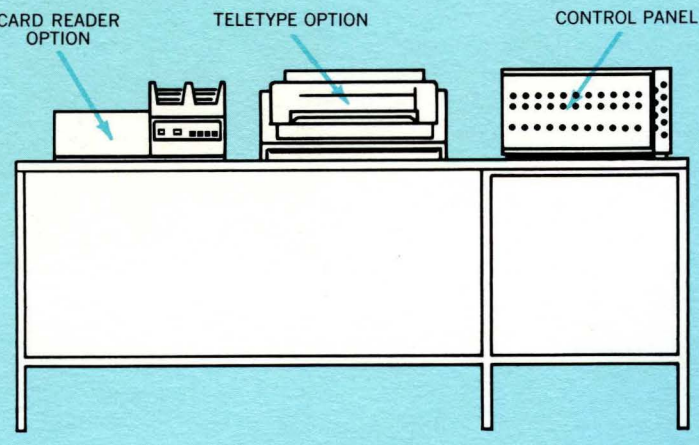
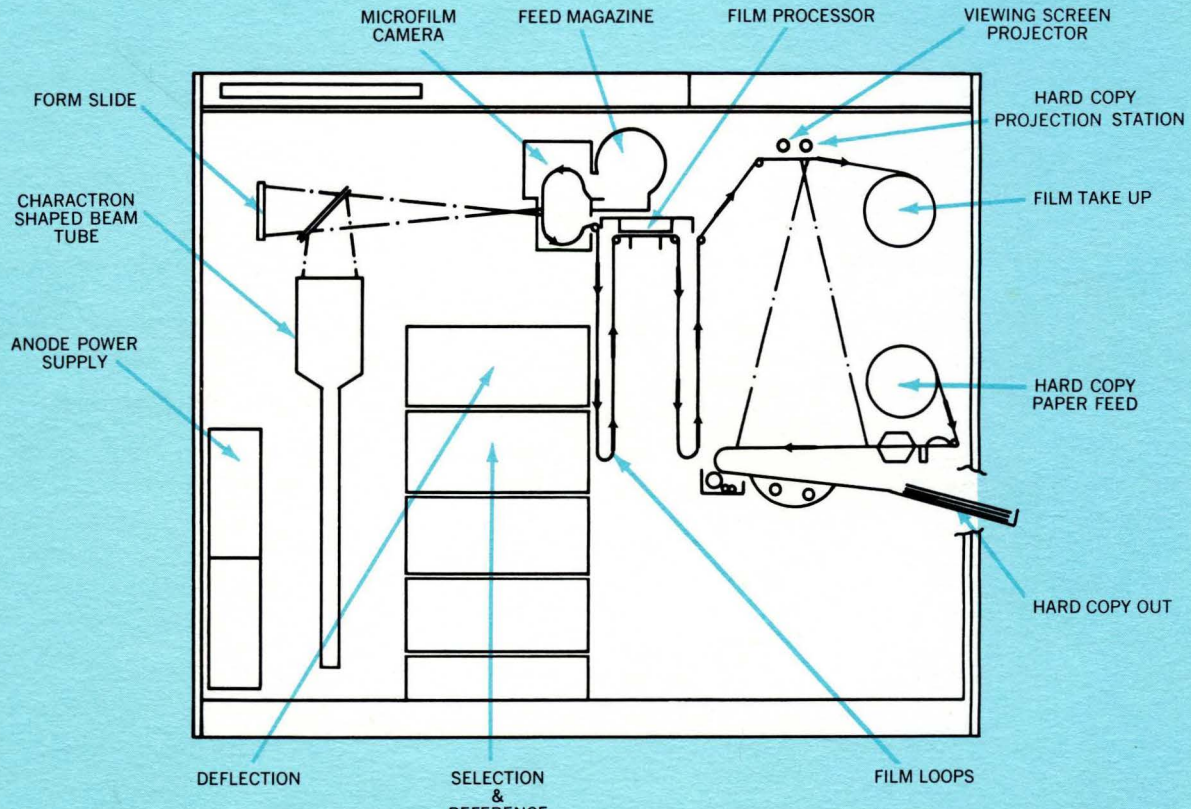
S-C 4060 DATA RECORDING SYSTEM

S-C 4060 SYSTEM ELEMENTS

S-C 4060 is a new stored program, data recording system which translates digital data into alphanumerics and graphics and then records the results on microfilm and/or paper. The system can provide an output source for high speed computers or it can operate independently since it is equipped with its own computer. The S-C 4060 provides such flexibility through a variety of options that it is the most powerful recording system available today.



PRODUCT CONTROL UNIT



DISPLAY HEAD

HARD COPY OPTION

The S-C 4060 was practically "user designed." Members of UAIDE, the society for Users of Automatic Information Display Equipment, recommended the features they wanted in the next generation of data recording equipment and most of their ideas have been incorporated in the S-C 4060. In addition the basic techniques used have been proven by UAIDE members in the United States and Europe who utilized the S-C 4020 Computer-Recorder, another product of Stromberg-Carlson.

The result of their experience has made it possible for Stromberg-Carlson to tailor the S-C 4060 to user requirements. It is designed on a "building block" philosophy so it can be introduced to an EDP center gradually and expanded whenever desired. Users of the S-C 4020 can utilize their existing software with the S-C 4060 and provide for future buildup. The S-C 4060 accepts input from a variety of sources.

It makes possible the use of low-cost consumables when on-line hard copy is desired, and it can produce hard copy output on white paper suitable for top management and government reports.

BASIC SYSTEM

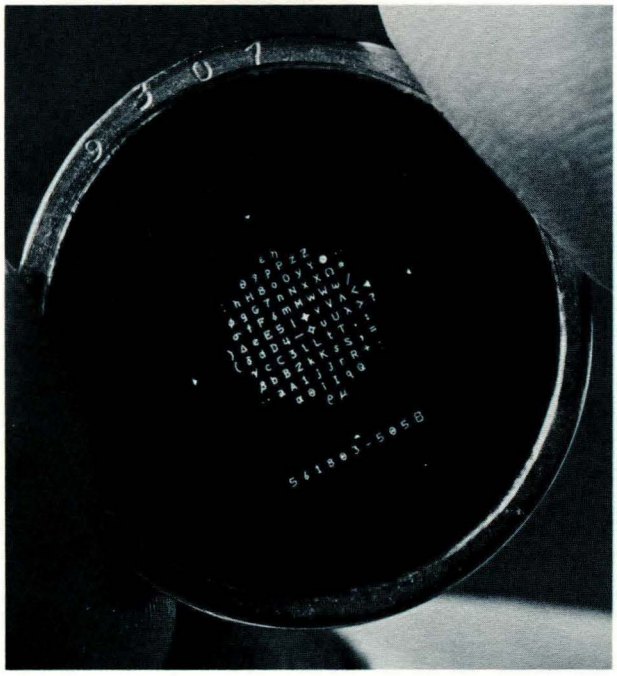
The S-C 4060 system can accept data on-line from the new generation of computers such as the IBM 360 and GE-635. It can also operate off-line from one or two magnetic tape transports, from paper tape and optionally from punched cards. The input section is designed in modular fashion and signals from almost any data source can be converted to the 16-bit word required. Working with tape, the system is capable of reading data at rates up to 90,000 characters or bytes per second.

Product Control Unit—This unit is a general purpose computer with an internally stored program. It has a built-in multiply and divide feature and a memory of 8,192 words which can be optionally expanded to 32,768.

The system is designed primarily to output data from separate large-scale computers. However, the computer in the Control Unit gives the S-C 4060 the capability of handling complete programs independently of external computers.

This capability also speeds programming operations. Users of other types of recording equipment must debug their programs on the main frame computers with resulting delays of 24 hours or more. Users of the S-C 4020 can perform most of this type of operation within the Product Control Unit.

A standard item of input-output equipment in the Product Control Unit which assists in the independent operation of the system is an ASR-33 teletype printer. The unit provides the following capabilities: (1) Read paper tape at 10 characters per second; (2) Punch tape at 10 characters per second; (3) Print at 10 characters per second; (4) Input by keyboard; (5) Off-line paper tape preparation, reproduction and listing.



Display Head Section—In this section, digital codes are converted to alphanumerics or line graphics and displayed on the face of a CHARACTRON® Shaped Beam Tube. Characters are formed by passing an electron beam through symbols etched into a tiny matrix in front of an electron gun. The characters are then reproduced on the tube screen.

The cathode ray tube on which characters are displayed is of such advanced design that characters of higher quality are obtained. Also, both upper and lower case letters are etched into the 96-character matrix and four distinct character sizes are available under program control.

A stroke generation system is provided for creating special characters by joining short line segments where desired. Resolution of drawn lines has been increased through the use of four line weights and four plotting point sizes.

Another improvement is the capability of changing character orientation by program control. This proves extremely valuable in annotating charts and graphs.

Film Recording—Recording can be accomplished on 35 or 16 mm film. The microfilm camera automatically records the data displayed on the tube face. Perforated or unperforated film can be produced. In the case of 16 mm film, an option is available for imprinting optical codes for automatic storage and retrieval systems.

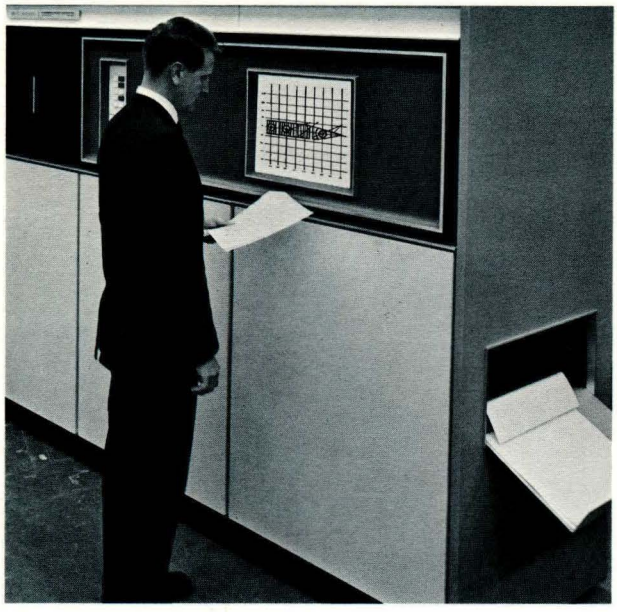
Standard formats which do not vary with each frame such as company symbols, forms or maps may be superimposed over the frame by a built-in slide projector. This system saves valuable computer time by relieving it of the task of providing data for the drawing of standard formats.

Optional equipment provides for the automatic production of output on hard copy white paper.

OPTIONAL EQUIPMENT

The extreme flexibility of the new S-C 4060 is apparent in the following optional equipment which can be added to the basic system quickly and easily. Most of the options can be added in the field when desired.

On-Line Film Processor—This major new option provides a built-in system that processes microfilm at a rate of 34 inches per minute and requires no external plumbing connections.



Viewer—Each frame of film is displayed for several seconds on an 11 by 14 inch viewing screen. The operator may manually interrupt the system and hold a given frame in the viewing station for 1½ minutes for checking purposes.

Hard Copy Option—The S-C 4060 uses an electro-static printing process and prints on a white paper. Either 8½ by 11 or 11 by 14 inch reports can be produced and the paper output will be automatically stacked or a roll take-up system is available if desired. Paper costs have been reduced to permit use of the system for the production of large volume reports.

Special Interfaces—Unlike earlier data recording systems which were designed to interface with a single data source, the S-C 4060 is designed for multiple sources of input. It can accept magnetic tape, punched paper tape, punched cards or operate on-line with the computer.

Card Reader—A reader capable of handling 100 cards per minute can be supplied.

Magnetic Tape Units—Special tape units can be supplied with the S-C 4060 or it can operate with units already in the computer center. The system is also capable of working with two tapes simultaneously. Tape read equipment is supplied with the S-C 4060 and tape write equipment is optionally available.

Memory—Additional memory can be added to the Product Control Unit's computer in blocks of 8,192 words up to a maximum capacity of 32,768.

Interrupts—An interrupt feature can be added as an option which permits priorities to be assigned to various input/output devices.

Cameras — A 16 or 35 mm microfilm camera equipped for either perforated or unperforated film can be selected as part of the basic equipment.

Film Coding — Film coding for retrieval systems can be accomplished automatically by the S-C 4060 on 16 mm film. Line indexing marks, image count blips and MIRACODE or KODAMATIC retrieval codes can be imprinted on the film at electronic speeds.

Display Monitor—A cathode ray tube display console may be added to the system to enable the operator to visually check the output of the system. A light pen and key switches allow the operator to transfer indicated (hooked) information on the tube face to the computer, or to edit, compose, or otherwise communicate with the data source.

SOFTWARE

Programs prepared for the S-C 4020 can be accepted directly by the S-C 4060 because of the conversion routine which is supplied to users. In addition, the system is provided with an assembly language, FORTRAN compiler and test and maintenance routines.

Other programs available include basic mathematical routines, graphic oriented routines such as general linear and non-linear, general polar grids, curve fit (second degree approximation and linear approximation), general bar graph, typewriter simulation, program to provide printing for IBM 1401/1403 BCD tapes, strip chart processing, and special input translators.

Users of the S-C 4060 will become members of UAIDE and will share their programming experience with other members.

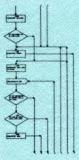
SERVICE

The S-C 4060 is completely solid state with the exception of the cathode ray tube and has integrated circuits in the low power modules. Therefore, the system is highly reliable and demands a minimum of maintenance. An experienced customer service organization provides service throughout the United States and in Europe. The system can be either leased or purchased.

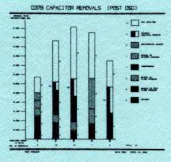
TYPICAL APPLICATIONS

ISOMETRIC PROJECTION

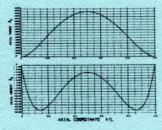
FLOW CHART



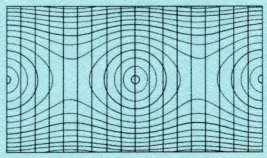
BAR CHART



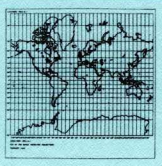
CURVE PLOTTING



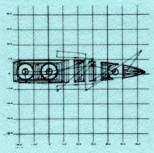
PLOTTING EXTRA LENGTH CHARTS



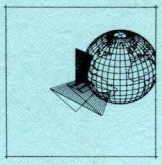
MAPPING



TOOL PATH DRAWING



ORBITAL PLOTTING



SPECIFIC LOGICAL FUNCTIONS

The S-C 4060 system is capable of performing a wide variety of manipulations on data which is presented to it in appropriate form and accompanied by adequate instructions. These functions can be performed without the use of a main frame computer. Only the imagination of the user limits the data recording applications to which the system can be put.

For example, the system can be used for a variety of graphical data presentations as well as routine printing of alphanumerics. By employing these techniques, a user can draw three dimensional views of various subjects and produce animated motion pictures by recording a series of slightly different film frames.

The examples shown here are just a few of the possible S-C 4060 applications. The specific logical functions of the system which make these applications possible include the following:

Line Drawing—Straight lines, solid or dashed can be drawn from any one addressable matrix point to any other point. Any of four different line widths can be used.

Curves—A curve that is smooth to the unaided eye can be drawn with a solid or dashed line through a series of data points (second degree fit criterion) on any of four coordinate systems: (1) log-log; (2) log-linear; (3) linear-log; and (4) linear-linear. The curve can also be drawn through a sequence of data points presented in polar coordinate form. The axes and curves can be titled and the coordinate intervals can be labeled.

Typewriter Fashion—Alphanumerics can be produced in typewriter fashion.

Bar Graphs—S-C 4060 can provide scaled and labelled bar graphs according to a set of format specifications.

Drawn Characters—Any Greek character can be drawn by vectors and plotted at any addressable location.

Tape Search—Magnetic tapes can be searched for a labelled piece of data which is then recorded or displayed.

**Pert*—The system can accept PERT data produced by a computer run and record output frames on microfilm or paper which can be fastened together so their lines and data form a PERT activity network.

**Flow Chart*—Starting with a sequenced list of computer program statements in FORTRAN II IV, S-C 4060 can produce a flow chart of the program complete with titles, branch reference points and other information.

**Diagramming*—Deriving the equivalent logical diagram from a set of Boolean equations, the system can draw the diagram in graphical form.

**Motion Pictures*—The system can plot and record in sequential frames, the positions of a moving object seen against a stationary or slowly changing background. After background data has been provided, only data about changes need be provided. Film can then be viewed on a motion picture projector.

**Global Mapping*—S-C 4060 can convert coordinate data concerning missiles or satellites into graphical form, showing path of object and its subpoint against an appropriate picture of the earth. Information which can be displayed includes orthographic projection of the earth, coastlines, grid lines, object path line, object subpoints line, and lines joining object path with subpoints to give a 3D effect.

**These particular functions require optional equipment.*

INSTRUCTION REPERTOIRE

(Execution times include instruction and operand access)

TYPE	MNEMONIC	TIME	DESCRIPTION
Load and Store	LDA	3.4 secs	Load A
	IMA	5.1	Interchange Memory & A
	IAB	1.7	Interchange A & B
	CRA	1.7	Clear A
	STA	3.4	Store A
Arithmetic	ADD	3.4	ADD
	SUB	3.4	SUB
	IRS	5.1	Increment, Replace Memory and Skip
Logical	ANA	3.4	AND to A
	ERA	3.4	Exclusive OR To A
Shift	LGL	1.7+.34n	Logical Left
	LGR	1.7+.34n	Logical Right
	ALR	1.7+.34n	Logical Left Rotate
	ARR	1.7+.34n	Logical Right Rotate
	ALS	1.7+.34n	Arithmetic Left
	ARS	1.7+.34n	Arithmetic Right
	LLL	1.7+.34n	Long Left Logical
	LRL	1.7+.34n	Long Right Logical
	LLR	1.7+.34n	Long Left Rotate
	LRR	1.7+.34n	Long Right Rotate
	LLS	1.7+.34n	Long Arithmetic Left
	LRS	1.7+.34n	Long Arithmetic Right
Transfer of control	JMP	1.7	Unconditional Jump
	JST	5.1	Jump & Store Location
	CAS	5.1	Compare Memory & A
	SPL	1.7	Skip If A Sign Plus
	SMI	1.7	Skip If A Sign Minus
	SZE	1.7	Skip If A Zero
	SNZ	1.7	Skip If A Non Zero
	SLZ	1.7	Skip If LSB A Zero
	SLN	1.7	Skip If LSB Non Zero
	SSC	1.7	Skip If C BIT Set
	SRC	1.7	Skip If C BIT Reset
	SS 1	1.7	Skip If Sense Switch 1 Set
	SS 2	1.7	Skip If Sense Switch 2 Set
	SS 3	1.7	Skip If Sense Switch 3 Set
	SS 4	1.7	Skip If Sense Switch 4 Set
	SR 1	1.7	Skip If Sense Switch 1 Reset
	SR 2	1.7	Skip If Sense Switch 2 Reset
	SR 3	1.7	Skip If Sense Switch 3 Reset
	SR 4	1.7	Skip If Sense Switch 4 Reset
Input-Output	OCP	3.4	Output Command Pulse
	SKS	3.4	Skip If Ready Line Set
	INA	5.1	Input To A
	OTA	5.1	Output From A
Control	SSP	1.7	Set A Sign Plus
	SSM	1.7	Set A Sign Minus
	CMA	1.7	Complement A
	CSA	1.7	Copy Sign to C BIT & Set A Sign Plus
	ACA	1.7	Add C To A
	SCB	1.7	Set C BIT
	RCB	1.7	Reset C BIT
	HLT		HALT
	NOP	1.7	No Operation
	ENB	1.7	Turn Program Interrupt On
	INH	1.7	Turn Program Interrupt Off

COMPUTER

The S-C 4060 includes a sixteen-bit binary word, general purpose computer with a 1.7 microsecond memory cycle time. It has a fully parallel machine organization and both indexing and multilevel indirect addressing.

Features of the computer include a flexible instruction repertoire, a powerful input/output bus structure, standard keyboard and paper tape unit.

The computer is designed for high speed scientific engineering applications and real-time, on-line data processing and control. It is capable of 294,000 computations per second. Options permit input and output to occur asynchronously and to be interleaved with processing. The computer performs programmed multiplications in 9.5 microseconds and divisions in 17.9 microseconds.

The command structure of the S-C 4060 is flexible and straight forward. A complete programming package including an assembler and comprehensive utility and diagnostic routines are provided with the system.

Parallel machine organization has permitted use of moderate speed circuitry and wide reliability margins.

S-C 4060 CHARACTERISTICS

PRODUCT CONTROL UNIT

Unit is a general purpose computer with the following specifications:

Type: Parallel, binary, solid state, integrated circuits, internally stored program.

Addressing: Single address with indexing and indirect addressing.

Word Length: 16 bits.

Machine Code: Two's complement.

Memory: Coincident-current ferrite core. 8,192-word modules expandable to 32,768 words. 1.7 microsecond cycle time.

Speed: Add 3.4 microsecond; Subtract 3.4 microsecond; multiply 9.5 microsecond; divide 17.9 microsecond.

Input/Output Lines: 16-bit input bus; 16-bit output bus; priority interrupt; external control and sense lines.

Input/Output Modes: For transfer between peripheral equipment and Product Control Unit: single word transfer; single word transfer with priority interrupt; direct multiplexed channel (DMC).

Interrupt: Single standard interrupt line. Optional priority interrupts available in multiples of 8 up to 256 lines.

DISPLAY HEAD

Unit converts digital data into analog signals required to drive display tube.

CRT Tube: Improved CHARACTRON Shaped Beam Tube with 96-character matrix and stroke character generator.

Character Set: 26 upper case; 26 lower case; 10 numerics; 34 special symbols. Resembles typewriter copy on 8½ x 11″ format. Type font is modified Craw Modern.

Character Ratios: Aspect ratio such that upper case "H" has 4-3 height to width ratio. Height to stroke ratio on film is: (1) 10 to 1 for upper case and equivalent height letters and (2) 7 to 1 for lower case letters.

Character Heights: Four sizes available under program control:

Normal:	Upper Case—32 plot positions Lower Case—24 plot positions
Small:	.75 x normal
Medium:	1.5 x normal
Large:	2 x normal

Speed: 40,000 characters per second.

Plotting: Capable of generating plots over a 4096 x 3072 equal increment, addressable point raster.

Spot Sizes: 2, 4, 8 and 16 addressable points.

Plot Modes: Plot random mode requires 30 microseconds. Plot sequential (Limited to change of 8 raster positions maximum) requires 10 microseconds.

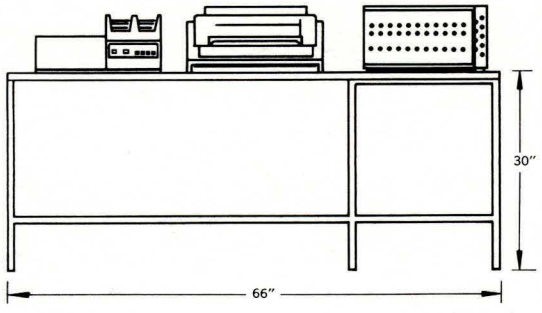
Line Generation: 4 weights. Minimum line length equals two addressable points. Maximum line length at minimum weight requires less than 1 millisecond.

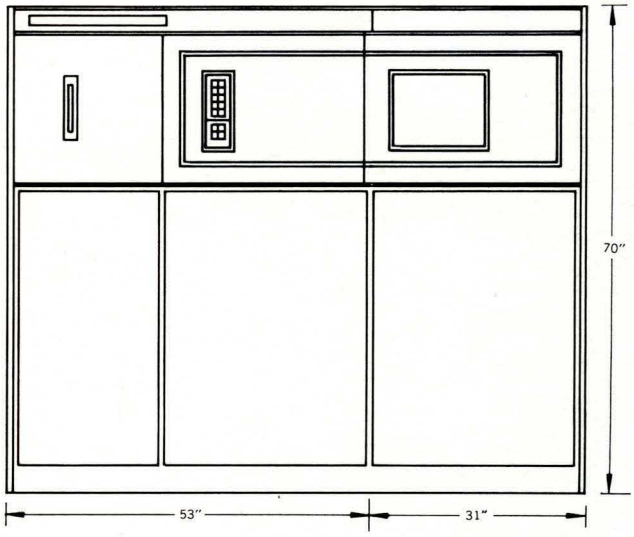
Forms Overlay: Superimposes forms on generated image under program control. Forms interchangeable by operator. Intensity of overlay form varies from 50-100% of normal character intensity. Uniform to the eye over entire range.

Forms Resolution: Line weights as small as .010 inch may be resolved when form is reproduced in 8½″ x 11″ format.

DIMENSIONS:

Basic Unit
Length of Product Control Unit...66″ Display Head...53″
Width of Product Control Unit...32″ Display Head...32″
Height of Product Control Unit...30″ Display Head...70″
Hard Copy Option
Length.....31″ Width.....32″ Height.....70″





RECORDING SECTION

Section converts displayed image into a latent image on microfilm and optionally onto hard copy paper.

Cameras: 16 or 35 mm, perforated or unperforated film.

On-Line Processor: Processes 35 mm film negative at 34 inches per minute. Resolution of 80 line pairs per millimeter provides film of semi-archival quality. Retention of film for over 1 year requires conventional washing. First frame can be viewed in 60 seconds. 600 ft. spool take-up provided.

Hard Copy Option: Generated white paper output suitable for top management and government reports from projected microfilm.

Rate: One 8½″ x 11″ or 11″ x 14″ frame every 2 seconds. First page available in less than 60 seconds.

Paper Costs: Approximately 2 cents per sheet.

Paper Sizes: 8½″ x 11″ or 11″ x 14″

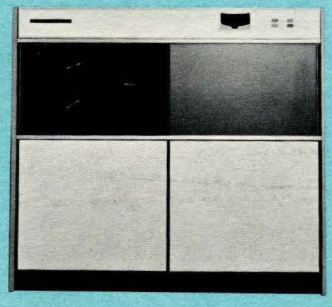
Paper Take-Up: Cut and stacked or roll.

Viewing Screen: 11″ high by 14″ wide. Brilliant enough for viewing in normal room light.

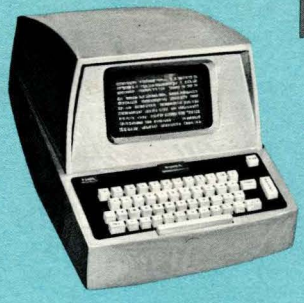
Viewing Time: Normally 1.9 seconds. Frame can be held for 1.5 minutes of viewing. When strip charting required, frame can be held on screen 1.9 seconds only.

OTHER STROMBERG-CARLSON PRODUCTS

S-C 4020 Computer Recorder



S-C 4400 Document Recorder



S-C 1100 Inquiry Display System

S-C 3070 Electronic Printer

S-C 1200 Digital-to Video Display System

Direct View Displays

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