SOFTWARE SUMMARY AND BIBLIOGRAPHY

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CHAPTER 1

SUMMARY OF SOFTWARE

INTRODUCTION TO DATA GENERAL COMPUTER SYSTEMS

Data General provides a wide spectrum of computer systems to meet a variety of control, computation, and processing needs. Data General designs systems in a modular fashion, with a logical series of hardware and software building blocks. Thus, to solve a user application need, Data General provides a wide range of modules in the following categories:

- · operating systems
- · high-level languages
- · applications and program development support software

System modularity solves each application with the proper selection of computer hardware and software. Data General's hardware and software products are also designed compatibly; smaller modules are compatible subsets of larger modules. Modularity and compatibility together provide an easy means for systems to grow as required with all of the original effort and modules retaining their usefulness. Alternatively, programs developed on larger systems can be run on smaller systems to further increase system efficiency.

Data General computer systems also provide the opportunity to distribute computer power, in a modular unified fashion, to different physical sites or logically separate tasks. Unlike large centralized computer systems, distributed systems are responsive, economical and uncomplicated. System components are built and run as a team, with computers intercommunicating through compatible hardware and languages to ensure success in each user application. This document examines each of the components required in building a computer system. Following this discussion, a complete bibliography of software publications is given to point out where further information can be found.

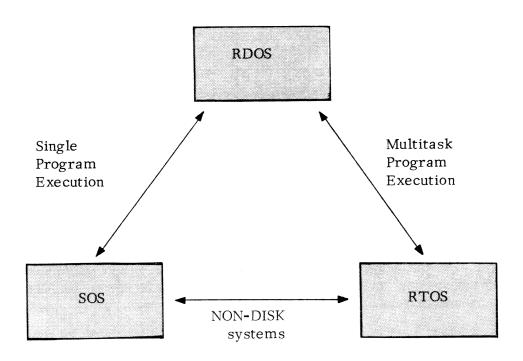
OPERATING SYSTEMS

Early minicomputer installations required programmers to write each program in a rigid environment. Programs could not be moved within computer memory, each

OPERATING SYSTEMS (Continued)

program had to provide its own software drivers to control its peripheral equipment, and computer resources could not be utilized with efficiency. Such programs, aptly named "stand-alone" programs, are today largely of historical interest only.

In addition to providing a stand-alone programming capability, Data General provides one or more operating systems with each computer system. There are three such operating systems; each is compatibly related to the others and addresses a specific need: The Stand-alone Operating System (SOS), Real Time Operating System (RTOS), and Real Time Disk Operating System (RDOS). These three systems address the full range of minicomputer applications.



Operating System Compatibility

SOS is a compact, easy-to-use operating system. It provides a monitor which supports a full line of program development utilities such as assemblers, FORTRAN and ALGOL compilers, and BASIC. (High level languages such as these will be described later in this chapter.) SOS permits program development to be accomplished using paper tape, cassette, or magnetic tape equipment.

RTOS is a fast, compact, core-resident, general-purpose, multitask operating system capable of controlling a wide variety of real time environments. RTOS provides standard interrupt servicing, device handling, and executive scheduling

OPERATING SYSTEMS (Continued)

functions. This lets users concentrate on applications programming rather than on the intricacies of hardware and executive design. RTOS also supports multitasking applications. These are applications where logically distinct functions are performed concurrently. RTOS schedules and dispatches system resources to each task according to its priority and readiness to act. This ensures that competitive tasks each get serviced, yet only the highest priority task that is ready performs its function at any moment. This resource scheduling provides great flexibility in handling real time events, events which occur without warning and require an immediate response.

Although RTOS can be used to provide rudimentary disk file support, elaborate disk file structures and a wider range of real time facilities are available only under RDOS. RDOS provides maximum system efficiency by offering a complete set of support features. The following summarizes these features:

Core and Disk Residency of the Operating System

This feature permits RDOS to provide large-system features without requiring large amounts of resident memory. The active, resident operating system retrieves system modules from disk as they are required.

Elaborate Overlay and Program Swap Facility

User programs exceeding the size of resident memory can be segmented into operational sequences which are stored on disk and reside in main memory only when needed.

Flexible File Structuring

RDOS provides a variety of disk file structures to provide prompt access and easy retrieval of data and programs stored on disk.

Complete Support for Program Development Aids

RDOS provides the ultimate in programming convenience by permitting users to communicate with the system through the system console. Alternatively, collections of user jobs can be run in a batch mode of operation, either locally or from a remote terminal.

Each operating system can be easily tailored by the user to provide that device support and these features which are required in his system. Programs can be developed under either RDOS or SOS for running under either of the three operating system. Operating system features found in SOS and RTOS are all found in RDOS.

OPERATING SYSTEMS (Continued)

Due to this compatibility between the operating systems, it is not uncommon to find a distributed computer system with some computers running under RTOS, while others perform more complex tasks or over-all supervisory management under RDOS.

HIGH LEVEL LANGUAGES

Developing programs to run on early computer systems was a formidable chore. Programmers had to write computer programs in a complex form called machine language. Machine language was, in essence, a collection of one's and zero's-each significant in some way-- which was very much removed from ordinary human language.

The first improvement over machine language is called assembler language, and Data General has expanded this form to make it an effective program development tool. Assembler language assigns meaningful mnemonic aids to machine instructions, permitting programs to be written which correspond somewhat to human language yet still provide complete, intricate manipulation of system hardware. Many higher level languages use assembler language as an intermediary step in their translation process.

Data General provides a collection of high level languages which resemble more closely the patterns of human communication. These languages solve a variety of scientific, educational, industrial, and commercial needs. These languages run variously under the SOS, RTOS, and RDOS operating systems.

The following high level languages are provided by Data General Corporation: ${\tt BASIC},\ {\tt FORTRAN},\ {\tt and}\ {\tt ALGOL}.$

Data General's <u>BASIC</u> is an easy-to-learn, scientific language which was originally developed at Dartmouth College for use by students. Data General's implementations of this language include a stand-alone version which can be run on a small system by one user, and larger time-sharing versions.

FORTRAN, an acronym for Formula translation, is a specialized language designed for use in programming applications which are mathmatical, scientific or engineering-oriented. Data General provides several versions of this language for use with each of the operating systems. Data General's FORTRAN provides reentrant object code. This facilitates the provision of real time features so that FORTRAN can be used as an industrial and process-control development tool. Data General's FORTRAN 5 is an advanced version of FORTRAN which produces programs competing in efficiency of execution with programs written originally in assembler

HIGH LEVEL LANGUAGES (Continued)

language. A special commercial subroutine package, CSP, is supplied to users familiar with FORTRAN who wish to address commercial applications. Similarly, a scientific subroutine package is also provided to aid FORTRAN users in developing scientific application programs. A special library of process-control functions, RTIOS, is provided for users addressing the problems found in industrial and process control applications.

ALGOL is another scientifically-oriented language with powerful high-level features, some not found in FORTRAN. ALGOL permits the easy manipulation of string data, and allows recursive and reentrant procedures to be written. Because of its versatility, ALGOL is often used as a language for writing other program development tools.

Finally, for numerical control applications Data General provides DATAPREPTM*. This numerical control system is a stand-alone program allowing a user to prepare parts programs for controlling two or three-axis point-to-point machine tools.

PROGRAM DEVELOPMENT SUPPORT

Required to round out any collection of system programs is a series of support programs such as loaders, debuggers and editors. Data General provides a complete selection of these programs for running either in the stand-alone mode or under one of the three operating systems.

A series of editor programs are given for the creation and modification of user source programs and libraries. Symbolic text editors permit either one or a number of program development personnel to participate in program creation concurrently. After creating application source programs, symbolic debuggers are provided to correct whatever deficiencies may be discovered during the assembly or loading of the program modules.

Finally, relocatable loaders are provided to form working programs from one or more program modules and program libraries. After forming these programs, a complete array of loaders called bootstrap programs are provided to start up the programs in specific hardware environments. The following table illustrates the relationships between system environments and each system program provided by Data General Corporation. This table shows the system environments in which various language processors, language libraries, applications programs, and data communications packages can be run. Language processors are editors, compilers, assemblers, and interpreters which are used in developing application programs. In this category, only BASIC--because it is an interpreter--executes the application program directly. In all other cases, the actual execution of the application program

^{*}DATAPREP is a trademark of Data General Corporation, Southboro, Massachusetts.

SYSTEM ENVIRONMENTS

SYSTEM SOFTWARE

	Stand-Alone	SOS	RTOS	RDOS
Language Processers			-	
ALGOL compiler Assembler BASIC DATAPREP text editor FORTRAN IV compiler FORTRAN 5 compiler library file editor macro assembler multi-terminal text editor octal (disk file) editor	X X X X X	X*XXXXXXX	X	X X X X X X X X X
Language Applications and Libraries ALGOL run-time Cache Memory Management (CMM) Commercial Subroutine Package (CSP) DATAPLOT FORTRAN IV run-time FORTRAN 5 run-time Real Time I/O Suppert (RTIOS) Scientific Subroutine Package (SSP) Sort/Merge	X	X X X X	X X X X	X X X X X X X
Stand-Alone Aids binary loader paper tape bootstrap loader cassette bootstrap loader (CBOOT) core-image loader/writer debuggers disk bootstrap loader (HIPBOOT) magnetic tape bootstrap loader (TBOOT) MCA bootstrap loader (MCABOOT)	X X X X X X	X X X X X	X X X X X X	X X X
Data Communications Asynchronous Single Line (4023/4029) Asynchronous Multiline (4100) Communications Multiplexer (4060/4073) Synchronous Line Adapter (4073/4074) Synchronous Com. Controller (4015) Remote Sync. Terminal Control Program IBM 360/370 Interfact (4025)			X X X X X X	X X X X X X

System Support Summary

^{*&}quot;X" means that the program is used in this environment.

PROGRAM DEVELOPMENT SUPPORT (Continued)

does not occur until the language library is searched to form a working program. Thus the table indicates that programs written in certain high level languages can be processed in some system environments and executed in others.

In summary, Data General provides a complete set of software systems to facilitate the application of computer power to real-world applications. Supporting each of these computer systems is a professional sales and service organization, a diverse customer-training department, a staff of specialized application engineers, and full documentation describing each of the system modules. The following section describes each of the software-support documents provided by Data General to assist in the full, efficient use of a computer system.

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CHAPTER 2

SOFTWARE DOCUMENTATION BIBLIOGRAPHY

BIBLIOGRAPHY CONVENTIONS

This chapter lists and describes each of the software manuals which are available for use with Data General computer systems. Manual descriptions are grouped into the following categories:

- 1) Initial Documentation Set
- 2) Operating Systems
- 3) Data Communications
- 4) Languages
- 5) Program Development and Support

Documents listed in the "Initial Documentation Set" include all these manuals which every user receives, regardless of system configuration. Contents of the remaining categories are self-descriptive. Certain manuals are described in more than are category to facilitate your searches for their titles. For example, "Single User Basic" is listed under category 1 since all users receive this manual. However, this manual is also listed in category 4 since the topic described is a language.

NUMBERING SCHEME

The following conventions are followed when part numbers are assigned for manuals produced by Data General Corporation. Each part number consists of three fields: An initial 3-digit field for a general category of manuals, a middle 6-digit field for each specific title, and a trailing 2-digit field describing the revision level of the manual. Thus in the following complete part number;

093-000075-05,

the initial field indicates a 093 general category, the specific part number is 75 (The Real Time Disk Operating System Reference Manual), and the manual indicated is at revision 5. Data General currently defines five general categories of manuals. These categories and their purposes are as follows:

NUMBERING SCHEME (Continued)

- Hardware technical reference. Manuals in this category contain initial, condensed hardware information. Manuals in this category are often--but not always--replaced by more expansive manuals in the "015" category. No manuals in the "014" series are described in this bibliography since their topics do not include software documentation.
- Hardware technical manual. Manuals in this category describe at length the hardware aspects of Data General computer systems. Included in this category are manuals describing the machine language instructions set of NOVA® * and ECLIPSETM * computers, and a manual used in peripherals programming.
- O17 Software application note. This class of software document describes one of two kinds of topics:
 - 1) data communications programming, and
 - 2) specialized software topics.
- O93 Software reference or user manual. This is the largest category of software documentation.

Bibliography entries in the remainder of this manual do not list the current revision level of any document. Consult either your document package list or the subscription service for the current revision loads of manuals.

^{*}NOVA is a registered trademark, and ECLIPSE is a trademark, of Data General Corporation, Southboro, MA.

INITIAL DOCUMENTATION SET

015-000023, NOVA Line, Computer Programmer's Reference Manual. This document explains the machine language programming and operation of Data General's NOVA line of computers. This reference defines in detail how the central processor functions, exactly what its machine language instructions do, how they handle data, and what their control and status information means. This manual or 015-000024 should be consulted before any other software documentation is studied.

015-000024, ECLIPSE Computer, Programmer's Reference Manual. This document describes the machine language programming and operation of Data General's ECLIPSE computer series.

015-000021, Peripherals, Programmer's Reference Manual. This document describes the machine language programming and operation of peripheral equipment used in Data General computer systems.

093-000001, Binary Format Punch. This manual describes a utility routine to be used without the support of an operating system. The utility punches operator-specified ranges of computer memory in binary format acceptable as input to the binary loader. The routine uses either the high-speed paper tape punch or the Teletype $^{\circledR}*$ ASR punch.

093-00002, <u>Bootstrap Loader</u>. This manual describes a utility routine to be used without the support of an operating system. The bootstrap loader is a short routine used to load the binary loader into computer memory. The binary loader, in turn, is used to load other stand-alone programs into computer memory.

093-000003, <u>Binary Loader</u>. This manual describes a utility routine, the binary loader, which is used to load absolute binary programs produced as output of the stand-alone assembler. The stand-alone assembler is not used in conjunction with an operating system.

093-000004, <u>Core Compare</u>. The core compare utility is a stand-alone program which compares an absolute binary format tape read in on either the high speed or Teletype paper tape readers, and compares this tape with the contents of the computer's resident memory.

093-000005, <u>Tape Duplicator</u>. This manual describes a stand-alone utility program which can be used to prepare or duplicate binary images on paper tape.

^{*}Teletype is a registered trademark of Teletype Corporation, Skokie, Illinois.

INITIAL DOCUMENTATION SET (Continued)

093-000017, Absolute Assembler. This manual describes the use of the absolute assembler, a stand-alone utility which translates symbolic NOVA assembly instructions into machine language. The absolute binary output of this assembler is loaded by means of the binary loader.

093-000018, NOVA Text Editor. The text editor is a utility program which is used to create or edit ASCII source files on either the line or character level. This manual describes the use and operation of this editor in the stand-alone mode, its use under the SOS and RDOS operating systems. Use under RDOS includes a multi-user foreground/background mode.

093-000019, Floating Point Interpreter User's Manual. This manual describes the use of the floating point interpreter, a software package which can be used to perform floating point calculations for programs run in a stand-alone environment which lacks floating point hardware. An extended relocatable floating point interpreter is also described in this manual. This extended interpreter can be used by programs running under SOS.

093-000020, <u>Debug II User's Manual</u>. This document describes the use and operation of a utility used to debug stand-alone programs numerically.

093-000037, Floating Point to Octal. This document describes a routine which can be used to perform floating point-to-octal calculations. This routine is used in conjunction with the stand-alone floating point package.

093-000038, Debug I User's Manual. This manual describes the use and operation of Debug I, a numeric debugger used to correct errors in stand-alone programs. This routine is particularly useful in computers having limited memory capacity.

093-000042, <u>Single User Basic</u>. Data General's Single User BASIC is an implementation of the BASIC language as developed at Dartmouth College. Keyboard mode of operation has been implemented as an extension to the language. This manual describes the use and operation of Data General's BASIC language. Included in this manual is a discussion of keyboard mode operation (permitting the use of the computer as a scientific calculator) and a discussion of keyboard mode for the dynamic debugging of BASIC programs. This program runs by itself, i.e., without the support of an operating system.

INITIAL DOCUMENTATION SET (Continued)

093-000067, Introduction to Programming the NOVA Computers. This manual is a condensation of course notes presented in the elementary and intermediate programming courses sponsored by Data General's customer training department. The manual gives a general presentation of programming concepts, including the following: writing, editing, assembling, loading, and executing a computer program.

093-000086, Absolute Math Routines. This manual describes the function and calling sequences of a series of mathematical and code-conversion functions. These routines are provided in source form and must be edited into stand-alone program sources before they can be used.

093-000090, Fundamentals of Mini-computer Programming. This manual provides an introduction to the fundamentals of programming a Data General computer. This manual is designed to be a supplement to training texts provided in Data General classroom instruction.

093-000106, Summary of Available Software. This manual provides a means for Licensees under a Program License Agreement to order licensed software. Software order forms are included in this manual.

Systems incorporating a computer with the program load hardware option will also receive the following document:

093-000055, Selfloading Bootstrap and Binary Loader. This manual describes a utility used with the hardware automatic program load option available on the SUPERNOVA $^{\oplus}$ * or NOVA family computers. This utility causes the binary loader to be placed in the highest locations of resident memory.

^{*}SUPERNOVA is a registered trademark of Data General Corporation, Southboro, Massachusetts.

OPERATING SYSTEMS

Stand-Alone Operating System (SOS)

093-000062, Stand-Alone Operating System User's Manual. The stand-alone operating system (SOS) is a single-task operating system used for program development in a non-disk environment. This manual describes the use and operation of SOS.

Real Time Operating System (RTOS)

Operating System (RTOS) is a small, core-resident, general-purpose multitask monitor designed to control a wide variety of real time environments. RTOS is a compatible subset of RDOS, Data General's Real Time Disk Operating System. This manual uses modular instruction techniques to describe key concepts in RTOS. Users of RTOS should be familiar with the contents of this manual before consulting other RTOS documentation.

093-000056, Real Time Operating System Reference Manual. This manual is the primary document to be consulted by users of RTOS, the core-only compatible subset of the Real Time Disk Operating System. Program development can be performed on either a SOS or RDOS system for efficient running under RTOS.

017-000006, <u>User Device Driver Implementation in RTOS</u>. This application note describes in depth the techniques required to add a device driver to RTOS on either a user level or on a system level.

017-000003, <u>Buffered I/O Package in RDOS/RTOS</u>. This is an application note describing BFPKG, a module in the system library, which provides asynchronous data buffering in main memory for user programs. BFPKG can be used by both RTOS and RDOS.

Real Time Disk Operating System (RDOS)

093-000083, Introduction to the Real Time Disk Operating System. This manual uses modular instruction techniques to describe key concepts in the Real Time Disk Operating System (RDOS). Users of RDOS should be familiar with the contents of this manual, including its glossary of terms, before consulting other RDOS documentation.

093-000075, Real Time Disk Operating System Reference Manual. Data General's Real Time Disk Operating System (RDOS) is a dual-programming real time operating system which can be used to control real time processes at the same time that it is being used for further program development. RDOS is modular in structure, and it is partially core-resident and partly disk-resident. It provides a multi-node overlay facility, allowing up to 128 overlay areas per user program. RDOS provides disk buffering (spooling) of I/O, and also provides both buffered and non-buffered I/O.

Real Time Disk Operating System (RDOS) (Continued)

093-000075, Real Time Disk Operating System Reference Manual. (Continued) This manual is the primary reference to be consulted when using RDOS facilities in user programs. Before consulting this reference, however, users should be acquainted with RDOS concepts as presented in the Introduction to RDOS, 093-000083.

093-000087, <u>BATCH User's Manual</u>. BATCH is a command interpreter and job supervisor which calls in and controls the execution of collections of user jobs such as assemblies, compilations, and relocatable loads. BATCH is a subsystem which exists as one of the many system programs supported by RDOS. This manual describes the use and operation of BATCH, and illustrates this operation with a sample BATCH job.

093-000105, <u>RDOS User's Handbook</u>. This pocket-sized handbook summarizes information required for the operation of the CLI under RDOS, and also gives summary information required for the use of such RDOS utilities as the assemblers, debugger, text editor, FORTRAN IV and BASIC.

093-000109, RDOS Command Line Interpreter (CLI) Reference Manual. This manual describes the use and operation of each command which can be issued to the RDOS Command Line Interpreter. The CLI is a system program which acts as the primary interface between the operating system and programs which are to be executed under the system. Also provided by the CLI are a number of file maintenance commands which are executed directly by the CLI. The CLI is accessed by the user via one of two system consoles, \$TTI or \$TTII.

017-000002, <u>User Device Driver Implementation in RDOS</u>. This is an application note which describes in depth the techniques which are required to add a device driver to RDOS, whether on a user level or on a system level.

017-000003, <u>Buffered I/O Package in RDOS/RTOS</u>. This is an application note describing BFPKG, a program module which provides asynchronous data buffering in main memory for user programs. BFPKG can be used by both RTOS and RDOS.

DATA COMMUNICATIONS

Asynchronous Lines

017-000015, Asynchronous Single Line Controller Software Package. This document describes a general purpose software subroutine package which can be used with either RTOS or RDOS to control the operation of the Type 4023/4029 Asynchronous Single Line Controller (ASC). The ASC permits a Data General computer to communicate with and control a model 37 Teletype, Bell 103 data set, or equivalent (if the 4023 option is used). Use of the 4029 option permits the use of Bell data sets 202C or 202D (or equivalent) for communications over telephone lines.

017-000014, Communications Multiplexer Software Package. This application manual describes a general purpose subroutine package which can be used to control the Type 4060/4073 Communications Multiplexer (CMS). The CMS package provides reentrant multitasking software that can be tailored to the characteristics of each line. Moreover, line and terminal procedures are implemented with ease, and optional modem control capabilities are available. The CMS package can be run under either RTOS or RDOS.

017-000005, Multiline Asynchronous Controller Software Package. This applications note describes a general purpose subroutine package which is used to control the operation of a multiline asynchronous multiplexer. This multiplexer may be used with one or more Data General computers to control up to 1024 lines. The subroutine package may be run under RTOS or RDOS.

Synchronous Lines

017-000001, Synchronous Communications Package. This is an application note which describes in depth a general-purpose software package which can be used to control the Synchronous Line Adapter (SLA). The Type 4073/4074 SLA is a communications controller for full or half-duplex synchronous data sets, Bell 201 or equivalent. The basic features of the SLA package include reentrant software suitable for a multitasking environment. Single or multiple lines, full or half-duplex operation, with ASCII or EBCDIC codes is available. The SLA is fully compatible with IBM Binary Synchronous protocol and message format. The SLA runs under either RTOS or RDOS, and is supplied with FORTRAN IV and FORTRAN 5 support packages.

017-000013, Synchronous Communications Controller Software Package. This document describes a general purpose subroutine package which can be used to control the Type 4015 Synchronous Communications Controller (SCC). This package is implemented as a procedure-independent runtime device driver to run under either RTOS or RDOS. The 4015 device enables any Data General computer to communicate with either a remote station or another computer. It provides a bi-directional full or half duplex interface at speeds up to 50K baud.

Inter-Computer Links

017-000008, IBM 360/370 Interface Software Package. This document describes a general purpose software subroutine package which can be used with either RTOS or RDOS to control the operation of the Type 4025 IBM 360/370 interface and a Data General computer. The Type 4025 interface combines a general purpose hardware control unit and a software driver package. General descriptions of IBM 360/370 channel control procedures and timing are presumed to be known by the user before consulting this reference.

017-000004, Remote Synchronous Terminal Control Program. This application note describes how the Remote Synchronous Terminal Control Program, RSTCP, allows a Data General computer with peripherals to be operated as a remote intelligent data terminal. RSTCP operates in IBM's Binary Synchronous Communications code, and can communicate on a point-to-point basis with either an IBM System 360/370 computer or with another RSTCP-equipped Data General computer system. An unattended operation feature allows RSTCP to obtain operation directives from a disk command file or from a remote computer acting as a master station.

LANGUAGES

Assembler

093-000040, Extended Assembler. This manual describes the use and operation of the extended assembler. This major utility permits the user to write source programs using familiar mnemonics which it will then translate into binary files acceptable to the computer. In addition to providing basic assembly functions, the extended assembler includes facilities for producing relocatable programs, for interprogram communication, and for conditional assembly. The extended assembler is produced in several forms, making it available for stand-alone use as well as use under the SOS and RDOS operating systems.

093-000081, Macro Assembler User's Manual. The macro assembler is an assembler which provides all the required features of the Data General extended assembler as a compatible subset of its own features. New features provided by the macro assembler include the following: a powerful macro facility which allows complete recursion as well as nested macro calls; expression evaluation that has been expanded to provide explicit as well as implicit precedence (operators include relational operators); an assembly repeat feature for producing many lines of source from a simple repeat construct; an assembly suppression feature that permits suppressing assembly until a given label is encountered; the capability of generating a three-digit number to replace a symbol anywhere in the assembly source program; optimal resolution in page zero of literal references. This manual describes the use and operation of the macro assembler under RDOS.

093-000054, NOVA Assembler for the IBM 360/370, CDC 6600, Univac 1100. This manual describes a series of assemblers, written in FORTRAN IV, whose purpose is to accept symbolic NOVA assembly source instructions and convert them into NOVA object code. Source input instructions are input to the IBM 360/370, CDC 6600, or UNIVAC 1100 computer systems using punched cards. Program output can be either absolute or relocatable binary object code for the binary or relocatable loaders.

093-000041, Relocatable Math Library File. This manual describes the use and contents of the relocatable math library file, a library of routines useful to the assembly language programmer writing for either stand-alone, SOS, RTOS, or RDOS environments. Routines provided in this library include code conversion, Boolean operations, integer arithmetic and trigonometric functions, and other miscellaneous functions.

BASIC

093-000064, Time-sharing Basic User's Manual. This manual describes Data General's time-sharing BASIC, a complete implementation of BASIC as developed at Dartmouth College, with all advanced BASIC features including full matrix

BASIC (Continued)

093-000064, Time-sharing Basic User's Manual. (Continued)

manipulation capabilities. Of particular interest is the implementation of string variables and string expressions that permit subsetting, concatenation, comparision, assignment and printing of strings. Time-sharing BASIC is loaded by means of the binary loader, and runs without the explicit support of an operating system.

093-000065, Extended BASIC User's Manual. This manual describes Data Generals's BASIC, a full implementation of the BASIC language as developed at Dartmouth College with additional language facilities such as string manipulation features, added user control of output formatting, assembly language-callable subroutines, matrix operations, and completely automatic system generation procedures. Additionally, Extended BASIC has a series of desk calculator commands and permits dynamic testing and debugging of BASIC programs at the console keyboard. Extended BASIC operates under both SOS and RDOS, and can run with or without the hardware floating point option. Extended BASIC systems will permit as many separate programs to run simultaneously as will fit within the constraint of the system's resident memory; programs waiting to be run are swapped to disk.

093-000097, Huntington Computer Project Teacher's Manual, Biology. This manual describes the use and operation of a series of BASIC programs illustrating biology computer models. The programs are described, and objectives of each program experiment are given. The manual is written as a teacher's quide, and it suggests preliminary preparations, operational guidelines, and follow-up after' each program has been run.

093-000098, <u>Huntington Computer Project Teacher's Manual</u>, Chemistry. This manual describes the use and operation of a series of BASIC programs illustrating chemistry computer models. The programs are described, and objectives of each program experiment are given. The manual is written as a teacher's guide, and it suggests preliminary preparations, operational guidelines, and follow-up after each program has been run.

093-000099, Huntington Computer Project Teacher's Manual, Earth Science. This manual describes the use and operation of a series of BASIC programs illustrating earth science computer models. The programs are described, and objectives of each program experiment are given. The manual is written as a teacher's guide, and it suggests preliminary preparations, operational guidelines, and follow-up after each program has been run.

BASIC (Continued)

093-000100, <u>Huntington Computer Project Teacher's Manual</u>, <u>Mathematics</u>. This manual describes the use and operation of a series of BASIC programs illustrating mathematical computer models and experiments. The programs are described, and objectives of each program experiment are given. The manual is written as a teacher's guide, and it suggests preliminary preparations, operational guidelines, and follow-up after each program has been run.

093-000101, Huntington Computer Project Teacher's Manual, Physics. This manual describes the use and operation of a series of BASIC programs illustrating physics computer models. The programs are described, and objectives of each program experiment are given. The manual written as a teacher's guide, and it suggests preliminary preparations, operational guidelines, and follow-up after each program has been run.

093-000102, <u>Huntington Computer Project Teacher's Manual</u>, <u>Social Studies</u>. This manual describes the use and operation of a series of BASIC programs illustrating social science computer models. The programs are described, and objectives of each program experiment are given. The manual is written as a teacher's guide, and it suggests preliminary preparations, operational guidelines, and follow-up after each program has been run.

093-000103, Huntington Computer Project Teacher's Manual, Teacher's Assistance. This manual describes the use and operation of a series of BASIC programs in the Huntington series. Unlike other programs in the series, these programs are designed for use by the teacher as an aid in calculating and sorting grades, and for performing statistical analyses of these grades.

ALGOL

093-000052, Extended ALGOL User's Manual. This manual describes Data General's extended ALGOL, a superset of ALGOL 60, with extensions. These extensions provide simplified, free-form I/O or formatted output, bit manipulation, easy manipulation of character string data, recursive and reentrant procedures, dynamic storage allocation, n-dimensional arrays, multi-precision arithmetic, dynamic type conversion for full mixed-mode capability, and explicit diagnostics. Also included in this manual is a description of all the ALGOL runtime routines. ALGOL can be run under either SOS, RTOS, or RDOS.

017-000016, ALGOL Cache Memory Management. Cache Memory Management (CMM), described in this manual, is a collection of functions and procedures available to programmers writing in Extended ALGOL. CMM provides a means to buffer large files into 256-word blocks and to determine which blocks reside in core,

ALGOL (Continued)

017-000016, ALGOL Cache Memory Management. (Continued)

keeping those blocks in core which are most recently used. CMM will handle with efficiency most scientific and business programming applications, especially those dealing with very large programs and large data bases.

FORTRAN

093-000053, FORTRAN IV User's Manual. This manual describes Data General's FORTRAN IV, its use and operation. Data General's FORTRAN IV is an implementation of the ANSI FORTRAN Standard X3.9-1966, with many extensions. Chief among these extensions are the following: system directory maintenance, file maintenance and file I/O, task execution control, program segmentation and control, user/system clock and calendar access, and foreground/background operation control. Although versions of FORTRAN IV can be run under SOS, the extensions involving disk file maintenance, real time operations, and foreground/background programming can be run only under a real time operating system, either RDOS or RTOS as appropriate.

093-000068, FORTRAN IV Run Time Library User's Manual. This manual provides an exhaustive description of run time routines supporting Data General's FORTRAN IV language. Additionally, this manual provides a detailed explanation of techniques used to manage the FORTRAN run time stack area, the mechanism which permits FORTRAN IV routines to be reentrant.

017-000012, FORTRAN IV Assembler Language Interface. This document describes, with the use of many examples, techniques to be followed in interfacing subprograms and task modules written in assembler language to a FORTRAN IV program. Also described in this manual is the code generated by the FORTRAN IV compiler and the partitioning of the runtime stack in a multitask environment.

093-000085, FORTRAN 5 User's Manual. Data General's FORTRAN 5 language provides a set of features which is a compatible superset of those provided by FORTRAN IV. Included in this list of new features is the following: full mixed mode numeric conversion; acceptance of any expression as a control variable or parameter in a DO statement or DO-implied list; generic library functions; declarations that may appear anywhere in a program; multiple entry points to subprograms; no reserved words or reserved function names; the ignoring of blanks except in Hollerith constants; and an IMPLICIT statement for data typing. By far the biggest feature of FORTRAN 5, however, is the degree of code optimization provided by this compiler. This manual describes the use and operation of FORTRAN 5 under RDOS.

FORTRAN (Continued)

093-000096, FORTRAN 5 Runtime Library User's Manual. This manual documents and categorizes the FORTRAN 5 runtime library for compiled FORTRAN 5 programs. This library contains mathematical routines, I/O routines, file maintenance routines, and multitask routines.

093-000104, Discrete Fourier Transform Use's Manual. The Data General Discrete Fourier Transform allows calculation of the Fourier coefficients for either the forward or inverse transform of a sequence of integer powers of two. This manual describes the calling sequences and use of this library with either Data General's FORTRAN IV or FORTRAN 5 languages.

093-000060, <u>Dataplot</u>. DATAPLOT is a group of relocatable binary subroutines forming a library which can be used to drive incremental plotting systems on Data General computers. The DATAPLOT subroutines are written in FORTRAN IV, FORTRAN 5 and assembly language; they are called by FORTRAN language programs using the CALL statement facility. When used with Data General digital plotters, the subroutines facilitate the production of charts, maps, drawings, special curves, and alphabetic characters or symbols.

093-000095, Real Time Input/Output System (RTIOS) User's Manual. The Real Time Input/Output System is a library of FORTRAN and assembly language routines which support analog and digital transfers under RDOS and RTOS. This library is consistent with standards set up by the Purdue Workshop on Standardization of Industrial Computer Languages. The current library implementation is compatible with ISA Standard S61.1, FORTRAN Procedures for Executive Functions and Process I/O. This manual describes the calling sequences and use of each routine in this library.

093-000107, FORTRAN Commercial Subroutine Package. This manual describes a collection of functions and subroutines which can be used in data handling applications written in either FORTRAN IV or in Data General's FORTRAN 5 languages. Included in this package are routines to perform data conversion, data comparison and manipulation, arithmetic, and input/output functions.

MISCELLANEOUS

093-000050, <u>DATAPREP</u> User's Manual. This document describes DATAPREP, a numerical control system program designed by Data General for use on any Data General computer. DATAPREP is a stand-alone program which enables a user to prepare parts programs for controlling two or three-axis point-to-point machine tools.

PROGRAM DEVELOPMENT AND SUPPORT

093-000044, The Symbolic Debugger User's Manual. This manual describes the use and operation of the symbolic debugger, Debug III, a major system utility. The symbolic debugger interfaces with user routines and allows the user to monitor and correct his program during its execution. The symbolic debugger provides up to eight active breakpoints within a program, and accumulators and carry can be examined or modified when a breakpoint is entered. This debugger comes in several different forms so that it can be used under SOS, RDOS, and RTOS. Two versions are provided for use with the real time operating systems, one of which leaves interrupts enabled and the other of which disables interrupts. If the user has an RDOS system with a memory management and protection unit, the appropriate debugger leaves enabled those interrupts which are essential for mapping purposes.

093-000069, Relocatable Binary Punch. This manual describes a stand-alone utility routine that punches ranges of computer memory contents in binary format on paper tape for input to the binary loader. One use for this utility is to produce an absolute version of a stand-alone relocatable program so that this program can later be reloaded using the binary loader.

093-000074, Library File Editor. The library file editor (LFE) is a utility program used to analyze the contents of a library file, list the titles (.TITL) of modules in the file, merge libraries, update libraries, extract logical records from a library, and to create new libraries selected from contents of system library files or from routines. This manual describes the use and operation of this utility under each of the three standard Data General operating systems: SOS, RTOS, and RDOS. The utility also can be operated in a stand-alone mode, and this operation is also described.

093-000080, Extended Relocatable Loaders User's Manual. The extended relocatable loader is a utility used to produce an executable program from one or more relocatable binaries produced by either the extended assembler or macro assembler programs. The relocatable loader also resolves references to global symbols found outside any given relocatable binary (in library modules, for example). This manual describes the use and operation of the extended relocatable loader in either its stand-alone form or in versions running under either SOS or RDOS.

093-000084, Octal Editor. The octal editor, OEDIT, is a utility running under RDOS which permits the user to examine and/or modify any word in user disk file space. This manual describes the operation of OEDIT.

PROGRAM DEVELOPMENT AND SUPPORT (Continued)

093-000092, Stand-alone Disk Editor. The stand-alone disk editor is a utility which permits every word in every block of disk storage to be examined and/or modified. This contrasts with the octal editor, OEDIT, which permits the accessing of only those words which are in user file space. This manual describes the use and operation of the stand-alone disk editor. Since this editor is of primary if not exclusive interest to users of RDOS, this manual also describes the RDOS hashing algorithm and provides a step-by-step search through RDOS partitions and subdirectories for file entries.

093-000108, RDOS Sort/Merge User's Manual. This manual describes a sort/merge utility which operates under the control of an RDOS system. This utility performs the following functions on tape or disk files: rearranges records; deletes records; reformats records; produces sorted disk address files; and merges files. Additional options available in this utility include the use of major and minor keys, upper and lower bounds, and specifying orders and types of collating sequences.

093-000111, <u>SUPEREDIT User's Manual</u>. This manual describes an enhance text editor which runs on both NOVA and ECLIPSE RDOS systems. This utility provides all of the important functions which are available from EDIT and other functions too. New features provided by SUPEREDIT include an expanded macro command facility and the ability to move blocks of text within a file.

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