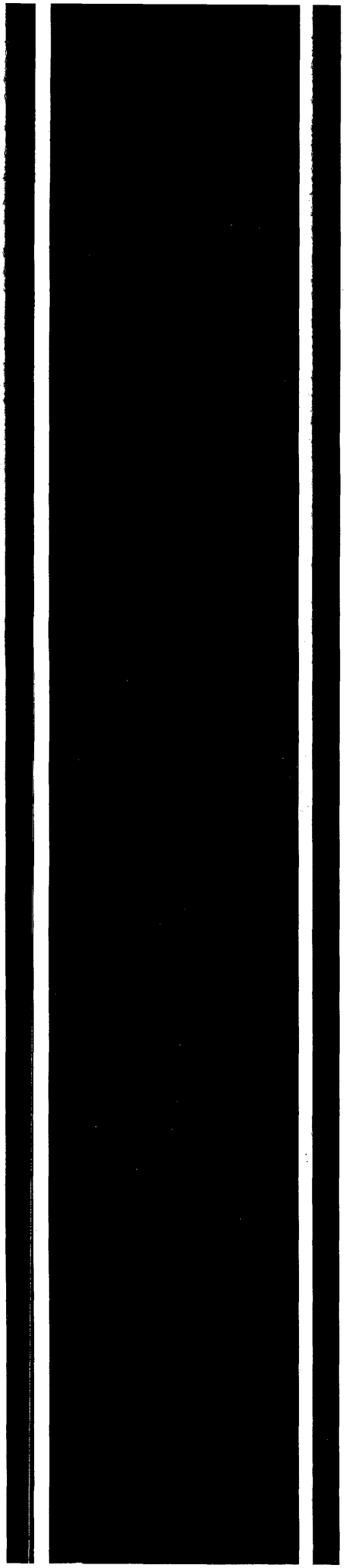

HEWLETT hp PACKARD

MAGNETIC TAPE SYSTEM

MAGNETIC TAPE SYSTEM

(A high-efficiency operating system for HP Software)

HEWLETT PACKARD

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PREFACE

To fully appreciate the Magnetic Tape System's features and advantages, the reader of this manual should be experienced with the use of HP Software through paper tape operating methods. However, such experience is not a prerequisite to the use of either this book nor the Magnetic Tape System. Although an attempt has been made herein to describe all aspects of the Magnetic Tape System itself, some descriptions unique to the HP Standard Software Systems have not been duplicated, but instead have been left in the reference manuals written specifically for those Systems. At appropriate locations the reader is directed to one or more of those other manuals, furnished with every HP Computer shipped.

The organization of this book has been carefully planned to prepare any user to make optimum use of the Magnetic Tape System as soon as possible. Any given user should, no matter how well he feels acquainted with Hewlett-Packard software, read this manual straight through at least once. After that, most users will be well qualified to review the individual sections selectively.

You are invited to use the form provided at the rear of this manual to make any comments about the descriptions. Please don't hesitate to do so at any time, especially if you need more information. If that form has already been used and you want to send us some more comments, please use your company letterhead and the address on this manual's title page.

This book has been bound with staples to allow you a means for making any changes you might find desirable. Further, the color stripe is unique within the library of HP Software manuals to help you identify this book more readily on your bookshelf. Or, by removing the staples and placing these pages into a three-ring binder, you can add this book to a similar collection of other reference manuals.

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SECTION I

INTRODUCTION

The Magnetic Tape System (MTS) provides a more convenient form of computer operation in which programs are processed with greater speed than that obtainable with paper tape operating methods. In this System source programs need be submitted only once to either of the System's two operating modes, batch processing or keyboard control, for compilation, loading, check-out, and execution with a small degree of operator intervention.

Three programming languages may be processed by the Magnetic Tape System using the HP Standard Software Systems listed below. In addition, a user can also include any other absolute programs needed.

Extended Assembler, in both Non-EAU and EAU versions

MT FORTRAN Compiler - Pass 1, and Pass 2 in both Non-EAU and EAU versions

ALGOL Compiler

BCS (Basic Control System) and its Relocating Loader

Program Library (of relocatable utility routines)

Symbolic Editor

MT Cross-Reference Symbol Table Generator

NOTE: All of these Standard Software Systems are replacements for the previous versions in that they will now operate for either the MTS or for paper tape processing methods. However, the MT FORTRAN Compiler and the MT Cross-Reference Symbol Table Generator both require access to a magnetic tape unit even when used in paper tape processing. More details are given in Section III of this book.

All of the Standard Software Systems listed above are included in the Magnetic Tape System, which exists as a set of HP software modules. That set also includes several SIO (System Input/Output) Drivers, an MTS directive program called the Inter-Pass Loader (.IPL.), and some System preparation programs. One of those System preparation programs is used to create one or more combinations of SIO Drivers which are then called SIO Modules; more detailed descriptions of SIO Modules are given in Section II under that title.

Each software module is furnished as a separate item so that the MTS can be configured to a specific set of peripheral devices and/or programming needs. A Prepare Tape System program is used to write the appropriate modules onto magnetic tape, then the MTS is set to either one of the two operating modes wanted. Either of those modes may be used throughout an operating sequence, or the batch processing mode can be given a directive to switch MTS control to the keyboard control mode at any point within its operating sequence.

When the Magnetic Tape System is configured three files are created on the magnetic tape. The boundaries of the first two are then fixed according to the number of programs they are to contain, as summarized below:

File 1..... contains only absolute programs, such as the MTS directive program .IPL., a "Standard SIO Module" named .MTS., any Standard Software Systems wanted, any user-furnished absolute programs, and any "Non-standard SIO Modules" a user may wish to include.

File 2..... contains only relocatable programs, such as the Program Library and any user-furnished routines that might be required in addition to those furnished with the MTS.

File 3..... is a "work file" area that can be used by any of the programs in File 1 and/or any of the routines in File 2.

HARDWARE REQUIREMENTS

To use any of the Magnetic Tape System's features your set of HP Computer hardware devices must include at least the following:

1. An HP Computer with at least an 8K (8,192) word memory.

   NOTE: If the Magnetic Tape Unit is an HP2020 the Computer may be a Model 2114A or a 2115A or a 2116B. If the Magnetic Tape Unit is an HP3030 the Computer must be either a 2115A with its DMA (Direct Memory Access) Option or a 2116B with its DMA option.

2. An HP Magnetic Tape Unit, either the HP2020 or the HP3030.

   NOTE: Only one Magnetic Tape unit can be used for execution of absolute programs, but more than one could be used for relocatable programs executing under the BCS.

3. A system input device, either an HP2752A Buffered Teleprinter or an HP2754B Buffered Teleprinter.

4. A batch input device, such as an HP2761A-07 Mark Sense Card Reader (or its equivalent), or an HP2737A Punched Tape Reader.

   NOTE: If the batch input device is not a Mark Sense Card Reader (or its equivalent), the Magnetic Tape System can best be operated only in its keyboard control mode. The batch processing mode could be used with other types of batch input device, but there would be practical limitations.

For additional improvement of operating speed and convenience the following other peripheral devices are recommended:

1. An HP2737A Punched Tape Reader.
2. An HP2753A High-Speed Tape Punch.
3. An HP2778A Line Printer (or its equivalent).
4. An additional 8K of Computer memory.

   NOTE: This is available only on an HP2116B Computer.

SECTION II

SYSTEM ORGANIZATION

Most of the terminology used for the Magnetic Tape System is similar to that used for other operating systems. However, in the MTS some of these terms may have slightly different meanings. For example, batch processing and keyboard control in the MTS do not have the same implications they would in a more elaborate operating system; yet they do correctly imply significant savings of operating time. These savings come about by applying these modes, through their MTS directives, to the processing of both source and relocatable object programs. Those MTS directives instruct the system's Inter-Pass Loader to utilize any of the available facilities, such as magnetic tape storage, through special programs called SIO Modules. Thus, a study of this Section will provide a better preparation for the MTS operating descriptions given in the Sections to follow.

BATCH PROCESSING

The principle feature of the Magnetic Tape System is its ability to be used for batch processing. Under this operating mode the need for operator intervention is greatly reduced by two techniques: (1) MTS directives are read from a deck of cards (or punched tape), and (2) The absolute programs to be used are loaded into core from magnetic tape rather than from an external physical input medium. Further, the batch processing mode can accept an MTS directive to switch the System to its other operating mode, keyboard control, which will then retain control until a request is made to return control to the batch processing mode.

KEYBOARD CONTROL

The keyboard control mode will also allow absolute programs to be loaded into core from magnetic tape, but requires the user to enter MTS directives through the system input device keyboard when they are needed during the processing sequence. Whether the operating mode is keyboard control or batch processing, the format of the MTS directives is the same.

MTS Directives

MTS directives are read by the MTS directive program called the Inter-Pass Loader, from either prepared cards (or tape) or from a keyboard, as already described. The Inter-Pass Loader then loads the required absolute program into the Computer's core memory from storage on magnetic tape. All absolute programs, including the Standard Software Systems and the Inter-Pass Loader, process inputs and outputs through an SIO (System Input/Output) Module.

NOTE: The term "MTS directives" is used to differentiate from the control statements required by the Extended Assembler, the MT FORTRAN Compiler, and the ALGOL Compiler.

Source Program Processing

Source programs are compiled or assembled by methods similar to the paper tape processing methods. The Magnetic Tape System is faster because physical handling for both the absolute programs and any intermediate outputs they produce is eliminated. That is, those programs and outputs are stored on- and accessed from- magnetic tape. For example, the Inter-Pass Loader is used to load the MT FORTRAN Compiler's Pass 1 from the magnetic tape's FILE 1. Pass 1 then writes its intermediate binary output into FILE 3. Next, the Inter-Pass Loader rewinds the magnetic tape to load Pass 2 from FILE 1. Finally, Pass 2 will

process that intermediate binary output from FILE 3 to produce the relocatable object program output on punched tape.

Relocatable Object Program Processing

Relocatable object program processing also takes advantage of the Magnetic Tape System's features. Again, the process is similar to paper tape processing in that the Program Library is searched for undefined symbol references in the object program; but the Magnetic Tape System speeds the process by eliminating the need to physically prepare the Program Library for that search. Inputs and outputs for all relocatable programs, i.e., those produced by the compilers and Extended Assembler, are processed by the BCS (Basic Control System) which uses the full Interrupt capabilities of the Computer.

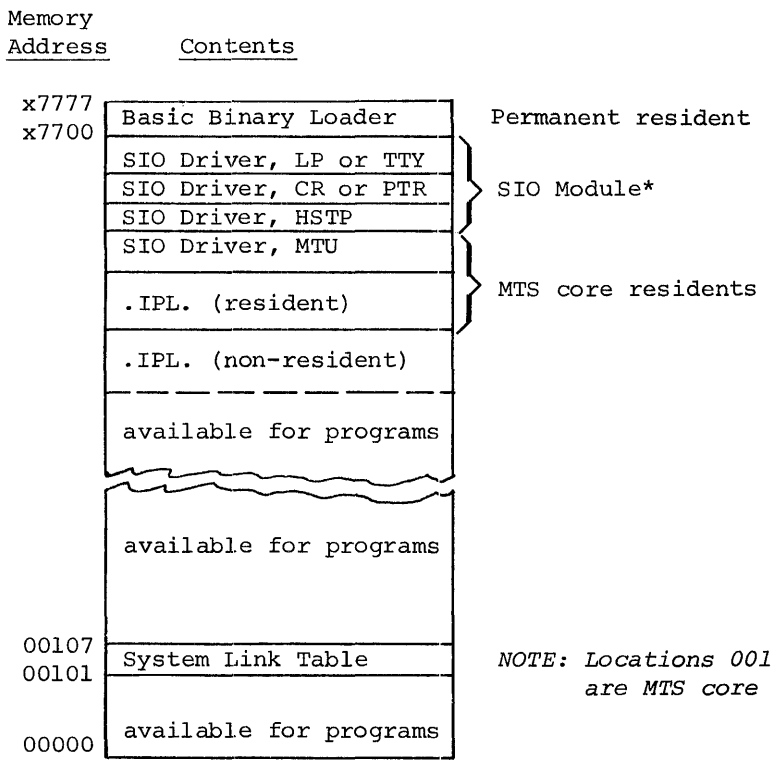
The Inter-Pass Loader is used to load the BCS Relocating Loader into core. Then the user can specify either that the program(s) and all symbol definitions are to be loaded into core ready for execution, or that those programs and definitions are to be punched in absolute binary form into one punched tape output for later loading and execution. The choice of these two options is specified in the same manner used for paper tape processing. (Refer to Chapter 3 of the *OPERATING MANUAL* - HP Part No. 02116-9057.)

INTER-PASS LOADER

As the primary MTS directive processor of the Magnetic Tape System a certain portion of the Inter-Pass Loader must be core-resident at all times. Then, to allow that portion of the Inter-Pass Loader to load one or more needed programs or routines from magnetic tape, an SIO Driver (and its System linkage words) for the Magnetic Tape Unit must also be core resident. Once these residencies are established the Inter-Pass Loader can load its non-resident portion, then any other SIO Drivers and their System linkage words, into core when they're needed. The core memory assignments for a typical MTS configuration are shown in Figure 2.1. (Another program is also core resident at all times; it's the Basic Binary Loader [BBL] through which the first absolute program needed for any system should be loaded.)

The resident portion of the Inter-Pass Loader is relatively small; its function is to load the non-resident portion into core from magnetic tape whenever .IPL. is to be used.

In a configured MTS the memory locations for the resident portion of the Inter-Pass Loader, the individual SIO Drivers, and their System Link Table are permanently reserved. These reservations are a small sacrifice of memory available for program storage, but they provide greater overall efficiency for the Magnetic Tape System.



* The Standard SIO Module .MTS. can be replaced by a Non-Standard SIO Module.

Legend:

x	= 1 for an 8K memory, 3 for a 16K memory.
LP	= Line Printer if available, otherwise TTY.
TTY	= Teleprinter.
CR	= Card Reader if available.
PTR	= Punched Tape Reader if available, otherwise TTY.
HSTP	= High-Speed Tape Punch if available, otherwise TTY.
MTU	= Magnetic Tape Unit.
.MTS.	= the required name for the Standard SIO Module.
.IPL.	= the required name for the Inter-Pass Loader.

FIGURE 2.1 Core Memory Assignments

MAGNETIC TAPE ORGANIZATION

As previously described, all software modules to be available through the Magnetic Tape System are stored on magnetic tape. Figure 2.2 shows the overall organization of that magnetic tape.

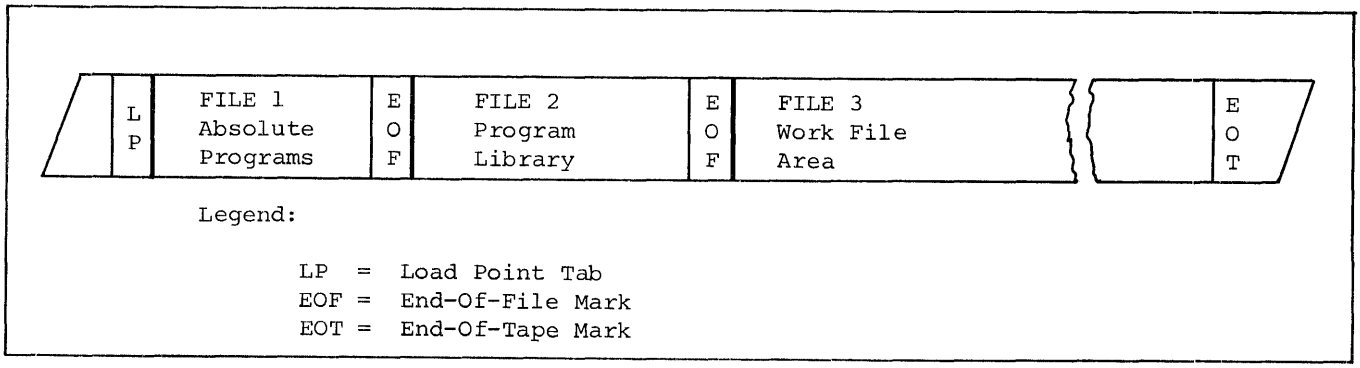


FIGURE 2.2 Magnetic Tape Organization

In FILE 1 each absolute program is given a unique name that is stored in a preface record for that Program, as shown in Figure 2.3. Each preface record includes a total of 8 words:

WORD#	CONTENTS
1 thru 5.....	Absolute program's I.D. (identification) Name. Refer to the *Prepare Tape System, (PTS)* descriptions in Section IV for I.D. Name rules and limitations.
6.....	S.A. (Starting Address) of the absolute program.
7.....	Record length (word count, entered by PTS) of the next physical record that is a continuance of the absolute program.
8.....	Absolute Load Address (entered by PTS) of the next physical record that is a continuance of the absolute program.

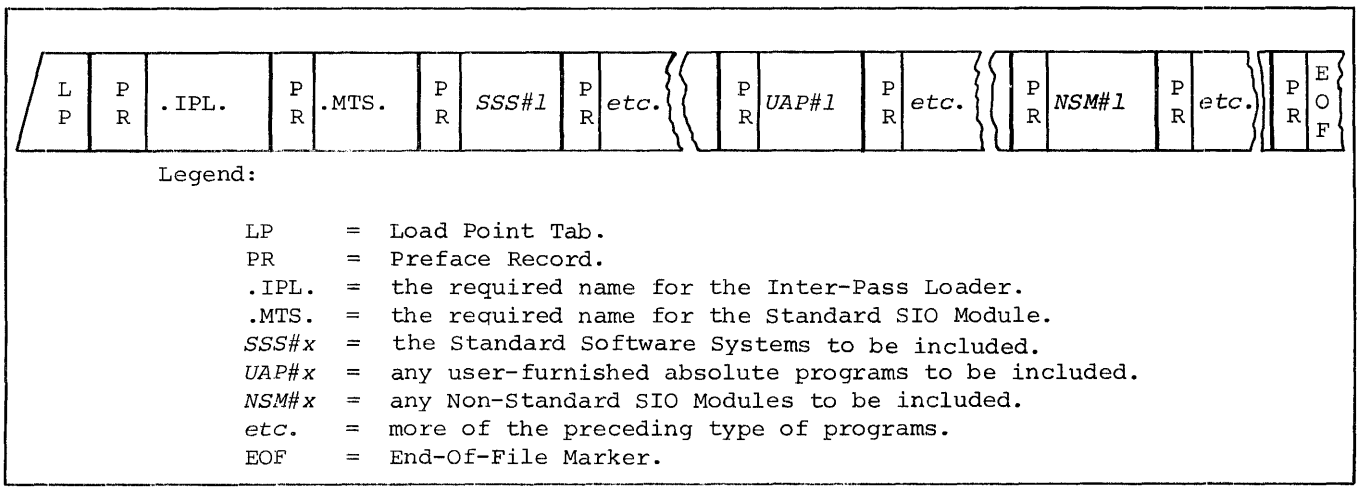


FIGURE 2.3 File 1 Internal Structure

Some absolute programs have to be written into more than one magnetic tape record. Each such MT record will also have a preface record, but it will differ slightly from that of the first record for the absolute program. First, word 6 is set by the Prepare Tape System (PTS) program to Ø which indicates the next physical record is a continuation of the absolute program. Then words 7 and 8 are used as described in the previous paragraph.

At the end of FILE 1 PTS will generate a dummy preface record in which word 6 has been set to a non-zero value. This prevents an attempt to read the EOF (End-Of-File Mark) as a part of the last absolute program read.

When FILE 2 is created the Prepare Tape System program merely copies the Program Library, and any user's relocatable programs submitted, onto the magnetic tape without any changes. Those programs may be so copied in any order, but thought should be given to using a sequence that will enable all needed routines to be found in one search of FILE 2. For example, if some user-furnished relocatable programs include references to routines in the HP Program Library they should be copied onto the magnetic tape first. Figure 2.4 shows how FILE 2 immediately follows the EOF of FILE 1, and is followed by its own EOF, then FILE 3. FILE 3 can use the rest of the magnetic tape, if need be.

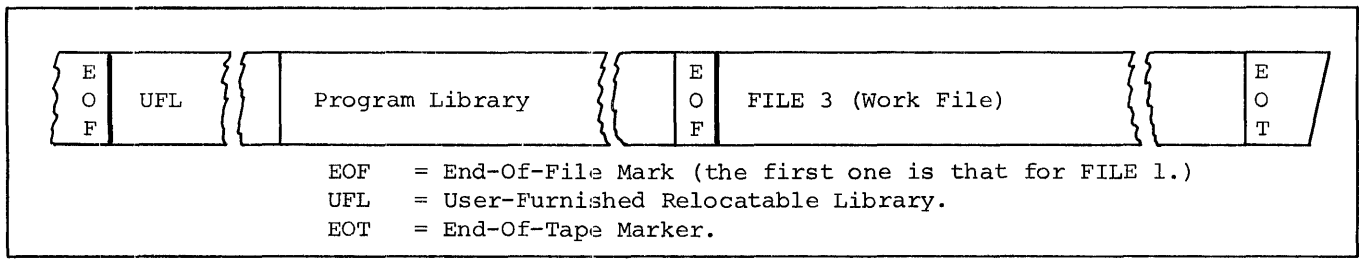


FIGURE 2.4 File 2 and File 3 Internal Structure

SIO MODULES

An SIO Module (Standard or Non-Standard) is merely a set of no more than three SIO Drivers, for the particular Computer's peripheral devices, that has been configured to the I/O channel (Input/Output) assignments of those devices. *(NOTE: The SIO Driver for the Magnetic Tape Unit is not included in any SIO Modules; it's always core resident.)* The Standard SIO Module (.MTS.) is so called because it is reloaded into core by the Inter-Pass Loader as soon as any Non-Standard Module is no longer in use.

All SIO Modules to be available for use in a configured MTS are absolute programs and are thereby given a unique name under which they're stored in FILE 1 on the magnetic tape. Then any Non-Standard Module can be loaded by the Inter-Pass Loader in response to an MTS directive from either a prepared card or a keyboard entry. Only one SIO Module can reside in memory at any one time; a Non-Standard Module currently in core will continue to provide the input/output configuration only as long as the current program in execution is not yet finished. Once that program's operating sequence is terminated the Inter-Pass Loader will reload the Standard SIO Module .MTS. in place of that Non-Standard Module.

The Standard SIO Module (.MTS.)

The Standard SIO Module, which must be named .MTS. when the Magnetic Tape System is configured, can be any one of the following combinations of SIO Drivers, numbered in order of the maximum effectiveness to the MTS:

1) TTY, CR, HSTP	2) TTY, PTR, HSTP	3) TTY, CR
4) TTY, PTR	5) TTY, HSTP	6) TTY

Where: TTY = Teleprinter CR = Card Reader HSTP = High-Speed Tape Punch

Non-Standard SIO Modules

Each Non-Standard Module to be available for use in the MTS can be any one of the following combinations of SIO Drivers, if those devices are available to the System:

1)	LP, CR, HSTP	5)	LP, CR	9)	TTY, PTR
2)	LP, PTR, HSTP	6)	LP, PTR	10)	TTY, HSTP
3)	TTY, CR, HSTP	7)	LP, HSTP	11)	TTY, LP
4)	TTY, PTR, HSTP	8)	TTY, CR	12)	TTY

where: LP = Line Printer
CR = Card Reader
HSTP = High-Speed Tape Punch
PTR = Punched Tape Reader
TTY = Teleprinter

NOTE: Any SIO Module in core retains some of the SIO TTY Driver's code.

System Link Table

Each SIO Driver in core has a corresponding entry in the System Link Table, as shown in Figure 2.5.

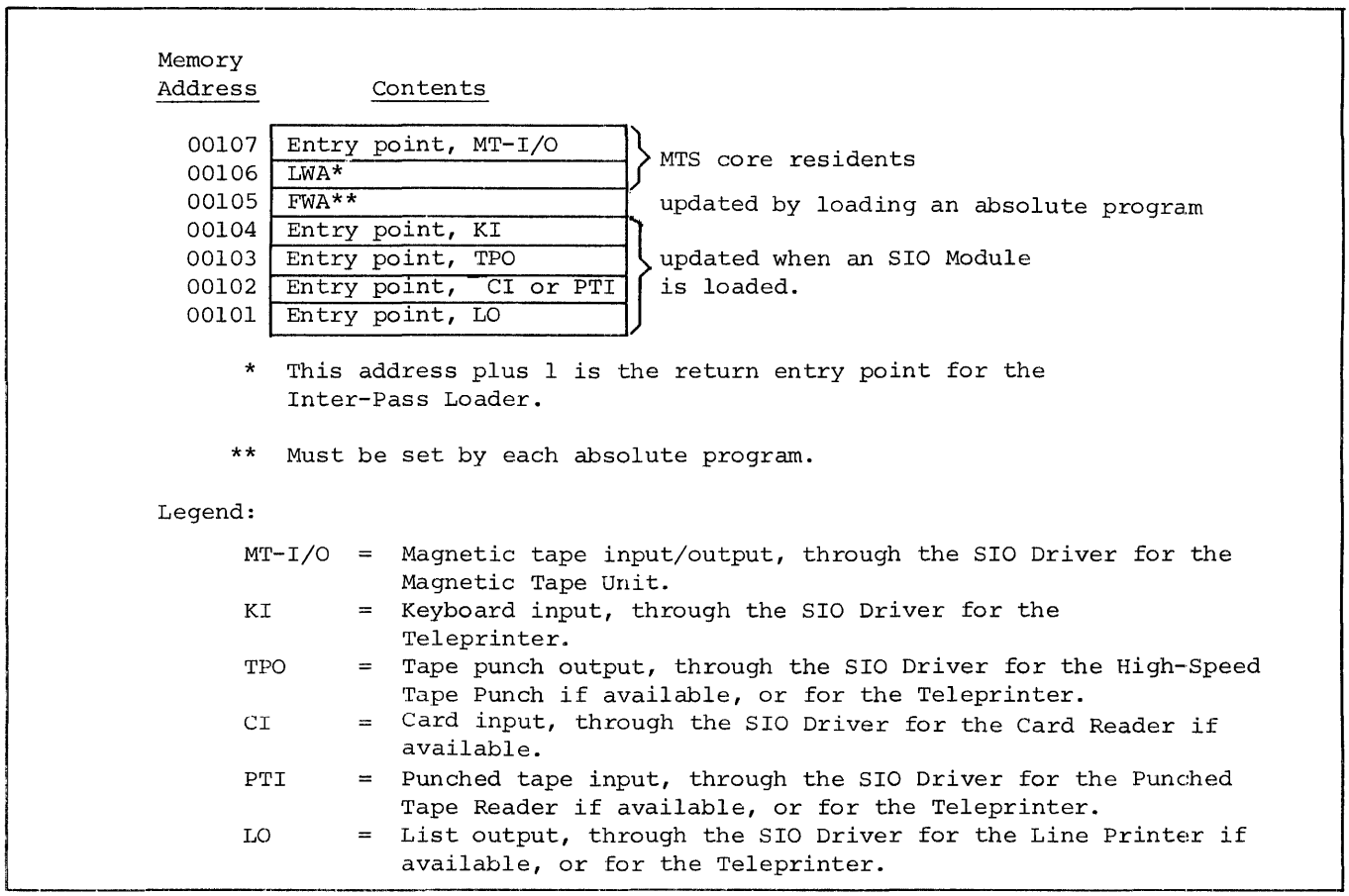


FIGURE 2.5 System Link Table

This Table is created or updated each time either an SIO Driver or an absolute program is loaded, by one of two schemes:

SIO Drivers. Locations 00101 thru 00104 and 00106 are subject to change each time an SIO Driver is loaded into core, either individually or as part of an SIO Module.

Location 00107 does not change in the MTS; its SIO Driver for the Magnetic Tape Unit is always core resident. Locations 00101 thru 00104 contain the absolute address of the entry point for each input or output function an absolute program might require. Location 00106 contains the LWA (Last Word Address of memory available to other programs.) In a paper tape system the LWA is updated with each SIO Driver loaded, but in the MTS it's set, when the MTS is configured, to the Inter-Pass Loader's resident portion first word address less 1.

Absolute Programs. Location 00105 contains the FWA (First Word Address of memory available to other programs.) That FWA must be updated by each absolute program as that program is loaded into core; this is the basis for one of the MTS Absolute Programming Rules given in section VI of this manual.

SIO Drivers

Each SIO Driver is capable of providing one or more of the input or output functions that can be requested through the System Link Table. For example, the SIO Driver for the Teleprinter has an entry point to one of its segments for keyboard inputs, another for punched tape inputs, another for tape punch output, another for list output (printing data on paper), etc. Or, the Teleprinter Driver's punched tape input segment can be replaced (overlayed) by the SIO Driver for the HP2737A Punched Tape Reader, or the tape punch output segment can be replaced by the SIO Driver for the HP2753A High-Speed Tape Punch, etc. Each such SIO Driver replacement will update or correct the corresponding entry in the System Link Table as the SIO Drivers are loaded. A maximum of five input or output functions can be so provided for in the Magnetic Tape System.

Each SIO Driver (or each segment of an SIO Driver) has an "initialization" portion that responds to a request from absolute programs to transfer data. Then a "continuation" and/or a "completion" portion finishes the response before returning control to the absolute program. In other words, data transfer through SIO Drivers takes place without interrupt.

The "initialization" portion interprets parameters from the absolute program's calling sequence to determine the type of input/output operation requested. Then that same portion checks the availability of the device and starts the data transfer. If the device is not ready either the Driver will keep trying until it is, or the user may have to turn-on or otherwise "ready" the device.

A "continuation" portion is necessary to devices not controlled by a DMA channel. The "continuation" portion makes the actual data transfer and updates index addresses.
NOTE: Data transfers through DMA use I/O channel 6.

Finally, the "completion" portion verifies the data transmission, or indicates any error conditions, and retries the operation if necessary. For the Magnetic Tape Unit, any write errors are automatically retried until either successful or EOT (the End-Of-Tape Marker) is reached. However, if any "parity errors" are detected on a read function, at least three repeat attempts will be made to read correctly. Then, if the error persists, the "completion" portion of that Driver will produce an error return and/or set status bits to indicate the problem.

SECTION III

STANDARD SOFTWARE SYSTEMS

All of the Standard Software Systems listed in Section I of this manual are replacements (as of August, 1969) for their previous versions, as previously noted. Each includes several new features, one of which is common to all and is used only with the Magnetic Tape System. That common feature is the inclusion of IPL calls. The other new features are also described in this Section III, but under separate headings for each of those Standard Software Systems.

For proper operation in the MTS, each absolute program stored in FILE 1 must conform to the several rules given in Section VI of this book. Two of those rules are listed here, to support the IPL Calls descriptions also given in this Section.

1. Have the final HALT instruction (HLT 77B) exactly one address prior to all (if more than one) S.A.'s (Starting Addresses) for that program.

   NOTE: The Inter-Pass Loader changes, as it loads a program into core, the final HALT instruction to a linkage word for an IPL Call. That is, it changes the HLT 77B code to a JSB 00106B,I (which is to the Inter-Pass Loader's entry point.)

2. Always return to the final HALT instruction's address with the A-Register contents set to Ø or -1 or -2, as described in the next subsection.

IPL CALLS

An IPL Call is a set of instructions within an absolute program through which MTS execution control is returned to the Inter-Pass Loader when that absolute program's required execution is finished. Two types of IPL Calls are possible. One is an IPL *Termination* Call in which the Inter-Pass Loader is instructed to only prepare for receipt of a new MTS Directive. The other is an IPL *Continuation* Call in which the Inter-Pass Loader is instructed to load (then pass execution control to) another absolute program stored in the magnetic tape's FILE 1. The specific application of IPL Calls are described in the following subsections for each of the Standard Software Systems.

All IPL Calls consists of appropriate instructions to accomplish two essential objectives:

1. To load the Computer's A-Register with a specific integer value just prior to satisfaction of the next objective.

   NOTE: The Inter-Pass Loader will interpret only three A-Register values; Ø,-1, and -2. Any other value will be treated as Ø.

2. To jump (JMP) to the absolute program's final HALT instruction's address which must conform to the absolute programming rule given in the second paragraph of this Section III.

Three possible methods by which these essential objectives might be satisfied are shown in Figure 3.1, on the following page.

MT FORTRAN Pass 1's IPL Continuation Call to load and give control to Pass 2:

```
Memory Address | Label (sample) | Operation | Operand
(S.A.-1)       |                | HLT       | 77B          Pass 1 final HALT*.
(S.A.)         | BEGIN          |  .        |  .           Start of Pass 1.
               |                |  .        |  .
               |                |  .        |  .
               | END            | CCA       |              Set A to -1.
               |                | JMP       | (S.A.-1)
```

Extended Assembler's IPL Continuation Call to load and give control to the MT Cross-Reference Symbol Table Generator:

```
(S.A.-1)       |                | HLT       | 77B          Extended Assembler final HALT*.
(S.A.)         | BEGIN          |  .        |  .           Start of Extended Assembler.
               |                |  .        |  .
               |                |  .        |  .
               | END            | LDA       | M2           Load A with the value in M2.
               |                | JMP       | (S.A.-1)
               | M2             | OCT       | -2           M2 contains the integer -2.
```

Any absolute program's IPL Termination Call to expect a new MTS Directive:

```
(S.A.-1)       |                | HLT       | 77B          The program's final HALT*.
(S.A.)         | BEGIN          |  .        |  .           Start of the program.
               |                |  .        |  .
               |                |  .        |  .
               | END            | CLA       |              Set A to Ø.
               |  .             | JMP       | (S.A.-1)
```

* This final HALT instruction is changed, by the Inter-Pass Loader, to a JSB 00106B,I.

FIGURE 3.1 Samples of IPL Calls

EXTENDED ASSEMBLER

Five new features have been added, and one change has been made, in this new version of the Extended Assembler. They're listed here, then described in detail (if necessary) in the following paragraphs:

1. Two IPL Calls are now included, for use with the Magnetic Tape System. They have no effect on the use of the Extended Assembler with paper tape processing methods.

2. A new optional parameter for the Assembler control statement is now available only for use with the MTS to select one or the other of the two IPL Calls listed above. That new parameter is the letter C.

3. Two of the original parameters for the Assembler control statement, the letters A and R, can now be used alone, if wanted, for program debugging purposes.

4. Program listings produced by the Extended Assembler now include two new techniques to help locate each error. One of these techniques identifies the source file (usually on paper tape) in which the error was detected, the other identifies the page of the listing on which the preceding error message can be found.

5. An MTS Directive can now be used to change the Extended Assembler so it will read its source program from the magnetic tape unit's FILE 3.

6. The entry point for keyboard inputs of the Extended Assembler's control statement has been changed to 120_8. (It was 110_8.)

When the Extended Assembler is used with the MTS, at the end of the 2nd pass execution either one of two IPL Calls can be used. The selection is made by the user when the Assembler control statement is written, either using or leaving out the letter C. When that parameter is used, the IPL Continuation Call occurs to instruct the Inter-Pass Loader to load, then pass execution control to, the MT Cross-Reference Symbol Table Generator. If that parameter isn't used, the IPL Termination Call occurs to merely return execution control to the Inter-Pass Loader. (The general concept of both types of IPL Calls has already been shown in Figure 3.1.)

All of the parameters for the Assembler control statement are available as described in Chapter 5 of the *Assembler* manual (HP Part Number 02116-9014.) In addition, the letters A and R each may now be used alone for program checkout purposes, and a new optional parameter, the letter C, is now available. If either A or R is the only parameter given in the control statement, only pass 1 will be executed to produce its error messages without listing the entire program or producing an object program output. The letter C (useful only with the MTS) if included in the control statement will select the IPL Continuation Call, or if not included will select the IPL Termination Call. The functions of these two IPL Calls have already been described in the preceding paragraph.

Error listings produced by the Extended Assembler now include two new entries to help locate each error. Pass 1 error listings are all preceded by a number that identifies the source file from which the error was read. That number is printed in the format "#ØØØ1", and has a value corresponding to the sequence in which the source file(s) were submitted to pass 1. Pass 2 (or 3) error messages are all preceded by an "error chaining number" to identify the next <u>previous</u> page of the listing on which another error message will be found. That <u>previous</u> page number is printed in the format "PGØØØ6", and is regressive. That is, it locates the listing of the <u>previous</u> error.

NOTE: The first error message will always be preceded by "PGØØØØ" to indicate there are no previous errors. Further, if there is more than one error on a given page in the listing, the first error page number printed on that page will be the only one that indicates the previous page.

Source programs can now be read from a mass storage device, if wanted. For example, in the MTS the Symbolic Editor can be directed to write its "updated file" output into the magnetic tape's FILE 3. Then the Extended Assembler can be changed to read that "updated file" from FILE 3 as its source program. Such a change is made by overlaying part of the Extended Assembler with a small program called "SEAMS" for the Non-EAU version, or "SEAMS-EAU" for the EAU version. That overlay program is furnished as an absolute program for inclusion in the MTS FILE 1 on magnetic tape, and is loaded into core only by the MTS Inter-Pass Loader in response to an MTS Directive.

The S.A. (Starting Address) or entry point for the Extended Assembler to accept its control statements from a keyboard must now be specified as 120. Make note of this change in Chapter 5 of the *Assembler* manual (HP Part Number 02116-9014), pages 5-5, 5-6 and 5-7.

MT FORTRAN COMPILER

Two new features have been added, and two changes have been made, in this new version of the MT FORTRAN Compiler. They're listed here, then described in detail (if necessary) in the following paragraphs:

1. One IPL Call is now included for use only with the Magnetic Tape System. It has no effect on the use of this Compiler with paper tape operating methods.

2. A new optional parameter is now available for the FORTRAN control statement. The letter T can now be used to print an assembly language symbol table without printing the entire object program.

3. A new S.A. (Starting Address) or entry point to Pass 1 of the MT FORTRAN Compiler is now available; it's 50_8 for keyboard entry of the FORTRAN control statement.

4. When this Compiler is to be used with the MTS, the name "FTN2" and the S.A. 100 must be assigned to its Pass 2 (at PTS time.)

When the MT FORTRAN Compiler is used with the MTS, at the completion of Pass 1 execution an IPL Continuation Call is used to load and pass execution control to Pass 2 when appropriate. This IPL Call is used whenever Pass 2 is to be executed; the user has no means of bypassing it. Further, in this MT FORTRAN Compiler, Pass 1 always directs its intermediate output to a magnetic tape unit and Pass 2 always reads its input from the same magnetic tape unit, even if it isn't being used under direction of the MTS.

All of the parameters for the FORTRAN control statement are the same as those described in the *FORTRAN* manual (HP Part Number 02116-9015.) Now there is one more available in the MT FORTRAN Compiler; it's the letter T. When the letter T is included in the FORTRAN control statement, the compiler will print a list of the assembly language symbols used in the Compiler's output, but *not* a listing of the assembly language version of the program. This parameter should not be used with the letter A (one of the original parameters) because A will cause the Compiler to print the entire assembly language version of the program and the list of symbols. *NOTE: If both A and T are used, the second one specified will be used by the Compiler, and the first one will be ignored.*

When using the MT FORTRAN Compiler with the MTS, it must first be stored on magnetic tape (in the MTS FILE 1) for access by the Inter-Pass Loader. This is done when the MTS is configured to the Computer's hardware through the preparation program called PTS (see Section IV of this manual.) During this PTS procedure any name can be used for Pass 1 and either 100 or 50 may be specified as its S.A. (Starting Address.) However, Pass 2 must be assigned the name "FTN2" and its S.A. must be specified as 100.

ALGOL COMPILER

Only one change has been made to the ALGOL Compiler, the addition of an IPL Termination Call for use with the MTS. This IPL Call has no effect on the use of The ALGOL Compiler with paper tape operating methods, and has already been described in the beginning of this Section.

BCS (BASIC CONTROL SYSTEM)

Three new features have been added to this new version of the BCS (and its Relocating Loader.) Further, when it's used with the MTS, two restrictions have been imposed on BCS. These features and restrictions are listed here, then described in detail (if necessary) in the following paragraphs:

1. Its non-releasable portion now includes an entry point labeled HALT, which provides either the "final HALT" instruction or an IPL Termination Call for

the MTS. If the BCS is configured for use with paper tape operating methods, the IPL Call is not created.

NOTE: Any absolute program produced by BCS operating with the MTS must be subsequently executed only through the MTS. Reason: Each program of this type will include a "copy" of that IPL Termination Call.

2. It can be used only with the new version of the Program Library (as described in the next subsection of this manual) which includes a new version of the .STOP routine.

3. It now prints the "entry point list" portion of its "Memory Allocation List" in the form of a table, i.e., in rows and columns.

4. When the Relocating Loader's "load to core" option is used (not requested to produce an absolute version of the program) it first sets all locations in available memory to 106055B, which is a special HALT instruction.

5. When PCS (Prepare Control System) program is used to configure BCS for the Magnetic Tape System, two requirements must be met:

   a. The response to the PCS request FWA MEM? must be 110B.

   b. The response to the PCS request LWA MEM? must be x5777B(where x = 1 for an 8K memory or 3 for a 16K memory.)

A certain portion of the BCS Relocating Loader must always be resident in core while the BCS is in use. This non-releasable portion now includes an entry point labeled HALT, which is used by the new version of the .STOP routine in the Program Library. The "final HALT" instruction for the BCS is directly associated with this HALT entry point, for use in one of two ways. If the BCS is being used with paper tape operating methods the "final HALT" instruction is left unchanged; if the BCS is being used with the MTS that "final HALT" instruction is changed to a JSB 00106B,I to become the linkage word for the IPL Termination Call to the MTS.

NOTE: All absolute programs produced by BCS operating under MTS direction will include that IPL Termination Call instead of a "final HALT" instruction. For this reason all such absolute programs can be executed only under MTS direction.

A special HALT instruction, 106055B, is loaded throughout available memory just prior to loading of a relocatable object program by the BCS Relocating Loader. As a result, all locations not used by that object program will provide protection for other sections of core and/or aid in program debugging.

PROGRAM LIBRARY

Only one of several changes made in the Program Library has a direct effect on the MTS. For this reason, descriptions of the other changes will be given only in the *Program Library* manual (HP Part Number 02116-9032.)

The routine called .STOP has been changed to return to an entry point labeled HALT in BCS. That entry point is for a segment of BCS that, among other tasks, completes work formerly done completely within the .STOP routine. That is, one of two possibilities will now occur: If the program is being executed under MTS direction, the word "STOP" will be printed then execution control will be returned to the Inter-Pass Loader. Or, if the program is being executed with paper tape operating methods, the word "STOP" will be printed then the Computer will HALT with *n* displayed in the B-Register (in the previous version *n* was displayed in the A-Register.) Then, if the RUN pushbutton is pressed the Computer will simply remain halted. Refer to the *FORTRAN* manual's (HP Part Number 02116-9015) descriptions of the STOP statement for the meaning of the *n* display.

SYMBOLIC EDITOR

One feature of this version of the Symbolic Editor is an IPL Termination Call, which is used only with the Magnetic Tape System. This IPL Call has no effect on the use of the Symbolic Editor with paper tape operating methods.

Complete descriptions for the Symbolic Editor are summarized in the following paragraphs for the convenience of users of the Magnetic Tape System:

Introduction

The Symbolic Editor eliminates the need to manually repunch an entire symbolic file to make some editing or updating changes for that file. Instead, only the changes to be made need to be punched, or if there are few enough, the changes can be input directly to the Symbolic Editor through a Teleprinter keyboard.

Before the details of the Symbolic Editor can be described, a few special terms must be introduced. Then, in later paragraphs some other terms can be used. To begin with, the original symbolic file to be processed is referred to as the Symbolic File Input, the list of changes to be made is called the Edit File, and the symbolic file produced is known as the Symbolic File Output.

Three forms of multiple editing schemes are also provided for. Each is subject to the size of available memory, but for most editing requirements the Symbolic Editor will be able to handle all multiple inputs. Here are the three schemes:

1. *Multi-tape Edit File,* in which an Edit File is presented from more than one physical punched tape. All such input tapes for one Edit File can be processed in a single edit sequence if the total number of records in that Edit File doesn't exceed available memory.

2. *Multi-tape Symbolic File Input,* in which the Symbolic File Input is presented from more than one physical punched tape. The Editor will maintain the statement numbering sequence for the total Symbolic File Input from one tape to the next. Then it will produce the corresponding Symbolic File Output on one single physical tape with one numbering sequence throughout that output tape.

3. *Multiple Symbolic File Input,* in which more than one Symbolic File Input is processed in the same edit sequence. Each such Symbolic File Input is presented one at a time, and the Editor is instructed to maintain a separate statement numbering sequence for each. Then the Editor can be set to process each one independently of the others. The Editor can also be used to list their corresponding Symbolic File Outputs separately. *NOTE: Only one Symbolic File Output may be listed by a given Editor execution.*

Inputs and outputs for the Symbolic Editor may be handled by as many as three different devices in various combinations. A Teleprinter keyboard is always required for entry of EDIT directives (which are statements by the user to control the Symbolic Editor's execution.) An Edit File may be read by a punched tape reader or typed in through the Teleprinter's keyboard. Then the Symbolic File Input(s) may be read from either the same punched tape reader or from a mass storage device (such as a magnetic tape unit.) Finally, the Symbolic File Output(s) can be directed to either a mass storage device or a tape punch unit. Table 3.1 on the following page shows the allowable combinations of such devices:

TABLE 3.1 Symbolic Editor Input/Output Devices

Symbolic File Input(s) source		Symbolic File Output(s) destination
PTI	→	PTO
PTI	→	MSO
MSI	→	PTO

where: PTI = Punched Tape Input, PTO = Punched Tape Output
MSO = Mass Storage Output, MSI = Mass Storage Input

The ability to read a Symbolic File Input from a mass storage device is especially useful to the HP Magnetic Tape System. Here's how: In the MTS the Extended Assembler always copies its source program (a symbolic file) onto the magnetic tape in FILE 3. That copy is left in FILE 3 until another program is executed (or the Assembler is used again) to write something else into FILE 3. Thus, it is possible to assemble a source program and find that it has some errors, then immediately correct those errors. That is, the assembly can be immediately followed by an execution of the Symbolic Editor to produce a corrected source program on punched tape. Then another assembly can be attempted, after which another edit sequence can follow, if need be.

Conversely, the ability to write the Symbolic File Output on a mass storage device is also useful to the MTS. The Extended Assembler can be used immediately after an edit sequence to read the Symbolic File Output as its source program from the magnetic tape unit.

Edit Operations

It has been noted earlier that the Edit File consists of the list of changes to be made. Each item in this list is referred to in this text as an edit instruction. There are ten possible edit instructions available for control of the Symbolic Editor.

`/I,r` — Insert one or more records <u>following</u> record *r*. The record(s) to be inserted are presented on the following line(s).

`/D,`r_1 [`,`r_2] — Delete record r_1 [or records r_1 through r_2.]

NOTE: In the intended usage of the Symbolic Editor, another edit instruction should be used in the line immediately following a /D edit instruction. However, if that following line starts with an character other than a slash "/" (the first character required for an edit instruction), that line will be used as a replacement line for the line(s) just deleted by the /D instruction.

`/R,`r_1 [`,`r_2] — Replace record r_1 [or records r_1 through r_2] with the record(s) presented on the following line(s).

`/CI,r,c` — Insert character(s) <u>following</u> character *c* of record *r*. The character(s) to be inserted are presented on the following line.

`/CD,r,`c_1 [`,`c_2] — Delete character c_1 [or character (s) c_1 through c_2] of record *r*.

`/CR,r,`c_1 [`,`c_2] — Replace character c_1 [or characters c_1 through c_2] of record *r* with the characters presented on the following line.

`/F,n` — Used only for a *Multiple Symbolic File Input*, this edit instruction tells the Editor to use the next series of edit instructions for *n*th Symbolic File Input tape submitted.

An entry */F,1* is implicit, therefore it never has to be made. However, a */F,n(last)* must always be specified for the total number of Symbolic File Inputs to be submitted, to limit the Editor to accepting only that number of tapes. The tape (or record) for any */F,n* number not specified will be only copied, without any changes.

/L [,*n*]* This must be the only edit instruction in its Edit File, to instruct the Editor to only list the Symbolic File Input. [The number *n* may be included, to select any one of several tapes have been written onto the mass storage device by either the Editor or the Extended Assembler.]

NOTE:* *If you use a /L,n edit instruction then attempt to read the Symbolic File Input from punched tape (use the EDIT directive /P), the Editor will print the message "CS ERR", delete the entire Edit File input, then print an asterisk "*" to ask for a new Edit File to be typed.*

/↑ May be used at any time while typing or punching the Edit File, to delete the preceding edit operation line. Several /↑ entries may be used successively, to delete as many preceding edit instruction lines as there are /↑ entries. This feature makes it possible to correct mistakes in an Edit File either as it is being typed in, or as the Edit File tape is being punched (off-line.)

/E Terminates the Edit File. Or, if it is the only entry in the Edit File, the Editor is instructed to copy the Symbolic File Input without any changes.

NOTE: All c,n, and r sequence numbers must be in ascending order, greater than Ø, and unique. Any particular r number must be used in only one edit instruction within any one Edit File for any one /F,n Symbolic File Input number. Any particular c number may be used only once within any one edit instruction.

Operating Procedures

The Symbolic Editor can be used either with paper tape operating methods or under direction of the Magnetic Tape System (MTS). These operating descriptions will cover both methods. They also introduce and describe the use of EDIT directives.

NOTE: Throughout this procedure you will be instructed to type in various control statements. There are two kinds of control statements used by the Symbolic Editor, in this text we have called them EDIT directives and edit instructions. Terminate each entry you type by pressing the Teleprinter's RETURN then LINE FEED keys.

1. Set the Teleprinter to LINE operation and check that all other input/output devices to be used are ready for operation.

2. If you're not going to use the Symbolic Editor under direction of the Magnetic Tape System (MTS), skip the rest of this step 2 and go to step 3.

   For the MTS, use the MTS directive :PROG,*EDIT* (see Section V of the *Magnetic Tape System* manual [HP Part Number 5950-9202]) to load the Symbolic Editor, then go to step 4.

NOTE: The program name EDIT *in this sample MTS directive is not a required name, but only an example.*

3. For paper tape operating methods, first be sure the Symbolic Editor tape (a standard software system) includes an SIO module that is configured for your particular set of Computer hardware. (If it doesn't include one, you should use the procedure given in Chapter 11 of the *Operating Manual* [HP Part Number 02116-9057.])

Then use the Basic Binary Loader (BBL) to load the configured Symbolic Editor tape (be sure to return the LOADER toggle switch to PROTECTED.) Now LOAD ADDRESS 000100B and press the Computer's PRESET, then RUN pushbuttons.

4. Now two messages will be printed on the Teleprinter, the second of which asks for a directive to the device from which the Editor is to read the Edit File. If that device is to be the punched tape reader, skip the rest of this step 4 and go to step 5.

   If you're going to type the Edit File in, first type the EDIT directive /T, then type the Edit File of edit instructions. Now go to step 7.

5. To read an Edit File from punched tape you must first place the Edit File tape into the punched tape reader and "ready" that reader. Then type the EDIT directive /P. The Edit File tape will be read immediately. Now, if you are going to use the *Multi-tape Edit File* feature skip the rest of this stip 5 and go to step 6.

   If you're not going to use the Multi-tape Edit File feature, the tape just read must include the edit instruction /E. (If it doesn't, the Editor will print the message "**END-OF-TAPE" then an asterisk"*", after which you must furnish that edit instruction by typing two EDIT directives: /C, then /E.) Now go to step 7.

6. If you are going to use the Multi-tape Edit File feature, place the next Edit File tape in the punched tape reader, "ready" the reader, then type the EDIT directive GO to instruct the Editor to read that tape. The Editor will read the tape then print the message "**END-OF-TAPE". Now you again have the option to read another tape, which you can use by repeating the first part of this step 6. This option to read another tape will continue to be presented until a tape that contains a /E edit instruction is read. Such a /E instruction will terminate the Edit File input and cause a message for step 7 to be printed. (If none of the tapes submitted have a /E edit instruction, you can furnish that instruction at the end of the appropriate tape by typing in two EDIT directives:/C, then /E.)

NOTE: The separate tapes of a Multi-tape Edit File must be submitted in a sequence that will keep the references to Symbolic File Input record numbers in ascending order.

7. After it has received a /E edit instruction, the Editor will ask for a directive to the device from which it is to read the Symbolic File Input(s). If that device is to be the punched tape reader, type* the EDIT directive /P, then place the Symbolic File Input tape in the reader and "ready" that reader. If the source device is to be the mass storage device (such as the magnetic tape unit) , type* the EDIT directive /M. (If you've followed step 1 properly, the mass storage device is already prepared for use.)

8. Next, the Editor will ask for a directive to the device on which it is to produce the Symbolic File Output(s). If that device is to be the tape punch unit, type* the EDIT directive /P. If that device is to be the mass storage device (allowed only if the source device EDIT directive is /P), type* the EDIT directive /M. As soon as it has received either a /P or a /M EDIT directive the Editor will read the Symbolic File Input from the source device and produce an output on the destination device specified.

**NOTE: If you type an invalid response to the request of either step 7 or step 8, the Editor will repeat the request message to indicate that it has rejected your reply. This rejection will repeat until you type a valid response. A response is valid only if the device specified is available in your system's set of input/output devices.*

9. If you are going to use the *Multiple Symbolic File Input* feature (your Edit File includes one or more /F,*n* edit instructions), skip the rest of this step 9 and go to step 12.

   If you are going to use the *Multi-tape Symbolic File Input* feature, skip the rest of this step 9 and go to step 10.

   If the source device is /P, after the Editor has produced the Symbolic File Output of step 8 it will print two messages "**END-OF-TAPE" and an asterisk "*" to ask you for the next EDIT directive. If the Symbolic File Input is now complete (and it is if you're this far into step 9), type /E. This will instruct the Editor to either punch a trailer on the punched tape output or write an EOF (End-Of-File mark) on the mass storage device, and print "*END". Now go to step 15.

   If the source device is /M, the Editor will print the message "*END" to indicate that it has punched a trailer on the punched tape output. Now go to step 15.

10. To use the Multi-tape Symbolic File Input feature after the Editor has produced the preceding Symbolic File Output (the first one was produced after step 8), load the next tape into the punched tape reader and "ready" the reader. Then type the EDIT directive /C to instruct the Editor to read that next tape and append its corresponding Symbolic File Output record onto the previous one. Then, if there is still another tape to be read, repeat this step 10.

11. After the last tape of the Multi-Tape Symbolic File Input has been read, terminate that input by typing the EDIT directive /E. Now the Editor will either punch a trailer on the punched tape output or write an EOF on the mass storage device, and print the message "*END". Now go to step 15.

12. To use the Multiple Symbolic File Input feature after the Editor has produced the preceding Symbolic File Output (the first one was produced after step 8), load the next tape into the punched tape reader and "ready" the reader.

13. Now if the destination device is the mass storage device, skip the rest of this step 13 and go to step 14.

    If the destination device is the tape punch unit, type the EDIT directive GO to instruct the Editor to punch a trailer then print the message "TEAR PUNCHED PAPER TAPE." After you have torn off that tape, type GO again to tell the Editor to read the next tape and produce an output tape. Repeat step 12 and this step 13 until the Editor has printed the message "*END" to indicate that it has punched the trailer for the last Symbolic File Output called for in your Edit File, then go to step 15.

14. If the destination device is the mass storage device, type the EDIT directive GO to instruct the Editor to read the next tape and produce an output record. Repeat step 12 then this step 14 until the Editor has printed the message "*END" to indicate that it has produced the last output record called for in your Edit File, then go to step 15.

15. If you're using the Symbolic Editor under direction of the Magnetic Tape System, skip the rest of this step 15 and go to step 16.

    After it has typed the message "*END" the Editor will HALT the Computer with 102077B in the T-Register (the MEMORY DATA Register on the HP2114A Computer.) If you want to use the Symbolic Editor again now, you only need to press the RUN pushbutton to restart this procedure at step 4.

16. When it's used under control of the MTS, after the Editor has printed the message "*END" it will return execution control to the Inter-Pass Loader. The Inter-Pass Loader will then type the request "*NEXT?" to ask you for the next MTS directive. If you want to use the Editor again, restart this Procedure at step 2; otherwise refer to Section V in the *Magnetic Tape System* manual (HP Part Number 5950-9002.)

Error Diagnostics

While either the Edit File(s) or the Symbolic File Input(s) are being read, any one or more of the following Teleprinter messages may be printed to indicate certain errors in the Edit File. (Some errors do not become apparent until the edit instructions are attempted on the Symbolic File Input[s].)

Each of these error messages will be followed by a copy of the offending edit instruction, the message "CONTROL STATEMENT DELETED!", and an asterisk "*". Then the Editor will resume operation to read the rest of the input tape (or record.)

None of the errors causing these messages to be printed will HALT the Editor's execution. Instead, they'll all be detected and cause the error diagnostic messages one at a time, as just described. Then you can use those messages to correct the Edit File and try again.

NOTE: The Symbolic File Output(s) produced by the same execution of the Editor that produced the error messages should not be used; the output(s) may not be valid.

Teleprinter Message		Explanation
**CS ERR	a.	Illegal edit instruction code.
	b.	Missing parameter (*r* or *c* number.)
	c.	The second *r* number in this edit instruction is smaller than the first one.
	d.	The second *c* number in this edit instruction is either smaller than the first one or is greater than number of characters in the record *r* specified.
**CHAR OV		The new line produced by this edit instruction exceeds the maximum of 72 characters for the line length.
**EDIT OVERFLOW		The number of records in the Edit File exceeds available core memory. This is an error that will "abort" the Editor's current execution. Before another execution can be started for this Edit File, the Edit File will have to be shortened (perhaps the best way to do that is to break it into two halves and use the Editor twice.)
**ILLEGAL VALUE		Either an *r* or a *c* parameter is not numeric, or the *r* number is greater than 4 digits, or the *c* number is greater than 2 digits.
**INSERT ERROR		The line following the /I or /CI edit instruction has a slash "/" in the first position*.

*See the asterisk note on page 3-12.

**REPLACE ERROR — The line following the /R or /CR edit instruction has a slash "/" in the first position*.

**NOTE:* *If the first or only character in the line(s) following an insert or a replace edit instruction is a slash "/", it must be preceded by an exclamation point "!". This instructs the Editor to use the / and the following character(s) as the new one(s), rather than expect another edit instruction.*

**SEQUENCE ERROR

a. The *r* number specified in this edit instruction is smaller than that in a preceding edit instruction.

b. The *r* number specified in this edit instruction is greater than the number of records in the Symbolic File Input.

Sample Execution Listings

The six separate listings in this subsection were generated through use of the Symbolic Editor. Their intent is to show you the steps used to make some changes in two Symbolic File Inputs during a single execution of the Symbolic Editor program. (The listings were generated by six separate Editor executions following the one that made the changes.) In each of the six listings executions the /L and /E edit instructions were used to illustrate their use too.

The first one of the six listings shows only the communication messages that passed between the user and the Editor during the execution in which the changes were actually made. There were only two kinds of EDIT directives typed by the user, three /P and three GO entries. All of the other messages were printed by the Editor.

In the remaining five listings the user typed a pattern of one EDIT directive /T, two edit instructions /L and /E for a typed Edit File, another EDIT directive /P, then after the listing one last EDIT directive /E. The actual listing output is the block of numbered statements, and all other messages are those printed by the Editor. These five listings show, in sequence, the contents of the Edit File, the first Symbolic File Input, the second Symbolic File Input, the first Symbolic File Output, and the second Symbolic File Output:

```
                    HP SYMBOLIC EDITOR

EDIT FILE DEVICE?
/P

SYMBOLIC FILE SOURCE DEVICE?
/P

SYMBOLIC FILE DESTINATION DEVICE?
/P


**END-OF-TAPE
*
GO

TEAR PUNCHED PAPER TAPE.
*
GO


**END-OF-TAPE
*
GO

*END
```

HP SYMBOLIC EDITOR

```
EDIT FILE DEVICE?
/T

*
/L
/E

SYMBOLIC FILE SOURCE DEVICE?
/P

0001  /D,1
0002  /CR,2,6,10
0003  BRIEF
0004  /R,5
0005  HAS DEMONSTRATED
0006  /CD,6,1,3
0007  /CI,7,4
0008  TAPE CALLED
0009  /I,8
0010  IT INCLUDES
0011  /F,2
0012  /I,3
0013  AND ITS
0014  SYMBOLIC
0015  FILE OUTPUT.
0016  /E


**END-OF-TAPE
*
/E

*END
```

```
                    HP SYMBOLIC EDITOR

EDIT FILE DEVICE?
/T

*
/L
/E

SYMBOLIC FILE SOURCE DEVICE?
/P

0001  TODAY WE'LL USE
0002  THIS SHORT
0003  SYMBOLIC FILE
0004  INPUT TAPE
0005  TO DEMONSTRATE
0006  THE USE OF
0007  THE SYMBOLIC
0008  EDITOR.
0009  THE INTENT TO GIVE YOU SOME IDEA OF HOW
0010  USEFUL THE SYMBOLIC EDITOR
0011  CAN BE TO ANY USER.
0012  THE REST OF THIS MESSAGE
0013  IS NOT PART OF THE EXPLANATION.


**END-OF-TAPE
*
/E

*END
```

```
                    HP SYMBOLIC EDITOR

EDIT FILE DEVICE?
/T

*
/L
/E

SYMBOLIC FILE SOURCE DEVICE?
/P

0001  THIS IS THE
0002  SECOND SYMBOLIC FILE
0003  INPUT.


**END-OF-TAPE
*
/E

*END
```

```
                              HP SYMBOLIC EDITOR

EDIT FILE DEVICE?
/T

*
/L
/E

SYMBOLIC FILE SOURCE DEVICE?
/P

0001  THIS BRIEF
0002  SYMBOLIC FILE
0003  INPUT TAPE
0004  HAS DEMONSTRATED
0005   USE OF
0006  THE TAPE CALLED SYMBOLIC
0007  EDITOR.
0008  IT INCLUDES
0009  THE INTENT TO GIVE YOU SOME IDEA OF HOW
0010  USEFUL THE SYMBOLIC EDITOR
0011  CAN BE TO ANY USER.
0012  THE REST OF THIS MESSAGE
0013  IS NOT PART OF THE EXPLANATION.


**END-OF-TAPE
*
/E

*END
```

```
                              HP SYMBOLIC EDITOR

EDIT FILE DEVICE?
/T

*
/L
/E

SYMBOLIC FILE SOURCE DEVICE?
/P

0001  THIS IS THE
0002  SECOND SYMBOLIC FILE
0003  INPUT.
0004  AND ITS
0005  SYMBOLIC
0006  FILE OUTPUT.


**END-OF-TAPE
*
/E

*END
```

MT CROSS-REFERENCE SYMBOL TABLE GENERATOR

The MT Cross-Reference Symbol Table Generator processes an Assembly language source program to produce a cross-referenced list of all the symbols appearing in that program. It is intended primarily for use in the Magnetic Tape System and can read the source program only from a magnetic tape unit. It can, however, be used with paper tape operating methods if the SIO module for such a paper tape system includes a magnetic tape unit driver. (Refer to the *Assembler* manual [HP Part Number 02116-9014] for details.)

One IPL Call, for use in the Magnetic Tape System only, is included in the MT Cross-Reference Symbol Table Generator. As described earlier in this Section, the IPL Call is used by the MTS to return execution control to the Inter-Pass Loader after an execution of the Generator is complete. The IPL Call has no effect on the use of the MT Cross-Reference Symbol Table Generator with paper tape operating methods.

Each source program to be processed by the MT Cross-Reference Symbol Table Generator may have been submitted to either the Assembler or the Symbolic Editor from more than one paper tape each of which was copied onto magnetic tape. The Generator will identify up to 32_{10} such separate tape copies, each of which may contain up to 2,048 statements. If more than 32 tape copies are included in the source program, the 33rd tape copy will restart the two-digit numbering sequence again (no number will be printed) and the 34th tape copy will be identified by a second "02" number, etc.,etc.

The output of the Generator is a list in which the symbols are presented in alphabetic order. Each symbol is followed by a four-digit number to identify the statement of the source tape (as copied onto magnetic tape) in which the symbol was defined. It the source program was submitted from more than one tape (copy), that four-digit statement number is followed by a two-digit number to identify the tape (copy) number in which the symbol was defined.

A series of four-digit numbers will follow either the first four-digit number or its companion two-digit number. These following four-digit numbers identify any other statements that refer to the symbol. If any of those referring statement numbers are from a source tape (copy) other than the first one, their identification number will also be followed by a two-digit number to identify that other tape (copy) number.

The tape (copy) number is determined by the order in which the tapes (copies) are encountered on the magnetic tape. The first tape (copy) number is implicit and never printed.

This is the format of the Generator's output:

ssss dddd/tt rrrr/tt rrrr/tt rrrr/tt rrrr/tt rrrr/tt rrrr/tt
rrrr/tt rrrr/tt etc.. etc. . . . . .
etc. . . . .

where:

ssss = the symbol
dddd = the defining statement number.
tt = the tape (copy) from which the symbol was read.
rrrr = the referring statement number(s).

Operating Procedures

The MT Cross-Reference Symbol Table Generator can be used either with paper tape operating methods or under direction of the Magnetic Tape System (MTS). These operating descriptions will cover both methods.

1. Set the Teleprinter to LINE operation and check that all other input/output devices to be used are ready for operation.

2. Be sure the proper magnetic tape is ready for use on the magnetic tape unit. *NOTE: This tape must have two EOF (End-Of-File marks) preceding the Assembler language source statements to be processed by the Generator.*

This requirement is already satisfied if you're going to use the Generator under direction of the MTS.

3. If you are going to use the MT Cross-Reference Symbol Table Generator with paper tape operating methods, use this step 3. If not, go to step 5.

   For paper tape operating methods, first be sure the MT Cross-Reference Symbol Table Generator tape (a standard software system) includes an SIO module that is configured for your particular set of Computer hardware. (If it doesn't include one, you should use the procedure given in Chapter 11 of the Operating Manual [HP Part Number 02116-9057.])

   Then use the Basic Binary Loader (BBL) to load the configured Generator tape (be sure to return the LOADER toggle switch to PROTECTED.

4. Now LOAD ADDRESS 000100B, and press the Computer's PRESET then RUN push-buttons.

5. For the Magnetic Tape System, use the MTS directive :PROG,X-REF (see Section V of the *Magnetic Tape System* manual [HP Part Number 5950-9202] to load the Generator. Execution will start automatically.

6. After the last record is read the Generator will print the cross-reference symbol table. Then, if it's being used with paper tape methods the Computer will HALT. If the Generator is under direction of the MTS it will return execution control to the Inter-Pass Loader. Now refer to Section V in the *Magnetic Tape System* manual (HP Part Number 5950-9002.)

During an execution of the Generator, the following messages may be printed:

Message	Explanation and Required Action
DD *sssss*	This symbol is defined more than once in the source program. Unless one or more of the definitions is (are) included in either an IFZ (or IFN) then XIF psuedo instruction sequence (see the *Assembler* manual [HP Part Number 02116-9014])the source program will have to be corrected.
TABLE OVERFLOW	The combined number of symbols and references exceeds the capacity of available memory. This condition can be escaped by using two (or more) passes. In each such pass, before performing step 4 (for paper tape systems) set the Switch Register's bit 15 to 1 (up), or in step 5 (for the MTS) use the MTS directive :PROG,X-REF/ then set bit 15 to 1. This will enable you to type in an alphabetic range before the pass begins, to limit the Generator to a table for symbols starting only with those alphabetic characters. Then for another pass, a different alphabetic range can be used. Here's an example of alphabetic ranges you might use for three passes: 1st pass = (space) thru 9 2nd pass = :(colon) thru L 3rd pass = M thru ← (left arrow) (Refer to the *Assembler* manual's appendix A for the full *ASCII Character* range sequence.)

SECTION IV

SYSTEM PREPARATION

It has already been stated that the Magnetic Tape System consists of several software modules so that it can be configured to any particular set of Computer hardware. Several separate procedures are required, the first of which must be learned (if it isn't already known) from the manual named in the following paragraph. All the other procedures are described in this Section.

BCS CONFIGURATION

The BCS (Basic Control System) also exists as a set of software modules that must be configured through use of its Prepare Control System (PCS) program. The *Basic Control System* manual (HP Part Number 02116-9017) contains a Chapter which describes that program. Use that program for the MTS, with these two requirements kept in mind:

1. The FWA must be specified as 110B.
2. The LWA must be specified as x5777B, where x = 1 for an 8K memory or 3 for a 16K memory.

One other factor should be considered when the BCS is to be configured. The BCS HP2020 Driver D.21 (or the BCS HP3030 Driver D.22) includes a file protect operating mode that can be used to relieve a programmer of one responsibility, protection of the first two files on the magnetic tape at execution time. This file protect mode also allows up to 255 files to be addressed and accessed by number. Any references to a file number greater than 255 will produce an EOT condition, regardless of the physical amount of tape used. When the file protect mode is used, the first two files are not addressable, only files 3 thru 255 can be used.

The Driver can be set to the file protect mode, or the unprotected mode, or both modes, when the BCS is constructed by PCS. Such settings are made by an appropriate response to the Equipment Table entry requests:

- To use the file protect mode, enter

  16,D.21,U1

  (NOTE: "16" and "D.21" are samples only, refer to the BCS manual to determine the correct response for your system.)

- To use the unprotected mode, enter

  16,D.21

- To use both modes, enter

  16,D.21,U1

  16,D.21

  (this will set up two Unit-Reference numbers for the mag. tape unit, one for each mode.)

SIO MODULE CONSTRUCTIONS

Before they can be written into FILE 1 in the MTS each SIO Module must be constructed into a form acceptable to the Prepare Tape System (PTS) and the Inter-Pass Loader. Use this procedure for each of the SIO Modules you expect to include in your MTS FILE 1:

1. Use the Basic Binary Loader (BBL) to load the SIO Teleprinter Driver. Be sure to return the LOADER toggle switch to PROTECTED (this doesn't apply to an HP2114A Computer.)

   NOTE: The SIO Teleprinter Driver should be the first one loaded for all SIO Module constructions, whether it is to be included in the final result or not.

2. LOAD ADDRESS 000002B. That is, set the Switch Register to 000002, then press the LOAD ADDRESS pushbutton.

3. Set the I/O Address (Select Code) of the device for which the SIO Driver was just loaded into the Switch Register's bits 0 thru 5. Then, if this step is being performed for the Teleprinter Driver, set the Switch Register's bit 15 to 0 (down) if the Teleprinter is a Model 2752A or to 1 (up) if it's a Model 2754B. All other bits in the Switch Register should be 0 (down.)

4. Press PRESET then RUN.

5. If a second input/output device is to be included in this SIO Module, repeat steps 1 thru 4 now, this time for that device's SIO Driver and I/O Address.

   NOTE: Each SIO Module must conform to the characteristics described in Section II of this manual. Further, the individual SIO Drivers must be submitted to this procedure in the order listed in Section II.

6. If a third input/output device is to be included in this SIO Module, repeat steps 1 thru 4 again this time for that device's SIO Driver and I/O Address.

7. If you're constructing a Non-Standard SIO Module, now you'll have to consider these facts: If that SIO Module is to include three SIO Drivers none of which will be for the Teleprinter, you'll have to load an extra Driver. This extra SIO Driver is actually the third one of the SIO Module under construction, and the set of three will replace the appropriate sections of the Teleprinter Driver to produce the desired final result. Now, if such an extra input/output device is to be included, repeat steps 1 thru 4 again, for that device's SIO Driver and I/O Address.

8. Use the BBL again to load the software module labeled "SIO SYSTEM DUMP". Be sure to return the LOADER toggle switch to PROTECTED.

9. Now LOAD ADDRESS 000002B again, then set the Switch Register to all zeroes (all down.)

10. Press RUN. The SIO Module will then be punched on paper tape, which should be rewound and marked with an SIO Module name that can be used for FILE 1. Refer to the Prepare Tape System subsection of this Section IV for name rules.

    NOTE: If a HALT occurs while this tape is being punched, it will probably show 102066B in the T-Register. This is caused by a short tape supply in the tape punch device. Install a new supply then repeat steps 9 and 10.

MTS BOOTSTRAP CONSTRUCTION

An MTS Bootstrap program is necessary to place the initial sections of the MTS into core ready for execution. For each particular MTS hardware configuration, the MTS Bootstrap must be constructed to conform to the Standard SIO Module construction. *NOTE: If the Standard SIO Module construction in any one MTS is changed, the MTS Bootstrap must also be reconstructed.* This is the MTS Bootstrap construction procedure:

1. Use the BBL to load .MTS. which is the Standard SIO Module.

2. Use the BBL again to load the SIO Driver for the magnetic tape unit. Be sure to return the LOADER toggle to PROTECTED (this doesn't apply to an HP2114A Computer.)

3. LOAD ADDRESS 000002B, then set the I/O Address of the magnetic tape unit into the Switch Register's bits 0 thru 5.

4. Press PRESET then RUN.

5. Now use the BBL again to load the special software module labeled "MTS BOOT". Be sure to return the LOADER toggle switch to PROTECTED.

   NOTE: MTS Boot consists of the resident and non-resident portions of the Inter-Pass Loader, plus some base page initialization code.

6. LOAD ADDRESS 000002B then press RUN. This will "set-up" the Inter-Pass Loader. Completion of the "set-up" is indicated when the Computer HALTs with 102077B in the T-Register.

7. Use the BBL again to load the SIO System Dump. Be sure to return the LOADER toggle switch to PROTECTED.

8. LOAD ADDRESS 000002B, then set the Switch Register to 100000B and press RUN. The MTS Bootstrap will now be punched on paper tape, which should be rewound and marked accordingly.

PREPARE TAPE SYSTEM

FILE 1 and FILE 2 in the MTS must be written only through the software module labeled "PREPARE TAPE SYSTEM" (PTS). Before the PTS can be used, it must also be configured to the MTS set of hardware, as described in steps 1 thru 9. Then use steps 10 thru 17 to write FILE 1 and FILE 2:

1. If you haven't used this procedure before or want to make a copy of the configured PTS, use the BBL to load the PTS software module, then proceed to step 2. If you do have a valid copy of the configured PTS, you can skip directly to step 10.

2. If your hardware includes an HP2753A High-Speed Tape Punch you can choose to save a copy of the configured PTS for later use by punching it on paper tape. If you intend to do so, use the BBL again to load the SIO Tape Punch Driver. Be sure to return the LOADER toggle switch to PROTECTED (this doesn't apply to an HP2114A Computer.) If you're not going to punch a tape, skip to step 5.

3. LOAD ADDRESS 000002B, then set the I/O Address of the tape punch device into the Switch Register's bit 0 thru 5.

4. Press PRESET then RUN.

5. Use the BBL to load the appropriate SIO Driver for the magnetic tape unit. Be sure to return the LOADER toggle switch to PROTECTED.

6. LOAD ADDRESS 000002B, then set the I/O Address of the magnetic tape unit into the Switch Register's bits 0 thru 5.

7. Press PRESET then RUN.

8. If you chose (in step 2) not to punch a copy of the configured PTS, skip directly to step 11.

9. If you chose (in step 2) to punch a copy of the configured PTS, use the BBL again to load the SIO SYSTEM DUMP. Be sure to return the LOADER to PROTECTED. The LOAD ADDRESS 000002B, set the Switch Register to 100000B, and press RUN. The configured PTS will now be punched on paper tape, which should be rewound and marked accordingly.

10. Use the BBL to load the configured PTS tape.

11. LOAD ADDRESS 000100B, then set the I/O Address of the Teleprinter to be used for MTS directives into the Switch Register's bits 5 thru 0.

    NOTE: If the Switch Register is not set to the Teleprinter's I/O Address PTS will not start. Be sure you make that Switch Register setting correctly.

12. Press PRESET then RUN.

13. Two lines of information will now be typed on the Teleprinter specified in step 11. The second is an inquiry by PTS that you must answer by typing the reply into the Teleprinter's keyboard. Remember, signal the end of each reply by pressing the RETURN then LINE FEED keys.

14. Reply to the "PROGRAM INPUT DEVICE S.C.=?" message by typing in the Select Code (I/O Address) for the HP2737A Punched Tape Reader. Or, if your hardware set dosen't include a Punched Tape Reader, use the S. C. for the Teleprinter.

15. Some more information will now be typed by PTS, then a pattern of two inquiries for each absolute program to be written into FILE 1 will begin. You must type an answer to each of these inquiries according to the rules given in the following subsections titled "Program I. D. Name Rules", "Program S. A. (Starting Address) Rules", and "PTS Directives". Study those subsections, plan all the responses your particular MTS will need, use them, then resume this procedure at step 16.

16. After the PTS directive "/E" has been used to signal the completion of FILE 1, PTS will print three more messages, the third of which is the instruction "*LOAD". This is your cue to begin loading relocatable subprograms (either user-furnished or those in the HP Program Library) for FILE 2. Before you do begin however, you should again refer to the "Magnetic Tape Organization" descriptions in Section II of this manual.

17. After PTS has written each set of relocatable programs into FILE 2, it will print the instruction "*LOAD" again. If no more programs are to be included, set the Switch Register to 100000B, then press RUN.

    Two messages will now be printed by PTS; "*EOF" to indicate that such a mark has been written at the end of FILE 2, and "*END" after which the magnetic tape will be rewound to the Load Point marker.

Program I.D. Name Rules

Each absolute binary program to be written into FILE 1 must be given a unique name, as previously noted. Each name must conform to these rules:

1. It must consist entirely of ASCII characters.

2. It may use a minimum of one character, or a maximum of ten characters.

3. The first two I.D. Names for FILE 1 must be .IPL. and .MTS. for the non-resident portion of the Inter-Pass Loader and the Standard SIO Module,

respectively. The .IPL. program is one of the software modules furnished for the MTS. The Standard SIO Module is the one you constructed earlier in this Section IV.

4. The MT FORTRAN Compiler's Pass 2 must be given the I.D. Name FTN2, and the MT Cross-Reference Symbol Table Generator must be given the I. D. Name X-REF.

5. It may not include any of these characters:

: (colon)
, (comma)
/ (slash)
(blank)
; (semi-colon)

The first blank in the name will terminate the I.D. Name input and can be used as a separator for a comment after that name. The comment must be complete on the same line. Each line is terminated by pressing the RETURN then LINE FEED keys.

NOTE: If you use the RUBOUT key to cancel a line in which you just made an error, PTS will immediately print a ← then make the return and line feed for you.

Program S.A. (Starting Address) Rules

An S.A. must be specified for each absolute program to be written into FILE 1. The S.A. for BCS (the Basic Control System) must be 2 (000002_8); and, for most circumstances, the S.A. should be 100 (000100_8) for all of the other Standard Software Systems listed in Section I for use in the MTS.

An alternate S.A. is provided in both the MT FORTRAN Compiler's Pass 1 and the Extended Assembler (Non-EAU and EAU versions). This alternate S.A. can be specified to allow entry of the control statements for those Systems through the keyboard. Such a capability enables a user to easily change the control statement between successive assemblies or compilations of a given source program. Table 4.1 shows the total effects of both the normal and the alternate S.A. specifications on the MTS.

TABLE 4.1 S.A. Specification Effects

S.A.*	MTS mode	Control Statement Source
100	:BATCH	source program card deck**
100	:TYPE	source program punched tape or card deck
50	:BATCH	source program card deck**
50	:TYPE	keyboard
120	:BATCH	source program card deck**
120	:TYPE	keyboard

* 50 is the alternate S.A. for MT FORTRAN Pass 1, 120 is the alternate S.A. for the Extended Assembler.

** The :BATCH mode normally uses card deck inputs. It could use punched tape(s) inputs, but there would be practical limitations involved.

PTS Directives

After specifying the S.A., place that absolute program's tape into the punched tape reader, ready that reader, and press the Computer's RUN pushbutton. After PTS has read that tape it will request the next I.D. Name. Now, if that absolute program was complete on the tape just read, repeat the sequence of I.D. Name and S.A. entries for the next absolute program.

However, if that previous absolute program exists on more than one tape, you must not enter either the I.D. Name nor the S.A. again, but instead you must enter the PTS directive /C. This will instruct PTS to append the next tape read into one "logical" program with the previous tape read. Then place that continuation tape into the punched tape reader, ready the reader, and press RUN. After all continuation tapes have been read, resume the normal I.D. Name and S.A. sequence for the next absolute program.

When all the absolute programs to be included in FILE 1 have been read, answer the next I.D. Name request by entering the PTS directive /E. This will cause PTS to write an EOF (End-Of-File mark) on the magnetic tape and print "*EOF". Now you should read the following paragraph, then proceed to the next step of the PTS procedure.

At some later time (usually after MTS has been in use for a while) you may want to add some other absolute programs to FILE 1. To do so, you'll have to use the PTS again, starting at step 1 of the PTS procedure. Select the appropriate steps as before, then respond to the first I.D. Name request with the PTS directive /A. (This is the only time you can use /A.) Another I.D. Name request will then be printed by PTS, for which you begin another series of responses of the type described in the preceding paragraphs.

NOTE: whenever you do use the PTS directive /A to add more programs to FILE 1, you'll have to rewrite FILE 2, of course. Do this by performing steps 16 and 17 of the PTS procedure.

MTS INITIALIZATION

This simple procedure is used either to place the MTS into operation for the first time, or to recover from accidental destruction of the core resident portions of the MTS. These steps may be performed any time that FILE 1 and FILE 2 exist on a magnetic tape that is properly installed on a magnetic tape unit:

1. Use the BBL to load the tape produced by the MTS Bootstrap Construction procedure in this Section IV.

2. LOAD ADDRESS 000100B.

3. Perform this step if the following conditions can be met, otherwise go to step 4:

   If your MTS meets the hardware requirements described in Section I for a batch input device and the Standard SIO Module .MTS. includes a Card Reader, set the Switch Register's bit 15 to 1 (up) and all other bits to 0 (down.) This will enable the Inter-Pass Loader to accept :BATCH as an MTS directive from the Teleprinter keyboard. Now press PRESET then RUN.

4. If step 3 was not used, set the entire Switch Register to 0 (all down). Now press PRESET then RUN.

5. Proceed now to Section V of this manual.

SECTION V

SYSTEM CONTROL

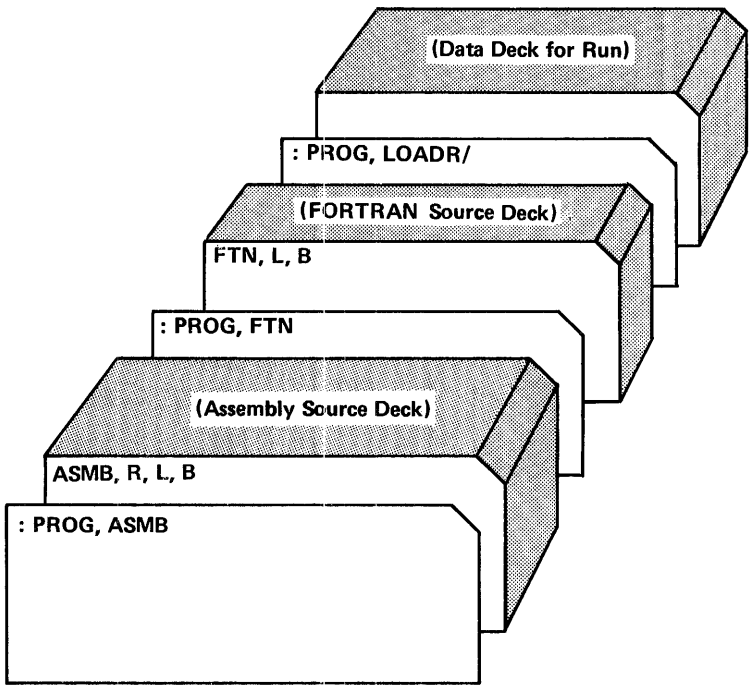
Two methods of operation are provided for in the Magnetic Tape System (MTS): batch processing or keyboard control. In either method special control statements (referred to in this text as MTS directives) are furnished by the user. These MTS directives may be either prepared on a series of cards (punched or marked) or typed in as they're needed.

The first MTS directive can only be typed in. It must be either :BATCH to set the MTS for batch processing (available only if step 3 in the *MTS INITIALIZATION* procedure of Section IV was used) or the first MTS directive for the keyboard control mode.

BATCH PROCESSING

The batch processing mode uses a prepared series of cards. Each card contains one MTS directive and is inserted into a "job deck" at appropriate locations. The "job deck" consists of source program statements for a programming language Compiler (or Assembler) and/or data cards for one or more programs to be executed. By locating the MTS directive cards at the beginning of each source and/or data deck, the MTS can be directed to load the appropriate program into core memory for execution as it's needed. Figure 5.1 shows how such a "job deck" and its MTS directives might look to provide operation of the MTS with little or no need for intervention by the user.

NOTE: In the sample "job deck"of Figure 5.1 one of the cards includes an MTS directive that will require a response from the user before its program can begin. Refer to the MTS DIRECTIVES *heading in this Section V for details.*



NOTE:
The names ASMB, FTN, and LOADR are samples only. Refer to Section IV for I. D. Name Rules.

FIGURE 5.1 A Sample "Job Deck"

The composite "job deck" shown in Figure 5.1 contains three MTS directives to perform these jobs: First, the Assembler is to be loaded into core then given execution control to produce an object program tape from its deck of source statements. Then the FORTRAN Compiler is to be loaded into core in place of the Assembler, to produce an object program tape from its deck of source statements. Finally, the BCS (Basic Control System) Relocating Loader is to be loaded into core in place of the FORTRAN Compiler, to load an object program tape (perhaps one or both of those just produced) into core for execution. That object program is expected to use the data deck of cards in its execution.

A "job deck" need not be limited to only three programs. Any number of jobs may be included in any one deck, as long as the size of the deck doesn't exceed the physical capacity of the card reader. Even so, the deck may be split into several physical stacks which may be loaded into the reader as space becomes available.

As each MTS directive card appears in the reader it is read by the MTS directive program called the Inter-Pass Loader. The Inter-Pass Loader (IPL) loads the next program into core in response to a :PROG card, then turns execution control over to that program. After the program has used all of its input cards it signals the IPL that its execution is complete. The IPL then reads the next card looking for a new MTS directive and, if it reads one, repeats the cycle. In this manner the need for a user or an operator to type in the MTS directives whenever a program is completed is eliminated.

Here are a few characteristics of the :BATCH mode that you should keep in mind:

1. At the end of any given program's execution, the IPL does not print the inquiry message "*NEXT?". Instead it will immediately read the next card in search of another MTS directive.

2. If the next card does not have a : (colon)in the first position (as required for all MTS directives) the IPL will ignore that statement and request the reader to read another card. This card skipping cycle will continue until a card with a : in the first position is read.

3. If the card with a : in the first position does not have a valid MTS directive, the IPL will then print out the complete contents of that card and the message "*CS ERR*", then temporarily HALT the Computer. This temporary HALT is provided to allow the user to remove the offending card from the reader's output tray, if such a removal is desired. To resume normal operation, the user only needs to push the Computer's RUN pushbutton.

NOTE: The IPL will print the contents of all cards with a : in the first position, whether or not they are valid MTS directives.

4. If two or more blank cards are read in succession, the IPL will assume that this is the end of the card deck. Thus, the Computer will HALT to wait for another deck to be loaded into the card reader. (This HALT will not turn off the card reader; the user must do that either by control settings or by removing any other cards from the reader's input tray.) To restart the MTS, the user must do only three steps: Place another deck in the reader, "ready" the reader, then press the Computer's RUN pushbutton.

KEYBOARD CONTROL

The MTS will be set to its keyboard control mode at any time that an MTS directive card containing :TYPE is read. Or when the MTS is started, it can be left in the :TYPE mode. Once the type mode is in use, the Inter-Pass Loader will read MTS directives only from the keyboard of the Teleprinter. Then, to perform the three jobs shown in Figure 5.1 the user (or operator) must start the series by typing in the MTS directive :PROG,ASMB. After that execution of the Assembler is complete, the Inter-Pass Loader will print the message "NEXT?" to ask for the next MTS directive from the keyboard. The user can supply the response to each such "NEXT?"

message only after it appears, thus the :BATCH mode provides an advantage over this keyboard mode.

NOTE: When the :TYPE mode is in use, the control statement for the Extended Assembler and/or the FORTRAN Compiler may have to be typed in through the keyboard, rather than read from the tape that contains the source program statements. Refer to the Program S.A. (Starting Address) Rules *description in Section IV of this manual.*

If the requirements described in step 3 of the MTS INITIALIZATION procedure in Section IV of this manual are satisfied, the user can switch the MTS to its :BATCH mode at any time between program executions. He does so by typing the MTS directive :BATCH.

OPERATING NOTE: The MTS provides a special advantage to the use of Standard Software Systems. Each of those Systems has some abnormal halts (described in their respective manuals) for which the user must check the cause of that halt, take some corrective action, then either press the RUN pushbutton to resume the current execution, or use the abort procedure of the MTS. The abort procedure consists of only two steps: LOAD ADDRESS 000077B, then press RUN. Then if the MTS is in the :BATCH mode, the IPL will read another card; or if the MTS is in the :TYPE mode, the IPL will print "*NEXT?" to request another MTS directive.

MTS DIRECTIVES

Three other MTS directives are available to user's of the Magnetic Tape System; their format and uses are described in the following paragraphs:

NOTE: Each MTS directive is terminated by the first blank (space) in the line for that MTS directive. The rest of that line may be used to enter a descriptive comment, if you like. The line is terminated in the :TYPE mode by pressing the RETURN then LINE FEED keys. The brackets [] are used to indicate the entry in the format is optional and may be left out of the MTS directive if it isn't to be used.

:PROG,*nnnnnnnnnn*[;*sssssssss*][/]

where: *nnnnnnnnnn* Is the name of the "control" program to be loaded into core from the magnetic tape's FILE 1. This name must agree exactly with the one assigned to the desired program at PTS time (see Section IV.)

sssssssss When needed, there can be one or more of this type of entry. Each such entry can be used to load one or more "support" program(s) for the "control" program named above. (For example, the Extended Assembler may require the use of its overlay program, as described in Section III.)

NOTE: The "control" then "support" program(s) must be entered in the same sequence in which they were written into FILE 1. If they aren't, the IPL will abort the :PROG, request and proceed to the next MTS directive

Then, if wanted, a Non-Standard SIO Module's name can also be included to load that Module in place of .MTS. (the Standard SIO Module) for use only during the execution of this "control" program.

NOTE: Each entry in this sssssssss *category must be separated from any other entry in this line by a ; (semicolon.)*

/ (slash) Is used whenever needed, to cause the MTS to pause before giving execution control to the "control" program named above. Such a pause can be used to allow the user to set a Switch Register option, or some other type of manual control.

:COMMENT, This MTS directive allows a line of descriptive or instructive comments to be included with the functional MTS directives. The system input device Teleprinter prints a log of all MTS directives, thus a series of :COMMENT, entries can be used to include some explanations of- or instructions for- the tasks being performed.

:PAUSE This MTS directive is normally used to HALT the MTS after a series of program executions is finished. Then the peripheral divices can be turned off or otherwise put on standby until the next series of executions is to be started. When that next series is ready, the MTS is easily restarted, by "readying" those devices again, turning on the Teleprinter, and pressing the Computer's RUN pushbutton.

SECTION VI

ABSOLUTE PROGRAMMING RULES

All Absolute programs to be written into FILE 1 for use in the Magnetic Tape System must conform to these rules. Failure to do so may cause some unpredictable results. Refer to Sections II and III of this manual for additional details.

1. Do not begin any coding before location 7B.
2. Always set location 1Ø5B to the last word address plus one (1) of the program.
3. Have the final halt instruction (HLT 77B) exactly one instruction prior to the starting address of the program.
4. Always return to the final halt instruction with the "A" register set for the proper IPL Call (usually zero (Ø).
5. Have your program load location 1Ø7B to zero (Ø).
6. Always specify a BSS 4 for locations 1Ø1B-1Ø4B.
7. The :BATCH mode entry point for absolute programs is usually location ØØ1ØØB. However, this is <u>not</u> true if the starting address (S.A.) specified at PTS time was ØØØØ2B or any address greater than Ø1777B; for such cases the S. A. specified will always be used for either the :BATCH or :TYPE mode. Further, the IPL <u>won't</u> provide an abort address if the S. A. specified was greater than Ø1777B.

   Location ØØØ77B is the standard abort address provided (it's changed by the IPL to a "JSB ØØ1Ø6B,I" to return control to IPL) whenever the S. A. specified is anywhere on the base page.

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