, flexibility, and unique qualities of the Sanders product line.
Introducing the Sanders 620 Stand Alone System.

The Sanders 620 Data Display is a compact, portable, stand alone alphanumeric display built to satisfy requirements expressed in a comprehensive market survey.
620 STAND-ALONE SYSTEM

I/O, EDITING, MEMORY, POWER SUPPLY AND DISPLAY FUNCTIONS CONTAINED WITHIN DESK TOP TERMINAL

768 CHARACTER MEMORY

64 CHARACTERS PER LINE - 32 LINES

ASYNCHRONOUS TRANSMISSION 110, 1200, AND 1800 BITS PER SECOND

REFRESH RATE 60 CYCLES PER SECOND

Compact circuitry and electronic packaging enable the elimination of the 701 Control Unit as I/O and editing features, memory, power supply, and display functions are contained in an attractive compact desk top terminal. In addition this system has many of the features of the Multi-Terminal 720 Communication System.
Sanders 620 System with Format Mode Option.

The format mode operation permits you to employ two separate superimposed data fields on the screen - one fixed and the other variable. Delta characters are used to define the segments of the variable field and when the format is retrieved, the cursor is located in the first alphanumeric position of the variable field. Only data contained between deltas will be transmitted to the computer if operating in the format mode.
Horizontal and vertical Tabs permit the better utilization of the memory save feature, previously explained on page 30.
Two typical equipment configurations for remote transmission are shown here. Use of the Sanders 716 Serial Distributor allows the use of 16 displays on one telephone line.
ADVANTAGES OF THE SANDERS 620 DATA DISPLAY SYSTEM

LOW COST, HIGH RELIABILITY

STAND-ALONE

COMPATABILITY - INTERFACES WITH MOST MODERN DIGITAL COMPUTERS CONTAINING DATASET ADAPTER INTERFACES

MEMORY SAVE - 768 CHARACTERS CAN BE POSITIONED IN ANY OF 2048 SCREEN POSITIONS

RESTRICTION OF OPERATOR TO SPECIFIC WORK AREAS FOR FORMAT PROTECTION

The 620 Data Display is a desk-top stand alone system and does not require a Control Unit of any kind connecting directly to a data phone thus doing away with equipment racks and extensive cabling. The size of the terminal allows it to be located anywhere and moved with relative ease. The low cost and high capabilities of this display make it the most competitive in industry.

The outstanding advantages of the exclusive memory save feature have been explained in the discussion of the Sanders 720 System. This feature allows the positioning of 768 characters in memory, over 2048 screen positions.

An operator is restricted to operation within a variable data block bounded by delta characters when the format option is used. This eliminates the accidental destruction of unchanging inductive information.
The user is responsible for defining his own communication system and writing the message processing programs for his particular application. Sanders supplies software support to the latest IBM release of the teleprocessing access method chosen by the user. Consultation and customer education are also provided.
First level support consists of a manual which provides detailed information for problem programmers, systems analysts, and systems programmers who wish to use the first-level software support. This is provided by Sanders as back-up for its Data Display Systems interfaced with IBM system 360 computers.
The manual covers two areas of support, the first being I/O processing which is concerned with the various methods of transmitting data from the CPU to the terminal and the terminal to the CPU without regard to the information content of the data. I/O processing support consists of increasing the capabilities of the standard IBM supported teleprocessing and graphic access methods to recognize the Sanders display terminals as distinct entities and to provide the same complement of access-method facilities that is provided for IBM supported devices.

The following list contains that I/O Processing routines and macros (distributed in card deck form).

<table>
<thead>
<tr>
<th>Routine</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Device Dependent Modules (DDM)</td>
<td>To replace IBM DDM's or add 720/620 DDM's to 360 library (DDM—a reference table which is used by specific read/write routines to communicate with devices such as display terminals).</td>
</tr>
<tr>
<td>2. Translation tables and &quot;TABLES&quot; macro</td>
<td>ASCII/EBCDIC, EBCDIC/ASCII translate table for Sanders display character set. The &quot;TABLES&quot; macro provides user access to the translate tables.</td>
</tr>
<tr>
<td>3. DOPEN routine and &quot;DOPEN&quot; macro</td>
<td>To allow Sanders displays (files) to be opened properly in a mixed network (2260's and 720's/620's) for remote systems using BTAM or QTAM).</td>
</tr>
</tbody>
</table>
The second area of support is for message data processing. This consists of a series of character manipulating routines and macro instructions to facilitate: general purpose editing, reformatting of message data for hard copy and the generation of control characters for positioning message data on the display screen. As such, they are optional for the user; they are not required as part of Sanders software interface to IBM 360 Systems but rather serve as additional aids for user programming of Sanders Displays.

The following is a list of the Message Data Processing Routines and Macros which are distributed in card deck form.

<table>
<thead>
<tr>
<th>Routine</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;EDITMOVE&quot;</td>
<td>To provide substitutions, insertions, and deletions of characters in I/O messages based on recognition of user specified characters in the message stream, i.e., can be used to strip format control characters in DISPLAY-TO-CPU messages.</td>
</tr>
<tr>
<td>&quot;POSITION&quot;</td>
<td>To facilitate generation of format control characters necessary to positioning data in a specific area of the display screen, i.e., generates required format characters in front of data which is to be displayed in specified blocks, lines, and fields.</td>
</tr>
<tr>
<td>&quot;HARD-COPY&quot;</td>
<td>To facilitate serial printing of multiblock display formats, i.e., aligning operator-generated variable data (page data) with heading information (form data) in order to print display message on hard-copy devices in the same format as the screen image.</td>
</tr>
</tbody>
</table>
In addition to descriptions of the appropriate routines, the reference manual contains other pertinent considerations involved in the software interface of Sanders equipment with System 360. For example, Appendices G and H are important as they concern Systems Generation considerations in allowing for device table entries for Sanders displays in both OS and DOS systems.
First Level Support card decks differ for OS and DOS. Each contains the required device dependent module for I/O processing and, message data processing macro routines. The device dependent module is a tabular set of constants which uniquely defines the Sanders display terminal. I/O requests via the language facilities of the IBM access method used, cause the common read/write routines to generate channel programs appropriate to the device to be communicated to in accordance with the set of constant data provided in the DDM.
INSTALLATION SUPPORT

- PRE-INSTALLATION
  - SYSTEM CONFIGURATION
  - ADDRESS AND CHANNEL ALLOCATION
  - ENVIRONMENT EVALUATION
  - APPLICATIONS CONSULTATION
  - DEVELOPMENT OF PHYSICAL LAYOUT

- INSTALLATION
  - DIAGNOSTIC PROGRAMS
  - ACCEPTANCE TESTS

- POST INSTALLATION
  - CUSTOMER EDUCATION
  - CONTINUING SYSTEMS SUPPORT

Sanders highly trained System and Field Engineers are involved in all phases of Installation support making the transformation to Sanders Display systems a smooth one.
Diagnostic test routines are available for both local (731 Stand Alone local exerciser) and Remote configurations (SSTPAK). As part of installation support they are run by Sanders and used to determine the correct functioning of Hardware modules as each routine possesses the capability of executing every meaningful combination of I/O operations for the Sanders 731 Data Communications Buffer.
Prior to Customer sign-off the Sanders installation team demonstrates a program operating under the operating system and teleprocessing access method required to gain customer acceptance for the newly installed system.
Memory Save, editing, high speed data transmission rates and other special features are not available in competitive equipment.

Systems can easily be tailored to individual requirements at moderate cost - per-terminal figures. Modern techniques, exhaustive production testing and a 200 hour "burn-in" test for completed components assures the reliability of Sanders equipment.

Sanders' displays are completely IBM compatible with the aid of first level support.

An extensive national sales and service organization enables Sanders Associates, Inc. to provide field service and system engineering support with the minimum of delay.
This concludes a slide presentation that Sanders Data Systems Division has been proud to make. We hope that this discussion has been informative as we believe the Sanders Data Display product line offers many superior features not available in competitive equipment.

Should any further questions arise please contact the local Sanders salesman, you will find him a most informed data communication representative.