CODE (OCTAL)	DESCRIPTION	DISPLAYED	PRINTED
100	Space		
101 - 111	Unused		
112	Cent sign	¢	¢
113	Period	.	.
114	Less than	<	<
115	Left parenthesis	(	(
116	Plus sign	+	+
117	Carriage return	←	Executed - not printed
120	Ampersand	&	&
121 - 131	Unused		
132	Exclamation point	!	!
133	Dollar sign	$	$
134	Asterisk	*	*
135	Right parenthesis	)	)
136	Semicolon	;	;
137	End of message		
140	Hyphen	-	-
141	Right diagonal	/	/
142 - 152	Unused		
153	Comma	,	,
154	Percent sign	%	%
155	Parity error	■	■
156	Greater than	>	>
157	Question mark	?	?

CODE (OCTAL)	DESCRIPTION	DISPLAYED	PRINTED
160 - 171	Unused		
172	Colon	:	:
173	Number sign	#	#
174	At sign	@	@
175	Apostrophe	'	'
176	Equal sign	=	=
177	End of print	—	No printout
200 - 300	Unused		
301		A	A
302		B	B
303		C	C
304		D	D
305		E	E
306		F	F
307		G	G
310		H	H
311		I	I
312 - 320	Unused		
321		J	J
322		K	K
323		L	L
324		M	M
325		N	N
326		O	O
327		P	P

CODE (OCTAL)	DESCRIPTION	DISPLAYED	PRINTED
330		Q	Q
331		R	R
332 - 340	Unused		
341	Space		
342		S	S
343		T	T
344		U	U
345		V	V
346		W	W
347		X	X
350		Y	Y
351		Z	Z
352 - 357	Unused		
360	Zero	0	0
361	One	1	1
362	Two	2	2
363	Three	3	3
364	Four	4	4
365	Five	5	5
366	Six	6	6
367	Seven	7	7
370	Eight	8	8
371	Nine	9	9
372 - 377	Unused		

TYPICAL CONTROL DATA 210 DISPLAY SYSTEM CONFIGURATION ON IBM 360 COMPUTER

SELECTOR OR MULTIPLEXER CHANNEL 360 COMPUTER

210 DISPLAY CONTROLLER

*OPTIONAL BUFFERED POLLER

DISPLAY — DISPLAY — DISPLAY — PRINTER

UP TO ELEVEN STATIONS EACH UP TO 1000 FEET FROM CONTROLLER

201A MODEM

VOICE GRADE COMMUNICATION LINE

201A MODEM — MULTIPLE STATION DISPLAY CONTROLLER — UP TO TWELVE DISPLAY OR PRINTER STATIONS

201A — SINGLE STATION CONTROLLER — ONE DISPLAY STATION

ONE BUFFERED PRINTER

UP TO EIGHT REMOTE SITES

*TWO BUFFERED POLLERS TO COMMUNICATE WITH UP TO 16 REMOTE SITES MAY BE CONFIGURED BY LIMITING THE NUMBER OF LOCAL STATIONS TO TEN.

CONTROL DATA
CORPORATION

DATA DISPLAY DIVISION
2401 NORTH FAIRVIEW AVENUE
SAINT PAUL, MINNESOTA 55113
TELEPHONE 631-0550

COMPUTER CONFIGURATIONS

FOR IBM 360 SERIES

210 DISPLAY SYSTEM

CONTROL DATA

THE RIGHT MOVE TO VISUAL MULTI-STATION INFORMATION SYSTEMS ON-LINE TO SYSTEM 360 COMPUTERS

The *Control Data 210* is an information entry and retrieval system that enables anyone to communicate, at computer speeds, easily and visually with a digital computer

Its effectiveness and economic feasibility is based primarily upon operating many display stations (both local and remote) through a single central controller, which uses only one computer data channel, so that many people may share the same computer . . . for all practical purposes . . simultaneously.

The local display stations may be up to 1000 feet from the central controller and the remote stations may be many miles from the central controller through the use of *DATAphone service.

Its competitive edge is based upon superior speed, repertoire and ease of operating. It can keep up with any of today's high-speed, powerful computers. Its character and symbol repertoire has been designed to accommodate all of today's varied business information demands, and can be adjusted optionally to handle some engineering and mathematical assignments. Its keyboard and clear, legible TV-type display can be used by all personnel requiring access to computer-generated data. And a specially designed printer is available for those installations requiring hardcopy records of display data.

*DATAphone is a registered TM of AT&T

From any angle, the *Control Data 210* deserves close scrutiny. It is one of the few devices that can make a total information management system possible, from a cost and time standpoint.

REPERTOIRE: The *Control Data 210* System uses a *Control Data 211* Entry/Display Station. This station displays a 6" x 8" page of data on a 14" cathode ray tube. The page can contain 1,000 characters (20 lines of 50 characters). These characters include the alphabet, arabic numerals (0-9), punctuation marks and commonly used symbols. A specially designed printer (*Control Data 218*) is available for installations where hardcopy records are required.

SPEED: The *Control Data 210's* ability to handle data at computer speeds is extremely important to the achieving of maximum efficiency in overall system operation through savings in computer time, transmission time and operator time.

This device is one of the few peripherals that can keep up with a computer's ability to calculate at microsecond and nanosecond speeds. It can transfer data at the rate of up to 50,000 symbols or characters per second. It can also transfer an entire page of data by single-key operation. Moreover, that page of data will be fully edited, prior to transmission to the computer, freeing the computer to perform calculations only. Even the printer operates independently of the computer system. This entire process provides more computer time for more people.

EASE OF OPERATION: The keyboard looks like and operates as easily as a standard electric keyboard, and all operation is noise-free. Characters and symbols are large (.25" high) and their size and light intensity are adjustable to ambient conditions, so that they are legible in all normal office environments. White (P-4) phosphor is used in the cathode ray tube to aid legibility, and data is refreshed approximately 50 times per second, insuring a flicker-free display.

Information may be typed into the system, or stored in the system via punched cards, magnetic tape, etc. After that, the operator types special code numbers to instantaneously call up entire pages of display data. He can edit, erase or change data without retyping the entire page, and an entry marker (underline symbol) enables him to keep track of input/output activity.

CONFIGURATION: One central controller with an interface to either a selector or a multiplexer channel of an IBM system 360 computer can control up to eleven local stations which may be either displays or printers as long as there are at least as many displays as there are printers, and an optional buffered poller unit which will communicate with up to eight remote sites. Each remote site may have either a multiple station controller or a single station controller. Two pollers may be included in the central controller by limiting the maximum number of local stations to ten.

For further information, contact your local Control Data Sales Office.

COMPUTER RECORDERS
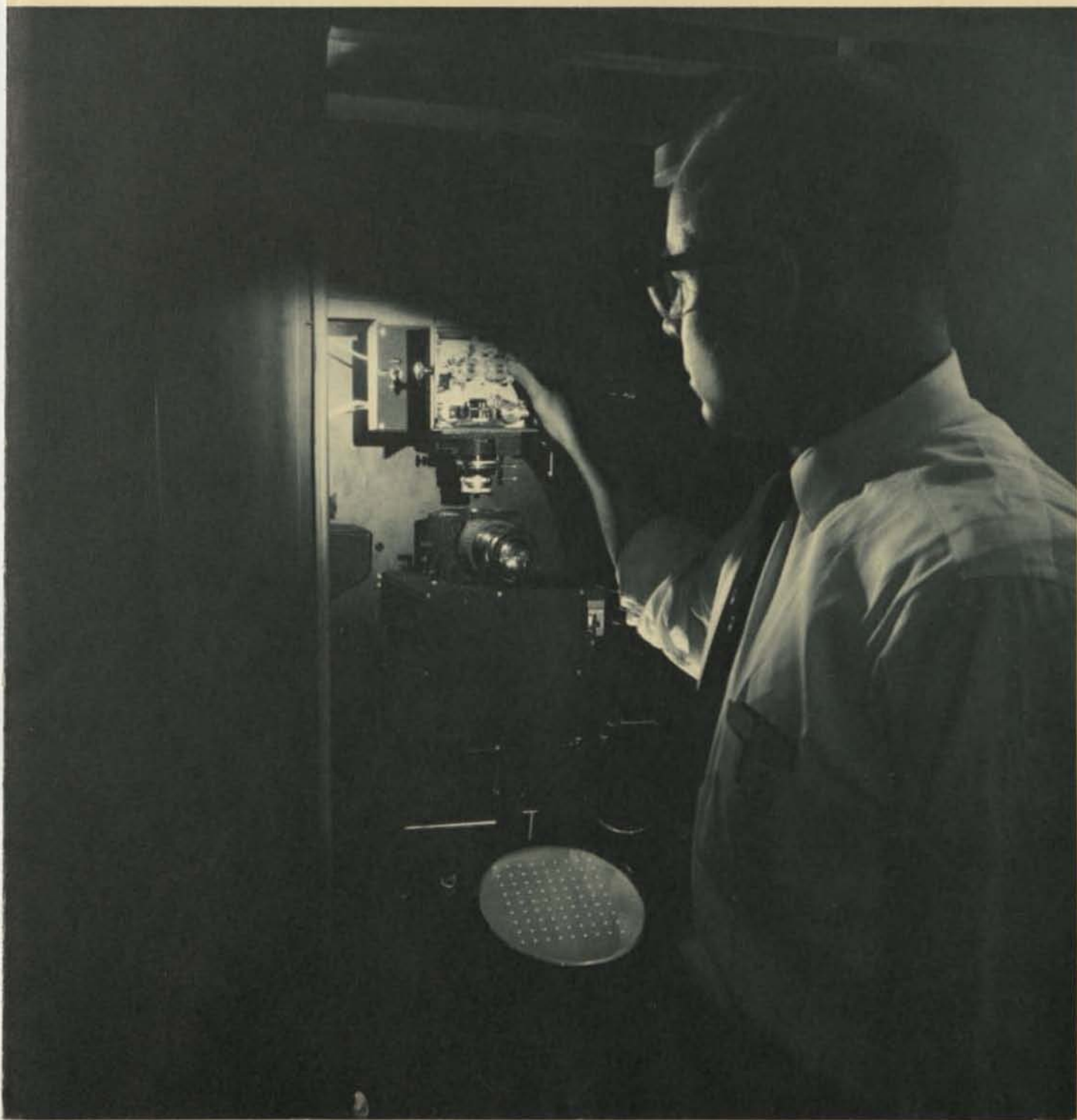
GENERAL DYNAMICS | ELECTRONICS

S-C 4020
FAST
EFFICIENT
COMPUTER
RECORDER

Designed and manufactured by General Dynamics/Electronics, S-C 4020 systems operate as peripheral equipment for the output of large scale digital computers. Output is on 35mm film or paper copy in the form of plotted curves, tabular data, alphanumeric printing or a combination of these operations.

Adaptable to both commercial and scientific applications, the S-C 4020 is compatible with most high-speed computers and data processing systems operating either direct from the computer or from magnetic tape.

CAPABILITIES OF THE S-C 4020 INCLUDE:

1. Recording data on microfilm at 17,500 characters per second;
2. Plotting graphs on microfilm at 12,500 points per second;
3. Recording complex multi-view engineering drawings, schematics or numerical tool paths in less than 1/2 second; and
4. Recording data on photorecording paper. Using the F-80 option, S-C 4020 output can be evaluated immediately, or the paper can be used as a master to produce multiple copies. The F-80 paper copy process can be operated simultaneously with 35mm microfilm or either recording process can be used alone.

In the F-80 system, information displayed on the face of the S-C 4020's CHARACTRON® Shaped-Beam Tube is projected through an optical system to the F-80 camera which records the image on 9⅝-inch wide photorecording paper. Daylight loading magazines are used. The paper, after being exposed, can be processed on-site using an oscillogram processor.

The first three of these functions are performed by a 35mm recording camera, and the fourth by the F-80 camera. The cameras view the screen of a CHARACTRON Shaped-Beam Tube, the character-generating heart of all computer recorders in the S-C 4000 series. Cameras may be operated individually or simultaneously.

APPLICATIONS OF THE S-C 4020

GRAPH PLOTTING: Plotting curves, drawing axes, projecting grid backgrounds and printing vectors are unique capabilities of the S-C 4020. The combination of these capabilities allows the recording in a fraction of a second of highly-accurate curves or other graph forms complete with necessary axis lines, headings and other pertinent data.
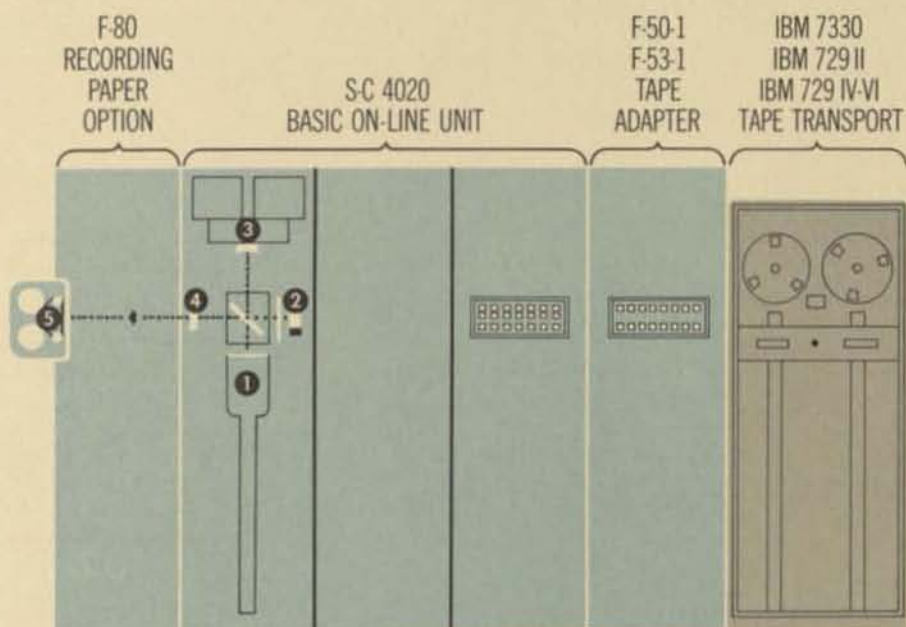
TABULAR RECORDING: Where printing of tabular data on standard forms is desired, the Form Projector eliminates the need for preprinted forms, allowing both data and form to be photographed simultaneously, resulting in substantial savings in time, paper, forms inventory, storage space and shipping costs. A small roll of microfilm is equivalent to the contents of a four-drawer file cabinet of paper copy.

AUTOMATIC DRAFTING: Mathematical formulae used for design of mechanical components and structures may be read in the form of multi-view or cross-section drawings with significant dimensions superimposed in the design.

NUMERICAL CONTROL: Tool path drawings can also be produced on the S-C 4020. After the design engineer has checked the drawing against the computer program, the same program may be used to operate the numerical control tool and produce the part.
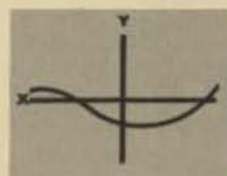
COMPUTER OUTPUT SUB-ROUTINE PACKAGE: The S-C 4020 output package consists of a set of programming subroutines for printing and plotting data on the S-C 4020. Packages are presently available for IBM 704 and 7090 computers. Sub-routines will be available for other large scale computers in the near future.

F-80
RECORDING
PAPER
OPTION

S-C 4020
BASIC ON-LINE UNIT

F-50-1
F-53-1
TAPE
ADAPTER

IBM 7330
IBM 729 II
IBM 729 IV-VI
TAPE TRANSPORT

AXIS GENERATOR

Draws horizontal and vertical graph axes starting at any specific point in the display area and proceeding either to the right or upward on the film format.

VECTOR GENERATOR

The Vector Generator is especially useful for scientific applications. It draws straight lines between two given points, regardless of angle. Extremely accurate.
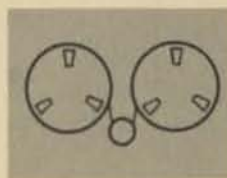
TAPE INPUT UNIT

For use when off-line operation is desired. Makes more efficient use of computer time. Compatibility with 200 bits per inch or 556 bits per inch is available.

FORM PROJECTOR

Superimposes selected form on recorded data, eliminating necessity for pre-printed forms and making use of all computer time for processing variable information.

TYPEWRITER SIMULATOR

Provides typewriter-like spacing of printed tabular data and solid copy. Change from plotter to printer, or vice versa, can be made within 67 microseconds.

PAPER COPY CAPABILITY

Produces paper copy on 9½-inch wide photorecording paper with the F-80 paper copy option. System allows S-C 4020 recorded data to be evaluated immediately.

S-C 4020 HIGH-SPEED RECORDER

1 CHARACTRON SHAPED-BEAM TUBE . . . . *Unique beam forming method of character generation results in extremely high resolution and high speed. Can display more than 10,000 characters on tube face.*

2 FORMS PROJECTOR. . . . . *Superimposes any standard format on tube face. Business forms, maps or other information may then be combined with data generated by tube.*

3 35 MM OR 16 MM MICROFILM CAMERA. . . . . . *Records combined information from face of CHARACTRON Shaped-Beam Tube and forms projector at high speeds on 35 mm or 16 mm film for archive storage, group viewing or reproduction.*

4 PHOTORECORDING PAPER CAMERA. . . . . *Records combined information on face of CHARACTRON Shaped-Beam Tube and forms projector on page-size photorecording paper for immediate viewing, office distribution or reproduction.*

5 PHOTORECORDING PAPER CARTRIDGE. . . . . *Data photographed by camera is recorded directly on 9½-inch wide photorecording paper. Cartridge can be removed for paper processing.*

S-C 4020 COMPUTER RECORDER

OPERATING CHARACTERISTICS

SPEED: Records data on microfilm or paper copy at speeds up to 17,500 characters and 12,500 plotting points per second on-line.

QUALITY: The unique character-forming technique, high intensity and resolution of the CHARACTRON Shaped-Beam Tube assure quality reproduction of both tabular and graphic data on microfilm.

ECONOMY: Provides substantial savings in time, paper, forms inventory, storage space and shipping costs; a small roll of microfilm is equivalent to the contents of a four-drawer file cabinet of paper.

SPACE SAVINGS: The high volume of output per square foot of floor space required by the S-C 4020 high-speed recorder provides additional economy.

EASE OF MAINTENANCE: Design configuration and extensive use of printed circuits in plug-in racks simplifies testing and maintenance of the S-C 4020 high-speed recorder.

VERSATILITY: Operates on-line or off-line ... records alphabetic, numeric and symbolic characters ... plots and records graphs ... is compatible with most high-speed computers and data processing systems in use today.

SPECIFICATIONS

DIMENSIONS:
Length .... *66 in.
Width .... 37 in.
Height .... 74 in.
*Basic unit options have the following lengths: F-50-1, 22 in.; F-53-1, 22 in.; F-80, 22 in.

POWER REQUIREMENTS:
Basic unit, or 208/120V, 3∅, 4 wire at 3200 watts

INPUT AND OUTPUT SIGNALS:
Inputs........................ "1" or "Up" +5 to +50V
"0" or "Down" 0 to −50V

Write line rise time: less than 1 microsecond
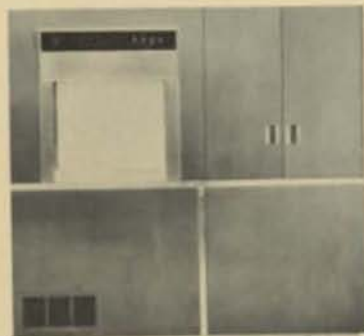Input Impedances .... 10,000Ω in parallel with 500 μμfd
Outputs.............. Ready Line: "Up" + 10 to ±05V
"Down" 0 to ±05V
Resume Pulse........................ Same as ready line
Polarity: Positive or negative, as desired
Rise and Fall Times (10,000Ω, in parallel with 500 μμfd load): less than 1 microsecond


S-C 4010 HIGH-SPEED MICROFILM RECORDER
In use at the United States Navy Proving Ground (Dahlgren, Va.) in conjunction with Naval Ordnance Research Calculator.

S-C 4020 HIGH-SPEED COMPUTER RECORDER
Most versatile recorder in the S-C 4000 series, the S-C 4020 is being used in military, commercial and scientific applications.

GENERAL DYNAMICS | ELECTRONICS G‖‖‖‖D SAN DIEGO
POST OFFICE BOX 2449, SAN DIEGO 12, CALIFORNIA
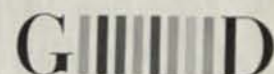
S-C 4020 BACKGROUND INFORMATION

One of the most interesting and versatile digital output devices available today is General Dynamics/Electronics' S-C 4020 High Speed Computer Recorder. The S-C 4020 takes information on-line or off-line from digital computers and records it at very high rates of speed on microfilm and/or photorecording paper. The recorded information may be in the form of alphanumeric data, plotted curves, vector lines, tabular data or any combination of these operations.

Business forms, maps, company symbols or other fixed information may be superimposed on the film or paper by using the automatic slide projection which is part of the basic unit.

The S-C 4020 is compatible with existing automatic microfilm and storage systems.

CAPABILITIES:

The S-C 4020 will accept data from magnetic tape at input rates up to 90,000 six-bit characters per second. The S-C 4020 will print this data at speeds in excess of 17,000 alphanumeric or symbolic characters per second. Frames combining characters, vectors and curves vary with the complexity of the drawing, but an average annotated graph can be recorded in fractions of a second. Produces hard copy simultaneously with microfilm recording. Constructs tabular reports, scheduling network charts such as PERT, PEP and SCANS, bar charts and budgets.

ADVANTAGES:

Substantial savings in time, paper forms inventory, storage space, and shipping costs are effected by utilizing the S-C 4020.

FEATURES INCLUDED IN BASIC UNIT:

Axis and Vector Generator -- draws horizontal and vertical graph axes starting at any specific point in the display area and proceeding either to the right or upward on the film format. The vector generator draws straight lines between two given points, regardless of angle.

Form Projector -- superimposes selected form on recorded data, eliminating necessity for pre-printed forms and making use of all computer time for processing variable information.

Typewriter Simulator -- provides typewriter-like spacing of printed tabular data and solid copy. Change from plotter to printer, or vice versa, can be made within 67 microseconds.

OPTIONAL EQUIPMENT:

F-40 Automatic Processing Camera-Projector -- records data displayed on the screen of the CHARACTRON^R Shaped Beam Tube, automatically processes the film and projects it on a viewing screen, incorporated in the cabinet, in less than 10 seconds after film exposure.

F-50-1 Tape Input Unit -- accepts 6-bit tape input and converts it to 36-bit parallel output.

F-80 Hard Copy Camera Option -- information displayed on the face of the CHARACTRON shaped beam tube within the S-C 4020 is projected through an optical system to the F-80 camera which records the image on 9-½ inch wide photorecording paper. Daylight loading magazines are utilized to enable paper handling without the usual darkroom requirement, except for

initial loading. The paper, after being exposed may be processed on-site using an F-85 Oscillogram Processor. Data may be evaluated immediately or the paper can be used as a master to produce multiple copies by a suitable diazo process or other conventional copying techniques.

INSTALLATION & APPLICATIONS:

David Taylor Model Basin, Carderock, Maryland

At the Applied Mathematics Laboratory, the S-C 4020 is utilized in the plotting of ship lines, the display of potential flow patterns, structural vibration studies, the generation of contour maps for flux and power distribution in a nuclear reactor, the display of data collected in ship maneuvering studies and war games. The film out-put produced by the S-C 4020 includes tables of data and computed results, graphs and contour maps in two and three dimensions.

Wright-Patterson Air Force Base, Dayton, Ohio

The S-C 4020 is used in the high temperature testing laboratory where supersonic aircraft are tested for stress and strain versus temperature.

Los Alamos Scientific Laboratory, Los Alamos, New Mexico

Used in conjunction with research sponsored by the Atomic Energy Commission.

North American Aviation, Los Angeles, California

Four units located at Autonetics, Rocketdyne, Space & Information Systems, and Los Angeles division, are used for plotting fuel flow trajectories of various fuel systems; visual analysis of aircraft and missile wing-fuselage influence coefficients; plots involving fuel tank design studies; aircraft, missile and spacecraft contour plotting of pressure

patterns; construction of cost analysis studies; program management and control programs; parts programming and numerical control programs.

General Dynamics/Astronautics, San Diego, California

Used to print flight test reports and to draw graphs and curves from computer plottings.

Jet Propulsion Laboratory, Pasadena, California

Plotting missile trajectories and for recording telemetry data from lunar and interplanetary space flights.

National Aeronautics and Space Administration, Huntsville, Ala.

At the Data Reduction Branch of NASA's Computation Center, the S-C 4020 will work with two IBM 7090 computers. Data from space vehicles is telemetered to ground stations and fed into an analog-to-digital converter system and then into the computer. Information is also presented to the computer from doppler tracking equipment used to track space vehicles. From the computer, the S-C 4020 takes the data and records the information on 35mm microfilm.

S-C 4020's have also been leased by NASA, Houston, Texas; Martin-Marietta Corp., Denver, Colorado; Computer Applications, Inc., New York, N. Y.; Atomic Weapons Research Establishment, United Kingdom Atomic Energy Authority, England; and Naval Ordnance Test Station, China Lake, Calif. Others have been installed in classified military systems.

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4/19/63

FOR IMMEDIATE RELEASE

GREAT BRITAIN LEASES HIGH SPEED COMPUTER RECORDER FOR ATOMIC ENERGY AUTHORITY

FROM GENERAL DYNAMICS/ELECTRONICS

SAN DIEGO, CALIF. -- Great Britain's United Kingdom Atomic Energy

Authority has leased an S-C 4020 High Speed Computer Recorder from

General Dynamics/Electronics-San Diego, it was announced here today.

Results of calculations on an IBM 7020 computer installed at the

Atomic Weapons Research Establishment at Aldermaston, England, will be recorded

by the S-C 4020 onto 35mm microfilm or 9 1/2-inch wide photorecording paper.

The recorder utilizes electron beams to translate computer output

into usable graphic form for management, engineers, and scientists. At electronic

speeds, it converts digital language into curves, maps, drawings, complex charts,

or alphanumerics.

Unique capabilities of the S-C 4020 which will be most utilized at

the Aldermaston facility are its speed and ability to present in an easy-to-read

graphical form the results of large mesh calculations, such as occur in partial

differential equations.

Other S-C 4020 units have been leased to the Applied Mathematics

Laboratory, David Taylor Model Basin, Carderock, Md.; Los Alamos Scientific

Laboratory, Los Alamos, N. M.; North American Aviation, Los Angeles, Calif.;

General Dynamics/Astronautics, San Diego; Jet Propulsion Laboratory, Pasadena,

Calif.; and the National Aeronautics and Space Administration, Huntsville, Ala.

-more-

The leasing agreement with the United Kingdom Atomic Energy Authority calls for complete service and maintenance by General Dynamics/ Electronics specialists who will also train the operators of this unit. Delivery is scheduled for May.

Under the agreement, the United Kingdom agency has options to continue the lease on a year-to-year basis or to purchase the unit outright.
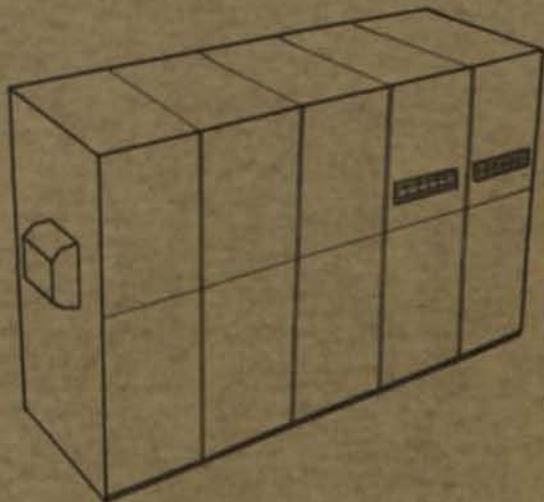
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G|||||||||D

THIS SAMPLE HARDCOPY IS PRODUCED ON
THE F-80 HARDCOPY CAMERA OPTION OF THE

GENERAL DYNAMICS|ELECTRONICS

S-C 4020

COMPUTER   RECORDER

THE S-C 4020 PRINTS 15,000 CHARACTERS
PER SECOND, PLOTS AND DRAWS VECTORS
AT A RATE OF 2500 PER SECOND DIRECTLY
ON MICROFILM, OR OPTIONALLY ON THIS
EASTMAN KODAK KIND 1555 PHOTORECORDING
PAPER.

GENERAL DYNAMICS|ELECTRONICS, P.O. BOX 2449, SAN DIEGO 12, CALIFORNIA.
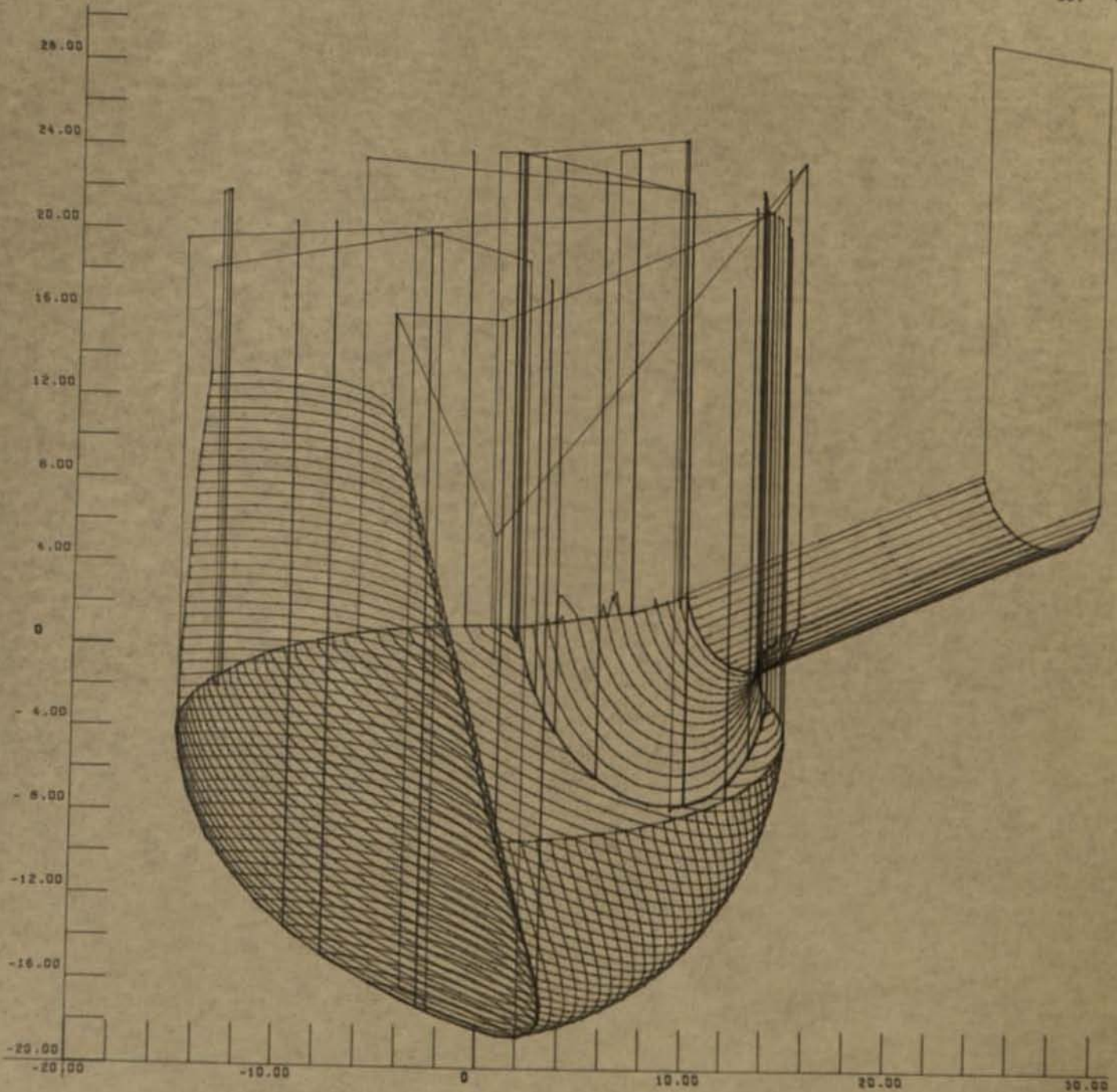
LATITUDE (DEG. N.)

LONGITUDE (DEG. W.)
MAP OF THE WORLD (MERCATOR PROJECTION)
FEBRUARY 1983

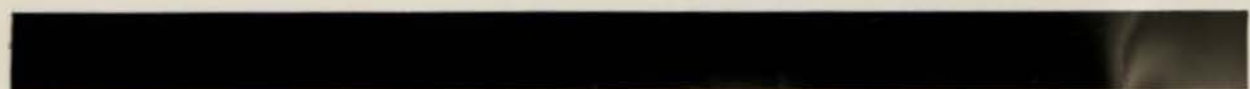| F-80 RECORDING PAPER OPTION | S-C 4020 BASIC ON-LINE UNIT | F-50-1 F-53-1 TAPE ADAPTER | IBM 7330 IBM 729 II IBM 729 IV-VI TAPE TRANSPORT |

S-C 4020 HIGH-SPEED RECORDER

❶ CHARACTRON SHAPED-BEAM TUBE . . . . *Unique beam forming method of character generation results in extremely high resolution and high speed. Can display more than 10,000 characters on tube face.*

❷ FORMS PROJECTOR . . . . *Superimposes any standard format on tube face. Business forms, maps or other information may then be combined with data generated by tube.*

❸ 35 MM OR 16 MM MICROFILM CAMERA . . . . . . *Records combined information from face of* CHARACTRON *Shaped-Beam Tube and forms projector at high speeds on 35 mm or 16 mm film for archive storage, group viewing or reproduction.*

❹ PHOTORECORDING PAPER CAMERA . . . . *Records combined information on face of* CHARACTRON *Shaped-Beam Tube and forms projector on page-size photo-recording paper for immediate viewing, office distribution or reproduction.*

❺ PHOTORECORDING PAPER CARTRIDGE . . . . *Data photographed by camera is recorded directly on 9½-inch wide photorecording paper. Cartridge can be removed for paper processing.*

JAMES E. NEWLAND
DISTRICT SALES MANAGER

455 MATHEW STREET, SANTA CLARA, CALIF. 95050
TELEPHONE: (408) 244-2300

MODEL 835
ELECTRONIC DIGITAL PLOTTING SYSTEM

CⒶLⒸOⓂⓅ

INTRODUCTION

The CalComp Model 835 Electronic Plotter has been developed to provide computer users with a high performance digital graphics system at a moderate price. Outstanding output quality is achieved and economically feasible for as few as 400 to more than 100,000 microfilm frames per month.

The CalComp Model 835 Electronic Plotter is an ultra
high speed digital incremental plotter, with the capability
of electronically recording a display on the face of a
cathode ray tube (CRT). The CRT display is transmitted
through the camera lens system and automatically recorded
onto 16mm or 35mm microfilm. The plotting area on the CRT
is optically reduced and appears as a standard 0.733" x
1 133" frame on the 35mm microfilm. The aspect ratio of the
35mm frame is such that a 15 times magnification provides an
11" x 17" hard copy page size with a plotting matrix of 2200
x 3400. The light spot on the CRT can be program controlled
to 32 levels of intensity and positioned anywhere within the
plotting matrix.

The camera used in the Model 835 for 35mm microfilm is
high quality, sprocket drive, and fully automatic. It has a
magazine for up to 400' of film which can produce up to 3200
plot frames. At the end of each plot, the microfilm is
advanced under program control in 200 milliseconds.

SYSTEM OPERATION

The Model 835 is a true digital incremental plotter
utilizing the basic design principles and circuitry developed,
perfected, and patented by CalComp for all of its digital
incremental plotters. Input commands from a digital computer
are used to produce discrete incremental steps relative to
the X-Y axes. In the CalComp Electromechanical plotters, bi-
directional step motors respond to these input commands to
produce movement of a pen relative to the plotting paper.
However, in the Model 835 Electronic Digital Plotting System,
the incremental plot commands produce deflection of the CRT
electron beam in discrete steps. The CRT display is transmitted
through the camera lens system and automatically recorded on
35mm or 16mm microfilm The exposed film may then be processed
to produce either positive or negative transparencies for
direct viewing or printing in a variety of processes.

There are several types of microfilm available commercially which are suitable for use in the Model 835. One of these types is Kodak 5461 RAR, available in 400' rolls for about $25 per roll. Additionally, there are several types of microfilm processors which are suitable. An excellent unit is the Recordak Pro Star which sells for approximately $3,000 and leases for about $125 per month. It is simple to operate and can process film at a rate of 5' per minute (40 plots per minute). Within five minutes from the time plots are recorded onto microfilm, over 100 plots can be developed by the Pro Star and made available for printing or viewing. CalComp has also developed a partial reversal chemistry which can be used with the Recordak Pro Star to develop a positive type exposure without the more complicated procedure and equipment required for a full reversal.

For film viewing and printing of hard copies, a wide range of equipment is available. The Recordak or Itek Model 18-24 Microfilm Reader-Printers can be used for excellent results at an economical price. These units provide a good quality viewing screen for the film and a hard copy of any selected frame can be obtained in less than one minute. A Model 835 graphics system has many other output capabilities some of which are shown in the following system block diagram
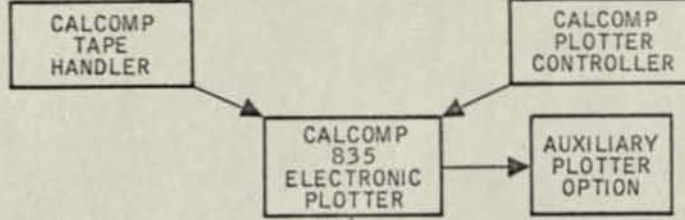
Computer System

PLOT PROGRAM → DIGITAL COMPUTER ← INPUT DATA

PLOTTING OPTIONS

MAG TAPE

OFF-LINE SYSTEM   ON-LINE SYSTEM

CALCOMP TAPE HANDLER   CALCOMP PLOTTER CONTROLLER

Calcomp 835 System

CALCOMP 835 ELECTRONIC PLOTTER → AUXILIARY PLOTTER OPTION

EXPOSED FILM

FILM PROCESSOR

Film Processing

DEVELOPED FILM

835 SYSTEM OUTPUT CAPABILITIES

REPRODUCTION SYSTEMS

LARGE VOLUME HARD COPY

STEREO PAIRS

THREE-DIMENSIONAL VIEWING

16MM MOVIE FILM

ANIMATION CARTOONS MOVIES

FILM READERS/ PRINTERS

IMMEDIATE
-VIEWING
-USE
-PRINTS

FILM ROLL

STORAGE FUTURE USE

2X2 SLIDES

PRESENTATIONS

UNITIZED MICROFILM DOCUMENTS

FOR USE WITH STANDARD MICROFILM SYSTEMS

PHOTO TYPE-SETTING

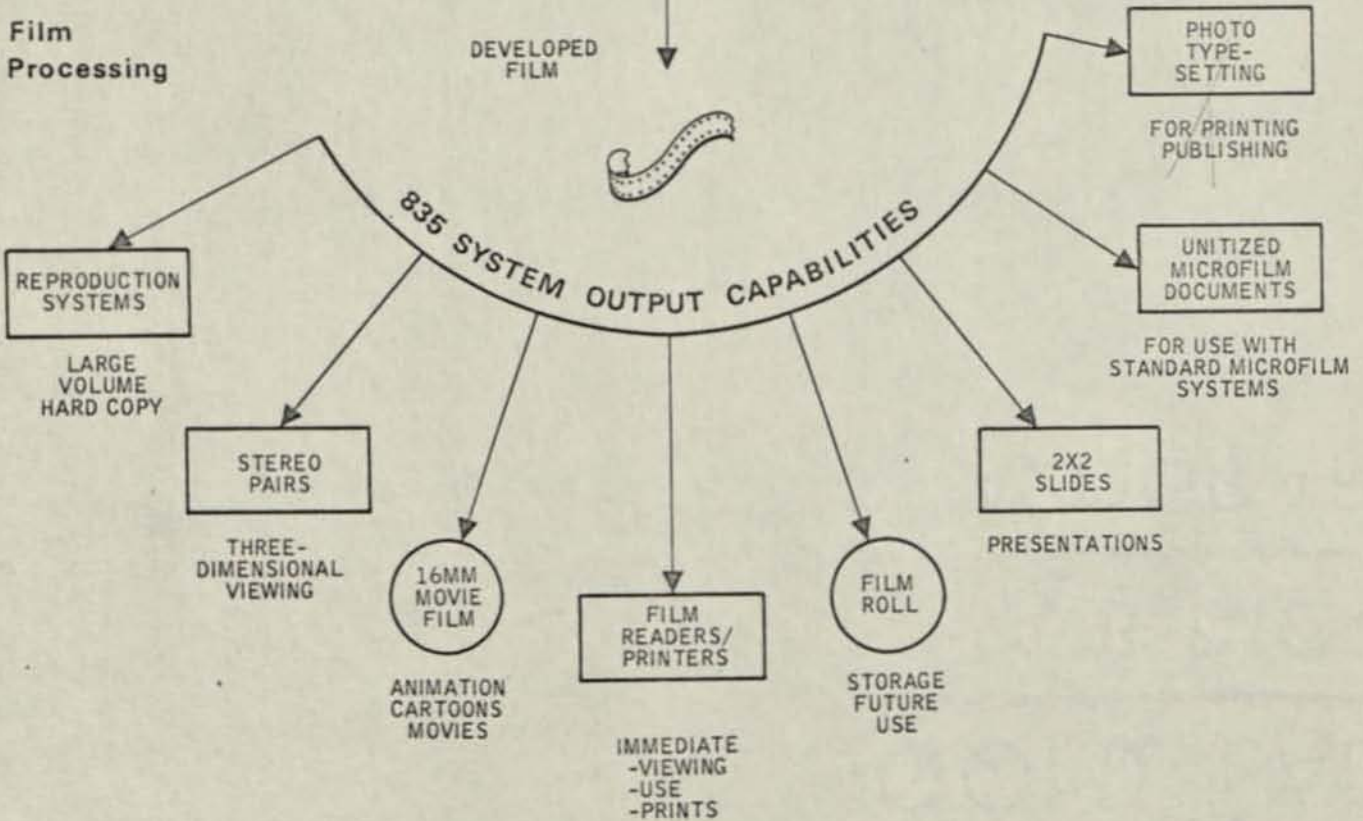FOR PRINTING PUBLISHING

BLOCK DIAGRAM FOR MODEL 835 GRAPHICS SYSTEM

An auxiliary plotter feature of the 835 permits the
connection of a CalComp 500 or 700 series plotter to the 835
so that input data may be fed to either the CRT or the me-
chanical plotter.

It is interesting to note that the 835, because of its
speed, output, quality, and available software, is a highly
versatile printer as well as a plotter. The 835 can print a
high quality, 132 column print line in excess of 1,000 lines
per minute on-line, or at a rate of about 350 lines per minute
with the 780 Tape Unit off-line. If the average number of
characters per line is reduced, the printing speed per line
increases accordingly.

COST

The basic price of the CalComp Model 835 Electronic
Plotter is $49,500. With the appropriate additional equip-
ment, the Model 835 can be operated either on-line or off-line
with most computers available today.

Cost - On-line

The cost of a CalComp Plotter Controller to operate the
Model 835 on-line to most computers is $6,500. The CalComp
835 system price would then be $56,000, including the basic
835 plotter. The CalComp on-line 835 system is capable of
accepting input commands at rates up to 100,000 characters per
second. The same plotter controller may also be used to drive
a CalComp electromechanical plotter.

Cost - Off-line

The Model 835 may be used off-line with CalComp Magnetic
Tape Unit Models 760, 770, or 780. An off-line installation
would cost $49,500 for the 835 plus $28,500 for a Model 760
Tape Unit, $29,500 for a Model 770 Tape Unit, or $34,500 for
a Model 780 Tape Unit. Therefore, depending upon the choice
of tape unit, the cost of an off-line operation would be
$78,000, $79,000, or $84,000. Tape speed on all models is 60
inches per second. However, the Model 780 provides the highest

system performance since it can read up to twice the number
of plot characters per inch of tape as compared to the 760
or 770 Tape Units.

ON-LINE VS OFF-LINE

As noted previously, the Model 835 can be operated either
on-line or off-line to a digital computer. There are advantages
to each of these plotting options depending on a user's
particular system, operation, and plotting requirements.

The off-line mode provides for several advantages which
result when separating the computing and plotting functions.
First of all, in larger facilities, each of several different
computers can be used to prepare plot tapes which can then be
plotted on the off-line CalComp system. Also, since a computer
is not required when the plots are actually made, the computer
can be used for other purposes during the plotting operation.
Finally, peak load processing of other work on the computer need
not interfere with off-line plotting.

On-line plotting with the 835 offers the most economical,
high performance, microfilm plotting system available to com-
puter users. It is especially suitable where the plotter is
the principal output device or where the computer can be
scheduled to perform plotting functions when required. On-line
plotting is also effective with a computer which can operate
in a multi-programming mode.

RESOLUTION

A simple but meaningful definition of resolution is hard
to develop for all cases. CalComp's experience indicates that
resolution must usually be evaluated in terms of the user's
application, the type of plot actually being produced, and the
intensity levels of the CRT light spot. However, the following
description is one way to describe the resolution capability of
the Model 835. If we were to draw, under FORTRAN program
control, a series of parallel (to the X-axis) horizontal lines

and process the microfilm to a 15 X magnification as described above, we could uniquely identify and clearly resolve 50 of these horizontal lines per inch along the 11" Y-axis.

SPEED

Maximum 835 performance can be achieved in the on-line mode where a speed of up to 100,000 increments per second may be realized. Since most computers cannot exceed the 835 plotting rate an unbuffered plotter controller is all that is usually required for 835 on-line operation. In the off-line mode a maximum plotting rate of 33,000 increments per second is available with the Model 780 Tape Unit or 16,500 increments per second when driven by the 760 or 770 Tape Units.

With a given incremental plotting rate for a Model 835, the plot time is directly proportional to the information content of the display. Typical graphs, simple engineering drawings, and other relatively uncomplicated presentations can usually be plotted in a few seconds. Plot time will be longer for displays with a higher information content, such as seismic sections or certain contour maps with many contour levels.

After the film is plotted (exposed) by the 835, the Recordak Pro Star and 18-24 Reader-Printer can be used to develop, view and print any plot in a few minutes.

SIZE

With the use of microfilm for the plotting medium, printed copies can be obtained in a number of different ways. The size of print that may be made from 835 microfilm is limited only by the enlarging capabilities of the particular process used. A 35mm frame can be magnified to 9 times for use on a standard 8 1/2" x 11" page size. For optimum resolution, as described above, CalComp recommends the 15 X magnification which results in an 11" x 17" double page size. This is also the size of a "B" size engineering drawing. The degree of magnification can vary, however, and the acceptance of the resolution of larger

plots is dependent entirely upon the user and his application.

SOFTWARE

Standard CalComp software is available for the 835 to
operate in the on-line or off-line mode with nearly any computer.
As explained above, the 835 operates on the same digital incre-
mental principle as all CalComp plotters. Therefore, plots are
created by making the appropriate FORTRAN calls using standard
CalComp developed software. These calling sequences consist
of the X-Y coordinates of the points that describe the various
graphs and geometries that are to be plotted as well as indi-
cating the location of alphanumeric information that is to be
plotted. Therefore, the 835 is capable of accepting random
instructions to move the light spot over the entire area of the
CRT that is used for plotting.

CalComp plotter programs written in FORTRAN to produce
plots for any of the CalComp electromechanical equipment can
produce plots for the 835 without any changes to the user's
FORTRAN program.

APPLICATIONS

The 835 is uniquely suited for a wide range of applications,
particularly where a high volume output with outstanding
quality is an important factor. In particular, the system is
extremely well suited for the preparation of engineering
drawings, wiring lists, circuit diagrams, contour maps, and
graphic presentations with annotation of the results of
scientific problems. The 835 can also readily produce business
graphs, charts, or other types of graphic outputs required by
business information systems for management.

The attached 835 samples demonstrate the versatility, high
quality, and overall performance of the 835 in several different
application areas. The samples were printed on an offset press
using printing plates which were prepared at 7 1/2 times magni-
fication from 35mm film initially exposed by the Model 835.
Following is a brief description of each of the samples:

General Graphs

Number 1 - <u>Exponential Flare-out</u>. This is a typical
engineering graph which used two intensity
levels in the plot.

Engineering Drawings

Number 2 - <u>Kearney & Trecker</u>. This drawing was completed
in six seconds using an 835 and 780 tape
handler operating at 33KC. This drawing can
be completed in two seconds with an 835
on-line.

Printing

Number 3 - <u>Alphanumeric Printing</u>. This sample demonstrates
the printing quality and resolution capabilities
of the 835 The smallest character size is
clearly discernible at a height of about 0.035"
the print lines are successively increased in
size by 0.005" over the preceeding line.

Number 4 - <u>Moistrite Offset</u>. Several intensities of the
CRT light spot were used to demonstrate 835
quality and flexibility for printing a catalog
page.

Special Drawings

Number 5 - <u>Piping Isometric</u>. This plot was prepared in
two seconds off-line using a 780 tape handler
at 33KC.

Number 6 - <u>Testing Wiggle Trace</u>. This plot is a wiggle
trace seismic section with variable area which
is used by the oil industry to obtain a
representation of the earth's sub-strata for
oil exploration. CalComp developed a special
software package for this application.

<u>Movies</u>

Number 7 - <u>CalComp Cartoon</u>. The 835 can be·used to
generate 16mm movies for entertainment,
training, or scientific analysis. This frame
is from a CalComp cartoon of an old car, with
animation showing wheels rotating, tires
going flat, and the radiator cap flying off.

In summary, the CalComp Model 835 is a highly versatile,
efficient, and reliable digital graphics system capable of
producing any kind of visual presentation that can be generated
by a computer program. The performance and reliability standards
that have made CalComp the leader in the fast-growing digital
graphics industry have been engineered into the 835, plus the
additional capabilities of ultra-high-speed plotting, incremental
intensity control, and choice of 35mm or 16mm film output.

We welcome the chance to discuss how the 835 system can
solve <u>your</u> particular digital graphics problems. Contact your
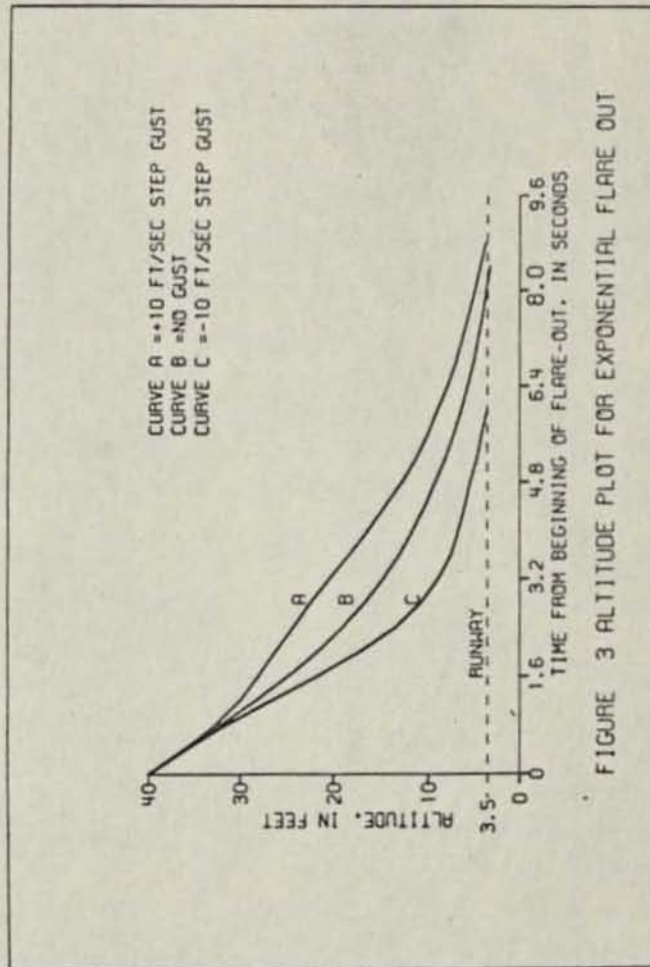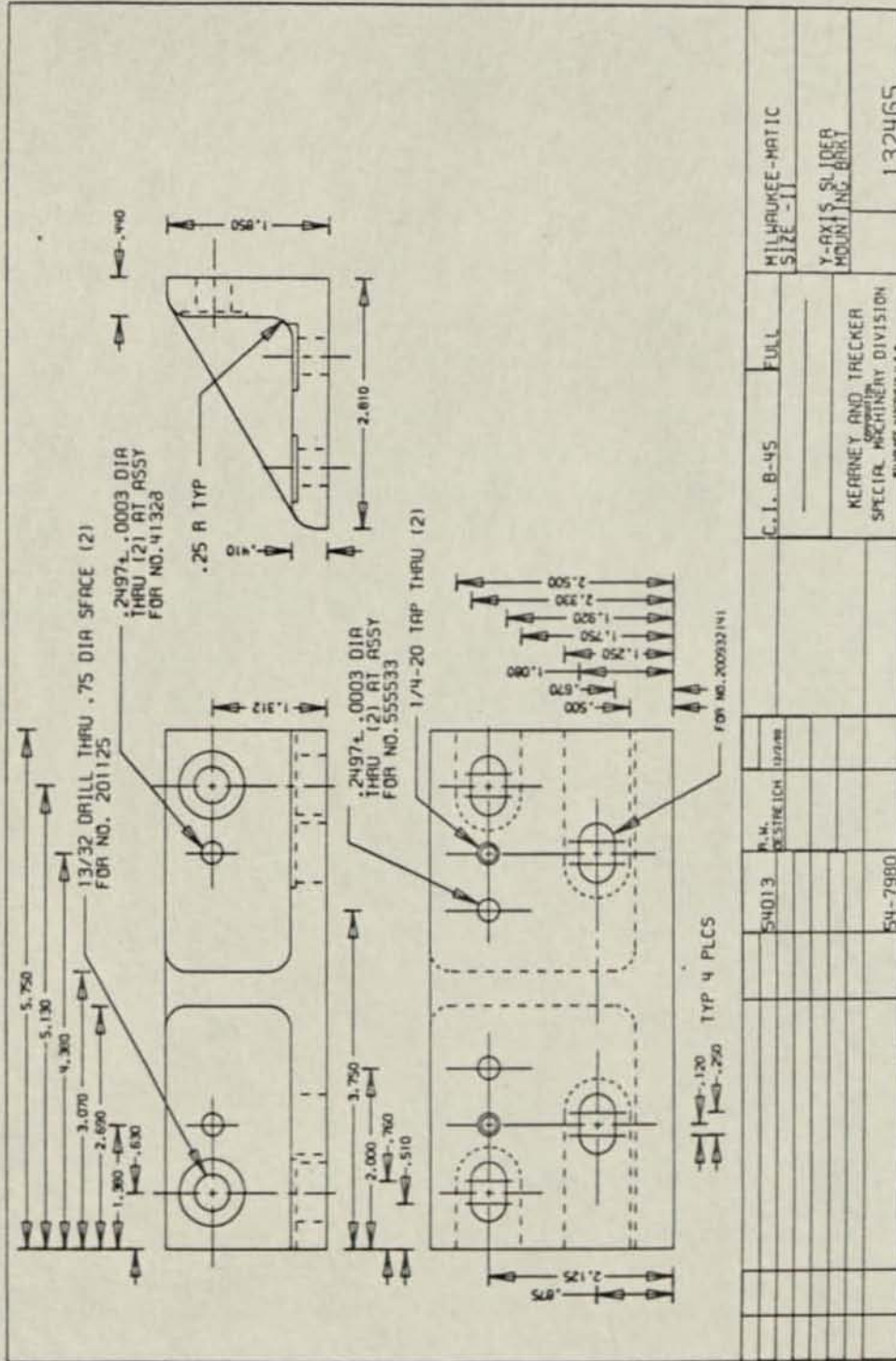local CalComp sales representative, or CalComp Marketing.

FIGURE 3 ALTITUDE PLOT FOR EXPONENTIAL FLARE OUT

-11-

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z 0 1 2 3 4 5 6 7 8 9
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z 0 1 2 3 4 5 6 7 8 9
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A B C D E F G H I J K L M N O P Q R S T U V W X Y Z 0 1 2 3 4 5 6 7 8 9

MOISTRITE OFFSET

VELLUM FINISH
WHITE

PER 1000 SHEETS

50	17 X22	41M	3600	15.42	11.99	10.95	10.07	9.43	9.04
	23 X35	85M	1800	31.96	24.86	22.70	20.87	19.55	18.74
	35 X45	166M	900	62.46	48.56	44.32	40.75	38.18	36.60
	35 X45	166M	SKIDS	-----	-----	-----	40.26	37.68	36.11
	38 X50	200M	800	75.20	58.50	53.40	49.10	46.00	44.10
60	17 X22	50M	3200	18.80	14.63	13.35	12.28	11.50	11.03
	23 X35	102M	1500	38.35	29.84	27.23	24.04	23.46	22.49
	23 X35	102M	SKIDS	-----	-----	-----	24.74	23.15	22.19
	35 X45	198M	800	74.45	57.92	52.87	48.61	45.54	43.66
	35 X45	198M	SKIDS	-----	-----	-----	48.02	44.95	43.07
	38 X50	240M	600	90.24	70.20	64.08	58.92	55.20	52.92
70	23 X35	119M	1200	44.74	34.81	31.77	29.21	27.37	26.24
	23 X35	119M	SKIDS	-----	-----	-----	28.86	27.01	25.88
	25 X38	140M	1000	52.64	40.95	37.38	34.37	32.20	30.87
	35 X45	232M	600	87.23	67.86	61.94	56.96	53.36	51.16
	35 X45	232M	SKIDS	-----	-----	-----	56.26	52.66	50.46

CREATED ON A CALCOMP 835 PLOTTER
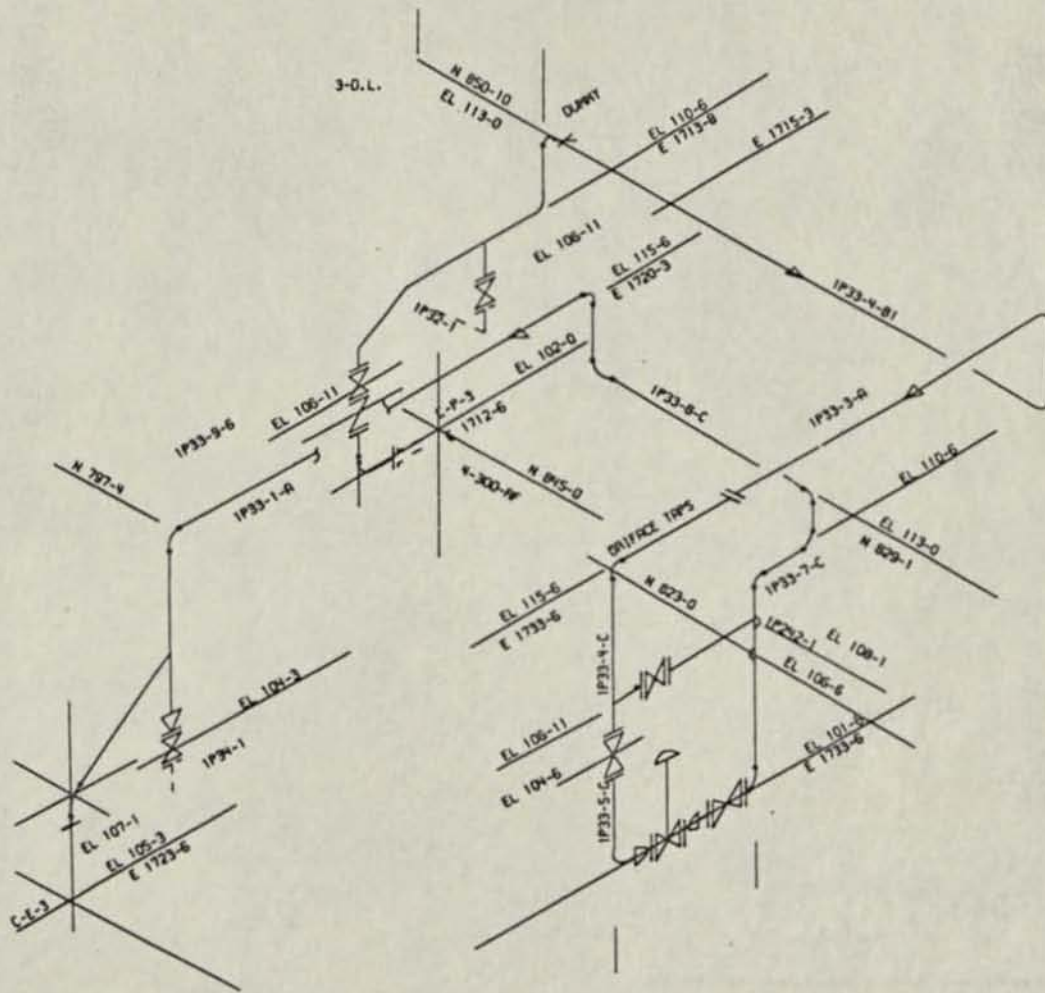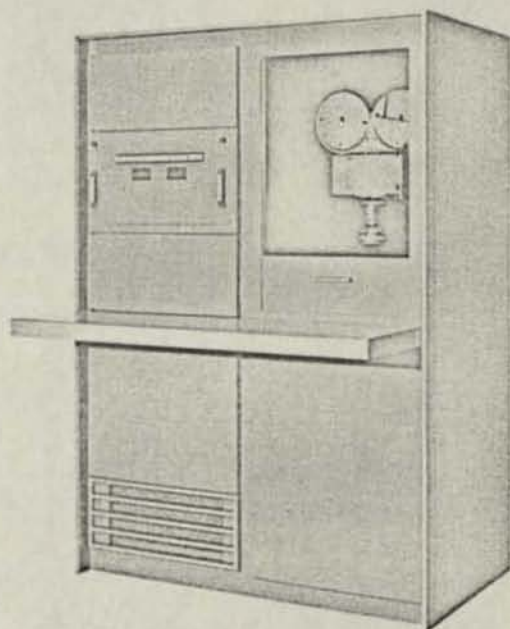
TESTING MIDDLE TRACE - VA
TRACES 1 THROUGH 24 PER SHOT ARE PLOTTED
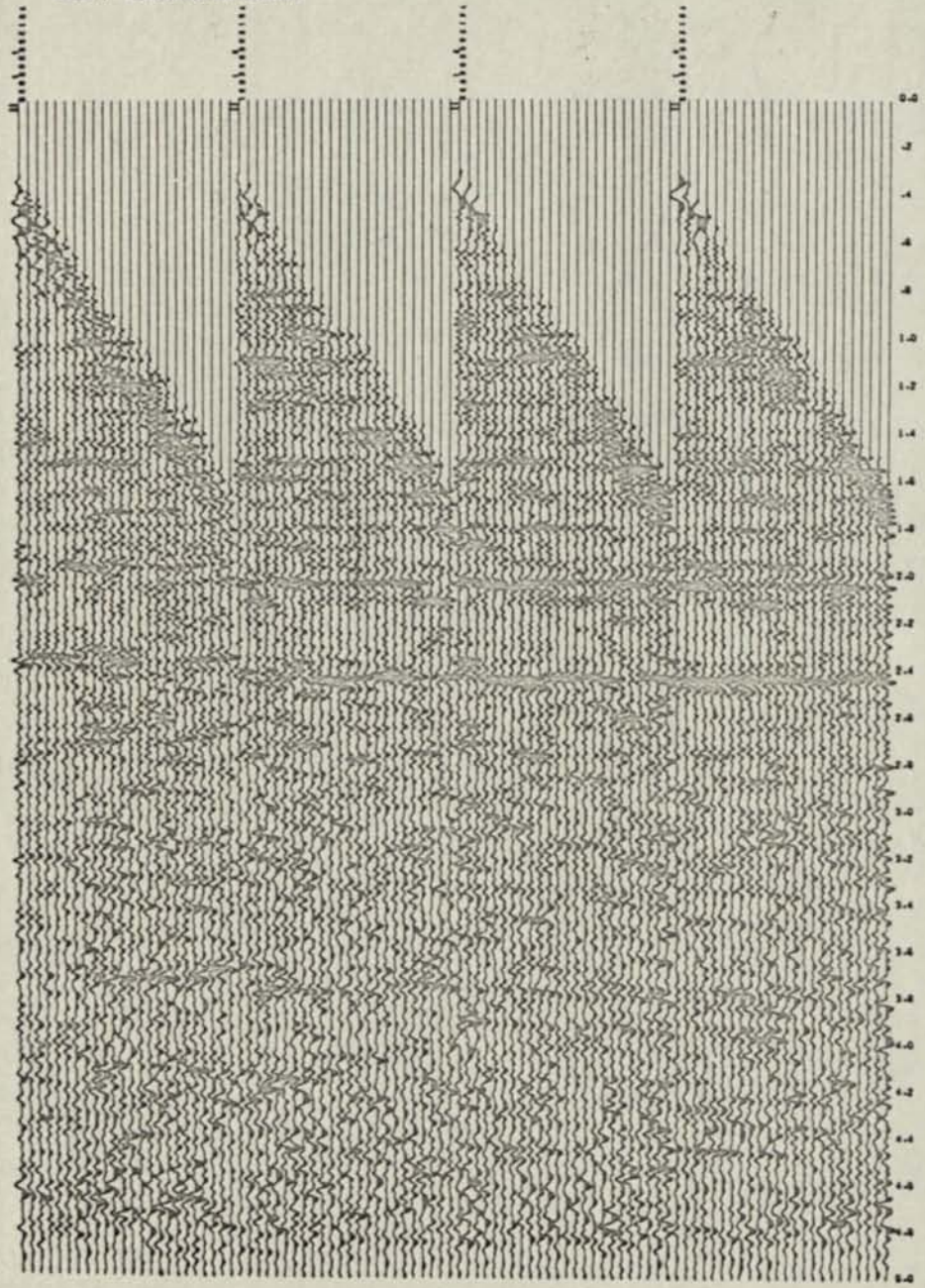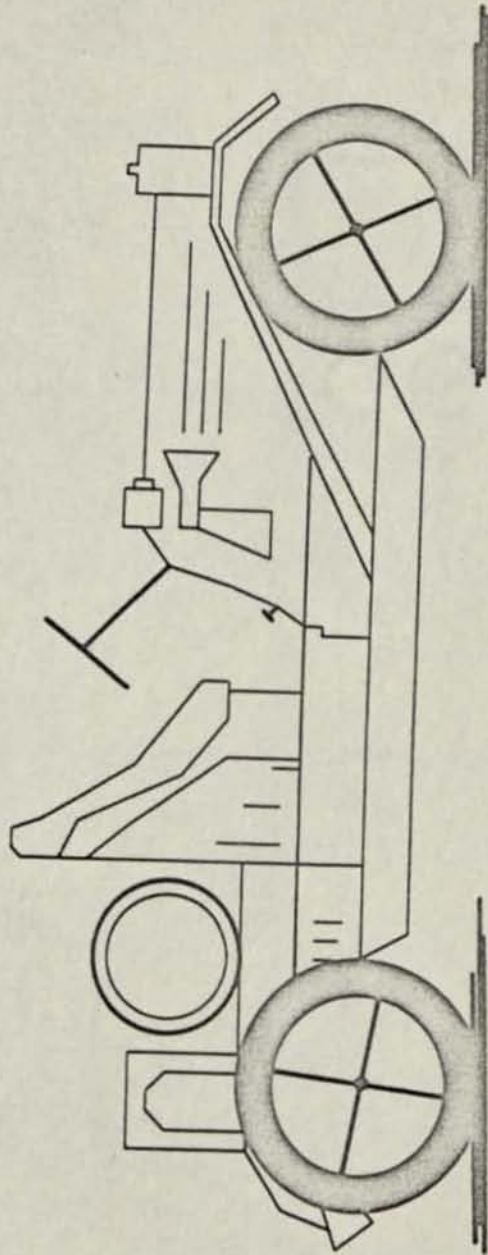
MODEL 835
# ELECTRONIC DIGITAL PLOTTING SYSTEM

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The CalComp Model 835 adds a new dimension to the concept of digital plotting. Fully compatible with existing CalComp systems, this new CRT/microfilm system is precision engineered to provide ultra high-speed plotting and recording of any computer output data that can be converted to graphic form. Unlike whole-value CRT systems, the Model 835 is a true digital incremental plotter—utilizing the basic design principles and circuitry developed, perfected and patented by CalComp. Meeting the high-volume needs of large-scale computer users, the Model 835 complements CalComp's line of electromechanical pen-on-paper digital plotters that are the quality standard of the industry.

These charts, program-generated on production models and shown here at twice microfilm size, indicate the high resolution of the Model 835's optical system.
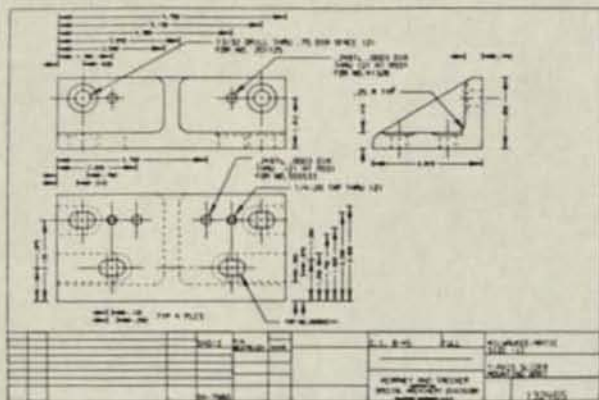

A complex machine drawing, plotted on-line in less than one second, illustrates the ratio of information-to-space that can be realized with Model 835.
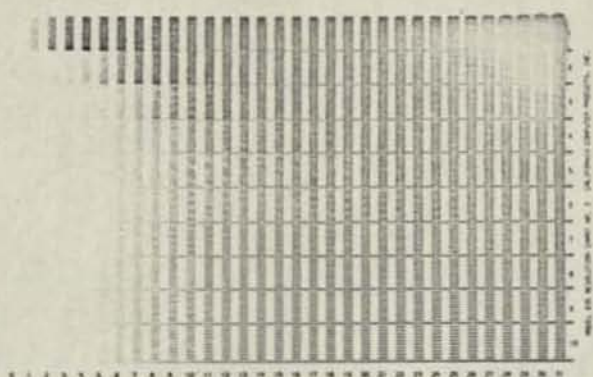
This tapered line scale, a combination of intensity and line spacing, shows the Model 835's capability to handle tapered lines by modulating intensity. This chart can also serve as a guide to programmers in shading areas or filling in solid blocks.

APPLICATIONS

The Model 835 Electronic Digital Plotting System has a wide range of applications, and can be used in any on-line or off-line installation where the volume of digital plotting required makes it desirable to supplement an existing electromechanical ink-on-paper plotting capability. The compatibility feature of the Model 835 makes it possible to expand the graphic output capability of a computer by several orders of magnitude, without extensive reprogramming. When desired, a microfilm viewer can be used to screen the system output, and selected material may be replotted on a CalComp electromechanical plotter. The microfilm output of the Model 835 is also suitable for photo reproduction and enlargement.
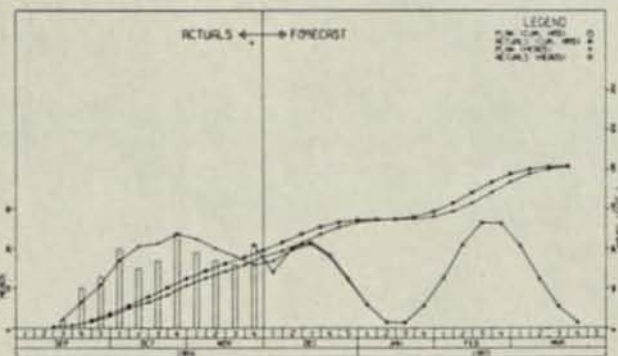
Manloading chart for a major development program — one of hundreds of applications for CalComp digital incremental plotters. A graph of this relative complexity can be plotted and recorded on microfilm with the Model 835 in less than 1 second.

CALIFORNIA COMPUTER PRODUCTS, INC.
305 North Muller Street   Anaheim, California 92803
Phone (714) 774-9141   TWX 910-591-1154

SYSTEM OPERATION

The Model 835 operates on the same basic principle as all CalComp digital incremental plotters, in that input commands from the computer are used to produce discrete incremental steps relative to the X and Y axes. In the CalComp electromechanical plotters, bidirectional step motors are used to produce movement of a pen relative to the plotting paper. In the Model 835 Electronic Digital Plotting System, the incremental plot commands produce deflection of the CRT electron beam in discrete steps. The Z-axis signals are used to raise and lower the pen in the electromechanical plotters, and to blank and unblank the electron beam in the Model 835. The CRT display is transmitted through the camera lens system and automatically recorded on 35-millimeter microfilm. At the end of each plot, the film is advanced

automatically. The exposed film may be processed to produce either positive or negative transparencies for direct viewing or photographic printing.

CONTROLS AND INDICATORS

The Model 835, like all CalComp systems, is designed for ease of operation and minimum setup time. Calibration is accomplished by adjusting a single knob. Front panel pushbuttons control power on/off, CRT and auxiliary plot enable, and film advance; lights indicate operating status (plot, ready, not ready). Exposed film frame counters are also located on the front panel. Calibration meter and adjustment controls are located beneath a small panel in the camera compartment.
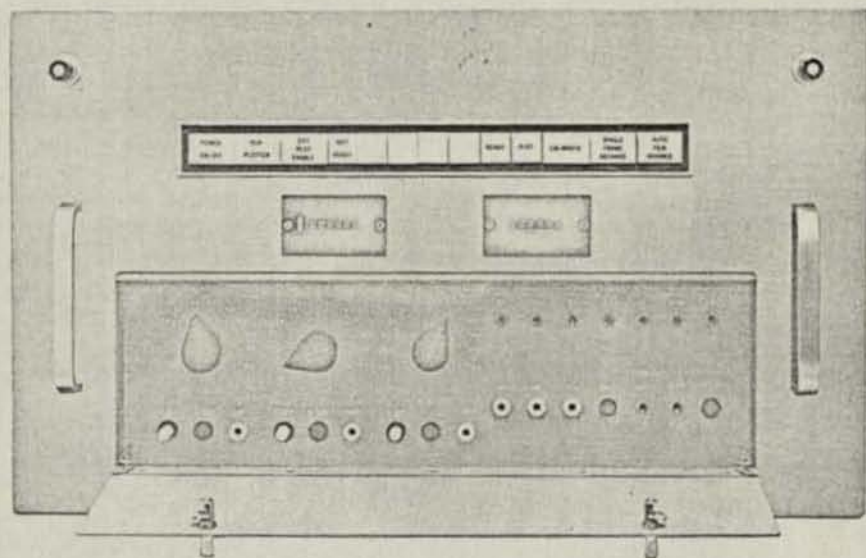
CONTROL PANEL
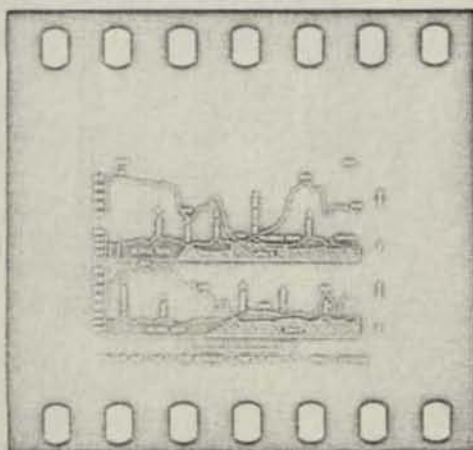
Sample plot shown above, slightly larger than actual microfilm size, requires less than 4 seconds plotting time on Model 835 at incremental rate of 33,000 steps per second.

Ultra high speed, fully incremental digital plotting, on-line or off-line

Up to 100,000 plot increments per second (equivalent to 500 lineal inches/second)

Capable of plotting a complete 2400-ft. reel of tape in 8 minutes
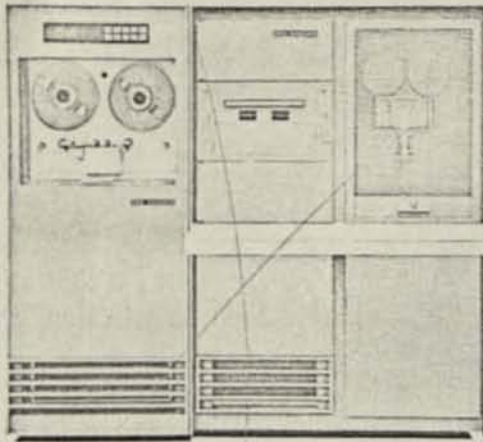
Fully automatic 35mm film recording of cathode ray tube display

Compatible with current CalComp digital plotting systems
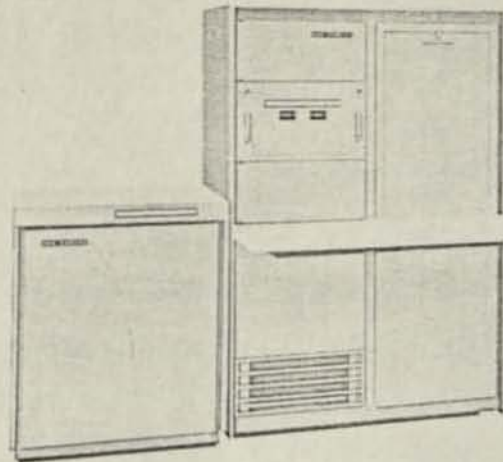
Equivalent plot size 11 x 17 inches

Standard 35mm film, double-frame format, 400-ft. capacity

All solid-state design, sillicon semiconductors (except CRT)

OFF-LINE SYSTEM — MODEL 835
WITH 700 SERIES MAGNETIC TAPE UNIT

ON-LINE SYSTEM — MODEL 835
WITH MODEL 110 PLOTTER CONTROLLER

The Model 835 is designed for off-line operation with CalComp magnetic tape unit Models 760, 770 and 780. Plotting is accomplished with the tape unit operating at a tape speed of 60 inches per second. The same tape unit may be used to drive either the Model 835 or a CalComp electromechanical plotter, 500, 600 or 700 series. The plotter programs and tape format for the Model 835 are compatible with the CalComp electromechanical plotters.

The Model 835 is designed for on-line operation with CalComp Plotter Controllers. The plotting system may be used in a time-shared configuration with other on-line equipment, and is capable of accepting input commands at rates up to 100,000 characters per second. The same Plotter Controller may also be used to drive any CalComp electromechanical plotter.

SPECIFICATIONS

PLOT AREA (35mm FILM) ....0.733 x 1.133 inches
PLOT AREA @ 15x magnification ....11 x 17 inches
EQUIVALENT INCREMENTAL STEP SIZE......................................005" at 15X magnification
PLOTTING MODE ....Fully incremental
CODE FORMAT .... CalComp standard 4-bit, full-step,
single character per plot command
MAXIMUM INCREMENTAL STEP RATE..................................... On-Line: 100,000 per second
(500 lineal in./sec. at 15X magnification)
Off-Line: 33,000 per second (Model 780),
16,500 per second (760,770), at tape speed of 60 ips
RESOLUTION ON 11" X 17" VIEW...................................2200(Y) x 3400(X) plotting matrix
STABILITY .... Less than ±0.5% drift in 8 hours
ACCURACY.. Better than 1.0% of full scale
CATHODE RAY TUBE...17" rectangular, P11 phosphor,
magnetic deflection
CAMERA .... fully automatic; 35 mm sprocket drive;
(16 mm sprocket drive optional)
POWER REQUIREMENTS .... 115 VAC, 60 cps, single phase, (standard);
(Other voltages and frequencies available).

OVERALL DIMENSIONS .... Width: 46"
Height: 68"
Depth: 26"
(plus 12" shelf)
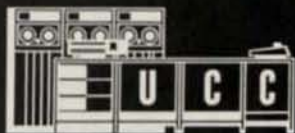
WHO SHOULD ATTEND Data Processing Managers and Senior Systems Analysts interested in the practical application of Optical Character Recognition equipment.

COURSE

- Introduction and History of OCR

    Early need for equipment and companies which responded

        Credit card systems

        Small companies and development laboratories

    Merger and growth pattern

    A look to the future

        Increasing labor costs

The real world (with slides)

Different machine techniques used to detect and identify characters, and major manufactures

Line scanning machines

"Map" or "mask" techniques

Matrix machines

Curve tracing devices

Special character fonts

INSTRUCTOR RESUME

Mr. P. L. Andersson has a B.S. in Mechanical Engineering from the University of Pennsylvania, 1953, and has taken postgraduate courses in business administration, marketing and electrical engineering. His early employers were RCA and General Electric. Starting in 1955, Mr. Andersson was employed by UNIVAC Division of Sperry Rand for a seven year period, where he acquired a sound background in computer technology. The last position he held at UNIVAC was at the technical management staff level. After leaving UNIVAC, Mr. Andersson became affiliated with the American Newspaper Publishers Association Research Institute as an internal consultant and staff member in charge of electronic development. In 1964, he left the ANPA Research Institute to form Andersson Associates, a consulting and development organization specializing in computer technology.

Mr. Andersson holds several patents in the computer field, and is the author of numerous articles and technical papers dealing with the use and management of computers and digital systems in industrial applications.

COURSE OBJECTIVES   To present in simple, understandable terms the factors related to the choice of equipment for a given application, and the need for, and the history of, Optical Character Recognition, with a limited technological forecast of present trends in the industry.

OUTLINE

Reject ratio
   Mutilated documents
   Unreadable characters
Disposition of readable and unreadable "rejects"
   Financial control conditions with proof and transit problems
   Information processing
   Text processing
Original document preparation

History
   Test scoring
   Punched card applications
Special schemes for mark and other types of sensing
   Fluorescent
   Bull and other bar codes
   Data trans terminals using mark sensing

ADVISORY PANEL

Panel Members, who cooperated in the development of this seminar, are also available for reply to your written questions on subjects covered during the seminar for three months after you attend. Panel members are:

Mr. P. L. Andersson
President
Andersson Associates

Mr. Robert D. Nixon
Curriculum Manager
University Computing Company

Mr. E. K. Zimmerman
Manager Information Services
University Computing Company

COURSE LIBRARY

OPTICAL CHARACTER RECOGNITION syllabus, a narrative outline of course content, including exhibits referred to in lectures.

OPTICAL SCANNING, a text comprised of OCR equipment, examples of problems, case histories and a look to the future.

OPTICAL CHARAC

WHO SHOULD ATTEND Data Processing Managers and Senior Systems Analysts interested in the practical application of Optical Character Recognition equipment.

- **Introduction and History of OCR**

  Early need for equipment and companies which responded

  - Credit card systems
  - Small companies and development laboratories

  Merger and growth pattern

  A look to the future

  - Increasing labor costs
  - Decreasing cost curve of electronic devices

  Potential for increasing use

  - Return documents
  - "Outside" originated documents
  - Text input
  - Handwritten characters

- **How the Machines Work**

  Signal-to-Noise ratio and what this means to the user

  - "Grey on grey"
  - Ideal conditions

  The real world (with slides)

  Different machine techniques used to detect and identify characters, and major manufactures

  - Line scanning machines
  - "Map" or "mask" techniques
  - Matrix machines
  - Curve tracing devices

  Special character fonts

- **Document Feeding Devices**

  Punched card document feeds

  - Traditional
  - Return document

  Journal tape readers

  - Retail applications

  Coupon readers

  Page readers

  Special readers

- **Guidelines in Machine Selection —**

  Cost and Economics

REGISTRATION

The $150 registration fee includes luncheons and the course library. To register write or call:

The Registrar
University Computing Company
1930 Hi-Line Drive
Dallas, Texas 75207
(214) 741-1946

LOCATION

The Airport Marina Hotel will host the Los Angeles offering of Optical Character Recognition. In San Francisco, the Thunderbolt Hotel will host this same seminar. Limousine or courtesy car service is available to both hotels from their respective airports.

COURSE OBJECTIVES To present in simple, understandable terms the factors related to the choice of equipment for a given application, and the need for, and the history of, Optical Character Recognition, with a limited technological forecast of present trends in the industry.

OUTLINE

Reject ratio
  Mutilated documents
  Unreadable characters
Disposition of readable and unreadable "rejects"
  Financial control conditions with proof and transit problems
  Information processing
  Text processing
Original document preparation
  What machines can be used for document preparation
  Verification, if any

● Magnetic Ink Character Recognition
  History — ABA
  Special problems unique to MICR
  Special applications of MICR
    Bank checks
    Coupons
    Potential

● Mark Sensing & Other Special Systems

History
  Test scoring
  Punched card applications
  Special schemes for mark and other types of sensing
    Fluorescent
    Bull and other bar codes
   Data trans terminals using mark sensing

● Applications I
  Economics—OCR vs. other types of input devices
    Remote data terminals
    Low cost off-line input machines
  Present and potential applications
  Installation considerations

● Applications II
  Detail study of a typical credit card application
  Detail study of information processing application
  Study of a page reader application, text processing

HOTEL ACCOMMODATIONS

Hotel accommodations are not made by University Computing, however room reservation cards will be sent to you with confirmation of your enrollment. The Airport Marina Hotel is holding a block of rooms for student registrations. Room rates are $15 for singles and $19 for doubles. The Hotel is located at 8601 Lincoln Street, Los Angeles, California, (213) 670-8111. In San Francisco the Thunderbolt Hotel is holding rooms at $16 for singles and $22 for doubles. The Thunderbolt is located at 101 Bayshore, Millbrae, California, (415) 697-7700.
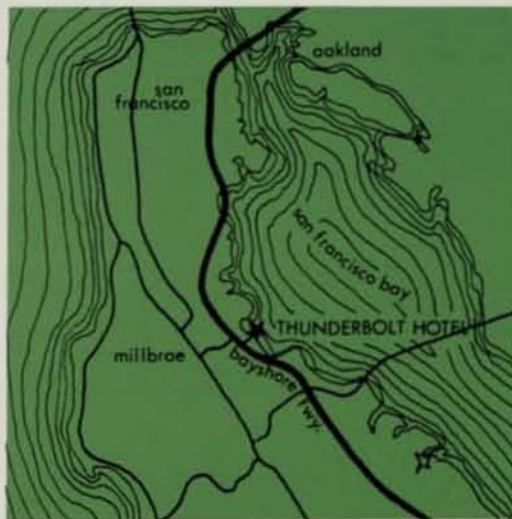
PARKING

Free parking is available at both hotels.

HOURS

Classes are from 9:30 a.m. to 5:30 p.m.

UNIVERSITY COMPUTING COMPANY

WORLD HEADQUARTERS   1949 N. STEMMONS FREEWAY, DALLAS, TEXAS

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Group World Headquarters
1949 Stemmons Freeway
Dallas, Texas 75207

1108 Computer Center
1949 Stemmons Freeway
Dallas, Texas 75207
(214) RI 7-6351

HOUSTON CENTER
400 Fannin Bank Building
Houston, Texas 77025

LOS ANGELES CENTERS
1107/1108 Computer Center
888 North Sepulveda Boulevard
El Segundo, California 90245
(213) 322-3093

TULSA CENTER
823 South Detroit
Tulsa, Oklahoma 74120
(918) LU 2-0975

WASHINGTON CENTER
312 Montgomery St.
Alexandria, Virginia 22314
(713) 683-3540

FEDERAL SYSTEMS DEPARTMENT
6201 Leesburg Pike
Falls Church, Virginia 22044

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Dallas, Texas 75207
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Willow Grove, Pennsylvania 19090
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Belmont, Mass. 02178

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Dallas, Texas 75207
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MORTGAGE SYSTEMS COMPANY
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(214) RI 7-6351

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Van Nuys, California 91401
(213) 781-7100

DATA COMMUNICATIONS SYSTEM DIVISION
10655 Harry Hines
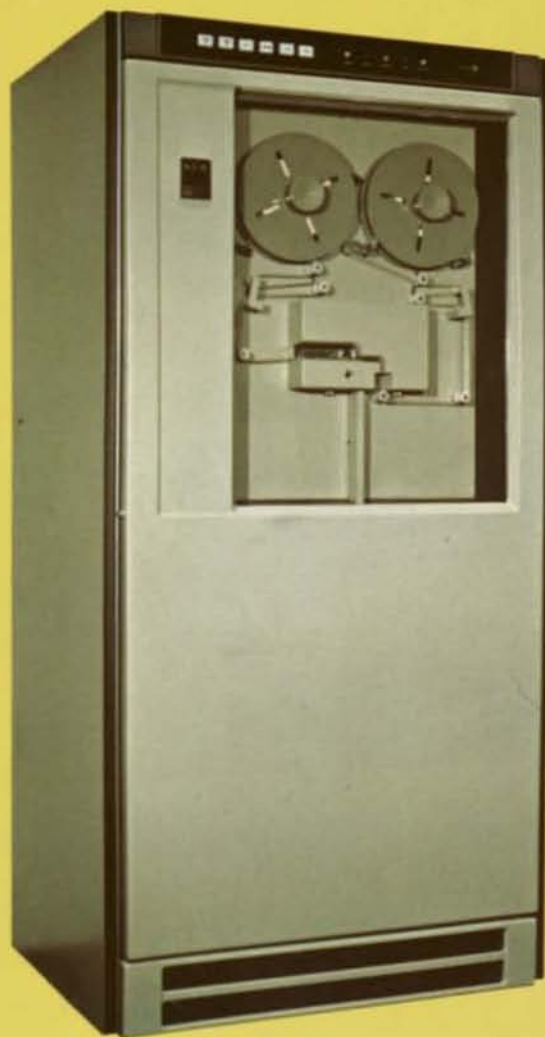Dallas, Texas 75220
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The NCR peripheral people announce the peripherals of the century
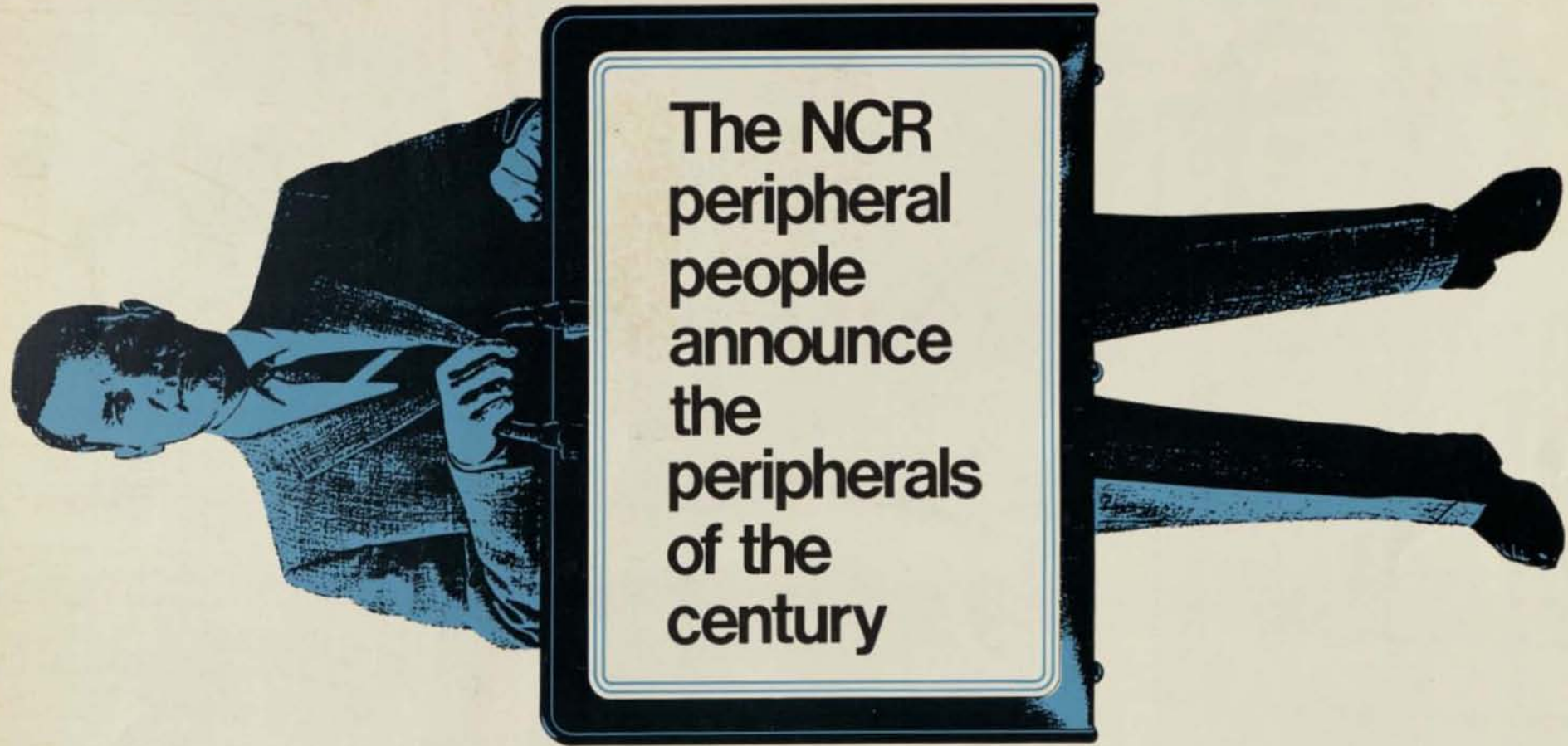
B-3 High Speed Tape Punch

Fast (200 cps), reliable, easy to maintain, accurate, and inexpensive. Few moving parts (none if not punching) insure long, maintenance-free life. The asynchronous B-3 is available in three sections: perforator, media handler and electronics with validity check (inhibits tape advancement when error is detected.)

C-3 Low Cost Printer

NCR built everything except blinding speed into this unit. It's reliable, offers flexibility, operator access never before possible. Prints 450 lpm using 48 of the 64 character set or 900 lpm using double numeric typedrum.

D-4 Punched Card Reader

This compact reader offers reading reliability at 300 cpm, features modular construction for easy service. The card track is fully accessible. Surprisingly inexpensive to buy, the real savings come in years of trouble-free operation.

C-5 High Speed Printer

Prints up to 3000 lpm. "Swing-away" typedrum, interchangeable tool steel drums. Excellent operator access to exchange drum, ribbon, paper and code discs. Magnetic particle clutch for years of maintenance-free operation. An honest breakthrough in a high speed printer. Incomparable!

H-6 CRAM (Card Random Access Memory)
Super CRAM! The billion bit (125 million byte) 4th Generation Peripheral reads and writes faster at random than many sequential units. Average access time is 115 ms. One controller can handle 8 CRAM-6 on one input line. Automatic read after write.

J-1 Dual Disc Unit
Fastest access time of any comparable disc drive—48 ms avg. With 12 read/write heads per disc surface you can access up to half a million bytes without head positioning. Each unit contains two disc packs (six surfaces, 72 read/write heads each) and offers up to 11.6 million eight bit bytes. Here's "big system" hardware at an amazingly low price.

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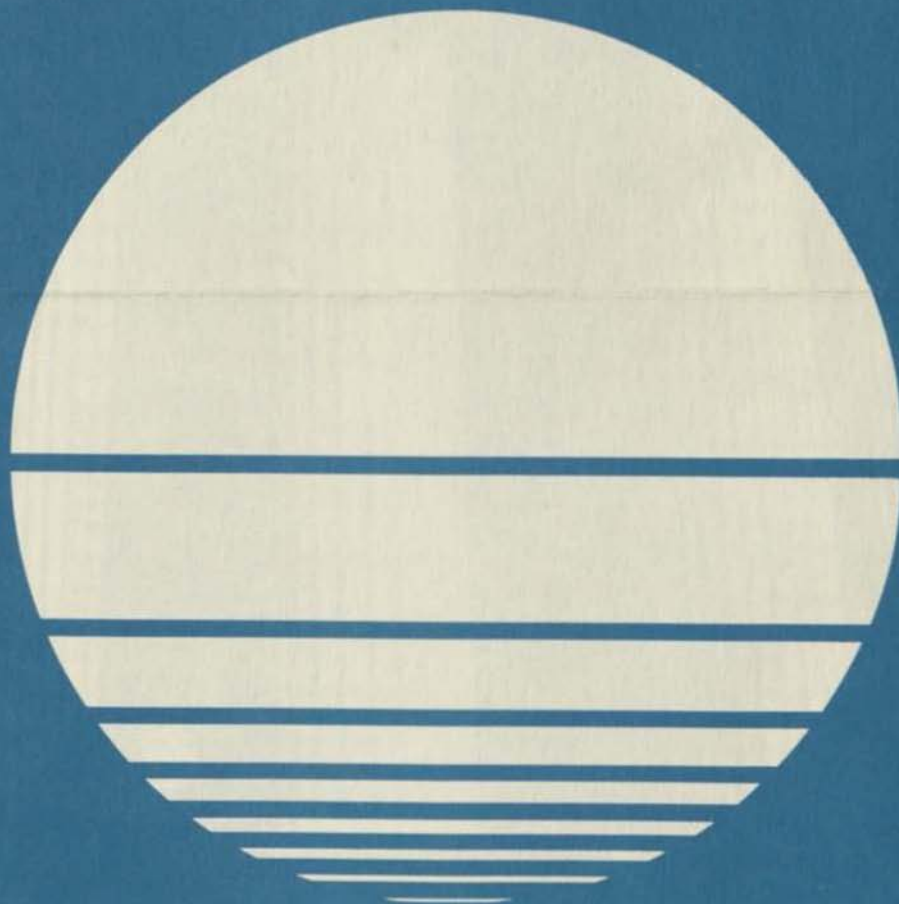
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Massachusetts Institute of Technology
August 4-15
Summer Session 1969

Display Technology

The type and quantity of information t
be displayed has changed dramati-
cally in recent years. This Program wi
emphasize the analysis and design
aspects of systems for the display of
computer-generated and other types
of information.

The Program will present important
hardware and software techniques
employed in modern display tech-
nology and is intended for engineers
and others who specify or design
information display systems.

Several display systems which have
been developed by the staff members
who are conducting the Program will
be described in detail as illustrative
examples.

to

ill

Topics to be covered in the Program include:

Organization of alphanumeric and graphic computer displays for inter- active and non-interactive situations

Circuit design techniques for cathode- ray tube displays; character and vector generators, deflection amplifiers, light pens and beam pens, power supplies

The use of low-cost magnetically deflected cathode-ray tubes in high- capacity alphanumeric displays

Organization of displays which use storage tubes

Software for computer-generated and controlled displays

Use of a complex scaler representation of the electromagnetic field to obtain a linear theory of wave propagation in optical systems. Properties of optical transfer and modulation transfer func- tions. Applications to electro-optical system design and to relief image recording and display

The Program will consist of lectures and discussions. Sessions will be held from 9:30 a.m. to noon, and from 1:30 p.m. to 4:30 p.m. each weekday. Notes covering and supplementing the lectures will be distributed to the participants.

The Program is under the direction of Professor James K. Roberge of the M.I.T. Department of Electrical Engi- neering. He will be assisted by Profes- sor J. Francis Reintjes, of the same Department, and staff members of the Electronic Systems Laboratory at M.I.T.

Tuition for the Program is $450, due and payable upon notification of admission. Academic credit is not offered.

Special Summer Programs

Beginning Tuesday, June 17
Computer-Aided Urban Design ... 4.70s

Infrared Spectroscopy: Technique* ... 5.16s

Industrial Dynamics ... 15.21s

Beginning Monday, June 23
Multistory Steel Building Technology* ... 1.55s

Non-Destructive Testing* ... 2.14s

New Developments in Modeling, Analysis, and Simulation of Engineering Systems ... 2.22s

Electronic Materials — Growth and Characterization ... 3.80s

Infrared Spectroscopy: Applications* ... 5.17s

Speech Communication ... 6.69s

Forecasting with Econometric Models ... 14.38s

Mathematical Programming ... 15.59s

Recent Advances in the Biomedical Sciences Pertinent to Oral Surgery* ... 20.87s

Beginning Monday, July 7
Recent Developments in Mechanical Vibrations ... 2.04s

Strain Gage Techniques: Lectures* ... 2.12s

Detection, Estimation, and Modulation Theory: Part I* ... 6.52s

Recent Advances in Radio Astronomy ... 8.98s

Statistical Method in Modern Experimentation ... 14.37s

Frontiers in Investment Management and Analysis ... 15.42s

Management of Research and Development ... 15.90s

Beginning Monday, July 14
Strain Gage Techniques: Laboratory* ... 2.13s

Programming Linguistics ... 6.23s

Detection, Estimation, and Modulation Theory: Part II* ... 6.53s

Semipermeable Membranes ... 10.67s

Management Science in Marketing ... 15.84s

Thermionic Energy Conversion* ... 22.98s

Nuclear Power Reactor Safety: Part I* ... 22.94s

Beginning Monday, July 21
Application of State-Variable Techniques to Communication Systems* ... 6.54s

Theory and Design of Optimal Linear Control Systems* ... 6.61s

Models for Financial Management and Long-Range Financial Planning ... 15.40s

Nuclear Power Reactor Safety: Part II* ... 22.95s

Beginning Monday, July 28
Computer Applications in Naval Architecture and Ocean Engineering ... 13.52s

Nuclear Power Reactor Safety: Part III* ... 22.96s

Beginning Monday, August 4
The Electron Microanalyzer and Its Applications ... 3.53s

Display Technology ... 6.63s

Fermentation Technology* ... 20.48s

Beginning Monday, August 11
Planning and Control of Ship Production Processes ... 13.39s

Management Information Systems ... 15.57s

Engineering Aspects of Aerospace and Undersea Medicine ... 16.44s

Beginning Monday, August 18
Prediction and Measurement of Stresses and Deformations in Soils* ... 1.35s

Physical Measurement and Analysis ... 2.15s

Industrialized Building ... 4.13s

Information Technology ... 6.55s

Welding Fabrication in Shipbuilding and Ocean Engineering* ... 13.67s

Communicating Technical Information* ... 21.10s

Beginning Tuesday, September 2
Planning and Control of Operations ... 15.72s

Operations Research for Public Systems* ... 18.10s

Beginning Monday, September 8
The Management of Human Resources* ... 15.37s

Programs marked with an asterisk (*) are of one week's duration. All others will extend through two weeks.

General Information

Admission: In order to maintain highest standards, the enrollment in each Special Summer Program is limited according to the facilities and staff which are available. If a Program is not over-subscribed, applications for it will be considered up to one week before it begins. However, early application is strongly advised. Application forms are available from the Director of the Summer Session, M.I.T.

The Institute reserves the right to select those applicants whose qualifications and experience suggest that they will receive the most benefit from the Program for which they are applying. Neither admission nor dormitory reservations are transferable except by specific Summer Session Office authorization, and then only when evidence of the qualifications of the proposed substitute has been filed in advance.

A limited number of Special Summer Program Scholarships are available to defray in part the Program tuition of members of teaching staffs (rank of instructor or higher) of other educational institutions. Request for such scholarships should accompany applications for admission.

Payments: Applicants whose admission has been approved will be notified as early as possible and will receive Bursar's remittance and registration cards. Both cards, together with full payment for tuition and housing in check, draft, or money order made payable to the Bursar, M.I.T., should be returned immediately to the Office of the Summer Session, Room E19-356, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139; they must be received one week before the opening of the Program. The amounts of tuition and room rent will be stated in the notification of admission; both may be included in one remittance, and both must be paid in full before the opening session of a Program. No bills are sent.

Those whose tuition is to be covered by contract with a government agency or with industry should apply for admission to the Summer Session Office in the usual way, as promptly as possible, noting on their applications that a contract or agency approval is being requested. At the same time they should arrange to have the *agency* send a purchase order or other evidence of its intention to authorize tuition payments to the Summer Session Office. This purchase order should reach the Summer Session Office at least one week before the Program begins. It should include the full name of the prospective registrant(s), as well as the name of the Program. If it is not sent, and if the Program is

a limited one for which others have applied, the Institute reserves the right to cancel admission.

Since housing charges (if any) are not covered by government contracts, these payments must be received independently from prospective registrants at least one week before the beginning of a Program.

Please note that a contract from industry or a government agency does not reserve a place in a Special Summer Program; it must be preceded or accompanied by a completed application for admission.

Refunds: Registrants who notify the Summer Session Office of cancellation of their plans before they arrive in Cambridge will be refunded their payments. However, no refunds of either tuition or rent will be made to those who leave before completing a Program in which they have been registered, and refunds of room rentals cannot be made for Saturdays, Sundays, or holidays during a Program.

Registration: Each person admitted to a Program should report to the main lobby of the Institute at 77 Massachusetts Avenue, Cambridge, at 8:30 a.m. on the day that his Program begins. At this time he completes formal registration, receives a receipt for payments, and is given cards of admission to the Program. Detailed information about special M.I.T. facilities and services will also be available.

Mail and Messages: Registrants for Special Summer Programs may have mail and messages addressed to them at the Summer Session Office. Please have the name of the Program included in the address.

Dormitory Accommodations: The M.I.T. dormitories will be available to all registrants in Special Summer Programs. Rooms for single men, as well as accommodations for married couples and single women, will be reserved if specifically requested in the application for admission. Applicants who wish other accommodations should correspond with Boston or Cambridge hotels.

The rate in an M.I.T. dormitory for single men and women is $7.00 and for married couples $10.00 for each 24-hour unit, beginning at 6 p.m. Children between the ages of 6 and 14 may be accommodated at the rate of $3.00 per night. There is no reduction in rate if these children occupy the same room as their parents. Children 15 years or over are charged at the rate of $7.00 per night. In general,

reservations will be available from 2 p.m. of the Sunday preceding the opening of a Program until 6 p.m. of the Saturday following its conclusion. Dormitory accommodations will not be available until noon on Tuesday, June 17, for Programs commencing that week. Dormitory reservations will be confirmed in the letter of notification of admission; this letter should be presented at the dormitory upon arrival. Please include payments for dormitory accommodations with tuition payments; both are due at least one week in advance. *Registrants in Special Summer Programs should make no rent payments at any dormitory office.*

N.B. Bed linen and towels are supplied. Dormitories do not have air-conditioning or private baths. Rooms for men and women may be on the same floor.

Each dormitory is open 24 hours every day. Children under six years of age may not be housed in any dormitory during the Summer Session, nor are pets allowed. No dormitory employee is authorized to modify these regulations.

College dining facilities on the campus will be available to Special Summer Program registrants and their guests. Registrants will enjoy guest privileges at the air-conditioned M.I.T. Faculty Club. In addition, there are restaurants within walking distance of the Institute, and many famous eating places and hotels are situated just across the Charles River in metropolitan Boston.

Recreational Facilities: Summer guests are welcome to use the Institute's libraries and recreational facilities, including tennis courts, softball fields, squash courts, swimming pool, and fleet of small sailboats.

Within easy access of the Institute campus are some of the world's finest museums, libraries, and art galleries. The famous Hatch Memorial Shell, outdoor summer concert hall for the Boston Pops Orchestra, is just across the Charles River Basin. Major League baseball games are scheduled throughout the summer at Fenway Park, only a short ride from the campus. Several summer theaters and the historical areas of Salem, Concord, Lexington, and Plymouth are within easy driving distance, and Cape Cod, the White Mountains of New Hampshire, the Green Mountains of Vermont, and many parts of the Maine seacoast may be visited on weekends.

ACM

**Association for
Computing Machinery
Presents**

computer
graphics I

A Professional
Development Seminar

Thursday, February 13, 1969   Los Angeles, Cal.
Friday, February 14, 1969   San Francisco, Cal.

Computer Graphics I

. . . will be the topic of discussion in these full day survey tutorials which provide a general introduction to interactive graphical data processing. This is a *basic* seminar for those who have no knowledge or experience with computer graphics. Some knowledge of the functions of translators and operating systems is assumed.

It is materially the same seminar as the half-day sessions on Computer Graphics given during the fall of 1967 (Palo Alto, October 27).

INSTRUCTORS

Andries van Dam, Associate Professor of Applied Mathematics, Brown University, is engaged in research on graphics and pictorial information retrieval. He received his Ph.D. in Computer and Information Sciences from the University of Pennsylvania and is the author of "Computer Driven Displays and their Use in Man/Machine Interaction" in *Advances in Computers,* vol. 7, 1966, Academic Press.

Samuel M. Matsa, Manager of IBM's New York Scientific Center, is responsible for applied research and development of advanced computer techniques and applications in graphics, management science and urban systems. He received his M.S. Degree in Electrical Engineering from M.I.T. where he started his career in informatics by doing pioneering work in numerical control languages. He is Chairman of the ACM Special Interest Committee on Graphics.

Seminars will be held from 9 a.m. - 5 p.m. at the following locations:

Thursday, February 13	Airport Marina Hotel Los Angeles, California
Friday, February 14	Mark Hopkins Hotel San Francisco, California

COURSE OUTLINE

8:30 REGISTRATION AND COFFEE

9:00 I. INTRODUCTION-CONCEPTS AND TERMINOLOGY

Background and motivation for graphical data processing

9:45 II. DISPLAY HARDWARE

A. Role of CPU, channel, buffer (or shared memory) and CRT logic
B. CRT physics and parameters such as resolution, write, and refresh rate
C. Extended capabilities such as character generation, conics, subroutining, and matrix transformations

10:45 COFFEE BREAK

11:00 III. DISPLAY SOFTWARE

A. Three coding levels
B. Assembly vs. compiler programming
C. Image generation
D. Attention handling

12:15 LUNCH

1:45 IV. DATA STRUCTURES

A. Geometry, topology, and subpicture structure of drawings
B. Graphical list processing and alternatives: tables, trees, lists, plexes, rings, associative memories
C. Subpicture identification and selective erasure and transformation
D. Mathematics of constraint satisfaction, three-dimensional transformations and projections and the hidden line problem

3:00 COFFEE BREAK

3:15 V. APPLICATIONS

A. Application oriented languages
B. On-line textile design
C. True (stereoscopic) three dimensional displays

4:30 VI. PANEL DISCUSSION

ACM was founded in 1947 as the professional society of the computing community. Its membership of more than 25,000 is dedicated to the advancement of the science and art of information processing. Through its educational activities and publications, ACM promotes the free exchange of information among computer specialists and the public alike.

This program is sponsored by the ACM Professional Development Committee, Richard G. Canning, Chairman. For additional information on this and other seminar programs, contact:

James M. Adams, Jr., Director of Education,
Association for Computing Machinery
211 East 43 Street, New York, N.Y. 10017

ASSOCIATION FOR COMPUTING MACHINERY

211 East 43 Street, New York, N.Y. 10017

Please enroll me in the seminar on COMPUTER GRAPHICS I. I fully understand that this seminar is a *basic* introduction to Computer Graphics designed for people with no previous experience in this field. The seminar is materially the same as the half-day Computer Graphics seminar held in Palo Alto on October 27, 1967.

SIGNATURE:

POSITION

COMPANY

COMPANY ADDRESS

CITY   STATE   ZIP

OFFICE PHONE   HOME PHONE

SEMINAR LOCATIONS
(*Check one*)

☐ Los Angeles, February 13

☐ San Francisco, February 14

SEMINAR FEE
(*Must Accompany Form*)

☐ $40 ACM Members
Member No. . . . .

☐ $55 Non-ACM members who are employees of ACM Corporate Members

☐ $70 Other non-ACM members

☐ $15 ACM Student members
Member No. . . . .

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