

Software Product Description

PRODUCT NAME: RSTS/E, Version 8.0

SPD 13.01.24

DESCRIPTION:

RSTS/E is a multiuser, general purpose timesharing system. Its uses include interactive timesharing, batch processing, program development, and special purpose applications. Up to 127 concurrent terminal users in both local and remote locations, through multiterminal services, can interact with application tasks. Without multiterminal services there can only be a maximum of 63 users. Tasks can share computational, storage, and input/output services provided by the RSTS/E system.

Programs can be written in any of several languages. The following languages are included on RSTS/E systems:

- BASIC-PLUS
- MACRO-11 assembly language

The following languages are optionally available for use on RSTS/E:

- BASIC-PLUS-2
- COBOL-81
- PDP-11 COBOL
- DIBOL-11/DECFORM
- FORTRAN IV
- FORTRAN-77

BASIC-PLUS-2, COBOL-81, and PDP-11 COBOL require the support of the Record Management Services (RMS) software that is included with all RSTS/E systems. The optional DATATRIEVE-11 data management software also uses RMS. The use of RMS is optional for DIBOL-11, FORTRAN-77, and MACRO-11 assembly language programs. BASIC-PLUS and FORTRAN-IV do not use RMS.

The RSTS/E system comprises the RSTS/E monitor, device drivers, Commonly Used System Programs (CUSPs) and standard software components. Some of the major features of RSTS/E include:

- Interactive timesharing
- Dynamic allocation of system resources
- User and job privileges
- Batch processing capabilities
- Extensive file processing including file sharing and protection mechanisms

- Magnetic tape processing
- Terminal handler designed for interactive environments
- Shared common code
- Software-maintained cache of frequently-accessed disk data
- Intertask communication
- Disk file and device backup and restore utilities
- System operations and access control utilities
- System reliability features
- System maintenance tools
- User Command Languages (DCL and CCL)
- System manager definition of user commands
- Line printer spooling
- Micro RSTS subset generation

Timesharing

Each user of a RSTS/E system is associated with some job on the system and normally interacts with that job by using a terminal. Jobs can also run detached (not using a terminal) or they can use pseudo keyboards, as in the case of batch jobs, which run under the control of other jobs. Although a RSTS/E system is limited to 63 jobs, some RSTS/E systems can support as many as 127 terminal users simultaneously. These limits (63 jobs and 127 multiple terminals) are not always achievable. The number of user jobs is also diminished by system processes and other detached jobs on the system, such as Error Logger, Operator Services, Queue Manager, line printer spoolers, batch processors, and batch jobs.

Dynamic Allocation of System Resources

RSTS/E schedules CPU time and memory residency among jobs based upon their priority and processing requirements. Jobs are rescheduled based upon timeslicing or as a result of waiting for system services. A round-robin algorithm is used to select among eligible jobs with the same priority. Job priorities can be altered by the system manager, any privileged user, or by a privileged program.

RSTS/E uses the memory management hardware capabilities to map a user's job area and any shared code into the user job's virtual address space. Jobs can be swapped out to disk storage when the memory is

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software

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needed for other jobs to run. A job's size can be expanded dynamically, subject to limits imposed by the system manager or other privileged users. The absolute limit for a job size is 64K bytes (32K words), but the usual limit is 56K bytes (28K words). BASIC-PLUS programs cannot be larger than 32K bytes (16K words).

Privilege

As a resource sharing system, RSTS/E gives every user access to all the system peripherals and resources, as well as a wide range of capabilities, unless otherwise restricted by the system manager or other privileged users. A privileged user has full access to all the capabilities allowed by the RSTS/E system, and may control the operations of the system such as starting up or shutting down the system. A privileged user can add or delete user accounts, including other privileged accounts. A privileged user can also designate certain programs as privileged, in order to grant program-selected privileged capabilities to normally nonprivileged users. Privileged users also have access to tools for controlling the use of system features that make the system operate more efficiently.

Batch Processing

Users can submit batch jobs to perform tasks that require no terminal interaction, or to run programs at a later time, for example, outside normal working hours. For each batch job, the user can set a limit on the amount of CPU and/or elapsed time allowed and can request error level checking. The system manager starts up and controls batch processors. There can be a maximum of eight batch processors per system. Each batch processor requires a pseudo keyboard and two jobs (one for itself and one for the batch job).

File System

Disk files can be created, updated, extended, deleted, and renamed under program control, or they can be created, deleted, and renamed using terminal commands. Files can be created and extended dynamically with the RSTS/E file system automatically allocating disk space wherever available. Alternatively, to enhance system performance, a file's location can be specified and/or a file can be preallocated to use physically contiguous space. A disk file's size is limited by the storage capacity of the volume on which it resides. One file cannot extend across multiple disk volumes.

Files can be accessed by multiple users simultaneously. When opened for shared update, multiple users can update the same file while it remains open. The file system's block interlock mechanism prevents different users from updating the same part of the file at the same time.

The RSTS/E disk structure consists of a hierarchy, that has a Master File Directory (MFD), Group File Directory (GFD), User File Directory (UFD), and files. Because you can create accounts for 254 groups and each group can have 255 user accounts the MFD on each disk can contain up to 64,771 accounts. Since each accounts directory requires disk space, the practical maximum number of accounts is limited by the

disk size and usage. The number of files that a UFD can contain varies, depending on parameters such as the size of the files. Each file is distinguished from other files in that UFD by its unique file name and type.

RSTS/E disk volumes, when used as file-structured devices, are either public or private. A public volume is the system disk or any volume initialized and mounted as a public volume. Other file-structured volumes are private. The system disk and any other mounted public volumes together constitute the public structure, which is a logical extension of the system disk, and to which all users access. However, files cannot span volumes within have the public structure. Users have access to mounted private volumes only if their UFD's exist on the private volumes, or if the protection codes of the files in other UFD's on those volumes permit access. Access to a disk file is governed by its protection code, which specifies read and write access for the file's owner, for other users within the owner's group, and for all other users. For executable files, the protection code specifies execute and read/write access for owner, group, and all other users. In addition, disks can be owned by one user on the system, so no other user can access files on that disk, regardless of the files protection code.

A special utility (FIT) provides file transfer capabilities to and from volumes (including RX01/RX02 floppy diskettes, for which FIT is the only file access method) using RT-11 file structure. This is limited to disks up to 33.5 million bytes in storage capacity. A separate utility handles interchange of files on flexible diskettes using the IBM 3741 single density format (Format 1). With this utility EBCDIC to ASCII translation is a user-specifiable option.

Magnetic Tape Processing

The user can process 9-track 800 or 1600 BPI magnetic tape by using one of the two labelling formats DOS-11 or ANSI.

DOS-11 format is used for interchange between PDP-11 systems: RSTS/E, RT-11, RSX-11M, RSX-11M-PLUS, IAS, and VAX/VMS.

ANSI format is used for interchange with the above systems as well as other computer systems. RSTS/E implements a subset of the ANSI format, defined by American National Standard Institute Specification X3.27 1978, which is used for interchange between systems that support the standard. When using ANSI labelling format, RSTS/E processes only volume-header, file-header, and end-of-file labels. RSTS/E does not perform access checking. A tape volume is considered private to the job which has access to that volume. RMS uses ANSI tape labelling format exclusively. Files may be processed using F (fixed-length) or D (variable-length) record formats.

RSTS/E utilities process single-volume file sets, except when PIP (Peripheral Interchange Program) is used. PIP can process volume sets consisting of more than one tape reel. Tapes conforming to a subset of ANSI X3.27-1978 can be read and written by the RMS utilities and PIP.

Terminal Handling

The RSTS/E terminal handler is designed for interactive environments and features:

- Full-duplex communications
- Modem control
- Type-ahead with immediate echo
- Programmable echo control
- Multiterminal I/O for individual jobs
- Pseudo keyboard capability

The echo control feature allows programs to handle terminal input one field at a time and to retain control of the screen display. This feature gives application programs the capability to use nonblock mode transfer terminals to simulate block mode input. RSTS/E does not support block mode transfer terminals.

Each RSTS/E system includes at least one terminal, the system console terminal, and potentially as many as 126 additional terminals. On systems purchased as DIGITAL supported, the console terminal must be either a:

- Hard copy device
- VT100 series with the VT1XX-AC printer port and printer.

On systems purchased as license only, the console terminal can be a VT100 series.

The multiterminal service feature allows any job to control multiple terminals, up to the maximum number configured for the system, on one logical channel. This feature allows one program to control a number of terminals that are all performing the same function.

Pseudo keyboards are logical devices that have the logical characteristics of real, physical terminals but have no terminals associated with them. Pseudo keyboards have input and output buffers to which a program can send output, and from which it can receive input. Using a pseudo keyboard as a communications device, a user can write a program to control other jobs. Each RSTS/E system includes at least one pseudo keyboard. The maximum total number of terminals and pseudo keyboards is 128.

Shared Common Code

RSTS/E allows the sharing of code that is common to multiple jobs. For example, the BASIC-PLUS Run Time System is shared by all users of that language. Another example of shared code is resident libraries of software routines, for example, RMS. The RMS resident library capability can be used by programs written in the languages that use RMS. EDT can also be used as a resident library.

The code that resides in the resident library must be written in the MACRO assembler language.

It is possible to create cluster libraries; that is, resident libraries that share the same address window in the user task's virtual address space. For example, the FMS-11/RSTS, COBOL-81 and RMS-11 resident libraries can be clustered so that they use 16K bytes (8K

words) of the user's virtual address space, rather than up to 40K bytes (20K words) if they were not clustered.

It is recommended that resident libraries be used on systems with greater than 248K bytes (124K words) of memory.

Disk Data Cache

RSTS/E can minimize accesses to disk for frequently used data by keeping data in a software-maintained cache, a specially designated area of system memory space. The data retained in this cache can be restricted to disk directory blocks only, or it can include data from disk files. In the latter case, a privileged user has the option to allow all disk files to be cached or to allow only certain eligible files to be put in cache.

It is recommended that data from disk files be stored in the software maintained cache only on systems with greater than 512K bytes (256K words) of memory.

Intertask Communication

RSTS/E jobs can communicate with each other by sending and/or receiving intertask messages under program control. Jobs can send messages to valid message receivers. Normally a job must have privileges to declare itself as a message receiver, however, the System Manager may allow this operation for non-privileged users also.

Disk File and Device Backup

RSTS/E provides the ability for total or selective backup of accounts and files to disks or to magnetic tapes. Selective backup can be done online. Backing up entire disk volumes can be performed off-line for all volumes including the system disk, or it may be performed on-line for any volume that is not logically mounted. Since the system disk is always logically mounted, it can only be backed up off-line, or files on it can be backed up selectively on-line.

System Operation Control

The system manager has the ability at system start-up time to:

- Add run-time systems
- Set the default run-time system
- Enable and/or disable devices
- Set system default parameters
- Allocate memory usage
- Install a new RSTS/E executive with different system generation parameters
- Initialize disk packs
- Verify and correct the file structure of RSTS/E disks
- Save and restore disk packs

The system manager and other privileged users have access to many utilities for controlling system operations on-line. The functions they can perform include the following:

- Define normal system startup control files
- Define automatic system restart control files
- Set the default keyboard monitor
- Logically mount and dismount disk packs

- Add or remove swap files, run-time systems, and resident libraries
- Add or remove system-dependent commands
- Define terminal characteristics for any terminal
- Change job priorities and other job-related parameters
- Add or delete user accounts, change passwords
- Dump account statistics for all or selected accounts
- Control usage of disk data cache feature

System Reliability

The error logging mechanism in RSTS/E records certain classes of hardware errors in a disk file. These errors include memory parity and disk or magnetic tape errors. The mechanism records system traps that occur in the executive, as well as other events such as system startup and shutdown. The system manager can print the error log and analyze it online.

If the hardware detects power failure, RSTS/E automatically ceases system operations. When the hardware detects power restoration, RSTS/E automatically reloads the system from the system disk, and reinitializes system operation by doing a "cold restart." The system resumes operation without operator intervention, but any users previously logged in will have to log in again. On systems that have MOS memory, the power failure destroys the content of memory unless the hardware battery backup option is installed. Without battery backup, the system will have to be manually restarted.

Likewise, if nonrecoverable hardware or system software errors result in a system crash, RSTS/E will attempt to dump the read/write portion of the executive's address space to a disk file then attempt to reload the system and do a "cold restart." Note that the system manager can disable either the crash dump or the automatic restart capability.

The system manager can check the reliability of most peripherals online by running a Device Test package. The package exercises the peripherals in an attempt to force errors and identify fault-prone devices. However, comprehensive error isolation requires that DIGITAL Field Service use standard diagnostic software.

System Maintenance

Software integrity is kept at a high level by using software maintenance tools that allow the system manager to correct software components that are found to be in error. Parts of the RSTS/E system are maintained by replacing the component in error (e.g. the RSX default runtime system CUSPs) and the rest of the system by patching.

Software module updates and patches are applied through an automatic, machine-readable maintenance update procedure, thus avoiding the effort and potential errors associated with keying in patches manually.

The RSTS/E Software Dispatch is a publication that contains articles describing known problems and

work-arounds. Where applicable, it includes instructions for patching the affected software components.

Program Development Tools

Program development on a RSTS/E system is facilitated by a wide selection of system utilities. The DEC Editor (EDT) can edit all types of text files, including RMS fixed length record files, variable length record files, and stream files.

The RSX run-time system provides an environment somewhat similar to that found on the RSX-11M Operating System, by handling a subset of the RSX-11M system directives. The RSX run-time system is required by all software using RMS, and by FORTRAN-77.

The RT-11 run-time system provides an environment similar to that found on the single-job monitor of the RT-11 Operating System, and handles a subset of the RT-11 directives. The RT-11 run-time system is required by FORTRAN IV and is also used during system generation. In addition the RT-11 run-time system is required for running the peripheral interchange program (PIP) and is therefore always present (but not necessarily resident in memory) on each RSTS/E system.

MACRO-11 assembly language programs involving subroutines callable by a higher-level language program, use the run-time system required by that higher-level language. When programming in MACRO-11 exclusively, the RSX run-time system is the preferred environment. The RT-11 environment can also be used.

Both the RSX and RT-11 environments provide the MACRO-11 Assembler, a Linker or Task Builder, and a Librarian utility. The Linker or Task Builder converts relocatable object modules, produced by the Assembler or optional language compilers, into executable images. Overlays do not require any special instructions or function calls in the source program. The user designates an overlay structure to the Linker or Task Builder with the overlay description language or interacting with DCL, and an executable task image with the desired overlays will be produced. The Librarian utility creates and maintains libraries of commonly used object module subroutines and Assembly language macro definitions. The Linker or Task Builder uses object libraries to resolve undefined external symbols.

User Command Languages

User commands to the RSTS/E system are handled and interpreted by one of the run-time systems capable of acting as a keyboard monitor.

The four standard Keyboard Monitors are DCL, RSX, RT-11, and BASIC-PLUS. All of these interpret sets of system commands, that is, English-like words followed by optional command parameters. These system commands allow users to perform all the fundamental functions required to use the RSTS/E system, such as logging on and off, and running programs. BASIC-PLUS and RT-11 have additional commands to perform actions appropriate for those environments.

Digital Command Language (DCL)

The DCL feature is based upon the DCL available on most DIGITAL operating systems. In particular, it is a subset of the DCL implemented on VAX/VMS. DCL is implemented as a keyboard monitor, and may be used either as the default keyboard monitor or an additional keyboard monitor. The command set gives the user access to most RSTS/E system features.

Concise Command Language (CCL)

The CCL feature allows each installation's system manager to define additional commands to run system utilities as well as other user programs. Each CCL command definition specifies the full form of the command and its abbreviation, the program that processes the command, and the entry parameters for the program.

Line Printer Spooling

There are two printer spooling packages. The larger of the two, which has been available on earlier versions of RSTS/E has the following characteristics:

- Users submit files for printing by command or program
- Multiple copies
- Multiple form types
- Spooling controlled by the system manager
- Up to eight spoolers per system
- Each spooler and the queue manager require a job slot
- Each spooler can be dedicated to a printer or handle general printing
- Spooled files must be of sequential organization and be less than 32767 blocks in length
- Spooled files cannot contain variable length records such as VAX/VMS "print format" files

The smaller spooling package, aimed primarily for use on small RSTS systems, e.g. Micro RSTS, has the following characteristics:

- Users submit files for printing by command or program
- Multiple copies
- Multiple forms types
- Spooling controlled by the system manager
- One spooler per system
- Spooler can control up to two printers
- Spooler and queue manager share the same job slot
- Any RMS file organization can be printed

Both spooling packages may be used on the same system, however, only one package may be directly addressed from DCL. The system manager determines which is used. Both may be accessed by the CCL command interface.

Both line printer spooling packages support keyboard spooling to hardcopy terminals, such as receive-only printers (serial LA180 and the LA120-RA). Note however, that data integrity is not checked on the serial line. The LA180 must remain on-line while keyboard spooling is in operation.

Micro RSTS Subset Generation

Micro RSTS is a proper subset of RSTS/E, generated from a RSTS/E distribution kit using the BUILD utility. The BUILD utility transfers the Micro RSTS file to a removable disk media common to both the RSTS/E system and the target Micro RSTS system. The RSTS/E supplied components are: command procedures and a presysgened RSTS monitor configured for the MICRO/PDP-11, including an installation certification procedure to verify installation completion. It is the user's responsibility to transport the resulting Micro RSTS software from the RSTS/E system to the target Micro RSTS system.

Layered products listed in the RSTS/E Cross Reference Table (SPD 20.97.xx) are capable of being run on a properly configured Micro RSTS system if there are sufficient system resources for that combination of products. Refer to the SPD for each product.

A single-use license-only option is required to use the Micro RSTS subset on each target system.

Standard RSTS/E Software Components

The following software components are supplied as integral parts of the RSTS/E Operating System:

- RMS-11
- RMS Utility Programs
- EDT
- SORT-11
- BASIC-PLUS
- MACRO-11

Record Management Services (RMS-11)

RMS-11 includes a set of run-time service routines and utility programs that provide a data management subsystem. This allows a user to create and manipulate files, and create, access, and alter records within files.

RMS supports three file organizations:

- Sequential
- Relative
- Indexed

The indexed file organization allows each indexed file to have one primary key and up to 254 alternate keys. In addition to random access based on key values, programs can access records in an indexed file sequentially in ascending order by key values. Records are stored physically only in primary key order.

RMS supports four record formats:

- Fixed length records
- Variable length records
- Variable length records with fixed control field
- Stream records

Indexed files are restricted to either of two record formats: fixed or variable. The stream record format is restricted to sequential disk files only. Languages that do not use RMS (for example FORTRAN IV) cannot process RMS files unless the record format is stream.

User programs are provided with logical data record access to RMS files through extended language syntax statements. The form of the statement is dependent upon the application language interface. The functional facilities provided are:

- OPEN
- CLOSE
- READ/GET
- WRITE/PUT
- REWRITE/UPDATE
- DELETE

RMS-11 supports cluster libraries for sharing application virtual address space between a resident library and resident libraries of other software systems that support cluster libraries.

RMS-11 supports Digital Network Architecture (DNA) Data Access Protocol (DAP). This support allows access by RMS from a RSTS/E system with DECnet/E to RMS files on remote DECnet nodes. The remote DECnet nodes may be RSTS/E, VAX/VMS, RSX-11M or RSX-11M-PLUS systems. In general, remote file access, to the programmer, appears the same as local file access, if dealing with a remote VMS or RSX node, where all types of file organizations may be accessed. However, if the remote node is a RSTS/E node, only sequentially organized files may be accessed with full capabilities.

RMS Utility Programs

The following set of utility programs supports RMS file-structured operations:

FILE DESIGN (DES) - An interactive utility to assist the user in designing files for optimum performance. This utility supersedes the RMS DEFINE utility provided with earlier versions of RSTS/E. The DEFINE utility is still provided with RSTS/E, Version 8.0, but may not be provided with later versions.

BACKUP - Creates a backup copy of one or more RMS files from a direct access device to another logical device or physical medium (typically, magnetic tape).

RESTORE - recreates from a backup copy the original RMS file on a direct access device or physical medium.

CONVERT - Initially loads or adds records to an output file from input data recorded on a sequential relative or indexed file; creates, supersedes, or extends a sequential output file from an input file.

DISPLAY - Lists attributes of RMS files and records.

INDEXED FILE LOAD (IFL) - Initial load utility for indexed files, optimized for performance and space.

EDT

EDT is a text editor that can be used to create a file, enter and manipulate text in the file, and save or delete work done during edit sessions. EDT works with any kind of text file.

EDT offers many features to make text editing easier

and more efficient. These features include:

- On-line HELP that can be used any time during an edit session
- Protection of files with journaling
- Startup command files which specify editing characteristics
- Keypad, line, nokeypad editing, depending on the terminal type
- Two kinds of line numbering
- Use of several files or parts of files at a time
- Redefinition of function keys by the users for frequent jobs

File Sort Utility (SORT-11)

RSTS/E includes a file sort utility, SORT-11 that accepts as input one RMS file, and creates a second, reordered RMS file. The input file can contain data stored in binary or ASCII format. The file organization can be sequential, relative, or indexed and the record format can be fixed length, variable length, or stream. Records can be sequenced by key fields in ascending or descending order. Sort keys can be:

- 1-word 2's complement
- Alphanumeric
- 2-word or 4-word floating point binary
- Packed decimal
- Numeric ASCII with the sign leading and separate
- Numeric ASCII with the sign trailing and separate
- Numeric ASCII with the sign leading and over-punched
- Numeric ASCII with the sign trailing and over-punched

SORT-11 has four possible sorting methods:

- Record Sort
- Tag Sort
- Address Routing Sort
- Indexed Sort

SORT-11 also includes a set of subroutines, callable from programs written in one of the languages that uses RMS. SORT-11 does not provide a file merge capability.

BASIC-PLUS

The BASIC-PLUS language processor comprises a compiler and run-time system. The BASIC-PLUS compiler produces a compact pseudo code that is interpreted by the run-time system. Being an incremental compiler, it checks each program line for syntax errors and returns an appropriate message if an error is found. The user can then correct the line (if necessary) by retyping it.

BASIC-PLUS programs can be saved in either source form or in compiled form (compact pseudo code).

The immediate mode feature of BASIC-PLUS allows single-line statements typed without a line number to be compiled and executed immediately. This is a par-

ticularly useful feature in interactive debugging of BASIC-PLUS programs.

BASIC-PLUS can serve as a powerful system programming language. The extensive file processing capabilities of BASIC-PLUS allow users to take full advantage of RSTS/E file processing features. Most system features of RSTS/E are accessible via the flexible SYS system function call mechanism.

In addition to the elementary BASIC statements, BASIC-PLUS also features:

- An incremental compiler
- Immediate mode statements
- Extensive file processing capabilities
- Access to most RSTS/E system features
- Virtual arrays
- Block I/O
- PRINT...USING formatting (optional)
- Extensive string support
- String arithmetic (optional)
- Matrix manipulation operations (optional)
- Long variable names (with EXTEND mode)
- IF...THEN...ELSE construct
- ON ERROR condition handlers
- Statement modifiers: IF, UNLESS, WHILE, UNTIL, FOR
- User-defined functions
- Multistatement lines
- Multiline statements
- Program chaining

NOTE: On some systems, it may not be possible to use all the optional features of BASIC-PLUS simultaneously, within 32K bytes (16K words).

MACRO-11

The MACRO-11 assembly language, which uses the PDP-11 instruction set, can be used for development of programs and/or subroutines. The MACRO-11 assembler is a two-pass assembler with the following features:

- Source and command string control of assembly functions
- Device and file name specifications for input and output files
- Error listing on command terminal and in listing files
- Alphabetized, formatted symbol table listing
- Optional cross-reference listing of symbols
- Relocatable object modules
- Global symbols for linking object modules
- Conditional assembly directives
- Program sectioning directives
- User-defined macros and macro libraries
- Comprehensive system macro library
- Extensive source and command string control of listing functions

SOURCE CODE INFORMATION:

Source code for the Terminal Driver and CUSPs is provided on all available distribution media and on microfiche. The source code modules are provided for system generation and user modification of the CUSPs.

This source code is provided on an "AS IS" basis without any warranty of any kind, either express or implied.

MINIMUM HARDWARE REQUIRED:

A RSTS/E configuration must include:

- Any PDP-11 CPU from the list below, with line clock
- Console terminal
- 248 K bytes (124K words) of memory
- 10M bytes of disk space
- Software distribution device/backup device of 10M bytes or greater

OPTIONAL HARDWARE:

Refer to Table I for a list of all hardware supported by RSTS/E.

Hardware limitations may limit the number of devices and/or memory that a particular system can support.

PREREQUISITE SOFTWARE:

None

OPTIONAL SOFTWARE:

The RSTS/E Optional Software Cross Reference Table (SPD 20.97.xx) lists the software which runs on RSTS/E. There may be several versions available of an optional software product. Refer to the RSTS/E Optional Software Cross Reference Table for the version of the product supported on RSTS/E, Version 8.0.

Optional software products may require system resources (e.g., physical memory, disk space) over and above the requirements for RSTS/E. If these extra resources are not available, severe system performance degradation can occur. Refer to SPD for specific resource requirements for each product.

SOFTWARE WARRANTY

Warranty for this software product is provided by DIGITAL with the purchase of a license for the product. There is no additional charge. This software product is warranted to conform to the Software Product Description (SPD). This means that DIGITAL will remedy any nonconformance when it is reported to DIGITAL by the customer during the warranty period.

The warranty period is ninety (90) days. It begins when the software is installed or thirty (30) days after delivery to the end user, whichever occurs first and expires ninety (90) days later or one hundred eighty (180) days after release of a subsequent version of the software.

Warranty Service

DIGITAL provides software warranty service worldwide. Service is provided in the country of purchase and is not transferable between countries.

DIGITAL will provide a service location which will accept reporting (in a format prescribed by DIGITAL) of a nonconformance problem caused when using the licensed software under normal conditions as defined by the SPD. DIGITAL will respond to a nonconformance problem in the current unaltered release of the licensed software by issuing correction information such as: correction documentation, corrected code, or notice of availability of corrected code; or a restriction or a bypass. The customer will be responsible for the preparation and submission of the problem report to the service location.

Warranty Exclusion

DIGITAL DOES NOT WARRANT THAT THE SOFTWARE LICENSED TO CUSTOMER SHALL BE ERROR FREE, THAT THE SOFTWARE SHALL OPERATE WITH ANY HARDWARE AND SOFTWARE OTHER THAN AS SPECIFIED IN THIS SPD, THAT THE SOFTWARE SHALL SATISFY CUSTOMER'S OWN SPECIFIC REQUIREMENTS, OR THAT COPIES OF THE SOFTWARE OTHER THAN THOSE PROVIDED OR AUTHORIZED BY DIGITAL SHALL CONFORM TO THE SPD.

DIGITAL MAKES NO WARRANTIES WITH RESPECT TO THE FITNESS AND OPERABILITY OF MODIFICATIONS NOT MADE BY DIGITAL.

IF THE SOFTWARE FAILS TO FUNCTION FOR REASONS STATED ABOVE, THE CUSTOMER'S WARRANTY WILL BE INVALIDATED AND ALL SERVICE CALLS WILL BE BILLABLE AT THE PREVAILING PER CALL RATES.

INSTALLATION

DIGITAL requires that a customer's first purchase of this software product include DIGITAL Installation Services. These services provide for installation of the software product by an experienced DIGITAL Software Specialist.

For subsequent purchases of this product only experienced customers should attempt installation. DIGITAL recommends that all other customers purchase DIGITAL's Installation Services.

DIGITAL's Installation Services can be purchased as part of a Packaged Service Option or bought separately.

ORDERING INFORMATION

DIGITAL provides a wide range of material and service options supporting this software product. Each option is described below. **IF YOU ARE ALREADY FAMILIAR WITH THESE OPTIONS YOU MAY OBTAIN THE ORDERING INFORMATION DIRECTLY FROM THE SOFTWARE OPTIONS CHART.** In most cases you will want to review the following descriptions to determine what options you require.

You will need a separate license for each CPU on which you will be using the software product (except as otherwise specified by DIGITAL). Then you will select the materials and service options you need to utilize the

product effectively. You can order the materials and service options individually. But, to ensure that you get the set of services you need and to simplify the ordering process, DIGITAL offers Packaged Service Options designed for your environment and experience level. We recommend that you review these packages based on your individual needs. Not only are they comprehensive but they are economical, since the cost of each package is less than the total cost of the individual service options.

You order the license, materials and services using order numbers of the form: Qxxxx-X?. "Qxxx" refers to the specific software product, "X" is the license code or material service option and "?" is the selectable media code for machine readable materials.

Single-Use licensed software is furnished under the licensing provisions of DIGITAL's Standard Terms and Conditions of Sale, which provide in part that the software and any part thereof may be used on only the single CPU on which the software is first installed, and may be copied, in whole or in part (with the proper inclusion of DIGITAL's copyright notice and any proprietary notices on the software) for use on such CPU.

LICENSE OPTIONS

Single-Use License Option

The Single-Use License is your right to use the software product on a single CPU and it includes your 90 day warranty.

For your first installation of this software product you must purchase as a **minimum**:

- Single-Use License option, and
- Distribution and Documentation option

The license gives you the right to use the software on a single CPU and the Distribution and Documentation option provides the machine readable software and related documentation.

To use this software product on additional CPU's, you must purchase as a **minimum**:

- Single-Use License option

In addition to the right to use, the license gives you the right to copy the software from your original CPU installation to the additional CPU. Therefore, the Distribution and Documentation option is not required, but optional.

PDP-11 Operating System General License Option

The PDP-11 Operating System General License option is a package of single-use licenses which are your right-to-use all of the following operating systems on a single CPU:

RT-11, RSX-11M, RSX-11S, RSX-11M-PLUS, DSM-11, RSTS/E, CTS 300

The General License option provides all the Single-Use License rights described above for each software product except it includes a 90 day warranty only for the first software product to be installed.

You purchase a General License option according to the category to which your CPU belongs. The categories are listed below.

QJB36-UZ	DCT11 Microprocessor Chip
QJB39-UZ	DCF11 Microprocessor Chip
QJB43-UZ	DCJ11 Microprocessor Chip
QJB46-UZ	KD11, KDF11 CPU Modules
QJB51-UZ	11C23 MICRO/PDP-11 Models and Systems
QJB56-UZ	11/03 through 11/23-Plus Models and Systems
QJB66-UZ	11/24 through 11/40 Models and Systems
QJB76-UZ	11/44 through 11/70 Models and Systems

For the first installation of this software product you must as a minimum:

- have, or purchase a General License option, and
- Distribution and Documentation option

To use this software product on additional CPU's, you must as a **minimum**:

- have, or purchase a General License option

MATERIALS AND SERVICE OPTIONS

PACKAGED SERVICE OPTIONS

System Start-Up Service Packages (SSSP) are comprehensive sets of services tailored to satisfy your first year startup needs for software service and training. Each package includes, for a fixed price, the Distribution and Documentation and a one year Software Product Service Agreement for this product as well as most dependent software products purchased concurrently. Other service components are included at various SSSP levels. DIGITAL offers three packages for this product:

SSSP Level III is the most comprehensive package designed to support new users, more complex system configurations, and users whose system availability is critical. In addition to a one year Software Product Service Agreement and the Distribution and Documentation materials, this package includes Installation, Orientation and a level of Training services to provide an indepth product understanding.

SSSP Level II is designed for customers with some system experience who want DIGITAL to install their software and assist them in initial system use. In addition to a one year Software Product Service Agreement and the Distribution and Documentation materials, this package includes Installation, Orientation and a level of Training services to expand on existing software product expertise.

SSSP Level I is designed for more experienced customers who want to maintain their own software. This package includes a one year Software Product Service Agreement and the Distribution and Documentation materials. In addition, this package includes a minimal level of Training services necessary to provide required product information.

For more information concerning SSSP, please contact your local DIGITAL sales office.

Distribution and Documentation Option

The Distribution and Documentation option provides the software object code in binary form and the basic documentation. You must have, or order, a Single-Use License to obtain this option. You will need this option to install the software for the first time. You will also need this option to obtain revised versions of the software product when they become available.

If you prefer to receive automatic distribution of revised versions for this product, you must purchase a Software Product Service Agreement.

Software Revision Right-To-Copy Option

The Right-To-Copy option allows a customer with multiple CPU's to copy a revised version of a software product from one CPU to another. Each CPU must be licensed for that product. You first install the revised software on one CPU; then you can make copies for additional CPU's by purchasing the Right-To-Copy option for each additional CPU.

If you prefer to automatically obtain the right-to-copy, you must purchase a Service Right-To-Copy for each additional CPU; this is a service added to a Software Product Service Agreement.

Documentation-Only Option

You can obtain one copy of the basic documentation by purchasing the Documentation-Only option.

Installation Service Option

Installation Service includes those services provided by a DIGITAL Software Specialist to successfully install a software product. Digital's Installation Service accelerates your productive use of this product.

Software Product Service Agreements

DIGITAL offers you a choice of three Software Product Service Agreements to support your software. These agreements provide a set of the following services depending on the agreement selected: remedial and maintenance service, revised versions of the software and documentation, telephone support and newsletters or dispatches containing suggested fixes for known problems.

The level of service you need depends primarily on three factors: (1) your available manpower, (2) your staff's level of expertise and (3) the importance to you of having your system current and operating at peak efficiency. Our DIGITAL representative can help you select the service best suited to your needs. The agreement types are listed below.

DECsupport Service is designed for people requiring high availability of their system and for customers who need regular access to DIGITAL's technical expertise. It is the most comprehensive support service, offering on site preventative maintenance and remedial support for critical problems. In addition, it also provides revised versions of the newsletters or dispatches.

BASIC Service is ideal for customers who have their own technical staff but need fast answers to operational questions. The telephone support provided in this service gives you timely answers and solves most software problems. In addition, you get revised versions of the software and documentation, and newsletters or dispatches.

Self-Maintenance Service is designed for customers who require only minimal support but wish to receive revised versions of the software and documentation information from DIGITAL. In addition, the service provides newsletters or dispatches.

All three agreements are available to licensed DIGITAL customers on an annual, contractual basis.

A variety of service options may be added to an existing Software Product Service Agreement as follows:

- Customers who want to copy the revised software received under their Software Product Service Agreement onto additional CPUs running that same product may order a Right-to-Copy for each CPU, Qxxxx-3Z.
- Customers who have a Software Product Service Agreement can obtain an additional copy of the documentation supplied under the Agreement by ordering the Documentation Update Service, Qxxxx-KZ.
- Customers who have a Software Product Service Agreement can obtain an additional copy of the dispatches supplied under the Agreement by ordering the Additional Dispatch Subscription Service, Qxxxx-1Z.
- Customers who have a Basic Service or DECsupport Service Agreement can add additional names to the three who, under the Agreement, may call the Telephone Support Center by ordering the Additional Telephone Support Center Contact Service, Qxxxx-6Z.

TRAINING FROM EDUCATIONAL SERVICES

DIGITAL's Educational Services sells a full spectrum of training products and services to support the installation, maintenance and/or management of DIGITAL software. Course formats vary from seminars to packaged training materials (self-paced instruction and computer-based instruction) to traditional classroom instruction at DIGITAL's 27 worldwide Training Centers. Training is included in most System Start-Up Service Packages (SSSP) and is available for your ongoing training needs for this software product and related products. Course recommendations are listed below and are grouped according to the SSSP available for this product.

The recommended courses for SSSP Level III are:

- RSTS/E User
- Programming in BASIC PLUS-2
or
- Programming in BASIC PLUS
- RSTS/E Advanced BASIC PLUS Programming
or
- BASIC PLUS-2 Programming with RMS-11

The recommended courses for SSSP Level II are:

- RSTS/E User
- Programming in BASIC or BASIC +2

For a complete listing of course schedules and prices, refer to the DIGEST, Education Services' quarterly publication. For curriculum-specific information, training recommendations and assistance in planning training programs, contact your Educational Services Marketing Representative.

Professional Software Services

DIGITAL Software Specialists are available on a per-call or resident contract basis to help in all phases of software development or implementation. Specialists are available to serve technical consultants, decision support consultants or business systems analysts. Resources are available to:

- Supplement your programming staff
- Assume project management responsibility
- Develop software
- Assure successful start-up and performance with product specific packaged services

Contact your DIGITAL representative for additional information and ordering details.

SOURCE MATERIALS OPTIONS

You can obtain optional source materials for this software product by signing DIGITAL's Software Program Sources License Agreement and then purchasing the source option(s) you want. The agreement entitles you to use the source materials at one customer facility or location which is specified in the agreement.

Most users do not require source materials. They are used primarily to make modifications to the software product. Source kits provided by DIGITAL do not necessarily contain all source files used by DIGITAL to build binary kits.

Source License and Sources Distribution Option

This option provides you with the machine readable source code for this software product. It gives you the right to use the source code on any CPU at the facility/location specified in the agreement which has a Single-Use License for the object code.

Source License and Sources Listings Option

This option provides you with listings of the source programs for this software product. It gives you the right to use the listings for any CPU at the facility/location specified in the agreement which has a Single-Use License for the object code.

Sources Distribution Option

This option provides you with the revised version of the machine readable source code for this software product.

Sources Listings Option

This option provides you with listings of source code for the revised version of the software product.

Chart

The distribution Media Codes used in the Software Options Chart are described below. You specify the desired Media Code at the end of the Order Number, e.g., QR430-HH=binaries on RL02 disk cartridge.

D = 9-track 800 BPI Magtape (NRZI)

Q = RL01 Disk Cartridge

E = RK05 Disk Cartridge

R = Microfiche

H = RL02 Disk Cartridge

T = RK06 Disk Cartridge

M = 9-track 1600 BPI Magtape (PE)

V = RK07 Disk Cartridge

Z = No hardware dependency

SOFTWARE OPTIONS CHART

NOTE: The availability of these software product options and services may vary by country. Customers should contact their local DIGITAL office for information on availability.

OPTIONS	ORDER NUMBER
LICENSE OPTIONS: A LICENSE IS REQUIRED FOR EACH CPU.	
Single-Use License	QR430-UZ
PDP-11 Operating System General License*	QJBxx-UZ*
MATERIALS AND SERVICE OPTIONS:	
PACKAGE SERVICE OPTIONS	
System Start-up Service Package, Level III	QR430-BD QR430-BE QR430-BH QR430-BM QR430-BQ QR430-BT QR430-BV
System Start-up Service Package, Level II	QR430-7D QR430-7E QR430-7H QR430-7M QR430-7Q QR430-7T QR430-7V
System Start-up Service Package, Level I	QR430-5D QR430-5E QR430-5H QR430-5M QR430-5Q QR430-5T QR430-5V
Distribution and Documentation Option	QR430-HD QR430-HE QR430-HH QR430-HM QR430-HQ QR430-HT QR430-HV
Software Revision Right-To-Copy Option	QR430-HZ
Documentation Only Option (Complete)	QR430-GZ
System Managers Documentation Kit	QR432-GZ

* For the complete Option Number, refer to the Ordering Information description for this option.

SOFTWARE OPTIONS CHART (continued)

OPTIONS	ORDER NUMBER
MATERIALS AND SERVICE OPTIONS: (continued)	
System User's Documentation Kit	QR433-GZ
System Programming Documentation Kit	QR426-GZ
System Primer Documentation Kit	QR439-GZ
RSTS/E and VAX/VMS System Comptibility Documentation Kit (media: Z)	QR470-GZ
Micro RSTS Documentation Kit	QR421-GZ
Installation Service Option	QR430-ID QR430-IE QR430-IH QR430-IM QR430-IO QR430-IT QR430-IV
DECsupport Service	QR430-9D QR430-9E QR430-9H QR430-9M QR430-9Q QR430-9T QR430-9V
Basic Service	QR430-8D QR430-8E QR430-8H QR430-8M QR430-8Q QR430-8T QR430-8V
Self-Maintenance Service	QR430-3D QR430-3E QR430-3H QR430-3M QR430-3Q QR430-3T QR430-3V
SOURCE CODE AND MATERIALS OPTION:	
Source License and Sources Distribution for RSTS/E Monitor, Run-Time Systems and Utilities	QR438-EM
Source License and Sources Listings for Run-Time Systems and Utilities	QR431-FR
Source License and Sources Listings for Monitor, INIT, and SysGEN	QR432-FR
Source License and Sources Listings for BASIC-PLUS Utilities	QR433-FR
Source License and Sources Listings for RSTS/E Monitor, Run-Time Systems and Utilities	QR438-FR
Sources Distribution for RSTS/E Monitor, Run-Time Systems and Utilities	QR438-NM
Sources Listings for RSTS/E Monitor, Run-Time Systems and Utilities	QR438-NR

TABLE I

Processor Type	MICRO/PDP-11	11/23-PLUS	11/24	11/34 11/34A	11/35 11/40 EIS Required	11/44	11/45-11/50 11/55-11/60	11/70
Optional Instruction sets.	CIS KEF11-AA	CIS KEF11-AA	CIS KEF11-AA	FPP	FIS	FPP CIS	FPP ¹	FPP
Parity or ECC								
Minimum Memory Bytes	256KB	256KB	248KB	248KB	248KB	512KB	248KB	512KB
Maximum Memory Bytes	3.8MB	3.8MB	3.8MB	248KB	248KB	3.8MB	248KB	3.8MB
Cache Memory	None	None	None	2KB optional on 11/34A	None	8KB	2KB standard on 11/60	2KB
Peripheral Interface	Extended LSI-11 BUS	Extended LSI-11 BUS	UNIBUS	UNIBUS	UNIBUS	UNIBUS	UNIBUS	UNIBUS MASSBUS
Maximum Number of Disk Drives ²								
RX01/2 ³	4 ⁴	4 ⁴	4	4	4	4	4	4
RX50	2	2	—	—	—	—	—	—
RD51	2	2	—	—	—	—	—	—
RK05 ⁵	—	—	8	8	8	8	8	8 ⁶
RL01/2 ⁷	4xRL02	4xRL02	4	4	4	4	4	4 ⁶
RK06/7	—	—	8	8	8	8	8	8 ⁶
RP02/3	—	—	8	8	8	8	8	—
RH11-RP04/5/6-RM02	—	—	8	8	8	8	8	—
RH70-RP04/5/6-RM02/3/5/80	—	—	—	—	—	—	—	16
UDA50/UDA50A/RA80/81/60 ⁸	—	—	8	8	—	8	—	8 ⁶
Tape Drives	Up to 4xTSV05 ⁹	Up to 4xTSV05 ⁹	Up to 8xTE16/ TU16/45 Up to 8xTE10/ TU10/TS03 or Up to 4x TS11/TU80 ⁹ Up to 4xTU56 Up to 4xTU77	Same as 11/24 TU77	Same as 11/24	Same as 11/24	Same as 11/24	UNIBUS Tapes Up to 8xTE10/ TU10/TS03 or Up to 4x TS11/TU80 ⁹ Up to 4xTU56 MASSBUS Tapes Up to 8xTE16/ TU16/45 Up to 4/TU77

TABLE I (cont.)

Processor Type	MICRO/PDP-11	11/23-PLUS	11/24	11/34 11/34A	11/35 11/40 EIS Required	11/44	11/45-11/50 11/55-11/60	11/70
Distribution Media	RL02	RL02	Either: 800BPI Tape 1600BPI Tape RK05/6/7 RL01/2	Same as 11/24	Same as 11/24	Same as 11/24	Same as 11/24	Same as 11/24
Backup Device	RL02 or RX50 or TSV05	RL02 or TSV05	Same media as distribution	Same as 11/24	Same as 11/24	Same as 11/24	Same as 11/24	Same as
Terminals ¹⁰ and Interfaces	Up to 14 LA12, LA34 LA36, LA38 LA50, LA100 LA120 LA180, LQP02 VT52, VT55 VT100, VT101 VT102, VT125 ¹¹ VT131 ¹² PC 300 ¹³ Up to 3 DZV11-C DHF11 Same as 11/23-PLUS	Up to 14 Same as Micro/PDP-11 Up to 3 DZV11-C DHF11 Modems: DF01-A DF02-AA/AC or DF03-AA/AC or BELL 103A compatible	Up to 127 Same as Micro/PDP-11 DL11, DJ11 DZ11,DH11 ¹⁴ Same as 11/23-PLUS	Up to 127 Same as Micro/PDP-11 Same as 11/24 Same as 11/23-PLUS	Up to 127 Same as Micro/PDP-11 Same as 11/24 Same as 11/23-PLUS	Up to 127 Same as Micro/PDP-11 Same as 11/24 Same as 11/23-PLUS	Up to 127 Same as Micro/PDP-10 Same as 11/24 Same as 11/23-PLUS	Up to 127 Same as Micro/PDP-10 Same as 11/24 Same as 11/23-PLUS

TABLE I (cont.)

Processor Type	MICRO/PDP-11	11/23-PLUS	11/24	11/34 11/34A	11/35 11/40 EIS Required	11/44	11/45-11/50 11/55-11/60	11/70
Other Peripherals	1 LPV11 plus Printer	1 LPV11 plus Printer	Up to 8 of the following in any combination LP11-A/B/C/D LP11-EA/EB/F LP11-G/H/J/K LP11-R/S/V/W LP11-X/Y/Z LA11-LA27 CM11, CD11, CR11 card readers One PC11 paper tape reader/punch	Same as 11/24	Same as 11/24	Same as 11/24	Same as 11/24	Same as 11/24
Hardware Supported Only on Systems Upgrading from RSTS/E, Version 7.2	NONE	NONE	TU58 ¹⁵ DECtape II	Same as 11/24	Same as 11/24	Same as 11/24	Same as 11/24	Same as 11/24

¹ FFP standard on 11/60² Dual ported disks cannot be used by two systems simultaneously.³ RX01/2 is only supported as a non-RSTS file structured device.⁴ On the MICRO/PDP-11 and PDP-11/23-PLUS only RX01's are supported.⁵ The RK05 should only be used as a distribution disk or data disk. An RK05F counts as 2 RK05J's.⁶ On the PDP-11/70 the UDA50/RA80/RA81/RA60 combinations must be the only disks or the UNIBUS.⁷ A minimum of two RL01 drives plus a software distribution device is required.⁸ A RSTS/E system cannot support both the UDA-50 and the RSTS/E 2780 Communications Package.⁹ The TSV05 and TU80 are only supported as TS11 compatible devices, without streaming at 25° per second.¹⁰ The console terminal must be a hard copy device or VT100 class terminal with printer port for supported systems.¹¹ The VT125 is only supported by RSTS/E as a VT100 in ANSI mode. VT52 mode is not supported.¹² The VT131 is only supported by RSTS/E as a VT100/VT102.¹³ The Professional 300 series Personal Computers are supported as subsets of the VT102.¹⁴ The DM11-BB is required for DH11 dial up.¹⁵ The same single user restrictions for the TU58 as RSTS/E, Version 7.0 still apply.

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