Getting Started With Your HP 1000 System

Models 20 and 21

HEWLETT **hp** *PACKARD*

LIST OF EFFECTIVE PAGES

Changed pages are identified by a change number adjacent to the page number. Changed information is indicated by a vertical line in the outer margin of the page. Original pages do not include a change number and are indicated as change number 0 on this page. Insert latest changed pages and destroy superseded pages.

HP Computer Museum
www.hpmuseum.net

For research and education purposes only.

This manual is intended to familiarize you with your newly installed Model 20 or 21 HP 1000 system in the shortest possible time. Once you feel comfortable in using the included hardware and software, you'll be able to clearly determine future priorities and action for efficient system management.

We begin by providing an overview of the "building blocks" comprising the system. These include the various hardware modules, HP pre-configured and relocatable software, and the sets of documentation. Also included are a few suggestions for organizing the working environment for smooth system operation.

Next, we provide procedural steps for booting in and running the RTE-M Primary System, which was pre-configured by HP to match your ordered hardware. This is followed by detailed procedures for basic execution of the supplied user programs.

Finally, we provide considerations and procedures for tailoring the system to your specific needs, either by relocating HP-supplied and/or user-written programs and adding them to the Primary System, or reconfiguring through system generation.

When these steps are completed, your HP 1000 system will have become a precise, efficient and user-designed tool for solving your on-going real-time computation, data management and measurement requirements.

To use this manual effectively, there are several other manuals you should have readily at hand when first starting to use the system:

- *21MX E-Series Computer Operating and Reference Manual,* 02109-90001.

  This manual describes the operating considerations, instruction set, structure and other characteristics of the Central Processing Unit (CPU), which is the heart of your HP 1000 system.

- *2645A Display Station User's Manual,* 02645-90001, and *2645A Display Station Reference Manual,* 02645-90005.

  These manuals describe how to use the keyboard/display terminal that is your operator's console. The console is your primary device for interacting with the operating system and requesting system services.

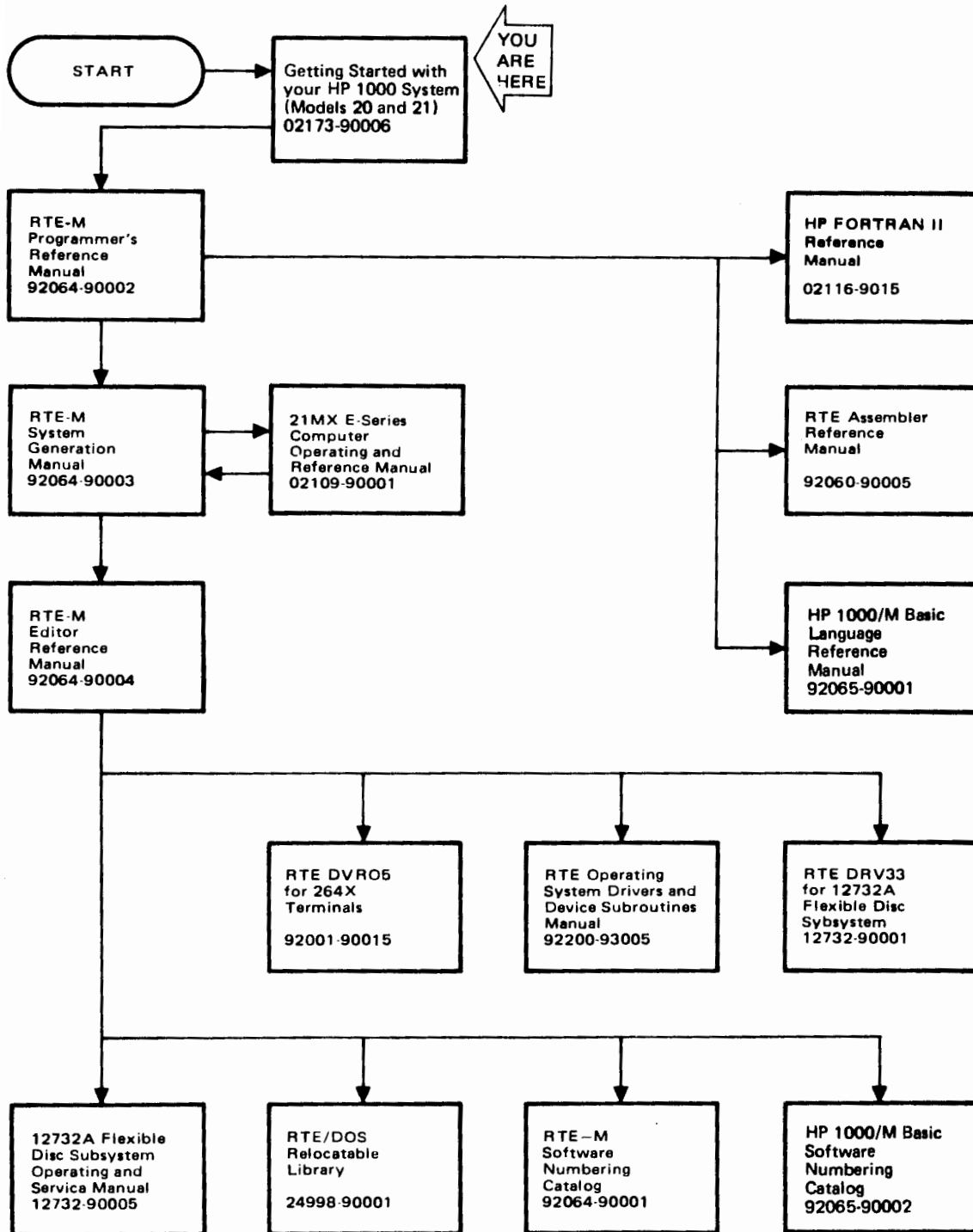- *RTE-M Programmmer's Reference Manual,* 92064-90002.

  This manual describes the functions of RTE-M snd procedures for using system services through operator commands and system calls coded into programs. The manual is the principal information source for the RTE-M operating system.

- *RTE-M Pocket Guide,* 92064-xxxxxx.

  A condensed version of frequently used reference material from other RTE-M manuals, such as control command formats, tables, error codes and messages, EXEC calls, memory structures, etc.

Other manuals that will be needed for later reference are listed in the appropriate sections of this manual.

DOCUMENTATION MAP

```
   ┌──────────┐        ┌─────────────────────┐      ┌──────────┐
   │          │        │ Getting Started with │      │ YOU      │
   │  START   │───────▶│ your HP 1000 System  │      │ ARE      │
   │          │        │ (Models 20 and 21)   │      │ HERE     │
   └──────────┘        │ 02173-90006          │      └──────────┘
        │              └─────────────────────┘
        ▼
┌───────────────┐                                   ┌───────────────┐
│ RTE-M         │                                   │ HP FORTRAN II │
│ Programmer's  │──────────────────────────────────▶│ Reference     │
│ Reference     │                                   │ Manual        │
│ Manual        │                                   │               │
│ 92064-90002   │                                   │ 02116-9015    │
└───────────────┘                                   └───────────────┘
        │
        ▼
┌───────────────┐     ┌─────────────────┐           ┌───────────────┐
│ RTE-M         │     │ 21MX E-Series   │           │ RTE Assembler │
│ System        │────▶│ Computer        │           │ Reference     │
│ Generation    │     │ Operating and   │           │ Manual        │
│ Manual        │◀────│ Reference Manual│           │               │
│ 92064-90003   │     │ 02109-90001     │           │ 92060-90005   │
└───────────────┘     └─────────────────┘           └───────────────┘
        │
        ▼
┌───────────────┐                                   ┌───────────────┐
│ RTE-M         │                                   │ HP 1000/M Basic│
│ Editor        │                                   │ Language      │
│ Reference     │                                   │ Reference     │
│ Manual        │                                   │ Manual        │
│ 92064-90004   │                                   │ 92065-90001   │
└───────────────┘                                   └───────────────┘
        │
        ├────────────────┬─────────────────┬──────────────────┐
        │                ▼                 ▼                  ▼
        │        ┌──────────────┐  ┌──────────────┐  ┌──────────────┐
        │        │ RTE DVR05    │  │ RTE Operating│  │ RTE DRV33    │
        │        │ for 264X     │  │ System Drivers│  │ for 12732A   │
        │        │ Terminals    │  │ and Device   │  │ Flexible Disc│
        │        │              │  │ Subroutines  │  │ Subsystem    │
        │        │ 92001-90015  │  │ Manual       │  │ 12732-90001  │
        │        └──────────────┘  │ 92200-93005  │  └──────────────┘
        │                          └──────────────┘
        │
        ├────────────────┬─────────────────┬──────────────────┐
        ▼                ▼                 ▼                  ▼
┌──────────────┐ ┌──────────────┐ ┌──────────────┐ ┌──────────────┐
│ 12732A       │ │ RTE/DOS      │ │ RTE-M        │ │ HP 1000/M    │
│ Flexible     │ │ Relocatable  │ │ Software     │ │ Basic        │
│ Disc Subsystem│ │ Library     │ │ Numbering    │ │ Software     │
│ Operating and│ │              │ │ Catalog      │ │ Numbering    │
│ Service Manual│ │ 24998-90001 │ │ 92064-90001  │ │ Catalog      │
│ 12732-90005  │ └──────────────┘ └──────────────┘ │ 92065-90002  │
└──────────────┘                                   └──────────────┘
```

CONTENTS

ILLUSTRATIONS

GLOSSARY OF TERMS FOR RTE-M SYSTEMS

ABSOLUTE PROGRAM - a program that has been relocated through use of the Relocating Loader and can be loaded into CPU memory for execution. An "absolute program" is synonymous with a "relocated program."

ABSOLUTE PROGRAM LOADER (APLDR) - a memory resident program that loads relocated (absolute) user programs into their pre-defined main memory locations, assigns an available ID segment to a program, and makes suitable entries into the ID segment so that the program has access to specific system services. APLDR is automatically called for program loading when using the LO operator command.

ASYNCHRONOUS DEVICE - a device that can perform I/O operations that are independent of time considerations but operates simultaneously with program execution. Interaction with the computer is through request/response circuitry.

BASE PAGE - a 1024-word area of memory containing the system's communication area, system and library links, resident program links and trap cells for interrupt processing. In MIII systems, each partitioned user program has one page for its own base page linking.

BLOCK - two logical disc sectors of 64 words each, totalling a block of 128 words.

CLASS I/O - a method of communication between a set of programs or devices that may be synchronous or asynchronous with respect to each other, in order to provide parallel processing of information. Class I/O allows a program to continue processing after initiating the operation, without requiring that it wait for completion (I/O without wait).

CLOSE FILE - a method of terminating access to a file so that no further read/write instructions may be performed on the file. (See also OPEN file.)

DATA CONTROL BLOCK (DCB) - a table within an executable program that contains information used by the File Management Package (FMP) in performing disc accesses.

DEVICE DOWN - relates to the state of a peripheral device. When the device is down, it is no longer operable. Also refers to the DN operator command, which sets the device down to make it unavailable for system use.

DEVICE UP - relates to the state of a peripheral device. When the device is up, it is operable. Also refers to the UP operator command, which sets the device up after it has been set down.

DEVICE REFERENCE TABLE - a table created during system generation consisting of logical unit numbers that provides logical addressing of peripheral devices. Each LU references an EQT entry and contains subchannel information. The table may be modified by using the operator LU command if desired. (See also Equipment Table and Interrupt Table.)

DIRECT MEMORY ACCESS - see Dual Channel Port Controller.

DUAL CHANNEL PORT CONTROLLER (DCPC) - a hardware capability that permits an I/O process to by-pass the operating system and directly access memory, thus providing a much faster transfer of data. The operating system controls access to the DCPC channels.

DYNAMIC MAPPING SYSTEM (DMS) - a hardware option allowing partitioned systems (only) of addressing memory configurations larger than 32K of physical memory.

ECHO DEVICE - if specified, a device that receives a copy of all user command input entered during system generation or on-line program relocation. RTMGN and RTMLD prompts are also echoed, but have a preceding asterisk (*) to define them as non-executable comments. Therefore, the echo file may be used as a command input file (answer file) for repetitive, automatic (non-interactive) generations or relocations. To use the echo file as a following command input file, the echo file must NOT be assigned to the same device as the MAP output, since the mix will contain data not preceded by an asterisk to define it as non-executable.

EQUIPMENT TABLE (EQT) - a table in memory associating each I/O interrupt location with a particular software processing routine (driver). For a given device, the EQT provides status information, temporary storage and parameter passing services. (See also Device Reference Table and Interrupt Table.)

EXTENDED EQT - a method for increasing the size of an Equipment Table entry, during system generation, that gives the specified I/O driver more words of buffer space than is available in the EQT temporary storage area.

EXTENDABLE FILE - is a file (type 3 and up) that is automatically extended in response to a write request to points beyond the range of the currently defined file. The extent is created with the same name and size, and the access is continued. Extensions will be of the same size as the base file, and all extensions of any given file will be on the same disc. No flags or pointers relating to the next extent are kept in the file area. Open flags are kept only in the base file directory entry.

EXTERNAL REFERENCE - a reference to a declared symbolic name not defined in the software module in which the reference occurs. An external reference is satisfied by searching another object module that defines the reference name by an entry point definition (i.e., a library search).

FILE CLOSED - see CLOSED FILE

FILE EXTENTS - see EXTENDABLE FILES

FILE LOCKED - see LOCKED FILE

FILE OPEN - see OPEN FILE

FILE MANAGER (FMGR) - an RTE-M program that provides file creation, access and manipulation services through FMGR commands entered by the user. FMGR exists in two different versions: one for flexible disc subsystems and one for tape cartridge subsystems.

ID SEGMENT - a block of 31 words associated with each resident program, that is used by the system to keep track of the program's name, software priority field, current scheduling status and other characteristics. Each resident program must have its own ID segment.

INTERRUPT TABLE - a table that interprets a received interrupt and causes the operating system to take one of three possible actions: (1) call an I/O driver, (2) schedule a program, (3) if nothing is found in the table, issue an illegal interrupt message.

LOCAL COMMON - an area of COMMON appended to a program and accessible only by that program, its subroutines or segments.

LOCKED DEVICE - see logical unit lock

LOCKED FILE - a file exclusively opened for one program and therefore not currently accessible to another program. In tape cartridge systems, opening one file on a tape cartridge effectively locks all other files on the tape from use by the program or other programs.

LOGICAL MEMORY - a 32K (maximum) address space described by a currently enabled memory map. If the System Map is enabled, it describes those areas of physical memory necessary for the operation of the system and does not change during system operation. When the User Map is enabled, it is updated to describe those areas needed by programs when it is to be executed. Port A and Port B Maps describe buffers during DCPC transfers. Logical memory is meaningful only for partitioned memory versions of RTE-M.

LOGICAL UNIT LOCK - a mechanism for acquiring temporary exclusive use of an I/O device or devices by a lower priority program, to ensure it's I/O completion before being preempted by a higher priority program.

LOGICAL UNIT NUMBER (LU) - a number used by a program to refer to an I/O device. Programs do not refer directly to the physical I/O device channel number, but through the LU number which has a cross-reference to the device. This allows I/O devices to be changed through operator intervention without having to change the programs or operating system.

MASTER SECURITY CODE - a flexible disc file protection mechanism, established during system generation or changed by the IN command, by which users possessing the master security code may gain access to files, security codes and track and sector addresses of individually protected files. Access is through DL and IN commands in the flexible disc version of the File Manager. Files may be read-only access, no access or unlimited access, depending upon the security code.

MEMORY BASED SYSTEM - an operating system (such as RTE-M) in which neither system modules nor user programs are swapped in and out of memory for execution. Typically, such systems do not permit on-line program development or relocation. Although RTE-M is memory based, it can be configured for on-line loading (tape cartridge system) and/or program development (flexible disc system).

MEMORY PROTECT FENCES - a method for protecting system areas, library areas and (optionally) COMMON areas by preventing stores and jumps to locations below a specified address. For resident programs not using COMMON, the memory protect fence is set at the base of the entire memory area. For programs using COMMON, all of logical memory is mapped and the fence is set at one of three possible locations, depending upon the the portion of COMMON being used.

MEMORY RESIDENT LIBRARY - a collection of reentrant or privileged library routines available to all programs, thus eliminating the need to append the needed routines to each program. All of these routines are fetched from relocatable libraries.

MEMORY RESIDENT PROGRAM - a program that executes from a dedicated area in main memory.

MULTI-TERMINAL MONITOR - a system software module that provides for interactive program development and editing in a multi-terminal environment.

OFF-LINE - refers to use of I/O devices not currently recognized by the main operating system and therefore do not receive system supervision or services.

OFF-LINE GENERATOR PROGRAM (RTMGN) - a combined minimum absolute MI system and RTE-M Generator program used to configure the initial user-defined RTE-M operating system. RTE-M configures and outputs a site-specific absolute RTE-M system in conformance with user specifications received through RTMGN queries and a subset of RTE-M Relocating Loader commands.

ON-LINE - refers to I/O devices recognized and controlled by the main operating system at the time they are being used. Some devices, such as the 2644/5A Display Station terminals, have their own memory module and can be switched from on-line to off-line mode or vice versa at the user's option.

ON-LINE LOADING - refers to the loading of a relocated (absolute) user program into its pre-determined location in main memory at some point in time after the operating system is generated and running. On-line loading requires use of the memory resident Absolute Program Loader (APLDR).

OPEN FILE - a method of gaining access to a specific file to perform a read/write instruction.

PARTITION - a block of memory with a fixed size (in pages) and identification number, and located in the User Program area of main memory. A program partition must have a minimum size of two pages; one page for a base page and one page for the user program. The user program area may be divided up into as many as 64 partitions during system generation. The partitioned memory scheme is available only to MIII versions of RTE-M.

PHYSICAL MEMORY - all of memory that is available to the user. Physical memory includes the operating system, libraries, COMMON, System Available Memory (SAM) and user program area or (for MIII systems) partitioned memory.

PRIMARY SYSTEM - an HP-configured RTE-M operating system that is capable of execution as soon as it is booted into main memory. The Primary System is delivered with HP 1000 Systems (Models 20 and 21) and is configured to match an HP 1000 customer's ordered hardware.

PRIVILEGED DRIVERS - I/O drivers whose interrupts are not processed by the central interrupt controller of the standard I/O processor (RTIOC). Such drivers offer improved response time, but must perform their own internal housekeeping; i.e., saving machine status.

PRIVILEGED INTERRUPTS - interrupts that by-pass normal interrupt processing to achieve optimum response time for interrupts having the greatest urgency. Privileged interrupts are handled by I/O privileged drivers.

PROGRAM STATE - refers to the status of an executable program at any given time. A memory resident user program is always in one of four possible states: executing, scheduled, suspended or dormant.

REAL-TIME EXECUTIVE - a collection of software modules comprising the total operating system; e.g., EXEC, SCHED, RTIOC, I/O drivers and various tables. For all practical purposes, Real-Time Executive, operating system and RTE-M are synonymous terms.

RELOCATABLE LIBRARIES - consists of the following libraries:

System Library (MSYLB) - subroutines that can be appended to each user program and are accessed by system entry points.

DOS/RTE Relocatable Library (RLIB1 and RLIB2) - a collection of utility subroutines that are primarily accessed by FORTRAN programs.

FORTRAN Formatters (FF.N AND FF4.N) - format subroutines for FORTRAN I/O operations.

RELOCATING LOADER (RTMLD) - a user program that sets the communications links and forms an absolute load module from a relocatable program. RTMLD creates the relocated program in conformance with the system snapshot and Relocating Loader commands entered by the user.

RESOURCE MANAGEMENT - an optional feature that allows the user to manage a specific resource shared by a particular set of programs, so that no two of these programs access the resource at the same time.

RESPONSE TIME - the total amount of time (system overhead) required to bring a real-time program or routine into execution in response to an interrupt, interval timer, call from another program or operator call. Response time is usually measured in milliseconds.

RTE-M EDITOR (EDITM) - a user utility program that obtains a source file and permits editing and manipulation of lines of text in response to EDITM control commands entered by the user. Use of the EDITM program also requires presence of the FMP routines in the system.

RTE-M GENERATOR (RTMGN) - a system generation program that is delivered to customer sites in two formats: an absolute version for initially configuring a site-specific operating system (see OFF-LINE GENERATOR PROGRAM), and a relocatable version used for successive reconfigurations.

SEGMENTED PROGRAM - a program consisting of a memory resident main segment that calls its segments from a flexible disc file to overlay one another in the same area of memory where they are executed. Each segment and the main operate as a single program. In RTE-M, the segments share the ID segment of the main.

SELECT CODE - an octal value that specifies the address of an I/O device card.

SESSION CONSOLE - in a multi-terminal environment, the specific terminal from which a program is scheduled for execution.

SOFTKEYS - a feature that permits a user to enter an entire command string by pressing a single function key on the terminal keyboard, thus both reducing the possibility of keystroke error and decreasing the time required in entering commands. The softkeys may be those supplied with the Primary System and/or user-defined softkeys.

SNAPSHOT - a file containing entry points of a program just relocated. A snapshot is required for programs with segments. (See also SYSTEM SNAPSHOT.)

SYNCHRONOUS DEVICE - devices that perform I/O operations in a fixed timing sequence, regardless of the readiness of the computer.

SUBCHANNEL NUMBERS - decimal numbers associated with the LU numbers of devices with multiple functions on the same device. Each subchannel number is associated with a specific subchannel; e.g., a 2645A terminal could have four subchannels: one for the keyboard, one each for the right and left tape channels, and one for an optional line printer.

SUBSYSTEM GLOBAL AREA (SSGA) - an area of memory providing multiple communications and buffering for HP susbsystems. It is accessed by entry point (using EXT statements) rather than COMMON declarations. Programs using SSGA access include the COMMON area in their maps and have the memory protect fence set below SSGA.

SYSTEM AVAILABLE MEMORY (SAM) - a temporary storage area used by the system for Class I/O, reentrant I/O and I/O buffering.

SYSTEM COMMON - an area of memory that is sharable by programs operating in different partitions of main memory. Memory resident programs always include System COMMON in their map to allow inter-program communication.

SYSTEM SNAPSHOT - a file containing a memory map that gives the entry points of the operating system, memory resident programs and address bounds of the space used. A snapshot is required input for programs to be relocated on-line.

TAPE CARTRIDGE SYSTEM - a mix of HP-supplied hardware/software consisting of one or more HP 2644/45A terminals equipped with tape cartridge subchannels as bulk storage devices, and a cartridge tape version of the RTE-M File Manager program to provide file creation, access and manipulation services.

TIME BASE GENERATOR (TBG) - an optional hardware module (real-time clock) that generates an interrupt in 10 millisecond increments. It is used to trigger execution of time-scheduled user programs at predetermined intervals.

TIME OUT - relates to the state of a peripheral device. When the amount of time the system will wait for an I/O transfer for a given device is exceeded (the time is determined at system generation), the device becomes inoperable. The device must then be restored to system use through operator command.

TIME SCHEDULING - the process of automatically scheduling a program for execution at pre-determined time intervals. Program scheduling is established through use of the IT command, and requires the presence of the Time Base Generator in the system.

If you were involved with the selection and ordering of your HP 1000 system, you're probably already familiar with most of its parts. If so, you can safely skip some of the topics in this section. For others, it's useful to familiarize yourself with the major elements comprising the total system before attempting to use its various services and features.

YOUR HP 1000 SYSTEM HARDWARE

There are some differences in the way Model 20 and Model 21 system hardware is packaged. The Model 20 system is installed in an attractive desk, with the system console and optional flexible disc unit that conveniently mount on the table surface. The Model 21 has its main hardware modules, except the system console, mounted in a functional upright cabinet. Extra racking space is provided to house additional hardware products.

COMPUTER

The computer's main function is to perform the computations and control system operation. The computer is a Model 2113A 21MX-E, featuring 64,000 bytes of high-density semiconductor memory (up to 622,000 bytes are available) and powerful sets of firmware instructions (small, permanent microporograms) for fast and reliable operation. This computer also features a power fail recovery system to protect main memory contents from electrical power failure for periods of up to two hours. A complete description of CPU's features and operation is given in the *21MX E-Series Computer Operating and Reference Manual, 02109-90001.*

SYSTEM CONSOLE

The 2645A Display Station is your primary device for directly and personally communicating with the total system to get service. It consists of a standard typewriter keyboard, plus special sets of control keys and function keys, an information video display screen, two drives for magnetic tape mini-cartridges used for information storage, and its own internal memory module.

On systems with multiple terminals, the 2645A unit assigned to logical unit number 1 (explained later) is always the main system control station, and is referred to as the system console. Other 2645A units that may be present on the system are remote user stations only. Complete descriptions and instructions for operating the terminal are given in the *2645A Display Station Users's Manual,* which should be conveniently located near the terminal for ready reference.

Descriptions of the Display Station features that are specifically available to HP 1000 users are defined under various control command descriptions in the *RTE-M Programmer's Reference Manual* and *RTE-M Pocket Guide.*

Information regarding the terminal's programmable features and accessories installation is given in the *2645A Display Station Reference Manual.* It is suggested that this manual be kept under controlled access so that it is always available when specifically needed.

FLEXIBLE DISC DRIVE

Although actually an option for HP 1000 systems, a 12732A Flexible Disc drive is very desirable for adding a higher level of mass storage and input/output capability to the system. It also provides more powerful on-line program development via a FORTRAN compiler, HP Assembler, a program source editor (EDITM), and a capability for writing segmented programs. However, HP 1000 systems without the flexible disc option can write user programs through use of the included HP 1000/M BASIC Interpreter.

OPTIONAL EQUIPMENT

The *HP 1000 Computer Systems Configuration Guide* gives the complete list of compatible equipment additions that are available for your system. Two desirable equipment options are a line printer for program development, report processing or data output, and additional flexible disc drives for faster and easier file handling and increased mass storage.

YOUR SYSTEM SOFTWARE

The set of software supplied with each HP 1000 system comes in both pre-configured and relocatable format. The term "pre-configured" means that HP has already relocated certain software modules for you that match your ordered hardware. You merely have to boot in (load into memory) such an absolute load module to begin executing it. Your HP 1000 Primary operating system (described later) is a typical example.

Relocatable software modules are user programs that you add to the system either through on-line relocation using the RTE-M Relocating Loader and system snapshot, or through complete reconfiguration (system generation).

The system software is delivered on flexible discs and/or mini-tape cartridges, depending on whether or not your system was ordered with a flexible disc drive (option 32).

a. Mini-cartridge based systems have all their software delivered *only* on cartridge tapes, and the programs are specifically designed for such systems. No attempt should be made to use these programs for disc applications (for instance, the mini-cartridge version of the File Manager program cannot be used to manipulate files on a flexible disc unit).

b. Flexible disc systems have most of their software on flexible discs, with a few utility programs on mini-cartridges. Such systems have all the software necessary to build both mini-cartridge based and disc based systems.

HP 1000 PRIMARY SYSTEM

As an HP 1000 owner, you receive an operating system already configured for your unique set of ordered equipment, whether flexible disc or tape cartridge based. This software is called the *Primary System,* and it's the cornerstone of your software building blocks. Most of this manual is concerned with showing you how to load, execute and build upon the Primary System.

Once the Primary System is booted into main memory, it offers:

- Immediate operation of your system.

- Demonstrations of system capabilities by executing available user programs.

- A base for a larger system as more programs are added on-line through use of the Relocating Loader.

- A capability for creating and adding user-written FORTRAN or HP Assembly Language programs if a flexible disc is available, or implementing user-written HP 1000/M BASIC programs on Primary Systems restricted to a mini-cartridge configuration.

- A capability for creating other systems precisely tailored to your specific applications using the RTE-M Generator, after you relocate the Generator for the Primary System.

YOUR HP-CONFIGURED USER PROGRAMS

We have already configured a number of user programs for you as part of your Primary System. These programs are relocated on either flexible disc or mini-cartridge media, depending on which was ordered with your HP 1000 system. The available user programs are as follows:

- APLDR — Absolute Program Loader — Used to load programs into main memory after they have been relocated for the system, using the system snapshot and Relocating Loader (RTMLD). Within the RTE-M context, a "relocated program" is synonymous with an "executable program" or "absolute load module" and is the only type of program that APLDR will load into memory.

- D.RCR or D.RFP — Directory Manager — Manages all accesses to file directories on either flexible discs or mini-cartridges.

- MAUTO — Power Fail Restart — Provides automatic system recovery after a power failure.

- RTMLD — RTE-M Relocating Loader — Creates absolute versions of relocatable program, subroutine and library modules that can be executed on an RTE-M system. This program will be used to perform on-line additions to your Primary System or any other RTE-M system.

- FMGR — RTE-M File Manager — Operator interface program for file handling and manipulation under user control.

- STRTM — Initialization and Start-up program. It loads specified programs into main memory and executes selected programs upon system boot up.

- KYDMP — Softkey Configurator — Sets up display terminal softkeys and labels, based on files created by the KEYS softkey definition program.

- BASIC/1000M — RTE-M version of BASIC Language Interpreter — Allows you to create and execute BASIC Language programs on your system.

The term "relocated" in this context means that you merely have to load any one of the above listed programs into memory from disc or tape to execute it. You load the program by typing the system command

　　　LO, *program file name* ▆▆▆

to get the program into memory and then type a RUN command to schedule the program for execution. The format for the RUN command differs slightly between non-partitioned memory and partitioned memory configurations, and will be described in detail later in this manual.

If your HP 1000 system was ordered as a multi-terminal configuration, the following user programs will also be included as part of your configured Primary System:

● PRMPT and RPN — These programs acknowledge user terminal interrupts, issue a prompt for an operator response and take following action upon receiving an operator's input.

● ONMTM — This program enables terminals on the HP 1000 system.

For a 1000 System Model 20 and 21, the Primary System is supplied on separate mini-cartrdiges or flexible discs and labeled as defined in Appendix A, "Configured System and Files" at the back of this manual.

YOUR STANDARD RELOCATABLE SOFTWARE

Relocatable programs are programs that require processing through use of Relocating Loader commands and the system snapshot before you can load them into memory for execution. In conformance with the system snapshot, the Loader sets up the communication links between the relocatable program and the system to form an absolute program, often referred to as an absolute load module.

FINDING RELOCATABLE FILES

How do you locate the specific flexible disc or mini-cartridge among the supplied sets that contains the progran to be relocated or library file to be searched? You'll need to reference the *RTE-M Software Numbering Catalog* located in the HP 1000 Binder Set. Check the the Master Table of Contents on the first page in Volume 1 of the Binders to find which volume contains the Numbering Catalog. In that manual, software modules are listed in two different ways: a numerical listing by part number, and an alphabetical listing by file name. Locate the file name of a desired module in the alphabetized listing and look across to the disc or mini-cartridge column for the disc or mini-cartridge Part Number. Locate this disc or tape from your set and mount it at the appropriate time during relocation or loading.

In flexible disc systems, 92064-13401, 92064-13402 and 92065-13401 are conveniently organized discs containing standard programs, subroutines and library modules in a relocatable format. These are used for on-line relocation or for relocating during a system generation.

The files !MCGEN (mini-cartridge version) and !MFGEN (flexible disc version) are absolute RTE-M systems with an included RTE-M Generator. In the *RTE-M System Generation Reference Manual*, these absolute files are referred to as the "Off-Line Generator." These systems are specifically designed for performing system generations if the currently configured system is not capable of running the RTE-M Generator. See the *RTE-M System Generation Reference Manual* for detailed boot-in procedures.

OFF-LINE DIAGNOSTICS

The various diagnostic programs are on mini-cartridges whether your system was ordered with or without a flexible disc susbsystem. Such program are used when equipment failures and malfunctions are encountered. Refer to the *Diagnostic Configurator Manual* (02100-90157) in the HP 1000 Service Binders supplied with your system for complete operating information.

RTE-M BASED 1000 SYSTEM UTILITIES

Softkey function programs are supplied that allow you to modify or create softkey definition files. You'll be told how to use supplied softkeys later in this manual, and other information is provided in the *2645A Display Station User's Manual* and *RTE Utilities Reference Manual*.

HP 1000 DOCUMENTATION SETS

All documentation for both hardware and software is supplied in a set of loose leaf binders. Some of this documentation should be located near the system for ready access by any user; other portions should be available for controlled access. Generally, it's a good idea to have someone at your installation delegated to maintain the documentation sets so that the manuals always reflect the current software.

A good general procedure is to have all software and operations reference manuals readily available to any user of the system, and all other manuals, such as hardware, maintenance and service manuals under controlled access. Controlled access for some documentation becomes critical in cases of equipment or software malfunction, so that it is always available for fast reference.

Manuals that should be on hand for any system user (depending upon how your system is configured) are as follows:

- *2645A Display Station User's Manual,* for users of either the system console or remote terminal in a multi-terminal environment. The manual is used in both flexible disc and mini-cartridge configurations.

- *12732A Flexible Disc Subsystem Operating And Service Manual,* for anyone using this device for I/O files.

- *RTE-M Programmers's Reference Manual,* for anyone who interacts (communicates) directly with the system via operator commands for program development services or system control and status reports.

- *RTE-M Software Numbering Catalogs,* for on-line program relocation and loading. Generaly required to find the correct file name of the module to be relocated and the specific mini-cartridge or flexible disc that contains the software module.

- *RTE-M Pocket Guide,* for fast reference information. Ideally, every active system user should have a personal copy.

- *RTE-M Editor Reference Manual,* used primarily during program development for editing lines of text in program source files.

- *HP 1000/M BASIC Reference Manual,* required for anyone writing programs using the HP 1000M BASIC Interpreter. BASIC is the program development language available for mini-cartridge HP 1000 systems.

- *HP FORTRAN Reference Manual* (FORTRAN II), required reference for anyone writing FORTRAN programs.

- *RTE Assembler Reference Manual,* required for anyone writing programs in assembly language.

- *21MX E-Series Computer Operating and Reference Manual,* required by anyone needing detailed information about the computer's operation and capabilities. The manual will also be required by Assembly Language programmers for its descriptions of the machine language Instruction Set.

- *RTE Utilities Reference Manual,* required for operating and programming information of supplied utility programs (i.e., softkey function programs).

All other manuals should be under the control of the system manager or person designated as librarian.

A list of the supplied manuals and their location is given in the "Manual And Software Record" page in the front of Volume 1 in the HP 1000 Binder Set of documents.

If your installed system equipment is already running and you're familiar with using the various hardware equipment, you can skip most of the items in this description and go on to "Loading Primary System From Disc/Tape." If not, here's a set of detailed procedures for turning on your hardware modules prior to booting in your Primary System.

1. TURN ON THE MAIN POWER

Before you can turn on the various components of the system, the main power must be turned on. At rear of the desk cabinet or top right of the upright cabinet, there is a power switch. Turn the switch to ON. Make sure the 21MX-E power switch at the rear of the computer is ON. At the same location, check that the Battery Switch is ON and the battery plugs are inserted in their receptacle.

2. SET TO OPERATE

At the front control panel of the 21MX-E processor, turn the key to RESET, STANDBY, and then OPERATE position. The key cannot be removed when it is in the correct position.

3. TURN ON SYSTEM CONSOLE

The ON/OFF switch for the 2645A Display Station is located at the rear of the terminal beneath the protective cover. Switch to ON. A TERMINAL READY message will gradually appear on the display screen to indicate the terminal is ready for operation.

For maximum efficiency, make sure the baud rate is set at 9600. If you plan to read long lists of data from the display screen, the baud rate can temporarily be set lower for more leisurely reading. Also ensure that the DUPLEX switch is on FULL, and PARITY switch is set to NONE.

If the terminal is to be operated in remote mode (directly communicating with the system), press the REMOTE and CAPS LOCK keys to the down position, with the AUTO LF (line feed) button up.

If the terminal is to be operated in off-line mode (temporarily disconnected from the central processor) the REMOTE key must be up and the AUTO LF key down.

If mini-cartridges are to be inserted in the cartridge tape units (CTU's) make sure an input tape is write protected and/or an output tape is set to RECORD. To avoid possible confusion in tape handling, it is good practise to always insert input tapes in the RIGHT hand CTU and output tapes in the LEFT. All tape handling instructions in this manual assume the rule is followed.

However, this convention is purely for operator convenience. In actual practice, both the right and left CTU's can be used for either input or output.

4. TURN ON FLEXIBLE DISC

Press the switch on the front of the flexible drive to ON. The power light at the front of the panel will glow to indicate the drive is ready.

If there is more than one flexible disc drive on the system, make sure that drive 0 is on. The Drive Select switch (slotted for turning with a screw driver) at the rear of the drive will be set to 0.

5. USING COMPUTER CONTROL PANEL

If all the steps listed above have been followed, as appropriate, you're now ready to boot in your Primary System from either disc or mini-cartridge. Before you can load either version into main memory, you need to familiarize yourself with the 21MX-E computer front panel. Figure 2-1 shows a detailed drawing of the panel with an explanation of the various switches and indicator lights. If you're already familiar with the front panel, skip the explanation and go directly to the appropriate (mini-cartridge or flexible disc) loading procedure.

It's not necessary to completely understand the functions of all these components to boot in your system. For now, you need only know enough to load the correct ROM bootstrap loader for your input device. The ROM Loader, in turn, boots in your system. If you want more details about the front panel than is given here, refer to the *21MX E-Series Computer Operating and Reference Manual*.

The triangular flags shown in Figure 2-1 will also be used in the step-by-step procedures for booting in your Primary System. Refer back to them as needed.

LOADING PRIMARY SYSTEM FROM DISC

If you're booting up your HP 1000 system for the first time, you should study and follow the step-by-step procedures described below. For subsequent system boot-ups, you'll probably find it easier and faster to use the quick summary procedures given in the "Flexible Disc Boot-Up Summary" at the end of this topic.

All flexible discs containing HP-supplied software are delivered with mounted paper Write Protect tabs. RTE-M requires the presence of these Write Protect tabs on all discs used by the system (including supplied blanks). If any disc on your system does not have a Write Protect tab, make sure one is mounted at the indicated place on its jacket before using the disc.

1. Locate the Primary System disc from your set of supplied software. Use caution in handling this disc, since it was specifically customized to your specific hardware. Therefore, the Primary System disc be kept in a secure location for controlled access when not in use to prevent accidental mishandling.

2. Lift up the door at the front of the disc drive (drive 0) by pressing the lower bar. The door on the drive will flip open. With the labeled side up and the oblong slot closest to the door, carefully insert the disc until it is locked firmly in place and close the door.

3. At the computer front control panel, turn the OPERATE key counterclockwise to R (reset), then back through STANDBY to OPERATE position $\underline{/A\backslash}$.

4. Press HALT on switch $\underline{/D\backslash}$ (lower half of switch).

5. Set Register Select light to S using switch $\underline{/F\backslash}$ (right or left).

6. Press CLEAR DISPLAY on switch $\underline{/G\backslash}$ (lower half), and set bits 6 through 11 of the Display Register $\underline{/C\backslash}$ to the octal select code for the flexible disc.

    This number can be found by checking the system configuration label mounted on the inside of the front cabinet door.

Figure 2-1. The 21MXE Front Panel
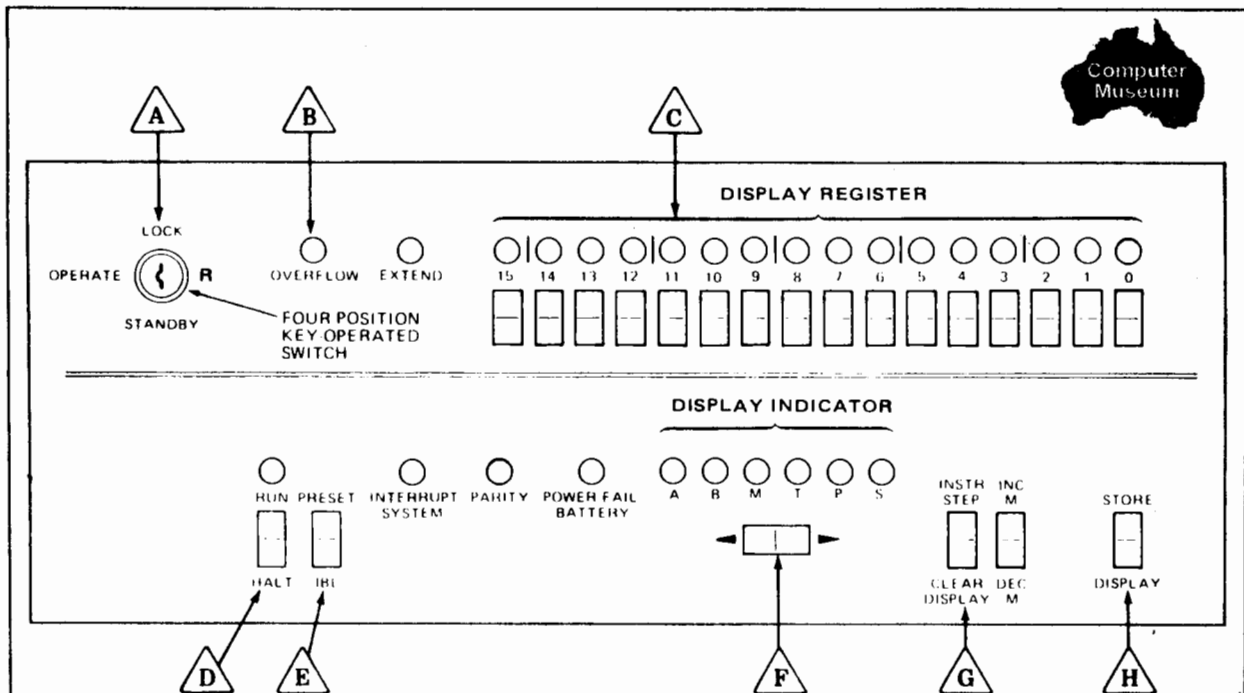
A STANDBY/OPERATE/LOCK/R

A four-position key-operated switch, STANDBY sustains memory and charges the battery when other power is off. Use when changing I/O cards in computer. You must reload system after STANDBY.

OPERATE applies power, key is not removable. Normal position when running computer to test programs.

LOCK is same as OPERATE except D is disabled; key is removable. Use to prevent someone halting system.

R resets after power goes off. Key must be turned to R after power off and before turning to another position. It restores memory power and causes memory to be cleared upon power up. Turn key counterclockwise to R; it will snap back to STANDBY.

B OVERFLOW

Lights if arithmetic overflow occurs. Usually can be ignored except during loading when it indicates an error in the initial binary loader, IBL.

C DISPLAY REGISTER

Shows content of S register when computer is running, of selected register when halted. Press upper half of switch to set a bit to 1, lower half to set bit to 0. Light turns on when bit is set to 1.

D RUN/HALT

Press RUN to begin programmed operation; press HALT to stop.

E PRESET/IBL

Press PRESET to initialize computer, clear the parity, overflow and extend bits, and turn off interrupt system while halted. Press IBL to write loader ROM (read-only-memory) into memory. (See *21MX-E Operator's Manual* for IBL details).

F REGISTER SELECT

Selects register to display on C. Press right half of switch to move lighted selection to right; left half to move it to left. Light wraps around at either end of row.

G INSTR STEP/CLEAR DISPLAY

Press INSTR/STEP to execute current instruction and advance P register to next instruction. If T lights when not selected, there is infinite indirect addressing and P register is not advanced. CLEAR DISPLAY clears each bit in display register C to zero; operates only during halt.

H STORE/MODE

You must press STORE to move contents of display register C to register selected by F. If T selected, contents are stored in memory at address in M register; M is incremented by 1; display is unchanged. Press MODE to select the alternate Display Register Set using F.

7. Set bits 15 and 14 to ON, and bit 0 to ON.

8. Press STORE on switch /H\ (upper half).

9. Press IBL on switch /E\ (lower half).

10. Press PRESET on switch /E\ (upper half), and press RUN on switch /D\ (upper half).

If you have followed the procedures correctly, the system will be loaded into main memory. The DRIVE SELECT light on the disc unit will glow. Should the system come to a halt with 102011 displayed in the computer's Display Register, a checksum error is indicated. Begin the boot-in procedure over again.

A successful load will first be indicated by a SET TIME message appearing on the display screen (ignore it for now). Completion of load will be indicated when the HP-supplied softkey functions are displayed on the console screen, as follows:

PROGRAM LIST	PARTITION LIST	BASIC KEYS	LOADER KEYS
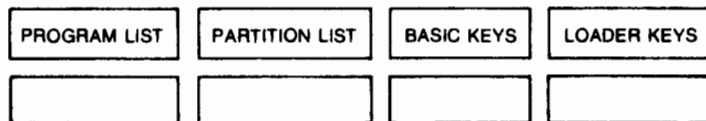
Your RTE-M Primary System is up and running!

Skip to "Checking Your System's Status" in Section III for your first steps in system operation.

FLEXIBLE DISC BOOT-UP SUMMARY

1. **Insert Primary System disc into drive. Turn CPU key to R, then back to OPERATE; press HALT.**

2. **Set Register Select to S; CLEAR DISPLAY; set bits 6-11 of Display Register to disc drive octal select code.**

3. **Set bits 15, 14 and 0 to ON.**

4. **Press STORE, IBL, PRESET and RUN.**

LOADING YOUR PRIMARY SYSTEM FROM MINI-CARTRIDGE

If you're booting up your HP 1000 system for the first time, you should study and follow the step-by-step procedures descibed below. Thereafter, it will be easier and faster to use the quick summary procedures described in "Mini-Cartridge Boot-Up Summary" at the end of this topic.

READING FILE DIRECTORIES

Each one of the mini-cartridges containing HP-supplied software (except Diagnostics) has a File Directory as its first file. This file cannot be read by the 12299C ROM Loader during the boot-up procedure. Therefore, you need to read past the first file BEFORE booting in the Primary System.

1. Locate the Primary System mini-cartridge (label no.1) and insert it into the right-hand tape channel of the Display Station.

2. Put the Display Station in LOCAL mode by setting the REMOTE key in the up position. Press the CAPS LOCK key to the down position.

3. Press the RESET TERMINAL button twice in rapid succession to clear terminal memory and to rewind all mini-cartridge tapes mounted.

4. Press the GOLD key, ▓ function key (FROM: R.TAPE), ▓ function key (TO: DISPLAY) and then the READ key. (Selection of the right tape channel is purely arbitrary; if left tape channel is used, press ▓ instead of ▓ .)

The Directory File at beginning of tape will now be displayed on the console screen, and the tape is positioned at the beginning of the Primary System file.

5. Press the REMOTE button down to put the console under computer control.

MINI-CARTRIDGE BOOT-UP

You are now ready to boot your Primary System into main memory.

1. At the computer front control panel, make sure the key is turned turned to OPERATE position /A\ (see Figure 2-1).

2. Press HALT on switch /D\ (lower half of switch), and set Register Select light to S by using switch /F\ (right or left).

3. Press CLEAR DISPLAY on switch /G\ (lower half), and set bits 6 through 11 of the Display Register /C\ to the octal select code of the system console.

   This number can be found by checking the System Configuration Label mounted on the inside of the front cabinet door.

4. Set bit 14 to ON (bit 15 must be set to zero; that is, "off").

5. Press STORE on switch /H\ (upper half); then press IBL on switch /E\ (lower half).

6. Press PRESET on switch /E\ (upper half); then press RUN on switch /D\ (upper half).

If you followed the procedures correctly, the system will be loaded into main memory. Loading will be indicated by the blinking of the green tape channel indicator light.

If the system comes to a halt with 102011 displayed in the computer's Display Register, it indicates a checksum error. You'll then have to begin the entire procedure over again, including the off-line reading of the File Directory on the mini-cartridge.

A successful load will first be indicated by a halt of 102077 in the Display Register. At this point, perform the following steps:

1. Remove the Primary System tape and insert cartridge 4 in the left CTU (Cartridge Tape Unit) and cartridge 2 in the right CTU.

2. Select the P register; press CLEAR DISPLAY; bit 1 on; press STORE.

3. Press PRESET; then press RUN.

A SET TIME message will appear on the display screen (ignore it for now). Completion of the load will be indicated when the HP-supplied softkey functions are displayed on the console screen as follows:

PROGRAM LIST	PARTITION LIST	BASIC KEYS	LOADER KEYS
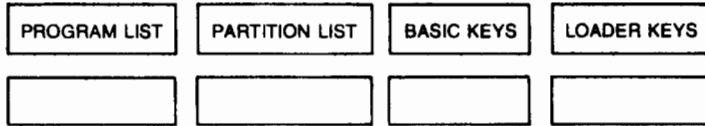
Your RTE-M Primary System is up and running!

Go on to the next topic for your first steps in system operation.

MINI-CARTRIDGE BOOT-UP SUMMARY

Reading Past File Directory:

1. **Insert Primary System mini-cartridge (tape 1) into left CTU.**

2. **Put terminal in local mode by "upping" REMOTE key and put CAPS LOCK key down.**

3. **Press RESET TERMINAL twice in rapid succession.**

4. **Press GOLD key; f1; f7 and READ key. When File Directory is displayed on screen, press REMOTE key down (on-line mode).**

Booting In:

1. **Turn CPU key to R (reset) and then back to OPERATE; press HALT; set Register Select to S; CLEAR DISPLAY; set bits 6-11 to octal select code of system console.**

2. **Set bit 15 to OFF and bit 14 to ON.**

3. **Press STORE; IBL; PRESET and RUN.**

4. **When halt 102077 appears in Display Register, remove Primary System tape. Insert cartridge 4 in left CTU and cartridge 2 in right CTU.**

5. **Select P register; CLEAR DISPLAY; set bit 1 to ON; press STORE, PRESET and RUN.**

CHECKING YOUR SYSTEM STATUS

'

Let's use a few simple commands to find out what user programs were loaded with the Primary System and therefore available for immediate use.

Press any key on the standard console keyboard to get the system's attention.

The system will respond by displaying an asterisk on the display screen:

*

to inform you that it is ready to receive your operator commands.

In all control command examples described in the rest of this manual, underlined portions indicate what you must enter (do not actually underline any portion of a command). Lower-case parameters shown in italic type indicate that you must fill in the characters required for the parameter.

To display all the user programs currently in memory, simply type the Program List command

*PL **RETURN**

where **RETURN** is the carraige return key. The Primary System will display a list of currently available programs in the following format (your system may have slight variations in memory bounds and may have additional programs):

```
PROGRAM LIST: NAME, PRIORITY, MAIN, BASE

APLDR      40 32131 40125     34     127
D.RFP       1 40126 42312    130     172
AUTOR       1 42313 42627    173     172
KYDMP      10 32000 36162      2      43
BASIC      90 32000 64342      2    1115
6 BLANK ID SEGMENTS
```

If your HP 1000 system was ordered with an HPIB, the following program will also be listed:

```
SRQ.P
```

If your HP 1000 system was ordered with a multi-terminal monitor capability (equipped with a system console and one or more additional user station terminals), the following programs will also be listed:

```
PRMPT
R$PNS
ONMTM
```

If your HP 1000 system has partitioned memory (MIII), you'll want to list the partition-resident programs and partition sizes. Again press any key to get the system's attention. After the system responds with an asterisk prompt (*), type the command

    *PL,,1 ▣▬▬

and the list of partitions and partition-resident programs will be displayed. The list will vary, depending upon how your system was ordered and the available memory size. However, the information will always be displayed under the following headings:

```
PTN# R SIZE     PAGES     PROGRAM

   1    16    21 - 36    BASIC
   2    14    37 - 50    <NONE>
   3    13    51 - 63    <NONE>
```

If you're not sure whether or not your system has non-partitioned memory or partitioned memory, use of the PL,,1 command will tell you. For a non-partitioned system the command will simply cause a repeat of the program list display; for a partitioned system, the command causes a partitioned memory display similar to that above.

CONTROL COMMAND ERRORS

If you make a keystroke error while typing in a control command, simply backspace using the BACK SPACE key and retype the command from the point of error. Alternatively, press the SHIFT/DEL (delete) keys and reenter the entire command.

CHECKING STATUS WITH SOFTKEYS

To get acquainted with the use of softkeys, let's perform the same system status checking operations described above, but this time we'll use supplied softkeys instead of the typed commands.

A softkey provides the extremely useful function of executing a frequently-used operator command string by pressing a single key.

A softkey can be configured to issue a command string of up to 80 characters to the system or user program. The advantages of softkeys are speed, convenience and a significant decrease in errors when typing commands.

A number of softkeys have been pre-defined for your Primary System. Appendix C of this manual gives a definition of the standard softkeys supplied. You can redefine and/or add to the supplied set for yourself as the need is established. See the *RTE Utilities Reference Manual* for operation of the Softkey Definition Program (KEYS). The *2645A Display Station Reference Manual* also has relevant information (Section II) regarding softkey programming.

To get the system's attention for a softkey operation, any key can be pressed, but for user convenience we recommend a standard practise of pressing either the ▣7▣ , ▣8▣ or ▣9▣ key in the set of numbered keys to the right of the standard keyboard. They're conveniently located near the "f" keys used for softkeys. When the system responds with its asterisk prompt, you merely have to press a single softkey to cause execution of the corresponding command string.

To initiate a softkey definition, press:

■ ■ system responds with an asterisk and outputs the characters defined for ■ to the system. This is identical to keying in the PL command to get the same program list displayed previously.

■ ■ gets prompt (*) and outputs the PL,,1 command to the system and the partition list is displayed if you have a partitioned system.

The PL command is itself so short that the softkey version may not seem all that advantageous. Our main intent here is to introduce you to the use of softkeys.

In the supplied softkeys, ■ has been defined (in all but the initial set) to reset the keys to the original set of softkey labels (those displayed when you booted in the Primary System). Thus, when you are in one of the other sets of softkeys, the sequence

■ ■ gets system attention and resets the keys to the original set of softkeys that were displayed on the console screen. You may now select a new set of softkey definitions to use. use. Each time you wish to send a command to the SYSTEM via a softkey, you must first get the system's attention by pressing a key (i.e., ■ or your own preferred equivalent) and wait for the * prompt. The softkey command (selected "f" key) may then be pressed.

Conversely, if the softkey is issuing commands to a PROGRAM rather than to the system, a sofkey may be pressed directly WITHOUT getting the system prompt, since no system attention is involved. In the supplied softkey files, the Reset ■ key always requires a preceding * prompt, since it is a system command.

FINDING YOUR AVAILABLE SOFTKEYS

When you define a set of softkey functions on the terminal screen, notice that there are always two rows of four softkeys. These correspond exactly to the two rows of four "f" keys on the console keyboard. Thus, you need only check the positioning of a desired function in the display to know which "f" key to press for the desired softkey.

SOFTKEY ERROR RECOVERY

When using softkeys, you may suddenly find that the console keyboard is "locked" and does not respond to any command or softkey. This is caused by attempting enter a softkey "f" function without first pressing some key (i.e., 7,8 or 9) to get system attention.

To release the keyboard, simply press the RESET TERMINAL button ONCE! Do *not* press this key twice, since such action will clear terminal memory and erase the softkeys. The keyboard will now function properly and the correct softkey sequence can be entered.

If the softkeys are accidently erased through pressing the RESET TERMINAL key twice, enter the command

   *RUN,KYDMP,,&O,RG,KY ■

to restore the softkeys on the terminal and continue normal processing.

EXECUTING SUPPLIED USER PROGRAMS

Now, let's try scheduling and executing a sample program, using a mix of control commands and softkeys. If you have a mini-cartridge system, inset cartridge 4 of your supplied set into the left CTU and cartridge 2 into the right CTU. No action is necessary if the Primary System disc is mounted on a flexible disc based system.

RUNNING BASIC WITH SOFTKEYS

The BASIC Interpreter was automatically loaded into memory by the Start-Up program when your Primary System was booted in, and is therefore available for writing your own programs. To demonstrate BASIC execution using softkeys, let's write a simple program using the sequences given below:

Enter softkeys ▇ ▇ to get the system's attention (*) and specify the BASIC softkeys. Wait for new softkey definition setup and labels to be output on the console display screen as follows:

RESET KEYS	LOAD PROGRAM -lu	LIST PROGRAM	SAVE PROGRAM -lu
RUN PROGRAM			END BASIC
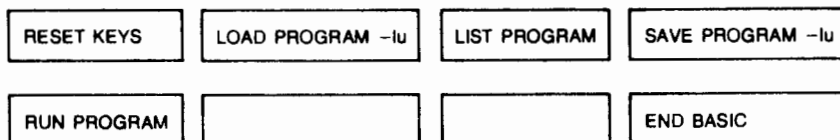
Now type the command

    *RUN,BASIC ▇

to schedule BASIC for execution. BASIC will respond with the message

    BASIC READY
    >
where > is BASIC's prompt character.

Type in the BASIC program given below:

```
10    DIM A$(20)  ▇
20    A$=''THIS IS BASIC''  ▇
30    PRINT A$  ▇
40    END  ▇
```

Now press softkey ▇ to list the program. Observe that your program is now listed on the display screen as received by BASIC and can be checked for errors.

Enter softkey ▇ to run the program and watch the program executing. The message

    THIS IS BASIC

will be printed on the terminal.

Enter softkey ▇ to exit from BASIC and return to system control. The message

    BYE

will be displayed on the screen.

Enter softkeys ▇ ▇ to get system prompt and reset the softkeys. You are now back to the original softkey set.

See the *HP 1000/M BASIC Language Reference Manual* for full details on using the BASIC Interpreter.

RUNNING OTHER SUPPLIED PROGRAMS

Since BASIC is automatically loaded into memory when the Primary System is booted in, we did not have to load BASIC via a LOAD command before we typed the RUN,BASIC command in the previous simple example. However, other supplied programs are NOT loaded automatically with the system, and must be loaded into memory from some input device (disc or tape) before they can be executed.

If you wish, the system start-up file &STRCM can be modified to load and execute additional programs upon system boot-up. See Appendix I of the *RTE-M System Generation Reference Manual* for the procedures.

Before going on to the loading and execution of other programs, you first need to know how to access I/O devices and how some simple LOAD command format options are used in non-partitioned and partitioned program loading.

INPUT/OUTPUT DEVICES

You address a particular I/O device through a numerical parameter you specify in some control command. This numerical parameter is called a Logical Unit Number in all RTE-M documentation, and each such number is assigned to a specific device that you want to input (read) from or output (write) to. Input and output devices are assigned their respective LU numbers when the RTE-M system is generated, and the numbers are thereafter used to address their devices.

Logical Unit Numbers are decimal integers between 0 and 63. Numbers 1 through 6 are referred to as "standard" LU's and are generally assigned to the following devices (and are so assigned in your Primary System):

    1 — system console (2645A keyboard and display screen)

    2 — system mass storage (flexible disc if present on system)

    3 — auxiliary mass storage (2nd flexible disc)

    4 — standard output device (e.g., left 2645A CTU)

    5 — standard input device (e.g., right 2645A CTU)

    6 — standard list unit (usually line printer or console display)

Logical Unit Number 0 is not associated with any particular device; it has a special purpose internal to the system. The remaining LU's (7-63) may be assigned to any type of device.

It is important to realize that you can reassign any LU number from one device to another (except LU 1, the system console) in case one device is down, or even for mere user convenience. See the LU and EQT control commands in the *RTE-M Programmer's Reference Manual* or *Pocket Guide* for details.

USING THE ABSOLUTE PROGRAM LOADER (APLDR)

A relocated user program is loaded into main memory from a flexible disc or mini-cartridge through the Absolute Program Loader. This Loader is always memory resident and is the only program that is not scheduled for execution through use of a RUN or ON command. Instead, the LOad command is used for loading into both non-partitioned and partitioned memory. The format of the LO command is slightly different for each of these two configurations however. Read whichever the following two sets of instructions is appropriate for the function you wish to perform.

LOADING PROGRAMS INTO NON-PARTIONED MEMORY

Get the system's attention by pressing any key. When the system prompts with an asterisk, enter the command

    *LO,*program file name* [,*sc* [,*drn*]] ▉

where the file name is the name of the program to be loaded and the optional parameters have the following meaning:

    sc   is the file security code (normally 0 for supplied software)

    drn   is a positive disc reference number(+), a negative mini-cartridge number, or negative disc LU.

Refer to the *RTE-M Programmer's Reference Manual* or *Pocket Guide* for more detailed format considerations.

The program will be loaded and the message

    APLDR DONE– xxxxx

will be displayed on the console screen, where xxxxx are the first five characters or less of the program file name. This name must be used when referring to the program in any following system commands.

LOADING PROGRAMS INTO PARTITIONED MEMORY

Get the system's attention by pressing any key and when it prompts with an asterisk, enter either the command

    *LO,*program file name* [,*sc* [,*drn* [,*prt #* [,*size*]]]] ▉

         or

    *LO,*lu number* [,,,*prt #* [,*size*]] ▉

where the file name is the name of the program to be loaded and the optional parameters have the following meaning:

sc   is a file security code (normally 0 for supplied software)

drn   is a positive disc reference number (+), a negative mini-cartridge LU number or negative flexible disc LU

prt #   is the number of the partition in which the program is loaded

size   is the partition size (in decimal number of pages) required by the program.

If none of the above optional parameters are specified, APLDR will attempt to load the named program into the first empty partition found.

If a particular partition is specified for the new program and another program is already located in that partition, APLDR will output the error message

> APLDR — REM program file name

and come to a pause. The occupying program can be removed from its partition and replaced with the new program be entering the commands

> *OF,*program name*,8 `RETURN`
>
> *GO,APLDR `RETURN`

to continue loading the new program. Note that the previously loaded program is now lost to your system and would have to be reloaded into memory from some storage device before it could be executed.

When APLDR completes its load, it will output the message

> APLDR DONE— xxxxx

where xxxxx are the first five characters or less of the loaded program's file name. This name must be used when refering to the program in any following commands.

Let's now try an actual loading example.

RUNNING THE FILE MANAGER

The File Manager (FMGR) program offers you the ability to manipulate program and data files from the console keyboard. The full range of File Manager services, commands and parameter options are described in the *RTE-M Programmer's Reference Manual* and *Pocket Guide*. The FMGR commands described below will introduce you to a few of the available file manipulation services.

Before the File Manager can be scheduled for execution it must be loaded, and the command sequence used for a non-partitioned memory configuration differs slightly from that used in partitioned memory.

If you're loading FMGR on a mini-cartridge system, make sure cartridge 4 of your set is in the left CTU and insert cartridge 3 into the right CTU. Get the system's attention by pressing any key and when the system prompts with an asterisk, enter the command

*RC,R ▮▮▮▮

to logically remount the right mini-cartridge. This informs the system that a new tape is mounted.

If you have a disc-based system, you already have the Primary System disc mounted, and this contains the FMGR program ready for loading.

LOADING FMGR INTO NON-PARTITIONED MEMORY

Enter the command

*LO,FMGR ▮▮▮▮

and you will then get the following message displayed on the console screen:

APLDR — REM program name

where program name is the name of the program that APLDR wants you to remove from memory so that it can load FMGR in its place. Enter the commands

*OF,*program file name*,8 ▮▮▮▮

*GO,APLDR ▮▮▮▮

and APLDR will off the current program and load the File Manager. A successful load will be indicated by the message

APLDR DONE– FMGR

displayed on the console screen. Skip to the subsection entitled "Running The File Manager" given below.

LOADING FMGR INTO PARTITIONED MEMORY

Check if FMGR is already in partitioned memory by entering the command

*PL,,1 ▮▮▮▮

or using the softkeys

▮ 7 ▮ ▮ f2 ▮

3-8

to display the current partitioned programs on the console screen. If FMGR is not currently loaded, load it into an empty partition large enough to receive it (see Appendix B for program partition size requirements) by entering the command

   *LO,FMGR,,,*n* [RETURN]

where *n* is the number of an empty partition large enough for the File Manager. If no available partition is large enough to accomodate the program, select an occupied partition and remove the occupying program by entering the command

   *OF,*program file name*,8 [RETURN]

and then enter the LO command as specified above.

EXECUTING FMGR

To execute FMGR in either a partitioned or non-partitioned configuration, now enter the command

   *RUN,FMGR [RETURN]

The File Manager will output a colon (:) prompt character to indicate it is ready to accept a FMGR command. The following commands are frequently used when running the Primary System (do not enter the colon from the keyboard):

:LL,1 [RETURN]   directs output to Logical Unit (LU) 1, which is the system console.

:CL [RETURN]   displays desired information from mounted discs or cartridge tapes. For a mini-cartridge system, the following display will appear on the system console:

                           LU   VALID   LOCK

                           04   YES
                           05   YES

                        For a disc-based system, the format of of the display will be:

                           LU   LAST TRACK   CR   LOCK

                           02   0066   00506

                        In either case, make a note of the LU number displayed by the CL command.

:DL [RETURN]   displays file directories (list of files currently mounted).

Now enter the command

   :DC,-*n* [RETURN]

where *n* is the LU number from the CL display.

The DC command LOGICALLY dismounts the unit from the system and informs the File Management Package that the unit is no longer available.

Enter another CL command and note that the unit is gone from the system. To restore (mount) the unit for system use, enter the command

:MC,*n* [RETURN]

where MC is the File Manager mount command and n is the same number specified previously. Enter another CL command and note that the unit is now back on the system.

CAUTION

It is very important that flexible discs be logically dismounted with a DC command before being physically removed from a drive and that an MC command is entered after a new disc is inserted. Failure to do so could cause the new disc to be erroneously written on. The only exception to this rule is when booting up a system system disc, where Logical Unit 2 (drive 0) is automatically mounted following boot-up.

To exit from the File Manager program, enter the command

:EX [RETURN]

and you will be returned to the operating system.

It is strongly recommended that FMGR be used to copy the following files from the configured system disc, either to another disc or a mini-cartridge for system backup:

1. ! MSYST (Primary System file)

2. &SNAP (system snapshot)

3. RTMLD (Relocating Loader)

4. FMGR (File Manager)

If the main system is lost, the copies can be used to recreate the system.

MAKING IT YOUR OWN

Your Primary System was configured and tested at the factory so that you could immediately demonstrate and familiarize yourself with some of the available HP 1000 features and services through "hands on" experience.

However, the main purpose of the Primary System is to provide a base that can be expanded to a more powerful operating system as your installation's needs are determined. This can be done by relocating and loading supplied or user-written programs on-line, or by creating a new system through system generation.

ADDING PROGRAMS

Your Primary System is set up with the building blocks to:

a. Relocate program modules within the memory structure of your specific system, using the Relocating Loader (RTMLD) and supplied system snapshot (&SNAP file).

b. Load relocated programs, using the memory resident APLDR program and system LOad command.

c. Manage and manipulate supplied files, using the File Manager (FMGR) program.

LOADING SUPPLIED RELOCATABLE PROGRAMS

You use the FMGR program and/or the following documentation to find the correct file name for relocating a program:

a. File Manager DL command to display currently mounted File Directory list.

b. Appropriate Software Numbering Catalogs.

c. *RTE-M System Generation Reference Manual* for required library searches for standard supplied programs.

ADDING THE SOFTKEY PROGRAM TO YOUR SYSTEM

To introduce you to the process of expanding your Primary System by adding a supplied relocatable program, let's assume you wanted to relocate and load the softkey program KEYS into the system. Perform following steps:

1. Check the master Table of Contents in Volume 1 of the HP 1000 Binder Set to find the location of the *RTE-M Software Numbering Catalog.* In the Catalog, look up the %KEYS file in the alphabetized section to find out which disc or mini-cartridge the file is located on.

8. To relocate the main program, enter the command

 ▮ f5 ▮ KEYS ▮ RETURN ▮

which is equivalent to entering the RELOCATE %KEYS command. Wait for a prompt. RTMLD will then inform you that the %KEYS file cannot be found on any currently mounted directory by issuing one of two messages, depending on whether you have a mini-cartridge or disc-based system:

FLEXIBLE DISC SYSTEM: the Loader issues the message

 ERR FN FMP-6

Enter the command

 DC,-2 ▮ RETURN ▮

to logically dismount the disc. Remove the Primary System disc from the drive and insert the disc containing the %KEYS file (92064-13402, as per the *RTE-M Software Numbering Catalog*). Logically mount the new disc by entering the command

 MC,2 ▮ RETURN ▮

Again enter the command

 ▮ f5 ▮ KEYS ▮ RETURN ▮

to resume relocation of the program.

MINI-CARTRIDGE SYSTEM: the Loader issues the message

 RTMLD: OPEN — %KEYS >0

Remove the cartridge from from the right CTU and insert the cartridge containing the %KEYS file (check the *RTE-M Software Numbering Catalog* for the correct cartridge). Enter the the command

 *RC,R ▮ RETURN ▮

to logically remount the new cartridge. Get system attention again (*) and enter the command

 *GO,RTMLD ▮ RETURN ▮

to resume relocation of the KEYS program.

9. Begin the required subroutine file searches by pressing the ▮ f6 ▮ softkey. Each time the ▮ f6 ▮ softkey is pressed, the following is output on the console display screen:

 SEARCH %

Immediately after each % character is displayed, enter one of the following four file names in order:

FMPF (disc version of FMP)
 or
FMPC (mini-cartridge versionof FMP)

MSYLB (system library)

RLIB1 (relocatable subroutine library)

RLIB2 (relocatable subroutine library)

As each search is completed, the Loader will output a hyphen prompt. Press the ▮▮ softkey and enter the file name of the next library to be searched.

Again, the Loader will inform you if it cannot find the requested file on any of the mounted directories by issuing one of the following messages:

ERR FN FMP-6 (disc-based system)

 or

RTMLD: OPEN — xxxxx (mini-cartridge system)

where xxxxx is the name of the requested library file the Loader is attempting to search. Use the same procedure you followed in mounting a new disc or mini-cartridge as described in Step 8 above.

10. Press the ▮▮ softkey (equivalent to DISPLAY UNDEFS command) and check the console screen to see if the NO UNDEFS message is displayed. If so, your library searches are completed. If the message

UNDEFS
xxxxx
yyyyy etc.

appears, locate the discs or mini-cartridges containing the needed files and continue the search procedure described in Step 9.

11. Press ▮▮ (equivalent to END command) to end the relocation process. The Loader will then display the number of pages of memory required to load the KEYS program. We suggest that you write the program name and required memory size in the proper columns in Appendix B, "User Program Partition Size Requirements," so that you have a permanent record.

RTMLD also asks if a snapshot is desired by issuing the message SNAPSHOT? on the console screen, followed by a hyphen prompt. The message may be safely ignored at this time.

12. For a flexible disc system, enter the command

     DC,-2 [RETURN]

and remove the Program Prep disc from the drive. Insert the Primary System disc into the drive and enter the command

     MC,2 [RETURN]

This remounts the system disc and allows access to the initial softkey files.

13. Terminate Loader execution by pressing the [■■] softkey, which is the same as entering an END command.

14. For a mini-cartridge system, remove the cartridge from the left CTU (output file) and insert cartridge No. 4 (softkey command files).

<div style="text-align:center">

CAUTION

</div>

> In a mini-cartridge system, NEVER remove a cartridge while the system is outputting to it. If it is removed, positioning is lost and the entire process must be restarted. A useful and safe convention is to always use the the left CTU for output and the right CTU for input. This will reduce the possibilitiy of accidental and premature unloading of the output file.

15. To return to the initial softkey set, enter the softkeys

     [■■] [■■]

to get the system's attention and reset the softkeys to the original set.

16. Insert the mini-cartridge containing your absolute output file (your relocated KEYS program) into the right-hand CTU. Enter the command

     *LO,5 [RETURN]

to load the file into main memory. The right-hand CTU indicator light will blink to indicate loading is taking place.

In a non-partitioned memory configuration, the APLDR program may output the message

     APLDR — REM RTMLD

which means the copy of the Loader currently in memory must be offed (removed) before your copy of the KEYS program can be loaded into the same space. Simply enter the commands

     *OF,RTMLD,8 [RETURN]
     *GO,APLDR [RETURN]

to remove the Loader and resume loading of the KEYS program.

APLDR will issue the message

    APLDR DONE — KEYS

when loading is completed. If you wish, you can use the PL (Program list) command or ███ softkey to confirm that the program is now in memory.

Your absolute copy of the KEYS program on the mini-cartridge in the right CTU can simply be labeled on the cartridge case for future identification, or FMGR can be used to store your program with other files on another mini-cartridge or flexible disc as a named file. See the FMGR commands in the *RTE-M Programmer's Reference Manual* for the procedures.

ADDING OTHER STANDARD PROGRAMS TO YOUR SYSTEM

The procedures for adding other programs to your Primary System are similar to those just described for adding the KEYS program. See the *RTE-M Programmer's Reference Manual* and its appendices for further information on loading other standard programs. However, certain programs require a few special considerations, as described below.

ADDING RTMLD OR RTMGN

In non-partitioned memory systems, the Relocating Loader and RTE-M Generator should reside in the highest positions in main memory because they require the unused memory space behind themselves for symbol table creation.

ADDING SMALL PROGRAMS

Small programs that require less than three pages of memory should be considered for relocation into the memory resident area. Programs located in this area share the base page with other programs and are only allocated the memory they actually use. This is therefore a relatively economical and efficient use of system resources.

Programs located into a partitioned memory area will be given a minimum of two pages of memory; a base page and a program page.

ADDING SEGMENTED PROGRAMS

A segmented program consists of a "main" program and one or more program segments that overlay one another in main memory as they are executed. The purpose of segmenting is to permit execution of a program that is larger than the available memory space. The RTE-M FORTRAN compiler and HP Assembler are typical examples of segmented programs. Relocating and loading such programs require special Relocating Loader control command inputs. See the Relocating Loader command section and Appendix D in the *RTE-M Programmer's Reference Manual.*

GETTING NEEDED ID SEGMENTS

Every program loaded requires an associated block of words called an ID segment (see the appendixes in either the *RTE-M Programmer's Reference* or *Generation Manuals* for description and format). The total number of ID segments is established at generation time.

Extra ID segments were configured into your Primary System, but if you run out when adding new programs, you can retrieve an ID segment by removing some unnecessary or seldom-used program by entering the command

   *OF,*program name*,8 ▣▣▣

to remove the program and free its ID segment for other system use.

ADDING USER-WRITTEN PROGRAMS TO YOUR SYSTEM

If you wish to write specific programs of your own and add them to your Primary System, you can create them on a Model 20/21 HP 1000 with option 32 (Flexible Disc Subsystem), or on another system.

To create your programs on an HP 1000 system with a flexible disc, perform the following steps:

1. Relocate the RTE-M Editor (EDITM) and either the HP Assembler or HP FORTRAN II compiler.

2. Create your source program using the RTE-M Editor (see the *RTE-M Editor Reference Manual* for procedures).

3. Assemble the program using the RTE-M Assembler or compile using the RTE-M FORTRAN compiler, as appropriate. In either case, the output from this process is called a RELOCATABLE MODULE.

4. Relocate the module (along with any required subroutines) by using the Relocating Loader and system snapshot as described for the KEYS relocation example. The absolute load module resulting from the relocation process can be output to a flexible disc file or mini-cartridge.

   If the program is to be segmented, the main program and segments must be processed by the Segment Preparation (SGPRP) program. See the *RTE-M Programmer's Referenced Manual* for details.

5. Load the relocated program (absolute load module) into the system using APLDR via the system LOad command as described earlier in this manual.

REGENERATING YOUR SYSTEM

As the requirements of your installation further increase or otherwise change, it may be more practical and efficient to create a new operating system rather than continuing to change programs in the Primary System. This process is called system generation.

You can use the Primary System to generate your own next system under the following qualifications:

a. If there is enough available memory left over in a non-partitioned Primary System for the RTE-M Generator (requires 16K), it can then be relocated and executed in the Primary System.

b. If there is insuffient memory in a non-partitioned system or no partition is large enough (16K), there are two optional courses to take:

   1. Create an interim system, for generation usage only, that is configured with only those drivers required for generation.

2. Use the supplied Generator from the RTE-M system software; either the flexible disc version (!MFGEN) or mini-cartridge version (!MCGEN), as appropriate.

Option 1 is recommended if your configuration has enough useful equipment for generating, such as a line printer, or if you anticipate performing frequent generations.

The recommended procedure for generating your new system is as follows:

1. Thoroughly study the procedures and planning criteria described in the *RTE-M System Generation Reference Manual*. You may also wish to study the format and function of the Relocating Loader commands described in the *RTE-M Programmer's Reference Manual,* since the Generator uses a subset of these commands.

2. Create an answer file (described in Section IV of the Generation Manual), either through use of the File Manager (FMGR) or RTE-M Editor (EDITM requires the flexible disc option) and output the answer file to a mini-cartridge.

3. Specify the left CTU (LU4) as the ouput device for answer file. Putting your answer file on a mini-cartridge allows use of the flexible disc as input device, thus providing maximum flexibility during generation. If you have a mini-cartridge based system, answer files are not practical because both CTU's are used for input and output during generation.

4. It may be advisable to terminate the answer file immediately after the final user program has been relocated. Terminating the answer file prior to generation completion forces the Generator to seek commands and data from the console keyboard by issuing prompts and queries on the display screen for the remaining input.

    This procedure allows you to watch the final phase of generation and make on-line decisions during the final memory allocations and partition definitions. During partition definition, be sure at least one partition has enough pages allocated for it to accomodate the largest program you plan to run. See Appendix B for the partition sizes required for the supplied standard programs.

    This method optimizes the speed of an answer file and generation control by operator intervention.

5. Run the Generator using the answer file or manually entered commands, and carefully watch the generation output for any errors as it is displayed on the console screen.

6. If the generation is a particularly large one, a single mini-cartridge may not be large enough to hold all the output. The Generator will report that it has run out of tape by issuing the message

    I/O NR L4 En S1

    Insert a blank cartridge and enter the commands

    *UP,*n* ⏎

    *GO,RTMGN ⏎

    where *n* is the EQT number displayed in the I/O NR message. The commands will "up" the CTU and cause generation to resume.

7. The Generator will issue a SNAPSHOT? message at generation end. A system snapshot is required for relocating programs on the system just generated. If your generated output was written to the left CTU (LU4), insert a blank cartridge in the right CTU (LU5) and enter the command

    *SNAP ON 5 [RETURN]

to output the system snapshot on the right CTU.

If you wish to write the snapshot to a flexible disc file on the mounted disc, simply enter the command

    *SNAP ON *file name* [RETURN]

and the Generator will output the system snapshot to that file.

If you wish to write the snapshot on another disc, use the DC, −2 and MC,2 commands to mount the new disc before issuing the SNAP ON file name command.

The disc or mini-cartridge containing the completed snapshot should be kept in a readily accessible location, since it will be used each time the Relocating Loader is used to relocate a new program on the system.

8. If the Generator output was written to a flexible disc file, make sure you keep a written record of the track and sector address reported at the end of generation. You will convert this information into an octal address, using the conversion table in Appendix F of the *RTE-M System Generation Reference Manual*. The octal equivalent, in turn, is entered into the B register of the computer during boot-up.

This concludes your introduction to the features and services of your HP 1000 Primary System. Expertise in using all the features and options available on this highly flexible system will come with some further study and hands-on experience.

As a start, we suggest you first check out any terms used that still seem strange or unfamiliar by looking them up in the glossary at the beginning of this manual. Then check the same terms or processes in the indexes or tables of contents in the appropriate reference manuals for their more detailed functional descriptions.

Such familiarization, coupled with more console practise in using the Primary System, should provide a good foundation for creating a system that meets your installation's requirements.

Mini-Cartridge Based Systems:

CARTRIDGE NO.	FILE NAMES	CONTENTS
1	!MSYS	Absolute configured system
2	BASIC	Relocated BASIC for configured system
3	FMGR	Relocated File Manager for configured system
	RTLMD	Relocated Relocating Loader for configured system
4	&SNAP	System snapshot file
	&ORGKY	Initial softkey definition file
	&BSCKY	Softkey definition file for BASIC
	&LDRKY	Softkey definition file for RTMLD
	&STRCM	System start-up file
5	&LISTF	System generation listing

Flexible disc based systems: All of the above files are located on the flexible disc labelled "Configured RTE-M ABSOLUTE SYSTEM & FILES."

The total partition size requirements of HP-supplied user programs are defined below. The blank spaces·are provided to maintain a record of partition size requirements for user-written programs.

PROGRAM	PROGRAM AREA	+	ADDITIONAL RQRD. WORK AREA	COMMENTS
ASMB	10	+	1 (Symbol Tables)	Includes area for segments
BASIC	12	+	2 (BASIC Prog. Space)	Add two pages if DCODE function is included
DSKET	5	+	0	
EDITM	7	+	1 (Edit file buffer area)	
FMGR	11	+	1 (File buffer area)	Subtract two pages for mini-cartridge based systems
FTN	9	+	1 (Symbol Tables)	Includes area for segments
KEYS	7	+	0	
KYDMP	4	+	0	
RTMGN	14	+	2 (Symbol Tables)	Large system generations may require more symbol table area
RTMLD	11	+	2 (Symbol Tables)	
RTMTG	7	+	0	
SGPRP	4	+	0	
————	————	+	————————	————————————
————	————	+	————————	————————————
————	————	+	————————	————————————
————	————	+	————————	————————————
————	————	+	————————	————————————
————	————	+	————————	————————————
————	————	+	————————	————————————
————	————	+	————————	————————————
————	————	+	————————	————————————
————	————	+	————————	————————————
————	————	+	————————	————————————

*Note: Program area includes 1 page for base page linkage.

SOFTKEY DEFINITION FILES

FILE NAME KEY NO.	LABEL	DEFINITION
&ORGKY		
f₁	Program List	PL CR
f₂	Partition List	PL,, CR
f₃	BASIC Keys	RU,KYDMP,,&B,SC,KY CR
		(see &BSCKY file)
f₄	Loader Keys	RU,KYDMP,,&L,DR,KY CR
		(see &LDRKY file)
f₅		
↓	Undefined	
f₈		
&BSCKY		
f₁	RESET KEYS	RU,KYDMP,,&O,RG,KY CR
		(see &ORGKY file)
f₂	LOAD PROGRAM — Lu	Load from lu CR — operator input
f₃	LIST PROGRAM	LIST CR
f₄	SAVE PROGRAM — Lu	SAVE ON lu CR — operator input
f₅	RUN PROGRAM	RUN CR
f₆	Undefined	
f₇	Undefined	
f₈	END BASIC	BYE CR
&LDRKY		
f₁	RESET KEYS	RU,KYDMP,,&O,RG,KY CR
		(see &ORGKY file)
f₂	READ SNAPSHOT	TR,&SNAP CR
f₃	OUTPUT file/lu	OUTPUT ON file/lu CR — operator input
f₄	MAP MODULES — lu	MAP MODULES ON lu/file CR — operator input
f₅	RELOCATE file/lu	RELOCATE % file or lu CR operator input
f₆	SEARCH file/lu	SEARCH % file or lu CR — operator input
f₇	DISPLAY UNDEFS	DISPLAY UNDEFS CR
f₈	END	END CR

In this index, topics with multiple page references have the principal reference listed in **boldface** type. All other references are given in standard typeface.

In this index, topics with multiple page references have the principal reference listed in **boldface type.** All other references are given in standard typeface.

In this index, topics with multiple page references have the principal reference listed in **boldface type**. All other references are given in standard typeface.