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THE UTOR, A PROGRAM FOR THE CONNECTION OF A NUMBER OF PERIPHERALS TO A GENERAL PURPOSE COMPUTER

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The UTOR, a program for the connection of a number of peripherals to a general purpose computer

by

P.J.W. ten Hagen & C.L. Pippel.

ABSTRACT

A real time operating system for a satellite computer (in casu a PDP8/I) is described. The satellite is used as a peripheral processor to a general purpose computer. The real time problems inherent to the servicing of all kinds of peripherals are tackled by splitting up the servicing into the urgent real time part and the less urgent follow-up. The interface between these two kinds of service processes is defined by means of meta-instructions for job handling. The design and implementation of these meta-instructions together with some examples is outlined. The complete operating system-assembly listing is added in the appendix.

KEYWORDS & PHRASES: Real time operating system, peripheral processor,
multi programming

CONTENTS

1. INTRODUCTION

In this report we describe an operating system for a small satellite computer (a PDP8/I).

The function of the operating system, called UTOR (Users coordinaTOR), is to establish the connection between a number of peripherals and the central general purpose computer (a Philips-Electrologica EL-X8-computer).

There are several reasons why we use a satellite computer to connect these peripherals instead of connecting them directly to the central computer:

1. The number of connections possible to the computer can be (and in our case is) smaller than the total number of connections required for all peripherals. A satellite counts for only two connections.
2. Some peripherals demand the attention of the CPU with high frequency. Putting a satellite in between, which takes care of all real time problems caused by those peripherals, results in a considerable reduction of overhead for the CPU.
3. The satellite can make each peripheral look like a simple standard machine to the central computer.
4. In many cases the connection between a special purpose computer and a peripheral is much cheaper than the hardware for a direct connection. This is especially true when the central computer is replaced. In this latter case only the connection between the new computer and the satellite has to be reestablished

The control of the UTOR over a peripheral can be devided into two parts:

1. The actions that are to be taken in order to fulfil the real time requirements. These actions have to be completed within a certain time-interval each time a device asks attention.
2. All actions that can safely be delayed if necessary. This set of actions is called *the administrative follow-up.*

The operating system has a set of primitive actions, that can split up the servicing of each peripheral into the real time treatment and the administrative follow-up. In this way all peripherals (including the central computer) are treated uniformly. The real time treatment takes place in interrupt routines. The follow-up consists of a number of jobs, initially created by the interrupt routines. Each job is created by putting it into the queue of its appropriate priority level. The real time treatment as well as the follow-up is subject to a multilevel priority schedule. This solves the problem of parallel servicing of all connected peripherals. The connection of another device causes no further problem with respect to this subject.

Initially the UTOR was meant to connect a number of terminals to the EL-X8. To this end the first version of the UTOR knew a two-level interrupt mechanism to deal with the real time problems, and one low-priority job queue for the follow-up. This version was designed and programmed by the first author of this report. It was presented as a "master thesis" under the title: "DE UTOR, een programma voor de koppeling van een aantal terminals aan een computer". It was carried out under the supervision and mentorship of Prof.Dr. F.E.J. KRUSEMAN ARETZ. The philosophy of how to use a terminal, and the ideas for the implementation of the UTOR were developed during many discussions between the author and his mentor. The author is also much indebted to J.V.M. VAN DER GRINTEN and C. ZUIDEMA from whom he received the first raw versions of the interrupt routines for the multiplexer and the interface with the EL-X8. When new peripherals had to be connected to the UTOR the concept of a multilevel jobmechanism which contains the multilevel interrupt routines was designed together by both authors. This version was implemented by the second author. It is also the version that we describe in this report.

When it was noticed that the UTOR could service all connected peripherals and still remain idly waiting most of the time, the idea arose to modify the UTOR and the PS/8 operating system of the PDP8 in such a way that PS/8-programs could run under supervision of the UTOR. This project was carried out by A.E. BROUWER and the second author. Since the interface between the UTOR and PS/8 was rather complex and all programs to be run had to be modified considerably, the hardware of the PDP8/I was extended to allow disconnecting the keyboard and teletype printer flags from the interrupt bus. The version of the UTOR listed in appendix A is the one with a simplified interface with PS/8, made possible by this hardware change.

2. THE SUPERVISOR

2.0. Task and Form of the Supervisor

The task of the supervisor is to distribute processortime over all peripherals that need servicing for their real time requests or for the administrative follow-up. We assume that all real time requests are initiated by the hardware through a one-level interrupt. (The PDP8/I has a one priority-level interrupt mechanism). The first and most urgent action undertaken by the supervisor is to find out how urgent a given interrupt needs to be serviced. This means that all UTOR routines are interruptable, except for some short (in time!) sections. All critical actions of the cooperating processes take place inside these protected sections. A call of the interrupt service routine always results in the creation of a *job* of a certain priority. Upon exit of the interrupt routine, the job with the highest priority is executed or continued.

The supervisor consists of the interrupt routine mentioned above, and a number of other routines that can be called from the specific peripheral service routines. These calls are referred to as *meta-instructions*. The meta-instructions can be added to the repertoire of machine instructions (in our case PAL8 assembly code). This creates a new machine that, in our experience, is much easier to deal with. Before describing the meta-instructions in detail, we shall give a complete job description in the next paragraph.

2.1. The Job mechanism

A job is an instruction to the supervisor to execute a certain routine with some specified data. The job can result in a change of the given data as well as in the creation of zero or more subsequent jobs.

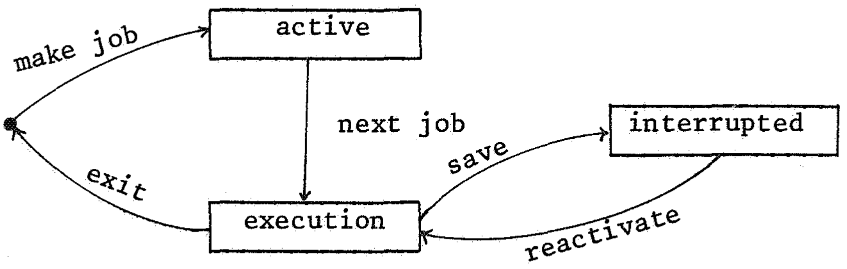
The execution of a job is an autonomous process. A job can be temporarily interrupted but never be terminated by the supervisor. Termination is accomplished by the job itself through execution of a meta-instruction. A job, just created, is specified by the following three parameters:

- the routine address
- the priority
- the data pointer.

The data pointer is the core memory address where the data can be found and stored. Two existing jobs may differ in the data pointer only! The priority is a measure for the urgence of a job. For each priority level there exists one queue of jobs. Only the first job of the queue is in execution. New jobs are always put at the end of the appropriate queue. Thus it follows that for each priority level only one job at a time can be in execution. In this way a job may have local variables as long as all incarnations of the same subroutine are of equal priority. Furthermore it follows that jobs of equal priority are executed in order of creation. A job once created can be in one of the following states:

- active, the job is in the queue
- in execution, the routine of the job is in execution
- interrupted, the job is saved on the interrupt stack.

The state of a job changes through execution of one of the meta-instructions as specified in the following transition diagram:



2.2. The Meta-instructions

The meta-instructions can be added to the program in the form of subroutine calls. We specify them below:

- MAKEJOB

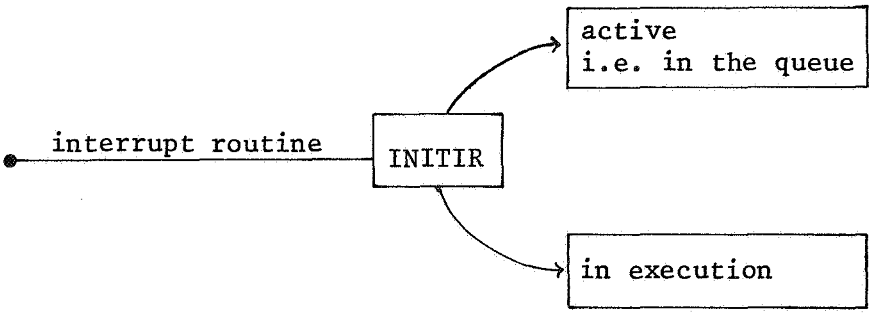
This is a call to the subroutine MAKEJB which creates the job specified by three parameters:

routine address (in accumulator)
job status word (in JSWMJ)
data pointer (in DTPNMJ)

The parameters are stored at fixed locations. Therefore, the interrupt must be disabled before storing, and may be enabled only after the call.

- INITIR

This is a call to the subroutine INTRAP by an interrupt routine, to ask for processor time. The accumulator contains the only parameter, the priority level. INTRAP decides whether the interrupted job must be continued or must be saved because of the higher priority of the interrupting routine. In the former case it executes MAKEJOB (calling address+1, priority, skip), followed by a return to the interrupted job; in the latter it executes SAVE, and continues the interrupt routine



- EXIT

This is a jump to DECIS, executed by a job when it has completed its activities. DECIS then either continues the last interrupted job or starts a job from the most urgent nonempty job queue, whichever has the highest priority.

- SAVE

This is a call to the subroutine STACK, which saves accumulator, link, data field, instruction field, program counter, data pointer, and job status word of the interrupted job on the interrupt stack.
The job status word contains the priority of the interrupted job. After execution of SAVE it can be found at the top of the stack. This makes the selection of the most urgent job by DECIS more easy.

- REACTIVATE

This is a call to the subroutine UNSTACK to restore registers and variables saved by STACK. In particular the program counter is restored, which means that the interrupted program is continued.

- NEXTJOB

Called by DECIS to start the next job from the job chain (if its priority is greater than that of the interrupt stack). In the listing it is represented by the label NEXTJB.

3. THE IMPLEMENTATION OF THE JOBMECHANISM

In this chapter we will describe in more detail how the jobmechanism is implemented. Illustrations are taken from the existing implementations on the PDP8/I. All terms used in this description, that directly refer to PDP8/I-hardware or the assembly listing (appendix A), will be denoted in capital letters (e.g., AC, LINK or L). For their precise definition, the reader is referred to the PDP8/I programming manual.

The status of a job can be defined as the way the specifying parameters are stored. These parameters contain all information to (re)start the job. The parameters are:

- routine address, consisting of PC (program counter) and
  IF (instruction field)
- priority, 3-bits register, thus allowing 7 levels of priority (at
  the moment only 4 levels are used)
- data pointer, actual data pointer
- registers, AC (accumulator), 12-bits and L (link), 1-bit.

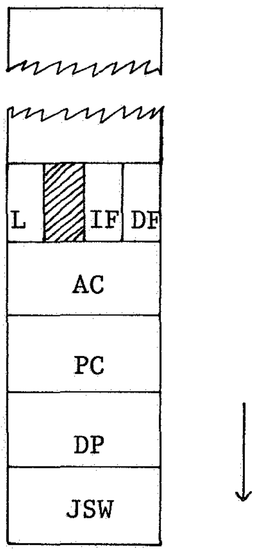
According to the transition diagram (c.f. 2.1) a job can be in one of three states:

- in execution

  The parameters denoted in capital letters are stored in the corresponding hardware registers. The "priority" and "actual data pointer" can be found in two memory locations named JSW and DATAPN respectively.
- interrupted

  The status of the interrupted job is saved on the interrupt stack, as depicted in fig. 3.1. The JWS of the job with highest priority among all interrupted jobs containing this priority lies on the top of the stack. The priority can be considered also as the priority of the stack as a whole. (Note that the priority of job in execution is always higher than that of the stack; therefore, if such a job is interrupted it is pushed on top of the stack).

fig. 3.1.

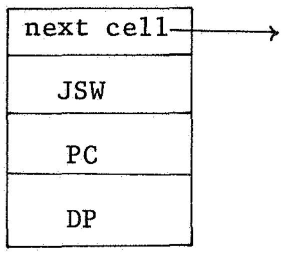


interrupt stack

- active

  The active job status fills a cell in the job chain. This cell contains (cf. fig. 3.2) only the job status word, the PC and the data pointer. All other hardware registers will be initialized in a standard way [i.e., AC := ∅; L := ∅; IF := ∅, DF := 3], when execution is started (NEXTJOB) and need not to be stored.

fig. 3.2.



job cell

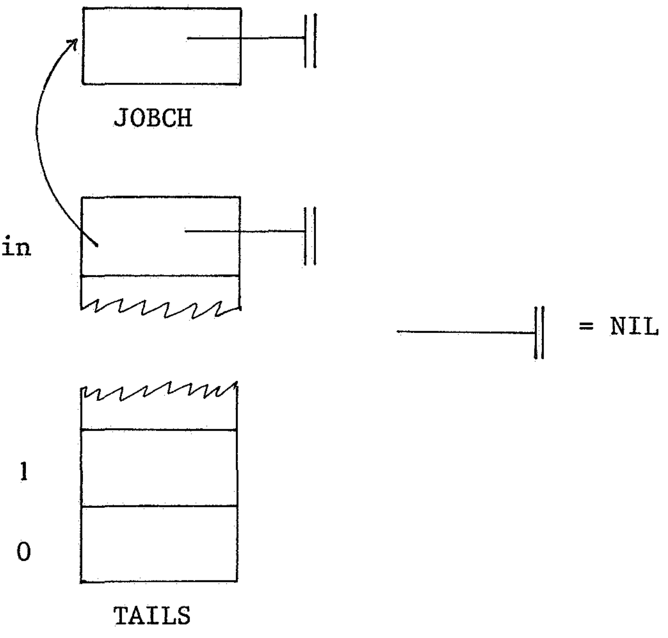
The so called job chain consists of several sub-chains, i.e., one for each priority level. A sub-chain of higher priority precedes a sub-chain of lower priority. The elements of the sub-chain are the job cells (fig. 3.2). The NEXT-pointer of the last cell in a sub-chain points to the first element of the next nonempty sub-chain, or to NIL if no such sub-chain exists. In the latter case it is also the last cell of the job chain.

The first cell in the job chain can be found through the pointer JOBCH. This pointer is used by NEXTJOB to find the active job that has to be brought in execution.

MAKEJOB puts a job of priority i at the end of the i-th sub-chain. In order to locate this position without a search of undefined length the supervisor disposes of an array of pointers, namely:

TAILS[0: N] (N is the highest priority level).

TAILS[i] points to the last active job of priority i, or to NIL when the sub-chain is empty; however, TAILS[N] points to JOBCH when the job chain is empty. JOBCH can be considered as the NEXT-field of the "job cell" that precedes the first existing job in the chain. The empty chain is depicted in fig. 3.3. Observe that the first defined pointer from TAILS [i] locates the position where an active job of priority i has to be inserted. This is also the case when the job chain is empty: The fact that a (sub-) chain is empty constitutes no exceptional situation.



empty job chain

fig. 3.3.

After one action of MAKEJOB for priority i, the empty chain turns into the chain of fig. 3.4. The reverse effect would be caused by an action of NEXTJOB. It is clear that both meta-instructions carry out some pointer setting.

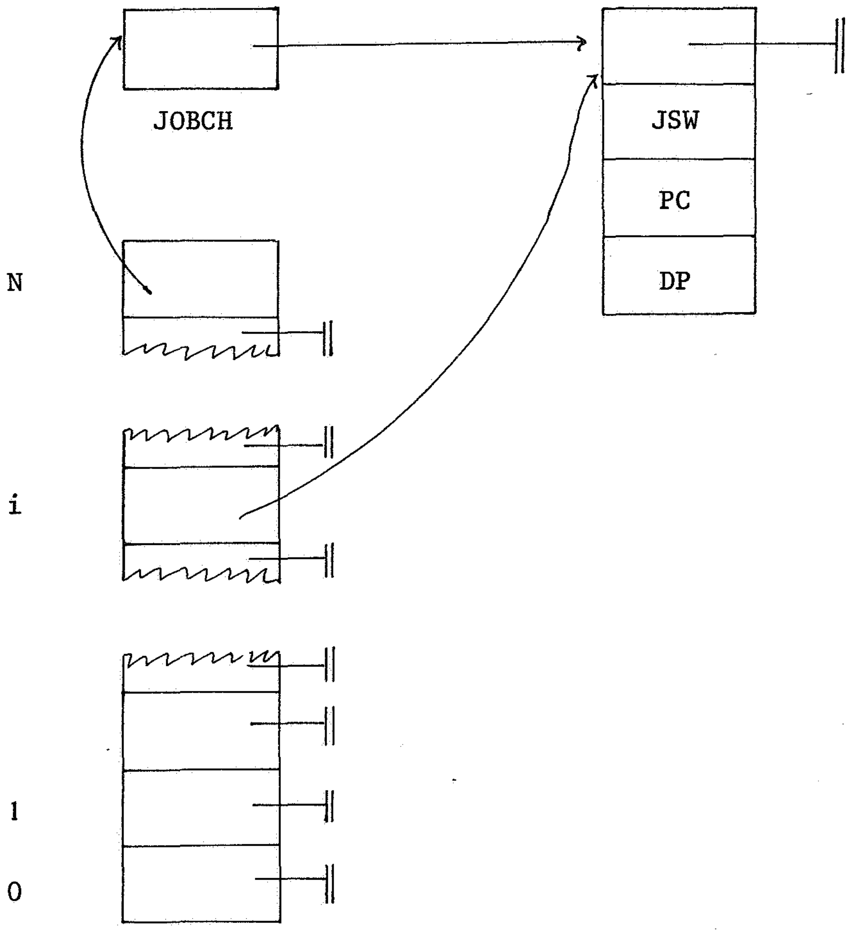


fig. 3.4.

The supervisor contains a routine called DECIS which determines whether a job from the stack will be restarted or a new job from the job chain will be executed, i.e., whether a REACTIVATE or a NEXTJOB will be executed. DECIS chooses REACTIVATE whenever the priority of the stack is equal to or greater than the priority of the job chain, or when the job chain is empty. In the latter case one might expect stack underflow. Stack underflow will not occur as long as the following condition remains valid: DECIS is executed only following an execution of the EXIT-instruction by an active job. This job has interrupted another job, or the background program, which never terminates, and always is started first (upon initialization of the whole system). Hence in both cases the stack is not empty. Observe that stack overflow will not occur due to the fact that a job can only be interrupted by a job of higher priority. There can be at most N+1 jobs interrupted. (N = max priority). So the stack will never grow over (N+1)*5 locations.

4. THE CONNECTION OF TERMINALS, AN ILLUSTRATIVE EXAMPLE

4.0. Introduction

To illustrate the programming of a peripheral in the UTOR, we describe in this chapter the connection of a number of terminals. In the first part a set of specifications for the use of terminals is justified. This leads to a number of rules for the information traffic between a user at the terminal and the central computer. In the second part (cf. section 4.4) the primitive actions defined in chapter 2 are applied to solve the real time problems as well as to implement these rules.

4.1. Specifications for the Use of a Terminal

The operating system in the central computer communicates with a user at a terminal through messages. To specify the way the UTOR processes these messages we don't need any knowledge about the task of the system. However, a little has to be known about its behaviour. The UTOR accepts messages from the central system for each terminal. These messages are treated in three stages. In the first stage the message is collected in a buffer and the UTOR requests permission to print it. In the second stage, when the permission is granted, the message is handed over to the multiplexer as a character string. In the third stage the multiplexer sends each character as a bitstream to the terminal.

In the opposite direction the multiplexer transforms the bitstream into characters. This constitutes the third stage. Each character is given the appropriate treatment in the second stage. This means that it might be used to build up a message for the central system. Complete messages are handed over to the central system in the first stage.

At each stage, the total number of work is divided into a number of jobs of equal priority. On the third stage the priority is high due to the real time requirements: the multiplexer must sample (put) the next bit from (on) the line within a relatively small interval of time. The priority level for the interface with the central computer is chosen below that for the multiplexer, though high enough to guarantee a high-speed message transfer. A relatively low priority level remains for the second stage jobs.

The treatment of the messages at the second stage is decisive for the way in which both user at the terminal and central system will communicate with each other. In the next section we will explain how the user can and should be able to use the terminal.

4.2. The Use of a Terminal

All kinds of on-line terminal use can be put into one of the following categories:

- interactive use.
  The user and the central system exchange (usually) short messages on question-and-answer base. This application is called the *sin/sout* (simple-in/simple-out) use.
- The use of a terminal as reader station or as output station.
  Possibly large amounts of data are read or printed, without intervention of the receiving station (user or central system). These applications will be referred to as the *full-duplex use*. In the following discussion we will only consider so-called *full-duplex terminals*. This means that the decision whether a character received from the keyboard will be printed or not (the so-called *echo*) is fully programmable. Full-duplex terminals allow among other things simultaneous input from keyboard/papertape reader and output to printer/papertape punch.

4.2.1. The Interactive Use

During the conversation between the user and the central system, the user can be in one of the following situations:

a) he is typing a message,

b) he is waiting for a message,

c) the message is being printed.

Situation a) changes into situation b) as soon as the user finishes his message by typing a line-feed character. When the central system detects the line-feed, it starts processing the message. By choosing the line-feed as the completer, we define messages to consist of one line of text. This seems to be most convenient to the user.

The UTOR keeps account of these situations mentioned above. This is necessary because the printer can be at the disposal of only one of the participants in the conversation at the time. The decision to whom the printer is assigned is made by the UTOR. When the user is allowed to type a message he also has the printer at his disposal, so that he can see what he types. As soon as he completes his message the UTOR puts the terminal in the waiting state (b). In the waiting state both participants can request the printer for one complete line of text. It is assigned to the first applicant. The user requests the printer by typing a character. The central system requests the printer by sending the first buffer of the line to the UTOR. Such a request can be made while the other participant is still printing. In that situation the UTOR assures that this request will be granted when the end of line occurs.

If the central system is a correct participant in the conversation it behaves as follows: it will not request the printer before it has a complete message ready. This guarantees the UTOR, that as soon as it assigns the printer to the system, there will be an opportunity to give the printer back to the user, within the amount of time needed to print one line (e.g., the central system cannot delay a user interrupt by printing an incomplete message). If the line consists of more than one buffer, the central system will send only one buffer at the time. As soon as this buffer gets empty the UTOR will make a request for the next one. This is necessary because the satellite computer has only a small buffer capacity. In practice the central system simply sends the first buffer of a message to the UTOR without concern about the turn. Sooner or later it will receive a request for the next buffer, which implies that it has got the disposition of the printer. The user on the other hand should be concerned about who's turn it is. If he does not finish a message properly (with a line-feed), he can hold up the progress of the conversation. We allow this situation because it causes no serious difficulties. The user can see what he is doing; he only frustrates the progress of his own program and, moreover, he might be holding it up deliberately, because he needs to think, or because of paper jam.

When the user types in the first character of his message one of two possible things happens:

- his character is printed, he got the turn,
- the terminal prints a message from the central system.
  This printing stops at the end of the line. The user now can restart typing the first character succesfully.

The UTOR accentuates the origin of the typed messages by printing them in different colours.

4.2.2. The Full-Duplex Use

In the full-duplex state, the printer is exclusively assigned to the central system. Every character read in or typed by the user is transmitted to the central system without echo. This allows simultaneous input and output. The interval buffer-organisation maintained by the UTOR can be the same as in the interactive case:

- one output buffer per terminal on request,
- transport of every filled input buffer to the central system.

Sofar nothing has been assumed about the capacity of the input channel from the UTOR to the central system. Since the satellite only has a small buffer capacity, each input buffer must be transferred to the central system, before the next buffer is filled. The channel allows transport of one buffer for one peripheral at the time. Therefore, regardless of the capacity of the channel, the UTOR should provide for a queue mechanism. The capacity of the queue must be large enough to contain all buffers that possibly can get filled from all peripherals during the time interval the system is allowed to ignore the channel (= the maximal transporting time for one buffer).

4.2.3. The Off-Line Terminal Use

The UTOR provides another facility for the terminal user. Until now we have assumed that the user was connected, via the UTOR, with the central system. In the off-line situation, there is no connection between the user and the system, but only between the user, the UTOR and possibly other terminals.

Although this type of use is of minor importance (e.g., the preparation of papertape, copy a tape from one terminal to another), it is included because it takes almost no extra effort to implement it. As a consequence of the possibility to change connections there must be an initial state, the so-called *solo-state*. In this state the user may request the UTOR to establish a connection; the UTOR also may connect the terminal with the central system or another terminal on their request. The solo-state is simulated by the UTOR, by printing every typed character. Therefore, the user can use this state to prepare his papertapes, and at the same time remain connectable with other stations.

The connections between two terminals is similar to the sin/sout-connection between user and central system (cf. 4.3). The rules concerning the turnover are somewhat different, in order to meet the fact that now both partners can behave badly (i.e., not finish their line of text). In this situation the sout-partner (passive) can give a command, which puts him in the sin-status immediately.

4.3. UTOR Commands

The UTOR supports a certain type of terminal use by giving each received character the appropriate treatment. In order to inform the UTOR that a certain connection or treatment is to be established, the user sends a *command* directly to the UTOR. A command is announced by typing the *attention signal:* @. Upon receipt of this character the UTOR puts the terminal into the command status. The user now can type in the specific command, and effectuates it by typing a line-feed.

A necessary condition for proper use of a terminal is, that both partners are permanently informed about the status of their terminal. For the terminal user it is also important to be able to reconstruct the terminal session from the listing on his printer.

A UTOR command is carried out in two stages:

a) The typing of the command.

b) The execution of the command by the UTOR.

Stage a) begins when the UTOR encounters the attention sign and ends when the line-feed is received. In stage b) the UTOR first informs the two stations involved, of the new state and next effectuates it. It is clear that now real time problems can occur: Both partners simultaneously can start typing a command, one of the two might continue typing, unaware of the change of state coming forward, etc. Moreover, the UTOR itself now becomes interested in the terminal printer.

In order to solve this type of real time problems, we first consider commands to change the type of use (e.g., switch from solo to sin/sout, switch from sin/sout to full-duplex). Only the following commands are allowed:

- the terminal is in sin/sout state and wants to change to a different application,
- the terminal is not in sin/sout state and wants to return to the sin/sout status.

It follows that a change of use always takes place via the sin/sout status. This guarantees that before a new type of use and connection is established, there has been an opportunity to carry on the conversation that is needed. Thanks to the sin/sout-connection this conversation is completely listed. The user in situation a) who wants to give a UTOR command needs to be in sin/sout status. As soon as he has the turn, he types a command, beginning with the attention sign. The command will be executed, as soon as he types the line-feed. Instead of a turnover, the new state is established. Incorrect commands cause an error message from the UTOR, followed by the reestablishment of the sin/sout status. The partner cannot disturb during the typing of a command. He remains in sin/sout status (waiting for a turnover), until the command is executed. During the printing of the UTOR message, that announces a new status, both partners are treated as if they are waiting for the turn (sout status).

In situation b) we must decide between the solo-status and the full-duplex status. In the former case the UTOR message consists of the name of the partner (terminal number or central system) the user wants to be connected with. Upon effectuation the UTOR checks, whether the partner is free (terminal must be in solo-status, the central system always is free). During the full-duplex status the user cannot see what he types (only his partner can!). Therefore, commands must be short to avoid errors. The command level also can be used to inform the system about the current input and output (e.g., stop and continue output in case of paperbreak). The latter type of commands are simply passed on to the system in a marked buffer. UTOR commands originating from the central system are received "at once" in one buffer. This solves the real time problem mentioned above. The command can be effectuated if the terminal is (still) in the right status or otherwise refused.

After a command the system waits for a UTOR reply that reports execution or refusal. A refusal can be received under the following circumstances.

a) The user started a command somewhat earlier. The refusal can be preceded by a report of the execution of a user command.

b) The terminal is not in the expected status. The refusal might be preceded by a report of a change of status.

c) In all other cases the command must have been illegal.

4.4. The Implementation

The three stages mentioned in section 4.1 are found back as three program sections:

4.4.1. The Multiplexer Interrupt Routine

The multiplexer routine can be described by the following program scheme:

```
MP: for each terminal do
    begin sample input line;
          if character completed then
          begin if character = attention sign
                then MAKEJOB (attention, prior 1, line)
                else MAKEJOB (investigate, prior 1, line);
                reset line status
          end
    end;

    for each terminal do
    if output then
    begin send next bit;
          if character completed then
          begin if buffer empty then
                begin if ¬ echomode then
                      MAKEJOB (report empty, prior 1, line)
                      output := false
                end
    end end;
    wait for clock interrupt;
    goto MP;
```

This cycling program is executed on the highest priority level. During the *wait for clock interrupt*, programs of lower priority may run. The communication with other program sections is established exclusively by means of the instruction MAKEJOB. These jobs specify the administrative follow-up, executed in the second stage, the so-called main program section (or main program). The boolean variable *output* is set *true* by the main program, each time a character or a buffer is handed over for printing.

4.4.2. The PX- and XP interrupt routines

The central system is seen by the UTOR as two peripherals, namely the PX apparatus for data transport from PDP8/I to central site, and the XP apparatus for data transport in the opposite direction.

4.4.2.1. The PX interrupt routine

Each time a PX transport is completed, a PX interrupt occurs. The PX interrupt routine can be described as follows:

```
PX done: if PXqueuelength > Ø then
         begin take next PX buffer from queue;
               send buffer;
               PXqueuelength := PXqueuelength -1
         end;
         wait for next PX interrupt;
         goto PX done;
```

The execution of *send buffer* takes place partially with the interrupt disabled. The busy-waiting for the ready flag after each buffer word takes less time than a return from interrupt entry interrupt sequence. In this case waiting with interrupt disabled reduces overhead. The instruction *wait for next PX interrupt* allows all other processes to run. The interrupt is caused by the last ready flag of a *send buffer* action. As long as *PXqueuelength* ≥ 1, *send buffer* will be executed in the PX interrupt routine. When the PX queue is empty, *send buffer* will be called from a jobroutine that puts buffers in the ,PX queue:

```
PX start: if PXqueuelength = Ø then send buffer else
          begin put buffer in PXqueue;
                PXqueuelength := PXqueuelength + 1
          end;
```

4.4.2.2. The XP interrupt routine

Each first word of an XP transport causes an XP interrupt. Then the following sequence of instructions is executed:

```
XP int: Sample terminal number;
        sample data;
        MAKEJOB (XPbuf, prior 1, terminal number);
        wait for next XP interrupt
        goto XP int;
```

For the same reason as in the case of the PX send buffer, the sampling of each word of the transport contains a busy-waiting loop, with the interrupt disabled. Since for each terminal only one unique XP buffer exists (cf. section 4.1) there is no queuing mechanism needed other than the normal MAKEJOB - NEXTJOB sequence. After sampling the terminal number, the XP routine can select the appropriate XP buffer to store the sampled data in.

4.4.3. The Main Program

The main program consists of a set of job routines. Some of these routines we have already encountered in the previous sections. They specify the way the interrupt routines communicate with the main program. We will now first give a short description of each of the job routines and next give a program scheme for the main program, that shows the conditions for creation of a job. This scheme together with the effect of each job on the terminal administration defines the implementation of the communication rules of section 4.1 - 4.2.

4.4.3.1. The Job routines of the Main Program

The variables that are controlled by the job routines constitute the terminal administration. For each terminal there exists such a set. Which set is currently worked upon is defined by the variable *line*. This variable is used as an index to the following lists. Each list contains one element per terminal.

1. *Status*; the status word indicates the operational state in which the terminal is working (e.g., solo, sin, sout, duplex, etc.) (cf. 4.2)). It also indicates any transition states between two operational states.
2. *Partner*; if defined, tells with whom the terminal is connected (note: in solo-state partner is undefined).
3. *Message;* a buffer, to collect a UTOR message from the terminal.
4. *Lastchar*; specifies the last received character.
5. *XP buffer status;* specifies whether or not there is an XP buffer present, and if so, whether or not it contains a closing symbol. This information is essential for the turnover decision.
6. *XP buffer pointer* and *-counter*.
7. *PX buffer pointer* and *-counter*.

Each job in the main program is of the same priority. For each priority level only one job at the time is in execution. These rules provide the mutual exclusion of jobs that happen to use the same administration. For descriptive reasons the parameter list of the routine MAKEJOB is of variable length. In this way we can specify all information of interest. It is understood that all parameters except the routine address and the priority ought to be stored under the data pointer.

The job routines:

1. *INVESTIGATE (TSNUF):*

```
if state = solo then MAKEJOB (PRINT, prior 1, line, char) else
if state = message then
begin if char = line feed then react on message else
      begin store message part;
            MAKEJOB (PRINT, prior 1, line, char)
      end
end else
if state = sin then
begin MAKEJOB (PRINT, prior 1, line, char);
```

```
        if partner = system then store char in PXbuffer
        else MAKEJOB (PRINT, prior 1, partner, char);
        if char = line feed then check on turnover
    end else
    if state = sout then check on turnover else
    if state = duplex then store char in PXbuffer
```

prior 1 is the priority of the main program.
The routine *store char in PXbuffer* creates a job in case the buffer gets filled, and asks a new buffer from the PX buffer pool. The job in question is created by: *MAKEJOB (PX OVER prior 1, line, PXbuffer, PXcounter)*.
The routines *react on message* and *check on turnover* will be discussed later.

2. *ATTENTION:*

```
    if state = solo then
    begin MAKEJOB (PRINT, prior 1, line, char):
        state := message;
        initialise administration
    end else
    if state = message then
    MAKEJOB (INVESTIGATE, prior 1, line, char) else
    if state = sin then
    begin if partner = system then
        begin state := message;
            MAKEJOB (PRINT, prior 1, char, line)
        end else
        begin inform (line, "stop", solo);
            inform (partner, "stop", solo)
        end
    if state = sout then
    begin if partner = system then check on turnover
        else force turnover
    end else
    if state = duplex then
```

```
begin close PXbuffer;
      MAKEJOB (PX OVER, prior 1, line PXbuffer, PXcounter);
      next PXbuffer; mark PXbuffer
end .
```

The routine *initialise administration* brings the administration in order for a disconnected terminal, e.g.: partner, last char and message buffer are set undefined; there is no PX buffer; the XP buffer is empty.
The routine *inform (line, "message", future state)* selects a buffer that contains the (fixed) message and prints it:

```
MAKEJOB (PRINT, prior 1, line, buffer pointer, buffer counter);
state := future state + transition.
```

The future state is an operational state that will be established when the printing is finished.
The routine *mark PX buffer* sets a flag in the PX buffer indicating that it contains a message instead of data. This should be noticed by the central system on arrival.

3. *PRINT:*

```
if single char then
begin extend MPqueue  (line, char); echo := true end
else
begin fill MPqueue (XPbuffer pointer, XPbuffer counter, line);
      echo := false
end; output := true
```

The boolean *single char* which is passed on to the multiplexer as a parameter, indicates that the terminal is in the process of echoing typed characters. If this is not the case, multiplexer is obliged to report (by creating a job!) that the printing is done (cf. 4.4.1).

4. *TAKE XP BUFFER:*

```
if message in buffer then
begin if state = solo then connect (line, system) else
      if partner ≠ system then refuse message else
      if message number = Ø then generate runout else
      if state = sin ∨ state = sout then react on message else
      if state = duplex then inform (line, "sin/sout", sout)
      else refuse message
end else
begin if state = sin ∨ state = sout ∨ state = duplex then
      begin define XP status; convert buffer;
            if XP counter ≠ Ø then
            begin if state = sin then check on turnover else
                  MAKEJOB (PRINT, prior 1, line, XPbuffer, XPcounter)
            end else
            MAKEJOB (REQUXP, prior 1, line)
      end else MAKEJOB (REQUXP, prior 1, line)
end .
```

Obviously an XP buffer can contain a message or data to be printed. If the data buffer is empty (after conversion) or received in a wrong situation, it is skipped by reporting the XP buffer empty again (REQUXP).

In a non sin/sout-state only two messages are accepted: 1. generate runout, by filling the XP buffer as specified. This buffer is then treated as data. 2. Put the terminal in sin/sout-state.

In the sin/sout-state several messages are possible. The routine *react on message* ends with the following statement:

```
if message correct then
begin inform (line, "some text", future state);
      affirm message
end else refuse message.
```

refuse message never changes any state. It just sends a special buffer to the system, that reports the refusal.

affirm message sends in a similar way an affirmative message to the system.

5. *REQUXP: MAKEJOB (PX OVER, prior 1, -line).*

   Sending a negative terminal number to the system in a buffer without data, indicates that the XP-buffer is empty again.

6. *PX OVER:*

   assure PX active; next PX buffer.

The routine *assure PX active* executes the statements listed in the PX section after the label *PX start* (cf. 4.4.2.1).

7. *REPORT READY:*

```
   lower transition state;
   if partner = system then
   begin MAKEJOB (REQUXP, prior 1, linè);
         if XP buffer status = last buffer of line
         then check on turnover;
         XP buffer status := buffer not present + XP buffer status
   end .
```

The routine *lower transition state* tries to finish the transition state in favor of the future state. The attempt will be succesful if there is no terminal partner or the partner has tried previously to enter the future state. This assures that the printing of the message on both terminals has finished.

The seven jobroutines together with some general purpose subroutines constitute the main program.
The interesting two general purpose routines to discuss are:

```
   react on message:
   if partner = system then
   begin deduce desired state;
         if desired state = duplex then
         begin inform (line, "duplex", transition + duplex);
               affirm message
         end else refuse message
   end else
```

```
begin deduce partner;
      if partner = system then
      begin inform (line, "sin", transition + sin);
            affirm message
      end else
      if partner = terminal then
      begin inform (line, "sin", transition + sin);
            if partner ≠ line then
            inform (partner, "hear", transition + sout)
      end else inform (line, "??", transition + solo)
end .
```

react on message first interprets the message and next composes the reaction. In situations where only one reaction is possible (e.g., solo, sin ∧ partner ≠ system), *react on message* is not called but the unique reaction is created instead.

```
check on turnover:
if partner = system then
begin if XP buffer present then
      begin if ¬ last time deleted then
            begin state := sout;
                  MAKEJOB (PRINT, prior 1, line, XP buffer, XP counter)
end end end else
if last char of partner = lf then
begin state := sin, state of partner := sout end
```

The routine *check on turnover* is called each time the active participant in the conversation (e.g., the sin-partner) reaches a situation that allows turnover, and each time a request for the turn is made by the sout-partner. If both conditions meet, the turnover is effectuated.

APPENDIX A

THE UTOR PROGRAM

As noted in the introduction, the UTOR and the PS/8 operating system have been adapted to enable running of PS/8-programs under supervision of the UTOR. Since PS/8 is not designed to run with interrupt enabled it is full of waiting-loops like

```
KSF
JMP.-1
```

and

```
TSF
JMP.-1
```

Also many PS/8-programs use PAGE Ø of FIELD Ø which has to be reserved for the UTOR since each interrupt starts the routine starting at ØØØ1. Therefore, two types of changes were necessary:

1. change systematically all references to FIELD Ø into references to FIELD 2 (not only CDF- and CIF-instructions, but also the memory field in disc- and DECtape-transfers).
2. change sequences like:

```
KSF                  TLS
JMP.-1      and      TSF
KRB                  JMP.-1
```

   into:

```
CIF Ø                IOF
JMS I (KWAIT   and   CIF Ø
KRB                  TLS
                     JMS I (TWAIT,
```

   where KWAIT and TWAIT are routines in the UTOR which save their calling address and field and execute EXIT.

On the first subsequent printer- or keyboard-interrupt this address is retrieved and PS/8 continued. Apart from these there were many incidental difficulties such as:

- the fact that the WORD COUNT- and CURRENT ADDRESS locations of the disc and DECtape are in FIELD Ø and cannot be shifted to FIELD 2,
- the fact that use of DECtape poses some real time requirements which cannot always be met,
- the use of KSF to test for a typed ^C (attention character of PS/8) where we don't want to use JMS KWAIT, or in contexts like:

```
    WT, KSF
        SKP
        JMP A
        SRF
        JMP WT
    A,  ...
```

where we wait for a keyboard or a display flag, whichever comes first,

- the fact that there was not always room to replace the (3-instruction) typing sequence by the (5-location) call to the UTOR,
- the fact that PS/8 system programs are not free from bugs, while it is absolutely necessary not to blow up the UTOR.

To solve some of these problems the hardware of the PDP8/I has been extended with keyboard interrupt enable, printer-interrupt enable and display interrupt enable flipflops. This resulted in the much smaller interface half of which can be seen in the listing.

Of course, the only way to handle these things clearly, without having to patch every system program before using it, is to use the time-sharing option, and this is the final solution adapted.

The adaption of the timesharing option has lead to a completely new implementation of the operating system. The description of this operating system falls outside the scope of this report. The design philosophy for this final version however, is totally different from the one described in this report.

In order to make reading of the program listing more easy, we now give an index of the most important sections and routines. The addresses refer to the machine addresses found in the listing.

Field Ø,	page Ø	global variables subroutine addresses
	page 1	general purpose routines for the main program

		KVØ8 visual display
		KVØ8 interrupt button
	page 26	Interface with PS/8
FIELD 3		conversion tables
		buffer space (buddies)

The program listing is followed by a cross reference table.

```
    1                   / UTOR DD. 12/3/73
    2                                   XLIST             /OPDEF
```

```
            / UTOR DD. 12/3/73

            /POINTERS IN FIELD 3
            HDADSP= 0               /!!/DYNAMIC STORAGE ALLOCATION
            HDMASK= HDADSP          /IDEM
            HDFSP=  20              /IDEM
            TAILS=  30              /JOB CHAIN
            HDMS=   763             /MESSAGES
            HDCHTB= 300             /CHARACTER TABLE
            HDTRB=  760             /SPECIAL SYMBOLS
            HDAVAIL=1400            /AVAIL LIST; 400 WORDS

            /IF ONE OF THE FOLLOWING TAGS IS CHANGED,
            / OTHER PROGRAMS MUST BE CHANGED TOO
            XLINE=  52
            LISTEN= 54
            TKOVR2= 400
            /

                    *0
0000  0000  ZERO,   0
0001  5577          JMP I   [INSPEC /SKIP CHAIN

0002  0000  X8,     0
0003  0000  MX8,    0

                    *4
            /SCRATCH REGISTERS
0004  0000  SV,     0
0005  0000  SV1,    0
0006  0000  SV2,    0
0007  0000  SV3,    0

            /AUTO INDEX REGISTERS
0010  0000  AUTIN1, 0               /USED BY TKXPBU
0011  0000  AUTIN2, 0               /IDEM
0012  0200  AUTIN3, JOBCH           /POINTS TO THE JOB-CHAIN
0013  0000  AUTIN4, 0               /SPN
0014  0000  AUTIN5, 0               /NOT USED
0015  0000  AUTIN6, 0               /NOT USED
0016  0000  AUTIN7, 0               /NOT USED
0017  0000  AUTIN8, 0               /USED IN XP INTERRUPT ROUTINE AND BY INIT

0020  1400  AVAIL,  HDAVAIL         /HEAD AVAIL LIST
0021  7777  JSW,    -1              /JOB STATUS WORD
                                    /JSW[0]=0
                                    /JSW[6:8]=FIELD OF JOB
                                    /JSW[9:11]=PRIORITY JOB
                                    /-1 FOR BACKGROUND JOB
0022  0000  JSWMJ,  0               /PARAMETER OF MAKE JOB
0023  0000  DTPNMJ, 0               /IDEM

            /PARAMETERS OF JOB ROUTINES
0024  0000  DATAPN, 0               /DATA POINTER
0025  0000  PAR1,   0               /LINE NUMBER
```

```
0026  0000  PAR2,     0                 /CHARACTER OR BUFFER POINTER
0027  0000  PAR3,     0                 /- NUMBER OF CHARACTERS

            /DATA
                      *30
0030  0000  RR,       0                 /POINTERS TO EXTRA OUTPUT REGISTER OF MP
0031  0000  R,        0                 /POINTER TO OUTPUT REGISTER OF MP
0032  0000  XPP,      0                 /XP BUFFER POINTERS
0033  0000  XPNUMB,   0                 /XP BUFFER COUNTER
0034  0000  PXP,      0                 /PX BUFFER POINTER
0035  0000  PXNUMB,   0                 /PX BUFFER COUNTER
0036  0000  XPMR,     0                 /XP MESSAGE STATUS
0037  0000  B1,       0                 /MESSAGE REGISTER
0040  0000  STATE,    0                 /TERMINAL STATUS
0041  0000  PRTNER,   0                 /TERMINAL PARTNER
0042  0000  LSTCHR,   0                 /LAST RECEIVED CHARACTER

0043  0000  SP1,      0                 /SCRATCH
0044  7700  LPCNT,    -MAXJOB           /INIT FOR CRJBSP; SCRATCH AFTER THAT
0045  0000  PART,     0                 /CURRENT PARTNER
0046  0000  A,        0                 /SCRATCH
0047  0000  CHAR,     0                 /SCRATCH
0050  7776  X7FLAG,   7776              /WAIT FOR TWO X8 INITIALIZATION FLAGS
0051  0000  LOOK,     0                 /DID WE CREATE A JOB DURING THISINTERRUPT?
0052  4000  XLINE,    4000              /TERMINAL CONNECTED WITH DISK: NONE
0053  0000  CANCEL,   0                 /CANCEL REQUEST
0054  0000  LISTEN,   0                 /IF ZERO WE IGNORE KEYBOARD INTERRUPTS
0055  0100  WARN,     100               /NUMBER OF NODES AVAILABLE
                                        /NEGATIVE IF AVAIL EXHAUSTED
                                        /STOPS ALL PRIOR 0 JOBS


            /MULTIPLEXER VARIABLES
0056  0000  MCHAR,    0                 /CHARACTER POINTER
0057  0000  MILP,     0                 /INITIAL LINE TO SENSE
0060  0000  SAVLN,    0                 /LAST LINE SERVED

0061  0000  SVAC,     0                 /SAVE AC
0062  0000  SVLINK,   0                 /SAVE LINK

            /DEFINITIONS
                      IFDEF DECIS <
            EXIT=     JMP I     [DECIS
            EXITSI=   JMP I     [EXITKI
            REACTIVATE=JMP I  [UNSTACK
            MAKE=     JMS I     [MAKEJB
            JOB=      0
            GETBUF=   JMS I     [GETBF
            FREEBUF=JMS I       [FRBUF
            SAVE=     JMS I     [STACK
            INITIR=   JMS I     [INTRAP
            INITJB=   JMS I     [INJCB
            GETNODE=JMS I       [GETND
            ECHO=     JMS I     [ECHOA
                      >

```

```
                TRNST1= 10
                TRNST2= 20
                MAXSZ=  7
                MSKPR=  4003
                MSKSZ=  7
                MAXJOB= 100
                PXBUCN= 40
                JOBCH=  200
                MAXPXB= 220
                MAXPR=  3
                CHMAX=  216
                DUMMY=  377
                ACURL=  300
                CR=     215
                LF=     12
                DELETE= 243
                NOT=    176
                BLCK=   216     /BLACK SHIFT
                RED=    17      /RED SHIFT

                STACKP= AUTIN3
                SPN=    AUTIN4
                        PAGE
```

```
0200  5601  INIT,    JMP I   .+1      /CHANGED INTO "JMP I [RDCOMM"

0201  2600  AMA,     START            /AC:=M[AC]
0202  3046           DCA     A
0203  1446           TAD I   A
0204  5601           JMP I   AMA

0205  0000  AMAL,    0                /AC:=M[AC+LINE NO]
0206  1025           TAD     PAR1
0207  4201           JMS     AMA
0210  5605           JMP I   AMAL

0211  0000  MALA,    0                /M[AC+LINE NO]:=CHAR
0212  1025           TAD     PAR1
0213  3046           DCA     A
0214  1047           TAD     CHAR
0215  3446           DCA I   A
0216  5611           JMP I   MALA

0217  0000  GTB1,    0                /CHAR:=AC:=M[B1+LINE NO]
0220  1037           TAD     B1
0221  4205           JMS     AMAL
0222  3047           DCA     CHAR
0223  5617           JMP I   GTB1

0224  0000  STB1,    0                /M[B1+LINE NO]:=CHAR
0225  3047           DCA     CHAR
0226  1037           TAD     B1
0227  4211           JMS     MALA
0230  5624           JMP I   STB1

0231  0000  GTSTC,   0                /CHAR:=M[AC+STATE]
0232  1040           TAD     STATE
0233  4205           JMS     AMAL
0234  3047           DCA     CHAR
0235  5631           JMP I   GTSTC

0236  0000  SETST,   0                /M[STATE+LINE NO]:=AC
0237  3047           DCA     CHAR
0240  1040           TAD     STATE
0241  4211           JMS     MALA
0242  5636           JMP I   SETST

0243  0000  GTPRT,   0
0244  1041           TAD     PRTNER   /PART:=M[PARTNER+LINE NO]
0245  4205           JMS     AMAL
0246  3045           DCA     PART
0247  1045           TAD     PART
0250  1003           TAD     MX8      /(PART=X8/RETURN+1)
0251  7650           SNA CLA
0252  2243           ISZ     GTPRT
0253  5643           JMP I   GTPRT

0254  0000  STPRT,   0
0255  3045           DCA     PART     /M[PARTNER+LINE NO]:=PART*=AC
```

```
0256  1045          TAD     PART
0257  3047          DCA     CHAR
0260  1041          TAD     PRTNER
0261  4211          JMS     MALA
0262  5654          JMP I   STPRT

0263  0000  STLCH,  0               /CHAR:=M[LAST CHAR+LINE NO]:=AC
0264  3047          DCA     CHAR
0265  1042          TAD     LSTCHR
0266  4211          JMS     MALA
0267  5663          JMP I   STLCH

0270  0000  GTLCH,  0               /CHAR:=M[LAST CHAR+LINE NO]
0271  1042          TAD     LSTCHR
0272  4205          JMS     AMAL
0273  3047          DCA     CHAR
0274  5670          JMP I   GTLCH

0275  0000  STXPMR, 0               /CHAR:=M[XPMR+LINE NO]:=AC
0276  3047          DCA     CHAR
0277  1036          TAD     XPMR
0300  4211          JMS     MALA
0301  5675          JMP I   STXPMR

0302  0000  GTXPMR, 0               /CHAR:=M[XPMR+LINE NO]
0303  1036          TAD     XPMR
0304  4205          JMS     AMAL
0305  3047          DCA     CHAR
0306  5702          JMP I   GTXPMR

0307  0000  MSSAGE, 0               /CREATE A JOB TO PRINT A MESSAGE
0310  3275          DCA     KEY     /NUMBER OF THE MESSAGE
0311  1377          TAD     (MSPT
0312  1275          TAD     KEY
0313  4201          JMS     AMA
0314  3026          DCA     PAR2    /POINTER TO THE MESSAGE BUFFER
0315  1376          TAD     (MSNR
0316  1275          TAD     KEY
0317  4201          JMS     AMA
0320  3027          DCA     PAR3    /COUNTS THE NUMBER OF CHARACTERS
0321  4564          ECHO            /CREATE JOB
0322  5707          JMP I   MSSAGE

0323  0000  SWITCH, 0               /EFFECTUATE TURNOVER
0324  3302          DCA     TRANS
0325  1025          TAD     PAR1
0326  1003          TAD     MX8
0327  7650          SNA CLA
0330  5340          JMP     PART2
0331  7240          STA
0332  4263          JMS     STLCH   /INITIALIZE INPUT STATUS
0333  7240          STA             /OF BOTH PARTNERS
0334  4224          JMS     STB1
0335  7305          CLA CLL IAC RAL
0336  1302          TAD     TRANS
```

```
0337  4236          JMS     SETST   /DEFINE LINE STATUS
0340  4775' PART2,  JMS     CHANGE
0341  1302          TAD     TRANS
0342  7110          CLL RAR
0343  2302          ISZ     TRANS
0344  7630          SZL CLA
0345  5723          JMP I   SWITCH
0346  5325          JMP     SWITCH+2

            TRANS=  GTXPMR
            KEY=    STXPMR

0347  0000  STPXP,  0               /LOAD PX BUFFER POINTER
0350  1026          TAD     PAR2    /AND PX BUFFER COUNTER
0351  3047          DCA     CHAR
0352  1034          TAD     PXP     /FROM JOB PARAMETERS
0353  4211          JMS     MALA
0354  1027          TAD     PAR3
0355  3047          DCA     CHAR
0356  1035          TAD     PXNUMB
0357  4211          JMS     MALA
0360  5747          JMP I   STPXP

0361  0000  GTPXP,  0               /GET PX BUFFER POINTER
0362  1034          TAD     PXP     /AND COUNTER
0363  4205          JMS     AMAL
0364  3026          DCA     PAR2
0365  1035          TAD     PXNUMB
0366  4205          JMS     AMAL
0367  3027          DCA     PAR3
0370  5761          JMP I   GTPXP
0375  0417
0376  1001
0377  0763
                    PAGE
```

```
0400  0000  TKOVR2, 0
0401  6002          IOF                 /CRITICAL
0402  3026          DCA     PAR2        /CHAR
0403  7001          IAC
0404  3021          DCA     JSW         /WE WILL JUMP TO TSNUF
0405  6214          RDF
0406  3022          DCA     JSWMJ       /SAVE DF (NOTE: LEVEL=0)
0407  1200          TAD     TKOVR2      /MAKE A JOB
0410  4573          MAKE JOB            /OF THE SUBROUTINE
0411  1052          TAD     XLINE       /TERMINAL NO
0412  0163          AND     [7
0413  3025          DCA     PAR1
0414  3027          DCA     PAR3        /NO BUFFER
0415  6001          ION                 /END OF CRITICAL
0416  5777'         JMP     TSNUF1      /PROCESS CHARACTER

0417  0000  CHANGE, 0                   /EXCHANGE PART AND PAR1
0420  1025          TAD     PAR1
0421  3046          DCA     A
0422  1045          TAD     PART
0423  3025          DCA     PAR1
0424  1046          TAD     A
0425  3045          DCA     PART
0426  5617          JMP I   CHANGE

0427  0000  BTWEEN, 0                   /SKIP IF 0<=CHAR<=AC
0430  7040          CMA
0431  1047          TAD     CHAR
0432  7700          SMA CLA
0433  5627          JMP I   BTWEEN
0434  1047          TAD     CHAR
0435  7700          SMA CLA
0436  2227          ISZ     BTWEEN
0437  5627          JMP I   BTWEEN

0440  0000  EQUAL,  0                   /SKIP IF EQUAL
0441  7041          CIA
0442  1047          TAD     CHAR
0443  7650          SNA CLA
0444  2240          ISZ     EQUAL
0445  5640          JMP I   EQUAL

0446  0000  NEQUAL, 0                   /SKIP IF NOT EQUAL
0447  4240          JMS     EQUAL
0450  2246          ISZ     NEQUAL
0451  5646          JMP I   NEQUAL

            /ROUTINE TO HANDOVER A RECEIVED CHARACTER, CALLED BY MULTIPLEXER

0452  0000  TKOVER, 0                   /CALLED BY THE MULTIPLEXER INTERRUPT
0453  7500          SMA                 /STOPBIT?                         ROUTIN
0454  5274          JMP     TK          /NO; SKIP CHARACTER
0455  7110          CLL RAR             /STRIP OFF EXTRANEOUS BITS
0456  7112          CLL RTR
0457  0162          AND     [377
```

```
0460  3311          DCA     SVCHAR   /STORE CHARACTER
0461  4565          GETNODE
0462  3023          DCA     DTPNMJ   /DATA POINTER
0463  1023          TAD     DTPNMJ
0464  3013          DCA     SPN      /AUTO INDEXER
0465  6414          TTRL
0466  3413          DCA I   SPN      /LINE NUMBER
0467  1311          TAD     SVCHAR
0470  3413          DCA I   SPN      /CHARACTER
0471  3413          DCA I   SPN      /NO BUFFER
0472  1376          TAD     (TSNUF   /PROCESS CHARACTER
0473  4573          MAKE JOB         /CREATE JOB
0474  6461  TK,     TTRINC           /SELECT NEXT LINE
0475  7346          ACM3
0476  1252          TAD     TKOVER
0477  3311          DCA     SVCHAR   /RETURN ADDRESS-3
0500  6201          CDF 00           /!
0501  1711          TAD I   SVCHAR   /FETCH CHARACTER
0502  0375          AND     (1770    /MASK STOP BITS
0503  3711          DCA I   SVCHAR   /RESTORE CHARACTER
0504  2311          ISZ     SVCHAR
0505  7132          STL RTR          /AC2000
0506  3711          DCA I   SVCHAR   /INITIALIZE CAW
0507  6231          CDF 30
0510  5652          JMP I   TKOVER

0511  0000  SVCHAR, 0
0575  1770
0576  0600
0577  0601
                    PAGE
```

```
0600  4566  TSNUF,   INITJB            /JOB.TO PROCESS ONE TERMINAL CHARACTER
0601  4561  TSNUF1,  JMS I    [GTSTC   /GET STATUS
0602  1163           TAD      [7
0603  4560           JMS I    [BTWEEN  /TRANSITION STATE?
0604  5576           EXIT              /THEN IGNORE INPUT
0605  1026           TAD      PAR2
0606  1157           TAD      [-ACURL
0607  7650           SNA CLA           /WAS IT TACURL?
0610  1156           TAD      [10      /YES
0611  1215           TAD      JUMPER
0612  1047           TAD      CHAR
0613  3214           DCA      .+1
0614  0000  TJUMP,   0                 /DISPATCH
0615  5616  JUMPER,  JMP I    .+1      /SWITCH ACCORDING TO STATUS
0616  0644           SOLO              /0 INITIAL STATE
0617  1000           TTRUM             /1 ASSEMBLE MESSAGE
0620  0715           TSIN              /2 CONVERSATION ACTIVE
0621  1307           TSOUT             /3 CONVERSATION PASSIVE
0622  1147           DUPLX1            /4 FULL DUPLEX ASCII INPUT
0623  3274           DUPLX2            /5 FULL DUPLEX BINARY INPUT
0624  3300           SINGLE            /6 FULL DUPLEX SINGLE CHARACTER
0625  3600           DECIS             /7 ILLEGAL, IGNORE

0626  0636           SOLAC             /0 EXIT INITIAL STATUS
0627  1074           NOMES             /1 ILLEGAL, ERROR
0630  0646           SINAC             /2 EXIT CONVERSATION
0631  0703           SOUTAC            /3 CHANGE CONVERSATION
0632  1154           DUPLAC            /4 ATTENTION IN DUPLEX
0633  3274           DUPLX2            /5 NOT SPECIAL
0634  3300           SINGLE            /6 NOT SPECIAL
0635  3600           DECIS             /7 ILLEGAL, IGNORE

0636  7001  SOLAC,   IAC               /STATUS:=1
0637  4555           JMS I    [SETST   /INITIALIZE MESSAGE ADMINISTRATION
0640  7240           STA
0641  4554           JMS I    [STLCH
0642  7240           STA
0643  4553           JMS I    [STB1

0644  4564  SOLO,    ECHO              /PRINT CHARACTER
0645  5576           EXIT

0646  4552  SINAC,   JMS I    [GTPRT   /PARTNER=X8?
0647  5267           JMP      NOX8     /NO
0650  4551           JMS I    [ACBUF   /YES, SEND DISCONNECTION MESSAGE
0651  1150           TAD      [ACURL
0652  4547           JMS I    [PXECHO
0653  4546           JMS I    [STPRT   /NO PARTNER
0654  4545           JMS I    [GTXPMR  /SKIP CURRENT XP BUFFER, IF ANY
0655  1047           TAD      CHAR
0656  7740           SMA SZA  CLA
0657  5262           JMP      SNEX
0660  4544           JMS I    [STXPMR
0661  4543           JMS I    [REQUA
0662  1156  SNEX,    TAD      [TRNST1  /TRANSITION TO SOLO
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```
0663  4555          JMS I   [SETST
0664  1142          TAD     [5      /INFORM TERMINAL
0665  4541          JMS I   [MSSAGE
0666  55/6          EXIT

0667  1045  NOX8,   TAD     PART    /INFORM PARTNER, IF ANY
0670  7041          CIA             /OF DISCONNECTION
0671  1025          TAD     PAR1
0672  7650          SNA CLA
0673  5262          JMP     SNEX
0674  4540          JMS I   [CHANGE
0675  1156          TAD     [TRNST1
0676  4555          JMS I   [SETST
0677  7327          AC6
0700  4541          JMS I   [MSSAGE
0701  4540          JMS I   [CHANGE
0702  5262          JMP     SNEX

0703  4552  SOUTAC, JMS I   [GTPRT  /PARTNER=X8?
0704  7410          SKP
0705  5250          JMP     SINAC+2 /YES, DISCONNECT
0706  1137          TAD     [TRNST2 /NO, FORCE TURNOVER
0707  4536          JMS I   [SWITCH
0710  7001          IAC
0711  4541          JMS I   [MSSAGE
0712  4540          JMS I   [CHANGE
0713  7326          CLA STL RTL
0714  5265          JMP     SNEX+3

0715  4564  TSIN,   ECHO            /ECHO CHARACTER
0716  1026          TAD     PAR2
0717  1135          TAD     [-CR
0720  7650          SNA CLA         /RETURN?
0721  5341          JMP     SINCR

0722  1026  TSXIT,  TAD     PAR2
0723  4554          JMS I   [STLCH  /SAVE LAST CHAR
0724  1134          TAD     [LF
0725  4533          JMS I   [NEQUAL /CHAR=LF?
0726  4532          JMS I   [TRTURN /YES, TRY TURNOVER
0727  4552  COMSIN, JMS I   [GTPRT
0730  7410          SKP
0731  5777'         JMP     DUPLX1+2/SEND TO X8
0732  1045          TAD     PART    /OR TO PARTNERS TERMINAL
0733  7041          CIA             /IF ANY
0734  1025          TAD     PAR1
0735  7650          SNA CLA
0736  55/6          EXIT
0737  4540          JMS I   [CHANGE
0740  5244          JMP     SOLO

0741  4531  SINCR,  JMS I   [GTLCH  /B1:=LAST CHARACTER
0742  1047          TAD     CHAR
0743  4553          JMS I   [STB1
0744  5322          JMP     TSXIT
```

```
                                    /LEVEL 0
0745  0000  NXTPXB, 0               /NEXT PX-BUFFER
0746  7305          AC2             /SIZE=2
0747  6201          CDF 00
0750  4572          GETBUF
0751  7402          HLT
0752  6001          ION
0753  3026          DCA     PAR2    /BUFFER POINTER
0754  1130          TAD     [-14
0755  3027          DCA     PAR3    /BUFFER COUNTER
0756  5745          JMP I   NXTPXB

                                    /LEVEL 0
0757  0000  FREEBF, 0               /RETURN PX-BUFFER TO POOL
0760  1027          TAD     PAR3
0761  1127          TAD     [14
0762  7041          CIA
0763  1026          TAD     PAR2    /BUFFER POINTER
0764  6201          CDF 00
0765  4571          FREEBUF
0766  0002          2       /SIZE=2
0767  6001          ION
0770  5757          JMP I   FREEBF
0777  1151
                    PAGE
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                /COLLECT INITIAL MESSAGE, SPECIFYING THE PARTNER
1000  4564      TTRUM,  ECHO
1001  1026              TAD     PAR2
1002  1135              TAD     [-CR
1003  7450              SNA             /RETURN?
1004  5576              EXIT            /IGNORE CR
1005  1126              TAD     [CR-LF
1006  7640              SZA CLA         /LF?
1007  5301              JMP     NOLFT
1010  4525              JMS I   [GTB1   /END OF MESSAGE
1011  7240              STA
1012  4533              JMS I   [NEQUAL /TWO DIGIT TERMINAL NO?
1013  4531              JMS I   [GTLCH  /NO, ONE DIGIT OR LETTER
1014  1377              TAD     (103    /C
1015  4533              JMS I   [NEQUAL
1016  5357              JMP     KILL

1017  1376              TAD     (130    /X
1020  4524              JMS I   [EQUAL
1021  5240              JMP     NOX
1022  1050              TAD     X7FLAG  /X8 PRESENT
1023  7710              SPA CLA
1024  5273              JMP     PBUSY+1 /NO CONNECTION WITH X8

1025  1002      TURNON, TAD     X8      /START SHAKE HAND SEQUENCE
1026  4546              JMS I   [STPRT  /PARTNER:=X8
1027  4523              JMS I   [NXTPXB /GET PX BUFFER
1030  4522              JMS I   [STPXP
1031  1150              TAD     [ACURL
1032  4547              JMS I   [PXECHO /INFORM X8
1033  1375              TAD     (11
1034  4541              JMS I   [MSSAGE /INFORM TERMINAL
1035  1156              TAD     [TRNST1
1036  4536              JMS I   [SWITCH
1037  5576              EXIT

1040  7240      NOX,    STA
1041  1002              TAD     X8
1042  4560              JMS I   [BTWEEN /VALID MESSAGE?
1043  5274              JMP     NOMES   /NO
1044  1047              TAD     CHAR    /YES, CONNECT IF PARTNER FREE
1045  4546              JMS I   [STPRT
1046  1025              TAD     PAR1
1047  4524              JMS I   [EQUAL  /OWN TERMINAL?
1050  5254              JMP     .+4     /AVOID CHECK ON PARTNER
1051  1134              TAD     [12
1052  4555              JMS I   [SETST
1053  5267              JMP     MEME

1054  4540              JMS I   [CHANGE
1055  4561              JMS I   [GTSTC
1056  4524              JMS I   [EQUAL  /PARTNER FREE?
1057  5272              JMP     PBUSY   /NO
1060  7307              AC4
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557   1061  4541             JMS I    [MSSAGE
558   1062  1045             TAD      PART     /YES, CONNECT
559   1063  4546             JMS I    [STPRT
560   1064  4540             JMS I    [CHANGE
561   1065  1137             TAD      [TRNST2
562   1066  4536             JMS I    [SWITCH
563   1067  7325  MEME,      AC3
564   1070  4541             JMS I    [MSSAGE
565   1071  5576             EXIT
566
567   1072  4540  PBUSY,     JMS I    [CHANGE /REPORT PARTNER BUSY
568   1073  7001             IAC
569
570   1074  1163  NOMES,     TAD      [7       /REPORT ERROR
571   1075  4541             JMS I    [MSSAGE
572   1076  1156             TAD      [TRNST1 /TRANSITION TO INITIAL STATE
573   1077  4555             JMS I    [SETST
574   1100  5576             EXIT
575
576   1101  4525  NOLFT,     JMS I    [GTB1    /PROCESS MESSAGE CHARACTER
577   1102  7240             STA
578   1103  4524             JMS I    [EQUAL
579   1104  5274             JMP      NOMES    /THREE DIGIT TERMINAL NO, ERROR
580   1105  4531             JMS I    [GTLCH
581   1106  1047             TAD      CHAR
582   1107  3045             DCA      PART
583   1110  1026             TAD      PAR2
584   1111  0121             AND      [177
585   1112  1374             TAD      (-72
586   1113  7100             CLL
587   1114  1134             TAD      [12
588   1115  7420             SNL               /DIGIT?
589   1116  5335             JMP      NOCF     /NO
590   1117  0373             AND      (17      /USELESS
591   1120  2045             ISZ      PART     /FIRST ONE
592   1121  5324             JMP      SETB1    /NO
593   1122  4554  TRXIT,     JMS I    [STLCH   /YES, SAVE
594   1123  5576             EXIT
595
596   1124  3047  SETB1,     DCA      CHAR     /ASSEMBLE TERMINAL NUMBER
597   1125  1045             TAD      PART     /MULTIPLY BY TEN
598   1126  7106             CLL RTL
599   1127  1045             TAD      PART
600   1130  7004             RAL
601   1131  1047             TAD      CHAR     /ADD NEXT DIGIT
602   1132  1372             TAD      (-12
603   1133  4771'            JMS      STB1     /STORE
604   1134  5322             JMP      TRXIT
605
606   1135  1370  NOCF,      TAD      (60-103 /WE CAME HERE WITH CHAR-60
607   1136  7450             SNA               /C?
608   1137  5344             JMP      TRXIT2   /YES
609   1140  1367             TAD      (103-130
610   1141  7650             SNA CLA           /X?
611   1142  2045             ISZ      PART     /AND NOT AFTER ANOTHER LETTER?
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612     1143  5274            JMP      NOMES    /ELSE ERROR
613     1144  1026  TRXIT2,   TAD      PAR2
614     1145  0121            AND      [177     /CHAR AGAIN
615     1146  5322            JMP      TRXIT
616
617     1147  1026  DUPLX1,   TAD      PAR2     /PUT CHAR IN PX BUFFER
618     1150  4554            JMS I    [STLCH
619     1151  1047            TAD      CHAR
620     1152  4547            JMS I    [PXECHO
621     1153  55/6            EXIT
622
623     1154  4766  DUPLAC,   JMS I    (ACBUF   /SEND "@" TO X8
624     1155  1150            TAD      [ACURL
625     1156  5350            JMP      DUPLX1+1
626
627     1157  1025  KILL,     TAD      PAR1     /SOMEONE TYPED @C
628     1160  7640            SZA CLA           /DID HE TYPE IT ON THE COMMAND TERMINAL?
629     1161  5274            JMP      NOMES    /NO, WE ARE NOT GOING TO LISTEN TO HIM
630     1162  2053            ISZ      CANCEL   /YES, RAISE FLAG TO KILL THE RUNNING PROG.
631     1163  7000            NOP               /USELESS
632     1164  5277            JMP      NOMES+3  /BACK TO INITIAL STATE
633     1166  3035
634     1167  7753
635     1170  7755
636     1171  0224
637     1172  7766
638     1173  0017
639     1174  7706
640     1175  0011
641     1176  0130
642     1177  0103
643                           PAGE
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                      /JOB TO PROCESS XP BUFFER
      1200  4566  TKXPBU, INITJB
      1201  1026          TAD     PAR2    /BUFPTR-1
      1202  1027          TAD     PAR3    /BUFCTR
      1203  4520          JMS I   [AMA
      1204  3047          DCA     CHAR    /LAST CHAR OF BUF
      1205  1117          TAD     [400
      1206  0047          AND     CHAR
      1207  3272          DCA     UP      /SAVE MESSAGE TYPE
      1210  1116          TAD     [600
      1211  4533          JMS I   [NEQUAL /MESSAGE BUFFER?
      1212  5777          JMP I   (XACURL /YES
      1213  4561          JMS I   [GTSTC
      1214  1047          TAD     CHAR
      1215  1115          TAD     [-7
      1216  7100          CLL
      1217  1142          TAD     [5
      1220  7620          SNL CLA         /VALID STATE?
      1221  5346          JMP     REQUXP  /NO, SKIP BUFFER
      1222  4273          JMS     TSTMNR  /YES, SET BUFFER INDICATION

      1223  1027          TAD     PAR3    /CONVERT BUFFER TO ISO CODE
      1224  7041          CIA
      1225  3272          DCA     UP
      1226  1026          TAD     PAR2
      1227  3010          DCA     AUTIN1  /READ POINTER
      1230  1026          TAD     PAR2
      1231  3011          DCA     AUTIN2  /WRITE POINTER

      1232  1410  LP,     TAD I   AUTIN1
      1233  0162          AND     [377    /8 BITS ONLY
      1234  1376          TAD     (-CHMAX
      1235  7540          SMA SZA         /LEGAL CODE?
      1236  5242          JMP     STOR-1  /NO, SKIP
      1237  1375          TAD     (ISOTAB+CHMAX   /CONVERT
      1240  4520          JMS I   [AMA
      1241  7510          SPA             /LEGAL RESULT?
      1242  7610          SKP CLA         /ELSE IGNORE
      1243  3411  STOR,   DCA I   AUTIN2  /STORE
      1244  2272          ISZ     UP      /NEXT OR CONVERSION DONE
      1245  5232          JMP     LP

      1246  1011          TAD     AUTIN2
      1247  1027          TAD     PAR3
      1250  7041          CIA
      1251  1010          TAD     AUTIN1
      1252  7450          SNA             /CONVERTED BUFFER EMPTY?
      1253  5346          JMP     REQUXP  /YES
      1254  3027          DCA     PAR3    /NO, SAVE -BUFCT
      1255  4561  ISOD1,  JMS I   [GTSTC
      1256  7305          AC2
      1257  4524          JMS I   [EQUAL  /X8 HAS TURN ALREADY?
      1260  5514          JMP I   [SOLO   /YES, CONTINUE PRINTING
      1261  1027          TAD     PAR3    /NO, STORE BUFFER LENGTH
      1262  3047          DCA     CHAR
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1263  1033              TAD     XPNUMB
1264  4513              JMS I   [MALA
1265  4531              JMS I   [GTLCH
1266  1134              TAD     [LF
1267  4533              JMS I   [NEQUAL
1270  4532              JMS I   [TRTURN /TRY TO GET TURN
1271  5576              EXIT

1272  0000  UP,         0               /SCRATCH

1273  0000  TSTMNR,     0
1274  7346              ACM3
1275  1047              TAD     CHAR
1276  7440              SZA             /CHAR=3
1277  7001              IAC
1300  7650              SNA CLA         /OR CHAR=2?
1301  1272              TAD     UP
1302  7650              SNA CLA         /AND UP NONZERO?
1303  7001              IAC
1304  7001              IAC
1305  4544              JMS I   [STXPMR
1306  5673              JMP I   TSTMNR

1307  4552  TSOUT,      JMS I   [GTPRT  /PARTNER=X8?
1310  5320              JMP     NOTX8   /NO
1311  4545              JMS I   [GTXPMR /BUFFER PRESENT?
1312  2047              ISZ     CHAR    /NO, END OF LINE?
1313  5335              JMP     TSXIT1
1314  4337              JMS     TURN
1315  1026              TAD     PAR2
1316  4547              JMS I   [PXECHO /SEND CHARACTER TO X8
1317  5576              EXIT

1320  4540  NOTX8,      JMS I   [CHANGE /SELECT PARTNER
1321  4531              JMS I   [GTLCH
1322  1134              TAD     [LF
1323  4524              JMS I   [EQUAL  /END OF LINE?
1324  5576              EXIT            /NO
1325  4525              JMS I   [GTB1
1326  1152              TAD     [DELETE
1327  4533              JMS I   [NEQUAL /AND LINE WAS NOT DELETED?
1330  5576              EXIT            /NO
1331  4540              JMS I   [CHANGE /YES, THEN TURNOVER
1332  4337              JMS     TURN
1333  4540              JMS I   [CHANGE
1334  5514              JMP I   [SOLO
1335  4554  TSXIT1,     JMS I   [STLCH
1336  5576              EXIT

1337  0000  TURN,       0               /EFFECTUATE TURNOVER
1340  7132              STL RTR         /ADD COLOUR SHIFT
1341  1026              TAD     PAR2
1342  3026              DCA     PAR2
1343  4564              ECHO            /PRINT CHAR OR BUFFER
1344  4536              JMS I   [SWITCH
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754   1345  5737           JMP I   TURN
755
756   1346  4543  REQUXP,  JMS I   [REQUA  /ASK NEXT XP BUFFER
757   1347  5576           EXIT
758   1375  0716
759   1376  7562
760   1377  1400
761                        PAGE
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1400  2026  XACURL, ISZ     PAR2
1401  1426          TAD I   PAR2     /SELECT MESSAGE NUMBER
1402  7650          SNA CLA          /=0?
1403  5231          JMP     RUNOUT   /RUNOUT
1404  4561          JMS I   [GTSTC
1405  4533          JMS I   [NEQUAL  /STATE=0?
1406  5777          JMP I   (TURNON  /MAKE CONNECTION
1407  1047          TAD     CHAR
1410  1115          TAD     [-7
1411  7100          CLL
1412  1142          TAD     [5
1413  7630          SZL CLA          /TRANSITION STATE?
1414  4552          JMS I   [GTPRT   /OR NOT CONNECTED WITH TERMINAL?
1415  5267          JMP     TBUSY    /REFUSE MESSAGE
1416  1047          TAD     CHAR
1417  1112          TAD     [-4      /STATE=SIN/SOUT?
1420  7710          SPA CLA
1421  5240          JMP     SISOUT   /YES
1422  1376  CONOUT, TAD     (3       /AC+3
1423  4247          JMS     NEWCON   /STATE:=SIN/SOUT
1424  4523          JMS I   [NXTPXB  /RESERVE PX-BUFFER
1425  4522          JMS I   [STPXP   /SAVE POINTERS
1426  1150          TAD     [ACURL   /AFFIRM MESSAGE
1427  4547          JMS I   [PXECHO
1430  5576          EXIT

1431  7130  RUNOUT, CLL CML RAR      /COUNT TO 4000
1432  1375          TAD     (-60     /60 BLANKS
1433  3027          DCA     PAR3
1434  1032          TAD     XPP
1435  4511          JMS I   [AMAL
1436  3026          DCA     PAR2     /POINTS TO (0
1437  57/4          JMP I   (ISOD1

1440  1426  SISOUT, TAD I   PAR2
1441  0376          AND     (3       /NEW STATUS
1442  7440          SZA              /=0?
1443  5222          JMP     CONOUT   /NO
1444  3045          DCA     PART     /YES, DISCONNECT
1445  4247          JMS     NEWCON
1446  5773'         JMP     REQUXP   /ASK AN XP-BUFFER

1447  0000  NEWCON, 0
1450  3043          DCA     SP1      /SAVE NEW STATUS
1451  1043          TAD     SP1
1452  3047          DCA     CHAR
1453  47/2'         JMS     TSTMNR   /SET BUFFER INDICATION
1454  1043          TAD     SP1
1455  1156          TAD     [TRNST1  /ADD TRANSITION BIT
1456  4555          JMS I   [SETST   /NEW STATE
1457  7344          CLL STA RAL
1460  1047          TAD     CHAR     /SELECT MESSAGE
1461  4541          JMS I   [MSSAGE
1462  1045          TAD     PART     /DEFINE PARTNER
1463  4546          JMS I   [STPRT
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1464  4510          JMS I   [GTPXP  /SKIP PX-BUFFER
1465  4507          JMS I   [FREEBF
1466  5647          JMP I   NEWCON

1467  4523  TBUSY,  JMS I   [NXTPXB /NEW PX BUFFER
1470  4522          JMS I   [STPXP  /STORE POINTERS
1471  1371          TAD     (NOT
1472  4547          JMS I   [PXECHO /REFUSE CONNECTION WITH X8
1473  1150          TAD     [ACURL
1474  4547          JMS I   [PXECHO /ATTENTION SYMBOL TO X8
1475  4507          JMS I   [FREEBF /RETURN BUFFER TO POOL
1476  5773'         JMP     REQUXP


1477  0000  OFFTRS, 0
1500  4561          JMS I   [GTSTC  /GET STATE
1501  1106          TAD     [-10
1502  0047          AND     CHAR
1503  7450          SNA             /TRANSITION STATE?
1504  5677          JMP I   OFFTRS  /NO, RETURN
1505  7041          CIA
1506  1047          TAD     CHAR    /REMOVE TRANSITION BIT
1507  3340          DCA     SVCHR   /SAVE FUTURE STATE
1510  1047          TAD     CHAR
1511  0156          AND     [10
1512  7650          SNA CLA
1513  5317          JMP     HITRS   /HIGH TRANSITION

1514  1340          TAD     SVCHR   /FINISH TRANSITION STATE
1515  4555          JMS I   [SETST
1516  5677          JMP I   OFFTRS

1517  4552  HITRS,  JMS I   [GTPRT  /PARTNER=X8?
1520  7410          SKP
1521  7402          HLT             /YES, IMPOSSIBLE
1522  4540          JMS I   [CHANGE
1523  4561          JMS I   [GTSTC  /STATE OF PARTNER
1524  1156          TAD     [10
1525  0047          AND     CHAR
1526  7640          SZA CLA         /IS IT LOW?
1527  5333          JMP     LTRS    /YES
1530  4540          JMS I   [CHANGE /NO, LOWER OWN TRANSITION
1531  1156          TAD     [10
1532  5314          JMP     HITRS-3
1533  1047  LTRS,   TAD     CHAR    /REMOVE ALL TRANSITIONS
1534  0163          AND     [7
1535  4555          JMS I   [SETST
1536  4540          JMS I   [CHANGE
1537  5314          JMP     HITRS-3
1540  0000  SVCHR,  0

1541  0000  CHBU1,  0               /CHANGE BUFFER
1542  3353          DCA     SVPXR   /NEW BUFFER
1543  6201          CDF 00
1544  1770          TAD I   (PXREPT /CURRENT BUFFER
872   1545  0367              AND      (7700
873   1546  4571              FREEBUF           /RETURN TO POOL
874   1547  0004              4
875   1550  6001              ION
876   1551  1353              TAD      SVPXR    /NEXT BUFFER
877   1552  5741              JMP I    CHBU1
878
879   1553  0000   SVPXR,     0
880   1567  7700
881   1570  1760
882   1571  0176
883   1572  1273
884   1573  1346
885   1574  1255
886   1575  7720
887   1576  0003
888   1577  1025
889                           PAGE
```

```
890   1600  6332  PX2,     CBUP2              /CLEAR PX-FLAG
891   1601  7305           CLA CLL IAC RAL    /PRIORITY INTERRUPT ROUTINE
892   1602  4567           INITIR             /INITIALIZE INTERRUPT ROUTINE
893   1603  6231           CDF 30
894   1604  7240           CLA CMA
895   1605  3366           DCA     PXREADY    /PXREADY:=TRUE
896   1606  1361           TAD     ATTPX
897   1607  7650           SNA CLA            /ANY BUFFERS?
898   1610  5576           EXIT
899   1611  2362           ISZ     PXIBC      /SPACE BUFFER POINTERS EMPTY?
900   1612  5221           JMP     PXS
901   1613  1760           TAD I   PXREPT
902   1614  4777           JMS I   (CHBU1     /NEXT BUFFER
903   1615  3360           DCA     PXREPT     /READ POINTER
904   1616  7201           CLA IAC
905   1617  1105           TAD     [-PXBUCN
906   1620  3362           DCA     PXIBC      /COUNTER
907   1621  1760  PXS,     TAD I   PXREPT
908   1622  2360           ISZ     PXREPT
909   1623  3367           DCA     TERNR      /TERMINAL NUMBER
910   1624  1760           TAD I   PXREPT
911   1625  2360           ISZ     PXREPT
912   1626  3370           DCA     BUFPTR     /BUFFER
913   1627  7240  PXSEND,  CLA CMA
914   1630  1361           TAD     ATTPX
915   1631  3361           DCA     ATTPX      /DECREASE COUNT
916   1632  1367           TAD     TERNR
917   1633  6342           APX1               /TERMINAL NUMBER TO X8
918   1634  7710           SPA CLA
919   1635  7040           CMA                /NEGATIVE TERMINAL NUMBER MEANS:
920   1636  6344           APX2               /ASK NEXT BUFFER
921   1637  6334           APX3
922   1640  7325           AC3
923   1641  6352           CKP
924   1642  1115           TAD     [-7        /-4 IN AC
925   1643  3365           DCA     SAVDIR
926   1644  4776  PXLOOP,  JMS I   (PXWAIT    /SEND BUFFER TO X8
927   1645  4342           JMS     PXCHAR
928   1646  6334           APX3
929   1647  4342           JMS     PXCHAR
930   1650  6344           APX2
931   1651  4342           JMS     PXCHAR
932   1652  6342           APX1
933   1653  2365           ISZ     SAVDIR
934   1654  5244           JMP     PXLOOP
935   1655  7201  PXDONE,  CLA IAC
936   1656  6356           CKP CAP            /INFORM X8
937   1657  1367           TAD     TERNR
938   1660  7750           SPA SNA CLA
939   1661  5267           JMP     .+6
940
941   1662  1130           TAD     [-14       /RETURN BUFFER TO POOL
942   1663  1370           TAD     BUFPTR
943   1664  6201           CDF 00
944   1665  4571           FREEBUF
```

```
1666  0002          2

1667  6001          ION
1670  3366          DCA     PXREADY /PXREADY:=FALSE
1671  5576          EXIT

              /JOB ROUTINE
              /INSERT PX-BUFFER IN QUEUE FOR X8
1672  6002    PXOVER, IOF
1673  6231          CDF 30
1674  1024          TAD     DATAPN
1675  3013          DCA     SPN
1676  1413          TAD I   SPN
1677  3367          DCA     TERNR   /TERMINAL NUMBER
1700  1413          TAD I   SPN
1701  3370          DCA     BUFPTR  /BUFFER
1702  1024          TAD     DATAPN
1703  4504          JMS I   [FREEND
1704  6001          ION
1705  2361          ISZ     ATTPX
1706  1361          TAD     ATTPX
1707  1366          TAD     PXREADY
1710  7650          SNA CLA         /IF ATTPX=1 AND PXREADY THEN PXSEND
1711  5227          JMP     PXSEND
1712  1361          TAD     ATTPX
1713  13/5          TAD     (-MAXPXB
1714  7700          SMA CLA
1715  7402          HLT             /TOO MANY PX-BUFFERS
1716  2363          ISZ     PXOBC
1717  5333          JMP     PX1
1720  7307          AC4             /GET SPACE FOR POINTERS
1721  6201          CDF 00
1722  4572          GETBUF
1723  7402          HLT
1724  6001          ION
1725  3764          DCA I   PXWAPT  /POINTER TO NEXT BUFFER
1726  1764          TAD I   PXWAPT
1727  3364          DCA     PXWAPT
1730  7201          CLA IAC
1731  1105          TAD     [-PXBUCN
1732  3363          DCA     PXOBC   /COUNTS THE NUMBER OF POINTERS
1733  1367    PX1,  TAD     TERNR   /TERMINAL NO
1734  3764          DCA I   PXWAPT
1735  2364          ISZ     PXWAPT
1736  1370          TAD     BUFPTR  /BUFFER POINTER
1737  3764          DCA I   PXWAPT
1740  2364          ISZ     PXWAPT
1741  5576          EXIT

1742  0000    PXCHAR, 0             /TAKE NEXT CHARACTER FROM BUFFER
1743  7200          CLA
1744  2370          ISZ     BUFPTR
1745  1770          TAD I   BUFPTR
1746  5742          JMP I   PXCHAR

```

```
1000    1747  0000  SETIF,  0                 /INITIALIZE POINTER BUFFER
1001    1750  3360          DCA     PXREPT  /READ POINTER
1002    1751  1360          TAD     PXREPT
1003    1752  3364          DCA     PXWAPT  /ALSO WRITE POINTER
1004    1753  1105          TAD     [-PXBUCN/EMPTY BUFFER
1005    1754  3362          DCA     PXIBC
1006    1755  1105          TAD     [-PXBUCN
1007    1756  3363          DCA     PXOBC
1008    1757  5747          JMP I   SETIF
1009
1010    1760  0000  PXREPT, 0               /PX READ POINTER
1011    1761  0000  ATTPX,  0               /ATTENTION PX
1012    1762  0000  PXIBC,  0               /PX INPUT BUFFER COUNTER
1013    1763  0000  PXOBC,  0               /PX BUFFER OUTPUT COUNTER
1014    1764  0000  PXWAPT, 0               /PX WRITE POINTER
1015    1765  0000  SAVDIR, 0               /
1016    1766  7777  PXREADY,7777            /PX READY
1017    1767  0000  TERNR,  0               /TERMINAL NUMBER
1018    1770  0000  BUFPTR, 0               /BUFFER POINTER
1019    1775  7560
1020    1776  2111
1021    1777  1541
1022                        PAGE
```

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1023   2000  6302  XP2,    CBUX2              /CLEAR XP-FLAG
1024   2001  7305          AC2                /PRIORITY IR
1025   2002  4567          INITIR             /INITIALIZE IR
1026   2003  6231          CDF 30
1027   2004  7305          AC2
1028   2005  6322          OKX
1029   2006  4300          JMS     XPWAIT     /TURNS INTERRUPT ON
1030   2007  6312          XPA1               /READ TERMINAL NUMBER
1031   2010  3255          DCA     XPTNR
1032   2011  1255          TAD     XPTNR
1033   2012  1032          TAD     XPP
1034   2013  3260          DCA     SCHARX
1035   2014  1660          TAD I   SCHARX
1036   2015  3256          DCA     XPBPTR     /XP-BUFFER[TERMINAL NUMBER]
1037   2016  1660          TAD I   SCHARX
1038   2017  3017          DCA     AUTIN8
1039   2020  3261          DCA     CNTCHR
1040   2021  1112          TAD     [-4
1041   2022  3257          DCA     XPLPCN
1042   2023  4300  XPLOOP, JMS     XPWAIT     /RECEIVE BUFFER FROM X8
1043   2024  6304          XPA3
1044   2025  4262          JMS     XPSTOR
1045   2026  6314          XPA2
1046   2027  4262          JMS     XPSTOR
1047   2030  6312          XPA1
1048   2031  4262          JMS     XPSTOR
1049   2032  2257          ISZ     XPLPCN
1050   2033  5223          JMP     XPLOOP
1051   2034  4565  XPDONE, GETNODE
1052   2035  3023          DCA     DTPNMJ
1053   2036  1023          TAD     DTPNMJ
1054   2037  3013          DCA     SPN
1055   2040  1255          TAD     XPTNR      /TERMINAL NUMBER
1056   2041  3413          DCA I   SPN
1057   2042  1256          TAD     XPBPTR     /BUFFER
1058   2043  3413          DCA I   SPN
1059   2044  1261          TAD     CNTCHR     /COUNT
1060   2045  3413          DCA I   SPN
1061   2046  7201          CLA IAC
1062   2047  3022          DCA     JSWMJ      /SET JSW
1063   2050  1103          TAD     [TKXPBU /TRANSLATE XP-BUFFER
1064   2051  45/3          MAKE JOB
1065   2052  7201          CLA IAC
1066   2053  6326          OKX CAX
1067   2054  55/6          EXIT
1068
1069   2055  0000  XPTNR,  0                  /XP TERMINAL NUMBER
1070   2056  0000  XPBPTR, 0                  /XP BUFFER COUNTER
1071   2057  0000  XPLPCN, 0                  /XP LOOP COUNTER
1072   2060  0000  SCHARX, 0                  /SAVE CHAR
1073   2061  0000  CNTCHR, 0                  /COUNT CHAR
1074
1075   2062  0000  XPSTOR, 0                  /PUT CHARACTER IN XP BUFFER
1076   2063  3260          DCA     SCHARX
1077   2064  1260          TAD     SCHARX
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2065  3417            DCA I   AUTIN8
2066  2261            ISZ     CNTCHR
2067  1260            TAD     SCHARX
2070  0117            AND     [400     /END MARKER
2071  7650            SNA CLA
2072  5662            JMP I   XPSTOR
2073  2257  XPSKIP,   ISZ     XPLPCN   /YES, SKIP REST OF BUFFER
2074  7410            SKP
2075  5234            JMP     XPDONE
2076  4300            JMS     XPWAIT
2077  5273            JMP     XPSKIP

2100  0000  XPWAIT,   0                /BUSY WAITING LOOP
2101  6002            IOF              /FOR ONE CHARACTER FROM XP
2102  6324            CAX
2103  6301            BUX2
2104  5303            JMP     .-1
2105  6302            CBUX2
2106  7200            CLA
2107  6001            ION
2110  5700            JMP I   XPWAIT


2111  0000  PXWAIT,   0                /BUSY WAITING LOOP
2112  6002            IOF              /FOR ONE CHARACTER TO PX
2113  6354            CAP
2114  6351            BUP2
2115  5314            JMP     .-1
2116  6332            CBUP2
2117  6001            ION
2120  5711            JMP I   PXWAIT

            INITIR=   JMS I   [.
2121  0000  INTRAP,   0                /INITIALIZE IR
2122  7510            SPA
2123  7402            HLT
2124  3022            DCA     JSWMJ
2125  1022            TAD     JSWMJ
2126  0377            AND     (MSKPR
2127  3004            DCA     SV       /PRIORITY INTERRUPT ROUTINE
2130  1021            TAD     JSW
2131  0377            AND     (MSKPR   /PRIORITY CURRENT JOB
2132  7040            CMA
2133  1004            TAD     SV
2134  7700            SMA CLA          /PRIORITY IR>PRIORITY CURRENT JOB?
2135  5341            JMP     EXCIR    /YES
2136  1321            TAD     INTRAP
2137  4573            MAKE JOB
2140  5502            JMP I   [EXKI
2141  4570  EXCIR,    SAVE             /SAVE STATUS
2142  1022            TAD     JSWMJ
2143  3021            DCA     JSW      /JOB STATUS WORD INTERRUPT ROUTINE
2144  6001            ION
2145  5721            JMP I   INTRAP   /EXECUTE INTERRUPT ROUTINE

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```
1133                    INITJB= JMS I   [.
1134    2146   0000     INJOB,  0               /INITIALIZE JOB
1135    2147   6002             IOF
1136    2150   6231             CDF 30
1137    2151   1024             TAD     DATAPN  /DATA AREA
1138    2152   3013             DCA     SPN     /AUTO INDEXER
1139    2153   1413             TAD I   SPN
1140    2154   3025             DCA     PAR1    /PAR1
1141    2155   1413             TAD I   SPN
1142    2156   3026             DCA     PAR2    /PAR2
1143    2157   1413             TAD I   SPN
1144    2160   3027             DCA     PAR3    /PAR3
1145    2161   1024             TAD     DATAPN
1146    2162   2024             ISZ     DATAPN  /DETECT ERRORS
1147    2163   4504             JMS I   [FREEND /RETURN NODE TO AVAIL LIST
1148    2164   6001             ION
1149    2165   5746             JMP I   INJOB
1150    2177   4003
1151                            PAGE
```

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                    /MULTIPLEXER SECTION
2200   6424   T1S,     T1ON                 /CLEAR AND START CLOCK
2201   7201            CLA IAC
2202   3022            DCA      JSWMJ
2203   1057            TAD      MILP        /1/5TH OF THE LINES
2204   6473            TTCR TTLR            /LOAD LINE COUNT REGISTER
2205   7200            CLA
2206   6231            CDF 30
2207   5777            JMP I    (HDTTI      /EXECUTE ALL TTI'S

2210   1060   OUTPUT,  TAD      SAVLN       /LAST OUTPUT LINE+1
2211   6413            TTCL TTLL            /LOAD LINE REGISTER
2212   7200            CLA
2213   1057            TAD      MILP
2214   3351            DCA      MNRCNT      /SET UP TTO-COUNT

2215   1456   TTOGO,   TAD I    MCHAR       /CURRENT CHARACTER
2216   7440            SZA                  /OUTPUT COMPLETED?
2217   5223            JMP      .+4         /NO
2220   4250            JMS      GETMCH      /FETCH NEW CHARACTER
2221   1456            TAD I    MCHAR       /NEW CHARACTER
2222   7440            SZA
2223   6404            TTC                  /OUTPUT NEXT BIT
2224   3456            DCA I    MCHAR       /RESTORE REMAINDER

2225   6401   TTDONE,  TTINCR               /SELECT NEXT LINE
2226   2056            ISZ      MCHAR       /SELECT NEXT CURRENT CHARACTER
2227   2351            ISZ      MNRCNT      /1/5TH DONE?
2230   5215            JMP      TTOGO       /NO, CONTINUE
2231   6414            TTRL                 /READ AND
2232   3060            DCA      SAVLN       /SAVE LAST LINE NUMBER
2233   2352            ISZ      MJRCNT      /ALL LINES DONE?
2234   5236            JMP      .+2
2235   4342            JMS      INIMP       /YES, RESET POINTERS

              EXITSI=  JMP I    [.
2236   7200   EXITKI,  CLA
2237   1051            TAD      LOOK
2240   7650            SNA CLA              /ANY JOB CREATED?
2241   5502            JMP I    [EXKI       /NO, TAKE THE "SMALL" EXIT
2242   4570            SAVE                 /THE INTERRUPTED PROGRAM ON THE STACK
2243   5776            JMP I    (DEC1       /AND PERFORM A DECISION

2244   0000   P2,      0
2245   0000   P3,      0
2246   0000   EPTR,    0
2247   0000   SVPT,    0

2250   0000   GETMCH,  0
2251   1060            TAD      SAVLN       /LINE NUMBER
2252   7104            CLL RAL              /TIMES TWO
2253   1030            TAD      RR
2254   3247            DCA      SVPT        /POINTS TO THE PARAMETERS
2255   1647            TAD I    SVPT
2256   3244            DCA      P2          /SAVE POINTER
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1207   2257  1247             TAD     SVPT
1208   2260  7001             IAC
1209   2261  3245             DCA     P3      /COUNTER
1210   2262  1645             TAD I   P3
1211   2263  7640             SZA CLA         /BUFFER?
1212   2264  5302             JMP     BF      /YES
1213
1214   2265  1244             TAD     P2      /SINGLE CHARACTER
1215   2266  7450             SNA             /ANYTHING TO DO?
1216   2267  5276             JMP     EXGM    /NO
1217   2270  0101             AND     [7400
1218   2271  7440             SZA             /ATTENTION?
1219   2272  5277             JMP     AT1     /YES
1220   2273  1244             TAD     P2      /CHARACTER
1221   2274  4500             JMS I   [FILLR  /ADD STOPBIT AND PUT THE CHARACTER INTO
1222                                          /MULTIPLEXER BUFFER                   THE
1223   2275  3647  EXGMM2,    DCA I   SVPT    /CLEAR PARAMETER
1224   2276  5650  EXGM,      JMP I   GETMCH
1225
1226   2277  4775' AT1,       JMS     FIRST   /PUT THE ATTENTION CHARACTER INTO THE
1227   2300  0244             AND     P2      /REMOVE ATTENTION BIT             BUFFER
1228   2301  5275             JMP     EXGMM2  /STORE CHARACTER BACK
1229
1230   2302  2244  BF,        ISZ     P2      /INCREASE POINTER
1231   2303  1644             TAD I   P2      /CURRENT CHARACTER
1232   2304  0101             AND     [7400
1233   2305  7440             SZA             /ATTENTION?
1234   2306  5334             JMP     DUB     /YES
1235   2307  2645             ISZ I   P3      /INCREASE CHARACTER COUNTER
1236   2310  5322             JMP     NOTLST
1237   2311  1644  BFLST,     TAD I   P2      /LAST CHARACTER
1238   2312  4774'            JMS     FILLRB
1239   2313  7201             CLA IAC         /PRIORITY ONE
1240   2314  3022             DCA     JSWMJ
1241   2315  1060             TAD     SAVLN   /LINE NO
1242   2316  3023             DCA     DTPNMJ
1243   2317  1077             TAD     [CLBUF  /CLOSE BUFFER
1244   2320  4573             MAKE JOB
1245   2321  5275             JMP     EXGMM2
1246
1247   2322  1645  NOTLST,    TAD I   P3
1248   2323  7104             CLL RAL
1249   2324  7650             SNA CLA         /0 OR 4000?
1250   2325  5311             JMP     BFLST
1251   2326  1644             TAD I   P2
1252   2327  4774'            JMS     FILLRB
1253   2330  1645             TAD I   P3
1254   2331  7710             SPA CLA
1255   2332  5340             JMP     DUB+4   /STORE POINTER
1256   2333  5337             JMP     DUB+3   /RESET AND STORE POINTER
1257
1258   2334  4775' DUB,       JMS     FIRST
1259   2335  0644             AND I   P2
1260   2336  3644             DCA I   P2
1261   2337  7240             STA
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2340  1244           TAD     P2
2341  5275           JMP     EXGMM2

2342  0000  INIMP,   0                 /INITIALIZE FOR NEXT LINES SCAN
2343  1076           TAD     [-5
2344  3352           DCA     MJRCNT
2345  3060           DCA     SAVLN
2346  1031           TAD     R
2347  3056           DCA     MCHAR
2350  5742           JMP I   INIMP
2351  0000  MNRCNT,  0
2352  0000  MJRCNT,  0

            ECHO=    JMS I   [.
2353  0000  ECHOA,   0
2354  6002           IOF
2355  1025           TAD     PAR1      /LINE NO
2356  7104           CLL RAL
2357  1030           TAD     RR
2360  3246           DCA     EPTR      /POINTER TO BUFFER
2361  1026           TAD     PAR2      /CHARACTER OR BUFFER POINTER
2362  3646           DCA I   EPTR      /STORE
2363  2246           ISZ     EPTR      /NEXT
2364  1027           TAD     PAR3      /COUNTER
2365  3646           DCA I   EPTR      /STORE
                     /ISZ    EPTR
2366  6001           ION
2367  5753           JMP I   ECHOA
2374  2563
2375  3046
2376  3601
2377  2610
                     PAGE
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2400  1024  CLBUF,  TAD     DATAPN
2401  3025          DCA     PAR1
2402  6231          CDF 30
2403  4777          JMS I   (OFFTRS
2404  4552          JMS I   [GTPRT
2405  5576          EXIT
2406  4543          JMS I   [REQUA
2407  4545          JMS I   [GTXPMR
2410  7344          CLA CLL CMA RAL
2411  1047          TAD     CHAR
2412  4544          JMS I   [STXPMR
2413  2047          ISZ     CHAR
2414  5576          EXIT
2415  4531          JMS I   [GTLCH  /TRY TURN
2416  4533          JMS I   [NEQUAL
2417  5576          EXIT
2420  4536          JMS I   [SWITCH
2421  1376          TAD     (BLCK
2422  3026          DCA     PAR2
2423  3027          DCA     PAR3
2424  4564          ECHO
2425  5576          EXIT

2426  0000  PXECHO, 0               /PUT CHAR IN PX BUFFER
2427  0121          AND     [177    /7 BITS ONLY
2430  1150          TAD     [INTREP /CONVERT TO X8 CODE
2431  4520          JMS I   [AMA
2432  7510          SPA             /VALID CHARACTER
2433  5246          JMP     PXECHX  /NO, SKIP
2434  3043          DCA     SP1     /SAVE CHARACTER
2435  4510          JMS I   [GTPXP  /GET POINTERS
2436  1043          TAD     SP1
2437  0375          AND     (777
2440  2026          ISZ     PAR2
2441  3426          DCA I   PAR2    /STORE IN BUFFER
2442  2027          ISZ     PAR3    /BUFFER FULL
2443  5250          JMP     TSTBIT  /NO
2444  4475  CHOXIT, JMS I   [SEND   /YES, SEND AWAY
2445  4522          JMS I   [STPXP  /RESTORE POINTERS
2446  7200  PXECHX, CLA
2447  5626          JMP I   PXECHO

2450  1043  TSTBIT, TAD     SP1     /SPECIAL CHARACTERS
2451  0117          AND     [400
2452  7650          SNA CLA
2453  5245          JMP     CHOXIT+1        /NO
2454  1026          TAD     PAR2    /YES, FILL
2455  3317          DCA     SP2     /REST OF LINE
2456  7346          CLA CLL CMA RTL
2457  3044          DCA     LPCNT
2460  2026  NILFIL, ISZ     PAR2
2461  1162          TAD     [DUMMY  /WITH DUMMIES
2462  3426          DCA I   PAR2
2463  2027          ISZ     PAR3
2464  7410          SKP
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1350    2465   5271            JMP      BCOUNT
1351    2466   2044            ISZ      LPCNT
1352    2467   5260            JMP      NILFIL
1353    2470   5256            JMP      NILFIL-2
1354    2471   1043   BCOUNT,  TAD      SP1      /ACCOUNT PROPER FORMAT
1355    2472   3426            DCA  I   PAR2     /FOR NEXT BUFFER
1356    2473   2044            ISZ      LPCNT
1357    2474   7410            SKP
1358    2475   5244            JMP      CHOXIT
1359    2476   1043            TAD      SP1
1360    2477   1374            TAD      (-600
1361    2500   7650            SNA CLA
1362    2501   5244            JMP      CHOXIT
1363    2502   4475            JMS  I   [SEND
1364    2503   1317            TAD      SP2
1365    2504   1044            TAD      LPCNT
1366    2505   3317            DCA      SP2
1367    2506   2317            ISZ      SP2
1368    2507   1717            TAD  I   SP2
1369    2510   0162            AND      [377
1370    2511   2026            ISZ      PAR2
1371    2512   3426            DCA  I   PAR2
1372    2513   2027            ISZ      PAR3
1373    2514   2044            ISZ      LPCNT
1374    2515   5306            JMP      .-7
1375    2516   5245            JMP      CHOXIT+1
1376
1377    2517   0000   SP2,     0
1378
1379    2520   0000   SETTI,   0                 /GENERATE TTI INSTRUCTIONS
1380    2521   1106            TAD      [-10     /DURING MULTIPLEXER INITIALIZATION
1381    2522   3047            DCA      CHAR
1382    2523   1003            TAD      MX8
1383    2524   3044            DCA      LPCNT
1384    2525   1373            TAD      (HDTTI-1
1385    2526   3017            DCA      AUTIN8
1386    2527   6201            CDF 00
1387    2530   1372   NXTTI,   TAD      (TTI     /CREATE TTI INSTRUCTIONS
1388    2531   3417            DCA  I   AUTIN8   /TTI
1389    2532   1156            TAD      [10      /LSW
1390    2533   1047            TAD      CHAR
1391    2534   3047            DCA      CHAR
1392    2535   1047            TAD      CHAR
1393    2536   3417            DCA  I   AUTIN8
1394    2537   7332            AC2000            /CAW
1395    2540   3417            DCA  I   AUTIN8
1396    2541   1371            TAD      (JMS I [TKOVER
1397    2542   3417            DCA  I   AUTIN8   /ROUTINE CALL
1398    2543   2044            ISZ      LPCNT
1399    2544   5330            JMP      NXTTI
1400    2545   7352            CLA CLL CMA RTR /JMP .I (END OF PAGE)
1401    2546   3417            DCA  I   AUTIN8
1402    2547   5720            JMP  I   SETTI
1403
1404    2550   0000   FILLR,   0                 /STORE CHARACTER TO BE PRINTED
```

```
2551  1117              TAD     [400     /ADD STOPBIT
2552  7104              CLL RAL          /AND STARTBIT
2553  3456              DCA I   MCHAR    /STORE
2554  1031              TAD     R
2555  1052              TAD     XLINE    /DIT SOMEONE SET XLINE
2556  7041              CIA              /TO THE NUMBER OF THE CURRENT TERMINAL?
2557  1056              TAD     MCHAR
2560  7650              SNA CLA
2561  4770'             JMS     TODISK   /THEN IT GOES TO THE DISK
2562  5750              JMP I   FILLR

2563  0000    FILLRB, 0
2564  1073              TAD     [1000    /EXTRA STOPBIT
2565  4350              JMS     FILLR
2566  5763              JMP I   FILLRB
2570  4231
2571  4474
2572  6402
2573  2607
2574  7200
2575  0777
2576  0216
2577  1477
                        PAGE
```

```
2600  2777              (OUTPUT            /CREATE LINK
                        *.-1
2600  7000  START,      NOP                /HLT
2601  7325              AC3                /LAS
2602  0163              AND      [7
2603  7450              SNA
2604  5200              JMP      START
2605  3002              DCA      X8        /NO OF TERMINALS
2606  1002              TAD      X8
2607  7041              CIA
2610  3003              DCA      MX8

            /CREATE JOB SPACE
2611  6231              CDF 30
                        /TAD     (-MAXJOB
                        /DCA     LPCNT
2612  1020              TAD      AVAIL
2613  7410              SKP
2614  1404  LPCRJS,     TAD I    SV        /CREATE A LIST OF NODES
2615  3004              DCA      SV
2616  7307              AC4
2617  1004              TAD      SV
2620  3404              DCA I    SV        /LINK TO NEXT NODE
2621  2044              ISZ      LPCNT     /FINISHED?
2622  5214              JMP      LPCRJS
2623  3404              DCA I    SV        /ZERO ENDS THE LIST

            /COMPUTE SIZE OF BUFFER
2624  3057              DCA      MILP
2625  1003              TAD      MX8
2626  1142              TAD      [5
2627  2057              ISZ      MILP
2630  7510              SPA
2631  5226              JMP      .-3
2632  1002              TAD      X8
2633  3365              DCA      DR       /DR=5*[X8+4 / 5]
                                          /MILP=[X8+4 /5]
2634  1365              TAD      DR
2635  7104              CLL RAL
2636  1365              TAD      DR
2637  3047              DCA      SP        /3*DR : R, RR
2640  1002              TAD      X8
2641  7106              CLL RTL
2642  7004              RAL
2643  1002              TAD      X8        /X8*9
2644  1047              TAD      SP
2645  3047              DCA      SP        /TOTAL SPACE NEEDED
2646  3004              DCA      SCNT
2647  1047              TAD      SP
2650  7104  LPSP,       CLL RAL
2651  2004              ISZ      SCNT
2652  7420              SNL
2653  5250              JMP      LPSP
2654  7650              SNA CLA
2655  2004              ISZ      SCNT
```

```
1484    2656  1004            TAD     SCNT
1485    2657  1376            TAD     (-13
1486    2660  7041            CIA               /-(LN(SP)+1)
1487
1488    2661  6201            CDF 00
1489    2662  4572            GETBUF            /DF:=3
1490    2663  7402            HLT
1491    2664  3046            DCA     A
1492
1493    2665  7240            CLA CMA           /ZERO BUFFER
1494    2666  1046            TAD     A
1495    2667  3017            DCA     AUTIN8
1496    2670  1047            TAD     SP
1497    2671  7041            CIA
1498    2672  3364            DCA     INICNT
1499    2673  3417            DCA I   AUTIN8
1500    2674  2364            ISZ     INICNT
1501    2675  5273            JMP     .-2
1502
1503    2676  6201            CDF 00
1504    2677  1375            TAD     (-11
1505    2700  3364            DCA     INICNT
1506    2701  1374            TAD     (XPP
1507    2702  3047            DCA     SPTR
1508    2703  1046            TAD     A
1509    2704  3447    ST1,    DCA I   SPTR      /ALLOCATE BUFFERS
1510    2705  1002            TAD     X8
1511    2706  1447            TAD I   SPTR
1512    2707  2047            ISZ     SPTR
1513    2710  2364            ISZ     INICNT
1514    2711  5304            JMP     ST1
1515    2712  3031            DCA     R         /MULTIPLEXER BUFFER
1516    2713  1365            TAD     DR
1517    2714  1031            TAD     R
1518    2715  3030            DCA     RR        /PARAMETERS MULTIPLEXER
1519    2716  1003            TAD     MX8
1520    2717  3364            DCA     INICNT
1521    2720  7240            CLA CMA
1522    2721  1032            TAD     XPP
1523    2722  3017            DCA     AUTIN8
1524    2723  7305    ST2,    CLA CLL IAC RAL /CREATE XP-BUFFER
1525    2724  6201            CDF 00
1526    2725  4572            GETBUF
1527    2726  7402            HLT
1528    2727  3417            DCA I   AUTIN8    /INITIALIZE XPP[0:X8]
1529    2730  2364            ISZ     INICNT
1530    2731  5323            JMP     ST2
1531    2732  7307            CLA CLL IAC RTL /INITIALIZE QUEUE FOR PX-BUFFER POINTERS
1532    2733  6201            CDF 00
1533    2734  4572            GETBUF
1534    2735  7402            HLT
1535    2736  4773'           JMS     SETIF
1536
1537                  /INITIALIZE MULTIPLEXER
1538    2737  1057            TAD     MILP
```

```
2740  7041                CIA
2741  3057                DCA     MILP
2742  4772'               JMS     SETTI
2743  4771'               JMS     INIMP
2744  6424                T1ON            /START CLOCK

                  /START INTERFACE X8
2745  6322                OKX
                          /ACM2
                          /DCA    X7FLAG

2746  4770'               JMS     INUSER  /MAKE CONNECTION PS-8 AND UTOR
                          /CLA CMA
                          /DCA    JSW     /LEVEL BACKGROUND PROGRAM
2747  6001                ION
                  /BACKGROUND PROGRAM, ROTATES AC LIGHTS
                  /TRY TO GIVE HIM A NICE PLACE
2750  0000                IFZERO 2760-.^4000 <ZBLOCK 2760-. >
2760  7024                CML RAL
2761  2024                ISZ     DATAPN
2762  5361                JMP     .-1
2763  5360                JMP     .-3

2764  0000        INICNT, 0
2765  0000        DR,     0

                  SCNT=   SV
                  SP=     CHAR
                  SPTR=   SP

                  HDTTI=  START+10        /WRITE TTI INSTRUCTIONS OVER START
2770  4600
2771  2342
2772  2520
2773  1747
2774  0032
2775  7767
2776  7765
2777  2210
                          PAGE
```

```
3000  7201  X7S,     CLA IAC
3001  6327           CBUX7 OKX CAX
3002  7200  OUT7S,   CLA
3003  2050           ISZ     X7FLAG
3004  5502           JMP I   [EXKI
                     /TAD    (HLT
                     /DCA    OUT7S   /HALT ON LS
3005  7305           AC2     /PRIORITY INTERRUPT ROUTINE
3006  4567           INITIR          /INITIALIZE IR
3007  1003           TAD     MX8
3010  3234           DCA     X7P1
3011  6231  AGPR,    CDF 30          /ASK XP-BUFFER
3012  4565           GETNODE
3013  3023           DCA     DTPNMJ
3014  1023           TAD     DTPNMJ  /DATA POINTER
3015  3013           DCA     SPN
3016  1234           TAD     X7P1    /-(TERMINAL NO + 1)
3017  3413           DCA I   SPN
3020  3413           DCA I   SPN     /NILL
3021  7305           AC2
3022  3022           DCA     JSWMJ   /PRIORITY
3023  1072           TAD     [PXOVER
3024  4573           MAKE JOB        /HANDLE TO X8
3025  6001           ION
3026  2234           ISZ     X7P1
3027  5211           JMP     AGPR
3030  5576           EXIT

3031  7201  P7S,     CLA IAC
3032  6353           CBUP7 OKP
3033  5202           JMP     OUT7S
3034  0000  X7P1,    0

3035  0000  ACBUF,   0
3036  4510           JMS I   [GTPXP  /GET POINTERS
3037  4507           JMS I   [FREEBF /RETURN TO POOL
3040  4523           JMS I   [NXTPXB /NEXT PX BUFFER
3041  4522           JMS I   [STPXP  /STORE POINTERS
3042  4531           JMS I   [GTLCH  /LAST CHARACTER
3043  1047           TAD     CHAR
3044  4547           JMS I   [PXECHO /TO X8
3045  5635           JMP I   ACBUF

3046  0000  FIRST,   0
3047  7104           CLL RAL
3050  7510           SPA
3051  5262           JMP     COLOUR
3052  7106           CLL RTL
3053  7006           RTL
3054  1377           TAD     (HDTRB-1
3055  3277           DCA     SVF
3056  1677           TAD I   SVF
3057  4776'          JMS     FILLRB
3060  1162           TAD     [DUMMY
3061  5646           JMP I   FIRST
```

```

3062  7200  COLOUR, CLA
3063  1040          TAD     STATE
3064  1060          TAD     SAVLN
3065  3277          DCA     SVF
3066  7344          CLA CLL CMA RAL
3067  1677          TAD I   SVF
3070  7640          SZA CLA
3071  1375          TAD     (RED-BLCK
3072  1374          TAD     (BLCK
3073  4776'         JMS     FILLRB
3074  1373          TAD     (1777
3075  5646          JMP I   FIRST

3076  0000  MCH,    0
3077  0000  SVF,    0

3100  0000  REQUA,  0               /ASK XP-BUFFER
3101  4565          GETNODE
3102  3023          DCA     DTPNMJ
3103  1023          TAD     DTPNMJ
3104  3013          DCA     SPN
3105  2021          ISZ     JSW     /INCREASE LEVEL OF CURRENT JOB
3106  7305          CLA CLL IAC RAL
3107  3022          DCA     JSWMJ
3110  1025          TAD     PAR1
3111  7040          CMA             /NEGATIVE TERMINAL NUMBER
3112  3413          DCA I   SPN
3113  3413          DCA I   SPN     /NILL
3114  1072          TAD     [PXOVER
3115  4573          MAKE JOB
3116  6001          ION
3117  5700          JMP I   REQUA

            GETNODE=JMS I   [.      /FROM THE AVAIL LIST
3120  0000  GETND,  0
3121  6002          IOF
3122  7240          CLA CMA
3123  1055          TAD     WARN
3124  3055          DCA     WARN
3125  1020          TAD     AVAIL
3126  7450          SNA
3127  5335          JMP     NOROOM  /AVAIL LIST EXHAUSTED
3130  3004          DCA     SV
3131  1420          TAD I   AVAIL
3132  3020          DCA     AVAIL
3133  1004          TAD     SV
3134  5720          JMP I   GETND
3135  6201  NOROOM, CDF 0
3136  4572          GETBUF
3137  7402          HLT             /EMPTY TOO
3140  5720          JMP I   GETND

3141  0000  FREEND, 0               /TO THE AVAIL LIST
3142  6002          IOF
```

```
3143  3004          DCA     SV      /BUFFER POINTER
3144  1004          TAD     SV
3145  7112          CLL RTR
3146  7770          SZL SPA SNA CLA
3147  7402          HLT
3150  1020          TAD     AVAIL
3151  3404          DCA I   SV      /SUCCESSOR OF SV
3152  1004          TAD     SV
3153  3020          DCA     AVAIL   /NEW FIRST FREE NODE
3154  2055          ISZ     WARN
3155  7000          NOP
3156  5741          JMP I   FREEND
3173  1777
3174  0216
3175  7601
3176  2563
3177  0757
                    PAGE
```

```
1707   3200  0000  TRTURN, 0                  /TEST TURN OVER CONDITIONS
1708   3201  4552          JMS I   [GTPRT     /PARTNER=X8?
1709   3202  5233          JMP     TURXIT     /NO, KEEP TURN
1710   3203  4525          JMS I   [GTB1      /LAST LINE WAS DELETED
1711   3204  1152          TAD     [DELETE
1712   3205  4533          JMS I   [NEQUAL
1713   3206  5233          JMP     TURXIT     /YES, KEEP TURN
1714   3207  4545          JMS I   [GTXPMR    /XP BUFFER PRESENT?
1715   3210  7344          CLA CLL CMA RAL
1716   3211  1047          TAD     CHAR
1717   3212  7710          SPA CLA
1718   3213  5233          JMP     TURXIT     /NO, KEEP TURN
1719   3214  4540          JMS I   [CHANGE    /TURN OVER
1720   3215  4536          JMS I   [SWITCH
1721   3216  4540          JMS I   [CHANGE
1722   3217  1032          TAD     XPP        /XP POINTERS
1723   3220  4511          JMS I   [AMAL
1724   3221  3026          DCA     PAR2
1725   3222  7132          STL RTR
1726   3223  1426          TAD I   PAR2
1727   3224  3426          DCA I   PAR2
1728   3225  1033          TAD     XPNUMB
1729   3226  4511          JMS I   [AMAL
1730   3227  7041          CIA                /DECREMENT AC
1731   3230  7040          CMA
1732   3231  3027          DCA     PAR3
1733   3232  4564          ECHO
1734   3233  1134  TURXIT, TAD     [LF
1735   3234  3047          DCA     CHAR
1736   3235  5600          JMP I   TRTURN
1737
1738   3236  0000  SEND,   0
1739   3237  1130          TAD     [-14
1740   3240  1026          TAD     PAR2
1741   3241  3026          DCA     PAR2
1742   3242  4565          GETNODE
1743   3243  3023          DCA     DTPNMJ     /DATA AREA
1744   3244  2021          ISZ     JSW        /INCREASE LEVEL OF CURRENT JOB
1745   3245  7305          CLA CLL IAC RAL
1746   3246  3022          DCA     JSWMJ      /JOB STATUS WORD
1747   3247  1023          TAD     DTPNMJ
1748   3250  3013          DCA     SPN        /POINTS TO DATA AREA
1749   3251  1025          TAD     PAR1       /STORE
1750   3252  3413          DCA I   SPN        /PAR1
1751   3253  1026          TAD     PAR2       /PAR2
1752   3254  3413          DCA I   SPN
1753   3255  1072          TAD     [PXOVER
1754   3256  4573          MAKE JOB           /HANDLE BUFFER TO X8
1755   3257  6001          ION
1756   3260  4523          JMS I   [NXTPXB    /NEXT PX BUFFER
1757   3261  5636          JMP I   SEND
1758
1759
1760   3262  0000  STAMP,  0                  /ADD CHARACTER TO PX BUFFER
1761   3263  1026          TAD     PAR2
```

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3264  3043           DCA     SP1      /SAVE CHARACTER
3265  4510           JMS I   [GTPXP   /GET PX POINTERS
3266  2026           ISZ     PAR2
3267  1043           TAD     SP1
3270  3426           DCA I   PAR2
3271  2027           ISZ     PAR3     /BUFFER FULL?
3272  2262           ISZ     STAMP    /NO, RETURN+1
3273  5662           JMP I   STAMP

3274  4262  DUPLX2,  JMS     STAMP    /STORE CHARACTER
3275  4236           JMS     SEND     /SEND BUFFER, IF ANY
3276  4522           JMS I   [STPXP   /RESTORE POINTERS
3277  5576           EXIT

3300  4262  SINGLE,  JMS     STAMP    /STORE SINGLE CHARACTER
3301  1377           TAD     (13      /SEND BUFFER AWAY
3302  5275           JMP     SINGLE-3
```

```
            /DYNAMIC STORAGE ALLOCCATION CORE
            /BUDDY SYSTEM AS DESCRIBED IN
            /KNUTH, THE ART OF COMPUTER PROGRAMMING (VOL 1)

            FLD=    30
            CK=     SV3

3303  0000  GETBIT, 0
3304  7112          CLL RTR
3305  3004          DCA     SV
3306  1004          TAD     SV
3307  7110          CLL RAR
3310  7110          CLL RAR
3311  7110          CLL RAR
                    /TAD    (HDADSP
3312  3005          DCA     WA      /WORD ADDRESS
3313  1004          TAD     SV
3314  0163          AND     [7
                    /TAD    (HDMASK
3315  3006          DCA     BA      /BIT ADDRESS
3316  5703          JMP I   GETBIT

3317  0000  INSERT, 0               /SV AFTER SV2 IN A DOUBLY LINKED LIST
3320  3004          DCA     SV      /POINTER TO THE NODE TO BE INSERTED
3321  1406          TAD I   SV2
3322  7450          SNA             /EMPTY LIST?
3323  5332          JMP     .+7     /YES
3324  7001          IAC
3325  3005          DCA     SV1     /PREDECESSOR FIELD OF THE SUCCESSOR
3326  1004          TAD     SV                                      OF SV
3327  3405          DCA I   SV1     /NEW PREDECESSOR
3330  7240          CLA CMA
3331  1005          TAD     SV1
3332  3404          DCA I   SV      /NEW SUCCESSOR OF SV
3333  1004          TAD     SV
3334  3406          DCA I   SV2     /SUCCESSOR OF SV2
3335  2004          ISZ     SV
3336  1006          TAD     SV2
3337  3404          DCA I   SV      /PREDECESSOR OF SV
3340  2004          ISZ     SV
3341  1007          TAD     CK      /CURRENT SIZE
3342  3404          DCA I   SV      /STORE
3343  5717          JMP I   INSERT


3344  0000  DELET,  0               /DELETE SV FROM A DOUBLY LINKED LIST
3345  3004          DCA     SV
3346  1404          TAD I   SV
3347  3005          DCA     SV1     /SUCCESSOR
3350  2004          ISZ     SV
3351  1404          TAD I   SV
3352  3006          DCA     SV2     /PREDECESSOR
3353  1005          TAD     SV1
3354  3406          DCA I   SV2     /NEW SUCCESSOR
3355  1005          TAD     SV1
```

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3356  7650           SNA CLA         /EMPTY LIST?
3357  5744           JMP I   DELET
3360  1006           TAD     SV2
3361  2005           ISZ     SV1
3362  3405           DCA I   SV1     /NEW PREDECESSOR
3363  5744           JMP I   DELET

3377  0013
                     PAGE
               /CALLING SEQUENCE
               /     CDF CUR
               /     TAD     BUFFER
               /     FREEBUF
               /     SIZECODE
               /
               FREEBUF=JMS I   [.
3400  0000     FRBUF,  0
3401  6002           IOF
3402  3364           DCA     LOC     /ADDRESS BUFFER
3403  1600           TAD I   FRBUF
3404  2200           ISZ     FRBUF
3405  0377           AND     (MSKSZ
3406  3007           DCA     CK      /BUFFER SIZE
3407  1071           TAD     [CIF
3410  6214           RDF
3411  3274           DCA     OUTFBF
3412  6251           CDF FLD
3413  1364           TAD     LOC
3414  7112           CLL RTR
3415  7770           SPA SNA SZL CLA
3416  7402           HLT             /ERROR
3417  1364           TAD     LOC
3420  4776'          JMS     GETBIT
3421  1406           TAD I   BA
3422  7040           CMA
3423  0405           AND I   WA
3424  3405           DCA I   WA      /OCCUPIED[LOC]:=FALSE
3425  1007     AGMRGE, TAD     CK      /TRY TO MERGE
                     /TAD    (HDMASK
3426  3367           DCA     MPNT
3427  1767           TAD I   MPNT
3430  0375           AND     (777
3431  7450           SNA             /MAXIMUM SIZE??
3432  5267           JMP     INS     /YES
3433  0364           AND     LOC     /EXOR(LOC, HDMASK[CK])
3434  7041           CIA
3435  7104           CLL RAL
3436  1364           TAD     LOC
3437  1767           TAD I   MPNT
3440  3365           DCA     LOCBDY  /ADDRESS BUDDY
3441  1365           TAD     LOCBDY
3442  4776'          JMS     GETBIT
3443  1406           TAD I   BA
3444  0405           AND I   WA
3445  7640           SZA CLA         /BUDDY OCCUPIED?
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```
3446  5267            JMP      INS      /YES.
3447  7305            CLA CLL  IAC RAL
3450  1365            TAD      LOCBDY
3451  3004            DCA      SV
3452  1404            TAD I    SV
3453  7041            CIA
3454  1007            TAD      CK
3455  7640            SZA CLA           /SIZE BUFFER=SIZE BUDDY
3456  5267            JMP      INS      /NO
3457  1365            TAD      LOCBDY
3460  4774'           JMS      DELET    /DELETE BUDDY FROM FREE LIST
3461  1767            TAD I    MPNT
3462  7040            CMA
3463  0365            AND      LOCBDY
3464  3364            DCA      LOC      /LOC:=MINIMUM(LOC, LOCBDY)
3465  2007            ISZ      CK
3466  5225            JMP      AGMRGE
3467  1373  INS,      TAD      (HDFSP
3470  1007            TAD      CK
3471  3006            DCA      SV2
3472  1364            TAD      LOC
3473  4772'           JMS      INSERT   /INSERT BUFFER IN FREE LIST
3474  7000  OUTFBF,   NOP
3475  5600            JMP I    FRBUF

            /CALLLING SEQUENCE:
            /         CDF CUR
            /         TAD      SIZECODE
            /         GETBUF
            /         ERROR
            /         NORMAL RETURN
            /
            /AC    SIZE
            /0        4
            /1       10
            /2       20
            /3       40
            /4      100
            /5      200
            /6      400
            /7     1000
            /
            GETBUF=   JMS I    [.
3476  0000  GETBF,    0
3477  6002            IOF
3500  3366            DCA      SIZE
3501  1366            TAD      SIZE
3502  0371            AND      (7777-MAXSZ
3503  7440            SZA
3504  7402            HLT               /OVERFLOW SIZE
3505  1071            TAD      [CIF
3506  6214            RDF
3507  3362            DCA      OUTGB    /PREPARE A PROPER RETURN
3510  6261            CDF FLD
3511  1366            TAD      SIZE
```

```
3512  3007            DCA     CK        /CURRENT SIZE
3513  1373  SRCHBF,   TAD     (HDFSP
3514  1007            TAD     CK
3515  3367            DCA     MPNT
3516  1767            TAD I   MPNT
3517  7440            SZA               /ANY SPACE?
3520  5327            JMP     GET       /YES
3521  1007            TAD     CK
3522  1370            TAD     (-MAXSZ
3523  7700            SMA CLA           /MAXIMUM SIZE
3524  5362            JMP     OUTGB     /NO SPACE
3525  2007            ISZ     CK
3526  5313            JMP     SRCHBF    /TRY AGAIN
3527  3364  GET,      DCA     LOC       /ADDRESS BUFFER
3530  1364            TAD     LOC
3531  4774'           JMS     DELET     /DELETE BUFFER FROM FREE LIST
3532  1007  SPLIT,    TAD     CK
3533  7041            CIA
3534  1366            TAD     SIZE
3535  7650            SNA CLA           /CORRECT SIZE?
3536  5353            JMP     FIN       /YES
3537  7240            CLA CMA           /DECREMENT SIZE
3540  1007            TAD     CK
3541  3007            DCA     CK
                      /TAD    (HDMASK
3542  1007            TAD     CK
3543  3367            DCA     MPNT      /MASK
3544  1373            TAD     (HDFSP
3545  1007            TAD     CK
3546  3006            DCA     SV2       /SELECT LIST
3547  1364            TAD     LOC
3550  1767            TAD I   MPNT      /SPLIT BUFFER AND
3551  4772'           JMS     INSERT    /INSERT ONE HALF IN FREE LIST
3552  5332            JMP     SPLIT

3553  1364  FIN,      TAD     LOC
3554  4776'           JMS     GETBIT
3555  1406            TAD I   BA
3556  1405            TAD I   WA
3557  3405            DCA I   WA        /OCCUPIED[LOC]:=TRUE
3560  2276            ISZ     GETBF
3561  1364            TAD     LOC
3562  7000  OUTGB,    NOP
3563  5676            JMP I   GETBF

3564  0000  LOC,      0
3565  0000  LOCBDY,   0
3566  0000  SIZE,     0
3567  0000  MPNT,     0

            WA=       SV1
            BA=       SV2
3570  7771
3571  7770
3572  3317
```

```
1999    3573  0020
2000    3574  3344
2001    3575  0777
2002    3576  3303
2003    3577  0007
2004                          PAGE
```

```
            /JOB SECTION

            /THE FOLLOWING CONDITIONS SHOULD HOLD:
            / * PRIORITY JOB>PRIORITY INTERRUPTED JOBS
            /** PRIORITY JOB >= PRIORITY JOB CHAIN

            EXIT=   JMP I   [.
3600  6001  DECIS,  ION             /GIVE CPU THE OPPORTUNITY TO LISTEN
3601  6231  DEC1,   CDF 30          /BUT NOT ALWAYS
3602  7300          CLA CLL
3603  6002          IOF
3604  3051          DCA     LOOK
3605  1777          TAD I   (JOBCH
3606  7450          SNA             /ANY JOBS?
3607  5574          REACTIVATE      /NO
3610  3013          DCA     SPN
3611  1413          TAD I   SPN
3612  0376          AND     (MSKPR
3613  3300          DCA     PCP     /PRIORITY JOB CHAIN
3614  1012          TAD     STACKP
3615  3004          DCA     SV
3616  1404          TAD I   SV
3617  0376          AND     (MSKPR  /PRIORITY INTERRUPT STACK
3620  7040          CMA
3621  1300          TAD     PCP
3622  7710          SPA CLA         /PRIOR. JOB CHAIN>PRIOR. INTERRUPT
3623  5574          REACTIVATE      /NO
                                                                   STACK?
3624  7344  NEXTJB, CLA CLL CMA RAL /AC:=-2
3625  1013          TAD     SPN
3626  3013          DCA     SPN
3627  1413          TAD I   SPN
3630  3777          DCA I   (JOBCH
3631  1300          TAD     PCP
3632  1375          TAD     (TAILS
3633  3355          DCA     LTAIL
3634  1013          TAD     SPN
3635  7041          CIA
3636  1755          TAD I   LTAIL
3637  7640          SZA CLA         /RESET TAIL[PCP]?
3640  5246          JMP     .+6     /NO
3641  1300          TAD     PCP
3642  1374          TAD     (-MAXPR
3643  7650          SNA CLA
3644  1377          TAD     (JOBCH
3645  3755          DCA I   LTAIL

            /IF AANTAL JOBS(PCP) =0 THEN
            /       (IF PCP=MAX PRIORITY THEN TAIL[PCP]:=LOC(HEADL)
            /        ELSE                   TAIL[PCP]:=0
            /       )

3646  1413          TAD I   SPN
3647  7510          SPA             /ERROR JSW
3650  7402          HLT             /YES
3651  3021          DCA     JSW     /JOB STATUS WORD
```

```
3652  1413                TAD I   SPN
3653  3356                DCA     SAJOB   /START ADDRESS
3654  1413                TAD I   SPN
3655  3024                DCA     DATAPN  /DATA POINTER
3656  7346                CLA CLL CMA RTL
3657  1013                TAD     SPN
3660  4504                JMS I   [FREEND /RETURN TO FREE LIST
3661  6201                CDF 0           /FOR CANCEL
3662  7325                CLA CLL CML IAC RAL      /3
3663  0021                AND     JSW
3664  7650                SNA CLA
3665  1053                TAD     CANCEL
3666  7640                SZA CLA
3667  4773'               JMS     ER
3670  1021                TAD     JSW
3671  0070                AND     [70     /FIELD OF JOB
3672  1067                TAD     [CIF CDF
3673  3274                DCA     .+1
3674  6203                CDF CIF
3675  7300                CLA CLL
3676  6001                ION
3677  5756                JMP I   SAJOB

3700  0000   PCP,         0

             MAKE=JMS I [.
             JOB=0
3701  0000   MAKEJB,      0
3702  6231                CDF 30
3703  4306                JMS     CRNODE  /CREATE A NODE
3704  4323                JMS     INNODE  /INSERT THE NODE IN THE JOB CHAIN
3705  5701                JMP I   MAKEJB

3706  0000   CRNODE,      0
3707  3356                DCA     SAJOB
3710  4565                GETNODE
3711  3013                DCA     SPN
3712  1022                TAD     JSWMJ
3713  3413                DCA I   SPN     /JOB STATUS WORD
3714  1356                TAD     SAJOB
3715  3413                DCA I   SPN     /ADDRESS JOB
3716  1023                TAD     DTPNMJ
3717  3413                DCA I   SPN     /DATA POINTER
3720  7346                CLA CMA CLL RTL
3721  1013                TAD     SPN     /ADDRESS OF THE NODE
3722  5706                JMP I   CRNODE

3723  0000   INNODE,      0               /INSERT A NODE
3724  2051                ISZ     LOOK
3725  3004                DCA     SV      /SAVE ADDRESS OF THE NODE
3726  1022                TAD     JSWMJ
3727  7510                SPA
3730  7402                HLT             /ERROR IN JSW
3731  0376                AND     (MSKPR  /PRIORITY JOB
3732  1375                TAD     (TAILS
3733  3355          DCA     LTAIL
3734  1755          TAD I   LTAIL   /POINTER DEFINED?
3735  7440          SZA
3736  5344          JMP     GETTL   /YES
3737  1355          TAD     LTAIL   /NO, SEARCH
3740  3013          DCA     SPN
3741  1413          TAD I   SPN     /AUTO INDEXER
3742  7450          SNA
3743  5341          JMP     .-2
3744  3354  GETTL,  DCA     POETS   /ENTRY POINT JOB CHAIN
3745  1754          TAD I   POETS   /INSERT NODE IN JOB CHAIN
3746  3404          DCA I   SV      /POINTS TO NEXT JOB
3747  1004          TAD     SV
3750  3754          DCA I   POETS
3751  1004          TAD     SV
3752  3755          DCA I   LTAIL   /RESET ENTRYPOINT JOB CHAIN[PRIORITY JOB]
3753  5723          JMP I   INNODE

3754  0000  POETS,  0
3755  0000  LTAIL,  0
3756  0000  SAJOB,  0
3773  5263
3774  7775
3775  0030
3776  4003
3777  0200
                    PAGE
                    REACTIVATE=JMP I          [.
     4000  7300     UNSTACK,CLA CLL           /RESTORE STATUS AFTER INTERRUPT
     4001  6231             CDF 30
     4002  1076             TAD       [-5
     4003  1012             TAD       STACKP
     4004  3012             DCA       STACKP
     4005  1412             TAD I     STACKP
     4006  3062             DCA       SVLINK  /LINK, IF, DF
     4007  1412             TAD I     STACKP
     4010  3061             DCA       SVAC    /SAVE AC
     4011  1412             TAD I     STACKP
     4012  3000             DCA       0       /PC
     4013  1412             TAD I     STACKP
     4014  3024             DCA       DATAPN  /DATA POINTER
     4015  1412             TAD I     STACKP
     4016  3021             DCA       JSW     /JOB STATUS WORD
     4017  1076             TAD       [-5
     4020  1012             TAD       STACKP
     4021  3012             DCA       STACKP  /DECREASE STACK POINTER
     4022  4777'            JMS       TSTCAN  /TEST CANCEL FLAG
     4023  1062             TAD       SVLINK
     4024  0070             AND       [70
     4025  1071             TAD       [CIF
     4026  3227             DCA       .+1
     4027  6202             CIF               /RESTORE INSTRUCTION FIELD
     4030  1062             TAD       SVLINK
     4031  7006             RTL
     4032  7004             RAL
     4033  0070             AND       [70
     4034  1066             TAD       [CDF
     4035  3236             DCA       .+1
     4036  6201             CDF               /RESTORE DATA FIELD
     4037  1062             TAD       SVLINK
     4040  7104             CLL RAL           /RESTORE LINK
     4041  7200             CLA
     4042  1061             TAD       SVAC    /AND AC
     4043  6001             ION
     4044  5400             JMP I     0

     4045  6001     EXKI,   ION
     4046  6272             CIF 70            /PREVENT INTERRUPTS
     4047  7300             CLA CLL
     4050  6244             RMF               /RESTORE IF, DF
     4051  1062             TAD       SVLINK
     4052  7004             RAL               /RESTORE LINK
     4053  1061             TAD       SVAC
     4054  5400             JMP I     0

     4055  3061     INSPEC, DCA       SVAC    /SAVE AC
     4056  7010             RAR
     4057  3062             DCA       SVLINK  /AND LINK
     4060  6234             RIB               /READ INTERRUPT BUFFER
     4061  0070             AND       [70
     4062  1066             TAD       [CDF
     4063  3264             DCA       .+1
```

```
4064  6201          CDF
4065  1400          TAD I   0        /NEXT INSTRUCTION TO BE EXECUTED IOF?
4066  1376          TAD     (-IOF
4067  7650          SNA CLA
4070  5246          JMP     EXKI+1   /DO NOT TURN ON IE
4071  3022          DCA     JSWMJ    /NO
4072  6421          T1SKP
4073  7410          SKP
4074  5775          JMP I   (T1S     /MULTIPLEXER
4075  6301          BUX2
4076  7410          SKP
4077  5774          JMP I   (XP2     /XP2 FLAG
4100  6331          BUP2
4101  7410          SKP
4102  5773          JMP I   (PX2     /PX2 FLAG
4103  6311          BUX7
4104  7410          SKP
4105  5772          JMP I   (X7S     /XP7 FLAG
4106  6341          BUP7
4107  7410          SKP
4110  5771          JMP I   (P7S     /PX7 FLAG
4111  6623          6623
4112  7410          SKP
4113  4770'         JMS     RF08     /DISK
4114  6031          KSF
4115  7410          SKP
4116  4767          JMS I   (KB      /KEYBOARD
4117  6041          TSF
4120  7410          SKP
4121  4766          JMS I   (TTY     /TELETYPE
4122  6771          DTSF
4123  7410          SKP
4124  4765          JMS I   (DTA     /DECTAPE
4125  6071          SRF
4126  7410          SKP
4127  4764'         JMS     SCOPE    /SCOPE
4130  6501          PLSF
4131  7410          SKP
4132  5763'         JMP     PLOTR    /PLOTTER
4133  6011          RSF
4134  7410          SKP
4135  5762'         JMP     HSR      /HIGH SPEED READER
4136  6021          PSF
4137  7410          SKP
4140  5761'         JMP     HSP      /HIGH SPEED PUNCH
4141  6254          SINT             /USER INTERRUPT?
4142  7410          SKP
4143  5355          JMP     CLEARU   /ALMOST IMPOSSIBLE
4144  6051          SNC
4145  5353          JMP     CLEAR    /CURSOR
4146  6374          RIS              /READ INTERRUPT STATUS
4147  7510          SPA              /INTERRUPT PENDING?
4150  7412          HLT SKP          /YES, STRANGE DEVICE
4151  4760'         JMS     ER       /NO, SOFTWARE ERROR
4152  5245          JMP     EXKI
```

```
2252
2253   4153  6052  CLEAR,  CCF                 /CLEAR CURSOR FLAG
2254   4154  5245          JMP     EXKI
2255
2256   4155  6204  CLEARU, CINT
2257   4156  4567          INITIR
2258   4157  4760'         JMS     ER
2259   4160  5263
2260   4161  4473
2261   4162  4532
2262   4163  4430
2263   4164  4535
2264   4165  4544
2265   4166  4444
2266   4167  4711
2267   4170  4453
2268   4171  3031
2269   4172  3000
2270   4173  1600
2271   4174  2000
2272   4175  2200
2273   4176  1776
2274   4177  4217
2275                       PAGE
```

```
                    SAVE=   JMS I   [.
4200  0000  STACK,  0               /SAVE STATUS AFTER INTERRUPT
4201  6231          CDF 30
4202  7300          CLA CLL
4203  1062          TAD     SVLINK
4204  6234          RIB
4205  3412          DCA I   STACKP  /LINK, INSTRUCTION FIELD, DATA FIELD
4206  1061          TAD     SVAC
4207  3412          DCA I   STACKP  /AC
4210  1000          TAD     0
4211  3412          DCA I   STACKP  /PROGRAM COUNTER
4212  1024          TAD     DATAPN
4213  3412          DCA I   STACKP  /DATA POINTER
4214  1021          TAD     JSW
4215  3412          DCA I   STACKP  /JOB STATUS WORD
4216  5600          JMP I   STACK

4217  0000  TSTCAN, 0
4220  7325          AC3
4221  0021          AND     JSW     /MASK PRIORITY
4222  7640          SZA CLA
4223  5617          JMP I   TSTCAN  /DONT CANCEL ANY JOB
4224  1053          TAD     CANCEL  /EXCEPT PRIORITY 0
4225  7650          SNA CLA
4226  5617          JMP I   TSTCAN
4227  3053          DCA     CANCEL  /CLEAR CANCEL FLAG
4230  4777'         JMS     ER      /REPORT

4231  0000  TODISK, 0               /CALLED BY FILLR IF XLINE IS SET
4232  7305          AC2
4233  3022          DCA     JSWMJ
4234  1456          TAD I   MCHAR   /GET CHAR
4235  3023          DCA     DTPNMJ  /SAVE
4236  3456          DCA I   MCHAR   /CLEAR, IT DOESNT GO TO THE TERMINAL
4237  1376          TAD     (TDSK   /BUT TO THE DISK
4240  4573          MAKE JOB
4241  5631          JMP I   TODISK

4242  1024  TDSK,   TAD     DATAPN  /GET CHAR
4243  6201          CDF 0           /ENABLE PROPER RETURN
4244  6212          CIF 10          /START UP THE PROGRAM THAT ASKED FOR IT
4245  4775          JMS I   (ROCHAR /BY CHANGING XLINE
4246  5576          EXIT            /READY
            ROCHAR= 3200
4375  3200
4376  4242
4377  5263
                    PAGE
```

```
                      IFNZRO .-4400 <THIS IS AN ASSEMBLY ERROR>
4400  0000  PLOUT,    0                   /CALLED BY ANY PROGRAM
4401  6002            IOF                 /CRITICAL
4402  3244            DCA      PLTEM      /AC CONTAINS PLOTINSTRUCTIONS
4403  1234            TAD      PLINS
4404  7640            SZA CLA
4405  4777'           JMS      ER         /SOMEONE ELSE IS PLOTTING
4406  1200            TAD      PLOUT
4407  3243            DCA      PLEX+2     /SAVE RETURN ADDRESS
4410  1244            TAD      PLTEM
4411  7112            CLL RTR
4412  7012            RTR
4413  7012            RTR
4414  0376            AND      (77
4415  1375            TAD      (6500
4416  3235            DCA      PLINS+1 /SECOND INSTRUCTION
4417  1244            TAD      PLTEM
4420  0376            AND      (77
4421  7440            SZA                 /ZERO IF END OF PLOTTING
4422  1375            TAD      (6500
4423  3234            DCA      PLINS      /FIRST INSTRUCTION
4424  6214            RDF
4425  1067            TAD      [CIF CDF
4426  3241            DCA      PLEX       /RETURN
4427  5576            EXIT

4430  6502  PLOTR,    PLCF
4431  1234            TAD      PLINS
4432  7650            SNA CLA             /SOMETHING TO PLOT?
4433  5575            EXITSI              /KILL THE PLOTTING PROG
                                          /OR IGNORE INTERRUPT
4434  0000  PLINS,    0;0
4435  0000
4436  3234            DCA      PLINS
4437  7001            IAC                 /THIS IS ALLOWABLE ONLY IF THE PLOTTING
                                          /PROGRAM TAKES VIRTUALLY NO TIME TO
                                          /COMPUTE ITS NEXT INSTRUCTION
4440  4567            INITIR
4441  6203  PLEX,     CDF CIF
4442  5643            JMP I    .+1
4443  0000            0

            PLTEM=    .
4444  0000  TTY,      0
4445  6374            RIS                 /READ INTERRUPT STATUS
4446  0073            AND      [1000
4447  7650            SNA CLA             /WAS FLAG ENABLED TO INTERRUPT BUS
4450  5644            JMP I    TTY        /NO, SOMEONE ELSE CAUSED THE INTERRUPT
4451  6042            TCF                 /YES, CLEAR FLAG
4452  5575            EXITSI

4453  0000  RF08,     0
4454  6616            6616                /READ STATUS
4455  0374            AND      (700
4456  7650            SNA CLA             /ANY INTERRUPT ENABLED?
```

```
4457  5653              JMP I    RF08       /NO, THIS INTERRUPT WAS NOT CAUSED
4460  6621              6621                                        BY THE D SK
4461  7410              SKP
4462  5266              JMP      RF08ER
4463  6611              6611
4464  6601              6601                /CLEAR ALL FLAGS
4465  5575              EXITSI
4466  6611   RF08ER,    6611
4467  6601              6601
4470  7200              CLA
4471  4567              INITIR
4472  4777'             JMS      ER

4473  6022   HSP,       PCF
4474  4567              INITIR              /EXITSI
4475  6203   PUEX,      CDF CIF  0
4476  5700              JMP I    PUNCH

                        IFZERO .-4500^4000 <ASSEMBLY ERROR!>
                        *4500
4500  2236   PUNCH,     EXITKI              /THE FLAG MIGHT HAVE BEEN UP WHEN WE
4501  6002              IOF                                                STARTED
4502  6026              PLS
4503  7200              CLA
4504  6214              RDF
4505  1067              TAD      [CIF CDF
4506  3275              DCA      PUEX
4507  5576              EXIT

                        IFNZRO .-4510 <ASSEMBLY ERROR!!>
4510  2236   READ,      EXITKI
4511  7240              CLA CMA
4512  3331              DCA      RCHAR
4513  3330              DCA      RTIM
4514  6014              RFC                 /IF THE CHAR IS PRESENT ALREADY
                                            /THIS CAUSES AN INTERRUPT IMMEDIATELY
4515  7200   RDLP,      CLA
4516  6214              RDF
4517  1067              TAD      [CIF CDF
4520  3326              DCA      REEX
4521  1331              TAD      RCHAR
4522  7500              SMA                 /STILL NEGATIVE?
4523  5326              JMP      REEX       /NO, WEVE GOT IT
4524  2330              ISZ      RTIM
4525  5315              JMP      RDLP       /CONTINUE WAITING
4526  6203   REEX,      CDF CIF  0
4527  5710              JMP I    READ

4530  0000   RTIM,      0
4531  0000   RCHAR,     0

4532  6012   HSR,       RRB
4533  3331              DCA      RCHAR
4534  55/5              EXITSI
```

```
2434    4535  0000  SCOPE,  0
2435    4536  63/4          RIS
2436    4537  0117          AND     [400
2437    4540  7650          SNA CLA
2438    4541  5735          JMP I   SCOPE
2439    4542  6072          CRF
2440    4543  5575          EXITSI
2441
2442    4544  0000  DTA,    0
2443    4545  6761          DTRA
2444    4546  0373          AND     (4
2445    4547  7650          SNA CLA
2446    4550  5744          JMP I   DTA
2447    4551  1163          TAD     [7
2448    4552  6764          DTXA
2449    4553  55/5          EXITSI
2450    4573  0004
2451    4574  0700
2452    4575  6500
2453    4576  0077
2454    4577  5263
2455                        PAGE
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2456   4600  0000  INUSER, 0
2457   4601  7201          CLA IAC
2458   4602  6366          KIE TIE
2459   4603  6201          CDF 00
2460   4604  6212          CIF 10
2461   4605  4777          JMS I   (7700
2462   4606  0002          2               /LOOKUP
2463   4607  5326  US0,    USER            /OWN VERSION OF USER SERVICE ROUTINE
2464   4610  0000          0
2465   4611  4305          JMS     EXUS    /NOT FOUND
2466   4612  7201          CLA IAC
2467   4613  6212          CIF 10
2468   4614  4777          JMS I   (7700
2469   4615  0002          2               /LOOKUP
2470   4616  5322  US1,    CDEC            /OWN VERSION OF COMMAND DECODER
2471   4617  0000          0
2472   4620  4305          JMS     EXUS
2473   4621  1207          TAD     US0
2474   4622  7001          IAC
2475   4623  6211          CDF 10
2476   4624  3776          DCA I   (7725   /TELL THE SYSTEM WHERE TO FIND THIS USR
2477   4625  6201          CDF 00
2478   4626  7327          CLA CLL CML IAC RTL
2479   4627  4572          GETBUF
2480   4630  7402          HLT
2481   4631  3240          DCA     US2
2482   4632  1207          TAD     US0
2483   4633  7001          IAC
2484   4634  3241          DCA     US2+1
2485   4635  6203          CIF CDF 00
2486   4636  4775          JMS I   (7607   /SWAP USR IN
2487   4637  0230          0230
2488   4640  0000  US2,    0
2489   4641  0000          0
2490   4642  4305          JMS     EXUS    /INPUT ERROR
2491   4643  6231          CDF 30
2492   4644  1240          TAD     US2
2493   4645  1374          TAD     (267
2494   4646  3327          DCA     RDPTR
2495   4647  1216          TAD     US1
2496   4650  7001          IAC
2497   4651  3727          DCA I   RDPTR   /NOTE PLACE OF COMMAND DECODER
2498   4652  1240          TAD     US2
2499   4653  3261          DCA     US3
2500   4654  1241          TAD     US2+1
2501   4655  3262          DCA     US3+1
2502   4656  6203          CIF CDF 00
2503   4657  4775          JMS I   (7607   /SWAP USR BACK
2504   4660  4230          4230
2505   4661  0000  US3,    0
2506   4662  0000          0
2507   4663  4305          JMS     EXUS    /OUTPUT ERROR
2508   4664  1240          TAD     US2
2509   4665  4571          FREEBUF
2510   4666  0006          6
```

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4667  1373          TAD    (7604   /NEW SYS HANDLER
4670  3011          DCA    11
4671  1372          TAD    (PATCH-1
4672  3010          DCA    10
4673  6201          CDF 00
4674  1410          TAD I  10
4675  3411          DCA I  11
4676  2330          ISZ    SCNTR
4677  5274          JMP    .-3
4700  3771          DCA I  (RDCOMM
4701  1370          TAD    (JMP I [RDCOMM/PROTECTION AGAINST STARTING A
4702  3767          DCA I  (INIT   /AT 200
                                                        PROGRAM
4703  3325          DCA    MODKB
4704  7410          SKP
4705  0000  EXUS,   0
4706  2054          ISZ    LISTEN
4707  6362          KIE
4710  5600          JMP I  INUSER

4711  0000  KB,     0
4712  6374          RIS
4713  0366          AND    (2000
4714  7650          SNA CLA
4715  5711          JMP I  KB
4716  6036          KRB
4717  1365          TAD    (-203
4720  7650          SNA CLA
4721  1054          TAD    LISTEN
4722  7650          SNA CLA
4723  5575          EXITSI
4724  4567          INITIR
4725  4764' MODKB,  JMS    ER
4726  5771'         JMP    RDCOMM

4727  0000  RDPTR,  0
4730  7643  SCNTR,  PATCH-SPEND
4764  5263
4765  7575
4766  2000
4767  0200
4770  5465
4771  5000
4772  5377
4773  7604
4774  0267
4775  7607
4776  7725
4777  7700
                    PAGE
```

```
5000  5576  RDCOMM, EXIT
5001  6361          KTID
5002  3054          DCA     LISTEN
5003  6201          CDF 0
5004  1777          TAD I   (PLINS   /ARE WE PLOTTING?
5005  7650          SNA CLA
5006  6371          SCID             /NO, DISABLE SCOPE, CURSOR AND PLOTTER
                                     /FROM INTERRUPT BUS
5007  3021          DCA     JSW
5010  6212          CIF 10
5011  4776          JMS I   (7700
5012  0010          10
5013  6212          CIF 10
5014  4776          JMS I   (7700    /TRICK
5015  0010          10
5016  4775' RDN,    JMS     CRL
5017  1374          TAD     (300
5020  4773'         JMS     PRINT
5021  4306          JMS     RDNAME
5022  3227          DCA     BLI
5023  6212          CIF 10
5024  7201          CLA IAC
5025  4464          JMS I   [200
5026  0002          2                /LOOKUP
5027  0000  BLI,    0
5030  0000          0
5031  4772'         JMS     ER
5032  1227          TAD     BLI
5033  3237          DCA     BLO
5034  6212          CIF 10
5035  4464          JMS I   [200
5036  0006          6                /CHAIN
5037  0000  BLO,    0

5040  2054  EXA,    ISZ     LISTEN
5041  6362          KIE
5042  5576          EXIT             /RETURN TO THE BACKGROUND PROGRAM

5043  0000  NM0,    0
5044  0000  NM1,    0
5045  0000  NM2,    0
5046  2524  NM3,    2524    /.UT EXTENSION

5047  0000  GETCH,  0
5050  4771'         JMS     RESYM
5051  1370          TAD     (-203
5052  7450          SNA
5053  5240          JMP     EXA
5054  1367          TAD     (-340+203
5055  7100          CLL
5056  1366          TAD     (100
5057  7420          SNL
5060  5264          JMP     GET1
5061  1365          TAD     (-40
5062  0364          AND     (77
5063  5647            JMP I   GETCH
5064  1363  GET1,     TAD     (240-215
5065  7650            SNA CLA
5066  5303            JMP     RD2EX
5067  1362            TAD     ("?
5070  4773'           JMS     PRINT
5071  5216            JMP     RDN

5072  0000  RD2,      0
5073  3305            DCA     NM
5074  4247            JMS     GETCH
5075  7106            CLL RTL
5076  7006            RTL
5077  7006            RTL
5100  3305            DCA     NM
5101  4247            JMS     GETCH
5102  7100            CLL
5103  1305  RD2EX,    TAD     NM
5104  5672            JMP I   RD2

5105  0000  NM,       0

5106  0000  RDNAME,   0
5107  3243            DCA     NM0
5110  3244            DCA     NM1
5111  3245            DCA     NM2
5112  42/2            JMS     RD2
5113  3243            DCA     NM0
5114  7430            SZL
5115  5331            JMP     EONAME
5116  4272            JMS     RD2
5117  3244            DCA     NM1
5120  7430            SZL
5121  5331            JMP     EONAME
5122  4272            JMS     RD2
5123  3245            DCA     NM2
5124  7430            SZL
5125  5331            JMP     EONAME
5126  4272            JMS     RD2
5127  7620            SNL CLA
5130  5326            JMP     .-2       /WAIT FOR CR
5131  4775' EONAME,   JMS     CRL
5132  1361            TAD     (NM0
5133  5706            JMP I   RDNAME
5161  5043
5162  0277
5163  0023
5164  0077
5165  7740
5166  0100
5167  7643
5170  7575
5171  52/6
5172  5263
5173  5200
```

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2670   5174  0300
2671   5175  5206
2672   5176  7700
2673   5177  4434
2674                         PAGE
```

```
5200  0000  PRINT,  0
5201  6046          TLS
5202  6041          TSF
5203  5202          JMP     .-1
5204  7200          CLA
5205  5600          JMP I   PRINT

5206  0000  CRL,    0
5207  1377          TAD     (215
5210  6201          CDF 00
5211  4200          JMS     PRINT
5212  1376          TAD     (212
5213  4200          JMS     PRINT
5214  5606          JMP I   CRL

5215  0000  PROK,   0
5216  3236          DCA     NUMB
5217  1375          TAD     (-4
5220  3237          DCA     PCTR
5221  1236  PRO,    TAD     NUMB
5222  7004          RAL
5223  7006          RTL
5224  3236          DCA     NUMB
5225  1236          TAD     NUMB
5226  7004          RAL
5227  0374          AND     (7
5230  1373          TAD     (260
5231  6201          CDF 00
5232  4200          JMS     PRINT
5233  2237          ISZ     PCTR
5234  5221          JMP     PRO
5235  5615          JMP I   PROK

5236  0000  NUMB,   0
5237  0000  PCTR,   0

5240  6361  ERROR,  KTID
5241  4206          JMS     CRL
5242  1372          TAD     ("E
5243  6201          CDF 00
5244  4200          JMS     PRINT
5245  1371          TAD     ("R
5246  6201          CDF 00
5247  4200          JMS     PRINT
5250  1370          TAD     (240
5251  6201          CDF 00
5252  4200          JMS     PRINT
5253  1024          TAD     DATAPN
5254  4215          JMS     PROK
5255  6002          IOF
5256  3022          DCA     JSWMJ
5257  6201          CDF 00
5260  1367          TAD     (RDCOMM
5261  4573          MAKE JOB
5262  5576          EXIT
```

```

5263  0000  ER,      0
5264  7200           CLA
5265  6201           CDF 0
5266  3053           DCA     CANCEL
5267  6002           IOF
5270  1263           TAD     ER
5271  3023           DCA     DTPNMJ
5272  3022           DCA     JSWMJ
5273  1366           TAD     (ERROR
5274  4573           MAKE JOB
5275  5576           EXIT

5276  0000  RESYM,   0
5277  6001           ION
5300  3320           DCA     ECHOFG
5301  6214           RDF
5302  1365           TAD     (CIF CDF
5303  3315           DCA     RESEX
5304  6031           KSF
5305  5304           JMP     .-1
5306  6036           KRB
5307  3321           DCA     RECHAR
5310  1321           TAD     RECHAR
5311  2320           ISZ     ECHOFG
5312  4200           JMS     PRINT
5313  7200           CLA
5314  1321           TAD     RECHAR
5315  6203  RESEX,   CDF CIF
5316  6001           ION
5317  5676           JMP I   RESYM
5320  0000  ECHOFG,  0
5321  0000  RECHAR,  0

5322  0304  CDEC,    FILENA CDECLT.SU
5323  0503
5324  1424
5325  2325
5326  2523  USER,    FILENA USER.SU
5327  0522
5330  0000
5331  2325

5365  6203
5366  5240
5367  5000
5370  0240
5371  0322
5372  0305
5373  0260
5374  0007
5375  7774
5376  0212
5377  0215
                     PAGE
```

```
            /OWN VERSION OF PS/8 SYSTEM HANDLER
            PATCH=  .
                    NOPUNC
                    *7605
                    ENPUNC

            SHNDLR= 7607
            SOFSET= 7747
            SWC=    SHNDLR-7+150
            SCA=    SHNDLR-7+151
7605  5606  MON,    JMP I   .+1
7606  5000          RDCOMM
7607  0000  SHNDLR, 0
7610  7346          CLA CLL CMA RTL
7611  3330          DCA     SYSCNT
7612  1607  STRY,   TAD I   SHNDLR
7613  7004          RAL
7614  7206          CLA RTL
7615  1312          TAD     S6603
7616  3273          DCA     SFUN
7617  1607          TAD I   SHNDLR
7620  0315          AND     S70
7621  3306          DCA     SFIELD
7622  1607          TAD I   SHNDLR
7623  7004          RAL
7624  0256          AND     S7600
7625  7041          CIA
7626  3350          DCA     SWC
7627  7240          CLA CMA
7630  2207          ISZ     SHNDLR
7631  1607          TAD I   SHNDLR
7632  3351          DCA     SCA
7633  1273          TAD     SFUN
7634  7012          RTR
7635  7620          SNL CLA
7636  5253          JMP     SGOED
7637  1306          TAD     SFIELD
7640  7640          SZA CLA
7641  5253          JMP     SGOED
7642  1314          TAD     S2201
7643  1351          TAD     SCA
7644  7630          SZL CLA
7645  4713          JMS I   SERR
7646  1350          TAD     SWC
7647  7041          CIA
7650  1351          TAD     SCA
7651  7630          SZL CLA
7652  4713          JMS I   SERR
7653  2207  SGOED,  ISZ     SHNDLR
7654  1306          TAD     SFIELD
7655  6615          6615
7656  7600  S7600,  7600
7657  1607          TAD I   SHNDLR
7660  1347          TAD     SOFSET
7661  7012          RTR
```

```
7662  7012             RTR
7663  0316             AND       S377
7664  6643             6643
7665  1607             TAD I     SHNDLR
7666  1347             TAD       SOFSET
7667  7012             RTR
7670  7012             RTR
7671  7010             RAR
7672  0331             AND       S7400
7673  6603  SFUN,      6603
7674  6214             RDF
7675  1311             TAD       SCDIF
7676  3306             DCA       SFIELD
7677  6623             6623
7700  5277             JMP       .-1
7701  2207             ISZ       SHNDLR
7702  6621             6621
7703  7410             SKP
7704  5332             JMP       SERROR
7705  2207             ISZ       SHNDLR
7706  6203  SFIELD,    CIF CDF
7707  6601             6601
7710  5607             JMP I     SHNDLR
7711  6203  SCDIF,     CDF CIF
7712  6603  S6603,     6603
7713  5263  SERR,      ER
7714  2201  S2201,     2201
7715  0070  S70,       70
7716  0377  S377,      377
7717  0500  S500,      500

            BOOT=      7720
7720  1256  BOOT,      TAD       S7600
7721  3350             DCA       SHNDLR-7+150
7722  1312             TAD       S6603
7723  3351             DCA       SHNDLR-7+151
7724  6603             6603
7725  6622             6622
7726  5325             JMP       .-1
7727  5725             JMP I     .-2

7730  7775  SYSCNT,    -3
7731  7400  S7400,     7400

            SERROR,
7732  7330             CLA CLL   CML RAR
7733  2330             ISZ       SYSCNT
7734  7610             SKP CLA
7735  5306             JMP       SFIELD
7736  7346             CLA CLL   CMA RTL
7737  1207             TAD       SHNDLR
7740  3207             DCA       SHNDLR
7741  5212             JMP       STRY
            SPEND=     .+PATCH-MON
```

```
2894
2895     0064   0200
2896     0065   5000
2897     0066   6201
2898     0067   6203
2899     0070   0070
2900     0071   6202
2901     0072   1672
2902     0073   1000
2903     0074   0452
2904     0075   3236
2905     0076   7773
2906     0077   2400
2907     0100   2550
2908     0101   7400
2909     0102   4045
2910     0103   1200
2911     0104   3141
2912     0105   7740
2913     0106   7770
2914     0107   0757
2915     0110   0361
2916     0111   0205
2917     0112   7774
2918     0113   0211
2919     0114   0644
2920     0115   7771
2921     0116   0600
2922     0117   0400
2923     0120   0201
2924     0121   0177
2925     0122   0347
2926     0123   0745
2927     0124   0440
2928     0125   0217
2929     0126   0203
2930     0127   0014
2931     0130   7764
2932     0131   0270
2933     0132   3200
2934     0133   0446
2935     0134   0012
2936     0135   7563
2937     0136   0323
2938     0137   0020
2939     0140   0417
2940     0141   0307
2941     0142   0005
2942     0143   3100
2943     0144   0275
2944     0145   0302
2945     0146   0254
2946     0147   2426
2947     0150   0300
2948     0151   3035
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0152  0243
0153  0224
0154  0263
0155  0236
0156  0010
0157  7500
0160  0427
0161  0231
0162  0377
0163  0007
0164  2353
0165  3120
0166  2146
0167  2121
0170  4200
0171  3400
0172  3476
0173  3701
0174  4000
0175  2236
0176  3600
0177  4055
                    FIELD 3
            /DATA FIELD 3

                    *HDADSP
0000  0000          ZBLOCK 200

            /POINTERS TO FREE SPACE
                    *HDFSP
0020  0000          0
0021  0000          0
0022  0000          0
0023  0000          0
0024  0000          0
0025  0000          0
0026  0000          0
0027  2000          2000

                    *HDMASK
0000  0004          0004
0001  0010          0010
0002  0020          0020
0003  0040          0040
0004  0100          0100
0005  0200          0200
0006  0400          0400
0007  1000          1000

            /LIST OF FREE AREAS
            /       SIZE=7
                    *2000
2000  3000          3000
2001  0027          HDFSP+7
2002  0007          7
```

```
3004                            *3000
3005    3000   4000             4000
3006    3001   2000             2000
3007    3002   0007             7
3008                            *4000
3009    4000   5000             5000
3010    4001   3000             3000
3011    4002   0007             7
3012                            *5000
3013    5000   0000             0000
3014    5001   4000             4000
3015    5002   0007             7
3016                   /UP FROM 6000 CORE IS USED BY THE PLOTTING ROUTINES
3017
3018
3019                   /ENTRY POINTS JOB CHAIN[0:MAXPR]
3020                            *TAILS
3021    0030   0000             0
3022    0031   0000             0
3023    0032   0000             0
3024    0033   0200             JOBCH
3025
3026                            *JOBCH
3027    0200   0000             0                   /POINTS TO FIRST WAITING JOB
3028
3029                   /SPECIAL CHARACTERS
3030                            *HDTRB
3031    0760   0137             0137                /UL
3032    0761   0174             0174                /BAR
3033    0762   0215             215                 /CR
3034
3035                            *HDMS
3036    0763   1016    MSPT,    BEL-1
3037    0764   1106             ZOM-1
3038    0765   1076             ROM-1
3039    0766   1023             OK-1
3040    0767   1035             HOCR-1
3041    0770   1064             ZSCLO-1
3042    0771   1051             RSCLO-1
3043    0772   1136             QUEST-1
3044    0773   1126             NOPT-1
3045    0774   1116             ACX8-1
3046    0775   1144             DUPL-1
3047    0776   1162             BIPL-1
3048    0777   1200             SINGL-1
3049    1000   1021             CRLF-1
3050    1001   7775    MSNR,    -3
3051    1002   7770             -10
3052    1003   7770             -10
3053    1004   7766             -12
3054    1005   7764             -14
3055    1006   7766             -12
3056    1007   7765             -13
3057    1010   7772             -6
3058    1011   7770             -10
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3059    1012  7770            -10
3060    1013  7762            -16
3061    1014  7762            -16
3062    1015  7762            -16
3063    1016  7776            -2
3064
3065    1017  0207  BEL,      207
3066    1020  0207            207
3067    1021  0207            207
3068    1022  0215  CRLF,     215
3069    1023  0012            012
3070    1024  0024  OK,       024
3071    1025  0223            223
3072    1026  0215            215
3073    1027  0012            012
3074    1030  0216            216
3075    1031  0300            300
3076    1032  0317            317
3077    1033  0113            113
3078    1034  0215            215
3079    1035  0012            012
3080    1036  0024  HOOR,     024
3081    1037  0223            223
3082    1040  0215            215
3083    1041  0012            012
3084    1042  0017            017
3085    1043  0300            300
3086    1044  0110            110
3087    1045  0317            317
3088    1046  0317            317
3089    1047  0322            322
3090    1050  0215            215
3091    1051  0012            012
3092    1052  0215  RSOLO,    215
3093    1053  0012            012
3094    1054  0017            017
3095    1055  0300            300
3096    1056  0123            123
3097    1057  0317            317
3098    1060  0314            314
3099    1061  0317            317
3100    1062  0215            215
3101    1063  0012            012
3102    1064  0216            216
3103    1065  0215  ZSOLO,    215
3104    1066  0012            012
3105    1067  0216            216
3106    1070  0300            300
3107    1071  0123            123
3108    1072  0317            317
3109    1073  0314            314
3110    1074  0317            317
3111    1075  0215            215
3112    1076  0012            012
3113    1077  0215  ROM,      215
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3114    1100  0012            012
3115    1101  0017            017
3116    1102  0300            300
3117    1103  0317            317
3118    1104  0115            115
3119    1105  0215            215
3120    1106  0012            012
3121    1107  0215  ZOM,      215
3122    1110  0012            012
3123    1111  0216            216
3124    1112  0300            300
3125    1113  0317            317
3126    1114  0115            115
3127    1115  0215            215
3128    1116  0012            012
3129    1117  0024  ACX8,     024
3130    1120  0223            223
3131    1121  0215            215
3132    1122  0012            012
3133    1123  0017            017
3134    1124  0300            300
3135    1125  0330            330
3136    1126  0270            270
3137    1127  0215  NOPT,     215
3138    1130  0012            12
3139    1131  0300            300
3140    1132  0116            116
3141    1133  0317            317
3142    1134  0120            120
3143    1135  0215            215
3144    1136  0012            012
3145    1137  0215  QUEST,    215
3146    1140  0012            012
3147    1141  0300            300
3148    1142  0077            077
3149    1143  0215            215
3150    1144  0012            012
3151    1145  0024  DUPL,     024
3152    1146  0223            223
3153    1147  0215            215
3154    1150  0012            012
3155    1151  0017            017
3156    1152  0300            300
3157    1153  0104            104
3158    1154  0125            125
3159    1155  0120            120
3160    1156  0314            314
3161    1157  0305            305
3162    1160  0330            330
3163    1161  0215            215
3164    1162  0012            012
3165    1163  0024  BIPL,     024
3166    1164  0223            223
3167    1165  0215            215
3168    1166  0012            012
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1167  0017            017
1170  0300            300
1171  0102            102
1172  0311            311
1173  0120            120
1174  0314            314
1175  0305            305
1176  0330            330
1177  0215            215
1200  0012            012
1201  0024  SINGL,    024
1202  0223            223
1203  0215            215
1204  0012            012
1205  0017            017
1206  0300            300
1207  0123            123
1210  0311            311
1211  0116            116
1212  0107            107
1213  0314            314
1214  0305            305
1215  0215            215
1216  0012            012

1217  0000  WORKSP,   0
```

```
3195                            *HDCHTB
3196    0300   7777   INTREP,   -1
3197    0301   7777             -1
3198    0302   7777             -1
3199    0303   7777             -1
3200    0304   7777             -1
3201    0305   7777             -1
3202    0306   7777             -1
3203    0307   7777             -1
3204    0310   7777             -1
3205    0311   0166             166
3206    0312   0567             567
3207    0313   7777             -1
3208    0314   7777             -1
3209    0315   7777             -1
3210    0316   7777             -1
3211    0317   7777             -1
3212    0320   7777             -1
3213    0321   0211             211
3214    0322   0212             212
3215    0323   0213             213
3216    0324   0214             214
3217    0325   7777             -1
3218    0326   7777             -1
3219    0327   7777             -1
3220    0330   7777             -1
3221    0331   7777             -1
3222    0332   7777             -1
3223    0333   7777             -1
3224    0334   7777             -1
3225    0335   7777             -1
3226    0336   7777             -1
3227    0337   7777             -1
3228    0340   0135             135
3229    0341   0201             201
3230    0342   0171             171
3231    0343   0575             575
3232    0344   0205             205
3233    0345   0204             204
3234    0346   0173             173
3235    0347   0170             170
3236    0350   0142             142
3237    0351   0143             143
3238    0352   0102             102
3239    0353   0100             100
3240    0354   0127             127
3241    0355   0101             101
3242    0356   0130             130
3243    0357   0103             103
3244    0360   0000             0
3245    0361   0001             1
3246    0362   0002             2
3247    0363   0003             3
3248    0364   0004             4
3249    0365   0005             5
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3250    0366  0006            6
3251    0367  0007            7
3252    0370  0010            10
3253    0371  0011            11
3254    0372  0132            132
3255    0373  0133            133
3256    0374  0110            110
3257    0375  0106            106
3258    0376  0112            112
3259    0377  0172            172
3260    0400  0600            600
3261    0401  0045            45
3262    0402  0046            46
3263    0403  0047            47
3264    0404  0050            50
3265    0405  0051            51
3266    0406  0052            52
3267    0407  0053            53
3268    0410  0054            54
3269    0411  0055            55
3270    0412  0056            56
3271    0413  0057            57
3272    0414  0060            60
3273    0415  0061            61
3274    0416  0062            62
3275    0417  0063            63
3276    0420  0064            64
3277    0421  0065            65
3278    0422  0066            66
3279    0423  0067            67
3280    0424  0070            70
3281    0425  0071            71
3282    0426  0072            72
3283    0427  0073            73
3284    0430  00/4            74
3285    0431  0075            75
3286    0432  0076            76
3287    0433  0144            144
3288    0434  0131            131
3289    0435  0145            145
3290    0436  0105            105
3291    0437  0176            176
3292    0440  0116            116
3293    0441  0012            12
3294    0442  0013            13
3295    0443  0014            14
3296    0444  0015            15
3297    0445  0016            16
3298    0446  0017            17
3299    0447  0020            20
3300    0450  0021            21
3301    0451  0022            22
3302    0452  0023            23
3303    0453  0024            24
3304    0454  0025            25
```

```
3305    0455  0026           26
3306    0456  0027           27
3307    0457  0030           30
3308    0460  0031           31
3309    0461  0032           32
3310    0462  0033           33
3311    0463  0034           34
3312    0464  0035           35
3313    0465  0036           36
3314    0466  0037           37
3315    0467  0040           40
3316    0470  0041           41
3317    0471  0042           42
3318    0472  0043           43
3319    0473  0120           120
3320    0474  0177           177
3321    0475  0117           117
3322    0476  0114           114
3323    0477  7777           -1
3324
3325                         *HDCHTB+200
3326    0500  0060   ISOTAB, 60
3327    0501  0261           261
3328    0502  0262           262
3329    0503  0063           63
3330    0504  0264           264
3331    0505  0065           65
3332    0506  0066           66
3333    0507  0267           267
3334    0510  0270           270
3335    0511  0071           71
3336    0512  0341           341
3337    0513  0342           342
3338    0514  0143           143
3339    0515  0344           344
3340    0516  0145           145
3341    0517  0146           146
3342    0520  0347           347
3343    0521  0350           350
3344    0522  0151           151
3345    0523  0152           152
3346    0524  0353           353
3347    0525  0154           154
3348    0526  0355           355
3349    0527  0356           356
3350    0530  0157           157
3351    0531  0360           360
3352    0532  0161           161
3353    0533  0162           162
3354    0534  0363           363
3355    0535  0164           164
3356    0536  0365           365
3357    0537  0366           366
3358    0540  0167           167
3359    0541  0170           170
```

```
3360    0542  0371            371
3361    0543  0372            372
3362    0544  0077            77
3363    0545  0101            101
3364    0546  0102            102
3365    0547  0303            303
3366    0550  0104            104
3367    0551  0305            305
3368    0552  0306            306
3369    0553  0107            107
3370    0554  0110            110
3371    0555  0311            311
3372    0556  0312            312
3373    0557  0113            113
3374    0560  0314            314
3375    0561  0115            115
3376    0562  0116            116
3377    0563  0317            317
3378    0564  0120            120
3379    0565  0321            321
3380    0566  0322            322
3381    0567  0123            123
3382    0570  0324            324
3383    0571  0125            125
3384    0572  0126            126
3385    0573  0327            327
3386    0574  0330            330
3387    0575  0131            131
3388    0576  0132            132
3389    0577  0077            77
3390    0600  0053            053
3391    0601  0055            055
3392    0602  0252            252
3393    0603  0257            257
3394    0604  0472            472
3395    0605  0336            336
3396    0606  0275            275
3397    0607  1275            1275
3398    0610  0074            074
3399    0611  0474            474
3400    0612  0276            276
3401    0613  0676            676
3402    0614  0176            176
3403    0615  0675            675
3404    0616  0140            140
3405    0617  0175            175
3406    0620  0173            173
3407    0621  0022            22
3408    0622  0024            24
3409    0623  0021            21
3410    0624  0223            223
3411    0625  0017            17
3412    0626  0216            216
3413    0627  0254            254
3414    0630  0056            56
```

```
0631  0134           134
0632  0072           072
0633  0273           273
0634  0077           77
0635  0240           240
0636  0077           77
0637  0077           77
0640  0077           77
0641  0077           77
0642  0050           050
0643  0251           251
0644  0333           333
0645  0335           335
0646  1074           1074
0647  1276           1276
0650  0077           77
0651  0077           77
0652  0077           77
0653  0077           77
0654  0077           77
0655  0077           77
0656  0077           77
0657  0077           77
0660  0077           77
0661  0077           77
0662  0077           77
0663  0077           77
0664  0077           77
0665  0077           77
0666  0011           011
0667  1412           1412
0670  0047           47
0671  0042           42
0672  0077           77
0673  0246           246
0674  0077           77
0675  0243           243
0676  0137           137
0677  0374           374
0700  0300           300
0701  0041           41
0702  0077           77
0703  0077           77
0704  0245           245
0705  0044           44
0706  0215           215
0707  0012           12
0710  0017           17
0711  0216           216
0712  0021           21
0713  0223           223
0714  0022           22
0715  0024           24
0716  0207           207
            ENDCTB=  .
```

```
3470                    $$
```

```
3471
A       0046     ACBUF   3035     ACURL   0300     ACX8    1117     AGMRGE  3425
AGPR    3011     AMA     0201     AMAL    0205     ATTPX   1761     AT1     2277
AUTIN1  0010     AUTIN2  0011     AUTIN3  0012     AUTIN4  0013     AUTIN5  0014
AUTIN6  0015     AUTIN7  0016     AUTIN8  0017     AVAIL   0020     BA      0006
BCOUNT  2471     BEL     1017     BF      2302     BFLST   2311     BIPL    1163
BLCK    0216     BLI     5027     BLO     5037     BOOT    7720     BTWEEN  0427
BUFPTR  1770     BOOT    7720     B1      0037     CANCEL  0053     CDEC    5322
CHANGE  0417     CHAR    0047     CHBU1   1541     CHMAX   0216     CHOXIT  2444
CK      0007     CLBUF   2400     CLEAR   4153     CLEARU  4155     CNTCHR  2061
COLOUR  3062     COMSIN  0727     CONOUT  1422     CR      0215     CRL     5206
CRLF    1022     CRNODE  3706     DATAPN  0024     DECIS   3600     DEC1    3601
DELET   3344     DELETE  0243     DR      2765     DTA     4544     DTPNMJ  0023
DUB     2334     DUMMY   0377     DUPL    1145     DUPLAC  1154     DUPLX1  1147
DUPLX2  3274     ECHO    4564     ECHOA   2353     ECHOFG  5320     ENDCTB  0717
EONAME  5131     EPTR    2246     EQUAL   0440     ER      5263     ERROR   5240
EXA     5040     EXCIR   2141     EXGM    2276     EXGMM2  2275     EXIT    5576
EXITKI  2236     EXITSI  5575     EXKI    4045     EXUS    4705     FILLR   2550
FILLRB  2563     FIN     3553     FIRST   3046     FLD     0030     FRBUF   3400
FREEBF  0757     FREEBU  4571     FREEND  3141     GET     3527     GETBF   3476
GETBIT  3303     GETBUF  4572     GETCH   5047     GETMCH  2250     GETND   3120
GETNOD  4565     GETTL   3744     GET1    5064     GTB1    0217     GTLCH   0270
GTPRT   0243     GTPXP   0361     GTSTC   0231     GTXPMR  0302     HDADSP  0000
HDAVAI  1400     HDCHTB  0300     HDFSP   0020     HDMASK  0000     HDMS    0763
HDTRB   0760     HDTTI   2610     HITRS   1517     HOOR    1036     HSP     4473
HSR     4532     INICNT  2764     INIMP   2342     INIT    0200     INITIR  4567
INITJB  4566     INJOB   2146     INNODE  3723     INS     3467     INSERT  3317
INSPEC  4055     INTRAP  2121     INTREP  0300     INUSER  4600     ISOD1   1255
ISOTAB  0500     JOB     0000     JOBCH   0200     JSW     0021     JSWMJ   0022
JUMPER  0615     KB      4711     KEY     0275     KILL    1157     LF      0012
LISTEN  0054     LOC     3564     LOCBDY  3565     LOCK    0051     LP      1232
LPCNT   0044     LPCRJS  2614     LPSP    2650     LSTCHR  0042     LTAIL   3755
LTRS    1533     MAKE    4573     MAKEJB  3701     MALA    0211     MAXJOB  0100
MAXPR   0003     MAXPXB  0220     MAXSZ   0007     MCH     3076     MCHAR   0056
MEME    1067     MILP    0057     MJRCNT  2352     MNRCNT  2351     MODKB   4725
MON     7605     MPNT    3567     MSKPR   4003     MSKSZ   0007     MSNR    1001
MSPT    0763     MSSAGE  0307     MX8     0003     NEQUAL  0446     NEWCON  1447
NEXTJB  3624     NILFIL  2460     NM      5105     NM0     5043     NM1     5044
NM2     5045     NM3     5046     NOCF    1135     NOLFT   1101     NOMES   1074
NOPT    1127     NOROOM  3135     NOT     0176     NOTLST  2322     NOTX8   1320
NOX     1040     NOX8    0667     NUMB    5236     NXTPXB  0745     NXTTI   2530
OFFTRS  1477     OK      1024     OUTFBF  3474     OUTGB   3562     OUTPUT  2210
OUT7S   3002     PART    0045     PART2   0340     PAR1    0025     PAR2    0026
PAR3    0027     PATCH   5400     PBUSY   1072     PCP     3700     PCTR    5237
PLEX    4441     PLINS   4434     PLOTR   4430     PLOUT   4400     PLTEM   4444
POETS   3754     PRINT   5200     PROK    5215     PRTNER  0041     PRO     5221
PUEX    4475     PUNCH   4500     PXBUCN  0040     PXCHAR  1742     PXDONE  1655
PXECHO  2426     PXECHX  2446     PXIBC   1762     PXLOOP  1644     PXNUMB  0035
PXOBC   1763     PXOVER  1672     PXP     0034     PXREAD  1766     PXREPT  1760
PXS     1621     PXSEND  1627     PXWAIT  2111     PXWAPT  1764     PX1     1733
PX2     1600     P2      2244     P3      2245     P7S     3031     QUEST   1137
R       0031     RCHAR   4531     RDCOMM  5000     RDLP    4515     RDN     5016
RDNAME  5106     RDPTR   4727     RD2     5072     RD2EX   5103     REACTI  5574
READ    4510     RECHAR  5321     RED     0017     REEX    4526     REQUA   3100
REQUXP  1346     RESEX   5315     RESYM   5276     RF08    4453     RF08ER  4466
```

```
ROCHAR 3200   ROM    1077   RR     0030   RSOLO  1052   RTIM   4530
RUNOUT 1431   SAJOB  3756   SAVDIR 1765   SAVE   4570   SAVLN  0060
SCA    7751   SCDIF  7711   SCHARX 2060   SCNT   0004   SCNTR  4730
SCOPE  4535   SEND   3236   SERR   7713   SERROR 7732   SETB1  1124
SETIF  1747   SETST  0236   SETTI  2520   SFIELD 7706   SFUN   7673
SGOED  7653   SHNDLR 7607   SINAC  0646   SINCR  0741   SINGL  1201
SINGLE 3300   SISOUT 1440   SIZE   3566   SNEX   0662   SOFSET 7747
SOLAC  0636   SOLO   0644   SOUTAC 0703   SP     0047   SPEND  5535
SPLIT  3532   SPN    0013   SPTR   0047   SP1    0043   SP2    2517
SRCHBF 3513   STACK  4200   STACKP 0012   STAMP  3262   START  2600
STATE  0040   STB1   0224   STLCH  0263   STOR   1243   STPRT  0254
STPXP  0347   STRY   7612   STXPMR 0275   ST1    2704   ST2    2723
SV     0004   SVAC   0061   SVCHAR 0511   SVCHR  1540   SVF    3077
SVLINK 0062   SVPT   2247   SVPXR  1553   SV1    0005   SV2    0006
SV3    0007   SWC    7750   SWITCH 0323   SYSCNT 7730   S2201  7714
S377   7716   S500   7717   S6603  7712   S70    7715   S7400  7731
S7600  7656   TAILS  0030   TBUSY  1467   TDSK   4242   TERNR  1767
TJUMP  0614   TK     0474   TKOVER 0452   TKOVR2 0400   TKXPBU 1200
TODISK 4231   TRANS  0302   TRNST1 0010   TRNST2 0020   TRTURN 3200
TRXIT  1122   TRXIT2 1144   TSIN   0715   TSNUF  0600   TSNUF1 0601
TSOUT  1307   TSTBIT 2450   TSTCAN 4217   TSTMNR 1273   TSXIT  0722
TSXIT1 1335   TTDONE 2225   TTOGO  2215   TTRUM  1000   TTY    4444
TURN   1337   TURNON 1025   TURXIT 3233   T1S    2200   UNSTAC 4000
UP     1272   USER   5326   US0    4607   US1    4616   US2    4640
US3    4661   WA     0005   WARN   0055   WORKSP 1217   XACURL 1400
XLINE  0052   XPBPTR 2056   XPDONE 2034   XPLOOP 2023   XPLPCN 2057
XPMR   0036   XPNUMB 0033   XPP    0032   XPSKIP 2073   XPSTOR 2062
XPTNR  2055   XPWAIT 2100   XP2    2000   X7FLAG 0050   X7P1   3034
X7S    3000   X8     0002   ZERO   0000   ZOM    1107   ZSOLO  1065
```

```
A            78#  139  140  150  152  299  302 1491 1494 1508
ACBUF       411   623 1612# 1620
ACM3        349   710
ACURL       125#  373  412  531  624  784  825
ACX8       3045  3129#
AC2         479   694 1024 1027 1586 1598 2305
AC2000     1394
AC3         563   922 1432 2294
AC4         556   975 1449
AC6         435
AGMRGE     1871# 1905
AGPR       1590# 1604
AMA         138#  141  145  225  229  648  679 1321
AMAL        143#  146  157  169  181  205  217  271  274  792
           1723  1729
AN         2324
APX1        917   932
APX2        920   930
APX3        921   928
ASSEMB     2324  2397 2408
ATTPX       896   914  915  964  965  969 1011#
AT1        1219  1226#
AUTIN1       37#  669  673  689
AUTIN2       38#  671  682  686
AUTIN3       39#  133
AUTIN4       40#  134
AUTIN5       41#
AUTIN6       42#
AUTIN7       43#
AUTIN8       44# 1038 1078 1385 1388 1393 1395 1397 1401 1495
           1499  1523 1528
AVAIL        46# 1445 1674 1678 1679 1694 1697
BA         1798  1867 1886 1981 1995#
BCOUNT     1350  1354#
BEL        3036  3065#
BF         1212  1230#
BFLST      1237# 1250
BIPL       3047  3165#
BLCK        130# 1312 1642 1643
BLI        2579  2584# 2587
BLO        2588  2592#
BOOT       2872#
BTWEEN      306#  310  313  314  370  541
BUFPTR      912   942  960  989  996  997 1018#
BUP2       1104  2209
BUP7       2215
BUX2       1093  2206
BUX7       2212
B00T       2871#
B1           70#  156  163
CANCEL       83#  630 2071 2298 2301 2734
CAP         936  1103
CAX        1066  1092 1580
CBUP2       890  1106
CBUP7      1608
```

```
CBUX2     1023  1095
CBUX7     1580
CCF       2253
CDEC      2470  2764#
CDECLT    2764
CHANGE     247   297#  304   432   437   447   470   552   560   567
           732   741   743   852   858   864  1719  1721
CHAR        79#  151   158   162   170   174   192   198   206   210
           218   260   264   308   311   318   377   416   474   543
           581   596   601   619   649   651   657   698   711   725
           769   776   807   813   834   838   840   855   861  1304
          1306  1381  1390  1391  1392  1566  1618  1716  1735
CHBU1      868#  877   902
CHMAX      123#  675   678
CHOXIT    1332# 1340  1358  1362  1375
CINT      2256
CK        1784# 1819  1856  1871  1895  1904  1907  1944  1946  1951
          1955  1960  1966  1967  1969  1972
CLBUF     1243  1295#
CLEAR     2246  2253#
CLEARU    2244  2256#
CNTCHR    1039  1059  1073# 1079
COLOUR    1625  1635#
COMSIN     462#
CONOUT     780#  799
CR         126#  453   506   509
CRF       2439
CRL       2575  2656  2682# 2688  2712
CRLF      3049  3068#
CRNODE    2089  2093# 2105
DATAPN      56#  955   961  1137  1145  1146  1295  1558  2063  2155
          2287  2314  2722
DECIS       98    99   388   397  2012#
DEC1      1193  2013#
DELET     1824# 1835  1839  1899  1959
DELETE     128#  738  1711
DR        1464  1466  1468  1516  1563#
DTA       2229  2442# 2446
DTPNMJ      53#  338   339  1052  1053  1242  1592  1593  1653  1654
          1743  1747  2101  2308  2737
DUB       1234  1255  1256  1258#
DUMMY      124# 1346  1632
DUPL      3046  3151#
DUPLAC     394   623#
DUPLX1     385   464   617#  625
DUPLX2     386   395  1771#
ECHO       110   231   406   451   504   752  1275# 1315  1733
ECHOA      110  1276# 1289
ECHOFG    2745  2754  2761#
ENDCTB    3469#
EONAME    2644  2648  2652  2656#
EPTR      1197# 1281  1283  1284  1286
EQUAL      316#  320   321   324   521   546   554   578   695   735
ER        2073  2250  2258  2302  2330  2390  2542  2586  2731# 2736
          2865
ERROR     2324  2397  2408  2711# 2739
```

```
EXA       2594# 2607
EXCIR     1123  1127#
EXGM      1216  1224#
EXGMM2    1223# 1228  1245  1263
EXIT        99   371   407   425   469   508   537   565   574   594
           621   705   730   736   740   746   757   786   898   949
           992  1067  1300  1307  1310  1316  1605  1774  2011# 2318
          2348  2406  2560  2596  2729  2741
EXITKI     100  1188# 2399  2409
EXITSI     100  1187# 2353  2373  2385  2432  2440  2449  2540
EXKI      1126  1191  1583  2181# 2201  2251  2254
EXUS      2465  2472  2490  2507  2525#
FILLR     1221  1404# 1414  1418
FILLRB    1238  1252  1416# 1419  1631  1644
FIN       1964  1979#
FIRST     1226  1258  1622# 1633  1646
FLD       1783# 1860  1942
FRBUF      105  1850# 1853  1854  1912
FREEBF     490#  499   818   827  1614
FREEBU     105   496   873   944  1849# 2509
FREEND     962  1147  1687# 1700  2066
GET       1950  1957#
GETBF      104  1932# 1984  1987
GETBIT    1786# 1799  1866  1885  1980
GETBUF     104   481   977  1489  1526  1533  1683  1931# 2479
GETCH     2603# 2615  2625  2630
GETMCH    1171  1200# 1224
GETND      109  1669# 1681  1685
GETNOD     109   337  1051  1591  1652  1668# 1742  2095
GETTL     2118  2124#
GET1      2612  2616#
GTB1       155#  159   512   576   737  1710
GTLCH      203#  207   473   515   580   701   733  1308  1617
GTPRT      179#  186   187   409   440   462   722   774   849  1299
          1708
GTPXP      269#  276   817  1325  1613  1763
GTSTC      167#  171   368   553   656   693   766   832   853
GTXPMR     215#  219   255   415   724  1302  1714
HDADSP       6#    7  2974
HDAVAI      13#   46
HDCHTB      11# 3195  3325
HDFSP        8# 1906  1945  1971  2978  3002
HDMASK       7# 2988
HDMS        10# 3035
HDTRB       12# 1628  3030
HDTTI     1160  1384  1569#
HITRS      843   849#  860   865
HOOR      3040  3080#
HSP       2241  2392#
HSR       2238  2430#
INICNT    1498  1500  1505  1513  1520  1529  1562#
INIMP     1185  1265# 1271  1542
INIT       136# 2522
INITIR     107   892  1025  1110# 1587  2257  2361  2389  2393  2541
INITJB     108   367   645  1133#
INJOB      108  1134# 1149
```

```
INNODE      2090  2107# 2131
INS         1877  1889  1897  1906#
INSERT      1801# 1821  1910  1976
INSPEC        24  2190#
INTRAP       107  1111# 1124  1131
INTREP      1320  3196#
INUSER      1550  2456# 2528
IS          2324
ISOD1        693#  794
ISOTAB       678  3326#
JOB          103   289   347  1064  1125  1244  1601  1664  1754  2086#
            2311  2728  2740
JOBCH         39   120# 2017  2036  2048  3024  3026
JSW           47#  285  1118  1129  1656  1744  2059  2069  2074  2157
            2289  2295  2568
JSWMJ         52#  287  1062  1114  1115  1128  1155  1240  1599  1658
            1746  2097  2110  2202  2306  2725  2738
JUMPER       376   380#
KB          2223  2530# 2534
KEY          222   224   228   256#
KIE         2458  2527  2595
KILL         518   627#
KTID        2561  2711
LF           127#  459   509   702   734  1734
LISTEN        18    84# 2526  2538  2562  2594
LOC         1852  1861  1865  1878  1881  1903  1909  1957  1958  1974
            1979  1985  1989#
LOCBDY      1883  1884  1891  1898  1902  1990#
LOOK          81# 1189  2016  2108
LP           673#  684
LPCNT         76# 1344  1351  1356  1365  1373  1383  1398  1452
LPCRJS      1447# 1453
LPSP        1478# 1481
LSTCHR        73#  199   204
LTAIL       2039  2042  2049  2115  2116  2119  2130  2134#
LTRS         857   861#
MAKE         102   289   347  1064  1125  1244  1601  1664  1754  2085#
            2311  2728  2740
MAKEJB       102  2087# 2091
MALA         148#  153   164   176   194   200   212   262   266   700
MAXJOB        76   118#
MAXPR        122# 2046
MAXPXB       121#  970
MAXSZ        115# 1936  1952
MCH         1648#
MCHAR         90# 1168  1172  1175  1178  1270  1407  1411  2307  2309
MEME         550   563#
MILP          91# 1156  1165  1457  1460  1538  1540
MJRCNT      1183  1267  1273#
MNRCNT      1166  1179  1272#
MODKB       2523  2542#
MON         2795# 2893
MPNT        1873  1874  1882  1900  1947  1948  1970  1975  1992#
MSKPR        116# 1116  1119  2022  2027  2113
MSKSZ        117# 1855
MSNR         227  3050#
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MSPT          223   3036#
MSSAGE        221#   232     424     436     446     534     557     564     571     814
MX8            27#   184     237    1382    1439    1458    1519    1588
NEQUAL        323#   325     326     460     514     517     654     703     739     767
             1309   1712
NEWCON        781    801     804#    819
NEXTJB       2032#
NILFIL       1345#  1352    1353
NM           2624   2629    2632    2635#
NM0          2598#  2638    2642    2657
NM1          2599#  2639    2646
NM2          2600#  2640    2650
NM3          2601#
NOCF          589    606#
NOLFT         511    576#
NOMES         591    542     570#    579     612     629     632
NOPT         3044   3137#
NOROOM       1676   1682#
NOT           129#   823
NOTLST       1236   1247#
NOTX8         723    732#
NOX           522    539#
NOX8          410    427#
NUMB         2691   2694    2697    2698    2708#
NXTPXB        478#   487     529     782     821    1615    1756
NXTTI        1387#  1399
OFFTRS        831#   836     847    1298
OK           3039   3070#
OKP           923    936    1608
OKX          1028   1066    1546    1580
OUTFBF       1859   1911#
OUTGB        1941   1954    1986#
OUTPUT       1162#  1429
OUT7S        1581#  1609
PART           77#   182     183     190     191     300     303     427     465     558
              582    591     597     599     611     800     815
PART2         239    247#
PAR1           57#   144     149     236     292     298     301     429     467     545
              627   1140    1278    1296    1659    1749
PAR2           58#   226     259     272     283     372     452     457     484     494
              505    583     613     617     646     668     670     728     750     751
              762    763     793     796    1142    1282    1313    1328    1329    1341
             1345   1347    1355    1370    1371    1724    1726    1727    1740    1741
             1751   1761    1764    1766
PAR3           59#   230     263     275     293     486     491     647     665     687
              692    697     790    1144    1285    1314    1330    1348    1372    1732
             1767
PATCH        2513   2546    2786#   2893
PBUSY         525    555     567#
PCP          2023   2029    2037    2045    2083#
PCTR         2693   2704    2709#
PLCF         2350
PLEX         2332   2347    2362#
PLINS        2328   2339    2344    2351    2355#   2357    2564
PLOTR        2235   2350#
PLOUT        2325#  2331
```

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PLSF      2233
PLTEM     2327  2333  2340  2366#
POETS     2124  2125  2128  2133#
PRINT     2577  2620  2675# 2680  2685  2687  2703  2715  2718  2721
          2755
PROK      2690# 2706  2723
PRTNER      72#  180   193
PRO       2694# 2705
PUEX      2394# 2405
PUNCH     2395  2399#
PXBUCN     119#  905   984  1004  1006
PXCHAR     927   929   931   994#  998
PXDONE     935#
PXECHO     413   532   620   729   785   824   826  1318# 1335  1619
PXECHX    1323  1334#
PXIBC      899   906  1005  1012#
PXLOOP     926#  934
PXNUMB      68#  265   273
PXOBC      973   985  1007  1013#
PXOVER     953# 1600  1663  1753
PXP         67#  261   270
PXREAD     895   948   966  1016#
PXREPT     871   901   903   907   908   910   911  1001  1002  1010#
PXS        900   907#
PXSEND     913#  968
PXWAIT     926  1101# 1108
PXWAPT     980   981   982   987   988   990   991  1003  1014#
PX1        974   986#
PX2        890# 2211
P2        1195# 1206  1214  1220  1227  1230  1231  1237  1251  1259
          1260  1262
P3        1196# 1209  1210  1235  1247  1253
P7S       1607# 2217
QUEST     3043  3145#
R           64# 1269  1408  1515  1517
RCHAR     2411  2419  2428# 2431
RDCOMM    2520  2521  2543  2560# 2727  2796
RDLP      2415# 2423
RDN       2575# 2621
RDNAME    2578  2637# 2658
RDPTR     2494  2497  2545#
RD2       2623# 2633  2641  2645  2649  2653
RD2EX     2618  2632#
REACTI     101  2019  2031  2142#
READ      2409# 2425
RECHAR    2752  2753  2757  2762#
RED        131# 1642
REEX      2418  2421  2424#
REQUA      420   756  1301  1651# 1666
REQUXP     662   691   756#  802   828
RESEX     2748  2758#
RESYM     2604  2743# 2760
RF08      2220  2375# 2379
RF08ER    2382  2386#
RIS       2247  2368  2435  2531
ROCHAR    2317  2319#
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ROM       3038  3113#
RR          63# 1203  1280  1518
RSOLO     3042  3092#
RTIM      2412  2422  2427#
RUNOUT     765   788#
SAJOB     2061  2081  2094  2099  2135#
SAVDIR     925   933  1015#
SAVE       106  1127  1192  2276#
SAVLN       92# 1162  1182  1201  1241  1268  1637
SCA       2794# 2816  2825  2830
SCDIF     2851  2863#
SCHARX    1034  1035  1037  1072# 1076  1077  1080
SCID      2566
SCNT      1476  1479  1483  1484  1565#
SCNTR     2518  2546#
SCOPE     2232  2434# 2438
SEND      1332  1363  1738# 1757  1772
SERR      2827  2832  2865#
SERROR    2858  2884#
SETB1      592   596#
SETIF     1000# 1008  1535
SETST      173#  177   246   400   422   434   549   573   811   846
           863
SETTI     1379# 1402  1541
SFIELD    2807  2821  2834  2852  2860# 2888
SFUN      2804  2817  2849#
SGOED     2820  2823  2833#
SHNDLR    2791  2793  2794  2797# 2800  2805  2808  2814  2815  2833
          2837  2843  2855  2859  2862  2873  2875  2890  2891
SINAC      392   409#  442
SINCR      455   473#
SINGL     3048  3179#
SINGLE     387   396  1776# 1778
SINT      2242
SISOUT     779   796#
SIZE      1934  1935  1943  1962  1991#
SNC       2245
SNEX       418   421#  431   438   449
SOFSET    2792# 2838  2844
SOLAC      390   399#
SOLO       381   406#  471   696   744
SOUTAC     393   440#
SP        1469  1474  1475  1477  1496  1566# 1567
SPEND     2546  2893#
SPLIT     1960# 1977
SPN        134#  340   342   344   345   956   957   959  1054  1056
          1058  1060  1138  1139  1141  1143  1594  1596  1597  1655
          1661  1662  1748  1750  1752  2020  2021  2033  2034  2035
          2040  2056  2060  2062  2065  2096  2098  2100  2102  2104
          2120  2121
SPTR      1507  1509  1511  1512  1567#
SP1         75#  805   806   809  1324  1326  1337  1354  1359  1762
          1765
SP2       1342  1364  1366  1367  1368  1377#
SRCHBF    1945# 1956
SRF       2230
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STACK           106  2277# 2291
STACKP          133# 2024  2146  2147  2148  2150  2152  2154  2156  2159
               2160  2282  2284  2286  2288  2290
STAMP          1760# 1768  1769  1771  1776
START           138  1431# 1435  1569
STATE            71#  168   175  1636
STB1            161#  165   243   404   475   603
STLCH           197#  201   241   402   458   593   618   745
STOR            677   682#
STPRT           189#  195   414   528   544   559   816
STPXP           258#  267   530   783   822  1333  1616  1773
STRY           2800# 2892
STXPMR          209#  213   256   419   719  1305
ST1            1509# 1514
ST2            1524# 1530
SU             2764  2768
SV               31# 1117  1121  1447  1448  1450  1451  1454  1565  1677
               1680  1689  1690  1695  1696  1788  1789  1795  1802  1808
               1812  1813  1815  1817  1818  1820  1825  1826  1828  1829
               1892  1893  2025  2026  2109  2126  2127  2129
SVAC             94# 2151  2177  2187  2190  2283
SVCHAR          336   343   351   353   355   356   358   362#
SVCHR           839   845   866#
SVF            1629  1630  1638  1640  1649#
SVLINK           95# 2149  2162  2167  2174  2185  2192  2280
SVPT           1198# 1204  1205  1207  1223
SVPXR           869   876   879#
SV1              32# 1807  1809  1811  1827  1831  1833  1837  1838  1994
SV2              33# 1803  1814  1816  1830  1832  1836  1908  1973  1995
SV3              34# 1784
SWC            2793# 2812  2828
SWITCH          234#  252   253   444   536   562   753  1311  1720
SYSCNT         2799  2881# 2886
S2201          2824  2866#
S377           2841  2868#
S500           2869#
S6603          2803  2864# 2874
S70            2806  2867#
S7400          2848  2882#
S7600          2810  2836# 2872
TAILS             9# 2038  2114  3020
TBUSY           775   821#
TDSK           2310  2314#
TERNR           909   916   937   958   986  1017#
THIS           2324
TIE            2458
TJUMP           379#
TK              332   348#
TKOVER          330#  350   360  1396
TKOVR2           19   281#  288
TKXPBU          645# 1063
TODISK         1413  2304# 2312
TRANS           235   245   248   250   255#
TRNST1          113#  421   433   535   572   810
TRNST2          114#  443   561
TRTURN          461   704  1707# 1736
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TRXIT      593#  604   615
TRXIT2     608   613#
TSIN       383   451#
TSNUF      346   367#
TSNUF1     295   368#
TSOUT      384   722#
TSTBIT    1331  1337#
TSTCAN    2161  2293# 2297  2300
TSTMNR     663   709#  720   808
TSXIT      457#  476
TSXIT1     726   745#
TTCL      1163
TTCR      1157
TTDONE    1177#
TTI       1387
TTINCR    1177
TTLL      1163
TTLR      1157
TTO       1174
TTOGO     1168# 1180
TTRINC     348
TTRL       341  1181
TTRUM      382   504#
TTY       2226  2367# 2371
TURN       727   742   748#  754
TURNON     527#  768
TURXIT    1709  1713  1718  1734#
T1ON      1153  1543
T1S       1153# 2205
T1SKP     2203
UNSTAC     101  2143#
UP         652   667   683   707#  715
USER      2463  2768# 2768#
US0       2463# 2473  2482
US1       2470# 2495
US2       2481  2484  2488# 2492  2498  2500  2508
US3       2499  2501  2505#
WA        1794  1869  1870  1887  1982  1983  1994#
WARN        85# 1672  1673  1698
WORKSP    3194#
XACURL     655   762#
XLINE       17    82#  290  1409
XPA1      1030  1047
XPA2      1045
XPA3      1043
XPBPTR    1036  1057  1070#
XPDONE    1051# 1086
XPLOOP    1042# 1050
XPLPCN    1041  1049  1071# 1084
XPMR        69#  211   216
XPNUMB      66#  699  1728
XPP         65#  791  1033  1506  1522  1722
XPSKIP    1084# 1088
XPSTOR    1044  1046  1048  1075# 1083
XPTNR     1031  1032  1055  1069#
XPWAIT    1029  1042  1087  1090# 1098
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XP2       1023# 2208
X7FLAG      80#  523  1582
X7P1      1589  1595  1603  1610#
X7S       1579# 2214
X8          26#  527   540  1436  1437  1463  1470  1473  1510
ZERO        23#
ZOM       3037  3121#
ZSOLO     3041  3103#
≮L00PP      99   100   101   102   104   105   106   107   108   109
           110  1110  1133  1187  1275  1668  1849  1931  2011  2085
          2142  2276
≮L0064    2582  2590
≮L0066    2171  2195
≮L0067    2076  2346  2404  2417
≮L0070    2075  2163  2170  2194
≮L0071    1857  1939  2164
≮L0072    1600  1663  1753
≮L0073    1417  2369
≮L0075    1332  1363
≮L0076    1266  2145  2158
≮L0077    1243
≮L0100    1221
≮L0101    1217  1232
≮L0102    1126  1191  1583
≮L0103    1063
≮L0104     962  1147  2066
≮L0105     905   984  1004  1006
≮L0106     833  1380
≮L0107     818   827  1614
≮L0110     817  1325  1613  1763
≮L0111     792  1723  1729
≮L0112     777  1040
≮L0113     700
≮L0114     696   744
≮L0115     658   770   924
≮L0116     653
≮L0117     650  1081  1338  1405  2436
≮L0120     648   679  1321
≮L0121     584   614  1319
≮L0122     530   783   822  1333  1616  1773
≮L0123     529   782   821  1615  1756
≮L0124     521   546   554   578   695   735
≮L0125     512   576   737  1710
≮L0126     509
≮L0127     492
≮L0130     485   941  1739
≮L0131     473   515   580   701   733  1308  1617
≮L0132     461   704
≮L0133     460   514   517   654   703   739   767  1309  1712
≮L0134     459   548   587   702   734  1734
≮L0135     453   506
≮L0136     444   536   562   753  1311  1720
≮L0137     443   561
≮L0140     432   437   447   470   552   560   567   732   741   743
           852   858   864  1719  1721
≮L0141     424   436   446   534   557   564   571   814
```

```
⇷L0142     423   660   772  1459
⇷L0143     420   756  1301
⇷L0144     419   719  1305
⇷L0145     415   724  1302  1714
⇷L0146     414   528   544   559   816
⇷L0147     413   532   620   729   785   824   826  1619
⇷L0150     412   531   624   784   825  1320
⇷L0151     411
⇷L0152     409   440   462   722   738   774   849  1299  1708  1711
⇷L0153     404   475
⇷L0154     402   458   593   618   745
⇷L0155     400   422   434   549   573   811   846   863
⇷L0156     375   421   433   535   572   810   841   854   859  1389
⇷L0157     373
⇷L0160     370   541
⇷L0161     368   553   656   693   766   832   853
⇷L0162     335   674  1346  1369  1632
⇷L0163     291   369   570   862  1433  1796  2447
⇷L0170    2521
⇷L0171    1396
⇷L0177      24
⇷L0376     227
⇷L0377     223
⇷L0575     354
⇷L0576     346
⇷L1166     623
⇷L1167     609
⇷L1170     606
⇷L1172     602
⇷L1173     590
⇷L1174     585
⇷L1175     533
⇷L1176     520
⇷L1177     516
⇷L1375     678
⇷L1376     675
⇷L1377     655
⇷L1567     872
⇷L1570     871
⇷L1571     823
⇷L1574     794
⇷L1575     789
⇷L1576     780   797
⇷L1577     768
⇷L1775     970
⇷L1776     926
⇷L1777     902
⇷L2177    1116  1119
⇷L2376    1193
⇷L2377    1160
⇷L2571    1396
⇷L2572    1387
⇷L2573    1384
⇷L2574    1360
⇷L2575    1327
⇷L2576    1312
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←L2577     1298
←L2774     1506
←L2775     1504
←L2776     1485
←L2777     1429
←L3173     1645
←L3174     1643
←L3175     1642
←L3177     1628
←L3377     1777
←L3570     1952
←L3571     1936
←L3573     1906   1945   1971
←L3575     1875
←L3577     1855
←L3774     2046
←L3775     2038   2114
←L3776     2022   2027   2113
←L3777     2017.  2036   2048
←L4165     2229
←L4166     2226
←L4167     2223
←L4171     2217
←L4172     2214
←L4173     2211
←L4174     2208
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←L4176     2199
←L4375     2317
←L4376     2310
←L4573     2444
←L4574     2377
←L4575     2338   2343
←L4576     2337   2341
←L4765     2536
←L4766     2532
←L4767     2522
←L4770     2521
←L4771     2520
←L4772     2513
←L4773     2511
←L4774     2493
←L4775     2486   2503
←L4776     2476
←L4777     2461   2468
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←L5167     2608
←L5170     2605
←L5174     2576
←L5176     2570   2573
←L5177     2564
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←L5365     2747
←L5366     2739
←L5367     2727
←L5370     2719
←L5371     2716
←L5372     2713
←L5373     2701
←L5374     2700
←L5375     2692
←L5376     2686
←L5377     2683
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